Estimation of pressure source occurring volcanic crustal deformation with FEM considering topography

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In order to grasp the activity of the volcano and evaluate it, it is necessary to grasp the behavior of the magma and the like. When volcanic disasters such as eruption occurred, we estimated the deformation source assuming volume change of the spherical pressure source or opening displacement of the dike using observation results of crustal deformation obtained by GNSS and InSAR . Conventionally, when calculating the crustal deformation, calculation was carried out based on a model assuming a semi-infinite homogeneous elastic body. However, if there is a deformation source especially in the shallow part of the volcano, the influence of the topography cannot be ignored. In recent years, along with the development of the technology of InSAR, crustal movement at the crater and its surroundings can be observed in a planar manner, and detailed analysis has become possible. Therefore, in order to more accurately estimate the deformation source, it is necessary to estimate with the topography added.

Based on this background, we developed a crustal deformation calculation system that incorporates the Finite Element Method (FEM) that divides elastic bodies into minute meshes and calculates displacement for each mesh. As a result, it became possible to analyze taking model topography and underground structure into account. In this study, we compare the deformation source estimated using the FEM with the deformation source estimated by the conventional method. In this presentation, we mainly examined the eruption of Mt.Ontake in Nagano Prefecture in 2014. We detected about 10cm crustal deformation in the crater and its surroundings with InSAR analysis by ALOS-2 satellite on the eruption (Yamada et al., 2014). Based on this observation result, we estimated the deformation source with a model assuming a conventional semi-infinite homogeneous elastic body, and we obtained the result that the almost vertical crack opened 45 cm. However, since the topography of the region where the crustal deformation was observed by this eruption is steep and it is thought that the deformation is also influenced by the topography, in this presentation we report the results of comparison of the conventional estimation and the estimation considering the influence of the topography.

Keywords: FEM, Mt.Ontake, GNSS, InSAR, ALOS-2

