



InterRidge

Steering Committee Meeting Report 2012

**St. Petersburg, Russia
2-3 June 2012**

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Co-Chair, Jon Copley
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Sept 2012

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Absent Steering Committee Members:

Jon Copley (UK, 2010)
Colin Devey (Germany, 1999)
Nicole Dubilier (Germany, 2004)
Jerome Dymont (France, 2001)
Pedro Ferreira (Portugal, 2009)
Dan Fornari (USA, 2009)
Nadine Le Bris (France, 2009)
Sung-Hyun Park (Korea, 2007)
Rolf Pedersen (Norway, 2001)
Kamesh Raju (India, 2005)

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APPENDIX I

InterRidge Chairs and Coordinators; Steering Committee Members;
National Correspondents

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Proposal for IR Working Group on Circum-Antarctic Ridges

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InterRidge: Third Decadal Plan 2014-23

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InterRidge 2012 Steering Committee Report

Meeting Agenda Day 1, Saturday 2nd June, 2012; 9:00AM – 5:30PM

1	9:00	Welcome and introduction	B. Murton
2	9:15	Accept 2011 meeting report, accept 2012 meeting agenda, and confirm Steering Committee Members; AOB to be added Review of 2011 meeting Action List	B. Murton
3	9:30	InterRidge Office Coordinator's report <ul style="list-style-type: none"> • Working Groups • InterRidge Fellowship and Postdoctoral Fellowship Programme • Cruise bursaries • Membership • Meetings • Other activities 	D. Milton
4 A	10:00	National updates Principal members	China – J.Chen / J. Li France – report submitted Germany – S. Petersen Japan – H. Kumagai UK – R. Hobbs USA – D. Fornari (report submitted)
10:30 GROUP PHOTO AND COFFEE BREAK			
4 B	10:50	National updates (cont) Associate and corresponding members	India – K. Raju (report to follow) Korea – S-H Park (report submitted) Norway – R. Pedersen (report to follow) Portugal – R. Santos Russia – S. Silantsev
5 A B C D E F G H	11:15	Working groups – updates: Arc-Backarc Systems Hydrothermal energy and ocean carbon cycles Mantle Imaging Oceanic Detachment Faults Seafloor Mineralisation SMART Vent Ecology Discussion of new WG proposal – Circum-Antarctic Ridges	M. Seton (report submitted) N. Le Bris/C. German (report submitted) N. Seama (report submitted) J. Escartin S. Petersen C. Devey (report to follow) K. Fujikura B. Murton

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13:00 LUNCH			
6	14:00	Marine Protected Areas along the MAR	R. Santos
7	14:45	Presentation on Deep Sea Minerals in the Pacific Islands region	A. Tawake - SOPAC
15:30 COFFEE BREAK			
8	15:45 – 17:30	Discussion – what is InterRidge’s main challenge in the next decade? What do nations want from InterRidge now that national programmes have ended?	B. Murton
19:00 End of Day 1; RIVER CRUISE AND DINNER			

Meeting Agenda Day 2, Sunday 3rd June 2012, 9:00AM – 3:00PM

9	9:00	Revision / acceptance of Third Decadal Plan	B. Murton
10:30 COFFEE BREAK			
10	11:00	Discussion of bid for the next InterRidge Office 2013-15	B. Murton
12.30 LUNCH			
11	13:30	IR Budget 2012 Update on membership	B. Murton
12	14.15	Next Steering Committee meeting location and date	B. Murton
13	14.30	Meeting adjourns	B. Murton

1 Welcome and introduction

The agenda of the 2012 Steering Committee meeting was circulated electronically to all Steering Committee members, Working Group Chairs and guests prior to the meeting. Bramley Murton welcomed members and guests to the meeting and thanked Georgy Cherkashov, our host at VNIIOkeangeologica, St Petersburg, as well as the InterRidge Russian Correspondent, Sergei Silantyev, and Dmitry Kaminsky, who helped in the organisation of the meeting.

Apologies were received from Jon Copley, Colin Devey, Nicole Dubilier, Jerome Dymont, Pedro Ferreira, Dan Fornari, Nadine Le Bris, Sung-Hyun Park, Rolf Pedersen and Kamesh Raju.

2 Accept 2011 meeting report, accept 2012 meeting agenda, and confirm Steering Committee Members

The 2011 Steering Committee Meeting Report, finalised in November 2011 and available on the IR website at: <http://www.interridge.org/stcom/reports> was accepted, as was the 2012 Agenda. At the 2012 Meeting, we welcomed Kats Fujikura, who acted as alternate for Yoshi Fujiwara (Vent Ecology WG), and Sven Petersen, an alternate for both Maurice Tivey (Seafloor Mineralisation WG) and Colin Devey. Kim Juniper attended as the new National Correspondent for Canada. We welcomed as guests Prof. Xianglong Jin, from the Second Institute of Oceanography, Hangzhou, Ricardo Santos from the University of the Azores, Portugal and Aquila Tawake from Fiji, representing SOPAC.

Review of 2011 meeting Action List

Item	Issue	Action	Who
2	StComm membership	Nominate a second USA StComm member. <i>No progress because no funding at end of Ridge 2000, but DF is in consultation with NSF re. 2013 funding</i>	C. German & D. Fornari
3A	Advertisement of IR funding opportunities	Target emails to PhD students across the IR community via National Correspondents; Advertise bursaries to ship schedulers; <i>Uptake of bursaries more than doubled in 2012</i>	D. Milton – completed.
3C	IR support for national funding	Send IR statements to China, France, Korea <i>Letters sent</i>	B. Murton – completed.
4	Portuguese membership	Contact R. Santos and explore Azores connection <i>2012 membership secured</i>	B. Murton – completed.
4A	Chinese cruises – possible bursary opportunities?	Contact Zhu Yongling <i>No berths available this year.</i>	D. Milton – completed.
4A1	French 2012 cruises details	Contact IR Office when information becomes available <i>Added to database</i>	J. Dymont – completed.
4A3	Russian membership	Letter of invitation to Russia <i>Awaiting reply – pleased to have Nikolay Bortnikov at this meeting</i>	B. Murton – completed.
4A4	Brazil membership	Contact de Souza <i>No response</i>	D. Milton – completed.
5	GRID-Arendal Atlas	Put Y. Beaudoin in touch with	D. Milton – completed.

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		INDEEP <i>Ongoing</i>	
6A	Hydrothermal Energy IR/SCOR WG	Ask StComm to approve \$10,000 for 2012 meeting <i>Meeting now likely to be in 2013 – no proposal received</i>	D. Milton – completed.
6C	Mantle Imaging WG future	Consult WG members. <i>Recommendation to disband WG – see WG reports section</i>	N. Seama – completed.
6D	Seafloor Mineralisation WG future	Consult WG members, ensure an alternate at Third Decadal Plan meeting. <i>3 yr extension to WG agreed.</i>	M. Tivey – completed.
6F1	New WG “SMART” proposal	Make revision to title. <i>This WG was accepted with its original title</i>	C. Devey – completed.
6F2	New “Arc and backarc” WG	Contact Australia about IR membership <i>Awaiting reply</i>	B. Murton – completed.
6F3	New “Arc and backarc” WG	Make revisions <i>Proposal accepted for new WG</i>	M. Seton – completed.
6F4	New: “Detachments” WG	Proposal to be sent to full StComm <i>Proposal accepted for new WG</i>	D. Milton – completed.
7	Data portals	IR Office to find weblink/contact for metadata <i>Webpage constructed.</i>	D. Milton – completed.
8	Maintenance of databases	INDEEP and Vent Ecology WG to be contacted <i>Nautilus and INDEEP are keen to work together. INDEEP now responsible for ChEssbase</i>	D. Milton – completed.
9A	Chinese cruises for cruise bursaries	Continue to liaise with Zhu Yongling <i>Ongoing</i>	D. Milton – completed.
9B	Nautilus cruise programme	Keep contact with Nautilus <i>Ongoing.</i>	D. Milton – completed
11	Third Decadal Plan meeting	Advertise via National Correspondents <i>35 people attended</i>	D. Milton – completed.
12	2011 Budget	Increase Fellowships from 2 to 4 <i>Currently in the award process</i>	D. Milton – completed.

DISCUSSION

4A3 – Russian membership:

GC – There had been no response to the letter InterRidge had sent to 5 key Russians, but Russia has a new Minister of Natural Resources.

4A4 – Brazil contact:

RS suggested contacting Marico-Pérez.

ACTION

DM to send a letter to the new minister, via GC.

DM to contact Marico-Pérez.

3 InterRidge Office

3.a Coordinator – Update

Coordinator Presentation

Debbie Milton, InterRidge Coordinator, highlighted the activities below.

Major activities for the Coordinator since the 2011 StComm meeting included:

- Last quarter of 2011: produced InterRidge News 2011; organised the Third Decadal Plan meeting in San Francisco; follow up of issues from 2011 StComm meeting.
- First quarter of 2012: Database development - linkage between cruise and vents databases; secured continued funding from ISA of \$45,000 for the Fellowship programme; IR membership – contacted Australia, Canada, Portugal and Russia; administration of cruise bursaries.
- Second quarter of 2012: Evaluation and selection of 2012 InterRidge and InterRidge/ISA Student/Post-doc Fellowships; organisation of IR-sponsored AGU sessions; Steering Comm meeting preparation
- Expected 3rd quarter of 2012: attending and organising meetings in Brest and Mauritius and possible Hydrothermal Energy WG meeting; follow up of issues from 2012 StComm meeting.
- Expected 4th quarter of 2012: production of annual IR Newsletter; AGU IR-sponsored sessions and posters; hand-over of IR office.

On-going activities for the Coordinator since the 2011 StComm meeting included:

- invoices to member nations, payments to IR-sponsored meetings;
- bi-weekly e-newsletters;
- education and outreach activities.

3.a.i. Working Groups

At the 2011 StComm meeting and since, three new Working Groups have been approved, one extended and one submitted to this meeting for approval.

New WGs

Arc-Backarc Systems	Chair: Maria Seton
Oceanic Detachment Faults	Co-Chairs: Pablo Canales and Javier Escartin
SMART	Chair: Colin Devey

3-year extension

Seafloor Mineralisation	Chair: Maurice Tivey
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Proposed new WG

Circum-Antarctic Ridges	Co-Chairs: Anne Briais, Jian Lin and Sung-Hyun Park
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3.a.ii. Website and email lists

Daily activities at the IR office include posting events, news and jobs to the website. Since 1st Jan 2012, 10 emails have been posted with IR bi-weekly news to the interridge-mail emailing list. As of May 2012, there were 1217 members on this list. In addition, the IR bi-weekly news e-mails are transmitted to the InterRidge-Japan e-mail list. With regards to the interridge-classifieds emailing list, as of May 2012 there were 202 members on this list.

3.a.iii. Member Database Website and email lists

As of May 2012, the Member Database contained 1627 registered members from 63 different countries. Very few people now register as IR members, and even fewer give more than minimum data about themselves.

3.a.iii. Cruise and Vents Databases

Version 2.1 of the Vents database was completed by Stace Beaulieu in Dec 2011. Subsequent additions are being documented as Version 2.2 – all are recorded on the website. Work has been done to make the vocabularies similar so that searching for vents and cruises is more efficient. Obtaining information on cruises remains difficult – hardly any information is sent to the IR Office for dissemination.

3.b InterRidge Education and Outreach – Update

Major accomplishments in Education and Outreach in the past year included the securing of funding from ISA of \$45,000 (\$15,000 for each year 2012-14). The InterRidge Cruise Travel Bursary Scheme has tripled its number of awards since 2011.

3.b.i. InterRidge Student and Postdoctoral Fellowship Programme

There were six applicants for InterRidge Fellowships this year, and four applications for the ISA award, creating competition for the first time and evidence of the growth of this scheme in developing nations. We expect to award 7 Fellowships in June 2012: four supported by InterRidge and three by the ISA Endowment Fund. The Office's recommendations for Fellows were sent to StComm members and have been on the website since mid-May:

<http://www.interridge.org/node/add/fellowships>

Recommended as IR Fellows:

Catherine Cole (Advisor: Rachael James - NOC UK; Sponsor: Richard Cosson & Ines Martin - Univ of Azores & Nantes)

Emanuele Fontana (Advisor: Paola Tartarotti - Univ. Milan; Sponsor: Lisa Gilbert - Williams College USA)

Alessio Sanfilippo (Advisor: Riccardo Tribuzio - Pavia Italy; Sponsor: Henry Dick - WHOI USA)

Jessica Till (Advisor: Yohan Guyodo - IMPMC Paris; Sponsor: Adrian Muxworthy - Imperial College UK)

Recommended as ISA Endowment Fund Fellows: (to be confirmed by the ISA Advisory Board on 6th June 2012)

Jian Hanchao (Advisor: John Chen - Peking Univ; Sponsor: Satish Singh - IGP Paris)

Sanitha Sivasadas (Advisor: Baban Ingole - NIO India; Sponsor: Ana Colaco - Portugal)

Andrew Thaler (Advisor: Cindy Van Dover - Duke Univ USA; to train Freddie Alei from Papua New Guinea)

Advertising this year included the InterRidge e-mailing list and website, and through the IR website. An announcement was sent to the following societies and organizations: AGU, Asia Oceania Geosciences Society, Brazilian Geophysical Society, CenSeam, ChEss, European Geosciences Union, Indian Geophysical Union, InterRidge, IODP, Ridge 2000, SCOR, Society of Exploration Geophysicists, South African Geophysical Association. All InterRidge members in

developing and emerging economy countries were emailed directly. Following a suggestion at last year’s StComm meeting, a list of students in national labs was constructed and these were also contacted.

3.b.iii. Cruise bursaries

This scheme is becoming increasingly known. In 2011 three bursaries were awarded – in 2012 we have nine participants in the scheme. The Australian ridge community is playing a leading role, as well as USA. Julie Perrot (France) offered a berth but there was no uptake.

Recipient	Host Scientist	Cruise location and date
Berta Biescas (Canada) Guillermo Bornstein (Spain) Jhon Mojica (Spain)	Suzanne Carbotte (USA)	Juan de Fuca Ridge June-July 2012
Camilla Palmiotto (Italy) Ross Parnell-Turner (UK) Alex Zheleznov (Russia)	Debbie Smith (USA)	Equatorial Atlantic June 2012
Daphne Cuvelier (France)	Kim Juniper (Canada)	Sept 2012
Daniela Wolf (Germany)	Maria Seton (Australia)	Easternmost Coral Sea and Lord Howe hotspot Oct 2012
tbd	Ben Cohen (Australia)	Tasmantid Seamounts Nov-Dec 2012

DISCUSSION

The mailing lists are increasingly out of date.

Hard copy IR News is still required as an IR product, but should they continue to be sent to individuals?

ACTION

DM to contact National Correspondents and ask them to update national members.

DM to send hard copies of IR News to institutions, rather than individuals. (An invite to re-register for a hard copy to be given via interridge-members mailing list).

4 National updates

As of May 2012, the total IR regional/national membership is 31.

4.a Principal Members

China National Update 2012

Report by Y. John Chen and Jiabiao Li, Co-Chairs, Steering Committee of InterRidge China
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Riding on the rapidly growing Chinese economy, the ridge program in China is moving ahead with a momentum in 2012, completing nine cruises to the global mid-ocean ridges and adding a new research vessel R/V “*Science*” to the Chinese national fleet of deep-sea research vessels.

Ridge-Crest Surveys

On board R/V “*Dayang Yihao*”, Chinese scientists have collected more evidence for active hydrothermal vents during 9 consecutive ridge cruises on the East Pacific Rise, South Mid-Atlantic Ridges and the Southwest Indian Ridges. Evidence for 5 new hydrothermal vent fields was collected at South Mid-Atlantic Ridge, and in particular the one at 26° South is probably the southernmost hydrothermal field in the global data base. For 2012-13 the Chinese ridge program will use two research vessels during 11 cruises, conducting research at Indian and Mid-Atlantic ridges. Scientists from WHOI, USA and the Institute of VNIIOkeangeologia, Russia, are invited to participate in some of the cruise legs for joint research.

A New Research Vessel

The body construction of a new research vessel, R/V “*Science*” was completed in October 2011 and all the furnishings and installation of the equipment will be finished in the summer of 2012. The new ship is now scheduled for delivery to the Institute of Oceanography, Chinese Academy of Science, Qingdao in August 2012. A test cruise is planned for conducting research in the western Pacific in the last quarter of 2012. By the end of 2012 the Chinese national fleet of deep-sea research vessels will have three ships including R/V “*Dayang Yihao*” (5600 tons) operated by COMRA, R/V “*Ocean #6*” (5827 tons) operated by Chinese Geological Survey at Guangzhou, and R/V “*Science*” (4864 tons) operated by Institute of Oceanography, Chinese Academy of Science. Another new ship, R/V “*Xiang Yang Hong #10*” (4500 tons) is planned to be delivered to the Second Institute of Oceanography at Hangzhou for deep-sea cruises.

After successfully completing five test dives to 5000 meter depth in July 2011 the Chinese manned submersible “*Chinese Dragon*” is now scheduled to conduct a test dive to the 7000 meter depth, a target depth designed for the Chinese manned submersible, in late 2012.

Symposiums and National Conference

1. A symposium called "Global mid-ocean ridge spreading processes and implications for the South China Sea evolution" was held in Guangzhou, October 9-11, 2011. It was attended by about 200 students and researchers from various parts of China. Distinguished international keynote speakers included Dr. Jian Li (Woods Hole Oceanographic Institution, USA) and Dr. Anne Briais (CNRS - Lab. Geosciences Environment, Toulouse, France).
2. The 2nd International Symposium on Scientific and Legal Aspects of the Regimes of the Continental Shelf and the Area, Hangzhou, China, 8-9 November 2011. Over 100 scientists and government officers participated in this 3-day conference and both Co-Chairs of InterRidge-China, Drs. Jiabiao Li and John Chen, were invited to give key-note speeches discussing important questions and issues in oceanic crust and the ridge-crest process.
3. The second national conference of “Deep Sea Research and Earth System Science Symposium” with a strong focus on Ocean Sciences will be held at the Conference Center in Shanghai, China on July 2-4, 2012. It is estimated to have over 600 scientists and students who will participate in this national conference (in Chinese).

A bid for the IR Office at Beijing, China

Drs. John Chen and Jiabiao Li are teamed up again in a bid to host the InterRidge Office at Peking University for 2013-1015. If successful this relocation of the InterRidge Office to Beijing will further boost China’s ridge program, which is at its energetic stage with a very strong momentum riding on the rapidly growing economy of China, and will allow it to give a much stronger contribution to the InterRidge community and global mid-ocean research.

France National Update 2012

Report submitted by J. Dymont.

In 2012, the French ridge community is pursuing projects over different spreading centres spanning the world's oceans.

The Mid-Atlantic Ridge (MAR) remains a favourite target, with the MoMAR (Monitoring the MAR) observatory being a major focus of interest. The observatory consists of two connected nodes, respectively dedicated to geophysics and ecology: the geophysical node is made of a cabled deep-sea seismometer and a pressure gauge, and the ecological node a video system, chemical analyzers and temperature probes. A buoy connects the observatory to the world by satellite link for real-time observations. Cruise MOMAR 2012 (P.I. M. Cannat, J. Blandin, P.M. Sarradin) is planned on R/V *Thalassa* in July 2012 to service the observatory. Cruise HYDROBSMOMAR (P.I. J. Perrot) is also scheduled on R/V *Thalassa* in August 2012 to redeploy the hydrophone network that monitors the seismicity of the Azores area as part of the MoMAR project.

Cruise COLMEIA (P.I. M. Maia), scheduled on R/V *L'Atalante* in January 2013, will investigate the Equatorial Atlantic "cold spot" in St Paul-St Peter area, in collaboration with Brazilian scientists.

Beyond the scheduled cruises, cruise proposals on the MAR have been ranked high to investigate the heat flux in the Oceanographer FZ area (cruise OCEANOGRAPLU, P.I. F. Lucazeau), to further study the 15°N oceanic core complexes (cruise ODEMAR, P.I. J. Escartin), and to collect and conduct experiments on hydrothermal mussel *Bathymodiolus Azoricus* (cruise BIOBAZ Centrale, P.I. F. Lallier).

In the Pacific Ocean, cruise MESCAL 2 (P.I. N. Lebris & F. Lallier) used R/V *L'Atalante* and deep-sea submersible *Nautile* in March 2012 to complete a series of biological dives on the East Pacific Rise between 9 and 13° N – a former attempt in 2010 had been interrupted for technical reasons.

Cruises FUTUNA 2 and 3 of R/V *L'Atalante* (P.I. Y. Fouquet), in November-December 2011 and May-June 2012 respectively, have been devoted to the exploration of hydrothermalism and mineral resources in the French EEZ of Wallis and Futuna Islands, in the SW Pacific, and supported by the industry. Cruise Futuna 2 was a reconnaissance cruise, whereas cruise Futuna 3 used AUV *Idef-X* and deep sea submersible *Nautile* to further explore potential targets.

In the Indian Ocean, experiment OHASISBIO (P.I. J.Y. Royer) used R/V *Marion Dufresne* from January to March jointly with other experiments to service the hydrophone network moored between Reunion and the French Austral and Antarctic Territories and listening for earthquakes on the Indian Ridges and in the Central Indian deformation zone, as well as for sea mammal vocalizations.

Later this year, cruise RHUM-RUM (P.I. G. Barruol and K. Sigloch), a French- German experiment scheduled in September and October 2012 on R/V *Marion Dufresne*, will drop about 55 OBSs between Madagascar, the Southwest Indian Ridge (SWIR), and the Central Indian Ridge (CIR), in an effort to image the mantle beneath the Reunion hotspot and the ridge-hotspot interaction between La Réunion and the CIR under the Rodrigues Ridge area.

A cruise proposal (Cruise SISMOSMOOTH, P.I. M. Cannat) has been ranked high to investigate seismically the structure of the SWIR and ultraslow accretion processes.

Cruises

Completed in the end of 2011 and beginning of 2012

FUTUNA 2: L'Atalante 4/11-14/12/2011 Apia - Suva

MESCAL 2:	L'Atalante	11-26/03/2012,	Manzanillo - Manzanillo
OHASISBIO	Marion Dufresne	20/01-12/03/2012,	Réunion - Réunion
FUTUNA 3:	L'Atalante	16/05-23/06/2012,	Suva – Nouméa
Scheduled for 2012 and early 2013			
MOMAR 2012	Thalassa	12-25/07/2012,	Ponta Delgada – Ponta Delgada
HYDROBSMOMAR	Thalassa	31/07-13/08/2012,	Ponta Delgada – Las Palma
RHUM/RUM	Marion Dufresne	21/09-26/10/2012,	Réunion - Réunion
COLMEIA	L'Atalante	January 2013	St Peter – Paul, Equatorial Atlantic

Germany National Update 2012:

Report by C. Devey; presented by S. Petersen.

Germany still has no centrally-organized ridge program since the SPP1144 ended in 2009, nevertheless there is significant ridge-related research occurring and planned in the near future. Cruises with a spreading axis focus have been carried out in the Red Sea (as part of the Jeddah Transect project together with the King Abdulaziz University in Jeddah, see <http://www.jeddah-transect.org>) this year and are planned for the Northern Kolbeinsey Ridge (RV *Poseidon* cruise 436, July 2012) and again the Red Sea (RV *Poseidon* cruise 442, November 2012). In the summer of 2011, the BMBF-funded cruise "BAMBUS" on the RV *Sonne* with the ROV *MARUM-Quest* studied numerous vents in the Manus Basin back-arc system with a focus on geochemical and biological processes. At the end of 2011, a joint cruise from Geomar, the University of Hawaii and Nautilus Minerals explored the bathymetry and hydrothermalism of the Northern Lau back-arc system. German researchers from University Bremen/MARUM are involved in hydrological-microbiological-geochemical observatory studies in a young ridge flank off the Mid-Atlantic ridge ("North Pond" 22.45°N, 46°05'W, see also IODP Leg 356) with RV *Merian* cruises in 2012 and probably early 2014.

German ridge research in the polar regions will start taking shape beginning in 2012 thanks to the Alfred-Wegener-Institute for Polar and Marine Research (AWI) funding of several cruises with the RV *Polarstern*: a) Vera Schindwein from AWI will lead two cruises to the ultra-slow spreading Southwest Indian Ridge in Dec 2012 and Dec 2013, b) Gerhard Bohrmann from MARUM will head a cruise to the Sandwich Plate in March 2013, and c) Antje Boetius (AWI and MPI-Bremen) will head the AURORA cruise to 83°N on the Gakkel Ridge in June 2014 using a new hybrid ROV/AUV system developed by WHOI for under-ice diving in a collaboration with Chris German from WHOI.

And many plans are afoot to continue and expand German ridge-related research. An international workshop held in Kiel in April 2012 looked at the science drivers for a return to the TAG area and generated significant interest in a multi-year, multi-national effort to do a segment-scale study. Also in April 2012, a new transatlantic graduate school (Helmholtz School for Ocean System Science and Technology, HOSST: see www.hosst.org), proposed jointly by Geomar and the Halifax Marine Research Institution in Nova Scotia, was funded by the Helmholtz Association. The call for the first 11 PhD positions will be announced in June and will include the possibility of working on the Mid-Atlantic Ridge. And the Universities of Bremen and Kiel have, together with Geomar, taken the first steps towards formulating a proposal to the German Science Foundation for a 12-year special research program on the deep seafloor.

DISCUSSION

SP - It was announced that two days ago, ISA had granted exploration licences to two more countries: France (south of the Russian area 10-12N MAR) and Korea (Carlsberg Ridge).

Japan National Update 2012

Report prepared by Kyoko Okino; presented by H. Kumagai

In reaction to the M9 earthquake on 11 March 2011, a substantial amount of ship time was devoted to monitoring radioactive levels offshore of Fukushima until September, and many urgent studies including aftershock surveys by OBSs, sea-bottom crustal displacement, surface environmental change etc. were carried out in 2011. In this context, some ridge-related studies were forced to change schedule, but we try to continue our efforts to promote ridge-related studies in Japan and to expand our community. The outline of ongoing projects and other activities are described below.

Domestic and International Meetings

An InterRidge-Japan symposium was held on November 1-2, 2011, at the Atmosphere and Ocean Research Institute (AORI), University of Tokyo. About sixty scientists participated in the symposium to share recent research activities. The second day of the symposium was dedicated to reviewing the Japanese ridge studies in this decade, and we discussed our scientific goals and strategies for the InterRidge third decade. We will also have a business meeting on May 22, 2012, at the Japan Geoscience Union Meeting, where we will share information on budget, cruise, workshops and international affairs, and discuss the InterRidge-Japan annual activity plan.

We hosted the international workshop on ‘Ocean Mantle Dynamics: From Spreading Center to Subduction Zones’ led by the IR Mantle Imaging WG, October 4-6, 2011. 77 scientists from six different countries gathered at AORI to discuss recent developments in the study of the dynamics of the oceanic lithosphere, melt production at oceanic spreading centers and islands arcs, and associated topics. The meeting was supported by several organizations, including the Japanese TAIGA project, the US Geoprisms program, AORI and the Ocean Alliance of the University of Tokyo, as well as InterRidge. The meeting was preceded by a field trip to the Horoman Peridotite Complex in Hokkaido led by Eiichi Takazawa from Niigata University. The field trip party visited several outcrops of fresh lherzolite, harzburgite and dunite along the Horoman River uplifted and exposed by thrust faulting. The field trip party also had several presentations on the petrology and seismic imaging of the Horoman complex. The first day of the scientific meeting focused on the structure of the oceanic lithosphere and asthenosphere, with an emphasis on results of recent imaging studies and laboratory experiments. The second day’s topic was melt migration beneath spreading centers and the formation of oceanic crust. The third day reviewed geochemical and experimental evidence for the transport mechanism and distribution of water in arc/backarc systems. Twenty six poster presentations, many of them from students and younger scientists, were a key part of the meeting, and they provoked a lot of good discussions at the poster time. InterRidge sponsored two awards for the best student poster presentations. Shusaku Yamazaki from Niigata University and Akiko Takeo from the Earthquake Research Institute of Tokyo University won the awards. The entire meeting program, including abstracts is available at: http://ofgs.aori.u-tokyo.ac.jp/intridgej/WS_2011/.

Project "TAIGA" is in the final phase

The interdisciplinary research project TAIGA, Trans-crustal Advection and In-situ biogeochemical processes of Global sub-seafloor Aquifer, was launched in 2008. The project is funded by MEXT (Ministry of Education, Culture, Sports

Science and Technology) from FY2008 to FY2012 and now we approach its final phase. As we introduced in the last IR news, we focus on subseafloor fluid advection which carries huge heat and chemical fluxes from the interior of the earth and supports growth of biosphere (beneath and on the seafloor). Three integrated study sites have been selected: the southern Mariana Trough as TAIGA of sulfur, the Indian Triple Junction as TAIGA of hydrogen, and the Okinawa Trough as TAIGA of methane. More than fifty scientists joined the project, and many seagoing studies are planned, mainly in the integrated study sites. Further information can be obtained at the project website (<http://www-gbs.eps.s.u-tokyo.ac.jp/~taiga/en/index.html>). The latest results will be presented in a special session at the AGU Fall meeting, “Deep sub seafloor biosphere” chaired by Ishibashi, Takai, Urabe and Edwards. The session will be arranged with another InterRidge session.

Cruises in FY2011

Although our cruise plan was changed by the emergency cruise due to the earthquake, we had 7 short cruises in the hydrothermal areas in the Okinawa Trough and 3 short cruises in Izu-Ogasawara-Mariana arc in FY2011. Post drilling surveys at Iheya North field using ROV, surface drilling cruise by BMS, acoustic survey by AUVs, and a wide area survey by ROV were conducted in the Okinawa Trough.

Cruises in FY2012

In reaction to the M9 earthquake, the R/V *Yokosuka* cruise in the Indian Triple Junction scheduled in 2011 was postponed to January-March 2013. Twenty dives of *Shinkai 6500* are planned to clarify the characteristics of geology, geochemistry and ecosystem around the hydrogen-rich Kairei hydrothermal site and two newly discovered hydrothermal sites in the Central Indian Ridge Segment 15/16 (Nakamura et al., PLoS ONE, 2012). We also plan to conduct the crust and upper mantle imaging around the triple junction by OBSs and OBEMs. This cruise is dedicated to the memory of Prof. Kensaku Tamaki, the former IR chair, and his pioneering works in Indian Ridge system. Several short cruises in the hydrothermal areas in the Okinawa Trough and the Mariana Trough backarc spreading centers will also be scheduled.

DISCUSSION

HK informed the StComm of likely problems in paying InterRidge’s Principal Member subscription in 2013, due to the ending of the TAIGA programme. The half paid by JAMSTEC will be difficult to find as the number of IR scientists in JAMSTEC is decreasing, as there is more interest in back arcs.

HK to rotate off the IR StComm at the end of 2012.

ACTION

DM to contact Nobu Seama, who is trying to coordinate Japan’s programme.

UK National Update 2012

Report by R. Hobbs

Reports of ongoing work for working groups:

Arc-back-arc systems

Large areas of the submarine parts of the active South Sandwich Island arc and its back-arc spreading centre have been mapped using multibeam bathymetry. Maps are being prepared for publication. Geochemical and petrological work is currently concentrating on silicic lavas from seamounts in collaboration with Birkbeck College, London, and on magmatic processes on the extinct West Scotia Ridge, and the early structure of the East Scotia and Central Scotia Seas in collaboration with Cardiff University, the Instituto Geológico y Minero de España and University of Grenada.

Vent Ecology

Investigations of vent biodiversity and ecology in the East Scotia Sea back-arc spreading centre and continuing, funded by the NERC ChEsSO grant (NE/DO1249X/1). The first paper reporting the hydrothermal sites and vent communities has been published (Rogers et al., 2012). They have discovered new hydrothermal vent communities which are probably the first to be found in Antarctic waters. The communities include a new species of crab, barnacles, limpets, snails, sea anemones, and a predatory seven armed starfish. They claim that this is a new biogeographic province created by the environmental conditions of the Southern Ocean. Tyler (National Oceanography Centre) has another cruise to the sites identified by Rogers et al (2012) at the end of 2012 (JC080). The ROV *Isis* will be used to characterise the chemosynthetic fauna and microbes and the environmental conditions that sustain them at a range of sites of active seafloor fluid-flow and will include: a complete a thorough mapping and documentation at each site; sampling of the of the vent/seep fluids and plume; a microbial and metazoan sampling programme; and fish traps. The material will be used for subsequent lab analyses.

Recently completed cruises:

Rogers (JC066) November 2011. Survey, sample, and identify the benthic fauna of seamounts on the southwest Indian Ridge and map the distribution of species in relation to topography, hydrography, and primary production. It will also assess Benthic Protected Areas (BPAs) recently proposed by the fishing industry for conserving the regional biodiversity of seamount communities. The project represents a major collaboration between U.K. scientists (Institute of Zoology, The Natural History Museum; Scottish Association for Marine Sciences), the Census of Marine Life programme (CoML), the World Conservation Union (IUCN), the UN Food and Agricultural Organisation (FAO) and the fishing industry (Southern Indian Ocean Deepwater Fishers? Association; SIODFA).

Copley (JC067) December 2011. ROV dives at a deep-sea hydrothermal vent field on the Southwest Indian Ridge (SWIR), to test key hypotheses relating to the global biogeography and ecology of chemosynthetic ecosystems.

Henderson (JC068) December 2012/January 2012. Map the concentration of seven critical ocean micronutrients (Fe, Zn, Co, Cd, Ni, Cu, Mn) at high spatial resolution for the full water column on a zonal section across the Atlantic at 40°S, including the mid-ocean ridge. This research includes: determination of the variations in physical and chemical speciation of these micronutrients; sources and fluxes, influences of advection and mixing; and phytoplankton ecosystem structure and functioning.

Leat (JR259) February-March 2012. British Antarctic Survey cruise on RRS James Clark Ross to Scotia and Weddell Seas. Cruise Report: Leat, P.T., Tate, A.J., Buys, G., 2012. Geology and Bathymetry, Scotia and Weddell Seas, RRS James Clark Ross JR259 Cruise Report. British Antarctic Survey Report AD6/3/JR259. Most of the cruise science time was spent in the Weddell Sea, doing multibeam bathymetry in collaboration with biological sampling, but some work was carried out on the West Scotia Ridge, on segment W5, and in the South West Scotia Sea near the East Scotia ridge back-arc spreading centre. Multibeam bathymetry and dredge samples were collected.

Forthcoming cruises:

- Tyler (JC080) end 2012 (see above report on Vent Ecology)
- Copley (JC082) early 2013. We propose to test hypotheses relating to hydrothermal emissions and associated chemosynthetic faunas on the Mid-Cayman Rise. This is the deepest known seafloor spreading centre and is located in a poorly ventilated and geographically isolated deep ocean basin. It specifically targets a region identified as a priority for investigation by the international Census of Marine Life to advance the understanding of global vent biogeography. In addition, its unique samples will provide resources for the wider marine biotechnology and microbial metagenomics research communities.
- Hobbs cruise to Costa Rica Ridge to investigate the effects of hydrothermal circulation on both the geophysics and oceanography in the Panama Basin still awaiting scheduling expected early 2014.

Further details of cruises can be obtained from the UK NERC Marine planning website:

<http://www.noc.soton.ac.uk/nmf/mfp/mfp.php>

Proposals in review:

Searle, Reston and Macleod have a joint proposal under consideration at NERC to do a major geophysical experiment (active and passive seismic + Autosub bathymetry and magnetics) over an ocean detachment fault at MAR 13N.

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DISCUSSION

R/V *Discovery* is afloat in Vigo and will start scientific programmes in 2014.

Undergraduate textbook by R. Searle is likely to be available in 2013.

USA National Update 2012

Report submitted by D. Fornari.

Introduction

The Ridge 2000 Program in the US formally ended in early FY2011. While dedicated funding for R2K science ended in late 2010. The primary goal of the Ridge 2000 Program (R2K) has been to achieve an integrated, holistic understanding of global mid-ocean ridge (MOR) processes. This ongoing work is building on the substantive body of knowledge that has been derived from past and current R2K field, laboratory and modeling efforts. In addition, R2K research and engineering

has played a formative role shaping current Ocean Observing (OOI) science and technology programs and related focused research programs like the Center for Dark Energy Biosphere Investigations (C-DEBI).

Research resulting from R2K studies continues to be published in peer-reviewed journals that will serve as part of the intellectual legacy of R2K. In addition, a special issue of *Oceanography Magazine*, focused on R2K research results was published in March 2012. The full issue and individual articles are available online at:

<http://tos.org/oceanography/archive/25-1.html>.

Achieving outstanding R2K programmatic goals requires data sharing among investigators across disciplinary boundaries and collaborative efforts to find causal linkages and to develop cross-disciplinary models to better understand underlying processes. The MGDS R2K Data Portal has made such data sharing far more efficient and easier for PIs and students. Many R2K PIs have made substantial progress in publishing the results of field studies and making those data sets available for comparative studies across geographic and process-oriented boundaries (e.g., at Integrated Studies Sites (ISS) and elsewhere). All environmental metadata and field data from R2K-funded cruises are archived and discoverable through the R2K Data Portal. The R2K data portal is administered by the Data Management Office (DMO), part of the Marine Geophysical Data System (MGDS) at Lamont-Doherty Earth Observatory (LDEO). See: <http://www.marine-geo.org/portals/ridge2000/> <http://www.marinegeo.org/portals/ridge2000/docs.php#data>

Ridge2000 related US cruises

There is currently no umbrella organization in the U.S. now to coordinate MOR research, but several other programs are ongoing and include field studies at ridges. First, the National Science Foundation's Ocean Observatories Initiative (OOI) is establishing a Regional Scale Node (RSN) at Axial Volcano on the Juan de Fuca Ridge. The UNOLS Office also maintains current and past catalogs of scheduled research cruises for US investigators in all branches of the ocean sciences. http://strs.unols.org/public/Search/diu_all_schedules.aspx?ship_id=0&year=2011

US Support for InterRidge

Funding was secured for US participation in InterRidge during calendar 2012 and our dues have been paid. Future funding is uncertain given the state of US NSF budget levels and expected cuts in NSF-OCE, however, several US investigators are working towards securing continued funding for US participation. Details of those efforts will be communicated to the IR office as they become available.

4.b Associate and Corresponding Members

Canada National Update 2012

Report by K. Juniper.

Photic zone hydrothermalism – in situ photosynthetic and chemosynthetic production has been found in Pacific Ocean volcanic arcs, raising the question of whether there are hybrid photo-chemosynthetic communities. In shallow water (< 200 m) biomass is dominated by background faunas exploiting localized production. In deep seas (>200 m) biomass is dominated by vent obligates hosting chemosynthetic symbionts.

The biological work of V. Tunnicliffe, on species patterns and population connectivity, was outlined. Volcanic arc vent communities have been studied in terms of biogeography, their relationship to back-arc and the effects of host rock and

volatiles, and the community dynamics and composition. Current studies on fish-dominated vents have shown a strong presence of Family Symphuridae in N. Mariana Arc and Tonga-Kermadec, with very high biomass and affiliated with native sulphur. Three new species have been discovered and examined for phylogenetics and population differentiation.

NW Rota Volcano, with on-going eruptions between 2003-11, is an example of a highly unstable habitat. Diffuse venting is highly variable, with frequent habitat collapse. In studying adaptations to this environment, the reproductive and dispersal features of dominant shrimp have been studied, as well as gene flow modeling to determine recruit sources.

In extending the concept of source-sink dynamics to Endeavour, sensitive species have been identified and it has been found that relatively few individuals contribute to the gene pool.

NEPTUNE Canada – cables have been laid to Endeavour and Middle Valley (but no instruments there as yet). Instruments such as seismometers, hydrophones etc are often grouped together on platforms for ease and to supply power. There is also a single instrument platform ODP 880 CSEM. Instruments on the seafloor are linked to a junction box, then node, then shore. There is free and open access to the data. A management plan controls access and intensity of scientific activity. Large samples are not allowed to be collected and only observation is allowed at other sites.

The Endeavour hydrothermal vents are the focus for international collaboration. At 2200-2400 m deep, 12 unique species and 60 native species have been identified. Temperature changes have been detected using water samples, and a tempo mini camera and sensors are allowed 2 hours of lighting per day, either as a block of time or 5 mins per hour. Peter Rona, Rutgers University, has carried out acoustic mapping, leading to an estimation of the total output from the plume and its relationship with tidal currents.

A 4-phase plan to connect Middle Valley has been developed. NEPTUNE Canada has node module components and is interested in connecting boreholes.

The 5th CBE will be hosted in August 2013 in Victoria.

DISCUSSION

KJ invited collaborations to develop and use sensors, and/or to use the data. NEPTUNE Canada would like to encourage independent funding for short term experiments – deployment of instruments, requiring 1 day per year to service which therefore needs to be built into the budget. NEPTUNE can deploy for others but would need funding - ~\$75,000 per day. BM suggested KJ produces a 1-page article for IR News explaining guidelines and workflow.

ACTION

KJ to write article for IR News 2012 (deadline: 1 Sept 2012)

India National Update 2012

K. Raju – report to follow.

Korea National Update 2012

Report submitted by S-H. Park

Korea Ridge related works are as follows:

Korea did three ridge related cruises on the Antarctic, Western Pacific and Indian Ocean.

The good news is that KOPRI is starting a three-year big project on the exploration of Australian-Antarctic Ridge (South of Tasmania).

We are planning two more cruises on the Australian-Antarctic Ridge including AUV survey.

1) Australian-Antarctic Ridge

KOPRI (Korea Polar Research Institute) conducted the research cruise on one segment (KR1) of the Australian-Antarctic Ridge in December 2011.

32 MAPRs and rock cores were done and a hydrothermal vent site was located more precisely. Also a multi-beam map was expanded around the axis.

We tried CTD sampling from a potential vent site and found the signals of methane and ^3He . The next cruise is scheduled in Jan-Feb, 2013 and we will try more CTDs, camera tows and dredges.

2) Central Indian Ridge

KORDI (Korea Ocean Research Institute) has performed an exploration for hydrothermal vents along the northern Central Indian Ridge (CIR), 80-120S in November-December 2011. The exploration was focused on the identification of a location of hydrothermal plumes which were investigated by previous works using CTD Toyo attached with MAPRs.

During the survey, at least 8 hydrothermal plumes were identified along the 7 ridge segments of the northern CIR. Most plume signals were hosted by ultramafic rocks exposed on the seafloor by the formation of Ocean Core Complex (OCC).

3) Tonga Arc

ROV (ROPOS of CSSF) surveys were performed along the hydrothermal vents on the two seamounts of Tonga Arc in January-February 2012. Detailed bathymetric data were obtained by ROV-mounted multibeam survey in the 1st leg. Visual survey and sampling of active and inactive hydrothermal vents were performed in the 2nd leg. During the ROV survey, more than 100 individual hydrothermal vents were observed in the two submarine caldera.

Norway National Update 2012

R. Pedersen – report to follow.

Portugal National Update 2012

Report by P. Ferreira and R. Santos (presented by R. Santos)

From mid-August to mid-October 2012, the Task Group for the Extension of the Continental Shelf (EMEPC) will conduct an oceanographic cruise aboard the Portuguese Navy Vessel NRP *Almirante Gago Coutinho*, to the mid-Atlantic ridge axis and off-axis area located between the Oceanographer and Hayes fracture zones. As in previous missions led by the EMEPC, the cruise will be characterized by a multidisciplinary approach under the scope of the extension of the Portugal's continental shelf program. A team of geology, macro and microbiology, oceanography and geophysics researchers from several national institutes and universities will be on-board to work in-situ with samples and data collected by the *Luso*, a 6000 meter rated ROV.

Three projects began in 2011 funded by the Portuguese National Science Foundation:

1. DEEFFUN - Biodiversity and functioning of the deep-sea hydrothermal field Menez Gwen- a contribution to management policies.

PI Ana Colaço (IMAR-DOP/UAç)

Starting date: 01-04-2011

Duration: 36 months

2. CARCACE - Colonization of mammal carcasses in the deep Atlantic ocean

PI- Ana Hilario- Cesam (IMAR-DOP/UAç partner)

Starting date: 01-06-2010

Duration: 36 months

3. TerRiftic project- unraveling melting processes and volcanism on the Terceira Rift, Azores: A melting inclusion study.

PI- Filipa Marques- CREMINER

Starting date: 01-03-2011

Duration: 36 months

Azores Science Foundation projects:

1. OceanA-Lab- Ocean acidification studies in the Azores: using a shallow-water hydrothermal vent as a natural laboratory

PI- Marina Carreiro e Silva (IMAR-DOP-UAç)

Starting date: 30-03-2012

Duration: 36 months

2. Marine Enzymes from the Azores: Using metagenomics and metatranscriptomics to identify biotechnologically relevant enzymes of marine bacterial origin

PI-Raul Silva Bettencourt (IMAR - DOP/UAç)

Starting date: 30-03-2012

Duration: 24 months

FP7

Hermione - Hotspot Ecosystem Research and Man's Impact On European Seas

PI- Phil Weaver (NOC)

Starting date: 01-04-2009

Duration: 36 months

Details of the Marine Park of the Azores will be given in Agenda item 6.

Missions at Sea:

2011- CARCACE- 25th August - Deployment of a cow carcass at the Condor seamount at 1000 m deep with the RV *Arquipélago*. (PI- Ana Colaço).

2011, 28/06/2011 to 23/07/2011- MoMARSAT2011 with RV *PourquoiPas?* and the ROV *Victor6000* for maintenance and redeployment of the MOMAR observatory. PI Mathilde Cannat.

2012 MoMARSAT cruise - maintenance of the Lucky Strike observatory - PI Mathilde Cannat - July 2012 (R/V *Thalassa* - ROV *Victor*)

2012 DeepFun cruise - habitat mapping, biodiversity and ecosystem function studies at Menez Gwen- July 2012- PI Ana Colaço (R/V *Thalassa* - ROV *Victor*)

Students

Completed:

Daphne Couvelier –Temporal variations of the Mid-Atlantic hydrothermal vent communities from the Lucky Strike vent field (February 2012 UAz).

New:

PhD - Silvia Lino. Bioprospecting deep-sea marine animal fatty acids from the Azores for possible therapeutic applications. (Promotors A Colaço & RSS).

PhD - Inês Barros. Immune response molecular mechanisms from the vent mussel, *Bathymodiolus azoricus*. (Promotors R Bettencourt & RSS).

PhD - Eva Martins. Adaptation mechanisms from the vent mussel *Bathymodiolus azoricus*, from genes to proteins. (Promotors R Bettencourt & RSS).

Post-Doc - Nélia Mestre. Deep-sea invertebrates' response to climate change (Promotor A Colaço)

Post-Doc - Inês Martins. Life in extreme environments: looking beyond the mussel *Bathymodiolus azoricus* physiological reactions to understand adaptations and survival strategies at deep-sea hydrothermal vent sites. (Promotor R Bettencourt).

InterRidge post-doc: Doutora Baby Divya - Bacteria gene expression in the vent mussel *Bathymodiolus azoricus* gill tissues. (Promotor R. Bettencourt).

Submission for PhD and Post-Doc InterRidge fellowships. Submitted by Ana Colaço & Inês Martins

DISCUSSION

JE described instruments and experiments associated with MoMARSAT in 2007, 2008 and 2013. ESONET ended 2011. EMSO is part of a European strategy of a network of seafloor observatories, with infrastructure to support interdisciplinary fields. It is funded by the EU and other countries.

Russia National Update 2012

Report by Sergei Silantyev

The following events have occurred during the first 5 months of 2012 within the scope of current activity of the Russian scientific community related to investigations of mid-oceanic ridges:

- Regular expedition of Russian RV “*Professor Logachev*” (Ship Owner - Polar Marine Geological Expedition, PMGE) to the Central Atlantic is beginning. The main goal of the expedition is the exploration of polymetallic sulfides ore deposits at the MAR crest zone. This cruise will carry out geophysical prospecting and sampling within the bounds of exploration provided by the Russian application for the prospecting of polymetallic sulfides by the Russian Federation claimed on the Seventeenth Session of the International Seabed Authority (11 – 22 July 2011, Kingston, Jamaica). The Russian

prospecting area is located at the axial part of the Mid-Atlantic Ridge between 12°48'-20°55' N and includes 100 separate blocks (100 km² for each). The operations of the current cruise will be focused at the most northern part of the Russian prospecting area: in Rift Valley between 20°00'-20°55' N. The following investigations are scheduled during the cruise: hydrophysical profiling; electrical exploration for prospecting of ore edifices; dredging and coring. Detailed surveying will be made if new areas with evidences of ore deposits are recognised.

- Russian Ridge website was prepared during the last few months. This website consists of different informative blocks: News - information on current RR/IR activities; Publications - all RR workshops Abstract Volumes/Papers (under construction); Information on RR Meetings; List of members; Photographs. This website will be finalized over the next few months. RR website will be presented at the Steering Committee meeting at St. Petersburg, 2-3 June, 2012. The address is: <http://russianridge.ihed.ras.ru>

DISCUSSION

BM asked how new work relates to the exploration of SMS.

SS replied that Russia has RV *Logachev* and four other ships. Six months per year are spent in the exploration area and this may be increased for *Logachev*.

4.c Status of potential membership upgrades / additions

The revised table of national memberships is posted at:

http://www.interridge.org/files/interridge/IR_member_nations_table_2012.pdf

Since the 2011 StCOM meeting, the InterRidge Office has been working with Australia, Canada, Portugal and Russia to encourage them to become either Principal or Associate Members. Portugal has renewed its Associate membership and Canada has also confirmed membership for 2012. Negotiations are continuing with other nations.

5 Current working groups – Updates

In 2012, there are 6 active IR working groups.

5.a Arc-backarc Systems

Chair: Maria Seton (USYD, Australia)

Co-chair: Cornel de Ronde (GNS Science, New Zealand)

Members: Richard Wysoczanski (NIWA/U. Victoria), Richard Arculus (ANU, Australia), Michael Gurnis (Caltech, USA), Jo Whittaker (USYD, Australia), Dietmar Müller (USYD, Australia), Colin Macpherson (Durham, UK), Erin Todd (Munster, Germany), Jim Gill (UCSC, USA), Sven Petersen (GEOMAR, Germany), Jonny Wu (NUT, Taiwan), Yoshihiko Tamura (JAMSTEC, Japan), Hiromi Watanabe (JAMSTEC, Japan), Jonathan Aitchison (USYD, Australia), Martin Patriat (Ifremer, France)

Activities:

- The working group was approved in January, 2012.

- An initial working group planning meeting is scheduled during the International Geological Congress (IGC) meeting in Brisbane (6-10 August, 2012).
- Members are involved in convening themes/symposia at the IGC 2012:
 - Theme: Mineral Deposits and Ore Forming Processes (Large, de Ronde)
 - Symposium: Volcanic and basin-hosted ores (Fe, Zn-Pb, Cu, U) (Gemmell, de Ronde, Bull, Leach)
 - Symposium: Marine minerals in Oceania (Cronan, de Ronde, Exon)
 - Symposium: Subduction zone magmatism including a special session on magmatism in the SW Pacific (Wysoczanski, Handler, Wilson)
 - Symposium: Plate tectonics, plate-mantle coupling and associated deformation (Seton, Iaffaldano)
 - Theme: A Dynamic Earth (Müller)
 - Symposium: Linking deep earth to plate tectonic and surface processes (Müller, Gurnis, Zhao)
- Members are involved in convening a session at the AGU 2012 Fall Meeting on “The Dynamics of Island Arcs and Backarc Spreading Centers” (Wiens, Seama, Stern, Seton).
- Members are involved in organising the SW Pacific IODP workshop to be held at the University of Sydney (9-11 October, 2012). The workshop aims to bring together ~70 scientists actively involved in research in the SW Pacific for the purpose of planning an IODP submission. The workshop is being organized by Exon, Seton, Gallagher and funded through the IODP-MI, Ocean Leadership and ANZIC. InterRidge working group members will be encouraged to attend the workshop.
- Members were involved in organizing a workshop on “Mariana Vent Larvae (MarVeL)” to discuss studies of connectivity between deep-sea hydrothermal vents, which was held in Okinawa, Japan between 10-11 May, 2012. The workshop was organized by Beaulieu, Mitarai, Watanabe and funded by the NSF and OIST.
- University of Sydney is hosting a workshop between 7-8 June, 2012 on “plate configurations in SE Asia based on evidence from the deep earth” organized by Müller, Suppe, Wu.
- Established joint supervision of an honours project between GNS (de Ronde) and the University of Sydney on arc volcanism in the Kermadec region.
- Website is currently under construction as a portal for more detailed information about the working group. A link will be made available from the InterRidge website.

5.b Hydrothermal Energy and Ocean Carbon Cycles

Co-Chairs - Nadine Le Bris (IFREMER, France), Christopher R. German (WHOI, USA)

Group Members - Wolfgang Bach (Univ. Bremen, Germany); Loka Bharathi (National Institute of Oceanography, India); Nicole Dubilier (Max Planck Institute Marine Microbiology, Germany); Katrina Edwards (Univ. Southern California, USA); Françoise Gaill (CNRS, Paris, France); Toshi Gamo (Univ. Tokyo, Japan); Peter Girguis (Harvard Univ., USA); Xiqiu Han (Second Institute of Oceanography, SOA, China); Julie Huber (Marine Biological Laboratory, Woods Hole, USA); Louis Legendre (LOV-UPMC, Villefranche, France); George W. Luther III (University of Delaware, USA); William E. Seyfried Jr. (Univ. Minnesota, USA); Stefan Sievert (WHOI, USA); Ken Takai (JAMSTEC, Japan); Andreas Thurnherr (Columbia Univ., USA); Margaret K. Tivey (WHOI, USA).

Hangzhou meeting. The second WG group meeting was held in Hangzhou, China on 10-11/10/11. It was hosted by the 2nd Institute of Oceanography. Xiqiu Han, also a member of the WG has been a greatly appreciated local organizer. The visit included additional exchanges with colleagues and seminars for students for several meeting attendees. The group of

attendees involved Loka Barati (India), T. Gamo (Japan), Chris German (US), G. W. Luther (US), X. Han (China), N. Le Bris (France) and L. Legendre (France), Sylvia Sander (NZ), and Stefan Sievert (US).

The first objective of the meeting was to initiate the discussion on the two review papers, that aim at synthesizing knowledge on : 1) seafloor and subseafloor carbon fixation processes and transfer in the ecosystem, 2) subseafloor to upper ocean impact on ocean carbon budgets. The second objective was to discuss the synthesis of this information into a conceptual model allowing us to address the role of ridge hydrothermal systems on the ocean C biogeochemistry on a more quantitative basis). Discussion on the modelling approach was led by L. Legendre on the second day. The two subgroups set the frame for a conceptual basis to these approaches.

Modelling. The first subgroup addressed the productivity of vent ecosystems, from the perspective of estimating the amount of carbon that is fixed chemosynthetically and can be transferred to consumers or to the water column. The second subgroup considered the potential role that hydrothermal systems may play in regulating global scale carbon budgets and related biogeochemical cycles (notably for the micro-nutrient Fe) in the deep ocean. The building of the two conceptual models has already generated interesting discussions on the priorities and necessary degree of simplification of the first models.

Following the Hangzhou meeting, the two sub-groups have been focusing upon formalizing the model approach guided by L. Legendre. A preliminary version of the water column model was completed by early 2012 and a revised version of the modelling is now being undertaken. A similar approach has been drafted for the seafloor ecosystem model and is being refined. As done for the water column model, the need is on constraining the unknowns for such complex systems that involve a variety of chemoautotrophic pathways and related abiotic conditions/ energy sources. Further plans will be to circulate draft paper versions to the whole WG, to allow integration of contributions from WG members not attending the workshop.

International workshop. Multiple options to coordinate a workshop in late Summer 2012 have been explored but proved impossible in terms of availabilities of suitable venues in Europe at dates that did not already clash with the organisers' own schedules and/or other IR-related events. Late 2012 is now being considered for the organization of this event, with a possibility of further postponing to early 2013 if not successful.

5.c Mantle Imaging

Chair - Nobukazu Seama (Japan)

Group Members (China, France, USA) - Douglas A. Wiens, Alan D. Chave, Douglas R. Toomey, Pascal Tarits, Wayne C. Crawford, John Chen.

We have decided on the closure of the Mantle Imaging WG, because the major role of the WG is over; we held the WG meeting (Workshop on Ocean Mantle Dynamics: From Spreading Center to Subduction Zone) last year in 2011, following a WG session in EGU 2010 (Two-phase dynamics of mid-ocean ridges and other systems: theory and observation), and I do not think we can do anything more. On the other hand, "mantle" is one of key words for ridge

researches as described in the plan for the third decade of InterRidge. Thus, we recommend that the "mantle" WG be renewed with new members with a variety of specialisms, which will be in line with the new IR plan.

Finally, I would like to express my gratitude to all the WG group members especially for the efforts in holding the workshop last year.

ACTION

BM thanked Nobi Seama and WG members for their work and it was agreed that this WG should disband. The mantle is a key element of the Third Decadal Plan and a new WG is expected to develop in the future.

5.d Oceanic Detachment Faults

Co-chairs: J. Pablo Canales (WHOI, USA) and Javier Escartin (CNRS-IPG Paris, France)

Members: Gretchen Früh-Green (ETH, Switzerland), Nick Hayman (Univ. of Texas, USA), Barbara John (Univ. of Wyoming, USA), Andrew McCaig (Univ. of Leeds, UK), Kyoko Okino (ORI, Japan), Timothy Reston (Univ. of Birmingham, UK), Deborah Smith (WHOI, USA), Zhen Sun (S. China Sea Inst. Oceanol., China)

The InterRidge Oceanic Detachments WG was put in place in January 2012, following the results and recommendations of the 2010 AGU Chapman Conference on "Detachments in the Oceanic Lithosphere":

(<http://www.ipgp.fr/rech/lgm/je/Chapman2010>)

The aim of this group is to foster research and collaborations within the community to advance the understanding of the processes that control oceanic detachment faulting and associated geological, chemical and biological phenomena.

On-going activities of the WG are:

- Special "Theme on oceanic detachments in AGU G-cubed electronic journal: Set up in November 2010, and to date, this Theme has collected 17 articles. The WG will discuss with AGU about maintaining the Theme open until 2014 (confirmed in June 2012 that it will be renewed for 12 months) and encourages the submission of relevant articles by the community.
- Dec. 2012 Meeting at AGU among the Members to establish a 2-year roadmap of WG activities.
- Convene a thematic session at the 2013 AGU Fall Meeting (session proposal probably due in April 2013) and EGU Spring 2015.
- Organize a 2-3 day InterRidge Theoretical Institute on a specific topic related to oceanic detachment faulting (e.g. mechanics of detachment faults). Tentative dates: Spring or Fall 2014.
- Organize an IODP-detachment related workshop in 2013 or 2014.

The WG will actively share information regarding on-going projects and planned cruises to facilitate exchanges in the community.

Relevant cruises:

R/V Knorr (NSF) – ends 12 June 2012

Atlantis ODP drilling

Rainbow microseismicity (NSF) 2013

16°N area (NSF) 2013

13°N area (UK) Autumn 2013?

TAG (Germany) 2013?

The future prospects are:

1. An active community committed to on-going research (demonstrated by G3 Theme), with 17 papers on-line, 4 in the pipeline, 8 submissions in 2012): tectonics, magmatism, hydrothermal activity, biology, etc.
2. Healthy program of cruises ahead (potentially up to 7 cruises, including a drilling project, in the next 24 months) with possibilities for training and exchanges.
3. Expected evolution of the field on a yearly basis, justifying meetings and special sessions every 24 months, in addition to regular meetings and sessions (of a more general character).

DISCUSSION

BM encouraged JE to plan meetings well ahead and to use the bursary scheme.

5.e Seafloor Mineralisation

Chair - Maurice Tivey (USA)

Group Members - Fernando Barriga (Portugal), Georgy Cherkashov (Russia), Yves Fouquet (France), Mark Hannington (Canada), Yasuhiro Kato (Japan), Jonguk Kim (Korea), Lisa Levin (USA), Rachel Mills (UK), K. A. Kamesh Raju (India), Xuefa Shi (China), Ingunn Thorseth (Norway), and Cindy Van Dover (USA).

Report presented by Sven Petersen.

The Seafloor Mineralization Working Group was renewed for a second term at the last InterRidge meeting in San Francisco in December 2011. Interest in the mineralization resources at mid-ocean ridges has continued unabated with the price of metals such as copper, gold and silver near historic highs and nations beginning to look at options for exploration of seafloor areas for polymetallic sulfide resources in “the area” under the regulations of the International Seabed Authority (ISA). Last year, the ISA approved license plans for China Ocean Minerals Resources Research and Development Association (COMRA) for work in the Indian Ocean. It is expected that the ISA will approve plans submitted by the Ministry of Natural Resources and the Environment of the Russian Federation for work on the central Mid-Atlantic Ridge (Logatchev region) at the upcoming ISA meeting in July. Other countries are actively considering submitting license requests before the end of the year.

In April, several members of the SMWG (Cherkashov, Hannington, Petersen, Tivey) attended a workshop hosted by GEOMAR in Kiel, Germany to discuss initiating a program for studying “the metal potential of a slow spreading ridge segment,” which will attempt to address some of the original topics of the working group including the spatial controls and timescales of evolution of seafloor metallic sulfide deposits.

In other related news the US National Science Foundation officially closed down the RIDGE2000 program, which had focused research efforts to study mid-ocean ridge processes including hydrothermal systems and their mineral resources. Future research funding in these areas is expected to be directed through the core science budget of the various sections of the Ocean Sciences (OCE) division. To close out the program, the RIDGE2000 office organized a special issue of Oceanography magazine on oceanic spreading center processes (<http://tos.org/oceanography/archive/25-1.html>) that compiles results of several major RIDGE2000 efforts.

Finally, a special session at Ocean Sciences in Salt Lake City (Feb 19-24, 2012) was convened on “Deep-Sea Conservation Imperatives in the 21st Century” chaired by Lisa Levin, Cindy Van Dover, Jeff Ardron and Craig Smith.

DISCUSSION

SP presented a discussion on “Budgeting SMS potential at slow-spreading ridges”. Hannington et al. (2011) in *Geology* estimate the total accumulation to be 6×10^8 tonnes, a figure based on existing knowledge of active sites. Four countries – China, Russia, Korea and France – now have exploration licences, so the WG should continue. Regional high-resolution geological and geophysical survey is necessary and there is now the technology to do so. SP outlined 6 questions:

- What is the metal flux of hydrothermal systems at a segment scale and how does it vary on geological time scales?
- How much of this metal is deposited as massive sulfides rather than as a dispersed anomaly in the regional sediments?
- What is the distribution between active and inactive deposits?
- What is the 3D seafloor pattern of fluid flow on a segment scale and how does it effect localization and mass distribution of hydrothermal deposits?
- What are the regional and local spatial controls on hydrothermal activity?
- What are the time scales for the evolution of hydrothermal systems?

SP pointed out that no systematic regional surveys have been done to establish SMS at segment scale. What is needed is AUV survey with multiple AUVs with high resolution sidescan sonar imagery. For example, in searching for the lost AF plane, 2675 km² were covered in 25 days (109 km² per day).

The project area TAG is suitable because:

- Much information is available
- Can test if AUV technology can detect buried deposits
- 20 km sections at a time
- 99% not visited

At Kiel, the aim is to develop 3D information on TAG 10x50x20 km – possible within 9-12 years. It requires much detailed imagery. Estimates need depth information – drilling, geophysical information (CSEM, sub-bottom profiling).

Mining is not necessarily favoured. Media are exaggerating the amounts, but knowledge is uncertain (thought to be towards the lower end of the stated amounts).

SS - Can % active/inactive sites be estimated?

SP – At TAG, 4 M tonnes with 3 inactive sites. All mounds close to TAG have oxidation evidence so there is imagery for past hydrothermal activity.

BM suggested that this could be a project to pull InterRidge together.

SP agreed.

Following discussion about AUV availability, BM asked if there was a need for a technology Working Group. SP supported a workshop, possibly March 2013. KJ suggested contacting ISA for funding support for the workshop.

ACTION

DM and BM to work on the possibility of a technology workshop for segment scale study, including ISA contact.

5.f SMART (South Mid Atlantic Ridge Targeted Exploration)

Chair: Colin Devey (IFM-GEOMAR)

Group members: Chris German (WHOI, USA), Sidney Mello (Univ. Federal Fluminense, Brazil), Lucia Campos (Univ. Federal do Rio de Janeiro, Brazil), Anton le Roex (Univ. Cape Town, South Africa), Cindy Van Dover (Duke University, USA), Gwyn Griffiths (NOC, Southampton, UK), Koichi Nakamura (AIST, Japan), Shinsuke Kawagucci (JAMSTEC, Japan), Jiabiao Li (2nd Inst. of Oceanog., China), Marcia Maia (Univ. Brest, France), Andrey Gebruk (Moscow, Russia) Nicole Dubilier (Max-Planck Inst., Bremen, Germany)

Report to follow.

5.g Vent Ecology

Co-Chairs: Stephane Hourdez (France) and Yoshihiro Fujiwara

Group Members (Austria, Canada, China, Germany, Japan, Korea, Portugal, Russia, UK, USA) - Maria Baker, Monika Bright, Ana Colaço, Nicole Dubilier, Sergey Galkin, Peter Girguis, Jung-Ho Hyun, Crispin Little, Anna Metaxas, Katsu Fujikura, Xiang Xiao.

Deep-sea Mining

The pilot Solwara 1 project could start operations in 2012. The vent biology community closely watches this world-first and worries about the consequences. Helen Rosenbaum wrote a very nice and comprehensive report on the subject, including economics and biology. This report can be downloaded from <http://stoplynas.org/wp-content/uploads/2011/11/Out-Of-Our-Depth.pdf>

And more generally about mining the ocean floor in the Pacific <http://www.deepseaminingoutofourdepth.org/>

High-throughput

The high-throughput page has nicely grown over the years. To have a look at the list of projects, go to <http://www.interridge.org/highthroughput>, and if you would like to add to the list, go to <http://www.interridge.org/node/add/highthroughput>.

Meetings

The CAREX Conference on Life in Extreme Environments, was held in Dublin, Ireland October 18-20 2011. It was an important event on the European and international scenes providing the opportunity to discuss and present the state of the art and the latest developments on research on life in extreme environments, and vent biology plays an important role in CAREX. For more details, see <http://www.carex-eu.org/activities/carex-conference-on-life-in-extreme-environments.html>

The 13th International Deep-Sea Biology Symposium will be held in Wellington, New Zealand 3-7 December 2012. Held every 3 years, this general deep-sea meeting includes presentations on hydrothermal vents. Registration opened February 1st and will close July 1st, 2012. For more details, see <http://www.confer.co.nz/dsbs2012/>

The 5th International Symposium on Chemosynthesis-Based Ecosystems will be held in Victoria, BC Canada August 18-23, 2013. Initially Hydrothermal Vent Biology Symposium, the scope has expanded to all chemosynthesis-based ecosystems to now include cold seeps, whale falls, sunken wood, and sulfidic caves. This meeting, held every 4 years, is the main focused symposium for the vent biology community. Registration is expected to begin November 2012. For more details, see <http://www.neptunecanada.ca/cbe5/>

Books

Elanor Bell (editor) and part of the CAREX community produced a book entitled “Life at Extremes: Environments, organisms and strategies for survival” that came out in March 2012 (CABI publishing ISBN-13: 978 1 84593 814 7). This book offers a transversal view of various extreme environments, including hydrothermal vents.

DISCUSSION

There was discussion about the focus of this WG.

KJ explained that the Biology WG disbanded in 2007 as it was too broad, and that only deep-sea mining is relevant to the Vent Ecology WG. There are opportunities with Nautilus to coordinate an international experiment to look at sites before and after mining.

JC suggested either forming a Ventsbase WG or adding this focus to the current WG.

BM pointed out the high societal relevance to IR science and that Nautilus wants scientists to help develop best practice. RS referred to the Dinard meeting in 2010 as an example where studies of pure ecology were very important, and this is acceptable for a WG. In the EEZ, environmental impact controls are very stringent and the same rules will eventually apply to the Area. Vent Ecology WG is a fundamental group to be called on for deep-sea mining issues. Inactive sites are unknown, but unique.

ACTION

BM - IR should look to be involved further with Nautilus in the international experiment.

KF – to ask WG to develop 2-3 high priority questions on which to focus the WG.

5.h Discussion of Working Groups – continuation and new WG

Discussion to be led by B. Murton.

New Working Group proposal

“Proposal for IR Working Group on Circum-Antarctic Ridges”; see Appendix III, pg 37.

BM explained that the regional focus of this WG was acceptable due to the logistical challenges, and then invited comments.

RH noted the diversity of ridge segments and that all IR activity is contained within this single WG.

KJ asked if there was a rationale for specific geographical entities. Is it different to the SWIR?

BM recognized that there is regional-specific science, and IR can help with the coordination.

HK said that the CAR WG was justified at the Toulouse workshop, Sept 2011.

There was discussion about databases and wikis, and where data will be stored. This will be addressed by the WG.

ACTION

DM to contact conveners. WG should:

- Produce a clearer prioritisation e.g. a timeline of activities and cruises
- Produce a list of ways in which topics and objectives are shared across the cruises
- List the objectives of all cruises
- Consider the InterRidge cruise bursary scheme for international collaborations.

6 Marine Protected Areas along the MAR

Presentation by Ricardo Santos.

RS concentrated on the OSPAR region, mean depth 2200m. Many seamounts exist off the Azores.

OSPAR Convention is a group of nations interested in caring for the environment of the Atlantic, in terms of habitat, biodiversity and pollution. In 2004 a set of priority habitats was listed, including deep-sea habitats (one of the first conventions to include this). This led to reports making monitoring of the future of these habitats obligatory.

Seamounts and hydrothermal vents were described, and a timeline of developments:

2000 - a position paper in IR News in 2000 on the need to conserve vent ecosystems.

2002 - Workshop on the Azores Triple Junction

2004 - Common Fisheries Policy - affected deep-sea trawls

2007 - Law Decree No.15/2007/A : Azores Protected Area Network, which integrated terrestrial and marine protected areas. The consequences of this were outlined.

2007 - Azores Scientific Criteria and Guidance were published.

OSPAR Network of MPAs and Proposed large EBSA

2010 - Dinard Report

7 Deep Sea Minerals in the Pacific Islands region

Presentation by Aquila Tawake.

Topics within the presentation were:

- History of Deep Sea Minerals Exploration in the Pacific Region.
- DSM potential in the Pacific Region based on previous studies.
- SPC-EU Deep Sea Minerals Project and Project Activities.
- Recent Exploration Interests and Exploration Tenements by Country.
- Update on Nautilus Minerals Activities.
- Update on KORDI Activities.
- Interests to participate in exploring “the Area”.

Recent exploration for SMS:

- Nautilus – exploration licenses granted in Vanuatu, Fiji, Solwara
- Bluewater Metals – (sub-company of Nautilus) exploring in PNG, Solomon Islands, Vanuatu, Tonga
- KORDI – exploring in Tonga, Fiji. Joint investment companies: Samsung; DSME; LS-Nikko Copper; SK networks.

- Nauru (NORI) and Tonga (TOML) have been granted exploration licences in the Clarion-Clipperton Fracture Zone.

8 Discussion – what is InterRidge’s main challenge in the next decade? What do nations want from InterRidge now that national programmes have ended?

Led by Bramley Murton.

BM – how can IR make a difference? Many nations do ridge science on their own, so science would not stop if IR did not exist. To what extent should IR be about meetings, or supporting active science. The difficulty of funding for some nations must be taken into account.

JE – there has been a big change with the loss of national programmes leading to a loss of focus in the IR community. In France, there is a new funding system of megaprojects with 10-15 parties, which consumes people’s time and efforts and this is bad for the IR community. A few people are working on MoMAR but not the ridge at large.

JC – with the disappearance of national programmes IR is the only organization carrying ridge science. IR’s strength is that it doesn’t depend on one agency.

HK – IR has a role in broader science. The Code of Conduct is valued by administrators in JAMSTEC as an example of self-organisation by scientists. IR-Japan community has a consensus of opinion to continue with IR, but that its style of action should change, such as using new communication tools. This might possibly mean less StComm meetings, and the first meeting of WG members could use these tools and save money. IR should change to a more sustainable structure. The co-ordinator’s role needs re-examining as to which parts to maintain, which to disband and start this discussion now, for the next office in 2016.

JC – there are two issues: science – is there a need to continue the IR programme? (most important); and budgetry (technical).

BM – agreed with HK that IR can fill the vacuum. He would like to see more activity within WGs. One StComm meeting every three years would lose momentum.

JC – it is important to meet and talk.

KJ – three points:

- There is an intellectual vacuum to be filled. IR has been coordinating a programme which generated its own ideas. Third Decadal Plan – too many ideas! Which are practical, which are matched to future funding? Is it time to narrow our scope? We need to get away from a “club” image, otherwise vigour will be lost. What are the societal needs, in terms of practical and pure science? The choice will be influenced by where the money is coming from.
- Revenue that keeps IR going is at risk, unless we adapt what we do to better fit the funders e.g. IR has helped bring ISA into the international ridge community by giving good scientific advice.
- NEPTUNE – encourages ridge studies through a cabled observatory. It needs people to use the data – the research does not cost, but it requires coordination.

BM - Code of Conduct and ISA links – should IR do more of this? Can IR develop better-articulated frameworks for how potential impacts can be assessed? This would be outward-facing (Code of Conduct is inward-facing).

KJ – no choice if want to be relevant. Role of IR is to learn more by coordinating science experiments and collaborating with industry. In Canada, there is a strong Arctic programme, with oil exploration in the Beaufort Sea. Companies had no knowledge of an environmental baseline so scientists were employed, who were free to publish results. This was strongly criticized but strong science is needed to minimize impact of resource exploration. Companies don’t have this. It leads to

good science, guidance is based on good science and everyone wins. It's an interesting model. Nautilus Minerals hired Van Dover. Does IR want to do more like this?

JE – There must be clear independence between scientists and companies.

JC – IR is a scientific organization and must maintain this position. We can approach ISA and industry but must stay neutral.

BM – IODP has an industrial liaison panel. If IR is to be relevant beyond its own scientific community, it must have an outward-looking approach, whether or not it takes money from industry. IR has no real influence with industry. If we linked with industry and ISA in a constructive way, they would have ownership of the first produced guidelines.

KJ – it is better for ISA to have sound advice from a group of scientists rather than a hired single scientist.

BM – Nautilus offered money to support ChEssBase last year – now working with INDEEP.

RH – it is the perception that industry is dirty money.

JE – 50% French scientists would not support this way.

RS – IR could invite government stakeholders, NGOs and companies to join scientists in a particular venture.

KJ – WWF established protected areas in open sea, but no direct connection with ridge scientists. IR can offer to them up-to-date understanding.

SP – environmental impact is not in Third Decadal Plan.

RH – IR could build a firewall – a liaison panel with industry, NGOs. If IR does not organize this, companies will find individuals to do the science they want done. IR should be a broker because it is right that people talk to each other.

JE – Other stakeholders would be fine if NGOs are included for balance.

KJ - a liaison group would be 4-5 people, charged to communicate with industry.

SP – need a WG to work on the science of impacts.

RH – WG has a historic connotation, so we should call it something different.

BM – several WGs may have need of liaison. Each WG may have one person on the panel. If there was a WG on technological development, it could engage with technologists.

KJ – Third Decadal Plan has been written in the way science has been done for past 20 years. Science has to change as industry is going to the ridge. IR must supply information to mitigate impact of resource exploration that will happen anyway. In the next 5 years, exploration could become invasive. A liaison panel might have members drawn from across the WGs plus others outside IR.

RH – would a liaison panel have IR financial support if drawn on by industry members? Science and industry can be linked, but must remain autonomous.

RS – carefully written rules are required.

KJ – ISA could be asked for partial support. Panel should produce rules of engagement. IR could operate between two worlds and all recognize the value of the exercise.

RS – it could act like an intercessional group in OSPAR. Its mission statement is to interact with stakeholders.

BM – we should go ahead and formulate a special liaison group.

KJ – IMMS next meeting is Shanghai, Oct 2012. IR could interact directly with mining interests, and meet two days beforehand. Group composition needed before this.

BM – request from each WG Chair one representative from each WG and one from the whole community.

KJ – WGs serve as resources, not necessarily give a member.

BM – IR Office will invite the community to set up liaison panel, wide invitation not restricted to WG or countries. Office should not dictate who are members (7-8 people). We want the community to come forward with the best-placed people. Office will work to get a balance, through consultation.

KJ – at what point do NGOs become included?

BM – no permanent membership for industry and NGOs, but come as invited guests.

BM then introduced the possibility of developing a cross-WG “Grand Challenge” for InterRidge. He asked if there is a role to enthuse the community with a grand challenge, eg. a segment-scale study. It could go beyond the Seafloor Mineralisation WG and include exploitation, ecology, oceanography (buoyancy, mixing). TAG – IR could invite WGs to devise experiments for a spatial study; we have NEPTUNE for time series. Would this help to focus and reinvigorate IR? SP – It would help to get funding for cruises because the science questions will be formed by the whole international community, especially if there is no national programme. It would help with the review process.

RH – how would a segment be chosen?

BM – not trying to reproduce Ridge 2000 – to include each speed will be too big. TAG would be the ideal spatial component.

SP – at a regional scale, it does not matter where.

BM – it has been calculated that to explore a segment would take 42,000 AUV years.

SP – will write a proposal for German R/V 2014 to TAG.

KJ – if the aim is to build a database – a spatial inventory – it could be a 10-year goal, using dedicated and opportunistic cruises.

BM asked if this segment scale “Grand Challenge” is worth exploring.

JE stated that people may be too busy.

JC – all IR can do is promote and encourage; IR has no resources, no ship time.

KJ – does IR have the resources to build a database? The US was unsuccessful at Endeavour because it was multidisciplinary, with unequal funding.

BM envisages a focused area across WGs, with a database.

KJ – it could happen slowly, if community kept informed.

JC suggested it could be done in the background, not upfront.

BM proposed the opposite, on the basis that people can choose not to be involved.

KJ – it could lead to funding opportunities eg. Schmidt Foundation (SP agreed). The Grand Challenge could create opportunities by communicating information to the community at large, rather than trying to direct people to it. IR could act as a catalyst.

SP, KJ, JE discussed possibilities and problems with using Google visualization.

KJ invited everyone to a NEPTUNE coordination workshop, 1 Dec 2012 ahead of AGU.

ACTION

BM – IR Office will develop the idea of a “Grand Challenge” and put together a plan to implement it. IR would host the database.

BM – IR Office will set up a liaison panel to draw up guidelines for SMS mining.

9 Revision / acceptance of Third Decadal Plan 2014-2023

See Appendix IV, pg. 41.

BM introduced this by asking the StComm to consider the value of a 10-year plan.

JC – used Third Decadal Plan (TDP) in a presentation to secure the Chinese office 2013-15.

BM – TDP sets out big questions, but they are not rigidly adhered to.

JC – WGs can be mandated to indicate where they fit in to TDP.

RH – TDP is important for raising awareness of programme managers – it is good publicity. It should be open enough to include new discoveries. TDP is a snapshot of our current priorities.

HK – process is very democratic, but contains unevenness in its current form.

BM asked for a focus on one question in each theme, pointing out that it is not for the Office to write it.

KF – Section F had not been circulated to the Vent Ecology WG.

KJ asked if it was a plan, important questions for the next decade, a vision or a state of the art statement. It was agreed that TDP should be a living document that could be updated by WGs, and should be reviewed by each new office.

JC – IR as a science organisation should have a plan.

ACTION

Vent Ecology given one month to edit Section F.

It was agreed to publish the TDP as a feature article within the IR News 2012.

10 Bid for the next InterRidge Office 2013-15

Presentation by J. Chen and J. Li.

JC outlined new initiatives:

- Implementation of the TDP.
- Promotion of collaborative research at ridges in the Southern Ocean.
- Encourage growth of the IR community – aim to increase core membership with Russia, Brazil and Australia.
- Distinguished lectureship programme, especially in developing countries – Chile, PNG, Fiji

JC outlined the proposed budget.

BM suggested a change to maintain support of the cruise bursaries at the current level.

HK – If Japan and USA cannot pay Principal Member fees in 2013, priorities for spending will have to be made.

AT supported the Distinguished Lecturer programme.

Closed session (JC, JL and XJ left the room).

BM – does there need to be a Plan B, if subscriptions are less in the future?

MS – Japanese Consortium may apply for more funding. Japan can pay \$10,000 if funding closes.

SP suggested the IR office waits until it happens and then deal with the situation, as there are other funding opportunities.

BM = most of IR funds are spent on the Coordinator's salary.

SP – this may open up the Chinese programme for international collaboration.

ACTION

The Chinese bid was accepted unanimously.

BM asked JC to amend the proposed budget, changing “Professional and media outreach” to “Distinguished Lecturer Programme”.

11 Workshops and meetings proposed for 2012-13

Meetings with some funding from InterRidge:

- First meeting of the Arc-Backarc Systems WG, August 2012
- Ridges and hotspots around the Mascarene Islands: present activity, past evolution, 3-7 Sept 2012
- Hydrothermal Energy and Ocean Carbon Cycles: International workshop in Europe, either late 2012 or early 2013
- 13th International Deep-Sea Biology Symposium, Wellington, NZ, 3-7 Dec 2012
- AGU Fall meeting, San Francisco, USA, 3-7 Dec 2012
- 5th International Symposium on Chemosynthesis-Based Ecosystems, 18-23 August 2013

Meetings listed as Upcoming Events on InterRidge website:

- Minerals of the Ocean-6 & Deep-sea Minerals and Mining-3, St Petersburg, 4-8 June 2012
- DEBI RCN Ocean Crust Processes and Consequences for Life, Bremen, Germany, 6-8 June 2012
- Goldschmidt 2012, Montreal, Canada, 24-29 June 2012
- EAS Congress 2012, Changwon City, Korea, 9-13 July 2012
- 34th International Geological Congress, Brisbane, Australia, 5-10 August, 2012
- AOGS – AGU Joint Assembly, Singapore, 13-17 August, 2012
- Rock Deformation Gordon Research Conference, New Hampshire, 19-24 August, 2012
- GEOCEAN Symposium and Summer School, Brest, France, 27-31 August, 2012
- Serpentine Days, Porquerolles Island, France, 2-6 Sept 2012
- ICDP Drilling Project, New York, USA, 13-17 Sept 2012

12 InterRidge Finances

12.a InterRidge Budget 2012

Refer to Appendix II pg. 35-36 for the estimated budget for 2012, together with a summary of the period 2010-12.

12.b. Status of payment of billed nations

Full membership fees were received in 2011 and China, USA and UK have paid for 2012 (as of May 2012). Debbie has sent invoices to all Principal and Associate Members. (Subsequent to this meeting, due to a technical error at NERC, UK, the 2011 Korean subscription was not received; investigations are continuing).

DISCUSSION

BM led a discussion about the rotation of members on the StComm. It was recognised that renewal is good in principle, making it more dynamic. The original terms of reference state 4 years' membership as the recommended length of service, whilst recognizing that some national ridge communities have less personnel to achieve this level of rotation.

ACTION

BM to ask IR StComm to either appoint new members or re-confirm existing members.

DM – send textbooks to A. Tawake.

13 Next StCOM meeting location and date

Recent StCOM meetings: 2011 China, 2010 UK, 2009 France, 2008 USA, 2007 Brazil, 2006 Russia, 2005 Germany, 2004 Korea, 2003 Japan, 2002 Italy, 2001 Japan.

ACTION

The 2013 StComm meeting will be in Victoria, British Columbia, Canada, 16-17 August 2013, by kind invitation of Kim Juniper. This adjoins the 5th CBE Symposium.

14 Meeting Adjourns

BM led thanks to our Russian hosts.

InterRidge Steering Committee Meeting 2012

Appendices

APPENDIX I

InterRidge Chairs and Coordinators – Past and Present

InterRidge Chairs

Bramley Murton (UK)	2010 - 2012
Jon Copley, co-chair (UK)	2010 - 2012
Jian Lin, chair (USA)	2007 - 2009
Chris German, co-chair (USA)	2007 - 2009
Colin Devey (Germany)	2004 - 2006
Kensaku Tamaki (Japan)	2000 - 2003
Mathilde Cannat (France)	1997 - 1999
Roger Searle (UK)	1994 - 1996
John Delaney, co-chair (USA)	1991 - 1993
H. David Needham, co-chair (France)	1991 - 1993

InterRidge Coordinators

Debbie Milton	Jan 2010 – Dec 2012
Stace Beaulieu	Oct. 2007 – Dec 2009
Rhian Waller	Jan. - Oct. 2007
Sabine Lange	July -Dec. 2006
Valérie Epllé	May - July 2006
Kristen Kusek (Education & Outreach)	March 2004 - Dec. 2007
Katja Freitag	March 2004 - May 2006
Agnieszka M. Adamczewska	Nov. 1999 - March 2004
Cara Wilson	March 1997 - Nov. 1999
Ruth Williams (acting)	Oct. 1996 - March 1997
Heather Sloan	Oct. 1993 - Oct. 1996
Trileigh Stroh	1991 - Oct. 1993

InterRidge Steering Committee Members - Past and Present

Canada

Steve Scott	2004 - 2006
S. Kim Juniper	1998 - 2003
	2012 -

China

Jiabiao Li	2008 - present
John Chen	2004 - present

France

Nadine Le Bris	2009 - present
Jérôme Dymont	2001 - present
Françoise Gaill	2004 - 2008
<i>ad hoc</i>	1998 - 2003
Javier Escartin, <i>ad hoc</i>	2002 - 2003
Mathilde Cannat	1997 - 2000
Catherine Mével	1999 - 2003
<i>ad hoc</i>	1997 - 1998
Daniel Desbrières, <i>ad hoc</i>	1997
	1991 - 1996
Jean Francheteau	1991 - 1998
H. David Needham, <i>ad hoc</i>	1995 - 1996
	1991 - 1994

Germany

Nicole Dubilier	2005 - present
Colin Devey	1999 - present
Peter M. Herzig	1996 - 2000
Roland Rihm	1995 - 1998

India

K. A. Kamesh Raju	2005 - present
Abhay V Mudholkar	2002 - 2004
Ranadhir Mukhopadhyay	2000 - 2001

Italy

Enrico Bonatti	1998 - 2002
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Japan

Michinari Sunamura	2009 - present
Hidenori Kumagai	2009 - present
Jun-ichiro Ishibashi	2006 - 2010
Nobukazu Seama	2005 - 2008
Masataka Kinoshita	2002 - 2004
Toshitaka Gamo	2001 - 2004
Kantaro Fujioka	1999 - 2001
Hiromi Fujimoto	1997 - 2000
Tetsuro Urabe	1994 - 1998
Kensaku Tamaki	2000 - 2004
	1992 - 1997

Korea

Sung-Hyun Park	2007 - present
Sang-Mook Lee	2001 - 2006

Norway

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Rolf Pedersen 2001 - present
Eirik Sundvor 1996 - 2000

Portugal

Pedro Ferreira 2009 - present
Fernando Barriga 2001 - 2008
Ricardo Santos, *ad hoc* 2002 - 2003
Miguel Miranda 1996 - 2000

Spain

Rosario Lunar 2005 - 2008
Juan José Dañobeita 1995 - 1998
Miquel Canals 1995 - 1998

UK

Richard Hobbs 2011 - present
Alex Rogers 2007 - 2011
Tim Henstock 2004 - 2011
Paul Dando 1999 - 2006
Damon Teagle 2002 - 2003
Christopher R. German, *ad hoc* 2002
1997 - 2001
Philippe Blondel, *ad hoc* 1997 - 2002
Lindsay Parson, *ad hoc* 1996 - 1998

Roger C. Searle 1994 - 1998
Martin Sinha 1991 - 1996

USA

Daniel Fornari 2009 - present
Jian Lin, chair 2007 - 2009
ad hoc 1999 - 2003
Chris German, co-chair 2007 - 2009
Donna Blackman 2005 - 2008
Charles Fisher 2002 - 2005
Deborah Smith 2003 - 2004
Spahr C. Webb, *ad hoc* 2002 - 2003
Christopher G. Fox, *ad hoc* 1998 - 2001
David Kadko 1999 - 2001
Alan Chave, *ad hoc* 1997 - 2001
Dave Christie 1997 - 2002
Karen Von Damm 1996 - 1998
Lauren Mullineaux, *ad hoc* 1996 - 2000
Robert S. Detrick 1992 - 1995
John Delaney 1991 - 1994
P. Jeff Fox 1991 - 1995
Charles H. Langmuir 1991 - 1996

InterRidge National Correspondents - current

Principal Members:

China – J. Chen (2004 - confirmed in 2008)
France – Jérôme Dymont (2004 - confirmed in 2008)
Germany - Colin Devey (1998 - confirmed in 2008)
Japan – Kyoko Okino (2005 - confirmed in 2008)
UK – Richard Hobbs (2011 -)
USA – Dan Fornari (2009 -)

Associate Members:

Canada – Kim Juniper (2012 -)
India – K. A. Kamesh Raju (2002 - confirmed in 2008)
Korea – Sung-Hyun Park (2007 - confirmed in 2008)
Norway - Rolf Pedersen (2001 - confirmed in 2008)
Portugal - Pedro Ferreira (2009 -)

Corresponding Members:

Australia – Jo Whittaker (2010 -)
Austria - Monika Bright (2001 - replied to email 2009)
Brazil - Suzanna Sichel (1997 - confirmed in 2008)
Bulgaria – Vesselin Dekov (2009 -)
Chile – Juan Diaz-Naveas and Luis Lara (2007 - confirmed in 2008)
Chinese Taipei – Saulwood Lin (2008 -)
Denmark – NO correspondent
Iceland - Karl Grönvold (1992 - NOT confirmed in 2008)
Italy – Paola Tartarotti (1997 - confirmed in 2006)
Mauritius - Daniel P. E. Marie (2002 - NOT confirmed in 2008)
Mexico – Alfredo Aguillon-Robles (2011 -)
Morocco - Jamal Auajjar (1998 - confirmed in 2006)
New Zealand – Richard Wysoczanski (2010 -)
Philippines - Graciano P. Yumul, Jr. (2000 - confirmed in 2008)
Russia - Sergei A. Silantsev (1998 - confirmed in 2008)
South Africa - Petrus Le Roux (2006 - NOT confirmed in 2008)
Spain – Rosario Lunar (2006 - replied to email 2007)

Sweden - Nils G. Holm (1993 - confirmed in 2006)

Switzerland - Gretchen Früh-Green (1995 - confirmed in 2006)

SOPAC – Aquila Tawake (2009 -)

APPENDIX II

InterRidge Estimated Budget for 2012

Income for 2012 financial year	Actual income \$	Estimate d spend \$	2012 budget
InterRidge member subscriptions (assuming the current 6 full & 4 assoc. members)	175,000		165,000
Host Nation's additional InterRidge subscription (one extra full membership fee)	25,000		25,000
Host Nation's support for InterRidge officers' T&S	16,800		16,800
ISA fellowships (* \$15K per annum 2012-14)	45,000		
<i>total income by F/Y</i>	261,800		
Carry Forward of Recurrent Contingency	117,750		438
Available balance	379,550		207,238
Expenditure for 2012 financial year			
Salary (66% FTE) for InterRidge coordinator (2012: 80%)		133,396	87,156
InterRidge officers's T&S		20,000	25,200
InterRidge Office set-up and consumable costs		600	3,000
InterRidge Office Site relocation and web maintenance costs at NOCS		2000	5,000
InterRidge sponsorship of meetings and workshops (e.g. 4 x \$10,000 each)		40,000	40,000
InterRidge fellowships		20,000	10,000
ISA Fellowships		15,000	15,000
Publishing (InterRidge News and policymakers' brochures)		7000	10,000
Professional and media outreach		200	7,000
InterRidge mobility awards for science cruise participation		15,000	20,000
Contribution in full from InterRidge for student prizes		2000	1,000
Total estimated expenditure by F/Y		255,196	235,738
InterRidge Office Recurrent Contingency		124,354	1,382
<i>Final balance</i>		379,550	
Support in kind (salary and overhead for IR chair and co-chair)			
Host Nation's support for salary (15% FTE) for IR Chair (Murton)			\$37,882
Host Nation's support for salary (10% FTE) for IR Co-Chair (Copley)			\$14,337

InterRidge 2012 Steering Committee Report

**APPENDIX II (Cont.)
InterRidge Office estimated budget for financial years 2010 to 2012**

Income for each financial year	<i>2010 budget</i>	<i>2010 actual</i>	<i>2011 budget</i>	<i>2011 actual</i>	<i>2012 budget</i>	<i>2012 estimated</i>
InterRidge member subscriptions (assuming the current 6 full and 4 associate members)	\$170,000	165,000	\$170,000	165,000	\$170,000	175,000
Host Nation's additional InterRidge subscription (one extra full membership fee)	\$25,000	25,000	\$25,000	25,000	\$25,000	25,000
Host Nation's support for InterRidge officers' T&S	\$16,800	16,800	\$16,800	16,800	\$16,800	16,800
ISA fellowships	\$10,000	15,000	\$10,000	15,000	\$10,000	45,000
<i>total income by F/Y</i>	<i>\$221,800</i>	221,800	<i>\$221,800</i>	221,800	<i>\$221,800</i>	261,800
Carry Forward of Recurrent Contingency	\$00000	52,500	\$6,644	125,550	\$13,938	117,750
Available balance		274,300		347,350		379,550
Expenditure for each financial year						
Salary (66% FTE) for InterRidge coordinator	\$82,956	107,000	\$85,306	128,400	\$87,156	133,396
InterRidge officers's T&S	\$25,200	3,800	\$25,200	20,200	\$25,200	20,000
InterRidge Office set-up and consumable costs	\$6,000	3,900	\$3,000	450	\$3,000	600
InterRidge Web Site relocation and maintenance costs at NOCS	\$10,000	250	\$5,000	950	\$5,000	2000
InterRidge sponsorship of meetings, StComm meeting and workshops (e.g. 4 x \$10,000 each)	\$40,000	11,300	\$40,000	31,600	\$40,000	40,000
InterRidge fellowships	\$10,000	7,000	\$10,000	10,000	\$10,000	20,000
ISA Fellowships	\$10,000	15,000	\$10,000	15,000	\$15,000	15,000
Publishing (InterRidge News and policymakers' brochures)	\$10,000	5,500	\$10,000	8,000	\$10,000	7000
Professional and media outreach	\$7,000	0	\$7,000	7,500	\$7,000	200
InterRidge mobility awards for science cruise participation	\$10,000	0	\$15,000	5,500	\$20,000	15,000
Contribution in full from InterRidge for student prizes	\$1,000	0	\$1,000	2,000	\$1,000	2000
<i>total expenditure by F/Y</i>		153,750		229,600		255,196
InterRidge Office Recurrent Contingency	\$6,644	120,550	\$13,938	117,750	\$4,382	124,354
Final balance		274,300		347,350		379,550

Support in kind (salary and overhead for IR chair and co-chair)

Host Nation's support for salary (15% FTE) for IR Chair (Murton)	\$36,198		\$37,100		\$37,882
Host Nation's support for salary (10% FTE) for IR Co-Chair (Copley)	\$14,110		\$14,223		\$14,337

APPENDIX III

Proposal for an IR Working Group on Circum-Antarctic Ridges (CAR)

Although Circum-Antarctic Ridges (CAR) represent over one third of the global mid-ocean ridge system, they remain the least known sections of mid-ocean ridges, mostly because of their location in high latitudes and areas of rough seas. However, Circum-Antarctic Ridges are unique by their shallow water depths, ultra-slow or intermediate spreading rates, and complicated series of transform offsets compared to low-latitude ridges. A number of scientific issues at various scales in space and time are ideally addressed in these areas, such as: (1) the boundaries and fluxes between the Pacific, Atlantic and Indian mantle domains; (2) the along-axis variability in ridge morphology, magma supply and basalt chemistry at constant spreading rate; and (3) the migration and exchanges between biological communities.

Because it is time to focus and coordinate an international effort to survey these ridges, we organized an InterRidge international workshop in Toulouse, France, from 28 to 30 Sept. 2011, which was also sponsored by the University of Toulouse. The main objectives of the workshop were to review the state of the art of the research on Circum-Antarctic Ridges, to identify the important scientific issues ranging from geosciences to biology, and to evaluate the need to form an IR Working Group on Circum-Antarctic Ridge research (see Workshop Report, http://www.interridge.org/circum_antarctic).

Scientific rationale: What drives the CAR WG?

Being created at various spreading rates, the **Circum-Antarctic Ridges** are expected to display a large range of morphologies and magma budgets. The workshop presentations and discussions, however, pointed out that the diversity of CAR basalts and mantle rocks depends not only on mantle reservoirs and spreading rate or mantle temperature, but also on poorly-known melting and crustal processes and mantle heterogeneities. The CAR show variations of basalt and peridotite chemistry suggesting heterogeneous mantle at various scales that are still to be determined. The CAR sample the Atlantic, Indian and Pacific mantle domains, but the only well known domain boundary is the Indian/Pacific mantle boundary near the Australian-Antarctic Discordance (AAD). These ridges represent a unique window on mantle processes at such a large spatial scale. The Southwest Indian Ridge (SWIR) and Southeast Indian Ridge (SEIR) show large variations of morphology at constant spreading rate, implying that other factors such as melting conditions and crustal processes play a significant role in ridge dynamics. The SWIR displays large areas of mantle outcrops, and a complex production of magma. The variations in time of magma production are not well understood, nor are the active accretion processes in these very variable contexts, as expressed in the seismicity. The interactions of the CAR with hotspots or cold spots are also poorly known.

Large sections of the CAR have not been surveyed at all, or have been investigated for geophysics and

sampling but not for hydrothermal signals. As a consequence, only a few hydrothermal vents (9 confirmed active sites) have been found so far along the CAR, in the Bransfield Strait (BS), East Scotia Sea (ESS), SWIR, and the Pacific-Antarctic Ridge (PAR). Given the vent distribution observed on other mid-ocean ridges, and the spreading rates of the CAR, over 300 vents are likely to exist. Therefore the major point about Circum-Antarctic hydrothermal systems is that most of them are still to be discovered! The major issues of how and how far species can disseminate are only envisaged near the BS and ESS, where specific species have been identified. Studies of biogeography are waiting for more sites to be discovered. Systematic measurements of light scattering and temperature anomalies in the water column using the Miniature Autonomous Plume Recorder (MAPR) suggest the presence of many more hydrothermal vents than have been discovered so far. Many more dedicated investigations would help confirm these potential sites and discover new vents. One important question at a global scale is the role of Fe released at hydrothermal vents on the global budget.

Objectives of the CAR WG

The scientific objectives of the CAR working group are to improve our knowledge on the following issues:

- How heterogeneous is the mantle? What is the role of mantle heterogeneities in the variability at the axis, compared to that of mantle temperature? Where and how should we collect samples to improve our understanding of mantle heterogeneities?
- How do the three large mantle domains (Atlantic, Indian, and Pacific) interact as they meet under the Circum-Antarctic Ridges?
- How do ridge processes vary with time? A few off-axis observations reveal significant evolutions in time, but off-axis surveys and sampling are still too rare.
- How uniform are chemosynthetic ecosystems along the CAR? Do they constitute a unique biogeographic province?
- What is the role of Fe released at hydrothermal vents on the global budget?

To address these questions requires a major, coordinated effort. The area is so vast that no single nation can make large scientific advances at the Circum-Antarctic Ridges. All participants to the workshop agreed that InterRidge can and should help with the survey of Circum-Antarctic Ridges, launch new projects, coordinate existing cruise projects, and share information. Because coordination appears to be a key to improve the surveys of Circum-Antarctic Ridges, participants suggested the creation of a new working group (CAR WG). By focusing on the Circum-Antarctic ridges, the CAR WG would create synergy between existing IR WGs such as “Mantle imaging”, “Back-arc basins”, or “Hydrothermal energy and ocean carbon cycles” for example.

Specific goals of the CAR IR working group are to:

1. Share information

- Use dynamic modes of communication like a web site and/or a blog or wiki.
- Design the WG web site to include topical discussion, geographical discussion, data information, cruise information, etc.

2. Coordinate cruises

- Information about cruises
- Participation in cruises

3. Define rules and protocols

- Share rock samples after 3 years
- Define protocols to compare vent fauna

Since the workshop, Henry Dick sent an exhaustive list of locations and descriptions of rock samples collected along the SWIR. This is a great example of how sharing information and samples can help increase our knowledge. A tentative plan for a meeting of the working group would be Fall AGU 2013 or later in 2014, after some cruises have been scheduled.

Main targets

To better collaborate investigations in the remote southern ocean, we discussed the plans already existing in the different countries. Several groups are committed or planning to survey sections of the Circum-Antarctic Ridges.

- Indian ridges (Yoshi Nogi): Japanese ice-breaker crosses the Indian Ocean to reach the Antarctic bases, and could include scientific survey south of 55°S.
- Australian-Antarctic Ridge (or SEIR south of Tasmania, Sung-Hyun Park): Two cruises were already done for mapping, sampling and searching for hydrothermal vents along the segments KR1 (160°E) and KR2 (152.5°E) of the AAR with the icebreaker R/V Aaron. Also KOPRI (Korea Polar Research Institute) will do two more cruises including an AUV cruise on KR1.
- AAR (Jérôme Dyment): A series of 6 transits of N/O L'Astrolabe between Tasmania and Dumont D'Urville (Antarctica) will collect magnetic profiles from margin to margin.
- AAR axis, off-axis volcanoes 135-150°E and part of George V transform fault system (Anne Briaux): mapping and rock/water column sampling; proposal submitted.
- SWIR (Huaiyang Zhou et al.): One leg per year to survey the centre of SWIR for polymetallic sulfides.
- SWIR (Vera Schlindwein): 2012/13: OBS deployment for a one year seismicity record at eastern SWIR (near 65°E) and another one at western SWIR near 13°E. The recovery cruise of this deployment will go along with the search for hydrothermal plumes/vents.
- SWIR in the Andrew Bain transform fault (Sato and Dick). Also surveys of the Conrad Rise.
- SWIR (Mathilde Cannat and Sylvie Leroy): Seismic cruise on the smooth, non-volcanic seafloor of the SWIR: proposal submitted.

- PAR south of 60°S near Macquarie triple junction (Jian Lin, planning)
- Antarctic Ridges rock sampling (Charlie Langmuir, Peter Michael, etc., planning)

The proposed priority targets for cruises on the CAR are the SWIR, the American-Antarctic Ridge (AAR), and the unsurveyed southern sections of the SEIR and PAR near the Macquarie triple junction.

Proposed membership

Anne Briais, Co-chair France, geophysics SEIR/PAR/AAR

Jian Lin, Co-chair USA, geophysics/hydrothermalism SWIR/AAR

Sung-Hyun Park, Co-chair Korea, petrology AAR/SEIR/PAR

Ed Baker, USA, hydrothermalism

Doug Connelly, UK, geochemistry

Dave Graham, USA, geochemistry SEIR

Hide Kumagai, Japan, geochemistry SWIR

Phil Leat* / Jon Copley, * UK, biology Scotia Ridge

Yoshi Nogi, Japan, geophysics SEIR

Daniel Sauter, France, geophysics SWIR

Chunhai Tao, China, geology SWIR

Huaiyang Zhou, China, petrology/geochemistry SWIR

Vera Schlindwein, Germany, geophysics SWIR

TBD*? India

Serguey Merkouriev* / German Leitchenkov?, * Russia, geophysics

Membership (13) : China (2), France (2), German (1), Japan (2), UK (2), USA (3), Korea (1), India (1),
Russia (1)

* Unconfirmed

APPENDIX IV

From ridge crest to deep-ocean trench: Formation and Evolution of the Oceanic Crust and Its Interaction with the Ocean, Biosphere, Climate and Human Society

A plan for the third decade of InterRidge science

InterRidge is the only scientific organisation that spans the single largest geological domain on the planet: the Earth's oceanic crust, representing more than 60% of the Earth's surface. The background for this framework is the recognition of a number of key areas of research that are needed to underpin our developing understanding of the formation and evolution of the oceanic crust and its interaction with the ocean, biosphere, climate and human society. The role of InterRidge has evolved from facilitating cooperation between ridge crest scientists to helping science focus on the major and fundamental aspects of ocean crust generation and evolution; from genesis at the ridge crest, to evolution on the flanks and under the abyssal plains to its fate at convergent margins, subduction zones, arcs and back-arc systems.

The following sections describe the results of a process of consultation of the ocean crust scientific community that was initiated in 2011 by InterRidge through an online forum and culminated on December 3rd 2011 at an open meeting in San Francisco. Following summaries from the current and future working groups, the process of science prioritisation was led by the InterRidge Chair (Bramley Murton) with assistance from three previous Chairs (Colin Devey, Jian Lin and Roger Searle). All of the attendees were asked to post their key scientific questions on a bulletin board. These were then organised into broad scientific themes. Attendees were then asked to self organise into groups under each of the science themes and draw up a list of the big scientific questions, their context and background, and how they might be implemented. Each group then elected one or two members that formed the writing group on the 4th December to compile each of the report sections presented here.

Five current working groups represented:

- 1) Hydrothermal Energy and Ocean Carbon Cycles
- 2) Long Range Exploration
- 3) Mantle Imaging
- 4) Seafloor Mineralisation
- 5) Vent Ecology

Four new working groups proposed:

- 1) Oceanic Detachment Faults
- 2) SMART (South Mid Atlantic Ridge Targeted Area)
- 3) Circum-Antarctic Ridges
- 4) Arc-Backarc Systems

The meeting recognised the desire of the community to expand and accommodate all ocean crust research, from the ridge crest to the arc and backarc systems. We then went on to define five areas of research priority:

- 1) Mid-Ocean Ridge Tectonic and Magmatic Processes
- 2) Seafloor and Sub-Seafloor Resources
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This is a draft document and has been prepared for consultation. Feedback from InterRidge members has been incorporated (up to 9th August 2012) and this new draft is presented for adoption by the InterRidge Steering Committee, subsequent to the StComm meeting in St Petersburg, Russia.

**SECTION A
MID-OCEAN RIDGE TECTONIC AND MAGMATIC PROCESSES**

Background:

The past ten years has seen a revolution in our understanding of the formation, structure and evolution of oceanic crust. In the same way that orbiting space telescopes have revealed the origins of the universe, and genetics have shown us the fundamental basis of life, new technologies for imaging and exploring the deep ocean crust have transformed our view of our planet.

Over 60% of the entire Earth's surface has been formed at active oceanic spreading ridges. During the latter half of the 20th century, our view of this deep seafloor was seen through a blurred lens. Sonar images were coarse and the resolution low. Visual observations were of limited extent and the recovery of rocks from below the seafloor was sparse. As a result, we developed a simplistic model for this oceanic crust. We thought all spreading ridges formed a similar type of structure: a layer-cake of volcanic lavas overlying coarse crystalline rocks that in turn rested on the mantle. Where there were differences, these were limited to local processes such as faults, hotspots and unusual plate boundary geometries.

With the birth of the 21st century, a new view has emerged. Informed by high-resolution geophysical imaging techniques, robotic underwater vehicles and deep-ocean drilling, we have discovered that the ocean crust is far from homogeneous. With decreasing spreading rate, the crust becomes increasingly complex. Large areas of the seafloor expose gaps in the volcanic portion of the crust and out crops of mantle rock are exposed at the seafloor. Entire ridge segments are found to spread by long-lived, low angle extensional faulting. The exposed mantle rocks are found to contain multiple small bodies of coarse crystallised magmatic rock but the overlying volcanic lavas are absent. Seawater reactions with the exposed mantle form serpentinite. Fluids released by this reaction are completely different to those at conventional hydrothermal vents: they have high pH, are rich in hydrogen and methane and, where hot, create complex organic molecules. These chemical and thermal fluxes have significant implications for the composition of the global ocean. The vents are also host to unusual species of macro and microorganisms whose genetic potential are just being explored. Mineral deposits formed at the hydrothermal vents are rich in non-ferrous metals such as copper, zinc and gold. The lack of volcanism allows such deposits to accumulate large tonnages. In turn, these have attracted the attention of industries interested in exploring for new, metal-rich resources to meet the growing global demand for raw commodities.

The heterogeneous structure of the oceanic crust is also expressed in time as well as space. Melt supply appears to vary through time at a given location, resulting in dramatic variations in crustal structure, thickness and hydrothermal fluxes. Even the spreading process, previously regarded as continuous, has been found to be episodic. Where new ocean crust is generated behind convergent margins, the ridges stop and start, often jumping to new sites by rifting older crust. Why this happens is unknown but is thought to link to changes in the structure and geometry of the subducting plate, the mantle wedge is affected and there are consequences for arc volcanism. Thus there is a connection to the entire Earth System: oceanic crust formed at spreading ridges is heterogeneous, evolves through interaction with the ocean, is modified by intra-plate volcanism, and as a result effects changes in convergent margins that in turn affect the formation of new oceanic crust in the arc and back-arc basins. This holistic approach is now recognised and embraced by InterRidge. The linkages between the mantle, lithosphere and biosphere are an integral part of the Earth system. The mineral resources formed by the oceanic crustal spreading are of growing economic importance. Hence, society at large is increasingly aware of the fundamental role played by the oceanic crust and its potential to meet the resource needs of the future.

Primary Questions:

- 1) What controls the structure of the oceanic crust?
- 2) What is the real extent of tectonic-dominated spreading?
- 3) How does oceanic spreading at slow and ultra-slow spreading rates work?
- 4) What is the diversity of structure and architecture of Oceanic Core Complexes?
- 5) What is the variation of oceanic crustal structure through time and how is this controlled?
- 6) What controls the variation and episodicity of spreading ridges in complex tectonic settings?

1) What controls the structure of the oceanic crust?

While the formation of heterogeneous oceanic crust is most prevalent with increasingly slow spreading rates, the link is not exclusive. New or dying rifts where the spreading rate is ultra-slow are not necessarily dominated by tectonic spreading. Is there a mantle effect? And if so, what is this: composition, temperature or both? Or are there some other processes, maybe a crustal one, in which shallower processes cause the crust to become heterogeneous? Could there be positive feedback between faulting, hydrothermal cooling and the suppression of volcanism? Are there links to global sea level such that rapid changes result in fluctuation in melt supply?

2) What is the real extent of tectonic-dominated spreading?

Oceanic core complexes (OCCs) are the expression of tectonic-dominated spreading. These are the result of low-angle detachment faults that uplift and expose large sections of upper-mantle. Where they are identified, they occur as isolated features on the ridge flank. But are these merely the surface expression of deeper, inter-linked structures that extend for tens to hundreds of kilometres along the ridge? Are they related to vast areas of ocean crust, exposed on some ridge flanks, which are described as smooth? Likewise, are they related to the even larger areas of smooth ocean crust, which have been discovered beneath several kilometres of sediment, bordering continental margins?

3) How does oceanic spreading at slow and ultra-slow spreading rates work?

Where OCCs form and the crust spreads asymmetrically, how is this accommodated? What is the structure of the conjugate flank? Are all OCCs alike or are there significant differences in their structure and architecture? And what controls these differences?

4) What is the diversity of structure and architecture of OCCs?

Are all OCCs 'plum-pudding' structures with gabbro bodies embedded in a peridotite/serpentinite matrix or are some completely peridotite? What is the proportion of magmatic material in OCCs and how does that compare with 'normal Penrose' oceanic crust?

5) What is the variation of oceanic crustal structure through time and how is this controlled?

Transform faults allow time slices through crustal sections to be exposed. Can they be used to allow studies of the variation in crustal architecture and melt supply? How does the lower oceanic crust form? Can we resolve the gabbro glacier model from the multiple intrusive sill one? Can we resolve how the ocean crust cools and the magnitude of its effects on ocean chemistry through alteration? What is the depth of serpentinisation where magmatic flux is low? How does serpentinisation affect the seismic potential of fault zones and can we apply this information to seismogenic zones in continental settings and subduction zones?

6) What controls the variation and episodicity of spreading ridges in complex tectonic settings?

Backarc basin spreading centres are unstable and jump in space and time often with hiatus in spreading. What controls this? Are there links to the subduction process and arc volcanoes? How does the mantle wedge link to backarc spreading? What are the ages of back arc spreading jumps and can we calibrate or unravel complicated magnetic anomaly signatures in backarc basins? Are there links between the structure, composition and morphology of the subducting slab of old oceanic crust and the formation of arc volcanoes and backarc spreading systems?

Implementation:

- a. New tools and observations: accessing the subsurface is essential to understanding the composition, structure and evolution of heterogeneous oceanic crust.
- b. IR will develop closer links with IODP drilling. Scientists should be encouraged to form closer links with engineers developing new emerging technologies such as active and passive EM, high-resolution seismic imaging, and seafloor drilling.
- c. Areas where ocean crustal diversity and heterogeneity are well developed should be identified where a concerted and coordinated research effort can be applied. A variety of techniques are needed and these should be focused on particular areas where the combined effort exceeds the sum of the individual parts. This is the role of InterRidge: to coordinate and encourage collaboration.

SECTION B SEAFLOOR AND SUB-SEAFLOOR RESOURCES

Background:

Research into seafloor and sub-seafloor hydrothermal systems over the past ~30 years has focused primarily on active vent sites, because: 1) plumes from active vents can be detected at kilometre-scale distances from their source; 2) active vents host lush, unique chemosynthetic ecosystems; and 3) active vents provide the opportunity for direct measurements of fluid fluxes, compositions and temperatures. Current estimates of the number of vent sites along the oceans' neo-volcanic zones and the total amount of hydrothermal sulfide on the ocean floor are biased towards active systems.

Growing evidence suggests that the total number of inactive/extinct vent sites, and total tonnage of sulfide from those sites, may be greater than that what has been discovered and estimated from active sites. The fate of seafloor sulfides after the hydrothermal system that fed them turns off is also poorly constrained. Little is known regarding the rate of sulfide oxidation on the seafloor or the biological communities that inhabit these deposits. The need for a better understanding of inactive sulfide deposits is further enhanced by the growing targeting of these deposits by exploration companies for their precious and base metal contents. Due to technical limitations and ecological concerns, inactive systems are a more likely source for metal resources than sulfides from active hydrothermal vent sites.

Primary questions:

- 1) How to identify inactive hydrothermal sulfide deposits on the seafloor?
- 2) How much hydrothermal sulfide is contained in inactive vent deposits?
- 3) How old are seafloor massive sulfide (SMS) deposits?
- 4) What types of organisms inhabit inactive sulfide deposits?
- 5) What is the geologic fate of inactive sulfide deposits?
- 6) Does basement lithology and water depth affect the mineral resource potential and biology of seafloor massive sulfides (SMS)?
- 7) What is the potential toxicity of inactive SMS deposits to surrounding fauna?

1) How to identify inactive hydrothermal sulfide deposits on the seafloor?

Unlike active vent sites, which we have learned to identify and locate using plume surveys, camera tows etc... inactive sulfide deposits can often be indistinguishable from volcanic structures. Methods for the detection of inactive sulfides using high-resolution mapping and remote sensing geophysical methods are critical to locating sulfide deposits that are invisible using many of the methods used to locate active deposits. Can we detect buried sulfide deposits? There is a need to verify remote sensing techniques by characterising the sub-surface expression of mineral deposits and their altered host rock.

2) How much hydrothermal sulfide is contained in inactive vent deposits?

A number of recent publications provide estimates of the total global resource of SMS (seafloor massive sulfide) deposits. These estimates are based almost exclusively on data from known active deposits. Surveys of inactive deposits from different seafloor tectonic environments are required to update global resource estimates to include inactive sulfides. These estimates are critical to organizations that hope to either explore for, or regulate, the exploration and exploitation of seafloor sulfide resources.

3) How old are Seafloor Massive Sulfide deposits?

What is the accumulation rate of sulfide, and how does it compare to the amount of sulfide that vents into the water column? What is the lifespan of a typical hydrothermal system? Are lifespans dependent on tectonic environment? How episodic is venting at a single vent site?

4) What types of organisms inhabit inactive sulfide deposits?

How do the ecosystems of inactive sulfide deposits compare with those of active sulfide deposits or normal basaltic substrates?

5) What is the geologic fate of inactive sulfide deposits?

What is the rate of oxidation? What are the effects of microorganisms on the breakdown of sulfide? How does the rate of oxidation compare to the rate of burial?

6) Does basement lithology and water depth affect the mineral resource potential and biology of seafloor massive sulfides?

Is there a systematic variation in chemistry and metal content of SMS formed at mafic-hosted or ultramafic-hosted hydrothermal systems? What is the chemical and thermal flux at slow and ultra-slow spread crust and does this vary with tectonic spreading and the formation of OCCs? What is the effect of different basement lithologies on vent biology?

7) What is the chemical toxicity of deposits and their sediments?

What biologically active, toxic elements are present in deposits and their associated sediments? Are there secondary enrichment processes, linked to diffuse fluid flow or redox fronts that might enhance the toxicity of deposits? What are the effects of plumes of detritus that might be introduced from seafloor mining activities, on the surrounding benthic communities?

Implementation:

- a. Many of these questions might be answered by large-scale, high-resolution characterizations of entire vent fields at ridge segment scales and integrating those with basin-wide modelling. This could be accomplished using properly instrumented AUVs and other distributed ocean observing platforms, supplemented by high resolution seafloor surveys and monitoring. Awareness must be built and guidance provided as to what “properly-instrumented” means.
- b. Sub-seafloor assessment of mineral deposits and occurrences should involve new technologies such as seabed drilling and wire-line logging to characterise mineral and host-rock types and their geophysical properties. These data will also be used to both calibrate remote detection methods (active and passive electro magnetism, resistivity, magnetism and active seismic detection) as well as to document the chemotoxic nature of the deposits and their surrounding sediments.
- c. InterRidge should continue to work with other agencies such as the International Seabed Authority and the Underwater Mining Institute towards developing guidance for best practice in assessing, monitoring and minimising environmental impact from resource exploration and exploitation.

SECTION C MANTLE CONTROLS

Background:

Geochemical studies of basalt sampled at mid-ocean ridges have demonstrated that the Earth's mantle is strongly heterogeneous. Heterogeneities are observed at different scales, from a few to thousands of kilometres. These heterogeneities result from fundamental processes of Earth evolution involving mixing and stirring of Earth's material. In turn they play a major role in controlling variations in the crustal formation through partial melting, both in the amount of the crustal production and in the geochemical signature of the products. The amount of magmatism will control the type of crust and the tectonic expression of seafloor spreading. The petrology and geochemistry affects the composition of percolating hydrothermal fluids, the vent mineralization, and their ecosystems.

The effects of mantle controls at mid-ocean ridges can be addressed in two complementary ways. First, the ridges are windows that allow better constraints of mantle heterogeneities at the different scales. Second, variations in ridge processes can be understood in relation to mantle heterogeneities: both compositional and temperature.

Primary Questions:

- 1) How are mantle heterogeneities expressed at different scales in time and space?
- 2) What are the relationships between variations in ridge processes and mantle heterogeneity?

1) How are mantle heterogeneities expressed at different scales in time and space?

Ridges represent essential windows to image, quantify and map mantle heterogeneities at different scales in both space and time. Such heterogeneities include mantle provinces (e.g. at slabs or in mantle down-welling areas such as at the AAD), broader geochemical domains (such as the DUPAL anomaly) or dynamic features such as mantle hotspots or plumes. Where ridges interact with mid-ocean ridges, the spreading process leaves behind a trail of crust that records the history of interaction with the mantle anomaly. Here, the ocean crust records time varying fluxes of hotspot mantle, mantle plumes and their tectonic effects on the spreading processes.

An example of mantle controls of the spreading ridge system is ridge-hotspot interaction. Here, the plate separation process records the influence of adjacent mantle 'hot-spots'. For example, the ridge and oceanic crust to the south of Iceland record the changing influence of the mantle anomaly beneath Iceland. Combining both geophysical studies of crustal and mantle anomalies south of Iceland with petrological and geochemical studies can test the presence or absence of an upwelling mantle plume beneath Iceland, leading to improved understanding the dynamics and physical and compositional properties of the mantle.

Another emerging frontier of research is the extent and nature of small-scale mantle heterogeneities (10 to 50 km). Although these seem to be ubiquitous, their effects on the spreading process are poorly understood. Also unknown are origins of these small-scale mantle heterogeneities. How are they generated and preserved? How do they interact with the dynamic mantle melting processes beneath the ridge crest and what effect do they have on the resulting accretion of oceanic crust? These questions are relevant to both areas of high and low melt production (i.e. mantle hot and cold spots) as well as volatile rich regions (i.e. mantle wet spots).

2) What is the relationship between variations in ridge processes and mantle heterogeneity?

A better understanding of ridge processes requires us to address how the mantle processes and heterogeneities affect the mechanisms of melt generation and migration to form the oceanic crust. Equally important is how mantle processes and heterogeneities control the tectonics of seafloor spreading. For example, 'amagmatic' spreading and the generation of ocean core complexes are associated with E-MORB – enriched mid-ocean ridge basalts – resulting from either reduced mantle melting and/or enriched mantle. It is not known how this relationship develops: by what process mantle thermal heterogeneity is conserved or how mantle heterogeneity affects the melt generation process and hence the spreading style.

Implementation:

- a. Various approaches will be used to address these questions. Of prime interest is mantle imaging through geophysical techniques such as seismic tomography, refraction and reflection, electromagnetic and potential field and gravity. This is very demanding on resources and therefore requires international collaboration.
- b. Integrating both wider scale global tomography experiments with more local scale ones is essential, as well as improving imaging resolution at greater depth.
- c. High-resolution mapping of mantle heterogeneities through detailed geochemical studies of rock samples (drilled, dredged, or collected by deep-sea vehicles), complemented by near-bottom (i.e. AUV-type) multibeam surveys is needed for specific locations. This requires international collaboration.
- d. The collection of geophysical and geochemical data should be complemented by physical property analyses of mantle rocks, where available.
- e. Numerical geodynamic modelling should help to better understand the mantle mixing processes. Key to this approach is to combine geophysics with rock geochemistry to better constrain melt fraction, crustal thickness and hence to unravel the effects of mantle composition and melting history.

SECTION D RIDGE-OCEAN INTERACTIONS AND FLUXES

Background:

From an oceanographic viewpoint, it has been generally assumed that geothermal heating has a small effect on global circulation. However, recent hydrographic modelling has demonstrated that this assumption is wrong. Instead, geothermal heating has a significant influence on mixing in the abyssal ocean with wider consequences for global thermohaline circulation. Although these modelling results, using coarse numerical grids, are based on passive heating above an impermeable seabed, they do not include the dynamic uplift created by the hydrothermal plumes. These plumes may, through convective entrainment, provide an important mechanism to lift some of the densest water away from the bottom boundary layer. The models also neglect mixing caused by tidal and current flow across the rough sea-floor of the mid-ocean ridges. Mixing of bottom water, the export of hydrothermal plumes and their chemical interactions may play a role in the transport of nutrients to the surface water and drawing down carbon. Over the next decade, ocean circulation models will increase in resolution and will be able to include more accurate bathymetry maps and geothermal flux models. Our challenge is to provide accurate estimates of the heat and mass fluxes at the ocean floor that can be integrated into these new models. Better models will lead to better prediction of the global circulation. We will be able to test the veracity of these models using geochemical tracers and through biological mapping using novel DNA mapping techniques.

Primary Questions:

- 1) Mixing and heating in the abyssal oceans
- 2) Biological/chemical tracer distribution - spatial/depth
- 3) Distribution of fluxes – focused vs. diffuse

1) Mixing and heating in the abyssal oceans

Heating of the abyssal ocean is necessary to maintain the global thermohaline circulation system that transport heat, nutrients, biological, chemical around the globe. Cold abyssal water, formed at the poles, fills the deep ocean basins from depths of about 1000 to over 5000m. This water has to be warmed to make it buoyant to rise to the surface to complete the circulation loop. To date, the coarse resolution simulations of ocean circulation means that the large contrasts in the spatial distribution of geothermal and hydrothermal fluxes are not properly represented. Within the next decade ocean circulation models will achieve spatial resolutions capable of including more realistic seabed topography and distribution of geothermal heating, hence providing more reliable predictions of abyssal ocean circulation. Ridges provide three mechanisms that may drive this process:

- the rough topography that interacts with flow in the abyssal ocean caused by tides or by large-scale ocean currents. Recent measurements have shown increased levels of mixing that may mix heat down from the surface into the deeper water masses;
- direct thermal heating of the abyssal ocean by cooling of the newly formed ocean crust. Approximately 70% of the Earth's heat loss is through oceanic lithosphere and, of that, most is through young oceanic crust at spreading ridges or along their flanks. Unlike surface heat fluxes, geothermal fluxes are unidirectional, always contributing towards increasing the buoyancy of the deep ocean;
- the flow of hydrothermal fluid focused in so-called black-smokers close to the ridge crests create a third type of mixing through entrainment. It has been estimated that this process may increase the volume of water affected by the hydrothermal plumes by a factor of ten thousand.

2) Biological and chemical distribution (or tracers)

Flourishing biological communities usually accompany hydrothermal activity which, in turn, provides significant chemical fluxes to the ocean. Some of these chemical species are deposited close to the hydrothermal vents; others are entrained by hydrothermal plumes and transported by oceanic circulation. Understanding the transportation processes will improve our knowledge of global oceanic circulation, through recognition of global biogeographical provinces, population connectivity and hydrothermal tracer distribution. It will also yield direct measurement of the global hydrothermal plume flux and indirect knowledge of hydrothermal vent fields in hitherto unexplored areas, e.g. Southern Ocean.

The deep-sea hydrothermal biological communities themselves attract interest, but they also provide much information about the environment of hydrothermal vents and invisible connectivity among hydrothermal vents, caused by a combination of hydrothermal plume and oceanic circulation. The animal distribution is closely correlated to environmental factors provided by hydrothermal activities. Understanding of the ecological and physiological features of the animals will lead us to understand how animal distributions correlate with the physical and chemical properties around hydrothermal vents, and furthermore, the speciation and subsequent evolution processes around hydrothermal vents. Population studies require genetics on large numbers of specimens from type localities. Identifying those localities is difficult, but will benefit significantly from higher resolution numerical modelling of ocean circulation, entrainment of hydrothermal plumes, their transport and eventual fate.

3) Distribution of fluxes – focused vs. diffuse

A challenge for more complete models of both heat and mass flux through the seafloor is estimating the distribution of the various forms of venting. There is strong spatial and temporal variation in heat and mass fluxes through the seafloor. There is also a paradox between the apparent deficit of hydrothermal cooling required to solidify the newly formed oceanic crust and the flux of hydrothermal discharge of key elements (such as Sr) to the ocean. One key to solving this paradox may be the partitioning between high and low-temperature fluxes. While the most spectacular vents, that are associated with high-temperature black-smokers that discharge mineral and chemical laden fluids into the ocean in plumes, are found close to the ridge axis, over the past decade diffuse vents that discharge low temperature heat-fluxes with a much lower chemical flux have been located on the ridge flanks. These have lower heat and chemical flux rates and different heat/chemical ratios, but are spread over larger areas.

Many questions remain as to the role of low temperature venting relative to the total heat flux from hydrothermal systems. What is the proportion of heat and mass flux that occurs through discrete vents (black-smokers) close to the ridge as opposed to diffuse vents on the ridge flanks? What methods can be developed for quantifying heat flux from low-temperature, diffuse flow? How are the spatial and temporal controls on low-temperature venting related to high-temperature venting? How do hydrothermal systems evolve through time from a volcanic eruption event to the off-axis? The hydrothermal plumbing in the ocean crust is likely to vary with spreading rate and spreading process. These variations need to be quantified to understand the nature and quantity of the fluxes in the deep ocean that can then be linked to improved circulation models.

Implementation:

- a. New high-resolution ocean circulation models to be built in collaboration with physical oceanographers.
- b. Long term observatories at both ridge and flank to monitor fluxes over a volcanic cycle.

- c. Integrated high-resolution studies incorporating numerical modeling of physical, chemical and biological data.
- d. Development of new syntheses of DNA data to map filters to the larval dispersal.
- e. The addition of new chemical/biological sensors to distributed observing platforms such as ARGOS floats and Ocean gliders used to map the internal structure of the oceans.
- f. Involvement with policy makers to develop a common environmental policy.

SECTION E OFF-AXIS PROCESSES

Background:

The on- and off-axis mid-ocean ridge processes have a major control on the formation and evolution more than 60% of the Earth's crust. The oceanic lithosphere is where the ocean and the solid earth interact, with a large variety of implications ranging from the global heat and chemical budgets to the effects of the subducting plates on earthquake genesis. Previous IR science plans focused on axial ridge processes and greatly improved our knowledge of accretionary processes and hydrothermal fluxes. Detailed investigations have brought insights into volcanic and tectonic processes generating the new ocean lithosphere. In situ observatories have monitored hydrothermal fluxes at specific localities for more than 10 years now, collecting precious information on the evolution over time of heat loss, chemical fluxes, mineralization and vent fauna. But we still observe a misfit between axial and global heat flux estimates, implying that the contribution of off-axis processes is significant. Hence it is time to investigate what happens on the ridge flanks.

The concept of "off-axis" evolution of the ocean lithosphere implies that we know the limit of the "axial" zone, which is not true, as its definition depends on which processes are concerned. Magmatism is active beyond the ridge crest at fast and slow spreading ridges, and fluid flow is active in crust that is tens of millions of years old. New technologies should help detect events and processes that become subdued away from the plate boundary, but remain significant at a planetary scale.

Primary Questions:

- 1) How do the accretion-driven processes (faulting, volcanism, hydrothermal circulation, and ecosystem dynamics) evolve, diminish, or change character with increasing distance off-axis?
- 2) Where is the edge of the "ridge crest"? How does it vary with time? How does it vary according to processes (tectonically active zone vs volcanically active zone vs hydrothermally active zone)?
- 3) What is the contribution of diffuse "cold" flow on the heat budget and on mineralisation?
- 4) What are the integrated processes that control the architecture of a subducting plate?
 - a. What is the extent of serpentinisation and how far off-axis is this process active? Does it stop before the plate enters subduction?
 - b. What is the lifetime of an abyssal hill? How are abyssal hills "rejuvenated" far from plate boundaries?
 - c. What characteristics of the ocean plate architecture created near the axis influence the behaviour of the subducting plate?

1) How do the accretion-driven processes (faulting, volcanism, hydrothermal circulation, and ecosystem dynamics) evolve, diminish, or change character with increasing distance off-axis?

The formation of new ocean crust is focused at the ridge axis and as this crust moves off-axis it undergoes fracturing and faulting that is determined by the spreading rate. Major normal faults at slow-spreading ridges begin to grow at ~2 km off-axis, and complete most of their growth by perhaps 10 km off-axis. At fast-spreading ridges, signs of active faulting have been recorded up to 35 km off-axis. Fast-spreading ridges lack the deep fault controlled axial valley associated with slow-spreading ridges. These faults may provide conduits for deeper hydrothermal circulation on slow-spreading ridges. Most volcanism at slow spreading ridges is focused in a narrow (axis +/- 2 km) zone, and any outlying volcanism appears to be confined to the median valley (axis +/- ~20 km). At fast-spreading ridges, most lavas are erupted in a narrow axial zone, but some flow down the rise flanks to distances of kms or 10s

of kms off-axis. At all spreading rates, off-axis, point-source volcanism (seamounts) can occur anywhere in the plate where there is a suitable magmatic source (e.g. Hawaii). Evidence is being gathered that show that there maybe some extrusive flows on the ridge flanks. Hydrothermal systems evolve by clogging of the fractures and faults in the ocean crust by mineral precipitation and by the reduction of mass-flux through the less permeable sedimentary cover whose thickness increases with crustal age. Off-axis seamounts that penetrate through this cover are still hydrothermally active and can be sites of either cold water inflow or warm water outflow.

2) Where is the edge of the “ridge crest”? How does it vary with time? How does it vary according to processes (tectonically active zone vs volcanically active zone vs hydrothermally active zone)?

The definition of the edge of the “ridge crest” is likely to be as fraught as identifying the continent-ocean boundary or the Moho. At the ridge, the volcanic, tectonic and hydrothermal zones are closely linked but the processes that determine their spatial extent are different and dependent on the spreading rate. However, hydrothermal activity can potentially occur anywhere there is a suitable heat source and permeability structure. For example, low-temperature hydrothermal activity occurs at the Lost City Vent Field, 15 km away from the magmatic axis of the Mid-Atlantic Ridge while at the Mid-Cayman Spreading Centre high-temperature venting occurs on Mt. Dent, also 15 km from the volcanic axis.

3) What is the contribution of diffuse off-axis “cold” hydrothermal flow on the heat budget, mineralisation and alteration of the oceanic crust?

Diffuse heat flow from off-axis oceanic crust and around seamounts is likely to be significant and may account for more than that in the immediate vicinity of the ridge-axis, although few constraints exist on this topic. Attempts to quantify this contribution are required.

4) What are the integrated processes that control the architecture of a subducting plate?

Subducting plates are mostly comprised of oceanic lithosphere formed at a mid-ocean ridge. Their thickness, structure and evolution are dependent on several aspects including spreading rate, off-axis volcanism, hydrothermal cooling, ridge segmentation and fracture zones. The mantle component of the plate is partly depleted in composition by extraction of the melt that formed the crust at mid-ocean ridge. The mafic part of the plate varies in thickness and structure from a layered ~7 km thick sequence (for spreading rates >5 cm per yr) to a mixture of peridotite and gabbro, often capped by basalt (for spreading rates <2 cm per yr). The mafic part of the plate also undergoes alteration, hydration and mineralisation. As the oceanic plate cools over time, while travelling towards the subduction zone, the lithosphere becomes thicker (being mostly defined thermally). Hydrothermal circulation continues to alter the upper plate chemically, with high-temperature hydrothermal circulation at the MOR, colder fluid interaction at abyssal seafloor, and again, greater fluid interaction just before subduction when bending of the plates induces extensional cracking. The specific questions in relation to these issues are:

a. What is the extent of serpentinisation and how far off-axis is this process active? Does it stop before the plate enters subduction?

Serpentinisation occurs when water is in contact with mantle rocks. It is observed at slow and ultra-slow ridges on axial valley walls, on ocean-core complexes and at fracture zones. It occurs again as the plate enters a subduction zone as bending opens fractures in the crust and provides a conduit for water to enter the upper mantle. This alteration may facilitate the subduction process by weakening the lithosphere and, as the downgoing slab is heated, provide a source of water to promote melting in the overlying mantle wedge. Observations from ophiolites show that serpentinisation can occur down to 10+ km.

b. What is the lifetime of an abyssal hill? How are abyssal hills “rejuvenated” far from plate boundaries?

Once formed in the axial zone of a mid-ocean ridge by a combination of volcanic and tectonic processes, abyssal hills become progressively buried by sediment. The small abyssal hills formed at fast-spreading ridges are tens to ~200 m high, so could be buried under thick sediments after several tens of millions of years (depending on sedimentation rate). They can be rejuvenated by the bending and fracturing of the plate as it enters a subduction zone. It appears that new faults are formed in such situations, but perhaps some old ones bounding abyssal hills might be reactivated. Abyssal hills may also be rejuvenated by propagating ridges. The interplay between old axial faults and rejuvenated ones has implications for seismicity, fluid flow and possible mineralisation of the crust.

c. What characteristics of the ocean plate architecture created near the axis influence the behaviour of the subducting plate?

When the mid-ocean ridge axis is anomalously hot or fertile, mantle material may melt to a larger degree, and a thicker-than-normal oceanic crust is formed in the so-called 'aseismic ridges' (such as the Nazca and Juan Fernandez Ridge near South America, but also Iceland). Such a thicker crust is buoyant and tends to resist subduction, in a similar way as subducting continental blocks do. Extensive intraplate volcanism (i.e. erupted away from the mid-ocean ridges and subduction zones, such as Hawaii) can also cause a thickened crust with similar subduction-resisting properties. Seamounts, like those on the Louisville ridge, also disrupt the subduction process and may temporarily lock-up the subduction process, increasing the likelihood of major earthquakes when failure eventually occurs.

Implementation:

- a. Develop predictive models to identify critical areas where off-axis processes can be observed.
- b. In such a vast area every opportunity should be exploited to collect data off-axis.
- c. AUV surveys of near-axis areas with ultra high-resolution bathymetry and profiling.
- d. Better use of transit routes: systematic coverage of ridge flanks, and collection of bathymetry data for all cruises and transits.
- e. Develop methods and tests for extrapolation from local to regional or global estimations of fluxes.
- f. Improve monitoring of hydrothermal vents to capture spatial distribution and temporal variation of fluxes: better estimate of the global fluxes.

SECTION F PAST, PRESENT, AND FUTURE OF VENT ECOSYSTEMS

Background:

The past 30 years have seen hydrothermal vent communities revolutionise our view and understanding of deep-sea biology. These spatially restricted communities harbour biomass many orders of magnitude greater than that of surrounding deep-sea environs. Moreover, many of these communities contain endemic species of microbes to metazoans with specific adaptations to cope with the challenging environmental conditions. The ongoing discovery of new sites, in new ridge systems, adds species diversity and complements our understanding of these systems at large.

Recent years have seen the emergence of new techniques in DNA sequencing that have enabled genomic sequencing, transcriptomic, proteomics, and metabolomics from more and more species (microbes to megafauna). These technologies provide us with new perspectives and data to address fundamental questions regarding the evolution of vent species, the ongoing processes of selection and speciation, the connectivity of vent communities, and the potential effects of global change on the survival of these biological assemblages. Recently, hydrothermal sulfide deposits have attracted a lot of attention from mining companies (both in national and international waters), with exploration permits covering active and inactive sites. Exploitation could, in the near future, become widespread with mining activities in the Manus Basin scheduled to begin in early 2013. In this context, it is increasingly urgent to better understand the forces that drive species evolution and community structure at vents and consequently, the susceptibility of individual species, vent communities and the ecosystem function to anthropogenic impacts.

Primary questions:

- 1) What are the molecular bases for physiological and life history adaptations to hydrothermal vent conditions? When did these adaptations occur?
- 2) How did these adaptations affect and yield the diversity of vent organisms?
- 3) How did past global environmental changes (e.g. global deep-sea anoxia) affect the evolution of vent species?
- 4) How does the dynamic nature of hydrothermal vents affect the evolution of species?
- 5) How resilient are vent species/communities and how may they be affected by deep-sea mining?
- 6) Could global change affect vent species and their function in the ecosystem? On what time scales?

The following questions represent some of our knowledge gaps regarding the evolution of vent communities, current connectivity and susceptibility to anthropogenic changes that can be addressed by the InterRidge community:

1) What are the molecular bases for physiological and life history adaptations to the hydrothermal vent conditions? When did these adaptations occur?

Vent conditions, including low oxygen, variable - and sometimes high - temperatures, radioactivity, potential toxins such as heavy metals and sulfide, and extreme gradients can all be challenging for the survival of organisms. This explains, at least in part, the very high degree of endemism encountered at hydrothermal vents. High throughput genome and transcriptome sequencing allows comparative genomics studies that can point to key mutations in the adaptation of vent organisms. Reconstruction of ancestral states during these analyses can allow the determination of the timing of such adaptations, and relate them to changes of environmental conditions or community composition. Symbioses have

evolved in different taxonomic groups and they represent a very large proportion of the biomass. Understanding how they evolved and what are the molecular adaptations they require could be addressed with similar approaches.

2) How did adaptations to vent conditions affect and yield the diversity of vent organisms?

The current biodiversity at hydrothermal vents is the result of complex processes that allowed speciation (allopatric and parapatric), with possible secondary connections of populations driven by tectonic events. The sharp gradients over small scales of space and time, along with the succession of numerous extinctions and recolonisations, likely drive rapid speciation. The study of the connection between adaptation and speciation can be tackled at the molecular level (partial or whole genome sequencing), and can only be understood in a solid geological context of the history of plate tectonics (typically over the past 250 million years) to understand secondary contacts of populations.

3) How did past global changes (e.g. global deep-sea anoxia) affect the evolution of species?

Some of the great extinctions in the deep-sea were the result of global environmental change. These changes affected not only temperature but also oxygen concentrations. Reduced oxygen events may have been widespread in the deep sea during the Mesozoic era and consequently may have influenced the evolution of deep-sea fauna. However, there are considerable gaps in our understanding of the origin, evolution and divergence of vent species and/or their adaptations. In particular, phylogenetic relationships with other deep-sea fauna often remain unclear. Only the most emblematic taxonomic groups have been studied to date and only tell part of the story.

4) How does the dynamic nature of hydrothermal vents affect the evolution of species?

Hydrothermal vent chimneys and sites have a limited persistence, and their biological communities are also adapted to life in a short-lived habitat. These extinctions followed by recolonisations form a succession of founder effects that can reduce diversity at a given site but also allow gene combinations otherwise unlikely to occur. This could allow the exploration of the adaptive landscape and could have very strong effects on the evolution of species. The genetic diversity of colonisers at a new site and its relationship with other populations has not been studied to date. Only mature sites, with an overlap of generations, have been studied to date.

5) How resilient are vent species/communities and how would they be affected by deep-sea mining?

Although adapted to episodic extinction of sites, the ability of vent species to disperse, as well as the critical population size to allow recovery from perturbation, have not been studied in most species. A wealth of information is available on some species but they do not represent all taxa, or all reproductive strategies (eg. direct vs. indirect development, large vs. small oocytes). Reproductive and dispersal strategies need to be studied in a wide variety of species. The episodic disturbance that characterises vent sites will not affect all species equally and thus the ecological balance that sustains the coexistence of species with similar niches, and with similar function in vent communities, is likely to be sensitive to both the frequency and intensity of disturbance. This is particularly important in the context of deep-sea mining because long-term and large spatial scale effects are likely with the exploitation of sulfides that host the communities.

6) Could global change affect vent species, and if so on what time scales?

In the context of global change, the vent ecosystems seem far from harm. However, little is known of the potential effects of warming, acidification, and increasing hypoxia of the oceans

on the vent communities. Although the deep-sea water surrounding hydrothermal vents is unlikely to be affected for many years to come, it is formed at the poles and its temperature is likely to increase. Once this water is formed, it will continue on its tracks and eventually reach the vent communities. The highly dynamic character of the environment (with different degrees of acidification, hypoxia and temperature) would suggest the effects would be minimal. However, if the species already live on the edge of their capacity to cope, then a minor change could have strong detrimental effects. This is especially true of symbiotic species that are dependent on fluid emissions for their symbionts and may not be able to cope with additional challenges. This would require thorough experiments on the physiology and response of a wide variety of species. The current genetic diversity within species (adaptive polymorphism) also needs to be evaluated to predict survival and adaptability of the species. The deep-sea water parameters will need to be monitored to determine the surrounding hydrothermal vents and the deep sea in general.

Implementation:

- a. The urgency due to the start of deep-sea mining requires an increased effort, in particular for studies of connectivity between populations, the function of the different species in the community and ecology in general.
- b. Connectivity studies would be facilitated with an increased effort towards transcriptome/genome sequencing. This sequencing effort will also benefit other fields of research including understanding adaptations to the vent environment and the evolution of these adaptations, as well as the history of vent phyla and communities. Understanding the evolutionary history of these species will help us predict their future.
- c. Experimental work on live animals to determine their physiological limits remains a basic need and many species need to be studied to better understand the spectrum of adaptations.
- d. Studying the physiology of animals under pressure remains a technological challenge and InterRidge could help in the dissemination of such technology.
- e. Although some species have been very well studied, most have not. We need to increase the phylogenetic coverage of studies of physiology, tolerance, reproductive/dispersal strategies and their ecological function in the community.