Cryptic magmatism indicated by resistivity structure beneath the Asahi mountains, Northeast Japan

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1. Introduction

The geology of the Asahi Mountains is mainly composed of Cretaceous to Paleogene granite and sedimentary rocks. Although the distance from Quaternary volcanoes (Shirataka and Gassan) to the area is more than 30 km, hot springs such as Senami (97.2 deg C) and Kira (88 deg C) are distributed around the area (Kimbara, 1992). In addition, low-frequency tremors which are generally related to magmatic or hydrothermal activity occur beneath the Asahi Mountains. These characteristics are the same as an area around Quaternary volcanoes in Northeast Japan. The purpose of this study is to consider the origin of heat sources beneath the Asahi Mountains with the two dimensional (2-D) structure of the crustal resistivity.

2. Magnetotelluric Soundings

Magnetotelluric method with far remote reference technique and 2-D inversion code (e.g. Umeda et al., 2006) was carried out to estimate the two dimensional (2-D) structure of the crustal resistivity. The 70 km long MT profile with 13 recording stations runs across the Asahi Mountains. The stations are arranged in a N60W direction parallel to the strike of the Asahi Mountains.

3. Two-Dimensional Magnetotelluric Modeling

A two-dimensional resistivity model shows that a high conductive body is clearly visible at a depth of 15 to 35 km beneath the Asahi Mountains. The granite is also visible as a low conductive body in a shallow part of the profile.

4. Discussion

Clusters of the normal type seismic activities around the survey line are located beneath the Asahi Mountains, the Shirataka Volcano and the Yamagata Basin faults at a depth of 5 to 15 km. On the 2-D profile of resistivity structure, these clusters are distributed western and eastern upper edge of the high conductive body. On the other hand, the low-frequency tremors occur in the marginal part of the high conductive body at a depth of 20 to 35 km. These observations suggest a high temperature condition of the body such as magmatic or hydrothermal activity.

It is highly possible that the high conductive body has a strong relationship to the tectonics around the area such as lifting of Cretaceous to Paleogene crystalline mountains and activities of low-frequency tremors, active faults and the Quaternary volcano.

Reference

Kimbara, K. (1992) Distribution Map and Catalogue of Hot and Mineral Springs in Japan, 394pp., Geol. Surv. of Japan, Tsukuba, Japan.

Umeda, K., Asamori, K., Negi, T. and Ogawa, Y. (2006) Magnetotelluric imaging of crustal magma storage beneath the Mesozoic crystalline mountains in a nonvolcanic region, northeast Japan, Geochem. Geophys. Geosyst., 7, Q08005, doi: 10.1029/2006GC001247.