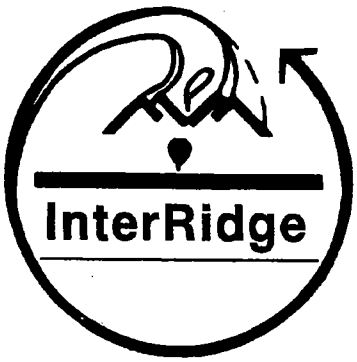

InterRidge Program Plan Addendum 1995

(Reprinted with Corrections, December 1996)

1.0 InterRidge Update Summary 1995

1.1 Membership

InterRidge Membership continues to expand. The InterRidge Chair and Steering Committee welcomed Germany, India, Portugal, Spain and Switzerland as new or upgrading members of InterRidge. Germany joined InterRidge as an Associate Member in late 1994 and Spain joined as a Principal Member for 1995. India and Switzerland joined as Corresponding Members. In 1995, InterRidge counted 5 Principal Members (France, Japan, Spain, UK, USA), 2 Associate Members (Germany, Portugal) and 11 Corresponding Members (Australia, Canada, Iceland, India, Italy, Korea, Mexico, Norway, Russia, Sweden, Switzerland). The InterRidge Office is continuing in its efforts to increase membership by contacting nations with active ridge crest research communities such as Chile, China and New Zealand.

1.2 InterRidge Phase 2 Projects

InterRidge has entered Phase 2 of its Program Plan which is designated to last from 1995 through 1997. Phase 2 involves in-depth studies in the form of major interdisciplinary field efforts conceived and co-ordinated by InterRidge, and development of a database information catalogue accessible to the international ridge sciences community via the Internet.

As the Phase 2 projects develop, InterRidge structure is changing from large working groups associated with the three principal program themes to smaller working groups formed around each project. The principal themes of InterRidge will remain in place and the projects will be grouped within them. There are currently 8 projects, each with a project leader who will act as rapporteur to the Steering Committee. The project working groups will be made up of investigators directly concerned with each of the projects. The current projects are:

Global Studies:

- ***Global Digital Atlas***: the establishment of a global multibeam bathymetric database by linking distributed databases via the World Wide Web. Chair: K. Tamaki.
- ***SWIR (Southwest Indian Ridge)***: co-ordinated reconnaissance mapping and sampling of a complete super-segment, the Southwest Indian Ridge from the Bouvet Triple Junction to the Rodrigues Triple Junction including integrated Ocean Drilling experiments. Chair: C.H. Langmuir.
- ***Arctic Oceans***: co-ordination of planning efforts for mapping and sampling of the Arctic Ridges. Chair: R. Rihm.

Meso-Scale Studies:

- ***4-D Architecture of the Oceanic Lithosphere***: an integrated study of a fast spreading segment (Hess Deep) in parallel with an integrated study of a slow spreading segment on the Mid-Atlantic Ridge both including important components of scientific drilling. Chair: L. Parson.
- ***Quantitative Fluxes Experiment***: segment-scale experiment to measure integrated magmatic, thermal, chemical and biological fluxes at Mid-Atlantic Ridge. Chair: TBA.
- ***Back-Arc Basin Database***: petrological database of Back-Arc Basins on the World Wide Web. Chair: K. Tamaki.

Active Processes:

- ***Event Detection and Response***: detection of transient ridge-crest seismic, volcanic and hydrothermal events, and logistical response to them through a strategy of international collaboration. Chair: K.L. Von Damm.
- ***Biological Studies***: promotion of integration of biological studies into ridge crest geosciences and advancement of this rapidly expanding field. Chairs: L.S. Mullineaux and D. Desbruyères.

It is envisaged that these projects will move forward through concerted international actions at sea and elsewhere, co-ordinated by InterRidge over a period of several years. This activity will bring the ships and technology of different nations together in major multi-disciplinary experiments focused on InterRidge thematic goals. Detailed science plans and calls to participate will be issued by the InterRidge Office. *InterRidge News* will reflect the project structure with the initiation of feature columns dedicated to reporting each project's progress.

It should be emphasised that the projects outlined above represent a focusing of InterRidge efforts in the near-term; however, broader long-term goals still remain. For example, it is the long-term aim of the Global Studies program to complete reconnaissance mapping of all the world ridges, and the current emphasis on SWIR and the Arctic is simply a step on the way.

1.3 WWW

The InterRidge World Wide Web home page is now on line. The home page address is: **http://www.dur.ac.uk/~dgl0zz1/** The InterRidge home page provides links to the InterRidge Researcher Electronic Directory, information concerning InterRidge program structure and events calendar, workshop announcements and various national and international program home pages.

1.4 Piggy-back Projects

The Fall/Winter 1995 issue of *InterRidge News* contained the first call for piggy-back and host projects as the InterRidge Office offers its services as a 'broker' matching investigators with smaller scale experiments with those who have funded ship time available. The provisional InterRidge calendar of upcoming events reflects the program's continuing interaction with a broad range of international organisations in working towards common aims and objectives.

1.5 InterRidge Office Transfer

With the end of the UK term as host country in 1996, the InterRidge Office will transfer to another of its principal member nations. The call for bids will be opened in January 1996 with a closing date in March. Bids received will be reviewed by the Steering Committee and a new host country chosen by the end of the Summer.

1.6 Recent InterRidge Workshops

On August 28 and 29, an actual/virtual meeting of the SWIR Working Group was held at Woods Hole Oceanographic Institution, MA, USA to draft a Project Plan. The result is an integrated 3-5 year science plan involving six to eight legs of ship time aimed at multi-disciplinary investigation of the super-slow-spreading Southwest Indian Ridge. The SWIR Project Plan is currently undergoing a last round of revision and will soon be available on the World Wide Web and for distribution in hard copy.

An InterRidge Meso-scale Studies Workshop, "Quantification of Fluxes at Mid-Ocean Ridges: Design for a segment scale box experiment" was held on 26-27 June 1995 in Cambridge, UK. Its principal objective was to design an experiment to quantify mass, energy and chemical fluxes occurring at mid-ocean ridges at the axial segment length scale and extending from the mantle up into the water column. Site selection as well as integration with other InterRidge projects were discussed.

The Biological Studies *Ad Hoc* Committee of InterRidge met on April 24 & 25 at Rutgers University, NJ, USA, to discuss integration of biological studies in the three principal InterRidge themes, draft an international agreement for sample exchange and maximise the effectiveness of biological sampling during 'geological' cruises. In addition to accomplishing these objectives, a number of other initiatives were recommended and undertaken by the ridge crest biologists. These include a Ridge Crest Biologist Directory on the WWW, an on-line sample database, and compilation and publication of a Faunal Identification Manual.

The Active Processes Workshop "Event Detection and Response & A Ridge Crest Observatory" was held on January 16 - 18 in Paris, France. The principal objectives of the workshop were: 1) to discuss and design techniques, instrumentation and methods relevant to the implementation of an event detection and response program and the development and deployment of a ridge crest observatory; and 2) to produce a white paper discussing the relevant issues and detailing specific project implementation plans.

1.7 Actions taken by the InterRidge Office

The principal activity of the final stages of Phase 1 was a series of workshops. Organisation and facilitation of a second generation of workshops has continued throughout 1995. In addition to the development of science and implementation plans, these workshops produced a number of recommendations for action to be taken by the InterRidge Office. The recommendations are summarised below and each is followed by the action taken in association with it.

1.7.1 Global Studies Workshop 1993

- To arrange workshops to explore and define critical scientific problems. This often leads to the planning of joint programs.

Three InterRidge workshops were held in 1994 including one on Global Studies: Arctic Ridges: Results and Planning; four in 1995 including one on Global Studies: SWIR Science Plan Meeting; and four are provisionally planned for 1996.

- To keep the community informed of funded and proposed programs, since this knowledge often of itself leads to the next natural step in the global exploration process, and helps to avoid duplication of effort.

Information concerning funded (and usually only scheduled) cruises has been made available to the community in InterRidge News *since it was first published. More recently, details concerning proposed but as yet unfunded or unscheduled projects have been published in the Indian Ocean Column of* InterRidge News. *This information is now also available via the InterRidge home page in the form of a link to the 'Oceanic' site as well as a European mirror of the Oceanic information concerning vessels surveying the Mid-Ocean Ridge.*

- When a logistical opportunity presents itself, to bring together diverse investigators from the different nations to share strategies, which leads to the optimisation of individual programs, and the planning of joint and co-ordinated programs.

Starting with an announcement in the Fall/Winter issue of InterRidge News, *the InterRidge Office will offer a 'brokerage' service to those investigators who are planning a project which might be 'piggy-backed' or who are willing to offer time/space on a funded cruise. This will include a call for open proposals from both.*

1.7.2 Segmentation and Fluxes at Mid-Ocean Ridges Symposium and Workshops 1993

- Facilitate international communication, discussion, exchange of data, exchange of cruise plans, and organise symposia, workshops, etc.

See section 1.7.1 above.

- Establish an Internet accessible catalogue of recent and pending surveys to aid in the co-ordination and planning of international collaborative projects.

See section 1.7.1 above.

- Act as a 'broker' by facilitating contact between individuals, groups or nations wishing to work on similar themes or in the same locations.

See section 1.7.1 above.

- Develop links with ODP with an aim towards encouraging development of various ridge crest drilling capabilities.

Planning for a joint InterRidge/ODP Conference to be convened by Henry Dick and Catherine Mével is now in progress. The provisional venue and date are WHOI on 1-4 April, 1996.

- Co-ordination of a science plan and site selection for an experiment to quantify fluxes at the segment scale.

An experiment design workshop was held in Cambridge, UK in June of this year resulting in the draft of a science plan and the selection of the 29°N segment as the primary target for this experiment. TAG and Snake Pit were named as secondary targets.

1.7.3 Back-arc Basin Studies Workshop 1993

- Establish and maintain a geographical index of existing geophysical and geochemical datasets and funded proposals in back-arc basins as well as both geochemical and geophysical database archives.

A series of home pages have been established for all three databases and are accessible via the InterRidge home page. Positive responses have been received but so far contributions have been limited. Following announcements on the e-mail and in InterRidge News, *a better response is anticipated.*

- Develop links between back-arc basin studies and ODP.

The issue of drilling in back-arc basins will be raised with the convenors of the joint InterRidge/ODP symposium.

1.7.4 4-D Architecture of the Oceanic Lithosphere Workshop 1994

- Facilitate rapid response to detected events through the development and maintenance of a list of platform capabilities and scheduling.

See 'Event Detection and Response...' section 1.7.5 below.

- Co-ordinate a GIS database for the selected experiment site(s).

Currently awaiting site selection in the Atlantic. A database already exists for Pacific data at Lamont.

- Co-ordinate drafting of experiment science plans.

Provisional working group leaders were appointed and the InterRidge Office is currently arranging for discussion between their selected working group members. Further action awaiting confirmation of site selection.

1.7.5 Event Detection and Response & A Ridge Crest Observatory 1995

Actions awaiting report completion

- Develop an Internet communications network to facilitate information exchange and collaboration between observatory scientists. It is envisioned that the scope of this work will require additional personnel in the InterRidge office.

It will be possible to initiate and maintain electronic bulletin boards which will cater to ridge crest researchers involved in 1) event detection and response and 2) ridge crest observatories. They will allow open communication across the community of bulletin board members as well as provide information on events and technical development to the InterRidge Office which can then be posted on the WWW. A call for subscribers will be sent out to all participants and anyone involved in the Active Processes Workshop and an announcement made over the InterRidge e-mail list. After the initial work is completed, this list and the accompanying WWW home page will require minimal maintenance which can be accomplished without additional personnel in the Office.

- Actively promote the implementation and use of World Wide Web home pages that permit observatory system developers and scientists to easily and effectively communicate. An important aspect of this is to provide investigators with simple, easy-to-use (i.e. cookbook style) instructions for setting up World Wide Web home pages. InterRidge should provide a versatile standard home page that could easily be downloaded and modified by individuals to suit their needs. The InterRidge home page should contain a directory with links to available information on specific categories of observatory activity, i.e. sites, tools, planned experiments, news of recent events. Pertinent information should be linked to other science networks (Volcano Net, Smithsonian Events...)

A WWW home page dedicated to Event Detection has been posted including links to the Co-Axial home page, Volcano Net, Smithsonian Events, etc. An investigators event home page template will also be made available with downloading and publication instructions. These facilities will be advertised to all participants and anyone involved in the Active Processes Workshop and an announcement made over the InterRidge e-mail list and in InterRidge News.

- Disseminate event information and observatory activities to the broader geosciences community.

An Event Detection and Ridge Crest Observatory Column could be published in InterRidge News.

- Devise a mechanism to allow scientists to rapidly respond to an event. In this regard, an up to date database of ship schedules, available equipment, interested PIs should be maintained to expedite a response.

The electronic bulletin board mentioned above would serve to notify concerned investigators of an event. Efforts are already being made towards posting an up to date ship schedule and platform specification listing accessible via the InterRidge WWW home page.

• There is an identified need to encourage compatibility between instrumentation developed by various national ridge crest research programmes. The evolving nature of observatory technology precludes *a priori* specification of unique technologies, however, the following broad classes of compatibility should be reviewed.

Mechanical (e.g. sub/ROV manipulator related)
Electronic (e.g. connector/power related)
Communications (e.g. data formats, baud rates, acoustic frequencies)
Positioning (e.g. navigation)

Encourage the respective agencies in each country to arrive at a uniform asset scheduling/sharing protocol to facilitate international collaboration and facilities utilisation.

If investigators involved provide the Office with a list of names and addresses, a letter will be circulated to all those currently working on instrumentation development detailing the points outlined above as well as to those responsible for deployment of existing instruments. The circulation list will be included and recipients encouraged to communicate with the object of specification compatibility and the development of a scheduling/sharing protocol.

1.7.6 Biological Studies at the Ridge Crest 1995

• International Sample Exchange Agreement

Open exchange of preserved and frozen samples from mid-ocean ridge hydrothermal vent sites is seen by the ridge crest biological studies community as imperative to the facilitation of collaborative research. Such an exchange program will also help to avoid duplicate sampling which is costly both in monetary and ecological terms. The opportunity exists under the auspices of InterRidge to draft and ratify an international agreement for the open exchange of samples for scientific purposes (non-commercial) in line with InterRidge objectives.

This international agreement would call for the establishment of a curatory clearing house in each InterRidge nation. These clearing houses would not function as sample repositories or archives but merely handle the formalities of sample exchange. Each national clearing house would be supervised by a national corresponding curator. The following people were suggested as national corresponding curators:

Miguel Biscoito	Portugal
Daniel Desbruyères	IFREMER, France
David Dixon	PML, UK
Hitoshi Hotta (?)	JAMSTEC, Japan
Sergei Sagalevitch (?)	Russia
Verena Tunnicliffe (?)	Victoria University, Canada
Robert Vrijenhock	Rutgers University, USA
K.O. Stetter	Germany

A letter was sent to the National Correspondent for each InterRidge Member asking for their thoughts and comments on this project and their evaluation of the level of interest for it in their country. No response was received. Invitations to serve as national corresponding curator were sent to the nominees by the InterRidge Office.

• Ridge Crest Biologist Directory

The InterRidge Office should compile and make available on the WWW a catalogue of ridge crest biology workers and summaries of their current research. This information will be passed to national corresponding curators.

This directory is now posted and advertised in the InterRidge News *beginning with the Fall/Winter 1995 issue.*

• Bio-Box

A working Bio-box currently exists (funded by US RIDGE and developed by Craig Cary and Jeff Stein) which has been deployed with notable success. The US ridge crest biology community's current recommendation to RIDGE is that samples collected by non-biologists using the Bio-box be sent to Verena Tunnicliffe for inventory and archiving. US RIDGE would like to encourage

international deployment by funding shipping and restocking of Bio-box which has been designed to attach to a number of different submersibles.

InterRidge should help co-ordinate development of Bio-boxes in other member nations. The developers of the US Bio-box are willing to share design and technological information as well as keeping and publishing records of deployment and a list of specimens collected with their locations. It is recommended that specimens collected by non-biologists using the Bio-box go to a (national) central sorting centre supervised by a person with no vested interest in distribution or exchange or alternatively to Verena Tunnicliffe. InterRidge would provide the new sorting centres with a list of taxonomists presently used by those in the US and Canada.

The InterRidge Office, as part of its platform specification compilation, is identifying those investigators and technicians who might be involved with Bio-box development. In addition, the members of the Biological Studies Ad Hoc *Committee have been sent a letter requesting the names and address of those concerned in their country. Once the list is complete they will be contacted and encouraged to co-operate in the development of compatible Bio-box components. A request was made of Verena Tunnicliffe for an up to date list of taxonomists.*

- Data Exchange

InterRidge should facilitate establishment of standardised national biological databases accessible via the WWW. The database format developed by Daniel Desbruyères was proposed as a model. A portion of the French database will be translated and distributed to the workshop participants by the InterRidge Office. Database information should include: dive numbers, locations, videos, stills, domicilliation of specimens, collection condition.

The French database format was translated and distributed with a request for comments and suggestions to participants of the Biological Studies Workshop. Responses are expected after distribution of the draft workshop report anticipated in August, 1996. Once received, a WWW home page containing the database will be produced.

- International Vent Biology Symposium

An international symposium on hydrothermal vent biology in Madeira in the 1996-7 time frame, with Craig Cary (US) and Miguel Biscoito (Portugal) as co-convenors. Funding opportunities should be explored for publication of the proceedings.

The InterRidge Office is corresponding with the co-convenors and the organisation of the symposium is underway.

- Species Identification Manual

InterRidge should endorse and facilitate the development of a standardised manual intended to aid organism identification by non-biologists, possibly based on the one developed at IFREMER. This manual will be distributed to members of any dive or cruise which might encounter vent biota.

Samples of the IFREMER manual pages were distributed to investigators who have identified various vent species with the request that they contribute manual pages for those species. Awaiting replies.

- Demarcation and Definition of Sanctuaries and Collection Areas

An InterRidge *ad hoc* committee should be set up to explore the concept of seafloor sanctuaries in terms of respect for on-going experiments and instrument deployment as well as diversity issues.

Presented to the Steering Committee who agreed to the usefulness of this idea.

In addition to the activity listed here, the InterRidge Office has also taken action on charges made by the Steering Committee and summarised in the 1994 Steering Committee Report.

2.0 InterRidge Structure 1995

Principal Member Nations: France, Japan, Spain, UK, USA
Associate Member Nations: Germany, Portugal

2.1 The Steering Committee :

R.C. Searle	(UK; Chair)
M. Canals	(Spain)
J.J. Dañobeitia	(Spain)
D. Desbruyères	(France)
R.S. Detrick	(USA)
J. Francheteau	(France)
C.H. Langmuir	(USA)
H.D. Needham	(France; ad hoc)
R. Rihm	(Germany)
M.C. Sinha	(UK)
K. Tamaki	(Japan)
T. Urabe	(Japan)
L.S. Mullineaux	(USA, ad hoc)

2.2 National Correspondents :

Principal Members:

France :	J. Francheteau
Japan :	H. Fujimoto
Spain :	J. Acosta, M. Canals
UK.:	J.R. Cann
USA:	R.S. Detrick

Associate Members:

Germany :	H.-U. Schmincke, R. Rihm
Portugal :	J.M.A. Miranda

Corresponding Members:

Australia :	T.J. Crawford
Canada :	S.K. Juniper, K.M. Gillis
Iceland :	K. Gronvold
India	D. Gopala Rao
Italy :	TBA
Korea :	S.-J. Han, B.-C. Suk
Mexico :	J.E. Aguayo-Camargo
Norway :	E. Sundvor
Russia :	S.G. Krasnov, A.V. Sobolev
Sweden :	N.G. Holm
Switzerland	G. Früh-Green

2.3 Phase 2 Project Working Groups :

2.3.1 Biological Studies

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

2.3.2 SWIR Project (provisional):

C.H. Langmuir	(USA; Chair)
C.R. German	(UK)
P. Halbach	(Germany)
J. Lin	(USA)
J. Madsen	(USA)
T.A. Minshull	(UK)
L.M. Parson	(UK)
Ph. Patriat	(France)
K. Tamaki	(Japan)

2.4 Liaisons with other organisations:

ODP: P.J. Fox, C. Mével
Int. Lithosphere Panel (ILP): J.C. Mutter
SCOR: M.C. Sinha

3.0 InterRidge Publications 1995

Steering Committee Meeting 1994 Report, pp. 33, January 1995.
Steering Committee Meeting December 1994 Report, pp. 8, February 1995.
Meso-Scale Studies Workshop Report: 4-D Architecture of the Oceanic Lithosphere, pp. 15, May 1995.
InterRidge News, vol. 4, no. 1, pp. 72, 1995.
InterRidge News, vol. 4, no. 2, pp. 52, 1995.

4.0 InterRidge Mailing List September 1995

Country	Number on mailing list	Percentage of total on mailing list	Number on e-mail-list	Percentage of total on e-mail-list	Percentage of total on mailing list on e-mail-list
Argentina	1	0.06			
Australia	16	0.90	12	1.67	75.0
Belgium	6	0.34	1	0.14	16.7
Brazil	2	0.11			
Canada	64	3.60	28	3.91	43.8
Chile	1	0.06			
China	3	0.17	2	0.28	66.7
Denmark	1	0.06			
Fiji	1	0.06			
France	133	7.49	82	11.44	61.7
French Polynesia	1	0.06	1	0.14	100
Germany	105	5.91	35	4.88	33.3
Greece	1	0.06			
Iceland	9	0.51	5	0.70	55.6
India	8	0.45	5	0.70	62.5
Ireland	2	0.11	1	0.14	50.0
Israel	1	0.06			
Italy	6	0.38	2	0.28	33.3
Japan	141	7.94	36	5.02	25.5
Korea	4	0.23	1	0.14	25.0
Mexico	4	0.23			
Netherlands	11	0.62	1	0.14	9.1
New Caledonia	1	0.06	1	0.42	100
New Zealand	3	0.17	3	0.42	100
Norway	6	0.38	3		50.0
Philippines	1	0.06			
Portugal	9	0.51	2	0.28	22.2
Puerto Rico	2	0.11	1	0.14	50.0
Russia	24	1.35	11	1.53	45.8
South Africa	1	0.06	1	0.14	100
Spain	14	0.79	6	0.84	42.9
Sweden	8	0.45	1	0.14	12.5
Switzerland	6	0.38	1	0.14	16.7
Turkey	1	0.06			
UK	162	9.12	76	10.60	46.9
USA	1017	57.26	399	55.65	39.2
Total	**1776**		**717**		**40.4**

5.0 InterRidge Meetings And Workshops 1995

Global Studies:
SWIR Project Science Plan
Woods Hole, MA, USA; 28 & 29 August, 1995
Meso-Scale Studies:
Quantification of Fluxes at the Mid-Ocean Ridge: Experiment Design
Cambridge, UK; 24 & 25 June, 1995
Active Processes:
Event Detection and Response & A Ridge Crest Observatory
Paris, France; 16 - 18 January, 1995
InterRidge Biological Studies Ad Hoc Committee Workshop:
Biological Studies at the Mid-Ocean Ridge Crest
New Brunswick, NJ, USA; 24 - 25 April, 1995
Administrative Meetings:
Steering Committee Meeting
Kiel, Germany; 11 & 12 September, 1995
Symposia:
Joint DeRidge-InterRidge Symposium
Kiel, Germany; 13 September, 1995

Workshop Summaries

5.1 Global Studies:

5.1.1 SWIR Project Science Plan
Woods Hole, MA, USA; 28 & 29 August, 1995
Convenor: C.H. Langmuir

The Southwest Indian Ridge (SWIR) was chosen as a focus for the Global Studies Program because it has an essentially constant, super-slow spreading rate along its entire length and exhibits two contrasting types of morphology. While this makes the area tectonically interesting, there remain some problems associated with this zone. High southern latitudes make shipboard work difficult in this area. As yet no regional hydrothermal surveys have been carried out and hence no biological data is available. The logistical problems associated with work in high latitudes has, in the past, led to an unco-ordinated approach of investigation through individual cruises. The logistical difficulties could be more effectively coped with through co-ordinated collaboration.

Characteristics of the Southwest Indian Ridge:

(A) Morphology and segmentation
(B) Regional geophysics
(C) Crustal structure and crustal thickness
(D) Petrology and geochemistry
(E) Distribution and characteristics of hydrothermal sites and associated biology

Scientific Problems to be Investigated

(A) How do the various aspects of crustal accretion respond as the spreading rate becomes very slow? Do models based on faster spreading rates adequately describe phenomena at super-slow ridges? The following aspects should be considered:
(i) Crustal structure and geophysics
(ii) Crustal composition
(iii) Hydrothermal activity
(iv) Biology
(B) What are the effects of variation in magmatic budget at constant spreading rate? How do such effects vary as a function of spreading rate?
(C) What are the characteristics and scale of the geographical boundaries for crustal composition and biogeographic provinces between the Atlantic and Indian Oceans?

General Strategy

The general objectives that should be accomplished by the program are:

- To provide the long wavelength perspective in terms of depth and basalt chemistry.
- To provide the critical dataset for a super-slow ridge that can be compared to faster spreading ridges: for the range of axial depth and segmentation style, we need, for multiple segments, multibeam bathymetry, gravity and magnetics surveys, seismic experiments that provide crustal structure information, closely spaced rock sampling, and an assessment of the hydrothermal budget.
- To locate specific hydrothermal sites, preferably in regions with different styles of segmentation, and lead to sampling of water and the associated biological community.

The primary emphasis of the program in terms of hydrothermal prospecting and detailed experiments should be on the north-eastern portion of the SWIR.

Elaboration of specific program components

Three different regions, representative of the range in magmatic budget and segmentation characteristics, would be selected for intensive study on the segment scale, with the ultimate aims of investigating and understanding the range in styles of crustal accretion at super-slow spreading rates and of identifying, observing and sampling hydrothermal sites and associated life.

(A) Regional high resolution bathymetry with underway geophysics
(B) Regional hydrothermal surveys
(C) Investigation of 3-D crustal structure
(D) Regional sampling and detailed sampling of individual segments
(E) Detailed hydrothermal and biological studies

Specific Project Design

(A) One leg of multibeam bathymetry and underway geophysics.
(B) One leg of petrological sampling.
(C) One or two legs of a deep-towed instrument package that would provide side-scan and hydrothermal sniffing.
(D) A seismic experiment to evaluate crustal structure in the three regions.
(E) An ROV leg with the aim of locating and photographing two active hydrothermal sites preferably in two of the three regions.
(F) A submersible leg to dive on the two hydrothermal sites and sample water, sulphides and animals.

Two additional legs would be needed to investigate the south-western portion of the ridge, for regional bathymetry, geophysics and sampling. These legs will be necessary to answer questions about the SWIR as a gateway between the Indian and Atlantic Oceans, and for comparison of geological, geophysical and petrological characteristics of the two ends of the ridge.

5.2 Meso-Scale Studies:

5.2.1 Quantification of Fluxes at the Mid-Ocean Ridge: Experiment Design

Cambridge, UK; 24 & 25 June, 1995

Convenors: H. Elderfield, S.E. Humphris, G.P. Klinkhammer, A. Schultz and H. Sloan

Quantification of mass, energy and chemical fluxes occurring at mid-ocean ridges has been identified as an important component of the InterRidge Meso-scale Studies Working Group for the next few years. The first Workshop dedicated to discussion of the types of fluxes that should be measured was held in Durham in 1993 in conjunction with a Symposium and Workshop on "Segmentation and Fluxes at Mid-Ocean Ridges". Three types of fluxes were identified extending from the mantle up into the water column (magmatic fluxes, chemical fluxes associated with rock-seawater interactions, and hydrothermal fluxes) and the concept of a "box" experiment was defined in which a segment of a mid-ocean ridge would be selected within which all fluxes would be quantified and their inter-relationships examined. This meeting was then followed up by a RIDGE/VENTS Workshop in September 1994 that tried to assess the status of knowledge of hydrothermal fluxes and their potential global impact. Issues important to the design of a segment-scale flux experiment that arose from that meeting included: the magnitude of flank fluxes, the relative importance of focused

and diffuse flow at the ridge axis, event plumes, vertical transport into upper oceanic levels, and models of vent productivity.

The logical next step was to get to grips with experimental design and to this end a two-day Inter-Ridge Workshop, convened by Harry Elderfield (U. Cambridge), Susan Humphris (Woods Hole Oceanographic Inst.), Gary Klinkhammer (Oregon State U.), Adam Schultz (U. Cambridge) and Heather Sloan (Inter-Ridge Office), was held in the Earth Sciences Department, University of Cambridge in June 1995 and attended by about 30 delegates from the UK, USA and Japan. The purpose of the Cambridge Fluxes Workshop was to design an experiment at the segment scale that would quantify magmatic, hydrothermal, chemical and biological fluxes.

The Workshop discussed the concept of a box experiment and then went on to discuss what fluxes need to be measured. It considered fluxes of heat and chemicals, the physics and chemistry of plumes, and biological interactions. It discussed what tools are available and what new tools are needed. Of new tools, travel time- and scintillation-tomography were emphasised. Next, there was consideration of what criteria define the site (or sites) and where is the best place to do the experiment. Emphasis was placed on the Atlantic hydrothermal sites: TAG, Snakepit, Broken Spur, Lucky Strike, Menez Gwen and Rainbow. A proposed timetable was outlined for the period 1995-1999.

5.3 Active Processes:

5.3.1 Event Detection and Response & A Ridge Crest Observatory

Paris, France; 16 - 18 January 1995

Convenor: J.R. Cann

The third theme area for InterRidge activities, that of Active Processes at mid-ocean ridges, held its first meeting rather belatedly at the Institut d'Océanographie in Paris early in the year. The Institut, a strange confection of turn of the century spiky ironwork, tall brick towers, marine murals of octopuses and trawlers, and a meeting room resembling a medical school operating theatre, was a suitable venue for some of the more recondite imaginings of the marine community.

This theme centres on the fact that the mid-ocean ridges are one of the most active environments on Earth. Each year about 3 km^3 of lava are erupted onto the seafloor at ridges, and perhaps 5 times as much magma is intruded into the crust. About 10% of the loss of the Earth's internal heat takes place at mid-ocean ridges through hydrothermal circulation and other forms of convection. Hydrothermal systems wax and wane, for reasons yet unclear, generating major sulphide deposits in some places, and strings of little vents in others. New faults are constantly being generated as the crust stretches, and evolve rapidly to maturity. The ridges host biological communities in a constant dynamic flux, that must both renew themselves in place and also seek new opportunities for colonisation.

Almost all of this activity takes place at the seafloor or within a few kilometres below the seafloor, in contrast to the situation at subduction zones, where much activity is far deeper in the Earth. This means that the mid-ocean ridges provide a unique opportunity to study active Earth processes and the complex interactions between them.

Understanding the dynamics of processes within a system requires information about the rate of the processes operating and about the episodicity of processes that vary in time. For many geological processes it is difficult to constrain rates or episodicity except indirectly. This is especially true of mid-ocean ridges. It has been difficult in the past to conduct continuous measurements on the ocean floor in the same way as has been possible on land. Our best efforts have often been an irregularly spaced series of snapshots rather than a continuous record. There are many examples of ways in which continuous observation of active processes can lead to new scientific insights.

Tectonics of spreading can be illuminated where spreading centres come above sea level. Events in Iceland have shown that crustal spreading there happens episodically, every 100-200 years in any segment. Studies of mid-ocean ridge seismicity have apparently not yet revealed the clustering of events in time that would be expected if Icelandic-type events were the norm. Events involving major eruptive episodes have been rare in Iceland in historic times, so there may be a longer periodicity, perhaps thousands of years, separating large spreading centre eruptions. At the other end of the scale, observation of the ultra-fast portion of the East Pacific Rise suggests that eruptions can be near continuous over substantial periods of time.

Generation of new faults and growth of existing faults is a continuing process at spreading centres, and the process there is much more clearly defined than in, for example, continental rifts, since distance from the spreading axis represents time as well as space. Studies of faulting at the Mid-Atlantic Ridge show that a new major fault must be generated every 100,000 years or so in a given spreading segment, and must grow fast to a length of tens of kilometres. Since there are very many spreading segments, in several there must be active fault growth occurring at any time.

Ocean floor volcanology is still an embryonic science. Pioneering work in subaerially exposed submarine volcanics has contributed much, as have submersible studies, but recent high resolution side-scan images of spreading centres have shown a great variety of morphology at a scale not previously accessible to view. By great good fortune, two seafloor eruptions have recently been studied as they happened, at 9°30'N on the East Pacific Rise and at the Coaxial Segment of the Juan de Fuca Ridge. In both cases it has been possible to define the overall geometry of the erupted unit, which has been done only once before for a single eruption.

In other places, such as further south on the East Pacific Rise and at 25°N on the Mid-Atlantic Ridge, there is evidence for much larger eruptive episodes. Perhaps even at slow-spreading ridges, crustal construction periodically takes place in major eruptive events.

Hydrothermal systems present important opportunities and also a rich variety of dynamics for study. Ocean floor hydrothermal systems have many characteristics that depend on deep water for their operation: the high pressure in deep water suppresses boiling over most of the circulation path, and the presence of the overlying ocean ensures that most of the water passes through the system once only. Understanding of hydrothermal systems requires estimates of the total fluxes of heat and chemicals from vent fields, and also observation of variability at a wide range of time scales, from that of the life time of the vent field down to that of the growth and collapse of individual sulphide chimneys. In between these limits are a rich variety of time variable behaviours, including hydrothermal brecciation events, megaplume generation, and periods of rapidly changing temperatures. The recent Coaxial eruptive event showed that short-lived hydrothermal systems can be generated above dykes intruded laterally beneath the surface.

Associated with hydrothermal systems are biological systems which have their own dynamics. Organisms must have developed a range of strategies to cope with the constantly changing environment in which they live. These will include strategies for reproduction, dispersal and settling within the vent field they now occupy, and also for the colonisation of new vent fields in adjacent parts of the ocean. These strategies will have to take account of the local geological environment and also oceanographic conditions. Major changes in vent ecosystems have been observed on repeated visits to a vent site, and it is not clear whether these are caused by a changing vent environment, by ecological succession, or even by human intervention. New eruptions give the opportunity for rapid growth of new colonies, but these may be relatively short lived because of the rapid cooling of the lava and dykes.

The workshop was concerned with all of these scientific areas, and showed, first, the very large extent of the growing effort in the international community on active processes. The US community has developed a major programme centred mostly on the Juan de Fuca Ridge, and there are new programmes starting in Japan, Canada, the UK and France. There are firm links with the ION programme, initiated by seismologists to emplace deep ocean seismic stations, but spreading into the rest of the marine community through a workshop held shortly before this one in Marseilles. The Ocean Drilling Program has also developed research into active processes through the recent drilling of active hydrothermal systems, and the instrumenting of them with long term monitoring packages.

The long term aim of the Active Processes initiative was defined as the development of observatories on the mid-ocean ridges which would be emplaced in sites at which events were expected, would be targeted at the types of events expected and at the critical phenomena anticipated, and would make measurements for periods of years. The concept of an observatory that arose was of a collection of instrumental packages, contributed to the observatory from different institutions in, perhaps, different countries, and able to send data to the shore and to receive control from the shore during the course of its life.

The workshop identified a number of types of events of scientific interest:

- Dyke injection, fissuring and minor faulting
- Volcanic eruptions of different types producing different volcanic products
- Magma recharge and related inflation and deflation of the seafloor
- Propagation and growth of major faults

- Slope failure by landsliding and debris flow
- Growth and flow of serpentinite diapirs
- Evolution of hydrothermal vent fields, either natural or induced by drilling
- Megaplume emission from hydrothermal systems
- Reproduction, recruitment and mortality events of vent communities

Three working groups at the workshop discussed different aspects of the problem. The group concerned with the scientific rationale recommended three types of observatory required: a segment scale observatory on slow spreading crust, a segment scale observatory on fast spreading crust, and vent field scale observatories. That on slow spreading crust would require acoustic and seismic monitoring of a wide area initially to identify suitably active segments, followed by detailed site surveys of candidate sites, and eventual deployment of a fully instrumented observatory. The research on fast spreading ridges should build on existing and planned work in the Pacific, but should, it was recommended, include an international effort on the super-fast East Pacific Rise at 17°S. Vent field observatories should target the full range of types of vent fields in different environments.

The working group on event detection, characterisation and response regarded a major initiative in this direction as a necessary prerequisite to an observatory. Crucial to a full characterisation of events would be a properly planned programme of observation and intervention. This requires the immediate establishment of an InterRidge Active Processes Committee, which would undertake wide consultations and co-ordinate an international programme of this type. The working group identified a wide range of activities for this Consulting Group, including co-ordinating the dissemination of information about event detection, increasing awareness of ship schedules, planning the components of a response and proposing baseline surveys of critical areas. The group would consider each event detected on its scientific and technical merits, and recommend the appropriate level of response from the international community.

The third working group was concerned with co-ordination and design of the infrastructure for an observatory. Many of the components necessary for an observatory are already available or are about to be tested, but the integration of these into a single system requires effort of many different kinds. The group recommended that the InterRidge Office should develop a system through the Internet that could allow information exchange and facilitate collaboration in instrument development. There should be an attempt to encourage compatibility between the instrumentation developed by various national programmes to allow, as far as possible, instruments to be exchanged between different observatory sites. The InterRidge Active Processes Committee should be charged to follow and facilitate the transfer of new technologies to developers of observatory systems to enhance effort as much as possible.

These recommendations are only given in outline here. A full report of the meeting will be available soon, and has the potential to enhance significantly the research in this important and innovative area of mid-ocean ridge science. In addition to the writing of the report, the meeting brought together individuals with the potential for fruitful collaboration in the future. It was an impressive three days.

5.3.2 InterRidge Biological Studies Ad Hoc Committee Workshop: Biological Studies at the Mid-Ocean Ridge Crest

Rutgers University in New Brunswick, New Jersey, USA; 24th-25th April, 1995
Convenors: D. Desbruyères and R.A. Lutz

The Biological *Ad Hoc* Committee held its first workshop at Rutgers University on 24th & 25th April 1995. The 25 participants included the members of the *Ad Hoc* Committee and various members of the ridge crest biologist community.

The objectives of the workshop were:

- To develop an implementation plan for integration of biological studies into the 3 principal InterRidge themes;
- To draft a formal international agreement to be endorsed by InterRidge to provide for exchange of data and samples;
- To develop approaches and methods to maximise the effectiveness of biological sampling and observations during "geological" cruises.

It is the opinion of the Biological *Ad Hoc* Committee that biological studies do not fall easily within the framework of InterRidge. The scales on which the three principal themes operate are not those used by biologists. This may be the reason for the very limited participation of biologists in InterRidge workshops. However, Active Processes is the most natural theme for biological studies to fit into.

A Basic Framework for Biological Studies at the Ridge Crest

1 Origin and Evolution of Vent Taxa

- Paleo-tectonics
- Paleo-oceanography (need input from geosciences)
- Evolution
- Genetics
- Biogeography

2 Community Structure and Species Persistence (Community Dynamics)

- Cold sulphide deposits
- Temporal variation
- Monitoring (observatories link)
- Ridge fauna
- Dispersal and reproduction
- Lifecycle
- Symbionts transmission
- Adaptation to extreme conditions

Hydrothermal vents are an unstable environment. Biological communities must persist within a segment and then disperse in lifecycles which help them to survive. Cold sulphide deposits are not being studied at present but may be the most important aspect of hydrothermal venting in terms of volume and their associated biological communities.

3 Biogeochemical Interaction

- Biological modification of vent fluid chemistry
- Biomineralisation
- Subsurface circulation system plumbing

These are fundamental processes occurring at hydrothermal vents, yet there is currently little or no work going on in these areas.

4 Biological Production

- Chemosynthetic production
- Symbiosis
- Ultrathermophily (limits of life)
- Exploration of OM from vents to ridge
- Cold biological production (psychlophilic chemosynthetic production)

All of this is currently under discussion over the Internet and an implementation plan is being formulated which will eventually be ready for discussion at the Steering Committee level.

Recommendations and Actions of the Biological Studies Ad Hoc Committee

International Sample Exchange Agreement and 'Bio-box'

The bio-box is an American concept. It is a box containing all the supplies and information necessary for non-biologists to effectively and correctly sample and preserve hydrothermal vent biota. Optimally, all vessels carrying a bio-box would be in communication with a biologist.

The International Sample Exchange Agreement pertains to preserved and frozen samples. Its aim is to avoid duplication of sampling which is costly not only in monetary terms but also in terms of environmental impact. The Biological *Ad Hoc* Committee will request ratification of the Agreement which will have been endorsed by all the member nations of InterRidge. The Agreement excludes commercial use of any exchanged sample. Each nation will have a curatory clearing house kept by a national corresponding curator whose responsibility it will be to:

- keep a record of all samples collected by PIs from his or her country;