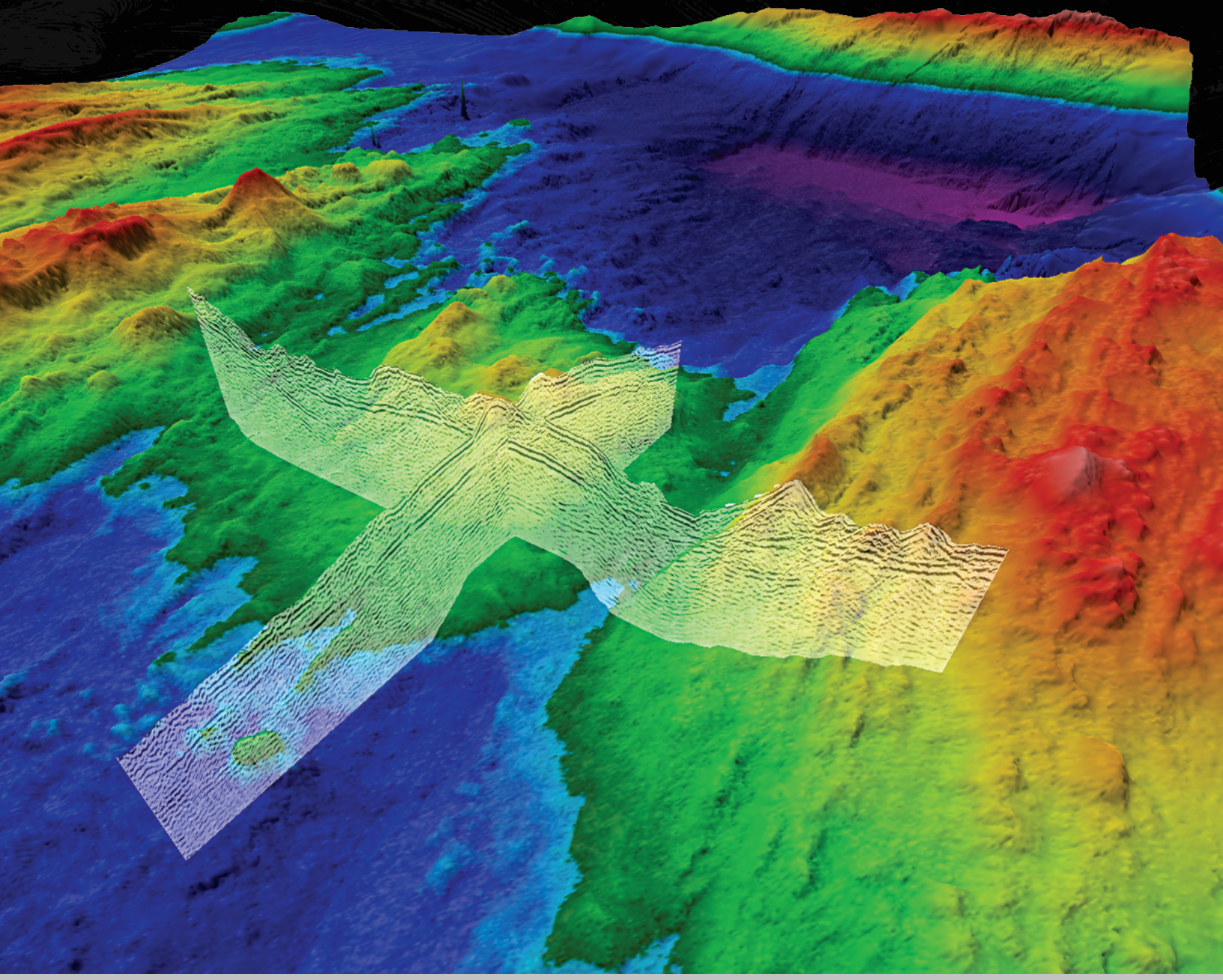
InterRidge News

Promoting international cooperation in ridge-crest studies



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For Contributors
Please send all items for publication via email to the InterRidge Coordinator.

Text should be in Microsoft Word format. Figures should preferrably be sent in eps or tif format for optimal printing, although other formats are accepted.

Deadline for InterRidge News Vol. 18 Contributions
15 September 2009

Letter from the Chairs

Jian Lin and Chris German

In 2009, we will enter the second half of the InterRidge (IR) Next Decade Plan for 2004 - 2013. We are delighted to report that the IR community is thriving! International cooperation on deep-sea research is getting stronger year by year. The tremendous international progress in mid-ocean ridge research is reflected in many exciting news stories reported in this 2008 IR Annual Newsletter.

The goal of the IR program is to advance international deep-sea research and exploration of the global mid-ocean ridge system. We progress towards this goal by creating a global community, planning and coordinating new science programs that no single nation can achieve alone, exchanging information, and sharing new technologies and facilities. IR is also dedicated to reaching out to the public, scientists and governments, and to providing a unified voice for ocean ridge researchers worldwide. Following are just a few examples of exciting progress in 2008 and new developments for 2009.

Progress in regional and national programs of the IR community

In Nov. 2008, the InterRidge-Japan group received great news that their application for a five-year new interdisciplinary initiative called *Project TAIGA* (Trans-crustal Advection and In-situ biogeochemical processes of Global sub-seafloor Aquifer) was funded. This success reflects a major community effort, science vision, and leadership of the InterRidge-Japan group.

Many exciting new developments in the regional and national research and education programs of the IR community, including Brazil, Chile, China, France, Germany, India, Japan, Korea, Norway, Philippines, Russia, UK, and USA, are reported in the *International Research* and *National News* sections of this Newsletter.

In the past year, the IR community expanded from 28 to 30 regional and national memberships with the addition of Chile and Chinese Taipei. The close to 2,500 individual members in the IR community now come from a total of 62 regions and countries with this year's addition of individual members from Colombia, Malaysia, Nepal, and Vietnam.

STOP PRESS: We have just received the fantastic late-breaking news that Jian Lin, IR Chair, has been elected Fellow of the American Association for the Advancement of Science. I hope you will all join with me in congratulating Jian on this prestigious and well-deserved recognition of his outstanding leadership in international education and research! Very best wishes, Chris German (IR Co-Chair).

Progress in IR working groups

In Oct. 2008, the SCOR (Scientific Committee on Oceanic Research) program announced co-funding with IR of a new SCOR working group on "Hydrothermal energy transfer and its impact on ocean carbon cycles." This new SCOR working group is the first to derive from IR activities in over a decade, and the successful proposal was developed from discussions at the 2007 IR Theoretical Institute.

Four new IR working groups (Long-Range Ridge Exploration, Mantle Imaging, Seafloor Mineralization, and Vent Ecology) were set up in 2008. The current and planned activities of the new and existing IR working groups, as well as other IR community science planning efforts, are reported in the *Working Group Updates* and *Workshop Reports* sections of this Newsletter.

Progress in IR outreach, education, and training of young scientists

Recently the International Seabed Authority (ISA) Endowment Fund has approved a three-year grant to co-fund the IR Student and Postdoctoral Fellowship program for 2009 - 2011. This is the first grant of its kind that IR has successfully obtained, and it will directly benefit international cooperation and training of the next generation of leading scientists. This and other news on the IR outreach and education activities are reported in the *Education and Outreach Update* and *Student Fellows* sections of this Newsletter.

We envision that the thrust for the IR program in 2009 will be the full activities of the IR working groups that cover a wide range of exciting research directions of major interest to the international community. As deep-sea research in the IR community is strengthening, we also expect additional upgrades of IR memberships from individual regions and nations. We look forward to another exciting year, working with you all and bringing the IR program to a new level in 2009!

Call for bids to host the next InterRidge Office, 2010 - 2012

Submission deadline: 31 March 2009

In January 2010 the InterRidge Office is due to rotate under the appointment of a new Chair. The full call for bids will be posted in January 2009 on the IR website.

Coordinator Update

Stace Beaulieu

The InterRidge (IR) program office is now in its second year at Woods Hole Oceanographic Institution (WHOI), and we are now almost halfway into the InterRidge Next Decade Plan for 2004 - 2013 (http://www.interridge.org/science/nextdecade).

Membership

The first of the four main functions of InterRidge (http://www.interridge.org/4mainfunctions) is to build and maintain an interactive international ridge-research community. In the past year, IR expanded from 28 to 30 regional and national memberships with the addition of Chile and Chinese Taipei as Corresponding Members. The ~2500 individual members in IR now come from a total of 62 countries with this year's addition of members from Colombia, Malaysia, Nepal, and Vietnam. The biweekly "interridge-mail" e-news is sent to over 1600 IR members, as well as being posted by the InterRidge-Japan program to its e-mail subscribers. We also email job postings ("interridge-classifieds") to over 100 IR members. We have been updating the IR membership list on a regular basis; please email the IR office or log on to your member account if you have changed your mail or email address.

Steering Committee

In October 2008, the IR Steering Committee meeting was held at WHOI in Woods Hole, Massachusetts, USA (photo below). We welcome three new Steering Committee Members for 2009: Dan Fornari (USA, new Chair of Ridge 2000 Program), Hidenori Kumagai (Japan), and Nadine Le Bris (France). For our Members rotating off the Committee, we thank Fernando Barriga (Portugal), Donna Blackman (USA), Françoise Gaill (France), Rosario Lunar (Spain), and Nobukazu Seama (Japan) for their years of leadership and service.

National Correspondents

We thank Steve Scott for serving as National Correspondent for Canada from 2004 - 2008, and Ian Wright for New Zealand from 1998 - 2008.

Working Groups

The second of the four main functions of InterRidge is to identify, through its working groups and workshops, the most compelling questions in ridge research and develop program plans to address these questions. Our eight current working groups cover a wide range of exciting research directions of major interest to the international community. Please find an update for each of our working groups starting on p. 44: Biogeochemical Interactions at Deep-Sea Vents, Deep Earth Sampling, Long-Range Ridge Exploration, Mantle Imaging, Monitoring and Observatories, Seafloor Mineralization, Ultra-slow Spreading Ridges, and Vent Ecology. At least two of our four new working groups will have their first meetings in 2009: Seafloor Mineralization (April 2009) and Vent Ecology (June 2009). We are also pleased to announce the approval of a new SCOR working group, to be co-funded by InterRidge, on "Hydrothermal energy transfer and its impact on ocean carbon cycles." The proposal was developed from discussions at the InterRidge Theoretical Institute (IRTI) on Biogeochemical Interaction at Deep-Sea Vents, held in September 2007. This is the first SCOR working group in over ten years to derive from InterRidge activities.

Workshops

IR co-sponsored the Magellan Workshop on "Lithospheric heterogeneities, hydrothermal regimes, and links between abiotic and biotic processes at slow spreading ridges" in September 2008 in Montpellier, France (see article, p. 51). The Magellan Workshop was relevant to several of our working groups, including Biogeochemical Interactions at Deep-Sea Vents, Deep Earth Sampling, and Ultra-slow Spreading Ridges. IR also sponsored the Monitoring and Observatories working group to participate in the USA Ridge 2000 Mid-Atlantic Ridge Workshop in March 2008 in Portland, Oregon, USA. IR scientists also co-organized and participated in the Qingdao Ocean Sciences Summer School in July 2008 in Qingdao, China (see article, p. 50) and a mid-ocean ridge special session at the Asia Oceania Geosciences (AOGS) Conference in June 2008 in Busan, Korea (see article, p. 52).

IR Steering Committee in Woods Hole, MA, USA, Oct. 2008: Front row (left to right): S. Beaulieu, J. Lin, J. Ishibashi; Back row: S Park, C. Fisher, M. Tivey, J. Chen, J. Dyment, D. Blackman, B. Ildefonse, S. Silantyev, S. Hourdez.

In line with the third of the four main functions of InterRidge, to act as a representative body for international ridge scientists in policy discussions, the IR office held a meeting in January 2008 with the ChEss (Chemosynthetic Ecosystems) office of the Census of Marine Life to discuss deep-sea mining of seafloor massive sulfides. This meeting led to a successful proposal for a policy workshop and public forum planned for

April 2009, sponsored by the WHOI Morss Colloquium program. For more details, please see the update from the working group for Seafloor Mineralization and advertisement on p. 57.

Code of Conduct

We presented the IR Statement of Commitment to Responsible Research Practices at Deep-Sea Hydrothermal Vents at the AOGS 2008 meeting. This "Code of Conduct" has now been endorsed by the ChEss program and adopted by the OSPAR Convention for the Protection of the Marine Environment of the North-East Atlantic. Individual IR members may log on to their user profiles or use the following web address to check a box in support of the statement: http://www.interridge.org/node/add/signstatement.

Databases

Also as part of the Next Decade Plan, the IR office in the past year has significantly revised the databases for ridge-crest cruises and for hydrothermal vents.

Cruise Database. In January 2008 IR launched a revised online database of international cruises to mid-ocean ridges and back-arc basin spreading centers (http://www.interridge.org/IRcruise). The >500 cruises in the database date back to 1982. IR members are able to enter their cruises directly to the database using an online form. IR also maintains an up-to-date list of upcoming ridge-crest cruises. If you would like your cruise to be featured on the IR website's "News from the Ridge Crest" page, please contact the IR office (coordinator@interridge.org).

Vents Database. The IR Coordinator is currently revising the InterRidge Global Hydrothermal Vents Database and will announce it to the community when the update is completed. The Vents Database was requested by a wide range of parties in this past year, including academic and government researchers, NGOs, public museums, private industry and consultants, and Google Earth.

Website

This year, we translated the IR website homepage into the languages of all Principal Member Nations (Chinese, English, French, German, and Japanese) plus Russian. We also hope to translate the IR homepage to additional languages (e.g., Spanish, Portuguese, Korean, Italian, etc.) and welcome volunteers from the IR community on this effort. Our website is updated daily; please feel free to contact the IR Coordinator with news, event listings, and job advertisements for the community.

InterRidge Student and Postdoctoral Fellowship Program: Announcement of partnership with ISA Endowment Fund for 2009 - 2011

We are very pleased to announce a new partnership with the International Seabed Authority (ISA) Endowment Fund for the InterRidge Student and Postdoctoral Fellowship Program. The ISA Endowment Fund is a new program for collaborative marine scientific research, with details and brochure available at: http://www.isa.org.jm/en/efund/. The mission of the ISA Endowment Fund is to support the participation of qualified scientists and technical personnel from developing countries in marine research activities and to provide opportunities for collaboration by these persons. The ISA Endowment Fund will provide funding for two InterRidge Student and Postdoctoral Fellowships each year for the next three years (2009 - 2011). At $5000 US for each Fellowship, our grant totals $30,000 US, and it reflects important progress in our long-term goal of soliciting external grants to strengthen InterRidge activities and promote international cooperation.

The InterRidge Next Decade Plan includes capacity building, or strengthening contacts to the less industrialized or non-coastal nations, heightening the appreciation that the world's oceans are relevant to the lives of all the peoples on Earth. For our next generation of ridge-crest scientists, InterRidge would like to enable individuals from developing countries to participate in research cruises and to obtain training in laboratory techniques for ridge-crest research.

We expect to offer a total of three Fellowships each year for 2009 - 2011 at the level of $5000 US for each Fellowship. One of the Fellowships is solely funded by InterRidge, which is open to a graduate student or postdoc from any nation. The remaining two Fellowships are funded by the ISA Endowment Fund, with the requirement that the graduate student or postdoc is either from a developing country or will assist in training those of a developing country. All Fellowships will have the same application form, and all proposals will undergo the same rigorous scientific review by InterRidge. Ranking of the applications will be based on several factors ranging from the quality and expected significance of the science to the fellowship providing an opportunity that the student is otherwise not likely to experience.

For more details on this announcement, please see: http://www.interridge.org/node/5675. The call for proposals for 2009 Fellows will be released in January 2009 on the IR website, and proposals will be due 31 March 2009.

Education and Outreach Update

S. Beaulieu

One of the four main functions of InterRidge (http://www.interridge.org/4mainfunctions) is, through education and outreach, to communicate the importance and excitement of ridge research to the general public and decision makers worldwide. Education and outreach (E&O) activities are also prominent in the InterRidge Next Decade Plan for 2004 - 2013 (http://www.interridge.org/science/nextdecade). In February 2008, our previous E&O Coordinator, Kristen Kusek, accepted a new position as director of public relations for the Earthwatch Institute. We thank Kristen for her outstanding service to InterRidge - both for her industrious contributions and her infectious good humor when working with the IR Office in Germany and Woods Hole. InterRidge's E&O activities in 2008 were conducted by the IR Coordinator, Stace Beaulieu.

Qingdao Ocean Sciences Summer School

InterRidge reached out to students of our newest Principal Member Nation at the Qingdao Ocean Sciences Summer School in Qingdao, China, in July 2008 (see article, p. 50). This Summer School was one of the largest gatherings ever held for graduate students in biogeosciences and oceanography in China. Approximately 200 students and 40 speakers participated in the event, entitled "International Advances in Deep-Sea Geo-Bioscience Research."

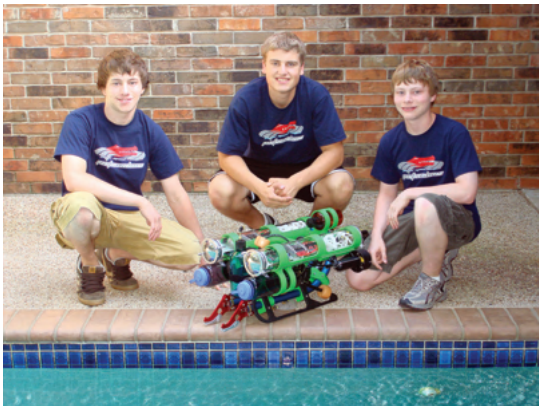
MATE International Student ROV Competition

The Marine Advanced Technology Education Center International Student ROV competition (http://www.marinetech.org/rov_competition/2008/index.php) was held at Scripps Institution of Oceanography in San Diego, California (USA) in June 2008. This year, the theme was "Discovering the Mysteries of Mid-Ocean Ridges," sponsored in part by the USA Ridge 2000 (R2K) Program. Student teams built ROVs for missions that simulated work at hydrothermal vents, such as measuring temperature at a black smoker, collecting sulfide and basalt samples, collecting vent crabs, and recovering an ocean bottom seismometer. In addition to building the ROVs, the students prepared technical reports and poster displays to describe their work. A total of 51 teams from 5 countries (Canada, China, Russia, UK, and USA) competed in the event. The competition was organized in two groups: "Ranger" teams, which consisted mainly of high school students, and "Explorer" teams which included college and university students. IR provided monetary awards of $250 each to two teams, plus an honorable mention. These teams' reports are posted on the IR website at: http://www.interridge.org/node/4902. Stace Beaulieu (IR Coordinator) and Donna Blackman (R2K Chair and IR Steering Committee member) served as judges at the competition.

For the Explorers, the InterRidge Award for Hottest Hydrothermal Vent Team went to Flower Mound High School, Flower Mound, Texas (USA). The Flower Mound High School team compared their ROV, "Petsuchos," to the French ROV *Victor 6000* working at the Mid-Atlantic Ridge. In particular, they pointed to the use of ROV *Victor 6000* in multi-disciplinary studies of the Rainbow hydrothermal site. To quote their report, "... we can see how the use of the unmanned ROV can help with the scientific exploration in extreme environmental conditions."

For the Rangers, the InterRidge Award for Hottest Hydrothermal Vent Team went to a group of students sponsored by the New York City Home Educators Alliance (USA). They compared their ROV, "gROVer," to the Canadian ROV *ROPOS* working at the Juan de Fuca Ridge. They met with

MATE ROV Explorer Team Award: Flower Mound High School team members include Collin Cragin, Luke Cragin, Nathan Georges, and Sung Ho Park.



MATE ROV Ranger Team Award: NYC ROV team members include Raph Hubbard, Joshua Rosenthal, Aviv Crowell Lang, Spencer Yamada, and Cole Houston.

Dr. Ed Mathez, curator at the American Museum of Natural History, to learn about the collection of the black smoker chimney on display at the museum. To quote their report, "In the process of preparing for the competition, we researched a team that brought black smokers to the surface. We learned that, while our missions are very different, the challenges and obstacles we face are very similar."

We also awarded an overall Honorable Mention to the Ranger team from Edgewater High School, Orlando, Florida (USA). This team's poster was the most effective in conveying to a general audience the importance of research at mid-ocean ridges. They compared their ROV, "Caprimulgus," to MBARI's ROV *Tiburon* working at the Juan de Fuca Ridge. As part of their fundraising and outreach, they set up a booth at a local farmer's market at which they practiced presenting and answering questions about their ROV and educated visitors about ROVs and mid-ocean ridges.

Other E&O activities in 2008

- Interview for IMarEst's Marine Scientist magazine: "Keeping an eye on the deep sea" (posted on the IR website);
- Two presentations for the Children's School of Science in Woods Hole, Massachusetts (USA) in July 2008;
- Presentation to Woods Hole Oceanographic Institution Ocean Science Journalism Fellows in September 2008. The journalists hailed from an impressive range of news outlets such as Scientific American, the Los Angeles Times, Yomiuri Shimbun (the largest daily newspaper in Japan), public television and public radio affiliates, and Climate Wire.

E&O activities planned for 2009

In 2009 we will be highlighting the IR Global Hydrothermal Vents Database on our website and Google Earth. We proposed two major E&O activities for 2009 at the recent IR Steering Committee meeting. Each of the activities involves ridge science in multiple languages. At the end of this year, we will announce which of the two activities we will pursue.

2008 InterRidge Student Fellows

As part of our mission to promote interdisciplinary, international collaboration for research of oceanic spreading centers, and to reach out to the next generation of ridge-crest scientists, we initiated the InterRidge Student Fellowship Program in 2008 with a call for proposals for two fellowships of up to $3000 US each. These fellowships can be used for any field of ridge-crest science. In particular these awards are encouraged to be used for international cruise participation, international laboratory use, and adding an international dimension to a student's thesis work. Please note that our Fellowship Program is expanded for 2009 - 2011 with a partnership with the International Seabed Authority Endowment Fund as mentioned in the Letter from the Chairs and the announcement on p. 3.

The InterRidge Steering Committee is very pleased to announce our 2008 InterRidge Student Fellows: **Michelle Harris**, a Ph.D. candidate at the National Oceanography Centre (NOC), UK, to work at a laboratory in Canada, and **Kerry Howard**, a Ph.D. candidate at Cardiff University, UK, to conduct research in France.

The competition was very strong for these two awards. All applicant proposals were reviewed by two topical science reviewers (one a native and the other a non-native English speaker). The Steering Committee then ranked the proposals, using criteria ranging from the quality and expected significance of the work to whether the fellowship would provide benefits to the student beyond just an addition to their thesis research, e.g., establish new collaboration, provide experience in communicating science outside of their native language. There was much discussion about the review process itself, and we learned a lot in this first year and will continue to improve the Fellowship Program in the years ahead. We are grateful to the major efforts of all student applicants and their advisors and sponsors,

as well as the thorough evaluations by all reviewers.

Michelle Harris - The title of Harris's project is "An oxygen isotope investigation of an intact section of upper ocean crust." Harris will analyze samples obtained at ODP/IODP Hole 1256D on the flank of the East Pacific Rise. These data will supplement existing whole rock oxygen data and be combined with strontium isotope data from the same samples to quantify fluid flow in the Site 1256 upper crust. Harris is advised by Prof. Damon Teagle and Dr. Tim Henstock at NOC, and the fellowship will be conducted with Dr. Neil Banerjee at University of Western Ontario, Canada.

Harris received an undergraduate degree in Geology at University of Leeds, UK. As part of her degree, she studied at the University of California Santa Barbara (UCSB), and Harris writes, "It was during my time at UCSB that I became interested in marine geology and hydrothermal systems and on my return to Leeds worked on some gabbro samples from IODP Hole 1309B with Dr A. McCaig for my Masters project." She decided to apply for a Ph.D. program because of her strong interest in mid-ocean ridges and their hydrothermal systems. Her thesis is investigating the role of hydrothermal fluids during the accretion of fast spread ocean crust using isotopes as tracers of fluids and diffusion modeling to determine cooling rates for samples from ODP Hole 1256D and also from Hess Deep. She will integrate these results into thermal models of crustal accretion to test potential geometries of crustal accretion.

Michelle Harris: holding a gabbro sample recovered from Hess Deep using the ROV *Isis* on RRS *James Cook* Cruise JC 21 in Jan. - Feb. 2008.

Kerry Howard - The title of Howard's proposal is "Accretion of fast-spread lower oceanic crust at Hess Deep." On the walls of the Hess Deep rift valley, a section of crust from the East Pacific Rise is exposed. Howard will conduct petrographic analyses, including electron backscatter diffraction measurements of crystal lattice-preferred orientations, for samples obtained with ROV *Isis* in 2008. Howard is advised by Dr. Chris MacLeod and Prof. Julian Pearce at Cardiff University, and the fellowship will be conducted with Dr. Benoît Ildefonse at Université Montpellier II, France.

Howard writes, "I developed an interest in geoscience somewhat later in life than many, but was so intrigued by it that I abandoned my 'normal' life to become an undergraduate at Leicester University." She developed an interest in igneous petrogenesis and geochemistry, and after receiving her undergraduate degree worked as research assistant to Dr. Laurence Coogan (University of Victoria, Canada), analyzing samples from the Oman ophiolite in order to investigate focused fluid flow at fast-spread mid-ocean ridges. After a short break from geology, she commenced a Ph.D. studentship at Cardiff University, investigating lower crustal accretion mechanisms at fast-spread mid-ocean ridges. Regarding her samples from the RRS *James Cook* JC21 research cruise to Hess Deep, Howard continues, "I am now looking forward to analysing these samples in a variety of ways, including the use of EBSD that has been made possible by this award. My current interests are mid-ocean ridges and ophiolites, and how insights into magmatic processes can be gained by combining fabric analyses with geochemistry."

Kerry Howard: at the University of Bergen in June 2008 using an electron probe to analyze olivines, pyroxenes, and plagioclase in samples recovered from the Hess Deep.

International Research:
MID-ATLANTIC RIDGE

Cruise MARCHE3/2008 and other cruises of the MARCHE experiment: a three-year hydroacoustic monitoring of the MOMAR section of the MAR at a regional scale

The MARCHE team: J. Goslin (PI)[1], N. Lourenço[2], J. Luis[3], R. Dziak[4], A. Balanche[1], C. Brachet[1], J. Perrot[1], J.-Y. Royer[1], N. Simão[1], J. Haxel[4], H. Matsumoto[4]

Abstract

The Mid-Atlantic Ridge Comprehensive Hydrophone Experiment (MARCHE) completed a long-term acoustic monitoring effort on the seismic activity of the MOMAR area and several segments of the Mid-Atlantic Ridge (MAR), southwest of the Azores Archipelago. The monitoring was achieved over a three-year period, which extended from July 2005 to mid-August 2008, by the deployment of the "MARCHE array" of four autonomous hydrophones (AUHs) moored in the SOFAR channel. The deployment, turn-over, and recovery of the array required five cruises. The MARCHE3 cruise, which sailed from 13-20 August 2008, was the final recovery cruise of the array.

Based on the statistics derived from the data recorded during the first two years of the deployment of the MARCHE array, we anticipate that ~8000 events will be detected and localized during the total deployment period. Preliminary interpretations of the spatial and temporal distributions derived from this catalog provide major insights on the processes active along the MOMAR section of the MAR, a region of sustained international research effort. The simultaneous deployment during 2007-2008 of the hydrophone array and of seafloor instruments on the Lucky Strike hydrothermal site will allow fruitful comparison between the inputs of the two techniques to the study of slow-spreading ridge processes.

1. Rationale for the deployment of the MARCHE hydrophone array and overall organization and schedule of the MARCHE experiment

The need for a multi-year acoustic monitoring of the MOMAR area by a dedicated array of AUHs sprung from two main observations:

- First, the multi-year, multiple turn-over deployment of the South Azores array (Feb. 1999 - June 2005) showed that, in spite of a constant seismic activity, the MOMAR section of the MAR was the location of relatively few seismic sequences. Eleven seismic sequences were observed during this period between 15°N and the Azores, which included between 39 and 198 events (Table 1; Simão et al., 2006). Among these, only one swarm occurred close to the Lucky Strike hydrothermal field on 16 March 2001 (Dziak et al., 2003; Dziak et al., 2004; Simão et al., 2006; Simão et al., in prep.).
- Second, the MOMAR section of the MAR is located in between the arrays which were previously deployed north (SIRENA array, see Goslin et al., 2004, and http://www-sdt.univ-brest.fr/internet/recherche/Chantiers/sirena) and south of the Azores (South Azores array). The monitoring of the MOMAR section was therefore inadequately achieved by these arrays.

Table 1: Event clusters detected along the MAR by the South Azores hydrophone array. The 16 March 2001 cluster is the only one during this 6-yr period to have occurred close to the Lucky Strike hydrothermal field (at 37°17.5'N, 32°16.5'W).

Date	Number of events	Mean latitude	Mean longitude
1999 04 06	165	24.364	-46.335
2000 02 18	39	16.553	-46.578
2000 10 05	111	31.605	-40.850
2001 01 12	45	26.450	-44.672
2001 02 28	96	28.981	-43.397
2001 03 16	128	37.360	-32.302
2001 07 13	64	28.644	-43.340
2001 11 12	52	22.218	-45.049
2001 12 13	59	26.899	-44.306
2002 03 24	198	24.319	-46.361
2004 04 16	54	32.827	-39.356

[1]UMR CNRS-UBO 6538 Domaines Océaniques, Université Européenne de Bretagne, Brest, France; [2]Estrutura de Missão para a Extensão da Plataforma Continental, Paço de Arcos, Portugal; [3]Centro de Investigação Marinha e Ambiental, Universidade do Algarve, Faro, Portugal; [4]PMEL/NOAA, Newport Oregon, USA

It was therefore decided to achieve a three-year monitoring of the MOMAR area by deploying and turning over an array of four AUHs, deployed west and south of the Azores, on both flanks of the MAR. Table 2 summarizes the various operations conducted within the framework of the MARCHE experiment.

2. Some earthquake statistics derived from the MARCHE hydro-acoustic data

The first two deployments (Goslin et al., 2008) allowed localization of a total of 4445 events. A total of 149 of these events occurred in a 1°-square area approximately centered on the Lucky Strike (LS) hydrothermal site (see white frame on Fig. 1). Only two events are listed in the catalog compiled by the National Earthquake Information Center of the U.S. Geological Survey for the same area and period. Among the events localized within the 1°-square area, 26 were localized with errors smaller than 2.5 km in both latitude and longitude by the four MARCHE AUHs.

The distributions of AUH-detected events vs. time show both long- (~one year) and short-period variations. For the short-term variations, activity is separated by periods of quiescence lasting up to several weeks, during which no event was detected in the area (Fig. 2).

Finally, Fig. 2 indicates that no event cluster has been detected in the vicinity of the Lucky Strike site during the first two years of deployment of the MARCHE array. One seismic sequence was observed by the MARCHE array on 13 February 2007. It included 55 events and its mean location was 36.085°N, 33.942°W.

Table 2: Operations conducted within the framework of the MARCHE experiment.

	Deployment (D), turn-over (TO), or recovery (R) cruises	Mooring operations & data recovered
1st deployment (July 2005 - April 2006)	KNORR 182 Leg 3 (D) (R/V *Knorr*)	M6 & M7 moored
	Hydro-MOMAR-05 (D) (R/V *Arquipélago*)	M2 & M8 moored
2nd deployment (April 2006 - August 2007)	MARCHE (R/V *Le Suroit*) (TO)	4 instruments turned-over, 2375 events localized
3rd deployment (August 2007 - August 2008)	MARCHE 2 (R/V *Le Suroit*) (TO)	3 instruments recovered, 2070 events localized; 4 instruments moored
Final recovery of the MARCHE array	MARCHE 3 (NRP *Alm. Gago Coutinho*) (R)	4 instruments recovered

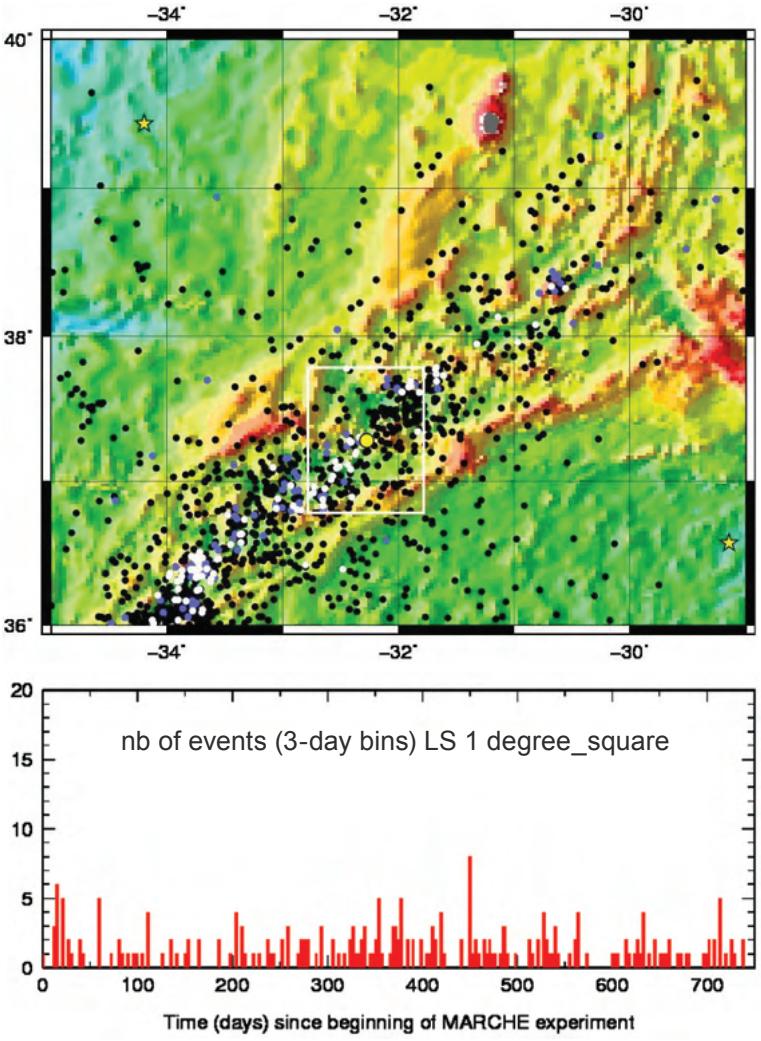


Figure 1: (upper) Black dots show the epicenters of earthquakes localized by interpreting acoustic signals recorded by the MARCHE array during its first two deployments (26 Jul. 2005 - 12 Apr. 2006 and 17 Apr. 2006 - 1 Aug. 2007). Epicenters localized by all four instruments of the first deployment are shown as blue dots. Among these, the subset of events located with an error <2.5 km in latitude and longitude are plotted as white dots. The yellow circle shows the position of the Lucky Strike hydrothermal field. The two yellow stars, in the NW and SE corners of the map, indicate two of the four sites where hydrophones of the MARCHE array were deployed.

Figure 2: (lower) Number of events vs. time in the one-degree box around the Lucky Strike hydrothermal site (see location of white frame on Fig. 1). The time origin of the plot is the beginning of the first deployment. The transition between the first and second deployment occurred between day 260 and 265.

3. Work in progress and future experiments

Interpretation of the signals recovered in August 2008 is presently in progress. Based on the statistics above, it is expected that more than 8000 events will be detected and localized by the MARCHE array during its 3-year deployment period.

Further analysis on the time- and space-distributions of events over the entire MOMAR area will be conducted as soon as the three-year catalog is completed and will provide new insights into active processes along the MOMAR section of the MAR.

Additional work in progress includes a Ph.D. thesis by Abel Balanche, expected to be completed soon. This work achieved a 2D finite-element mechanical model of the conversion process between seismic and acoustic waves at the seafloor interface. This model shows that a double-couple source mechanism produces T-waves which can enter the SOFAR channel with adequate angles to be trapped into this channel. It also confirms that a source with a high S-wave content is more efficient in producing T-waves than a simple explosive source that only generates P-waves (Balanche et al., 2007). This work will allow a more accurate determination of earthquake magnitudes from the amplitudes of the acoustic signals recorded by AUHs.

Further development of AUHs is presently underway in Brest. The prototype was successfully tested in shallow water in July 2008. We plan to test it in real operational conditions offshore Villefranche-sur-Mer before the end of this year. After this second test is completed, a first array of four instruments will be assembled and deployed at the MARCHE sites in 2009, thus continuing the monitoring of the MOMAR section of the MAR at a regional scale.

4. Web sites related to the MARCHE experiment

Additional information on MARCHE, including the preliminary cruise reports related to the first two deployments, can be accessed through links from the MARCHE web home page: http://www-sdt.univ-brest.fr/internet/recherche/Chantiers/marche. Additional information on MOMAR and previous acoustic monitoring in the region (the SIRENA and South Azores arrays) can be found at: http://www.momar.org.

5. Acknowledgments

The scientific parties on board R/V *Knorr*, R/V *Arquipélago*, R/V *Le Suroit* and NRP *Alm. Gago Coutinho* wish to thank the ships' masters, the officers and crews of these four ships for their efficient seamanship. The French Ministry of Research funded ship time for the three cruises sailed aboard *Arquipélago* and *Le Suroit*. The Portuguese Estrutura de Missão para a Extensão da Plataforma Continental (EMEPC) and its Director, Pr. M. Pinto De Abreu, secured shiptime on NRP *Alm. Gago Coutinho* to sail the MARCHE3/2008 cruise. Salaries and travel costs were provided by the universities and institutions to the nationals of the three countries involved. The cost of developing and building the MARCHE hydrophones, the deployment costs and the freight costs were shared between the NOAA Ocean Exploration Program, the French CNRS/INSU (Institut National des Sciences de l'Univers), and the MOMAR-France Program.

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please refer to the cover image and photos, the national news for France,
and the update from the Monitoring and Observatories Working Group.
www.momar.org

R/V *Celtic Explorer* cruise to survey and sample the V-shaped ridges, south of Iceland: testing the heartbeat of the Iceland Plume

Bramley Murton[1], Stephen Jones[2], Gavin Elliot[1], Stephanie Ingles[1], Godfrey Fitton[3], and Nicholas White[4]

V-Shaped Ridges (VSRs), developed in oceanic crust to the south of Iceland (Fig. 1), are the world's best window into the time-dependent dynamics of mantle convection (Vogt 1971, 1974, 1979; Vogt and Avery 1974). It is generally agreed that VSRs result from melting anomalies that propagate outward from Iceland, but the cause of the melting anomalies and what drives the mantle flow that carries them are debated. From their geometry, the VSRs appear to derive from perturbations in mantle melting that advect away from Iceland at a rate of 20 cm per year (Murton and Parson 1993; Jones et al. 2002). This astonishing velocity is 10 times faster than the adjacent mid-ocean ridge spreading rate, and the fluctuations in melting have affected the adjacent continental margins and deep ocean circulation throughout the Eocene. Previous work in this region, which acquired detailed bathymetry and collected and analysed basalt samples from the Reykjanes Ridge, concluded that the VSRs were the result of anomalous regions of southward advecting asthenosphere that yield higher degrees of mantle melting (Taylor et al. 1995, 1997; Murton et al. 2002).

The new survey, on board the Irish research ship R/V *Celtic Explorer* with PIs SJ and BM, acquired essential bathymetric data and volcanic samples of the VSRs. These will be used to answer questions about temporal variation in mantle convection. They will also contribute to site survey data in support of IODP proposal 646-Full (lead PI BM; proposal summary available at: http://www.interridge.org/files/interridge/646-Full_Cover[1].pdf). The survey, on cruise CE008 from 20 April - 16 May 2008, covered one of the VSRs (VSR2W) developed in oceanic crust south of Iceland.

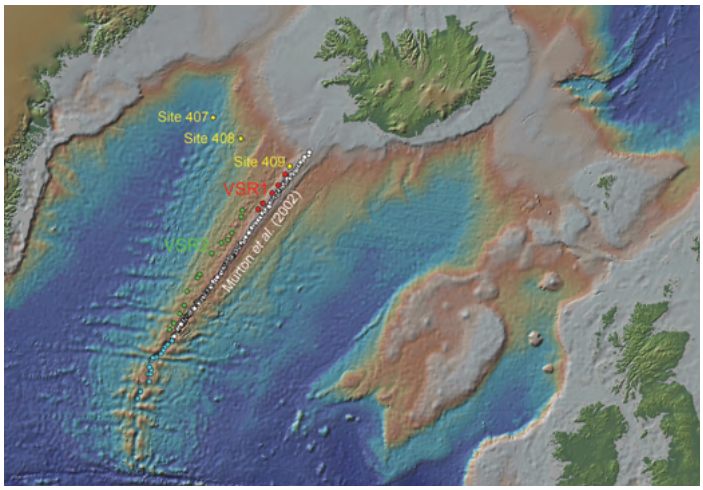

Figure 1: V-shaped ridges southwest of Iceland are revealed by the free air gravity field. White dots are the locations of samples taken in the 1990's (Murton et al. 2002). The blue, green and red dots are the locations of the R/V *Celtic Explorer* samples on the southern Reykjanes Ridge, VSR2W, and VSR1W respectively.

We collected a total of 80 new samples from 33 dredge stations and bathymetrically surveyed the entire strike of VSR2W using the portable multibeam echosounder system 'RESON SeaBat 8160' (Fig. 2). These new data are the first to have been collected from the off-axis VSRs since the first reflection seismic survey that lead to discovery of the VSRs in the 1960s. Initial results show that the VSRs are the result of thermal and compositional fluctuations that propagate out from Iceland at a rate of up to 20 cm per year over a distance of 1000 km. These fluctuations are wholly compatible with an origin within an upwelling mantle plume beneath Iceland, where composition and temperature appear to be intrinsically linked, and which is deflected southwards along the Reykjanes Ridge. Further isotopic and trace element analyses are underway which, by comparison with the Reykjanes Ridge geochemical data, will be used to test hypotheses for the geometry of the wedge of asthenospheric mantle as it advects away from Iceland.

Acknowledgements

Other seagoing scientists and students involved with cruise CE008 include: Garath Roberts and Sarah Nixon (Cambridge), Janine Guinan, (Marine Institute, Ireland), Samantha Unsworth (NOCS), Cora McKenna (University College, Cork), and Zara Archibald and Catherine Breheny (National University of Ireland, Galway). The work was only possible due to the dedication of the crew and officers of the R/V *Celtic Explorer* who managed to cope with adverse and, at times, extreme North Atlantic weather conditions (Fig. 3). We are also indebted to John Davis and Tim LeBas (NOC) and Danny Wake (Reson Offshore Ltd.) for assistance in the initial Reson set-up. Ship time and logistical support was granted to SJ by the Science Foundation, Ireland and the Marine Institute, Ireland. Support for the Reson multibeam echosounder and dredging was granted to BM and GE from a UK-IODP grant (NE/G001251/1), titled "Site Survey for IODP Proposal 646-Full: Icelandic V-Shaped-Ridges."

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[1]National Oceanography Centre (NOC), Southampton, UK; [2]Trinity College, Dublin, Ireland; [3]University of Edinburgh, UK; [4]University of Cambridge, UK

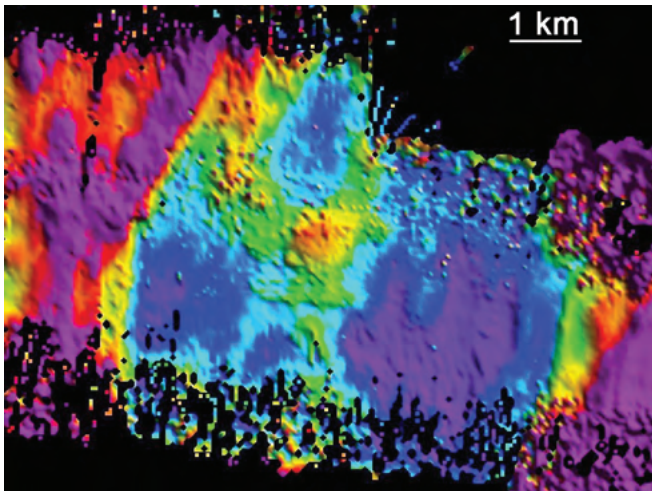

Figure 2: (left) A segment of raw Reson 8160 multibeam data (grid node spacing 50 m) showing a seamount and scarp (sampling targets on VSR2W). The multibeam swath echosounder was fitted to the hull of the R/V *Celtic Explorer* especially for the survey and achieved a swath width of ~3 km in 2000-m water depth.

Figure 3: Able-bodied seaman 'Vinney' and bosun 'Davey' celebrate a haul of fresh glassy basalt from VSR2W, SW of Iceland.

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Structure and development of the axial volcanic ridge: Cruise JC24 to the Mid-Atlantic Ridge, 45°N

Roger Searle[1], Bramley Murton[2] and the JC24 Shipboard Scientific Party (Kay Achenbach[1], Pedro Ferreira[3], Tim LeBas[2], Chris Mallows[1], Kirsty Morris[2], Nicole Schroth[2], Maurice Tivey[4], Peter van Calsteren[5], Chris Waters[4] and Isobel Yeo[1])

Background and objectives

This study grew out of discussions at the 1st InterRidge Theoretical Institute on "The Thermal Regime of Ocean Ridges and Dynamics of Hydrothermal Circulation" at Sestri Levanti, Italy, in September 2002. The workshop led to one of us (RS) convening, with Jian Lin (current InterRidge Chair), a special session at the EGS-AGU-EUG Joint Assembly in April 2003 on "High Resolution Geophysical Imaging and Geological Sampling Studies of Young Ocean Floor," at which RS, BM, MT and others began the planning of this project.

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Axial volcanic ridges (AVRs) appear to be nearly ubiquitous but non-steady state features of slow-spreading ridge segments. They are tens of kilometres long, a few kilometres wide and a few hundred metres high. They consist of thousands of small, circular volcanoes that presumably overlie fissures and feeder dykes (Smith and Cann, 1993; Head et al., 1996; Lawson et al., 1996) and therefore should reflect the composition and development of the uppermost part of the effusive layer of the oceanic crust and its mantle sources. Individual volcanoes range from single small cones ~100 m in diameter to large, flat-topped edifices ~2 km in diameter and occur singly, in rows or piled into larger edifices. Differences in the appearance of individual AVRs (e.g., freshness of volcanic structures, degree of tectonism) suggest an evolutionary model (Parson et al., 1993; Head et al., 1996; Briais et al., 2000), in which early voluminous sheet flows give way to fissure volcanism that is increasingly focussed into central volcanoes. This model is as yet untested. AVRs are thought to contain the youngest seafloor in any segment (Hussenoeder et al., 1996; Smith et al., 1999; Briais et al., 2000), though estimates of their duration range from ~25 ka (Ballard and Van Andel, 1977; Barclay et al., 1998) to ~600 ka (Thatcher and Hill, 1995; Searle et al., 1998).

The objectives of this study are therefore:

1. To date the growth of an AVR and hence infer rates of melt supply to the crust;
2. To determine the structural, age and compositional relations between different volcanic units of the AVR;
3. Hence, to test published models for AVR formation;
4. To infer the nature and variation of mantle sources and their melting histories.

Shipboard operations

To address these issues RRS *James Cook* (cruise JC24) visited the Mid-Atlantic Ridge at 45°30'N in May - June 2008, where the half-spreading rate is 11 km Ma^{-1}, and a well-developed AVR exists with strong geochemical diversity (Keeton and Searle, 1996; www.petdb.org). We carried out a detailed study of the AVR using the TOBI deep-towed vehicle (Flewellen et al., 1993) and the ROV *Isis*. We also used Mini-Autonomous Plume Recorders (MAPRs; Baker and Milburn, 1997), both deployed from TOBI and in separate "tow-yo" surveys, to search for hydrothermal plumes in the area. In addition to the shipboard scientific party, our team includes shore-based colleagues Jon Davidson and Yaoling Niu (Durham University), Ken Sims (WHOI), Louise Thomas (Open University), and Milène Cormier (University of Missouri).

The cruise began with a 7-day TOBI survey, guided by an earlier low-resolution bathymetry map (Keeton and Searle, 1996), in which we first insonified the AVR from each side with N-S survey lines, followed by an interleaving survey plan to cover the AVR with 22 E-W lines spaced about 1.4 km apart (Fig. 1). The primary aim of these E-W lines was to give a dense grid of near-bottom magnetic field observations; however, with TOBI's 3-km-range, 6-m-resolution sidescan sonar, this survey plan also provided complete sidescan coverage in all four orthogonal look-directions. During the course of this survey, two MAPRs (courtesy of Ed Baker, NOAA) were deployed on a cable below TOBI, which was towed at about 400-500 m above the seafloor. These supplemented TOBI's own CTD and light scattering sensor to provide a continuous vertical array of water column measurements.

During the TOBI survey, which was conducted at about 2 knots, we also ran the ship's EM120 multibeam echosounder.

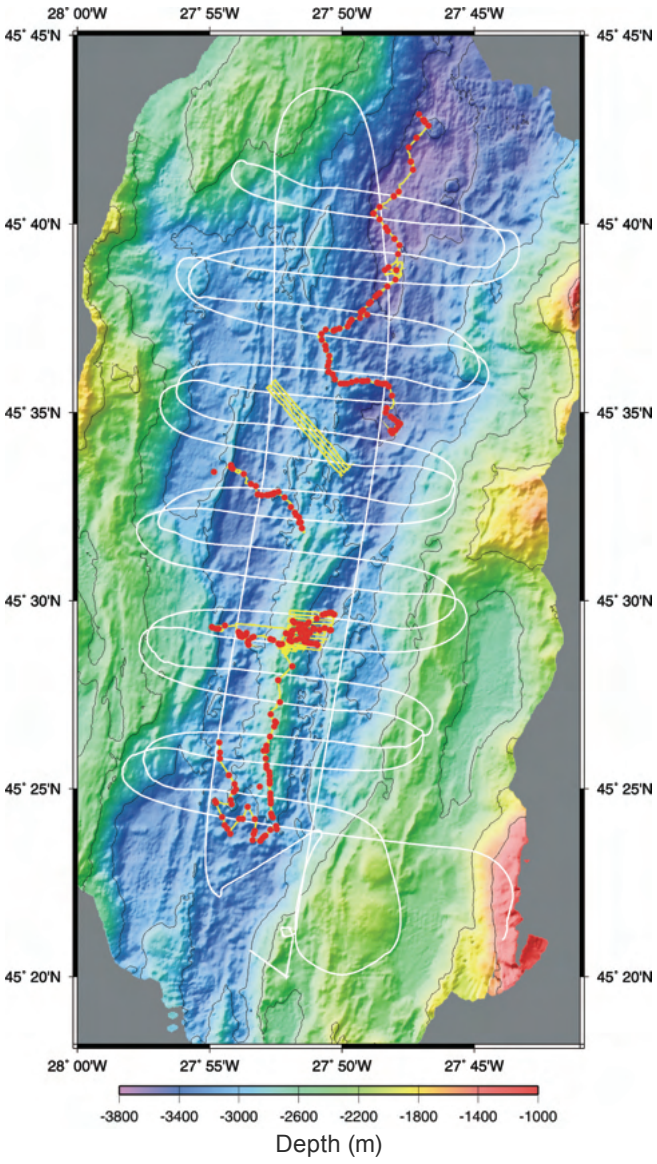

Figure 1: Shaded relief bathymetry of the 45°30'N area with JC24 operations superimposed. Black lines, 500m contours; white line, TOBI track; yellow lines, ROV *Isis* tracks; red dots, sample positions (note that *Isis* tracks are obscured by the sampling symbols). The AVR lies between the two N-S TOBI tracks and is roughly outlined by the 3000-m contour.

The slow ship speed and closely spaced tracks resulted in a large degree of over-sampling with the multibeam, and enabled us to produce a gridded Digital Terrain Model (DTM) with a horizontal resolution of ~50 m (Fig. 1).

TOBI position was initially estimated from a combination of vehicle depth and tow-cable length using a dynamic tow-cable simulation, and sidescan mosaics were prepared using PRISM software (Le Bas, 2005). The sidescan and bathymetry were then compared, and positions of salient features were found to agree to within 500 m or less. Control points were then manually selected by visually matching common features in the two datasets, and used to produce a corrected TOBI track. Subsequently, GPS/USBL-navigated *Isis* bathymetry was compared, and positions of the re-navigated sidescan were found to agree with the *Isis* bathymetry to within a few tens of metres.

TOBI total magnetic field data were inverted with bathymetry to produce crustal magnetisation maps (Parker and Huestis, 1974; Guspi, 1987). Since magnetic palaeointensity increased approximately monotonically from ~45 ka to ~3 ka (McElhinny and McFadden, 2000), we took crustal magnetisation as an approximate proxy for age and used the magnetisation map to help target *Isis* dives. The map showed high magnetisation in the southern half of the AVR (which is also slightly shallower overall), particularly near its southern tip; there was also a high magnetisation area on the median valley (MV) floor to the NE of the AVR.

We used a combination of the EM120 bathymetry, TOBI magnetisation and especially TOBI sidescan to plan *Isis* dive tracks (Fig. 1). The aim was to provide representative imaging and sampling of different parts of the AVR and its surroundings, to investigate the relations among and within different volcanic units, and to sample as broad an age range as possible. *Isis* is instrumented with a range of video cameras and CTD; we added a three-component magnetometer (from WHOI) and, for some dives, MS2000 high-resolution multibeam bathymetry and/or MAPRs. *Isis* also may sample up to ~65 kg: as well as rocks, we also collected samples of deep-sea corals. On most dives, we attempted to sample each significantly different volcanic unit (e.g., individual small cones or haystacks, major lava flow fronts), either side of significant lithological or structural boundaries, and other outcrops provided by faults, etc. The northernmost dive targeted an area of extensive flat MV floor associated with high magnetisation that might have represented the beginning of a new cycle of AVR building. Two dives (near 45°35'N and 45°29'N, Fig. 1) were dedicated to MS2000 surveys, which were flown some 100 m above the seafloor, out of visual range of the bottom. With tracks spaced ~180 m apart, we obtained essentially complete coverage with 2.8-m grid spacing.

Finally, during instrument down-time or when the weather was too poor for *Isis* operations, we conducted a number of "tow-yo" MAPR wire-line surveys to supplement the measurements made during the TOBI survey.

Preliminary results

Thirteen *Isis* dives were completed. Three included along-axis coverage of the AVR, seven investigated the flanks, three touched on older rocks exposed by the MV wall faults or outcropping above them, and six included investigation of the MV floor around the AVR. We recovered 270 rock samples (almost all basalt) and 56 biological samples. Rock samples were described on board and any external glass removed and separately curated.

Typical volcanic "hummocky" terrain extends the whole length of the AVR from ~45°24'N to ~45°40'N. However, north of 45°33'N, the AVR has lower topographic relief, lower magnetisation, and increased levels of tectonism, suggesting this is older than the southern half. The AVR contains only one or two large (~2 km diameter) flat-topped seamounts, though several more occur on the surrounding MV floor. Volcanism on the AVR is largely confined to a very large number (estimated at ~3000) of small volcanic centres. These tend to be aligned along a number of N-S ridges, especially in the central part of the AVR. A surprising observation was the high angle of repose of many of the seamount flanks. In places, near the summit of these seamounts, haystacks of basaltic pillow lavas forming slopes in excess of 60° were encountered. We ascribe these steep slopes to the high viscosity of erupted magmas due to their extensive cooling during ascent through the highly permeable volcanic carapace.

Small spurs aligned at right angles to the main AVR trend are common on its flanks, and usually comprise single lines of small volcanoes, often overlapping. The general sense appears to be of magmatism initially focused near the AVR axis and subsequently building edifices outwards along the lines of

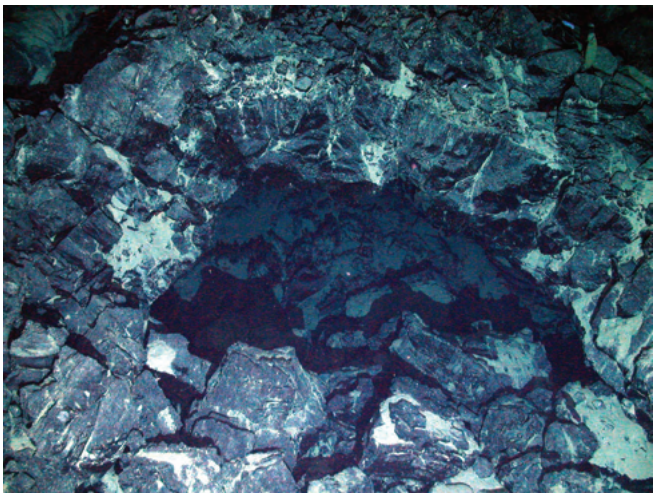

Figure 2: Hollow lava tube in the median valley (MV) floor flanking the AVR.

greatest topographic gradient. A few much larger spurs occur (e.g., near 45°31'N, 27°51'W), and usually trend NNE. They appear to be controlled by underlying oblique tectonic trends associated with the dextral non-transform offset to the next segment north.

In some places the hummocky volcanoes of the AVR abut directly against the major normal faults of the MV walls. Elsewhere, extensive flat-lying lavas were found and, where possible, we investigated their contacts with the AVR. In several places minor faulting revealed the internal structure of these lavas, including open lava tubes and feeder dykes (Fig. 2).

The TOBI magnetisation map revealed a central anomaly magnetic high with a width (trough-to-trough) of 7 km, much less than the 18 km predicted for the Brunhes chron at this spreading rate. This narrow magnetisation high coincides closely with the AVR, and suggests there may have been a hiatus between previous magmatism and construction of the current AVR.

MS2000 bathymetry from the two *Isis* survey dives has revealed a wealth of new information, including relationships between volcanic and tectonic features. It also shows that TOBI sidescan reliably images all volcanic cones down to a diameter of ~20 m. One surprising feature was vertical failure scars, evidence for extensive volcanic flank collapse in young cones on the AVR. This indicates that tectonic erosion of the crust begins almost as soon as it is formed, and long before it is affected by major faulting at the edges of the MV floor (Yeo et al., 2008). Magnetisation maps from the *Isis* surveys show more detail; in particular, that magnetisation highs are not confined to the AVR crest but also occur on its flanks and lateral spurs, in various relationships to the volcanic architecture.

Visual estimates of sample ages were made in two ways: 1) by using the degree of sediment cover around the outcrop, and 2) estimated from the appearance (degree of freshness, etc.) of the hand specimen. Both estimates show a considerable amount of scatter. Although the youngest estimates fall on the axis of the central and southern AVR crest, young ages also occur in places on its flanks and south of its southern tip, while some of the oldest estimates also occur on the AVR crest.

MAPRs on the TOBI survey showed hydrothermal plume signals in the NE of the survey and on the eastern flank of the AVR near 45°29'N, 27°51'W. However, despite a detailed MAPR tow-yo grid and *Isis* dives in the plume vicinity (one of which encountered a buoyant plume), we were unable to precisely locate the plume source on the seafloor.

Future work

Post-cruise analysis at Durham (RS, KA, IY) will focus on analysing the tectonic and volcanic structure of the AVR, building a volcano-stratigraphic model of it, and incorporating the results of the other studies into the model. U-series radiometric dating will be carried out on selected samples by PVC, LT and KS. Analysis of magnetic survey data will be led by MT with additional magnetic palaeointensity measurements conducted by MC, to provide detailed magnetic age proxies. Geochemical analyses will be carried out at Southampton (BM, NS), Durham (JD, YN) and Lisbon (PF) to investigate melt sources, magma storage and fractionation processes, to fingerprint individual volcanic units, and to provide the analyses needed to support the U-series dating. KM will analyse the coral samples, and BM will analyse the MAPR data with Ed Baker at NOAA.

Acknowledgements

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Serpentine cruise - ultramafic hosted hydrothermal deposits on the Mid-Atlantic Ridge: First submersible studies on Ashadze 1 and 2, Logatchev 2 and Krasnov vent fields

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Summary of operations and cruise objectives

During the French-Russian Serpentine cruise (Feb. 25 - Apr. 5, 2007) on board the R/V *Pourquoi Pas?*, we used ROV *VICTOR 6000* to conduct multidisciplinary explorations and sampling on ultramafic hosted hydrothermal fields between 13°-17°N on the Mid-Atlantic Ridge (MAR). The Serpentine cruise was part of a 4-year cooperation program between France and Russia. Targets were the Ashadze 1 and 2 (12°58'N), Logatchev 1 (14°45'N) and 2 (14°43'N) and Krasnov (16°38'N) hydrothermal fields (Fig. 1). These hydrothermal fields were localized after several Russian cruises of the R/V *Professor Logatchev* (Batuev et al., 1994; Krasnov et al., 1995; Cherkashov et al., 2000; Sudarikov et al., 2001; Beltenev et al., 2003, 2004). The major objective of the Serpentine cruise was to study the geological, geochemical, biological, and microbial processes in hydrothermal fields associated with mantle derived serpentinites along the MAR. Four targets, Ashadze 1 and 2 and Logatchev 1 and 2, are on serpentinized peridotites and interspersed gabbroic basement rocks. In contrast, Krasnov is on a basaltic basement.

In addition to the sampling operations, a significant portion of the dives was dedicated to obtaining real-time, fine-scale multibeam bathymetric maps. These maps, post-processed on board for subsequent use for sampling operations, have a resolution of a few tens of centimeters. This type of map was for the first time obtained on a ridge at 4000-m water depth. Near seafloor high resolution magnetic maps (3-component magnetometer), CTD and turbidity measurements, water sampling and in situ manganese analyses were also performed during the bathymetric surveys. A high resolution black and white camera (OTUS) was also used to produce mosaic images of the active hydrothermal fields. ROV observations and sampling were complemented by a night program of dredging, water sampling, CTD, and geophysical surveys. The data obtained at 3 altitudes (50, 20, and 8 m) above the seafloor allow us to produce bathymetric maps, physical and chemical anomalies maps, as well as magnetic and biological maps at different scales. The results of the explorations lead to the first submersible observations of three new, high-temperature, active hydrothermal sites at

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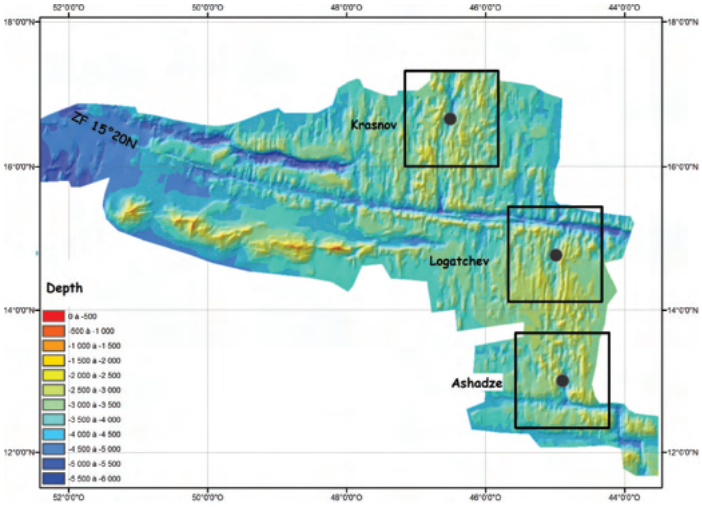


Figure 1: Working areas during the Serpentine cruise.

Ashadze 1, Ashadze 2, and Logatchev 2 (Fouquet et al., 2007) and of one inactive hydrothermal site (Logatchev 5). The importance of the inactive Krasnov site as the largest currently known accumulation of seafloor massive sulfides in the oceans was also confirmed.

Cruise results: Regional setting of the vent fields

Prior to the Serpentine cruise, Ashadze was known to consist of three closely spaced hydrothermal sites (Ashadze 1, 2, and 3) located at about 13°N, 44°50'W (Fig. 2). At Ashadze, the top of the wall, at 2300-m depth, corresponds to the termination of a large fossil corrugated surface. The axial valley at this latitude is strongly asymmetric, with higher relief to the west. This asymmetry is reversed immediately to the south, where the axial magnetic anomaly appears offset by a few kilometers to the west (Cannat et al., 2007). The active and extinct Ashadze vents are roughly aligned to the north of an irregular, south-facing slope, which we interpret as the surface expression of this minor axial discontinuity (Cannat et al., 2007). We find similarities between this general context and the setting of the two active Logatchev vent fields (Fig. 3): Logatchev 1 on the east axial valley wall near 14°45'N (main and largest site; e.g., see article by Borowski et al., this volume), and the smaller Logatchev 2 in a seemingly off-axis position near 14°43'N. Note: prior to the Serpentine cruise the Logatchev 2 field was never visited by a submersible or ROV and was considered inactive. Both fields lie to the north of a small offset axial discontinuity, and in an inward position relative to fossil corrugated surfaces. Based on seafloor morphology, dive observations, and rock sampling, we developed a model whereby ultramafic-hosted hydrothermal venting in the 13-15°N region of the MAR involves both large active normal faults, and an inside corner-type position relative to a small ridge offset. The geologic control of the Krasnov site is simpler. The Krasnov field is an inactive hydrothermal field at l6°38.4'N, 46°28.5'W (Fig. 1). This field is located at a depth of 3700-3750 m, 600 m above the inner floor of the eastern slope of the rift valley. The sulfide deposit is located at the top of the eastern rift wall, where a large volcano, rising from the rift valley floor to the top of the rift valley walls, coalesces with the rift wall.

High resolution mapping and local geological setting

Near seafloor high-resolution bathymetric maps were obtained using a new multibeam bathymetric system (RESON 7125 echo sounder) mounted on ROV *Victor*. The resolution of these maps is 5% of the altitude above the seafloor. Detailed maps obtained on board and direct observations with the ROV allow us to precisely determine the local geological and tectonic settings for each hydrothermal field. Maps at 50 m above the seafloor were done to investigate the relationships between the vent fields and their tectonic/volcanic environments. Higher resolution mapping, 20 m above the seafloor, was done at the scale of the vent fields. These maps, which have resolutions of a few tens of centimetres, are unique tools to understand the local geological control on the vents. Our observations also emphasize the role of slope failure, and spreading-parallel or oblique structural lineaments on the fine scale topography of MAR axial valley walls and the control of the hydrothermal discharge (Ondreas et al., 2007).

Ashadze. The Ashadze 1 hydrothermal field is located on the western slope of the MAR rift valley and differs from all previously discovered MAR high temperature hydrothermal fields that are located on the eastern rift slopes or in the central (axial) part of the rift valley. This area was the main goal of the cruise. One major result of the Serpentine cruise is the discovery of two active black smoker fields (Ashadze 1 and Ashadze 2) located at different levels on the western wall: Ashadze 1 at 4100 m depth, and Ashadze 2 at 3300 m (Fig. 2). The Ashadze 1 site is the deepest active black smoker field so far known in the oceans (Fig. 4). The high-resolution bathymetric maps show a clear relationship between landsliding processes, transversal faults, and the location of the Ashadze 1 site. We also sampled extinct sulfide chimneys near the base of the axial valley wall at 4530-m depth (Ashadze 4). In contrast to the other Ashadze sites, this deepest site is basalt hosted. The Ashadze 1 and 2 sites, 5-km apart, are respectively 4 km and 9 km off-axis. Active vents at Ashadze 1 are distributed over an area about 150-m long, along an EW-trending south-facing scarp. High resolution mapping (450 x 450 m area) reveals the fine structure of sulfide mounds, as well as complex fissure arrays near the vents. Away from the vents, topography appears dominated by slope failure, with prominent landslides. Black smokers at Ashadze 2 (3260 m) lie in a narrow (about 70 m), N-S trending graben-like trough (Ondréas et al., 2007) bounded to the east by a faulted gabbroic body. To the west, it is limited by a narrow N-S trending ridge, 20 to 50 m-high, that bears numerous

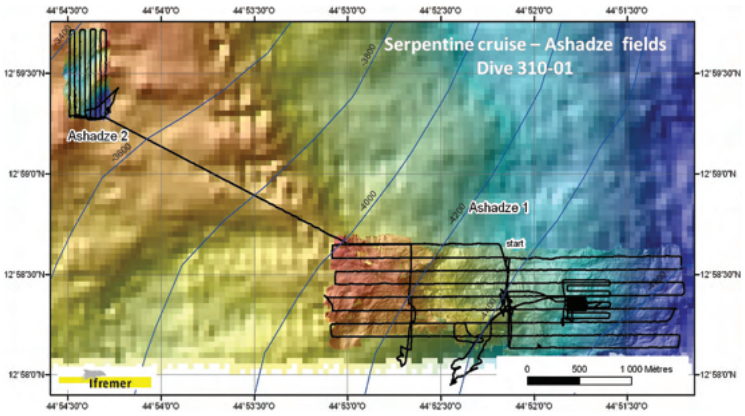
extinct hydrothermal chimneys.

The host rocks of the deposits at Ashadze 1, 2, and 3 are serpentinized peridotites with interspersed gabbroic bodies which are very common in the rift valley slopes in this segment of the MAR. Two sampling dives were carried out to study the composition of fluids, the animal communities, the bacteria, and the minerals associated with the hydrothermal vents. Another original characteristic is the unexpected observation of gas bubbles in the smokers of Ashadze 1. These bubbles are the evidence of ongoing subsurface boiling processes, and indicate that the temperature at shallow depth must be over 400°C. On the Ashadze 2 site a large group of smokers occurs, in a crater-shaped depression, about 25 m in diameter at the bottom of the graben structure. This constructional structure may indicate the sometimes-explosive nature of the hydrothermal fluid emissions.

Logatchev. These sites are on the eastern wall of the rift valley. Logatchev 1 and 2 sites, 5 km apart, are located 8 km and 12 km off-axis. We only mapped Logatchev 1 with the ROV (Fig. 3) . It comprises many vents in a NW-trending elongated area about 400 m-long (e.g., see article by Borowski et al., this volume). High resolution mapping at 20-m altitude (550 x 750 m) reveals the circular shape of the main sulfide mounds, as well as complex arrays of scarps and fissures, oriented predominantly E-W and NE-SW (Ondreas et al., 2007). Numerous lens-shaped slump features are also revealed near the vents.

One important goal was the exploration for new sites in the Logatchev area. During a 13-km exploration dive (Fig. 3), we unsuccessfully looked for the Logatchev 3 site at the top of the rift valley wall. However, the Logatchev 2 site, thought to be inactive, was localized and found to be active and located on serpentinized mantle rocks. The venting fluids (temperature 320°C) are unusual for their low salinity, which is the first observation of the production of a condensed vapor phase for a mantle-based hydrothermal system. In addition, its position 12 km off-axis, moves from 8 (Logatchev 1) to 12 km the possibility to have off-axis black smokers along the MAR. At the end of the exploration, a new low temperature (dominantly birnessite) inactive hydrothermal field (Logatchev 5) was discovered at the summit of the Logatchev ridge, located 1 km east of Logatchev 1. The second objective at Logatchev 1 was black smoker fluid sampling for time-series studies and additional biological observations and sampling.

Krasnov. This site was observed for the first time by ROV during the Serpentine dives. Submersible observations as well as a high-resolution map established at an altitude of 50 m, revealed several spectacular characteristics of this deposit. First, it is probably the largest accumulation of massive sulfides known



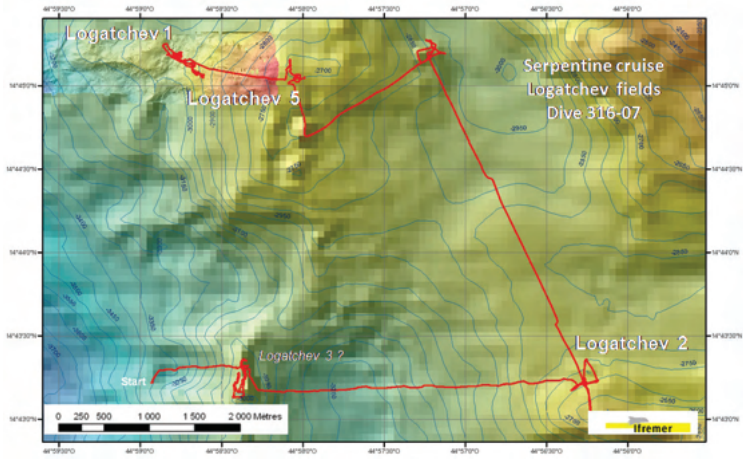


Figure 2: (upper) High resolution mapping operations done during dive 310-01 at Ashadze 1 and 2.

Figure 3: (lower) Exploration and high resolution map at Logatchev 1 done during dive 316-07.

to date. The second remarkable characteristic is the collapse of half of the sulfide mound towards the axial valley. This phenomenon creates a large deposit of sulfide talus in the west and a spectacular 100-m high semi-circular section of the mound, showing the heart of the massive sulfide mound at the east. The site was found to be inactive. The samples collected by the ROV and by dredging show a dominance of iron sulfides, and the scarcity of minerals rich in zinc and copper. The samples also revealed the brecciated character of the mineralization and the almost-complete replacement of a basaltic breccia by a mixture of pyrite and silica. This type of mineralization is very similar to the samples collected by drilling in the heart of the TAG sulfide mound at 26°N on the MAR.

Hydrothermal precipitates

Basaltic hosted deposits are dominated by pyrite and silica at Krasnov (Fe: 39%, Si: 11%, Cu: 2.2%, Zn: 0.14%) and by sphalerite and pyrite at Ashadze 4 (Fe: 24%, Si: 1.5%, Cu: 0.15%, Zn: 32%). Ultramafic deposits are characterized by high copper concentration dominated by chalcopyrite and isocubanite. Ashadze 1 (Fe: 33%, Si: 1.3%, Cu: 14%, Zn: 14%)

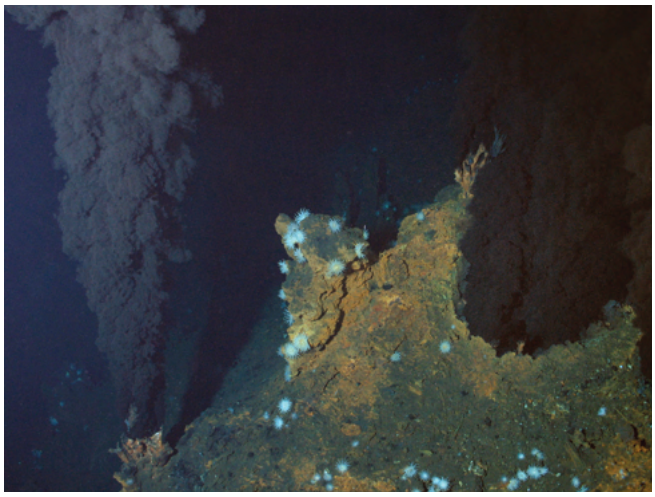


Figure 4: Ashadze 1 black smokers at 4100-m water depth. Temperatures up to 370°C were measured on this site.

and Logatchev 2 (Fe: 20%, Si: 3%, Cu: 14%, Zn: 23%) are enriched in sphalerite. New samples at Logatchev 1 confirm that copper is largely dominant at this site (Fe: 29%, Si: 3%, Cu: 28%, Zn: 4%) (Fouquet et al., 2007). The Ashadze 2 field is unusual; the small active crater can be interpreted as a hydrothermal volcano built up with a mixture of carbonates and secondary copper sulfides and copper chlorides. Massive sulfide chimneys are associated with the active smokers at the center of the crater. Many inactive carbonate/sulfide mounds are also aligned along a N-S depression. Two types of hydrothermal deposits are observed: massive copper-rich sulfides associated with the black smokers and carbonate/sulfide chimneys. Average composition of hydrothermal deposits for Ashadze 2 is Fe: 26%, Si: 11%, Cu: 11%, Zn: 5%, Ca: 8%. The dominant carbonate is aragonite, Mg-calcite is rare, and talc is common (Fouquet et al., 2007).

Hydrothermal fluids

As previously observed at all ultramafic sites on the MAR between 12°N and the Azores Triple Junction, the active serpentinization process, observed down to 4080-m depth at Ashadze 1, generates hydrogen and abiogenic hydrocarbons during the hydration of olivine and pyroxene minerals through catalytic reactions (Fischer-Tropsch type reactions). Fluids, enriched in H_2 and hydrocarbons, confirm the specificity of ultramafic environments as previously found at Rainbow (36°14'N), Lost City (30°N), and Logatchev 1 (Charlou et al., 2002; Douville et al., 2002). Very strong anomalies in temperature, nephelometry, CH_4 (from 1 to 120 ml/l), and helium were found in the seawater column above the Ashadze and Logatchev high-temperature fields. The fluids at these sites exhibit different temperatures (370°C at Ashadze 1, 359°C at Logatchev 1, and 320°C at Logatchev 2) and different chemical characteristics: pH (3.9 at Ashadze 1, 4.3 at Logatchev 1, and 4.4 at Logatchev 2) and chloride (535 mM at Logatchev 1, 150 mM at Logatchev 2, and 620 mM at Ashadze 1), signifying that phase separation is occurring and controlling the fluid chemistry (Charlou et al., 2007). All fluids are issued from ultramafics and controlled by seawater-peridotite interaction. They show low silica (5 to 10 mM), low H_2S (<0.5 mM) and are extraordinarily enriched in hydrogen gas (up to 70 percent of total gas). Gas bubbles were observed coming out from Ashadze 1 vents, and pulses of clear fluid were observed venting from Logatchev 2. All fluids issued from the new sites contain very high concentrations of H_2, CO_2, and CH_4. Preliminary calculations show that one vent at Ashadze 1 produces 1 million cubic meters of natural H_2 per year (Charlou et al., 2002, 2007).

Biology

Ashadze. The Ashadze 1 site communities are surprising for several reasons. The first surprise is the absence or very low abundance of known species that host symbionts (e.g., *Rimicaris exoculata*). In contrast, two species, known to date from other sites as peripheral, form dense populations (anemones and chaetopterid polychaetes; Fig. 5). On the chimney wall, two species of alvinocaridid shrimp are present, by decreasing order of abundance: *Mirocaris fortunata* and *Rimicaris exoculata*. This latter species, found as swarms of several thousands of individuals at other MAR sites, was only observed as isolated individuals. The gastropod *Shinkailepas briandi* forms small clusters of about 10 individuals, and some platyhelminths are also found in the oxidized and active zones of the chimneys. In the oxidized zones, the most visible population is composed of actinarian anemones of the species *Maractis rimicarivora*, previously described from other deep Atlantic sites (TAG and Snake Pit). This species, as indicated by its name, is most likely carnivorous or omnivorous. Conspicuous bacterial mats are also common in the oxidized zones. At the surface of oxidized chimneys we can also observe a high abundance of tubes of a chaetopterid polychaete. These tubes form large accumulations at the base of the chimneys and are used as substrata for other species and for bacterial mats. Similar chaetopterids were observed at other active sites on the MAR (Rainbow, TAG) but never in such high densities. A diverse associated fauna was observed, specifically abundant populations of the amphinomid polychaete *Archinome* sp., scaleworms (Polynoidae) such as *Iphionella* sp. and *Levensteiniella iris*. Two species of *Phymorhynchus* (gastropod) are also present and are considered as predators of other mollusks or necrophagous. Pycnogonids were also collected at the base of the chimneys. The carnivorous/necrophagous level is also represented by the crab *Segonzacia mesatlantica* and by the zoarcid fish *Pachycara thermophilum*. Some galatheids are also present.

Logatchev. At Logatchev 1, in comparison to observations made during previous cruises (e.g., Gebruk et al., 2000), biological observations indicate a variation of the proportion of some species and the continuation of intense biological activity

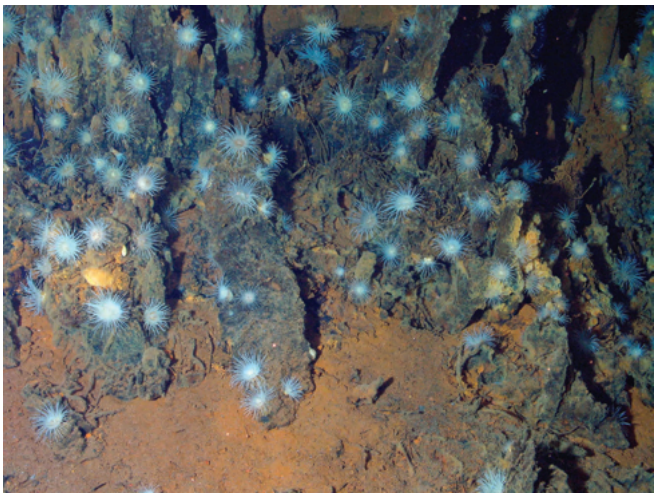


Figure 5: Ashadze 1 populations of *Maractis rimicarivora.*

on the Irina 2 area. However, the vesicomyid clams, emblematic of this area, have disappeared. The finding of extensive dead mussel fields on Logatchev 2 is surprising. The shells are intact, recent, and seem to indicate a catastrophic event that rapidly destroyed the environment favourable to the growth of mussels. A few live mussels and large populations of shrimp were however observed on the active chimney.

Krasnov. From a biological point of view, few fauna were observed; only a few bacterial mats covering several tens of square meters were observed at the bottom of the cliff splitting the sulfide mound.

Cruise website

http://www.ifremer.fr/serpentine

Acknowledgements

We thank the crew of R/V *Pourquoi pas?* and ROV *Victor* for their constant technical effort to make the Serpentine cruise a success. We warmly thank Dr. Ivanov, Dr. Beltenev, and the scientific group of the R/V *Professor Logatchev* for exchange of information before and during the cruise when we met at the Ashadze 2 field. We also thank D. Smith for making available regional multibeam maps for the Ashadze area.

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For an extended version of this article by Fouquet et al., please download the PDF from the online supplement to this year's InterRidge News at: **www.interridge.org/IRNewsletter**.

New coordinates for the hydrothermal structures in the Logatchev vent field at 14°45'N on the Mid-Atlantic Ridge:

Supplement to article in InterRidge News, Vol. 16

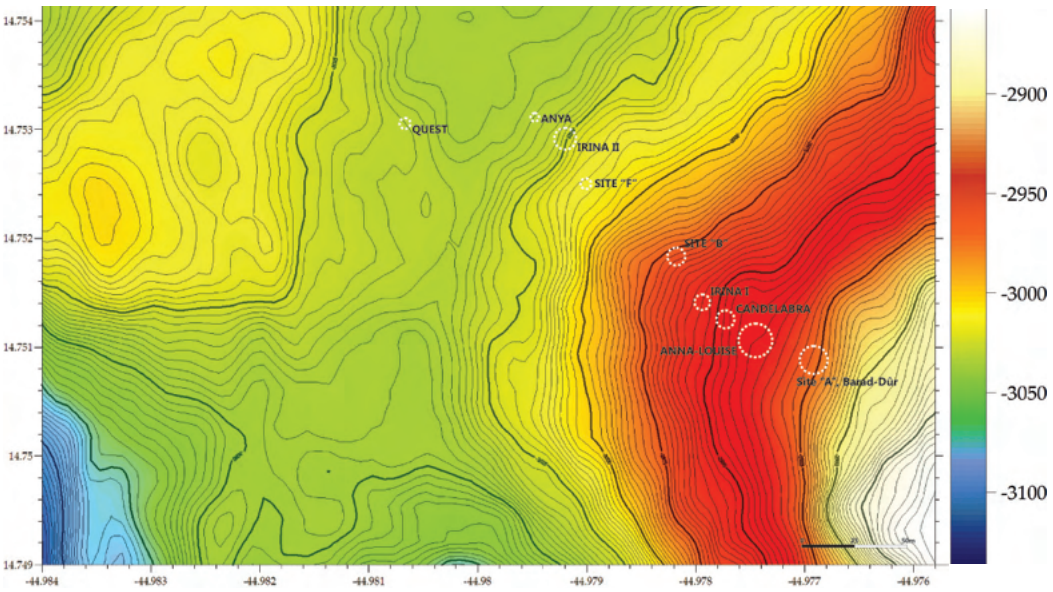
C. Borowski[1], S. Petersen[2], N. Augustin[2]

In last year's issue of InterRidge News, we reported on a new calibration of the geographic positions of the hydrothermal vent structures in the Logatchev hydrothermal field (LHF) based on long-baseline (LBL) navigation data obtained with the Woods Hole Oceanographic Institution ROV *Jason II* during the German cruise MSM04/3 with R/V *Maria S. Merian* in Jan. - Feb. 2007 (Borowski et al., 2007). We also reported on the detection of an additional smoking crater next to "Anna-Louise" vent that had been visited during earlier cruises by submersible and ROV dives, but was not recognized as a separate hydrothermal structure. A recent re-examination of our video material, however, revealed that our initial interpretation of the identities of the "new" crater and "Anna-Louise" was incorrect: "Anna-Louise" is indeed the southernmost and at 25-m diameter the largest of the smoking craters in LHF as was already described by Gebruk et al. (2000). The name "Smokey Strobe" is therefore invalid. The "new" crater (referred to as "Anna-Louise" in Borowski et al., 2007, and Petersen et al., 2007) is located between "Anna-Louise" and "Irina I" and resembles the craters "Irina I" and "Site B" in size. We named the "new" crater "Candelabra" referring to a black smoker on its rim which had already been named during an earlier cruise with R/V *Meteor* in 2004.

Table 1: New coordinates for the LHF vent structures obtained during R/V *Maria S. Merian* cruise MSM04/3.

Site	Latitude	Longitude	Water depth	Distance to next structure
Quest	14.75291	-44.9806	3026 m	121 m
Marker "Anya"	14.75285	-44.9795	3029 m	38 m
Irina II	14.75279	-44.9792	3021 m	67 m
Site F	14.75225	-44.9788	2963 m	110 m
Site B	14.75166	-44.9781	2946 m	50 m
Irina I	14.75127	-44.9778	2935 m	33 m
Candelabra	14.75112	-44.9776	2926 m	30 m
Anna-Louise	14.75095	-44.9774	2911 m	70 m
Site A	14.75076	-44.9768	2914 m	

Figure 1: Revised locations of the LHF vent structures.



The previous article (Borowski et al., 2007) referred to geographic coordinates of the hydrothermal structures in a table which by mistake was not included. We therefore present here the coordinates (Table 1) and a revised version of the map given by Petersen et al. (2007) (Fig. 1).

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International Research:
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Drilling submarine hydrothermal systems in the Tyrrhenian Sea, Italy

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Over the past decade, modern seafloor research has greatly intensified in volcanic arc environments, especially those of the western Pacific. The discoveries of native sulfur lakes, venting of highly acidic fluids, and sites discharging liquid CO_2 showed that arc hydrothermal systems are distinct from those at mid-ocean ridges (de Ronde et al., 2001; Stoffers et al., 2006; Embley et al., 2007). However, relatively few studies have focused on the mineral endowment and the characterization of the size and anatomy of seafloor sulfide and sulfate deposits of volcanic arcs.

During R/V *Meteor* cruise M73/2 (14-30 August 2007), three hydrothermal vent sites in the southeastern Tyrrhenian Sea were studied that are known to be associated with sulfide and sulfate deposits (Minitti and Bonavia, 1984; Tufar, 1991; Marani et al., 1997; Dekov and Savelli, 2004). Drilling at the Palinuro and Marsili volcanic complexes and offshore Panarea Island (Fig. 1) was conducted by an international team of scientists from Australia, Canada, China, Germany, Italy, and the UK employing the British Geological Survey (BGS) Rockdrill 1, a lander-type seafloor drilling device (Petersen et al., 2005). Key questions to be addressed during this project included the role of boiling and/or magmatic degassing on mineral precipitation and its effect on associated microbial communities as well as the role of the various sources of sulfur within the hydrothermal system. Recovery of up to 5-m long drill cores revealed, for the first time, the subseafloor nature of hydrothermal sulfide and sulfate deposits forming in an arc environment.

The Palinuro volcanic complex (Fig. 2) represents a complex submerged arc volcano that consists of several coalesced eruption centers located along an E-W trending fault system extending seaward off the northern limit of Calabria, Italy. It is bounded to the north by the continental slope of the Southern Apennines and faces the Marsili back-arc basin to the south. Palinuro has an overall extent of 50 km with a maximum width of 22 km at its base and rises to a water depth of ~70 m. Research at Palinuro focused on a sulfide occurrence located in a small topographic depression (ca. 630 to 650-m water depth) at the summit of a volcanic edifice in the western part of the volcanic complex. Low-temperature hydrothermal activity is widespread as evidenced by staining of the fine-grained sediments covering the seafloor and local protrusions of iron oxide crusts and chimneys. The discovery of living tube worm colonies (Fig. 3a) and shimmering water during a previous research cruise in 2006 indicates that active venting is still taking place,

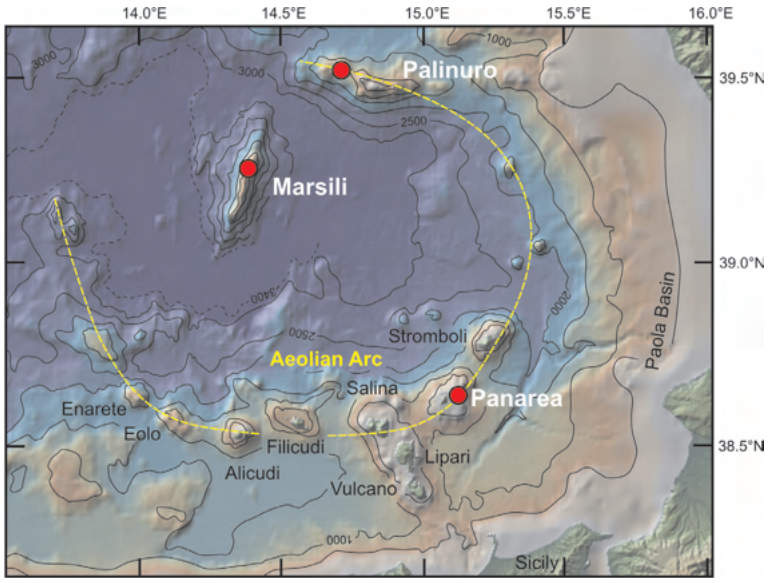

Figure 1: Regional map of the Aeolian arc with the locations of the study sites. Source: GeoMapApp.

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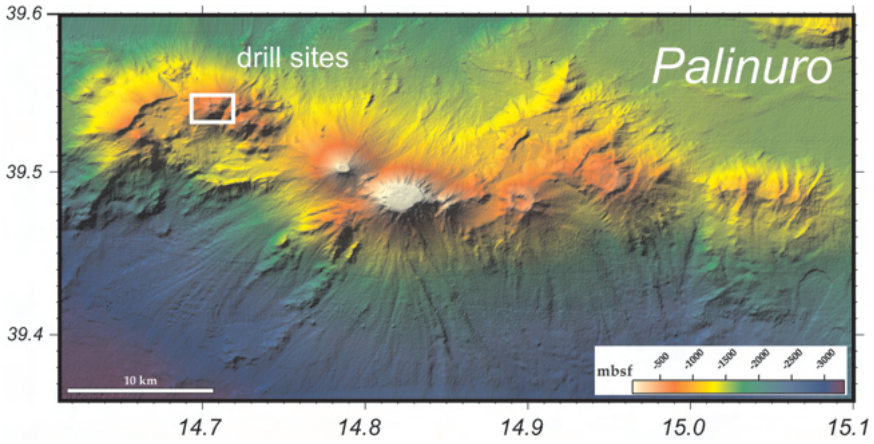

Figure 2: Bathymetric map of the Palinuro volcanic complex showing the location of the drill sites at this working area during R/V *Meteor* cruise M73/2.

although hot fluid venting and smoker activity have not been observed (Petersen et al., 2008). The occurrence of tube worms related to active hydrothermal venting has, to our knowledge, not previously been documented for the Mediterranean Sea or the Atlantic Ocean. Drilling in the area revealed that a zone of massive sulfide mineralization is buried beneath a layer of unconsolidated sediments. A total of eleven successful holes were drilled recovering 12.7 m of massive to semi-massive sulfides. One deployment yielded 4.9 m of continuous core consisting of massive sulfides and sulfates (Figs. 3b, c). All drill holes ended in mineralization and, therefore, the mineralized zone remains open in all directions.

Additional coring was performed in areas of increased sediment thickness using the vibrocorer function of BGS Rockdrill 1 and a conventional gravity corer. Pore water was sampled from the sediment cores to constrain down-hole variations in pore water and sulfur isotope chemistry. TV-guided grab sampling at Palinuro retrieved warm (Tmax = 60°C) native sulphur cemented sediments indicating that hydrothermal activity is ongoing in the study area.

Panarea, the smallest of the Aeolian Islands, forms a small archipelago that emerges from a submarine stratovolcano that rises more than 1200 m above the surrounding seafloor. Submarine gas venting is widespread around Panarea and likely related to a regional seismic and volcanic event that started in 2002 and affected the subaerial volcanoes of the area including Stromboli and Aetna. A high-resolution bathymetric survey of the near-shore (<70 m water depth) study area previously performed by our Italian co-workers (Esposito et al., 2006) revealed the presence of numerous circular depressions ranging from <10 to over 100 m in diameter.

Shallow drilling at Panarea was mainly conducted within the circular depressions and a channel-like trough interpreted to have formed by overlapping of several craters along one NW-SE striking fault. A total of 38 holes were drilled at water depths ranging from 60 to 90 m. A number of drill holes returned massive anhydrite and gypsum with disseminated sulfides locally infilling vugs and fractures. These massive sulfates are interpreted to represent a cap forming at the interface between seawater and ascending hydrothermal fluids. Additional drilling recovered variably altered volcanic rocks allowing correlation between the geology on land and in the near-shore environment.

The Marsili volcanic complex represents a prominent NNE-SSW trending volcanic feature located in the central part of the <2 Ma old ocean crust-floored Marsili back-arc basin (Fig. 1). It is the largest volcanic edifice in the Tyrrhenian Sea and has an overall length of 55 km, a maximum width of 30 km, and a height of 3000 m. Marsili possesses a long and narrow summit region that stretches 20 km along the main axis of the volcano and rises to a water depth of ca. 500 m. The morphol-

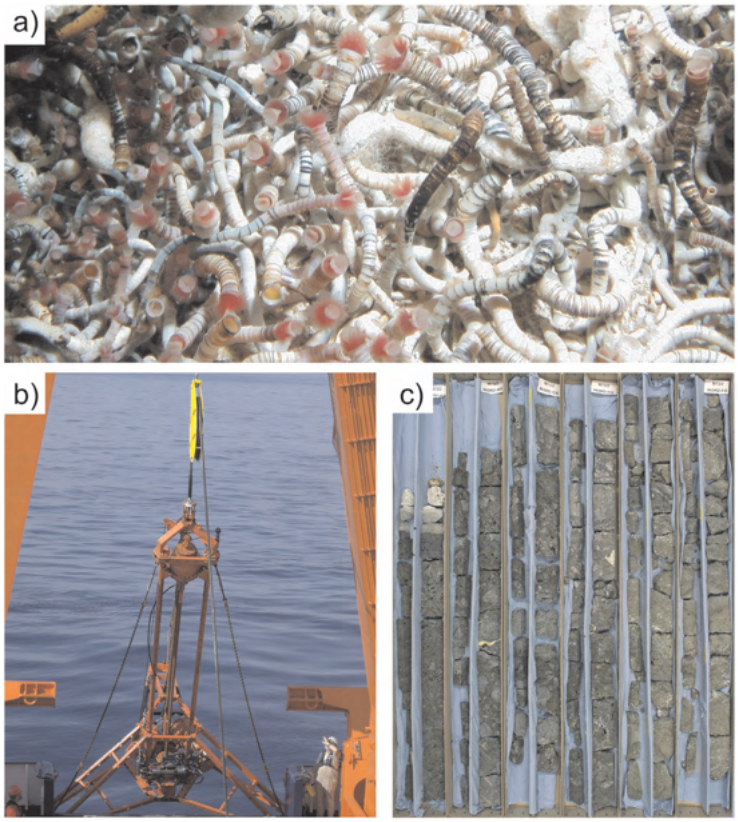

Figure 3: **(a)** Living siboglinid tube worms at the western summit of the Palinuro volcanic complex. **(b)** BGS Rockdrill 1 during operation onboard R/V *Meteor* cruise M73/2; **(c)** Drill core totalling 4.9 meters of massive sulfides and sulfates recovered from the Palinuro volcanic complex.

ogy of the volcanic edifice suggests that this complex represents the superinflated spreading ridge of the Marsili back-arc basin (Marani and Trua, 2002). During R/V *Meteor* cruise M73/2, TV-guided grab sampling and drilling were conducted at two peaks of the elongated summit region. Weakly altered basaltic or andesitic lava and iron oxides were recovered, but sulfide mineralization was not encountered.

Detailed bathymetric mapping using a ship-based Kongsberg EM120 multibeam system was conducted around all three sites showing complex volcanic structures with multiple volcanic eruptive centres at Palinuro and Marsili. The bathymetric survey at Panarea complemented previous mapping of the near-shore environment (Esposito et al., 2006). In addition to the geological investigations, extensive sampling of microbiological material was conducted during the cruise for further analyses. Onshore research will focus on the study of the microbial community structure and investigations constraining the presence and diversity of functional genes of the sulfur and carbon cycles. Cultivation of microbial groups adapted to the hydrothermal environment, including sulfur oxidizers, chemolithoautotrophic thermophiles, actinomycetes, and phototrophs, will be conducted.

Acknowledgements

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International Research:
WESTERN PACIFIC

A submersible study of the Mariana Trough back-arc spreading center at 17°N

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Abstract

Cruise YK08-08 Leg-1 of the Japanese R/V *Yokosuka* using the submersible *Shinkai 6500* took place in the Mariana Trough from 25 June - 6 July 2008 to study the formation of oceanic lithosphere in the active back-arc spreading center. Three submersible dives were devoted to the median valley of the segment center at 17°N. Visual observations provide ground references for sidescan sonar imagery collected in 2003 to investigate volcanotectonic features. Observations confirm that the seafloor is paved with sheet lava flows of high effusion rates. Inferred from sediment cover, sheet lava flows in the axial portion of the median valley are considered to be youngest, with the eastern margin regarded as older than the western margin. The N-S trending tectonic structures (i.e., faults, fissures) oblique to the median valley could be younger than the valley-parallel NNW-SSE trending structures.

1. Introduction

The preface of our study was a deep-towed sidescan sonar (~100 kHz) survey of the central Mariana Trough back-arc spreading centers in 2003 (Deschamps et al., 2004). The segment at 17°N is characterized by a dome-shaped topography shoaling at the segment center (Fig. 1). The morphology is suggested to be a consequence of enhanced magma supply. Sidescan sonar imagery with high backscattering intensities, indicative of smooth surfaces, was dominant in the median valley of the segment center (Fig. 2). Bumpy surfaces were confined to small ridges in the axial portion of the median valley or the segment end (Deschamps et al., 2004, 2005; Asada et al., 2007). The bumpy sidescan sonar images suggest pillow mounds and ridges, and the smooth surfaces suggest sheet-like lava flows or lobate flows. The different flow morphologies primarily reflect the rate at which the lava erupted. The presence of sheet flow morphology suggests a high rate of eruption, while pillow flow morphology suggests a low rate of eruption, with lobate flow morphology intermediate (e.g., Gregg and Fink, 1995). Smooth surfaces occupy half of the survey area. Such a broad area of smooth surfaces is unusual among slow spreading centers (the central part of Mariana Trough has full spreading rate ~30 km/Myr).

As corroborative evidence for the high effusion, mantle Bouguer gravity anomaly in the 17°N segment shows bulls-eye low with large amplitude (Kitada et al., 2006). Consistently, seismic velocity structure shows that the thickness of crust in the spreading axis at 17°N is ~2 km thicker than off-axis (Takahashi et al., 2008). These observations indicate that enhanced magma supply yielded lava flows of high effusion rate and produced the thick crust. As a result of the crustal structure, the abnormal crustal thickness extends off-axis ~30 km. It may indicate that duration of the enhanced magma supply is ~1 Myr (30 km ÷ 30 km/Myr).

Why would such a large amount of magma be provided to the 17°N segment? The previous petrological study did not suggest an answer to the above question (Gribble et al., 1996), potentially due to sparse rock sampling at this segment. Therefore, to investigate chemistry of magma in this segment, we need to collect more rock samples at sites carefully selected by utilizing visual observations in consideration of the volcanotectonic situation.

We revisited the Mariana Trough to dive in the 17°N segment with the submersible *Shinkai 6500* in June - July 2008. Objectives of the submersible survey were: 1) observation of lava flow morphology, faults, and fissures and their spatial variation; 2) collection of rock and sediment samples for chemical and age analysis; and 3) geophysical measurements using a deep-sea magnetometer and a sub-bottom profiler to investigate magnetization of the lava flow and thickness of sedimentary layers that cover the lavas. Because the magnetization intensities relate to age of lava, deep-sea magnetic data may provide geophysical evidence for discussion of old and new lava flows. However, quantifiable degrees of sedimentation superposed on the lavas suggest relative age differences of formation, and in this article we focus on this and our visual geological observation.

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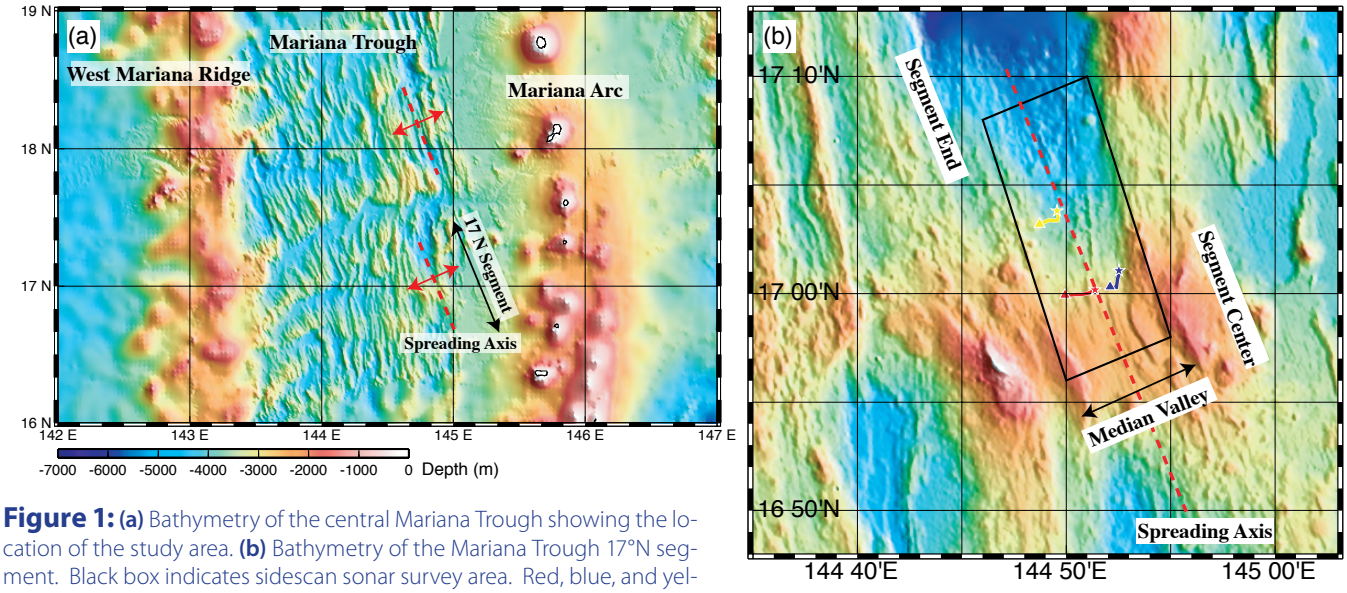

Figure 1: **(a)** Bathymetry of the central Mariana Trough showing the location of the study area. **(b)** Bathymetry of the Mariana Trough 17°N segment. Black box indicates sidescan sonar survey area. Red, blue, and yellow lines show *Shinkai 6500* dives #1088, #1089, and #1090, respectively.

2. YK08-08 Leg-1 cruise

Three *Shinkai 6500* dives were devoted to the Mariana Trough at 17°N (Dives #1088, #1089, and #1090). We dove to the median valley in the segment center to observe lava morphology both of smooth and bumpy surfaces indicated in the sidescan sonar imagery. The submersible carried a magnetometer and a sub-bottom profiler, and geophysical measurements were operated continuously during all dives. We also conducted a surface-ship geophysical survey to collect swath bathymetry, magnetic and gravity data in the central part of the trough between the Mariana Arc and the West Mariana Ridge (remnant-arc).

3. Submersible dive observations

3.1 Dive #1088

The landing point was the axial portion of the median valley and the eastern foot of a small ridge of ~150-m relative height elongating in NNW-SSE (~N20°W), sub-parallel to the median valley direction (Fig. 2). The dive traversed the ridge and continued on the western flank of the median valley at ~3420-m depth towards the western wall. The small ridge corresponds to bumpy sidescan sonar imagery, while the portion around the landing point and the western flank are smooth surfaces with high backscatter intensity. Morphology at the landing point was jumbled-wrinkled lavas (Fig. 3). The lava morphology suggests sheet and turbulent flow at high eruption rates. The lava flows could be very young, because they show no or little accumulation of sediment, potentially the freshest lava flows observed among the three dives.

The small ridge mainly consists of pillow, ~2 m in length and ~1m in diameter, and pahoehoe lavas. The small ridge is covered with thin sediment and is probably an old construction compared to the portion around the landing point. The western half of the dive route had a mixture of pahoehoe, folded sheet, lobate sheet, and jumbled flows produced by sheet flows with high effusion rate (Fig. 3). Topography consists of a series of ridges and troughs with relative height ~5-10 m. The topography may be originated to be tectonic structures such as faults or volcanic structures such as fissures or lava channels. Strikes of the ridges and troughs are in the NNW-SSE or N-S direction. According to tectonic interpretation of the sidescan sonar images (Asada et al., 2007), the submersible passed across an area of N-S lineated structures, and then across an area of NNW-SSE lineated structures. Sediment coating in the area of N-S structures tends to be thinner than that in the area of NNW-SSE structures, perhaps suggesting that the N-S structures are newer. Sediment cover more or less gradually increases toward the margin of the median valley. The sub-bottom profiler indicated very thin sediment cover through the dive route, however it was difficult to obtain clear reflection images from the sediment/lava boundary due to rough seafloor relief.

3.2 Dive #1089

The eastern margin of the median valley where we landed has lobate sheets covered with thin sediments. The submersible landed on a tumulus feature that is several meters in height and ~10 m in diameter with wrinkled surface and wide and deep inflation cracks. In adjoining places, spherical to bulbous pillows are exposed on the sedimentary cover. Swollen and fractured pillows and irregular pillow lobes were present on the sedimentary plain.

The sidescan sonar imagery shows a small volcano complex that consists of bumpy aggregates of dome-like structures superposed on fan-shaped lava terraces along the foot of the eastern valley wall. The terraces appear to be overlain by large domes 100-300 m across that form a broad ridge 1 km east-west and 700 m north-south and 30-40 m in height (Fig. 2). The terraces are floored by sedimentary plains, with sporadically exposed

big pillows. The thickness of the sedimentary layers is estimated to be ~0.5-2 m from the sub-bottom profiler measurement. The thickest sedimentary layers among our dives are observed in this portion.

The submersible climbed a very steep slope of 60-70° of the hummocky ridge of elongate and knobby pillows directing downslope with a thin sedimentary carapace. The summit of the hummocky ridge is cut by faults running NNE and NNW, which expose truncated pillow lobes.

3.3 Dive #1090

The dive traversed the western flank of the valley ~3 miles north of #1088 (Fig. 2). The submersible landed on a small ridge with large pillows and lava tubes, with diameters ~1.5 m, which is covered by thick sediment of ~0.5 m. N-S trending fissures having sharp edges suggesting very fresh crack surfaces are developed. We found a large depression along the ridge, formed when basement collapses or subsides due to tectonic movement, with its floor covered with sediments.

The western lava flow plain with greater than 500-m in width is associated with a thick sediment blanket consistent with low backscattering intensity of the sidescan sonar image. The area has a series of ridges and valleys with several meters high undulation. Direction of these ridges and valleys are NNW-SSE. Some fissures are trending N-S, with width ~5 m and depth greater than 10 m. They look fresh because cut sections of pillows and lava tubes are exposed on the sharp fissure walls. The N-S fissures cut the NNW-SSE trending structures and are

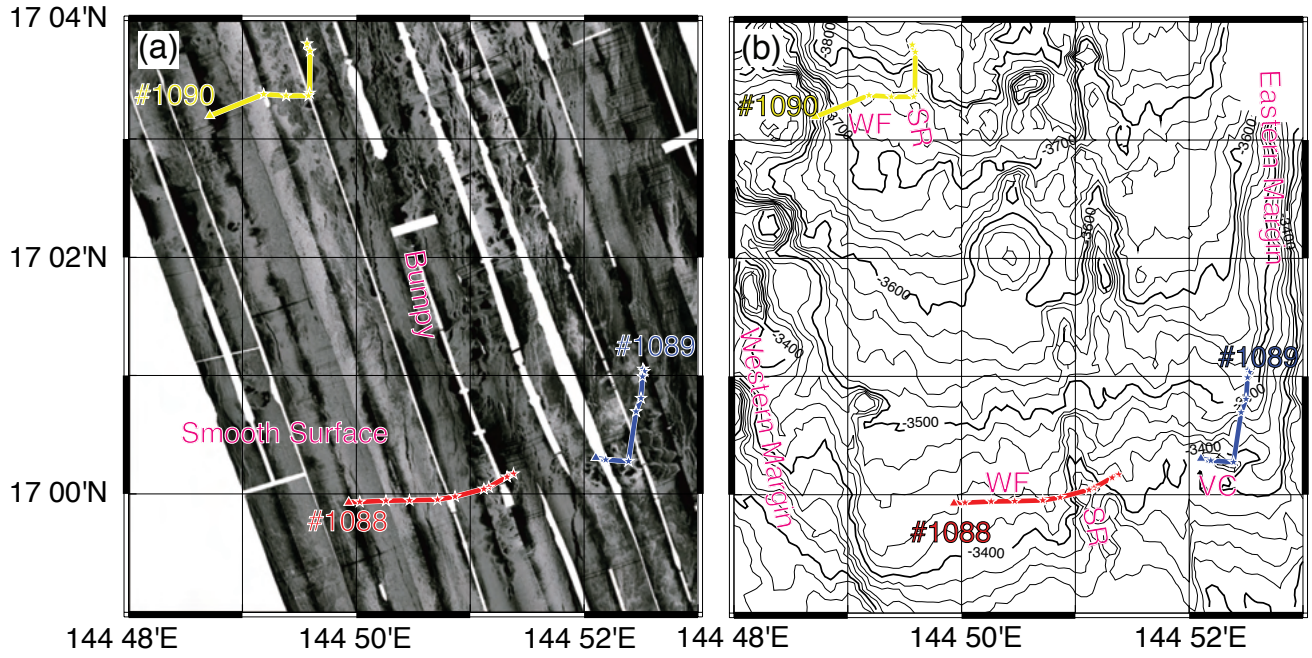

Figure 2: (above) **(a)** Sidescan sonar backscattering image of the median valley in the 17°N segment center (data from Asada et al., 2007). Light color shows high backscattering intensity. **(b)** Bathymetric map with 20-m contours. Red, blue, and yellow lines show *Shinkai 6500* dive tracks #1088, #1089, and #1090, respectively. Symbols on the dive tracks point to sampling sites. SR: small ridge, WF: western flank, VC: volcano complex.

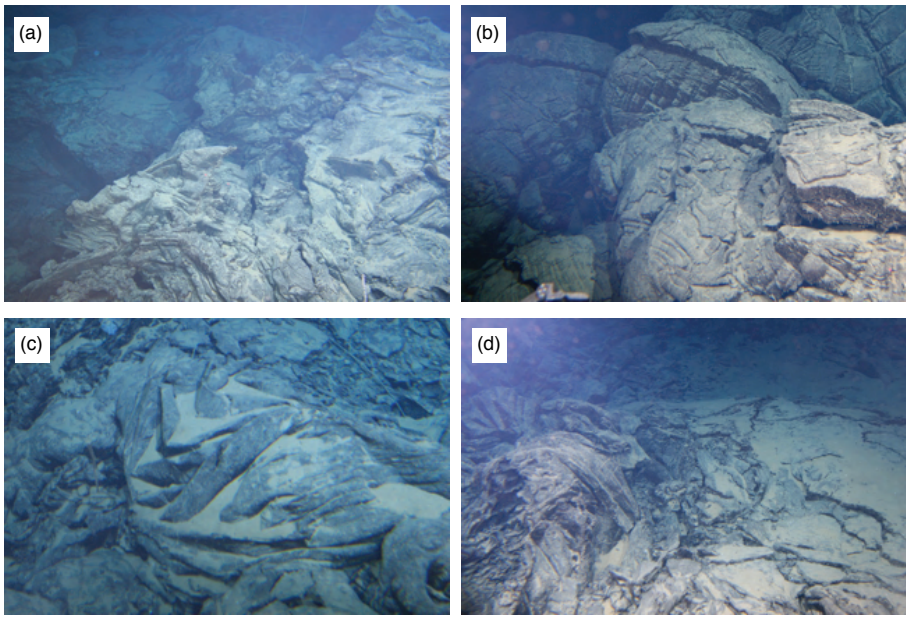

Figure 3: (right) Photos of lava flow morphology taken during *Shinkai 6500* dive #1088. **(a)** Jumbled lava flows near the landing point. **(b)** Pillow lavas on the small ridge. **(c)** Folded sheet lavas on the western flank of median valley. **(d)** Pahoehoe-like lavas on the western flank of median valley.

therefore considered to be newer than the NNW-SSE trending structures.

The morphology in the portion between the lava plain and the western margin is sheet flows visible in thinly sediments. The lava flow morphology is similar to that found in #1088. In the western end of the dive near the western wall of the median valley, the seafloor is composed of pillows and lava tubes. In visual observation, heavy sedimentation is obvious compared to the seafloor in #1088, thus the seafloor in #1090 is considered slightly old. However as a result of the sub-bottom profiler observation, thickness of the sedimentary layers is estimated to be less than several tens of centimeters. Therefore, the sedimentation of western margins of the median valley is thinner than that of the eastern margin in dive #1089.

4. Sample descriptions

4.1. Rock samples

Basaltic rock samples were collected at total of 22 stations in the three dives (Fig. 2). The rock samples are folded crust of sheet flows or pillow lava fragments. Samples obtained from #1088, particularly those from the axial portion of the median valley, have glass rings and almost no manganese coating (<1 mm) indicating very fresh lavas. Compared to the samples from #1088, those collected in #1089 and #1090 appear older because of manganese coating and on-site sediment accumulation. All samples collected in #1088, #1090, and the northern plain of #1089 are aphyric basalts. On the other hand, samples collected from the pillow lavas on the terraces and the hummocky ridge of the small volcano complex in #1089 are plagioclase-phyric.

4.2. Sediment samples

Sediment samples that coated lava flows were collected at 6 stations using push corers. These samples are hemipelagic, olive brown-colored, clay or silty sand including volcanic glass, oxides of iron or manganese, radiolaria, foraminifera, and nannofossils (coccolithophores). Although specific age within a narrow range was not determined, species of the fossils of planktonic foraminifera are identified as follows: *Globigerinoides ruber* (Early Miocene-recent), *Globigerinoides tenellus* (Late Pliocene-recent), *Sphaeroidinella dehiscens* (Early Pliocene-recent), *Beella digitata* (Pleistcene-recent), and *Globorotalia truncatulinoides* (Late Pliocene-recent).

5. Concluding remarks

Three dives of the submersible *Shinkai 6500* in the back-arc spreading center of the Mariana Trough at 17°N were conducted during the R/V *Yokosuka* YK08-08 Leg-1 cruise. Our visual geological observation confirmed the following features in the sidescan sonar survey: bumpy surfaces of the sidescan images were pillow mounds or ridges, and smooth surfaces with high backscattering intensities were jumbled-wrinkled, folded sheet, or lobate lava flows. Observations indicated sheet lava flows of high effusion rates. Sheet lava flows in the axial portion of the median valley were considered to be youngest, with sedimentation more or less gradually increasing toward the western margin of the median valley. The observed eastern margin of the median valley was covered with sedimentary layers of ~0.5-2 m thickness and was regarded as oldest among three dives. As for the tectonic features, the N-S trending tectonic structures (i.e., faults, fissures) could be younger constructions than the NNW-SSE trending structures because they showed relatively little accumulation of sediment, and they cut the other structures in some places.

Acknowledgements

We express great appreciation to the R/V *Yokosuka* crew and *Shinkai 6500* team for their excellent operations. We thank Mr. Satoshi Okada of Nippon Marine Enterprises for his invaluable help at sea. Part of this work is a contribution of the research program at the IFREE, JAMSTEC, and the Grant-in-Aid for Scientific Research from the MEXT, Japan (No. 20540417).

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International Research:
CENTRAL INDIAN RIDGE

Sampling and surveying ridge-hotspot interaction on the Central Indian Ridge, 19°S: Cruise KNOX11RR

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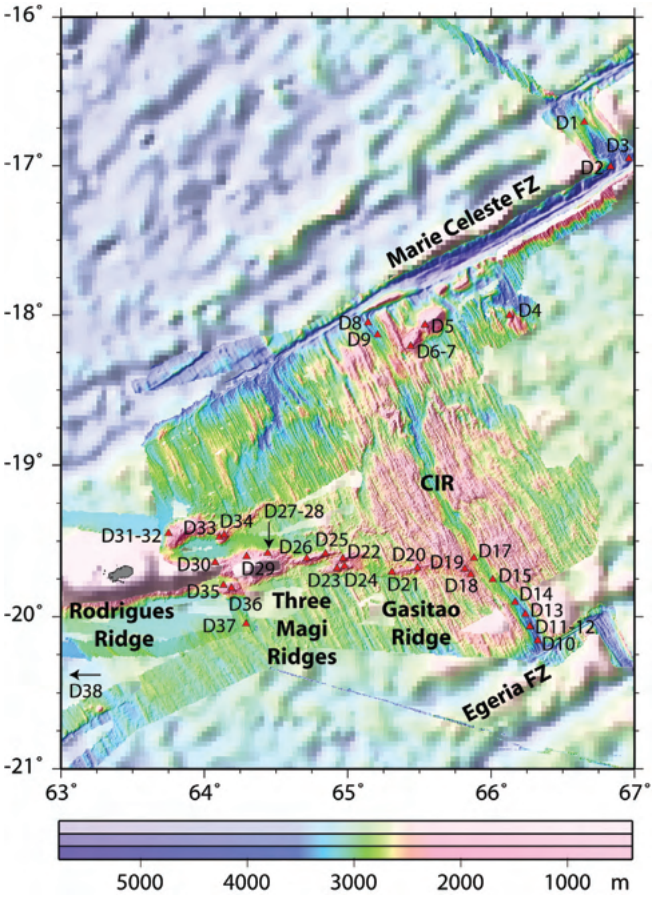
The KNOX11RR cruise of November 2007 was a 19-day, multinational joint geochemical sampling and geophysical surveying cruise to the Central Indian Ridge (CIR), between 16°70'S and 20°16'S, and the adjacent Gasitao Ridge, Three Magi Ridges, and Rodrigues Ridge (Fig. 1; Dyment et al., 1999). This region presents an opportunity to study the oblique interaction between a spreading ridge (CIR) and a hotspot (presently located at Réunion Island, ~1100 km to the west of the ridge).

Our principal goal was to test the hypotheses of Murton et al. (2005) and Nauret et al. (2006) regarding the direction of asthenospheric mantle flow between Réunion and the CIR. In the first case, Murton et al. (2005) found that young (zero age) basalts from the CIR exhibit an enrichment in incompatible elements that increases northward towards the Marie Celeste Fracture Zone (FZ). In addition, CIR basalts appear to lie on a mixing line between N-MORB and a source component that closely resembles present-day Réunion hotspot lavas. This suggests that enriched mantle is being supplied from Réunion in the form of an eastward-flowing tongue of material that migrates towards the CIR against the motion of the lithosphere. In contrast, Nauret et al. (2006) noted that only off-axis magmatism, located to the west of the ridge axis, appears to contain a Réunion component. They suggested that Réunion-like source material is diverted further south towards the Egeria FZ.



Thus, our strategy was to sample the Marie Celeste FZ and select sections of the CIR as well as the adjacent (off-axis) ridges to supplement samples collected on previous French and UK cruises. Noble gas (He, Ne, Ar) and volatile (CO_2, H_2O, Cl, F, and S) analyses of fresh basaltic glass rims combined with major and trace element and radioisotope data (Sr, Nd, Pb, Hf, Os) will provide the means to discriminate between the two hypotheses outlined above.

During the KNOX11RR cruise, we recovered material from 28 out of a total of 38 dredges along the Marie Celeste FZ, the CIR axis, the Three Magi Ridges, the Gasitao Ridge, and the

Figure 1: Bathymetric map of CIR and the adjacent Gasitao Ridge, Three Magi Ridges, and Rodrigues Ridge. The three levels of color for the bathymetry data represent a) pale colors, bathymetry "predicted" from satellite altimetry (Smith and Sandwell, 1997); b) intermediate colors, previous multibeam bathymetric data from R/V *Marion Dufresne* (1998; Dyment et al., 1999), *L'Atalante* (2000; Dyment et al., 2000), and *Hakuho-Maru* (2007; Okino et al., 2008); c) bright colors, multibeam bathymetric data collected by R/V *Revelle* on this cruise. Sample locations are shown as solid triangles.

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Rodrigues Ridge. Eleven dredges were successfully deployed along the ridge axis and another three at adjacent seamounts. Basalts from this region are fresh, aphyric and, in many cases, have glass rims, up to ~3 cm thick (Fig. 2). One dredge (D2) recovered coarse-grained gabbros, as well as harzburgitic and lherzolitic material, from an oceanic core complex located at the intersection of the CIR with the Marie Celeste FZ. The off-axis structures, i.e., the Three Magi Ridges, the Gasitao Ridge, and the Rodrigues Ridge, were also dredged and mapped. Thirteen dredges generally yielded older, Mn-encrusted pillow basalt fragments. However, variable amounts of fresh basaltic glass were recovered from several stations. Multibeam bathymetry and magnetics were collected throughout the cruise.

Preliminary results of helium isotope and abundance analyses show that the helium concentrations decrease southward along the CIR (Fig. 3). MORB-like $^3He/^4He$ ratios are found in glasses recovered in the vicinity of the Marie Celeste FZ, while the highest $^3He/^4He$ ratios (~11R_A, where R_A = atmospheric $^3He/^4He$) are found between 18.91° and 19.95°S on the ridge axis. However, even higher ratios were measured in some of the glass samples recovered off axis, from the Three Magi Ridges and the Gasitao Ridge.

Therefore, our initial data appear consistent with asthenospheric flow impinging the ridge axis adjacent to the Gasitao Ridge. Additional noble gas and volatile data will be combined with major/trace element and radioisotope data to provide further details of ridge-hotspot interaction at the CIR.

Acknowledgments

We would like to thank Captain T. Desjardins and the crew of the R/V *Revelle* for their dedicated support. The KNOX11RR cruise was funded by University of California Ship Funds. We acknowledge NSF grant OCE-0726573 and CNRS INSU "Soutien aux campagnes océanographiques" for cruise-related expenses and analytical work.

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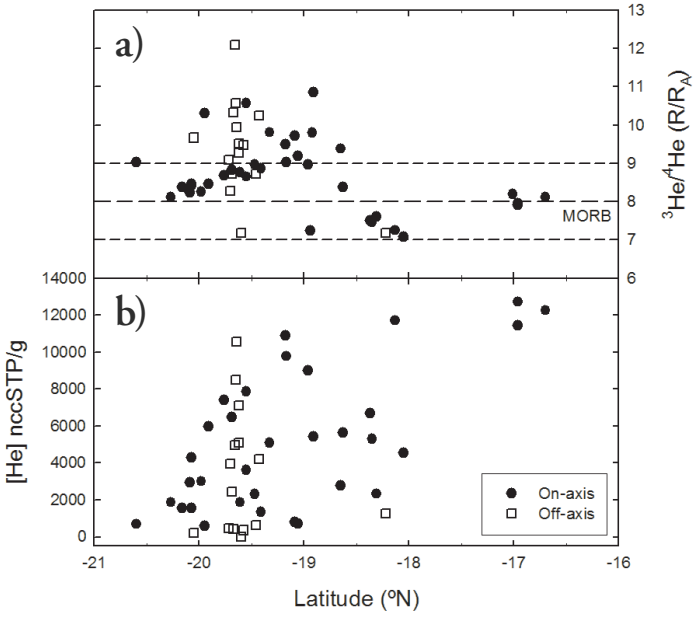


Figure 2: (upper) Pillow basalt fragment with fresh glass rim.

Figure 3: (lower) **(a)** Helium isotope ratios ($^3He/^4He$) and **(b)** concentrations of Central Indian Ocean basalt glasses as a function of latitude. Helium isotope ratios are shown as R/R_A, where $R = ^3He/^4He$ ratio measured in the sample and $R_A = ^3He/^4He$ ratio of air. With the exception of dredges D1 - D3, all on-axis samples were dredged between the Marie Celeste and Egeria FZs. With the exception of dredges D4 - D7, all off-axis samples were collected to the west of the CIR axis. Samples include those collected during KNOX11RR (Füri et al., unpublished), CD127 (Murton et al., 2005), and GIMNAUT (Nauret et al., 2006) cruises.

National News

Brazil

Susanna E. Sichel

In this year's update we would like to report on an education and outreach program for secondary school teachers in Brazil. The program was funded by Fundaçâo de Amparo a Pesquisa do Estado do Rio de Janeiro (FAPERJ) as part of a larger effort to support Diffusion and Informal Education in the areas of Science and Technology in the State of Rio de Janeiro, Brazil (Oct. 2007/Oct. 2008). The pilot study included the development of classes and activities for secondary school students in the areas of oceanography and geology. I led a team of co-PIs and associates in producing a CD titled "An Invitation in Oceanography: For Divulgation in Schools," which is designed in a simple way for biology, geography and science teachers. The CD, with material in Portuguese, was provided to approximately 200 schools in Brazil. The CD has 30 classes in PowerPoint, including: What is Oceanography, Historical Review, The Planet Earth, Marine Geology, Origin of Ocean Basin, Water Pollution, Marine Ecology, Water Waves, Water Circulation, Pollutions, and Future of the Ocean.

We selected four cities for the pilot study: Arraial do Cabo, Nova Friburgo, Cachoeira de Macacu, and Teresopolis. Arraial do Cabo (population 25,248) was chosen because we received significant logistical support and infrastructure from the Institute of Ocean Studies Almirante Paulo Moreira (IEAPM), which is a military organization as part of the Brazilian Navy. IEAPM is a full partner in the enterprise, offering their oceanography museum, auditorium and transportation for students and teachers. We received interest from 30 schools (20% private) that sent their teachers to our program. Initially, the local teachers attended a presentation on the goals of the project, definition of terms, and strategies for the future. Following the activity, teachers received products such as class materials in CD-ROM on topics of local geologic and oceanographic interest, such as changes in the coastal processes and erosion, distance of the continental platform, prevailing wind direction. We emphasized the importance of ocean currents in the region and how the rise of cool and productive waters make Arraial do Cabo unique as a site for studying meteorological and oceanographic processes. IEAPM will lend us a vessel to take the school teachers to the ocean for one day of oceanography. They will learn how to collect samples including water samples, read water temperature, pH, salinity, etc.

The other three cities in our pilot study offered an additional challenge in that they are not located at the coast. In Nova Friburgo (population 178,300), all 49 state public schools and 20 private schools received the CD, as well as one university with a Geography program. In Cachoeira de Macacu City (population 48,543), the CDs were given to all 63 schools, both private and public. In Teresopolis (population 147,000), a city located in the coastal mountains, teachers from three schools participated in the program. The first-year activity was organized to emphasize the ecology of the region and the water cycle from their natural spring sources along its many small rivers and lakes, which eventually flow to the ocean. Teachers expressed the greatest interest in examples of local geology and oceanography that could be used in their science courses.

In conclusion, our project "Invitation to Oceanography: Divulgation in Schools" was well accepted. The teachers who had the chance to participate were impressed by the program. The main challenge for the project was the limited number of people working on it, at part time due to limited funding, and the large amount of time involved with visiting school by school to explain the project. Our next goals are to distribute the CDs in Rio and Niteroi, first to the top 10 private schools as well as in several public schools. We are also giving out the CDs in universities that offer geography and biology degrees.

Updated news: IR's national correspondent in Brazil, Susanna Sichel, and collaborators at several universities in Brazil, France, and USA have been funded by Petrobras for a major geological study of the St. Peter and St. Paul system on the Mid-Atlantic Ridge. Look for a first report from this project in next year's Newsletter.

Figure 1: Teacher workshop in Teresopolis.

For an update from NEPTUNE Canada, see the online supplement at:
www.interridge.org/IRNewsletter.

Chile

Juan Diaz-Naveas and Luis Lara

Geological, chemical and biological studies at the Chile Triple Junction

A 21-day student and research cruise with participants from Chile and the USA has recently been approved for early 2010 on the Chile margin with the support of University of California Ship Funds (R/V *Revelle*) and NOAA's Office of Ocean Exploration and Research (OE). Lead PIs for the project in Chile include Juan Diaz, Luis E. Lara, Jorge Munoz, Javier Sellanes, V. Gallardo and E. Quiroga. In the USA, the cruise PI will be Andrew Thurber who is supervised by Lisa Levin at SIO. In addition, NOAA OE has awarded funding for preliminary detection, location, mapping and photography of the seafloor at new seep and vent sites along the Chile margin including the adjacent Chile Rise, close to the Chile Triple Junction, using the *Sentry* AUV. That project includes co-PIs from WHOI (Chris German and Tim Shank), SIO (Donna Blackman and Kevin Brown), University of Washington (Marv Lilley) and NOAA-PMEL (John Lupton and Ed Baker). Most recently, a further project "Biology of a Ridge Subduction Zone," has also been submitted to NOAA OE FY 2009 (Lead PI Lisa Levin, SIO) to secure funds for a follow-on biological study that will examine the species composition, biogeography and diversity of the triple junction ecosystems. Ideally, this will add an extra 3 days of shiptime to the cruise for TV (camera) guided operations using a remote sampler (multicorer). Carefully placed, quantitative biological samples will be collected at spots identified by *Sentry*. These samples will also provide geochemical descriptions of the sediments in the novel settings discovered. Proposed sampling areas range from 45°-47°S, at depths of 800 to 3000 m. In addition to support from Chile and U.S. sources, this project will also make important contributions to the Census of Marine Life projects ChEss and COMARGE.

China

Y. John Chen and Jiabiao Li

Year 2008 is the first year after China became a principal member nation in the InterRidge community. This year the Chinese research vessel *DayangYihao* is conducting its third around-the-globe expedition, which includes work on the Southern East Pacific Rise (SEPR) and the Southwest Indian Ridge (SWIR). We just received great news that new high-temperature hydrothermal vent fields were discovered on the SEPR near the equator during the *DayangYihao* DY115-20 Leg 3 expedition in Aug. - Sept. 2008 (Fig. 1). In addition, the Qingdao Ocean Sciences Summer School on "International Advances in Geo-Biological Research" was held in Qingdao, China, July 14-20, 2008. Several InterRidge scientists helped to co-organize this well-attended summer school and gave lectures (http://www.interridge.org/node/5580; also see article, p. 50). Chinese scientists also co-organized and contributed abstracts to a special session on "Recent multidisciplinary studies of mid-ocean ridges and ophiolites", 5th Asia Oceania Geosciences Society Conference, Busan, Korea, June 17, 2008 (http://www.interridge.org/node/4893; also see article, p. 52).

New hydrothermal vent fields discovered on the Southern East Pacific Rise near the equator

Chinese scientists and a team of researchers and engineers from WHOI, USA, successfully completed a 25-day research

Figure 1: Celebrating onboard R/V *DayangYihao* the discovery of hydrothermal vents just south of the equator on the EPR.

cruise in Aug. - Sept. 2008 on board the Chinese R/V *DayangYihao* to the SEPR near the equator. As the continuation of the successful collaboration between the Second Institute of Oceanography, SOA, China, and WHOI in exploring the Southwest Indian Ridge in 2007, the recent joint cruise was also equipped with WHOI's autonomous underwater vehicle *ABE*. This expedition follows the work of a 2005 expedition by R/V *DayangYihao*, during which strong water column turbidity anomalies were measured in the region. Several new high-temperature hydrothermal vent fields were discovered along the SEPR ridge axis and on an off-axis seamount located between 1.4°S to 2.2°S. A significant portion of the hydrothermal activity at the ridge axis appears to be concentrated along the edges of a seafloor fissure system. High-resolution bottom bathymetry, deep-tow magnetics, color photography, water column data, as well as hydrothermal sulfide deposit samples were obtained during the cruise. An abstract was submitted at sea and preliminary results of major findings of this cruise will be reported at the Fall AGU Meeting in San Francisco, 15-19 December 2008.

Expedition to the Southwest Indian Ridge

R/V *DayangYihao* will conduct a few legs of investigation of the SWIR near 49.5°E, where the first active high-temperature hydrothermal vent field of the SWIR was discovered in Feb. - March 2007 (see Tao et al., InterRidge News, 2007). These legs will occur in late 2008 - early 2009 and will include microbiological sampling and further investigation of the active hydrothermal vent field and seafloor geology. Furthermore, a seismic experiment using ocean bottom seismometers is being planned for this part of the SWIR for the late 2009 - early 2010 field season.

France

Jérôme Dyment

Mid-ocean ridge studies in France are either part of the MOMAR project, which plays a central role in focusing efforts at a national scale, or individual cruise projects:

MOMAR

In 2007, the two diving cruises planned on hydrothermal vents Rainbow and Lucky Strike were shortened and postponed due to technical problems with ROV *Victor* and R/V *Pourquoi pas?*. Only nine dives of the submersible *Nautile*, mostly devoted to the collection of biological and rock samples, were achieved on site Rainbow as part of the MOMARDREAM experiment (see InterRidge News, 2007). The experiments that could not take place in 2007 were rescheduled to August and September 2008 onboard R/V *L'Atalante* with ROV *Victor*.

During cruise MOMAR 08 Leg 1 on site Lucky Strike (Aug. 9-24, Chief Scientist Javier Escartin), two pressure gauges, as part of the GRAVILUCK experiment (PI Valerie Ballu), and the TEMPO module, as part of the EXOCET/D project (PI Pierre-Marie Sarradin), were recovered. The initial part of the BATHYLUCK experiment (PI Javier Escartin) involved the deployment of temperature sensors and geo-microbiological experimentation. The detailed micro-bathymetric survey of the Lucky Strike volcano, started during cruise MOMARETO in 2006, was significantly extended during this cruise.

Cruise MOMAR 08 Leg 2 on site Rainbow (Aug. 25 - Sept. 15, Chief Scientist Jérôme Dyment) was the second and final part of the MOMARDREAM experiment. This leg conducted micro-bathymetric, magnetic, and high resolution photographic surveys over the site and surrounding areas. Chemical and physical parameters were measured over selected vent sites, where fauna were also collected (including *Rimicaris exoculata* and *Bathymodiolus azoricus*). Fluids were taken for the study of abiogenic organic compounds. In addition, a large collection of various rocks was dredged over Rainbow.

A third cruise, BBMOMAR 2 of R/V *Le Suroît*, (Aug. 8-17, Chief Scientist Wayne Crawford) was devoted to the recovery and (re)deployment of Ocean Bottom Seismometers (OBS) on the Lucky Strike segment. After this cruise, thanks to the addition of Portuguese OBSs to be recovered in fall 2008 by a Portuguese ship, more than 15 OBSs are collecting seismological data to describe precisely the seismicity of the segment.

Finally, a fourth cruise, MARCHE 3 of R/V *Almirante Gago Coutiñho* (a Portuguese vessel; Aug. 13-20, Chief Scientists Jean Goslin, Nuno Lourenço, Bob Dziak) recovered four hydrophones moored in the SOFAR channel south of the Azores. The data collected by these instruments are essential to determine the seismicity over a large section of the Mid-Atlantic Ridge south of the Azores, including the Lucky Strike and Rainbow areas (see article by Goslin et al., this volume).

Among the upcoming cruises already planned for the MOMAR area, cruise BATHYLUCK (PIs Javier Escartin and Anne Deschamps), scheduled for summer 2009 on R/V *Pourquoi pas?* with ROV *Victor*, is an integrated, multi-scale study of the Lucky Strike hydrothermal field and its setting. The project aims to understand the interplay between tectonics and volca-

nism along the zone of crustal accretion, constrain the physical and chemical characteristics and temporal evolution of hydrothermal activity, and investigate their effect on geo-microbiological interactions. Cruise MOMARSAT (PIs M. Cannat, J. Blandin and P.-M. Sarradin), pre-scheduled for 2010, will be a demonstration mission of the ESONET Network of Excellence supported by the European Union. The project aims to deploy an acoustically-linked multidisciplinary observing system at the Lucky Strike vent field, with satellite connection to shore, marking the first step toward the installation of a permanent observatory in the MOMAR area.

Other cruises completed in 2008 or planned for 2009 and 2010

An important experiment that was completed in 2008 is the recovery of the three hydrophones moored in the SOFAR channel in the Indian Ocean as part of the project DEFLO-HYDR (PI Jean Yves Royer). Two hydrophones were recovered by R/V *Marion Dufresne* during a scientific cruise of the French Polar Institute (IPEV), and the third by the same ship during a logistical tour of the French Austral and Antarctic Territories (TAAF). The data collected by these instruments are currently being analyzed.

In the beginning of 2009, project OHA-SIS-BIO (PI Jean Yves Royer) will redeploy these hydrophones with R/V *Marion Dufresne* in order to monitor (1) the earthquake activity associated with the three contrasted Indian ridges and the intraplate deformation zone in the Central Indian Basin, and (2) the vocal activity of marine mammals such as large whales to improve our knowledge on their presence, abundance, and migration patterns.

In the same area, cruise GEISEIR (PI Christophe Hémond), scheduled for Jan. - Feb. 2009 on R/V *Marion Dufresne*, will collect dredged and wax-cored samples on selected sections of the Southeast Indian Ridge (SEIR) in order to investigate the isotopic heterogeneities observed along this ridge and the dynamics of the underlying mantle. The samples will enable further testing of the hypothesis that the unique isotopic pattern observed along the SEIR reveals striations between ancient mantle sources and recycled material. This cruise also offers a unique opportunity to collect bathymetric and geophysical data in a remote ridge section, in complement to several previous American cruises.

The SMOOTHSEAFLOOR project (PIs Daniel Sauter and Mathilde Cannat) aims to better constrain the composition, structure, magnetic signature and mode of formation of the "smooth seafloor" domains described during a previous cruise on the Southwest Indian Ridge. These domains may have been formed with no or very little volcanic activity and probably expose exhumed mantle rocks with an undetermined proportion of magmatic intrusives. The proposal was ranked highly and may be scheduled in the end of 2009 on R/V *Marion Dufresne*.

A set of three cruises is scheduled or pre-scheduled in the Pacific Ocean for the end of 2009 and the beginning of 2010, onboard R/V *L'Atalante* with the submersible *Nautile* and AUV *ASTER*^{X}. This long-awaited event underlines the continuous interest of the French community for the area, despite logistical and financial difficulties which prevented earlier scheduling. Cruise PARISUB (PI Pascal Gente) will achieve a detailed investigation of the interaction between a plume, the Mathematicians hotspot, and a spreading axis, the East Pacific Rise (EPR) at 16°N. Cruise MESCAL (PIs François Lallier and Nadine Le Bris) on the EPR at 9, 11, and 13°N will focus on two themes: (a) the colonization strategies and adaptation of *Alvinella pompejana* to thermal and chemical stresses, and (b) the integrative biology of thiotrophic endosymbiosis. Cruise BIG (PI Anne Godfroy) in the Guaymas Basin, which displays both hydrothermal and cold seep sites, will characterize the physicochemical gradients and the microbial and faunal communities along these gradients to evaluate the taxonomical and functional similarities within the two habitats.

Germany

Colin Devey

The German ridge program entered its final year in September 2008. Of the three cruises still planned for the final year, one (to be lead by Ingo Grevemeyer and concentrating on active and passive seismic studies of the Logatchev area) has unfortunately been cancelled due to new propulsion problems with the vessel *Maria S. Merian*. Juggling of other cruise schedules and piggy-backing of some experiments will hopefully allow us to nevertheless rescue a large portion of the science scheduled to be carried out on that cruise. *(continued on next page)*

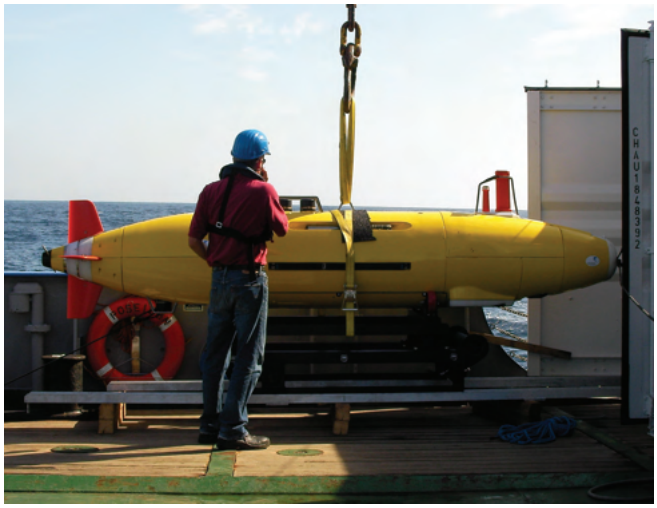


Figure 1: New AUV for German ridge studies.

Other major activities include the delivery of the 6000-m capable AUV for ridge studies by the company Hydroid LLC of Massachusetts, USA (Fig. 1). The vehicle is presently undergoing seatrials before being put into action at Logatchev in January 2009. Fig. 1 shows the vehicle aboard R/V *Poseidon* during these trials. The vehicle can be operated in three different configurations, either with a Reson 7125D multibeam, a black and white camera and flash, or a sub-bottom profiler. Common to all configurations is an Edgetech 2200 side-scan sonar, a Seabird CTD, an Ecotech backscattering detector, and an Eh sensor, the latter kindly provided by Koichi Nakamura of AIST, Japan. On the research front, the German Ridge community is initiating a proposal to G-cubed for a thematic issue on slow-spreading ridges. Colin Devey, Nadine Le Bris, Nicole Dubilier, Jian Lin and Doug Connelly will be put forward as guest editors.

India

K.A. Kamesh Raju

Recent cruise onboard R/V *Sonne* to the Carlsberg Ridge and the Andaman Sea

The NIO-RVS2 cruise from 17 Oct. - 1 Dec. 2007 was conducted as the second phase field program of the CSIR (India) - Network Program, "Tectonic and oceanic processes along the Indian ridge system and the back arc basins." The main objective of the cruise was to acquire multiparameter data together with deep-tow and seafloor imaging over segments of the Carlsberg Ridge (CR) and the Andaman Backarc Spreading Center (ABSC; Fig. 1). The cruise was conducted onboard the German research vessel R/V *Sonne* (Fig. 2) chartered by the National Institute of Oceanography (NIO). We also collaborated with the Hawaii Mapping Research Group (HMRG), University of Hawaii, and hired equipment (MAPRs) from PMEL, NOAA (USA). Observations included multibeam mapping, magnetics, deep-tow surveys along the rift valley, ocean floor imaging with OFOS (Ocean Floor Observing System, Fig. 3) at selected locations, and seabed sampling using a TV-guided-grab (Fig. 4), dredge, spade core and gravity core. Water column sampling, CTD and MAPR observations were also carried out over the CR and ABSC segments.

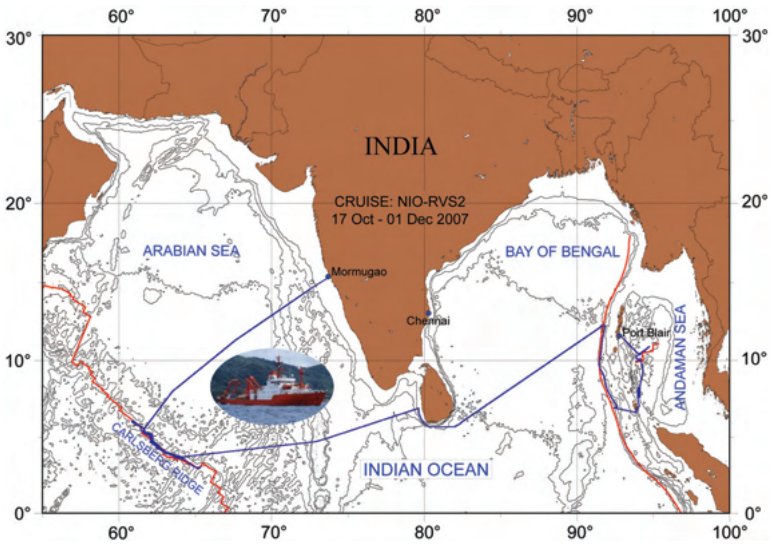


Figure 1: Cruise track.

Figure 2: Cruise participants.

Surveys during the cruise included an approximately 600-km long segment of the CR, part of the ABSC, and a region off the Nicobar Islands covering the "off Nicobar swarm" (the most energetic earthquake swarm ever observed; Kamesh Raju et al., 2007, Geophysical Research Letters 34, L03305, doi:10.1029/2006GL028730). The cruise was organized into two legs: the first on the CR and the second in the Andaman Sea, starting from Goa (Mormugao, Port) and ending at Port Blair, in the Andaman Islands (Fig. 1). The deep-tow tracks were planned along the rift valley based on multibeam data acquired during earlier cruises. We conducted CTD observations at anomalous tectonic regions identified from the deep-tow side-scan and MAPR data. Prominent optical signatures indicative of an active hydrothermal field were noticed over the CR. Further investigations are required to locate the origin of the identified plume. Systematic seabed sampling followed by OFOS observations were carried out at selected locations. The deep-tow system IMI-30, hired from HMRG, was operated along 11 tows: six along the CR and five in the Andaman Sea. Seabed sampling included 10 dredge operations, 14 TV-grab operations, one spade core and four gravity core operations. OFOS was operated at five locations on the CR and one location in the Andaman Sea. Twenty-one CTD operations, including a towed CTD, were carried out. The marine magnetometer was towed between the stations and during transit. Benthic and microbial studies were carried out on the seabed samples and water column samples, respectively. The water samples were filtered and stored for onshore analysis. Onboard analysis was carried out for pH, dissolved oxygen, and SiO_4. Water samples were collected in specially designed copper tubes for the analysis of helium. Many of the results from this cruise were reported at a special session at the AOGS 2008 meeting in Busan, Korea (see article, p. 52).

Figure 3: OFOS (Ocean Floor Observing System).

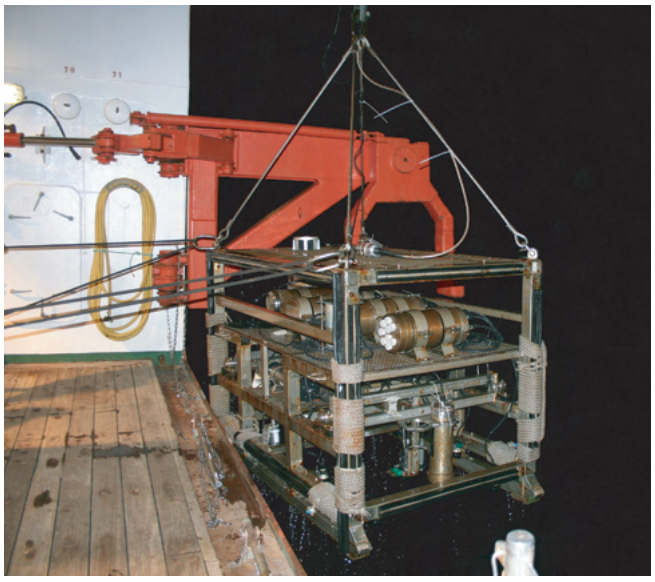
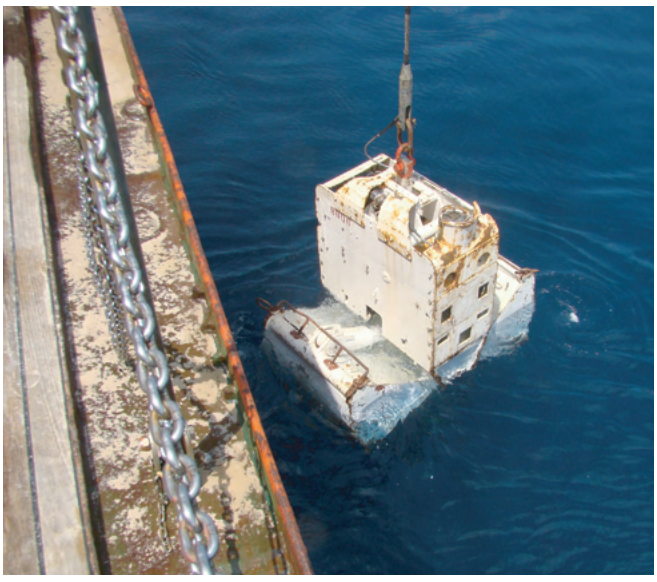


Figure 4: TV-guided-grab.



Japan

Kyoko Okino

The InterRidge-Japan program continues efforts to promote ridge-related studies in Japan, despite a fiscal predicament*. In FY2007, the annual contribution to InterRidge was shared by three organizations. Although we have been forced to get along without an umbrella project supporting InterRidge-Japan for two years, several seagoing research programs were funded and executed, as described below.

An InterRidge-Japan symposium was held on October 30-31, 2007, at Ocean Research Institute, University of Tokyo. About sixty scientists participated in the symposium to share recent research activities. We encouraged graduate students to present their studies in this symposium, and 13 students gave talks. We plan a similar symposium in October 2008. We also had a business meeting on May 26, 2008, at the Japan Geoscience Union Meeting, where we shared information on budget, cruise, workshops and international affairs, and discussed the InterRidge-Japan annual activity plan. We designated Hidenori Kumagai (JAMSTEC), as successor for Nobukazu Seama, for the IR steering committee in 2009. We submitted a proposal for a new interdisciplinary research project among microbiology, geochemistry, geology, and geophysics, focusing on trans-crustal advection and in-situ biogeochemical processes of global sub-seafloor aquifer. We submitted an initial proposal to MEXT (Ministry of Education, Culture, Sports, Science and Technology) last year, but unfortunately without success. We rebuilt the research framework, polished up the execution plan and submitted the revised proposal in May 2008. The proposal is now under review, and we hope to start the new project at the end of this year.

In FY2007, seven ridge-related and/or hydrothermalism-related cruises were conducted mainly around Japan Island. Three cruises, R/V *Natsushima* NT07-11 and NT07-13 and R/V *Kaiyo* KY08-01, were successfully conducted in the backarc Okinawa Trough, and these results will be utilized for planned deep-sea drilling in hydrothermal vent areas. Another cruise focusing on hydrothermal activity was done in Izu-Ogasawara arc. Two ocean-bottom electro- magnetometers (OBEMs) were recovered on R/V *Kairei* KR07-16 cruise, as part of a magnetotellic (MT) transect across the central Mariana arc- backarc area (http://www.marine-geo.org/tools/search/entry.php?id=KR07-16). In the Parece Vela Basin, the extinct backarc basin behind the Mariana arc, a large oceanic core complex was investigated mainly by dredge hauls during R/V *Hakuho-maru* KH07-2. Cruise R/V *Hakuho-maru* KH07-4-2 visited the Southwest Indian Ridge at 34º-40º E near the Marion hotspot in January 2008. Geophysical mapping, seismic reflection and refraction surveys using air-guns and 10 ocean bottom seismometers (OBSs), deployment of OBEMs for MT transect across the spreading axis and rock sampling were accomplished (http://ofgs.ori.u-tokyo.ac.jp/~intridgej/report_html/KH07-4-2/KH07-4-2.htm).

In FY2008, four ridge cruises were funded and three have already been conducted. Two cruises using submersible *Shinkai 6500* targeted the lower crustal section of backarc lithosphere along the Mariana Trench (YK08-8-1) and the backarc spreading axis of the Central Mariana Trough (YK08-8-2). Another cruise to hydrothermal vents at Hatoma Knoll, Okinawa Trough, was also done using ROV *Hyper-Dolphin* (NT08-13). In this area, the world's first blue smoker chimney was discovered in 2006. For the remaining funded cruise, R/V *Mirai* will cross the Pacific Ocean and visit the Chile Triple Junction in early 2009. Geophysical mapping, rock sampling, and OBS deployment are planned to reveal the geophysical and geological process of ridge subduction. Also in FY2008, four additional cruises on R/V *Natsushima* with ROV *Hyper-Dolphin* were conducted for hydrothermal vent biological research: NT08-07 to Myojinsho Caldera (PI K. Inoue), NT08-12 to Kagoshima Bay (PI Y. Fujiwara), NT08-15 to the Okinawa Trough (PI H. Yamazaki), and NT08-17 to Kagoshima Bay (PIs K. Inoue and T. Yamanaka).

The threat of spiking oil prices throws a shadow over our seagoing research. A planned R/V *Hakuho-maru* cruise along the Southwest Indian Ridge near the Marion Hotspot, where we conducted the survey and deployed OBEMs early this year, was postponed to next fiscal year, January or February 2010, due to the rapid increase of fuel cost. Fortunately the deployed OBEMs will be recovered by a Japanese fisheries training vessel, however the delay of planned study is unavoidable. Additional cruises are planned for FY2009.

We are pleased to announce that the 4th International Symposium on Chemosynthesis-Based Ecosystems - Hydrothermal Vents, Seeps and Other Reducing Habitats will be held in Okinawa, Japan, from 29 June - 3 July 2009. This symposium, sponsored in part by InterRidge, highlights the recent achievements in the field of unique ecosystems driven by chemosynthesis rather than photosynthesis. For more information, please consult: http://www.jamstec.go.jp/xbr/4th_CBE/.

For more information onInterRidge-Japan, please see our web site (in Japanese): http://ofgs.ori.u-tokyo.ac.jp/~intridgej/.

* ***Editor's note:*** Just prior to publication, we received news that InterRidge-Japan received funding for Project TAIGA with lead PI T. Urabe (see Letter from the Chairs, p. 1).

Korea

Sung-Hyun Park

Korean ridge scientists were involved this year with the AOGS 2008 special session on mid-ocean ridges and ophiolites (see article, p. 52). Our presentations included studies of the tectonics structure of the Ayu Trough and recent results on IODP 1256D core. An additional meeting to "kick-off" plans for future Korean ridge research was held in September 2008, organized by former InterRidge Steering Committee member Sang-Mook Lee and current Steering Committee member Sung-Hyun Park (Fig. 1).

An upcoming cruise on the Russian R/V *Yuzhmorgeologiya* in late 2008 will dredge rock samples from the eastern Bransfield Strait. We plan to conduct hydro-acoustic monitoring to examine the overall temporal and spatial pattern of earthquake and icequake production in this region, and we also plan to survey for hydrothermal activity using towed CTD and MAPRs.

Plans are moving forward for the new Korean icebreaker *Araon* which will service the King Sejong Station on King George Island, a research station for the Korea Antarctic Research Program. We expect sea trials to be conducted in 2009. The expected annual cruise track of *Araon* will provide opportunities for ridge research, for example in the remote Pacific-Antarctic Ridge.

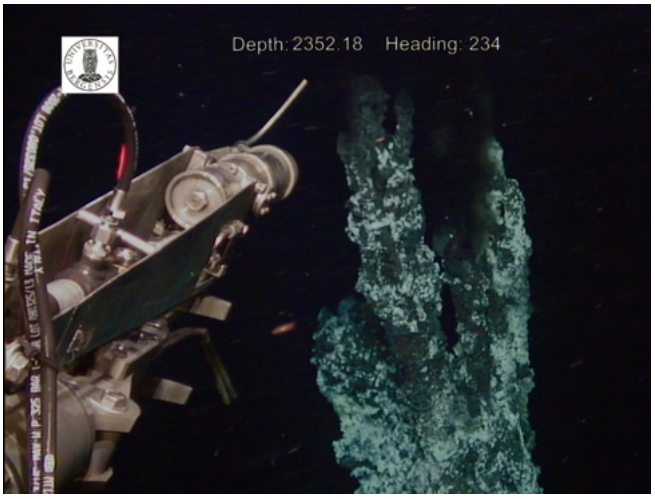
Figure 1: Scientists, including Sang-Mook Lee and Sung-Hyun Park (third and fourth from left, respectively), and students meeting to "kick-off" plans for future Korean ridge research.

Norway

Rolf Pedersen

As in recent years, the ridge research in Norway is primarily a research theme at the University of Bergen with most of the research activities being organized by the Department of Earth Science and a new Centre for GeoBiology (www.geobio.uib.no). In summer 2008 two Norwegian lead cruises were organized to the Mohns-Knipovich ridge. A geophysical cruise with R/V *Haakon Mosby* (PETROBAR-08) acquired multi-channel seismic and OBS data across the southernmost Knipovich Ridge. A multidisciplinary cruise with R/V *G.O. Sars* (H2DEEP-08) focused on core complex formation and hydrothermal activity where the Mohns Ridge passes into the Knipovich Ridge at ~73°N. An international science party with members from Norway, Switzerland, Portugal, Russia and the USA participated on this cruise, which partly was funded through the ESF EUROMARC program. The first leg of this cruise succeeded in locating a new black smoker vent field at ~2400-m water depth (Fig. 1; press release at: http://www.interridge.org/node/5581). A large hydrothermal mound that appears to have a diameter comparable to the TAG mound on the Mid-Atlantic Ridge is associated with the new field. Associated with the field are also vent endemic fauna that appear to be distinct from the fauna found further south in the Atlantic. During the second leg of this cruise, the Jan Mayen vent fields, discovered in 2005, were revisited to recover seafloor experiments.

Figure 1: Sampling fluids with ROV *Bathysaurus* from a chimney discovered at Loki's Castle hydrothermal field.



Philippines:

Investigations of the oceanic lithospheric fragments in Mindoro: Clues to the arc - continent collision in Central Philippines

G.P. Yumul Jr.[1,2], C.B. Dimalanta[1], K.L. Queaño[3], E.J. Marquez[4], R.A. Tamayo Jr.[1], F.T. Jumawan[1], L.T. Armada[1], J.A.S. Gabo[1], R.D.O. Mediavillo[1], D.E.L. Riguer[1] and C.D.U. Carranza[1]

In 2003 researchers from the National Institute of Geological Sciences, University of the Philippines, and the Mines and Geosciences Bureau with support from the Department of Science and Technology began a campaign to investigate the arc-continent collision in west Central Philippines. The Palawan microcontinental block, a fragment rifted from the southern margin of mainland Asia, collided with the Philippine Mobile Belt during the Early to Middle Miocene. As a result, various features believed to have been produced by the collision event were preserved and can be observed in Palawan, Romblon Island Group (RIG), and western Panay (Fig. 1). The geological, geophysical and geochemical investigations were initially carried out in RIG and were followed by similar studies in northwestern Panay. This year, investigations of the arc-continent collision are currently being pursued in Mindoro Island. Of particular interest are the northwest-southeast-trending ultramafic belts in the island. Three ophiolitic belts have previously been reported in Mindoro, namely: the Eocene Lubang-Puerto Galera, the Cretaceous Mangyan and the Middle Oligocene Amnay Ophiolitic Complex (Fig. 2). These belts of ophiolitic rocks represent several episodes of accretion in the area.

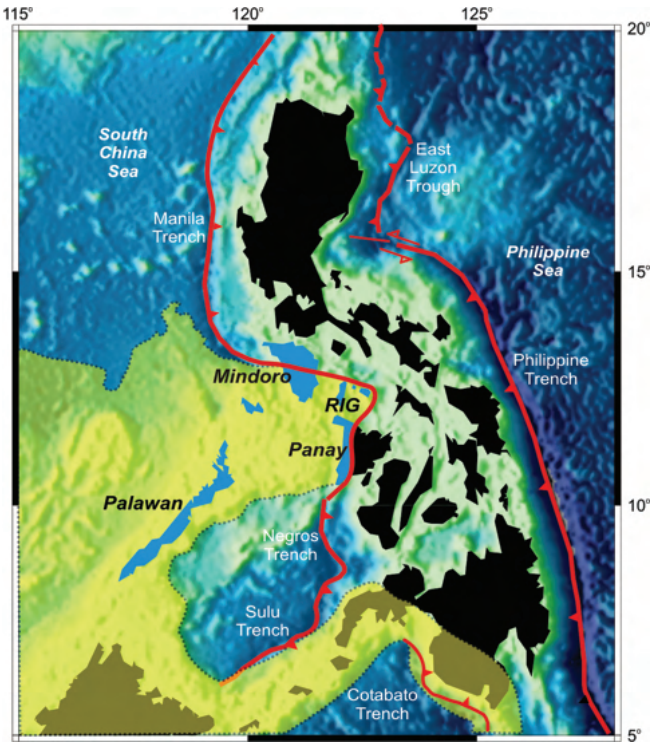


Figure 1: Tectonic map of the Philippines showing subduction systems bounding the archipelago. The Palawan microcontinental block (yellow shaded region) is believed to have collided with the Philippine archipelago during the Early Miocene. Features related to the collision event are believed to be preserved in Palawan, Mindoro, Romblon Island Group, and western Panay (light blue colored areas). This year's research campaign focused on Mindoro Island. Map created using the Generic Mapping Tools (Wessel and Smith, 1995).

The current research initiatives are directed at the collection of geological, geochemical and geochronological data for the other ophiolitic bodies (Mangyan and Puerto Galera Ophiolitic Complexes) to see how these compare with the Amnay Ophiolitic Complex (AOC). Are there really three separate ophiolite complexes or are they all, in fact, part of one big dismembered ophiolitic complex? Field campaigns in northwestern Mindoro Island conducted in April 2008 began to tackle the various aspects of the complex tectonic evolution of the area (Fig. 3). During these surveys, extensive outcrops of the Halcon Metamorphic Complex were identified in the northern part of the island as well as in the Paluan area on the northwestern portion of the island. In this area, the schists encountered consist of talc-chlorite and quartz-mica varieties (Fig. 3a). The general trends of the foliations of these metamorphic rocks were recorded. In the westernmost portion of the island, talc-chlorite schists exhibit foliations plunging to the northwest. A southeast-trending plunge in the foliations of the schists near Paluan was observed. In the northern coastal areas of Mindoro Island, metamorphic rocks include quartz-mica schists, phyllites, amphibolites and metagabbros which are best seen near the vicinity of Abra de Ilog. Ophiolitic bodies were also observed during the mapping at this site. Limited outcrops of the pillow basalts, gabbros and peridotites of the Mangyan Ophiolitic Complex were observed near Paluan. In Mamburao, the limited exposures of the pillow basalts were highly weathered and some show chloritization whereas the peridotites are moderately to extensively serpentinized. Harzburgites representing the upper mantle sequence of the AOC were mapped in Santa

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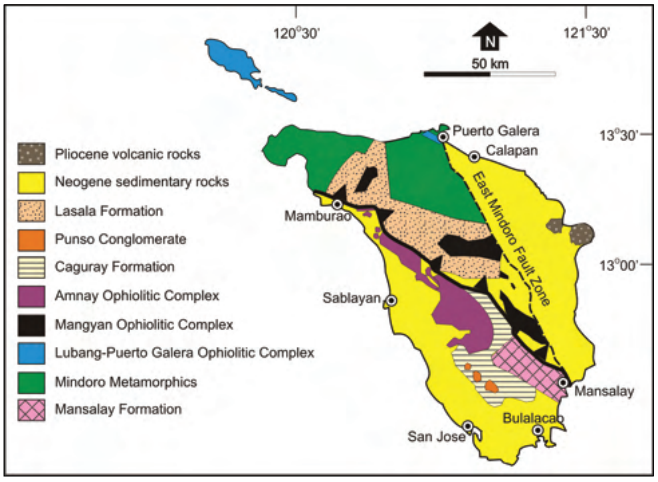

Figure 2: (left) Three NW-trending belts of ophiolitic units comprise Mindoro Island. These are the Lubang-Puerto Galera, Mangyan and AOC (Sarewitz and Karig, 1986; Jumawan et al., 1998).

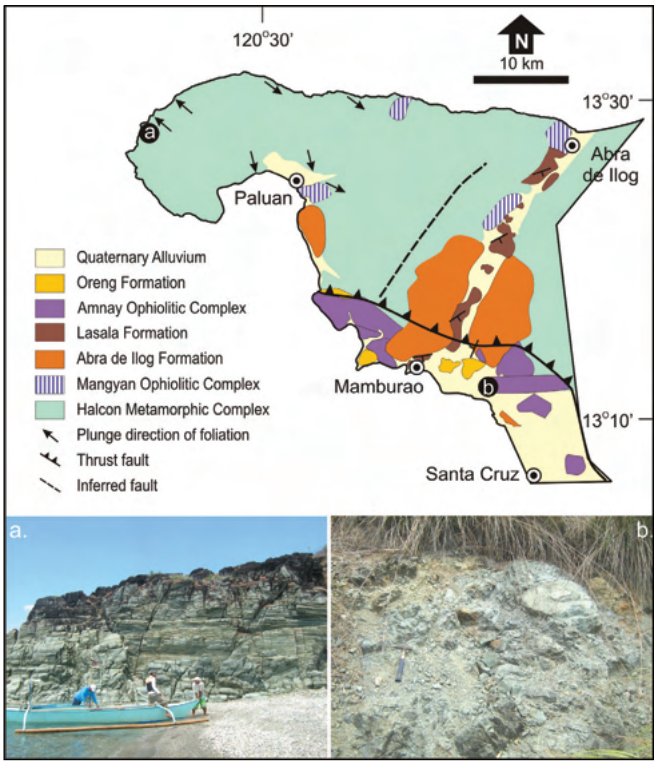

Figure 3: Geologic map of NW Mindoro. Units of the Mangyan Ophiolitic Complex were mapped near Paluan and Abra de Ilog. Photos show the other units encountered, including **(a)** the talc-chlorite schist of the Halcon Metamorphic Complex, and **(b)** the serpentinized harzburgite unit of the AOC.

Cruz. The harzburgites show a high degree of serpentinization (Fig. 3b). Jumawan (1999) attributes this to the presence of a major thrust fault structure in the area. Gabbros and basaltic flows are variably weathered at this site. Sedimentary units of limited distribution were observed along the N-NE-trending valley connecting Abra de Ilog in the north to Mamburao in the south. These sedimentary rocks are composed primarily of calcareous sandstones, mudstones and patches of conglomeratic sandstones. Initial paleontological examination of the mudstones indicates a Pliocene -Pleistocene age based on the calcareous nannofossils (Analyst: A.G.S. Fernando).

Concurrent with the field mapping, rock sampling was also conducted for geochemical analyses. In addition, geochronological analyses will be targeted to address the lack of well-constrained ages for the various features observed in Mindoro Island. This ongoing research endeavor is one of the projects under the natural sciences cluster of the Philippines-Taiwan Science and Technology Cooperation Program on Geosciences. Collaborations within this cooperation program are through the Department of Science and Technology of the Philippines and the National Science Council of Taiwan.

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Russia

Sergei Silantyev

Among the most important results of investigations of ridge processes carried out by Russian scientists in 2008, we would like to highlight the following:

VNIIOkeangeologia and PMGE

The 31st cruise of R/V *Professor Logatchev* was conducted at the MAR axial zone between 19-21°N in Dec. 2007 - May

2008. Explorations on this cruise lead to the discovery of a new large ore deposit ("Zenith-Victory") of hydrothermal affinity at 20°07.75'N, 45°37.35'W. This new hydrothermal field is located on the east slope of the rift valley. Host rocks are basaltic, and no hydro-chemical signal of hydrothermal activity has been detected in this area. The estimated ore reserves of Zenith-Victory amount to no less than 10 million tonnes and are characterized by Cu and Cu-Zn mineralization. Also during this cruise, it was established that the hydrothermal ore deposit "Pui des Folles," discovered in 1996 by a French expedition at the seamount with the same name (20°30.50'N, 45°38.50'W), occupied considerably more area than proposed earlier. Four new inactive hydrothermal vents were discovered by the *Professor Logatchev* expedition in this area.

Other VNIIOkeangeologia activities included the 4th International Conference "Minerals of the Ocean" in May 2008 in St. Petersburg. More than 50 scientists from Russia, China, Germany, and USA attended this meeting (see: www.vniio.ru).

Geological Institute (GIN)

Investigations of the northern Knipovich Ridge and North Barents Sea (including western continental slope of the Arctic ocean) were continued in 2008 in the framework of project "Late Mesozoic - Cenozoic tectonic - magmatic history of the Barents Sea shelf and slope as a clue to paleogeodynamic reconstructions in the Arctic Ocean" as well as "International Polar Year" (see: www.ginras.ru). Seismic profiling and multibeam (SeaBat 8150) surveying as well as dredging of bedrock were conducted in 78-82°N, 30-55°E during the 1st Leg of the 25th cruise of R/V *Akademik Nikolai Strakhov* (chief scientist A.V. Zayonchek). It was established that Orel Trench (Eagle Trench), located just to the east of Spitsbergen, is a contemporary rift characterized by anomalously high heat flow (500 mW/m^2). Investigations of the intersection of Knipovich and Mohns Ridges were carried out during the 2nd Leg of this cruise in the framework of the program "Main problems of Oceanology: physics, geology, biology, ecology of the World Ocean" (Project: "Regularities of the construction and origin of oceanic crust in key areas of the Atlantic: tectonics, magmatism, formation Fe-Mn substances", PI J.M. Pusharovsky). The main result obtained during this 2nd Leg is evidence for migration of the intersection toward SE. Thick Fe-Mn crusts (3-6 cm) are common peculiarities of basalts dredged here. This expedition was carried out under cooperation with NPD, Norway.

IGEM

The ages of 150 grains of zircon from 8 gabbro samples dredged at 4 sites in the axial zone of the MAR at 5°30'6"-5°32'4"N during the 10th cruise of R/V *Akademik Ioffe* (2001-2002) and 22nd cruise of R/V *Professor Logatchev* (2003) have been studied using SIMS technique on SHRIMP-II by regular procedure (i.e., Ludwig, 2000, Berkeley Geochronology Center Special Publication 2, 22 pp.). Two groups of zircon grains, different in color, morphology and inner structure, occur in the rocks. Transparent, colorless, prismatic and short-prismatic zircon grains with corroded surface prevail in gabbronorites. Such zircon grains are interpreted to have a magmatic origin and are related to a gabbronorite crystallization event. Pink-semitransparent rounded grains were found among fine (<150 m) fraction only. Sub-idiomorphic crystals with coarse zoning and thin disparate newly formed rims occur in troctolite. These zircon grains are considered xenogenic. Calculated $^{238}U/^{206}Pb$ zircon ages varied from 2.39±0.19 to 0.76±0.04 Ma. An occurrence of zircon grains of different ages in the same rock samples is evidence for the existence of the heterogeneous lithospheric mantle underlying the MAR.

A thorough Sr-Nd isotopic study of fresh pillow-lavas with remnants of quenched glass, dredged from the axial rift zone of the MAR between 5-7°N, has been carried out. This study revealed small-scale isotope heterogeneity in the basalts and their glasses. The $^{87}Sr/^{86}Sr$ ratios of basalt and glasses in some of the samples do not coincide - in the glasses the Sr-isotope ratio may be higher or lower than that of the basalt by 0.01-0.02%. The $^{143}Nd/^{144}Nd$ ratios of the constituents are practically indistinguishable within analytical error. There is no essential correlation between the isotopic characteristics of the samples and their geochemical features. Sea water was also shown to have no influence on Sr and Nd isotope composition in the studied pillow-lavas. The Sr-isotope heterogeneity is believed to be evidence for small-scale heterogeneity of the basaltic melts, which did not homogenize due to the fast ascent and eruption.

The first data on temperature homogenization of fluid inclusions, fluid salinity and helium isotope ratios were obtained in a course of chimney samples collected during the 2007 Serpentine cruise on the French R/V *Pourquoi Pas?* with ROV *Victor* at the MAR Logatchev hydrothermal field (14°45'N) and Ashadze hydrothermal field (12°58'N). The most important findings are that the formation temperature, fluid salinity, and R/Ra ratios ranged more significantly than these figures measured directly for venting fluids.

Vernadsky Institute

The 2007 Serpentine cruise was led by scientists from France and Russia (see article by Fouquet et al., this volume). Participation of Russian scientists in this expedition was provided by cooperation between Federal Agency of Sciences and Innovations and IFREMER, France. Another important result from sample collection during this cruise is evidence of the presence of two distinct types of residual peridotites in the MAR segment just south of 15°20'N FZ - characterized by very high depletion degree (Logatchev) and moderate and low degree of depletion (Ashadze). In addition, the first data on U-Pb and Lu-Hf system behavior in Zr from trondhjemites and host gabbro sampled at Ashadze during the Serpentine cruise were obtained in close cooperation with GEMOC Key National Cen-

ter of Macquarie University, Australia. Sixty grains of Zr have been analyzed by LA-ICP-MS. Almost all Zr grains judging by isotope dating have very young age of ~1 Ma. Only one grain proved very old of ~2.5 - 3 Ga.

A large study with comparative analyses of geochemical peculiarities of MORB glasses sampled during the 16th cruise of *Akademik Boris Petrov* and 19th and 20th cruises of *Professor Logatchev* at the MAR between 29°-34°N and 12°-18°N has been published in 2008 (Petrology, 2008, 16, 1, 36-62). This work was conducted by cooperation with University of Tasmania, Australia. Data presented in this work indicate that MORB melts occurring at 29-34°N were derived by the melting of a mantle source with a homogeneous distribution of volatile components and arrived at the surface without significant fractionation. On the other hand MAR segments between 12-18°N combine contrasting geodynamic environments of magmatism, which predetermined the development of a large plume region with the widespread mixing of the melting products of geochemically distinct mantle sources.

The results of a study of a representative collection of samples recovered by deep-sea drilling from the oceanic basement 10 miles west of the MAR rift valley axis at 15°44'N (ODP sites 1275B and 1275D) also were published in 2008 (Petrology, 2008, 16, 4, 353–375). The article details the sequence of magmatic and metamorphic events resulting in the formation of a typical oceanic core complex of slow-spreading ridges. The samples studied in this work were granted to Russian scientists according to a Vernadsky - WHOI collaboration in the study of MAR bedrocks drilled at ODP Leg 209.

In addition, a synthesis of results of field studies in Iceland in 2001 and 2003 (performed within Wolfgang Paul Award and Max-Planck Society grant to A. Sobolev) has been carried out in 2008. New data on average compositions (Ni excess and Mn deficit) of olivine phenocrysts for olivine-rich lavas as well as bulk rock $^{187}Os/^{188}Os$ ratios from Iceland basalt show that these tracers are linked for Icelandic Quaternary lavas, strengthening the recycling model. An estimate of the osmium isotopic composition of both the recycled crust and the mantle peridotite implies that Icelandic Quaternary lavas are derived in part from an ancient crustal component with ages between 1.1 and 1.8 billion years and from a peridotite end-member close to present day oceanic mantle (Sobolev et al., Science, 2008, 321, 536).

Winogradsky Institute of Microbiology

The following results were obtained from the Serpentine expedition: (1) An enrichment performing anaerobic methane oxidation at 70-90°C was obtained; (2) An enrichment performing methanogenesis from acetate at 85°C was obtained from the sample from Ashadze; (3) Four strains of anaerobic hydrogenogenic carboxydotrophic representatives of *Thermococcus* spp. have been isolated from the samples from Logatchev. 16S rRNA gene analysis revealed that they are very close to *Thermococcus barophilus* earlier isolated from MAR hydrothermal vent samples; (4) New species *Deferribacter ferriautotrophicus* has been isolated from an Ashadze chimney sample. The scientific team that conducted this investigation includes Russian scientists (T. Sokolova, E. Bonch-Osmolovskaya, G. Slobodkina, A. Slobodkin) as well as a French scientist (J. Querellou, IFREMER). These data will be presented at "Extremophiles 2008," in Cape Town, South Africa, September 2008.

Meetings planned for 2009

(1) Russian Ridge Workshop "Hydrothermal Systems in Mid-Ocean Ridges: Interaction between Magmatic and Hydrothermal Processes" - St. Petersburg, Russia, June 2009.
(2) International Conference "Oceanic Minerals" - joint with 38th Annual Conference of the Underwater Mining Institute (UMI) - Gelendzhik, Russia, September 2009.

For an extended version of the news from Russia, please download the PDF from the online supplement to this year's InterRidge News at: **www.interridge.org/IRNewsletter**.

UK

Tim Henstock

Two major research cruises to the ridge crest were conducted with RRS *James Cook* and ROV *Isis* in 2008. In January - February, cruise JC21 with lead PI Chris MacLeod used ROV *Isis* and a rock drill to sample the Hess Deep at the East Pacific Rise. Preliminary results from this cruise will be presented at the 2008 AGU Fall Meeting. In May - June, cruise JC24 with lead PI Roger Searle surveyed with TOBI side scan sonar and used ROV *Isis* to sample the Mid-Atlantic Ridge at 45°N (see article by Searle et al., this volume). This cruise was an international collaboration involving scientists from Portugal, UK,

and the USA. Also in 2008, cruise CE008 on R/V *Celtic Explorer* involved a collaboration between UK and Irish scientists to examine the V-shaped ridges southwest of Iceland (see article by Murton et al., this volume).

In terms of technology developments in the UK, the AUV *Autosub6000* completed its first science mission in summer 2008. This AUV has 6000-m depth capability, endurance ~36 hours, and equipment including swath bathymetry, likely to be extended with a 3-C magnetometer. We anticipate a strong role for this vehicle in the new IR Working Group "Long-Range Ridge Exploration."

A major research cruise on RRS *James Cook* is planned for January - February 2009 in the East Scotia Sea with Chief Scientist Rob Larter. Regional swath mapping will be conducted and BRIDGET tow-yo and SHRIMP towed camera surveys will refine hydrothermal vent locations. This cruise is the first of three cruises funded within a consortium grant programme led by PI Paul Tyler: ChEsSO; the remaining two cruises will follow with ROV *Isis* in 2010 and 2011 visiting the East Scotia Ridge and Bransfield Strait back-arc basin, respectively.

Recently funded field projects include a study of hydrothermal activity and deep-ocean biology at the Mid-Cayman Spreading Centre (PI Jon Copley). This study will use the AUV *Autosub6000* to map vents and then ROV *Isis* to investigate them in detail. A study of benthic biodiversity of seamounts in the southwest Indian Ocean, along the axis of the SW Indian Ridge (PI Alex Rogers) has also been funded, recently.

The medium to long-term outlook for ridge-crest science in the UK is currently constrained as *Discovery* approaches its end of life. The process to procure a replacement for *Discovery* is under way, aiming for delivery in 2010/2011. The specification calls for a ~100-m platform with a high degree of flexibility for modern marine studies.

USA

Kathleen Phillips and Donna Blackman, SIO Ridge 2000 Office

Mid-term program review

The Ridge 2000 Program (R2K) has transitioned from its initial phase (2001-2007) to its final phase (2008-2012) following a major Program Review. The U.S. National Science Foundation convened an external review panel that concluded the R2K Program has obtained a strong suite of multi-disciplinary data at the Integrated Studies Sites (ISS) during its first phase and has contributed significantly to deep-sea technological development, which has benefited the entire field. The R2K education and outreach programs were noted to be exemplary and to have been particularly effective at the K-12 level. The Program has collected a unique set of multi-disciplinary, co-located datasets at three ISS: the East Pacific Rise (EPR) 8-11°N, the Endeavour segment of the Juan de Fuca Ridge, and the Eastern Lau Spreading Center. In order to reach the goals set forth in the R2K Science Plan, the Review Panel recommended that the program redirect major efforts to spur integration and synthesis of these unique datasets and to work towards the development of models that elucidate the interplay between various parts of the spreading, hydrothermal, and vent (eco)systems. The R2K Steering Committee agreed with this recommendation and has been working to increase integration and synthesis across the R2K community. Although the majority of R2K efforts will now focus on integration and synthesis of existing data, specifically targeted field programs are also expected to play a role during the Program's final phase.

Research updates

Several successful research cruises were conducted in the 2007/2008 field season, including one Rapid Response Cruise in the Juan de Fuca region in response to a seismic swarm north of the Blanco fracture zone within the Juan de Fuca plate in late March 2008. The short response cruise, aboard the R/V *Wecoma*, was organized by researchers at NOAA/PMEL in Oregon, and conducted CTD casts to investigate whether there were any water column anomalies associated with this unusual, intra-plate swarm. No strong anomalies were observed, however sample analysis is ongoing at NOAA/PMEL.

At the Lau Basin, a cruise on R/V *Kilo Moana*, led by Fernando Martinez, Joe Resing, and Ed Baker, conducted deep-tow sidescan mapping of the axial region from Tow Cam to ABE vent fields and a narrower region over the Valu Fa Ridge. Water column surveys and sampling targeted the extent of hydrothermal activity associated with mapped seafloor structures.

The recent field season was a busy one at the Endeavour ISS. A series of R/V *Atlantis* cruises conducted acoustic scintillation experiments, complementary survey and mapping work at Axial Volcano, biological field studies and tubeworm sampling, and measuring physical properties and sampling of black smokers. R2K scientists collaborated with NEPTUNE Canada during recent cruises to Endeavour, being part of the larger effort on successful installation of 800 km of fiber optic cable as well as

repeaters, branching units and cables that will eventually be connected to the node at the Endeavour site. There are also a number of upcoming cruises to Endeavour including continuation of the acoustic scintillation and biological field studies begun in the last field season, and a new microbiological field program to study hyperthermophile growth in sulfide deposits and diffuse fluids. A seismic tomography cruise on R/V *Langseth* is scheduled for August 2009, and NEPTUNE Canada will also continue its work on the observatory with the planned installation of the Endeavour node in September 2009.

A diverse group of field programs were conducted on the EPR ISS on R/V *Atlantis*, starting with a study of protistan abundance and diversity at hydrothermal vent systems and continuing studies on physical oceanography and larval dispersal. Karen Von Damm and Marv Lilley led a cruise to investigate the changes in hydrothermal vent fluid chemistry and biology that followed the 2005/2006 eruption. The final cruises of the season investigated microbiology and biogeochemistry, and conducted in situ studies of vent fluid chemistry. A new long-term geodetic network was deployed at the 2005/2006 eruption site and in situ electrochemical analyzers were deployed and tested. A 3-D multichannel seismic survey was just completed on the R/V *Langseth*. There are two upcoming microbiological cruises to the EPR that will take place in fall 2008.

More information on these cruises and the upcoming cruises is available in the new edition of the R2K Ridge Events newsletter, which can be found on the R2K website at: http://www.ridge2000.org/science/info/newsletters.php.

Education and outreach

R2K continues its successful education and outreach work with both ongoing projects and new collaborations. The FLEXE (From Local to EXtreme Environments) project is a component of the international GLOBE program. This year approximately 600 middle and high school students from the USA and Germany participated in the 2007 Energy Unit pilot, which followed a "live" research cruise to the EPR via the web. The next unit on deep-sea ecology and microbial processes is currently under construction.

In June 2008, R2K collaborated with the MATE (Marine Advanced Technology Education) Center to host the 2008 International ROV Competition (also see Education and Outreach Update, this volume). This year's competition had a deep-sea hydrothermal vent theme and drew over 400 middle, high school, and college students to the University of California San Diego swimming pool to compete in teams tasked with a series of "missions" with ROVs that they designed and constructed themselves. The annual competition aims to give students a chance to learn real-world engineering, scientific, and critical thinking skills and gives them exposure to careers in these fields through a large network of industry and academic sponsors.

Other outreach efforts include sponsoring the development of a hydrothermal vent visualization product that will be featured at the Birch Aquarium at Scripps in their upcoming deep-sea exhibit. The completed product will be made available to other museums and education centers around the country. 2008 has also seen the launching of the R2K Media Bank (http://media.marine-geo.org/), an online repository for ridge and vent photographs, movies, illustrations, and other images (see article in Online Resources, this volume).

Final phase program activities

The final phase of R2K will emphasize integration and synthesis of R2K results and the development and testing of models that incorporate linked components of the spreading center and hydrothermal (eco)system. To enhance integration and synthesis, both within R2K and with the broader ridge research community, R2K convened three Integration and Synthesis workshops, focused on each of the three ISS. These workshops took place in September 2008 and focused largely on small group break-out sessions designed to get different groups of scientists working together to integrate their various disciplinary results with an aim of spurring interdisciplinary publication of linked findings. Workshop reports are available at: http://ridge2000.org/science/meetings/index.php.

Integration and Synthesis Oversight Committees (ISOC) have been formed for each of the ISSs. These committees of 5-6 scientists meet on a semi-regular basis to discuss ideas for enhancing Integration at the ISS and worked together on the organization of the September workshops. The R2K Office now has the capability to facilitate group discussions through web conferences that include a teleconference and the ability for a group of scientists to show slides, images, and applications over the Internet. This system has worked well for hosting ISOC web/tele-conferences, and is available to the entire community to help facilitate communication among colleagues at different institutions.

Office rotation

November 2008 marks the end of the R2K Office rotation at Scripps Institution of Oceanography (SIO). The R2K office will move to Woods Hole Oceanographic Institution (WHOI) where Dan Fornari will take the helm as Program Chair. The SIO Office (Donna Blackman, Chair; Katie Phillips, Science Coordinator; Katherine Haak, Program Administrator; Liz Goehring, K-12 Education and Outreach Coordinator; and Eric Simms, Informal Education and Outreach Coordinator) has enjoyed hosting the program and working with the InterRidge community on a number of workshops and projects. Liz Goehring will continue to oversee Education and Outreach work for the R2K Program, and Eric Simms will continue his role in the FLEXE project. Breea Govenar and Janet Moore will be serving as the Science Coordinator and Program Administrator, respectively, at the new office at WHOI.

Working Group Updates

Biogeochemical Interactions at Deep-Sea Vents

Chair - N. Le Bris (IFREMER, France)

Members

The WG for Biogeochemical Interactions at Deep-Sea Vents had one new change in membership for 2008: Huaiyang Zhou has joined the IR WG for Deep Earth Sampling, and we invited Xiqiu Han (Second Institute of Oceanography, China) to join our WG in replacement. Xiqiu's expertise in oxygen and carbon isotopic signatures of chemosynthetic processes fits perfectly with the WG objectives, and she will bring a complementary view from China.

IRTI

Many of our WG activities in this past year have been as a follow-up to the InterRidge Theoretical Institute on Biogeochemical Interactions at Deep-Sea Vents (Woods Hole, Sept. 10-14, 2007), with the help of the IR office, WHOI colleagues and chairs of the discussion groups (see article in 2007 InterRidge Newsletter). Our workshop report is available at: http://www.interridge.org/files/interridge/IRTI_2007_rept_full_posted_NLB.pdf.

The development of original strategies and collaborative projects was a main objective of the IRTI. Beyond smaller-scale initiatives, the proposition for a coordinated action on an international basis was issued from the workshop. A common concern about the capacity of hydrothermal systems to derive chemical energy to fix CO_2 into biomass arose from four of the IRTI discussion groups (plume biogeochemistry, life in extreme environments, hidden biosphere, long-term seafloor ecosystems changes) and provided the basis for such an initiative.

Below, we highlight in particular two direct outcomes from the IRTI:

- a SCOR proposal for a synthesis and modelling effort on which a future large-scale biogeochemical flux experiment will be based (developed from the several discussion groups mentioned above), and
- interactions with the GEOTRACES program (another SCOR-affiliated program) that developed more specifically from the discussion group on plume biogeochemistry.

New SCOR Working Group

A major achievement of our WG in this past year is the approval of a new SCOR Working Group, to be co-funded by InterRidge, on "Hydrothermal energy transfer and its impact on ocean carbon cycles." This new Working Group will be co-chaired by Nadine Le Bris (IFREMER, France) and Chris German (WHOI, USA). Currently, the proposal is posted on the SCOR website at: http://www.scor-int.org/2008GM/Ridges.pdf. We will also create a mirror webpage for this new SCOR-InterRidge initiative as part of the on-going IR WG for Biogeochemical Interactions at Deep-Sea Vents.

Hydrothermal venting is widespread throughout all ocean basins, and the local fixation of carbon and the export of biolimiting nutrients to the broader ocean may be much greater than previously recognized. Recent advances in molecular methods as well as in situ and in vivo experimentation now provide us new opportunities for a coordinated, integrating effort in which interdisciplinary approaches and modelling can be proposed. The main objective is to set the basis for a revised consideration of the diverse pathways of CO_2 fixation driven by hydrothermal processes and the potential contribution that they may make to the global ocean carbon cycle. Our new SCOR support should allow larger initiatives to be organized on this topic, involving a broader community of researchers, including other IR WGs.

This is the first SCOR Working Group in over ten years to be stimulated from InterRidge activities. We congratulate those involved with the proposal and thank all who were involved with the discussions at the IRTI. Please feel free to contact Nadine (Nadine.Le.Bris@ifremer.fr), Chris (cgerman@whoi.edu), or the InterRidge office (coordinator@interridge.org) with questions or suggestions for the new SCOR Working Group.

Links with the GEOTRACES program

GEOTRACES is one of the newest SCOR-affiliated programs and seeks to conduct a series of 2-D cross sections of the oceans, spanning entire ocean basins, to characterize global-ocean biogeochemistry on scales comparable to the WOCE program's physical oceanographic studies. In the USA the first priority is a trans-North Atlantic geochemical section, currently planned to be conducted in 2010, that will include one station at the TAG hydrothermal mound. A second priority for U.S. GEOTRACES, identified at a meeting held in Oct. 2008, will be to run a pair of sections in the eastern Pacific. One will run from north to south between Alaska and Tahiti and intercept dispersing hydrothermal plumes that span the Pacific basin, emanating from (from North to South): the Juan de Fuca Ridge, Loihi Seamount (Hawaii), East Pacific Rise (EPR) 9-10°N and EPR 10-20°S. The complementary E-W section will run between Tahiti and Peru, where the western

half of the section will be designed to sample along the axis of the dispersing hydrothermal plume that originates at the southern EPR (the world's biggest plume, originating from the world's fastest-spreading ridge). The eastern half of the same section will provide a contrast with the iron and manganese-rich lenses of water that make up the oxygen minimum zone that extends offshore from the Peru Margin - one of the most highly productive regions of surface ocean. The time frame for these section studies is currently anticipated to be 2012-2014. We expect that our WG will work together with GEOTRACES in the development of these programs and, in particular, a complementary process-oriented and submersible-led investigation of the high-temperature vent-sources for the southern EPR plume, focussed along the super-fast SEPR ridge-axis.

Links with other IR WGs

The activities of our WG are tightly connected with other IR WGs. Members of the Vent Ecology, Deep Earth Sampling, and Monitoring and Observatories WGs actively participated in the IRTI, and several are also involved in the SCOR Working Group. The development of interdisciplinary approaches and dedicated tools, in turn, provide inputs to the reflexion of these WGs. We will continue developing synergies in the future with other IR WGs. Particularly, we will be pleased to provide contributions to future InterRidge Theoretical Institutes and workshops.

Upcoming events

- ASLO Aquatic Sciences Meeting, Nice, France, Jan. 25-30, 2009. Session: From molecules to organisms: Chemoautotrophic pathways and mechanisms of energy transfer in extreme marine environments.
- Goldschmidt Conference, Davos, Switzerland, June 2009. Session: Pathways and regulation of energy and carbon transfer in extreme deep-sea environments.

Deep Earth Sampling

Chair - B. Ildefonse (Univ. Montpellier II, France)

Members

The WG for Deep Earth Sampling has one new member in 2008: Huaiyang Zhou (Tongji University, China).

Recent events

- A Magellan workshop "Lithospheric heterogeneities, hydrothermal regimes, and links between abiotic and biotic processes at slow spreading ridges," partly funded by InterRidge, was held in September 2008 in Montpellier, France (see article, this volume).
- IODP recently set up a Thematic Review Committee (Oceanic Crustal Structure and Formation; www.iodp.org/trc/), which met in Oct. 2008 in Zürich, Switzerland. A report should be available soon on the IODP web site.

Future of the WG

Our WG was formed in 2004 as part of the InterRidge Next Decade Plan. Following our activities associated with the Mission Moho Workshop in 2006 and a group proposal submitted to IODP in 2007, it was time in 2008 to either disband the WG or move forward with a new mandate. We held several discussions over email prior to the 2008 IR Steering Committee meeting. At this recent IR STCOM meeting, it was recognized the importance of our WG in this upcoming year as the IODP INVEST workshop in September 2009 (listed below) will be receiving input for planning the next decade of IODP science beyond 2013. The Steering Committee emphasized the importance of our WG in contributing to this planning for the future of scientific ocean drilling. Thus, we will continue the WG, with a more focused mandate to provide inputs on priorities and targets to the 2009 IODP INVEST workshop. In the short term, we are planning to meet for a discussion just prior to the AGU Fall Meeting in December 2008. We also plan to identify money and time to possibly organize a dedicated WG meeting next year, before the INVEST workshop. In addition, the IR Steering Committee recognized the need for a liaison between this IR WG, representing the IR community-at-large, and IODP.

Upcoming events

- AGU Fall Meeting, Sunday, December 14, 2008, WG meeting with discussion open to other community members who are interested in joining our planning effort for the 2009 IODP INVEST Workshop (contact Benoit Ildefonse for details on this meeting: Benoit.Ildefonse@um2.fr).
- ECORD Summer School on Geodynamics of Mid-Ocean Ridges, 31 August - 11 September 2009, Bremen, Germany, http://www.glomar.uni-bremen.de/ECORD_Summer_School_2009.html. The IR WG members are involved in organizing this summer school with colleagues from MARUM and the IODP core repository in Bremen. We hope to attract about 30 Ph.D. students and postdocs, to work on geody-

namics of mid-ocean ridges, with a focus on drilling results (and projects) in the Atlantic. We will take advantage of the Atlantic cores being stored in Bremen to conduct practical courses using IODP cores and samples. The summer school is primarily sponsored by GLOMAR and MARUM in Bremen, and by ECORD, and partially funded by InterRidge to open the participation to students/instructors from non-ECORD countries.

- IODP New Ventures in Exploring Scientific Targets (INVEST) Workshop, Sept. 23-25, 2009, University of Bremen, Germany, http://www.marum.de/iodp-invest.html. The purpose of this workshop is to define the scientific research goals of the second phase of the IODP, expected to begin late in 2013.

Long-Range Ridge Exploration

Chair - C. Devey (IFM-GEOMAR, Germany)

The WG for Long-Range Ridge Exploration was formed in 2008 and currently includes members from 8 countries (Brazil, China, France, Germany, Japan, South Africa, UK, and USA). The plan for this WG is to identify vehicles with the necessary reliability, depth and endurance capability for long-range exploration of the mid-ocean ridge, define standard sensor packages and standardise calibration and data processing, develop a cruise plan, and identify the most urgent targets for such exploration work. Although we have not yet had our first meeting, several WG members attended the IEEE/OES Autonomous Underwater Vehicles (AUV) workshop on 13-14 October 2008 at Woods Hole Oceanographic Institution.

Mantle Imaging

Chair - N. Seama (Kobe Univ., Japan)

The WG for Mantle Imaging was formed in 2008 and currently includes members from 4 countries (China, France, Japan, and USA). Our WG membership is still being developed. The key scientific questions to be addressed by imaging the mantle beneath spreading centers are: 1) clarifying mantle dynamics associated with different ridge systems, and 2) identifying the parameters controlling various lithospheric features at different types of ridge systems. High quality images of the mantle structure beneath spreading centers can only be achieved through international collaboration, because large-scale seismic and electromagnetic experiments in the same area are required. Several members of our WG will meet in association with a symposium on "Deep Slab and Mantle Dynamics" in February 2009 in Kyoto, Japan.

Monitoring and Observatories

Chairs - J. Escartin (IPGP, France) & R. Santos (Univ. Azores, Portugal)

Revised mandate for the WG

Our WG started in 2001 as part of the Event Detection and Response and Observatories WG, and the combined WG was renamed the Monitoring and Observatories WG in 2002. The original mandate for our WG was "to encourage multidisciplinary studies at the Mid-Atlantic Ridge, with the ultimate goal of developing observatory-type efforts on the Azores area, encompassing the Lucky Strike, Menez Gwen and Rainbow hydrothermal vents, to characterize this portion of the ridge and understand the integration of tectonic, volcanic, biological and hydrothermal systems in space and time." Following the second MoMAR (Monitoring the Mid-Atlantic Ridge) planning workshop in 2002, additional community meetings that this WG has organized or participated in include:

- 2003: ESF Exploratory Workshop "Long-term monitoring of deep-ocean hydrothermal systems"
- 2004: USA Ridge 2000 Mid-Atlantic Ridge Workshop
- 2005: International MoMAR Implementation Workshop
- 2008: USA Ridge 2000 Mid-Atlantic Ridge 35-37.5°N Workshop.

There are numerous on-going and upcoming integrated studies and monitoring efforts at MoMAR Lucky Strike including a test observatory site at Lucky Strike in 2010 (MoMARSAT project, France). It was suggested that special attention should be given to the planning and coordination of scientific activities in this area, to the sharing of data and information, and to the development of a data policy for activities at this site. This translated into an effective coordination of U.S., French and Portuguese cruises and experiments in summer - fall 2008, and the release of a first GIS database for the MoMAR area through the MoMAR web page (http://www.momar.org).

At the 2008 InterRidge Steering Committee meeting it was thus determined that the WG should continue with a revised mandate, focusing on the specific tasks of the MoMAR GIS database, cruise coordination, and planning for the next major international MoMAR workshop. This thrust is justified because of the expected installation of the ESONET MoMARSAT observatory in 2010 and the need for international collaboration in data sharing and cruise scheduling in the MoMAR area. The WG will also aid in identifying new sites and new experiments (e.g., new monitoring opportunities) in the MoMAR area and promoting collaboration among international scientists with complementary research interests and tools. Although focused on MoMAR, the WG will expand efforts to communicate with other mid-ocean ridge observatory programs. The WG will also follow the development of the OSPAR MPA sites, which included Rainbow, and the eventual extension of the continental shelf, which may include Rainbow within Portuguese instead of international waters.

Members

Due to the evolution of the Monitoring and Observatories WG as described above, there will be a significant change in membership for 2009. R. Santos will rotate off as co-chair at the end of 2008, but will stay on as a WG member. Our new co-chair will be Ana Colaço (Portugal). Our new membership will initially include Doug Connelly (UK), Emilie Hooft (USA), and Anna-Louise Reysenbach (USA), but additional members will be added based on developing projects or needs identified by the community.

MoMAR cruises

Coordination of U.S., French and Portuguese field programs in the MoMAR area in 2008 involved a total of 5 cruises, with activities focused primarily at Raibow and Lucky Strike. These included ROV *Jason II* dives onboard R/V *Revelle* (PI A.-L. Reysenbach, K. Ding and J. Seewald, 07-08/08), ROV *VICTOR* dives at Lucky Strike and Rainbow onboard N/O *L'Atalante* (PIs J. Escartin and J. Dyment, 08/08), hydrophone recovery for hydroacoustic monitoring of seismicity onboard *Gago Coutinho* (PI J. Goslin, 09/08), OBS recovery and deployment onboard N/O *Suroit* (PI W. Crawford, 08/08), and a series of ROV test dives including the MoMAR area onboard *Gago Coutinho* (PI N. Lourenço, 10-11/08).

Visit the InterRidge website
for more information about our working groups,
including proposals for the new WGs in 2008:
http://www.interridge.org/WGlist

Seafloor Mineralization

Chair - M. Tivey (WHOI, USA)

The WG for Seafloor Mineralization was formed in 2008 and currently includes members from 10 countries (Canada, China, France, India, Japan, Korea, Norway, Russia, UK, and USA). Our WG has as its focus the objective of understanding the formation and evolution of seafloor massive sulfide (SMS) deposits. Most known SMS deposits are still active hydrothermal systems and yet their preserved and relict counterparts remain relatively unexplored and undocumented. The primary objective of the WG will be to target the inactive and preserved systems in order to address gaps in knowledge of the biology, geochemistry, and geophysics of SMS deposits. In this way, progress can be made towards understanding the govern-

ing processes behind SMS deposit formation and preservation and will help to assess the complete inventory of such deposits. A sound scientific base of knowledge would not only advance science but also inform the commercial and political world of the importance of these multi-faceted resources and encourage responsible development.

The first meeting of our WG will be in association with the event on 2 April 2009 sponsored by Woods Hole Oceanographic Institution, InterRidge, and ChEss, titled "Deep-Sea Mining of Seafloor Massive Sulfides: A Reality for Science and Society in the 21st Century" (see advertisement on p. 57, this volume). This workshop and public colloquium will bring together scientists, specialists in marine conservation, mineral economics, and public international law, the International Seabed Authority, national interests, and representatives of industry and NGOs to discuss deep-sea mining of seafloor massive sulfides. Members of other IR WGs, including Vent Ecology and Biogeochemical Interactions at Deep-Sea Vents, are also likely to attend this event.

Ultra-slow Spreading Ridges

Chair - J. Snow (Univ. Houston, USA)

The Ultraslow Spreading Ridges WG has been quietly active over the past few years. The membership of the WG has been informal, including Jon Snow, Eric Hellebrand, Henry Dick and Peter Michael (all USA), Wilfried Jokat (Germany), and several others. The community has made progress in the arctic ridges, the Southwest Indian Ridge, and other localities. Some of the highlights of research activities include, but not limited to, the following:

Research cruises

- Chinese cruise in 2007 found the first ultra-slow black smoker system on the Southwest Indian Ridge (see: http://www.interridge.org/node/86)
- Norwegian cruise in 2008 found the first high-temperature system on the Knipovich Ridge (see: http://www.interridge.org/node/5581)
- Japanese cruise to the Southwest Indian Ridge near the Marion hotspot in January 2008 (see: http://www.interridge.org/node/5452)
- USA and UK funding to study the Mid-Cayman Spreading Center in 2009 and 2010, respectively.

Conferences

- IODP continental breakup symposium, working group on arctic margins, Pontresina, Switzerland, 2006.
- Polar Ridges Meeting and Workshop, Sestri Levante, Italy, 2006.
- AGU Fall Meeting: V12-C, I-II-III (posters) "Tectonics, Petrology, and Geochemistry of Ultraslow Spreading Ridges: Recent Advances," 2006.
- AGU Fall Meeting: Multiple presentations in session "Bringing Together Observations and Models at Rifted Margins and Extensional Basins," 2007.
- International Lherzolite Conference, presentations by Dick, Snow, Hellebrand, von der Handt on Gakkel Ridge mantle dynamics, 2008.
- Geological Society of America, presentations by Snow and Dick, ultraslow spreading and continental breakup, 2008.
- AGU Fall Meeting: T05 "Magmatic, Tectonic, and Hydrothermal Interactions at (Ultra-) Slow Spreading Mid-Ocean Ridges," and T07 "Evolution of Magma-Starved Rifts in Oceans, Continents and Backarcs," 2008.

Selected papers

- Liu, et al. (2008) Ancient, highly heterogeneous mantle beneath Gakkel ridge, Arctic Ocean. Nature 452: 311-316.
- Goldstein, et al. (2008) Origin of a "Southern Hemisphere" geochemical signature in the Arctic upper mantle. Nature 453: 89-93.
- Sohn, et al. (2008) Explosive volcanism on the ultraslow Gakkel ridge, Arctic Ocean. Nature 453: 1236-1238.

The Ultraslow Spreading Ridges WG was formed as a merger of the Arctic and SW Indian Ridge WGs in 2004 as part of the InterRidge Next Decade Plan. Our objective at that time was to convene an international workshop on ultraslow spreading ridges, which we successfully held in 2006 in Sestri Levante, Italy, as listed above. Following the rules for IR WGs as described in the 2006 InterRidge News, our work is completed, and it is now time to disband the WG.

Editor's Note: At the IR Steering Committee meeting in October 2008, the decision to disband the WG in its current form was agreed upon, but it was noted that the Steering Committee would also welcome future proposals to develop a new WG on this theme at any time in the future.

Vent Ecology

Chairs - S. Hourdez (Sta. Biol. Roscoff, France) and C. Fisher (Penn. State Univ., USA)

Members

The Vent Ecology WG was officially created in 2008. It comprises members from 11 different countries and is chaired by Stéphane Hourdez (France) and Charles Fisher (USA). As proposed when the WG formed, C. Fisher will rotate off as co-chair at the end of 2008, but will stay on as a WG member. We will select a new co-chair from the current WG members.

Recent and upcoming meetings

- The International Conference of Comparative Physiology and Biochemistry (Masai Mara National Reserve, Kenya, 19-25 July 2008) had a special session organized by C. Fisher on Life in Extreme Environments of the Deep-Sea. The session included presentations by 6 IR biologists from Austria, France, and the USA.
- A ChEss workshop, "Phylogeny and taxonomy of vesicomyid and mytilid bivalves," was held in Roscoff, France, 5-10 September 2008. The workshop was co-organized by S. Hourdez and Heiko Sahling and attended by numerous IR biologists.
- A similar ChEss workshop was held in Hawaii from 28-31 October 2008: "Siboglinidae: a model system for the understanding of evolution, adaptive radiation, microbial symbioses and ecology at extreme environments." The organizers were Adrian Glover, Ana Hilario & Thomas Dahlgren.
- Two back-to-back CAREX (Life in Extreme Environments) workshops will be held in San Feliu de Guixols, Spain, from 29 Nov. - 5 Dec. 2008. S. Hourdez will participate in both workshops ("Priorities for environment-specific technological developments and infrastructures" and "Identification of model ecosystems in extreme environments").
- The ASLO Meeting (25-30 January 2009, Nice, France) will have a topical session on "Life in extreme environments: deep-sea chemosynthetic ecosystems" organized by François Lallier (France) and C. Fisher (USA).
- The 4th International Symposium on Chemosynthesis-Based Ecosystems - Hydrothermal Vents, Seeps and Other Reducing Habitats will be held June 29 - July 3, 2009, in Okinawa, Japan. Yoshihiro Fujiwara and Yoshiko Takeoka are organizing this meeting and can be contacted at 4th_CBE_office@jamstec.go.jp. The early registration deadline is 31 January 2009. The Vent Ecology WG will meet during this meeting, and IR has agreed to provide some support both for the WG and for the CBE meeting. We will request additional support from national programs for travel to Japan for IR researchers to attend the meeting.

Mineral mining policy and activity

One of the goals of IR is to encourage the protection and management of the oceanic ridge environment. C. Fisher has been invited and will provide input to Nautilus Minerals during the Nautilus Minerals Environmental Review on November 17, 2008, in Memphis, Tennessee, regarding best practices in mining at back-arc basins. He will also give a presentation, titled "Physiological ecology and biodiversity of animal life around hydrothermal vents and hydrocarbon seeps," to the Underwater Mining Institute meeting on "Marine Minerals: Technological Solutions and Environmental Challenges" in Oxford, Mississippi, on November 19, 2008. An upcoming ICES (International Council for the Exploration of the Sea) symposium on issues confronting the deep oceans will be held in the Azores from 26-30 April 2009 (http://www.ices.dk/iceswork/symposia/2007.3.ACE06.pdf). This symposium and a preceding event on 2 April 2009 sponsored by WHOI, InterRidge, and ChEss ("Deep-Sea Mining of Seafloor Massive Sulfides: A Reality for Science and Society in the 21st Century"), will be attended by some members of the Vent Ecology WG.

Online resources

Our WG aims at encouraging cutting edge collaborations among researchers in the field. For this, IR will assist in setting up two online resources for the WG and other interested vent ecologists:

- The first, which will be available through our WG webpage on the IR website, will provide information on completed, on-going, and planned projects that use high throughput molecular approaches to better characterize the physiological and ecological potential and realized activities of vent biota (such as genomics, transcriptomics, and proteomics). These approaches are costly, and to best utilize our international community's resources, analyses should probably not be duplicated but rather planned to complement one another.
- The second resource will provide a venue for vent ecologists to provide information on the availability of biological samples from previous or planned cruises, and as well as for others to place requests for valuable samples. This will be coordinated with the CoML ChEss (and OBIS) efforts, which at this time do not yet include frozen samples. The WG will continue to work closely with ChEss and the CoML with respect to integration of biological studies across the world and compiling searchable inventories of samples.

Workshop Reports

Qingdao Ocean Sciences Summer School 2008

S. Beaulieu and J. Lin

Hosted by the Ocean University of China from 14-20 July 2008, the Qingdao Ocean Sciences Summer School was one of the largest gatherings ever held for graduate students in biogeosciences and oceanography in China. Approximately 200 students and 40 speakers participated in the event, entitled "International Advances in Deep-Sea Geo-Bioscience Research." The Summer School was organized by the National Laboratory for Marine Science & Technology (MNL) in Qingdao and the International Professionals for Advancement of Chinese Earth Sciences (IPACES) and was sponsored by the Chinese Ministry of Education, Ministry of Science and Technology, Natural Science Foundation of China (NSFC), China Ocean Mineral Resources R&D Association (COMRA), and other research institutions and universities. Dr. Zuosheng Yang, Distinguished Professor and Honorary Director of the Institute of Estuarine and Coastal Studies at the Ocean University of China, led the Organizing Committee. InterRidge Chair, Jian Lin (WHOI), was also involved in organizing the event, coordinating the international participation.

InterRidge scientists provided lectures on the state-of-the-art international research of mid-ocean ridge processes as well as deep-sea exploration technologies. Lectures covered a broad array of subjects, ranging from geophysics to physical oceanography to microbiology to underwater vehicle technology. Speakers were from China, France, UK, and USA, with a number of contributions from InterRidge, including:

- Jian Lin (WHOI, USA), InterRidge Chair, gave the opening address and keynote talk, entitled "Oceanic lithosphere geological structure, rheology, and hydrothermal interactions along the global mid-ocean ridges."
- Y. John Chen (Peking University, China) and Jiabiao Li (Second Institute of Oceanography, SOA, China) – both are InterRidge Steering Committee members from China – gave talks on "Thermal structure of the oceanic crust and lithosphere" and "Tension cracks on the continental margins and deformation models," respectively.
- Nadine Le Bris (IFREMER, France), Chair of the InterRidge Working Group for Biogeochemical Interactions at Deep-Sea Vents, gave a 3-hour tutorial on this subject, entitled "Biogeochemical interactions at hydrothermal vents."
- Xiang Xiao (Third Institute of Oceanography, SOA, China), member of the InterRidge Working Group for Vent Ecology, presented "Microbiodiversity of deep-sea hydrothermal vent."
- Stace Beaulieu (WHOI, USA), InterRidge Coordinator, taught the students about "Hydrothermal vent ecology - Larval supply, colonization, and community development."
- Several other InterRidge members also provided lectures on a diverse range of subjects. Dana Yoerger (WHOI, USA) conducted a 3-hour overview of "Technologies for scientific exploration of the deep-sea floor." Chunhui Tao (Second Institute of Oceanography, SOA, China) presented recent developments in "Prospecting indicators and investigating methods for discovering seafloor hydrothermal sulfide deposits." Milene Cormier (University of Missouri, USA), who presented a lecture on "Application of emerging geophysical methods for characterizing volcanism at mid-ocean ridges," was also embarking on a 5-year, U.S. NSF-funded partnership with China in studying the intra-plate seismotectonics of northern China. Guangxue Li (Dean of Marine Geosciences, Ocean University of China) gave a talk titled "Management system of magnetic data in three oceans."

The Qingdao Summer School is expected to have lasting impacts for the graduate students from throughout China who attended as reflected in comments by the participating students and staff members. Students also became aware of fellowship opportunities including the new InterRidge Fellowship Program to assist with costs such as participation in international research and cruises.

Figure 1: Dana Yoerger, Stace Beaulieu, Zuosheng Yang, and Jian Lin at the Qingdao Ocean Sciences Summer School (photo by Leonna Tien, Scripps Institution of Oceanography, USA).

The InterRidge participants would like to thank the Organizing Committee, the Ocean University of China, and the sponsoring organizations for a very successful Summer School and an enriching opportunity to interact with Chinese students and colleagues. For more details, see http://www.interridge.org/node/5580.

Figure 2: (upper right) Chunhui Tao presenting a lecture at the Qingdao Ocean Sciences Summer School (photo by S. Beaulieu).

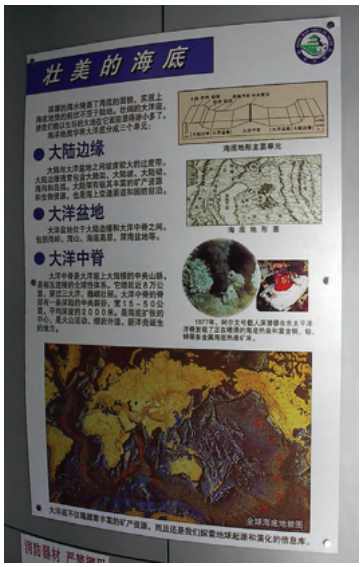

Figure 3: (lower right) Overlooking Beach No. 1 and the campus of the Ocean University of China in Qingdao (photo by S. Beaulieu).

Figure 4: (left) A poster about mid-ocean ridges and hydrothermal vents is on display at the Qingdao Aquarium (photo by S. Beaulieu).

ESF Magellan Workshop Series:
Lithospheric heterogeneities, hydrothermal regimes, and links between abiotic and biotic processes at slow spreading ridges

Conveners: Marguerite Godard (Marguerite.Godard@gm.univ-montp2.fr), Gretchen Früh-Green, and Christopher MacLeod

Recent discoveries of low-temperature hydrothermal vents specific to mantle exhumation areas and of abiotic synthesis of hydrocarbons directly associated with these vents highlight the strong links between the structural and petrological heterogeneities of the lithosphere formed at slow spreading ridges and the development of conditions favourable to life in extreme environments.

A workshop was held in Montpellier, France, from 10-12 September 2008 that brought together specialists in marine geology and geochemistry, oceanography, biology and petrology. Its aim was to develop a European-initiated, mission-specific platform (MSP) Integrated Ocean Drilling Program (IODP) drilling proposal to investigate geological, physical and chemical evolution of the accretion system at slow spreading ridges and the life it sustains. The workshop was supported by European Science Foundation (Magellan Workshop Series), UK-IODP, and InterRidge. InterRidge co-sponsored the workshop in support of Working Groups for Biogeochemical Interactions at Deep-Sea Vents, Deep Earth Sampling, and Ultra-slow Spreading Ridges. A total of twenty-three participants from six European countries and the USA attended the workshop (Fig. 1, next page).

The workshop was introduced by a series of presentations that provided an updated view of tectono-magmatic processes in magma-starved slow spreading centres, the associated development of H_2-generating, serpentine-hosted hydrothermal fields and on related microbial communities, as well as an introduction to the most recent improvements in seabed rock drills (e.g., BGS, MeBo). Discussions focused on (i) the development of novel uses of MSP to explore ridge processes and options to design a drilling experiment, and (ii) the major questions and rationale that drive interest in Scientific Ocean Drilling at slow spreading ridges today. Atlantis Massif (Mid-Atlantic Ridge, 30°N) was chosen as a target area because (i) it samples a typical slow spreading ridge with intrusive mantle lithosphere (mantle rocks intruded by gabbros), (ii) it hosts a H_2-generating hydrothermal system (Lost City Hydrothermal Field), (iii) abundant geophysical and geological data are available at this site (e.g., IODP Expeditions 304-305), and (iv) it has shallow bathymetry and a smooth topography. Substantial discussion was directed at defining the detailed objectives and work plan, with the intention of submitting an MSP proposal to IODP in April 2009 (coordinator: Gretchen Früh-Green) focused on the exploration/characterization of interactions between faulting, serpentinization, fluid flow and microbial activity in the shallow ultramafic/mafic seafloor. We invite others, especially from non-European IODP member countries to contact the workshop conveners for more information or to get involved with this effort.

Figure 1: Participants at the Magellan Workshop, September 2008, Montpellier, France.

5th Asia Oceania Geosciences Society Conference (AOGS 2008)

Sung-Hyun Park and Jian Lin

The 5th Asia Oceania Geosciences Society Conference (AOGS 2008) was held in Busan, Korea, June 16-20, 2008. AOGS is a relatively young geosciences organization with the purpose to advance geosciences in Asia and to promote cooperation between Asian scientists and the international community. Mr. Seung-soo Han, the Prime Minister of Korea and UN Special Envoy on Global Climate Change Treaty, gave an inspiring opening speech. This was one of the best attended AOGS meetings (http://www.asiaoceania.org/society/index.asp).

A special session on "Recent multidisciplinary studies of mid-ocean ridges and ophiolites" was held during the 2nd day of the conference (for session summary, please see: http://www.interridge.org/node/4893). In recent years, several Asian countries, for example, Japan, China, India, and Korea, have started scientific programs to explore and investigate geological, hydrothermal, and biological processes at mid-ocean ridges and the deep seafloor, while increasing collaborations with US and European counterparts under the auspices of InterRidge. Ophiolites, which are ancient oceanic crust exposed on land, have also attracted scientists in Asia as they offer important accessible sections of mid-ocean ridges. This special session was organized to promote further collaboration of Asian scientists and the international community and to encourage discussion of joint projects at greater scale. The session was co-convened by Sung-Hyun Park (Korea Polar Research Institute), Jian Lin (Woods Hole Oceanographic Institution, USA), John Chen (Peking University, China), Susumu Umino (Kanazawa University, Japan), Natsue Abe (Japan Agency for Marine-Earth Science and Technology), and K.A. Kamesh Raju (National Institute of Oceanography, India).

The special session attracted 27 abstracts that reflect rapid recent progress of Asian countries and the international community in the investigation and exploration of ocean ridges and ophiolites. It was one of the sessions receiving the most submitted abstracts of the AOGS 2008 conference. The special session covered a wide range of topics on recent research of the Central Indian Ridge, Southwest Indian Ridge, East Pacific Rise, Western Pacific, back-arc basins, drilling of the

oceanic crust, ophiolites, and microbiological evolution of hydrothermal vents. The session also included a presentation of the InterRidge commitment to responsible research practices at deep-sea hydrothermal vents. The session included the following submitted abstracts:

Responsible Research of Deep-Sea Hydrothermal Vents Promoted by the InterRidge Program, S.E. Beaulieu et al.

Interaction of the Reunion Hotspot and the Central Indian Ridge near Rodrigues Island (Indian Ocean), J. Dyment et al.

Effects of Magma Supply on Crustal Accretion Along the Intermediate-Spreading Juan de Fuca and Gorda Ridges, Y.J. Chen.

Slope Control of the Submarine Lava Morphology Revealed by the Transect Across the Southern East Pacific Rise, S. Umino et al.

Tectonics Structure of Ayu Trough: A Divergent Plate Boundary at the Southernmost Philippine Sea, S.M. Lee et al.

Multidisciplinary Investigations over the Carlsberg Ridge, Indian Ocean, K.A. Kamesh Raju et al. (see India's National Update, this volume)

Water Column Geochemical Anomalies at 5°53'N Carlsberg Ridge, NW Indian Ocean: New Hydrothermal Event(s) or Remnants of Mega Plume CR-2003?: A Case Study, D. Ray et al.

Mantle Melting Beneath the Carlsberg Ridge: Abyssal Peridotite Chrome-spinel Compositions, E. Babu et al.

Geochemical Characteristics of Sulfide Chimneys from the First Active Hydrothermal Vent Field on the Southwest Indian Ridge, C. Tao et al.

Detection of Hydrothermal Methane Plume Near Newly Discovered Hydrothermal Field in Southwest Indian Ridge, H. Zhou et al.

The Discovery of New Hydrothermal Sites on the Eastern Part of the Southwest Indian Ridge, X. Han et al.

Disseminated Sulphides in the Andesites from the Andaman Back-arc Basin, Mudholkar et al.

Sink Pathways and Transformation of Phosphorus in Andaman Backarc Basin Sediments with Hydrothermal Signatures, B. Nath.

Electrical Structure Beneath the Central Mariana Subduction, Fore-arc, Arc, Back-arc System, T. Matsuno et al.

The Consequence of the Symbioses on the Evolution of Deep-sea Hydrothermal Vent Organisms, Y.J. Won.

Dynamic and Metabolic Diversity of a Deep Sea Hydrothermal Vent Microbial Community Revealed by Combined Molecular Approaches, F.P. Wang et al.

Diversity and Abundance of Ammonia-Oxidizing Archaea in Hydrothermal Vent Habitats Studied by Archaeal AmoA Surveys and Real Time PCR, S.F. Wang et al.

A Xenolith-Inferred Structure of an Old Oceanic Plate: Implications from Petit-Spot Studies in the Cretaceous Pacific Plate, N. Abe et al.

Mantle Melting and Source Heterogeneity Under Superfast Spreading Ancient East Pacific Rise (EPR): A Detailed Geochemical Study of Basaltic Rocks from Hole 1256D, S. Park et al.

Synchrotron Radiation X-ray Powder Diffraction Studies of Basaltic Sheeted Dike and Gabbro from IODP site 1256, Y. Lee et al.

Along Axis Variations of Magmatic System in Fast-Spread Oceanic Crusts: Evidence from the Northern Oman Ophiolite, S. Miyashita et al.

Dunites and Wehrlites from the Northern Oman Ophiolite: One Suite or More? S. Arai.

Paleo-Ridge Segment Structure and Geochemical Variability in the Fizh Mantle Section, the Oman Ophiolite, E. Takazawa et al.

Interaction Between Hydrothermalism and Magmatism in the Mantle of the Oman Ophiolite: Evidence from Diopsidite-Related Gabboic Dykes, M. Python et al.

Preliminary Study of the Thermal Structure of the Oceanic Crust - a New Approach Using Crystal Size Variations of the Sheeted Dikes, S. Umino et al.

Formation of Inactive Hydrothermal Deposits in the Northern Lau Back-Arc Basin, SW Pacific: Inferences Based on Mineralogy, Geochemistry and REE Systematics, A.L. Paropkari et al.

Abundance and Activity of Metal Immobilizing Bacteria in Carlsberg Ridge Ecosystem, R. Antony et al.

Visit the InterRidge website for workshop reports and other publications:
http://www.interridge.org/publications

Online Resources

MGDS Media Bank: http://media.marine-geo.org/

Vicki Ferrini[1]

Media Bank is an online repository of high-quality images, videos, illustrations and animations suitable for use within the scientific community and for education and public outreach (EPO), that is hosted by the Marine Geoscience Data System (MGDS). The initial focus of Media Bank was to serve USA Ridge 2000 research and EPO efforts, but it was constructed as a flexible system that could accommodate media from other multidisciplinary marine geoscience research initiatives.

Images and videos in the gallery can be browsed as thumbnails or as preview images (Fig. 1). A full suite of metadata is provided for each image, enabling links to relevant cruises and database entries (Fig. 2). Images are tagged with metadata to provide keyword search functionality and are sorted into categories (e.g., Geology, Biology). Keywords can also be included in the URL to enable direct links to images. For example, http://media.marine-geo.org/search/node/EPR will assemble all images from the East Pacific Rise.

We encourage the contribution of high-quality media for inclusion in the Media Bank, and we can accommodate restricted downloads of full-resolution images. For more information on how to submit media, please see http://media.marine-geo.org/contribute or contact Vicki Ferrini (ferrini@ldeo.columbia.edu).

Figure 1: (upper) Screen grab of Media Bank interface, highlighting images from USA Ridge 2000 Program.

Figure 2: (lower) Screen grab of an individual image and metadata from the Media Bank.

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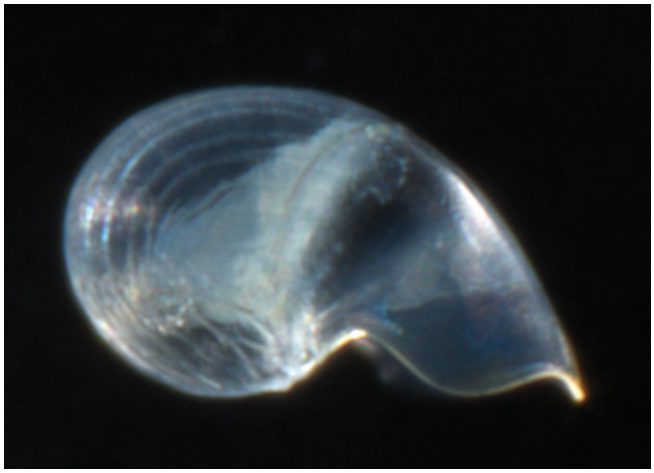
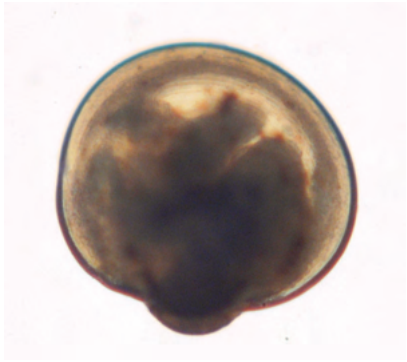
Photographic identification guide to larvae at hydrothermal vents in the Eastern Pacific: http://www.whoi.edu/science/B/vent-larval-id/

Susan W. Mills[1], Stace E. Beaulieu[1], and Lauren S. Mullineaux[1]





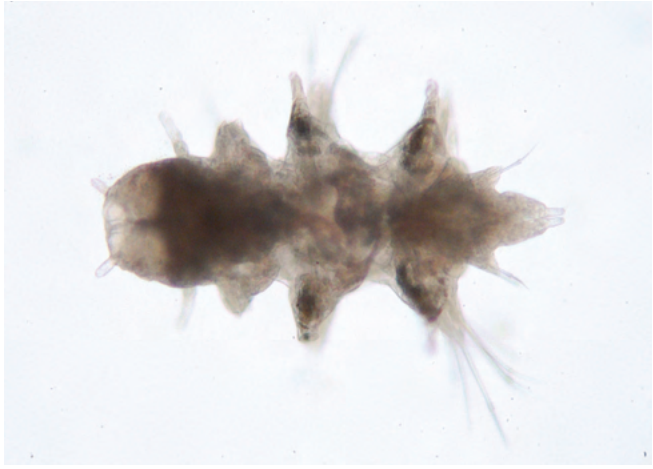
Photos: From the top to lower right

Larval gastropod: *Ctenopelta porifera*, 300 m.

Larval bivalve: mussel *Bathymodiolus thermophilus*, 400 m..

Larval polychaete: nereid nectochaete, 400 m..

Vent crab megalopae: *Bythograea thermydron* (8 mm) and *B. microps* (3 mm).



We would like to announce our "Photographic Identification Guide to Larvae at Hydrothermal Vents in the Eastern Pacific," available online at: http://www.whoi.edu/science/B/vent-larval-id/. The purpose of this website is to assist researchers in the identification of larvae of benthic invertebrates at hydrothermal vents. Our work is based on plankton sampling at the East Pacific Rise (EPR) 9-10° N vent field from 1991 - present. In this first version of the guide, we have included frequency data from large-volume plankton pump samples taken between 1998 and 2004. Later we plan to include data through 2007, including time-series sediment trap samples.

The guide includes an "Introduction and Methods" section that details the collection of larvae, a section on "Terminology" for gastropod and polychaete larvae, and "Literature Cited" for descriptions of species. Gastropod, bivalve, polychaete, arthropod, and other larval types are sorted alphabetically, and gastropod larvae may also be sorted by size. Throughout the guide, clicking on images will open a higher resolution version in a separate pop-up window. Clicking on species names will open an information page on that species. Each information page also includes thumbnail images of species that are similar in appearance.

Although our own samples are limited to the EPR 9-10° N site, we would like to expand the guide by adding additional species, including those from other areas. We welcome contributions from the InterRidge community.

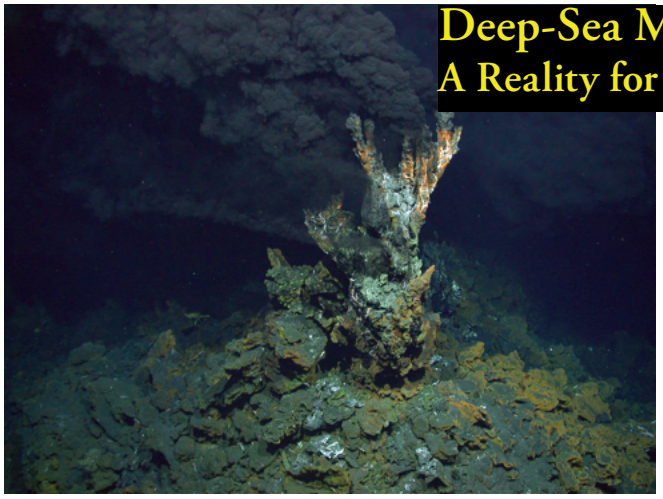
We would like to thank Stacy Kim, Pat McMillan, Anne Beaudreau, Andrew Sweetman, Diane Adams, and taxonomists, especially Anders Warén, for their help with this project. We received support from the U.S. National Science Foundation (grants OCE - 9619605, 9712233, and 0424593 and ATM - 0428122) and the WHOI Deep Ocean Exploration Institute (grant to L. Mullineaux and S. Beaulieu).

[1]*Biology Department, Woods Hole Oceanographic Institution, Woods Hole, MA 02543, USA, Email: smills@whoi.edu*

Upcoming Events

Dec. 14-19, 2008	AGU Fall Meeting 2008, San Francisco, CA, USA
Jan. 25-30, 2009	ASLO Aquatic Sciences Meeting 2009, Nice, France
Apr. 2, 2009	Deep-Sea Mining of Seafloor Massive Sulfides workshop, Woods Hole, MA, USA (see advertisement next page)
Apr. 18-24, 2009	European Geosciences Union (EGU) General Assembly 2009, Vienna, Austria
Apr. 26-30, 2009	ICES Symposium on issues confronting the deep oceans, Horta, Azores, Portugal
May 11-14, 2009	OCEANS '09 IEEE, Bremen, Germany
May 20-24, 2009	International Marine Conservation Congress, Washington, DC, USA
May 23-27, 2009	AGU Joint Assembly 2009 - The Meeting of the Americas, Toronto, Canada
Jun. 21-26, 2009	Goldschmidt Conference 2009, Davos, Switzerland
Jun. 22-25, 2009	SubSeaTECH 2009 - International Conference on Subsea Technologies, St. Petersburg, Russia
Jun. 29 - Jul. 3, 2009	4th International Symposium on Chemosynthesis-Based Ecosystems, Okinawa, Japan (see advertisement next page)
Jul. 10-11, 2009	InterRidge Steering Committee Meeting 2009, Paris, France
Aug. 11-15, 2009	Asia Oceania Geosciences Society (AOGS) 2009, Singapore
Aug. 30 - Sep. 11, 2009	ECORD Summer School 2009: Geodynamics of mid-ocean ridges, Bremen, Germany
Sep. 21-25, 2009	OceanObs'09 Conference, Venice, Italy
Sep. 23-25, 2009	IODP New Ventures in Exploring Scientific Targets (INVEST) 2009, Bremen, Germany
Sep. 2009	Underwater Mining Institute (UMI) 2009, Gelendzhik, Russia
2010	12th Deep-Sea Biology Symposium, Iceland

Visit the InterRidge website for Upcoming Event listings:
http://www.interridge.org/events



Deep-Sea Mining of Seafloor Massive Sulfides: A Reality for Science and Society in the 21st Century

5th Morss Colloquium, Thursday, April 2, 2009

Woods Hole Oceanographic Institution, Woods Hole, MA, USA

Morning: Workshop

Objective: to bring together scientists, specialists in marine conservation, mineral economics, and public international law, the International Seabed Authority, national interests in SMS, and representatives of industry and NGOs.

Afternoon: Public Forum

Keynote Speakers and Panel Discussion

Rod Eggert (Division Director, Economics and Business, Colorado School of Mines)

Lyle Glowka (Senior Legal Advisor to the Convention on Biological Diversity)

Nii Allotey Odunton (Secretary-General, International Seabed Authority)

Maurice Tivey (Dept. Chair, Geology and Geophysics, Woods Hole Oceanographic Institution)

We thank our sponsors!
WHOI, InterRidge, and ChEss

For more information, contact Stace Beaulieu (InterRidge Coordinator), coordinator@interridge.org

4th International Symposium on Chemosynthesis-Based Ecosystems

–Hydrothermal Vents, Seeps and Other Reducing Habitats – June 29-July 3, 2009, Okinawa, JAPAN

This symposium highlights the recent achievements in the field of unique ecosystems driven by chemosynthesis rather than photosynthesis. Major topics include biogeography, biodiversity, evolution, symbiosis, ecology, physiology, geochemistry, microbiology, and research technology & methods. This symposium follows upon the successes of three previous symposia. The 1st & 2nd International Symposia on Deep-Sea Hydrothermal Vent Biology were held in Madeira, Portugal in 1997 and in Brest, France in 2001, respectively. The 3rd International Symposium on Hydrothermal Vent and Seep Biology was held in San Diego, USA in 2005. The number of presentations regarding other reducing habitats such as whale falls and sunken wood increased remarkably in the latest symposium. Therefore, we have decided to use the new title for this 4th symposium.

http://www.jamstec.go.jp/xbr/4th_CBE/

Registration & Abstract Deadline: Jan. 31, 2009

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Sponsors include:

Country	Dates	PI	Ship	Cruise ID / Location	Research Objectives
Canada	21 Jul - 17 Aug 2009	M. Best	CCGS Tully with ROV ROPOS	Juan de Fuca (Endeavour)	Installation of Endeavour node for NEPTUNE Canada (http://www.neptunecanada.ca/sensors-instruments/locations/endeavour.dot)
China	Late 2008	X. Xiao	R/V DayangYihao	Leg 1 / SWIR (49.5°E)	Microbiological sampling of active hydrothermal vent field
China	Early 2009	C. Tao	R/V DayangYihao	Legs 2 & 3 / SWIR (49.5°E)	Seafloor geology of active hydrothermal vent field
China / USA	Late 2009 / early 2010		R/V DayangYihao	SWIR	Seismic experiment using OBSs
France	Fall 2008			MAR (Lucky Strike)	OBS recovery cruise for 4-month deployment from BBMoMAR'08
France	Jan - Feb 2009	C. Hemond	R/V Marion Dufresne	GEISEIR / SEIR	Collect dredge and wax-core samples on selected sections of the Southeast Indian Ridge
France	Early 2009	J.Y. Royer	R/V Marion Dufresne	OHA-SIS-BIO / Indian Ocean	Hydrophones to monitor earthquake activity and vocal activity of marine mammals
France	May - June 2009	J. Escartin; A. Deschamps	N/O Pourquoi Pas? with ROV Victor	BATHYLUCK / MAR (Lucky Strike)	Temperature sensors, OBS, mapping, fluid chemistry, and geomicrobiology
France	Late 2009	D. Sauter; M. Cannat	R/V Marion Dufresne	SMOOTHSEAFLOOR / SWIR	To better constrain the composition, structure, magnetic signature and mode of formation of the smooth seafloor domains on the Southwest Indian Ridge
France	Late 2009	P. Gente	R/V L'Atalante with submersible Nautile and AUV ASTERx	PARISUB / EPR (16°N)	Investigation of the interaction between a plume, the Mathematicians hotspot, and the EPR spreading axis
France	2009	J. Perrot	NRP Don Carlos	HYDROBS MOMAR / MAR	Hydrophones over wider MoMAR area
France	Early 2010	F. Lallier; N. Le Bris	R/V L'Atalante with submersible Nautile and AUV ASTERx	MESCAL / EPR (9°N, 11°N, 13°N)	(a) Colonization strategies and adaptation of *Alvinella pompejana* to thermal and chemical stresses, and (b) integrative biology of thiotrophic endosymbiosis
France	Early 2010	A. Godfroy	R/V L'Atalante with submersible Nautile and AUV ASTERx	BIG / Guaymas Basin	Characterize microbial and animal communities along physicochemical gradients to evaluate taxonomical and functional similarities within vent and cold seep habitats
France	2010	M. Cannat; J. Blandin	N/O Pourquoi Pas? with ROV Victor	MOMARSAT / MAR (Lucky Strike)	Deploy an acoustically-linked multidisciplinary observing system at Lucky Strike vent field as an observatory in the MoMAR area; Azores ESONET component
Germany	9 Dec 2008 - 10 Jan 2009	W. Weinrebe	R/V Maria S. Merian	MSM10/2 / MAR (15°N)	Geophysics
Germany	15 Jan - 15 Feb 2009	N. Dubilier	R/V Maria S. Merian with ROV	MSM10/3 / MAR (15°N)	Biology, fluid chemistry, time-series measurements
Germany	1 Apr - 9 May 2009	R. Seifert	R/V Meteor with ROV and AUV	M78/2 / MAR (4-11°S)	Biology, fluid chemistry
Germany	Summer 2009 or 2010	C. Borowski	R/V Poseidon with AUV	MAR (Menez Gwen)	AUV mapping
Germany	Summer 2011	C. Borowski	R/V Meteor	MAR (Menez Gwen)	Geochemistry of fluids and solids, biology
Japan	Jan - Mar 2009	N. Abe	R/V Mirai	MR08-06 Leg 1 / Chile Triple Junction	Oceanic crust formation; several programs combined on this cruise
Japan	May 2009	Y. Ohara	R/V Yokosuka with Shinkai 6500	YK09-05 / Parece Vela Basin	Geophysics
Japan	July 2009	K. Okino	R/V Yokosuka with AUV Urashima	YK09-08 / Mariana Trough, southern	

Japan	Oct 2009	K. Tamaki; Nakamura; Nakagawa	R/V Yokosuka with Shinkai 6500	YK09-12 / Central Indian Ridge, Rodrigues Triple Junction	
Japan	Jan - Feb 2010	H. Kumagai; K. Okino; N. Seama	R/V Hakuho-maru	(originally KH08-4) / SWIR near Marion hotspot (26-39°E)	Dredging and geophysical mapping, OBEM recovery
Korea	Dec 2008	S.H. Park; M. Park	R/V Yuzhmorgeologiya	Bransfield Strait	Rock dredging and CTD and MAPR on active spreading centers and fossil ridges, and hydrophone array
Russia / India	To be determined		R/V "Akademik Boris Petrov"	Indian Ocean	Multidisciplinary investigations
UK	Jan 2009	R. Larter	RRS James Cook	E Scotia Ridge	Regional swath mapping and BRIDGET towed sensor and SHRIMP towed camera surveys to refine hydrothermal vent locations
UK	Jan 2010	P. Tyler	RRS James Cook with ROV Isis	E Scotia Ridge	Detailed analysis of ESR vents with ROV Isis
UK	Jan 2011	A. Rogers	RRS James Cook with ROV Isis	Bransfield Strait	Vents and seeps in Bransfield Strait
USA	10 - 30 Nov 2008	D. Caron; K. Wommack	R/V Atlantis with Alvin	Guaymas Basin and EPR (9°N)	Protists and viruses at hydrothermal vents
USA	13 - 28 Nov 2008	R. Embley	R/V Thompson	Lau Basin	NOAA VENTS program
USA	5 - 18 Dec 2008	A. Teske	R/V Atlantis with Alvin	Guaymas Basin	Microbial carbon and sulfur cycling in the hydrothermally altered sediments of Guaymas Basin
USA	23 Dec 2008 - 6 Jan 2009	H. Schouten	R/V Atlantis	Galapagos Triple Junction	Magnetics
USA	Jan - Feb 2009	R. Dunn		Lau Basin	Lower crustal and upper mantle imaging
USA	Spring 2009	C. Fisher; A. Reysenbach	R/V Thompson with ROV Jason II	Lau Basin	Macro- and micro-biology at vent fields along the ELSC/VFR
USA	27 Jun - 15 Jul 2009	J. Holden; M. Lilley	R/V Atlantis with Alvin	Juan de Fuca	Hyperthermophiles; resistivity instrument
USA	20 Jul - 4 Aug 2009	R. Lee	R/V Atlantis with Alvin	Juan de Fuca	Thermobiology of paralvinellid worms
USA	18 Aug - 9 Sep 2009	D. Toomey	R/V Langseth	Juan de Fuca (Endeavour)	Seismic tomography survey
USA	20 Sep - 25 Oct 2009	C. German	To be determined, with HROV	Mid-Cayman Spreading Center	Discovery, geochemistry, and micro- and macro-biological characterization of hydrothermal vents
USA	25 Nov - 6 Dec 2009	A. Reysenbach; M.K. Tivey	R/V Atlantis with Alvin	Guaymas Basin	Microbiology and geochemistry during early stages of chimney growth
USA	Fall 2009	D. Wiens	R/V Langseth	Lau Basin	Crustal structure, upper mantle properties, models of mantle flow and melting; deployment of OBSs
USA	2009	F. Martinez; J. Resing; E. Baker		Lau Basin	Seafloor, plume mapping
USA / Chile	Early 2010	A. Thurber; J. Sellanes; C. German	R/V Revelle with AUV Sentry	Chile Triple Junction	Preliminary detection, location, mapping and photography of new seep and vent sites along the Chile margin including the adjacent Chile Rise, close to the Chile Triple Junction
USA	Late 2010	D. Wiens		Lau Basin	Recovery of OBSs

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Updated Nov. 2008

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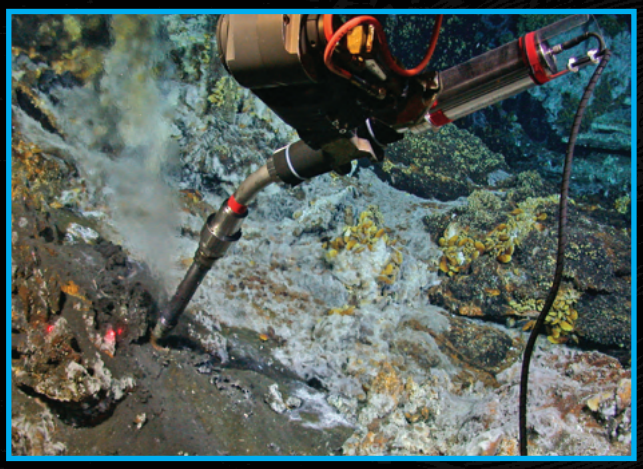
* Rotating off Committee at end of 2008.

** New Committee member in 2009.



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Cover: Perspective image of bathymetry and multichannel seismic profiles centered on the Lucky Strike Hydrothermal Field at 37°17′N on the Mid-Atlantic Ridge. This image was produced from a scene file of the MoMAR study site, available for download at the Ridge View visualization portal of the USA Ridge 2000 program (http://ridgeview.ucsd.edu), funded by NSF, and courtesy of G. Kent. The data were acquired during MoMAR cruises funded by CNRS, IFREMER, and IPGP (Cannat et al., 1999, Earth Planet. Sci. Lett. 173: 257-269; Singh et al., 2006, Nature 442: 1029-1032).

Back cover: Hydrothermal vents at Lucky Strike Hydrothermal Field. Digital images from ROV *Jason II* during KNOX18RR cruise, funded by NSF, courtesy of A.-L. Reysenbach, and copyright Woods Hole Oceanographic Institution 2008.