

INTERRIDGE NEWS

Promoting international cooperation in ridge-crest studies



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2006

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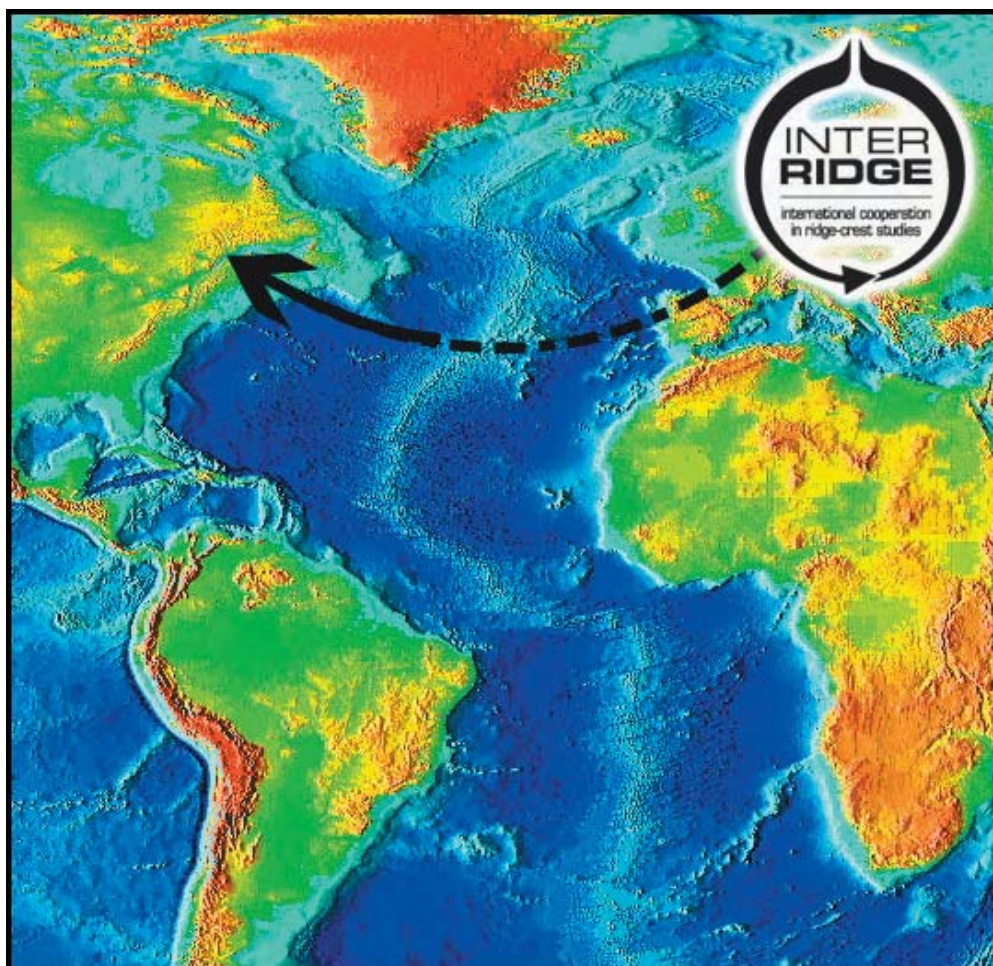
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INTERRIDGE NEWS



Vol. 15 November 2006

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Please send all items for publication via email to the InterRidge Office (coordinator@interridge.org) Text should be in Microsoft Word format. Figures should preferably be sent in eps format for optimal printing, although other formats are accepted.

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LETTER FROM THE CHAIR

I am writing this as Sabine and I, some 8 weeks before I hand over leadership of InterRidge to the excellent tag-team of Jian Lin and Chris German in Woods Hole, finish up our last issue of InterRidge News and generally tidy up loose ends here in Kiel. At such times it is of course normal to take stock of how one feels. And I have to admit to having mixed emotions about leaving the job as Chair. Whilst I am looking forward to having more free time for research (I, as I guess all other Chairs before me, underestimated how much time InterRidge takes up), my three years as InterRidge Chair have been an exciting time for InterRidge in general and for me personally. It was a time in which I got to know and work closely with many colleagues around the world – an enormously satisfying and energizing experience. We had some stimulating scientific meetings, for example the Indian Ridges meeting in Goa, the Back-arc basins meeting in South Korea, the MoMAR meeting in Lisbon and more recently the Polar Ridges meeting in Sestri Levante. InterRidge got out there and spread the word, with Kristen Kusek helping us to build a flourishing education outreach initiative and Chuck Fisher and the Biology Working Group finishing off the Statement of Good Practice which then got presented at big “Science meets the Press” gatherings in the USA and Europe. And we talked a lot about where ridge science (and InterRidge in general) is going. This latter point was a source of heated debate at the last Steering Committee meeting in Moscow and finally lead to the new Terms of Reference for working groups described in detail on p. 51 of this issue. I personally think that this new way of dealing with Working Groups will add to the scientific vigour of InterRidge. I encourage you all to participate actively in submitting proposals for Working Groups to

the new Chairs. And at the same time please don't forget the possibility of getting additional working group funding from other sources. The Scientific Committee on Oceanic Research (SCOR, see the article on p. 35), with which InterRidge is affiliated, funds groups of up to 10 international researchers to meet over 3 years to address a well-defined problem, just one of many options to make doing international science easier.

So InterRidge seems to me well situated for the years ahead. We have several dynamic working groups pushing hard to advance ridge science. We are becoming increasingly recognised and respected both by the wider scientific community and decision-makers worldwide. But above all, we have a community of dedicated scientists willing to give up their time and effort to make InterRidge and the science it represents work and work well. So, in closing my last editorial, I should like to say my own very personal thanks to these scientists: to the InterRidge Steering Committee and the Working Group Chairs for their constant hard work behind the scenes to keep things moving along, I was constantly impressed by the dedication and commitment of all of them; to Peter Herzig, Director of the Leibniz Institute of Marine Sciences here in Kiel for his unwavering financial and personal support for InterRidge; to the three (!) InterRidge Coordinators Katja, Valèrie and Sabine for keeping everything going regardless of where I was when we should have been meeting; and finally to Chuck Fisher, leader of Ridge2000 during my first two years as Chair, for good advice and the courage of his convictions at all times.

Colin Devey



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www.interridge.org**



COORDINATOR UPDATE



Steering Committee News

The 2006 Steering Committee Meeting was held in Moscow, Russia, in June. The bid from the Woods Hole Oceanographic Institute to host the Office from 2007-2009 was unanimously accepted at this meeting, the new InterRidge chair will be Dr. Jian Lin, Dr. Chris German is nominated as co-chair. The position of the new InterRidge coordinator was announced at the end of October. The membership of the Steering Committee did not change in Moscow except for Chuck Fisher, Pennsylvania State University, who completed his term for the USA and rotated off. With the office moving to the USA there will be strong American representation on the IR Steering Committee and so no need was seen, at present, to appoint another Steering Committee member from the USA to replace Chuck.

Due to problems in raising funding for the fees as an associated member, Canada has requested to change its status, becoming a corresponding member of InterRidge. Russia, on the other hand, has now more than 100 members listed in the InterRidge database and there was strong and concrete interest in them becoming an associate member.

The re-organization of the working groups was discussed and a generic plan how the working groups should operate was formulated (see p. 51 of this issue).

The next Steering Committee Meeting is planned to coincide with the congress of the Brazilian Geophysical Society in Rio de Janeiro in mid-November 2007.

InterRidge Meetings

In February InterRidge held a 90-minute symposium at the American Association for the Advancement of Sciences (AAAS) meeting in St. Lois, Missouri, USA. The symposium was entitled: "Latest Ocean Ridge Research: Microbes, Mining, Management and More". The "InterRidge statement of commitment to responsible research practices at deep-sea hydrothermal vents" (see p. 5 of this issue) drafted by the biology working group was presented at this meeting. A copy of this statement can be downloaded from the IR website.

In July InterRidge held a science symposium with 6 InterRidge speakers at the EuroScience Open Forum (ESOF) in Munich, Germany. In addition, an outreach exhibit was presented for one week, the IMAX film "Volcanoes of the Deep Sea" was shown and a press conference was held.

In September InterRidge, together with ChEss and R2K, co-hosted the Polar Ridges Meeting and Workshop in Sestri Levante, Italy. This successful meeting was attended by 60 scientists to discuss the future of research on polar mid-ocean ridges (see workshop report under "Other InterRidge News" in this issue). There was also a pre-meeting field trip to Ligurian Ophiolites and three one day post-meeting field trips to Brione and to the Lanzo peridotite (Musine, Lanzo Sud); Chenaillet ophiolite and to the Lanzo peridotite (Mt.Arpone and Lanzo Nord).

The abstract volume is available on the InterRidge website. Thanks to the local organizers Prof. E. Rampone and G. Borghini who made this meeting happen.

And finally, thanks

The term for hosting the InterRidge office in Kiel, Germany, is almost completed and this is the last issue of InterRidge News that we will be printing. My thanks go to Swen Meyer who has been a student helper for almost 3 years now and has helped especially with the layout of this year's InterRidge News. Katja Freitag, who had been the coordinator for 2 1/2 years, left InterRidge in May to start a new job in South Africa. Thanks to Katja and her well organized office it was not very difficult for me to join InterRidge for the remaining six months. I started with the ESOF meeting in Munich which was a nice opportunity to meet the Education and Outreach coordinator and some of the Steering Committee Members. In September I attended the Polar Ridges Meeting and Workshop in Sestri Levante, Italy. Those of the InterRidge community who have been to this pretty coastal town know that this is an outstanding place to hold a meeting and I would like to thank Elisabetta Rampone, our local organizer, for choosing Sestri Levante for this InterRidge meeting.

Sabine Lange

INTERRIDGE STATEMENT OF COMMITMENT TO RESPONSIBLE RESEARCH PRACTICES AT DEEP-SEA**HYDROTHERMAL VENTS****OVERVIEW:**

As marine research scientists we especially appreciate the uniqueness and complexity of the deep-sea hydrothermal vent fauna and environments, and are particularly interested in preserving vents for their scientific, aesthetic, ecological, and potential economic values. In fact, because of the specialized nature of the equipment required to work at deep-sea hydrothermal vents, such as occupied and unoccupied research submersibles, scientists are the primary group of people who have the opportunity to visit these extraordinary environments. The potential for significant impact of scientific activities on a single vent site or a population of vent animals pales in comparison to the potential for disturbance by volcanic/tectonic events or industrial mining/harvesting activities. Nonetheless, we recognize that some scientific activities could adversely affect individual sites or impact communities more than is necessary, if research activities are not carefully planned and executed. In addition, because only a limited number of sites are currently known and scientists from a wide variety of disciplines frequently work at single locations, we recognize the potential for use conflicts among scientists, at sites where scientific activity is intense.

The sustainable use and protection of the oceans is best served by a fundamental understanding of complex marine systems. This understanding is only attainable through scientific research. As a result, detailed research on the oceans is an integral and necessary part of effective resource management and environmental protection. Most forms of observation and investigation of natural systems involve some disturbance of the systems being studied. In the interest of environmental stewardship, it must be the goal of research scientists to minimize disturbances as much as possible, while still gathering the information necessary both to understand the systems and to form a basis for sustainable use strategies. Therefore, marine scientists should always evaluate their research plans from a conservative standpoint, and choose the most environmentally friendly research approach.

BACKGROUND:**Why are hydrothermal vent ecosystems important and different?**

Hydrothermal vents are present in all of the world's oceans in areas associated with tectonic and/or volcanic activity. The most abundant and widely distributed of these are hydrothermal vents associated with deep-sea spreading centers, areas where the plates that make up the surface of the Earth are moving apart and new sea-floor is being formed. Understanding this process of plate tectonics is central to understanding the dynamics of our planet, including extreme geological events such as tsunamis,

earthquakes, and volcanic eruptions. Furthermore, this process results in extreme environments that are home to high densities of specialized microbes and animals, the study of which may lead to exciting new discoveries applicable to societal needs.

Hydrothermal-vent environments are extreme for life because of the chemistry and temperature of the hydrothermal fluid, the rapid temporal changes in the fluid properties, and the extreme gradients that characterize the environments the organisms inhabit. Hydrothermal-vent environments are also very productive because of the chemical energy in the vent fluid, energy that microbes can harvest and use to reproduce, grow and thrive. As a result, hydrothermal vents are characterized by dense communities of remarkable animals, that are specially adapted for life at the vents and are different from the fauna found in the surrounding deep sea. The specialized microbes that form the basis of the biological productivity at all hydrothermal vents include groups that can live in truly extreme conditions of temperature and chemistry. These include some of the most primitive forms of life on Earth. Deep-sea hydrothermal vent communities were discovered in the late 1970's and we have only begun to unravel the potential of scientific discovery contained in the fluids, microbes, and animals of these exciting, but remote, environments. Furthermore, hydrothermal vents in different areas of the world are home to different communities of animals, in the same way that the different continents are home to different groups of animals and plants. There are currently six biogeographic provinces of hydrothermal vent fauna spread around the Pacific, Atlantic, and Indian Oceans that are recognized by hydrothermal vent biologists. It is likely that additional biogeographic provinces will be discovered as additional spreading systems are explored in more remote areas of the deep sea (e.g., in the Arctic Ocean). The potential for continuing fundamental discoveries of biotechnological and perhaps medical importance is high in the fauna of these extreme environments. Continuing study of these environments is essential to developing an understanding of the ecology of the deep sea, the limits to life, and perhaps even the origin of life.

Because of the tight coupling between the biological activity and the hydrothermal fluid, high-density communities are only found in areas of active venting of hydrothermal fluid. However, active vent sites are distributed very patchily along oceanic spreading centers. Distances between active vents can be as little as a few tens of meters, but sites are often separated by as much as 100 km or more. We do not fully understand how the animals that live at vents have adapted to the long-range dispersal and colonization challenges that lead to rapid community development as

soon as new vents are formed. However, their dispersal and colonization abilities contribute to a high degree of homogeneity between communities within a biogeographic province.

The presence of hydrothermal vents can be very erratic over time as well. Hydrothermal vents are a direct result of dynamic and often ephemeral tectonic and volcanic activity. Individual vents can form and then cease to be active on time scales of years. Consequently, the microbial and animal communities that the vents sustain can develop and die out on very short time scales. Over the first three decades of study after their discovery, numerous vent systems and their biological communities have been seen to develop and then cease to exist. Metapopulations of vent animals must be adapted to extreme geological events, including events that may cover a vent site in hot lava, topple a 75m tall hydrothermal chimney, or result in complete cessation of venting at a site.

RESPONSIBLE RESEARCH PRACTICES:

The Primary purpose of this document is to affirm our commitment to responsible research activity at hydrothermal vents. As members of an international research community we encourage all scientists to abide by the following guidelines:

- 1) Avoid, in the conduct of scientific research, activities that will have deleterious impacts on the sustainability of populations of hydrothermal vent organisms.
- 2) Avoid, in the conduct of scientific research, activities that lead to long lasting and significant alteration and/or visual degradation of vent sites.
- 3) Avoid collections that are not essential to the conduct of scientific research.
- 4) Avoid, in the conduct of scientific research, transplanting biota or geological material between sites.
- 5) Familiarize yourself with the status of current and planned research in an area and avoid activities that will compromise experiments or observations of other researchers. Assure that your own research activities and plans are known to the rest of the international research community through InterRidge and other public domain data bases
- 6) Facilitate the fullest possible use of all biological, chemical and geological samples collected through collaborations and cooperation amongst the global community of scientists.

We also reaffirm our commitment to open international sharing of data, ideas and samples in order to avoid unnecessary re-sampling and impact on hydrothermal vents,

and to further our global understanding of these habitats for the good of all people on Earth.

For example, the international community through the Census of Marine Life program and InterRidge are developing open databases with detailed information on all available vent biological samples preserved in laboratories and museums around the globe as a resource to minimize repeat sampling of vent fauna. In addition, many national ridge programs are hosting open-access databases of geological, chemical, and biological hydrothermal vent data.

INTERRIDGE:

InterRidge is a non-profit organization concerned with promoting all aspects of mid-ocean ridge research for the benefit of all people of the world. InterRidge members realize that research on this globally distributed but remote system can only be achieved by international collaboration and cooperation.

The InterRidge mandate has four principal components:

- 1) To build and maintain an interactive international ridge research community.
- 2) To identify, through InterRidge working groups and the workshops and conferences they organize, the most compelling questions in ridge research and develop program plans to address these questions.
- 3) To act as a representative body for international ridge scientists in policy discussions.
- 4) Through education and outreach, to communicate the importance and excitement of ridge research to the general public and decision makers worldwide.

At present InterRidge is directed by a steering committee made up of representatives from 11 member nations, representing not only their own national scientists but also those from an additional 17 corresponding nations.

CONCENSUS:

The Steering committee of InterRidge and the chairs of all InterRidge working groups unanimously support this statement of commitment to responsible research practices at hydrothermal vents and urge scientists of all nations to follow the guidelines outlined when planning and executing their research expeditions.

Signed on 17 Feb. 2006 at IFM-GEOMAR, Kiel, Germany by

Prof. Colin Devey,
InterRidge Chair

on behalf of InterRidge Steering Committee Members and Working Group Chairs.

INTERNATIONAL RESEARCH

INTRODUCING THE ENDEAVOUR MARINE PROTECTED AREA - MANAGEMENT SUPPORT SYSTEM PROJECT CHARTER.

K. Conley¹

The Endeavour Hydrothermal Vent Marine Protected Area (EHV MPA) was designated Canada's first MPA under the Oceans Act in March 2003. It is also the first internationally protected hydrothermal vent site. Canada's second MPA, the Sable Gully in the Maritimes Region, was designated in 2004. More recently, three additional Atlantic Coast MPAs have been designated and five additional MPAs are expected to be designated by completion of phase I of the Oceans Action Plan (Table 1). The Endeavour MPA, along with the Sable Gully MPA, is in the forefront of MPA management in Canada and can serve to inform future Canadian as well as international MPA initiatives.

Fisheries and Oceans Canada has drawn up a project charter for an Endeavour Marine Protected Area - Management Support System. The purpose of this Management Support System is to develop a spatial database and web mapping system for use in the management, monitoring, and reporting of human activities in the Endeavour Hydrothermal Vents Marine Protected Area. All appropriate steps will be taken

to seek existing databases that can support the development of the EHV MPA spatial database. The project will be completed by the end of March 2006.

Background

In order for vessels to access and work in Canadian Marine Protected Areas, the work needs to be consistent with regulations and the management plan for the area. Regulatory requirements include providing information relative to the activities conducted within the MPA for use by the Government of Canada (e.g. preliminary and final cruise reports, provision of data collected). The MPA regulations and management plan of the EHV MPA are intended to first protect the EHV ecosystem and secondly to provide for responsible research to contribute to the conservation, management, and understanding of the area. To ensure management of the MPA is based on informed decisions, the spatial and temporal extent of human activity within the MPA needs to be documented in a timely manner. This information can then be used to monitor, report on, manage, and ultimately plan for the future management of the Endeavour MPA.

Currently, the primary activities that occur within the Endeavour MPA are research projects, predominantly by foreign research vessels (4-7 per year) and Canadian Coast Guard research vessels (1-2 per year). An underwater fibre optic cabled Canadian observatory network, project NEPTUNE, is to be installed ~2007/08. Coordination of research activities in the Endeavour area is currently conducted through the RIDGE2000 ISS site coordinator. Information relevant to work in the Endeavour area carried out through other funding programs is provided to RIDGE2000 by researchers with an interest in informing others of their work so as to avoid conflict. This RIDGE2000 work provides an opportunity to access data for the development of the Endeavour MPA management support system project.

A problem for the MPA Manager is that information relevant to cruises taking place in the Endeavour MPA are held in disparate locales and in varying formats (paper,

Table 1: Designated and planned Canadian Marine Protected Areas

Canadian Marine Protected Area	Designation date
Endeavour Hydrothermal Vent	March 2003
Sable Gully in Maritimes Region	2004
Eastport, NL	2005
Basin Head, PE	
Gilbert Bay, NL	
Musquash Estuary, NB	2006/07 (estimated)
Tarium Niriyutait, NWT	
Bowie Seamount (BC)	
St. Lawrence Estuary, PQ	
Manicouagan Peninsula, PQ	

¹Fisheries and Oceans Canada, 4166 Departure Bay Rd Nanaimo BC V9T 4B7, Canada, email: EHVMPA@pac.dfo-mpo.gc.ca, website: http://www.pac.dfo-mpo.gc.ca/oceans/mpa/Endeavour_e.htm.

electronic, CD, etc.). The MPA Manager therefore cannot view information on current deployments within the area, let alone cumulative deployments/recoveries to understand impacts of activities within and make management decisions for the area. Understanding human impacts within the area is based solely on the number of vessels accessing the area per year. By developing a spatial database, it is envisioned that anthropogenic impacts within the area could be better understood. This understanding is a critical baseline for managing the Endeavour MPA.

Goals

The three major goals of the Endeavour Marine Protected Area Management Support System are:

1) to develop a data management tool for the management of the Endeavour MPA. This would include a spatial database that serves as:

- a tracking system to follow proposed activities from receipt of plan submission, review, consideration for authorization, response to the proponent, licensing, receipt of reports/data, etc.;
- a data registry (i.e. log of data received through authorization process);
- in-house information for the MPA Manager during review of a proposed activity (e.g. how does the work relate to existing projects, nature of instruments to be used, proponent history in the area);
- to keep track of point, line, and polygon data related to research activities (e.g. instrument deployment/recovery, ROV trackline, cable installations, research study areas).

2) to develop and deploy an Internet based web mapping application that displays temporal and spatial elements of cruise plans, and disseminates and/or provides a data entry capability to populate the spatial database.

3) to develop a bathymetric dataset derived from multi-beam data.

In addition to having the ability to flag potential conflicts among users, the development and maintenance of the spatial database and a web mapping application will:

- provide an effective and efficient tool for Fisheries and Oceans Canada to deliver on their responsibilities to the Canadian government. These include being able to generate regular reports on the activities within the MPA and the effectiveness of MPA management. The management support system would furthermore provide a tool to allow the MPA Manager to make informed decisions. It would also be a critical tool for other people involved in any aspects related to MPA's to engage in MPA management, planning, and development of future MPAs.

- enable consideration of proposed activities to allow responsible research in the MPA consistent with regulations and management objectives. Research is increasingly considered a socio-economic activity as well as a provider of objective information.
- continue to demonstrate Canada's leadership of oceans management - the EHV MPA designation and management is currently an MPA example that can motivate and encourage international efforts to conserve hydrothermal vent sites and other offshore areas as it highlights that responsible cutting edge research can still take place at the EHV MPA.
- make information available to a broader audience.

The MPA Manager will work within existing data submission processes, as appropriate, in order to obtain the necessary data for the Endeavour Marine Protected Area Management Support System.

Potential Issues

As with most projects, there are major issues which may impact the success of this project. The major issues which may impact the success of this project include:

- Data ownership and/or policies.
- Project resourcing.
- Access to relevant datasets.
- Adherence to spatial data sharing standards (relevant datasets).
- Stakeholder cooperation. There has been considerable stakeholder cooperation to date, particularly from the research community.
- Legal considerations (e.g. will research coordination create liability issues? Are there any liability or other legal issues associated with making data/information available to the public via the internet?).

A more detailed project description for the Endeavour Hydrothermal Vents Marine Protected Area Management Support System, or other information relevant to the MPA can be obtained through the MPA Manager, Kevin Conley (see contact information at the beginning of this article).

InterRidge Coordinator's Note

Many areas of current ridge research may be designated as marine protected areas in the not-too-distant future. It is therefore in the interest of all ridge researchers to support and contribute to developing management systems such as the Endeavour Marine Protected Area - Management Support System thereby demonstrating that responsible ridge research can and must continue in these areas.

DISCOVERY OF NEW HYDROTHERMAL VENTS ON THE SOUTHERN MID-ATLANTIC RIDGE (4°S - 10°S) DURING CRUISE M68/1

A. Koschinsky¹, A. Billings², C. Devey³, N. Dubilier⁴, A. Duester², D. Edge⁵, D. Garbe-Schönberg⁶, C. German², O. Giere⁴, R. Keir³, K. Lackschewitz³, H.A. Mai⁷, H. Marbler¹, J. Mawick¹, B. Melchert³, C. Mertens⁸, M. Peters⁹, S. Sander¹⁰, O. Schmale³, W. Schmidt⁷, R. Seifert¹¹, C. Seiter⁷, U. Stöber⁸, I. Suck¹², M. Walter⁸, S. Weber¹¹, D. Yoerger², M. Zarrouk⁷, F. Zielinski⁴

1. Introduction

Until a few years ago, except for some hints from water column anomalies (German et al., 2002), no hydrothermal vent system was known on the southern Mid-Atlantic Ridge (MAR). The recent cruise M68/1 (27 April – 2 June, 2006; Figure 1) with the German R/V Meteor continued hydrothermal exploration on the southern MAR, which, as part of the German Special Priority Program SPP 1144, had been started during cruises M62/5 in 2004 (Devey et al., 2005 and in press) and M64/1 in 2005 (Haase et al., in press).

Following the investigations performed during these cruises and during the British cruise CD169 in 2005 (German et al., 2005), the goal of cruise M68/1 was to continue the detailed interdisciplinary work in the selected hydrothermally active areas in the tectonically, volcanically and hydrothermally active range between 4 and 11°S on the MAR. This included mapping and exploration for additional hydrothermal vent systems on a regional scale and sampling of hydrothermal vent fluids, associated vent fauna, host rock and sulphide samples. Also the biogeographic role of the southern MAR

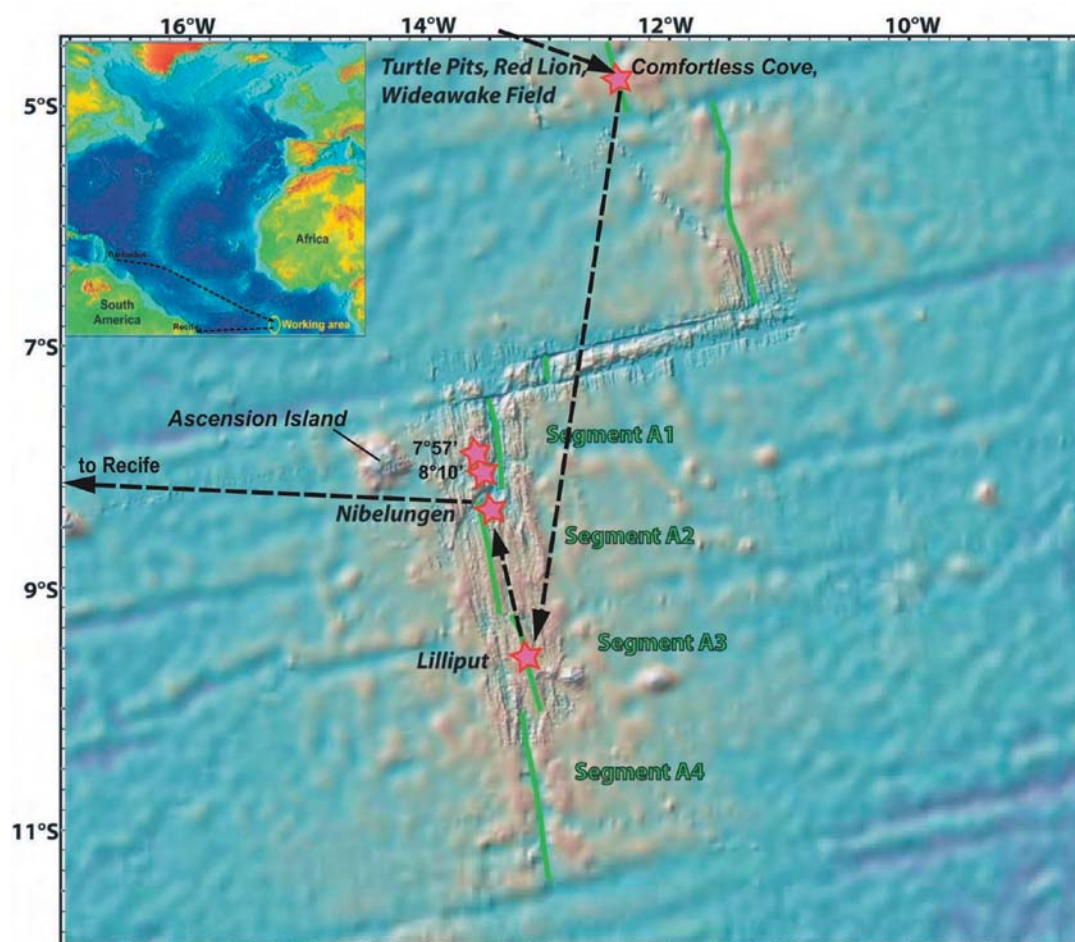


Figure 1: Track and working areas of cruise M68/1 at 5°S, 9°S, and 8°S, on the southern MAR

¹ International University Bremen IUB, School of Engineering and Science, Bremen, Germany; ² Woods Hole Oceanographic Institution WHOI, MA, USA; ³ Leibniz Institute for Marine Sciences IFM-GEOMAR, Kiel, Germany; ⁴ Max-Planck Institut of Marine Microbiology, Bremen, Germany; ⁵ National Oceanography Centre NOC, Southampton, U.K.; ⁶ Department of Geosciences, Christian-Albrechts-Universität Kiel, Germany; ⁷ MARUM Center of Marine Environmental Sciences, University Bremen, Germany; ⁸ Institute of Environmental Physics, University Bremen, Germany; ⁹ Institute for Geology and Paleontology, Westfälische Wilhelms-Universität Münster, Germany; ¹⁰ Department of Chemistry, University of Otago, Dunedin, New Zealand; ¹¹ Institute of Biogeochemistry and Marine Chemistry, University Hamburg, Germany; ¹² FIELAX GmbH, Bremerhaven, Germany

with respect to the distribution of hydrothermal fauna and the differences between hydrothermal systems at the northern and the southern MAR, which are disconnected by large fracture zones, were in the focus of this work. In two of the target areas, at 4°48'S and 9°33'S, some active vents had been found during the former cruises (German et al., 2005; Haase et al., submitted), but another site at 8°18'S was just known from its strong plume signals (Devey et al., 2005).

The work plan included detection and mapping of the hydrothermal plumes by CTD and turbidity sensors and localization of the hydrothermal emanation sources using the AUV ABE (WHOI). Bathymetric mapping was carried out with the multibeam echosounder system of RV Meteor, and high-resolution mapping with the AUV. The ROV Quest (MARUM, Univ. Bremen) was deployed in parallel and subsequent to the AUV discoveries in the known and newly discovered fields to sample rocks, sulfides, fluids and animals.

2. First Results

2.1 The area at 5°S

Three active vent fields at 4°48'S named Turtle Pits, Red Lion and Wideawake were already known in this area from cruises CD169 and M64/1 in 2005. CTD tow-yos confirmed intense hydrothermal plumes rising up to 300 m above the seafloor (Figure 2) that could be related to the known vent sites and further sites still to be discovered. The Turtle Pits field is situated in a water depth of 2990 m on the flank of a volcanic edifice in the centre of the segment. It is a young post-eruptive system with extremely high vent temperatures, which had not been expected for

the slow-spreading MAR (Haase et al., submitted). Turtle Pits consists of two mound areas composed of sulfide debris with numerous small active black smokers at the top of the mounds. Between the two mounds there is another active black smoker with vertical walls, which was called "Southern Tower". Photomosaicing of this largest chimney at Turtle Pits showed that this structure had grown by 4m within one year. While in 2004 a maximum temperature of 400°C was recorded at "Two Boats", during M68/1 a stable average temperature measurement of 407°C with a maximum of 408.5°C could be recorded with the temperature sensor of the fluid sampling system KIPS (Garbe-Schönberg et al., 2006; Figure 3a). This is the highest temperature found so far in hydrothermal fluids worldwide. Escape of vapour bubbles clearly indicated phase separation of the fluids close to the critical point of seawater, which was confirmed by chemical analyses of the fluids.

The diffuse-flow field Wideawake, which is located about 200 m to the east of Turtle Pits, shows young lava flow and a more diverse biological inhabitation, including *Bathymodiolus* mussels, occasional *Rimicaris* shrimps, conid snails and limpets, and the rare occurrence of the *Calyptogena* clam. The fluid temperatures reach about 18°C. Fluid chemical data indicate that the diffuse fluids originate from the same source as the hot neighbouring Turtle Pits vent, but are diluted by entraining seawater in the subsurface.

The Red Lion hydrothermal field is located about 2 km north of Turtle Pits in 3050 m water depth. It is characterized by four active chimneys with different occurrences, called „Shrimp Farm“, „Sugarhead“, „Mephisto“ and „Tannenbaum“. Revisiting this site after one year revealed significant changes in the structure of the chimneys and in the biological inhabitation of the smokers, which consists

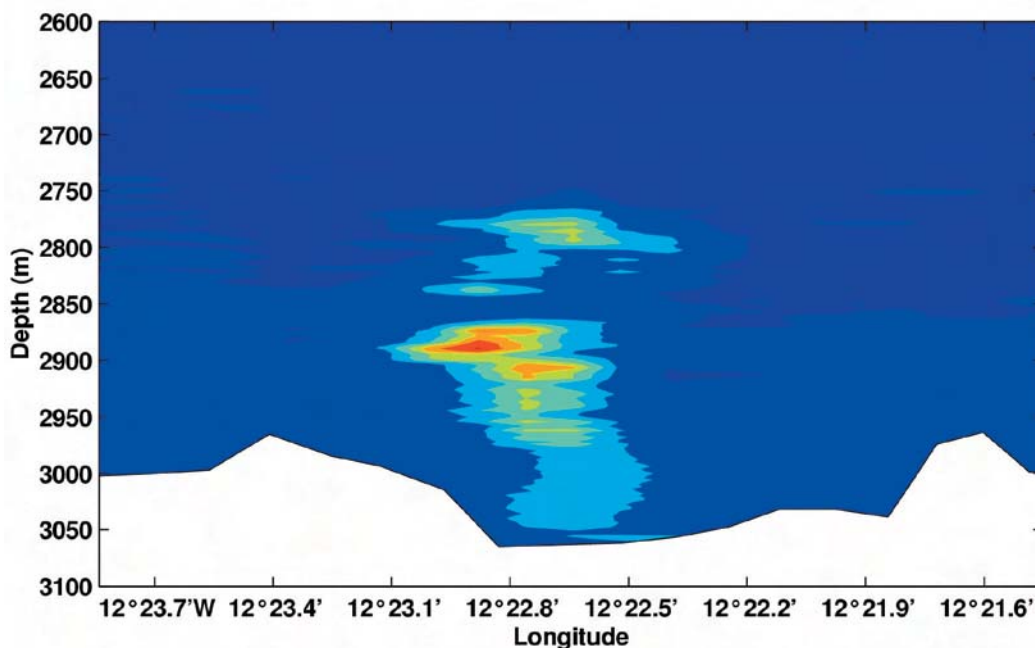


Figure 2: Backscatter signal along a west-to-east orientated tow-yo track north of the 5° S vent sites. The lateral extent of the core plume signal is < 1km. Data from the CTD nephelometer in Dntu relative to background.

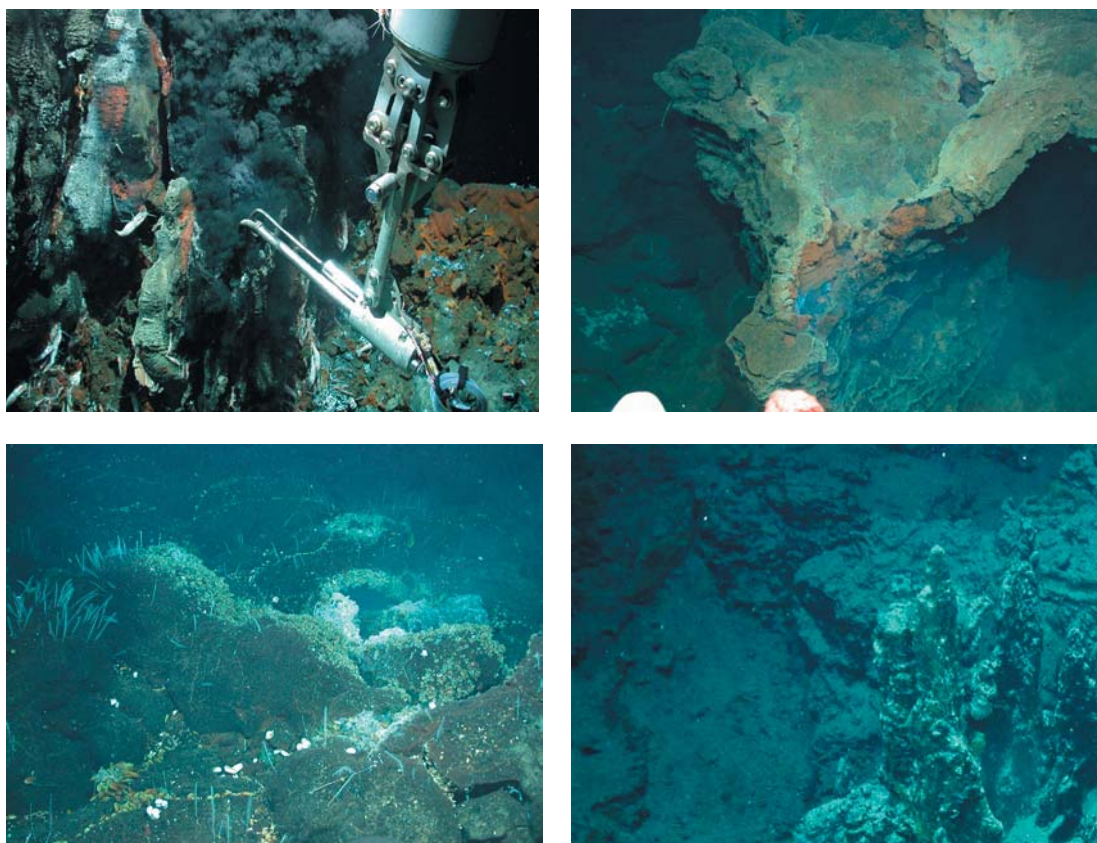


Figure 3: Pictures of the newly discovered vents, taken by the ROV Quest (courtesy of MARUM, University Bremen) during M68/1 dives: a) Fluid sampling of the 407°C hot vent in the 5°S area; b) Lava roof and tube structures (site "Roman City") in the 9°S area; c) The diffuse vent site "Candelabrum Meadow" in the 9°S area; d) Inactive chimney structure in the Nibelungen field (9°S).

nearly exclusively of shrimps. In comparison to the M64/1 expedition the shrimp coverage has drastically decreased on the wide flanges of „Shrimp Farm“, and the head of the smoker „Sugarhead“, which was covered with shrimps in 2005, had broken off. „Mephisto“ has more extensive shrimp colonisation this year. The reason for the change in shrimp populations is not known. The fluids appear to have similar compositions as in 2005 and temperatures range between 196°C and 349°C.

In addition to the three known vent sites, CTD mapping and AUV dives revealed numerous records of temperature, turbidity, and Eh anomalies, which clearly originated from further active vent sites. The combined use of AUV and ROV led to the discovery of three active sites in the "Comfortless Cove" field located at 2996 m water depth between the Turtle Pits and Red Lion fields (Figure 4). This new field includes one 13 m high hot-temperature vent "Sisters Peak", which is characterized by one extinct chimney and one active chimney issuing 399°C hot fluids. The fluid chemistry is clearly similar to the Turtle Pits fluid chemistry. In the vicinity of "Sisters Peak", two diffuse vent sites with fluids of temperatures <10°C were discovered. The "Golden Valley" to the NE of "Sisters Peak" is a 30 m long fissure that is completely covered with golden-brown *Bathymodiolus* mussels. "Foggy Corner" to the N of "Sisters

Peak" emanates cloudy water and is characterized by patches of mussels.

The origin of further water column signals in the 5°S area could not be followed due to time constraints. Several weaker signals lie south of the known vents and indicate the presence of further (possibly diffuse) hydrothermal sources.

2.2 The area at 9°S

The target area at 9°33'S is located at a depth of 1500 m (Figure 5) in a ridge segment with considerably thickened crust. A diffuse hydrothermal field, which was called Lilliput during its discovery during cruise M64/1 in 2005 because of the high abundance of very young mussel populations, was revisited. The AUV deployments yielded several additional targets located both north and south of the Main Lilliput site. The subsequent ROV dives revealed that all of them were low-temperature diffuse-flow sites, proving that the AUV ABE is also able to locate this type of hydrothermal venting, although water column signals are much less pronounced compared to hot vent systems.

Besides sites with active diffuse venting, the area is characterized by a large region of fresh lava and big mounds of orange-to red-coloured, Fe-rich hydrothermal sedi-

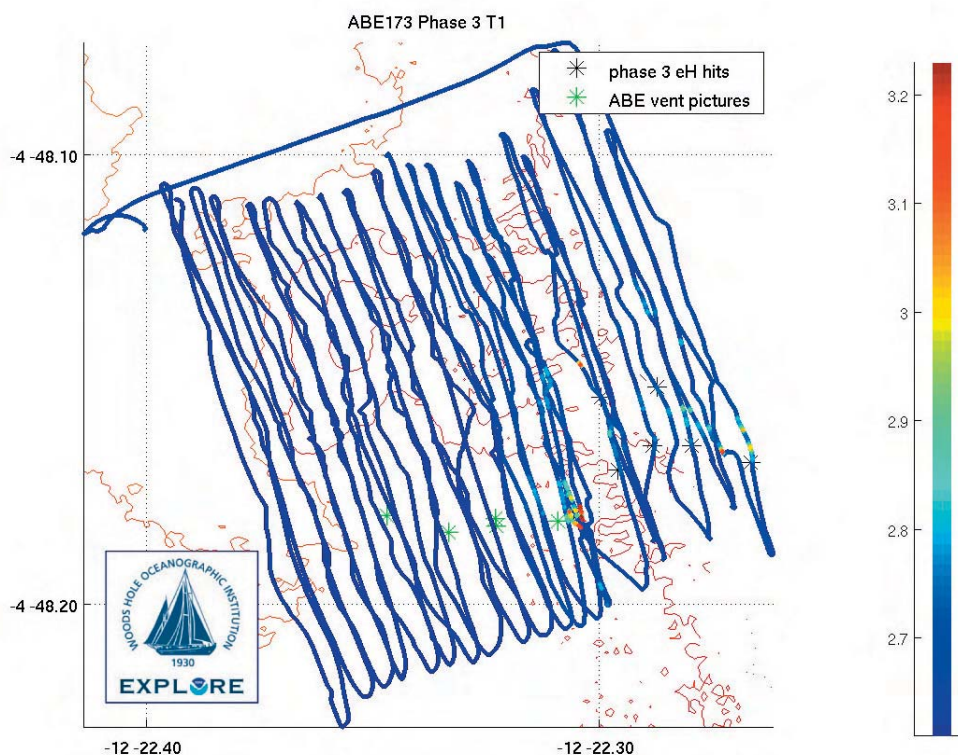


Figure 4: Temperature measurements and hits of the Eh sensor recorded during the ABE 173 dive in the Comfortless Cove field, indicating several sites of hydrothermal fluid flow.

ments with no evidence for present-day venting. South of the Main Lilliput site, a bizarre underwater landscape of a drained former lava lake, consisting of lava pillars, lava domes and wide caves (we called the place "Roman City"; Figure 3b) was discovered. Further AUV signals in the area could be confirmed by the discovery of one diffuse-flow mussel field (Limtoc site) just south of the Main Lilliput site and two diffuse-flow fields (Lustrog and Candelabrum Meadow sites) north of Main Lilliput. The dominance of very young mussels (*Bathymodiolus* sp.) in all sites probably implies a very recent re-activation of hydrothermal fluid flow in this area. A former phase of hydrothermal activity is indicated by the mostly dissolved remains of older mussels and the ubiquitous presence of hydrothermal Fe-rich mud. Besides the common young mussels, and some shrimps and crabs, in all diffuse-flow sites, the northernmost site is characterized also by dense accumulations of hydrozoans (giving the site the name "Candelabrum Meadow"; Figure 3c). Fluid temperatures were mostly below 10°C, however, a maximum of 17°C was measured in the mussel field Limtoc. We did not find any high-temperature field in the area at 9°30' S, which had been expected based on clear anomalies of gases and metals in the water column about 300-400 m above the seafloor.

2.3 The area at 8°S

CTD stations at 8°18'S confirmed the existence of a strong hydrothermal plume about 300 m above the seafloor that was found here during cruise M62/5 in December 2004

(Devey et al., 2005). This area is characterized by very complex current patterns and temporal variability of the location and intensity of the hydrothermal plume. Several AUV dives, the first one of which nearly missed the source of the plume (Figure 6), including a photo mapping survey finally revealed the source of the plume: a black smoker in a large field of otherwise dead chimneys along a steep slope at 2905 m water depth. A visit of the site with the ROV showed that the vent is not a chimney structure, but is a four meter deep crater with a diameter of about half a meter, from which an enormous volume of black "smoke" emanates at high velocity. This crater called "Drachenschlund" (Dragon Throat) resembles the ones found in the ultramafic-hosted Logatchev hydrothermal field at 15°N (Kuhn et al., 2004). The inaccessibility of the bottom of the crater made sampling and temperature measurements of the end-member fluids impossible, but still shipboard analysis of the dilute fluid samples gained above the crater throat clearly indicated influence of serpentinization processes. This was already anticipated from the high CH_4/Mn ratio (Devey et al., 2005) and high Fe concentrations in the hydrothermal plume. In addition a few serpentinized breccias could be found at the crater wall of Drachenschlund. However, dredge and volcanite wax corer samples recovered only basaltic rocks and glasses. The southern extent of the Nibelungen field is characterized by several extinct chimneys (Figure 3d) and some lava structures. The absence of further active vents implies that the extensive plume signal in the water column derives from just one single active vent site, the smoking crater, confirming the enormous fluid

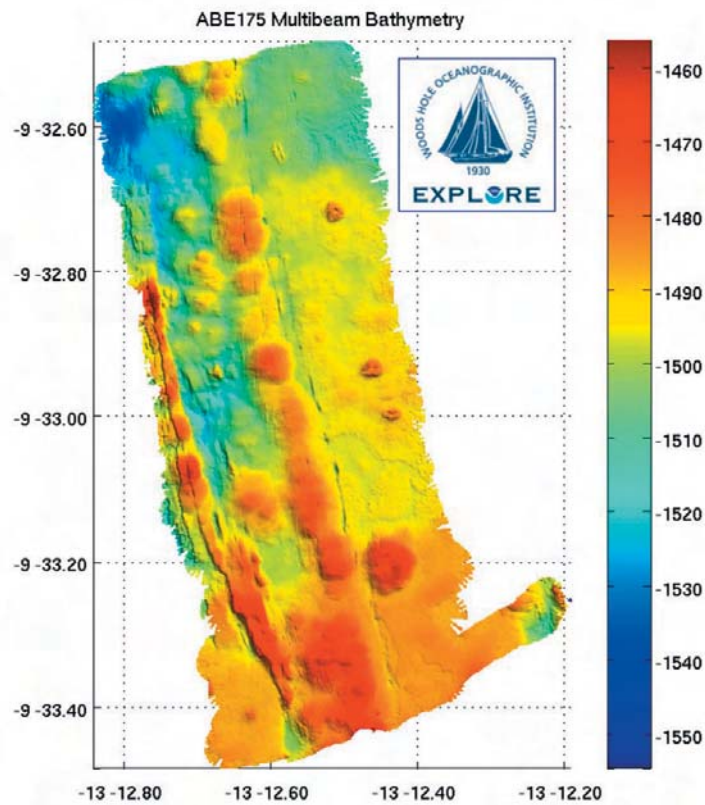


Figure 5: Bathymetry plot of the 9°S area obtained with ABE's SM2000 bathymetry

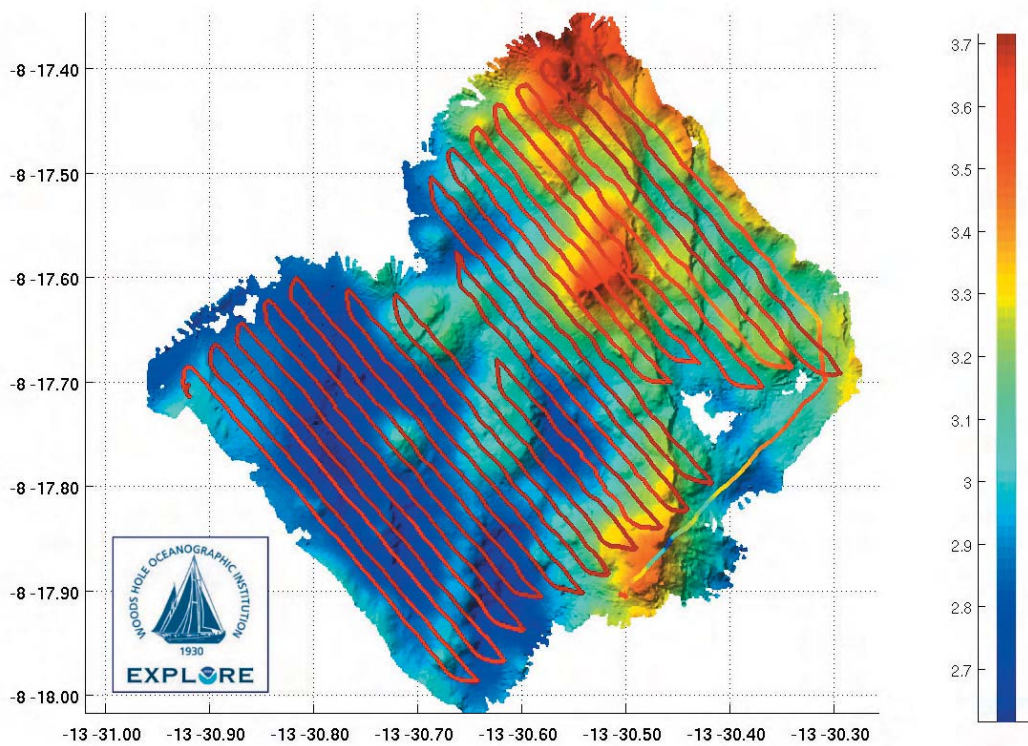


Figure 6: a) Eh data superimposed on the multibeam bathymetry for the ABE178 dive in the Nibelungen field, indicating that the dive nearly missed the active vent, due to terrain and current complexity; the complete mapped area showed only background values, except for the track of the AUV to its starting point which covered the single active site

output of this crater.

Another target area at 7°57'S in the A1 segment close to Ascension had shown turbidity and temperature anomalies during CTD stations and TOBI sidescan sonar deployments of former cruises (Devey et al., 2005). These anomalies apparently originated from terrace structures at the western rift valley, close to the center of the segment. CTD tow-yo and AUV data identified a distinct plume with its maximum turbidity anomaly lying directly above terraces. However, due to time constraints, the source of these hydrothermal signals could not be identified. Also gas anomalies above the seafloor at about 2000 m water depth identified in CTD stations conducted at 8°10'S indicated hydrothermal venting, but again the hydrothermal source could not be traced.

3. Outlook

Cruise M68/1 was the third of a series of cruises performed as part of the German DeRidge Program SPP 1144, aiming at the discovery and exploration of hydrothermal systems on the southern MAR. Two more cruises in 2007 and 2008 are planned to continue this work in the area 4-10°S, including the investigation of geological, geochemical and biological interactions in the discovered vent systems and of the temporal variability of the post-eruptive 5°S vent system. The present preliminary assumption that the similarity of hydrothermal vent fauna south and north of the large equatorial fracture zones does not require the definition of a new biogeographic province on the southern MAR will be verified by further investigations.

Acknowledgments

We would like to thank Captain Kull and his crew on R/V Meteor for their professionalism and excellent cooperation during cruise M68/1, which was a major contribution to the success of the expedition. Furthermore, we acknowledge the professional patronage of the German Ministry of Foreign Affairs as well as Captain Berkenheger at the "Leitstelle Meteor". We wish to thank the German Science Foundation (DFG) for funding the cruise and subsequent scientific work in the framework of the priority program SPP 1144 "From Mantle to Ocean: Energy-, Material-, and Life Cycles at Spreading Axes". Participation of the WHOI team and the ABE autonomous vehicle was funded by the NOAA Ocean Exploration program in the USA.

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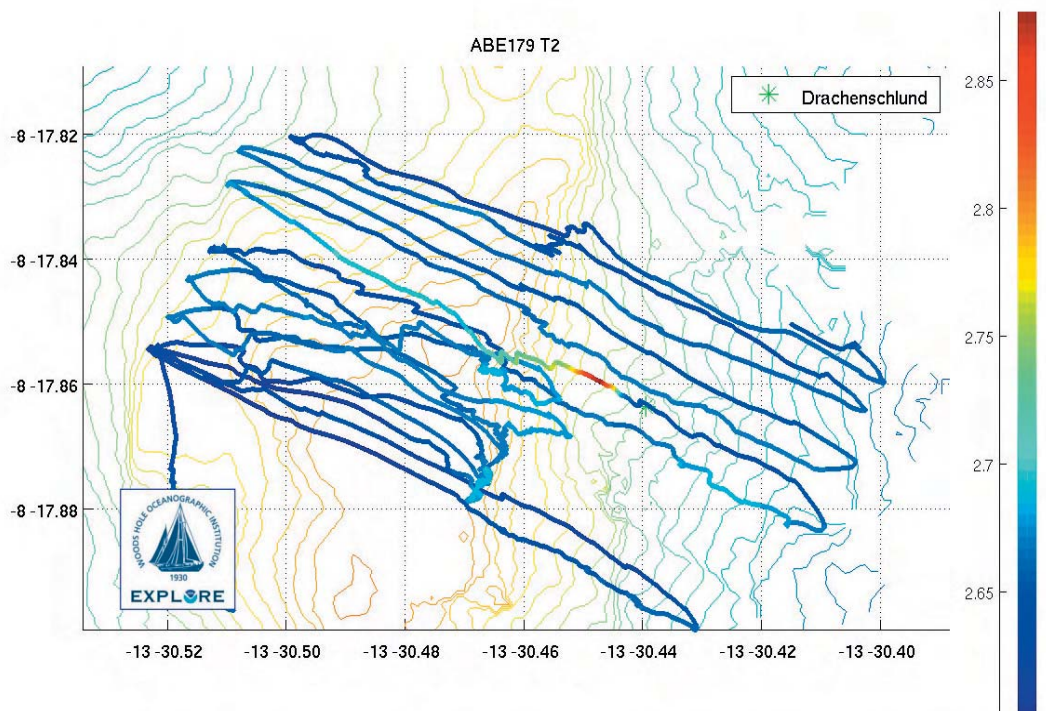


Figure 6: b) Temperature data for the subsequent dive ABE 179 confirmed the location of the hot vent "Drachenschlund" at the edge of a steep cliff.

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THE "MARCHE" CRUISE: ACOUSTIC MONITORING OF THE MID-ATLANTIC RIDGE AT A REGIONAL SCALE AROUND THE MoMAR SITE USING AUTONOMOUS HYDROPHONES

The MARCHE shipboard party:

J. Goslin (PI)¹, C. Brachet¹, J. Perrot¹, N. Simão¹, J. Haxel², J. Luis³

The objective of the MARCHE cruise was to perform turn-over operations of four autonomous hydrophones, which had been deployed in June/July 2005, to monitor the seismic activity of a vast section of the MAR, which includes the MoMAR hydrothermal sites. This acoustic monitoring effort is conducted within the framework of an international cooperation on-going since 2000 between *UMR6538 Domaines Océaniques, the Pacific Marine Environmental Laboratory (PMEL), the Centro de Geofísica da Universidade de Lisboa and the Centro de Investigação Marinha e Ambiental da Universidade do Algarve.*

The instruments were moored in the SOFAR channel for nine months, in order to record low-magnitude seismic events which escape detection, or are poorly localized by land-based seismic networks.

The R/V Le Suroit sailed for the MARCHE cruise from Concarneau, Brittany, France on 4 April, 2006 and docked in Horta (Is. Faial, Azores) on 20 April, after having completed the turn-over operations on the four hydrophone moorings,

located to the West and South of the Azores.

Two of the four instruments had been deployed in June 2005 at sites M6 and M7 during the third leg of Voyage 182 of R/V Knorr, sailed under the direction of Matt Fowler (PMEL). The other two (M2 and M8) had been deployed during the Hydro-MOMAR 05 cruise of R/V Arquipélago in July 2005 (J. Luis, C. Brachet, J. Haxel, J. Perrot and N. Simão boarded the Arquipélago for the Hydro-MOMAR 05 cruise).

The turn-over operations were achieved smoothly in spite of dominantly rough sea conditions, thanks to the seamanship of the Suroit's crew.

The four hydrophones worked perfectly and recorded continuously the acoustic signals over the nine-month deployment period. A preliminary inspection of the data shows that numerous events have been detected by the Marche hydrophone array. The detailed processing and interpretation of the acoustic signals has just started in Brest.

Table 1: Locations of the four hydrophone moorings which were turned over during the April 2006 MARCHE cruise

	Latitude			Longitude		
	Deg.	Min.		Deg.	Min.	
turn-over M8	36	35,00	N	29	09,00	W
turn-over M7	32	30,00	N	33	00,00	W
turn-over M6	36	00,00	N	42	00,00	W
turn-over M2	39	25,00	N	34	12,00	W

¹UMR CNRS-UBO 6538 "Domaines Océaniques", Brest, France; ²PMEL/NOAA, Newport Oregon, USA; ³Centro de Investigação Marinha e Ambiental, Universidade do Algarve, Faro, Portugal

The instruments were re-moored at the same sites. A "MARCHE2" recovery cruise is planned aboard the Suroit around mid-July 2007. When recovered, the hydrophone array will thus have monitored the seismic activity of the MoMAR section of the MAR for a period of two years.

Additional information can be accessed by following several links from the MARCHE web home page:

<http://www-sdt.univ-brest.fr/internet/recherche/chantiers/marche>

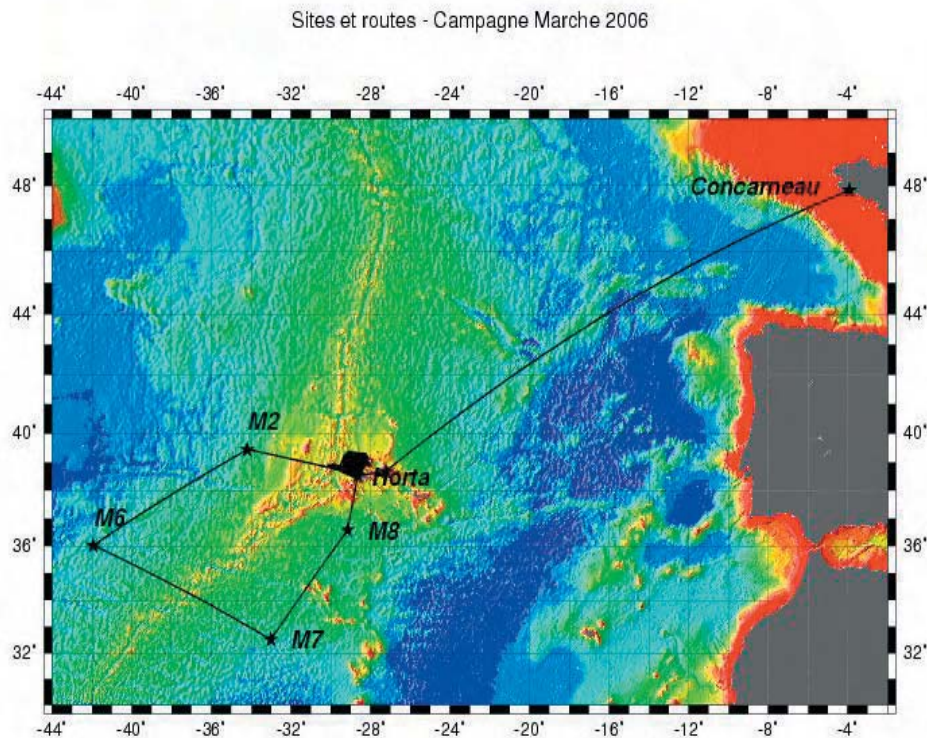


Figure 1: Hydrophone mooring locations and tracks of R/V Le Suroit during the MARCHE cruise, superimposed on the predicted topography of Smith and Sandwell (1997). Closely spaced tracks, west of the Azores islands, were sailed during a multi-beam survey on the Azores Plateau achieved during the MARCHE and the STRIPAREA cruises (see the report of this latter cruise by Luis, J. et al., this volume)

THE "STRIPAREA" CRUISE: HIGHLY DETAILED MULTIBEAM BATHYMETRY SURVEY OF AZORES TRIPLE JUNCTION AREA.

J. Luis (co-PI)¹, N. Lourenço¹, J. Mata¹, P. Madureira², J. Goslin (co-PI)³, J. Perrot³, C. Brachet³, N. Simão³

The STRIPAREA cruise was sailed on board the N/O Suroit, as a result of an international collaboration involving CIMA (UALG), CGUL (ULIS) and the French Research lab: UMR6538/CNRS from Brest. This collaboration started also with the PMEL/NOAA lab, Newport, USA, in the early stages of the preparation of the SIRENA project, which comprised the installation on the north Atlantic of an

autonomous hydrophone network, and has involved since, the participation of member of both labs in cruises SIRENA 1 (2001), SIRENA 2/D274 (2002), Hydro-MoMAR-05 (2005), MARCHE 1 (2006) and STRIPAREA 2006.

The presence of R/V Le Suroit in the Azorean waters,

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following the MARCHE 1 cruise last April, was a major opportunity that allowed to take advantage of the quality and reliability of its hull-mounted EM300 swath bathymetry system. Benefiting from the already long-lasting Franco-Portuguese collaboration, it was relatively straightforward to set up with IFREMER, the STRIPAREA cruise as a piggy-back operation to the MARCHE1 cruise. The contract for the STRIPAREA cruise planned three complete days of multibeam surveying operations. It was possible to sail two additional days of surveying, which were gained as a result of the speedy hydrophone turn-over operations performed during the MARCHE1 cruise. Jean Goslin, PI and Chief Scientist of the MARCHE Project, agreed to devote these two days to extend the STRIPAREA survey area.

The main objectives of the STRIPAREA cruise dealt with the kinematics and tectonics of the Eurasia/Africa/North America triple junction (TJ). The Azores Archipelago is believed to be the location of the third arm of this RRR triple junction. It is also believed that this triple junction has progressively migrated to the north since its onset about 30 Ma ago and that this migration is related to the build-up of the Azores plateau. However, the current TJ location is still a matter of debate. It was therefore considered that a highly detailed multibeam bathymetry survey, together with along-track sea-level magnetic anomalies measurements would reveal the existence of structures related with the evolution of the TJ.

The R/V Le Suroit sailed near 1400 miles, during the five days and achieved a complete-coverage survey of an approx. 10 000 km-square area. Ship tracks were chosen to follow and adjust with previous swath surveys performed

over the MAR axis such as FARA-SIGMA (Needham et al., 1991) and SUDAÇORES (Cannat et al., 1998); and also to target specific seafloor features previously imaged during the AZZORRE 99 cruise with the deep-tow TOBI sonar (Ligi et al., 1999). Two specific E-W tracks were performed north of Faial to investigate possible seafloor surface ruptures resulting from the recent 1998 Faial earthquake ($M_w - 6.2$).

The EM300 system performs optimally around 1500 m water depths, hence given the average range of water depths between 1000 and 2000m on the survey area, we were able to produce a high resolution grid of 50 m x 50 m. This grid will enable the detailed morphological analysis of volcano-tectonic features in the ATJ area. The swath bathymetric data was processed with MB-System and Mirone (J. Luis, in press) softwares.

Analysis of the data is ongoing but several preliminary observations can be outlined:

- 1) The Terceira axis does not intersect the MAR axis neither the North Azores Fracture Zone. It is disrupted by a series of NW-SE faults.
- 2) The faulting pattern is complex with fault families identifiable in three main directions: WSW-ESE, NW-SE, WNW-ESE disrupting nearly N-S MAR generated Abyssal hill fabric and controlling several basins.
- 3) The surveyed region is largely depleted from volcanic constructs. This is in clear contrast with the much higher magmatic budget observed in the adjoining MAR axis to the West and Faial Ridge to the East. The highly detailed swath bathymetry survey together with the along-track sea-level magnetic measurements will now help to clarify the nature of the present-day ATJ and its recent evolution.

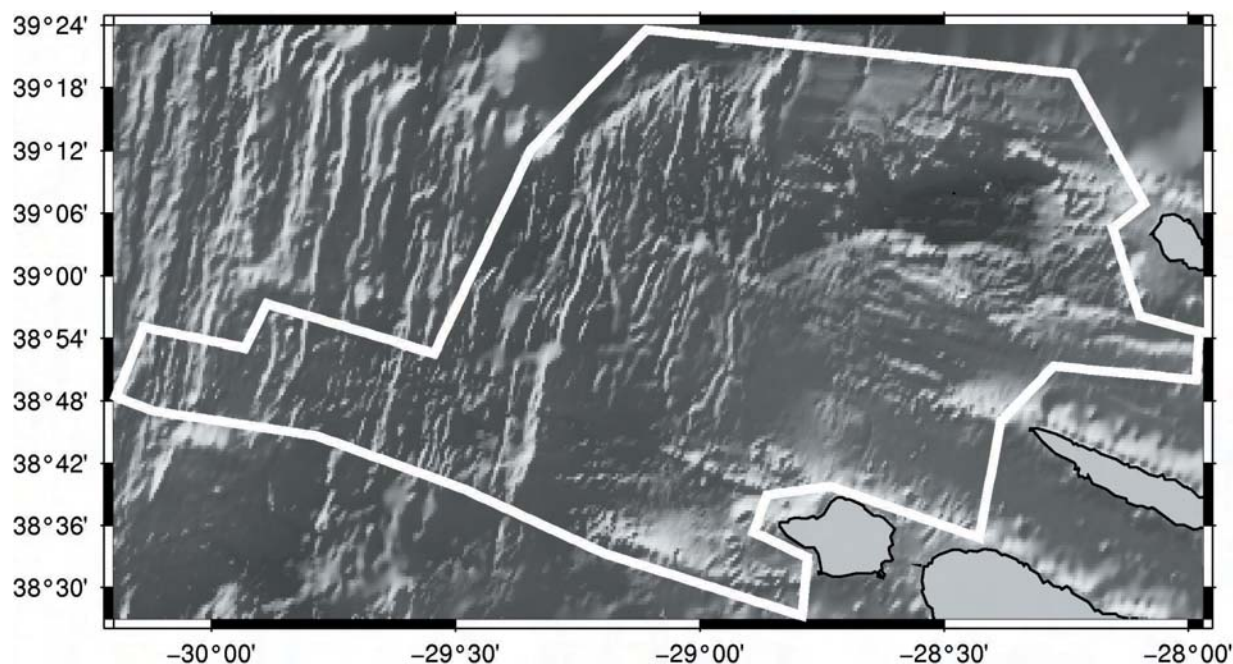


Figure 1: Bathymetric map of the Azores Triple Junction area. The white line outlines the extent of the STRIPAREA survey. This figure was constructed from a lower resolution grid (500 m grid spacing).

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LOST VILLAGE – A “FAUBOURG” OF LOST CITY:

BENTHIC STUDIES USING MIR SUBMERSIBLES AT NORTH ATLANTIC HYDROTHERMAL SITES IN 2005

S.V. Galkin, biological group and the “Mir” submersibles team

The 50th cruise of R/V *Akademik Mstislav Keldysh* had 2 manned submersibles on board and started on 28th May 2005 from Kaliningrad, Russia, and ended in Kaliningrad on 17th September 2005. The purpose of the cruise was to study hydrothermal vent fields along the mid-Atlantic Ridge (MAR) and also to investigate the shipwreck sites of the BS “Bismarck” and the HMS “Titanic”. Our paper discusses the biological studies we undertook at the hydrothermal vent fields Broken Spur, Lost City and Rainbow.

Studies were focused on all hydrothermal ecosystems: benthic, benthopelagic, and planktonic components were examined with equal priority. The biological team consisted of Sergey Galkin (head of the biological group, benthos distribution, mapping and landscape approach to the vent communities), Natalia Budaeva (benthic studies, polychaet biology), Olga Kamenskaya (protozoan studies), Georgy Vinogradov (water column and near-bottom ecology, amphipod biology), Darya Zasko (radiolarian studies), Alexander Vereshchaka (shrimps and plankton studies) Vladimir Gagarin (primary production, deck works), Eteri Musaeva (macroplankton studies), and Vladimir Dyakonov (computation biologist). Subject of the present contribution are preliminary results of investigations of benthic fauna.

Broken Spur

Initial observations made in 1993 at Broken Spur suggested a low biomass relative to other deep-water mid-Atlantic vent communities (e.g. TAG, Snake Pit, Logachev). Vent fauna at Broken Spur is associated with isolated chimney structures of various morphologies. Several main morphological types of hydrothermal edifices include high, column-like (Triple Chimney, Judy's Tower, Spire), high massive (Saracen's Head, Bogdanov Site), and relatively low, platform structures with fattened tops (White Mushroom, White Button, point “ ”). During this 50th cruise attention was focused on detailed research of spatial distributions of animals associated with the different types of vent structures. Communities were studied at 7 sites: White Mushroom, Saracen's Head, Bogdanov Site, Triple Chimney, Judy's

Tower, White Button, and Spire (Fig. 1).

Several spatial faunal assemblages associated with discrete biotopes were identified:

1. “Swarms” of shrimps *Rimicaris exoculata* were concentrated near relatively high-temperature vents that discharge characteristic-black smoke or turbid shimmering water. The continuous, extremely dense swarms of shrimps usually did not exceed a distribution zone of 1 m around, and commonly stayed within a limit of a few tens of centimeters of the vents. As analysis of the recovered samples from this zone shows, fauna other than shrimps was rare and represented by sporadic individuals of polychaetes (fam. Spionidae). The most dense aggregations of *Rimicaris exoculata* were observed on massive structures and sometimes in the upper part of column-like structures. In all cases, dense aggregations of *Rimicaris exoculata* were found where the topography of vent structures provided enough substrate that was washed over with warm shimmering water.

2. The second dominant shrimp, *Mirocaris fortunata*, was common in weakly shimmering water and formed aggregations of hundreds of individuals per m². Slow-flow areas were covered with bacterial mats. Crabs *Segonzacia mesatlantica*, gastropods *Phymorhynchus*, brittle stars *Ophioclinella acies* (tens of individuals per dm²), and *Alvinocaris* sp. were all common in this area. Gastropods Peltospiridae (especially *Peltospira smaragdina*) and Fissurelidae formed patches of very dense aggregations. In samples recovered in this zone a number of polychaets (Polynoidae, Spionidae, Capitellidae, Hesionidae, *Archinome rosacea*) were recorded. The low temperature discharge biotope marked by weakly shimmering water was sometimes inhabited by small aggregations of *Bathymodiolus puteoserpentis*. Single picnogonids were observed together with mussels. This assemblage was topographically associated with horizontal flanges of column-like structures and was especially common when associated with low and mushroom-like structures that had flat tops. A few meiofaunal taxa (Nematoda, Harpacticoida, Foraminifera) were collected in sediment

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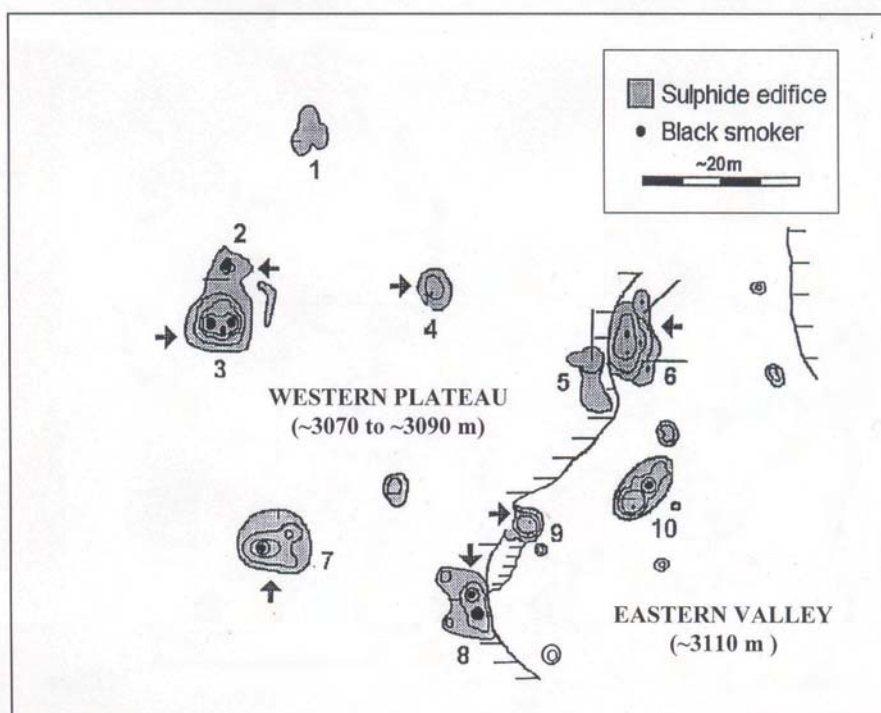


Figure 1: Interpretation of Broken Spur hydrothermal field, showing main structures. (after Copley et al., 1997). 1 Mound "K"; 2 Judy's Tower; 3 Triple Chimney; 4 White Button; 5 Dog's Head; 6 Bogdanov Site; 7 The Spire; 8 Saracen's Head; 9 White Mushroom. Arrows indicate structures, explored during the 50th cruise of "Akademik Mstislav Keldysh"

from this habitat..

3. Settlements of actinostolid actinians *Maractis rimicavorivora* (originally incorrectly identified as *Parascyonis ingolfi*) occupied the closest peripheral zones of vents. These settlements are characteristic for the inactive base of all types of vent structures. In this zone chaetopterid polychaetes and *Phymorhynchus* are also abundant. Spionid and archinomid polychaetes, and *Ophioctinella acies* were recorded on friable hydrothermal deposit material near the base of chimneys. More or less dense populations of actinians and chaetopterids are also distributed throughout the field between venting structures.

Based on observations, videos and sampling, comprehensive descriptions of all investigated structures were carried out. No significant changes in hydrothermal activity and total faunal abundance were recorded relative to our previous observations in 2002 (Vereshchaka et al., 2002).

Lost City

The Lost City hydrothermal field is located at 30°N on the Atlantis massif more than 15 km away from the spreading axis at a water depth of 750 to 900m. This field is distinctly different from all other known hydrothermal fields in that it is underlain by ultramafic rocks and is dominated by spectacular, steep-sided carbonate chimneys (Kelley et al., 2001). Some of the carbonate structures exceed 70 m in height. Weakly shimmering water is found on the tops of and sometimes between the columns.

The fluid composition is controlled by the interaction between seawater and mantle peridotite. These subsurface reactions create fluids rich in hydrogen and methane (Kelley et al., 2001, 2005), which are important energy sources for the primary producers of the Lost City ecosystem. These producers are represented by Archaea and eubacteria, their concentration reaches 10^7 - 10^8 cells per gram of wet carbonate. At the same time, communities of typical hydrothermal vent animals were not found at this field and it was originally thought that vent endemic fauna at Lost City is absent. In July 2002 Lost City was revisited on the 47th cruise of the RV *Akademik Mstislav Keldysh*. During two biological dives with *Mir* submersibles several samples of bottom fauna were recovered including endemic hydrothermal species (limpets Peltospiridae, amphipods, archinomid polychaetes etc.) inhabiting porous interiors of the carbonate edifices. Two subfossil valves and 6 fragments of bivalve shells presumably belonging to *Bathymodiolus* were collected at the base of the tower complex at a depth of 830 m (Gebruk et al., 2002; Vereshchaka et al., 2002). In 2003 during 19 dives with the submersible *Alvin* (Kelley et al., 2005) ten discrete, active vent sites were sampled. Recovered samples revealed that over 65 morpho-species were present, and >90% of these fauna were in the order of hundreds of micrometers or less in size.

The task of our 2005 expedition was to make comprehensive observations of and take samples from the different biotopes. Active chimneys, inactive tower flanges and the

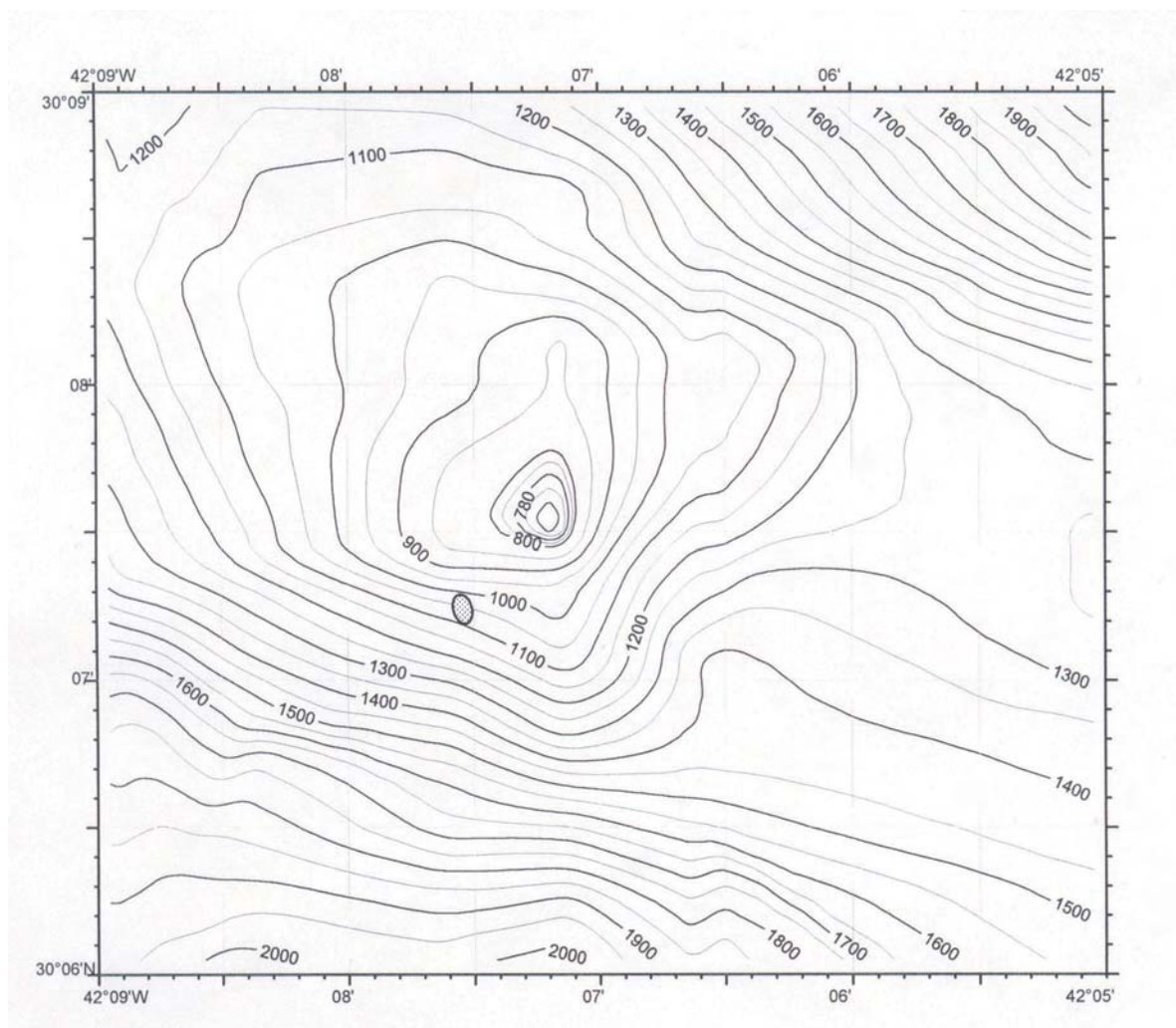


Figure 2: Bathymetry of the Atlantis massif showing the location of dead mussels' field (dotted oval). Central active carbonate complex Lost City occupies the (ohne the) depths shallower than 850-900 m.

base of the complex were explored. Discrete sites were sampled using a suction sampler, bathometers, sieve nets and closing corers for co-registered temperature, fluids, rocks and biota. Initial analysis of recovered samples revealed the presence of at least 55 species. Of the most abundant taxa, polychaetes are most diverse (>14 species). Coelenterates (11 species) and small crustaceans (not less 7 species) are also abundant.

Our observations reveal qualitative differences in species abundance and composition relative to substrate type.

Active tower tops and walls. White friable carbonate prevails; thermal discharges are often visible by characteristic shimmering of the water. Temperatures up to 50°C were measured. Bacterial mats are often visible on the surface. Porous channels and crevices of carbonate that is rich in bacterial mats provide habitat for many small animals including vent endemic species. The most characteristic fauna in this biotope are amphipods *Bouvierella curtirama*, limpets *Protolyra valvatoides*, harpacticids, ostracods, tanaids, giant (up to 1 cm long) nematodes, and representatives of several families of polychaetes (*Ophriotrocha* sp. and *Ceratulidae* were observed only in this zone).

Bivalves *Cuspidariidae* and *Thyasiridae* were recorded. Sessile animals are almost absent. Numerous euphausiids *Nematoscelis* and hyperiids *Paraphronima* and *Streetsia* swarms were present in the water.

Inactive chimneys and tower walls. These are made up of relatively hard, glaucous or yellowish rocks. There is no visual evidence for current hydrothermal activity. Non-vent animals are fairly abundant, corals *Lophelia* sp. and *Cariophyllia sarsiae* are often observed. *Lophelia* forms bushes of up to 2 m in diameter. Gorgonian corals, alciornarians (*Stolonifera*?) and actinians *Sideractis glacialis* and *Amphianthus* sp. are common. Diverse hydroids associated with corals and rocks were collected and include *Halecium tenellum*, *Sertularella gayi*, *Zanclaea costata*, *Mirocomella polydiademata* and other species. Also common in this zone were the sponges *Demospongia* and *Hexactinellida* (*Farrea*). Polychaete fauna is also rich in species: representatives of *Serpulidae* (2 species) and *Spirorbidae* are common. *Polynoidae*, *Eunicidae*, *Spionidae*, *Dorvilleidae*, *Sabellidae*, *Phyllodocidae*, *Archinome rosacea* were observed, often in association with corals. Among larger mobile animals, gerionid crabs, galateids (*Munidopsis*



Figure 3: "Lost Village", depth 1069m. Carbonate structures (right) and aggregations of mussels' valves. Photo-image from hand-held digital camera.

scabra), *Agononida* and *Munida*, the swimming crab *Bathynectes maravigna*, echinoids *Araeosoma fenestratum* and Cidaridae, asteroids resembling *Ceramaster*, and brittle stars are common.

The complex base at 850-900m. At the base of the tower complex carbonate structures and hard rocks are locally covered with sediment. Macrofaunal composition and appearance in this zone is similar to the previous one. Analyses of our sediment samples revealed that fauna of this sediment are similar to ordinary background fauna and typically represented by meiobenthic taxa: Nematoda, Harpacticoida, small Polychaeta and numerous diverse foraminifera.

Observations and sampling show that there is a well-defined boundary between vent and non-vent habitats at Lost City. This is generally true for all small, in particular vent-typical animals. However we repeatedly observed large crabs, fishes and echinoderms in active zones near the tops of the central complex. In the stomach of a sea urchin *Araeosoma fenestratum* bacterial clots were found. The question which remains unclear is how far chemosynthetically derived production can be consumed by non-vent fauna and to what degree hydrothermal processes can influence the surrounding background community. To clarify this, we collected samples of vent and non-vent animals for stable isotope (C and N) analyses.

The most remarkable find on our expedition was the discovery of an extinct hydrothermal community which we named Lost Village. During a Mir-2 dive (St.4806, dive # 29/408, 29.08.2005; pilots: E.Chernjaev, V.Schadilov, investigator: S.Galkin) the southern slope of the Atlantis massif was investigated. At a depth range of 1016 - 1072 meters, a dense aggregation of mytilid valves was revealed which presumably belong to *Bathymodiolus azoricus*. The estimated sizes of Lost Village is about 80-100 m long (north to south) and from 25 up to 40-50 m wide (west to east) (Fig. 2). The abundance and disposition of valves in the field (sometimes forming clusters and agglomerations around carbonate blocks) are strong evidence that they lived in this area, rather than having drifted here from shallower depths (Fig. 3). Traces of contemporary hydrothermal activity within the limits of and proximal to the field are absent. Tentative age estimations of the sampled valves (by V.V.Maslennikov) suggest the valves represent three generations: thousand years, hundreds, and tens of years (Fig. 4). The carbonate rocks making up a field presumably formed during low-temperature (<100°C) hydrothermal activity (A.Y.Lein's data). Thus, for the first time in the Lost City area, the remains of a large, classical, hydrothermal community were discovered. This community was similar in shape and structure to modern upper-bathial Atlantic communities found at Menez Gwen and Lucky Strike with



Figure 4: Valves and fragments of *Bathymodiolus azoricus* from southern slope of Atlantis massif.

a dominance of *Bathymodiolus azoricus*. The discovered community existed in historically recent time as testified by the condition of the valves. This could suggest that similar oases may exist today. The extinction of the mytilids may have been caused by abrupt changes in hydrothermal activity. Having discovered this community, we now know that Lost City area hosts (at least from time to time) large populations of *Bathymodiolus azoricus*, which may be compared (in terms of biomass and abundance) with dense populations of the same species living at other fields along the mid-Atlantic ridge. Mytilid populations may also exist at smaller hydrothermal fields spatially separated from the main carbonate massif. Further exploration to find these is therefore necessary not only in the central area of the active complex but also along the slopes of the Atlantis massif.

Lost City and Broken Spur occupy an intermediate location between the northernmost and southernmost hydrothermal areas, making their species composition especially interesting from a biogeographical perspective. For example,

the geographic boundary between species ranges of *Bathymodiolus puteoserpentis* and *B. azoricus* remains unclear. Morpho-anatomical analyses of mussels collected at Broken Spur showed all sampled specimens belong to the species *Bathymodiolus puteoserpentis* (Vereshchaka et al., 2002). Mytilids valves collected at Lost City apparently belong to *B. azoricus*. Amphipods *Bouvierella curtirama* are known from Rainbow and Lucky Strike. Thus, Lost City hosts vent species associated with shallower, more remote areas rather than with the closest but much deeper Broken Spur. It therefore seems likely that depth plays a mayor role in separating these two mytilids species along the MAR and may in fact be a more important isolation factor for vent fauna distribution than distance.

Rainbow

The Rainbow hydrothermal field at 360N was repeatedly visited by our expeditions since 1995. These observations revealed significant changes of hydrothermal activity and distribution of fauna in scales of several years (Vereshchaka

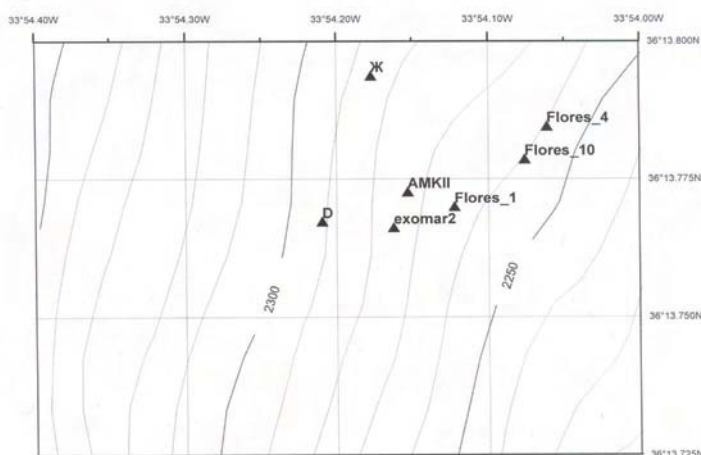


Figure 5: Bathymetry of Rainbow field showing locations of markers. Marker AMKII: investigated structure (Fig.6).

et al., 2002). During our 2005 expedition, we concentrated on researching specific structures, with the purpose of carrying out complete geological and biological surveys. These observations will form a further base for monitoring temporal changes in the community.

One mature active structure in the central part of the field (mark AMKII) was investigated in great detail (Fig. 5,6). During the dive of Mir-2 (St.4819, dive #32/411, 04.09.2005. Pilots: V.Nischeta, investigators: V.Maslennikov (geology), S.Galkin (biology), ten passes from base to top were carried out with continuous video-recording. The documentation of the ore-facial profile of the structure was carried out. At the same time biological surveys were conducted and distribution of fauna was documented with reference to the rock facies. Faunal assemblages associated with different geo-morphological facies were described.

1. The basis of the structure (depth 2317-2313 m) is underlain by serpentinites and covered by metalliferous sediments and serves as a habitat for numerous Chaetopterids and hydroids (*Stegopoma plicatile*, *Candelabrum phrigium* a.o.). Settlements of the branchy xenophyophores *Luffamina* are characteristic for this zone. Numerous Nematoda, Harpacticoida, Tanaidacea, Foraminifera and other small animals were found in the sediment.

2. Chaetopterids, hydroids and xenophyophores are abundant and also present in an overlying zone (2313-2308 m), on a cone composed of fragments of pipes and massive blocks of sphalerite-pyrite ore. In this zone rare shrimps *Mirocaris fortunata* and rather abundant *Alvinocaris* sp. were observed. Gastropods *Protolyra thorvaldsoni*, *Pseudorimula mesatlantica*, *Peltospira smaragdina* and *Phymorhynchus* sp. are abundant. Polynoid polychaetes and picnogonids were recorded. Tanaids living in small houses constructed from particles of deposit material amounted to up to 200 individuals per several cm².

3. At a depth range of 2309-2303 m, the prevailing substratum consists of upright inactive pipes with a brown or dark surface. Shimmering water emissions are observed locally

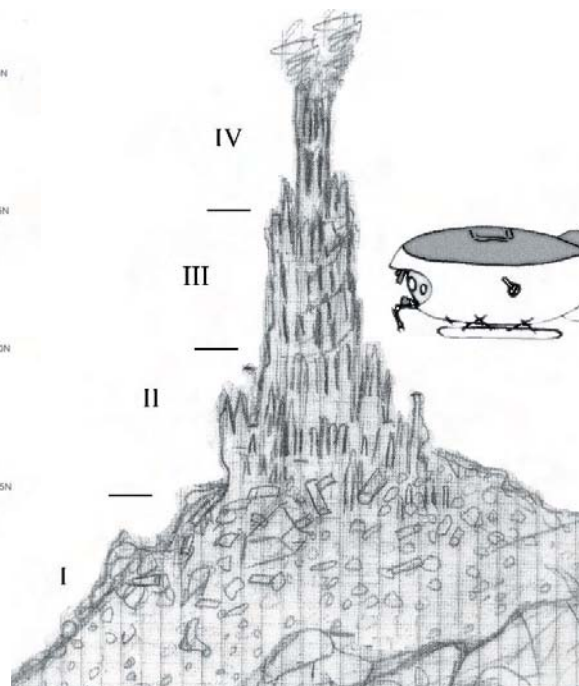


Figure 6: Active hydrothermal structure AMKII investigated in detail during the dives of Mir 2 (Stations 4812, 4819). View from the NE. Scale bar -5m. Reconstruction by V.V.Maslennikov, computer processing by G.M.Vinogradov. I – IV: main geo-morphological facies (see text).

in this zone. The amount of dark rocks increases towards the top part of the structure. Shrimps (*Mirocaris fortunata*; up to 100 ind/m²) are associated with these rocks. On a surface of the pipes, individual mollusks, *Bathymodiolus*, were observed that appear to be lifeless.

4. At a depth range of 2303-2301 m the vent structure consists of fused pipes of dark or orange color. In this zone, shimmering water emissions and black smokes are most distinctive compared to the other zones. These water emissions sites are marked by swarming shrimps *Rimicaris exoculata* (the swarm sizes are up to 0,5 m in diameter). The top of the structure (2300 m) represents a multichannel, ramified smoker with no visible fauna.

During the dives, 35 species were collected. Detailed sampling, photo and video documentation were carried out. We believe this information will be useful as comparable material in future visits to this site.

Acknowledgements

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MoMARETO: A CRUISE DEDICATED TO THE SPATIO-TEMPORAL DYNAMICS AND THE ADAPTATIONS OF HYDROTHERMAL VENT FAUNA ON THE MID-ATLANTIC RIDGE

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The Mid Atlantic Ridge (MAR), located close to the Azores Triple Junction (ATJ), has been extensively studied over the past 15 years. Over ten cruises were conducted in the area, leading to the discovery of three major vent fields - Menez Gwen, Lucky Strike and Rainbow -, located on three segments of the south-eastern limb of the ATJ (Ondréas et al. 1997). The vent fields differ by their depths (850 to 2350 m), their tectonic settings, the composition of their host rocks (mantle-derived serpentinized peridotite vs. basalt), the nature of associated volcanism, their fluid composition and the dominance of different key faunal assemblages (Fouquet et al. 1998, Desbruyères et al. 2001).

The drop in hydrostatic pressure due to depth differences between the three fields directly affects the chemistry of high temperature effluents and their mineral particle content. At the shallowest site, Menez Gwen (850 m), phase separation of high temperature fluids produces a metal-depleted fluid and a gas-rich vapour phase (Charlou et

al. 2000, 2002, Douville et al. 2002). The emitted fluids are clear with a low mineral particle content. The geological structures are small, their height restricted to a few meters. Faunal communities are dominated by large patches of the bivalve *Bathymodiolus azoricus*. Important populations of the shrimp *Mirocaris fortunata* colonize active surfaces and live within the mussel assemblages.

Lucky Strike is one of the largest known active vent fields. The vent sites are distributed around a large lava lake at depths varying from 1650 to 1750 m (Fouquet et al., 1995). Well-defined hydrothermal edifices such as Tour Eiffel, Elisabeth and Bairro Alto, as well as diffuse flow areas, are scattered throughout the vent field. The composition of hydrothermal fluids varies significantly from site to site, suggesting the presence of two fluid sources (Charlou et al. 2000). Faunal communities are dominated by extensive mussel beds of *B. azoricus* partially covered by visible microbial mats. The vicinity of active high-temperature

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chimneys, flanges and cracks are colonized by *Chorocaris chacei*/*M. fortunata* shrimp assemblages (Desbruyères et al. 2001).

The Rainbow vent field (2350 m) is located on the deepest active segment of the ATJ area. The nature of the host rocks differs from the two other fields with the presence of ultramafic rocks. Hydrothermal emissions are characterized by acidic fluids enriched in iron and gas (H_2 and CH_4) and relatively impoverished in H_2S (Charlou et al. 2000, 2002). The relief of the field is particularly chaotic. Several sulphide edifice complexes can be found within the 400 m long field. The main hydrothermal structures are often surrounded by numerous thin pinnacles. The walls of large edifices are covered by swarms of *R. exoculata* and *M. fortunata* shrimp assemblages. Small *B. azoricus* patches, encrusted with particles, were sporadically found (Desbruyères et al. 2001).

The MoMARETO cruise was held from August 6 to September 6, 2006 on the new French oceanographic vessel *Pourquoi pas ?*, with the ROV Victor 6000. The cruise was

organised in two legs permitting fifty-six scientists to work on board. At two occasions, shuttles with the Portuguese oceanographic vessel *Arquipélago* allowed visits by scientists and journalists and the transfer of fresh biological samples to the LabHorta land-based laboratory installed in Fayal island (Azores). Although most of the dives were centred on Lucky Strike, two other vent fields, Menez Gwen and Rainbow, were also visited.

The main objective of the MoMARETO cruise was to study the spatial and temporal dynamics of hydrothermal communities colonizing the MoMAR zone, located on the ATJ. The first leg of the cruise was dedicated to the final integration and validation phase of 13 equipment prototypes developed during the European EXOCET/D project. A fine-scale bathymetric study of the Lucky Strike area was also conducted. The proposed approach for the second leg was to study the response of different hydrothermal species to their environment at two temporal scales: a very short-term response of organisms to habitat micro-variations (hours-days) and a longer observatory-type scale where the dynamics of faunal assemblages will be linked to broader-scale habitat variations (months-years).

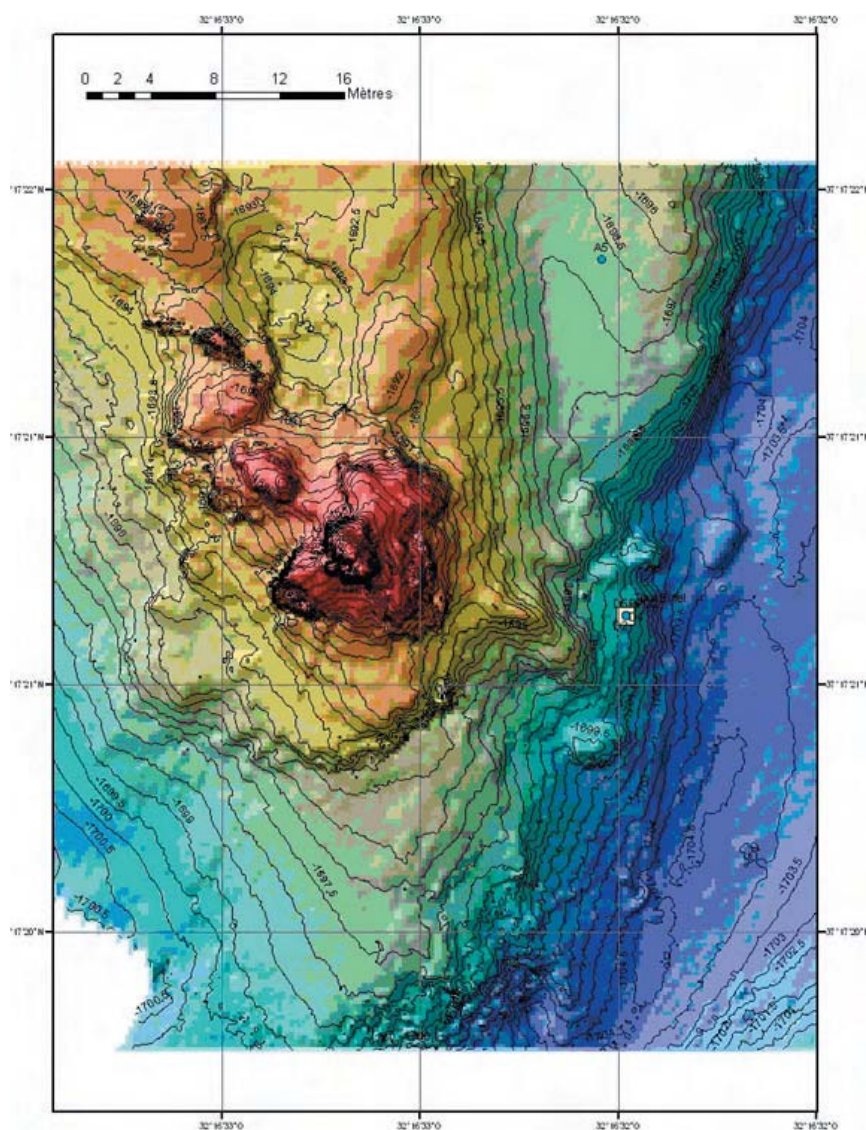


Figure 1: Raw bathymetric map of the 11 m high Tour Eiffel hydrothermal edifice, Lucky Strike vent field. The map was obtained during the MoMARETO cruise using a Reson 7125 multibeam echosounder mounted on Victor 6000 survey module. The transects were done at 8 m above bottom and the resolution attained is approximately 25 cm. The map was plot using the CARAIBES software.

Leg 1 - August 6-17

The first two dives of the cruise were used to gather microbathymetric data of the Lucky Strike vent field with the new survey module of the ROVVictor 6000. This module includes a Reson 7125 multibeam echosounder, an OTUS black-and-white high-resolution photo camera, and a Simrad EK60 fish echosounder. A first survey surrounding the lava lake was done at 30 m altitude (1200 m x 800 m). A raw 50-cm resolution map was obtained with the CARAÏBES software. A second passage was done at 8 m to couple the microbathymetric survey with OTUS imagery. A complete coverage of the Tour Eiffel edifice was done (Figure 1). A first image mosaic mapped the distribution of faunal assemblages around the structure.

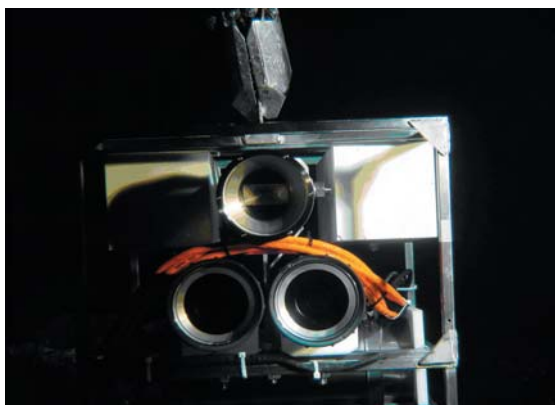
The next four dives were used to test different tools developed during the EXOCET/D project. The general objective of this project was to develop, implement, and test reliable and cost-effective technologies to study deep marine biodiversity in fragmented habitats. Three major themes were identified for instrument improvement and/or development: 1.1) quantitative imaging, 1.2) sampling and *in situ* measurements and, 1.3) faunal sampling and *in vivo* experiments.

1.1 Quantitative imaging

Two stereo-video camera, CAMEREO (Figure 2A) and IRIS, were developed and tested during the cruise. The underwater video imagery obtained by the cameras will be used to make projective 3-D reconstructions of small-scale scenes (Figure 3). This will not only improve the image mosaicking process but will permit the scaling of features present in the image (e.g. organism size and density) and to associate the precise positioning of *in situ* measurements to faunal distribution.

An advanced 3D viewer software (A3DV) was tested during the cruise. For this, real 3D data issued from IRIS stereo camera imagery were to be annotated and visualized by the A3DV. Unfortunately, 3D reconstructions from the stereo camera were too long to process on board and were not available during the trials. A compromise solution was found by using recently acquired bathymetric data as a 3D mesh. The newly-developed A3DV was able to visualize and annotate the 3D bathymetric mesh.

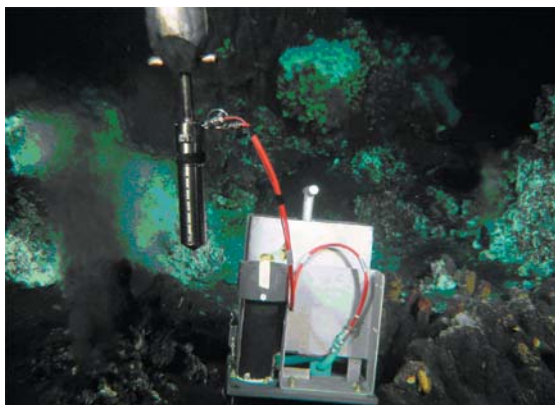
TEMPO, a long-term imaging module was developed to study community dynamics and patterns of succession in remote habitats. This module is composed of a deep-sea autonomous video camera and two LED projectors. The



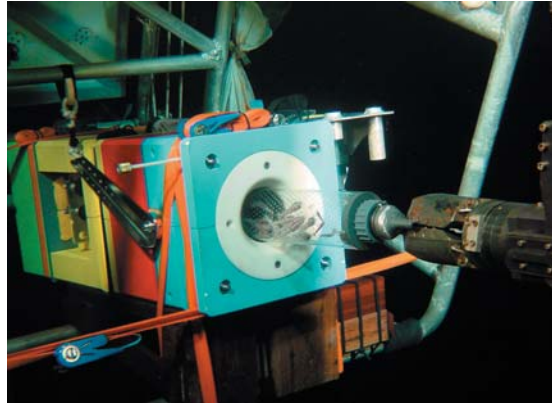
A.



B.



C.



D.

Figure 2: A. CAMEREO autonomous stereo-video camera (AWI, Germany). B. Isosampler (ISObaric SAMPLER) hydrothermal flux sensor (Earth-Ocean Systems Ltd, UK). C. AISICS instrumented microbial colonisation system (Ifremer, France) and D. PERISCOP hyperbaric sampling device (Université Pierre et Marie Curie).

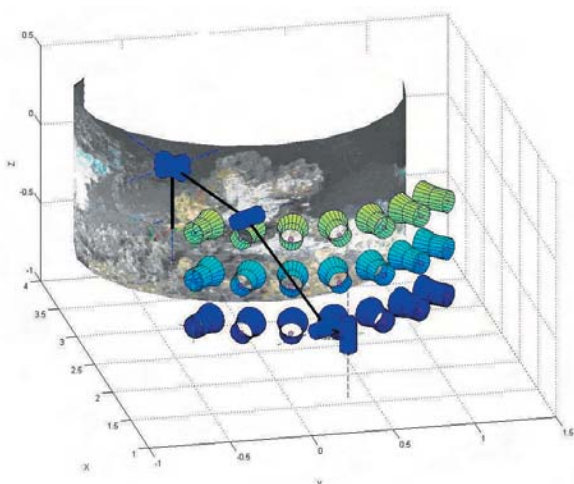


Figure 3: IRIS stereo-video camera (Ifremer, France) was developed to achieve the 3D reconstruction of small underwater structures. This system based on stereovision techniques is operated by Victor 6000 robotic arm. The image acquisition phase was done by visual servoing that allows a precise control of the camera position.

video camera is able to pilot the projectors and to record digital pictures on a hard disk. A biofouling protection, based on localized microchloration, was installed on the camera port hole and on the lights (Delauney et al. in prep.). TEMPO is also equipped with a CHEMINI Fe *in situ* analyzer and with three temperature probes, and is powered by a Sea-Monitoring Node (SEAMON, Blandin et al. 2005). TEMPO was deployed and tested during one dive during the first leg. During the second leg, Victor 6000 was used to precisely position the module near a mussel assemblage and a CLSI link was used to control the complete setting (camera and CHEMINI probe). The operational module was moored for one year and will be recovered during the RECO cruise in the summer 2007.

To evaluate the potential of using acoustic backscatter data to study deep-sea community distribution and dynamics, a Tritech Super SeaKing Dual Frequency Profiler was installed on Victor 6000. The longitudinal axis of the sonar housing was perpendicular to the axis of Victor's main video camera. The sonar was programmed to acquire and log each ping's backscatter at the highest resolution available. A series of tests were performed to acquire acoustic and vision data. Several vertical transects were done on different hydrothermal edifices and habitat types during both legs. Visual data were used to train classification algorithms and validate the results obtained. Future work will include the use of these algorithms to georeference acoustic bottom returns, thus contributing to the development of accurate 3D models of the observed structures.

1.2 Sampling and *in situ* measurements

Deep-sea ecosystems are characterised by limited spatial scales, steep biogeochemical and physical gradients, and

the coexistence of chemically reactive species (hydrogen sulphide, reduced metals) and dissolved gases (oxygen, methane). Appropriate instrumentation is necessary to study the extreme variability of environmental factors (Sarrazin et al. 1999). *In situ* analyses are preferable when possible in order to circumvent sample artefacts and alterations caused by depressurisation and temperature effects. Different analysers and sensors were adapted and optimised from existing instruments and tested during the MoMARETO cruise.

A second-generation *in situ* chemical analyser based on flow analysis and colorimetric detection (Le Bris 2001) was tested. Two CHEMINI modules were used for the analysis of total sulphide and iron II or total iron (II + III, Sarradin et al. 2005). The module is designed around an engraved manifold and a miniaturised photometric system. The first results obtained showed analytical performance comparable to a bench-top system, with detection limits close to $0.2 \mu\text{M}$ for both variables. In parallel, a second *in situ* chemical analyser (Deep Probe Analyser DPA), was developed and tested for the same chemical variables.

Sampling followed by on-board analysis often remains the only analytical way to complement the range of geochemical species covered by *in situ* sensors. It is also used to validate data obtained by *in situ* measurements. PEPITO is a small-volume water sampler enabling the intake of a high number of samples (up to 25). It has been tested and used during the whole cruise for many different purposes: ground-truthing of the CH_4 sensor, *in situ* filtration on $0.45 \mu\text{m}$ filters, water sampling in the vicinity of hydrothermal assemblages (pH, CH_4 , dissolved and particulate Fe, Cu, Cd, Pb and organic matter) and microbial mat sampling.

Capsum (Germany) type methane sensors (METS), that had been modified and optimised within EXOCET/D, were tested during the cruise. Two different sensors were used in a flow system using either a CTD pump or the PEPITO pump. The sensors were installed on the Victor 6000 survey module in line with the PEPITO water sampler. Water samples were taken in parallel with the *in situ* measurements for direct comparison with the sensor signal.

The isosampler (ISObaric SAMPLER) hydrothermal flux sensor (Earth-Ocean Systems Ltd, UK) is designed to determine simultaneously the temperatures and flow rates in the hydrothermal vent habitat (Figure 2B). The isosampler was deployed to quantify the fluxes of fluid and heat within faunal assemblages located on Menez Gwen and Lucky Strike fields. It operated over a wide variety of temperatures and flow rate regimes.

A dedicated sensor package with a CTD and an acoustic Doppler current meter was designed to allow the collection of time series measurement over several days on the seafloor. The instrument consists of a commercially-available CTD (type CTD 48 from SEA & Sun Technology, Germany)

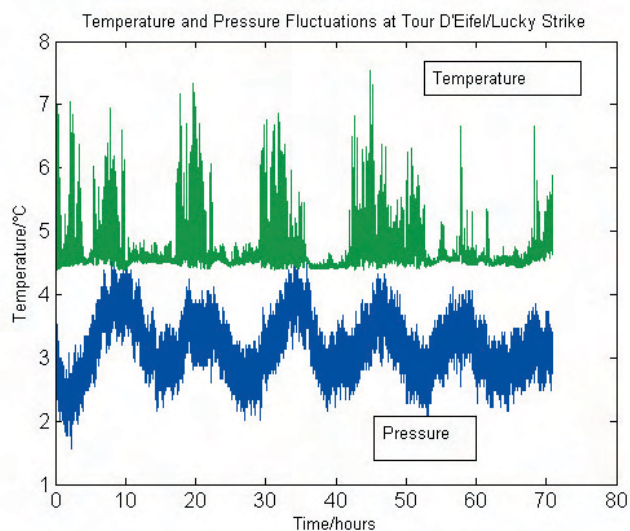


Figure 4: Pressure and temperature data as recorded during three days in the vicinity of Tour Eiffel edifice by the CTD/acoustic Doppler current meter sensor package (University of Bremen, Germany).

upgraded to deployment depths down to 4000 m, a data logger consisting of a PIC controller with an SD-Ram disc as storage medium that was designed at MARUM, and a commercial available Acoustic Doppler Current Meter (Type AQUADOPP working at 2 MHz from NORTEK, Norway). This autonomous package was deployed during three days close to the Tour Eiffel hydrothermal edifice. The data acquired will be used to extract information regarding the influence of tides on the fluid flow and the exchange of heat and salt in the surrounding water mass. Preliminary results clearly show a tidal influence on hydrothermal venting activity in the Lucky Strike region. Figure 4 shows that rising water levels during flood phases are connected with enhanced fluid outflow from hot vents. The current-meter data show an enhanced vertical flow directed towards the bottom from the lower 8 m of the water column, while the horizontal current components were just above the level of detection of the ADCP in use.

1.3 Faunal sampling and *in vivo* experiments

Microorganisms play a crucial role in biogeochemical processes and recent studies, based on molecular biological methods, suggest that less than 5% of marine microbial species have been identified (Sogin et al. 2006). Thus a variety of biochemical pathways and key enzymes remain to be discovered. The development of advanced sampling technologies is required to pursue the discovery of new microorganisms. AISICS is an instrumented microbial colonisation system (Figure 2C). This autonomous device allows the *in situ* colonisation of a specific substratum by indigenous microorganisms. It is coupled with a water sampler and a temperature probe, providing information on temperatures and fluid composition during colonisation events. AISICS was deployed four times (from 50 to 70 h

periods) on an active hydrothermal chimney during the cruise. Temperature was continuously recorded inside the system and fluids were sequentially sampled (4 samples per deployment).

Live organisms studies represent a luxury that biologists studying deep-sea fauna rarely access. Yet, this type of research has proved very valuable towards understanding the biology of such organisms. In the case of hydrothermal vent ecosystems, relevant biological features such as thermotolerance, reproduction, or primary production have been determined using *in vivo* experimentation but at native pressure. Nevertheless, a pre-requisite to successful *in vivo* pressure experiments of collected organisms is to insure their survival throughout recovery. PERISCOP is a hyperbaric sampling device, allowing the collection and recovery of deep-sea organisms at their natural pressure (isobaric collection) at depths reaching 3000 m. It allows an access to live animals or bacteria, by avoiding a traumatic and often lethal decompression. PERISCOP was tested successfully during the first leg. At the end of the cruise, the pressure retention of PERISCOP was almost perfect (95%) and the temperature inside the system remained fairly low (6.5°C for a bottom temperature of 4.5°C). Several types of organisms were collected using the PERISCOP, from two different depths, 1700 and 2300 m (Figure 2D).

In addition to collection devices, high-pressure instruments to study the physiological processes developed by the endemic fauna of vents and other deep-sea habitats are still rare. DESEARES (DEep-SEA RESpirometer) was developed to better understand, by an ecophysiological approach, the mechanisms responsible for the life and evolution of key organisms living in extreme deep-sea habitats. DESEARES is composed of three small pressure chambers, two dedicated to experiments and a third one serving as the control. The temperature inside the chambers is controlled and the circulating fluid is composed of sea water with known concentrations of different gases mimicking the *in situ* conditions of the animals. The system that control fluid composition is called SYRENE. It was developed during the VENTOX European project. DESEARES and SYRENE were installed on-board the ship during the entire cruise.

Leg 2 - August 18-September 6

This leg was entirely dedicated to biological studies. It heavily relied on the instrumentation tested during the first leg. While some studies were dedicated to one particular site, many of them rely on samples collected on the three sites visited.

2.1 Spatial distribution and temporal dynamics of hydrothermal communities

2.1.1 Spatial distribution of *Bathymodiolus azoricus* mussel assemblages in relation to environmental factors on the Tour Eiffel edifice

The principal goal of this ecological study was to examine the spatial distribution of the *B. azoricus* mussel assemblage on the Tour Eiffel edifice in relation to environmental factors. A total of 12 dives were spent to deploy a complex array of twelve instrumented chains (which also served as markers for the sampling units) around the 11 m-high hydrothermal edifice (Figure 5). Each chain was equipped with two autonomous temperature probes. *In situ* measurements with CHEMINI and water sampling with PEPITO were done on each sampling unit. Following that, the fauna was quantitatively collected using both the suction sampler and the submersible grab. Four days of short-term temperature measurements were obtained on each sampling unit. The ecological data will be used to assess and compare the temperature and chemical gradients within the microhabitats colonized by the mussels, to compare the biological descriptors (community composition, density, biomass, condition index, isotopic ratios, etc.) from one assemblage to the other, to relate these descriptors to the measured environmental variables, and finally to assess and compare the short-term variability of temperature within these assemblages. Fluid flow measurements, using both a visual and an hot-film techniques, were simultaneously acquired on several mussel patches around the Tour Eiffel edifice (Sarrazin et al. in prep). Autonomous *in situ* oxygen measurements, coupled with temperature measurements, were also acquired within the mussel assemblages.

Instrumented markers were deployed on the sampled surfaces to study the long-term dynamics of temperature within the faunal assemblages. The temperature data will be analyzed to identify significant scales of variability, common to several sampling units, using PCNM statistical analyses (Borcard and Legendre 2002). The TEMPO module completed the temporal study by monitoring both visually and chemically one of these mussel assemblages during one year. The data obtained will give insights about the natural dynamics of vent mussel communities, on the eventual reaction of the benthos to environmental events (temperature changes, disturbances) as well as on the role of biological interactions on community dynamics. To explore colonization patterns in the vicinity of mussel assemblages, six instrumented substrata (stone and wood) were deployed.

Imagery data (photo and video) was collected to be added to the hydrothermal vent time series investigated through a Marbef Ph.D. study (EU Network of excellence on Marine Biodiversity and Ecosystem Functioning). The major objective of this thesis is to assess the dynamics of hydrothermal ecosystems through time by using data from previous cruises at the same site. The emphasis was put on the Tour Eiffel edifice for which a bulk of historical data is available. This large edifice is one of the major active venting structure of the Lucky Strike vent field. Video transects were surveyed to allow reconstruction of the entire structure, followed by zoomed-in transects near the chimney (2-3 m) to observe the distribution of the different communities. The fine com-



Figure 5: For the ecological study on *Bathymodiolus azoricus* faunal assemblages, twelve instrumented chains were deployed around the Tour Eiffel hydrothermal edifice.

position of the faunal assemblages was visually sub-sampled on the four sides of the structure (N, E, S, W) by taking close-up images at three different depths. The periphery of the edifice was also imaged to see the frontier of life and hydrothermal activity. Variations in the morphology of the structure, venting activity and faunal distribution will be reported, in order to investigate the temporal dynamics of the hydrothermal vent habitat.

TRACS colonization panels, filled with different textures (alfafa, stones and wood), were deployed in the vicinity of two active hydrothermal sites (Lucky Strike and Rainbow) to study larval recruitment and colonization patterns.

2.1.2 Composition and distribution of hydrothermal vent megafauna

The goal of this study was to identify the composition and distribution of the megafauna on different hydrothermal edifices by using two approaches: acoustic sonar imagery and video imagery. Several transects on different edifices from the three vent fields were done, using both imaging systems. The usefulness of acoustic signals to study the composition and the distribution of the fauna in the vent environment will be evaluated.

2.1.3 Temporal variations of *Bathymodiolus azoricus* genetic structure and influence of introgression patterns in the evolution of allelic clines in the ATJ.

The survey of the genetic structure of *B. azoricus* mussel and *M. fortunata* shrimp populations along a bathymetric gradient on the MAR was initiated during the MARVEL (1997) and the ATOS (2001) cruises. To complement this study, biological samples of both species were collected at the three visited vent fields. The regulation of *Bathymodiolus* transcriptome in relation to different vent environmental stressors (pressure, temperature, hydrocarbon, metal and oxygen concentrations) will also be studied. For this, specimens were subjected to *in vivo* experiments in the DESEARES system, using qPCR and micro-array hybridization. Experimented animals will be genotyped at several

enzyme loci and stress proteins will be quantified to analyse the relationships between phenotype and genotype. This will help understanding how natural selection is shaping vent populations and potentially, hybridization patterns. The level of gene expression in mussel individuals using DNA microarrays will be assessed from different mussel assemblages at Lucky Strike to determine how environmental variations can affect mussel physiology (in relation to project 2.1.1). Mantle cavity water of *B. azoricus* was collected from animals of the three vent fields to study protist diversity using sequencing and FISH techniques.

2.1.4 Particulate fluxes and larval dispersal of *Bathymodiolus azoricus*

Larval dispersal of species associated to hydrothermal vents remains obscure, the main difficulty being the collection of larvae throughout the year. The objectives of this project was to study the larval dispersal of *B. azoricus* and associated hydrothermal particles on two hydrothermal sites, and determine the origin of the larvae and young recruits. Larvae of *B. azoricus* were successfully collected during past cruises using a particle trap, equipped with a current meter (Comtet et al. 2000, Khrpounoff et al. 2000). This system was deployed for one year during the Exomar cruise (2005) at Rainbow. The particle trap was picked up during MoMARETO and redeployed on Menez Gwen for one year. The larvae and particles collected will be analysed to assess seasonal larval and recruit distributions on these hydrothermal sites. The origin of larvae and young recruits will be determined with molecular studies to assign individuals to a particular population, in conjunction with the population genetic study (2.1.3). The retention hypothesis will be tested by the determination of the origin population.

2.2 Response and adaptation of hydrothermal organisms to the characteristics and short-term variations of their habitats

2.2.1 Microbial populations of active hydrothermal edifices

The major objective of this project was to study the microbial communities inhabiting active hydrothermal edifices and to identify the thermophilic and hyperthermophilic microorganisms involved in the degradation of organic matter. Most heterotrophic thermophilic species described to-date are coming from the hot part of the hydrothermal ecosystem. Many of these species belong to the archaeal order Thermococcales or to the bacterial order Thermotogales and are strict heterotrophs (Rinker et al. 1999, Godfroy et al. 2000, Adams et al. 2001, Postec et al. 2005a). They use both carbohydrates and proteic carbon sources. While these species are quite easy to grow *in vivo*, it is still not known if they play a key role in the degradation of organic matter at vents.

Even though molecular studies of hydrothermal active structures evidenced a very large diversity in both the

Archaea and Bacteria domains (Takai et al. 2001, Schrenk et al. 2003), the physiological role of these microorganisms is not trivial to infer. To identify the microorganisms involved in the degradation of organic matter in relation with the physico-chemical conditions, the AISICS module was deployed four times on a small active chimney. The colonization module was filled with different organic substrates. Molecular analysis of enriched microbial populations (diversity of both 16SRNA and 16SrRNA genes and FISH experiments) will be performed.

In addition to the colonization experiments, a continuous enrichment culture in a bioreactor was performed on board (Postec et al. 2005b). Hydrothermal fluid (supplemented with organic matter) was used as culture medium and the AISICS-sampled chimney fragment as *inoculum*. This continuous culture was maintained during 19 days at 65°C. The cell concentration was checked daily and samples were regularly conditioned for both molecular and cultural analyses.

During the EXOMAR cruise (2005), specific molecular markers for the anaerobic oxydation of ammonia (ANAMMOX, Jetten et al. 2005) were evidenced in both mineral and animal hydrothermal samples. To complete this work, hydrothermal chimney fragments and faunal samples were used for ANAMMOX activity measurements. The gills of different *Bathymodiolus* individuals from Lucky Strike and Menez Gwen were also dissected and preserved for identification and analysis of their bacterial symbionts.

2.2.2 Bioavailability of trace elements in hydrothermal organisms

The adaptation and tolerance of hydrothermal species to the toxicity and the short-term variations of their habitats influence their spatial distribution (Cosson and Vivier 1997). The objective of this project was to better understand fluid/organisms interactions at the scale of the habitat. For this, certain chemical "stress" biomarkers will be followed and the level of impregnation of trace elements, including radio-elements, will be quantified. The organisms studied came from the twelve sampling units of the ecological study (2.1.1) where the environment was characterised at small spatial scales. Experimental studies will be done to evaluate the penetration pathways of trace elements in the organisms, their distribution in different tissues and their bioaccumulation.

2.2.3 Physiology of hydrothermal organisms in simulated *in situ* conditions

The objective of this project was to study the effect of oxygen partial pressures on antioxidant systems of several hydrothermal vent species. This habitat is naturally rich in "pollutants" and its fauna is submitted to oxidative threat. The high metabolic aerobic activity linked to potentially high *in situ* temperatures lead to the production of high levels of Reactive Oxygen Species (ROS). Four types of experiments were done in the DESEARES respirometer

system (Figure 6) to study i) the physiological response of deep-sea crustaceans (*Segonzacia mesatlantica* and *R. exoculata*) to different concentrations of oxygen in their natural pressure conditions, ii) the adaptation of crabs to temperature and different oxygen partial pressures, iii) the phenotypic plasticity of crustacean hemocyanins to variation of physico-chemical conditions, and iv) the effect of pressure and oxygen concentrations on the mussel *B. azoricus*.



Figure 6: DESEARES (DEep-SEA RESpirometer) was used to perform *in vivo* experiments in simulated conditions on different hydrothermal species.

2.2.4 Stress response of hydrothermal shrimp species in relation to pressure and temperature variations

Previous *in vivo* experiments showed that the thermotolerance of adult hydrothermal shrimps was relatively low (Shillito et al. 2001, Ravaux et al. 2003), which seems paradoxical in this "extreme" ecosystem. Pressure conditions and the presence of toxic compounds in the habitat may influence the response to stress (Feder and Hoffman 1999). Studies on thermal stress response were continued by considering the role of pressure variations. Three species of shrimps (*R. exoculata*, *M. fortunata* and *C. chacei*) were collected with or without PERISCOP isobaric faunal sampler. Their physiological response (heat shock proteins) in relation to pressure and temperature variations will be compared. The activation and/or the transposition of certain elements of the genome in response to temperature and pressure variations will also be studied.

2.2.5 Genome size and transposable elements in hydrothermal species

The major objectives of this project were to study the variability of genome size in hydrothermal species and to characterise transposable elements in vent crustacean species. The size of the genome can be variable between related species or between populations of the same species. This variability could be correlated with the number of transposable elements found in their genome. The genome size will be estimated in several populations of different species (especially in four crustacean species) collected at

Rainbow, Lucky Strike and Menez Gwen. The copy number of some transposable elements, already characterised in the laboratory, will be estimated on the same sample. New transposable elements will also be characterized using DNA and RNA extractions done on board. Correlations between genome size and copy number of different transposable elements will be investigated. Moreover the study of transposable element activity (at the RNA level) and their abundance in the genome will help assessing the role of these elements in species adaptation to hypervariable environments such as hydrothermal vents.

2.2.6 Short-term and long-term experiments on *Bathymodiolus azoricus*

Three cages were moored at Menez Gwen and filled with mussels. These cages will be periodically recovered by the Arquipélago to carry out studies on live *B. azoricus* mussels throughout the year. Cd, Cu and Zn contamination experiments, feeding experiments with microalgae as well as physiological studies at seasonal scales are planned. The dissolution rate of mussel shells will be studied through experimental devices (resin blocks) attached to the cages. These experiments are partially conducted by Ph.D. students through the MoMARNET Marie Curie training network.

2.2.7 Trophic ecology of vent species

The goal of this project was to complement previous trophic studies by evaluating the carbon and energy flux in the vent food web (Colaço et al. 2002). Biological samples (*B. azoricus*, *S. mesatlantica*, *R. exoculata*, *M. fortunata*) were collected and preserved. Total carbon and calorimetric analyses of muscle tissues will be done.

The relative contribution of filter-feeding vs. endosymbiosis-derived food in the diet of *B. azoricus* will be evaluated by a biomarker approach. Fatty acid biomarkers of the two types of endosymbionts (methanotrophic and thiotrophic) will be identified through labelling with ^{13}C stable isotope and GC-IRMS analyses. Once the labelling is optimised, the natural abundance of the biomarkers will be evaluated in wild mussels. The identification of biomarkers will enable the study of *B. azoricus* nutritional plasticity, its response to seasonal events, as well as the differences observed between vent sites. Enrichment experiments ($\text{NaH}^{13}\text{CO}_3$) were done on-board to measure the turnover of incorporated ^{13}C in gills vs. remaining tissues. The results obtained will be used to identify the exact timing for biomarker search. Specific biomarkers for methanotrophic and thio-oxidising symbionts as well as for phytoplankton species chosen for the enrichment will be identified. The particles collected with the particle trap (2.1.4) will be analysed to identify the resources available to the mussels.

2.2.8 Bone structure and gene expression in deep-sea fish

Bone can adapt to reduced pressures (e.g. reduced air pressure during space flight) by modifying its metabolism, pattern of gene expression and structure. What would

happen at high pressures? Deep-sea fish reach depths of several thousand meters where they encounter extremely high pressures. They are therefore a good model to study the adaptation of bone to increased pressure. The objective of the DeepBone project within the MoMARETO cruise was to collect deep-sea fish in order to compare their bony structure and mineralization-related gene expression with those of surface fish. Two different strategies were used to capture fish specimens around hydrothermal vents: baited traps and suction sampler chasing. Despite numerous attempts, only three fish were collected during the cruise, all using the suction device and all from the same species: *Pachycara saldanhai*. One of these specimens, represents the biggest captured so far for this species (total length: 27.8 cm). Various bone tissues have been sampled and conditioned on board for future analysis (e.g. histology, *in situ* hybridization, gene expression, etc).

3. Conclusions and Perspectives

The first leg of MoMARETO cruise was a real success with 13 instrument prototypes tested, developed within the EXOCET/D European project for the study of deep-sea extreme habitats. These instruments for quantitative imaging, *in situ* measurements, faunal sampling and *in vivo* experiments will greatly improve our capacity to explore, observe and monitor these remote ecosystems. The second leg led to a detailed ecological study of Tour Eiffel mussel assemblages. Biological samples were collected on the three vent fields visited to feed genetic, physiological and ecotoxicological studies.

In addition to the acquisition of fundamental insights about the dynamics, functioning and adaptations of hydrothermal communities, the data acquired during this cruise, reinforced by past studies in the same area, constitute a fundamental basis for the establishment of a long-term observatory on the MoMAR zone.

Web sites related to the MoMARETO cruise

<http://www.ifremer.fr/MoMARETO>

<http://www.ifremer.fr/exocetd>

<http://www.ipgp.jussieu.fr/rech/lgm/MOMAR/>

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THE FIRST COLLABORATIVE CHINA-INTERNATIONAL CRUISES TO INVESTIGATE MID-OCEAN RIDGE HYDROTHERMAL VENTS

(31 August - 5 October 2005 and 23 November 2005 - 6 January 2006)
J. Lin¹ and C. Zhang²

The first around-the-globe marine geoscience expedition by a modern Chinese research ship was conducted in 2005 and early 2006. The 297-day expedition departed from Qingdao, China in April 2005 and returned to Qingdao in January 2006, traveling more than 40,000 nautical miles in the Pacific, Atlantic, and Indian Oceans. The expedition was organized and funded by the China Ocean Mineral Resources R & D Association (COMRA) and was carried out on its research ship R/V DaYangHiHao (meaning "Ocean #1", see Figure 1). The goal of this around-the-globe expedition was to survey and investigate regions of abundant manganese nodules and cobalt-rich ferromanganese crusts in the western and central Pacific Ocean, as well as to collect samples of hydrothermal deposits and to search for new hydrothermal vents along mid-ocean ridges in the eastern Pacific Ocean, the Atlantic Ocean, and the Indian

Ocean. This expedition also coincided with the celebration of China's first expedition to the Indian Ocean 600 years ago, in the Ming Dynasty, led by ocean explorer Zheng He.

R/V DaYangYiHao is a well-maintained modern research ship. It has a weight capacity of 5,600 tons, measures 105 meters in length, and is equipped with a ship dynamic positioning control system and a variety of geophysical, geological, and microbiological instruments. The ship has a cruising speed of 12 knots and a maximum occupancy of 75 persons, including 25 crew members and 50 spaces for shipboard technical support staff and science party.

Out of the six legs in the 2005-2006 around-the-globe expedition, two legs (cruise DY105-17A) were devoted to

¹Woods Hole Oceanographic Institution, USA; ²University of Georgia, USA



Figure 1: China's research ship R/V DaYangYiHao (Ocean #1), which is owned by China Ocean Mineral Resources D & D Association (COMRA). Photo courtesy of Mr. Huisheng Lu, Captain of R/V DaYangYiHao.

COMRA's cooperative projects with international institutions. The first was a China-US cooperative leg that took place during 31 August – 5 October 2005 to investigate hydrothermal vents on the East Pacific Rise (EPR). The second was a China-US-Germany cooperative leg that took place during 23 November 2005 - 6 January 2006 to investigate hydrothermal vent processes of the Southwest Indian Ridge and Central Indian Ridge. These two COMRA-international cooperative legs are briefly described in the following sections.

1. East Pacific Rise leg (31 August – 5 October 2005; Acapulco, Mexico, to Kingston, Jamaica)

The EPR leg was a joint cruise between COMRA and the Woods Hole Oceanographic Institution (WHOI). The Chinese Chief Scientist of the cruise was Mr. Shiqin Guo, COMRA's Chief Geologist. The US Chief Scientist of the cruise was Dr. Jian Lin, a senior scientist and a geophysicist at WHOI. Dr. John Chen, InterRidge-China Chair and a professor from Peking University, and Dr. Chuanlun Zhang, a geo-microbiologist from the University of Georgia, also participated in the cruise.

The EPR leg successfully collected samples of hydrothermal deposits near the EPR 13°N region using Chinese built TV-guided grabbers, including recovery of a well-preserved piece of relic hydrothermal-vent chimney, which has hosted tubeworms and contains valuable macro- and micro-biological records. A significant accomplishment of the leg was the discovery, for the first time, of strong evidence for active water column plumes on the EPR immediately south of the equator. This discovery was made during a comprehensive water column survey program using six MAPR (Miniature Autonomous Plume Recorder) instruments on loan to WHOI from Dr. Ed Baker of NOAA/PMEL. A

WHOI built deep-tow magnetometer was also used in the cruise surveys.

After the completion of the EPR leg, the ship sailed through the Panama Canal and arrived in Kingston, Jamaica, where an open house of the ship was held for government officials and the public of Jamaica, as well as for foreign diplomatic delegations based in Jamaica. The ship captain, Mr. Huisheng Lu, and the cruise science party also visited the headquarters of the International Seabed Authority in Kingston, Jamaica, and were warmly received by Mr. Satya Nandan, the Secretary General of the International Seabed Authority and his staff members.

2. Indian Ocean Leg (23 November 2005 – 6 January 2006; Capetown, South Africa, to Singapore)

The Indian Ocean leg was a China-US-Germany cooperative cruise. Mr. Shiqin Guo of COMRA was the Chinese Chief Scientist, while Dr. Jian Lin was the US Chief Scientist. Dr. Erwin Suess and Dr. Sven Petersen of IFM-GEOMAR were the participating German scientists. They led a pioneering program with Dr. Xiqiu Han of the Second Institute of Oceanography in Hangzhou to continuously record methane anomalies in the water columns using the METS instrument.

The Indian Ocean leg conducted comprehensive survey of water columns along the Southwest Indian Ridge (SWIR), which is of ultraslow spreading rate, and the Central Indian Ridge (CIR), which is of intermediate spreading rate. Along the CIR, the cruise surveyed and imaged the Kairei and Edmond hydrothermal vent sites and collected hydrothermal deposit samples. A survey program was also conducted along the CIR between the Kairei and the Edmond hydrothermal vent sites to measure water column anomalies using the MAPRs sensors and the METS instrument. Deep-tow magnetometer was also used in the cruise surveys.

Along the Southwest Indian Ridge, the cruise discovered, for the first time, a region of major hydrothermal plume anomalies on a ridge segment west of the Gallieni Fracture Zone. The measured turbidity anomalies by the MAPRs instruments were by far the strongest known anomalies along the SWIR. COMRA is currently planning another cooperative cruise returning to the SWIR in February-March 2007 to further investigate hydrothermal vent processes. The planned Feb-March 2007 cruise will use COMRA's new remotely operative vehicle (ROV) and potentially WHOI's autonomous underwater vehicle ABE.

Results of the above COMRA-international cooperative cruises were reported at the mid-ocean ridge special sessions at the July 2006 Western Pacific Geophysical Meeting organized by the American Geophysical Union (AGU) in Beijing, as well as will be presented at AGU's fall annual meeting in December 2006 in San Francisco, California.

INTERRIDGE AND THE SCIENTIFIC COMMITTEE ON OCEANIC RESEARCH

E. Urban

The Scientific Committee on Oceanic Research (SCOR) has been encouraging international cooperation in, and advancement of, ocean sciences since it was established by the International Council of Science in 1957. Thirty-five nations provide Nominated Members to international SCOR, which conducts its work through a variety of mechanisms.

Sponsorship of large-scale ocean research projects

SCOR sponsors five large-scale ocean research projects:

1. the Global Ocean Ecosystem Dynamics (GLOBEC) project (with the International Geosphere-Biosphere Programme [IGBP] and the Intergovernmental Oceanographic Commission [IOC]),
2. the Global Ecology and Oceanography of Harmful Algal Blooms (GEOHAB) project (with IOC),
3. the Surface Ocean – Lower Atmosphere Flux Study (SOLAS: with IGBP, the World Climate Research Programme and the Commission on Atmospheric Chemistry and Global Pollution),
4. the Integrated Marine Biogeochemistry and Ecosystem Research (IMBER) project (with IGBP),
5. and the GEOTRACES project.

The most recently established of these projects is GEOTRACES, which is an international study of the global marine biogeochemical cycles of trace elements and their isotopes. It includes studies of hydrothermal systems in terms of their input and removal of trace elements and their isotopes (see www.geotraces.org) and thus is an area of potential cooperation between SCOR and InterRidge. Toshitaka Gamo and Chris German from the InterRidge community participated on the GEOTRACES Planning Committee that produced the GEOTRACES Science Plan.

Sponsorship of working groups

The purpose of a SCOR working group may be to synthesize the state of an area of science, make recommendations about research priorities, conduct method development, and/or conduct intercalibration exercises. Presently, SCOR does not have any working groups related to ridge processes, but sponsored three previous groups related to InterRidge, which produced two documents:

- Holm, N.G. 1992. *Marine Hydrothermal Systems and the Origin of Life*. Kluwer Academic Publishers, Dordrecht, The Netherlands. (from WG 91 on Chemical Evolution and Origin of Life in Marine Hydrothermal Systems)
- Parson, L.M. and M. Sinha. 1997. *Linked Mass and Energy Fluxes at Ridge Crests and BRIDGE Research Results*. Southampton Oceanography Centre Report No. 3. (from WG 99 on Linked Mass and Energy Fluxes at Ridge Crests)

SCOR accepts working group proposals from many sources

and some groups are conducted in cooperation with other organizations or research projects. SCOR is seeking new working groups on geological topics, so would be open to proposals on topics of interest to InterRidge. Information about working groups and how to propose them can be found at <http://www.jhu.edu/scor/WGs.htm>.

Project affiliations

Recognizing that some important ocean science activities are conducted by projects not involved with SCOR and that SCOR could provide a service to the international ocean science community by encouraging such projects, SCOR created a mechanism for project affiliations in 1995. Currently, five projects—InterRidge, the Census of Marine Life (CoML), International Antarctic Zone Program (iAnZone), International Marine Global Change Study (IMAGES), and International Ocean Colour Co-ordinating Group (IOCCG) – are affiliated with SCOR. InterRidge has been affiliated with SCOR since 1996. InterRidge has been represented at three of the past four SCOR annual meetings. Agnieszka Adamczewska gave an extended presentation of InterRidge's achievements and plans at the 2002 SCOR General Meeting in Sapporo, Japan. Meeting participants were impressed by the quality and scope of InterRidge activities. Colin Devey attended the 2004 and 2005 SCOR meetings, most recently representing the German SCOR committee as well as InterRidge.

SCOR does not provide financial support to affiliated projects, but affiliation may increase a project's international visibility and access to scientists in SCOR member nations, as well as providing the benefit of SCOR advice on project committees and activities. Each affiliated project is reviewed for continued affiliation at each SCOR General Meeting. SCOR has also provided opportunities for chairs of affiliated projects to meet with other projects to discuss common opportunities and challenges (see <http://www.jhu.edu/scor/ProjCoord.htm>). Affiliated projects can apply to SCOR for funds to help developing country scientists attend their scientific meetings; SCOR provided support for one individual to attend the InterRidge Theoretical Institute on Back-arc Spreading Systems in South Korea in 2004.

Information about all SCOR activities can be found on the SCOR Web site at www.jhu.edu/scor or by contacting Ed Urban, SCOR Executive Director, at Ed.Urban@jhu.edu.

ChEss – A CENSUS OF MARINE LIFE PROJECT

POLAR FIELD PROGRAMME

M. Baker¹, E. Ramirez-Llodra², P. Tyler¹, C. German³

ChEss (www.noc.soton.ac.uk/chess) is one of the 14 field projects of the Census of Marine Life (CoML, www.coml.org) initiative. The CoML is a global network of scientists from over 70 nations investigating life in the oceans, past, present and future. ChEss focuses upon deep-water chemosynthetic ecosystems, aiming at describing the biogeography of deep-water chemosynthetic ecosystems and the processes driving them. ChEss has 3 main components: 1- ChEssBase, a web-based database; 2- Long-term field projects and 3- Outreach & Education.

The key science questions posed by ChEss scientists are: 1- What are the species phylogenetic relationships amongst different chemosynthetic habitats? 2- What is the role of deep-water circulation (i.e. N Atlantic Deep-Water or Circumpolar Circulation) and geological barriers in gene flow? 3- What are the environmental factors driving patterns of biodiversity in reducing habitats? In an attempt to answer these questions, the ChEss Scientific Steering Committee has selected priority areas for the field programme: A- Equatorial Atlantic Belt region: cold seeps off Costa Rica and the Gulf of Mexico, Cayman Trough spreading centre, Barbados accretionary prism, continental margin off NE Brazil, MAR north and south of the equatorial Fracture Zones and the West African continental margin; B- SE Pacific region: Chile Triple Junction, Chile trench, OMZ region on Chilean margin and coincident whale migration and wood-fall areas; C- New Zealand region: vents on Kermadec Arc, seeps north and south of NZ, high concentrations of whale populations in Kaikoro Canyon and extensive sunken wood in South fjords; D- Polar regions: vents along the Gakkel Ridge (beneath the ice-covered surface waters) and (ultra-)slow ridges of the Norwegian-Greenland Sea (Arctic); Scotia Arc, Bransfield Strait and Antarctic margin. The most recent addition to these sites is the Polar Regions; important pieces of the global biogeographic puzzle. ChEss will begin their polar field programme in the Antarctic with the ChEsSo project.

ChEsSo (**C**hemosynthetic **E**cosystems in the **S**outhern **O**cean): ChEsSo is a new UK-led NERC-funded Consortium Project, led by Prof. Paul Tyler (NOCS) for the exploration and investigation of chemosynthetic habitats in the Antarctic region south of the Polar Front. Detailed investigation and analysis will be conducted of four contrasting types of chemosynthetically-driven communities, together with their regional tectonic setting, and the specific hydrothermal vent and cold seep environments they inhabit. The communities chosen for the investigation comprise: those associated

with high temperature, bare rock hydrothermal vents on the East Scotia Ridge, high temperature, sediment-hosted hydrothermal activity (Bransfield Strait), mud volcanoes (South Sandwich forearc basin) and methane hydrates (north of King George Island). To achieve these aims, the plan is to have three cruises, one of which is geophysical and geochemical, whilst the other two will use the UK ROV ISIS. Subsequent analysis of geological, chemical and biological (both microbial and metazoan) samples will allow comparison of vent and seep communities among the four sites. Morphological, molecular, lipid and stable isotope analyses will be used to determine the phylogeography of species, and understand their food web processes. In concert, this programme will determine whether colonization of vents and seeps, in these distant chemosynthetically-driven ecosystems, is driven by oceanographic or geologic processes or, instead, whether any site has hosted completely isolated evolution. Is there a Southern Ocean "gateway" in existence that enables gene-flow of chemosynthetic fauna from the Southern Pacific Ocean to the South Atlantic Ocean? This multidisciplinary programme will start in April 2008, for 4 years, with cruises planned for 2009 and 2010.

A multidisciplinary National Science Foundation and NASA Astrobiology funded programme will take place in the Spring of 2007 to investigate hydrothermal processes and the biogeography and ecology of chemosynthetic fauna on the Gakkel Ridge. This International Polar Year-sponsored biological research programme led by Dr. Tim Shank (WHOI), will utilize novel methods of autonomous vent discovery and remote seafloor sampling technologies. The AMORE cruise in 2001 detected plume signals considered to be associated with nine vent sites, estimated to be located to within ~2-5 km (Edmonds et al., *Nature*, 2003), separated from the Mid-Atlantic Ridge for ~25 million years. The present isolation of the Arctic Ocean and its separation from all other ridge systems raises fundamental questions about the evolution and ecology of Arctic vent fauna. The aim of this planned project is to locate and sample these sites through phased survey strategies using the newly-designed AUVs Jaguar and Puma in order to determine how these potentially unique ecosystems may have evolved in isolation and how they relate to chemosynthetic fauna in known biogeographic regions. The technological development of the AUV component of the field programme is being used as an analogue for autonomous extra-terrestrial sample return for future missions to Europa. A new towed fiber-optic real-time imaging and discrete seafloor sampling

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system has also been constructed to facilitate taxonomic and molecular characterization of the faunal diversity within the Arctic Ocean and assess the historical migratory pathways utilized by these vent species.

ChEss co-funded the recent Polar Ridges Meeting and Workshop, held in Sestri Levante in September 2006 with the aim to strengthen links between geological and biological research in these regions.

THE GENERAL BATHYMETRIC CHART OF THE OCEANS (GEBCO)

B. Whitmarsh¹

GEBCO is a project that is open to all those interested in mapping the ocean floor. It relies largely on the voluntary efforts of an international collaborating community of scientists and hydrographers. GEBCO is officially a joint project of the Intergovernmental Oceanographic Commission (IOC) of UNESCO and the International Hydrographic Organization (IHO).

The aims of GEBCO

The aims of GEBCO are to:

- 1) Develop and constantly improve the authoritative description of the global ocean floor by producing maps and data sets whose quality is known,
- 2) Act as the designated international authority for undersea feature names,
- 3) Advance the development and application of sea floor mapping technology,
- 4) Encourage and facilitate scientific cooperation and the exchange and preservation of bathymetric data and associated metadata,
- 5) Foster collaboration among individuals and organizations with established and developing expertise, assisting local and regional mapping efforts to attain a global standard of quality,
- 6) Identify oceanic areas that are insufficiently surveyed and recommend to surveying and/or ocean-going organizations and institutions that such areas are mapped,
- 7) Promote education and training in ocean mapping,
- 8) Bring together producers and users of bathymetry, enabling the production of maps and grids more widely useful in science and education.

GEBCO's products and activities

GEBCO has a number of products which are widely used within the oceanographic community. The principal product is the GEBCO Digital Atlas, the current version of which was published in GEBCO's Centenary Year (2003). The GEBCO Digital Atlas - Centenary Edition (GDA-CE) contains a 1-minute global bathymetric grid, digitized contours, the GEBCO gazetteer of undersea feature names, coastline databases and a software interface. The interface allows the user to customise the displayed bathymetry and to access functions that, for example, display bathymetric

profiles and compute track lengths. The GDA software interface also allows the user to export the data in the form of a simple ASCII file. Version 2.0 of the GDA-CE Software Interface is now (September 2006) available. This latest release contains new features including the option to display your own file(s) of data points on the GEBCO data sets. The GDA-CE is available as a two-volume CD-ROM set and can be purchased from http://www.bodc.ac.uk/products/bodc_products/gebco/. The 1 arc-minute grid has recently been made freely available and can be downloaded from http://www.bodc.ac.uk/data/online_delivery/gebco/. This source provides only the basic grid in a simple file format (netCDF) readable by GMT and many commercial or free-ware graphics or GIS packages. The user has the option to download either the complete global grid file or just the data for a user-defined geographic area.

Another product that should appear towards the end of 2006 is a new world map based on the GDA-CE grid. This will be on a single sheet and will show ocean bathymetry and satellite images of the land surface. This product will be available for download and can therefore be printed at any size; however, the layout of feature names was optimized for display at approximately 1:35 million scale, that is, poster sized. Watch www.gebco.net for an announcement.

GEBCO's Sub-Committee on Undersea Feature Names (SCUFN) aims to define the nomenclature used to describe undersea features, to provide guidelines on naming and to consider and decide on names which have been submitted to the Sub-Committee. It arose from the need for a uniform policy for the handling of geographical names and for the standardization of undersea feature names so as to achieve consistent naming on bathymetric maps and nautical charts. Existing named features are listed in a Gazetteer which can be downloaded from <http://www.ngdc.noaa.gov/mgg/gebco/underseafeatures.html> and proposals for new names can be submitted electronically via <http://www.ngdc.noaa.gov/mgg/gebco/scufn/index.html>.

GEBCO is also active in training a new generation of ocean bathymetrists. Since 2004, with the financial support of the Nippon Foundation, GEBCO has been running a

¹GEBCO Permanent Secretary, National Oceanography Centre, Southampton, United Kingdom

one-year course leading to a Postgraduate Certificate in Ocean Bathymetry at the Center for Coastal and Ocean Mapping/Joint Hydrographic Center in the University of New Hampshire, USA. On average six students a year, mostly from less economically developed countries, have taken the course. The program is already broadening the worldwide network of people active in ocean bathymetry. Anyone interested in learning more about this course should contact Dave Monahan, the Project Manager, at monahand@ccom.unh.edu.

GEBCO welcomes new contributions

GEBCO can only advance and generate better products if it has access to new datasets and expertise. GEBCO does not and cannot, with the resources available to it, conduct bathymetric surveys at sea. Therefore it is entirely dependent on contributed datasets, or on datasets being put into the public domain by being submitted to a national or international data centre, such as the IHO's Data Center for Digital Bathymetry in Boulder, Colorado, USA. Mid-

ocean ridge investigators have collected many detailed multibeam surveys and GEBCO products would be improved if these were incorporated. Data values averaged to approximately 1 km resolution would be sufficient for inclusion into GEBCO's global grid now; however, because in future GEBCO may seek a finer resolution grid, it would also encourage investigators to make entire, full-resolution data sets public once the primary research objectives of the survey have been met. Anyone interested in discussing how to participate in GEBCO through sharing their data should contact Colin Jacobs, the GEBCO Bathymetric Editor, at clj@noc.soton.ac.uk. Experts in database management, cartographic software and the like are also encouraged to offer their expertise and assistance.

Further information

Further information about GEBCO and its activities can be obtained by visiting the GEBCO web site (www.gebco.net) or by contacting GEBCO's Permanent Secretary, Bob Whitmarsh, at rbw@noc.soton.ac.uk.

EDUCATION AND OUTREACH

INTERRIDGE E&O UPDATE

K. M. Kusek

It has been a great pleasure to have the opportunity to jumpstart IR's education outreach program under the chairmanship of Colin Devey. I want to thank Colin for recognizing the value of outreach for IR from the beginning, for trusting me to develop a program that works for IR, and for constantly supporting me no holds barred along the way. Colin's open mind, encouraging manner and more-often-than-not sharp wit make him a fun leader and great colleague, and I treasure the many lessons I have learned from him. The many challenges inherent in spearheading outreach for an international organization are far outnumbered by the rewards of finding creative ways to effectively share the excitement of deep ocean research with the greater public. I feel lucky to have a job for which I hold such great passion. I look forward to continuing our outreach program next year at Woods Hole, and thank you for your continued support. --Kristen

E&O UPDATE

Please contact Kristen Kusek for more information on any of the following (kristenkusek@aol.com).

SCIENCE OUTREACH

Oceanography magazine

InterRidge is sponsoring an entire ridge-focused issue of Oceanography magazine that will be published in March 2007 (www.tos.org). Sponsors include IR, NSF, NOAA,

ChEss, and DeRidge. The issue will feature a spate of ridge-related research topics led by IR's international suite of researchers, including: Mid ocean ridge ecosystems, Biogeography, Mineralization and fluid chemistry, Deep Earth sampling, Mantle flow and magma production, Slow and ultraslow spreading ridges, Hot spot interactions, Back-arc spreading systems, Monitoring and observatories, Vent research technology, Policy issues, Education outreach, Origin of Life and a special feature in honor of the 30th anniversary of vent discovery.

MEDIA AND PUBLIC OUTREACH

AAAS and ESOF

IR participated in two major international press outreach events in 2006: the annual meeting of the American Association for the Advancement of Science (AAAS) in St. Louis, MO, USA (February), and the EuroScience Open Forum (ESOF) in Munich, Germany (July).

The speakers for the 90-minute scientific session for AAAS were: Edward Baker, Chuck Fisher, Steve Scott and Colin Devey. AAAS attracted at least 5,000 scientists, 1,500 on family science day, and roughly 1,000 journalists.

ESOF included a press conference, 2.5-hour scientific session, showing of the IMAX film "Volcanoes of the Deep Sea" (followed by Q&A session), and a week-long educa-

tion outreach exhibit held in conjunction with Germany's national science week. ESOF speakers included: Edward Baker, Chuck Fisher, Antje Boëtius, Chris German, Steve Scott and Colin Devey. Outreach leaders included: Kusek, Gretchen Früh-Green, Monika Bright and Liz Goehring (Ridge 2000). Thanks to all for your active participation in making the event a huge success. ESOF involved more than 2,100 participants from 58 countries, including 485 journalists.

Each of these media outreach events was a success that resulted in a spate of interviews for the panelists and news articles featuring ridge research. While it is challenging to keep track of all of the stories generated by press events as large as AAAS and ESOF, our panelists were interviewed by reporters from media as diverse as Science News, Der Spiegel (Germany), Chemistry World (UK), Marine Technology Reporter, San Diego Union Tribune, Ottawa Citizen, Hannoversche Allgemeine, Natural History magazine, Discovery Channel, a Swedish magazine for children, and many more. Here is a link to the Science News article called "Venting Concerns" that resulted directly from the ESOF session.

<http://www.sciencenews.org/articles/20061007/bob7.asp>

A particularly memorable moment at ESOF was when Chuck Fisher was also chosen as one of four speakers from the entire ESOF meeting to be interviewed publicly in a special public science event by BBC radio broadcaster Quentin Cooper. To be chosen for such an event, one needs the ability to speak well publicly, to not embarrass easily, and to have a sharp sense of humor (Chuck's discussion of gut-less, buttless vent worms did the trick!).



Thanks for Gretchen Früh-Green, our InterRidge outreach booth at ESOF included remote-controlled submarines – a big hit with kids of all ages.



ESOF Outreach Team (missing from photo: Monika Bright) (G. Früh-Green, K. Kusek, L. Goehring)



InterRidge Press Conference (S. Scott, C. German, E. Baker, C. Fisher)

Science Writer-at-Sea

Since our successful pilot test of the Science Writer-at-Sea program (<http://www.interridge.org/sciencewriteratsea/Norway2005/index.html>) last summer, we have formed key partnerships with ASTC (Association of Science-Technology Centers), Natural History magazine (US), PM magazine (Germany), and five US-based science journalism graduate programs. ASTC is comprised of 540 museums from 40 countries. Science Writer-at-Sea is a training and outreach program that targets two significant links in the science communication pipeline: the world's future storytellers – graduate-level journalism students – and marine scientists. The basic goals are three-fold: (1) Provide a practical, yet inspiring science journalism 'boot camp' for student writers placed at sea, in labs and in the field, (2) Accomplish education outreach objectives for scientists in a cost-effective way encouraging open dialogue between scientists and journalists; and (3) Boost public understanding of the ocean via the main product: compelling multimedia 'story packages' generated by the immersive experience and featured in a number of national and international museums, magazines, and other websites. With our new partners, the stories generated through Science Writer-at-Sea have the potential to literally reach millions of viewers.

We recently submitted a grant to the NOAA Ocean Explo-

ration program, and are actively pursuing other funding opportunities so that the program continues to grow. Should the funding come through, we will offer three immersive training internships in 2007, including a cruise slated for March-April 2007 under the leadership of Roger Searle (University of Durham, UK). Searle's cruise will be the first for the new British research vessel, the RMS James Cook, and will journey to the Mid-Atlantic Ridge (14-16°N). In addition to the Writer-at-Sea experiences, we will host a 2-day workshop at the end of '07 involving our major partners to more specifically plan the way forward.

Since our pilot test, Kusek has presented the program at AGU (2005), and published two relevant articles: one in the UK publication Teaching Earth Sciences, the other in Current: The Journal of Marine Education. She will pres-

ent the program at the upcoming GSA meeting in Phila, PA as well (October 23, 2006). If you would like more information about the details of the NOAA proposal – or the plans for the future of the program in general – please contact Kristen.

COMING SOON...

InterRidge is excited to have been asked by ChEss (Census of Marine Life) to assist in a meeting to be held in the Galapagos (June 2007) to honor the 30th anniversary of vent discovery. IR will assist in media outreach and general design of the public outreach part of the program.

RIDGE SCIENCE OUTREACH EFFORTS ARE ONGOING IN INDIA

C. Subrahmanyam

Keeping the flame alive

PEOPLE IGNA, association of twin cities' returnees from Germany, celebrates its 20th anniversary



REVELRY ON RETURN Hyderabadis Twenty years of good times being relived PHOTO: P.V. SIVAKUMAR

Talk of Hyderabad Diaspora and you can find the confident lot settled across professions, in Osaka, Perth, London, Chicago and Singapore alike. While some decide to make the foreign lands their home, others prefer to return for the cuppa Irani chai, Osmania biscuit and dum biryani. And a few decide to form associations on their return to the Pearl City, in order to keep the ties with the foreign land going. One such association is the Indo-German Nachkontakt As-

sociation (IGNA), comprising Hyderabadis who have returned from Germany, after having stayed as students, scientists, businessmen and so on. The organisation celebrated its 20 years of inception last week. Attended by an elite mix of Indian and German dignitaries and members of the association, the do at Minerva Grand had people talking about cuisine, wine, weather, places and rest of things related to Germany. "This is a returnees association and we have over 160

members. To be a member a person must have stayed in Germany over three months. This is an unregistered body. We meet together often and organise popular talk annually as part of the celebrations. We also help students go to Germany, providing guidance on universities and scholarships since the association is in touch with the colleges there. Also we are linked with other organisations such as DAAD, the German Academic Exchange Service, and Max Mueller Bhavan," says M.M.

Dixit, president of IGNA. The recent celebrations that spread over two days kicked off with a cultural evening featuring a Kuchipudi recital by students of Pallavi Academy of Fine Arts, followed by popular lectures and the screening of Voyage into the Abyss aboard Khairunnisa boat on Hussain Sagar. But there is more to the cultural offerings on the anvil from Berlin. "We will be working with Hyderabad closely. We are definitely going to bring in music

concerts and exhibitions to the twin cities. Hyderabad Film Club has recently had a German film screening and we have some films in the International Children's Film Festival this year as well," says Gabriele. M. Landwehr, director Goethe-Institut Max Mueller Bhavan, Chennai who was here for the IGNA event. Talk of maintaining ties and the folks here, otherwise considered laid back in the nawabi style, are still the best, the event showcased. SYEDA FARIDA

Figure 1: Newspaper clipping from "The Hindu" (15 November 2005) In left picture: Consul, office of the Consulate General of Germany Chennai, India (on left) and the Executive Director of the Goethe German Language Zentrum in Hyderabad (on right).

Ridge science outreach efforts are ongoing in India. On 12 November 2005, the DVD "Voyage into the Abyss", endorsed by InterRidge and produced by Future Vision, was screened at the Indo-German Nachkontakt Association's (IGNA) 20th anniversary celebration in Hyderabad. It complemented numerous other activities that took place

during a cultural evening. This successful celebration received positive media coverage (Figure 1).

IGNA comprises more than 160 members who are Hyderabadis that spent more than 3 months in Germany as students, business people or scientists.

¹(Emeritus Scientist) NGRI, Hyderabad, India

NATIONAL NEWS



AUSTRIA

M. Bright



A joint American-Austrian cruise to the newly erupted vent site 9°50'N at the East Pacific Rise will take place in October/November 2006. For the first time, Austrian scientists lead by Monika Bright will financially contribute to an oceanographic cruise using R/V Atlantis and DSV Alvin by fundings of the Austrian Science Foundation.

The Austrian team will continue to study the giant tubeworm symbiosis. In detail, we aim to investigate the infection process, growth, and developmental processes in *Riftia pachyptila* as well as cell kinetics in symbiont-containing and symbiont-free host tissue. Cruise activities will include the recovery and re-deployments of tubeworm settlement devices to collect tubeworms. In addition we will study the

present status of the meiobenthic community (small animals between 63 microns and 1 mm) shortly past eruption and to follow the succession of colonization and development of communities. Cruise activities include collection of meiofauna from different natural substrates, from the water column at various heights above the bottom, and from off-axis sediments. Additionally, meiofauna settlement devices will be deployed and recovered.

Also the Austrian-wide educational outreach program 'extreme 4 kids' will take place during the cruise. Children between 6 and 16 years will be able to participate in a wide range of activities (www.hydrothermalvent.com).



CANADA

S. Scott



Funding for CanRidge denied

My request to the Natural Sciences and Engineering Research Council of Canada's (NSERC) "Major Facilities Access" (MFA) program for the \$US5,000 fee as an InterRidge Associate Member plus some travel expenses was rejected in March. Canada therefore is now just a Corresponding Member of InterRidge. MFA is the only program that comes even close to being relevant for such an application. The panel gave many reasons why my proposal should be supported but questioned whether a membership fee was a legitimate use of MFA funds. The MFA

program provides money to do science such as the 3-year \$C1,050,000 grant I hold to subsidize Canadian users of the remotely operated vehicle ROPOS (see further, below), but not to talk about science. I was advised to seek the funds from an existing marine program but have been told that their funding priorities do not include memberships. Canada's major funding agency, NSERC, does not have a mechanism for supporting membership in any international scientific organizations such as InterRidge that do not do science themselves but only coordinate science. I have discussed this problem at length with senior NSERC

personnel. They are certainly aware of the problem and NSERC will convene a meeting of its council to discuss its policy on international commitments.

NEPTUNE Canada

The Canadian NEPTUNE cabled observatory <www.neptunecanada.ca> on the Juan de Fuca Plate is progressing according to plan. To date the project has received \$31.9 million (Canadian) from the Canadian Foundation for innovation and \$30.5 million from the British Columbia Knowledge Development Fund (total \$62.4 million). There is a shortfall of \$20 million if all objectives are to be met and NEPTUNE is making progress in securing these additional monies. Contracts have been let for surveying the first cable routes, laying cable and building nodes. The first scientific proposals have been adjudicated and funds awarded. The first phase of the live system is expected to be "wet" in 2007. Our American partners who are responsible for the southern portion of the network are still awaiting a funding decision.

ROPOS

The Canadian remotely operated vehicle, ROPOS, operated by the Canadian Scientific Submersible Facility (CSSF) as a not-for-profit enterprise, has undergone a major modification program. To the current shallow live-boating mode (1000m depth) and deep water mode (to 5000m) utilizing a cage to transport the ROV up and down in the water column has been added an intermediate depth (2500m) mode. The new system does away with the cumbersome cage, huge winch and need for a very robust A-frame. Instead, launch and recovery is with a special crane and uses a much lighter winch. The reduction in foot print and weight means that ROPOS can operate off many more ships. It can also operate in worse weather conditions than previously. Field trials of the new system went flawlessly. Additional recent improvements include larger capacity fibre optic data transmission, better navigation and a new manipulator. ROPOS recently completed a best-ever 52 hour continuous dive with this new system. The upgrade was funded by a grant from the Canadian Foundation for Innovation matched by the British Columbia Knowledge Development Fund. The next phase of the upgrade is a ship-to-shore video conferencing and Internet link by satellite. CSSF will be cost-sharing the operation of the new communication system with NEPTUNE Canada during the installation of NEPTUNE instruments in 2007 and 2008.

GAC-MAC 2007

The joint annual meeting of Geological Association of Canada – Mineralogical Association of Canada to be held May 23-25, 2007 north of 60° latitude in Yellowknife, Northwest Territories, will feature a session on "Submarine volcanism and associated mineralization: modern vs. ancient". Further information is available at <www.nwtgeoscience.ca/Yellowknife2007>.

ECOR

I have been appointed Vice President of the Engineering Committee on Ocean Resources and chair its Specialist Panel on Marine Mining. ECOR's aims are:

* To provide a forum for the exchange of information and views on engineering matters relating to the exploration and exploitation of ocean resources, through publications, meetings and website.

* To promote, initiate and co-ordinate study, research and development into the exploration and exploitation of ocean resources, through ECOR standing Specialist Panels and ad hoc Working Groups. The current Specialist Panels, each having a 3-year lifetime, are Fisheries, Marine Renewable Energy, Underwater Vehicles, Underwater Monitoring, Marine Mining, and Marine Archeology. The only working group at present is Ocean Sequestration of Carbon.

* To advise government and intergovernmental organisations on engineering matters relating to the exploration and exploitation of ocean resources.

ECOR held a one-day symposium on March 23 in conjunction with the Ocean International 2006 (OI06) mega-show and conference (7000 attendees and 300 exhibitors) in the Excel Centre, Docklands, London, UK at which the 6 specialist panels and the working group made presentations.

Marine Mining

The ECOR Specialist Panels of most relevance to InterRidge are Marine Mining and Underwater Vehicles. A subset of the Marine Mining specialist panel has produced a 13-page report entitled "Mineral deposits in the sea: a future resource". It covers the current situation and future prospects for mining phosphorites, manganese nodules, crusts and sulfides. The authorship is Steve Scott (University of Toronto, Canada), M.A. Atmanand (National Institute of Ocean Technology, India), James Hein (United States Geological Survey, USA), David Heydon (Nautilus Minerals, Canada) and Charles Morgan (Planning Solutions, USA). The report, as well as that from the Underwater Vehicles panel, is available at the ECOR web site <www.rina.org/ecor>. A subsequent report on marine mining with a different authorship of experts will cover diamonds, heavy minerals including gold, and aggregates.

Nautilus Minerals <www.nautilusminerals.com>, a Vancouver based company, started trading on the Toronto Ventures Exchange on May 10. The company has an exploration license covering a large area of the Manus Basin offshore eastern Papua New Guinea. It has recently completed a 3-leg assessment program of their Suzette site (now named Solwara-1 Project) in the eastern Manus with farm-in partner Placer Dome Oceania (since taken over by Barrick Gold Corporation of Toronto, now the largest gold mining company in the world). The first assessment leg in 2005 mapped in detail using geological and geophysical techniques the several deposits, including Suzette (Solwara-1), on and around SuSu Knolls that had originally been discovered and explored for research

purposes in the mid-1990s by Ray Binns of CSIRO and Steve Scott of the University of Toronto. A drilling leg followed in January-February 2006 conducted by UK-based Seacore (recently taken over by Fugro) using their proprietary equipment on board the ship D.P. Hunter. An ROV operated by Canyon Offshore made >65 dives to guide the drilling and to conduct other sampling. A total of 32 holes were drilled at Suzette to assess the thickness and grade of the deposits and a 15 tonne bulk sample was taken to test the mineral processing and metallurgy. Bulk sampling was done with a cutting head attached to the ROV that might serve as a prototype for an eventual mining machine, if the deposits prove to be economic and the PNG government issues a mining license. The third leg was a Woods Hole Oceanographic Institution-led expedition involving Nautilus that did detailed mapping and sampling in the eastern and central Manus Basins this past summer. Details are in the Nautilus web site as are the company's plans for a 191m ship.

Another player in marine mining for sulfides, Neptune Minerals, also hired Seacore to drill their Brothers Seamount site in the Kermadec arc offshore North Island, New Zealand in December 2005. According to Neptune's web site <www.neptuneminerals.com>, there was "... no accumulation at or near the surface of commercial quantities of sulphide mineralisation in the areas drilled." Assay results are on their web site.

Environment will be an issue, as it is in all new mining operations on land. To that end, three biologists, a microbiologist from Toronto and macrobiologists from Australia and USA, were invited onboard for the drilling at Suzette to begin

the environmental assessment. A plus over land mining is the small footprint of disturbance. In a typical land mine, many more tonnes of waste rock than ore have to be removed. Universally accepted environmental protocols do not yet exist, although the International Marine Minerals Society has produced on its web site <www.immsoc.org> a voluntary "Code for Environmental Management of Marine Mining" and the UN's International Seabed Authority is preparing regulations to control the environmental impact of deep sea mining in international waters. It is anticipated that the UN regulations will be adopted by nations in whose waters mining might take place.

As the ECOR paper concludes, "We are probably witnessing the dawning of an industry for deep-sea mining of base and precious metal sulfides Obstacles to overcome, besides technical and financial, are national and UN regulations governing marine exploration and mining activities, and the public perception that such activities might be unacceptably harmful to the environment."

Movements

Kim Juniper, my predecessor on InterRidge, has left the University of Quebec at Montreal for the University of Victoria where he occupies the BC Leadership Chair in Ocean Ecosystems and Global Change. Later this year, he will vacate his position as co-chief scientist of NEPTUNE Canada to take on the role of Special Science Projects Coordinator. I retired from the University of Toronto at the end of June but retain emeritus status and good research funding that will enable me to continue my work on seafloor hydrothermal deposits and their ancient analogues.



FRANCE

J. Dymant



Recent ridge activities in France have been mostly focused on the development of the MOMAR (MONitoring the Mid-Atlantic Ridge) project south of the Azores, although other areas have been investigated through individual dedicated cruises.

1) MOMAR activities

A major reward of the French effort in the MOMAR area is the discovery of a large axial magma chamber beneath the central part of the Lucky Strike segment, as a result of cruise SISMOMAR in summer 2005 [Singh et al., *Nature*, 2006]. This effort has continued in 2006 with three major cruises. Cruise GRAVILUCK, led by Valérie Ballu, took place in August 2006 onboard N/O "L'Atalante" with

deep-sea submersible "Nautile". The cruise aimed to start an ambitious program of deep-sea geodesy, together with gravity experiments, geological investigations, and physical oceanography measurements on the Lucky Strike segment (see web site <http://www.insu.cnrs.fr/web/article/rub.php?rub=411>). Cruise MOMARETO, led by Pierre Marie Sarradin, took place in August 2006 onboard the new N/O "Pourquoi Pas?" with ROV "Victor". Again, the Lucky Strike hydrothermal site was the main target of the cruise, which intended to develop biological experiments based on the devices built as part of the EU-funded EXOCET-D project (see web site <http://www.ifremer.fr/momareto/>). So in August 2006 two major French research vessels and the two French deep-sea submersibles met on hydrothermal site

Lucky Strike! Another experiment in the MOMAR area was cruise MARCHE led by Jean Goslin in April 2006 onboard N/O Le Suroît. This is the most recent of several cruises dedicated to the acquisition of earthquake epicenter locations in the Azores area through hydrophones moored in the SOFAR channel (see report, this issue).

In 2007, three cruises are scheduled to the MOMAR area. Cruise MARCHE 2 onboard N/O "Le Suroît" (P.I. Jean Goslin) will recover and possibly re-moor the hydrophones, in order to pursue monitoring of the seismicity around the Azores area. Conversely, cruise BB-OBS onboard N/O "Le Suroît" (P.I. Wayne Crawford) will moor new broadband Ocean Bottom Seismometers (OBS) of the French National OBS facility around the Azores. Cruise MOMAR-DREAM onboard N/O "Pourquoi Pas?" (P.I.s Jérôme Dymont and Françoise Gaill) will study the role of iron in the geological, hydrological, and biological processes at this hydrothermal site standing on a ultrabasic basement, systematically characterize the site to prepare for IODP drilling (P.I. Jérôme Dymont & Françoise Gaill). Because monitoring is a long term endeavour which requires revisiting the sites, various small cruises have been grouped to form a second MOMAR cruise onboard N/O "Pourquoi Pas?". This includes follow-ups of cruises carried out this year, namely short cruises GRAVILUCK 2 (P.I. Valérie Ballu) and RECO (P.I. Pierre-Marie Sarradin), which aim to recover experiments left on the seafloor during cruises GRAVILUCK and MOMARETO in 2006 and also some work as preparation for cruise BATHYLUCK, prescheduled for 2008; the short cruise BATHYLUCK 1 (P.I. Javier Escartin) will deploy temperature probes to be recovered in 2008.

France is also active in supporting the IODP proposal to drill the Rainbow hydrothermal site on ultramafic basement, a proposal coordinated by Yves Fouquet; a modified version of the proposal has been submitted in April 2006 and has recently come back with rather positive reviews.

2) Other ridge activities

Two ridge-related cruises outside the MoMAR area also took place on French ships in 2006. Cruise AOC (for Aden-Owen-Carlsberg) led by Marc Fournier on N/O "Beautemps Beupré" in September 2006, aimed to investigate the structure and kinematics of the triple junction between the Somalia, Arabia and Indian plate. In a recent paper, Fournier et al. (*Earth and Planetary Science Letters*, 2003) have suggested that this triple junction may not be located at the intersection of the Owen transform

fault and the Carlsberg Ridge but further west. The AOC cruise confirmed this interpretation and recognized a major graben extending the transform plate boundary westward; however, the newly defined Arabia-India extensional plate boundary appears to be a diffuse one further west.

Cruise PLURIEL, led by Marcia Maia onboard N/O "Marion Dufresne" in September and October 2006, was designed to investigate the evolution of plume-ridge interaction in the vicinity of Amsterdam-St Paul hotspot, on the Southeast Indian Ridge. This long cruise collected bathymetric and geophysical data as well as many dredged basalt samples on a seamount chain extending northeastward of the present hotspot on the Indian plate. It is expected that the cruise will help to constrain the geophysical and geochemical characteristics of plume-ridge interaction in the case of the hotspot approaching the ridge, a case only well documented on the Foundation hotspot-Pacific-Antarctic Ridge interaction (Maia et al., *Marine Geology*, 2000). The rifted St Paul-Amsterdam plateau also bears resemblance to the Azores hotspot – Mid-Atlantic Ridge interaction as documented by Gente et al. (*Geochemistry, Geophysics and Geosystems*, 2003).

Only one cruise is scheduled for 2007 in areas other than MOMAR. Cruise SERPENTINE, led by Yves Fouquet on the 15°N MAR segment, will investigate the only other example of a high temperature hydrothermal site on an ultramafic basement, and is therefore very complementary to works conducted at Rainbow. The cruise should take place onboard N/O "Pourquoi Pas?" with ROV Victor in February-March 2007.

Cruise PARISUB (P.I. Pascal Gente) on the East Pacific Ridge at 18°N, first scheduled in 2004 then cancelled for financial reasons, could not be scheduled in December 2006 - January 2007, as initially expected, because no other operation requires the ship in the Pacific Ocean in the same period, making the choice between achieving either two cruises in the Atlantic and Caribbean areas or one cruise in the Pacific area (plus the additional time needed to cross the Panama Channel) unfortunately obvious. Future constraints on the oceanographic fleet (N/O "Pourquoi Pas?" shared with the French hydrographic survey and N/O "L'Atalante" to be probably refurbished in 2008) make cruises in the Pacific Ocean difficult to consider in the next few years.

Other cruise proposals related to ridges which have been positively reviewed in 2006 but could not be scheduled in 2007 include:

Cruise name	Area	Discipline	Proponent	Ranking
Gala	Iau basin	Geosciences	Etienne Ruellan	Priority 2a
GeiSeir	SEIR	Geochemistry	Christophe Hémond	Priority 2b
BIG 2008	EPR	Biology		Priority 1
SmoothSeaFloor	SWIR off axis	Geosciences	Mathilde Cannat	Priority 2a



GERMANY



C. Devey

The year 2006 was a good one for ridge science (and the infrastructure which can support it) in Germany. A major expansion of the German fleet of deep-diving ROVs was begun, with orders being placed by both IFM-GEOMAR in Kiel and AWI in Bremerhaven for such machines. And German seafloor science made a strong move into AUV technology as the Marum institute in Bremen placed an order for a 5000m-capable AUV with the company ISE of Canada. The German 6-year ridge program "From Mantle to Ocean" (SPP1144) also reached its mid-point this year. The science is slowly making the transition from exploration to publication, following the spate of cruises in 2005-2006. May 2006 saw another cruise to the southern area close to Ascension (see article from Andrea Koschinsky). Onboard were both the Bremen ROV "Quest" and the AUV "ABE"

from Woods Hole. It was a cruise in which the technology and the timing of simultaneous ROV and AUV deployments worked almost flawlessly and yielded some major firsts. Among the highlights were the hottest temperature hydrothermal fluid ever sampled in the oceans and the observation of a new serpentinite-hosted hydrothermal vent. At the time of writing, an SPP1144 cruise is underway to drill short holes with the British Rock Drill II in the Logatchev hydrothermal field to gain information about the 3rd dimension of this system. The German ridge community is slowly gearing up for the final round of proposals (deadline 31 March 2007) within the present program, there is still lots of exciting science to do to round off our studies of the Logatchev and Ascension areas.



JAPAN



K. Okino

The InterRidge-Japan program sponsored by the JSPS, which supported the Japanese annual contribution to InterRidge, Japanese attendance at steering committees meetings and workshops, and the participation in international cruises for four years, ended at the end of FY2005 (March, 2006). We submitted a successor proposal to continue the ridge related studies but unfortunately without success. In FY2006, the annual contribution to InterRidge has been shared by four institutes and universities and the activity with several seagoing cruises are continued by the efforts of individual ridge researchers. We are now trying to reassemble the domestic long-range plan and have just submitted a new proposal to JSPS, which aims to encourage the interdisciplinary research among microbiology, geochemistry, geology and geophysics.

Diving cruises near the Rodriguez Triple Junction

The Shinkai 6500 diving cruise was conducted at the southernmost Central Indian Ridge in January to February, 2006. The area includes two completely different types of hydrothermal fields, the Kairei and the Edmond. The Kairei field is known for its extraordinarily high concentration of hydrogen in hydrothermal fluids and for the chemolithoautotrophic ecosystem, which were supposed to be due to the serpentinization of ultramafic rocks at high temperature. The Kairei site itself is surrounded by basalt lava, however there are exposures of highly serpentinized olivine-dominated rocks (olivine gabbro-troctolite-dunite) within 15km of the vent field which were directly observed by the

submersible. An interaction of infiltrating seawater as the source of hydrothermal fluid with such olivine-dominated rocks can enrich hydrogen as a substrate for the unique H₂-based ecosystem.

Magnetotelluric transect across the central Mariana arc-backarc area

Under the collaboration of Japan, US and Australia, a marine magnetotelluric transect program across the central Mariana subduction system using ocean bottom electromagnetometers (OBEMs), ocean bottom electrometers (OBEs), and ocean bottom magnetometers (OBMs) has just started to get a comprehensive image of the electrical conductivity structure of the area. The survey line covers the active backarc spreading center of the Mariana Trough and will lead us the better understanding of the crust and mantle dynamics related to the backarc spreading. During R/V Kairei cruise in December 2005, 33 OBEMs, 7 OBMs and 7 OBEs were successfully deployed along the transect. All the instruments measure the geomagnetic and/or electric fields continuously from deployment until September, 2006.

Hydrothermal activity researches in backarc basins

In the southern Mariana Trough, a submersible dive cruise in July-August, 2005 and dredge/mapping cruise in September 2006 were conducted to reveal the temporal and spatial variation of hydrothermal activity, the associated microbial activities, and its geological background. An-

other Shinkai 6500 diving cruise was just ended in October 2006 in the Manus Basin and North Fiji Basin. Biological, geochemical and petrological sampling were done in 6 hydrothermal sites.

Coming cruise to the Rodriguez Segment, the Central Indian Ridge

From December 2006 to January 2007, a R/V Hakuho-maru cruise will take place near the Rodriguez Segment, 18-20°S

on the Central Indian Ridge. The area is affected by the Reunion hotspot and some hydrothermal signature was detected in a previous cruise. The main purpose of the cruise is to understand the ridge-hotspot interaction and find new hydrothermal vents along the Central Indian Ridge. We will utilize a Japanese AUV "r2D4" which is equipped with chemical sensors, sonar and magnetometer. The survey will be done in collaboration with UK and Mauritian scientists.



NORWAY

R. B. Pedersen



The recent discovery of vent fields at the Arctic Mid-Ocean Ridge at 71°N generated new momentum for Norwegian ridge research. The 71°N vent fields were revisited during a cruise with R/V "G.O. Sars" in June 2006. During this cruise vent fluids, hydrothermal deposits, and micro- and macrofauna were sampled from the vent fields by researchers from the University of Bergen and University of Washington. The 71°N fields may again be visited in July 2007 to recover fluid samplers and geomicrobial experiments deployed at some of the vent sites. The main focus of this upcoming cruise will however be to locate new vent sites in deeper waters further to the north at the Arctic Mid-Ocean Ridge.

The ridge research group at the University of Bergen is currently also investigating the architecture of lithosphere formed at this ultraslow spreading ridge. A geophysical cruise to the Jan Mayen area in July 2006 obtained OBS and multi channel seismic data from the magmatically robust, southernmost segment of the Mohns Ridge. These data are currently being processed and analysed together with seismic data previously acquired from more magmatically starved segments of the Knipovich Ridge.

A Russian-Norwegian cruise to the northern Knipovich Ridge took place in September 2006 with R/V "Akademik Nikolay Strakhov". During this cruise both seismic and bathymetry data were acquired from the ridge area, where also igneous rocks and their soft sediment cover were sampled. A workshop is planned to take place in Norway later this year to discuss the preliminary results from the cruise.

The MAR-ECO project, which is an international project coordinated by the Institute of Marine Research and the

University of Bergen, applies modern technology and platforms to describe and understand the patterns of distribution, abundance and trophic relationships of the macro- and megafauna inhabiting the mid-oceanic North Atlantic. The focus is on photosynthetic communities in the waters associated with the mid-Atlantic Ridge between Iceland and the Azores. Several cruises were conducted in the years 2003-2005. The project is currently in the 'analysis and publication' phase, and results include original analyses and descriptions of abundance and distribution patterns. The significance of the ridge topography and the Sub-polar front as structuring factors has been demonstrated for both pelagic and demersal communities. For many species range records have been revised and several new species to science have been described.

The US commitment of a vessel in 2007 and the UK commitments for 2007, 2008, and 2009 extend the fieldwork beyond the original 2003-2005 field phase, and represents a significant opportunity for further studies. The cruises will be used for focused studies in and near the Charlie-Gibbs Fracture Zone, in waters associated with the Sub-polar Front. Planning of these cruises began during the all-project Aberdeen workshop in July 2006, and efforts are now underway to mobilize relevant technology. There will be a planning meeting for ECOMAR (UK effort) in Aberdeen in January 2007.

MAR-ECO aims to develop and demonstrate strategies and technology for use in other mid-ocean ridge areas and hence provide a basis for world-wide exploration of ridge-associated communities and ecosystems. It is the long-term goal that this initiative will lead to an expansion of MAR-ECO efforts southwards along the mid-Atlantic Ridge.



PHILIPPINES



G.P. Yumul Jr.^{1*}, C.B. Dimalanta¹, R.A. Tamayo, Jr.¹, E.G.L. Ramos¹, N.T. Ramos¹, L.T. Armada¹, J.A.S. Gabo¹, J.G. Regodon¹, M.G. Asio-Montes¹, E.J. Marquez², K.L. Queaño³ and T.A. Tam III⁴

International meetings of the International Geological Correlation Programme (IGCP) Projects 507 and 516

The Philippines are hosting international meetings of two projects under the International Geological Correlation Programme (IGCP). The IGCP was launched in 1972 by the United Nations Educational, Scientific and Cultural Organization (UNESCO) together with the International Union of Geological Sciences (IUGS). The IGCP, which is now known as the International Geoscience Programme, aims to facilitate cooperation among geoscientists from different countries by bringing them together through joint multi-disciplinary research works, meetings and workshops.

“Paleoclimates of the Cretaceous in Asia” (IGCP 507)

The IGCP Project 507 on “Paleoclimates in Asia during the Cretaceous: Their variations, causes, and biotic and environmental responses” is one of the newly-approved projects within the UNESCO-IUGS umbrella and will run from 2006 until 2010. Information and important clues that will provide an idea of what transpired during the Cretaceous and what caused changes in the paleoclimate in Asia will be generated and synthesized. The project hopes to undertake detailed surveys in South and

East Asia which will consist of studies on basin architecture, stratigraphic framework, lithologic and biotic indicators and geochemical properties of paleosols and marine and terrestrial fossils. Through the compilation of such data, it is hoped that the spatial paleoclimatic variations and temporal paleoclimatic changes can be delineated. The identification of these paleoclimatic-forcing factors will be useful in studies dealing with tectonic reconstructions, relative sea-level changes and igneous activities. To discuss the implementation of the IGCP Project 507, the first annual meeting of the Regional Coordinators will be held in the Philippines on November 11 – 13, 2006. Plans for the project's activities and annual symposium will also be discussed during the business meeting. The Philippines will be presenting the advances it has made in the study of ophiolites (Figure 1) and how these impact in the understanding of the Cretaceous period. It will be pointed out that the generation of oceanic lithospheres, characterized by intermediate- to fast-spreading centers, characterized this part of Asia.

Geological Anatomy of East and South Asia (IGCP 516)

The 2nd symposium of the IGCP Project 516 which deals with the “Geological Anatomy of East and South Asia: Paleogeography and Paleoenvironment in Eastern Tethys”



Figure 1: Cretaceous oceanic lithospheres are exposed in different parts of the Philippines. The photo on the left shows the diabase dikes of the Sibuyan Ophiolite Complex, found in the central portion of the Philippines archipelago. The photo on the right shows the pillow basalts of the Casiguran Ophiolite Complex in Northern Sierra Madre, Luzon (Queaño, 2006).

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will be held in Quezon City, Philippines. This project commenced last year and the first international symposium was held in Tsukuba, Japan last October 10 to 17, 2005. The IGCP Project 516 aims to gather data that will lead to an understanding of how blocks and fragments derived from Gondwana were assembled and emplaced to form the Asian continent. In order to achieve its objective, it will be necessary to identify and correlate these blocks and terranes through a synthesis of available data. Ideas pertaining to crustal evolution, breaking apart of continental landmasses, collision of terranes and fragments as well as the formation of natural resources will be presented and discussed in the different IGCP 516 symposia planned. Scientists from Pakistan, Sri Lanka, India, Bangladesh, Myanmar, Lao PDR, Thailand, Cambodia, Vietnam, Indonesia, Brunei, Papua New Guinea, Philippines, China, Korea,

Taiwan, Japan and the Russia Far East will be participating in the Philippines leg of the IGCP Project 516. The project encourages international collaboration involving various disciplines in the geoscientific field which include, among others, studies of igneous, sedimentary and metamorphic rocks, geochemistry, tectonics, geophysics and economic geology. The results which will be obtained regarding how terranes and blocks were assembled through time to form the present Asian continent are useful in our understanding of some very destructive phenomena like volcanic eruptions, earthquakes and other geologic hazards. The Philippines, in this meeting, will be presenting data and information on how the Baguio Mineral District, which is host to world-class gold and porphyry-copper deposits, has evolved from a marginal basin setting to a mature island arc (Figure 2).

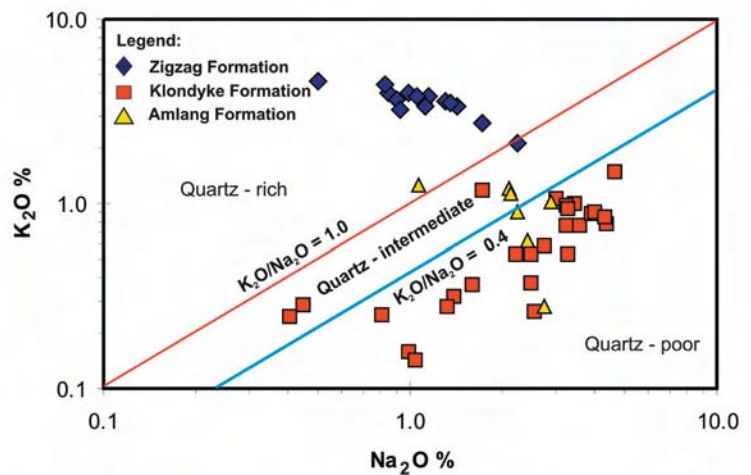
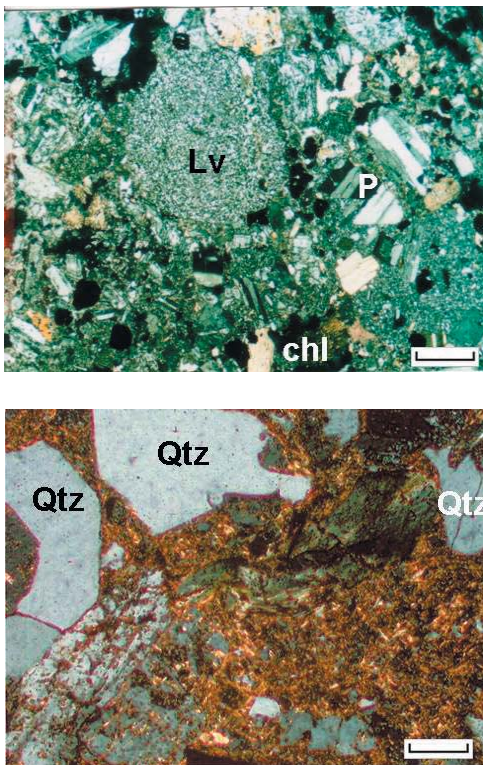


Figure 2: Petrographic and geochemical data from sedimentary units in the Baguio Mineral District show that the Zigzag Formation samples (bottom photo) are quartz-rich vis-à-vis the Klondyke Formation samples which are quartz-poor (top photo). This feature is also observed in the Na_2O vs. K_2O diagram. The Zigzag and Klondyke Formations offer evidence showing how the mineral district has evolved.



RUSSIA



S. Silantyev

The many Russian researchers from national scientific, applied industrial and educational centers continued their intensive work on the mid-ocean ridge systems in 2006. Among the most important current investigations and results obtained in this year are the following:

1. The new project of the Geological Institute of the Russian Academy of Science "Late Mesozoic - Cenozoic tectonic - magmatic history of the Barents Sea shelf and slope as a clue to paleodynamic reconstructions in the Arctic Ocean" was launched in 2006. The study of the late Mesozoic – Cenozoic geodynamic evolution of the Barents Sea continental margin will give a better insight into the rifting/spreading history of the Arctic Ocean. Defining more precisely the time intervals of main uplift pulses and quantifying their amplitudes in relation to late Cenozoic glacial-influenced erosion/sedimentation processes, associated isostatic rebounds and changes of temperature regimes will be critical to determine earlier environmental conditions. The proposed project activities include: (1) synthesizing available evidence on rift-related igneous events and specifying geodynamic environments of individual magmatic manifestations within the Arctic large Igneous Province; (2) integrating seismic, gravity and magnetic data with geological information and drilling results in order to (a) identify the general structure of the crust, (b) recognize the outlines of Cenozoic depositional areas and reconstruct their former environments, and (c) model vertical movements responsible for depositional & erosional processes; (3) revising the existing concepts of glacial history and glacial-isostatic processes; (4) developing a comprehensive model of Late Mesozoic-Cenozoic tectonic-magmatic evolution of the Barents Sea continental margin in relation to the adjacent deep oceanic seabed of the Eurasian Basin.
2. In the framework of this Project cruise of the R/V "Akademik Nikolai Strakhov" was conducted in 2006 (August – October) at the northern termination of the Knipovich Ridge and along a transect from the North Knipovich Ridge to the west coast of Svalbard. Seismic profiling, 3-D survey, magnetic and gravimetric profiling, heat flow measurement as well as dredging and sedimentological sampling were carried out during this expedition. (for more detail information see: [http:// www.ginras.ru](http://www.ginras.ru), in Russian)
3. The 30-th cruise of R/V "Professor Logachev" (Polar Marine Expedition - PMGRE) was operated in 2006 at the MAR axial zone in an area of recently-discovered sulfide ore deposit at 16°38'N. During recent cruises of "Professor Logachev" it had been found that the ore deposit at 16°38' was not accompanied by a chemical anomaly (signal) in the water column and therefore

probably not related to active hydrothermal vents. In the context of this problem, investigations of the composition of basaltic glasses sampled from this part of the rift valley are being carried out in the Vernadsky Institute of the Russian Academy of Science to determine the possible relationships of the ore mineralization with zero age magmatism on the MAR at 16°38'N.

As examples for fruitful cooperation of R-Ridge scientists with the international community mention should be made of the following:

- A collaborative study of the major processes at the MAR crest zone in the framework of the scientific cooperation between the Federal Agency for Sciences and Innovation of the Russian Federation and IFREMER, France. This cooperation involves investigations as part of the bilateral project "The Mid-Atlantic ridge Geodynamics and the ore formation processes". The participation of Russian Scientists in a cruise of the French R/V "Pourquoi Pas" is scheduled for 2007.
- A study of petrology and geochemistry of plutonic rocks from typical oceanic core complex from MAR, 15°44'N. Rocks examined were recovered by drilling in ODP Leg 209, Sites 1275B and 1275A. This study is carried out in close cooperation between scientists from Vernadsky Institute of Russian Academy of Sciences and WHOI, USA (Dr. H.J.B. Dick and Dr. P.B. Kelemen).
- Scientists from Norway took part in the organization and execution of the cruise of the R/V "Akademik Nikolai Strakhov" to the Knipovich Ridge and Northern Barents Sea.

In 2006 the IR Steering Committee Meeting was held at Moscow in the Vernadsky Institute of the Russian Academy of Sciences. During this meeting, high level officials from the Russian Academy of Sciences and Steering Committee members exchanged views on the future perspective for scientific cooperation in ridge studies world-wide.

The regular (already 3-th) International Conference "Minerals of the Ocean – Future Developments" has been held in Summer, 2006, at St.Petersburg. The main objectives of this conference were the following: hydrothermal deposits, ferromanganese oxide and phosphorite deposits, gas hydrates.

The next Workshop of Russian-RIDGE will be held in the Vernadsky Institute, Moscow, on September 4-6, 2007. This Workshop will be dedicated to the memory of Professor Leonid Dmitriev who was the founder of Russian Ridge and a pioneer in the studies of the petrology and geochemistry of the mid-ocean ridges. The proposed main subject of this Workshop will be geochemical, petrological, and geophysical segmentation of the mid-ocean ridges and its relationship to the geodynamic parameters of oceanic lithosphere accretion.



SOUTH AFRICA

P. le Roux



A small petrology group from the University of Cape Town (UCT) participated in the ANT XXIII/5 cruise of the FS Polarstern from Punta Arenas, Chile, to Cape Town, South Africa (April-June 2006). The UCT involvement forms part of ongoing collaboration with workers from AWI in Germany, Vrije Universiteit (VU), Amsterdam, the Netherlands and LDEO in the US. The focus of this collaboration is unraveling the geochemical and geophysical characteristics and evolution of the major off-axis, aseismic

ridges in the South Atlantic. During the two month cruise, the VU-UCT-LDEO group managed to successfully recover significant basaltic samples from the Shona Ridge, Discovery Seamounts, Walvis Ridge, Agulhas Ridge and Cape Rise Seamounts. Considering the extreme sea conditions in the South Atlantic during this time of the year, captain Stefan Schwarze and the crew of the Polarstern deserve special mention for their professional and skilled handling of the dredging operations.



USA



D. Blackman¹, K. Haak¹, K. Phillips¹, L. Goehring¹, and E. Simms¹

There have been many science and outreach highlights for the Ridge 2000 program (R2K) during the past year. The R2K Office at Scripps Institution of Oceanography has been up and running since November, 2005. The community-wide Vancouver meeting in November, 2005, provided an excellent overview of the first few years of R2K progress, as well as a forum for discussing next steps. Continuation of work at the 3 Integrated Studies Sites (ISS- Endeavour, East Pacific Rise (EPR) 8-11°N, and Lau) was endorsed for the next few years and the desire to bring on new site(s) in the future (post ~2008) was embraced by the community. Individual focus workshops for science integration and data sharing have now been held for each ISS. Reports for these meetings are available at <http://www.ridge2000.org/science/meetings/index.html>. The Ridge Theoretical Institute in late June was truly interdisciplinary. This RTI illustrated many ways that modeling can further understanding of spreading center hydrothermal systems, both directly, in terms of physical/chemical/biological insights, and through feedback with observational studies. Speakers for the short course did an outstanding job and you can access their slides at <http://www.ridge2000.org/science/meetings/RTI06.php>.

Our joint PSU-SIO Education & Outreach team is in full gear, with two new projects having been approved for NSF funding early this Summer- development of an Image Bank for hydrothermal systems, and partnership in the international GLOBE science education program. Both projects involve collaboration between R2K and InterRidge

outreach. The GLOBE project will, for the first time, involve K-12 students and educator groups worldwide in marine science and the excitement of learning about 'extreme' environments. The Image Bank will be part of the R2K Data Management System and will serve multiple uses, including R2K, InterRidge and ChEss outreach and scientific purposes. R2K and InterRidge E&O teams recently worked together and with scientists on an Outreach Activity for the Euroscience Open Forum, in late summer in Munich.

R2K participated in planning discussions for the NSF Ocean Observatory Initiative (OOI) during the Spring. As the budget for the global buoy network became known, it was clear that the phase 1 deployment of OOI could not support 2 mid-ocean ridge sites. Despite both the EPR and MoMAR sites being highly ranked for science and readiness, only one could be put forward for phase 1. This was a challenging community discussion, and strong support was voiced for each site. After considerable debate, the R2K Steering Committee set EPR as the first priority for phase 1 observatory work and set laying the groundwork for an eventual MoMAR observatory as a goal for the next few years. A first step in such groundwork could evolve from an upcoming International Data Sharing workshop, to be held in Kiel in Spring 2007, with EU, Japanese and US participation.

An opportune indication in April 2006 of likely recent seafloor eruption at the EPR set the context for 2 rapid response cruises to the site. A group of scientists led by Jim

¹Ridge 2000 Office

Cowen spent a week on site in May, deploying CTD's and obtaining towed camera images and rock samples that confirmed the eruption. In late June, several Alvin dives were devoted to a range of multidisciplinary studies; this team was led by Karen Von Damm. Through significant logistical effort by NSF, shipboard crews, and R2K scientists, all in a very short time, both the May and June cruises obtained important early chemical and biological characterizations within a few months of the eruption(s?). A series of previously-scheduled cruises late 2006 through Spring 2007 will provide exciting updates on the evolution of the system after this eruption (further information is available at www.ridge200.org, in the 'time critical studies' and 'integrated studies/east pacific rise' links).

To complete 2006, 2 special sessions at Fall AGU will emphasize R2K work as well as related studies throughout the oceans: 1) Comparison of oceanic spreading center characteristics at different sites- insights on the interplay between mantle, crustal, hydrological and biological processes; 2) Recent deep-sea eruptions- phenomena observed before, during, and after. We hope to see you there and/or at the R2K booth in the exhibit area.

WORKING GROUP UPDATES

INTERRIDGE WORKING GROUPS – A NEW LOOK

C. Devey

As we see again and again at InterRidge science meetings, the main scientific driving force in InterRidge is our Working Groups. Yet we must also recognise that the performance of the working groups, measured in terms, for example, of their generating science plans for international cooperation, is very heterogeneous. This heterogeneity stems in most cases from the extent to which scientific questions are being tackled adequately by national programs, obviating the need for direct InterRidge involvement. At its 2006 meeting, the InterRidge Steering Committee considered this situation in detail and as a result adopted new rules for the formation and funding of working groups with the aim of helping these groups become more focussed and structured. These rules are as follows:

1. Up to 10 international proponents should propose the formation of a Working Group. The proposal should clearly state which problem is to be addressed, how the group plans to address this problem (this will normally be in the form of organising an international workshop), what the expected outcome of the Working Group will be (e.g. publication, science plan) and the time-plan for the work.
2. This Working Group proposal is considered by the Steering Committee. If it is accepted InterRidge provides US\$2,000 "leverage money" to help the proponents to meet, possibly flanking another major congress. Normally, the aim of this meeting is for these proponents to finalise a plan for a workshop.
3. The workshop plan is submitted to the Steering Committee, if accepted the usual maximum of US\$3,000 is given for workshop support/leverage.
4. The workshop may have two end-member outcomes

- either it produces a clear plan for how InterRidge can help push forward science through a coordinated effort or it concludes that national programs are dealing with the burning issues at present and so InterRidge involvement is not absolutely necessary at the present time. The former outcome could lead to a proposal to InterRidge to continue the Working Group (for example to finance a further meeting to discuss concrete implementation of the science plan), the latter outcome leads to the Working Group disbanding for the time being.

Many of the present InterRidge Working Groups have had such workshop meetings and so their status, according to these new rules, is as follows:

Ultraslow spreading ridges: Held Workshop in Sestri Levante Sept. 2006. Report being prepared, many plans for further work. Expect to submit proposal to continue Working Group.

Hotspot-Ridge Interaction: Held a workshop in 2003 which showed many national programs to be active and no pressing need for InterRidge intervention. The Working Group Chairs therefore have concluded that the work of this group is concluded.

Back-arc basins: Held a workshop in South Korea in 2004 which showed many national programs to be active and no pressing need for InterRidge intervention. The Working Group Chair therefore concluded that the work of this group is concluded.

Biology: This working group is presently working on a workshop proposal. This proposal will be examined by the Steering Committee in 2007.

Monitoring and Observatories: This working group organised an international meeting in Lisbon in May 2005 on the MoMAR region which led to the establishment of a "MoMAR steering committee". The MoMAR work, having been started up by InterRidge, has gained enough momentum in several nations (see, for example, the update from the French office) so that direct InterRidge intervention at present does not appear necessary. The InterRidge Working Group has therefore completed its work although InterRidge remains very receptive for new proposals for monitoring and observatories.

Deep Earth sampling: As anticipated, this group was able to make significant advances towards IODP which resulted in a joint workshop with the title "Mission Moho: Understanding the formation and evolution of the oceanic lithosphere" in Oregon in September 2006. The report from this workshop

is still in preparation but it seems likely that this workshop will lead to the formation of several groups developing proposals to the IODP structure.

Biogeochemical interactions at deep-sea vents: This group has been highly active organising sessions at international meetings around the world. They are at present organising a Theoretical Institute (TI), scheduled for 2007. Following this TI I expect the InterRidge Steering Committee will receive proposals to support further work in this emerging field, perhaps in collaboration with SCOR.

This summary means that InterRidge starts a new year with 4 working groups, Ultraslow ridges, Biology, Deep Earth Sampling and Biogeochemical Interactions. So the field is wide open for proponent groups to suggest new directions for InterRidge research!

WORKSHOP REPORTS

POLAR RIDGES MEETING AND WORKSHOP, SESTRI LEVANTE, ITALY, SEPTEMBER 2006: CONVERGING IDEAS ON DIVERGENT MARGINS



J. Snow, H. Dick, E. Rampone, C. Devey



In recent years, Polar mid-ocean ridges have been the focus of some of the most exciting scientific results from mid-ocean ridges globally. 60 scientists from the international mid-ocean ridge community met in the Italian coastal town of Sestri Levante for four days in mid-September, 2006 to discuss the progress and future of research on polar mid-ocean ridges. These include the trans-Arctic Gakkel Ridge and the circum-Antarctic SW Indian and American-Antarctic ridges. These mid-ocean ridges belong primarily to the ultraslow class of mid-ocean ridges (<16 mm/yr full spreading rate). Ultraslow ridges have gained increased recognition in recent years because of the very successful exploration of the Arctic ridge system by a number of cruises since the drafting of the InterRidge Arctic Mapping and Sampling Plan in 1998 (ref). Since then, we have seen the first intentional hard rock sampling in pack ice, mapping by submarine beneath the arctic ice an extensive program of mapping and sampling on Gakkel Ridge, and on Lena Trough.

The venue turned out to be unexpectedly germane to the discussion of the geology and geophysics of mid-ocean

ridges. Situated on ocean crust that had once formed part of the nonvolcanic rifted margin of the ancient Tethys ocean, the hills surrounding the conference are constructed of just the same type of rocks that make up much of the lithosphere of the ultraslow spreading ridges. Through the presentations by Italian, French and Swiss participants new to mid-ocean ridges per se, it became clear during the meeting that the western Alpine Tethyan ophiolites form a powerful analog for the study of mid-ocean ridge spreading under conditions of magmatic starvation. The western Tethyan ophiolites are a particularly good example of such rocks, and warrant further investigation and comparison in the future course of mid-ocean ridge studies.

A second convergence of thought and action came between the global mid-ocean ridge community and the community of scientists studying rifted margins. The International Ocean Drilling Program scheduled a conference at nearly the same time in the Swiss Alpine town of Pontresina (an easy half-day drive away) to carry out a similar discussion for their scientific program – with a little hasty rescheduling, the two conferences took place back to back over the



course of 10 days. Scientifically, the study of continental margins, particularly the non-volcanic ones, has converged to a surprising extent with the ultraslow mid-ocean ridge community. This is because the tectonics of late nonvolcanic continental rifting have a very similar constellation of geodynamic forcing functions (e.g. spreading rate, thermal structure).

Scientists at the conference presented some of their newer research stemming from the exploration of ultraslow spreading ridges. Particularly exciting new work was presented by Steven Goldstein, of the Lamont Doherty Earth Observatory, Chuanzhou Liu of the Max-Planck Institute for Chemistry in Mainz, and Sergei Silantyev, of the Vernadsky Institute of Geochemistry, Russia. The common theme of these talks was the unusually continental nature of the magmatic, and tectonic processes of accretion along the Gakkel Ridge, something that had never before been suggested for a major mid-ocean ridge. Of particular interest to many in the seagoing ridge community was the detail with which tectonic and magmatic structures in ophiolites

that were previously considered "dismembering" features during obduction have proven to be sea floor features with a direct relationship to magma starved rifting and tectonics (Gianreto Manatschal, Strasbourg; Françoise Chalot-Prat Nancy, Elisabetta Rampone, Genova)

In the workshop part of the meeting, delegates from 7 countries (Japan, Germany, Korea, France, Britain, China, Italy, and the US) discussed recent developments in polar ridge research in their countries and plans for the immediate future. Heartening developments include the plans in both China and Korea for increased participation in ultraslow and in particular polar mid-ocean ridge research, and the development of a new Autonomous Underwater Vehicle (AUV) by the US for mapping and sampling beneath ice, which is to be tested next summer. Another is the idea that a program similar to the SCICEX program may be in the offing. Somewhat discouraging is the sudden halt in activity on USCGC Healy due to a tragic accident this summer.

New programs that are evolving include detailed observations in several areas, including the SWIR and Gakkel Ridges, where general survey has already been completed. There is a strong sense that a further mapping and sampling survey of the Eastern Gakkel between the end of the AMORE 2001 program and the Siberian shelf edge should be planned. This survey may require a different set of techniques and competences and face a new set of challenges than previous legs. A planning meeting to discuss implementation of an international Eastern Gakkel Program is planned for early 2007 in Woods Hole.



MISSION MOHO WORKSHOP

B. Ildefonse¹, D. M. Christie², and Mission Moho Workshop Steering Committee (N. Abe, S. Arai, W. Bach, D. Blackman, R. Duncan, E. Hooft, S. Humphris, and J. Miller)

Formation and Evolution of Oceanic Lithosphere

The Mission Moho workshop, co-sponsored by IODP-MI, the Joint Oceanographic Institutions, Ridge 2000, and InterRidge, was held 7-9 September 2006 in Portland, Oregon, USA (full report online at www.iodp.org). It was convened to discuss and prioritize scientific objectives to be addressed by scientific ocean drilling, as part of our strategy to study the formation and evolution of the ocean lithosphere. It directly addressed InterRidge Deep Earth Sampling objectives to identify further the sub-seafloor biosphere, and to achieve total penetration of ocean crust, through international, collaborative, and multidisciplinary projects.

The potential for the Integrated Ocean Drilling Program (IODP, www.iodp.org) to contribute to an improved understanding of the composition, structure, and evolution of the ocean lithosphere is enormous and has been enunciated in planning documents since ocean drilling began. In April 1961, the first successful drilling and coring of oceanic basement was achieved offshore Guadalupe Island. A few meters of basalt were recovered, from about 3800m water depth. This remarkable breakthrough, beautifully reported by John Steinbeck in *Life* magazine, was intended to be the first stage of project Mohole, a much more ambitious project to drill through the ocean crust to the Mohorovičić discontinuity (Moho). Considerable progress has been made since the early days of scientific ocean drilling in our understanding of the architecture of the ocean crust and related mid-ocean ridge accretion and alteration processes. Yet, the number of completed ocean crust drilling expeditions at the present time remains relatively limited (45 holes deeper than 200 meters below sea floor started in basaltic crust or reached it below sediments; 37 holes deeper than 10 meters below sea floor in gabbros and serpentinitized peridotites). The fundamental goal of drilling a complete section through the oceanic crust and into the upper mantle has been reiterated through the last 45 years of scientific ocean drilling. IODP platforms are the only tools readily available for direct scientific sampling and measurements in hard rocks below the seafloor. It is highlighted in the IODP Initial Science Plan as the "21st Century Mohole" Initiative, one of eight high-priority scientific objectives. Inherent in this goal is the need for scientific and technical growth, for a clearly defined scientific strategy, and for parallel development of essential technology and operational experience.

The Mission Moho workshop set out to refine scientific objectives, to propose elements of a global strategy for understanding the formation and evolution of the oceanic lithosphere, and to begin the process of community prioritization for studies of these processes via ocean drilling. Since the early 1970's, the standard model of a uniformly layered ocean crust has evolved. Continuous investigations using ocean drilling and other marine geological tools have led to a more detailed and spatially variable picture of crustal architecture. Ocean crust produced at fast spreading ridges appears to be uniformly layered and relatively homogeneous, reflecting a relatively uniform mode of accretion. In contrast, crust created at slow and ultra-slow spreading ridges is spatially heterogeneous over distances as small as a few hundred meters, both along- and across-isochrons. For example, at some ridge segment centers in the northern Atlantic, magmatic processes dominate, and accretionary processes resemble those of fast spreading ridges. This similarity, however is limited in space, and crustal architecture typically varies along-axis, toward segment ends, where it is more heterogeneous and even discontinuous. In such areas, the ocean crust consists of a mixture of serpentinitized peridotite and gabbroic intrusions, locally capped by lavas ± sheeted dikes.

Although only 20% of modern ridges are spreading at fast spreading rates (>80 mm/yr), ~50% of present day ocean crust and ~30% of the Earth's surface was produced by fast spreading. The great majority of crust subducted back into the mantle during the last 200 Ma formed at fast spreading ridges. Hence, an understanding of accretion processes at one site might reasonably be extrapolated to describe a significant portion of the Earth's surface. Current working models include competing styles of magmatic accretion (e.g., gabbro glacier vs. sheeted sills), that can only be tested by sampling the ocean basement using scientific drilling.

In addition to the fundamental objective of drilling at least one hole through the entire crust, a thorough evaluation of lateral variability at multiple scales, and of correlations between seismic and lithological transitions will ultimately require multiple penetrations of the dike/gabbro transition, the lower crust, and the crust/mantle boundary in different tectonic settings. Therefore, in order to fully understand the architecture of the ocean crust, the slow-spreading end of the spectrum must be considered as well. Exploration of the nature of the Moho at slow-spreading ridges is an essential complement to the vision that we will gain from drilling in fast-spread crust. For example, serpentinitized mantle rocks are commonly incorporated into the crust (as

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defined seismically) at slow-spreading ridges. Drilling in this type of crust, down to fresh peridotite, will test competing hypotheses on the nature of the Moho. For example, is the Moho, (1) the boundary between the residual upper mantle and the igneous crust, or (2) a broader zone of layered ultramafic and mafic rocks, or (3) a serpentinization front, or, perhaps, some combination of these three.

Alteration of the oceanic crust encompasses a wide range of water-rock reactions that change the physical properties of the crust on a variety of temporal and spatial scales. One strategy for studying the aging of oceanic crust is to drill multi-hole transects along seafloor spreading flow lines to examine the time-integrated changes in physical and chemical properties. To date, drilling has been concentrated either relatively close to the mid-ocean ridge axes or close to subduction zones; very few holes have been drilled in crust between ~20-80 Myr old. There are no sites in the vicinity of ~60-65 Myr old which, based on heat flow measurements, is the average age at which the crust becomes sealed and the heat flux from the mantle becomes solely conductive. An additional important aspect of alteration is its spatial heterogeneity and variability in style. Although drilling cannot address this on a global scale, sampling and logging of closely spaced holes, in conjunction with cross-hole experiments, would provide important information on the length scales of variability.

The sub-seafloor biosphere also plays an important role in the chemical evolution of oceanic crust. The spatial distribution of microbes in the crust is not known but is likely influenced by host rock composition, temperature and permeability. Progress in understanding subseafloor microbial distribution, and its interactions with geochemical alteration processes, will proceed hand-in-hand with determination of the distribution of rock type, temperature and permeability as a function of depth and crustal age, and of how these relationships influence the distribution of microbial activity.

Finally, the technological requirements for achieving our objectives were discussed by a special panel that included several drilling engineers. In addition to deep drilling (see below), desired developments include improved core recovery, higher temperature tolerances for drilling and especially logging tools (> 150-200°C), and the ability to obtain oriented cores.

Mission Moho workshop was also aimed to develop guidance on the scientific and operational framework of a future "Mission Moho" within IODP.

The Moho is a seismic boundary assumed to represent the interface between the crust and the pristine mantle. Mission Moho will provide the scientific framework and encourage the technical development that will ultimately allow us to drill to and beyond this "last frontier". The primary goal of Mission Moho is to determine the nature of the Moho by in situ sampling and data collection. The road to the Moho will be a long one. Progressively deeper and more technically challenging drillholes will probe and sample the ocean crust, examining the primal architecture of the ocean crust

and ultimately sampling Earth's uppermost mantle.

A clear consensus emerged at the end of the workshop that drilling a deep, full crustal penetration hole through fast-spread (high magma flux) crust, through the Moho and into the uppermost mantle, at a single site, is the community first priority, and that a future Mission Moho should be articulated around achieving this goal as soon as feasible. Only by drilling and sampling such a complete section we will be able to estimate the bulk composition of the crust, establish the chemical connections between the lavas erupted and melts coming from the mantle, test competing models of lower crustal magmatic accretion, understand the extent and intensity of hydrothermal exchange between the ocean crust and seawater, calibrate regional seismic measurements, understand the origin of magnetic anomalies, and make estimates of the chemical fluxes returned to the mantle by the subduction of oceanic lithosphere. With samples of the upper mantle we can define, at least in one place, the geological meaning of the Moho and address fundamental questions about the nature of melt migration in the mantle, mantle deformation, cooling rates of the lithosphere, and the composition of the uppermost mantle.

The workshop participants also recognized that the primary Mission Moho objective of full crustal penetration must be supplemented by studies of spatial and temporal variability if a comprehensive understanding of the formation of the ocean lithosphere is to be achieved. Sampling crust and upper mantle produced at low spreading rates (i.e., low magma flux), in order to at least partially address the variability of lithospheric architecture and potentially of the nature of the Moho, is also an important goal of Mission Moho. However, the extent to which current or planned drilling projects in slow-spread crust should be included in Mission Moho was not discussed. Criteria for inclusion of such projects will have to be defined by a mission proponent team. One particularly important mission objective is an assessment of the role of serpentinization in modifying the seismic signature of the crust and the transition to typical mantle velocities, because seismic studies are and will remain one of our primary tools for investigation of the subsurface over wide areas. The relationship between lithologic variability and subsurface seismic images can only be investigated by deep drilling one or more complete sections through non-layered, slow-spread crust.

Finally, the evolution of the oceanic crust, i.e., understanding the alteration, thermal, and fluid-flow history in the crust while recognized as a fundamental scientific goal for IODP, was not perceived as an essential element of Mission Moho.

Penetrating the entire ocean crust will require riser drilling technology. The world's only scientific riser drilling vessel "Chikyu" ("Earth" in Japanese; www.jamstec.go.jp/chikyu/eng) is currently undergoing System Integration Tests. Chikyu's first multiple platform IODP project involving both riser and riserless drilling is scheduled in the Nankai Trough beginning in September 2007. For eventual penetration of the oceanic fast-spread crust, a technically challenging,

phased modification of the riser from the current 2500-meter maximum depth to 4000-4500 meters will be required. The construction of such deep-water riser capability was recently included as one of five domestic science and technology high priorities by the Japanese Government. Even with this depth capability being available sometime after 2010, the journey to Moho will be long. The number of potential deep drilling sites, on fast-spread seafloor that is old enough, and therefore cold enough (>15 million years) but still shallow enough for riser capability is limited.

It is imperative that any site chosen for a deep penetration hole is thoroughly investigated and characterized geophysically, geologically, geochemically and petrologically. Boreholes are spatially limited, and they need to be understood in their broader context. Spatial context for ODP and IODP drillholes is primarily provided before and after drilling occurs through appropriate site surveys, and can be complemented by field studies in ophiolites, in particular the Oman ophiolite, and by drilling in tectonic windows (e.g., Hess Deep) that provide direct access to the lower crust and rocks that once formed the uppermost mantle. These windows of opportunity provide important short cuts to test models of lower crustal accretion, hydrothermal alteration and physical properties. The knowledge

gained will enable model refinements and better experimental designs for progressively deeper penetration of intact oceanic crust.

IODP has recently established deep holes at two complementary sites. Hole U1309D (1415 m below sea floor) has recovered a complex series of gabbroic rocks from slow-spread Atlantic Ocean crust. Hole 1256D (1507 m below seafloor) has, for the first time, penetrated the entire pillow basalt and sheeted dike sequence in superfast-spread crust of the eastern Pacific Ocean, terminating in the transition between sheeted dikes and underlying gabbros. A lot of experience about drilling deep in the ocean crust was gained with these two holes, and with earlier deep ODP Holes 504B and 735B. Holes 1256D and U1309D remain open and will very likely be deepened in coming years. Site 1256 is a potential location for a deep penetration crustal hole and much can be learned from continued drilling at this site. At the same time, potential alternative sites need to be identified and evaluated before a final full crustal penetration site is selected. In the near term, riserless drilling should be used to penetrate the crust in Hole 1256D as deeply as possible, and to prepare a cased hole for subsequent riser drilling at the selected deep penetration site.

INTERRIDGE OUTSTANDING STUDENT AWARD 2006

This year's InterRidge outstanding student award went to Anna Cipriani, a PhD student at Columbia University (Lamont-Doherty Earth Observatory), for her presentation at the Polar Ridges Meeting and Workshop in Sestri Levante, Italy.

Here is a short description of how she came to this award for the presentation:

"From magma-engorged to magma starved "constipated" lithosphere: the mid atlantic ridge from 40°N to the equator" (A. Cipriani, D. Brunelli, M. Ligi and E. Bonatti)



Since an early age I have been fascinated with rocks, fossils, and minerals. Therefore, at the end of high school I enrolled at the University of Padua (Italy) to study Geology. Early in my undergraduate years, I developed a strong interest in learning about the structure of mid-ocean ridges and the formation of the oceanic basins. Since 1996, I have participated to a number of major marine geology/geophysics expeditions in the central Atlantic, in the Peri-Antarctic Ocean and in the Red Sea, including an ODP leg. I will defend my PhD thesis next week ("Pulsating generation of the oceanic lithosphere and isotopic fingerprints of its mantle source"). During my thesis research at Columbia University (Lamont-Doherty Earth Observatory), I have been investigating the variations through time of the processes of creation of lithosphere at a single ridge segment, by studying a section of oceanic lithosphere exposed near the Vema Transform (Central Atlantic). I have been particularly interested in understanding the genetic relationship between the peridotitic upper mantle and the basaltic oceanic crust through Sr, Nd and Pb isotope systematics. In particular, there is much debate about whether source composition is a strong control on the degree of mantle melting or, instead, that source enrichment is correlated with relatively high mantle temperature. Resolving the question of whether source composition or temperature is more important, will give earth scientists a more fundamental understanding of the genesis of mid-ocean ridge basalts worldwide. After my defense, I will continue to work at LDEO as a Post-

doc and I cannot wait to dive to a mid-ocean ridge (anybody out there needs a helper on their next submersible dive?).

Also once again, I would like to thank InterRidge for the Student Award I received in Sestri. It was very much unex-

pected. I am really proud that my work has been recognized by such a fine group of scientist working on mid ocean ridges. It really means a lot to me.

Anna Cipriani

UPCOMING EVENTS

FIRST SCIENCE CRUISE OF THE NEW BRITISH RESEARCH SHIP "JAMES COOK"

A UK cruise is scheduled to study the Mid-Atlantic Ridge near the Fifteen Twenty Transform Fault between 5 March (depart Tenerife) and 17 April (return to Tenerife), 2007. Co-principal investigators are Roger Searle (Durham University), Chris MacLeod (Cardiff University), and Bramley Murton (National Oceanographic Centre, Southampton). We will use the TOBI deep-towed vehicle and the 'BRIDGE' oriented seabed rock drill to carry out a detailed study of this area where peridotite outcrops extensively near the ridge axis and oceanic core complexes are common. We propose to test the focused mantle/melt upwelling hypothesis directly by drilling a large number of orientated peridotite rock cores from the median valley and measuring

rock fabric and palaeomagnetic directions. Sonar images from TOBI will allow us to map out the areas of peridotite outcrop and reveal spatial variations in the distribution of magmatic bodies, while deep-towed magnetics will provide a high-resolution seafloor spreading history and help in lithological identification. This will be the first science cruise of the new British research ship "James Cook", and we hope to be able to host an InterRidge "Science Writer at Sea". Further details are available at <http://www.dur.ac.uk/r.c.searle/Cruise1520/cruise-index.html>

Roger Searle

Russian-RIDGE

NEXT WORKSHOP OF R-RIDGE WILL BE HELD IN VERNADSKY INSTITUTE, MOSCOW, ON SEPTEMBER 4-6, 2007.

This Workshop will be dedicated to the memory of Professor Leonid Dmitriev who was the founder of Russian Ridge and a pioneer in the Studies of the Petrology and Geochemistry of the Mid-Ocean Ridges Bedrock

Workshop is held to discuss the results of interdisciplinary studies of Mid-Oceanic Ridges (MOR) obtained for the period 2005-2007 and to coordinate further investigations.

Main subject of this Workshop will be geochemical, petrological, and geophysical segmentation of the Mid-Ocean Ridges and its relationships with geodynamic parameters of oceanic lithosphere accretion.

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**EGU GENERAL ASSEMBLY
VIENNA, AUSTRIA
15 – 20 APRIL 2007**



**BG6.05 / BIOGEOCHEMICAL INTERACTIONS IN CHEMOSYNTHETIC DEEP-SEA ECOSYSTEMS: METHODS,
TOOLS AND STRATEGIES**

Convener: N. Le Bris (IFREMER, France). Co-conveners: C. R. German (WHOI, USA), W. Bach (RCOM, U. Bremen, Germany), S. Duperron (U. Paris6, France)

Session description:

The past decade has raised challenging issues about the nature of processes driving the interactions between the biotic and abiotic components of hydrothermal and other deep-sea chemosynthetic ecosystems (methane seeps, massive organic falls,...) and their role in the response of ecosystems to disturbance.

The respective importance of microbial metabolisms in carbon fixation, mineralisation and rocks alteration, the interplay between invertebrate diversity, small-scale structuration of physico-chemical gradients and the dynamics of microbial energy and element fluxes are major questions

that need to be answered.

This session will address advanced inter-disciplinary research to understand basic mechanisms linking geochemical, biogeochemical, geobiological and biological processes, including the development of new instrumental devices for the exploration, observation, experimentation and monitoring at relevant scales on the seafloor.

Abstract submission deadline: *January 15, 2007*

More info on: <http://meetings.copernicus.org/egu2007>

**TS8.5/GD06.1/GMPV17 TRACING HYDROTHERMAL CIRCULATION AT MID-OCEAN RIDGES USING
GEOCHEMISTRY, GEOPHYSICS AND MODELLING**

**Convener: V. Chavagnac
Co-conveners: F. Fontaine, Briaïs, A., Morris A.**

The circulation of seawater within the axial zones and flanks of mid-ocean ridges: (i) influences heat transport from the lithosphere to the hydrosphere; (ii) modifies the bulk, chemical and isotopic composition of the oceanic crust and its physical properties (magnetism, porosity, density and seismic velocity) via fluid-rock interaction and the formation of secondary minerals; and (iii) alters the chemistry of seawater through the expulsion of high to low temperature hydrothermal fluids at various depths.

This session will bring together geophysicists, geochemists, mineralogists and modellers interested in the complexities of oceanic hydrothermal circulation. Within this broad remit, papers that aim to improve understanding of seawater circulation pathways through the oceanic crust and the role of hydrothermal cycling in heat, chemical and material fluxes between the lithosphere and the hydrosphere are particularly welcome.

Sponsor: MOMARNET

CALENDAR OF UPCOMING EVENTS

- | | |
|---------------------------|--|
| 11 – 15 Dec 2006 | AGU Fall Meeting
<i>San Francisco, USA</i> |
| 7 – 9 Dec 2006 | SCOR Summit of International Large-Scale Ocean Research Projects
<i>London, UK</i> |
| 6 – 9 March 2007 | SOLAS Science 2007
<i>Xiamen, China</i> |
| 15 – 20 April 2007 | EGU General Assembly
<i>Vienna, Austria</i> |
| 19 – 24 May 2007 | ESF - Conference
<i>Ocean Controls in Abrupt Climate Change</i>
<i>Obergurgl, Austria</i> |
| June 2007 | ChEss SSC meeting
<i>In conjunction with the 30th anniversary of vent discovery</i>
<i>Galapagos</i> |
| 27 – 31 Aug 2007 | 42nd European Marine Biology Symposium
<i>Kiel, Germany</i> |
| 4 – 6 Sep 2007 | Russian-Ridge Workshop
<i>Moscow, Russia</i> |
| 25 – 28 Sep 2007 | European Symposium on Marine Protected Areas
<i>Murcia, Spain</i> |
| 19 – 22 Nov 2007 | 10th International Congress of the Brazilian Geophysical Society
<i>Rio de Janeiro, Brazil</i> |
| 19 – 22 Nov 2007 | InterRidge Steering Committee Meeting
<i>Rio de Janeiro, Brazil</i> |

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UPCOMING CRUISES

Country	PI	Cruise ID/Location	Research Objectives	Ship	Dates (Ports)
Germany	S. Petersen	HYDROMAR IV/Logatchev Hydrothermal Field at MAR 14°45'N	Carry out shallow drill holes (15m) in sulfide mounds using BGS Rockdrill 2	R/V Maria S. Merian	8 Nov. - 30 Nov 06 Fort de France - FdF (Martinique)
Germany	C. Borowski	MSM 04/3 Hydrothermal Field at MAR 14°45'N	Hydrothermalism at the Logatchev hydrothermal field as part of the SPP 1144 program; investigation with ROV	R/V Maria S. Merian	Jan 23 - Feb 14 07 Martinique - Las Palmas
France	Y. Fouquet	SERPENTINE - MAR 15°N hydrothermal fields	multidisciplinary hydrothermal studies	R/V Pourquoi Pas? ROV Victor	Feb - 7 March 07 Azores
UK	R. C. Searle (Durham University)	JC007, MAR 13N to 16N	Test the hypothesis that mantle upwelling and melting is focused at the centres of slow spreading ridge segments and transposed by sub-horizontal flow away from there. Test the hypothesis that plate accretion and separation mechanisms are fundamentally different in 'magma-starved' areas. Test mechanisms of detachment faulting and extensional strain localisation in the lower crust and upper mantle.	James Cook	5 March - 17 April 07 Tenerife - Tenerife
France	J. Dymont, F. Gaill	Rainbow hydrothermal fields	multidisciplinary hydrothermal studies + IODP site survey	R/V Pourquoi Pas? ROV Victor	June - 7 July 07 Azores
France	V. Ballu	Lucky Strike hydrothermal field	Recovery of deep sea geodesy instruments from cruise GRAVILUCK 1 (2006)	R/V Pourquoi Pas? ROV Victor	Jul 07 (4 days) Azores
France	J. Escartin A. Deschamps	Lucky Strike hydrothermal field	Mooring of temperature probes preceeding cruise BATHYLUCK 2 (pre-scheduled for 2008)	R/V Pourquoi Pas? ROV Victor	Jul 07 (3 days) Azores
France	P. M. Sarradin	RECO - MAR Lucky Strike hydrothermal field	Recovery of biological experiments from cruise MOMARETO (2006)	R/V Pourquoi Pas? ROV Victor	Jul 07 (3 days) Azores
France	J. Goslin	MARCHE-MAR, azores area	recovery and re-mooring of hydrophons in the SOFAR channel for determination of regional seismicity	R/V Le Suroit	July - 7 Aug 07
Germany	S. Petersen	M73/2 Southeastern Tyrrhenian Sea	Hydrothermalism at the Aeolian Archipelago Carry out shallow drill holes (15m) using BGS Rockdrill I	R/V Meteor	14 -30 Aug 07 Genua - Heraklion
Germany	T. Kuhn	MSM 06/2 Hydrothermal Field at MAR 14°45'N	Hydrothermalism at the Logatchev hydrothermal field as part of the SPP 1144 program; investigation with ROV	R/V Maria S. Merian	18 Oct - 18 Nov 07 Las Palmas - Fortalezza
Germany	C. Devey	MSM 06/3 Hydrothermal Field at MAR 14°45'N	Hydrothermalism at the southern MAR as part of the SPP 1144 program; investigation with ROV and AUV	R/V Maria S. Merian	21 Nov - 22 Dec 07 Fortalezza - Dakar

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