Interpretation of the stress field estimated from the 2000 Miyakejima-Kozushima seismic swarm

Eiichi Fukuyama[1]; Atsuki Kubo[1]

[1] NIED

Kubo and Fukuyama (2003, Seismol. Soc. Jpn. fall meeting, P100) estimated a stress field during the seismic swarm activity between the Miyakejima and Kozushima islands from the end of June to September, 2000 using the NIED moment tensor catalogue obtained by regional broadband waveforms.

This swarm activity consists of two stages: Period A: from June 26 to July 1, 2000 when the magma migrated westward from the Miyakejima volcano and Period B: after July 1, 2000 when swarm activity continues for more than a few months between the Miyakejima and Kozushima islands. During these periods, more than 1500 moment tensors were estimated and Kubo and Fukuyama (2003) used about 1000 focal mechanisms whose variance reductions are greater than 80%. Their result shows that the maximum principal stress direction is parallel to the strike of the dike and the minimum principal stress axis directs perpendicular to the corresponding dike strike for both periods. They did not observe any spatio-temporal change in stress field in each dataset.

Here, we try to interpret the above stress field using dike models proposed based on crustal deformation data. First we consider the stress field in Period B because of its simplicity under a continuous swarm activity environment. In order for the minimum principal stress to be perpendicular to the dike surface, seismic activity should occur above the dike body since near the dike surface a compressive stress will dominate perpendicular to the dike surface. Since the focal mechanism data used for the stress tensor analysis was shallower than 5km in depth, the head of the dike should be deeper than 8km.

In the Period A, on the other hand, if we apply the same model above, the dike head should be deeper than 8km since the swarm activity occurred shallower than 5km. However, this model is not consistent with the modeling result using the tiltmeter array in the Miyakejima island as well as the observation that a submarine volcanic eruption occurred during the westward migration of magma from the Miyakejima volcano. Taking into account these features, we consider that the swarm activity occurred in front of the migrating magma. The stress field ahead of the magma shows maximum stress axis parallel the dike strike and a minimum perpendicular to the dike strike. This model is consistent with the geodetic observation.

In conclusion, we could obtain an additional information to the dike modeling of the 2000 Miyakejima-Kozushima swarm using the stress tensor inversion of moment tensors of earthquakes.