An investigation of three-dimensional electrical resistivity structure under Kikai Caldera

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We have conducted an electromagnetic experiment to reveal a 3-D electrical resistivity (or conductivity) structure under Kikai Caldera, SW Japan. The electrical resistivity is highly sensitive to thermal structure and the presence of partial melt or magma and fluid in the crust and in the upper mantle. Imaging an electrical resistivity structure provides key constraints on the distribution of magma reservoirs in the crust and in the upper mantle and volcanic structures and activities of this submarine caldera. Our electromagnetic experiment is one part of an integrated marine investigation of Kikai Caldera since October 2016 with T/S Fukae-maru, Kobe University. By semiannual research cruises to the Kikai Caldera region, we have repeatedly deployed and recovered ocean-bottom electro-magnetometers (OBEMs) by changing their locations to obtain a data set that is useful for imaging a 3-D electrical resistivity structure. We set 13 observational sites so far, and we have 10-sites data available for analysis. The 10 sites cover an area of 13 km ×16 km within the submarine double caldera with site-distances of ˜5-10 km. The OBEMs measured time variations of electromagnetic fields at sampling rates of 8 Hz and 60 s with instrumental tilts and temperature at seafloor. Data suggested instrumental vibrations during observations, likely because of strong ocean current near the Kuroshio Current or between islands, and unstable positions of OBEMs on very rugged seafloor of lavas in this volcanic area. We carefully checked the time-series data and selected available data terms. We finally obtained magnetotelluric (MT) response functions at the 10 sites at a period range from 21 s to 8192 s, using the BIRRP program [Chave and Thomson, 2004]. For imaging a 3-D electrical resistivity structure, we carried out a 3-D inversion of the MT response functions using an inversion program of Usui et al. [2018]. Undulating seafloor in the study area, which can severely distort the MT responses, was incorporated into a 3-D inversion model with tetrahedron meshes. A preliminary 3-D inversion model (RMS misfit = ˜1.7) shows a shallow conductive area of 3-10 Ω-m at <5-10 km depths, which is thin to the west and is thick to the east, and an underlying deep resistive area of 30-300 Ω-m at 10-30 km depths.

