Vol. 10 (1) Spring 2001

InterRidge News

Initiative for international cooperation in ridge-crest studies

Contents

Continued over page ....

InterRidge News is published twice a year by the InterRidge Office, Ocean Research Institute, University of Tokyo, 1-15-1 Minamidai, Nakano, Tokyo 164-8639, Japan. Editor: Agnieszka M. Adamczewska.
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InterRidge Office Updates

Contents continued...

International Ridge-Crest Research cont ...

Errata sheet for InterRidge news, Fall 2000 issue, vol. 9.2

☞ Pp. 18. The species name of the mussle is incorrect. Throughout the article the Latin name *Bathymodius thermophylus* should be replaced with *Bathymodius* ***puteoserpentis***

☞ Pp. 26. The correct authorship for the article "New fields with manifestations of hydrothermal activity in the Logatchev area (14ºN, Mid-Atlantic Ridge)" is as follows:
Cherkashev G.A.[1], Ashadze A.M.[2], Gebruk A.V.[3] **and Krylova E.M.[3]**

☞ Pp. 68 The correct contact details for Dr. Colin Devey, German Steering Committee Representative are;
Tel: + 49 421 218 **9205**
Fax: + 49 421 218 **9460**

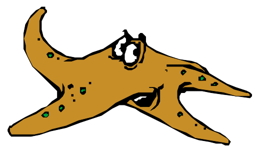
The InterRidge *Wishhhhhh List...*

On suggestion of the IR Steering Committee, we have opened the InterRidge Wishhhhhhh list to facilitate and poromote sample exchange between ridge scientists. Please submit requests for samples, to the IR Office. Iwould like to encourage all ridge scientist to check the Wishhhh list and share samples with your international colleagues. The success of this initiative is dependent on YOU! Below are two requests for samples. If you have such samples to share, please contact the appropriate scientists.

I wish I could get my hands on ....
Requested samples.....

Request for:
CHIMINEY SAMPLES

Samples of manganese encrusted chimneys as well as hydrothermal or hydrogenous ferromanganese samples and associated sediments collected from any other midoceanic ridge system".
Contact: Ranadip Banerjee
<banerjee@darya.nio.org> or
<banerjee@csnio.ren.nic.in>



SEARCH FOR GRAPHITE

Sediment trap deposits collected nearby vents, and/or grab samples of particulates from vents (0.0X to 1 gram quantities). Old collections are OK.
If such materials are available in your drawers, please contact: Jacques Jedwab
<jjedwab@ulb.ac.be>

Wishhhhhh list ....

Would you like to get your hands on certain samples; be they rocks, crabs or tubeworms!
Send your 'wish list' to the InterRidge office and we will post it on the IR website and print it in the next issue of IR news.
Cooperation is the key to good science!

InterRidge Office Updates

Coordinator's Update

Member Nations

The membership of Nations actively involved in InterRidge activities continues to grow. This year, Korea has joined InterRidge as an Associate Member nation. Dr Sang-Mook Lee, from the Deep-Sea Resources Research Center will be the Steering Committee representative for Korea. This brings the total number of countries actively involved in InterRidge to eleven.

The next two years will be crucial for the InterRidge community. The current InterRidge programme is nearing the end of its 10 year plan and it is time for the international community to convene together and develop the "Next Decade" InterRidge plan. During the next Steering Committee meeting, 1-2 June, Kobe, Japan, discussions will be initiated about priority issues that need to be addressed. Representatives from Principal and Associate member nations will meet in a workshop, early next year, to formulate a new "Project plan" for the next decade. The continually increasing number of nations actively involved in InterRidge will ensure that a highly international ridge community will utilise their expertise to define and refine scientific questions and focus interests, thereby, strengthening the InterRidge programme and the future "Project plan". As a consequence, the highly international planning process will be of direct benefit to individual scientists and national programs for the nations involved, while at the same time the "Project plan" will provide opportunities for the involvement of other nations.

Upcoming InterRidge meetings

The new millennium starts off with a busy meetings schedule. A number of InterRidge workshops, and other meetings are already scheduled for 2001, as well as 2002. The demand for sharing and exchange of information and ideas continues to grow. An ever increasing demand to pool resources and expertise, on an international level, in order to maximise research output and minimise costs for individual nations is the driving force for organising more international meetings.

The 2nd International Symposium on Deep-sea Hydrothermal Vent Biology

After the success of the 1st International Symposium on Hydrothermal Vent biology in 1997, Madeira, Portugal, the second meeting is scheduled for 8-12 October 2001 in Brest, France. Registration for this meeting is now open and the latest information about the meeting can be found by following the links from the 'Meetings' menu on the InterRidge home page, or directly from the URL: *http://www.ifremer.fr/2ishvb/*

InterRidge Steering Committee meeting

The next Steering Committee meting will be hosted by Dr. Nobukazu Seama at the Department of Earth & Planetary Sciences, Kobe University, Kobe, Japan 1 – 2 June 2001 (latest information can be accessed at (*http://www.intridge.org/stcom01.html*). An important issue on the agenda will be discussions about formulating the "InterRidge Project plan" for the next decade.

InterRidge MOMAR Workshop

The 2nd MOMAR workshop will take place either late this year or early next year, in the Azores, Portugal. The organisation of the workshop is underway.

InterRidge Theoretical Institute (IRTI): Thermal Regime of Ocean Ridges and the Dynamics of Hydrothermal Circulation

This IRTI is being jointly organized by the Hotspot-Ridge Interactions working group and the Global Distribution of Hydrothermal Vents working group. The IRTI will have a short course component, which will focus on the modelling aspects of the dynamics of hydrothermal circulation in the crust, a field excursion and a workshop component to synthesize the current models, debate controversies, and outline the future directions for collaborative research. The IRTI will be held 9-13 September 2002, at the University of Pavia, Italy, for more information see the back of this issue of IR news or look on the IR website.

SWIR Workshop

A workshop to synthesise current knowledge and identify areas, both disciplinary and geographically that require investigation and decide on future direction of research in this area has been proposed. The plan is to have the workshop in early 2002 at the Southampton Oceanography Centre, UK.

Management and Conservation of Hydrothermal Vent Ecosystems Workshop

This workshop was held at the Institute of Ocean Sciences, Victoria, B.C., Canada, 28 - 30 Sept. 2000 with an aim to bring together scientists, policy makers and mining experts to discuss the future uses and the need for conservation of these unique ecosystems. A workshop report that outlines the issues discussed, proposes a 'code of conduct' for users of these unique ecosystems, and suggests management/conservation strategies should be available anytime now. Please send any comments and feed back on the report to the InterRidge Office. Your input will be greatly appreciated.

This workshop has generated a great deal of interest at an international level and will certainly increase overall awareness within the general community about the potential

InterRidge Office Updates

threats, as well as prove some guidelines as to how the future of these underwater habitats can be secured.

Steering Committee

This year there are quite a number of new Steering committee representatives. The new representative for Norway at the SC will be Prof. Rolf Pedersen, Prof. Fernando Barriga will represent Portugal, Dr. Jérôme Dyment, will be the second French representative, Dr. Toshitaka Gamo will be the second Japanese representative, and of course, as a new Associate member nation Korea will be represented by Dr. Sang-Mook Lee.

The InterRidge programme is now in its 3rd, and final stage of the first decade plan. Thus, a new InterRidge Project plan, for the next decade, will need to be established during this three year term of the InterRidge Office. A Working Group will be formed before the upcoming Steering Committee meeting in 2001, Kobe, Japan. The members of the working group will be the representatives from Principal and Associate Member countries. The working group will plan a workshop in the first half of 2002, to devise a new InterRidge Project plan for the next decade.

Working Groups

After the last Steering Committee meeting the 4-D Architecture working group was dissolved. Additionally, a new working group, the "Hotspot-Ridge Interactions Working Group" was crated, and the Biology working group will continue with new co-chairs: Dr Françoise Gaill (France) and Dr S. Kim Juniper (Canada) and a completely new membership. The membership of the new Biology Working group can be found on page 11 of this issue, as well as on the InterRidge website *http://www.intridge.org/wg-bio.htm*.

The members of the new Biology WG will initially meet on the evening of Sunday, 8th October , during the 2nd International Symposium on Deep-sea Hydrothermal Vent Biology to initiate discussions about the direction of future Ridge Biology research. The group will meet at various other times during the meeting to identify new scientific questions for the Biology WG that will benefit from international cooperation.

New InterRidge Working Group – "Hotspot-Ridge Interactions Working Group"

The "Hotspot-Ridge Interactions Working Group" was formed, with Jian Lin as the chair, in view of relatively new problems relating to various aspects of looking at hotspot-ridge interactions. The membership for this group can be found on page 11, in this issue. A brief outline of the motivations for creating this WG, together with some preliminary objectives and research agenda are on page 13 and on the IR web site at *http://www.intridge.org/wg-hotsp.htm*.

New WG Members

Since Korea has joined InterRidge as an Associate Member Nation, they have nominated the following representatives to join the InterRidge working groups: Dr. Young-Keun Jin as a member of the Arctic Ridges WG; Dr. Sang-Mook Lee as a member of the Back-Arc Basins WG; and Dr. Jung-Ho Hyun as a member of the new Biological Studies WG.

InterRidge home page

We are continuing to upgrade and improve our web site to maximise information transfer and make it user friendly. To make our homepage more interactive we have divided it into two frames. The latest information about meetings, announcements and any other current, ridge related items is now at your fingertips, accessible directly from the left hand side frame on our homepage. The right hand side frame contains the familiar menus with lots of ridge related information. Due to the volume of information on our website a brief outline of what can be found there is available on page 6 of this issue.

We have secured an alias for our website to make the IR URL easy to remember, you can now access the InterRidge home page by simply typing:
http://www.intridge.org

The newest feature on our website is an interactive map (created by Chie Honsho) linked to the "Global hydrothermal vents database". It allows you to search all known hydrothermal vent sites around the world just by clicking on the different areas of the globe! Of course you can still search the database by conventional method by typing in search words in any of the fields. The interactive map can be accessed from the Hydrothermal Vents database menu, just follow the links starting at "InterRidge Databases" on the IR home page. If you have discovered a new hydrothermal vent site remember to send us the information so we can update this database!

We are very pleased to see that the use of the InterRidge website continues to increase. As always, any comments and suggestions are welcome and remember that I always like to receive updates and new information about meetings and ridge related cruises, as well as job vacancies and other ridge related bits and peaces of information. A brief summary of what can be found on the InterRidge website is also available at *http://www.intridge.org/latest.htm*

Agnieszka Adamczewska
InterRidge Coordinator
April 2001

InterRidge Office Updates

InterRidge Website

http://www.intridge.org/

The InterRidge office maintains an extensive web site containing various information including upcoming meetings, scheduled ridge related cruises, job vacancies as well as 9 different databases. These databases on the InterRidge website were initiated in response to a request by the international community to have a 'centralised' clearing house for information collected by scientists all over the world so that relevant information is readily available to everybody at one site. A brief summary of what can be found on the InterRidge website is available at http://www.intridge.org/latest.htm

We are pleased that the use of the InterRdige website is steadily increasing and we continue to encourage you make use of this resource and to continue to submit the latest and up to date information to our office. To make our homepage more interactive we have divided it into two frames. The latest information about meetings, announcements and any other current, ridge related items is now at your fingertips, accessible directly from the left hand side frame on our homepage. The right hand side frame contains the familiar menus, the general contents of which are outlined below. As always any comments and suggestsions are always welcome.

The new alias for the IR website makes the URL easy to remember, you can now access the InterRidge home site by simply typing http://www.intridge.org

1) Information section

This section provides links to Ridge related meetings, cruises and other miscellaneous information, as well as a little bit about InterRidge structure and its role.

Below you will find a brief summary of each of the eleven menus found on the InterRidge homepage.

News

This is the section of our web page that will be changed and updated most frequently based on the information that is received by the InterRidge office. The date of the latest update appears at the bottom right hand corner of the InterRidge home page, as well as the News page itself.

In the News menu you will find a link to the latest broadcast (distributed by email from the InterRidge Office) and new announcements, as well as a link to an archive of past broadcasts.

I will continue to send out e-mail broadcasts with urgent or important information to all our members that have indicated they wish to receive e-mail notices.

This page also provides a link to vacant job positions that are forwarded to the InterRidge office.

The News page will also contain miscellaneous information of interest to Ridge scientists and relevant to InterRidge activities.

About us

An introduction to what is InterRidge, as well as InterRidge Office contact and mailing address details. A short description of the InterRidge programme, including the objectives of the programme as well as management structure and national membership of InterRidge.

Meetings

A calendar of upcoming conferences, meetings and workshopsrelevant to ridge studies, with links to further information as it become available.

Upcoming cruises

This table has appeared in the back of the IR news for a long time, but we now also posted it on our website where the information on upcoming cruises can be updated on a regular basis.

2) Activities section

This section is concerned with the scientific and management structure of InterRidge. The menus in this section are relatively unchanged from the ones that were present on the original home page.

Science plan

An outline of the scientific purpose of InterRidge.

Projects and Working Groups

Currently there are nine Working Groups responsible for different aspects of ridge research. An outline of the current working groups and updates of their activities can be found here.

Additionally this section provides links to major projects that InterRidge is currently involved in and projects that are directly relevant to InterRidge activities - such as MOMAR and Marine Protected Areas project.

InterRidge Office Updates

IR publications

A list of all the publications distributed by the InterRidge office. Many of which are available on request. The most recent publications are available as downloadable PDF files.

Member Nations

A list of the InterRidge National Correspondents, and their contact details, from all of our Member Nations.

3) InterRidge databases section

One of the major objectives of InterRidge is to facilitate the advancement of ongoing work of individuals, national and international groups by providing centralised information and data-exchange services. Thus, we maintain a number of databases that contain data submitted from Ridge scientists from around the world. We rely on contributions from individuals to continuously update the information and increase the number of records. I would like to take this opportunity to encourage everyone to become familiar with the databases on our website and contribute information on a regular basis to ensure that this important resource contains current and up to date information. An overview of the databases maintained by InterRidge appears below and can also be found on our website.

Member directory

If you want to find the contact details of somebody involved in Ridge research, this is the place to look for them. Is your name in our database? If its not and you are involved in Ridge related research then please take a moment to fill in our electronic membership: just click the “Mailing list sign up” on the home page or fill in the signup form in this issue.

Reference search

A new database with references related to all aspects of Ridge research. Make sure you check this out and add your ridge related publications to this database!

Other services

Here you will find links to two more reference databases maintained by InterRidge. Again, the reference databases are a great resource and require your regular input.

Furthermore, you can calculate the spreading rate of the sea floor at any place around the globe!

Hydrothermal Ecological Reserves Page

http://triton.ori.u-tokyo.ac.jp/~intridge/reser-db.htm

This page lists all the current ecological reserves that have been proposed at hydrothermal vents. These vary in breadth and scope; at Juan de Fuca the Canadian government has proposed the Endeavour vent field as a pilot marine protected area, while other reserves consist of requests from individual scientists conducting experiments in specific areas. There is also an on-line form to submit reserves to the page.

Overview of databases:-

International MOR & BAB Cruise Database

A database of over 300 cruises compiled since 1992, which have taken place on mid-ocean ridges or in back-arc basins. The database contains the principal investigators, the ship, the study region and a short summary of the cruise objectives. The information for these cruises can also be accessed from an on-line map.

International Vessel & Vehicle Database

A database of vessels and vehicles (submersibles etc) capable of conducting mid-ocean ridge science. Links are provided to that ship’s homepage, for access to up-to-date scheduling information.

Hydrothermal Vent Faunal Database

A database of almost 500 species of fauna found at hydrothermal vents listing the general geographic range of the species and references.

MOMAR References Database

A database of over 300 references from the MOMAR region (the Mid-Atlantic Ridge near the Azores).

Hydrothermal Vent Database

A database listing the known (*i.e*. ground-truthed) and suspected (*i.e*. plumes observed, vents not yet ground-truthed) vents, including the location, general description, and references. Its one of a kind! Have you discovered a new vent site or confirmed an existence of a suspected one? Let us know about it!

This new database now has an interactive map which allows you to search all known hydrothermal vent sites around the world just by clicking on the different areas of the globe !

Hydrothermal Vent Biology Samples

Data on existing hydrothermal vent biology. Samples are presented in two ways: (1) short summaries of the major collections of hydrothermal vent biology samples and (2) a database of existing samples (still under development). Researchers with hydrothermal biology samples are strongly encouraged to submit information to either form.

InterRidge Office Updates

InterRidge Publications

The following InterRidge publications are available upon request. Fill out an electronic request from at http://www.intridge.org/act3.html
or contact the InterRidge office by e-mail at intridge@ori.u-tokyo.ac.jp.

InterRidge News:

Past issues of InterRidge News, are avalable starting with the first issue published in 1992 until the present. Information about the research articles published in each issue can be found on the InterRidge website: http://www.intridge.org/irn-toc.htm

The InterRidge News issues published from 2000 (*ie*. InterRidge News 9.1 and all following issues) are available as downloadable PDF files from the same URL address on the InterRidge website, using Adobe Acrobat 4.0 or later versions.

Workshop and Working Group Reports:

InterRidge **MOMAR (*MO*nitoring the *M*id-*A*tlantic *R*idge)** workshop report, April, 1999.
InterRidge **Mapping and Sampling the Arctic Ridges: A Project Plan**, pp. 25, December 1998.
ODP-InterRidge-IAVCEI Workshop Report: **The Oceanic Lithosphere and Scientific Drilling into the 21st Century**, pp. 89.
InterRidge Global Working Group Workshop Report: **Arctic Ridges: Results and Planning**, pp. 78, October 1997.
InterRidge **SWIR Project Plan**, pp. 21, October 1997 (revised version).
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.

Workshop and Symposium Abstract Volumes:

InterRidge Workshop: **MOMAR (*MO*nitoring the *M*id-*A*tlantic *R*idge)** Abstract Volume, pp. 82, Oct. 1998.
InterRidge Workshop: **Mapping and Sampling the Arctic Ridges** Abstract Volume, pp. 30, Oct. 1998.
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.
ODP-InterRidge-IAVCEI Workshop: **The Oceanic Lithosphere and Scientific Drilling into the 21st Century**, pp. 126, 1996.

Steering Committee and Program Plan Reports:

InterRidge STCOM Meeting Report, WHOI, USA, 2000.
InterRidge STCOM Meeting Report, Bergen, Norway, 1999.
InterRidge STCOM Meeting Report, Barcelona, Spain, 1998.
InterRidge STCOM Meeting Report, Paris, France, 1997.
InterRidge STCOM Meeting Report, Estoril, Portugal, 1996.
InterRidge STCOM Meeting Report, Kiel, Germany, pp. 22, 1995.
InterRidge STCOM Meeting Report, San Francisco, USA, 1994.
InterRidge STCOM Meeting Report, Tokyo, Japan, 1994.
InterRidge STCOM Meeting Report, Seattle, USA, pp. 6, 1993.
InterRidge Meeting Report, York, UK, 1992.
InterRidge Meeting Report, Brest, France, pp. 39, 1990.
InterRidge Program Plan Addendum 1997, pp. 10, January 1998.
InterRidge Program Plan Addendum 1996, pp. 10, April 1997.
InterRidge Program Plan Addendum 1995, pp.10, 1996.
InterRidge Program Plan Addendum 1994, pp.15, 1995.
InterRidge Program Plan Addendum 1993, pp. 9, 1994.
InterRidge Program Plan, pp. 26, 1994.

Send to (address also on the reverse side): InterRidge Office, Ocean Research Institute, University of Tokyo, 1-15-1 Minamidai, Nakano, Tokyo 164-8639, Japan

InterRidge Mailing List Sign up Form

Or sign up on the web at:

http://www.intridge.org/signup.htm

You can use this form to join our regular mailing list to receive *InterRidge News*, or to be placed on our electronic mailing list and to be put on the electronic directory on the web (**http://www.intridge.org**). Currently there are over 2800 scientists active in mid-ocean ridge research on our mailing list. The electronic directory contains a listing of each researcher's field of interest and expertise as well as their full address information. Links are also provided to personal or departmental web pages.

Indicate whether you would like to

☐ *receive electronic notices and information (include your e-mail address)*
☐ *receive the IR news and be on our mailing list*
☐ *This is a hange of address notice.*

Name (Title, First, Last)

____

Department/Institute________________________________

Address________________________________

____

City____________________ **State/County**____________________

Post Code____________________ **Country**____________________

Phone:____ country code area code number **Fax:**____ country code area code number

E-mail:________________________________

WWW: ________________________________

What are your fields of interest/expertise?

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

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InterRidge Office Updates

Overview of InterRidge Working Groups

More information on working groups can be found on our website;
http://www.intridge.org/act2.html

Arctic Ridges

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

Current Activities: Coordination of international cruise to the Gakkel Ridge in 2001.

Chair: Colin Devey (Germany)

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

Back-Arc Basins

Objectives: Summarize past work on Back-Arc Basins and coordinate future studies.

Current Activities: Compiling report on past work in Back-Arc Basins.

Chair: J.-M. Auzende (France)

WG members: Ph. Bouchet (France), J.-L. Charlou (France), K. Fujioka (Japan), E. Grácia (Spain), P. Herzig (Germany), J. Ishibashi (Japan), Y. Kido (Japan), S-M. Lee (Korea), R. Livermore (UK), S. Scott (Canada), R. J. Stern (USA), K. Tamaki (Japan), and B. Taylor (USA).

Biological Studies

Objectives: The primary objectives of this working group have been addressed and under new chairman ship a set of new objectives will be discussed at a meeting to be held in conjunction with the Vent Biology symposium in Brest, Oct. 2001

Chairs: F Gaill (France) and S.K. Juniper (Canada).

WG members: M. Biscoito (Portugal), O. Gierre (Germany), J-H Hyun (S. Korea), A. Metaxas (Canada) T. Shank (USA), K. Takai (Japan), P. Tyler (UK) and F. Zal (France)

Global Digital Database

Objective: Establish a database of global multibeam bathymetry and other data for mid-ocean ridges and back-arc basins.

Current Activities: Compiling data.

Chair: Philippe Blondel (UK)

WG members: J. S. Cervantes (Spain), C. Deplus (France), M. Jakobsson (Sweden), K. Okino (Japan), M. Ligi (Italy), R. Macnab (Canada), T. Matsumoto (Japan), K. A. K. Raju (India), W. Ryan (USA), and W. Weinrebe (Germany).

Global Distribution of Hydrothermal Activity

Objectives: Target key areas of the global MOR that should be explored for hydrothermal activity and coordinate international collaboration to explore them.

Current Activities: Organizing the InterRidge Theoretical Institute on the Thermal regime of Ocean Ridges and the Dynamics of Hydrothermal Circulation to be held in the Spring of 2001.

Chair: Chris R. German (UK)

WG members: E. Baker (USA), Y. J. Chen (USA), D. Cowan (UK), T. G. Gamo (Japan), E. Grácia (Spain), P. Halbach (Germany), S.-M. Lee (Korea), G. Massoth (N.Z), J. Radford-Knoery (France), A-L. Reysenbach (USA), D. S. Scheirer (USA), S. D. Scott (Canada), K. G. Speer (France), C. A. Stein (USA), V. Tunnicliffe (Canada) and C. L. Van Dover (USA).

4-D Architecture

The working group was dissolved during the IR Steering Committee meeting in June 2000.

HotSpot-Ridge Interactions

Objectives: This WG was formed during the 2000 Steering Committee meeting to promote and facilitate global research to better understand the physical and chemical interactions between mantle plumes and mid-ocean ridges and their effects on seafloor geological, hydrothermal, and biological processes.

Current Activites: The agenda for this new WG is being developed.

Chair: J. Lin (USA)

WG members: R.K. Drolia (India), J. Dyment (France), J. Escartín (France), J. Freire Luis (Portugal), E. Grácia (Spain), D.W. Graham (USA), K. Hoernle (Germany), G.T. Ito (USA), L.M. MacGregor (UK) N. Seama (Japan)

Event Detection and Response & Observatories

Objectives: Develop detection methods of transient ridge-crest seismic, volcanic and hydrothermal events, and the logistical responses to them.

Current Activites: Development of MOMAR project.

Chair: Chris Fox (USA)

WG member: K. Mitsuzawa (Japan)

SWIR

Objective: Coordinate reconnaissance mapping and sampling of the Southwest Indian Ridge.

Current Activities: Coordinating upcoming cruises.

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), T. Kanazawa (Japan) and C. L. Van Dover (USA).

Undersea Technology

Objective: Foster the development of undersea technology and disseminate information about it.

Current Activities: Development of MOMAR project.

Chair: Alan Chave (USA)

WG members: J. R. Delaney (USA), H. Momma (Japan), J. Kasahara (Japan), M. Kinoshita (Japan), A. Schultz (UK), D. S. Stakes (USA), P. Tarits (France) and H. Villinger (Germany).

Updates on InterRidge Projects

Event Detection and Response/Observatories Working Group

Chris Fox, Chair (fox@pmel.noaa.gov)

NOAA/PMEL, 2115 S.E. OSU Drive, Newport, OR 97365 USA

Acoustic monitoring of North Atlantic seismicity continues using six hydrophones (see InterRIDGE News 8.1, March, 1999). The first year of data has been retrieved, processed and posted on NOAA/PMEL web site at *http://www.pmel.noaa.gov/vents/acoustics/seismicity/seismicity.html* Results are extremely exciting and there were several presentations at the Fall 2000 AGU meeting in San Francisco. The R/V ATLANTIS will service the array in March, 2001 and the second year's results will be posted as they become available. A third year of observations was approved by the National Science Foundation and a plan to maintain the array as a long-term observation system has been proposed.

Planning for a follow-up workshop for MOMAR (MOnitoring the Mid-Atlantic Ridge) has begun with a tentative date and location of late 2001, early 2002 in the Azores. More information will be broadcast as plans are assembled.

The Working Group Chair, Chris Fox, is scheduled to rotate off the Steering Committee after the June 2001 meeting. Anyone interesting in assuming these duties should let the INTERRidge Office know of their interest.

Gorda Ridge Eruption

At about 0055 GMT on JD 094 (Tuesday April 3, 1800 PDT), volcanic seismicity was detected by the NOAA/PMEL T-phase Monitoring System, which continuously monitors northeast Pacific seismicity using the Navy SOSUS arrays. The current activity is located on the central Gorda Ridge. The initial 18 hours of activity are very similar to earlier JdF events: no large main shock, rapidly repeating earthquakes, the presence of a band of continuous tremor, and evidence of epicentre migration downrift presumably related to magma dike injection. Nearly 1,000 events were hydroacoustically detected in the first 18 hours. The event is relatively loud, being heard on multiple SOSUS arrays even without the benefit of beamforming, with several events being recorded by the Pacific Northwest seismic arrays. No clear acoustic evidence of eruption has been detected as of 4/5 0830 PDT.

The general location is at 42.17 N, 127.083W (or 42 10'N; 127 5'W). This location is on the segment just below the North Gorda segment, which was the site of the February 1996 eruption. The location is analogous to that event, being located near the summit of the "narrowgate" on the south side.

A response effort is currently under discussion by the combined event response team funded by NSF RIDGE and the NOAA Vents Program. Jim Cowen (U Hawaii) and Bob Embley (NOAA/PMEL) are coordinating the response effort. Equipment has been pre-staged in Seattle for the response.

Details of the event, response coordination, and all new developments will be broadcast at the following web site: *http://www.pmel.noaa.gov/vents/acoustics/seismicity/nepac/gordaridge01.html*

Information on the activities of InterRidge Working Groups can be found on the IR web site under the menu "Projects & WG" or by going directly to:

http://www.intridge.org/act2.htm

Past updates of the EDR/O WG can be found on the InterRidge web page at:

http://www.intridge.org/wg-edr.htm

Updates on InterRidge Projects

Arctic Ridges Working Group

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The planning for the joint American-German two-ship cruise to the Gakkel Ridge (Arctic Ocean) is entering the final stages. The ships will leave Tromso, Norway in late July for a two-month geophysical/petrological expedition to this previously virtually unstudied ridge (the rationale behind the cruise is outlined in the InterRidge workshop reports). The major aims are to achieve a first-order sampling of a major portion of the ridge and to collect geophysical information relevant to the crustal production processes occurring on this slowest-spreading of all ridges. An overview of the cruise plan is presented in this volume (see page 45). Some information on the petrological aspects of the cruise are available at *http://www.mpch-mainz.mpg.de/~geo/Arctic*

Of further interest to the Arctic Ridge working group are the IODP (successor to ODP, designated starting date October 2003) plans for alternative drilling platforms. There is a strong thrust in Europe (lead, amongst others, by Prof. Jörn Thiede, Alfred-Wegner-Institute for Polar Research, Bremerhaven) to build an ice-breaking drill ship, capable of drilling in the high arctic. This ship could make many fascinating targets of InterRidge significance accessible.

Past updates of the Arctic Rdiges WG can be found on the InterRidge web page at:

http://www.intridge.org/arctic.htm

Hotspots-Ridge Ineractions Working Group

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Nearly all of the global mid-ocean ridge system is hidden beneath the oceans, except where it interacts with hotspot mantle plumes, such as Iceland, the Azores, and the Galapagos. It is estimated that the hotspot mantle plumes affect > 12,000 km of the global mid-ocean ridge system. The hotspot plumes provide a unique tectonic window seeing into mantle convection and geochemical heterogeneities of the Earth's deeper layers. They also cause systematic geochemical, geological, and geophysical variations on the ridge system and provide shallow bathymetric regions for deep-sea biological colonies. The last decade has witnessed several exciting new discoveries on the internal structure of oceanic hotspots and their interaction with ridges. However, due to the complexity of hotspot-ridge interactions and the global distribution of hotspots, it is clear that improved communication is needed to make the future international investigations better coordinated, multi-disciplinary, and cost-effective.

The New Working Group

In 2000 the InterRidge Steering Committee recommended the creation of a new InterRidge Working Group on "Hotspot-Ridge Interactions". The first Working Group consists of ten scientists who are actively working on hotspot-ridge research from France, Germany, India, Japan, Portugal, Spain, UK, and US (a list of members can be found on Page 11). The charge of this new Working Group is to promote and facilitate global research to better understand the physical and chemical interactions between mantle plumes and mid-ocean ridges and their effects on seafloor geological, hydrothermal, and biological processes. A Working Group plan will be formulated in the upcoming months.

The first activity of the Working Group was the creation of an

Updates on InterRidge Projects

InterRidge web page on "Hotspot-Ridge Interactions" (*http://www.intridge.org/hotspot.htm*). The initial features of this web page include the geographic coordinates, relevant cruises, and research paper references on a global array of 18 near-ridge hotspots including Afar, Ascension, Azores, Balleny, Bouvet, Cobb, Discovery, Easter, Galapagos, Gough, Guadalupe, Iceland, Jan Mayen, Louisville, Marion, Shona, St. Paul/Amsterdam, and Tristan da Cunha. It is envisioned that this web page will eventually establish on-line access to the latest discoveries, references, abstracts, future conferences, new cruises, and shared data resources. The Working Group welcomes comments and suggestions on how this web page can be made most useful to researchers. Please send correspondence to the InterRidge office (intridge@ori.u-tokyo.ac.jp) or Working Group Chair Jian Lin (jlin@whoi.edu).

Recent Workshops

The US RIDGE Program sponsored a workshop on "Physical and Chemical Effects of Mantle Plume - Spreading Ridge Interaction" on June 26-28, 2000 in Troutdale, Oregon (http://ridge.oce.orst.edu/meetings/PRIworkshop). The workshop was convened by Dave Graham, Garrett Ito, and John Chen and attended by approximately 50 researchers and students. The objectives of the workshop were (1) to provide a forum for discussing recent and ongoing research, (2) to assess our current understanding of mantle plume-spreading ridge systems, and (3) to identify the most important outstanding problems and establish a coordinated strategy to address them. Keynote talks and discussion sessions of the workshop were organized around three inter-linked themes of geodynamics and mantle flow, plate tectonic evolution, and magma genesis, crustal accretion and hydrothermal activity. A set of recommended investigative strategies will be included in a progressing workshop report. In addition, a special session on "Interaction between Hotspots and Mid-Ocean Ridges" was held during the European Geophysical Society (EGS) meeting on March 26-30, 2001 in Nice, France (Javier Escartin, Sara Bazin, and Wayne Crawford, convenors).

A symposium on "Icelandic Plume and Crust" will be held in Iceland on September 8-10, 2001 (Emilie Hooft Toomey, Bryndís Brandsdóttir, and Sean Solomon, convenors). This meeting will bring together US, Icelandic, and international investigators to integrate new seismic results with modelling and geophysical, geological, and geochemical studies. The symposium is sponsored by the US National Science Foundation, the Iceland Research Council, the US RIDGE office, and the Svartsengi Geothermal Power Plant (*http://ridge.oce.orst.edu/meetings/IceSeis2001*).

The RIDGE "Integrated Studies" Sites

The "RIDGE 2000 Program" is being proposed to succeed the current RIDGE Program in the US. The new program is built around two multi-disciplinary, collaborative science themes, "Integrated Studies" and "Exploratory and Time-Dependent Studies" (*http://ridge.oce.orst.edu*). The "Integrated Studies" are envisioned to be "cohesive, integrated experiments at a small number of selected sites, designed to fully characterize the fundamental 'type' units of the global system as integrated volcanic, tectonic and biological systems from mantle to ocean". In response to a call for nominations, the RIDGE office received two proposals from the US research community on hotspot-influenced spreading centre sites: the Galapagos and Iceland. The nominations for these and other "Integrated Studies" sites can be found in the RIDGE web page (*http://ridge.oce.orst.edu/Integ_Studies*).

Latest information about the Hotspot-Ridge Interactions Working Group as well as a link to "Ridge-Hot Spot Interactions Reference Database", which inlucdes an interactive map, and links to relevant cruises can be found on the InterRidge web page at:

http://www.intridge.org/wg-hotsp.htm

We encourage and welcome new reference submissions to the Ridge-Hot Spot database.

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

New zoarcid fish species from deep-sea hydrothermal vents of the Atlantic and Pacific Oceans

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Introduction

The fish family Zoarcidae has 45 genera, two of which have been recorded from active hydrothermal vent fields, *Pachycara* Zugmayer, 1911 and *Thermarces* Rosenblatt & Cohen, 1986.

The genus *Pachycara* contains 17 species occurring in the Pacific, Atlantic, Antarctic and Indian Oceans (Møller and Anderson, 2000). Three of them, *P. gymninium* Anderson and Peden, 1988, *P. rimae* Anderson, 1989 and *P. thermophilum* Geistdoerfer, 1994, have been collected in active deep-sea hydrothermal vents, the last two being endemic to this type of environment (Tunnicliffe *et al.*, 1998).

To date, only one species of *Pachycara* (*P. thermophilum*) has been recorded from the Mid-Atlantic Ridge hydrothermal vents. This species was originally described from Snake Pit (23°22´N, 3,480 m) and subsequently found at Logatchev (14°45´N, 3,000 m), TAG (26°N, 3,700 m) and Broken Spur (29°N, 3,020 m) (Parin, 1995; Anderson and Bluhm, 1996; Geistdoerfer, 1997).

In contrast with *Pachycara*, *Thermarces* has only 3 nominal species, all of them restricted to chemosynthetically-driven environments: *Thermarces cerberus* Rosenblatt & Cohen, 1986, from 21°N, 13°N, 11°N and 9°N, in the East Pacific Rise and also in the Galapagos Ridge, *T. andersoni* Rosenblatt & Cohen, 1986 from 13°N EPR [considered a doubtful species (Anderson, 1994)], and *T. pelophilum* Geistdoerfer, 1999 from the Barbados accretionary complex.

Collection of specimens

Mid-Atlantic Ridge - (*Pachycara* n. sp.).

In 1997 the newly discovered Rainbow vent field, in the Mid-Atlantic Ridge (36°13.8´N, 2270 – 2320 m) was first visited by biologists, during *Nautile*'s diving cruise MARVEL (Aug – Sept 1997, PIs: D. Desbruyères and A-M. Alayse). In one of the dives (PL 1197, 23/8/1997) a zoarcid fish was seen dwelling among mussels (Fig. 1). At that time it was impossible to collect a specimen. One year later, during AMORES cruise PICO (Jun – Jul 1998, PI: D. Desbruyères) and the Franco-Portuguese AMAR (Luis Mendes-Victor, FCT contract PRAXIS/2/2.1/MAR/1748/95), cruise SALDANHA (July 1998, PI: F. Barriga), Rainbow vent field was revisited and explored with *Nautile*. This time 6 specimens were collected with the submersible's slurp-gun, and preserved for identification.

Figure 1. *Pachycara* sp. n. amongst mussels at Rainbow vent field. Photograph taken from video recorded by the Nautile during MARVEL cruise (Atlantic Ocean).

Figure 2. *Thermarces* sp. n. at 9°50'N, EPR. Photograph taken from video recorded by the Nautile during HOT'96 cruise (Pacific Ocean).

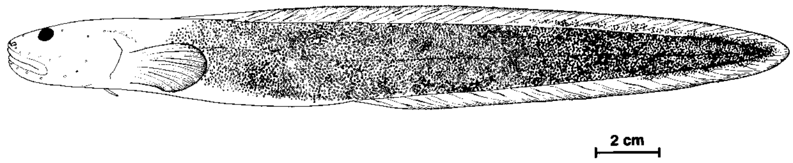

Figure 3. *Pachycara* sp. n. Drawing of the holotype, 247 mm SL.

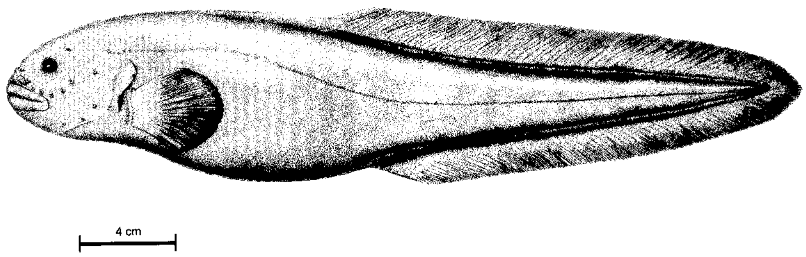

Figure 4. *Thermarces* sp. n. Drawing of the holotype, 375 mm SL.

East Pacific Rise, 9°N (*Thermarces* n. sp.).

Two specimens were collected with a baited fish trap during HOT 96 cruise (Feb – Mar 1996, PI: F. Gaill.) (*Nautile* dive PL 1079, 08/03/1996) at the East Wall site (9°50.6'N, 2530 m) among mussels (many of them dead) (Fig. 2).

Results

Pachycara n. sp. (Fig. 3)

This new species, being described elsewhere, is distinguished by the following characters: 31-32+85-86=117 vertebrae, gill rakers 2+14, dorsal fin with 109 rays, anal fin with 90-91 rays, pelvic fins present, with 2 rays, their length 11.4-13.5% HL, lateral line with medium-lateral and ventral branches, the latter very inconspicuous, scales absent from cheek, nape and abdomen.

It is undoubtedly very closely related to *P. thermophilum* Geistdoerfer, 1994, which also occurs in the same type of environment, 1,100 km south of Rainbow vent field. The first major difference found in our specimens is the presence of two branches of the lateral line (medium-lateral only in *P. thermophilum*).

Other differences include the interorbitary width, which is consistently higher in our specimens than in *P. thermophilum* and the number of caudal vertebrae and dorsal and anal fin rays, whose counts are also higher in our specimens. In fact the vertebral formula do not coincide with any of the other 17 described species of *Pachycara*, with the exception of *P. bulbicep*s, Garman,1899, which can easily be separated from our new species by the absence of pelvic fins.

Colour, uniformly light brown with whitish scale pockets, gives the specimens a mottled appearance. Outer margins of dorsal, anal and pectoral fins are dark. Eyes bluish and abdomen dark bluish brown. On video images taken by the submersible, the specimens appear almost white, with dark dorsal, anal and pectoral fins.

To date, this species is only known from Rainbow hydrothermal vent field, Mid-Atlantic Ridge (36°13.8'N, 2 270 – 2 320 m).

Thermarces n. sp. (Fig. 4)

This new species, being described elsewhere, is diagnosed by the following characters: vertebral formula 26-27+61=87-88, 79-81 dorsal fin rays, 15 pectoral fin rays and four teeth in a single row on vomer.

Our two specimens can easily be separated from *T. cerberus* and *T. pelophilum* by the above mentioned characters. Moreover, in all specimens of *T. cerberus* examined, teeth on vomer are not only more numerous, but always arranged in a patch, and not in a single row. Although colour should not be used as a diagnostic characteristic, it is worthwhile noting that our two specimens were uniformly dusky brown, when captured. After four years in preservative, they have more or less kept the same colour. On the contrary, *T. cerberus* when fresh, are very light yellowish brown, sometimes mottled. After an equivalent time in preservative they become colourless. Another remarkable difference is the size of the body. *Thermarces* n. sp. is noticeable more corpulent than *T. cerberus*. Both differences, in colour and size, were confirmed by video observations.

This new species is only known with certainty from 9°N, 2520 m, East Pacific Rise.

Ecological information

Pachycara n. sp. lives well inside the active areas, usually amongst mussels and in between small boulders at the base of chimneys. Direct observations showed that these fish are usually solitary, the minimum observed distance between two specimens being 1.5 m. Consequently they seem not to be very abundant. In general they are not very active, unless disturbed. The temperature measured with *Nautile*'s probe in the exact place where a specimen was collected at Rainbow (marker PP37, 2287 m), was 15°C. Sea water temperature outside the active site was 3.8°C.

Stomach content analysis in one specimen revealed the remains of shrimp *Rimicaris exoculata* (Crustacea, Decapoda, Bresiliidae) together with orange-brown particles of oxides, very characteristic of Rainbow vent field. Based on the information available, *Pachycara* n. sp. can probably be considered endemic to Rainbow.

Thermarces n. sp. collected at East Wall (EPR, 9°N) lives inside or in the periphery of mussel beds (*Bathymodiolus thermophilus*) covering certain depressions on the basalts, bathed by mild temperature hydrothermal fluids (6.7°C) coming from diffuse vents (sea water temperature was 1.7°C). At this site the density of these fish was very low (4-5 individuals over several tens of square metres).

During the mission HOPE 99 (Apr – May 1999, PI: F. H. Lallier), great effort was made to obtain more specimens of this new species. All vent zoarcids collected at 13° and 9°N belonged to the species *T. cerberus*, which live in great numbers amongst clumps of *Riftia pachyptila*. On video images, all specimens observed showed the typical whitish colouration, leading us to conclude that they were all *T. cerberus*. At 9°N, none of the specimens recorded on video during the mission could be assigned to this new species, neither at East Wall, nor at various other sites extending 5 km further north.

Conclusions

The finding of these new species reinforces the position of the family Zoarcidae, as the dominant fish taxon in the hydrothermal vent environment. In the description of *Thermarces* n. sp., the authors will deal with the affinities of the new species with the *T. cerberus*/*T. andersoni* complex. In future missions to the EPR, emphasis should also be put in obtaining more specimens from *Thermarces* n. sp., not only to obtain material for genetic analyses in order to establish the relationship between the two species, but also to ascertain their distribution. We also expect to be able to collect more specimens of *Pachycara* n. sp. during the forthcoming ATOS cruise, scheduled for June 2001, in order to obtain material for genetic analyses.

Acknowledgements

The authors are indebted to Françoise Gaill, Daniel Desbruyères, Fernando Barriga and François Lallier, Chief-Scientists of HOT 96, MARVEL and PICO, SALDANHA and HOPE 99 cruises respectively, for the invitations to take part in these cruises and collaboration on board. Thanks are also due to the Captains and crews of the French *N/O Nadir* and *N/O L'Atalante*, the pilots and technicians of the deep submersible *Nautile*, and several colleagues for all their help at various levels during the cruises. Helena Encarnação of the Museu Municipal do Funchal (História Natural) made the fine illustrations.

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

Report on the Discovery of *Gallionella ferruginea* from an active Hydrothermal Field in the Deep Sea

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The iron bacterium *Gallionella ferruginea* has been described from a variety of different habitats, including freshwater ferruginous mineral springs, shallow brackish waters, and also from marine hydrothermal shallow water environments (Hanert, 1989; Hanert, 1992), but this is the first report of *G. ferruginea* from an active, deep sea hydrothermal venting site.

The role these bacteria play in oxidizing and fixing iron has been known for more than 150 years. In order to get their energy out of the oxidation of iron, they must live in a relatively specific environment containing reduced iron, the right amount of oxygen and sufficient amounts of carbon, phosphorus and nitrogen. By oxidizing the dissolved iron, the bacteria remove it from the water and produce an insoluble precipitate of ferric hydroxide (Hanert 1989; Hanert 1992; Lütters-Czekalla, 1990).

Iron mineralisations from hydrothermal fluids that are emitted at the seafloor occur mostly as massive sulphides. However, iron hydroxide precipitates, mainly in the form of jasper, also exist in many submarine hydrothermal fields. Relic filamental structures within the jasper indicate bacterial origin (Juniper *et al.*, 1995). Here we show that vent fluid from an active field in the North Fiji Basin contains well-preserved stalks of *G. ferruginea*, the precipitation of iron hydroxide by bacterial action can consequently also take place in these extreme environments.

In the North Fiji Basin several hydrothermal fields are known. In addition to the extinct, sulphide-dominated chimney- and mound-fields, and the active high-temperature sulphatic White Lady Site, low-temperature, diffuse vents also exist. These low temperature fields were the main research focus of cruise, SO 134, with the German *R/V Sonne* in September 1998.

For the sea-floor survey we mainly used the Hydro Bottom Station (HBS), a device especially constructed for the sampling and monitoring of diffuse vents. Its frame carries two TV cameras, and supports probes which enable measurement of several physico-chemical parameters, which together with the video pictures are transmitted on-line directly on board. Hydrothermal fluids can be sampled from about 1 m above as well as up to 15 cm below the seafloor surface.

The studied venting sites occur in the North Fiji Basin along the central spreading ridge in the northern part of the N15 segment at 173°54.9'E and 16°59.5'S; they are usually characterized by elongated mounds consist of highly fractured, glassy basaltic (N-MORB) pillow lava material. Within a radius of about 20 m, biological activity increased with closer proximity to the vents and culminated in an abundance of up to 300 individual animals per square meter (mostly *Bathymodiolus, Ifremeria, Alviniconcha,* and *Munidopsis*), clustering immediately above and around the vents. The fluid samples were taken in a water depth of 1995 m. In the immediate surroundings of the venting sites no signs of present or former high-temperature activity were detected. White (bacterial mats? silica precipitates?) and brown (iron oxide) patches were abundant in close proximity to the vents. At the venting site itself, the water was strongly shimmering with an outflow estimated at 3-4 cm/sec, the flow however, was not continuous but rather rhythmically pulsating.

With the *in situ* HBS analytical capabilities we measured temperatures of the emanating fluids between 3.0 and 12.6°C, pH values between 7.0 and 7.7 (mean 7.5), and Eh values reaching from +103 to -75 mV (mean -38 mV), the latter coinciding with the highest temperature; the ambient sea water on the other hand had a temperature of 2.2°C and an Eh between 260 and 360 mV, averaging 280 mV, and a pH of approximately 7.9.

Further analyses revealed that the hydrothermal fluids have relatively constant values of 10 mmol/L Ca and 55 mmol/L Mg, Si varies between 0.1 and 0.3 mmol/L, Mn between 31 and 894 nmol/L (mean 239), Fe between 5 and 759 nmol/L (mean 137), and methane contents vary between 32 and 1640 nmol/L. The total S^{2-} varied between 0.02 and 130 µmol/L, thiosulphate concentrations ranged from below the detection limit of 0.07 to 3.2 µmol/L, and sulphite from below the detection limit of 0.05 to 3.2 µmol/L. These latter compounds are intermediate, metastable products of the aerobic oxidation of sulphides to sulphate. Since in our samples a considerable amount of sulphide was detected, the low thiosulphate and sulphite concentrations observed could result from the oxidation of the reduced forms to the more oxidised sulphur species.

The low metal and high gas concentrations indicate the origin of the

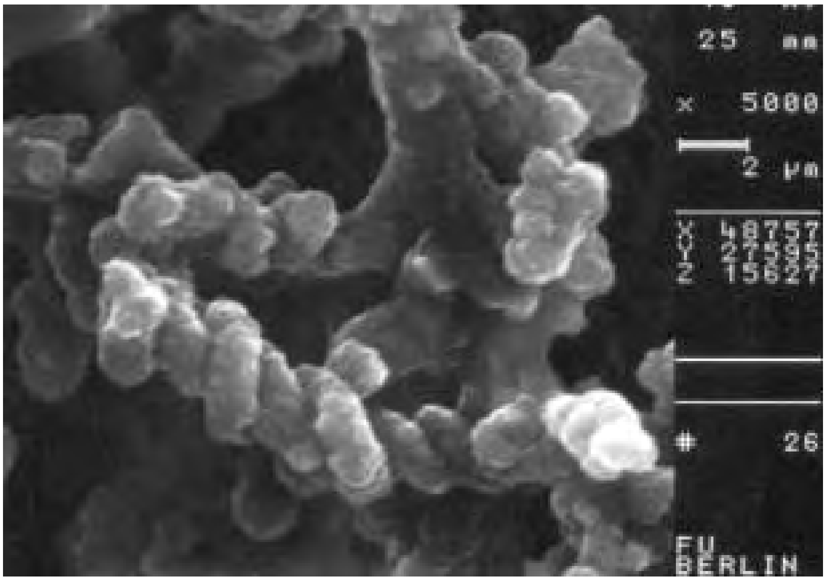

Figure 1. SEM image of several stalks of *Gallionella ferruginea* which make up a network within the bacterial mats; 2 mm scale bar is shown on the right.

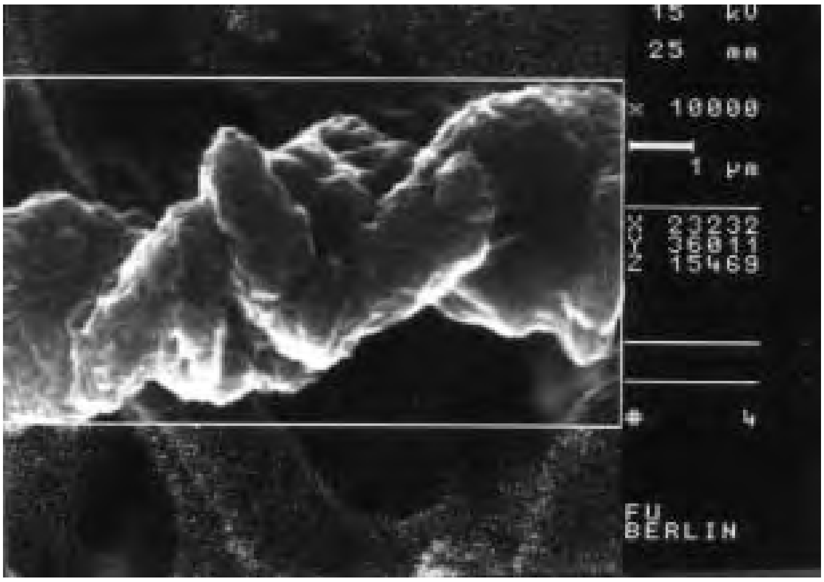

Figure 2. SEM image of a twisted stalk of *Gallionella ferruginea*; 1 mm scale bar is shown on the right.

fluids from a condensed vapour phase from a boiling subsurface mixed with seawater (Halbach *et al.*, 2001). The highest metal and gas values were reached in those samples which were taken from below the sea floor, *i.e.* in less sea water diluted fluids (max. ratio 1:33 of hydrothermal fluid : sea water).

After filtration of the fluid, the filtered solid material was studied under the scanning electron microscope. Apart from zooplanctonic skeletons, basaltic glass material, fragments of iron- and manganese crusts, some Cu- and Zn-sulphides, also several reddish-brown clusters of bacterial matter were observed. Figures 1 and 2 show the characteristic twisted stalks of *G. ferruginea*; they are relatively fresh, and consist of two individual, now silica-coated fibers with an average diameter of 1µm. EDX analysis (n=10) yielded between 24-58 wt % SiO_2, 1.5-6.5 wt % MnO, and 37-72 wt % Fe_2O_3. Mn and Fe correlate positively with each other. P_2O_5 varies between 2.0 and 3.0%, and SO_4 averages 7.8%.

The chemolithotrophic bacterium *G. ferruginea* occurs in sharply limited physico-chemical conditions characterized by a low redox potential in an Eh range of +200 to +320 mV, pH limits ranging from 6.0 to 7.6, and the temperature ranging between 8 and 16°C. In the typical habitats of *Gallionella*, anaerobic water containing ferrous iron comes into contact with oxygen. Besides Fe(II), such environments often contain reduced sulphur compounds.

Studies by Lütters-Czekalla have shown that *G. ferruginea* is able to utilize Fe(II) as well as the reduced sulphur compounds sulphide and thiosulphate as electron donor and energy source. *Gallionella* grows at the interface between the oxidizing and the reducing zones in sulphide-O_2 microgradient cultures on sulphide (pH 6.5 - 7.0) as well as on thiosulphate; thiosulphate oxidation proceeds, as does iron (II) oxidation within the pH range 5.4 to 7.4, with the optimum at 6.9. *G. ferruginea* completely oxidizes thiosulphate to sulphate in all phases of growth, thus there are no intermediate products to be observed.

The above-mentioned Eh and pH values are in accordance with those measured in the North Fiji Basin. The chemical environment obviously is at the interface between the reducing (minimum Eh of -75) conditions of the emanating hydrothermal fluid and the oxidizing (maximum Eh of +360) conditions of the ambient sea water. The pH between 7.0 and 7.7 of the fluid and of 7.9 in the seawater correspond to the values given by Hanert (1992) as well as Lütters-Czekalla (1990).

The hydrothermal fluid has temperatures of about 10°C, which is within the temperature range given by Hanert (8-16°C), and carries CH_4 and CO_2 as carbon sources, which are also required for bacterial growth (Hanert, 1989). However, the measured iron concentrations in the hydrothermal fluid are by a factor of at least 100 below those given by Hanert as the most common measured in *Gallionella* habitats. So either the iron contents in the fluid fluctuate and the iron supply during the life spans of the bacteria was higher than at the time when the fluid was sampled or *G. ferruginea* can also survive in environments with considerably lower iron concentrations. Since the iron content in other end member fluids of the North Fiji Basin (Ishibashi *et al*., 1994) is only about 10 times higher than our maximum iron concentrations, it is unlikely that a fluctuation will ever reach 100 or more times the measured value. Thus, while dilution with ambient sea water would result in more favourable temperature conditions for the existence of *Gallionella*, the original fluid with its higher Fe-concentrations would still not provide the high iron contents postulated by Hanert (1989) to be necessary for the existence of *Gallionella*.

The colloidal iron oxyhydrate produced by *G. ferruginea* will dehydrate over time and convert to more stable crystalline phases like ferrihydrite, and finally also goethite. These are phases found in the Fe-Si oxide (jasper) mineralizations formed by low-temperature venting, as they are known from most hydrothermal areas of the ocean (Juniper *et al*., 1995). The iron-hydroxide filaments within the jasper have so far been interpreted as only indicating microbial origin. In the North Fiji Basin where coating by silica before compaction perfectly preserved the typical morphology, the existence of the iron oxidizing bacteria *Gallionella ferruginea* has for the first time been proven in an environment of low-temperature deep sea vents. Thus, firstly, the range of habitats of this bacteria can now be extended to this, often considered to be toxic, deep sea environment, and secondly, bacterial genesis of the Fe-bearing part of jasper has become much more likely than formerly predicted.

Acknowledgements

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

Hydrothermal vents and associated biological communities in the Indian Ocean

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Active seafloor hydrothermal systems associated with chemosynthesis-based communities are well known in many locations in the Atlantic (Van Dover, 1995) and Pacific Oceans (Tunnicliffe *et al.*, 1998). Although indirect evidence of hydrothermal activity, such as hydrothermal plumes and some vent organisms (*e.g.* Herzig and Plüger, 1988; Southward *et al.*, 1997), has been reported from the Indian Ocean, the exact location of a hydrothermally active site complete with associated chemosynthetic species had not been found so far.

In August 2000, a research cruise to the Indian Ocean using the Japanese ROV *Kaiko* (JAMSTEC) was planned in order to search for hydrothermalism and associated biological communities, and was focused on a small volcanic knoll, named the Hakuho Knoll, located approximately 22km north of the Rodriguez Triple Junction, where the hydrothermal plume and heaps of dead shells of *Calyptogena* were found (Gamo *et al.*, 1996; Fujimoto *et al.*, 1999; Fig. 1). Prior to the ROV dives, topographic surveys, tow-yo observations using a deep tow camera system equipped with water sampler, CTD and transmissiometer measurements, as well as biological and geological observations using a deep-tow camera system were conducted as a series of pre-site surveys. After the surveys, four *Kaiko* dives were made on the Hakuho Knoll.

During the *Kaiko* dives, active hydrothermal vents and thriving hydrothermal vent communities were discovered on the southwestern flank of the Hakuho Knoll (Hashimoto *et al.*, in press). At least seven active vent sites including black smoker complexes, the largest of which was over 10m in height, covered approximately 40m by 80m of the upper part of a small mound (25°19.17'S, 70°02.4'E) between depths of 2420m and 2450m (Hashimoto *et al.*, in press). The tops of some black smoker complexes could not be observed due to extreme vent conditions. The maximum temperature measured from an active black smoker was 360°C, and the pH (at 25°C) was 3.4 (Hashimoto *et al.*, in press). This vent site was named the "Kairei Field" after the R/V *Kairei*.

Numerous shrimp belonging to the genus *Rimicaris* were on the surface of active chimneys, including black smokers. Actinians tended to occur on bare rocks, starting as close as 1-2m from the black smokers and were present as far as the outer margin of the vent fields. Dense beds of undescribed mytilid species, *Bathymodiolus* sp., were seen between the swarms of *Rimicaris* and actinians beds. Galatheids belonging to the genus *Munidopsis* occurred on and around mussel beds. Parasitic

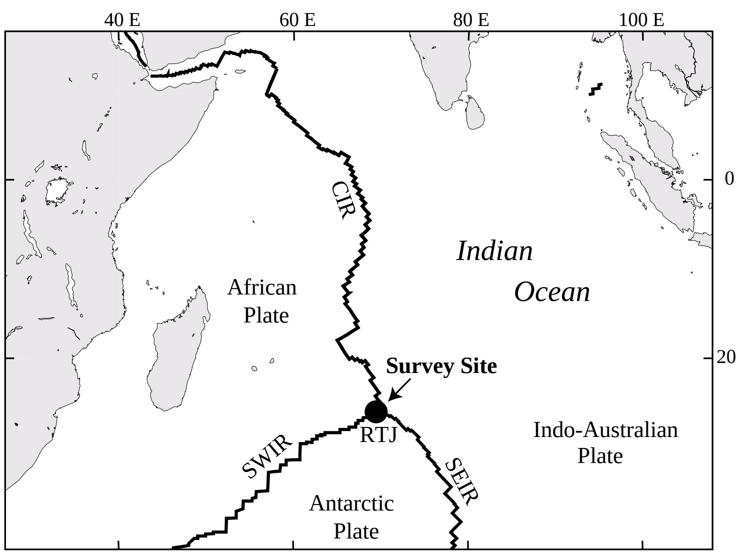

Figure 1. Location of the survey site, north of the Rodriguez Triple Junction (RTJ) in the Indian Ocean. CIR, SWIR and SEIR refer to the Central Indian Ridge, South West Indian Ridge and South East Indian Ridge, respectively.

International Ridge-Crest Research: **Biological Studies:** Hashimoto *et al.*, cont ....

Figure 2. Dense hydrothermal vent communities at the Kairei Field. *Rimicaris* swarms and actinians beds were observed around an active black smoker complex. *Alviniconcha* snails, *Austinograea* crabs and small-sized scale worms can be seen at the base of the complex (25°19.16'S, 70°02.34'E, 2436m).

polynoids (*Branchipolynoe* sp.) were identified in the mantle cavity of the deep-sea mussels. *Alviniconcha* and *Phymorhynchus* snails, *Austinograea* crabs and red polynoid polychaetes were found and captured around the bases of active chimneys and near crevices emitting heated effluent. Aggregations of undescribed cirripeds (*Neolepas* sp.) were abundant on altered basaltic rocks located 3-10m from active chimneys and around the edge of shimmering crevices surrounded by deep-sea mussels. Zoarcid fish were observed, albeit rarely, within the active hydrothermal vent area. Other organisms of interest noted on the active vent field included provannid gastropods, limpets including *Lepetodrilus* sp. and alvinocaridid shrimp. During the Kaiko dives, twenty species of vent-specific organisms were collected within and near the vent fields, and an additional six species were observed (Hashimoto *et al.*, in press). A typical scene of the vent communities at the Kairei Field is shown in Fig. 2.

To date, decapod crustaceans belonging to the genus *Rimicaris* were known only from the Atlantic Ocean (Tunnicliffe *et al.*, 1998). The hydrothermal vent communities of the Kairei Field are closely similar to those of the Atlantic vent fields in appearance. However, some organisms including the *Ophryotrocha* polychaetes, *Alviniconcha* snails, *Austinograea* crabs and *Neolepas* barnacles were known only from the Pacific vent sites (Southward *et al.*, 1997; Tunnicliffe *et al.*, 1998). Other vent organisms including actinostolid sea anemones, *Branchipolynoe* polynoids, *Lepetodrilus* limpets, *Phymorhynchus* snails, *Bathymodiolus* mussels, *Chorocaris* shrimps and *Munidopsis* squat lobster were reported in the deep-sea hydrothermal vent fauna from the Atlantic and Pacific Oceans.

This suggests that significant communication exists between the vent fauna in the Indian and Pacific oceans. Similar communication might exist between the Indian and Atlantic oceans. This finding is significant as it lends support to the hypothesis that communication between the Pacific and the Atlantic vent faunas occurred by way of the Western Pacific and Indian Oceans (Southward *et al.*, 1997; Tunnicliffe *et al.*, 1998; Hashimoto *et al.*, in press). Further examination of the organisms inhabiting the Kairei Field in the Indian Ocean will undoubtedly contribute to our understanding of the biogeography and evolution deep-sea chemosynthesis-based communities.

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

The Archaean Park Project Update

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Introduction

The *Archaean Park Project* is a major ridge-related research program to explore, drill and monitor the subsurface biosphere and crustal fluid circulation, which occurs beneath seafloor hydrothermal systems. Here, we briefly summarize the results of the research done in the first fiscal year (2000) and outline the cruise plan for the coming field season. A brief research plan of the project was described elsewhere (Urabe *et al.*, 2000).

We put emphasis on the following research activities in 2000 to prepare for the main sea-going phase in 2001:

1) test drilling at Toyoha Mine,
2) development of *in situ* instruments for sampling, monitoring, and incubation,
3) detailed cruise planning, and
4) site survey.

Toyoha Mine Drilling

The Toyoha mine is a lead-zinc-copper-tin-silver vein-type deposit in Hokkaido, Japan and is known as the world's largest producer of the rare metal indium. The potassium-argon dating on hydrothermal minerals shows that the mineralisation age ranges between 2.93-0.96 Ma and the age of the Izumo Vein, which we drilled, is as young as 0.49+/-0.96 Ma (Sawai *et al.*, 1989). Besides, the high rock temperature (>200°C) at deeper levels of the mine suggest that the mineralisation is still going on at greater depths. Oxygen and hydrogen isotopic work on the fluid suggests significant contribution of magmatic fluid, which is quite rare as most of the ore-forming fluids for vein type deposits normally originate from down-circulated meteoric (surface) water (Hamada and Imai, 2000)

Horizontal drilling was performed accross a length of 100 meters in an adit 550 meters below the surface to penetrate the Izumo Vein, which cut through basaltic lava of Miocene age. The rock temperature was 120°C about ten years ago, which has since been cooled down by air circulation. The temperature of fluid obtained from the hole is 38°C, which is significantly cooler than boiling temperature observed from the same vein ten years ago.

The preliminary results of the test drilling will be presented by several authors at a special session "Cm: Archaean Park" during the Japan Earth & Planetary Sciences Joint Meeting, June 6, 2001 in Tokyo. Microbiologists already identified autotrophic, thermophilic bacteria in the fluid and other "hot springs" discharged on the wall of the adits.

Research Plan

Major research gear will be tethered to the submarine drilling system BMS (Boring Machine System *or* Benthic Multicoring System; Japan) for direct sampling of microorganisms, rocks and fluids beneath hydrothermal vents. The BMS and *Mothership Hakurei-Maru #2* have been extensively used for drilling in hydrothermal areas, lava flows and carbonate rocks by its owner, Metal Mining Agency of Japan (MMAJ) since 1996. The maximum capacity of coring is designed to be 20 meters but average penetration for a daily operation is about 10 meters. The diameter of the core is approximately 44 mm. The current technical challenge for the BMS is to raise core recovery.

The drilled holes will be visited during upcoming ROV and manned submersible cruises to use them for various long-term measurements and *in situ* monitoring. Extensive geophysical, geological and geochemical surveys will be conducted to map and monitor the drill site to delineate the lateral extent and the structure of the biosphere, as described by Urabe *et al.* (2000). The effect of ocean and earth tides on the temperature, fluid flow, and permeability structure of the oceanic crust will be evaluated through seafloor monitoring. The dispersion of hydrothermal plumes will be monitored to determine the influence of biomass ejected to the ocean.

Target Site

The target site chosen for the first three years (2000-2002) of the Archaean Park project is the calc-alkaline, dacitic volcano, Suiyo Seamount (140°39'E, 28°33'N) on the volcanic front of the Izu-Bonin (Ogasawara) Arc, western Pacific (Watanabe *et al.*, 1994). The volcanic edifice has a caldera at the summit with a diameter and depth of 1.5 km and 500 m, respectively. There is a hydrothermal field on the floor of the caldera at a depth of 1380 meters, International Ridge-Crest Research: **Biological Studies:** Urabe *et al.*, cont ....

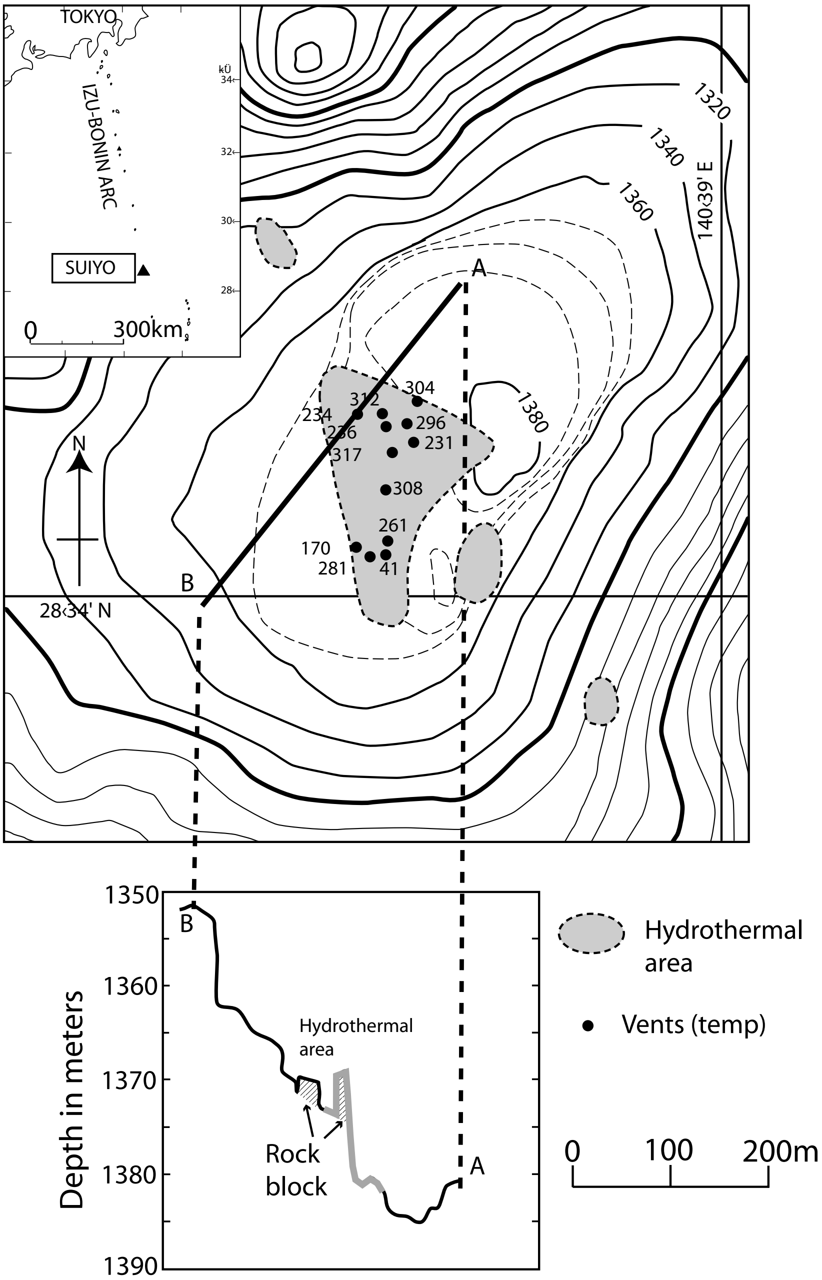

Figure 1. Location and topography of the Suiyo Seamount. Contours are in meters. The numbers show temperatures (°C) of vent fluid measured during the Shinkai 2000 dives in October 2000.

where high-temperature fluid (temp = 230° - 317°C) is venting through the sediments (Fig. 1). The height of the chimneys is very low; usually less than 0.5 meter and they are composed of chalcopyrite, sphalerite, anhydrite, barite, and others.

No fatty acids of terrestrial plant origin were found in the sediments (Yamanaka *et al.*, 2001) and the very low hydrocarbon contents in the hydrothermal fluid (Tsunogai *et al.*, 1994), both indicate that the sediments are free from contamination of organic matter which may supply energy to heterotrophic micro-organisms. This is probably an indicator that the hydrothermal system at the Suiyo Seamount is at an early stage of development.

Cruise Schedule

Five cruises are planned to go to the Suiyo Seamount during the 2001 field season (Table 1). The first two cruises have been chartered by the Archaean Project and the latter three will be joint JAMSTEC cruises. First of all, we are planning to drill several holes using the BMS on the *R/V Hakurei-Maru#2*. Casing pipe will be inserted to prevent the holes from collapsing. Then, *ROV Hakuyo 2000* (sister vehicle of *ROPOS*) will be used to install instruments for fluid sampling as well as temperature sensors, flow meters and others. Comparison of chemical composition of end-member fluids in 2000, and previously (Ishibashi; unpubl. data), with that from the casing pipes is crucial for evaluation of the effect of drilling on the system.

The *Shinkai 2000* cruises will be devoted for deployment and/or recovery of instruments, hydrophone-array experiments, and others in August and for sampling and *in situ* incubation in October. A multidisciplinary team of scientists will be involved in these cruises to maximise the benefits of cooperation among microbiologists and geo-scientists.

The last cruise of *R/V Kairei* will focus on conducting water column surveys, electromagnetic surveys, side-scan sonar mapping and so on. These studies will enable us to delineate the size, extent and the thermal structure of the subsurface hydrothermal circulation and its interaction with the sub-vent biosphere.

Conclusions

We, the members of the Archaean Park Project will have a pretty busy field season this year. We hope that the combined efforts will give us a chance to determine the anatomy of the unknown structure of a hydrothermal system for the first time in the world.

Footnote:

The Archaean Park Project (International Research Project on Interaction Between Sub-Vent Bio-

Table 1. Tentative Cruise Schedule of the Archaean Park Project and related cruises to the Suiyo Seamount, Izu-Bonin Arc in 2001. The Principal Investigators are tentative.

1. (June 18 – June 27) : BMS Drilling, *R/V Hakurei-Maru #2*
   P.I.s: K. Marumo and T. Urabe
   Mission: Drilling, Coring, Hydrosweep mapping
2. (16 days ca. end of July) : ROV Hakuyo 2000 / *R/V Shinsei-Maru*
   P.I.s: K. Nakamura and T. Urabe
   Mission: Instrument deployment, fluid sampling, etc
3. (August 21 – September 18): DSV "Shinkai 2000" / *R/V Natsushim*
   P.I.: Masataka Kinoshita
   Mission: Instrument deployment / recovery, measurement
4. (October 4 – October 26) : DSV "Shinkai 2000" / *R/V Natsushima*
   P.I.: A. Maruyama
   Mission: Fluid sampling, filtering, in situ incubation
5. (December 7 – December 27) *R/V Kairei*
   P.I.s: J. Ishibashi and N. Seama
   Mission: Side-scan sonar, water column, electromagnetic survey

sphere and Geo-Environment) is a five year project (2000 – 2004FY) with mid-term re-evaluation in 2002 funded by MEXT (Ministry of Education, Culture, Sports, Science & Technology) through the Special Coordination Fund. The main participating organizations are: National Institute for Advanced Industrial Science & Technology (formerly, GSJ and NIBH), Hokkaido University, Tohoku University, Tsukuba University, University of Tokyo, Tokyo Pharmaceutical University, Tokai University, Kobe University, Hiroshima University, Kyushu University, CRIEPI, and Japanese Coast Guard (formerly, HDJ), as well as additional collaborations with researchers from other laboratories. Currently, our home page (*http://www.gsj.go.jp/~marumo/*) is in Japanese and the English version is under construction.

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The InterRidge community is invited to propose points for discussion by the Biology Committee. Forwarded your suggestions to the Co-Chairs: Françoise Gaill (francoise.gaill@snv.jussieu.fr) and S.Kim Juniper (juniper.kim@uqam.ca).

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

Diversity within 9°50'N Mussel Beds on the East Pacific Rise: Establishment of Train Station, East Wall, and Biovent Mussel Beds as Long-Term Study Sites

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Diversity is a fundamental measure of ecological communities, yet we have very little quantitative information about how the number of species and species types change within vent habitats during the hydrothermal cycle. The 9°50'N hydrothermal field on the East Pacific Rise is probably the most well-studied site in terms of accumulation of species diversity through a hydrothermal cycle, with species richness reaching 75% of the regional mega- and macrofaunal species pool within less than 5 years following the establishment of new vent sites (Shank *et al.*, 1988). This analysis was based on replicate, semi-quantitative video surveys of habitats along ~1.4 km of what was an eruptive fissure in 1991 and what is now known as the BioGeoTransect (Shank *et al.*, 1998).

In November 1999, the first of a series of quantitative samples within mussel bed habitats at 9°50'N was collected using "pot" samplers (Van Dover *et al.*, 1999). *Biovent* is the most northerly mussel bed and is separated by ~ 2.5 km from *Train Station*, the most southerly mussel bed. The *Biovent* mussel bed is also the oldest site, with the mussel bed established prior to the 1991 eruption (*i.e.*, > 8 years old at the time of sampling). The *Train Station* mussel bed first began to develop in ~ 1994 (5 yr old at the time of sampling). The *East Wall* mussel bed began to develop in 1995, but the *Wall* mussel beds lie beneath an older, pre-eruption bed at the top of the wall.

For each mussel bed, mussels and associated organisms are collected in replicate mussel pots. Sample processing results in lists of species and numbers of individuals per litre of mussel habitat for each mussel bed, from which species-effort curves may be developed and quantitative comparisons can be made. Other measures are collected from the samples, including an index of mussel condition and size-frequency distributions for mussels and other dominant taxa.

Processing of the 1999 samples is nearly complete. Several features are immediately outstanding:

1) Species richness within 9°50'N mussel beds is lower than that observed in mussel beds from ~17°S on the East Pacific Rise using comparable methods;
2) The 9°50'N species list is largely (>90%) a subset of the 17°S species list;
3) *Train Station* has the lowest species richness (preliminary identifications yielded 33 species at *Train Station* versus ~43-45 species at *East Wall* and *Biovent*).

In comparing the dominant taxa within 9°50'N mussel beds (Table 1), *Train Station* and *East Wall* have remarkably similar compositions, with limpets (*Lepetodrilus elevatus*), amphipods (*Ventiella sulfuris*) and copepods making up >75% of the total number of individuals at each site. *Biovent* differs in having a relatively high proportion (25%) of polychaetes (*Amphisamytha galapagensis*) and few amphipods (<1%). In addition, 8% of the *Biovent* individuals are *Archinome rosacea*, a carnivorous polychaete capable of capturing limpets and even small crustaceans (amphipods, leptostracans; Ward and Van Dover, pers. obs.). Mussel (*Bathymodiolus thermophilus*) post larvae and

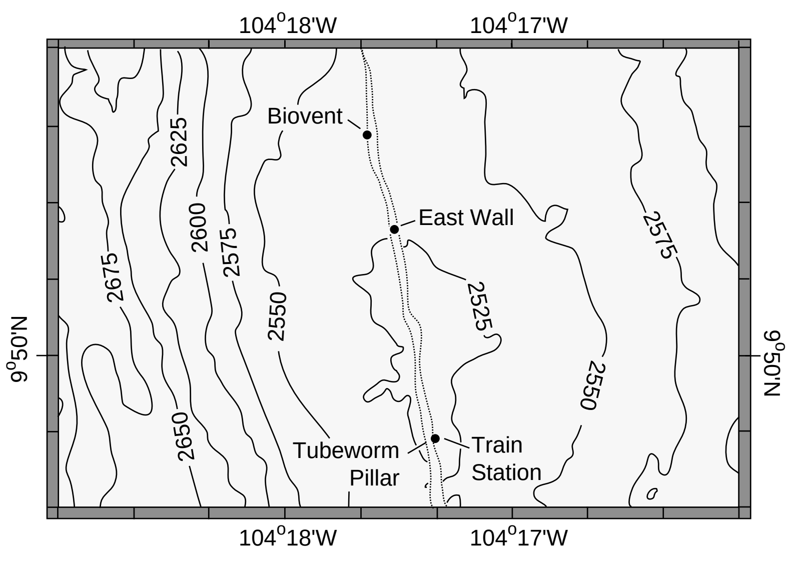

Figure 1. Mussel bed location map, 9°50'N hydrothermal field, East Pacific Rise.

Figure 2. Temperature probe deployment configuration, Train Station 1999.

Table 1. Comparison of numerically dominant taxa of three mussel beds at 9°50'N.

DOMINANT TAXA	Relative Abundance (%) Train Station	East Wall	Biovent
Polychaeta			
Amphismytha galapagenesis	6	7	25
Archinome rosacea	<1	<1	8
Ophyryotrocha akessoni	5	7	2
Bivalvia (mussels)			
Bathymodiolus thermophilus < 5 mm	2	6	4
Gastropoda (limpets)			
Lepetodrilus elevatus	38	41	34
Lepetodrilus ovalis	1	2	3
Amphipoda			
Ventiella sulfuris	27	17	<1
Copepoda	19	17	19
% Total	98	97	95
Total Number of Individuals	19908	11917	13215
Total Volume of Mussels Sampled (litres)	16.4	14.5	15.6

early juveniles always contribute >2% of the total number of individuals in any mussel bed.

Each mussel bed is marked by a pair of temperature probes that have been logging continuously since deployed in 1999 (Fig. 2). The next scheduled sampling of the mussel beds will take place in December 2001, at which time the temperature loggers will be replaced with new probes. The temperature data is of coarse temporal and spatial resolution, but when used together with mussel condition indices, we will have a measure of the "health" of each mussel bed. Additional sampling periods at the 9°50'N mussel beds are funded but not yet scheduled. Because these mussel beds have become critical time-series study sites, and because the investment in sampling processing is already immense, we request that, within at least a 8-m radius of the temperature probes, these sites be considered research sanctuaries.

Time-series measures of diversity within 9°50'N mussel beds are one component of a larger program to study global patterns of biodiversity and biogeography within the mussel bed habitat of chemosynthetic communities.

Acknowledgements

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International Ridge-Crest Research: **Ophioloites**

Early Palaeozoic North Qilian Oceanic Basin, an Analogue to Modern West Pacific: Evidence from Geochemical Characteristics of Ophiolites

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Introduction

The Chinese continent is a composite continent made up of many blocks (*e.g*. North China, Tarim, Qaidam in the north, and Lhasa, Qiangtang, Yangzi, and South China in the south) that are joined together by several complex orogenic belts. Most of these orogenic belts contain ophiolites, which record the tectonic histories of the Paleo-Asian Ocean, the Tethys, and the early stages of the Pacific.

The North Qilian Orogenic Belt (NQOB) is a Caledonian orogen located on the south-western margin of North China Block. It is connected with the Kunlun Mountains to the west and the Qinling Mountains to the east, forming the huge Qinling-Qilian-Kunlun orogenic belt in central China. NQOB contacts with the Hexi Corridor active continental margin to the north and Qaidam block to the south by thrust faults, and is separated from the Tarim block to the west by the Altyn strike-slip fault (Fig. 1).

NQOB is mainly composed of accretionary complex, including ophiolites, blueschists, eclogites, arc volcanics (Xiao *et al.*, 1978; Xia *et al.*, 1996; Zhang *et al.*, 1997), and probably some micro continental blocks. The orogen was formed by closing of the North Qilian ocean which existed mainly from the Cambrian to the Ordovician (Xia *et al.*, 1996). Nevertheless, tectonic architecture of the oceanic basin is still disputable. Xiao *et al.* (1978) proposed that the early Paleozoic North Qilian area was part of the Paleo-Asian sea. Xia *et al*. (1996) suggested that it was a small oceanic basin, while Zhang *et al.* (1997) hypothesised that it was a large and mature ocean, probably comparable to the modern West Pacific. On the other hand, Ge *et al.* (1999) argue that is was a continental rift. Since the geochemical characteristics of ophiolites from different tectonic settings are quite different, ophiolites are

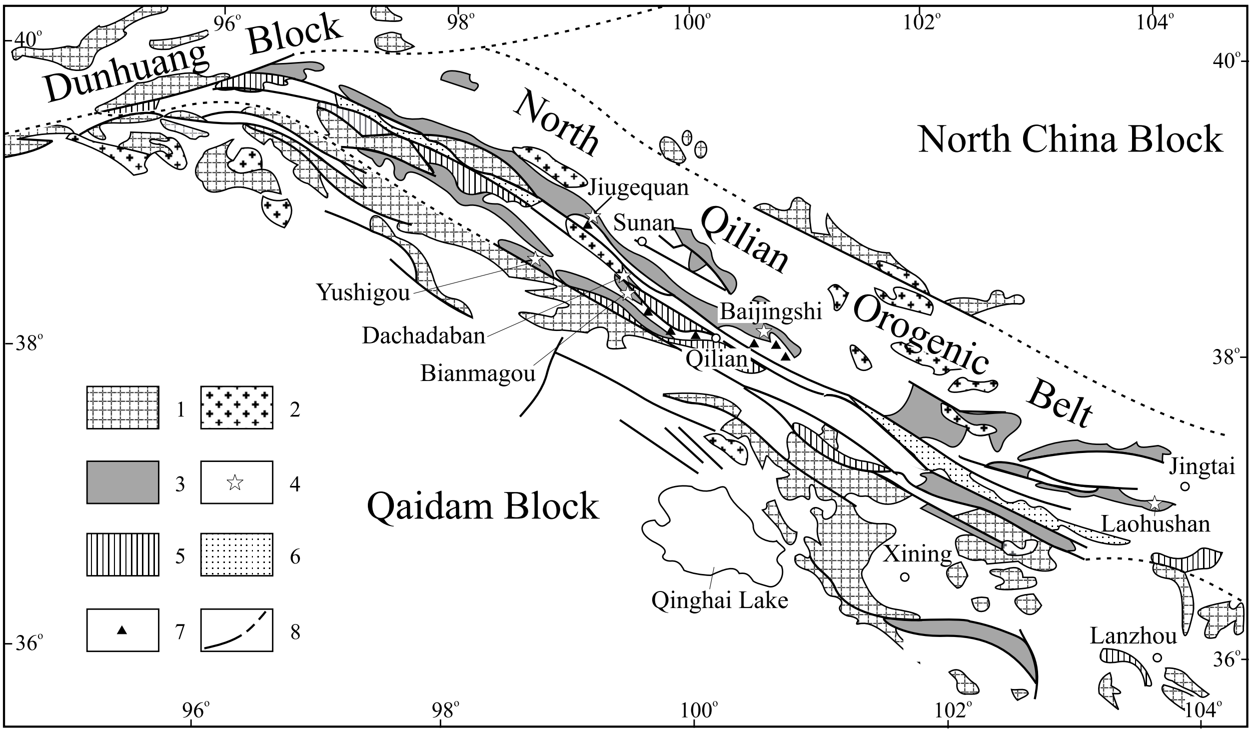

Figure 1. Distribution diagram for the North Qilian Ophiolites: 1 - Pre-Cambrian basement rocks; 2 - Granite; 3 - Ophiolitic and accretionary complex; 4 - Ophiolite; 5 - Bimodal volcanics; 6 - Island-arc volcanic rocks; 7 - Blueschist; 8 - Faul

very significant in reconstructing the tectonic frame of this ancient oceanic basin. In this paper, the main geological and geochemical characteristics of ophiolites from NQOB are outlined, and feature of the early Paleozoic North Qilian oceanic basin is discussed, mainly based on the geochemistry of the ophiolites.

Geological and geochemical characteristics of North Qilian ophiolites

Generally NQOB is divided into two parts, the west part and the east part. Large blocks of Proterozoic strata, considered to be allochthonous nappes, occur in the west part. In the east part, four ophiolite belts, namely the Yushigou, Bianmagou, Dachadaban and Jiugequan ophiolite belts (Fig. 1), occur from south to north (Xia *et al.*, 1996; Zhang *et al.*, 1997). Xiao *et al.* (1978) and Xia *et al.* (1991) proposed that the North Qilian ophiolites belong to three different times, Proterozoic, mid-Cambrian and early-mid Ordovician. Nevertheless, most recent studies agree that they were formed mainly from the late Cambrian to the Ordovician (Xia *et al.*, 1996).

Lots of geochemical studies have been made on the North Qilian ophiolites. Xia *et al.* (1991) proposed that the volcanics from these ophiolites are mostly E-MORBs. Zhang *et al.* (1997) considered that the North Qilian ophiolites belong to Cordilleran type.

1. Yushigou ophiolite— Mid-ocean ridge

The Yushigou ophiolite is situated ~80 km west of Qilian County, Qinghai province. It is composed of peridotite, gabbro and basalt units, and contacts with Carboniferous-Permian sediments by thrust faults. Both Sm-Nd isotopic dating of the basic lava (522 - 495 Ma) (Xia *et al.*, 1996) and radiolarian in the nodular silicates indicate that the ophiolite was formed from the late Cambrian to early Ordovician. The peridotites and gabbros are covered unconformably with mid-Ordovician greywackes, sandstones, limestones and slates (Xiao *et al.*, 1978), indicating that the ophiolite was probably already obducted onto the foreland by that time.

The Yushigou basalts are of typical MORB in geochemistry (Fig. 2). The rare earth element (REE) contents are about 10 times that of chondrite. In a chondrite-normalized diagram, the REE distribution is flat, with no light rare earth metals (LREE) depletion or enrichment, no obvious depletion of high field strength elements (HFSE). It is believed that the Yushigou ophiolite was formed in a mid-ridge spreading setting (Xiao *et al.*, 1978).

2. Bianmagou ophiolite— Forearc basin

The Bianmagou ophiolite is situated between 58 - 70 km south of Sunan county, Gansu province. It is composed of meta-peridotite, gabbro and basalt units, as well as some diabase dykes intruded in the peridotite. The peridotite and gabbro are separated by Cambrian (?) sandy slate and Carboniferous siltstone and limestone. A bimodal association of basaltic andesite and rhyolite occur in the north part of the section. Between the ophiolite and the bimodal association is a ~2 km wide mylonite zone, which is mainly composed of siltstones and basalts. All of the sediments contact with the ophiolite and bimodal volcanics by thrust faults.

According to Zhang *et al.* (1997), the Bianmagou meta-peridotite unit is mainly harzburgites and dunites, and is depleted in Al and Ca. Most of the basalts have LREE depletion, similar to N-MORB (Fig. 2), but some have E-MORB affinity. The Th/Ta ratio is ~1.0 and no HFSE anomaly is observed. The εNd (t) of the gabbro and basalt is within +5.7 ~ +7.1 (assuming t=500 Ma), indicating that they originated from depleted mantle source.

The bimodal association is composed of interbedded basaltic andesites and rhyolites. The basaltic andesites have both, high SiO_2 (54.25 - 61.19%) and MgO (5.78 - 9.71%) contents, and at the same time are strongly depleted in Ti (TiO_2 = 0.30 - 0.45%, Ti/Zr = 63-73). The REE pattern is flat or slightly depleted in LREE, with $(La/Yb)_N$ = 0.65 - 1.55 (N means normalization to chondrite). The HFSE and Y are within 8-10 and 5 - 9 times of chondrite, respectively. Based on the above data, Wang *et al*. (2000) proposed that the Bianmagou basaltic andesites are boninites. The rhyolites have low REE contents (<40 times of chondrite), contrasting with those from continental rifts or active continental margins. In addition, the εNd (t) (+3.4 - +3.7) and the REE distribution pattern (Fig. 2) of the rhyolites are similar to that of the basaltic andesites (εNd (t)=+3.1 - +3.5), suggesting that they were probably derived from a common parental magma. Negative Eu anomaly of the rhyolites indicates fractionation of plagioclase during the magma evolution. It was proposed that the Bianmagou ophiolite was from a fore-arc basin (Zhang *et al*. 1997) and the bimodal association was from an intra-arc setting (Wang *et al*., 2000).

3. Dachadaban ophiolite— Forearc setting

The Dachadaban ophiolite outcrops 48 - 58 km south of Sunan County. It is made up of meta-peridotites, gabbros and pillow lavas, and contacts with the Bianmagou bimodal association to the south and Triassic red malasse to the north by thrust faults. The ophiolite is covered unconformably with Devonian red molasse and Silurian sandstones. Zhang *et al*. (1997) conducted a detailed geochemical study of the Dachadaban ophiolite and confirmed the existence of boninites.

Zhang *et al*. (1997) divided the Dachdaban pillow lavas into three groups based on their geochemistry:

Group 1: low TiO_2 (0.23 - 0.34%) and high MgO (11.3 - 15.6%) contents, and high Mg' (0.74 - 0.77).

Group 2: higher in TiO_2 (0.30-0.66%), and lower in MgO (4.4 - 11.9%) and

International Ridge-Crest Research: **Ophioloites:** Qian *et al.*, cont....

Mg' (0.76 - 0.64). Both Group 1 and 2 are very low in Ti/V (8 - 11.5) and Ti/Zr (55 - 76) ratios, and are typical boninites, with Group 2 being more highly evolved (Fig. 2).

Group 3: has medium MgO (5.5 - 8.6%) and higher TiO_2 (0.92 - 1.90%) contents, and is typical MORB (Zhang *et al*., 1997).

Modern boninites occur mainly in forearcs in the West Pacific, and are generally believed to be indicative of forearc settings. Chen *et al* (1995) and Zhang *et al*. (1997) concluded that the Dachadaban ophiolite was formed in fore-arc settings.

4. Jiugequan ophiolite—Back arc basin

The Jiugequan ophiolite is situated about 40 km west of Sunan County. It is composed of meta-peridotites, cumulitic gabbros, brecciated gabbros, massive basalts and pillow lavas, and is covered with interbedded turbidites and basalts (Qian *et al*., 2001). The whole ophiolite section is about 2500 m thick. It dips northeastward, and is covered with Silurian conglomerates and sandstones. The ophiolite overlies blueschists (~ 1 km thick) and Ordovician red molasse, the boundary comprises a southwestward vagrant thrust system. Ar-Ar dating of glaucophanes from the blueschists gives an age of 460 - 440 Ma. It is proposed that the ophiolite was formed in mid-late Ordovician (Xia *et al*., 1996).

Qian *et al*. (2001) divided the Jiugequan ophiolite section into two parts, the lower part and the upper part, which are separated by a ~10 m thick silicate layer. The lower part is made up of peridotites, gabbros and basalts, while the upper part is mainly tubiditic sandstone, siltstone and cherts, with intercalated basalt. All basalts from the lower part are N-MORBs ($(La/Yb)_N$=0.68 - 0.91), while those from the upper part are mostly E-MORBs ($(La/Yb)_N$=1.52 - 3.96) with only a few N-MORBs. Nb is depleted, but no obvious depletion for Zr, Hf and Ti is observed. The εNd (t) of the basalts is in the range of +2.7 - +6.8. From bottom to top, the Jiugqequan basalts become more and more enriched in highly incompatible elements (Th, Nb, La, Ce, Nd, Sm, Zr, Hf), and more and more depleted in less incompatible elements (Y, Yb, Lu) (Fig. 2). Consequently, incompatible element ratios, such as La/Ce, La/Yb, La/Nb, Sm/Nd, Zr/Nb, Zr/Y and Ti/Y, vary systematically. Furthermore, incompatible element ratios correlate significantly with each other and also with εNd (t). It was proposed that the Jiugequan ophiolite was probably from a seamount in a back-arc basin (Qian *et al*., 2001).

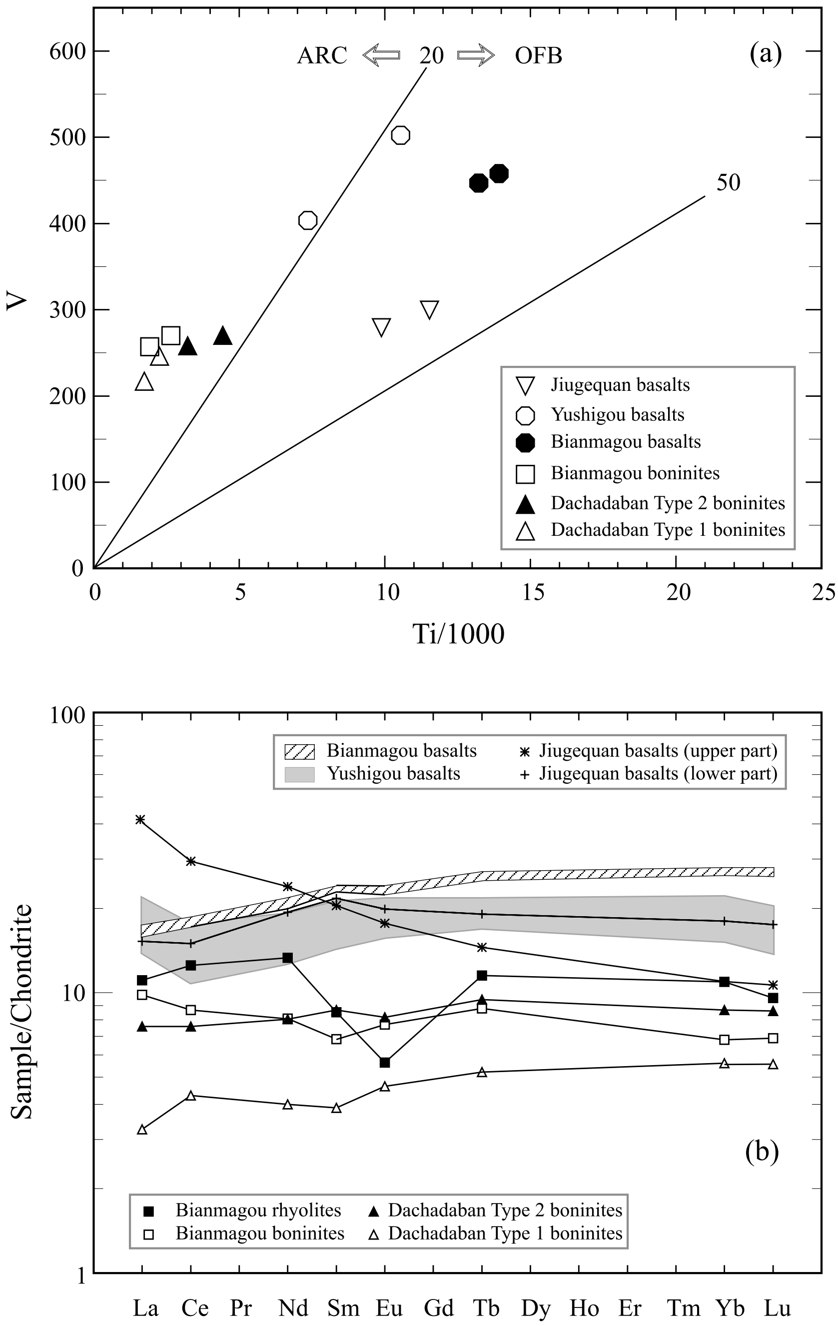

Figure 2. V vs. Ta (a) and REE distribution (b) diagrams for volcanics from North Qilian ophiolite belts

Discussion

The architecture of the early Paleozoic North Qilian oceanic basin is still controversial. Some argue that it was a small basin, others postulate that it was a large mature ocean, or a continental rift. In contrast, there is no such controversy regarding the existence of ophiolites in the NQOB, and most researchers agree that these ophiolites were emplaced on active continental margin through arc-continent collision events. Geochemical study has shown that the ophiolites mostly were formed in small oceanic basins, such as fore-arc, intra-arc, and back-arc basin. Nevertheless, arc-type ophiolites do not necessarily mean that there was no existence of a large oceanic basin. A typical case is the circum-Pacific orogenic belt, where arc-type ophiolite nappes are being obducted onto active continental margins. Zhang *et al*. (1997) have pointed out that the North Qilian ophiolites belong to the Cordilleran type. Based mainly on geochemistry of the ophiolites, we agree with Zhang *et al*. (1997) that the North Qilian Oceanic basin was probably very large during the early Paleozoic, similar to the present West Pacific.

Palaeontological data also strongly support these conclusions. Cambrian-Ordovician fossil biota from NQOB, such as coral and trilobita, are composed of not only North China and South China specimens, but also contain species from North America, Siberian, Baltic Sea and Australia. It was not until the Silurian that the area was occupied by simple South China fauna, indicating adjacence of the Qaidam Block to the North China Block by that time.

In summary, ophiolites from the North Qilian Mountains were formed in diverse tectonic settings, such as mid-ocean ridge, fore-arc basin, and back-arc basin, and are of Cordilleran type. The early Paleozoic North Qilian area was a composite of volcanic arcs, fore-arc and back-arc basins, similar to the feature of modern West Pacific. Ophiolites, as well as fossil biota, indicate that the whole North Qilian oceanic basin in early Palaeozoic was probably large in scale.

Acknowledgements

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International Ridge-Crest Research: **Mid-Atlantic Ridge**

Surveys of the southern Mid-Atlantic Ridge by RRS James Clark Ross

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Much of our knowledge of slow-spreading mid-ocean ridges is based on data collected during the many cruises in the North Atlantic over the past 30 - 40 years. However, the character of the Earth's geoid over the North Atlantic, which is dominated by the broad Azores and Icelandic anomalies, is markedly different to that of the South Atlantic. Assuming that magmatic and ultimately tectonic ridge processes are in some way affected by mantle temperature and composition reflected in the geoid character, the northern Mid-Atlantic Ridge (MAR) is not necessarily representative of slow-spreading ridges.

We have begun a programme of surveys of the more poorly studied southern MAR, using transits of the British Antarctic Survey vessel *RRS James Clark Ross*. The vessel has recently been fitted with a new Simrad EM120 multibeam sonar with 191 1-degree beams, making it one of the highest resolution hull-mounted deepwater sonars available to academic researchers. By deviating our track by a few days during each 6-monthly transit to and from Antarctica, we aim progressively to survey much of the northern section of the MAR in the South Atlantic. Our first season's effort has concentrated on an area south of the Chain Fracture Zone (Fig. 1). This area is transitional between the Equatorial Atlantic, which has been proposed to be a region of anomalously cold mantle (Bonatti, 1996), and the South Atlantic proper, and hence may provide an early indication of any links between ridge processes and the state of the underlying mantle in this region. To the north, the survey abuts a detailed survey of the Chain FZ collected by joint Italian-Russian cruises (M. Ligi, pers. comm.).

In addition to the multibeam sonar, we are able to routinely collect three-component magnetometer data and Topas narrow-beam sediment profiler records. As the transit database develops, it will also be used to study sedimentary processes of the UK, Iberian, African and South American margins, and other volcanic and tectonic features.

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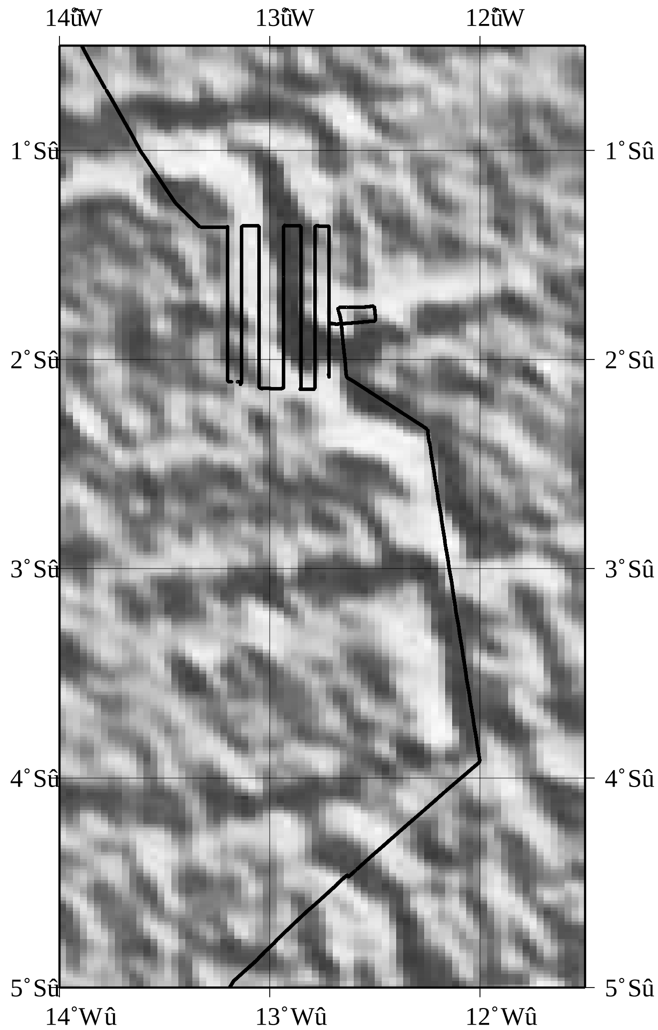

Figure 1. A shaded-relief image of the marine free-air gravity field over the northernmost South Atlantic showing the tracks of the transit cruise of the *RRS James Clark Ross*.

International Ridge-Crest Research: **Mid-Atlantic Ridge**

Seafloor Mapping and Sampling of the MAR 30°N Oceanic Core Complex-MARVEL (Mid-Atlantic Ridge Vents in Extending Lithosphere) 2000

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The purpose of this cruise was to document the detailed structure, composition, and metamorphic history of the domal massif at the eastern intersection of the Mid-Atlantic Ridge 30°N and the Atlantis transform fault. Reconnaissance data collected by Blackman and Cann in 1996 (Cann *et al*., 1997; Blackman *et al*., 1998) suggested that the hypothesis of oceanic core complex formation (review by Lagabrielle *et al*., 1998) could explain the observed morphology, sidescan facies, dredge sample compositions and sea surface gravity signals. Our intent on this cruise was to obtain a closer look at the massif and, thereby, test this hypothesis with a suite of high-resolution seafloor mapping and sampling tools.

We concentrated on two main areas: a spreading-parallel corridor across the dome including the inferred hanging wall on the east flank, and the southern face of the massif where cross-sectional exposures of the footwall were expected. Transponder networks were laid out in each of these areas to provide a navigation base for all our near-bottom studies. The DSL120 sidescan sonar was towed ~100 m off the seafloor to obtain backscatter and phase bathymetry data (Fig. 1). During the 3.5 day survey, we acoustically mapped the major regions of the southern half of the massif and its flanks. Portions of the south wall and the dome are almost 100% imaged by these data, whereas the east and west flank coverage is less complete. The striations that had been previously imaged in the Tobi sidescan were also evident in the finer resolution DSL120 data from the southern part of the corrugated dome (Fig. 2). The steep scarps at the top of the southern face were also imaged clearly. The southern part of the volcanic block adjacent to the east of the dome appears to be sediment covered except where a few small scarps make bright acoustic reflections (Fig. 2).

Near-bottom magnetics data were obtained with a three-axis fluxgate magnetometer which was towed ~25 m behind the DSL120. The total field magnetic anomaly data are of high quality, showing a magnetic reversal captured within the massif and some local magnetization highs that suggest possible post/syn-uplift volcanic activity on the southeast flank. It is notable that the magnetic anomaly amplitudes are quite consistent even though much of the massif appears to be of serpentinized peridotite composition. The stability of the towed magnetometer suggests that we will be able to obtain at least some 3-component magnetic measurements. This could provide constraints on rotation of fault blocks during the formation of the massif.

Based on the sidescan imagery and on bathymetric data, we carried out a series of Alvin dives targeted on likely outcrop areas (bright, steep acoustic reflectors). We maintained a schedule of daytime submarine mapping/sampling operations and nighttime Argo II video/digital imaging transects. Nine Alvin dives were located along the south wall and one on the southeast flank. These dives ranged in depth from 3100 m to 750 m. Orientations of some foliations and joints were measured with the Geocompass and 89 *in situ* samples were obtained. Significant portions of large, steep outcrops were too competent to be sampled by Alvin. Variably serpentinized peridotite makes up about half our sample suite and although some of it is highly weathered, many samples are relatively fresh. A range of gabbroic rock types, including gabbro, gabbronorite and oxide gabbros were recovered. These rocks tend to be more deformed than nearby peridotites, displaying both, crystal plastic and cataclastic deformation fabrics. A suite of texturally and compositionally diverse gneissic metagabbros was obtained from large talus blocks on the south-eastern flank of the massif. Many of

International Ridge-Crest Research: **Mid-Atlantic Ridge:** Blackman *et al.*, cont ...

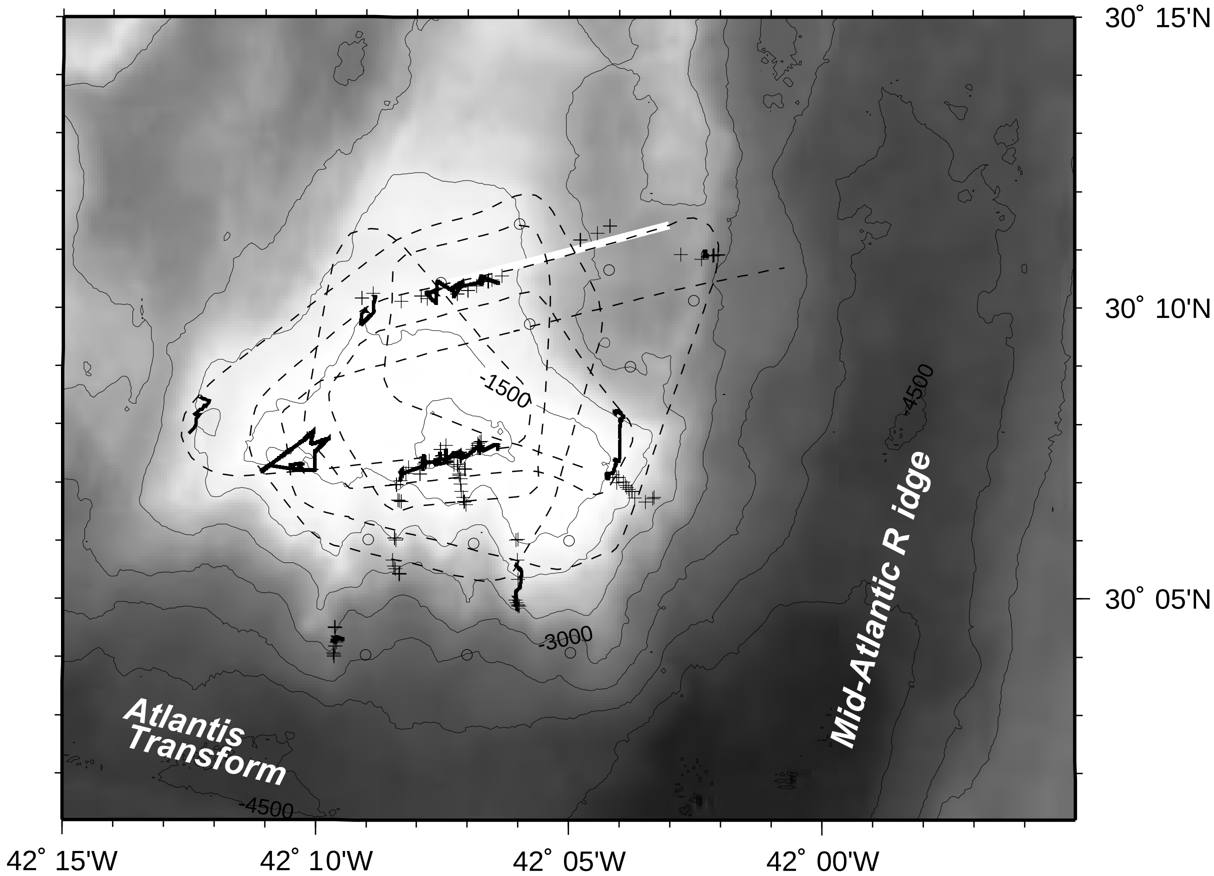

Figure 1. MARVEL 2000 mapping and sampling. Bathymetry is contoured at 500 m intervals. The domal massif was mapped with sidescan (dash), Argo imaging (bold), and Alvin samples were obtained (+). Circles show transponders. Thick white line shows location of sidescan data in Figure 2. Seafloor gravity stations are located along Alvin tracks in the spreading parallel transect.

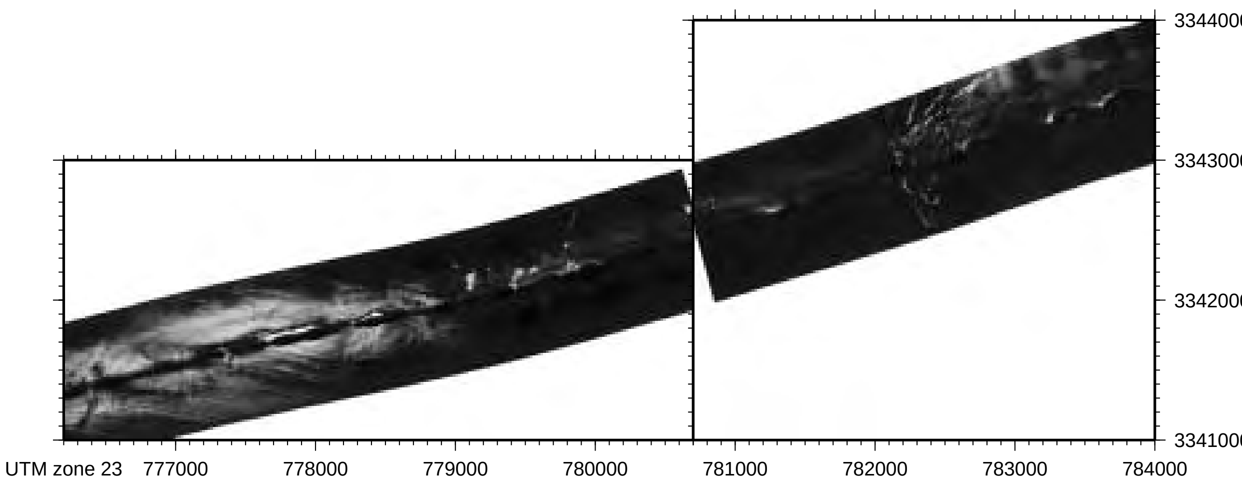

Figure 2. DSL120 sidescan data from the dome of the massif and the adjacent block to the east. Strong reflectors are light, low backscatter areas are black. The break in slope (x~782500) onto the east block shows a series of small, bright scarps.

these rocks show the affects of multiple hydrothermal events. A few *in situ* south wall samples showed variable degrees of rodingitization.

Four full dives and a short engineering dive were completed along the spreading corridor for collection of seafloor gravity measurements as well as rock samples, which were obtainable only from very sparse outcrops due to a 1-5-m thick layer of pelagic ooze and limestone. This capping calcareous rock is strongly lithified and in some places is interstratified with polymict breccia that contains clasts of weathered basalt, gabbro, and serpentinite. The eastern end of this transect was the east scarp of a volcanic terrane previously interpreted to be a fault-bounded 'rider' block, about 5 km from the median valley axis. Our final dive extended the spreading corridor coverage west to where the upper surface of the dome slopes gently to the west. The seafloor gravity data corroborate the positive anomaly associated with the dome of the massif that was first detected in sea surface gravity data (Blackman *et al*., 1998). Modelling of the combined datasets is underway and we expect to place limits on the geometry of the subsurface basalt/ peridotite (footwall/hanging wall?) boundary to the east. Basalt was collected from the massif dome and rider block and small ledges of pillow basalts were observed and sampled near the western edge of the rider block. These basalts are less altered than the peridotite collected from the south wall. A serpentinized peridotite was also recovered from rubble atop the dome. We did not directly observe a contact between the basalts of the eastern block and the peridotites/gabbros of the central part of the massif.

During the first 3 Argo II lowerings, digital still and video cameras were used in the down-looking mode to image the upper surface of the massif. Extensive areas of sediment and rubble were observed, although some outcrop of probable older volcanic material was documented. The rubble commonly occurs in quasi-linear strands separated by sediment that in many places displays ripple marks. The cameras were reconfigured to a 30° downward-looking orientation for mosaicking steep scarps. Most of these transects were located on the southern wall, emphasizing the topmost part of the scarp which was extensively imaged. A crude anastomosing foliation is widely developed there and its apparent dip changes from SW-dipping in the west to gently SE-dipping in the east across the central-eastern portion of the scarp. Oriented samples show that there is a range of deformation fabrics with more diverse orientations than is suggested by the outcrop-scale features. Parts of the top, south wall scarp are massive and jointed and dikes occur locally. The contact between subhorizontal sedimentary breccias and bedded calcareous sedimentary rocks and the underlying basement rocks was traced across several kilometres of the scarp edge. This angular unconformity hints at the possibility that the top of the massif may once have been close to or above sea level. Two Argo II runs were made on the deeper south wall ridges where steep, continuous outcrops were observed during Alvin dives. Massive, jointed outcrops of over 100 m extent with discontinuous dikes were mosaicked to document large-scale structural relationships. A short run was conducted on a westernmost slope characterized by a bright sonar reflector. The latter documented outcrops of fractured basaltic material amongst rubble and sediment. Much of the reflector is simply talus.

The most spectacular initial finding of the cruise is the discovery of a field of active and inactive hydrothermal vent structures (fig. 3). The fact that they are located on crust that is over 1 M.y. old and that the underlying rock type is mainly serpentinized peridotite make the 'Lost City' vents unique amongst currently known spreading centre vent fields. Evidence of hydrothermal activity in the vicinity of ultramafic exposures on the flanks of the Mid-Atlantic Ridge had been found in the water column by the late eighties (*e.g.* Rona *et al.*, 1987) and sulphide mounds and chimneys occur in the Logatchev fields, near 15°N, and the axial Rainbow site, near 36°N, which also host black smokers. In contrast to these sites, the individual edifices in the Lost City are the largest known in the ocean, reaching up to 60 m in height and >10 m in diameter at the top. The chimneys are not constructed of sulphide minerals, instead they have a carbonate-magnesium hydroxide composition (Kelley *et al*., in review for Nature, Feb. 2001). Temperatures up to 75° C were measured at active, diffusely venting sites. Microbial communities occur within and on carbonate flanges that extend laterally from the vent chimneys for up to 1 meter. Samples of vent fluids and microbial material were recovered and the results of onshore analyses are presented in Kelley *et al*. (2001).

Our multi-disciplinary operations and scientific party made this a very interesting cruise and the results will further elucidate what processes control the formation of the domal massif at the eastern RTI of the Mid-Atlantic Ridge, 30°N. The indurated sediment cover, although only meter-scale in thickness, could not be penetrated with the instruments we employed so the question of whether the corrugated top surface of this and other similar domes (Karson, 1999; Tucholke *et al*.,1999) is actually the fault surface of a large-scale detachment is still unanswered. However, we did not find evidence to disprove the oceanic core complex hypothesis—in fact, it is still a viable model based on our initial findings. Even though the nature of the corrugated surface of the dome could not be documented because of its sedimentary cover, we recovered a diverse suite of fault rocks from minor exposures on this surface and the underlying material exposed on the south wall (detachment footwall?). In addition, we documented that the bulk of the south wall is composed of peridotite and gabbro whereas all igneous samples

International Ridge-Crest Research: **Mid-Atlantic Ridge:** Blackman *et al.*, cont ...

Figure 3. Carbonate chimney in the Lost City hydrothermal vent field. Several ArgoII digital still images have been mosaicked to show a ~10 m portion of this feature.

from the inferred hanging wall area are basalts. A possible alternative to the oceanic core complex hypothesis is that the massif was uplifted by some combination of steep faulting and volumetric expansion related to serpentinization. Basaltic lavas could have erupted directly onto the exposed mafic and ultramafic plutonic rocks. As the onshore analysis proceeds, we are considering all evidence that could confirm or rule out these current hypotheses. Subsequent cruises will provide additional constraints on the geologic history of the Atlantis Massif through studies of the subsurface section of the region. Scheduled for Spring 2001: rock drill (UK) and multichannel seismic reflection (US). Pending: hydrothermal vent field mapping (US-2002) and drilling (ODP-2003).

Our new seafloor gravity and deep-tow magnetics data will be quite important for assessing the deeper structure of the massif. The sidescan data both confirms initial sonar interpretation and fills in gaps in the previous Tobi coverage to enable more complete analysis. Our new bathymetric data are being combined with swath bathymetry from both Simrad and Tobi so that several portions of the massif's morphology will be available at few-meter scale resolution. Petrological, geochemical, tectonic and microstructural studies will be conducted on the samples in the coming year. Paleomagnetic analysis will be applied to the oriented samples to determine whether and how much rotation may have occurred in the footwall or hanging wall (limited sampling in the latter) as the massif formed. Our results, like those in other similar massifs, show that crustal drilling will probably be required to provide the geological data required to test current hypotheses of the origin and evolution of these dome-like massifs and hydrothermal systems that they support.

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A New Hydrothermal Plume at 12°54.6' N Mid-Atlantic Ridge: Initial Results of the *R/V Yuzhmorgeologiya* Cruise

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Introduction

First report of possible hydrothermal activity in this area came from the NOAA regional survey on the *R/V Researcher* of the Mid-Atlantic Ridge (MAR) between the TAG site at 26°N and the Vema Fracture Zone at 11°N (Klinkhammer *et al.*, 1985). According to the distribution of manganese in bottom seawater in the rift valley and over the east wall at 12°55'N, the west wall source at this site were determined as the most possible by G. Klinkhammer *et al.* (1985). In 1991-92 during the 10-th cruise of Russian *R/V Geolog Fersman* relatively high concentrations of chemical and physical hydrothermal tracers in bottom waters and sediments at 8 stations along the MAR rift valley near 13°N were detected. In the 9-th cruise of the *R/V Akademik Nikolai Strakhov*, manganese hydrothermal crusts were dredged at 13°21.6'N and 13°25'N (Bazilevskaya *et al.*, 1991). Here we present some preliminary results from a CTD study and geological sampling at 13°N obtained during the Fall 2000 cruise of the *R/V Yuzhmorgeologiya* (October 2000) in the area between 12°47' N and 13°07' N MAR.

Results

Sonar surveying, including bathymetric mapping with a narrow-beam echo-sounder and sidescan sonar imaging using a 30 kHz vehicle MAK towed 180-200 m above the sea floor was conducted during the initial part of the cruise. Based on the results of this survey, two tow-yo CTD profiles were made over the rift valley basin at 13°05'N. Significant increase of potential temperature and salinity was observed in the deep part (4100 - 4500 m) of the central rift basin. We attribute these measurements to the elevated advective heat flow by heated seawater through the seafloor along the rift valley axis. No other evidence of hydrothermal emission associated with high temperature venting in the central rift basin was observed. Further CTD investigations were concentrated over the west wall of the rift valley in the intensively faulted area at 12°54.6' N (Fig. 1). A total of

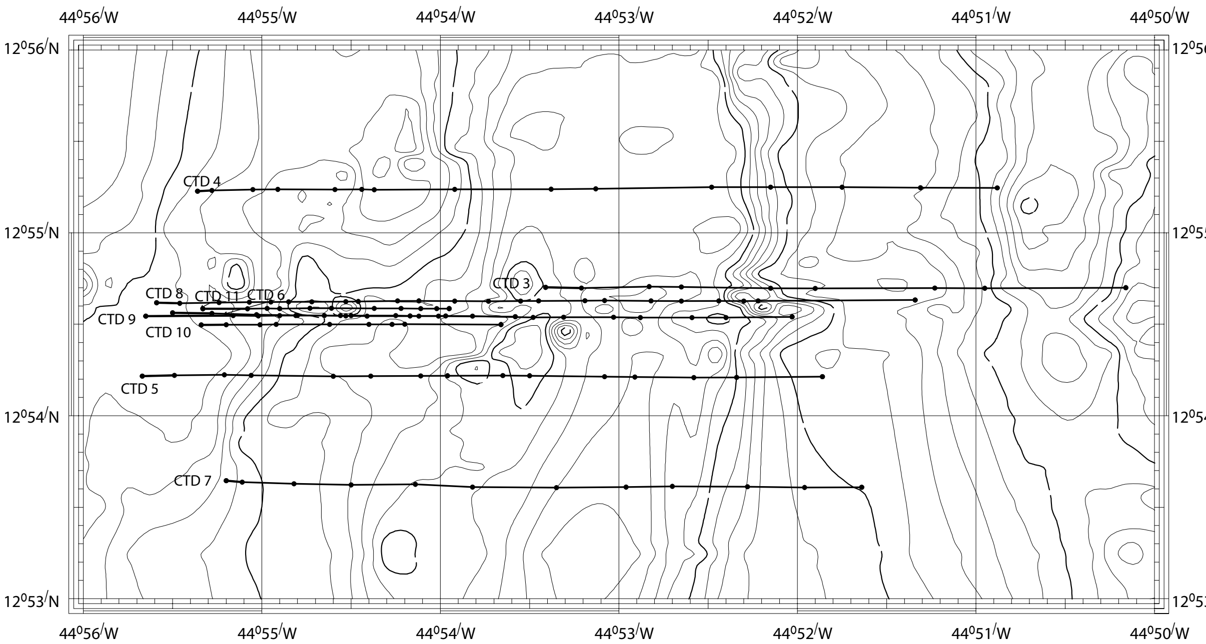

Figure 1. Bathymetric map of the area at 12°55' N, MAR showing the position of CTD profiles.

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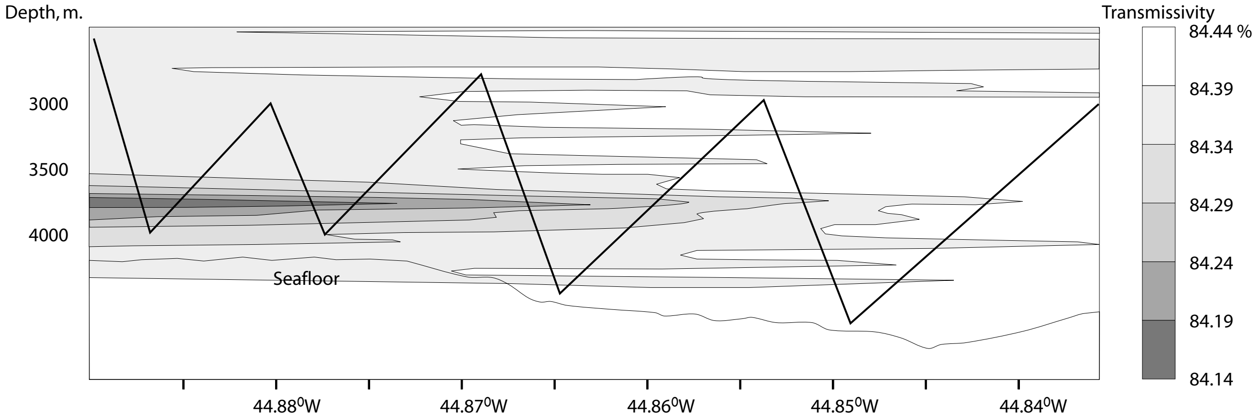

Figure 2. Transmissivity depth profile CTD3. Low transmissivity indicates layers of water with increased concentrations of suspended particulate matter, characteristic of deep-ocean hydrothermal plumes.

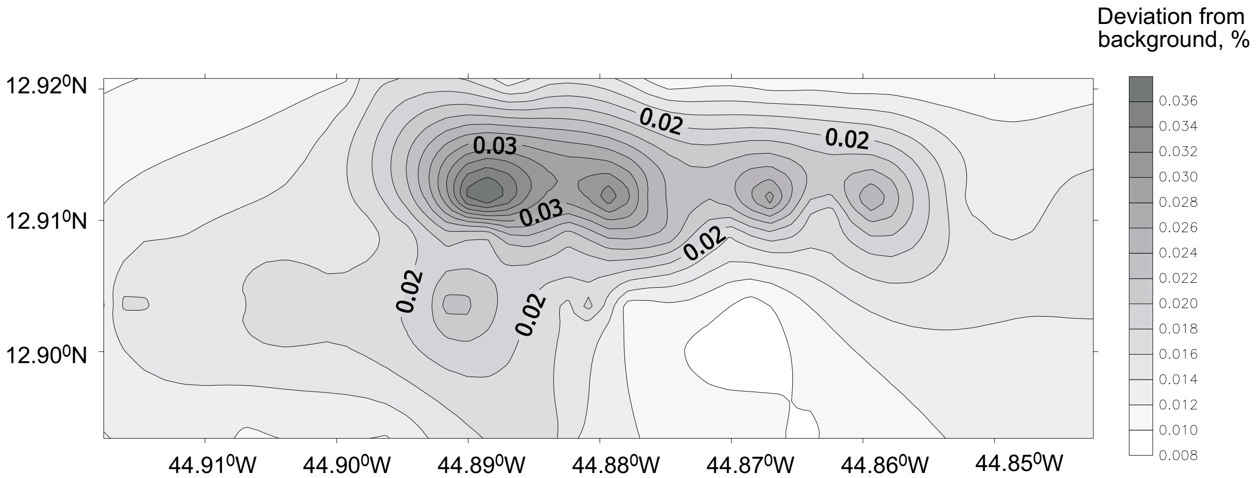

Figure 3. Distribution of suspended matter according to transmissometer data at 3800m depth.

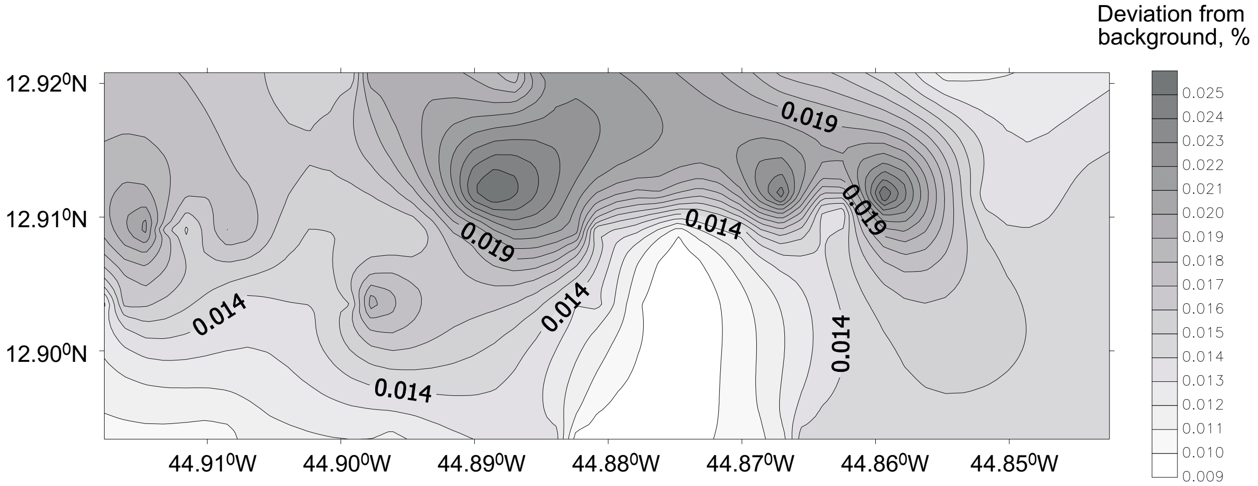

Figure 4. Distribution of suspended matter according to transmissometer data at 3900m depth.

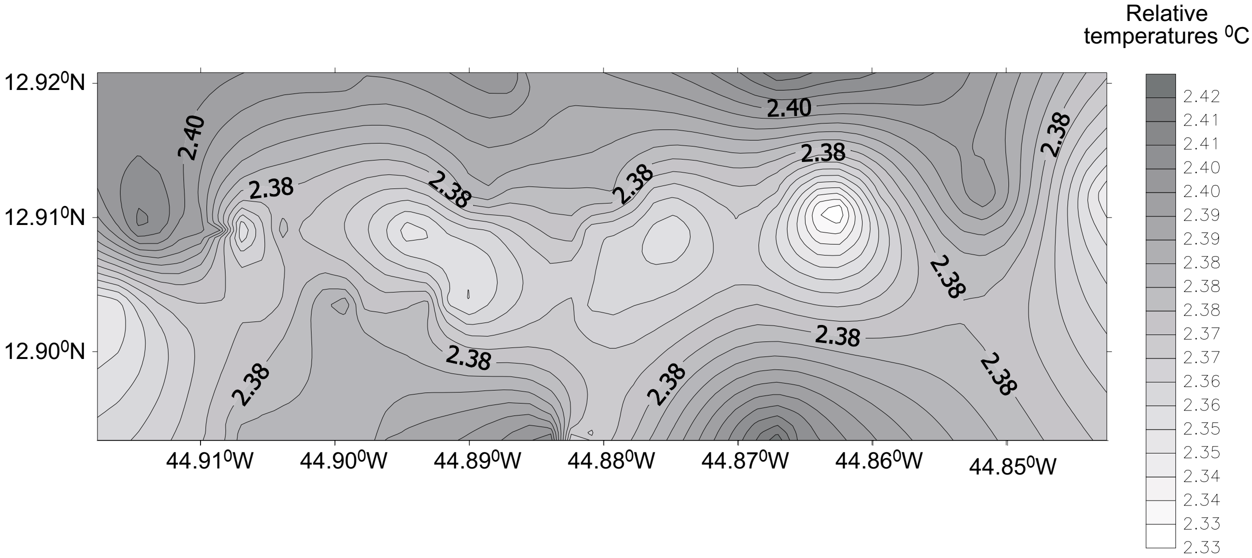

Figure 5. Distribution of bottom water temperatures at 3800m depth according to CTD data.

eight CTD tow-yo transects were made here. All profiles were surveyed normal to the rift valley, extending from the western slope at 3500 - 3600 m depth eastwards into the rift valley (4400 - 4500 m depth). Transmissometer anomalies of different strengths accompanied by salinity and temperature variations were identified. Pronounced anomalies in light transmission were observed at most of the stations of the 3rd transect (Fig. 2). Close similarities in the depth (~3850 ± 50 m) of maximum transmissometer measurements were determined along all transects. The lateral extent of the plume was ~4.5 km to the E and 2 km to the S (Figs. 3 and 4) from the point of maximum transmissometer measurements. The extent of the plume in N and W directions was 1.5 and 1 km respectively. Turbidity maxima were accompanied by temperature anomalies (Fig. 5).

Photographic/video survey operated from the tow-vehicle NEPTUNE was limited by the extremely complex bottom relief. During the TV survey we observed, in real time, some shrimp and clouds resembling hydrothermal smoke. We nearly lost NEPTUNE in the last dive after which we named the discovered hydrothermal plume “The Neptune Beard”.

Samples of hydrothermal sediment were collected within the area of the plume distribution. Substantial amount of sediment were recovered in 8 box cores and 1 gravity core deployments in the centre of maximum transmissometer measurements and the surrounding vicinity (4 km). On board mineralogical analysis was made of hydrothermal mineral concentrations in the surface layer of sediments. Maximum concentrations of Fe oxides in sediments (Fig. 6) practically coincide with most pronounced transmissometer and temperature anomalies in the plume of water immediately above.

Discussion

The sonar surveys show a clear tectonic control of the hydrothermal plume that is located above the intersection between W-E and NE-SW faults. Previous investigations (Krasnov *et al.*, 1995) indicated that minor transverse faults and, especially, their intersections with the rift valley marginal faults control hydrothermal activity on the MAR.

The transmissometer and other CTD data presented here, together with the distribution of Fe oxides in the surface layer of sediments indicates that the hydrothermal source for the anomalies observed is located somewhere close to the west end of the 3rd CTD tow-yo line. The particle rich hydrothermal plume layers disperse laterally through the water column mainly from west to east. The plume-depth for maximum anomalies was near-constant along all tow-yos. It is consistent with these layers of high particle concentrations all representing different parts of the same laterally advecting plume.

Negative temperature anomalies (Fig. 5) were formed by the entrainment of cold bottom waters from local deeps, in accordance with the Atlantic model for plume forming (Sudarikov and Roumiantsev, 2000).

The lateral extent of the plume is comparable with most Atlantic plumes according to previous studies at TAG, Broken Spur and Logatchev (Rudnicki and Elderfield, 1993; German *et al*., 1997; Sudarikov and Roumiantsev, 2000), but the strength of the transmissometer signal is not as high as at the Rainbow plume – the strongest on the MAR (German *et al*., 1996; German *et al*., 1997). This observation along with the absence of sulphides in the surface layer of sediment in the potentially active area provide proposal for the existence of normally active (or relatively modest), may be mostly low-temperature hydrothermal site with Fe(Mn)-dominant fluids centred around 12°54.6’N.

International Ridge-Crest Research: **Mid-Atlantic Ridge:** Sudarikov *et al.*, cont ...

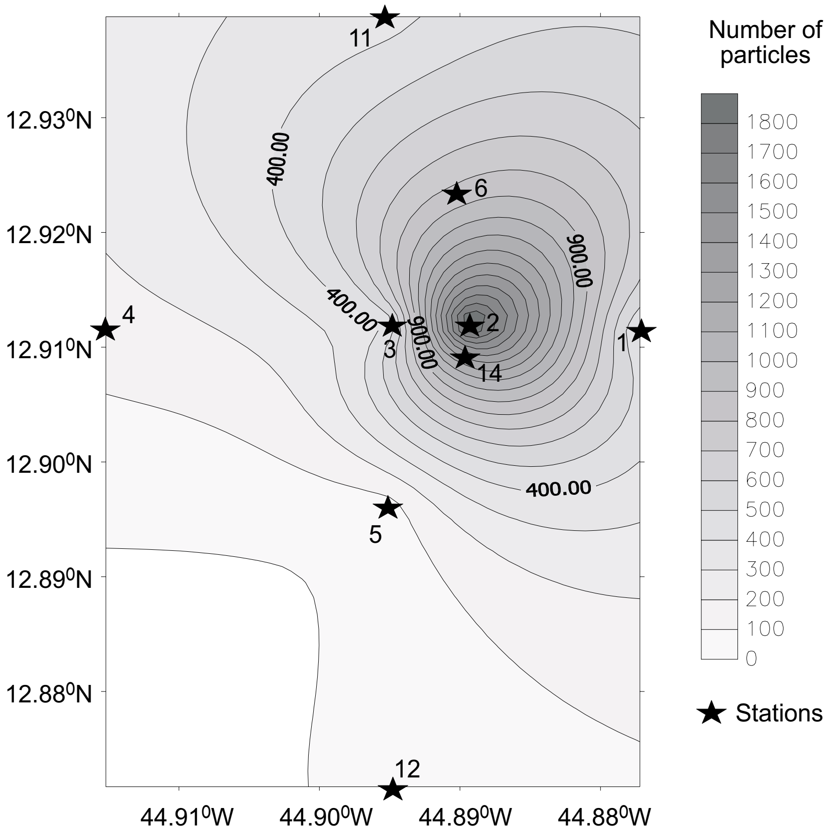

Figure 6. Distribution of Fe-oxides in the surface layer of sediments (size 0.1-1.0 mm)

Acknowledgements

This work was partly supported by grants from the Russian Foundation for Basic Researches (##98-05-64169, 99-05-65258). We thank Master B.V.Petropavlovsky, the officers and crew of the *R/V Yuzhmorgeologiya* for their efficiency during the cruise. We are also grateful to the MAK and NEPTUNE team who operated the vehicles for their enthusiasm and expert technical assistance.

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Editor's Note

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Agnieszka Adamczewska
InterRidge News Editor

International Ridge-Crest Research: **Triple Junction**

Magnetic petrology and variations of basalts along the Mid-Oceanic Ridge near Bouvet Triple Junction

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Introduction

The Bouvet triple junction (BTJ) in the South Atlantic, which is the region of intersection of the American-Antarctic Ridge (AAR), the Mid-Atlantic Ridge (MAR), and the Southwestern Indian Ridge (SWIR), provides major geological constraints on the history of the South ocean opening (Fig.1). While it is generally agreed that the BTJ motion has occurred in a few stages with different directions, currently there are various hypotheses as to the direction and rate of BTJ motion. The kinematic interpretation of this region is mainly based on the constraints from linear magnetic anomalies. Thus, to better understand the complicated dynamics of the formation of the BTJ, multidisciplinary studies, including petromagnetic research are required.

We addressed both, the petromagnetic properties of basalts forming the magnetically active layer under mid-ocean ridges in the influence zone of the Bouvet Island magmatism as well as the composition and structure of primary-magmatic titanomagnetite, actually controlling these properties. This work is based on the data of the Russian-Italian expeditions in the BTJ region (Fig.1) in cruise 18 of *R/V "Akademik N. Strakhov"* in 1995 and cruise 16 of *R/V "Gelendzhik"* in 1996 (Didenko *et al.*, 1999).

Petromagnetic Properties of the SWIR and MAR Basalts

Morphologically, the rift valley between the Bouvet and Moses transforms may be subdivided into three segments: north western (dredges 26, 27, 30, 31), central (dredges 15, 16, 25), and south eastern (dredges 22, 24).

The natural remanent magnetization (*NRM*) of rift basalts from the SWIR is rather high and averages

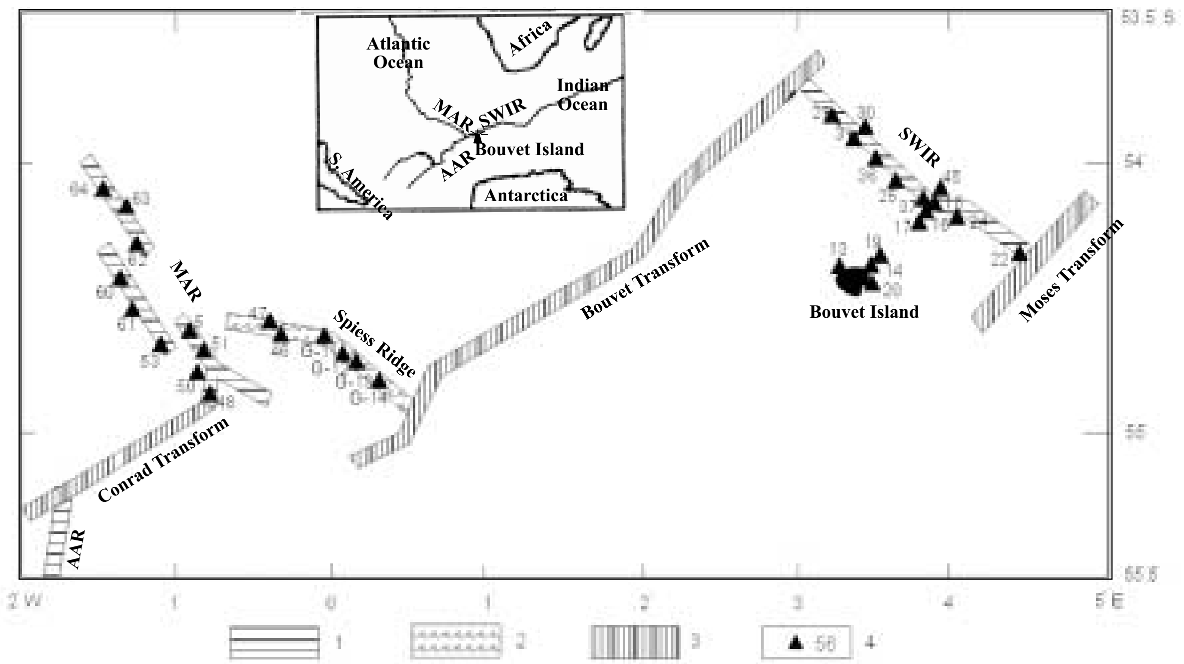

Figure 1. Schematic map showing the study area and position of dredging stations of *R/V "Akademik N. Strakhov"* and *R/V "Gelendzhik"*.
1 - rift zones of Mid-Ocean Ridges: AAR - American-Antarctic, MAR - Mid-Atlantic, SWIR - Southwestern Indian; 2 - volcanic Spiess Ridge; 3 - transform fault zones; 4 - dredging stations (the presence or absence of the letter "G" next to the numbers refers to "*Gelendzhik*" or "*Akademik N. Strakhov*" respectively).

9.9 ± 7.9 A/m. The highest values are in rocks from the central segment, with an average *NRM* 15.3 ± 10.7 A/m, and a maximum of 40 A/m (dredges 15, 16, 25), while the least magnetic basalts were from the south eastern segment, with an average *NRM* of 6.6 ± 6.5 A/m. The initial magnetic susceptibility (*k*) in basalts of the SWIR rift valley varies within wide limits, from 0.6 to 51 and averages $7.57 \pm 6.78 \cdot 10^{-3}$ SI units. The saturation magnetization (J_s) characterizing the concentration of magnetic minerals in rocks (in our case, this primary magmatic titanomagnetite) varies slightly from segment to segment and averages 0.56 ± 0.26 Am^2/kg; this value is also characteristic of oceanic basalts.

The MAR rift valley within the study region is also composed of three segments (Fig. 1): northern (dredges 62, 63), central (53), and southern (48, 50 to 52). The Spiess Ridge (dredges 46 and G-11-14) adjoins the southern segment in the southeast.

The *NRM* values in the MAR basalts vary substantially, from 0.7 to 60 and average 21.6 ± 14.3 A/m. The Spiess Ridge basalts have higher *NRM* values. The NRM average from the MAR basalts is nearly twice as high as that of the SWIR basalts. However, the modal *NRM* value in the MAR basalts, which is more representative, is lower (15 A/m) and comparable with the modal value from samples dredges from the SWIR rift valley. The *k* of these basalts is also highly variable (from 0.6 to 143), averaging $52.1 \pm 41.3 \cdot 10^{-3}$ SI units, which is nearly an order of magnitude higher than the values in the SWIR rocks.

The Koenigsberger ratio (*Q*) value is smallest in the Spiess Ridge basalts. The magnetic susceptibility characterises not only the composition and concentration of the magnetic fractions in basalts, but also its structural features. Thus, since the amounts of the magnetic minerals are similar (the J_s distribution in all basalts is nearly Gaussian, with a mean of 0.62 ± 0.17 Am^2/kg), such a difference is naturally related to structural differences in the magnetic grains of these basalts. Apparently, the titanomagnetite grains in basalts of the MAR segments are under the action of lower stresses than the titanomagnetite grains in basalts of both, the Spiess Ridge and central SWIR segment. This conclusion is indirectly confirmed by lower J_{rs}/J_s ratios for the MAR when compared with basalts of other structures: 0.216 ± 0.058, MAR; 0.304 ± 0.089, Spiess Ridge; and 0.300 ± 0.070, central SWIR segment.

Curie points of basalts and the titanomagnetite composition

It was very important to determine the primary Curie points (T_c) in oceanic basalts and to reject samples markedly enriched in the titanomaghemite and/or titanomagnetite phases, because the primary T_c of basalts with an appreciable titanomaghemite concentration cannot be determined from thermomagnetic analysis, and samples with T_c close to the magnetite value are likely to be of the glacial drift origin.

Many dredged MAR and SWIR basalts yield "normal" J_s versus T distributions with a distinct bend near the Curie point and with virtually vanishing J_{rs}. Heating - cooling cycle (20-600-20° C) increases J_s, on average, by a factor of 1.5 to 2. Repeated curves of *Js* versus *T* commonly yield evidence of two phases, *i.e.*, beside titanomagnetite, some amount of magnetite newly formed during the laboratory heating as result of partial decomposition of the original titanomagnetite is present. Many basalt samples are virtually unaltered; their repeated curves are of the single-phase type and have T_c shifted to the right by 20-25°C.

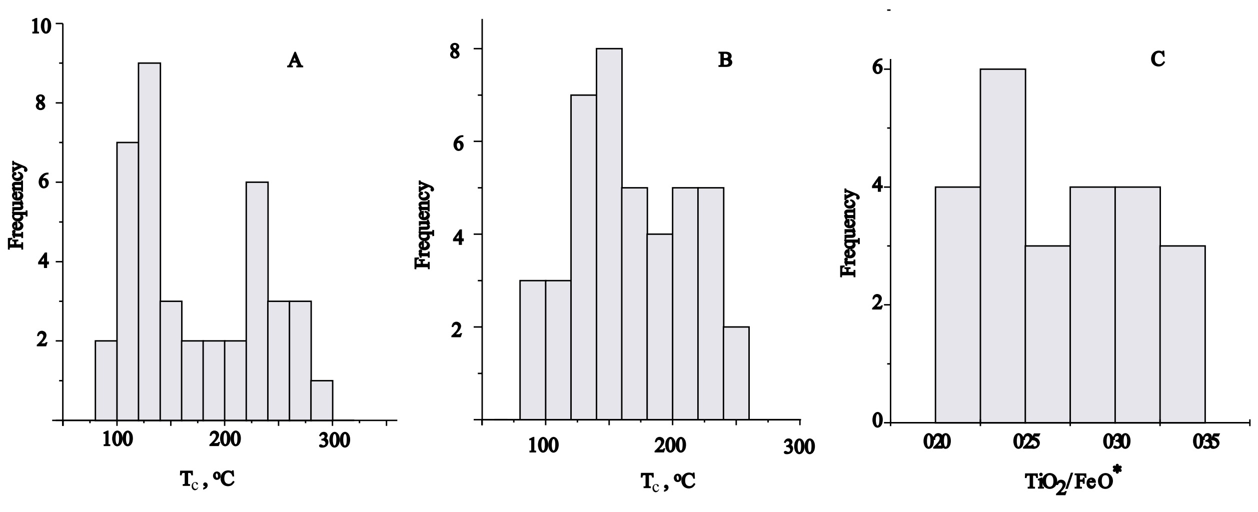

Figure 2. Measured T_c distribution for basalts of the axial (A) SWIR and (B) MAR zones, and distrubution of TiO_2/FeO^* in titanomagnetites of the Spiess Ridge basalts.

The T_c distributions in unaltered basalts from the MAR and SWIR rift zones are quite similar: first, they range from 90 to 300° C, and second, they are bimodal (Fig. 2). The first modal values of T_c lie within the range 120-150° C in both, MAR and SWIR basalts. Such T_c values correspond to a 60-67 % concentration of the ulvospinel component in titanomagnetite and are closely comparable to other oceanic basalts. The second modal value of T_c, greater than 200° C, is also observed in both of the regions studied. We consider in greater detail the T_c distribution in basalts from various MAR and SWIR structures in the BTJ region.

The T_c values of the main magnetic mineral tend to rise in the direction from the Bouvet to Moses transforms along the rift valley. However, this tendency is deceptive. The overall T_c distribution across all of the samples is bimodal with modes at 120-130° C and 220-230° C. However, whereas basalts of the north western segment have a single mode at 120° C, coinciding with the T_c average, rocks from the two other segments have both modes. To establish primary differences in T_c values from basalts dredged from various structures in the BTJ region, titanomagnetite compositions were examined.

The microprobe analyses of titanomagnetite compositions estimated from TiO_2/FeO^* ratio in 81 grains from various MAR segments are relatively stable. This ratio is 0.27-0.31 for the northern, central, and southern segments of MAR, and its distribution has a single mode close to the average. The T_c estimates from these grains lie between 120-170°C, which is close to the first mode of their measured T_c distribution (130-150°C).

We did not obtain any microprobe evidence for a second group of titanomagnetites with T_c above 200° C in the MAR axial zone basalts. High T_c are caused by significant low-temperature oxidation of titanomagnetite to titanomaghemite in basalt. The absence of high T_c titanomagnetite is supported by the positive correlation between T_c and remnant coercive force, characteristic of variously oxidized titanomagnetites. Thus, the presence of the second magnetic phase may be due to secondary processes other than oxidation.

The Spiess Ridge basalts (24 studied grains) exhibit a different, bimodal distribution of TiO_2/FeO^*. Two groups of samples gave TiO_2/FeO^* averages of 0.23 and 0.30. It is remarkable that T_c estimates derived from microprobe data and measured values coincide so closely. The TiO_2/FeO^* distribution in the titanomagnetite of basalts from the SWIR (112 studied grains) axial zone is bimodal, with averages of 0.32-0.34 for basalts of the northwestern and southeastern segments and 0.23 for basalt of the central segment.

Thus, based on the thermomagnetic and microprobe data, one may state that two primary sets of titanomagnetite compositions are present in the Spiess Ridge and the SWIR basalts, and they differ in T_c by about 80-90°. Only one primary composition set with T_c in a range of about 130 to 150° C is reliably recognized in titanomagnetites from the MAR axial zone basalts.

Discussion

Many researchers studied the magnetic mineralogy and petromagnetic properties of oceanic crust basalts. It is generally agreed that TiO_2/FeO^* ratio in titanomagnetite of oceanic basalts varies within rather narrow limits (0.28-0.32), which yields 0.6-0.67 for the ulvospinel portion (Furuta, 1993; Pechersky *et al*., 1993). The Curie points of titanomagnetites of such compositions range from 120 to 170° C, and the corresponding isotherms are located at a depth of about 1 km under the young oceanic crust of mid-ocean ridges, which determines the thickness of the magnetically active layer.

In the BTJ region, these variations are likely to be petrochemically and petromagnetically interrelated and cause pronounced magnetic anomalies over the central SWIR segment and Spiess Ridge. As shown above, the T_c values of basalts from the axial MAR zone and northern and southern segments of the axial SWIR zone differ from those of the Spiess Ridge and central segment of the axial SWIR zone by about 100° C. Such an increase in T_c should have increased the thickness of the magnetically active layer under Spiess Ridge and central segment of the axial SWIR zone by about 1 km. Even at the early stage of oceanic crust formation, the anomalous magnetic field might have been affected by grains of magnetite and low-Ti titanomagnetite of layers 2B and 3 (T_c>500° C) that formed as result of the high-temperature decomposition of primary titanomagnetites and some silicates.

Model estimates and magnetic observations of profiles (Bonatti *et al*., 1997) crossing the “normal” axial MAR zone and the “anomalous” Spiess Ridge (Fig. 3a) support the above statements. The estimated thickness of magnetically active masses amounts to about 1 km in the first case (Fig. 3b) and 2 km in the second case (Fig. 3c).

Similar results were obtained for Cenozoic basalts of the Khamar Daban hotspot (continental plume). The thermomagnetic analysis showed that the T_c, determining the ferromagnetic fraction composition, can vary widely (from 140 to 600° C), depending on the relative composition of titanomagnetites to weakly oxidized magnetite. The resulting histograms show the presence of three modal T_c values of about 150°, 230° and 350° C (the magnetite phase is ignored because it is a product of the primary titanomagnetite decomposition). The primary nature of the titanomagnetites with this T_c is supported by the discreteness of their distribution, and a model of melt

International Ridge-Crest Research: **Triple Junction:** Didenko *et al.*, cont ...

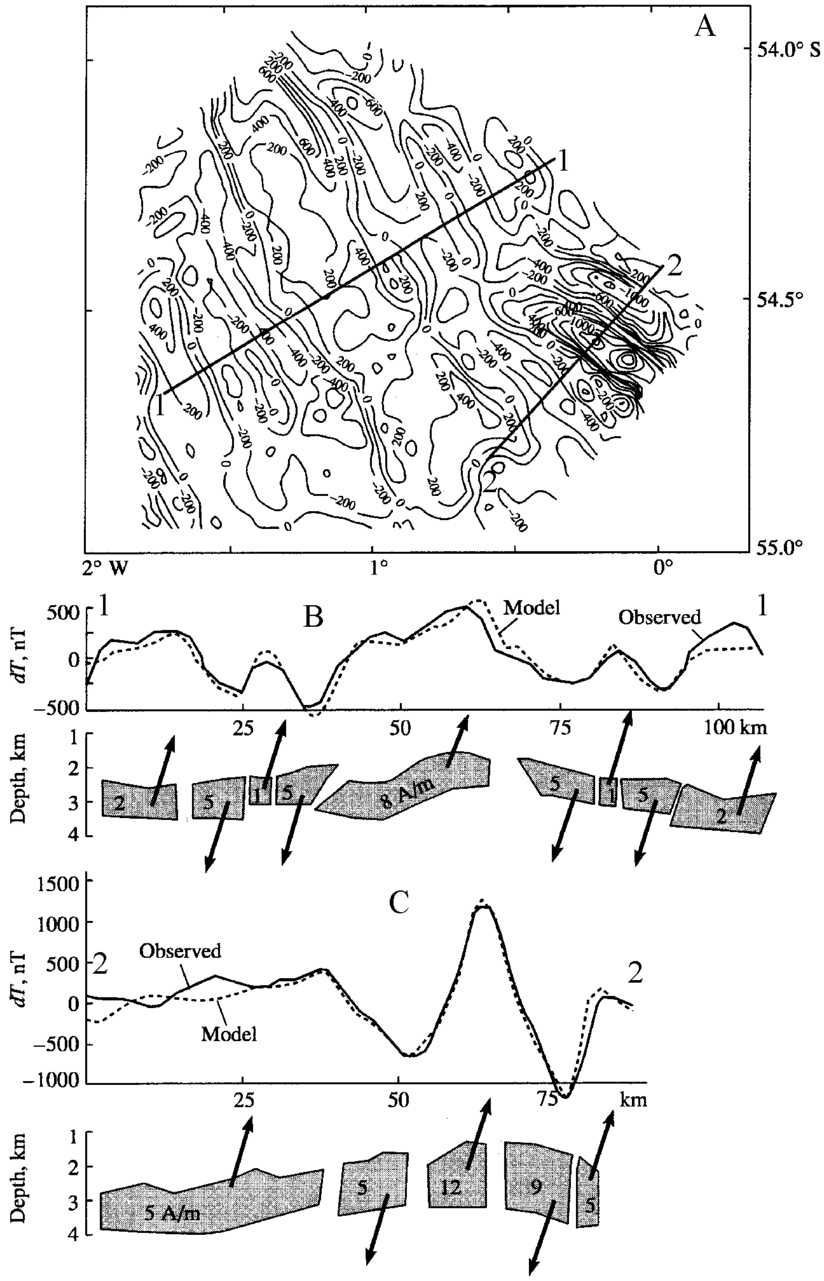

Figure 3. The map (A) of anomalous magnetic field (dTa) in MAR (profile 1-1) and Spiess Ridge (profile 2-2), and observed and model magnetic profiles across the MAR (B) and Spiess Ridge (C) structure (Bonatti *et al*., 1997).

formation at different depths may be suggested as an alternative to the oxidation variant (Didenko & Tikhonov, 2000).

Conclusions

Our analysis of the magnetic petrology of basalts dredges in the MAR and SWIR rift zones showed that the distribution of these characteristics is laterally heterogeneous. This primarily concerns the Curie points depending on primary composition of titanomagnetite. The MORB magmas are likely to originate at one depth level, and the titanomagnetite geobarometry fixes its pressures at 15 to 17 kbar (Pechersky *et al.,* 1975). In the Bouvet plume magmatism area, magmas originate at two levels: olivine and chrome-spinel form at a deeper level (near 20 kbar), and titanomagnetite compositions with T_c more than 200° C form at shallower levels. The latter, are controlled by the depth of the last equilibrium state of the magmas (12-14 kbar), where they either occupy a peripheral chamber or are at an intermediate position in the case of slow upward magma motion accompanied by fractional crystallization.

Acknowledgements

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International Ridge-Crest Research: **Arctic Ridges**

International Gakkel Ridge Icebreaker Cruise in Summer 2001

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The first expedition dedicated to studying and sampling Gakkel Ridge has been scheduled for Summer 2001. The expedition is an international effort that will involve two icebreaking science vessels and scientists from Germany and the United States. The ships will leave from Tromsø, Norway on July 29 for a 62 day cruise to the polar region. The expedition comes after several years of planning and is a direct result of two InterRidge workshops.

Gakkel Ridge stretches 1800 km across the Eurasian Basin of the Arctic Ocean (Fig. 1). To the west it passes *via* Lena Trough and the Molloy Fracture Zone into Knipovich Ridge, the most northern part of the MAR. Its eastern end runs into the continental margin of the Laptev Sea, where rifting continues (Drachev *et al.*, 1998). Spreading rates decrease from 1.33 cm/yr (full rate) at the western end to 0.63 cm/yr at the eastern end in the Laptev Sea. Spreading is nearly orthogonal to the strike of the ridge and there is only one major offset in the ridge axis at about 60°E (Kovacs *et al.*, 1985).

Gakkel Ridge provides a unique opportunity to increase our understanding of mid-ocean ridges. It is an end-member of the global spectrum of mid-ocean ridges in many respects, and offers a unique combination of the so-called "forcing functions" (*e.g.* spreading rate, geographical location, obliquity, segmentation) which may control the composition of the erupted magmas and the crustal thickness. It is the slowest spreading mid-ocean ridge with an exceptionally deep rift valley, and the thinnest known crust for a normal ridge (<4 km: Reid and Jackson, 1981; Coakley and Cochran, 1998). It extends the range of spreading rates that can be investigated by a factor of two, and thus will greatly extend the range of values over which we can investigate the relationships between ridge properties and spreading rate. Unlike slow-spreading ridges in the Indian Ocean it has few transform offsets, and therefore allows separation of the roles of spreading rate and ridge obliquity in mid-ocean ridge crustal genesis. Again, relative to Indian Ocean ridges, Gakkel Ridge is far from the Indian Ocean, and therefore allows separation of the effects of spreading rate from the anomalous Indian Ocean mantle source in the geochemistry of basalts. Analysis of a few small basalt and peridotite samples from Gakkel Ridge suggests the extent of melting may be very low (Mühe *et al.*, 1997; Hellebrand *et al.*, in press). This has implications for the development of the magmatic plumbing systems beneath the ridge and the ratio of peridotite to basaltic crust, which may be present in the ridge axis.

While so far there is little doubt on the existence of thin crust in the rift valley, the situation off-axis is different. Observations in the past and a recent study (Weigelt & Jokat, in press) indicate that in the Arctic there might be no simple relationship between spreading velocity and crustal thickness away from the Gakkel rift valley. Although spreading velocity decreases, sparse seismic refraction data and gravity modelling suggest a thickening of the oceanic crust. Currently it is not clear if this observation is typical or if it represents only local variations in the composition of the oceanic crust. In any case it challenges currently accepted theoretical models. Maybe Gakkel Ridge represents a threshold spreading environment, where existing global models fail in general. Therefore, three transects off the axis of Gakkel Ridge, in the Nansen and Amundsen basins, have been designed to enlarge the geophysical database for testing this hypothesis.

How the mantle beneath the Arctic Ocean is related to the mantle beneath the northernmost Atlantic Ocean and the rest of the planet, and how it may have been influenced by the nearby continents are additional basic questions that will be addressed by geochemical studies of the igneous rocks. It is conceivable that polar mantle has rather different characteristics than equatorial mantle, and Gakkel Ridge is our sole opportunity to sample this portion of the earth's interior.

Despite the compelling rationale for intensive study, Gakkel Ridge remains little studied geophysically and virtually unsampled because of the heavy pack ice covering the Arctic Ocean. Even the bathymetry of the ridge was not known in detail several years ago. A dramatic change in knowledge occurred when side scan sonar instruments were mount-

International Ridge-Crest Research: **Arctic Ridges:** Michael *et al.*, cont ...

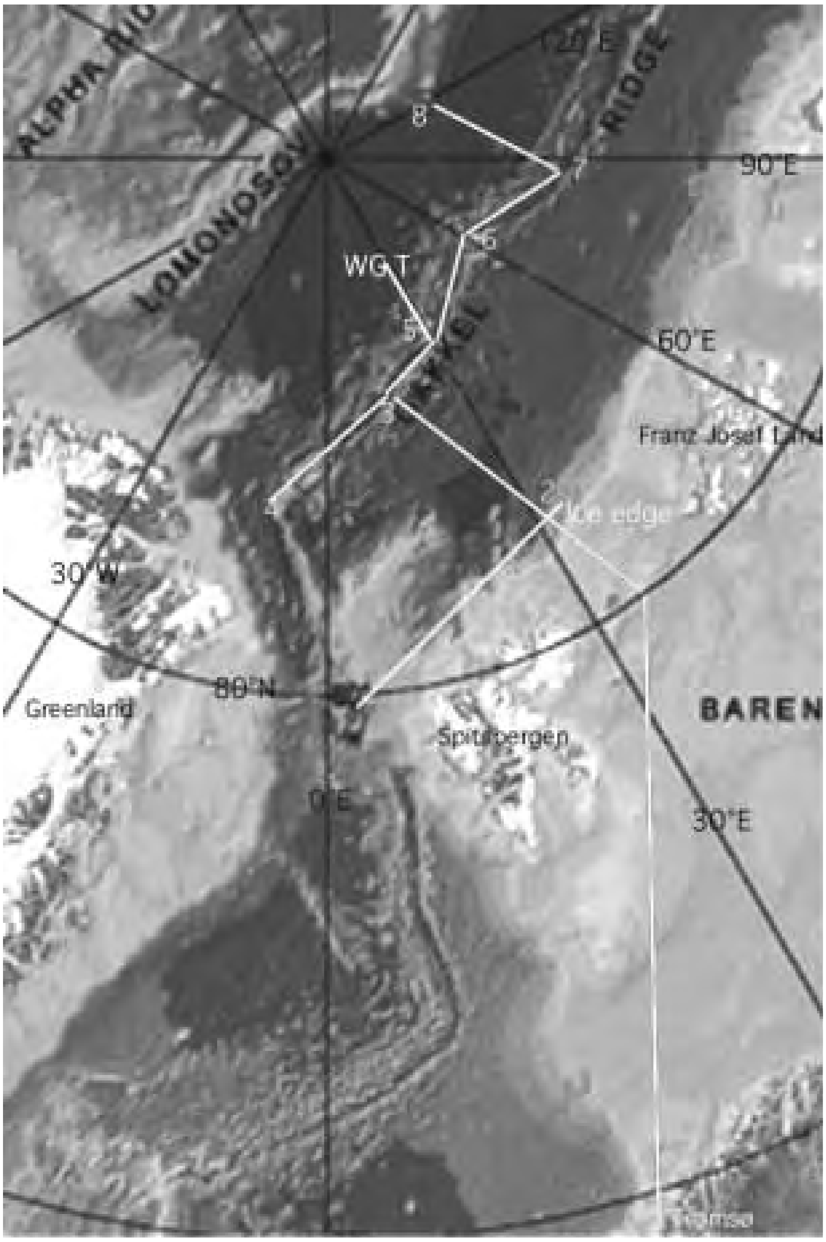

Figure 1. International Bathymetric Chart of the Arctic Ocean (IBCAO) showing anticipated cruise track (light line) from Tromsø (lower right) to Gakkel Ridge. Numbers along track show planned sequence: Tromsø-2-3-4-5-6-7-8-7-6-5-WGT-5-3-2-Tromsø. Amundsen Basin lies north of Gakkel Ridge, Nansen Basin lies south of Gakkel Ridge. IBCAO is available at *http://www.ngdc.noaa.gov/mgg/bathymetry/arctic/arctic.html*

ed on a US Navy nuclear submarine and used for the seafloor mapping within the SCICEX program in 1998 and 1999 (Coakley and Cochran, 1998) (*http://imina.soest.hawaii.edu/HMRG/SCAMP/Archive/menu/SCAMP_Pulldown2.htm*). These charts produced swath bathymetry and sonar backscatter maps of most of Gakkel Ridge and provide the framework for planning of a sampling regimen. Another leap ahead was the completion this year of the new U.S. Polar icebreaker, USCGC Healy, whose primary mission is Arctic science. It makes it more feasible to assemble an international two-ship scientific expedition to the high Arctic, where two icebreakers travelling in tandem are needed for geophysical profiling and to traverse the thick sea ice safely and efficiently.

Scientists from Germany and the United States will undertake such an expedition in late Summer, 2001 using Polarstern (*http://e-net.awi-bremerhaven.de/Polar/polarstern.html) and USCGC Healy (http://www.uscg.mil/pacarea/healy/intro.htm*). The combination of scientific rationale, exciting new geophysical data and logistical opportunity has created a situation where the least-studied mid-ocean ridge can be investigated to provide tests of competing models for ocean crust formation. Multibeam bathymetry, sidescan sonar, gravity, magnetic, heat flow and rock sampling will be done from both ships. In addition, working together will allow the two ships to run seismic surveys. Miniature Autonomous Plume Recorders (MAPRs: Baker *et al.*, 1998) have been re-designed for use in ice-covered waters, and will be deployed with every rock sampling attempt to detect possible hydrothermal anomalies. The ships will be able to do CTD/rosette casts and camera tows if desired.

Even with the co-operative effort of two icebreakers, the project will present extraordinary and diverse challenges:

- The ice conditions, which can vary greatly from year to year, will strongly influence the level of success. A speed of three knots is possible in “normal ice”. Dredging operations will take considerably longer than they do in open water even under normal ice conditions but will probably be feasible based on experiences dredging in the Lena Trough (Snow *et al.*, in press). Alternative sampling methods including an experimental vertically dropped grab sampler as well as a video grab will reduce the need for careful manoeuvring of the ships, which may not be possible at times in the ice. Particularly thick or compressive ice might present a situation where no scientific operations are possible.

- The very slow spreading and sedimented nature of much of the Gakkel Ridge axis present a further challenge. A program of parallel sampling of steep rift valley walls and the rift valley axis is planned to maximize chances for sample recovery in such areas. Magnetic data from Gakkel Ridge (Brozena *et al.*, in prep.) combined with recent experience on the ultraslow Southwest Indian Ridge (H.J.B. Dick, pers. comm.) suggest that volcanic centres will not be continuous and may be separated by large areas of peridotite and plutonic rock.

The cruise will start in Tromsø and conduct a geophysics traverse directly to the ridge, passing east of Svalbard (Fig. 1). This off-axis transect will be performed to reveal the crustal structure of the Nansen Basin, using both steep and wide angle seismic methods. Reconnaissance sampling at a 30-km spacing combined with seismic surveying will proceed westward along the ridge toward its intersection with Lena Trough (Fig. 1). The ships will then backtrack east along the ridge, sampling in detail specific areas that will be selected based on the results of shipboard analysis of reconnaissance samples. Heat flow measurements will be taken whenever possible. Parallel with the petrological and geological sampling program, seismological and magnetotelluric stations will be deployed on ice floes to retrieve the first information on the seismic and electrical conductivity structure of the Arctic mantle beneath Gakkel Ridge. Reconnaissance sampling and seismic surveying will continue east to about 90°E.

The exciting discovery of lava fields at 90°E that might have been erupted as recently as 1999 (Mueller and Jokat, 2000; Edwards *et al.*, 2001), raises the possibility of current hydrothermal activity on Gakkel Ridge. Extensive sampling of the lavas is planned and photo mapping and a CTD/rosette will be used to detect and pinpoint hydrothermal vents or plumes, especially when MAPRs suggest a promising anomaly. In the extremely fortuitous case that a vent is discovered, the expedition is prepared for biological studies and preservation.

From 90°E, the ships will complete a geophysical traverse across Amundsen Basin to the foot of Lomonosov Ridge before returning westward along Gakkel Ridge to 30°E, performing detailed sampling of selected areas along the way (Fig. 1). A short seismic survey partway into the Amundsen Basin at 30°E will complete the second off-axis geophysical transect. The ships will return to Tromsø and Bremerhaven, respectively.

This truly multidisciplinary expedition has been designed to meet the high risks operating in the Arctic in terms of redundant scientific capabilities of both ships and concerning safety problems in this hostile environment. There is a high risk for all the equipment used and the personnel, but we hope that joining forces in the Arctic will give benefits to all involved groups.

Partial list of Institutions/Universities involved -listed in Alphabetical order: -

- Alfred Wegener Institute, Bremerhaven
- Lamont-Doherty Earth Observatory
- Max Planck Institute, Mainz
- Oregon State University
- The University of Tulsa
- University of Bremen
- University of Kiel
- University of Muenster
- University of Texas at Austin
- Woods Hole Oceanographic Institution

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International Ridge-Crest Research: **Arctic Ridges:**

Japan-Russia Cooperation at the Knipovich Ridge in the Arctic Sea

K. Tamaki[1], G. Cherkashov[2], and Knipovich-2000 Scientific Party

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Introduction

The Knipovich-2000 Cruise was first planned through discussion between K. Tamaki, G. Cherkashov, and K. Crane at the InterRidge Arctic Ridge Workshop at Kiel, Germany in 1998. K. Tamaki submitted a proposal to the Ministry of Education, Science, Culture, and Sports of Japanese Government with a title of "InterRidge Arctic Ridge Research Program" to solicit funds to use the *R/V Professor Logachev* for a month-long research cruise. The proposal was accepted by the Ministry's Grant for the Aid of Scientific Research for the term of 1999 to 2001. A pre-cruise meeting was held at VNIIO, St. Petersburg in January 2000 and was attended by K. Tamaki, G. Cherkashov, K. Crane, H. Tokuyama, B. Baranov, M. Maslov, M. Sorokin (Polar Marine Geosurvey Expedition) and other Russian scientists. At the meeting K. Tamaki and G. Cherkashov were assigned as co-chief scientists of the cruise and the original science plan was devised to focus research at the Knipovich Ridge.

The research strategy consisted of an along-axis towing of ORE sidescan sonar with additional self recording instruments (LSS, CTD, magnetometer, and pH meter). Bottom rock sampling, CTD water sampling, bottom sediment sampling, heatflow measurements, and deployment of an OBS seismic network were planned to be carried out based on the obtained data. SEAMarc image data, bathymetry, and interpretations provided by Kathy Crane were invaluable for the planning of this scientific cruise. The second pre-cruise meeting was held at VNIIO, St. Petersburg and at the Institute of Microbiology, Moscow in June 2000 attended by K. Tamaki, G. Cherkashov, M. Sorokin, J. Campbell, and V. Gladysh (chief engineer of ORE system) to discuss the configuration of ORE towing system. Tamaki and Sorokin completed a contract document on the R/V Logachev research cruise during the meeting. The name of the research cruise was assigned as "Knipovich-2000". At the Moscow meeting, most of the Russian scientists who planned to join the cruise attended and discussed the science plans.

Operation of the cruise

The objectives of the Knipovich-2000 research cruise are summarized as follows.

1. Understanding the tectonics of ultraslow sea-floor spreading system at the Knipovich Ridge
2. Finding active hydrothermal vents along the Knipovich Ridge
3. Understanding the magmatism of the Knipovich Ridge.
4. Detecting microearthquake activity along the Knipovich Ridge

The instrumentation used in Knipovich-2000 cruise

1. ORE deeptow sidescan sonar (30 kHz, 2.4 km swath) that is installed

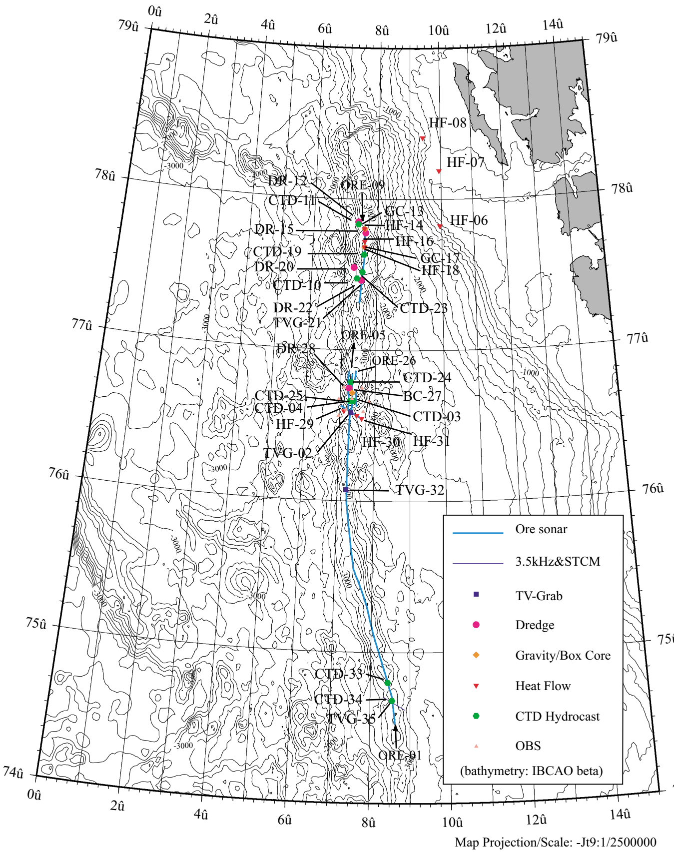

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Figure 2. Ship's tracks and sampling sites of the Knipovich-2000 Cruise.

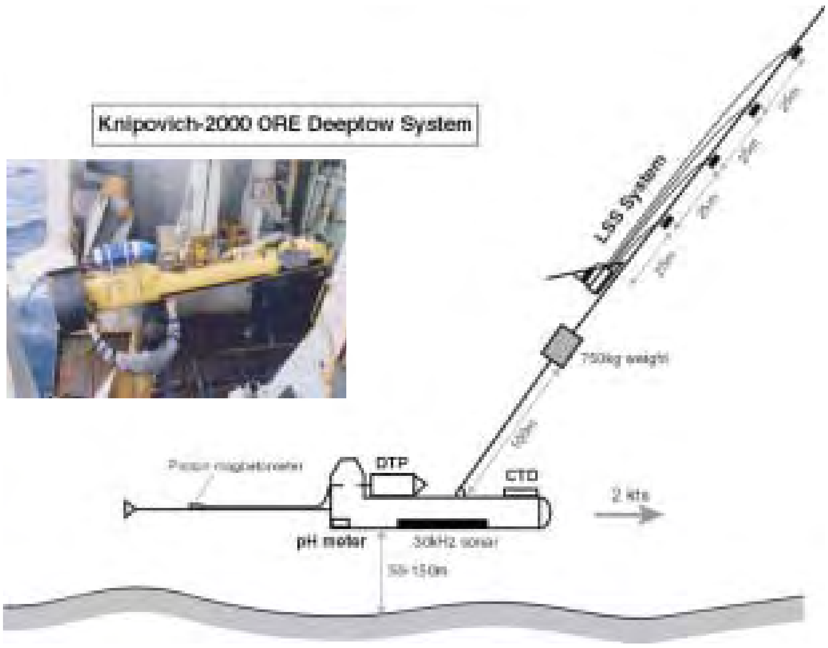

Figure 1. Schematic diagram showing the ORE system and attached self-recording devices. Insert - ORE deeptow sidescan sonar system

with the following four self-recording systems: A) LSS (Light Scattering System) provided by C. German and J. Campbell; B) CTD provided by K. Crane; C) Proton magnetometer provided by K. Tamaki and K. Okino; D) pH meter provided by Y. Koike (Fig. 1).

2. 3.5 kHz echo sounder
3. Shipboard Three Component Magnetomter provided by Y. Nogi
4. TV grab
5. CTD rosette waster sampler (12 x 5 L)
6. Gravity core (6 m)
7. Box core
8. Two heatflow meters
   A) Norwegian system provided by K. Crane and A. Nilsen
   B) Japanese system provided by M. Kinoshita and S. Goto
9. Dredge sampler
10. Ship positioning was done by DGPS system of Ashtech.

The Knipovich-2000 was divided into two Legs. Leg 1 is from August 30 (Bergen, Norway) to September 10 (Longyearbyen, Svalbard), 2000, and Leg 2 is from September 10 (Longyearbyen, Svalbard) to September 23 (Bergen, Norway). The ORE sidescan sonar system attached with the above multi-sensors along the axis of the Knipovich Ridge was towed from the southern end at 74° 30' toward the north with a swath width of 2.5 km and ship speed of 2 knots (Fig. 2). Mosaic mapping was done at the Logachev Area at 76°30'N (Fig. 3), the most intensive volcanic zone in the Knipovich Ridge. Most of operations of CTD, TV Grab, heatflow, OBS deployment, sediment sampling, and rock sampling were done based on the swath of sidescan sonar image (Fig. 4). In total 10 CTDs, 5 rock dredges, 3 sediments samplings, and 6 heatflow measurements were done. Eight OBSs were deployed at the Logachev area and seven were recovered by *R/V Haakon Mosby* after 25 days of recording the data at the sea bottom.

Results

The along axis ORE sonar images and a variety of stationary operations executed within the sonar swath pro-

International Ridge-Crest Research: **Arctic Ridges:** Tamaki and Cherkashov cont ...

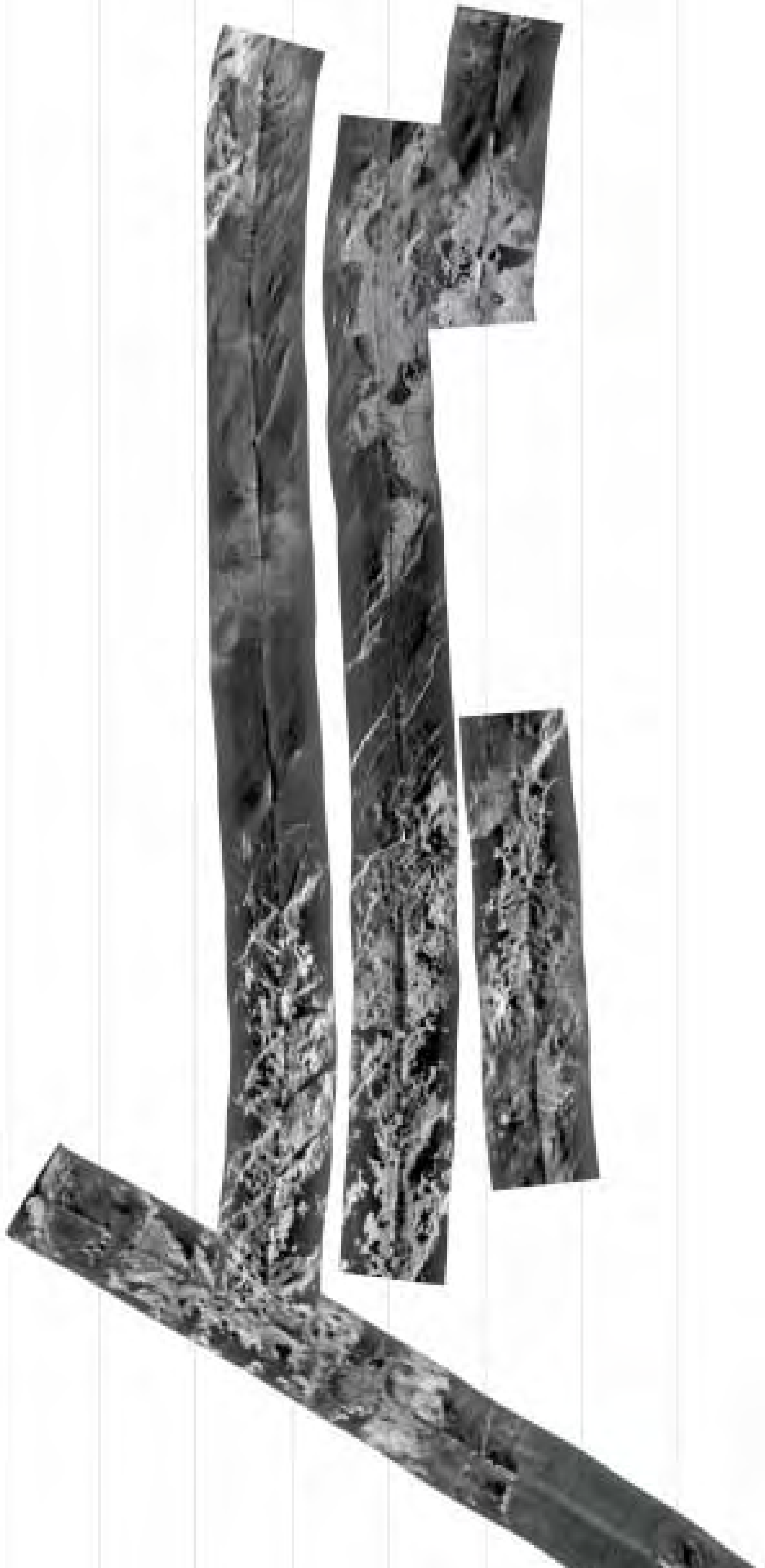

Figure 3. Mosaic image of the Logachev Area

vided a number of new findings on the Knipovich Ridge, a little known ultraslow-spreading system in the Arctic region. One of the most important achievements of the Knipovich-2000 cruise in terms of tectonics is identification of segmentation of the Knipovich Ridge. The ORE deeptow sonar images confirmed intensive volcanic activity at most of the topographic highs in the center of the rift. Specifically four large seamounts in the rift valley of the Knipovich Ridge all appeared as active volcanoes with abundant fresh lava flows and pillow mounds. They are identified as the centers of four fundamental segments of the Knipovich Ridge. The scale of each segment is about 100 km. We further identified smaller-order segmentation with a length of about 20 km. The correct identification of segmentation provided the basis to devise a sampling plan for the cruise. It will also contribute to any future research at the Knipovich Ridge.

The combination of ORE sonar images and TV grab operations turned out to be a strong tool for understanding the geology in the rift. The ORE sonar data were quickly processed into image mosaic maps on board and TV grab operations were planned using the images combined with SBL sonar navigation. TV grab operations provided bottom video images and at the same time returned invaluable rock samples for ground truthing and for sonar image interpretation.

The sonar images of the axial volcanoes made it possible to recover fresh basalt samples from the bottom. At four sites at the axial volcanoes fresh basaltic samples were obtained with abundant glass. Further laboratory analyses of major and trace elements and isotopes will elucidate the mantle geochemistry and dynamics of the Knipovich Ridge for the first time, as well as providing a powerful tool for understanding the magmatic processes in the rift in relation to tectonism.

The northernmost dredge samples from the rift wall contained unexpected hard sedimentary rocks. Although the reason for these outcrops of hard (= old?) sedimentary rocks in the rift wall is puzzling, the dredge results will constrain a unique tectonic history at the very northern end of the Knipovich Ridge. The age determinations of the sedimentary rocks by microfossil analyses are planned.

One of the heatflow data points in the northern Knipovich Ridge was very low with a value of 70 mW/m^2, despite the fact that it was obtained in the centre of the rift. The site appears to be located at the zone of non-transform offset. The reason for the anomalously low heat flow is difficult to understand but encourages further, more systematic heatflow measurements in this area for better understanding of the thermal structure of ultraslow-spreading systems. A heatflow transect at the Logachev rift mountain appears to fit with age-heatflow curve, but confirmation will need further systematic heatflow measurements in this area.

A focused survey was conducted at the Logachev rift mountain at 76°40’, with additional mapping by ORE deeptow, a transect of heatflow measurements, deployment of OBS seismic network, TV grab observation and collection of fresh basalt samples. As the Logachev rift mountain is the largest volcano in the Knipovich Ridge, further composite analyses of all of the obtained data are expected to provide a fundamental contribution to the understanding of tectonics and magmatism of the Knipovich Ridge.

The temperature/salinity data for the water horizon 150 m above the bottom were obtained during towing the ORE system and five temperature/pressure anomalies were detected. The scale and origin of these anomalies require further studies and discussions. Anomalies with proposed hydrothermal origin will be compared with other data obtained during the cruise (light scattering, CTD from the hydrocasts, CH_4) and the results of post-cruise processing (TDM, He, trace elements).

Vertical CTD profiles (eight - in “CTD - LSS - pH” and two - in “CTD – pH” configurations) were carried out. As a result, the data on the distribution of temperature, salinity, light scattering, pH, ATP, as well as methane concentration in the water column above the different segments of the Knipovich Ridge have been collected. Anomalies in the distribution of all the studied parameters at different ridge segments were detected. The site in the southern part of the ridge that was visited twice (74°48’N 08°26.5’E) with anomalies of LS, CH_4, pH and ATP, seems the most promising for finding hydrothermal activity.

Relationship of detected anomalies (first of all, the CH_4, LS and pH) to hydrothermal activity will be studied in the laboratory after the analysis of other indicator components (*e.g.* TDM, helium and trace elements) in the water samples. It is important, that the selection of indicator elements depends on the type of hydrothermal activity (jet or diffuse flow) and geological setting (host rocks etc). Anomalies also need to be sorted out based on the variety of indicators, since the anomalies can be caused not only by the hydrothermal activity, but also by other non-hydrothermal factors, like tidal currents, underlying sediments, water flowing down along the continental slope, etc. We hope to determine the geological control of the distribution of hydrothermal zones and to compare their geological setting with that of the analogous zones at the Mid- Atlantic Ridge and the South-West Indian Ridge. Preliminarily, it can be suggested that hydrothermal sites related to basalt magmatism (as at TAG, Snake Pit, etc.) can be expected in the northern part of the ridge, where there is more volcanic activity, whereas in the southern part, the hydrothermal activity related to ultramafic rocks (as at Logachev and Rainbow sites) is more likely. Additionally, the sediment hosted hydrothermal mineralization at those parts of the rift valley which are covered with thick sediments can not be excluded.

A post cruise meeting for the Knipovich-2000 Cruise is planned to be held in early November, 2001 at St.-Petersburg. Further integration of analysed results will provide additional, novel information about the geology and geochemistry of the Knipovich Ridge. The home page of Knipovich-2000 is now at *http://www2.ori.u-tokyo.ac.jp/~asada/k2k/* with more updated information.

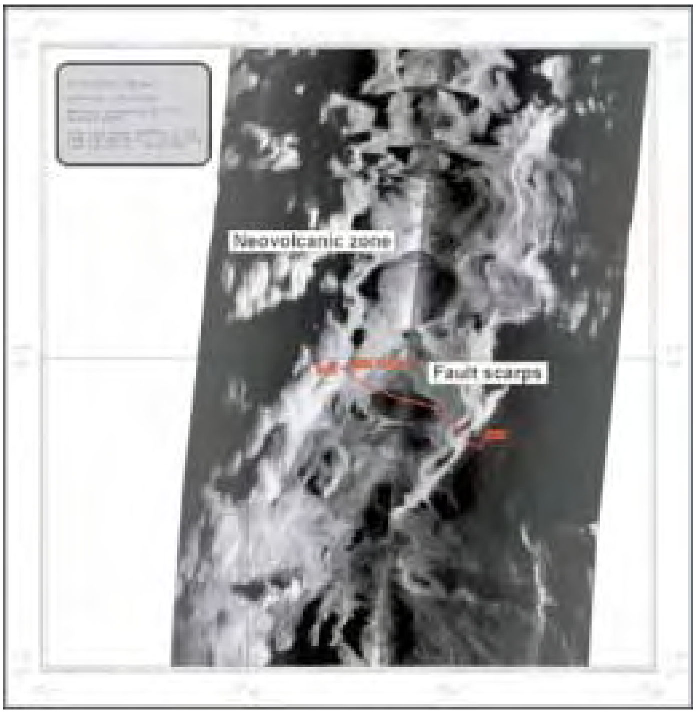

Figure 4. TV Grab towing track of ORE sonar image at the site TVG-21 at the northern part of the Knipovich Ridge

International Ridge-Crest Research: **Arctic Ridges**

Temporal gravity variations observed in SE Iceland

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Abstract

Repeated gravity measurements between 1991 and 2000 SE and N of Vatnajökull and distant base stations (established since 1968) have been carried out as an experiment in active glacial isostasy. Relative to the distant points, gravity in the Höfn area, 70 km from ice centre, decreased at a rate of –3 ± 2 µGal/a corresponding to an uplift rate of 1.5 ± 1 cm/a (Bouguer effect) between 1968 and the 1990s. Points closer to ice centre (>40 km, at ice edge), between 1991 and 2000 experienced an additional gravity change of – 4 ± 2 µGal/a relative to Höfn, adding another ~2 cm/a uplift rate. Points to the NE from Höfn, far from the ice, show variable behaviour not yet understood, but groundwater and ocean tide effects have so far been neglected. Comparison to a model with an elastic lid and a viscous halfspace asthenosphere suggests a thin lid (<10 km) and low viscosity (<10^{18}) Pas asthenosphere viscosity, somewhat less than earlier estimates.

Introduction

The shrinking icecap Vatnajökull, SE Iceland, induces the lithosphere to respond by uplift and gravity decrease, depending on flexure and asthenosphere viscosity. Observations of elevation and gravity change promise to reveal the elastic and viscous effects. As an experiment in current glacial isostasy, we observed temporal gravity change by annually repeated gravity observations 1991 – 2000 (except 1994) at points between 40 and 120 km from ice centre. In 1991 a null GPS survey was conducted (Einarsson *et al.*, 1994) at the same points. GPS should render reliable height change in a few years, but the observations were repeated only in part (Sjöberg *et al.*, 2000) demonstrating a general tendency of uplift in the region amounting to 3 – 8 mm/a. Relative gravity changes require at least 10 years to be reliably established. The gravity survey was therefore extended to distant Icelandic gravity base stations first measured in 1968. Note that this study has also very practical aspects related to Höfn fisheries harbour, affected by the uplift. Preliminary results are presented, but analysis and interpretation are still in progress.

The survey

The gravity stations (Fig. 1) are grouped as "local", "regional" and "distant". A base station near the fishing town of Höfn í Hornafirði was chosen (701) for its accessibility and stability. The "local" dense line of 14 points is approximately radial from ice margin from Hoffellsjökull to Stokksnes. Some 10 "regional" points are distributed near the ice edge from the vicinity of Breiðamerkurjökull (~40 km SE from ice centre) to Djúpivogur (120 km from centre).

For the gravity observations several LaCoste & Romberg spring gravimeters were used. All "local" and regional" stations were connected by car transport to 701 either directly or via other often repeated stations. In most surveys only one instrument could be used (but two simultaneously in 1993, 1995 and 1996, one model G, one D). During 1995 and 1996 the airport point 7307 (established 1985) was connected by small chartered plane with scheduled flights to base stations in E and

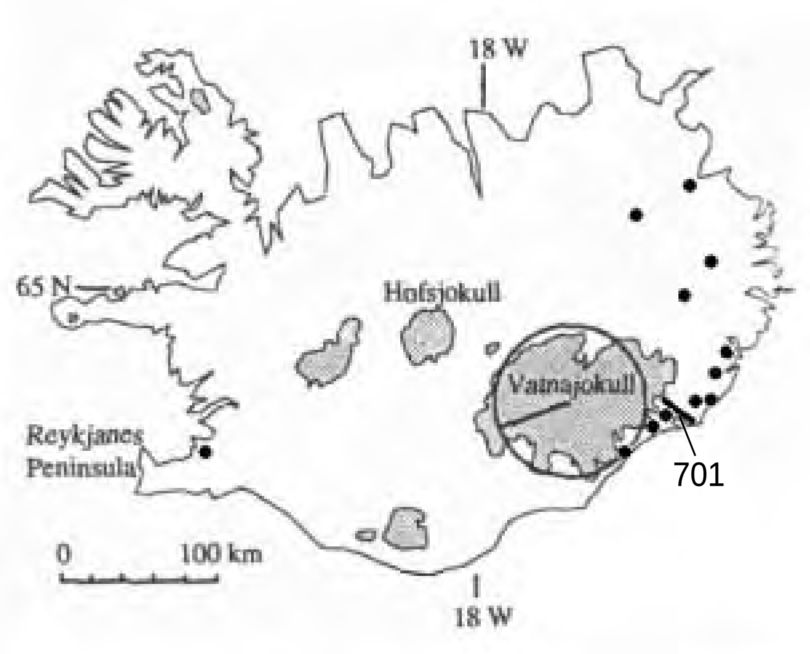

Figure 1. Stations used for measuring temporal gravity change: a local dense line of points, regional points E of Vatnajökull and distant points in Reykjavík and NE Iceland.

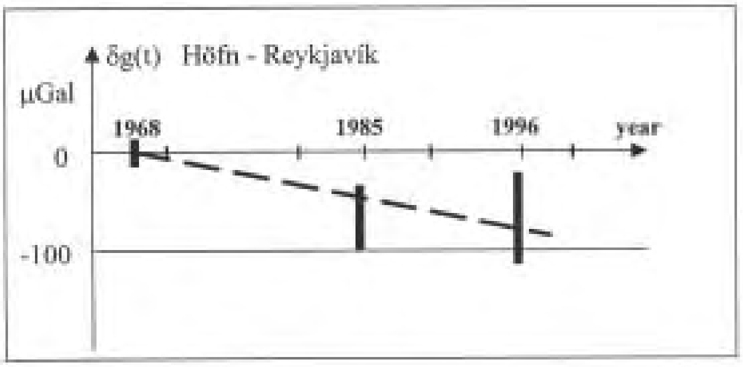

Figure 2. Gravity change between Höfn (station 5219) and Reykjavík between 1968 and 1996.

NE Iceland and one in Reykjavík (Pálmason *et al*., 1973; Þorbergsson *et al*., 1990); thus, the local link, between the 1968 base 5219 and the new base 7307, was frequently measured. Note that in 1985, 5219 was replaced by 7307, directly linked with Reykjavík, but since 219 had not been exactly measured (Þorbergsson *et al*., 1990) this needs to be considered in the interpretation.

The field observations were always checked immediately and indicated an observational uncertainty of the order of 10 μGal. The data were processed with the aid of our program GRAVI (P. Smilde, pers. comm.1996). GRAVI uses all repeated observations to define the drift statistically by two parameters: individual error or standard deviation and correlation length in time (4 to 5 hours). The correlation function is assumed Gaussian. If field readings are "outside" any correlation length, interpolation is linear between base readings. Data snooping is applied to identify large errors. GRAVI combines observations with different instruments with scale adjustment.

Preliminary results

In 1968 only point 5219 was measured vs. RVIK A, in 1985 only 7307. In 1996, 7301 was measured by us vs. RVIK AA (preliminary for 1996), and 1991 – 1998 (destroyed afterwards) both local stations were connected to 701. The following scheme can be established (Table 1).

Italics in brackets imply that the value was determined indirectly from 7307 – 701: –480 ± 10 μGal (trend –1 ± 2 μGal/a); 5219 – 701: –1064 ± 25 μGal (trend –1.5 ± 3 μGal/a + sinusoidal curve ±20 μGal of unknown nature) and 7307 – 5219: +584 ± 25 μGal (1992: 580; 1996: 610; 1998: 560 μGal). The increase at 7307 of 26 ±55 μGal from 1985 to 1996 is insignificant, but taking the differences [5219 – RVIKA] for 1968, 1985 and 1996 indicates a decrease of about 70 μGal in just over 20 years (*centre line*); a linear trend (Fig. 2) would be – 3 ± 2 μGal/a corresponding to an uplift rate of 15 ± 10 mm/a vs. Reykjavik (Bouguer effect).

In 1995, 701 was connected to base stations NE and N of Vatnajökull (northern most: Vopnafjördur) and gave a decrease rate at 7307 of –2 to –4 μGal/a (–3 ± 2), with uncertainty stemming from the gravimeter scales (gravity difference up to 100μGal). This agrees with the link to Reykjavík: The gravity decrease of Höfn is higher than the uplift results published by Sjöberg *et al*. (2000), who report repeated GPS campaigns 1992 and 1996 giving values between 3 and 8 mm/a uplift rates with errors of ≤ 3 mm/a. It is too early to comment on the differences or more detailed results.

The local and regional gravity observations between Breiðarmerkurjökull in the SW and Djúpivogur in the NE relative to base station 701 near Höfn are still being analysed, but it is clear that the stations nearer to ice centre consistently experienced an additional gravity decrease by about – 4 μGal/a (Fig. 3) corresponding to an estimated additional uplift rate of up to 20 mm/a (*e.g.* Heinar close to the ice edge). Stations farther away from ice than 701 have a more erratic behaviour. Near 701 one can still recognize a continuing trend (now: gravity increase by about 1 μGal/a or –5 mm/a vs. 701), but several regional stations show gravity decrease again, not predicted by any model, and having a significantly "wavy signature". These results need to be substantiated. All these stations lie close to the coast, but amplitudes of >10 μGal are remarkable. Whether an 18 a (lunar orbit) or an 11 a period (sunspot cycle) may be involved is not clear. Ocean tides and meteorological effects are also obvious candidates but have not been accounted for. Groundwater and ocean tides will be checked.

The analysis of the field measurements is still in progress and the actual rates of gravity change, their more detailed temporal behaviour and the error bounds will be determined more accurately. However, the temporal gravity decease in the Höfn area, with respect to distant stations, is now well established.

Table 1. Gravity measurements

Relative to RVIK A	1968	1985	1996
5219	5808 ±17	(5736 ±32)	(5737 ±55)
dg (year - 1968) at 5219	0	- 72±35	- 71±65
7307	(6392 ±30)	6321 ±20	6347 ±50

International Ridge-Crest Research: **Arctic Ridges:** Jacoby *et al.*, cont ...

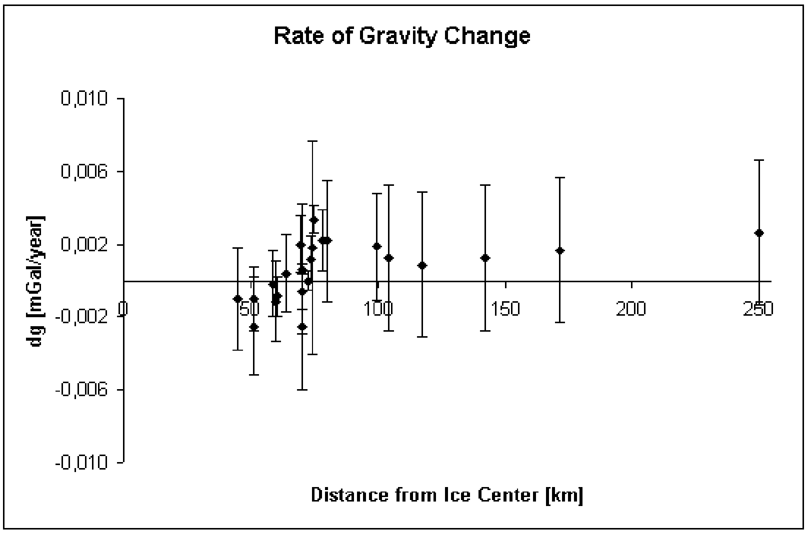

Figure 3. Rate of gravity change versus distance from ice centre. The values and error bars are preliminary; error bars from linear regression of annual values. Some stations with "erratic wavy" trends removed.

Interpretation

While detailed modelling awaits data analysis improvements, some comparisons with published models give clues of lithosphere and asthenosphere properties. For the unloading history we refer to Sigmundsson (1991) and Sigmundsson and Einarsson (1992). They estimate an ice loss of ~180 km^3 for the shrinking of Vatnajökull related to the temperature rise in Iceland since about 1890. The history is rather uncertain prior to that and may have involved a minimum in the Medieval and considerable growth of about ~1300 km^3 from year 900 to the 19th century. Such a loading history will not yet be considered.

Modelling has to involve viscoelastic behaviour; a simple model has an elastic lithosphere and a viscous asthenosphere with disc-shaped loads (Sigmundsson and Einarsson, 1991); using their values for the lithosphere elasticity (incompressible: Poisson's ratio ν = 0.5; Young's modulus E = 10^{11} Pa; thickness d = 10 km) and asthenosphere viscosity (η = 10^{18} Pas), uplift and gravity change rates of 13 mm/a and –2.6 µGal/a, respectively, are predicted for Höfn (70 km from ice centre). These predictions are slightly smaller than what we estimate from our observations. If near-ice stations (~50 km from ice centre) rise additionally vs. 701 by as much as 20 mm/a, as indicated, this is also not quite accounted for by the above model (η = 10^{18} Pas, giving ~15 mm/a). While, again, the difference is not significant, both deviations point to the same direction of smaller viscosity and perhaps thinner or less stiff lithosphere.

Wolf *et al*. (1997) presented a fully Maxwell viscoelastic model (lithosphere: μ=0.33 10^{11} Pa, $\eta \rightarrow \infty$, 100 km asthenosphere: viscosity varied, infinite subtratum: μ=1.45 10^{11} Pa, η=10^{21} Pas) with loading similar to the above, but assuming also a better elliptical geometry. In addition they investigated also the earlier loading history. Their models with recent unloading only give "too small" uplift and gravity change rates (about 1/5) for their minimum as thenosphere viscosity (5 10^{18} Pas); the parameter variation explored for the longer loading-unloading history gives no fit at all, but would suggest a considerably lower asthenosphere viscosity (in the order of 10^{17} Pas).

Discussion and Conclusions

The preliminary data analysis of repeated gravity measurements in Iceland shows with confidence that the region SE of Vatnajökull is experiencing gravity decrease and uplift, but future analysis must include large-scale mass movements related to recent eruptions and possibly irregular tectonics, ocean tides, groundwater and atmosphere, as well as man-made changes. It is unlikely that the apparent discrepancy between these results and repeated GPS observations will disappear with completion of the data analysis. It will then be interesting to see if further GPS data will confirm the previous measurements. If both data sets on the time behaviour of height and gravity indicate different change, this information must be scrutinized and new models must be considered.

Acknowledgements

Thanks to DFG (Deutsche Forschungsgemeinschaft) for financing plane charter. Loan of instruments is gratefully acknowledged (L&R G-688 – G. Hein, UBW München; L&R G-455 – G. Pálmason, Orkustofnun, Reykjavík; L&R D-187 – Uni Jena), especially also the field assistence by B. Higgs, G. Jung-Jacoby, G. Wilhelmi, D. Kracke, R. Heinrich and S. Bürger. Magnús Tumi Gudmundsson, Raunvísindastofnun, Háskola Íslands, Reykjavik, cooperated in tying Höfn and Reykjavík. Information on the Icelandic gravity network was provided by G. Þorbergsson, Orkostofnun, Reykjavik. Albert Eymundsson, school principal and now mayor of Höfn always generously let us use the school Hafnarskoli; Páll Halldorsson and Solveig Ásgrimsdóttir, Reykjavík helped in many ways during our stay in Iceland.

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OCEANIC GRAPHITE: A CASE FOR THE MINERALOGIST

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Sveral years ago, I used to point my guns (light microscope, SEM, EMP, XRD) at any peculiar particne found in manganese nodules, sediment trap deposits, GEOSECS filters, Red Sea trough sediments, etc. (*e.g.* Jedwab, 1980; 1991). Although these vagaries resulted in several unexpected findings, from cosmic dust to Cu-Pb-Zn minerals to iron-vanadium oxides, I should never advise a grant-seaker to submit such a suicidary "proposal". But some findings, exotic as they are, have perhaps a wide ranging relevance and deserve some attention.

The case of oceanic graphite is intriguing (Jedwab and Boulègue, 1984). When all organic molecules and gases are actively looked for and found, graphite is not mentioned as a reality, or accounted for in thermodynamic calculations nor biochemical cycles. However, graphite is undoubtedly present (Fig. 1), and should be considered for its properties: thermodynamic, intercalative, reducing, and high stability (once formed). The finding of a vanadium-titanium carbide included in graphite (Jedwab and Boulègue, 1989) would tend to prove that the latter is perhaps a messenger of very deep-seated phenomena, or very peculiar places.

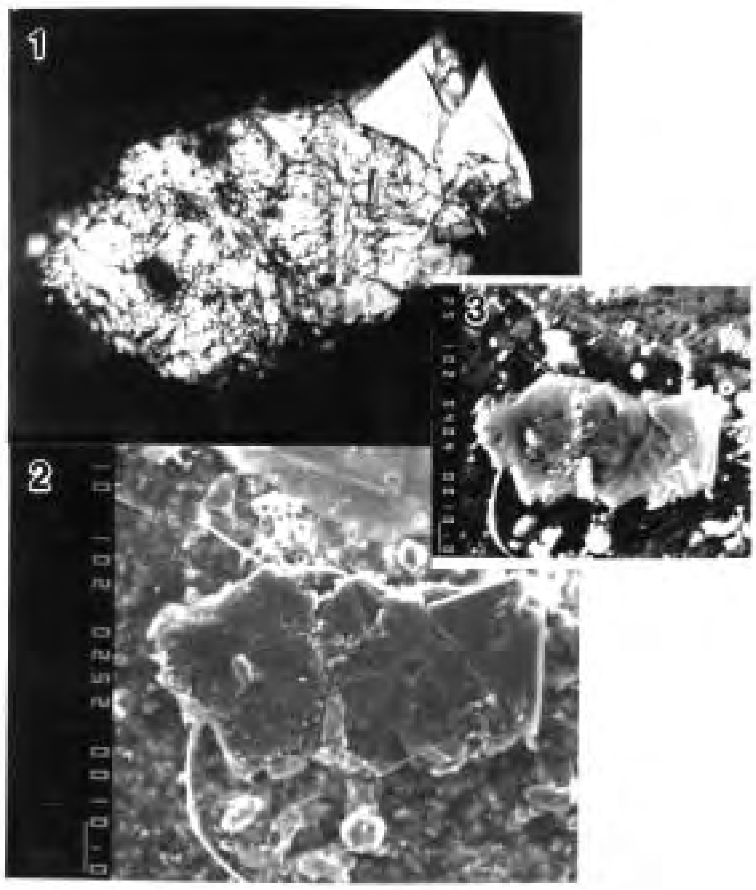

Figure 1. Graphite particle of about 80 µm. Sediment trap moored 200 m away from active vents at 13° N EPR, (Clipperton and Geocyatherm Cruises-1983). 1 - Reflected light microscope, oil immersion, unpolarized; 2 - Scanning electron microscope, secondary electron mode; 3 (insert) - Same, back-scattered mode. White dots dusting the graphite are sulphoarsenides and sulphoantimonides of Fe, Cu, Pb.

International Ridge-Crest Research: **Mid-Ocean Ridge:** Jedwab cont ...

It must of course be recognized that, unless one studies a sample in which the quantities of graphite are very large (which has not yet been observed in vent smokes or sediment traps), its detection in mixtures of particles is challenging, since its diagnostic properties are among the least encouraging ones. The drawbacks are: the micrometric dimensions, a very low secondary X-ray and backscattered electron yield under the electron beam, a very low optical reflectivity, a very low visibility against overwhelmingly abundant sulphides (either under the reflected light microscope, or under the SEM), and finally, the general use of carbon for the metallization of SEM/EMP-stubs and organic membrane filters as supports. In brief, one finds graphite when one wants to.

From our experience, it happens that an easy way to catch graphite in trap deposits is to observe membrane filter mounts under the SEM/EMP, and find concentrations of unusual Fe-Zn-Pb-As-Sb-Bi-S spots, included in, or deposited on, graphite crystals.(By the way, this association is quite remarkable and still problematic.) The direct SEM-search for particles with very low back scattered electron yield is also effective, but there are too many other organic particles which interfere. Another means is to scan fixed membrane filter mounts under the reflected light microscope equipped with oil immersion objectives, where graphite can be caught after some exercise: bluish-grey shine, reflection anisotropism along edges, incomplete platelet stacks with linear kinks, slight transparency of very thin leaves. Definitive diagnosis must of course be achieved under the EMP.

Although the literature of oceanic graphite is very poor (Scott, 1997), I suspect that this is just an observational circumstance, and I think that this should be overcome. The main reason for such an endeavour is of course not a purely mineralogical one, but the present awareness that there are indeed complicated carbon cycles, both biogenic and abiogenic, linking the oceanic crust, the hydrothermal vent deposits and their inhabitants, the emitted gases and particles, and their fate in deep ocean waters. One may thus no longer pretend to ignore graphite in such a global perspective.

So far, only a very small number of samples have been investigated, to our knowledge (one or two from EPR?). It would thus be interesting to collect data on a wider set of localities/samples. All inquiries, comments and suggestions are welcome. A request for samples can be found in the "Wishhhhh list"in this issue.

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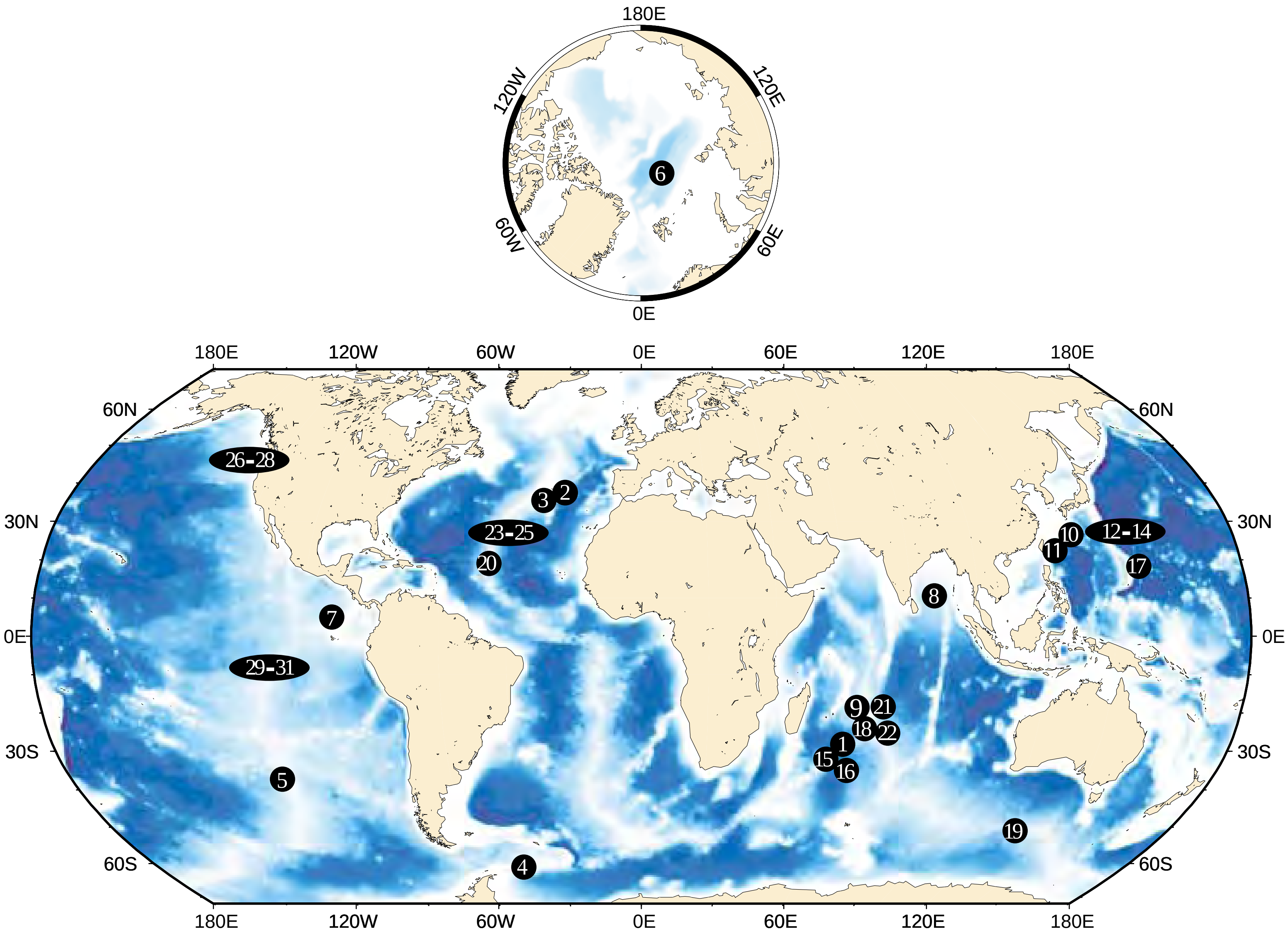

Ridge Cruises 2001

World Ridge Cruise Schedule, 2001, continued...

Map No.	Country	PI	Institution	Cruise ID/Location	Research Objectives	Ship	Dates
1	France, Denmark	E.Humler	Univ France	SWIFT-SWIR 49-35E	mapping and sampling of the west of SWIR	Marion Dufresne	Feb-Mar '01
2	France	Y.Fouquet	Ifremer	IRIS-Rainbow	investigate biology and geoscience	ROV Victor	21 May- 08 Jun '01
3	France	P.M.Sarradin D.Dixon	Ifremer	ATOS-VENTOX project	Resarch into the specialised adaptations and processes in deep-sea hydrothermal vent fauna and microbinal populations	L'Atalante, ROV-Victor	20 Jun- 21 July '01
4	Germany, Canada, USA	P.Herzig	Freiberg	HydroArc,Bransfield Strait-Antactic Peninsula	Investigation of hydrothermally active volcanoes in a sedimented marginal basin	RV SONNE	9 Feb - 28 Mar '01
5	Germany, France, Canada	P.Stoffers, P.Herzig	Kiel U.	SO157-FOUNDATION 3, Pacific-Antarctic spreading axis near 38S	Detailed dredge sampling of the spreading axis close to Foundation hotspot	RV SONNE	15 Jun - 14 July '01
6	Germany, USA	P.Michael, C.Devey, J.Wilfried	U.Tulsa	Gakkel Ridge	First ever geophysical and petrological investigation of the Gakkel spreading axis between 0 and 90E	Healy, Polarstern	31 July- 7 Oct '01
7	Germany, USA	K.Haase, U.Tulsa, A.Dehghani	Institut fur Geo-wisenschaften	SO160-GARIMAG, fossil Galapagos Rise at about 11S,95W,SE Pacific	Bathymetric,gravimetric,and magnetic study and gredge sampling of a segment of the fossil Galapagos Rise spreading axis	RV SONNE	18 Sep- 10 Oct '01
8	India	Damesh Raju, PS Rao	NIO	Adaman Sea	Multibeam mapping,geophysics,sampling	Sagar Kanya	8 Jan- 11 Feb '01
9	India	Mukhopadhyay	NIO	Central Indian Ridge	Multibeam mapping, geophysics sampling, CTD	Sagar Kanya	25 May- 28 Jun '01
10	Japan	Takai	JAMSTEC	Okinawa Trough	Sediments and microbio sampling at the hydrothermal area	Kairei	27 Jun.- 17 July '01

11	Japan	Tamaki	ORI	Southern Okinawa Trough	Deep tow sidescan sonar survey of the rift zone		May - Jun '02
12	Japan	Kinoshita	JAMSTEC	Ogasawara (Bonin) Arc	Shinkai 2000 submersible dive for installing monitoring instruments at the hydrothermal site	Natsushima	19 Aug - 17 Sep '01
13	Japan	Maruyama	JAMSTEC	Ogasawara (Bonin) Arc	Shinkai 2000 submersible dive for microbiological study at the hydrothermal site	Natsushima	5 Oct - 27 Oct '01
14	Japan	Ishibashi	Kyushu Univ.	Ogasawara (Bonin) Arc	Geochemical water sampling at the hydrothermal sites	Kairei	7 Dec - 27 Dec '01
15	Japan	E.Kikawa	JAMSTEC	SW Indian Ridge	Survey outcrops of lower oceanic crust	Kairei, ROV Kaikou	5-29 Sep '01
16	Japan	Matsumoto	JAMSTEC	SWIR-Atlantis II FZ	Shinkai 6500 submersible dives at lower crust and mantle outcrop	Yokosuka	21 Dec - 15 Jan '02
17	Japan	Arima	Yokohama National Univ.	Mariana Trough and Mariana Arc	Sediments and microbio sampling at the hydrothermal area	Kairei	08 Jan - 24 Feb '02
18	Japan	Takai	JAMSTEC	Rodriguez triple junction	Shinkai 6500 submersible dives at hydrothermal sites	Yokosuka	21 Jan - 24 Feb '02
19	Japan	Shinohara	ERI	Australia - Antarctic Discordance	OBS/OBM crustal structure, deep-tow magnetics, SeaBeam mapping	Hakuho- maru	27 Jan- 12 Feb '02
20	Russia	Sorokin,	PMGE	MAR,10-30deg.N	Focused survey at four previously discovered hydrothermal sites	Logachev	Sep - Nov '01

World Ridge Cruise Schedule, 2001, continued...

Map No.	Country	PI	Institution	Cruise ID/Location	Research Objectives	Ship	Dates
21	UK	L.Parson, C.German, B.Murton	SOC	CD 127/ CIR,19-26S	Ridge-Hotspot Interaction & hydrothermal activity on the CIR	RRS Charles Darwin	22 April - 23 May '01
22	UK	P.Tyler, C.German	SOC	CD 128/ Rodrigues Triple Junction, 25-26S	Hydrothermal Plume Processes (Biogeochemistry) in the Indian Ocean	RRS Charles Darwin	27 May- 27 Jun '01
23	USA	Smith	WHOI	MAR	Mooring recovery	Atlantis	06 Mar- 01 Apr '01
24	USA, Russia	C.Van Dover, S. Sudarikov	W&M, U Miami, MBARI	MAR	Sampling of vent sites along MAR Exploration of a new vent field at 13N Bore-hole site data recovery	Atlantis	26 Jun - 30 July '01
25	USA	Lutz	Rutgers	MAR	imaging of hydrothermal vent and ambient environments by IMAX and HDTV systems	Atlantis, Alvin	03 Aug - 30 Aug '01
26	USA	Johnson	UW	Juan de Fuca	Hydrothermal system	Thompson	17 Jun - 03 July '01
27	USA, Canada	B.Emley	NOAA	Axial Volcano, Juan de Fuca Ridge centered at 46 deg.N; 130deg.W	Sampling of biology, chemistry and geology, mapping and recover and deploy instruments.	Ron Brown	12 July - 30 July '01
28	USA	Ed. Baker	NOAA	Axial Volcano and southern Juan de Fuca Ridge	CTD plume mapping and sampling Mooring deployments and recoveries	Wecoma	16 July - 02 Aug '01
29	USA	Cary	W&M	EPR		Atlantis, Alvin	15 Oct - 02 Nov '01
30	USA	Shouten	WHOI	EPR		Atlantis, Alvin, ABE	06 Nov - 05 Dec '01
31	USA	Childress, Van	UCSB, W&M	EPR		Atlantis, Alvin	09 Dec- 01 Jan '02

National News....

UK: BRIDGE

The main UK InterRidge activity in the coming few months involves two back-to-back cruises to the Central Indian Ridge, funded as an initial component of the NERC's new Indian Ocean research campaign. Both cruises will be aboard the RRS *Charles Darwin* (cruises CD127 and CD128) both of which will be operating in and out of Mauritius. Details of the plans for each cruise are given below:

CD127 (Mauritius-Mauritius; April 23-May 24, 2001)

Chief Scientist: Dr Lindsay Parson (SOC)

Co-PI's: Bramley Murton & Chris German (SOC)

Two of the most pressing questions in modern mid-ocean ridge research are: 1) what controls the biogeographic distribution of vent-specific fauna; and 2) what are the effects on a spreading ridge of its location in the vicinity of a mantle hot-spot? We have targeted the Central Indian Ridge as a key study area in which we can directly investigate both issues.

In the first of our two cruises, then, we propose to locate the source for - and determine the detailed geological setting of - previously detected hydrothermal signals along the Central Indian Ridge, 21-26S. We also plan to evaluate the extent of any interaction between the intermediate spreading Central Indian Ridge and the weak Rodrigues "hot-spot" (20°S) – specifically, in terms of: a) the intensity and composition of MOR volcanism; b) spreading kinematics; c) local and regional structural style; d) segmentation character and e) the compositional effects of plume-MORB mantle mixing. Our final objective for this cruise is to evaluate whether there is any statistically significant - and geologically interpretable - difference in the incidence of high-temperature hydrothermal venting along the Central Indian Ridge in the vicinity of, and away from, the Rodrigues Hot-Spot. Our programme will rely heavily upon use of the TOBI deep-tow sidescan sonar vehicle, equipped with our purpose-built in situ plume sensor string. Other equipment used will include the SHRIMP seafloor imaging platform, for ground-truthing sidescan sonar images, standard dredging equipment for sidescan-targetted rock sampling along the ridge-crest and a 12-bottle CTD-rosette for vertical profile sampling and analysis – complete with both standard optical and novel *in situ* dissolved Mn and Fe sensors, to be deployed wherever TOBI/sensor string data indicate that hydrothermal sources may exist.

CD128 (Mauritius-Mauritius; May 27 – June 27, 2001)

Chief Scientist: Prof. Paul Tyler (SOC)

Co-PI's: Chris German, Peter Statham, Bill Jenkins, David Dixon & Peter Herring (SOC)

This cruise aims to undertake a detailed biological and geochemical study of the hydrothermal plume overlying the Rodriguez Triple Junction, 25°S 70°E Central Indian Ridge, the first sustained source of high-temperature hydrothermal venting to be identified in this ocean (Gamo et al., 1986; Fujimoto et al., 1998). Geochemically, the site represents an important intermediary environment, mid-way between previous study areas on the Mid-Atlantic Ridge (MAR) and those on the East Pacific Rise (EPR) and Juan de Fuca Ridge (JdF). Study of this site is timely because it will allow the impact of hydrothermal venting upon global chemical ocean budgets to be thoroughly re-evaluated. Biologically, we propose the first investigation of the vent-associated mid-water pelagic fauna of the southern Indian Ocean. We will compare the pelagic fauna both within and outwith the geochemically-defined hydrothermal plume with the fauna trawled previously by us above both MAR and EPR vent-sites at comparable (2000-3000m) water depths. There will be a particular focus on the plankton, small nekton and larvae and/or juveniles obtained using the RMT 1+8M midwater trawl system. This will allow the role of pelagic distribution and dipersal of plankton and small nekton in relation to vent-plumes to be established. Geochemical studies will rely upon plume mapping and sampling using the BRIDGET deep-tow plume instrument complemented with larger volume CTD and *in situ* filtration operations.

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National News....

Germany:DeRidge

The German community is embarking on the long and tortuous road to establishing the De-Ridge Initiative on an official footing with the funding agencies. Assuming this attempt is successful the German community is keen to host the InterRidge office when the present term in Japan ends.

Ridge-related activities in Germany in 2001 are concentrated on back-arc and Arctic environments, with several cruises either under way or planned for the period Feb-Oct 2001. The latest information from the funding agencies is that an initiative under the leadership of Porf. H. Schmeling (Uni. Frankfurt) to begin a multi-disciplinary (petrology, applied and theoretical geophysics, remote observation, hydrothermalism) four-year study of Iceland and adjacent ridges has a good chance of being funded this year which will provide a major impetus for ridge and plume-ridge interaction studies in Germany. So the German Ridge community is looking to the future with large plans and great expectations.

For more information about DeRidge contact:

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http://www.Ozeankruste.de/DeRidge/deridge.html

InterRidge - Japan

Japanese ridge research scientists are keeping up high activity with a number of seagoing research plans. Last summer a team of Japanese biologists and water geochemists (Hashimoto, Ohta, and Gamo) found active black smokers with dense biota at the Rodriguez Triple Junction, the first discovery of active vents in the Indian Ocean (see page 21 of this issue). The discovery is the results of 8 years of research activity of the Japanese ridge research group in the Indian Ocean.

The geochemical signature of hydrothermal activity was found first by the Japanese water geochemists (PI: Gamo) during the Rodriguez Triple Junction Cruise by *R/V Hakuho-maru* of Ocean Research Institute, University of Tokyo (PIs: Tamaki and Fujimoto). A couple dives by Shinkai 6500 submersible were done at the site in 1998 during INDOYOU cruise by *R/V Yokosuka* of JAMSTEC (PI: Fujimoto) but were unsuccessful in locating a hydrothermal site. An entire cruise of *R/V Kairei* (JAMSTEC) was devoted to conduct an intense survey of the site (so-called "Gamo site") by CTD tow-yow and ROV "Kaiko", with the triumphant result of locating amazingly active black smokers.

This hydrothermal site, on the Hakuho knoll, was named "Kairei". Already a further research cruise by submersible Shinkai 6500 is scheduled early next year (see World Ridge Cruise Schedule of this issue) to conduct intensive observations of the Kairei site (PI: Takai, a microbiologist of JAMSTEC).

The recent cruise of *R/V Hakuho-maru* to the Gulf of Aden, the Aden New Century Cruise (PI: Tamaki and Fujimoto, Dec. 4, 2000 – Jan. 12, 2001) found strong hydrothermal signatures by CTD tow-yow conducted by Gamo at a newly found hotspot in the Gulf of Aden. The *R/V Hakuho-maru* is equipped with a new SeaBeam system 2120 with a transmitting frequency of 20kHz and 1° narrow beam and successfully obtained high quality bathymetry data that vividly shows ridge-hotspot interaction between the Gulf of Aden rift system and the hotspot. All these new findings will be published soon in initial short papers.

In the coming years (2001 to 2002), the Japanese fleet has 11 ridge related cruises scheduled to the Ogasawara-Mariana (Bonin-Mariana) volcanic Arc, the Okinawa Trough, the Rodriguez Triple Junction, the Southwestern Indian Ridge, and the Australia-Antarctica Discordance (see the

National News....

World Ridge Cruise Schedule in this issue).

The "Archean Park" project (PI: Urabe), the largest ridge-related program in Japan, focusing on the deep-sea subsurface microbiology, will start their seagoing research from this year (see page 23 of this issue), with a total of five cruises planned to the Ogasawara-Marina Arc with young scientists PIs for each cruise.

All throughout the above activity we are trying to enhance the opportunities for young scientists and graduate students who will lead the next decade InterRidge program. Also we are always anticipating and encouraging coordinated, international collaborations to improve the performance of the program. Please contact the PIs of each programme if you have further interests in the subject and for proposals of collaboration.

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Canada: CanRidge

CanRidge held it's first national planning meeting in Montréal on February 3, 2001. The meeting focused on planning field and laboratory studies for the coming year. Field investigations will be carried out at two locations in 2001. Both expeditions will use the Canadian remotely-operated vehicle ROPOS for sampling, surveys and deployment of in situ experiments at sites on the Juan de Fuca Ridge (northeast Pacific).

A May 6-16, 2001 cruise to the Endeavour Segment hydrothermal vents will use the Canadian ship John P. Tully as the support vessel for dive operations. In addition to Canadian scientists, 2 researchers from the laboratory of Dr. Chuck Fisher of The Pennsylvania State University will join the cruise as will Dr. Ian MacDonald of Texas A&M University. Planned field work includes mapping and sampling of the Clam Bed vent field, to complete the first phase of a habitat and biodiversity survey of the High Rise vent field area began in 1999 in collaboration with the Department of Fisheries and Oceans Canada. Other sampling operations include collection of diffuse vent fluid and suspended particulate samples for biogeochemical and microbiological studies (Juniper & Suttle), deployment of experimental modules for studies of faunal colonisation (Metaxas, Tunnicliffe) and sulphide mineral weathering (Léveillé) and faunal collections (Tunnicliffe, Fisher). A prototype macro digital camera (MacDonald) will be used for in situ examination of the microhabitat created by the tubes of the sulphide worm Paralvinella sulfincola, particularly in relation to colonisation by juvenile worms, copepods and filamentous bacteria. Sulphide mineral samples will be collected from the Main Endeavour field for laboratory studies of microbial weathering (Léveillé et al.).

In a continuing collaboration with NOAA PMEL and US university investigators, CanRidge scientists will participate in the NeMO 2001 cruise to Axial Volcano. The primary focus of this long term research program has been time series observations of the response of the hydrothermal system to a 1998 seafloor eruption. Canadian investigations have focused on the de novo assembly of faunal communities (Tunnicliffe) and food webs (Juniper) at vents created by the 1998 eruption. Other work conducted at the Axial Volcano hydrothermal vents includes studies of Fe-oxide formation (Scott) and the development of a model system for the study of faunal-microbial-mineral interactions (Juniper) using the sulphide worm Paralvinella sulfincola. Planned field work for 2001 by CanRidge investigators includes follow-up faunal and suspended particulate sampling at vents on the 1998 lava flow, video observations and sampling of the sulphide worm habitat in the ASHES vent field, deployment of experimental modules for studies of faunal colonisation (Metaxas, Tunnicliffe) and sulphide mineral weathering (Léveillé), and sampling of Fe-oxides and sulphides for biomineralisation and bioweathering studies (Scott, Ferris, Léveillé, Juniper, Vali, Williams-Jones).

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National News....

France: Dorsales

Workshop « Population genetics and evolutionary sciences in vent taxa»

Roscoff, 23/1/2001, organized by Didier Jollivet

Hydrothermal vent fauna could be considered as an ancient fauna which evolved under strong selective constraints due to the extreme nature, the tremendous variability in space and time and the level of fragmenttation of the habitat. As a consequence, species have developped specific adaptations that raise questions about selective processes acting on physiology, reproduction and dispersal. This workshop recommanded to focus studies on the following main areas :

- phylogeography and historical processes of the oceanic ridge colonization
- phylogenies of the main vent taxa and molecular clock calibration
- molecular ecology of micro-, meio- and macrofauna
- metapopulations, gene flow and dispersal modeling
- stabilizing and diversifying selection in natural populations
- molecular processes which may alter genetic diversity or slow down species evolution (DNA repair systems, transposable elements, etc.)

Workshop: «Hotspot/ridge interaction»

Paris, 21/1/2001, organized by Javier Escartin and Marcia Maia

The interaction of hotspots with nearby mid-ocean ridges strongly influences the thermal regime, melt production and geochemistry at the axis, as indicated by along-axis geophysical and geochemical anomalies. The nature of hotspots (e.g., plumes vs. mantle heterogeneities), the details of mantle flow and melt extraction under the axis, and their temporal and spatial variations are poorly understood. The workshop identified two areas that could be addressed using existing data:

- Integration of geophysical and geochemical data to better understand their origin, and the constraints they provide in ridge-hotspot interaction processes
- Numerical modeling on near-ridge hotspots, with integration and/or prediction of geophysical and geochemical observations.

French representative at the InterRidge Steering Committee

The Dorsales Committe has nominated Jérôme Dyment to replace Mathilde Cannat from 2001 as the second representative for France.

Call for proposals

Following the two workshops, a call for proposals was issued last january by the Dorsales Committee, for a total budget of approximately 100,000 $. The two themes prioritized for year 2001 are :

- Population genetics and evolutionary sciences in vent taxa
- Hotspot/ridge interaction

The future of Dorsales

The Dorsales program was renewed in 1998 for 4 year. 2001 is therefore the last year of this second mandate.

The Dorsales Committee has started discussing what could be the focus of a future program. Two main topics have been provisionally identified :

- Developping a long term observatory on the mid-Atlantic Ridge South of Azores : participation to the MOMAR program
- Biogeochemical interactions at mid-ocean ridges

Further discussions are still necessary with the scientific community as well as the funding agencies.

For more information on DORSALES contact:

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Previous updates from various Nations can be found on the IR web site under the menu "Member Nations" or by going directly to:

http://www.intridge.org/act4.html

Upcoming Meetings and Workshops

Calendar of MOR Research related events (2001)

More details about all of the following meetings can be found via the Meetings menu on the InterRidge homepage:

http://www.intridge.org/info3.html

12 - 16 January 2001	**International Conference on the Geology of Oman.** Muscat, Sultanate of Oman.
26 - 30 March 2001	**26th General Assembly of the EGS.** Nice, France.
8 - 12 April 2001	**EUG (European Union of Geosciences) XI meeting.** Strasbourg, France
24 - 26 May 2001	**RUSSIAN RIDGE.** St. Petersburg, Russia
1 - 2 June 2001	**InterRidge Steering Committee Meeting.** Kobe, Japan.
10 - 15 June, 2001	**10th Water-Rock Interaction Symposium.** Sardinia, Italy.
18 - 24 August, 2001	**Second International Conference of Comparative Physiology & Biochemistry in Africa**. Chobe National Park, Botswana.
25 - 27 August, 2001	**Joint Geosciences Assembly (JGA).** International Convention Center, Taipei, Taiwan
8 - 10 September, 2001	**Symposium on the Icelandic Plume and Crust.** Reykjanes Peninsula, Iceland
Fall 2001	**MORMAR** Workshop
8 - 13 October, 2001	**Second International Symposium on Deep-Sea Hydrothermal Vent Biology.** Brest, France
10 - 14 December 2001	**AGU 2001 Fall Meeting.** San Francisco, CA, USA.
20 - 25 April, 2002	**"Minerals Of The Ocean" - International Conference.** St. Petersburg, Russian Federation
Spring 2002	**SWIR Workshop.** SOC, UK
9 - 13 September, 2002	**InterRidge Theoretical Institute (IRTI) Thermal Regime of Ocean Ridges and Dynamics of Hydrothermal Circulation.** University of Pavia, Italy.

Upcoming Meetings and Workshops

International Conference on the Geology of Oman

Sultan Qaboos University, Muscat, Sultanate of Oman

January 12-16, 2001

http://www.geoconfoman.unibe.ch/

Convenors: Prof. Dr. Tjerk Peters, Bern University, Switzerland, (lina@mpi.unibe.ch)
Dr. Hilal bin Mohammed Al-Azry, Deputy Director General of Minerals, MCI

This conference highlights the last 10 years of geologic research in one of the most fascinating and well exposed outcrop areas of the world. Besides the ophiolites, this conference provides an excellent opportunity to discuss the Southern Tethys, Pangea, the hydrocarbons of the Arabian continent, and the hydrogeology of arid regions. Field excursions will provide insight into the unique geologic features. Some of the field trips will be offered twice, i.e. before and after the conference.

European Geophysical Society (EGS) XXVI General Assembly Meeting

26-30 March 2001, Nice, France

http://www.copernicus.org/EGS/egsga/nice01/nice01.htm

SE9.03. Marine geophysics. Mantle Exposures at Mid-Ocean Ridges: Geophysical Signatures, Mechanisms of Emplacement, and Associated Hydrothermal Plumes and Deposits

Convenor: Gracia, E. (egracia@ija.csic.es)
Co-Convenors: Charlou, J.L., Fouquet, Y.
Session Information: http://dg.ija.csic.es/Egs01/egs.html

SE9.04 Marine geophysics: Interaction between hot-spots and mid-ocean ridges

Co-convenors: Javier Escartín (escartin@ccr.jussieu.fr),
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Session Information: http://www.ipgp.jussieu.fr/depts/lgm/EGS2001.html

Upcoming Meetings and Workshops

American Geophysical Union Fall Meeting

10-14 December 2001, San Francisco, CA, USA

http://www.agu.org/meetings/fm01call.html

Important Dates:

May 25 - deadline to propose Special Sessions to the Fall Meeting Program Committee.
August 30 - deadline for receipt of the Postal/Express Mail Abstracts.
September 6 - deadline for receipt of the Electronic Abstracts.
November 9 - deadline for pre-registration and housing.

Program Committee:

Chair and Union (U) Robert A. Duce (rduce@ocean.tamu.edu)
Biogeosciences (B) Kathy Hibbard (kathyh@eos.sr.unh.edu)
Geomagnetism and Paleomagnetism (GP) Steve Constable (sconstable@ucsd.edu)
Seismology (S) Rachel Abercrombie Chair (rachel@seismology.harvard.edu)
Seismology (S) Megan P. Flannigan, Co-Chair (flanagan5@llnl.gov)
Tectonophysics (T) Ray Russo Chair (ray@earth.northwestern.edu)
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Volcanology, Geochemistry and Petrology (V) Don Dingwell (Dingwell@petro1.min.uni-muenchen.de)

10th Water-Rock Interaction Symposium

10-15 June, 2001, Villasimius, Italy

http://www.unica.it/wri10/

Convenor: Luca Fanfani (lfanfani@unica.it)

Objectives:

To promote advancements in the study of the interactions between aqueous fluids and their geologic environment.
To encourage a wide spectrum of researchers to attend and present their results.
To organize and lead field trips to locations where water-rock interaction has had a significant impact on the environment.

Important Dates:

November 30th, 2000	Submission of symposium papers
December 31st, 2000	Early registration

Upcoming Meetings and Workshops

European Union of Geosciences XI Meeting

8-12 April 2001, Strasbourg, France.

http://eost.u-strasbg.fr/EUG

Convenors: B. Ildefonse benoit@dstu.univ-montp2.fr (France),
C. Garrido carlosg@goliat.ugr.es (Spain), J.Phipps Morgan jpm@geomar.de(Germany)

Important Dates:

November 30th 2000   Submission of abstracts
January 31st 2001   Registration at reduced rate

G2 Structure, composition and accretion of the oceanic crust: geophysical, petrological and geochemical constraints

The objective of this session is to promote comparison of observational and theoretical constraints on oceanic crustal genesis and evolution, with the aim of reaching a better understanding of the processes that create and shape the seafloor. This session will bring together results from recent studies on seafloor magmatic, tectonic, and hydrothermal processes. The session will focus on processes of crustal accretion at spreading ridges, and on along-axis variability of hydrothermal processes and in the composition and structure of oceanic crust.

Second International Conference of Comparative Physiology & Biochemistry in Africa

18-24 August 2001, Chobe National Park, Botswana

http://www.users.bigpond.net.au/morlab/chobe/chobe.htm

Convenors: Aline Fiala and Horst Felbeck

Relevant Session:
Adaptive Physiology and Biochemistry of Organisms of Vents and Seeps

Important Dates:

1st February, 2001   Deadline for registration and accommodation payment
1st May, 2001   Deadline for abstracts

Upcoming Meetings and Workshops

1st InterRidge Theoretical Institute (IRTI)

Thermal Regime of Ocean Ridges and Dynamics of Hydrothermal Circulation

9-13 September 2002, University of Pavia, Italy

Organising Committee: C. German (Co-Chair), J. Lin (Co-Chair), A. Fisher, M. Cannat, R. Tribuzio & A. Adamczewska

We are pleased to announce the first IRTI to be held in Italy in September 2002. The principal objectives of this theoretical institute will be:

(1) To foster exchange of information on recent progress in observational, experimental, and modeling studies of hydrothermal circulation and their implications for thermal evolution of the oceanic lithosphere.
(2) To identify key scientific issues that could be addressed in coming years and discuss a general plan for more focused international collaboration in this important research field.
(3) To educate a broad spectrum of international researchers, post-docs, and graduate students on the state-of-the-art research approaches, especially experimental and theoretical modeling capabilities.

The Institute will take place over 4 1/2 days' duration comprising 2 days' short-course and one day's field excursion to study hydrothermal alteration in the northern Apennine ophiolites followed by a further 1 1/2 days' workshop for a subset of the short-course/field trip participants.

We have arranged for 19 Invited Speakers and Discussion Leaders from across the international community to lead the proposed short-course as follows:

Martin Sinha (UK), Rob Evans (USA), Javier Escartin (France), Roger Searle (UK), John Chen (USA), Jason Phipps Morgan (Germany), Mathilde Cannat (France), Joe Cann (UK), Bill Seyfried (USA), Karen Von Damm (USA), Ed Baker (USA), Testuro Urabe (Japan), Earl Davis (Canada), Andy Fisher (USA), Rob Lowell (USA), Will Wilcock (USA), Deborah Kelley (USA), Kathy Gillis (Canada) & Riccardo Tribuzio (Italy).

The short-course and workshop will be held in the historic lecture theatre of the University of Pavia, situated approximately 30miles/50km south of Milano. The field course will be to the northern Apennine ophiolites, where exceptional hydrothermal alteration exposures can be observed.

Participation: We anticipate 50-100 attendees for the short course and field excursion and about 30 attendees for the workshop. Because space is likely to be limited, those interested in participating, either to the short-course and field excursion or for the full duration of the whole IRTI, should register their interests with Agnieszka Adamczewska at (intridge@ori.u-tokyo.ac.jp).

We look forward to seeing you in Italy!

Chris German (cge@soc.soton.ac.uk) & Jian Lin (jlin@whoi.edu)

Upcoming Meetings and Workshops

The 2nd International Symposium on Deep-sea Hydrothermal Vent Biology

8-12 October 2001, Brest, France

http://www.ifremer.fr/2ishvb/

Organisers:
Daniel Desbruyères, France (Daniel.Desbruyeres@ifremer.fr)
Verena Tunnicliffe, Canada (tunnshaw@uvvm.uvic.ca)
InterRidge Office (Japan) in cooperation with "DORSALES" (CNRS - SDV, INSU, IFREMER) France.

Major topics of the Symposium will be:

- Ecology, microdistribution, temporal evolution,
- Interactions of organisms and habitat, in-situ chemical analysis, monitoring of environmental patterns,
- Physiology - Adaptation,
- Microbiology of symbioses and free-living bacteria, thermophiles, sub-seafloor biomass,
- Biogeography, evolution, genetics and taxonomy,
- Cold-seeps and food-falls communities,
- Shallow water hydrothermal vents.

Deadlines:
15 May 2001. Deadline for abstracts submission and booking for hotels and excursions.
1 June 2001. Final circular and programme.
1 December 2001. Submission of manuscripts of extended abstracts (to Cahier de Biologie)

Biology Working Group Meeting

Sunday 8th October, during the 2nd International Symposium on Deep-sea Hydrothermal Vent Biology

The Co-Chairs of the Biology Working Group, will meet with the Biology Group members over dinner on the evening of Sunday, Oct. 8 at 7:00 pm (venue to be determined) to finalize the discussion agenda. The Bio. WG will meet later that week for discussions. The InterRidge community is invited to propose points for discussion by the Biology Committee. These suggestions should be forwarded to the Co-Chairs:

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