InterRidge News

Vol. 1, No. 1

Spring/Summer 1992

Second formal InterRidge meeting held in York, March 1992

Representatives of ten InterRidge countries (Australia, Canada, France, Germany, Iceland, Japan, Portugal, Spain, United Kingdom, and United States) met in York, UK, on March 11-13, 1992. Representatives of other invited countries (Italy, Norway, CIS, India, and South Korea) were unable to attend. N. Holm (Sweden; chair of SCOR WG 91 on chemical evolution and origin of life in marine hydrothermal systems) participated as a SCOR scientific liaison, and J. Bender as an ODP liaison. The meeting was hosted by J. Cann of the University of Leeds.

The principal goal of the meeting was to reach agreement on a Program Plan for InterRidge, and to establish the framework for its implementation over the coming decade. Major items on the agenda were:

- Specific themes or projects, if any, on which InterRidge should concentrate its efforts during the first part of the decadal program;
- Levels of InterRidge coordination appropriate to these projects;
- Organization and administration of InterRidge;
- Schedules for program development and implementation.

The supporting document for the meeting was an updated version of the InterRidge Draft Program Plan. A previous version was widely circulated for comments in December 1991, and a summary was published in *RIDGE Events* of Fall 1991.

Meeting participants agreed on three principal themes on which the program should focus during its active phase: global studies, meso-scale (regional) studies, and active processes. Working groups will be established around these themes to develop appropriate project plans and to coordinate actions as necessary.

The draft program plan was accepted by participants after discussion and incorporation of proposed amendments. This plan will be circulated to National Correspondents in June 1992; please contact the appropriate Correspondent for a copy.

Attendees agreed that a proactive, adequately supported InterRidge Office is essential to achievement of InterRidge goals. Functions that should be served by an InterRidge Office include creating an effective, broadly international context for ridge research, facilitating information exchange (including a data catalogue and cruise trackline/station information), and organizing general meetings and workshops. It was agreed that the InterRidge Office should remain at the University of Washington for 12-18 months, and then move to the home institution of a non-US InterRidge Co-Chair.

Copies of the full meeting report may be obtained from the InterRidge Office, from National Correspondents, or from Steering Group members (listed on page 26 of this issue).

Contents

InterRidge News is published by the InterRidge Office, School of Oceanography, WB-10, University of Washington, Seattle WA 98195 USA; phone-(206) 543-9893, fax-(206) 685-0596, Omnet-INTER.RIDGE, Internet-intridge@u.washington.edu, telex-7402021 GLBL. Trileigh Stroh, Editor.

Ridge Research Around the World

Segmentation of the Mariana Trough Back-Arc Spreading Center at 18°N

Laura S. L. Kong[1], Nobukazu Seama[2], Hiromi Fujimoto[2], Junzo Kasahara,[3] and KH92-1 Shipboard Scientific Party

[1]NOAA / Pacific Tsunami Warning Center, Ewa Beach, HI 96706
[2]Ocean Research Inst., Univ. of Tokyo, Tokyo 164, Japan
[3]Earthquake Research Inst., Univ. of Tokyo, Tokyo 113, Japan

KH92-1 Mariana Trough Survey

In order to establish the actively-spreading Mariana Trough back-arc spreading center at 18°N as a regionally well-characterized natural geological and geophysical seafloor observatory, a detailed geophysical survey was conducted in January, 1992, aboard the *R/V Hakuho Maru* (Ocean Research Institute, University of Tokyo). During the 100-hr KH92-1 survey, which was part of a 19-day multi-disciplinary cruise that included Mariana forearc and Ayu Trough studies, data were collected through multi-narrow beam SeaBeam bathymetry, shipboard 3-component and ship-towed total force magnetometer, ocean bottom seismometer (OBS), refraction and seismic reflection, and gravity measurements along a 100-km long region centered about the spreading axis and extending northward from the Pagan Fracture Zone (Figure 1). Along-axis variations in median valley morphology and rift-axis segmentation at this slow-spreading center were mapped, and the dominant wavelengths and amplitudes of rift mountain topography documented using coverage that extended 20-25 km outside the valley. The high-resolution bathymetric survey proved essential for selecting and successfully deploying the OBSs for the seismic experiment, and for accurately locating the shooting line along the crest of the Axial Ridge, suggested by Hawkins et al. (1990) as the most likely along-axis locale for an active magma chamber from petrological data and ALVIN observations of hydrothermal vent deposits. A 500-km long west-east geophysical profile (Parece Vera Basin to Mariana Trench) was collected to investigate density structure, and to characterize the location for a ocean-floor geophysical station which will scientifically reuse the old TPC-1 trans-Pacific telephone cable (Japan to Guam) passing about 80 km west of the Mariana Trough axis at 18°N (IRIS Steering Committee for Scientific Use of Submarine Cables, 1992).

➢

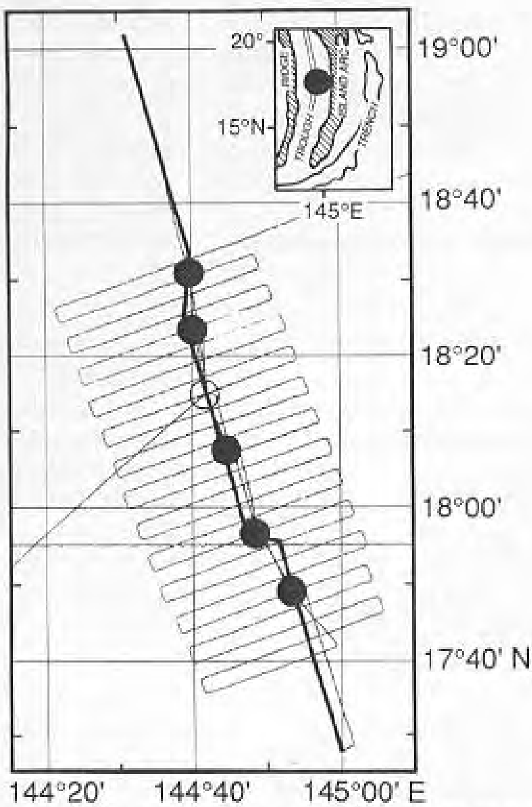


Figure 1. *Mariana Trough KH92-1 SeaBeam ship track (thin line), 185-km air gun seismic line (two 12-liter sources, 80 m shot spacing, thick line), and OBS locations (circles). Two OBSs, one digital and one analog-recording instrument, were deployed at 17°57'N. Open circle indicates unrecoverd OBS. The seismic experiment along the neovolcanic zone was designed to correlate along-axis variations in crustal structure with the ridge segmentation. Inset shows experiment location.*

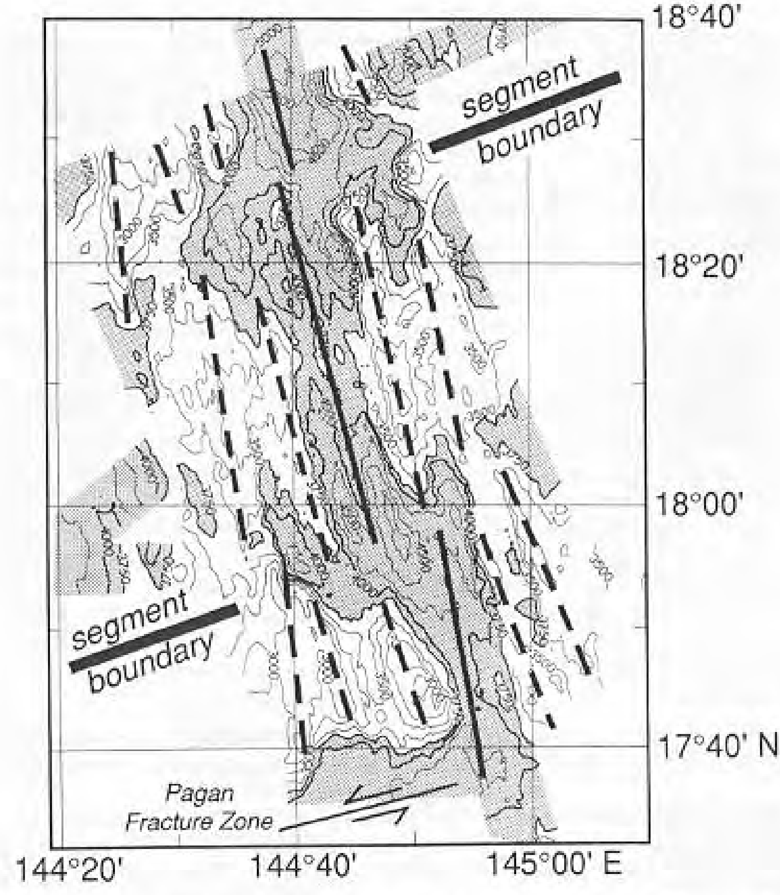


Figure 2. *SeaBeam bathymetry (250 m contour interval) and tectonic interpretation. The 3750 m contour line and shaded area delineate the median valley, and the 4000 m contour line outlines the location of the Axial Ridge Segment centered at 18° 12'N. Thick solid lines show the axes of morphologically-defined ridge segments marking the neovolcanic zone within the median valley, and thick dashed lines show the locations of prominent off-axis topographic highs.*

This near-complete geophysical coverage along the 100-km length of Mariana Trough allowed comparison of its characteristics with those of the well-studied MARK area (Mid-Atlantic Ridge at Kane Fracture Zone, 23°N) on the Mid-Atlantic Ridge, and for the first time, to investigate the crustal accretion process at two slow-spreading centers forming under different tectonic scenarios (back-arc spreading center and mid-ocean ridge). Preliminary results show a number of similarities which indicate that crustal construction and trough evolution at this back-arc spreading center is indistinguishable morphologically and magnetically from those characterizing the mid-ocean ridge.

SeaBeam and Three-Component Geomagnetic Field Data

Altogether, over 1700 km of SeaBeam data, primarily encompassing a *50 by 100 km area centered about the* ridge axis, were collected during the 46-hour bathymetric survey and the ensuing seismic experiment (Figure 1). About 80% areal coverage was obtained using a 4-km track spacing and 16 kt ship speed (sample interval ~125 m). A Magnavox Series 5000 navigation system utilizing Kalman filtering gives the best ship location and speed using several navigational sensors; Global Positioning System data were generally available 24 hours a day. Visual examination of SeaBeam track crossings in areas of steep topography to estimate the ship's navigation accuracy showed good correlation, suggesting errors were minimal (< 50-100 m). Real-time interpretations were made possible through real-time color displays on a computer workstation, 4-color pen plotter, and roll chart recorder. Merging and plotting of the entire data set on a large-format color electrostatic plotter was accomplished at sea using Uniras software.

Underway shipboard three-component magnetometer (STCM; Isezaki, 1986; Seama et al., 1992) data were col*lected using three shipdeck-mounted or*thogonal fluxgate magnetometers. Information on the magnetic structure of oceanic crust is obtained by measuring only the relative changes in the magnetic field vectors, which are often more accurately measured than the absolute values. The collection of three-component, instead of total-intensity, data is also desirable because its amplitudes are not affected by the direction of the reference geomagnetic field and strike of the magnetic lineations. In the Mariana Trough area, vector amplitudes of the east and vertical components of the magnetic anomaly field ranged up to 600 nT (Figure 3a).

Continuously-logged precision gyrocompass information along with the 1985 International Geomagnetic Reference Field were used to calculate each component's magnetic anomaly field from the 1-second sampled data, which was then filtered and resampled at one-minute intervals to remove short-wavelength anomalies. Magnetic structural boundary locations (MBSD, Figure 3b), resulting from magnetic polarity reversals or *changes in topography, correspond to* peaks in the intensity of the spatial differential vectors; the strike of the boundary parallels the direction of the zero-value of the magnetic field component.

➤

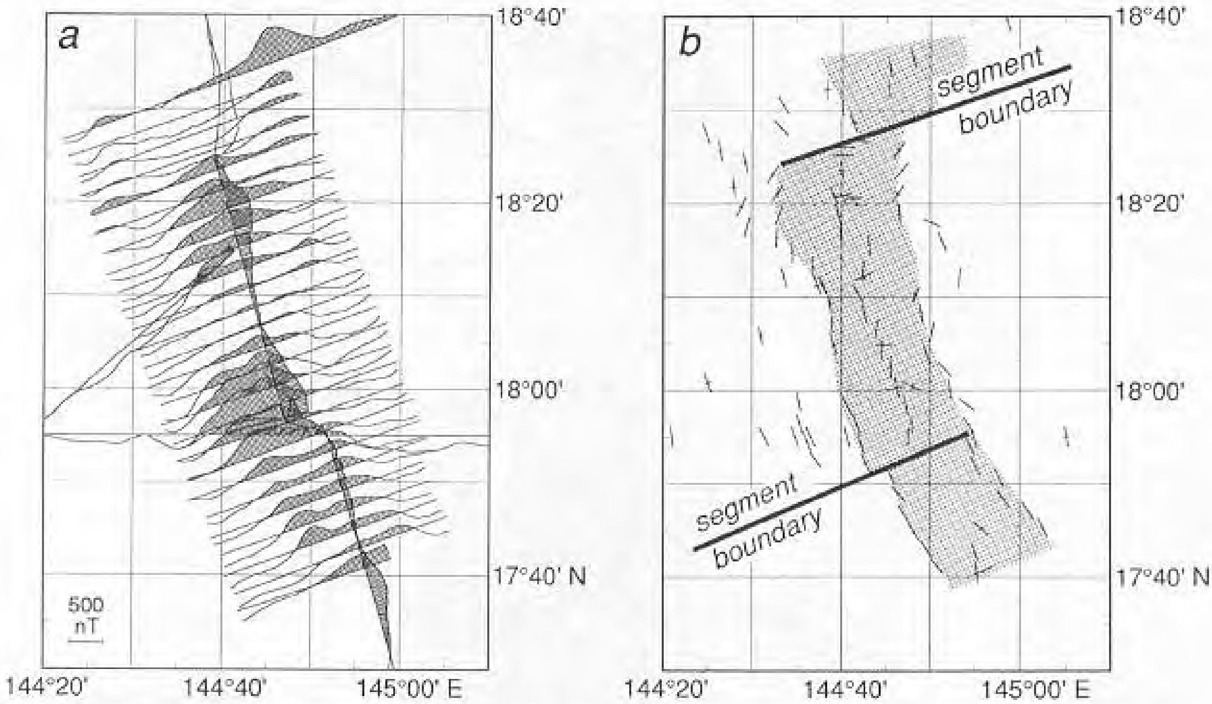


Figure 3. (a) Profiles of the vertical component of the magnetic field anomaly along the ship's track (which is plotted as the zero value datum for the anomaly). Positive values (shaded area) roughly correspond to zones of normally-magnetized crust.

(b) Magnetic Boundary Strike Diagram (MBSD). Locations (crosses) and strikes (longer line of each cross) of magnetic boundaries. The shorter line of the cross corresponds to twice the standard deviation in the strike declination. Stippled areas show regions of normal magnetization. Magnetically-defined ridge segmentation agrees with the morphologically-defined segmentation (Figure 2).

Median Valley Segmentation

Three ridge-axis spreading segments marking the neovolcanic zone were found within the median valley from 17°40'N to 18°35'N (Figure 2). The median valley (taken as the 3750 m depth contour) narrows and widens along axis, being narrowest adjacent to the Pagan Fracture Zone and at the Axial Ridge Segment center (9 km), and widest at the segment boundaries (20-25 km). Magnetically-defined segments are well-correlated with the locations of the morphologically-defined segments (Figures 2, 3). This ridge-axis segmentation is consistent with earlier interpretations based on less-comprehensive U.S. Naval Oceanographic Office bathymetry data (Hawkins et al., 1990; Lonsdale, unpublished manuscript). The segment boundaries, small (5-8 km) non-transform discontinuities, are recognizable in the magnetic structure as abrupt changes in the MBSD strikes at 18°25'N, 144°41'E, and as offsets in the magnetic strikes at 17°52'N, 144°44'E (Figure 3b); structural boundary locations related to topography (Axial Ridge) do not represent segment boundaries. The width of the normally-magnetized zone is relatively constant (19-24 km), but its location and strength vary along the axis, attaining a minimum near 18°07'N.

Numerous circular to elliptical contours interpreted as small volcanic cones can be identified within the median valley. Statistics for 40 cones (avg diameter = 1.1±0.7 km, elongation [ratio of basal length to width] = 1.8±1.3, height / mean radius = 0.13±0.07) are similar to those found for 65 MARK area Mid-Atlantic Ridge volcanoes (1.2±0.5, 1.3±0.3, 0.14±0.05, respectively; Kong and Cann, unpublished manuscript). This suggests that the processes responsible for volcano formation may be the same at a back-arc spreading center as at a mid-ocean ridge. The topographic relief characterizing the segments (63-km long Axial Ridge - 840 m, 34-km long Southern Segment - 330 m) also agree with the linear correlation found along the Mid-Atlantic Ridge from 24°-30°N (Lin et al., 1990).

The 100-km long study region is dominated by an axial ridge (Figure 2, 4000 m depth contour) traceable as a N164°E-trending line of volcanic cones (3 km avg spacing, 70 m avg height, 4 km avg basal diameter). The ridge crest from 18°10'-18°14'N exists as a 2-km wide plateau topped by several volcanic cones (<3750 m) where ALVIN dives have discovered high- and low-temperature hydrothermal venting (Hawkins et al., 1990). The vertical magnetic field strength is markedly subdued from 18°05'-18°12'N (north-south profile, Figure 3a). Similar magnetic anomaly minima near hydrothermal fields have also been observed in the MARK area (Schultz et al., 1988), and TAG area (Mid-Atlantic Ridge, 26°N, McGregor et al., 1977). The presence of hydrothermal activity suggests that the low magnetization may be caused by crustal temperatures above the Curie temperature, or the destruction of magnetic characteristics through hydrothermal alteration. The axial ridge morphologic character, including its elevation, linear shape, and distribution and shapes of volcanic cones, is comparable to that found in the MARK area (Kong et al., 1988), indicating that the slow spreading rate, independent of regional tectonic setting, may be the determining factor in the topographic construction.

The Southern Mariana Trough segment is offset 8 km to the east of the Axial Ridge segment (Figures 2, 3). The segments are separated by a morphological deep (> 4900 m), coincident with a notice-

➤

able decrease in the vertical component magnetic field strength and an offset to the east in the location of the central magnetic anomaly. This segment is characterized also by a N164°E trending line of volcanic cones (65 m avg height, 1.1 km avg basal diameter). The Southern segment, in contrast to the linear Axial Ridge segment, has a more sinuous character that indicates more dispersed volcanic construction. The southern segment terminus can be traced as a 100-m high ridge into the Pagan Fracture Zone Trough.

The Northern Marianas Trough segment is less well documented because of the limited amount of SeaBeam and magnetic data. The trough axis is offset by 5 km to the east from the Axial Ridge segment, and dominated by a morphologic deep (5400 m at 18°36'N, 144°39'E) at its southern terminus (Figure 2, 4500 m depth contour). Magnetic structural boundaries (Figure 3b) are probably related to the extreme topography associated with the valley walls.

Rift Mountain Segmentation

To both the east and west of the Axial Ridge segment, two sets of axis-parallel rift mountain topographic highs can be identified (Figure 2, thick dashed lines). The features are similar in elevation and shape (several 100 m high, tapering and deepening toward the distal ends) to those of the Axial Ridge, and have a remarkably constant across-axis spacing (8-11 km) that suggests a temporal variation in the processes that control ridge construction (either by magmatism and/or tectonic faulting). Assuming an average half-spreading rate of 15 mm/yr based on the observed width of the zone of normal magnetization, this spacing corresponds to a 0.5-0.7 Ma variation. Similarly-spaced rift mountain features are also present to the north and south of the segment boundaries (Figure 2).

The along-axis length of crestal mountain topographic highs also appears to be relatively constant (30-45 km) and shallowest toward the segment midpoint, revealing a spatial variation in the amount of the constructed topography or availability of magma. Furthermore, comparison of the locations of the ridge segments within the median valley with those inferred off-axis (rift mountains) shows that the segmentation boundaries are fixed in this study area. Regularly-spaced rift mountain topography coincident with the latitudes of inferred ridge segments is also characteristic of the slow-spreading Mid-Atlantic Ridge (e.g., MARK area, Kong et al., 1988).

REFERENCES

Hawkins, J. W., P. F. Lonsdale, J. D. Macdougall, and A. M. Volpe, Petrology of the axial ridge of the Mariana Trough backarc spreading center, *Earth Planet. Sci. Lett.*, *100*, 226-250, 1990.

IRIS Steering Committee for Scientific Use of Submarine Cables, Scientific use of submarine telecommunications cables, *EOS*, *73*, 97, 1992.

Isezaki, N., A new shipboard three component magnetometer, *Geophysics*, *51*, 1992-1998, 1986.

Kong, L. S. L., R. S. Detrick, P. J. Fox, L. A. Mayer, and W. B. F. Ryan, The morphology and tectonics of the MARK area from SeaBeam and SeaMARC I observations (Mid-Atlantic Ridge 23°N), *Mar. Geophys. Res.*, *10*, 59-90, 1988.

Lin, J., G. M. Purdy, H. Schouten, J.-C. Sempéré, and C. Zervas, Evidence from gravity data for focused magmatic accretion along the Mid-Atlantic Ridge, *Nature*, *344*, 627-632, 1990.

McGregor, B. A., C. G. A. Harrison, J. W. Lavelle, and P. A. Rona, Magnetic anomaly pattern on the Mid-Atlantic Ridge crest at 26°N, *J. Geophys. Res.*, *82*, 231-238, 1977.

Schultz, N. J., R. S. Detrick, and S. P. Miller, Two and three-dimensional inversions of magnetic anomalies in the MARK area (Mid-Atlantic Ridge 23°N), *Mar. Geophys. Res.*, *10*, 41-47, 1988.

Seama, N., Y. Nogi, and N. Isezaki, A new method for determining position and strike of magnetic boundary using vector data of the geomagnetic anomaly field, *Geophys. J. Int.*, submitted, 1992.

Sedimentary processes on the Kolbeinsey Ridge

Hans-Joachim Wallrabe-Adams, Klas S. Lackschewitz and Jorn Thiede
GEOMAR Research Center for Marine Geosciences, Wischhofstr. 1-3, D-2300 Kiel 14, F.R.G.

In 1988 a ridge-related joint project between GEOMAR, the Geological Institute (P. Stoffers), the Geophysical Institute and the Institute of Applied Physics (University of Kiel) began to investigate the geology of the Kolbeinsey Ridge north of Iceland This project, called "The Greenland-Scotland Ridge: modern geodynamics of the world's ocean most important hot spot system", was funded by the German Ministry of Research and Technology. Termination of the project was December 31, 1990. Scientific interest was focused on the aseismic Iceland-Faeroe ridge and on the active mid-ocean ridge segment between Iceland and Jan-Mayen (Kolbeinsey Ridge, Fig. 1).

As part of this project, scientists from GEOMAR focused on the investigation of sediment composition and distribution in the vicinity of the Kolbeinsey Ridge. Of pronounced interest were the relations between volcanic, hydrothermal, detritic and biogenic particle input and the resulting sedimentary deposits. Dating and correlation of sediment layers allowed us to reconstruct changing depositional process in space and time. Geochemical investigations have been used to elucidate elements or element groups suitable for characterizing these different depositional processes.

Investigations in the target area performed during five expeditions led to a better understanding of depositional processes near the ridge crest. The geotectonic-structural character of the mid-ocean ridge as well as the oceanographic and climatic processes are highly important inter-regional factors influencing the depositional processes. Of more local importance are the morphological structure, depth and volcano-tectonic activities of ridge segments. In detail, ridge crest morphology and small-scale current systems which depend on this morphology play an important role by controlling sediment distribution patterns, sediment transport and the maintenance of ecological niches for sessile benthos (foraminifers, sponges).

In the southernmost part of the Kolbeinsey Ridge, explosive volcanic activity, the appearance of which is highly dependent on water depth, provides the most important contribution to sedimentary deposition. North of the Spar Fracture Zone, deposition is mainly of pelagic character. The Spar Fracture Zone itself is characterized locally by typical sediments due to its extreme morphology. In addition, presumably hydrothermal processes in the vicinity of the Spar Fracture Zone and the southern Kolbeinsey Ridge caused remarkably high concentrations of As (up to 300 ppm) and Ba (up to 6000 ppm) at different stratigraphic levels. Recent low-temperature hydrothermal activity near Kolbeinsey Island leads to Fe-rich precipitates in this area (D. Stuben and P. Stoffers, pers. comm.).

Sediments sampled in regions distant from the ridge crest exhibit an increasing clay content occurring parallel to a color change from gray-black to olive-gray.

Between Iceland and ca. 68° N, sediment cores located west of the ridge axis exhibit a primarily pelagic succession of sandy-silty clays to sandy silts with typical dark-brown colors. East of the ridge crest, sediments are more olive-gray, which is related to higher portions of volcanic material.

Obviously, north of ca. 68° N the volcanic material is distributed less homogeneously over the ridge area, but is locally more concentrated on the western side. This is probably due to the complex hydrodynamic and oceanographic situation in this area.

The experiences from these investigations are the basis for future studies in the Reykjanes Ridge between 57° and 59°N (Fig. 1), starting in late 1991 (3-year study of "MOR sediments": financial support by the German Ministry of Research and Technology).

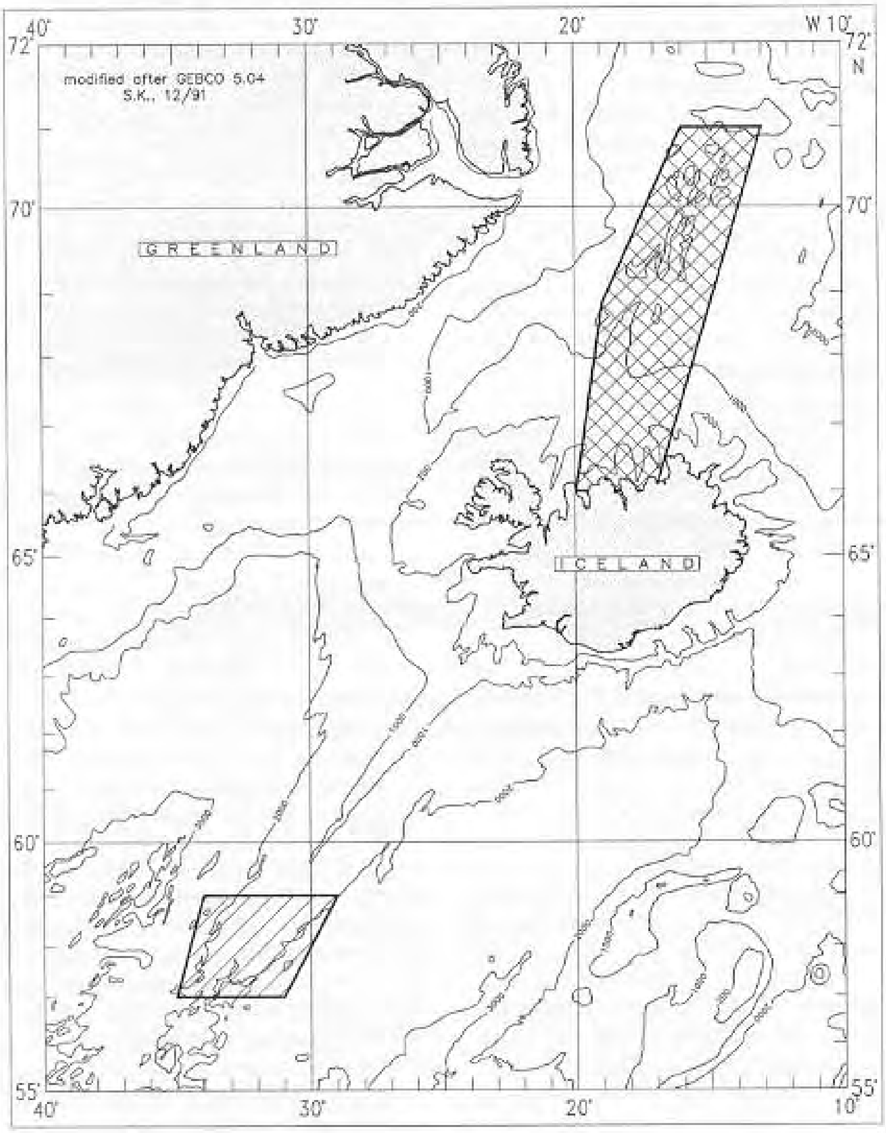


Figure 1. Area of investigation during the Greenland-Scotland Ridge Project 1988 - 1990 (Kolbeinsey Ridge, N. Iceland) and the location of the future study area on the southern Reykjanes ridge between 57° N and 59° N.

The PACMANUS/PACLARK Program: Search for Modern "Kuroko-Type" Analogues in the SW Pacific

Graeme Wheller[1], Ray Binns[1], and Steve Scott[2]
[1]CSIRO Division of Exploration Geoscience, PO Box 136, North Ryde, 2113, NSW, Australia
(Internet: graemew@syd.deg.csiro.au)
[2]Department of Geology, University of Toronto, Toronto, M5S 3B1, Canada
(Internet: scottsd@ecf.utoronto.ca)

The PACMANUS/PACLARK collaborative research program involves research institutions and universities in Australia, Canada and Papua New Guinea. Co-Chief Scientists are Ray Binns (CSIRO) and Steve Scott (University of Toronto). Its primary aim is to study the origins and geological environments of modern seafloor hydrothermal deposits hosted by felsic volcanics, in order to improve exploration for ancient VMS and exhalative ore deposits on land. Commencing in 1986, the program has involved five cruises by *R/V Franklin*, *HMAS Cook* and the *R/V Akademik Mstislav Keldysh* with its MIR submersibles to the Woodlark and Manus Basins near Papua New Guinea (Fig. 1).

The highlight of the program so far is the October 1991 discovery of the actively-forming PACMANUS polymetallic sulfide field at 1650 m depth in the eastern Manus Basin (Binns and Wheller, 1991). The field extends discontinuously along an area almost 3 km long and 400 m wide. It includes sulfide chimneys and mounds and anoxic vent fauna and is forming along the crest of a prominent seafloor ridge composed of dacite flows and domes in a complex back-arc and plate boundary environment. Chimneys are up to 4 m high. Andesitic and rhyolitic volcanics occur nearby while basaltic lavas form neighbouring volcanic structures. The site is one of the closest modern analogues to ancient VMS deposits hosted largely by felsic volcanic rocks.

In both the Manus and Woodlark Basins, submarine mafic lavas formed by seafloor spreading are closely juxtaposed with continental rocks as exposed on nearby islands. The incipient nature of spreading in both cases, and the presence of attenuated continental crust, introduces the possibility of extensive fractional crystallization of basaltic magmas and the formation of evolved felsic lavas.

In particular, in the Manus Basin, seafloor spreading occurs behind the New Britain island arc and marks the boundary between the Pacific and Bismarck plates (Taylor et al., 1991). Ma-

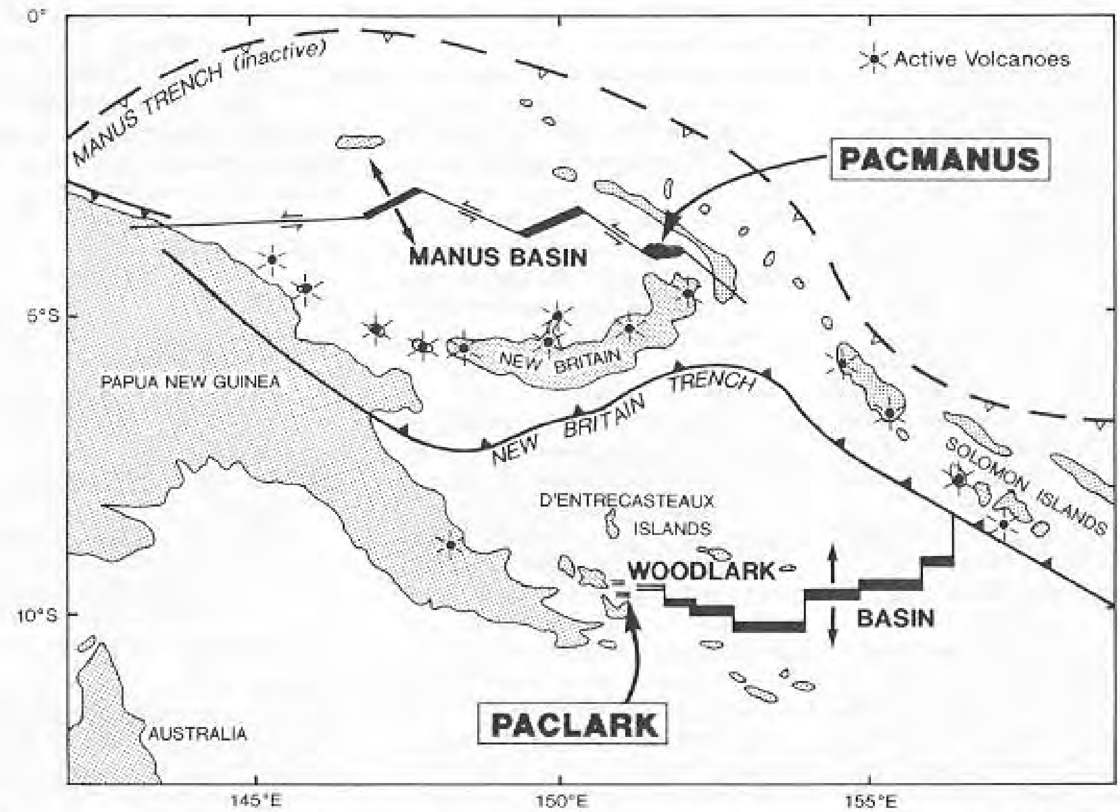


Figure 1. Locations of PACMANUS operations in the Manus Basin and PACLARK operations in the Woodlark Basin, Papua New Guinea.

jor northwest-trending transform faults bound a short spreading segment in the eastern Manus Basin from which previous expeditions had retrieved basaltic and dacitic volcanics and detected turbidity, Mn and CH_4 anomalies in the seawater column (Craig and Poreda, 1987; Crook, 1990; Sakai, 1991). This segment is 180 km east of the central Manus spreading ridge where active black smokers and sulfide chimneys and mounds have been photographed and sampled (Both et al., 1986; Tufar, 1990; Crook 1990).

The new PACMANUS field and its associated "smoke" plume were discovered using a deep-tow video/still camera system in conjunction with dredging, sediment coring, shipboard methane analysis and CTD-transmissometer traverses. Extensive collections of felsic volcanic host rocks were recovered by dredge. Small samples of sulfides from the field were obtained by an accidental collision of the camera system with an actively venting chimney.

One sample, probably from the chimney wall, contains subequal proportions of crystalline anhydrite and chalcopyrite. Another is a massive sulfide conduit lining, containing chalcopyrite (with bornite inclusions) replaced by tennantite and overgrown by sphalerite. Bulk assays are 10 and 30% Cu and 2 and 10 ppm Au respectively. Some dacite hyaloclastite fragments dredged from the vicinity are coated by manganiferous crusts. The dacites themselves have arc tholeiite or back-arc basin basalt (BABB) affinities.

Cruises to the Woodlark Basin focused on its western part near the D'Entrecasteaux Islands. In this area, the Woodlark Spreading Ridge (WSR) is propagating into the Cretaceous-Tertiary continental crust of Papua New Guinea. Formation of the ridge began more than 5 Ma ago as a result of complex microplate rotations caused by oblique convergence between the Pacific and Indo-Australian plates (Benes et al., 1989; Weissel et al., 1982). In the rift-tip region, new bathymetric data, combined with dredge, deep-tow camera and submersible observations and sampling, reveal the existence of a complex series of small, deep rift valleys separated by orthogonal faults, with intervening continental highs. One of the basins (East Basin) is floored by young volcanics and three volcanic seamount structures (Franklin, Cheshire and Dobu) occur in different parts of the tip area.

The submarine volcanics erupted from these sites include MORB-like basalts, Fe-Ti-basalts and andesites, as well as mildly peralkaline rhyolites. The rhyolites are similar to those erupted by now-dormant volcanoes on the D'Entrecasteaux Islands (Smith, 1976). Large-ion lithophilic element (LILE) enrichment relative to high-field-strength elements (HFSE) in the mafic rocks increases progressively from East Basin, through Franklin and Cheshire Seamounts to Dobu Seamount. East Basin basalts are similar to East Pacific Rise tholeiites in major-element composition but those from Franklin and Cheshire Seamounts are similar to Mariana back-arc lavas. The Dobu andesites are transitional to calc-alkaline in nature.

In the rift-tip region, new bathymetric data, combined with dredge, deep-tow camera and submersible observations and sampling, reveal the existence of a complex series of small, deep rift valleys separated by orthogonal faults, with intervening continental highs.

Overall, these differences, together with smaller variations within sites, imply source heterogeneity and multiple episodes of partial melting throughout the tip region, as well as low-pressure fractional crystallization. The source heterogeneity may have developed as a result of subduction along a putative "Trobriand arc" during the Tertiary (Wheller et al., 1990).

Hydrothermal deposits in the western Woodlark Basin occur only on the summit of Franklin Seamount (Binns et al., 1992; Binns et al., submitted). Rising to 2138 m depth, Franklin straddles the western end of the bathymetrically- and magnetically-recognizable WSR and is about 250 m high. The deposits consist of numerous mounds of Fe-Mn-Si oxyhydroxides on the crest and flanks of the seamount, and sulfate chimneys up to 2 m high on the floor of its summit caldera. Weak, low-temperature, clear-water venting was observed at seven sites in various localities.

The chimneys consist mainly of frondescent barite and botryoidal silica with disseminated pyrite, sphalerite, galena and chalcopyrite. They contain high concentrations of Au (4-21 ppm), Ag (140-545 ppm), As, Sb and Hg that are among the highest known from modern seafloor hydrothermal deposits. Fluid inclusions in the barite indicate formation temperatures of about 2500°C and U-series disequilibrium indicates an age between 30 and 8000 years.

The Fe-Mn-Si deposits vary from cm-scale spires to semi-continuous mounds up to 100 by 200 m across and 1-2 m high. They contain elevated concentrations of Cu, Zn, As, Sb and Hg. Most are covered by a thin Mn crust but have pale yellow to deep red-brown interiors. They have a complex origin involving successive deposition of and replacement by hydrothermal phases, microbial construction, and degradation or diagenetic alteration. Some samples retain significant Eu anomalies indicative of hydrothermal fluids but others appear to have re-equilibrated with seawater.

In addition to the modern analogue studies, parallel research of ancient VMS and exhalite deposits is developing within the PACMANUS/PACLARK program. With an emphasis on applied mineral exploration problems, and an interactive cross-fertilization of research between modern and ancient environments, this program aims to make significant contributions to ore genesis research and to the discovery of future natural resources.

REFERENCES

Benes, V., S.D. Scott, R.A. Binns, and G.R. Brown, Rift propagation into an accreted continental margin: the geology and tectonics of the Western Woodlark Basin, *EOS Trans. AGU*, *70(43)*, 1348, 1989.

Binns, R.A., G.E. Wheller, S.D. Scott, Yu. A. Bogdanov, A.P. Lisitsin, and SUPACLARK Participants, Hydrothermal deposits of Franklin Seamount, Western Woodlark Basin, Papua New Guinea, Eleventh Australian Geological Convention, *Geol. Soc. Aust. Abstr.*, *32*, 72-73, 1992.

Binns, R.A., S.D. Scott, Y.A. Bogdanov, A.P. Lisitsin, V.V. Gordeev, E.G. Gurvich, E.J. Finlayson, T. Boyd, L.E. Dotter, G.E. Wheller, and K.G. Muravyev, Hydrothermal oxide and gold-rich sulfate deposits of Franklin Seamount, Western

Woodlark Basin, Papua New Guinea, *Econ. Geol.*, submitted.

Binns, R.A. and G.E. Wheller (compilers), Report on the PACLARK-V/ PACMANUS-1 cruise, *R/V Franklin*, Woodlark and Manus Basins, Papua New Guinea, *CSIRO Division of Exploration Geoscience Restricted Report 263R*, 107 pp., 1991.

Both, R., K. Crook, B. Taylor, S. Frogan, B. Chappell, E. Frankel, L. Liu, J. Sinton, and D. Tiffin, Hydrothermal chimneys and associated fauna in the Manus back-arc basin, Papua New Guinea, *EOS Trans. AGU*, *67*, 489-490, 1986.

Craig, H. and R. Poreda, Studies of methane and helium in hydrothermal vent plumes, spreading axial basalts and volcanic island gases, University of California, Scripps Institution of Oceanography, *SIO Reference 87-14*, 37-43, 1987.

Crook, K.A.W., Cruise report Manus Leg: 21st cruise of *R/V Akademik Mstislav Keldysh*, 21 May-7 June 1990, *SOPAC Cruise Report*, *135*, 26 pp., 1990.

Sakai, H., Expedition: east Manus Basin hydrothermal field, *Hakuro-Maru* Cruise KH90-3, Leg 2, A brief summary report for SOPAC, *SOPAC Cruise Report*, *138*, 3 pp., 1991.

Smith, I.E.M., Peralkaline rhyolites from the D'Entrecasteaux Islands, Papua New Guinea, in *Volcanism in Australasia*, edited by R.W. Johnson, pp. 275-285, Elsevier, Amsterdam, 1976.

Taylor, B., K.A.W. Crook, J.M. Sinton, and L. Petersen, Manus Basin, Papua New Guinea, SeaMARC II sidescan sonar imagery and bathymetry, in *1:1,000,000 Pacific Seafloor Atlas*, Hawaii Institute of Geophysics, Honolulu, HI, Sheets 4-6, 1991.

Tufar, W., Modern hydrothermal activity, formation of complex massive sulfide deposits and associated vent communities in the Manus Back-arc Basin (Bismarck Sea, Papua New Guinea), *Mitt. Osterr. Geol. Ges.*, *82*, 183-210, 1990.

Weissel, J.K., B. Taylor, and G.D. Karner, The opening of the Woodlark Basin, subduction of the Woodlark spreading system and the evolution of northern Melanesia since mid-Pleistocene time, *Tectonophysics*, *87*, 253-277, 1982.

Wheller, G.E., R.A. Binns, D.J. Whitford, R.L. Chase, and P. Michael, Volcanic rocks from the western Woodlark Basin, Papua New Guinea: a re-activated subduction environment? Tenth Australian Geological Convention, *Geol. Soc. Aust. Abstr.*, *25*, 302-303, 1990.

(Canada, continued from page 11)

mineral precipitation and black smokers are relatively commonplace.

Leg 139 of the Ocean Drilling Program was the first of a two leg program designed to investigate hydrothermal processes at sediment covered spreading centers. The primary objective of this first leg was to characterize the regional pattern of hydrothermal circulation.

ODP drilled 22 holes at four sites during Leg 139. One site was considered a recharge site along a bounding fault on the eastern edge of the ridge. Two sites were drilled in an area of high heat flow and known hydrothermal venting and one in a deposit of massive sulfide mineralization. Notable highlights and achievements of Leg 139 included: successful drilling, logging and coring operations in the highest downhole temperatures to date for ODP/DSDP (estimated at 300-350°C), coring of almost 160 m of massive sulfide deposits in two holes, the first two deployments of the circulation-obviating retrofit kit (CORK) with installed instrumentation and the first operational deployment of the pressure core sampler (PCS). The high temperatures encountered in a number of the holes created surprisingly little difficulty both in coring and logging. Downflow of cold seawater had a natural cooling effect and was recorded at up to 50,000 liters a minute at one location. Two of the deepest holes were sealed with CORKs.

The bounding fault turned out not to be a recharge site. The volcanic basement is highly permeable and seawater appears to be recharging the hydrothermal system by lateral flow probably from the south and west. The basement rocks drilled at this site are very fresh olivine-phyric basalts with MORB chemistry. A series of deep holes were drilled at the second, high temperature site. One hole, which was later corked, was drilled to a depth of 960 mbsf. Between 250 and 450 m the sediments have been enriched in sodium with a concomitant loss in the surrounding pore water. From 600 to 800 m the sediments have lost Ca, Na and K and probably represent the zone where present-day vent fluids are being generated. The lowest sediments are epidotized and albitized. Well-differentiated, vesicular gabbro sills were intersected throughout the hole; apparently these have no discernible contact haloes and they are cut by quartz-chlorite-epidote and wairakite-sphalerite-chalcopyrite-quartz veins. At the third site, the flow and compositional characteristics of the vent zone were tested. Seafloor mounds identified at this site contain Fe- and Mg- silicates, anhydrite and sulfide. There appears to be a relatively impermeable "cap" at about 25-50 m depth, underlain by less altered sediments. Temperatures close to 300°C were encountered within 35 m of the seafloor. The zone of maximum discharge appears underlain by highly variolitic basaltic andesite which is confined to the limits of an observed acoustic reflector. A black smoker was initiated by drilling of the hole closest to the vent site.

The most exciting discoveries were made in the two holes drilled at the fourth site on a 35-m-high mound immediately south of Bent Hill. In one hole 65 m and in the other, 95 m of massive sulfide were intersected. Neither hole managed to penetrate the full thickness of the sulfide body because of hole cleaning problems. The deposit, of at least 25 million tons, is distinctly zoned with a pyrrhotite-sphalerite-chalcopyrite assemblage being successively replaced by pyrite and magnetite. Base metals have been redistributed; vuggy pyrite zones infilled with carbonate and silica.

It appears that the most vigorous hydrothermal activity is now primarily focused over the buried andesitic edifice. Fluids are forming at about 275°C through reaction with sediments. They are metal-poor, CO_2-rich and represent the waning stage of the Middle Valley hydrothermal activity.

Remember: your contributions to InterRidge News are welcome. Please send research articles, meeting announcements, program updates, and other items of interest to the InterRidge Office. Publication of the next issue of InterRidge News will be in November-December 1992.

Focus on GERMANY

(Mittelozeanische Rücken – Aspekte der Forschung in Deutschland)

Hans-Joachim Wallrabe-Adams
GEOMAR Research Center for Marine Geosciences, Kiel, GERMANY

History

German marine science studies started in the second half of the last century, with expeditions to Arctic and Antarctic regions; e.g., the expedition of the R/V *Grönland* in 1868 to the area between Greenland and Spitsbergen. Further expeditions were sent to all seas: The *Valdivia* expedition of 1898-1899 into Antarctic regions and the cruise of *Gazelle* (1874-1876) into the South Atlantic, the Indian Ocean and the Pacific. During this cruise one of the first manganese nodules was discovered on the ocean floor. Most investigations mainly concerned meteorological, oceanographic and biological problems.

During 1925-1927 the German Atlantic Expedition (R/V *Meteor I*) took place, carrying out systematic bathymetric measurements by applying new echo sounding techniques. This new technology for the first time revealed the existence and complex morphology of the Mid-Atlantic Ridge. Several expeditions followed. In the middle of the 20th century marine sciences in Germany were pushed forward by decisions resulting from the International Geophysical Year (1957/1958). As a consequence, the German Science Foundation (DFG) in 1960 took over marine sciences as a central part of research. In 1968 the German government declared marine sciences as one of the major research fields, and in 1969 a General Ocean Research Program was established. The objectives of this program were defined by a working group consisting of the German Ministry of Research and Technology (BMFT), the Federal Institute of Geosciences and Natural Resources (BGR), the Geological Institute of the University of Kiel, and the two commercial companies Metallgesellschaft AG and Preussag AG. Subsequently, several special collaborative programs have been supported, leading to a more systematic marine research program focusing on marine minerals exploration. First initial goals of the program were the investigation of manganese nodules and metalliferous sediments in the Pacific Ocean and the Red Sea.

Institutions

Naturally, most institutions located at the German coast are devoted to marine research:

- Marine research in the Departments of Geosciences, Biology and Physics of the University of Bremen aims on the southern and equatorial Atlantic.
- The Alfred Wegener Institute for Polar and Marine Research (AWI) in Bremerhaven concentrates on Arctic and Antarctic regions. It runs the Georg Von Neumayer Station on the shelf ice of Antarctica and the R/V *Polarstern*.
- In Hamburg the Department of Geosciences of the University is active in the fields of marine geophysics and geochemistry. There is also a federal institute called the Biological Center Hellgoland which works on biotopical and environmental issues.
- Kiel is the site of five institutions: the Institute for Geology and Paleontology and the Institute for Geophysics at Kiel University, the Institute for Oceanology, the Institute for Polar Ecology, and GEOMAR Research Center for Marine Geosciences, which was founded in 1987. These institutions cover the whole field of marine and polar research.
- Due to the new political situation in eastern Germany the Institute of Baltic Research (IFO) in Rostock-Warnemunde was established recently.
- Geomarine research is also performed at the Department of Geosciences of Greifswald University.
- Coastal processes and environmental conditions are studied by GKSS Research Center (Geesthacht).
- The Research Institute Senckenberg in Wilhelmshaven, and working groups at the University of Oldenburg have recently been combined in the TERRAMAR Center for Coastal Research.
- Major research on hydrothermalism and ore-forming processes as well as also all kinds of marine aspects are carried out by the Federal Institute of Geosciences and Natural Resources (BGR), Hannover.
- The Mineralogical Institute at the RWTH Aachen and the Center for Marine Raw Material Research of the University of Clausthal-Zellerfeld are also engaged in investigations of marine ore deposits.
- Besides these institutions, some small working groups and single scientists at different universities are engaged in marine research (e.g., University of München, University of Regensburg, Senckenberg Museum, Frankfurt/M).
- In the past, Preussag AG (Hannover) has been a commercial investigator of marine resources, especially on manganese nodules and metalliferous deposits.

Technology

Marine sciences in Germany are supported by many research vessels, ranging in size from small boats to the 10,000-ton icebreaker R/V *Polarstern*. The three biggest and most modern vessels are R/V *Polarstern*, R/V *Meteor*, and R/V *Sonne* (rebuilt 1991), all equipped with multibeam echo sounders (Hydrosweep), multifrequency echosounders (Parasound), and several deep-sea sampling facilities. Smaller research vessels equipped at a lower technological level, but nevertheless useful ships, are R/V *Valdivia*, R/V *Poseidon* and R/V *A. v. Humboldt*.

Specific deep-sea sampling devices useful for ridge studies have been developed; for example, an "ocean floor observation system" (OFOS) with TV and photo equipment, now being furnished with additional chemical sensors, and an electro-hydraulic TV-guided heavy-duty grab. Unfortunately Germany has no deep-sea diving facilities such as submersibles or ROV's.

Mid-ocean ridge research

Ridge work by German institutions has been carried out intensively since 1969 in the context of raw material research. In addition to the reconnaissance studies of natural resources generated in active mid-ocean ridges, more recently other aspects have become important. Mass transfer and exchange pro-

*(**Germany**, continued on page 25)*

Focus on CANADA

(Gros Plan sur Canada)

John Malpas[1], with input from Steven Scott[2] and James Franklin[3]
[1]Memorial University of Newfoundland, Centre for Earth Resources Research, St. John's, Newfoundland A1B CANADA
[2]Marine Geology Research Lab, Dept. of Geology/Earth Sciences Center, University of Toronto, Toronto, Ontario M5S 3B1 CANADA
[3]Canadian Geological Survey, 601 Booth Street, Ottawa, Ontario K1R 7L1 CANADA

The Canadian program for investigation of ocean ridge evolution (CANRIDGE) has concentrated in the last few years on the Juan de Fuca Ridge system which is located immediately off Canada's west coast. This culminated in 1991 in drilling by the JOIDES Resolution during Leg 139 of the Ocean Drilling Program in Middle Valley (Figure 1).

CANRIDGE I was a marine geological and geophysical expedition in June 1991 to Middle Valley on northern Juan de Fuca Ridge and to Southern Explorer Ridge, both in the NE Pacific, on board Canadian Forces Auxiliary Vessel *Endeavour*. The main objective of the cruise was to further understanding of ridge processes off Canada's west coast as a contribution to the international RIDGE program. Chief Scientist for CANRIDGE I was Steve Scott of the University of Toronto's Marine Geology Research Laboratory. During the approximately 6 1/2 days on station, two deployments and recoveries of ocean bottom magnetometers (OBMs), six camera/video tows, five dredges, four sediment cores, ten CTD/transmissometer surveys with hydrocasts and a few km of echo sounding surveys were conducted.

At Middle Valley, deployment of the two OBMs preceded a peak in an ongoing magnetic storm, with the result that excellent signals were recorded by both instruments. The processed data are revealing the electrical structure of the crust and upper mantle with good precision in the vicinity of a suspected igneous intrusion which has bowed up sediments in the center of the valley. In response to a request to look for possible hydrothermal activity near the fault scarps bounding the east side of Middle Valley in the vicinity of proposed site MV-7 of ODP Leg 139, two CTD/transmissometer "tow-yos", three camera/video tracks and some echo sounding surveys were conducted. Echo sounding demonstrated that a prominent feature seen on a 1:25,000 SeaMARC mosaic and thought to be a hydrothermal mound actually lies about 0.7 n. mi. further to the north and is probably the same feature that can be seen on the 1:50,000 SeaBeam map.

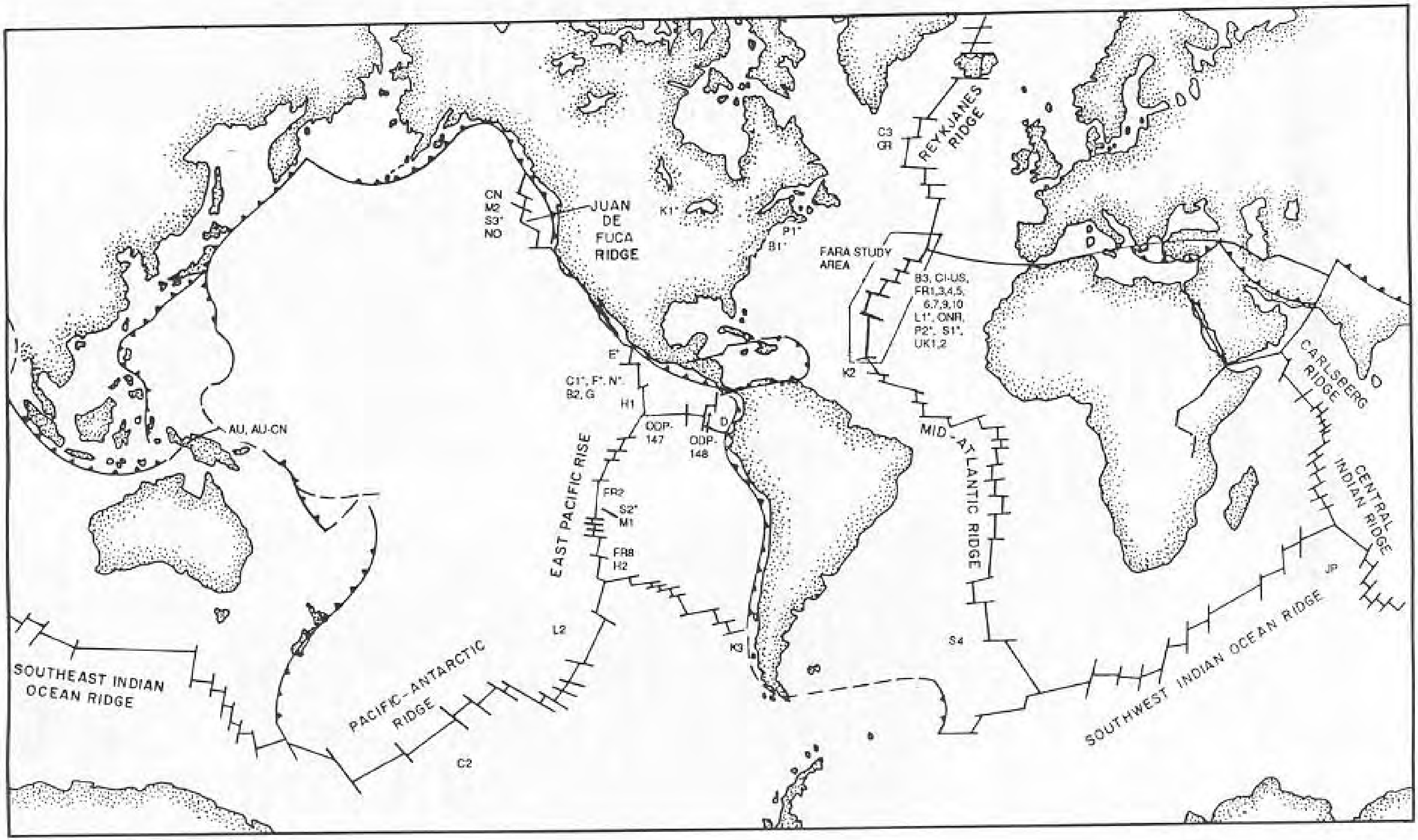
At Southern Explorer Ridge, the two OBMs were deployed again on either side of the ridge but only one was recovered despite extensive searches. Several camera/video tows and two dredges were made along the ridge to fill in some critical gaps in data, and a previously undetected sulfide deposit of unknown size was encountered north of the AGOR 171 vent field. One camera/video tow had to be abandoned because of a very strong NE to SW surface current, the likes of which had never before been experienced at Southern Explorer Ridge. Several CTD/transmissometer surveys on top of and adjacent to the ridge showed that the hydrothermal and particulate plume from the active Magic Mountain and AGOR 171 vent fields extends towards the southeast where it has not been previously detected in 1985 to 1989 expeditions. The height of the plume off bottom well to the east of the ridge suggests that this is the same plume emanating from the top of the ridge rather than another plume from a new off-axis source. CANRIDGE II with CFAV *Endeavour* is scheduled for June 1992.

For most of the length of the Juan de Fuca Ridge, magma is supplied in abundance, and although the spreading rate is only 5.8 cm per year, the morphology of the ridge is similar to that of faster spreading-rate ridges. At the north end of the system at its intersection with the Sovanco Fracture Zone (Figure 1), the supply of magma appears diminished significantly and a deep extensional basin is present. Because of the proximity of the system to the continental margin, this basin is filled with Pleistocene turbidite sediments. Although the basement shoals to the south, away from the fracture zone intersection, sediment cover over the full 10-15-km width of the valley between the primary bounding normal faults persists over a distance of 60 km along the axis.

Constraints from seismic reflection profiles and heat flow measurements in Middle Valley allowed for initial estimates of temperatures at the sediment/basement interface of about 150-350°C, in spite of large variations in sediment thickness. Upper crustal temperatures are buffered by large-scale hydrothermal circulation. The fact that temperatures decrease systematically away from the center of the valley suggests that hydrothermal recharge is taking place along normal faults that control basement depth and through the thinner sediment cover. Hydrothermal discharge has resulted in the formation of significant

(Canada, continued on page 9)

World Ridge-Crest Research Projects 1992-1993



KEY

- NSF-funded cruises are coded on the map by a single letter and number. The letter corresponds to the first PI; numbers are used when more than one PI has the same last initial.
- An asterisk (*) indicates RIDGE cruises (all funded by NSF).
- Other cruises are noted by a two- or three-letter code followed by a number.
- Where cruise dates are specifically given, they are in 1992 unless otherwise indicated. All cruise dates are subject to change.
- Please contact T. Stroh concerning any omissions or corrections to the information given below. An updated map will be included in the next issue.

RIDGE projects

Code	PI's	Institution(s)	Location	Research	Funding
B1*	Buck	LDGO	LDGO	Models of along-axis segmentation & across-axis structure of mid-ocean ridges	MG&G
C1*	Childress	UCSB	EPR: 13°N	Physiological ecology of hydrothermal vent animals	BO
E*	Edmond	MIT	EPR: 21°N	Vent fluid chemistry	MG&G
F*	Felbeck	Scripps	EPR: 13°N	Ecological physiology of vent tubeworms	BO
K1*	Kohlstedt	Minnesota	Minnesota	Role of deformation in melt migration	MG&G
L1*	Langmuir	LDGO	MAR: south of Azores	Geological sampling using ZAPS, CTD, nephelometer, transmissometer	MG&G
N*	Nelson	UC-Davis	EPR: 13°N	Physiological ecology of vent bacteria	BO
P1*	Parmentier/ Forsyth	Brown University	Brown	Modelling studies of mid-ocean ridge dynamics: spreading center structure & segmentation	MG&G
P2*	Purdy/Solomon/ Toomey	WHOI/MIT/Oregon	MAR: 29°N	Seismic tomography	MG&G
S1*	Sempéré	UW	MAR: 24°-31°N	Hydrosweep, gravity, magnetic survey	MG&G
S2*	Sinton/Batiza/ Mahoney	U. Hawaii	Pacific Plate between 15°-19°S	3-D analysis of melting regime at superfast spreading	MG&G
S3*	Spiess	Scripps	Juan de Fuca	Seafloor strain measurements	MG&G

Other NSF-funded ridge-crest projects

Code	PI's	Institution(s)	Location	Research	Funding
B2	Batiza	HIG	EPR: 13 N	Temporal petrology	MG&G
B3	Bryan/Casey	WHOI/U. Houston	MAR: 31°-34°N	Petrology/geochemistry; participation in Petrov cruise	MG&G
C2	Cande/Haxby	LDGO	Pacific-Antarctic Ridge: 60-70 S	Magnetics, multibeam flowline	MG&G
C3	Constable	SIO	Reykjanes	UK EM/seismic experiment (2 legs)	MG&G
D	Dorman/Hildebrand	SIO	Galapagos Ridge	Near-bottom refraction	ODP
G	Garmany/Stoffa	U.Texas	EPR: 13 N	OBS survey	MG&G
H1	Haymon/Fornari	UCSB/LDGO	EPR: 9 N	ALVIN: hydrothermal chemistry	ODP
H2	Hey	HIG	EPR: 27-32 S	GLORIA survey	MG&G
K2	Kastens	LDGO	MAR: Vema	LDGO side-scan survey	MG&G/ ODP
K3	Klein/Karsten	Duke/HIG	Chile Triple Junction	Petrology	MG&G
L2	Lonsdale	SIO	EPR: 35-55 S	SeaMARC II survey	MG&G
M1	Macdonald/Forsyth	UCSB/Brown	EPR: 16-19 S	Gravity rolls: SeaMARC II and multibeam	MG&G
M2	Mottl/Wheat	Hawaii	Juan de Fuca: near 48°N	Hydrothermal upwelling through outcrops on east flank	MG&G
S4	Schilling	URI	MAR: 41-51 S	Petrology/geochemistry	MG&G

ODP cruises

Code	Chief Scientists	Institutions	Location	Research
ODP-147	Gillis/Mével	WHOI/U. Curie	Hess Deep	Attempt to drill Moho (26 Nov 92-21 Jan 93)
ODP-148	Alt/Kinoshita	Michigan/ERI-Tokyo	Near Costa Rica Rift	Return to 504B

U.S. ridge-crest cruises: not funded by NSF

Code	Chief Scientist(s)	Institution(s)	Location	Research	Ship	Dates
NOAA	Embley	NOAA	Juan de Fuca: N. Cleft sgt	ROV testing and operations	DISCOVERER	22 June-mid-July 92
ONR	Baggeroer/Orcutt	MIT/SIO	MAR: Kane near 24°N to ~27°30'N	Leg 2 (1992): reconnaissance geological/geophysical survey (ONR Nat. Lab Init.)	EWING (tentative)	TBD

International ridge-related projects*

Code	Country	Chief Scientist(s)	Institution(s)	Location	Research	Ship	Dates
AU	Australia	Binns	CSIRO	Manus & Woodlark basins	Exploring spreading systems activity and potential Cu-Zn ore deposits	FRANKLIN	1992
AU-CN	Canada/ Australia	Binns/Scott	CSIRO-Sydney/ U. Toronto	Eastern Manus Basin	PACMANUS II: camera/video, dredge, coring, CTD, hydrocasts of active vent field on Pual Ridge	FRANKLIN	June 93
CN	Canada	Scott/Thomson	U. Toronto/ IOS/Pat Bay	Explorer & N. Juan de Fuca	CANRIDGE II: Survey polymetallic sulfides & hydrothermal plumes	ENDEAVOUR	July 92
CI-US	CIS/US	Silantyev/(US)	Vernadsky Inst.	MAR: 30°-34°N	Geophysics, sampling; axial segmentation study	PETROV	Jun-Aug 92
FR1	France	Auffret	IFREMER/ Brest	MAR: south of Azores (FARA)	Sediment coring for past hydrothermal activity ("GEOFAR")	NOROIT	1993+
FR2	France	Auzende	IFREMER	EPR: 18°-19°S	Structure, petrology, geochemistry ("NAUDUR")	NADIR/Nautile	1993+
FR3	France	Auzende/Mével	IFREMER/ U. Curie	MAR: 23°N (FARA)	Submersible studies of south wall of Kane fracture zone ("KANAUTE")	NADIR/Nautile	Nov-Dec 92
FR4	France	Bougault	IFREMER	MAR: 15°20'N (FARA)	Submersible study of RTI: chemistry of rocks and water, structure, metallogenesis ("FARANAUTE")	L'ATALANTE/ Nautile	March-April 92
FR5	France	Cannat	INSU	MAR: 20°-24°N (FARA)	Petrology/geochemistry ("SEADMA 2")	SUROIT	1993+
FR6	France	Dubois	IPG/Paris	MAR: south of Kane (FARA)	Gravity studies ("GRAVINAUT")	NADIR/Nautile	1993+
FR7	France	Fiala-Medioni	INSU	MAR (FARA)	Biological support vessel for *Alvin* operations: MAR hydrothermalism ("MAR 93")	SUROIT (tentative)	1993+ (tentative)
FR8	France	Francheteau	IPG/Paris	EPR/Easter Microplate	Submersible study of ridge and microplate ("PITO")	NADIR/Nautile	1993+
FR9	France	Montagner/ Karezewski	IPG-Paris/ INSU	MAR: 23°N	Seismometer measurements in DSDP Hole 396B ("OFM")	NADIR/Nautile	April-May 92
FR10	France	Needham/Avedik	IFREMER	MAR: south of Hayes (FARA)	Multichannel seismics ("DORMASIS")	L'ATALANTE	April-May 92
GR	Germany	Thiede/ Wallrabe-Adams/ Lackschewitz	GEOMAR	Reykjanes Ridge between 58°-60°N	Sedimentation on mid-ocean ridges	A. v. HUMBOLDT	April-June 92
JP	Japan	Tamaki/Fujimoto	ORI/Tokyo	Indian Ocean	Geophysics, Izanagi, MCS, OBS, CTD, deep-tow TV	HAKUHO-MARU	5 July-17 Sept 93
UK1	UK	Elderfield	Cambridge	MAR: 23°-26°N	Formation of hydrothermal plumes and metalliferous deposits	DARWIN	15 March-April 93
UK2	UK	Parson	IOSDL	Kane-Atlantic Super Segment	Geophysics	DARWIN	6 Feb - 11 Mar 93

* Information requested from all InterRidge correspondents

+Provisional planning: to be decided in Fall 1992

International Initiatives

Cooperative ridge research efforts between InterRidge nations

French-American Ridge Atlantic (FARA) Program Update

Charles H. Langmuir
Lamont-Doherty Geological Observatory, Palisades, NY 10964

The French-American Ridge Atlantic (FARA) program is aimed at understanding the diverse processes that control crustal creation on a slow-spreading ridge, including geological, geophysical, petrological, hydrothermal and biological aspects of the problem. The latitude window between 15°N and 40°N on the Mid-Atlantic Ridge was selected for study because it includes a range of depths and segmentation styles, and allows investigation of the effects of a variety of crustal accretion variables at a slow spreading rate. The latitude window is also of interest because it contains two shallow and geochemically enriched regions with different characteristics—a small depth and geochemical anomaly near 15°N, associated with small off-axis ridges, and the Azores hot spot, a large feature whose effects dominate the depth and geochemistry of much of the central North Atlantic.

Cruises to date, building upon previous results, have mapped the bathymetry of virtually the entire MAR axis from 14°N-41°N. The data demonstrate that a large range in accretion styles can exist at a constant spreading rate. Although the entire area is slow-spreading, the axial depth varies from greater than 4500 m near the Kane transform, to less than 1500 m near the Azores hot spot. In contrast to the deep rift valley associated with much of the Mid-Atlantic Ridge, the MAR near the Azores has a morphology similar to a medium spreading ridge such as the Juan de Fuca, complete with near-axis seamounts that are the shallowest near-ridge features. There is also a diversity of segmentation styles. The segmentation ranges from a series of small en echelon ridge segments with no offset of the rift valley walls, to a series of larger segments separated by distinct offests of the rift valley of 30 km or more. The northern part of the region, from 34°N to 39°N, contains a substantial number of large transform offsets, in contrast to other comparable lengths of ridge where there are no true transforms at all. The data collected thus far demonstrate clearly the variability that can occur at constant spreading rate. How this variability may relate to petrological, hydrothermal, and biological signals will emerge as the program proceeds. An aim of the upcoming cruises is to discover hydrothermal sites on the Azores platform that can serve as a focus for more detailed studies that can investigate potential contrasts with the known hydrothermal sites on more typical MAR segments at TAG and near the Kane transform.

More detailed studies are also an important part of the FARA program, including further investigation of the TAG and Snake Pit hydrothermal sites, detailed studies of individual ridge segments and transform faults, and off-axis investigations. Both the Kane and 15°20'N transforms are being investigated in detail by French and U.S. cruises. Recent French results (FARANAUT, Henri Bougault, chief scientist) have discovered abundant ultramafic outcrops along substantial lengths of the rift valley walls north and south of the 15°20'N transform. These outcrops appear to be associated with large methane anomalies in the water column. It appears that the classic model for simple layering of the ocean crust is in jeopardy for the MAR, since peridotites outcrop for substantial distances along rift valley walls, in addition to the well known peridotite occurences within the transform domain.

The FARA program was originally envisaged in the program plan to take place in two major sea-going efforts separated by one year. Due to difficulties in ship scheduling and the different timing of submitting and funding proposals in France and the U.S., the first year of ship operations has been spread out over eighteen months, with several U.S. cruises not taking place until the second half of 1992. (Project summaries for these cruises were presented in the last RIDGE newsletter.) The results from these cruises need to be made available to the French and U.S. communities for effective planning of the second phase of the program. Therefore there will be an open meeting prior to AGU where the French and U.S. cruise results can be presented and discussed, and where planning and coordination can take place in preparation for a second major sea-going year that is envisaged to occur in 1994. French proposals for the 1994 programs will be submitted in January, 1993, while most U.S. proposals will be submitted to NSF's April 1, 1993 target date for RIDGE programs (see Table below). Of course, since all proposals are evaluated through standard peer review procedures, the detailed nature and timing of field programs is subject to the uncertainties of the normal funding and ship scheduling process.

Although FARA is being undertaken as a French-American program, there has been substantial activity by other nations, particularly the United Kingdom and Russia, in the 15°N-40°N window. Thus far, this activity has been carried out in parallel, but the multi-national effort is being increasingly integrated, in large part due to InterRidge planning and objectives. British

>

scientists will make use of FARA results to carry out a survey with their deep-towed bottom instrument package of the MAR north of the Hayes transform in 1993. These results will help to plan and focus the 1994 field programs. Russian scientists, with their U.S. collaborators, may undertake a series of cruises this summer. British, French and Portuguese scientists have proposed a large, five-leg program of study of the Azores triple junction region that would build upon the FARA results. This program, called MARFLUX, would be funded as a European initiative by the EEC. Japan may have a submersible program in the Atlantic in collaboration with U.S. investigators. Japanese, British and Portuguese scientists have been invited to participate in U.S. FARA cruises. Scientific efforts in 1994 may involve six or more nations. Scientists from other nations are being invited to the pre-AGU FARA planning meeting, so that the programs from various nations with interests in the area can be effectively coordinated for maximum scientific benefit.

For further information concerning planning and activities in the 15°N-40°N region, contact Charles Langmuir (Lamont-Doherty Geological Observatory, Palisades, NY 10964, Phone: 914-359-2900 x657), David Needham (IFREMER, C.O.B., BP 70 29263 Plouzané, France, Phone: 33-98-22-42-21), David Epp (National Science Foundation, 1800 G St., Washington, DC, Phone: 202-357-9456), or the RIDGE Office at Woods Hole Oceanographic Institution.

FARA Cruise Information

FARA TIMETABLE

June-November	1992	Completion of U.S. FARA first year cruises
Pre-Fall AGU	1992	Open FARA meeting for presentation of cruise results from French and U.S. cruises, and for planning and coordination of focused international efforts for the 1994 ship year.
Fall AGU	1992	Special sessions for 15°N-40°N region
January 15	1993	French proposal deadline for 1994 cruises
April 1	1993	U.S. NSF deadline for 1994 cruises (RIDGE)

CRUISE INFORMATION 15°N-40°N

French FARA Cruises

Cruise ID	PI	Aim
Sigma	David Needham	Bathymetry and underway geophysics of entire rift valley from 33°N-41°N, with additional data down to 16°N
Seadma	Pascal Gente	On- and off-axis bathymetry and geophysics of the MAR south of the Kane transform
Faranaut	Henri Bougault	Submersible investigations, bathymetry and geophysics between 14°N and 16°N
Dormasis	David Needham	Multichannel seismics to investigate crustal structure south of the Hayes transform
Kanaut	Catherine Mével	Submersible investigations of Kane transform

U.S. FARA Cruises for 1992

PI's	Aim
John Delaney, Fred Spiess	Detailed survey of Kane fracture zone walls
Charles Langmuir, Gary Klinkhammer	Petrological and hydrothermal sampling between Hayes transform and 41°N
Jean-Christophe Sempéré	Off-axis bathymetry and geophysics near the Atlantis transform
Mike Purdy, Sean Solomon	OBS experiments of two contrasting ridge segments

Related U.S. and Foreign Cruises

PI's	Nation	Aim
Brian Tucholke	US	Off-axis bathymetry north of the Kane transform
Roger Searle Julian Pearce	UK	Deep-towed side scan and sampling of segments north of the Kane transform
Joe Cann	UK	Deep-towed side scan and sampling of several segments between Kane and Atlantis transforms
Lindsay Parson	UK	Deep-towed side scan, photography and water column work between 29°N and the Azores triple junction
Harry Elderfield	UK	Water column work on hydrothermal plumes indentified on Parson cruise

Potential Cruises (not yet funded or not yet scheduled)

PI's	Nation	Aim
Leonid Dmitriev	CIS	Mapping and sampling between Atlantis and Hayes transforms
Peter Rona Geoff Thompson	US	*ALVIN* investigations of 15°N region
Cindy Van Dover	US	Biological investigations of TAG and Snakepit hydrothermal sites
Henri Bougault (+25 others)	France, UK, Portugal	Water column, deep-towed side scan and submersible studies of Azores triple junction region
Jeff Karson	US	*ALVIN* studies of biology at TAG and MARK hydrothermal sites
Steve Chamberlain Richard Lutz Holger Jannasch	US	*ALVIN* studies of biology at TAG and MARK hydrothermal sites

The STARMER Project, 1987-1992: Five Years of Japanese-French Cooperation in the North Fiji Basin

Jean-Marie Auzende
IFREMER/CB-BP 70, Marine Geosciences Department, Plouzané 29280 FRANCE

Project history

The Seapso program in 1985 represented a first coordinated approach by French teams to back-arc basin studies. As a part of this program, IFREMER (Institut Français de Récherche pour l'Exploitation de la Mer), ORSTOM (Institut pour la Récherche en Coopération) and INSU (Institut National des Sciences de l'Univers) jointly explored the North-Fiji Basin Ridge where the existence of an axial ridge was assumed but not demonstrated. One of the major results of the Seapso-Leg 3 cruise of the *R/V Jean Charcot* was the discovery and the partial mapping of an "active" accreting ridge axis in this marginal basin.

Based on the results of the Seapso cruise, Japanese and French scientists decided to undertake a joint project to study the rift systems of the Western Pacific. This project, coordinated by IFREMER for France and the Science and Technology Agency (STA) in Japan, was agreed upon in June 1987 and named STARMER. Its precise objective was a five-year interdisciplinary (geological, geochemical and geophysical) study of the North Fiji Basin Ridge Axis. Since this date, seven cruises have been carried out, representing more than nine months at sea. Four of them were dedicated to surface-ship surveys, including swath bathymetric mapping, geophysical profiling, water sampling, gravity coring and dredging. The three others were diving cruises using the *Nautile* (June-July 1989), the new Japanese submersible *Shinkai 6500* (September-November 1991), and *Cyana* (December-January 1992). The results have given rise to about 100 scientific papers and oral presentations in international and national journals and symposia.

As a result of these intensive studies, the North Fiji Basin Ridge, unknown seven years ago, is one of the most exhaustively investigated ridge axes of the world ocean. Today, a ridge segment more than 800 km long and 100 km wide is fully mapped using the SeaBeam and Furono echosounders*. Along the whole length of the axis, a water-column sample has been taken every 20 km and a rock sample every 10 km (Fig. 1).

Principal ridge characteristics

The main characteristics of the ridge can be summarized as follows:

From south to north, the first segment (between 21°40'S and 20°40'S) is characterized by an axial N-S ridge culminating at less than 2500 m water depth. This segment abuts to the north a 045°-trending transverse feature, interpreted as a pseudo-fault resulting from the northward propagation of the ridge.

Between 20°40'S and 18°30'S, the axial ridge shows a typical "fast-spreading ridge" morphology similar to that of the East Pacific Rise. It is a 200-m-high and 8-km-wide domed ridge cut in some places by a 200-m-wide, 50-m-deep axial graben. To the north this segment propagates into the northern segment.

North of 18°30'S there is a change of direction of the ridge axis from N-S to 015°. From south to north, this area is characterized by the shoaling of the axial zone from 2800 m to less than 1900 m at the northern tip of the 015° segment. The morphology of the ridge in this segment is also very similar to a typical "fast-spreading ridge." The northern limit of the 015° branch of the North Fiji Basin Ridge is the 16°40'S triple junction representing the convergence of the 015° ridge, the left-lateral North Fiji Fracture Zone and a 160°-trending axis propagating toward the north. The triple junction is marked by a peculiar feature, a triangular graben bounded by 045° and 060° normal faults. A 20-km-long neovolcanic ridge lies within this graben.

The 160° axis ridge can be divided into two main domains. The southern one is characterized by a deep graben cutting a large volcanic massif. The northern one is narrower and occupied by "en echelon graben," separated by elongated ridges.

The 160° ridge axis propagated recently (less than 1 My ago) into oceanic crust with a N-S grain produced during the previous phase of opening of the North Fiji Basin, between 3.5 and 1 My ago.

Concerning the hydrothermal processes, different types of hydrothermal activity have been discovered and explored either during the *Nautile* cruise in 1989 or during the *Shinkai 6500* cruise in 1992. The most famous site is the "White Lady," located around 17°S and characterized by 285°C shimmering hot water, very poor in metallic elements, that is expelled through an anhydrite chimney. This water probably represents the low-salinity end-member explained by phase separation in the levels of the oceanic crust. Other active sites with varying characteristics (low temperature, diffusion, etc.) have been observed all along the axis.

Future efforts

The STARMER program ended in January with the last *Cyana* diving cruise in the back arc basin of the New Hebrides. The year 1992 will be devoted to the analysis of the data with the objective of preparing the special STARMER Symposium at the Kyoto International Geological Congress in August, following the project review meeting held in Nouméa in February 1991.

A new five-year cooperative Japanese-French project will be signed during the following months and will start in 1993. The aim of this new joint program, which may be considered as a contribution to InterRidge, will be the comparative study of the processes and related fluxes in different marginal basins of the Southwest Pacific: the Fiji, Lau, Manus, and Woodlark basins. In most cases, taking into account the work previously done by other nations, the bilateral cooperation will be extended to a third or fourth partner.

** A first set of SeaBeam maps has been published (1/200 000 scale, six colored sheets) by both parts in 1990 and can be freely obtained upon request to J.-M. Auzende. A second set of maps including the last results will be soon published at a 1/500 000 scale in two colored sheets .*

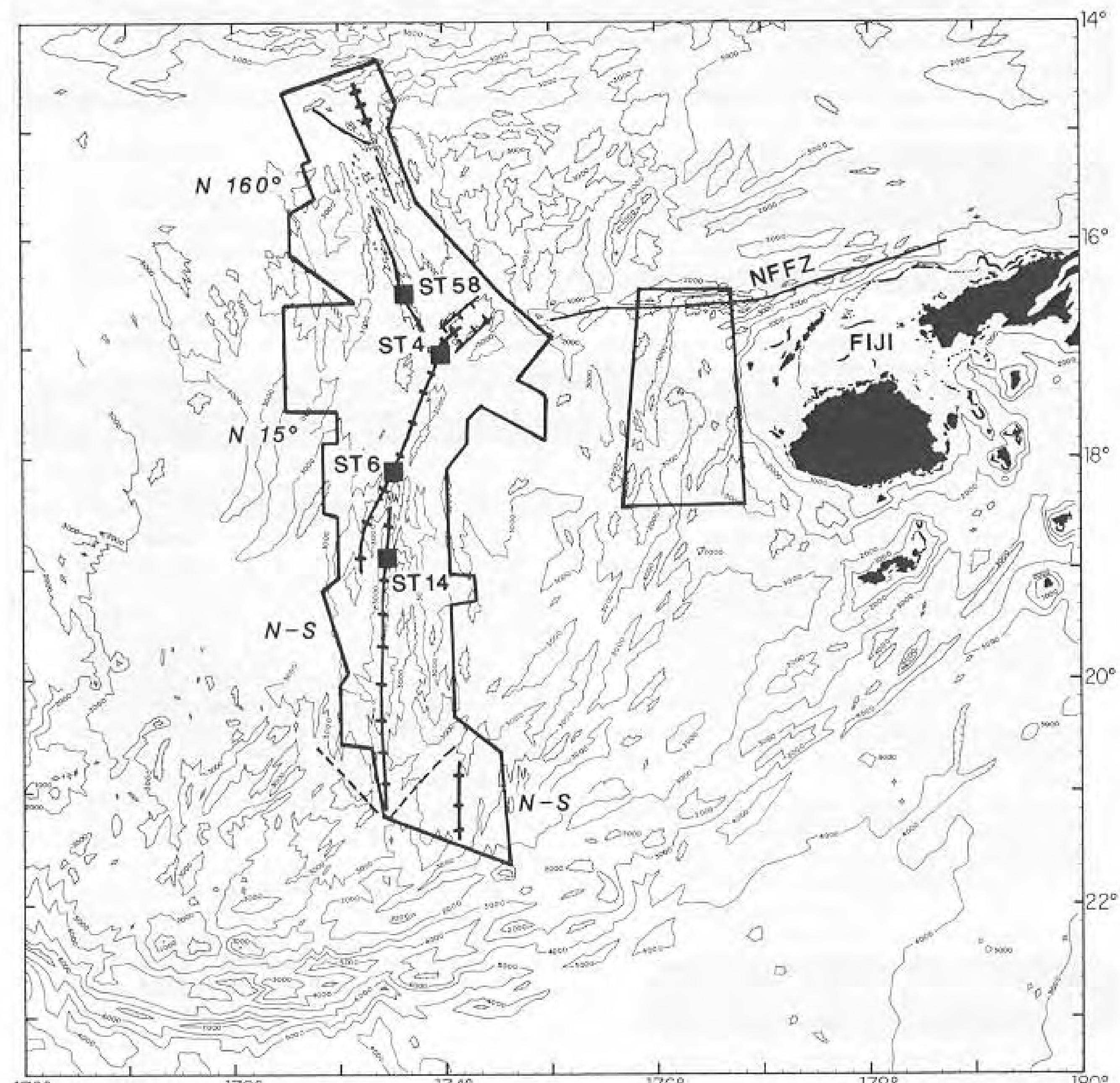


Figure 1. *Simplified bathymetric map of the North Fiji Basin. The envelopes indicate the area of full multi-narrow beam survey coverage. The axis is indicated by a cross-hatched line, the ridge by a thick solid line, and graben by hachured lines. ST4, 6, 14, and 58 are the diving sites. N 160, 15, and N-S are the different major segments of the ridge. NFFZ: North Fiji Fracture Zone.*

News from National Ridge Research Programs

BRIDGE

From The BRIDGE Newsletter; Lindsay Parson, editor...

BRIDGE News:

The good, good news, of course, is that BRIDGE funding came through via the 1991 Public Expenditure Supplement Round, £4.5m, as follows: zero for 1992/93; £1.5m for 1993/94; and £3m for 1994/95. NERC Earth Sciences Directorate (ESD) have advised that there is no guarantee of funds for 1995/96 (or beyond), but it would be reasonable for planning purposes to make the assumption of funding continuing at £3m pa for a finite period.

A quorum of the interim BRIDGE Steering group convened in Leeds on the 17 January to discuss this news and to prepare a working BRIDGE Science Plan for ESD consideration. This would ideally include some advance of 'seed' money into the 92/93 year to spin up the programme. The meeting also proposed a full BRIDGE Steering Committee, which has since been approved of by Professor Jim Briden (Director, ESD). The new membership is as follows:

J.R. Cann (Chairman: University of Leeds); Colin Summerhayes (Alternate Chairman: IOSDL); R.C. Searle (University of Durham); P. Hedgecock (IOSDL); L.M. Parson (IOSDL); P. Dando (PML); H. Elderfield (Cambridge); M. Sinha (Bullard, Cambridge); R.S.J. Sparks (Bristol); and R.W. Nesbitt (Southampton).

As a result of the meeting, a letter was distributed to the BRIDGE community, seeking suggestions for amendments or additions to the objectives, etc., as laid out in the original "green" book. ... By next spring, a firm plan for announcements of opportunity and timing of funding will be available.

Swath bathymetry. One major discussion point over the next few months will be the use of BRIDGE funds for the acquisition of a UK swath bathymetry facility. The wording in the ABRC advice to the Secretary of State was that he "hoped that NERC will be able to secure access at an early date to a Swath Bathymetry system." "Secures Access" was a phrase to be discussed at length at a meeting of the Swath Bathymetry Advisory Group at the end of April. The membership is as follows: B.J. Hinde (Chairman; NSS HQ); L.M. Parson (IOSDL); M.L. Somers (IOSDL); P. Barker (BAS); R.B. Kidd (Cardiff); G.K. Westbrook (Birmingham); S. White (NSS, HQ); K. Robertson (Secretary; RVS).

InterRidge/Japan

The Ridge Flux Project

Outline of the project

The prime purpose of this project is to measure quantitatively the flux of energy and mass from earth's interior to its surface environment at oceanic ridges, where about 80% of such flux is estimated to occur. This research is funded from the Science and Technology Agency of Japan and is a part of STA's "New Pacific Research Project." This research will provide invaluable information for the understanding of the interaction of lithosphere with hydro-, atmo-, and biospheres of the evolving earth systems.

The cruises will be conducted as bilateral projects with France and the USA, but the participation from other countries including SOPAC through *InterRidge* coordination is highly welcome.

Schedule

April 1992 - March 1993	Feasibility study and cruise planning
April 1993 - March 1998	5 year project. About 2 cruises a year are planned.

InterRidge/Japan--cont.

Target areas

We will decide the targets through discussion during the feasibility study. Tentative candidates include: (A) Superfast spreading center of East Pacific Rise between 0 and 20°S (north of Easter Islands), and (B) Marginal basin spreading centers in Southwest Pacific area like Manus where very fast spreading rate is observed.

Research outline

The mid-oceanic ridge is one of the most remarkable features on the earth, extending more than 80,000 km in length. It became evident that the ridges can be divided into segments and a segment, 30-100 km long, corresponds to a single volcano with an individual magma chamber. Therefore, if we can measure the total flux of mass and energy from one segment volcano, it becomes possible to estimate roughly the total discharge over the entire length of the ridge.

This project aims to compare the magmatic, hydrothermal, and biological activities occurring both in mid-oceanic ridges and in back-arc basin spreading/rifting centers, which are the two major settings of the oceanic ridges on the earth. Deployment of a submarine volcano-hydrothermal observatory (monitoring station) and diving with manned submersibles will be the most important operations of this research, besides the conventional surveys and sampling from the surface ships.

Comité Dorsales (France)

From the Comité Dorsales Lettre №0 (translated); Jean Francheteau, editor...

The "Dorsales" Committee

The study of mid-oceanic ridges is one of the primary components of international oceanographic research. Various countries have organized themselves according to national plans (the RIDGE Program in the US, BRIDGE in the UK). In addition, an international program (InterRidge) is under development. In consideration of this situation, and in response to the recommendation of its Comité Oceanoscope (Oceanographic Committee), INSU (Institut National des Sciences de l'Univers) has established a "Comité Dorsales" (Ridges Committee) to energize and represent the French scientific community in the area of ridge research. This Committee will include 13 members, under the presidency of J. Francheteau. The President is designated for four years, and membership of the committee will rotate in groups every two years.

Mandate

The Committee met for the first time on January 21, 1992. After discussion, it was decided that the Committee should:

- Choose, according to thematic, geographic, and technological considerations, the principal directions for French ridge research. This focusing effort on the part of the community is necessary in order to integrate the French position in the context of the InterRidge program.
- Coordinate actions of different research groups to reach a better integration of efforts.
- Promote mid-ocean ridge research within the community and the funding agencies.
- Energize the community through facilitating information exchange (creation of a "Dorsales" newsletter).
- Establish liaisons with national (PNEHO, DBT, ...) and international (InterRidge, ODP) programs.
- Maintain an advisory role in defining a formal program based on thematic and/or specific geographic objectives.

To play this role in maintaining an active connection with the scientific community, the Committee decided to organize a "Ridge" workshop, open to all, next Spring.

SCOR Working Group 91 to hold symposium on Marine Hydrothermal Systems and the Origin of Life

See page 25 for details

Notices & Announcements

Portugal

The University of Lisbon and the Instituto Hidrográfico da Marinha are developing a project concerning the bathymetry of the Açores area. Thus, we are gathering information from research institutes and national hydrographic authorities that have in the past done research in this area and are willing to collaborate with us.

We will be pleased to collect multibeam data (in digital and/or analog form) as well as specific surveys. All contributions will be clearly referred in the final maps produced and the contributor will have access to the final data base.

J. Miguel A. Miranda
C. Geofisica da Universidade de Lisboa
Rua da Escola Politécnica, 58
1200 LISBOA, PORTUGAL

João Alveirinho Dias
Instituto Hidrográfico da Marinha
Geologia Marinha
Rua das Trinas,
1200 LISBOA, PORTUGAL

Spain

Joint Spanish Institute of Oceanography — Group of Marine Geology/University of Barcelona (IEO/GGM-UB) cruise to the South Scotia Ridge (Antarctica)

Since the first marine geology and geophysics cruise in 1985/86 in the Scotia, Bransfield and South Shetland areas, several other Spanish cruises have been done in Antarctic waters under the management of the IEO. Other institutions, like the University of Barcelona, have collaborated in the analysis of samples and in the interpretation of seismic profiles.

This year, a marine geology and geophysics cruise was planned for February 1992 on board the new Spanish oceanographic vessel *BIO Hesperides*. Commander J.C. Manzano has the great responsibility and prestige of commanding the most valuable "jewel" of the Spanish oceanographic fleet.

The 1992 cruise research tasks were centered on the South Scotia Ridge, from Elephant Island to South Orkney Islands, with an eventual extension to the northern reaches of the Powell Basin. In the case of bad weather, an alternative plan to work in more protected areas, such as the South Shetland Islands, also exists. The following equipment was used during the cruise:

- SIMRAD EM-12 and EM-1000 multibeam echosounders
- Bentech Topographic Parametric Sonar, TOPAS, which combines topographic mapping and sub-bottom high-resolution seismic profiling
- Multichannel seismic reflection system
- Proton magnetometer
- Hydrographic sensor and sampling system
- Sediment sampling apparatus

The major aim of the cruise is to obtain combined geophysical records along the South Scotia Ridge in order to establish its detailed morphology, its relations with the adjacent basins (Scotia and Powell Basins), and its evolution in the frame of the more general geodynamics of the frontiers between Drake, Scotia and Antarctica plates.

Twenty-three scientists and technicians will participate in the cruise, under the direction of J. Acosta (IEO) and M. Canals (GGM-UB). Spanish PhD students now at IFREMER (Fr.) and WHOI (USA), working on plate frontiers, have also been invited to join the cruise.

Funds come from the Spanish "Comisión Asesora de Investigaciòn Científica y Técnica" (Antarctic Program), and from the IEO itself.

Korea

From a letter received earlier this spring from Dr. Byong-Kwon Park, President, Korea Ocean Research and Development Institute (KORDI)...

I am pleased to inform you that we will have the Commissioning ceremony of *R/V Onnuri* on March 20 in Korea. As you may know, on the occasion of the delivery of a 350-ton research and submarine tending vessel, *Eardo*, and a 1400-ton multipurpose ocean-going research vessel, *Onnuri*, including SeaBeam 2000 and a 96-channel seismic system, we intend to join the world's oceanographic community in a visible and active role by participation in one or more of the large international oceanographic programs.

Cyprus

SCOR

SCOR Working Group 91: Chemical Evolution and Origin of Life in Marine Hydrothermal Systems

Nils Holm
Department of Geology and Geochemistry, Stockholm University, S-106 91, Stockholm, Sweden

A major focus of the Scientific Committee on Oceanic Research (SCOR) is on the activities carried out in its working groups. The Working Group on "Chemical Evolution and Origin of Life in Marine Hydrothermal Systems" (WG91) was established at the SCOR General Meeting in Acapulco in 1988. The aim of the work of WG91 is to bring some order into the debate on whether or not it is likely that life once originated in the hydrothermal systems of the mid-ocean ridges. That hypothesis was presented by John Corliss, John Baross and Sarah Hoffman at the International Geological Congress in Paris twelve years ago and has been disputed extensively ever since.

The work carried out by SCOR Working Groups is structured by the terms of reference specified at the establishment of each group. For WG91 the terms of reference are:

1. To determine likely constituents necessary for neo-abiogenesis according to the state of art of the origin of life sciences and thermodynamic calculation.
2. To review available data concerning primordial organic monomers and polymers already observed in hydrothermal systems (for example, carboxylic acids, amino acids, cyano- and heterocyclic compounds); compile a list of potential substances that have to be searched for; and differentiate compounds formed abiogenically and biogenically.
3. To evaluate the role of different classes of possible inorganic catalysts which may be required for the synthesis of organic compounds in hydrothermal systems.
4. To sponsor a symposium and published set of papers in 1992 summarizing the state of knowledge and identifying research opportunities in this field.

Note that the term "hydrothermal vent" is never used in this context. The debate on the Corliss-Baross-Hoffman model has been limited to whether or not organic compounds would survive the conditions of hot vents. WG91, on the other hand, compiles information on the conditions of all environments of hydrothermal systems and their variations, both spatially and temporally.

Members of WG91 are: Nils Holm (chairman), Yurij Bogdanov, Graham Cairns-Smith, Roy Daniel, James Ferris, Remy Hennet, Everett Shock, Bernd Simoneit, and Hiroshi Yanagawa. Michael Russell has participated as an associate member. The group has had two official gatherings thus far: in Kristineberg, Sweden, in June 1990, and in Redmond, Oregon, in June 1991. A workshop was also organized in conjunction with the 9th International Conference on the Origin of life in Prague in July 1989. The main goal of that workshop was to answer the question: "What experimental, theoretical and field studies need to be done in order to test the hydrothermal model for the origin of life?"

The easiest way to describe the type of scientific data that have been processed by WG91 is probably to list the contents of the final report that is under preparation. The report is scheduled for publication by the end of the summer 1992. It will be published as a special issue of the journal *Origins of Life and Evolution of the Biosphere* as well as a separate book (both published by Kluwer Academic Publishers) entitled "Marine Hydrothermal Systems and the Origin of Life":

1. Why are hydrothermal systems proposed as plausible environments for the origin of life? (Holm)
2. Hydrothermal systems: their varieties, dynamics, and suitability for prebiotic chemistry (Holm, Hennet)
3. Modern life at high temperatures (Daniel)
4. High temperature/high pressure organic geochemistry (Simoneit)
5. Chemical environments of submarine hydrothermal systems (Shock)
6. Chemical markers of prebiotic chemistry in hydrothermal systems (Ferris)
7. Hydrothermal organic synthesis experiments (Shock)
8. An experimental approach to chemical evolution in submarine hydrothermal systems (Yanagawa, Kobayashi)
9. Mineral theories of the origin of life and an iron sulfide example (Cairns-Smith, Hall, Russell)
10. Future research (all WG members)

The terms of reference specify that a symposium in 1992 should conclude the official work of WG91. Originally a symposium was planned to be organized in conjunction with the 10th International Conference on the Origin of Life in Barcelona, Spain. That meeting has, however, been postponed for a year, so the "hydrothermal origin of life symposium" will be held in conjunction with the SCOR General Meeting in Göteborg, Sweden, in September of this year. **[See meeting announcement next page]**

Even though WG91 will be disbanded once its official mission in completed, several of the members of the group plan joint research efforts for the future. Some limited laboratory experiments based on the conclusions of the theoretical work have already been carried out and will be published soon. Several of the major program components of InterRidge are in line with the spirit of the work of SCOR Working Group 91. Thus future research with regard to hydrothermal activity and the origin of life would probably benefit from being included into the framework of InterRidge.

International Lithosphere Panel

The InterRidge Office gratefully acknowledges a gift of $1000 from the International Lithosphere Panel to support publication of InterRidge News. The efforts of ILP in promoting international communication and cooperation in ridge-related research are greatly appreciated.

Marine Hydrothermal Systems and the Origin of Life

Symposium convened by SCOR Working Group 91

September 18, 1992

A one-day symposium on "Marine Hydrothermal Systems and the Origin of Life" will be held in conjunction with the SCOR General Meeting in Göteborg, Sweden, and will report on the results of four years of work within Working Group 91 (entitled "Chemical Evolution and Origin of Life in Marine Hydrothermal Systems). The symposium will also present ideas for future research opportunities in this science field.

Participants in the 4th International Paleoceanography Conference in Kiel, Germany, September 21-25 may combine the two meetings and use the convenient overnight ferry connection between Göteborg and Kiel.

For further information, please contact Nils G. Holm, Department of Geology and Geochemistry, Stockholm University, S-106 91 Stockholm, Sweden; phone +46 8 16 47 43; fax +46 8 34 58 08; E-mail (Internet) "Holm_N@geokem.su.se".

(Germany, *continued from page 10)*

cesses between the deep earth, the crust, the circulating seawater, and the influence on the oceanic environment are emerging topics of research.

Though a joint German research program for mid-ocean ridge research is still missing, several projects dealing with this topic are being conducted by small working groups at different research institutions. Major topics include hydrothermal activities at mid-ocean ridges, back-arc basins and intraplate volcanic centers, metalliferous sediments and ore deposits, petrology of mid-ocean ridge magmas and mantle sources, and the sedimentary environment of mid-ocean ridges. Research areas are the Pacific Ocean (e.g., East Pacific Rise, Okinawa Trough, Mariana, Galapagos Rift, Lau back-arc basin), the Indian Ocean, Red Sea, and the North Atlantic up to arctic regions. Work at sea utilizes primarily swath bathymetric mapping and geophysical surveys, hard rock and sediment sampling, and water analyses (methane, trace elements). Field observations are carried out by deep-towed acoustic vehicles (side-scan) and TV systems.

The biological group concerning mid-ocean ridge ecology is still very small, working on high-temperature bacteria and macro-organisms in the vicinity of hydrothermal vent areas.

All research projects are financially supported by the German Ministry of Research and Technology (BMFT) and the German Science Foundation (DFG).

Some examples of mid-ocean ridge related research and research on similar volcanic environments performed during the past five years may serve as an overview of German ridge-related activities:

Galapagos rift
- "GARIMAS program," massive sulfides, area between Inca F. Z. and Galapagos Microplate studied during 4 research cruises by Preussag, University of Heidelberg, and University of Hamburg; area between Galapagos Microplate and Steiger deep studied by University of Karlsruhe.

East Pacific Rise
- "GEOMETEP I-V programs"; Ore formation in the EPR, Northern EPR near 13°N, Southern EPR (Easter plate to Galapagos Microplate, 23°S - 30°S, 18°S - 0°), complete mapping with more details between 18°S and 21°S; BGR, Preussag, together with IFREMER (France).
- "OLGA program," ore deposits at 21°S; University of Marburg.

Indian Ocean
- "GEMINO program," Rodriguez Triple Junction, hydrothermal mineralizations; RWTH Aachen (participants University of Hamburg, University of Kiel).

Atlantic Ocean
- "Greenland-Scotland Ridge Project," Iceland-Faeroe Ridge, Kolbeinsey Ridge, Aegir Ridge, Jan Mayen-Mohns Ridge, geophysics, petrology, sedimentology, geochemistry (comprising 6 cruises of R/V *Poseidon*, R/V *Polarstern*, R/V *Meteor*); GEOMAR, University of Kiel.

Red Sea
- Ore deposits in the deeps of the central Red Sea, massive sulfides in the northern part; Preussag, University of Karlsruhe and others.
- Environmental impact investigations related to ocean mining carried out by the Institute of Hydrobiology and Fisheries of Hamburg University.

Back-arc and hot-spot areas
- Lau basin; BGR, most recently in cooperation with IFREMER, using the submersible *Nautile*.
- Okinawa trough; University of Clausthal and University of Hamburg.
- Tyrrhenian Sea, hydrothermal activities and intraplate volcanism; University of Karlsruhe.
- Mariana back arc; University of Kiel, Scripps Institution.
- Macdonald and Tahitia hot spot; University of Kiel.
- Strait of Sicily; University of Kiel.

Ongoing ridge-related research

Atlantic Ocean
- Sedimentation processes in mid-ocean ridges: Reykjanes Ridge between 58°N and 60°N; GEOMAR.
- Gran Canaria clastic apron, ODP pre-site survey; GEOMAR.
- Petrology of the mid-ocean ridge and magmatic structure of the mantle in the northern North Atlantic (Norwegian-Greenland Sea); University of Kiel.
- St. Helena hot spot; University of Kiel.
- South Atlantic and eastern North Atlantic, episodicity of crust formation geophysics, bathymetry, flow-line across the Atlantic Ocean; BGR.

Pacific Ocean
- EPR hydrothermal massive sulfides; University of Kiel.
- Easter Microplate - Orongo transform fault, hydrothermalism; University of Kiel.
- Pitcairn, hot spot volcanism; University of Kiel.
- Hess deep, pre-site survey ODP mantle drilling; BGR, IFO, University of Greifswald.

Indian Ocean
- Geothermal metallogenesis Indian Ocean (GEMINO); RWTH Aachen.
- Structural segmentation and hydrothermalism of mid-ocean ridges, Indian Ocean and Atlantic; RWTH Aachen.

Mediterranean Sea
- Volcanism and hydrothermal activities in the Aegean Sea, Tyrrhenian Sea, and Strait of Sicily; University of Kiel.

German ridge-related research will continue in the future. In early March this year a group of scientists met in Hamburg to discuss joint activities in the frame of InterRidge.

InterRidge National Correspondents

AUSTRALIA

Dr. Tony Crawford
ODP Office, Geology Department
University of Tasmania
GPO Box 252C Hobart
Tasmania, AUSTRALIA 7000
Phone: 002-202476
Fax: 002-232547

CANADA

Dr. John Malpas
Memorial University
Centre for Earth Resources Research
St. John's, Newfoundland
CANADA
Phone: 709-737-8142
Fax: 709-737-2589
E-mail: odp@kean.ucs.mun.ca

CIS

Dr. Leonid V. Dmitriev
Vernadsky Institute of Geochemistry
Academy of Sciences
19, Kosygina Street
Moscow 117975 Russia CIS
Phone: 137-58-36
Fax: 095 938 2054
Telex: 411196 TERRA SU

FRANCE

Dr. David Needham
IFREMER/Centre de Brest
Département de Geosciences Marines
B.P.70 29263 Plouzané
FRANCE
Phone: 98-22-42-21
Fax: 98-22-45-49
Telex: 940627 IFREMER F

GERMANY

Dr. Hans-Ulrich Schmincke
GEOMAR
Forschungszentrum für Marine Geowissenschaften
Wischhofstrasse 1-3, Geb. 4
BRD-2300 Kiel 14 GERMANY
Phone: (0431) 725391
Fax: (0431) 7202-156

ICELAND

Dr. Karl Gronvold
Nordic Volcanological Institute
University of Iceland
Geoscience Building, Sudurgata
101 Reykjavik ICELAND
Phone: 1-694300
Fax: 1-29767
Telex: 2307 ISINFO

ITALY

Dr. Enrico Bonatti
Departement de Geologie
University de Bologne
Via Zamboni 17
Bologne 1-40127 ITALY
Fax: 39-51-24-31-17

JAPAN

Dr. Kensaku Tamaki
Ocean Research Institute
University of Tokyo
1-15-1, Minamidai, Nakano-ku
Tokyo 164 JAPAN
Phone: 03-376-1251
Fax: 03-375-6716
E-mail: ktamaki@tansei.cc.u-tokyo.ac.jp
Telex: 25607 ORIUT J

KOREA

Dr. Sang-Joon Han
Director, Marine Geology and Geophysics Division
Korea Ocean Research and Development Institute
Ansan P.O. Box 29
Seoul 425-600 KOREA

Dr. Bong Chool Suk
Head, Marine Geophysics Laboratory
Korea Ocean Research and Development Institute
Ansan P.O. Box 29
Seoul 425-600 KOREA

MEXICO

Dr. J. Eduardo Aguayo-Camargo
Instituto de Ciencias del Mar y Limnologia
Universidad Nactional Autonoma de Mexico
Apartado Postal 70-305
Mexico City 04510 MEXICO
Phone: 525-548-2766
Fax: 525-548-2582

NORWAY

Dr. Eirik Sundvor
Seismology Observatory
University of Bergen
Allegt 41 5000
Bergen NORWAY
Phone: 5-213401
Fax: 5-320009
Telex: 42877 UBBRB N

PORTUGAL

Dr. J. Miguel A. Miranda
C. Geofisica da Universidade de Lisboa
Rua da Escola Politécnica, 58
1200 Lisboa
PORTUGAL
Phone: (351 1) 3961521
Fax: (351 1) 3953327
E-mail: fgeocgul@ptearn.bitnet

SPAIN

Dr. J. Acosta
Department of Marine Geology
Instituto Español de Oceanografia
C/Corazon de Maria, 8, 18
28002 Madrid SPAIN
Phone: (1) 347 36 18
Fax: (1) 413 55 97

Dr. Miguel Canals
Group of Marine Geology
Department of Dynamic Geology
University of Barcelona
Nucli Universitari de Pedralbes
08071 Barcelona SPAIN
Phone: (3) 402 13 60
Fax: (3) 402 13 40

UNITED KINGDOM

Dr. Johnson R. Cann
Department of Earth Sciences
University of Leeds
Leeds
LS2 9JT UNITED KINGDOM
Phone: 532-335200
Fax: 532-336017
E-mail: ear6jrc@uk.ac.leeds.cms1

USA

Dr. John R. Delaney
School of Oceanography, WB-10
University of Washington
Seattle, WA 98195 USA
Phone: 206/543-4830, -9893
Fax: 206/685-0596
Telemail: J.DELANEY
E-mail: jdelaney@u.washington.edu
Telex: 7402021 GLBL

InterRidge Steering Group

John R. Delaney—co-chair
(address above)

Daniel Desbruyeres
Directeur du Département Environnement Profond
IFREMER-DRO/EP
Centre de Brest: BP 70
Plouzané 29280 FRANCE
Phone: 98-22-43-01
Telex: Océan A 940627 F
Fax: 98-22-45-47
Telemail: D.DESBRUYERES

Robert Detrick
RIDGE Office
Woods Hole Oceanographic Inst.
Woods Hole, MA 02543
Phone: 508-457-2000 x.3335
Fax: 508-457-2187
E-mail: ridge@copper.whoi.edu
Telemail: R.DETRICK

P. Jeff Fox
University of Rhode Island
Graduate School of Oceanography
Narragansett, RI 02882 USA
Phone: 401/792-6879
Fax: 401/792-6160
Telemail: J.FOX

Jean Francheteau
Institut de Physique du Globe
Lab de Geophysique Marine
Tour 14-15, 1 étage,
4 Place Jussieu
75230 Paris CEDEX
05 FRANCE
Phone: 44-27-48-31
Telex: 202810 VOLSISM F
Fax: 44-27-33-73

Charles Langmuir
Lamont-Doherty Geological Observatory
Palisades, NY 10964 USA
Phone: 914/359-2900
Fax: 914/365-3183
Telemail: C.LANGMUIR
Telex: 710-576-2653

David Needham—co-chair
(address above)

Martin C. Sinha
Bullard Labs
Department of Earth Sciences
University of Cambridge
Madingley Rise, Madingley Road
Cambridge
CB3 OEZ UNITED KINGDOM

Kensaku Tamaki
[address above]