IODP Proposal Cover Sheet

898 - Pre

Fore Arc Mohole-to-Mantle

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Title	Oceanic to Proto-Arc Mantle Transformation: Fore Arc M2M (Moho-to-Mantle) in the Bonin Trench, Northwestern Pacific		
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Keywords	Mantle, Lower Crust, Moho, Fore-arc	Area	Bonin Trench

Proponent Information

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Abstract

We aim to drill through deep oceanic crust and the Moho into the uppermost mantle beneath the Bonin fore-arc in the NW Pacific. The goals are to understand the origin and evolution of supra-subduction zone crust, the nature of the Moho, and the geochemical and geodynamic evolution of recently accreted lithospheric mantle.

Although peridotite samples are not geologically rare on the Earth's surface, fresh and in situ peridotite from recently convected mantle has yet to be obtained. We propose to drill into relatively young oceanic mantle; our target site is the fore-arc mantle/crust section exposed on the landward slope of the Bonin Trench. We sample the fresh lower igneous crust and the uppermost mantle peridotite, including the intervening boundary layer, that were accreted during the tectonism and magmatism associated with initiation of subduction at ~5248 Ma.

We explore:
1. Petrology: Peridotite and gabbro preserve records of melt-mantle reaction during subduction initiation and information of the pre-existed oceanic lithosphere
2. Tectonophysics: Peridotite records the structural history of subduction initiation, ocean lithosphere formation, and subsequent deformation
3. Fluid and Hydrology: Serpentinite in the fore-arc mantle to mantle-crust boundary records hydrology and chemistry of the subduction fluids during subduction initiation
4. Biosphere: Circulation of subducted fluids in the mantle and crust and their boundary (Moho) generates an unusual deep biosphere

Our objectives differ from those of the M2M projects aimed at mid ocean ridges, which focus on the formation of the oceanic crust during sea-floor spreading. Our focuses are on: (1) subduction initiation and (2) physical, chemical, and biological interactions between the mantle, crust and surface environment in a supra-subduction zone setting. These are entirely relevant to the driving force of the plate tectonics and interactions between Earth's deep mantle and the surface. They also address the IODP Science Plan Challenges 8, 9, 10 and 11 in the EARTH CONNECTIONS theme and Challenges 5 and 6 in the BIOSPHERE FRONTIERS theme.

898 - Pre

Scientific Objectives

1. Petrology: Peridotite and gabbro preserve records of melt-mantle reaction during subduction initiation and information of the pre-existed oceanic lithosphere
2. Tectonophysics: Peridotite records the structural history of subduction initiation, ocean lithosphere formation, and subsequent deformation
3. Fluid and Hydrology: Serpentinite in the fore-arc mantle to mantle-crust boundary records hydrology and chemistry of the subduction fluids during subduction initiation
4. Biosphere: Circulation of subducted fluids in the mantle and crust and their boundary (Moho) generates an unusual deep biosphere

Non-standard measurements technology needed to achieve the proposed scientific objectives

898 - Pre

Proposed Sites (Total proposed sites: 4; pri: 4; alt: 0; N/S: 0)

Site Name	Position (Lat, Lon)	Water Depth (m)	Penetration (m)			Brief Site-specific Objectives
			Sed	Bsm	Total	
FM-01A (Primary)	28.472002 142.894852	7000	50	450	500	Ultramafic rocks such as peridotite, pyroxenites and serpentinites
FM-02A (Primary)	28.464926 142.851044	6500	50	450	500	lower crustal rocks such as gabbro and troctolite
FM-03A (Primary)	28.476512 142.922145	7500	50	50	100	Serpentinite muddy sediments and/or ultramafic rocks such as peridotite, serpentinite and pyroxenite
FM-04A (Primary)	28.483096 142.960488	8000	50	50	100	serpentinite muddy sediment and/or ultramafic rocks such as peridotite, serpentinite and pyroxenite