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Electromagnetic resistivity monitoring of Izu-Oshima volcano

Yuji Takahashi[1]; Hisashi Utada[2]

[1] ERI, Univ Tokyo; [2] ERI, Univ. of Tokyo

Temporal resistivity structure change is expected associated with volcanic activities since the resistivity is significantly sensitive to the temperature change or the existence of fluid. Actually, the anomalous change in the apparent resistivity associated with Izu-Oshima 1986 eruption was detected by Yukutake et al. (1990) by using DC (Direct Current) method. In this study, a new resistivity monitoring system was designed and developed based on CSEM (Controlled Source Electromagnetic) method which has a potential to achieve high resolution in both spatial and temporal domains. This system was named ACTIVE (Array of Controlled electromagnetics to Image Volcanic Edifice). ACTIVE consists of an electric dipole source and several vertical magnetic receivers. The target depth is from several hundreds meter to several kilo meters. Three fundamental techniques were developed for ACTIVE, including data processing, electromagnetic fields simulator and resistivity change imaging tool. In this presentation, we show (1) simulations of the resistivity changes associated with eruption scenario of Izu-Oshima volcano, and (2) response function and resistivity change detected by 3 years monitoring at the central caldera of Izu-Oshima.

(1)Anomalous apparent resistivity change had been detected since several months before the 1986 eruption. Utada (2003) has shown that the change is explained by the gradual magma ascent within the vent. We have simulated the application of ACTIVE to the magma ascending model of Utada (2003). The results show that the response function will significantly change up to 6%. The fast imaging technique by using the first-order Born approximation could clearly reconstruct the underground resistivity decrease.

(2)The continuous observation has been carried out since July 2002. One hour signal generated from electric dipole source are received at 5 receivers. The data were converted into mean response function of each site every two days, and to monthly estimates. Average S/N ratio is about 1000 to 100 for each site and frequency. The obtained data show that the responses in 2005 are significantly smaller than those of 2002 with maximum decrease of 7%. The applied imaging indicates that the observed changes can be ascribed partly to near surface change and partly to slight decrease of resistivity below the summit crater.