3-D velocity structure in a relatively wide region including the source area of the 2000 Western Tottori Earthquake

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1. Introduction

It can be considered that the 2000 Western Tottori Earthquake (13:30, 6 October 2000, Mj=7.3) occurred on an under-developed fault because no active fault was found in the source area. Also, both the strain rate in the latest two years (1997-1999) and the cumulative strain in the past 100 years (1883-1994) were very small in the source area (Geographical Survey Institute, 2001). Furthermore, deep low frequency earthquakes were found in the vicinity of the source area (Ohmi, 2001).

Daisen volcano, which had been active until 20,000 years ago, is located to the east of the source area. In the Yokota area to the west, volcanic activity with alkali basalt, which might have continued until Middle Pleistocene, is found. Since the seismic active zone nearly parallel to the coast line in San'in district corresponds well to the Quaternary volcanic front including Daisen volcano, etc., there might be some relationship between them such as, for example, deep fluid generated by igneous activity triggers earthquakes.

In this study we obtained 3-D velocity structure in a relatively wide region including the source area by a travel-time tomography in order to discuss relationship between the crustal structure and the occurrence of the 2000 Western Tottori Earthquake.

2. Data and method

We used data from seismic catalogues by JUNEC and JMA. The periods of the data were from 1985 to 1995 for JUNEC and from 1985 to 2001 for JMA. We selected 7,642 events which occurred in and around Chugoku, Shikoku and Kinki. The number of the station used was 271. The total number of P- and S-times was 292,884.

We inverted the data for 1-D velocity structure which was used as the initial model for the 3-D tomography. Hypocenters of the events were relocated simultaneously.

In the 3-D tomography we used a grid-type inversion. The grid intervals were 0.15 degree by 0.15 degree in the horizontal direction and 5 km in the depth. We used pseudo-bending for ray tracing.

3. Results

In the target region from central Shimane to central Tottori, the checker board initially given +/- 3 % velocity anomaly was recovered to around +/- 2 % at the depth of 10 km. The pattern of the checker board was almost recovered at the depths of 5 and 15 km. Unfortunately it was partly recovered at layers deeper than 20 km.

The resulting tomographic images show a low velocity anomaly with more than 4 % in the area including Lake Nakaumi and Daisen volcano at the depth of 5 km. We see a high velocity anomaly with 1-2 % in the northwestern Okayama to the southeast of the source area at 10 km. At the depths of 15-20 km, the source area shows a high velocity anomaly with about 2 % and a low velocity anomaly exists to the west which includes the alkali basalt area near Yokota. A low velocity anomaly with more than 2 % can be found near Daisen volcano at 30 km.

In the E-W cross section along the seismic active zone parallel to the coast line, low velocity anomalies exist in the lower crust (20-30 km) near Sambe volcano, Yokota, Daisen volcano and northern Hyogo. The area of the deep low frequency earthquakes located to the west of the source area corresponds to a low velocity anomaly.

The 2000 Western Tottori Earthquake occurred in the area between the two low velocity anomalies near Daisen volcano and the Yokota alkali basalt area.