Resistivity structure around the Aira caldera, SW Japan, inferred from the magnetotelluric measurements

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The Aira caldera is located in southern Kyushu, the southwestern part of Japan, and was formed by the catastrophic eruptions (VEI=7) of the Aira volcano approximately 29,000 years ago. Total volume of the magma erupted was estimated to be about 400 km^3(Aramaki, 1984). There are two active volcanoes in the caldera: Sakurajima and Wakamiko. Sakurajima is a post-caldera volcano and started to grow in the southwestern part of the caldera after 3,000 years of the Aira eruptions. It repeats explosive eruptions more than eight hundred times per year in recent three years. Wakamiko is a submarine volcano occupying the northeastern part of the caldera. Although there is no clear evidence showing the fact of an eruption, hydrothermal fluids exceeding 200 degrees centigrade are extensively discharged from several fumaroles located at the sea bottom.

Since co-eruptive depression of the ground around the Kagoshima Bay was observed before and after the 1914 eruption of Sakurajima volcano (Omori, 1916), a magma reservoir of Sakurajima volcano is presumed to be located at a depth of 10 km beneath the Aira caldera (Mogi, 1958). Accumulation of the magma to the reservoir is still lasting because an upheaval of the ground around the Sakurajima has been observed since the first half of the 1990's. The objective of this study is to clarify the corresponding electrical resistivity structure to the assumed magma reservoir and to the supply paths to Sakurajima volcano and to the submarine volcano.

We have conducted the magnetotelluric (MT) measurement mainly along two traverse lines in the direction of WNW-ESE crossing the Aira caldera since 2009. The MT data at 39 sites in total, including 16 seafloor sites, were obtained for the last four years. For the seafloor observation, the electromagnetic field was recorded for about two to three weeks with a sampling interval of 8 Hz using several OBEMs (Ocean Bottom Electro-Magnetometers). For the land observation, the MTU-5 systems of Phoenix Geophysics Ltd. were used to measure the EM field with the frequency range of 0.001-320 Hz. We performed a 2-D analysis along two lines across the Aira caldera. The strike direction for 2-D analysis was estimated from the individual impedance data obtained on land by using a decomposition technique (Groom and Bailey, 1989). Then, a 2-D inversion (Ogawa and Uchida, 1996) was applied to the TM-mode data set.

A high conductive region of less than 10 Ωm (C1) was found in the southern profile beneath eastern Aira caldera at depths greater than 7-8 km. This conductor appears to extend upward, but it is not clear because of shortage of the higher frequency data obtained by OBEMs. Location of the conductor C1 seen in the resistivity model is roughly in agreement with the location of depression source inferred from the geodetic data (Eto and Nakamura, 1986). This indicates that C1 is possibly the structure relevant to the magma reservoir.