Electrical resistivity structure beneath the southern Tohoku, Northeast Japan, inferred from a joint inversion of magnetotelluric and geomagnetic transfer functions

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SUMMARY

Significant in-land activities in southern Tohoku are implications of the ongoing subduction system in Northeast Japan. Knowing that fluids play an essential role in arc magmatism and the associated seismicity, this study is intended to understand the deep subsurface fluids distribution beneath the southern Tohoku to clarify the origin of the in-land activities. A magnetotelluric survey delineating the subsurface electrical resistivity structure is suitable for this purpose because bulk resistivity is sensitive to the composition and connectivity of fluids. Time-varying electric and magnetic field data were recorded at 15 stations along a profile line. The frequency-domain response functions of the measured fields were interpreted to yield a two-dimensional electrical resistivity structure using a newly developed joint inversion code. In addition to the commonly used response functions, the inter-station horizontal magnetic field transfer function was also considered to determine the regional trend and estimate the electrical resistivity structure. The result shows that in the southern Tohoku, especially beneath the survey line, a fluid-rich area is located under the back-arc side instead of the volcanic front. This understanding comes after inversion reveals an upper mantle – middle crustal conductor between a back-arc volcano and the volcanic front, well-correlated with a swarm of deep low-frequency events. The bulk conductivity of the conductor could be explained by some degree of partially molten rock and saline water originating from the upwelling flow above the subducting slab. In addition, a surficial, inclined conductive body is found on the back arc, the boundary of which is very consistent with the eastward dipping reverse fault of the Tsukioka fault zone.

Keywords: electrical resistivity structure, magnetotelluric method, geomagnetic transfer function, inversion, subduction zone