Fluid and melt distribution in the crust and upper mantle imaged by wide-band magnetotellurics, in NE Japan: implications for seismicity and deformation

S. Masuda[1], Y. Ogawa[2,3] and M. Ichiki[4]
[1]Tokyo Institute of Technology, Tokyo, Japan, masuda.s.an@m.titech.ac.jp
[2]Tokyo Institute of Technology, Tokyo, Japan, ogawa.y.aa@m.titech.ac.jp
[3]Tohoku University, Sendai, Japan, yasuo.ogawa.d1@tohoku.ac.jp
[4]Tohoku University, Sendai, Japan, Masahiro.Ichiki.B5@tohoku.ac.jp

SUMMARY

The central Tohoku region is a typical subduction zone with arc volcanoes. Volcanic and earthquake-related phenomena occurring in the central Tohoku region involve melts and crustal fluids, and we aim to image their distribution through electrical resistivity. In order to image such resistivity distributions in three-dimensions, we analyzed magnetotelluric (MT) data, comprising of 410 stations covering the central part of the Tohoku region (100km x 100km area) with several kilometer spacings.
We have found characteristic low resistivity along the volcanic front and on the forearc side and resistive bodies in between were detected. The low resistivity along the volcanic front rises in a continuous shape in the NNE-SSW direction from 40 km depth to 15 km and then splits and rises toward Quaternary volcanoes such as Naruko Volcano, Onikobe Caldera, Takamatsu-dake, and Mt. Kurikoma. This indicates the ascending melt and fluid paths into the crust. The discriminations between crustal fluids and melts were discussed by use of seismic tomography results based on Vp/Vs ration. The electrical conductors with high Vp/Vs were interpreted as melts and those with low Vp/Vs were interpreted as crustal fluids. Furthermore, correlations of electrical conductors with multiple volcanic subsidence around Mt. Kurikoma after the 2011 Tohoku earthquake suggest the deformation of large melt or fluid distribution under the extension stress of the 2011 Tohoku earthquake. High resistivity zones separating the volcanic front conductor from the forearc conductor suggest that the fluid/melt path to volcanic front and to the forearc are separated and that lateral fluid movement at the uppermost part of the upper mantle may not be feasible. On the forearc side, the low resistivity zones are arranged in isolated blocks, which imply the fluid source to the respective inland earthquakes on the forearc side.

Keywords: magnetotelluric, fluid, melt, deformation, earthquakes