

Controlled-source electromagnetic survey for investigating Kusatsu-Shirane volcano, Japan

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SUMMARY

The controlled source electromagnetic (CSEM) method has been gaining attention for the investigation and monitoring of subsurface resistivity structures in volcanic areas due to its high sensitivity to thin resistive bodies and low susceptibility to noise. We have been conducting CSEM surveys to elucidate the subsurface resistivity structure of the Kusatsu-Shirane Volcano and its temporal variations. In these surveys, we employ an EM-ACROSS transmitter using dipoles oriented north-south and east-west and eight receivers 4–6 km away from the transmitter. EM-ACROSS is synchronized with a 10MHz GPS signal, allowing it to transmit signals with accurately controlled phases over long periods. As a result of analyzing 200 hours of receiver data, we obtained CSEM data with standard errors of less than 2% at many frequencies. The inversion of the CSEM data revealed a low-resistivity body corresponding to a clay layer, and beneath this clay layer, low-resistivity fluid-rich and high-resistivity gas-rich reservoirs. In contrast, the inversion of magnetotelluric (MT) data acquired simultaneously with the CSEM data could not recover the gas-rich reservoir beneath the clay layer. This difference in resistivity structure results from the higher sensitivity of CSEM data to resistive layers compared to MT data. Using the CSEM data, we will elucidate the temporal changes in the subsurface resistivity structure of the Kusatsu-Shirane Volcano.

Keywords: Controlled source electromagnetics (CSEM), Magnetotellurics, Volcanic hazards and risks
