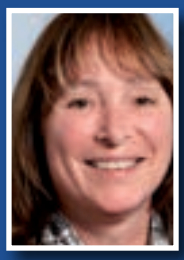
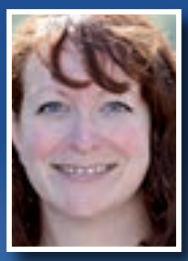
Expedition Co-Chief Scientists

Professor Gretchen Früh-Green



Gretchen Früh-Green was appointed Professor at the Department of Earth Sciences of the ETH Zurich, Switzerland in 2010. She completed a PhD and Swiss habilitation at the ETH and is leading research in Marine Geology and Geochemistry. She is strongly committed to serving the scientific drilling community and has been involved in many phases of the ocean drilling programmes. Her research interests include studies of fluid-rock-microbe interaction and geochemical fluxes during hydrothermal alteration of crustal and mantle sequences exposed in modern ocean basins and in ophiolites. Her research particularly focuses on serpentinization processes and understanding the production and cycling of volatiles and hydrocarbons at slow-spreading ridges, highlighted by the discovery of the spectacular 'Lost City' hydrothermal field at Atlantis Massif.

Dr Beth Orcutt



Beth Orcutt is a Senior Research Scientist at the Bigelow Laboratory for Ocean Sciences, Maine, USA. She has a PhD in Marine Sciences from the University of Georgia, USA, where she investigated how microorganisms make and eat methane at deep-sea cold seeps. As a postdoctoral scientist at the University of Southern California, USA, and then at the Center for Geomicrobiology at Aarhus University, Denmark, Beth was involved in the design and installation of sub-surface observatories for the study of life below the seafloor in oceanic crust, participating in IODP Expeditions 327 and 336 as an observatory specialist and microbiologist. Beth's research interests revolve around the interaction of microbiology and chemistry below the seafloor in sediment and rocks, and in determining how microbes affect global chemical cycles.

Expedition Operator

Mission-specific platform operations are conducted for IODP by the European Consortium for Ocean Research Drilling (ECORD), which represents the ocean-drilling efforts of 15 European countries, plus Canada and Israel. Operations are undertaken by the ECORD Science Operator comprising the British Geological Survey (BGS), the University of Bremen and the European Petrophysics Consortium comprising the universities of Leicester, UK, Montpellier, France, and Aachen, Germany.

During the expedition regular updates are posted on the expedition webpage at:

www.eso.ecord.org/expeditions/357/357.php

International Ocean Discovery Program www.iodp.org

The International Ocean Discovery Program (IODP) is an international marine research programme supported by 25 countries, which explores Earth's history and structure recorded in seafloor sediments and rocks, and monitors sub-seafloor environments. Through multiple platforms - a feature unique to IODP - scientists sample the deep biosphere and sub-seafloor ocean, environmental change, processes and effects, and solid earth cycles and dynamics.

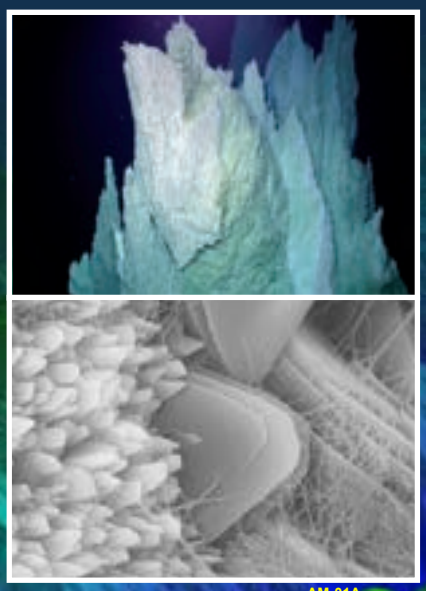
IODP is funded by a number of entities acting as international partners: three of the IODP members are platform providers, the U.S. National Science Foundation (NSF), Japan's Ministry of Education, Culture, Sports, Science and Technology (MEXT), and ECORD. Additional funding is provided by the Australia-New Zealand IODP Consortium (ANZIC), India's Ministry of Earth Sciences (MoES), the People's Republic of China Ministry of Science and Technology (MOST), the South Korea Institute of Geoscience and Mineral Resources (KIGAM) and Brazil's Coordination for Improvement of Higher Education Personnel (CAPES) programme.

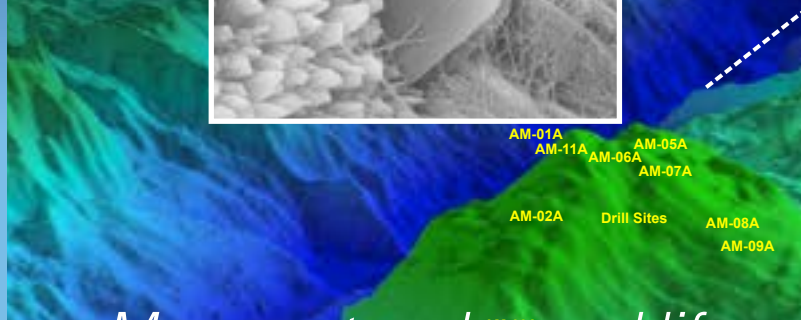
Credits: 3D-bathymetry image of the Atlantis Massif; inserts: 'Lost City' hydrothermal chimney - NOAA Expedition Lost City 2005 (image courtesy University of Washington), archaeal biofilms collected on 'Lost City' chimneys (Scanned Electronic Microscope image courtesy Früh-Green and Lang).

This brochure is produced by the ECORD Science Operator.

IODP
INTERNATIONAL OCEAN DISCOVERY PROGRAM

The Atlantis Massif Serpentinization and Life Expedition





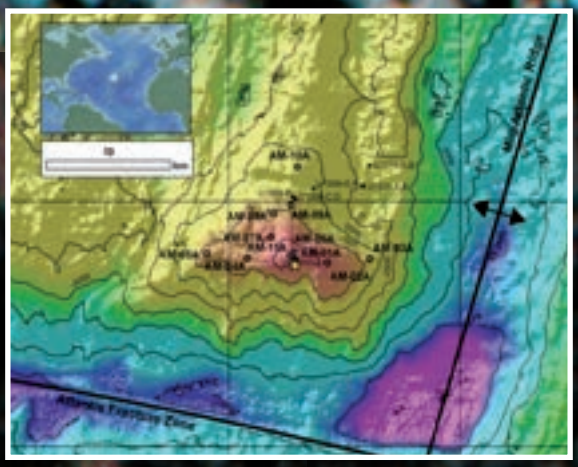
Movement, carbon and life in deep seafloor rocks

IODP Expedition 357

ECORD
EUROPEAN CONSORTIUM FOR OCEAN RESEARCH DRILLING

www.iodp.org
www.ecord.org

The **Atlantis Massif** is a prominent, nearly 4,000 metre high, underwater mountain on the Mid-Atlantic Ridge, part of the world's longest mountain chain that extends from the Arctic Ocean to the South Atlantic *(right)*. The massif is remarkable for several reasons. First, it is made up of rocks from the Earth's mantle, which have a distinct chemistry compared to most rocks at the seafloor. Second, mantle rocks react in the presence of seawater in a process called serpentinization, which produces methane, hydrogen and heat, among other things. These rock reactions excite scientists because they represent possible sources to fuel life in the absence of sunlight and may be analogous to conditions found on other planets, or early in Earth's history. These processes also resulted in the spectacular underwater world of 'Lost City', where impressive white towers of carbonate up to tens of metres tall form when warm alkaline waters exit the mantle rocks at the seafloor. These structures also represent a deep-sea 'oasis' on the seafloor and harbour unique microorganisms.







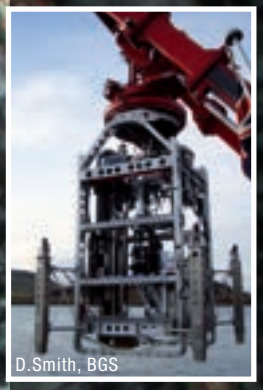
In October 2015, a team of scientists led by Co-Chief Scientists Gretchen Früh-Green (ETH Zurich, Switzerland) and Beth Orcutt (Bigelow Laboratory for Ocean Sciences, USA) will sail from Southampton, UK, onboard the British Royal Research Vessel *James Cook* on a 6-week expedition to explore the Atlantis Massif. The team will specifically address questions on three themes:

- **Life on the rocks:** What kind of life exists on and within rocks at the Atlantis Massif? Is life in this environment unique and different to life known from other environments on Earth? Does the diversity of life change in response to the type of rocks, the age of the rocks, or other factors?

- **Follow the carbon:** How does carbon get transformed in this environment? What role does life play in the transformations? Do the reactions between rocks and seawater lead to carbon storage in the seafloor and thus impact the global carbon cycle ?

- **Slip and slide:** How were mantle rocks detached from deeper in the ocean crust and brought up to the seafloor? How much variability is there in rock type and deformation structures, and how do water and heat move through the system?

An international team of 32 scientists will participate in the expedition, which is planned and conducted by the European Consortium for Ocean Research Drilling (ECORD) as part of the International Ocean Discovery Program (IODP). Nine members of the science team will join scientists and engineers from the ECORD Science Operator (ESO) during the 6-week offshore phase of the expedition. While at sea, the team will collect cores of rocks from the Atlantis Massif using two types of seabed rock drills operated by the British Geological Survey (BGS) *(left)* and the MARUM (University of Bremen, Germany) *(below)*. This is the first IODP expedition to use this type of remotely operated drilling technology.





Only a minimum number of measurements will be carried out on the rock cores while at sea. The entire scientific team and members of ESO will therefore meet for an onshore phase of the expedition at the IODP Bremen Core Repository and MARUM laboratories in Germany in early 2016. Then cores will be fully described and sampled for various types of analysis. The initial results of the expedition will be published in peer-reviewed journals and in an IODP proceedings volume. After a period of one year, the cores may be used by any scientific researcher who wishes to study them for new research.

Background image: serpentinites - NOOA Expedition Lost City 2005, image courtesy Gretchen Früh-Green.