

# Long-term earthquake forecasts and the seismic hazard map project in Japan

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The first large earthquake for which the long-term earthquake forecast had been publicized in Japan took place in Tokachi-Oki area off the southeastern coast of Hokkaido on 26 September 2003. The forecasted magnitude was  $M=8.0-8.2$  and that of the 2003 event was 8.0. The forecast was made in March 2003 that an occurrence probability of a large interplate earthquake in the area along the Kuril trench in the coming 30 years is 60%. Detailed studies show that the focal region of the 2003 Tokachi-Oki earthquake was slightly smaller than the forecast. Although the forecast was not perfect, it turns out to be a valid one. Fundamental information on which the forecast was made comes from historical earthquake data and paucity of written documents in the 19th century in eastern Hokkaido limits the accuracy of long-term forecasts in this region. All the sites where strong shakings were recorded, coincided with areas where probability of strong shaking had been evaluated as high on a preliminary seismic hazard map of northern Japan.

On November 29, 2004 a severe earthquake of  $M7.1$  attacked eastern Hokkaido and injured 14 people. This event had also been forecasted in March 2003. The forecasted magnitude was  $7.0-7.2$  and the event was thought to take place anywhere in a region off the coasts of Tokachi and Nemuro and the 30-yr probability was estimated as 80%.

Long-term forecasts have been publicized not only for other great and large earthquakes along oceanic trenches surrounding the Japanese islands, but also for many large shallow inland earthquakes in Japan. The first long-term forecast was made in September 1996 for an earthquake on the Itoigawa-Shizuoka Tectonic Line active fault system, which almost cuts across the central part of Japan. The forecasts are made public by the Headquarters of Earthquake Research Promotion, which was established after the devastating Kobe earthquake of 1995. One of the major present tasks of the organization is to complete the first national seismic hazard map by the end of March 2005. All damaging seismic sources in Japan will be evaluated: identifiable sources and sources whose location and occurrence time cannot be specified in advance. Even for identifiable sources, the occurrence time cannot be predicted. At first an expression -probability of earthquake occurrence in the coming several hundreds years is high- is used, but later using much short time range is recommended and now occurrence probability in 30 years is used for the forecast. For great earthquakes along oceanic trenches, whose repeat times are mostly on the order of decades, calculated probabilities may amount to several tens of percents. On the other hand, 30-year probabilities evaluated for shallow inland earthquakes, whose recurrence intervals are on the order of 1,000 to 10,000 years, are utmost 10% or so. The 30-yr probability for the Kobe earthquake of 1995 which could have been calculated prior to its occurrence, amounts to only 0.02-8%. Small probability does not necessarily mean safe; expressions, probability is high and slightly high are now used in relative sense for the forecasts of shallow inland earthquakes. Historical data are fully used for the evaluation of earthquakes along the oceanic trenches because of short recurrence interval. On the other hand, geomorphological and geological data are mainly used for shallow inland earthquakes. The size of a future earthquake is estimated from the empirical relationship between earthquake magnitude and fault length/source area. The location of most events is fairly precisely known from active fault data and historical earthquake catalogs.