Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

SSS34-P07 Room:Convention Hall Time:May 21 13:45-15:15

Shear-wave Splitting Analysis in the Focal Area of Earthquake Swarm at the Hakone Volcano from 1995 to 2010

NIHARA, Yu[1*], TADOKORO, Keiichi[1], YUKUTAKE, Yohei[2], HONDA, Ryou[2], Hiroshi Ito[2]

[1]Grad. Sch. Environ. Stud., Nagoya Univ., [2]Hot Springs Research Institute

Many intense earthquake swarms have been reported in the Hakone caldera. The relation between the occurrence of earthquake swarms and crustal fluid has 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 station located just above the focal area of earthquake swarm occurred at Hakone Volcano to depict crack distribution and discuss the relation between the crack structure and the occurrence of earthquake swarm.

We used the seismograms of the earthquakes recorded at the station KZR located just above the focal area of earthquake swarms occurred in 2001 and 2009 for the period between April 1995 and June 2010. We used the events where incident angles less than 35 degrees to avoid the effect of S-P conversion wave. We selected also the seismograms with clear S wave first motion. We applied the method that computes the cross-correlation with rotating the coordinate axes (e.g., Shih and Meyer, 1990) with steps of 5 degrees and shifting the time of one component waveform by steps of 5 ms for the two horizontal component waveforms with low-pass filtered at 10 Hz. 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), respectively, when the cross-correlation coefficient attains the maximum value. We quantified the error of the solution on the basis of the reliability estimation for the correlation coefficient with Fisher's z-transformation. We determined the 95 % confidence interval of z and transformed back to define the confidence interval of correlation coefficient. We omitted the events which confidence interval is wider than 20 ms (about 1/4 of wavelength) from the result as unreliable data.

We divide the events used for the analysis into the following two groups: 1) the events of earthquake swarms occurred in 2001 and 2009 (Group-I), and 2) the other events (Group-II). The numbers of events used are 51 for Group-I and 115 for Group-II. The averages and the standard errors of PHI and DT are 140+/-2 degrees and 86+/-2 ms for Group-I and 125+/-2 degrees and 55+/-2 ms for Group-II. The angle of PHI is measured clockwise from the north. The values of PHI and DT for Groups-I and II are significantly different. The difference of PHI reflects the difference of anisotropy in the paths. The depths of events are shallower than 2.5 km for Group-I and 30 km for Group-II. The result of Group-I suggests that the orientation of cracks is parallel to the orientation of focal alignment of earthquake swarm in 2009. Moreover, the cracks with relatively higher density are distributed in the focal areas of earthquake swarm when the earthquake swarms occurred. The facts suggest that the observed crack structure is related to the occurrence of earthquake swarm. The result of Group-II suggests that cracks whose orientation is different from that in the focal area of earthquake swarm are widely distributed around the station KZR. The value of DT for Group-I is higher than that for Group-II. The result suggests that the density of cracks in the focal area of earthquake swarm become relatively higher only during the period of earthquake swarm if the paths from the event of Group-II pass through the crack structure in the focal area of earthquake swarm.

In conclusion, we found that the cracks oriented in the different direction from that of widely-distributed cracks are distributed in the focal area of earthquake swarm and its density may become higher during the period of earthquake swarm. It is presumed that the crustal fluid selectively inject into the crack structure in the shallow region and causes the earthquake swarms at the Hakone Volcano.

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