Estimate the stress field in the region of the 2000 Western Tottori Earthquake

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To study the mechanism of large earthquakes, we tried to determine the stress field near the faults prior to and after the 2000 Western Tottori Earthquake (Mw=6.6) using the focal mechanism data from the Joint Group for Dense Aftershock Observation.

We used the data of the hypocenters and focal mechanisms of aftershocks determined by Shibitani et al (2004). Since many aftershocks did not occurred in the southern region of the aftershock area, we additionally determined the hypocenters and focal mechanisms of aftershocks occurred in this region.

We calculated the stress changes due to the slip distribution of the mainshock, estimated by Iwata and Sekiguchi (2002), using the formulas of Okada (1992). The direction of the maximum compressive stress axis calculated from the stress change was compared with the P axis direction of focal mechanisms.

We estimated the four parameters of the stress tensor, the directions of the three principal stress axes and the ratio among of the principal stress, using the stress inversion method developed by Horiuchi et al (1995). The 95% confidence limits for the parameters of the stress tensor were estimated by the method of Gephart and Forsyth (1984).

To investigate whether the pre-existing fault planes oriented in a predominant direction or not, we tried to distinguish the fault plane of aftershocks by the method of Horiuchi et al (1995), using the estimated parameters of the stress tensor. A numerical test was made by applying the method of Horiuchi et al (1995) to an artificial data set. It is found that about 70% of fault planes are distinguished from auxiliary planes and there are no events whose auxiliary planes are determined as fault planes.

In the northern two regions of the aftershock area, the 95% confidence region of ¥sigma1 (maximum compressive stress axis) distributes almost same direction. The P axes almost oriented in N120E direction, and this direction is consistent with the direction of ¥sigma1 axis. These results suggest that the stress field is almost homogeneous in these two regions after the mainshock occurred. From the comparison between the directions of the maximum compressive stress axes by the stress change and the P axes, we found that the P axes are not consistent with the maximum compressive stress axes by the stress change. Thus, it is expected that the directions of the P axes were not affected by the stress change in these two regions. From these results, it is inferred that the ¥sigma1 axis prior to the mainshock was oriented in N120E direction and the magnitude of the stress was large so that the direction of the maximum compressive stress was not modified by the stress change.

In the southern end of the mainshock fault, the 95% confidence region of ¥sigma1 distributes to east-west direction, different from that of the northern two regions of the aftershock area. The direction of the P axes almost oriented in east-west direction was consistent with the direction of maximum compressive stress axes by stress change, although the stress change was only a few MPa.. Thus, it is possible that the magnitude of initial stress prior to the mainshock was smaller than that in the northern two regions of the aftershock area.

We found that the azimuths of the estimated fault planes distribute widely in the northern region of the aftershock area. It is possible that the pre-existing fault plane distributed to the random direction in this region. On the other hand, the estimated fault plane of the aftershocks mainly oriented in N50E and N130E in the southern end of the aftershock area. This result suggests that the aftershocks occurred on the conjugate fault planes with the ¥sigma1 axis oriented in east-west direction, because the pre-existing fault plane distributed to the random direction.