2017 Geodynamics Seminar

Generation of the Oceanic Lithosphere at a Melt-Starved and Ultraslow Mid-Ocean Ridge

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1:30 - 2:30 p.m.
Carriage House, Quissett Campus, WHOI

Summary

Melt-starved regions of the global mid-ocean ridge system are uncommon but offer unique insights into tectonically-dominated plate divergence mechanisms. They are also good laboratories to investigate interactions between melts and mantle in the ridge's lithosphere: for a given volume of erupted basaltic melt, the volume of reacted mantle there is potentially greater than at more magmatically robust ridges.

Seismic and gravity data indicate that the easternmost portion of the Southwest Indian Ridge (SWIR; spreading rate 14 mm/yr), between the Melville Fracture Zone and the Rodrigues Triple Junction, receives about half the average mid-ocean ridge melt supply. In addition, most of this melt is focused toward volcanic centers, leaving intervening corridors of nearly amagmatic spreading. In these corridors, the seafloor exposes wide expanses of partially serpentinized mantle-derived peridotites, with a small (~5%) proportion of gabbroic rocks and a thin (≤ a few hundred meters) and very discontinuous basaltic cover. Off-axis dredging shows that mantle-derived material has been continuously exhumed in these corridors over the past 8 to 10 Myrs. The proposed tectonic interpretation is that mantle-derived material is exhumed in the footwall of successive large offset normal faults, each accommodating up to 1.5 myrs-worth of plate separation and dipping alternatively to the north beneath the African-Somalian plate, or to the south beneath the Antarctic plate.

In this presentation, I use bathymetry, gravimetry, seafloor reflectivity, seismic data, dredging results, and preliminary submersible observations to outline a conceptual model of the generation of the oceanic lithosphere at melt-starved mid-ocean ridges. This includes addressing crustal and lithospheric ages and architecture, the context and chemical consequences of melt-mantle interactions, and the transition from fault-controlled nearly amagmatic spreading to more magmatic spreading toward adjacent volcanic centers. I also discuss the relevance of this model to more magmatically active slow and ultraslow ridges.