

IODP Proposal Cover Sheet

951 - Pre

North Hawaiian Arch Crust

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Title	Drilling Middle Aged Oceanic Crust on North Arch off Hawaii		
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Keywords	Upper crust, North Arch, Landslides	Area	North Arch off Hawaii

Proponent Information

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Abstract

We propose to drill a complete upper crustal section and into the uppermost gabbros in 80 Ma crust spread at 8 cm/a on the North Arch off-Hawaii. The goals are to understand the architecture and evolution of the oceanic crust, the relationship between the diversity of Moho and aging of oceanic lithosphere and to evaluate the history and mechanics of gigantic landslides near Hawaii.

Previous drilling into tectonically undisturbed oceanic crust is limited and skewed to young and slow-spread crust <4 cm/a, with a wide gap of crustal age between 20 and 110 Ma, including the world average age of 63 Ma and spreading rate of 8 cm/a. Thus, previous drilling of oceanic crust has not sampled representative oceanic crust. The spreading rate interval of 7-10 cm/a bears a key to understand the change in the style of upper crustal extension from magmatic accretion to stretching. Subduction of aged and hydrated lithosphere is particularly important in generating arc magmas and large earthquakes through dehydration, which ultimately plays fundamental roles in deep circulation of volatiles and the geochemical evolution of the mantle.

The oceanic crust on the North Arch meets the target spreading rate (8cm/a) and the age gap (~80Ma) and is ideal to understand the physical and chemical evolution of aged oceanic lithosphere and the diversity of Moho, including the effect of intraplate volcanism, as well as the history of hazardous landslides. It is also located accessible from a major international airport.

Challenges 5, 6, 9, 10, 11 and 12 will be addressed by providing information of deep oceanic crust of unrecovered age and spreading rate gaps in ocean drilling as a subduction input.

The overarching goals to be addressed by drilling are to better constrain:

- 1) the nature of layer 2/3 transition and its relations with the dike-plutonic transition,
- 2) the relationships between the style of crustal extension and the architecture of the upper crust,
- 3) the styles and vigor of hydrothermal circulation and alteration with declining temperature in the aged oceanic crust,
- 4) the physical and chemical evolution of oceanic lithosphere with special reference to the Moho diversity and the North Arch volcanism,
- 5) the frequency, size and possible failure mechanics of hazardous giant landslides caused by the periodic collapse of Hawaiian shield volcanoes
- 6) the depth limits of microbial life in aged, hydrated, and cold crust where metabolic strategies have remained completely unexplored.

Scientific Objectives

We propose to drill a complete upper crustal section into the uppermost gabbros in ~80 Ma crust formed at a spreading rate of ca. 8 cm/a on the North Arch off-Hawaii in the central Pacific.

The overarching goals to be addressed by drilling are to better constrain:

- 1) the nature of layer 2/3 transition and its relations with the dike-plutonic transition,
- 2) the relationships between the style of crustal extension and the architecture of the upper crust, including the thicknesses of extrusive and sheeted dike sections and the ratios of pillow/sheet flows,
- 3) the styles and vigor of hydrothermal circulation and alteration in aged oceanic crust,
- 4) the physical and chemical evolution of oceanic lithosphere with special reference to the Moho diversity and the North Arch volcanism,
- 5) the frequency, size and possible failure mechanics of hazardous landslides caused by the collapse of Hawaiian shields, and
- 6) the depth limits of microbial life in aged, hydrated, and cold crust where metabolic strategies have remained completely unexplored.

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

Proposed Sites (Total proposed sites: 2; pri: 1; alt: 1; N/S: 0)

Site Name	Position (Lat, Lon)	Water Depth (m)	Penetration (m)			Brief Site-specific Objectives
			Sed	Bsm	Total	
NA-01A (Primary)	23.63055 -155.83200	4317	130	2000	2130	Complete penetration from sediment through extrusive rocks and sheeted dikes into gabbro; underlain by the Moho reflector
NA-02A (Alternate)	23.24647 -156.41315	4233	130	2000	2130	Alternate site on the normal-reverse boundary of magnetic anomaly labeled 34 in Fig. 7; same objectives as NA-01A