Long-Term Seismic Activity and Present Microseismicity on Active Faults in Southwest Japan

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Abstract. Excavations across several active faults in southwest Japan have disclosed a series of large geologically recent earthquakes for each fault studied. Recurrence intervals range from 1,000 to 20,000 years for the Shikano, Yamasaki, Umehara, Atotsugawa, and Atera faults. Strong irregularity in the intervals is found for the Umehara fault, one of the 1891 Nobi earthquake faults. Activity on the Atotsugawa and Atera faults, two large conjugate faults, seems to be coupled. Some geologically estimated events coincide well with the historical earthquakes.

Microearthquake distribution on and around an active fault seems to depend on the mode of the latest large earthquake associated with the fault and the lapse of time from it. Difference of microseismic pattern around individual faults may reflect different stages in an earthquake cycle of a several-thousand-year period. Relatively large aseismic regions of 20-km diameter, found on both the Yamasaki and Atotsugawa faults, may be where the stresses were almost completely released during the latest large slip events about 1,100 and 120 years ago, respectively.

A series of large earthquakes represents a long-term behavior of an active fault, while medium-scale earthquakes and microseismic patterns provide a medium-term activity. The 3-4 year period fluctuation in the microseismic activity around the Yamasaki fault is one of short-term characteristics.

1. Introduction

Precise knowledge of time dependent properties of active faults is becoming increasingly important in estimating earthquake risk in a region of active faults.

Long-term activity of a fault is characterized mainly by time intervals between successive earthquakes that ruptured the entire fault or the greater part of it. With the average recurrence interval and the occurrence time of the latest event, the dates of the future earthquakes would be predicted in a long timescale.

In an inter-seismic period of large earthquakes, we have a medium-term activity of smaller events including microearthquakes. Present-day microseismicity around the region of faults must have something to do with both the most latest and forthcoming large earthquakes originating from the faults.

The purpose of this paper is to show the geologically disclosed long-term nature of active faults in southwest Japan and to discuss the microseismicity around the faults in connection with the recent large earthquakes confirmed by the former study. The first part of this paper will be devoted to the review of the trenching studies of faults. This geological method (SIEH, 1978a, b, 1981) enabled us to get more direct and detail-
ed evidence of faulting than geomorphological estimations of slip rates. The second part will deal with distribution of active faults and related microseismicity. Emphasis will be place on how the distribution pattern of microearthquakes differs from fault to fault. In the third part, we will try to quantify the medium-to-short term microseismic activity by the use of data from a long-running observation of 18 years. Finally, we will present tentative interpretations of long-, medium-, and short-term fault activities in terms of spatial and temporal patterns of seismicity.

The target area in this paper is shown in Fig. 1. The region in and around the Kinki and Chubu districts has the most dense population of active faults, and the historical seismicity shows that the probability of causing damaging earthquakes in that region is about twice as high as the average in the whole inland of Japan (Mat-

![Fig. 1. Distribution of active faults and microearthquakes in the western part of Japan. Active faults together with active folds beneath the sea are mapped based mainly on a geomorphological interpretation made by the RESEARCH GROUP FOR ACTIVE FAULTS (1980a, b). Microearthquake foci with magnitude 1.0 or above are plotted putting together all the seismicity data in 1979 compiled by each observatory or observation center attached to universities (GROUP OF COMPILATION FOR MICROSEISMICITY OF JAPAN, 1979, 1983). Trenching researches were conducted at the Shikano, Yamasaki, Nobi, Atotsugawa and Atera faults.](image-url)