

Earthquake Prediction Research in Japan, past ten years and next ten years

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When the Kobe earthquake occurred in 1995, the Research Program for Earthquake Prediction (old program) was underway in its 7th five-year term. The principal purpose of the project was to find precursors of earthquakes and to reveal their mechanisms. In spite of the intensive research in 30-year-long project, little were identified on reliable precursors. After intensive discussion among researchers, a new project named 'The New Program of Research and Observation for Earthquake Prediction' (new program) was proposed by Geodesy Council in August, 1998.

In the 7th term of the Research Program for Earthquake Prediction, which started in 1994, the following three objects were proposed. (1) To promote and refine fundamental observational research based on long- and short-term prediction technique, (2) To detect reliable precursors and to make specially designed observation to estimate the potential occurrence of earthquakes. (3) To promote fundamental researches for earthquake prediction. The overall purpose of the program was to identify precursors and try to make long- and short-term prediction into practical use.

A renovated program for earthquake prediction research started on 1999, aiming for understanding the full process of earthquakes, from preparation stage through their occurrence. In the program the importance of computer simulation for forecasting crustal activity was emphasized. Though individual projects have not altered very much, the structure of the program was fundamentally reconsidered.

The new program that started on 1999 composed of the following themes, (1) Observations and researches for the crustal activity on the preparation stage of earthquakes. (2) Refinement of the monitoring observation. (3) Simulation of crustal activity and development of new technology.

The structure of the 2nd new program for earthquake prediction research is basically the same as the previous program. The program consists of the following themes, (1) Observations and researches for the crustal activity in the preparation stage of the earthquakes. (2) Forecast simulation and monitoring observation for the crustal activity. (3) Development of new technology on observation and experiment for earthquake prediction. The program differs the previous one in two aspects. First the importance of the collaboration between researches on fundamental process and observation are emphasized. Second the simulation research is regarded as more important than in the previous program.

The most prominent achievement in the 1st new program is the establishment of the asperity model on fault planes. Large earthquakes occur at some persistent patches called asperities where plate surfaces are stuck during an interseismic period. Aseismic sliding occurs on the other area of the fault, stressing the asperities. Regarding this model as a working hypothesis many researches are underway in the 2nd program, including, for example, research on slow-slip and coupling using GPS data, research on aseismic slip using repeating microearthquakes, and research on the spatial and temporal variation of the reflection at the plate boundaries. Computer simulation of the friction and slip are intensively studied.

In the future research asperity model should be tried to be applied to inland earthquakes as well as interplate earthquakes. Using the model mid- and short-term prediction should be incorporated into simulation of crustal activity. The premonitory change in seismicity or electromagnetic phenomena should be physically understood in the framework of preparation process of earthquakes. New methodologies for monitoring stress and coupling state on the fault, overwhelming in quality or quantity, are above all expected.