Three-dimensional Electrical Resistivity Structure of Tokachidake Volcano Revealed by GREATEM Survey Data

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The Tokachidake Volcano is a group of quaternary volcanoes in central Hokkaido. Historical eruptions accompanied by pyroclastic materials occurred in 1926, and phreatic eruption occurred in 1962 and 1988. During the 1926 eruption, a collapse of the caldera cone resulting in mudflow which struck the area claiming 146 deaths and missing persons. After the 1988-89 eruption, vigorous fumarolic activities have continued in the central part of the volcano group and seismic activities and crustal deformations have been observed. To study the structure of Tokachidake Volcano and discuss the process of its phreatic eruption, which can help in future eruptions mitigation, airborne electromagnetic (AEM) surveys using the grounded electrical-source airborne transient electromagnetic (GREATEM) system were conducted over Tokachidake Volcano. We performed numerical forward modeling to generate a three-dimensional (3D) resistivity structure model that fits the GREATEM data where the stitched 1D resistivity model was used as the initial model. A 3D electromagnetic forward-modeling scheme based on a staggered-grid finite-difference method was modified and used to calculate the response of the 3D resistivity model along each survey line. We verified the model by examining the fit of magnetic-transient responses between the field data and 3D forward-model computed data. The 3D resistivity models show that a moderately resistive structure (50–200 Ωm) is characteristic of most of the volcano, and were able to delineate a very conductive structure zone within the volcanic edifice. This structure may be either hydrothermal or alteration zone caused by previous large sector collapse.

Keywords: Airborne EM, 3D resistivity modeling, GREATEM survey, Volcanic surveys

