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Demonstration of 11-directional muography in Omuro-yama Scoria cone, Izu, Japan

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Muography is the method of determining inner bulk density structures of volcano by using cosmic-ray muons. When we get muography image from one direction, there is no spatial resolution along muon path. However, by observing from multiple directions, three-dimensional density structure can be obtained. In recent years, three-dimensional density reconstruction using two or three muographic images has been performed (Tanaka et al., 2010, Rosas-Carbajal et al., 2017), but they obtained three-dimensional density structure with only several hundreds of meters spatial resolution due to lack of information. To improve the spatial resolution, we suggested “omni-directional muography”, putting ten or more observation points to surround the volcano (Nagahara and Miyamoto, 2018), and we estimated its feasibility by simulation. On the other hand, in recent years, detectors for muography have become larger (Morishima et al., 2018, Olah et al., 2019), and a detector necessary for omni-directional muography can be prepared. Therefore, we demonstrated omni-directional muography in Omuro-yama Scoria cone, Izu, Japan.

Omuro-yama is a scoria cone formed by a single eruption. The mountain baseline diameter is about 1 kilometer and the height from base is 300 meters. The eruption has been investigated by sediment surveys (Koyano et al., 1996). This mountain has many advantages that are suitable for omnidirectional muography. 1) no mountains around Omuroyama, so no contamination of muon path except in the Omuroyama body. 2) easy to access the detector sites, 3) enough statistics of penetrating muons because of size. We started observing Omuro-yama in 2018. In 2018, we observed for two months from three directions using a 0.01 square meter emulsion detector. In 2019, we performed a three-month observation from eight directions using a 0.02 square meter emulsion detector. As a result of preliminary three-dimensional density reconstruction using the analysis method of Nishiyama et al. (2014), a region with a low density over 200 m in diameter was found under the crater. Currently, we are considering this result carefully. We plan to observe from 30 directions by 2021, including 11 points.

In this presentation, we report the latest analysis results of observation results from 11 directions and future plan.

