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Comparison of 1D and 2D Inversion Results of Magnetotelluric Data Acquired at Sakurajima Volcano

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A total of 35 magnetotelluric (MT) soundings were carried out on Sakurajima Island in FY2024. The MT data cover a broadband frequency range from 0.001 to 400 Hz. After checking the data, we identified the artificial noise at approximately 60 Hz and 0.1 Hz. Therefore, the time series data were processed using the notch filter and remote reference method to reduce the noise. The magnetic data from Sukomo (SKM) and Noto (ONT-308) sites were used as a reference. As a preliminary step toward 3D inversion, this study aims to evaluate the ability of the 1D and 2D inversions to reveal the underground resistivity structure beneath the Sakurajima Volcano. The 1D analyses were carried out using Occam's inversion code (Constable et al., 1987) from the sum of squared (ssq; Rung-Arunwan et al., 2016) elements of the impedance tensor. Then, we performed the 2D inversions using the inversion code of Ogawa and Uchida (1996).

The almost similar underground resistivity structures are observed in both 1D and 2D models. Both the 1D and 2D results highlight three main resistivity structures that exist on Sakurajima Island. The near-surface resistive structure is correlated with the lava layer to prevent the upwelling volcanic flow. Then, the conductive structure was found in the NE-SW direction of Sakurajima Island. It seems to have a strong correlation with the magma plumbing system from Aira Caldera to the active crater. The 1D results indicate two conductive zone around Kitadake is separated by a high resistivity layer. However, in the 2D model, this conductive zone appears as a single conductive structure. The conductive structure was also found in the west of Sakurajima Island. In this area, the 2D results show a thin resistive layer near the surface and a conductive layer beneath it. Moreover, the 1D results also indicate the presence of a high-resistivity layer below the conductive zone. We suggest that this conductive zone represents the lateral intrusion of magma from the main NE-SW magma pathway, as proposed by Hidayati et al (2007). Then, the high resistivity structures were observed underlying the magma chamber beneath the Kitadake crater and on the southeastern side of Sakurajima Island, both in 1D and 2D models.

The above results show that 1D and 2D models can be used as an initial approach in structural imaging. Comparing 1D and 2D models leads us to gain valuable information about the main structure of Sakurajima. However, the 1D model does not take into account the distribution of land, sea, and 3D structure. Meanwhile, the 2D model is depend on the profile orientation on the structure. Therefore, we need to perform 3D inversion to obtain a more reliable model and compare it with 1D and 2D results to reveal the underground structure more comprehensively.