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Shallow Resistivity Structure of Sakurajima Volcano Revealed by Audio-frequency Magnetotellurics

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An audio-frequency magnetotelluric (AMT) survey was conducted at the foot of Sakurajima volcano in November 2007. This survey was carried out within the framework of the 7th National Project for Prediction of Volcano Eruptions. The main objective was to clarify the shallow layers of Sakurajima volcano for better understanding of the volcanic activity. We measured electromagnetic fields at frequencies from 1 to 10400 Hz at 27 locations along only three lines set on the northern, western, and southeastern flanks of the volcano. The three profiles enclosed the summit area where access is prohibited because of frequent explosive vulcanian eruptions. The data quality was generally considered to be good at frequencies higher than 2 Hz. Two-dimensional and three-dimensional (3-D) modeling approaches were applied to the data.

As a result of 3-D modeling, we obtained the following features in the resistivity model. The surface layer showed a high resistivity from several hundreds to thousands of ohm-meters and corresponded to the lava. This surface layer covered a highly conductive layer with a resistivity of less than tens of ohm-meters, interpreted as containing seawater or groundwater. However, the basement structure was not clearly detected, except for in an area of northern Sakurajima. The first lava layer was distributed thickly in northern and western parts of Sakurajima, and the boundary between the first and second layers was typically located at around sea level.

The conductive second layer was found at deeper levels beneath areas such as the Haruta-yama lava dome and the Nabe-yama pumice cone. This depression of the low resistivity layer is probably caused by the fracture zone associated with previous eruptions, which is formed above the conductive layer. In the proximity of Hikino-hira lava dome and the Taisho crater, the second conductive layer was found at a depth shallower than sea level, suggesting that a hydrothermal system has developed underneath this area. In contrast, elevation of the second layer was not seen on the side of Taisho crater located nearest to the edge of Nabe-yama, implying that a heat source is not present beneath the eastern foot of Sakurajima.

Key words: Sakurajima volcano, electrical resistivity structure, hydrothermal system, flank eruption, prediction of volcanic eruptions

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