Large local-scale isotopic heterogeneities of the MORB source mantle: A case study on the SWIR

J.M. WARREN[3], C. SAKAGUCHI[2], N. SHIMIZU[1],
E. NAKAMURA[2], AND H. J. B. DICK[1]

[1] Woods Hole Oceanographic Institution;
nshimizu@whoi.edu; hdick@whoi.edu
[2] Institute for Study of the Earth's Interior, Misasa, Japan;
csaka@misasa.okayama-u.ac.jp;
eizonak@misasa.okayama-u.ac.jp
[3]MIT/WHOI Joint Program; jmwarren@whoi.edu

The ultra-slow spreading Oblique Segment of the Southwest Indian Ridge (SWIR) provides a unique opportunity to address scale lengths, timing and origins of mantle chemical and isotopic heterogeneities, because degrees of melting experienced by peridotites are expected to be very small and hence they represent the closest approach to asthenospheric mantle compositions. We undertook detailed geochemical studies on peridotites and pyroxenites from two dredges, which each represent sampling scale lengths of <1 km. Dredge 96, from the inside-corner high of the SWIR with the Shaka Fracture Zone, contains lherzolites and harzburgites associated with abundant pyroxenite veins. In contrast, Dredge 85 – from an amagmatic region of the Oblique Segment – was selected for its lack of veins in any of the peridotites.

Nd and Sr isotopes in Cpx and Opx separates were determined by TIMS at ISEI, Japan. Isotopic compositions overlap those of Indian MORB, indicating that effects of seawater alteration on Sr isotopes were minimized by acid leaching. The isotopic range for Dredge 96 (ε_{Nd}= 5-11; $^{87}Sr/^{86}Sr$= 0.701913-0.703753) covers 40% of the entire Indian MORB Nd dataset, and is greater than that observed previously in SWIR peridotites. In contrast, Dredge 85 has a restricted isotopic range (ε_{Nd}= 11-14; $^{87}Sr/^{86}Sr$= 0.702307-0.702661), with more depleted Nd than has previously been observed in peridotites. Nd and Sr isotopic compositions of Dredge 96 range from a depleted (DMM) to an enriched (Bouvet hotspot) composition. Pyroxenites and peridotites with signatures of melt-rock reaction have affinities to basalts from Bouvet hotspot, which was in the vicinity of this ridge segment at ~20 Ma. Peridotite Cpx Pb isotopes are almost identical to Bouvet basalts (e.g., $^{206}Pb/^{204}Pb$= 19.039-19.606). We suggest that the large local-scale isotopic heterogeneities observed among Dredge 96 peridotites are the result of asthenospheric veining by Bouvet melts, followed by recent interactions between migrating vein-dominated melts and residual peridotite. In contrast, isotopic compositions and trace element abundances indicate that Dredge 85 peridotites are unaffected by the Bouvet hotspot.