The GEISEIR Cruise: Sr, Nd and trace elements high resolution of mantle signal beneath the Southeast Indian Ridge

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In 2010, a first study at that scale was initiated on the Southeast Indian Ridge (SEIR) on about 1500km of ridge, sampling the most recent lavas at pace of 5 or 10 km.
This study was conceived to evaluate mantle melting conditions and mantle composition at high resolution. Fresh basaltic glasses were recovered from ~185 localities along the axis between 80° and 100°E during the expeditions GEISEIR on board the R/V Marion Dufresne. From 80°E to 96°E the sampling density was 0.1 km^{-1} and from 9°E to 100°E it was 0.2 km^{-1}.
Hf, Pb (1) as well as He isotope (2) data have been published already. Hanan et al. (1) have confirmed the bimodal Hf composition of the upper mantle proposed by (3). Graham et al. (2) concluded "the length scales of MORB $^{3}He/^{4}He$ variability to be dominantly controlled by folding and stretching of heterogeneities during regional and mesoscale mantle flow, and by sampling during the partial melting process".
Trace element enrichment (La/Sm ratio but also K/TI) shows no correlation with Sr or Nd isotopes and reveals that isotope variations are not simply due to ancient source enrichment. A preliminary statistical analysis reveals that, as it was the case for Hf and Pb, Sr and Nd isotope ratios distribution cannot be simply fitted by a normal Gaussian distribution. It probably requires at least a bimodal one. It remains to evaluate to which group the bridging samples must be assigned. Once this is confirmed, we must explain how the distribution which was thought to be seen only on Pb and Hf isotopes, is also revealed by Sr and Nd. Namely the recycling ancient oceanic crust delaminated as pyroxenitic veins. The three components mixing or contamination processes proposed by Hanan et al. (1) is then tested to fit the Sr and Nd arrays versus Hf and Pb.

(1) Hanan et al. 2013, Earth Planet. Sci. Lett. 375-1, 196-208.
(2) Graham et al. 2014, Geochem. Geophys. Geosyst., 15.
(3) Graham et al. 2006, Nature 440l9.