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Application of induction vectors to a 3-D modeling of the shallow resistivity structure of Aso volcano (2)

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In order to reveal a preparation zone for volcanic explosion, we carried out Audio-frequency Magnetotelluric (AMT) surveys around Naka-dake craters of Aso volcano. Five components of electromagnetic data were collected at a total of 44 sites in August 2004 and in June 2005 (Kanda et al., 2005). No remarkable volcanic activity had been observed at Aso volcano since 1995. The whole area of Naka-dake 1st crater, an active crater of Aso during recent 70 years, had been covered with hot acid water, which is a characteristic phenomenon in a quiet period of the volcanic activity. Some eruptive activities, such as decrease of the crater lake water, mud eruptions, or crater glows, has been observed since 2000. Recent changes in geomagnetic total intensities also suggested that thermal energy storage has been in progress at the shallow part beneath Naka-dake 1st crater or its around.

Results of 2-D inversions for some sections crossing Naka-dake craters revealed that extremely low resistivity was found at about a few hundreds meter depth just beneath the 1st crater. This conductor probably corresponds to the zone of thermal energy storage inferred from geomagnetic field variations. On the other hand, no shallow conductor was found beneath the 4th crater, which has been inactive during past 70 years. Those results suggest that the shallow conductor beneath the crater is closely related to the mechanism of controlling the volcanic activity of Naka-dake (Kanda et al., 2005). Although the 2-D results well revealed the resistivity structure of each section, resistivity between adjacent sections does not show continuous variation and the data should be affected by local topography. 2-D interpretations are not sufficient. In this study, the vertical geomagnetic field is used to investigate a 3-D resistivity structure of Aso volcano. The WinGLink software of Geosystem Srl. was used for a forward calculation of the 3-D resistivity modeling, which is based on a finite differencing scheme on staggered grids developed by Mackey et al. (1993).

It has been found that a direction of induction vector (Parkinson, 1962) is greatly affected by the local topography. Induction vectors obtained at all the sites tend to point the 1st crater or its southwest at a frequency bands from about 1000 Hz to 3Hz. Existence of a conductor around the crater is suggested. Vectors tend to point west of the Naka-dake area at around 1 Hz, which is consistent with the regional tendency of the induction vectors shown by Hashimoto et al. (2002). On the other hand, induction vectors calculated from an uniform resistivity model with 3-D topography showed that vectors pointed to the direction of the 1st crater for the sites located at relatively lower elevations (west to north of Naka-dake craters), while for sites located south to east of the craters, vectors tended to point the direction of Naka-dake or Taka-dake edifices that are higher than elevations of those sites. Even if a shallow conductor beneath the 1st crater was added to the model, induction vectors of those sites did not point to the 1st crater. These tendencies are most prominent at 100 Hz. As the frequency is lower, the effect of topography is smaller and hardly observed at 1Hz.

In former presentation last year, I tried to construct a 3-D model around Aso volcano that can explain qualitative nature of induction vectors, but this try-and-error method has no end to reach the most likely solution. In this presentation, I will report how to remove the topographic effect and to extract the information of underneath structure masked by the effect.