Interpretation of the high conductive anomaly in the upper mantle beneath the Society hotspot

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The mantle upwellings are one of the most important features for understanding the mantle dynamics. A large-scale mantle upwelling beneath the French Polynesia region in the South Pacific has been suggested from seismic studies, which is called the South Pacific superplume, and a slow velocity anomaly continues from the core mantle boundary to the upper mantle just beneath the Society hotspot (e.g., Suetsugu et al., 2009). However, the previous studies are not enough to understand the geometry, temperature, and composition of the Society hotspot. Then, we carried out the TIARES project that composed of multi-sensor stations that include broadband ocean bottom seismometers, ocean bottom electromagnetometers (OBEMs), and differential pressure gauges from 2009 to 2010 (Suetsugu et al., 2012). In this study, we will present the results of observed data obtained from OBEMs.

In order to obtain three-dimensional (3-D) image of the upwelling of the Society hotspot in terms of electrical conductivity, we newly settled eleven OBEMs. In addition to these data, the old data obtained by Nolasco et al. (1998) was reanalyzed, and we obtained magnetotelluric (MT) responses at 20 sites totally. A 3-D marine MT inversion program (Tada et al., 2012; Baba et al., 2013), which can treat topographic change distorting EM data, was applied to these MT responses to estimate 3-D electrical conductivity image beneath the seafloor.

The 3-D electrical conductivity image revealed a thumb-like high conductive anomaly beneath the Society hotspot. To clarify the cause of the high conductivity, water content, melt fraction, and H_2O and CO_2 contents in the upper mantle were estimated by adopting results of rock experiments at high temperatures and pressures. As a result, the upper mantle in the high conductive anomaly involves more water, melt, H_2O, and CO_2 rather than that in the surrounding area. Furthermore, temperature of high conductive anomaly might be higher than the surrounding area.

Keywords: hotspot, electrical conductivity, upper mantle, melt, volatiles

