How much heterogeneity in the mantle MORB source?

Henry Dick

It has long been known that there are primary compositional gradients in major and trace element composition in the residual mantle dredged from slow spreading ocean ridges. These gradients have been correlated directly to the major element composition of spatially associated basalts showing that the most depleted peridotites and refractory basalts are associated with mantle plume regions in the Atlantic and Indian Oceans. The peridotites used to show this correlation come almost entirely from fracture zones, and thus represent a sample skewed to the distal end of a mantle melting cell beneath a ridge segment. Now peridotites have been dredged in abundance from the Gakkel and SW Indian Ridge far from any mantle hot spot, and far from any transform in regions that should reflect the lowest degree of mantle melting anywhere in the oceans: ultraslow spreading ridges. Analysis of spatially associated MORB and peridotites from one of these locations, 9°-16°E on the SW Indian Ridge show that the basalts are consistently less depleted isotopically than the peridotites, implying that they represent very low degrees of melting of a depleted mantle hosted enriched vein assemblage. Many of these peridotites, however, appear to represent moderate degrees of mantle melting, despite the fact that they occur in regions where there is little or no crust, and the mantle has spread onto the sea floor for long periods. This, then raises two interesting questions: to what are the relative mass contributions of veins and host mantle to basalt generation? and How heteregeneous is the primary mantle source before melting. The new evidence suggests that both these questions remain unanswered .

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