IODP Proposal Cover Sheet

921 - APL

Hole 896A Biosphere Restoration

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Title	Restoring and sampling ODP Hole 896A for linked crustal, fluid, and biosphere studies
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Area	Costa Rica Rift

Proponent Information

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Abstract

Leveraging the proximity and activities of planned Expedition 384 Panama Basin Crustal Architecture to restore Hole 504B by removing an observatory to enable new logging, we propose a 3-4 day APL to visit the nearby (<2 km away) Hole 896A to remove a similar borehole observatory and sample the deep biosphere. Hole 896A represents an opportunistic analogue to the Juan de Fuca Ridge flank system (i.e. IODP Expeditions 301 and 327), allowing hypothesis-testing pertaining to the diversity and function of the microbial deep biosphere within basaltic crust. Hole 896A was originally drilled in 1993 to a total depth of 469 meters below seafloor, penetrating 290 m of basaltic basement with an age of 6-7 Ma. Upper basement conditions at this site are very similar to the Juan de Fuca Ridge flank, experiencing hydrothermal (58ºC) and chemically-reduced and highly altered fluids that circulate in relatively young basaltic crust. Hole 896A was revisited in 2001 during which wireline operations revealed the presence of flocculent material in the basement portion of the borehole. This material suspiciously resembled flocculent microbial mat material observed at 'snow blower' hydrothermal vents. Initial evaluation of flocculent material that was opportunistically scraped from wireline tools confirms the presence of biofilm-forming microorganisms, yet the compositions of the microbial communities were distinctly different from those observed in the Juan de Fuca Ridge flank subsurface, even though thermal and chemical compositions are nearly identical. Differences may suggest site-specific characteristics influence the structure of subsurface crustal microbial communities, or that temporal events may influence composition (as has been observed at the Juan de Fuca). We propose to restore Hole 896A with the operational goals of (1) removing a stuck wireline packer system from the borehole, (2) conducting wireline operations with advanced temperature and fluid sampling tools to collect samples for microbiological and geochemical analyses, and (3) time permitting, log the hole to complement currently scheduled logging in Hole 504B. Similar operations are planned for Expedition 384 in Hole 504B, so the technical expertise, tools, and sensors will be on site. Currently Hole 896A is inaccessible; however, the proposed operations will not only make this legacy hole available to future cutting-edge coupled microbiological, biogeochemical and hydrologic experiments but also will provide initial samples to facilitate and direct research directions. Proposed operations will further the current IODP science plan, advancing Biosphere Frontiers and other challenges (e.g., 10 and 14).

921 - APL

Scientific Objectives

The primary scientific hypothesis to be tested is that microbial community phylogenetic structure and functional potential within upper basaltic basement is primarily influenced by fluid geochemical and thermal conditions, which are almost identical at Hole 896A and the eastern Juan de Fuca Ridge flank sites (i.e. the same species are found everywhere, and the environment selects for them to be dominant). Our primary scientific objective is to collect a pristine sample of borehole fluid from depth in Hole 896A for microbiological and geochemical analysis. Fluid sampling will be achieved using the Kuster Sampler (which is planned for deployment on Exp. 376 [Brothers Arc Flux]) in addition to the Water Sampler Temperature Probe, which was recently used on Exp. 366. Both are deployed on the wireline. A secondary objective is to log the hole, thus providing a comparison to crustal properties at Hole 504A, about 2 km away. However, to complete these objectives requires removing the wireline packer system currently blocking entry into Hole 896A. Restoring Hole 896A combined with the planned restoration of Hole 504B provide the potential for a range of future research directions, such as a future legacy installation of a “CORK-Lite” borehole observatory system for in situ experimentation. Such experiments could include, but are not limited to, metabolic, perturbation and tracers studies for microbiological, biogeochemical, and hydrogeological research.

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

Removal of the wireline CORK that is stuck in Hole 896A will require a fishing tool, and removing the packer will require either a fishing overshot or a mill to grind it up. Such tools will already be onboard to conduct similar operations at Hole 504B during Expedition 384. Wireline operations will require a sampler to collect fluid from the borehole. We propose using the Kuster Sampler (planned for deployment on Exp. 376) and/or the Water Sampler Temperature Probe (used on Exp. 366). Logging operations would require the sample tool suite that will be used in Hole 504B.

921 - APL

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

Site Name	Position (Lat, Lon)	Water Depth (m)	Penetration (m)			Brief Site-specific Objectives
			Sed	Bsm	Total	
CRR-01A (Primary)	1.2168 -83.7232	3459	0	0	0	Removal of the wireline CORK that is stuck in Hole 896A will require a fishing tool, and removing the packer will require either a fishing overshot or a mill to grind it up. Such tools will already be onboard to conduct similar operations at Hole 504B during Expedition 384. Wireline operations will require a sampler to collect fluid from the borehole. We propose using the Kuster Sampler (planned for deployment on Exp. 376) and/or the Water Sampler Temperature Probe (used on Exp. 366). Logging operations would require the sample tool suite that will be used in Hole 504B.