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Development of a Joint Inversion Technique using Gravimetric and Muon-radiographic Data for Resolving Three-dimensional Density Structure of a Gigantic Body

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We have developed a method of analyzing gravimetric and muon-radiographic data for visualizing a three-dimensional density structure of a volcano. The method searches for a density structure that best explains the muon and gravity data simultaneously. For finding a solution, techniques in least-squares inversion were employed. According to the model simulation we have conducted, this new method was proved to have higher potential than previous gravimetric inversion and previous muon tomography [*Taira*,2010; *Tanaka et al.*,2010].

As a demonstration, we applied this method to Mt. Showa-Shinzan lava dome, Hokkaido, Japan. At this site, muon observation has already been performed with emulsion cloud chamber (ECC). The effective area of ECC was 1200 cm^2, and the exposure time was 4 month.*Tanaka et al.*,[2007] calculated the amount of matter on the muon trajectories in the unit of gcm^{-2} (density times length). In addition to the muon data, we newly collected gravity data at 35 stations on / around the lava dome. The data was measured by using a LaCoste Romberg Gravimeter (G-875). Position of a gravity station was determined by GPS interferometry between a reference station and a moving station. Thereby, we conducted joint inversion of the muon and gravity data.

The joint inversion yielded us the three-dimensional density profile of Mt.Showa-Shinzan. The density profile suggested the two features of the dome. Firstly, lava had intruded beneath the dome in a cylindrical shape whose diameter was 300 meter. This is inferred by the existence of high density($\rho > 2.4\mathrm{g/cc}$) region localized at an altitude of 220 $\sim$ 260 meter. Secondly, we found a ultra high density region which was suspected to be a spine spreading vertically near the top of the dome.

References

[1] Tanaka et al. (2007),*Geophys. Res. Lett.*, *34*, L22311.

[2] Tanaka et al. (2010),*J. Geophys. Res.*, *115*, B12332.