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ソサエティー・ホットスポットの上部マントル3次元電気伝導度構造
3-D electrical conductivity image of 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. Nolasco et al. (1998) carried out magnetotelluric (MT) survey around the Society hotspot, which is one of the hotspots in the French Polynesia region, in order to estimate electrical conductivity structure beneath and the vicinity of the Society hotspot in two-dimension. This previous study is not enough to understand the geometry of the hotspot, because the hotspot is tubed like form according to the results from the seismic study. Moreover, Suetsugu et al. (2009) suggested that the slow velocity anomaly continues from the lower mantle to the uppermost upper mantle just beneath the Society hotspot. The geometry, temperature, and composition of the Society hotspot remain controversial, however, due to still insufficient accumulation of the geophysical data.

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. To obtain three-dimensional (3-D) image of the upwelling of the Society hotspot in terms of electrical conductivity, we newly settled eleven OBEMs and obtained MT responses at 20 sites totally. A 3-D marine MT inversion program, which can treat topographic change distorting EM data, was applied to these MT responses to estimate 3-D electrical conductivity image. The result detected a conductive anomaly elongating from the mantle transition zone to the uppermost upper mantle just below the Society hotspot. This feature is consistent with the slow velocity anomaly obtained from the surface wave tomography (Suetsugu et al., 2009). We calculated differences in temperature between the conductive anomaly and the surrounding mantle using conductivity-temperature relationship for dry olivine based on laboratory measurements. The resultant temperature difference is about 400 K at the depth of around 100 km, which is much larger than that estimated from a past seismic study. These results might imply that the effects of partial melt and/or volatiles are necessary in order to explain the high electrical conductivity anomaly beneath the hotspot.

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