3D imaging of NE Japan forearc: implications for fluid distribution and transport

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Seismological, petrological, and electromagnetic studies have suggested that water plays a major role in the phenomenon of the subduction zones, such as seismotectonics and magma genesis.

The northeastern Japan arc is a typical subduction zone where the Pacific plate subducts under the North American plate, and several fluid circulation models have been obtained in this area. However, the previous seismological and petrological models on the fluid distribution and transport in the forearc have differences. As for electromagnetic induction studies, the limitation of the two-dimensional modeling approach hampered imaging the forearc, because the data in the Kitakami mountains are influenced by strong three-dimensional responses.

In this study, we used the magnetotelluric method, which is an electromagnetic method using natural electric and magnetic field variations. Field. This method can image the crust and the upper mantle by resistivity, which is sensitive to the existence and connectivity of a small amount of fluids. I conducted wideband magnetotelluric observations in central and southern Iwate Prefecture. I compiled the new data with the old data which were obtained in the past studies in the area. The total number of stations is 100. This data set covers the area with approximately 10 km spacing. The period range was between 0.003 s and 2,000 s and will be useful to investigate the crustal and uppermost mantle structure. The full tensor impedances data and tipper data were inverted using a three-dimensional inversion code.

The following characteristic structures were analyzed in the final resistivity model.
High resistivity anomalies that extend from the lower crust to the surface in a wide area in the forearc, which imply distribution of granite bodies derived from the slab melting in the Early Cretaceous. The seismic low-velocity anomaly and the collocated resistive anomalies along the Pacific coast imply the distribution of granite rather than that of fluid (water wall). Low resistivity anomalies at a depth of 5 km or less which are located about several km to 30 km to the east of the volcanic front. They suggest that the fluids are supplied from the mantle eastward beyond the volcanic front. Low resistivity anomalies at a depth of 5 km or less just below the volcanic front, which implies upwelling fluids from the slab
Thus, fluid from the mantle is supplied to the volcanic front and also further eastward beyond the volcanic front. However, there is no significant fluid supply at the Pacific coastal area, where seismic low velocity is found but the corresponding resistivity is high, implying that the area is characterized by a dry Cretaceous granite.

Keywords: fluid, subduction zone, resistivity, magnetotelluric method

