

A pressure source model inferred from ground deformation around Unzen Volcano

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Mt. Fugen which is one of Unzen Volcanoes is in Shimabara peninsula of Nagasaki prefecture, and erupted from 1990 after 198 years dormancies. Many researchers studies about the pressure source of this volcano, and at least the geodesy field, there are many researches, for example, using leveling data (e.g. Hendrasto et al., 1997), using GPS data (e.g. Nishi et al., 1995), using tide data (e.g. Tada et al., 1996). The pressure source model of Unzen Volcano was mainly considered as three pressure sources from the ground deformation. The ground deformation accompanying the volcanic activity of the Unzen Volcano have continued, also after the eruption had stopped, and it was continued also in spring of 2004 (Kohno et al., 2004). Since the model which consists of three pressure sources is not taking the ground deformation after the deformation which occurred after eruption had stopped, it needs to build the new model for explaining this ground deformation. So, this research examine the unific model which can explain the vertical displacements which observed around Unzen Volcano from the early stages of an eruption to after the eruption had stopped.

We used the leveling data from 1991 to 2004 and Mogi Model (e.g. Mogi, 1958)

Since Mogi Model is the approximate solution which assumed the half-infinite medium, in previous studies, displacement was calculated with assuming that all observation points were on the same plane. However, Unzen Volcano has steep geographical feature, there is a maximum of 800 m vertical interval between observation points. Therefore, it is thought that an error has included in calculated vertical displacements by conventional calculation method. In this research, we took altitude correction in consideration of the vertical drop of the observation points of Unzen Volcano. And we treated unknown parameters of pressure sources as the location (longitude, latitude, depth) and the amount of volume changes. We searched the best-fit parameters by grid-search to minimize the residuals between the observations and the calculations.

As the result, we found that the four pressure-source model can explain the leveling data from 1991 to 2004. The four sources are ascending from a depth of Chidiwa bay toward the crater. There are many models which concluded three pressure sources, but we found the four source model is the best by AIC. The position of three shallower sources that we estimated in this study, match the position of three scatterers that were detected by seismic array analysis (Watanabe 2005). Moreover, we didn't use horizontal displacements in analysis, when we calculated horizontal displacements using our result, the calculated vectors are better than the result one which use the old model.