

IODP Proposal Cover Sheet

937 - Pre

Deepening Hole U1309D

Received for: 2018-04-02

Title	Accessing the Building Blocks of Life: Deepening Hole U1309D, Atlantis Massif, Mid-Atlantic Ridge		
Proponents	Andrew McCaig, Donna Blackman, Benoit Ildefonse, Barbara John, Frieder Klein, Marvin Lilley, Johan Lissenberg, Benedicte Menez, Antony Morris, Geoffery Wheat, Natsue Abe, Muriel Andreani, Javier Escartin, Marguerite Godard, Christopher MacLeod, Yasukiko Ohara, Stephane Roumejon, Ivan Savov, Esther Schwarzenbach, William Seyfried		
Keywords	serpentinization, hydrogen, methane, gabbro, fluid	Area	Mid-Atlantic Ridge

Proponent Information

Proponent	Andrew McCaig
Affiliation	University of Leeds
Country	United Kingdom

Permission is granted to post the coversheet/site table on www.iodp.org

Abstract

The Atlantis Massif Oceanic Core Complex (OCC) is one of the best studied locations in the ocean crust, the site of four IODP expeditions so far (304, 305, 340T and 357). It is the site of the Lost City Hydrothermal Field (LCHF), venting alkaline fluids rich in hydrogen and methane at 40-90 centigrade. IODP Hole U1309D, located 5km north of the LCHF, is the deepest (1415m) hole so far drilled in young (<2 Ma) ocean crust, sampling a primitive series of gabbroic rocks interpreted in part to be metasomatised peridotite. Gabbroic lithologies in Hole U1309D contrast with serpentinized peridotites sampled near the LCHF by seafloor coring in Exp. 357 and sampling on the south wall of the Massif. The hydrologic regime is also very different at the two locations, with deep permeability required beneath the LCHF, and a low permeability conductive regime evidenced by a linear thermal gradient deeper than 750 mbsf in Hole U1309D.

The principle aim of this proposal is to sample fluids and rocks in a stable regime with temperatures higher than ever sampled before by IODP. So far Hole U1309D has drilled very well, and the Hole was in good condition after the logging Expedition 340T. We hope to access temperatures above 200 centigrade, where active serpentinization is occurring in olivine-rich rocks, and where the building blocks for life (H₂, CH₄, higher hydrocarbons) are hypothesised to be created inorganically.

The main objectives are:

- to sample fluids in the existing hole, in a range of lithologies and locations where fluid ingress is suspected, and at temperatures up to 140 centigrade
- to leave a clean hole for future logging and fluid sampling once thermal equilibrium has returned
- to sample lithologies that have never been below temperatures of 200 centigrade (except for a few hours during drilling) to eliminate low T alteration and microbial activity.
- to sample H₂, CH₄, other organic molecules and cations in fluid inclusions to compare with ambient fluids. We hypothesise that concentration gradients in volatile species may exist in the Massif
- to study uptake of volatile elements such as B and Li in rocks that have never been closer than 1.5 to 2km from the ocean reservoir.
- to quantify processes of melt-rock reaction critical to assembling oceanic gabbro bodies
- to assess hole stability and drilling strategies at higher temperatures

Scientific Objectives

- 1) to sample lithologies that have never been below temperatures of 140 to 200 C (except for a few hours during drilling) and which have not been subjected to low T alteration and conditions conducive for microbial activity.
- 2) to sample fluids in the existing hole, in a range of lithologies and locations where fluid ingress is suspected, and at temperatures up to 140 C
- 3) to sample H₂, CH₄, other organic molecules and cations in fluid inclusions to compare with ambient fluids. We hypothesise that concentration gradients in volatile species may exist in the Massif
- 4) to study uptake of volatile elements such as B and Li in rocks that have never been closer than 1.5 to 2km from the ocean reservoir.
- 5) to further quantify processes of melt-rock reaction critical to assembling oceanic gabbro bodies and to our understanding of crustal architecture and lithological heterogeneities at slow-spreading ridges, and how these reaction link to mantle melting.
- 6) to test whether rocks that experienced slower cooling deeper in Hole U1309D record younger polarity magnetic components than those documented during Expedition 304/305, in order to further constrain the crustal cooling history
- 7) to assess hole stability and drilling strategies at temperatures above 140 C, including new protocols for preserving high temperature samples away from atmospheric weathering and low temperature reaction.
- 8) to leave a clean hole for future logging and fluid sampling once thermal equilibrium has returned

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

Sampling of fluids using downhole logging tools at selected intervals
Preserving selected samples away from atmospheric alteration and at ambient temperature

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	
AMDH-01A (Primary)	30.1687 -42.1186	1656	0	800	800	Deepen existing Hole U1309D by 800 to 1000m; log Hole including fluid sampling