Conductivity anomalies in the deep subsurface of central Hokkaido

T. Hashimoto[1], J. Pan[1], A. Suzuki[1], M. Takada[1], K. Okada[1], R. Tanaka[1] and M. Tamura[2]
[1]Hokkaido University, hasimoto@sci.hokudai.ac.jp
[2]Res. Inst. of Energy, Environment and Geology, Hokkaido Res. Org., tamura-makoto@hro.or.jp

SUMMARY

Central Hokkaido is known for its volcanic activity, with three volcanoes currently classified as active. Among them, Mount Tokachi has experienced three magmatic eruptions in the 20th century and has a well-established monitoring system for volcanic activity. However, more research is needed on the deep subsurface structure of this region, especially the electrical conductivity structure below 10 km. In recent years, a magnetotelluric (MT) transect survey conducted by Iwama (2022) across central Hokkaido from east to west has suggested the presence of a large conductive body in the lower crust of this region. However, this survey was based on measurements along a single profile, and although it relied on 3D modeling that considered the distribution of land and sea, structures beside the survey line were relatively unreliable as they were not constrained by real data. Therefore, to verify the extent of this conductive anomaly, we deployed new arrays to the south and north of the transect from 2022 to 2023. Combining this new data with the previous ones, we re-executed the modeling with impedance data from a total of 50 sites.

Our modeling, incorporating the new data, revealed a large, conductive anomaly extending approximately 20-40 km deep and 40 km wide. This discovery is particularly intriguing as the conductor appears to underlie the entire volcanic chains of this region, with the current active volcanoes, Mount Taisetsu and Mount Tokachi, located at its northern and southern edges, respectively. In addition, this conductor corresponds to the distribution of seismic low velocity anomalies reported by Koulakov et al. (2014), and generally lies between the Conrad and the Moho discontinuities. Furthermore, as is well known, both Mount Taisetsu and Mount Tokachi are associated with clusters of deep low-frequency earthquakes, suggesting some involvement of fluids. From these facts, we suspect that this conductor may have played a fundamental role in the formation of the volcanic chains in this region. While further quantitative assessment is needed, this conductor may represent regions where fluids expelled from the subducting Pacific Plate have ascended and concentrated in the lower crust of the overriding plate, or possibly areas where partial melting has occurred as a result. This potential implication opens up new avenues for researching and understanding this region.

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Keywords: central Hokkaido, magmatic system, conductivity anomaly