Determining Melt Flow at the East Pacific Rise through Hf and Nd Isotopes

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Introduction
The East Pacific Rise (EPR) around 9°N is one of the best studied location of the ridge system. The EPR between 6°N and 18°N is migrating westwards relative to the hot spot reference frame. It has been noticed at the EPR that there is a stepwise function in the crustal thickness across discontinuities along the ridge such as transform faults [1]. Because the ridge is migrating the ridge segment on either side of a transform fault is either leading (is in the direction of the migration) or trailing. At the EPR the axial depth at leading edge of the ridge segment is shallower indicating increased crustal thickness and thus increased melt accumulation. It has been argued that this additional melt is the result of low degree melts that are formed at the edges of the melting regime of the trailing edge of a segment will “cross” the transform zone so that it minimizes the distance it needs to move “upstream” (against the direction of the migrating ridge) [1, 2]. The melts that “cross” the transform are low degree melts from the edges of the melting regime and should have a trace element characteristic that should be observable in the basalts. In addition, if an isotopically distinct low solidus component exists in the sub ridge mantle then this component would be concentrated in these low degree melts. We used existing collections to obtain as high a density of sampling as possible to test this hypothesis

Experimental
We analyzed 80 MORB for Hf, Nd and Pb isotopic composition. Regular dissolution and separation techniques were used to prepare Hf, Nd and Pb separates. Separates were analyzed on our multi-collector inductively coupled plasma mass spectrometer (Thermoquest NEPTUNE) in static mode. Reproducibility of mass fractionation corrected 176Hf/177Hf and 143Nd/144Nd is routinely better then 4 ppm, which is better then our previous techniques. Pb isotopes were also measured on the NEPTUNE using thallium to correct for mass fractionation. Pb isotope ratios were reproducible to better then 100 ppm.

Results and Discussion
Figure 1 shows the Hf-isotope variations along the ridge. Nd and Pb – isotopes show similar variations. The isotopic variations show the following pattern: the leading edge of the ridge is always less radiogenic than the associated trailing edge. In addition, the total variation at the trailing edge is less than at the leading edge. These observations indicate that low degree melts indeed have crossed the discontinuities as predicted by the crustal thickness variations.

Conclusions
The pattern of isotopic variations along the ridge indicates that 1. The sub-ridge mantle contains an unradiogenic low solidus component and 2. Melts seem to choose the “road of least resistance” which means that low degree melts generated at the edges of the melting regime will take the shortest path towards the ridge and cross discontinuities that create ridge segmentation.

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References