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InterRidge News

Initative for international cooperation in ridge-crest studies

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Tel: +33 1 44 27 75 78; Fax: +33 1 44 27 39 11; **E-mail: intridge@ext.jussieu.fr; http://www.lgs.jussieu.fr/~intridge**

InterRidge Office Updates

Coordinator Update

Membership

Italy and Canada will both be upgrading to Associate members in 1998. Brazil has joined InterRidge as a Corresponding member. India and Korea have been discussing the possibility of becoming Associate members.

Publications

The *Arctic Ridges Workshop Report* from the November 1994 workshop is at the printers and copies will be sent out to participants in late October.

FARA Volume

Following the Iceland Symposium, a volume of results from the 15°-40°N area of the Mid-Atlantic Ridge was to be published in the Maurice Ewing series through AGU. However not enough papers were received to constitute a Ewing Volume. Consequentially, the papers were submitted in June to *Earth and Planetary Sciences Letters* to be published in a special issue.

The *Handbook of deep-sea hydrothermal vent fauna* is now available from IFREMER. For more information, including ordering details, see the advertisement on page 9. InterRidge will be distributing copies of the handbook to submersibles and ROVs.

Meetings

The *First International Symposium on Deep-Sea Hydrothermal Vent Biology*, was recently held in Madeira, Portugal 19-24 October, 1997. 114 people, from 12 countries, attended this meeting, during which 83 talks and posters were presented. The InterRidge Office produced the abstract volume for the Symposium, and will be compiling a citable volume of contributions from the Symposium. During the meeting there was a scheduled discussion on the InterRidge sponsered International Biological Sample Exchange Agreement.

Special Sessions at Fall AGU

There will be two InterRidge sponsored sessions at this year's Fall AGU meeting in San Francisco, CA, USA. The T11 session, "Magma focusing and the segmentation of Mid-Ocean Ridges at all spreading rates" developed out of the 4-D Architecture of Oceanic Lithosphere working group. This session will be followed by an open discussion/4-D working group meeting to focus on the key areas of uncertainty in ridge architecture and how to address them. The V16 session, "Hydrothermal Activity at Different Spreading Rates" developed out of the Hydrothermal Fluxes working group. This session, will be followed by a panel to discuss unresolved questions about hydrothermal fluxes such as 1) the partitioning along axis as a function of spreading rate but also with tectonic vs. magmatic controls and 2) the partitioning between on-axis vs. off-axis, and between high-T axial flow, diffuse axial flow and off-axis flow. For a complete list of all ridge related sessions at this year's Fall AGU meeting, see page 60.

1997 Steering Committee meeting

The 1997 Steering Committee meeting was held in Paris 25-26 September. The status of each of the working groups was reviewed, an overview of these can be found on the facing page.

WWW pages

Over the past several months the InterRidge webpages (http:/ www.lgs.jussieu.fr/~intridge) have been restructured to include more information about the current activities of InterRidge and to facilitate locating this information. Almost all of the working groups now have a page that includes the working group membership, a summary of current activities, and a listing of relevant workshop reports. Pages have also been created for most member nations of InterRidge. These pages contain the most recent country update, as well as a link to that nations ridge program, if it exists. In upcoming months bulletin boards will be set up for the working groups, and a mirror site will be established on the Ridge server in the USA.

As before, the InterRidge web pages include the InterRidge Researcher Electronic Directory and Ridge Crest Biologist Directory, a calendar of upcoming meetings and workshops, a list of InterRidge publications, the global Ridge-Crest cruise schedule and links to other relevant home pages. These pages are being constantly updated, and suggestions or comments are welcomed!

Cara Wilson
InterRidge Coordinator
27 October 1997

Check out RIDGE's
Event Detection and Response
Bulletin Board:

http://ridge.unh.edu/observatory/

InterRidge Office Updates

Overview of InterRidge Working Groups

More information on the working groups can be found on our website at http://www.lgs.jussieu.fr/~intridge/wg.html

Global Studies

Global Digital Database:

Objective: to establish a global multibeam bathymetric database

Current Activities: establishing the membership of the working group and inventorying the available data

Chair: Philippe Blondel (UK)

SWIR:

Objective: Coordinate reconnaissance mapping and sampling of a complete super-segment, the Southwest Indian Ridge from the Bouvet Triple Junction to the Rodrigues Triple Junction, including integrated Ocean Drilling experiments.

Recent/Current Activities: The SWIR Project Plan was published last spring. Several cruises to the SWIR have taken place this summer, or will be happened in the coming year.

Chair: Catherine Mével (France)

WG members: M. Canals (Spain), C. German (UK), N. Grindlay (USA), C. Langmuir (USA), A. Le Roex (South Africa), C. MacLeod (UK), J. Snow (Germany), K. Tamaki (Japan), and C. L. Van Dover (USA)

Arctic Oceans:

Objective: to coordinate planning efforts for mapping and sampling the Arctic Ridges.

Recent/Current Activities: The report from the 1994 workshop has just been published. The WG will be producing a Project Plan.

Chair: Roland Rihm (Germany)

WG members: B. J. Coakley (USA), K. Crane (USA), O. Dauteuil (France), C. W. Devey (Germany), V. Glebowsky (Russia), K. Gronvold (Iceland), H. R. Jackson (Canada), W. Jokat (Germany), Y. Kristoffersen (Norway), P. J. Michael (USA), N. C. Mitchell (UK), H. A. Roeser (Germany), H. Shimamura (Japan), and C. L. Van Dover (USA)

Meso-Scale Studies

4-D Architecture:

Objective: to initiate an integrated study of fast spreading lithosphere (Hess Deep) in parallel with an integrated study of a slow spreading segment on the Mid-Atlantic Ridge, both including important components of scientific drilling.

Current Activities: There are several cruises scheduled in the next year. The WG is sponsoring a special session at this Fall's AGU meeting, followed by a discussion of future directions.

Chair: Lindsay M. Parson (UK)

WG members: S. Allerton (UK), D. K. Blackman (USA), M. Cannat (France), J. Dyment (France), P. Gente (France), K. M. Gillis (Canada), E. Grácia (Spain), P. B. Kelemen (USA), J. Lin (USA), N. Seama (Japan), M. C. Sinha (UK), and M. Tolstoy (USA)

Hydrothermal Fluxes:

Objective: Segment-scale experiment to measure integrated magmatic, thermal, chemical and biological fluxes at the Mid-Atlantic Ridge.

Current Activities: There have been several cruises in the past years that have concentrated on the hydrothermal aspects of the above objective. The future direction of this WG is currently being reviewed. There will be a special session at AGU this fall focusing on hydrothermal variabilty at different spreading rates, followed by a panel discussion on what the critical issues are to address in the future.

Chair: Chris R. German (UK)

Back-Arc Basins:

Objective: to complete the Back-Arc Basins Project Plan and develop a Back-Arc Basins database

Current Activities: establishing the membership of the working group and drafting the Project Plan.

Chairs: H. Fujimoto (Japan) and J.-M. Auzende (New Caledonia)

Active Processes

Event Detection and Response and Observatories:

Objective: Detection of transient ridge-crest seismic, volcanic and hydrothermal events, and logistical responses to them through a strategy of international collaboration and the establishment of a long-term observatory in the Atlantic.

Current Activites: Planning is underway for a workshop next fall (1998) "Designing long-term monitering systems of the Mid-Atlantic Ridge" which will be held in either Lisbon or the Azores.

Chair: Chris Fox (USA)

Undersea Cables:

Objective: to explore the range of science that can be done with undersea cables, and the logistics involved.

Chair: Alan Chave (USA)

Current Activities and WG members: see page 4.

Biological Studies:

Objective: Promotion of integration of biological studies into ridge crest geosciences and advancement of this rapidly expanding field.

Recent activities: The First International Symposium on Deep-Sea Hydrothermal Vent Biology is took place October 20-24 in Madeira, Portugal.

Chair: L.S. Mullineaux (USA).

WG members: P. R. Dando (UK), J. R. Delaney (USA), D. Desbruyères (France), D. R. Dixon (UK), S. S. Drachev (Germany), A. Fiala-Médioni (France), C. R. Fisher (USA), H. Fricke (Germany), F. Gaill (France), J. Hashimoto (Japan), S. K. Juniper (Canada), R. A. Lutz (USA), Douglas C. Nelson (USA), S. Ohta (Japan), A.-L. Reysenbach (USA), K.O. Stetter (Germany), and V. Tunnicliffe (Canada)

InterRidge Office Updates

Undersea Cables Working Group Update

Alan Chave, Chair

Wood Hole Oceanographic Instítiute, Woods Hole, MA 02543 USA

In recent years, there has been increasing interest in placing permanent instrumentation on mid-ocean ridges for active process studies. This poses some significant technical problems in delivering long term power and providing a means for data retrieval. Traditionally, the former has been based on self-contained batteries, while the latter has required instrument retrieval during irregular site visits with a surface ship. Such an approach is limiting both in terms of the types of sensors which can be employed and in the types of science which can be accomplished.

In the fall of 1997, the Interridge Working Group on Undersea Cables was organized to address this sort of issue. Submarine cables are an attractive technology to provide the power and communications infrastructure for a permanent active processes observatory. In fact, there has been considerable activity in using submarine cables (both retired commercial cables and new, dedicated scientific cables) in Japan and the US in recent years, as summarized in the proceedings of an international workshop held in Okinaway early in 1997. The proceedings from this workshop are available (contact Alan Chave at alan@faraday.whoi.ed).

As a baseline comparison, providing one watt continuously to a seafloor instrument using state-of-the-art lithium batteries would require about 210 D-size units costing about US$10K and occupying a 23 cm id pressure case 1 m long. Scaling this up to appreciably higher power levels is logistically and economically infeasible. Similarly, real time communications to seafloor instruments with alternative technologies is difficult to accomplish. One approach might be based on commercially-available acoustic modems that can transmit data from the seafloor to a surface buoy at data rates of order 10 kbit/s (higher rateshave been achieved experimentally). Getting the data from a surface buoy to land in real time is currently problematical, although it might become easier as low earth orbiting satellite-based global cellular phone systems become available over the next few years. These communications issues are compounded by the difficulty of deploying and powering a surface buoy over long time periods, particularly in areas where winter weather is severe. While the technical approach outlined here is not unique, it reflects the current state-of-the-art using autonomous instrumentation.

As an alternative, submarine cables can provide continuous power at the several hundred watt level and communications at the 100 kbit/s level using analog submarine telephone technology. Data rates in excess of 1 gigabit/s are feasible on fiber optic cables. Communications over cables can be bi-directional, opening up the possibility of interacting with seafloor instruments from shore or even conducting perturbation experiments remotely. Most of the early use of submarine cables for scientific purposes has been concentrated on abandoned commercial cables, with the implied requirement that one can work only wherecables currently exist. This is not strictly true; it is possible to pick up and re-lay abandoned cables to where they are wanted using research vessels. It is also possible to lay new fiber optic cables from research platforms.

The Interridge Working Group is considering these sorts of issues. A major focus will be on the Mid-Atlantic Ridge because of the strong multinational focus in that region. The group will also be working closely with the InterRidge Event Detection and Response & Observatories Working Group in the planning of a workshop "Designing long-term monitoring systems of the Mid-Atlantic Ridge" which will be held next fall (1998) in either Lisbon or the Azores.

Working Group Members:

Alan Chave (USA), Chair	alan@faraday.whoi.edu
John R. Delaney (USA)	jdelaney@u.washington.edu
Hiroyasu Momma (Japan)	
Hajimu Kinoshita (Japan)	jimmy@jamstec.go.jp
Adam Schultz (UK)	adam@esc.cam.ac.uk
Debra S. Stakes (USA)	debra@mbari.org
Pascal Tarits (France)	tarits@univ-brest.fr
Heinrich Villinger (Germany)	vill@alf.zfn.uni-bremen.de

Lost a colleague's e-mail address?

Try finding it on the InterRidge Electronic Directory

There are currently over 200 people who are active in Mid-Ocean Ridge research listed on the InterRidge Electronic Directory. This directory contains a listing of each researcher's field of interest and expertise as well as their full address information. It is accessible on the World Wide Web via the InterRidge Home Page (**http://www.lgs.jussieu.fr/~intridge/electdir.htm**) making it possible to carry out searches quickly and easily. If you would like to be listed in the directory complete this form and send it to the InterRidge Office. Links can also be provided to your personal or departmental web page.

Indicate whether you would like your name to appear on:

☐ *the InterRidge Electronic Directory*
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Department/Institute____________________

Address____________________

____

City__________ **State/County**__________

Post Code__________ **Country**__________

Phone:__________ (country code, area code, number) **Fax:**__________ (country code, area code, number)

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Which InterRidge Program Theme(s) is/are of interest to you?

☐ Active Processes ☐ Meso-Scale Studies ☐ Global Studies

What are your fields of interest/expertise?

☐ Biochemistry	☐ Gravity	☐ Plate kinematics
☐ Biogeography	☐ Heat Flow	☐ Rheology
☐ Biology	☐ Hydrology	☐ Seafloor Morphology
☐ Crustal structure	☐ Hydrothermal vents/plumes	☐ Sedimentology
☐ Ecology	☐ Larval Dispersion	☐ Seismology
☐ Electromagnetism	☐ Magnetism	☐ Structural geology
☐ Engineering/Instrumentation	☐ Microbiology	☐ Sulfide Ores
☐ Event detection and response	☐ Modeling	☐ Tectonics
☐ Genetics	☐ Ophiolites	☐ Volcanology
☐ Geochemistry	☐ Petrology	☐ Other__________

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The InterRidge Office
Laboratoire de Pétrologie,
Tour 26, 3ème étage, couloir 26-25
Université Pierre et Marie Curie
4 Place Jussieu
75252 Paris Cédex 05
France

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InterRidge Publications

All of the following InterRidge publications are available from the InterRidge Office upon request at **intridge@ext.jussieu.fr**.

InterRidge News:

InterRidge News, 1997, 6, 2, pp. 64
InterRidge News, 1997, 6, 1, pp. 72
InterRidge News, 1996, 5, 2, pp. 68
InterRidge News, 1996, 5, 1, pp. 52
InterRidge News, 1995, 4, 2, pp. 52
InterRidge News, 1995, 4, 1, pp. 72
InterRidge News, 1994, 3, 2, pp. 44
InterRidge News, 1994, 3, 1, pp. 28
InterRidge News, 1993, 2, 2, pp. 4
InterRidge News, 1993, 2, 1, pp. 32
InterRidge News, 1992, 1, 1, pp. 26

Workshop and Working Group Reports:

New! InterRidge Global Working Group Workshop Report: Arctic Ridges: Results and Planning, pp. 78, October 1997.
InterRidge SWIR Project Plan, pp. 21, April 1997 (*This report can also be found on the InterRidge web page*).
InterRidge Meso-Scale Workshop Report: Quantification of Fluxes at Mid-Ocean Ridges: Design/Planning for the Segment Scale Box Experiment, pp. 20, March 1996.
InterRidge Active Processes Working Group Workshop Report: Event Detection and Response & A Ridge Crest Observatory, pp. 61, December 1996.
InterRidge Biological *Ad Hoc* Committee Workshop Report: Biological Studies at the Mid-Ocean Ridge Crest, pp. 21, August 1996.
InterRidge Meso-Scale Workshop Report: 4-D Architecture of the Oceanic Lithosphere, pp. 15, May 1995.
InterRidge Meso-Scale Project Symposium and Workshops Reports, 1994: Segmentation and Fluxes at Mid-Ocean Ridges: A Symposium and Workshops & Back-Arc Basin Studies: A Workshop, pp. 67, June 1994.
InterRidge Global Working Group Report 1993: Investigation of the Global System of Mid-Ocean Ridges, pp. 40, July 1994.
InterRidge Global Working Group Report 1994: Indian Ocean Planning Meeting Report, pp. 3, 1994.
InterRidge Meso-Scale Working Group Meeting Report, Cambridge, UK, pp.6, 1992.

Symposium Abstract Volumes:

First International Symposium on Deep-Sea Hydrothermal Vent Biology Abstract Volume, pp. 118, Oct. 1997.
Fara-InterRidge Mid-Atlantic Ridge Symposium Results from 15°N to 40°N. J. Confer. Abs. 1(2), 1996.
The Oceanic Lithosphere and Scientific Drilling into the 21st Century, an ODP-InterRidge-IAVCEI Workshop, 1996.

Steering Committee and Program Plan Reports:

InterRidge Program Plan Addendum 1996, pp. 10, April 1997.
InterRidge Program Plan Addendum 1995, pp.10, 1996.
InterRidge Steering Committee Meeting Report, Estoril, Portugal, 1996, pp. 17, December 1996.
InterRidge Program Plan Addendum 1994, pp.15, 1995.
InterRidge Steering Committee Meeting Report, Kiel, Germany, pp. 22, 1995.
InterRidge Program Plan Addendum 1993, pp. 9, 1994.
InterRidge Program Plan, pp. 26, 1994.
InterRidge Steering Committee Meeting Report, San Francisco, USA, 1994.
InterRidge Steering Committee Meeting Report, Tokyo, Japan, 1994.
InterRidge Steering Committee Meeting Report, Seattle, USA, pp. 6, 1993.
InterRidge Meeting Report, York, UK, 1992.
InterRidge Meeting Report, Brest, France, pp. 39, 1990.

International Ridge-Crest Research: **Biological Studies**

The discovery of a "Deep Sub-Surface Biosphere": Remarks by a microbiologist

Holger W. Jannasch

Woods Hole Oceanographic Institution, Woods Hole, MA 02543, USA

The announcement of the above discovery came somewhat as a surprise to microbiologists. It is known that most microbes live within the subsurface, soil, sediments, etc. and they are found as deep down as liquids will carry them, mainly water and oil. They may be metabolically active or inactive dependent on exploitable energy available and subjective to a maximum growth or survival temperature. How long their viability can be maintained, is still unknown. The reason for the apparent newness of their occurrence deep down is, it seems, a growing understanding among geochemists that microbes are indeed almost ubiquitous biochemical agents throughout, and defining the outer limits of, the earth's biosphere.

In connection with the deep subsurface, the use of the term "biosphere" was another surprise for a biologist. In and below the Earth's surface, its biosphere ultimately depends on photosynthetically generated organic carbon and free oxygen which, during a complex food chain, turn into a large variety of electron donors and acceptors, ultimately returned to H_2O and CO_2 by aerobic and anaerobic metabolism. In the darkness , photosynthesis will diminish with depth and, by definition, cannot "rival the Earth's surface biosphere in terms of size and diversity" unless (see below) there is a substantial non-photosynthetic source of biochemically exploitable energy.

It has to be remembered that the microbial "chemolithoautotrophic" production of organic matter in the dark at deep-sea hydrothermal vents by free-living or symbiotic microbes is also largely aerobic, i.e., it uses photosynthetically provided free oxygen (Jannasch, 1997). This production most likely applies as well to the temporary "snow storm" appearance of microbial material often observed at the early stage of new vent eruptions (Haymond et al., 1993). Judging from its morphology and analytical data, it appears to represent blow-outs of bacterial populations and their products from surface lava pockets where it has accumulated during aerobic microbial oxidation of reduced inorganic species. These products can be either metal oxides/hydroxides attached to polysaccharide sheaths (Wirsen et al., 1993), or the newly described network of elemental sulfur (Taylor and Wirsen, 1997). Anaerobic chemolithotrophic bacteria or archaea are, of course, also present at hydrothermal vents, but the isolations of these hyperthermophiles (growing at temperatures of up to 110°C) from vent orifices are no evidence that these organisms originate in the deep subsurface (Jannasch, 1997).

The most relevant point of these deep subsurface occurrence of microbes appears to be the postulation and prediction of a biosphere that is indeed independent of photo-synthetically supplied electron donors or acceptors. For instance, a deep subsurface continuous geochemical supply of hydrogen, along with enough CO_2 as an electron acceptor (Landau and Stevens, 1997), could support a biosphere run anaerobically by methanogenic microbes (archaea). So far the age of deep subsurface methane and its turnover rate is entirely unknown. Proof for such a system could well be achieved with careful sampling, culturing, and DNA/RNA-extractions from both original sam-

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March 13, 1998

Send submissions by e-mail or by diskette via the post.
Please do not send articles in Word 7 format!

International Ridge-Crest Research: **Biological Studies**: Jannasch continued

ple material and cultures aiming at sample hybridization. Also still requiring analytical-experimental work is the postulated abiotic synthesis of organic carbon (Holm, 1992) that might serve as another basis of an autonomous deep subsurface biosphere. As evident from Shock's earlier remarks (1992), this organic synthesis in hydrothermal systems is still being discussed in terms of "potential" processes.

Presently we are far from having discovered any substantial light-independent autonomous deep subsurface biosphere. On the other hand, this area of biogeochemistry is briskly developing and, as indicated by recent RIDGE and InterRidge workshops, represents one of the most exciting and fasted growing research areas within the InterRidge program. Furthermore, this work has definite implications for extraterrestrial microbiology.

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International Ridge-Crest Research: **Biological Studies**

Hydrothermal vent fauna of the Logatchev area (14°45'N, MAR): preliminary results from the first Mir and Nautile dives in 1995

A. V. Gebruk[1], L. I. Moskalev[1], P. Chevaldonné[2], S. M. Sudarikov[3], E. S. Chernyaev[1]

[1]*P.P. Shirshov Institute of Oceanology, Russian Academy of Sciences, Nakhimovsky Pr. 36, Moscow, 117851, Russia*
[2]*Institute of Marine and Coastal Sciences, Rutgers University, 71 Dudley Rd., New Brunswick, NJ 08901-8521, USA*
[3]*Institute of Geology and Mineral Resources of the Ocean (VNII Okeangeologiya), Angliisky Pr.1, St.-Petersburg, 190121, Russia*

Introduction

The Logatchev hydrothermal area, also known as the "14°45 site", was discovered by geologists from VNII Okeangeologiya, St.-Petersburg on the 7th cruise of the *RV Professor Logatchev* in 1993-1994 (Batuyev et al., 1994; Bogdanov et al., 1995a,b; Sagalevitch and Bogdanov, 1995; Krasnov et al., 1995, 1996). First studies of this area were conducted using a TV-monitored grab, a deep-towed photo system, a box corer and a dredge. In 1995 this site was revisited with submersibles. Two Mir dives were conducted on the 35th cruise of the *RV Akademik Mstislav Keldysh* in February, followed by four Nautile dives during the Microsmoke cruise in December (D. Prieur, chief scientist). The primary objectives of these six dives were geological and/or microbiological studies, but macrofaunal sampling was conducted with slurp guns and mechanical arms. The Logatchev hydrothermal fauna remains one of the least known among the hot vent communities on the MAR. Biological observations, based on photo-transects, dredge and grab samples taken at Logatchev, have been published by Gebruk et al. (1997). Here we report additional biological information on Logatchev, based on Mir slurp-gun samples and video records, completed with Microsmoke Nautile dive reports.

Geological setting

The Logatchev hydrothermal area lies at 2930-3050 m depth on the eastern slope of the rift valley, 35 miles south from the transform fault at 15°20'N (Bogdanov et al., 1995a). The vent area has a NW-SE extension of at least 500 m and includes one main hydrothermal mound and at least 10 smaller mounds and/or other structures, most of them inactive (sites "I" and "M" on Fig. 1 were apparently observed from Nautile and reported as dead sites). The main mound covers an area of 200×150 m and is 10-20 m high, but the total surface area of Logatchev is at least 200,000 m^2. Several active hydrothermal sites have been observed on top of the mound, with two different types of venting. Two vent sites, 20-30 m in diameter, are characterized by 7-15 m wide craters discharging black smoke. The rim of the craters is usually marked with small chimneys, 1-2 m high, or 20-30 cm long, bent smoking "pipes". Black smoke discharged from craters and bent chimneys spreads horizontally or even downslope ("creeping smoke"). These smokers were recently described as a new type of a mineral-forming system by Bogdanov et al. (1997). The largest site with "smoking craters", first mapped by Russian geologists, was named "Anne-Louise" by French microbiologists (Fig. 1). This site lies at 2950 m and has two groups of craters: one with a central crater 7-8 m in diameter and 2-3 m deep, with 1 small chimney, and the second with a central crater up to 15 m in diameter, 4-5 m deep, with about 10 small (<30 cm high) bent chimneys along the rim. Another site with smoking craters lies ca. 100 m NW of "Anna-Louise" at the depth of 2970 m. It was also mapped in the earlier studies and was marked by French divers as "Irina" (Fig. 1). It has very active smokers located in a central crater about 10 m in diameter discharging black smoke at a temperature of 348°C. The crater has at least 10 very small bent chimneys, 10-20 cm high. At some distance from the central crater there is a group of several smaller craters, 1-2 m in diameter, and at least one 1 m high chimney discharging "creeping smoke". A third field with smoking craters, 1-2 m in diameter, was found by Mir-2 at 2980 m in the SW part of the main mound (site "B" on Fig.1).

In the SE part of the Logatchev area, a single pillar-like chimney was identified at 2940 m (site "A" on Fig. 1). It is 4 m high and 0.5-0.8 m in diameter, discharging high-temperature fluid entrained vertically, but the plume rapidly becomes horizontal.

Sulphide deposits on the main mound are generally characterized by high concentration of Cu, as well as Zn, Co and As (Bogdanov et al., 1995a).

Another active hydrothermal mound, 30-40 m in diameter, lies about 200 m NW from the main mound. An active field on top of this mound was marked with an "Irina-Microsmoke" marker by French divers, and is referred to as "Irina-2" (Fig. 1). It includes several, mostly inactive, chimney complexes around a central edifice characterized by extensive diffuse flow, and one very active, wide and short (0.5 m high and 0.5 m in diameter), black smoker with a temperature of 353°C.

The area between "Irina-2" and the main mound shows numerous

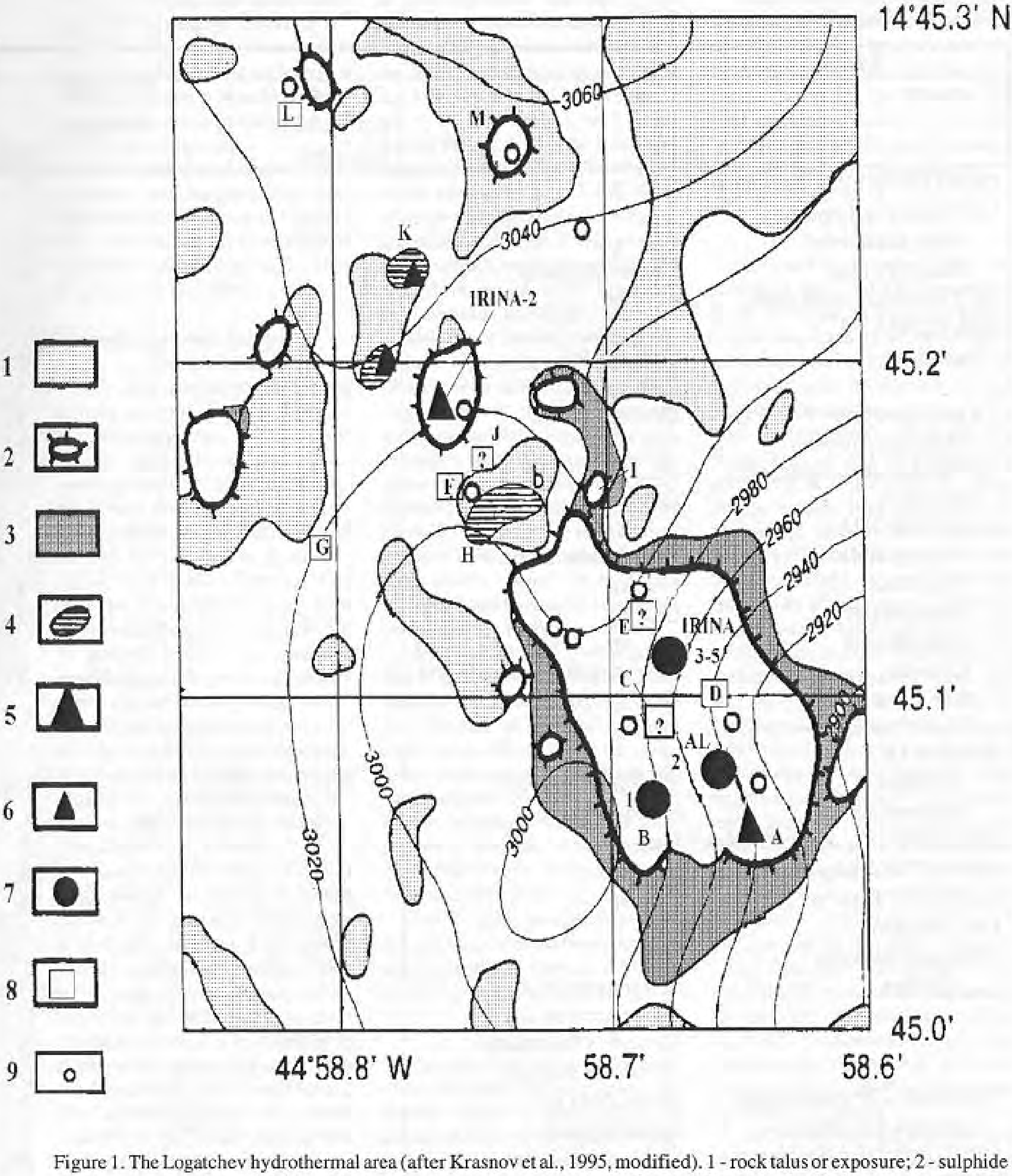

Figure 1. The Logatchev hydrothermal area (after Krasnov et al., 1995, modified). 1 - rock talus or exposure; 2 - sulphide mounds; 3 - sulphide sediments; 4 - low-temperature hydrothermal deposits; 5 - high-temperature black smokers (chimneys); 6 - low-temperature vents; 7 - "smoking craters"; 8- diffuse flow sites; 9 - hydrothermal communities mapped by *Professor Logatchev* expeditions; AL - "Anne-Louise"; ? - diffuse flow sites with unconfirmed location observed from Nautile; 1,2 and 3-5 - locations of five slurp-gun samples specified in Table 1.

Table 1. Fauna of the Logatchev hydrothermal area.

Taxon		Record			
Higher taxa	Genus/Species	*RV Logatchev* grab/dredge/ box-corer	*RV AMK* Slurp-gun 1	2	3,4,5
DEMOSPONGIA, Fam indet.	Gen. sp.				+
HYDROZOA/Leptolida,					
Fam. indet.	Gen. sp.		+		
Candelabridae	*Candelabrum sp.*				+
ACTINIARIA, Fam.indet.	Gen. sp.		+		
POLYCHAETA					
Spionidae	Gen. sp. 1				+
	Gen. sp. 2			+	+
Chaetopteridae	Gen. sp.				+
Polynoidae/free-liv.	Gen. sp.				+
*Polynoidae/commensal	Gen. sp.				
Hesionidae	Gen. sp.			+	
GASTROPODA					
Clypeosectidae	*Pseudorimula sp.*			+	
Trochidae	Gen. sp.			+	+
Peltospiridae	Gen. sp.				+
Cocculinidae	Gen. sp.		+		
Conidae	*Phymorhynchus moskalevi*	+	+	+	+
Cerithiacea	Gen. sp.	+			
?Cancellariidae	Gen. sp.			+	
BIVALVIA					
Mytildae	*Bathymodiolus sp.*	[+]		+	[+]
Vesicomyidae	*Ectenagena sp.*	+			
PANTOPODA, Ammotheidae	Gen. sp.				+
CIRRIPEDIA/Lepadomorpha	Gen. sp.			+	+
ISOPODA, Fam. sp.	Gen. sp.				+
DECAPODA/					
Macrura/Natantia					
Caridea	*Alvinocaris sp.1*				+
	Alvinocaris sp.2		+		
	Rimicaris exoculata		+	+	+
	Mirocaris keldyshi		[+]	+	[+]
Brachyura/Bythograeidae	*Segonzacia sp.*				+
Anomura/Galatheidae	*Munidopsis sp.*		+		
OPHIUROIDEA/Ophiuridae	*Ophioctenella acies*				[+]
PISCES	*Pachycara thermophilum*				+

RV Logatchev - collected by the *RV Professor Logatchev* cruises 7-8 (1993-1994) and 10 (1995); *AMK* - collected by the *Akademik Mstislav Keldysh*, cruise 35 (1995); * - collected by the Microsmoke expedition; [+] - > 10 ind. per sample. Location of slurp-gun samples 1,2 and 3-5 is shown on Fig. 1.

small sites (ca. 2×3 m) of diffuse flow through the soft sediment marked with mussel shells. Such areas of diffuse venting are also common on top of the main mound. The sites "H" and "K" (Fig. 1) observed from Nautile, apparently correspond to two of the "low-temperature hydrothermal deposit" sites originally mapped by Russian geologists.

The near-bottom water in the Logatchev area contains high concentrations of methane: up to 182×10^{-4} ml/l, which exceeds by four orders of magnitude the background value (Bogdanov et al., 1995a).

Hydrothermal vent fauna

The main mound

Five slurp-gun samples of benthic fauna were taken in 1995 by Mir-2 at the following sites on the main mound: No 1 - in the area of the smoking crater "B" at 2970-2990 m, No 2 - on a dead mussel bed ca. 2×3 m^2, at 2960 m NE from site "B" and and Nos 3-5 - on the 1 m high chimney at "Irina" (Fig. 1; Table 1). Photographs of these three biotopes were presented in Bogdanov et al. (1995a). In general, benthic communities around smoking craters are relatively poor. On the southern slope of the mound (site "B") the vent community was dominated by the caridean shrimp *Mirocaris keldyshi* with individuals usually spaced 5 cm apart, and anemones reaching densities of 20 ind/m^2 (Bogdanov et al., 1995a).

A more diverse fauna (Table 1) was found on the chimney at "Irina" (a sketch of this site is given in Gebruk et al., 1997). In terms of biomass, it was dominated by mussels, which form dense clusters slightly below the zone of diffuse flow. The mussels appear to belong to a new species of *Bathymodiolus* which is currently being described (Krylova, pers. comm.). The Logatchev mussels also harbor commensal polynoid polychaetes. Shrimps, mainly *M. keldyshi*, anemones and the ophiuroid *Ophioctenella acies* (up to 10 ind/m^2) were also abundant. The caridean shrimp *Rimicaris exoculata* was found in all three biotopes, but did not form swarms so typical of many other MAR vent communities.

Two single incomplete specimens of the caridean shrimp genus *Alvinocaris*, provisionally identified as *A.* aff. *longirostris* and *A.* aff. *muricola* (see Gebruk et al., 1997) and referred to as *Alvinocaris sp. 1* and *A. sp. 2* in Table 1, were found around the crater "B" (the latter) and on the chimney at "Irina" (the former). Those records require further studies, especially in the light of the intact specimens collected in this area by Nautile, which seem to be more closely related to *A. markensis* (M. Segonzac, pers. comm.). In addition, extensive bacterial mats (several m^2) were observed at "Irina" during French dives. Observations and collections from "Anne-Louise" report bythograeid crabs (presumably *Segonzacia sp.*), anemones and two species of shrimps (presumably *R. exoculata* and *M. keldyshi*). Video records from the pillar-like chimney at the site "A" revealed at least two shrimp species, *R.exoculata* and *M.keldyshi*, ophiuroids and bythograeid crabs. No mussels were observed.

A total of 28 species were identified from the different hydrothermal biotopes on the main mound (Table 1). Swarms of shrimps were not observed in this area, and the abundance of organisms in all the communities studied was relatively low. Highest numbers (>10 ind. per sample) were found for *Bathymodiolus* sp., *Mirocaris keldyshi*, and *Ophioctenella acies*.

Additionally, an extensive bacterial mat was observed from Nautile at one of the diffuse flow sites ("E") on top of the main mound (Fig. 1).

The "Irina-2" site

The vent community at "Irina-2", observed and sampled during the Nautile dives, is characterized by extensive mussel beds sometimes partially covering sulfide edifices, formed by live and dead mussels reaching 20 cm in length. There were also abundant ophiuroids, gastropods of the genus Phymorhynchus, caridean shrimps, anemones, bythograeid and galatheid crabs.

Other sulphide structures

Observations from Nautile indicate numerous dead mussels at the site "M", also reported to have a "hydrothermal community" by Russian geologists (Fig. 1). Mussel shells were used as an indicator for other "hydrothermal benthic communities" mapped in earlier geological surveys at Logatchev (Fig. 1).

Sedimented areas

Sediment communties were not studied in detail during submersible dives. However, at least one dredge sample was taken by the *RV Professor Logatchev* in 1995 in the soft sediment area north-east of the mapped section of the Logatchev area: start -14°45.326'N, 44°58.507'W, depth 3010 m, end - 14°44.874'N, 44°57.699' W, depth 2780 m. This dredge brought back one valve of *Ectenagena* sp., 133 mm long (see also Gebruk et al., 1997). This is the fourth record of vesicomyid bivalves from the MAR, but certainly the most significant. Although Segonzac (1992) reported an undetermined vesicomyid in the Snake Pit area, this was only based on a very small (5 mm) isolated specimen (M. Segonzac, pers. comm.). Also, two manganese-coated valves of what appeared to be large vesicomyid clams have previously been found at 15°07'N, at a depth of 3424 m in a sedimented fracture-zone area, off axis (M. Segonzac in Van Dover, 1995). In addition, live specimens of *Calyptogena sp.* have also been reported from the Vema fracture zone, at 4500-5000 m, more than a hundred km from the ridge axis (Auzende et al., 1989). At Logatchev, large, live vesicomyid clams seem to occur within the axis, close to a sedimented hydrothermal setting.

Other fauna sampled in the Logatchev area with a grab and box-corer during the *RV Professor Logatchev* cruises include *Bathymodiolus* sp. (>50 ind.), *Phymorhynchus moskalevi* and a gastropod of the superfamily Cerithiacea, which thus increases to 29 the total number of species recorded so far from the Logatchev hydrothermal area.

Additionally, observations from Nautile report bacterial mats and a mussel bed at site "F" (also rich in Fe-Mn deposits); bacterial mats, mussels, *Phymorhynchus* and ophiuroids at site "K"; mussels and gastropods at site "J", SE of "Irina-2"; and dead mussels, gastropods and numerous crinoids at site "G" (Fig. 1), the latter being of special interest, but requiring further confirmation.

Conclusion

The Logatchev hydrothermal area is of great biological and ecological interest. It is the southernmost known vent area in the Atlantic Ocean, and as such represents an important extension of our biogeographical knowledge. In addition, it is , to our present knowledge, the most isolated venting area on the MAR, the closest known area being Snake Pit at 23°22'N. The present report indicates a high number of taxa compared to the relatively small effort put so far into investigating the vent communities of this area. It is possible that the diversity of biotopes such as black smokers, smoking craters, diffuse flow areas, bacterial mats, mussel beds and sedimented areas, and possibly the peculiar geochemical features associated with Logatchev ("creeping smoke", Cu-rich deposits), have produced a particularly high biodiversity compared to other vent areas. Forthcoming results from recent Alvin dives in the area (R.C. Vrijenhoek, R.A. Lutz, chief scientists), will certainly help to address this issue.

Acknowledgements

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International Ridge-Crest Research: **Back-Arc Basins**

Structure and Paleoenvironment of the Ulleung Back-arc Basin, East Sea of Korea

Sang-Joon Han and Sik Huh

Marine Geology & Geophysics Division, Korea Ocean Research & Development Institute, Ansan P.O.Box 29, Seoul 425-600, Korea

Introduction

The East Sea (Sea of Japan) is a semi-enclosed marginal sea surrounded by Korea, Japan and Russia, yet it has deep ocean character, reaching depths greater than 2,000 m. This sea is one of the typical back-arc seas (Karig, 1971; Uyeda and Kanamori, 1979; Kimura and Tamaki, 1986; Jolivet et al., 1991) which have developed behind the circum-Pacific volcanic and seismic belt. To better understand the characteristics of this back-arc basin, an interdisciplinary scientific research entitled "Basin structures and past changes in the East Sea, Korea (BASAPES)" was launched in 1994 (PI: Sang-Joon Han). We conducted multibeam bathymetric (SeaBeam 2000), 3.5 kHz sub-bottom profiler, gravity, magnetic and multichannel seismic reflection surveys, and 12 m piston corings around the Ulleung Back-arc Basin onboard the *R/V Onnuri*.

This article presents the results of the second and the third years' performances to investigate the characteristics of back-arc basin (129°00'-132°00'E and 35°00'-38°30'N) in terms of marine geological, geophysical, and geochemical researches in the northeastern part of the Ulleung (Tsushima) Basin and its margin with the following objectives: (1) to investigate the contemporary sedimentation processes based on multibeam acoustic and high-resolution seismic surveys, (2) to analyze the gravity and magnetic patterns of the basement structures of the Ulleung Basin, (3) to study chronology, structure, and stratigraphy of the geology based on multichannel seismic data with a view to constructing the tectonic framework of the back-arc basin in the East Sea, (4) to establish tephrochronology based on analysis and correlation of tephra layers to investigate past volcanic activity in the Ulleung Back-arc Basin, and (5) to reconstruct paleoceanographic environments from the chemical tracers of sediments.

Scope of the Study

To analyze contemporary sedimentation processes, we constructed two dimensional bathymetry of the seafloor and three dimensional seafloor imagery of the East Sea based on the multibeam data. For better interpretation of shallow depth geological structures, high-resolution seismic data were combined with the seafloor images.

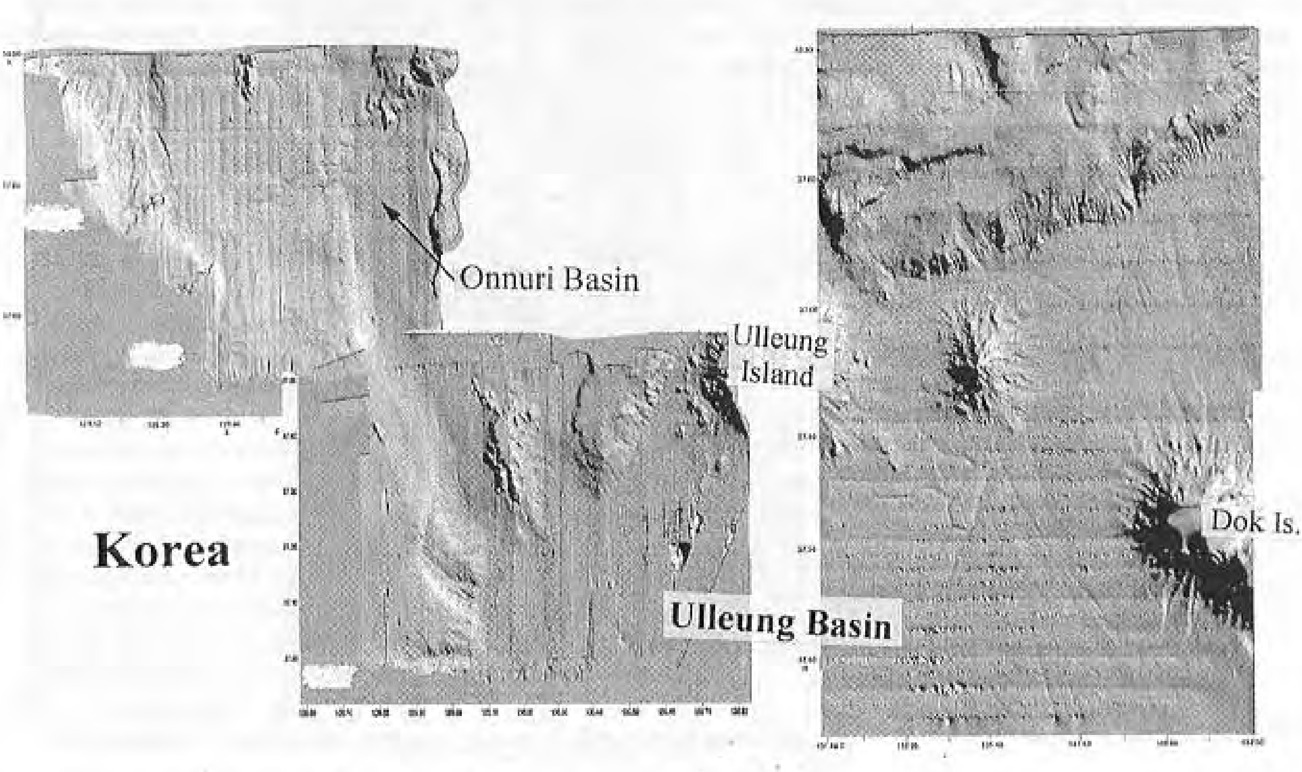

Figure 1. The seafloor image of the East Sea from a compilation of multibeam data acquired during this study.

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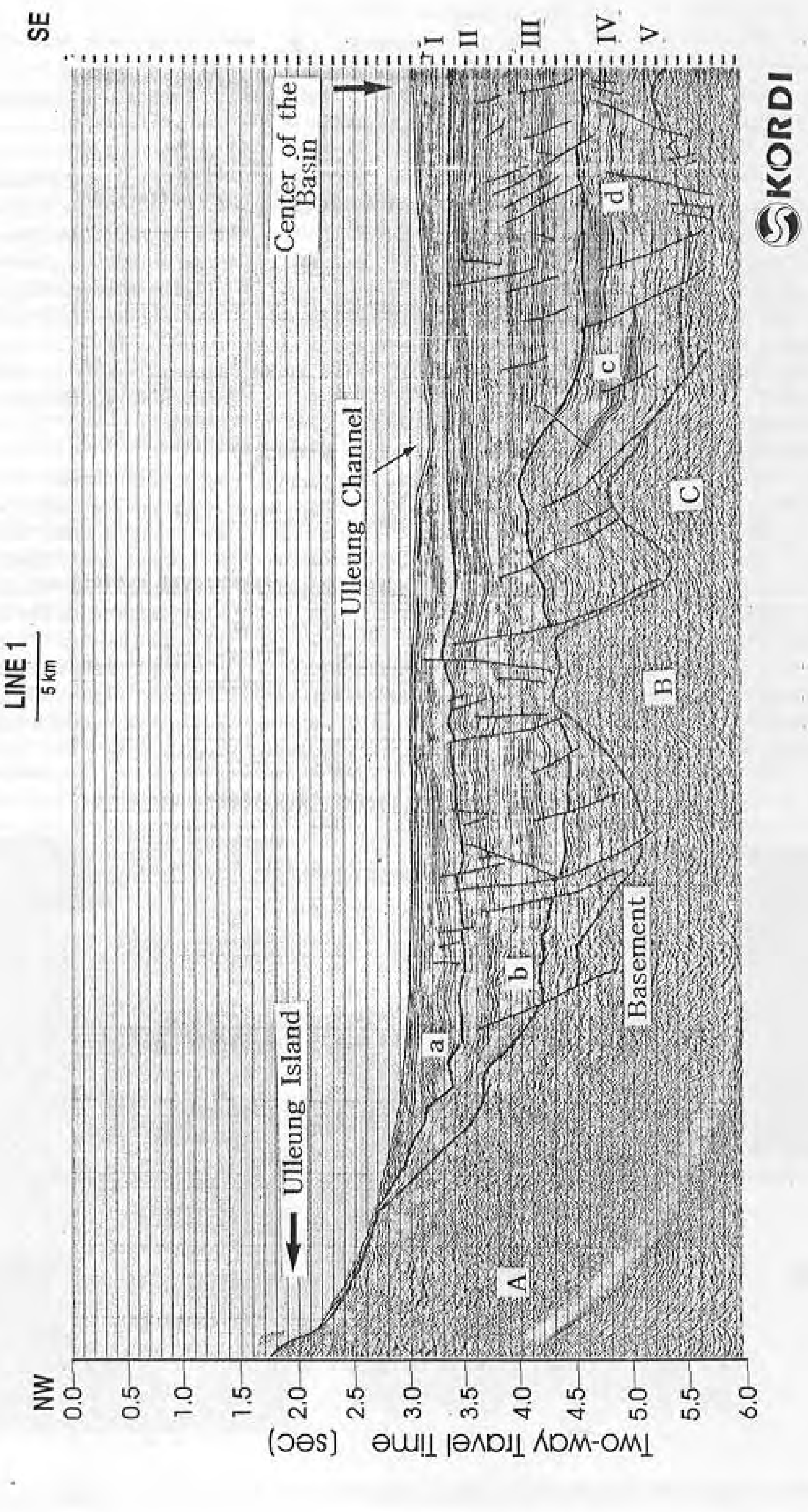

Figure 2. Interpreted migrated seismic section between Ulleung and Dok Volcanic Islands (Line 1).

Gravity and magnetic data were compiled from ship-borne equipment, satellites, and other instumentation to reveal and interpret deep anomalous geological structures.

We analyzed deep seismic reflection data, and developed processing sequences for enhancing the high-resolution components. We also interpreted the seismic data in terms of stratigraphy, chronology, and geologic structures of the Ulleung Basin to show the characteristics of this back-arc basin.

Using 12 m piston core sediments, we established tephrochronology based on the correlation of tephra layers derived from nearby volcanic islands. Finally, combined with the chemical tracers of geochemical analyses, we examined and reconstructed the paeoceanographic environments in the Ulleung Back-arc Basin.

Results of the Study

To analyze contemporary sedimentation processes, we constructed a seafloor image to provide detailed features of physiographic units in the back-arc basin (Fig. 1). This image shows the steep and narrow slope of western margin of the Ulleung Basin. Onnuri Basin is a rifted basin between the slope of the Korea Peninsula and the Korea Plateau which is believed to be a fragment of continental crust (Tamaki, 1988). Two volcanic islands (Ulleung and Dok Islands) were formed in the Pliocene or Pleistocene as the result of the subduction in the Japan Trench. Evolution of these two islands formed the Ulleung Interplain Gap between them, which headed northwest for the entrance to the Japan Basin.

Using gravity and magnetic data, we verified the previously undefined intrusive and/or extruded volcanic bodies in the Ulleung Back-arc Basin and their relationships to the formation of Ulleung and Dok Islands. From the interpretation of basement structure in the back-arc basin, free-air gravity anomalies correlated well with the topography, and reflect uncompensated isostatic equilibrium at the center of basin. The magnetic data reduced to the pole manifest the magnetic sources of Ulleung and Dok Islands, and the occurrence of pronounced gravity highs indicates a volcanic seamount between two islands (Fig. 1).

The interpretation of 56-channel seismic data in terms of stratigraphy, chronology, and geologic structures combined with OBS (Ocean Bottom Seismometer) data indicates that the Ulleung Basin may be composed of oceanic crust as the result of a short period of back-arc spreading. A thick sediment cover with maximum 4 km thickness overlies the basement which is highly deformed by volcanic activity (Fig. 2). The extension since the middle Miocene has caused deep-seated large normal faults that detached into the volcanic domes. The formation ages of sedimentary layers are estimated as the middle (IV sequence) and late Miocene (III sequence), Pliocene (II sequence), and Pleistocene (I sequence) from the bottom. In the seismic section, volcanics have intruded the sediment or volcaniclastic layers through time (colored areas; volcanics 'a', 'b', 'c', and 'd') and basement highs also have prevailed (deep volcanics A, B, and C) from the activity of Ulleung and Dok Islands. Normal fault cuts the volcanic intrusive 'c' in the middle of section.

Tephra layers characterized by distinctive sedimentological, mineralogical, and geochemical characteristics, reflect a single eruptive episode. Widespread two marker-tephra layers (about 9,300 yr. B.P. for Ulleung-Oki ash erupted from Nari Caldera and about 22,000 yr. B.P. for Aira-Tanzawa ash derived from Aira Caldera in southern Japan) were correlated with their source volcanoes using the back-arc characteristics in the East Sea, Korea (Fig. 3). During the Holocene period (present~9,300 yr. B.P.), correlation of marker-tephra layers yields a sedimentation rate of 17~23 cm/kyr. Whereas, the sedimentation rate increased to 22~31 cm/kyr during the late Pleistocene (9,300~22,000 yr. B.P.). Several tephra layers of primary type also intercalated in core sediments, which would originate from Ulleung Island and northwestern Honshu. Interpretation of these tephra layers provides a detailed correlation of core sediments in the Ulleung Basin. Study of tephrochronology also provides important information on paleoclimate, depositional histories, and geochemical characteristics of source volcanoes through time in the East Sea.

In the reconstruction of paleoceanography from chemical tracers, we found that decomposition rates of organic carbon calculated

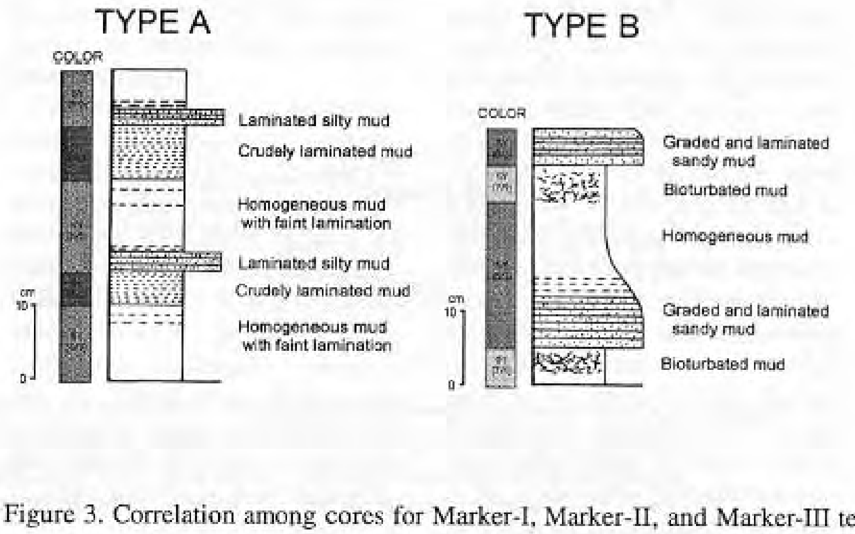

Figure 3. Correlation among cores for Marker-I, Marker-II, and Marker-III tephras.

International Ridge-Crest Research: **Back-Arc Basins**: Han and Huh continued...

from core sediments were 0.20 mol C/m^2/yr in the upper slope, and 0.004~0.03 mol C/m^2/yr in the lower slope and basin plain. Distributions of organic carbon, nitrogen, biogenic silica, and strontium in the core have been determined in order to reconstruct the variations of paleo-primary productivity in the southwestern part of the East Sea. There were large fluctuations in primary productivity during the last 110,000 yr. Past levels of bottom water oxygenation in the East Sea have varied from weakly oxic to severely euxinic (beyond anoxic) condition. A new model for the oxygenation level of deep water of the East Sea has been developed so that the accumulation rate of hydrogenetic molybdenum may be incorporated with the relationships among euxinic level, primary productivity, and residence time of bottom water (Fig. 4). Using this model, euxinic level and residence time of bottom water in the East Sea during the last 110,000 yr. were calculated. The results showed that redox environment of water column in the East Sea was severely euxenic during the periods of Oxygen Isotope Stage 4, Oxygen Isotope Stage 2, and transitional period when the cold Oyashio current through Thugaru Strait was replaced by the inflow of warm Tsushima current, as that of the Black Sea (Lyons and Berner, 1992) in the present. The residence time of bottom water during the glaciation period was estimated to be 2 to 6 times longer than that of the present.

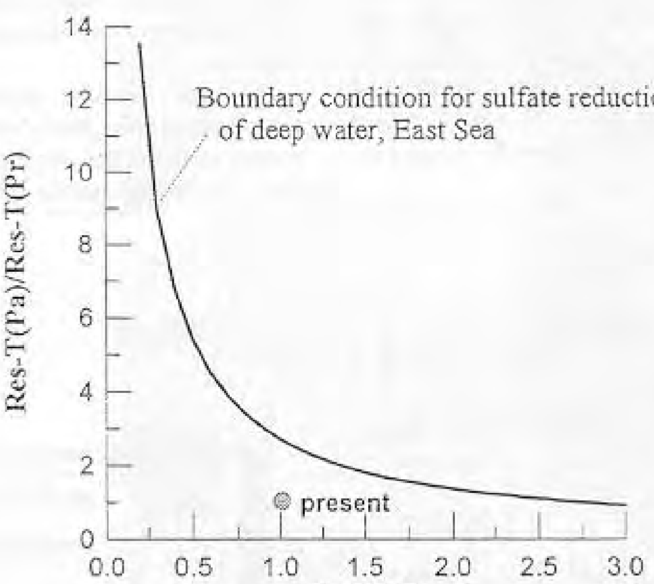

Figure 4. Model for the oxygenation level of deep water of the East Sea coupled with primary productivity and vertical ventilation. X-axis is paleo primary productivity/present primary productivity (PaP/PrP), and Y axis is paleo residence time/present residence time of deep water (Res-T(Pa))/(Res-T(Pr)).

Applications

The geophysical and geological techniques developed and improved in this study can directly be used to explore hydrocarbon and other mineral resources in the Korean seas. The formation mechanism and evolution of the East Sea as a back-arc basin is expected to be clarified more accurately than before, when the presence of oceanic crust in the Ulleung Basin has been proved from oceanic bottom seismometer data and from the results of this study. In addition, the tephra layers erupted from nearby volcanic islands in the East Sea can serve as a framework for stratigraphic correlation and for paleoceanographic research.

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Boundary between Active and Extinct Zones in the Lau Basin-Havre Trough, Southwest Pacific: Results of the LAUHAVRE Cruise of *R/V Yokosuka*

T. Matsumoto[1], K. Kobayashi[1**], T. Yamazaki[2*], J. Delteil[3*], E. Ruellan[3**], S. Abe[4], M. Aoki[5], G. Buffet[3], C. De Rondo[6], J. Etoubleau[7], T. Fujiwara[1], P. A. Jarvis[1], M. Joshima[2], T. Kula[8], H. Kumagai[9], F. Murakami[2], A. Nishizawa[10], A. Pelletier[3], N. Takahashi[1] and I. Wright[11]*

[1]*Japan Marine Science & Technology Center, 2-15 Natsushima, Yokosuka 237, Japan*
[2]*Geological Survey of Japan, 1-1-3 Higashi, Tsukuba 305, Japan*
[3]*Geoscience Azur, Université Nice, Sophia-Antipolis 06560, France*
[4]*Central Research Institute of Electric Power Industry 1646 Abiko, Chiba 270, Japan*
[5]*Nippon Marine Enterprises Ltd., JAMSTEC branch, 2-15 Natsushima, Yokosuka 237, Japan*
[6]*EOS Research ,University of Otago, PO Box 56, Dunedin, New Zealand*
[7]*IFREMER, COB, B70, 29280 Plouzané, France*
[8]*Ministry of Lands & Natural Resources, Nukualofa, Tonga*
[9]*Earthquake Research Institute, Univ. of Tokyo, 1-1-1 Yayoi, Bunkyou-ku, Tokyo, 113 Japan*
[10]*Hydrographic Department, 5-3-1 Tsukiji Tokyo 104, Japan*
[11]*NIWA, PO Box 14-901, Kirbirnie, Wellington, New Zealand*

* Co-chief scientist for Leg 1
** Co-chief scientist for Leg 2

Outline of the Cruise

The Lau Basin–Havre Trough is a V-shaped contiguous backarc basin extending some 2,700 km between Tonga and New Zealand in the southwestern Pacific Ocean. It is bordered by the Tonga-Kermadec arc-trench system on the east and by a remnant arc such as Lau and Colville Ridges. Northward along the Pacific-Australian plate boundary between 39°S and 15°S there is a doubling of the convergence rate from 45 mm/yr to 90 mm/yr (De Mets et al., 1990), and a concomitant increase in the back-arc widening rate from 15 to 110 mm/yr (Parson and Wright, 1996). This difference seems to be reflected in the tectono-magmatic style of backarc activity, from ocean floor spreading to arc rifting which propagates southward. The southern part of the actively spreading Lau Basin is characterized by the Valu Fa Ridge which hosts an extensive hydrothermal ventings on its axis (Fouquet et al., 1991; Pierce et al., 1996). The southernmost tip of the Valu Fa Ridge appears to extend to 23°00'S (Wiedicke and Collier, 1993), whereas tectonic morphology south of 23°00'S has been mostly unknown. At about 26°S the NNW-trending Louisville seamount chain in the Pacific plate intersects with the Tonga Trench but tectonic influences of this collision has so far been unknown.

R/V Yokosuka attempted to investigate this less surveyed region in its cruise in January to February, 1997. The area between 22°30'S and 27°S was focused on, although other areas, including the southern Havre Trough around 31°30'S and 35°S, were also surveyed (Fig. 1). The expedition was organized under the aegis of the French-Japanese cooperative scientific program *New STARMER*. Scientists were also invited from New Zealand and Tonga to work together onboard. Shipboard investigation comprised swath bathymetry, seismic reflection profiling, gravity and magnetic measurements, ocean bottom seismometer (OBS) observation as well as dredge hauls collecting basement rocks.

A total of 22 lines of seismic reflection were recorded to overview the Lau Basin and Havre Trough, and to compare the tectonic setting of the study area with other regions. An example of one of the schematic illustrations of the WNW to ESE profiles around 26°15'S (profile #9 in the northern Havre Trough) is shown in Fig. 2. There is a 50-km wide sedimented basin (called Western Sub-Basin:WSB) with a water depth of 2,500 m in the western limb of the profile. The OBSs were installed in this WSB. The eastern wing of the trough has been upheaved and is occasionally disrupted by intrusives. The eastern margin of the trough is sharply bordered by the volcanic scarp of the Tonga arc. Reverse faults and folds are recognized on the Tonga arc between 23°30'S–24°S where the Osborne Seamount at the northern tip of the Louisville Ridge is being subducted into the Tonga Trench. However, in the backarc region behind the arc, topography such as graben predominates, indicating prevalence of extensional tectonics there.

Detailed topographic maps were completed by swath bathymetry with almost 100% coverage for three target areas; the northern Havre trough around 26°S, the southern Lau Basin around 24°S, and the southernmost Havre Trough. The latter is divided into two small segments; one from 31°45'S to 32°28'S, and the other bounded by 34°55'S and 36°45.5'S. Magnetic total force and three-components, as well as gravity anomalies were measured throughout this survey area. Igneous and sedimentary rocks were collected by 12 dredge hauls in the northern Havre Trough (7 sites) and southern Lau Basin areas (5 sites). There is a sharp contrast in the degree of hydrothermal alteration showed a sharp contrast between these two areas, which may help to

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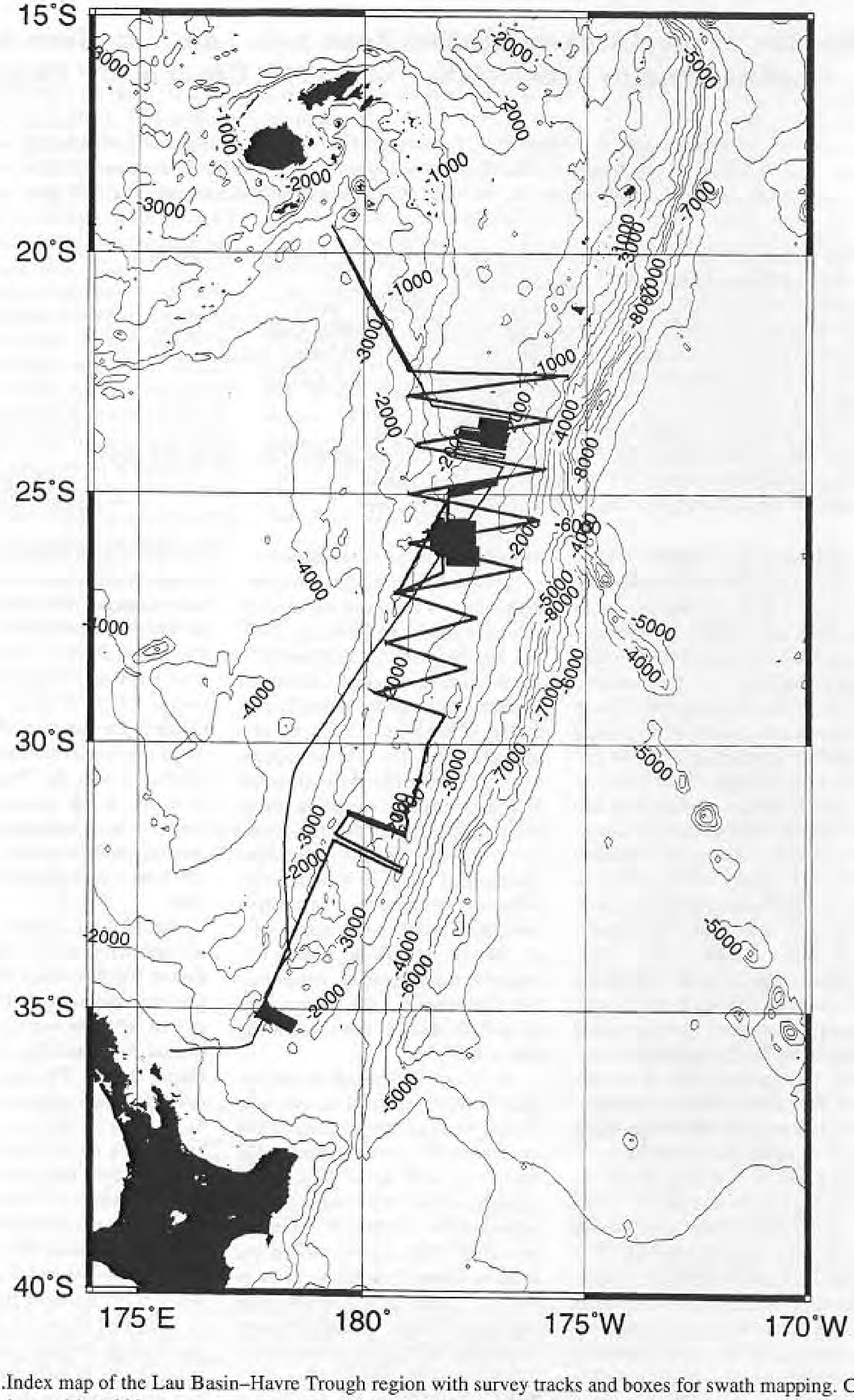

Figure 1.Index map of the Lau Basin–Havre Trough region with survey tracks and boxes for swath mapping. Contour interval is 1,000 m.

define the boundary between the area of present-day hydrothermal activity with volcanic eruptions, and the older extinct zones.

Major Results of Survey

Northern Havre Trough near 26°S

The general morphology of this area consists of three structural units; the sedimented basin in southwest, the northeastern portion with volcanic edifices and the south-central area (Fig. 3). The southwestern area (WSB mentioned above) is characterized by a thick sedimentary cover revealed by seismic profiling. Dredge hauls retrieved fine-grained, tan-colored, soft sediment. We tentatively concluded that this area represents initiation of rifting of the Lau-Colville Ridge about 6 Ma before the backarc opening commenced.

The sea floor in the northeastern area is made up of many small ridges and elongated seamounts. Major structural trends are primarily N40-45° and secondly N65°, which are 25° to 45° oblique to the general tectonic fabrics (N15-20°E) of the Havre Trough. We can further observe some NS to N15-20° trending normal faults. The depths are highly variable from 1,100 m to 2,300 m. Two dredge hauls from a fault scarp and on the flank of seamount provided weathered (presumably old ?) pillow lavas, some with glassy margins.

The south-central area is separated from the northeastern area by a southeastward extension of the WSB. Topographic features are dominated by horsts and grabens with tilted blocks. The tectonic trend is N40-45°, consistent with northeastern area. Indurated solidified sediments were collected from two dredge sites, indicating the lowermost layers of sedimentary sequences have been exposed by tilting which upheaved a part of this area relative to the western portion of the trough. On the whole, no evidence was seen in favor of recent volcanism and seismic activity. Preliminary analysis of OBS records seem to indicate that no near earthquakes occurred during our observation.

Southern Lau Basin near 24°S

The eastern wing of this area near 177°W is characterized by the axial rift valley expressed as a very deep graben with steep scarps on both the eastern and western sides (Fig. 4). It generally trends in a direction of N20° in harmony with the Valu Fa Ridge in the north. The bottom of the graben is deeper than 3,000 m, and the width, between scarp crests, amounts to 10 km. Rocks (large boulders of pillow lava) collected from one site (23°41'S) of the northern western (east-facing) scarp of the graben are extremely fresh, indicating that they are products of recent volcanic eruptions fractured by young tectonism.

The northern extension of the rift valley near 23°35'S stems northward into three parallel, elongated grabens separated by two sharp ridges. These grabens become narrower and slightly shallower northward. These ridges and axial graben may be interpreted to be a neo-volcanic zone in the rift valley. Further north at 23°30'S the graben is offset to east and west by 9 km into two valleys. Between the two a narrow and shallow (2,400 m deep) valley extends northward by 4-5 km and is connected to a deep graben further north.

At a site south of the neo-volcanic zone (23°53'S) large amounts (>60 kg) of hydrothermally altered green-colored rocks (mainly andesite and/or dacite in composition) were collected. Propyllitic mineral assemblage containing chlorite in the exposed rocks implies very recent hydrothermal alteration, since these minerals would be quickly dissolved into sea water. This area may be a present-day active hydrothermal field.

The CMT database of shallow seismicity in the years 1977-1996 indicates that shallow earthquake swarms are centered near 24°S, 117.3°W, close to the deep graben. Focal mechanism solutions show a predominance of extensional stress with small amounts of strike-slip component.

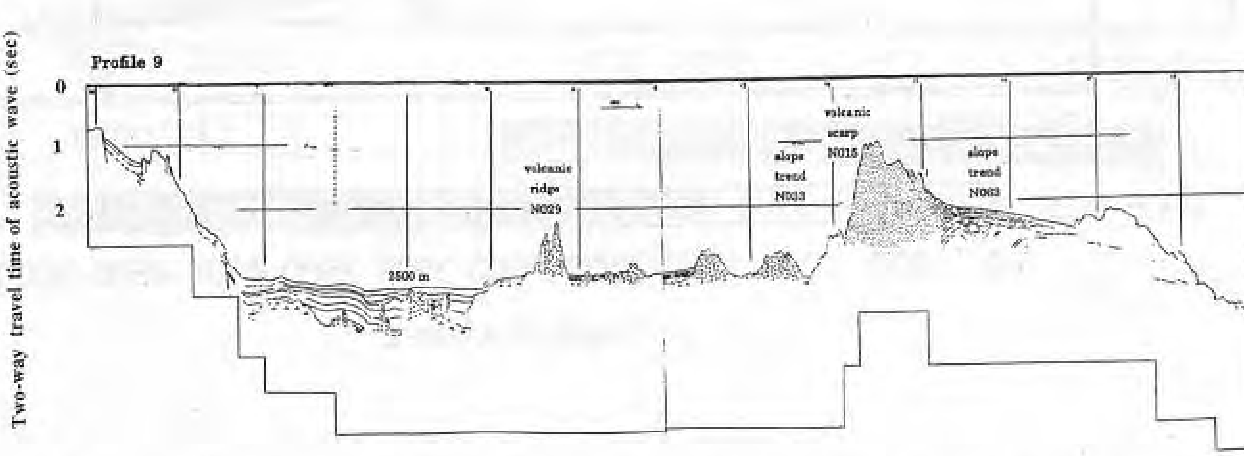

Figure 2. Schematic representation of a seismic reflection profile crossing the northern Havre Trough.

International Ridge-Crest Research: **Back-Arc Basins**: Matsumoto et al. continued...

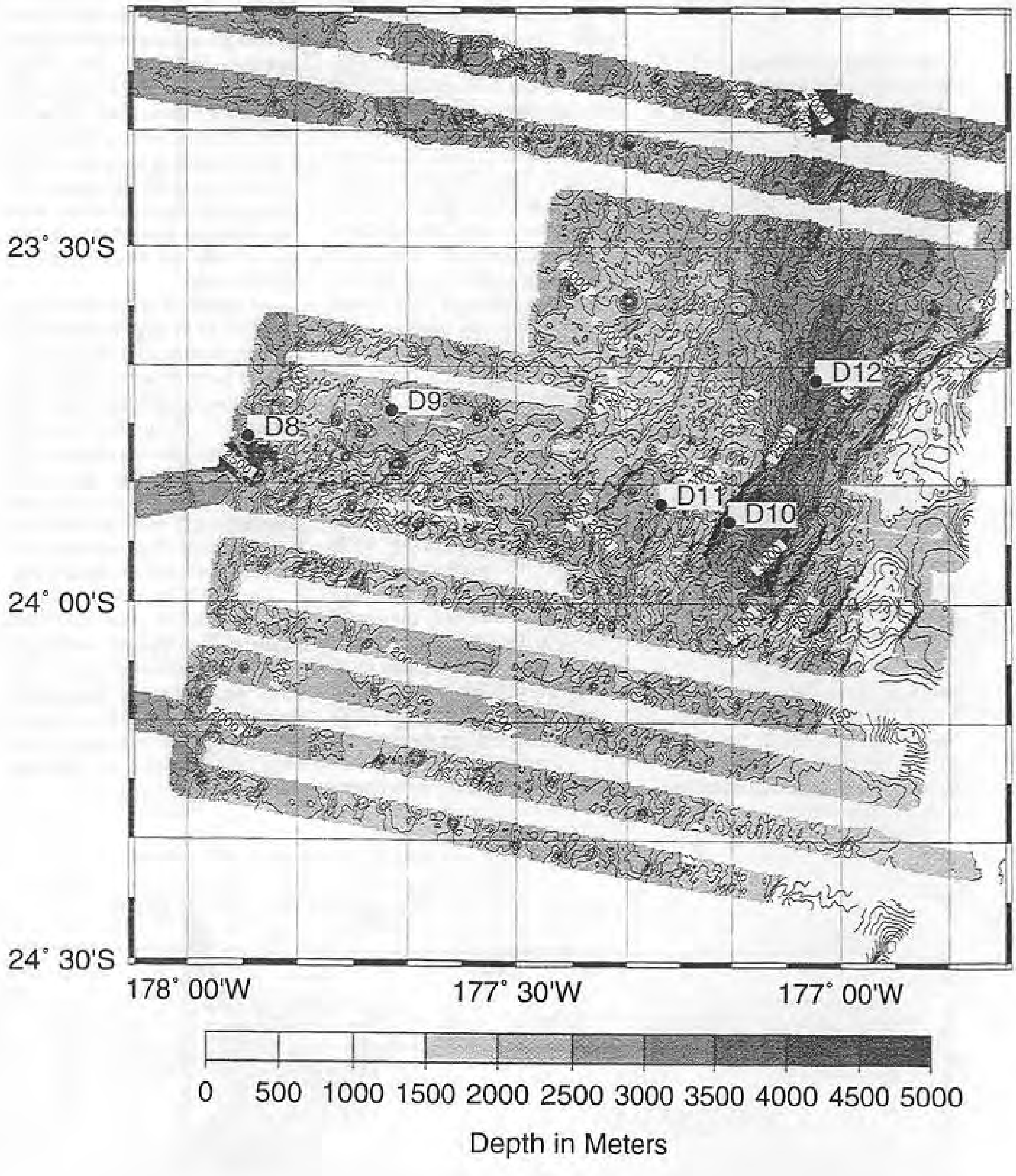

Figure 3. Bathymetric map of the northern Havre Trough with sites of dredge hauls. Contour interval is 500 m.

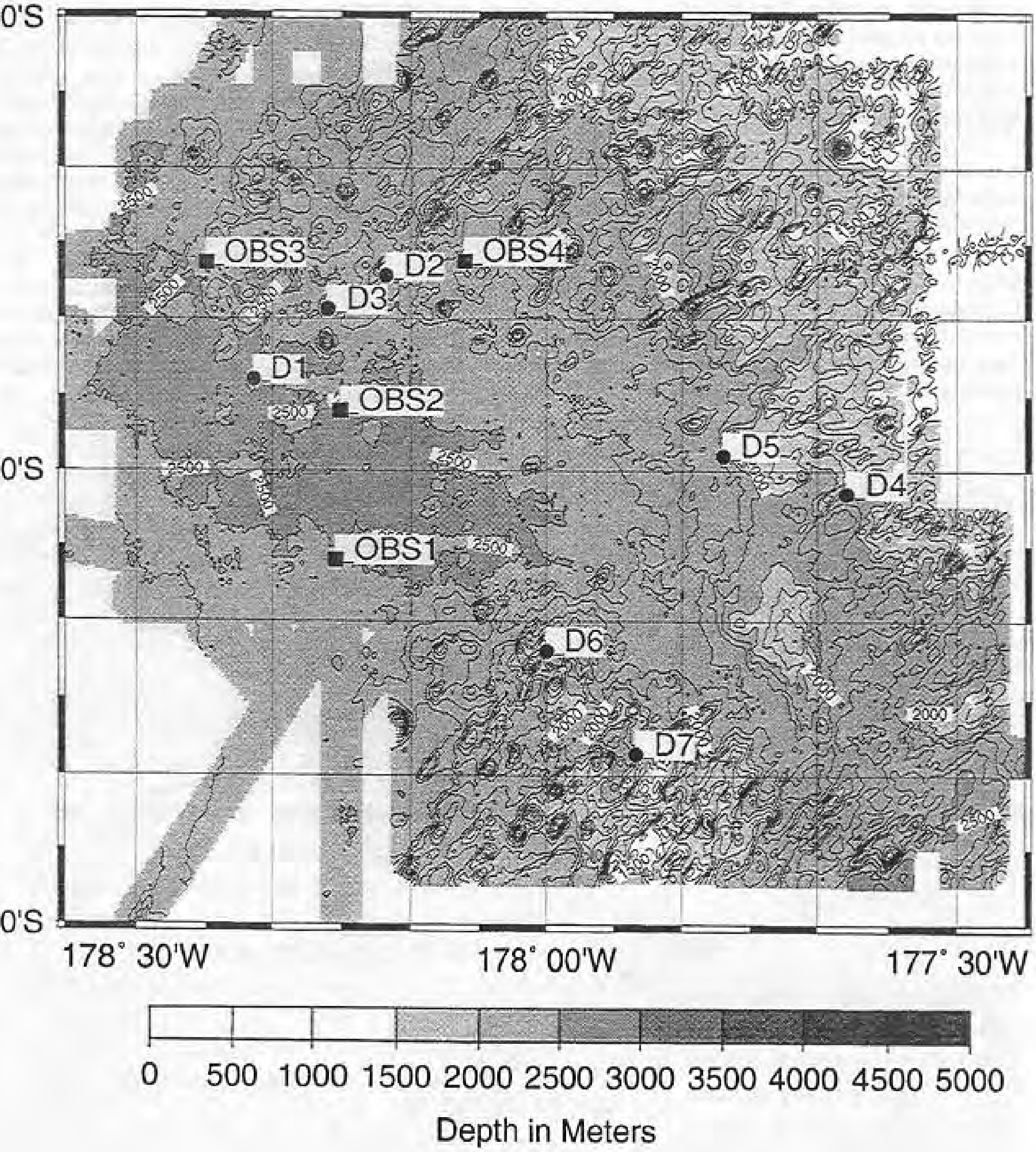

Figure 4. Bathymetric map of the southern Lau Basin with sites of OBSs and dredge hauls. Contour interval is 500 m.

International Ridge-Crest Research: **Back-Arc Basins:** Matsumoto et al. continued...

Summary

(1) The whole surveyed area (southern Lau basin and Havre Trough) is basically characterized by a tensional stress regime associated with grabens and normal faults trending oblique to the general trend of the trench-arc system. Products of extension are predominant even in a collision zone at which the Louisville Ridge in the Pacific plate intersects with the Tonga Trench.

(2) The southernmost tip of the Lau Basin (24°S) is dominated by active tectonism and magmatism. The N20°-trending rift valley located at 177°W in the eastern wing of the basin is the most active area. Considering its topography and activity, the rift may possibly represent the front of southward propagation of the Valu Fa Ridge spreading ridge.

(3) In the northernmost Havre Trough (25°30'S), on the contrary, no evidence was seen for recent volcanic, hydrothermal and seismic activities. Many old and inactive seamounts are distributed in the central and eastern parts of the basin, whereas a relatively flat sedimented basin exists in its western limb.

(4) The whole basin is not symmetric. the older western wing of the basin is filled with sediment, whilst younger (recently active in the north) tectono-magmatic zones are located in the east.

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InterRidge

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The InterRidge Office proposes to act as a broker, matching projects which may be 'piggy-backed' with funded and scheduled cruises that have available time and space.

Proposals of both piggy-back projects and ship time will be published in InterRidge News and on the InterRidge World Wide Web Home Page (http://www.lgs.jussieu.fr/~ intridge). Proposal submission should include:

for ship time proposed:

- objectives and dates of the planned cruise
- ports of call, location of study
- equipment to be employed/deployed
- space (deck, lab, accommodation) and time available

for piggy-back project proposed:

- objectives and time required
- shipboard equipment/facilities required
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- preferred location(s)

Submissions and enquiries should be directed to the InterRidge Office at intridge@ext.jussieu.fr.

International Ridge-Crest Research: **South West Indian Ridge**

Sampling the South West Indian Ridge: first results of the EDUL cruise (*R/V Marion Dufresne II*, August 1997)

C. Mével[1], P. Agrinier[2], M. Cannat[1], S. Decitre[3], A. Dappoigny[4], E. Humler[1], N. Jendrzejewski[2], J.R. Kienast[1], J. Ludden[3], B. Murton[5], O. Oufi[1], A. Rabain[1], M. Seyler[1], and Y. Tamura[6]

[1]Laboratoire de Pétrologie, UPMC, Case 110, 4 place Jussieu, 75252 Paris Cédex 05, France
[2]Institut de Physique du Globe de Paris, 4 Place Jussieu, 75252 Paris Cédex 05, France
[3]Centre de Recherches Pétrographiques et Géochimiques, Université de Nancy,15 Rue Notre Dame des Pauvres, 54501 Vandoeuvre-les-Nancy Cédex, France
[4]Laboratoire de Modelisation du Climat et de l'Environnement, CEN Saclay, L'Orme-des-Merisiers, 91191 Gif Sur Yvette Cédex, France
[5]Southampton Oceanography Center, European Way, Empress Dock, Southampton, SO14 3ZH, UK
[6]Department of Earth Sciences, Faculty of Science, Kanazawa University, Kanazawa University, Kakuma, Kanazawa, 920-11, Japan

The Southwest Indian Ridge (SWIR) has been selected by the InterRidge program for the case study of an ultra-slow spreading center. It opens at a half spreading rate of 7-8 mm/y, about half of the average spreading rate of the Mid-Atlantic Ridge. The limited seismic data available suggest that the crustal thickness is significantly less than the average for mid-ocean ridges. Moreover, global seismic tomography suggests a very cold mantle structure beneath the ridge, especially east of the Melville fracture zone. Recent cruises of the *R/V Atalante* have achieved complete bathymetric and gravity coverage of the axis between the Rodrigues triple junction and 49°E (Mendel et al., in press ; Rommevaux et al., in press ; Patriat et al., 1995). These new data confirm that the average depth of the axis increases towards the triple junction. The bathymetric and gravimetric segmentation of the axis has a wavelength on the order of 100 km. The height difference between segment center and ends is often very marked and may reach 2000 m. The purpose of the EDUL cruise was to use this new dataset to conduct a systematic sampling of both the rocks and the water column along this portion of the ridge axis, in order to:

- characterize the amount of partial melting in the mantle, relative to the general deepening of the axis eastward and to the regional segmentation,
- constrain the composition of the mantle source,
- estimate the contribution of serpentinized peridotites and gabbros to the architecture of the crust,
- evaluate the extent of seawater penetration in the oceanic lithosphere,
- document possible chemical anoma-

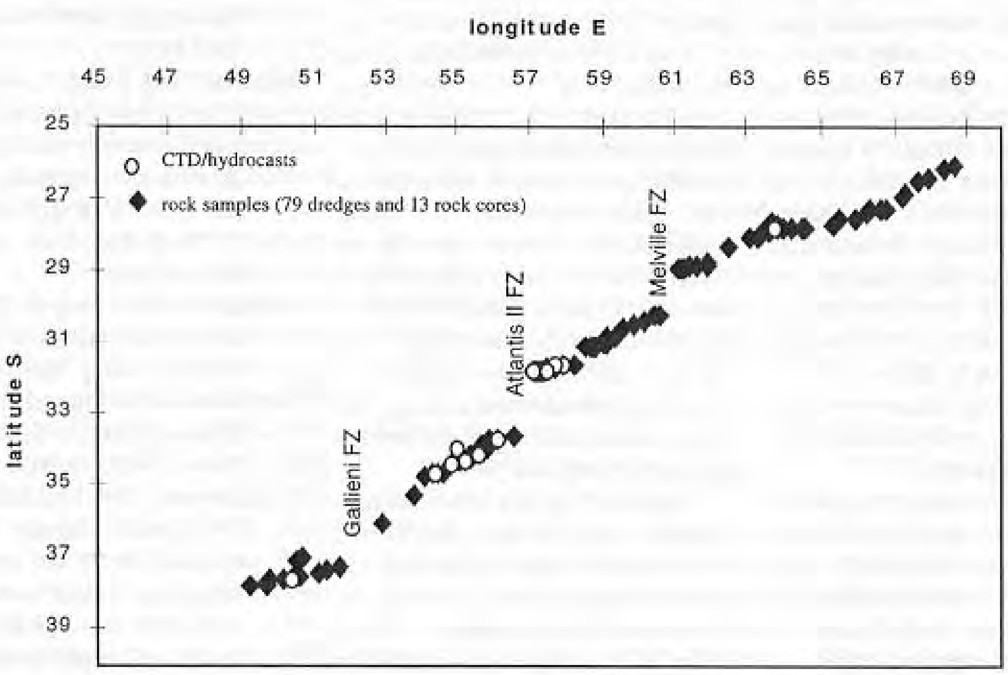

Figure 1. Locations of rock samples and CTDs taken along the SWIR during the EDUL cruise

International Ridge-Crest Research: **SWIR**: Mével continued

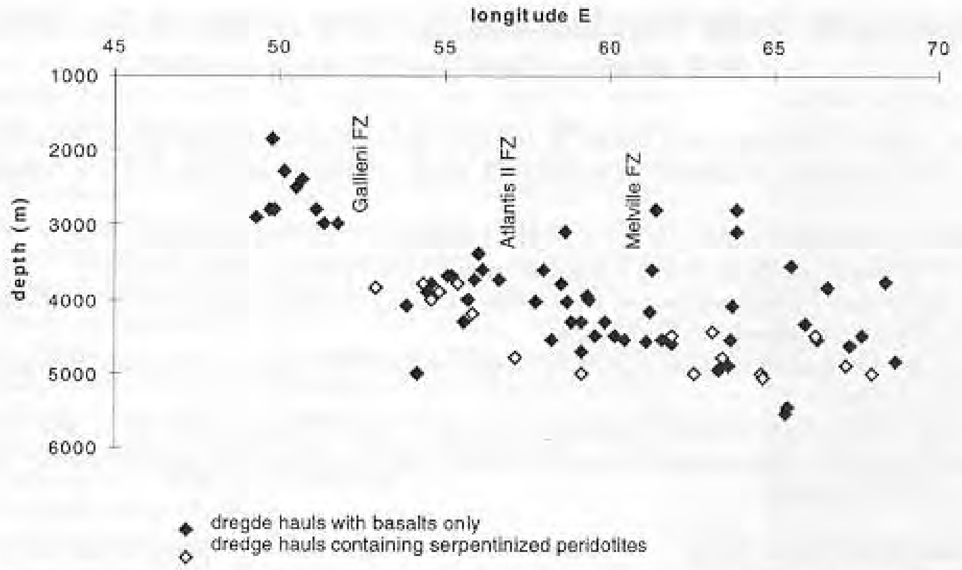

Figure 2. Types of rock recovered along the SWIR during the EDUL cruise, shown versus longitude and depth.

lies in the water column related to hydrothermal activity.

Extensive rock sampling has been achieved, through 76 successful dredge hauls and 13 rock cores (Fig. 1).

A systematic sampling of the center and extremities of the segments defined by the bathymetry and gravity was carried out in the axis, on structures identified as axial volcanic ridges or invidual volcanoes. More detailed sampling was conducted in a few areas in order to address local variations, for instance where the axial valley appears filled with volcanic plugs (Cannat et al., 1997), such as the Jourdanne mounts (64°E) and the area east of the Atlantis II fracture zone (57°E). The freshness of the basalts is quite variable, and sediments were collected in many of the dredge hauls. The basalts vary from aphyric to highly phyric. The highly phyric rocks may contain up to 20-30% large plagioclase crystals and small proportions of olivine phenocrysts, and they seem to be more abundant in the center of the segments.

In order to document the architecture of the crust, dredge hauls were also carried out in the axial valley walls, in areas characterized by positive MBA that correspond to discontinuities between segments. The samples confirmed that serpentinized peridotites frequently crop out and therefore make up a significant portion of the crust (Fig. 2). Only west of the Gallieni fracture zone, where the average depth of the axial valley decreases drastically, were peridotites not recovered. Hand specimen examination of the peridotites show that they contain abundant clinopyroxene, suggesting that they have experienced low amounts of partial melting. The peridotites are occasionally cross-cut by gabbroic and basaltic dikes. However massive gabbros are not abundant. The composition of the upper lithosphere appears mostly bimodal, consisting primarily of volcanic and residual rocks.

Due to technical problems during the cruise, only 13 CTD/hydrocasts could be carried out, and these in the western part of the survey area (Fig. 1). To attempt to identify anomalies in the water column, we used nephelometry sensors lent by Ed Baker. The sensors, either mounted on the CTD, or on a MAPR installed on the dredge cable (Baker and Milburn, 1997), did not indicate evidence for hydrothermal activity. The fluids collected at the 13 stations are currently being analyzed.

These preliminary results are consistent with low magma budgets and discontinuous magmatic activity expected in this cold environment: the the freshness of the basalts collected in the axial valley is quite variable, the peridotites are rich in clinopyroxene, and serpentinized peridotites are an important constituent of the crust at least in discontinuities between segments. Petrological and geochemical analyses of the samples collected are in progress.

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Hydrothermal circulation and the seismic structure of upper oceanic crust: Results from the EXCO-cruise

Ingo Grevemeyer[1], Norbert Kaul[1], Heiner Villinger[1] and Wilfried Weigel[2]

[1]*FB Geowissenschaften, Universität Bremen, Postfach 33 04 40, 28334 Bremen, Germany*
[2]*Institut für Geophysik, Universität Hamburg, Bundesstraße 55, 20146 Hamburg, Germany*

Introduction

Heat flow measurements on ridge flanks indicate a deficiency of heat flux, based on plate cooling models (e.g. Jacobson, 1992; Stein and Stein, 1994). The most likely explanation is that hydrothermal circulation of seawater through the oceanic crust has removed a major amount of heat. But hydrothermal circulation is also an evolutionary process that affects the seismic properties of upper oceanic crust, called layer 2A (Houtz and Ewing, 1976). Seismic velocities likely increase because pore space and cracks fill with hydrothermal minerals as the crust ages.

The driving force for convection of seawater through the ocean floor is the temperature distribution with depth, which is a function of age. In juvenile crust steep geothermal gradients and high temperatures at shallow depth drive a vigorous hydrothermal circulation system. The alteration of basalts is intensified with increasing temperature. This scenario implies that the high temperature axial system, with its rapidly moving fluids, is accompanied by a comparatively large amount of hydrothermal alteration and sealing of open void spaces. At the much lower temperatures in the ridge flank system the chemical reactivity and the vigor of hydrothermal circulation are reduced. However, hydrothermal fluid flow into the crust appears to be weakened or stopped by sediment blanketing. Away from spreading ridges, where the observed heat flux equals that predicted, hydrothermal heat transfer has ceased and seawater is no longer available for hydrothermal alteration and precipitation of secondary minerals. It is this stage that seismic velocities, being very sensitive to pore filling, reach their maximum values. This event is suggested to be controled by the integrated sediment permeability, which depends on sediment composition, thickness and diagenetic processes (Jacobson, 1992). Previous estimates on the age of this transition differ widely (Houtz and Ewing, 1976; Rohr, 1994; Grevemeyer and Weigel, 1996).

During the EXCO (EXchange between Crust and Ocean) cruise we applied geophysical techniques to study the impact of hydrogeological processes on the evolution of the properties of oceanic crust formed at "superfast" spreading rates on the East Pacific Rise south of the Garrett Fracture Zone.

The Survey

Field work for EXCO was conducted from the German *R/V Sonne* in late 1995. The cruise explored a 720 km long tectonic corridor on the Nazca plate (Figure 1). Swath-mapping bathymetry, magnetics, seismic refraction and reflection experiments and heat flow data were acquired on seafloor created over the last 8.5 million years (Weigel et al., 1996). Seafloor spreading anomalies derived from our magnetic data suggest that the average Nazca spreading rate has been 85 mm/yr (half rate) since magnetic anomaly 4A (Grevemeyer et al., 1997).

Seismic Structure

To sample variations in the upper crustal velocity structure, six 50 to 100 km long refraction lines were shot over 0.5 to 8.3 Myr old seafloor (Fig. 1). The source used was a single 32-liter airgun towed at a nominal depth of 10 m. At 13.8 MPa the gun produced a dominant seimic frequency of 6 Hz. As a receiver we deployed digital recording ocean-bottom hydrophones supplied by the GEOMAR Institute, Kiel.

Seismic refraction arrivals from the upper oceanic crust are of excellent quality (Grevemeyer and Weigel, 1997). A two-dimensional ray tracing algorithm (Zelt and Smith, 1992) was used to derive the seismic velocity structure from the refraction data. The modeling yielded a velocity structure which closely matches the seismic model of layer 2 created at the East Pacific Rise (e.g. Kent et al., 1994; Christeson et al., 1997). Thus upper crust composes of a low-velocity surficial layer 2A (400-700 m thick) underlain by layer 2B with velocities > 5.4-5.6 km/s. The modeling suggests that the transition zone between the layers must be a steep gradient or a first-order discontinuity (Fig. 2).

While the velocities in layer 2B remain constant off-axis, the seismic structure of the layer 2A is a function of plate age. Velocities increase gradationally from about 2.9 in 0.5 Myr old crust to values of 4.3 km/s in 8.3 Myr old crust (Fig. 3). At the ridge crest Tolstoy et al. (1997) traced velocities of 2.35 km/s, suggesting that layer 2A velocity rapidly increase close to the ridge axis (ca. 1 km/s per 1 Myr) and slowly thereafter (0.1-0.2 km/s per 1 Myr).

Heat Transfer

Heat flow measurements were carried out using a multi-penetration probe of the violin-bow design (Hyndman et al., 1979). Eleven thermistors are mounted in a string of 3 m length to give gradients at ten different depth points and *in situ* thermal conductivity. In order to assess the regional decrease of heat

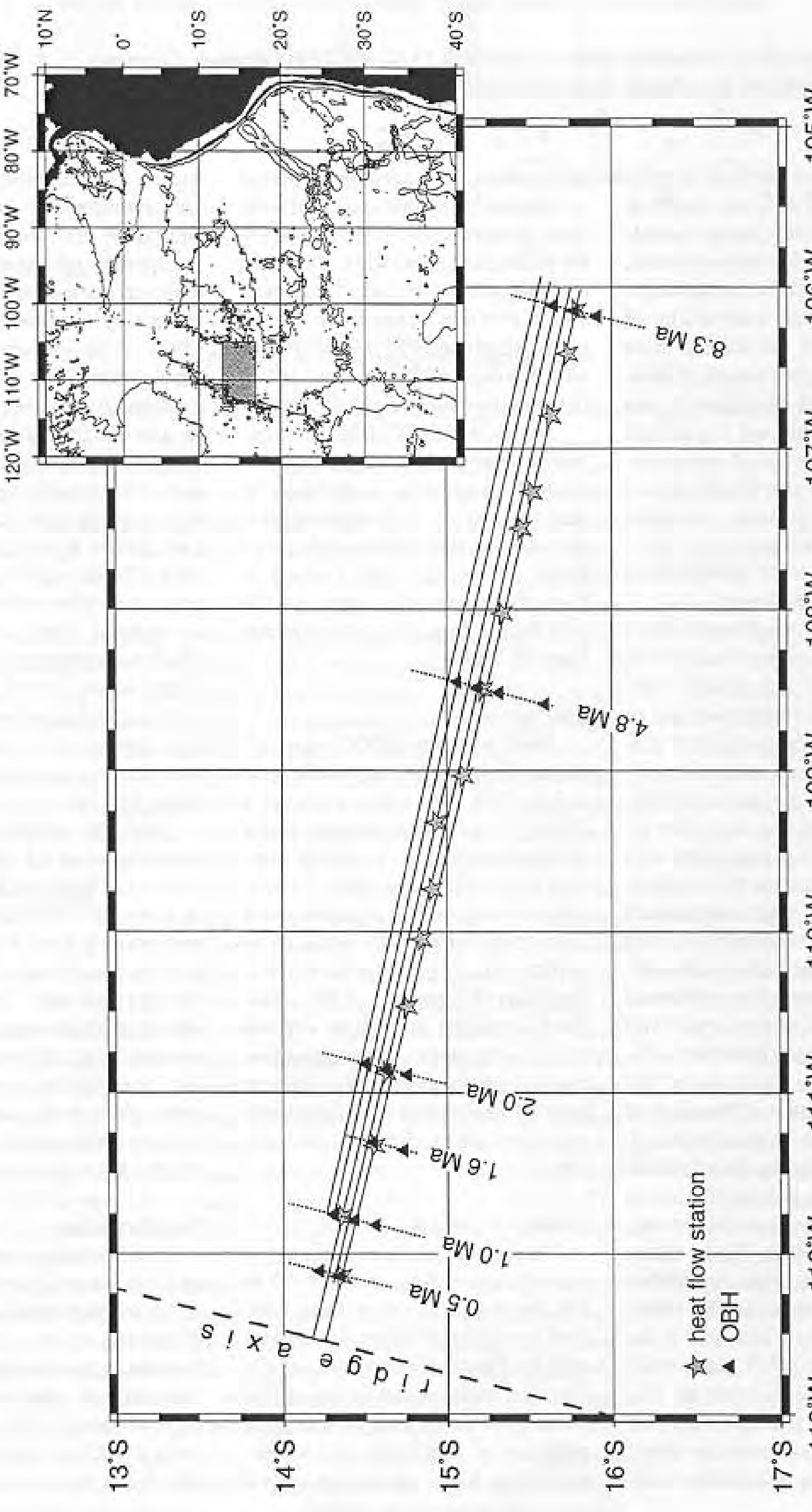

Figure 1. Location map showing the EXCO-study area, seismic tracks and heat flow stations. Seismic refraction lines are shown long with crustal ages.

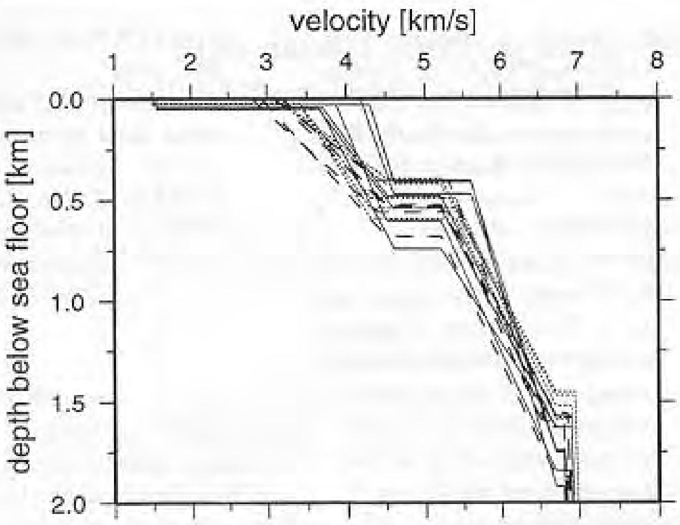

Figure 2: Compressional velocity-depth models derived from two-dimensional ray tracing modeling of 17 OBH positions on 0.5 to 8.3 Myr old seafloor.

flow with age as well as the known, highly variable local values, we attempted to measure heat flow at age intervals of roughly 0.5 Myr (45 km). These regional stations consisted of up to 9 local measurements on profiles parallel and perpendicular to the ridge crest with a spacing of 1000 m.

At the end of the survey 16 locations, comprising a total number of 86 penetrations, have been investigated. Fig. 3 has the heat flow values as a function of distance from the ridge axis. The heat flow values range from 60 to 470 mW/m^2 and show significant variations, both along and normal to the strike of ridge axis. In general, almost all values lie below the trend predicted by the plate cooling model, suggesting that heat is being removed by circulation fluids. However, even in the case of very high heat flux on 0.5 Myr old crust and a sediment thickness of less than 10-20 m no signs of advective fluid flow can be detected in the data. The scatter decreases for ages greater than 5 Ma and the observed heat flux approaches the trend of the plate cooling model at about 8.5 Ma (Kaul et al., 1996). This may suggest that hydrothermal fluid flow becomes restricted in this area. Particular interesting is that the sedimentary cover is still less thick than about 50 m, suggesting that sediment blanketing cannot be the sole factor governing the fluid flow into the hardrock subbottom.

Summary

At the "superfast" spreading East Pacific Rise south of the Garrett Fracture Zone, we studied age-dependent trends in the structure and properties of oceanic crust; this study was the first attempt in nearly two decades to use an integrated approach to study both variations in the heat transfer and upper crustal structure. The heat flow data suggest that a major amount of heat flux is removed by hydrothermal circulation. However, hydrothermal heat flux decreases for ages greater than 5 Ma and the observed flux approaches values predicted by the plate cooling model at about 8.5 Ma. The seismic velocity structure is inherently affected by hydrothermal circulation, in a way that hydrothermal precipitation of secondary minerals decreases porosity and increases velocities as the crust ages. We found a two-stage evolution: fast at young ages (? 0.5 Ma) and slowly thereafter.

Acknowledgements

We want to thank the captain and crew of the *R/V Sonne* (leg 105) for their excellent support during the survey. This project was founded by the German Ministery of Education, Science, Research and Technology.

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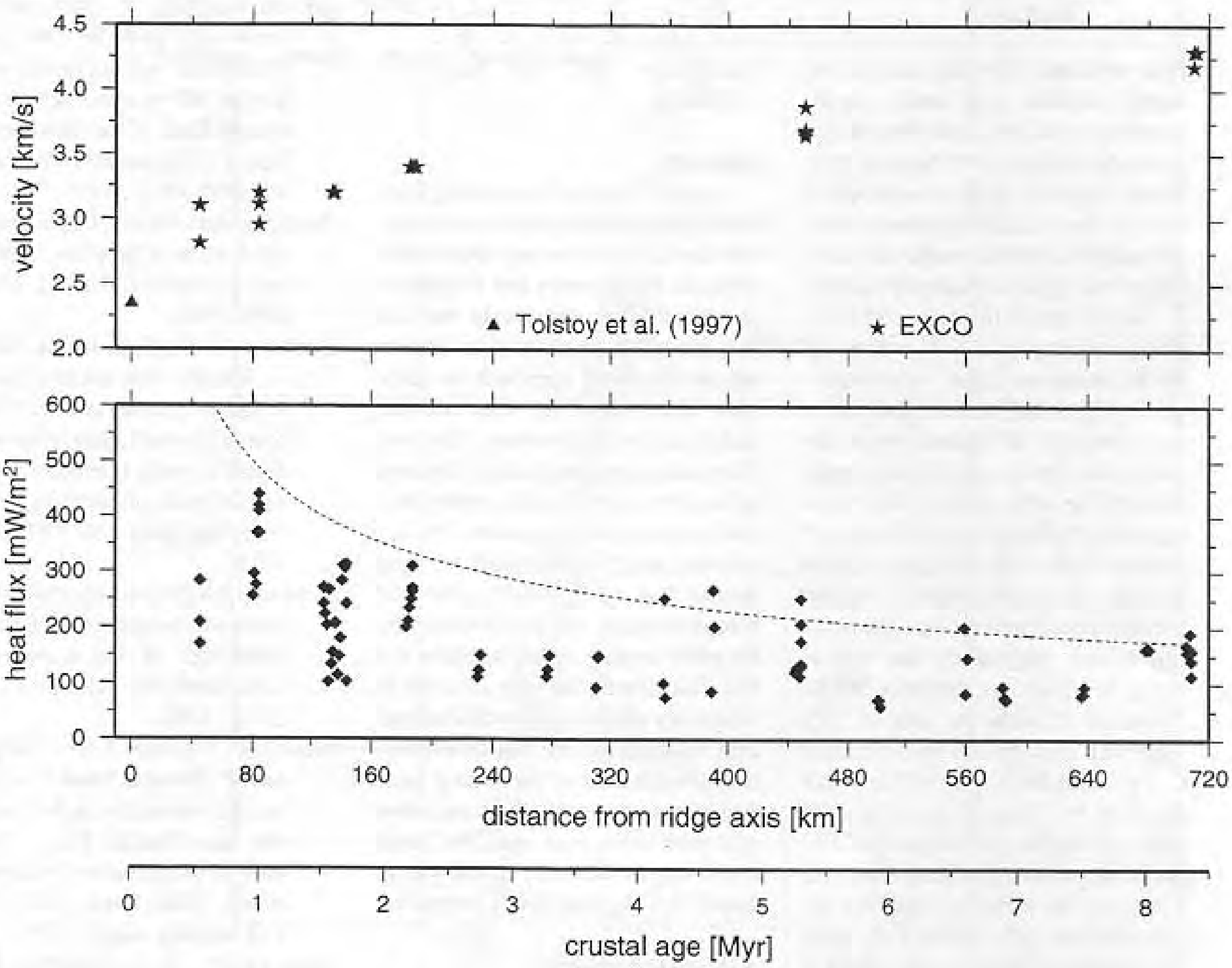

Figure 3: Upper crustal seismic velocities (top) and heat flow data (bottom) versus age. The broken line is a plate cooling model.

High-density sampling of the Kolbeinsey Ridge: Details of the magmatic chemistry of a slow-spreading axis

C. W. Devey[1], M. Wieneke[1,2] and K. M. Haase[3]

[1]Geologisch-Paläontologisches Institut, Universität Kiel, Olshausenstr. 40, D-24118 Kiel, Germany
[2]Graduiertenkolleg "Dynamik globaler Kreisläufe", Geb. 12, Wischhofstr. 1-3, D-24148 Kiel, Germany
[3]Lamont-Doherty Earth Observatory, Columbia University, Palisades, New York 10964, USA

Introduction

The Kolbeinsey Ridge is the world's shallowest ridge segment, lying directly north of Iceland (Fig. 1). It is bounded to the south by the Tjörnes Fracture Zone and to the north by the Jan Mayen Fracture Zone. The Kolbeinsey Ridge can be divided into three segments, the South, Middle and North Kolbeinsey Ridge respectively (hereafter SKR, MKR and NKR) separated by non-transform overlappers. Work on the tectonic evolution of the Kolbeinsey Ridge (Appelgate, 1997) suggests that the SKR rift tip is propagating northward The NKR corresponds to the region of the axis which crosses the Eggvin Bank. Magnetic studies (Vogt et al., 1980) have shown a half-spreading rate of 1 cm/yr for the Kolbeinsey Ridge near Iceland. Although the SKR is a slow-spreading axis it shows no axial summit graben, in marked contrast to the MKR and NKR (Schilling et al., 1983). This probably reflects a northwards decrease in the magma supply per unit length to the ridge. Previous geochemical work based on relatively low-resolution sampling of the ridge has shown that it is characterized by high degrees of melting (Klein and Langmuir (1987), based on samples analysed by Schilling et al. (1983)), presumably due to the presence of a thermal anomaly beneath Iceland, but that no material contribution from an enriched Iceland plume is visible in the composition of the Kolbeinsey lavas (Mertz et al., 1991). These conclusions were based mainly on samples derived from the SKR, and data from the few samples available from further north (e.g. Schilling et al., 1983; Mertz et al.,

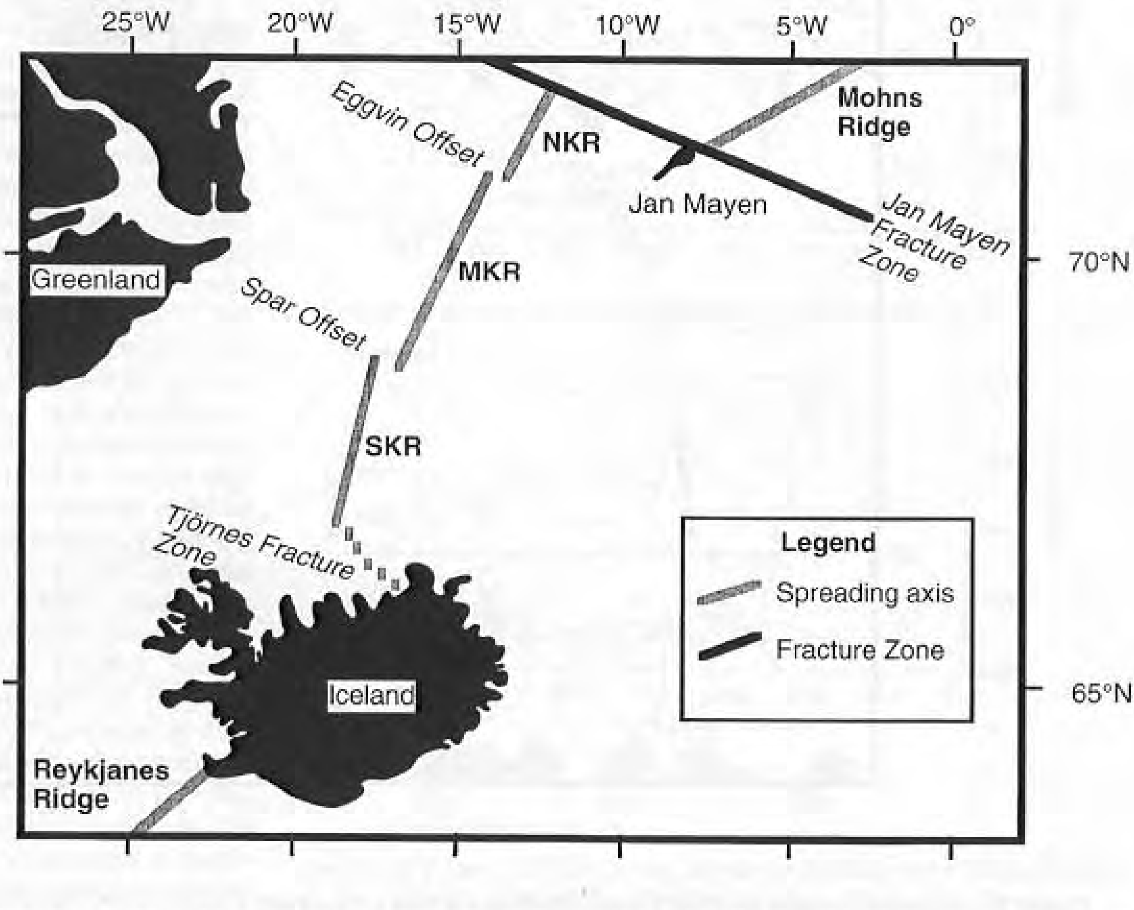

Figure 1: The location of the Kolbeinsey Ridge north of Iceland. "SKR", "MKR" and "NKR" refer to the Southern, Middle and Northern Kolbeinsey Ridge respectively.

International Ridge-Crest Research: **4D Architecture**: Devey et al. continued...

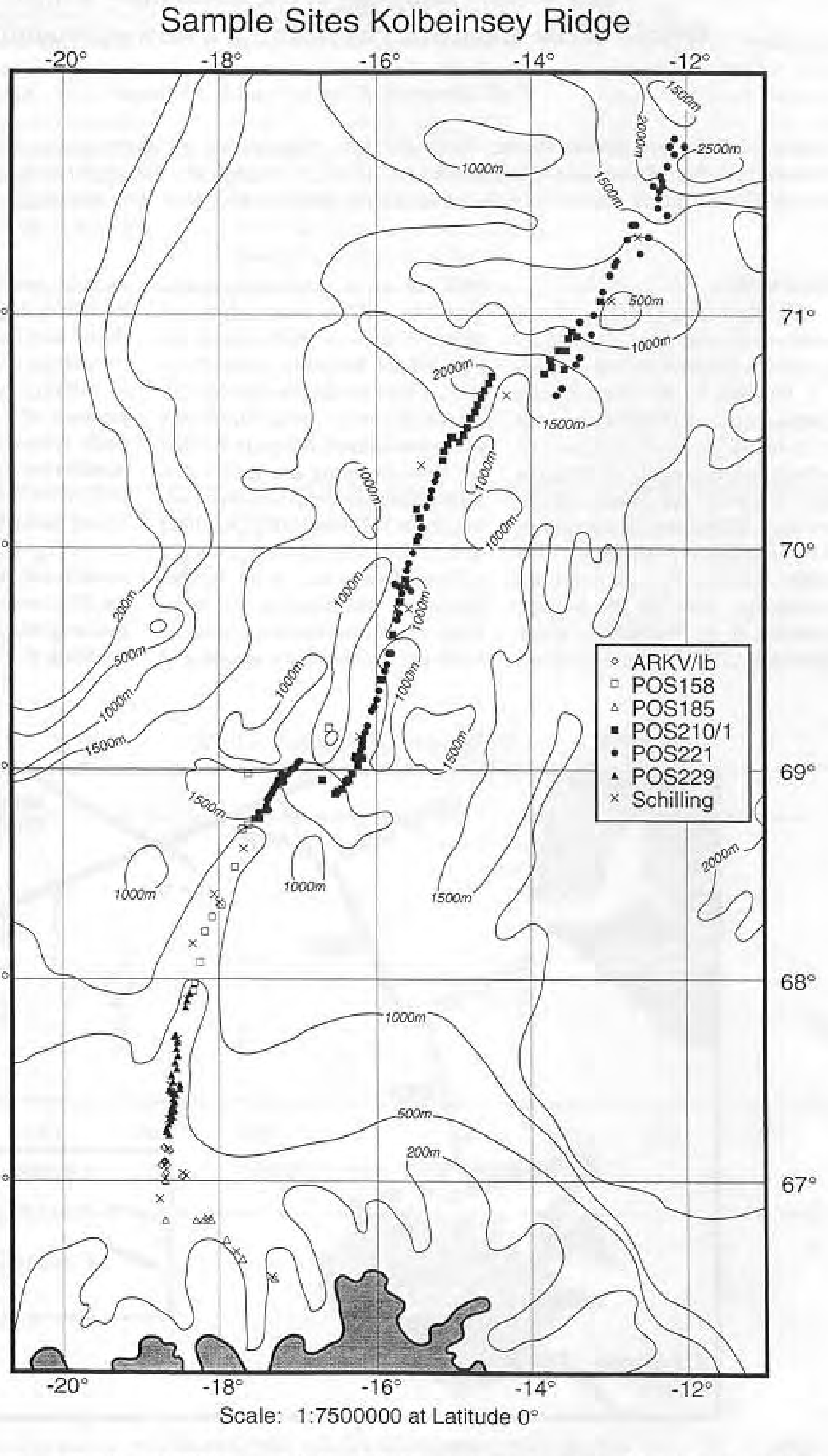

Figure 2: Location of samples from the Kolbeinsey Ridge. Filled symbols mark samples from the cruises discussed in this article. The map was made using the PanMap software from the Alfred-Wegner-Institut, Bremerhaven, bathymetric contours are merely indicative.

1991) have suggested that major geochemical changes occur across the segment boundaries. In the period 1995-1997 we undertook three cruises with the German *R/V Poseidon* in order to investigate (1) which mantle sources influence the region, (2) how closely the boundaries between the magma sources are correlated with ridge offsets, (3) how the melting and shallow fractionation processes change along the neovolcanic zone, and (4) the relative (and possibly exact) timing of eruption events along the axis. The approach adopted during these cruises was to try and sample the entire axis at a spacing of 1-2 nautical miles and hence achieve a sufficiently dense sample coverage that details of magmatic system processes could be discerned. Details of the cruises and of the research vessel *Poseidon*, together with cruise reports and station/sample lists can be found on the German De-Ridge Homepage at http://www.gpi.uni-kiel.de/~cwd/DeRidge/deridge.html.

Sampling

The stations from which magmatic samples were successfully recovered are shown in Fig. 2. Between 68°20'N and 71°N sampling was guided by side-scan images and interpretations kindly provided by Bruce Appelgate (SOEST, Hawaii). Using this information it was relatively easy to sample the active volcanic zone, and we estimate that most of our samples are younger than about 10 ka. As noted previously by Schilling et al. (1983) it is relatively difficult to recover magmatic samples from outside the neovolcanic zone at high northern latitudes because of the recent high sedimentation rates associated with glaciations (up to 60 cm/ka according to Lackschewitz et al., 1994). Our attempts to sample off-axis features yielded mainly dropstones and sediment. North and south of the region covered by side-scan, the ridge axis was located using magnetic data (Srivastra et al., 1988; Appelgate, unpub.). Guided by this information, we managed to sample almost the whole ridge axis at the required sample density. Only the region between 68°40'N and 67°55'N has a lower sampling density due to the repeated presence of sea-ice which prevented sampling during our cruises.

Results and Discussion

Samples recovered consisted of both pillows and sheet-flow fragments, mostly with well-developed glass rims. Samples from the shallower regions of the SKR and the whole of the NKR are characterized by well-developed vesicularity.

All glass samples (so far 131 in total) recovered from the MKR have been analysed by microprobe for major elements, a subset by ICP-MS for trace elements (M.W., K.M.H., C.W.D. and Solveigh Laß, unpub. results). Most samples from the NKR (41 samples) and SKR (46 samples) have also been analysed, although the most southerly samples from cruise POS229 (June 1997) are still being prepared. Selected geochemical results are shown in Fig. 3. There are clear geochemical differences between each of the spreading segments, the NKR shows relatively low and variable MgO and high and variable K_2O/TiO_2, the MKR is relatively homogeneous with some "fliers" (at the segment centre for MgO, towards the segment ends for K_2O/TiO_2), whilst the SKR is also relatively homogeneous but clearly distinguishable from

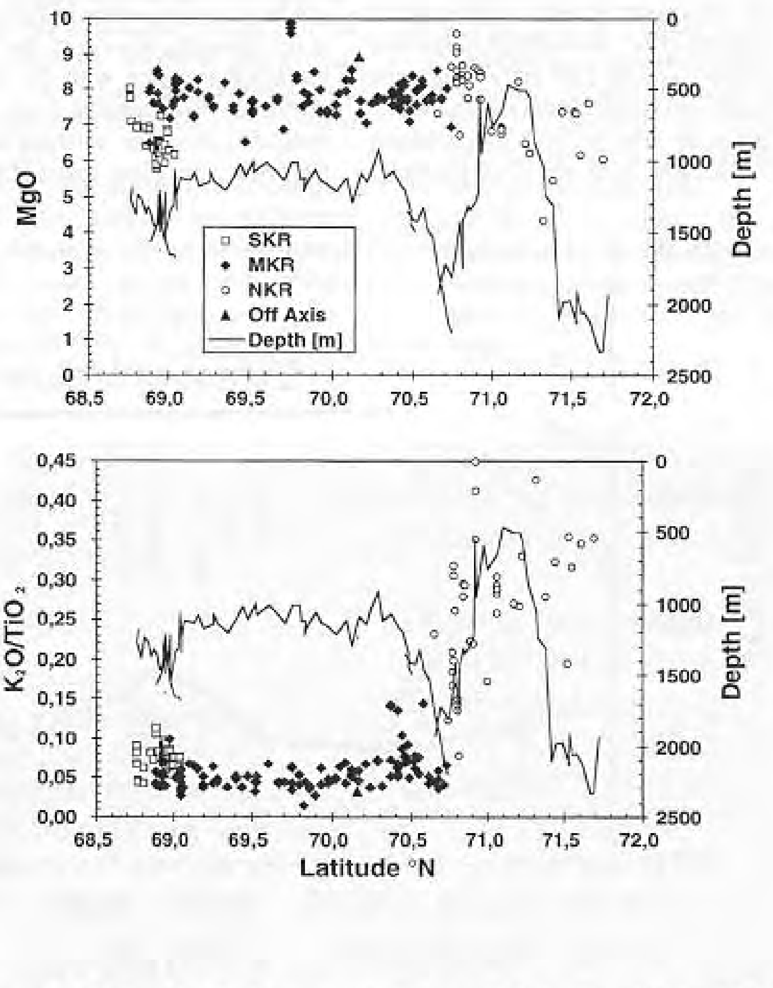

Figure 3: MgO and K_2O/TiO_2 versus latitude on the Kolbeinsey Ridge. All data come from microprobe analyses of glass. See text for discussion.

International Ridge-Crest Research: **4D Architecture:** Devey et al. continued...

the MKR. This observation implies that each segment is fed by a different mantle source and that there is no simple central magma supply system for each segment.

The progressive decrease of MgO northwards on the NKR probably reflects the influence of the cold lithosphere to the north of the Jan Mayen Fracture Zone, a right-lateral transform with 220 km offset (implying a crustal age difference of about 20 Ma at 1 cm/yr half-spreading rate). The homogeneous MgO on the MKR (with the exception of one high-MgO dredge at the segment center) implies a relatively well-homogenized magmatic system on this part of the ridge, a feature which is also reflected in constant values of Fe_8 and Na_8 (indicators for the depth and degree of melting, repectively, Klein and Langmuir, 1987). The small overlapping offsets at either end of the MKR do not appear to have a pronounced thermal effect on the MKR magmatic system, and no "M" or "W" patterns in the along-axis geochemical variations, as seen on both the southern MAR and EPR for example (e.g. Batiza and Niu, 1992; Niu and Batiza, 1994), are visible on the MKR. At present, insufficient analyses are available along the whole of the SKR to be able to look for similar variations with latitude there, although a trend of decreasing MgO towards the rift tip is evident on Fig. 3. Similar MgO decreases have been found at other propagating rift tips (e.g. on the Galapagos Rise, Sinton et al., 1983). The stronger fractionation of magmas in the propagating SKR tip probably reflects a combination of relatively low magma supply and high cooling rates.

The trace element data on the samples (not shown) confirm the major element observations and imply that the chemical differences between the segments reflect differences in source composition and not merely differences in such factors as degree or depth of melting. Thus, for example, large portions of the MKR appear to lie on mixing lines with the NKR, the MKR samples with the lowest content of NKR material come, paradoxically, from the northern end of the MKR, very close to the NKR. In the region of the SKR/MKR overlapper (the "Spar Offset", previously referred to as the "Spar Fracture Zone") two samples from the MKR ridge tip clearly are derived from the SKR source, showing that although this ridge offset marks, as a first approximation, the boundary between two different mantle domains, material exchange across this boundary does occur. Detailed work on one axial ridge volcano on the MKR (Laß, 1997, Fig. 4) shows that a similar relationship between morphology and geochemistry exists at a smaller scale within the SKR. The volcano is clearly distinguished geochemically from the neighboring parts of the ridge but yielded one sample, at 68.954°N, which resembles the lavas from the ridge adjacent to the north.

Isotopic work on the samples is in progress, initial results (K.M.H. and M.W., unpub. data) confirm the picture produced by the major and trace elements, and emphasize the enriched nature of the NKR source. Whether this source is related to that of Jan Mayen, which lies some 200 km to the east, will only be discernable when

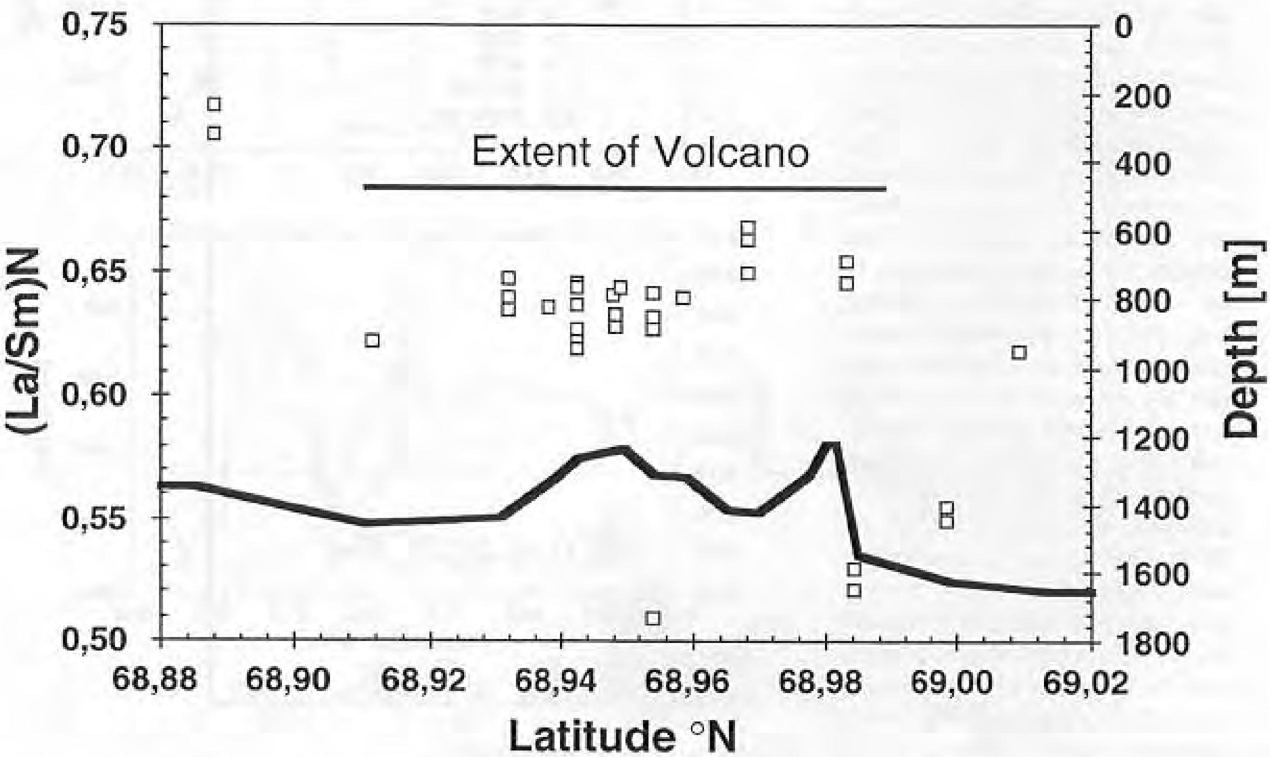

Figure 4: (La/Sm)N (chondrite normalised) versus latitude along a transect across a ridge-axis volcano on the SKR. The thick line shows the smoothed axial topography, the thinner line brackets the topographic limits of the volcano (after Laß, 1997).

Sr, Nd and Pb isotope analyses are available. U-series isotopes studies are also planned on suitable samples to investigate melting and the timing of eruption processes.

The intense sampling of the Kolbeinsey Ridge reported here has already exposed many facets of the detailed magmatic geochemistry of this axis and our data give a robust picture of the small scale regional compositional variations. Much work still remains to be done on the samples so far collected, but we hope that, when completed, this data set will provide a reference to which ridges in other regions of the world can be compared.

Acknowledgements

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Verena Tunnicliffe
Department of Biology,
University of Victoria,
P.O. Box 3020,
Victoria, BC V8W 3N5,
CANADA
Tel: +1 250 721 7135
Fax: +1 250 721 7120
Email: tunnshaw@uvvm.uvic.ca

International Ridge-Crest Research: **4D Architecture**

The FOUNDATION HOTLINE Cruise: past and recent ridge-hotspot interaction zones in the South Pacific

Márcia Maia[1], Roger Hékinian[2], Dietrich Ackermand[3], Ali Dehghani[4], Pascal Gente[1], David Naar[5], John O'Connor[6], Karine Perrot[1], Jason Phipps Morgan[7], Guillaume Ramillien[8], Sidonie Revillon[9], Ali Sabetian[4], David Sandwell[7], and Peter Stoffers[3]

[1]UMR 6538 CNRS Domaines Océaniques, Université de Bretagne Occidentale, 6, Av. Le Gorgeu, 29287 Brest Cedex, France
[2]IFREMER, BP 70, 29 280 Plouzané, France
[3]Geologisch-Paläontologisches Institut, Universität Kiel, Olshausenstrasse 40, 24 118, Kiel, Germany
[4]Institut für Geophysik, Universität Hamburg, Bundestrasse 55, 20146, Hamburg, Germany
[5]Marine Sciences Department, University of South Florida, 140 7th Ave. South, St. Petersburg, FL, 33701-5016, USA
[6]GEOMAR, Kiel, Germany
[7]SCRIPPS Institution of Oceanography, Institute of Geophysics and Planetary Physics, La Jolla, CA, 92093-0225, USA
[8]GRGS-CNES, 18 Av. Edouard Belin, 31055 Toulouse, France
[9]UPR 4661 CNRS Géosciences Rennes, Université de Rennes 1, Campus de Beaulieu, 35042 Rennes Cedex, France

The *NO L'Atalante* cruise "Foundation Hotline" (January-February 1997) was the second part of the French-German program to study the Foundation Seamounts in the South Pacific. This chain, 1800 km long, lies roughly between 32°S/130°W and 38°S/111°W, near the Pacific-Antarctic Ridge axis (see Fig. 1). The program started in 1995 with a German cruise on board *R/V Sonne*, conducted by the GPI, Kiel University, with the main objectives being to sample and to survey bathymetrically the volcanoes of the chain. Until this cruise, the chain, discovered by satellite altimetry (Mammerickx, 1992) had remained unexplored. Among the results of this cruise, one of the most important is the characterization of the chain as a result of the activity of a new hot spot, named the Foundation hot spot (Devey et al., 1997). The geochemical signature is close to a HIMU type (Hémond and Devey, 1996) and a chronological progression exists, with seamounts becoming progressively older with increasing distance from the supposed location of the Foundation hot spot (O'Connor et al., 1996). A second important result is the characterization of a ridge-hot spot interaction zone near the PAR axis (Devey et al., 1997). In this zone, the morphology of the edifices changes, with the formation of elongated ridges (Binard and Maia, 1995), and the geochemical signature shows a trend of mixing between the hot spot and the ridge (Hemond and Devey, 1996; Devey et al., 1997). Effective Elastic Thickness changes along the chain, becoming smaller near the ridge axis, showing that the hot spot and the ridge became progressively closer (Maia et al., 1996). The geo-dynamical setting where the Foundation seamounts were formed is complex. Near the western part of the chain, between longitudes 134°W and 130°W, a large area is affected by volcanism, away from the trend of the hot spot. A fossil axis, possibly related to a paleo-microplate, was identified by Mammerickx (1992) and the chemical composition of a

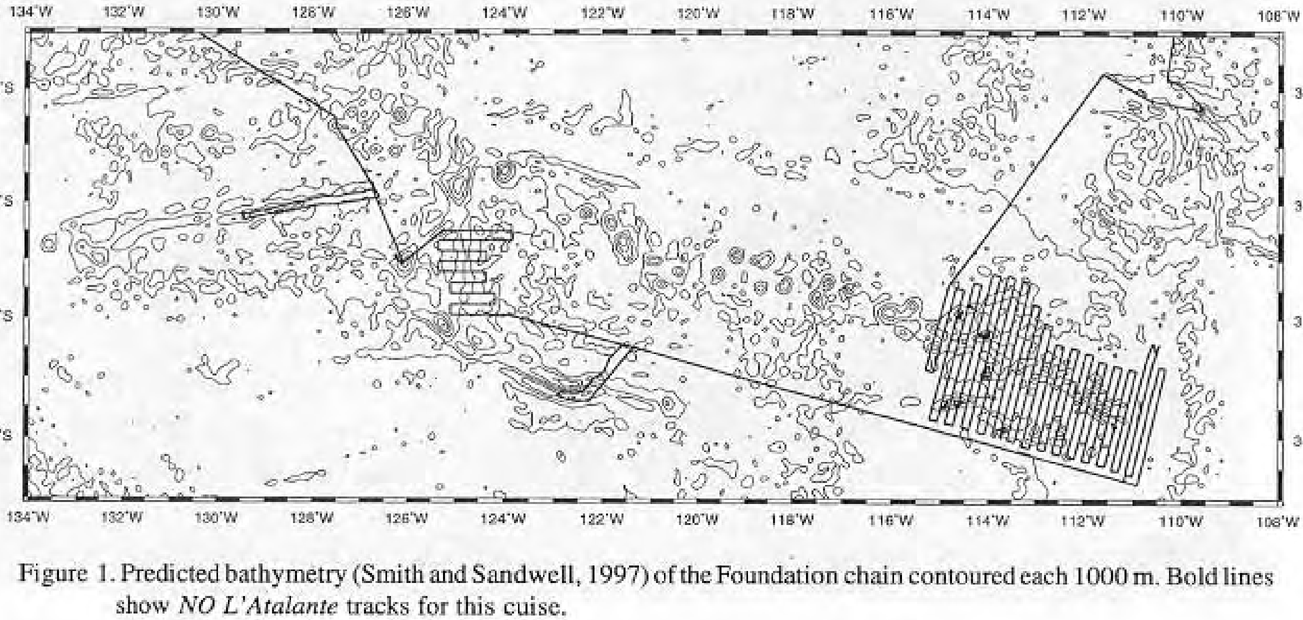

Figure 1. Predicted bathymetry (Smith and Sandwell, 1997) of the Foundation chain contoured each 1000 m. Bold lines show *NO L'Atalante* tracks for this cuise.

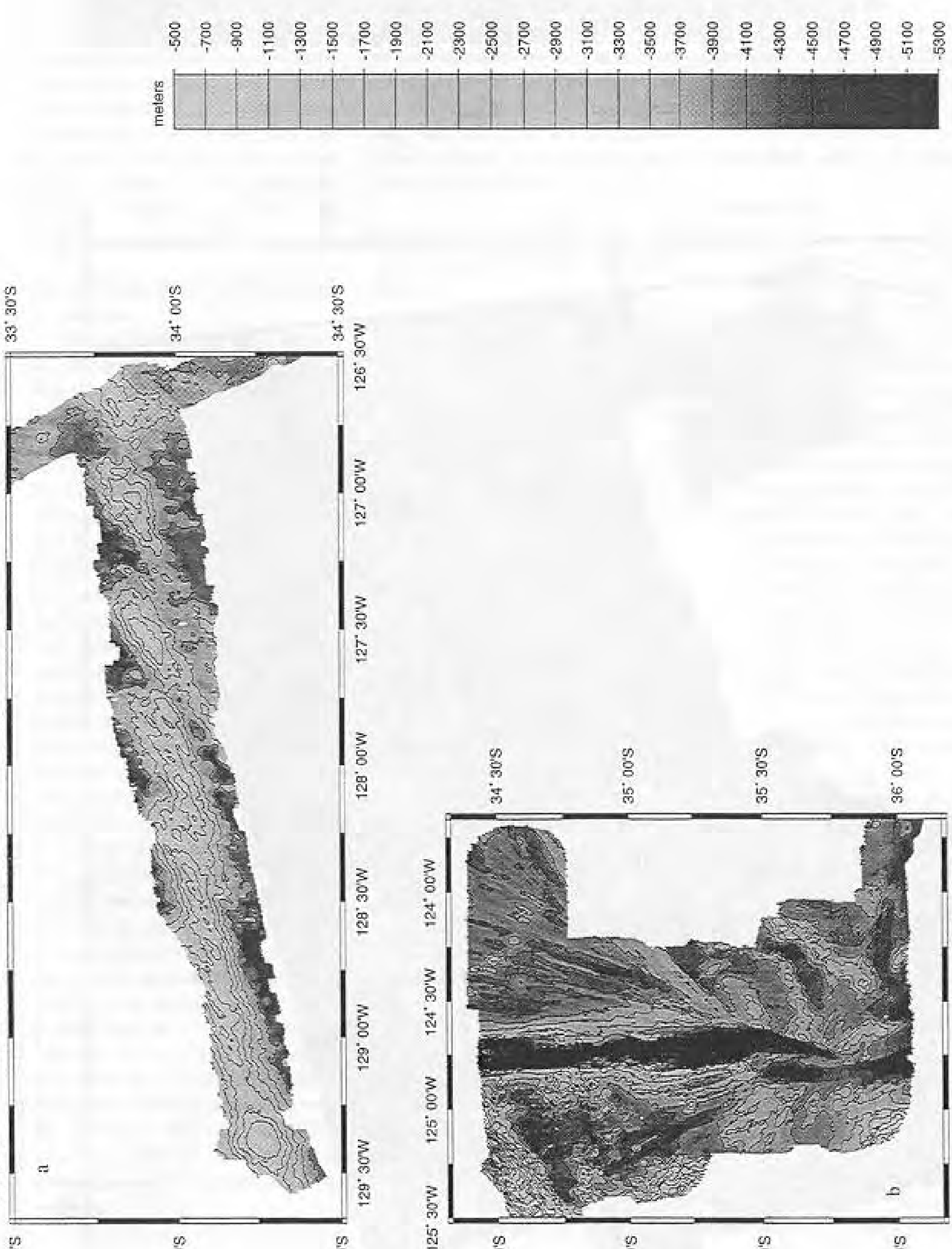

Figure 2. Multibeam bathymetry of (a) the Del Cano ridge, with a contour interval of 500 m and (b) the propagator with a contour interval of 200 m.

International Ridge-Crest Research: **4D Architecture**: Maia et al. continued...

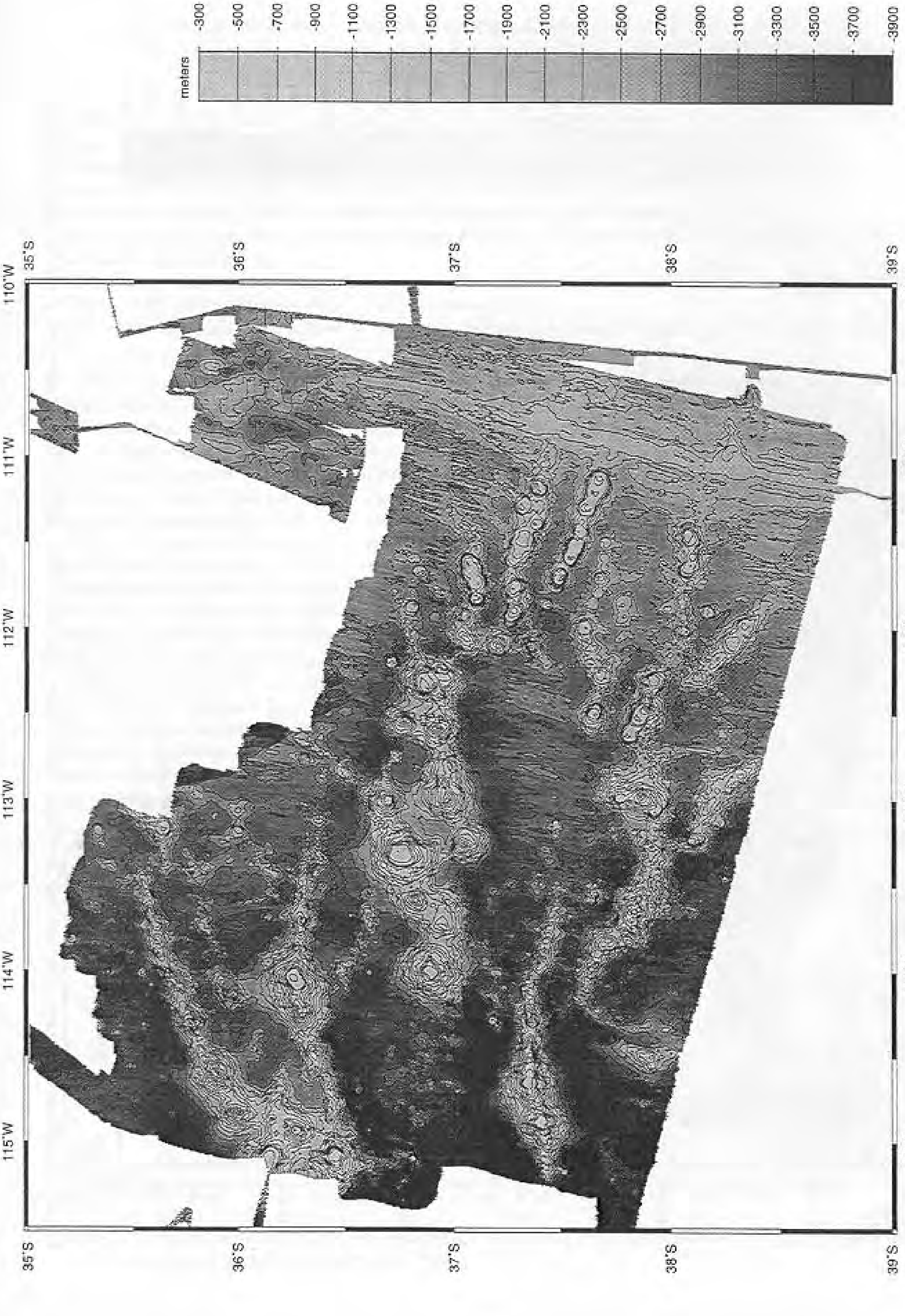

Figure 3. Multibeam bathymetry of the interaction zone. Contour interval is 200 m.

dredged seamount (Hémond and Devey, 1996; Devey et al., 1997) suggests that another ridge-hot spot interaction zone may have existed in the past.

The main scientific objectives of the *NO L'Atalante* cruise were the geophysical investigation of the PAR-hot spot interaction zone and of some particular features of the western part of the Foundation chain, including the paleo-axis. Rock sampling was planned in order to complete the coverage obtained during the 1995 *R/V Sonne* cruise, especially in the western part of the chain.

The Del Cano Ridge and the Fossil Propagator

The Del Cano ridge (Fig. 2a) is a singular feature. It is roughly parallel to the direction of the neighboring Resolution, Mocha and Agassiz fracture zones and was interpreted as being a fracture zone itself by Mammerickx (1992). However, Tebbens and Cande (1997) in a recent kinematic study of the South Pacific explained the feature as a seamount chain. Our survey covered the eastern part of the Del Cano ridge, and revealed a morphology significantly different from that of a fracture zone. The ridge is formed by a series of *en echelon* ridges, roughly 50 km long, borded by basins, with a N50-N60 orientation. A single well-individualized volcano was observed west of the survey area. This edifice is slightly elongated following the same direction of the *en echelon* ridges. These data suggest a senestral shearing along the Del Cano ridge. A short bottom video camera profile and a single successful dredge indicate that the feature is old. It is possible that the Del Cano ridge is formed by old crust strongly tectonized by a left-side shearing. Elongated volcanoes, located between the Del Cano ridge and the fossil axis, were sampled in order to date and to determine their chemical composition.

The paleo-axis was found to be a fossil propagator (Fig. 2b), with a north-south direction of propagation, probably active between 25 and 20 m.y.. The propagation history is complex, and two successive propagation events are already identified. At the tip of the propagator, depths reach 5200 m and the average along-axis depth is 4700 m. Paleo-axis relief is strongly asymetric, with the steeper scarps located generally on the west flank. On the east flank, off-axis relief appears clearly as a series of fan-organized abyssal hills. On the west flank, volcanism masks the abyssal relief, except for the southern part, near the tip of the propagator, where abyssal relief appears as a series of curved hills.

Ridge-hot spot interaction zone and the axis of the Pacific-Antarctic ridge

Structures of the interaction zone look very complex, as shown in Fig. 3. Volcanism is scattered over a wide area, along a 200 km large band. This band is considerably larger than the Foundation chain itself and elongated ridges are located both south and north of the alignement. Those ridges display variable directions. Along the prolongation of the Foundation chain, oriented N110, the ridges form 100 km long features, with well formed volcanic edifices rising up to 500 m below sea level. Three of the ridges show N70/N80 directions. Near the PAR axis, the ridges become smaller and display a smoother topography, formed by a series of calderas, without the huge volcanic edifices of the former features. The direction also changes to N110 and they intersect the axis roughly perpendicularly. Two of the ridges are located in the prolongation of the Foundation chain and a third one further south. Bottom video camera showed inactive hydrothermal vents near the edge of one caldera in the central ridge. Features located north and south of the Foundation alignement do not display the same directions. South, the directions are generally parallel to the alignement, with ridges forming a fan. North, the ridges strike N60, between the chain and the southern boundary of the Juan Fernandez microplate.

The Pacific-Antarctic ridge axis at the intersection zone has a smooth morphology and is shallower than the neighboring segments. The edges of this segment are, to the north, an OSC and to the south, the "V" of a southwards propagator. The eastern flank of the ridge does not show any trace of intraplate volcanism and the abyssal hills are well developed.

Acknowledgements

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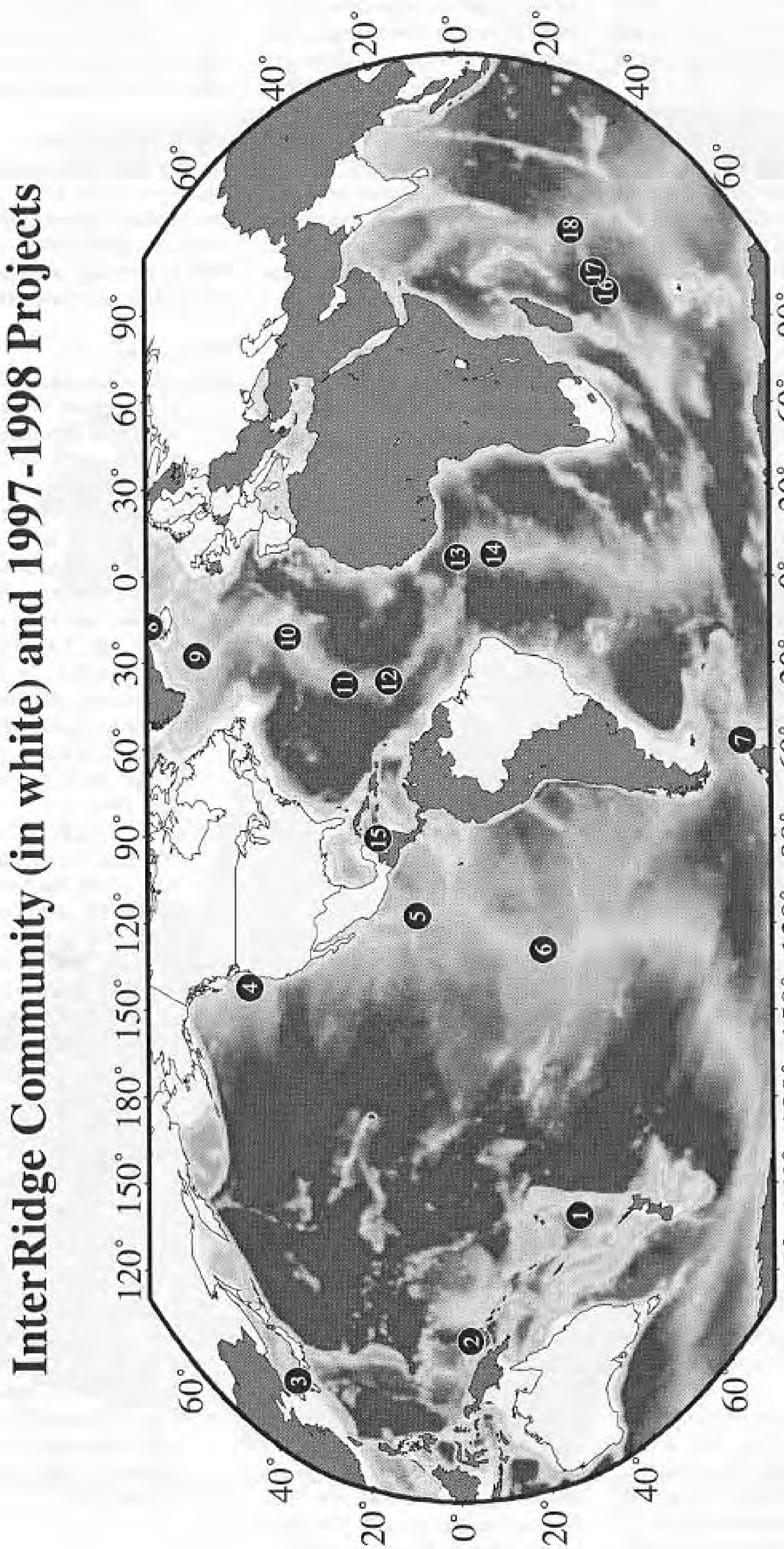
World Ridge Cruise Map



World Ridge Cruise Schedule 1997-1998*

Map No.	Country	PI	Institution	Name/Location	Research Objectives	Ship	Dates
2	Australia/ Canada	Binns/Davis/ Scott	CSIRO Australia/ Geol. Survey Can./ Univ. of Toronto	PACMANUS IV: Eastern Manus Basin, Bismark Sea, Papua New Guinea	Core drilling to 100m at PACMANUS hydrothermal field with PROD seafloor drill	Franklin	Oct/Nov '97
4	Canada/ USA	Tunnicliffe	U. Victoria/GSC/ NOAA/ Penn State Univ.	Juan de Fuca Ridge, Axial Seamount ASHES Vent Field	Biological and geological aspects of ASHES Vent Field	J. P. Tully/ ROPOS II	Jun/Jul '97
17	France	Mével	Univ. Paris 6	EDUL: Southwest Indian Ridge	Dredge & rock core sampling to look at regional and segment scale variations	Marion Dusfrene	Aug '97
16	France/ Japan	Mével/Tamaki	Univ. Paris 6/ U. Tokyo - ORI	FUJI: Southwest Indian Ridge	TOBI survey and OBS deployment on SWIR, E and W of Melviille Fracture Zone	Marion Dusfrene	Oct '97
10	France	Fouquet	IFREMER	FLORES: Azores, Mid-Atlantic Ridge		Atalante/ Nautile	Jun/Jul '97
10	France	Desbruyères/ Alayse	IFREMER	MARVEL: Azores Sea, Mid-Atlantic Ridge	study of deep-sea hydrothermal vent communities, influence of depth, chemical, physical and biological factors	Atalante /Nautile	Jun/Jul '97
13	France	Hékinian/ Juteau	IFREMER/Univ. Bretagne Occidentale	Saint Paul Transform (Equatorial Atlantic)	magmatic and tectonic processes	Nadir/ Nautile	Dec '97
15	France	Mercier de l'Epinay	CNRS - Geosciences Azur	Caynaute: Cayman Trough in the northern Caribbean	Geological dives to explore the Cayman Trough	Nadir/ Nautile	Jan '98
10	France	Cannat/ Rommevaux	Univ. Paris 6	Sudaçores - MAR: 34° - 38°N south of the Azores platform, the axis and extending off-axis up to 10-13 myrs.	examine influence of the Azores hot spot on the MAR with multibeam bathymetry, reflectivity, gravimetry, magnetism and single channel seismics survey, and dredges	Atalante /Nautile	May/Jun '98
10	France	Goslin	Univ. Bretagne Occidentale	TRIATNORD - MAR north of the Azores		Atalante /Nautile	Jun/Jul '98
10	France/ Portugal	Desbruyères/	IFREMER	PICO (Picking Instruments and Cleaning Operation) on the Azores Triple Junction Area (Menez Gwen, Lucky Strike, Famous and Rainbow)	recover instruments and study temporal evolution. Biological sampling from the main populations to study the reproduction and population dynamics.	Nadir/ Nautile Archipelago	Jul '98
10	Germany	Devey	Geolog. Inst./ Univ. of Kiel	Azoren: Azores Platform, Eurasia/ Africa Plate Boundary	examine hot-spot origin of the Azores Platform, look at magma generation	Poseidon	Aug 97
8	Germany	Stoffers	Univ. of Kiel	Kolbeinsey Ridge	submersible dives with water and rock sampling	Poseidon/ JAGO	Jul 97
7	Germany	Suess	GEOMAR Kiel	Bransfield Strait, Antarctica		Polarstern	Nov/Jan '98

*Archives of the 'World Ridge Cruise Schedule' as published in *InterRidge News* from 1992 onwards are accessible on the World Wide Web via the InterRidge Home Page (http://www.lgs.jussieu.fr/~intridge).

World Ridge Cruise Schedule 1997-1998, continued...

Map No.	Country	PI	Institution	Name/Location	Research Objectives	Ship	Dates
14	Germany	Stoffers/Devey	Univ. Kiel	"Ascension", region between Ascension Island and MAR	Investigate ridge/hotspot interaction near Ascension, detailed sampling of MAR and hotspot seamounts	Meteor	Mar/Apr '98
18	India	Mukhopadhyay	National Institute of Oceanography/ U. Hawaii	Central Indian Ridge, south of 10°S	Mapping of regional tectonic fabric, effectss of fracture zone on crustal generation, seamount formation and evolution.	Sagar Kanya	Jul/Aug 97
18	India	Mukhopadhyay	National Institute of Oceanography/ U. Hawaii	Central Indian Ridge, south of 10°S	Mapping of regional tectonic fabric, effectss of fracture zone on crustal generation, seamount formation and evolution.	Sagar Kanya	Aug/Sep '98
1	Japan	Matsumoto/ Kobayashi/ Yamazaki/ Delteil/Ruellan	JAMSTEC/Univ. Nice, France	Lau Basin/Havre Trough, Southwest Pacific	swath bathymetry, seismic reflection profiling, gravirty and magnetic measurements, OBS	Yokosuka/ Shinkai 6500	Jan-Feb '97
6	Japan	Urabe/Fujioka	JAMSTEC	MODE '97: Southern EPR 13°-19°S 2 Legs	15 dives each leg	Yokosuka/ Shinkai 6500	Jul/Aug '97 Aug/Sep '97
12	Japan		JAMSTEC/WHOI	MODE '98: MAR 15°20'N, Cape Verde Fracture Zone		Yokosuka/ Shinkai 6500	Jun/Jul 98
12	Japan		JAMSTEC	MODE '98: MAR 14°45'N	explore methane rich hydrothermal sites	Yokosuka/ Shinkai 6500	Jul/Aug 98
18	Japan		JAMSTEC	MODE '98: Indian Ocean R-R-R triple junction		Yokosuka/ Shinkai 6500	Sep/Oct 98
6	Japan	Urabe	JAMSTEC	EPR 18°S		Atlantis/ Alvin	Sep. '98
17	Japan		JAMSTEC/WHOI	MODE '98: SWIR, Atlantis II fracture Zone		Yokosuka/ Shinkai 6500	Oct/Nov '98
3	Korea	Han	Korea Ocean Resh. & Dev. Inst.	MECBES: East Sea, 35°-37°10'N and 129.5°-132°E 35°-37°10'N and 129.5°-132°E	Basin structure and past changes in the East Sea. SeaBeam 2000, mag., grav., multi-channel seismics, sed. sampling	Onnuri	Mar/Apr '97
3	Korea		Korea Institute of Geology, Mining and Minerals	Study on data acquisition techniques East Sea	Development of 3-D seismic survey techniques, multi-channel seismics	Tamhae II	May '97 (30 days)

World Ridge Cruise Schedule 1997-1998, continued...

3	Korea		Korea Institute of Geology, Mining and Minerals	Geological Mapping Project: East Sea	Geophysical study of the Korean continental margin; mult-beam bathy., grav., mag. and mult-channel seismics	Tamhae II	Jun/Jul '97 (60 days)
3	Korea		Korea Institute of Geology, Mining and Minerals	Korea Petroleum Development Company project	Petroleum exploration around the Korean continental margin: multi- channel seismics	Tamhae II	Aug/Sep '97 (60 days)
11	Russia	Batuev/ Cherkashev	Polar Mar. Geo.Exp. Sevmorgeologiya/ VNIIOkeangeol.	Logatchev - 13: Mid-Atlantic Ridge, 24°N- 26°N	Investigation of relic and active hydrothermal vents. Electric field profiling, CTD, dredging, coring, TV grab, submersible.	Prof. Logatchev	Apr/Jun '97
7	United Kingdom	Larter	BAS	JR18 SLICE-Sandwich Lithospheric and Crustal Exp.: South Sandwich arc and East Scotia Sea	Crustal structure and geodynamics of the South Sandwich Arc and back arc. Multi channel seismic reflection, wide angle OBS and land stations, geodetic mapping, sampling on land and at sea - dredge, coring	James Clark Ross	Jan/Mar '97
10	United Kingdom	German	SOC/BRIDGE	FLAME: Fluxes at AMAR Exp.: Rainbow, Lucky Strike, Famous, 36°-37°N, Mid-Atlantic Ridge	Study of hydrothermal discharge at 3 sites, physical oceanography, plume geochemistry, marine biology	Discovery/ BRIDGET	May/Jun '97
6	United Kingdom/ USA	Kent/Harding/ Orcutt/Sinha/ Singh/White	WHOI/ U. of Cambridge/ BIRPS	ARAD 3-D East Pacific Rise, 9°03'N	3-D seismic reflection imaging, 3-D wide angle/ocean bottom seismometer survey of the axial magma chamber(s) beneath OSC	Ewing	Sep/Oct '97
17	United Kingdom	Dick/Natland	U. of Wales, Cardiff	ODP leg 176 - Hole 735B at Atlantis II Fracture Zone	deepening on hole into more gabbros and hopefully ultramafics	Joides Resolution	Oct/Dec '97
17	United Kingdom	MacLeod/ Allerton/Dick/ Robinson	U. of Wales, Cardiff	SWIR, Hole 735B Atlantis II Fracture Zone, 32°40'S, 57°15'E	geology of lower crust using ROPOS with deep-towed magnetics, and rock drills	James Clark Ross	Mar/May '98
9	United Kingdom	Peirce/Searle/ Sinha	Durham Univ.	MAR: Reykjanes Ridge	seismic mapping of magma chamber	Discovery	Jul/Aug '98
4	USA	Webb	Scripps Inst. of Oceanography	DINS II: Escanaba Trough, Gorda Ridge, JdF-Middle Valley	Recovering OBS's deployed to observe seismicity associated w/ hydrothermal venting	Wecoma	Apr/May '97
12	USA	Collins	WHOI	MAR: MARK 15°20' N	on-bottom seismic refraction experiments (NOBEL)	Ewing	Jun/Jul '97
10	USA/UK	Fornari/ Sington/ Vrijenhoek	WHOI/BBC/ Rutgers	MAR - Lucky Strike		Atlantis/ Alvin	Jun/Jul '97
10-12	USA	Vrijenhoek/ Lutz	Rutgers	MAR: 15°-37°N	Biology of seven hydrothermal sites	Atlantis/ Alvin	Jul '97
4	USA	Chadwick/	OSU/ MBARI	JdF: south Cleft segment	install acoustic extensometer instruments/ DSL120 Survey	Atlantis/ Alvin	Aug/Sep '97

World Ridge Cruise Schedule 1997-1998, continued...

Map No.	Country	PI	Institution	Name/Location	Research Objectives	Ship	Dates
4	USA	Delaney/Fisher	U. Washington/ Penn. State Univ.	Juan de Fuca Ridge	biological studies	Atlantis/ Alvin/Jason	Sept. '97
4	USA	Becker/ Johnson/ Cowen/Lilley	U. Miami/ U. Washington/U. Hawaii	JdF: Endeavor Ridge and Middle Valley, 48° N, 128° W and Gorda Ridge	Long-term monitoring of temp. and pressure in hydrothermal system with CORKs; study temporal changes in young ocean crust; test bare rock heat flow instruments/ develop proxies of microbial activity in ocean crust	Atlantis/ Alvin	Sep/Oct '97
5	USA	Lutz	Rutgers Univ.	EPR, 9°50' N	Documenting temporal changes in biological community	Atlantis/ Alvin	Oct/Nov '97
5	USA	Childress/ Chave/Van Dover/Taylor/	UCSB/WHOI/U. Alaska	EPR, 9° and 13°N	biology	Atlantis/ Alvin	Nov/Dec '97
5	USA	Toomey/ Wilcock/ Detrick	U. Oregon/ U. Washington/ WHOI	EPR Undershoot, 9°-10°N	image lower crust/upper mantle structure along the EPR between 9°-10°N	Ewing	Nov/Dec '97
5	USA	Mullineaux/ Peterson/Fisher	WHOI/UNC/U. Penn. State	EPR, 9°50'N	recruitment of vent organisms	Atlantis/ Alvin	May '98
4	USA	Becker/Chave	U. Miami/WHOI	Juan de Fuca	test a low light CCD spectral imaging system for studing light at vents.	Atlantis/ Alvin	Jun/Jul '98
4	USA	Cowen	U. Hawaii	Juan de Fuca		Atlantis/ Alvin	Jul. '98
4	USA	Fisher	U. Penn. State	Juan de Fuca, 48°N; "Biological Observatory Program" #5, see Juniper et al, *IR News* 3(2)	study tubeworm growth and productivity, examine the roles of bacteria and tubeworms in the nutrition of other fauna.	Atlantis/ Alvin	Jul/Aug '98
6	USA	Lilley	U. Washington	EPR, 17°-20°S	collect water, sulfide and basalt samples as well as plume studies, biological sampling, rock coring and geological mapping.	Atlantis/ Alvin	Oct/Nov '98
5	USA	Manahan/Cary	USC/U. Delaware	EPR, 9-10°N	study larval dynamics in hydrothermal vent sites, specifically reproductive stategies, early larval growth dynamics, and dispersal mechanisms	Atlantis/ Alvin	Nov/Dec '98
6	USA	Sinton	U. Hawaii	EPR, near 17°26'S, 18°10'-18°20'S, and 18°37'S	conduct volcanological investigations of single eruptive sequences using deep towed 120 KHz surveys, ALVIN dives, rock dredging and wax coring.	Atlantis/ Alvin	Dec'98

If you have a ridge-related scheduled or proposed cruise that is not listed here, please inform the InterRidge Office at intridge@ext.jussieu.fr.

National News....

Brazil

Brazilian research in Marine Geology and Geophysics is mostly concentrated in the continental margins, where the 3 Brazilian oceanographic vessels are active. Research related to the Mid Ocean Ridge (MOR), is mainly restricted to international cooperation and Ph.D. thesis development with pre-existent data, or in cooperation with other countries.

The main program involving Mid Oceans Ridges that Brazil is involved with is the project entitled "The Magmatic and Tectonic Processes in the Saint Paul Transform (Equatorial Atlantic)". This is a French program under the coordination of Roger Hékinian (IFREMER) and Thierry Juteau (Université Bretagne Ocidental, UBO). The cruise with the *R/V Nadir* (Dec. 6-28, 1997) will include 18 dives (up to 4000 m) with the submersible Nautile. The Brazilian researcher Susanna Sichel (Dept. of Geology/LAGEMAR - Universidade Federal Fluminense UFF) will be part of the scientific team. The Brazilian participation is part of a 4 year (1997 - 2000) scientific cooperative program between Brazil and France, under the coordination of S. Sichel and T. Juteau.

In the South Atlantic, research involving the morphotectonic and gravimetric axial segmentation of the MOR between 6°23'S and 10°10'S is the subject of a Ph.D. thesis of Jorge Palma (Dept. Nacional de Produção Mineral and Lagemar/UFF), and will be completed in 1997 at the Institute Astronomic and Geophysics, Universidade of São Paulo/ Brazil. This research is based mainly on data from NGDC (USA) collected during the Oceanographic research program between Brazil and USA - Centratlan Project (1980/88) in the South Atlantic.

In the North Atlantic, research on the tectonics and volcanism at 45°N of the MOR, is the theme of a Ph.D. dissertation of Sidney Mello (Lagemar/UFF), in the University of Leeds, advised by Dr. Joe Cann and to be completed in 1998.

Crustal studies of the area around the northern tip of the Antarctic Peninsula using seismic, magnetic and gravimetric data have been carried out at the Lagemar/Uff, including the Bransfield Strait spreading center. Some of the results will be presented by Luiz Torres and Luiz Gamboa at the 5th International Congress of the Brazilian Geophysical Society (Sept., 97). As a part of Brazilian effort on the development of new studies related to the MOR, a Symposium on "Tectonic Evolution of the Atlantic Ocean Basin and the Mid-Atlantic Ridge", organized by J. Cann (University of Leeds) and S. Mello (Lagemar/UFF) will be held at the "5th International Congress of the Brazilian Geophysical Society", São Paulo, Brazil, (Oct., 1997). In addition, several short courses related to MOR active processes will take place at Lagemar/UFF, between 1997 and 2000, as part of the Scientific Cooperation Program between Brazil and France (CAPES/COFECUB). Scientists from UBO, France and Leeds, UK (J. Cann) (Leeds- UK) have been invited.

For more information contact:

Dr. Susanna Eleonora Sichel
Brazilian InterRidge Correspondent
(E-mail sichel@spacenet.com.br)

or

Jorge Palma
(E-mail jorge@iag.usp.br)

Both at:
Dept. de Geologia - Lagemar UFF
Av. Litorânea s/nº 4° andar
CEP: 24210-340 - Gragoatá Niterói RJ Brazil
Telephone and Fax +55 021 719 4241

National News

Canada: CanRidge

Canada will be upgrading to Associate Member status in InterRidge beginning in January 1998.

A New ROPOS

A new ROPOS remotely-operated vehicle (ROV) was constructed last March-June at the International Submarine Engineering in Port Coquitlam, British Columbia. Personnel from the Canadian Scientific Submersible Facility participated in the reconstruction effort. The new vehicle replaces the original ROPOS which was lost at sea during a violent storm in October 1996. Many technological improvements are incorporated into the new vehicle, including new vehicle and scientific telemetry systems. All are described in an upcoming issue of the Marine Technology Society Journal (October, 1997) where there will be a collection of articles on subsea scientific sampling systems. The new ROPOS performed its first scientific dives during the ROPAX'97 cruise to Axial Seamount (see below and www.ropos.com)

ROPAX'97

Chief Scientist - Verena Tunnicliffe (University of Victoria)

This combined scientific and engineering cruise was jointly sponsored by NSERC Canada, NOAA/PMEL, the NOAA West Coast National Underwater Research Center, the Geological Survey of Canada, International Submarine Engineering Ltd and the Canadian Scientific Submersible Facility. The new ROPOS vehicle was staged on the *CCGV John P. Tully* for a cruise to Axial Seamount (Juan de Fuca Ridge) from June 29 - July 13, 1997. During the previous year extensive water column, bathymetric and camera sled work from the German ship *R/V Sonne* at this site supplemented a large database accumulated by NOAA (USA).

Cruise Summary

Primarily, the cruise was the first deep water test of the new ROPOS. Prior to this cruise, the new vehicle had seen less than 300m water in a "live-boating" mode only. Secondly, the intent was to characterize the smokers of the ASHES ventfield and to collect fluid, rock and biotic information for comparison with previous years. Recordings of seismic events on Axial coupled with a record of elevated hydrothermal fluid temperatures from one ALVIN dive in 1995 indicate that this system is in a state of flux. The observation of an eruption in 1993 on the northern flank of the volcano (CoAxial Segment) suggests an imminent eruption is not out of the question. Thirdly, we wished to assess both instrumentation and study sites for an extensive study in 1998. Within the context of observing the vent fields, many sub-objectives encompassing biological, chemical and geological studies were set. Four graduate students were involved in this cruise and acquisition of information for their dissertations, and training in shipboard activities were important goals. Documentation of a ventfield on the eastern side of Axial caldera was important to extending information on biological and chemical diversity of this system.

While all the objectives of our ambitious program could not be met in entirety, we achieved the primary goal: proving the new system at depth and successfully integrating and deploying instrumentation. The system arrived directly from the shop in Port Coquitlam with a new telemetry interface through the deep-water cage. The telemetry system represented a new advance by the manufacturer and required several days to tune and complete programming. Alignment of the fibre optic interfaces caused initial problems. International Submarine Engineering (ISE) provided support at sea and flew a team to the ship for 24-hours to address several problem were addressed. ROPOS was returned to ISE for final adjustments after the cruise.

In the ASHES ventfield of Axial Seamount (45° 56.02'N 130° 0.80'W), we examined a structure discovered the previous year (Phoenix Vent) and sampled a new structure (Ropos Vent). All other sulphide chimneys except one were relocated and the corrected fixes for each were obtained. Major changes were documented in several structures including the doubling in size of both Inferno and Mushroom from studies in 1987. The anhydrite mound (Virgin Vent) remained the same. Sulphide samples from these structures were set to the GSC in Ottawa and to Freiberg, Germany. Transecting surveys of the vent field located clear boundaries of hydrothermal influence and will be used to document localized changes and the distribution of predators. Within ASHES several observations of the alvinellid polychaete, *Paralvinella sulphincola*, were taken along with scans for chemical characteristics; characterization of the habitat of this unusual animal is the subject of a graduate study.

We investigated the caldera wall to the west of ASHES climbing from the caldera floor (1445 m) to the rim (1345 m). Areas of concentrated, low temperature venting were located part-way up the wall. As part of an investigation of gradients on chemical characteristics, the NOAA Scanner was used to take *in situ* readings of iron, manganese, sulphide and temperature. These scans were repeated in the ASHES ventfield and again on our last dive on the eastern side of the caldera. The chemical character varied and the gradient may reflect differences in the underlying heat source.

continued on next page....

National News....Canada continued

We traversed about a kilometer of the vent fields of the eastern caldera to relocate a large expanse of tubeworms found the year previously (Sonne Ventfield: 45°56.5'N, 129° 59.1'W). This area differs from ASHES in that the fluid source is very diffuse and the communities include large numbers of clams. Sulphide levels that increased about a meter off the substratum in one tubeworms field suggest large volumes of vent water advecting laterally. This area will be the focus of more work next year as the geological, chemical and biological characteristics differ from those of the western caldera.

Scientific Personnel:

Verena Tunnicliffe	Univ. Victoria, Canada	Anja Schulze	Univ. Victoria, Canada
Kim Juniper	Univ. Quebec (Montréal), Canada	Jozeé Sarrazin	Univ. Quebec (Montréal), Canada
Bob Embley	NOAA-Newport, USA	Damien Grelon	Univ. Quebec (Montréal), Canada
Gary Massoth	NOAA-Seattle, USA	Susan Hanneman	NOAA-Newport, USA
Janet Voight	Field Museum Chicago, USA	Heike Preissler	Univ. Freiberg, Germany
Maia Tsurumi	Univ. Victoria, Canada		

Other CanRidge Activities

REVEL'97

Graduate students from the laboratories of Kim Juniper (Université du Québec à Montréal) and Verena Tunnicliffe (University of Victoria) participated in a Jason/Alvin cruise on the *R/V Atlantis* to the Endeavour Segment of the Juan de Fuca Ridge from September 5-26. The Canadian Coast Guard Vessel *Bartlett* served as a mid-cruise shuttle for scientific personnel. Keith Shepherd, the ROPOS operations manager and chief pilot (shepherd@ios.bc.ca), participated in the second leg of the cruise to plan recovery of a sulfide chimney, an operation scheduled for the summer of 1998 using the ROPOS vehicle. Jason was used to locate and image the candidate chimney. The Alvin portion of the cruise focused on biological studies at the Observatory site in the Main Endeavour vent field, and in the nearby Clam Bed field.

PACMANUS IV to Eastern Manus Basin

Ray Binns (CSIRO, North Ryde) and Steve Scott (University of Toronto) are leading an Australia-Canada-PNG-USA expedition onboard *RV Franklin* to eastern Manus Basin in October 1997 where, in 1993, the team discovered the large "PACMANUS" hydrothermal site and, in 1995, the extremely active "Susu" site. Both of these are forming on the tops of felsic volcanic knolls and ridges. This contrasts with the DESMOS hydrothermal site discovered in the basin in 1990 within a small basaltic cauldron.

The PACMANUS team was intending to use for the first time the PROD seafloor diamond drill system being built in Australia from a Williamsons (Seattle) design but it will not be ready on time. Instead, they will concentrate their effort on documenting and sampling the new Susu site by deep-tow photography/video and other conventional means. They will also undertake some site survey work at PACMANUS in support of ODP proposal 479Rev2 "Anatomy of an active, felsic volcanic-hosted hydrothermal system."

PACMANUS and Susu are rare examples of hydrothermal activity associated with submarine felsic volcanic rocks and are close modern analogs for ancient volcanogenic massive sulfide deposits. Although both are unusual in terms of their high base and, especially, precious metal contents, their detailed characterization is expected to help interpret land-based equivalents and their geological setting.

Together, the PACMANUS-DESMOS-Susu Knolls sites define a hydrothermally active region of volcanic edifices and sedimented graben some 4000 km^2 in extent. This region is comparable in size to important mineral districts on land containing clusters of orebodies with varied characteristics, and it offers the possibility of establishing regional as well as local controls on location and style of mineralization. The PACMANUS and Susu hydrothermal fields both occur at bathymetric highs, reflecting maximum magmatic activity, which in turn is focused by local structures. These sites provide an opportunity to compare and contrast two felsic-hosted massive sulfide sites in the same general tectonic environment, and thereby to reach generally applicable conclusions regarding ore genetic processes.

For more information about CanRidge contact:

S. Kim Juniper,
Canadian InterRidge Correspondent
Le Stang - rue Jim Sevellec
Ste-Anne-du-Portzic
29200 Brest, France
Tel. +33 2 98 05 0671
(on sabbatical from Université du Québec à Montréal until June, 1998)
Email: juniper.kim@uqam.ca

National News....

France: Dorsales

Preparation of an evaluation report and National Symposium for the Dorsales program

The Dorsales program has now been active for 4 years and will be evaluated by it's funding agencies (CNRS, IFREMER and BRGM) this fall and winter. An evaluation report is being prepared about the Dorsales program. This evaluation will be based on:

(1) a report soon to be in print. This report will include a summary of the objectives, budget, and past activities of the program, progress reports on projects it has funded, and an outline of the future directions,

(2) a national symposium that will held 24-25 November 1997 in Paris at CNRS. The organizational committee is comprised of P. Agrinier (chair), G. Ceuleneer, O. Dauteuil, A. Fiala-Médioni, J. Francheteau, and P. Sarradin. There will be seventeen 20 or 30 minute talks during the first day and a half, and a poster session the evening of the 24th of November. The second afternoon will be devoted to a round-table discussion. An abstract volume will be published following the Symposium.

Calls for Proposals 1997

There have been two calls for proposals made by the program in 1997:

Hydrothermal species at the ridge crest: processes associated with recruitment
(3 proposals have been funded)

Time scales of heat and magmatic fluxes at the Mid-Ocean Ridge
(2 proposals have been funded)

For more information about Dorsales contact:

Jean Francheteau
Dorsales Chair
Université de Bretagne Occidentale
6 avenue Le Gorgeu
29285 Brest Cédex, France
E-mail: franch@univ-brest.fr

http://orchidee.u-strasbg.fr

Germany: DeRidge

German ridge studies have in July 97 continued in the Norwegian - Greenland Sea with a *R/V Poseidon* cruise to Kolbeinsey Ridge (PI: Peter Stoffers, GPI, Kiel University), carrying the German submarine JAGO. Project partners were the universities of Freiberg and Regensburg, and scientists from Iceland and Canada. 200 km north of Iceland a 1000 m long and 500 m wide hydrothermal field has been discovered in a volcanically active zone at water depths around 400 m. The water has temperatures of up to 250°C and is boiling at the seafloor. Water samples were taken as well as samples of anhydrite, which covers large portions of the seafloor in the vent area. In addition to analyses of the water and rock samples, microbiological processes in the vent field will be studied.

Following the DeRidge decision to focus on two themes (a) Evolution of Oceanic Crust and (b) Back Arc Basins the two working groups have started constituting themselves through meetings and exchange of paperwork. The Back Arc Basins group has expanded to "Back Arcs, Fore Arcs and Island Arcs" and has been closely linked to the research program of the German *R/V Sonne*. After completion of the geophysically oriented first stage project EXCO on the EPR (see article on pg. 23 of this issue), the Evolution of Oceanic Crust group aims at a second stage project involving a slow spreading ridge and the integration of additional geo-parameters (e. g. petrology, geochemistry, sedimentology).

The DeRidge homepage has been transferred to Kiel University and is maintained by Colin Devey. The address is: **http://www.gpi.uni-kiel.de/~cwd/DeRidge/deridge.html**

The next DeRidge plenum will probably be scheduled as usual in connection with next years ODP Kolloquium, which will be held in Freiburg in March, 1998.

Since no funds for DeRidge coordination are available, only a low budget service can be maintained. Contacts are:

Roland Rihm
German InterRidge Correspondent
GEOMAR,
Wischhofstr. 1-3,
24148 Kiel, Germany
Tel: +49 431 600 2652
Fax: +49 431 600 2978
E-mail: rrihm@geomar.de

and

Colin Devey
Geologisch-Paläontologisches Institut der Universität Kiel,
Olshausenstr. 40,
D-24118 Kiel, Germany
Tel: +49 431 880 2085
Fax: +49 431 880 4376
E-mail: cwd@zaphod.gpi.uni-kiel.de

http://www.gpi.uni-kiel.de/~cwd/DeRidge/deridge.html

National News....

InterRidge-Japan

Japan Marine Science and Technology Center (JAMSTEC) is planning the "MODE'98" (Mid-Oceanic Diving Expedition in 1998) cruise which will focus on the hydrothermal and segmentation processes in the crustal area of the central Mid-Atlantic Ridge and the Central - Southwestern Indian Ridge by the Japanese deep sea submersible Shinkai6500 with her mother ship Yokosuka.

Tentative schedule of the cruise is:

Transit:	22 May 1998 (Fri.)	Leave Yokosuka
	17 Jun. 1998 (Wed.)	Arrive San Juan
Leg 1:	19 Jun. 1998 (Fri.)	Leave San Juan
	18 Jul. 1998 (Sat.)	Arrive Lisbon (Lisbon Expedition)
Leg 2:	22 Jul. 1998 (Wed.)	Leave Lisbon
	25 Aug. 1998 (Tue.)	Arrive Marseilles
Transit:	01 Sep. 1998 (Tue.)	Leave Marseilles
	18 Sep. 1998 (Fri.)	Arrive Port Louis
Leg 3:	21 Sep. 1998 (Mon.)	Leave Port Louis
	17 Oct. 1998 (Sat.)	Arrive Port Louis
Leg 4:	23 Oct. 1998 (Fri.)	Leave Port Louis
	18 Nov. 1998 (Wed.)	Arrive Port Louis
Transit:	21 Nov. 1998 (Sat.)	Leave Port Louis
	10 Dec. 1998 (Thu.)	Arrive Yokosuka

Target areas and objectives in each leg are:

Leg 1: Cape Verde Fracture Zone, 15°20'N, Mid-Atlantic Ridge
Leg 2: Methane-rich hydrothermal vents at 14°45'N and/or other hydrothermal site(s), Mid-Atlantic Ridge
Leg 3: Indian Ocean R-R-R triple junction and/or its vicinity
Leg 4: Atlantis-II Fracture Zone, Southwest Indian Ridge

Leg 1 and Leg 4 will be conducted through the JAMSTEC-WHOI collaboration program under the InterRidge initiative. Leg 2 and Leg 3 will be conducted within the framework of the Japanese contribution to InterRidge, and details in these two legs will be coordinated by the "InterRidge-Japan" national correspondent on the basis of proposals by scientists in the InterRidge member countries. Submission of diving proposals for the "InterRidge-Japan legs" will be announced later. However, please note that the above plan is subject to change since the proposal for the whole cruise is now being reviewed by the Japanese Ministry of Finance. The final schedule will be fixed by the end of next March.

For more information contact either:

Nobuhiro Isezaki,
Japanese InterRidge Correspondent
Department of Earth Sciences,
Faculty of Science, Chiba University,
Yayoi-cho 1-33, Inage-ku, Chiba-shi,
Chiba 260, Japan
E-mail:nisezaki@science.s.chiba-u.ac.jp

or

Takeshi Matsumoto
Japan Marine Science & Techology Centre,
2-15 Natsushina-cho,
Yokosuka-shi,
Kanagawa 237, Japan
E-mail: matsumotot@mstkid.jamstec.go.jp

National News....

Norway

The Knipovich Ridge is a fragment of the divergent boundary between the Eurasian and North-American plates, striking from the North Atlantic through the Norwegian-Greenland Basin and the Eurasian Subbasin of the Arctic Ocean. It is characterized by a number of features different from those of the two well known tectonotypes recorded at divergent boundaries: mid-ocean ridges and transform faults. These features include:

(1) The ridge is morphologically not well pronounced. It consists of several (up to 6-7) mountain ranges and valleys, the most abrupt of which is probably the axial rift valley.
(2) The ridge has an oblique orientation (an angle of 40-60 degrees) relative to the spreading direction in the region.
(3) The ridge is located in an asymmetric position in the basin.
(4) A typical spreading magnetic field is absent and the axial band of earthquake epicenters is greatly dispersed and discontineous, with a dominating role of strike slip rather than the normal fault component in focal mechanisms.
(5) The Earth's crust appears to be unusually thick. Moreover, the Knipovich Ridge area is characterized by specific conditions for magma generation (shallowness of melting) and sedimentation (the proximity of Spitsbergen archipelago and the influence of ice dispersion).

Norwegian ridge related studies have been carried out at the Institute of Solid Earth Physics, University of Bergen, and the Department of Geology, University of Oslo, in close cooperation with institutions abroad - especially the US Naval Research Laboratory, Washington DC. Joint U.S-Norwegian side-scan sonar investigations with SeaMARC II were carried out in 1989 and 1990. This work was followed upwith U.S., Russian and Norwegian research at Knipovich Ridge in 1995 and1996 (see *InterRidge News* 6(1)). Future plans are to use the Russian MIR submersible to investigate the floor of the Knipovich Ridge in specific areas where previous surveys have indicated hydrothermal activity and recent volcanism. The Naval Research Laboratory would provide most of the funding with smaller contribution from Norway and Russia. Hopefully this investigation will be carried out in 1998.

In addition to this submersible investigation, we also hope to get funding for another joint Russian-Norwegian project related to the Knipovich Ridge. Based on analyses of a broad set of available geological-geophysical data we will attempt to:

- clarify the geodynamic features in the Knipovich Ridge area responsible for its non-typical structural and geophysical parameters based on analysis of the latest bathymetric, magnetometric, geothermal, seismic and seismologic data;
- make correlation with other fragments of the divergent boundary between the Eurasian (African) and North-American plates, in particular with the northern near-equator zone in the Atlantic Ocean where the boundary is also subjected to abrupt azimuth variations, and to determine the place the Knipovich Ridge holds in classification of interplate boundaries;
- study the petrology of basalts, and of mantle derived peridotites, and hydrothermal phenomena in this unusal geological setting.

A new data set on magmatism along the Knipovich Ridge, which is important for solving the geodynamic problems mentioned above, was obtained in 1996 during the Russian-American-Norwegian expedition onboard *R/V Professor Logachev*. Magmatic rocks were sampled from 7 stations. They are mainly presented by recent plateau basalts with high concentrations of silicium and low concentrations of ferrum. Indicators of hydrothermal phenomena were also obtained during this cruise. Hydrothermal activity is indicated by near bottom temperature anomalies, the presence of low-temperature hydrothermal mineralization, Fe-Mn oxyhydroxide crusts on dredged basalts, and hydrothermal mound-like structures detected by camera at the rift valley.

For more information contact:

Dr. Eirik Sundvor, Norwegian InterRidge Correspondent
Institute of Solid Earth Physics
University of Bergen, Allegt. 41
N-5007 Bergen, Norway
Tel: +47 55 21 34 20
Fax: +47 55 32 00 09
E-mail: eirik.sundvor@ifjf.uib.no

National News....

Spain

Spanish Ridge Activities aboard the *R/V Hesperides* (1992-1996)

The Institute of Earth Sciences (Jaime Almera) from the CSIC and the Marine Geosciences Group of the University of Barcelona (UB) started working on ridge-related studies in 1992, when the *R/V Hesperides* was launched as part of the Spanish Antarctic Program. Seven geology-geophysics cruises have taken place (Table I), which concentrated on the NW Antarctic Peninsula (Bransfield Basin region), the Galapagos, and the EPR at southern (Eastern Island) and northern latitudes around 22°N at the junction between Pacific and Rivera plates.

The South Scotia Ridge (SSR) is the left-lateral plate boundary between the Scotia and Antarctic Plates, and marks the southern limit of the Scotia Arc. The SSR is composed of a series of fragmented blocks from the East Scotia Ridge to the Bransfield Basin. During the SCOTIA 92 cruise, the western portion of the SSR (between Elephant and Orkney Islands) was explored. Its morphology is constituted of two continuous parallel crests limited by deep rhombohedral depressions, formerly interpreted as intra-transform spreading centres. One of these depressions was mapped and studied during this cruise, and was re-interpreted as a pull-apart basin developed by the sinistral strike-slip motion along the SSR.

The Bransfield Basin (BB) is the narrow, elongated basin located at the northern tip of the Antarctic Peninsula, forming the southwestern edge of the Scotia Arc. The Bransfield Basin is an active rift basin that separates the South Shetland Islands microplate from the Antarctic Plate. Morphologically, the BB is composed of three small basins, Western, Central and Eastern. The Central and Eastern BB were surveyed by the GEBRA 93 cruise during which the first swath-bathymetric maps of the BB were acquired (Table I). The Central BB is dominated by several large volcanic edifices aligned with the basin axis that may be formed during incipient stages of seafloor spreading. One of the edifices was monitored for 9 months during the GEBRATERM project in order to record water temperature variations which might be related to any hydrothermal activity. Finally, during the GEBRAP cruise in 1996, the Western BB was also mapped and all the large volcanic edifices of the Central BB were systematically dredged. As future research, a joint IFREMER-UB proposal will be submitted in 1998 with the aim to explore in detail the submarine edifices of the BB with the submersible Nautile.

Easter or Rapanui island is located just near the EPR around 27°S. The PASO-94 geophysical expedition was intended to define the oceanic crustal structure within an oceanic island near the EPR and to examine if any influence from the Easter Microplate was marked within the crustal structure.

The Galapagos Spreading Center (GSC) lies in the eastern Pacific, 170 km north of Galapagos Archipelago, and represents the tectonic boundary between the Cocos and Nazca plates. The GSC is an intermediate-rate spreading center, with spreading increasing from west to east (40 mm/yr to 65 mm/yr). The Galapagos-96 cruise investigated the variations in axial morphology and the ridge hotspot interaction by means of high resolution bathymetry and gravity data.

The northern EPR (22°N) shows several overlapping spreading centers. The location of the EPR at this latitude between the Rivera and the Pacific Plate is an intriguing place in terms of oceanic crustal structure. The CORTES-96 cruise transected the Pacific ocean from the continental crust of the Jalisco Block to the tip of the Baja California Peninsula crossing the EPR at around 22°N. The purpose of this research is to evaluate the evolution of the oceanic crust and its contact with the continental crust, which appears to be few miles offshore. We collected more than 300 km of multichannel seismic data were collected in addition to wide-angle data recorded from 6 OBSs at both sides of the EPR. Magnetics and gravity data was also recorded along the seismic lines.

For more information contact either of the Spainish InterRidge Correspondents:

Dr. Juan José Dañobeitia
Inst. Jaime Almera de Ciencias de la Tierra
CISC
C/Lluis Sole i Sabaris s/n
08028 Barcelona, Spain
E-mail : jjdanobeitia@ija.csic.es

or

Dr. Miquel Canals
Marine Geology Group
Dept. de Geología Dinámica, Geofísica i Paleontologia
Univ. de Barcelona
Zona Universitaria de Pedralbes
08071 Barcelona, Spain
E-mail: miquel@natura.geo.ub.es

continued on next page....

National News....Spain continued

Table I. Ridge-related cruises with UB or ICTB participation or leadership (1992-1996).

Cruise	Year	Scientific Party	Study Area	Data
SCOTIA	1992	IEO, UB, USW	South Scotia Ridge	Swath-Bathymetry Magnetics MC Seismic Reflection
GEBRA	1993	UB, ICM, USal IEO, RCMG, RU	Central Bransfield Basin Eastern Bransfield Basin	Swath-Bathymetry Magnetics HR Seismic Reflection Sediment cores
GEBRATERM	1994	UB	Central Bransfield Basin (Seamount E)	Thermistor chains, CTDs
GEBRAP	1996	UB, ICM-CSIC, UV, RCMG	Western Bransfield Basin Central Bransfield Basin Antarctic Peninsula Margin	Swath-Bathymetry Magnetics HR Seismic Reflection Sediment cores Rock samples
PASO-94	1994	ICTB-CSIC, ICM-CSIC, UH, UBO, USC, USF	Easter Island, microplate interactions near EPR	Swath Bathymetry Magnetics, Gravity MC Seismic reflection Wide angle seismics (Land-stations)
GALAPAGOS-96	1996	ICTB-CSIC ICM-CSIC WHOI, USF	Galapagos spreading center.	Swath Bathymetry Magnetics, Gravity
CORTES-96	1996	ICTB-CSIC ICM-CSIC UCM, IGN CICESE, LGM ORSTOMt	EPR at 22 ° N	Swath Bathymetry Back-scattering Magnetics, Gravity MC Seismic reflection OBS

Acronyms

ICM	Instituto de Ciencias del Mar, CSIC (Spain)
IEO	Instituto Español de Oceanografía (Spain)
UB	Universidad de Barcelona (Spain)
USal	Universidad de Salamanca (Spain)
ICTB	Instituto Ciencias de la Tierra de Barcelona (Spain)
UCM	Universidad Complutense de Madrid (Spain)
IGN	Instituto Geografico Nacional (Spain)
UV	Universidad de Vigo (Spain)
USW	University of South Wales, Cardiff (United Kingdom)
RCMG	Renard Centre of Marine Geology - University of Gent (Belgium)
UBO	Universite de Bretagne Occidental (France)
ORSTOM	(France)
LGM	Laboratoire de Geophysique Marine Villefranche sur mer (France)
UH	University of Hamburg (Germany)
USC	Universidad de Dantiago de Chile (Chile)
CICESE	Division Ciencias de la Tierra Ensenada (Mexico)
UNAM	Universidad Autonoma de Mexico (Mexico)
RU	Rice University (USA)
WHOI	Woods Hole Oceanographic Institution (USA)
USF	Univeristy of South Florida (USA)

National News....

Switzerland

In Switzerland, research related to ridge processes has traditionally involved comparative field, geochemical and petrologic studies of ophiolites and marine sediments with their modern analogues. In addition, a number of scientists have participated on ODP legs or have shore-based projects on ODP material. Under the direction of Judith McKenzie at the ETH-Zurich, Switzerland has hosted the ESCO secretariat for the past two years. Many research groups are also indirectly involved in ridge-related research through field and laboratory studies of igneous, metamorphic and sedimentary processes at ocean/continent transition zones and in subduction zone settings. In this report, I would like to introduce a few of these research groups and summarize some of their on-going ridge-related projects.

The Lower Oceanic Crust-Upper Mantle Transition:
A Comparison between Alpine Ophiolites and Modern Atlantic Oceanic Lithosphere

Jean Bertrand and Lionel Bolou (Dept. of Mineralogy, University of Geneva), in collaboration with Daniel Bideau and Roger Hékinian (IFREMER, Brest), are collecting new petrologic and geochemical data on oceanic and ophiolitic rocks formed in slow-spreading ridge environments [e.g. segments of the equatorial Mid Atlantic Ridge (Vema and Romanche fracture zones) and the Ligurian Tethyan domain (Montgenèvre massif, Western Alps, and Northern Apennines, Italy)]. The Montgenèvre and the Apennine ophiolites are considered to have originated from a slow-spreading ridge segment of the Alpine Piemont-Ligurian Tethys and are relatively unaffected by Alpine metamorphism, thus, allowing comparisons with analogous oceanic material. The aims of this study are (1) to better characterize upper mantle evolution and processes of emplacement and crystallization of extracted magmas; and (2) to develop better criteria to discriminate between subsolidus effects originating during the oceanic and orogenic stages. The comparisons will be primarily based on structural features at diverse scales, major and trace element geochemistry, and the chemical and isotopic compositions of primary and secondary mineral phases, and will involve numerous chemical and petrological techniques.

Formation and Evolution of the Western Indian Ocean

Understanding the Mesozoic evolution of the western Indian Ocean, recorded in the magmatic and sedimentary sequences of the Masirah Island Ophiolite, has been the focus of extensive studies by a large number of earth scientists at the University of Bern. Under the direction of Tjerk Peters, this interdisciplinary project compliments previous work of DSDP and ODP and has produced a relatively complete picture of the complex magmatic, metamorphic and tectonic processes that have affected the oceanic lithosphere of the Indian Ocean since the break-up of Gondwana. Field, petrological, geochemical and isotopic studies indicate that heterogeneous melting processes during MORB-type ridge magmatism (150-145 Ma) produced a thin oceanic crust near a continental margin or a transform fault and was followed by normal faulting and extensive hydrothermal alteration. In the Mid-Cretaceous, this oceanic lithosphere was further affected by extensional tectonics favoring alkaline volcanism of OIB affinity, the intrusion of a suite of hornblende gabbro, dolerite and granite and the uplift of some crustal blocks to sea level with the unconformable deposition of platform carbonates. After renewed subsidence during the Late Cretaceous, an intra-oceanic thrusting event shortly predated obduction onto the Arabian continental margin. By integrating numerous field and laboratory data, this group in Bern has formulated a comprehensive tectono-magmatic model of the interplay between ridge and hydrothermal processes, inter-oceanic rifting and thrusting, transform tectonics, hot spot activity and final obduction of the western Indian oceanic lithosphere.

Hydrothermal Alteration and Geochemical Fluxes in the Oceanic Lithosphere

Together with colleagues at the ETH-Zurich, Gretchen Frueh-Green has been involved in a number of ridge-related projects that can be summarized into three main areas of research: 1) Fluid flow and geochemical fluxes during hydrothermal alteration; 2) Controls and consequences of serpentinization processes in different tectonic environments (in part as the Ph.D. thesis of Alessio Plas); and 3) Methane and hydrogen formation in mid-ocean ridge hydrothermal systems. These projects combine petrological, geochemical and stable isotope methods with microstructural and fluid inclusions studies and involve strong international collaboration. By examining dredged samples, ODP drill cores and exhumed oceanic sequences, the aim is to evaluate the mechanisms of seawater penetration into the oceanic lithosphere and to quantify geochemical fluxes during hydrothermal alteration at sedimented and unsedimented

continued on next page....

ridges. In addition, recent studies with Deborah Kelley (Seattle) on methane-rich fluids trapped in inclusions in oceanic layer 3 have given a better understanding of the controls on volatile chemistry at depth and will help to quantify carbon fluxes from mantle and deep-seated hydrothermal systems to the shallow marine environment. Samples under investigation in these projects include sediments, gabbroic rocks and/or serpentinised peridotites (1) recovered during ODP Legs 107, 118, 125, 139, 147, 149 and 168; (2) exposed at the Vema Fracture Zone Transverse Ridge, Atlantic Ocean (results from cruise EW93-05); and (3) from exhumed oceanic lithosphere in the Penninic Nappes in the Alps and the Troodos Ophiolite, Cyprus.

Ocean-Continent Transitions in the Alps and the Atlantic

Niko Froitzheim (University of Basel), Gianreto Manatschal and Daniel Bernoulli (both at the ETH Zurich) are studying the structure, sedimentation, and metamorphism along Mesozoic-age passive continental margins, during stages of rifting, continental break-up, and beginning sea-floor spreading. The margins under study are in the Alps (Jurassic-age margin between the Apulian microcontinent and the Piemont-Liguria ocean) and in the Atlantic (West-Iberia margin). They have found rifting-related, Jurassic extensional detachment faults unroofing mantle material in the Alps of the Engadine area (Ph.D. thesis of Gianreto Manatschal). Niko Froitzheim took part in the 1995 GALINAUTE II cruise led by Gilbert Boillot on the Galicia banks, with the French submersible Nautile, where evidence for mantle exhumation by detachment faulting was found. Gianreto Manatschal and Niko Froitzheim took part in ODP Leg 173 "Return to Iberia", in 1997, where a mantle window and an extensional klippe of continental crust were drilled in the ocean-continent transition area of the Iberia Abyssal Plain. This area is very similar to the mantle window and klippe that have been reconstructed for the Jurassic margin in the Alps. The comparison between field data in the Alps and drilling data in the ocean proved to be extremely helpful for the understanding of the break-up process. Presently a project "Comparative Anatomy of Passive Continental Margins: Iberia and Eastern Alps" is in progress (one postdoc, Gianreto Manatschal, and one Ph.D. student at ETH).

As the Swiss correspondent, I wish to apologize in advance to anyone who has been left out of this report and welcome any contributions that may be included in subsequent reports.

Gretchen L. Frueh-Green
Swiss InterRidge Correspondent
Institute for Mineralogy and Petrography
ETH-Zürich, Sonneggstrasse 5
CH-8092 Zürich, Switzerland

Tel: +41 1 632 3794
Fax: +41 1 632 1294
E-mail: gretli@erdw.ethz.ch

National News....

UK: BRIDGE

On 20-21 May 1997 BRIDGE sponsored the meeting Modern Ocean Floor Processes and the Geological Record, organised jointly with the Marine Studies Group of the Geological Society of London and the Challenger Society for Marine Science. This meeting was hosted by the Geological Society and the Royal Institution. The theme was the interrelationship of research into deep-ocean processes occurring today, and fossilised ocean systems such as Troodos, Kizildag, Oman and the Urals. The meeting attracted participants from Europe, Canada, the USA, Russia and Australia and the papers are currently being prepared as a Special Publication of the Geological Society.

In June and July BRIDGE scientists and a BBC film crew joined the newly commissioned *R/V Atlantis* on her first scientific voyage as the support vessel for ALVIN. BRIDGE had been in contact with BBC television since 1996 regarding opportunities for filming hydrothermal vent systems. The BBC is currently producing a major new eight-part documentary series entitled "Earth Story" due for broadcast in 1998. "Earth Story" will consider the Earth as a functioning system and will approach the subject from an historical perspective: not just "what do we know?" but also "how did we come to know it?". The second episode will consider the deep oceans. The BBC and several BRIDGE scientists were able to join Atlantis on her transit from Bermuda to the Azores in late June and film ALVIN diving operations and interviews to camera.

BRIDGE biologists Eve Southward, Cathy Allen-Copley and Andrey Gebruk remained aboard Atlantis when she sailed out of the Azores on a major investigation of Atlantic vent fauna. Through the goodwill of the chief scientists, Bob Vrijenhoek and Rich Lutz from Rutgers University who had organised this cruise, BRIDGE was able to add a number of dive days to pursue BRIDGE interest in the feeding biology of shrimp and other animals from the deeper sites of the North Atlantic. The cruise was a great success – to the credit of the chief scientists and due in no small part to the hard work of Tim Shank, also from Rutgers. The results are now being worked up.

There was even time during this cruise to rendezvous with the French support ship *l'Atalante* over the ridge where her submersible NAUTILE had just located the vents of the – somewhat elusive – RAINBOW vent site. In a rare opportunity, NAUTILE and ALVIN dived together proving the Atlantic is not as wide politically as it is geographically.

Back in the UK BRIDGE has managed to squeeze one more research project into its programme, bringing the total to 44. This will be a seismic mapping study of the magma chamber found recently under the Reykjanes Ridge and should be a fitting nail in the coffin of "no magma chambers under this slow spreading centre". The PI for this study will be Christine Peirce of Durham University and her co-PIs are Roger Searle, former InterRidge Chair, and Martin Sinha, former InterRidge Steering Committee member.

Forty-four separate projects in a multidisciplinary programme like BRIDGE generate a considerable volume of data. BRIDGE's approach to mid-ocean ridge studies has always been to select active geographical areas and dissect them in great detail from all scientific perspectives. To maximise the benefits from this technique it will be necessary to integrate the data output from the different geological, oceanographic, chemical and biological approaches. Just such a synthesis is now being planned. The BRIDGE Steering Committee has formed a small BRIDGE Data Committee to oversee the collation and integration of the data from all BRIDGE research and produce a definitive dataset for the BRIDGE geographical areas. This monumental task is being undertaken by Dr Philippe Blondel of Southampton Oceanography Centre, InterRidge Steering Committee member and Chair of InterRidge's Global Ridge Bathymetry Database Project. It is expected that the unified BRIDGE data product will be available in CD-ROM format by the year 2000 and should have educational as well as research interest.

For information about BRIDGE please contact:

Dr Keith Harrison, BRIDGE Programme Manager
Department of Earth Sciences
University of Leeds
Leeds LS2 9JT, UK

Tel: 44 113 233 5241
Fax: 44 113 233 5259
E-mail: BRIDGE@earth.leeds.ac.uk
http://www.soc.soton.ac.uk/CHD/bridge

National News....

USA: RIDGE

RIDGE is in the process of revising the RIDGE Science Plan for the next 5 years. It is likely that the new Science Plan will be organized around questions related to various time and spatial scales, rather than the Program Element Committees (PECS) that currently exist. A draft of the revised Science Plan will be put on the RIDGE website for community input. A draft may be available prior to the Fall AGU in San Francisco.

At the Fall Meeting of AGU there are several special sessions of interest to the ridge-crest community. This year, the RIDGE Smoker will be held on Thursday evening, Dec. 11 - we hope that many InterRidge participants will turn out for what we hope will be an entertaining evening.

RIDGE recently co-sponsored several workshops:

Workshop on the Detection and Rapid Response to Volcanic Events on the Mid-ocean Ridge - March, 1997, Lynnwood Washington, co-sponsored with NOAA VENTS. Approximately 65 scientists and students gathered to outline the important measurements to be made during a rapid response to a detected volcanic event. Much of the discussion centered on determining the time frame over which measurements must be made, and the current state of the technology necessary to make these measurements. A draft workshop report is available on the RIDGE website; the final workshop report will be available this Fall.

A Workshop on the Subsurface Biosphere at Mid-Ocean Ridges - March, 1997, Washington, D.C., co-sponsored with JOI/USSAC, NOAA VENTS, and the University of Washington Volcano Systems Center. 100 scientists and students gathered to discuss the evidence for a subsurface biosphere, both in terrestrial and submarine environments. One of the most rewarding aspects of this workshop was that so many insightful and enthusiastic researchers turned their attention to this subject, and promising new collaborations were born.

Summer School on Active Processes at Mid-Ocean Ridges - Aug. - Sept., 1997, Myvatn, Iceland, co-sponsored with NorFA/NORDVULK. US and Nordic participants gathered for a series of lectures, field trips, and poster sessions related to active processes as observed on Iceland and at mid-ocean ridges. Initial indications are that the summer school was a great success, with all participants walking away with a greater understanding of the scale and scope of active processes.

A workshop on Mantle Flow and Melt Generation Beneath Mid-Ocean Ridges was held in Providence, RI in early October. The goal of this workshop was to critically examine new observational constraints on mantle flow and melt production beneath mid-ocean ridges in light of new experimental and theoretical advances, especially those related to the MELT Experiment from the southern East Pacific Rise.

The latest edition of the RIDGE Events newsletter was distributed late July. The next issue is due out in early January. As always, current announcements related to RIDGE can be found on the RIDGE website. You can reach us at:

RIDGE Office
Ocean Process Analysis Laboratory
Morse Hall
39 College Road
University of New Hampshire
Durham, NH
03824-3525 USA

Tel: +1 603-862-4051
Fax: +1 603-862-0083
E-mail: ridge@unh.edu
WWW: http://ridge.unh.edu

Upcoming Meetings and Workshops

Calendar

More details on these meetings can be found on the calendar page of our web site, http://www.lgs.jussieu.fr/~intridge/calendar.html

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Conference on Marine Benthic Habitats and their Living Resources
Noumea, New Caledonia, November 10-16, 1997

134th Meeting of the Acoustical Society of America
San Diego, CA, USA, December 1-5, 1997

American Geophysical Union Fall Meeting
San Francisco, CA, USA, December 8-12, 1997

Volcanic and Magmatic Studies Group (VMSG) Annual Meeting
University of Leicester, UK, January 7-8, 1998

Winter School on Ocean Ridge Processes in Oman
Oman, February 15-24, 1998

6th Zonenshain International Conference on Plate Tectonics
Moscow, Russia, February 17-20, 1998

Oceanology International 98
Brighton, UK, March 10-13, 1998

International Symposium on Japan-France Kaiko-Tokai Project: Tectonics of subduction in the Nankai Trough
Maison Franco-Japonaise, Ebisu, Tokyo, Japan, March 25-27, 1998

Extreme Enironments: Joint meeting of the Marine Biological Association of the UK and the Challenger Society for Marine Sciences
University of Plymouth, Plymouth, UK, March 30-April 3, 1998

GEOSCIENCE 98
Keele University, Keele, Staffordshire, UK, April 14-18, 1998

European Geophysical Society: 13th General Assembly
Nice, France, April 20-24, 1998

Geological Association of Canada and the Mineralogical Association of Canada Joint Annual Meeting
Quebec City, Canada, May 18-20,1998

American Geophysical Union Spring Meeting
Boston, MA, USA, May 26-29, 1998

InterRidge Steering Committee Meeting
Barcelona, Spain, October 1-2, 1998 (provisional)

InterRidge Workshop: Designing long-term monitoring systems of the Mid-Atlantic Ridge
Lisbon or the Azores, Portugal, fall 1998

Upcoming Meetings and Workshops....

134th meeting of the Acoustical Society of America

San Diego, CA, USA 1-5 December, 1997

Special Session on "Acoustic observations of ocean ridge processes"

For more details see: http://asa.aip.org/call134.html

European Geophysical Society XXIII General Assembly

Nice, France 20-24 April 1998

Special Sessions on:
"Hot spots and plumes in the mantle" and
"Combined geophysical and geochemical approaches to study mid-ocean ridges"

For more details see: http://www.copernicus.org/EGS/EGS.html

Winter School on Ocean Ridge Processes in Oman

Oman, 15 - 24 February, 1998

The winter school is supported by: Sultan Qaboos University (Oman), Centre National de la Recherche Scientifique (France), RIDGE (USA), DORSALE (France), and InterRidge.

Purposes of the School

- To provide an opportunity for graduate students, post-docs, and investigators working on ridge-related problems to gain first-hand knowledge of Oman geology and its implications for mid-ocean ridge processes. For the European and American participants to the '96 and '97 Iceland Summer Schools, this new experience will emphasize the sharp contrast between, on the one side, an active and slow spreading system, examined only from the surface and, on the other, a dead, fast spreading system examined from the surface down to 10-20 Km, thanks to erosion. Because of the opportunities provided by this ophiolite, the accent will be put of the fundamental mechanisms of accretion in a fast and time-independent ridge system. Of course, this will not exclude presentation and discussion of other ridge and ophiolite systems.
- To promote interaction among young scientists in the marine and ophiolite communities.

Organization of the Winter School

The meeting will be organised around a combination of formal lectures, poster sessions, informal discussions and field trips. During the 9 days school, 4 days will be devoted to "classroom" activities. Mornings will be devoted to 3 or 4 formal lectures; afternoons will be reserved for general discussion of the day's topic, short presentations, discussions of posters, previews and background information concerning up-coming field trips. Five days should be reserved for field trips to the southern part of the ophiolite where the emphasis will be on deep ridge processes (mantle diapirism and accretion of lower crust) in a fast spreading system and in northern part of the ophiolite where the emphasis will be on shallower ridge processes and on tectonic activity in a complex ridge system.

For more details see:

http://www.dstu.univ-montp2.fr/TECTONOPHY/WinterSchool/WSintro.html

Upcoming Meetings and Workshops

American Geophysical Union 1997 Fall Meeting

San Francisco, CA, USA, 8-12 December 1997

Special Sessions

There will be panel discussions at the end of the two InterRidge sponsored sessions, "Magma focussing and the segmentation of Mid-Ocean Ridges at all spreading rates" and "Hydrothermal Activity at Different Spreading Rates".

Shallow Crustal Architecture of Submarine and Subaerial Rift Zones: T11D, T12D, T21A
Our goal is to bring together people in various disciplines (geomorphology, volcanology, geochemistry, seismology, geophysics, theoretical modeling, etc.) to understand the fundamental processes which govern shallow level magma storage and transport, dike emplacement and eruption, and faulting and fissuring at rift zones. A rift zone is one of the most common features constructed at both submarine (e.g., mid-ocean ridges, seamounts) and subaerial (e.g., Hawaii, Iceland) volcanoes. A major goal of this session is to compare and contrast processes operating in the formation and evolution of rift zones in the submarine and subaerial environments, and thus to promote a better understanding of rift zone processes globally. **Conveners:** *Deborah K. Smith, Laura S. L. Kong and Kevin T. M. Johnson*

Twenty Years Since Galapagos:
Discoveries, Questions and Future Directions in Seafloor Hydrothermal System Research: V11D, V12F, V22E
The discovery of warm springs at the Galapagos Spreading Center twenty years ago revolutionized our ideas on how the oceans work, by introducing a previously unrecognized process into our models of oceanic crustal accretion, mineral deposit formation, chemistry and physics of the ocean and oceanic crust, and identification and evolution of chemosynthetically based animal communities. Seafloor hydrothermal systems are now known to be a common phenomenon on the mid-ocean ridge system, over a wide range in spreading rates. The hydrothermal fluids provide an important medium for the transport of energy and mass between the oceanic crustal, water, biological, and even atmospheric reservoirs, although the magnitude, and in some cases even the direction, of these fluxes remains a subject of debate. Laboratory and theoretical modeling have provided critical insights to our understanding of hydrothermal systems, as much of the system remains inaccessible to direct sampling. Early studies suggested that these systems were remarkably similar to one another and temporally invariant; more recent studies have shown that this is not the case. Technological advances permitting detailed time series sampling have shown that very rapid changes can and do occur. With >20 sampled sites of hydrothermal activity, no two display the same chemical, physical and/or biological properties. Magmatic events are now also known to severely perturb not only the hydrothermal system itself, but also the overlying water column and adjacent biological communities. The session will focus on addressing our current state of knowledge of subseafloor hydrothermal systems and the influence of these systems on the ocean and oceanic crust, as well as the outstanding questions and approaches needed to address them - now and in the future. **Conveners:** *Karen L. Von Damm and William E. Seyfried, Jr.*

Instabilities in Hydrothermal Systems: V11G, V21E, V12B
Hydrothermal systems often exhibit unsteady or cyclical behavior. In shallow systems, periodic changes in heat and mass discharge may be frequent and quite regular as exemplified by some geysers. Volcanic crater lakes, such as those on Mount Ruapehu and Mount Poas, exhibit longer term and less regular periodic changes. There have also been suggestions that high-frequency pressure fluctuations in hydrothermal systems influence volcano seismicity. Evidence from banded veins indicates that unsteady flow must also be a common aspect of deeper hydrothermal systems. This special session is intended to bring together geochemists, volcanologists, seismologists, and hydrogeologists to examine the causes, frequency, and physical and geochemical consequences of instabilities in hydrothermal systems. **Conveners:** *Daniel O. Hayba and Andrew W. Woods*

Global and Local Variability in Crustal Accretion Processes at Mid-Ocean Ridges: T21E, T22C, T31C, T32A
Recent field observations in the Indian Ocean have filled the gap at the intermediate spreading ridges in the global coverage of the mid-ocean ridges, and observations along the Reykjanes Ridge have revealed details of the ridge-hotspot interaction. This special session will revisit one of the most important problems of the seafloor spreading at oceanic spreading centers: global and local variability of crustal accretion processes with more complete observations spanning all the spreading rates and all the major oceans. The objective of this special session is to promote comparison of observational constraints and crustal flow models of crustal accretion of the mid-ocean ridge systems at various scales and at all spreading rates. We solicit papers describing geological, geophysical, and petrological constraints on this topic from all the mid-ocean ridges. We also solicit papers presenting theoretical models of mid-ocean ridges. Results of off-axis surveys are also welcomed. **Conveners:** *Y. John Chen and James R. Cochran*

Upcoming Meetings and Workshops....Fall AGU Continued

Magma focussing and the segmentation of Mid-Ocean Ridges at all spreading rates: T31D, T32D, T41C
This special session will focus on the relationships between along axis variations in magma supply, and the segmentation of Mid-Ocean Ridges at all scales and spreading rates. Recent cruises to the EPR, MAR and SWIR have obtained new data on this topic for a wide range of spreading rates, and models of 3D melt and mantle upflow, mantle melting, along-axis melt migration, and thermo-mechanical properties of the axial lithosphere are being refined. The objective of this session is to promote comparison of these recent observational and theoretical constraints, at all spreading rates. We specifically solicit papers relating the tectonic (and volcanologic) segmentation of mid-ocean ridges with (1) petrological and geochemical constraints on the modes and extent of magma focusing, either in the asthenosphere, or at crustal and lithospheric levels and (2) with geophysical constraints on along-axis variations of crustal and upper mantle structure (and their possible interpretations in terms of magmatic processes). Abstracts addressing these issues through theoretical models of mid-ocean ridges are of course also solicited.
Conveners: *Mathilde Cannat and Lindsay Parson*

Tribute to Marcus Langseth: Recent Advances in Marine Hydrogeology: T31E, T32F, T41A
This session will commemorate the career of Marcus Langseth, who passed away early this year. Mark made numerous important contributions to marine geology and geophysics as well as to the infrastructure of marine geosciences in terms of both instrumentation and ship operations. For over 30 years he was a leading figure in marine geothermal and hydrogeological studies, from both conventional ships and DSDP/ODP drillships. Mark's interests in marine hydrogeology spanned the ocean basins from spreading centers to ridge flanks to subduction zones. We honor his contributions by highlighting recent advances in marine hydrogeology at any of these settings. In particular, 1996 saw four consecutive legs of the Ocean Drilling Program (168-171A) addressing hydrogeological problems at sites where Mark's legacy is especially significant. We welcome abstracts describing these and any other recent investigations relevant to marine hydrogeology. **Conveners:** *Eli Silver and Keir Becker*

Magmatic, Tectonic, and Hydrothermal Processes Along the Southern East Pacific Rise: T41B, T42C
The southern East Pacific Rise (EPR) is the fastest-spreading portion of the global mid-ocean ridge (MOR). Understanding the behavior of the superfast southern EPR is a collective goal that has been addressed by multidisciplinary exploration of its morphology, seafloor properties, water column characteristics, subseafloor velocity structure, and biota. Within the past 3 years these studies have produced significant new results and insights. In 1998-1999, the Alvin submersible will be used on the southern EPR for the first time to investigate and sample sites of interest identified by previous studies. The purpose of this special session is to bring forward the latest results and questions about the southern EPR before the 1998-1999 field season commences.
Conveners: *Rachel M. Haymon, Marie-Helene Cormier, and Daniel S. Scheirer*

Hydrothermal Activity at Different Spreading Rates: V41C, V51E, V52D
This special session will focus on integrating hydrothermal research carried out in different settings on Mid-Oceanic Ridges (MOR). Two themes will be emphasized: the distribution of hydrothermal activity at different spreading rates of the global MOR, and the partitioning of hydrothermal activity and fluxes between diffuse and focussed flow, in axial and off-axial systems. Abstracts relating vent distribution to tectonic and volcanic activity are also welcomed.
Conveners: *Cara Wilson and Chris R. German*

Don't Miss the RIDGE Smoker at AGU

Thursday, Dec. 11, 1997

Japanese Pavillion at the Cathedral Hill Hotel

Upcoming Meetings and Workshops....

Geological Association of Canada/Mineralogical Association of Canada Joint Annual Meeting

Quebec City, Canada, 18-20 May 1998

Special Session:
"Ophiolites: Recent discoveries and implications for the genesis of the lithosphere"

For more details see: http://www.ggl.ulaval.ca/quebec1998.html

Geoscience 1998

Keele University, Staffordshire, UK, 16-17 April 1998

Special Symposium:
"Magmatism and Mineralization in Arcs and Ocean Basins"

For more details see: http://www.geolsoc.org.uk

6th Zonenshain International Conference on Plate Tectonics

Moscow, Russia, 17-20 February, 1998

Organized by:
The L. P. Zonenshain Laboratory of the Institute of Oceanology, The Russian Academy of Sciences, Geological department of the Moscow State University, and GEOMAR Research Institute of Marine Geosciences, Kiel

Eight different symposiums and three workshops are planned, including the following symposia:

InterRidge progress and Russian perspectives
Convenors: M. Cannat, H. Dick and L. Dmitriev
Structure, dynamics, magmatism and fluid flows of subduction zones
Convenors: M. Lomize, E. Suess
Polar regions of the Earth: tectonics and environmental changes
Convenors: S. Drachev, J. Thiede

For more information contact:

Dr. Elena Pristavakina
Institute of Oceanology
Nakhimosky prosp. 36
Moscow 117851, Russia
Tel: +7 095 124 7396
Fax: +7 095 124 5983
E-mail:prist@sbg.geol.msu.ru
or baranov@chip.sio.rssi.ru

InterRidge National Correspondents

Australia
Dr. Trevor Falloon
Geology Department
University of Tasmania
GPO Box 252C, Hobart
Tasmania 7000, Australia
e-mail: Trevor.Falloon@geol.utas.edu.au

Brazil
Dr. Suzanna Sichel
Dept. de Geologia - Lagemar UFF
Av. Litorânea s/n° 4° andar
CEP: 24210-340
Gragoatá Niterói RJ Brazil
e-mail: sichel@spacenet.com.br

Canada
Dr. Kim Juniper
Le Stang - rue Jim Sevellec
Ste-Anne-du-Portzic
29200 Brest, France
e-mail: juniper.kim@uqam.ca

and

Dr. Kathryn M. Gillis
School of Earth and Ocean Sciences
University of Victoria, MS 4015
Victoria, BC V8W 2Y2, Canada
e-mail: kgillis@postoffice.uvic.ca

Denmark
Dr. John Hopper
Danish Lithosphere Centre
Oester Voldgade 10, Kobenhavn
1350, Denmark
e-mail: jrh@dlc.ggu.min.dk

France
Dr. Jean Francheteau, Dorsales Chair
Université de Bretagne Occidentale
Département des Sciences de la Terre
6 Avenue Le Gorgeu
29285 Brest Cédex, France
e-mail: franch@univ-brest.fr

Germany
Dr. Roland Rihm
GEOMAR
Wischofstrasse 1-3, Geb. 12
24148 Kiel, Germany
e-mail: rrihm@geomar.de

Iceland
Dr. Karl Gronvold
Nordic Volcanological Institute
University of Iceland, Geoscience Building
101 Reykjavik, Iceland
e-mail: karl@norvol.hi.is

India
Dr. D. Gopala Rao
Geological Oceanography Division
National Institute of Oceanography
H.O. Dona Paula
Goa 403 004, India
e-mail: ocean@bcgoa.ernet.in

Italy
Prof. Enrico Bonatti
Lamont-Doherty Earth Observatory
Columbia University
Palisades, NY 10964, USA
e-mail: toby@ldeo.columbia.edu

and

Dr. Paola Tartarotti
Dipartimento di Geologià, Paleontologia e Geofisica,
Universita di Padova,
Via Giotto 1,
35137 Padova, Italy
e-mail: tar@epidote.dmp.unipd.it

Japan
Prof. Nobuhiro Isezaki
Department of Earth Sciences,
Faculty of Science, Chiba University,
Yayoi-cho 1-33, Inage-ku, Chiba-shi,
Chiba 260, Japan
e-mail: nisezaki@science.s.chiba-u.ac.jp

Korea
Dr. Sang-Mook Lee
Dept. of Geological Sciences
University of Durham
South Road, Durham
DH1 3LE, UK
e-mail: s.m.lee@durham.ac.uk

Mexico
Dr. J. Eduardo Aguayo-Camargo
Inst. de Ciencias del Mar y Limnologia
U. Nacional Autonoma de Mexico
Apartado Postal 70-305
Mexico City, 04510, Mexico
e-mail: aguayo@mar.icmyl.unam.mx

Norway
Dr. Eirik Sundvor
Institute of Solid Earth Physics
University of Bergen
Allegt. 41
5007 Bergen, Norway
e-mail: eirik.sundvor@ifjf.uib.no

Portugal
Dr. J. Miguel A. Miranda
C. Geofísica da Univ. de Lisboa
Rua da Escola Poliécnica, 58
1250 Lisboa, Portugal
e-mail: miguel@ig2.cc.fc.ul.pt

Russia
Dr. Alexander V. Sobolev
Vernadsky Inst. of Geochemistry
Russian Academy of Sciences
19, Kosygina Street
Moscow 117975, Russia
e-mail: asobolev@glas.apc.org

and

Russia (Continued)
Dr. Sergei P. Maschenkov
VNIIOkeangeologia
1 Angliysky Prospect
190121 St. Petersburg, Russia
e-mail: ocean@sovamsu.sovusa.com

South Africa
Dr. Anton P. le Roex
Department of Geological Sciences
University of Cape Town
Rondebosch 7700, South Africa
e-mail: alr@geology.uct.ac.za

Spain
Dr. Juan José Dañobeitia
Inst. Jaime Almera de Ciencias de la Tierra
CISC
C/Lluis Sole i Sabaris s/n
08028 Barcelona, Spain
e-mail: jjdanobeitia@ija.csic.es

and

Dr. Miquel Canals
Marine Geology Group
Dept. de Geología Dinámica, Geofísica i Paleontologia
Univ. de Barcelona
Zona Universitaria de Pedralbes
08071 Barcelona, Spain
e-mail: miquel@natura.geo.ub.es

Sweden
Dr. Nils Holm
Dept. of Geology and Geochemistry
Stockholm University
S-106 91 Stockholm, Sweden
e-mail: Nils.G.Holm@geokem.su.se

Switzerland
Dr. Gretchen Früh-Green
Department of Earth Sciences
ETH-Z, Sonneggstr. 5
CH-8092 Zurich, Switzerland
e-mail: gretli@erdw.ethz.ch

United Kingdom
Prof. Roger C. Searle
Department of Geological Sciences
University of Durham
South Road, Durham
DH1 3LE, UK
e-mail: R.C.Searle@durham.ac.uk

USA
Dr. Karen Von Damm, RIDGE Chair
RIDGE Office, OPAL
University of New Hampshire
Morse Hall
Durham, NH 03824-3525, USA
e-mail: ridge@unh.edu

InterRidge Steering Committee

Dr. Mathilde Cannat
InterRidge Chair
Laboratoire de Pétrologie
CNRS-URA 736
Université Pierre et Marie Curie
4 place Jussieu
75252 Paris Cédex 05, France
tel: 33-1-44-27-51-92
fax: 33-1-44-27-39-11
e-mail: mac@ccr.jussieu.fr

***Dr. Phillippe Blondel**, ad hoc*
Southampton Oceanography Centre
Empress Dock, Southampton
SO14 3ZH, UK
tel: 44-1703-596-555
fax: 44-1703-596-554
e-mail: pbo@soc.soton.ac.uk

Dr. Miquel Canals
Marine Geology Group
Dept. de Geologia Dinamica, Geofisica i Paleontologia
Univ. de Barcelona
Zona Universitaria de Pedralbes
08071 Barcelona, Spain
tel: 34-3-402-13-60
fax: 34-3-402-13-40
e-mail: miquel@natura.geo.ub.es

***Dr. Alan D. Chave**, ad hoc*
Department of Geology & Geophysics
Woods Hole Oceanographic Institution
Woods Hole, MA 02543, USA
tel: 1-508-289-2833
fax: 1-508-457-2150
e-mail: alan@faraday.whoi.edu

Dr. Dave M. Christie
COAS
Oregon State University
104 Oceanography Adm. Building
Corvallis, OR 97331-5503, USA
tel: 1-541-737-5205
fax: 1-541-737-2064
e-mail: dchristie@oce.orst.edu

Dr. Juan José Dañobeitia
Inst. Jaime Almera de Ciencias de la Tierra, CSIC
C/Lluis Sole i Sabaris s/n
08028 Barcelona, Spain
tel: 34-3-330-2716
fax: 34-3-411-0012
e-mail: jjdanobeitia@ija.csic.es

***Dr. Daniel Desbruyères**, ad hoc*
Directeur du Département de l'Environnement Profond
IFREMER-DRO/EP
Centre de Brest, B.P. 70
29280 Plouzané Cédex, France
tel: 33-98-22-43-01
fax: 33-98-22-45-47
e-mail: ddesbruy@ifremer.fr

***Dr. Christopher G. Fox**, ad hoc*
NOAA/PMEL/VENTS Program
2115 S.E. OSU Drive
Newport OR 97365, USA
tel: 1-541-867-0276
fax: 1-541-867-3907
e-mail: fox@pmel.noaa.gov

Prof. Jean Francheteau
Université de Bretagne Occidentale
Départ. des Sciences de la Terre
6 Avenue Le Gorgeu, B.P. 809
29285 Brest Cédex, France
tel: 33-2-98-01-61-21
fax: 33-2-98-01-66-20
e-mail: franch@univ-brest.fr

Dr. Hiromi Fujimoto
InterRidge Japan
Ocean Research Institute, Univ. of Tokyo
1-5-1, Minamidai, Nakano-ku
Tokyo, 164, Japan
tel: 81-3-5351-6429
fax: 81-3-5351-6429
e-mail: fujimoto@trout.ori.u-tokyo.ac.jp

***Dr. Christopher R. German**, ad hoc*
Challenger Division for Seafloor Processes
Southampton Oceanography Centre
European Way, Empress Dock
Southampton, SO14 3ZH, UK
tel: 44-1703-596-542
fax: 44-1703-596-554
e-mail: cge@soc.soton.ac.uk

Dr. Peter Herzig
Institut für Mineralogie und Lagerstättenlehre
Technische Universität Bergakademie Freiberg
Brennhausgasse 14
09596 Freiberg, Germany
tel: 49-3731-39-2662
fax: 49-3731-39-2610
e-mail: herzig@mineral.tu-freiberg.de

***Dr. Catherine Mével**, ad hoc*
Laboratoire de Pétrologie,
Université Pierre et Marie Curie
4 Place Jussieu, Tour 26, 3ème étage
75252 Paris Cedex 05, France
tel: 33-1-44-27-51-93
fax: 33-1-44-27-39-11
e-mail: cam@ccr.jussieu.fr

Dr. Miguel Miranda
Instituto Nacional de Invest Cientifica
Centro de Geofisica
Universidade de Lisboa
Rua da Escola Politécnica 58
1250 Lisboa, Portugal
tel: 351-1-396-1521 ext 209
fax: 351-1-395-3327
e-mail: miguel@ig2.cc.fc.ul.pt

Dr. Lauren Mullineaux
Biology Department
Woods Hole Oceanographic Institution
Woods Hole, MA 02543, USA
tel: 1-508-289-2989
fax: 1-508-457-2134
e-mail: lmullineaux@whoi.edu

***Dr. Lindsay Parson**, ad hoc*
Southampton Oceanography Centre
Empress Dock, Southampton,
SO14 3ZH, UK
tel: 44-1703-596-541
fax: 44-1703-596-554
e-mail: lmp@soc.soton.ac.uk

Dr. Roland Rihm
GEOMAR
Wischofstrasse 1-3, Geb. 12
24148 Kiel, Germany
tel: 49-431-600-2630
fax: 49-431-600-2978
e-mail: rrihm@geomar.de

Prof. Roger Searle
Dept. of Geological Sciences
University of Durham, South Road
Durham, DH1 3LE, UK
tel: 44-191-374-2537
fax: 44-191-374-2510
e-mail: R.C.Searle@durham.ac.uk

Dr. Eirik Sundvor
Institute of Solid Earth Physics
University of Bergen, Allegaten 41
5007 Bergen, Norway
tel: 47-55-58-3401
fax: 47-55-58-9669
e-mail: eirik.sundvor@ifjf.uib.no

Dr. Kensaku Tamaki
Ocean Research Institute
University of Tokyo
1-5-1, Minamidai, Nakano-ku
Tokyo, 164, Japan
tel: 81-3-5351-6443
fax: 81-3-5351-6445
e-mail: tamaki@aix3.ori.u-tokyo.ac.jp

Dr. Tetsuro Urabe
Geological Survey of Japan
1-1-3, Higshi
Tsukuba, 305, Japan
tel: 81-298-54-3612
fax: 81-298-54-3633
e-mail: urabe@gsj.go.jp

Dr. Karen Von Damm
RIDGE Office, OPAL
University of New Hampshire
Morse Hall
Durham, NH 03824-3525, USA
tel: 1-603-862-4051
fax: 1-603-862-0083
e-mail: ridge@unh.edu