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Electromagnetic imaging of fluids under the brittle crust

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This paper presents a 3D inversion result of the magnetotelluric soundings over the caldera regions in the central part of NE Japan arc. The 181 MT stations in total were located around the Naruko volcano with ~3km grid covering the area of 40km (EW) x 80km (NS). We have used the full tensor components of impedance tensors at representative eight periods (0.4~1300s). The inversion code of WSINV3DMT was used. The initial model had a uniform earth of 100 ohmm with surrounding oceans (0.25 ohmm). The final model gave rms of 2.5 with error floor of 10%. Significant features of the model are the thick resistive upper crust in the caldera regions and sub-vertical conductors arising from the lower crust to the geothermal manifestations. The top of such sub-vertical conductor coincides with the cutoff depth of the shallow seismicity. In particular, the sub-vertical conductor at Naruko volcano has a deep root in the mid-to-lower crust underneath the Mukaimachi Caldera, which is located 20km west of the Naruko volcano. The supply of the high salinity fluid may be originated sideways and may imply the path of the fluids, which is presumably blocked by the impermeable consolidated volcanic rocks directly above the lower crustal conductor. The resistivity of the mid-to-lower crustal conductors is significantly low at the Naruko volcano, compared with those at Sanzugawa caldera to the north. The difference may be due to the salinity as well as the porosity of the fluid, because seismic tomography result does not show such differences. A helium isotope anomaly at Naruko volcano may support that the flux from the upper mantle is large.

Keywords: fluids, brittle crust, resistivity, electromagnetic induction, magnetotelluric method