The magma plumbing system of Mt. Meakandake imaged by broadband magnetotelluric survey

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SUMMARY

We show the geometrical relationship between the subsurface structure and the locations of deep low-frequency earthquakes, volcanic micro-earthquakes, demagnetization sources, and ground deformation around the Meakandake volcano.

Imaging the magma plumbing system is crucial for understanding the processes occurring beneath a volcano. However, prior to our study, knowledge on the subsurface structure of Meakandake volcano was limited to shallow depths, leaving the overall image of the magma plumbing system unknown. Therefore, we conducted 54 broadband magnetotelluric measurements from 2020 to 2023. The study region is approximately 50 km × 50 km area centered on Meakandake volcano, with sites spacing ranging 2 to 8 km apart. We used data from 92 sites, including existing audio-frequency/broadband magnetotelluric data and estimated three-dimensional resistivity structure. We used the full components of the impedance and tipper in the period range from 0.003 to 4096 s for the inversion.

Our modeling reveals an elongated conductor (1-10 Ωm) slanting towards the northeast at shallow depths less than 10 km, and then curving towards the northwest from the Meakandake at greater depth. A pressure source of the ground inflation from 2016 to 2017 is located above the conductor at a depth of 3 km. A cluster of deep low-frequency earthquakes is located at the southern edge of the conductor, ranging from depths of 15 to 30 km. Shallow volcanic earthquakes and demagnetization sources are located at the top of the conductor. In summary, dynamic phenomena occur around the conductor. Considering these findings, the bending conductor is interpreted as a pathway for magmatic fluids.

Acknowledgments: This study was supported by the Ministry of Education, Culture, Sports, Science and Technology of Japan, under its Second Earthquake and Volcano Hazards Observation and Research Program.

Keywords: Magnetotellurics, Meakandake volcano, Magma plumbing system, 3-D resistivity model