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Promoting international cooperation in ridge-crest studies

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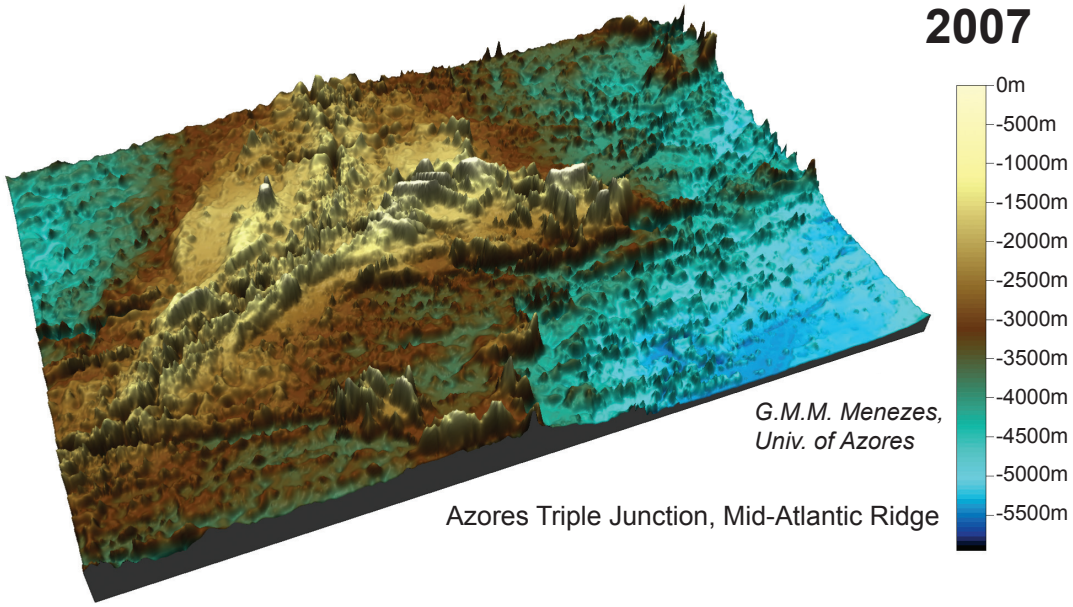

G.M.M. Menezes, Univ. of Azores

Azores Triple Junction, Mid-Atlantic Ridge

Image Competition Winners

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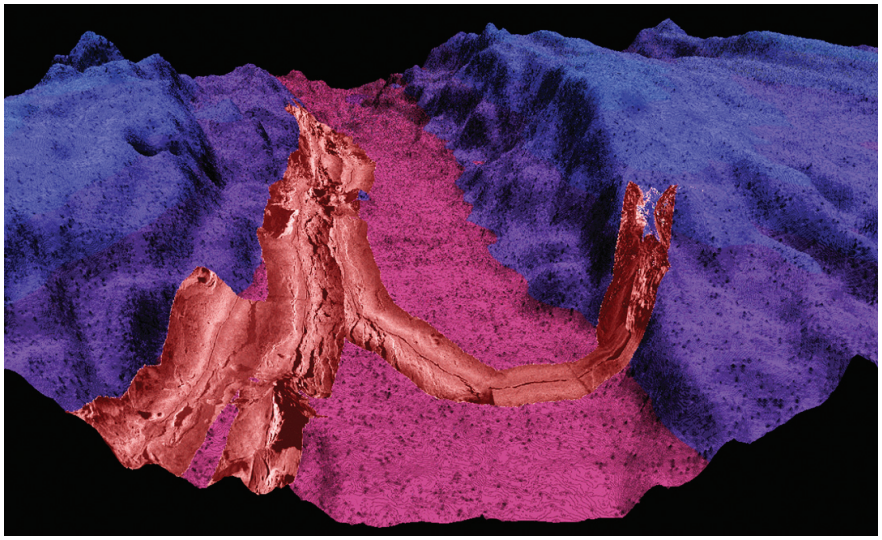

Great Dodo Lava Plain, Central Indian Ridge *A. Asada, Univ. of Tokyo*

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DEADLINE FOR INTERRIDGE NEWS VOL. 17 CONTRIBUTIONS
30 SEPTEMBER 2008

CRUISE MOMARDREAM-NAUT AND OTHER MOMAR EXPERIMENTS AT RAINBOW AND LUCKY STRIKE IN SUMMER 2007

F. Gaill[1], V. Ballu[2], M. Cannat[2], W. Crawford[2], J. Dyment[2], J. Escartín[2], T. Fouquet[3], J. Goslin[4], G. Reverdin[5], P.-M. Sarradin[3], P. Tarits[4], M. Andreani[6] , E. Bonnivard[1], K. Bucas[3], G. Burgaud[4], M.A. Cambon[3], V. Cueff[3], C. Durand[3], O. Gros[1],7, G. Hamel[2], M. Henriques[9], E. Hois[8], B. Ildefonse[6], C. Konn[3,11], N. Le Bris[3], H. Le Guyader[1], J. Ravaux[1], B. Shillito[1], J.Y. Toullec[10], M. Zbinden[1]

I. Operations at Rainbow Site: Project MoMARDREAM

The Rainbow vent site, one of the few known sites with ultramafic basement rock, is an ideal target for the multidisciplinary study of hydrothermal phenomena. A few years ago the research community decided to include studies at Rainbow as part of the MoMAR project. This site is characterized by the abundance of iron, an element that plays a major role in active processes at the scales of the spreading center down to molecules. The international program IODP (Integrated Ocean Drilling Program) is also considering Rainbow as a possible drilling site.

After several reconnaissance cruises, the main objective outlined for project MoMARDREAM is to define Rainbow using a multidisciplinary approach. The MoMARDREAM project is headed by Jérôme Dyment (IPGP-Paris), Françoise Gaill (CNRS-Université Paris 6) and Yves Fouquet (Ifremer). Its goals are two-fold: to study the role of iron in geological, hydrological, and biological processes; and to survey the site to prepare for the drilling project. Beyond the requirement of a "zero state" for repeated observations, and eventually the site monitoring required as part of the MoMAR project, the research community needs a comprehensive inventory of Rainbow's biological populations in order to preserve its fragile environment. Therefore we proposed to map the site in detail (including geological, physical/chemical and ecological parameters); to collect rock, fluid, and biological samples; and to deploy and recover colonization modules. In our initial proposal we planned to use the R/V *Pourquoi pas?* and ROV *Victor*; however, for technical reasons we had to use deep-sea manned submersible, *Nautile*, for the first cruise—hence the cruise name, MoMARDREAM-Naut.

The first 9 *Nautile* dives (July 8th-19th 2007) were dedicated to the biology and the geology of the Rainbow site. F. Gaill was chief scientist of this cruise, and J. Dyment was project leader. A major objective of the biological work was to understand the role of iron in the symbiotic relationship between *Rimicaris exoculata* shrimps and their associated bacteria. These interactions were studied *in situ* and for the first time, *in vivo*, in pressurized aquaria (IPOCAMP) sampled with PERISCOP designed by B. Shillito and G. Hamel. Microbiology was a primary focus of this first cruise. Microbial diversity, including bacteria, virus, fungi, protists and shrimp symbionts, will be studied by a team led by M.A. Cambon. J. Ravaux and J.Y. Toullec studied the stress responses of shrimps. The genomic characteristics of arthropod species will be analyzed by E. Bonnivard.

The microhabitat of these shrimps and other fauna was physically and chemically characterized by N. Le Bris and K. Bucas (Fig. 1). Additional physico-chemical measurements on symbiotic systems such as mussels were performed, and *in situ* experiments were monitored for 3 days. Colonization experiments, previously deployed at the Rainbow site during the MoMARETO cruise in 2006, were recovered successfully by O. Gros and F. Gaill (Fig. 2).

Fig. 1. See p. 8.
In situ measurements in **A.** *Bathymodiolus azoricus* and **B.** *Rimicaris exoculata*.

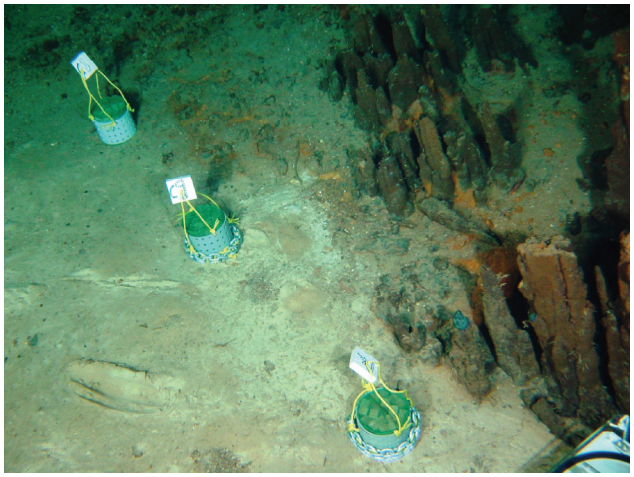

Fig. 2. Colonisation experiments at Rainbow using TRACs.

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H. Le Guyader classified the collected animals. Preliminary results indicate that organic substrates are colonized by fauna after one year of deployment. These experiments are part of CHEMECO, a project funded by the European Science Foundation (http://www.esf.org/activities/eurocores/programmes/eurodeep.html). Samples were also collected for the University of the Azores because a Portuguese team is also associated with this project.

About 20 fluid samples were collected by C. Konn and J.L. Charlou from 6 different vents exhibiting a temperature close to 350°-360° C (Fig. 3). The purpose was to collect new hydrothermal fluids samples from Rainbow in order to extend existing time series. Fluids were already sampled during cruises Flores (2004), and Exomar (2005), so one of the major aims will be to track any change in the fluids composition with time. Previous results indicate that all sampled fluids at Rainbow would exhibit a unique geochemical signature at the scale of the hydrothermal site.

Two *Nautile* dives and a dredging program were achieved by B. Ildefonse, M. Andreani and E. Hoisé to further constrain the lithology and geological structures on the seafloor at the scale of the massif that hosts Rainbow. This massif presents the characteristic dome morphology and varied lithology of oceanic core complexes. The abundant sediment cover of the massif precludes continuous geological mapping and successful dredging. The Rainbow serpentinite basement was continuously observed to a distance of about 1 km to the south of the hydrothermal site. Serpentinites were also found on the northwestern, northern, and northeastern flanks of the massif. Olivine-orthopyroxene-bearing gabbro was observed ~ 8700 m north of the site. Basalts and fresh basaltic glass were also recovered in talus and sediments on the southwest and northeast flanks of the massif.

Fig. 3. Fluid sampling with titanium syringes.

A second part of the MoMARDREAM cruise will hopefully take place in 2008 using the ROV *Victor*. The goal will be to perform high resolution microbathymetric and magnetic surveys.

II. Other MoMAR operations

Better understanding of the temporal and spatial variability of the water column is another key to the MoMAR project. The oceanographic studies initiated in 2006 during the Graviluck'06 cruise have been complemented with CTD casts both at Rainbow and Lucky Strike. This work has two purposes: 1) document variability in the water column to properly interpret the pressure records at the seafloor in order to extract a geodetic signal; 2) quantify the effect of seafloor topography on turbulent mixing, a key process in the transfer of dense bottom water masses to the surface, allowing a better understanding of the global oceanic cycle.

As part of the implementation of the MoMAR integrated study site at Lucky Strike, we carried out several experiments during the MoMARDREAM-Naut, BBMoMAR, and MARCHES2'07 cruises in 2007. First, we deployed a network of 4 short-period and one long-period OBS to monitor microseismicity, centered at the Lucky Strike volcano and with a total aperture of ~9 km. This microseismicity study was complemented by the recovery and redeployment of four hydrophones moored west and south of the Azores Plateau. This turn over was achieved as part of the MARCHE regional, long-term (July 2005-Summer 2008) acoustic monitoring program. Microseismic and hydroacoustic monitoring for 2006-2007 is complemented with pressure gauge records in the lava lake at the center of the hydrothermal field, and at the base of the volcano's east flank. These temporal studies will be continued through 2008-2009, with the deployment of temperature sensors at several hydrothermal vents at the Lucky Strike site during the Bathyluck'08 cruise, scheduled for June 2008.

The next major step in the MoMAR observatory effort is to develop and install two pilot seafloor observatory nodes acoustically linked to a surface buoy with telemetry to land. This effort will be coordinated within the EU ESONET project as one of several proposed multidisciplinary seafloor observatories.