

Seismic Activities in Izu-Oshima: enhanced concept of 'a volcano as a mechanically weak spot'

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Seismic activities and ground deformations around volcanoes are reliable markers of the stress change caused by magma emplacement and accumulation. From a dense seismic network and GPS array deployed in Izu-Oshima Island, we had pointed out that the seismic activities correlated with ground deformation. There were several events in which the seismicity near the summit synchronously increased as the ground inflation. The period and interval of the events are a few months and a few years, respectively. In the last year, we can catch a new activity occurring in March to July 2007 (we call the 2007 event, hereafter), and we estimate precise hypocenters and focal mechanisms. Then, we compare them with those in the past activity occurring in April to August, 2004 (the 2004 event).

Seismic activities in Izu-Oshima are clearly categorized in two groups: a smoothly time-dependent activity located inside of the caldera region and burst-type activities occurring around coast of the island. At first, we mentioned the seismic activities inside of the caldera, and then those around coast of the island.

The seismicity inside of the caldera correlates well with the ground inflation. We re-picked arrival times and relocate around 300 events occurring in the 2007 event, whose magnitudes are 0 to 2. We also estimate the focal mechanisms for larger earthquakes. We found following common features in both of the 2004 and 2007 events. 1) Hypocenters of the both events are located at the same region. 2) They are mainly divided into two groups. One is composed of the events that aligned on a vertical plane of NW-SE direction at northern part of north region of the caldera. The other is aligned on another vertical plane that directs to NNE-SSW at southern part of north region of the caldera. The south end of the whole activity is the summit (central crater). 3) Focal mechanisms of earthquakes in the northern part are mainly strike-slips whose compression axes direct NW-SE and extension axes do NE-SW. Those in the southern part are also strike-slips with NE-SW compression and NW-SE extension. Totally, the hypocenters and focal mechanisms reflect two dikes with different strike directions.

The earthquakes occurring around the coast of the island are divided into several groups in hypocenter locations. Most active regions in the recent time are the western region and the north region. In the west region, the hypocenters are located on vertical plane that aligned in E-W direction. The focal mechanisms of the earthquakes are right lateral strike slips whose nodal plane coincides with the plane of hypocenters. In the northern part, the hypocenter distribution is similar, but focal mechanisms are left lateral strikes.

Considering whole seismic activities in Izu-Oshima volcano, I deduce the mechanism generating earthquakes that obeys the concept of 'mechanically weak spot confined by large ambient tectonic stress' proposed by Nakamura (1988) and Yamaoka (1988). However, their concept is too simple and is not enough to explain all observation facts revealed in the modern network. I propose that the concept should be enhanced to a multi-layered point of view. The seismic activity inside of the caldera might be caused by the ambient stress and a weak spot of summit crater. The activities around coast of the island might be by ambient stress and weak body of the volcano. In the presentation, we will explain using the numerical models, and illustrate the validity of the concept. We will also show that the ground inflation accompanied with high seismicity inside of the caldera can be composed by composite dikes located beneath the hypocenters inside of the caldera. In conclusion, we propose the model that explains the seismic activity in Izu-Oshima using enhanced concept of 'a volcano as mechanically weak spot confined by large ambient tectonic stress'. This concept is renewed and upgraded by observations in the modern seismic and geodetic network.