Seismic activity correlated with the ground inflation at Izu-Oshima volcano

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The seismic activity around a volcano is one of the reliable markers of the emplacement of magma, and it often gives us important information on the eruptive activity at the volcano. However, some activities are not directly generated by magma emplacement but by slips on the pre-existing faults affected by stress changes, whose origin is apart from the hypocenters. Therefore, it is important to investigate seismic activities around volcanoes in detail and to reveal their mechanisms. Izu Oshima volcano is thought to be now preparing for a future volcanic eruption from the time passed since the latest eruption and the average eruption intervals. From a dense seismic network and a dense GPS network, which are upgraded and installed in the last 3 years, we found out a characteristic seismicity around the volcano. Seismic activities are clearly categorized in two kinds: a stable activity occurring inside of the caldera region, burst-type activities occurring around the coast of the island. The seismicity inside of the caldera region correlates well with the ground inflation activity. The increase in the seismicity synchronized with the ground inflation. The mechanism of the correlation is still unsolved. We analyzed the seismic activity inside of the caldera at and present its possible mechanism.

We re-picked arrival times and measured travel time differences from waveform correlations. Then, we relocate around 300 events occurring in the last two years, whose magnitudes are -1 to 1, using DD method. We also estimate the focal mechanisms for larger events. From them, we found following points. 1) Hypocenters in the caldera are mainly divided into two groups. One is composed of the events that located on a vertical plane of NW-SE direction. They are situated at northern part in the caldera. The other group is also aligned on another vertical plane that directs to NE-SW and is southward of the former group. Focal depths range 1 to 2.5km, which is exactly shallower than the source of the ground inflation. 2) The northern group is aligned close to the dikes of the previous eruption. The direction of the hypocentral distribution is parallel to alignment of the craters. It supports that the earthquakes in the northern group are generated at the edge of the previous dike. Their focal mechanisms also support the above hypothesis, because the estimated fault plane agrees with ambient stress field. 3) The southern group is located at just northeast of the central crater, and it seems the conduit that connects the inflation source to the central crater. 4) The earthquakes in the both groups occur randomly in time and space, and there is no distinct migration of hypocenters. The rate of event occurrence gradually (not abruptly) increases when the magma intrudes at the depth.

Dleterich et al.(2000) pointed out that the seismicity of south flank of Kilauea, Hawaii is well correlated with the strain rate calculated from magma intrusion at the rift zone, where is apart from the seismic zone. They presented a model that the earthquakes on the pre-existent horizontal fault plane are generated by the stress change by the magma intrusion at the rift zone. The pre-existing fault is sensitive to the stress change and easily generates earthquakes. The seismicity inside of the caldera at Izu-Oshima is probably caused by the same mechanism. The pre-existing faults created by the previous eruption in1986 are activated by the magma intrusion at the depth and they make the seismic activities inside of the caldera. The precise hypocenter distribution, their focal mechanisms and the space-temporal pattern of the seismic activity, presented here, support the above hypothesis. The ground inflation accompanied with the seismic activity in the caldera is one of evidences that the magma accumulates beneath the volcanoes at the depth, and it is not reflecting the upward migration of the magma to shallower region or just beneath the central crater.