

IODP Proposal Cover Sheet

800-Full

 New Revised Addendum

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Title:	The Nature of the Lower Crust and Moho at Slower Spreading Ridges (SloMo)		
Proponent(s):	Henry J.B. Dick, Woods Hole Oceanographic Inst., Shoji Arai, Kanazawa University James H. Natland, University of Miami, Christopher J. MacLeod, Cardiff University, Paul T. Robinson, Dalhousie University, Maurice Tivey, Woods Hole Oceanographic Institution and SloMo Proponent group (attached)		
Keywords: (5 or less)	Ocean crust, Gabbro, Peridotite, Moho	Area:	Indian Ocean, SW Indian Ridge

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Permission to post abstract on iSAS Web site: Yes No

Abstract: (400 words or less)

This proposal is to drill through the Atlantis Bank gabbroic massif into mantle 2.2 km NE of 1.5-km deep Hole 735B to 500-m below Moho. There are 2 major objectives. First to recover the lowermost gabbros and crust-mantle transition in order to understand the processes creating Mid-Ocean Ridge Basalt – the most abundant magma type on Earth, and second, resolve the controversy as to whether the Moho at slow spreading ridges can be a serpentinization front. Based on geologic mapping, geochemistry, and seismic refraction, it is believed that the igneous crust-mantle boundary below Atlantis Bank is ~2.5 km above Moho. This is an ideal location, then, to test the serpentinization front hypothesis.

The drill site is also positioned at the center of the 700-km²-gabbro massif to recover the crust-mantle transition where it is most fully developed at the likely point of focused melt flow from the mantle. This will test competing hypotheses for MORB petrogenesis: one supported by experimental petrology that it segregates at depths of 10 to 30 km where primary MORB melts were last in equilibrium with the olivine plus two pyroxene mantle assemblage, and then transported to the crust with little additional mantle interaction. The alternative hypothesis is that MORB aggregates and pools in the mantle at the base of the crust, where melt-rock reaction with the mantle and lower crust, significantly modifies the melt composition prior to intrusion to higher levels and eruption to the seafloor. The latter process has two major implications: 1) the assumed composition of primary magmas, based on compositions calculated assuming that MORB is produced by simple fractional crystallization of a parental melt is incorrect, and that 30 years of experimental petrology has used the wrong composition in predicting mantle-melt equilibrium, and 2) that hybridized mantle produced by melt-rock reaction at the base of the crust is a

significant contributor to the bulk composition of the crust. The results will profoundly affect our understanding of magma generation and the fundamental linkage between the mantle, melt, and crust.

In addition, the new hole, combined with the existing holes will produce a transit spaced at ~ 1-km intervals to look at the lateral heterogeneity of the crust, while at the same time testing the nature of magnetic reversals in plutonic rock, as well as document the stress-strain evolution of a plate boundary undergoing asymmetric seafloor spreading.

Scientific Objectives: *(250 words or less)*

- ❖ Test competing models for the nature of the lower ocean crust beneath a typical magmatic accretionary ridge segment.
- ❖ Constrain the nature of the Moho at a location where it is has been suggested that it is a serpentinization front.
- ❖ Determine the lateral heterogeneity of the lower ocean crust and the scale and manner of melt intrusion.
- ❖ Determine the Nature of magnetic anomaly transitions in the lower crust.

Please describe below any non-standard measurements technology needed to achieve the proposed scientific objectives.

None

Proposed Sites:

Site Name	Position	Water Depth (m)	Penetration (m)			Brief Site-specific Objectives
			Sed	Bsm	Total	
AtBk-1A	32°42.75'S, 57°17.11'E	700	0	6000	6000	Crust-mantle boundary & Moho
AtBk-2A	32°41.00'S, 57°20.35'E	1700	1+	500+	501+	Core the dike-gabbro transition
AtBk-3A	32°40.3'S, 57°17.5'E	700	0	500+	500+	Determine the lateral heterogeneity of the lower ocean crust