

Volcano tectonic earthquakes related with the large scale uplift of Iwojima Volcano, Japan

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Increase of volcanic earthquakes and crustal deformation are usually observed before a volcanic eruption. Just before the small submarine eruption near Iwojima Volcano, Japan, in April 2012, we observed precursory volcanic earthquakes and rapid crustal deformation. However Iwojima regularly very active without eruptions except for small phreatic explosions; more than 20000 earthquakes and an uplift of about 3m were observed during 2006-2012. For eruption predictions at very active volcanoes, we have to distinguish a volcanic activity leading to an eruption from a normal activity. We examine a possibility of eruption prediction on the basis of a relationship between earthquakes and crustal deformation observed in Iwojima.

Iwojima Island, located about 1250 km to the south of Tokyo, Japan, is a volcanic island where a seismic activity and crustal deformation are very active. The island, measuring 8km in length and 4 km across, has a dome-like mountain Motoyama (a post caldera dome) at the earthen part of the island and a volcanic cone Suribachi at the southwestern edge of the island. According to a long period geodetic observation by Ukawa et al. (2006), the crustal deformation can be classify into 2 phases. The first is an island wide large uplift centering on Motoyama, and the second is contraction and subsidence at local area centering on Motoyama and uplift around that area. They are interpreted by superposition of crustal deformations by a shallow contraction source and a deep seated inflation source beneath Motoyama.

We used the coordinates of the 3 GPS stations of NIED (after 2003) and 2 GPS stations of GEONET of GSI (after 1999) in Iwojima with reference to Chichijima station of GEONET (about 220km to the northwest of Iwojima), and daily numbers of earthquakes counted at seismic stations of NIED at Motoyama after 2001 and JSDF during 1999-2001.

We found that the cumulative number of earthquakes and displacements of Suribachi stations have the highest correlation coefficient of about 0.998 during 1999-2012. The cumulative number is almost proportional to the displacements with a coefficient of 156.6 ± 0.2 events/cm. The movements of the Suribachi stations are mainly caused by the island wide large uplift originated from the deep seated inflation source. The high correlation shows the earthquakes are controlled by the uplift of Iwojima. However, the precursory activity of the eruption in 2012 is largely different from the proportional relation, suggesting that it was caused by a different source related with the eruption. The result suggests we can probably judge an abnormal activity related with a volcanic eruption when we observe an activity deviated from the proportional relation.

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