Resistivity Structure under the Kutcharo Caldera and the Geophysically Observed Signs of Volcanic activities

Ryo Honda[1]; Yusuke Yamaya[2]; Hiroshi Ichihara[3]; Toru Mogi[4]; Makoto Uyeshima[5]; Mitsuhiro Nakagawa[6]
[1] Grad. School of Sci., Hokkaido Univ.; [2] ERI, Univ. Tokyo; [3] JAMSTEC/IFREE; [4] ISV, Hokkaido Univ.; [5] ERI, Univ. Tokyo; [6] Hokkaido Univ.

Kutcharo caldera had been recurrently erupting, sometimes explosively, and still has a potential of disastrous eruptions. Accordingly, it must be quite important to clarify the mechanisms of volcanic activity of the Kutcharo caldera region. Recently, the history of the eruptive activity around the area has been revealed by detailed research of the tephra stratigraphy. On the other hand, the subsurface structure of this caldera region has scarcely been discussed, nor explored. So we conducted Magnetotelluric (MT) exploration over the Kutcharo caldera and surrounding regions, and clarified the resistivity structure. In this report, we introduce our observation and show some explanations about the constructed resistivity structure, with relationships to low frequency seismicity and the observed upheaval upon Atosanupuri volcano.

Ichihara et al. (2009) conducted MT observation around the Teshikaga region, which aimed to investigate the active fault around southwestern rim of the Kutcharo caldera. The dataset of Ichihara et al. (2009) is quite serviceable to our exploration. So we extended their observation lines towards NNW direction, which is normal to the volcanic line of this region, consequently we obtained enough data for the analyses. Wideband MT observations were carried out during September 2009 and July 2010. Equipments used are MTU-5 and MTU-5A units manufactured by Phoenix Geophysics Ltd. and ADU-07 units manufactured by Metronix Ltd. Measurements at all stations are conducted with Pb-$PbCl_2$ electrodes and induction coils, for 2 electric components and 3 magnetic components, respectively. Recorded time series are converted into 40 frequency tables. In the conversion, only for the MTU data, we adopted remote reference processing (Gamble et al., 1978) with magnetic data recorded at GSI geodetic survey station, Esashi. We also conducted long period MT measurements at 9 stations with U-43 unit, manufactured by Terratechnica Ltd., from June to September 2010.

Most of acquired data shows enough S/N ratios for the structural analyses. Dominant strike direction based on the phase tensor (Caldwell et al., 2004) is assumed to N60E in the research area. Then two dimensional resistivity structures are constructed along 5 analysis lines, by inversion scheme developed by Ogawa and Uchida (1996). General appearance shown on resulted all analysis sections is as follows. Surface tephra layer shows high resistivity values. Then Tertiary layer shows low (around 10 Ohm-m). Upper crust shows relatively high resistivity values, again, and shows anticline-like upheaval just under the volcanic line. Upper crust shows relatively high resistivity towards back-ark side. These characteristics are compatible to Sato et al. (2001). Only for the section slicing the Atosanupuri volcano shows extraordinary low resistivity zone (LRZ). Upon a pseudo plane view drawn from 2-D sections, it is obvious that LRZ exists underneath the Kutcharo caldera, and the low frequency events are occurring around LRZ. Just above LRZ, upheaval and downwelling ground motions were observed by InSAR analyses, during 1993 to 1998 (GSI, 2005). The source of this disturbance is assumed to the 6 km depth, which coincides to the top of the LRZ. LRZ can be explained as zone of high melt fraction, and the heat and magma provision of the Atosanupuri volcano.