Volocano-tectonic earthquakes correlated to stress rate in Izu-Oshima volcano

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It is well known that the seismicity around a volcano is one of the well-established indicators of volcanic activities. Many evidences show that increasing seismicity is followed by the volcanic eruptions or magma intrusion because magma migration makes large stress change. On the other hand, the increasing seismicity does not always result to volcanic eruptions. Therefore, seismicity around volcano is generally treated as a powerful but not definite indicator of volcanic eruption. It is partly because the stress change that generates earthquakes has not been estimated quantitatively and the cause of the stress change has not been studied systematically. Aim of this presentation is to reveal the effect of stress as well as stress rate on volcano-tectonic earthquakes occurring at Izu-Oshima volcano.

Izu-Oshima is located at central Japan and is a volcano island. The ambient tectonic stress affects largely eruptive activities in this volcano. In the latest eruption in 1986, fissure eruptions and large scale dike intrusion followed a summit eruption. The activity ceased in early 1990s. At present, the volcanic activity is low but distinct volcano-tectonic seismic activities synchronized with the ground deformations are observed every 2-3 years. The present activities are characterized as follows. 1) Seismic activities are clearly categorized in two groups: One is an earthquake swarm occurring at the depth of 1-2km beneath the summit caldera (caldera swarm, hereafter). The other is earthquake swarms that occur off the north and west coast of the island at the depth of 3 to 8km (off-coast swarms). 2) Hypocenters in the swarms are aligned on several sub-vertical planes. Each seismic swarm occurs on almost same plane repeatedly. 3) The pressure source of the ground inflation is located beneath the summit caldera at the depth of several kilometers.

We evaluate temporal change of Coulomb stress generated by magma intrusion and ambient tectonic stress on the supposed planes where earthquake swarms occur. For the off-coast swarms, burst-type of swarms are generated when Coulomb stress exceed 100-500 KPa from the level of the previous swarm. On the other hand, the caldera swarms are activated when stress changes rapidly, that is to say stress rate is high. The different stress response in the two swarms can be explained by rock property where earthquake occur. Seismic structure deduced from large scale seismic exploration shows that the layer in which the off-coast swarms occur is similar to normal upper crust structure otherwise the layer in the caldera swarm has more week medium composed by maybe volcanic deposits. We propose that there are two kinds of earthquake generating mechanisms around the volcano and the rock property control the stress response to the volcano-tectonic earthquakes. Further study at other volcanoes will be helpful to understand the volcano-tectonic earthquake systematically.