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Development of a joint inversion technique using gravity 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 gravity and muon-radiographic data for resolving a three-dimensional density structure of a volcano. In the method, we search for a density structure that explains the muon and gravity data by using a linear inversion scheme.
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 cm2, and the exposure time was four 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 dome. The gravity data were measured by using a LaCoste Romberg Gravimeter
(G-875). Positions of gravity stations were determined by GPS interferometry.
First, we performed a so-called checkerboard test with a synthetic data to test the resolution. We concluded from the result of the test that a horizontal spatial resolution is about 200 m in our configuration. Based on the conclusion, we conducted joint inversion of the actual 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, we could visualize the high density magma which had intruded beneath the dome at an altitude of 220 - 260 m. Secondly, we found an ultra high density region which was suspected to be a spine spreading vertically near the top of the dome.

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