Universality of slow initial phase as shown in seismograms of a foreshock of the Hyogo-ken Nanbu earthquake

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The onset of velocity seismogram of P wave is characterized as a gradual increase of amplitude named as slow initial phase. The duration of slow initial phase scales as the eventual size of an earthquake (e.g. Iio, 1995). Recently, Sato and Kanamori (1999) proposed that a circular crack model with an accelerating rupture velocity and giving a physical basis on the slow initial phase.

Seismograms of a foreshock (M3) of the 1995 Hyogo-ken Nanbu earthquake (M7.2) showed a clear slow initial phase (Katao and Iio, 1995). They also reported that four events in the same region never showed such a slow phase. Although a cause of a slow initial phase is controversial, there is a large possibility that a slow initial phase is related to a nucleation process of an earthquake. It is, thus, important to specify whether a slow initial phase is a special feature of a foreshock or not.

In order to reveal universality of a slow initial phase for M3 class earthquakes, we search all seismograms of M3 class events from 1976 to 2000 recorded at stations of Abuyama seismic network. We select 33 events with good S/N ratio in the small region around the foreshock hypocenter, 3 km x 3 km in horizontal and from 10 to 20 km in depth, to reduce propagation effects on seismograms. We have recognized no slow initial phase such as observed in the seismograms of the foreshock, indicating that M3 class events in this region shows no universality on a slow initial phase. We, therefore, conclude that the slow initial phase of the foreshock is seriously unusual. Our results show that the slow initial phase of the foreshock is generated by not propagation effects but a source effect and reflects a feature of the source process as a dynamic rupture during the nucleation process of the mainshock .