

Inferring pressure sources beneath of Unzen Volcano from deformations of the ground surfaces

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It has been proposed that there are four pressure sources beneath of Unzen Volcano, which is located on Shimabara Peninsula, west Kyushu Island (Matsushima et. al., 2001) These sources were determined by forward modeling, which calculated displacement were compared geodetic survey data That was observed after the eruption stopped in 1995. As calculate method, Matsushima used Yamakawa-Mogi(1958) calculates the displacements of ground surface assuming a point source into the semi-infinite elastic body and they calculated observation station's displacements without the altitude the stations. We calculated displacements, used the pressure source's parameters, by means of Yamakawa-Mogi(1958) after consideration of the altitude of the observation station and then we found that the higher the altitude of the stations the wider the differences between the results and another results which were calculated without the altitude of the stations. The biggest difference was 1 cm. And in Matsushima et. al., (2001), they discussed inflation or deflation of pressure sources from relationship between the results of leveling and the horizontal displacements which were observed by GPS survey. But they didn't discuss that the calculated horizontal displacements, which used the determined parameters of pressure sources, accorded with the observation. Therefore we discussed the four pressure sources, by means of considering the altitude of the observation station, calculating both of vertical displacements observed by leveling and horizontal displacements observed by GPS survey, and comparing between calculated data and observed data.

As observed data, we used leveling data and GPS surveying data, observation period were 1996-1999 and 1999-2001. About leveling survey, we adopted the data that was obtained along the western coast at of Shimabara peninsula and the northern flank toward the summit of Unzen Volcano. And about GPS surveying data, we used observed data from 14 stations in all over Shimabara peninsula that were set and monitored by Kyushu University and Geographical Survey Institute. In calculation, we calculated both vertical and horizontal displacement applying the point source model (Mogi, 1958) as well as Matsushima et. al., (2001) on condition of considering the altitude of observation station.

The calculated data compared to the leveling data by forward modeling in order to obtain the pressure source's parameters(location and volume change of pressure sources), and we made the parameters much consistent with observed by comparison between the horizontal displacement vectors from calculation, and GPS surveying data. As a result, A-source, which has been supposed to be the shallowest of the four pressure sources, was redetermined to be just 80 m west of the lava dome, 1000 m depth. That is to say, it shifted to further south from the result of Matsushima et. al., (2001) by 320 m. This result can be said to be more accuracy because it approximately consists with the result of reflection seismic surveying at Unzen Volcano (Matsumoto et. al., 2001). After that, comparing calculated horizontal displacement with the observed data, we found that they had similarity in the point of that Unzen Volcano was inflated in 1996-1999, and then turned into deflating in 1999-2001. This can explain that magma supplying continued for a while after the eruption stopped in 1995, then since around 1999, magma supplying decreased gradually, and finally stopped, magma chamber started to deflate by cooling.

By this study, we could improve the result of Matsushima et. al., (2001) using the leveling and GPS survey data, and more accurately infer the four pressure sources and the changes of volume.