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Shear-wave Splitting Analysis in the Focal Area of Earthquake Swarm at the Hakone Volcano

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Hakone Volcano is one of the active volcanos with fumarolic activity. Many intense earthquake swarms have been reported in the Hakone caldera. The relationship between the occurrence of earthquake swarms and crustal fluid have been discussed in the previous studies. It is considered that hydrothermal activity from deep underground causes the earthquake swarms.

We performed the shear wave splitting analysis for the seismograms recorded at the stations located just above and around the focal area of the earthquake swarms to depict the seismic structure, that is the crack distribution, and discuss the relationship between the structure and the occurrence of the earthquake swarms.

We used the seismograms of the earthquakes recorded at five stations (KZR, T.OSS, KIN, KZY and KOM) located in and around the Hakone volcano for the period between June 2009 and February 2010. We adopted the rotated axis and the lag time as the direction of faster split shear waves polarization (PHI) and the time lag between the two split shear waves (DT) when the cross-correlation coefficient attains the maximum value.

The average values of PHI at two stations located above the focal area correspond to each fault strike of the earthquake swarms. In contrast, the average values of PHI at three stations located around the focal area correspond to the direction of the maximum horizontal compressive stress. The fact suggests that the cracks formed by stress field are distributed widely around the focal area, but the clustered cracks aligned in the same direction as the fault strike are locally distributed near the focal area.

We find that the average values of DT near the focal area are relatively high compared to the values around the focal area. The fact suggests that the cracks near the focal area are distributed with higher density than that of the cracks formed by stress field.

In conclusion, we found that the cracks near the focal area aligned in the different direction on the stress field with relatively high density. The result suggests that the crustal fluid selectively flowed into the planar structure and caused the earthquake swarms in August 2009.

Keywords: Shear-wave splitting, Hakone Volcano, earthquake swarm, crustal fluid, crack