Successive characteristic precursor before a strong earthquake and tree potentials --Plant physiology encounter with geoelectricmagnetics--

Hideo TORIYAMA

International Study Center "Before Day", Tokyo Branch 4-7-10 Zenpukuji, Suginami-ku, Tokyo, Japan,
Tel: 81-3-3399-5959, Fax: 81-3-5382-2730, E-mail: tbp-toriyama@hotmail.com

Under normal condition, tree potential shows certain patterns. Preceding earthquakes of magnitude 7 or above, anomalous potential changes were often observed throughout the period of June 1977 to September 2004. In the case of *Ulmus Keaki* tree, dramatic anomalous potential appeared during the period 17 days to 4 hours prior to a strong earthquakes (M=7.8) which occurred on July 12, 1993 at southwest off the coast of Hokkaido, northern Japan. The anomalous potential was observed five times with different patterns during June 25 to July 13. The five stages of successive characteristic anomalous tree potential suggest that five changing precursory processes precede in the hypocentric area of the strong earthquake.

1. Introduction

Earthquake occurs in the geophysical course of events covering the whole globe. The sphere of events, especially the distributions of underground epicenters, extends to between 5 to 500 Km from the earth's surface. The vicinity of the earth's surface is a biosphere which all kinds of organisms resides. Thus, one could conjecture that earthquakes and certain organisms, especially many kind of tree, which grow on the surface on the earth, would be closely related.

Between August 1992 and September 2004, the present author attempted to measure the potential of an *Ulmus* tree in the suburbs of Tokyo. During the period many small and moderate earthquakes and several large ones occurred in the area of Japan. In this paper, distinctive characteristics of tree potential anomalies prior to a strong earthquake (M=7.8) are presented together with author's comments.

2. Material and Methods

An *Ulmus Kaeki* tree which had been growing naturally for thirty years in the garden of Tokyo Branch of International Study Center "Before Day" was used for measurement of tree potential. A rectangular area (10mm x 60mm) of bark from an area the trunk of the *Ulmus* tree 2.5 m above the ground was removed with a razor, exposing green phloem tissue. A lengthwise cut in the green phloem, cambium and xylem tissue was made and a silver electrode (width: 0.5mm, length: 50mm) was inserted into the lengthwise cut. The electrode was fixed with vinyl tape and then completely covered with insulator to prevent permeation by rain, snow or dew. The silver electrode was connected to one terminal of an electric polyrecorder (EPA-121A, TOA Electronics Ltd.) with shielding wire. Another silver electrode (width: 0.5mm, length: 100mm) was buried at a depth of 1m at a point 1.5m east of the *Ulmus* tree. The underground electrode was connected with a shielding wire to another terminal of the polyrecorder. The significance of this circuit, referred to as the A-system in the measurings, is the same as that used in the case of the silk tree (Toriyama, 1994), except in terms of the material of the electrode. Next, two silver electrodes (width:0.5mm, length:50mm) were fixed to the trunk at intervals of 2.5m. Each electrode was connected to the terminals of the polyrecorder with a shielding wire. This circuit referred to as the B-system. Then, the distance from the observation post to the hypocenter of the strong earthquake (M=7.8) is about 700km.

3. Data

An outline of the date obtained is shown in Fig.2. On July 12th at 22h17m, a strong earthquake (M=7.8) occurred, indicated with an arrow. Precursory phenomena, which took place five times with different patterns, appeared about 17 days prior to the main shock. Representative data may be summed up as follows (Toriyama, 1994).

From early June through June 24, 1993, the potential of the *Ulmus* tree indicated normal trends (Fig.1a-A). However, high frequency anomalous potential were observed 7h on June 25 through 10h on July 4 (Fig.1b-A). Further, the pattern of anomalous potential changed from 10h of July 4 through 11h on July 8 (Fig.1c-A).

Furthermore, from 11h on July 8 through 22h on July 10, another type of anomalous change appeared (Fig.1d-A). Next, as shown in Fig.1e-A yet another type of anomalous change occurred 0h20m on July 11 through 5h on July 13. In the meantime the strong earthquake (M=7.8) occurred (Fig.1f). Then, after main shock the the potential returned to a pattern which was nearly normal. Finally, it may be remarked here that it is difficult to observe any relationship between the potential change of the B-system (two electrode on the *Ulmus* trunk) and precursory phenomena (3).

4. Discussion and Comments

It must be mentioned here that anomalous tree potential pattern changed five times during June 25 to July 13. The author conjecture that the remarkable variation in anomalous potential of *Ulmus* tree was closely related to precursory phenomena, which include geoelectromagnetic, geoelectric, and geophysicochemical factors. Five stages of successive characteristic anomalous tree potential suggest that five changing precursory process precede in the hypocentric area. These matters are serious problems not to be overlooked for the study of earthquake prediction.

Perhaps it is right to say at the outset that author's fundamental thought is as follows. As shown schematically in Fig.3, an irreversible process of precursor travel through the hypocentric area (P1-Pn). It is important to discriminate between the signals (P1s - Pns) and precursors themselves (p1-pn).

The precursor occur and travel multiply with geophysical, geophysicochemical, geoelectrical, geoelectromagnetical phenomena.

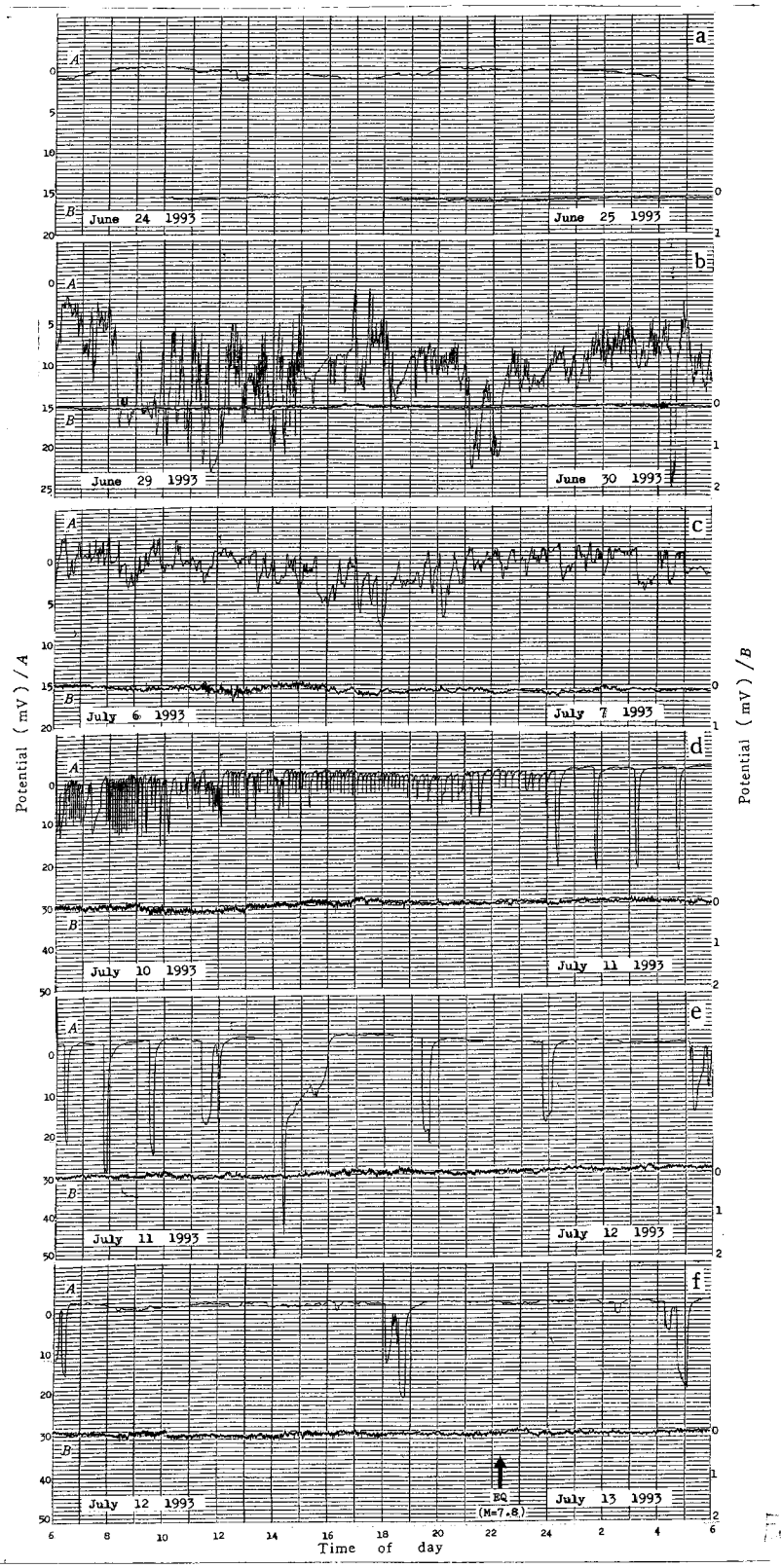

Fig.1a~f. Recording of the bioelectric potential of *Ulmus Keaki* in the field of International Study Center "Before Day",Tokyo Branch. A: potential difference between the silver electrode on the tree and that buried underground. B: potential difference between the two electrodes on the trunk of the *Ulmus* tree. Arrow (EQ) indicates the main shock of Hokkaido Southwest off Earthquake (M=7.8).

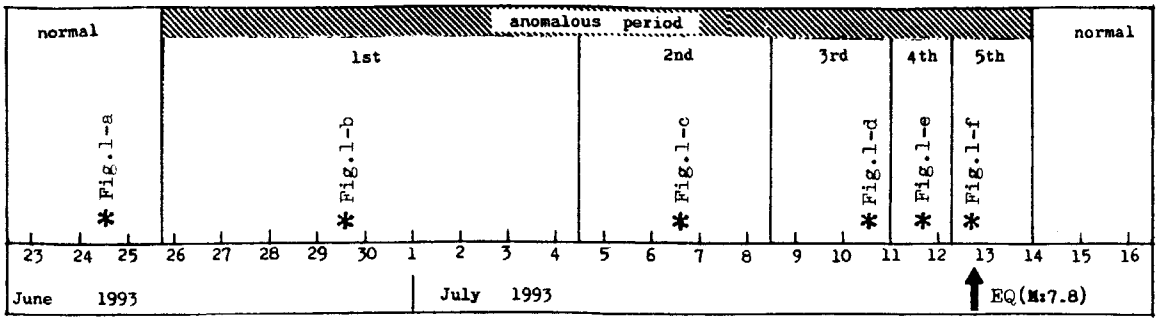

Fig. 2 Time table from June 23 through July 16, 1993. Asterisks indicate figures shown in Figs.1 a~f Arrow (EQ) indicates the main shock of Hokkaido Southwest off Earthquake (M = 7.8).

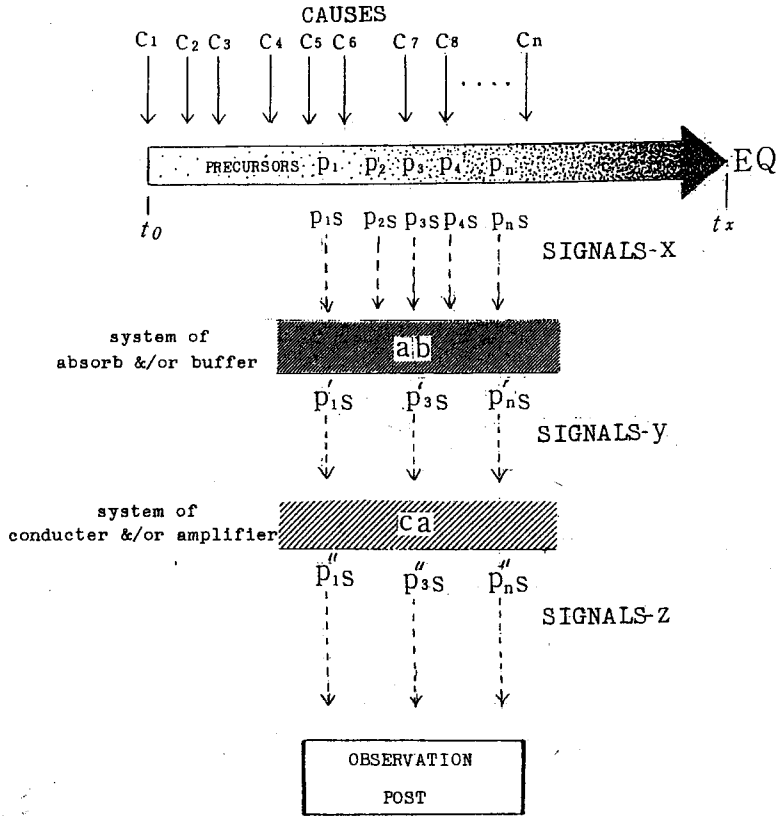

Fig.3. A scheme of earthquake precursors and their signals. to: initial time of causes beginning. tx: time at main shock.

Actually, earthquakes occur in various places, and in several types of locations. Different types of locations are likely to exhibit different precusory phenomena prior to an earthquake. That is to say, one precursor may be geoelectromagnetically, and another geoelectrochemically, dominant. It seems reasonable to suppose that essential nature of precursor (P1-Pn) develops characteristically. Our conclusion is that earthquake precursor patterns are individual and varied (Toriyama, 1991).

To put it another way, different characteristic precursors may occur on the same magnitude earthquake. In the exact sense, then, we could not observe the true state of the precursors directly for any earthquake, but we may catch the signals which reflect the precursors.

Here, let us then consider the signals. The author would like to suggest the next hypothesis, (a) Initially, signals-X (P1S-PnS) reflect the precursors (P1-Pn), (b) Signals-X,Y,Z travel as geoelectromagnetic and/or geoelectric information.

We are then apt to make an image that the signals propagate concentrically from the hypocentric area. However, the signal propagation is not so simple. Probably, two kinds of systems lie on the course from the observation post to the hypocentric area. One is the "ab-system" which prevents the signals; the other one is "ca-system" which intensifies the signals (Fig.3).

Furthermore, it seems reasonable to suppose that the details of these systems depend upon the location of hypocentric area. Geology of Japan states we have a very complicated geology (Kimura et al 1993), so the precursory signals probably do not propagate concentrically. Instead, the signals probably propagate in an irregular pattern such as an amoeba's outline. The author has thus avoided applying statistics in this investigation.

References

Kimura, T., Hayami, I. and S. Yoshida, Geology of Japan, University of Tokyo Press. (in Japanese).

Toriyama, H. and M, Kawaguchi, Anomalous potential of the Albizzia plant in the field during the 1978 Miyagi-Ken-Oki earthquake -- A report for earthquake prediction, Zishin, Second Series, 34, 1-11,1981.

Toriyama,H., Bioelectric potential of plants in the field, J. Inst. Electrostatics, 6, 276~284, 1982.

Toriyama,H., Individuality in the anomalous bioelectric potential of silk trees prior to earthquakes, Science Report of Tokyo Woman's Christian University, 94-95, 1067-1077,1991.

Toriyama,H., Possibility of earthquake prediction by the measurement of tree potential, Electromagnetic Phenomena Related to Earthquake prediction (Edited by M. Hayakawa and Y. Fuginawa), 103-114,1994.