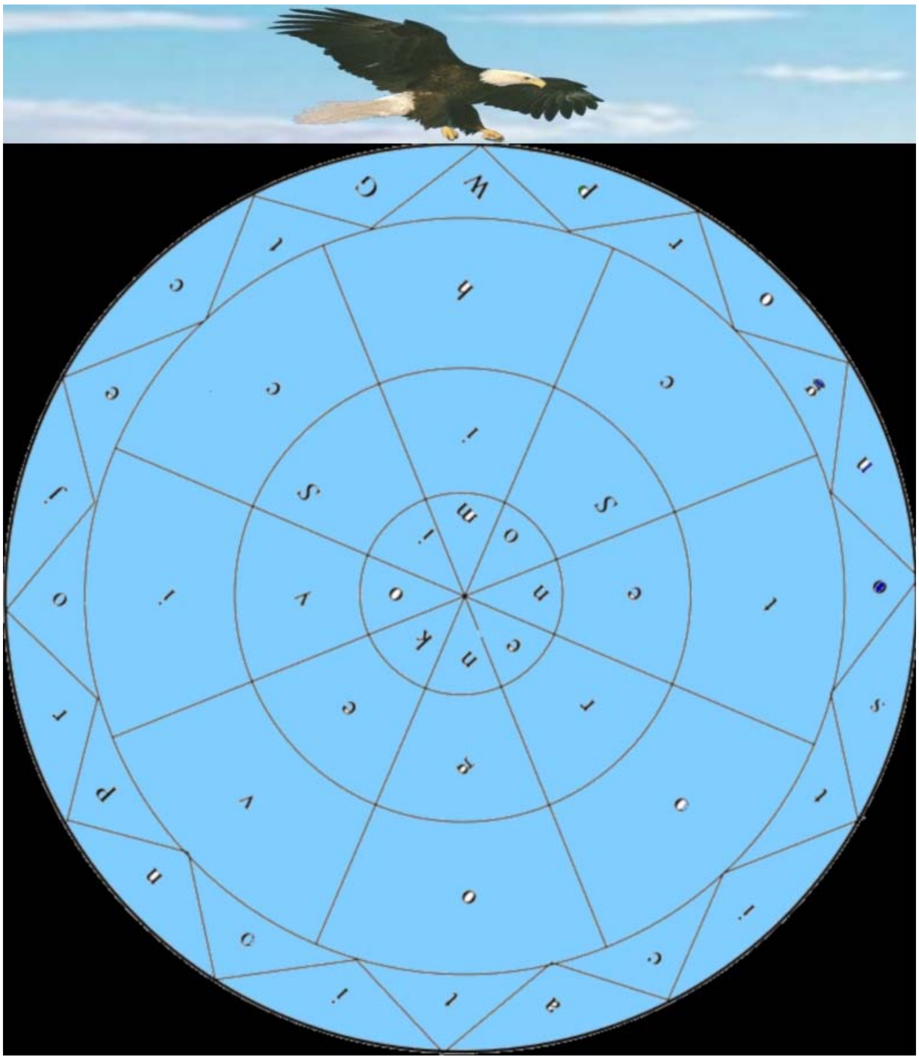
THE COSMIC ENERGY GRAVITATIONAL GENESIS OF THE INCREASE OF THE SEISMIC AND VOLCANIC ACTIVITY OF THE EARTH IN THE BEGINNING OF THE 21 ST CENTURY AD

Book · December 2012

Sergey Victorovich Simonenko
Russian Academy of Sciences

Sergey V. Simonenko

THE COSMIC ENERGY GRAVITATIONAL GENESIS OF THE INCREASE OF THE SEISMIC AND VOLCANIC ACTIVITY OF THE EARTH IN THE BEGINNING OF THE 21ST CENTURY AD



Nakhodka

2012

THE MINISTRY OF EDUCATION AND SCIENCE OF THE RUSSIAN FEDERATION

INSTITUTE OF TECHNOLOGY AND BUSINESS

Dr. Sergey V. Simonenko

THE COSMIC ENERGY GRAVITATIONAL GENESIS OF THE INCREASE OF THE SEISMIC AND VOLCANIC ACTIVITY OF THE EARTH IN THE BEGINNING OF THE 21ST CENTURY AD

Nakhodka
2012

UDC 536:531:550.3:55
BBK 22.3
C37

Scientific Editor: Dr. phys.-math. sci., Prof. G. Sh. Tsitsiashvili,
Deputy Director of the Office of Russian Academy of Sciences,
Institute for Applied Mathematics IAM FEB RAS

Reviewers of the monograph:
Dr. geol.-mineral. sci., Prof. V.A. Abramov, Head of the laboratory of the regional geology
and tectonophysics of the V. I. Il'ichev Pacific Oceanological Institute,
Far Eastern Branch of Russian Academy of Sciences;
Dr. sci. techn. A.N. Zhirabok, Professor of the Far Eastern State Technical University

Simonenko Sergey V.

C37 The Cosmic Energy Gravitational Genesis of the Increase of the Seismic and Volcanic Activity of the Earth in the Beginning of the 21st Century AD**:** Monograph. - Nakhodka: Institute of Technology and Business,
2012. – 220 p.
ISBN 978-5-89694-140-8

The founded cosmic geology and the cosmic geophysics [Simonenko, 2007a; 2007b; 2007] are extended by taking into account the established evaluation of the significant energy gravitational influence on the Earth of the Sun owing to the gravitational interaction of the Sun with the outer large planets. The solution of the fundamental problem [Imbrie et al., 1993] of the origin of the major 100-kyr glacial cycle during the Milankovitch chron [Berger, 1994] is presented based on the consideration of the combined predominant energy gravitational influence on the Earth of the Sun, the Moon, the Venus and the Jupiter. The cosmic energy gravitational genesis of the increase of the seismic and volcanic activity of the Earth in the end of the 20th century AD [Abramov, 1997] and in the beginning of the 21st century AD is founded based on the generalized formulation [Simonenko, 2007] of the first law of thermodynamics applied for the Earth subjected to the cosmic non-stationary energy gravitational influences of the Solar System. Based on established range of the fundamental periodicities $T_{tec,f} = T_{clim1,f} = 696 \div 708$ years (determined by the combined non-stationary energy gravitational influences on the Earth of the Sun owing to the Jupiter and the Saturn, the system Sun-Moon, the Venus and the Jupiter) of the global seismotectonic, volcanic and climatic activities of the Earth, the cosmic geophysics is founded the range $2020 \div 2061$ AD [Simonenko, 2012] of the maximal seismotectonic, volcanic and climatic activities of the Earth during the past $696 \div 708$ years of the history of humankind.

For specialists in non-equilibrium thermodynamics, continuum mechanics, hydrodynamics, physical oceanography, geology, geophysics, seismology, volcanology, climatology, hydrogeophysics and glaciology.

UDC 536:531:550.3:55
BBK 22.3

ISBN 978-5-89694-140-8

Author's e-mail: sergeyvsimonenko@yahoo.com

This monograph is the result of the lifetime permanent mental work dedicated to the foundation of the Thermohydrogravidynamics (Cosmic Physics) of the Solar System intended for the long- term deterministic predictions of the strong earthquakes, the planetary cataclysms, the Earth's climate and the Earth's fresh water resources in order to sustain the stable evolutionary development, the survival, greatness and cosmic dignity of the humankind in the present and forthcoming epochs of the critical surrounding cosmic, seismotectonic, volcanic and climatic conditions of the human existence on the Earth.

The monograph is dedicated to the blessed memory of the great Russian scientist, Academician Victor I. Ilyichev supported in 1993 the author's hydrodynamic and oceanographic PhD's studies (as the head of the Doctoral Council of Oceanography) resulted to this monograph.

Nolite flere, non est mortuus, sed dormit.
Dignum laude virum Musa vetat mori.

INTRODUCTION

It is well known that the problems of the effective control of the space-time variations of the oceanic medium [Akulichev, Bezotvetnykh et al., 2001; Akulichev, Dzyuba et al., 2001; Makarov, Uleysky and Prants, 2003; Simonenko and Lobanov, 2012] and the geophysical environment [Dolgikh, 2000; Dolgikh et al., 2002; Dolgikh, 2004; Dolgikh et al., 2004], the problems of the long-term predictions of the strong earthquakes [Abramov, 1997; Vikulin, 2003; Dolgikh et al., 2007], the climate change [Milankovitch, 1938; Hays et al., 1976; Berger and Loutre, 1991; Syun-Ichi Akasofu, 2004; Ponomarev et al., 2007] and the planetary cataclysms [Simonenko, 2007] are the significant problems of the modern sciences. In this regard, it was pointed out [Akulichev, Morgunov et al., 2007] that "the global problems of climate change and catastrophic natural phenomena (related with the dynamic oceanic processes) require the extended theoretical and experimental studies in this field with application of newest technologies".

It is well known that "the deterministic prediction of the time of origin, hypocentral (or epicentral) location, and magnitude of an impending earthquake is an open scientific problem" [Sgrigna and Conti, 2012]. It was conjectured [Sgrigna and Conti, 2012] that the possible earthquake prediction and warning must be carried out on a deterministic basis. However, it was pointed out [Sgrigna and Conti, 2012] with some regret that the modern "study of the physical conditions that give rise to an earthquake and the processes that precede a seismic rupture of an ordinary event are at a very preliminary stage and, consequently, the techniques of prediction of time of origin, epicentre, and magnitude of an impending earthquake now available are below standard". The authors [Sgrigna and Conti, 2012] argued that "a new strong theoretical scientific effort is necessary to try to understand the physics of the earthquake". It was conjectured [Sgrigna and Conti, 2012] that the present level of knowledge of the geophysical processes "is unable to achieve the objective of a deterministic prediction of an ordinary seismic event, but it certainly will in a more or less distant future tackle the problem with seriousness and avoiding scientifically incorrect, wasteful, and inconclusive shortcuts, as sometimes has been done". It was conjectured [Sgrigna and Conti, 2012] conjectured that "it will take long time (may be years, tens of years, or centuries) because this approach requires a great cultural, financial, and organizational effort on an international basis". It was conjectured [Sgrigna and Conti, 2012] that a possible contribution to a deterministic earthquake prediction approach is related with observations and physical modelling of earthquake precursors to formulate, in perspective, "a unified theory able to explain the causes of its genesis, and the dynamics, rheology, and microphysics of its preparation, occurrence, postseismic relaxation, and interseismic phases".

It was pointed out [Zhu and Zhan, 2012] that the gravity changes (derived from regional gravity monitoring data in China from 1998 to 2005) exhibited noticeable variations before the occurrence of two large earthquakes in 2008 in the areas surrounding Yutian (Xinjiang) and Wenchuan (Sichian). These results are consistent with the previous empirical finding [Abramov, 1997; p. 60] that the anomalous variations of the gravity field on the background of the Moon-Sun induced variations go in front of the earthquakes. A recent research by Zhan and his colleagues [Zhan, Zhu et al., 2011] demonstrated that significant gravity changes were observed before all nine large earthquakes that ruptured within or near mainland China from 2001 to 2008. It was pointed out [Zhu and Zhan, 2012] that the past experience and empirical data showed that “earthquakes typically occur within one to two years after a period of significant gravity changes in the region in question”. It was concluded [Zhu and Zhan, 2012] that the “additional research is needed to remove the subjective nature in the determination of the timeframe of a forecasted earthquake”.

It was conjectured [Console, Yamaoka and Zhuang, 2012] that the recent destructive earthquakes occurred in China (2008), Italy (2009), Haiti (2010), Chile (2010), New Zealand (2010), and Japan (2011) “have shown that, in present state, scientific researchers have achieved little or almost nothing in the implementation of short- and medium-term earthquake prediction, which would be useful for disaster mitigation measures”. It was conjectured [Console, Yamaoka and Zhuang, 2012] that “this regrettable situation could be ascribed to the present poor level of achievements in earthquake forecast”. It was pointed out [Console, Yamaoka and Zhuang, 2012] that “although many methods have been claimed to be capable of predicting earthquakes (as numerous presentations on earthquake precursors regularly show at every international meeting), the problem of formulating such predictions in a quantitative, rigorous, and repeatable way is still open”. It was formulated [Console, Yamaoka and Zhuang, 2012] that “another problem of practical implementation of earthquake forecasting could be due to the lack of common understanding and exchange of information between the scientific community and the governmental authorities that are responsible for earthquake damage mitigation in each country: they operate in two different environments, they aim at different tasks, and they generally speak two different languages”. It was pointed out [Console, Yamaoka and Zhuang, 2012] that “the way how seismologists should formulate their forecasts and how they should transfer them to decision-makers and to the public is still a tricky issue”. It was clearly formulated [Console, Yamaoka and Zhuang, 2012] that “the formulation of probabilistic earthquake forecasts with large uncertainties in space and time and very low probability levels is still difficult to be used by decision-making people”. It was conjectured [Console, Yamaoka and Zhuang, 2012] that “in real circumstances the authorities deal with critical problems related to the high cost of evacuating the population from an area where the scientific methods estimate an expected rate of destructive earthquake as one in many thousand days, while they require much more deterministic statements”. The authors [Console, Yamaoka and Zhuang, 2012] invited researches “to report methods and case studies that could concretely contribute or, at least seemed promising, to improve the present frustrating situation, regarding the practical use of earthquake forecasts”.

In this monograph we found the cosmic energy gravitational genesis of the increase of the seismic and volcanic activity of the Earth in the end of the 20^{th} century AD [Abramov, 1997] and in the beginning of the 21^{st} century AD [Simonenko, 2007]. The cosmic energy gravitational genesis of the increase of the seismic and volcanic activity of the Earth in the end of the 20^{th} century AD [Abramov, 1997] and in the beginning of the 21^{st} century AD [Simonenko, 2007] is based on the generalized formulation [Simonenko, 2007] of the first law of thermodynamics applied for the Earth subjected to the cosmic non-stationary energy gravitational influences of the Solar System.

To do this, we use the synthesis [Simonenko, 2007] of *the thermodynamic approaches* [Gibbs, 1873; de Groot and Mazur, 1962; Gyarmati, 1970; Landau and Lifshitz, 1976; Prigogine 1977; Akulichev, 1978; Keller and Hess, 1981; Evans, Hanley and Hess, 1984; Prigogine and Stengers, 1984; Nicolis and Prigogine, 1989; Simonenko, 2004, 2006, 2007a; 2007; 2008; 2009; 2010], *the continuum mechanical and hydrodynamic approaches* [Helmholtz, 1858; Sommerfeld, 1949; Batchelor, 1967; Akulichev, 1978; Landau and Lifshitz, 1988; Saffman, 1992; Kogan and Simonenko, 1992; Simonenko and Kogan, 1992; Sedov, 1994; Simonenko, 1992, 1995, 2001, 2004, 2006; 2007a; 2007; 2008; 2009; 2010], *the acoustic approaches* [Akulichev, 1978; Akulichev, Bezotvetnykh et al., 2001; Akulichev, Dzyuba et al., 2001; Makarov, Uleysky and Prants, 2003; Dzyuba, 2006; Dolgikh et al., 2007; Akulichev, Morgunov et al., 2007; Akulichev, Bugaeva et al., 2011], *the classical theory of the Newtonian gravity*, *the astronomical approaches* [Chandler, 1892; Perelman, 1956; Zhirmunsky and Kuzmin, 1990; Gor’kavyi and Fridman, 1994; Avsjuk and Suvorova, 2007; Simonenko, 2007], *the geological approaches* [Khain, 1958; Verhoogen, Turner, Weiss, Wahrhaftig and Fyte, 1970; Milanovsky, 1979; Abramov, 1993; Abramov, 1997; Hofmann, 1990; Avsjuk, 1996; Khain, 2003; Abramov and Molev, 2005; Avsjuk and Suvorova, 2007; Morozov, 2007; Khain and Poletaev, 2007; Vikulin and Melekestcev, 2007; Pavlenkova, 2007; Tveritinova and Vikulin, 2007; Simonenko, 2007a; 2007; 2008; 2009; 2010; 2011; 2012], *the geophysical approaches* [Chandler, 1892; Munk and Hassan, 1961; Runcorn et al., 1988; Chao and Gross, 1995; Abramov, 1993; Abramov, 1997; Dolgikh, 2000; Dolgikh, et al., 2002; Dolgikh et al., 2004; Dolgikh, 2004; Vikulin, 2003; Dolgikh et al., 2007; Simonenko, 2007a; 2007; 2008; 2009; 2010; 2011; 2012], *the seismological approaches* [Turner, 1925; Davison, 1936; Richter, 1964; Keylis-Borok and Malinovskaya, 1964; Clark, Dibble, Fyfe, Lensen and Suggarte, 1965; Johnston, 1965; Fedotov, 1965; Ambraseys, 1970; Shimazaki and Nakata, 1980; Suyehiro, 1984; Jacob, 1984; Christensen and Ruff 1986; Vikulin and Vikulina, 1989; Barrientos and Kansel, 1990; Ilyichev and Cherepanov, 1991; Abramov, 1997; Vikulin, 2003; Simonenko, 2007a; 2007; 2008; 2009; 2010; 2011; 2012], *the climatological approaches* [Milankovitch, 1938; Hays et al., 1976; Berger and Loutre, 1991; Imbrie et al., 1993; Muller and MacDonald, 1995; Berger, 1999; Elkibbi and Rial, 2001; Bol'shakov, 2003; Pinxian et al., 2003; Simonenko, 2007a; 2007; 2008; 2009; 2010; 2011; 2012; Simonenko, Gayko and Sereda, 2012], *oceanological approaches* [Webster and Yang, 1992; Fu and Teng, 1993; Latif and Barnett, 1994; Yamagata and Masumoto, 1992; Miller et al., 1994; Oort and Yienger, 1996; Delworth et al., 1996; Nakamura et al., 1997; Mantua et al., 1997; Minobe, 1997; Zhang et al., 1997; Thompson and Wallace, 1998; Overland et al., 1999; Minobe and Mantua, 1999; Ponomarev et al., 1999a; Ponomarev et al., 1999b; Wang and Ikeda, 2000; White and Cayan, 2000; Minobe, 1997; Miller and Schneider, 2000; Diaz et al., 2001; Li et al., 2001; Tourre et al., 2001; Nakamura et al., 2002; Global-regional linkages in the Earth system, 2002; Gong et al., 2003; Auad, 2003; Qiu, 2003; Ponomarev et al., 2003; Vasilevskaya et al., 2003; Savelieva et al., 2004; Polonsky et al., 2004; Krokhin, 2004; Ogi and Tachibana, 2006; Ponomarev et al., 2007; Lobanov et al., 2007; Simonenko, 2007a; 2007; 2008; 2009; 2010; 2011; 2012; Simonenko and Lobanov, 2011; 2012; Simonenko, Lobanov and Sereda, 2012] and *the hydro-geophysical approaches* [Tugarinov, 1973; Moskalev, 1991; Gorbunova and Spivak, 1997; Simonenko, 2007a; 2007; 2008; 2009; 2010].

We use the established generalized differential formulation [Simonenko, 2007a; 2007; 2008] of the first law of thermodynamics (for moving rotating deforming compressible heat-conducting stratified macroscopic continuum region τ subjected to the non-stationary Newtonian gravity):

$$dU_\tau + dK_\tau + d\pi_\tau = \delta Q + \delta A_{np,\partial\tau} + dG$$

extending the classical formulation [Gibbs, 1873] by taking into account (along with the classical infinitesimal change of heat δQ and the classical infinitesimal change of the internal energy $dU_\tau \equiv dU$) the infinitesimal increment of the macroscopic kinetic energy dK_τ, the infinitesimal increment of the gravitational potential energy $d\pi_\tau$, the generalized expression [Simonenko, 2007a; 2007] for the infinitesimal work $\delta A_{np,\partial\tau}$ done on the continuum region τ by the surroundings of τ, the infinitesimal amount dG of energy (given by the expression (1.52)) added (or lost) as a result of the Newtonian non-stationary gravitational energy influence on the continuum region τ during the infinitesimal time interval dt.

In Section 1 we begin by considering the inherent physical incompleteness of the classical expression [de Groot and Mazur, 1962; Gyarmati, 1970] for the macroscopic kinetic energy per unit mass ε_k defined (in classical non-equilibrium thermodynamics) as the sum of the macroscopic translational kinetic energy per unit mass $\varepsilon_t = \frac{1}{2}\mathbf{v}^2$ of the mass center of a continuum region and the macroscopic internal rotational kinetic energy per unit mass $\varepsilon_r = \frac{1}{2}\theta\,\boldsymbol{\omega}^2$, where $\mathbf{v}$ is the speed of the mass center of a small continuum region, $\boldsymbol{\omega}$ is an angular velocity of internal rotation [Gyarmati, 1970], θ is an inertia moment per unit mass of a small continuum region [de Groot and Mazur, 1962]. The classical de Groot and Mazur expression has inherent physical incompleteness [Simonenko, 2004] related with the questionable assumption about the rigid-like rotation of a small continuum region. The classical de Groot and Mazur expression [de Groot and Mazur, 1962] does not consider the non-equilibrium component of the macroscopic velocity field related with the velocity shear defined by the rate of strain tensor e_{ij}.

We proved [Simonenko, 2006] the necessity of development of the new conception of the macroscopic internal shear kinetic energy suggested earlier explicitly by Evans, Hanley and Hess [Evans, Hanley and Hess, 1984] and Simonenko [Simonenko, 1992]. In Subsection 1.1 we present a new physical concept [Simonenko, 2004] of the macroscopic internal shear kinetic energy expressing the macroscopic kinetic energy of the non-equilibrium (irreversible) dissipative shear motion near the mass center of a small macroscopic continuum region. We present also a new physical concept [Simonenko, 2004] of the macroscopic internal kinetic energy of shear-rotation coupling expressing the kinetic energy of local coupling between irreversible dissipative shear and reversible rigid-like rotational macroscopic continuum motions near the mass center of a small macroscopic continuum region. Basing on the analysis of the relative continuum motion in the Euclidean space in the inertial Cartesian coordinate system K, we present the analytical formula (1.6) for the macroscopic kinetic energy [Simonenko, 2004] of a small macroscopic continuum region considered in a stratified shear three-dimensional flow.

The macroscopic kinetic energy K_τ of a small continuum region τ (in a stratified shear three-dimensional flow) is presented as the sum of the macroscopic translational kinetic energy K_t , the classical de Groot and Mazur's macroscopic internal rotational kinetic energy K_r, the macroscopic internal shear kinetic energy K_s [Simonenko, 2004] and the macroscopic internal kinetic energy of shear-rotational coupling $K_{s,r}^{coup}$ [Simonenko, 2004] with a small correction of the order $O\,(d_\tau^7)$ determined by the diameter d_τ of a continuum region τ. In Subsection 1.1 we present also the analytical formula (1.13) [Simonenko, 2004] for the macroscopic kinetic energy per unit mass ε_k of a small macroscopic continuum region τ considered in a stratified shear three-dimensional flow. The macroscopic kinetic energy per unit mass ε_k is presented [Simonenko, 2004] as a sum of the macroscopic translational kinetic energy per unit mass $\varepsilon_t = \frac{1}{2}v^2$ of the mass center of a continuum region, the classical macroscopic internal rotational kinetic energy per unit mass ε_r [de Groot and Mazur, 1962; Gyarmati, 1970], the new macroscopic internal shear kinetic energy per unit mass ε_s [Simonenko, 2004] and the new macroscopic internal kinetic energy of shear-rotational coupling per unit mass $\varepsilon_{s,r}^{coup}$ [Simonenko, 2004] with a small correction. In Subsection 1.1 we present the definition of the macroscopic internal kinetic energy (of a small continuum region), which may be considered [Simonenko, 2004] as the macroscopic kinetic energy in the K'-coordinate system related with the mass center of a continuum region. We consider the consequences of the obtained formulae (1.6) and (1.13) for the macroscopic kinetic energy and the macroscopic internal kinetic energy of the homogeneous continuum sphere and cube. The presented expression (1.13) for ε_k and its particular form (1.24) for homogeneous continuum regions of spherical and cubical shapes generalized [Simonenko, 2004] the classical de Groot and Mazur expression in classical non-equilibrium thermodynamics [de Groot and Mazur, 1962; Gyarmati, 1970] by taking into account the new macroscopic internal shear kinetic energy per unit mass ε_s, which expresses the kinetic energy of irreversible dissipative shear motion, and also the new macroscopic internal kinetic energy of shear-rotational coupling per unit mass $\varepsilon_{s,r}^{coup}$, which expresses the kinetic energy of local coupling between irreversible dissipative shear and reversible rigid-like rotational macroscopic continuum motions. The deduced expression (1.13) for ε_k confirmed [Simonenko, 2004] the postulate [Evans, Hanley and Hess, 1984] that the velocity shear ($e_{ij} \neq 0$) represents an additional energy source in the postulated formulation [Evans, Hanley and Hess, 1984] of the first law of thermodynamics for non-equilibrium deformed states of continuum motion.

Following the "Statistical thermohydrodynamics of irreversible strike-slip-rotational processes" [Simonenko, 2007a] and the "Thermohydrogravidynamics of the Solar System" [Simonenko, 2007], in Subsection 1.2 we present the generalized differential formulation (1.43) of the first law of thermodynamics (in the Galilean frame of reference) for non-equilibrium shear-rotational states of the deformed finite one-component individual continuum (characterized by the symmetric stress tensor $\mathbf{T}$) region τ moving in the non-stationary gravitational field.

In Subsection 1.3 we present the generalized differential formulation [Simonenko, 2007a; 2007] of the first law of thermodynamics (in the Galilean frame of reference) for non-equilibrium shear-rotational states of the deformed finite individual region τ of the compressible viscous Newtonian one-component continuum moving in the non-stationary gravitational field. We present the generalization [Simonenko, 2007a; 2007] of the classical [Gibbs, 1873] expression $\delta A_{np,\partial\tau} = -\delta W = -pdV$ by taking into account (for Newtonian continuum) the infinitesimal works δA_c and δA_s, respectively, of acoustic and viscous Newtonian forces acting during the infinitesimal time interval dt on the boundary surface $\partial\tau$ of the individual continuum region τ.

Based on the generalized differential formulation (1.53) of the first law of thermodynamics (equivalent to the formulation (1.43)), in Subsection 1.4 we present the analysis [Simonenko, 2007a; 2007] of the gravitational energy mechanism of the gravitational energy supply into the continuum region τ owing to the local time increase of the potential ψ of the gravitational field inside the continuum region τ subjected to the non-stationary Newtonian gravitational field.

In Subsection 1.5 we present the evaluation [Simonenko, 2007a; 2007] of the time periodicity of the global volcanic and climate variability induced by the non-stationary cosmic energy gravitational influences on the Earth.

Using the established [Simonenko, 2004; 2006] generalized expression (1.6) for the total macroscopic kinetic energy $(K_\tau)_\alpha$ of each subsystem α, in Subsection 1.6 we present the conditions [Simonenko, 2007] of the thermodynamic equilibrium in the closed thermohydrogravidynamic system. In Subsection 1.6.1 we consider the equilibrium state of the closed thermohydrodynamic system in classical statistical physics [Landau and Lifshitz, 1976]. In Subsection 1.6.2 we present the foundation [Simonenko, 2007] of the conservation law of the total energy for the closed thermodynamic system τ in the frame of the continuum model. In Subsection 1.6.3 we present the consideration [Simonenko, 2007] of the classical statistical properties of the thermodynamically equilibrium subsystem in classical statistical physics [Landau and Lifshitz, 1976]. In Subsection 1.6.4 we present the definition of entropy (of the thermodynamic system in classical statistical physics [Landau and Lifshitz, 1976]) related with the Galilean principle of relativity. In Subsection 1.6.5 we present the formulation of the condition [Simonenko, 2007] of the thermodynamic equilibrium for the closed thermohydrogravidynamic system considered in the coordinate system K'_{sys} of the mass center C_{sys} of the thermohydrogravidynamic system under imposed conservation laws of the total energy and the total angular momentum. In Subsection 1.6.6 we present the generalized expression [Simonenko, 2007] for the angular momentum of the subsystem τ_α (the small macroscopic continuum region τ_α) for the non-equilibrium thermodynamic state. In Subsection 1.6.7 we present the condition (1.117) of the thermodynamic equilibrium [Simonenko, 2007] for the closed thermohydrogravidynamic system (consisting of N thermohydrogravidynamic subsystems) considering in the inertial coordinate system K'_{sys} related with the mass center C_{sys} of the thermohydrogravidynamic system. In Subsection 1.6.8 we present the conditions of the thermodynamic equilibrium [Simonenko, 2007] of the closed thermohydrogravidynamic system consisting of N thermohydrogravidynamic subsystem considered in the arbitrary inertial coordinate system K. In Subsection 1.6.8.1 we present the condition (1.121) [Simonenko, 2007] of the thermodynamic equilibrium (of the closed thermohydrogravidynamic system) describing the relative movements of the mass centers of all subsystems. In Subsection 1.6.8.2 we present the foundation [Simonenko, 2007] of the conditions (1.125) and (1.118) of the thermodynamic equilibrium of the closed thermohydrogravidynamic system relative to the macroscopic non-equilibrium kinetic energies [Simonenko, 2004] of the subsystems τ_α.

Following the "Statistical thermohydrodynamics of irreversible strike-slip-rotational processes" [Simonenko, 2007a] and the "Thermohydrogravidynamics of the Solar System" [Simonenko, 2007], in Subsection 1.7 we present (taking into account the shear-rotational thermodynamic states of the considered subsystem τ) the generalization of the Le Chatelier – Braun principle [Landau and Lifshitz, 1976] on the closed rotational thermohydrogravidynamic systems $(\tau + \bar{\tau})$ consisting of two subsystems τ and $\bar{\tau}$. We present the physical interpretation [Simonenko, 2007a; 2007] of the relaxation processes (after the deformational influences on the subsystem τ) in the rotational thermohydrogravidynamic systems $(\tau + \bar{\tau})$ in terms of the total entropy of the rotational thermohydrogravidynamic systems $(\tau + \bar{\tau})$.

In Subsection 1.8 we present the subsequent generalization (1.155) of the established generalized differential formulation (1.50) [Simonenko, 2007a; 2007; 2008; 2009; 2010] of the first law of thermodynamics. The subsequent generalization (1.155) of the first law of thermodynamics is suggested for description of moving rotating deformed compressible heat-conducting stratified individual macroscopic region τ of turbulent electromagnetic plasma subjected to the non-stationary Newtonian gravitational and electromagnetic fields.

In Section 2 we present the fundamentals of the cosmic geology [Simonenko, 2007] applicable for the planets of the Solar System. In Subsection 2.1 we present the expressions [Simonenko, 2007] for the total energy E_{τ_α} and the total angular momentum $\mathbf{M}_{\tau_\alpha}$ of the planet τ_α (and the satellite of the planet) taking into account the internal thermohydrogravidynamic structure of the planet τ_α (and the satellite of the planet).

Considering the Solar System as the open thermohydrogravidynamic system containing the set of separate thermohydrogravidynamic subsystems (the planets τ_α and the satellites of the planets) and disregarding the presence of atmospheres and hydrospheres (of the planets and the satellites of the planets), we present the expressions (2.17) and (2.18) for the total energy and the total angular momentum [Simonenko, 2007] of the Solar System consisting of N cosmic material objects (the Sun, the planets, the satellites of the planets, the midget planets, known asteroids and comets of the Solar System). Using the expressions (2.17) and (2.18), we present the evidence [Simonenko, 2007] of the mutual energy transformations between the accumulated internal energies (of the accumulated internal energies of deformation, compression and strain of the continuum of the planets), the macroscopic internal rotational energy [de Groot and Mazur, 1962; Gyarmati, 1970] and the macroscopic internal non-equilibrium kinetic energies [Simonenko, 2004] of the planets. We present the evidence [Simonenko, 2007] that the mutual energy transformations can result to the evolutionary changes of the directions (and axes) of rotation of the planets and satellites (of the planets) of the Solar System.

Taking into account the system of the expressions (2.19) and (2.20) for the total energy and the total angular momentum of the subsystem τ (the subsystem τ of the planet ($\tau+\bar{\tau}$) without the surrounding subsystem $\bar{\tau}$ (the atmosphere or the atmosphere and hydrosphere)) of the planet ($\tau+\bar{\tau}$), we demonstrate the evidence [Simonenko, 2004a; 2007] of the mutual energy transformations between the accumulated internal energy U_τ of the subsystem τ and the macroscopic internal rotational kinetic energy $(K_r)_\tau$ (of the subsystem τ of the planet ($\tau+\bar{\tau}$)), the macroscopic internal shear kinetic energy $(K_s)_\tau$ (of the subsystem τ of the planet ($\tau+\bar{\tau}$)) and the macroscopic internal kinetic energy of shear-rotational coupling $(K_{s,r}^{coup})_\tau$ (of the subsystem τ of the planet ($\tau+\bar{\tau}$)) during the seismotectonic relaxation of the planet ($\tau+\bar{\tau}$). We demonstrate that these energy transformations give the real evidence [Simonenko, 2007] to consider the seismotectonic relaxation of the planet ($\tau+\bar{\tau}$) as the planetary process [Vikulin, 2003].

Using the generalized differential formulation (2.21) of the first law of thermodynamics (taking into account the additional term related with the space-time density e_τ of heating due to the disintegration of radio-active elements and the human industrial activity inside the planet ($\tau+\bar{\tau}$) of the Solar System), in Subsection 2.2 we present the non-catastrophic model [Simonenko, 2007a; 2007] of the thermohydrogravidynamic evolution of the total energy of the subsystems (τ and $\bar{\tau}$) of the planet ($\tau+\bar{\tau}$), which evolve during some time period without formation of the new planetary fractures in the subsystem τ surrounding by the subsystem $\bar{\tau}$ (representing the atmosphere or the atmosphere and hydrosphere).

In Subsection 2.3 we present the synthesis of the cosmic geology [Simonenko, 2007; 2009; 2010] of the Earth (applicable for the terrestrial planets of the Solar System) taking into account the convection in the lower geo-spheres of the Earth (the planet), the density differentiation, the translational, rotational and deformational movements of the tectonic plates, the creation of the new planetary tectonic fractures induced by the energy gravitational influences of the Solar System and our Galaxy. Using the generalized differential formulation (2.21) of the first law of thermodynamics, in Subsection 2.3.1 we present the thermohydrogravidynamic N-layer model [Simonenko, 2007; 2009; 2010] of the non-fragmentary geo-spheres of the Earth (the planet of the Solar System). Based on the deduced [Simonenko, 2007] evolution equation (2.30) of the total energy E_τ of the subsystem τ (consisting of N successively embedded to each other subsystems (geo-spheres) $\tau_N, \tau_{N-1}, \ldots, \tau_2, \tau_1$) of the planet ($\tau+\bar{\tau}$), in Subsection 2.3.1 we present the expression (2.31) for the necessary power $W_{br}(\Delta\Sigma_i)$ (in particular, of the external cosmic energy gravitational influence), which is sufficient [Simonenko, 2007] to break the crystalline root (of the considered continental and oceanic planetary tectonic formations characterized [Abramov and Molev, 2005; p. 245] by the mantle penetrated deep roots) in one section characterized by the area $\Delta\Sigma_i$. Based on the combined data [Abramov and Molev, 2005; p. 245; Pavlenkova, 2007] about the roots of continents, we present the evidence [Simonenko, 2007] that the translational mobility of the upper subsystem $\tau_1=\tau_{ext}$ (along with a separate tectonic plates and geo-blocks of the subsystem $\tau_1=\tau_{ext}$) of the Earth is greatly restricted by the deepened roots of the continental and the oceanic planetary formations. We present (for two data [Abramov and Molev, 2005; p. 245; Pavlenkova, 2007; p. 107] about the roots of continents) the evidence [Simonenko, 2007] that it is easier to realize (by action of the external cosmic gravitational field) the assumed [Pavlenkova, 1995] rotation of the mantle (as a whole) relative to the fluid kernel with the slippage on the boundary of the kernel and the mantle of the Earth than to split the mantle of the Earth by means of the new global tectonic fracture into two equal parts in the different sides of the main secant plane intersecting the centre of the Earth. Using the evolution equation (2.32) for the sum $K_\tau + \pi_\tau$ of the total macroscopic kinetic energy K_τ and the total macroscopic potential (gravitational) energy π_τ of the subsystem τ (of the Earth or a planet of the Solar System), we present the evidence [Simonenko, 2007] that the revealed time period 100 million years [Hofmann, 1990] of the maximal endogenous activity of the Earth [Morozov, 2007; p. 496] is induced by the periodic changes (characterized by the time period of 200 million years) of the potential of the gravitational field (of the Solar System and our Galaxy) influencing on the Earth considered as the cosmic material object (in the frame of the Solar System) moving around the center of our Galaxy.

Based on the generalized differential formulation (2.21) of the first law of thermodynamics (containing the new additional term related with the space-time density e_τ of the sources of heat), in Subsection 2.3.2 we present the synthesis of the thermohydrogravidynamic translational-shear-rotational N-layer tectonic model [Simonenko, 2007] of the fragmentary geo-spheres of the Earth (of the planet ($\tau + \bar{\tau}$) of the Solar System). We present the evolution equation (2.36) of the total energy of the geo-sphere $\tau_1 = \tau_{ext}$ (the first upper layer of the subsystem τ of the planet ($\tau + \bar{\tau}$)). The evolution equation (2.36) represents the thermohydrogravidynamic model of the translational-shear-rotational tectonics of moving rotating deforming compressible heat-conducting stratified macroscopic geo-blocks τ_{1j} (j = 1, 2, …, N_1) surrounded by the coupled viscous plastic layers and subjected to the non-stationary Newtonian gravity and heating related with disintegration of the radio-active elements (in the geo-sphere τ_{ext}).

In Subsection 2.3.3 we present the universal energy thermohydrogravidynamic approach [Simonenko, 2007] of formation of the planetary fractures in the frame of the generalized differential formulation (2.21) of the first law of thermodynamics [Simonenko, 2007] and the thermohydrogravidynamic translational-shear-rotational N-layer tectonic model [Simonenko, 2007] (presented in Subsection 2.3.2) of the fragmentary (consisting of geo-blocks) geo-spheres of the Earth (and the planet of the Solar System of the terrestrial group: the Mercury, the Venus and the Mars). Based on the generalized differential formulation (2.21) of the first law of thermodynamics and the mathematical inductive method, we present the evolution equations (2.39), (2.41) and (2.42) describing [Simonenko, 2007] the evolutions of the total energy of the geo-block τ_{1j} (of the first upper layer (geo-sphere) $\tau_1 = \tau_{ext}$ of the subsystem τ of the planet ($\tau + \bar{\tau}$)) under formation of the integer number of various uncrossed (between itself) fracture surfaces breaking the Earth's crust. Using the deduced evolution equations (2.39), (2.41) and (2.42), we formulate the established [Simonenko, 2007] energy sources of the destruction in the geo-block τ_{1j}: the total non-stationary gravitational fields (the external cosmic and the terrestrial), the internal heat related with the disintegration of the radio-active elements, the heat flux from the upper boundary of the situated below second layer (subsystem) τ_2 and the work of stress forces on the surface of the geo-block τ_{1j}.

In Section 3 we present the fundamentals of the cosmic geophysics [Simonenko, 2007] applicable for the planets of the Solar System. In Subsection 3.1 we consider the energy gravitational influences [Simonenko, 2007; 2009; 2010] on the Earth of the inner planets and the outer planets of the Solar System. In Subsection 3.1.1 we present the derivation of the analytical relation [Simonenko, 2009; 2010] for the energy gravitational influences (on the Earth) of the inner and the outer planets in the second approximation of the elliptical orbits of the planets of the Solar System. In Subsection 3.1.2 we present the evaluation [Simonenko, 2007] of the relative maximal instantaneous energy gravitational influences (on the unit mass at the surface point D_3 of the Earth) of the inner planets and the outer planets in the first approximation of the circular orbits of the planets. In Subsection 3.1.2 we present also the evaluation [Simonenko, 2009; 2010] of the relative maximal instantaneous energy gravitational influences (on the unit mass of the Earth at the mass center C_3 of the Earth) of the inner and the outer planets in the first approximation of the circular orbits of the planets. In Subsection 3.1.3 we present the evaluation [Simonenko, 2007; 2009; 2010] of the relative values of the maximal integral energy gravitational influences on the Earth of the inner planets (the Mercury and the Venus) and the outer planets (the Mars, the Jupiter, the Saturn, the Uranus, the Neptune and the Pluto) in the approximation of the circular orbits of the planets of the Solar System.

In Subsection 3.2 we present the evaluations [Simonenko, 2009; 2010] of the relative maximal (instantaneous and integral) energy gravitational influence of the Moon on the Earth as compared with the maximal (instantaneous and integral) energy gravitational influences on the Earth of the planets of the Solar

System. In Subsection 3.2.1 we present the evaluation [Simonenko, 2009; 2010] of the relative maximal instantaneous energy gravitational influence of the Moon on the Earth (as compared with the maximal instantaneous energy gravitational influences on the Earth of the planets of the Solar System) in the second approximation of the elliptical orbits of the Earth and the Moon around the combined mass center $C_{3,MOON}$ of the Earth and the Moon. In Subsection 3.2.2 we present the evaluation [Simonenko, 2009; 2010] of the maximal integral energy gravitational influence of the Moon on the Earth (as compared with the maximal integral energy gravitational influences on the Earth of the planets of the Solar System) in the second approximation of the elliptical orbits of the Earth and the Moon around the combined mass center $C_{3,MOON}$ of the Earth and the Moon.

In Subsection 3.3 we evaluate the energy gravitational influence of the Sun on the Earth owing to the gravitational interaction of the Sun with the outer large planets (the Jupiter, the Saturn, the Uranus and the Neptune) of the Solar System. In Subsection 3.3.1 we evaluate the relative characteristic maximal positive instantaneous energy gravitational influences of the Sun on the Earth owing to the gravitational interaction of the Sun with the outer large planets of the Solar System. In Subsection 3.3.2 we evaluate the maximal positive integral energy gravitational influences of the Sun on the Earth owing to the gravitational interaction of the Sun with the outer large planets in the first approximation of the circular orbits of the planets of the Solar System.

In Subsection 3.4 we demonstrate the established [Simonenko, 2007; 2009; 2010] real cosmic energy gravitational genesis of the strong earthquakes and the global planetary cataclysms. Using the expression (3.51) for the maximal positive integral energy gravitational influence $E_g(\tau_2, D_3, m_\tau)$ of the Venus (i = 2) on the macroscopic continuum region τ of the mass m_τ near the surface point D_3 of the Earth, in Subsection 3.4.1 we present the confirmation [Simonenko, 2007] of the real cosmic energy gravitational genesis of preparation of earthquakes. In Subsection 3.4.2 we demonstrate the evidence of the integral energy gravitational influence on the Earth of the Sun (owing to the gravitational interactions of the Sun with the Jupiter τ_5 and the Saturn τ_6) and the Moon as the predominant cosmic trigger mechanism of the earthquakes preparing by the combined integral energy gravitational influence on the Earth of the Sun (owing to the gravitational interactions of the Sun with the Jupiter τ_5 and the Saturn τ_6, the Uranus τ_7 and the Neptune τ_8), the Venus, the Jupiter, the Moon, the Mars and the Mercury. In Subsection 3.4.3 we found the catastrophic planetary configurations established by the cosmic seismology [Simonenko, 2007]. In Subsection 3.4.3.1 we present the established [Simonenko, 2007] catastrophic planetary configurations related with the maximal (positive) and minimal (negative) combined integral energy gravitational influence on the Earth τ_3 of the planets of the Solar System. We formulate the global prediction thermohydrogravidynamic principles (consistent with the generalized differential formulations (1.43) and (1.50) of the first law of thermodynamics of the established cosmic seismology [Simonenko, 2007; 2008; 2009; 2010]) associated with the maximal (positive) and minimal (negative) combined planetary integral energy gravitational influence on the Earth. In Subsection 3.4.3.2 we found the catastrophic planetary configurations related with the maximal (positive) and minimal (negative) combined integral energy gravitational influence on the Earth τ_3 of the Sun (owing to the gravitational interactions of the Sun with the Jupiter τ_5, the Saturn τ_6, the Uranus τ_7 and the Neptune τ_8) and the planets of the Solar System. We formulate the global prediction thermohydrogravidynamic principles (consistent with the generalized differential formulations (1.43) and (1.50) of the first law of thermodynamics of the established cosmic seismology [Simonenko, 2007; 2008; 2009; 2010]) associated with the maximal (positive) and minimal (negative) combined planetary and solar integral energy gravitational influence on the Earth of the planets of the Solar System and the Sun owing to the gravitational interaction of the Sun with the outer large planets (the Jupiter (τ_5), the Saturn (τ_6), the Uranus (τ_7) and the Neptune (τ_8)).

In Subsection 3.5 we present, classical shear (deformational) model [Короновский и Абрамов, 2000] of the earthquake focal region, the rotational model [Vikulin, 2003] of the earthquake focal region and the generalized thermohydrogravidynamic shear-rotational model [Simonenko, 2007a; 2007; 2008] (of the earthquake focal region) taking into account the classical macroscopic rotational kinetic energy [de Groot and Mazur, 1962; Gyarmati, 1970], the macroscopic non-equilibrium kinetic energies [Simonenko, 2004], the internal (terrestrial) energy gravitational influences and the external (cosmic) energy gravitational influences [Simonenko, 2007a; 2007; 2008] on the focal region of earthquakes. Using the evolution equation (1.67) (deduced from the generalized differential formulation (1.43) of the first law of thermodynamics) of the total mechanical energy of the macroscopic continuum region τ (of the compressible viscous Newtonian continuum), in Subsection 3.5.1 we present the thermodynamic foundation of the generalized thermohydrogravidynamic shear-rotational model [Simonenko, 2007a; 2007] and the classical shear (deformational) model [Короновский и Абрамов, 2000] of the earthquake focal region. We demonstrated [Simonenko, 2007a; 2007] the physical adequacy of the classical deformational (shear) model [Короновский и Абрамов, 2000] of the earthquake focal region for the quasi-uniform medium of the Earth's crust characterized by practically constant viscosity. Using the evolution equation (1.67) of the total mechanical energy of the macroscopic continuum region τ (of the compressible viscous Newtonian continuum), in Subsection 3.5.2 we present the thermodynamic foundation of the rotational model [Vikulin, 2003] of the earthquake focal region. We demonstrated [Simonenko, 2007a; 2007] the physical adequacy of the rotational model [Vikulin, 2003] of the earthquake focal region for the seismic zone of the Pacific Ring. In Subsection 3.5.3 we found the local energy and entropy prediction thermohydrogravidynamic principles determining the fractures formation in the macroscopic continuum region τ subjected the combined integral energy gravitational influence of the planets of the Solar System, the Moon and the Sun owing to the gravitational interaction of the Sun with the outer large planets (the Jupiter, the Saturn, the Uranus and the Neptune). In Subsection 3.5.3.1 we formulate the local energy prediction thermohydrogravidynamic principles (determining the fractures formation in the macroscopic continuum region τ) related with the maximal (positive) and minimal (negative), respectively, combined integral energy gravitational influence on the macroscopic continuum region τ of the planets of the Solar System, the Moon and the Sun owing to the gravitational interaction of the Sun with the outer large planets (the Jupiter, the Saturn, the Uranus and the Neptune). In Subsection 3.5.3.2 we formulate the local entropy prediction thermohydrogravidynamic principle determining the fractures formation in the macroscopic continuum region τ subjected the combined integral energy gravitational influence of the planets of the Solar System, the Moon and the Sun owing to the gravitational interaction of the Sun with the outer large planets (the Jupiter, the Saturn, the Uranus and the Neptune).

In Subsection 3.6 we present the confirmation of the cosmic energy gravitational genesis [Simonenko, 2007] of the seismotectonic (and volcanic) activity and the global climate variability induced by the cosmic non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter. In Subsection 3.6.1 we present the empirically established [Turner, 1925; Мэй Ши-юн, 1960; Tamrazyan, 1962; Fedotov, 1965; Филлипас, 1965; Davison, 1936; Ambraseys, 1970; Christensen and Ruff 1986; Barrientos and Kansel, 1990; Jacob, 1984; Shimazaki and Nakata, 1980; Suyehiro, 1984; Clark, Dibble, Fyfe, Lensen and Suggarte, 1965; Johnston, 1965; Abramov, 1997; p. 72; Vikulin and Vikulina, 1989; Vikulin, 2003; p. 16-17] time periodicities of the seismotectonic activity of the Earth. Using the equivalent generalized differential formulations (1.43), (1.50) and (1.53) of the first law of thermodynamics [Simonenko, 2007] for the Earth, in Subsection 3.6.2 we present (in the frame of the real elliptical orbits of the Earth, the Sun, the Moon, the Venus, the Mars and the Jupiter) the successive approximations [Simonenko, 2007] for the time periodicities of the maximal (instantaneous or integral) separate cosmic non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter. According to the thermohydrogravidynamic theory [Simonenko, 2007], these time periodicities correspond to the related time periodicities of the Earth's periodic seismotectonic (and volcanic) activity and the global climate variability induced by the separate cosmic non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter. In Subsection 3.6.2.1 we present the successive time periodicities [Simonenko, 2007] of the maximal (instantaneous and integral) energy gravitational influences on the Earth of the system Sun-Moon. In Subsection 3.6.2.2 we present the successive time periodicities [Simonenko, 2007] of the maximal (instantaneous and integral) energy gravitational influences on the Earth of the Venus. In Subsection 3.6.2.3 we present the successive time periodicities of the maximal (instantaneous and integral) energy gravitational influences on the Earth of the Jupiter [Simonenko, 2007] and the Sun owing to the gravitational interaction of the Sun with the Jupiter. In Subsection 3.6.2.4 we present the successive time periodicities [Simonenko, 2007] of the maximal (instantaneous and integral) energy gravitational influences on the Earth of the Mars. Based on the equivalent generalized differential formulations (1.43), (1.48) and (1.53) of the first law of thermodynamics [Simonenko, 2007] used for the Earth, in Subsection 3.6.2.5 we present the time periodicities [Simonenko, 2007] of the periodic global seismotectonic (and volcanic) activity and the global climate variability of the Earth induced by the combined different combinations of the cosmic energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Jupiter, the Mars and the Sun owing to the gravitational interaction of the Sun with the Jupiter. In Subsection 3.6.3 we confirm the real cosmic energy gravitational genesis [Simonenko, 2007] of the strongest Japanese earthquakes. In Subsection 3.6.4 we present the previous evaluation [Simonenko, 2007] of the mean time periodicities 94620 years and 107568 years of the global climate variability (related with the $G(a)$ - factor and $G(b)$ - factor determined by the cosmic non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter) and the mean time periodicities 100845 years and 121612.5 years of the global climate variability related with the $G(b)$ - factor determined by the cosmic non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter. In Subsection 3.6.5 we present the real confirmation [Simonenko, 2007] of the cosmic energy gravitational genesis of the modern short-term time periodicities of the Earth's global climate variability determined by the combined cosmic factors: G-factor related with the combined cosmic non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Mercury, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter; $G(a)$ -factor related to the tectonic-endogenous heating of the Earth as a consequence of the periodic continuum deformation of the Earth due to the G -factor; $G(b)$ -factor related to the periodic atmospheric-oceanic warming or cooling as a consequence of the periodic variable (increasing or decreasing) output of the heated greenhouse volcanic gases and the related variable greenhouse effect induced by the periodic variable tectonic-volcanic activity (activization or weakening) due to the G -factor; $G(c)$ -factor related to the periodic variations of the solar activity owing to the periodic variations of the combined planetary non-stationary energy gravitational influence on the Sun.

In Subsection 3.7 we found the cosmic energy gravitational genesis of the seismotectonic (and volcanic) activity and the global climate variability induced (owing to the G-factor, $G(a)$ -factor and $G(b)$ -factor) by the combined non-stationary cosmic energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun (owing to the gravitational interaction of the Sun with the Jupiter, the Saturn, the Uranus and the Neptune). In Subsection 3.7.1 we evaluate the time periodicities of the maximal (instantaneous and integral) energy gravitational influences of the Sun on the Earth owing to the gravitational interaction of the Sun with the outer large planets (the Jupiter, the Saturn, the Uranus and the Neptune). In Subsection 3.7.1.1 we present the time periodicities [Simonenko, 2007] of the maximal (instantaneous and integral) energy gravitational influences on the Earth of the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter. In Subsection 3.7.1.2 we evaluate the time periodicities of the maximal (instantaneous and integral) energy gravitational influences on the Earth of the Saturn and the Sun owing to the gravitational interaction of the Sun with the Saturn. In Subsection 3.7.1.3 we evaluate the time periodicities of the maximal (instantaneous and integral) energy gravitational influences on the Earth of the Uranus and the Sun owing to the gravitational interaction of the Sun with the Uranus. In Subsection 3.7.1.4 we evaluate the time periodicities of the maximal (instantaneous and integral) energy gravitational influences on the Earth of the Neptune and the Sun owing to the gravitational interaction of the Sun with the Neptune. In Subsection 3.7.1.5 we found the fundamental global time periodicities (related to the combined planetary, lunar and solar non-stationary energy gravitational influences on the Earth) of the Earth's periodic global seismotectonic (and volcanic) activity and the global climate variability induced by the different combinations of the cosmic non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter, the Saturn, the Uranus and the Neptune. In Subsection 3.7.1.6 we present the thermohydrogravidynamic solution of the fundamental problem [Imbrie, Berger et al., 1993] of the origin of the major 100-kyr glacial cycle (during Pleistocene) determined by the non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Jupiter and the Sun owing to the gravitational interactions of the Sun with the Jupiter, the Saturn, the Uranus and the Neptune.

In Subsection 3.8 we analyze the global seismicity and volcanic activity of the Earth from the biblical Flood (occurred in 2104 BC according to the orthodox biblical chronology) and predict the forthcoming range $2020 \div 2061$ AD of the maximal seismotectonic, volcanic and climatic activities of the Earth during the past $696 \div 708$ years of the history of humankind. In Subsection 3.8.1 we present the foundation of the ranges of the fundamental global seismotectonic, volcanic and climatic periodicities $T_{tec,f} = T_{clim1,f} = 696 \div 708$ years and $T_{tec,f} = T_{clim2,f} = 348 \div 354$ years determined by the combined predominant non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Jupiter and the Sun owing to the gravitational interactions of the Sun with the Jupiter and the

Saturn. In Subsection 3.8.2 we present the evidence of the founded ranges of the fundamental global seismotectonic and volcanic time periodicities $T_{tec,f} = T_{clim1,f} = 696 \div 708$ years and $T_{tec,f} = T_{clim2,f} = 348 \div 354$ years based on the statistical analysis of the historical eruptions [Thordarson and Larsen, 2007] of the Katla and the Hekla volcanic systems in Iceland. In Subsection 3.8.2.1 we present the generalized formulation [Simonenko, 2005] of the weak law of large numbers used for the statistical analysis of the historical volcanic eruptions [Thordarson and Larsen, 2007]. In Subsection 3.8.2.2 we present the statistical analysis of the historical volcanic eruptions [Thordarson and Larsen, 2007] of Katla volcano. In Subsection 3.8.2.3 we present the statistical analysis of the historical volcanic eruptions [Thordarson and Larsen, 2007] of Hekla volcano. In Subsection 3.8.3 we present the confirmation of the cosmic energy gravitational genesis of the predominant short-range time periodicities (7i/6 years and 6j/5 years determined by small integers i and j) of the Chandler's wobble of the Earth's pole and sea water and air temperature variations. In Subsection 3.8.3.1 we found the cosmic energy gravitational genesis of the predominant time periodicities $T_{clim1,1} = (T_{ch})_1 \approx 6/5\,\text{yr} = 1.2$ years and $T_{clim1,2} = (T_{ch})_2 \approx 7/6\,\text{yr} = = 1.1666666....$years of the global climate variability induced by the combined non-stationary energy gravitational influence on the Earth of the Venus, the Mercury and the Moon. In Subsection 3.8.3.2 we present the combined analysis of the Chandler's wobble of the Earth's pole [Simonenko, 2011] and the variations [Simonenko, Gayko and Sereda, 2012] of sea water and air temperature during 1969-2010 for the costal station Possyet of the Japan Sea.

In Subsection 3.8.4 we present the evidence of the founded (in Subsection 3.8.1) range of the fundamental global periodicities $T_{tec,f} = T_{clim1,f} = 696 \div 708$ yr (of the global seismotectonic and volcanic activities and the climate variability of the Earth) obtained from the established links between the great natural cataclysms in the ancient history of humankind from the final collapse of the ancient Egyptian Kingdom and the biblical Flood to the increase of the global seismicity and the global volcanic activity in the beginning of the 20th century [Richter, 1969] and the modern increase of the global seismicity and the volcanic activity in the end of the 20th century [Abramov, 1997] and in the beginning of the 21st century [Simonenko, 2007; 2009; 2010]. In Subsection 3.8.4.1 we consider the great natural cataclysms in the history of humankind from the final collapse of the ancient Egyptian Kingdom (near 2190 BC) and the biblical Flood (occurred in 2104 BC according to the orthodox Jewish and Christian biblical chronology). In Subsection 3.8.4.2 we reveal the linkage of the last major eruption of Thera (1450 BC) [LaMoreaux, 1995] and the greatest earthquake destroyed the ancient Pontus (63 BC). In Subsection 3.8.4.3 we reveal the linkage of the greatest earthquake destroyed the ancient Pontus (63 BC), the earthquake destroyed the ancient Greek Temple of Artemis (614 AD) and the great frost event (628 AD) [LaMarche and Hirschboeck, 1984] related with the atmospheric veil (recorded in Europe in 626 AD [Stothers and Rampino, 1983]) induced by the great unknown volcanic eruption (apparently, Rabaul' [LaMarche and Hirschboeck, 1984] eruption). In Subsection 3.8.4.4 we reveal the linkage of the greatest earthquake destroyed the ancient Pontus (63 BC) and the great earthquakes [Vikulin, 2008] occurred in England (1318 AD and 1343 AD), Armenia (1319 AD), Portugal (1320 AD, 1344 AD and 1356 AD) and Japan (1361 AD). In Subsection 3.8.4.5 we reveal the linkage of the final collapse of the ancient Egyptian Kingdom (occurred near 2190 BC), the biblical Flood (occurred in 2104 BC according to the orthodox Jewish and Christian biblical chronology) and the last major eruption of Thera (1450 BC) [LaMoreaux, 1995]. In Subsection 3.8.4.6 we reveal the linkage of the planetary disasters in the Central Asia (10555 BC) [Bunsen, 1848, pp. 77-78, 88] and in the ancient Egyptian Kingdom (10450 BC) [Hancock, 1997], and the greatest earthquake destroyed the ancient Pontus (63 BC). In Subsection 3.8.4.7 we reveal the linkage of the previous great eruptions of Thera (Santorini) (between 1628 and 1450 BC [LaMoreaux, 1995]), the greatest (in the United States in the past 150 years up to 1872) earthquake in Owens Valley, California (1872 AD), the eruptions of Santorini in 1866 and 1925 AD and the great eruption of Krakatau in 1883 AD. In Subsection 3.8.4.8 we reveal the linkage of the eruption of Tambora (1815 AD) and the Thera (Santorini) eruption in the range 1700 $\div$ 1640 BC [Betancourt, 1987; Habberten et al., 1989]. In Subsection 3.8.4.9 we reveal the linkage of the increase of the global seismicity (along with the increase of the volcanic activity) in the end of the 19th century and in beginning of the 20th century [Richter, 1969] and the eruption of Thera (Santorini) between 1600 and 1500 BC [Antonopoulos, 1992]. In Subsection 3.8.4.10 we reveal the linkage of the increase of the global seismicity (along with the increase of the volcanic activity) in the end of the 20th [Abramov, 1997] century and the eruption of Hekla (1300 AD) [Thordarson and Larsen, 2007] in Iceland and the great earthquake (1303 AD) in China [Vikulin, 2008].

In Subsection 3.9 we present the evidence of the established [Simonenko, 2012] forthcoming range $2020 \div 2061\,\text{AD}$ AD of the maximal seismotectonic, volcanic and climatic activities of the Earth during the past $696 \div 708$ years of the history of humankind. We present the evidence of the related subsequent subranges $(2023 \pm 3$ AD, 2040.38 ± 3 AD and 2061 ± 3 AD$)$ of the increased peaks of the forthcoming global seismotectonic and volcanic activities and the climate variability of the Earth in the 21st century.

The main results and conclusions are summarized in Section 4.

1. THE GENERALIZED FORMULATION OF THE FIRST LAW OF THERMODYNAMICS FOR MOVING ROTATING DEFORMING COMPRESSIBLE HEAT-CONDUCTING STRATIFIED MACROSCOPIC INDIVIDUAL CONTINUUM REGION τ SUBJECTED TO THE NON-STATIONARY NEWTONIAN GRAVITATIONAL AND ELECTROMAGNETIC FIELDS

1.1. The generalized expression for the macroscopic kinetic energy of a small continuum region in non-equilibrium thermodynamics

De Groot and Mazur defined the macroscopic kinetic energy per unit mass ε_k as [de Groot and Mazur, 1962] the sum of the macroscopic translational kinetic energy per unit mass $\varepsilon_t = \frac{1}{2}\mathbf{v}^2$ of a continuum region (particle) mass center and the macroscopic internal rotational kinetic energy per unit mass $\varepsilon_r = \frac{1}{2}\theta\,\boldsymbol{\omega}^2$:

$$\varepsilon_k = \varepsilon_t + \varepsilon_r = \frac{1}{2}\mathbf{v}^2 + \frac{1}{2}\theta\,\boldsymbol{\omega}^2, \tag{1.1}$$

where $\mathbf{v}$ is the speed of the mass center of a small continuum region, $\boldsymbol{\omega}$ is an angular velocity of internal rotation [Gyarmati, 1970], θ is an inertia moment per unit mass of a small continuum region [de Groot and Mazur, 1962]. Gyarmati's definition [Gyarmati, 1970] of the macroscopic kinetic energy per unit mass is analogous to de Groot and Mazur's one. The classical de Groot & Mazur's and Gyarmati's definition (1.1) of the macroscopic kinetic energy per unit mass for a shear flows has some inherent physical incompleteness associated with the assumption about the rigid-like rotation of the continuum region with the angular velocity vector $\boldsymbol{\omega}$. This definition is based on the assumption of local thermodynamic equilibrium since it does not consider the non-equilibrium shear component of the macroscopic continuum motion related with the rate of strain tensor e_{ij}. However, the assumption of local thermodynamic equilibrium, as noted by de Groot and Mazur [de Groot and Mazur, 1962], may be justified only by reasonable agreement of the experimental results with the theoretical deductions based on this assumption.

Thus, we see that the introduction of the conception of the ″shear energy″ is caused by the incompleteness of the definition for the macroscopic kinetic energy in classical non-equilibrium thermodynamics [de Groot and Mazur, 1962; Gyarmati, 1970]. We derive in Subsection 1.1 the formula for the macroscopic kinetic energy per unit mass of a small continuum region considered in a stratified shear three-dimensional flow. The obtained formula removes the limitations of the classical expression (1.1).

Landau and Lifshitz defined [Landau and Lifshitz, 1976] the macroscopic internal energy of a small macroscopic continuum region as the difference between the total kinetic energy of the continuum region and kinetic energy of the translational macroscopic motion of the continuum region. According to Landau and Lifshitz's definition [Landau and Lifshitz, 1976] of the macroscopic internal energy, the term $\frac{1}{2}\theta\,\boldsymbol{\omega}^2$ in the expression (1.1) is the internal energy of the macroscopic (hydrodynamic) continuum motion. The classical definition [de Groot and Mazur, 1962; Gyarmati, 1970] of the macroscopic internal rotational kinetic energy per unit mass $\frac{1}{2}\theta\,\boldsymbol{\omega}^2$ is consistent with the Landau and Lifshitz's definition of the macroscopic internal energy. We shall use further the Landau and Lifshits's definition [Landau and Lifshitz, 1976] of the macroscopic internal energy.

Following the works [Simonenko, 2004; 2005; 2006; 2007a; 2007; 2008], we shall present the foundation of the generalized expression for the macroscopic kinetic energy in non-equilibrium thermodynamics. We shall assume that τ is a small individual continuum region (domain) bounded by the closed continual boundary surface $\partial\tau$ considered in the three-dimensional Euclidean space with respect to a Cartesian coordinate system K. We shall consider the small continuum region τ in a Galilean frame of reference with respect to a Cartesian coordinate system K centred at the origin O and determined by the axes X_1, X_2, X_3 (see Fig. 1).

The unit normal K-basis coordinate vectors triad $\boldsymbol{\mu}_1, \boldsymbol{\mu}_2, \boldsymbol{\mu}_3$ is taken in the directions of the axes X_1, X_2, X_3, respectively. The K-basis vector triad is taken to be right-handed in the order $\boldsymbol{\mu}_1, \boldsymbol{\mu}_2, \boldsymbol{\mu}_3$, see Fig. 1. $\mathbf{g}$ is the local gravity acceleration.

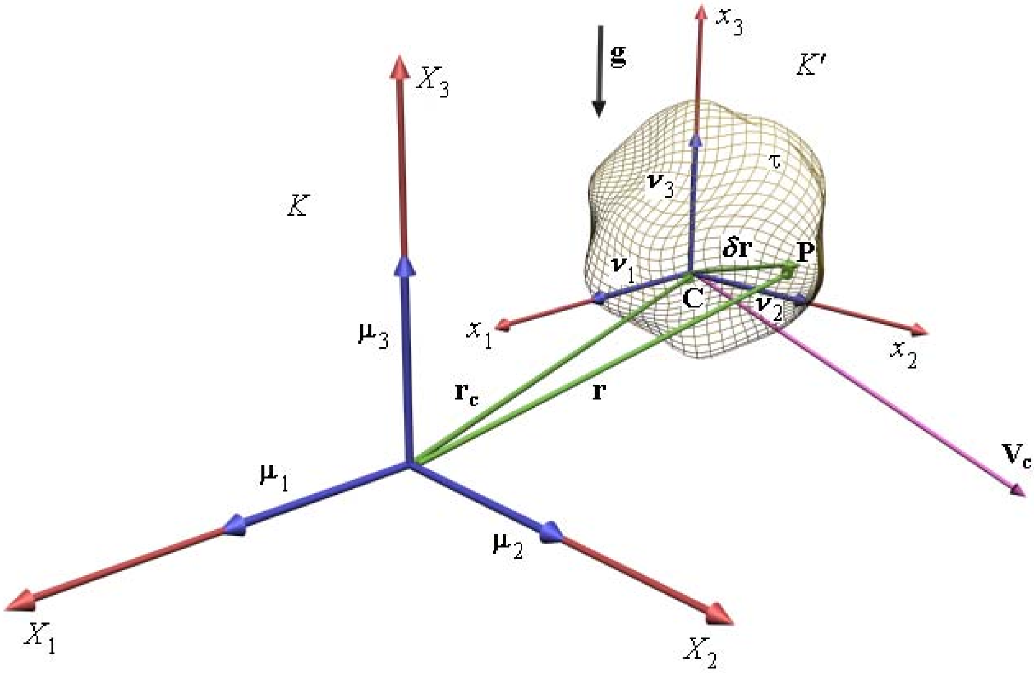


Fig. 1. Cartesian coordinate system K of a Galilean frame of reference and the continuum region mass center-affixed Lagrangian coordinate system K'

An arbitrary point P in three-dimensional physical space will be uniquely defined by the position-vector $\mathbf{r} = \mathrm{X_i}\boldsymbol{\mu}_\mathrm{i} \equiv (\mathrm{X_1}, \mathrm{X_2}, \mathrm{X_3})$ originating at the point O and terminating at the point P. The continuum region-affixed Lagrangian coordinate system K' (with the axes x_1, x_2, x_3) is centered to the mass center C of the continuum region τ. The axes x_1, x_2, x_3 are taken parallel to the axes X_1, X_2, X_3, respectively: the axis x_i parallel to the axis X_i, where i=1, 2, 3. The unit normal $K'-$basis coordinate vector triad $\boldsymbol{\nu}_1, \boldsymbol{\nu}_2, \boldsymbol{\nu}_3$ is taken in the directions of the axes x_1, x_2, x_3, respectively. The $K'-$basis vector triad is taken to be right-handed in the order $\boldsymbol{\nu}_1, \boldsymbol{\nu}_2, \boldsymbol{\nu}_3$. The mathematical differential of the position-vector $\mathbf{r}$, $\delta\mathbf{r} \equiv \mathrm{x_i}\boldsymbol{\nu}_\mathrm{i} \equiv (\mathrm{x_1}, \mathrm{x_2}, \mathrm{x_3})$, expressed in terms of the coordinates $\mathrm{x_i}$ (i=1, 2, 3) in the K'- coordinate system, originates at the mass centre C of the continuum region τ and terminates at the arbitrary point P of the continuum region.

The position-vector $\mathbf{r_c}$ of the mass center C of the continuum region τ in the K- coordinate system is given by the following expression

$$\mathbf{r_c} = \frac{1}{m_\tau} \iiint_\tau \mathbf{r}\rho dV, \tag{1.2}$$

where

$$m_\tau = \iiint_\tau \rho dV$$

is the mass of the continuum region τ, $dV = dX_1 dX_2 dX_3$ is the mathematical differential of physical volume of the continuum region, $\rho \equiv \rho(\mathbf{r}, t)$ is the local macroscopic density of mass distribution, $\mathbf{r}$ is the position-vector of the continuum volume dV, t is the time. The speed of the mass centre C of the continuum region τ is defined by the following expression

$$\mathbf{V}_c = \frac{d\mathbf{r_c}}{dt} = \frac{\iiint_\tau \mathbf{v}\rho dV}{m_\tau}, \tag{1.3}$$

where $\mathbf{v} = \frac{d\mathbf{r}}{dt}$ is the hydrodynamic velocity vector, the operator $d/dt = \partial/\partial t + \mathbf{v}\cdot\nabla$ denotes the total derivative following the continuum substance [Batchelor, 1967]. The relevant three-dimensional fields such as the velocity and the local mass density (and also the first and the second derivatives of the relevant fields) are assumed to vary continuously throughout the entire continuum bulk of the continuum region τ. The instantaneous macroscopic kinetic energy of the continuum region τ (bounded by the continuum boundary surface $\partial\tau$) is the sum of the kinetic energies of small parts constituting the continuum region τ when the number of the parts, n tends to infinity and the maximum from their volumes tends to zero [Batchelor, 1967]:

$$K_\tau \equiv \iiint_\tau \frac{\rho \mathbf{v}^2}{2} dV, \tag{1.4}$$

where $\mathbf{v}$ is the local hydrodynamic velocity vector, ρ is the local mass density, dV is the mathematical differential of physical volume of the continuum region. We use the common Riemann's integral here and everywhere.

For the analysis of the relative continuum motion in the physical space in the vicinity of the position-vector $\mathbf{r_c}$ of the mass centre C we have the Taylor series expansion (consistent with the Helmholtz's theorem [Helmholtz, 1858; Sommerfeld, 1949]) of the hydrodynamic velocity vector $\mathbf{v}(\mathbf{r})$ for each time moment t:

$$\mathbf{v}(\mathbf{r_c} + \delta\mathbf{r}) = \mathbf{v}(\mathbf{r_c}) + \boldsymbol{\omega}(\mathbf{r_c}) \times \delta\mathbf{r} + \sum_{i,j=1}^{3} e_{ij}(\mathbf{r_c})\delta r_j \,\boldsymbol{\mu}_i +$$

$$+ \frac{1}{2}\sum_{i,j,k=1}^{3} \frac{\partial^2 v_i}{\partial X_j \partial X_k} \delta r_j \delta r_k \,\boldsymbol{\mu}_i + \mathbf{v}_{res}, \tag{1.5}$$

where $\mathbf{v}(\mathbf{r}) \equiv (v_1(\mathbf{r}), v_2(\mathbf{r}), v_3(\mathbf{r}))$ is the hydrodynamic velocity vector at the position-vector $\mathbf{r}$; $\delta\mathbf{r} \equiv \mathbf{r} - \mathbf{r_c} \equiv (\delta r_1, \delta r_2, \delta r_3) \equiv (x_1, x_2, x_3)$ is the differential of the position-vector $\mathbf{r}$;

$$\boldsymbol{\omega}(\mathbf{r}) \equiv \frac{1}{2}(\nabla \times \mathbf{v}(\mathbf{r})) = (\omega_1, \omega_2, \omega_3)$$

is the angular velocity of internal rotation (a half of the vorticity vector) in the K- coordinate system at the position-vector $\mathbf{r}$;

$$\boldsymbol{\omega}_v(\mathbf{r}) \equiv (\nabla \times \mathbf{v}(\mathbf{r}))$$

is the local vorticity in the K- coordinate system at the position-vector $\mathbf{r}$;

$$e_{ij}(\mathbf{r}) = \frac{1}{2}\left(\frac{\partial v_i(\mathbf{r})}{\partial X_j} + \frac{\partial v_j(\mathbf{r})}{\partial X_i}\right)$$

is the rate of strain tensor in the K- coordinate system at the position-vector $\mathbf{r}$, (i, j=1, 2, 3);

$$\nabla \equiv \boldsymbol{\mu}_1 \frac{\partial}{\partial X_1} + \boldsymbol{\mu}_2 \frac{\partial}{\partial X_2} + \boldsymbol{\mu}_3 \frac{\partial}{\partial X_3}$$

is the gradient operator;

$$\mathbf{v}_{res} = \sum_{i=1}^{3} w_i \boldsymbol{\mu}_i$$

is the small residual part of the Taylor series expansion (2.5), where

$$w_i = O\left(d_\tau^3\right), \ (i= 1, 2, 3),$$

$$d_\tau = \sup_{A,B \in \partial\tau} \sqrt{(\mathbf{r}(A,B))^2}$$

is the diameter of the continuum region τ, the vector $\mathbf{r}(A,B)$ originates at point A and terminates at point B of the surface $\partial\tau$. The linear on $\delta\mathbf{r}$ terms of the Taylor series expansion (1.5) are presented in the classical form [Batchelor, 1967].

Substituting formula (1.5) into the formula (1.4) and integrating by parts, then we obtain the following expression [Simonenko, 1995; 2001; 2004; 2006]:

$$K_\tau = K_t + K_r + K_s + K_{s,r}^{coup} + K_{res} = \frac{1}{2} m_\tau \mathbf{V}_c^2 + \frac{1}{2} \sum_{i,k=1}^{3} I_{ik}\omega_i(\mathbf{r}_c)\omega_k(\mathbf{r}_c) +$$

$$+ \frac{1}{2} \sum_{i,j,k=1}^{3} J_{jk} e_{ij}(\mathbf{r}_c) e_{ik}(\mathbf{r}_c) + \sum_{i,j,k,m=1}^{3} \varepsilon_{ijk} J_{jm} \omega_i(\mathbf{r}_c)\, e_{km} + K_{res}, \tag{1.6}$$

where m_τ is the mass of the continuum region τ, I_{ik} is the ik- component of the classical inertia tensor depending on the mass distribution in the continuum region τ under consideration:

$$I_{ik} = \lim_{n\to\infty} \left\{ \sum_{\alpha=1}^{n} m_\alpha \left(\delta_{ik} \left(\sum_{j=1}^{3} x_{\alpha j}^2 \right) - x_{\alpha i} x_{\alpha k} \right) \right\} \equiv \iiint_{\tau, K'} \left(\delta_{ik} \left(\sum_{j=1}^{3} x_j^2 \right) - x_i\, x_k \right) \rho dV, \tag{1.7}$$

where $x_{\alpha i}, x_{\alpha k}$ are the i, k- components, respectively, of the vector $\delta\mathbf{r}_\alpha$ originating at the mass centre C of the continuum region τ and terminating at the α -th part of the continuum region τ; m_α is the mass of the α -th part; x_i, x_k are the i, k- components of the vector $\delta\mathbf{r}$, respectively, in the $K'-$ coordinate system; δ_{ik} is the Kronecker delta-tensor: $\delta_{ik}=1$ for i=k, $\delta_{ik}=0$ for i $\neq$k; ε_{ijk} is the third-order permutation symbol: $\varepsilon_{ijk}=0$ if any two indices are equal, $\varepsilon_{ijk}=1$ if (i, j, k) is an even permutation of (1, 2, 3), $\varepsilon_{ijk}=-1$ if (i, j, k) is an odd permutation of (1, 2, 3); J_{jk} is the j,k- component classical centrifugal tensor depending on the mass distribution in the continuum region τ under consideration:

$$J_{jk} = \mathop{lim}_{n\to\infty} \left\{ \sum_{\alpha=1}^{n} m_\alpha x_{\alpha j} x_{\alpha k} \right\} \equiv \iiint_{\tau, K'} x_j\ x_k\ \rho dV, \tag{1.8}$$

$K_{res} = O\ (d_\tau^7)$ is a small residual part of the macroscopic kinetic energy after substitution the Taylor series expansion (1.5) into formula (1.4).

Formula (1.6) states that the macroscopic kinetic energy K_τ of the small continuum region τ is the sum of the macroscopic translational kinetic energy K_t of the continuum region τ moving as a whole at speed equal to the speed $\mathbf{V_c}$ of the center of mass of the continuum region τ:

$$K_t = \frac{1}{2} m_\tau \mathbf{V}_c^2; \tag{1.9}$$

the macroscopic internal rotational kinetic energy K_r of the continuum region τ (rotating with the angular velocity $\boldsymbol{\omega}(\mathbf{r_c}) \equiv (\omega_1(\mathbf{r_c}), \omega_2(\mathbf{r_c}), \omega_3(\mathbf{r_c}))$ as a whole):

$$K_r = \frac{1}{2}\sum_{i,k=1}^{3} I_{ik}\omega_i(\mathbf{r_c})\omega_k(\mathbf{r_c}) \equiv \frac{1}{2} I_{ik}\,\omega_i(\mathbf{r_c})\omega_k(\mathbf{r_c}); \tag{1.10}$$

the macroscopic internal shear kinetic energy K_s of the continuum region τ (subjected to deformation by the local shear related with the rate of strain tensor $e_{ij}(\mathbf{r_c})$):

$$K_s = \frac{1}{2}\sum_{i,j,k=1}^{3} J_{jk} e_{ij}(\mathbf{r_c}) e_{ik}(\mathbf{r_c}) \equiv \frac{1}{2} J_{jk} e_{ij}(\mathbf{r_c}) e_{ik}(\mathbf{r_c}); \tag{1.11}$$

the macroscopic kinetic energy of shear-rotational coupling $K_{s,r}^{coup}$ (related with the kinetic energy of local coupling between irreversible dissipative shear and reversible rigid-like rotational macroscopic continuum motions) of the continuum region τ:

$$K_{s,r}^{coup} = \sum_{i,j,k,m=1}^{3} \varepsilon_{ijk} J_{jm}\omega_i(\mathbf{r_c})\, e_{km}(\mathbf{r_c}) \equiv \varepsilon_{ijk} J_{jm}\omega_i(\mathbf{r_c}) e_{km}(\mathbf{r_c}). \tag{1.12}$$

We adopt here and everywhere the Einstein summation convention: the repeated indices i, j, k, m are summed. The macroscopic internal rotational kinetic energy K_r is the classical [de Groot and Mazur, 1962; Gyarmati, 1970] kinetic energy of reversible (equilibrium) rigid-like macroscopic rotational continuum motion. The macroscopic internal shear kinetic energy K_s expresses the kinetic energy of irreversible (non-equilibrium) shear continuum motion related with the rate of strain tensor e_{ij}. The macroscopic internal kinetic energy of the shear-rotational coupling $K_{s,r}^{coup}$ expresses the kinetic energy of the local coupling between irreversible deformation and reversible rigid-like rotation. We attach the additional word "internal" for designations of macroscopic kinetic energies in accordance with the Landau and Lifshitz's definition [Landau and Lifshitz, 1976] of the internal energy of a small macroscopic thermodynamic system and also by bearing in mind the de Groot and Mazur's and Gyarmati's definition [de Groot and Mazur, 1962; Gyarmati, 1970] of the term $\varepsilon_r = \frac{1}{2}\theta\,\boldsymbol{\omega}^2$ in expression (1.1) as the macroscopic internal rotational kinetic energy per unit mass.

The deduced expression (1.6) for K_τ confirms the postulate [Evans, Hanley and Hess, 1984] that the velocity shear ($e_{ij} \neq 0$) represents an additional energy source taking into account in the Evans, Hanley and Hess's extended formulation [Evans, Hanley and Hess, 1984] of the first law of thermodynamics for non-equilibrium deformed states of continuum motion. The energies $K_r, K_s, K_{s,r}^{coup}$ and K_{res} are the Galilean invariants with respect to different inertial K- coordinate systems as well as the local kinetic energy dissipation rate per unit mass $\varepsilon_{dis} = 2\nu\,(e_{ij})^2$ in an incompressible viscous Newtonian continuum characterized by the molecular kinematic viscosity ν.

We obtained [Simonenko, 2004] from (1.6) the following expression for the macroscopic kinetic energy per unit mass $\varepsilon_k = \frac{K_\tau}{m_\tau}$:

$$\varepsilon_k = \varepsilon_t + \varepsilon_r + \varepsilon_s + \varepsilon_{s,r}^{coup} + \varepsilon_{res} =$$

$$= \frac{1}{2}\mathbf{V}_c^2 + \frac{1}{2}\sum_{i,k=1}^{3}\theta_{ik}\omega_i\omega_k + \frac{1}{2}\sum_{i,j,k=1}^{3}\beta_{jk} e_{ij} e_{ik} + \sum_{i,j,k,m=1}^{3}\varepsilon_{ijk}\beta_{jm}\omega_i e_{km} + \varepsilon_{res}, \tag{1.13}$$

where

$$\theta_{ik} = \frac{I_{ik}}{m_\tau} = \frac{I_{ik}}{\iiint_\tau \rho dV} \quad (i, k = 1, 2, 3) \tag{1.14}$$

is the ik- component of the classical inertia tensor per unit mass of the continuum region τ;

$$\beta_{ik} = \frac{J_{ik}}{m_\tau} = \frac{J_{ik}}{\iiint\limits_\tau \rho dV} \quad (i, k= 1, 2, 3) \tag{1.15}$$

is the ik- component of the classical centrifugal tensor per unit mass of the continuum region τ;

$$\varepsilon_t = \frac{K_t}{m_\tau} = \frac{1}{2}\mathbf{V_c^2} \tag{1.16}$$

is the macroscopic translational kinetic energy per unit mass of the continuum region τ (moving as a whole at speed $\mathbf{V}_c$ of the mass center of the continuum region τ);

$$\varepsilon_r = \frac{K_r}{m_\tau} = \frac{1}{2}\theta_{ik}\omega_i\omega_k \tag{1.17}$$

is the macroscopic internal rotational kinetic energy per unit mass of the continuum region τ (rotating with the angular velocity $\boldsymbol{\omega}(\mathbf{r_c}) \equiv (\omega_1(\mathbf{r}_c), \omega_2(\mathbf{r}_c), \omega_3(\mathbf{r}_c))$ as a whole);

$$\varepsilon_s = \frac{K_s}{m_\tau} = \frac{1}{2}\beta_{jk}e_{ij}e_{ik} \tag{1.18}$$

is the macroscopic internal shear kinetic energy per unit mass of the continuum region τ (expressing the kinetic energy of irreversible dissipative shear motion related with the rate of strain tensor $e_{ij}(\mathbf{r_c})$);

$$\varepsilon_{s,r}^{coup} = \frac{K_{s,r}^{coup}}{m_\tau} = \varepsilon_{ijk}\beta_{jm}\omega_i e_{km} \tag{1.19}$$

is the macroscopic internal kinetic energy of the shear-rotational coupling per unit mass (of the continuum region τ), $\varepsilon_{res} = O\ (d_\tau^4)$ is the residual correction. The energies $\varepsilon_r, \varepsilon_s, \varepsilon_{s,r}^{coup}$ and ε_{res} are the Galilean invariants with respect to different inertial K coordinate systems as well as the local kinetic energy dissipation rate per unit mass $\varepsilon_{dis} = 2\nu\ (e_{ij})^2$, where ν is the molecular viscosity. We have $\varepsilon_r = O\left(d_\tau^2\right), \varepsilon_s = O\left(d_\tau^2\right),\ \ \varepsilon_{s,r}^{coup} = O\left(d_\tau^2\right),\ \varepsilon_{res} = O\left(d_\tau^4\right)$, when $d_\tau \to 0$, where d_τ is the earlier defined diameter of the continuum region τ.

For a homogeneous continuum region of simple form (sphere or cube) we have

$$I_{ik} = I\,\delta_{ik},\ \ J_{jk} = J\delta_{jk}, \tag{1.20}$$

where δ_{ik}, δ_{jk} are the Kronecker delta-tensors. Formula (1.10) for the macroscopic internal rotational kinetic energy K_r is reduced to the classical expression

$$K_r = \frac{1}{2}I\boldsymbol{\omega}^2, \tag{1.21}$$

where $\boldsymbol{\omega}^2 = \omega_1^2 + \omega_2^2 + \omega_3^2$. Formula (1.11) for the macroscopic internal shear kinetic energy K_s is reduced to the expression [Simonenko, 2004; 2006]:

$$K_s = \frac{1}{2}\,Je_{ij}e_{ij} \equiv \frac{1}{2}J\,(e_{ij})^2, \tag{1.22}$$

which is proportional to the local kinetic energy dissipation rate per unit mass $\varepsilon_{dis} = 2\nu\ (e_{ij})^2$ in an incompressible viscous Newtonian continuum, where ν is the molecular viscosity. The macroscopic internal kinetic energy of shear-rotational coupling $K_{s,r}^{coup}$ vanishes for the homogeneous continuum region τ of the form of the sphere or cube. Consequently, the macroscopic kinetic energy K_τ for the homogeneous continuum region τ of the shape of sphere or cube is given by following expression [Simonenko, 2004; 2006]:

$$K_\tau = \frac{1}{2} m_\tau \mathbf{V}_\mathbf{c}^2 + \frac{1}{2}\mathbf{I\omega}^2 + \frac{1}{2} J\,(e_{ij})^2 + K_{res} \quad (1.23)$$

Hence, the macroscopic kinetic energy per unit mass ε_k for the homogeneous continuum sphere or cube τ is expressed as the sum of explicit terms [Simonenko, 2004; 2006]:

$$\varepsilon_k = \frac{1}{2}\mathbf{V}_\mathbf{c}^2 + \frac{1}{2}\theta\,\boldsymbol{\omega}^2 + \frac{1}{2}\beta\,(e_{ij})^2 + \varepsilon_{res}, \quad (1.24)$$

where $\varepsilon_t = \frac{1}{2}\mathbf{V}_\mathbf{c}^2$ is the macroscopic translational kinetic energy per unit mass of the continuum region τ; $\theta = I/m_\tau$; $\beta = J/m_\tau$; $\varepsilon_r = \frac{1}{2}\theta\,\boldsymbol{\omega}^2$ is the classical [de Groot and Mazur, 1962; Gyarmati, 1970] macroscopic internal rotational kinetic energy per unit mass of the continuum region τ; $\varepsilon_s = \frac{1}{2}\beta\,(e_{ij})^2$ is the macroscopic internal shear kinetic energy per unit mass of the homogeneous continuum sphere or cube τ [Simonenko, 2004; 2006].

We have the following expression for the macroscopic internal kinetic energy K_{int} of the homogeneous continuum region τ of the shape of sphere or cube [Simonenko, 2004; 2006]:

$$K_{int} = \frac{1}{2}\mathbf{I\omega}^2 + \frac{1}{2} J\,(e_{ij})^2 + K_{res}. \quad (1.25)$$

The macroscopic internal kinetic energy per unit mass ε_{int} for the homogeneous continuum region τ of the shape of sphere or cube is given by the sum of explicit terms [Simonenko, 2004; 2006]:

$$\varepsilon_{int} = \frac{1}{2}\theta\,\boldsymbol{\omega}^2 + \frac{1}{2}\beta\,(e_{ij})^2 + \varepsilon_{res}. \quad (1.26)$$

Compare formula (1.24) with the de Groot and Mazur's definition (1.1). Expression (1.24) is reduced to de Groot and Mazur's definition (1.1) under condition

$$e_{ij} = 0 \ \ (i, j=1, 2, 3) \quad (1.27)$$

of local thermodynamic equilibrium. Therefore, we can conclude that the definition (1.1) of the macroscopic kinetic energy per unit mass ε_k in classical non-equilibrium thermodynamics [de Groot and Mazur, 1962; Gyarmati, 1970] is based on the assumption $e_{ij} = 0$ of local thermodynamic equilibrium [Evans, Hanley and Hess, 1984; Simonenko, 2004; 2006].

The obtained formula (1.13) for ε_k and its particular form (1.24) (obtained for homogeneous continuum regions of spherical and cubical shapes) generalized [Simonenko, 2004; 2006] the classical de Groot and Mazur expression (1.1) in classical non-equilibrium thermodynamics [de Groot and Mazur, 1962; Gyarmati, 1970] by taking into account the irreversible dissipative shear component of the macroscopic continuum motion related with the rate of strain tensor e_{ij}. The expression (1.13) for ε_k contains the new macroscopic internal shear kinetic energy per unit mass ε_s, which expresses the kinetic energy of irreversible dissipative shear motion, and also the new macroscopic internal kinetic energy of the shear-rotational coupling per unit mass $\varepsilon_{s,r}^{coup}$, which expresses the kinetic energy of local coupling between irreversible dissipative shear and reversible rigid-like rotational macroscopic continuum motions. The deduced formula (1.13) for ε_k confirmed [Simonenko, 2004; 2006] the postulate [Evans, Hanley and Hess, 1984] that the velocity shear ($e_{ij} \neq 0$) represents an additional energy source in the extended formulation [Evans, Hanley and Hess, 1984] of the first law of thermodynamics for non-equilibrium deformed states of continuum motion.

The macroscopic internal shear kinetic energy per unit mass (for homogeneous continuum regions of spherical and cubical shapes):

$$\varepsilon_s = \frac{1}{2}\beta\,(e_{ij})^2 \tag{1.28}$$

is proportional to the kinetic energy viscous dissipation rate per unit mass:

$$\varepsilon_{dis,\,s} = 2\nu\,(e_{ij})^2 \tag{1.29}$$

in an incompressible viscous Newtonian continuum characterized by the kinematic viscosity ν. We have shown [Simonenko, 2006] that the proportionality

$$\varepsilon_s \propto \varepsilon_{dis,\,s} = 2\nu\,(e_{ij})^2 \tag{1.30}$$

is the basis of the established association [Prigogine and Stengers, 1984; Nicolis and Prigogine, 1989] between a structure and an order (and, hence, the associated macroscopic kinetic energy), on the one hand, and irreversible dissipation, on the other hand, for the dissipative structures of turbulence in viscous Newtonian fluids.

1.2. The generalized differential formulation of the first law of thermodynamics (in the Galilean frame of reference) for non-equilibrium shear-rotational states of the deformed one-component individual finite continuum region (characterized by the symmetric stress tensor $\mathbf{T}$) moving in the non-stationary Newtonian gravitational field

Following the works [Simonenko, 2007a; 2007; 2008], we shall present the foundation of the generalized differential formulation of the first law of thermodynamics (in the Galilean frame of reference) for non-equilibrium shear-rotational states of the deformed finite one-component individual continuum region (characterized by the symmetric stress tensor $\mathbf{T}$) moving in the non-stationary Newtonian gravitational field. We shall consider the deformed finite one-component individual continuum region in non-equilibrium shear-rotational states characterized by the following condition:

$$e_{ij} \neq 0 \quad (i, j=1, 2, 3). \tag{1.31}$$

Considering the graphical methods in the thermodynamics of fluids [Gibbs, 1873], Gibbs formulated the first law of thermodynamics for the fluid body (fluid region) as follows (in Gibbs' designations):

$$d\varepsilon = dH - dW, \tag{1.32}$$

where $d\varepsilon$ is the differential of the internal thermal energy of the fluid body, dH is the differential change of heat across the boundary of the fluid body related with the thermal molecular conductivity (associated with the corresponding external or internal heat fluxes), $dW = pdV$ is the differential work produced by the considered fluid body on its surroundings (surrounding fluid) under the differential change dV of the fluid region (of volume V) characterized by the thermodynamic pressure p.

Landau's and Lifshitz's formulation [Landau and Lifshitz, 1976; p. 62] of the first law of thermodynamics for the general thermodynamic system (material region) is given by the equivalent form (in Landau's and Lifshitz's designations):

$$dE = dQ - pdV, \tag{1.33}$$

where $dA = -pdV$ is the differential work produced by the surroundings (surroundings of the thermodynamic system) on the thermodynamic system under the differential change dV of volume V of the thermodynamic system characterized by the thermodynamic pressure p; dQ is the differential heat transfer (across the boundary of the thermodynamic system) related with the thermal interaction of the thermodynamic system and the surroundings (surrounding environment), i.e. $dQ > 0$ is the differential energy in the form of the added heat to the thermodynamic system (if the thermodynamic system receives the heat from the surroundings) or $dQ < 0$ is the differential energy in the form of the returned heat (if the thermodynamic system returns the heat to the surrounding environment); E is the energy of the thermodynamic system, which should contain (as supposed [Landau and Lifshitz, 1976]) the kinetic energy of the macroscopic continuum motion.

We shall use the differential formulation of the first law of thermodynamics [de Groot and Mazur, 1962] for the specific volume $\vartheta = 1/\rho$ (of unit mass) of the compressible viscous one-component deformed continuum with no chemical reactions:

$$\frac{du}{dt} = \frac{dq}{dt} - p\frac{d\vartheta}{dt} - \vartheta\ \mathbf{\Pi} : \mathrm{Grad}\,\mathbf{v}\,, \tag{1.34}$$

where u is the specific (per unit mass) internal thermal energy, d/dt is the total derivative following the continuum substance, p is the thermodynamic pressure, $\mathbf{\Pi}$ is the viscous-stress tensor, $\mathbf{v}$ is the hydrodynamic velocity of the continuum macro-differential element mass center [de Groot and Mazur, 1962], dq is the differential change of heat across the boundary of the continuum region (of unit mass) related with the thermal molecular conductivity described by the heat equation [de Groot and Mazur, 1962]:

$$\rho\frac{dq}{dt} = -\mathrm{div}\,\mathbf{J}_q\,, \tag{1.35}$$

where $\mathbf{J}_q$ is the heat flux [de Groot and Mazur, 1962]. The viscous-stress tensor $\mathbf{\Pi}$ is taken from the decomposition of the pressure tensor $\mathbf{P}$ [de Groot and Mazur, 1962]:

$$\mathbf{P} = p\boldsymbol{\delta} + \mathbf{\Pi}\,, \tag{1.36}$$

where $\boldsymbol{\delta}$ is the Kronecker delta-tensor.

Considering the Newtonian viscous-stress tensor $\mathbf{P}^v \equiv \mathbf{\Pi}$ of the compressible viscous Newtonian continuum with the components [Gyarmati, 1970]:

$$\Pi_{ij} = \left\{\left(\frac{2}{3}\nu\rho - \eta_v\right)\mathrm{div}\,\mathbf{v}\right\}\delta_{ij} - 2\nu\rho\, e_{ij}\,, \tag{1.37}$$

the differential formulation (1.34) of the first law of thermodynamics (for the continuum region (of unit mass) of the compressible viscous Newtonian one-component deformed continuum with no chemical reactions) can be rewritten as follows

$$\frac{du}{dt} = \frac{dq}{dt} - p\frac{d\vartheta}{dt} + \left(\nu_2 - \frac{2}{3}\nu\right)(\mathrm{div}\,\mathbf{v})^2 + 2\nu(e_{ij})^2\,, \tag{1.38}$$

where $\nu = \eta/\rho$ is the coefficient of the molecular kinematic (first) viscosity, $\nu_2 = \eta_v/\rho$ is the coefficient of the molecular volume (second) viscosity [Landau and Lifshitz, 1988]. The first and the second terms in the right-hand side of relation (1.38) are analogous to the corresponding respective first and the second terms in the right-hand side of the classical formulations (1.32) and (1.33). The third term in the right-hand side of relation (1.38):

$$dq_{i,c} = \left(\frac{\eta_v}{\rho} - \frac{2}{3}\nu\right)(\mathrm{div}\,\mathbf{v})^2\,dt \tag{1.39}$$

is related with the "internal" heat induced during the time interval dt by viscous-compressible irreversibility [Simonenko, 2006]. The fourth term in the right-hand side of relation (1.38):

$$dq_{i,s} = 2\nu\,(e_{ij})^2\,dt \tag{1.40}$$

is related with the "internal" heat induced during the time interval dt by viscous-shear irreversibility [Simonenko, 2006]. The differential formulation (1.38) of the first law of thermodynamics (for the continuum element of the compressible viscous Newtonian one-component deformed continuum with no chemical reactions) is taken into account (in addition to the classical terms) the viscous-compressible irreversibility and viscous-shear irreversibility inside the continuum element of the compressible viscous Newtonian one-component deformed continuum with no chemical reactions.

Using the differential formulation (1.34) of the first law of thermodynamics [de Groot and Mazur, 1962] for the total derivative du/dt (following the liquid substance) of the specific (per unit mass) internal thermal energy u of an compressible viscous one-component deformed continuum with no chemical reactions, the heat equation (1.35) [de Groot and Mazur, 1962], the general equation (based on the Newtonian second law applied for continuum) of continuum movement [Gyarmati, 1970]:

$$\frac{d\mathbf{v}}{dt} = \frac{1}{\rho}\operatorname{div}\mathbf{T} + \mathbf{g} \tag{1.41}$$

for the deformed continuum characterized by the symmetric stress tensor $\mathbf{T} = -\mathbf{P}$ [Gyarmati, 1970] of general form (in particular, with the components [Gyarmati, 1970]:

$$T_{ij} = -\left\{p + \left(\frac{2}{3}\nu\rho - \eta_v\right)\operatorname{div}\mathbf{v}\right\}\delta_{ij} + 2\nu\,\rho\,e_{ij} \tag{1.42}$$

for the compressible viscous Newtonian one-component continuum) and taking into account the time variations of the potential ψ of the non-stationary gravity field (characterized by the local gravity acceleration vector $\mathbf{g} = -\nabla\psi$) inside of an arbitrary finite macroscopic individual continuum region τ, we derived [Simonenko, 2007] the generalized differential formulation (for the Galilean frame of reference) of the first law of thermodynamics (for moving rotating deforming compressible heat-conducting stratified macroscopic continuum region τ subjected to the non-stationary Newtonian gravity):

$$d\left(K_\tau + U_\tau + \pi_\tau\right) = dt\iint_{\partial\tau}\left(\mathbf{v}\cdot(\mathbf{n}\cdot\mathbf{T})\right)d\Omega_{\mathbf{n}} - dt\iint_{\partial\tau}\left(\mathbf{J}_q\cdot\mathbf{n}\right)d\Omega_{\mathbf{n}} + dt\iiint_{\tau}\frac{\partial\psi}{\partial t}\rho dV, \tag{1.43}$$

where

$$\delta A_{np,\partial\tau} = dt\iint_{\partial\tau}\left(\mathbf{v}\cdot(\mathbf{n}\cdot\mathbf{T})\right)d\Omega_{\mathbf{n}} \tag{1.44}$$

is the differential work done during the infinitesimal time interval dt by non-potential stress forces (pressure, compressible and viscous forces for Newtonian continuum) acting on the boundary surface $\partial\tau$ of the continuum region τ; $d\Omega_{\mathbf{n}}$ is the differential element (of the boundary surface $\partial\tau$ of the continuum region τ) characterized by the external normal unit vector $\mathbf{n}$ (normal to the differential element of the continuum boundary surface $d\Omega_{\mathbf{n}} \in \partial\tau$); $\mathbf{t} = \mathbf{n}\cdot\mathbf{T}$ is the stress vector [Gyarmati, 1970], $\mathbf{T} = -\mathbf{P}$ [Gyarmati, 1970], where $\mathbf{P}$ is the pressure tensor characterized (in particular, for the model of the compressible viscous Newtonian continuum characterized by the coefficients of kinematic viscosity ν and the volume viscosity η_v) by components:

$$P_{ij} = \left\{p + \left(\frac{2}{3}\nu\rho - \eta_v\right)\operatorname{div}\mathbf{v}\right\}\delta_{ij} - 2\nu\rho\, e_{ij}; \tag{1.45}$$

$$\delta Q = -dt\iint_{\partial\tau}\left(\mathbf{J}_q\cdot\mathbf{n}\right)d\Omega_{\mathbf{n}} \tag{1.46}$$

is the differential (infinitesimal) change of heat of the macroscopic individual continuum region τ related with the thermal molecular conductivity of heat across the boundary $\partial\tau$ of the continuum region τ (more precisely, δQ is the differential (infinitesimal) amount of energy exchanged across the boundary $\partial\tau$ of the continuum region τ as a result of thermal molecular conductivity of heat, $\mathbf{J}_q$ is the heat flux [de Groot and Mazur, 1962] (across the element $d\Omega_{\mathbf{n}}$ of the continuum boundary surface $\partial\tau$) describing by the heat equation (1.35);

$$\pi_\tau \equiv \iiint_{\tau}\psi\rho dV \tag{1.47}$$

is the macroscopic potential energy (of the macroscopic individual continuum region τ) related with the non-stationary potential ψ of the gravity field (characterized by the local gravity acceleration vector $\mathbf{g} = -\nabla\psi$);

$$U_\tau \equiv \iiint_{\tau}u\rho dV \tag{1.48}$$

is the classical microscopic internal thermal energy of the macroscopic individual continuum region τ;

$$K_\tau = \iiint_\tau \frac{\rho \mathbf{v}^2}{2} d\,V \tag{1.49}$$

is the instantaneous macroscopic kinetic energy (earlier defined in Subsection 1.1 by expression (1.4)) of the macroscopic individual continuum region τ (bounded by the continuum boundary surface $\partial\tau$). The instantaneous macroscopic kinetic energy K_τ is given by the relation (1.6) [Simonenko, 2004; 2006] for the small macroscopic individual continuum region τ.

The generalized differential formulation (1.43) of the first law of thermodynamics can be rewritten as follows:

$$dU_\tau + dK_\tau + d\boldsymbol{\pi}_\tau = \delta Q + \delta A_{np,\partial\tau} + dG \tag{1.50}$$

extending the classical [Gibbs, 1873] formulations (1.32) and (1.33):

$$dU = \delta Q - pdV, \; (d\varepsilon \equiv dU, \; -\delta W = -pdV) \tag{1.51}$$

by taking into account (along with the classical infinitesimal change of heat δQ and the classical infinitesimal change of the internal energy $dU_\tau \equiv dU$) the infinitesimal increment of the macroscopic kinetic energy dK_τ, the infinitesimal increment of the gravitational potential energy $d\boldsymbol{\pi}_\tau$, the generalized infinitesimal work $\delta A_{np,\partial\tau}$ done on the continuum region τ by the surroundings of τ, the infinitesimal amount dG of energy:

$$dG = dt \iiint_\tau \frac{\partial\psi}{\partial t} \rho dV \tag{1.52}$$

added (or lost) as the result of the Newtonian non-stationary gravitational energy influence on the continuum region τ during the infinitesimal time interval dt.

The generalized differential formulation (1.43) of the first law of thermodynamics can be rewritten as follows [Simonenko, 2007a; 2007; 2008]:

$$\frac{dE_\tau}{dt} = \frac{d}{dt}\left(K_\tau + U_\tau + \boldsymbol{\pi}_\tau\right) = \iiint_\tau \left(\frac{1}{2}\mathbf{v}^2 + u + \psi\right)\rho dV =$$

$$= \iint_{\partial\tau} \left(\mathbf{v}\cdot(\mathbf{n}\cdot\mathbf{T})\right) d\Omega_{\mathbf{n}} - \iint_{\partial\tau} \left(\mathbf{J}_q \cdot \mathbf{n}\right) d\Omega_{\mathbf{n}} + \iiint_\tau \frac{\partial\psi}{\partial t} \rho dV. \tag{1.53}$$

The equivalent generalized differential formulations (1.43), (1.50) and (1.53) of the first law of thermodynamics take into account the following factors:

1) the classical heat thermal molecular conductivity (across the boundary $\partial\tau$ of the macroscopic continuum region τ) related with the classical infinitesimal change of heat δQ:

$$\delta Q = -dt \iint_{\partial\tau} \left(\mathbf{J}_q \cdot \mathbf{n}\right) d\Omega_{\mathbf{n}}, \tag{1.54}$$

2) the classical infinitesimal change of the internal energy dU_τ of the macroscopic continuum region τ:

$$dU_\tau \equiv d \iiint_\tau u\rho dV, \tag{1.55}$$

3) the established [Simonenko, 2007] infinitesimal increment of the macroscopic kinetic energy dK_τ of the macroscopic continuum region τ:

$$dK_\tau = d \iiint_\tau \frac{\rho \mathbf{v}^2}{2} dV, \tag{1.56}$$

4) the established [Simonenko, 2007] infinitesimal increment of the gravitational potential energy $d\boldsymbol{\pi}_\tau$ of the macroscopic continuum region τ:

$$d\pi_\tau = d\iiint_\tau \psi\rho dV, \tag{1.57}$$

5) the established [Simonenko, 2007] generalized infinitesimal work $\delta A_{np,\partial\tau}$ done on the macroscopic continuum region τ by the surroundings of τ:

$$\delta A_{np,\partial\tau} = dt\iint_{\partial\tau} (\mathbf{v}\cdot(\mathbf{n}\cdot\mathbf{T}))\, d\Omega_{\mathbf{n}}, \tag{1.58}$$

6) the established [Simonenko, 2007] infinitesimal amount dG of energy added (or lost) as the result of the Newtonian non-stationary gravitational energy influence on the macroscopic continuum region τ during the infinitesimal time interval dt:

$$dG = dt\iiint_\tau \frac{\partial\psi}{\partial t}\rho dV. \tag{1.59}$$

The generalized differential formulations (1.43), (1.50) and (1.53) of the first law of thermodynamics (given for the Galilean frame of reference) are valid for non-equilibrium shear-rotational states of the deformed finite individual continuum region (characterized by the symmetric stress tensor $\mathbf{T}$ in the general equation (1.41) of continuum movement [Gyarmati, 1970]) moving in the non-stationary gravitational field. The generalized differential formulations (1.43) and (1.50) of the first law of thermodynamics [Simonenko, 2007] are the subsequent generalizations of the classical formulations (1.32) and (1.33) of the first law of thermodynamics taking into account: 1) the generalized expression (1.44) for the differential work $\delta A_{np,\partial\tau}$ done during the infinitesimal time interval dt by non-potential stress forces acting on the boundary surface $\partial\tau$ of the individual continuum region τ and 2) the time variations of the potential ψ of the non-stationary gravitational field inside the individual continuum region τ due to the deformation of the individual continuum region τ and due to the external gravitational influence (of the external gravity field) on the individual continuum region τ moving in the combined (terrestrial + cosmic) non-stationary gravitational field.

The generalized expression [Simonenko, 2007] for the infinitesimal work $\delta A_{np,\partial\tau}$ (done during the infinitesimal time interval dt by non-potential pressure and viscous forces acting on the boundary surface $\partial\tau$ of the individual macroscopic continuum region τ) is given in Subsection 1.3 for the Newtonian symmetric stress tensor $\mathbf{T}$ characterized by the components (1.42).

1.3. The generalized differential formulation of the first law of thermodynamics (in the Galilean frame of reference) for non-equilibrium shear-rotational states of the deformed finite individual region of the compressible viscous Newtonian one-component continuum moving in the non-stationary gravitational field

There are evidences [Verhoogen, Turner, Weiss, Wahrhaftig, Fyte, 1970] that the rocks of the Earth's crust at protracted loadings may be considered as fluids characterized by the very high viscosity. According to the classical viewpoint [Verhoogen, Turner, Weiss, Wahrhaftig and Fyte, 1970], the local mechanism of creation of the earthquakes is related with the release of the accumulated potential energy of the elastic deformation during the sudden local break (i.e., the discontinuous shear) of the Earth's crust (or the sudden increase of fluidity in the local region of the Earth' crust) accompanied by viscous relaxation and generation of seismic waves. It was conjectured [Ranguelov, Dimitrova, Gospodinov, Lamykina, 2003] that "more punctual and refined methods of the mathematical analysis are obligatory" for "the practical assessment of the seismic hazard". Taking into account the established [Simonenko, 2004] conception of the macroscopic internal shear kinetic energy (per unit mass) ε_s related with the rate of medium deformation (i.e., with the rate of strain tensor $e_{ij} = \dfrac{d\varepsilon_{ij}}{dt}$, where ε_{ij} is the deformation tensor [Sommerfeld, 1949]), we have elucidated [Simonenko, 2005] (from the viewpoint of non-equilibrium thermodynamics) the mechanism of generation of seismic waves from the deformed finite zone of the Earth's crust. The proportionality (1.30) takes place also for deformed compressible finite region of the Earth's crust for sudden rise of fluidity (in a local region of the Earth's crust) related with the local sudden medium deformation in the separate seismic zones of the seismic activity. Taking into account the established [Simonenko, 2004] proportionality (1.30), we have assumed [Simonenko, 2005] that the accumulated potential energy of the elastic deformation (related with the deformation tensor ε_{ij}) converts to the macroscopic internal shear kinetic energy K_s (related with the rate of strain tensor e_{ij}) in the seismic zone simultaneously with the damping of K_s by viscous dissipation and radiation of seismic waves during several oscillations. In Section 3 we shall evaluate this mechanism on the basis of the generalized differential formulation (1.43) of the first law of thermodynamics in the Galilean frame of reference for non-equilibrium shear-rotational states of the deformed finite individual continuum region (characterized by the symmetric stress tensor $\mathbf{T}$) moving in the non-stationary gravity field.

Following the works [Simonenko, 2007a; 2007; 2008], we shall present the foundation of the generalized differential formulation of the first law of thermodynamics (in the Galilean frame of reference) for non-equilibrium shear-rotational states of the deformed finite individual region of the compressible viscous Newtonian one-component continuum moving in the non-stationary gravity field. The generalized differential formulation (1.43) of the first law of thermodynamics (formulated for the Galilean frame of reference) is valid for arbitrary symmetric stress tensor $\mathbf{T}$, in particular for non-equilibrium shear-rotational states of the deformed finite individual region of the compressible viscous Newtonian one-component continuum moving in the non-stationary gravity field. The coefficient of molecular kinematic (first, shear) viscosity $\nu = \eta/\rho$ and the coefficient of molecular volume (second) viscosity $\nu_2 = \eta_v/\rho$ are assumed to vary for each time moment t as an arbitrary continuous functions of the Cartesian space (three-dimensional) coordinates.

The generalized differential work $\delta A_{np,\partial\tau} = dt\iint\limits_{\partial\tau}(\mathbf{v}\cdot(\mathbf{n}\cdot\mathbf{T}))\,d\Omega_{\mathbf{n}}$ (done during the infinitesimal time interval dt by non-potential pressure and viscous forces acting on the boundary surface $\partial\tau$ of the individual continuum region τ) for the Newtonian symmetric stress tensor $\mathbf{T}$ (characterized by the components (1.42)) is given by three explicit terms [Simonenko, 2007]:

$$\delta A_{np,\partial\tau} = \delta A_p + \delta A_c + \delta A_s = \tag{1.60}$$

$$= - dt\iint\limits_{\partial\tau} p(\mathbf{v}\cdot\mathbf{n})\,d\Omega_{\mathbf{n}} - dt\iint\limits_{\partial\tau}\left(\frac{2}{3}\eta - \eta_v\right)\mathrm{div}\,\mathbf{v}(\mathbf{v}\cdot\mathbf{n})\,d\Omega_{\mathbf{n}} + dt\iint\limits_{\partial\tau} 2\eta\, v_\beta n_\alpha e_{\alpha\beta}\,d\Omega_n ,$$

where

$$\delta A_p = - dt\iint\limits_{\partial\tau} p(\mathbf{v}\cdot\mathbf{n})\,d\Omega_{\mathbf{n}} \tag{1.61}$$

is the differential work of the hydrodynamic pressure forces acting on the boundary surface $\partial\tau$ of the individual continuum region τ (bounded by the continuum boundary surface $\partial\tau$) during the infinitesimal time interval dt;

$$\delta A_c = - dt\iint\limits_{\partial\tau}\left(\frac{2}{3}\eta - \eta_v\right)\mathrm{div}\,\mathbf{v}(\mathbf{v}\cdot\mathbf{n})\,d\Omega_{\mathbf{n}} \tag{1.62}$$

is the differential work (related with the combined effects of the acoustic compressibility, molecular kinematic viscosity and molecular volume viscosity) of the acoustic (compressible) pressure forces acting on the boundary surface $\partial\tau$ of the individual continuum region τ (bounded by the continuum boundary surface $\partial\tau$) during the infinitesimal time interval dt;

$$\delta A_s = dt\iint\limits_{\partial\tau} 2\eta\, v_\beta n_\alpha e_{\alpha\beta}\,d\Omega_n \tag{1.63}$$

is the differential work of the viscous Newtonian forces (related with the combined effect of the velocity shear, i.e. the deformation of the continuum region τ, and the molecular kinematic viscosity) acting on the boundary surface $\partial\tau$ of the individual continuum region τ (bounded by the continuum boundary surface $\partial\tau$) during the infinitesimal time interval dt.

Along with the equation (1.38) of the differential formulation of the first law of thermodynamics [de Groot and Mazur, 1962] for the total derivative du/dt (following the continuum substance) of the internal thermal energy per unit mass u of the one-component deformed continuum with no chemical reactions, the thermohydrodynamic theory [de Groot and Mazur, 1962] contains additionally the equations of the mass and momentum balances:

$$„\frac{\partial\rho}{\partial t} = -\mathrm{div}\rho\mathbf{v}, \tag{1.64}$$

$$\rho\frac{d\mathbf{v}}{dt} = -\mathrm{Grad}\ p + \eta\Delta\mathbf{v} + \left(\tfrac{1}{3}\eta + \eta_v\right)\mathrm{Grad\ div}\ \mathbf{v}“. \tag{1.65}$$

The generalized differential formulation (1.43) of the first law of thermodynamics (together with the generalized differential work $\delta A_{np,\partial\tau}$ given by the expression (1.60)) is valid for non-equilibrium shear-rotational states of the deformed finite individual region of the compressible viscous Newtonian one-component continuum moving in the non-stationary gravity field. The coefficient of molecular kinematic (first, shear) viscosity $\nu = \eta/\rho$ and the coefficient of molecular volume (second) viscosity $\nu_2 = \eta_v/\rho$ are assumed to vary for each time moment t as an arbitrary continuous functions of Cartesian space (three-dimensional) coordinates.

The generalized differential formulation (1.43) of the first law of thermodynamics takes into account the dependences of the hydrodynamic pressure on the hydrodynamic vorticity $\boldsymbol{\omega}_v$ and on the rate of strain tensor e_{ij} (for compressible viscous Newtonian one-component continuum moving in the non-stationary gravity field) by means of the component δA_p (in the expression (1.60) for $\delta A_{np,\partial\tau}$) given by the expression (1.61). The presence of the third term δA_s (given by the expression (1.63) and related with the combined effect of the molecular kinematic viscosity and the deformation of the continuum region τ defined by the rate of strain tensor $e_{\alpha\beta}$) in the expression (1.60) for $\delta A_{np,\partial\tau}$ is generalized essentially the classical formulations (1.32) and (1.33) of the first law of thermodynamics by taking into account the differential work of the viscous Newtonian forces acting on the boundary continuum surface $\partial\tau$ of the individual continuum region τ.

The general equation (1.41) of continuum movement [Gyarmati, 1970] for the compressible viscous Newtonian one-component continuum (characterized by the coefficient of molecular kinematic viscosity $\nu = \eta/\rho$ and the coefficient of molecular volume viscosity $\nu_2 = \eta_v/\rho$ considering as the continuous functions of Cartesian three-dimensional coordinates) is reduced to the following equation

$$\rho\frac{d\mathbf{v}}{dt} = -\mathrm{Grad}\ p + \eta\Delta\mathbf{v} + \left(\tfrac{1}{3}\eta + \eta_v\right)\mathrm{Grad\ div}\ \mathbf{v} + (\mathrm{Grad}\,\eta)\cdot\mathbf{e} - \mathrm{div}\ \mathbf{v}\mathrm{Grad}\left(\tfrac{2}{3}\eta - \eta_v\right) + \mathbf{g}, \tag{1.66}$$

where $(\mathrm{Grad}\,\eta)\cdot\mathbf{e}$ is the internal multiplication of the vector $(\mathrm{Grad}\,\eta)$ and the rate of strain tensor $\mathbf{e}$ ($e_{\alpha\beta}$) in accordance with the corresponding definition [Gyarmati, 1970]. The equation (1.66) generalizes the Navier-Stokes equation (1.65) (given for $\mathbf{g} = 0$) by taking into account the dependences of the coefficient of molecular kinematic viscosity $\nu = \eta/\rho$ and the coefficient of molecular volume viscosity $\nu_2 = \eta_v/\rho$ on the space (three-dimensional) Cartesian coordinates.

The relevant example for illustration of the significance of the term δA_s (in the expression (1.60) for the differential work $\delta A_{np,\partial\tau}$) is related with the thermodynamic consideration [Simonenko, 2007] of the processes of the energy exchange [Dolgikh, 2000] between the oceans and the lithosphere of the Earth. According to the expression (1.63) for the term δA_s, the energy exchange between the oceans (and the atmosphere) and the lithosphere of the Earth is possible only under the presence of the medium acoustic compressibility (i.e., $\mathrm{div}\ \mathbf{v} \neq 0$) and the medium deformations (i.e., $e_{\alpha\beta} \neq 0$) in the boundary regions of fluid (in the oceans), air (in the atmosphere) and the compressible deformed lithosphere of the Earth.

According to the generalized expression (1.60) for the differential work $\delta A_{np,\partial\tau}$, the energy exchange between the oceans (and the atmosphere) and the lithosphere of the Earth is impossible for absolutely rigid non-deformed ($e_{\alpha\beta} = 0$) and non-compressible ($\operatorname{div} \mathbf{v} = 0$) lithosphere.

We have the evolution equation for the total mechanical energy $(K_\tau + \pi_\tau)$ of the deformed finite individual macroscopic continuum region τ [Simonenko, 2007a; 2007]:

$$\frac{d}{dt}(K_\tau + \pi_\tau) = \frac{d}{dt}\iiint_\tau \left(\frac{1}{2}\mathbf{v}^2 + \psi\right)\rho dV =$$

$$= \iiint_\tau p \operatorname{div}\mathbf{v} dV + \iiint_\tau \left(\frac{2}{3}\eta - \eta_v\right)(\operatorname{div}\mathbf{v})^2 dV - \iiint_\tau 2\nu (e_{ij})^2 \rho dV +$$

$$+ \iint_{\partial\tau} (\mathbf{v}\cdot(\mathbf{n}\cdot\mathbf{T}))\, d\Omega_{\mathbf{n}} + \iiint_\tau \frac{\partial\psi}{\partial t}\rho dV \tag{1.67}$$

obtained from the generalized differential formulation (1.43) of the first law of thermodynamics for the compressible viscous Newtonian one-component continuum moving in the non-stationary gravity field.

In the Section 3 we shall use the evolution equation (1.67) of the total mechanical energy to found the rotational, shear and the shear-rotational models [Simonenko, 2007a; 2007] of the earthquake macroscopic focal region.

1.4. Cosmic and terrestrial energy gravitational genesis of the seismotectonic (and volcanic) activity of the Earth induced by the combined cosmic (due to the energy gravitational influences of the Sun, the Moon, the planets of the Solar System and our Galaxy) non-stationary energy gravitational influences on the individual continuum region τ (of the Earth) and by the non-potential terrestrial stress forces acting on the boundary surface $\partial\tau$ of the individual continuum region τ

Following the works [Simonenko, 2007a; 2007; 2008], we present the physical mechanisms of the energy fluxes to the continuum region τ related with preparation of earthquakes. The equivalent generalized differential formulations (1.43) and (1.53) of the first law of thermodynamics show that the non-stationary gravitational potential ψ gives the following gravitational energy power

$$W_{gr}(\tau) = \iiint_\tau \frac{\partial\psi}{\partial t}\rho dV = \frac{dG}{dt} \tag{1.68}$$

associated with the gravitational energy power of the total (external and internal) non-stationary gravity fields. According to the equivalent generalized differential formulations (1.43) and (1.53) of the first law of thermodynamics and to the evolution equation (1.67) for the total mechanical energy $(K_\tau + \pi_\tau)$ of the deformed finite individual macroscopic continuum region τ, the energy power of the non-stationary gravitational field may produce the fractures in the continuum region τ. We shall consider this aspect in Section 3.

The generalized differential formulation (1.53) of the first law of thermodynamics and the expression (1.68) for the gravitational energy power $W_{gr}(\tau)$ show that the local time increase of the potential ψ of the gravitational field inside the continuum region τ ($\partial\psi/\partial t > 0$) is related with the supply of the gravitational energy into the continuum region τ. According to the generalized differential formulation (1.53) and to the evolution equation (1.67), the total energy $(K_\tau + U_\tau + \pi_\tau)$ of the continuum region τ and the total mechanical energy $(K_\tau + \pi_\tau)$ of the continuum region τ are increased if $\partial\psi/\partial t > 0$.

According to the generalized differential formulation (1.53) of the first law of thermodynamics and to the evolution equation (1.67), the gravitational energy supply into the continuum region τ may induce the formation of fractures in the continuum region τ related with the production of earthquake. This conclusion corresponds to the conception [Abramov, 1997; p. 60] that the anomalous variations of the gravity field on the background of the Moon-Sun induced variations go in front of earthquakes. The established first stage [Abramov, 1997; p. 60] of the anomalous variations of the gravity field related with the time increase of the gravity field corresponds to the gravitational energy supply into the continuum region τ before the earthquake. The generalized differential formulation (1.53) of the first law of thermodynamics gives also the theoretical foundation of the detected non-relativistic classical "gravitational" waves [Korochentsev, 2009] (the propagating disturbances of the gravitational field of the Earth) from the moving focal regions of earthquakes. The theoretical foundation of the non-relativistic classical "gravitational" waves is based on the fact that the last term of the generalized differential formulation (1.53) can be rewritten as

$$W_{gr}(\tau) = \iiint_{\tau} \frac{\partial \psi}{\partial t} \rho dV = \iint_{\partial\tau} (\mathbf{J}_{\mathbf{g}} \cdot \mathbf{n}) d\Omega_{\mathbf{n}}, \; \operatorname{div} \mathbf{J}_{\mathbf{g}} = \rho \frac{\partial \psi}{\partial t}, \tag{1.68a}$$

where $\mathbf{J}_{\mathbf{g}}$ is the energy flux (across the boundary $\partial\tau$ of the continuum region τ) of the gravitational energy related with the change of the total energy of the continuum region τ.

According to the generalized formulation (1.53) of the first law of thermodynamics and to the evolution equation (1.67), the supply of energy into the continuum region τ is related with the work:

$$A_{np,\partial\tau} = \int_{t_0}^{t} dt \iint_{\partial\tau} (\mathbf{v} \cdot (\mathbf{n} \cdot \mathbf{T}))\, d\Omega_{\mathbf{n}} \tag{1.69}$$

done by non-potential stress forces (pressure, compressible and viscous forces for Newtonian continuum) acting on the boundary surface $\partial\tau$ of the continuum region τ during the time interval ($t - t_0$).

The considered mechanisms of the energy supply to the Earth's macroscopic continuum region τ should result to the irreversible process of the splits formation in the rocks related with the generation of the high-frequency acoustic waves from the focal continuum region τ before the earthquake. Taking this into account, the sum $\delta A_c + \delta A_s$ in the expression (1.60) may be interpreted [Landau and Lifshitz, 1988; p. 78] as the energy flux (related with the compressible and viscous forces acting on the boundary surface $\partial\tau$ of the continuum region τ) [Simonenko, 2008, 2009, 2010]:

$$\delta F_{vis,c} = \delta A_c + \delta A_s \tag{1.70}$$

directed across the boundary $\partial\tau$ of the continuum region τ. The considered mechanisms of the energy supply to the Earth's macroscopic continuum region τ is related with the experimentally detected [Dolgikh et al., 2007] significant increase of the energy flux $\delta F_{vis,c}$ of the geo-acoustic energy from the focal region τ before the earthquake.

1.5. Cosmic energy gravitational genesis of the global volcanic and climate variability induced by the cosmic non-stationary energy gravitational influences on the Earth

Using the evolution equation (1.67) for the total mechanical energy $K_\tau + \pi_\tau$ (of the deformed finite individual macroscopic continuum region τ) and the generalized differential formulation (1.53) of the first law of thermodynamics, we derived the evolution equation for the internal energy U_τ of the macroscopic continuum region τ [Simonenko, 2007, 2008]:

$$\frac{d}{dt} U_\tau = -\iint_{\partial\tau} (\mathbf{J}_q \cdot \mathbf{n})\, d\Omega_{\mathbf{n}} + \iiint_{\tau} 2\nu (e_{ij})^2 \rho dV - \iiint_{\tau} \left(\frac{2}{3}\eta - \eta_v\right) (\operatorname{div}\mathbf{v})^2 dV - \iiint_{\tau} p \operatorname{div}\mathbf{v} dV. \tag{1.71}$$

If the period of variations of the potential of the external cosmic non-stationary gravitational field (of the Sun, the Moon, the planets of the Solar System and our Galaxy influencing on the continuum region τ of the Earth τ_3) is equal to $T_{eg}(\tau) \equiv T_{energy}(\tau)$ then the same time periodicity $T_{eg}(\tau) \equiv T_{energy}(\tau)$ will characterize the periodic variations of the rate of strain tensor e_{ij} and the divergence $\operatorname{div}\mathbf{v}$ of the velocity vector $\mathbf{v}$ of the continuum motion inside of the subsystem τ of the Earth τ_3. Taking into account that the quadratic functions $(e_{ij})^2$ and $(\mathrm{div}\mathbf{v})^2$ have the time period $\frac{1}{2}T_{eg}(\tau)$ of temporal variations, we obtained [Simonenko, 2007, 2008], according to the evolution equation (1.71), the time periodicity $T_{endog}(\tau)$

$$T_{endog}(\tau) = \frac{1}{2} T_{eg}(\tau) \tag{1.72}$$

of variations of the internal energy U_τ of the macroscopic continuum region τ as a result of the irreversible dissipation of the macroscopic kinetic energy determined by the second and the third terms in the right-hand side of the evolution equation (1.71).

1.6. Thermodynamic equilibrium of the closed thermohydrogravidynamic system

1.6.1. The equilibrium state of the closed thermodynamic system in classical statistical physics

Following the "Thermohydrogravidynamics of the Solar System" [Simonenko, 2007] and using the established [Simonenko, 2004; 2006] generalized expression (1.6) for the total macroscopic kinetic energy $(K_\tau)_\alpha$ of each subsystem α, in Subsection 1.6 we present the foundation of the conditions of the thermodynamic equilibrium for the closed thermohydrogravidynamic system. Landau and Lifshitz [Landau and Lifshitz, 1976] considered the problem of finding of the maximal total entropy of the thermodynamic system consisting of N subsystems not taking into account the internal structure of each subsystem (considering the subsystems as the material points). Considering the entropy S_α of each subsystem α as a function of the internal energy, Landau and Lifshitz [Landau and Lifshitz, 1976; p. 52] postulated the following expression for the total entropy S_{tot} of the closed thermodynamic system (taking into account the Galilean principle of relativity):

$$S_{tot} = \sum_{\alpha=1}^{N} S\left(E_\alpha - \frac{1}{2}\frac{\mathbf{P}_\alpha^2}{m_\alpha} \right), \tag{1.73}$$

where E_α is the total energy of each subsystem α, $\mathbf{P}_\alpha/(2m_\alpha)$ is the macroscopic kinetic energy of the translational motion of each subsystem α, $\mathbf{P}_\alpha$ is the momentum of each subsystem α, m_α is the mass of each subsystem α, S is the universal function. Landau and Lifshitz considered the problem of finding of the maximal total entropy S_{tot} of the thermodynamic system under imposed conservation laws of the total momentum $\mathbf{P}_{tot}$ and total angular momentum $\mathbf{M}_{tot}$:

$$\sum_{\alpha=1}^{N} \mathbf{P}_\alpha = \mathbf{P}_{tot} = \mathbf{const}_1 , \tag{1.74}$$

$$\sum_{\alpha=1}^{N} [\mathbf{r}_\alpha \times \mathbf{P}_\alpha] = \mathbf{M}_{tot} = \mathbf{const}_2 . \tag{1.75}$$

Following to the Lagrang's method and considering the uncertain vectors $\boldsymbol{a}$ and $\mathbf{b}$, Landau and Lifshitz obtained the condition of the maximum of S_{tot} by equating to zero the derivative of the Lagrang's function

$$L = \sum_{\alpha=1}^{N} \{ S_\alpha + \boldsymbol{a} \cdot \mathbf{P}_\alpha + \mathbf{b} \cdot [\mathbf{r}_\alpha \times \mathbf{P}_\alpha] \} \tag{1.76}$$

on the momentums $\mathbf{P}_\alpha$ of each subsystem α. Taking into account the thermodynamic definition of temperature, the derivative of S_α on the momentum $\mathbf{P}_\alpha$ is presented in the following form [Landau and Lifshitz, 1976]:

$$\frac{\partial S_\alpha}{\partial \mathbf{P}_\alpha}\left(E_\alpha - \frac{\mathbf{P}_\alpha^2}{2m_\alpha}\right) = \frac{\partial S_\alpha\left(E_\alpha - \frac{\mathbf{P}_\alpha^2}{2m_\alpha}\right)}{\partial\left(E_\alpha - \frac{\mathbf{P}_\alpha^2}{2m_\alpha}\right)} \frac{\partial\left(E_\alpha - \frac{\mathbf{P}_\alpha^2}{2m_\alpha}\right)}{\partial \mathbf{P}_\alpha} = -\frac{1}{T_\alpha}\frac{\mathbf{P}_\alpha}{m_\alpha} = -\frac{\mathbf{V}_\alpha}{T_\alpha}, \tag{1.77}$$

where $\mathbf{V}_\alpha$ is the macroscopic translational speed of the subsystem α.

The derivative of the scalar product $\boldsymbol{a} \cdot \mathbf{P}_\alpha$ on the momentum $\mathbf{P}_\alpha$ is presented in the following form [Landau and Lifshitz, 1976]:

$$\frac{\partial}{\partial \mathbf{P}_\alpha}\boldsymbol{a}\cdot \mathbf{P}_\alpha = \boldsymbol{a}. \tag{1.78}$$

The derivative of the scalar product $\mathbf{b}\cdot[\mathbf{r}_\alpha \times \mathbf{P}_\alpha]$ on the momentum $\mathbf{P}_\alpha$ is presented in the following form [Landau and Lifshitz, 1976]:

$$\frac{\partial}{\partial \mathbf{P}_\alpha}\mathbf{b}\cdot[\mathbf{r}_\alpha \times \mathbf{P}_\alpha] = [\mathbf{b}\times \mathbf{r}_\alpha]. \tag{1.79}$$

Consequently, the derivative of the Lagrang's function on the momentum $\mathbf{P}_\alpha$ is given by the following expression [Landau and Lifshitz, 1976]:

$$\frac{\partial L}{\partial \mathbf{P}_\alpha} = -\frac{\mathbf{V}_\alpha}{T} + \boldsymbol{a} + [\mathbf{b}\times \mathbf{r}_\alpha], \tag{1.80}$$

from which we have (under condition $\frac{\partial L}{\partial \mathbf{P}_\alpha} = 0$) the following expression [Landau and Lifshitz, 1976]:

$$\mathbf{V}_\alpha = \mathbf{u} + [\mathbf{\Omega}\times \mathbf{r}_\alpha], \tag{1.81}$$

where

$$\mathbf{u} = T\boldsymbol{a}, \quad \mathbf{\Omega} = T\mathbf{b}. \tag{1.82}$$

Landau and Lifshitz concluded from expression (1.81) that the translational macroscopic motion and the rigid-like rotation as a whole characterize the state of the thermodynamic equilibrium [Landau and Lifshitz, 1976]. Landau and Lifshitz considered the imposed conservation laws (1.74) and (1.75) of the total momentum $\mathbf{P}_{tot}$ and the total angular momentum not taking into account the thermohydrogravidynamic structure of each subsystem α (considered as a material point) and the gravity field. In this Section we shall consider further the thermohydrogravidynamic structure of each subsystem α considering as a finite continuum region τ_α subjected to the gravitational field.

1.6.2. The conservation law of the total energy for the closed thermohydrogravidynamic system τ in the frame of continuum model

Prigogine and Stengers [Prigogine and Stengers, 1984] considered the differential dE (during the time interval dt) of the total energy E of the unclosed thermodynamic system in the following form:

$$dE = d_iE + d_eE \,. \tag{1.83}$$

The term d_iE related with the internal production of energy is considered equal to zero as a consequence of the conservation law [Prigogine and Stengers, 1984]. Consequently, the total increment of energy dE is related with the term d_eE describing the energy exchange with the external surroundings of the considered thermodynamic system [Prigogine and Stengers, 1984].

We postulate the conservation law for the total energy E_τ:

$$dE_\tau = d\,(K_\tau + U_\tau + \pi_\tau) = 0, \tag{1.84}$$

or

$$(K_\tau + U_\tau + \pi_\tau) = E_\tau = \text{const} \tag{1.85}$$

for the closed thermodynamic system τ subjected to the self-induced own gravitational field. Considering the problem of finding of the maximal entropy of the thermodynamic system, we shall postulate the conservation of the total momentum, the total angular momentum and the total energy of the thermodynamic system considering in the frame of the model of continuum subjected to the self-induced own gravitational field.

The expression (1.85) can be rewritten for closed system in the following form:

$$(K_\tau + U_\tau + \pi_\tau) = \iiint_\tau \left(\frac{1}{2}\rho \mathbf{v}^2 + u + \psi \right) \rho dV = E_\tau = \text{const}\,, \tag{1.86}$$

where $U_\tau \equiv \iiint_\tau u\rho dV$ is the classical internal thermal energy of molecular chaos and the short-range intermolecular electromagnetic interactions [de Groot and Mazur, 1962; Sommerfeld, 1954], $\pi_\tau \equiv \iiint_\tau \psi\rho dV$ is the potential energy of the thermodynamic system τ, ψ is the potential of gravitational forces in the point characterized by the position-vector $\mathbf{r}$, ρdV is the mass concentrated in volume dV of the three-dimensional Euclidean space. We consider the classical Newtonian gravitation and assume that the potential ψ do not depend on the speed of the material bodies containing in the thermodynamic system τ.

1.6.3. Statistical properties of thermodynamically equilibrium subsystem in classical statistical physics

According to Landau and Lifshitz [Landau and Lifshitz, 1976], the statistical properties of each thermodynamic subsystem α is defined by its energy $E_{\alpha}(\mathbf{p},\mathbf{q})$, the momentum $\mathbf{P}_{\alpha}(\mathbf{p},\mathbf{q})$ and the angular momentum $\mathbf{M}_{\alpha}(\mathbf{p},\mathbf{q})$ considering as a functions of coordinates $\mathbf{q} \equiv (\mathbf{q}_1,\mathbf{q}_2,...,\mathbf{q}_N)$ and momentums $\mathbf{p} \equiv (\mathbf{p}_1,\mathbf{p}_2,...,\mathbf{p}_N)$ of all N particles constituting the thermodynamic subsystem α.

The unique additive combination of this values is the linear combination [Landau and Lifshitz, 1976] for the distribution function ρ_a of each thermodynamic subsystem α:

$$\ln\rho_a = \alpha_a + \beta E_a(\mathbf{p},\mathbf{q}) + \boldsymbol{\gamma}\cdot\mathbf{p}_a(\mathbf{p},\mathbf{q}) + \boldsymbol{\delta}\cdot\mathbf{M}_a(\mathbf{p},\mathbf{q}) \tag{1.87}$$

characterized by constant identical factors α_a, β, $\boldsymbol{\gamma}$, $\boldsymbol{\delta}$ for each thermodynamic subsystem α of the closed thermodynamic system. Taking into account the existence of only seven independent additive integrals of movement: the energy, three components of the momentum vector and three component of the angular momentum vector, Landau and Lifshitz [Landau and Lifshitz, 1976] concluded that the seven independent constants $\beta,\boldsymbol{\gamma},\boldsymbol{\delta}$ can, obviously, be defined using the seven constants of additive integrals of movement for all closed thermodynamic system.

Thus, the values of additive integrals of movement (the energy, three components of the momentum vector and three component of the angular momentum vector) are completely define the statistical properties of the closed thermodynamic system [Landau and Lifshitz, 1976] including the average values of the physical values. Using the stated reasons, Landau and Lifshitz [Landau and Lifshitz, 1976] considered the distribution function ρ for the closed thermodynamic system:

$$\rho = \mathrm{const}\,\delta(E - E_o)\delta(\mathbf{P} - \mathbf{P}_o)\delta(\mathbf{M} - \mathbf{M}_o), \tag{1.88}$$

for the micro-canonical distribution corresponding to the constant values of the energy E_o, the impulse $\mathbf{P}_o$, momentum and the angular momentum $\mathbf{M}_o$ of the thermodynamic system. Taking into account that the impulse and the angular momentum are related with the movement as a whole (uniform translational movement and uniform rotation (for system in the state of thermodynamic equilibrium), Landau and Lifshitz [Landau and Lifshitz, 1976] concluded that statistical condition of the system depends only on the energy. This statement is valid for the closed thermodynamic system considered in the state of thermodynamic (statistical) equilibrium. We have the micro-canonical distribution for the closed thermodynamic system [Gibbs, 1928; Landau and Lifshitz, 1976] considered in the state of thermodynamic (statistical) equilibrium:

$$\rho = \mathrm{const}\ \delta(E - E_o) \tag{1.89}$$

corresponding to the constant value of energy E_o of the closed thermodynamic system.

Thus, the total energy defines the statistical properties of the closed thermodynamic system considered in the state of thermodynamic (statistical) equilibrium. We see that the reasons of the classical statistical physics testify in favour of using of the energy for consideration of the problem of thermodynamic equilibrium for the closed thermodynamic system.

In Subsection 1.6.6 we shall consider the angular momentum for each subsystem α defined by the following form:

$$\sum_{\beta=1}^{N}\left[\mathbf{r}_{\beta} \times \mathbf{P}_{\beta}\right], \tag{1.90}$$

where index β characterizes the small macro-differential parts of the subsystem α. We shall conclude that the angular velocity of rotation $\boldsymbol{\omega}_\alpha$ of the subsystem α as a whole and the classical inertia tensor $(I_{ij})_\alpha$ (defining the classical macroscopic internal rotational kinetic energy K_r) define the sum (1.90) also for the state of thermodynamic equilibrium ($e_{ij} = 0$) of the subsystem α. We shall see that the sum (1.90) depends on the classical centrifugal tensor $(J_{ij})_\alpha$ of the subsystem α and on the rate of strain tensor $(e_{ij})_\alpha$ (defining the established [Simonenko, 2004] macroscopic non-equilibrium kinetic energies) if the subsystem α is far ($e_{ij} \neq 0$) from the state of thermodynamic equilibrium ($e_{ij} = 0$).

1.6.4. Entropy of the thermodynamic system in classical statistical physics and the Galilean principle of relativity

Taking into account that the entropy is the Galilean invariant [Landau and Lifshitz, 1976], the entropy S_α of the thermodynamic subsystem τ_α (designated also by α) is the universal function S of the internal energy

$$E_{int,\alpha} = E_\alpha - \frac{\mathbf{P}_{c,\alpha}^2}{2m_\alpha}, \tag{1.91}$$

i. e.

$$S_\alpha \equiv S\left(E_\alpha - \frac{1}{2}\mathbf{V}_{c,\alpha}^2 m_\alpha \right), \tag{1.92}$$

where E_α is the total energy of the subsystem α. The internal energy $E_{int,\alpha}$ of the subsystem α contains the all possible and admissible energies (except the kinetic energy of the translational movement of the mass center of the subsystem α). The internal energy $E_{int,\alpha}$ of each subsystem α contains the energies K_r, K_s, $K_{s,r}^{coup}$, K_{res}, U, π corresponding to the subsystem α.

Following to Landau and Lifshitz [Landau and Lifshitz, 1976], we postulate the entropy S_{tot} of the total thermodynamic system by the following expression:

$$S_{tot} = \sum_{\alpha=1}^{n} S_\alpha = \sum_{\alpha=1}^{n} S\left(E_\alpha - \frac{1}{2m_\alpha}\mathbf{P}_{c,\alpha}^2 \right). \tag{1.93}$$

From definition (1.93) we see that the entropy S_{tot} is the total value describing the thermodynamic system.

Let us find the maximum of function S_{tot} considered as a function of the following variables:

$$\underset{(1)}{K_r}, \underset{(2)}{K_s}, \underset{(3)}{K_{s,r}^{coup}}, \underset{(4)}{U}, \underset{(5)}{\pi} \tag{1.94}$$

for each subsystem α $(\alpha = 1,...,N)$, i.e. let us find the maximum of function S_{tot} depending on 5N variables, where N is the number of considered subsystems. Since each subsystem α is defined also by the position-vector $\mathbf{r}_{c,\alpha}$ of the mass center (C, α), then we add also 3N variables not considering the configuration of the subsystem α defined by the boundary surface $\partial\tau_\alpha$.

Though the entropy of each subsystem α, according to definition (1.92), do not depends on the momentum $\mathbf{P}_{c,\alpha}$ of this subsystem α, nevertheless, the total entropy S_{tot} depends on the set of momentums $\mathbf{P}_{c,\alpha}$ $(\alpha = 1,\ldots, N)$.

We shall find the maximum of S_{tot} under imposed restrictions (on the closed thermodynamic system) characterized by the conservation laws of the total energy and the total angular momentum [Simonenko, 2007]:

$$\sum_{\alpha=1}^{N} E_\alpha = \sum_{\alpha=1}^{N} \iiint_{\tau_\alpha} \left(\frac{1}{2}\rho\mathbf{v}^2 + u\rho + \psi\rho \right) dV = E_{tot} = \mathrm{const}_1, \tag{1.95}$$

$$\sum_{\alpha=1}^{N} \iiint_{\tau_\alpha} [\mathbf{r} \times \rho\mathbf{v}] dV = \mathbf{M}_{tot} = \mathbf{const}_2 \tag{1.96}$$

presented for the coordinate system K'_{sys} related with the mass center C_{sys} of the thermodynamic system.

1.6.5. The condition of the thermodynamic equilibrium for the closed thermohydrogravidynamic system considered in the coordinate system K'_{sys} of the mass center C_{sys} of the thermohydrogravidynamic system under imposed conservation laws of the total energy and the total angular momentum

We divide mentally the thermohydrogravidynamic system into sufficiently small but finite macroscopic subsystems α $(\alpha = 1,\ldots, N)$. We define by symbol $\mathbf{V}_{c,\alpha}$ the speed of the mass center of each subsystem relative to inertial coordinate system K'_{sys} related with the mass center C_{sys} of the thermohydrogravidynamic system. We assume that the subsystems α $(\alpha = 1,\ldots, N)$ are not in the states of thermodynamic equilibrium at the initial time moment. We postulate the conservation laws (1.95) and (1.96) for the total energy E_{tot} and the total angular momentum $\mathbf{M}_{tot}$ obtained in the inertial coordinate system K'_{sys}.

In accordance with the second law of thermodynamics [Prigogine and Stengers, 1986; Nicolis and Prigogine, 1990], we shall find the maximum of entropy S_{tot} [Simonenko, 2007]:

$$\max\left\{ \sum_{\alpha=1}^{N} S\left(E_\alpha - \frac{1}{2} m_\alpha \mathbf{V}_{c,\alpha}^2 \right) \right\} \tag{1.97}$$

under imposed conditions (1.95) and (1.96), according to which the total energy E_α of the subsystem α and the total angular momentum $\mathbf{M}_\alpha$ of the subsystem α are defined by the following expressions [Simonenko, 2007]:

$$E_{\tau_\alpha} \equiv E_\alpha = \iiint_{\tau_\alpha} \left(\frac{1}{2}\rho\mathbf{v}^2 + u\rho + \psi\rho \right) dV, \tag{1.98}$$

$$\mathbf{M}_{\tau_\alpha} \equiv \mathbf{M}_\alpha = \iiint_{\tau_\alpha} [\mathbf{r} \times \rho \mathbf{v}] dV . \quad (1.99)$$

The potential ψ of the gravitational field in non-relativistic approximation (Newtonian gravity in Euclidean space) for mass distribution in the thermohydrogravidynamic system $\tau = \sum_{\alpha=1}^{N} \tau_\alpha \equiv \bigcup_{\alpha=1}^{N} \tau_\alpha$ (representing the set of subsystem τ_α) is given by classical expression [Landau and Lifshitz, 1988, Theory of Field; p. 382]:

$$\psi = -\gamma \iiint_{\tau} \frac{\rho dV}{R}, \quad (1.100)$$

where R is the distance from the point of space (in which the potential ψ is calculated) to the element of mass ρdV, γ is the gravitational constant.

1.6.6. Angular momentum of the subsystem τ_α (macroscopic continuum region τ_α) for the non-equilibrium thermodynamic state

Let us calculate the angular momentum (1.99) of the macroscopic subsystem τ_α (continuum region τ_α). Landau and Lifshitz [Landau and Lifshitz, 1976; p. 53] considered the expression $[\mathbf{r}_\alpha \times \mathbf{P}_\alpha]$ instead of the integral (1.99). It means the consideration of the finite macroscopic thermohydrogravidynamic systems as the material point that is inconsistent with the considered continuum approach. Let us calculate the integral (1.99) for arbitrary distributions of density ρ and the continuum velocity $\mathbf{v}$ in the continuum region τ_α.

For the analysis of the relative continuum motion in the physical space in the vicinity of the position-vector $\mathbf{r}_{c,\alpha}$ of the mass centre $C_\alpha \equiv (C, \alpha)$ of the continuum region τ_α we have [Simonenko, 2004; 2005; 2006] the Taylor series expansion of the hydrodynamic velocity vector $\mathbf{v}(\mathbf{r})$ for each time moment t:

$$\mathbf{v}(\mathbf{r}_{c,\alpha} + \delta\mathbf{r}) = \mathbf{v}(\mathbf{r}_{c,\alpha}) + [\boldsymbol{\omega}(\mathbf{r}_{c,\alpha}) \times \delta\mathbf{r}] + \sum_{i,j=1}^{3} e_{ij}(\mathbf{r}_{c,\alpha}) \delta r_j \boldsymbol{\mu}_i + \frac{1}{2} \sum_{i,j,k=1}^{3} \frac{\partial^2 v_i}{\partial X_i \partial X_k} \delta r_j \delta r_k \boldsymbol{\mu}_i + \mathbf{v}_{res} . \quad (1.101)$$

Integral (1.99) is calculated by Saffman [Saffman, 1992] by neglecting the square-law and subsequent terms in relation (1.101). Saffman [Saffman, 1992] calculated the angular momentum $\mathbf{M}^c_{\tau_\alpha}$ (characterized by the i-component $\mathbf{M}^c_{\tau_\alpha}(i)$ of the vector $\mathbf{M}^c_{\tau_\alpha}$) of the continuum region τ_α relative to the mass center C_α (defined by the position-vector $\mathbf{r}_{c,\alpha}$ in the coordinate system *K*) in the following form:

$$\mathbf{M}^c_{\tau_\alpha}(i) = \underbrace{\varepsilon_{ijk}\, e_{kl} J_{jl}}_{(1)} + \underbrace{\frac{1}{2}(\delta_{ij} J_{kk} - J_{ij})\omega_j}_{(2)}, \quad (1.102)$$

where J_{jl} is the *jl*-component of the centrifugal tensor written (in approximation $\rho = const$) in the following form [Saffman, 1992]:

$$J_{ij} = \rho \iiint_{\tau_\alpha} \delta x_i \delta x_j dV . \qquad (1.103)$$

The first term (1) in expression (1.102) is reduced to zero if the continuum region τ_α has the spherical symmetry [Saffman, 1992], when the continuum region τ_α has the center of symmetry as for case of homogeneous cube or sphere.

The expression (1.102) shows that the angular momentum $\mathbf{M}^c_{\tau_\alpha}$ of deformed continuum region τ_α depends on the rate of strain tensor e_{kl} in the point C_α of the mass center defined by the position-vector $\mathbf{r}_{c,\alpha}$. Formula (1.102) generalizes the classical definition [de Groot and Mazur, 1962] of the angular momentum $\mathbf{M}$ of the fluid region (of mass m_τ) in non-equilibrium thermodynamics:

$$\frac{\mathbf{M}}{m_\tau} = \Theta \boldsymbol{\omega} \qquad (1.104)$$

for non-equilibrium states of continuum motion. Taking into account the expression (1.102), we obtained from expression (1.99) the following relation [Simonenko, 2007]:

$$\begin{aligned} \mathbf{M}_{\tau_\alpha} &= \iiint_{\tau_\alpha} \left[(\mathbf{r}_{c,\alpha} + \delta \mathbf{r}) \times \rho \mathbf{v} \right] dV = \left[\mathbf{r}_{c,\alpha} \times \iiint_{\tau_\alpha} \rho \mathbf{v} dV \right] + \mathbf{M}^c_{\tau_\alpha} = \\ &= \left[\mathbf{r}_{c,\alpha} \times \mathbf{P}_{\tau_\alpha} \right] + \sum_{i=1}^{3} \varepsilon_{ijk} e_{kl} J_{jl} \boldsymbol{\mu}_i + \sum_{i=1}^{3} \frac{1}{2} \left(\delta_{ij} J_{kk} - J_{ij} \right) \omega_j \boldsymbol{\mu}_i , \end{aligned} \qquad (1.105)$$

where the vector $\mathbf{M}^c_{\tau_\alpha}$ is described by two components given by expression (1.102). We see that expression (1.105) for the angular momentum $\mathbf{M}_{\tau_\alpha}$ of a small macroscopic continuum region τ_α contains two additional terms [Saffman, 1992] along with the classical [Landau and Lifshitz, 1976] term $\left[\mathbf{r}_{c,\alpha} \times \mathbf{P}_{\tau_\alpha} \right]$.

In expression (1.105) the first additional term characterized by components $(\mathbf{M}_s)_i = \varepsilon_{ijk} e_{kl} J_{jl}$ is related with the non-equilibrium shear local continuum velocity field. In expression (1.105) the second additional term characterized by components $(\mathbf{M}_r)_i = \frac{1}{2} \left(\delta_{ij} J_{kk} - J_{ij} \right) \omega_j$ is related with the equilibrium rotational local continuum velocity field. In expression (1.105) these two additional terms do not depend on the momentum $\mathbf{P}_{\tau_\alpha}$ of the subsystem α (continuum region τ_α):

$$\mathbf{M}_s = \sum_{i=1}^{3} (\mathbf{M}_s)_i \boldsymbol{\mu}_i = \sum_{i=1}^{3} \varepsilon_{ijk} e_{kl} J_{jl} \ \boldsymbol{\mu}_i , \qquad (1.106)$$

$$\mathbf{M}_r = \sum_{i=1}^{3} (\mathbf{M}_r)_i \boldsymbol{\mu}_i = \sum_{i=1}^{3} \frac{1}{2} \left(\delta_{ij} J_{kk} - J_{ij} \right) \omega_j \ \boldsymbol{\mu}_i . \qquad (1.107)$$

Formula (1.105) generalizes the classical expression $\left[\mathbf{r}_{c,\alpha} \times \mathbf{P}_{\tau_\alpha} \right]$ in the classical statistical physics [Landau and Lifshitz, 1976]. The importance of the shear component $\mathbf{M}_s$ (of the total macroscopic internal angular momentum $\mathbf{M}^{c}_{\tau_\alpha} = \sum_{i=1}^{3} M^{c}_{\tau_\alpha}(i)\boldsymbol{\mu}_i$) is obvious for the continuum region τ_α characterized by arbitrary non-symmetric (relative to the mass center) form.

1.6.7. The conditions of the thermodynamic equilibrium for the closed thermohydrogravidynamic system (consisting of N thermohydrogravidynamic subsystems) considering in the inertial coordinate system K'_{sys} related with the mass center C_{sys} of the thermohydrogravidynamic system

The expression (1.98) can be rewritten in the following form [Simonenko, 2007]:

$$E_\alpha = \frac{1}{2} m_\alpha \mathbf{V}^2_{c,\alpha} + (K_s)_\alpha + (K_r)_\alpha + (K^{coup}_{s,r})_\alpha + U_\alpha + \pi_\alpha =$$

$$= \frac{\mathbf{P}^2_{\tau_\alpha}}{2m_\alpha} + (K_s)_\alpha + (K_r)_\alpha + (K^{coup}_{s,r})_\alpha + U_\alpha + \pi_\alpha . \quad (1.108)$$

As a result, expression (1.95) can be rewritten in the following form:

$$\sum_{\alpha=1}^{N} \frac{\mathbf{P}^2_{\tau_\alpha}}{2m_\alpha} + (K_s)_\alpha + (K_r)_\alpha + (K^{coup}_{s,r})_\alpha + U_\alpha + \pi_\alpha = E_{tot} . \quad (1.109)$$

Taking into account the expression (1.105), the conservation law of the total angular momentum (1.96) can be rewritten in the following form [Simonenko, 2007]:

$$\sum_{\alpha=1}^{N} ([\mathbf{r}_{c,\alpha} \times \mathbf{P}_{\tau_\alpha}] + \mathbf{M}^{c}_{\tau_\alpha}) = \mathbf{M}_{tot} , \quad (1.110)$$

where the vector $\mathbf{M}^{c}_{\tau_\alpha}$ is given by the expression (1.102) for each component $\mathbf{M}^{c}_{\tau_\alpha}(i)$. To find the maximum (1.97) of the total entropy S_{tot} (given by the expression (1.93)):

$$\max\{\sum_{\alpha=1}^{N} S(E_\alpha - \frac{1}{2} m_\alpha \mathbf{V}^2_{c,\alpha})\},$$

we follow the Lagrang's method and consider the uncertain factors $\boldsymbol{a}$ (vector) and β_T (scalar value). The Lagrang's function has the following form [Simonenko, 2007] :

$$L = \sum_{\alpha=1}^{N} \{S(E_\alpha - \frac{1}{2} m_\alpha \mathbf{V}^2_{c,\alpha}) + \boldsymbol{a} \cdot ([\mathbf{r}_{c,\alpha} \times \mathbf{P}_{\tau_\alpha}] + \mathbf{M}^{c}_{\tau_\alpha}) +$$

$$+ \beta_T [\frac{\mathbf{P}^2_{\tau_\alpha}}{2m_\alpha} + (K_s)_\alpha + (K_r)_\alpha + (K^{coup}_{s,r})_\alpha + U_\alpha + \pi_\alpha]\}, \quad (1.111)$$

where the point (·) after the vector $\boldsymbol{a}$ designates the scalar product of the corresponding vectors, S is some universal function of thermodynamic state.

We find the first (from the set of conditions) condition of the maximum of the Lagrang's function (1.111) by equating to zero the derivative of L on momentums $\mathbf{P}_{\tau_\alpha}$ (for α = 1, 2,…….., N):

$$\sum_{i=1}^{N} \{\frac{\partial S}{\partial \mathbf{P}_{\tau_\alpha}} (E_i - \frac{1}{2} m_\alpha \mathbf{V}^2_{c,i}) + \frac{\partial}{\partial \mathbf{P}_{\tau_\alpha}} (\boldsymbol{a} \cdot ([\mathbf{r}_{c,i} \times \mathbf{P}_{\tau_i}] + \mathbf{M}^{c}_{\tau_i})) +$$

$$+ \frac{\partial}{\partial \mathbf{P}_{\tau_\alpha}} \beta_T (\frac{\mathbf{P}^2_{\tau_i}}{2m_i} + (K_s)_i + (K_r)_i + (K^{coup}_{s,r})_i + U_i + \pi_i\} = 0, \quad (1.112)$$

where the vector $\boldsymbol{a}$ and the scalar value β_T will be find.

Using the equality:

$$\frac{\partial}{\partial \mathbf{P}_{\tau_\alpha}} S(E_i - \frac{\mathbf{P}_{\tau_i}}{2m_i}) = -\frac{1}{T_\alpha}\frac{\mathbf{P}_{\tau_\alpha}}{m_\alpha} = -\frac{1}{T_\alpha}\mathbf{V}_{c,\alpha}, \tag{1.113}$$

and also the identity:

$$\frac{\partial}{\partial \mathbf{P}_{\tau_\alpha}}(\boldsymbol{a}\cdot[\mathbf{r}_{c,\alpha}\times\mathbf{P}_{\tau_\alpha}] = [\boldsymbol{a}\times\mathbf{r}_{c,\alpha}], \tag{1.114}$$

we get the necessary condition of maximum of the total entropy S_{tot}:

$$\frac{\mathbf{V}_{c,\alpha}}{T_\alpha} + [\boldsymbol{a}\times\mathbf{r}_{c,\alpha}] + \beta_T\frac{\mathbf{P}_{\tau_\alpha}}{m_\alpha} = 0, \tag{1.115}$$

where $\mathbf{r}_{c,\alpha}$ is the position-vector of the mass center of the thermodynamic subsystem τ_α. We used the identity

$$\frac{\partial(\mathbf{P}_{\tau_\alpha}\cdot\mathbf{P}_{\tau_\alpha})}{\partial\mathbf{P}_{\tau_\alpha}} = 2\mathbf{P}_{\tau_\alpha} \tag{1.116}$$

for deduction of expression (1.115). We obtained from expression (1.115) the following relation [Simonenko, 2007] :

$$\frac{\mathbf{V}_{c,\alpha}}{T_\alpha} + [\boldsymbol{a}\times\mathbf{r}_{c,\alpha}] + \beta_T\mathbf{V}_{c,\alpha} = 0.$$

As a result, we obtained the following relation [Simonenko, 2007]:

$$\mathbf{V}_{c,\alpha}(\frac{\mathbf{1}}{T_\alpha} - \beta_T) = [\boldsymbol{a}\times\mathbf{r}_{c,\alpha}].$$

Finally, we obtained the condition of the thermodynamic equilibrium [Simonenko, 2007]:

$$\mathbf{V}_{c,\alpha} = \frac{1}{\left(\frac{1}{T_\alpha} - \beta_T\right)}[\boldsymbol{a}\times\mathbf{r}_{c,\alpha}]. \tag{1.117}$$

Since we consider the subsystems in the inertial coordinate system K'_{sys} (related with the mass center C_{sys} of the closed thermohydrogravidynamic system) then the speed of the translational movement of each subsystem τ_α is equally to 0 as it is obvious from the expression (1.117). If T_α=const then the condition (1.117) do not means that each subsystem τ_α rotates as a whole (as a rigid body) with the angular velocity $\boldsymbol{a}/(\frac{1}{T_\alpha} - \beta_T)$ in the equilibrium state. Expression (1.117) shows only that the mass centers of all subsystems α (in the equilibrium state characterized by maximum of entropy S_{tot}) rotate as a rigid-like body.

In Subsection 1.6.8.2 we shall show that the equilibrium state of the closed thermohydrogravidynamic system is characterized by the following conditions for each subsystem τ_α:

$$(K_s)_\alpha = 0, (K_{s,r}^{coup})_\alpha = 0. \tag{1.118}$$

1.6.8. The conditions of the thermodynamic equilibrium of the closed thermohydrogravidynamic system consisting of N thermohydrogravidynamic subsystem considered in the inertial coordinate system K

1.6.8.1. The condition of the thermodynamic equilibrium (of the closed thermohydrogravidynamic system) describing the relative movements of the mass centers of all subsystems

Now we consider the problem of finding of the maximal entropy S_{tot} of the thermohydrogravidynamic system in the arbitrary inertial coordinate system K not connected with the mass center C_{sys} of the thermohydrogravidynamic system. We add (in addition to the postulated conservation laws (1.109) and (1.110)) the additional conservation law of the total momentum of the thermohydrogravidynamic system. The Lagrang's function (1.111) with the additional term $\mathbf{c}\cdot\mathbf{P}_{\tau_\alpha}$ [Landau and Lifshitz, 1976] (characterized by the uncertain vector **c)** can be rewritten [Simonenko, 2007]:

$$L=\sum_{\alpha=1}^{N}\{S(E_\alpha-\frac{1}{2}m_\alpha\mathbf{V}^2_{c,\alpha})+\boldsymbol{a}\cdot([\mathbf{r}_{c,\alpha}\times\mathbf{P}_{\tau_\alpha}]+\mathbf{M}^c_{\tau_\alpha})+$$

$$+\beta_T[\frac{\mathbf{P}^2_{\tau_\alpha}}{2m_\alpha}+(K_s)_\alpha+(K_r)_\alpha+(K^{coup}_{s,r})_\alpha+U_\alpha+\boldsymbol{\pi}_\alpha]+\mathbf{c}\cdot\mathbf{P}_{\tau\alpha}\}. \tag{1.119}$$

As a result, the condition (1.115) can be rewritten in the following form [Simonenko, 2007]**:**

$$\frac{\mathbf{V}_{c,\alpha}}{T_\alpha}+\mathbf{c}+[\boldsymbol{a}\times\mathbf{r}_{c,\alpha}]+\beta_T\mathbf{V}_{c,\alpha}=0, \tag{1.120}$$

which gives the expression for the speed $\mathbf{V}_{c,\alpha}$ of the mass center (C**,** α) of the subsystem τ_α [Simonenko, 2007]:

$$\mathbf{V}_{c,\alpha}=\frac{1}{\left(\frac{1}{T_\alpha}-\beta_T\right)}[\boldsymbol{a}\times\mathbf{r}_{c,\alpha}]+\frac{\mathbf{c}}{\left(\frac{1}{T_\alpha}-\beta_T\right)}. \tag{1.121}$$

Using the expression (1.121), we obtained [Simonenko, 2007] that the mass centers of subsystem can move as a whole in a translational motion and a rigid-like rotation only for $T_\alpha=\mathrm{const}$. Consequently, the constant temperature $T_\alpha=\mathrm{const}$ is the necessary but the not sufficient condition of the thermodynamic equilibrium of the thermohydrogravidynamic system. If $T_\alpha=T=\mathrm{const}$ then the vector value (in formula (1.121))

$$\mathbf{V}_c=\frac{\mathbf{c}}{\left(\frac{1}{T}-\beta_T\right)} \tag{1.122}$$

can be considered as the speed $\mathbf{V}_c$ of the mass center C_{sys} of the closed thermohydrogravidynamic system $\tau=\sum_{\alpha=1}^{N}\tau_\alpha\equiv\bigcup_{\alpha=1}^{N}\tau_\alpha$ containing the set of subsystem τ_α.

1.6.8.2. The conditions of the thermodynamic equilibrium of the closed thermohydrogravidynamic system relative to the macroscopic non-equilibrium kinetic energies of the subsystems τ_α

Let us find the conditions of maximal entropy S_{tot} relative to the macroscopic internal shear kinetic energies $(K_S)_\alpha$ (for $\alpha = 1, 2,.., N$) under conservation laws for the total momentum, the total angular momentum and the total energy of the closed thermohydrogravidynamic system. Considering the entropy S_{tot} of the closed thermohydrogravidynamic system s as function of the macroscopic internal shear kinetic energies $(K_S)_\alpha$ (for $\alpha = 1, 2,.., N$) and by equating to zero the derivative of the Lagrang's function L (given by expression (1.119)) on $(K_S)_\alpha$, we obtained the necessary condition for the maximum of the entropy S_{tot} [Simonenko, 2007]:

$$\sum_{\alpha=1}^{N}\left\{\frac{\partial S}{\partial (K_S)_\alpha}\left(E_\alpha - \frac{1}{2}\frac{\mathbf{P}^2_{\tau_\alpha}}{m_\alpha}\right) + \frac{\partial}{\partial (K_S)_\alpha}\left(\boldsymbol{a}\cdot\left(\left[\mathbf{r}_{c,\alpha}\times\mathbf{P}_{\tau_\alpha}\right] + \mathbf{M}^c_{\tau_\alpha}\right)\right) + \right.$$

$$\left. + \frac{\partial}{\partial (K_S)_\alpha}\beta_T\left(\frac{\mathbf{P}^2_{\tau_\alpha}}{2m_\alpha} + (K_s)_\alpha + (K_r)_\alpha + \left(K^{coup}_{s,r}\right)_\alpha + U_\alpha + \boldsymbol{\pi}_\alpha\right) + \frac{\partial}{\partial (K_s)_\alpha}\left(\mathbf{c}\cdot\mathbf{P}_{\tau_\alpha}\right)\right\} = 0 \, . \tag{1.123}$$

We obtained the relation [Simonenko, 2007]:

$$\frac{\partial}{\partial (K_s)_\alpha}\left(E_\alpha - \frac{\mathbf{P}^2_{\tau_\alpha}}{2m_\alpha}\right) = \frac{1}{T_\alpha}$$

by using the postulated relation

$$\frac{\partial S\left(E_\alpha - \mathbf{P}^2_{\tau_\alpha}/2m_\alpha\right)}{\partial\left(E_\alpha - \mathbf{P}^2_{\tau_\alpha}/2m_\alpha\right)} = \frac{1}{T_\alpha} \tag{1.124}$$

for the temperature T_α in the analogous way as it was early implicitly postulated by Landau and Lifshitz [Landau and Lifshitz, 1976] in deduction of the condition (1.77). Since the momentums $\mathbf{P}_{\tau_\alpha}$ and the internal angular momentums $\mathbf{M}^c_{\tau_\alpha}$ do not depend explicitly from $(K_S)_\alpha$ then we obtained from the condition (1.123) the following relation [Simonenko, 2007]:

$$\frac{1}{T_\alpha} + \beta_T = 0 \, .$$

Consequently, we have for any subsystem α the following relation [Simonenko, 2007]:

$$\beta_T = -\frac{1}{T_\alpha} = \text{const} \, . \tag{1.125}$$

If $T_\alpha = T = \text{const}$ then (using (1.125)) we obtained [Simonenko, 2007] the expression for $\mathbf{V}_C$ in relation (1.122)

$$\mathbf{V}_c = \frac{\mathbf{c}}{2}T \, . \tag{1.126}$$

We obtained then (in relation (1.121)) the expression for the angular velocity $\boldsymbol{\Omega}$ of rotation of the mass center of each subsystem α [Simonenko, 2007]:

$$\boldsymbol{\Omega} = \frac{\boldsymbol{a}\,T}{2} \, . \tag{1.127}$$

We see that the angular velocities of rotation of the mass center of each subsystem α are equal in the state of thermodynamic equilibrium. Thus, we obtained [Simonenko, 2007] from the condition (1.123) the expression $\beta_T = -\frac{1}{T_\alpha} = -\frac{1}{T}$ (given by (1.125)) in relation (1.121) for the speeds $\mathbf{V}_{c,\alpha}$ of the mass centers of all subsystems. It is clear that the coefficient β_T must have the same physical dimension as the physical dimension of the value $\frac{1}{T_\alpha}$. However, the determination β_T by equating to zero of the derivative of the Lagrangian function L (determined by expression (1.123)) on $(K_S)_\alpha$ do not elucidate the question relative to the values of $(K_S)_\alpha$, which give the maximal value of the entropy S_{tot}. We obtained [Simonenko, 2007] the constants $\boldsymbol{a}$ and $\mathbf{c}$ (for $T_\alpha = T = \text{const}$):

$$\boldsymbol{a} = \frac{2\mathbf{\Omega}}{T},\ \mathbf{c} = \frac{2\mathbf{V}_c}{T} \tag{1.128}$$

and showed that the mass centers of all subsystems (see the expression (1.121)) rotate as a whole in the rigid-like rotational continuum motion. The value β_T must be constant for all subsystems in the state of thermodynamic equilibrium. Consequently, from relation (1.125) we concluded that $\beta_T = -\frac{1}{T}$ in the state of thermodynamic equilibrium in which the temperature of all subsystems are equal: $T_\alpha = T$.

We have shown above that the condition of maximal entropy at the state of thermodynamic equilibrium gives that the mass center of each subsystem rotate on the circular trajectory characterized by the corresponding fix distance from the axis of rotation $\mathbf{\Omega}$. Let us analyze the question relative to the values of the macroscopic internal shear kinetic energies $(K_s)_\alpha$ and $(K_{s,r}^{coup})_\alpha$ defining the state of the thermodynamic equilibrium of each subsystem α. Using the condition (1.27) of local thermodynamic equilibrium and the definitions (1.11) and (1.12), respectively, for the macroscopic internal shear kinetic energy K_s of the continuum region τ and the macroscopic kinetic energy of shear-rotational coupling $K_{s,r}^{coup}$, we obtained [Simonenko, 2007] that the subsystems α (α = 1, 2,…, N) have the non-equilibrium macroscopic internal shear kinetic energies $(K_s)_\alpha = 0$ and the non-equilibrium macroscopic internal kinetic energies of shear-rotational coupling $(K_{s,r}^{coup})_\alpha = 0$ in the state of thermodynamic equilibrium characterized by the conditions (1.118).

It means that the all composite parts of each subsystem rotate in a rigid-like motion in the state of thermodynamic equilibrium. Since the vector $\mathbf{\Omega}$ is fixed for the total thermohydrogravidynamic system then the projection of the vector $\mathbf{r}_{c,\alpha}$ (on the direction perpendicular to $\mathbf{\Omega}$) is constant. We showed [Simonenko, 2007] that the rigid-like rotation (of the closed thermohydrogravidynamic system) is the state of thermodynamic equilibrium characterized by the maximal entropy under the imposed conservation laws for the total energy, the total momentum and the total angular momentum of the thermohydrogravidynamic system. We concluded [Simonenko, 2007] that the planets of the Solar System cannot rotate ideally (with constant angular velocities of internal rotation) owing to the external (cosmic) disturbing energy gravitational influences (acting on the planets of the Solar System).

1.7. Generalized Le Chatelier-Braun's principle for rotational thermohydrogravidynamic systems characterized by the shear-rotational states

Following the "Thermohydrogravidynamics of the Solar System" [Simonenko, 2007], in Subsection 1.7 we present the generalization of the Le Chatelier – Braun principle [Landau and Lifshitz, 1976] on the closed rotational thermohydrogravidynamic systems ($\tau + \bar{\tau}$) consisting of two subsystems τ and $\bar{\tau}$. The

Le Chatelier-Braun's principle (for induced small deviations of the subsystem τ from the state of the thermodynamic equilibrium) is formulated [Landau and Lifshitz, 1976; p. 84] as follows. The external action (disturbing the body from the state of thermodynamic equilibrium) stimulates the processes, which tend to diminish the results of this disturbing action [Landau and Lifshitz, 1976; p. 84].

Let us consider the closed rotating thermodynamic system $(\tau+\bar{\tau})$ consisting of the unclosed individual macroscopic continuum region τ (the subsystem in the viscous compressible continuum, which can be the focal region of earthquakes) and some large subsystem $\bar{\tau}$ complementing the subsystem τ to obtain the closed thermodynamic system $(\tau+\bar{\tau})$. Let S be the total entropy of the thermodynamic system, y is the some quantity determining the state of the subsystem τ, such as that the condition of maximal entropy S relative to y:

$$\frac{\partial S}{\partial y}=0 \tag{1.129}$$

indicates that the subsystem τ is in the state of the partial thermodynamic equilibrium. Under such condition, the subsystem τ is not necessary in the thermodynamic equilibrium with the surrounding subsystem $\bar{\tau}$. We, obviously, consider here the partial (internal) thermodynamic equilibrium of the subsystem τ since the one parameter, as a rule, is not enough to define the condition of thermodynamic equilibrium of the subsystem τ located in the closed thermodynamic system $(\tau+\bar{\tau})$.

Let x be the second thermodynamic variable (describing the subsystem τ) such as that if we have also the condition:

$$\frac{\partial S}{\partial x}=0 \tag{1.130}$$

at the same time with the condition (1.129) then it means that the subsystem τ is not only in the internal (partial) thermodynamic equilibrium, but the subsystem τ is also in the thermodynamic equilibrium with the surrounding subsystem $\bar{\tau}$.

We assume that the total energies E_τ and $E_{\bar{\tau}}$ of the macroscopic subsystems τ and $\bar{\tau}$, respectively, can be expressed by the following relations [Simonenko, 2007]:

$$E_\tau=K_\tau+U_\tau+\pi_\tau=(K_t)_\tau+(K_r)_\tau+(K_s)_\tau+(K_{s,r}^{coup})_\tau+(K_{res})_\tau+U_\tau+\pi_\tau, \tag{1.131}$$

$$E_{\bar{\tau}}=K_{\bar{\tau}}+U_{\bar{\tau}}+\pi_{\bar{\tau}}=(K_t)_{\bar{\tau}}+(K_r)_{\bar{\tau}}+(K_s)_{\bar{\tau}}+(K_{s,r}^{coup})_{\bar{\tau}}+(K_{res})_{\bar{\tau}}+U_{\bar{\tau}}+\pi_{\bar{\tau}}. \tag{1.132}$$

in accordance with the generalized formulation (1.43) of the first law of thermodynamics and in accordance with the generalized formula (1.6) for the macroscopic kinetic energy of the small continuum regions: the subsystems τ and $\bar{\tau}$.

The definitions of all terms corresponding to subsystem τ in formula (1.131) are given in Subsection 1.2. The definitions of all terms corresponding to the subsystem $\bar{\tau}$ in formula (1.132) are analogous.

Let us consider the angular momentum $\mathbf{M}_\tau$ of the macroscopic continuum region τ as the variable y. We designate the angular momentum of the subsystem $\bar{\tau}$ by the symbol $\mathbf{M}_{\bar{\tau}}$. Considering the total entropy of the closed system $(\tau+\bar{\tau})$ (containing the subsystems τ and $\bar{\tau}$):

$$S=S_\tau(\mathbf{M}_\tau,E_\tau)+S_{\bar{\tau}}(\mathbf{M}_{\bar{\tau}},E_{\bar{\tau}})$$

and supposing that the total angular momentum $\mathbf{M}$ of the closed system $(\tau+\bar{\tau})$ is constant:

$$\mathbf{M}=\mathbf{M}_\tau+\mathbf{M}_{\bar{\tau}}=\mathbf{const}_{\mathbf{M}},$$

we obtained [simonenko, 2007] that the condition (1.129) gives the relation:

$$\frac{\partial S}{\partial \mathbf{M}_\tau}=\frac{\partial S_1(\mathbf{M}_\tau)}{\partial \mathbf{M}_\tau}+\frac{\partial S_2(\mathbf{M}_{\bar{\tau}})}{-\partial \mathbf{M}_{\bar{\tau}}}=\frac{\partial S_1(\mathbf{M}_\tau)}{\partial \mathbf{M}_\tau}-\frac{\partial S_2(\mathbf{M}_{\bar{\tau}})}{\partial \mathbf{M}_{\bar{\tau}}}=0,$$

from which we obtained [simonenko, 2007] the condition

$$\frac{\mathbf{\Omega}_\tau}{T_\tau}=\frac{\mathbf{\Omega}_{\bar{\tau}}}{T_{\bar{\tau}}} \tag{1.133}$$

as a consequence of the formula [Landau and Lifshitz, 1976; p. 51, 93]:

$$\frac{\partial S}{\partial \mathbf{M}}=\frac{\partial S}{\partial E}\left(\frac{\partial E}{\partial \mathbf{M}}\right)_S=\frac{1}{T}\mathbf{\Omega}.$$

According to the previous results of Subsection 1.6, the temperature T_τ of the subsystem τ and the temperature $T_{\bar\tau}$ of the surrounding subsystem $\bar\tau$ are equal ($T_\tau = T_{\bar\tau}$) in the state of thermodynamic equilibrium. Then we have from relation (1.133) the equality of the angular velocity $\boldsymbol{\Omega}_\tau$ of rotation of the subsystem τ and the angular velocity $\boldsymbol{\Omega}_{\bar\tau}$ of rotation of the surrounding subsystem $\bar\tau$ for $T_\tau = T_{\bar\tau}$ in accordance with the results of Subsection 1.6. Thus, the condition (1.129) means for $y = \mathbf{M}_\tau$ that the angular velocities of rotation $\boldsymbol{\Omega}_\tau$ and $\boldsymbol{\Omega}_{\bar\tau}$ are equal ($\boldsymbol{\Omega}_\tau = \boldsymbol{\Omega}_{\bar\tau}$) for the subsystem τ and for the surrounding subsystem $\bar\tau$. This is the partial condition of the thermodynamic equilibrium for the subsystem τ.

Let us consider the macroscopic internal shear kinetic energy $(K_s)_\tau$ [Simonenko, 2004] of the macroscopic continuum region τ as the variable x. Considering the condition (1.130) of equilibrium for $x = (K_s)_\tau$:

$$\frac{\partial S}{\partial (K_s)_\tau} = 0 \tag{1.134}$$

and assuming that the total energy of the closed thermodynamic system is constant:

$$E_\tau + E_{\bar\tau} = \mathrm{const}_E,$$

we obtained [Simonenko, 2007] the following condition:

$$\frac{\partial S}{\partial (K_s)_\tau} = \frac{\partial S_\tau}{\partial E_\tau}\frac{\partial E_\tau}{\partial (K_s)_\tau} - \frac{\partial S_{\bar\tau}}{\partial (E)_{\bar\tau}}\frac{\partial E_{\bar\tau}}{\partial (K_s)_{\bar\tau}} = 0, \tag{1.135}$$

from which we derived the following condition [Simonenko, 2007]:

$$\frac{1}{T_\tau} = \frac{1}{T_{\bar\tau}} \tag{1.136}$$

as a consequence of formula [Landau and Lifshitz, 1976; p. 93 and p. 51]:

$$\frac{\partial S}{\partial E} = \frac{1}{T}$$

and relation

$$\frac{\partial E_\tau}{\partial (K_s)_\tau} = \frac{\partial E_{\bar\tau}}{\partial (K_s)_{\bar\tau}} = 1.$$

From relation (1.136) we obtained [Simonenko, 2007] that the temperature T_τ of the macroscopic region τ is equal to the temperature $T_{\bar\tau}$ of the surrounding subsystem $\bar\tau$. It is the partial condition of the thermodynamic equilibrium. The choice of the variable $x = (K_s)_\tau$ is made to show that the energy $(K_s)_\tau$ is the physically significant variable. We also showed [Simonenko, 2007] that the total energies of the subsystems τ and $\bar\tau$ may be calculated by using the formulae (1.131) and (1.132). In Section 3 it will be used. Thus, the conditions (1.129) and (1.130) denote that the subsystem τ is characterized by the internal thermodynamic equilibrium (the rigid-like rotation at constant temperature) and simultaneously the subsystem τ is characterized by the thermodynamic equilibrium with the surrounding environment (medium) having the same temperature and rotating with the same angular velocity of rotation. Thus, we evaluated [Simonenko, 2007] the physical significance of the thermodynamic parameters (variables) $y = \mathbf{M}_\tau$ and $x = (K_s)_\tau$ for the subsystem τ. The consideration of these variables results to the classical conditions [Landau and Lifshitz, 1976] of the thermodynamic equilibrium for the rotating body. This gives the basis to consider the generalized thermodynamic forces (acting on the subsystem τ):

$$F_X = \frac{\partial S}{\partial x} = \frac{\partial S}{\partial (K_S)_\tau}, \tag{1.137}$$

$$F_Y \equiv F_{Y_i} = \frac{\partial S}{\partial y} = \frac{\partial S}{\partial (\mathbf{M}_\tau)_i}. \tag{1.138}$$

We considered [Simonenko, 2007] the conditions of the thermodynamic equilibrium [de Groot and Mazur, 1962; Prigogine, 1977] of the subsystem τ:

$$F_X = 0, \tag{1.139}$$
$$F_X = 0, \tag{1.140}$$
which are equivalent to conditions (1.129) and (1.130). The conditions (1.139) and (1.140) of the thermodynamic equilibrium denote [Prigogine, 1977] the following condition for the first differential dS:
$$dS = \frac{\partial S}{\partial x}dx + \frac{\partial S}{\partial y}dy = 0$$
for the state of the thermodynamic equilibrium of the closed thermodynamic system. Decomposing the change of the entropy S of the total thermodynamic system relative to the value S_o of the entropy in the equilibrium state [Prigogine, 1977]:
$$S - S_o \approx dS + \frac{1}{2}d^2S, \tag{1.141}$$
we obtained [Simonenko, 2007] (taking into account that $dS = 0$ in the state of the thermodynamic equilibrium) the negative sign of the second differential d^2S, i.e. $d^2S < 0$. We obtained [Simonenko, 2007] the conditions:
$$\frac{\partial^2 S}{\partial x^2} = \left(\frac{\partial F_X}{\partial x}\right)_y < 0, \tag{1.142}$$
$$\left(\frac{\partial F_X}{\partial x}\right)_y\left(\frac{\partial F_Y}{\partial y}\right)_x - \left(\frac{\partial F_X}{\partial y}\right)_x^2 \equiv \frac{\partial^2 S}{\partial x^2}\frac{\partial^2 S}{\partial y^2} - \left(\frac{\partial^2 S}{\partial x \partial y}\right)^2 > 0 \tag{1.143}$$
in addition to conditions (1.139) and (1.140) as a consequence of the negative sign ($d^2S < 0$) of the second differential d^2S of entropy S.

We also obtained [Simonenko, 2007] the necessary condition:
$$\frac{\partial^2 S}{\partial y^2} = \left(\frac{\partial F_Y}{\partial y}\right)_x < 0 \tag{1.144}$$
from conditions (1.142) and (1.143).

It is well known that the state of the thermodynamic equilibrium of the closed thermodynamic system is stable [Prigogine, 1977]. Consequently, the subsystem τ of the closed equilibrium thermodynamic system cannot obtain the macroscopic internal shear kinetic energy K_S by action of the surroundings (the ambient environment $\bar{\tau}$) of the subsystem τ. It is clear that we can create the condition $(K_S)_\tau > 0$ only by action on the subsystem τ of the external (for the closed system) force (for example, the external force of gravitation). Considering the Le Chatelier-Braun's principle, Landau and Lifshitz [Landau and Lifshitz, 1976] supposed also the availability the external action disturbing the thermodynamic equilibrium of the continuum region τ with the ambient environment ($\bar{\tau}$) in the closed thermodynamic system.

We showed [Simonenko, 2007] that the transient external influence on the subsystem τ (related with the added macroscopic internal shear kinetic energy $(K_S)_\tau > 0$ to the subsystem τ during this influence) can decrease the entropy S of the total system up to some quantity $S|_y$, which is less than the value S_o in the equilibrium state (in accordance with the Reif's understanding [Reif, 1977] of the mechanism of decreasing of the entropy of the body as the result of interaction with external bodies). We showed [Simonenko, 2007] then that the entropy S of the thermodynamic system is increased after the relaxation processes in closed system, but do not reach the value S_o in the initial equilibrium state. The entropy S is less than S_o as a result of the relaxation processes diminishing the result of the external action on the subsystem τ.

The external influence on the subsystem τ disturbs the thermodynamic equilibrium of the subsystem τ with the surrounding subsystem $\bar{\tau}$ by means of the added macroscopic internal shear kinetic energy $(K_S)_\tau > 0$ and the subsequent violation of the condition (1.139) of thermodynamic equilibrium denoting (as a consequence of condition (1.136)) the equality of temperature T_τ of the subsystem τ and the temperature $T_{\bar{\tau}}$ of the surrounding environment (medium) $\bar{\tau}$ of the closed thermodynamic system. Really, the deformation of the subsystem τ is related with the increase $(K_s)_\tau$ relative to the zero equilibrium value. It develops the relaxation processes in the subsystem τ related with dissipation of the energy $(K_s)_\tau$ to heat and corresponding heating of the subsystem τ as a result of shear and volume molecular viscosity in the considered continuum. This results to the violation of the condition (1.139). Some amount of energy $(K_s)_\tau$ converts to the radiation of seismic acoustic waves.

Following to the formal scheme [Landau and Lifshitz, 1976] of presentation of the Le Chatelier-Braun's principle, we assumed [Simonenko, 2007] that some projection $y \equiv y_i = (\mathbf{M}_\tau)_i$ (the projection of the vector $\mathbf{M}_\tau$ on the axis X_i of the Cartesian coordinate system K) do not change immediately as a result of the sharp change $(K_S)_\tau > 0$ relative to the equilibrium zero value. Such spontaneous influence $(K_S)_\tau > 0$, as shown above, is not possible in equilibrium thermodynamic fluid system since the liquid deforms under the weak stress forces. It is possible for the solid Earth's crust of the lithosphere as a result of transformation of the accumulated potential energy [Abramov, 1997] of elastic compression and deformation to the macroscopic internal shear kinetic energy $(K_s)_\tau$. The gravitational influence of the system Sun-Earth-Moon is considered [Abramov, 1997] as the trigger mechanism of discharge (of the accumulated potential energy) in the focal regions of earthquakes. The last term in the right of the generalized differential formulation (1.43) of the first law of thermodynamics express the total influence (on the macroscopic volume τ) of the non-stationary (time-dependent) gravitational field induced by planets (and satellites) of the Solar System, the Sun, Moon, the midget planets, known asteroids and comets of the Solar System. The last term in the right-hand side of the generalized differential formulation (1.43) describes, obviously, the mechanism of the energy gravitational influence on the earthquake focal region. In Section 3 we shall present the foundation of the significance of the energy gravitational influences of the Moon, the Sun, the Venus, the Jupiter and the Mercury as the cosmic trigger mechanism of discharge in the focal regions of earthquakes.

Following to the formal scheme [Simonenko, 2007], let $\Delta x = \Delta(K_s)_\tau \equiv (K_s)_\tau$ be the change of the macroscopic internal shear kinetic energy relative to zero equilibrium value for the momentary action on the subsystem τ. The change ΔF_X of the magnitude of the generalized thermodynamic force F_X (as a result of the external action on the subsystem τ) is equal (under condition $y \equiv y_i = (\mathbf{M}_\tau)_i = \text{const}$) [Simonenko, 2007]:

$$\left(\Delta F_X\right)_y = \left(\frac{\partial F_X}{\partial x}\right)_y \Delta x = \left(\frac{\partial F_X}{\partial x}\right)_y (K_s)_\tau. \qquad (1.145)$$

The change of the value $x = (K_s)_\tau$ after the action on the subsystem τ leads to the violation of the condition of thermodynamic equilibrium (1.140), corresponding to equality (1.133), since the temperature T_τ is increased in the subsystem τ (as a result of dissipation of the macroscopic internal shear kinetic energy $(K_s)_\tau$) and the angular velocity of rotation $\mathbf{\Omega}_\tau$ of the subsystem τ is changed in accordance with the generalized differential formulation (1.43) of the first law of thermodynamics. The generalized thermodynamic force $F_X \equiv \Delta F_X$ will have the following value [Simonenko, 2007]:

$$(F_X)_{F_Y=0} = \left(\frac{\partial F_X}{\partial x}\right)_{F_Y=0} \Delta x \qquad (1.146)$$

after the time moment of attainment of the condition $F_Y = 0$ of internal equilibrium in the subsystem τ (and the satisfaction of the conditions (1.133) and (1.136)) as a result of the outflow of heat from subsystem τ and the attainment of equality of the angular velocity $\mathbf{\Omega}_\tau$ of rotation of the subsystem τ and the angular velocity $\mathbf{\Omega}_{\bar{\tau}}$ of rotation of the surrounding subsystem $\bar{\tau}$ (as a result of radiation of the seismic acoustic waves from the subsystem τ and its surroundings). Here the derivative is taken for the constant value $F_Y = 0$.

We compared [Simonenko, 2007] the changes of the magnitude of the generalized thermodynamic forces $(\Delta F_X)_y$ and $(\Delta F_X)_{F_{Y=0}}$, given by the expressions (1.145) and (1.146), respectively. Using the results [Landau and Lifshitz, 1976], we obtained [Simonenko, 2007]:

$$\left(\frac{\partial F_X}{\partial x}\right)\Big|_{F_Y=0} = \frac{\partial(F_X,F_Y)}{\partial(x,F_Y)} = \frac{\dfrac{\partial(F_X,F_Y)}{\partial(x,y)}}{\dfrac{\partial(x,F_Y)}{\partial(x,y)}} = \left(\frac{\partial F_X}{\partial x}\right)_y - \frac{\left(\dfrac{\partial F_X}{\partial y}\right)_x^2}{\left(\dfrac{\partial F_Y}{\partial y}\right)_x}. \tag{1.147}$$

Taking into account the inequality (1.143) and also the negative sing (according to inequality (1.144)) of the denominator in the second term of (1.147), we obtained [Simonenko, 2007] the condition:

$$\left(\frac{\partial F_X}{\partial x}\right)_y < \left(\frac{\partial F_X}{\partial x}\right)_{F_Y=0}, \tag{1.148}$$

or

$$(\Delta F_X)_y < (\Delta F_X)_{F_Y=0}. \tag{1.149}$$

We obtained [Simonenko, 2007] from expressions (1.142) and (1.145):

$$(\Delta F_X)_y = \left(\frac{\partial F_X}{\partial x}\right)_y \Delta x = \left(\frac{\partial^2 S}{\partial x^2}\right)_y \Delta x = \frac{\partial^2 S}{\partial (K_s)_\tau^2}(K_s)_\tau < 0, \tag{1.150}$$

$$(\Delta F_X)_{F_Y=0} = \left(\frac{\partial^2 S}{\partial x^2}\right)_{F_Y=0} \Delta x > (\Delta F_X)_y < 0. \tag{1.151}$$

We showed [Simonenko, 2007] that $(F_x)_{F_Y=0} < 0$. Taking into account the expressions of the second differentials of entropy:

$$d^2S\big|_y = \frac{1}{2}\left(\frac{\partial^2 S}{\partial x^2}\right)\Big|_y (\Delta x)^2 = \frac{1}{2}\frac{\partial^2 S}{\partial (K_S)_\tau^2}\ \Big|_y \left((K_S)_\tau\right)^2 \quad ,$$

$$d^2S\big|_{F_Y=0} = \frac{1}{2}\left(\frac{\partial^2 S}{\partial x^2}\right)\Big|_{F_Y=0} (\Delta x)^2 .$$

for constant y and $F_Y = 0$, respectively, and also the inequality (1.149) and condition $d^2S < 0$, we obtained [Simonenko, 2007] that relations (1.150) and (1.151) give the inequality [Simonenko, 2007]:

$$d^2S\big|_y < d^2S\big|_{F_Y=0} < 0, \tag{1.152}$$

from which follows that $(F_x)_{F_Y=0} < 0$. Thus, the external deformational influence on the subsystem τ (in the form of the added macroscopic internal shear kinetic energy $(K_s)_\tau$ creating the condition $d^2S\big|_y < 0$) stimulates the relaxation processes in the subsystem τ, which give the attainment of the inequality (1.152). We see that the relaxation processes attenuate the decrease of entropy of the thermodynamic system as a result of the added macroscopic internal shear kinetic energy $(K_s)_\tau$ to the subsystem τ. Taking into account that the generalized thermodynamic forces $(F_X)_y$ and $(F_X)_{F_{Y=0}}$ are negative in inequalities (1.150) and (1.151), the inequality (1.149) can be rewritten as the following inequality [Simonenko, 2007]:

$$\left|(\Delta F_X)_y\right| > \left|(\Delta F_X)_{F_Y=0}\right|, \tag{1.153}$$

which presents the content of the stated [Landau and Lifshitz, 1976] above the Le Chatelier-Braun's principle for induced small deviations of the subsystem τ (located in the surrounding environment $\bar{\tau}$ composing with the subsystem τ the closed thermodynamic system) from the state of thermodynamic equilibrium. Using the inequality (1.152), we obtained [Simonenko, 2007]

$$S\big|_{F_Y=0} = S_o + \frac{1}{2}d^2S\big|_{F_Y=0} > S\big|_y = S_o + \frac{1}{2}d^2S\big|_y, \tag{1.154}$$

i.e. the entropy $S\big|_{F_Y=0}$ is increased in compared to the entropy $S\big|_y$ (related with the added macroscopic internal shear kinetic energy $(K_S)_\tau > 0$ to the subsystem τ) after completion of the relaxation processes in the thermodynamic system. However, the entropy of the thermodynamic system (after completion of the relaxation processes) do not attain the value S_o corresponding to the initial equilibrium state but it is less than S_o. We obtained [Simonenko, 2007] the increase of entropy $\Delta S = S|_{F_Y=0} - S|_y > 0$ in the thermodynamic system as a result of irreversible processes relaxing the deformational influence (related with the added macroscopic internal shear kinetic energy $(K_S)_\tau > 0$ to the subsystem τ) on the subsystem τ.

Thus, we have shown that the macroscopic internal shear kinetic energy $(K_s)_\tau$ and the angular momentum $\mathbf{M}_\tau$ (of the macroscopic continuum region τ) can be considered as the thermodynamic variables (x and y) describing the state of the macroscopic continuum region τ (the subsystem τ located in the closed thermodynamic system). We established [Simonenko, 2007] that the entropy S of the thermodynamic system is reduced up to the some value $S|_y$ (which is less than the value S_o characterized the equilibrium state of the thermodynamic system) as a result of the external momentary deformational influence (especially, induced by cosmic gravitation) on subsystem τ related with the added macroscopic internal shear kinetic energy $(K_s)_\tau$, when the some component $y \equiv y_i = (\mathbf{M}_\tau)_i$ of the angular momentum $\mathbf{M}_\tau$ do not change directly as a result of sharp change $(K_S)_\tau > 0$ relative to the equilibrium zero value. Generalizing the Le Chatelier-Braun's principle on the rotational thermodynamic systems, we showed [Simonenko, 2007] that the total entropy of the closed thermodynamic system is increased up to the value $S|_{F_Y=0}$, which is less than the value S_o and is larger than the value $S|_y$ ($S_o > S|_{F_Y=0} > S|_y$) as a result of irreversible relaxation processes in the thermodynamic system diminishing the result of the deformation influence on the subsystem τ related with the added macroscopic internal shear kinetic energy $(K_S)_\tau > 0$ to the subsystem τ.

1.8. The non-equilibrium statistical thermohydrogravidynamics of turbulent plasma subjected to the non-stationary gravitational and electromagnetic fields

Based on the founded Non-equilibrium Statistical Thermohydrodynamics of Turbulence [Simonenko, 2004; 2006] and the Thermohydrogravidynamics of the Solar System [Simonenko, 2007; 2008; 2009; 2010] it was deduced (in 2011) the subsequent generalization of the first law of thermodynamics (for moving rotating deformed compressible heat-conducting stratified individual macroscopic region τ of turbulent electromagnetic plasma subjected to the non-stationary Newtonian gravity and the non-stationary electromagnetic field):

$$P(t)dt + dU_\tau + dK_\tau + d\pi_\tau + dE_{e,m,\tau} + \delta F_{e,m} = \delta Q_{e,m} + \delta Q + \delta A_{np,\partial\tau} + dG + c^2 dm_\tau \qquad (1.155)$$

extending the established generalized differential formulation (1.50) by taking into account the infinitesimal change dU_τ of the internal energy U_τ of turbulent plasma without the emitted fast neutrons in the individual region τ, the increment dK_τ of the macroscopic kinetic energy K_τ of turbulent plasma in the individual region τ, and the following additional terms: the useful energy production $P(t)dt$ of fast neutrons (emitted during time interval dt due to the thermonuclear reaction between two nuclei of deuterium or between nuclei of deuterium and tritium in a high temperature plasma) characterized by the positive released energy power $P(t)$ (which should be directed from the individual region τ to sustain the controlled thermonuclear process), the differential change $dE_{e,m,\tau}$ of electromagnetic energy $E_{e,m,\tau}$ inside the individual region τ of plasma, the energy flux $\delta F_{e,m}$ of electromagnetic energy radiated across the boundary surface $\partial\tau$ of the individual region τ, the differential heating $\delta Q_{e,m}$ due to the differential work of electrodynamic forces (resulted to the Joule heating owing to the plasma current) and due to the dissipated electromagnetic waves inside the individual region τ, and the differential amount of energy $c^2 dm_\tau > 0$ released (as a consequence of the thermonuclear burning mechanism proposed by Dr. Hans Bethe in 1939 for the Sun) due to the thermonuclear reaction related to the conversion of the differential amount of mass

dm_τ (a small difference between the initial and final reactive components of the thermonuclear reaction inside the individual region τ) into energy. The problem of the controlled thermonuclear reactions (analyzed by Academician P.L. Kapitza in 1978 in his Nobel Lecture [Kapitza, 1978]) has not yet been solved by the world national and international research centers. It is clear that the general generalized differential formulation (1.155) represents the thermodynamic key for the final solution of this problem. The general generalized differential formulation (1.155) of the first law of thermodynamics is deduced to describe the combined thermohydrogravielectromagnetic dynamics of the controlled thermonuclear reactions inside the individual region τ of turbulent electromagnetic plasma subjected to the non-stationary Newtonian gravity and the non-stationary electromagnetic field. In particular, the reduced differential formulation

$$dE_{e,m,\tau} = \delta A_p = -pdV_\tau \tag{1.156}$$

(with zero others terms in formulation (1.155)) leads to the Stefan-Boltzman law

$$E_{e,m,\tau} / V_\tau \sim T^4 \tag{1.157}$$

and to the classical [Landau and Lifshitz, Statistical Physics, 1976] relation

$$pV_\tau^{4/3} = \text{const} \tag{1.158}$$

for the adiabatic process related with the equilibrium electromagnetic black-body radiation (the gas of photons) contained in the individual region τ characterized by the volume V_τ. It is clear without any doubt that the sustainable controlled thermonuclear reactions can be realized under the reliable controlled synchronization of the different differential terms in the general generalized formulation (1.155), which takes into account the combined thermohydrogravielectromagnetic dynamics related with the sustainable thermonuclear process characterized by the useful energy power $P(t) > 0$ released from the individual region τ of turbulent electromagnetic plasma subjected to thermonuclear reaction.

The generalized formulation (1.155) of the first law of thermodynamics (for moving rotating deformed compressible heat-conducting stratified individual macroscopic region τ of turbulent electromagnetic plasma subjected to the non-stationary Newtonian gravity and the non-stationary electromagnetic field) can be used by the young scientists and researchers of the world ("Benedictio Domini sit vobiscum") for the urgent nearest practical realization of the controlled thermonuclear reactions to enhance the energy power of humankind before the forthcoming range $2020 \div 2061$ AD [Simonenko, 2012] of the maximal seismotectonic, volcanic and climatic activities of the Earth in the 21st century during the past $696 \div 708$ years of the history of humankind.

2. THE COSMIC GEOLOGY

2.1. The total energy and the total angular momentum of the Solar System

Following the works [Simonenko, 2007a; 2007; 2008; 2009; 2010], we present the fundamentals of the cosmic geology. We consider the Solar System as the unclosed non-equilibrium thermodynamic system by taking into account the influences of the external (cosmic) gravitational field of our Galaxy. We consider the planets of the Solar System as unclosed non-equilibrium thermodynamic systems subjected to the gravitational influences of the Solar System and the external (cosmic) gravitational field of our Galaxy. The gravitational influences of the Solar System and the external (cosmic) gravitational field of our Galaxy deform the lithosphere of the Earth and displace the tectonic geo-blocks disturbing the Earth's continuum near the ideal rigid-like rotational state of the thermodynamic equilibrium.

We deduced [Simonenko, 2007; 2008; 2009; 2010] the expressions for the total energy and the total angular momentum of the Solar System. The position-vector $\mathbf{r}_{\mathbf{c},\alpha}$ of the mass center of the planet τ_α is given by the following expression [Simonenko, 2007; 2008; 2009; 2010]:

$$\mathbf{r}_{\mathbf{c},\alpha} = \frac{1}{m_{\tau_\alpha}} \iiint_{\tau_\alpha} \mathbf{r}\rho dV = \frac{\iiint_{\tau_\alpha} \mathbf{r}\rho dV}{\iiint_{\tau_\alpha} \rho dV} . \tag{2.1}$$

The speed of the mass center C_α of the planet τ_α (characterized by mass m_{τ_α}) is given by the following expression [Simonenko, 2007; 2008; 2009; 2010]:

$$\mathbf{V}_{c,\alpha} = \frac{\iiint_{\tau_\alpha} \mathbf{v}\rho dV}{m_{\tau_\alpha}} . \tag{2.2}$$

The macroscopic kinetic energy of the planet τ_α is given by the following expression [Simonenko, 2007; 2008; 2009; 2010]:

$$K_{\tau_\alpha} = \iiint_{\tau_\alpha} \frac{\rho \mathbf{v}^2}{2} d\,V . \tag{2.3}$$

The hydrodynamic continuum velocity in the vicinity of the position-vector $\mathbf{r}_{\mathbf{c},\alpha}$ of the mass center C_α of the planet τ_α is given by the Taylor series expansion [Simonenko, 2004; 2006; 2007; 2008; 2009; 2010]:

$$\mathbf{v}\,(\mathbf{r}_{\mathbf{c},\alpha} + \delta\mathbf{r}) = \mathbf{v}\,(\mathbf{r}_{\mathbf{c},\alpha}) + \boldsymbol{\omega}\,(\mathbf{r}_{\mathbf{c},\alpha}) \times \delta\mathbf{r} + \sum_{i,j=1}^{3} e_{ij}(\mathbf{r}_{\mathbf{c},\alpha})\delta r_j \; \boldsymbol{\mu}_i +$$
$$+ \frac{1}{2} \sum_{i,j,k=1}^{3} \frac{\partial^2 v_i(\mathbf{r}_{c,\alpha})}{\partial X_j \partial X_k} \delta r_j \delta r_k \; \boldsymbol{\mu}_i + \mathbf{v}_{\alpha,res} , \tag{2.4}$$

where

$$\delta\,\mathbf{r} \equiv \mathbf{r} - \mathbf{r}_{\mathbf{c},\alpha} \equiv (\delta r_1, \delta r_2, \delta r_3) \equiv (x_1, x_2, x_3) ;$$

$$\boldsymbol{\omega}\,(\mathbf{r}_{c,\alpha}) \equiv \frac{1}{2} [\nabla \times \mathbf{v}\,(\mathbf{r})] \equiv (\omega_{\alpha,1}, \omega_{\alpha,2}, \omega_{\alpha,3})$$

is the angular velocity vector of rotation of the planet τ_α;

$$e_{ij}(\mathbf{r}_{c,\alpha}) = \frac{1}{2}\left(\frac{\partial v_i(\mathbf{r})}{\partial X_j} + \frac{\partial v_j(\mathbf{r})}{\partial X_i} \right)$$

is the rate of strain tensor at the position-vector $\mathbf{r}_{\mathbf{c},\alpha}$ of the mass center C_α of the planet τ_α;

$\mathbf{v}_{\alpha,res} = \sum_{i=1}^{3} w_{\alpha,i} \boldsymbol{\mu}_i$ is the residual part of the Taylor series expansion (2.4) for the planet τ_α;

$$w_{\alpha,i} = O\left(d_{\tau_\alpha}^3\right), \ (i = 1, 2, 3);$$

$$d_{\tau_\alpha} = \sup_{A,B \in \partial_{\tau_\alpha}} \sqrt{(\mathbf{r}(A,B))^2}$$

is the diameter of the planet τ_α, ∂_{τ_α} is the boundary surface of the planet's τ_α continuum.

The macroscopic kinetic energy of the planet τ_α (considered as the macroscopic continuum region τ_α characterized by practically constant values of the angular velocity vector $\boldsymbol{\omega}\,(\mathbf{r}_{c,\alpha})$ and the rate of strain tensor $e_{ij}(\mathbf{r}_{c,\alpha})$ for the continuum region τ_α) is given by the following expression [Simonenko, 2004; 2005; 2006; 2007; 2008]:

$$K_{\tau_\alpha} = (K_t)_{\tau_\alpha} + (K_r)_{\tau_\alpha} + (K_s)_{\tau_\alpha} + (K_{s,r}^{coup})_{\tau_\alpha} + (K_{res})_{\tau_\alpha} =$$

$$= \frac{1}{2} m_\tau \mathbf{V}_c^2 + \frac{1}{2} \sum_{i,k=1}^{3} I_{ik}(C_\alpha)\omega_i(\mathbf{r}_{c,\alpha})\omega_k(\mathbf{r}_{c,\alpha}) + \frac{1}{2} \sum_{i,j,k=1}^{3} J_{jk}(C_\alpha)e_{ij}(\mathbf{r}_{c,\alpha})e_{ik}(\mathbf{r}_{c,\alpha}) +$$

$$+ \sum_{i,j,k,m=1}^{3} \varepsilon_{ijk} J_{jm}(C_\alpha)\omega_i(\mathbf{r}_{c,\alpha})\, e_{km}(\mathbf{r}_{c,\alpha}) + (K_{res})_{\tau_\alpha}, \quad (2.5)$$

where

$$(K_t)_{\tau_\alpha} = \frac{(\mathbf{P}_{\tau_\alpha})^2}{2m_{\tau_\alpha}} = \frac{1}{2} m_{\tau_\alpha} \mathbf{V}_{c,\alpha}^2 \quad (2.6)$$

is the macroscopic translational kinetic energy of the orbital movement of the planet τ_α moving as a whole at speed $\mathbf{V}_{c,\alpha}$ of the mass center of the continuum region of the planet τ_α,

$$(K_r)_{\tau_\alpha} = \frac{1}{2} \sum_{i,k=1}^{3} I_{ik}(C_\alpha)\omega_i(\mathbf{r}_{c,\alpha})\omega_k(\mathbf{r}_{c,\alpha}) \quad (2.7)$$

the macroscopic internal rotational kinetic energy of the planet τ_α rotating with the angular velocity $\boldsymbol{\omega}\,(\mathbf{r}_{c,\alpha})$ as a whole,

$$(K_s)_{\tau_\alpha} = \frac{1}{2} \sum_{i,j,k=1}^{3} J_{jk}(C_\alpha)e_{ij}(\mathbf{r}_{c,\alpha})e_{ik}(\mathbf{r}_{c,\alpha}) \quad (2.8)$$

is the macroscopic internal shear kinetic energy of the planet τ_α subjected to continuum deformation by the local shear related with the rate of strain tensor $e_{ij}(\mathbf{r}_{c,\alpha})$,

$$(K_{s,r}^{coup})_{\tau_\alpha} = \sum_{i,j,k,m=1}^{3} \varepsilon_{ijk} J_{jm}(C_\alpha)\omega_i(\mathbf{r}_{c,\alpha})\, e_{km}(\mathbf{r}_{c,\alpha}) \quad (2.9)$$

is the macroscopic kinetic energy of shear-rotational coupling of the planet τ_α (related with the kinetic energy of planetary coupling between irreversible dissipative shear and reversible rigid-like rotational macroscopic continuum motions in the continuum region of the planet τ_α), $(K_{res})_{\tau_\alpha} = O(d_{\tau_\alpha}^7)$ is a small residual part of the macroscopic kinetic energy of the planet τ_α related with the residual terms in the Taylor series expansion (2.4).

The classical inertia tensor $I_{ik}(C_\alpha)$ and the classical centrifugal tensor $J_{jk}(C_\alpha)$ of the planet τ_α (relative to the mass center C_α of the planet τ_α) are given by the classical expressions

$$I_{ik}(C_\alpha) = \iiint_{\tau_\alpha, K'} \left(\delta_{ik} \left(\sum_{j=1}^{3} x_j^2 \right) - x_i x_k \right) \rho dV, \text{ (i, k = 1, 2, 3)}, \tag{2.10}$$

$$J_{jk}(C_\alpha) = \iiint_{\tau_\alpha, K'} x_j x_k \rho dV, \text{ (j, k = 1, 2, 3)}. \tag{2.11}$$

The component $M^C_{\tau_\alpha}(i)$ of the angular momentum (relative to the mass center C_α of the planet τ_α) of the planet τ_α is given by the following expression [Saffman, 1992]:

$$M^C_{\tau_\alpha}(i) = \varepsilon_{ijk} e_{kl}(\mathbf{r}_{c,\alpha}) J_{jl}(C_\alpha) + \frac{1}{2}(\delta_{ij} J_{kk}(C_\alpha) - J_{ij}(C_\alpha))\omega_j(\mathbf{r}_{c,\alpha}). \tag{2.12}$$

We obtained [Simonenko, 2007; 2008] from expression (2.12) the classical formula [de Groot and Mazur, 1962; Gyarmati, 1970] for uniform spherical continuum region τ_α (characterized by constant density):

$$\frac{M^C_{\tau_\alpha}}{m_{\tau_\alpha}} = \theta \boldsymbol{\omega}. \tag{2.13}$$

We obtained [Simonenko, 2007; 2008] the following expression for the total angular momentum $\mathbf{M}_{\tau_\alpha}$ of the planet τ_α (or the satellite τ_α of a planet):

$$\mathbf{M}_{\tau_\alpha} = \iiint_{\tau} [(\mathbf{r}_{c,\alpha} + \delta\mathbf{r}) \times \rho\mathbf{v}] dV = \left[\mathbf{r}_{c,\alpha} \times \iiint_{\tau_\alpha} \rho\mathbf{v} dV \right] + \mathbf{M}^C_{\tau_\alpha} =$$

$$= \underset{(1)}{[\mathbf{r}_{c,\alpha} \times \mathbf{P}_{\tau_\alpha}]} + \underset{(2)}{\sum_{i=1}^{3} \varepsilon_{ijk} e_{kl}(\mathbf{r}_{c,\alpha}) J_{jl}(C_\alpha) \boldsymbol{\mu}_i} + \underset{(3)}{\sum_{i=1}^{3} \frac{1}{2}(\delta_{ij} J_{kk}(C_\alpha) - J_{ij}(C_\alpha))\omega_j(\mathbf{r}_{c,\alpha})\boldsymbol{\mu}_i}. \tag{2.14}$$

The first term (1) of the expression (2.14) is the orbital angular momentum of the planet τ_α related with the orbital movement of the planet τ_α, the second term (2) is the internal shear angular momentum related with the non-equilibrium deformation of the planet τ_α (the continuum region of the planet τ_α), the third term (3) is the internal rotational angular momentum related with the equilibrium rotational motion of the planet τ_α (the continuum region of the planet τ_α).

The total energy E_{τ_α} of the planet τ_α is given by the following expression [Simonenko, 2007; 2008]:

$$E_{\tau_\alpha} = K_{\tau_\alpha} + U_{\tau_\alpha} + \pi_{\tau_\alpha} =$$

$$= (K_t)_{\tau_\alpha} + (K_r)_{\tau_\alpha} + (K_s)_{\tau_\alpha} + (K^{coup}_{s,r})_{\tau_\alpha} + (K_{res})_{\tau_\alpha} + U_{\tau_\alpha} + \pi_{\tau_\alpha}, \tag{2.15}$$

where

$$\pi_{\tau_\alpha} = \iiint_{\tau_\alpha} \psi \rho dV \tag{2.15a}$$

is the macroscopic potential energy of the planet τ_α related with the non-stationary potential ψ of the gravity field produced by the planet τ_α and by the surrounding planets (and satellites) of the Solar System, the Sun, the Moon, midget planets, known asteroids and comets of the Solar System and by our Galaxy,

$$U_{\tau_\alpha} = \iiint_{\tau_\alpha} u \rho dV \tag{2.15b}$$

is the classical internal thermal energy of the planet τ_α,

$$\psi(\mathbf{r}, t) = -\gamma \iiint \frac{\rho dV}{R} \tag{2.16}$$

is the potential of the gravitational forces created for time moment t by the mass distribution (of the surrounding planets (and satellites) of the Solar System, the Sun, the Moon, midget planets, known asteroids and comets of the Solar System, and our Galaxy) characterized by the mass density ρ at the point of the three-dimensional space defined by the position-vector $\mathbf{r}$, R is the distance between the element of mass ρ dV and the point of space characterized by the position-vector $\mathbf{r}$.

Considering the Solar System as the open thermodynamic system containing the set of separate thermodynamic subsystems (planets τ_α and satellites of the planets) and disregarding the presence of atmospheres and hydrospheres (of planets and satellites of the planets), we derived the expressions [Simonenko, 2004a; 2007; 2008] for the total energy and the total angular momentum for the Solar System consisting of N cosmic material objects (the surrounding planets (and satellites) of the Solar System, the Sun, the Moon, midget planets, known asteroids and comets of the Solar System):

$$\sum_{\alpha=0}^{N} \left\{ \frac{(\mathbf{P}_{\tau_\alpha})^2}{2m_{\tau_\alpha}} + (K_r)_{\tau_\alpha} + (K_s)_{\tau_\alpha} + (K_{s,r}^{coup})_{\tau_\alpha} + (K_{res})_{\tau_\alpha} + U_{\tau_\alpha} + \boldsymbol{\pi}_{\tau_\alpha} \right\} = E_{tot}(t) =$$
$$= E_{tot}(t_o) + \delta E_{tot}(t), \tag{2.17}$$

$$\sum_{\alpha=0}^{N} \left\{ \left[\mathbf{r}_{C_\alpha} \times \mathbf{P}_{\tau_\alpha}\right] + \sum_{i=1}^{3} \varepsilon_{ijk} e_{kl}(\mathbf{r}_{C_\alpha}) J_{jl}(C_\alpha)\boldsymbol{\mu}_i + \sum_{i=1}^{3} \frac{1}{2}(\delta_{ij} J_{kk}(C_\alpha) - J_{ij}(C_\alpha))\omega_j(\mathbf{r}_{C_\alpha})\boldsymbol{\mu}_i \right\} =$$
$$= \mathbf{M}_{tot}(t) = \mathbf{M}_{tot}(t_o) + \delta\mathbf{M}_{tot}(t), \tag{2.18}$$

where the index $\alpha = 0$ corresponds to the Sun, the non-zero indexes $\alpha \neq 0$ correspond to the cosmic material objects (planets, satellites of planets, midget planets, known asteroids and comets of the Solar System). The system (2.17) and (2.18) of algebraic equations (which contains the all real parameters of the Sun, planets, satellites of planets, midget planets, known asteroids and comets of the Solar System) gives the possibility of transformations between the different energies (of the surrounding planets (and satellites) of the Solar System, the Sun, the Moon, midget planets, known asteroids and comets of the Solar System) related with the corresponding changes of orbital parameters (of the surrounding planets (and satellites) of the Solar System, the Sun, the Moon, midget planets, known asteroids and comets of the Solar System) and the directions of rotation of the surrounding planets (and satellites) of the Solar System, the Sun, the Moon, midget planets and known asteroids of the Solar System. It was pointed [Vikulin and Melekestcev, 2007] the predominant contribution of the Jupiter **(**more than 60%) and the Saturn (near 30%) into the total angular momentum of the Solar System.

The system of equations (2.17) and (2.18) contains in the right-hand sides the variation of the total energy $\delta E_{tot}(t)$ and the variation of the total angular momentum $\delta\mathbf{M}_{tot}$ related with the external (cosmic) energy gravitational influences of our Galaxy on the Solar System. We deduced [Simonenko, 2009; 2010] the expression for the total energy $E_{tot}(t)$ of the Solar System by taking into account the atmospheres and hydrospheres of the planets and satellites, the midget planets and known asteroids of the Solar System.

Each planet (and the satellite, for example, the Moon) subjected to the external energy gravitational influences can reduce the overfilled internal energy (of the accumulated internal energy of continuum deformation, compression and strain) by creation of the new planetary fractures during the process of synchronization of the Earth and the planets of the Solar System. We evaluated [Simonenko, 2004a; 2007; 2008] the result of the thermodynamic process of the seismic (tectonic) relaxation of the planet ($\tau + \bar{\tau}$) after formation of the new planetary fracture. Disregarding the influences of atmosphere and (or) hydrosphere $\bar{\tau}$ during the small time of the seismic (tectonic) relaxation of the planet ($\tau + \bar{\tau}$), we considered [Simonenko, 2004a; 2007; 2008] the system of the conservation laws of the total energy and the total angular momentum of the subsystem τ of the planet ($\tau + \bar{\tau}$):

$$\frac{(\mathbf{P}_\tau)^2}{2m_\tau} + (K_r)_\tau + (K_s)_\tau + (K_{s,r}^{coup})_\tau + U_\tau + \boldsymbol{\pi}_\tau = (E(t))_\tau = E_{tot}(\tau), \tag{2.19}$$

$$\left[\mathbf{r}_c \times \mathbf{P}_\tau\right] + \sum_{i,j,k,l=1}^{3} \varepsilon_{ijk} e_{kl} J_{jl}(C)\boldsymbol{\mu}_i + \sum_{i,j,k=1}^{3} \frac{1}{2}(\delta_{ij} J_{kk}(C) - J_{ij}(C))\omega_j \boldsymbol{\mu}_i = (\mathbf{M}(t))_\tau = \mathbf{M}_{tot}(\tau). \tag{2.20}$$

Taking into account the weakness of the interaction effect between the subsystems τ and $\bar{\tau}$ (atmosphere and (or) hydrosphere) on the boundary surface $\partial\tau$ and disregarding the energy gravitational interaction of the subsystem τ with subsystem $\bar{\tau}$ and others cosmic material objects during the small time of the seismic (tectonic) relaxation, it was shown [Simonenko, 2004a] that the system of equations (2.19) and (2.20) admits the oscillating energy transformations between the accumulated internal energy U_τ (of the accumulated internal energy of continuum deformation, compression and strain of the subsystem τ) and the macroscopic internal kinetic energies $(K_s)_\tau$, $(K_r)_\tau$, $(K_{s,r}^{coup})_\tau$. The oscillating energy transformations (subjected to the damping due to viscocity) are related with the small final change of the direction of rotation of the subsystem τ of the planet ($\tau+\bar{\tau}$) [Simonenko, 2004a].

Recognizing in 2004 [Simonenko, 2004a] the general mathematical nature of the generalized differential formulation (1.50) of the first law of thermodynamics (valid for arbitrary finite macroscopic continuum regions of the ocean, atmosphere and the Earth's interior), the author made the mental jump from the turbulent eddy [Simonenko, 2004; 2005; 2006] to the planets of the Solar System [Simonenko, 2007]. Based on the generalizations (1.6) and (1.50) used for the planet (the Earth) of the Solar System, the author reported (in September 15, 2004 in the report "The macroscopic non-equilibrium kinetic energies of a small fluid particle" [Simonenko, 2004a] on the International conference on the Arctic and North Pacific, Chapter 1: Climate change and natural disasters) about the inevitable abrupt change of the angular velocity vector of the Earth's rotation during the strong earthquake. Since the convincing confirmation of this prediction for the December 26, 2004 Indonesia earthquake, the author concentrated during 2004-2010 on the subsequent parallel development of the Non-equilibrium Statistical Thermohydrodynamics of Turbulence [Simonenko, 2005; 2006] and the Thermohydrogravidynamics (Cosmic Physics) of the Solar System [Simonenko, 2007; 2008; 2009; 2010] by synthesizing the Newton's theory of gravitation, the Newton's laws of motion and the classical thermodynamic, continuum mechanical, hydrodynamic, astronomical, geological, geophysical, seismological, climatological, hydro-geophysical and oceanological approaches into the presented deductive thermohydrogravidynamic theory of the global geological and geophysical planetary processes subjected to the non-stationary Newtonian gravitational field of the Solar System and our Galaxy. The predicted effect [Simonenko, 2004a] of the small abrupt change of the direction of rotation of the subsystem τ of the Earth is consistent with the real geophysical data [Kotlyar and Kim, 1994] demonstrating of the small abrupt change of the angular velocity of Earth' rotation during the strong earthquakes.

2.2. Non-catastrophic models of the thermohydrogravidynamic evolution of the total energy of the subsystems of the planet ($\tau+\bar{\tau}$) subjected to the cosmic non-stationary energy gravitational influences of the Solar System and our Galaxy

2.2.1. Thermohydrogravidynamic evolution of the total energy E_τ of the subsystem τ bounded by the external boundary surface $\partial\tau$, on which the subsystem τ interacts with the subsystem $\bar{\tau}$ representing the atmosphere or atmosphere and hydrosphere of the planet ($\tau+\bar{\tau}$)

It was noted earlier [Zhirmunsky and Kuzmin, 1990] that the periods of circulation of the main majority of the planets of the Solar System (including the asteroids between the Mars and Jupiter) are close to the geometric progression characterized by the module e (e =2.7182…), while the Earth and Neptune fall out from these planets. It demonstrates the special positions of the Earth and Neptune in respect to the others planets during process of formation of the Solar System and in the present time. It shows that the periods of circulation of the Earth and Neptune are not synchronized with the all totality of periods of circulation for others planets. The average distances of the planets of the Solar System from the Sun are practically synchronized forming the geometric progression characterized by module $e^{2/3}$ [Zhirmunsky and Kuzmin, 1990]. Consequently, it means the possible change of parameters of the orbit of the Earth (in the process of synchronization of the Earth and the all totality of the planets of the Solar System) related with the change of the total energy (including the change of the angular velocity of the Earth's rotation) and the periodic activization of the tectonic processes.

Following the works [Simonenko, 2007a; 2007; 2008; 2009; 2010], we present the formulation of the non-catastrophic model of the thermohydrogravidynamic evolution of the total energy E_τ of the subsystem τ subjected to the cosmic non-stationary energy gravitational influences of the Solar System and our

Galaxy. The subsystem τ is bounded by the external boundary surface $\partial\tau$, on which the subsystem τ interacts with the subsystem $\bar{\tau}$ representing the atmosphere or atmosphere and hydrosphere of the planet ($\tau+\bar{\tau}$) subjected to the cosmic non-stationary energy gravitational influences of the Solar System and our Galaxy. Following to Gor'kavyi and Fridman [Gor'kavyi and Fridman, 1994], we consider the Solar System as the complex hierarchy of the thermohydrogravidynamic subsystems saturating by different energy sources and possessing by the amazing wealth of the collective processes. Using the generalized differential formulation (1.53) of the first law of thermodynamics, we deduced [Simonenko, 2007a; 2007; 2008; 2009; 2010] the integral evolution equation (in the inertial coordinate system) for the total energy of an arbitrary planet (of the Solar System) considered as the macroscopic continuum region characterized by internal thermohydrogravidynamic structure.

To take into account the additional energy source related with heating as the result of disintegration of radio-active elements of the planet of the Solar System, the human industrial activity and the underground nuclear explosions, we considered [Simonenko, 2007a; 2007; 2008; 2009; 2010] (in the right-hand side of the generalized differential formulation (1.53) of the first law of thermodynamics) the new additional term related with the space-time density e_τ of the sources of heat. Taking into account the additional energy source e_τ, the formulation (1.53) can be rewritten as follows [Simonenko, 2007a; 2007; 2008; 2009; 2010]:

$$\frac{dE_\tau}{dt}=\frac{d}{dt}\left(K_\tau+U_\tau+\boldsymbol{\pi}_\tau\right)=\frac{d}{dt}\iiint_\tau\left(\frac{1}{2}\mathbf{v}^2+u+\psi\right)\rho dV=$$

$$=\iint_{\partial\tau}\left(\mathbf{v}\cdot(\mathbf{n}\cdot\mathbf{T})\right)d\Omega_{\mathbf{n}}-\iint_{\partial\tau}\left(\mathbf{J}_q\cdot\mathbf{n}\right)d\Omega_{\mathbf{n}}+\iiint_\tau\frac{\partial\psi}{\partial t}\rho dV+\iiint_\tau e_\tau\rho dV \tag{2.21}$$

for the macroscopic continuum region τ, for example for the subsystem τ bounded by the external boundary surface $\partial\tau$, on which the subsystem τ interacts with the subsystem $\bar{\tau}$ representing the atmosphere or atmosphere and hydrosphere of the planet ($\tau+\bar{\tau}$). Here $\mathbf{n}$ is the external unit normal vector of the surface $\partial\tau$. The potential of the non-stationary gravity field ψ (in the subsystem τ) is created owing to all objects of our Galaxy. The differential formulations (1.53) and (2.21) of the first law of thermodynamics take into account the heating related with the gravitational differentiation of the stratified continuum (inside the continuum region τ) and the heating related with with the gravitational interaction of the considered subsystem τ with the surrounding material objects of our Galaxy.

Integrating the equation (2.21), we obtained [Simonenko, 2007a; 2007; 2008; 2009; 2010] the expression for the total energy $(E(t))_\tau$ of the subsystem τ of the planet ($\tau+\bar{\tau}$):

$$(E(t))_\tau=(K_t(t))_\tau+(K_r(t))_\tau+(K_s(t))_\tau+(K_{s,r}^{coup}(t))_\tau+U_\tau(t)+\boldsymbol{\pi}_\tau(t)=$$

$$=(K_t(t_o))_\tau+(K_r(t_o))_\tau+(K_s(t_o))_\tau+(K_{s,r}^{coup}(t_o))_\tau+U_\tau(t_o)+\boldsymbol{\pi}_\tau(t_o)+$$

$$+\int_{t_o}^{t}\left(\iint_{\partial\tau}\left(\mathbf{v}\cdot(\mathbf{n}\cdot\mathbf{T})\right)d\Omega_{\mathbf{n}}\right)dt'-\int_{t_o}^{t}\left(\iint_{\partial\tau}\left(\mathbf{J}_q\cdot\mathbf{n}\right)d\Omega_{\mathbf{n}}\right)dt'+$$

$$+\int_{t_o}^{t}\left(\iiint_\tau\frac{\partial\psi}{\partial t'}\rho dV\right)dt'+\int_{t_o}^{t}\left(\iiint_\tau e_\tau\rho dV\right)dt'. \tag{2.22}$$

The first term in the third row of the expressions (2.22) gives the energy exchange between the oceans and the atmosphere (containing the subsystem $\bar{\tau}$) and the subsystem τ containing the geo-spheres of the planet including the lithospheres of the Earth and the planets of the terrestrial group. The first term in the third row of the expressions (2.22) controls the angular velocity of rotation of the planet's subsystem τ. According to the expressions (2.22), the long-range changes of the Earth's angular velocity of rotation are defined by the following factors: the periodic variation of the gravitational potential ψ (related with the first term in the fourth row of the expressions (2.22)) of the non-stationary gravity field (produced by the planets (and satellites) of the Solar System, the Earth, the Sun, the Moon, midget planets, known asteroids and comets of the Solar System), the periodic changes of the intensity of solar radiation (the second term in the third row of the expressions (2.22)), which change the distribution of average circulations of the atmosphere and oceans and the corresponding thermohydrodynamic parameters (related with the first term in the third row of the expressions (2.22)) near the upper boundary of the Earth's lithosphere. Considering the factor of the solar influence on the rotational motion of the Earth on the basis of the actual observations, it was obtained [Эйгенсон, 1958; p. 36] the similar conclusion about the universal role of the solar activity controlling partially the absolute value of the angular velocity of the Earth's rotation. It is important to use the real information [Dolgikh, 2000] about the lithosphere oscillations for modeling of the energy exchange (described by the first term in the third row of the expressions (2.22)) between the oceans and the atmosphere (containing the subsystem $\bar{\tau}$) and the subsystem τ containing the lithosphere and others geo-spheres of the Earth.

The first term in the fourth row of expression (2.22) gives the contribution to the change of the total energy of the subsystem τ taking into account the change of the potential ψ of the non-stationary gravitational field (produced by the planet ($\tau+\bar{\tau}$) and others planets of the Solar System) in the subsystem τ of the planet ($\tau+\bar{\tau}$). According to the expression (2.22), the compression of the subsystem τ of the planet ($\tau+\bar{\tau}$) accompanied by the increase of the gravitation potential ψ in the fixed point of space must induce the increase of the internal thermal energy and the corresponding heat flux from the kernel of the planet. This conclusion is in agreement with the Milanovsky's conclusion [Milanovsky, 1979] that the geological eras of the intensive increase of the heat flux correspond to the eras of general compression of the Earth. Three full cycles (of the geological eras of compression, stretching and more long-lasting reduction of the tectonic motions) [Milanovsky, 1979] of the total duration of 570 million years correspond approximately to three cycles of circulation (characterized by the period of 200 million years [Kazancev, 2002; p. 10]) of the Solar System around the center of our Galaxy. Taking this into account, we revealed [Simonenko, 2007] the galactic energy gravitational genesis of each cycle (the compression, stretching and more long-lasting reduction of the tectonic motions) of the geological eras of the Earth during the latest 570 million years.

We obtained [Simonenko, 2007a; 2007; 2008] the time evolution of the total energy $(E(t))_\tau$ for the planet τ not having the atmosphere (for example, the Mercury) or for arbitrary satellite of the planet, except the Titan possessing the developed atmosphere and except the Triton possessing the weak atmosphere [Bazilevskii, 2000]. Integrating the equation (2.21) under the obvious condition $\iint_{\partial\tau} (\mathbf{v}\cdot(\mathbf{n}\cdot\mathbf{T}))\, d\Omega_{\mathbf{n}} = 0$ on the external boundary $\partial\tau$ of the considered celestial objects, we obtained [Simonenko, 2007a; 2007; 2008] the time evolution law of the total energy $(E(t))_\tau$:

$$(E(t))_\tau = (K_t(t))_\tau + (K_r(t))_\tau + (K_s(t))_\tau + (K_{s,r}^{coup}(t))_\tau + U_\tau(t) + \pi_\tau(t) =$$
$$= (K_t(t_o))_\tau + (K_r(t_o))_\tau + (K_s(t_o))_\tau + (K_{s,r}^{coup}(t_o))_\tau + U_\tau(t_o) + \pi_\tau(t_o) -$$
$$- \int_{t_o}^{t} \left(\iint_{\partial\tau} (\mathbf{J}_q \cdot \mathbf{n})\, d\Omega_{\mathbf{n}} \right) dt' + \int_{t_o}^{t} \left(\iiint_{\tau} \frac{\partial\psi}{\partial t'} \rho dV \right) dt' + \int_{t_o}^{t} \left(\iiint_{\tau} e_\tau \rho dV \right) dt' .$$

(2.23)

2.2.2. Thermohydrogravidynamic evolution of the total energy $E_{\bar{\tau}}$ of the subsystem $\bar{\tau}$ representing the atmosphere or atmosphere and hydrosphere of the planet ($\tau+\bar{\tau}$)

Following the works [Simonenko, 2007a; 2007; 2008], we shall present the formulation of the non-catastrophic model of the thermohydrogravidynamic evolution of the total energy $E_{\bar{\tau}}$ of the subsystem $\bar{\tau}$ representing the atmosphere or atmosphere and hydrosphere of the planet ($\tau+\bar{\tau}$) subjected to the cosmic non-stationary energy gravitational influences of the Solar System and our Galaxy. Considering the differential formulation (1.53) of the first law of thermodynamics (with the additional source $e_{\bar{\tau}}$ of heat in the subsystem $\bar{\tau}$) for the subsystem $\bar{\tau}$ (atmosphere or atmosphere and hydrosphere), which surrounds the subsystem τ, we obtained [Simonenko, 2007a; 2007; 2008] the evolution equation for the total energy $E_{\bar{\tau}}$ of the subsystem $\bar{\tau}$ (which has the external boundary surface $\partial(\tau+\bar{\tau})$ and the inner boundary surface $\partial\tau$):

$$\frac{dE_{\bar{\tau}}}{dt} = \frac{d}{dt}\left(K_{\bar{\tau}} + U_{\bar{\tau}} + \boldsymbol{\pi}_{\bar{\tau}}\right) = \frac{d}{dt}\iiint\limits_{\bar{\tau}}\left(\frac{1}{2}\mathbf{v}^2 + u + \psi\right)\rho dV = -\iint\limits_{\partial\tau}\left(\mathbf{v}\cdot(\mathbf{n}\cdot\mathbf{T})\right) d\Omega_{\mathbf{n}} +$$

$$+\iint\limits_{\partial\tau}\left(\mathbf{J}_q\cdot\mathbf{n}\right) d\Omega_{\mathbf{n}} + \iiint\limits_{\bar{\tau}}\frac{\partial\psi}{\partial t}\rho dV + \iint\limits_{\partial(\tau+\bar{\tau})}\left(\mathbf{v}\cdot(\mathbf{k}\cdot\mathbf{T})\right) d\Sigma_{\mathbf{k}} -$$

$$- \iint\limits_{\partial(\tau+\bar{\tau})}\left(\mathbf{J}_q\cdot\mathbf{k}\right) d\Sigma_{\mathbf{k}} + \iiint\limits_{\bar{\tau}} e_{\bar{\tau}}\rho dV, \qquad (2.24)$$

where $\mathbf{k}$ is the external unit normal vector of the external boundary surface $\partial(\tau+\bar{\tau})$, $d\Sigma_{\mathbf{k}}$ is the differential element of area of the surface $\partial(\tau+\bar{\tau})$, $-\mathbf{n}$ is the external unit normal vector of the inner boundary surface $\partial\tau$ of the subsystem $\bar{\tau}$.

2.2.3. Thermohydrogravidynamic evolution of the total energy $E_{(\tau+\bar{\tau})}$ of the planet ($\tau+\bar{\tau}$) consisting from interacting (on the surface $\partial\tau$) subsystems τ and $\bar{\tau}$ (the atmosphere or atmosphere and hydrosphere of the planet ($\tau+\bar{\tau}$))

Following the works [Simonenko, 2007a; 2007; 2008], we present the formulation of the non-catastrophic model of the thermohydrogravidynamic evolution of the total energy $E_{(\tau+\bar{\tau})}$ of the planet ($\tau+\bar{\tau}$) consisting from interacting (on the surface $\partial\tau$) subsystems τ and $\bar{\tau}$ (the atmosphere or atmosphere and hydrosphere of the planet ($\tau+\bar{\tau}$)) subjected to the cosmic non-stationary energy gravitational influences of the Solar System and our Galaxy. Adding the equations (2.21) and (2.24), we obtained [Simonenko, 2007a; 2007; 2008] the evolution equation for the total energy $E_{(\tau+\bar{\tau})}$ of the planet ($\tau+\bar{\tau}$) consisting from interacting (on the surface $\partial\tau$) subsystems τ and $\bar{\tau}$:

$$\frac{dE_{(\tau+\bar{\tau})}}{dt} = \frac{dE_{\tau}}{dt} + \frac{dE_{\bar{\tau}}}{dt} = \frac{d}{dt}\iiint\limits_{\tau}\left(\frac{1}{2}\mathbf{v}^2 + u + \psi\right)\rho dV + \frac{d}{dt}\iiint\limits_{\bar{\tau}}\left(\frac{1}{2}\mathbf{v}^2 + u + \psi\right)\rho dV = \qquad (2.25)$$

$$= \iint\limits_{\partial(\tau+\bar{\tau})}\left(\mathbf{v}\cdot(\mathbf{k}\cdot\mathbf{T})\right) d\Sigma_{\mathbf{k}} - \iint\limits_{\partial(\tau+\bar{\tau})}\left(\mathbf{J}_q\cdot\mathbf{k}\right) d\Sigma_{\mathbf{k}} + \iiint\limits_{(\tau+\bar{\tau})}\frac{\partial\psi}{\partial t}\rho dV + \iiint\limits_{\tau} e_{\tau}\rho dV + \iiint\limits_{\bar{\tau}} e_{\bar{\tau}}\rho dV.$$

Integrating the equation (2.25) under the obvious condition $\iint\limits_{\partial(\tau+\bar{\tau})}\left(\mathbf{v}\cdot(\mathbf{k}\cdot\mathbf{T})\right) d\Sigma_{\mathbf{k}} = 0$ on the external boundary surface $\partial(\tau+\bar{\tau})$ of the planet ($\tau+\bar{\tau}$), we obtained [Simonenko, 2007a; 2007; 2008] the time dependence of the total energy $(E(t))_{(\tau+\bar{\tau})}$ of the planet ($\tau+\bar{\tau}$):

$$(E(t))_{(\tau+\bar{\tau})} = (K_t(t))_{\tau} + (K_r(t))_{\tau} + (K_s(t))_{\tau} + (K_{s,r}^{coup}(t))_{\tau} + U_{\tau}(t) + \boldsymbol{\pi}_{\tau}(t) + (K(t))_{\bar{\tau}} +$$

$$+ U_{\bar{\tau}}(t) + \boldsymbol{\pi}_{\bar{\tau}}(t) = (K_t(t_o))_{\tau} + (K_r(t_o))_{\tau} + (K_s(t_o))_{\tau} + (K_{s,r}^{coup}(t_o))_{\tau} + U_{\tau}(t_o) +$$

$$+ \boldsymbol{\pi}_{\tau}(t_o) + (K(t_o))_{\bar{\tau}} + U_{\bar{\tau}}(t_o) + \boldsymbol{\pi}_{\bar{\tau}}(t_o) - \int\limits_{t_o}^{t}\left(\iint\limits_{\partial(\tau+\bar{\tau})}\left(\mathbf{J}_q\cdot\mathbf{k}\right) d\Sigma_{\mathbf{k}}\right) dt' +$$

$$+\int_{t_o}^{t}\left(\iiint_{(\tau+\bar{\tau})}\frac{\partial\psi}{\partial t'}\rho dV\right)dt' + \int_{t_o}^{t}\left(\iiint_{\tau} e_{\tau}\rho dV\right)dt' + \int_{t_o}^{t}\left(\iiint_{\bar{\tau}} e_{\bar{\tau}}\rho dV\right)dt' . \qquad (2.26)$$

The expression (2.26) shows that the total kinetic energy of the planet ($\tau+\bar{\tau}$) cannot be presented as the sum of the kinetic energies of translational, rotational, shear and the shear-rotational coupling for the planet (as a whole) as a consequence of the thermodynamic non-equilibrium of the considered planetary continuum related with the shear continuum motion in the atmosphere and hydrosphere $\bar{\tau}$ of the planet ($\tau+\bar{\tau}$). The relation (2.26) shows that the total kinetic energy $(K(t))_{\bar{\tau}}$, the total internal thermal energy $U_{\bar{\tau}}(t)$ and the total potential gravitational energy $\pi_{\bar{\tau}}(t)$ of the subsystem $\bar{\tau}$ are the energy factors, which regulate the angular velocity of rotation of the subsystem τ of the planet ($\tau+\bar{\tau}$), in particular the subsystem $\tau_{3,0}$ of the Earth ($\tau_{3,0}+\overline{\tau_{3,0}}$) containing the atmosphere and hydrosphere $\overline{\tau_{3,0}}$.

According to the expression (2.26), the total energy $(E(t))_{(\tau+\bar{\tau})}$ of the planet ($\tau+\bar{\tau}$) changes as a result of the following factors: the heat flux in the form of electromagnetic radiation of the Sun on the external boundary surface $\partial(\tau+\bar{\tau})$ of the planet ($\tau+\bar{\tau}$), the variation of the gravitational potential in subsystems τ and $\bar{\tau}$ of the planet ($\tau+\bar{\tau}$) due to the gravitational influences of celestial objects of the Solar System (including the own gravitational contribution of the planet) and the cosmic non-stationary gravitational influence of our Galaxy, the heating (inside the subsystem τ) due to the disintegration of radio-active elements, the heating in atmosphere and hydrosphere of the planet due to the human industrial activity (now for Earth and on others planets in future).

Considering the space-time energy density e_{τ} as the energy density of the thermonuclear reaction inside the Sun and rejecting the last term (containing space-time energy density $e_{\bar{\tau}}$), we used [Simonenko, 2009; 2010] the equation (2.26) for the evaluation [Simonenko, 2009, p. 206; 2010, p. 206] of the relative maximal instantaneous energy gravitational influences of the planets of the Solar System on the Sun and for the foundation [Simonenko, 2009, p. 214; 2010, p. 214] of the cosmic energy gravitational genesis of the time periodicities of the solar activity induced by the planetary energy gravitational influences on the Sun.

2.3. Cosmic geology of the Earth (of the terrestrial planet of the Solar System) taking into account the convection in the lower geo-spheres of the Earth (of the planet), the solar radiation, the disintegration of the radio-active elements, the density differentiation, the translational, rotational, deformational and compressible movements of the tectonic plates, the creation of the new planetary fractures induced by the energy gravitational influences of the Solar System and our Galaxy

2.3.1. Thermohydrogravidynamic N-layer model of the non-fragmentary geo-spheres of the Earth (of the planet of the Solar System)

Following the monographs [Simonenko, 2007; 2008], we shall present the thermohydrogravidynamic N-layer model of the non-fragmentary geo-spheres of the Earth (of the planet of the Solar System) taking into account the convection in the lower geo-spheres of the Earth (of the planet), the solar radiation, the disintegration of the radio-active elements, the density differentiation, the translational, rotational, deformational and compressible movements of the tectonic plates, the creation of the new planetary fractures induced by the energy gravitational influences of the Solar System and our Galaxy. Let us consider the thermohydrogravidynamic N-layer model [Simonenko, 2007; 2008] for the planet ($\tau+\bar{\tau}$) having the atmosphere or the atmosphere and hydrosphere considered as the subsystem $\bar{\tau}$. We shall use for each planet of the Solar System the division of the inner material continuum of the planet on some number of N layers (different for each planet) in accordance with the established (in geology and geophysics) traditional conception [Abramov, 1993; Khain, 2003; Abramov and Molev, 2005] considering the internal structure of the Earth consisting of several geo-spheres characterized by the different physical-chemical and thermodynamic properties.

Taking into consideration the generalized formulation (1.53) of the first law of thermodynamics, we obtained [Simonenko, 2007; 2008] the evolution equation (2.24) for the total energy $E_{\bar{\tau}}$ of the subsystem $\bar{\tau}$ (which is the first upper layer (gas and liquid substance) of the atmospheric and hydrospheric planet). The evolution equation (2.24) take into account the next factors: the flux to the subsystem $\bar{\tau}$ of the heat in the form of electromagnetic radiation of the Sun on the external boundary surface $\partial(\tau+\bar{\tau})$ of the subsystem $\bar{\tau}$, the energy gravitational influence (external and internal) on the subsystem $\bar{\tau}$, the energy interaction between the subsystem τ of the planet ($\tau+\bar{\tau}$) on the inner boundary surface $\partial\tau$, the heating of the subsystem $\bar{\tau}$ as a result of various sources (disintegration of the radio-active elements and human industrial activity).

Let us consider the subsystem τ_{ext} (the first layer after the subsystem $\bar{\tau}$), having the external (for τ_{ext}) surface $\partial\tau$ (see Fig. 2) as the inner boundary surface of the subsystem $\bar{\tau}$. The subsystem τ_{ext} has the inner boundary surface $\partial\tau_i$, which delimits the subsystem τ_{ext} from the next subsystem τ_{int}. Based on the generalized formulation (1.53) of the first law of thermodynamics, we obtained [Simonenko, 2007; 2008] the evolution equation for the total energy of the subsystem τ_{ext}:

$$\frac{d}{dt}\left(K_{\tau_{ext}}+U_{\tau_{ext}}+\pi_{\tau_{ext}}\right)=\frac{d}{dt}\iiint\limits_{\tau_{ext}}\left(\frac{1}{2}\mathbf{v}^2+u+\psi\right)\rho dV=$$

$$=\iint\limits_{\partial\tau}\left\{\mathbf{v}\cdot(\mathbf{n}\cdot\mathbf{T})-(\mathbf{J}_q\cdot\mathbf{n})\right\}d\Omega_{\mathbf{n}}-\iint\limits_{\partial\tau_i}\left\{\mathbf{v}_{ext}(\partial\tau_i)\cdot(\mathbf{m}_i\cdot\mathbf{T})-(\mathbf{J}_q\cdot\mathbf{m}_i)\right\}d\Sigma_{-\mathbf{m}_i}+$$

$$+\iiint\limits_{\tau_{ext}}\frac{\partial\psi}{\partial t}\rho dV+\iiint\limits_{\tau_{ext}}e_{\tau_{ext}}\rho dV, \qquad (2.27)$$

where (apart from the usual designations) $\mathbf{n}$ is the external unit normal vector of the surface $\partial\tau$, $-\mathbf{m}_i$ is the external unit normal vector of the internal surface $\partial\tau_i$ of the subsystem τ_{ext}, $\mathbf{v}_{ext}(\partial\tau_i)$ is the vector of the continuum velocity on the external side of the surface $\partial\tau_i$ inside the subsystem τ_{ext}, $e_{\tau_{ext}}$ is the space-time density of the heat sources related with disintegration of the radio-active elements in the subsystem τ_{ext}.

Taking into account that the subsystem τ_{int} (confined by the external surface $\partial\tau_i$ and located inside the subsystem τ_{ext}) has no jumps of the velocity continuum, we obtained [Simonenko, 2007; 2008] the evolution equation for the total energy of the subsystem τ_{int} (of the planet ($\tau+\bar{\tau}$)):

$$\frac{d}{dt}\left(K_{\tau_{int}}+U_{\tau_{int}}+\pi_{\tau_{int}}\right)=\frac{d}{dt}\iiint\limits_{\tau_{int}}\left(\frac{1}{2}\mathbf{v}^2+u+\psi\right)\rho dV=$$

$$=\iint\limits_{\partial\tau_i}\left\{\mathbf{v}_{int}(\partial\tau_i)\cdot(\mathbf{m}_i\cdot\mathbf{T})-(\mathbf{J}_q\cdot\mathbf{m}_i)\right\}d\Sigma_{\mathbf{m}_i}+\iiint\limits_{\tau_{int}}\frac{\partial\psi}{\partial t}\rho dV+\iiint\limits_{\tau_{int}}e_{\tau_{int}}\rho dV, \qquad (2.28)$$

where $\mathbf{v}_{int}(\partial\tau_i)$ is the vector of the continuum velocity on the internal side of the surface $\partial\tau_i$ in the subsystem τ_{int}, $\mathbf{m}_i$ is the external unit normal vector of the surface $\partial\tau_i$ of the subsystem τ_{int}, $e_{\tau_{int}}$ is the space-time density of the heat sources related with disintegration of the radio-active elements in the subsystem τ_{int}.

Adding the equations (2.27) and (2.28) (by using the equality $d\Sigma_{\mathbf{m}_i}=d\Sigma_{-\mathbf{m}_i}$ of the elements of area of the surface $\partial\tau_i$), we obtained [Simonenko, 2007; 2008] the evolution equation for the total energy of the thermodynamic subsystem $\tau = \tau_{int} + \tau_{ext}$ consisting from two (interacting on the surface $\partial\tau_i$ of the tangential jump of the continuum velocity) subsystems τ_{ext} and τ_{int} enclosed inside of the subsystem τ_{ext} :

$$\frac{d}{dt}\left(K_\tau + U_\tau + \pi_\tau\right) = \frac{d}{dt}\iiint_\tau \left(\frac{1}{2}\mathbf{v}^2 + u + \psi\right)\rho dV =$$

$$= \iint_{\partial\tau} \left\{\mathbf{v}\cdot(\mathbf{n}\cdot\mathbf{T}) - (\mathbf{J}_q\cdot\mathbf{n})\right\} d\Omega_{\mathbf{n}} + \iint_{\partial\tau_i} \left\{\mathbf{v}_{int}(\partial\tau_i) - \mathbf{v}_{ext}(\partial\tau_i)\right\}\cdot(\mathbf{m}_i\cdot\mathbf{T})d\Sigma_{\mathbf{m}_i} +$$

$$+ \iiint_\tau \frac{\partial\psi}{\partial t}\rho dV + \iiint_\tau e_\tau \rho dV, \qquad (2.29)$$

where e_τ is the space-time density of the heat sources related with disintegration of the radio-active elements in the thermodynamic subsystem $\tau = \tau_{int} + \tau_{ext}$, the function e_τ is equal to the function $e_{\tau_{int}}$ inside of the subsystem τ_{int} and the function e_τ is equal to function $e_{\tau_{ext}}$ inside of the subsystem τ_{ext}.

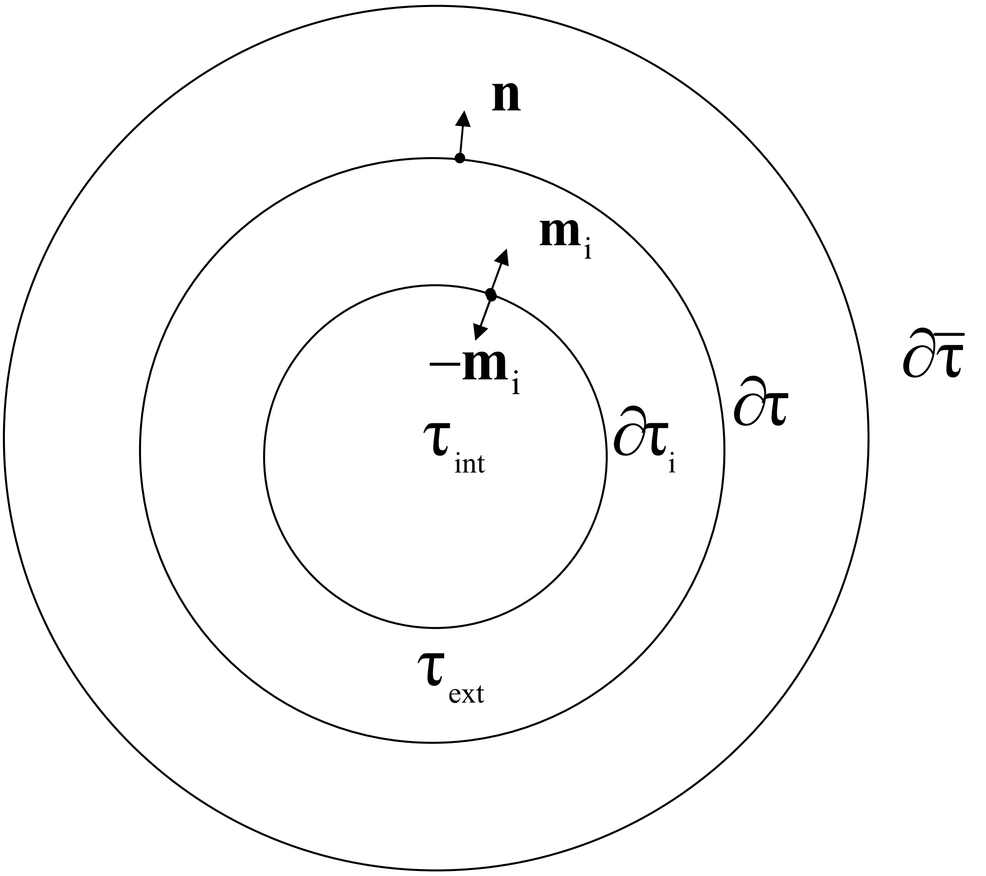


Fig. 2. The geometric sketch of the planetary structure

Using the mathematical inductive method and the generalized formulation (1.53) of the first law of thermodynamics, we obtained [Simonenko, 2007; 2008] the evolution equation for the total energy E_τ of the subsystem τ (consisting of N successively embedded to each other subsystems (geo-spheres) τ_N, τ_{N-1},

…, τ_2, τ_1, from which the subsystem $\tau_1 = \tau_{ext}$ is first upper layer (geo-sphere) of the subsystem τ, and the subsystem τ_N is the internal kernel of the subsystem τ of the planet ($\tau + \overline{\tau}$)):

$$\frac{dE_\tau}{dt} = \frac{d}{dt}\left(K_\tau + U_\tau + \pi_\tau\right) = \frac{d}{dt}\iiint\limits_{\tau}\left(\frac{1}{2}\mathbf{v}^2 + u + \psi\right)\rho dV =$$

$$= \frac{d}{dt}\sum_{i=1}^{N}\left(K_{\tau_i} + U_{\tau_i} + \pi_{\tau_i}\right) = \iint\limits_{\partial\tau}\left\{\mathbf{v}\cdot(\mathbf{n}\cdot\mathbf{T}) - (\mathbf{J}_q\cdot\mathbf{n})\right\} d\Omega_{\mathbf{n}} + \tag{2.30}$$

$$+ \sum_{i=1}^{N-1}\iint\limits_{\partial\tau_i}\left\{\mathbf{v}_{int}(\partial\tau_i) - \mathbf{v}_{ext}(\partial\tau_i)\right\}\cdot(\mathbf{m}_i\cdot\mathbf{T})d\Sigma_{\mathbf{m}_i} + \iiint\limits_{\tau}\frac{\partial\psi}{\partial t}\rho dV + \iiint\limits_{\tau} e_\tau \rho dV,$$

where $\partial\tau_i$ is the surface (characterized by the number i, i = 1, 2, …, N-1) of the jump of the velocity (vector) continuum, on which (or only on a certain part) the velocity vector of continuum has the jump from the functional vector values $\mathbf{v}_{int}(\partial\tau_i)$ (having on the internal side of the surface $\partial\tau_i$) up to the functional vector values $\mathbf{v}_{ext}(\partial\tau_i)$ having on the external side of surface $\partial\tau_i$. Taking into account the fundamental uniformity of the considered thermohydrogravidynamic approach to the planets of the Solar System, the evolution equation (2.30) of the total energy of the subsystem τ is valid for the subsystem τ of each planet ($\tau + \overline{\tau}$) of the Solar System.

Considering the subsystem $\tau = \tau_{3,0}$ of the Earth ($\tau_{3,0} + \overline{\tau_{3,0}}$), the stress tensor $\mathbf{T}$ in equation (2.30) can be taken into account for the real physical structure [Abramov, 1993; Khain, 2003; Abramov and Molev, 2005] of all N successively embedded to each other subsystems $\tau_N, \tau_{N-1}, \ldots, \tau_2, \tau_1$ (geo-spheres [Khain, 2003; Abramov and Molev, 2005]). The deduction of equation (2.30) is realized strictly mathematically in a general case for arbitrary symmetrical stress tensor $\mathbf{T}$. The deduction of equation (2.30) does not suppose any simplifications related with suggestion of the spherical forms of the boundary surfaces $\partial\tau_i$ (i = 1, 2, …, N-1), which delimit a different subsystems $\tau_1, \tau_2, \ldots, \tau_{N-1}, \tau_N$. If there are no jumps of the velocity (vector) continuum on the boundary surfaces $\partial\tau_i$ then we have the equalities $\mathbf{v}_{int}(\partial\tau_i) = \mathbf{v}_{ext}(\partial\tau_i)$ for each i. In this case, we have from equation (2.30) the reduced equation (2.21).

The equation (2.30) shows that the energy can be received from the non-stationary external (of the Sun, the Moon, planets, satellites of planets, midget planets, known asteroids and comets of the Solar System and the material objects of our Galaxy) and internal (of the Earth) gravity fields to create the jumps of the velocity continuum related with rotation of the geo-spheres with respect to each other and characterized by the slippage on the boundary surfaces $\partial\tau_i$ (i = 1, 2, …, N-1).

Taking into account the data about the continental and oceanic planetary tectonic formations characterized [Abramov and Molev, 2005; p. 245] by the mantle penetrated deep roots reaching the kernel of the Earth, the consideration of the first term in the third row of equation (2.30) gives the following expression (after integration of this term on the area section $\Delta\Sigma_i$ of the deepening crystalline planetary tectonic root):

$$W_{br}(\Delta\Sigma_i) = -\iint\limits_{\Delta\Sigma_i}\left\{\mathbf{v}_{int}(\partial\tau_i) - \mathbf{v}_{ext}(\partial\tau_i)\right\}\cdot(\mathbf{m}_i\cdot\mathbf{T})d\Sigma_{\mathbf{m}_i} \tag{2.31}$$

for the necessary power (in particular, of the external energy gravitational influence), which is sufficient to break the considered crystalline root in one section characterized by the area $\Delta\Sigma_i$. It was noted [Abramov and Molev, 2005; p. 247] that even the gravitational and rotational momentums of forces have not destroyed the roots of crystalline shields formed before the Cambrian time. This, according to equation (2.30), leads to the weak mobility of the crystalline shields relative to their surroundings. As a result, we obtained [Simonenko, 2007; 2008] (for the considered planetary tectonic formations [Abramov and Molev, 2005; p. 245]) the impossibility of slippage of the upper mantle as a whole relative to the lower mantle of the Earth.

Taking into account the data [Pavlenkova, 2007; p. 107] about the deep roots of the continents, we derived [Simonenko, 2007; 2008] from equation (2.30) the possibility of rotation of the upper mantle (as a whole) relative to the lower mantle (characterized by the slippage in the intermediate connecting zone) under sufficiently powerful external energy gravitational influences if the roots of the oceanic and continental planetary formations does not lower below the upper mantle. We obtained [Simonenko, 2007; 2008] from equation (2.30) that (for two data [Abramov and Molev, 2005; p. 245; Pavlenkova, 2007; p. 107] about the roots of continents) the mantle can rotate as a whole with the slippage on the dividing boundary of the mantle and the external fluid kernel. This theoretical conclusion confirmed [Simonenko, 2007; 2008] the considered [Pavlenkova, 1995] suggestion about rotation of the mantle relative to the kernel. The obtained theoretical result is consistent with the modern data [Pavlenkova, 2007; p. 107] about the rotation of the mantle relative to the kernel.

From equation (2.30) we obtained [Simonenko, 2007; 2008] that the translational mobility of the upper subsystem $\tau_1 = \tau_{ext}$ of the Earth (also as a separate tectonic plates and geo-blocks of the subsystem $\tau_1 = \tau_{ext}$) is greatly restricted as a result of deepened roots of the continental and oceanic planetary formations (for two data [Abramov and Molev, 2005; p. 245; Pavlenkova, 2007] about the roots of continents). According to the evolution equation (2.27) of the total energy of the subsystem τ_{ext}, the restriction of the translational mobility of the upper subsystem $\tau_1 = \tau_{ext}$ of the Earth leads to the intensification of the deformational and rotational motions [Khain and Poletaev, 2007; Vikulin and Melekestcev, 2007; Pavlenkova, 2007; Tveritinova and Vikulin, 2007] of a separate tectonic plates and geo-blocks (in the subsystem τ_{ext}) under the external energy gravitational influences on the Earth. The intensification of the deformation and rotation of a separate tectonic plates and geo-blocks (in the subsystem τ_{ext}) has the main role in the natural seismic activity of the Earth [Melnikov, 2007].

It was shown [Simonenko, 2007; 2009; 2010] that it is easier to realize (by action of the external cosmic gravitational field) the rotation of the separate geo-block (weakly coupled with the surrounding geo-blocks by means of the plastic surroundings (surrounding continuum) in the seismic zone of the Pacific Ring) than to split the geo-block by means of formation of the main line flat fracture. Using the similar reasoning (as for foundation of the stated above result of the monographs [Simonenko, 2007; 2009; 2010]) to the tectonic plate coupled by means of the plastic surroundings with the adjacent tectonic plates in the upper mantle, we established [Simonenko, 2007; 2009; 2010] that it is easier to realize (by action of the external cosmic gravitational field) the rotation of the separate tectonic plate (weakly coupled with the adjacent tectonic plates by means of the plastic surroundings) than to split of the tectonic plate by means of formation of the new main line flat tectonic fracture. We deduced [Simonenko, 2009; 2010] also that it is easier to realize (by action of the external cosmic gravitational field) the rotation of the mantle (as a whole relative to the fluid kernel with the slippage on the boundary of the kernel and the mantle of the Earth) than to split the mantle of the Earth by means of the new global tectonic fracture into two equal parts in the different sides of the main secant plane intersecting the centre of the Earth. This result is the base of the initial consideration of the model of the non-fragmentary geo-spheres of the planet. It was concluded [Simonenko, 2007; 2009; 2010] that the slippage of the mantle on the surface of the fluid kernel, deformation and rotation of the separate tectonic plates and geo-blocks relative to each other are the main non-equilibrium tectonic processes (mechanisms), which relax the external cosmic energy gravitational influences on the Earth (and on the planets of the Solar System).

Taking into account two estimates (180 million years [Zhirmunsky and Kuzmin, 1988] or 200 million years [Kazancev, 2002; p. 10]) for the time period of circulation of the Solar System around the center of our Galaxy and also the established unique period of 100 million years [Hofmann, 1990] of the maximal endogenous activity of the Earth [Morozov, 2007; p. 496], we concluded [Simonenko, 2007; 2009; 2010] that the time period of 200 million years corresponds exactly to the one circulation of the Solar System around the center of our Galaxy. In the frame of the considered thermohydrogravidynamic N-layer model of the non-fragmentary geo-spheres of the Earth (the planet of the Solar System), the time period of 200 million years corresponds really to the established unique period of 100 million years [Hofmann, 1990] of the maximal endogenous activity of the Earth. This correspondence is deduced rigorously from the evolution equation:

$$\frac{d}{dt}\left(K_\tau + \pi_\tau\right) = \frac{d}{dt} \iiint_\tau \left(\frac{1}{2} \mathbf{v}^2 + \psi \right) \rho dV =$$

$$= \iiint_{\tau} p\,\mathrm{div}\mathbf{v}dV + \iiint_{\tau}\left(\frac{2}{3}\eta - \eta_v\right)(\mathrm{div}\mathbf{v})^2 dV - \iiint_{\tau} 2\nu(e_{ij})^2\rho dV + \iint_{\partial\tau}(\mathbf{v}\cdot(\mathbf{n}\cdot\mathbf{T}))\, d\Omega_{\mathbf{n}} +$$

$$+ \iint_{\partial\tau_i}((\mathbf{v}_{int}(\partial\tau_i) - \mathbf{v}_{ext}(\partial\tau_i))\cdot(\mathbf{m}_i\cdot\mathbf{T}))\, d\Sigma_{\mathbf{m}_i} + \iiint_{\tau}\frac{\partial\psi}{\partial t}\rho dV, \qquad (2.32)$$

for the sum $K_\tau + \pi_\tau$ of the total macroscopic kinetic energy K_τ and the total macroscopic potential (gravitational) energy π_τ of the subsystem τ (of the Earth or the planet of the Solar System) consisting from two subsystems (of the Newtonian compressible continuum): the whole kernel τ_{int} and the whole mantle τ_{ext} (surrounding the kernel)), which can slip (as a whole) on the boundary surface $\partial\tau_i$ (the surface of the kernel τ_{int}) related with the tangential jump of the continuum velocity. Here (apart from the usual designations) $\mathbf{n}$ is the external unit normal vector of the surface $\partial\tau$ of the subsystem τ of the Earth (the planet ($\tau+\bar{\tau}$) of the Solar System), $-\mathbf{m}_i$ is the external unit normal vector of the internal surface $\partial\tau_i$ of the mantle τ_{ext}, $\mathbf{m}_i$ is the external unit normal vector of the surface $\partial\tau_i$ of the kernel τ_{int}, $\mathbf{v}_{ext}(\partial\tau_i)$ is the vector of the continuum velocity on the external side of the surface $\partial\tau_i$ inside the mantle τ_{ext}, $\mathbf{v}_{int}(\partial\tau_i)$ is the vector of the continuum velocity on the internal side of the surface $\partial\tau_i$ in the kernel τ_{int}. We remind that ψ (in equation (2.32)) is the total gravitational potential taking into account the internal gravitational field (created by the subsystem $\tau = \tau_{ext} + \tau_{int}$) and the external gravitational field created by the whole external surroundings of the subsystem $\tau = \tau_{ext} + \tau_{int}$: the subsystem $\bar{\tau}$ of the planet ($\tau+\bar{\tau}$), the Solar System and our Galaxy.

If the period of variations of the potential of the external gravitational field (acting on the composite subsystem $\tau = \tau_{ext} + \tau_{int}$ of the planet ($\tau+\bar{\tau}$)) is equal to $T_{eg}(\tau)$ then the same period of time $T_{eg}(\tau)$ will characterize the periodic variations of the rate of strain tensor e_{ij} and the divergence $\mathrm{div}\mathbf{v}$ of the velocity vector $\mathbf{v}$ of the continuum motion inside of the subsystem $\tau = \tau_{ext} + \tau_{int}$ of the planet ($\tau+\bar{\tau}$). Then, according to equation (2.32), the period of variations of the total macroscopic kinetic and gravitational energies of the subsystem $\tau = \tau_{ext} + \tau_{int}$ of the planet ($\tau+\bar{\tau}$) (as a result of the irreversible dissipation of the macroscopic kinetic energy described by the second and the third terms in the right-hand side of equation (2.32)) is equal to $\frac{1}{2}T_{eg}(\tau)$ as a consequence that the quadratic functions $(e_{ij})^2$ and $(\mathrm{div}\mathbf{v})^2$ have the time period $\frac{1}{2}T_{eg}(\tau)$. It can be established for the harmonic law of change of the partial derivative $\frac{\partial\psi}{\partial t}$ on time.

The last term

$$W_{gr}(\tau) = \iiint_{\tau}\frac{\partial\psi}{\partial t}\rho dV \qquad (2.33)$$

in the right-hand side of equation (2.32) changes periodically owing to the periodic realignments of the structure of the Solar System during circulations of the Solar System (around the centre of our Galaxy) characterized by the time period of 200 million years, which is exactly two times larger than the time period 100 million years [Hofmann, 1990] of the maximal endogenous activity of the Earth [Morozov, 2007; p. 496]. These realignments of the structure of the Solar System must induce the periodic changes (characterized by the time period of 200 million years) of the gravitational field of the Sun and the planets of the Solar System influencing on the Earth.

We concluded [Simonenko, 2007; 2008; 2009; 2010] that the established time period of 100 million years [Hofmann, 1990] of the maximal endogenous activity of the Earth is the result (according to the equation (2.32)) of the periodic changes (characterized by the time period of 200 million years) of the potential of the gravitational field (of the Solar System and our Galaxy) influencing on the Earth considered in the frame of the Solar System as the cosmic material object moving around the center of our Galaxy. It was also concluded [Simonenko, 2007; 2008; 2009; 2010] that the same time period of 100 million years must characterize the maximal endogenous activities of all planets (and the satellites of the planets) of the Solar System.

2.3.2. Thermohydrogravidynamic translational-shear-rotational N-layer tectonic model of the fragmentary geo-spheres of the Earth (of a planet of the Solar System)

Following the monographs [Simonenko, 2007; 2008; 2009; 2010], we consider the thermohydrogravidynamic translational-shear-rotational N-layer tectonic model of the fragmentary geo-spheres of the Earth (of a planet of the Solar System) taking into account the convection in the lower geo-spheres of the Earth (of the planet), the solar radiation, the disintegration of the radio-active elements, the density differentiation, the translational, rotational, deformational and compressible movements of the tectonic plates, the creation of the new planetary fractures induced by the energy gravitational influences of the Solar System and our Galaxy. In accordance with the adopted conception [Abramov, 1993; Vikulin, 2003; Khain, 2003; Abramov and Molev, 2005] about the structure of the upper mantle of the Earth, we shall consider that the upper subsystem τ_{ext} of a planet (of the terrestrial group) consists of a separate geo-fragments: tectonic plates and geo-blocks, which we shall designate as geo-blocks to not reduce the generality of the considered thermohydrogravidynamic approach. Consider an arbitrary j-th geo-block τ_{1j} of the first upper subsystem τ_{ext} of the planet (for example, the Earth). If the geo-block τ_{1j} slips with the jump of the continuum velocity relative to a plastic layer $\overline{\tau_{1j}}$ surrounding the geo-block τ_{1j}, then it gives [Simonenko, 2007; 2008; 2009; 2010] the additional term in the right-hand side of equation (2.27):

$$\iint_{\partial\tau_{1j}} \{\mathbf{v}_{int}(\partial\tau_{1j}) - \mathbf{v}_{ext}(\partial\tau_{1j})\} \cdot (\mathbf{n}_{1j} \cdot \mathbf{T}) d\Sigma_{\mathbf{n}_{1j}}, \tag{2.34}$$

where $\partial\tau_{1j}$ is the boundary surface of the geo-block τ_{1j}, $\mathbf{v}_{int}(\partial\tau_{1j})$ is the continuum velocity on the boundary surface $\partial\tau_{1j}$ inside the geo-block τ_{1j}, $\mathbf{v}_{ext}(\partial\tau_{1j})$ is the continuum velocity (of the plastic layer surrounding the geo-block τ_{1j}) on the boundary surface $\partial\tau_{1j}$ inside the plastic layer, $\mathbf{n}_{1j}$ is the external unit normal vector of the surface $\partial\tau_{1j}$. Considering the geo-block τ_{1j} surrounded by the plastic layer around the lateral and the lower boundary surfaces, we refer the plastic layer below the geo-block τ_{1j} to the subsystem τ_{ext} in the considered model of the subsystem τ_{ext}.

Consider the general case. We assume that for N_1 geo-blocks (plates) τ_{1j} (j = 1, 2, …, N_1) of the first subsystem (layer or the geo-sphere) $\tau_1 = \tau_{ext}$ of the Earth there are the differences of the continuum velocities on the boundary surface $\partial\tau_{1j}$ of each (j = 1, 2, …, N_1) geo-block τ_{1j} (j = 1, 2, …, N_1) and in the plastic layer directly attached to the boundary $\partial\tau_{1j}$. It is necessary [Simonenko, 2007; 2008; 2009; 2010] for this case to add the additional term (in the right-hand side of equation (2.27)) consisting of the sum of separate components (2.34) for each geo-block τ_{1j} characterized by the number j (j = 1, 2, …, N_1):

$$\sum_{j=1}^{N_1} \iint_{\partial\tau_{1j}} \{\mathbf{v}_{int}(\partial\tau_{1j}) - \mathbf{v}_{ext}(\partial\tau_{1j})\} \cdot (\mathbf{n}_{1j} \cdot \mathbf{T}) d\Sigma_{\mathbf{n}_{1j}}. \tag{2.35}$$

Thus, if the subsystem τ_{ext} consists of N_1 separate geo-blocks τ_{1j} surrounded by the plastic layers then the equation (2.27) can be rewritten as follows [Simonenko, 2007; 2008; 2009; 2010] :

$$\frac{d}{dt}\left(K_{\tau_{ext}} + U_{\tau_{ext}} + \pi_{\tau_{ext}}\right) = \frac{d}{dt}\iiint\limits_{\tau_{ext}}\left(\frac{1}{2}\mathbf{v}^2 + u + \psi\right)\rho dV =$$

$$= \iint\limits_{\partial\tau}\left\{\mathbf{v}\cdot(\mathbf{n}\cdot\mathbf{T}) - (\mathbf{J}_q\cdot\mathbf{n})\right\}d\Omega_{\mathbf{n}} - \iint\limits_{\partial\tau_i}\left\{\mathbf{v}_{ext}(\partial\tau_i)\cdot(\mathbf{m}_i\cdot\mathbf{T}) - (\mathbf{J}_q\cdot\mathbf{m}_i)\right\}d\Sigma_{-\mathbf{m}_i} + \tag{2.36}$$

$$+\iiint\limits_{\tau_{ext}}\frac{\partial\psi}{\partial t}\rho dV + \iiint\limits_{\tau_{ext}} e_{\tau_{ext}}\rho dV + \sum_{j=1}^{N_1}\iint\limits_{\partial\tau_{1j}}\left\{\mathbf{v}_{int}(\partial\tau_{1j}) - \mathbf{v}_{ext}(\partial\tau_{1j})\right\}\cdot(\mathbf{n}_{1j}\cdot\mathbf{T})d\Sigma_{\mathbf{n}_{1j}},$$

where τ_{ext} is the upper subsystem containing of N_1 geo-blocks τ_{1j} (j = 1, 2, …, N_1) surrounded by the plastic layers included completely to the subsystem τ_{ext}. The macroscopic kinetic energy $K_{\tau_{ext}}$, the microscopic (molecular) internal energy $U_{\tau_{ext}}$ and the potential gravitational energy $\pi_{\tau_{ext}}$ of the subsystem τ_{ext} consist of the corresponding sums of the energies of a separate geo-blocks and the corresponding energies of all plastic layers. The energies of a separate geo-blocks (for the great sizes of geo-blocks and narrow plastic layers) are much greater than the energies of plastic layers, which can be neglected. However, we cannot neglect the last term (presented by the sum in the right-hand side of equation (2.36)) since it expresses the power of energy expenses needed for the slippage of all geo-blocks τ_{1j} (j = 1, 2, …, N_1) relative to its plastic surroundings. This term is very significant in the total energy balance. The equation (2.36) shows that the energy sources of the slippage of the geo-blocks τ_{1j} (j = 1, 2, …, N_1) of the upper subsystem $\tau_1 = \tau_{ext}$ relative to the plastic surroundings (and also of the translational motions, rotations and deformations of the geo-blocks) are the non-stationary gravitational field (in the subsystem τ_{ext}), the heating related with disintegration of radio-active elements (in the subsystem τ_{ext}), the heat flux from the upper boundary of the (situated below) second layer (the subsystem) τ_2 and the works of the stress forces on the upper boundary $\partial\tau$ and on the lower boundary $\partial\tau_i$ of the subsystem $\tau_1 = \tau_{ext}$ of the planet ($\tau + \overline{\tau}$). In the following Subsection we consider the energy aspects related with the fracture formation in the arbitrary geo-block τ_{1j} defined by the index j in the range from j = 1 up to j = N_1.

2.3.3. The universal thermohydrogravidynamic theory of formation of the planetary fractures in the frame of the generalized differential formulation of the first law of thermodynamics and the thermohydrogravidynamic translational-shear-rotational N-layer tectonic model of the fragmentary (consisting of geo-blocks) geo-spheres of the Earth (of the planet of the Solar System)

Following the monographs [Simonenko, 2007; 2008; 2009; 2010], we consider the universal thermohydrogravidynamic theory of formation of the planetary fractures in the frame of the generalized differential formulation (2.21) of the first law of thermodynamics and the thermohydrogravidynamic translational-shear-rotational N-layer tectonic model of the fragmentary (consisting of geo-blocks) geo-spheres of the Earth (of the planet of the Solar System). It was shown [Simonenko, 2007; 2008; 2009; 2010] that for the Pacific Ring (characterized by the presence of the plastic layers around the geo-blocks) it is more probably (from the energy viewpoint) to realize the rotation of the geo-blocks than to break up the geo-blocks related with formation of the new main line flat fractures. The process of formation of the main line flat fractures can be energetically more probable in reality with respect to the geo-blocks rotation for geo-blocks powerfully coupled between each other (as for solid crystalline rocks).

The splitting of the geo-block τ_{1j} (of the first layer (geo-sphere) $\tau_1 = \tau_{ext}$ of the Earth) can be realized in reality by three possible variants: by formation of one or several main line flat fractures splitting the geo-block τ_{1j} into two or more number of parts, by formation of one or several twisted surfaces of fractures transient or not transient into the closed surfaces, and also by combination of one or several main line flat fractures with one or several twisted surfaces of fractures transient or not transient into the closed surfaces.

We consider now two (evaluated in monographs [Simonenko, 2007; 2008; 2009; 2010]) energy thermohydrogravidynamic approaches (describing the formation of the main line flat fracture of the geo-block and rotation of the geo-block surrounded by the plastic layer) and also three possible more general and pointed above variants of the geo-block destruction within the framework of the universal energy thermohydrogravidynamic approach describing the formation of an arbitrary breaking (to pieces) surface in the chosen geo-block τ_{1j}.

Consider the energy aspect of the process of the fracture formation on the arbitrary surface $F_{1j}(\tau_{1j})$ (flat or twisted and finally, possibly, becoming closed) in the chosen geo-block τ_{1j}. There is the possibility [Simonenko, 2007; 2008; 2009; 2010] to consider the processes of the fracture formation of various forms within the framework of the universal energy thermohydrogravidynamic approach. To use the energy thermohydrogravidynamic approaches [Simonenko, 2007; 2008; 2009; 2010] for the breaking (to pieces) surfaces of various forms it is necessary to adopt the following terminology and consider the additional geometric development.

Let us consider in beginning the formation of one arbitrary fracture surface (the continuum break) $F_{1j}(\tau_{1j})$ in the chosen geo-block τ_{1j} confined by the external surface $\partial\tau_{1j}$. If the surface $F_{1j}(\tau_{1j})$ is closed initially then we have the functional values of the continuum velocities vectors $\mathbf{v}_{int}(F_{1j}(\tau_{1j}))$ and $\mathbf{v}_{ext}(F_{1j}(\tau_{1j}))$ on the inner side of the surface $F_{1j}(\tau_{1j})$ and on the outer side of the surface $F_{1j}(\tau_{1j})$, respectively. Writing the evolution equations of the total energy for the internal subsystem $(\tau_{1j})_{int}$ (situated inside of the surface $F_{1j}(\tau_{1j})$) and for external subsystem $(\tau_{1j})_{ext}$ (situated between the surfaces $F_{1j}(\tau_{1j})$ and $\partial\tau_{1j}$) and then adding these equations, we obtained (similarly as it was made in Subsection 2.3.1 with equations (2.27) and (2.28) for the total energy of two combined subsystems τ_{int} and τ_{ext}) the evolution equation [Simonenko, 2007; 2008; 2009; 2010] of the total energy of the geo-block τ_{1j} consisting of two interacting subsystem $(\tau_{1j})_{int}$ and $(\tau_{1j})_{ext}$:

$$\frac{d}{dt}\left(K_{\tau_{1j}} + U_{\tau_{1j}} + \pi_{\tau_{1j}}\right) = \frac{d}{dt}\iiint_{\tau_{1j}}\left(\frac{1}{2}\mathbf{v}^2 + u + \psi\right)\rho dV =$$
$$= \iint_{\partial\tau_{1j}}\left\{\mathbf{v}\cdot\left(\mathbf{n}_{1j}\cdot\mathbf{T}\right) - (\mathbf{J}_q\cdot\mathbf{n}_{1j})\right\} d\Omega_{\mathbf{n}_{1j}} +$$
$$+ \iint_{F_{1j}(\tau_{1j})}\left\{\mathbf{v}_{int}(F_{1j}(\tau_{1j})) - \mathbf{v}_{ext}(F_{1j}(\tau_{1j}))\right\}\cdot\left(\mathbf{m}(F_{1j}(\tau_{1j}))\cdot\mathbf{T}\right)d\Sigma_{\mathbf{m}(F_{1j}(\tau_{1j}))} +$$
$$+\iiint_{\tau_{1j}}\frac{\partial\psi}{\partial t}\rho dV + \iiint_{\tau_{1j}} e_{\tau_{1j}}\rho dV, \tag{2.37}$$

where $\mathbf{v}_{int}(F_{1j}(\tau_{1j}))$ is the continuum velocity vector on the inner side of the surface $F_{1j}(\tau_{1j})$ in the subsystem $(\tau_{1j})_{int}$, $\mathbf{v}_{ext}(F_{1j}(\tau_{1j}))$ is the continuum velocity vector on the outer side of the surface $F_{1j}(\tau_{1j})$ in the subsystem $(\tau_{1j})_{ext}$, $\mathbf{n}_{1j}$ is the external unit normal vector of the surface $\partial\tau_{1j}$ confined the geo-block τ_{1j}, $d\Sigma_{\mathbf{m}(F_{1j}(\tau_{1j}))}$ is the element of area of the surface $\partial\tau_{1j}$, $\mathbf{m}(F_{1j}(\tau_{1j}))$ is the external unit normal vector of the surface $F_{1j}(\tau_{1j})$, $e_{\tau_{1j}}$ is the space-time density of the heat sources (in the geo-block

τ_{1j}) related with disintegration of radio-active elements.

Considering the formation of the integer number k_{1j}^{cl} of uncrossed between itself closed breaking (to pieces) surfaces $(F_{1j}(\tau_{1j}))_i$ (i = 1, 2,…., k_{1j}^{cl}) in the geo-block τ_{1j}, we modified [Simonenko, 2007; 2008; 2009; 2010] the equation (2.37) by the change of the term presented in the third row by the following sum:

$$\sum_{i=1}^{k_{1j}^{cl}} \iint_{(F_{1j}(\tau_{1j}))_i} \left\{\mathbf{v}_{int}(F_{1j}(\tau_{1j}))_i - \mathbf{v}_{ext}(F_{1j}(\tau_{1j}))_i\right\} \cdot \left(\mathbf{m}(F_{1j}(\tau_{1j}))_i \cdot \mathbf{T}\right) d\Sigma_{\mathbf{m}(F_{1j}(\tau_{1j}))_i} , \qquad (2.38)$$

where the index i designates the same values as in equation (2.37), only on the surface $(F_{1j}(\tau_{1j}))_i$. As a result (by using the mathematical inductive method), we obtained [Simonenko, 2007; 2008; 2009; 2010] the evolution equation (instead of equation (2.37)) for description of the total energy of the geo-block τ_{1j} during formation of the integer number k_{1j}^{cl} of uncrossed between itself closed breaking (to pieces) surfaces $(F_{1j}(\tau_{1j}))_i$ (i = 1, 2,…., k_{1j}^{cl}):

$$\frac{d}{dt}\left(K_{\tau_{1j}} + U_{\tau_{1j}} + \pi_{\tau_{1j}}\right) = \frac{d}{dt} \iiint_{\tau_{1j}} \left(\frac{1}{2}\mathbf{v}^2 + u + \psi\right)\rho dV =$$
$$= \iint_{\partial\tau_{1j}} \left\{\mathbf{v}\cdot\left(\mathbf{n}_{1j}\cdot\mathbf{T}\right) - (\mathbf{J}_q \cdot \mathbf{n}_{1j})\right\} d\Omega_{\mathbf{n}_{1j}} + \qquad (2.39)$$
$$+\sum_{i=1}^{k_{1j}^{cl}} \iint_{F_{1j}(\tau_{1j})_i} \left\{\mathbf{v}_{int}(F_{1j}(\tau_{1j}))_i - \mathbf{v}_{ext}(F_{1j}(\tau_{1j}))_i\right\} \cdot \left(\mathbf{m}(F_{1j}(\tau_{1j}))_i \cdot \mathbf{T}\right) d\Sigma_{\mathbf{m}(F_{1j}(\tau_{1j}))_i} +$$
$$+\iiint_{\tau_{1j}} \frac{\partial\psi}{\partial t}\rho dV + \iiint_{\tau_{1j}} e_{\tau_{1j}}\rho dV .$$

Let us consider now the formation of the unclosed breaking (to pieces) surface $S_{1j}(\tau_{1j})$ inside of the geo-block τ_{1j} assuming that the surface $S_{1j}(\tau_{1j})$ do not reach the boundary surface $\partial\tau_{1j}$ of the geo-block τ_{1j}. It is possible in this case to close mentally the surface $S_{1j}(\tau_{1j})$ as a result of the conceivable additional surface supposing naturally the equal values of the continuum velocities on the different sides of the conceivable additional surface. We obtained [Simonenko, 2007; 2008; 2009; 2010] in this case the evolution equation for the total energy:

$$\frac{d}{dt}\left(K_{\tau_{1j}} + U_{\tau_{1j}} + \pi_{\tau_{1j}}\right) = \frac{d}{dt} \iiint_{\tau_{1j}} \left(\frac{1}{2}\mathbf{v}^2 + u + \psi\right)\rho dV =$$
$$= \iint_{\partial\tau_{1j}} \left\{\mathbf{v}\cdot\left(\mathbf{n}_{1j}\cdot\mathbf{T}\right) - (\mathbf{J}_q \cdot \mathbf{n}_{1j})\right\} d\Omega_{\mathbf{n}_{1j}} +$$
$$+ \iint_{S_{1j}(\tau_{1j})} \left\{\mathbf{v}_{int}(S_{1j}(\tau_{1j})) - \mathbf{v}_{ext}(S_{1j}(\tau_{1j}))\right\} \cdot \left(\mathbf{m}(S_{1j}(\tau_{1j}))\cdot\mathbf{T}\right) d\Sigma_{\mathbf{m}(S_{1j}(\tau_{1j}))} +$$
$$+\iiint_{\tau_{1j}} \frac{\partial\psi}{\partial t}\rho dV + \iiint_{\tau_{1j}} e_{\tau_{1j}}\rho dV , \qquad (2.40)$$

which is analogous to equation (2.37) with the corresponding to the considered case designations. The question concerning to the definition of the "internal" and "external" parts of the unclosed breaking surface $S_{1j}(\tau_{1j})$ and the corresponding continuum velocities $\mathbf{v}_{int}(S_{1j}(\tau_{1j}))$ and $\mathbf{v}_{ext}(S_{1j}(\tau_{1j}))$, respectively, on the “internal” and “external” parts of the unclosed surface $S_{1j}(\tau_{1j})$ is decided by the simple agreement: by closing mentally unclosed breaking surface $S_{1j}(\tau_{1j})$ by the conceivable additional surface (on which there is no the jump of the continuum velocities), let us agree that this additional surface together with the surface $S_{1j}(\tau_{1j})$ should contain the mass center of the geo-block τ_{1j}. Then naturally to name by the “internal” part of the formed closed surface the side of this surface, inside of which is found the mass center of the considered geo-block.

Considering the formation of the integer number k_{1j}^{uncl} of unclosed uncrossed between itself breaking surfaces $(S_{1j}(\tau_{1j}))_l$ (l = 1, 2,…., k_{1j}^{uncl}) in the geo-block τ_{1j}, we also close mentally each surface $(S_{1j}(\tau_{1j}))_l$ to obtain the closed surface (together with the conceivable additional surface for each l) containing the mass center of the geo-block τ_{1j}. In this case we modify the equation (2.40) by the change of the term situated in the third row by the sum. As a result, we obtained [Simonenko, 2007; 2008; 2009; 2010] the following evolution equation (by using the mathematical inductive method) for the total energy of the geo-block τ_{1j} having k_{1j}^{uncl} unclosed uncrossed between itself breaking surfaces $(S_{1j}(\tau_{1j}))_l$ (l = 1, 2,…., k_{1j}^{uncl}):

$$\frac{d}{dt}\left(K_{\tau_{1j}} + U_{\tau_{1j}} + \boldsymbol{\pi}_{\tau_{1j}}\right) = \frac{d}{dt}\iiint\limits_{\tau_{1j}}\left(\frac{1}{2}\mathbf{v}^2 + u + \psi\right)\rho dV =$$

$$= \iint\limits_{\partial\tau_{1j}}\left\{\mathbf{v}\cdot\left(\mathbf{n}_{1j}\cdot\mathbf{T}\right) - (\mathbf{J}_q\cdot\mathbf{n}_{1j})\right\} d\Omega_{\mathbf{n}_{1j}} +$$

$$+\sum_{l=1}^{k_{1j}^{uncl}} \iint\limits_{(S_{1j}(\tau_{1j}))_l}\left\{\mathbf{v}_{int}(S_{1j}(\tau_{1j}))_l - \mathbf{v}_{ext}(S_{1j}(\tau_{1j}))_l\right\}\cdot\left(\mathbf{m}(S_{1j}(\tau_{1j}))_l\cdot\mathbf{T}\right)d\Sigma_{\mathbf{m}(S_{1j}(\tau_{1j}))_l} +$$

$$+\iiint\limits_{\tau_{1j}}\frac{\partial\psi}{\partial t}\rho dV + \iiint\limits_{\tau_{1j}} e_{\tau_{1j}}\rho dV\,, \qquad (2.41)$$

where the index l denotes the same values as in equation (2.40) only on the surface $(F_{1j}(\tau_{1j}))_l$ for each l. It is clear that if some surface $(F_{1j}(\tau_{1j}))_l$ (for certain l) reaches the surface $\partial\tau_{1j}$ of the geo-block τ_{1j} then the split geo-block τ_{1j} gives two separate geo-blocks. We can consider in this case separately each split part of the geo-block τ_{1j}.

Using the previous results and designations, we deduced [Simonenko, 2007; 2008; 2009; 2010] the evolution equation (using the mathematical inductive method) for the total energy of the geo-block τ_{1j} during the simultaneous formation (in the geo-block τ_{1j}) of the integer number k_{1j}^{cl} of uncrossed between itself closed breaking surfaces $(F_{1j}(\tau_{1j}))_i$ (i = 1, 2,…., k_{1j}^{cl}) and the integer number k_{1j}^{uncl} of unclosed uncrossed between itself breaking surfaces $(S_{1j}(\tau_{1j}))_l$ (l = 1, 2,…., k_{1j}^{uncl}):

$$\frac{d}{dt}\left(K_{\tau_{1j}} + U_{\tau_{1j}} + \boldsymbol{\pi}_{\tau_{1j}}\right) = \frac{d}{dt}\iiint\limits_{\tau_{1j}}\left(\frac{1}{2}\mathbf{v}^2 + u + \psi\right)\rho dV =$$

$$= \iint\limits_{\partial\tau_{1j}}\left\{\mathbf{v}\cdot\left(\mathbf{n}_{1j}\cdot\mathbf{T}\right) - (\mathbf{J}_q\cdot\mathbf{n}_{1j})\right\} d\Omega_{\mathbf{n}_{1j}} +$$

$$+\sum_{i=1}^{k_{1j}^{cl}} \iint_{(F_{1j}(\tau_{1j}))_i} \left\{\mathbf{v}_{int}(F_{1j}(\tau_{1j}))_i - \mathbf{v}_{ext}(F_{1j}(\tau_{1j}))_i\right\} \cdot \left(\mathbf{m}(F_{1j}(\tau_{1j}))_i \cdot \mathbf{T}\right) d\Sigma_{\mathbf{m}(F_{1j}(\tau_{1j}))_i} +$$

$$+\sum_{l=1}^{k_{1j}^{uncl}} \iint_{(S_{1j}(\tau_{1j}))_l} \left\{\mathbf{v}_{int}(S_{1j}(\tau_{1j}))_l - \mathbf{v}_{ext}(S_{1j}(\tau_{1j}))_l\right\} \cdot \left(\mathbf{m}(S_{1j}(\tau_{1j}))_l \cdot \mathbf{T}\right) d\Sigma_{\mathbf{m}(S_{1j}(\tau_{1j}))_l} +$$

$$+\iiint_{\tau_{1j}} \frac{\partial \psi}{\partial t} \rho dV + \iiint_{\tau_{1j}} e_{\tau_{1j}} \rho dV . \qquad (2.42)$$

According to the evolution equation (2.42) for the total energy of the geo-block τ_{1j}, the real realization in the geo-block τ_{1j} of the integer number k_{1j}^{cl} of uncrossed between itself closed breaking surfaces $(F_{1j}(\tau_{1j}))_i$ (i = 1, 2,…., k_{1j}^{cl}) and the integer number k_{1j}^{uncl} of unclosed uncrossed between itself breaking surfaces $(S_{1j}(\tau_{1j}))_l$ (l = 1, 2,…., k_{1j}^{uncl}) requires the necessary energy power, which can realize the formation of fractures in the geo-block τ_{1j}.

The process of the fractures formation (destruction) in the geo-block τ_{1j} (according to the evolution equation (2.42)) is defined by the energy powers (available for given geo-block τ_{1j}) of different destructive energy influences (sources). These energy sources (according to the evolution equation (2.42)) for given geo-block τ_{1j} are: the total non-stationary gravitational fields (the external cosmic and the planetary), the internal heat related with the disintegration of the radio-active elements, the heat flux from the upper boundary of the situated below second layer (subsystem) τ_2 and the work of stress forces on the surface of the geo-block τ_{1j}. The role of the external non-stationary gravitational field (according to the evolution equation (2.42)) as the source of formation of fractures is increased by the fact [Abramov, 1993] that the gravitational energy dominates among all others energies for the Earth. It was also shown earlier [Avsjuk, 1996; Avsjuk and Suvorova, 2007] that the global evolution of the Sun-Earth-Moon system is determined by the non-stationary gravitational field.

It is clear that weak external non-stationary influences (including the gravitational influence) on the considered geo-block τ_{1j} cannot realize the fractures or can realize only one fracture from the considered closed or unclosed fractures of the geo-block τ_{1j} since the formation of fractures requires the sufficient power of the external energy influence on the considered geo-block τ_{1j}. Obviously, the processes of formation of fractures in the Earth's crust occur in reality in accordance with the formulated variational principle [Simonenko, 2007; 2008; 2009; 2010]: the processes of the fractures formation in the Earth's crust occur on the surfaces, where the forced energy influences are sufficiently intense to form the fractures formation.

Considering the total ensemble of geo-blocks τ_{1j} (j =1, 2, …, N_1) of the first upper geo-sphere $\tau_1 = \tau_{ext}$ of the planet (for example, the Earth) and using the set of equations (2.42) for j =1, 2, …, N_1, we deduced [Simonenko, 2007; 2008; 2009; 2010] that the processes of destruction and rotation of the geo-blocks in the upper geo-sphere $\tau_1 = \tau_{ext}$ (or in the some subsystem of the upper geo-sphere $\tau_1 = \tau_{ext}$) should be initiated (owing to the specific characteristics of the geo-blocks structure and the properties of the plastic surroundings of the geo-blocks) by the general increase ($\partial\psi/\partial t > 0$) of the gravitational potential and by the increase of intensity of the others earlier established factors of the fracture formation. It was concluded [Simonenko, 2007; 2008; 2009; 2010] that the general increase of the gravitational potential ($\partial\psi/\partial t > 0$) is related with the general increase of the seismotectonic activity (associated with the partial or total splitting of the separate geo-blocks, by the geo-blocks rotation and by the slippage of the separate adjacent geo-blocks) before the strong earthquakes (characterized by the simultaneous slippage, splitting, rotation of the several geo-blocks coupled by the plastic layers) and before the global planetary cataclysms characterized by the slippage along the weakened global planetary fractures (such as the "Atlantiok" zone [Abramov, 1997; p. 70] penetrating the Eurasian continent from the Pacific Ocean to the Atlantic Ocean and the Great Britain, the rotation of the upper mantle (as a whole) relative the lower mantle characterized by the slippage in the intermediate connecting zone [Pavlenkova, 2007; p. 107], and by formation of the new global planetary fractures penetrating the Earth's continents as a whole. The stated theoretical conclusion [Simonenko, 2007; 2008; 2009; 2010] is in agreement with the early established [Keylis-Borok and Malinovskaya, 1964] and exceptionally significant [Richter, 1964] regularity related with the general increase of seismic activity before the strong earthquakes.

Thus, we have demonstrated the established [Simonenko, 2007; 2008; 2009; 2010] exceptionally significant role of the external cosmic non-stationary gravitational field (changing the figure of the Earth and the gravitational field of the Earth acting on the considered geo-block τ_{1j}) for formation of fractures realizing the tectonic processes in the Earth's crust. The stated [Simonenko, 2007; 2008; 2009; 2010] conclusion confirmed the Khain's suggestion that the movements along the weakened planetary fractures "can occur owing to the influence of the astronomical factors" [Khain, 1958; p. 138].

In the following Subsection we shall present the evaluated [Simonenko, 2007; 2008; 2009; 2010] deterministic cosmic energy gravitational influences on the Earth of the planets of the Solar System and the Moon, and also the new evaluations of the very significant deterministic cosmic energy gravitational influences on the Earth of the Sun owing to the gravitational interaction of the Sun with the outer large planets (mainly due to energy gravitational influences of the Jupiter and the Saturn on the Sun).

3. THE COSMIC GEOPHYSICS

3.1. The energy gravitational influences on the Earth of the planets of the Solar System

3.1.1. The instantaneous energy gravitational influences on the Earth of the planets of the Solar System in the approximation of the elliptical orbits of the planets

We consider the movement of the Earth τ_3 and the inner (or outer) planet τ_i around the Sun $\tau_{0,0}$ in the approximation of the elliptical orbits of the planets. The planets revolve in the ecliptic plane XZ (see Fig. 4). To obtain the expression for the energy gravitational influences on the Earth (in the second approximation) of the inner and the outer planets, we consider the mass center of the Sun located at the fixed point O of the origin of the coordinate system. The mass center C_3 of the Earth τ_3, the mass center O of the Sun and the mass center C_i of the inner (i=1, 2) and the outer (i=4, 5, 6, 7, 8, 9) planet τ_i are located on the direct coordinate axis X at a certain initial time moment t = 0 characterized by the minimal distance between the mass center C_i of the inner (i=1, 2) and the outer (i=4, 5, 6, 7, 8, 9) planet τ_i and the mass center C_3 of the Earth τ_3. The fixed mass center O of the Sun is considered as the right focus of the elliptical orbits of the inner (i=1, 2) planet τ_i, the outer (i=4, 5, 6, 7, 8, 9) planet τ_i and the Earth τ_3.

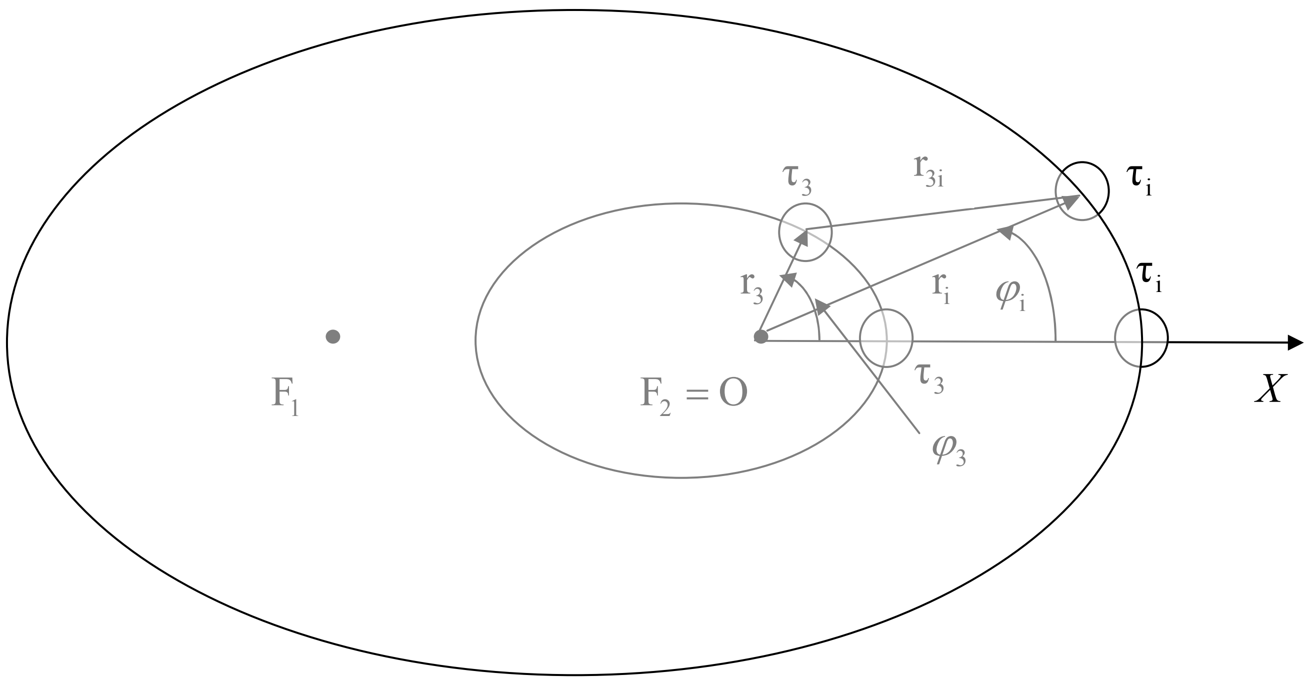


Fig. 4. The geometric sketch of circulation of the outer planet τ_i (the Mars or the Jupiter, the Saturn, the Uranus, the Neptune and the Pluto) and the Earth τ_3 around the mass center O of the Sun

We have the following relations:

$$r_i(\varphi_i(t)) = \frac{p_i}{(1+e_i\cos\varphi_i(t))}, \quad \text{(i=1, 2, 4, 5, 6, 7, 8, 9)} \tag{3.1}$$

$$r_3(\varphi_3(t)) = \frac{p_3}{(1+e_3\cos\varphi_3(t))} \tag{3.2}$$

for the distance $r_i(\varphi_i(t))$ between the mass center O of the Sun and the mass center C_i of the inner (i=1, 2) or the outer (i=4, 5, 6, 7, 8, 9) planet τ_i and for the distance $r_3(\varphi_3(t))$ between the mass center O of the Sun and the mass center C_3 of the Earth τ_3. Here p_i and e_i are the focal parameter and the eccentricity, respectively, of the elliptical orbit of the inner (i=1, 2) and the outer (i=4, 5, 6, 7, 8, 9) planet τ_i, p_3 and e_3 are the focal parameter and the eccentricity, respectively, of the elliptical Earth's orbit. We have $\varphi_i(0) = 0$ (i=1, 2, 3, 4, 5, 6, 7, 8, 9) for the initial time moment t = 0.

We shall consider the gravitational potential $\psi_{3i}(C_3, \text{int}, \text{ext}, t, r_3(\varphi_3(t)))$ created by the inner (i=1, 2) or the outer (i=4, 5, 6, 7, 8, 9) planet τ_i in the mass center C_3 (of the Earth τ_3) characterized by the distance $r_3(\varphi_3(t))$ from the mass center O of the Sun:

$$\psi_{3i}(C_3, \text{int}, \text{ext}, t, r_3(\varphi_3(t))) \quad = \quad -\gamma \frac{M_i}{r_{3i}(C_3, C_i, t)}, \tag{3.3}$$

where $r_{3i}(C_3, C_i, t)$ is the distance between the mass center C_3 of the Earth τ_3 and the mass center C_i of the inner (i=1, 2) or the outer (i=4, 5, 6, 7, 8, 9) planet τ_i. We find the distance $r_{3i}(C_3, C_i, t)$ for the outer (i=4, 5, 6, 7, 8, 9) planet τ_i from the following relation:

$$\left(r_{3i}(C_3, C_i, t)\right)^2 = \left(r_3(\varphi_3(t))\right)^2 + \left(r_i(\varphi_i(t))\right)^2 - r_3(\varphi_3(t))\, r_i(\varphi_i(t))\cos\left(\varphi_3(t) - \varphi_i(t)\right), \tag{3.4}$$

which is valid also for the inner (i=1, 2) planet τ_i owing to the equality $\cos\left(\varphi_3(t) - \varphi_i(t)\right) = \cos\left(\varphi_i(t) - \varphi_3(t)\right)$. Consequently, the relation (3.3) can rewritten as follows:

$$\psi_{3i}(C_3, \text{int}, \text{ext}, t, r_3(\varphi_3(t))) =$$

$$= -\frac{\gamma M_i}{\sqrt{\left(r_3(\varphi_3)\right)^2 + \left(r_i(\varphi_i(t))\right)^2 - 2r_3(\varphi_3)r_i(\varphi_i(t))\cos(\varphi_3 - \varphi_i(t))}}. \tag{3.5}$$

We obtained [Simonenko, 2009; 2010] the expression for the partial derivative $\frac{\partial}{\partial t}\psi_{3i}(C_3, \text{int}, \text{ext}, t, r_3(\varphi_3(t)))$ of the gravitational potential (3.5):

$$\frac{\partial}{\partial t}\psi_{3i}(C_3, \text{int}, \text{ext}, t, r_3(\varphi_3(t))) =$$

$$= \frac{\gamma M_i r_i(\varphi_i(t))\dfrac{d\varphi_i(t)}{dt}}{\left(\left(r_3(\varphi_3(t))\right)^2 + \left(r_i(\varphi_i(t))\right)^2 - 2r_3(\varphi_3(t))r_i(\varphi_i(t))\cos(\varphi_3(t) - \varphi_i(t))\right)^{\frac{3}{2}}} \times$$

$$\times\left\{r_3(\varphi_3(t))\sin(\varphi_i(t) - \varphi_3(t)) + \frac{e_i r_i(\varphi_i(t))\sin\varphi_i(t)}{(1+e_i\cos\varphi_i(t))} - \frac{e_i r_3(\varphi_3(t))\sin\varphi_i(t)\cos(\varphi_i(t) - \varphi_3(t))}{(1+e_i\cos\varphi_i(t))}\right\}, \tag{3.6}$$

where the distance $r_i(\varphi_i(t))$ (between the mass center O of the Sun and the mass center C_i of the inner (i=1, 2) or the outer (i=4, 5, 6, 7, 8, 9) planet τ_i) and the distance $r_3(\varphi_3(t))$ (between the mass center O of the Sun and the mass center C_3 of the Earth τ_3) are given by the relations (3.1) and (3.2), respectively.

The expression (3.6) is reduced to the expression [Simonenko, 2007]

$$\frac{\partial}{\partial t}\psi_{3i}(C_3,\text{int}) = \frac{\partial}{\partial t}\psi_{3i}(C_3,\text{ext}) = \frac{\gamma M_i R_{O3} R_{Oi}\omega_i \sin(\omega_i - \omega_3)t}{[R_{O3}^2 + R_{Oi}^2 - 2R_{O3}R_{Oi}\cos(\omega_i - \omega_3)t]^{3/2}} \tag{3.7}$$

under the following conditions: $e_i = 0$, $e_3 = 0$ and $d\varphi_i(t)/dt = \omega_i$ corresponding to the circular orbits of the planet τ_i (i=1, 2, 4, 5, 6, 7, 8, 9) and the Earth τ_3. The obtained expression (3.6) for the partial derivative $\frac{\partial}{\partial t}\psi_{3i}(C_3, \text{int}, \text{ext}, t, r_3(\varphi_3(t)))$ generalizes the expression (3.7) corresponding to the circular orbits of the planet τ_i (i=1, 2, 4, 5, 6, 7, 8, 9) and the Earth τ_3 by taking into account the eccentricity e_i of the elliptical orbit of the inner (i=1, 2) or the outer (i=4, 5, 6, 7, 8, 9) planet τ_i and the eccentricity e_3 of the elliptical orbit of the Earth τ_3.

The first term in the figured brackets of the expression (3.6) gives the principal contribution to the partial derivative $\frac{\partial}{\partial t}\psi_{3i}(C_3, \text{int}, \text{ext}, t, r_3(\varphi_3(t)))$. The expression (3.6) contains the additional two small terms (vanishing at $e_i \to 0$ and $e_3 \to 0$) related with the contribution to the partial derivative $\frac{\partial}{\partial t}\psi_{3i}(C_3, \text{int}, \text{ext}, t, r_3(\varphi_3(t)))$ of the eccentricities e_i and e_3 of the elliptical orbits of the planet τ_i (i=1, 2, 4, 5, 6, 7, 8, 9) and the Earth τ_3, respectively.

The combined maximal contribution of these additional two terms to the partial derivative $\frac{\partial}{\partial t}\psi_{3i}(C_3, \text{int}, \text{ext}, t, r_3(\varphi_3(t)))$ is of the order

$$O(e_i, e_3)\left(\max\frac{\partial}{\partial t}\psi_{3i}(C_3, \text{int})\right) \tag{3.8}$$

for the inner (i=1, 2) planet τ_i, and of the order

$$O(e_i, e_3)\left(\max\frac{\partial}{\partial t}\psi_{3i}(C_3, \text{ext})\right) \tag{3.9}$$

for the outer (i=4, 5, 6, 7, 8, 9) planet τ_i. Consequently, the contribution of the first term in the figured brackets of the expression (3.6) is $O(1/e_i, 1/e_3)$ times larger than the contribution of the additional two new terms related with the eccentricities e_i and e_3 of the elliptical orbits of the planet τ_i (i=1, 2, 4, 5, 6, 7, 8, 9) and the Earth τ_3, respectively. Using the maximal eccentricity $e_1 = 0.206$ of the Mercury's orbit, we have that the contribution of the first term in the figured brackets of the expression (3.6) is approximately 5 times larger than the contribution of the additional two new terms (in the figured brackets of the expression (3.6)) related with the eccentricities $e_1 = 0.206$ and $e_3 = 0.017$ of the elliptical orbits of the Mercury τ_1 and the Earth τ_3, respectively. We have that the first term (in the figured brackets of the expression (3.6)) is significantly larger than the contribution of the additional two new terms for the others planets (of the Solar System) having the small eccentricities of the elliptical orbits.

Thus, the obtained [Simonenko, 2007; 2009; 2010] evaluation (in the frame of the first approximation of the circular orbits of the planets) of the relative maximal energy gravitational influences on the Earth (of the planets of the Solar System) may be considered as the first sound approximation for the evaluation of the relative maximal energy gravitational influences of the inner (i=1, 2) and the outer (i=4, 5, 6, 7, 8, 9) planets on the Earth. We present in Subsection 3.1.2 the obtained [Simonenko, 2007; 2009; 2010] evaluation of the maximal positive value $\max\frac{\partial}{\partial t}\psi_{3i}(C_3, \text{int})$ (of the partial derivative $\frac{\partial}{\partial t}\psi_{3i}(C_3, \text{int})$ of the gravitational potential $\psi_{3i}(C_3, \mathrm{int})$ created by the inner planet τ_i at the mass center C_3 of the Earth τ_3) and the maximal positive value $\max \frac{\partial}{\partial t}\psi_{3i}(C_3, \mathrm{ext})$ (of the partial derivative $\frac{\partial}{\partial t}\psi_{3i}(C_3, \mathrm{ext})$ of the gravitational potential $\psi_{3i}(C_3, \mathrm{ext})$ created by the outer planet τ_i at the mass center C_3 of the Earth τ_3.

3.1.2. The evaluation of the relative maximal planetary instantaneous energy gravitational influences on the Earth in the approximation of the circular orbits of the planets of the Solar System

Following the monograph [Simonenko, 2007], we consider the movement of the Earth τ_3 and the inner planet τ_i around the Sun $\tau_{0,0}$ in the first approximation of the circular orbits of the planets. The planets revolve in the ecliptic plane XZ (see Fig. 5 and Fig. 6). The mass center of the Sun is located at the fixed point O of the origin of the coordinate system. The mass center C_3 of the Earth, the mass center O of the Sun and the mass center C_i of the inner planet τ_i are located on the direct coordinate axis X at a certain initial time moment t=0 characterized by the minimal distance between the Earth and the inner planet τ_i (see Fig. 5).

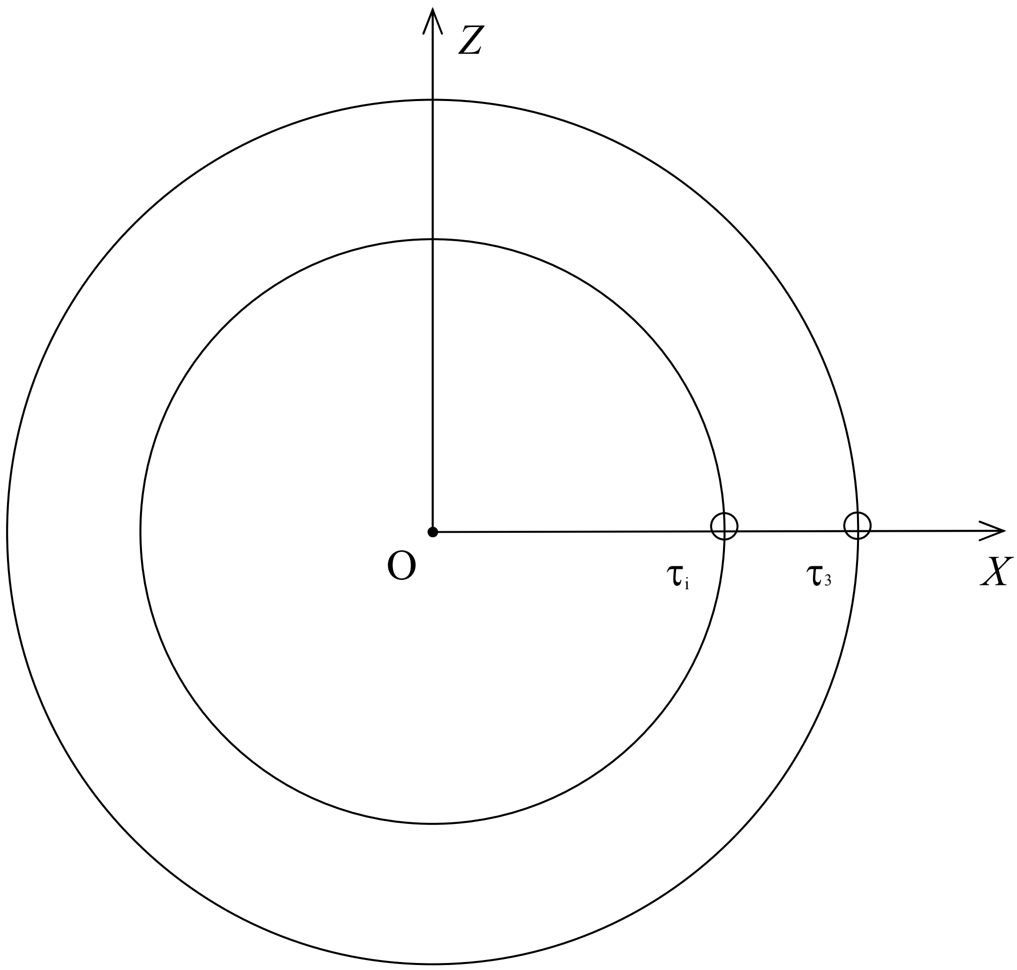


Fig. 5. The initial (t=0) planetary configuration characterized by the opposition of the inner planet τ_i (the Mercury or the Venus) and the Earth τ_3

We have the expressions for the angles φ_i and φ_3

$$\varphi_i = \omega_i t = \frac{2\pi}{T_i} t, \tag{3.10}$$

$$\varphi_3 = \omega_3 t = \frac{2\pi}{T_3} t, \tag{3.11}$$

which describe the positions of the mass centers of the planet τ_i and the Earth τ_3 during the time t.

We shall consider the gravitational potential $\psi_{3i}(C_3, \text{int})$

$$\psi_{3i}(C_3, \text{int}) = -\gamma \frac{M_i}{d_{3i}(C_3)} \tag{3.12}$$

created by the inner planet τ_i in the mass center C_3 of the Earth. We find the distance $d_{3i}(C_3)$ between the mass center C_i of the inner planet τ_i and the mass center C_3 of the Earth (see Fig. 7) from the following relation:

$$d_{3i}^2(C_3) = (R_{O3}^2 + R_{Oi}^2 - 2R_{O3}R_{Oi}\cos(\omega_i t - \varphi_3). \tag{3.13}$$

The relation (3.12) can be rewritten as follows [Simonenko, 2007]:

$$\psi_{3i}(C_3, \text{int}) = -\frac{\gamma M_i}{\sqrt{R_{O3}^2 + R_{Oi}^2 - 2R_{O3}R_{Oi}\cos(\omega_i t - \varphi_3)}}. \tag{3.14}$$

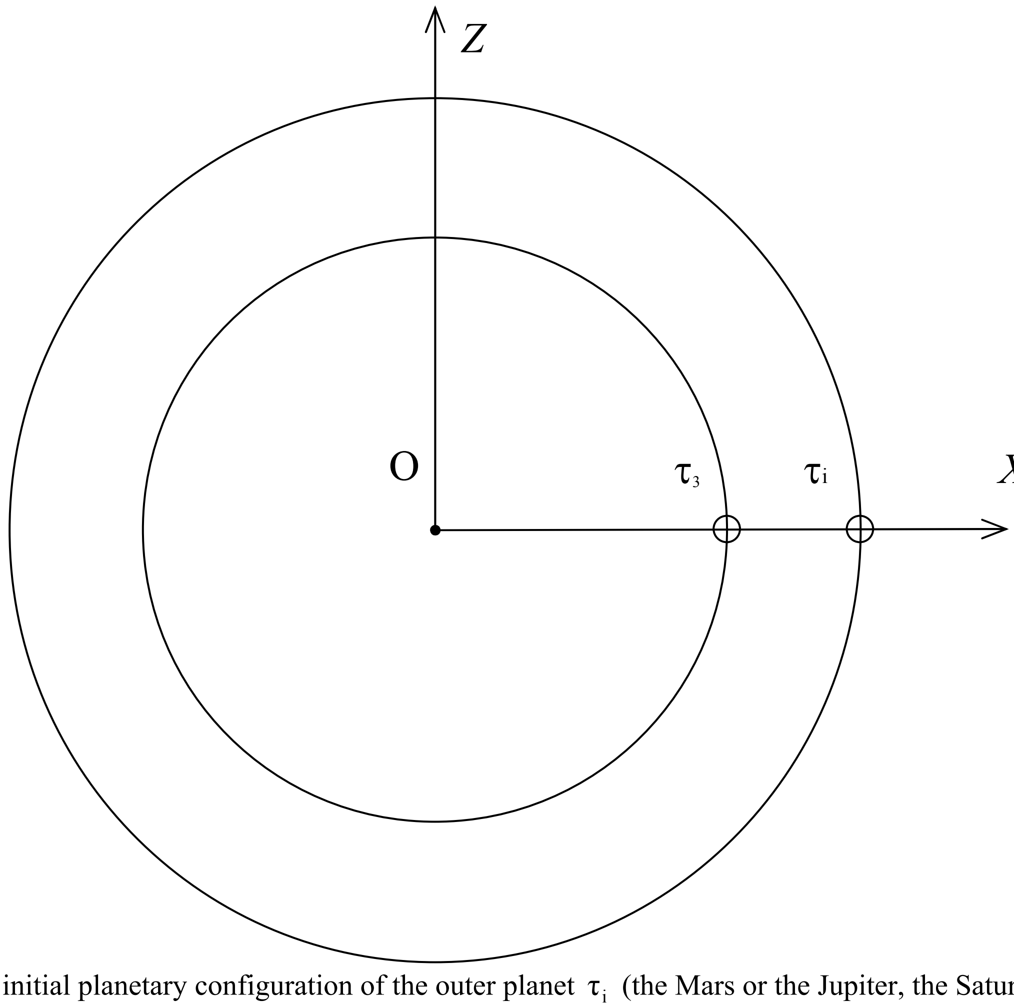


Fig. 6. The initial planetary configuration of the outer planet τ_i (the Mars or the Jupiter, the Saturn, the Uranus, the Neptune and the Pluto) and the Earth τ_3

We derived [Simonenko, 2007] the expression for the partial derivative $\frac{\partial}{\partial t}\psi_{3i}(C_3, \text{int})$ of the gravitational potential (3.14):

$$\frac{\partial}{\partial t}\psi_{3i}(C_3,\text{int}) = \frac{\gamma M_i R_{O3} R_{Oi} \omega_i \sin(\omega_i - \omega_3)t}{[R_{O3}^2 + R_{Oi}^2 - 2R_{O3}R_{Oi}\cos(\omega_i - \omega_3)t]^{3/2}}, \tag{3.15}$$

which reduces to zero for the time moments $t_n^*(i,3) = \frac{1}{2}\frac{T_i T_3}{(T_3 - T_i)} n$ (for i = 1, 2; n = 0, 1, 2,…), when the mass centers of the Sun, the Earth and the inner planet τ_i are located on the direct line.

Let us consider Fig. 8 for the Earth and the outer planet τ_i. We have (for configuration of the Earth and the outer planet τ_i shown on Fig. 8) the expression for the distance $d_{i3}(C_3)$ between the mass center C_i of the planet τ_i and the mass center C_3 of the Earth:

$$d_{3i}^2(C_3) = R_{O3}^2 + R_{Oi}^2 - 2R_{O3}R_{Oi}\cos(\omega_3 - \omega_i)t\,. \tag{3.16}$$

The gravitational potential created by the outer planet τ_i at the point C_3 (for configuration shown on Fig. 8) is given by the following expression:

$$\psi_{3i}(C_3,\text{ext}) = -\frac{\gamma M_i}{d_{3i}(C_3)} = -\frac{\gamma M_i}{\sqrt{R_{O3}^2 + R_{Oi}^2 - 2R_{O3}R_{Oi}\cos(\varphi_3 - \omega_i t)}}\,. \tag{3.17}$$

We derived [Simonenko, 2007] the expression of the partial derivative $\frac{\partial}{\partial t}\psi_{3i}(C_3,\text{ext})$ of the expression (3.17):

$$\frac{\partial}{\partial t}\psi_{3i}(C_3,\text{ext}) = -\frac{\gamma M_i R_{O3} R_{Oi} \omega_i \sin(\omega_3 - \omega_i)t}{[R_{O3}^2 + R_{Oi}^2 - 2R_{O3}R_{Oi}\cos(\omega_3 - \omega_i)t]^{3/2}}\,. \tag{3.18}$$

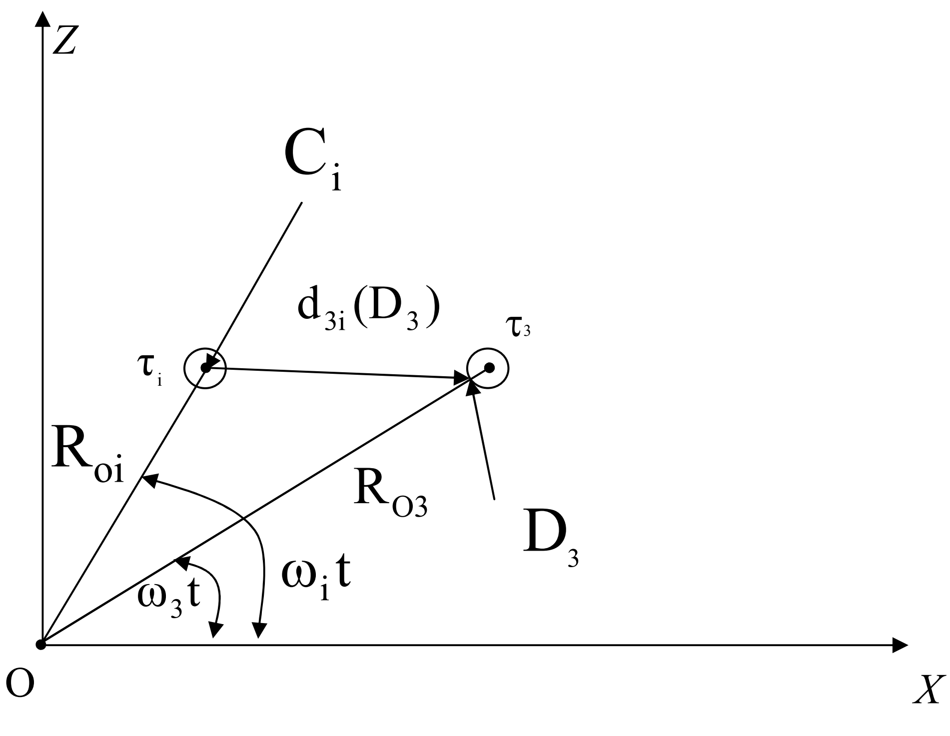


Fig. 7. The geometric sketch of circulations of the Earth τ_3 and the inner planet τ_i (the Mercury or the Venus) around the mass center O of the Sun

We used [Simonenko, 2009; 2010] the maximal positive value $\max\frac{\partial}{\partial t}\psi_{3M}(C_3,\text{int})$ (of the partial derivative $\frac{\partial}{\partial t}\psi_{3M}(C_3,\text{int})$ of the gravitational potential $\psi_{3M}(C_3,\text{int})$ created by the Mercury at the mass center C_3 of the Earth) as a scale of the energy gravitational influence of the planets of the Solar System on the Earth in the considered first approximation of the circular orbits of the planets. To evaluate the relative energy gravitational influence of the inner planet τ_i (the Mercury or the Venus) at the mass center C_3 of the Earth, we considered [Simonenko, 2009; 2010] the ratio $f(i, C_3)$ of the maximal positive value $\max \frac{\partial}{\partial t} \psi_{3i}(C_3, \mathrm{int})$ (of the partial derivative $\frac{\partial}{\partial t} \psi_{3i}(C_3, \mathrm{int})$ of the gravitational potential $\psi_{3i}(C_3, \mathrm{int})$ created by the inner planet τ_i at the point C_3) and the maximal positive value $\max \frac{\partial \psi_{31}(C_3, \mathrm{int})}{\partial t}$ (of the partial derivative $\frac{\partial \psi_{31}(C_3, \mathrm{int})}{\partial t}$ of the gravitational potential $\psi_{31}(C_3, \mathrm{int}) \equiv \psi_{3M}(C_3, \mathrm{int})$ created by the Mercury at the mass center C_3 of the Earth):

$$f(i, C_3) = \frac{\max \frac{\partial \psi_{3i}(C_3, \mathrm{int})}{\partial t}}{\max \frac{\partial \psi_{3M}(C_3, \mathrm{int})}{\partial t}}. \quad (i = 1, 2) \tag{3.19}$$

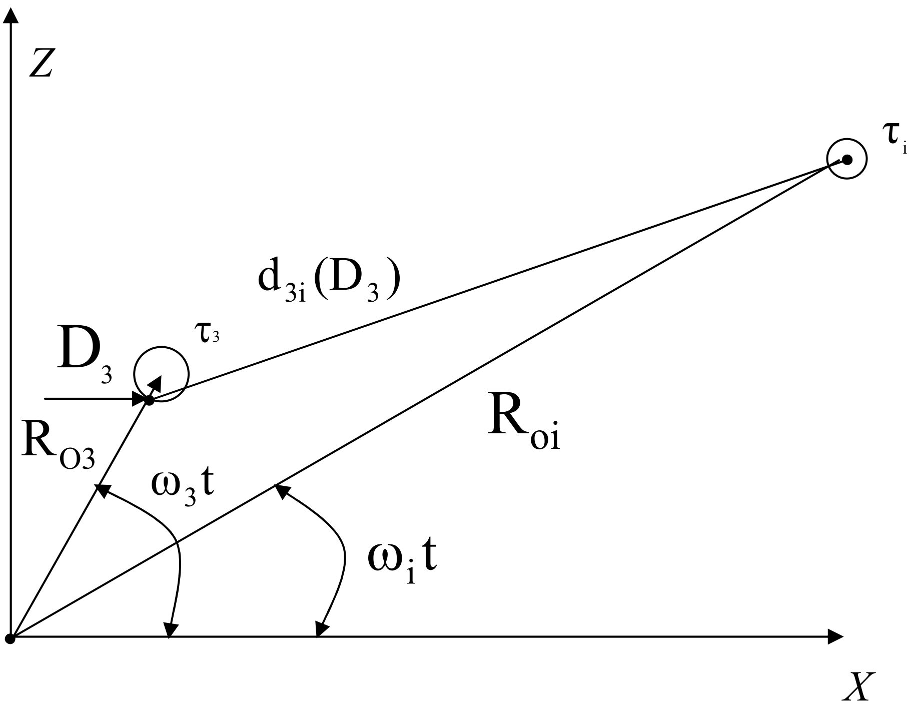


Fig. 8. The geometric sketch of circulation of the outer planet τ_i (the Mars or the Jupiter, the Saturn, the Uranus, the Neptune and the Pluto) and the Earth τ_3 around the mass center O of the Sun

We obtained [Simonenko, 2009; 2010] from expression (3.19) the obvious value $f(1, C_3) = 1$ for the Mercury τ_1 (i = 1). Using the formula (3.19) for the Venus (i = 2), we calculated [Simonenko, 2009; 2010] the numerical value $f(2, C_3) = 37.69807434$ for the following numerical values [Zhirmunsky and Kuzmin, 1990]: the mass $M_M = 0.06M_3$ of the Mercury, where M_3 is the mass of the Earth; the mass $M_V = M_2 = 0.82M_3$ of the Venus; the time period $T_3 = 365.3$ days of the Earth's circulation around the Sun; the time period $T_M = 88$ days of the Mercury's circulation around the Sun; the time period $T_V = T_2 = 224.7$ days of the Venusian circulation around the Sun; the average radius $R_{OM} = R_{O1} = 57.85 \cdot 10^6$ km of the Mercury's orbit around the Sun; the average radius $R_{O3} = 149.6 \cdot 10^6$ km of the Earth's orbit and the average radius $R_{OV} = R_{O2} = 108.1 \cdot 10^6$ km of the Venusian orbit around the Sun. The calculated value $f(2, C_3) = 37.69807434$ means that the power of the maximal energy gravitational Venusian influence (on the unit mass at the mass center C_3 of the Earth) is $f(2, C_3) = 37.69807434$ times larger than the power of the maximal energy gravitational influence of the Mercury (on the unit mass at the mass center C_3 of the Earth).

To evaluate the relative energy gravitational influence on the Earth of the outer planet τ_i at the mass center C_3 of the Earth, we considered [Simonenko, 2009; 2010] the ratio $f(i, C_3)$ (for i = 4, 5, 6, 7, 8, 9) of the maximal value $\max\frac{\partial}{\partial t}\psi_{3i}(C_3, \text{ext})$ of the partial derivative $\frac{\partial}{\partial t}\psi_{3i}(C_3, \text{ext})$ of the gravitational potential $\psi_{3i}(C_3, \text{ext})$ (created by the outer planet τ_i at the mass center C_3 of the Earth) and the maximal value $\max\frac{\partial}{\partial t}\psi_{3M}(C_3, \text{int})$ of the partial derivative $\frac{\partial}{\partial t}\psi_{3M}(C_3, \text{int})$ of the gravitational potential $\psi_{3M}(D_3, \text{int})$ (created by the Mercury at the mass center C_3 of the Earth):

$$f(i, C_3) = \frac{\max\frac{\partial\psi_{3i}(C_3, \text{ext})}{\partial t}}{\max\frac{\partial\psi_{3M}(C_3, \text{int})}{\partial t}} . \quad (i = 4, 5, 6, 7, 8, 9) \qquad (3.20)$$

Using the formula (3.20), we calculated [Simonenko, 2009; 2010] the following numerical values: $f(4, C_3)$ =0.67441034 (for the Mars τ_4, i = 4), $f(5, C_3)$ =7.41055774 (for the Jupiter τ_5, i = 5), $f(6, C_3)$ = 0.24601009 (for the Saturn τ_6, i = 6), $f(7, C_3)$ =0.00319056 (for the Uranus τ_7, i = 7), $f(8, C_3)$ =0.00077565 (for the Neptune τ_8, i = 8) and $f(9, C_3)$ = $3.4813\cdot10^{-8}$ (for the Pluto τ_9, i = 9). We used the following additional planetary numerical values [Zhirmunsky and Kuzmin, 1990]: the mass $M_{MARS} = M_4 = 0.11M_3$ of the Mars, the time period $T_{MARS} = T_4 = 687$ days of the Mars circulation around the Sun, the average radius $R_{OMARS} = R_{O4} = 227.7\cdot10^6$ km of the Mars'orbit, the mass $M_J = M_5 = 318M_3$ of the Jupiter, the time period $T_J = T_5 = 4332$ days of the Jupiter's circulation around the Sun, the average radius $R_{OJ} = R_{O5} = 777.6\cdot10^6$ km of the Jupiter's orbit, the time period $T_{SAT} = T_6 = 10759$ days of the Saturn's circulation around the Sun, the mass $M_{SAT} = M_6 = 95.2M_3$ of the Saturn, the average radius $R_{OSAT} = R_{O6} = 1426\cdot10^6$ km of the Saturn's orbit, the mass $M_U = M_7 = 14.6M_3$ of the Uranus, the time period $T_U = T_7 = 30685$ days of the Uranus' circulation around the Sun, the average radius $R_{OU} = R_{O7} = 2868\cdot10^6$ km of the Uranus' orbit, the mass $M_N = M_8 = 17.2M_3$ of the Neptune, the average radius $R_{ON} = R_{O8} = 4497\cdot10^6$ km of the Neptune's orbit, the time period $T_N = T_8 = 60189$ days of the Neptune's circulation around the Sun, the mass $M_P = M_9 = 0.002M_3$ of the Pluto, the time period $T_P = T_9 = 90465$ days of the Pluto's circulation around the Sun and the average radius $R_{OP} = R_{O9} = 5900\cdot10^6$ km of the Pluto's orbit.

Taking into account the calculated powers of the maximal energy gravitational influences of the planets on the unit mass of the Earth (at the mass center C_3 of the Earth) in the frame of the considered first approximation of the circular orbits of the planets, we obtained [Simonenko, 2009; 2010] the following numerical sequence of the non-dimensional relative maximal powers of the planetary energy gravitational influences on the unit mass of the Earth (at the mass center C_3 of the Earth): $f(2, C_3)$ =37.69807434 (for the Venus), $f(5, C_3)$ = 7.41055774 (for the Jupiter), $f(1, C_3)$ = 1 (for the Mercury), $f(4, C_3)$ = 0.67441034 (for the Mars), $f(6, C_3)$ = 0.24601009 (for the Saturn), $f(7, C_3)$ = 0.00319056 (for the Uranus), $f(8, C_3)$ = 0.00077565 (for the Neptune) and $f(9, C_3)$ = $3.4813\cdot10^{-8}$ (for the Pluto).

To evaluate the relative energy gravitational influence of the inner planets τ_i (the Mercury and the Venus) and the outer planets τ_i (the Mars, the Jupiter, the Saturn, the Uranus, the Neptune and the Pluto) at the surface point D_3 (which is the intersection of the direct line (connecting the mass center O of the Sun and the mass center C_3 of the Earth) with the surface of the Earth), we obtained [Simonenko, 2007] the gravitational potential $\psi_{3i}(D_3, \text{int})$

$$\psi_{3i}(D_3, \text{int}) = -\frac{\gamma M_i}{\sqrt{(R_{O3} - R_3)^2 + R_{Oi}^2 - 2(R_{O3} - R_3)R_{Oi}\cos(\omega_i t - \varphi_3)}} . \qquad (3.21)$$

created by the inner planet τ_i at the surface point D_3 of the Earth. We derived [Simonenko, 2007] the expression for the partial derivative $\frac{\partial}{\partial t}\psi_{3i}(D_3, \text{int})$ of the gravitational potential (3.21):

$$\frac{\partial}{\partial t}\psi_{3i}(D_3,\mathrm{int}) = \frac{\gamma M_i (R_{O3} - R_3)R_{Oi}\omega_i \sin(\omega_i - \omega_3)t}{[(R_{O3} - R_3)^2 + R_{Oi}^2 - 2(R_{O3} - R_3)R_{Oi}\cos(\omega_i - \omega_3)t]^{3/2}}. \quad (3.22)$$

The gravitational potential created by the outer planet τ_i at the surface point D_3 (for configuration shown on Fig. 8) is given by the following expression [Simonenko, 2007]:

$$\psi_{3i}(D_3,\mathrm{ext}) = -\frac{\gamma M_i}{d_{3i}(D_3)} = -\frac{\gamma M_i}{\sqrt{(R_{O3} - R_3)^2 + R_{Oi}^2 - 2(R_{O3} - R_3)R_{Oi}\cos(\varphi_3 - \omega_i t)}}. \quad (3.23)$$

We derived [Simonenko, 2007] the expression of the partial derivative $\frac{\partial}{\partial t}\psi_{3i}(D_3,\mathrm{ext})$ of the gravitational potential (3.23):

$$\frac{\partial}{\partial t}\psi_{3i}(D_3,\mathrm{ext}) = -\frac{\gamma M_i (R_{O3} - R_3)R_{Oi}\omega_i \sin(\omega_3 - \omega_i)t}{[(R_{O3} - R_3)^2 + R_{Oi}^2 - 2(R_{O3} - R_3)R_{Oi}\cos(\omega_3 - \omega_i)t]^{3/2}}, \quad (3.24)$$

which is reduced to the relation (3.22) as a consequence of the equalities $\sin(\omega_i - \omega_3)t = -\sin(\omega_3 - \omega_i)t$ and $\cos(\omega_i - \omega_3)t = \cos(\omega_3 - \omega_i)t$. However, we take into account that the expression (3.24) is given for the outer planet τ_i, but the expression (3.22) is given for the inner planet τ_i.

We used [Simonenko, 2007; 2009; 2010] the maximal positive value $\max\frac{\partial}{\partial t}\psi_{3M}(D_3,\mathrm{int})$ (of the partial derivative $\frac{\partial}{\partial t}\psi_{3M}(D_3,\mathrm{int})$ of the gravitational potential $\psi_{3M}(D_3,\mathrm{int})$ created by the Mercury at the surface point D_3 of the Earth) as a scale of the energy gravitational influence of the planets of the Solar System on the Earth (at the surface point D_3) in the considered first approximation of the circular orbits of the planets.

To evaluate the relative energy gravitational influence of the inner planet τ_i (the Mercury and the Venus) at the surface point D_3, we considered [Simonenko, 2007; 2009; 2010] the ratio $f(i, D_3)$ of the maximal positive value $\max\frac{\partial}{\partial t}\psi_{3i}(D_3,\mathrm{int})$ (of the partial derivative $\frac{\partial}{\partial t}\psi_{3i}(D_3,\mathrm{int})$ of the gravitational potential $\psi_{3i}(D_3,\mathrm{int})$ created by the inner planet τ_i at the point D_3) and the maximal positive value $\max\frac{\partial}{\partial t}\psi_{3M}(D_3,\mathrm{int})$ (of the partial derivative $\frac{\partial}{\partial t}\psi_{3M}(D_3,\mathrm{int})$ of the gravitational potential $\psi_{31}(D_3,\mathrm{int}) \equiv \psi_{3M}(D_3,\mathrm{int})$ created by the Mercury at the surface point D_3 of the Earth):

$$f(i,D_3) = \frac{\max\frac{\partial\psi_{3i}(D_3,\mathrm{int})}{\partial t}}{\max\frac{\partial\psi_{3M}(D_3,\mathrm{int})}{\partial t}}. \ (i = 1, 2) \quad (3.25)$$

To evaluate the relative energy gravitational influence of the outer planet τ_i at the surface point D_3 of the Earth, we considered [Simonenko, 2007; 2009; 2010] the ratio $f(i,D_3)$ (for i = 4, 5, 6, 7, 8, 9) of the maximal positive value $\max\frac{\partial}{\partial t}\psi_{3i}(D_3,\mathrm{ext})$ (of the partial derivative $\frac{\partial}{\partial t}\psi_{3i}(D_3,\mathrm{ext})$ of the gravitational potential $\psi_{3i}(D_3,\mathrm{ext})$ created by the outer planet τ_i at the surface point D_3) and the maximal positive value $\max\frac{\partial}{\partial t}\psi_{3M}(D_3,\mathrm{int})$ (of the partial derivative $\frac{\partial}{\partial t}\psi_{3M}(D_3,\mathrm{int})$ of the gravitational potential $\psi_{3M}(D_3,\mathrm{int})$ created by the Mercury at surface point D_3):

$$f(i,D_3)=\frac{\max\dfrac{\partial\psi_{3i}(D_3,ext)}{\partial t}}{\max\dfrac{\partial\psi_{3M}(D_3,int)}{\partial t}}\ .\ (i=4,5,6,7,8,9) \qquad (3.26)$$

Using the formulae (3.25) and (3.26) with the average radius R_3 = 6371 km of the Earth and with the additional planetary numerical values [Zhirmunsky and Kuzmin, 1990], we calculated [Simonenko, 2009; 2010] the following numerical values (corrected slightly the previous numerical values of $f(i,D_3)$ [Simonenko, 2007]): $f(2,D_3)$= 37.70428085 (for the Venus), $f(5,D_3)$= 7.40926122 (for the Jupiter), $f(1,D_3)$= 1 (for the Mercury), $f(4,D_3)$= 0.67420160 (for the Mars), $f(6,D_3)$= 0.24596865 (for the Saturn), $f(7,D_3)$ = 0.00319004 (for the Uranus), $f(8,D_3)$ = 0.00077552 (for the Neptune) and $f(9,D_3)$ = $3.4807\cdot10^{-8}$ (for the Pluto).

Taking into account the calculated powers of the maximal energy gravitational influences of the planets on the unit mass of the Earth (at the mass center C_3 of the Earth and at the surface point D_3 of the Earth) in the frame of the considered first approximation of the circular orbits of the planets, we obtained [Simonenko, 2007; 2009; 2010] the following order of signification of the planets of the Solar System (Venus, the Jupiter, the Mercury, the Mars, the Saturn, the Uranus, the Neptune and the Pluto) in respect of the planetary power of the maximal energy gravitational influences on the unit mass of the Earth.

To evaluate the relative energy gravitational influence of the inner planet τ_i at the surface point D_3 and at the mass center C_3 of the Earth, we considered [Simonenko, 2009; 2010] the ratio $q_i(D_3,C_3)$ of the maximal value $\max\frac{\partial}{\partial t}\psi_{3i}(D_3, int)$ and the maximal value $\max\frac{\partial}{\partial t}\psi_{3i}(C_3, int)$:

$$q_i(D_3,C_3)=\frac{\max\dfrac{\partial\psi_{3i}(D_3,int)}{\partial t}}{\max\dfrac{\partial\psi_{3i}(C_3,int)}{\partial t}}\ .\ (i = 1, 2) \qquad (3.27)$$

To evaluate the relative energy gravitational influence of the outer planet τ_i at the surface point D_3 and at the mass center C_3 of the Earth, we considered [Simonenko, 2009; 2010] the ratio $q_i(D_3,C_3)$ of the maximal value $\max\frac{\partial}{\partial t}\psi_{3i}(D_3, ext)$ and the maximal value $\max\frac{\partial}{\partial t}\psi_{3i}(C_3, ext)$:

$$q_i(D_3,C_3)=\frac{\max\dfrac{\partial\psi_{3i}(D_3,ext)}{\partial t}}{\max\dfrac{\partial\psi_{3i}(C_3,ext)}{\partial t}}\ .\ (i=4,5,6,7,8,9) \qquad (3.28)$$

Using the formula (3.27), we calculated [Simonenko, 2009; 2010] the following numerical values: $q_1(D_3,C_3)=1.000123023$ (for the Mercury) and $q_2(D_3,C_3)=1.000287771$ (for the Venus). Using the formula (3.28), we calculated [Simonenko, 2009; 2010] the following numerical values: $q_4(D_3,C_3)=0.999813318$ (for the Mars), $q_5(D_3,C_3)=0.999948084$ (for the Jupiter), $q_6(D_3,C_3)=0.999954640$ (for the Saturn), $q_7(D_3,C_3)=0.999956727$ (for the Uranus), $q_8(D_3,C_3)=0.999957084$ (for the Neptune) and $q_9(D_3,C_3)=0.999957263$ (for the Pluto).

The revealed [Simonenko, 2009; 2010] small difference of the maximal energy gravitational influence of each planet at the surface point D_3 and at the mass center C_3 of the Earth results to the small difference of the combined maximal energy gravitational influences of the planets of the Solar System at the points C_3 and D_3 of the Earth. It was recognized [Simonenko, 2009; 2010] that the small difference of the combined planetary maximal energy gravitational influences at the surface point D_3 and at the mass center C_3 of the Earth must lead to the following related geophysical phenomena: the small oscillatory motion of the rigid kernel of the Earth relative to the fluid kernel of the Earth; the small oscillation of the Earth's pole (i.e., the Chandler's wobble of the Earth's pole); the small oscillations of the boundary of the Pacific Ocean (i.e., the seismic zone of the Pacific Ring); the oscillations, rotations and deformations of the geo-blocks weakly coupled with the surrounding plastic layers in all seismic zones of the Earth and the formation of fractures related with the strong earthquakes and the planetary cataclysms.

3.1.3. The evaluation of the relative maximal planetary integral energy gravitational influences on the Earth in the approximation of the circular orbits of the planets of the Solar System

We assume that φ_{03} and φ_{0i} are the initial phases of the Earth τ_3 and the planet τ_i, respectively. Consequently, the positions of the center of the Earth τ_3 and the center of the planet τ_i (inner or outer) for the time moment t are given (instead of the relations (3.10) and (3.11)) by the following expressions:

$$\varphi_i = \omega_i t = \frac{2\pi}{T_i} t + \varphi_{0i} , \tag{3.29}$$

$$\varphi_3 = \omega_3 t = \frac{2\pi}{T_3} t + \varphi_{03} . \tag{3.30}$$

Taking into account the initial phases φ_{03} and φ_{0i}, the expressions (3.15), (3.18), (3.22) and (3.24) can be generalized as follows [Simonenko, 2009; 2010]:

$$\begin{aligned} &\frac{\partial}{\partial t}\psi_{3i}(C_3,\mathrm{int}) = \frac{\partial}{\partial t}\psi_{3i}(C_3,\mathrm{ext}) = \frac{\partial}{\partial t}\psi_{3i}(C_3) = \\ &= \frac{\gamma M_i R_{O3} R_{Oi}\omega_i \sin\{(\omega_i - \omega_3)t + \varphi_{0i} - \varphi_{03}\}}{[R_{O3}{}^2 + R_{Oi}^2 - 2R_{O3}R_{Oi}\cos\{(\omega_i - \omega_3)t + \varphi_{0i} - \varphi_{03}\}]^{3/2}}, \end{aligned} \tag{3.31}$$

$$\begin{aligned} &\frac{\partial}{\partial t}\psi_{3i}(D_3,\mathrm{int}) = \frac{\partial}{\partial t}\psi_{3i}(D_3,\mathrm{ext}) = \frac{\partial}{\partial t}\psi_{3i}(D_3) = \\ &= \frac{\gamma M_i (R_{O3} - R_3) R_{Oi}\omega_i \sin\{(\omega_i - \omega_3)t + \varphi_{0i} - \varphi_{03}\}}{[(R_{O3} - R_3)^2 + R_{Oi}^2 - 2(R_{O3} - R_3)R_{Oi}\cos\{(\omega_i - \omega_3)t + \varphi_{0i} - \varphi_{03}\}]^{3/2}}, \end{aligned} \tag{3.32}$$

We obtained [Simonenko, 2007] the integral energy gravitational influence $\Delta_g E_3(\tau_i, \varphi_{0i}, \varphi_{03}, t, t_0)$ on the Earth τ_3 owing to the non-stationary instantaneous energy gravitational influence of the planet τ_i (inner or outer) during the time interval (t_0, t):

$$\Delta_g E_3(\tau_i, \varphi_{0i}, \varphi_{03}, t, t_0) = \int_{t_0}^{t}\left(\iiint_{\tau_3}\left(\frac{\partial\psi_{3i}(C_3)}{\partial t'}\right)\rho dV\right)dt' \approx M_3\int_{t_0}^{t}\left(\frac{\partial\psi_{3i}(C_3)}{\partial t'}\right)dt', \tag{3.33}$$

where M_3 is the mass of the Earth. Substituting (3.31) into (3.33), we obtained [Simonenko, 2007]:

$$\begin{aligned} &\Delta_g E_3(\tau_i, \varphi_{0i}, \varphi_{03}, t, t_0) = \\ &= M_3\int_{t_0}^{t}\frac{\gamma M_i R_{O3} R_{Oi}\omega_i \sin\{(\omega_i - \omega_3)t' + \varphi_{0i} - \varphi_{03}\}}{[(R_{O3})^2 + R_{Oi}^2 - 2R_{O3}R_{Oi}\cos\{(\omega_i - \omega_3)t' + \varphi_{0i} - \varphi_{03}\}]^{3/2}}dt'. \end{aligned} \tag{3.34}$$

The result of integration of the expression (3.34) is given by the analytical relation [Simonenko, 2007]:

$$\begin{aligned} &\Delta_g E_3(\tau_i, \varphi_{0i}, \varphi_{03}, t, t_0) = \\ &= \frac{2\alpha_i}{(\omega_i - \omega_3)\chi_i}\left[\frac{1}{[\beta_i - \chi_i\cos\{(\omega_i - \omega_3)t_0 + \varphi_{0i} - \varphi_{03}\}]^{1/2}} - \frac{1}{[\beta_i - \chi_i\cos\{(\omega_i - \omega_3)t + \varphi_{0i} - \varphi_{03}\}]^{1/2}}\right] \end{aligned} \tag{3.35}$$

characterized by the following coefficients

$$\alpha_i = \gamma M_3 M_i R_{O3} R_{Oi}\omega_i , \ \beta_i = (R_{O3})^2 + (R_{Oi})^2, \ \ \chi_i = 2R_{O3}R_{Oi} . \tag{3.36}$$

Using the initial phases $\varphi_{03} = 0$ and $\varphi_{0i} = 0$ for the initial time moment $t_0 = 0$, the expression (3.35) gives the more simple relation [Simonenko, 2007]:

$$\Delta_g E_3(\tau_i,0,0,t,0) = \frac{2\alpha_i}{(\omega_i - \omega_3)\chi_i}\left[\frac{1}{[\beta_i - \chi_i]^{1/2}} - \frac{1}{[\beta_i - \chi_i \cos\{(\omega_i - \omega_3)t\}]^{1/2}}\right] \tag{3.37}$$

used for calculation of the maximal integral energy gravitational influence of the planet τ_i (inner or outer) on the Earth τ_3. Consider the expression (3.37) by taking into account that the mass center C_i of the inner planet τ_i, the mass center C_3 of the Earth τ_3 and the mass center O of the Sun are located on the axis *X* for the initial time moment $t_0 = 0$ as it is shown on Fig. 6. Considering the time duration

$$t_1^*(i,3) = \frac{1}{2}\frac{T_i T_3}{(T_3 - T_i)}, \ (i = 1, 2) \tag{3.38}$$

we obtain that the mass center C_i of the inner planet τ_i, the mass center C_3 of the Earth τ_3 and the mass center O of the Sun will localized again on the some straight line and the distance between the mass centers of the inner planet τ_i and the Earth τ_3 will be maximal. We obtained [Simonenko, 2007; 2009; 2010] from relation (3.37) the positive integral energy gravitational influence on the Earth's continuum during the time $t_1^*(i,3)$:

$$\Delta_g E_3(\tau_i,0,0,t_1^*(i,3),0) = \frac{2\alpha_i}{(\omega_i - \omega_3)\chi_i}\left[\frac{1}{[R_{O3} - R_{Oi}]} - \frac{1}{[R_{O3} + R_{Oi}]}\right] > 0. \tag{3.39}$$

We obtained [Simonenko, 2007] from relation (3.37) that the integral energy gravitational influence on the Earth of the inner planet τ_i is equal to the zero

$$\Delta_g E_3(\tau_i,0,0,t_2^*(i,3),0) = 0 \tag{3.40}$$

during the time duration

$$t_2^*(i,3) = \frac{T_i T_3}{(T_3 - T_i)}, \ (i = 1, 2) \tag{3.41}$$

when the distance between the mass centers of the inner planet τ_i and the Earth τ_3 will be minimal.

We tested [Simonenko, 2007] the relation (3.37) for the outer planet τ_i and the Earth τ_3 assuming that the mass centers the outer planet τ_i and the Earth τ_3, and the mass center O of the Sun are located on the axis *X* for the initial time moment $t_0 = 0$ as it is shown on Fig. 6. Considering the time duration

$$t_1^*(3,i) = \frac{1}{2}\frac{T_i T_3}{(T_i - T_3)}, \ (i = 4, 5, 6, 7, 8, 9) \tag{3.42}$$

we have that the mass center of the outer planet τ_i, the mass center C_3 of the Earth τ_3 and the mass center O of the Sun will again located on the some straight line and the distance between the mass centers of the outer planet τ_i and the Earth τ_3 will be maximal. We obtained [Simonenko, 2007] from relation (3.37) the negative integral energy gravitational influence on the Earth of outer planet τ_i during the time $t_1^*(3,i)$:

$$\Delta_g E_3(\tau_i,0,0,t_1^*(3,i),0) = \frac{2\alpha_i}{(\omega_i - \omega_3)\chi_i}\left[\frac{1}{[R_{Oi} - R_{O3}]} - \frac{1}{[R_{Oi} + R_{O3}]}\right] < 0. \tag{3.43}$$

Considering the time duration

$$t_2^*(3,i) = \frac{T_i T_3}{(T_i - T_3)}, \tag{3.44}$$

we obtained [Simonenko, 2007] from relation (3.37) the zero integral energy gravitational influence on the Earth from the outer planet τ_i during the time $t_2^*(3,i)$:

$$\Delta_g E_3(\tau_i,0,0,t_2^*(3,i),0) = 0. \tag{3.45}$$

Using the expressions (3.36), we established [Simonenko, 2007] that the expressions (3.39) and (3.43) give the following extreme values

$$\max_t \Delta_g E_3(\tau_i,0,0,t,0) = \Delta_g E_3(\tau_i,0,0,t_1^*(i,3),0) =$$

$$= 2\gamma M_3 M_i \frac{R_{Oi} T_3}{(R_{O3}^2 - R_{Oi}^2)(T_3 - T_i)} > 0, \quad (i = 1, 2), \tag{3.46}$$

$$\min_t \Delta_g E_3(\tau_i,0,0,t,0) = \Delta_g E_3(\tau_i,0,0,t_1^*(3,i),0) =$$

$$= 2\gamma M_3 M_i \frac{R_{O3} T_3}{(R_{Oi}^2 - R_{O3}^2)(T_3 - T_i)} < 0, \quad (i = 4, 5, 6, 7, 8, 9) \tag{3.47}$$

of the integral energy gravitational influences (respectively, the positive maximal integral energy gravitational influence from the inner planet τ_i and the negative minimal integral energy gravitational influence from the outer planet τ_i) for the given initial phases $\varphi_{03} = 0$ and $\varphi_{0i} = 0$ (for the initial time moment $t_0 = 0$) corresponding to the initial configurations shown on Fig. 5 and Fig. 6, respectively.

Using the relation (3.46), we obtained [Simonenko, 2007] for the Mercury (i =1) and for the Venus (i = 2) the following expressions of the maximal positive integral energy gravitational influences on the Earth:

$$\max_t \Delta_g E_3(\tau_1,0,0,t,0) = \Delta_g E_3(\tau_1,0,0,t_1^*(1,3),0) =$$

$$= 2\gamma M_3 M_1 \frac{R_{O1} T_3}{(R_{O3}^2 - R_{O1}^2)(T_3 - T_1)} > 0, \quad i = 1, \tag{3.48}$$

$$\max_t \Delta_g E_3(\tau_2,0,0,t,0) = \Delta_g E_3(\tau_2,0,0,t_1^*(2,3),0) =$$

$$= 2\gamma M_3 M_2 \frac{R_{O2} T_3}{(R_{O3}^2 - R_{O2}^2)(T_3 - T_2)} > 0, \quad i = 2. \tag{3.49}$$

Considering the mass m_τ of the macroscopic continuum region near the surface point D_3 (instead of the mass M_3 of the Earth) in relations (3.48) and (3.49), we obtained [Simonenko, 2007] the following expressions for the positive integral energy gravitational influences of the Mercury (i =1) and the Venus (i = 2) on the macroscopic continuum region of the mass m_τ near the surface point D_3 of the Earth:

$$\max_t \Delta_g E_3(\tau_1, D_3, m_\tau,0,0,t,0) = \Delta_g E_3(\tau_1, D_3, m_\tau,0,0,t_1^*(1,3),0) =$$

$$= 2\gamma\, m_\tau M_1 \frac{R_{O1} T_3}{(R_{O3}^2 - R_{O1}^2)(T_3 - T_1)} > 0, \quad i = 1, \tag{3.50}$$

$$\max_t \Delta_g E_3(\tau_2, D_3, m_\tau,0,0,t,0) = \Delta_g E_3(\tau_2, D_3, m_\tau,0,0,t_1^*(2,3),0) =$$

$$= 2\gamma\, m_\tau M_2 \frac{R_{O2} T_3}{(R_{O3}^2 - R_{O2}^2)(T_3 - T_2)} > 0, \quad i = 2. \tag{3.51}$$

We shall use the expression (3.48) as a measuring unit for evaluations of the maximal absolute values of the integral energy gravitational influences on the Earth of the planets of the Solar System and the Moon.

Considering the ratio of the extreme value $\max_t \Delta_g E_3(\tau_i,0,0,t,0)$ (given by the expression (3.46)) and the maximal positive integral energy gravitational influence $\max_t \Delta_g E_3(\tau_1,0,0,t,0)$ (given by the expression (3.48)) of the Mercury on the Earth, we obtained [Simonenko, 2007] the relative values $s(i)$ of the maximal integral energy gravitational influences on the Earth of the inner planets:

$$s(i) = \frac{\max_t \Delta_g E_3(\tau_i,0,0,t,0)}{\max_t \Delta_g E_3(\tau_1,0,0,t,0)} = \frac{M_i}{M_1}\, \frac{R_{Oi}(R_{O3}^2 - R_{O1}^2)(T_3 - T_1)}{R_{O1}(R_{O3}^2 - R_{Oi}^2)(T_3 - T_i)}, \quad i = 1, 2. \tag{3.52}$$

We have the obvious value $s(1) = 1$ for the Mercury (i = 1). We calculated [Simonenko, 2007] the value $s(2) = 89.6409$ for the Venus (i = 2) based on the planetary numerical values [Zhirmunsky and Kuzmin, 1990] of the average radii of the orbits, the time periods of circulations around the Sun and the masses of the Earth, the Venus and the Mercury.

Since the values given by the expression (3.47) are negative for the outer planets, we used the absolute (positive) value

$$\left|\min_t \Delta_g E_3(\tau_i,0,0,t,0)\right| = \left|\Delta_g E_3(\tau_i,0,0,t_1^*(3,i),0)\right| =$$

$$= 2\gamma\, M_3 M_i \frac{R_{O3}T_3}{(R_{Oi}^2 - R_{O3}^2)(T_i - T_3)} > 0,\ i = 4, 5, 6, 7, 8, 9. \qquad (3.53)$$

Using the expressions (3.53) and (3.48), we obtained [Simonenko, 2007] the relative values $s(i)$ of the maximal integral energy gravitational influences on the Earth of the outer planets of the Solar System (i = 4, 5, 6, 7, 8, 9):

$$s(i) = \frac{\left|\min_t \Delta_g E_3(\tau_i,0,0,t,0)\right|}{\max_t \Delta_g E_3(\tau_1,0,0,t,0)} = \frac{M_i}{M_1}\,\frac{R_{O3}(R_{O3}^2 - R_{O1}^2)(T_3 - T_1)}{R_{O1}(R_{Oi}^2 - R_{O3}^2)(T_i - T_3)},\ i = 4, 5, 6, 7, 8, 9. \qquad (3.54)$$

Based on the planetary numerical values [Zhirmunsky and Kuzmin, 1990], we calculated the following numerical values [Simonenko, 2007]: $s(4) = 2.6396$ for the Mars (i=4), $s(5) = 31.319$ for the Jupiter (i=5), $s(6) = 1.036$ for the Saturn (i=6), $s(7) = 0.0133$ for the Uranus (i=7), $s(8) = 0.003229$ for the Neptune (i=8) and $s(9) = 1.4495 \cdot 10^{-7}$ for the Pluto (i=9).

Taking into account the calculated relative values $s(i)$ of the maximal integral energy gravitational influences on the Earth of the planets of the Solar System, we obtained [Simonenko, 2007] the following order of signification of the planets of the Solar System: the Venus ($s(2) = 89.6409$), the Jupiter ($s(5) = 31.319$), the Mars ($s(4) = 2.6396$), the Saturn ($s(6) = 1.036$), the Mercury ($s(1) = 1$), the Uranus ($s(7) = 0.0133$), the Neptune ($s(8) = 0.003229$) and the Pluto ($s(9) = 1.4495 \cdot 10^{-7}$) in respect of the established significance of the planetary maximal integral energy gravitational influences on the Earth.

We established [Simonenko, 2007] that the Venus and the Jupiter induce the main maximal integral energy gravitational influences on the Earth. The Mars, the Saturn and the Mercury induce the combined maximal integral energy gravitational influence on the Earth, which is one order of the magnitude smaller than the maximal integral energy gravitational influence of the Jupiter. The maximal integral energy gravitational influences on the Earth of the Uranus, the Neptune and the Pluto are two, three and seven orders of the magnitude, respectively, smaller than the maximal integral energy gravitational influence of the Mercury.

3.2. The energy gravitational influence on the Earth of the Moon

3.2.1. The evaluation of the relative maximal instantaneous energy gravitational influence of the Moon on the Earth in the second approximation of the elliptical orbits of the Earth and the Moon around the combined mass center $C_{3,MOON}$ of the Earth and the Moon

We consider the movement of the Earth τ_3 and the Moon along the elliptical orbits around the combined mass center $C_{3,MOON}$ of the Earth and the Moon. We have the following relations

$$r_{MOON}(\varphi_{MOON}(t)) = \frac{p_{MOON}}{(1 + e_{MOON}\cos\varphi_{MOON}(t))}, \qquad (3.55)$$

$$r_E(\varphi_E(t)) = r_E(\varphi_{MOON}(t) + \pi) = \frac{p_E}{(1 - e_E\cos(\varphi_{MOON}(t) + \pi))} = \frac{p_E}{(1 + e_E\cos\varphi_{MOON}(t))} \qquad (3.56)$$

for the distance $r_{MOON}(\varphi_{MOON}(t))$ between the combined mass center $C_{3,MOON}$ (of the Earth and the Moon) and the mass center C_{MOON} of the Moon and for the distance $r_E(\varphi_E(t))$ between the combined mass center $C_{3,MOON}$ and the mass center C_3 of the Earth τ_3. We have the focal parameter and the eccentricity p_{MOON} and e_{MOON}, respectively, of the elliptical orbit of the Moon. p_E and e_E ($e_E = e_{MOON}$) are the focal parameter and the eccentricity, respectively, of the elliptical Earth's orbit around the combined mass center $C_{3,MOON}$ of the Earth and the Moon. We have the expression for the distance $d_{3M}(E_M)$:

$$d_{3M}(E_M) = \frac{p_{MOON}}{(1 + e_{MOON}\cos\varphi_{MOON}(t))} + \frac{p_E}{(1 + e_E\cos\varphi_{MOON}(t))} - R_3 \tag{3.57}$$

between the mass center C_{MOON} of the Moon and the point E_M, which is the intersection of the direct line (connecting the mass center C_{MOON} of the Moon and the mass center C_3 of the Earth τ_3) with the surface of the Earth τ_3. We have the expression for the gravitational potential $\psi_{3MOON}(E_M)$ created by the Moon at the point E_M of the Earth τ_3:

$$\psi_{3MOON}(E_M) = -\gamma \frac{M_{MOON}}{d_{3M}(E_M)}. \tag{3.58}$$

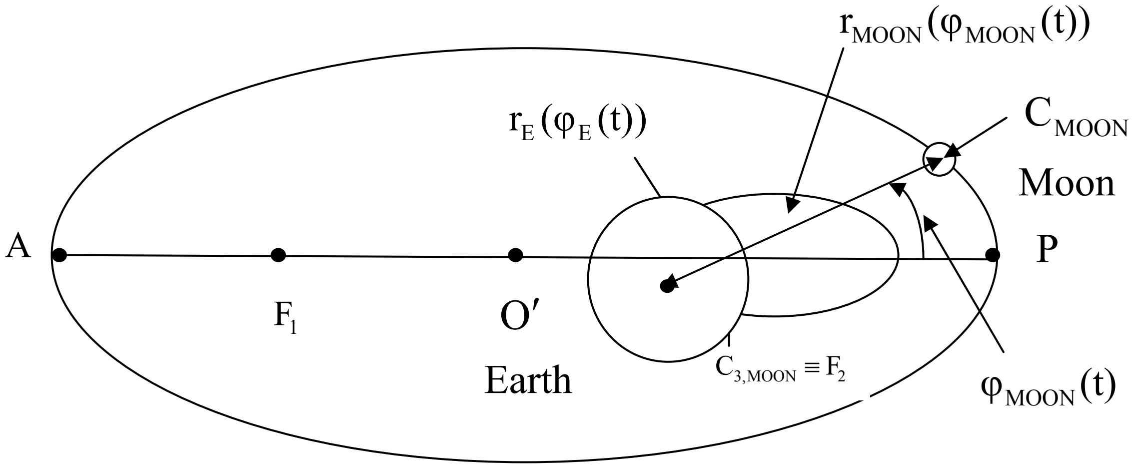


Fig. 9. The geometric sketch of circulation of the mass center C_3 of the Earth τ_3 and the mass center C_{MOON} of the Moon around the combined mass center $C_{3,MOON}$ of the system Earth-Moon

We obtained [Sioneneko, 2009; 2010] from the relation (3.58) the expression for the partial derivative $\frac{\partial}{\partial t}\psi_{3MOON}(E_M)$ of the gravitational potential $\psi_{3MOON}(E_M)$ created by the Moon at the point E_M of the Earth τ_3:

$$\frac{\partial}{\partial t}\psi_{3MOON}(E_M) = \frac{\gamma M_{MOON} e_{MOON} p_{MOON} \sin(\varphi_{MOON}(t))}{(p_{MOON} + p_E - R_3(1 - e_{MOON}\cos\varphi_{MOON}(t)))^2}\frac{d\varphi_{MOON}(t)}{dt}. \tag{3.59}$$

We have the expression for the distance $d_{3M}(C_3)$:

$$d_{3M}(C_3)=\frac{p_{MOON}}{(1+e_{MOON}\cos\varphi_{MOON}(t))}+\frac{p_E}{(1+e_E\cos\varphi_{MOON}(t))} \qquad (3.60)$$

between the mass center C_{MOON} of the Moon and the mass center C_3 of the Earth τ_3. We have the expression for the gravitational potential $\psi_{3MOON}(C_3)$ created by the Moon at the mass center C_3 of the Earth τ_3:

$$\psi_{3MOON}(C_3)= -\gamma\frac{M_{MOON}}{d_{3M}(C_3)}. \qquad (3.61)$$

We obtained [Simonenko, 2009; 2010] from the relation (3.61) the expression for the partial derivative $\frac{\partial}{\partial t}\psi_{3MOON}(C_3)$ (of the gravitational potential $\psi_{3MOON}(C_3)$ created by the Moon at the mass center C_3 of the Earth τ_3):

$$\frac{\partial}{\partial t}\psi_{3MOON}(C_3)=\frac{\gamma M_{MOON}e_{MOON}p_{MOON}\sin(\varphi_{MOON}(t))}{(p_{MOON}+p_E)^2}\frac{d\varphi_{MOON}(t)}{dt}. \qquad (3.62)$$

We can obtain the focal parameter p_{MOON} of the elliptical orbit of the Moon in terms of the average distance R_{3M} (between the mass centers of the Earth and the Moon) and the eccentricity $e_{MOON}=e_E$ of the elliptical orbits of the Moon and the Earth around the combined mass center $C_{3,MOON}$ of the Earth and the Moon.

Using the relation (3.55), we have the relation for the large semi-axis a_{MOON} of the elliptical orbit of the Moon:

$$2a_{MOON}=r_{MOON}(0)+r_{MOON}(\pi)=\frac{p_{MOON}}{(1+e_{MOON})}+\frac{p_{MOON}}{(1-e_{MOON})}=\frac{2p_{MOON}}{(1-e^2_{MOON})}, \qquad (3.63)$$

which gives the relation for the focal parameter p_{MOON} of the elliptical orbit of the Moon in terms of the eccentricity e_{MOON} and the large semi-axis a_{MOON} of the elliptical orbit of the Moon:

$$p_{MOON}=(1-e^2_{MOON})\ a_{MOON}. \qquad (3.64)$$

We can obtain the large semi-axis a_{MOON} of the elliptical orbit of the Moon in terms of the average distance R_{3M} (between the mass centers of the Earth and the Moon) and the eccentricity e_{MOON} of the elliptical orbit of the of the Moon. Defining the average distance R_{3M} (between the mass centers of the Earth and the Moon) as the average arithmetic value of the large semi-axis a_{MOON} and the small semi-axis b_{MOON} of the elliptical orbit of the Moon:

$$R_{3M}=(a_{MOON}+b_{MOON})/2, \qquad (3.65)$$

and using the definition of the eccentricity e_{MOON} of the elliptical orbit of the Moon:

$$e_{MOON}=\frac{c_{MOON}}{a_{MOON}}=\frac{\sqrt{a^2_{MOON}-b^2_{MOON}}}{a_{MOON}}, \qquad (3.66)$$

we obtained [Simonenko, 2009; 2010] the relation for the average distance R_{3M} (between the mass centers of the Earth and the Moon):

$$R_{3M} = \frac{a_{MOON}\left(1+\sqrt{1-e_{MOON}^2}\right)}{2}, \tag{3.67}$$

which leads to the relation for the large semi-axis a_{MOON} (of the elliptical orbit of the Moon) in terms of the average distance R_{3M} (between the mass centers of the Earth and the Moon) and the eccentricity e_{MOON} of the elliptical orbit of the Moon:

$$a_{MOON} = \frac{2R_{3M}}{(1+\sqrt{1-e_{MOON}^2})}. \tag{3.68}$$

Using the relations (3.64) and (3.68), we obtained [Simonenko, 2009; 2010] the relation for the focal parameter p_{MOON} of the elliptical orbit of the of the Moon in terms of the average distance R_{3M} (between the mass centers of the Earth and the Moon) and the eccentricity e_{MOON} of the elliptical orbit of the Moon:

$$p_{MOON} = \frac{2R_{3M}(1-e_{MOON}^2)}{(1+\sqrt{1-e_{MOON}^2})}. \tag{3.69}$$

Using the relation (3.69) and the relations [Savelyev, 1991]:

$$p_{MOON} = p_{MOON,E}\frac{M_3}{(M_3+M_{MOON})}, \tag{3.70}$$

$$p_E = p_{MOON,E}\frac{M_{MOON}}{(M_3+M_{MOON})}, \tag{3.71}$$

the relation (3.62) can be rewritten as follows [Simonenko, 2009; 2010]:

$$\frac{\partial}{\partial t}\psi_{3MOON}(C_3) = \frac{\gamma M_{MOON}e_{MOON}\left(1+\sqrt{1-e_{MOON}^2}\right)\sin(\varphi_{MOON}(t))}{2R_{3M}(1-e_{MOON}^2)\left(\frac{M_{MOON}}{M_3}+1\right)^2}\frac{d\varphi_{MOON}(t)}{dt}. \tag{3.72}$$

Taking $\sin(\varphi_{MOON}(t)) = 1$ and equating $\frac{d\varphi_{MOON}(t)}{dt}$ to ω_{MOON} (for the corresponding hypothetical circular orbits of the Earth and the Moon), we obtained [Simonenko, 2009; 2010] the characteristic maximal positive value $\text{char.max.pos.}\frac{\partial}{\partial t}\psi_{3MOON}(C_3, \text{second approx.})$ of the partial derivative $\frac{\partial}{\partial t}\psi_{3MOON}(C_3)$ (obtained in the second approximation of the elliptical orbits of the Earth and the Moon around the combined mass center $C_{3,MOON}$ of the Earth and the Moon):

$$\text{char.max.pos.}\frac{\partial}{\partial t}\psi_{3MOON}(C_3, \text{second approx.}) = \\ = \frac{\gamma M_{MOON}e_{MOON}\left(1+\sqrt{1-e_{MOON}^2}\right)\omega_{MOON}}{2R_{3M}(1-e_{MOON}^2)\left(\frac{M_{MOON}}{M_3}+1\right)^2}. \tag{3.73}$$

We used the maximal positive value $\max\frac{\partial}{\partial t}\psi_{3M}(C_3,\text{int})$ (of the partial derivative $\frac{\partial}{\partial t}\psi_{3M}(C_3,\text{int})$ of the gravitational potential $\psi_{3M}(C_3,\text{int})$ created by the Mercury at the mass center C_3 of the Earth moving around the mass center O of the Sun along the hypothetical circular orbit) as a scale of the energy gravitational influence of the Moon on the Earth. To evaluate (in the second approximation) the relative power of the energy gravitational influence of the Moon on the Earth, we obtained [Simonenko, 2009; 2010] the ratio $f_{MOONM}(C_3, \text{second approx.})$ of the characteristic maximal positive value $\text{char.max.pos.}\frac{\partial}{\partial t}\psi_{3MOON}(C_3, \text{second approx.})$ and the maximal positive value $\max\frac{\partial}{\partial t}\psi_{3M}(C_3, \text{int})$:

$$f_{MOONM}(C_3, \text{second approx.}) = \frac{\text{char.max.pos.}\frac{\partial}{\partial t}\psi_{3MOON}(C_3, \text{second approx.})}{\max\frac{\partial}{\partial t}\psi_{3M}(C_3, \text{int})}. \tag{3.74}$$

We calculated [Simonenko, 2009; 2010] the corresponding numerical value $f_{MOONM}(C_3, \text{second approx.})$=19.44083 taking into account the following numerical values: e_{MOON}=0.05, $M_{MOON} = M_3/81$, $M_M = 0.06M_3$, $T_{MOON} = 29.5306$ days and $T_M = 88$ days.

The calculated numerical value $f_{MOONM}(C_3, \text{second approx.})$=19.44083 (evaluated in the frame of the considered second approximation) means that the power of the maximal energy gravitational influence of the Moon (on the unit mass of the Earth at the mass center C_3 of the Earth) is $f_{MOONM}(C_3, \text{second approx.})$=19.44083 times larger than the maximal power of the energy gravitational influence (on the unit mass at the mass center C_3 of the Earth) of the Mercury moving around the mass center O of the Sun along the hypothetical circular orbit.

Taking into account the calculated [Simonenko, 2009; 2010] non-dimensional maximal instantaneous energy gravitational influences on the unit mass of the Earth at the mass center C_3 of the Earth: $f(2,C_3)$=37.69807434 (for the Venus), $f_{MOONM}(C_3, \text{second approx.})$=19.44083404 (for the Moon), $f(5,C_3)$ = 7.41055774 (for the Jupiter), $f(1,C_3)$ = 1 (for the Mercury), $f(4,C_3)$ = 0.67441034 (for the Mars), $f(6,C_3)$ = 0.24601009 (for the Saturn), $f(7,C_3)$ = 0.00319056 (for the Uranus), $f(8,C_3)$ = 0.00077565 (for the Neptune) and $f(9,C_3)$ = $3.4813 \cdot 10^{-8}$ (for the Pluto), we obtained [Simonenko, 2009; 2010] the following order of significance (in the frame of the considered second approximation) of the Moon and the planets of the Solar System: the Venus, the Moon, the Jupiter, the Mercury, the Mars, the Saturn, the Uranus, the Neptune and the Pluto. The obtained numerical sequence (of the non-dimensional maximal instantaneous energy gravitational influences on the unit mass of the Earth at the mass center C_3 of the Earth) revealed [Simonenko, 2009; 2010] the main instantaneous energy gravitational influences on the Earth of the Venus, the Moon, the Jupiter, the Mercury and the Mars, which determine (in collection) the main combined instantaneous energy gravitational influence on the Earth (not taking into account the instantaneous energy gravitational influences of the Sun and our Galaxy).

3.2.2. The evaluation of the maximal integral energy gravitational influence of the Moon on the Earth in the second approximation of the elliptical orbits of the Earth and the Moon around the combined mass center $C_{3,MOON}$ of the Earth and the Moon

We evaluated [Simonenko, 2009; 2010] the maximal integral energy gravitational influence of the Moon on the Earth in the approximation of the elliptical orbits of the Earth and the Moon around the combined mass center $C_{3,MOON}$ of the Earth and the Moon. We have the integral energy gravitational influence $\Delta_g E_3(\mathrm{Moon}, \varphi_{MOON}(t_0), t, t_0)$ of the Moon on the Earth τ_3 during the time interval (t_0, t):

$$\Delta_g E_3(\mathrm{Moon}, \varphi_{MOON}(t_0), t, t_0) = \int_{t_0}^{t}\left(\iiint_{\tau_3}\left(\frac{\partial \psi_{3MOON}(C_3)}{\partial t'}\right)\rho dV\right)dt' \approx M_3 \int_{t_0}^{t}\left(\frac{\partial \psi_{3MOON}(C_3)}{\partial t'}\right)dt', \qquad (3.75)$$

where M_3 is the mass of the Earth. Substituting the expression (3.72) into formula (3.75) and integrating, we obtained [Simonenko, 2009; 2010] the following analytical relation:

$$\Delta_g E_3(\mathrm{Moon}, \varphi_{MOON}(t_0), t, t_0) =$$

$$= -\frac{\gamma M_3 M_{MOON} e_{MOON}\left(1+\sqrt{1-e_{MOON}^2}\right)\left(\cos(\varphi_{MOON}(t) - \cos(\varphi_{MOON}(t_0))\right)}{2R_{3M}(1-e_{MOON}^2)\left(\frac{M_{MOON}}{M_3}+1\right)^2}. \qquad (3.76)$$

Considering the following phases: $\varphi_{MOON}(t) = \pi$ and $\varphi_{MOON}(t_0) = 0$, we obtained [Simonenko, 2009; 2010] from relation (3.76) the maximal positive value of the integral energy gravitational influence of the Moon on the Earth:

$$\max_t \Delta_g E_3(\mathrm{Moon}, \varphi_{MOON}(t_0), t, t_0) = \frac{\gamma M_3 M_{MOON} e_{MOON}\left(1+\sqrt{1-e_{MOON}^2}\right)}{R_{3M}(1-e_{MOON}^2)\left(\frac{M_{MOON}}{M_3}+1\right)^2}. \qquad (3.77)$$

To evaluate (in the second approximation) the maximal integral energy gravitational influence of the Moon on the Earth, we considered [Simonenko, 2009; 2010] the ratio $s(\mathrm{Moon, second\ approx.})$ of the maximal positive value (3.77) (of the integral energy gravitational influence of the Moon on the Earth) and the maximal positive value (3.48) (of the integral energy gravitational influence of the Mercury on the Earth):

$$s(\mathrm{Moon, second\ approx.}) = \frac{\max_t \Delta_g E_3(\mathrm{Moon}, \varphi_{MOON}(t_0), t, t_0)}{\max_t \Delta_g E_3(\tau_1, 0, 0, t, 0)} =$$

$$= \frac{e_{MOON}\left(1+\sqrt{1-e_{MOON}^2}\right)M_{MOON}(R_{O3}^2 - R_{O1}^2)(T_3 - T_1)}{(1-e_{MOON}^2)\left(\frac{M_{MOON}}{M_3}+1\right)^2 M_1 R_{3M} R_{O1} T_3}. \qquad (3.78)$$

Using the relation (3.78), we calculated [Simonenko, 2009; 2010] the numerical value $s(\mathrm{Moon, second\ approx.}) = 13.0693$ for the following numerical values: the eccentricity $e_{MOON} = 0.05$ of the elliptical orbits of the Moon and the Earth around the combined mass center $C_{3,MOON}$ of the Earth and the Moon, the mass $M_1 = M_M = 0.06M_3$ of the Mercury, the mass $M_{MOON} = M_3/81$ of the Moon, the average distance R_{3M} = 384400 km between the mass centers of the Earth and the Moon, the time period T_3 = 365.3 days of the Earth's circulation around the Sun; the time period T_1=T_M = 88 days of the Mercury's circulation around the Sun, the average radius R_{OM} = R_{O1} = 57.85 $\cdot 10^6$ km of the Mercury's orbit around the Sun, the average radius R_{O3} = 149.6 $\cdot 10^6$ km of the Earth's orbit around the Sun. The calculated numerical value $s(\mathrm{Moon, second\ approx.}) = 13.0693$ revealed [Simonenko, 2009; 2010] the very significant correction of the previous numerical value $s(\text{Moon}) = 2.9178$ [Simonenko, 2007] obtained in the first approximation for the surface point D_3 of the Earth.

Thus, considering the aspect of the planetary gravitational preparation of the strong earthquakes, we demonstrated [Simonenko, 2007] the Venusian ($s(2) = 89.6409$) and the Jupiter's ($s(5) = 31.319$) energy gravitational predominance [Simonenko, 2007] in supplying of the cosmic planetary gravitational energy to the focal region of the preparing earthquakes. We demonstrated [Simonenko, 2009; 2010] the very significant ($s(\text{Moon, second approx.}) = 13.0693$) maximal integral energy gravitational influence of the Moon on the Earth. The Venus, the Jupiter and the Moon induce the main combined planetary and lunar integral energy gravitational influence on the Earth. The combined maximal integral energy gravitational influence on the Earth of the Mars ($s(4) = 2.6396$), the Saturn ($s(6) = 1.036$) and the Mercury ($s(1) = 1$) is one order of the magnitude smaller than the maximal integral energy gravitational influence of the Venus. The combined maximal integral energy gravitational influence on the Earth of the Uranus ($s(7) = 0.0133$), the Neptune ($s(8) = 0.003229$) and the Pluto ($s(9) = 1.4495 \cdot 10^{-7}$) is two orders of the magnitude smaller (i.e., negligible) than the maximal integral energy gravitational influence of the Mercury.

It was suggested [Avsjuk, 1996] the hypothesis that the Chandler's wobble of the Earth's pole can be generated by the motion of the rigid kernel of the Earth induced by the disturbances in the system Sun-Earth-Moon. Taking into account the considered results of Subsections 3.1 and 3.2, we stated [Simonenko, 2009; 2010] that the mentioned above related geophysical phenomena (the small oscillatory motion of the rigid kernel of the Earth relative to the fluid kernel of the Earth; the small oscillation of the Earth's pole (i.e., the Chandler's wobble of the Earth's pole); the small oscillations of the boundary of the Pacific Ocean (i.e., the seismic zone of the Pacific Ring); the oscillations, rotations and deformations of the geo-blocks weakly coupled with the surrounding plastic layers in all seismic zones of the Earth and the formation of fractures related with the strong earthquakes and the planetary cataclysms) are induced by the combined non-stationary cosmic energy gravitational influence of the planets of the Solar System, the Sun and the Moon.

3.3. The energy gravitational influence of the Sun on the Earth owing to the gravitational interaction of the Sun with the outer large planets (the Jupiter, the Saturn, the Uranus and the Neptune) of the Solar System

3.3.1. The evaluations of the relative characteristic maximal positive instantaneous energy gravitational influences of the Sun on the Earth owing to the gravitational interaction of the Sun with the outer large planets of the Solar System

We shall consider the movement of the Sun, the Earth τ_3 and the outer large planet τ_j ($j = 5, 6, 7, 8$) in the ecliptic plane (see Fig. 10) around the combined mass center $C(S, j)$ of the Sun and the outer large planet τ_j in the approximation of the elliptical orbits of the Sun, the Earth and the outer large planet τ_j. The combined mass center $C(S, j)$ of the system the Sun – the outer large planet τ_j (the Sun and the outer large planet τ_j) is considered as the right focus $F_1 \equiv C(S, j)$ of the elliptical orbits of the outer large planet τ_j ($j = 5, 6, 7, 8$) and the Earth τ_3.

We have the following relations:

$$r_j(\varphi_j(t)) = \frac{p_j}{(1 + e_j \cos\varphi_j(t))}, \qquad (j = 5, 6, 7, 8) \tag{3.79}$$

$$r_{Sj}(\varphi_{Sj}(t)) = r_{Sj}(\varphi_j(t)+\pi) = \frac{p_{Sj}}{(1+e_{Sj}\cos\varphi_j(t))}, \ (j=5,6,7,8) \tag{3.80}$$

$$r_3(\varphi_3(t)) = \frac{p_3}{(1+e_3\cos\varphi_3(t))}. \tag{3.81}$$

for the distance $r_j(\varphi_j)$ between combined mass center $C(S,j)$ and the mass center C_j of the planet τ_j, for the distance $r_{Sj}(\varphi_j+\pi)$ between combined mass center $C(S,j)$ and the mass center $C_S \equiv O$ of the Sun, and for the distance $r_3(\varphi_3(t))$ between combined mass center $C(S,j)$ and the mass center C_3 of the Earth τ_3, respectively. Here p_j and e_j are the focal parameter and the eccentricity, respectively, of the elliptical orbit of the planet τ_j ($j=5,6,7,8$). p_{Sj} and $e_{Sj}=e_j$ are the focal parameter and the eccentricity, respectively, of the elliptical orbit of the mass center $C_S \equiv O$ of the Sun. p_3 and e_3 are the focal parameter and the eccentricity, respectively, of the elliptical Earth's orbit. We have $\varphi_j(0)=0$ ($j=5,6,7,8$), $\varphi_{Sj}(0)=\pi$ and $\varphi_3(0)=0$, respectively, for the initial time moment t = 0.

We shall consider the gravitational potential $\psi^S_{3j}(C_3,t) \equiv \psi^S_{3j}(C_3,t,r_3(\varphi_3(t)))$ created by the Sun in the mass center C_3 (of the Earth τ_3) characterized by the distance $r_3(\varphi_3(t))$ between from the combined mass center $C(S,j)$ of the Sun and the planet τ_j:

$$\psi^S_{3j}(C_3,t,r_3(\varphi_3(t))) = -\gamma\frac{M_S}{r_{S3}(t)}, \tag{3.82}$$

where $M_S = 333000\cdot M_3$ is the mass of the Sun, $r_{S3}(t) = |\mathbf{r}_{S3}(t)|$ is the distance between the mass center $C_S \equiv O$ of the Sun and the mass center C_3 of the Earth τ_3.

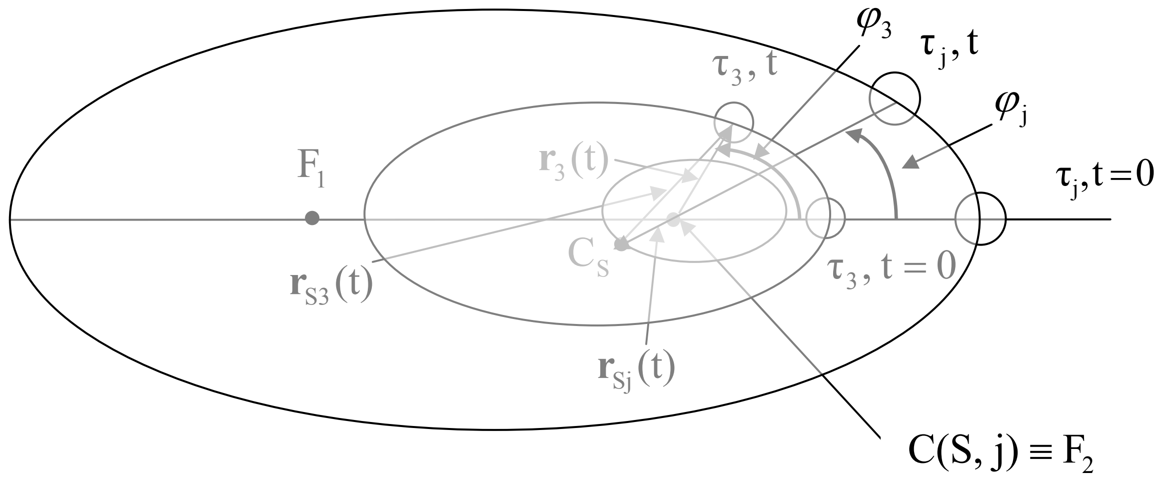


Fig. 10. The geometric sketch of movement of the outer large planet τ_j (the Jupiter, the Saturn, the Uranus and the Neptune) and the Earth τ_3 around the combined mass center $C(S, j)$ of the Sun and the outer large planet τ_j

We find the distance $r_{S3}(t)$ from the following relation:

$$(r_{S3}(t))^2 = (r_{Sj}(t))^2 + (r_3(t))^2 - 2r_{Sj}(t)r_3(t)\cos(\pi + \varphi_j(t) - \varphi_3(t)). \tag{3.83}$$

Consequently, the relation (3.82) can rewritten as follows:

$$\psi_{3j}^S(C_3, t) = -\frac{\gamma M_S}{\sqrt{(r_{Sj}(t))^2 + (r_3(t))^2 - 2r_{Sj}(t)r_3(t)\cos(\pi + \varphi_j(t) - \varphi_3(t))}}. \tag{3.84}$$

We obtain the expression for the partial derivative $\frac{\partial}{\partial t}\psi_{3j}^S(C_3, t)$ of the gravitational potential $\psi_{3j}^S(C_3, t)$:

$$\begin{aligned} \frac{\partial}{\partial t}\psi_{3j}^S(C_3, t) &= \frac{\gamma M_S r_{Sj}(\varphi_j + \pi) r_3(\varphi_3)\sin(\varphi_3 - \varphi_j)}{(r_{S3}(t))^3}\frac{d\varphi_j(t)}{dt} + \\ &+ \frac{\gamma M_S r_{Sj}(\varphi_j + \pi) e_{Sj}\sin\varphi_j [r_{Sj}(\varphi_j + \pi) + r_3(\varphi_3)\cos(\varphi_3 - \varphi_j)]}{(r_{S3}(t))^3 (1 + e_{Sj}\cos\varphi_j)}\frac{d\varphi_j(t)}{dt}. \end{aligned} \tag{3.85}$$

Using the expressions (3.80), (3.81) and (3.83), the relation (3.85) can be rewritten as follows:

$$\frac{\partial}{\partial t}\psi_{3j}^S(C_3, t) = \gamma M_S \frac{p_{Sj}}{(1 + e_{Sj}\cos\varphi_j)} \frac{p_3}{(1 + e_3\cos\varphi_3)} \sin(\varphi_3 - \varphi_j) \times$$

$$\times \frac{\dfrac{d\varphi_j(t)}{dt}}{\left[\left(\dfrac{p_{Sj}}{(1+e_{Sj}\cos\varphi_j)}\right)^2+\left(\dfrac{p_3}{(1+e_3\cos\varphi_3)}\right)^2+2\dfrac{p_{Sj}p_3\cos(\varphi_j-\varphi_3)}{(1+e_{Sj}\cos\varphi_j)(1+e_3\cos\varphi_3)}\right]^{\frac{3}{2}}}+$$

$$+\frac{\gamma M_S p_{Sj} e_{Sj}\sin\varphi_j}{(1+e_{Sj}\cos\varphi_j)^2}\left[\frac{p_{Sj}}{(1+e_{Sj}\cos\varphi_j)}+\frac{p_3\cos(\varphi_3-\varphi_j)}{(1+e_3\cos\varphi_3)}\right]\times \tag{3.86}$$

$$\times \frac{\dfrac{d\varphi_j(t)}{dt}}{\left[\left(\dfrac{p_{Sj}}{(1+e_{Sj}\cos\varphi_j)}\right)^2+\left(\dfrac{p_3}{(1+e_3\cos\varphi_3)}\right)^2+2\dfrac{p_{Sj}p_3\cos(\varphi_j-\varphi_3)}{(1+e_{Sj}\cos\varphi_j)(1+e_3\cos\varphi_3)}\right]^{\frac{3}{2}}}.$$

The first term of the expression (3.86) gives the principal contribution to the partial derivative $\frac{\partial}{\partial t}\psi^S_{3j}(C_3, t)$. The expression (3.86) contains the additional second term (vanishing at $e_{Sj} \to 0$) related with the contribution to the partial derivative $\frac{\partial}{\partial t}\psi^S_{3j}(C_3, t)$ of the eccentricities e_j and $e_{Sj} = e_j$ of the elliptical orbits of the outer large planet τ_j (j=5, 6, 7, 8) and the Sun, respectively.

The combined maximal contribution of this additional second term to the partial derivative $\frac{\partial}{\partial t}\psi^S_{3j}(C_3, t)$ is of the order

$$O(e_j)\left(\max\frac{\partial}{\partial t}\psi^S_{3j}(C_3, t)\right). \tag{3.87}$$

Consequently, the contribution of the first term of the expression (3.86) is $O(1/e_j)$ times larger than the contribution of the additional second term related with the eccentricities e_j and $e_{Sj} = e_j$ of the elliptical orbits of the outer planet τ_j (j=5, 6, 7, 8) and the Sun, respectively.

To evaluate the characteristic maximal positive value $\text{char.max.pos.}\frac{\partial}{\partial t}\psi^S_{3j}(C_3, t)$ of the partial derivative $\frac{\partial}{\partial t}\psi^S_{3j}(C_3, t)$ (given by the expression (3.86)) we consider the time moments $t_*(k)$, related with the conditions

$$\sin(\varphi_3-\varphi_j)=1,\ \cos(\varphi_3-\varphi_j)=0, \tag{3.88}$$

which give the following relation for the angles φ_3 and φ_j

$$(\varphi_3-\varphi_j)=\frac{\pi}{2}+2\pi k,\quad k=0,1,2.... \tag{3.89}$$

Considering the following relations (for the corresponding hypothetical circular orbits of the Earth and the planet τ_j ($j=5,6,7,8$)) for the angles $\varphi_3(t)$ and $\varphi_j(t)$:

$$\varphi_3(t) \approx \frac{2\pi}{T_3} t, \ \varphi_j(t) \approx \frac{2\pi}{T_j} t, \tag{3.90}$$

the condition (3.89) gives (for $k = 0$) the following time t_* and the corresponding angles $\varphi_3(t_*)$ and $\varphi_j(t_*)$:

$$t_* = \frac{1}{4} \frac{T_3 T_j}{(T_j - T_3)}, \quad \varphi_3(t_*) = \frac{\pi}{2} \frac{T_j}{(T_j - T_3)}, \quad \varphi_j(t_*) = \frac{\pi}{2} \frac{T_3}{(T_j - T_3)}, \tag{3.91}$$

which result to the characteristic maximal positive value $\text{char.max.pos.} \frac{\partial}{\partial t} \psi^S_{3j}(C_3, t)$ of the partial derivative $\frac{\partial}{\partial t} \psi^S_{3j}(C_3, t)$:

$$\text{char.max.pos.} \frac{\partial}{\partial t} \psi^S_{3j}(C_3, t) \equiv \frac{\partial}{\partial t} \psi^s_{3j}(t_*) = \frac{\gamma M_S p_{Sj}}{(1 + e_{Sj} \cos\varphi_j(t_*))} \frac{p_3}{(1 + e_3 \cos\varphi_3(t_*))} \omega_j \times$$
$$\times \frac{1}{\left[\left(\frac{p_{Sj}}{(1 + e_{Sj}\cos\varphi_j(t_*))}\right)^2 + \left(\frac{p_3}{(1 + e_3 \cos\varphi_3(t_*))}\right)^2\right]^{3/2}} + \tag{3.92}$$

$$+ \gamma M_S p_{Sj} e_{Sj} \sin\varphi_j(t_*) \frac{p_{Sj}}{(1 + e_{Sj} \cos\varphi_j(t_*))^3} \omega_j \frac{1}{\left[\left(\frac{p_{Sj}}{(1 + e_{Sj}\cos\varphi_j(t_*))}\right)^2 + \left(\frac{p_3}{(1 + e_3 \cos\varphi_3(t_*))}\right)^2\right]^{3/2}}.$$

We shall use the relation [Simonenko, 2007; 2009; 2010] for the maximal positive value $\max \frac{\partial}{\partial t} \psi_{3M}(C_3, \text{int})$ (of the partial derivative $\frac{\partial}{\partial t} \psi_{3M}(C_3, \text{int})$ of the gravitational potential $\psi_{3M}(C_3, \text{int})$ created by the Mercury (moving around the mass center O of the Sun along the hypothetical circular orbit) at the mass center C_3 of the Earth):

$$\max \frac{\partial}{\partial t} \psi_{3M}(C_3, \text{int}) = p(1, C_3) \frac{\gamma M_M R_{O3} R_{OM} \omega_M}{[R^2_{O3} + R^2_{OM}]^{3/2}} \tag{3.93}$$

as a scale of the energy gravitational influence of the Sun (owing to the outer large planets τ_j (j=5, 6, 7, 8) of the Solar System) on the Earth. To evaluate the relative power of the energy gravitational influence of the Sun (owing to the outer large planets τ_j (j=5, 6, 7, 8) of the Solar System) on the Earth as compared with the power of the energy gravitational influence of the Mercury, we find the ratio $f_{SUN\,M}(j, C_3, \text{char.})$ of the characteristic maximal positive value $\text{char. max. pos.} \frac{\partial}{\partial t} \psi^S_{3j}(C_3, t)$ (given by the expression (3.92)) and the maximal positive value $\max \frac{\partial}{\partial t} \psi_{3M}(C_3, \text{int})$ (given by the expression (3.93)):

$$f_{SUN\,M}(j, C_3, \text{char.}) = \frac{\text{char.max.pos.} \frac{\partial}{\partial t} \psi^S_{3j}(C_3, t)}{\max \frac{\partial}{\partial t} \psi_{3M}(C_3, \text{int})} =$$

$$= \frac{1}{2p(1, C_3)} \frac{M_j}{M_1} \frac{\left[R^2_{O3} + R^2_{O1}\right]^{3/2}}{R^3_{O3} R_{O1}} \frac{R_{Oj} T_1}{T_j} \frac{(1 - e^2_j)}{(1 - e^2_3)^2} \frac{(1 + \sqrt{1 - e^2_3})^2}{(1 + \sqrt{1 - e^2_j})} \times$$

$$\times \frac{1}{(1+e_{Sj}\cos\varphi_j(t_*))\left\{\left(\frac{p_{Sj}}{p_3}\right)^2 \frac{1}{(1+e_{Sj}\cos\varphi_j(t_*))^2} + \frac{1}{(1+e_3\cos\varphi_3(t_*))^2}\right\}^{3/2}} \times$$

$$\times\left[\frac{1}{(1+e_3\cos\varphi_3(t_*))} + \frac{e_{Sj}\sin\varphi_j(t_*)}{(1+e_{Sj}\cos\varphi_j(t_*))^2}\frac{p_{Sj}}{p_3}\right], \quad (j=5,6,7,8) \tag{3.94}$$

where $\left(\frac{p_{sj}}{p_3}\right)^2$ is given by the following relation ($j=5,6,7,8$):

$$\frac{p_{Sj}^2}{p_3^2} = \left(\frac{p_j M_j}{M_S p_3}\right)^2 = \left(\frac{M_j}{M_S}\right)^2 \left(\frac{p_j}{p_3}\right)^2 = \left(\frac{M_j}{M_S}\right)^2 \left(\frac{(1-e_j^2)}{(1-e_3^2)}\frac{R_{Oj}}{R_{O3}}\frac{(1+\sqrt{1-e_3^2})}{(1+\sqrt{1-e_j^2})}\right)^2 . \tag{3.95}$$

Using the relation (3.95), the ratio $f_{SUN\,M}(j, C_3, char.)$ (given by the expression (3.94)) can be rewritten as follows:

$$f_{SUN\,M}(j, C_3, char.) = \frac{M_j\left[R_{O3}^2 + R_{O1}^2\right]^{3/2} R_{Oj} T_1 (1-e_j^2)(1+\sqrt{1-e_3^2})^2}{2p(1,C_3) M_1 R_{O3}^3 R_{O1} T_j (1-e_3^2)^2 (1+\sqrt{1-e_j^2})} \times \tag{3.96}$$

$$\times \frac{1}{(1+e_{Sj}\cos\varphi_j(t_*))} \frac{1}{\left\{\left(\frac{M_j}{M_S}\frac{(1-e_j^2)}{(1-e_3^2)}\frac{R_{Oj}}{R_{O3}}\frac{(1+\sqrt{1-e_3^2})}{(1+\sqrt{1-e_j^2})}\right)^2 \frac{1}{(1+e_{Sj}\cos\varphi_j(t_*))^2} + \frac{1}{(1+e_3\cos\varphi_3(t_*))^2}\right\}^{3/2}} \times$$

$$\times\left[\frac{1}{(1+e_3\cos\varphi_3(t_*))} + \frac{e_{Sj}\sin\varphi_j(t_*)}{(1+e_{Sj}\cos\varphi_j(t_*))^2}\frac{M_j}{M_S}\frac{(1-e_j^2)}{(1-e_3^2)}\frac{R_{Oj}}{R_{O3}}\frac{(1+\sqrt{1-e_3^2})}{(1+\sqrt{1-e_j^2})}\right]. \quad (j=5,6,7,8)$$

The obtained formula (3.96) is valid only for the outer large planets (the Jupiter, the Saturn, the Uranus (τ_7) and the Neptune) of the Solar System. Using the formula (3.96) and the planetary numerical values [Zhirmunsky and Kuzmin, 1990; Simonenko, 2007; 2008; 2009; 2010], we calculate the following numerical values (of the non-dimensional energy gravitational influences of the Sun on the Earth owing to the gravitational interaction of the Sun with the outer large planets): $f_{SUN\,M}(5, C_3, char.) =$ 884.935424 (for the Sun owing to the gravitational interaction of the Sun with the Jupiter), $f_{SUN\,M}(6, C_3, char.) = 194.923355$ (for the Sun owing to the gravitational interaction of the Sun with the Saturn), $f_{SUN\,M}(7, C_3, char.) = 21.27951$ (for the Sun owing to the gravitational interaction of the Sun with the Uranus) and $f_{SUN\,M}(8, C_3, char.) = 20.833557$ (for the Sun owing to the gravitational interaction of the Sun with the Neptune).

Taking into account the calculated numerical values $f_{SUN\,M}(j, C_3, char.)$ ($j=5,6,7,8$), we obtain the following order of significance of the outer large planets of the Solar System: the Jupiter (τ_5), the Saturn (τ_6), the Uranus (τ_7) and the Neptune (τ_7) in respect of the evaluated characteristic maximal positive instantaneous energy gravitational influences of the Sun on the Earth owing to the gravitational interaction of the Sun with the outer large planets of the Solar System.

3.3.2. The evaluations of the maximal positive integral energy gravitational influences of the Sun on the Earth owing to the gravitational interaction of the Sun with the outer large planets in the first approximation of the circular orbits of the planets of the Solar System

We shall use the relation (3.85) for the evaluation of the maximal positive integral energy gravitational influences of the Sun on the Earth owing to the gravitational interaction of the Sun with the outer large planets in the first approximation of the circular orbits of the outer large planets of the Solar System. Considering the orbit of the outer large planet τ_j $(j = 5, 6, 7, 8)$ of the Solar System as the circular (in the first approximation), we obtain that the orbit of the mass center $C_S \equiv O$ of the Sun may be considered as circular also (in the first approximation) for the closed system the Sun – the outer large planet τ_j (the Sun and the outer large planet τ_j). Consequently, we can consider (in the first approximation) in the relation (3.85) the average radius $\langle r_{Sj} \rangle$ instead of r_{Sj} for the hypothetical circular orbit of the mass center $C_S \equiv O$ of the Sun in the closed system the Sun – the outer large planet τ_j $(j = 5, 6, 7, 8)$. We can consider (in the first approximation) in the relation (3.85) the average radius R_{O3} of the Earth's orbit instead of r_3. The average radius $\langle r_{Sj} \rangle$ is given by the following expression

$$\langle r_{Sj} \rangle = R_{Oj} \frac{M_j}{M_S}, \tag{3.97}$$

where M_S is the mass of the Sun, M_j is the mass of the planet τ_j $(j = 5, 6, 7, 8)$. Using the relation (3.97) and the relations $\varphi_3 = \omega_3 t$, $\varphi_j = \omega_j t$ (for the hypothetical circular orbits of the Earth and the planet τ_j around the combined mass center $C(S, j)$ of the Sun and the planet τ_j), the relation (3.85) can be rewritten as follows

$$\frac{\partial}{\partial t}\psi_{3j}^S(C_3, t) = \frac{\gamma M_j R_{Oj} R_{O3} \omega_j \sin(\omega_3 - \omega_j)t}{\left[\left(R_{Oj}\frac{M_j}{M_S}\right)^2 + R_{O3}^2 + 2R_{Oj}\frac{M_j}{M_S}R_{O3}\cos(\omega_j - \omega_3)t\right]^{3/2}}. \tag{3.98}$$

The main interest of this Subsection is related with the maximal positive integral energy gravitational influences of the Sun on the Earth owing to the gravitational interaction of the Sun with the outer large planets τ_j $(j = 5, 6, 7, 8)$:

$$\max_t \Delta_g E_3(\text{Sun} - \tau_j, \varphi_{0j}, \varphi_{03}, t, t_0) \tag{3.99}$$

under the following initial (for the initial time moment $t = t_0$) angles: $\varphi_{0j} = 0$ and $\varphi_{03} = 0$ characterizing the initial configuration of the outer large planet τ_j and the Earth τ_3, respectively. These initial angles ($\varphi_{0j} = 0$ and $\varphi_{03} = 0$) correspond (see Fig. 10) to the minimal distance between the mass center C_j of the outer large planet τ_j and the mass center C_3 the Earth τ_3 for the initial time moment $t = t_0 = 0$. Taking into account $\varphi_{0j} = 0$, $\varphi_{03} = 0$ and using the derived expression (3.98) for $\frac{\partial}{\partial t}\psi_{3j}^S(C_3, t)$, we have the following expression for the integral energy gravitational influence of the Sun on the Earth owing to the gravitational interaction of the Sun with the outer large planet τ_j:

$$\Delta_g E_3(\mathrm{Sun}-\tau_j,0,0,t,t_0) = M_3\int_{t_0}^{t}\frac{\partial}{\partial t'}\psi_{3j}^{S}(C_3,t')\,dt' =$$

$$M_3\int_{t_0}^{t}\frac{\gamma M_j R_{Oj}R_{O3}\omega_j \sin(\omega_3-\omega_j)t'dt'}{\left[\left(R_{Oj}\frac{M_j}{M_S}\right)^2+R_{O3}^2+2R_{Oj}\frac{M_j}{M_S}R_{O3}\cos(\omega_j-\omega_3)t'\right]^{3/2}}. \tag{3.100}$$

Introducing the following designations

$$\beta_{Sj}=R_{O3}^2+\left(R_{Oj}\frac{M_j}{M_S}\right)^2,\ \chi_{Sj}=2R_{O3}R_{Oj}\frac{M_j}{M_S},\ \alpha_j=\gamma M_3 M_j R_{O3}R_{Oj}\omega_j, \tag{3.101}$$

the expression (3.100) can be rewritten as follows

$$\Delta_g E_3=(\mathrm{Sun}-\tau_j,0,0,t,t_0)=\int_{t_0}^{t}\frac{\alpha_j\sin(\omega_3-\omega_j)t'dt'}{\left[\beta_{Sj}+\chi_{Sj}\cos(\omega_j-\omega_3)t'\right]^{3/2}}. \tag{3.102}$$

Introducing the new variable $u=\cos(\omega_j-\omega_3)t'$, the expression (3.102) can be rewritten as follows

$$\Delta_g E_3=(\mathrm{Sun}-\tau_j,0,0,t,t_0)=\int_{\cos(\omega_j-\omega_3)t_0}^{\cos(\omega_j-\omega_3)t}\frac{du}{(\omega_j-\omega_3)\left[\beta_{Sj}+\chi_{Sj}u\right]^{3/2}}. \tag{3.103}$$

Taking into account the relation

$$\int\frac{du}{\left[\beta_{Sj}+\chi_{Sj}u\right]^{3/2}}=F(u)=-\frac{2}{\chi_{Sj}}\frac{1}{\left[\beta_{Sj}+\chi_{Sj}u\right]^{1/2}}+C, \tag{3.104}$$

and integrating the relation (3.103), we have the following expression

$$\Delta_g E_3(\mathrm{Sun}-\tau_j,0,0,t,t_0)=\frac{2\alpha_j}{(\omega_3-\omega_j)\chi_{Sj}}\left\{\frac{1}{\left[\beta_{Sj}+\chi_{Sj}\cos(\omega_j-\omega_3)t\right]^{1/2}}-\frac{1}{\left[\beta_{Sj}+\chi_{Sj}\cos(\omega_j-\omega_3)t_0\right]^{1/2}}\right\}. \tag{3.105}$$

Considering the initial time moment $t_0=0$, the expression (3.105) gives the relation:

$$\Delta_g E_3(\mathrm{Sun}-\tau_j,0,0,t,0)=\frac{2\alpha_j}{(\omega_3-\omega_j)\chi_{Sj}}\left\{\frac{1}{\left[\beta_{Sj}+\chi_{Sj}\cos(\omega_j-\omega_3)t\right]^{1/2}}-\frac{1}{\left[\beta_{Sj}+\chi_{Sj}\right]^{1/2}}\right\}. \tag{3.106}$$

The relation (3.106) gives the maximal positive integral energy gravitational influences of the Sun on the Earth owing to the gravitational interaction of the Sun with the outer large planets τ_j $(j=5,6,7,8)$:

$$\max_t \Delta_g E_3(\mathrm{Sun}-\tau_j,0,0,t,0)=\Delta_g E_3(\mathrm{Sun}-\tau_j,0,0,t_1^*(3,j),0)=$$

$$=\frac{2\alpha_j}{(\omega_3-\omega_j)\chi_{Sj}}\left\{\frac{1}{[\beta_{Sj}-\chi_{Sj}]^{1/2}}-\frac{1}{\left[\beta_{Sj}+\chi_{Sj}\right]^{1/2}}\right\}, \tag{3.107}$$

which are attained at first under the time moments $t=t_1^*(3,j)=\frac{1}{2}\frac{T_3T_j}{(T_j-T_3)}$, where $j=5,6,7,8$. The following time moments

$$t_n^c(3,j)=\frac{1}{2}\frac{T_3T_j}{(T_j-T_3)}+n\frac{T_3T_j}{(T_j-T_3)},\ (j = 5, 6, 7, 9; n = 0, 2, 3, \ldots\ldots..)$$

give the same maxima

$$\max_t \Delta_g E_3(\mathrm{Sun}-\tau_j,0,0,t,0)=\Delta_g E_3(\mathrm{Sun}-\tau_j,0,0,t_n^c(3,j),0)=$$

$$=\frac{2\alpha_j}{(\omega_3-\omega_j)\chi_{Sj}}\left\{\frac{1}{[\beta_{Sj}-\chi_{Sj}]^{1/2}}-\frac{1}{\left[\beta_{Sj}+\chi_{Sj}\right]^{1/2}}\right\}, \tag{3.108}$$

which are attained under the time moments $t = t_n^c(3, j)$, where j = 5, 6, 7, 9; n = 0, 1, 2, 3, … . The time moments $t = t_n^c(3, j)$ define the planetary configurations characterizing by the maximal distances between the mass center C_j of the outer large planet τ_j (j = 5, 6, 7, 9) and the mass center C_3 of the Earth τ_3. Taking into account the designations (3.101), the relation (3.108) can be rewritten as follows

$$\max_t \Delta_g E_3(\text{Sun} - \tau_j, 0, 0, t, 0) = \frac{2\gamma M_3 M_j R_{Oj} T_3}{(T_j - T_3)} \frac{1}{\left(R_{O3}^2 - \left(\frac{R_{Oj} M_j}{M_S}\right)^2\right)}. \tag{3.109}$$

We shall use the expression (3.48) as a measuring unit for evaluations of the maximal positive integral energy gravitational influences of the Sun on the Earth owing to the gravitational interaction of the Sun with the outer large planet τ_j $(j = 5, 6, 7, 8)$. Considering the ratio of the maximal positive integral energy gravitational influence $\max_t \Delta_g E_3(\text{Sun} - \tau_j, 0, 0, t, 0)$ (given by the expression (3.109)) of the Sun on the Earth (owing to the gravitational interaction of the Sun with the outer large planets τ_j) and the maximal positive integral energy gravitational influence $\max_t \Delta_g E_3(\tau_1, 0, 0, t, 0)$ (given by the expression (3.48)) of the Mercury on the Earth, we obtain the relative values $s(\text{Sun} - \tau_j, \text{first approx.})$ of the maximal integral energy gravitational influences of the Sun on the Earth owing to the gravitational interaction of the Sun with the outer large planets τ_j $(j = 5, 6, 7, 8)$:

$$s(\text{Sun} - \tau_j, \text{first approx.}) = \frac{\max_t \Delta_g E_3(\text{Sun} - \tau_j, 0, 0, t, 0)}{\max_t \Delta_g E_3(\tau_1, 0, 0, t, 0)} =$$

$$= \frac{M_j}{M_1} \frac{R_{Oj}}{R_{O1}} \frac{(T_3 - T_1)}{(T_j - T_3)} \frac{(R_{O3}^2 - R_{O1}^2)}{\left(R_{O3}^2 - \left(\frac{R_{Oj} M_j}{M_S}\right)^2\right)}. \tag{3.110}$$

Using the formula (3.110) and the planetary numerical values [Zhirmunsky and Kuzmin, 1990; Simonenko, 2007] of the average radii of orbits of the Earth, the Mercury and the Jupiter (j=5), the time periods of circulations around the Sun and the masses of the Jupiter, the Mercury and the Sun, we calculate the numerical value $s(\text{Sun} - \tau_5, \text{ first approx.}) = 4235.613239$, which means that the maximal integral energy gravitational influence of the Sun (owing to the gravitational interaction of the Sun with the Jupiter) on the unit mass of the Earth (at the mass center C_3 the Earth τ_3) is $s(\text{Sun} - \tau_5, \text{first approx.})/s(5) = 4235.613239/31.319 = 135.2410115$ times larger than the power of the maximal integral energy gravitational influence of the Jupiter (at the mass center C_3 the Earth τ_3).

Using the formula (3.110) and the planetary numerical values [Zhirmunsky and Kuzmin, 1990; Simonenko, 2007] of the average radii of orbits of the Earth, the Mercury and the Saturn (j=6), the time periods of circulations around the Sun and the masses of the Saturn, the Mercury and the Sun, we calculate the numerical value $s(\text{Sun} - \tau_6, \text{ first approx.}) = 887.4442965$, which means that the maximal integral energy gravitational influence of the Sun (owing to the gravitational interaction of the Sun with the Saturn) on the unit mass of the Earth (at the mass center C_3 the Earth τ_3) is $s(\text{Sun} - \tau_6, \text{first approx.})/s(6) = 887.4442965/1.036 = 856.6064638$ times larger than the power of the maximal integral energy gravitational influence of the Saturn (at the mass center C_3 of the Earth τ_3).

Using the formula (3.110) and the planetary numerical values [Zhirmunsky and Kuzmin, 1990; Simonenko, 2007] of the average radii of orbits of the Earth, the Mercury and the Uranus (j=7), the time periods of circulations around the Sun and the masses of the Uranus, the Mercury and the Sun, we calculate the numerical value $s(\text{Sun} - \tau_7, \text{ first approx.}) = 93.8337322$, which means that the maximal integral energy gravitational influence of the Sun (owing to the gravitational interaction of the Sun with the Uranus) on the unit mass of the Earth (at the mass center C_3 the Earth τ_3) is $s(\mathrm{Sun}-\tau_7, \text{first approx.})/s(7) = 93.8337322/0.0133 = 7055.167834$ times larger than the power of the maximal integral energy gravitational influence of the Uranus (at the mass center C_3 of the Earth τ_3).

Using the formula (3.110) and the planetary numerical values [Zhirmunsky and Kuzmin, 1990; Simonenko, 2007] of the average radii of orbits of the Earth, the Mercury and the Neptune (j=8), the time periods of circulations around the Sun and the masses of the Neptune, the Mercury and the Sun, we calculate the numerical value $s(\mathrm{Sun}-\tau_8, \text{ first approx.}) = 87.8477601$, which means that the maximal integral energy gravitational influence of the Sun (owing to the gravitational interaction of the Sun with the Neptune) on the unit mass of the Earth (at the mass center C_3 of the Earth τ_3) is $s(\mathrm{Sun}-\tau_8, \text{first approx.})/s(8) = 87.8477601/0.003229 = 27205.87182$ times larger than the power of the maximal integral energy gravitational influence of the Neptune (at the mass center C_3 of the Earth τ_3).

Thus, taking into account the calculated relative values $s(\mathrm{Sun}-\tau_j, \text{first approx.})$ of the maximal integral energy gravitational influences of the Sun on the Earth owing to the gravitational interaction of the Sun with the outer large planets τ_j $(j = 5, 6, 7, 8)$, we obtain the following order of signification of the outer large planets τ_j $(j = 5, 6, 7, 8)$ of the Solar System: the Jupiter $(s(\mathrm{Sun}-\tau_5, \text{ first approx.}) = 4235.613239)$, the Saturn $(s(\mathrm{Sun}-\tau_6, \text{ first approx.}) = 887.4442965)$, the Uranus $(s(\mathrm{Sun}-\tau_7, \text{ first approx.}) = 93.8337322)$ and the Neptune $(s(\mathrm{Sun}-\tau_8, \text{ first approx.}) = 87.8477601)$ in respect of the established evaluation of the maximal integral energy gravitational influences of the Sun on the Earth owing to the gravitational interaction of the Sun with the outer large planets τ_j $(j = 5, 6, 7, 8)$. We establish that the Sun induce the main maximal integral energy gravitational influences on the Earth owing to the gravitational interaction of the Sun with the outer large planets τ_j $(j = 5, 6, 7, 8)$.

Considering the aspect of the cosmic gravitational preparation of the strong earthquakes, we can state the established predominance of the maximal integral energy gravitational influences of the Sun on the Earth owing to the gravitational interaction of the Sun with the Jupiter $(s(\mathrm{Sun}-\tau_5, \text{ first approx.}) = 4235.613239)$, the Saturn $(s(\mathrm{Sun}-\tau_6, \text{ first approx.}) = 887.4442965)$, the Uranus $(s(\mathrm{Sun}-\tau_7, \text{ first approx.}) = 93.8337322)$ and the Neptune $(s(\mathrm{Sun}-\tau_8, \text{ first approx.}) = 87.8477601)$ along with the established [Simonenko, 2007; 2009] Venusian $(s(2) = 89.6409)$ and the Jupiter's $(s(5) = 31.319)$ planetary energy gravitational predominance and the established [Simonenko, 2009; 2010] significant maximal integral energy gravitational influence of the Moon $(s(\mathrm{Moon}, \text{second approx.}) = 13.0693)$ on the Earth.

Thus, taking into account the previously established planetary [Simonenko, 2007] and lunar [Simonenko, 2009; 2010] numerical values and also the calculated relative values $s(\mathrm{Sun}-\tau_j, \text{first approx.})$ of the maximal integral energy gravitational influences of the Sun on the Earth owing to the gravitational interaction of the Sun with the outer large planets τ_j $(j = 5, 6, 7, 8)$, we obtain the following order of significance of the cosmic bodies of the Solar System: the Sun (owing to the gravitational interaction of the Sun with the Jupiter, the Saturn, the Uranus and the Neptune), the Venus, the Jupiter, the Moon, the Mars, the Saturn, the Mercury, the Uranus, the Neptune and the Pluto in respect of the evaluated integral energy gravitational influences of these cosmic bodies on the Earth.

3.4. The real cosmic energy gravitational genesis of the strong earthquakes and the global planetary cataclysms

3.4.1. The confirmation of the real cosmic energy gravitational genesis of preparation of earthquakes

Using the formula (3.51), we evaluated [Simonenko, 2007; 2009; 2010] the numerical value $E_g(\tau_2, D_3, m_\tau)$ of the integral energy gravitational influence of the Venus on the macroscopic continuum region τ (the focal region of the preparing earthquake) of mass m_τ near the surface point D_3 of the Earth during the time

$$T_g(2) = t_1^*(3,2) = \frac{1}{2}\frac{T_2 T_3}{(T_2 - T_3)} = 291.902 \text{ days} \tag{3.111}$$

of the energy gravitational influence of the Venus on the macroscopic continuum region τ of the Earth. Using the expression (3.51) for the maximal positive integral energy gravitational influence $E_g(\tau_2, D_3, m_\tau)$ of the Venus (i = 2) on the macroscopic continuum region τ of mass m_τ near the point D_3 of the Earth, we obtained [Simonenko, 2007; 2009; 2010] the obvious estimation for the value $E_g(\tau_2, D_3, m_\tau)$:

$$E_g(\tau_2, D_3, m_\tau) = 2\gamma\, m_\tau M_2 \frac{R_{O2} T_3}{(R_{O3}^2 - R_{O2}^2)(T_3 - T_2)} =$$

$$= 2\gamma (l_\tau)^3 \rho_\tau M_2 \frac{R_{O2} T_3}{(R_{O3}^2 - R_{O2}^2)(T_3 - T_2)} > 0 , \tag{3.112}$$

where the final expression for the estimation $E_g(\tau_2, D_3, m_\tau)$ is given for the focal region of the cubical form characterized by the size l_τ of the cube. Considering the following numerical values: l_τ =10 km $\rho_\tau = 5000$ kg/m^3 (the average density of the cubical focal region) and using the numerical value $\gamma = 6.67 \cdot 10^{-11}\, \mathrm{J \cdot m/kg^2}$ (of the gravitational constant) and the following known [Zhirmunsky and Kuzmin, 1990] parameters of the Solar System: $T_V = T_2$ = 224.7 days, $R_{OV} = R_{O2} = 108.1 \cdot 10^6$ km, $M_V = M_2 = 0.82 M_3$, $M_3 = 6 \cdot 10^{24}$ kg, T_3 = 365.3 days, we calculated [Simonenko, 2007; 2009; 2010] from the expression (3.112) the numerical estimation for the value $E_g(\tau_2, D_3, m_\tau)$:

$$E_g(\tau_2, D_3, m_\tau) = 8.619 \cdot 10^{19}\, \mathrm{J}, \tag{3.113}$$

which is close to the change "$\Delta W \approx 10^{20}$ J" [Vikulin, 2003; p. 94] of the rotational kinetic energy of the Earth during the strongest earthquakes. The order of magnitude of the estimation (3.113) for the value $E_g(\tau_2, D_3, m_\tau)$ is consistent with the earlier estimation of the seismotectonic energy E_{ST} [Vikulin, 2003; p. 94], which can discharge in the focal region of the strongest earthquakes. Obviously, the seismotectonic energy $E_{ST}(\tau_2, D_3, m_\tau)$ cannot be larger than $E_g(\tau_2, D_3, m_\tau)$:

$$E_{ST}(\tau_2, D_3, m_\tau) \le E_g(\tau_2, D_3, m_\tau). \tag{3.114}$$

It was pointed out [Vikulin, 2003; p. 96] that the coincidence of the values E_{ST} and ΔW is not the casual fact: it is the indication that the strongest earthquake can be considered as the energy quantum corresponding to the regular change of the rotational regime of the Earth. Using the equivalent generalized differential formulations (1.43), (1.50) and (1.53) of the first law of thermodynamics for the focal region τ of the preparing earthquake, we found rigorously the equality of the orders of the magnitude of the values E_{ST} and ΔW for the strongest earthquakes. Consequently, the coincidence of the orders of the magnitude of the values E_{ST}, ΔW and $E_g(\tau_2, D_3, m_\tau)$ is the indication that the regular changes of the rotational regime of the Earth are related with the regular discharges of the accumulated potential energy (in the different focal regions of earthquakes) supplying by the cosmic gravitational energy influences of the planets of the Solar System, the Sun and the Moon.

Thus, based on the equivalent generalized differential formulations (1.43), (1.50) and (1.53) of the first law of thermodynamics used for the Earth's macroscopic continuum region τ (the focal region of the preparing earthquake), we evaluated [Simonenko, 2007; 2009; 2010] the reality of the cosmic energy gravitational genesis of preparation of the earthquakes.

3.4.2. The evidence of the integral energy gravitational influence on the Earth of the Sun (owing to the gravitational interactions of the Sun with the Jupiter τ_5 and the Saturn τ_6) and the Moon as the predominant cosmic trigger mechanism of the earthquakes preparing by the combined integral energy gravitational influence on the Earth of the Sun (owing to the gravitational interactions of the Sun with the Jupiter τ_5 and the Saturn τ_6, the Uranus τ_7 and the Neptune τ_8), the Venus, the Jupiter, the Moon, the Mars and the Mercury

We evaluated [Simonenko, 2007] the relative (normalized on the maximal integral energy gravitational influence of the Mercury τ_1 on the Earth) average integral energy gravitational planetary influences corresponding to the time duration $T_{MOON}/2$ of the maximal integral energy gravitational influence of the Moon on the Earth. We took into account the time durations of the maximal integral energy gravitational influences on the Earth of the inner planets (the Mercury τ_1 and the Venus τ_2):

$$T_g(i) = t_1^*(i,3) = \frac{1}{2}\frac{T_i T_3}{(T_3 - T_i)}, \quad (i = 1, 2), \tag{3.115}$$

which are the time durations of supplying of the cosmic planetary gravitational energy from the inner planets (i=1, 2) to the focal region of the preparing earthquakes. We took into account the time durations of the maximal integral energy gravitational influences on the Earth of the outer planets (the Mars τ_4, the Jupiter τ_5, the Saturn τ_6, the Uranus τ_7, the Neptune τ_8 and the Pluto τ_9):

$$T_g(i) = t_1^*(3,i) = \frac{1}{2}\frac{T_i T_3}{(T_i - T_3)}, \quad (i = 4, 5, 6, 7, 8, 9) \tag{3.116}$$

which are the time durations of supplying of the cosmic planetary gravitational energy from the outer planets (i = 4, 5, 6, 7, 8, 9) to the focal region of the preparing earthquakes.

We defined [Simonenko, 2007] and calculated the relative values $s(i)$ (normalized on the maximal integral energy gravitational influence of the Mercury (i =1) on the Earth) of the maximal integral energy gravitational influences on the Earth of the planets of the Solar System (i = 1, 2, 4, 5, 6, 7, 8, 9). We evaluated [Simonenko, 2007] the relative (normalized on the maximal integral energy gravitational influence of the Mercury (i =1) on the Earth) average values $e(i)$ of the integral energy gravitational influences on the Earth of the planets of the Solar System corresponding to the time duration $T_{MOON}/2$ of the maximal integral energy gravitational influence of the Moon on the Earth. This evaluation is given by the following formula [Simonenko, 2007]:

$$e(i) = s(i)\frac{0.5T_{MOON}}{T_g(i)}, \quad (i = 1, 2, 4, 5, 6, 7, 8, 9). \tag{3.117}$$

Using the expression (3.115) for the time $T_g(i)$ of supplying of the cosmic planetary gravitational energy from the inner planets (i=1, 2), the expression (3.116) for the time $T_g(i)$ of supplying of the cosmic planetary gravitational energy from the outer planets (i = 4, 5, 6, 7, 8, 9) and the expression (3.117) for the relative average values $e(i)$, we calculated the following numerical values [Simonenko, 2007]: $T_g(1) = 57.96$ days and $e(1) = 0.2547$ (which is one order of magnitude smaller than $s(\text{Moon, second approx.}) = 13.0693$) for the Mercury; $T_g(2) = 291.902$ days and $e(2) = 4.5342$ (which is smaller than $s(\text{Moon, second approx.}) = 13.0693$) for the Venus; $T_g(4) = 390.0545$ days and $e(4) = 0.0999$ (which is significantly smaller than $s(\text{Moon, second approx.}) = 13.0693$) for the Mars; $T_g(5) = 199.4705$ days and $e(5) = 2.3182$ (which is smaller significantly than

$s(\text{Moon, second approx.}) = 13.0693$) for the Jupiter; $T_g(6) = 189.069$ days and $e(6) = 0.0809$ (which is significantly smaller than $s(\text{Moon, second approx.}) = 13.0693$) for the Saturn; $T_g(7) = 184.8506$ days and $e(7) = 0.001066$ (which is four orders of the magnitude smaller than $s(\text{Moon, second approx.}) = 13.0693$) for the Uranus; $T_g(8) = 183.7653$ days and $e(8) = 0{,}0002594$ (which is four-five orders of the magnitude smaller than $s(\text{Moon, second approx.}) = 13.0693$) for the Neptune; $T_g(9) = 183.3905$ days and $e(9) = 1.1671 \cdot 10^{-8}$ (which is nine orders of the magnitude smaller than $s(\text{Moon, second approx.}) = 13.0693$) for the Pluto.

We established [Simonenko, 2007] the following order of significance of the planets of the Solar System and the Moon for the cosmic gravitational preparation of the strong earthquakes: the Venus ($s(2) = 89.6409$), the Jupiter ($s(5) = 31.319$), the Moon ($s(\text{Moon, second approx.}) = 13.0693$), the Mars ($s(4) = 2.6396$), the Saturn ($s(6) = 1.036$), the Mercury ($s(i) = 1$), the Uranus ($s(7) = 0.0133$), the Neptune ($s(8) = 0.003229$) and the Pluto ($s(9) = 1.4495 \cdot 10^{-7}$). We established [Simonenko, 2007] the different order of significance of the planets of the Solar System and the Moon related with the defined relative average values $e(i)$: the Moon ($s(\text{Moon, second approx.}) = 13.0693$), the Venus ($e(2) = 4.5342$), the Jupiter ($e(5) = 2.3182$), the Mercury ($e(1) = 0.2547$), the Mars ($e(4) = 0.0999$), the Saturn ($e(6) = 0.0809$), the Uranus ($e(7) = 0.001066$), the Neptune ($e(8) = 0.0002594$) and the Pluto ($e(9) = 1.1671 \cdot 10^{-8}$). Taking into account the obtained [Simonenko, 2007] numerical values $e(i)$ for the planets of the Solar System and the numerical value $s(\text{Moon, second approx.}) = 13.0693$ [Simonenko, 2009; 2010] for the Moon, we established [Simonenko, 2009; 2010] the predominant significance of the Moon (along with the minor significance of the Venus, the Jupiter and the Mercury) as the predominant cosmic trigger mechanism of the earthquakes preparing by the combined integral energy gravitational influences on the Earth of the Venus, the Jupiter, the Moon, the Mars and the Mercury.

Taking into account the additional significant results of Subsection 3.3, let us evaluated now the relative (normalized on the maximal integral energy gravitational influence of the Mercury (i =1) on the Earth) average values $e_S(j)$ (corresponding to the time duration $T_{MOON}/2$ of the maximal integral energy gravitational influence of the Moon on the Earth) of the integral energy gravitational influences on the Earth of the Sun owing to the gravitational interaction of the Sun with the outer large planets τ_j $(j = 5, 6, 7, 8)$. This evaluation is based on the following formula:

$$e_S(j) = s(\text{Sun} - \tau_j, \text{first approx.}) \frac{0.5 T_{MOON}}{T_g(j)}. \quad (j = 5, 6, 7, 8) \tag{3.118}$$

We take into account the time durations of the maximal integral energy gravitational influences on the Earth of the Sun owing to the gravitational interaction of the Sun with the outer large planets τ_j (the Jupiter τ_5, the Saturn τ_6, the Uranus τ_7 and the Neptune τ_8):

$$T_g(j) = t_1^*(3, j) = \frac{1}{2} \frac{T_i T_3}{(T_j - T_3)}, \quad (j = 5, 6, 7, 8) \tag{3.119}$$

which are the time durations of supplying of the cosmic solar gravitational energy from the Sun (owing to the gravitational interaction of the Sun with the outer large planets τ_j, $j = 5, 6, 7, 8$) to the focal region of the preparing earthquakes. Taking into account the calculated relative values $s(\text{Sun} - \tau_j, \text{first approx.})$ of the maximal integral energy gravitational influences of the Sun on the Earth owing to the gravitational interaction of the Sun with the outer large planets τ_j $(j = 5, 6, 7, 8)$ and using the expressions (3.118) and (3.119), we calculate the following numerical values: $e_S(5) = 313.5305$ (for the Sun owing to the Jupiter τ_5), $e_S(6) = 69.3047$ (for the Sun owing to the Saturn τ_6), $e_S(7) = 7.4951$ (for the Sun owing to the Uranus τ_7) and $e_S(8) = 7.0584$ (for the Sun owing to the Neptune τ_8).

Taking into account the obtained [Simonenko, 2007] numerical values $e(i)$ for the planets of the Solar System, the numerical value $s(\text{Moon, second approx.}) = 13.0693$ [Simonenko, 2009; 2010] for the Moon and the obtained numerical values $e_S(j)$ for the Sun (owing to the gravitational interaction of the Sun with the outer large planets τ_j, $j = 5, 6, 7, 8$), we establish the predominant significance of the Sun (owing to the gravitational interactions of the Sun with the Jupiter τ_5 and the Saturn τ_6) and the Moon as the predominant cosmic trigger mechanism (along with the minor significance of the Sun (owing to the gravitational interactions of the Sun with the Uranus τ_7 and the Neptune τ_8), the Venus, the Jupiter and the Mercury) of the earthquakes preparing by the combined integral energy gravitational influences on the Earth of the Sun (owing to the gravitational interactions of the Sun with the Jupiter τ_5 and the Saturn τ_6, the Uranus τ_7 and the Neptune τ_8), the Venus, the Jupiter, the Moon, the Mars and the Mercury.

3.4.3. The catastrophic planetary configurations of the cosmic seismology

3.4.3.1. The catastrophic planetary configurations related with the maximal (positive) and minimal (negative) combined integral energy gravitational influence on the Earth τ_3 of the planets of the Solar System

Taking into account the considered planetary and lunar energy gravitational influences on the Earth [Simonenko, 2007; 2009; 2010], we established [Simonenko, 2009; 2010] that the maximal probabilities of a strong earthquakes (induced by the planetary and lunar energy gravitational influences on the Earth) are attained in two catastrophic planetary configurations:

a) when the Sun, the Moon, the inner planets (the Mercury and the Venus) and the outer planets (the Mars, the Jupiter, the Saturn, the Uranus, the Neptune and the Pluto) are aligned in a straight line with the Earth, and moreover (in the first catastrophic configuration): the inner planets (the Mercury and the Venus) are in close conjunctions with the Earth (and simultaneously in mutual close opposition), the outer planets (the Mars, the Jupiter, the Saturn, the Uranus, the Neptune and the Pluto) are in close oppositions with the Earth and the Moon in full moon or in new moon configuration depending on the temporal orientation of the lunar orbit;

b) when the Sun, the Moon, the inner planets (the Mercury and the Venus) and the outer planets (the Mars, the Jupiter, the Saturn, the Uranus, the Neptune and the Pluto) are aligned in a straight line with the Earth, and moreover (in the second catastrophic configuration): the inner planets (the Mercury and the Venus) are in close oppositions with the Earth, the outer planets (the Mars, the Jupiter, the Saturn, the Uranus, the Neptune and the Pluto) are in close conjunctions with the Earth and the Moon in new moon or in full moon configuration depending on the temporal orientation of the lunar orbit.

These two (shown on Fig. 11 and Fig. 12) catastrophic planetary configurations a) and b) are deduced from the global prediction thermohydrogravidynamic principles. The catastrophic planetary configuration a) (shown on Fig. 11) is founded based on the global prediction thermohydrogravidynamic principle (consistent with the generalized differential formulations (1.43) and (1.50) of the first law of thermodynamics of the established cosmic seismology [Simonenko, 2007; 2008; 2009; 2010]) associated with the maximal (positive) combined planetary integral energy gravitational influence on the Earth:

$$\Delta G_p(t) = \int_{t_0}^{t} dG_p = \textit{local maximum for time moment } t^{\bullet}, \tag{3.120}$$

where the time moment $t^{\bullet}$ is related with the maximal (positive) combined integral energy gravitational influence on the Earth τ_3 of the planets of the Solar System for the time moment $t = t^{\bullet}$:

$$\Delta G_p(t^*) = \max_t \Delta G_p(t) = \max_t \left\{ \sum_{i=1, i\neq 3}^{9} \int_{t_0}^{t} \left(\iiint_{\tau_3} \frac{\partial \psi_{3i}}{\partial t'} \rho dV \right) dt' \right\}. \tag{3.121}$$

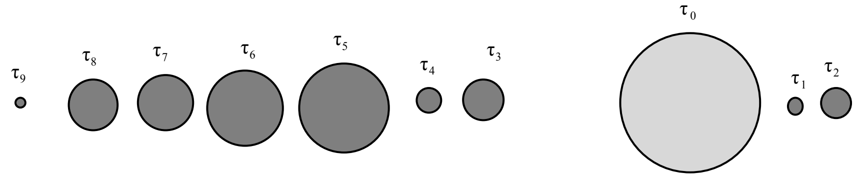


Fig. 11. The catastrophic planetary configuration a) characterized by the maximal (positive) combined integral energy gravitational influence on the Earth τ_3 of the planets of the Solar System

The catastrophic planetary configuration b) (shown on Fig. 12) is founded based on the global prediction thermohydrogravidynamic principle (consistent with the generalized differential formulations (1.43) and (1.50) of the first law of thermodynamics of the established cosmic seismology [Simonenko, 2007; 2008; 2009; 2010]) associated with the minimal (negative) combined planetary integral energy gravitational influence on the Earth:

$$\Delta G_p(t) = \int_{t_0}^{t} dG_p = \textit{local minimum for time moment } t_*, \tag{3.122}$$

where the time moment t_* is related with the minimal (negative) combined integral energy gravitational influence on the Earth τ_3 of the planets of the Solar System for the time moment $t = t_\bullet$:

$$\Delta G_p(t_\bullet) = \min_t \Delta G_p(t) = \min_t \left\{ \sum_{i=1, i\neq 3}^{9} \int_{t_0}^{t} \left(\iiint_{\tau_3} \frac{\partial \psi_{3i}}{\partial t'} \rho dV \right) dt' \right\}. \tag{3.123}$$

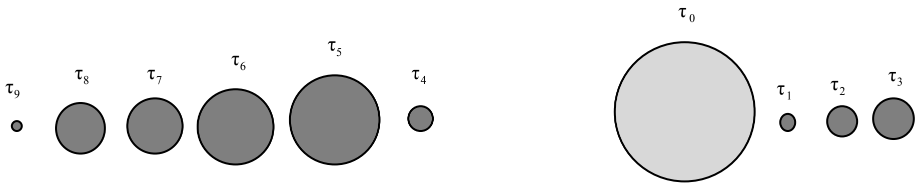


Fig. 12. The catastrophic planetary configurations b) characterized by the minimal (negative) combined integral energy gravitational influence on the Earth τ_3 of the planets of the Solar System

3.4.3.2. The catastrophic planetary configurations related with the maximal (positive) and minimal (negative) combined integral energy gravitational influence on the Earth τ_3 of the Sun and the planets of the Solar System

Taking into account the considered planetary [Simonenko, 2007; 2009; 2010] and the additional (considered in Subsection 3.3) very significant solar energy gravitational influences on the Earth (owing to the gravitational interaction of the Sun with the outer large planets τ_j, $j = 5, 6, 7, 8$), we establish that the global planetary cataclysms (accompanied by the finite change of the space orientation of the Earth's axis, the irreversible deformation of the Earth's surface and by the strong catastrophic earthquakes) are attained in two catastrophic planetary configurations (determined by the planetary and solar energy gravitational influences on the Earth) shown on Fig. 13 and Fig. 14, respectively.

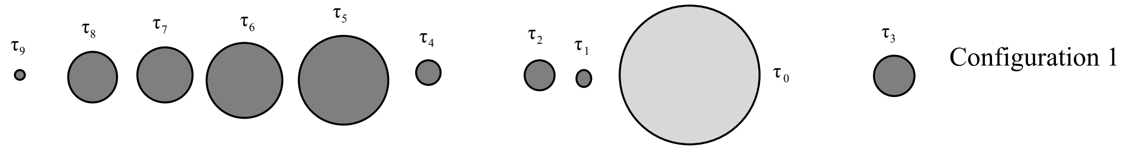


Fig. 13. The catastrophic planetary configuration 1 determined by the maximal combined integral energy gravitational influences on the Earth (τ_3) of the Sun (due to the gravitational interactions of the Sun (τ_0) with the Jupiter (τ_5), the Saturn (τ_6), the Uranus (τ_7), and the Neptune (τ_8)), the Mercury (τ_1), the Venus (τ_2), the Mars (τ_4) and the Jupiter (τ_5) aligned in a straight line

These two (shown on Fig. 13 and Fig. 14) catastrophic planetary configurations 1 and 2 are deduced from the global prediction thermohydrogravidynamic principles. The catastrophic planetary configurations 1 (shown on Fig. 13) is founded based on the global prediction thermohydrogravidynamic principle (consistent with the generalized differential formulations (1.43) and (1.50) of the first law of thermodynamics of the established cosmic seismology [Simonenko, 2007; 2008; 2009; 2010]) associated with the maximal (positive) combined integral energy gravitational influence on the Earth of the planets of the Solar System and the Sun (owing to the gravitational interaction of the Sun with the outer large planets τ_j, $j = 5, 6, 7, 8$):

$$\Delta G(t) = \int_{t_0}^{t} dG = \textit{local maximum for time moment } t^{\bullet}, \tag{3.124}$$

where the time moment $t^{\bullet}$ is related with the maximal (positive) combined planetary and solar integral energy gravitational influence on the Earth τ_3 for the time moment $t = t^{\bullet}$:

$$\Delta G(t^*) = \max_t \Delta G(t) = \max_t \left\{ \sum_{i=1, i\neq 3}^{9} \int_{t_0}^{t} \Big(\iiint_{\tau_3} \frac{\partial \psi_{3i}}{\partial t'} \rho dV\Big) dt' + \sum_{j=5,6,7,8} \int_{t_0}^{t} \Big(\iiint_{\tau_3} \frac{\partial \psi_{3j}^{S}}{\partial t'} \rho dV\Big) dt' \right\}. \tag{3.125}$$

The catastrophic planetary configuration 2 (shown on Fig. 14) is founded based on the global prediction thermohydrogravidynamic principle (consistent with the generalized differential formulations (1.43) and (1.50) of the first law of thermodynamics of the established cosmic seismology [Simonenko, 2007; 2008; 2009; 2010]) associated with the minimal (negative) combined planetary and solar integral energy gravitational influence on the Earth:

$$\Delta G(t) = \int_{t_0}^{t} dG = \textit{local minimum for time moment } t_*, \tag{3.126}$$

where the time moment t_* is related with the minimal (negative) combined planetary and solar integral energy gravitational influence on the Earth τ_3 for the time moment $t = t_{\bullet}$:

$$\Delta G(t_{\bullet}) = \min_t \Delta G(t) = \min_t \left\{ \sum_{i=1, i\neq 3}^{9} \int_{t_0}^{t} \Big(\iiint_{\tau_3} \frac{\partial \psi_{3i}}{\partial t'} \rho dV\Big) dt' + \sum_{j=5,6,7,8} \int_{t_0}^{t} \Big(\iiint_{\tau_3} \frac{\partial \psi_{3j}^{S}}{\partial t'} \rho dV\Big) dt' \right\}. \tag{3.127}$$

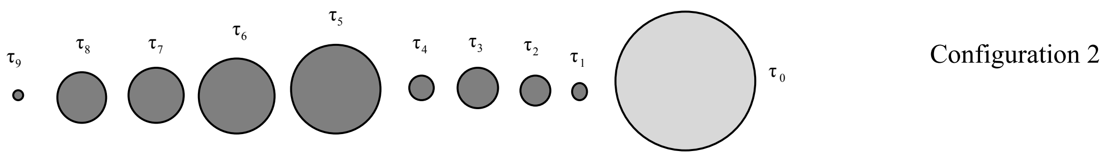


Fig. 14. The catastrophic planetary configuration 2 determined by the minimal combined integral energy

gravitational influences on the Earth (τ_3) of the Sun (due to the gravitational interactions of the Sun (τ_0) with the Jupiter (τ_5), the Saturn (τ_6), the Uranus (τ_7), and the Neptune (τ_8)), the Mercury (τ_1), the Venus (τ_2), the Mars (τ_4) and the Jupiter (τ_5) aligned in a straight line

We can state (according to cosmic geophysics) without any doubt that all previous global planetary cataclysms (accompanied by the finite change of the space orientation of the Earth's axis, the irreversible deformation of the Earth's surface and by the strong catastrophic earthquakes) were occurred during a time periods of the satisfactory realization of the catastrophic planetary configurations (shown on Fig. 13 and Fig. 14) of the planets and the Sun aligned approximately in a straight line, when the planets and the Sun are visible (especially, for catastrophic planetary configuration 1 shown on Fig. 13) from the Earth within the narrow angle range (related with one or two zodiacal constellations). Without any doubt, we can state that all future global planetary cataclysms (accompanied by the finite change of the space orientation of the Earth's axis, the irreversible deformation of the Earth's surface and by the strong catastrophic earthquakes) will be related with the time periods of the satisfactory realization of the catastrophic planetary configurations (shown on Fig. 13 and Fig. 14) of the planets and the Sun aligned approximately in a straight line.

Thus, taking into account the obtained results of this Subsection 3.4.3 and the founded [2007; 2009; 2010] galactic energy gravitational genesis (considered in Section 2) of the time periodicity of 100 million years [Hofmann, 1990] of the maximal endogenous heating of the Earth (explained by the periodic deformation of the Earth due to the periodic energy gravitational influences on the Solar System of the center of our Galaxy), we solve the major Wegener's problem (Wegener, 1929) by finding the predominant cosmic energy gravitational influences on the Earth (of the center of our Galaxy and the Solar System) capable of to break up the supercontinent Pangaea and responsible for the subsequent continental drift.

3.5. The generalized thermohydrogravidynamic shear-rotational, classical shear (deformational) and rotational models of the earthquake focal region τ, and the local energy and entropy prediction thermohydrogravidynamic principles determining the fractures formation in the macroscopic continuum region τ

3.5.1. The generalized thermohydrogravidynamic shear-rotational and the classical shear (deformational) models of the earthquake focal region based on the generalized differential formulation of the first law of thermodynamics

Following the works [Simonenko, 2007a; 2007; 2008], we present the foundation of the generalized thermohydrogravidynamic shear-rotational model of the earthquake focal region based on the generalized differential formulation (1.53) of the first law of thermodynamics used for the earthquake focal region. Using the evolution equitation (1.67) of the total mechanical energy of the subsystem τ (the macroscopic continuum region τ) of the Earth, we shall show now that the formation of fractures (modeling by the jumps of the continuum velocity on some surfaces) are related with irreversible dissipation of the macroscopic kinetic energy and the corresponding increase of entropy. We consider at the beginning the analysis of formation of the main line flat fracture (associated with the surface $F_1(\tau)$ of the continuum velocity jump) inside of the macroscopic continuum region τ (bounded by the closed surface $\partial\tau$). The macroscopic continuum region τ may be divided into two subsystem τ_1 and τ_2 by continuing mentally the surface $F_1(\tau)$ by means of surface $R_1(\tau)$ crossing the surface $\partial\tau$ of the macroscopic region τ. The surface of the subsystem τ_1 consists of the surface $(\partial\tau)_1$ (which is the part of the surface $\partial\tau$) and the surfaces $F_1(\tau)$ and $R_1(\tau)$. The surface of the subsystem τ_2 consists of the surface $(\partial\tau)_2$ (which is the part of the surface $\partial\tau$) and the surfaces $F_1(\tau)$ and $R_1(\tau)$.

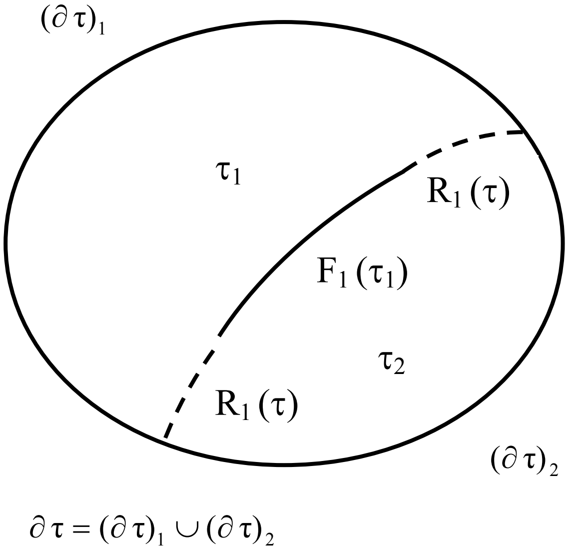


Fig. 15. The macroscopic continuum region τ containing two subsystem τ_1 and τ_2 interacting on the surface $F_1(\tau)$ of the tangential jump of the continuum velocity

Using the formulation (1.67), we have the evolution equations for the total mechanical energies of the macroscopic subsystems τ_1 and τ_2:

$$\frac{d}{dt}(K_{\tau_1} + \pi_{\tau_1}) = \frac{d}{dt}\iiint_{\tau_1}\left(\frac{1}{2}\mathbf{v}^2 + \psi\right)\rho dV =$$

$$= \iiint_{\tau_1} p\,\mathrm{div}\mathbf{v}dV + \iiint_{\tau_1}\left(\frac{2}{3}\eta - \eta_v\right)(\mathrm{div}\mathbf{v})^2 dV - \iiint_{\tau_1} 2\nu(e_{ij})^2\rho dV + \iint_{(\partial\tau)_1}(\mathbf{v}\cdot(\mathbf{n}\cdot\mathbf{T}))\,d\Omega_{\mathbf{n}} +$$

$$+ \iint_{F_1(\tau)}(\mathbf{v}_1(\tau_1)\cdot(\zeta_1\cdot\mathbf{T}))\,d\Sigma_{\zeta_1} + \iint_{R_1(\tau)}(\mathbf{v}_1(\tau_1)\cdot(\zeta_1\cdot\mathbf{T}))\,d\Sigma_{\zeta_1} + \iiint_{\tau_1}\frac{\partial\psi}{\partial t}\rho dV, \tag{3.128}$$

$$\frac{d}{dt}(K_{\tau_2} + \pi_{\tau_2}) = \frac{d}{dt}\iiint_{\tau_2}\left(\frac{1}{2}\mathbf{v}^2 + \psi\right)\rho dV =$$

$$= \iiint_{\tau_2} p\,\mathrm{div}\mathbf{v}dV + \iiint_{\tau_2}\left(\frac{2}{3}\eta - \eta_v\right)(\mathrm{div}\mathbf{v})^2 dV - \iiint_{\tau_2} 2\nu(e_{ij})^2\rho dV + \iint_{(\partial\tau)_2}(\mathbf{v}\cdot(\mathbf{n}\cdot\mathbf{T}))\,d\Omega_{\mathbf{n}} -$$

$$- \iint_{F_1(\tau)}(\mathbf{v}_1(\tau_2)\cdot(\zeta_1\cdot\mathbf{T}))\,d\Sigma_{-\zeta_1} - \iint_{R_1(\tau)}(\mathbf{v}_1(\tau_2)\cdot(\zeta_1\cdot\mathbf{T}))\,d\Sigma_{-\zeta_1} + \iiint_{\tau_2}\frac{\partial\psi}{\partial t}\rho dV, \tag{3.129}$$

where ζ_1 is the external unit normal vector of the surface (of the subsystem τ_1) presented by surfaces $F_1(\tau)$ and $R_1(\tau)$, $-\zeta_1$ is the external unit normal vector of the surface (of the subsystem τ_2) presented also by surfaces $F_1(\tau)$ and $R_1(\tau)$. Adding the equations (3.128) and (3.129) (by using the equality $d\Sigma_{\zeta_1} = d\Sigma_{-\zeta_1}$ of the elements of area of surfaces $F_1(\tau)$ and $R_1(\tau)$), we get the evolution equation for the total mechanical energy $(K_\tau + \pi_\tau) = (K_{\tau_1} + K_{\tau_2} + \pi_{\tau_1} + \pi_{\tau_2})$ of the macroscopic region τ consisting from subsystems τ_1 and τ_2 interacting on the surface $F_1(\tau)$ of the tangential jump of the continuum velocity:

$$\frac{d}{dt}\left(K_\tau + \pi_\tau\right) = \frac{d}{dt}\iiint_\tau \left(\frac{1}{2}\mathbf{v}^2 + \psi\right)\rho dV =$$

$$= \iiint_\tau p \operatorname{div}\mathbf{v} dV + \iiint_\tau \left(\frac{2}{3}\eta - \eta_v\right)(\operatorname{div}\mathbf{v})^2 dV - \iiint_\tau 2\nu\left(e_{ij}\right)^2 \rho dV +$$

$$+ \iint_{\partial\tau} \left(\mathbf{v}\cdot\left(\mathbf{n}\cdot\mathbf{T}\right)\right) d\Omega_{\mathbf{n}} + \iint_{F_1(\tau)} \left((\mathbf{v}_1(\tau_1) - \mathbf{v}_1(\tau_2))\cdot\left(\zeta_1\cdot\mathbf{T}\right)\right) d\Sigma_{\zeta_1} + \iiint_\tau \frac{\partial\psi}{\partial t}\rho dV, \qquad (3.130)$$

where $\mathbf{v}_1(\tau_1)$ is the vector of the continuum velocity on the surface $F_1(\tau)$ in the subsystem τ_1, $\mathbf{v}_1(\tau_2)$ is the vector of the continuum velocity on the surface $F_1(\tau)$ in the subsystem τ_2.

The evolution equation (3.130) takes into account the total mechanical energy $(K_\tau + \pi_\tau) = (K_{\tau_1} + K_{\tau_2} + \pi_{\tau_1} + \pi_{\tau_2})$ of the macroscopic region τ consisting from subsystems τ_1 and τ_2 interacting on the surface $F_1(\tau)$ of the tangential jump of the continuum velocity. The first term in the second row (of the equation (3.130)) describes the evolution of the total mechanical energy of the macroscopic continuum region τ due to the continuum reversible compressibility, the second and the third terms in the second row expresses the dissipation of the macroscopic kinetic energy by means of the irreversible continuum compressibility and the velocity shear. The forms of three terms in the second row (of the equation (3.130)) are related with the considered model of the compressible viscous Newtonian continuum. The fourth, fifth and the sixth terms in the third row (of the equation (3.130)) are the universal terms for arbitrary model of continuum characterized by symmetrical stress tensor $\mathbf{T}$. The fourth term express the power

$$W_{np,\partial\tau} = \delta A_{np,\partial\tau} / dt = \iint_{\partial\tau} \left(\mathbf{v}\cdot\left(\mathbf{n}\cdot\mathbf{T}\right)\right) d\Omega_{\mathbf{n}} \qquad (3.131)$$

of external (for the continuum region τ) non-potential stress forces acting on the boundary surfaces $\partial\tau$ of the macroscopic continuum region τ. The fifth term express the power of external (for the continuum region τ) forces on different sides of the velocity jumps during the fractures formation on the surfaces $F_i(\tau)$. The sixth term in equation (3.130) presents the power of the total mechanical energy added (or lost) as the result of the Newtonian non-stationary gravitational energy influence on the macroscopic continuum region τ related with variations of the potential ψ of the gravity field in the continuum region τ.

Consider the equation (3.130) for one continuum velocity jump on the non-stationary surfaces $F_1(\tau)$ during the time interval $(t, t+\Delta t)$. We calculated [Simonenko, 2007] the energy dissipation during formation of the surface dislocation. Taking into account the form of fifth term on the right-hand side of the evolution equation (3.130), we obtained [Simonenko, 2007] the expression for the work $\delta A_{np,F_1(\tau)}$ (done during the time interval $(t, t+\Delta t)$ by the external (for the continuum region τ) non-potential stress forces acting on different sides of the velocity jump on the surface $F_1(\tau)$):

$$\delta A_{np,F_1(\tau)} = \int_t^{t+\Delta t} \left(\iint_{F_1(\tau)} \left((\mathbf{v}_1(\tau_1) - \mathbf{v}_1(\tau_2))\cdot\left(\zeta_1\cdot\mathbf{T}\right)\right) d\Sigma_{\zeta_1} \right) dt, \qquad (3.132)$$

which reduces to the following expression (after transposition of integration order):

$$\delta A_{np,F_1(\tau)} = \iint_{F_1(\tau)} \left(\int_t^{t+\Delta t} (\mathbf{v}_1(\tau_1) - \mathbf{v}_1(\tau_2))\cdot\left(\zeta_1\cdot\mathbf{T}\right) dt \right) d\Sigma_{\zeta_1}. \qquad (3.133)$$

To test the formula (3.133), we calculated [Simonenko, 2007] the energy $\delta A_{np,\Delta\Sigma}$, which dissipates during formation of the surface dislocation on the small surface $\Delta\Sigma$ during the time interval $(t, t+\Delta t)$. Using the theorem about the average value and integrating the internal integral on time, we obtained [Simonenko, 2007] from relation (3.133) for $F_1(\tau) = \Delta\Sigma$ the following relation:

$$\delta A_{np,\Delta\Sigma} = \iint_{\Delta\Sigma} \left((\mathbf{w}(\zeta_1, t+\Delta t) - \mathbf{w}(-\zeta_1, t+\Delta t) \right) \cdot < (\zeta_1 \cdot \mathbf{T}) > d\Sigma_{\zeta_1} , \tag{3.134}$$

where $< (\zeta_1 \cdot \mathbf{T}) >$ is the average value of the stress vector for the element of area $d\Sigma_{\zeta_1}$ of the two-side surface $\Delta\Sigma$, $\mathbf{w}(\zeta_1, t+\Delta t)$ and $\mathbf{w}(-\zeta_1, t+\Delta t)$ are the vectors of the continuum displacement on different sides of the element of area $d\Sigma_{\zeta_1}$ of the two-side surface $\Delta\Sigma$ in the points characterized by normal unit vectors ζ_1 and -ζ_1. Using the obvious expression for "linear" time average $< (\zeta_1 \cdot \mathbf{T}) >$:

$$< (\zeta_1 \cdot \mathbf{T}) > = \frac{1}{2} \left((\mathbf{p}(\zeta_1, t) - \mathbf{p}(-\zeta_1, t+\Delta t) \right) \tag{3.135}$$

as the arithmetical average of the values of the stress vectors $\mathbf{p}$ on the different sides from the surface of the jump of the continuum velocity, we obtained [Simonenko, 2007] the expression for the elementary work of the external non-potential stress forces on the two-side surface $\Delta\Sigma$ of dislocation:

$$\delta A_{np,\Delta\Sigma} = \frac{1}{2} \iint_{\Delta\Sigma} \left((\mathbf{w}(\zeta_1, t+\Delta t) - \mathbf{w}(-\zeta_1, t+\Delta t) \right) \cdot \left((\mathbf{p}(\zeta_1, t) + \mathbf{p}(-\zeta_1, t+\Delta t) \right) d\Sigma_{\zeta_1} . \tag{3.136}$$

This expression was obtained in the frame of the classical linear approach [Sedov, 1994; p. 544] to formation of surface dislocations in rigid compressible continuum on the small area of surface $\Delta\Sigma$. It is clear that the suggestion (3.135) is valid only for weak tangential jumps of the continuum displacement. Consequently, we can consider the expression (3.132) as the natural nonlinear generalization of the expression (3.136) for arbitrary surface $F_1(\tau)$ of dislocation and for strong tangential jumps of the continuum displacement on the surface $F_1(\tau)$ of dislocation. The work (3.132) of the external (for the continuum region τ) non-potential stress forces should be negative. The sufficient energy $\delta E_{d,F_1(\tau)}$ needed for formation of the surface $F_1(\tau)$ of dislocation is equal to the work of the internal forces in the macroscopic continuum region τ. The energy $\delta E_{d,F_1(\tau)}$ should be positive and equal to the expression (3.132) with the sign "-":

$$\delta E_{d,F_1(\tau)} = - \delta A_{np,F_1(\tau)} = - \int_t^{t+\Delta t} \left(\iint_{F_1(\tau)} \left((\mathbf{v}_1(\tau_1) - \mathbf{v}_1(\tau_2)) \cdot (\zeta_1 \cdot \mathbf{T}) \right) d\Sigma_{\zeta_1} \right) dt > 0. \tag{3.137}$$

The formulae (3.132), (3.136) and (3.137) are obtained (taking into account the generalized differential formulation (1.43) of the first law of thermodynamics) for the model of continuum characterized by the arbitrary symmetrical stress tensor $\mathbf{T}$.

The macroscopic internal shear kinetic energy $(K_s)_{\tau_1}$ (of the subsystem τ_1), the macroscopic internal rotational kinetic energy $(K_r)_{\tau_1}$ (of the subsystem τ_1) and the macroscopic kinetic energy of shear-rotational coupling $(K_{s,r}^{coup})_{\tau_1}$ (of the subsystem τ_1) are the significant components of the macroscopic internal shear-rotational kinetic energy $(K_{s\text{-}r})_{\tau_1}$ [Simonenko, 2004; 2005; 2006, 2007a; 2007; 2008]:

$$(K_{s\text{-}r})_{\tau_1} = (K_r)_{\tau_1} + (K_s)_{\tau_1} + (K_{s,r}^{coup})_{\tau_1} \tag{3.138}$$

taken into account (along with the classical internal thermal energy U_{τ_1} of the macroscopic continuum region τ_1, the macroscopic potential energy π_{τ_1} of the macroscopic continuum region τ_1 and the macroscopic translational kinetic energy $(K_t)_{\tau_1} = \frac{1}{2} m_{\tau_1} (\mathbf{V}_c)^2_{\tau_1}$ of the continuum region τ_1 (of a mass m_{τ_1}) moving as a whole at speed equal to the speed $(\mathbf{V}_c)_{\tau_1}$ of the center of mass of the continuum region τ_1) in the generalized differential formulation (1.43) of the first law of thermodynamics for the macroscopic continuum region τ_1.

The macroscopic internal shear kinetic energy $(K_s)_{\tau_2}$ (of the subsystem τ_2), the macroscopic internal rotational kinetic energy $(K_r)_{\tau_2}$ (of the subsystem τ_2) and the macroscopic kinetic energy of shear-rotational coupling $(K_{s,r}^{coup})_{\tau_2}$ (of the subsystem τ_2) are the significant components of the macroscopic internal shear-rotational kinetic energy $(K_{s\text{-}r})_{\tau_2}$ [Simonenko, 2004; 2005; 2006, 2007a; 2007; 2008]:

$$(K_{s\text{-}r})_{\tau_2} = (K_r)_{\tau_2} + (K_s)_{\tau_2} + (K_{s,r}^{coup})_{\tau_2} \quad (3.139)$$

taken into account (along with the classical internal thermal energy U_{τ_2} of the macroscopic continuum region τ_2, the macroscopic potential energy π_{τ_2} of the macroscopic continuum region τ_2 and the macroscopic translational kinetic energy $(K_t)_{\tau_2} = \frac{1}{2} m_{\tau_2} (\mathbf{V}_c)_{\tau_2}^2$ of the continuum region τ_2 (of a mass m_{τ_2}) moving as a whole at speed equal to the speed $(\mathbf{V}_c)_{\tau_2}$ of the center of mass of the continuum region τ_2) in the generalized differential formulation (1.43) of the first law of thermodynamics for the macroscopic continuum region τ_2.

The macroscopic internal shear kinetic energy $(K_s)_{\tau_1}$ (of the subsystem τ_1), the macroscopic internal rotational kinetic energy $(K_r)_{\tau_1}$ (of the subsystem τ_1), the macroscopic kinetic energy of shear-rotational coupling $(K_{s,r}^{coup})_{\tau_1}$ (of the subsystem τ_1), the macroscopic translational kinetic energy $(K_t)_{\tau_1} = \frac{1}{2} m_{\tau_1} (\mathbf{V}_c)_{\tau_1}^2$ (of the subsystem τ_1), the macroscopic potential energy π_{τ_1} (of the subsystem τ_1), the macroscopic internal shear kinetic energy $(K_s)_{\tau_2}$ (of the subsystem τ_2), the macroscopic internal rotational kinetic energy $(K_r)_{\tau_2}$ (of the subsystem τ_2), the macroscopic kinetic energy of shear-rotational coupling $(K_{s,r}^{coup})_{\tau_2}$ (of the subsystem τ_2), the macroscopic translational kinetic energy $(K_t)_{\tau_2} = \frac{1}{2} m_{\tau_2} (\mathbf{V}_c)_{\tau_2}^2$ (of the subsystem τ_2) and the macroscopic potential energy π_{τ_2} (of the subsystem τ_2) are the significant energy components taken into account in the presented thermohydrogravidynamic shear-rotational model described by the evolution equation (3.130) for the total mechanical energy $(K_\tau + \pi_\tau)$ of the macroscopic region τ consisting from interacting subsystems τ_1 and τ_2.

Using of the generalized differential formulation (1.43) of the first law of thermodynamics for the macroscopic continuum region τ of the Earth's crust characterized by practically constant viscosity, we obtained [Simonenko, 2007a; 2007; 2008] the thermodynamic foundation of the classical deformational (shear) model [Abramov, 1997] of the earthquake focal region for the quasi-uniform medium of the Earth's crust characterized by practically constant viscosity.

3.5.2. The rotational model of the earthquake focal region based on the generalized differential formulation of the first law of thermodynamics

Following the works [Simonenko, 2007a; 2007; 2008], we present the foundation of the rotational model [Vikulin, 2003] of the earthquake focal region for the seismic zone of the Pacific Ring. It was noted [Vikulin, 2003] that the studies of the dislocation models of the focal regions of strong earthquakes showed the bad correspondence with the model of flat endless dislocation in the uniform continuum [Shamsi and Stacey, 1969; Mount and Suppe, 1987; Guo, 1988].

The analysis [Vikulin, 2003; p. 58] showed that the conditions exist to realize the rotational mechanism related with the rotation of the geo-blocks by means of the stress forces related with the Earth rotation in the vicinity of the seismic zone of the Pacific Ring. It was noted [Vikulin, 2003; p. 58] that the rotational mechanism can be more real in compared to the conventional mechanism related with the formation of the main line flat fracture inside of the focal region.

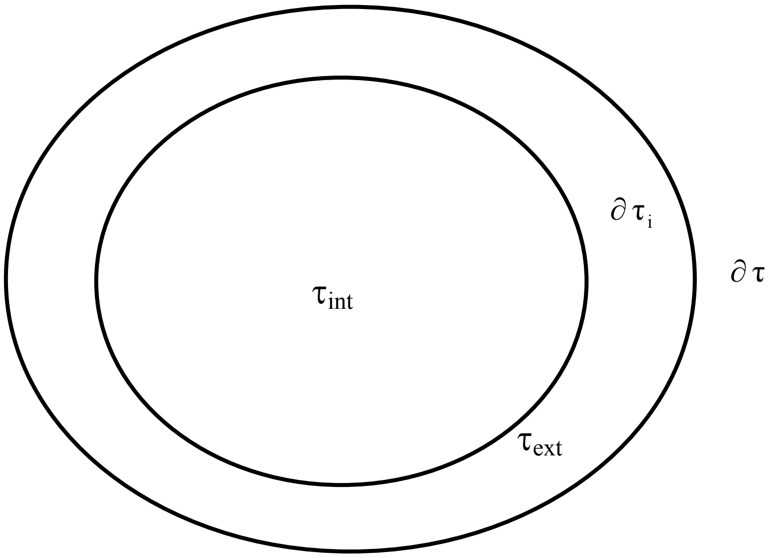


Fig. 16. The macroscopic continuum region τ consisting from the subsystems τ_{int} and τ_{ext} interacting on the surface $\partial\tau_i$ of the geo-block τ_{int}

We considered [Simonenko, 2007a; 2007; 2008; 2009; 2010] the energy thermodynamic rotational mechanism [Vikulin, 2003] (of the earthquake focal region) related with formation of the circular continuum velocity jump revealed in the form of circular dislocation after relaxation of the seismic process in the earthquake focal region. The developed and tested mathematical formalism of description of the main line flat fracture was generalized [Simonenko, 2007a; 2007; 2008; 2009; 2010] for the closed surfaces of the continuum velocity jumps.

Following to the rotational model [Vikulin, 2003] of the earthquake focal region, we considered [Simonenko, 2007a; 2007; 2008; 2009; 2010] the separate geo-block τ_{int} of the seismic zone. If the external influences of the non-stationary gravitational forces (on the geo-block τ_{int}) and the non-potential stress forces (on the boundary $\partial\tau_i$ of the geo-block τ_{int}) exceed the certain critical value then the geo-block may rotate and slip relative to the surrounding fine plastic layer (subsystem) τ_{ext} with the tangential continuum velocity jump on the boundary surface $\partial\tau_i$ of the geo-block τ_{int}. We assumed [Simonenko, 2007a; 2007; 2008; 2009; 2010] that fine plastic layer (subsystem) τ_{ext} is limited by external surface $\partial\tau$ of the considered thermodynamic system τ consisting from the macroscopic subsystems τ_{int} and τ_{ext}.

Using the evolution equitation (1.67) of the total mechanical energy of the subsystem τ, we derived [Simonenko, 2007a; 2007; 2008; 2009; 2010] the evolution equations for the total mechanical energy of the macroscopic subsystems τ_{int} and τ_{ext}:

$$\frac{d}{dt}\left(K_{\tau_{int}} + \boldsymbol{\pi}_{\tau_{int}}\right) = \frac{d}{dt}\iiint_{\tau_{int}}\left(\frac{1}{2}\mathbf{v}^2 + \psi\right)\rho dV =$$

$$= \iiint_{\tau_{int}} p\,\mathrm{div}\mathbf{v}\,dV + \iiint_{\tau_{int}}\left(\frac{2}{3}\eta - \eta_v\right)(\mathrm{div}\mathbf{v})^2 dV - \iiint_{\tau_{int}} 2\nu\left(e_{ij}\right)^2 \rho dV + \tag{3.140}$$

$$+ \iint_{\partial\tau_i}\left(\mathbf{v}_{int}(\partial\tau_i)\cdot(\mathbf{m}\cdot\mathbf{T})\right) d\Sigma_{\mathbf{m}} + \iiint_{\tau_{int}}\frac{\partial\psi}{\partial t}\rho dV,$$

$$\frac{d}{dt}\left(K_{\tau_{ext}} + \boldsymbol{\pi}_{\tau_{ext}}\right) = \frac{d}{dt}\iiint_{\tau_{ext}}\left(\frac{1}{2}\mathbf{v}^2 + \psi\right)\rho dV =$$

$$
=\iiint_{\tau_{ext}} p\,\mathrm{div}\mathbf{v}\,dV+\iiint_{\tau_{ext}}\left(\frac{2}{3}\eta-\eta_v\right)(\mathrm{div}\mathbf{v})^2 dV-\iiint_{\tau_{ext}}2\nu\left(e_{ij}\right)^2\rho dV+ \tag{3.141}
$$

$$
+\iint_{\partial\tau}\left(\mathbf{v}\cdot(\mathbf{n}\cdot\mathbf{T})\right)d\Omega_{\mathbf{n}}-\iint_{\partial\tau_i}\left(\mathbf{v}_{ext}(\partial\tau_i)\cdot(\mathbf{m}\cdot\mathbf{T})\right)d\Sigma_{-\mathbf{m}}+\iiint_{\tau_{ext}}\frac{\partial\psi}{\partial t}\rho dV,
$$

where $\mathbf{m}$ is the external unit normal vector of the surface $\partial\tau_i$ of the subsystem τ_{int}, $-\mathbf{m}$ is the internal unit normal vector of the surfaces $\partial\tau_i$, which limits the subsystem τ_{ext} from within, $\mathbf{n}$ is the external unit normal vector of the surfaces $\partial\tau$, $\mathbf{v}_{int}(\partial\tau_i)$ are the velocities vectors on the inner side of the surface $\partial\tau_i$ in the subsystem τ_{int}, $\mathbf{v}_{ext}(\partial\tau_i)$ are the velocities vectors on the outer side of the surface $\partial\tau_i$ in the subsystem τ_{ext}.

Adding the evolution equations (3.140) and (3.141) and using the condition of equality $d\Sigma_{\mathbf{m}}=d\Sigma_{-\mathbf{m}}$ of the area elements of the surface $\partial\tau_i$, we obtained [Simonenko, 2007a; 2007; 2008; 2009; 2010] the evolution equation for the total mechanical energy of the macroscopic continuum region τ consisting from the subsystems τ_{int} and τ_{ext} interacting on the surface $\partial\tau_i$ of the continuum velocity jump:

$$
\frac{d}{dt}\left(K_\tau+\pi_\tau\right)=\frac{d}{dt}\iiint_{\tau}\left(\frac{1}{2}\mathbf{v}^2+\psi\right)\rho dV=
$$

$$
=\iiint_{\tau} p\,\mathrm{div}\mathbf{v}\,dV+\iiint_{\tau}\left(\frac{2}{3}\eta-\eta_v\right)(\mathrm{div}\mathbf{v})^2 dV-\iiint_{\tau}2\nu\left(e_{ij}\right)^2\rho dV+\iint_{\partial\tau}\left(\mathbf{v}\cdot(\mathbf{n}\cdot\mathbf{T})\right)d\Omega_{\mathbf{n}}+
$$

$$
+\iint_{\partial\tau_i}\left(\left(\mathbf{v}_{int}(\partial\tau_i)-\mathbf{v}_{ext}(\partial\tau_i)\right)\cdot(\mathbf{m}\cdot\mathbf{T})\right)d\Sigma_{\mathbf{m}}+\iiint_{\tau}\frac{\partial\psi}{\partial t}\rho dV. \tag{3.142}
$$

The equation (3.142) is analogous to equation (3.130). The energy needed for formation of the continuum velocities jumps (on the surfaces $F_1(\tau)$ and $\partial\tau_i$) are related with the penultimate terms in the right-hand sides of equations (3.130) and (3.142).

Similarly to expression (3.137), we obtained [Simonenko, 2007a; 2007; 2008; 2009; 2010] the expression for the sufficient energy $\delta E_{d,\partial\tau_i}$ needed for rotation of the subsystems τ_{int} during the time interval $(t,t+\Delta t)$ relative to the surrounding fine plastic layer (subsystem) τ_{ext} (with the tangential continuum velocity jump $(\mathbf{v}_{int}(\partial\tau_i)-\mathbf{v}_{ext}(\partial\tau_i))$ on the boundary surface $\partial\tau_i$ of the geo-block τ_{int}):

$$
\delta E_{d,\partial\tau_i}=-\delta A_{np,\partial\tau_i}=-\int_t^{t+\Delta t}\left(\iint_{\partial\tau_i}\left(\left(\mathbf{v}_{int}(\partial\tau_i)-\mathbf{v}_{ext}(\partial\tau_i)\right)\cdot(\mathbf{m}\cdot\mathbf{T})\right)d\Sigma_{\mathbf{m}}\right)dt>0. \tag{3.143}
$$

Taking into account the information [Vikulin, 2003] that the critical continuum stresses (required for rotation of the geo-block τ_{int} weakly coupled with the surrounding plastic layer τ_{ext}) are less than the critical continuum stresses required to split the mountain rock by forming the main line flat fracture, we concluded [Simonenko, 2007; 2008; 2009; 2010] that the required energy $\delta E_{d,\partial\tau_i}$ (given by the expression (3.143)) is less than the required energy $\delta E_{d,F_1(\tau)}$ (given by the expression (3.137)) if the displacements of the rock continuum on different sides of the analyzed different jumps of the continuum displacements (the closed dislocation and the main line flat fracture) have the same order of magnitude and the ratio of the surfaces area of the closed dislocation to the surfaces area of the main line flat fracture is not exceed 10.

This thermodynamic energy consideration showed [Simonenko, 2007; 2008; 2009; 2010] the preferable realization of the rotational motion of the geo-block τ_{int} (under the existence of the surrounding plastic layer around the geo-block τ_{int}) as compared with formation of the of the main line flat fracture inside the geo-block τ_{int} . This result explains the rotational motions of the geo-blocks in the seismic zone of the Pacific Ring [Vikulin, 2003] and the vortical structures of the lithosphere of Earth [Vikulin and Melekestcev, 2007] and the lithospheres of the planets [Tveritinova and Vikulin, 2007] of the Solar System.

3.5.3. The local energy and entropy prediction thermohydrogravidynamic principles determining the fractures formation in the macroscopic continuum region τ subjected to the combined integral energy gravitational influences of the planets of the Solar System, the Moon and the Sun owing to the gravitational interaction of the Sun with the outer large planets (the Jupiter, the Saturn, the Uranus and the Neptune)

3.5.3.1. The local energy prediction thermohydrogravidynamic principles determining the fractures formation in the macroscopic continuum region τ subjected to the combined integral energy gravitational influences of the planets of the Solar System, the Moon and the Sun owing to the gravitational interaction of the Sun with the outer large planets (the Jupiter, the Saturn, the Uranus and the Neptune)

Following the works [Simonenko, 2007a; 2007; 2008; 2009; 2010], we can formulate the local energy prediction thermohydrogravidynamic principle of the fractures formation. The preferable realization of the rotational motion [Vikulin, 2003] (within the seismic zone of the Pacific Ring) and the preferable realization of the shear [Abramov, 1997] and the shear-rotational [Simonenko, 2007] motions (for uniform continuum) resulted to the formulation [Simonenko, 2007a; 2007; 2008; 2009; 2010] of the general principle of the fractures formation: the fracture forms on a surface where the external (combined cosmic and terrestrial for the considered macroscopic continuum region τ) energy gravitational influence is sufficient to produce the fracture formation.

The local energy prediction thermohydrogravidynamic principles (determining the fractures formation in the considered macroscopic continuum region τ subjected the combined integral energy gravitational influence of the planets of the Solar System, the Moon and the Sun owing to the gravitational interaction of the Sun with the outer large planets) of the cosmic seismology [Simonenko, 2007; 2008; 2009; 2010] can be formulated mathematically as follows:

$$\Delta G(\tau, t) = \int_{t_o}^{t} dG =$$

$$= \int_{t_0}^{t} dt \iiint_{\tau} \frac{\partial \psi}{\partial t} \rho dV = \textit{local maximum for time moment } t^*, \tag{3.144}$$

and

$$\Delta G(\tau, t) = \int_{t_o}^{t} dG =$$

$$= \int_{t_0}^{t} dt \iiint_{\tau} \frac{\partial \psi}{\partial t} \rho dV = \textit{local minimum for time moment } t_*, \tag{3.145}$$

which can be reformulated (under the more weak mathematical requirement) as follows:

$$\Delta G(\tau, t) = \int_{t_o}^{t} dG \geq (\Delta G(\tau))^{p}_{cr} > 0, \tag{3.146}$$

and

$$\Delta G(\tau, t) = \int_{t_o}^{t} dG \leq (\Delta G(\tau))^{n}_{cr} < 0, \tag{3.147}$$

where $(\Delta G(\tau))_{cr}^{p}$ is the positive critical value of the combined (cosmic and terrestrial) integral energy gravitational influence on the macroscopic continuum region τ to produce the fractures inside the macroscopic continuum region τ, $(\Delta G(\tau))_{cr}^{n}$ is the negative critical value of the combined (cosmic and terrestrial) integral energy gravitational influence on the macroscopic continuum region τ to produce the fractures inside the macroscopic continuum region τ.

3.5.3.2. The local entropy prediction thermohydrogravidynamic principle determining the fractures formation in the macroscopic continuum region τ subjected to the combined integral energy gravitational influences of the planets of the Solar System, the Moon and the Sun owing to the gravitational interaction of the Sun with the outer large planets (the Jupiter, the Saturn, the Uranus and the Neptune)

Taking into account the fundamental physical distinction [Planck, 1930; Prigogine, 1977] between the classical "reversible" macroscopic rotational [de Groot and Mazur, 1962] and "irreversible" macroscopic non-equilibrium kinetic energies [Simonenko, 2004], we deduced (in 2005) the generalized relation [Simonenko, 2006; 2006a]:

$$du + d\varepsilon_r(\tau) - d\varepsilon_s(\tau) - d\varepsilon_{s,r}^{coup}(\tau) = Tds - pd\vartheta \tag{3.148}$$

extending the classical [Gibbs, 1873] relation (for the differential ds of entropy per unit mass s of the one-component macrodifferential deformed continuum element with no chemical reactions):

$$du = Tds - pd\vartheta \tag{3.149}$$

by taking into account the total differentials $d\varepsilon_r(\tau)$, $d\varepsilon_s(\tau)$ and $d\varepsilon_{s,r}^{coup}(\tau)$ (following the continuum substance of the small macroscopic continuum region τ) of the classical macroscopic internal rotational kinetic energy per unit mass $\varepsilon_r(\tau)$ [de Groot and Mazur, 1962], the macroscopic internal shear kinetic energy per unit mass $\varepsilon_s(\tau)$ [Simonenko, 2004; 2006] and the macroscopic internal kinetic energy of a shear-rotational coupling per unit mass $\varepsilon_{s,r}^{coup}(\tau)$ [Simonenko, 2004; 2006]. Based on the established generalizations (1.13) and (3.148), we deduced (in 2005) the generalization [Simonenko, 2006a]:

$$\frac{ds}{dt} = \frac{1}{T}\frac{dq}{dt} - \frac{1}{T\rho}\mathbf{\Pi}:\mathrm{Grad}\,\mathbf{v} + \frac{1}{T}\frac{d\varepsilon_r(\tau)}{dt} - \frac{1}{T}\frac{d\varepsilon_s(\tau)}{dt} - \frac{1}{T}\frac{d\varepsilon_{s,r}^{coup}(\tau)}{dt} \tag{3.150}$$

extending the classical expression (deduced in accordance with the classical Boltzmann's statistical approach identifying the entropy with the molecular disorder) for the entropy production per unit time in the one-component macro-differential deformed continuum element with no chemical reactions [de Groot and Mazur, 1962]:

$$\frac{ds}{dt} = \frac{1}{T}\frac{dq}{dt} - \frac{1}{T\rho}\mathbf{\Pi}:\mathrm{Grad}\,\mathbf{v} \tag{3.151}$$

by taking into account the classical "reversible" macroscopic rotational ($\varepsilon_r(\tau)$) and "irreversible" ($\varepsilon_s(\tau)$ and $\varepsilon_{s,r}^{coup}(\tau)$) macroscopic non-equilibrium creative kinetic energies [Simonenko, 2004] of the small macroscopic continuum region τ. Using the established generalized expression (3.150) for the entropy production, we demonstrated [Simonenko, 2006a] the temporal reduction of entropy at the initial stage of irreversible transition [Itsweire et al., 1986] of the freely decaying stratified turbulence to internal gravity waves. Thereby, we revealed [Simonenko, 2006a] the creative constructive role of the established macroscopic non-equilibrium kinetic energies $\varepsilon_s(\tau)$ and $\varepsilon_{s,r}^{coup}(\tau)$ [Simonenko, 2004]. Simultaneously, we verified [Simonenko, 2006a] the validity of the Prigogine's foresight that the Boltzmann's "identification of entropy with molecular disorder could contain only one part of the truth" [Ilya Prigogine – Autobiography, Translation from the French text, 1977]. The fundamental constructive role of the established macroscopic non-equilibrium kinetic energies $\varepsilon_s(\tau)$ and $\varepsilon_{s,r}^{coup}(\tau)$ was demonstrated [Simonenko, 2007] also by revealing the creative role of the cosmic non-stationary energy gravitational influences reducing the entropy of the planet $(\tau+\bar{\tau})$ as a whole after the irreversible relaxation processes in the focal region τ of earthquake. This demonstration is related with the established [Simonenko, 2007; 2007a; 2007b] generalization (presented in Subsection 1.7) of the Le Chatelier-Braun principle [Gibbs, 1928] for equilibrium rotating planet $(\tau+\bar{\tau})$.

The developed (in 2006) the generalized thermohydrogravidynamic shear-rotational model [Simonenko, 2007a; 2007b] explained [Simonenko, 2007; 2008; 2009; 2010] the significant increase of the energy flux $\delta F_{vis,c} \equiv \delta A_{vis,c}$ of the geo-acoustic energy [Dolgikh et al., 2007] from the focal region before the prepared earthquake. The classical and generalized expressions ((3.151) and (3.150), respectively, for the entropy production) describe the positive (in accordance with the second law of thermodynamics) irreversible entropy production for continuum characterized by the symmetric pressure tensor $\mathbf{P} = -\mathbf{T} = p\boldsymbol{\delta} + \boldsymbol{\Pi}$ and the symmetric viscous-stress tensor $\boldsymbol{\Pi}$. We obtained (in 2006) the explicit expression for the irreversible viscous-compressible entropy production $\sigma_{vis,c}$ for the viscous compressible Newtonian continuum

$$\sigma_{vis,c} = \frac{d_i s}{dt} = -\frac{1}{T\rho}\boldsymbol{\Pi}:\mathrm{Grad}\mathbf{v} = \frac{\varepsilon_{dis}}{T} = \frac{2\nu}{T}(e_{ij})^2 + \frac{(\eta_v - 2\eta/3)}{T\rho}(\mathrm{div}\mathbf{v})^2 > 0. \quad (3.152)$$

The expression (3.152) can be rewritten (based on the established generalization (1.50) of the first law of thermodynamics for the symmetric tensor $\boldsymbol{\Pi}$) as follows

$$\sigma_{vis,c} = \frac{d_i s}{dt} = \frac{1}{Tm_\tau}\frac{\delta A_{vis,c}}{dt} - \frac{1}{Tm_\tau}\frac{dK_\tau}{dt} - \frac{1}{Tm_\tau}\frac{d\pi_\tau}{dt} + \frac{1}{Tm_\tau}\frac{dG}{dt} > 0 \quad (3.153)$$

by taking into account the mass m_τ of the continuum region τ at the absolute temperature T, the power $\delta f_{vis,c}/dt = (1/m_\tau)\,\delta A_{vis,c}/dt$ of the geo-acoustic energy radiated from the unit mass of the focal region τ (subjected to the non-stationary gravitation), the total derivative $(1/m_\tau)dK_\tau/dt$ of the macroscopic kinetic energy per unit mass $\varepsilon_k(\tau) = K_\tau/m_\tau$, the total derivative $(1/m_\tau)d\pi_\tau/dt$ of the gravitational potential energy per unit mass π_τ/m_τ, and the total energy power per unit mass $(1/m_\tau)dG/dt$ of the combined (terrestrial and cosmic) non-stationary energy gravitational influence on the continuum region τ subjected to the non-stationary gravitational field.

Based on the generalization (1.13) and the evaluation (3.153), we deduced (in 2006) the following condition

$$\frac{\delta f_{vis,c}}{dt} > \frac{d}{dt}\left(\frac{1}{2}\mathbf{V}_c^2 + \varepsilon_r(\tau) + \varepsilon_s(\tau) + \varepsilon_{s,r}^{coup}(\tau) + \psi\right) - \frac{\partial\psi}{\partial t} > 0 \quad (3.154)$$

for occurrence of a deep earthquakes characterized by the positive power $\delta f_{vis,c}/dt > 0$ of the geo-acoustic energy radiated from the unit mass of the focal region τ. According to the condition (3.154), the criterion

$$\frac{d}{dt}\left(\frac{1}{2}\mathbf{V}_c^2 + \varepsilon_r(\tau) + \varepsilon_s(\tau) + \varepsilon_{s,r}^{coup}(\tau) + \psi\right) - \frac{\partial\psi}{\partial t} = \frac{d}{dt}(\varepsilon_m(\tau)) - \frac{\partial\psi}{\partial t} > 0 \quad (3.155)$$

is the "sine qua non" for occurrence of the earthquakes radiating the positive power per unit mass $\delta f_{vis,c}/dt > 0$ of the geo-acoustic energy from the focal region τ of the Earth. The criterion (3.155) may be considered as the local entropy prediction thermohydrogravidynamic principle consistent with the generalized differential formulation (1.50) of the first law of thermodynamics. The criterion (3.155) imposes the special relationship (for realization of a deep earthquakes) between the variations of the total derivative $d(\varepsilon_m(\tau))/dt$ of the mechanical kinetic energy per unit mass $\varepsilon_m(\tau) = \varepsilon_k(\tau) + \psi$ and the local time derivative $\partial\psi/\partial t$ of the potential ψ of the combined (terrestrial and cosmic) non-stationary gravitational field.

3.6. The cosmic energy gravitational genesis of the seismotectonic (and volcanic) activity and the global climate variability induced by the combined non-stationary cosmic energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter

3.6.1. Empirical time periodicities of the seismotectonic activity of the Earth

It was pointed out [Abramov, 1997; p. 72] that the sinusoidal "saw-like" form of the graphic dependence of growth and recession of the seismotectonic activization of the separate geological structure is related with the following empirical time periodicities:

$$11 \text{ years}, \tag{3.156}$$

$$22 \text{ years}, \tag{3.157}$$

$$44 \text{ years}, \tag{3.158}$$

$$88 \text{ years}, \tag{3.159}$$

$$352 \text{ years}. \tag{3.160}$$

$$704 \text{ years}, \tag{3.161}$$

$$1056 \text{ years}. \tag{3.162}$$

It was pointed out [Vikulin, 2003; p. 16] that the strongest earthquakes in the all boundary region of the Pacific Ocean are characterized by the established tendency for recurrence on average once during the following time period [Fedotov, 1965; Davison, 1936; Christensen and Ruff 1986; Barrientos and Kansel, 1990; Jacob, 1984; Shimazaki and Nakata, 1980; Suyehiro, 1984; Clark, Dibble, Fyfe, Lensen and Suggarte, 1965; Johnston, 1965]:

$$T_r = 100 \pm 50 = 50 \div 150 \text{ years}. \tag{3.163}$$

It was pointed out [Vikulin, 2003; p. 16] also that the close values for recurrence of the strongest earthquakes were established for different seismic belts of the Earth: $90 \div 140$ years for the Caucasus [Tamrazyan, 1962] and 150 years for the Anatolian fault zone [Ambraseys, 1970]. We present the data of the monograph [Vikulin, 2003; p. 17] concerning to the recurrence of the strongest earthquakes in different regions of the of the seismic zone of the Pacific Ring [Vikulin, 1992; 1994; 2003]:

$$90 \pm 40 = 50 \div 130 \text{ years – Kamchatka}, \tag{3.164}$$

$$130 \pm 50 = 80 \div 180 \text{ years – Japan}, \tag{3.165}$$

$$110 \pm 50 = 60 \div 160 \text{ years – Peru}, \tag{3.166}$$

$$100 \pm 50 = 50 \div 150 \text{ years – Aleutians}. \tag{3.167}$$

It was pointed out [Vikulin, 2003; p. 17] that for the Japanese chute Nankay (stretched to the Tokyo) are revealed the characteristic time periodicities [Vikulin and Vikulina, 1989] of the strongest earthquakes:

$$600 \text{ years}, \tag{3.168}$$

$$1200 \text{ years}. \tag{3.169}$$

It was revealed the empirical range of the time periodicities [Kyrillov, 1957]:

$$250 \div 300 \text{ years}. \tag{3.170}$$

for recurrence of the strongest earthquakes in Turkey.

It was revealed the empirical range of the time periodicities [Turner, 1925]:

$$240 \div 280 \text{ years} \tag{3.171}$$

for recurrence of the strongest earthquakes in China. It was earlier revealed also the empirical time periodicity [Мэй Ши-юн, 1960] near:

$$1000 \text{ years} \tag{3.172}$$

for recurrence of the strongest earthquakes in China.

Based on the data presented in the monograph [Vikulin, 2003] concerning to the recurrence of the strongest earthquakes in different regions of the Earth, Dr. A.V. Vikulin made the valid conclusion that the seismic processes have the global nature for the Earth. In the next Subsection we present the explanation [Simonenko, 2007] of the considered empirical time periodicities by the different combinations of the cosmic energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter

3.6.2. The time periodicities of the maximal (instantaneous and integral) energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter

3.6.2.1. The time periodicities of the maximal (instantaneous and integral) energy gravitational influences on the Earth of the system Sun-Moon

If the configuration of the Sun and the Moon is characterized at any time moment by the maximal combined (instantaneous or integral) energy gravitational influence on the Earth, then the Sun and the Moon will have the recurrence of the same configuration after different integer numbers of circulations ($j_{MOON,3}$ circulations of the Moon around the Earth and $m_{3,MOON}$ circulations of the Earth around the Sun) to satisfy the following condition [Simonenko, 2007]:

$$j_{MOON,3}\,T_{MOON} = m_{3,MOON}\,T_3. \tag{3.173}$$

Following the known method [Perelman, 1956], we presented [Simonenko, 2007] the ratio T_3/T_{MOON} by the following mathematical fraction:

$$\frac{T_3}{T_{MOON}} = \frac{365.3}{29.5306} = 12 + \frac{109328}{295306} = 12 + \cfrac{1}{2 + \cfrac{1}{1 + \cfrac{1}{2 + \cfrac{1}{2 + \cfrac{1}{1 + \cfrac{1}{8 + \cfrac{458}{1204}}}}}}}. \tag{3.174}$$

Considering the different approximation of the ratio T_3/T_{MOON}, we obtained [Simonenko, 2007] the successive approximations for the time periodicities:

$$(T_{S\text{-}MOON,3})_1 = 3 \text{ years}, \tag{3.175}$$

$$(T_{S\text{-}MOON,3})_2 = 8 \text{ years}, \tag{3.176}$$

$$(T_{S\text{-}MOON,3})_3 = 19 \text{ years}, \tag{3.177}$$

$$(T_{S\text{-}MOON,3})_4 = 27 \text{ years}, \tag{3.178}$$

$$(T_{S\text{-}MOON,3})_5 = 235 \text{ years} \tag{3.179}$$

of recurrence of the maximal (instantaneous and integral) combined energy gravitational influences of the system Sun-Moon on the Earth in the first, second, third, fourth and fifth approximations, respectively. We can verify that the time periodicity

$$(T_{S\text{-}MOON,3})_3 = (T_{S\text{-}MOON,3})_1 + (T_{S\text{-}MOON,3})_2 = 11 \text{years} \tag{3.180}$$

may be considered approximately as the third approximation of recurrence of the maximal (instantaneous and integral) energy gravitational influences of the system Sun-Moon on the Earth.

3.6.2.2. The time periodicities of the maximal (instantaneous and integral) energy gravitational influences on the Earth of the Venus

If the configuration of the Earth and the Venus is characterized at any time moment by the maximal (instantaneous or integral) energy gravitational influence on the Earth, then the Earth and the Venus will have the recurrence of the same configuration (in the frame of the real elliptical orbits of the Earth and the Venus) after different integer numbers of circulations ($k_{V,3}$ circulations of the Venus around the Sun and $m_{3,V}$ circulations of the Earth around the Sun) to satisfy the following condition [Simonenko, 2007]:

$$k_{V,3}\,T_V = m_{3,V}\,T_3. \tag{3.181}$$

Following the known method [Perelman, 1956], we presented [Simonenko, 2007] the ratio T_3/T_V by the following mathematical fraction:

$$\frac{T_3}{T_V} = \frac{365.3}{224.7} = 1 + \frac{1406}{2247} = 1 + \cfrac{1}{1 + \cfrac{1}{1 + \cfrac{1}{1 + \cfrac{1}{2 + \cfrac{1}{280}}}}} \quad . \tag{3.182}$$

Considering the different approximation of the ratio T_3/T_V, we obtained [Simonenko, 2007] the successive approximations for the time periodicities [Simonenko, 2007]:

$$(T_{V,3})_1 = 3 \text{ years,} \tag{3.183}$$

$$(T_{V,3})_2 = 8 \text{ years} \tag{3.184}$$

of recurrence of the maximal (instantaneous and integral) energy gravitational influences of the Venus on the Earth in the first and second approximations, respectively. We can verify that the time periodicity

$$(T_{V,3})_3 = (T_{V,3})_1 + (T_{V,3})_2 = 11 \text{ years} \tag{3.185}$$

may be considered as the third approximation of recurrence of the maximal (instantaneous and integral) energy gravitational influences of the Venus on the Earth.

3.6.2.3. The time periodicities of the maximal (instantaneous and integral) energy gravitational influences on the Earth of the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter

If the configuration of the Earth, the Jupiter and the Sun is characterized at any time moment by the maximal (instantaneous or integral) energy gravitational influences on the Earth, then the Earth, the Jupiter and the Sun will have the recurrence of the same configuration (in the frame of the real elliptical orbits of the Earth and the Jupiter) after different integer numbers of circulations ($n_{J,3}$ circulations of the Jupiter around the Sun and $m_{3,J}$ circulations of the Earth around the Sun) to satisfy the following condition [Simonenko, 2007]:

$$n_{J,3} T_J = m_{3,J} T_3. \tag{3.186}$$

Following the known method [Perelman, 1956], we presented [Simonenko, 2007] the ratio T_J/T_3 by the following mathematical fraction:

$$\frac{T_J}{T_3} = \frac{4332}{365.3} = 11 + \cfrac{1}{1 + \cfrac{1}{6 + \cfrac{1}{12 + \cfrac{24}{41}}}}. \tag{3.187}$$

Considering the different approximation of the ratio T_J/T_3, we obtained [Simonenko, 2007] the successive approximations for the time periodicities [Simonenko, 2007]:

$$(T_{J,3})_1 = 11 \text{ years} \tag{3.188}$$

$$(T_{J,3})_2 = 12 \text{ years} \tag{3.189}$$

$$(T_{J,3})_3 = 83 \text{ years} \tag{3.190}$$

of recurrence of the maximal (instantaneous and integral) energy gravitational influences on the Earth of the Jupiter and the Sun (owing to the gravitational interaction of the Sun with the Jupiter) in the first, second and third approximations, respectively.

3.6.2.4. The time periodicities of the maximal (instantaneous and integral) energy gravitational influences on the Earth of the Mars

If the configuration of the Earth and the Mars is characterized at any time moment by the maximal (instantaneous or integral) energy gravitational influence on the Earth, then the Earth and the Mars will have the recurrence of the same configuration (in the frame of the real elliptical orbits of the Earth and the Mars) after different integer numbers of circulations ($g_{MARS,3}$ circulations of the Mars around the Sun and $m_{3,MARS}$ circulations of the Earth around the Sun) to satisfy the following condition [Simonenko, 2007]:

$$g_{MARS,3} T_{MARS} = m_{3,MARS} T_3. \tag{3.191}$$

Following the known method [Perelman, 1956], we presented [Simonenko, 2007] the ratio T_{MARS}/T_3 by the following mathematical fraction:

$$\frac{T_{MARS}}{T_3} = \frac{687.0}{365.3} = 1 + \frac{3217}{3653} = 1 + \cfrac{1}{1 + \cfrac{1}{7 + \cfrac{1}{2 + \cfrac{1}{1 + \cfrac{1}{1 + \cfrac{47}{59}}}}}}. \tag{3.192}$$

Considering the different approximation of the ratio T_{MARS}/T_3, we obtained [Simonenko, 2007] the successive approximations for the time periodicities [Simonenko, 2007]:

$$(T_{MARS,3})_1 = 15 \text{ years}, \tag{3.193}$$

$$(T_{MARS,3})_2 = 32 \text{ years}, \tag{3.194}$$

$$(T_{MARS,3})_3 = 47 \text{ years}, \tag{3.195}$$

of recurrence of the maximal (instantaneous or integral) energy gravitational influences of the Mars on the Earth in the first, second and third approximations, respectively.

3.6.2.5. The time periodicities of the periodic global seismotectonic (and volcanic) activity and the global climate variability of the Earth induced by the combined different combinations of the cosmic energy gravitational influences of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter

We have shown [Simonenko, 2007] that the periodic recurrence (characterized by the time periodicity T_{energy}) of the maximal integral energy gravitational influences on the Earth (defined by the planetary combination of the system Sun-Moon and the arbitrary combination of the planets: the Venus, the Mars and the Jupiter) leads (according to the generalized differential formulation (1.43) applied for the Earth) to the periodic recurrence of the maximal seismotectonic (and volcanic) activity (characterized by the same time periodicity $T_{tec} = T_{energy}$) of the geo-spheres of the Earth. We have shown [Simonenko, 2007] that the periodic recurrence (characterized by the time periodicity T_{energy}) of the maximal integral energy gravitational influences on the Earth (defined by the combination of the system Sun-Moon and the arbitrary combination of the planets: the Venus, the Mars and the Jupiter, and the Sun owing to the gravitational interaction of the Sun with the Jupiter) leads (according to the generalized differential formulation (1.43) applied for each geo-block of Earth) to the periodic recurrence of the maximal seismotectonic (and volcanic) activity (characterized by the same time periodicity $T_{tec} = T_{energy}$) of each geo-block of Earth. We have shown [Simonenko, 2007] that the periodic recurrence (characterized by the time periodicity $T_{tec} = T_{energy}$) of the maximal seismotectonic (and volcanic) activity of the geo-spheres of the Earth and each geo-block of the Earth (defined by the combination of the system Sun-Moon and the arbitrary combinations of the planets: the Venus, the Mars, the Jupiter, and the Sun owing to the gravitational interaction of the Sun with the Jupiter) leads to the periodic recurrence (characterized by the time periodicity $T_{tec} = T_{energy}$) of the maximal concentration of the atmospheric greenhouse gases owing to the periodic increase (characterized by the time periodicity $T_{tec} = T_{energy}$) of the output of the greenhouse gases related with the periodic seismotectonic-volcanic activization of the Earth. We have shown [Simonenko, 2007] that the periodic increase (characterized by the time periodicity $T_{tec} = T_{energy}$) of the average planetary concentration of the atmospheric greenhouse gases leads (as a consequence of the greenhouse effect produced by the gravity-induced periodic tectonic-volcanic activization accompanied by the increase of the atmospheric greenhouse gases) to the periodic global planetary warming related with the increase (characterized by the time periodicity $T_{tec} = T_{energy}$) of temperature of the system atmosphere-oceans of the Earth. We have shown [Simonenko, 2007] that the periodic decrease (characterized by the time periodicity $T_{tec} = T_{energy}$) of the average planetary concentration of the atmospheric greenhouse gases leads (as a consequence of the decreased greenhouse effect) to the periodic global planetary cooling related with the fall (characterized by the time periodicity $T_{tec} = T_{energy}$) of temperature of the atmosphere-oceans system of the Earth. We have shown [Simonenko, 2007] that the time periodicity T_{energy} of the periodic recurrence of the maximal integral energy gravitational influences on the Earth (defined by the combination of the system Sun-Moon and the arbitrary combinations of the planets: the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter) corresponds to the following (two) global time periodicities of the Earth's climate variability [Simonenko, 2007]: the first time periodicity $T_{clim1} = T_{tec} = T_{energy}$ (related with the periodic seismotectonic-volcanic activity of the geo-spheres of the Earth and each geo-block of the Earth induced by the cosmic non-stationary combined energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter) and the second time periodicity $T_{clim2} = T_{endog} = T_{energy}/2$ related with the periodic volcanic activity determined by the periodic tectonic-endogenous heating (of the geo-spheres of the Earth, each geo-block of the Earth, and the atmosphere and the oceans of the Earth) induced by the periodic continuum deformation (characterized by the time periodicity T_{energy}) owing to the periodic cosmic non-stationary combined energy gravitational influences (characterized by the time periodicity T_{energy}) on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter.

Based on the equivalent generalized differential formulations (1.43), (1.50) and (1.53) [Simonenko, 2007] of the first law of thermodynamics for the Earth and using the obtained successive approximations for the time periodicities of the periodic recurrence of the maximal (instantaneous and integral) energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter, we founded [Simonenko, 2007; 2009; 2010] the sets of the global seismotectonic and volcanic periodicities T_{tec} (of the periodic global gravity-induced seismotectonic and volcanic activities and the cosmic geological cycles of the thermohydrogravidynamic evolution of the Earth owing to the main cosmic G-factor related to the differential dG of the combined cosmic non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter) and the global climatic periodicities T_{clim1} (of the periodic global gravity-induced climate variability and the global variability of the quantities of the fresh water and glacial ice resources owing to the $G(b)$-factor related to the periodic atmospheric-oceanic warming or cooling as a consequence of the periodic variable (increasing or decreasing) output of the heated greenhouse volcanic gases and the related variable greenhouse effect induced by the periodic variable tectonic-volcanic activity (activization or weakening) due to the G-factor):

$$T_{tec} = T_{clim1} = T_{energy} = (T_{S\text{-}MOON,3})_{i}^{l_o} \times (T_{V,3})_{j}^{l_2} \times (T_{MARS,3})_{k}^{l_4} \times (T_{J,3})_{n}^{l_5}, \tag{3.196}$$

determined by the successive global periodicities T_{energy} (defined by the multiplications of various successive time periodicities related to the different combinations of the following integer numbers: $i = 1, 2, 3, 4, 5$; $j = 1, 2$; $k = 1, 2, 3$; $n = 1, 2, 3$; $l_o = 0,1$; $l_2 = 0,1$; $l_4 = 0,1$; $l_5 = 0,1$) of recurrence of the maximal combined energy gravitational influences on the Earth of the different combined combinations of the cosmic non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter. The global seismotectonic and volcanic periodicities T_{tec} (of the global periodic seismotectonic and volcanic activity) and the global climatic periodicities T_{clim1} (of the global periodic climate variability) are related with the periodic recurrence of the maximal combined integral energy gravitational influences on the Earth induced by the different combinations of the cosmic non-stationary energy gravitational influences of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter.

Using the equivalent generalized differential formulations (1.43), (1.50) and (1.53) [Simonenko, 2007] of the first law of thermodynamics for the Earth and the obtained successive approximations for the time periodicities of the periodic recurrence of the maximal (instantaneous and integral) energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter, we founded [Simonenko, 2007; 2009; 2010] the set of the global volcanic and climatic periodicities $T_{clim2} = T_{endog} = T_{energy}/2$ (of the periodic global tectonic-endogenous heating determining the periodic global volcanic activity and the related global climate variability and the global variability of the quantities of the fresh water and glacial ice resources and the cosmic geological cycles of the thermohydrogravidynamic evolution of the Earth owing to the $G(a)$-factor related to the tectonic-endogenous heating contributing to the differential increase dU_{τ_3} of the internal thermal energy U_{τ_3} of the Earth τ_3 as a consequence of the periodic continuum deformation of the Earth τ_3 due to the G-factor):

$$T_{clim2} = T_{energy}/2 = (T_{S\text{-}MOON,3})_i^{l_o} \times (T_{V,3})_j^{l_2} \times (T_{MARS,3})_k^{l_4} \times (T_{J,3})_n^{l_5}/2, \qquad (3.197)$$

determined by the successive global periodicities T_{energy} (defined by the multiplications of various successive time periodicities related to the different combinations of the following integer numbers: $i = 1, 2, 3, 4, 5$; $j = 1, 2$; $k = 1, 2, 3$; $n = 1, 2, 3$; $l_o = 0,1$; $l_2 = 0,1$; $l_4 = 0,1$; $l_5 = 0,1$) of recurrence of the maximal combined energy gravitational influences on the Earth of the different combined combinations of the cosmic non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter. The global volcanic and climatic periodicities $T_{clim2} = T_{endog} = T_{energy}/2$ (of the global periodic volcanic and climatic variability) are related with the periodic recurrence of the maximal combined integral energy gravitational influences on the Earth induced by the different combinations of the cosmic non-stationary energy gravitational influences of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter.

By comparing the global seismotectonic, volcanic and climatic time periodicities (obtained from the expression (3.196)) with the empirical time periodicities of the seismotectonic activity of the Earth submitted in Subsection 3.6.1 we established [Simonenko, 2007] that the empirical time periodicities (of the seismotectonic activity of the Earth) may be satisfactory approximated by the expression (3.196) with the different combinations of the various integer numbers.

The calculated time periodicity 24 years (given by 3 × 8 years determined by the combination of the system Sun-Moon and the Venus) is close to empirical time periodicity 22 years given by (3.157).

The calculated time periodicity 45 years (given by 3 × 15 years determined by the combination of the system Sun-Moon, the Venus and the Mars) is close to the empirical time periodicity 44 years given by (3.158).

The empirical time periodicity 88 years (given by (3.159)) is equal to the same time periodicity 88 years (given by 8 × 11 years determined by the combination of the system Sun-Moon, the Venus, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter). Since the ratio 88 years/ T_{MARS}=46.786 in close to 47, we concluded [Simonenko, 2009; 2010] that the time periodicity 88 years is determined also by the Mars.

The calculated range of the time periodicities $88 \div 96$ years (given by $8 \times (11 \div 12)$ years determined by the planetary combination of the system Sun-Moon, the Venus, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter) gets into the ranges of the empirical time periodicities: the range $T_r = 100 \pm 50$ years (given by (3.163)), the range 90 ± 40 years (given by (3.164)), the range 130 ± 50 years (given by (3.165)), the range 110 ± 50 years (given by (3.166)) and the range 100 ± 50 years (given by (3.167)).

The calculated time periodicity 96 years (given by 3×32 years determined by the combination of the system Sun-Moon, the Venus and the Mars) gets into the ranges of the empirical time periodicities: the range $T_r = 100 \pm 50$ years (given by (3.163)), the range 90 ± 40 years (given by (3.164)), the range 130 ± 50 years (given by (3.165)), the range 110 ± 50 years (given by (3.166)) and the range 100 ± 50 years (given by (3.167)).

The calculated range of the time periodicities $99 \div 108$ years (given by $3\times 3\times (11 \div 12)$ years determined by the combination of the system Sun-Moon, the Venus, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter) gets into the ranges of the empirical time periodicities: the range $T_r = 100 \pm 50$ years (given by (3.163)), the range 90 ± 40 years (given by (3.164)), the range 130 ± 50 years (given by (3.165)), the range 110 ± 50 years (given by (3.166)) and the range 100 ± 50 years (given by (3.167)).

The calculated range of the time periodicity 120 years (given by 8×15 years determined by the combination of the system Sun-Moon, Venus and the Mars) gets into the ranges of the empirical time periodicities: the range $T_r = 100 \pm 50$ years (given by (3.163)), the range 90 ± 40 years (given by (3.164)), the range 130 ± 50 years (given by (3.165)), the range 110 ± 50 years (given by (3.166)) and the range 100 ± 50 years (given by (3.167)).

The calculated time periodicity 135 years (given by $3\times 3\times 15$ years determined by the combination of the system Sun-Moon, the Venus and the Mars) gets into the range of the empirical time periodicities $T_r = 100 \pm 50$ years (given by (3.163)).

The calculated time periodicity 152 years (given by $152 = 19\times 8$ determined by the combination of the system Sun-Moon and the Venus) gets into the ranges of the empirical time periodicities: the range 130 ± 50 years (given by (3.165)) and the range 110 ± 50 years (given by (3.166)).

The calculated range $165 \div 180$ years (given by $15\times (11 \div 12)$ years determined by the combination of the system Sun-Moon, the Mars, Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter) gets into the range of the empirical time periodicities 130 ± 50 years (given by (3.165)).

The calculated time periodicity 249 years (given by $249 = 3\times 83$ years determined by the combination of the system Sun-Moon, the Venus, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter) is near the lower value of the range of the empirical time periodicities $250 \div 300$ years (given by (3.170)) and gets into the range $240 \div 280$ years of the empirical time periodicities (given by (3.171)).

The calculated time periodicity 285 years (given by 19×15 years determined by the combination of the system Sun-Moon and the Mars) is close to the upper value of the range $240 \div 280$ years of the empirical time periodicities (given by (3.171)).

The calculated time periodicity 285 years (given by 19×15 years determined by the combination of the system Sun-Moon and the Mars) gets into the range of the empirical time periodicities $250 \div 300$ years (given by (3.170)).

The calculated range of the time periodicities $264 \div 288$ years (given by $3\times 8\times (11 \div 12)$ years determined by the combination of the system Sun-Moon, the Venus, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter) gets approximately into the range of the empirical time periodicities $240 \div 280$ years (given by (3.171)).

The calculated time periodicity 352 years (given by 32×11 years determined by the combination of the system Sun-Moon, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter) is equal to the empirical time periodicity 352 years (given by (3.160)).

The empirical time periodicities 704 years [Abramov, 1997] (given by (3.161)), 1056 years [Abramov, 1997] (given by (3.162)), 600 years [Vikulin and Vikulina, 1989] (given by (3.168)), 1200 years [Vikulin and Vikulina, 1989] (given by (3.169)) and 1000 years [Мэй Ши-юн, 1960] (given by (3.172)) were also well approximated [Simonenko, 2007; 2008; 2009; 2010] by the different combinations of the system Sun-Moon, the Venus, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter.

Finally, the established [Simonenko, 2007] global seismotectonic, volcanic and climatic periodicity of 4320 years (given by $3\times 8\times 15\times 12$ years determined by the recurrence of the maximal combined energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter) represents the fundamental basis of Hindu cosmological time cycles.

3.6.3. Cosmic energy gravitational genesis of the strongest Japanese earthquakes

We demonstrated [Simonenko, 2007; 2009; 2010] the cosmic energy gravitational genesis of the strongest (M ≥ 7.9) Japanese earthquakes.

To confirm the proposed cosmic energy gravitational genesis of the strongest (M ≥ 7.9) Japanese earthquakes, we present in Table 1 the time periods T_1 (given in years) of recurrence of the strongest Japanese earthquakes [Vikulin, 2003; p. 17] and the obtained [Simonenko, 2007; 2009; 2010] corresponding time periodicities (given in years) induced by the given (in Table 1) corresponding planetary combinations.

Taking into account the time periodicity 83 years (given by (3.190)), the year 1927 AD of the Jupiter's opposition with the Earth, the time periodicity 88 years $= 8\times 11$ years (given by (3.159) and determined by the system Sun-Moon, the Venus, the Jupiter, the Mars and the Sun owing to the gravitational interaction of the Sun with the Jupiter) and the year 1923 AD of the strongest Japanese earthquake in the Tokyo region, we predicted [Simonenko, 2009; 2010] "the time range $2010 \div 2011$ AD (1927+83 $\div$ 1923+88) of the next sufficiently strong Japanese earthquake near the Tokyo region".

Table 1

The time periods T_1 (given in years) of recurrence of the strongest Japanese earthquakes [Vikulin, 2003; p. 17] and the obtained [Simonenko, 2007; 2009; 2010] corresponding time periodicities (given in years) induced by the following planetary combinations

Region	Magnitude M of the strongest Japanese earthquakes	Date of the strongest Japanese earthquake	The time periods T_1 (given in years) of recurrence of the strongest Japanese earthquakes	Corresponding time periodicities (given in years) determined by the following planetary combination
Tokyo region	7.9	1.01.1605		
	8.2	31.12.1703	98	$88 \div 96 = 8\times(11\div 12)$ –Sun-Moon-Venus-Jupiter- Sun (due to Jupiter) – Mars
				$96 = 3\times 32$ – Sun-Moon-Venus-Mars
	8.2	1.09.1923	220	$209\div 228 = 19\times(11\div 12)$ – Sun-Moon-Jupiter- Sun (due to Jupiter)
South-west from Tokyo	8.6	20.09.1498		
	7.9	31.01.1605	107	$96 = 3\times 32$ – Sun-Moon-Venus-Mars
				$120 = 8\times 15$ – Sun-Moon-Venus-Mars
	8.4	28.10.1707	102	$96 = 3\times 32$ – Sun-Moon-Venus-Mars
				$120 = 8\times 15$ – Sun-Moon-Venus-Mars
	8.4	23.12.1854	147	$152 = 19\times 8$ – Sun-Moon-Venus
	8.0	7.12.1944	90	$88\div 96 = 8\times(11\div 12)$ – Sun-Moon-Venus-Jupiter- Sun (due to Jupiter)

The occurrence of the strong Japanese earthquake on 11 March, 2011 confirmed the proposed [Simonenko, 2007; Simonenko, 2009; 2010] cosmic energy gravitational genesis of the strongest Japanese earthquakes.

3.6.4. The evaluated mean time periodicities 94620 years and 107568 years of the global climate variability (related with the $G(a)$ - factor and $G(b)$ - factor determined by the cosmic non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter) and the mean time periodicities 100845 years and 121612.5 years of the global climate variability related with the $G(b)$ - factor (determined by the cosmic non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter)

It is well known [Bol'shakov, 2003; p. 82] that 50% of the climatic variability during Pleistocene [Hays, Imbrie and Shackleton, 1976] is related with the time periodicities 106000 years, 94000 years and 122000 years; 25% of the climatic variability during Pleistocene [Hays, Imbrie and Shackleton, 1976] is related with the time periodicities 40000 years, 41000 years and 43000 years; 10% of the climatic variability during Pleistocene [Hays, Imbrie and Shackleton, 1976] is related with the time periodicities 23000 years 24000 years.

Based on the generalized differential formulation (1.43) of the first law of thermodynamics applied for the Earth, we developed the fundamentals of the thermohydrogravidynamic theory of the paleoclimate [Simonenko, 2007] of the Earth and proposed [Simonenko, 2007] the partial solution of the problem of the 100000-year climate periodicity [Berger, 1999] during Pleistocene by taking into account the $G(a)$ - factor and $G(b)$ - factor determined by the cosmic non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter.

It was noted [Bol'shakov, 2003; p. 82] that the spectrum [Hays et al., 1976] of the variations of the summer insolation on 60^0 northern latitude of the Earth during last 468000 years (calculated based on the Milankovitch theory [Milankovitch, 1938]) does not contain the main time periodicity 100000 years of the climatic variability during the last 1000000 years. It was concluded [Imbrie et al., 1993; p. 730] that the foundation of the 100000-year climate periodicity is not possible in the frame of the Milankovitch theory [Milankovitch, 1938] since the variations of the radiation (related with the variations of the eccentricity of the Earth's orbit) are very small to control adequately the change of the Earth's climate.

According to the estimation [Bol'shakov, 2003; p. 28] based on the numerical data [Berger and Loutre, 1991] of the variation of the eccentricity e of the Earth's orbit during the last 2000000 years and the Milankovitch dependence $(1 - e^2)^{-0.5}$ [Milankovitch, 1938] of the average (annual) solar energy flux related with the eccentricity e of the Earth's orbit, the variations of the average (annual) solar energy flux are not exceeded 0.16%. It was also concluded [Bol'shakov, 2003; p. 100] that the Milankovitch theory [Milankovitch, 1938] cannot predict the climate variability related with the 100000-year periodicity. It was presented [Bol'shakov, 2003; p. 100-101] the explicit contradiction of the Milankovitch theory [Milankovitch, 1938]: the glacial epochs (according the empirical data [Hays et al., 1976]) during the last 500000 years correspond to the minimal values of the eccentricity of the Earth's orbit [Bol'shakov, 2003; p. 100], but the Milankovitch theory (in which the glacial epochs are associated with the minimal values of the solar radiation related with the minimal values of the eccentricity of the Earth's orbit) predict four (from five) glacial epochs during the last 750000 years [Bol'shakov, 2003; p. 100, Fig. 23] corresponding to the maximal values of the eccentricity of the Earth's orbit taken from the work [Berger, 1988, Fig. 9]. It was concluded [Bol'shakov, 2003; p. 114] that the genesis of the 100000-year climate periodicity is not explained. The analogous conclusion was made [Berger, 1999, p. 312; Elkibbi and Rial, 2001]. Thus, we see that the solution of the problem of the 100000-year climate periodicity during Pleistocene [Berger, 1999; Bol'shakov, 2003; p. 100] cannot be obtain in the frame of the Milankovitch theory [Milankovitch, 1938].

We founded the near 100000 years Earth's climate periodicities in the frame of the thermohydrogravidynamic theory [Simonenko, 2007] using the conclusion that for the time periodicity T_{energy} of the periodic recurrence of the maximal integral energy gravitational influences on the Earth (defined by the combination of the system Sun-Moon and the arbitrary combination of the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter) we have two global time periodicities of the Earth's climate variability: the time periodicity $T_{tec} = T_{energy}$ (related with the periodic tectonic-volcanic activity of the geo-spheres of the Earth and each geo-block of the Earth induced by the cosmic non-stationary combined energy gravitational influence on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter) and time periodicity $T_{endog} = T_{energy} / 2$ related with the periodic tectonic-endogenous heating (of the geo-spheres of the Earth, each geo-block of the Earth, the atmosphere and the oceans of the Earth) and related global volcanic activity induced by the periodic continuum deformation (characterized by the time periodicity T_{energy}) owing to the periodic cosmic non-stationary combined energy gravitational influence (characterized by the time periodicity T_{energy}) on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter.

Considering the time periodicity 19 years of the maximal combined integral energy gravitational influence on the Earth of the system Sun-Moon (in the third approximation), the time periodicity 8 years of the maximal integral energy gravitational influence on the Earth of the Venus (in the second approximation), the time periodicity 15 years of the maximal integral energy gravitational influence on the Earth of the Mars (in the first approximation) and the time periodicity 83 years of the maximal integral energy gravitational influence on the Earth of the Jupiter (in the third approximation) and the Sun owing to the gravitational interaction of the Sun with the Jupiter, we obtained [Simonenko, 2007] the time periodicity

$$T_{clim2} = T_{endog} = T_{energy} / 2 = 0.5 \times 19 \times 8 \times 15 \times 83 \text{ years} = 94620 \text{ years} \tag{3.198}$$

of the global climate variability of the Earth related with the periodic tectonic-endogenous heating (of the geo-spheres of the Earth, each geo-block of the Earth, the atmosphere and the oceans of the Earth) and related global volcanic activity induced by periodic continuum deformation (characterized by the time periodicity T_{energy}) owing to the periodic cosmic non-stationary combined energy gravitational influences (characterized by the time periodicity T_{energy}) on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter.

Considering the time periodicity 27 years of the maximal combined integral energy gravitational influence on the Earth of the system Sun-Moon (in the fourth approximation), the time periodicity 3 years of the maximal integral energy gravitational influences on the Earth of the Venus (in the first approximation), the time periodicity 15 years of the maximal integral energy gravitational influences on the Earth of the Mars (in the first approximation) and the time periodicity 83 years of the maximal integral energy gravitational influences on the Earth of the Jupiter (in the third approximation) and the Sun owing to the gravitational interaction of the Sun with the Jupiter, we obtained [Simonenko, 2007] the time periodicity

$$T_{tec} = T_{clim1} = T_{energy} = 27 \times 3 \times 15 \times 83 \text{ years} = 100845 \text{ years} \tag{3.199}$$

of the Earth's periodic seismotectonic (and volcanic) activity and the global climate variability of the Earth induced by the combined cosmic non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter.

Considering the time periodicity 27 years of the maximal combined integral energy gravitational influence on the Earth of the system Sun-Moon (in the fourth approximation), the periodicity 3 years of the maximal integral energy gravitational influence on the Earth of the Venus (in the first approximation), the periodicity 32 years of the maximal integral energy gravitational influence on the Earth of the Mars (in the second approximation) and the periodicity 83 years of the maximal integral energy gravitational influence on the Earth of the Jupiter (in the third approximation) and the Sun owing to the gravitational interaction of the Sun with the Jupiter, we obtained [Simonenko, 2007] the time periodicity

$$T_{clim2} = T_{endog} = T_{energy} / 2 = 0.5 \times 27 \times 3 \times 32 \times 83 \text{years} = 107568 \text{ years} \tag{3.200}$$

of the global climate variability of the Earth related with the periodic tectonic-endogenous heating (of the geo-spheres of the Earth, each geo-block of the Earth, the atmosphere and the oceans of the Earth) and related global volcanic activity induced by periodic continuum deformation (characterized by the time periodicity T_{energy}) owing to the periodic cosmic non-stationary combined energy gravitational influences (characterized by the time periodicity T_{energy}) on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter.

Considering the time periodicity 235 years of the maximal combined integral energy gravitational influence on the Earth of the system Sun-Moon (in the fifth approximation), the time periodicity 3 years of the maximal integral energy gravitational influences on the Earth of the Venus (in the first approximation), the time periodicity 15 years of the maximal integral energy gravitational influences on the Earth of the Mars (in first approximation) and the range of the time periodicities $(11 \div 12)$ years of the maximal integral energy gravitational influences on the Earth of the Jupiter (in the first and second approximations) and the Sun owing to the gravitational interaction of the Sun with the Jupiter, we obtained [Simonenko, 2007] the range of the time periodicities

$$T_{tec} = T_{clim1} = T_{energy} = 235 \times 3 \times 15 \times (11 \div 12) \text{ years} = 116325 \div 126900 \text{ years} \qquad (3.201)$$

of the global periodic seismotectonic (and volcanic) activity and the global climate variability of the Earth induced by the combined integral cosmic non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter. The average value 121612.5 years (of the calculated range $116325 \div 126900$ years of the time periodicities given by (3.201)) is very close to the empirical time periodicity 122000 years [Hays, Imbrie and Shackleton, 1976] of the climatic variability during Pleistocene. The value 124000 years (corresponding to the strong local maximum of the amplitude-frequency spectrum [Berger and Loutre, 1991] of the variations of the eccentricity of the Earth's orbit during the last 2 millions years) gets into the predicted theoretical range (3.201) of the time periodicities $116325 \div 126900$ years [Simonenko, 2007].

Table 2

The empirical time periodicities (related with the problem of the 100000-year climate periodicity during Pleistocene [Berger, 1999]) and the founded time periodicities established in the frame of the thermohydrogravidynamic theory [Simonenko, 2007a; 2007; 2008] of the Earth's paleoclimate

The empirical time periodicities of the Earth's climatic variability	[Hays, Imbrie and Shack-leton, 1976]: 94000 years	[Muller and MacDonald,1995]: 100000 years	[Hays, Imbrie and Shack-leton, 1976]: 106000 years	[Hays, Imbrie and Shack-leton, 1976]: 122000 years
The founded time periodicities of the Earth's global climate variability established in the frame of thermohy-drogravidynamic theory [Simonenko, 2007]	[Simonenko, 2007; p. 148]: 94620 years	[Simonenko, 2007; p. 148]: 100845 years	[Simonenko, 2007; p. 148]: 107568 years	[Simonenko, 2007; p. 148]: average periodicity 121612.5 years
The established physical genesis of the time periodicities of the Earth's global climate variability revealed in the frame of the thermohydrogra-vidynamic theory [Simonenko, 2007] of the Earth's paleoclimate	The global periodic Earth's tectonic-endogenous heating related with the periodic continuum deformation (and related global volcanic activity) induced by *the combined cosmic non-stationary energy gravitational influence on the Earth of the system Sun-Moon, the Venus, the Mars,*	The global periodic Earth's atmospheric-oceanic warming as a consequence of the greenhouse effect produced by the gravity-induced (*owing to the combined cosmic non-stationary energy gravitational influence on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the*	The global periodic Earth's tectonic endogenous heating related with the periodic continuum deformation (and related global volcanic activity) induced *by the combined cosmic non-stationary energy gravitational influence on the Earth of the*	The global periodic Earth's atmospheric-oceanic warming as a consequence of the greenhouse effect produced by the gravity-induced (*owing to the combined cosmic non-stationary energy gravitational influence on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the*

	the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter	*Sun owing to the gravitational interaction of the Sun with the Jupiter*) periodic global tectonic-volcanic activization accompanied by increased output of the atmospheric greenhouse gases	*system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter*	*gravitational interaction of the Sun with the Jupiter*) periodic global tectonic-volcanic activization accompanied by increased output of the atmospheric greenhouse gases

The recurrence of the maximal tectonic (and volcanic) activity of the Earth (characterized by the range of the time periodicities $116325 \div 126900$ years) must lead to the recurrence of the maximal concentration of the atmospheric greenhouse gases characterized by the same time periodicities $116325 \div 126900$ years) owing to the periodic increase of production of the atmospheric greenhouse gases related with tectonic-volcanic activization of the Earth. The periodic increase of the atmospheric greenhouse gases concentration (characterized by the range of the time periodicities $116325 \div 126900$ years) must lead to the periodic climate variability related with the atmospheric-oceanic warming as a consequence of the greenhouse effect.

The established [Simonenko, 2007] cosmic energy gravitational genesis of the range (3.201) of the time periodicities $116325 \div 126900$ years (corresponding to the empirical time periodicity 122000 years [Hays, Imbrie and Shackleton, 1976] of the global climate variability) is explained in the frame of the thermohydrogravidynamic theory [Simonenko, 2007] by considering the combined energy gravitational influence on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter.

We present in Table 2 the empirical time periodicities [Muller and MacDonald, 1995; Hays, Imbrie and Shackleton, 1976] of the Earth's global climatic variability (related with the problem of the 100000-year climate periodicity during Pleistocene [Berger, 1999]) and the calculated time periodicities in the frame of the thermohydrogravidynamic theory [Simonenko, 2007].

The empirical time periodicity 94000 years [Hays, Imbrie and Shackleton, 1976] during Pleistocene is in good agreement with the calculated [Simonenko, 2007] time periodicity 94620 years ($0.5\times 19\times 8\times 15\times 83$ years) of the Earth's global climatic variability related with the combined cosmic non-stationary energy gravitational influence on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter.

Taking this agreement into account, we revealed [Simonenko, 2007] the cosmic energy gravitational genesis (related with the combined cosmic non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter) of the periodic Earth's tectonic-endogenous heating and related global volcanic activity (characterized by the time periodicity 94620 years) induced by the periodic continuum deformation owing to the combined cosmic non-stationary energy gravitational influence on the Earth of the system Sun-Moon, the Venus, the Mars, Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter.

The established cosmic energy gravitational genesis of the time periodicity 100845 years ($27\times 3\times 15\times 83$ years) [Simonenko, 2007] is in agreement with the experimental data [Pinxian et al., 2003; p. 2524-2535], which revealed the time periodicity 100000 years of the climatic variability. The established cosmic energy gravitational genesis of the time periodicity 100845 years [Simonenko, 2007] is also in agreement with the experimental data [Pinxian et al., 2003; p. 2536-2548], which revealed the same time periodicity 100000 years of the variability of the carbon concentration in the Earth's sedimentary rocks. The empirical time periodicity 100000 years [Muller and MacDonald, 1995] during Pleistocene is in good agreement with the calculated time periodicity 100845 years [Simonenko, 2007] of the Earth's climatic variability related with the combined cosmic non-stationary energy gravitational influence on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter. Taking into account this agreement, we revealed [Simonenko, 2007] the cosmic energy gravitational genesis (related with the combined cosmic non-stationary energy gravitational influence on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter) of the periodic atmospheric-oceanic global planetary warming and cooling (characterized by the time periodicity 100845 years) as a consequence of the greenhouse effect produced by the gravity-induced periodic global tectonic-volcanic activization accompanied by the increased output of the atmospheric greenhouse gases.

The empirical time periodicity 106000 years [Hays, Imbrie and Shackleton, 1976] during Pleistocene is in good agreement with the calculated [Simonenko, 2007] time periodicity 107568 years ($0.5\times 27\times 3\times 32\times 83$ years) of the Earth's global climatic variability related with the combined cosmic non-stationary energy gravitational influence on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter. Taking into account this agreement, we revealed [Simonenko, 2007] the cosmic energy gravitational genesis (related with the combined cosmic planetary non-stationary energy gravitational influence on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter) of the periodic Earth's global tectonic-endogenous heating and related global volcanic activity (characterized by the time periodicity 107568 years induced by the periodic continuum deformation owing to the combined cosmic non-stationary energy gravitational influence on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter).

The empirical time periodicity 122000 years [Hays, Imbrie and Shackleton, 1976] during Pleistocene is in good agreement with the calculated [Simonenko, 2007] average time periodicity 121612.5 years ($235\times 3\times 15\times (11+12)\times 0.5$ years) of the Earth's global climatic variability related with the combined cosmic non-stationary energy gravitational influence on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter. Taking this agreement into account, we revealed [Simonenko, 2007] the cosmic energy gravitational genesis (related with the combined cosmic non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter) of the periodic global atmospheric-oceanic warming (characterized by the average time periodicity 121612.5 years) as a consequence of the greenhouse effect produced by the gravity-induced periodic global tectonic-volcanic activization accompanied by the increased output of the atmospheric greenhouse gases.

Using the presented (in Table 2) calculated time periodicities of the Earth's global climatic variability, we calculated [Simonenko, 2007] the average theoretical time periodicity 106160 years, which is in good agreement with the empirical time periodicity 106000 years corresponding to the main maximum of the spectrum [Hays, Imbrie and Shackleton, 1976] of the combined isotopic-oxygen variations based on the empirical data RC11 - 120 and E49 - 18.

Using the presented (in Table 2) empirical time periodicities of the Earth's global climatic variability, we calculated [Simonenko, 2007] the average empirical time periodicity 105500 years, which is in fairly good agreement with the empirical time periodicity 106000 years corresponding to the main maximum of the spectrum [Hays, Imbrie and Shackleton, 1976] of the combined isotopic-oxygen variations based on the empirical data RC11 - 120 and E49 - 18. The calculated [Simonenko, 2007] average theoretical time periodicity 106160 years is in fairly good agreement with the empirical predominant time periodicity of 105000 years [Gorbarenko et al., 2011] characterizing the Okhotsk Sea productivity and lithological proxies stacks during the last 350 kyr.

The agreement of the obtained average theoretical global time periodicity 106160 years [Simonenko, 2007] with the empirical time periodicity 106000 years [Hays, Imbrie and Shackleton, 1976] confirmed [Simonenko, 2007] the validity of the established cosmic planetary energy gravitational genesis (related with the combined cosmic non-stationary energy gravitational influence on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter) of the revealed time periodicities (in the frame of the thermohydrogravidynamic theory [Simonenko, 2007a; 2007; 2008]) of the Earth's global climatic variability. The agreement of the obtained average theoretical global time periodicity 106160 years [Simonenko, 2007] with the empirical time periodicity 105000 years [Gorbarenko et al., 2011] is the additional confirmation of the validity of the established cosmic planetary energy gravitational genesis (related with the combined cosmic non-stationary energy gravitational influence on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter) of the revealed [Hays, Imbrie and Shackleton, 1976] time periodicities of the Earth's global climatic variability.

3.6.5. Cosmic energy gravitational genesis of the modern short-term time periodicities of the Earth's global climate variability determined by the combined cosmic factors: G-factor related with the combined cosmic non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Mercury, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter; $\mathrm{G}(a)$-factor related to the tectonic-endogenous heating of the Earth as a consequence of the periodic continuum deformation of the Earth due to the G-factor; $\mathrm{G}(b)$-factor related to the periodic atmospheric-oceanic warming or cooling as a consequence of the periodic variable (increasing or decreasing) output of the heated greenhouse volcanic gases and the related variable greenhouse effect induced by the periodic variable tectonic-volcanic activity (activization or weakening) due to the G-factor; $\mathrm{G}(c)$-factor related to the periodic variations of the solar activity owing to the periodic variations of the combined planetary non-stationary energy gravitational influence on the Sun

Using the evaluations [Simonenko, 2009; 2010] of the relative maximal instantaneous energy gravitational influences of the planets of the Solar System on the Sun and using the established [Simonenko, 2009; 2010] time periodicities of the solar activity induced by the energy gravitational influences on the Sun of the planets of the Solar System, we established [Simonenko, 2009; 2010] the following short-term time periodicities (of the solar activity induced by the planetary energy gravitational influences on the Sun):

$$0.96359 \div 1.2302 \text{ years} \tag{3.202}$$

determined by the combined energy gravitational influence of the Mercury, the Venus and the Earth on the Sun;

$$5.5359 \div 7 \text{ years} \tag{3.203}$$

determined by the combined energy gravitational influence of the Mercury, the Venus and the Earth on the Sun;

$$11 \div 13.008 \text{ years} \tag{3.204}$$

determined by the combined energy gravitational influence of the Jupiter, the Mercury, the Venus, the Earth and the Mars on the Sun;

$$19.9945 \div 29.4525 \text{ years} \tag{3.205}$$

determined by the combined energy gravitational influence of the Jupiter, the Mercury, the Saturn and the Venus on the Sun;

$$33 \div 35.73 \text{ years} \tag{3.206}$$

determined by the combined energy gravitational influence of the Jupiter, the Mercury, the Venus, the Mars and the Earth on the Sun;

$$47.36 \div 53 \text{ years} \tag{3.207}$$

determined by the combined energy gravitational influence of the Jupiter, the Mercury, the Venus and the Earth on the Sun;

$$58.905 \div 63.3564 \text{ years} \tag{3.208}$$

determined by the combined energy gravitational influence of the Jupiter, the Mercury, the Saturn and the Venus on the Sun;

$$83 \div 88.4095 \text{ years} \tag{3.209}$$

determined by the combined energy gravitational influence of the Jupiter, the Mercury, the Saturn, the Venus and the Earth on the Sun;

$$106.7177 \div 118.58 \text{ years} \tag{3.210}$$

determined by the combined energy gravitational influence of the Jupiter, the Mercury, the Saturn and the Mars on the Sun.

Taking into account these short-term time periodicities (founded in Subsection 6.2.9 of the monographs [Simonenko, 2009; 2010]) of the solar activity; the modern short-term time periodicities (founded in Subsection 4.3.2.10 of the monographs [Simonenko, 2009; 2010]) of the global climate variability induced by the non-stationary energy gravitational influences on the Earth of the Mercury, the Venus, the Moon, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter; the time periodicities (founded in Subsections 4.4.5.3 and 4.4.5.4 of the monographs [Simonenko, 2009; 2010]) of the Earth's periodic global climate variability induced by the different combinations of the cosmic non-stationary energy gravitational influences of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter; we evaluated [Simonenko, 2009; 2010] the following ranges of the main modern short-term time periodicities of the Earth's global climate variability:

$$[0.96359 \div 3] \text{ years} \tag{3.211}$$

consistent approximately with the empirical range $[1 \div 3]$ years of the time periodicities [Li et al., 2001; Krokhin, 2004; Ponomarev et al., 2007] of the global climate variability;

$$(3 \div 7] \text{ years} \tag{3.212}$$

consistent with the same empirical range $(3 \div 7]$ years of the time periodicities [Thompson and Wallace, 1998; Wang and Ikeda, 2000; Gong et al., 2003; Ogi and Tachibana, 2006; Oort and Yienger, 1996; White and Cayan, 2000; Diaz et al., 2001; Fu and Teng, 1993; Ponomarev et al., 1999a; Ponomarev et al., 1999b; Ponomarev et al., 2007] related with the ENSO climate variability;

$$(7 \div 15] \text{ years} \tag{3.213}$$

consistent approximately with the evaluated empirical range $8 \div 15$ years [Ponomarev et al., 2007] of the quasi-decadal climate variability [Nakamura et al., 1997; Tourre et al., 2001; Auad, 2003; Qiu, 2003; Ponomarev et al., 2003a; 2003b; 2003c; Polonsky et al., 2004];

$$[16 \div 19] \text{ years} \tag{3.214}$$

consistent approximately with the evaluated empirical [Ponomarev et al., 2007] quasi-twenty-year climate variability of the Pacific Ocean and the continental marginal Pacific areas [Latif and Barnett, 1994; Minobe, 1997; Tourre et al., 2001; Auad, 2003];

$$[19.9945 \div 29.4525] \text{ years} \tag{3.215}$$

consistent with the evaluated empirical range $20 \div 30$ years [Ponomarev et al., 2007] of the climate variability for the Asian continental (adjacent to the Far Eastern seas) and Pacific marginal areas;

$$[32 \div 36] \text{ years} \tag{3.216}$$

consistent approximately with the evaluated [Dmitrieva and Ponomarev, 2012] empirical time periodicity 37 years characterizing the South-Eastern tropical area, Kuroshio Current region (including East China an Japan/East Seas), central and northeastern Pacific;

$$[16 \div 36] \text{ years} \tag{3.217}$$

consistent approximately with the evaluated [Ponomarev et al., 2007] empirical range $15 \div 35$ years of the time periodicities of the global climate variability [Yamagata and Masumoto, 1992; Trenberth and Hurrel, 1994; Latif and Barnett, 1994; Miller et al., 1994; Delworth et al., 1996; Zhang et al., 1997; Mantua et al., 1997; Minobe and Mantua, 1999; Tourre et al., 2001; Auad, 2003; Ponomarev et al., 2003a; 2003b; 2003c];

$$[41.5 \div 54] \text{ years} \tag{3.218}$$

consistent approximately with the evaluated (based on the wavelet analysis) interdecadal cycle of approximately 50 years [Goncharova, Gorbarenko, Shi, Bosin, Fischenko, Zou and Liu, 2012] characterizing the regional climate variability of the Japan Sea, and in good agreement with the estimated (based on the spectral Fourier analysis) time periodicity 48 years [Kalugin and Darin, 2012] obtained from the studies of sediments from Siberian and Mongolian lakes;

$$[57 \div 63.3564] \text{ years} \tag{3.219}$$

consistent approximately with the revealed climatic time periodicity 60 years [Monin and Sonechkin, 2005];

$$[76 \div 96] \text{ years} \tag{3.220}$$

in good agreement with the estimated (based on the spectral Fourier analysis) time periodicity 88 years [Kalugin and Darin, 2012] obtained from the studies of sediments from Siberian and Mongolian lakes;

$$[99 \div 124.5] \text{ years} \tag{3.221}$$

consistent approximately with the evaluated [Ponomarev et al., 2007] quasi-hundred-year time periodicity of the global climate variability [Auad, 2003; Miller and Schneider, 2000; Webster and Yang, 1992; Li et al., 2001; Nakamura et al., 2002; Global-regional linkages in the Earth system, 2002; Overland et al., 1999; Vasilevskaya et al., 2003; Savelieva et al., 2004], and in good agreement with the estimated (based on the spectral Fourier analysis) time periodicity 109 years [Kalugin and Darin, 2012] obtained from the studies of sediments from Siberian and Mongolian lakes, and consistent approximately with the evaluated (based on the wavelet analysis) interdecadal cycle of approximately 100 years [Goncharova, Gorbarenko, Shi, Bosin, Fischenko, Zou and Liu, 2012] characterizing the regional climate variability of the Japan Sea.

The combination of the founded ranges (3.218) and (3.219) gives the explanation of the evaluated empirical range $50 \div 70$ years of the time periodicities [Minobe, 1997] of the global climate variability in the northern region of the Pacific Ocean and for the Northern America.

The range (3.216) of the global climatic time periodicities $32 \div 36$ years is determined by the range (3.206) of the time periodicities $33 \div 35.73$ years of the solar activity (induced by the combined energy gravitational influence of the Jupiter, the Mercury, the Venus, the Mars and the Earth on the Sun) and mainly the range of the global climatic (and seismotectonic) time periodicities $33 \div 36$ years ($3 \times (11 \div 12)$ years) [Simonenko, 2007] related with the combined cosmic non-stationary energy gravitational influence on the Earth of the system Sun-Moon, the Venus, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter. The established time periodicity 35 years [Hattory, 1977] of the sesmotectonic activity of various regions of the seismic zone of the Pacific Ring is in good agreement with the mean value 34.5 years of the established range of the global climatic (and seismotectonic) time periodicities $33 \div 36$ years [Simonenko, 2007]. The mean value 34.5 years (of the established range of the global climatic (and seismotectonic) time periodicities $33 \div 36$ years [Simonenko, 2007]) is also in good agreement with the evaluated [Dmitrieva and Ponomarev, 2012] empirical time periodicity 37 years characterizing the South-Eastern tropical area, Kuroshio Current region (including East China and Japan/East Seas), central and northeastern Pacific. These good agreement (of the independent studies [Hattory, 1977; Simonenko, 2007; Dmitrieva and Ponomarev, 2012]) confirms the validity of the thermohydrogravidynamic theory [Simonenko, 2007; 2009; 2010] of the seismotectonic, volcanic and climatic evolution of the Earth.

3.7. The cosmic energy gravitational genesis of the seismotectonic (and volcanic) activity and the global climate variability induced (owing to the G-factor, $\mathrm{G}(a)$-factor and $\mathrm{G}(b)$-factor) by the combined non-stationary cosmic energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun (owing to the gravitational interaction of the Sun with the Jupiter, the Saturn, the Uranus and the Neptune)

3.7.1. The time periodicities of the maximal (instantaneous and integral) energy gravitational influences of the Sun on the Earth owing to the gravitational interaction of the Sun with the outer large planets (the Jupiter, the Saturn, the Uranus and the Neptune)

Taking into account the results of Subsection 3.3 (revealing the very significant energy gravitational influence of the Sun on the Earth owing to the gravitational interaction of the Sun with the outer large planets of the Solar System), it is necessary to deduce (using the generalized differential formulation (1.50) of the first law of thermodynamics and the related results of Subsections 3.3 for the Earth) the time periodicities of the maximal (instantaneous and integral) energy gravitational influences of the Sun on the Earth owing to the gravitational interaction of the Sun with the outer large planets (the Jupiter, the Saturn, the Uranus and the Neptune).

3.7.1.1. The time periodicities of the maximal (instantaneous and integral) energy gravitational influences on the Earth of the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter

Using the results of Subsections 3.3.1 and 3.6.2.3, we have the successive approximations for the time periodicities [Simonenko, 2007] $(\mathrm{T}_{J,3})_1 = 11$ years, $(\mathrm{T}_{J,3})_2 = 12$ years and $(\mathrm{T}_{J,3})_3 = 83$ years (given by (3.188), (3.189) and (3.190), respectively) of recurrence of the maximal (instantaneous and integral) energy gravitational influences on the Earth of the Jupiter [Simonenko, 2007] and the Sun (owing to the gravitational interaction of the Sun with the Jupiter) in the first, second and third approximations, respectively.

3.7.1.2. The time periodicities of the maximal (instantaneous and integral) energy gravitational influences on the Earth of the Saturn and the Sun owing to the gravitational interaction of the Sun with the Saturn

Let us obtain (in the frame of the real elliptical orbits of the Earth and the Saturn) the first, second and third approximations for the time periodicities characterizing the maximal (instantaneous and integral) energy gravitational influences on the Earth of the Saturn and the Sun owing to the gravitational interaction of the Sun with the Saturn. If the configuration of the Earth, the Saturn and the Sun (considered as the closed system) is characterized at any time moment by the maximal (instantaneous or integral) combined energy gravitational influences on the Earth of the Saturn and the Sun (owing to the gravitational interaction of the Sun with the Saturn), then the Earth, the Saturn and the Sun will have the recurrence of the same (approximately) configuration after different integer numbers of circulations ($l_{\mathrm{SAT},3}$ circulations of the Saturn around the combined mass center of the Sun and the Saturn and $\mathrm{m}_{3,\mathrm{SAT}}$ circulations of the Earth around the combined mass center of the Sun and the Saturn) to satisfy the following condition:

$$l_{\mathrm{SAT},3}\,\mathrm{T}_{\mathrm{SAT}} = \mathrm{m}_{3,\mathrm{SAT}}\,\mathrm{T}_3 . \tag{3.222}$$

Following the known method [Perelman, 1956], we present the ratio $\mathrm{T}_{\mathrm{SAT}}/\,\mathrm{T}_3$ by the following mathematical fraction:

$$\mathrm{m}_{3,\mathrm{SAT}}\,/\,l_{\mathrm{SAT},3} = \frac{\mathrm{T}_{\mathrm{SAT}}}{\mathrm{T}_3} = \frac{10759}{365.3} = 29 + \cfrac{1}{2 + \cfrac{1}{4 + \cfrac{347}{265}}}.$$

Considering the first approximation of the ratio T_{SAT}/T_3 given by the rational number $m_{3,SAT}/l_{SAT,3} = 29$, we have from condition (3.222) the first approximation:

$$T_{SAT} \approx 29\, T_3 \tag{3.223}$$

denoting that 29 circulations of the Earth (around the combined mass center of the Sun and the Saturn) correspond approximately to 1 circulation of the Saturn around the combined mass center of the Sun and the Saturn. The first approximation gives the first approximate time periodicity $(T_{SAT,3})_1 = 29$ years of the maximal (instantaneous or integral) combined energy gravitational influences (in the first approximation) on the Earth of the Saturn and the Sun owing to the gravitational interaction of the Sun with the Saturn.

Considering the second approximation of the ratio T_{SAT}/T_3 given by the following rational number

$$\frac{m_{3,SAT}}{l_{SAT,3}} = 29 + \frac{1}{2} = \frac{59}{2},$$

we have from condition (3.222) the second approximation:

$$2T_{SAT} \approx 59\, T_3 \tag{3.224}$$

denoting that 59 circulations of the Earth (around the combined mass center of the Sun and the Saturn) correspond approximately to 2 circulations of the Saturn around the combined mass center of the Sun and the Saturn. The second approximation (3.224) gives the second approximate time periodicity $(T_{SAT,3})_2 = 59$ years of the maximal (instantaneous or integral) combined energy gravitational influences (in the second approximation) on the Earth of the Saturn and the Sun owing to the gravitational interaction of the Sun with the Saturn.

Considering the third approximation of the ratio T_{SAT}/T_3 given by the following rational number

$$\frac{m_{3,SAT}}{l_{SAT,3}} = 29 + \frac{1}{2 + \frac{1}{4}} = \frac{265}{9},$$

we have from condition (3.222) the third approximation:

$$9T_{SAT} \approx 265\, T_3 \tag{3.225}$$

denoting that 265 circulations of the Earth (around the combined mass center of the Sun and the Saturn) correspond approximately to 9 circulations of the Saturn around the combined mass center of the Sun and the Saturn. The third approximation (3.225) gives the third approximate time periodicity $(T_{SAT,3})_3 = 265$ years of the maximal (instantaneous or integral) combined energy gravitational influences (in the third approximation) on the Earth of the Saturn and the Sun owing to the gravitational interaction of the Sun with the Saturn.

Thus, we found the time periodicities:

$$(T_{SAT,3})_1 = 29 \text{ years}, \tag{3.226}$$

$$(T_{SAT,3})_2 = 59 \text{ years}, \tag{3.227}$$

$$(T_{SAT,3})_3 = 265 \text{ years} \tag{3.228}$$

of recurrence of the maximal (instantaneous and integral) combined energy gravitational influences on the Earth of the Saturn and Sun (owing to the gravitational interaction of the Sun with the Saturn) in the first, second and third approximations, respectively.

3.7.1.3. The time periodicity of the maximal (instantaneous and integral) energy gravitational influences on the Earth of the Uranus and the Sun owing to the gravitational interaction of the Sun with the Uranus

Let us obtain (in the frame of the real elliptical orbits of the Earth and the Uranus) the first approximation for the time periodicities characterizing the maximal (instantaneous or integral) energy gravitational influences on the Earth of the Uranus and the Sun owing to the gravitational interaction of the Sun with the Uranus. If the configuration of the Earth, the Uranus and the Sun (considered as the closed ystem) is characterized at any time moment by the maximal (instantaneous or integral) combined energy gravitational influences on the Earth of the Uranus and the Sun (owing to the gravitational interaction of the Sun with the Uranus), then the Earth, the Uranus and the Sun will have the recurrence of the same configuration (approximately) after different integer numbers of circulations ($w_{U,3}$ circulations of the Uranus around the combined mass center of the Sun and the Uranus and $m_{3,U}$ circulations of the Earth around the combined mass center of the Sun and the Uranus) to satisfy the following condition:

$$w_{U,3}\,T_U = m_{3,U}\,T_3 . \qquad (3.229)$$

Following the known method [Perelman, 1956], we present the ratio T_U/T_3 by the following mathematical fraction:

$$m_{3,U}/w_{U,3} = \frac{T_U}{T_3} = \frac{30685}{365.3} = 83 + \cfrac{1}{1 + \cfrac{1}{1825 + \cfrac{1}{2}}}.$$

Considering the first approximation of the ratio T_U/T_3 given by the rational number $m_{3,U}/w_{U,3} = 84$, we have from condition (3.229) the first approximation:

$$T_U \approx 84\,T_3 \qquad (3.230)$$

denoting that 84 circulations of the Earth (around the combined mass center of the Sun and the Uranus) correspond approximately to 1 circulation of the Uranus around the combined mass center of the Sun and the Uranus. The first approximation gives the first approximate time periodicity $(T_{U,3})_1 = 84$ years of the maximal (instantaneous or integral) combined energy gravitational influences (in the first approximation) on the Earth of the Uranus and the Sun owing to the gravitational interaction of the Sun with the Uranus. Thus, we found the following time periodicity:

$$(T_{U,3})_1 = 84 \text{ years}, \qquad (3.231)$$

of recurrence of the maximal (instantaneous and integral) combined energy gravitational influences on the Earth of the Uranus and Sun (owing to the gravitational interaction of the Sun with the Uranus) in the first approximation.

3.7.1.4. The time periodicities of the maximal (instantaneous and integral) energy gravitational influences on the Earth of the Neptune and the Sun owing to the gravitational interaction of the Sun with the Neptune

Let us obtain (in the frame of the real elliptical orbits of the Earth and the Neptune) the first, second and third approximations for the time periodicities characterizing the maximal (instantaneous or integral) energy gravitational influences on the Earth of the Neptune and the Sun owing to the gravitational interaction of the Sun with the Neptune. If the configuration of the Earth, the Neptune and the Sun (considered as the closed system) is characterized at any time moment by the maximal (instantaneous or integral) combined energy gravitational influences on the Earth of the Neptune and the Sun (owing to the gravitational interaction of the Sun with the Neptune), then the Earth, the Neptune and the Sun will have the recurrence of the same (approximately) configuration after different integer numbers of circulations ($p_{N,3}$ circulations of the Neptune around the combined mass center of the Sun and the Neptune and $m_{3,N}$ circulations of the Earth around the combined mass center of the Sun and the Neptune) to satisfy the following condition:

$$p_{N,3}\,T_N = m_{3,N}\,T_3 . \qquad (3.232)$$

Following the known method [Perelman, 1956], we present the ratio T_N/T_3 by the following mathematical fraction:

$$m_{3,N}/p_{N,3} = \frac{T_N}{T_3} = \frac{60189}{365.3} = 164 + \cfrac{1}{1 + \cfrac{1}{3 + \cfrac{1}{3 + \cfrac{156}{233}}}}.$$

Considering the first approximation of the ratio T_N/T_3 given by the rational number

$m_{3,N} / p_{N,3} = 165$, we have from condition (3.232) the first approximation:

$$T_N \approx 165\, T_3 \tag{3.233}$$

denoting that 165 circulations of the Earth (around the combined mass center of the Sun and the Neptune) correspond approximately to 1 circulation of the Neptune around the combined mass center of the Sun and the Neptune. The first approximation gives the first approximate time periodicity $(T_{N,3})_1 = 165$ years of the maximal (instantaneous or integral) combined energy gravitational influences (in the first approximation) on the Earth of the Neptune and the Sun owing to the gravitational interaction of the Sun with the Neptune.

Considering the second approximation of the ratio T_N / T_3 given by the following rational number

$$m_{3,N} / p_{N,3} = 164 + \cfrac{1}{1 + \cfrac{1}{3}} = \frac{659}{4},$$

we have from condition (3.232) the second approximation:

$$4T_N \approx 659\, T_3 \tag{3.234}$$

denoting that 659 circulations of the Earth (around the combined mass center of the Sun and the Neptune) correspond approximately to 4 circulations of the Neptune around the combined mass center of the Sun and the Neptune. The second approximation (3.234) gives the second approximate time periodicity $(T_{N,3})_2 = 659$ years of the maximal (instantaneous or integral) combined energy gravitational influences (in the second approximation) on the Earth of the Neptune and the Sun owing to the gravitational interaction of the Sun with the Neptune.

Considering the third approximation of the ratio T_N / T_3 given by the following rational number

$$m_{3,N} / p_{N,3} = 164 + \cfrac{1}{1 + \cfrac{1}{3 + \cfrac{1}{3}}} = \frac{2142}{13},$$

we have from condition (3.232) the third approximation:

$$13T_N \approx 2142\, T_3 \tag{3.235}$$

denoting that 2142 circulations of the Earth (around the combined mass center of the Sun and the Neptune) correspond approximately to 13 circulations of the Neptune around the combined mass center of the Sun and the Neptune. The third approximation (3.235) gives the third approximate time periodicity $(T_{N,3})_3 = 2142$ years of the maximal (instantaneous or integral) combined energy gravitational influences (in the third approximation) on the Earth of the Neptune and the Sun owing to the gravitational interaction of the Sun with the Neptune.

Thus, we found the time periodicities:

$$(T_{N,3})_1 = 165 \text{ years}, \tag{3.236}$$

$$(T_{N,3})_2 = 659 \text{ years}, \tag{3.237}$$

$$(T_{N,3})_3 = 2142 \text{ years} \tag{3.238}$$

of recurrence of the maximal (instantaneous and integral) combined energy gravitational influences on the Earth of the Neptune and Sun (owing to the gravitational interaction of the Sun with the Neptune) in the first, second and third approximations, respectively.

3.7.1.5. The fundamental global time periodicities (related to the combined planetary, lunar and solar non-stationary energy gravitational influences on the Earth) of the Earth's periodic global seismotectonic (and volcanic) activity and the global climate variability induced by the different combinations of the cosmic non-stationary energy gravitational influences of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter, the Saturn, the Uranus and the Neptune

Using the equivalent generalized differential formulations (1.43), (1.50) and (1.53) [Simonenko, 2007] of the first law of thermodynamics for the Earth and the calculated time periods of the periodic recurrence of the maximal integral energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Mars and the Jupiter, we calculated [Simonenko, 2007] the set of the gravity-induced time periodicities (3.196) of the Earth's periodic seismotectonic and volcanic activity and the global climate variability related with the periodic recurrence of the maximal combined integral energy gravitational influences on the Earth induced by the different combinations of the cosmic non-stationary energy gravitational influences of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter, the Saturn, the Uranus and the Neptune. Taking into account the very significant non-stationary energy gravitational influence (established in Subsection 3.3) on the Earth of the Sun owing to the gravitational interaction of the Sun with the Jupiter and using the same successive approximations for the time periodicities [Simonenko, 2007] $(T_{J,3})_1 = 11$ years, $(T_{J,3})_2 = 12$ years and $(T_{J,3})_3 = 83$ years (given by (3.188), (3.189) and (3.190), respectively) of recurrence of the maximal (instantaneous and integral) energy gravitational influences on the Earth of the Jupiter [Simonenko, 2007] and the Sun (owing to the gravitational interaction of the Sun with the Jupiter in the first, second and third approximations, respectively), we have expanded in Subsection 3.6.2 the previous results (taking into account the very significant energy gravitational influence on the Earth of the Sun owing to the gravitational interaction of the Sun with the Jupiter) of the monographs [Simonenko, 2007; 2009; 2010] by establishing the time periodicities of the maximal (instantaneous and integral) energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter. We expand in this Subsection the results of the Subsection 3.6.2 by establishing the fundamental global time periodicities (related to the combined planetary, lunar and solar non-stationary energy gravitational influences on the Earth) of the Earth's periodic global seismotectonic (and volcanic) activity and the global climate variability induced by the different combinations of the cosmic non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter, the Saturn, the Uranus and the Neptune.

It was founded [Simonenko, 2007; 2009; 2010] that the time periodicities of the Earth's global climate variability are determined by the combined cosmic factors: G-factor related with the combined cosmic non-stationary energy gravitational influences on the Earth, $G(a)$-factor related to the tectonic-endogenous heating of the Earth as a consequence of the periodic continuum deformation of the Earth due to the G-factor, $G(b)$-factor related to the periodic atmospheric-oceanic warming or cooling as a consequence of the periodic variable (increasing or decreasing) output of the heated greenhouse volcanic gases and the related variable greenhouse effect induced by the periodic variable tectonic-volcanic activity (activization or weakening) due to the G-factor, $G(c)$-factor related to the periodic variations of the solar activity owing to the periodic variations of the combined planetary non-stationary energy gravitational influence on the Sun. We consider in this Subsection the combined G, $G(a)$ and $G(b)$ cosmic factors related with the cosmic non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter, the Saturn, the Uranus and the Neptune.

We take into account the established successive approximations for the commensurable [Alfvėn and Arrhenius, 1976] time periodicities of recurrence of the maximal (instantaneous and integral) energy gravitational influences on the Earth: $\{(T_{S\text{-}MOON,3})_i\} = 3$ years $(i = 1)$, 8 years $(i = 2)$, the Metonic cycle of 19 years $(i = 3)$, 27 years $(i = 4)$ for the system Sun-Moon [Simonenko, 2007; 2009; 2010]; $\{(T_{V,3})_j\} = 3$ years $(j = 1)$, 8 years $(j = 2)$ for the Venus [Simonenko, 2007; 2009; 2010];

$\{(T_{MARS,3})_k\} = 15$ years $(k=1)$, 32 years $(k=2)$, 47 years $(k=3)$ for the Mars [Simonenko, 2007; 2009; 2010]; $\{(T_{J,3})_n\} = 11$ years $(n=1)$, 12 years $(n=2)$, 83 years $(n=3)$ for the Jupiter [Simonenko, 2007; 2009; 2010] and for the Sun owing to the gravitational interaction of the Sun with the Jupiter; $\{(T_{SAT,3})_m\} = 29$ years $(m=1)$, 59 years $(m=2)$, 265 years $(m=3)$ for the Saturn and for the Sun owing to the gravitational interaction of the Sun with the Saturn; $\{(T_{U,3})_q\} = 84$ years $(q=1)$ for the Uranus and for the Sun owing to the gravitational interaction of the Sun with the Uranus; $\{(T_{N,3})_r\} = 165$ years $(r=1)$, 659 years $(r=2)$, 2142 years $(r=3)$ for the Neptune and for the Sun owing to the gravitational interaction of the Sun with the Neptune.

Based on the generalized formulation (1.50) of the first law of thermodynamics used for the Earth as a whole, we found (taking into account the established [Simonenko, 2007] cosmic G-factor and $G(b)$-factor) the fundamental sets of the fundamental global seismotectonic and volcanic time periodicities $T_{tec,f}$ (of the periodic global seismotectonic and volcanic activities owing to the G-factor) and the fundamental global climatic periodicities $T_{clim1,f}$ (of the periodic global climate variability and the global variability of the quantities of the fresh water and glacial ice resources owing to the $G(b)$-factor):

$$T_{tec,f} = T_{clim1,f} = T_{energy,f} = L.C.M.\{(T_{S\text{-}MOON,3})_i^{l_o}, (T_{V,3})_j^{l_2}, (T_{MARS,3})_k^{l_4}, (T_{J,3})_n^{l_5}, (T_{SAT,3})_m^{l_6}, (T_{U,3})_q^{l_7}, (T_{N,3})_r^{l_8}\} \quad (3.239)$$

determined by the successive global fundamental periodicities $T_{energy,f}$ (defined by the least common multiples $L.C.M.$ of various successive time periodicities related to the different combinations of the following integer numbers: $i = 1,2,3,4$; $j = 1,2$; $k = 1,2,3$; $n = 1,2,3$; $m = 1,2,3$; $q = 1$; $r = 1,2,3$; $l_o = 0,1$; $l_2 = 0,1$; $l_4 = 0,1$; $l_5 = 0,1$; $l_6 = 0,1$; $l_7 = 0,1$; $l_8 = 0,1$) of recurrence of the maximal combined energy gravitational influences on the Earth of the different combined combinations of the cosmic non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interactions of the Sun with the Jupiter, the Saturn, the Uranus and the Neptune.

Based on the generalized formulation (1.50) of the first law of thermodynamics used for the Earth as a whole, we found (taking into account the established [Simonenko, 2007] cosmic G-factor and the $G(a)$ and $G(b)$-factors) the fundamental set of the fundamental global climatic periodicities

$$T_{clim2,f} = T_{endog,f} = T_{energy,f}/2 = \frac{1}{2} L.C.M.\{(T_{S\text{-}MOON,3})_i^{l_o}, (T_{V,3})_j^{l_2}, (T_{MARS,3})_k^{l_4}, (T_{J,3})_n^{l_5}, (T_{SAT,3})_m^{l_6}, (T_{U,3})_q^{l_7}, (T_{N,3})_r^{l_8}\} \quad (3.240)$$

(of the periodic global climate variability and the global variability of the quantities of the fresh water and glacial ice resources related with the periodic tectonic-endogenous heating and related global volcanic activity) determined by the $G(a)$ and $G(b)$-factors related to the different combined combinations of the cosmic non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interactions of the Sun with the Jupiter, the Saturn, the Uranus and the Neptune.

3.7.1.6. The thermohydrogravidynamic solution of the fundamental problem of the origin of the major 100-kyr glacial cycle (during Pleistocene) determined by the non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Jupiter and the Sun owing to the gravitational interactions of the Sun with the Jupiter, the Saturn, the Uranus and the Neptune

A simple Milankovitch origin of the 100-kyr glacial cycle “is ruled out” [Imbrie, Berger et al., 1993] “because the eccentricity-driven 100-kyr radiation cycle is much too small and its phase too late to force the corresponding climate cycle directly”. We present in Subsection 3.6.4 the results of the previous evaluation [Simonenko, 2007; 2009; 2010] of the mean time periodicities 94620 years and 107568 years of the global climate variability determined by the $G(a)$ - factor and $G(b)$ - factor (related with the cosmic non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter) and the mean time periodicities 100845 years and 121612.5 years of the global climate variability determined by the $G(b)$ - factor (related with the cosmic non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter). Taking into account the established (in Subsection 3.3) significance of the non-stationary energy gravitational influences on the Earth of the Sun owing to the gravitational interaction of the Sun with the Jupiter, the Saturn, the Uranus and the Neptune, we present in this Subsection the thermohydrogravidynamic solution of the fundamental problem [Imbrie, Berger et al., 1993] of the origin of the major 100-kyr glacial cycle during the Milankovitch chron [Berger, 1994].

The major 100-kyr glacial cycle is determined by the non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Jupiter and the Sun owing to the gravitational interactions of the Sun with the Jupiter, the Saturn and the Uranus. We obtain from formula (3.239) (for $l_o = 1$, $l_2 = 1$, $l_4 = 0$, $l_5 = 1$, $l_6 = 1$, $l_7 = 1$, $l_8 = 0$) the following fundamental global periodicities $T_{tec,f} = T_{clim1,f}$ (in the range $79 \div 121$ kyr) of the periodic global seismotectonic and volcanic activities (owing to the G-factor) and the periodic global climate variability and the global variability of the quantities of the fresh water and glacial ice resources (owing to the $G(b)$-factor) determined by the combined planetary and solar non-stationary energy gravitational influences on the Earth (of the system Sun-Moon, the Venus, the Jupiter and the Sun owing to the gravitational interactions of the Sun with the Jupiter, the Saturn and the Uranus):

$$T_{tec,f} = T_{clim1,f} = L.C.M.\{3,8,11,59,84\} = L.C.M.\{8,3,11,59,84\} = \\ = L.C.M.\{8,8,11,59,84\} = 109032 \text{ years}, \qquad (3.241)$$

which is in good agreement with the predominant Mann's (1967) period of 109 kyr [Berger, 1988] in spectrum of geological data for the Missourian rocks;

$$T_{tec,f} = T_{clim1,f} = L.C.M.\{19,8,12,29,84\} = 92568 \text{ years}, \qquad (3.242)$$

$$T_{tec,f} = T_{clim1,f} = L.C.M.\{27,8,12,59,84\} = 89208 \text{ years} \qquad (3.243)$$

and

$$T_{tec,f} = T_{clim1,f} = L.C.M.\{27,3,12,29,84\} = 87696 \text{ years}, \qquad (3.244)$$

which are located near the empirical [Imbrie, Mix and Martinson, 1993] predominant period of 91 kyr (in spectra of the oxygen isotopic composition $\delta^{18}O$ records).

The obtained fundamental global periodicities $T_{tec,f} = T_{clim1,f}$ (in the range $79 \div 121$ kyr owing to the G and $G(b)$-factors) result to the mean fundamental global seismotectonic, volcanic and climatic periodicity of

$$< T_{tec,f} > = < T_{clim1,f} > = 94626 \text{ years}, \qquad (3.245)$$

which enhances the weak eccentricity-driven [Milankovitch, 1930] variations of solar insolation (related to the consistent predominant period of 94782 years [Berger, 1978] in variations of the orbital Earth's eccentricity). It explains the predominant empirical [Ruddiman et al., 1986] 95-kyr period in variations of the North Atlantic sea-surface temperatures for the last 1.1 million years.

We obtain from the formula (3.240) (for $l_o = 1$, $l_2 = 1$, $l_4 = 0$, $l_5 = 1$, $l_6 = 1$, $l_7 = 1$, $l_8 = 0$) the following fundamental global climatic periodicities $T_{clim2,f}$ (in the range $79 \div 121$ kyr) of the periodic global climate variability and the global variability of the quantities of the fresh water and glacial ice resources (owing to the $G(a)$ and $G(b)$-factors) determined by the combined non-stationary energy gravitational influences on the Earth (of the system Sun-Moon, the Venus, the Jupiter and the Sun owing to the gravitational interactions of the Sun with the Jupiter, the Saturn and the Uranus):

$$T_{clim2,f} = 0.5 \cdot L.C.M.\{3,3,83,29,84\} = 101094 \text{ years}, \qquad (3.246)$$

which is in good agreement with the empirical periodicity near 100 kyr in variations of the measured deep-sea sediment oxygen isotopic composition $\delta^{18}O$ [Muller and MacDonald, 1996; Shackleton, 2000] and in variations of the atmospheric CO_2 [Pisias and Shackleton, 1984; Shackleton, 2000];

$$T_{clim2,f} = 0.5 \cdot L.C.M.\{19,8,12,59,84\} = 94164 \text{ years}, \qquad (3.247)$$

which is in good agreement with the empirical periodicity of 94 kyr [Hays et al., 1976] corresponding to the predominant maximum of the calculated spectrum of the estimated summer sea-surface temperatures T_s in the southern Indian Ocean during the past 468 kyr; and

$$\mathrm{T_{clim2,f}} = 0.5 \cdot L.C.M.\{27,3,11,29,84\} = 120582 \text{ years}, \quad (3.248)$$

which is located between the empirical periodicities of 119 kyr and 122 kyr [Hays et al., 1976] corresponding to the predominant maxima of the calculated spectra of the percentage of *Cycladophora davisiana*.

The established fundamental global climatic periodicities $\mathrm{T_{clim2,f}}$ (in the range $79 \div 121$ kyr owing to the $\mathrm{G}(a)$ and $\mathrm{G}(b)$-factors) result to the mean fundamental global climatic periodicity

$$< \mathrm{T_{clim2,f}} > = 105280 \text{ years}, \quad (3.249)$$

which is in good agreement with the empirical [Gorbarenko et al., 2011] climatic periodicity

$$105 \text{ kyr} \quad (3.250)$$

(corresponding to the predominant maxima of the calculated spectra of the productivity and lithological stacks of the deep-sea sediment records for the Okhotsk Sea during the last 350 kyr) and with the empirical [Hays et al., 1976] climatic periodicity

$$106 \text{ kyr} \quad (3.251)$$

corresponding to the predominant maximum of the calculated spectrum of the measured oxygen isotopic composition $\delta^{18}\mathrm{O}$ of planktonic foraminifera.

Based on the founded fundamental global climatic periodicities (in the range $79 \div 121$ kyr) $\mathrm{T_{clim1,f}}$ and $\mathrm{T_{clim2,f}}$, we derive the mean combined fundamental global climatic periodicity $< \mathrm{T_{clim,f}} >$ (determined by the combined non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Jupiter and the Sun owing to the gravitational interactions of the Sun with the Jupiter, the Saturn and the Uranus)

$$< \mathrm{T_{clim,f}} > = 99.953 \text{ kyr}, \quad (3.252)$$

which is in good agreement with the empirical major 100-kyr glaciation cycle [Kukla, 1977; Imbrie, Berger et al., 1993] characterizing the Milankovitch chron [Berger, 1994].

We obtain from formula (3.239) (for $l_o = 1,\ l_2 = 1,\ l_4 = 0,\ l_5 = 1,\ l_6 = 1,\ l_7 = 1,\ l_8 = 1$) the fundamental global seismotectonic, volcanic and climatic periodicity (of the periodic global seismotectonic and volcanic activities (owing to the G-factor) and the periodic global climate variability and the global variability of the quantities of the fresh water and glacial ice resources (owing to the $\mathrm{G}(b)$-factor) determined by the combined planetary and solar non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Jupiter and the Sun owing to the gravitational interactions of the Sun with the Jupiter, the Saturn, the Uranus and the Neptune)

$$\mathrm{T_{tec,f}} = \mathrm{T_{clim1,f}} = L.C.M.\{3,3,12,29,84,2142\} = 124236 \text{ years}, \quad (3.253)$$

which is located between the estimated predominant 123818-yr [Berger, 1978] and 125-kyr [Berger, 1999] periods of variations of the orbital Earth's eccentricity.

We obtain from formula (3.240) (for $l_o = 1,\ l_2 = 1,\ l_4 = 0,\ l_5 = 1,\ l_6 = 1,\ l_7 = 1,\ l_8 = 1$) the fundamental global climatic periodicity

$$\mathrm{T_{clim2,f}} = 0.5 \cdot L.C.M.\{3,8,12,29,84,2142\} = 0.5 \cdot L.C.M.\{8,3,12,29,84,2142\} =$$
$$= 0.5 \cdot L.C.M.\{8,8,12,29,84,2142\} = 124236 \text{ years} \quad (3.254)$$

of the periodic global climate variability and the global variability of the quantities of the fresh water and glacial ice resources (owing to the $\mathrm{G}(a)$ and $\mathrm{G}(b)$-factors) determined by the combined non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Jupiter and the Sun owing to the gravitational interactions of the Sun with the Jupiter, the Saturn, the Uranus and the Neptune.

The founded fundamental global climatic periodicities $\mathrm{T_{clim1,f}} = 124236$ yr (owing to the $\mathrm{G}(b)$-factor) and $\mathrm{T_{clim2,f}} = 124236$ yr (owing to the $\mathrm{G}(a)$ and $\mathrm{G}(b)$-factors) determine the combined fundamental global climatic periodicity (determined by the combined non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Jupiter and the Sun owing to the gravitational interactions of the Sun with the Jupiter, the Saturn, the Uranus and the Neptune)

$$\mathrm{T_{clim,f}} = 124236 \text{ years}, \quad (3.255)$$

which is in good agreement with the climatic period of 125 kyr characterizing the Croll chron [Berger, 1999].

Thus, the generalized thermohydrogravidynamic theory [Simonenko, 2007; 2009; 2010] of the paleoclimate generalizes the Milankovitch's (1930) theory of the paleoclimate (taking into account the variability of solar insolation related to the periodic variations of the eccentricity of the Earth's orbit due to the G-factor) by taking into account the additional established cosmic $\mathrm{G}(a)$, $\mathrm{G}(b)$ and $\mathrm{G}(c)$-factors. The presented thermohydrogravidynamic solution of the fundamental problem of the origin of the major 100-kyr glacial cycle (determined during Pleistocene by the non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Jupiter and the Sun owing to the gravitational interactions of the Sun with the Jupiter, the Saturn and the Uranus) shows that the Thermohydrogravidynamics (Cosmic Physics) of the Solar System represents the reliable thermohydrogravidynamic theory destined to play an important role for the stable evolutionary development of humankind in the present and forthcoming epochs of the critical surrounding cosmic, seismotectonic, volcanic and climatic conditions of the human existence on the Earth.

3.8. The analysis of the global seismicity and volcanic activity of the Earth from the biblical Flood (occurred in 2104 BC according to the orthodox biblical chronology) to found the forthcoming range $2020 \div 2061$ AD of the maximal seismotectonic, volcanic and climatic activities of the Earth during the past $696 \div 708$ years of the history of humankind

3.8.1. The foundation of the ranges of the fundamental global seismotectonic, volcanic and climatic periodicities $\mathrm{T}_{\mathrm{tec,f}} = \mathrm{T}_{\mathrm{clim1,f}} = 696 \div 708$ years and $\mathrm{T}_{\mathrm{tec,f}} = \mathrm{T}_{\mathrm{clim2,f}} = 348 \div 354$ years determined by the combined predominant non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Jupiter and the Sun owing to the gravitational interactions of the Sun with the Jupiter and the Saturn

To evaluate the behavior of the global seismicity and volcanic activity of the Earth from the biblical Flood (occurred in 2104 BC according to the orthodox biblical chronology) to the beginning of the 21st century AD, we deduced [Simonenko, 2012] from formula (3.239) (for $l_{\mathrm{o}} = 1,\ l_2 = 1,\ l_4 = 0,\ l_5 = 1,\ l_6 = 1,\ l_7 = 0,\ l_8 = 0$) the ranges of the following fundamental global seismotectonic, volcanic and climatic periodicities (determined by the combined predominant non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Jupiter and the Sun owing to the gravitational interactions of the Sun with the Jupiter and the Saturn):

$$\mathrm{T}_{\mathrm{tec,f}} = \mathrm{T}_{\mathrm{clim1,f}} = (L.C.M.\{3, 8, 12, 29\} \div L.C.M.\{3, 3, 12, 59\}) = 696 \div 708 \text{ years} \qquad (3.256)$$

and

$$\mathrm{T}_{\mathrm{tec,f}} = \mathrm{T}_{\mathrm{clim2,f}} = (L.C.M.\{3,3, 12, 29\} \div 0.5L.C.M.\{3, 3, 12, 59\}) = 348 \div 354 \text{ years}. \qquad (3.257)$$

Considering the time periodicity $(\mathrm{T}_{\mathrm{S\text{-}MOON,3}})_1 = 3$ years (or $(\mathrm{T}_{\mathrm{S\text{-}MOON,3}})_2 = 8$ years) of the maximal combined energy gravitational influence on the Earth of the system Sun-Moon in the first (or second) approximation, the time periodicity $(\mathrm{T}_{\mathrm{V,3}})_2 = 8$ years (or $(\mathrm{T}_{\mathrm{V,3}})_1 = 3$ years) of the maximal energy gravitational influences on the Earth of the Venus in the second (or first) approximation, the time periodicity $(\mathrm{T}_{\mathrm{J,3}})_2 = 12$ years (in the second approximation) of the maximal energy gravitational influences on the Earth of the Jupiter and the Sun owing to the gravitational interactions of the Sun with the Jupiter, the time periodicity $(\mathrm{T}_{\mathrm{SAT,3}})_1 = 29$ years (in the first approximation) of the maximal energy gravitational influences on the Earth the Sun owing to the gravitational interactions of the Sun with the Saturn, we obtained [Simonenko, 2012] from formula (3.239) (for $l_{\mathrm{o}} = 1,\ l_2 = 1,\ l_4 = 0,\ l_5 = 1,\ l_6 = 1,\ l_7 = 0,\ l_8 = 0$) (as the lower boundary of the founded range (3.256) [Simonenko, 2012]) the fundamental global seismotectonic, volcanic and climatic periodicity (of the Earth's periodic global seismotectonic and volcanic activity and the global climate variability)

$$T_{tec,f} = T_{clim1,f} = L.C.M.\{3, 8, 12, 29\} = L.C.M.\{8, 3, 12, 29\} = 3\times2\times4\times29 \text{ years} = 696 \text{ years} \quad (3.256a)$$

determined by the combined predominant non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Jupiter and the Sun owing to the gravitational interactions of the Sun with the Jupiter and the Saturn.

The established range (3.256) of the fundamental global seismotectonic, volcanic and climatic periodicities [Simonenko, 2012] contains the experimental time periodicity 704 years [Abramov, 1997] of the global seismotectonic activity. The established range (3.257) of the fundamental global seismotectonic, volcanic and climatic periodicities [Simonenko, 2012] contains the experimental time periodicity 352 years [Abramov, 1997] of the global seismotectonic activity.

We deduce from formula (3.239) (for $l_o = 1,\ l_2 = 1,\ l_4 = 1,\ l_5 = 1,\ l_6 = 1,\ l_7 = 0,\ l_8 = 0$) the fundamental global seismotectonic, volcanic and climatic periodicity (determined by the combined predominant non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interactions of the Sun with the Jupiter and the Saturn)

$$T_{tec,f} = T_{clim1,f} = T_{energy,f} = L.C.M.\{3, 3, 15, 12, 59\} = 3\times5\times4\times59 \text{ years} = 3540 \text{ years}, \quad (3.258)$$

which transforms into the classical Babylonian “sar” of 3600 years under the final practical transformation $59 \to 60$ for the time periodicity $(T_{SAT,3})_2 = 59$ years.

Considering the time periodicity or $(T_{S\text{-}MOON,3})_2 = 8$ years of the maximal combined energy gravitational influence on the Earth of the system Sun-Moon in the second approximation, the time periodicity $(T_{V,3})_2 = 8$ years of the maximal energy gravitational influences on the Earth of the Venus in the second approximation, the time periodicity $(T_{J,3})_2 = 12$ years (in the second approximation) of the maximal energy gravitational influences on the Earth of the Jupiter and the Sun owing to the gravitational interactions of the Sun with the Jupiter, the time periodicity $(T_{SAT,3})_1 = 29$ years (in the first approximation) of the maximal energy gravitational influences on the Earth the Sun owing to the gravitational interactions of the Sun with the Saturn, and the time periodicity $(T_{MARS,3})_1 = 15$ years of the maximal of the maximal energy gravitational influences on the Earth of the Mars (in the first approximation), we obtain from formula (3.239) (for $l_o = 1,\ l_2 = 1,\ l_4 = 1,\ l_5 = 1,\ l_6 = 1,\ l_7 = 0,\ l_8 = 0$) the fundamental global seismotectonic, volcanic and climatic periodicity (of the Earth’s periodic global seismotectonic and volcanic activity and the global climate variability)

$$T_{tec} = T_{clim1} = T_{energy} = L.C.M.\{8, 8, 15, 12, 29\} = 2\times4\times3\times5\times29 \text{ years} = 5 \times 696 \text{ years} = 3480 \text{ years} \quad (3.258a)$$

determined by the combined predominant non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interactions of the Sun with the Jupiter and the Saturn.

The practical transformation $59 \to 60$ in the expression $L.C.M.\{3, 3, 15, 12, 59\}$ (of (3.258)) produces the following fundamental global seismotectonic, volcanic and climatic periodicities:

$$T_{tec,f} = T_{clim1,f} = L.C.M.\{3, 3, 15, 12, 60\} = 60 \text{ years} \quad (3.259)$$

and

$$T_{tec,f} = T_{clim2,f} = 0.5 \cdot L.C.M.\{3, 8, 15, 12, 60\} = 60 \text{ years} \quad (3.260)$$

revealed by A.S. Monin and D.M. Sonechkin [Monin and Sonechkin, 2005] experimentally.

We deduce also (under the final transformation $59 \to 60$) the fundamental global seismotectonic, volcanic and climatic periodicity (determined by the combined predominant non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interactions of the Sun with the Jupiter and the Saturn)

$$T_{tec,f} = T_{clim1,f} = T_{energy,f} = L.C.M.\{3, 8, 15, 12, 60\} = 120 \text{ years}, \quad (3.261)$$

which is in good agreement with the mean periodicity of recurrence of the strongest earthquakes in different regions (especially for Japan and Peru) of the seismic zone of the Pacific Ring [Vikulin, 2003].

3.8.2. The evidence of the founded ranges of the fundamental global seismotectonic and volcanic time periodicities $T_{tec,f} = T_{clim1,f} = 696 \div 708$ years and $T_{tec,f} = T_{clim2,f} = 348 \div 354$ years based on the statistical analysis of the historical eruptions of the Katla and the Hekla volcanic systems in Iceland

3.8.2.1. The generalized formulation of the weak law of large numbers

We shall use the generalization [Simonenko, 2005] of the classical special formulation [Nicolis and Prigogine, 1989] of the weak law of large numbers for the statistical analysis of the historical eruptions of the Katla and the Hekla volcanic systems. The generalization [Simonenko, 2005] of the classical special formulation [Nicolis and Prigogine, 1989] of the weak law of large numbers takes into account the coefficients of correlations $\rho(x_i, x_k) \neq 0$ between the random variables x_i and x_k of the infinite set of random variables $x_1, x_2, ..., x_n$ .... characterized by the same variance $\sigma^2 = \overline{(x_i - a)^2}$ and the same statistical mean $a = \overline{x_i}$ of the random variables $x_1, x_2, ..., x_n$ .... . It was proved [Simonenko, 2005] mathematically that the limit of probability

$$\lim_{n\to\infty} \Pr\left\{ \left| \frac{(x_1 + x_2 + ... + x_n)}{n} - a \right| < \varepsilon \right\} = 1 \qquad (3.262)$$

is satisfied (for any $\varepsilon > 0$) if the following condition:

$$\lim_{n\to\infty} \frac{\sigma^2}{n^2} \sum_{i,k=1; i\neq k}^{n} \rho(x_i, x_k) = 0 \qquad (3.263)$$

is satisfied for the coefficients of correlations $\rho(x_i, x_k)$.

Let us formulate the conditions of creation of the various possible pair combinations $((t_2)_i, (t_1)_i)$ of different previous $(t_1)_i$ and subsequent $(t_2)_i$ dates of real volcanic eruptions. We take the dates $(t_1)_i$ and $(t_2)_i$ from the experimental sequence $\{T_k\} = T_1, T_2, ..., T_N$ of different dates of real volcanic eruptions, where T_1 is the initial date of real volcanic eruption, T_N the final date of real volcanic eruption. We form the various possible pair combinations $((t_2)_i, (t_1)_i)$ (i=1, 2, 3, …, n) of two dates $(t_1)_i$ and $(t_2)_i$ taken from the experimental sequence $\{T_k\} = T_1, T_2, ..., T_N$ of different dates of real volcanic eruptions To obtain the experimental evidence of the founded ranges of the fundamental global volcanic periodicities $T_{tec,f} = T_{clim1,f} = 696 \div 708$ years, we take into account all possible pair combinations $((t_2)_i, (t_1)_i)$ satisfying the imposed conditions

$$\left|(t_2)_i - (t_1)_i - 696\right| \leq 88 \text{ years}, \qquad (3.264)$$

$$\left|(t_2)_i - (t_1)_i - 708\right| \leq 88 \text{ years}. \qquad (3.265)$$

Considering the various possible pair combinations $((t_2)_i, (t_1)_i)$ of two dates $(t_1)_i$ and $(t_2)_i$ under imposed conditions (3.264) and (3.265), we obtain the random variable $x_i \equiv (\Delta t)_i = (t_2)_i - (t_1)_i$ characterizing by the mean value

$$\langle \Delta t \rangle = \frac{1}{n} \sum_{i=1}^{n} (\Delta t)_i, \qquad (3.266)$$

which must be very close to the statistical mean $a = \overline{x_i} \equiv \overline{(\Delta t)_i}$ for sufficiently large number n according to the proved [Simonenko, 2005] formulation (3.262) if the condition (3.263) is satisfied for the coefficients of correlations $\rho(x_i, x_k)$. We assume that the condition (3.263) is satisfied.

3.8.2.2. The statistical analysis of eruptions of Katla volcano

The real dates of Katla volcano eruptions are given by the following experimental sequence [Thordarson and Larsen, 2007]:
$\{T_k\} = T_1, T_2, ..., T_N$ = 920, 934, 938, 1179, 1245, 1262, 1357, 1416, 1440, 1500, 1580, 1612, 1625, 1660, 1721, 1755, 1823, 1860, 1918, 1955, 1999, 2011 AD.

Taking into account the imposed condition (3.264), we obtain from this experimental sequence [Thordarson and Larsen, 2007] the following pair combinations $((t_2)_i, (t_1)_i)$ of two dates $(t_1)_i$ and $(t_2)_i$ (between the Katla volcano eruptions): (2011, 1245) characterized by $\Delta t = t_2 - t_1$= 766 years, (2011, 1262) characterized by $\Delta t = t_2 - t_1$= 749 years, (2011, 1357) characterized by $\Delta t = t_2 - t_1$=654 years, (1999, 1245) characterized by $\Delta t = t_2 - t_1$=754 years, (1999, 1262) characterized by $\Delta t = t_2 - t_1$=737 years, (1999, 1357) characterized by $\Delta t = t_2 - t_1$=642 years, (1955, 1179) characterized by $\Delta t = t_2 - t_1$=776 years, (1955, 1245) characterized by $\Delta t = t_2 - t_1$=710 years, (1955, 1262) characterized by $\Delta t = t_2 - t_1$=693 years, (1918, 1179) characterized by $\Delta t = t_2 - t_1$=739 years, (1918, 1245) characterized by $\Delta t = t_2 - t_1$=673 years, (1918, 1262) characterized by $\Delta t = t_2 - t_1$=656 years, (1860, 1179) characterized by $\Delta t = t_2 - t_1$=681 years, (1860, 1245) characterized by $\Delta t = t_2 - t_1$=615 years, (1823, 1179) characterized by $\Delta t = t_2 - t_1$=644 years, (1721, 938) characterized by $\Delta t = t_2 - t_1$=783 years, (1660, 934) characterized by $\Delta t = t_2 - t_1$=726 years, (1660, 938) characterized by $\Delta t = t_2 - t_1$=722 years, (1625, 920) characterized by $\Delta t = t_2 - t_1$=705 years, (1625, 934) characterized by $\Delta t = t_2 - t_1$=691 years, (1625, 938) characterized by $\Delta t = t_2 - t_1$=687 years, (1612, 920) characterized by $\Delta t = t_2 - t_1$=692 years, (1612, 934) characterized by $\Delta t = t_2 - t_1$=678 years, (1612, 938) characterized by $\Delta t = t_2 - t_1$=674 years, (1580, 920) characterized by $\Delta t = t_2 - t_1$=660 years, (1580, 934) characterized by $\Delta t = t_2 - t_1$=646 years and (1580, 938) characterized by $\Delta t = t_2 - t_1$=642 years. Taking into account of these n=28 numerical values of Δt, we obtain the mean experimental time periodicity (between the Katla volcano eruptions)

$$\langle \Delta t \rangle_{696} = \frac{1}{28} \sum_{i=1}^{28} (\Delta t)_i = 697.6785 \text{ years}, \qquad (3.267)$$

entering into the founded range of the fundamental global seismotectonic and volcanic time periodicities $T_{tec,f} = T_{clim1,f} = 696 \div 708$ years [Simonenko, 2012] determined by the combined predominant non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Jupiter and the Sun owing to the gravitational interactions of the Sun with the Jupiter and the Saturn.

Taking into account the imposed condition (3.265), we obtain the following pair combinations $((t_2)_i, (t_1)_i)$ of two dates $(t_1)_i$ and $(t_2)_i$ (between the Katla volcano eruptions): (2011, 1245) characterized by $\Delta t = t_2 - t_1$= 766 years, (2011, 1262) characterized by $\Delta t = t_2 - t_1$= 749 years, (2011, 1357) characterized by $\Delta t = t_2 - t_1$=654 years, (1999, 1245) characterized by $\Delta t = t_2 - t_1$=754 years, (1999, 1262) characterized by $\Delta t = t_2 - t_1$=737 years, (1999, 1357) characterized by $\Delta t = t_2 - t_1$=642 years, (1955, 1179) characterized by $\Delta t = t_2 - t_1$=776 years, (1955, 1245) characterized by $\Delta t = t_2 - t_1$=710 years, (1955, 1262) characterized by $\Delta t = t_2 - t_1$=693 years, (1918, 1179) characterized by $\Delta t = t_2 - t_1$=739 years, (1918, 1245) characterized by $\Delta t = t_2 - t_1$=673 years, (1918, 1262) characterized by $\Delta t = t_2 - t_1$=656 years, (1860, 1179) characterized by $\Delta t = t_2 - t_1$=681 years, (1823, 1179) characterized by $\Delta t = t_2 - t_1$=644 years, (1721, 938) characterized by $\Delta t = t_2 - t_1$=783 years, (1660, 934) characterized by $\Delta t = t_2 - t_1$=726 years, (1660, 938) characterized by $\Delta t = t_2 - t_1$=722 years, (1625, 920) characterized by $\Delta t = t_2 - t_1$=705 years, (1625, 934) characterized by $\Delta t = t_2 - t_1$=691 years, (1625, 938) characterized by $\Delta t = t_2 - t_1$=687 years, (1612, 920) characterized by $\Delta t = t_2 - t_1$=692 years, (1612,

934) characterized by $\Delta t = t_2 - t_1$=678 years, (1612, 938) characterized by $\Delta t = t_2 - t_1$=674 years, (1580, 920) characterized by $\Delta t = t_2 - t_1$=660 years, (1580, 934) characterized by $\Delta t = t_2 - t_1$=646 years and (1580, 938) characterized by $\Delta t = t_2 - t_1$=642 years. Taking into account of these n= 27 numerical values, we obtain the mean experimental time periodicity (between the Katla volcano eruptions)

$$\langle \Delta t \rangle_{708} = \frac{1}{27} \sum_{i=1}^{27} (\Delta t)_i = 700.7407 \text{ years} \tag{3.268}$$

entering into the founded range of the fundamental global seismotectonic and volcanic time periodicities $T_{tec,f} = T_{clim1,f} = 696 \div 708$ years [Simonenko, 2012] determined by the combined predominant non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Jupiter and the Sun owing to the gravitational interactions of the Sun with the Jupiter and the Saturn.

The mean value 699.2096 years of the calculated mean experimental time periodicities (3.267) and (3.268) (of the considered eruptions of Katla volcano) is very close to the mean value 702 years the founded theoretical range of the fundamental global seismotectonic, volcanic and climatic time periodicities $T_{tec,f} = T_{clim1,f} = 696 \div 708$ years [Simonenko, 2012]. We can see that the founded theoretical range of the fundamental global seismotectonic, volcanic and climatic time periodicities $T_{tec,f} = T_{clim1,f} = 696 \div 708$ years [Simonenko, 2012] contains the calculated mean experimental time periodicities (3.267) and (3.268) of the considered eruptions of Katla volcano [Thordarson and Larsen, 2007]. This agreement confirms the established cosmic energy gravitational genesis [Simonenko, 2007] of the global seismotectonic, volcanic and climatic activity of the Earth.

3.8.2.3. The statistical analysis of eruptions of Hekla volcano

The real dates of Hekla volcano eruptions are given by the following experimental sequence [Thordarson and Larsen, 2007]: $\{T_k\} = T_1, T_2, ..., T_N$ = 1104, 1158, 1206, 1222, 1300, 1341, 1389, 1440, 1510, 1554, 1597, 1636, 1693, 1725, 1766-1768, 1845, 1878, 1913, 1947-1948, 1970, 1980-1981, 1991, 2000.

Taking into account the imposed condition (3.264), we obtain from this experimental sequence [Thordarson and Larsen, 2007] the following pair combinations $((t_2)_i, (t_1)_i)$ of two dates $(t_1)_i$ and $(t_2)_i$ (between the Hekla volcano eruptions): (2000, 1222) characterized by $\Delta t = t_2 - t_1$=778 years, (2000, 1300) characterized by $\Delta t = t_2 - t_1$= 700 years, (2000, 1341) characterized by $\Delta t = t_2 - t_1$= 659 years, (2000, 1389) characterized by $\Delta t = t_2 - t_1$= 611 years, (1991, 1222) characterized by $\Delta t = t_2 - t_1$= 769 years, (1991, 1300) characterized by $\Delta t = t_2 - t_1$= 691 years, (1991, 1341) characterized by $\Delta t = t_2 - t_1$= 650 years, (1980.5, 1206) characterized by $\Delta t = t_2 - t_1$= 774.5years, (1980.5, 1222) characterized by $\Delta t = t_2 - t_1$= 758.5 years, (1980.5, 1300) characterized by $\Delta t = t_2 - t_1$=680.5 years, (1980.5, 1341) characterized by $\Delta t = t_2 - t_1$= 639.5 years, (1970, 1206) characterized by $\Delta t = t_2 - t_1$= 764 years, (1970, 1222) characterized by $\Delta t = t_2 - t_1$= 748 years, (1970, 1300) characterized by $\Delta t = t_2 - t_1$= 670 years, (1970, 1341) characterized by $\Delta t = t_2 - t_1$= 629 years, (1947.5, 1206) characterized by $\Delta t = t_2 - t_1$= 741.5 years, (1947.5, 1222) characterized by $\Delta t = t_2 - t_1$= 725.5 years, (1947.5, 1300) characterized by $\Delta t = t_2 - t_1$= 647.5 years, (1913, 1158) characterized by $\Delta t = t_2 - t_1$=755 years, (1913, 1206) characterized by $\Delta t = t_2 - t_1$= 707 years, (1913, 1222) characterized by $\Delta t = t_2 - t_1$= 691 years, (1913, 1300) characterized by $\Delta t = t_2 - t_1$= 613 years, (1878, 1104) characterized by $\Delta t = t_2 - t_1$= 774 years, (1878, 1158) characterized by $\Delta t = t_2 - t_1$= 720 years, (1878, 1206) characterized by $\Delta t = t_2 - t_1$= 672 years, (1878, 1222) characterized by $\Delta t = t_2 - t_1$= 656 years, (1845, 1104) characterized by $\Delta t = t_2 - t_1$= 741 years, (1845, 1158) characterized by $\Delta t = t_2 - t_1$= 687 years, (1845, 1206) characterized by $\Delta t = t_2 - t_1$= 639 years, (1845, 1222) characterized by $\Delta t = t_2 - t_1$= 623 years, (1767, 1104) characterized by $\Delta t = t_2 - t_1 = 663$ years and (1767, 1158) characterized by $\Delta t = t_2 - t_1 = 609$ years.

Taking into account of these n=32 numerical values of Δt, we obtain the mean experimental time periodicity (between the Hekla volcano eruptions)

$$\langle \Delta t \rangle_{696} = \frac{1}{32} \sum_{i=1}^{32} (\Delta t)_i = 693.328 \text{ years}, \tag{3.269}$$

which is near the lower boundary (696 years) of the founded range of the fundamental global seismotectonic and volcanic time periodicities $T_{tec,f} = T_{clim1,f} = 696 \div 708$ years [Simonenko, 2012] determined by the combined predominant non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Jupiter and the Sun owing to the gravitational interactions of the Sun with the Jupiter and the Saturn.

Taking into account the imposed condition (3.265), we obtain the following pair combinations $((t_2)_i, (t_1)_i)$ of two dates $(t_1)_i$ and $(t_2)_i$ (between the Hekla volcano eruptions): (2000, 1222) characterized by $\Delta t = t_2 - t_1$=778 years, (2000, 1300) characterized by $\Delta t = t_2 - t_1$= 700 years, (2000, 1341) characterized by $\Delta t = t_2 - t_1$= 659 years, (1991, 1222) characterized by $\Delta t = t_2 - t_1$= 769 years, (1991, 1300) characterized by $\Delta t = t_2 - t_1$= 691 years, (1991, 1341) characterized by $\Delta t = t_2 - t_1$= 650 years, (1980.5, 1206) characterized by $\Delta t = t_2 - t_1$= 774.5years, (1980.5, 1222) characterized by $\Delta t = t_2 - t_1$= 758.5 years, (1980.5, 1300) characterized by $\Delta t = t_2 - t_1$=680.5 years, (1980.5, 1341) characterized by $\Delta t = t_2 - t_1$= 639.5 years, (1970, 1206) characterized by $\Delta t = t_2 - t_1$= 764 years, (1970, 1222) characterized by $\Delta t = t_2 - t_1$= 748 years, (1970, 1300) characterized by $\Delta t = t_2 - t_1$= 670 years, (1970, 1341) characterized by $\Delta t = t_2 - t_1$= 629 years, (1947.5, 1206) characterized by $\Delta t = t_2 - t_1$= 741.5 years, (1947.5, 1222) characterized by $\Delta t = t_2 - t_1$= 725.5 years, (1947.5, 1300) characterized by $\Delta t = t_2 - t_1$= 647.5 years, (1913, 1158) characterized by $\Delta t = t_2 - t_1$=755 years, (1913, 1206) characterized by $\Delta t = t_2 - t_1$= 707 years, (1913, 1222) characterized by $\Delta t = t_2 - t_1$= 691 years, (1878, 1104) characterized by $\Delta t = t_2 - t_1$= 774 years, (1878, 1158) characterized by $\Delta t = t_2 - t_1$= 720 years, (1878, 1206) characterized by $\Delta t = t_2 - t_1$= 672 years, (1878, 1222) characterized by $\Delta t = t_2 - t_1$= 656 years, (1845, 1104) characterized by $\Delta t = t_2 - t_1$= 741 years, (1845, 1158) characterized by $\Delta t = t_2 - t_1$= 687 years, (1845, 1206) characterized by $\Delta t = t_2 - t_1$= 639 years, (1845, 1222) characterized by $\Delta t = t_2 - t_1$= 623 years and (1767, 1104) characterized by $\Delta t = t_2 - t_1$= 663 years. Taking into account of these n=29 numerical values, we obtain the mean experimental time periodicity (between the Hekla volcano eruptions [Thordarson and Larsen, 2007])

$$\langle \Delta t \rangle_{708} = \frac{1}{29} \sum_{i=1}^{29} (\Delta t)_i = 701.8447 \text{ years} \tag{3.270}$$

entering into the founded range of the fundamental global seismotectonic and volcanic time periodicities $T_{tec,f} = T_{clim1,f} = 696 \div 708$ years [Simonenko, 2012] determined by the combined predominant non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Jupiter and the Sun owing to the gravitational interactions of the Sun with the Jupiter and the Saturn. The mean value 697.5863 years of the calculated mean experimental time periodicities (3.269) and (3.270) (of the considered eruptions of Hekla volcano) is in very good agreement with the mean value 702 years the founded theoretical range of the fundamental global seismotectonic, volcanic and climatic time periodicities $T_{tec,f} = T_{clim1,f} = 696 \div 708$ years [Simonenko, 2012].

The analogous statistical analysis of the historical eruptions of the Katla and the Hekla volcanic systems in Iceland [Thordarson and Larsen, 2007] confirms also the founded range of the fundamental global seismotectonic and volcanic time periodicities $T_{tec,f} = T_{clim2,f} = 348 \div 354$ years determined by the combined predominant non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Jupiter and the Sun owing to the gravitational interactions of the Sun with the Jupiter and the Saturn.

Thus, the founded theoretical range of the fundamental global seismotectonic, volcanic and climatic time periodicities $T_{tec,f} = T_{clim1,f} = 696 \div 708$ years [Simonenko, 2012] (determined by the combined predominant non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Jupiter and the Sun owing to the gravitational interactions of the Sun with the Jupiter and the Saturn) contains the calculated mean experimental time periodicities (3.267) and (3.268) (of the considered eruptions of Katla volcano [Thordarson and Larsen, 2007]), the calculated mean experimental time periodicity (3.270) (of the considered eruptions of Hekla volcano [Thordarson and Larsen, 2007]), the experimental time periodicity 704 years [Abramov, 1997] of the global seismotectonic activity of the Earth, and the evaluated (based on the wavelet analysis) time periodicity of approximately 700 years [Goncharova, Gorbarenko, Shi, Bosin, Fischenko, Zou and Liu, 2012] characterizing the regional climate variability of the Japan Sea. This agreement confirms the established cosmic energy gravitational genesis [Simonenko, 2007] of the global seismotectonic, volcanic and climatic activity of the Earth.

3.8.3. The cosmic energy gravitational genesis of the predominant short-range time periodicities (7i/6 years and 6j/5 years determined by small integers i and j) of the Chandler's wobble of the Earth's pole and sea water and air temperature variations

3.8.3.1. The cosmic energy gravitational genesis of the predominant time periodicities $T_{clim1,1} = (T_{ch})_1 \approx 6/5\,\text{yr} = 1.2$ years and $T_{clim1,2} = (T_{ch})_2 \approx 7/6\,\text{yr} = 1.1666666....$years of the Chandler's wobble of the Earth's pole and the global climate variability induced by the combined non-stationary energy gravitational influence on the Earth of the Venus, the Mercury and the Moon

The fundamentals of the solution of the Chandler's problem [Chandler, 1892] are presented in the monographs [Simonenko, 2007; 2008; 2009; 2010]. The cosmic energy gravitational genesis of the Chandler's variations of the latitude of the Earth (related with the Chandler's wobble of the Earth's pole) was explained [Simonenko, 2007; 2008; 2009; 2010] by the combined non-stationary energy gravitational influence of the Sun, the Venus, the Mercury, the Moon and the Jupiter. The cosmic energy gravitational genesis of the Chandler's wobble of the Earth's pole was founded [Simonenko, 2007; 2008; 2009; 2010] based on the generalized differential formulation (1.43) of the first law of thermodynamics for the Earth subjected to the non-stationary energy gravitational influences of the Mercury, the Venus, the Moon and the Jupiter. We founded [Simonenko, 2009; 2010] the total average first approximate range of the time periodicities (of the Chandler's wobble of the Earth's pole):

$$\left\langle T_{M,V,MOOM} \right\rangle_1 = 405 \div 447.25\,\text{days} = 1.1088 \div 1.2245\ \text{yr} \tag{3.271}$$

induced by the combined non-stationary energy gravitational influence of the Venus, the Mercury and the Moon on the Earth. We obtained [Simonenko, 2011] that the average of the range (3.271) is given by the value

$$(405 + 447.25)/(2 \cdot 365.25) = 1.166666667\ \text{yr} = \frac{14}{12}\ \text{yr} = \frac{7}{6}\,\text{yr}, \tag{3.272}$$

which gives the following previously established values: the mean experimental period of 14/12 yr = 14 months (Chandler, 1892) of the Chandler's wobble of the Earth's pole, and the time periodicity of 7 yr [Simonenko, 2009; 2010] of the established intensification of the Chandler's wobble of the Earth's pole. The analysis [Simonenko, 2009; 2010] showed that the time periodicities

$$(T_{M,V,MOON,3}(T_{ch}))_1 \approx 6\,\text{yr},\ (T_{M,V,MOON,3}(T_{ch}))_2 \approx 7\,\text{yr} \tag{3.273}$$

are related with the established intensification of the Chandler's wobble of the Earth's pole due to the combined non-stationary energy gravitational influence of the Venus, the Mercury and the Moon on the Earth. It was founded [Simonenko, 2011] that the time periodicities (3.273) correspond to the following time periodicities

$$(T_{ch})_1 \approx 6/5 = 1.2\,\text{yr},\ (T_{ch})_2 \approx 7/6\,\text{yr} = 1.1666666...\text{yr} \tag{3.274}$$

characterizing the main maxima of the calculated [Simonenko, 2011] frequency spectra $S_x(f)$ and $S_y(f)$ of the documented [Kotlyar and Kim, 1994] variations of the experimental coordinates x and y of the Earth's pole.

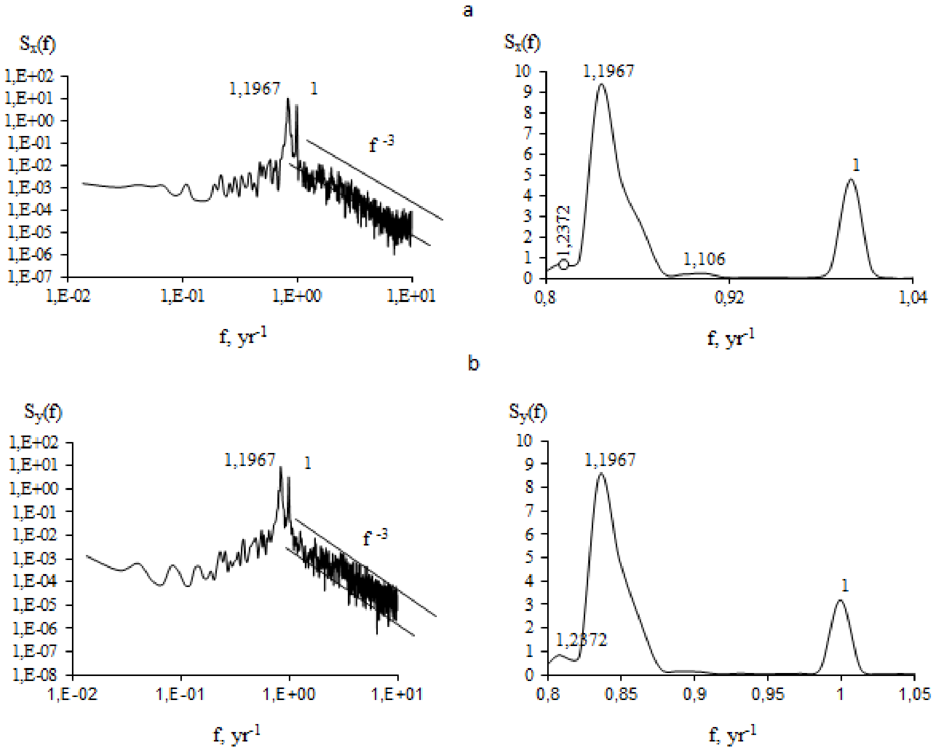


Fig. 17. The calculated [Simonenko, 2011] frequency spectra $S_x(f)$ (a) and $S_y(f)$ (b) of the documented [Kotlyar and Kim, 1994] variations of the experimental coordinates x and y of the Earth's pole during 1897-1969 AD

The calculated [Simonenko, 2011] frequency spectra $S_x(f)$ (a) and $S_y(f)$ (b) (presented on Fig. 17 for 1897-1969 AD) demonstrate the main maxima for $(T_{ch})_1 \approx 6/5 = 1.2$ yr and 1 yr.

The calculated [Simonenko, 2011] frequency spectra $S_x(f)$ (a) and $S_y(f)$ (b) (presented on Fig. 18 for 1897-1989 AD) demonstrate the main maxima for $(T_{ch})_1 \approx 6/5 = 1.2$ yr and 1 yr.

The calculated [Simonenko, 2011] frequency spectra $S_x(f)$ (a) and $S_y(f)$ (b) (presented on Fig. 19 for 1969-1989 AD) demonstrate the main maxima for $(T_{ch})_2 \approx 7/6\,\mathrm{yr} = 1.1666666...$ yr and 1 yr.

The calculated [Simonenko, 2011] frequency spectra $S_x(f)$ (a) and $S_y(f)$ (b) (presented on Fig. 20 for 1969-2010 AD) demonstrate the main maxima for $(T_{ch})_1 \approx 6/5 = 1.2$ yr and 1 yr.

According to the thermohydrogravidynamic theory [Simonenko, 2007; 2008; 2009; 2010] of the global climate evolution (taking into account the cosmic $G(b)$-factor related with the atmospheric-oceanic warming as a consequence of the greenhouse effect produced by the periodic tectonic-volcanic activization accompanied by increased output of the atmospheric greenhouse gases) induced by the cosmic non-stationary energy gravitational influences on the Earth, the same time periodicities

$$T_{clim1,1} = (T_{ch})_1 \approx 6/5 = 1.2\,\mathrm{yr},\ \ T_{clim1,2} = (T_{ch})_2 \approx 7/6\,\mathrm{yr} = 1.1666666...\mathrm{yr} \tag{3.275}$$

must characterize the global climate variability induced by the combined non-stationary energy gravitational influence of the Venus, the Mercury and the Moon on the Earth.

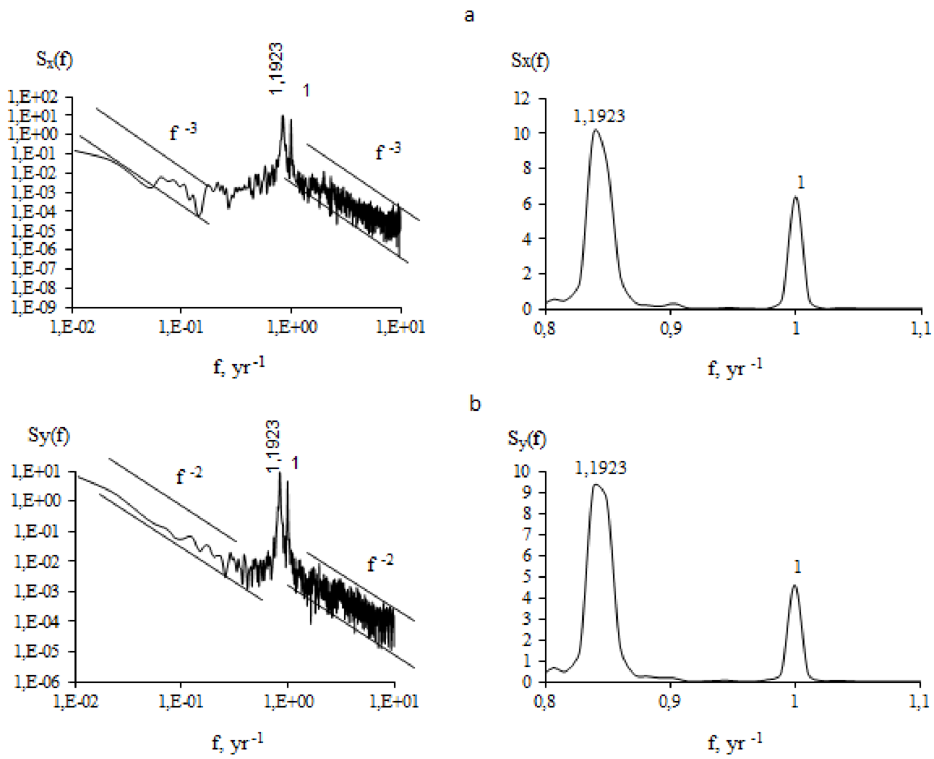


Fig. 18. The calculated [Simonenko, 2011] frequency spectra $S_x(f)$ (a) and $S_y(f)$ (b) of the documented [Kotlyar and Kim, 1994] variations of the experimental coordinates x and y of the Earth's pole during 1897-1989 AD

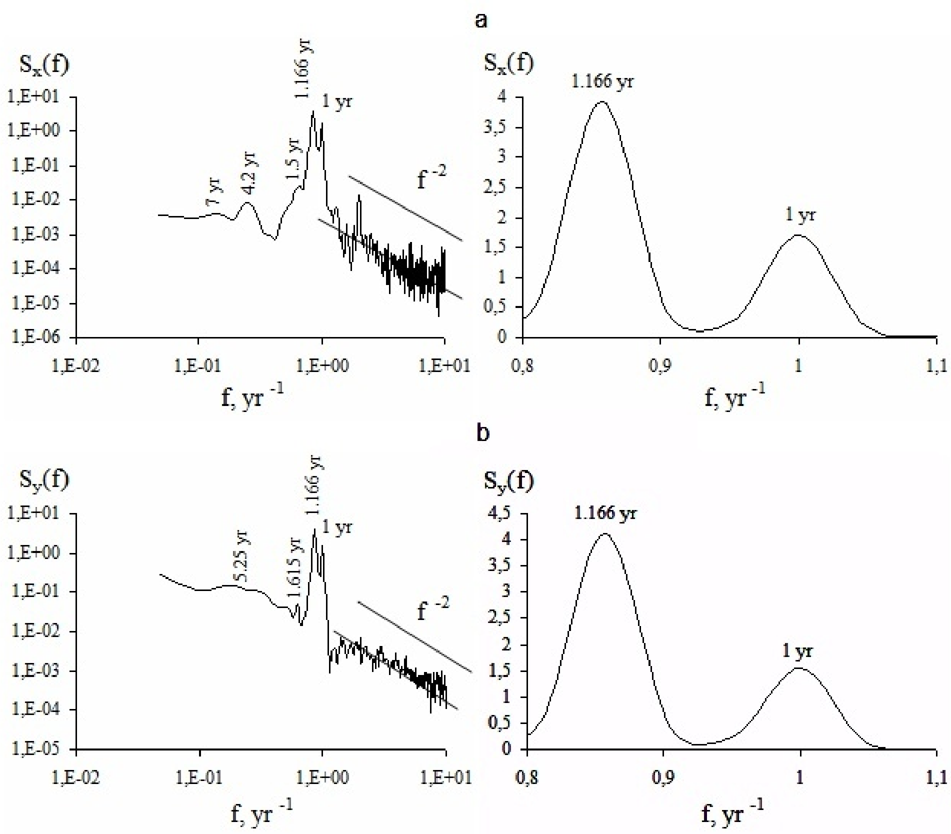


Fig. 19. The calculated [Simonenko, 2011] frequency spectra $S_x(f)$ (a) and $S_y(f)$ (b) of the documented [Kotlyar and Kim, 1994] variations of the experimental coordinates x and y of the Earth's pole during 1969-1989 AD

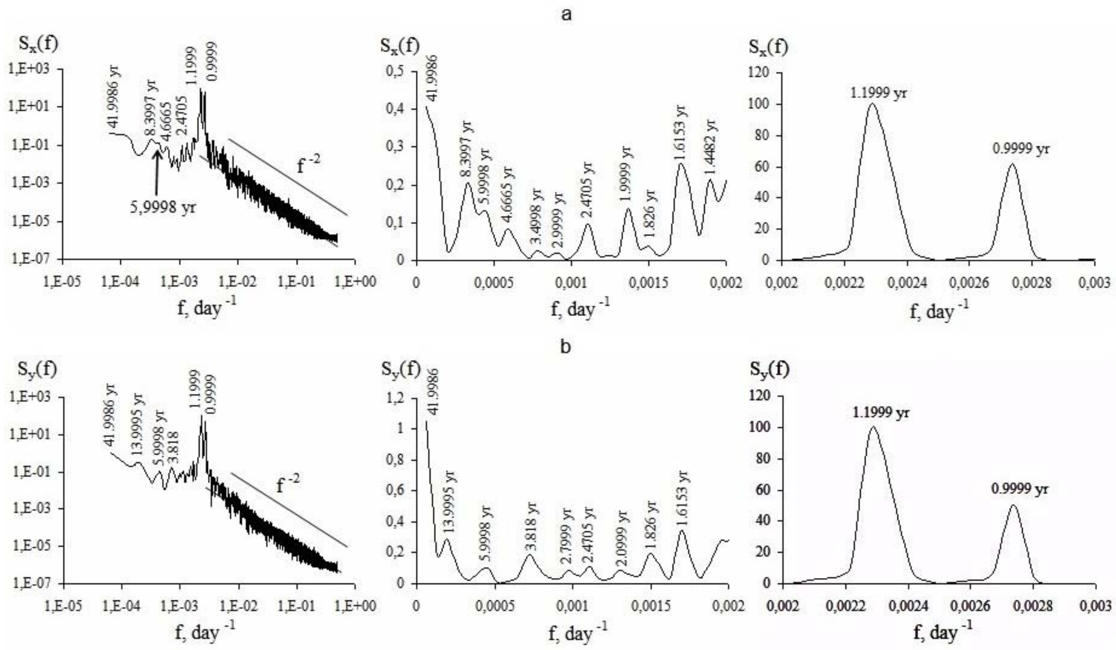


Fig. 20. The calculated [Simonenko, 2011] frequency spectra $S_x(f)$ (a) and $S_y(f)$ (b) of the documented [Earth Orientation Centre data] variations of the experimental coordinates x and y of the Earth's pole during 1969-2010 AD

To prove this deduction of the thermohydrogravidynamic theory [Simonenko, 2007; 2008; 2009; 2010], we present in Subsection 3.8.3.2 the combined analysis of the Chandler's wobble of the Earth's pole [Simonenko, 2011] and the variations of sea water and air temperature for the costal station Possyet of the Japan Sea [Simonenko, Gayko and Sereda, 2012].

3.8.3.2. The combined analysis of the Chandler's wobble of the Earth's pole and the variations of sea water and air temperature during 1969-2010 AD for the costal station Possyet of the Japan Sea

Let us fulfil the combined analysis of the Chandler's wobble of the Earth's pole [Simonenko, 2011] and the variations [Simonenko, Gayko and Sereda, 2012] of sea water and air temperature during 1969-2010 AD for the costal station Possyet of the Japan Sea. We see that the calculated [Simonenko, Gayko and Sereda, 2012] spectra $S_{T,W}(f)$ and $S_{T,A}(f)$ of the sea water temperature variations (Fig. 21a) and the air temperature variations (Fig. 21b) have the coincided and nearly coincided local maxima for the following predominant experimental time periodicities: 0.9999 years (for the sea water and air temperature variations), 1.4999 years (for the sea water temperature variations) and 1.49995 years (for the air temperature variations), 2.3332 years (for the sea water temperature variations) and 2.333 years (for the air temperature variations), 3.2306 years (for the sea water temperature variations) and 3.2307 years (for the air temperature variations), and 8.3997 years (for the sea water and air temperature variations).

The calculated spectrum $S_{T,W}(f)$ (presented on Fig. 21a for the time range 1969-2010 AD) of variations of sea water temperature demonstrates the predominant experimental time periodicities $T_{W,exp,i}$, which are in a very good agreement with the following periodicities

$$T_{W,2,i} = i(T_{ch})_2 = i7/6 \text{ years} \equiv i7/6 \text{ yr}, \ i = 1, 2, 4, 18, \tag{3.276}$$

i.e., the predominant experimental time periodicities $T_{W,exp,i}$ of variations of sea water approximately equal to

$$T_{W,exp,i} \approx T_{W,2,i} = i(T_{ch})_2 = i7/6 \text{ yr}, \quad i = 1, 2, 4, 18. \tag{3.277}$$

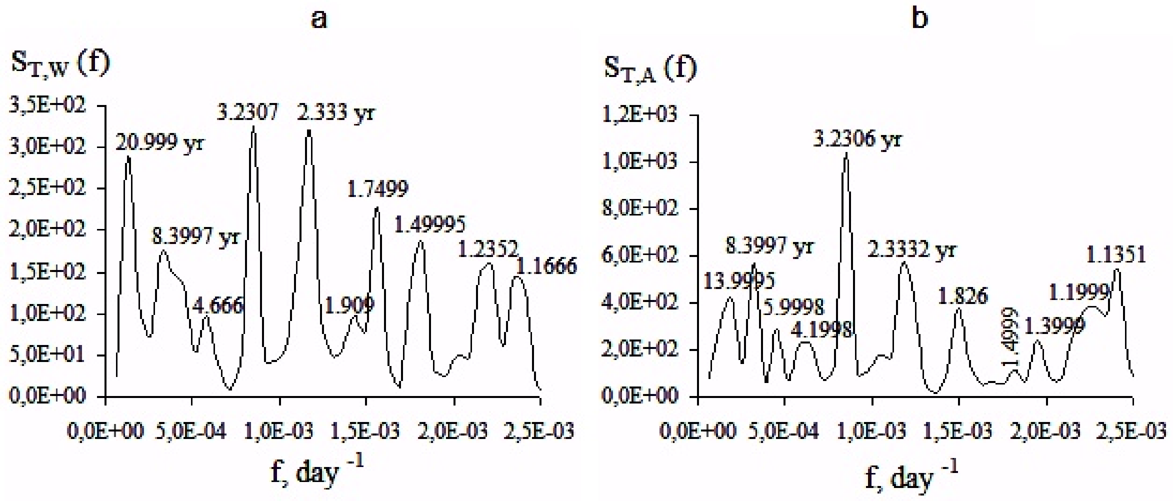


Fig. 21. The calculated spectrum $S_{T,W}(f)$ (a) of variations of sea water during 1969-2010 for the costal station Possyet of the Japan Sea [Simonenko, Gayko and Sereda, 2012]. The calculated spectrum $S_{T,A}(f)$ (b) of variations of air temperature during 1969-2010 AD for the costal station Possyet of the Japan Sea [Simonenko, Gayko and Sereda, 2012]

Table 3a

The predominant experimental time periodicities $T_{W,exp,i}$ of variations of the sea water temperature (during 1969-2010 AD for the costal station Possyet of the Japan Sea [Simonenko, Gayko and Sereda, 2012]) and the time periodicities $T_{W,2,i} = i(T_{ch})_2 = i7/6$ yr for i=1, 2, 4, 18

I	1	2	4	18
$T_{W,2,i}$ in yr	1.1666…	2.333…	4.666…	21
$T_{W,exp,i}$ in yr	1.1666	2.3332	4.666	20.999

Table 3a shows a very good agreement between the predominant experimental time periodicities $T_{W,exp,i}$ of variations of the sea water temperature (during 1969-2010 AD for the costal station Possyet of the Japan Sea) and the time periodicities $T_{W,2,i} = i(T_{ch})_2$ for i=1, 2, 4, 18. The predominant experimental time periodicity $T_{W,exp,1} = 1.1666$ yr is in a very good agreement with the periodicity $T_{W,2,1} = (T_{ch})_2 = 7/6\,\text{yr} = 1.1666...$ yr obtained from the formula (3.276) for the integer i=1. The predominant experimental time periodicity $T_{W,exp,2} = 2.3332$ yr is in a very good agreement with the periodicity $T_{W,2,2} = 2(T_{ch})_2 = 7/3\,\text{yr} = 2.333...\text{yr}$ obtained from the formula (3.276) for the integer i=2. The predominant experimental time periodicity $T_{W,exp,4} = 4.666$ yr is in a very good agreement with the periodicity $T_{W,2,4} = 4(T_{ch})_2 = 14/3\,\text{yr} = 4.666...$ yr obtained from the formula (3.276) for the integer i=4. The predominant experimental time periodicity $T_{W,exp,18} = 20.999$ yr is in a very good agreement with the periodicity $T_{W,2,18} = 18(T_{ch})_2 = 21\,\text{yr}$ obtained from formula the (3.276) for the integer i=18.

The calculated spectrum $S_{T,W}(f)$ (presented on Fig. 21a for the time range 1969-2010 AD) of variations of sea water temperature demonstrates the predominant experimental time periodicities $T_{W,exp,j}$, which are in a very good agreement with the following periodicities

$$T_{W,1,j} = j(T_{ch})_1 = j6/5 \text{ yr}, \ j = 1, 7, \quad (3.278)$$

i.e., we have the following relations for the sea water

$$T_{W,exp,j} \approx T_{W,1,j} = j(T_{ch})_1 = j6/5 \text{ yr}, \ j = 1, 7. \quad (3.279)$$

Table 3b

The predominant experimental time periodicities $T_{W,exp,j}$ of variations of the sea water temperature (during 1969-2010 AD for the costal station Possyet of the Japan Sea [Simonenko, Gayko and Sereda, 2012]) and the time periodicities $T_{W,1,j} = j(T_{ch})_1 = j6/5$ yr, $j = 1, 7$

j	1	7
$T_{W,1,j}$ in yr	1.2	8.4
$T_{W,exp,j}$ in yr	1.2352	8.3997

Table 3b shows a very good agreement between the predominant experimental time periodicities $T_{W,exp,j}$ of variations of the sea water temperature (during 1969-2010 AD for the costal station Possyet of the Japan Sea) and the time periodicities $T_{W,1,j} = j(T_{ch})_1 = j6/5$ yr for j = 1, 7. The predominant experimental time periodicity $T_{W,exp,1} = 1.2352$ yr is in a very good agreement with the periodicity $T_{W,1,1} = (T_{ch})_1 = 1.2$ yr obtained from the formula (3.278) for the integer j=1. The predominant experimental time periodicity $T_{W,exp,7} = 8.3997$ yr is in a very good agreement with the periodicity $T_{W,1,7} = 7(T_{ch})_1 = 8.4$ yr obtained from the formula (3.278) for the integer j = 7.

Table 4a

The predominant experimental time periodicities $T_{A,exp,i}$ of variations of air temperature (during 1969-2010 AD for the costal station Possyet of the Japan Sea [Simonenko, Gayko and Sereda, 2012]) and the time periodicities $T_{A,2,i} = i(T_{ch})_2 = i7/6$ yr for i=1, 2, 12

I	1	2	12
$T_{A,2,i}$ in yr	1.1666…	2.333…	14
$T_{A,exp,i}$ in yr	1.1351	2.3332	13.9995

The calculated spectrum $S_{T,A}(f)$ (presented on Fig. 21b for the time range 1969-2010 AD) of variations of the air temperature demonstrates the predominant experimental time periodicities $T_{A,exp,i}$, which are in a very good agreement with the following periodicities

$$T_{A,2,i} = i(T_{ch})_2 = i7/6 \text{ yr}, \ i = 1, 2, 12, \quad (3.280)$$

i.e., we have the following relations for the air

$$T_{A,exp,i} \approx T_{A,2,i} = i(T_{ch})_2 = i7/6 \text{ yr}, \ i = 1, 2, 12. \quad (3.281)$$

Table 4a shows a very good agreement between the predominant experimental time periodicities $T_{A,exp,i}$ of variations of the air temperature (during 1969-2010 AD for the costal station Possyet of the Japan Sea) and the time periodicities $T_{A,2,i} = i(T_{ch})_2 = i7/6$ yr for i=1, 2, 12. The predominant experimental time periodicity $T_{A,exp,1} = 1.1351$ yr is in a very good agreement with the periodicity

$T_{A,2,1} = (T_{ch})_2 = 7/6\,\text{yr} = 1.1666...\,\text{yr}$ obtained from the formula (3.280) for the integer i=1. The predominant experimental time periodicity $T_{A,\exp,2} = 2.3332$ yr is in a very good agreement with the periodicity $T_{A,2,2} = 2(T_{ch})_2 = 7/3\,\text{yr} = 2.333...\text{yr}$ obtained from the formula (3.280) for the integer i=2. The predominant experimental time periodicity $T_{A,\exp,12} = 13.9995$ yr is in a very good agreement with the periodicity $T_{A,2,12} = 12(T_{ch})_2 = 14$ yr obtained from the formula (3.280) for the integer i = 12.

Table 4b

The predominant experimental time periodicities $T_{A,\exp,j}$ of variations of the air temperature (during 1969-2010 AD for the costal station Possyet of the Japan Sea [Simonenko, Gayko and Sereda, 2012]) and the time periodicities $T_{A,1,j} = j(T_{ch})_1 = j6/5$ yr, $j = 1, 5, 7$

J	1	5	7
$T_{A,1,j}$ in yr	1.2	6	8.4
$T_{A,\exp,j}$ in yr	1.1999	5.9998	8.3997

The calculated spectrum $S_{T,A}(f)$ (presented on Fig. 21b for the time range 1969-2010 AD) of variations of the air temperature demonstrates the predominant experimental time periodicities $T_{A,\exp,j}$, which are in a very good agreement with the following periodicities

$$T_{A,1,j} = j(T_{ch})_1 = j6/5\ \text{yr},\ j = 1, 5, 7, \tag{3.282}$$

i.e., we have the following relations for the air

$$T_{A,\exp,j} \approx T_{A,1,j} = j(T_{ch})_1 = j6/5\ \text{yr},\ j = 1, 5, 7. \tag{3.283}$$

Table 4b shows a very good agreement between the predominant experimental time periodicities $T_{A,\exp,j}$ of variations of the air temperature (during 1969-2010 AD for the costal station Possyet of the Japan Sea) and the time periodicities $T_{A,1,j} = j(T_{ch})_1 = j6/5$ yr for j=1, 5, 7. The predominant experimental time periodicity $T_{A,\exp,1} = 1.1999$ yr is in a very good agreement with the periodicity $T_{A,1,1} = (T_{ch})_1 = 1.2\,\text{yr}$ obtained from the formula (3.282) for the integer j=1. The predominant experimental time periodicity $T_{A,\exp,5} = 5.9998$ yr is in a very good agreement with the periodicity $T_{A,1,5} = 5(T_{ch})_1 = 6\,\text{yr}$ obtained from the formula (3.282) for the integer j=5. The predominant experimental time periodicity $T_{A,\exp,7} = 8.3997$ yr is in a very good agreement with the periodicity $T_{A,1,7} = 7(T_{ch})_1 = 8.4\,\text{yr}$ obtained from the formula (3.282) for the integer j=7.

The combined Fig. 22 demonstrates the calculated [Simonenko, 2011] frequency spectra $S_x(f)$ (a) and $S_y(f)$ (b) of the documented [Earth Orientation Centre data] variations of the experimental coordinates x and y of the Earth's pole during 1969-2010 AD. The combined Fig. 22 demonstrates also the calculated spectrum $S_{T,W}(f)$ (c) of variations of sea water during 1969-2010 AD for the costal station Possyet of the Japan Sea [Simonenko, Gayko and Sereda, 2012]. The combined Fig. 22 demonstrates also the calculated spectrum $S_{T,A}(f)$ (d) of variations of air temperature during 1969-2010 AD for the costal station Possyet of the Japan Sea [Simonenko, Gayko and Sereda, 2012]. The calculated [Simonenko, 2011] frequency spectra $S_x(f)$ (a), $S_y(f)$ (b), $S_{T,W}(f)$ (c) and $S_{T,A}(f)$ (d) have the same slope of -2 demonstrating the single cosmic energy gravitational genesis of the Chandler's wobble of the Earth's poll and sea water and air temperature variations for the costal station Possyet of the Japan Sea.

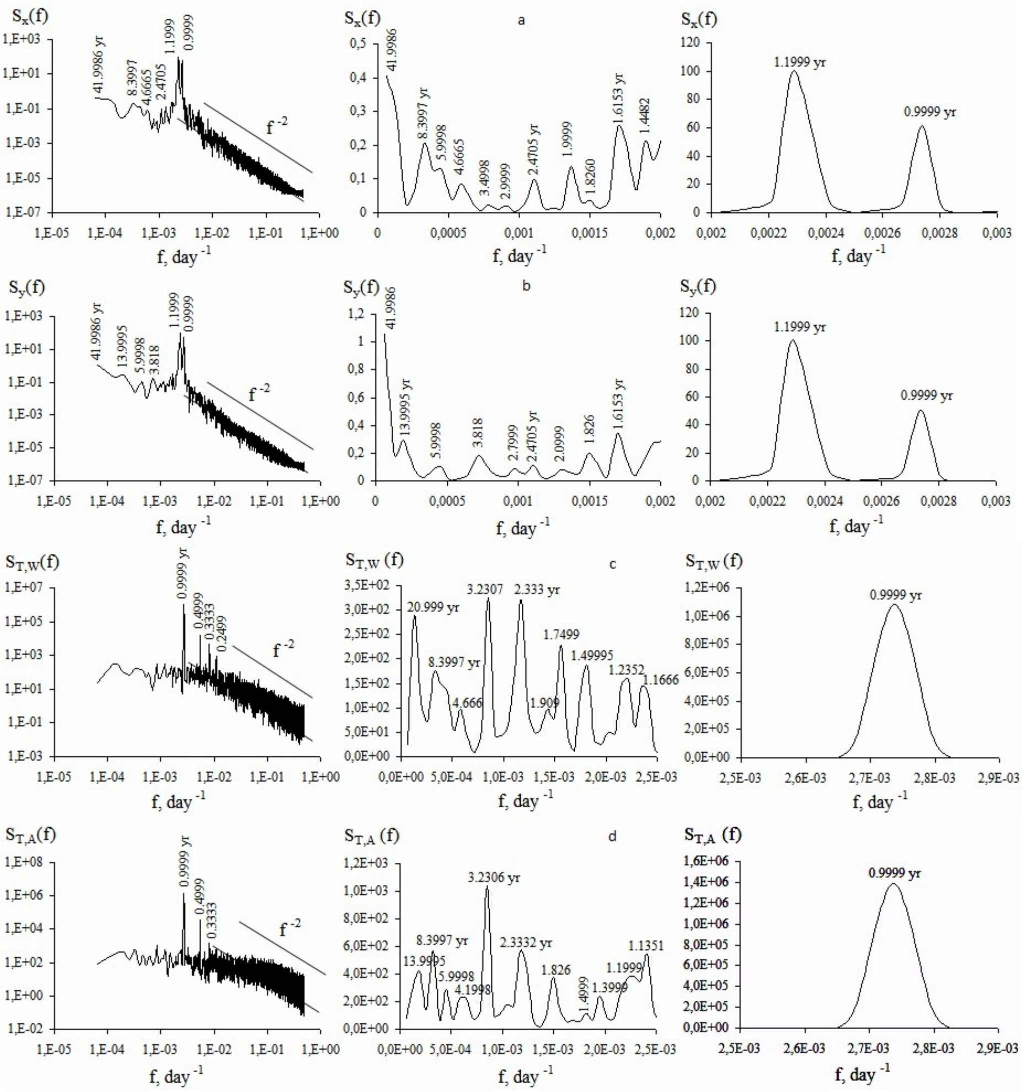


Fig. 22. The calculated [Simonenko, 2011] frequency spectra $S_x(f)$ (a) and $S_y(f)$ (b) of the documented [Earth Orientation Centre data] variations of the experimental coordinates x and y of the Earth's pole during 1969-2010 AD. The calculated spectrum $S_{T,W}(f)$ (c) of variations of sea water during 1969-2010 AD for the costal station Possyet of the Japan Sea [Simonenko, Gayko and Sereda, 2012]. The calculated spectrum $S_{T,A}(f)$ (d) of variations of air temperature during 1969-2010 AD for the costal station Possyet of the Japan Sea [Simonenko, Gayko and Sereda, 2012]

Thus, the previous theoretical results [Simonenko, 2007, 2008, 2009, 2010], the spectral studies [Simonenko, 2011] of the Chandler's wobble of the Earth's pole, and the spectral analysis [Simonenko, Gayko and Sereda, 2012] of the experimental variations of sea water and air temperature (during 1969-2010 AD for the costal station Possyet of the Japan Sea) confirm the cosmic energy gravitational genesis of the predominant short-range periodicities (7i/6 yr and 6j/5 yr determined by small integers i and j) of the Chandler's wobble of the Earth's pole and sea water and air temperature variations for the costal station Possyet of the Japan Sea.

3.8.4. The evidence of the founded range of the fundamental global periodicities $T_{tec,f} = T_{clim1,f} = 696 \div 708$ yr (of the global seismotectonic and volcanic activities and the climate variability of the Earth) obtained from the established links between the great natural cataclysms in the ancient history of humankind from the final collapse of the ancient Egyptian Kingdom and the biblical Flood to the increase of the global seismicity and the global volcanic activity in the beginning of the 20th century and the modern increase of the global seismicity and the volcanic activity in the end of the 20th century and in the beginning of the 21st century

We present in Subsection 3.8.4 the evidence of the founded [Simonenko, 2012] range of the fundamental global periodicities $T_{tec,f} = T_{clim1,f} = 696 \div 708$ yr (of the global seismotectonic and volcanic activities and the climate variability of the Earth) based on the established links between the great natural cataclysms in the ancient history of humankind from the final collapse of the ancient Egyptian Kingdom and the biblical Flood to the increase of the global seismicity and the global volcanic activity in the beginning of the 20th century [Richter, 1969] and the modern increase of the global seismicity and the volcanic activity in the end of the 20th century [Abramov, 1997] and in the beginning of the 21st century [Simonenko, 2007; 2009; 2010].

3.8.4.1. The great natural cataclysms in the history of humankind from the final collapse of the ancient Egyptian Kingdom (near 2190 BC) and the biblical Flood (occurred in 2104 BC according to the orthodox Jewish and Christian biblical chronology)

We have the documented time 63 BC of "the greatest earthquake ever experienced" [Cassius Dio Cocceianus, Dio's Roman history] destroyed many cities of the ancient Pontus located in Asia Minor. The ancient Minoan empire declined as a consequence of the great Minoan volcanic eruptions at islands Thera [Bolt et al., 1978] and Crete [Marinatos, 1939]. The "conventionally accepted" [LaMarche and Hirschboeck, 1984; p. 126] date of $1500 \div 1450$ BC of the volcanic eruption at Thera (Santorini) is based on the archaeological evidence [Lamb, 1977]. Archaeologists [Sivertsen, 2009] and geophysicists [Bolt et al., 1978] placed usually the Minoan volcanic eruption at island Thera (Santorini) near 1500 BC. This volcanic eruption had the global planetary evidences revealed worldwide [LaMoreaux, 1995]. Especially, Stanley and Sheng reported [Stanley and Sheng, 1986] the evidence for the presence of ash ejected from the explosion of Santorini in sediment cores recovered in the eastern Nile Delta of Egypt. Weisbued [Weisbued, 1985] pointed out that some biblical scholars have suggested that the Israelites' exodus from Egypt took place a date closer to 1450 BC (i.e., near the date 1450 BC of the last major eruption of Thera (Santorini) [LaMoreaux, 1995]), whereas LaMoreaux [LaMoreaux, 1995; p. 174] dated it to about 1440 BC, while others have maintained that the exodus took place around 1200 BC.

Despite the global planetary consequences [LaMoreaux, 1995] of the great Minoan volcanic eruption, the exact date of the eruption has not been determined. Marinatos [Marinatos, 1939] dated the great Minoan volcanic eruption to about 1400 BC, whereas Hammer et al. concluded [Hammer et al., 1987] that the eruption of Thera occurred in the range $1665 \div 1625$ BC. The eruption catalogue of Simkin et al. [Simkin et al., 1981] gives the range of dates $1490 \div 1450$ BC for Santorini eruption. Betancourt suggested [Betancourt, 1987] the range $1700 \div 1640$ BC as the most probable date of the eruption of Thera. Running the radiocarbon analysis of samples from Akrotini, Hubberten et al. concluded [Hubberten et al., 1989] that the catastrophic eruption of Thera occurred most probably in the same range $1700 \div 1640$ BC giving "the exact time of the great eruption seem to agree a date of about 1670 BC" [Antonopoulos, 1992; p. 158], whereas Antonopoulos [Antonopoulos, 1992; p. 155] dated it to about the range $1600 \div 1500$ BC ("1550 BC plus or minus 50 years"). Friedrich et al. [Friedrich et al., 2006] argued: "Precise and direct dating of the Minoan eruption of Santorini (Thera) in Greece, a global Bronze Age time marker, has been made possible by the unique find of an olive tree, buried alive in life position by the tephra (pumice and ashes) on Santorini".

The "radiocarbon wiggle-matching" dating analysis of the olive tree revealed [Friedrich et al., 2006] that the eruption occurred during the range $1627 \div 1600$ BC with 95.4% probability. The authors [Friedrich et al., 2006] argued: “It is a century earlier than the date derived from traditional Egyptian chronologies”. The studies [LaMarche and Hirschboeck, 1984] of the tree frost rings of the bristlecone pine in California revealed the frost damage (related with the period of global cooling) between 1628 and 1626 BC. Based on revealed frost-ring damage, LaMarche and Hirschboeck dated [LaMarche and Hirschboeck, 1984] tentatively the cataclysmic eruption of Santorini (Thera) to 1828 $\div$ 1626 BC. This estimate 1828 $\div$ 1626 BC is based on the accepted hypothesis “that major eruptions are likely to be closely followed by notable frost events – at better than the 99.9% confidence level”. Baillie [Baillie, 1989] stated that an Irish oak minimum-growth period is the real evidence of a large volcanic eruption (accompanied by volcanic veil of fine ash and aerosols) that began in 1628 BC. LaMoreaux has stated [LaMoreaux, 1995]: “It is believed that this is an earlier time when Thera began its period of volcanic activity. This could represent the first of a series of large eruptions which left two major caldera that have occurred at Thera. A final large eruption and collapse took place in 1450 BC, which agrees with archaeological evidence”.

Antonopoulos indicated [Antonopoulos, 1992; p. 158] that it is important to remember that the date about 1550 BC “is the date of the beginning of the eruption and not of the widespread destruction in Crete”. It is very important for subsequent analysis to take into account the additional information related with the date about 1550 BC [Antonopoulos, 1992; p. 158]: “It is also the date when the Thera volcano became active again after a long period of quiescence and ejected the coarser pumice which form the lowest layer in the tephra deposits. The effects of this phase of the eruption were probably confined only to Thera. It did not result in the formation of the caldera, but all settlements on the island were obliterated, and all the inhabitants were either killed or driven away. Thus, since just a few skeletons and valuables have been found, it seems as if the inhabitants had enough warning to collect some of their belongings and evacuate”.

Finally, LaMoreaux stated [LaMoreaux, 1995]: “The eruptions of Thera (Santorini) between 1628 and 1450 BC constituted a natural catastrophe unparalleled in all history. The last major eruption in 1450 BC destroyed the entire Minoan Fleet at Crete at a time when the Minoans dominated the Mediterranean world”. LaMoreaux has believed [LaMoreaux, 1995] that “over the period from 1628 to 1450 BC Thera experienced a number of very explosive volcanic events”.

As we can see from the first point of view, the exact date of the eruption of Thera (Santorini) is the subject of controversy. We intent to solve this controversy in this Subsection by establishment of the non-controversial exact dates of the different distinct eruptions of Thera (Santorini).

It is well known that the ancient Egyptian Kingdom declined near 2190 BC as a consequence of the long-lasting catastrophic drought related with the extraordinary decrease of the depth of the Nile. The decline of the ancient Egyptian Kingdom coincided with the small ice age in Europe. The recurrence of the next catastrophic drought occurred in Egyptian Cairo in 1200 AD during the Arabic conquest of the Egypt.

According to the orthodox Jewish and Christian biblical chronology [Genesis, 7:11], the Flood occurred in the Jewish year 1656 (which is 2104 BC) as a consequence of the rainstorm during the 40 days [Genesis, 7:12]. We have the intermediate mean date 2147 BC between the biblical Flood (2104 BC) and the final collapse of the ancient Egyptian Kingdom (2190 BC) related with the long-lasting catastrophic drought.

Reconstructing the ancient history of the humankind in his “Egypt’s Place in Universal History”, Von Bunsen [Von Bunsen, 1848, pp. 77-78, 88] revealed the marks of the planetary disaster, related with the dramatic change of the landscape of the Central Asia in 10555 BC. Considering the ancient history of the humankind in his “Fingerprints of the Gods” [Hancock, 1997], Graham Hancock revealed the Egyptian marks of the planetary disaster in 10450 BC. It was suggested [Simonenko, 2009; 2010] that the Bunzen’s and Hancock’s estimations are related with the same planetary disaster during the time range 10555 BC $\div$ 10450 BC in the ancient history of the humankind. Taking into account the documented times (10555 BC [Von Bunzen, 1848] and 10450 BC [Hancock, 1997]), we can evaluate the mean date 10502.5 BC of the planetary disaster in the Central Asia and Egypt.

We get the time duration 10439.5 years (10502.5 - 63) between the greatest [Cassius Dio Cocceianus, Dio's Roman history] earthquake (63 BC) destroyed the ancient Pontus (located in Asia Minor) and the obtained mean date 10502.5 BC of the planetary disaster in the Central Asia [Von Bunsen, 1848, pp. 77-78, 88] and Egypt [Hancock, 1997]. The obtained time duration 10439.5 years is approximately equal to the time period 10440 years (3×3480 years) consisting of 3 time periods of 3480 years given by the fundamental global seismotectonic, volcanic and climatic periodicity (3.258a) determined by the combined predominant non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interactions of the Sun with the Jupiter and the Saturn. The obtained time duration 10439.5 years confirms the stated hypothesis [Ilyichev and Cherepanov, 1991, p. 1371] about the recurrence of the super-earthquakes characterized by the average approximate time periodicity of 10000 years.

The considered above catastrophic droughts, great earthquakes and great volcanic eruptions in the history of the humankind are the climatic and geophysical mutually related links of the one evolutionary chain determined by the combined cosmic non-stationary energy gravitational influence on the Earth of the Sun, the Moon and the planets of the Solar System. The founded (in Subsection 3.8.1) range of the fundamental global seismotectonic, volcanic and climatic periodicities $T_{tec,f} = T_{clim1,f} = 696 \div 708$ years (determined by the combined predominant non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Jupiter and the Sun owing to the gravitational interactions of the Sun with the Jupiter and the Saturn) gives the opportunity to discover one clear viewpoint in the frame of the established cosmic geophysics [Simonenko, 2007] towards these planetary catastrophes.

3.8.4.2. Linkage of the last major eruption of Thera (1450 BC) and the greatest earthquake destroyed the ancient Pontus (63 BC)

Les us analyze the great natural cataclysms in the ancient history of the humankind to verify the established time periodicities (3.256a) and (3.258a) of the Earth's periodic seismotectonic and volcanic activity and the global climate variability of the Earth induced by the combined cosmic non-stationary energy gravitational influences of the system Sun-Moon, the Venus, the Jupiter and the Sun owing to the gravitational interactions of the Sun with the Jupiter and the Saturn.

Using the time difference 1387 years (1450 - 63) between the date 1450 BC [LaMoreaux, 1995] of last major eruption of Thera and the greatest earthquake in the ancient Pontus (63 BC), we get the ratio:

$$\frac{(1450 - 63)\ \text{years}}{696\ \text{years}} = \frac{1387}{696} = 1.9928, \qquad (3.284)$$

which shows that we have approximately 2 time periods of 696 years (given by (3.256a)) between these cataclysms. Using the classical date 1500 BC [Bolt et al., 1978; Sivertsen, 2009] of the eruption of Thera (Santorini), we get the ratio:

$$\frac{(1500 - 63)\ \text{years}}{696\ \text{years}} = \frac{1437}{696} = 2.0646, \qquad (3.285)$$

which is slightly larger than the previous estimation (3.284).

The closeness of the ratios (3.284) and (3.285) to the integer number 2 confirms the founded cosmic energy gravitational genesis of the fundamental global seismotectonic, volcanic and climatic periodicity (3.256a) [Simonenko, 2012] determined by the combined predominant non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Jupiter and the Sun owing to the gravitational interactions of the Sun with the Jupiter and the Saturn. Taking into account that the estimation (3.284) is closer to the integer number 2 than the estimation (3.285), we can conclude that the date 1450 BC [LaMoreaux, 1995] is more probable than the classical date 1500 BC [Bolt et al., 1978; Sivertsen, 2009] of the eruption of Thera (Santorini).

3.8.4.3. Linkage of the greatest earthquake destroyed the ancient Pontus (63 BC), the earthquake destroyed the ancient Greek Temple of Artemis (614 AD) and the great frost event (628 AD) related with the atmospheric veil (recorded in Europe in 626 AD) induced by the great unknown volcanic eruption

The ancient Greek city Ephesus (later a major Roman city on the west coast of Asia Minor) was destroyed by an earthquake occurred in 614 AD. The Ephesus was famed owing to the Temple of Artemis, one of the Seven Wonders of the Ancient World. Using the time difference 677 years (614 + 63) between the major earthquake destroyed the Temple of Artemis (614 AD) and the greatest earthquake in the ancient Pontus (63 BC), we get the ratio:

$$\frac{(614 + 63)\ \text{years}}{696\ \text{years}} = \frac{677}{696} = 0.9727, \qquad (3.286)$$

which shows that we have approximately 1 time period of 696 years between these earthquakes.

Using the time difference 689 years (626 + 63) between the greatest earthquake destroyed the ancient Pontus (63 BC) and great unknown volcanic eruption (apparently, Rabaul' [LaMarche and Hirschboeck, 1984] eruption, whose atmospheric veil was recorded in Europe in 626 AD [Stothers and Rampino, 1983] and resulted to the great frost events in 628 AD [LaMarche and Hirschboeck, 1984]), we get the ratio:

$$\frac{(626+63)\text{ years}}{696\text{ years}}=\frac{689}{696}=0.9899, \tag{3.287}$$

which shows that we have approximately 1 time period of 696 years (given by (3.256a)) between the greatest earthquake destroyed the ancient Pontus (63 BC) and great unknown volcanic eruption.

The closeness of the ratios (3.286) and (3.287) to the integer number 1 confirms the founded cosmic energy gravitational genesis of the fundamental global seismotectonic, volcanic and climatic periodicity (3.256a) [Simonenko, 2012] determined by the combined predominant non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Jupiter and the Sun owing to the gravitational interactions of the Sun with the Jupiter and the Saturn.

3.8.4.4. Linkage of the greatest earthquake destroyed the ancient Pontus (63 BC) and the great earthquakes occurred in England (1318 AD and 1343 AD), Armenia (1319 AD), Portugal (1320 AD, 1344 AD and 1356 AD) and Japan (1361 AD)

Using the time differences 1381 years (1318 + 63) and 1382 years (1318 + 63) between the great earthquakes [Vikulin, 2008] occurred in England (1318 AD) and Armenia (1319 AD), respectively, and the greatest earthquake in the ancient Pontus (63 BC), we get the ratio:

$$\frac{(1318+63)\text{ years}}{696\text{ years}}=\frac{1381}{696}=1.9842, \tag{3.288}$$

which shows that we have approximately 2 time periods of 696 years (given by (3.256a)) between these great earthquakes in the ancient Pontus (63 BC) and in England (1318 AD) and Armenia (1319 AD). Using the time difference 1406 years (1343 + 63) between the great earthquake in England (1343 AD) and the greatest earthquake of the ancient Pontus (63 BC), we get the ratio:

$$\frac{(1343+63)\text{ years}}{696\text{ years}}=\frac{1406}{696}=2.0201, \tag{3.289}$$

which shows that we have approximately 2 time periods of 696 years (given by (3.256a)) between these great earthquakes.

Using the mean date 1330.5 AD between the great earthquakes in England (1318 AD and 1343 AD) and the greatest earthquake in the ancient Pontus (63 BC), we get the ratio:

$$\frac{(1330.5+63)\text{ years}}{696\text{ years}}=\frac{1393.5}{696}=2.0021, \tag{3.290}$$

which shows that the great earthquakes in England (1318 AD and 1330.5 AD) occurred approximately after 2 time periods of 696 years (given by (3.256a)) from the date 63 BC of the greatest earthquake in the ancient Pontus.

Using the mean date 1332 AD between the great earthquakes in Portugal (1320 AD and 1344 AD) and the greatest earthquake in the ancient Pontus (63 BC), we get the ratio:

$$\frac{(1332+63)\text{ years}}{696\text{ years}}=\frac{1395}{696}=2.0043, \tag{3.291}$$

which shows that the great earthquakes in Portugal (1320 AD and 1344 AD) occurred approximately after 2 time periods of 696 years (given by (3.256a)) from the date 63 BC of the greatest earthquake in the ancient Pontus.

Using the time difference 1424 years (1361 + 63) between the great earthquake in Japan (1361 AD) and the greatest earthquake in the ancient Pontus (63 BC), we get the ratio:

$$\frac{(1361+63)\text{ years}}{696\text{ years}}=\frac{1424}{696}=2.0459, \tag{3.292}$$

which shows that we have approximately 2 time periods of 696 years (given by (3.256a)) between these great earthquakes.

The closeness of the ratios (3.290), (3.291) and (3.292) to the integer number 2 (for England, Portugal and Japan) confirms the founded cosmic energy gravitational genesis of the fundamental global seismotectonic, volcanic and climatic periodicity (3.256a) [Simonenko, 2012] determined by the combined predominant non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Jupiter and the Sun owing to the gravitational interactions of the Sun with the Jupiter and the Saturn.

3.8.4.5. Linkage of the final collapse of the ancient Egyptian Kingdom (occurred near 2190 BC), the biblical Flood (occurred in 2104 BC according to the orthodox Jewish and Christian biblical chronology) and the last major eruption of Thera (1450 BC)

We have the intermediate mean date 2147 BC ((2190+2104)/2) between the final collapse of the ancient Egyptian Kingdom (near 2190 BC) and the biblical Flood (2104 BC). Using the time difference 697 years (2147- 1450) between the intermediate mean date 2147 BC and the last major eruption of Thera (1450 BC) [LaMoreaux, 1995], we get the corresponding ratio:

$$\frac{(2147 - 1450) \text{ years}}{696 \text{ years}} = \frac{697}{696} = 1.0014, \qquad (3.293)$$

which shows that we have approximately 1 time period of 696 years between the intermediate mean date 2147 BC (between the final collapse of the ancient Egyptian Kingdom (near 2190 BC) and the biblical Flood (2104 BC)) and the last major eruption of Thera (1450 BC).

Using the classical date 1500 BC [Bolt et al., 1978; Sivertsen, 2009] of the eruption of Thera (Santorini), we get the corresponding ratio:

$$\frac{(2147 - 1500) \text{ years}}{696 \text{ years}} = \frac{647}{696} = 0.9295. \qquad (3.294)$$

Since the estimation (3.293) is closer to the integer number 1 than the estimation (3.294), we can conclude once again that the date 1450 BC [LaMoreaux, 1995] is the more probable date for the last major eruption of Thera than the classical date 1500 BC [Bolt et al., 1978; Sivertsen, 2009] of the eruption of Thera (Santorini).

The closeness of the ratios (3.293) and (3.294) to the integer number 1 confirms the founded cosmic energy gravitational genesis of the fundamental global seismotectonic, volcanic and climatic periodicity (3.256a) [Simonenko, 2012] determined by the combined predominant non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Jupiter and the Sun owing to the gravitational interactions of the Sun with the Jupiter and the Saturn.

3.8.4.6. Linkage of the planetary disasters in the Central Asia (10555 BC) and in the ancient Egyptian Kingdom (10450 BC), and the greatest earthquake destroyed the ancient Pontus (63 BC)

Using the time duration 10439.5 years (10502.5 - 63) between the greatest [Cassius Dio Cocceianus, Dio's Roman history] Pontic earthquake (63 BC) in Asia Minor and the obtained mean estimation 10502.5 BC ((10555+10450)/2) of the planetary disaster (10555 BC) in the Central Asia [Von Bunsen, 1848, pp. 77-78, 88] and the planetary disaster (10450 BC) in ancient Egyptian Kingdom [Hancock, 1997], we get the ratio

$$\frac{(10502.5 - 63) \text{ years}}{696 \text{ years}} = \frac{10439.5}{696} = 14.9992 \approx 15, \qquad (3.295)$$

confirming the fundamental global seismotectonic, volcanic and climatic periodicity (3.256a) determined by the combined predominant non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Jupiter and the Sun owing to the gravitational interactions of the Sun with the Jupiter and the Saturn.

We get also the ratio

$$\frac{(10502.5 - 63) \text{ years}}{3480 \text{ years}} = \frac{10439.5}{3480} \approx \frac{10440}{3480} = \frac{3 \times 3480}{3480} = 3,$$

(3.296)

confirming the fundamental global seismotectonic, volcanic and climatic periodicity (3.258a) determined by the combined predominant non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interactions of the Sun with the Jupiter and the Saturn.

Thus, the obtained rations (3.284), (3.285), (3.286), (3.287), (3.288), (3.289), (3.290), (3.291), (3.292), (3.293), (3.294), (3.295) (which can be approximated by various integer numbers for different regions of the Earth) confirm the fundamental global seismotectonic, volcanic and climatic periodicity (3.256a) determined by the combined predominant non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Jupiter and the Sun owing to the gravitational interactions of the Sun with the Jupiter and the Saturn.

3.8.4.7. Linkage of the previous great eruptions of Thera (Santorini) (between 1628 and 1450 BC), the greatest (in the United States in the past 150 years up to 1872) earthquake in Owens Valley, California (1872 AD), the eruptions of Santorini in 1866 and 1925 AD and the great eruption of Krakatau in 1883 AD

We present in Subsection 3.8.4.7 the linkage of the previous great eruptions of Thera (Santorini) (between 1628 and 1450 BC [LaMoreaux, 1995]), the greatest (in the United States in the past 150 years up to 1872) earthquake in Owens Valley, California (1872 AD), the eruptions of Santorini in 1866 and 1925 AD and the great eruption of Krakatau in 1883 AD.

Papazachos (see also [Antonopoulos, 1992]) considered [Papazachos, 1989] the largest eruptions (accompanied by tsunamis) of the Santorini volcano, which occurred (during the last five centuries) in 1457, 1573, 1560, 1866 and 1925 AD. We can interpret the eruptions of Santorini in 1866 and 1925 AD and the eruption of Krakatau in 1883 AD as terrible manifestation (in the 19^{th} and 20^{th} centuries) of the time periodicity of 3480 years = 5 × 696 years given by (3.258a). The mean date 1874.5 AD between the eruptions of Santorini (1866 AD) and Krakatau (1883 AD) is close to the date 1872 AD of the greatest (in the United States in the past 150 years up to 1872) earthquake in Owens Valley, California. The date 1925 AD of the eruption of Santorini is close to the year 1923 AD of the strongest Japanese earthquake in the Kanto region (and in Torbat-e Heydariyeh, Iran; Sichuan, China; Kamchatka, USSR; Humbolt County, California, USA).

Using the mean date 1613.5 BC of the obtained range $1627 \div 1600$ BC of the first Santorini's eruption (based on the "radiocarbon wiggle-matching" dating analysis [Friedrich et al., 2006] with 95.4% probability), we get the time duration 3479.5 years from this mean date 1613.5 BC and the eruption of Santorini in 1866 AD. We get the ratio of the obtained time duration 3479.5 years to the time periodicity of 3480 years

$$\frac{(1613.5+1866)\ \text{years}}{3480\ \text{years}} = \frac{3479.5}{3480} = 0.999856, \qquad (3.297)$$

which is very close to the integer number 1. It means that the eruption of Santorini in 1866 AD is related with the first minor eruption of Santorini in the obtained range $1627 \div 1600$ BC [Friedrich et al., 2006]. Really, considering the eruption of the Santorini in 1866 AD, we can obtain the corresponding date $t_p(1866\ \text{AD})$ of previous eruption related with the founded time periodicity 3480 years given by (3.258a). To do this, we have the obvious equation

$$t_p(1866\ \text{AD}) + 3480\ \text{years} = 1866\ \text{years},$$

which gives the following date of the first minor eruption of Santorini:

$$t_p(1866\ \text{AD}) = 1866\ \text{years} - 3480\ \text{years} = 1614\ \text{BC} \qquad (3.298)$$

in agreement with the mean date 1613.5 BC of the obtained range $1627 \div 1600$ BC [Friedrich et al., 2006] of the Santorini's eruption.

Antonopoulos associated [Antonopoulos, 1992; p. 166] "the eruption at Thera with the analogous Krakatau eruption" occurred in 1883 AD. We can interpret the great eruption of Krakatau in 1883 AD as the manifestation of the periodic increase of the global seismicity and volcanic activity related with the founded time periodicity 3480 years given by (3.258a). Really, considering the eruption of Krakatau in 1883 AD, we can obtain the time duration 3496.5 years between the great eruption of Krakatau in 1883 AD and the mean date 1613.5 BC of the obtained range $1627 \div 1600$ BC of the first Santorini's eruption (based on the "radiocarbon wiggle-matching" dating analysis [Friedrich et al., 2006]). We get the ratio of the obtained time duration 3496.5 years to the time periodicity of 3480 years

$$\frac{(1613.5+1883)\ \text{years}}{3480\ \text{years}} = \frac{3496.5}{3480} = 1.0047, \qquad (3.299)$$

which is very close to the integer number 1, denoting that the eruption of Thera (Santorini) in the obtained range $1627 \div 1600$ BC [Friedrich et al., 2006] is related with the great eruption of Krakatau in 1883 AD.

Using the mean value 1613.5 BC of the obtained range $1627 \div 1600$ BC of the first minor eruption of Santorini [Friedrich et al., 2006], we get the time duration 3485.5 years from this mean date 1613.5 BC and the greatest (in the United States in the past 150 years up to 1872) earthquake in Owens Valley, California (1872 AD). We get the ratio of the obtained time duration 3485.5 years to the time periodicity of 3480 years

$$\frac{(1613.5 + 1872)\ \text{years}}{3480\ \text{years}} = \frac{3485.5}{3480} = 1.00158, \tag{3.300}$$

which is very close to the integer number 1. It denotes that the greatest earthquake in Owens Valley, California (1872 AD) is related with the first Santorini's eruption in the obtained range 1627-1600 BC [Friedrich et al., 2006]. The obtained closeness of the estimations (3.296), (3.297) and (3.300) to the integer number 1 confirms the founded fundamental global seismotectonic, volcanic and climatic periodicity (3.258a) determined by the combined predominant non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interactions of the Sun with the Jupiter and the Saturn.

Considering the greatest (in the United States in the past 150 years up to 1872) earthquake in Owens Valley, California (1872 AD), we can obtain (based on the founded time periodicity 3480 years given by (3.258a)) the corresponding date $t_p(1872\ \text{AD})$ of previous maximal planetary seismic and volcanic activity from the obvious relation

$$t_p(1872\ \text{AD}) + 3480\ \text{years} = 1872\ \text{years},$$

which gives the following date of previous maximal planetary seismic and volcanic activity:

$$t_p(1972\ \text{AD}) = 1872\ \text{years} - 3480\ \text{years} = 1608\ \text{BC}, \tag{3.301}$$

entering to the obtained range 1627-1600 BC [Friedrich et al., 2006] of the eruption of Santorini.

Considering the eruption of Santorini in 1925 AD, we can obtain the corresponding date $t_p(1925\ \text{AD})$ of previous eruption related with the founded time periodicity 3480 years given by (3.258a). To do this, we have the obvious relation

$$t_p(1925\ \text{AD}) + 3480\ \text{years} = 1925\ \text{years},$$

which gives the following date of the second minor eruption of Santorini:

$$t_p(1925\ \text{AD}) = 1925\ \text{years} - 3480\ \text{years} = 1555\ \text{BC} \tag{3.302}$$

in a good agreement with the mean value 1550 BC [Antonopoulos, 1992; p. 155] of the established range $1600 \div 1500$ BC of the Santorini's eruption.

3.8.4.8. Linkage of the eruption of Tambora (1815 AD) and the Thera (Santorini) eruption in the range $1700 \div 1640$ BC

We present in Subsection 3.8.4.8 the linkage of the eruption of Tambora (1815 AD) and the Thera (Santorini) eruption in the range $1700 \div 1640$ BC [Betancourt, 1987; Habberten et al., 1989].

The eruption of Thera (Santorini) was the great natural cataclysm. However, in terms of the erupted volume, it ranks smaller [Pyle, 1996] than the eruption of the Tambora occurred in 1815 AD. Considering the eruption of the Tambora occurred (1815 AD), we can obtain (based on the founded time periodicity 3480 years given by (3.258a)) the corresponding date $t_p(1815\ \text{AD})$ of the previous great world eruption from the obvious relation

$$t_p(1815\ \text{AD}) + 3480\ \text{years} = 1815\ \text{years},$$

which gives the following date of the previous great world eruption:

$$t_p(1815\ \text{AD}) = 1815\ \text{years} - 3480\ \text{years} = -1665\ \text{years} = 1665\ \text{BC}, \tag{3.303}$$

which is very close to the mean date 1670 BC of the suggested range $1700 \div 1640$ BC [Betancourt, 1987; Hubberten et al., 1989] of the eruption of Thera (Santorini). The date 1665 BC is very close to the average date of 1675 BC [LaMarche and Hirschboeck, 1984] based "on grain from storage jars from the destruction level" [Batancourt and Weinstein, 1976]. This agreement confirms the founded fundamental global seismotectonic, volcanic and climatic periodicity (3.258a) determined by the combined predominant non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interactions of the Sun with the Jupiter and the Saturn.

3.8.4.9. Linkage of the increase of the global seismicity (along with the increase of the volcanic activity) in the end of the 19th century and in the beginning of the 20th century and the eruption of Thera (Santorini) between 1600 and 1500 BC

We present in Subsection 3.8.4.9 the linkage of the increase of the global seismicity (along with the increase of the volcanic activity) in the end of the 19th century and in beginning of the 20th century [Richter, 1969] and the eruption of Thera (Santorini) between 1600 and 1500 BC [Antonopoulos, 1992].

The former President of the Seismological Society of America made in 1969 the statement [Richter, 1969] about the increase of the global seismicity recorded in the range 1896 $\div$ 1906 AD up to 1969:

"One notices with some amusement that certain religious groups have picked this rather unfortunate time to insist that the number of earthquakes is increasing. In part they are misled by the increasing number of small earthquakes that are being catalogued and listed by newer, more sensitive stations throughout the world. It is worth remarking that the number of great [that is, 8.0 and over on the Richter scale] earthquakes from 1896 to 1906 (about twenty-five) was greater than in any ten-year interval since".

The seismologists Seweryn J. Duda and Markus Båith revealed [Duda, 1965; Båith and Duda, 1979] the range 1900 $\div$ 1920 AD characterized by the maximal energy release per year for the whole time period up to 1977. The eruption of Santorini occurred in 1925 AD, i.e. near the end of the established range 1900 $\div$ 1920 AD. Considering the range 1900 $\div$ 1925 AD as the range of the maximal global seismic activity in the end of the 19th century and in the beginning of the 20th century (along with the eruption of Santorini in 1925 AD), we can obtain (based on the founded time periodicity 3480 years given by (3.258a)) the corresponding time range $t_p(1896 \div 1925\,\text{AD})$ of the previous maximal global seismic and volcanic activities from the obvious relation

$$t_p(1896 \div 1925\,\text{AD}) + 3480\,\text{years} = 1896 \div 1925\,\text{years}, \qquad (3.304)$$

which gives the following range of the corresponding previous maximal global seismic and volcanic activities:

$$t_p(1896 \div 1925\,\text{AD}) = 1584 \div 1555\,\text{BC}$$

(3.305)

entering to the established range $1600 \div 1500$ BC [Antonopoulos, 1992; p. 155] of eruption of Santorini. This agreement confirms the founded fundamental global seismotectonic, volcanic and climatic periodicity (3.258a) determined by the combined predominant non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interactions of the Sun with the Jupiter and the Saturn.

Thus, we have revealed the evident linkages between the different distinct eruptions of the Thera (Santorini) dated in the following ranges: 1700÷1640 BC [Betancourt, 1987; Habberten et al., 1989], $1628 \div 1626$ BC [LaMarche and Hirschboeck, 1984], 1627÷1600 BC [Friedrich et al., 2006], 1600÷1500 BC [Antonopoulos, 1992], 1628÷1450 BC [LaMoreaux, 1995] and the eruptions of the Tambora (1815 AD), the Santorini (1866 AD and 1925 AD) and the Krakatau (1883 AD). Based on the fundamental global seismotectonic, volcanic and climatic periodicity (3.258a) and taking into account the eruptions of the Tambora (1815 AD), the Santorini (1866 AD and 1925 AD) and the Krakatau (1883 AD), we have shown the real possibility of different distinct eruptions of Thera (Santorini): near 1665 BC (in accordance with the range 1700÷1640 BC [Betancourt, 1987; Habberten et al., 1989]), near 1613.5 BC (in accordance with the range 1627÷1600 BC [Friedrich et al., 2006]) and in the range 1584÷1555 BC (in accordance with the range 1600÷1500 BC [Antonopoulos, 1992]). Consequently, we can consider the possibility of the final major catastrophic eruption near 1450 BC [LaMoreaux, 1995].

3.8.4.10. Linkage of the increase of the global seismicity (along with the increase of the volcanic activity) in the end of the 20th century and the eruption of Hekla (1300 AD) in Iceland and the great earthquake (1303 AD) in China

We present in Subsection 3.8.4.10 the linkage of the increase of the global seismicity (along with the increase of the volcanic activity) in the end of the 20th [Abramov, 1997] century and the eruption of Hekla (1300 AD) [Thordarson and Larsen, 2007] in Iceland and the great earthquake (1303 AD) in China [Vikulin, 2008].

Considering the date (1300 AD) of the eruption of Hekla (1300 AD) [Thordarson and Larsen, 2007] in Iceland and the date (1303 AD) of great earthquake in China [Vikulin, 2008] and using the founded range (3.256) of the fundamental global periodicities $T_{tec,f} = T_{clim1,f} = 696 \div 708$ yr (of the global seismotectonic and volcanic activities and the climate variability of the Earth determined by the combined predominant non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Jupiter and the Sun owing to the gravitational interactions of the Sun with the Jupiter and the Saturn**),** we can evaluate, respectively, the following ranges of the next possible seismotectonic and volcanic activities of the Earth

$$1300 \text{ years} + 696 \text{ years} \div 1300 \text{ years} + 708 \text{ years} = 1996 \div 2008 \text{ AD}, \tag{3.306}$$

$$1303 \text{ years} + 696 \text{ years} \div 1303 \text{ years} + 708 \text{ years} = 1999 \div 2011 \text{ AD}, \tag{3.307}$$

The lower boundaries of these ranges are related with the increase of the global seismicity (along with the increase of the volcanic activity) in the end of the 20th [Abramov, 1997] century. The upper boundary (2008 AD) of the range (3.306) is coincided with the predicted [Simonenko, 2007] date (2008 AD) of the next great Chinese earthquake. The upper boundary (2011 AD) of the range (3.307) is coincided with the predicted [Abramov, 1997] date (2011 AD) of next strong earthquake in the Kanto region. The upper boundary (2011 AD) of the range (3.307) is coincided with the upper boundary (2011 AD) of the predicted [Simonenko, 2009; 2010] time range $(2010 \div 2011 \text{AD})$ of the next sufficiently strong Japanese earthquake near the Tokyo region.

3.9. The forthcoming range $2020 \div 2061\,\text{AD}$ of the maximal seismotectonic, volcanic and climatic activities of the Earth during the past $696 \div 708$ years of the history of humankind and the related subsequent subranges (2023 ± 3 AD, 2040.38 ± 3 AD and 2061 ± 3 AD) of the increased peak global seismotectonic and volcanic activities and the climate variability of the Earth

Based on the established links between the different natural cataclysms in the history of humankind and using the founded range (3.256) of the fundamental global seismotectonic, volcanic and climatic periodicities $T_{tec,f} = T_{clim1,f} = 696 \div 708$ yr of the global seismotectonic, volcanic and climatic activities of the Earth, we evaluated [Simonenko, 2012] the forthcoming range

$$2020 \div 2061\,\text{AD} \tag{3.308}$$

of the maximal seismotectonic, volcanic and climatic activities of the Earth during the past $696 \div 708$ years of the history of humankind. We give below the details of this evaluation [Simonenko, 2012].

Considering the date (63 BC) of the greatest earthquake destroyed the ancient Pontus, we can evaluate (based on the founded time periodicity 696 years given by (3.256a) and the obvious calculation) the date of the next approximate peak of the maximal global seismotectonic, volcanic and climatic activity of the Earth (determined by the combined predominant non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Jupiter and the Sun owing to the gravitational interactions of the Sun with the Jupiter and the Saturn)

$$-63 \text{ years} + 3 \times 696 \text{ years} = 2025\,\text{AD}. \tag{3.309}$$

Considering the date (63 BC) of the greatest earthquake destroyed the ancient Pontus, we can evaluate (based on the founded time periodicity 696 years given by (3.256a)) the approximate date of the first nearest peak of the maximal global seismotectonic, volcanic and climatic activity of the Earth (determined by the combined predominant non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Jupiter and the Sun owing to the gravitational interactions of the Sun with the Jupiter and the

Saturn)

$$-63\text{ years} + 1\times 696\text{ years} = 633\ \text{AD}, \tag{3.310}$$

which is very close to the date 626 AD of the recorded atmospheric veil in Europe [Stothers and Rampino, 1983] and the resulted great frost events in 628 AD [LaMarche and Hirschboeck, 1984]. This satisfactory agreement shows that these geophysical events are closely correlated.

Considering the date (63 BC) of the greatest earthquake destroyed the ancient Pontus, we can evaluate (based on the founded time periodicity 696 years given by (3.256a)) the approximate date of the next second peak of the maximal global seismotectonic, volcanic and climatic activity of the Earth (determined by the combined predominant non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Jupiter and the Sun owing to the gravitational interactions of the Sun with the Jupiter and the Saturn)

$$-63\text{ years} + 2\times 696\text{ years} = 1329\ \text{AD}, \tag{3.311}$$

which is in good agreement with the mean date (1330.5 AD) of great earthquakes in England (occurred in 1318 AD and 1343 AD [Vikulin, 2008]). It means that these great earthquakes in the ancient Pontus (63 BC) and in England (1318 AD and 1343 AD) can be considered as the closely related events for evaluation of the forthcoming range of the maximal seismotectonic, volcanic and climatic activities of the Earth in the 21st century AD during the past $696 \div 708$ years of the history of humankind.

Considering the date (1318 AD) of the great earthquake in England and the founded range (3.256) of the fundamental global periodicities $T_{tec,f} = T_{clim1,f} = 696 \div 708\text{ yr}$ (of the global seismotectonic and volcanic activities and the climate variability of the Earth determined by the combined predominant non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Jupiter and the Sun owing to the gravitational interactions of the Sun with the Jupiter and the Saturn**),** we can evaluate the following range of the next possible strong earthquake in England

$$1318\text{ years} + 696\text{ years} \div 1318\text{ years} + 708\text{ years} = 2014 \div 2026\ \text{AD}, \tag{3.312}$$

which gives the mean date

$$(2014 + 2026\ \text{AD})/2 = 2020\,\text{AD}. \tag{3.313}$$

of the initial phase of the rapid increase of the global seismotectonic and volcanic activities and the climate variability of the Earth in the 21st century.

We can see that the upper value (2026 AD) of the range (3.312) is near the evaluation (3.309) of the approximate date of the next peak of the maximal global seismotectonic, volcanic and climatic activity of the Earth (determined by the combined predominant non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Jupiter and the Sun owing to the gravitational interactions of the Sun with the Jupiter and the Saturn) in the 21st century. Consequently, we can evaluate (based on (3.309), (3.312) and (3.313)) the first more narrow subrange of the increased peak global seismotectonic and volcanic activities and the climate variability of the Earth in the 21st century

$$2020 \div 2026\,\text{AD} = 2023 \pm 3\ \text{AD} \tag{3.314}$$

determined by the time periodicity $\{(T_{S\text{-}MOON,3})_1\} = 3\text{ years}$ of recurrence of the maximal (instantaneous and integral) combined energy gravitational influences on the Earth of the system Sun-Moon and the Venus.

To evaluate the duration of the next subrange of the increased global seismotectonic and volcanic activities and the climate variability of the Earth in the 21st century, it is necessary to consider the dates (in the range $1300 \div 1389\,\text{AD}$) of the volcanic eruptions [Thordarson and Larsen, 2007] in Iceland on the Hekla (1300 AD, 1341 AD and 1389 AD) and the Katla (1357 AD) volcanic systems, and the dates (in the range $1300 \div 1389\,\text{AD}$) of the great earthquakes [Vikulin, 2008] in China (1303 AD), England (1318 AD and 1343 AD), Armenia (1319 AD), Portugal (1320 AD, 1344 AD and 1356 AD), Austria (1348 AD) and Japan (1361 AD). We evaluate the mean time value of these volcanic eruptions and great earthquakes as follows

$$(1300+1341+1389+1357+1303+1318+1343+1319+1320+1344+1356+1348+1361)/13 =$$

$$= 1338.38\ \text{years} = 1338.38\,\text{AD}. \tag{3.315}$$

Using the mean time value (3.315) and the founded range (3.256) of the fundamental global periodicities $T_{tec,f} = T_{clim1,f} = 696 \div 708\text{ years}$ (of the global seismotectonic and volcanic activities and the climate variability of the Earth determined by the combined predominant non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Jupiter and the Sun owing to the gravitational interactions of the Sun with the Jupiter and the Saturn**)**, we can evaluate the second subrange of the increased global seismotectonic and volcanic activities and the climate variability of the Earth in the 21st century as follows

$$1338.38 \text{ years} + 696 \div 708 \text{ years} = 2034.38 \div 2046.38 \text{ AD}, \quad (3.316)$$

which is characterized by the increased peak intensity of the global seismotectonic and volcanic activities and the climate variability of the Earth in the 21st century near the following mean time of the subrange (3.316):

$$(2034.38 + 2046.38)/2 \text{ years} = 2040.38 \text{ years} = 2040.38 \text{ AD}, \quad (3.317)$$

Based on the mean time (3.317), we obtain the more narrow second subrange of the increased peak global seismotectonic and volcanic activities and the climate variability of the Earth in the 21st century

$$2040.38 \text{ years} \pm 3 \text{ years} = 2037.38 \div 2043.38 \text{ AD}. \quad (3.318)$$

determined by the time periodicity $\{(T_{S\text{-}MOON,3})_1\} = 3$ years of recurrence of the maximal (instantaneous and integral) combined energy gravitational influences on the Earth of the system Sun-Moon and the Venus.

Reconstructing the ancient history of the humankind in his "Egypt's Place in Universal History" [Von Bunzen, 1848], Bunzen revealed the marks of the planetary disaster related with the dramatic change of the landscape of the Central Asia in 10555 BC. Considering the ancient history of the humankind in his "Fingerprints of the Gods" [Hancock, 1997], Graham Hancock revealed the Egyptian marks of the planetary disaster in 10450 BC. We assumed [Simonenko, 2009; 2010] that the Bunzen's (10555 BC) and Hancock's (10450 BC) estimations are related with the same (or, the distinct events of the same) planetary disaster during the time range 10555 BC ÷ 10450 BC in the ancient history of the humankind. Taking into account the global time periodicity (of the Earth's periodic seismotectonic and volcanic activity and the global climate variability) 12540 years [Simonenko, 2007; p. 136] of recurrence of the maximal seismotectonic and volcanic activity and the global climate variability and considering the documented dates (10555 BC [Von Bunzen, 1848] and 10450 BC [Hancock, 1997] revealed in the Central Asia and Egypt, respectively) as a manifestations of the same global cataclysm (accompanied by a super-earthquakes), we can evaluate the possible time range of recurrence of these disasters:

- (10555 years ÷ 10450 years) + 12540 years = 1985 years ÷ 2090 years = 1985 ÷ 2090 AD. (3.319)

The founded (in Subsection 3.9) forthcoming range $2020 \div 2061$ AD [Simonenko, 2012] (of the maximal seismotectonic, volcanic and climatic activities of the Earth during the past $696 \div 708$ years of the history of humankind) is the more accurate and narrow estimation of the obtained range 1985 ÷ 2090 AD. However, taking into account the closeness of estimations (presented in Subsection 3.8.4.6) (3.295) and (3.296) to integers 15 and 3, respectively, we can conclude that the obtained mean estimation 10502.5 BC (of the planetary disaster (10555 BC) in the Central Asia [Von Bunsen, 1848, pp. 77-78, 88] and the planetary disaster (10450 BC) in ancient Egyptian Kingdom [Hancock, 1997]) can be considered as the more probable date related with the same planetary disaster in the ancient history of the humankind. Using the obtained mean estimation 10502.5 BC ((10555+10450)/2) of the planetary disaster (10555 BC) in the Central Asia [Von Bunsen, 1848, pp. 77-78, 88] and the planetary disaster (10450 BC) in ancient Egyptian Kingdom [Hancock, 1997], we can evaluate the more probable date of recurrence of these disaster:

- (10502.5 years) + 12540 years = 2037.5 years = 2037.5 AD, (3.320)

which enter into the second obtained subrange $2037.38 \div 2043.38$ AD (given by (3.318)) of the increased peak global seismotectonic and volcanic activities and the climate variability of the Earth in the 21st century. It means that the second obtained subrange $2037.38 \div 2043.38$ AD will be the more dangerous and destructive for the humankind in the 21st century.

Considering the date (63 BC) of the greatest earthquake destroyed the ancient Pontus and the founded time periodicity 708 years given by the upper value in the founded range (3.256) of the fundamental global periodicities $T_{tec,f} = T_{clim1,f} = 696 \div 708$ yr of the global seismotectonic and volcanic activities and the climate variability of the Earth determined by the combined predominant non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Jupiter and the Sun owing to the gravitational interactions of the Sun with the Jupiter and the Saturn**)**, we can evaluate the third next subrange of the increased peak global seismotectonic and volcanic activities and the climate variability of the Earth in the 21st century

$$-63 \text{ years} + (3 \times 708 \text{ years}) \pm 3 \text{ years} = 2061 \pm 3 \text{ years} = 2058 \div 2064 \text{ AD} \quad (3.321)$$

determined by the combined predominant non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Jupiter and the Sun owing to the gravitational interactions of the Sun with the Jupiter and the Saturn. The time periodicity $\{(T_{S\text{-}MOON,3})_1\} = 3$ years (of recurrence of the maximal (instantaneous and integral) combined energy gravitational influences on the Earth of the system Sun-Moon and the Venus) determines the width of the subrange (3.321).

Thus, taking into account the founded range (3.256) of the fundamental global periodicities $T_{tec,f} = T_{clim1,f} = 696 \div 708$ yr [Simonenko, 2012] of the global seismotectonic and volcanic activities and the climate variability of the Earth determined by the combined predominant non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Jupiter and the Sun owing to the gravitational interactions of the Sun with the Jupiter and the Saturn, we evaluate (inside the established range $2020 \div 2061$ AD [Simonenko, 2012] of the maximal seismotectonic, volcanic and climatic activities of the Earth during the past $696 \div 708$ years of the history of humankind) the subsequent subranges (2023 ± 3 AD given by (3.314), 2040.38 ± 3 AD given by (3.318) and 2061 ± 3 AD given by (3.321)) of the increased peak global seismotectonic and volcanic activities and the climate variability of the Earth in the 21st century. Consequently, the worldwide safety precautions are needed to prepare in advance for these increased peaks of the global seismotectonic, volcanic and climatic intensification of the Earth in the 21st century.

4. THE SYNTHESIS OF MAIN RESULTS AND CONCLUSIONS

We have founded in this monograph the cosmic energy gravitational genesis of the increase of the seismic and volcanic activity of the Earth in the end of the 20th century [Abramov, 1997] and in the beginning of the 21st Century AD [Simonenko, 2007]. To do this, the Thermohydrogravidynamics of the Solar System [Simonenko, 2007; 2007a; 2008] and the *Fundamentals of the Thermohydrogravidynamic Theory of Cosmic Genesis of the Planetary Cataclysms* [Simonenko, 2009; 2010] are extended by taking into account the additional non-stationary energy gravitational influences on the Earth of the Sun owing to the gravitational interactions of the Sun with the Jupiter, the Saturn, the Uranus and the Neptune. The presented extended thermohydrogravidynamic theory of cosmic genesis of the planetary cataclysms is based on the established generalized formulation [Simonenko, 2007a; 2007] of the first law of thermodynamics for moving rotating deforming compressible heat-conducting stratified macroscopic continuum region τ subjected to the non-stationary Newtonian gravitational field.

Using the classical continuum-mechanical theoretical approach [Batchelor, 1967], we have presented in Subsection 1.1 the generalized expression (in non-equilibrium thermodynamics [Simonenko, 2004; 2006]) for the macroscopic kinetic energy of a small continuum region. We have generalized [Simonenko, 2004; 2006] the classical expression [de Groot and Mazur, 1962] in classical non-equilibrium thermodynamics for the macroscopic kinetic energy per unit mass of a small macroscopic continuum region (considered in a stratified three-dimensional shear flow) by taking into account the irreversible shear component of the hydrodynamic velocity field related with the rate of strain tensor e_{ij}. The macroscopic kinetic energy (of the small macroscopic continuum region) is presented as a sum of the macroscopic translational kinetic energy and three Galilean invariants: the classical macroscopic internal rotational kinetic energy [de Groot and Mazur, 1962], the established macroscopic internal shear kinetic energy [Simonenko, 2004; 2006] and the established macroscopic internal kinetic energy of shear-rotational coupling [Simonenko, 2004; 2006] with small correction. The obtained formula (1.13) for the macroscopic kinetic energy per unit mass ε_k and its particular form (1.24) for homogeneous continuum regions of spherical and cubical shapes generalize the classical de Groot and Mazur expression (1.1) in classical non-equilibrium thermodynamics [de Groot and Mazur, 1962; Gyarmati, 1970] by taking into account the established [Simonenko, 2004; 2006; 2007a; 2007] macroscopic internal shear kinetic energy per unit mass ε_s, which expresses the kinetic energy of irreversible dissipative shear motion, and also the established [Simonenko, 2004; 2006] macroscopic internal kinetic energy of shear-rotational coupling per unit mass $\varepsilon_{s,r}^{coup}$, which expresses the kinetic energy of local coupling between irreversible dissipative shear and reversible rigid-like rotational macroscopic fluid motions. The presented expression (1.13) confirms the postulate [Evans, Hanley and Hess, 1984] that the velocity shear ($e_{ij} \neq 0$) represents an additional energy source taking into account in the Evans, Hanley and Hess's postulated formulation of the first law of thermodynamics for non-equilibrium deformed states of fluid motion.

We have presented the established conceptions [Simonenko, 2004; 2006; 2007a; 2007]: the macroscopic internal shear kinetic energy (expressing the kinetic energy of the non-equilibrium shear motion near the mass center of the small macroscopic continuum region); the macroscopic internal kinetic energy of shear-rotational coupling (expressing the kinetic energy of the nonlinear coupling between the equilibrium rigid-like rotational motion and the non-equilibrium shear motion near the mass center of the small macroscopic continuum region); the macroscopic internal kinetic energy of the small macroscopic continuum region (expressing the macroscopic kinetic energy in the K' - coordinate system related with the mass center of the continuum region); the macroscopic internal shear-rotational kinetic energy (defined as the sum of the macroscopic internal rotational kinetic energy, the macroscopic internal shear kinetic energy and the macroscopic internal kinetic energy of shear-rotational coupling). The established analytical formulae for the macroscopic kinetic energy (per unit mass), the macroscopic internal shear kinetic energy (per unit mass), the macroscopic internal rotational kinetic energy (per unit mass), the macroscopic internal kinetic energy of shear-rotational coupling (per unit mass), the macroscopic internal kinetic energy (per unit mass) are presented in tensorial forms for the small macroscopic continuum region considered in a stratified shear three-dimensional flow. The analytical formulae for the established energies are derived from the mathematical analysis of the relative fluid motion (in the Euclidean space) considered in the inertial Cartesian coordinate system K within the frame of the classical continuum-mechanical theoretical approach [Batchelor, 1967].

We have established [Simonenko, 2004] that the macroscopic internal kinetic energy may be approximated for a small continuum region as the sum of the macroscopic internal shear kinetic energy, the macroscopic internal kinetic energy of shear-rotational coupling and the classical de Groot and Mazur macroscopic internal rotational kinetic energy [de Groot and Mazur, 1962].

We have presented the evidence [Simonenko, 2006] that the established proportionality [Simonenko, 2004] $\varepsilon_s \propto \varepsilon_{dis}$ of the macroscopic internal shear kinetic energy per unit mass $\varepsilon_s = \frac{1}{2}\beta\,(e_{ij})^2$ (for homogeneous continuum regions of spherical and cubical shapes) and the kinetic energy dissipation rate per unit mass $\varepsilon_{dis} = 2\nu\,(e_{ij})^2$ in an incompressible viscous Newtonian continuum (characterized by the kinematic viscosity ν) may be considered as the real foundation of the remarkable association [Prigogine and Stengers, 1984; Nicolis and Prigogine, 1989] between a structure and an order (and, hence, the related kinetic energy), on the one hand, and the irreversible dissipation, on the other hand, for the dissipative structures in viscous Newtonian fluids.

Based on the postulates of thermodynamics, continuum mechanics and hydrodynamics, we have presented in Subsection 1.2 the equivalent generalized differential formulations (1.43), (1.50) and (1.53) (given for the Galilean frame of reference) of the first law of thermodynamics [Simonenko, 2007a; 2007; 2008] for non-equilibrium shear-rotational states of the deformed finite one-component individual continuum region (characterized by the symmetric stress tensor $\mathbf{T}$) moving in the non-stationary Newtonian gravitational field. The equivalent generalized differential formulations (1.43), (1.50) and (1.53) are valid for moving rotating deforming compressible heat-conducting stratified macroscopic continuum region τ subjected to the non-stationary Newtonian gravity). The generalized differential formulation (1.50):

$$dU_\tau + dK_\tau + d\pi_\tau = \delta Q + \delta A_{np,\partial\tau} + dG \qquad (1.50)$$

generalizes the classical [Gibbs, 1873; Landau and Lifshitz, 1976; p. 62] formulations (1.32) and (1.33):

$$dU = \delta Q - pdV,\ (d\varepsilon \equiv dU, -\delta W = -pdV)$$

by taking into account (along with the classical infinitesimal change of heat δQ and the classical infinitesimal change of the internal energy $dU_\tau \equiv dU$) the infinitesimal increment of the macroscopic kinetic energy dK_τ, the infinitesimal increment of the gravitational potential energy $d\pi_\tau$, the generalized expression [Simonenko, 2007a; 2007] for the infinitesimal work $\delta A_{np,\partial\tau}$ done on the continuum region τ by the surroundings of τ, the infinitesimal amount dG of energy (given by the expression (1.52)) added (or lost) as the result of the Newtonian non-stationary gravitational energy influence on the continuum region τ during the infinitesimal time interval dt. The equivalent generalized differential formulations (1.43), (1.50) and (1.53) of the first law of thermodynamics may be considered as the same differential formulations (1.43), (1.50) and (1.53) of the first law of thermohydrogravidynamics for the continuum region τ. The presented generalized expression [Simonenko, 2007a; 2007] for infinitesimal work $\delta A_{np,\partial\tau}$ (done on the continuum region τ by the surroundings of τ) generalizes the classical [Gibbs, 1873] expression

$$\delta A_{np,\partial\tau} = -\,\delta W = -\,pdV$$

by taking into account (for Newtonian continuum) the infinitesimal work δA_c (given by expression (1.62)) of the acoustic forces and the infinitesimal work δA_s (given by expression (1.63)) of the viscous forces acting during the infinitesimal time interval dt on the boundary surface $\partial\tau$ of the individual continuum region τ bounded by the continuum boundary surface $\partial\tau$.

Based on the equivalent generalized differential formulations (1.43), (1.50) and (1.53) of the first law of thermodynamics and the obtained expression (1.68) for the gravitational energy power $W_{gr}(\tau)$, we have presented in Subsection 1.4 the established [Simonenko, 2007a; 2007] gravitational energy mechanism of the gravitational energy supply into the continuum region τ owing to the local time increase of the potential ψ of the gravitational field inside the continuum region τ subjected to the non-stationary Newtonian gravitational field. We have presented the evidence that the revealed gravitational mechanism [Simonenko, 2007a; 2007] of the gravitational energy supply into the continuum region τ is consistent with the empirical finding [Abramov, 1997; p. 60] that the anomalous variations of the gravity field on the background of the Moon-Sun induced variations go in front of the earthquakes. Based on the equivalent generalized differential formulations (1.43), (1.50) and (1.53) of the first law of thermodynamics, we have presented the conclusion [Simonenko, 2007] about the significant increase of the energy flux $\delta F_{vis,c}$ (given by expression (1.70)) of the geo-acoustic energy from the focal region τ before the earthquake in a good agreement with the results of the detailed experimental studies [Dolgikh et al., 2006].

Using the established [Simonenko, 2004; 2006] generalized expression (1.6) for the total macroscopic kinetic energy $(K_\tau)_\alpha$ of each subsystem α, we have presented in Subsection 1.6 the deduction [Simonenko, 2007] of the conditions of the thermodynamic equilibrium in the closed thermohydrogravidynamic system. We have considered in Subsection 1.6.1 the equilibrium state of the closed thermodynamic system in classical statistical physics [Landau and Lifshitz, 1976]. We have presented in Subsection 1.6.2 the conservation law [Simonenko, 2007] of the total energy for the closed thermohydrogravidynamic system τ in the frame of the continuum model. We have considered in Subsection 1.6.3 the classical statistical properties of the thermodynamically equilibrium subsystem in the classical statistical physics [Landau and Lifshitz, 1976]. We have presented in Subsection 1.6.4 the definition of entropy (of the thermodynamic system in the classical statistical physics [Landau and Lifshitz, 1976]) related with the Galilean principle of relativity. We have formulated in Subsection 1.6.5 the condition of the thermodynamic equilibrium for the closed thermohydrogravidynamic system considered in the coordinate system K'_{sys} of the mass center C_{sys} of the thermohydrogravidynamic system under imposed conservation laws of the total energy and the total angular momentum. We have presented in Subsection 1.6.6 the generalized expression [Simonenko, 2007] for the angular momentum of the subsystem τ_α (macroscopic continuum region τ_α) for the non-equilibrium thermodynamic state. We have presented in Subsection 1.6.7 the condition (1.117) of the thermodynamic equilibrium [Simonenko, 2007] for the closed thermohydrogravidynamic system (consisting of N thermohydrogravidynamic subsystems) considering in the inertial coordinate system K'_{sys} related with the mass center C_{sys} of the thermohydrogravidynamic system. We have presented in Subsection 1.6.8 the conditions of the thermodynamic equilibrium [Simonenko, 2007] of the closed thermohydrogravidynamic system consisting of N thermohydrogravidynamic subsystem considered in the arbitrary inertial coordinate system K. We have presented in Subsection 1.6.8.1 the condition (1.121) of the thermodynamic equilibrium (of the closed thermohydrogravidynamic system) describing the relative movements of the mass centers of all subsystems. We have presented in Subsection 1.6.8.2 the conditions (1.125) and (1.118) of the thermodynamic equilibrium [Simonenko, 2007] of the closed thermohydrogravidynamic system relative to the macroscopic non-equilibrium kinetic energies of the subsystems τ_α. We have presented the evidence [Simonenko, 2007] that the disturbing cosmic energy gravitational influences (acting on the planets of the Solar System) can induce the irregular variations of the angular velocities of internal rotation of the planets of the Solar System.

Taking into account the shear-rotational thermodynamic states of the considered macroscopic subsystem τ, we have presented in Subsection 1.7 the generalization [Simonenko, 2007a; 2007] of the Le Chatelier – Braun principle [Landau and Lifshitz, 1976] on the closed equilibrium rotating thermohydrogravidynamic systems $(\tau + \bar{\tau})$ consisting of two subsystems: macroscopic continuum region τ (the subsystem in the viscous compressible continuum, which can be the focal region of the earthquakes) and some large subsystem $\bar{\tau}$ complementing the subsystem τ to obtain the closed thermohydrogravidynamic system $(\tau+\bar{\tau})$. We have presented the evaluation [Simonenko, 2007a; 2007] of the relaxation processes in the closed rotational thermohydrogravidynamic systems $(\tau + \bar{\tau})$ in terms of the total entropy of the rotational thermohydrogravidynamic systems $(\tau + \bar{\tau})$ after the deformational influence on the subsystem τ. We have presented the evidence [Simonenko, 2007a; 2007] that the entropy S of the thermohydrogravidynamic system is reduced up to the some value $S|_y$ (which is less than the value S_o characterizing the equilibrium state of the thermohydrogravidynamic system) as a result of the external momentary deformational influence on the subsystem τ (especially, induced by the cosmic gravitation) related with the added macroscopic internal shear kinetic energy $(K_s)_\tau$, when the component $y \equiv y_i = (\mathbf{M}_\tau)_i$ of the angular momentum $\mathbf{M}_\tau$ do not change directly as a result of sharp change $(K_S)_\tau > 0$ relative to the equilibrium zero value. Generalizing the Le Chatelier-Braun's principle on the rotational thermohydrogravidynamic systems, we have presented the evidence [Simonenko, 2007a; 2007] that the total entropy of the closed thermohydrogravidynamic system is increased up to the value $S|_{F_Y=0}$, which is less than the value S_o and is larger than the value $S|_y$

($S_o > S|_{F_Y=0} > S|_y$) as a result of the irreversible relaxation processes (in the thermohydrogravidynamic system) diminishing the result of the deformation influence on the subsystem τ related with the added macroscopic internal shear kinetic energy $(K_S)_\tau > 0$ to the subsystem τ. Taking into account that the external influence on the subsystem τ of the Earth ($\tau + \bar{\tau}$) can realize the increasing cosmic gravitational field (by means of the term $W_{gr}(\tau)$ given by the expression (1.68) in the generalized differential formulation of the first law of thermodynamics (1.53)), we have presented the evidence [Simonenko, 2007] that the resulting reduction (up to the value $S|_{F_Y=0}$, which is less than the value S_o characterizing the equilibrium state of the rotational Earth) of the entropy S of the Earth ($\tau + \bar{\tau}$) reveals the creative role of the external cosmic energy gravitational influences on the Earth.

We have presented in Subsection 1.8 the subsequent generalization (1.155) of the first law of thermodynamics (for moving rotating deformed compressible heat-conducting stratified individual macroscopic region τ of turbulent electromagnetic plasma subjected to the non-stationary Newtonian gravity and the non-stationary electromagnetic field) extending the established generalized differential formulation (1.50) by taking into account (along with the infinitesimal change dU_τ of the internal energy U_τ of turbulent plasma without the emitted fast neutrons in the individual region τ, the increment dK_τ of the macroscopic kinetic energy K_τ of turbulent plasma in the individual region τ) the following additional terms: the useful energy production $P(t)dt$ of fast neutrons (emitted during time interval dt due to the thermonuclear reaction between two nuclei of deuterium or between nuclei of deuterium and tritium in a high temperature plasma) characterized by the positive released energy power $P(t)$ (which should be directed from the individual region τ to sustain the controlled thermonuclear process), the differential change $dE_{e,m,\tau}$ of electromagnetic energy $E_{e,m,\tau}$ inside the individual region τ of plasma, the energy flux $\delta F_{e,m}$ of electromagnetic energy radiated across the boundary surface $\partial\tau$ of the individual region τ, the differential heating $\delta Q_{e,m}$ due to the differential work of electrodynamic forces (resulted to the Joule heating owing to the plasma current) and due to the dissipated electromagnetic waves inside the individual region τ, and the differential amount of energy $c^2 dm_\tau > 0$ released (as a consequence of the thermonuclear burning mechanism proposed by Dr. Hans Bethe in 1939 for the Sun) due to the thermonuclear reaction related to the conversion of the differential amount of mass dm_τ (a small difference between the initial and final reactive components of the thermonuclear reaction inside the individual region τ) into energy. The generalized formulation (1.155) of the first law of thermodynamics (for moving rotating deformed compressible heat-conducting stratified individual macroscopic region τ of turbulent electromagnetic plasma subjected to the non-stationary Newtonian gravity and the non-stationary electromagnetic field) is presented for the urgent practical realization of the controlled thermonuclear reactions [Kapitza, 1978] to enhance the energy power of humankind before the forthcoming range $2020 \div 2061$ AD [Simonenko, 2012] of the maximal seismotectonic, volcanic and climatic activities of the Earth in the 21st century during the past $696 \div 708$ years of the history of humankind.

We have presented in Section 2 the fundamentals of the cosmic geology [Simonenko, 2007; 2008]. We have presented in Subsection 2.1 the expressions [Simonenko, 2007] for the total energy E_{τ_α} and the total angular momentum $\mathbf{M}_{\tau_\alpha}$ of the planet τ_α (and the satellite of the planet) taking into account the internal thermohydrogravidynamic structure of the planet τ_α (and the satellite of the planet). Considering the Solar System as the open thermohydrogravidynamic system containing the set of separate thermohydrogravidynamic subsystems (the planets τ_α and the satellites of the planets) and disregarding the presence of atmospheres and hydrospheres (of the planets and the satellites of the planets), we have presented the expressions (2.17) and (2.18) [Simonenko, 2004a; 2007; 2008] for the total energy and the total angular momentum for the Solar System consisting of N cosmic material objects (the Sun, the planets, the satellites of the planets, the midget planets, known asteroids and comets of the Solar System). Using the expressions (2.17) and (2.18), we have presented the evidence [Simonenko, 2004a; 2007; 2008] of the mutual energy transformations between the accumulated internal energies (of the accumulated internal energies of deformation, compression and strain of the continuum of the planets) and the macroscopic internal rotational [de Groot and Mazur, 1962; Gyarmati, 1970] and the macroscopic internal non-equilibrium kinetic energies

[Simonenko, 2004] of the planets. We have demonstrated the evidence [Simonenko, 2004a; 2007; 2008] that the mutual energy transformations can result to the evolutionary change of the directions (and axes) of rotation of the planets and the satellites (of the planets) of the Solar System.

Taking into account the system of the expressions (2.19) and (2.20), respectively, of the total energy and the total angular momentum of the subsystem τ (the subsystem of the planet ($\tau+\overline{\tau}$) without the surrounding subsystem $\overline{\tau}$ (the atmosphere or the atmosphere and hydrosphere)) of the planet ($\tau+\overline{\tau}$), we have presented the evidence [Simonenko, 2004a; 2007; 2008] of the mutual energy transformations between the accumulated internal energy U_τ of the subsystem τ and the macroscopic internal rotational kinetic energy $(K_r)_\tau$ (of the subsystem τ of the planet ($\tau+\overline{\tau}$)), the macroscopic internal shear kinetic energy $(K_s)_\tau$ (of the subsystem τ of the planet ($\tau+\overline{\tau}$)) and the macroscopic internal kinetic energy of shear-rotational coupling $(K_{s,r}^{coup})_\tau$ (of the subsystem τ of the planet ($\tau+\overline{\tau}$)) during the seismotectonic relaxation of the planet ($\tau+\overline{\tau}$). These energy transformations gave the real evidence [Simonenko, 2007a; 2007; 2008] to consider the seismotectonic relaxation of the planet ($\tau+\overline{\tau}$) as the global planetary process [Vikulin, 2003].

In Subsection 2.2. we have presented the non-catastrophic models [Simonenko, 2007a; 2007; 2008] of the thermohydrogravidynamic evolution of the total energy of the subsystems (τ and $\overline{\tau}$) of the planet ($\tau+\overline{\tau}$) subjected to the cosmic non-stationary energy gravitational influences of the Solar System and our Galaxy. Using the generalized differential formulation (2.21) of the first law of thermodynamics (taking into account the additional term related with the space-time density e_τ of heating due to the disintegration of the radio-active elements inside the planet ($\tau+\overline{\tau}$) of the Solar System and the human industrial activity), we have presented in Subsection 2.2.1 the non-catastrophic model [Simonenko, 2007] of the thermohydrogravidynamic evolution of the total energy E_τ of the subsystem τ (of the planet ($\tau+\overline{\tau}$)) bounded by the external boundary surface $\partial\tau$, on which the subsystem τ interacts with the subsystem $\overline{\tau}$ representing the atmosphere or atmosphere and hydrosphere of the planet ($\tau+\overline{\tau}$). We assumed [Simonenko, 2007] that the planet ($\tau+\overline{\tau}$) evolves during some time period without formation of the new planetary tectonic fractures in the subsystem τ surrounded by the subsystem $\overline{\tau}$ (the atmosphere or the atmosphere and hydrosphere).

We have presented the integral expression (2.22) for the time evolution of the total energy $(E(t))_\tau$ of the subsystem τ of the planet ($\tau+\overline{\tau}$) in the absence of the new catastrophic planetary tectonic fractures in the subsystem τ surrounded by the subsystem $\overline{\tau}$ (atmosphere or atmosphere and hydrosphere). Based on expression (2.22), we have presented the evidence [Simonenko, 2007a; 2007; 2008] that the time evolution of the total energy $(E(t))_\tau$ of the subsystem τ is determined by the dynamic and thermal energy exchanges on the boundary surface $\partial\tau$, by the time change of the potential ψ of the gravitational field in the subsystem τ of the planet ($\tau+\overline{\tau}$), by the thermal heating in the subsystem τ owing to disintegration of the radio-active elements. We have presented the evidence [Simonenko, 2007a; 2007; 2008] that the regulation of the macroscopic internal rotational kinetic energy $(K_r(t))_\tau$ and the angular velocity $\boldsymbol{\omega}(\tau)$ of rotation of the subsystem τ of the planet ($\tau+\overline{\tau}$) is determined (under thermodynamically equilibrium regime of rotation of the subsystem τ characterizing by constant angular velocity $\boldsymbol{\omega}(\tau)$ for all continuum region τ and by $(K_s(t))_\tau = 0$ and $(K_{s,r}^{coup}(t))_\tau = 0$) by the time change of the potential ψ of the gravitational field in the subsystem τ and also by the dynamic energy exchange [Dolgikh, 2000] on the boundary surface $\partial\tau$ between the atmosphere-hydrosphere (representing the subsystem $\overline{\tau}$) and the subsystem τ containing the lithosphere and all geo-spheres of the planet ($\tau+\overline{\tau}$). This conclusion is in agreement with the documented [Эйгенсон, 1958] phenomenon of the partial solar determination of the rotational regime of the Earth by means of atmospheric and oceanic circulations. We have presented also the evidence [Simonenko, 2007a; 2007; 2008] that the long-term changes of the angular velocity of the Earth's rotation are defined by changes of thermal heating owing to disintegration of the radio-active elements and by cyclic changes of the solar radiation activity, which change the distributions of the average circulations of the atmosphere and the oceans and the corresponding fields of the thermohydrodynamic parameters near the lithosphere of the Earth. Based on the expression (1.63) for the differential work δA_s of the viscous Newtonian forces (related with the combined effect of the velocity shear and the molecular kinematic viscosity), we have presented the evidence [Simonenko, 2007a; 2007; 2008] that the energy exchange between the atmosphere-hydrosphere (the oceans and the atmosphere) and the lithosphere of the Earth is possible only under the presence of the medium acoustic compressibility (i.e., $\operatorname{div}\mathbf{v} \neq 0$) and the medium deformations (i.e., $e_{\alpha\beta} \neq 0$) in the boundary regions of fluid (in the oceans), air (in the atmosphere) and the lithosphere of the Earth. We have presented the evidence [Simonenko, 2007a; 2007; 2008] that it is necessary to use the real information about the oscillations of the lithosphere [Dolgikh, 2000] for modeling of the energy exchanges between atmosphere-hydrosphere and the lithosphere of the Earth by means of the term δA_s (alongside with the terms δA_p and δA_c in the expression (1.60) for the differential work $\delta A_{np,\partial\tau}$).

Using the expression (2.22), we have presented the evidence [Simonenko, 2007a; 2007; 2008] that the compression of the subsystem τ of the planet ($\tau+\bar{\tau}$) accompanied by the increase of the gravitational potential ψ in the fixed point of space must induce the increase of the internal thermal energy and the corresponding heat flux from the kernel of the planet in accordance with the Milanovsky's conclusion [Милановский, 1979] that the geological eras of the intensive increase of the heat flux correspond to the eras of general compression of the Earth. We have presented in Subsection 2.2.1 the evidence [Simonenko, 2007a; 2007; 2008] of the galactic energy gravitational genesis (related with the circulation of the Solar System around the center of our Galaxy) of each cycle (the compression, the stretching and the more long-lasting reduction of the tectonic motions) of the geological eras of the Earth during the latest 570 million years.

Using the generalized differential formulation (1.53) of the first law of thermodynamics (with the additional source of heat $e_{\bar{\tau}}$ in the subsystem $\bar{\tau}$) for the total combined subsystem $\bar{\tau}$ (atmosphere or atmosphere and hydrosphere) in the frame of the thermohydrogravidynamic theory, in Subsection 2.2.2 we have presented the deduction [Simonenko, 2007a; 2007; 2008] of the evolution equation (2.24) for the total energy $E_{\bar{\tau}}$ of the subsystems $\bar{\tau}$ taking into account the dynamic and thermal energy exchanges on the boundary surface $\partial\tau$ dividing the subsystems τ and $\bar{\tau}$, the time change of the potential ψ of the gravitational field in the subsystem $\bar{\tau}$ of the planet ($\tau+\bar{\tau}$) and the total fluxes of heat (related with the electromagnetic radiation of the Sun) on the external boundary surface $\partial(\tau+\bar{\tau})$ of the planet ($\tau+\bar{\tau}$).

Based on the generalized differential formulation (1.53) of the first law of thermodynamics taking into account all above listed energy factors for the subsystems τ and $\bar{\tau}$ of the planet ($\tau+\bar{\tau}$), in Subsection 2.2.3 we have presented the deduction [Simonenko, 2007a; 2007; 2008] of the evolution equation (2.25) for the total energy $E_{(\tau+\bar{\tau})}$ of the planet ($\tau+\bar{\tau}$) consisting from the subsystems τ and $\bar{\tau}$ interacting on the boundary surface $\partial\tau$. The deduced (from the evolution equation (2.25)) expression (2.26) for the evolution of the total energy $(E(t))_{(\tau+\bar{\tau})}$) is considered [Simonenko, 2007a; 2007; 2008] the long-term energy sources, which define (for the planet ($\tau+\bar{\tau}$)) the amazing wealth of the collective processes in the Solar System [Gor'kavyi and Fridman, 1994] excepting the striking heating.

We have presented in Subsection 2.3 the synthesis of the cosmic geology [Simonenko, 2007; 2008] taking into account the convection in the lower geo-spheres of the planet (of the Earth), the density differentiation, the translational, rotational and deformational movements of the tectonic plates, the creation of the new planetary tectonic fractures induced by the energy gravitational influences of the Solar System and our Galaxy. Using the generalized differential formulation (2.21) of the first law of thermodynamics, we have presented in Subsection 2.3.1 the fundamentals of the thermohydrogravidynamic N-layer model [Simonenko, 2007; 2008] of the non-fragmentary geo-spheres of the planet (of the Earth) of the Solar System. Based on the founded [Simonenko, 2007; 2008] evolution equation (2.30) of the total energy E_τ of the subsystem τ (consisting of N successively embedded to each other subsystems (geo-spheres) $\tau_N, \tau_{N-1}, \ldots, \tau_2, \tau_1$) of the planet ($\tau+\bar{\tau}$), we have presented in Subsection 2.3.1 the expression (2.31) for the necessary power $W_{br}(\Delta\Sigma_i)$ (in particular, of the external energy gravitational influence), which is sufficient to break the crystalline root of the considered continental and oceanic planetary tectonic formations (characterized [Abramov and Molev, 2005; p. 245] by the mantle penetrated deep roots) in one section characterized by the area $\Delta\Sigma_i$. We have presented the evidence [Simonenko, 2007; 2008] that the translational mobility of the upper subsystem $\tau_1 = \tau_{ext}$ of the Earth (also as a separate tectonic plates and geo-blocks of the subsystem

$\tau_1 = \tau_{ext}$) is greatly restricted by the deep roots of the continental and oceanic planetary formations (for two data [Abramov and Molev, 2005; p. 245; Pavlenkova, 2007] about the roots of continents). We have presented the evidence [Simonenko, 2007; 2008] (for two data [Abramov and Molev, 2005; p. 245; Pavlenkova, 2007; p. 107] about the roots of continents) that it is easier to realize (by action of the external cosmic gravitational field) the assumed [Pavlenkova, 1995] rotation of the mantle (as a whole) relative to the fluid kernel with the slippage on the boundary of the fluid kernel and the mantle of the Earth than to split the mantle of the Earth by means of the new global tectonic fracture breaking the mantle into two equal parts in the different sides of the main secant plane intersecting the centre of the Earth. Using the evolution equation (2.32) for the sum $K_\tau + \pi_\tau$ of the total macroscopic kinetic energy K_τ and the total macroscopic potential (gravitational) energy π_τ of the subsystem τ (of the Earth or the planet of the Solar System), we have presented the evidence [Simonenko, 2007; 2008] that the revealed time period 100 million years [Hofmann, 1990] of the maximal endogenous activity of the Earth [Morozov, 2007; p. 496] has the galactic energy gravitational genesis related with the periodic changes (characterized by the time period near 200 million years) of the potential of the gravitational field (of the Solar System and our Galaxy) influencing on the Earth considered as the cosmic material object moving (in the frame of the Solar System) around the center of our Galaxy.

Based on the generalized differential formulation (2.21) of the first law of thermodynamics, we have presented in Subsection 2.3.2 the thermohydrogravidynamic translational-shear-rotational N-layer tectonic model [Simonenko, 2007; 2008] of the fragmentary geo-spheres of the planet ($\tau + \overline{\tau}$) (of the Earth) of the Solar System. We have presented the evolution equation (2.36) of the total energy of the geo-sphere $\tau_1 = \tau_{ext}$ (the first upper layer of the subsystem τ of the planet ($\tau + \overline{\tau}$)). The evolution equation (2.36) represents the thermohydrogravidynamic model [Simonenko, 2007; 2008] of the translational-shear-rotational tectonics of moving rotating deforming compressible heat-conducting stratified macroscopic geo-blocks τ_{1j} (j = 1, 2, …, N_1) surrounded by the coupled viscous plastic layers and subjected to the cosmic non-stationary Newtonian energy gravitational influences and heating related with disintegration of the radio-active elements (in the geo-sphere τ_{ext}).

We have presented in Subsection 2.3.3 the universal energy thermohydrogravidynamic approach [Simonenko, 2007; 2008] intended to explain the formation of the planetary fractures in the frame of the generalized differential formulation (2.21) of the first law of thermodynamics and the thermohydrogravidynamic translational-shear-rotational N-layer tectonic model (presented in Subsection 2.3.2) of the fragmentary (consisting of geo-blocks) geo-spheres of the Earth (the planet of the Solar System). Based on the generalized differential formulation (2.21) of the first law of thermodynamics and the mathematical inductive method, we have presented the deduction of the evolution equations (2.39), (2.41) and (2.42) [Simonenko, 2007; 2008] describing the evolution of the total energy of the geo-block τ_{1j} (of the first upper layer (geo-sphere) $\tau_1 = \tau_{ext}$ of the subsystem τ of the planet ($\tau + \overline{\tau}$)) under formation of the integer number of various (uncrossed between itself) breaking fracture surfaces. Using the deduced evolution equations (2.39), (2.41) and (2.42), we have presented the established [Simonenko, 2007; 2008] energy sources of the destruction (formation of the fractures) in the geo-block τ_{1j}: the total non-stationary gravitational fields (the external, cosmic and the internal, terrestrial), the internal heat related with the disintegration of the radio-active elements, the heat flux from the upper boundary of the situated below second layer (subsystem) τ_2 and the work of stress forces on the surface of the geo-block τ_{1j}. By considering in Subsection 2.3.3 the established [Simonenko, 2007; 2008] exceptionally significant role of the external cosmic non-stationary gravitational field for formation of the tectonic fractures, we have presented the evidence [Simonenko, 2007; 2008] of the Khain's suggestion that the movements along the weakened planetary fractures "can occur owing to the influence of the astronomical factors" [Khain, 1958; p. 138].

We have presented in Section 3 the development of the established cosmic geophysics [Simonenko, 2007; 2008]. We have presented in Subsection 3.1 the evaluation [Simonenko, 2007; 2008; 2009; 2010] of the instantaneous and integral energy gravitational influences on the Earth of the inner planets (the Mercury and the Venus) and the outer planets (the Mars, the Jupiter, the Saturn, the Uranus, the Neptune and the Pluto) of the Solar System.

We have presented in Subsection 3.1.1 the derived [Simonenko, 2009; 2010] analytical expression (3.6) for the instantaneous energy gravitational influences on the Earth of the inner and the outer planets in the second approximation of the elliptical orbits of the planets of the Solar System. We have presented the evidence [Simonenko, 2009; 2010] that the obtained evaluations [Simonenko, 2007; 2008] (presented in Subsection 3.1.2 based on the first approximation of the circular orbits of the planets) of the relative maximal planetary instantaneous energy gravitational influences on the Earth (of the planets of the Solar System) may be considered as the first sound approximation.

We have presented in Subsection 3.1.2 the evaluation [Simonenko, 2007; 2008] of the relative maximal planetary instantaneous energy gravitational influences on the unit mass of the Earth at the mass center C_3 of the Earth and at the surface point D_3 of the inner and the outer planets in the first approximation of the circular orbits of the planets. Considering the maximal positive value $\max \frac{\partial}{\partial t}\psi_{3M}(C_3,\mathrm{int})$ (of the partial derivative $\frac{\partial}{\partial t}\psi_{3M}(C_3,\mathrm{int})$ of the gravitational potential $\psi_{3M}(C_3,\mathrm{int})$ created by the Mercury at the mass center C_3 of the Earth) as a scale of the instantaneous energy gravitational influence of the planets of the Solar System on the Earth (in the considered first approximation of the circular orbits of the planets), we have presented in Subsection 3.1.2 the obtained [Simonenko, 2009; 2010] numerical sequence of the non-dimensional relative maximal powers of the planetary instantaneous energy gravitational influences on the Earth (on the unit mass of the Earth at the mass center C_3 of the Earth): $f(2,C_3)$ =37.69807434 (for the Venus), $f(5,C_3)$ = 7.41055774 (for the Jupiter), $f(1,C_3)$ = 1 (for the Mercury), $f(4,C_3)$ = 0.67441034 (for the Mars), $f(6,C_3)$ = 0.24601009 (for the Saturn), $f(7,C_3)$ =0.00319056 (for the Uranus), $f(8,C_3)$ = 0.00077565 (for the Neptune) and $f(9,C_3)$ = $3.4813\cdot10^{-8}$ (for the Pluto). Considering the maximal positive value $\max \frac{\partial}{\partial t}\psi_{3M}(D_3,\mathrm{int})$ (of the partial derivative $\frac{\partial}{\partial t}\psi_{3M}(D_3,\mathrm{int})$ of the gravitational potential $\psi_{3M}(D_3,\mathrm{int})$ created by the Mercury at the surface point D_3 of the Earth) as a scale of the instantaneous energy gravitational influence of the planets of the Solar System on the Earth (in the considered first approximation of the circular orbits of the planets), we have presented in Subsection 3.1.2 the slightly corrected [Simonenko, 2009; 2010] numerical sequence (of the previously obtained numerical values [Simonenko, 2007; 2008]) of the non-dimensional relative maximal powers of the planetary instantaneous energy gravitational influences on the Earth (on the unit mass of the Earth at the surface point D_3 of the Earth): $f(2,D_3)$= 37.70428085 (for the Venus), $f(5,D_3)$= 7.40926122 (for the Jupiter), $f(1,D_3)$= 1 (for the Mercury), $f(4,D_3)$= 0.67420160 (for the Mars), $f(6,D_3)$= 0.24596865 (for the Saturn), $f(7,D_3)$ = 0.00319004 (for the Uranus), $f(8,D_3)$ = 0.00077552 (for the Neptune) and $f(9,D_3)$ = $3.4807\cdot10^{-8}$ (for the Pluto). Using the obtained numerical values $f(i,D_3)$ and $f(i,C_3)$ (for i=1, 2, 4, 5, 6, 7, 8, 9), we have presented in Subsection 3.1.2 the conclusion [Simonenko, 2009; 2010] that the small difference of the combined maximal instantaneous energy gravitational influences of the planets of the Solar System at the points C_3 and D_3 of the Earth can explain the following related geophysical phenomena: the small oscillatory motion of the rigid kernel of the Earth relative to the fluid kernel of the Earth; the small oscillation of the Earth's pole (i.e., the Chandler's wobble of the Earth's pole [Chandler, 1892]); the small oscillations [Vikulin, 2003] of the boundary of the Pacific Ocean (i.e., the seismic zone of the Pacific Ring); the oscillations [Dolgikh, 2000], rotations [Vikulin, 2003] and deformations [Abramov, 1993; 1997] of the geo-blocks weakly coupled with the surrounding plastic layers in all seismic zones of the Earth and the formation of fractures related with the strong earthquakes and the planetary cataclysms.

We have presented in Subsection 3.1.3 the evaluation [Simonenko, 2007] of the relative maximal planetary integral energy gravitational influences on the Earth in the approximation of the circular orbits of the planets of the Solar System. Based on the equivalent generalized differential formulations (1.43), (1.50) and (1.53) of the first law of thermodynamics used for the Earth, we have presented in Subsection 3.1.3 the following order of signification of the inner planets (the Mercury and the Venus) and the outer planets (the Mars, the Jupiter, the Saturn, the Uranus, the Neptune and the Pluto) of the Solar System [Simonenko, 2007]: the Venus ($s(2) = 89.6409$), the Jupiter ($s(5) = 31.319$), the Mars ($s(4) = 2.6396$), the Saturn ($s(6) = 1.036$), the Mercury ($s(1) = 1$), the Uranus ($s(7) = 0.0133$), the Neptune ($s(8) = 0.003229$) and the Pluto ($s(9) = 1.4495 \cdot 10^{-7}$) in respect of the relative non-dimensional values $s(i)$ of the maximal planetary integral energy gravitational influences (normalized on the maximal integral energy gravitational influence of the Mercury on the Earth) on the Earth. We have presented the evidence [Simonenko, 2007] of the predominant combined planetary integral energy gravitational influence on the Earth of the Venus and the Jupiter. The combined maximal planetary integral energy gravitational influence on the Earth of the Mars, the Saturn and the Mercury is one order of the magnitude smaller than the maximal integral energy gravitational influence of the Jupiter. The maximal combined planetary integral energy gravitational influences on the Earth of the Uranus, the Neptune and the Pluto are two, three and seven orders of the magnitude, respectively, smaller than the maximal integral energy gravitational influence of the Mercury on the Earth.

We have presented in Subsection 3.2 the evaluation [Simonenko, 2009; 2010] of the relative maximal instantaneous and integral energy gravitational influence of the Moon on the Earth as compared with the maximal planetary instantaneous and integral energy gravitational influences on the Earth (of the planets of the Solar System). We have presented in Subsection 3.2.1 the evaluation [Simonenko, 2009; 2010] of the relative maximal instantaneous energy gravitational influence of the Moon on the Earth in the second approximation of the elliptical orbits of the Earth and the Moon around the combined mass center $C_{3,MOON}$ of the Earth and the Moon. Considering the maximal positive value $\max \frac{\partial}{\partial t}\psi_{3M}(C_3, \mathrm{int})$ (of the partial derivative $\frac{\partial}{\partial t}\psi_{3M}(C_3, \mathrm{int})$ of the gravitational potential $\psi_{3M}(C_3, \mathrm{int})$ created by the Mercury moving around the mass center O of the Sun along the hypothetical circular orbit) as a scale of the instantaneous energy gravitational influence of the planets of the Solar System and the Moon on the Earth, we have presented the foundation the non-dimensional numerical value $f_{MOONM}(C_3, \text{second approx.})$=19.44083, which means that the power of the maximal instantaneous energy gravitational influence of the Moon (on the unit mass of the Earth at the mass center C_3 of the Earth) is 19.44083 times larger than the power of the maximal instantaneous energy gravitational influence (on the unit mass at the mass center C_3 of the Earth) of the Mercury moving around the mass center O of the Sun along the hypothetical circular orbit. Taking into account the calculated non-dimensional maximal planetary instantaneous energy gravitational influences [Simonenko, 2007] and maximal lunar instantaneous energy gravitational influence [Simonenko, 2009; 2010] on the unit mass of the Earth at the mass center C_3 of the Earth: $f(2,C_3)$=37.69807434 (for the Venus), $f_{MOONM}(C_3, \text{second approx.})$=19.44083404 (for the Moon), $f(5,C_3)$ = 7.41055774 (for the Jupiter), $f(1,C_3)$ = 1 (for the Mercury), $f(4,C_3)$ = 0.67441034 (for the Mars), $f(6,C_3)$ = 0.24601009 (for the Saturn), $f(7,C_3)$ = 0.00319056 (for the Uranus), $f(8,C_3)$ = 0.00077565 (for the Neptune) and $f(9,C_3)$ = $3.4813 \cdot 10^{-8}$ (for the Pluto), we have evaluated [Simonenko, 2009; 2010] the following order of significance (in the frame of the considered second approximation of the elliptical orbits of the Earth and the Moon around the combined mass center $C_{3,MOON}$ of the Earth and the Moon) of the Moon and the planets of the Solar System: the Venus, the Moon, the Jupiter, the Mercury, the Mars, the Saturn, the Uranus, the Neptune and the Pluto in respect of the maximal planetary and lunar instantaneous energy gravitational influences on the unit mass of the Earth at the mass center C_3 of the Earth.

We have presented in Subsection 3.2.2 the evaluation [Simonenko, 2009; 2010] of the maximal integral energy gravitational influence of the Moon on the Earth in the approximation of the elliptical orbits of the Earth and the Moon around the combined mass center $C_{3,MOON}$ of the Earth and the Moon. Based on the equivalent generalized differential formulations (1.43), (1.50) and (1.53) of the first law of thermodynamics used for the Earth, we have presented in Subsection 3.2.2 the foundation [Simonenko, 2009; 2010] that maximal positive integral energy gravitational influence of the Moon on the Earth is $s(\text{Moon, second approx.}) = 13.0693$ times larger than the maximal positive integral energy gravitational influence of the Mercury on the Earth. Considering the aspect of the cosmic planetary gravitational preparation of the Earth's geological cataclysms and the strong earthquakes, we have established the Venusian ($s(2) = 89.6409$) [Simonenko, 2007], the Jupiter's ($s(5) = 31.319$) [Simonenko, 2007] and the Moon's ($s(\text{Moon, second approx.}) = 13.0693$) [Simonenko, 2009; 2010] energy gravitational predominance in supplying of the cosmic planetary and lunar gravitational energy to the focal region of the preparing earthquakes. The Venus, the Jupiter and the Moon form the predominant planetary and lunar integral energy gravitational influence on the Earth. The combined maximal integral energy gravitational influence on the Earth of the Mars ($s(4) = 2.6396$) [Simonenko, 2007], the Saturn ($s(6) = 1.036$) [Simonenko, 2007] and the Mercury ($s(i) = 1$) [Simonenko, 2007] is one order of the magnitude smaller than the maximal integral energy gravitational influence of the Jupiter. The combined maximal integral energy gravitational influence on the Earth of the Uranus ($s(7) = 0.0133$) [Simonenko, 2007], the Neptune ($s(8) = 0.003229$) [Simonenko, 2007] and the Pluto ($s(9) = 1.4495 \cdot 10^{-7}$) [Simonenko, 2007] is two orders of the magnitude smaller (i.e., negligible) than the maximal integral energy gravitational influence of the Mercury.

We have presented in Subsection 3.3 the evaluation of the energy gravitational influence of the Sun on the Earth owing to the gravitational interaction of the Sun with the outer large planets (the Jupiter, the Saturn, the Uranus and the Neptune) of the Solar System. We have presented in Subsection 3.3.1 the evaluations of the relative characteristic maximal positive instantaneous energy gravitational influences of the Sun on the Earth owing to the gravitational interaction of the Sun with the outer large planets of the Solar System. We have presented in Subsection 3.3.1 the evaluations of the characteristic maximal positive instantaneous energy gravitational influences of the Sun on the Earth (owing to the gravitational interaction of the Sun with the outer large planets of the Solar System) as compared with the maximal planetary instantaneous energy gravitational influences on the Earth of the planets of the Solar System. The evaluations of the relative characteristic maximal positive instantaneous energy gravitational influences of the Sun on the Earth (owing to the gravitational interaction of the Sun with the outer large planets of the Solar System) are obtained in the approximation of the elliptical orbit of the Earth τ_3 around the combined mass center $C(S, j)$ of the Sun and the outer large planets τ_j ($j = 5, 6, 7, 8$). Considering the maximal positive value $\max \frac{\partial}{\partial t} \psi_{3M}(C_3, \mathrm{int})$ (of the partial derivative $\frac{\partial}{\partial t} \psi_{3M}(C_3, \mathrm{int})$ of the gravitational potential $\psi_{3M}(C_3, \mathrm{int})$ created by the Mercury (moving around the mass center O of the Sun along the hypothetical circular orbit) at the mass center C_3 of the Earth) as a scale of the energy gravitational influence of the Sun (owing to the outer large planets τ_j (j=5, 6, 7, 8) of the Solar System) on the Earth, we have calculated the following ratios $f_{SUN\,M}(j, C_3, \mathrm{char.})$ (given by the expression (3.96) for $j = 5, 6, 7, 8$): $f_{SUN\,M}(5, C_3, \mathrm{char.}) = 884.935424$ (for the Sun owing to the gravitational interaction of the Sun with the Jupiter), $f_{SUN\,M}(6, C_3, \mathrm{char.}) = 194.923355$ (for the Sun owing to the gravitational interaction of the Sun with the Saturn), $f_{SUN\,M}(7, C_3, \mathrm{char.}) = 21.27951$ (for the Sun owing to the gravitational interaction of the Sun with the Uranus) and $f_{SUN\,M}(8, C_3, \mathrm{char.}) = 20.833557$ (for the Sun owing to the gravitational interaction of the Sun with the Neptune). These numerical values $f_{SUN\,M}(j, C_3, \mathrm{char.})$ ($j = 5, 6, 7, 8$) are calculated based on the characteristic maximal positive values char. max. pos. $\frac{\partial}{\partial t} \psi^{S}_{3j}(C_3, t)$ (given by the expression (3.92) for $j = 5, 6, 7, 8$) and the maximal positive value $\max \frac{\partial}{\partial t} \psi_{3M}(C_3, \mathrm{int})$ (given by the expression (3.93)). Taking into account the calculated numerical values $f_{SUN\,M}(j, C_3, \mathrm{char.})$ ($j = 5, 6, 7, 8$), we have established the following order of significance of the outer large planets of the Solar System: the Jupiter (τ_5), the Saturn (τ_6), the Uranus (τ_7) and the Neptune (τ_7) in respect of the evaluated characteristic maximal positive instantaneous energy gravitational influences of the Sun on the Earth owing to the gravitational interaction of the Sun with the outer large planets of the Solar System.

We have presented in Subsection 3.3.2 the evaluations of the maximal positive integral energy gravitational influences of the Sun on the Earth (owing to the gravitational interaction of the Sun with the outer large planets) in the first approximation of the circular orbits of the planets of the Solar System. Based on the equivalent generalized differential formulations (1.43), (1.50) and (1.53) of the first law of thermodynamics used for the Earth, we have presented in Subsection 3.3.2 the foundation of the relations (3.106), (3.108) and (3.109) for the maximal positive integral energy gravitational influences of the Sun on the Earth owing to the gravitational interaction of the Sun with the outer large planets τ_j $(j = 5, 6, 7, 8)$. Considering the maximal positive integral energy gravitational influence $\max_t \Delta_g E_3(\mathrm{Sun}-\tau_j, 0, 0, t, 0)$ (given by the expression (3.109)) of the Sun on the Earth (owing to the gravitational interaction of the Sun with the outer large planet τ_j, $j = 5, 6, 7, 8$) and the maximal positive integral energy gravitational influence $\max_t \Delta_g E_3(\tau_1, 0, 0, t, 0)$ (given by the expression (3.48)) of the Mercury on the Earth, we have calculated the following relative values (ratios) $s(\mathrm{Sun}-\tau_j, \text{first approx.})$ (defined by the relation (3.110) for $j = 5, 6, 7, 8$) of the maximal integral energy gravitational influences of the Sun on the Earth owing to the gravitational interaction of the Sun with the outer large planets τ_j $(j = 5, 6, 7, 8)$: $s(\mathrm{Sun}-\tau_5, \text{ first approx.}) = 4235.613239$ (for the maximal integral energy gravitational influence of the Sun owing to the gravitational interaction of the Sun with the Jupiter), $s(\mathrm{Sun}-\tau_6, \text{ first approx.}) = 887.4442965$ (for the maximal integral energy gravitational influence of the Sun owing to the gravitational interaction of the Sun with the Saturn), $s(\mathrm{Sun}-\tau_7, \text{ first approx.}) = 93.8337322$ (for the maximal integral energy gravitational influence of the Sun owing to the gravitational interaction of the Sun with the Uranus) and $s(\mathrm{Sun}-\tau_8, \text{ first approx.}) = 87.8477601$ (for the maximal integral energy gravitational influence of the Sun owing to the gravitational interaction of the Sun with the Neptune). Taking into account the calculated relative values $s(\mathrm{Sun}-\tau_j, \text{first approx.})$ of the maximal integral energy gravitational influences of the Sun on the Earth owing to the gravitational interaction of the Sun with the outer large planets τ_j $(j = 5, 6, 7, 8)$, we have established the following order of signification of the outer large planets τ_j $(j = 5, 6, 7, 8)$ of the Solar System: the Jupiter $(s(\mathrm{Sun}-\tau_5, \text{ first approx.}) = 4235.613239)$, the Saturn $(s(\mathrm{Sun}-\tau_6, \text{ first approx.}) = 887.4442965)$, the Uranus $(s(\mathrm{Sun}-\tau_7, \text{ first approx.}) = 93.8337322)$ and the Neptune $(s(\mathrm{Sun}-\tau_8, \text{ first approx.}) = 87.8477601)$ in respect of the presented evaluation of the maximal integral energy gravitational influences of the Sun on the Earth owing to the gravitational interaction of the Sun with the outer large planets τ_j $(j = 5, 6, 7, 8)$.

Thus, considering the aspect of the cosmic gravitational preparation of the strong earthquakes, we have demonstrated in Subsection 3.3 the predominance of the maximal integral energy gravitational influences of the Sun on the Earth owing to the gravitational interaction of the Sun with the Jupiter $(s(\mathrm{Sun}-\tau_5, \text{ first approx.}) = 4235.613239)$, with the Saturn $(s(\mathrm{Sun}-\tau_6, \text{ first approx.}) = 887.4442965)$, with the Uranus $(s(\mathrm{Sun}-\tau_7, \text{ first approx.}) = 93.8337322)$ and with the Neptune $(s(\mathrm{Sun}-\tau_8, \text{ first approx.}) = 87.8477601)$ along with the established [Simonenko, 2007; 2009] Venusian $(s(2) = 89.6409)$ and the Jupiter's $(s(5) = 31.319)$ planetary energy gravitational predominance and the established [Simonenko, 2009; 2010] significant maximal integral energy gravitational influence of the Moon $(s(\text{Moon, second approx.}) = 13.0693)$ on the Earth.

Thus, taking into account the previously established planetary [Simonenko, 2007] and lunar [Simonenko, 2009; 2010] numerical values and also the calculated relative values $s(\mathrm{Sun}-\tau_j, \text{first approx.})$ of the maximal integral energy gravitational influences of the Sun on the Earth owing to the gravitational interaction of the Sun with the outer large planets τ_j $(j = 5, 6, 7, 8)$, we have established in Subsection 3.3 the following order of significance of the cosmic bodies of the Solar System: the Sun (owing to the gravitational interaction of the Sun with the Jupiter, the Saturn, the Uranus and the Neptune), the Venus, the Jupiter, the Moon, the Mars, the Saturn, the Mercury, the Uranus, the Neptune and the Pluto in respect of the evaluated integral energy gravitational influences of these cosmic bodies on the Earth.

We have presented in Subsection 3.4 the confirmation of the real cosmic energy gravitational genesis of the strong earthquakes and the global planetary cataclysms. We have presented in Subsection 3.4.1 the confirmation [Simonenko, 2007; 2009; 2010] of the real cosmic energy gravitational genesis of preparation of earthquakes. Using the approximate expression (3.51) for the maximal positive integral energy gravitational influence $E_g(\tau_2, D_3, m_\tau)$ of the Venus (i = 2) on the macroscopic continuum region τ of mass m_τ near the surface point D_3 of the Earth, we have presented in Subsection 3.4.1 the evidence [Simonenko, 2007] of the real cosmic energy gravitational genesis of the preparation of earthquakes. Based on the equivalent generalized differential formulations (1.43), (1.50) and (1.53) of the first law of thermodynamics used for the Earth's macroscopic continuum region τ (the focal region of the preparing earthquake), we have shown [Simonenko, 2007] that the regular changes of the rotational regime of the Earth are related with the regular discharges of the accumulated potential energy (in the focal region of earthquakes) supplying by the cosmic energy gravitational influences of the planets of the Solar System, the Sun and the Moon.

We have presented in Subsection 3.4.2 the evidence of the integral energy gravitational influence on the Earth of the Sun (owing to the gravitational interactions of the Sun with the Jupiter τ_5 and the Saturn τ_6) and the Moon as the predominant cosmic trigger mechanism of the earthquakes preparing by the combined integral energy gravitational influence on the Earth of the Sun (owing to the gravitational interactions of the Sun with the Jupiter τ_5 and the Saturn τ_6, the Uranus τ_7 and the Neptune τ_8), the Venus, the Jupiter, the Moon, the Mars and the Mercury. Taking into account the obtained [Simonenko, 2007] numerical values $e(i)$ for the planets of the Solar System, the numerical value $s(\text{Moon, second approx.}) = 13.0693$ [Simonenko, 2009; 2010] for the Moon and the calculated (in Subsection 3.4.2) numerical values $e_S(j)$ for the Sun (owing to the gravitational interaction of the Sun with the outer large planets τ_j, $j = 5, 6, 7, 8$), we have established in Subsection 3.4.2 the predominant significance of the Sun (owing to the gravitational interactions of the Sun with the Jupiter τ_5 and the Saturn τ_6) and the Moon as the predominant cosmic trigger mechanism (along with the minor significance of the Sun (owing to the gravitational interactions of the Sun with the Uranus τ_7 and the Neptune τ_8), the Venus, the Jupiter and the Mercury) of the earthquakes preparing by the combined integral energy gravitational influences on the Earth of the Sun (owing to the gravitational interactions of the Sun with the Jupiter τ_5 and the Saturn τ_6, the Uranus τ_7 and the Neptune τ_8), the Venus, the Jupiter, the Moon, the Mars and the Mercury.

We have presented in Subsection 3.4.3 the catastrophic planetary configurations of the established cosmic seismology [Simonenko, 2007]. We have presented in Subsection 3.4.3.1 the foundation of the established catastrophic planetary configurations [Simonenko, 2009; 2010] related with the maximal (positive) and minimal (negative) combined integral energy gravitational influence on the Earth τ_3 of the planets of the Solar System. We have presented in Subsection 3.4.3.2 the foundation of the new catastrophic planetary configurations related with the maximal (positive) and minimal (negative) combined integral energy gravitational influence on the Earth τ_3 of the Sun (mainly, owing to the gravitational interactions of the Sun with the Jupiter τ_5 and the Saturn τ_6, the Uranus τ_7 and the Neptune τ_8) and the planets of the Solar System.

We have presented in Subsection 3.5 the generalized thermohydrogravidynamic shear-rotational [Simonenko, 2007; 2009; 2010], classical shear (deformational) [Короновский и Абрамов, 2000] and rotational [Vikulin, 2003] models of the earthquake focal region τ, and the established local energy and entropy prediction thermohydrogravidynamic principles determining the fractures formation in the macroscopic continuum region τ. We have presented in Subsection 3.5.1 the thermodynamic foundation of the generalized thermohydrogravidynamic shear-rotational [Simonenko, 2007; 2009; 2010] and the classical shear (deformational) [Короновский и Абрамов, 2000] models of the earthquake focal region based on the generalized differential formulations (1.43) and (1.53) of the first law of thermodynamics. Using the evolution equation (1.67) (deduced from the generalized differential formulations (1.43) and (1.53) of the first law of thermodynamics) of the total mechanical energy of the macroscopic continuum region τ (of the compressible viscous Newtonian continuum), we have presented in Subsection 3.5.1 the thermodynamic foundation of the classical deformational (shear) model [Короновский и Абрамов, 2000] of the earthquake focal region for the quasi-uniform medium of the Earth's crust characterized by practically constant viscosity. Based on the generalized differential formulation (1.43) of the first law of thermodynamics for the macroscopic continuum region τ, we have presented the generalized thermohydrogravidynamic shear-rotational model [Simonenko, 2007a; 2007] of the earthquake focal region by taking into account the classical macroscopic rotational kinetic energy [de Groot and Mazur, 1962; Gyarmati, 1970], the macroscopic non-equilibrium kinetic energies [Simonenko, 2007], the internal (terrestrial) energy gravitational influences and the external (cosmic) energy gravitational influences on the focal region τ of the preparing earthquakes. Using the evolution equation (3.142) (deduced from the generalized differential formulations (1.43) and (1.53) of the first law of thermodynamics) of the total mechanical energy of the macroscopic continuum region τ (consisting from the subsystems τ_{int} and τ_{ext} interacting on the surface $\partial\tau_i$ of the geo-block τ_{int}), we have presented in Subsection

3.5.2 the evidence [Simonenko, 2007] of the physical adequacy of the rotational model [Vikulin, 2003] of the earthquake focal region for the seismic zone of the Pacific Ring. We have formulated in Subsection 3.5.3.1 the local energy prediction thermohydrogravidynamic principles (3.144) and (3.145) determining (according to the generalized differential formulations (1.43), (1.50) and (1.53) of the first law of thermodynamics [Simonenko, 2007]) the fractures formation in the macroscopic continuum region τ subjected the combined integral energy gravitational influence of the planets of the Solar System, the Moon and the Sun owing to the gravitational interaction of the Sun with the outer large planets (the Jupiter, the Saturn, the Uranus and the Neptune). We have formulated in Subsection 3.5.3.2 the local entropy prediction thermohydrogravidynamic principle (3.155) determining (according to the generalized differential formulations (1.43), (1.50) and (1.53) of the first law of thermodynamics [Simonenko, 2007] and according to the generalized differential expression (3.150) [Simonenko, 2006a] for the entropy production per unit time in the one-component macrodifferential deformed continuum element with no chemical reactions) the fractures formation (and related positive power $\delta f_{vis,c} / dt > 0$ (given by (3.154)) of the geo-acoustic energy radiated from the unit mass of the focal region τ of earthquake) in the macroscopic continuum region τ subjected the combined integral energy gravitational influence of the planets of the Solar System, the Moon and the Sun owing to the gravitational interaction of the Sun with the outer large planets (the Jupiter, the Saturn, the Uranus and the Neptune).

We have presented in Subsection 3.6 the real confirmation [Simonenko, 2007] of the cosmic energy gravitational genesis of the seismotectonic (and volcanic) activity and the global climate variability induced by the combined non-stationary cosmic energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter. We have presented in Subsection 3.6.1 the empirically established [Turner, 1925; Мэй Ши-юн, 1960; Tamrazyan, 1962; Fedotov, 1965; Филлипас, 1965; Davison, 1936; Ambraseys, 1970; Christensen, Ruff 1986; Barrientos and Kansel, 1990; Jacob, 1984; Shimazaki and Nakata, 1980; Suyehiro, 1984; Clark, Dibble, Fyfe, Lensen and Suggarte, 1965; Johnston, 1965; Abramov, 1997; p. 72; Vikulin and Vikulina, 1989; Vikulin, 2003; p. 16-17] time periodicities of the seismotectonic activity of the Earth.

Using the equivalent generalized differential formulations (1.43), (1.50) and (1.53) of the first law of thermodynamics used for the Earth, we have presented in Subsection 3.6.2 (in the frame of the real elliptical orbits of the Earth and the Moon, the Venus, the Mars and the Jupiter) the successive approximations of the obtained time periodicities of the maximal (instantaneous and integral) energy gravitational influences on the Earth of the system Sun-Moon [Simonenko, 2007], the Venus [Simonenko, 2007], the Mars [Simonenko, 2007], the Jupiter [Simonenko, 2007] and the Sun owing to the gravitational interaction of the Sun with the Jupiter. We have presented in Subsection 3.6.2.1 the successive approximations of the time periodicities [Simonenko, 2007] of the maximal (instantaneous and integral) energy gravitational influences on the Earth of the system Sun-Moon. We have presented in Subsection 3.6.2.2 the successive approximations of the time periodicities of the maximal (instantaneous and integral) energy gravitational influences on the Earth of the Venus. We have presented in Subsection 3.6.2.3 the successive approximations of the time periodicities of the maximal (instantaneous and integral) energy gravitational influences on the Earth of the Jupiter [Simonenko, 2007] and the Sun owing to the gravitational interaction of the Sun with the Jupiter. We have presented in Subsection 3.6.2.4 the successive approximations of the time periodicities of the maximal (instantaneous and integral) energy gravitational influences on the Earth of the Mars.

Based on the equivalent generalized differential formulations (1.43), (1.50) and (1.53) of the first law of thermodynamics used for the Earth, we have presented in Subsection 3.6.2.5 the successive approximations of the obtained [Simonenko, 2007] time periodicities (3.196) of the periodic global seismotectonic (and volcanic) activity and the global climate variability of the Earth (and related cosmic geological cycles of the thermohydrogravidynamic evolution of the Earth owing to the $G(a)$-factor and the $G(b)$-factor) induced by the combined different combinations of the cosmic energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Jupiter, the Mars and the Sun owing to the gravitational interaction of the Sun with the Jupiter. The time periodicities (3.196) are determined by the successive global periodicities T_{energy} (defined by the multiplications of various successive time periodicities related to the different combinations of the following integer numbers: $i = 1, 2, 3, 4, 5$; $j = 1, 2$; $k = 1, 2, 3$; $n = 1, 2, 3$; $l_o = 0, 1$; $l_2 = 0, 1$; $l_4 = 0, 1$; $l_5 = 0, 1$) of recurrence of the maximal combined energy gravitational influences on the Earth of the different combined combinations of the cosmic non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter. We have presented in Subsection 3.6.2.5 the successive approximations of the obtained [Simonenko, 2007] time periodicities (3.197) of the periodic global tectonic-endogenous heating related with the periodic global volcanic activity and related global climate variability and the global variability of the quantities of the fresh water and glacial ice resources and the cosmic geological cycles of the thermohydrogravidynamic evolution of the Earth owing to the $G(a)$-factor. The time periodicities (3.197) are determined by the successive global periodicities $T_{energy}/2$ (defined by the multiplications of various successive time periodicities related to the different combinations of the following integer numbers: $i = 1, 2, 3, 4, 5$; $j = 1, 2$; $k = 1, 2, 3$; $n = 1, 2, 3$; $l_o = 0,1$; $l_2 = 0,1$; $l_4 = 0,1$; $l_5 = 0,1$) of recurrence of the maximal combined energy gravitational influences on the Earth of the different combined combinations of the cosmic non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter. We have presented in Subsection 3.6.2.5 the evidence [Simonenko, 2007; 2009; 2010] that the empirical time periodicities [Turner, 1925; Мэй Ши-юн, 1960; Tamrazyan, 1962; Fedotov, 1965; Филлипас, 1965; Davison, 1936; Ambraseys, 1970; Christensen, Ruff 1986; Barrientos and Kansel, 1990; Jacob, 1984; Shimazaki and Nakata, 1980; Suyehiro, 1984; Clark, Dibble, Fyfe, Lensen and Suggarte, 1965; Johnston, 1965; Abramov, 1997; p. 72; Vikulin and Vikulina, 1989; Vikulin, 2003; p. 16-17] of the seismotectonic activity of the Earth (submitted in Subsection 3.6.1) may be satisfactory approximated by the time periodicities (3.196) characterized by different combinations of the various integer numbers.

We have presented in Subsection 3.6.3 the evidence [Simonenko, 2007] of the cosmic energy gravitational genesis of the strongest ($M \geq 7.9$) Japanese earthquakes [Vikulin, 2003] near the Tokyo region and south-west from Tokyo. The predicted [Simonenko, 2009; 2010] "time range 2010 $\div$ 2011 AD (1927+83 $\div$ 1923+88) of the next sufficiently strong Japanese earthquake near the Tokyo region" (determined by the system Sun-Moon, the Venus, the Jupiter, the Mars and the Sun owing to the gravitational interaction of the Sun with the Jupiter) was confirmed by occurrence of the strong Japanese earthquake on 11 March, 2011. The occurrence of the strong Japanese earthquake on 11 March, 2011 may be considered as the real confirmation of the proposed [Simonenko, 2007; Simonenko, 2009; 2010] cosmic energy gravitational genesis of the strongest Japanese earthquakes.

We have presented in Subsection 3.6.4 the evidence [Simonenko, 2007] of the mean time periodicities 94620 years and 107568 years of the global climate variability (related with the $G(a)$ - factor [Simonenko, 2007; 2009; 2010] and $G(b)$ - factor [Simonenko, 2007; 2009; 2010] determined by the cosmic non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter) and the mean time periodicities 100845 years and 121612.5 years of the global climate variability related with the $G(b)$ - factor (determined by the cosmic non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter).

We revealed [Simonenko, 2007] the cosmic energy gravitational genesis (related with the combined cosmic non-stationary energy gravitational influence on the Earth of the Sun, the Moon, the Venus, the Mars and the Jupiter) of the periodic Earth's tectonic-endogenous heating (characterized by the time periodicity 94620 years) induced by the periodic continuum deformation owing to the combined cosmic non-stationary energy gravitational influence on the Earth of the Sun, the Moon, the Venus, the Mars and the Jupiter. We have defined more precisely in Subsection 3.6.4 that the empirical time periodicity 94000 years during Pleistocene [Hays, Imbrie and Shackleton, 1976] is in good agreement with the founded [Simonenko, 2007] time periodicity 94620 years ($0.5\times 19\times 8\times 15\times 83$ years) of the Earth's global climatic variability related with the combined cosmic non-stationary energy gravitational influence on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter [Simonenko, 2007] and the Sun owing to the gravitational interaction of the Sun with the Jupiter. The founded [Simonenko, 2007] time periodicity 94620 years ($0.5\times 19\times 8\times 15\times 83$ years) of the Earth's global climatic variability is determined (according the Table 2) by the global periodic Earth's tectonic-endogenous heating related with the periodic continuum deformation (and related global volcanic activity) induced by the combined cosmic non-stationary energy gravitational influence on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter.

We revealed [Simonenko, 2007] the cosmic energy gravitational genesis (related with the combined cosmic non-stationary energy gravitational influence on the Earth of the Sun, the Moon, the Venus, the Mars and the Jupiter) of the periodic atmospheric-oceanic global planetary warming and cooling (characterized by the time periodicity 100845 years) as a consequence of the greenhouse effect produced by the gravity-induced periodic tectonic-volcanic activization accompanied by increase of the atmospheric greenhouse gases (especially, the carbon dioxide CO_2) concentration. The established cosmic energy gravitational genesis [Simonenko, 2007] of the time periodicity 100845 years is in good agreement with the experimental data [Pinxian et al., 2003; p. 2524-2535], which revealed the time periodicity 100000 years of the climatic variability, and also with the experimental data [Pinxian et al., 2003; p. 2536-2548], which revealed the same time periodicity 100000 years of the variability of the carbon concentration in the Earth's sedimentary rocks. We have defined more precisely in Subsection 3.6.4 that the empirical time periodicity 100000 years during Pleistocene [Muller and MacDonald, 1995] is in good agreement with the founded [Simonenko, 2007] time periodicity 100845 years ($27\times 3\times 15\times 83$ years) of the Earth's global climatic variability related with the combined cosmic non-stationary energy gravitational influence on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter [Simonenko, 2007] and the Sun owing to the gravitational interaction of the Sun with the Jupiter. The founded [Simonenko, 2007] time periodicity 100845 years ($27\times 3\times 15\times 83$ years) of the Earth's global climatic variability is determined (according the Table 2) by the global periodic Earth's amospheric-oceanic warming as a consequence of the greenhouse effect produced by the gravity-induced (owing to the combined cosmic non-stationary energy gravitational influence on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter) periodic global tectonic-volcanic activization accompanied by increased output of the atmospheric greenhouse gases.

We revealed [Simonenko, 2007] the cosmic energy gravitational genesis (related with the combined cosmic non-stationary energy gravitational influence on the Earth of the Sun, the Moon, the Venus, the Mars and the Jupiter) of the periodic Earth's global tectonic-endogenous heating (characterized by the time periodicity 107568 years induced by the periodic continuum deformation owing to the combined cosmic non-stationary energy gravitational influence on the Earth of the Sun, the Moon, the Venus, the Mars and the Jupiter. We have defined more precisely in Subsection 3.6.4 that the empirical time periodicity 106000 years during Pleistocene [Hays, Imbrie and Shackleton, 1976] is in good agreement with the founded [Simonenko, 2007] time periodicity 107568 years ($0.5\times 27\times 3\times 32\times 83$ years) of the Earth's global climatic variability related with the combined cosmic non-stationary energy gravitational influence on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter [Simonenko, 2007] and the Sun owing to the gravitational interaction of the Sun with the Jupiter. The founded [Simonenko, 2007] time periodicity 107568 years ($0.5\times 27\times 3\times 32\times 83$ years) of the Earth's global climatic variability is determined (according the Table 2) by the global periodic Earth's tectonic endogenous heating related with the periodic continuum deformation (and related global volcanic activity) induced by the combined cosmic non-stationary energy gravitational influence on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter.

We revealed [Simonenko, 2007] the cosmic energy gravitational genesis (related with the combined cosmic non-stationary energy gravitational influence on the Earth of the Sun, the Moon, the Venus, the Mars and the Jupiter) of the periodic atmospheric-oceanic warming (characterized by the average time periodicity 121612.5 years) as a consequence of the greenhouse effect produced by the gravity-induced periodic global tectonic-volcanic activization accompanied by increase of the atmospheric greenhouse gases (especially, the carbon dioxide CO_2) concentration. We have defined more precisely in Subsection 3.6.4 that the empirical time periodicity 122000 years during Pleistocene [Hays, Imbrie and Shackleton, 1976] is in good agreement with the founded [Simonenko, 2007] average time periodicity 121612.5 years ($235\times 3\times 15\times (11+12)\times 0.5$ years) of the Earth's global climatic variability related with the combined cosmic non-stationary energy gravitational influence on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter [Simonenko, 2007] and the Sun owing to the gravitational interaction of the Sun with the Jupite. The founded [Simonenko, 2007] average time periodicity 121612.5 years of the Earth's global climatic variability is determined (according the Table 2) by the global periodic Earth's atmospheric-oceanic warming as a consequence of the greenhouse effect produced by the gravity-induced (owing to the combined cosmic non-stationary energy gravitational influence on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter) periodic global tectonic-volcanic activization accompanied by increased output of the atmospheric greenhouse gases.

We have presented in Subsection 3.6.5 the evidence [Simonenko, 2007; 2009; 2010] of the cosmic energy gravitational genesis of the modern short-term time periodicities of the Earth's global climate variability determined by the combined cosmic factors: G-factor related with the combined cosmic non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Mercury, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter; $\mathrm{G}(a)$-factor related to the tectonic-endogenous heating of the Earth as a consequence of the periodic continuum deformation of the Earth due to the G-factor; $\mathrm{G}(b)$-factor related to the periodic atmospheric-oceanic warming or cooling as a consequence of the periodic variable (increasing or decreasing) output of the heated greenhouse volcanic gases and the related variable greenhouse effect induced by the periodic variable tectonic-volcanic activity (activization or weakening) due to the G-factor; $G(c)$-factor related to the periodic variations of the solar activity owing to the periodic variations of the combined planetary non-stationary energy gravitational influence on the Sun. We have presented in Subsection 3.6.5 the following evaluated [Simonenko, 2009; 2010] successive ranges of the short-term time periodicities of the solar activity: $0.96359 \div 1.2302$ years (determined by the combined energy gravitational influence of the Mercury, the Venus and the Earth on the Sun), $5.5359 \div 7$ years (determined by the combined energy gravitational influence of the Mercury, the Venus and the Earth on the Sun), $11 \div 13.008$ years (determined by the combined energy gravitational influence of the Jupiter, the Mercury, the Venus, the Earth and the Mars on the Sun), $19.9945 \div 29.4525$ years (determined by the combined energy gravitational influence of the Jupiter, the Mercury, the Saturn and the Venus on the Sun), $33 \div 35.73$ years (determined by the combined energy gravitational influence of the Jupiter, the Mercury, the Venus, the Mars and the Earth on the Sun), $47.36 \div 53$ years (determined by the combined energy gravitational influence of the Jupiter, the Mercury, the Venus and the Earth on the Sun), $58.905 \div 63.3564$ years (determined by the combined energy gravitational influence of the Jupiter, the Mercury, the Saturn and the Venus on the Sun), $83 \div 88.4095$ years (determined by the combined energy gravitational influence of the Jupiter, the Mercury, the Saturn, the Venus and the Earth on the Sun) and $106.7177 \div 118.58$ years (determined by the combined energy gravitational influence of the Jupiter, the Mercury, the Saturn and the Mars on the Sun). We have presented in Subsection 3.6.5 the following evaluated [Simonenko, 2009; 2010] and experimentally confirmed (by different authors mentioned in Subsection 3.6.5) successive ranges of the main modern short-term time periodicities of the Earth's global climate variability (determined by the variability of the solar activity and determined by the variability of the combined cosmic non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Mercury, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter): $[0.96359 \div 3]$ years, $(3 \div 7]$ years, $(7 \div 15]$ years, $[16 \div 19]$ years, $[19.9945 \div 29.4525]$ years, $[32 \div 36]$ years, $[16 \div 36]$ years, $[41.5 \div 54]$ years, $[57 \div 63.3564]$ years, $[76 \div 96]$ years and $[99 \div 124.5]$ years.

We have presented in Subsection 3.7 the evidence of the cosmic energy gravitational genesis of the seismotectonic (and volcanic) activity and the global climate variability induced (owing to the G-factor, $G(a)$-factor and $G(b)$-factor) by the combined non-stationary cosmic energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun (owing to the gravitational interaction of the Sun with the Jupiter, the Saturn, the Uranus and the Neptune). We have presented in Subsection 3.7.1 the evaluations of the time periodicities of the maximal (instantaneous and integral) energy gravitational influences of the Sun on the Earth owing to the gravitational interaction of the Sun with the outer large planets (the Jupiter, the Saturn, the Uranus and the Neptune). We have presented in Subsection 3.7.1.1 the time periodicities $(T_{J,3})_1 = 11$ years, $(T_{J,3})_2 = 12$ years and $(T_{J,3})_3 = 83$ (in the first, second and third approximations, respectively) years of the maximal (instantaneous and integral) energy gravitational influences on the Earth of the Jupiter [Simonenko, 2007] and the Sun owing to the gravitational interaction of the Sun with the Jupiter. We have presented in Subsection 3.7.1.2 the evaluations of the time periodicities $(T_{SAT,3})_1 = 29$ years, $(T_{SAT,3})_2 = 59$ years and $(T_{SAT,3})_3 = 265$ years (in the first, second and third approximations, respectively) of the maximal (instantaneous and integral) energy gravitational influences on the Earth of the Saturn and the Sun owing to the gravitational interaction of the Sun with the Saturn. We have presented in Subsection 3.7.1.3 the evaluation of the time periodicity $(T_{U,3})_1 = 84$ years (in the first approximation) of the maximal (instantaneous and integral) energy gravitational influences on the Earth of the Uranus and the Sun owing to the gravitational interaction of the Sun with the Uranus. We have presented in Subsection 3.7.1.4 the evaluations of the time periodicities $(T_{N,3})_1 = 165$ years, $(T_{N,3})_2 = 659$ years and $(T_{N,3})_3 = 2142$ years (in the first, second and third approximations, respectively) of the maximal (instantaneous and integral) energy gravitational influences on the Earth of the Neptune and the Sun owing to the gravitational interaction of the Sun with the Neptune. We have presented in Subsection 3.7.1.5 the foundation of the fundamental global time periodicities (3.239) and (3.240) of the Earth's periodic global seismotectonic (and volcanic) activity and the global climate variability (related to the combined planetary, lunar and solar non-stationary energy gravitational influences on the Earth) induced by the different combinations of the cosmic non-stationary energy gravitational influences of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter, the Saturn, the Uranus and the Neptune. Based on the generalized formulation (1.50) of the first law of thermodynamics used for the Earth as a whole, we have founded (taking into account the established [Simonenko, 2007] cosmic G-factor and $\mathrm{G}(b)$-factor) the fundamental sets of the fundamental global seismotectonic and volcanic time periodicities $\mathrm{T}_{\mathrm{tec,f}}$ (given by (3.239)) and the fundamental global climatic periodicities $\mathrm{T}_{\mathrm{clim1,f}}$ (given by (3.239)) determined by the successive global fundamental periodicities $\mathrm{T}_{\mathrm{energy,f}}$ (defined by the least common multiples $L.C.M.$ of various successive time periodicities related to the different combinations of the following integer numbers: $\mathrm{i}=1,2,3,4$; $\mathrm{j}=1,2$; $\mathrm{k}=1,2,3$; $\mathrm{n}=1,2,3$; $\mathrm{m}=1,2,3$; $\mathrm{q}=1$; $\mathrm{r}=1,2,3$; $l_{\mathrm{o}}=0,1$; $l_2=0,1$; $l_4=0,1$; $l_5=0,1$; $l_6=0,1$; $l_7=0,1$; $l_8=0,1$) of recurrence of the maximal combined energy gravitational influences on the Earth of the different combined combinations of the cosmic non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interactions of the Sun with the Jupiter, the Saturn, the Uranus and the Neptune. Based on the generalized formulation (1.50) of the first law of thermodynamics used for the Earth as a whole, we have founded (taking into account the established [Simonenko, 2007] cosmic G-factor, the $\mathrm{G}(a)$-factor and $\mathrm{G}(b)$-factor) the fundamental set of the fundamental global volcanic and climatic periodicities (of the periodic tectonic-endogenous heating and related global volcanic activity related with periodic global climate variability and the global variability of the quantities of the fresh water and glacial ice resources related) $\mathrm{T}_{\mathrm{clim2,f}}=\mathrm{T}_{\mathrm{endog,f}}=\mathrm{T}_{\mathrm{energy,f}}/2$ (given by (3.240)) related to the different combined combinations of the cosmic non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interactions of the Sun with the Jupiter, the Saturn, the Uranus and the Neptune. We have presented in Subsection 3.7.1.6 the thermohydrogravidynamic solution of the fundamental problem [Imbrie, Berger et al., 1993] of the origin of the major 100-kyr glacial cycle (during Pleistocene) explained (in Subsection 3.7.1.6) by the non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Jupiter and the Sun owing to the gravitational interactions of the Sun with the Jupiter, the Saturn, the Uranus and the Neptune. The presented (in Subsection 3.7.1.6) extended thermohydrogravidynamic theory of the paleoclimate ([Simonenko, 2007; 2009; 2010]) generalizes the Milankovitch's (1930) theory of the paleoclimate (taking into account the variability of solar insolation related to the periodic variations of the eccentricity of the Earth's orbit due to the G-factor) by taking into account the additional established cosmic $\mathrm{G}(a)$, $\mathrm{G}(b)$ and $\mathrm{G}(c)$-factors. The presented (in Subsection 3.7.1.6) thermohydrogravidynamic solution of the fundamental problem [Imbrie, Berger et al., 1993] of the origin of the major 100-kyr glacial cycle gives the additional evidence of the validity of the extended thermohydrogravidynamic theory (taking into account the non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Jupiter and the Sun owing to the gravitational interactions of the Sun with the Jupiter, the Saturn, the Uranus and the Neptune) destined to play an important role for the stable evolutionary development of humankind in the present and forthcoming epochs of the critical surrounding cosmic, seismotectonic, volcanic and climatic conditions of the human existence on the Earth.

We have presented in Subsection 3.8 the analysis of the global seismicity and volcanic activity of the Earth from the biblical Flood (occurred in 2104 BC according to the orthodox biblical chronology). Based on the extended thermohydrogravidynamic theory, we have presented the evidence of the forthcoming range $2020 \div 2061$ AD [Simonenko, 2012] of the maximal seismotectonic, volcanic and climatic activities (determined mainly by the combined predominant non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Jupiter and the Sun owing to the gravitational interactions of the Sun with the Jupiter and the Saturn) of the Earth during the past $696 \div 708$ years of the history of humankind. We have presented in Subsection 3.8.1 the foundation of the ranges of the fundamental global seismotectonic, volcanic and climatic periodicities $\mathrm{T}_{\mathrm{tec,f}}=\mathrm{T}_{\mathrm{clim1,f}}=696 \div 708$ years determined by the combined predominant non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Jupiter and the Sun owing to the gravitational interactions of the Sun with the Jupiter and the Saturn. We have presented in Subsection 3.8.2 the evidence of the founded ranges of the fundamental global seismotectonic and volcanic time periodicities $\mathrm{T}_{\mathrm{tec,f}}=\mathrm{T}_{\mathrm{clim1,f}}=696 \div 708$ years based on the presented statistical analysis of the historical eruptions [Thordarson and Larsen, 2007] of the Katla and the Hekla volcanic systems in Iceland. We have presented in Subsection 3.8.2.1 the generalized formulation [Simonenko, 2005] of the weak law of large numbers used for the presented statistical analysis of the historical eruptions [Thordarson and Larsen, 2007] of the Katla and the Hekla volcanic systems. Based on the generalized formulation [Simonenko, 2005] of the weak law of large numbers, we have presented in Subsection 3.8.2.2 the statistical analysis of the historical eruptions [Thordarson and Larsen, 2007] of Katla volcano.

We have shown in Subsection 3.8.2.2 that the founded theoretical range of the fundamental global seismotectonic, volcanic and climatic time periodicities $T_{tec,f} = T_{clim1,f} = 696 \div 708$ years [Simonenko, 2012] contains the calculated mean experimental time periodicities $\langle \Delta t \rangle_{696} = 697.6785$ years (given by (3.267)) and $\langle \Delta t \rangle_{708} = 700.7407$ years (given by (3.268)) of the considered historical eruptions of Katla volcano [Thordarson and Larsen, 2007]. We have shown in Subsection 3.8.2.2 that the mean value 699.2096 years of the calculated mean experimental time periodicities (3.267) and (3.268) (of the considered eruptions of Katla volcano) is very close to the mean value 702 years the founded theoretical range of the fundamental global seismotectonic, volcanic and climatic time periodicities $T_{tec,f} = T_{clim1,f} = 696 \div 708$ years [Simonenko, 2012]. We have shown in Subsection 3.8.2.3 that the mean value 697.5863 years of the calculated mean experimental time periodicities (3.269) and (3.270) (of the considered eruptions of Hekla volcano) is in very good agreement with the mean value 702 years the founded theoretical range of the fundamental global seismotectonic, volcanic and climatic time periodicities $T_{tec,f} = T_{clim1,f} = 696 \div 708$ years [Simonenko, 2012]. The obtained (in Subsections 3.8.2.2 and 3.8.2.3) agreements of the experimental and theoretical volcanic time periodicities confirm the established cosmic energy gravitational genesis [Simonenko, 2012] of the founded range of the fundamental global seismotectonic, volcanic and climatic time periodicities $T_{tec,f} = T_{clim1,f} = 696 \div 708$ years determined by the combined predominant non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Jupiter and the Sun owing to the gravitational interactions of the Sun with the Jupiter and the Saturn.

The founded theoretical range of the fundamental global seismotectonic, volcanic and climatic time periodicities $T_{tec,f} = T_{clim1,f} = 696 \div 708$ years [Simonenko, 2012] contains the experimental time periodicity 704 years [Abramov, 1997] of the global seismotectonic activity of the Earth. The founded theoretical range of the fundamental global seismotectonic, volcanic and climatic time periodicities $T_{tec,f} = T_{clim1,f} = 696 \div 708$ years [Simonenko, 2012] contains also the evaluated (based on the wavelet analysis) time periodicity of approximately 700 years [Goncharova, Gorbarenko, Shi, Bosin, Fischenko, Zou and Liu, 2012] characterizing the regional climate variability of the Japan Sea. These additional agreements confirm the validity of the founded theoretical range of the fundamental global seismotectonic, volcanic and climatic time periodicities $T_{tec,f} = T_{clim1,f} = 696 \div 708$ years [Simonenko, 2012] determined by the combined predominant non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Jupiter and the Sun owing to the gravitational interactions of the Sun with the Jupiter and the Saturn.

We have presented in Subsection 3.8.3 the evidence [Simonenko, 2011] of the cosmic energy gravitational genesis of the predominant short-range time periodicities (7i/6 years and 6j/5 years determined by small integers i and j) of the Chandler's wobble of the Earth's pole [Chandler, 1892] and sea water and air temperature variations [Simonenko, Gayko and Sereda, 2012]. We have presented in Subsection 3.8.3.1 the evidence [Simonenko, 2011] of the cosmic energy gravitational genesis of the predominant time periodicities $T_{clim1,1} = (T_{ch})_1 \approx 6/5\,\text{yr} = 1.2$ years and $T_{clim1,2} = (T_{ch})_2 \approx 7/6\,\text{yr} = 1.1666666....$years of the Chandler's wobble of the Earth's pole and the global climate variability induced by the combined non-stationary energy gravitational influence on the Earth of the Venus, the Mercury and the Moon. We have presented in Subsection 3.8.3.2 the combined analysis of the Chandler's wobble of the Earth's pole [Simonenko, 2011] and the variations of sea water and air temperature during 1969-2010 for the costal station Possyet [Simonenko, Gayko and Sereda, 2012] of the Japan Sea. Based on the previous theoretical results [Simonenko, 2007, 2008, 2009, 2010], the spectral studies [Simonenko, 2011] of the Chandler's wobble of the Earth's pole, and the spectral analysis [Simonenko, Gayko and Sereda, 2012] of the experimental variations of sea water and air temperature (during 1969-2010 AD for the costal station Possyet of the Japan Sea), we have confirmed the cosmic energy gravitational genesis of the predominant short-range periodicities (7i/6 yr and 6j/5 yr determined by small integers i and j) of the Chandler's wobble of the Earth's poll and sea water and air temperature variations for the costal station Possyet [Simonenko, et al., 2012] of the Japan Sea.

We have presented in Subsection 3.8.4 the additional evidence of the founded [Simonenko, 2012] range of the fundamental global periodicities $T_{tec,f} = T_{clim1,f} = 696 \div 708$ yr (of the global seismotectonic and volcanic activities and the climate variability of the Earth) based on the established links between the great natural cataclysms in the ancient history of humankind from the final collapse of the ancient Egyptian Kingdom and the biblical Flood to the increase of the global seismicity and the global volcanic activity in the beginning of the 20th century [Richter, 1969] and the modern increase of the global seismicity and the volcanic activity in the end of the 20th century [Abramov, 1997] and in the beginning of the 21st century [Simonenko, 2007; 2009; 2010]. We have considered in Subsection 3.8.4.1 the great natural cataclysms in the history of humankind from the final collapse of the ancient Egyptian Kingdom (near 2190 BC) and the biblical Flood (occurred in 2104 BC according to the orthodox Jewish and Christian biblical chronology).

We have presented in Subsection 3.8.4.2 the evidence (confirming the founded range of the fundamental global periodicities $T_{tec,f} = T_{clim1,f} = 696 \div 708$ yr [Simonenko, 2012]) of the linkage of the last major eruption of Thera (1450 BC) [LaMoreaux, 1995] and the greatest earthquake destroyed the ancient Pontus (63 BC) [Cassius Dio Cocceianus, Dio's Roman history].

We have presented in Subsection 3.8.4.3 the evidence (confirming the founded range of the fundamental global periodicities $T_{tec,f} = T_{clim1,f} = 696 \div 708$ yr [Simonenko, 2012]) of the linkage of the greatest earthquake destroyed the ancient Pontus (63 BC), the earthquake destroyed the ancient Greek Temple of Artemis (614 AD) and the great frost event (628 AD) [LaMarche and Hirschboeck, 1984] related with the atmospheric veil (recorded in Europe in 626 AD [Stothers and Rampino, 1983]) induced by the great unknown volcanic eruption (apparently, Rabaul' [LaMarche and Hirschboeck, 1984] eruption).

We have presented in Subsection 3.8.4.4 the evidence (confirming the founded range of the fundamental global periodicities $T_{tec,f} = T_{clim1,f} = 696 \div 708$ yr [Simonenko, 2012]) of the linkage of the greatest earthquake destroyed the ancient Pontus (63 BC) and the great earthquakes [Vikulin, 2008] occurred in England (1318 AD and 1343 AD), Armenia (1319 AD), Portugal (1320 AD, 1344 AD and 1356 AD) and Japan (1361 AD).

We have presented in Subsection 3.8.4.5 the evidence (confirming the founded range of the fundamental global periodicities $T_{tec,f} = T_{clim1,f} = 696 \div 708$ yr [Simonenko, 2012]) of the linkage of the final collapse of the ancient Egyptian Kingdom (occurred near 2190 BC), the biblical Flood (occurred in 2104 BC according to the orthodox Jewish and Christian biblical chronology) and the last major eruption of Thera (1450 BC) [LaMoreaux, 1995].

We have presented in Subsection 3.8.4.6 the evidence (confirming the founded range of the fundamental global periodicities $T_{tec,f} = T_{clim1,f} = 696 \div 708$ yr [Simonenko, 2012]) of the linkage of the planetary disasters in the Central Asia (10555 BC) [Von Bunsen, 1848, pp. 77-78, 88] and in the ancient Egyptian Kingdom (10450 BC) [Hancock, 1997], and the greatest earthquake destroyed the ancient Pontus (63 BC).

We have presented in Subsection 3.8.4.7 the evidence (confirming the founded fundamental global periodicity $T_{tec,f} = T_{clim1,f} = 5 \times 696$ years $= 3480$ years (given by (3.258a)) determined by the combined predominant non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interactions of the Sun with the Jupiter and the Saturn) of the linkage of the previous great eruptions of Thera (Santorini) (between 1628 and 1450 BC [LaMoreaux, 1995]), the greatest (in the United States in the past 150 years up to 1872) earthquake in Owens Valley, California (1872 AD), the eruptions of Santorini [Papazachos, 1989] in 1866 and 1925 AD and the great eruption of Krakatau in 1883 AD.

We have presented in Subsection 3.8.4.8 the evidence (confirming the founded fundamental global periodicity $T_{tec,f} = T_{clim1,f} = 5 \times 696$ years $= 3480$ years given by (3.258a)) of the linkage of the eruption of Tambora (1815 AD) and the Thera (Santorini) eruption in the range $1700 \div$ 1640 BC [Betancourt, 1987; Habberten et al., 1989].

We have presented in Subsection 3.8.4.9 the evidence (confirming the founded fundamental global periodicity $T_{tec,f} = T_{clim1,f} = 5 \times 696$ years $= 3480$ years given by (3.258a)) of the linkage of the increase of the global seismicity (along with the increase of the volcanic activity) in the end of the 19th century and in beginning of the 20th century [Richter, 1969] and the eruption of Thera (Santorini) between 1600 and 1500 BC [Antonopoulos, 1992].

We have revealed (based on combined analysis presented in Subsections 3.8.4.1, 3.8.4.2, 3.8.4.3, 3.8.4.4, 3.8.4.5, 3.8.4.6, 3.8.4.7, 3.8.4.8 and 3.8.4.9) in Subsection 3.8.4.9 the evident linkages between the different distinct eruptions of the Thera (Santorini) dated in the following ranges: 1700÷1640 BC [Betancourt, 1987; Habberten et al., 1989], $1628 \div 1626$ BC [LaMarche and Hirschboeck, 1984], 1627÷1600 BC [Friedrich et al., 2006], 1600÷1500 BC [Antonopoulos, 1992], 1628÷1450 BC [LaMoreaux, 1995] and the eruptions of the Tambora (1815 AD), the Santorini (1866 AD and 1925 AD) and the Krakatau (1883 AD). Based on the fundamental global seismotectonic, volcanic and climatic periodicity (3.258a) and taking into account the eruptions of the Tambora (1815 AD), the Santorini (1866 AD and 1925 AD) and the Krakatau (1883 AD), we have founded the real possibility of different distinct eruptions of Thera (Santorini): near 1665 BC (in accordance with the range 1700÷1640 BC [Betancourt, 1987; Habberten et al., 1989]), near 1613.5 BC (in accordance with the range 1627÷1600 BC [Friedrich et al., 2006]) and in the range

1584÷1555 BC (in accordance with the range 1600÷1500 BC [Antonopoulos, 1992]). We have shown in Subsection 3.8.4.9 that we can consider the possibility of the final major catastrophic eruption near 1450 BC [LaMoreaux, 1995].

We have presented in Subsection 3.8.4.10 the evidence (confirming the founded range of the fundamental global periodicities $T_{tec,f} = T_{clim1,f} = 696 \div 708$ yr [Simonenko, 2012]) of the linkage of the increase of the global seismicity (along with the increase of the volcanic activity) in the end of the 20th century [Abramov, 1997] and the eruption of Hekla (1300 AD) in Iceland [Thordarson and Larsen, 2007] and the great earthquake (1303 AD) in China [Vikulin, 2008].

We have presented in Subsection 3.9 the evidence of the forthcoming range $2020 \div 2061$ AD [Simonenko, 2012] of the maximal seismotectonic, volcanic and climatic activities of the Earth in the 21st century during the past $696 \div 708$ years of the history of humankind. We have presented in Subsection 3.9 the evidence of the related subsequent subranges (2023 ± 3 AD, 2040.38 ± 3 AD and 2061 ± 3 AD) of the increased peak global seismotectonic and volcanic activities and the climate variability of the Earth in the 21st century during the past $696 \div 708$ years of the history of humankind. It is clear that the additional fundamental studies (in the frame of the established cosmic geology and cosmic geophysics [Simonenko, 2007]) are needed to be not in some partial ignorance concerning to the behavior of the global seismicity of the Earth during the founded range $2020 \div 2061$ AD [Simonenko, 2012] of the maximal seismotectonic, volcanic and climatic activities of the Earth in the 21st century.

Evaluating the negative consequences of the underground nuclear explosions (especially, the violation of the Earth's water and seismotectonic processes leading to the established [Simonenko, 2007; 2009; 2010] decrease of the natural warning omens associated with the prepared earthquakes), we proved [Simonenko, 2007; 2009; 2010] that the underground nuclear explosions (during the established [Simonenko, 2007] modern activization of the seismotectonic and water-related processes of the Earth in the beginning of the 21st century) can initiate the small planetary cataclysm on the Eurasian continent accompanied by the super-earthquakes. Appealing to the world community and to the United Nations, we identified [Simonenko, 2007; 2009; 2010] the continuing underground nuclear explosions (produced by Northern Korea in 2006 and 2009 during the modern seismotectonic planetary activization [Simonenko, 2007]) as the very dangerous crime against the humankind. In this regard, the statement that "the furthest underground nuclear explosions and the furthest proliferation and development of the military technologies of production of the nuclear weapon in the world are disagree with the ethics of survival of the Eurasian nations in the third millennium" [Simonenko, 2010; p. 272] is still very actual for the humankind in the beginning of the 21st century.

We have presented in this monograph the final synthesis of the Cosmic Geology and the Cosmic Geophysics to create in advance the urgent technologies of the long-term deterministic predictions of the strong earthquakes, the planetary cataclysms, the Earth's climate and the Earth's fresh water resources in order to sustain the stable evolutionary development, the survival, greatness and cosmic dignity of the humankind in the 21st century before the founded forthcoming range $2020 \div 2061$ AD *of the maximal seismotectonic, volcanic and climatic activities of the Earth during the past* $696 \div 708$ *years of the history of humankind.*

REFERENCES

Abramov V.A. The structure and dynamics of the tectonosphere of the Aldan's shield. Part 1. Methodology, principles, preconditions. Vladivostok: Dalnauka, 1993. 161 p. Part 2. Fundamentals of the synthetic geotectonics. Vladivostok: Dalnauka, 1993. 216 p. In Russian.

Abramov V.A. Causes and forerunners of earthquakes // Proceedings of the Vladivostok Professor's Club. 1997. No. 1. P. 50–63. In Russian.

Abramov V.A. Forecasting of disastrous earthquakes // Proceedings of the Vladivostok Professor's Club. 1997. No. 1. P. 64–77. In Russian.

Abramov V.A., Molev V.P. Ecological and radiometrical monitoring of the South Primorye. Vladivostok: Dalnauka, 2005. 316 p. In Russian.

Abramov V.A. Synthesis-Geodynamics of Planetary System // Bulletin of the Far Eastern Branch, RAS, 1995. No. 4. P. 24–27. In Russian.

Cassius Dio Cocceianus. Dio's Roman history, with an English translation by Earnest Cary, PH.D., on the basis of the version of Herbert Baldwin Foster, PH.D. In nine volumes. Vol. 3. http://www.archive.org/details/diosromanhistory03cassuoft (accessed December 30, 2010).

Akulichev V.A. Cavitation in cryogenic fluids. Moscow: Nauka, 1978. 280 p. In Russian.

Akulichev V.A., Bezotvetnykh V.V., Kamenev S.I. et al. Acoustic tomography of water medium dynamics in the Japan Sea shelf zone // Dokl. RAN. 2001. Vol. 381, No. 2. P. 243–246. In Russian.

Akulichev V.A., Bugaeva L.K., Morgunov Yu.N., Solov'ev A.A. Influence of mesoscale eddies zones on sound propagation at the North-West of Pacific Ocean // Dokl. RAN. 2011. Vol. 441, No. 6. P. 821–824. In Russian.

Akulichev V.A., Dzyuba V.P., Gladkov P.V., Kamenev S.I., Morgunov Yu. N. On acoustic tomography scheme of hydrophysical parameters for marine environment // Proceedings of the fifth intern. conf. on "Theoretical and computational acoustics". Ed. E.-C. Shang, Q. Li and T. F. Gao. Beijing, China, 2001. P. 107–114.

Akulichev V.A., Morgunov Yu.N., Kamenev S.I., Polovinka Yu.A., Bezotvetnykh V.V., Burenin A.V., Voitenko E.A., Strobykin D.S. Development of remote acoustic methods and means of research in oceanology // Far Eastern Seas of Russia, Book 4: Physical methods of research. Moscow: Nauka, 2007, 628 p., P. 71–86. In Russian.

Alfven H., Arrhenius G. Evolution of the Solar System. Moscow: Publ. office "Mir", 1979. 511 p. In Russian.

Ambraseys N.N. Some characteristic features of the Anatolian fault zone // Tectonophysics. 1970. Vol. 9. No. 2–3. P. 143–165.

Antonopoulos J. The great Minoan eruption of Thera volcano and the ensuing tsunami in the Greek archipelago // Natural Hazards. 1992. Vol. 5, No. 2. P. 153-168.

Auad G. Interdecadal dynamics of the North Pacific Ocean // J. Phys. Oceanogr. 2003. Vol. 33, No. 12. P. 2483–2503.

Avsjuk Yu.N. Tidal forces and natural processes. Moscow: UIPE RAS, 1996. 188 p. In Russian.

Avsjuk Yu.N., Suvorova I.I. Astrometric and geophysical surveys materials that supplement a fund of geodynamic information // Rotational processes in geology and physics. Moscow: KomKniga, 2007. 528 p., P. 457–470. In Russian.

Baith M., Duda S.J. Some aspects of global seismicity // Tectonophysics. 1979. No. 54. P. TI-T8.

Barrientos S.E., Kausel E. Genesis y proceso de rupture del terremoto del 3 demarzo de 1985 // Rev. geophis. 1990. Vol. 46, No. 1. P. 3-18.

Batchelor G.K. An introduction to fluid dynamics. Cambridge: Cambridge University Press, 1967. 615 p.

Berger A.L. Long-term variations of caloric insolation resulting from the Earth's orbital elements // Quaternary Research. 1978. Vol. 9. P. 139–167.

Berger A.L. Long term variations of daily insolations and Quaternary climatic changes // J. Atmos. Sci. 1978. Vol. 35, No. 12. P. 2362–2367.

Berger A. Milankovitch theory and climate // Reviews of Geophysics. 1988. Vol. 26, No. 4. P. 624–657.

Berger A., Loutre M.F. Insolations values for the climate of the last 10 million years // Quat. Sci. Rev. 1991. Vol. 10. P. 297–317.

Berger W.H. The 100-kyr ice-age cycle: internal oscillation or inclinational forcing? // Int. Journ. of Earth Sciences. 1999. Vol. 88. P. 305–316.

Betancourt P.P. Dating the Aegean Late Bronze Age with radiocarbon // Archaeometry. 1987. No. 29.

P.45-49.

Betancourt P.P., Weinstein G. A. Am. J. Archaeol. 1976. No. 80. P. 329-348.

Bol'shakov V.A. The new concept of the orbital theory of paleoclimate. Moscow: the Russian Agricultural Academy press, 2003. 256 p. In Russian.

Bolt B.A., Horn W.L., Macdonald G.A., Scott R.F. Geological hazards. Moscow: Publ. office "Mir", 1978. 440 p. In Russian.

Cassius Dio Cocceianus. Dio's Roman history. 9 vols., vol. 3. Engl. tr. by Earnest Cary, available at http://www.archive.org/details/diosromanhistory03cassuoft

Chandler C. On the variation of the latitude // Astron. J. 1892. Vol. 11, No. 12. P. 97–107.

Christensen D.H., Ruff L.J. Rupture process of the March 3, 1985 Chilean earthquake // Geophys. Res. Lett. 1986. Vol. 13, No. 8. P. 721–724.

Clark R.H., Dibble R.R., Fyfe H.E., Lensen G.J., Suggarte R.P. Tectonic and earthquake risk zoning // Trans. Roy. Soc. N.Z. Gen. 1965. Vol. 1, No. 10. P. 113–126.

Console R., Yamaoka K.,. Zhuang J. Implementation of short- and medium-term earthquake forecasts. // International Journal of Geophysics. 2012. Vol. 2012, article ID 217923, 2 pages, doi:10.1155/2012/217923.

Davison Ch. Great earthquakes. London: Thomas Murby Co., 1936.

De Groot S.R., Mazur P. Non-equilibrium thermodynamics. Amsterdam: North-Holland, 1962. 441 p.

Delworth T.S., Manabe S., Stouffer R.J. Interdecadal variability of the thermohaline circulation in a coupled ocean-atmosphere model // J. Climate. 1996. Vol. 6. P. 1993–2011.

Diaz H., Hoerling M.P., Eischeid J.K. ENSO variability, teleconnections and climate change // Intern. J. Climatol. 2001. Vol. 21, No. 15. P. 1845–1862.

Dmitrieva E., Ponomarev V. Multiple scale pacific SST variability in terms of cluster analysis // Marine environmental and resources in XXI century: Abstracts of the 2nd Russia-China Symposium on Marine Science. Vladivostok: FEB RAS, 2012. 224 p., P. 39-40.

Dolgikh G.I. The investigations of the wave fields of the ocean and lithosphere by laser-interference methods. Vladivostok: Dalnauka, 2000. 160 p. In Russian.

Dolgikh G.I. Application of laser-interference methods in ocean investigations // Proc. of the Intern. conf. on "the Arctic and North Pacific"/ Ed. V.I. Sergienko et al. Vladivostok, 2004. P. 32.

Dolgikh G.I., Dolgikh S.G., Kovalev S.N. et al. A laser nanobarograph and its application to the study of pressure-strain coupling // Izv. RAN. Fizika Zemli. 2004. Vol. 40, No. 8. P. 82–90. In Russian.

Dolgikh G.I., Valentin D.I., Dolgikh S.G. et al. Application of horizontally and vertically oriented strainmeters in geophysical studies of transitional zones // Izv. RAN. Fizika Zemli. 2002. Vol. 38, No. 8. P. 69–73. In Russian.

Dolgikh G.I., Kuptsov A.V., Larionov I.A. et al. Deformation and acoustic precursors of earthquakes // Dokl. RAN. 2007. Vol. 413, No. 1. P. 96–100. In Russian.

Duda S.J. Secular seismic energy release in the circum-Pacific belt // Tectonophysics. 1965. No. 2. P. 409-452.

Dzyuba V.P. Scalar-vector methods of the theoretical acoustics. Vladivostok: Dalnauka, 2006. 195 p. In Russian.

Earth Orientation Centre data. http://hpiers.obspm.fr/eop-pc/

Elkibbi M., Rial J. An outsider's review of the astronomical theory of the climate: is the eccentricity-driven insolation the main driver of the ice ages? // Earth-Science Reviews. 2001. Vol. 56. P. 161–177.

Evans D.J., Hanley H.J., Hess S. Non-Newtonian phenomena in simple fluids // Physics Today. 1984. Vol. 37. P. 26–33.

Fedotov S.A. About the seismic cycle, possibility of quantitative seismic division and the long-term seismic forecast // Seismic division of the USSR. Moscow: Nauka, 1968. P. 121–150. In Russian.

Fedotov S.A. Regularities of the distribution of strong earthquakes in Kamchatka, the Kuril Islands, and northeastern Japan. Trudy Inst. Fizika Zemli Akad. Nauk SSSR. 1965. Vol. 36, No. 203. P. 63–93. In Russian.

Friedrich W.L., Kromer B., Friedrich M., Heinemeier J., Pfeiffer T., Talamo S. Santorini eruption radiocarbon dated to 1627-1600 B.C. // Science. 2006. Vol. 312. P. 548.

Fu C.B., Teng H.L. Relationship between summer climate in China and the El Niňo/Southern Oscillation phenomenon // Frontiers in atmospheric sciences. Allerton, 1993. P. 166–178.

Gibbs J.W. Graphical methods in the thermodynamics of fluids // Trans. Connect. Acad. 1873. II, April-May. P. 309–342.

Gibbs J.W. The collected works of J. Willard Gibbs: In 2 vol. Vol. 2. N.Y. etc.: Longmans, Green,

1928.
Global-regional linkages in the Earth system / Ed. P. Tyson et al. N.Y. etc.: Springer, 2002. 186 p. (Global Change. IGBP Ser.).
Goncharova A. Gorbarenko S., Shi X., Bosin A., Fischenko V., Zou J., Liu Y. Millennial – centennial – interdecadal scale climate and environmental changes of the Japan Sea sediments over the last 60 thousand years: investigation based on wavelet analysis // Marine environmental and resources in XXI century: Abstracts of the 2nd Russia-China Symposium on Marine Science. Vladivostok: FEB RAS, 2012. 224 p., P. 53-54.
Gong G., Entekhabi D., Cohen J. Relative impact of Siberian and North America snow anomalies on the winter Arctic Oscillation // Geophys. Res. Lett. 2003. Vol. 30, No. 16. P. 21–24.
Gorbarenko S.A., Harada N., Malakhov M.I., Velivetskaya T.A., Vasilenko Yu.P., Bosin A.A., Derkachev A.N., Goldberg E.L. Responses of the Okhotsk Sea environment and sedimentology to global climate changes at the orbital and millennial scale during the last 350 kyr // Deep-Sea Research II. 2011. doi: 10.1016/j.dsr2.2011.05.016.
Gorbunova E.M., Spivak A.A. Changes in ground-water regime under the impact of underground nuclear explosions // Geo-ecology. 1997. No. 6. P. 29–37. In Russian.
Gor'kavyi N.N., Fridman A.M. Physics of planetary rings: Celestial mechanics of continuous medium. Moscow: Nauka, 1994. 348 p. In Russian.
Guo Z. Significance of a ground and block rotation in the earthquake prediction // Northwest. Seismol. J. 1988. Vol. 10, No. 1. P. 82–85.
Gyarmati I. Non-equilibrium thermodynamics. Field theory and variational principles. B.: Springer, 1970. 184 p.
Hammer C.U., Clausen H.B., Friedrich W.L., Tauber H. The Minoan eruption of Santorini in Greece dated to 1645 BC // Nature. 1987. Vol. 328. P. 517-519.
Hancock G. Fingerprints of the Gods. Moscow: Publ. office "Veche", 1997. 496 p. In Russian.
Hattory S. Migration and Periodicity of Seismic Activity in the World // Bull. of Inter. Instit. of Seismol. Tokio. 1977. Vol.15. P. 33-47.
Hays J.D., Imbrie J., Shackleton N. Variations in the Earth's orbit: Pacemaker of the ice ages // Science. 1976. Vol. 194. P. 1121–1132.
Helmholtz H. About integrals of hydrodynamic equations related with vortical motions // Crelles Journ. 1858. Vol. 55. P. 25.
Hofmann H.J. Precambrian time units and nomenclature – The geon concept // Geology. 1990. Vol. 18. P. 340–341.
Hubberten B.M., Calamiotou M., Apostolakis C., Filippakis S., Grinamis A. Radiocarbon dates from the Akrotiri excavations // Third International Congress, Thera and the Aegean World III, 1989. Vol. 2. 4. P. 65-69, Santorini, Greece.
Ilyichev V.I., Cherepanov G.P. On one possible consequence of underground nuclear tests // Dokl. AN SSSR. 1991. Vol. 316, No. 6. P. 1367–1371. In Russian.
Imbrie J., Berger A., Boyle E. et al. On the structure and origin of major glaciation cycles. 2. The 100000-year cycle // Paleoceanography. 1993. Vol. 8. P. 699–735.
Imbrie J., Mix A.C., Martinson D.G. Milankovitch theory viewed from Devils Hole // Nature. 1993. Vol. 363. P. 531–533.
Itsweire E.C., Helland K.N., Van Atta C.W. The evolution of a grid-generated turbulence in a stably stratified fluid // J. Fluid Mech. 1986. Vol. 162. P. 299-338.
Jacob K.H. Estimates of long-term probabilities for future great earthquakes in the Aleutians // Geophys. Res. Lett. 1984. Vol. 11, No. 4. P. 295–298.
Johnston J.A.R. Earthquake fault Line hazards with special reference to Wellington // N.Z. Engng. 1965. Vol. 20, No. 8. P. 320–322.
Kalugin I., Darin A. High resolution geochemical signal of paleoclimate in the bottom sediments based on scanning x-ray fluorescence analysis on synchrotron radiation (XRF SR) // Marine environmental and resources in XXI century: Abstracts of the 2nd Russia-China Symposium on Marine Science. Vladivostok: FEB RAS, 2012. 224 p., P. 70.
Kapitza P.L. Plasma and the controlled thermonuclear reaction: Nobel lecture in physics // Institute for Physical problems of the USSR Academy of Sciences, Moscow, USSR.
Kazancev Yu. V. Evolution of the Solar System and the climate of the Earth. Vladivostok: Dalnauka, 2002. 136 p. In Russian.
Keller J.U., Hess S. Properties of global constitutive equations of non-equilibrium thermodynamics based on linear local laws // J. Non-Equilibrium Thermodynamics. 1981. Vol. 6. P. 217.

Keylis-Borok V.I., Malinovskaya L.N. One regularity in the occurrence of strong earthquakes // J. Geophys. Res. 1964. Vol. 69. P. 3019–3024.

Khain V.E. Modern geotectonic hypothesizes // Bul. of MOIP. 1958. Vol. 30, No. 5. P. 138. In Russian.

Khain V.E. The Earth: a unique planet in the Solar System // Herald of the Russian Academy of Sciences. 2003. Vol. 73, No. 9. P. 822–829. In Russian.

Khain V.E., Poletaev A.I. Rotational tectonics: Prehistory, modern condition, perspectives of development // Rotational processes in geology and physics. Moscow: KomKniga, 2007. 528 p., P. 9–14. In Russian.

Kogan V.Ya., Simonenko S.V. Internal bore in shallow sea // Izv. RAN. Fizika atmosfery i okeana. 1992. Vol. 28, No. 9. P. 123–129. In Russian.

Korochentsev V.I. Interaction of electromagnetic, elastic, gravitational waves in the physical environment and their mathematical counterparts in the humanities // Proceedings of the Vladivostok Professor's Club. 2009. No. 12. P. 18–29. In Russian.

Kotlyar P.E., Kim V.I. The position of the Earth's pole and the seismic activity of the Earth. Novosibirsk: UIGGM SB RAS, 1994. 126 p. In Russian.

Krokhin V.V. Interannual variability of temperature and precipitation anomalies over the Eastern Russia and its relationship to teleconnection indexes // Pacif. Oceanogr. 2004. Vol. 2, No. 1/2. P. 85–94.

Kukla G.I. Pleistocene land-sea correlations. 1. Europe // Earth-Sci. Rev. Vol. 13. P. 307-374.

Kyrillov I.V. On the periodicity of destructive earthquakes at the Caucasus and in Turkey // Dokl. AN SSSR. 1957. Vol. 115, No. 4. P. 771–773. In Russian.

LaMarche V. C., Hirschboeck K. K. Frost rings in trees as records of major volcanic eruptions // Nature. 1984. Vol. 307. P. 121-126.

Lamb H.H. Climate: Present, Past and Future. Methuen, London. 1977. Vol. 2.

LaMoreaux P.E. Worldwide environmental impacts from the eruption of Thera // Earth and Environmental Science. Environmental Geology. 1995. Vol. 26, No. 3. P. 172-181.

Landau L.D., Lifshitz E.M. Theoretical physics. Vol. 2. Theory of field. Moscow: Nauka, 1988. 512 p. In Russian.

Landau L.D., Lifshitz E.M. Theoretical physics. Vol. 5. Statistical physics. Moscow: Nauka, 1976. 584 p. In Russian.

Landau L.D., Lifshitz E.M. Theoretical physics. Vol. 6. Hydrodynamics. Moscow: Nauka, 1988. 733 p. In Russian.

Latif M., Barnett T.P. Causes of decadal climate variability over the North Pacific and North America // Science. 1994. Vol. 266. P. 634–637.

Li C.Y., Sun S.Q., Mu M.Q. Origin of the TBO-interaction between anomalous East-Asian winter monsoon and ENSO cycle // Adv. Atmos. Sci. 2001. Vol. 18, No. 4. P. 554–566.

Lobanov V.B., Ponomarev V.I., Salyuk A.N., Tishchenko P.Ya., Talley L.D. Structure and dynamics of synoptic scale eddies in the northern Japan Sea // Far Eastern Seas of Russia, Book 1: Oceanologic research. Moscow: Nauka, 2007, 660 p., P. 450–473. In Russian.

Makarov D.V., Uleysky M.Yu., Prants S.V. Ray chaos and ray clustering in an ocean waveguide // Chaos. 2003. Vol. 14, No. 1. P. 79–95.

Mantua N.J., Hare S.R., Zhang Y. et al. A Pacific interdecadal climate oscillation with impacts on salmon production // Bull. Amer. Meteorol. Soc. 1997. Vol. 78. P. 1069–1079.

Marinatos Sp. The volcanic destruction of Minoan Crete // Antiquity. 1939. Vol. 13, No. 52. P. 426.

Melnikov O.A. The leading role of basic rotational geodynamic mechanisms in natural seismicity of the Earth // Rotational processes in geology and physics. Moscow: KomKniga, 2007. 528 p., P. 439-448. In Russian.

Milankovitch M. Mathematische klimalehre und astronomische theorie der klimaschwankungen, Berlin: Gebruder Borntreger, 1930. 176 p.

Milankovitch M. Astronomische Mittel zur Erforschung der erdgeschichtlichen Klimate. Handbuch der Geophysik. Bd. 9, Lfg. 3, 1938, p. 593–698.

Milanovsky E.E. To the problem of genesis and development of the linear structures of platforms // Bul. MSU. Ser. 4. Geology. 1979. No. 6. P. 29-53. In Russian.

Milanovsky E.E., Vikulin A.V. Preface // Rotational processes in geology and physics. Moscow: KomKniga, 2007. 528 p., P. 9–14. In Russian.

Miller A.J., Cayan D.R., Barnett T.P. Interdecadal variability of the Pacific Ocean: model response to observed heat flux and wind stress anomalies // Climate Dynam. 1994. Vol. 9. P. 287–302.

Miller A.J., Scheider N. Interdecadal climate regime dynamics in the North Pacific Ocean: Theories, observations and ecosystem impacts // Progr. Oceanogr. 2000. Vol. 47. P. 355–379.

Minobe S. A 50–70 year climatic oscillation over the North Pacific and North America // Geophys. Res. Lett. 1997. Vol. 24. P. 683–686.

Minobe S., Mantua N. Interdecadal modulation of interannual atmospheric and oceanic variability over the North Pacific // Ibid. 1999. Vol. 43. P. 163–192.

Monin A.S., Sonechkin D.M. Variations of climate. Moscow: Nauka, 2005. 192 p. In Russian.

Morozov Yu.A. Towards the phenomenology of structures and processes of rotational genesis // Rotational processes in geology and physics. Moscow: KomKniga, 2007. 528 p., P. 471–504. In Russian.

Morozova L.I. Satellite monitoring of earthquakes. Vladivostok: Dalnauka, 2005. 137 p. In Russian.

Moscalev Y.N. Late consequences of ionizing radiation. Moscow: Publ. office «Mir», 1991. 464 p. In Russian.

Mount V.S., Suppe J. State of stress near the San Andreas fault: implications for wrench tectonics // Geology. 1987. Vol. 15, No. 12. P. 1143–1146.

Muller R.A., MacDonald G.J. Glacial cycles and orbital inclination // Nature. 1995. Vol. 377. P. 107–108.

Muller R.A., MacDonald G.J Simultaneous presence of orbital inclination and eccentricity in proxy climate records from Ocean Drilling Program Site 806 // Geology. 1997. Vol. 25. P. 859-861.

Munk W.Y., Hassan E.S.M. Atmospheric excitation of the Earth's wobble // Geophys. J. Roy. Astron. Soc. 1961. Vol. 4. P. 339.

Nakamura H., Izumi T., Sampe T. Interannual and decadal modulations recently observed in the Pacific storm track activity and East Asian winter monsoon // J. Climate. 2002. Vol. 15, No. 14. P. 1855–1874.

Nakamura H., Lin G., Yamagata T. Decadal climate variability in the North Pacific during the recent decades // Bull. Amer. Meteorol. Soc. 1997. Vol. 78, No. 10. P. 2215–2225.

Nicolis G., Prigogine I. Exploring complexity. An introduction. N.Y.: Freeman, 1989. 313 p.

Novotryasov V.V., Simonenko S.V. About an interpretation of empirical orthogonal functions of temperature variations of semidurnal period // Izv. AN SSSR. Fizika atmosfery i oceana. 1989. Vol. 25, No. 3. P. 327–330. In Russian.

Ogi M., Tachibana Y. Influence of the Arctic Oscillation on the negative correlation between Okhotsk Sea ice and Amur River discharge // Geophys. Res. Lett. 2006. Vol. 33. P. 1–4. L08709.

Oort A.H., Yienger J.J. Observed interannual variability in the Hadley Circulation and its connection to ENSO // J. Climate. 1996. Vol. 9, No. 11. P. 2751–2767.

Overland J.E., Adams J.M., Bond M.A. Decadal variability of the Aleutian Low and its relation to high latitude circulation // Ibid. 1999. Vol. 12. P. 1542–1548.

Papazachos B.C. Long and short term prediction of the volcanic eruption in Santorini / 3rd International Congress, Santorini, Greece. 1989.

Pavlenkova N.I. Structural regularities in the lithosphere of continents and plate tectonics // Tectonophysics. 1995. Vol. 243. P. 223–239.

Pavlenkova N.I. Rotational movements of large elements of the Earth and global geodynamics // Rotational processes in geology and physics. Moscow: KomKniga, 2007. 528 p., P. 103–114. In Russian.

Perelman Ya.I. Entertaining astronomy. Moscow: State publishing office of the technical-theoretical literature, 1956. 212 p. In Russian.

Pisias N.G., Shackleton N.J. Modelling the global climate response to orbital forcing and atmospheric carbon dioxide changes // Nature. 1984. Vol. 310. P. 757–759.

Pinxian W., Jun T., Xinrong C. et al. Exploring cyclic changes of the ocean carbon reservoir // Chinese Science Bulletin. 2003. Vol. 48, No. 23. P. 2536–2548.

Pinxian W., Quanhong Z., Zhimin J. et al. Thirty million year deep-sea records in the South China Sea // Chinese Science Bulletin. 2003. Vol. 48, No. 23. P. 2524–2535.

Polonsky A.B., Basharin D.V., Voskresenskaya E.N. Relationship between the North Atlantic Oscillation, Euro-Asian climate anomalies and Pacific variability // Pacif. Oceanogr. 2004. Vol. 2, No. 1/2. P. 52–66.

Ponomarev V.I., Kaplunenko D.D., Dmitrieva E.V., Krokhin V.V., Novorotsky P.V. Climate variations in the northern part of Asia-Pacific region // Far Eastern Seas of Russia, Book 1: Oceanologic research. Moscow: Nauka, 2007. 660 p., P. 17–48. In Russian.

Ponomarev V.I., Kaplunenko D.D., Krokhin V.V., Ishida H. Climate change in the Northeast Asia and Northwest Pacific during 20th century // Recent advances in marine science and technology, 2002. Tokyo: Jap. Intern. Mar. Sci. and Technol. Federation, 2003a. P. 27–36.

Ponomarev V.I., Kaplunenko D.D., Krokhin V.V., Ishida H. Seasonality of climate change in the

North Hemisphere Asian Pacific // Proc. symp. 2.1, 20th Pacific sci. congr. «Adaptation of Asia Pacific to global change». Bangkok, 2003b. P. 55–66.

Ponomarev V.I., Krokhin V.V., Kaplunenko D.D., Salomatin A.S. Multiscale climate variability in the Asian Pacific // Pacif. Oceanogr. 2003c. Vol. 1, No. 2. P. 125–137.

Ponomarev V.I., Trusenkova O.O., Trousenkov S.T. et al. The ENSO signal in the Northwest Pacific // Proc. Science Board'98 symp. 1997/98 El Nino event, Fairbanks, 14–25 Oct., 1998. Sidney (Canada), 1999b. P. 9–31. (PICES Sci. Rep.; No. 10.)

Ponomarev V.I., Trusenkova O.O., Trousenkov S.T. Relationship between surface temperature anomalies in the mid-latitude North Pacific region and ENSO // Rep. Intern. Workshop on the global change studies in the Far East, Sept. 7–9, 1999a, Vladivostok. Vladivostok: Dalnauka, 2002. Vol. 2. P. 34–65. (TEACOM Rubl.; No. 7.)

Prigogine I. Autobiography. Translation from the French text. From Nobel Lectures, Chemistry 1971–1980, World Scientific Publishing Co.: Singapore, 1980.

Prigogine I. Time, structure and fluctuations: Nobel lecture in chemistry // Brussels. 1977. (Free Univ. of Brussels prepr.)

Prigogine I. Time, structure and fluctuations: Nobel lecture in chemistry // Science. 1978. Vol. 201. P. 777–785.

Prigogine I., Stengers I. Order out of chaos: Man's new dialogue with nature. Toronto: Bantam Books, 1984. 349 p.

Pyle D.M. The global impact of the Minoan eruption of Santorini, Greece // Environmental Geology. 1996. Vol. 30, No. 1-2. P. 59-61.

Qiu B. Kuroshio extension variability and forcing of the Pacific decadal oscillations: responses and potential feedback // J. Phys. Oceanogr. 2003. Vol. 33, No. 12. P. 2465–2482.

Ranguelov B., Dimitrova S., Gospodinov D. et al. Fractal properties of the mediterranean seismotectonic model for seismic hazard assessment // Annual, Geology and Geophysics. Sofia. 2003. Vol. 46, Part 1. P. 397–401.

Reif F. Statistical physics, Berkeley physics course. Vol. 5. Moscow: Nauka, 1977. 352 p. In Russian.

Richter C.F. Discussion of paper by V.I. Keylis-Borok and L.N. Malinovskaya, 'One regularity in the occurrence of strong earthquakes' // J. Geophys. Res. 1964. Vol. 69.

Richter C.F. Natural History. December 1969. P. 44.

Ruddiman W.F., Shackleton N.J., McIntyre A. North Atlantic sea-surface temperatures for the last 1.1 million years // North Atlantic Paleoceanography, Spec. Publ., 21, edited by C.P. Summerhayes and N.J. Shackleton, P. 155-173, Geological Society of America, Boulder, Colo., 1986.

Runcorn S. K., Wilkins G.A., Groten L. et al. The excitation of the Chandler Wobble surveys in Geophys. // 1988. Vol. 9. P. 419–449.

Saffman P.G. Vortex dynamics. Cambridge: Cambridge Univ. press, 1992.

Saffman P.G. Vortex models of isotropic turbulence // Phil. Trans. R. Soc. Lond. 1997. Vol. 355. P. 1949–1956.

Savelieva N.I., Semiletov I.P., Weller G.E. et al. Climate change in the Northern Asia in the second half of the 20th century // Pacif. Oceanogr. 2004. Vol. 2, No. 1/2. P. 74–84.

Sedov L.I. Mechanics of continuous medium. Vol. 2. Moscow: Nauka, 1994. 560 p. In Russian.

Sgrigna V., Conti L. A deterministic approach to earthquake prediction. International Journal of Geophysics. 2012. Vol. 2012. Article ID 406278, 20 pages, doi:10.1155/2012/406278.

Shackleton N.J. The 100,000-year ice-age cycle identified and found to lag temperature, carbon dioxide, and orbital eccentricity // Science. 2000. Vol. 289, No. 5486. P. 1897-1902.

Shamsi S., Stacey F.D. Dislocation models and seismomagnetic calculation for California 1906 and Alaska 1964 earthquakes // Bull. Seismol. Soc. Amer. 1969. Vol. 59, No. 4. P. 1435–1448.

Shimazaki K., Nakata T. Time-predictable recurrence model for large earthquakes // Geophys. Res. Lett. 1980. Vol. 7, No. 4. P. 279–282.

Simkin T., Siebert L., McClelland L., Bridge D., Newhall C., Latter J. H. Volcanoes of the World. Hutchinson Ross. Stroudsburg. 1981.

Simonenko S.V. The thermodynamics of the nonlinear shear flows // Proc. of the Intern. conf. on "Pacific Ocean environments and probing" / Ed. Y. Okada. Okinawa, 1992. Vol. 2. P. 1079–1084.

Simonenko S.V. The statistical analysis and dynamic interpretation of temperature variations near the shelf boundary // The abstracts of the second Annual Meeting of PICES. Seattle, (Wash.), 1993. P. 36.

Simonenko S.V. The kinetic energy of turbulence // The abstracts of the 20th General Assembly of the European Geophysical Society. Hamburg, 1995. (Ann. Geophys.; Vol. 13, supplement).

Simonenko S.V. Non-equilibrium statistical thermohydrodynamics // The abstracts of the VIII

Russian congr. on “Theoretical and applied mechanics”. Perm, 2001. P. 528. In Russian.

Simonenko S.V. The macroscopic non-equilibrium kinetic energies of a small fluid particle // J. Non-Equilibrium Thermodynamics. 2004. Vol. 29, No. 2. P. 107–123.

Simonenko S.V. The macroscopic non-equilibrium kinetic energies of a small fluid particle // Proc. of the Intern. conf. on “The Arctic and North Pacific” / Ed. V.I. Sergienko et al. Vladivostok, 2004a. P. 26.

Simonenko S.V. Non-equilibrium statistical thermohydrodynamics. Vol. I. Towards the foundation of the tolerance theory and the theory of dissipative non-equilibrium turbulent chaos. Vladivostok: the Pacific State University of Economics press, 2004. 120 p.

Simonenko S.V. Non-equilibrium statistical thermohydrodynamics. Vol. II. Towards the foundation of the theory of the non-equilibrium dissipative small-scale turbulence and the tolerance theory related with the quality control. Vladivostok: the Pacific State University of Economics press, 2005. 188 p.

Simonenko S.V. Generalization of the classical special formulation of the law of large numbers // Bul. of the Far Eastern Branch, RAS, 2005. No. 6. P. 77-84.

Simonenko S.V. Non-equilibrium statistical thermohydrodynamics. Foundation of the theory of the small-scale turbulence and the tolerances theory. Vladivostok: the Pacific State University of Economics press, 2006a. 334 p. In Russian.

Simonenko S.V. Non-equilibrium statistical thermohydrodynamics of turbulence. Moscow: Nauka, 2006. 174 p.

Simonenko S.V. Statistical thermohydrodynamics of irreversible strike-slip-rotational processes // Rotational processes in geology and physics. Moscow: KomKniga, 2007a. 528 p., P. 225–251. In Russian.

Simonenko S.V. Thermohydrogravidynamics of the Solar System. Nakhodka: Institute of Technology and Business press, 2007b. 159 p. In Russian.

Simonenko S.V. Thermohydrogravidynamics of the Solar System. Nakhodka: Institute of Technology and Business press, 2007. 182 p.

Simonenko S.V. Thermohydrogravidynamic evolution of the planets and the tolerances theory. Vladivostok: the Pacific State University of Economics press, 2008. 308 p. In Russian.

Simonenko S.V. Fundamentals of the thermohydrogravidynamic theory of cosmic genesis of the planetary cataclysms. Nakhodka: Institute of Technology and Business press, 2009. 273 p.

Simonenko S.V. Fundamentals of the thermohydrogravidynamic theory of cosmic genesis of the planetary cataclysms. Second Edition. Nakhodka: Institute of Technology and Business press, 2010. 281 p.

Simonenko S.V. Fundamentals of the thermohydrogravidynamic theory of cosmic genesis of the planetary cataclysms // Physics of Geospheres: 7-th All-Russia Symposium, September 5-9, 2011, Vladivostok, Russia: Proceedings / V.I. Il’ichev Pacific Oceanological Institute FEB RAS. – Vladivostok: Dalnauka, 2011. 556 p., P. 490-494. In Russian.

Simonenko S.V. Fundamentals of the non-equilibrium statistical thermohydrodynamics of turbulence // Physics of Geospheres: 7-th All-Russia Symposium, September 5-9, 2011, Vladivostok, Russia: Proceedings / V.I. Il’ichev Pacific Oceanological Institute FEB RAS. – Vladivostok: Dalnauka, 2011. 556 p., P. 495-499. In Russian.

Simonenko S.V. Fundamentals of the non-equilibrium statistical thermohydrodynamics of turbulence // The abstracts of the International conference “Fluxes and Structures in Fluids: Physics of Geospheres” / ed. by Yu. D. Chashechkin. Vladivostok, 2011. 332 p., P. 183-186.

Simonenko S.V. Fundamentals of the non-equilibrium statistical thermohydrodynamics of turbulence // Selected Papers of the International conference “Fluxes and Structures in Fluids: Physics of Geospheres” / ed. by Yu. D. Chashechkin and V. G. Baydulov. Moscow: Nauka, 2012. 192 p., P. 100-106.

Simonenko S.V. Fundamentals of the thermohydrogravidynamic theory of the global seismotectonic, volcanic and climatic variability of the Earth // Marine environmental and resources in XXI century: Abstracts of the 2nd Russia-China Symposium on Marine Science. Vladivostok: FEB RAS, 2012. 224 p., P. 165-166.

Simonenko S.V., Kogan V.Ya. Experimental and theoretical investigation of undular bore formation upstream the bank // Proc. of the Intern. conf. on “Pacific Ocean environment and probing” / Ed. Y. Okada. Okinawa, 1992. Vol. 2. P. 1275–1280.

Simonenko S.V, Lobanov V.B. Dissipative structure of turbulence in mesoscale eddy // The abstracts of the International conference “Fluxes and Structures in Fluids: Physics of Geospheres” / ed. by Yu. D. Chashechkin. Vladivostok, 2011. 332 p., P. 187-190.

Simonenko S.V, Lobanov V.B. Dissipative structure of turbulence in mesoscale eddy // Selected Papers of the International conference “Fluxes and Structures in Fluids: Physics of Geospheres” / ed. by Yu. D. Chashechkin and V. G. Baydulov. Moscow: Nauka, 2012. 192 p., P. 106-112.

Simonenko S.V., Gayko L.A., Sereda A.V. The cosmic energy gravitational genesis of the predominant short-range periods (7i/6 yr and 6j/5 yr determined by small integers i and j) of the Chandler's wobble of the Earth's pole and sea water and air temperature variations for the costal station Possyet of the Japan Sea // Marine environmental and resources in XXI century: Abstracts of the 2nd Russia-China Symposium on Marine Science. Vladivostok: FEB RAS, 2012. 224 p., P. 148-149.

Simonenko S.V., Lobanov V.B., Sereda A.V. Dissipative and energy structure of turbulence and internal gravity waves in mesoscale eddy of the Japan Sea // Marine environmental and resources in XXI century: Abstracts of the 2nd Russia-China Symposium on Marine Science. Vladivostok: FEB RAS, 2012. 224 p., P. 167-168.

Sivertsen B.J. The Minoan Eruption // The Parting of the Sea. Princeton University press, 2009. 25 p.

Sommerfeld A. Vorlesungen über theoretische physic. Bd. 2I. Mechanik der deformierbaren medien. 2. neubearb. Aufl. Leipzig, 1949.

Stanley D.J., Sheng H. Volcanic shards from Santorini (Upper Minoan ash) in the Nile delta, Egypt // Nature. 1986. Vol. 320. P. 733-735.

Suyehiro S. Earthquake prediction efforts in Japan // Atti Conf. Int. zone seismiche Area Mediterr. Matera. 16–18 Nov. 1981. Potenza. 1984. P. 41–44.

Syun-Ichi A. Role of the International Arctic Research Center (IARC) in the arctic science community // Proc. of the Intern. conf. on "The Arctic and North Pacific" / Ed. V. I. Sergienko et al. Vladivostok, 2004. P. 27.

Tamrazyan G.P. About periodicity of seismic activity during the last one and half-two thousand years (as an example for Armenia) // Izv. AN SSSR. Fizika Zemli. 1962. No. 1. P. 76–85. In Russian.

Tarasov N.T., Tarasov N.V. Influence of nuclear explosions on seismic regime // Dokl. RAN. 1995. Vol. 343, No. 4. P. 543–546. In Russian.

Thompson D.W.J., Wallace J.M. The Arctic Oscillation signature in the wintertime geopotential height and temperature fields // Geophys. Res. Lett. 1998. Vol. 25, No. 9. P. 1297–1300.

Thordarson T., Larsen G. Volcanism in Iceland in historical time: Volcano types, eruption styles and eruptive history // Journal of Geodynamics. 2007. Vol. 43. P. 118–152.

Tourre Y.M., Rajagopalan B., Kushnir Y. et al. Patterns of coherent decadal and interdecadal climate signals in the Pacific basin during the 20th century // Ibid. 2001. Vol. 28. P. 2069–2072.

Trenberth K.E., Hurrel J.W. Decadal atmosphere-ocean variations in the Pacific // Climate Dynam. 1994. Vol. 9. P. 303–319.

Tugarinov A.I. General geochemistry. Moscow: Publ. office «Atomizdat», 1973. 288 p. In Russian.

Turner H.H. Monthly Not. R. Astron. Soc. Geophys. 1925. Suppl. 1. No. 6.

Tveritinova T.Yu., Vikulin A.V. Wave rotational-elastic tectonics of the planets // Rotational processes in geology and physics. Moscow: KomKniga, 2007. 528 p., P. 271–278. In Russian.

Vasilevskaya L.N., Savelieva N.I., Plotnikov V.V. Assessments of large-scale connection between the atmosphere and ice cover in the Sea of Okhotsk // Pacif. Oceanogr. 2003. Vol. 1, No. 1. P. 35–41.

Verhoogen J., Turner F.J., Weiss L.E. et al. The Earth. An introduction to physical geology. N.Y.: Holt, Rinehart and Winston, Inc., 1970.

Vikulin A.V. About conception and value of seismic risk // Computing technologies. 1992. Vol. 1, No. 3. P. 118–123. In Russian.

Vikulin A.V. Migration of the largest earthquake foci in Kamchatka and North Kuriles, reiteration of earthquakes // Volcanology and Seismology. 1992. No. 1. P. 62–69. In Russian.

Vikulin A.V. On the nature of Australian earthquakes // Volcanology and Seismology. 1994. No. 2. P. 99–108. In Russian.

Vikulin A.V. Physics of wave seismic process. Petropavlovsk-Kamchatsky: the Kamchatsky State Pedagogical University press, 2003. 151 p. In Russian.

Vikulin A.V. Seismicity and the Earth's rotation // Computing technologies. 1992. Vol. 1, No. 3. P. 124–130. In Russian.

Vikulin A.V. The world of the vortical motions. Petropavlovsk-Kamchatsky: the Kamchatsky State Technical University press, 2008. 230 p. In Russian.

Vikulin A.V., Melekestcev I.V. Vortexes and life // Rotational processes in geology and physics. Moscow: KomKniga, 2007. 528 p., P. 39–101. In Russian.

Vikulin A.V., Vikulina S.A. Regularities in distribution of earthquake centres in the region of Nankay chute. Petropavlovsk- Kamchatsky: KGS IEP AS USSR, 1989. Prepr. No. 5. 44 p. In Russian.

Von Bunsen. Aegypten's Stelle in der Weltgeschichte, 1845–57, 5 vols; Engl. tr. by C.H. Cottrell as Egypt's Place in Universal History. London, 1848–67, 5 vols.

Wang J., Ikeda M. Arctic Oscillation and Arctic sea-ice oscillation // Geophys. Res. Lett. 2000. Vol.

27, No. 9. P. 1287–1290.
Webster P.J., Yang S. Monsoon and ENSO: Selectively interactive systems // Quart. J. Roy. Meteorol. Soc. 1992. Vol. 118. P. 877–926.
Wegener A. Die entstehung der kontinente und ozeane. Braunschweig: Vieweg, 1929.
Weisbued S. Santorini volcanic ash found in Egypt // Science News. 9 November 1985.
White W.B., Cayan D.R. A global El-Niňo–Southern Oscillation wave in surface temperature and pressure and its interdecadal modulation from 1900 to 1997 // J. Geophys. Res. 2000. Vol. 105, No. C5. P. 11232–11242.
Yamagata T., Masumoto Y. Interdecadal natural climate variability in the Western Pacific and its implications in global warming // J. Meteorol. Soc. Jap. 1992. Vol. 70. P. 167–175.
Zhang Y., Wallace J.M., Battisti D.S. ENSO-like interdecadal variability: 1900-1993 // J. Climate. 1997. Vol. 10. P. 1004–1020.
Zhan F.B., Zhu Y., Ning J., Zhou J., Liang W., Xu Y. Gravity changes before large earthquakes in China: 1998–2005 // Geo-Spatial Information Science, 2011. Vol. 14, No. 1. P. 1–9.
Zhirmunsky A.V., Kuzmin V.I. Critical levels in the development of natural systems. Leningrad: Nauka, 1990. 223 p. In Russian.
Zhu Y., Zhan F.B. Medium-term earthquake forecast using gravity monitoring data: Evidence from the Yutian and Wenchuan earthquakes in China // International Journal of Geophysics, 2012. vol. 2012, article ID 307517, 6 pages, doi:10.1155/2012/307517.
Короновский Н.В., Абрамов В.А. Землетрясения: причины, последствия, прогноз // Современное естествознание: Энциклопедия. Т. 9. Науки о Земле. 2000. 368 с. – С. 113–120. In Russian without translation to English.
Мэй Ши-юн О сейсмической активности Китая // Изв. АН СССР. Сер. Геофиз. 1960. – С. 381–395. In Russian without translation to English.
Ньюкирк Г., Фрейзиэр К. Цикл солнечной активности // Физика за рубежом. Сборник научно-популярных статей. – М.: Мир, 1983. – С. 204–234. In Russian without translation to English.
Филлипас С.Ф. О некоторых закономерностях сейсмической активности северо-западной части Тихоокеанского пояса // Современные движения земной коры. – Тарту, 1965. № 2. – С. 366–375. In Russian without translation to English.
Эйгенсон М.С. О солнечном управлении вращательным движением Земли. Международный геофизический год. / Информ. бюлл. – № 1. Изд-во АН УССР, 1958. In Russian without translation to English.

CONTENTS

INTRODUCTION 3

1. THE GENERALIZED FORMULATION OF THE FIRST LAW OF THERMODYNAMICS FOR MOVING ROTATING DEFORMING COMPRESSIBLE HEAT-CONDUCTING STRATIFIED MACROSCOPIC INDIVIDUAL CONTINUUM REGION τ SUBJECTED TO THE NON-STATIONARY NEWTONIAN GRAVITATIONAL AND ELECTROMAGNETIC FIELDS 15

1.1. The generalized expression for the macroscopic kinetic energy of a small continuum region in non-equilibrium thermodynamics 15

1.2. The generalized differential formulation of the first law of thermodynamics (in the Galilean frame of reference) for non-equilibrium shear-rotational states of the deformed one-component individual finite continuum region (characterized by the symmetric stress tensor $\mathbf{T}$) moving in the non-stationary Newtonian gravitational field 22

1.3. The generalized differential formulation of the first law of thermodynamics (in the Galilean frame of reference) for non-equilibrium shear-rotational states of the deformed finite individual region of the compressible viscous Newtonian one-component continuum moving in the non-stationary gravitational field 26

1.4. Cosmic and terrestrial energy gravitational genesis of the seismotectonic (and volcanic) activity of the Earth induced by the combined cosmic (due to the energy gravitational influences of the Sun, the Moon, the planets of the Solar System and our Galaxy) non-stationary energy gravitational influences on the individual continuum region τ (of the Earth) and by the non-potential terrestrial stress forces acting on the boundary surface $\partial\tau$ of the individual continuum region τ 29

1.5. Cosmic energy gravitational genesis of the global volcanic and climate variability induced by the cosmic non-stationary energy gravitational influences on the Earth 30

1.6. Thermodynamic equilibrium of the closed thermohydrogravidynamic system 31

1.6.1. The equilibrium state of the closed thermodynamic system in classical statistical physics 31

1.6.2. The conservation law of the total energy for the closed thermohydrogravidynamic system τ in the frame of continuum model 33

1.6.3. Statistical properties of thermodynamically equilibrium subsystem in classical statistical physics 34

1.6.4. Entropy of the thermodynamic system in classical statistical physics and the Galilean principle of relativity 35

1.6.5. The condition of the thermodynamic equilibrium for the closed thermohydrogravidynamic system considered in the coordinate system K'_{sys} of the mass center C_{sys} of the thermohydrogravidynamic system under imposed conservation laws of the total energy and the total angular momentum 36

1.6.6. Angular momentum of the subsystem τ_α (macroscopic continuum region τ_α) for the non-equilibrium thermodynamic state 37

1.6.7. The conditions of the thermodynamic equilibrium for the closed thermohydrogravidynamic system (consisting of N thermohydrogravidynamic subsystems) considering in the inertial coordinate system K'_{sys} related with the mass center C_{sys} of the thermohydrogravidynamic system 39

1.6.8. The conditions of the thermodynamic equilibrium of the closed thermohydrogravidynamic system consisting of N thermohydrogravidynamic subsystem considered in the inertial coordinate system K 41

1.6.8.1. The condition of the thermodynamic equilibrium (of the closed thermohydrogravidynamic system) describing the relative movements of the mass centers of all subsystems 41

1.6.8.2. The conditions of the thermodynamic equilibrium of the closed thermohydrogravidynamic system relative to the macroscopic

non-equilibrium kinetic energies of the subsystems τ_α 42
1.7. Generalized Le Chatelier-Braun's principle for rotational thermohydrogravidynamic systems characterized by the shear-rotational states 43
1.8. The non-equilibrium statistical thermohydrogravidynamics of turbulent plasma subjected to the non-stationary gravitational and electromagnetic fields 49
2. THE COSMIC GEOLOGY 51
2.1. The total energy and the total angular momentum of the Solar System 51
2.2. Non-catastrophic model of the thermohydrogravidynamic evolution of the total energy of the subsystems of the planet ($\tau+\bar{\tau}$) subjected to the cosmic non-stationary energy gravitational influences of the Solar System and our Galaxy 55
2.2.1. Thermohydrogravidynamic evolution of the total energy E_τ of the subsystem τ bounded by the external boundary surface $\partial\tau$, on which the subsystem τ interacts with the subsystem $\bar{\tau}$ representing the atmosphere or atmosphere and hydrosphere of the planet ($\tau+\bar{\tau}$) 55
2.2.2. Thermohydrogravidynamic evolution of the total energy $E_{\bar{\tau}}$ of the subsystem $\bar{\tau}$ representing the atmosphere or atmosphere and hydrosphere of the planet ($\tau+\bar{\tau}$) 57
2.2.3. Thermohydrogravidynamic evolution of the total energy $E_{(\tau+\bar{\tau})}$ of the planet ($\tau+\bar{\tau}$) consisting from interacting (on the surface $\partial\tau$) subsystems τ and $\bar{\tau}$ (the atmosphere or atmosphere and hydrosphere of the planet ($\tau+\bar{\tau}$)) 58
2.3. Cosmic geology of the Earth (of the terrestrial planet of the Solar System) taking into account the convection in the lower geo-spheres of the Earth (of the planet), the solar radiation, the disintegration of the radio-active elements, the density differentiation, the translational, rotational, deformational and compressible movements of the tectonic plates, the creation of the new planetary fractures induced by the energy gravitational influences of the Solar System and our Galaxy 59
2.3.1. Thermohydrogravidynamic N-layer model of the non-fragmentary geo-spheres of the Earth (of the planet of the Solar System) 59
2.3.2. Thermohydrogravidynamic translational-shear-rotational N-layer tectonic model of the fragmentary geo-spheres of the Earth (of a planet of the Solar System) 65
2.3.3. The universal thermohydrogravidynamic theory of formation of the planetary fractures in the frame of the generalized differential formulation of the first law of thermodynamics and the thermohydrogravidynamic translational-shear-rotational N-layer tectonic model of the fragmentary (consisting of geo-blocks) geo-spheres of the Earth (of the planet of the Solar System) 66
3. THE COSMIC GEOPHYSICS 72
3.1. The energy gravitational influences on the Earth of the planets of the Solar System 72
3.1.1. The instantaneous energy gravitational influences on the Earth of the planets of the Solar System in the approximation of the elliptical orbits of the planets 72
3.1.2. The evaluation of the relative maximal planetary instantaneous energy gravitational influences on the Earth in the approximation of the circular orbits of the planets of the Solar System 75
3.1.3. The evaluation of the relative maximal planetary integral energy gravitational influences on the Earth in the approximation of the circular orbits of the planets of the Solar System 82
3.2. The energy gravitational influences on the Earth of the Moon 85
3.2.1. The evaluation of the relative maximal instantaneous energy gravitational influence of the Moon on the Earth in the second approximation of the elliptical orbits of the Earth and the Moon around the combined mass center $C_{3,MOON}$ of the Earth and the Moon 85
3.2.2. The evaluation of the maximal integral energy gravitational influence of the Moon on the Earth in the second approximation of the elliptical orbits of the Earth and the Moon around the combined mass center $C_{3,MOON}$ of the Earth and the Moon 90
3.3. The energy gravitational influence of the Sun on the Earth owing to the gravitational interaction of the Sun with the outer large planets (the Jupiter, the Saturn, the Uranus and the Neptune) of the Solar System 91
3.3.1. The evaluation of the relative characteristic maximal positive instantaneous energy

gravitational influences of the Sun on the Earth owing to the gravitational interaction of the Sun with the outer large planets of the Solar System 91
3.3.2. The evaluation of the maximal positive integral energy gravitational influences of the Sun on the Earth owing to the gravitational interaction of the Sun with the outer large planets in the first approximation of the circular orbits of the planets of the Solar System 97
3.4. The real cosmic energy gravitational genesis of the strong earthquakes and the global planetary cataclysms 100
3.4.1. The confirmation of the real cosmic energy gravitational genesis of preparation of earthquakes 100
3.4.2. The evidence of the integral energy gravitational influence on the Earth of the Sun (owing to the gravitational interactions of the Sun with the Jupiter τ_5 and the Saturn τ_6) and the Moon as the predominant cosmic trigger mechanism of the earthquakes preparing by the combined integral energy gravitational influence on the Earth of the Sun (owing to the gravitational interactions of the Sun with the Jupiter τ_5, the Saturn τ_6, the Uranus τ_7 and the Neptune τ_8), the Venus, the Jupiter, the Moon, the Mars and the Mercury 102
3.4.3. The catastrophic planetary configurations established by the cosmic seismology 103
3.4.3.1. The catastrophic planetary configurations related with the maximal (positive) and minimal (negative) combined integral energy gravitational influence on the Earth τ_3 of the planets of the Solar System 104
3.4.3.2. The catastrophic planetary configurations related with the maximal (positive) and minimal (negative) combined integral energy gravitational influence on the Earth τ_3 of the Sun and the planets of the Solar System 105
3.5. The generalized thermohydrogravidynamic shear-rotational, classical shear (deformational) and rotational models of the earthquake focal region τ, and the local energy and entropy prediction thermohydrogravidynamic principles determining the fractures formation in the macroscopic continuum region τ 107
3.5.1. The generalized thermohydrogravidynamic shear-rotational and the classical shear (deformational) models of the earthquake focal region based on the generalized differential formulation of the first law of thermodynamics 107
3.5.2. The rotational model of the earthquake focal region based on the generalized differential formulation of the first law of thermodynamics 111
3.5.3. The local energy and entropy prediction thermohydrogravidynamic principles determining the fractures formation in the macroscopic continuum region τ subjected to the combined integral energy gravitational influences of the planets of the Solar System, the Moon and the Sun owing to the gravitational interaction of the Sun with the outer large planets (the Jupiter, the Saturn, the Uranus and the Neptune) 114
3.5.3.1. The local energy prediction thermohydrogravidynamic principles determining the fractures formation in the macroscopic continuum region τ subjected to the combined integral energy gravitational influences of the planets of the Solar System, the Moon and the Sun owing to the gravitational interaction of the Sun with the outer large planets (the Jupiter, the Saturn, the Uranus and the Neptune) 114
3.5.3.2. The local entropy prediction thermohydrogravidynamic principle determining the fractures formation in the macroscopic continuum region τ subjected to the combined integral energy gravitational influences of the planets of the Solar System, the Moon and the Sun owing to the gravitational interaction of the Sun with the outer large planets (the Jupiter, the Saturn, the Uranus and the Neptune) 115
3.6. The cosmic energy gravitational genesis of the seismotectonic (and volcanic) activity and the global climate variability induced by the combined non-stationary cosmic energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter 116

3.6.1. Empirical time periodicities of the seismotectonic activity of the Earth 116
3.6.2. The time periodicities of the maximal (instantaneous and integral) energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter 117
3.6.2.1. The time periodicities of the maximal (instantaneous and integral) energy gravitational influences on the Earth of the system Sun-Moon 117
3.6.2.2. The time periodicities of the maximal (instantaneous and integral) energy gravitational influences on the Earth of the Venus 118
3.6.2.3. The time periodicities of the maximal (instantaneous and integral) energy gravitational influences on the Earth of the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter 119
3.6.2.4. The time periodicities of the maximal (instantaneous and integral) energy gravitational influences on the Earth of the Mars 119
3.6.2.5. The time periodicities of the periodic global seismotectonic (and volcanic) activity and the global climate variability of the Earth induced by the combined different combinations of the cosmic energy gravitational influences of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter 120
3.6.3. Cosmic energy gravitational genesis of the strongest Japanese earthquakes 124
3.6.4. The evaluated mean time periodicities 94620 years and 107568 years of the global climate variability (related with the $\mathrm{G}(a)$ - factor and $\mathrm{G}(b)$ - factor determined by the cosmic non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter) and the mean time periodicities 100845 years and 121612.5 years of the global climate variability related with the $\mathrm{G}(b)$ - factor (determined by the cosmic non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter) 125
3.6.5. Cosmic energy gravitational genesis of the modern short-term time periodicities of the Earth's global climate variability determined by the combined cosmic factors: G-factor related with the combined cosmic non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Mercury, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter; $\mathrm{G}(a)$ -factor related to the tectonic-endogenous heating of the Earth as a consequence of the periodic continuum deformation of the Earth due to the G -factor; $\mathrm{G}(b)$ -factor related to the periodic atmospheric-oceanic warming or cooling as a consequence of the periodic variable (increasing or decreasing) output of the heated greenhouse volcanic gases and the related variable greenhouse effect induced by the periodic variable tectonic-volcanic activity (activization or weakening) due to the G -factor; $\mathrm{G}(c)$ -factor related to the periodic variations of the solar activity owing to the periodic variations of the combined planetary non-stationary energy gravitational influence on the Sun 130
3.7. The cosmic energy gravitational genesis of the seismotectonic (and volcanic) activity and the global climate variability induced (owing to the G-factor, $\mathrm{G}(a)$ -factor and $\mathrm{G}(b)$ -factor) by the combined non-stationary cosmic energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun (owing to the gravitational interaction of the Sun with the Jupiter, the Saturn, the Uranus and the Neptune) 133
3.7.1. The time periodicities of the maximal (instantaneous and integral) energy gravitational influences of the Sun on the Earth owing to the gravitational interaction of the Sun with the outer large planets (the Jupiter, the Saturn, the Uranus and the Neptune) 133
3.7.1.1. The time periodicities of the maximal (instantaneous and integral) energy gravitational influences on the Earth of the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter 133
3.7.1.2. The time periodicities of the maximal (instantaneous and integral) energy

gravitational influences on the Earth of the Saturn and the Sun owing to the gravitational interaction of the Sun with the Saturn 133
3.7.1.3. The time periodicities of the maximal (instantaneous and integral) energy gravitational influences on the Earth of the Uranus and the Sun owing to the gravitational interaction of the Sun with the Uranus 134
3.7.1.4. The time periodicities of the maximal (instantaneous and integral) energy gravitational influences on the Earth of the Neptune and the Sun owing to the gravitational interaction of the Sun with the Neptune 135
3.7.1.5. The fundamental global time periodicities (related to the combined planetary, lunar and solar non-stationary energy gravitational influences on the Earth) of the Earth's periodic global seismotectonic (and volcanic) activity and the global climate variability induced by the different combinations of the cosmic non-stationary energy gravitational influences of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interaction of the Sun with the Jupiter, the Saturn, the Uranus and the Neptun 137
3.7.1.6. The thermohydrogravidynamic solution of the fundamental problem of the origin of the major 100-kyr glacial cycle (during Pleistocene) determined by the non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Jupiter and the Sun owing to the gravitational interactions of the Sun with the Jupiter, the Saturn, the Uranus and the Neptune 138
3.8. The analysis of the global seismicity and volcanic activity of the Earth from the biblical Flood (occurred in 2104 BC according to the orthodox biblical chronology) to found the forthcoming range $2020 \div 2061$ AD of the maximal seismotectonic, volcanic and climatic activities of the Earth during the past $696 \div 708$ years of the history of humankind 141
3.8.1. The foundation of the ranges of the fundamental global seismotectonic, volcanic and climatic periodicities $T_{tec,f} = T_{clim1,f} = 696 \div 708$ years and $T_{tec,f} = T_{clim2,f} = 348 \div 354$ years determined by the combined predominant non-stationary energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Jupiter and the Sun owing to the gravitational interactions of the Sun with the Jupiter and the Saturn 141
3.8.2. The evidence of the founded ranges of the fundamental global seismotectonic and volcanic time periodicities $T_{tec,f} = T_{clim1,f} = 696 \div 708$ years and $T_{tec,f} = T_{clim2,f} = 348 \div 354$ years based on the statistical analysis of the historical eruptions of the Katla and the Hekla volcanic systems in Iceland 143
3.8.2.1. The generalized formulation of the weak law of large numbers 143
3.8.2.2. The statistical analysis of eruptions of Katla volcano 144
3.8.2.3. The statistical analysis of eruptions of Hekla volcano 145
3.8.3. The cosmic energy gravitational genesis of the predominant short-range time periodicities (7i/6 years and 6j/5 years determined by small integers i and j) of the Chandler's wobble of the Earth's pole and sea water and air temperature variations 147
3.8.3.1. The cosmic energy gravitational genesis of the predominant time periodicities $T_{clim1,1} = (T_{ch})_1 \approx 6/5\,\text{yr} = 1.2$ years and $T_{clim1,2} = (T_{ch})_2 \approx 7/6\,\text{yr} = 1.1666666....$ years of the Chandler's wobble of the Earth's pole and the global climate variability induced by the combined non-stationary energy gravitational influence on the Earth of the Venus, the Mercury and the Moon 147
3.8.3.2. The combined analysis of the Chandler's wobble of the Earth's pole and the variations of sea water and air temperature during 1969-2010 AD for the costal station Possyet of the Japan Sea 150
3.8.4. The evidence of the founded range of the fundamental global periodicities $T_{tec,f} = T_{clim1,f} = 696 \div 708$ yr (of the global seismotectonic and volcanic

activities and the climate variability of the Earth) obtained from the established links between the great natural cataclysms in the ancient history of humankind from the final collapse of the ancient Egyptian Kingdom and the biblical Flood to the increase of the global seismicity and the global volcanic activity in the beginning of the 20th century and the modern increase of the global seismicity and the volcanic activity in the end of the 20th century and in the beginning of the 21st century 155
3.8.4.1. The great natural cataclysms in the history of humankind from the final collapse of the ancient Egyptian Kingdom (near 2190 BC) and the biblical Flood (occurred in 2104 BC according to the orthodox Jewish and Christian biblical chronology) 155
3.8.4.2. Linkage of the last major eruption of Thera (1450 BC) and the greatest earthquake destroyed the ancient Pontus (63 BC) 157
3.8.4.3. Linkage of the greatest earthquake destroyed the ancient Pontus (63 BC), the earthquake destroyed the ancient Greek Temple of Artemis (614 AD) and the great frost event (628 AD) related with the atmospheric veil (recorded in Europe in 626 AD) induced by the great unknown volcanic eruption 157
3.8.4.4. Linkage of the greatest earthquake destroyed the ancient Pontus (63 BC) and the great earthquakes occurred in England (1318 AD and 1343 AD), Armenia (1319 AD), Portugal (1320 AD, 1344 AD and 1356 AD) and Japan (1361 AD) 158
3.8.4.5. Linkage of the final collapse of the ancient Egyptian Kingdom (occurred near 2190 BC), the biblical Flood (occurred in 2104 BC according to the orthodox Jewish and Christian biblical chronology) and the last major eruption of Thera (1450 BC) 159
3.8.4.6. Linkage of the planetary disasters in the Central Asia (10555 BC) and in the ancient Egyptian Kingdom (10450 BC), and the greatest earthquake destroyed the ancient Pontus (63 BC) 159
3.8.4.7. Linkage of the previous great eruptions of Thera (Santorini) (between 1628 and 1450 BC), the greatest (in the United States in the past 150 years up to 1872) earthquake in Owens Valley, California (1872 AD), the eruptions of Santorini in 1866 and 1925 AD and the great eruption of Krakatau in 1883 AD) 160
3.8.4.8. Linkage of the eruption of Tambora (1815 AD) and the Thera (Santorini) eruption in the range $1700 \div 1640$ BC 161
3.8.4.9. Linkage of the increase of the global seismicity (along with the increase of the volcanic activity) in the end of the 19th century and in the beginning of the 20th century and the eruption of Thera (Santorini) between 1600 and 1500 BC 162
3.8.4.10. Linkage of the increase of the global seismicity (along with the increase of the volcanic activity) in the end of the 20th century and the eruption of Hekla (1300 AD) in Iceland and the great earthquake (1303 AD) in China 163
3.9. The forthcoming range $2020 \div 2061$ AD of the maximal seismotectonic, volcanic and climatic activities of the Earth during the past $696 \div 708$ years of the history of humankind and the related subsequent subranges (2023 ± 3 AD, 2040.38 ± 3 AD and 2061 ± 3 AD) of the increased peak global seismotectonic and volcanic activities and the climate variability of the Earth 163
4. THE SYNTHESIS OF MAIN RESULTS AND CONCLUSIONS 167
REFERENCES 187
THE SURVIVAL OF THE EURASIAN NATIONS IN THE 21ST CENTURY 202
FROM THE SCIENTIFIC EDITOR 211
ABOUT AUTHOR 218

THE SURVIVAL OF THE EURASIAN NATIONS IN THE 21ST CENTURY

Sergey V. Simonenko

Introduction

The developments of the human civilizations are the most mysterious and difficultly predictable phenomena. Considering the history of the human civilizations, one can conjecture that the survivals of civilizations depend on the political and the natural environmental (seismotectonic, volcanic and climatic) conditions. Can the world community (and especially, the scientific community) give the exact prediction of the development of the modern human civilization in the near future?

It is well known that the ancient Egyptian Kingdom declined near 2190 BC as a consequence of the long catastrophic drought related with the extraordinary decrease of the depth of the Nile. The decline of the ancient Egyptian Kingdom coincided with the small ice age in Europe. The recurrence of the next catastrophic drought occurred in Egyptian Cairo in 1200 AD during the Arabic conquest of the Egypt.

The ancient European civilization on islands Tira and Crete collapsed as a consequence of the founded (in Subsection 3.8.4.9) different distinct eruptions of Thera (Santorini): near 1665 BC (in accordance with the range 1700÷1640 BC [Betancourt, 1987; Habberten et al., 1989]), near 1613.5 BC (in accordance with the range 1627÷1600 BC [Friedrich et al., 2006]) and in the range 1584÷1555 BC (in accordance with the range 1600÷1500 BC [Antonopoulos, 1992]). These volcanic eruptions decreased the mean planetary temperature of the Earth leading to the bad harvests worldwide.

It is well known that the ancient Mayas' civilization destructed in the beginning of the ninth century AD as a consequence of the long catastrophic drought leading to the disappearance of the fresh water resources in the lakes and artificial reservoirs intended for collection of the rain-water. The destruction of the Mayas' civilization coincided with the extremely cold weather of the European history.

The cosmic geophysics [Simonenko, 2007; 2009; 2010] gives the opportunity to discover one clear sight towards these planetary catastrophes. Analyzing the seismic belts around the Pacific Ocean, the Japanese seismologist Hattory concluded [Hattory, 1977] that the characteristic time of the seismic cycle was approximately 35 years for different seismic zones. This average seismic periodicity 35 years was explained by the average value 34.5 year of the evaluated time range $33 \div 36 = 3 \times (11 \div 12)$ years [Simonenko, 2007; 2009] of the Earth's periodic seismotectonic and volcanic activity and the global climate variability induced by the combined cosmic non-stationary energy gravitational influence on the Earth of the system Sun-Moon, the Venus, the Jupiter and the Sun owing to the gravitational interactions of the Sun with the Jupiter. The established time periodicity 35 years [Hattory, 1977] of the sesmotectonic activity of various regions of the seismic zone of the Pacific Ring is in good agreement with the mean value 34.5 years of the established range $33 \div 36 = 3 \times (11 \div 12)$ years [Simonenko, 2007; 2009] of the Earth's periodic seismotectonic and volcanic activity and the global climate variability. The mean value 34.5 years (of the established range $33 \div 36$ years [Simonenko, 2007]) is also in good agreement with the evaluated [Dmitrieva and Ponomarev, 2012] empirical time periodicity 37 years characterizing the South-Eastern tropical area, Kuroshio Current region (including East China and Japan/East Seas), central and northeastern Pacific. These good agreement (of the independent studies [Hattory, 1977; Simonenko, 2007; Dmitrieva and Ponomarev, 2012]) is the real confirmation of the validity of the thermohydrogravidynamic theory [Simonenko, 2007; 2009; 2010] of the seismotectonic, volcanic and climatic evolution of the Earth.

We have the time duration 3390 years (2190+1200) between the catastrophic drought in the ancient Egyptian Kingdom (2190 BC) and the catastrophic drought in 1200 AD occurred in the Egyptian Cairo. The time duration 3390 years gets into the evaluated time range $3135 \div 3420 = 19 \times 15 \times (11 \div 12)$ years [Simonenko, 2007; p. 134] of the time periodicities of the Earth's periodic seismotectonic and volcanic activity and the global climate variability explained (in Subsection 3.6.2.5) by the combined cosmic non-stationary energy gravitational influence on the Earth of the system Sun-Moon, the Mars, the Jupiter and the Sun owing to the gravitational interactions of the Sun with the Jupiter.

We have the time duration 400 years between the catastrophic droughts related with the destruction of the ancient Mayas' civilization and with the terrible hunger in Egyptian Cairo in 1200 AD. The time duration 400 years is very close to the time periodicity 405 years = 27×15 years [Simonenko, 2007; p. 144] of the Earth's periodic seismotectonic and volcanic activity and the global climate variability determined the combined cosmic non-stationary energy gravitational influence on the Earth of the system Sun-Moon and the Mars. The revealed satisfactory correspondences of the evaluated time durations between the catastrophic droughts and the founded time periodicities [Simonenko, 2007; p. 132] of the Earth's periodic seismotectonic and volcanic activity and the global climate variability are in good agreement with the stated conclusion [Simonenko, 2007; p. 150] that these time periodicities must characterize the time variability of the quantity of the fresh water in lakes, artificial reservoirs and rivers of the Earth's continents. The revealed satisfactory correspondences are in good agreement with the cosmic geophysics [Simonenko, 2007] considering the catastrophic droughts as manifestations of the seismotectonic and volcanic activity of the Earth.

The stated hypothesis [Ilyichev and Cherepanov, 1991; p. 1371] about the recurrence of the super-earthquakes characterized by the average approximate time periodicity of 10000 years was confirmed by the foundation of the range (10032÷10944) years [Simonenko, 2007; p. 140] of the time periodicities of the Earth's periodic seismotectonic and volcanic activity and the global climate variability determined by the combined cosmic non-stationary energy gravitational influence on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter and the Sun owing to the gravitational interactions of the Sun with the Jupiter. Using the average value 10488 years of the founded range (10032÷10944) years [Simonenko, 2007; p. 140] and taking into account the documented time 10555 BC of the planetary disaster revealed in the Central Asia [Von Bunsen, 1848; p. 77-78, 88], we evaluate the time 67 BC (10488-10555=-67) of the super-earthquake in the Central Asia, which is very close to the documented time 63 BC of "the greatest earthquake ever experienced" [Cassius Dio Cocceianus] destroyed many cities of the ancient Pontus located in the Minor Asia. Among other things, this greatest Pontic earthquake (63 BC) led to the suicide of Mithridates VI of Pontus (the king of Pontus also known as Eupator Dionysius remembered as the most formidable enemy of the Roman Republic during the Mithridatic Wars) and to the final defeat of Pontus in 63 BC.

The mentioned above catastrophic events (catastrophic droughts, great volcanic eruptions, planetary disasters and super-earthquakes) in the ancient history of the humankind show that it is very important for elites and governments of the Eurasian nations to anticipate ahead of time the natural planetary cataclysms to realize the preventive precautionary measures for the evolutionary development in the 21st century. Taking into account the founded forthcoming range $2020 \div 2061\,\mathrm{AD}$ [Simonenko, 2012] of the maximal seismotectonic, volcanic and climatic activities of the Earth during the past $696 \div 708$ years of the history of humankind, we analyze the joint survival of the Eurasian nations in the 21st century.

Taking into account the modern increase of the seismotectonic and volcanic activity of the Earth [Simonenko, 2007; p. 151], we concluded [Simonenko, 2007; 2009; 2010] that the subsequent underground nuclear explosions on the Eurasian continent may initiate the super-earthquake characterized [Simonenko, 2007; p. 92] by the destructive slippage along the "Atlantiok" zone [Abramov, 1997; p. 74] penetrating the Eurasian continent from the Japan Sea to the Eurasian continent and Iceland. We can state that the more reasonable variant of survival of the Eurasian nations in the 21st century is related with the rapid ratification of the CTBT in the near future by the Eurasian states (the Democratic People's Republic of Korea, Indonesia, Iran, Israel, Egypt, Pakistan, India and China), whose ratification is necessary for the CTBT to go into force.

Taking into account the founded forthcoming range $2020 \div 2061\,\mathrm{AD}$ [Simonenko, 2012] of the maximal seismotectonic, volcanic and climatic activities of the Earth during the past $696 \div 708$ years of the history of humankind, we appeal to the elites and governments of the Eurasian nations (ratified the CTBT) to consider the possibility [Simonenko, 2010] of the subsequent integration of the Eurasian nations in the frame of the Eurasian Association (EAA) intended for the joint survival of the Eurasian states in the 21st century.

We accentuate the nonproliferation of the weapons of mass destruction on the Eurasian continent during the modern critical time period of the human existence on the Earth related with the founded forthcoming range $2020 \div 2061\,\mathrm{AD}$ [Simonenko, 2012] of the maximal seismotectonic, volcanic and climatic activities of the Earth during the past $696 \div 708$ years of the history of humankind. The final rapid ratification of the Comprehensive Nuclear-Test-Ban Treaty (CTBT) is argued to support the geopolitical equilibrium and stability in the world required for survival of the Eurasian nations in the 21st century. The establishment of the Eurasian Association (EAA) of the Eurasian states (ratified the CTBT) in a realistic perspective can facilitate the entry into force of the CTBT. Whether such responses prevail over the shorter-term modern problems of the Eurasian states depend on the awareness of the critical moment of the seismotectonic, volcanic and climatic conditions on the Earth [Simonenko, 2007; 2009; 2010, 2012].

The real cosmic seismotectonic, volcanic and climatic time periodicities and impending threats for the human existence on the Earth in the 21st century

Based on the founded cosmic geology [Simonenko, 2007; p. 71-92], we founded the 100 million years galactic time periodicity [Simonenko, 2007; p. 84] of the galactic hot ages of the maximal thermal heating [Hofmann, 1990; p. 340-341] of the Earth as a result of the Earth's periodic compressions and deformations induced by the periodic non-stationary galactic energy gravitational influences of our Galaxy on the Earth moving in the frame of the Solar System around the center of our Galaxy with the time period of 200 million years. We revealed the galactic energy gravitational genesis [Simonenko, 2007; p. 68] of each cycle (the compression, stretching and more long-lasting reduction of the tectonic motions) of the geological eras of the Earth during the latest 570 million years.

The evaluated (in the frame of the cosmic geophysics [Simonenko, 2007]) range (116325÷126900) years [Simonenko, 2007; p. 146] of the time periodicities (of the Earth's periodic seismotectonic and volcanic activity and the global climate variability) contains the empirical time periodicity 122000 [Hays et al., 1976] of the global climate variability during Pleistocene. The average time periodicity 121612.5 years [Simonenko, 2007; p. 146] of the evaluated range (116325÷126900) years is in good agreement with the empirical time periodicity 122000 years [Hays et al., 1976] of the global climate variability during Pleistocene. The founded [Simonenko, 2007; p. 138-150] main average time periodicities 94620 years, 100845 years, 107568 years and 121612.5 years (determined by the combined cosmic non-stationary integral energy gravitational influence on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter [Simonenko, 2007] and the Sun owing to the gravitational interaction of the Sun with the Jupiter) are in good agreement with the following empirical climate time periodicities: 94000 years [Hays et al., 1976], 100000 years [Muller and MacDonald, 1995; p. 107-108; Pinxian et al., 2003; p. 2553], 106000 years [Hays et al., 1976] and 122000 years [Hays et al., 1976] during Pleistocene. The revealed time periodicity 100000 years [Muller and MacDonald, 1995; p. 107-108] of the climate variability and the corresponding time variability of the carbon concentration in the Earth's sedimentary rocks [Pinxian et al., 2003; p. 2553] confirms the founded cosmic energy gravitational genesis of the corresponding time periodicity 100845 years [Simonenko, 2007; p. 148] of recurrence of the maximal seismotectonic and volcanic activity and the global climate variability related with the atmospheric-oceanic warming (due to the greenhouse effect created by the periodic tectonic-volcanic activizations) produced by the cosmic non-stationary combined energy gravitational influence on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter [Simonenko, 2007] and the Sun owing to the gravitational interaction of the Sun with the Jupiter.

Using the presented (Table 2 in Subsection 3.6.4) calculated time periodicities of the Earth's global climatic variability, we calculated [Simonenko, 2007] the average theoretical time periodicity 106160 years, which is in good agreement with the empirical time periodicity 106000 years corresponding to the main maximum of the spectrum [Hays, Imbrie and Shackleton, 1976] of the combined isotopic-oxygen variations based on the empirical data RC11 - 120 and E49 - 18. The calculated [Simonenko, 2007] average theoretical time periodicity 106160 years is in fairly good agreement with the empirical predominant time periodicity of 105000 years [Gorbarenko et al., 2011] characterizing the Okhotsk Sea productivity and lithological proxies stacks during the last 350 kyr. These good agreement (of the independent experimental and theoretical studies [Hays, Imbrie and Shackleton, 1976; Simonenko, 2007; Gorbarenko et al., 2011] is the additional confirmation of the validity of the thermohydrogravidynamic theory [Simonenko, 2007; 2009; 2010] of the seismotectonic, volcanic and climatic evolution of the Earth.

The founded range (58162.5÷63450) years [Simonenko, 2007; p. 146] of the time periodicities of the global climate variability (determined by the combined cosmic non-stationary integral energy gravitational influence on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter [Simonenko, 2007] and the Sun owing to the gravitational interaction of the Sun with the Jupiter) contains the revealed (during Pleistocene) empirical mean climate time periodicity 59000 years [Pletnev and Sukhanov, 2006; p. 701] based on the 210-m core in borehole near Honshu Island.

The stated hypothesis [Ilyichev and Cherepanov, 1991; p. 1371] about the recurrence of the super-earthquakes characterized by the average approximate time periodicity of 10000 years was confirmed by the foundation of the additional (along with the mentioned above) global time periodicity (of the Earth's periodic seismotectonic and volcanic activity and the global climate variability) 12540 years [Simonenko, 2007; p. 136] of recurrence of the maximal seismotectonic and volcanic activity and the global climate variability determined by the combined cosmic non-stationary integral energy gravitational influence on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter [Simonenko, 2007] and the Sun owing to the gravitational interaction of the Sun with the Jupiter.

Establishing the predominant solar, planetary (the Venusian and the Jupiter's) and the lunar energy gravitational influences on the Earth, we founded the cosmic energy gravitational genesis [Simonenko, 2007; 2009] of the Chandler's wobble [Chandler, 1892; p. 97-107] of the Earth's pole (and the detected oscillations [Vikulin, 2003; p. 76] of the boundary of the Pacific Ocean representing the seismic zone of the Pacific Ring) induced by the Sun (exciting the periodicity of 1 year) and the Venus, the Jupiter, the Moon and the Mercury (exciting the Chandler's periods of 405-447.25 days [Simonenko, 2009; 2010, p. 105]).

Based on the founded cosmic geophysics [Simonenko, 2007; p. 93-155], we established the short-term and long-range time periodicities [Simonenko, 2007; 2009; 2010] of the seismotectonic and volcanic activizations, the climate variabilities and the variabilities of the fresh water resources and the glacial ice of the mountain, Arctic and Antarctic glaciers of the Earth owing to the fundamental energy gravitational influences of the Sun and the Moon, the Venus, the Mars and the Jupiter. The founded time periodicities [Simonenko, 2007; 124-150] of the seismotectonic activity were confirmed by the empirical time periodicities of the strong earthquakes worldwide during the long time period of the first and the second millenniums [Abramov, 1997; Vikulin, 2003].

Unfortunately, the predicted [Simonenko, 2007; p. 154-155] Chinese 2008 earthquakes had not been detected by means of the preventive precursors and natural warning omens owing to the violation of the natural seismotectonic and volcanic processes related with the realized Chinese underground nuclear explosions. The powerful 7.8-magnitude (on Richter scale) Sichuan 2008 earthquake with the epicenter in the Venchuan region was the largest destructive seismological cataclysm after 1949 and excels the Tangshan 1976 earthquake.

We established [Simonenko, 2007] the cosmic energy gravitational genesis of the strongest Japanese earthquakes [Vikulin, 2003] by revealing the satisfactory correspondence of the empirical time periods of recurrence of the strongest Japanese earthquakes and the time periodicities determined by different Sun-Moon and planetary combinations. Taking into account the time periodicity 83 years (of recurrence of the maximal energy gravitational influences of the Jupiter on the Earth), the year 1927 AD of the Jupiter's opposition with the Earth, the time periodicity 88 years (of recurrence of the maximal combined energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter [Simonenko, 2007; 2009; 2010] and the Sun owing to the gravitational interaction of the Sun with the Jupiter) and the year 1923 AD of the last strongest Japanese earthquake in the Tokyo region, we founded [Simonenko, 2009; 2010] in advance the time range $2010 \div 2011$ AD (1927+83 $\div$ 1923+88) of the next sufficiently strong Japanese earthquake near the Tokyo region. The previous independent prediction of the strong earthquake in 2011 AD for the Kanto region was given by Prof. V.A. Abramov in 1997 AD [Abramov, 1997].

The powerful 6.6-magnitude (on Richter scale) Japanese earthquake (that occurred on March 14, 2010) near Tokyo (with the epicenter in the Fukushima Prefecture) gets into the predicted time range $2010 \div 2011$ AD [Simonenko, 2009; Simonenko, 2010]. The powerful 6.8-magnitude (on Richter scale) Japanese earthquake (that occurred on March 11, 2011) near Tokyo gets also into the predicted time range $2010 \div 2011$ AD [Simonenko, 2009; Simonenko, 2010].

The time periodicity 88 years (of the global seismotectonic and volcanic activity and the global climate variability related with recurrence of the maximal combined energy gravitational influences on the Earth of the system Sun-Moon, the Venus, the Mars, the Jupiter [Simonenko, 2007; 2009; 2010] and the Sun owing to the gravitational interaction of the Sun with the Jupiter) is in good agreement with the estimated (based on the spectral Fourier analysis) climatic time periodicity 88 years [Kalugin and Darin, 2012] obtained from the studies of sediments from Siberian and Mongolian lakes. These good agreement (of the independent experimental and theoretical studies [Abramov, 1997; Simonenko, 2007; 2009; 2010; Kalugin and Darin, 2012] is the additional confirmation of the validity of the thermohydrogravidynamic theory [Simonenko, 2007; 2009; 2010] of the seismotectonic, volcanic and climatic evolution of the Earth.

According to the cosmic geophysics [Simonenko, 2007; p. 93-155; 2009], the founded forthcoming range $2020 \div 2061\,\mathrm{AD}$ [Simonenko, 2012] of the maximal seismotectonic, volcanic and climatic activities of the Earth (during the past $696 \div 708$ years of the history of humankind) is related with the modern increase of the seismotectonic and volcanic activity [Abramov, 1997; Simonenko, 2007; 2009; 2010] and the global atmospheric-oceanic warming. This conclusion is consistent with the established [Keylis-Borok and Malinovskaya, 1964; p. 3019-3024] regularity related with the general increase of the seismotectonic activity before the strong earthquakes.

The considered (in Subsection 3.8.4) events in the ancient history of the humankind show that the catastrophic droughts, great volcanic eruptions, the planetary disasters and the super-earthquakes in the history of the humankind are the climatic and geophysical mutually related links of the one evolutionary chain determined by the combined cosmic non-stationary energy gravitational influence on the Earth. We appeal to the world community to understand the modern increase of the seismotectonic and volcanic activity of the Earth, the global atmospheric-oceanic warming and the reduction of the Earth's fresh water resources as the preventive precursors of the forthcoming super-earthquakes during the founded forthcoming range $2020 \div 2061\,\mathrm{AD}$ [Simonenko, 2012] of the maximal seismotectonic, volcanic and climatic activities of the Earth during the past $696 \div 708$ years of the history of humankind in the 21st century. The first dangerous and destructive increased peak of the global seismotectonic and volcanic activities and the climate variability of the Earth is evaluated (in Subsection 3.9) during the forthcoming subrange $2020 \div 2026\,\mathrm{AD}$ (given by (3.314)).

The elites and governments of the Eurasian nations (ratified the CTBT) have the sufficient time to consider the possibility of the subsequent integration of the Eurasian nations before the first subrange $2020 \div 2026\,\mathrm{AD}$ of the increased peak global seismotectonic and volcanic activities and the climate variability of the Earth in the 21st century.

Inadmissibility of the nuclear explosions on the Eurasian continent during the founded forthcoming range $2020 \div 2061\,\mathrm{AD}$ of the maximal seismotectonic, volcanic and climatic activities of the Earth in the 21st century

On December 6, 2006, General Assembly of the United Nations adopted a resolution underlining the necessity of the rapid signing and ratification of the Comprehensive Nuclear-Test-Ban Treaty (CTBT) accepted on the fiftieth Session of the United Nations General Assembly in 1996. Taking into account the modern increase of the seismotectonic and volcanic activity of the Earth, we founded the necessity [Simonenko, 2007; p. 155] of the total United Nations' prohibition against the furthest underground nuclear explosions breaking the fragile [Ilyichev and Cherepanov, 1991; p. 1367] lithosphere of the Earth. It was conjectured [Simonenko, 2007; p. 155] that the new underground nuclear explosions on the Eurasian continent can lead to the initiation of the possible small global planetary cataclysm during the modern increase of the seismotectonic and volcanic activity of the Earth, when the fragile Earth's crust (saturated by ample water penetrating through the tectonic fractures and cracks) is subjected to the very strong combined energy gravitational influence of the Solar System and our Galaxy. The new underground nuclear explosions may initiate the possible super-earthquakes characterized [Simonenko, 2007; p. 92] by the destructive slippage along the "Atlantiok" zone [Abramov, 1997; p. 74] penetrating the Eurasian continent from the Japan Sea to the England and Iceland. The awakened world volcanoes and the recent strong destructive earthquakes occurred in China (2008), Italy (2009), Haiti (2010), Chile (2010), New Zealand (2010), and Japan (2011) confirmed the founded increase [Simonenko, 2007; p. 151] of the modern seismotectonic and volcanic activity of the Earth. The detected oscillations [Vikulin, 2003; p. 75-76] of the boundary of the Pacific Ocean and Alpine-Himalayas' belt with the annual and Chandler's periods are the natural forerunners of the most destructive consequences of the future small global planetary cataclysm in the seismic belts of the Pacific Ocean, the European and Asian regions.

It is clear that total United Nations prohibition and tough measures against the new nuclear explosions may be achieved only by facilitating the entry into force of the CTBT in the near future before the first subrange $2020 \div 2026\,\mathrm{AD}$ of the increased peak global seismotectonic and volcanic activities and the climate variability of the Earth in the 21st century. The CTBT has so far been signed by 177 states and ratified by 138 countries. However, of the 44 states whose ratification is sufficient for the CTBT to go into force, 9 states have still not ratified the CTBT, including the Democratic People's Republic of Korea, Indonesia, Iran, Israel, Egypt, Pakistan, India, China and the United States. If the world society cannot prevent the subsequent development of the military nuclear technologies and underground nuclear explosions on the Eurasian continent then it will lead to the chain reaction of proliferation of the military nuclear technologies in the world assisting to the initiation of the possible small global planetary cataclysm in the 21st century on the Eurasian continent. It is inadmissible risk for the United Nations to permit the subsequent proliferation and development of the military technologies of production of the nuclear weapon in the world. The new underground nuclear explosions (apart from the underground nuclear explosions realized in 2006 and 2009 by the Democratic People's Republic of Korea) will increase the international political problems and will assist to the initiation of the possible small global planetary cataclysm in the 21st century on the Eurasian continent. It is clear that the key to solution of the problem of non-proliferation of the military nuclear technologies and nuclear disarmament in the 21st century is related with a sequence of simultaneous combined ratifications: by the United States and China, by India and Pakistan, by Israel, Egypt and Iran, and one-sided ratifications: by Indonesia and by the Democratic People's Republic of Korea. The survival of the Eurasian nations in the 21st century demands the final rapid ratification of the CTBT in the near future (before the first subrange $2020 \div 2026\,\text{AD}$ of the increased peak global seismotectonic and volcanic activities and the climate variability of the Earth in the 21st century) by means of the sequence of the following ratifications: by the Democratic People's Republic of Korea; by Indonesia; by Iran, Israel and Egypt; by Pakistan and India; and by China and the United States.

The entry into force of the CTBT may be achieved only by the combined efforts of the political powers of the world community and especially by the combined efforts of the Russia (ratified the CTBT), Great Britain (ratified the CTBT), France (ratified the CTBT), the United States and China as the permanent representatives of the Security Council of the United Nations. The entry into force of the CTBT is one of the most essential preconditions for the survival of the Eurasian and world nations in the 21st century.

Taking into account the modern activization of the seismotectonic and volcanic activity of the Earth, the atmospheric-oceanic warming, the melting of the Arctic ice and the mountain glaciers and the reduction of the world fresh water resources, it is reasonably for the elites and governments of the Eurasian nations (ratified the CTBT) to discuss in advance (before the first subrange $2020 \div 2026\,\text{AD}$ of the increased peak global seismotectonic and volcanic activities and the climate variability of the Earth in the 21st century) the subsequent integration of the UE, Russia and others countries of the Commonwealth of Independent States (CIS) in the frame of the Eurasian Association (EAA) of the sovereign states facilitating the entry into force of the CTBT for the joint survival of the Eurasian nations on the Eurasian continent in the 21st century.

Instead of the political confrontation related with the senseless NATO's eastward expansion in the modern historical period of the critical environmental seismotectonic, climatic and volcanic conditions on the Earth [Simonenko, 2007; p. 149], the basic precondition of the survival of the UE's, Russian and CIS' nations (ratified the CTBT) is the rapid attainment of the favorable political conditions for joint practical actions intended for development of the extraordinary measures to diminish the destructive consequences during the founded forthcoming range $2020 \div 2061\,\text{AD}$ [Simonenko, 2012] of the maximal seismotectonic, volcanic and climatic activities of the Earth in the 21st century during the past $696 \div 708$ years of the history of humankind. The additional (apart from the underground nuclear explosions realized by the Democratic People's Republic of Korea in 2006 and 2009) underground nuclear explosions on the Eurasian can initiate the increased peak of the global seismotectonic and volcanic activities and the climate variability of the Earth before the first predicted (in Subsection 3.9) subrange $2020 \div 2026\,\text{AD}$ of the increased peak global seismotectonic and volcanic activities and the climate variability of the Earth in the 21st century.

In this regard, the more reasonable variant of the survival of the Eurasian and world nations in the 21st century is related with the final rapid ratification of the CTBT in the near future by the Eurasian states (the Democratic People's Republic of Korea, Indonesia, Iran, Israel, Egypt, Pakistan, India and China) to not permit the new underground nuclear explosions, which may initiate the possible super-earthquakes on the Eurasian continent along the "Atlantiok" zone [Abramov, 1997; p. 74] penetrating the Eurasian continent from the Japan Sea to the Eurasian continent and Iceland.

Summary and conclusions

We have considered the founded real cosmic seismotectonic, volcanic and climatic time periodicities [Simonenko, 2007; 2009; 2010; 2012] and impending threats [Simonenko, 2012] for the human existence on the Earth in the 21st century. Based on the founded global time periodicity (of the Earth's periodic seismotectonic and volcanic activity and the global climate variability) 12540 years [Simonenko, 2007; p. 136] of recurrence of the maximal seismotectonic and volcanic activity and the global climate variability of the Earth and using the obtained mean adequate estimation 10502.5 BC of the planetary disaster (10555 BC) in the Central Asia [Von Bunsen, 1848, pp. 77-78, 88] and the planetary disaster (10450 BC) in ancient Egyptian Kingdom [Hancock, 1997], we have evaluated (in Subsection 3.9) the probable date (of recurrence of the same disaster) 2037.5 AD, which enter into the second obtained subrange $2037.38 \div 2043.38\,\text{AD}$ (given by (3.318) in Subsection 3.9) of the increased peak global seismotectonic and volcanic activities and the climate variability of the Earth in the 21st century. We have conjectured (in Subsection 3.9) that the modern increase of the seismotectonic and volcanic activity of the Earth, the global atmospheric-oceanic warming and the reduction of the Earth's fresh water resources may be considered as the preventive precursors of the possible small global planetary cataclysms on the Eurasian continent during the founded forthcoming range $2020 \div 2061\,\text{AD}$ [Simonenko, 2012] of the maximal seismotectonic, volcanic and climatic activities of the Earth (and on the Eurasian continent) in the 21st century during the past $696 \div 708$ years of the history of humankind.

By considering the problem of the survival of the Eurasian nations in the 21st century, we have revealed the necessity of awareness of the community of interests of the Eurasian nations during the modern planetary seismotectonic and volcanic activization of the Earth before the forthcoming range $2020 \div 2061\,\text{AD}$ [Simonenko, 2012] of the maximal seismotectonic, volcanic and climatic activities of the Earth. In this regard, it is reasonably to discuss by the elites and governments of the Eurasian nations (ratified the CTBT) the conditions for the subsequent integration of the Eurasian nations to facilitate the entry into force of the CTBT for the joint survival in the 21st century. The difficulties can be reduced if conscious efforts will be made by the governments of the Eurasian nations (ratified the CTBT) to stimulate the positive responses pointed to consolidation of the Eurasian nations.

In this regard, it is important for governments of the Eurasian nations to take conscious controlling policies appropriate for the modern increase of the seismotectonic and volcanic activity of the Earth, the global atmospheric-oceanic warming and the reduction of the Earth's fresh water resources. In realization of this, good co-ordination is needed between the Eurasian governments. Governments of the Eurasian nations can develop ahead of time the extraordinary measures to diminish the destructive consequences during the founded forthcoming range $2020 \div 2061\,\text{AD}$ [Simonenko, 2012] of the maximal seismotectonic, volcanic and climatic activities of the Earth. The additional (apart from the underground nuclear explosions realized by the Democratic People's Republic of Korea in 2006 and 2009) underground nuclear explosions on the Eurasian continent can initiate the very strong seismic activity before the first (evaluated in Subsection 3.9) dangerous and destructive increased peak $(2020 \div 2026\,\text{AD})$ of the global seismotectonic and volcanic activities and the climate variability of the Earth. In determining geopolitical priorities of the Eurasian nations in the 21st century, governments of the Eurasian nations should re-examine the balance between the national political interests and the general human (and reasonable) strategy intended for the joint survival in the 21st century on the Eurasian continent. The more reasonable variant of the survival of the Eurasian nations in the 21st century can be realized by the final rapid ratification of the CTBT in the near future by the Democratic People's Republic of Korea, Indonesia, Iran, Israel, Egypt, Pakistan, India and China. The security of life of the Eurasian nations in the 21st century rightly depends on the awareness of governments of the Eurasian states (still not ratified the CTBT) the conscious balance between of the own political interests and general political strategy for the joint survival of the Eurasian nations in the 21st century.

The world economic crisis and the anticipations [Kupchan, 2003; Khannam, 2008; Starobin, 2009; Zakaria, 2009] of a return to multipolar world and the decline of American hegemonic dominance stimulated new doubts [Stiglitz, 2010; Lelong and Cohen, 2010] about the capacities of the United States to provide the leadership for the global economic stability and advancement of the world. At the same time, the anticipations of the American decline have generated the reasonable skepticism [Ikenberry and Inoguchi, 2010] argued by "the three global advantages of a large open market, the world's reserve currency, and overwhelming military power with global reach". The deep arguments were presented also [Norrlof, 2010] for continuing American hegemonic leadership. The development of new multipolar power centers, especially the rise of China [Jacques, 2009; Inoguchi, 2009] in Asia, requires the sufficient time for creation "new principles and logics – for the organization of regional and international order" [Ikenberry and Inoguchi, 2010]. In recent years of development of the new principles and logics of the new multipolar international order, some countries have attempted to create nuclear weapon.

The Democratic People's Republic of Korea (North Korea) was evaluated [Benard and Leaf, 2010] as the world's most dangerous regime, which used the deep division (concerning to the assessment and the corresponding responses on the modern world's threats related with proliferation of the weapons of mass destruction) between the permanent members (the United States, the United Kingdom, France, Russia and China) of the UN Security Council.

The North Korea conducted the second underground nuclear explosion on 25 May 2009. This nuclear test was evaluated by the leaders of all democratic countries as the direct and reckless challenge for the international community to counter the subsequent proliferation of the weapons of mass destruction. Unfortunately, however, the reasonable recent efforts by the United States were failed in collecting of all permanent members of the UN Security Council for adequate UN's measures against the North Korea. Now the world community seeing the obvious intention of North Korea to develop in the near future the nuclear weapon.

We see that the development of multipolarity reveals the obvious uncoordinated tendentious centrifugal intentions of the main multipolar power centers related with non-proliferation control. The subsequent development of the multipolarity will produce the additional structural complexity of the multipolar power centers to control the non-proliferation of the military nuclear technologies worldwide in the 21st century. Therefore, it is necessary to ratify the Comprehensive Nuclear-Test-Ban Treaty (CTBT) by the Eurasian states (still not ratified the CTBT) before the first predicted (in Subsection 3.9) subrange $2020 \div 2026$ AD of the increased peak global seismotectonic and volcanic activities and the climate variability of the Earth in the 21st century

The new underground nuclear explosions and the subsequent proliferation and development of the military technologies of production of the nuclear weapon in the world are disagree with the ethics of survival of the Eurasian nations in the 21st century.

References

Abramov V.A. Forecasting of disastrous earthquakes // Proceedings of the Vladivostok Professor's Club. 1997. No. 1. P. 6–77. In Russian.

Antonopoulos J. The great Minoan eruption of Thera volcano and the ensuing tsunami in the Greek archipelago // Natural Hazards. 1992. No. 5. P. 153-168.

Benard A. and Leaf P. Combating Terrorism and WMD Proliferation: Not at the U.N. Security Council, http://legalworkshop.org/2010/09/24/combating-terrorism-and-wmd-proliferation-not-at-the-u-n-security-council (accessed September 24, 2010).

Betancourt P.P. Dating the Aegean Late Bronze Age with radiocarbon // Archaeometry. 1987. No. 29. P. 45-49.

Bolt B.A., Horn W.L., Macdonald G.A., Scott R.F. Geological hazards. Moscow: Publ. office "Mir", 1978. 440 p. In Russian.

Cassius Dio Cocceianus. Dio's Roman history, with an English translation by Earnest Cary, PH.D., on the basis of the version of Herbert Baldwin Foster, PH.D. In nine volumes. Vol. 3. http://www.archive.org/details/diosromanhistory03cassuoft (accessed December 30, 2010).

Chandler C. On the variation of the latitude // Astron. J. 1892. Vol. 11, No. 12. P. 97–107.

Dmitrieva E., Ponomarev V. Multiple scale pacific SST variability in terms of cluster analysis // Marine environmental and resources in XXI century: Abstracts of the 2nd Russia-China Symposium on Marine Science. Vladivostok: FEB RAS, 2012. 224 p., P. 39-40.

Friedrich W.L., Kromer B., Friedrich M., Heinemeier J., Pfeiffer T., Talamo S. Santorini eruption radiocarbon dated to 1627-1600 B.C. // Science. 28 April 2006. Vol. 312. No. 5773. P. 548.

Hancock G. Fingerprints of the Gods. Moscow: Publ. office "Veche", 1997. 496 p. In Russian.

Gorbarenko S.A., Harada N., Malakhov M.I., Velivetskaya T.A., Vasilenko Yu.P., Bosin A.A., Derkachev A.N., Goldberg E.L. Responses of the Okhotsk Sea environment and sedimentology to global climate changes at the orbital and millennial scale during the last 350 kyr // Deep-Sea Research II. 2011. doi: 10.1016/j.dsr2.2011.05.016.

Hattory S. Migration and Periodicity of Seismic Activity in the World // Bull. of Inter. Instit. of Seismol. Tokio. 1977. Vol.15. P. 33-47.

Hays J.D., Imbrie J., Shackleton N. Variations in the Earth's orbit: Pacemaker of the ice ages // Science. 1976. Vol. 194. P. 1121–1132.

Hofmann H.J. Precambrian time units and nomenclature – The geon concept // Geology. 1990. Vol. 18. P. 340–341.

Hubberten B.M., Calamiotou M., Apostolakis C., Filippakis S., Grinamis A. Radiocarbon dates from the Akrotiri excavations // Third International Congress, Thera and the Aegean World III, Santorini, Greece. 1989. Vol. 2. 4. P. 65-69.

Ikenberry G. J. and Inoguchi T. Introduction // International Relations of the Asia-Pacific. 2010. Vol. 10. No. 3. P. 383-388.

Ilyichev V.I. and Cherepanov G.P. On one possible consequence of underground nuclear tests // Dokl. AN SSSR 1991. Vol. 316. No. 6. P. 1367-1371. In Russian.

Inoguchi T. World order debates in the twentieth century: through the two-level game and the second image (reversed) // The Chinese Journal of International Politics. 2010. No. 3(2). P. 155-188.

Jacques M. When China Rules the World: The End of the Western World and the Birth of a New Global Order. New York: The Penguin Press, 2009.

Kalugin I., Darin A. High resolution geochemical signal of paleoclimate in the bottom sediments based on scanning x-ray fluorescence analysis on synchrotron radiation (XRF SR) // Marine environmental and resources in XXI century: Abstracts of the 2nd Russia-China Symposium on Marine Science. Vladivostok: FEB RAS, 2012. 224 p., P. 70.

Keylis-Borok V. and Malinovskaya L. One regularity in the occurrence of strong earthquakes // J. Geophys Res. 1964. Vol. 69. P. 3019–3024.

Khannam P. The Second World: Empires and Influence in the New Global Age. New York: Random House, 2008.

Kupchan C. The End of the American Era: U.S. Foreign Policy and the Geopolitics of the Twenty-first Century. New York: Knopf, 2003.

Lelong J.B. and Cohen S.S. The End of influence: What Happens When Other Countries Have the Money. New York: Basic Books, 2010.

Muller R., MacDonald G. Glacial cycles and orbital inclination // Nature. 1995. Vol. 377. P. 107–108.

Norrlof C. America's Global Advantage: US Hegemony and International Cooperation. New York: Cambridge University Press, 2010.

Pinxian W., Quanhong Z., Zhimin J. et al. Thirty million year deep-sea records in the South China Sea // Chinese Science Bulletin. 2003. Vol. 48, No. 23. P. 2524–2535.

Pletnev S.P., Sukhanov V.V. Dynamics of Foraminifera Community in the Sea of Japan during Two Last Million Years // Oceanology. 2006. Vol. 46, No. 5. P. 695–702. In Russian.

Simonenko S.V. Thermohydrogravidynamics of the Solar System. Nakhodka: Institute of Technology and Business press, 2007. 182 p.

Simonenko S.V. Fundamentals of the thermohydrogravidynamic theory of cosmic genesis of the planetary cataclysms. Nakhodka: Institute of Technology and Business press, 2009. 273 p.

Simonenko S.V. Fundamentals of the thermohydrogravidynamic theory of cosmic genesis of the planetary cataclysms. Second Edition. Nakhodka: Institute of Technology and Business press, 2010. 281 p.

Simonenko S.V. Fundamentals of the thermohydrogravidynamic theory of the global seismotectonic, volcanic and climatic variability of the Earth // Marine environmental and resources in XXI century: Abstracts of the 2nd Russia-China Symposium on Marine Science. Vladivostok: FEB RAS, 2012. P. 165-166.

Starobin P. After America: Narratives for the New Global Age. New York: Penguin Group, 2009.

Stiglitz J. America, Free Markets, and the Sinking of the World Economy. New York: Norton, 2010.

Vikulin A.V. Physics of wave seismic process. Petropavlovsk-Kamchatsky: the Kamchatsky State Pedagogical University press, 2003. 151 p. In Russian.

Von Bunsen. Aegypten's Stelle in der Weltgeschichte, 1845–57, 5 vols; Engl. tr. by C.H. Cottrell as Egypt's Place in Universal History. London, 1848–67, 5 vols.

Zakaria F. The Post-American World. New York: Norton, 2009.

FROM THE SCIENTIFIC EDITOR

Images recognition by multidimensional intervals

G.Sh. Tsitsiashvili

Распознавание образов с помощью многомерных интервалов

Г.Ш. Цициашвили

В работе [1] изложен алгоритм интервального распознавания образов. В случае единственного признака, характеризующего объекты первого из двух классов, строится минимальный отрезок для единственного признака, который включает в себя все объекты первого класса. Если каждый объект характеризуется несколькими признаками, строится многомерный отрезок, являющийся прямым произведением одномерных отрезков указанного типа. В качестве правила, распознающего новый объект как объект первого класса, полагается принадлежность признака (в многомерном случае - набора признаков), характеризующего этот объект, к уже построенному одномерному (многомерному) отрезку. Преимуществом алгоритма интервального распознавания образов перед известными является линейная по числу признаков и по числу объектов вычислительная сложность в его реализации. Этот алгоритм успешно применялся во многих задачах медицинской географии и экологии, в задачах метеорологии и рыболовства [2] – [9]. Он хорошо сработал, когда общее число объектов в обучающей выборке было порядка 20-30, а число признаков более 3.

Однако применительно к задачам горного дела возникла ситуация, когда единственный признак (несколько признаков), характеризующий объекты первого класса - проявления горного давления, не может прогнозироваться с помощью единственного отрезка. Иными словами есть проявления, имеющие предвестников, а есть проявления, которые не имеют предвестников. В этой ситуации единственный отрезок на множестве признаков уже не характеризует все проявления, пропуская те из них, накануне которых возникает явление так называемого молчания. В настоящей работе метод интервального распознавания учитывает особенности описанной ситуации. Он базируется на построении не одного отрезка или интервала, а нескольких непересекающихся интервалов, внутри которых на множестве признаков содержатся точки, характеризующие объекты первого класса. Тем самым объекты первого класса разбиваются на классы, для каждого из которых распознавание производится отдельно. Если исходная выборка на каждом шаге пополняется новым объектом, то тогда возникает последовательность классификаций объектов первого класса, которую можно характеризовать как иерархическую классификацию.

Пусть первый класс объектов характеризуется набором вещественных чисел

$B = \{b_j, 1 \le j \le m\}$,

а второй класс объектов набором вещественных чисел

$$A = \{a_i, 1 \le i \le n\}, -\infty, \infty \in A,$$

причем m много меньше n. Пусть вещественные числа $c,$ d удовлетворяют неравенству $c \le d$. Определим интервал (c, d) условием $(c, d) = \{f: c < f < d\}$, если $c < d$. Если же $c = d$, то полагаем, что интервал (c, d) состоит из единственной точки $c = d.$ Построим следующее правило распознавания объекта b набора B. Каждому числу $b \in B$ сопоставим два числа

$$k(b) = max\{a \in A: a \le b\},$$

$$r(b) = min\{a \in A: a \ge b\}.$$

#

В результате вокруг каждого числа $b \in B$ построен интервал $(k(b), r(b))$.

Лемма 1. *Если* b_i, $b_j \in B$, *то интервалы* $(k(b_i), r(b_i))$, $(k(b_j), r(b_j))$ *либо совпадают, либо не пересекаются.*

Доказательство. Пусть между точками b_i, b_j на вещественной оси нет точек набора A, тогда по построению интервалы $(k(b_i), r(b_i))$, $(k(b_j), r(b_j))$ совпадают. Наоборот, если между точками b_i, b_j на вещественной оси имеются точки набора A, тогда по построению интервалы $(k(b_i), r(b_i))$, $(k(b_j), r(b_j))$ не пересекаются. Таким образом, точки набора b разбиваются на классы (эквивалентности) по их принадлежности совпадающим интервалам. Лемма доказана.

Предположим теперь, что множество A состоит из n объектов, причем каждый объект i характеризуется l-мерным вектором $u_i = (a_i^1, \dots, a_i^l)$. Аналогично считаем, что множество B состоит из m объектов, причем каждый объект j характеризуется l-мерным вектором $b_j = (b_j^1, \dots, b_j^l)$. Определим интервал $\left(k\left(b_j^t\right), r\left(b_j^t\right)\right)$ равенством

$k(b_j^t) = max\{a_i^t: \ a_i^t \le b_j^t, 1 \le i \le n\}$,

$r(b_j^t) = \min\{a_i^t: \ a_i^t \ge b_j^t, 1 \le i \le n\}$.#

По этим интервалам построим l-мерный интервал, являющийся их прямым произведением

$$\otimes_{t=1}^{l} \left(k(b_i^t), \quad r(b_i^t)\right).$$

Лемма. *Если* $1 \le i \ne j \le m$, *то* $l-$ *мерные интервалы* $\otimes_{t=1}^{l} \left(k(b_i^t), \quad r(b_i^t)\right)$, $\otimes_{t=1}^{l} \left(k\left(b_j^t\right), \quad r\left(b_j^t\right)\right)$ *либо совпадают, либо не пересекаются.*

Доказательство. Действительно, по построению для любого t, $1 \le t \le l$, одномерные интервалы $\left(k(b_i^t), \quad r(b_i^t)\right), \left(k\left(b_j^t\right), \quad r\left(b_j^t\right)\right)$ либо совпадают, либо не пересекаются. Если эти одномерные интервалы при всех t, $1 \le t \le l$, совпадают, то совпадают и их прямые произведения $\otimes_{t=1}^{l} \left(k(b_i^t), r(b_i^t)\right)$, $\otimes_{t=1}^{l} \left(k\left(b_j^t\right), r\left(b_j^t\right)\right)$. В противном случае хотя бы при одном t эти интервалы не пересекаются и значит не пересекаются их прямые произведения. Таким образом, вектора набора B разбиваются на подмножества (классы эквивалентности) по их принадлежности к совпадающим $l-$ мерным интервалам. Лемма доказана.

Предположим теперь, что на вход нашей распознающей системы поступают -мерные вектора $(c_1(n, 1), \dots, c_1(n, l))$, причем каждый из этих векторов принадлежит либо множеству A, либо множеству B. Пусть на шаге 0 в систему введено два $l-$ мерных вектора $(+\infty, \dots, +\infty)$, $(-\infty, \dots, -\infty) \in A$. Предположим, что n_0 - первый шаг, на котором $[(c]_{n_0,1}, \dots, c_{n_0,l}) \subset B$, тогда строится первый l-мерный интервал, содержащий $[(c]_{n_0,1}, \dots, c_{n_0,l})$.

Далее пусть на шаге $n > n_0$ вектор $(c_{n,1}, \dots, c_{n,l}) \in A$. Тогда если он не принадлежит ни одному из уже построенных интервалов, то система этих интервалов сохраняется. Если же $[(c]_1(n, 1), \dots, c_1(n, l))$ принадлежит одному из уже существующих интервалов, то тогда этот интервал разбивается на подинтервалы по известному правилу. Пусть теперь на шаге $n > n_0$ вектор $(c_{n,1}, \dots, c_{n,l}) \in B$. Тогда если он не принадлежит ни одному из уже построенных интервалов, то строится новый интервал, содержащий этот вектор. В противном случае система интервалов на данном шаге сохраняется.

Замечание. *В результате такого построения на шаге* $n > n_0$ *образуется либо новый интервал, содержащий* $[(c]_{\downarrow}(n,1), \dots, c_{\downarrow}(n,l)$ *), либо вектор* $[(c]_{\downarrow}(n,1), \dots, c_{\downarrow}(n,l)$ *) попадает в одну из компонент разбиения. Тем самым данные вектора подчиняются описанной выше иерархической классификации.*

Список литературы

1. Цициашвили Г.Ш., Болотин Е.И. Разработка быстрого алгоритма распознавания образов в приложении к задачам прогнозирования // Информатика и системы управления. 2010. № 2. С. 25-27.
2. Болотин Е.И., Цициашвили Г.Ш., Голычева И.В. Некоторые аспекты и перспективы факторного прогнозирования эпидемического проявления очагов клещевого энцефалита на основе многомерного анализа временных рядов // Паразитология. 2002. Т. 36, № 2. С. 89-95.
3. Болотин Е.И., Цициашвили Г.Ш., Бурухина И.Г., Голычева И.В. Возможности факторного прогнозирования заболеваемости клещевым энцефалитом в Приморском крае // Паразитология. 2002. Т. 36, № 4. С. 280-285.
4. Болотин Е.И., Цициашвили Г.Ш. Пространственно временное прогнозирование функционирования очагов клещевого энцефалита // Вестник ДВО РАН. 2003. №.1. С. 5-19.
5. Шатилина Т.А., Цициашвили Г.Ш., Радченкова Т.В.Опыт использования метода интервального распознавания для прогноза экстремальной ледовитости Татарского пролива (Японское море) // Метеорология и гидрология. 2006. № 10. С. 65-72.
6. Горяинов, А.А., Шатилина Т.А., Цициашвили Г.Ш., Лысенко А.В., Радченкова Т.В. Климатические причины снижения запасов амурских лососей в 20-м столетии // Дальневосточный регион - Рыбное хозяйство. 2007. № 1,2 (6,7). С. 94-114.
7. Болотин Е.И., Цициашвили Г.Ш., Федорова С.Ю., Радченкова Т.В. Факторное временное прогнозирование критических уровней инфекционной заболеваемости // Экология человека. 2009. № 10. С. 23-29.
8. Болотин Е.И., Цициашвили Г.Ш., Федорова С.Ю. Теоретические и практические аспекты факторного прогнозирования инфекционной заболеваемости // Экология человека. 2010. № 7. С. 42-47.
9. Болотин Е.И., Ананьев В.Ю., Цициашвили Г.Ш. Прогнозирование инфекционной заболеваемости: новые подходы // Здоровье населения и среда обитания. 2010. №5. С. 15-19.

PREDOMINANT PERIODICITIES OF THE AIR TEMPERATURE FLUCTUATIONS FOR FAR EASTERN STATIONS DURING 1980-2009

G.Sh.Tsitsiashvili[1], T.A. Shatilina [2], T.V. Radchenkova[1]

1 – Office of Russian Academy Sciences, Institute for Applied Mathematics IAM FEB RAS, Vladivostok, Radio str. 7, Russia, tel. (4232) 31-23-75, E-mail: guram@iam.dvo.ru

2 – Pacific Fisheries Research Centre (TINRO), 4 Shevhenko Alley, Vladivostok 690091, Russia, E-mail: shatilina@tinro.ru

We present the analysis of the air temperature *T(t)* dynamics for the considered stations and for different months. By using the method of the smallest squares, we evaluate the coefficients *a,b* of the linear mean temperature dependences $\tau(t)=at+b$ and fluctuations

$$s=\sqrt{\frac{1}{n}\sum_{t=1}^{n}(T(t)-\tau(t))^2}\ ,$$

where *n* is the period of observation. We consider the ratio a/s characterizing the mean dependences and then select the stations and months for large and small ratio *a/s.* We analyze then the temperature oscillations for different extreme situations: the small values of *a/s* (Table 1) and the large values of *a/s* (Table 2). The analyzed (in Tables 1 and 2) time periodicities were evaluated ([1], p. 227) by taking into account the following cosmic factors: a) the Earth's tectonic-endogenous heating ([1], p. 149) related with the periodic continuum deformation induced by the cosmic non-stationary energy gravitational influences on the Earth in the frame of the generalized differential formulation of the first law of thermodynamics ([1], p. 23), b) the Earth's atmospheric-oceanic warming ([1], p. 149) (as a consequence of the natural greenhouse effect) produced by the gravity-induced periodic tectonic-volcanic activization accompanied by the increase of the atmospheric greenhouse gases concentration.

Based on the thermohydrogravidynamic theory, it was founded ([1], pp. 135-136) the recurrence of the maximal combined energy gravitational influences on the Earth of the Sun, the Moon and the Venus characterized by the time periodicity near 3 years (in the first approximation), that must lead (by taking into account the factor b) to the strong mean temperature time dependences characterized by the same time periodicity near 3 years.

Based on the experimental data about the range of the Chandler's periods (of the Chandler's wobble of the Earth's pole) during the time range 1970-1991, it was founded the statistical average time periodicity 4.91 years (of the maximal combined energy gravitational influence on the Earth of the Mercury, the Venus and the Moon) which must give (as a consequence of the factor b) the time periodicity near 5 years of the global temperature variability during 1970-1991. The time periodicity 6 years was founded ([1], p. 109) as a consequence of the Earth's tectonic-endogenous heating induced by the combined energy gravitational influences on the Earth of the Mercury, the Moon and the Jupiter (taking into account the factor a). the time periodicity 6 years was also founded ([1], p. 112) as a consequence of the combined energy gravitational influences (the factor b) of the Mercury, the Venus and the Moon on the Earth (in the second approximation). It was shown ([1], p. 113) the recurrence of the maximal combined energy gravitational influences on the Earth of the Mercury, the Venus and the Moon has the time periodicity 7 years (in the third approximation), that must lead to (by taking into account the factor b) to the strong mean temperature time dependences characterized by the same time periodicity of 7 years.

Based on the thermohydrogravidynamic theory, it was founded ([1], p. 109) the short-term time periodicity near 12 years (in the first approximation) of intensification of the Chandler's wobble of the Earth's pole and related Earth's periodic seismotectonic (and volcanic) activity and the global climate variability (as a consequence of the factor b) induced by the combined non-stationary energy gravitational influence on the Earth of the Mercury, the Moon and the Jupiter.

Based on the thermohydrogravidynamic theory, it was founded ([1], p. 226) the total range $11 \div 13.008$ years of the time periodicities of the solar activity induced by the combined energy gravitational influences on the Sun of the Jupiter, the Mercury, the Venus, the Earth and the Mars.

We calculated [2] (Tables 1, 2) the Fourier coefficients of the differences *T(t) - τ(t)* during the time range 1980-2009 for the considered periodicities 2, 3, 5, 6, 7, 10 years. We also calculate the mean value of the marked coefficients (which are larger than the critical value 0.15) for each time periodicity.

The presented analysis of the reveled [2] time ranges and distinct time periodicities of the temperature variations of the atmosphere and hydrosphere of the Earth confirm the hypothesis about the predominant time periodicities 5 years and 6 years (for obvious multimodal character of highly fluctuating time temperature dependences) and 7 years (for small multimodal character related with strong mean temperature dependences). The present study gives the confirmation of this hypothesis based on the data about the air temperature fluctuations for stations of the Far East during the time range 1980-2009.

But now it is interesting to analyze how errors of linear trend calculations influence on Fourier coefficients. For this aim we suggest and then use modified method of the coefficients calculation. It is based on the following considerations. Suppose that the function *x(t)* is defined in integer points *t=1,…,T+m+1:*

$$x(t) = \sum_{j=0}^{m} a_j t^j + \sum_{k=1}^{T} c_k \exp\left(\frac{2\pi ikt}{T}\right),$$

where i is the imaginary unit. Calculate Fourier coefficients $c_k = r_k + ij_k$ and their absolute values s_k, $k = 1,...T-1$, without a_j, $j = 0,...,m$, calculations.

Introduce the functions

$$\Delta_0 x(t) = x(t),\ \Delta_{j+1}x(t) = \Delta_j x(t+1) - \Delta_j x(t),\ j = 0,...,m,\ t = 1,...,T,$$

then

$$\Delta_{m+1}x(t) = \sum_{k=1}^{T} c_k \left[\exp\left(\frac{2\pi ik}{T}\right) - 1\right]^{m+1} \exp\left(\frac{2\pi ikt}{T}\right), t = 1,...,T,$$

and so

$$c_k = r_k + ij_k = \sum_{k=1}^{T} \frac{\Delta_{m+1}x(t)\, e^{\frac{2\pi ikt}{T}}}{T\left[e^{\frac{2\pi ik}{T}} - 1\right]^{m+1}}.$$

Denote

$$\left[\left(\cos\frac{2\pi k}{T} - 1\right) - i\sin\frac{2\pi k}{T}\right]^{m+1} = A_k + iB_k$$

where A_k, B_k are real numbers:

$$A_k = \rho_k^{m+1}\cos(m+1)\varphi_k,\ B_k = \rho_k^{m+1}\sin(m+1)\varphi_k,$$

$$\rho_k = \sqrt{\left(\cos\frac{2\pi k}{T} - 1\right)^2 + \left(\sin\frac{2\pi k}{T}\right)^2},\ \ \varphi_k = -arctg\frac{\sin\frac{2\pi k}{T}}{\cos\frac{2\pi k}{T} - 1}.$$

Then we obtain

$$r_k = \sum_{t=1}^{T} \frac{\Delta_{m+1}x(t)\left(A_k\cos\frac{2\pi kt}{T} + B_k\sin\frac{2\pi kt}{T}\right)}{T\left[\left(\cos\frac{2\pi k}{T} - 1\right)^2 + \left(\sin\frac{2\pi k}{T}\right)^2\right]^m},$$

$$j_k = -\sum_{t=1}^{T} \frac{\Delta_{m+1}x(t)\left(A_k\sin\frac{2\pi kt}{T} - B_k\cos\frac{2\pi kt}{T}\right)}{T\left[\left(\cos\frac{2\pi k}{T} - 1\right)^2 + \left(\sin\frac{2\pi k}{T}\right)^2\right]^m},$$

$$s_k = \sqrt{r_k^2 + j_k^2}, k = 1,...,T-1.$$

Analogously suppose that the function *x(t)* is defined in integer points *t=1,…,T+m+1*:

$$x(t) = \sum_{j=0}^{m} a_j t^j + \varepsilon(t),$$

where $\varepsilon(t),\ t=1,...,T+m+1,$ are independent random variables with $M\varepsilon(t)=0,\ D\varepsilon(t)=\sigma^2$. We are to estimate the parameter σ^2. It is obvious that

$$\Delta_{m+1}x(t)=\Delta_{m+1}\varepsilon(t)$$

where

$$\Delta_{m+1}\varepsilon(t)=\sum_{k=0}^{m+1}\varepsilon(t+k)\ (-1)^{m+1-k}C_{m+1}^{k},$$

consequently

$$M\Delta_{m+1}\varepsilon(t)=0,\ D\Delta_{m+1}\varepsilon(t)=F_{m+1}\sigma^2,\ F_{m+1}=\sum_{k=0}^{m+1}(C_{m+1}^{k})^2$$

and so almost surely

$$\frac{\sum_{t=1}^{T}(\Delta_{m+1}x(t))^2}{TF_{m+1}}\to\sigma^2\ ,\ T\to\infty.$$

Table 1. Fourier coefficients (calculated by modified method) of the deviation *T(t) - τ(t)* for the time periodicities 2, 3, 5, 6, 7, 10, 11, 12 years for the small values of *a/s*.

Table 2. Fourier coefficients (calculated by modified method) of the deviation *T(t) - τ(t)* for the time periodicities 2, 3, 5, 6, 7, 10, 11, 12 years for the large values of *a/s*.

Stations, Months			Time periodicities					
	2	3	5	6	7	10	11	12
Nemuro, Apr.	**0,200**	**0,192**	**0,100**	**0,189**	**0,039**	**0,049**	**0,128**	**0,187**
Nemuro, May	**0,078**	**0,218**	**0,045**	**0,149**	**0,327**	**0,149**	**0,110**	**0,081**
Abashiri, July	**0,055**	**0,070**	**0,331**	**0,250**	**0,084**	**0,086**	**0,357**	**0,391**
Asahikawa, July	**0,153**	**0,104**	**0,244**	**0,323**	**0,135**	**0,098**	**0,185**	**0,321**
Wakkanai, July	**0,122**	**0,058**	**0,396**	**0,197**	**0,018**	**0,098**	**0,510**	**0,261**
Suttsu, July	**0,222**	**0,215**	**0,105**	**0,318**	**0,026**	**0,085**	**0,183**	**0,323**
Taejon, July	**0,069**	**0,143**	**0,204**	**0,189**	**0,128**	**0,082**	**0,170**	**0,168**
Aomori, Aug.	**0,294**	**0,283**	**0,691**	**0,597**	**0,291**	**0,562**	**0,109**	**0,220**
Asahikawa, Aug.	**0,291**	**0,301**	**0,635**	**0,585**	**0,297**	**0,474**	**0,127**	**0,240**
Sapporo, Aug	**0,252**	**0,281**	**0,585**	**0,551**	**0,344**	**0,327**	**0,113**	**0,224**
Suttsu, Aug.	**0,356**	**0,273**	**0,593**	**0,573**	**0,339**	**0,243**	**0,059**	**0,213**
Urakava, Aug.	**0,328**	**0,375**	**0,612**	**0,564**	**0,357**	**0,358**	**0,098**	**0,189**
Hakodate, Aug	**0,200**	**0,192**	**0,100**	**0,189**	**0,039**	**0,049**	**0,128**	**0,187**

We also calculate the mean value of the marked coefficients (which are larger than the critical value 0.285) for each time periodicity.

Stations, Months	Time periodicities							
	2	3	5	6	7	10	11	12
Taejon, Jan.	**0,711**	**0,244**	**0,288**	**0,132**	**0,123**	**0,154**	**0,143**	**0,183**
Izuhara, Feb.	**0,319**	**0,118**	**0,056**	**0,104**	**0,361**	**0,045**	**0,479**	**0,249**
Kagoshima, Feb	**0,225**	**0,283**	**0,062**	**0,107**	**0,559**	**0,059**	**0,605**	**0,075**
Abashiri, Mar.	**0,180**	**0,257**	**0,127**	**0,075**	**0,196**	**0,034**	**0,159**	**0,243**
Tokio, Mar.	**0,160**	**0,444**	**0,047**	**0,408**	**0,156**	**0,078**	**0,059**	**0,148**
Kagoshima, Aug	**0,045**	**0,142**	**0,046**	**0,069**	**0,096**	**0,063**	**0,194**	**0,030**
Vlad-k, Sep.	**0,166**	**0,078**	**0,065**	**0,100**	**0,018**	**0,017**	**0,163**	**0,083**
Kagoshima, Sep.	**0,180**	**0,101**	**0,176**	**0,183**	**0,172**	**0,062**	**0,167**	**0,047**
Izuhara, Oct.	**0,051**	**0,158**	**0,263**	**0,120**	**0,107**	**0,091**	**0,286**	**0,137**
Fukuoka, Oct.	**0,032**	**0,152**	**0,266**	**0,041**	**0,010**	**0,039**	**0,128**	**0,121**

Consequently modified method decreases values of Fourier coefficients for small periods and so large periods with 12, 11, 10, 7, 6, 5 years become more important. It is interesting to say that the marked periodicities are not enough to obtain pikes at the curve of temperature dynamics.

The authors thank S.V. Simonenko for his suggestion to include periods 11, 12 years into our research.

References

1. Simonenko S.V. Fundamentals of the Thermohydrogravidynamic Theory of Cosmic Genesis of the Planetary Cataclysms. Edited by G. Sh. Tsitsiashvili. Nakhodka: Institute of Technology and Business press, 2010. 281 p.
2. Tsitsiashvili G.Sh., Shatilina T.A., Radchenkova T.V. Analysis of the periodicities of the air temperature fluctuations for far eastern stations during 1980-2009. International Conference “Fluxes and Structures in Fluids: Physics of Geospheres - 2011”. Selected papers. Institution of the Russian Academy of sciences A.Yu. Ishlinsky Institute for Problems in Mechanics of the RAS. Moscow. 2012. P. 131-135.

ABOUT AUTHOR

Dr. Sergey Victorovich Simonenko, physicist, researcher, geologist, geophysicist, oceanographer, hydrologist. The author has graduated from the Moscow Physical-Technical Institute, the Faculty of Aerophysics and Space Explorations (the speciality – thermodynamics and aerodynamics, the specialization – physics of oceans). In 2000 he has been appointed as a Leading Scientist of the V.I. Il’ichev Pacific Oceanological Institute, Far Eastern Branch of the Russian Academy of Sciences. In 2008 Dr. Simonenko has been inducted as an Honorary Director General of the International Biographical Centre, Cambridge, England. In 2009 he has been inaugurated as a Vice-President of the Recognition Board of the World Congress of Arts, Sciences and Communications, Cambridge, England. In 2010 he has been appointed as a Lifetime Deputy Governor of the American Biographical Institute Research Association. In 2010 he has been inducted into the Inner Circle of the International Biographical Centre “in recognition of his services to Humankind with the most Important and Vital Good (“Thermohydrogravidynamics of the Solar System”) for Survival, Greatness and Cosmic Dignity of Humankind on Earth” (IBC, Cambridge, England, 2010).

The author’s biographies are included in the international biographical publications: Who’s Who in the World (2006, 2007, 2008, 2009, 2010) published by America’s biographical publisher Marquis Who’s Who®. The author’s biographies are included in the following publications of the International Biographical Centre (IBC, Cambridge, England): 2000 Outstanding Intellectuals of the 21st Century (2006, 2007, 2008, 2009, 2010, 2011, 2012); Outstanding Scientists of the 21st Century, Inaugural Edition (2007) “for outstanding contribution in the field of Non-equilibrium Statistical Thermohydrodynamics of Turbulence and Thermohydrogravidynamics of the Solar System” (Diploma, IBC, Cambridge, England, September 2007); Cambridge Blue Book (2008/9) “for an outstanding contribution in the field of Turbulence and Water-related Cosmic Processes” (Certificate, IBC, Cambridge, England, 2nd December 2008); 2000 Outstanding Scientists (2008/2009); Dictionary of International Biography (2008, 2009, 2010); Top Two Hundred of the IBC (2010) for establishment of “the well-founded time periods of periodic tectonic activity of the Earth induced by the Sun, Moon and the planets of the Solar System” (Certificate, IBC, Cambridge, England, 26th February 2010).

“For an outstanding contribution to physics and geophysics related with the solutions of the turbulence and the Chandler’s problems” (2000 Outstanding Intellectuals of the 21st Century, IBC, Cambridge, England, 2009, p. 84), Dr. Sergey V. Simonenko has been included in 2000 Outstanding Intellectuals of the 21st Century as a Greatest Intellectual as documented in the 2000 Outstanding Intellectuals of the 21st Century, 2009, p. 115. The Governing Board of Editors of the American Biographical Institute (ABI) has selected Dr. Sergey V. Simonenko “as a Great Mind of the 21st Century” as documented in the Fourth Edition of Great Minds of the 21st Century, p. 295. “In recognition of outstanding contribution to international communities and life success for the betterment of society and services to humankind”, Dr. Sergey V. Simonenko has been selected by the Governing Board of Editors of the ABI among those to whom the Fourth Edition is dedicated as documented in the Fourth Edition (pp. cccxxx-cccxxxvi).

Dr. Simonenko has been awarded by the IBC Awards (presented on his website: www.drsergeyvsimonenkohondgibc.ru): the Pinnacle of Achievement Award “for the exceptional achievements in the arena of the turbulence problem solution” (2008); the Da Vinci Diamond “in recognition of an outstanding contribution to: solutions of turbulence & Chandler’s problems” (2008); the Lifetime Achievement Award “in recognition of an outstanding contribution to: physics of turbulence and cosmic geophysics” (2008).

Dr. Simonenko has been awarded by the following medals: the IBC Silver Medal “2000 Outstanding Intellectuals of the 21st Century” (Inscription: “GREAT BRITAIN to S V Simonenko Physicist”) in 2006; the IBC Silver Medal “Outstanding Scientists of the 21st Century” (Inscription: “GREAT BRITAIN to Dr S V Simonenko Physicist”) in 2007; the IBC Silver Medal “2000 Outstanding Intellectuals of the 21st Century” (Inscription: “To Dr. S.V. Simonenko Creator of Cosmic Geophysics”) in 2008; the IBC Lifetime Achievement Award Golden Medal (Inscription: “Presented to Dr S V Simonenko the Founder of Turbulence and Solar System Physics 2008”) in 2008; the IBC Commemorative Medal “Top Two Hundred of the IBC” (Inscription: “GB TO DR. SERGEY V. SIMONENKO HonDG IBC”) in 2008; the IBC Silver Medal “2000 Outstanding Scientists” (Inscription: “Dr. S.V. Simonenko the Founder of Cosmic Geology”) in 2008, the ABI Gold Medal for Russia (in the name of Russian people and Russia) in 2009; the ABI Medal “Great Minds of the 21st Century” (Inscription: “Dr. Sergey V. Simonenko 2009”) in 2009; the OIA’s Official Medal related with lifetime induction into the Noble Order of International Ambassadors and appointed personal title “The Honorable” (Inscription: “The Hon. Dr. Sergey V. Simonenko H.E.”) in 2009; the IBC Silver Medal “2000 Outstanding Intellectuals of the 21st Century” (Inscription: “Dr. S.V.

Simonenko Founder of Cosmic Seismology") in 2010; the World Medal of Freedom (Inscription: "The Hon. Dr. Sergey V. Simonenko. H.E. 2010") in 2010 "for significant accomplishments in the field of Cosmic Physics (Thermohydrogravidynamics)" (Citation of Honor, The Governing Board of Editors of the ABI, July 21, 2010); the IBC Silver Medal "Dictionary of International Biography" (Inscription: "Dr. S.V. Simonenko, Founder of Cosmic Climatology") in 2010; the IBC Gold Medal "Salute to Greatness" (Inscription: "Presented to Dr. S. V. Simonenko Cosmic Phys. Founder 2010") in 2010; the ABI Golden Medal "Leading Intellectuals of the World" (Inscription: "The Hon. Dr. Sergey V. Simonenko, H.E. 2010") in 2010; the IBC Silver Medal "Lifetime of Honour" (Inscription: "Dr. Sergey V Simonenko Founder of Cosmic Physics 2012") in 2012.

Dr. Sergey V. Simonenko has been inducted into the Leading Intellectuals of the World as an approved Charter Member Number 35 certified "by the following outstanding contribution to society: Foundation: Thermohydrodynamics of Turbulence and Thermohydrogravidynamics, Cosmic Geology / Geophysics / Seismology / Climatology; Solutions: Turbulence, Chandler's, 10000-year Climate Periodicity Problems" (Certificate, ABI, USA, December 31, 2010). His achievements have been recognized also in 2010 by lifetime induction into The American Biographical Institute's Great Minds of the 21st Century Hall of Fame "for outstanding accomplishments in Physics: Thermohydrodynamics and Thermohydrogravidynamics", which is subject of notice in the Fourth Edition of Great Minds of the 21st Century.

In recognition of his exceptional contributions to Physics, Dr. Simonenko has been honored in 2011 by the biographical inclusion into the Inaugural Edition of the First and Foremost of the International Biographical Centre (IBC, Cambridge, England). His efforts "in the arena of The Cosmic Physics and Earthquakes Prediction" have been recognized also in 2011 by inclusion into "Director General's Roll of Honour" (IBC, Cambridge, England, 17th September 2012).

By publishing of this monograph, Dr. Sergey V. Simonenko has initiated the Sergey V. Simonenko Global World-wide Prognostication Project intended for the global world-wide predictions of the forthcoming catastrophic seismotectonic processes of the Earth during the founded range 2020÷2061 AD [Simonenko, 2012] of the maximal seismotectonic, volcanic and climatic activities of the Earth in the 21st century during the past 696÷708 years of the history of humankind. The main object of the Global World-wide Prognostication Project is to make more precise the obtained subsequent subranges (2023±3 AD, 2040.38±3 AD and 2061 ±3 AD) of the increased peaks of the forthcoming range 2020÷2061 AD [Simonenko, 2012] of the maximal seismotectonic, volcanic and climatic activities of the Earth in the 21st century.

By publishing the previous fundamental monographs [Simonenko, 2004; 2005; 2006a; 2006; 2007a; 2007; 2008; 2009; 2010] (recognized by the world community by means of the related international awards presented on the website: dsergeyvsimonenkohondgibc.ru), the author has presented the real evidence of his potential ability to be the real head of the Global World-wide Prognostication Project. For rapid realization of the Global World-wide Prognostication Project, the author can accept the financial support in the official form from the International Organizations: the United Nations, UNESCO, the Scientific and Governmental Institutions world-wide. All possible (scientific and financial) contributions to the Sergey V. Simonenko Global World-wide Prognostication Project will be officially documented on the author's website: www.dsergeyvsimonenkohondgibc.ru and used for the subsequent development of the Project.

Although the author believes into the final satisfactory realization of the Project (before 2020 AD by the personal author's efforts in the frame of the Russian Academy of Sciences and the Ministry of Education and Science of the Russian Federation), the speed of realization of the Project may be not sufficient for the world community and the mentioned above International Organizations for the adequate control of the global world-wide natural processes during the range 2020÷2061 AD [Simonenko, 2012] of the maximal seismotectonic, volcanic and climatic activities of the Earth in the 21st century. All possible official proposals to support the Sergey V. Simonenko Global World-wide Prognostication Project should be send on the author's E-mail (sergeyvsimonenko@yahoo.com) briefly in the clear form.

The author announces officially in advance that he cannot accept the financial support from the independent anonymous persons since the Project is the matter of great concern related (not with the author's financial happiness) with the stable evolutionary development of the humankind during the forthcoming range 2020÷2061 AD [Simonenko, 2012]. Thereby, the author cannot admit that the additional scientific results (related with the corrected prognostication of the global seismicity in the range 2020÷2061 AD) will be the means of commerce. All scientific results obtained in the frame of the Sergey V. Simonenko Global World-wide Prognostication Project will be immediately published and accessible on the author's website: www.dsergeyvsimonenkohondgibc.ru in the open access for the world community.

Sergey Victorovich Simonenko

THE COSMIC ENERGY GRAVITATIONAL GENESIS OF THE INCREASE OF THE SEISMIC AND VOLCANIC ACTIVITY OF THE EARTH IN THE BEGINNING OF THE 21ST CENTURY AD

Scientific monograph

The monograph is printed by using the original-model,
which was prepared by author without the editorial preparation.
The monograph was signed in printing by 13.12.2012

The numerical printing
Registration-publishing sheets 14.3. Conventional-printer's sheets 14.7
The edition of 100 copies.

Published by the publishing-printing complex of the
Institute of Technology and Business

692900, Nakhodka, 14 Dalnya Street

Author's e-mail: sergeyvsimonenko@yahoo.com