A three-dimensional electrical conductivity model of the crust beneath the southern Tohoku district, NE Japan

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This study reports a three-dimensional electrical resistivity distribution model in the crust beneath the onshore southern Tohoku district, NE Japan. The southern Tohoku district here contains southern Yamagata prefecture, southern Miyagi prefecture, eastern Niigata prefecture, and northern Fukushima prefecture. This resistivity analysis aims three-fold. (1) To delineate fluid distribution in the crust beneath the onshore forearc of southern Tohoku district: The seismic swarm beneath around Iwaki city has been active since the 2011 off the Pacific coast of Tohoku Earthquake. The seismicity is interpreted as being induced by fluid migration from the deep crust. We investigate if conductive body in the crust elongates northwards from beneath Iwaki city. (2) To detect whether outstanding crustal fluid distributes beneath the onshore backarc. (3) To reveal a finer three-dimensional crustal conductivity distribution model beneath Ou-backbone range in southern Tohoku district, which we expect to give the interpretation of genesis of the volcanoes and of another seismic swarm occurring beneath around Yonezawa-city.

We compile the magnetotelluric (MT) and geomagnetic transfer function (GDS) data which were acquired by Uchida (2004), Umeda et al. (2008), Asamori et al. (2011), Uyeshima (private comm.) and Ogawa (private comm). The 118 observation sites locate in the study area. Both MT and GDS frequency response is used to model three-dimensional resistivity distribution. The period range is 0.03 to 652 second.

The resultant resistivity model reveals no conductor beneath the onshore forearc in Fukushima prefecture. The model rather shows resistor there with over several-thousand Ωm, which corresponds to the Abukuma batholiths. Thus, our model indicates that the area only around Iwaki-city is peculiar forearc, where fluid migrates upward from deep crust. Neither exists an outstanding conductor beneath backarc of the study area. However, a few local shallow conductors (down to 5 km depth) lie beneath the backarc. The bottom boundary of one of the conductors around Iide-Mountain area clearly bounds the local seismicity there. Although the cut-off depth of seismicity shows distinct undulation beneath regional backarc of the study area, the resistivity distribution shows no correspondence to the cut-off depth undulation. The outstanding crustal conductors are found beneath Ou-backbone range in the study area. We find the clear correspondence between deep low frequency events (20-40 km depth) and the conductor beneath Bandai-Azuma volcanoes. This image is similar with the relation of low velocity and deep low frequency event (Niu et al., 2018; Chen et al., 2019). The conductor beneath Ou-backbone range delineates the hot-finger image. The conductor branches at about 20 km depth.

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