IODP360 - Raman spectra of a core sample taken at the Atlantis Bank

Website: https://www.bco-dmo.org/dataset/854820
Data Type: Other Field Results
Version: 1
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Project
» Collaborative Research: Delineating The Microbial Diversity and Cross-domain Interactions in The Uncharted Subseafloor Lower Crust Using Meta-omics and Culturing Approaches (Subseafloor Lower Crust Microbiology)

Program
» International Ocean Discovery Program (IODP)

Contributors	Affiliation	Role
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Abstract
IODP360 - Raman spectra of a core sample taken at the Atlantis Bank. Sample taken on board of the R/V JOIDES Resolution between November 30, 2015 and January 30, 2016.

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Coverage

Spatial Extent: **Lat**:-32.70567 **Lon**:57.278183
Temporal Extent: 2015-11-30 - 2016-01-30

Acquisition Description

Location: Atlantis Bank oceanic core complex (SW Indian Ridge, Indian Ocean), 182.44 m below the seafloor, sample IODP X360-21-R2, organic inclusion and Fe-Mn oxide. Depth of seafloor at sampling site is 710.2 mbsl.

For more details on core sampling and data acquisition, please see Li et al. (2020).

Processing Description

Organic inclusions were analyzed in a petrographic thin section.

Raman spectra were collected using a Horiba LabRam HR confocal Raman system using a blue laser with a wavelength of 473 nm, a 600 grooves/mm grating, and a 50x objective. The slit size was 150 µm and the confocal hole diameter was 1mm. This setting was chosen to minimize oxidation of the Fe-Mn oxide that was intergrown with the organic inclusions

Background was subtracted using the software code LabSpec 6

Spectral artifacts from oxidation of the Fe-Mn oxide and thin section polymer.

BCO-DMO processing notes:

- Adjusted column names to comply with database requirements
- Merged 3 tables into 1 (based on wavenumbers).
- Added location (lat/lon) of Atlantis Bank oceanic core complex

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Related Publications

Li, J., Mara, P., Schubotz, F., Sylvan, J. B., Burgaud, G., Klein, F., … Edgcomb, V. P. (2020). Recycling and metabolic flexibility dictate life in the lower oceanic crust. Nature, 579(7798), 250–255. doi:10.1038/s41586-020-2075-5 https://doi.org/https://doi.org/10.1038/s41586-020-2075-5
Results

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Parameters

Parameter	Description	Units
Shift	Raman shift	reciprocal centimeter (cm-1)
Intensity	Raman Intensity	arbitrary units
Wavenumber	Wavenumbers	reciprocal centimeter (cm-1)
Latitude	Latitutde of sampling location	decimal degrees
Longitude	Longitude of sampling location	decimal degrees

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Instruments

Dataset-specific Instrument Name	Horiba LabRam HR confocal Raman system
Generic Instrument Name	Raman Microscope
Dataset-specific Description	Raman spectra were collected using a Horiba LabRam HR confocal Raman system using a blue laser with a wavelength of 473 nm, a 600 grooves/mm grating, and a 50x objective. The slit size was 150 µm and the confocal hole diameter was 1mm. This setting was chosen to minimize oxidation of the Fe-Mn oxide that was intergrown with the organic inclusions.
Generic Instrument Description	The Raman microscope is a laser-based microscopic device used to perform Raman spectroscopy. The Raman microscope begins with a standard optical microscope, and adds an excitation laser, laser rejection filters, a spectrometer or monochromator, and an optical sensitive detector such as a charge-coupled device (CCD), or photomultiplier tube, (PMT). One example is the XploRA confocal Raman microscope (information from the manufacturer).

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Deployments

IODP-360

Website	https://www.bco-dmo.org/deployment/810905
Platform	R/V JOIDES Resolution
Report	http://publications.iodp.org/scientific_prospectus/360/index.html
Start Date	2015-11-30
End Date	2016-01-30

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Project Information

Collaborative Research: Delineating The Microbial Diversity and Cross-domain Interactions in The Uncharted Subseafloor Lower Crust Using Meta-omics and Culturing Approaches (Subseafloor Lower Crust Microbiology)

Coverage: SW Indian Ridge, Indian Ocean

NSF abstract:

The lower ocean crust has remained largely unexplored and represents one of the last frontiers for biological exploration on Earth. Preliminary data indicate an active subsurface biosphere in samples of the lower oceanic crust collected from Atlantis Bank in the SW Indian Ocean as deep as 790 m below the seafloor. Even if life exists in only a fraction of the habitable volume where temperatures permit and fluid flow can deliver carbon and energy sources, an active lower oceanic crust biosphere would have implications for deep carbon budgets and yield insights into microbiota that may have existed on early Earth. This is all of great interest to other research disciplines, educators, and students alike. A K-12

education program will capitalize on groundwork laid by outreach collaborator, A. Martinez, a 7th grade teacher in Eagle Pass, TX, who sailed as outreach expert on Drilling Expedition 360. Martinez works at a Title 1 school with ~98% Hispanic and ~2% Native American students and a high number of English Language Learners and migrants. Annual school visits occur during which the project investigators present hands on-activities introducing students to microbiology, and talks on marine microbiology, the project, and how to pursue science related careers. In addition, monthly Skype meetings with students and PIs update them on project progress. Students travel to the University of Texas Marine Science Institute annually, where they get a campus tour and a 3-hour cruise on the R/V Katy, during which they learn about and help with different oceanographic sampling approaches. The project partially supports two graduate students, a Woods Hole undergraduate summer student, the participation of multiple Texas A+M undergraduate students, and 3 principal investigators at two institutions, including one early career researcher who has not previously received NSF support of his own.

Given the dearth of knowledge of the lower oceanic crust, this project is poised to transform our understanding of life in this vast environment. The project assesses metabolic functions within all three domains of life in this crustal biosphere, with a focus on nutrient cycling and evaluation of connections to other deep marine microbial habitats. The lower ocean crust represents a potentially vast biosphere whose microbial constituents and the biogeochemical cycles they mediate are likely linked to deep ocean processes through faulting and subsurface fluid flow. Atlantis Bank represents a tectonic window that exposes lower oceanic crust directly at the seafloor. This enables seafloor drilling and research on an environment that can transform our understanding of connections between the deep subseafloor biosphere and the rest of the ocean. Preliminary analysis of recovered rocks from Expedition 360 suggests the interaction of seawater with the lower oceanic crust creates varied geochemical conditions capable of supporting diverse microbial life by providing nutrients and chemical energy. This project is the first interdisciplinary investigation of the microbiology of all 3 domains of life in basement samples that combines diversity and "meta-omics" analyses, analysis of nutrient addition experiments, high-throughput culturing and physiological analyses of isolates, including evaluation of their ability to utilize specific carbon sources, Raman spectroscopy, and lipid biomarker analyses. Comparative genomics are used to compare genes and pathways relevant to carbon cycling in these samples to data from published studies of other deep-sea environments. The collected samples present a rare and time-sensitive opportunity to gain detailed insights into microbial life, available carbon and energy sources for this life, and of dispersal of microbiota and connections in biogeochemical processes between the lower oceanic crust and the overlying aphotic water column.

About the study area:

The International Ocean Discovery Program (IODP) Expedition 360 explored the lower crust at Atlantis Bank, a 12 Ma oceanic core complex on the ultraslow-spreading SW Indian Ridge. This oceanic core complex represents a tectonic window that exposes lower oceanic crust and mantle directly at the seafloor, and the expedition provided an unprecedented opportunity to access this habitat in the Indian Ocean.

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Program Information

International Ocean Discovery Program (IODP)

Website: http://www.iodp.org/index.php

Coverage: Global

The International Ocean Discovery Program (IODP) is an international marine research collaboration that

explores Earth's history and dynamics using ocean-going research platforms to recover data recorded in seafloor sediments and rocks and to monitor subseafloor environments. IODP depends on facilities funded by three platform providers with financial contributions from five additional partner agencies. Together, these entities represent 26 nations whose scientists are selected to staff IODP research expeditions conducted throughout the world's oceans.

IODP expeditions are developed from hypothesis-driven science proposals aligned with the program's science plan *Illuminating Earth's Past, Present, and Future*. The science plan identifies 14 challenge questions in the four areas of climate change, deep life, planetary dynamics, and geohazards.

IODP's three platform providers include:

- The U.S. National Science Foundation (NSF)
- Japan's Ministry of Education, Culture, Sports, Science and Technology (MEXT)
- The European Consortium for Ocean Research Drilling (ECORD)

More information on IODP, including the Science Plan and Policies/Procedures, can be found on their website at http://www.iodp.org/program-documents.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1658031

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