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DATABASE OF EARTHQUAKE PRECURSORS

BY

SEISMOLOGY AND VOLCANOLOGY RESEARCH DIVISION

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地震前兆現象のデータベース

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序

1978年大規模地震対策特別措置法の施行に伴い「東海地震」予知のための体制が整えられ，巨大地震予知の道が開かれた。これを機に，巨大地震に劣らず，ある場合にはそれ以上の危険を孕む直下型地震に対しても予知の実現を求める声が興り，内外に地震災害が発生する都度その声は高まってきた。この世論の高まりを受け，遅かれ早かれ，気象庁が直下型地震への取り組みを迫られるのは必至と考えられた。

しかしながら，直下型地震予知の実現を図ることはいろいろな意味で困難であり，具体的な予知手法の研究に入るには時期尚早という感がなかったわけではない。にもかかわらず，上記のような認識の下に，気象研究所はこの課題に挑戦し「特別研究　直下型地震予知の実用化に関する総合的研究（5年計画）」に踏み切った。1984～88年にわたって実施された同研究の内容を次に示す。

1．直下型地震予知に関連した前兆現象の研究
　（ｉ）　前兆現象の評価判定の研究
　（ii）　特異地点の検出評価手法の研究
　（iii）　埋め込み式体積歪計による，特異地点の前兆現象検出手法の研究
2．直下型地震の予知観測手法の研究
　（ｉ）　機動的観測システムの開発研究

当初の計画では5年で一応の目途をつけるという予定であったが，研究を進める中で困難さがより浮き彫りにされるとともに，一部目標の設定を手直しする必要が生じた。これを受けて，平成元年度からは二期目の5年計画がスタートしている。

本報告は主として1.（ｉ）に関連するものである。ここでは，過去の地震活動の再調査，各種前兆現象の調査検討及びその信頼性，有効性の評価，異常現象の客観的判定手法の開発，地震発生予測についての統計的評価法等に関する研究が行われた。個々の研究成果についてはそれぞれ既に発表されているものもある。

上記の研究の過程で，過去に報告された各種前兆現象に関する資料の収集と調査が広汎に亘り行われた。また，研究効果を高めるため，検索，分類等が容易に行えるようそれらを整理し「前兆現象データベース」を作製した。その際，記載された前兆現象それぞれについて，有効性についての評価を行った。評価には，この研究の目的である“気象庁における直下型地震予知の業務化策定に資する”ことが多分に反映されている。

地震前兆現象の総合的理解は地震発生論の基礎であるばかりでなく，前兆現象の完全な捕捉と，それが内包する情報についての的確な判断に地震予知の成否がかかっているとも言える。このため，多くの研究機関が前兆現象に関する研究と精力的に取り組んでいる。この「前兆現象データベース」がそれらの研究の一助となることを願い，今回印刷発行し利用に供することとした。

このデータベースは我々の研究の素材のままとも言えるもので，もとより完全は期し難い。利用上の欠点，内容の不備等について御指摘をいただき，修正増補し，より良いデータベースを作り上げていきたいと思う。

平成2年3月

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Preface

This Database of Earthquake Precursors is one of the products of the five-year project, carried out from 1984 to 1988, titled "A Study on Prediction of Destructive Intraplate Earthquakes". The Database consists of a precursor file, an earthquake file and a reference file, with brief comments at the beginning.

Some such databases as this have already been published by other scientists (Rikitake, 1976, 1986 ; Niazi, 1983 ; Hamada, 1987). They included in their respective bases the statistical results such as relationship between earthquake magnitudes and time durations of precursors, or between earthquake magnitudes and the maximum distances within which earthquake precursors are observable.

Besides these databases there is a precursor compilation by the Shizuoka Prefectural Office (1985). A successful earthquake prediction is most needed for this prefecture and its neighbors, where a big interplate earthquake is predicted to be imminent. In fact, most countermeasures in Japan are taken with this expected earthquake in view.

In spite of these predecessors, we worked on a similar database again. Our standpoint is, however, rather different from the others'. First, we could not be indifferent to moderate earthquakes which might occur right below populated areas. They might cause no less damage than big earthquakes. Second, we intended our database to be a tool for the JMA's (Japan Meteorological Agency) duty service for earthquake prediction in future, although the service is now limited to the predicted earthquake stated above.

As one step toward a practical prediction, we should reexamine which of the large number of reported precursors are real, and which can meet the requirements of practical use. With our present knowledge, however, it is not an easy task to ascertain which precursory phenomenon is a real one. What we can say is, at most, whether a certain phenomenon reported as a precursor is reliable or not, judging from the description and/or figures in the reports.

There is no doubt that precursory phenomena have very much to do with the occurrence of an earthquake itself. It is indispensable not only for predicting earthquakes but elucidating the whole earthquake phenomena to get a sufficient knowledge of earthquake precursors. Properly speaking, an earthquake, its precursors and its after-effects should be brought together on a common ground.

Wyss (1989) proposes quite a number of criteria, any of which has to be satisfied by any given precursor. His criteria are severely strict. All of his criteria, of course, have been taken into accounts, though not together, in our evaluting the reliability of the collected precursors. From a practical point of view, however, they are so strict that almost all that have been reported as precursors would fail to come up to them.

In the present study, all precursors were classified into three ranks, 1, 2 and 3. The smaller the rank number, the higher the reliability. The criteria by which the ranks were determined were left to each evaluator who was responsible for each observation such as geodetic observation, seismic observaion, observation of crustal deformation. The criteria for the respective observations are described in the first part of this Database. We should have set common criteria for all observations, but we could not do so because of so many different methods of observation and analysis.

As a result, the supreme rank (rank 1) was given to 8 percent of the total precursors, about half of which were foreshocks. The result was not an unexpected one, being only a little short of what had been expected. There are, however, some difficulties for practical prediciton. Almost all precursors reported, including foreshocks, were not recognized as such prior to the main shocks.

If not recognized prior to an earthquake, a precursor would be of no use to practical prediction. Precursors should be such that they can be used to calculate, for example, the probabilities of future earthquakes. We have been making efforts to gain the know-how of prediction on the basis of the data which we counted reliable. It should be said that we have taken the initial steps rather than that we have gone a long way to the destination.

Our Database is not nearly perfect. The criteria of reliability that each of us had are very subjective. Moreover, we have in most cases consulted only original papers and reports, not communicating directly with their authors to confirm their statements. So we have decided not to publish the reliability ranks thus determined. However, several figures in this Database will help to understand our criteria for determining the reliability. Various figures which show the statistical relationships among various quantities concerning the given precursors are given in the last part of this report. We wish the readers to glance over them as well as the numerical tables.

An important thing remains to be stated. All earthquakes in the present Database are those that had, at least, one reported precursor. Earthquakes without any reported precursors are not included. We are well aware of their importance and defect of our Database due

to their absence. We are now examining such earthquakes which, if included, might occupy a large part of an earthquake file. The result will appear in the near future.

Finally, we intend to improve this Database, for which we earnestly request the readers' criticisms and suggestions.

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