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Heterogeneity from mantle to crust at the central Southwest Indian Ridge (1) -Upper mantle-

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Mantle is heterogeneous in terms of geophysical (e.g., bathymetry, geomagnetics, and gravity) and geological (e.g., petrology and geochemistry) aspects. Because heterogeneity is enhanced at slow spreading ridge, the ultra-slow spreading Southwest Indian Ridge (SWIR) is suitable for understanding the heterogeneity. We conducted geophysical and geological investigations since 2007 at the segment along the central SWIR between 35^{o}E and 40^{o}E, where the ridge segment is close to the Marion hotspot.

Serpentinised mantle peridotites occurring as clasts in the conglomerate were dredged from a topographic high within the Prince Edward fracture zone at 35^{o}E. A marine electromagnetic experiment was conducted along a 110 km transect across a subsegment at 37^{o}E to reveal an electrical resistivity structure of the upper mantle.

The peditotites are considered to have originally been lherzolite based on petrographic and mineral chemical composition analyses. Chemical compositions of spinel (Cr# and Mg#) in the peridotites suggest that the peridotites have undergone moderate partial melting without enhancement of melting by the hotspot regardless of proximity of the dredge site to the Marion hotspot. Light rare earth elements of clinopyroxene are more depleted than were previously reported for SWIR peridotites, suggesting that the peridotites have undergone little to no metasomatism of a melt-mantle interaction. Osmium isotope ratios are highly depleted, resulting in that a model age of rhenium depletion (T_{RD}) is 1 billion years. These results suggest that the dredged peridotites have not been enriched after the last melt extraction event 1 billion years ago, preserve their initial depleted compositions without hotspot effects, and show the presence of a refractory mantle domain under the central SWIR.

A preliminary 2-D electrical resistivity structure of the upper mantle down to 200 km depth does not show a remarkable conductive melting region beneath the ridge axis and a more conductive asthenospheric mantle than those observed at other mid-ocean ridges. The resistivity model suggests that the presence of the Marion hotspot does not result in enhancement of melt production beneath the ridge and enrichment of conductors like water in the upper mantle at present.

The result of this study suggests that the source mantle contain ancient, refractory, and depleted portion. This mantle may be a part of the depleted mantle prevailed under the Marion Rise, which was proposed by Zhou and Dick (2013) and may be supported by the absence of slow velocity anomalies around the Marion hotspot in upper mantle seismic tomography images (e.g., Zhao, 2007).