

DEEP-SEA NEWSLETTER



No. 23, March 1995

SEVENTH DEEP SEA BIOLOGY SYMPOSIUM

IMBC.CRETE.94



In the summer of 1841, Edward Forbes dredged the Aegean to the north of Crete and came to the conclusion that the deep ocean was totally devoid of life. He was wrong, and well over 100 deep-sea biologists demonstrated just how wrong he was during the seventh D-S B Symposium held at the Royal Knossos Village Hotel, Hersonissos, Crete from Thursday 29 September to Tuesday 4 October 1994. Forbes would have been delighted.

On the last day of the Symposium, a smooth-talking great Dane caught me in an off-guard moment and elicited a promise to write a fairly low-key account of the meeting for the Deep-Sea Newsletter. I conveniently forgot all about it until I received Torben's *crie de coeur* this morning. Consequently, like Brian Bett's piece on the 6th Symposium in Copenhagen (Deep-Sea Newsletter, 19), this will not be a blow by blow account, but rather a collection of random thoughts and hazy recollections.

The Symposium must be counted a success, with many old friendships being renewed and new ones being forged, though some of the geriatrics missed their old pals who failed to come, possibly because of the relative inaccessibility of the venue. But many of those who did attend took advantage of a subsidised visit to a history-rich holiday island to extend their stay into a vacation. Consequently, it was a pleasure to see an unusual number of non-biologist partners, particularly during the marvellous excursion day to the ruins of Gortys and Faestos and the beach at Matala.

Meeting and talking informally to rarely encountered colleagues is a major function of any symposium, particularly in a small, far-flung community such as ours. But for it to work you need a relaxed, friendly and informal atmosphere not fraught with organisational chaos. The

Greeks, of course, invented the word chaos, but it was conspicuously absent from the meeting which, despite an exceptionally full programme, ran remarkably smoothly. For this we have to thank the organising committee, ably headed by 'old' Tassos, but (I suspect) with most of the real work done by 'young' Tassos (what a pity he speaks such terrible English), Nadie and Chris (Zorba) Smith and their excellent, helpful and hospitable band of helpers.

Against the rival attractions of sun, sand, sea and - mountains of stark naked flesh (mostly overweight and middle-aged, like me, unfortunately), the lecture room remained amazingly well populated through four and a half days of intense science - and the limited, but generally excellent, poster display was also well-used. The topics covered by the lectures and posters ranged geographically from the high Atlantic to the antarctic and from the western Pacific to the eastern Mediterranean, the latter almost within a stone's throw of where we were sitting. They also ranged from broad-brush biogeography and phylogenetics, through community structure and biodiversity, via feeding behaviour and reproductive strategies, to histology, physiology and biochemistry - and even to the use of the deep Mediterranean as a rubbish tip! Perhaps inevitably these days, almost a quarter of

the scientific sessions were devoted to hydrothermal vents, seeps and other extreme environments. But I shouldn't moan, since my own pet interest, the seasonal sedimentation of phytodetritus, also got far more than its fair share of coverage.

The standard of the presentations was generally quite good, though the usual crop of appalling ones outnumbered the best. You can't, as they say, teach old dogs new tricks, but I was encouraged by the impression that the youngsters outperformed the oldsters, so the future seems brighter. Unfortunately, almost all of the talks were rushed, for 20 minutes was the standard slot and as many as 20 separate lectures were crammed into a single day. This is too many; I defy anyone to stay alert and interested throughout such a feast. Perhaps as a result, the limited public discussion was disappointingly uninspired, uncontroversial - and dull!

This was decidedly not the fault of the organisers. They did a superb job within what seems to have become the standard symposium format. So what is the answer for the future? I don't have one, but I have a number of suggestions. First, don't even consider simultaneous sessions. We are still too small and intimate a family to introduce such divisiveness. But do cut down the number of talks. If financing organisations still need to think their protégés are giving lectures to justify their funding, let us tell them white lies! They are wrong; a good discussion is worth a dozen bad lectures. Second, give each speaker more time - at least 30 minutes, so that there is at least a possibility of discussion. If, as a result, sessions finish early, then let us have a longer coffee break; people talk during breaks. Third, organise specific discussion sessions on 'hot' topics, introduced by good speakers who will encourage the shy ones to speak up.

So how do you decide which lectures to accept? Not easy, but I suggest that a good general policy would be unashamedly ageist; the older you are, the less chance of your talk being accepted. Why? Because with rare exceptions the over 50s don't have anything very interesting to say. (That will go down well with some of my contemporaries!). In any case most of us wrinklies rely on youngsters to do our research while we push paper - so let them present the results. The future is theirs, so let them have the lion's share of the present.

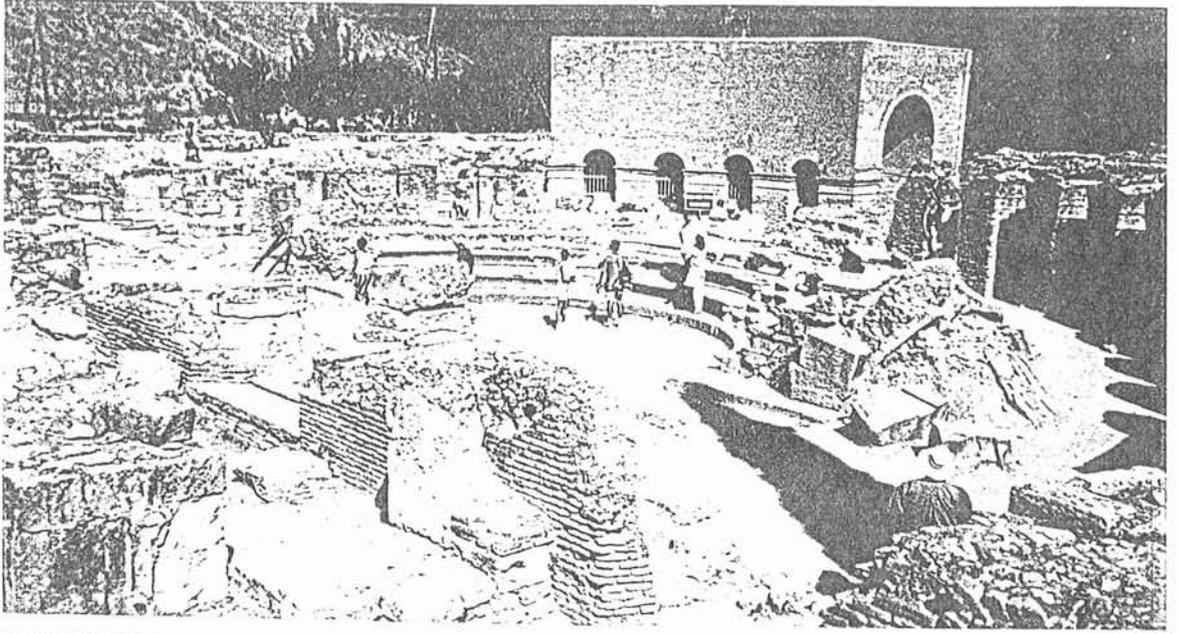
Well, I've got that off my chest, somewhat under false pretences since I was supposed to be commenting simply on the Crete symposium. However, the democratically decided venue for the Eighth symposium, and my last, will be Galway in Ireland. It will be organised by John Patching, with me poking my oar in at every possible opportunity. So if you disagree with my expressed views, please let me or John know, otherwise you may not like the arrangements in 1997. But come to Galway anyway. The weather will probably be appalling, but the scenery is superb - 40 shades of green to contrast with the wonderful burnt ochre of Crete. While there is nothing to compare with the Minoan palaces, of course, there are dozens of fascinating neolithic and celtic sites. Irish hospitality will be just as warm as the Cretan version, with the velvet coolness of the local vin noir to contrast with the fire of retzina and raki! Oh yes, and there will be lots of deep-sea biology too.

Tony Rice
IOSDL, Wormley

In addition to Edward Lear's beautifully illustrated book on his travels in Crete in the 1860's, the Symposium donated your editor a model of a silver-plated Greek galley "for his life-time achievement in marine biology", here admired by T.W., Bernd Christiansen, Antje Boëtius and Tony Rice. (A. Gebruk phot.)



Excursion
day to Cen-
tral and
South Crete:
Amongst the
ruins at
Gortys.
(Buz Wilson
phot.)



- and at
Faestos.
(Tassos II
phot.)



- and the
happy lunch
with vine
leaves above
and wine
pitchers in
front.
(Tassos II
phot.)



SCIENTIFIC PROGRAMME OF THE SYMPOSIUM

ORAL PRESENTATIONS (in case of two or more authors, the presenter is listed first)

A. Eleftheriou Marine biology in Minoan Crete. Welcoming address.

Deep-Sea Biota - Fish Behaviour:

I.G. Priede Does the abyssal benthic scavenging granadier fish *Nematonurus* (*Coryphaenoides*) *armatus* respond to seasonal changes in the North Atlantic?

A. Smith Activity patterns of abyssal scavengers observed at baits deployed on the deep ocean floor (plus video projection).

P.M. Bagley Tracking of abyssal benthic scavenging fishes using ingestible pingers and transponders.

Deep-Sea Biota - Macrofauna:

A.L. Rice, M.H. Thurston The IOSDL DEEPSEAS Programme; introduction and dramatic time-lapse
B. Bett photographic results.

M.H. Thurston, B. Bett Hatchling size and aspects of biology in the deep-sea amphipod genus
Eurythenes (Crustacea: Amphipoda: Lysianassoidea).

D. Gaspard, V. Barbin Growth stages highlighted by cathodoluminescence in recent brachiopods.

G.S. Lawson, M. Sheader Reproductive and feeding biology of a deep-sea ampeliscid.
P.A. Tyler, M. Thurston, J.D. Gage

G.C.B. Poore, B.F. Cohen The biogeography of the Gnathiidae (Crustacea: Isopoda) on the coast, shelf
and slope of Eastern Australia.

Deep-Sea Biota - Megafauna:

B. Bett, B.E. Narayanaswamy A quantitative photographic survey of "spoke-burrow"-type lebensspuren on the
A.L. Rice, M.H. Thurston Cape Verde Abyssal Plain. Short Communication.

H. Thiel, G. Schriever Observations on baited and unbaited time-lapse cameras.
H. Bluhm

H.M. Thurston, B. Bett Scavenging abyssal megafauna in the Eastern North Atlantic Ocean.
A.L. Rice

J.Y. Aller Spatial and temporal distribution of benthic communities on the Nova Scotia Rise
as indicators of physical processes.

R. George Pressure induced metabolic adapted strategies in deep-sea megafauna.

H.M. Moore, D. Roberts Gut structure and feeding strategies in deposit feeding abyssal holothurians.
Short communication.

B.A.D. Manship, D. Roberts Bacterial profiles along the digestive tracts of deposit feeding abyssal
holothurians. Short communication.

- U. Witte, G. Graf Reproductive pattern, particle uptake and biodeposition rate of deep-sea sponges from the deep.
- A. Brandt Composition, abundance, diversity and community patterns of Peracarida (Crustacea, Malacostraca) in two areas of the North Atlantic.
- S.K. Bronsdon, M. Ripley Reproductive strategies of two deep-sea epizoic anemones from the NE Atlantic.
P.A.Tyler, A.L.Rice, J.D.Gage
- C.M.Young, S.George Larval growth, development and survival of the bathyal echinoid *Aspidodiadema jacybyi* under different physical and dietary regimes.
S. Ekaratne
- L.E.Hawkins, S.Hutchinson Coelomic fluid composition of deep-sea holothurians: evidence of bouyancy?

Pelagic-benthic Coupling

- B. Christiansen Standing stock and carbon demand on the near-bottom fauna: a comparison of two oceanic locations in the NE Atlantic.
- C.R.Smith, D.J. Hoover Benthic-pelagic coupling in the abyssal ocean: benthic community structure and bioturbation along the equatorial Pacific carbon-flux gradient.
S.P. Garner, S.E. Doan
- C.M.Young, P.A.Tyler Do seasonal pulses of macrophyte detritus entrain reproductive rhythms in tropical deep-sea?
R.H. Emson
- J.A. Koslow Trophodynamic models of mid-slope fish community off Southeastern Australia: orange roughly energetics and fluxes to deep water via sedimentation, vertical migration and lateral advection.

Hydrothermal vents, cold seeps & special environments:

- P. Chevaldonné Microecology of a hydrothermal vent chimney at 9°50'N on the East Pacific Rise.
A. Godfroy, J. Guezennec
F. Marec, Y. Fouquet
- U. Luth, A. Gebruk Occurrence of carbonate cemented rocks and bacterial mats along the oxic-anoxic gradient in a methane seep area off the Crimean coast in the Black Sea.
M. Gulin, C. Luth
N. Pimenov
- A. Godfroy, F. Marec Rapid indentification of new Archaea bacterians from deep-sea vents of the Mid Atlantic Ridge.
- F. Zal, D. Jollivet Life-history and population structure of *Paralvinella grasslei*, a polychaete annelid from deep-sea hydrothermal vents.
P. Chevaldonné
D. Desbruyères
- T.M. Shank, D.J. Fornari Rapid development of biological community structure and associated geologic features at hydrothermal vents at 9°-10 North, East Pacific Rise.
M.E.R. Haymon, M. Lilley
K. Von Damm, R.A. Lutz
- K. Olu, A. Duperret Ecology of cold seep communities on the northern Peruvian active margin.
M. Sibuet, J.-P. Foucher
A. Fiala-Medioni, J. Bourgois
- A. Gebruk Unusually strong input of methane carbon into biota of deep-water heat affected community in Froliha Bay, Lake Baikal.

- J.P. Barry, R.E. Kochevar Distribution and growth rates of Vesicomylid clams in relation to pore water
C.H. Baxter, P.J. Whaling chemistry of cold seeps in Monterey Bay, California, USA.
- A. Fiala-Medioni, V. Pranal Deep-sea symbiotic models chemocynthetic based: comparison of bivalve
J.-C. Colomines molluscs from hydrothermal vents and cold seeps.
- M.J. Youngbluth Predation by large physonect siphonophores in a hypoxic midwater environment.
B.H. Robison, K.R. Reisenbichler

Microbiology, Biochemistry & Molecular Biology:

- K. Lochte Microbial investigations in deep-sea sediments of the Weddell Sea, Antarctica.
- A. Boëtius, K. Lochte Enzymatic degradation potentials of microbial assemblages in slope and deep-sea
sediments.
- T.J. Ferrero, D.K. Boardman Preliminary results and assessment of a sediment homogenisation technique
M. Ripley, D. Eardley enabling direct measurement and comparison of nematode populations with
G.A. Wolff, S.J. Rowland sediment biogeochemistry and bacteriology.
J. Patching, P.J.D. Lamshead
N.J. Debenham, A. Becket
- M.B. Black, W.R. Hoeh Phylogenetic relationships of tube worms (Vestimentifera and Pogonophora)
R.A. Lutz, R.C. Vrijenhoek inferred from mitochondrial COI sequence.
- C.S. France, T.D. Kocher Mitochondrial 16s rRNA sequence variation in populations of the scavenging
deep-sea amphipod *Eurythenes gryllus* (Crustacea, Lysianassoidea) from the
North Atlantic and North Pacific Oceans.

Meiofauna:

- A. Vanreusel, M. Vincx Nematode biomass spectra of two abyssal sites in the NE Atlantic with a
B. Bett, A.L. Rice presumed contrasting food supply.
- T. Soltwedel, O. Pfannkuche The size structure of deep-sea metazoan meiobenthos in the NE Atlantic:
H. Thiel nematode size spectra in relation to environmental variables.
- P.J.D. Lamshead A nematode latitudinal diversity pattern in the North Atlantic deep sea.
G. Boucher, M. Hodda
P. Jensen, D. Thistle, J. Tietjen
- C. Bussau, G. Schriever Evaluation of abyssal metazoan meiofauna from a manganese nodule area of the
H. Thiel Eastern South Pacific.
- C. Luth, C. Bussau Small scale variability of meiobenthos and sedimentary biochemical indicators of
T. Soltwedel, H. Thiel biological abundance and activity in the deep sea. Short communication.
- J. Svavarsson Pattern of foraminifer (Protozoa) epizoites on the Arctic deep water isopod
B. Daviosdottir *Arcturus baffini* (Crustacea, Isopoda, Valvifera).
- O. Gross, C. Hemleben Ecology of deep-sea foraminiferans maintained in laboratory cultures.

Video presentations:

- T.M. Shank Best hydrothermal vents hits at 9°North (EPR).

B.H. Robison In situ observations of the deep pelagic fauna of the Monterey Submarine Canyon.

Eastern Mediterranean:

M. Türkay The Eastern Mediterranean deep-sea benthos. Studies in a peculiar environment.

S. Scheibe, A. Boëtius Labile organic matter and microbial heterotrophic activities in deep-sea
A. Tselepides, H. Thiel sediments of the Eastern Mediterranean Sea.

R. Danovaro, A. Tselepides Distribution of deep-sea meiobenthos in the Levantine Sea.

D. Fiege, N.M. Ben-Eliahu Polychaeta of the Central and Eastern Mediterranean deep sea.
K.N. Papadopoulou-Smith

B. Galil The deep sea Levantine fauna - new records.

B. Galil, H. Zibrowius Keyhole to the past. Preliminary benthic samples from Eratosthenes Seamount (Eastern Mediterranean).

A. Tselepides Macrobenthic communities of the continental slope of the Aegean Sea.

G. Albertelli, N. Della Croce Experimental traps and deep-sea bottom fauna.

I. Siokou-Frangou Deep-sea meso-zooplankton in the Eastern Mediterranean.
E.D. Christou, M.A. Pancucci-
Papadopoulou

H. Zibrowius Mediterranean deep benthos (Recent and Pleistocene) photographed by CYANA during geological cruises.

H. Zibrowius A marine cave as a mesocosm of the deep Mediterranean.
N. Boury-Esnault, J.-G. Harmelin
J.-C. Romano, E. Vacelet
J. Vacelet

B. Galil, M. Türkay Litter at the bottom of the sea: a sea bed survey in the Eastern Mediterranean. Short communication.

Distribution/Diversity/Community Structure:

E. Schein, M. Roux Adaptation to the deep sea and diversity. I: The example of Bivalves. Short
N. Ameziane communication.

M. Roux, N. Ameziane Adaptation to the deep sea and diversity. II: The example of stalked Crinoids.
E. Schein Short communication.

G.D.F. Wilson How many species of abyssal invertebrates are there? Data on Isopoda and Polychaeta from the North Clipperton-Clariou Fraction Zone.

P.V.R. Snelgrove Ageing food patches as a factor contributing to high deep-sea macrofaunal
J.F. Grassle, R.F. Petrecca diversity.

K. v. Juterzenka Ecological significance of a deep-sea brittle star in the northern North Atlantic.

M.A. Rex, C.T. Stuart Latitudinal gradients of species richness in the deep-sea benthos.

- T.Brattegard, S.F.Jellestad Distribution, growth and prey selection in the Northeast Atlantic deep-water starfish *Psilaster andromeda* (Asteroidea).
- J.A. Koslow, A. Williams The demersal fish fauna on the continental slope off Western Australia: patterns of abundance, species richness, community structure and trophodynamics.

Large projects:

- T. Fukushima Introduction of Japan Deep-Sea Impact Experiment (JET).
- J. Galeron, M.-L. Mahaut EUMELI (JGOFS-France) programme in the tropical Northeast Atlantic.
M. Sibuet, A. Dinet Community structure and carbon transfer through the benthic food web.
N. Cosson, A. Khripounoff
P. Crassous
- H. Bluhm Megabenthic recolonization during the DISCOL experiment.
- C. Borowski Responses to an environmental impact in the deep-sea: benthic macrofauna in the DISCOL experiment area (DEA) of the SE Pacific.
- D. Thistle, G.D.F. Wilson Is the HEBBLE isopod fauna hydrodynamically modified: a second test.
- P.R.V. Snelgrove Long-term studies of benthic macrofaunal communities at the Long-term
J.F. Grassle Ecosystem Observatory (LEO-2500) on the continental slope and rise off New
R.F. Petrecca Jersey, USA, and the Effects of sewage sludge disposal.
- D.D. Trueblood A simulation of deep seabed mining environment disturbance: the Benthic
E. Ozturgut Impact Experiment.
- T. Wolff Location of next Symposium?

Invitations had been submitted from Galway, Monterey, Wilmington and Genova. Many felt that after so many meetings in Europe it was time to gather in America in 1997. However, since this was the second official (and third unofficial) invitation from Galway, and since it was decided before voting that the Ninth Symposium in the year 2000 should not be in Europe, Galway was chosen by a great majority, with Monterey being second.

Ed.

POSTER SESSIONS:

- P.M. Bagley, S. Addison ATTIS (Acoustic Telemetry and Transponder Interrogation System): A new
A. Smith, I.G. Priede benthic lander vehicle with acoustic telemetry to the surface and a high frequency fish.
- M.N. Ben-Eliahu, D. Fiege Shelf and deep-water Serpulidae (Annelida) of the Central and Eastern Mediterranean.
- C. Bishop, M. Varney Preliminary mass spectrometric lipid profiles of the deep-sea asteroid
P.A. Tyler *Plutonaster bifrons*.
- A. Boëtius, E. Damm Microbial activity and organic matter mineralization in Arctic slope and deep-sea sediments.
- A. Bozzano, J.E. Cartes Preliminary data about *Bathypterois mediterraneus* feeding behaviour in the Catalan Sea.
- J.E. Cartes, J.C. Sorbe Preliminary data about seasonal structure population of deep-water cumaceans on the Western Mediterranean slope (between 400 and 1300 m).

- L. Dantart, X. Turón
F. Milagros, S. Carner Ecological and seasonal variation in populations of deep-sea invertebrates in the Northwestern Mediterranean: I. Molluscs (preliminary results).
- A.B. Dolle, K. Jeskulke
K. Poremba Nitrification in deep-sea sediments of the Northeast Atlantic (47°N 19°W).
- A.B. Dolle, O. Pfannkuche
H. Thiel Biogeochemical Sediment Analysis: a comparative study of Deep-Sea sediments in the Northeast Atlantic at 59°N 20°W and 49°N 19°W.
- D. Eardly, J. McInerney
R. Powell, J.W. Patching Phylogenetic diversity of marine microbial communities in deep waters and sediments of the Northeast Atlantic.
- D. Fiege, Y. Liao *Penilpidia ludwigi* (Marenzeller, 1893) (Holothuroidea: Elpidiidae) rediscovered from the Eastern Mediterranean.
- G.Joëlle, M.Sibuet,
A.Khripounoff, P.Crassous EUMELI (JGOFS-France) programme in the tropical Northeast Atlantic. A pluridisciplinary approach of the benthic ecosystem study.
A.Vangriesheim, M.-L.Mahaut
- D.J. Hoover, C.R. Smith
S.P. Garner, S.E. Dyan Macrofaunal and megafaunal contributions to bioturbation along the JGOFS EqPac Transect.
- C. Jouin-Toulmond
D. Augustin Anatomy and ultrastructure of the anterior circulatory system, and erythrocytes in Alvinellidae, a polychaete family from hydrothermal vents.
- A. Toulmond, F.H. Lallier
J. de Frescheville The body fluids of hydrothermal vent tubeworms exhibit unusual carbon dioxide-combining properties.
- B.A.D. Manship
D. Roberts Bacterial profiles along the digestive tracts of deposit-feeding abyssal holothurians.
- B. Martin Feeding ecology of benthopelagic fishes in the Eastern North Atlantic.
- K.L. Miskov
P. Buhl Mortensen Soft bottom amphipods in the Skagerrak (NE North Sea), a comparison between 1933 and to-day's fauna.
- B. Morales-Nin
E. Massuti, F. Sardà Distribution and growth patterns of *Alepocephalus rostratus* (Alepocephalidae) in the upper and middle slope of the N.W. Mediterranean fish.
- P. Buhl Mortensen
M. Howland, T. Brattegard The deep water coral *Lophelia pertusa* (L.) as habitat for large invertebrates.
- K. Olu, S. Lance
M.Sibuet, A.Fiala-Medioni Chemosynthetic communities sustained by fluid expulsion on the Barbados accretionary complex.
- K. Poremba, K. Jeskulke Impact of pressure on bacterial activity in sea water samples collected at the European continental margin.
- I.G. Priede, N.R. Merrett Estimation of abundance of mobile benthic fauna, especially fishes, from static baited camera data.
- J.C. Relaxans, R. De Witt
T. Bouvier, J.F. Gaillard Sedimentary organic matter and microbial respiration in frontal areas of the Southern Ocean (ANTARES cruise).
P. Treguer
- F.Sardà, C.Bas, M.Roldan
C.Pla, J.Lleonart Differentiation of populations of *A. antennatus* Risso, 1816, using enzymatic and morphometric analyses in Mediterranean distribution area.

F. Sardà, J.E. Cartes
A.Bozzano, M.Ballesteros

Day-night variations in deep-sea megafauna by experimental benthic and pelagic trawling in the Western Mediterranean.

T.M. Shank, M.B. Black
W.R. Hoeh, R.A. Lütz
R.C. Vrijenhoek

Evolutionary relationships among hydrothermal vent shrimps (Caridea, Bresiliidae).

V. Solís-Weiss
P. Hernández-Alcántara

The annelid polychaetes of the deep sea in the Mexican Pacific.

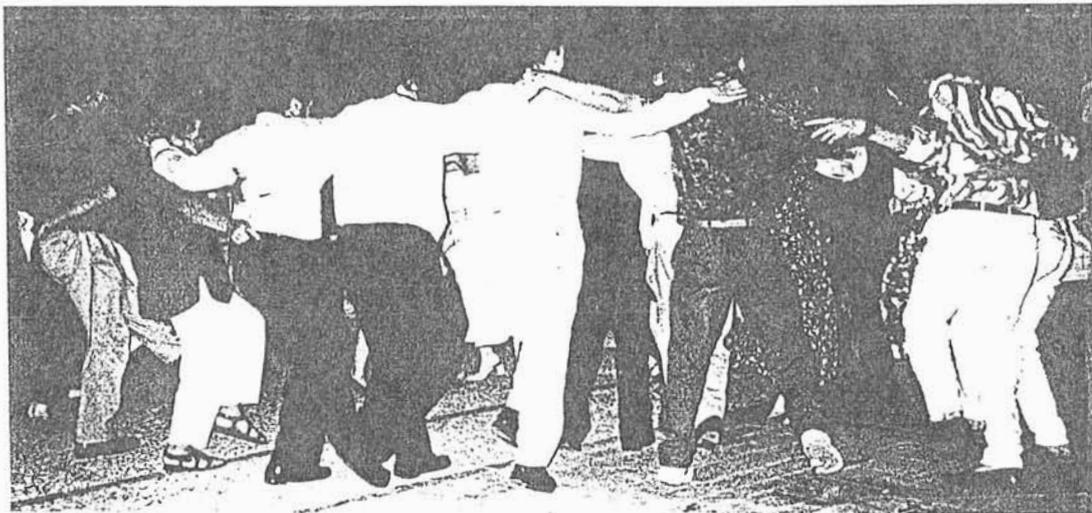
J. Staton, C. Young

Genetic divergence between two populations of the bathyal echinoid *Pharosoma placenta*.

F. Zal, D. Desbruyères
C. Jouin-Toulmond

Sexual dimorphism in Alvinellidae, a polychaete family from deep-sea hydrothermal vents: observations on *Paralvinella grasslei*.

The Symposium was attended by a total of 102 biologists, coming from the following countries: Australia 3, Denmark 1, France 13, Germany 19, Greece 8, Iceland 1, Ireland 2, Israel 2, Italy 2, Japan 1, Mexico 2, Norway 4, Russia 1, Spain 4, Sweden 1, UK 20, and USA 18.



Last night's celebrations: Breathless participation in Greek round dance. (A. Gebruk phot.)

Your Editor performing his terrifying Maori haka war cry - an old symposium tradition. (A. Gebruk phot.)

Dieter Fiege (Germany), M. Nechama Ben-Eliahu (Israel) and Viviane Solís-Weiss (Mexico) at dinner table. (Buz Wilson phot.)



Those who ran the show: The two Tassos: Anastasios Tselepidis & A. Eleftheriou and Nadie & Chris J. Smith. (Buz Wilson phot.)

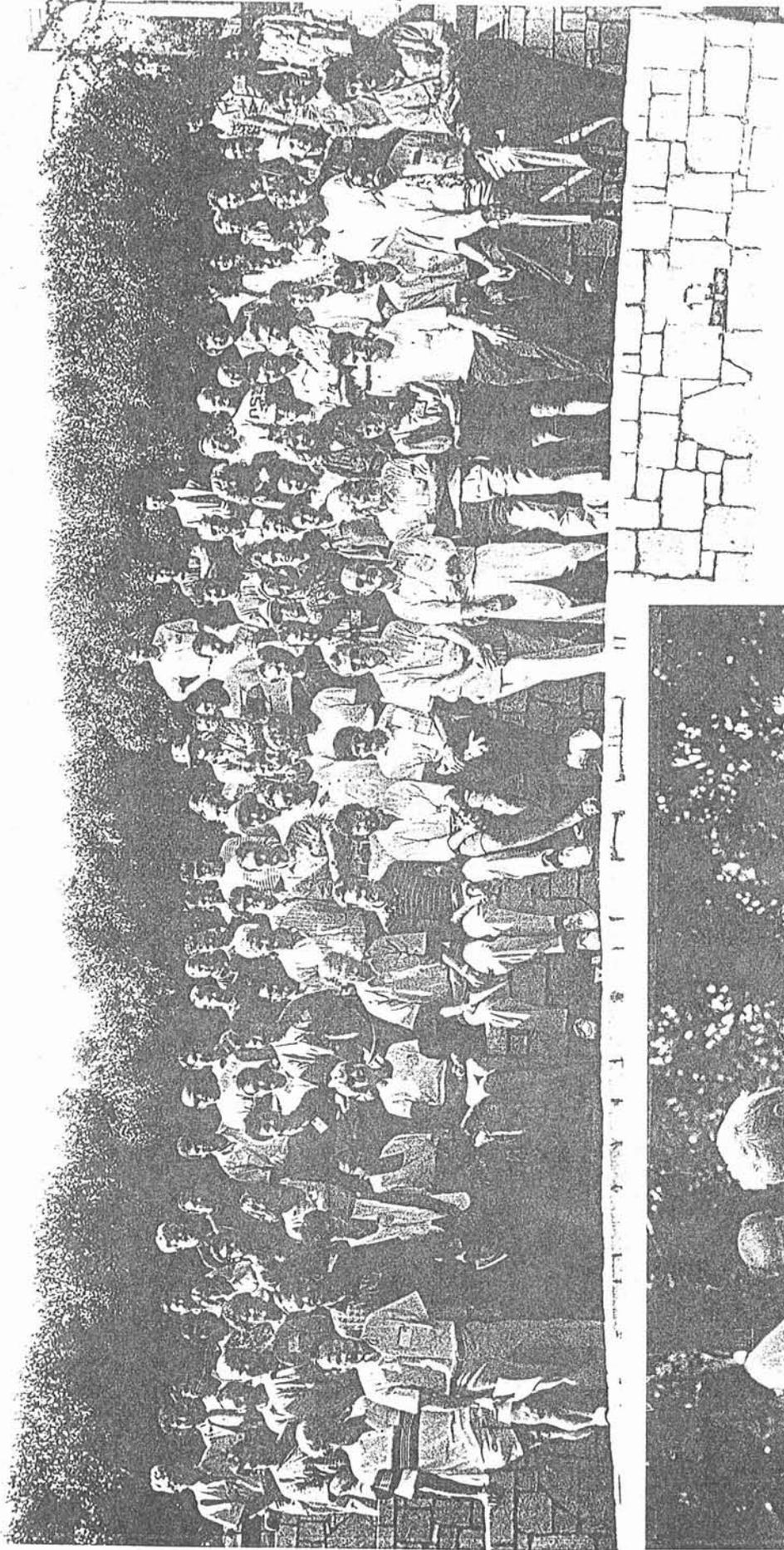


Final dinner: John Lambshead (GB), David Thistle (US) and Sarah Bronson (GB).

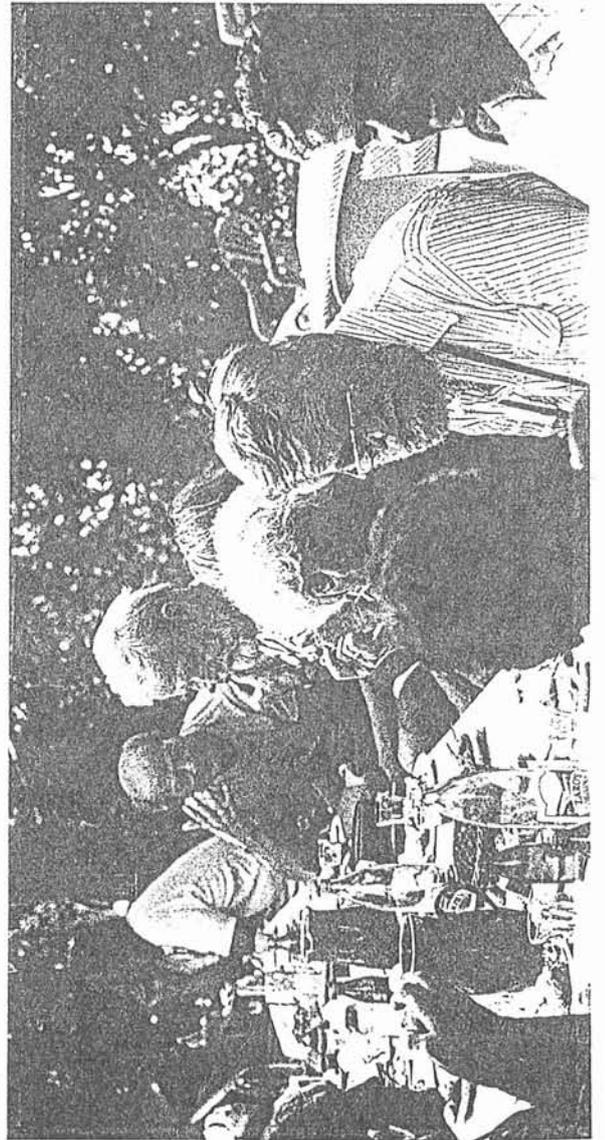
Helmuth Barthel (Germany), Jörundur Svavarsson (Iceland) and Angelika Brandt (Germany).

Robert Y. George (US) and Heather Moore (Ireland).

(All Buz Wilson phot.)



Lunch during the mid-symposium excursion.
From left: (foreground) Thomas Soltwedel
(Germany), Jon-Arne Sneli (Norway), ?, T.W.,
Hjalmar Thiel (Germany), Anne & Mike Thur-
ston (GB) and Hartmut Bluhm (Germany).
(Tassos II phot.)



THE 8TH DEEP-SEA BIOLOGY SYMPOSIUM - GALWAY 1997

A date for your diaries and a plea for comments and suggestions

As reported elsewhere in this newsletter, it was decided to hold the next Deep-sea Biology Symposium in Galway, Ireland in 1997. The final date has yet to be decided but you may like to make a note of the meeting now.

Galway has been identified as one of the fastest growing cities in Europe. It has a young lively population, partly due to the presence of University College Galway and the regional technical college. This, coupled with the traditional Irish welcome makes it a pleasant base for the tourist and those who plan to stay longer. The city boasts a full range of cultural, sporting and entertainment facilities including a grand selection of pubs and restaurants etc. The city is still small enough to avoid the disadvantages of city living. It has its own personality and a centre which has strong echoes of its history. Walking is still a feasible method of getting around. It is possible to walk to the edges of the city and into the country from any point in town. The unspoilt countryside, mountains and seashores of the Burren and Conemara are less than an hour's drive away. University College Galway is located on the bank of the River Corrib in the centre of Galway city. Opened to students in 1845, the student population now exceeds 7,000 and there are some 800 staff. Thanks to its location on the West coast of Ireland, with direct access to varied, pristine inshore environments and the Atlantic itself, the college has a long tradition of involvement with marine sciences. This commitment to marine science was given particular recognition in 1992 with the establishment of the Martin Ryan Marine Science Institute. Housed in purpose-built accommodation paid for by a private donation and fully equipped, thanks to funding under the EC STRIDE programme, the institute consists of sections specialising in marine botany, marine microbiology, physical and chemical oceanography, meteorology and marine zoology.

Tony Rice (IOS) will be working with me to ensure that the meeting is a successful one, but we would both greatly value your thoughts and comments on any aspect of the symposium. As I mentioned in Crete, now is the time to let us have your suggestions, whilst the 1994 meeting is fresh in your minds. Several people spoke to me at the meeting. The following points seemed clear:

- The cost of accommodation etc. should make it possible for students to attend.
- We should not introduce parallel sessions.
- More time is needed for discussion, formal and informal.
- The best time for the meeting would be around June/July.

If you have other points of view contact me. The climate may be cooler than Crete, but you can be sure of a warm welcome in Galway.

John Patching, Marine Microbiology, The Ryan Institute, University College, Galway, Ireland
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NEW CORRESPONDENTS

After many years of devoted service as distributors of D-SN, Fred Grassle (U.S. East Coast) and Barry Hargrave (Canada) have been relieved from their duties. We all thank them for their work and welcome those who have been willing to take over:

- U.S. East: Dr. Craig Young, Division of Marine Science, Harbor Branch Oceanogr. Inst., 5600 Old Dixie Highway, Fort Pierce, FL 34946, U.S.A.
Canada: Dr. Verena Tunnicliffe, Dept. of Biology, University of Victoria, P.O.Box 1700, Victoria, B.C., Canada V8W 2Y2. Tel: (604) 721-7094. Fax: (604) 721-7120.

Requests for receipt of D-SN should be directed to the correspondents. The latest list of these was included in D-SN No. 21, 1993, p. 8. Contributions on new discoveries and other matters of interest to the deep-sea community may be sent through your correspondent or directly to me whose gratitude will in both cases be unlimited.

Editor

SPECIMEN DISPERSION IN GERMANY

The Hamburg benthos deep-sea research group does not exist any more. Most of the members of the group disperse(d) to other institutions. The project BIOTRANS/BIO-C-FLUX with its central station at 47°N 20°W NE Atlantic terminated at the end of 1994, but we keep an interest in this long-term station. Our project DISCOL in the SE Pacific ($\approx 07^{\circ}\text{S}$, 88°E) finished with the end of 1993. We hope to revive our research in that region with new funds and a cruise in 1996, since the process of recolonization after a large-scale disturbance had not come to an end after 3 years.

Although we are now scattered over northern Germany, we still cooperate and wish to extend our cooperation and the good ties to other deep-sea researchers all over the world.

Karin Lochte has moved to shallower waters and is now becoming increasingly engaged in Baltic Sea research. She will remain linked to deep-sea research by proposed projects which will be carried out in close cooperation with some 'old' partners of the previous BIOTRANS/BIO-C-FLUX-Group and some 'new' ones. They will focus on studies in the benthic boundary layer of the Arabian Sea and the NE Atlantic.

Olaf Pfannkuche's research objectives are mainly focussed on the biogeochemical transport of energy and matter in the benthic boundary layer, geographically fixed to the Arabian Sea and the NE Atlantic. The projects are funded by German national resources and by the EU (MAST II). In 1995 two cruises to the Arabian Sea are planned (March, September/October). Within MAST III it is planned to apply for funding of continuing activities in OMEX and for lander technology.

Gerd Schriever runs his own consulting company, but we remain tied together in the EU desk study RISKER on the environmental risk of deep-sea research, in the follow-up to DISCOL, and in an international ocean environment course designed as adult education for professionals from developing countries.

Hjalmar Thiel will start on April 1, 1995, to build up a new deep-sea research group which is planned to have a small scientific/technical core group and will draw interested scientists from other departments of the institute towards cooperation in multidisciplinary projects. Plans for institute projects are directed primarily towards polar deep sea, but participation in research on the environmental protection of the deep sea, in the follow-up to DISCOL, and in EU studies are discussed or proposals are pending.

These are our new addresses:

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Hjalmar, Gerd, Karin, Olaf

HYDROTHERMAL VENTS IN LAKE BAIKAL:

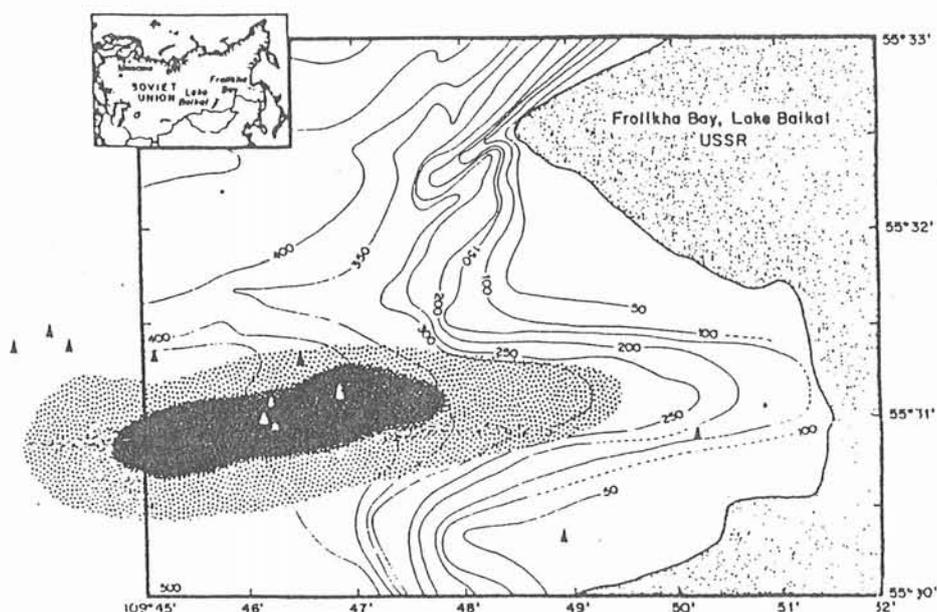
Large Input of Methane Carbon into the Surrounding Biota

The area in the north-east part of Lake Baikal, in Froliha Bay, centered around 55°30'56"N, 109°46'08"E (420 m depth), was the study site of the 1991 Russian Academy of Sciences expedition on the R/V *Vereshchagin* and the tugboat *Balhash*, reequipped for carrying the PISCES submersible. Three square km of the lake floor were explored at depths of 400–500 m.

The temperature in the sediment of this area exceeds 16°C (Crane et al., 1991a), compared with the normal ambient water temperature of 3.4–3.5°C. There is no visible indication of hydrothermal activity, venting, or bubbling gas. However, a lot of plant debris (leaves, grass, branches and tree trunks) was observed on the lake floor, which has a smooth relief with a small E-W gradient. In addition to elevated heat flow at the 50 m x 250 m field, the central part of the study area is characterized by interstitial water enriched by Ca, Mg, Na and K (Shanks & Callender, 1992), and is marked by several fields of whitish bacterial mat ranging from 3 to 60 m in diameter, most of them localized within slight bottom depressions, sometimes with aggregations of sponges at the periphery. These mats are formed by the complex community of microorganisms dominated by the filamentous colourless sulfur bacteria *Thioploca* and with heterotrophic diatoms of the genus *Melosira* also abundant (Gebruk et al., 1993).

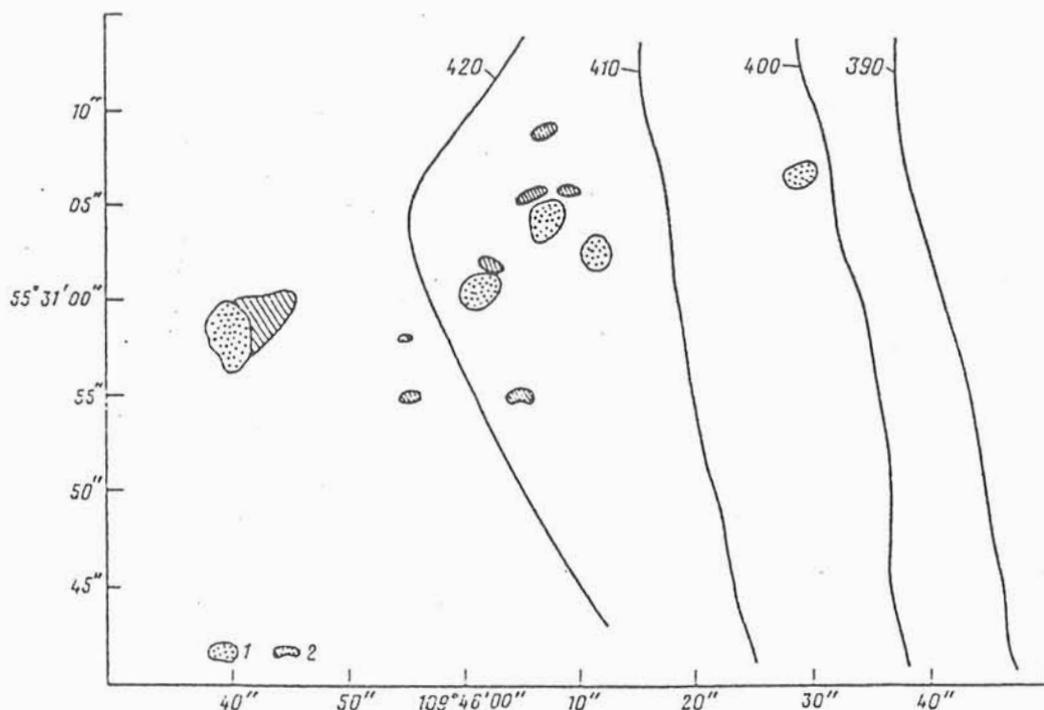
Compilation of 11 heat flow stations within Froliha Bay. The region of light stippling represents an excess of 300 mW/m². There are no constraints on the heat flow to the south of the vent field.

From Crané et al., 1991a



Five groups of invertebrates dominate the Froliha Bay bottom community: amphipods (Gammaridae), chironomids (Chironomidae), planarians (Dendrocoelidae), sponges (*Baicalospongia bacillifera*), and oligochaetes (Tubificidae?). All species found are typical for Baikal, and lack any obvious 'hydrothermal' specialization, such as symbiotic bacteria. Two groups of fishes – sculpins (Cottoidae) and golomjankas (Big Baikal oilfish) – *Comephorus baicalensis* are common. Baikal sculpins, as well as all sponges, planarians, and amphipods are endemic to Lake Baikal. Thus, the thermal field contains a concentration of the animals that also live in the surrounding area. There is no obvious reaction of benthic animals to the occurrence of bacterial mats.

At two stations, one within the mat field and one outside, the following parameters were measured: the level of bacterially mediated CO₂-assimilation (dark-bottle, heterotrophic and chemosynthetic); degradation of cellulose, glucose and protein; sulfate reduction; methane generation and -oxidation in the sediment (0–1; 2–4; 5–8; 9–14 cm deep) and in the bacterial mat; and CO₂-assimilation and methane-oxidation in the water (0–1 cm; 0.5 and 3.5 m above the floor). Within the field, most organic matter is utilized for CH₄ production at the maximal rate of 0.53 ml CH₄/kg per 24 hrs (upper 2–4 cm sediment layer) (Gebruk et al., 1993). A maximum methane oxidation rate of 0.707 ml CH₄/kg per 24 hrs occurs in the 0–1 cm layer, implying utilization by methanotrophic bacteria of methane produced in the deeper sediment layers. Assays of cellulose-, protein- and



The study site of the 1991 expedition

1, bacterial mats

2, fields of sponges

glucose degradation indicate that low-molecular organic compounds and H_2 (substrates for the CH_4 -generation) originate from the degradation of plant-derived organic matter. At the terminal stage of cellulose degradation, most organic matter (up to 2.288 mg C/kg per 24 hrs) is utilized for CH_4 -generation, and only part (0.017–0.226 mg C/kg per 24 hrs) for sulphate reduction. We assume that H_2S generated by sulphate-reducing bacteria (maximum rate 0.30 mg S/kg per 24 hrs in 0–1 cm layer) stimulates the growth of bacterial mats in areas with favourable hydrogen sulfide concentrations.

Our data indicate a correlation of peaks for methane oxidation and sulphate reduction in the 0–1 cm layer, just above the peak for methane generation (2–4 cm layer). Methane generation in the upper sediment layer seems to be of special importance, as it results in bacterially mediated methane oxidation close to the detrital layer and the enrichment of detritus with methane carbon. This feature is not typical for marine methane seep sites, which normally are characterized by a methane oxidation peak associated with the base of the sulphate reduction zone, and hence usually deeper in the sediment (Dando & Hovland, 1992).

Enrichment of the detritus with methane carbon results in its incorporation into the tissues of the local benthic fauna. Stable carbon isotope analysis of five dominant animal groups (Table 1) demonstrates a high level of $\delta^{13}C$ depletion, indicating a bacterial origin of carbon via biogenic methane.

Table 1. The results of carbon stable isotope analysis measured with an MI-12-1201B isotope ratio mass-spectrometer, given relative to the PeeDee Belemnite (PDB) standard in the notation: $\delta^{13}C$ (o/oo)=[$(^{13}C/^{12}C)$ sample/ $(^{13}C/^{12}C)$ standard - 1]x1000 (modified, from Gebruk et al., 1993)

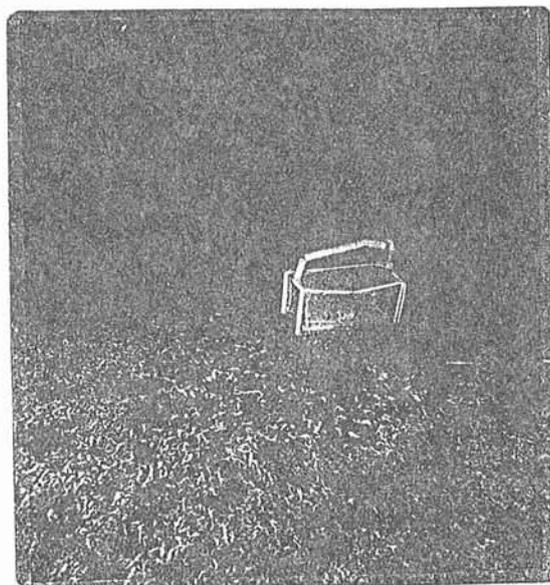
Material examined	$\delta^{13}C$, o/oo
sponges	-64.0
planarians	-59.5
oligochaetes	-66.1
amphipods	-68.3
chironomids	-72.3
0–14 cm sediment layer at the thermal field	-44.2–49.5
bacterial-diatom mat	-41.2–41.6
normal Baikal sediment	-29–30
phytoplankton (from Kiyashko et al., 1991)	- 30
terrestrial vegetation (from Kiyashko et al., 1991)	- 27

High and almost equal level of carbon depletion in animal groups with different feeding strategies suggests short food webs and direct utilization of detritus aggregations enriched with methane carbon by scavengers and predators.

There are three groups of factors that may be of importance in understanding the key role of methanobacteria in the Froliha Bay ecosystem. They include:

1. Different roles of methane and sulphate systems in marine and freshwater environments, the latter being limited in sulphate.
2. Common factors for deep-water zone of Baikal, that include low oxygen concentration and increased content of biogenic and organic matter, that stimulate bacterial activity (Votintsev, 1987).
3. Local Froliha Bay features that include accumulation of terrigenous plant material and elevated heat flow.

Our results indicate the presence over a large area of a peculiar benthic community affected by geothermal heat flow, with neither a methane- nor a sulfide-specific fauna, but with an important role for the methane system, as indicated by the large amount of methane carbon incorporated in the tissues of the local macro- and meiofauna. In contrast, marine hot-vent communities are normally much smaller in the areal extent and largely dependent upon organics produced by chemoautotrophic bacteria, mainly of the sulfur group. This was also proposed previously for the Froliha Bay ecosystem (Crane et al., 1991b; Monastersky, 1990; Kuznetsov et al., 1991). A major energy flow through the sulfide system, with prevalence of sulfide-specific fauna, is also characteristic of methane-seep communities (Dando & Hovland, 1992). The role of the methane system, and the input of methane carbon into the surrounding biota, seem to increase when methane concentrations become elevated as a result of large-scale, bacterially mediated methane generation in the upper sediment layer close to deposits of organic matter.



Bacterial mat in Froliha Bay, Lake Baikal at the depth of 420 m, with 0.5 m long amphipod trap

The author is thankful to Andrew Gooday for the correction of English usage.

References

- Crane, K., B. Hecker & V. Golubev, 1991a: Heat flow and hydrothermal vents in Lake Baikal, U.S.S.R. - EOS 72 (53): 585, 588-589.
- Crane, K., B. Hecker & V. Golubev, 1991b: Hydrothermal vents in Lake Baikal. - Nature 350: 281.
- Dando, P.R. & M. Hovland, 1992: Environmental effects of submarine seeping natural gas. - Cont. Shelf Res. 12: 1197-1207.
- Gebruk, A., A.P. Kuznetsov, B.B. Namasaraev & J. Miller, 1993: Role of bacterial organic matter in nutrition of deep-water benthic animals in the Froliha Bay (Lake Baikal) in conditions of enhanced heat flow. - Izvestija Akad. Nauk SSSR Ser.biol. 6: 903-908. (In Russian).
- Kiyashko, S.I., A.M. Mamontov & M.Zh. Chernyaev, 1991: Food web analysis of Baikal fish by ratios of stable carbon isotopes. - Doklady Academi Nauk SSSR (Translated by Plenum Publ. Corp.) 318 (5): 1268-1271.
- Kuznetsov, A.P., V.P. Strizhov, V.S. Kuzin, V.A. Fialkov & V.S. Jastrebov, 1991: New in the nature of Lake Baikal. Community based on bacterial chemosynthesis. - Izvestija Akad. Nauk SSSR Ser.biol. 5: 766-772. (In Russian).
- Monastersky, R., 1990: Life blooms on floor of deep Siberian lake. - Science News Aug. 18: 103.
- Shanks, W. & E. Callender, 1992: Thermal springs in Lake Baikal. - Geology 20: 495-497.
- Votintsev, K., 1987: Hydrochemical investigations of Lake Baikal and rivers and lakes of its basin. - Pp. 124-148 in: G. Galazij & K. Votintsev (eds.): *The way of Baikal cognition*. Nauka, Novosibirsk. (In Russian).

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THE MICRO-SCALE DISTRIBUTION OF THE HYDROTHERMAL NEAR-BOTTOM SHRIMP FAUNA

During August–October 1994 we were involved in the 34th voyage of R/V "Akademik Mstislav Keldysh" (The BRAVEX 94 Programme) which was aimed at studies on the Middle Atlantic hydrothermal areas: TAG and Broken Spur (situated at appr. 26° and 29°N, resp.). One of the main biological objectives was investigation of a hydrothermal influence upon the pelagic ecosystems. We had to estimate the general direction and values of the organic matter fluxes in the vent vicinities and to describe quantitatively and qualitatively the pelagic and benthopelagic populations of the whole water column in the locations. For these studies, standard methods (closing plankton nets, 150 l bottles) were used as well as direct observations from DRSV "Mir". The report on these results will be published in the future.

As a separate branch of our voyage activity, we sampled shrimp populations in the vicinity of the hydrothermal vents which were believed to represent the benthopelagic component, especially important in the matter and energy transport between benthic and water column communities. Since the deep-living bresiliid shrimps are the most prominent and important component of this hydrothermal fauna and are able to move about in the area, any information of their biology seems to be useful for better understanding of ecosystem processes in the hydrothermal vents. We used slurp-guns and traps to sample them. It seemed impossible to estimate quantitatively the real concentrations of the animals in the sites by these gears. At the same time, we could compare the species composition and structure of the shrimp taxocenes in different sites of the hydrothermal fields. This article presents a glimpse of the preliminary results obtained during our voyage.

MATERIAL

Shrimps were sampled with different gears: near-bottom traps, slurp-guns attached to the DSRV "Mir-1", and the pump-trap (the trap which was moved to and from in the shrimp aggregations). In addition, the results of visual observation from "Mir-1" were used. The material was taken in two locations: TAG and Broken Spur, the former being sampled much more representatively; the animals were caught at different distances from the main smoker (the point "0") in the South-West direction:

- (a) point "0", slurp-gun sample inside the vent, from the crack (depth ab. 0.5 m, Station (St.) 3415, 24.09.1994).
- (b) point "0", pump-trap sample in the main shrimp aggregation in the black smoker (St. 3415, 24.09.94).
- (c) 5 m from point "0", trap sample on periphery of the main shrimp aggregation (put St. 3369, 17.09.94, retrieved St. 3393, 22.09.94).
- (d) 15 m from point "0", slurp-gun sample above ochre field in the shimmering waters (put St. 3415, 24.09.94).
- (e) 30 m from point "0", trap sample (put St. 3369, 17.09.94, retrieved St. 3394, 22.09.94).
- (f) about 1000 m from point "0", trap sample (5 m above bottom, put St. 3359, 14.09.94, retrieved 26.09.94).

In the Broken Spur location the material was taken in the different sites of the hydrothermal valley at distances of 2–5 m from the tops of different smokers:

- (a) Saracene's Head Smoker, trap sample (put St. 3336, 09.08.1994, retrieved St. 3425, 29.09.94).
- (b) BX16 Smoker (near Dog's Head Smoker), trap sample (put St. 3425, 29.09.94, retrieved St. 3434, 01.10.94).
- (c) Point Q, trap sample (put St. 3426, 29.09.94, retrieved St. 3434, 01.10.94).
- (d) BX16 slurp-gun sample from the shimmering waters (St. 3425, 29.09.94).

The distribution of larvae was studied by means of the near-bottom samples with closing BR 113/140 plankton nets in the water layer 10–400 m above bottom (3552–3128 m in the TAG location, 16.09.1994, St. 3365 and 3155–2756 m in the Broken Spur location, 10.09.1994, St. 3341). Also the material of Sigsbee trawling was used (the Broken Spur location, 01.10.1994, St. 3433).

The make the results statistically significant, either all the shrimps or 200 randomly selected specimens (if catch was too large) were identified and measured. A total of 1740 specimens was thus treated.

RESULTS

We found 5 species of shrimps belonging to 5 genera. Three species have been previously known, two others remain undescribed. The former are *Rimicaris exoculata*, *Chorocaris chacei*, and *Alvinocaris markensis*. The other species are to be described in the nearest future and will be marked in the paper as Sp.1 and Sp.2. The locations, microbiotopes where they are met, are presented in Table 1.

Table 1. Locations and microbiotopes of the North Atlantic hydrothermal shrimps

Species	Locations	Microbiotopes
<i>Rimicaris exoculata</i>	TAG Broken Spur	everywhere Smoker BX16
<i>Chorocaris chacei</i>	TAG Broken Spur	everywhere except point "0" Smoker BX16
<i>Alvinocaris markensis</i>	Broken Spur	Saracene's Head Smoker
Sp. 1	TAG Broken Spur	periphery of hydrothermal field everywhere except point "0"
Sp. 2	TAG Broken Spur	everywhere Smoker BX16

The ratio of species and its microscale variability is presented in Table 2 for different sites of the TAG hydrotherm field.

Table 2. Ratio (% abundances) of shrimps in the TAG location at different distances from the hill top (m). -- = missing, 0 = present but their T concentration is close to zero

Species	Microbiotopes ordered regarding to their distance from the centre of the hydrothermal hill					
	0 m (crack)	0 m (crack)	5 m (centre)	15 m shimmer.waters	30 m	1000 m
<i>R. exoculata</i>	72	79	54	91	2	--
<i>Ch. chacei</i>	--	--	46	1	34	--
Sp. 1	--	--	--	8	62	--
Sp. 2	28	21	0	0	2	--

Beyond any doubts, *R. exoculata* is the most abundant species met throughout the hydrothermal field and dominating in the black smokers and shimmering waters, where it builds up 70-90% of the total shrimp numbers. In the Broken Spur location, the slurp-gun sample provided a similar proportion - 75%. Outside the black smokers and shimmering waters, the proportion of *R. exoculata* abruptly falls to 50% at the periphery of the main aggregation and to 2% at the edge of the hill.

The other abundant species is Sp. 2, which was caught together with the former species and seemed to have similar ecological requirements. However, its numbers in the shrimp communities were much lower and ranged from 10-20% in the shimmering waters to 0-2% in the other sites.

Chorocaris chacei was extremely rare in the black smokers and shimmering waters. Its numbers rose sharply at the main smoker periphery and near the hydrothermal hill margins, where the species constituted 30-50% of all shrimps present.

Sp. 2 dominated exclusively throughout the periphery of the hydrothermal hill of the TAG location, being also met around the BX16 Smoker (Broken Spur), where the species dominated (75% by numbers).

Outside the hydrothermal field, no shrimp was observed visually or caught in the trap, and we found only the lysianassid amphipod *Eurythenes gryllus* and juvenile euphausiid *Thysanopoda acutifrons*.

The sampled young specimens with carapace length 5-6 mm belonged to *Chorocaris chacei* and Sp. 1. The data about their spatial distribution are scarce, but the tendency to concentrate on the hydrothermal field periphery can be traced (according to the Sigsbee trawl, slurp-gun samples and baited traps). They were lacking in the black smokers and shimmering waters and present on the TAG field periphery (15 and 30 m from the point "0") and BX16 point (Broken Spur), where they made up 20-30% of the total species population by numbers.

The larvae of hydrothermal bresiliid shrimps have proved to be pelagic. The specimens with the carapace length 1–3 mm were caught in the near-bottom layer by BR plankton nets: one above Broken Spur field, the other above the TAG location. The larvae will be described in the nearest future. Certainly, the youngest bresiliids live in the water column. They are believed to dwell in the near-bottom layer, because none of them were found more than 400 m from the bottom. Their concentration above the hydrothermal field was estimated as 3–4 ind/1000 cubic metres.

DISCUSSION

Rapid evolution of the bresiliid shrimps has led to appearance of some species which dominate and determine the "face" of the North Atlantic hydrothermal communities. Each of these species occupies a specific ecological niche. The primary consumers of the chemosynthesized production are the shrimps *R. exoculata* (Van Dover et al. 1988) and Sp. 2. These species comprise the main bulk of the shrimp aggregations in the black smokers and shimmering waters. Their juveniles dwell only in these microbiotopes, while the adults are able to move more freely and can appear throughout the hydrothermal fields. The weak specimens and exuvia are spread around; for instance, three remainders of exuvia were found in the sedimentation trap installed by Dr. V.N. Lukashin in the Broken Spur location. Probably, the other three species of shrimps live mainly on these remnants. Being very similar ecologically, the other three species are related to different microbiotopes inside the hydrothermal field not so close to the outlet of hydrothermal waters.

Chorocaris chacei, which seems to be able to live partially on the primary chemosynthetic production (Segonzac et al. 1993), is the most abundant at the periphery of the main shrimp aggregations. According to direct visual observations, it can there hunt the weak specimens of *R. exoculata* and Sp. 2. Sp. 1 occurs at the very margin of the hydrothermal field, where it probably acts as a necrophage. *C. markensis*, which is also necrophagous (Segonzac et al. 1993), is never found together with Sp. 1, demonstrating spatial microscale isolation. According to M. Segonzac (1992), the species live at the smoker's peripheries, that is likely to be not as far from the hydrothermal field centre as Sp. 1. They are the representatives of necrophagous species that are believed to ascend above the hydrothermal fields at a distance of 20–50 m (Van Dover et al. 1988; our visual observations) in search of organic remnants.

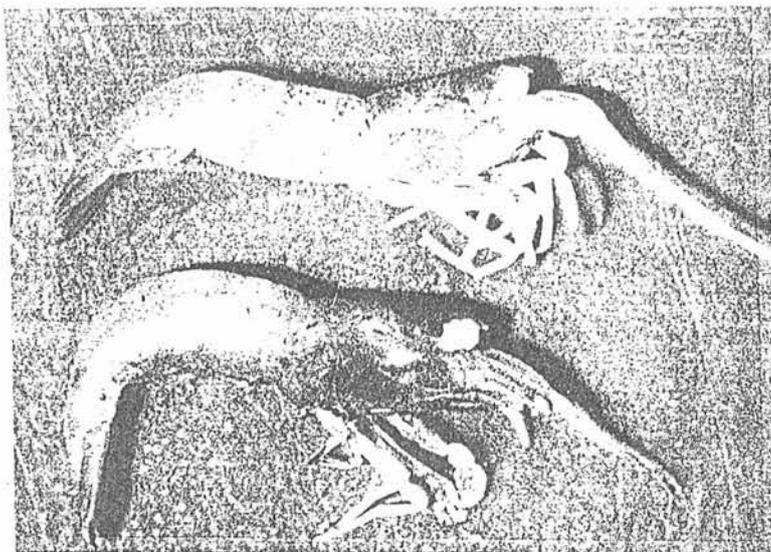
A more detailed food analysis will be published in the future after examination of the shrimp gut contents. Nevertheless, the trophic zonality related to the distance from the outlet point can be seen now:

1. primary consumers of chemosynthesized organic matter in the black smokers and shimmering waters which build up the main bulk of the hydrothermal shrimp population (*R. exoculata* and Sp. 2);
2. animals which act both as primary consumers and carnivores necrophages and live near the periphery of the main shrimp aggregations (*Ch. chacei*);
3. necrophages around the vents: *A. markensis* and, close to the margins of the hydrothermal fields, Sp. 1.

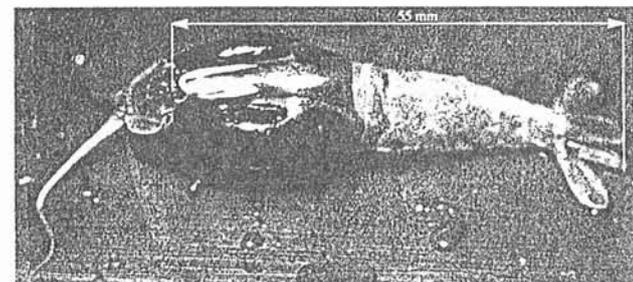
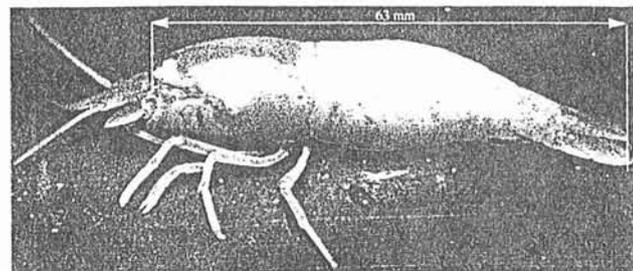
The shrimps seem to have pelagic larvae which develop in the near-bottom layer in the vicinities of hydrothermal fields where they have been sampled by nets and observed from DRSV. When they attain a carapace length of 5 mm, the larvae are believed to descend to the sea-floor at the hydrothermal field margins and may be caught there by trawls and baited traps. At this time, they seem to live mainly on the organic matter remnants, avoiding the vicinities of the hydrothermal water outlets. When they become mature, the specimens find the microsites of their preferred dwelling.

References

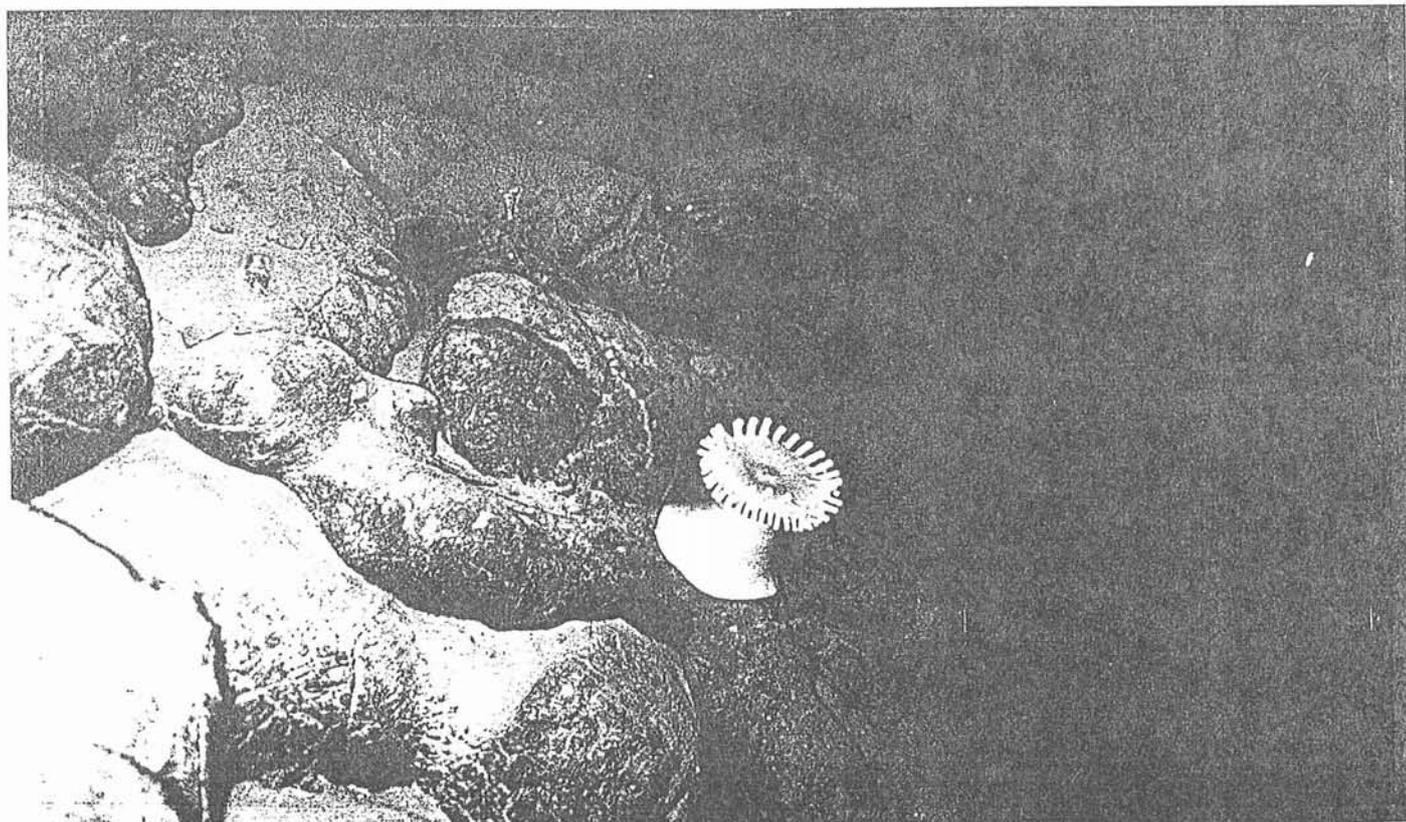
- Segonzac, M., 1992: Les peuplements associés à l'hydrothermalisme océanique du Snake Pit (dorsale médio-atlantique; 23°N, 3480 m). Composition et microdistribution de la mégafaune. – C.R. Acad. Sci. Paris 314 (III): 593–600.
- Segonzac, M., M. de Saint Laurent & B. Casanova, 1993: L'enigme du comportement trophique des crevettes Alvinicariidae des sites hydrothermaux de la dorsale médio-atlantique. – Cah. Biol. Mar. 34: 535–571.
- Van Dover, C.L., B. Fry, J.F. Grassle, S. Humphris & P.A. Rona, 1988: Feeding biology of the shrimp *Rimicaris exoculata* at hydrothermal vents on the Mid-Atlantic Ridge. – Mar. Biol. 98: 209–216.



Above: New family, genus and species of hydrothermal vent species (sp. 1) from the Mid-Atlantic Ridge. Female top, male (with big claws) below. Length about 40 mm. (I. Omel'chenko phot.)



To the right: The three described alvinocarid vent shrimps: *Alvinocaris markensis* (63 mm), *Chorocaris chacei* (63 mm) and *Rimicaris exoculata* (55 mm). (After Segonsac et al. 1993)



Sea anemone (diameter ab. 20 cm) on lava in the vent vicinity. (I. Omel'chenko phot.)

ORGANISM/HYDROTHERMAL ENVIRONMENT INTERFACES

Our research program is focused on the study of protective surfaces of deep-sea vent species. Briefly, we want

- to determine the main characteristics of the protective surfaces of hydrothermal vent species in order to understand their key role in a) the organism's adaptation to the chemical and physical characteristic of the vent environment and b) settlement and recruitment of the fauna,
- to compare these characteristics with that of organisms from different areas to estimate the genetic, molecular and cellular diversity of these systems and the faunal evolution considering a) the environment characteristics (bathymetry, temperature), b) the ocean site (EPR Pacific, mid-Atlantic Ridge, Gulf of Mexico...) and c) the phylogenetic type (crustaceans, polychaetous annelids and vestimentiferans).

To summarize, we are interested in four questions: 1) the structural characteristics of the protective surfaces, 2) their properties, 3) their role in fouling and settlement processes, and 4) the molecular phylogeny and evolution of the adaptation processes related to these surfaces.

The state of the collected material determines the outcome of our studies. We would like to develop new devices to make it possible to collect animals without stressing them during the recovering process.

State of the art

It is known that a protective surface is one of the prerequisites for species to invade hydrothermal vent environments (Tunnicliffe 1991). It has been shown that vent worm surfaces from the EPR are both chemically and physically stable (Gaill & Hunt 1987, Gaill 1993) and that their constituents are original, considering their composition, magnitude and properties. These surfaces are made either of chitin (vestimentiferan tubes and polychaete setae) or collagen (vestimentiferans and polychaetous annelids). The vestimentiferan chitin is a very rare form which differs from that of the vent crab cuticle by its polymeric arrangement, its way and rate of synthesis (Shillito et al. 1993, 1995). The gross structural characteristics of the vestimentiferan tubes is similar in species originating from different sites, but differ in their biochemical composition (Shillito et al. in press). Such differences are not observed for the crab cuticles (Gaill et al. in preparation). The thermal stability of the collagens from these animals is related to the temperature of the habitat (Gaill et al. 1995) and these molecules exhibit both ancestral (Gaill et al. 1991) and evolved characteristics (Mann et al. 1993). These surfaces are also important as they may play a role in the fauna settlement. These surfaces are associated with bacteria in polychaetous annelids (Gaill & Hunt 1987, Gaill et al. 1989) as well as in crustaceans (Segonzac 1994, Casanova et al. 1993). This last type of organism is also thought to play a key role in the larval dispersion process of the EPR vents (Zal et al. 1995).

Collagen is a well known protein existing in all the metazoans, whereas chitin is a typical non-vertebrate component. If collagen is the most abundant component of the vertebrate body, chitin is the most abundant animal polymer in nature (Muzarelli 1987). This last polysaccharide is always tightly associated with proteins whereas collagen is loosely associated with polysaccharides. Genes (Exposito et al. 1993) and sequence of the collagen types from invertebrates (Exposito et al. 1992, Gaill et al. 1995) are beginning to be determined but almost nothing is known about the proteins which are linked to the chitin from marine invertebrates. Analysis of the sequence of these proteins and of their genes may bring much information related to the molecular phylogeny and the structural evolution of the vent fauna. Such information, related to structural components, will also be useful in order to compare similar results obtained on physiological molecules from the same species (hemoglobins). As collagen and chitin are extracellular and located at the animal surface, it is obvious that they may have evolved with the milieu, and it would be also of interest to compare these molecular and genetic characteristics with those of intracellular components such as the cytoskeleton components.

Comparison of the proteins and related gene sequences from these protective surfaces will give us some insight into the phylogeny of these organisms and thus some information about the evolution of vent fauna. Although phylogenetic analyses of the vent organisms (Williams et al. 1994, Feral et al. 1994, Jollivet et al. 1995) and microorganisms (Distel et al. 1993, Erauso et al. 1994) have been carried out, their goal is mainly taxonomic or directed towards the understanding of genetic flux processes (Jollivet et al. in press). Almost nothing is known about the functional evolution of these faunas. In fact, a few protein sequences are now available in vent prokaryotes (Purcarea et al. 1995) and eucaryotes (Mann et al. 1993, Gaill et al. 1995) as well as in cold-seep organisms (Susuki et al. 1993). These results indicate the antiquity of the molecules analysed, which have unusual behaviours whatever their role is (structural, metabolic or physiological). In this respect, knowledge of the gene

characteristics and of their expressed proteins will bring new insight into the strategies of colonizing the vents and in the vent fauna origin.

Technology requirement for recovering samples

The state of the collected material is crucial for our studies. This is obvious for molecular biological studies, but also for structural analysis related to the molecular level. Life time of mRNA is short and we experienced in the past that decompression and/or temperature variations alter the cellular characteristics and the intracellular molecular arrangement of the collected samples. We would like to develop new devices allowing to collect animals without stressing them during the recovering process. Freezer devices will allow to catch the animal in situ in a way allowing more comprehensive analysis and will be interesting for enzymology. Pressure device will permit to recover non-stressed animals; if decompression is quickly made and followed immediately by plunging them in liquid nitrogen it will increase the probability of reducing molecular and cellular interaction artefacts. Combination of pressure and temperature stability would be the best solution. At least construction of high pressure vessel which would adapt with the thermostable pressure device would be a benefit for the whole biologist community and especially the physiologist who would work on non- (or less) stressed animals.

An extensive bibliography of 59 publications, 1983-1995, on hydrothermal vent Polychaeta and Vestimentifera, originating from our laboratory, will be sent on application.

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A CRUISE TO INVESTIGATE THE DEEP-SEA SEDIMENT COMMUNITY AND PROCESSES IN THE ARABIAN SEA

The Arabian Sea occupies the upper part of the Indian Ocean between Somalia, Arabia and the Indian sub-continent. It is currently the focus of quite intense oceanographic effort with ships of many nations being involved in an international JGOFS (Joint Global Ocean Fluxes Study) exercise. Unfortunately, the benthic community has, to a large extent, been ignored in this international effort, despite the obvious importance of the benthos in mediating carbon burial.

Despite this lack of interest by JGOFS, a group of researchers in the UK took advantage of a call for seetime proposals made in 1992 for an 'Indian Ocean Campaign' on RRS *Discovery*. A proposal was submitted by John Gage (the author of this article) from the Scottish Association for Marine Science (SAMS, formerly SMBA), Tony Rice from the Institute of Oceanographic Sciences Deacon Laboratory (IOSDL) and Paul Tyler from the Department of Oceanography, University of Southampton. The proposal was eventually approved and, with the help of several colleagues from the UK and USA, plans for the first major deep-sea benthic cruise in the Arabian Sea since the John Murray Expedition of 1933-34 started to take shape. These preparations came to fruition in early October 1994 when a party of 22 weary scientists (see below) hauled themselves aboard the now refitted RRS *Discovery* berthed in Muscat, Oman.

The John Murray Expedition employed a coal-fired trawler, the *Mabahiss*, built in 1929 and approximately 42 m long. She was owned by the Egyptian Coastguard and Fisheries Service and specially fitted out for the expedition with, amongst other equipment, an early echo-sounder and a winch system for deep trawling. In comparison, RRS *Discovery* is now more than 90 m long and equipped with a wealth of navigational and scientific aids undreamt of in the early 1930s. Her benthic collecting gear, including the USNEL box corer, SMBA multicorer, the IOS epibenthic sledge and our newly developed benthic lander, would scarcely have been recognisable to the *Mabahiss* scientists - except for the faithful old Agassiz trawl that both they - and we - used routinely in order to catch megabenthos.

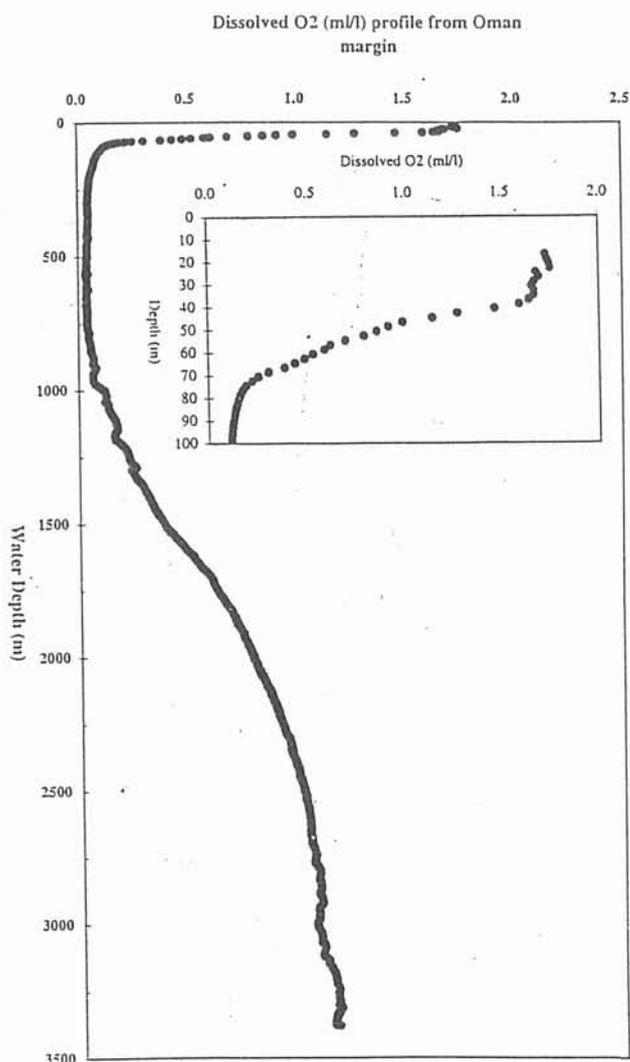


Fig. 1. Calibrated oxygen concentration values from CTD mounted sensor.

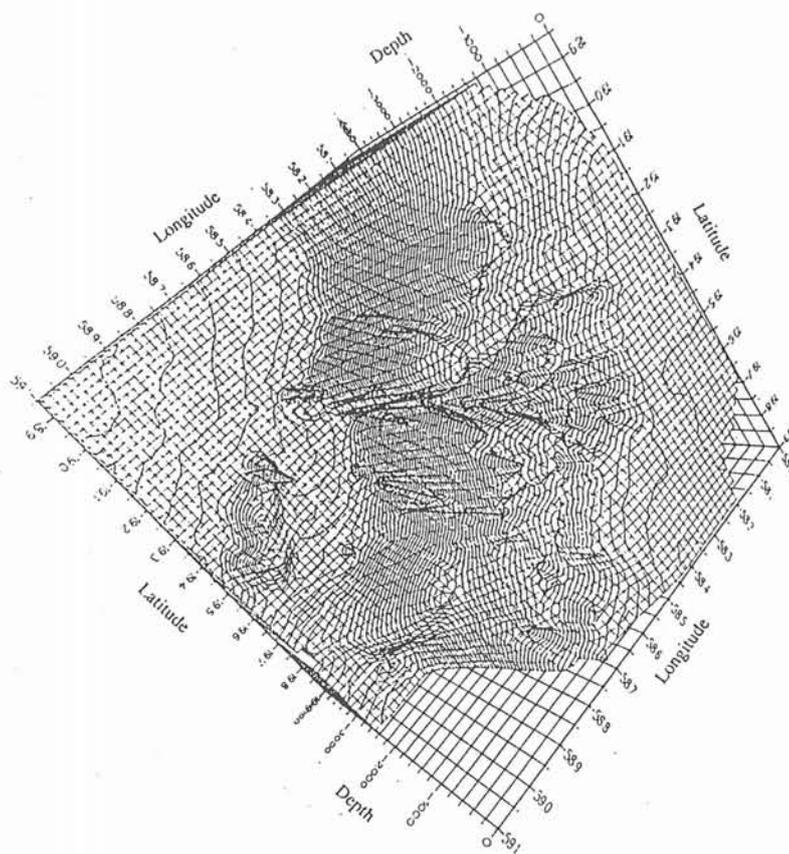


Fig. 2. Three dimensional representation of the bathymetry in the region of the *Discovery* study area.

Our main plan was to focus our work on a transect from the shelf edge on the southern coast of Oman out into deep water in the adjacent Murray Basin - and beyond if we had time! The cruise objectives addressed particularly the effect on the benthos of the intense oxygen minimum zone (OMZ); a feature well developed all over the Arabian Sea, and known to impinge on the adjacent continental margin from depths shallower than 100 m down to more than 1500 m.

One specific objective in attempting to map the distribution of benthos through the OMZ was to make a comparison with previous findings by cruise participant Lisa Levin (Scripps Institution of Oceanography) of zoned benthic distributions on the sides of seamounts emerging into the OMZ in the equatorial eastern Pacific. This zonation was expressed as an intensification of benthic biomass and activity at the interface of the OMZ with oxygenated water masses. Another important objective was to investigate the response to the dysaerobic conditions in terms of benthic fluxes and bioturbation, and to determine how organism interactions affect the recycling and / or burial of organic matter in this biogeochemically important area.

The ultimate goal will be to develop a partitioned food-web model for the sediment community, that includes a variety of microbial chemoautotrophic and heterotrophic components, and redox mechanisms.

One of the early findings of the *Mabahiss* expedition was quickly confirmed by *Discovery* - the extremely rugged and steep nature of the continental slope along the southern coast of Oman. Although scientists aboard *Mabahiss* were then unaware of the almost vanishingly low concentrations of dissolved oxygen in the water (Fig. 1), the John Murray Expedition was responsible for discovering the existence, to quote the Cruise

Narrative in the John Murray Expedition Scientific Report written by the cruise leader R.B. Seymour Sewell, " ... of a zone between the depths of some 100 metres and 1300 metres in which there seems to be a complete absence of life, though above and below there is a varied and in places a rich fauna". We proved this to be erroneous, although the general finding of a soft, green mud occasionally smelling strongly of H₂S certainly was confirmed!

Although we started off working a full suite of sampling gear at a 3300 m JGOFS position in the Murray Basin, our subsequent efforts were spent carefully working on an adjacent area of the slope. A major aim became the bathymetric mapping of this section of the slope (Fig. 2); aided by additional data from preceding *Discovery* cruises we were eventually able to locate suitable benthic sampling stations in this complex region.

Benthic sampling and *in situ* measurements were very considerably helped by the gorgeous weather (the wind scarcely blew above Force 3) and by the attractions of flying fish and dolphins - but less so by the ominous large, dark shadows that swam just at the edge of the ship's lights at night. On the hottest days we longed for a swim, but understood the Captain's reluctance to risk the paperwork involved in dealing with anyone eaten by a shark! Had the sharks had a taste of us they would have found that the scientists on board were being fed extremely well by the ship's catering department!

There is not enough space here to describe all the important scientific activities and discoveries made by the cruise participants, so a few highlights will have to suffice. Other work not mentioned here will be covered by my colleagues, perhaps in later issues of the Deep-Sea Newsletter, and certainly in scientific papers.

Our CTD was equipped to measure dissolved oxygen, calibrated values of dissolved oxygen down our transect, provided by Andy Patience, gave some extraordinarily low near-bottom values, with a low of 0.16 ml l⁻¹ at about 400 m depth - only slightly more than the lowest values recorded anywhere in the ocean outside of completely deoxygenated basins such as the Black Sea. On the basis of these data we expected marked changes in the composition, species richness and body size-related biomass of the benthic fauna in line with trends previously described in the Pacific by Lisa Levin.

One fairly predictable result was that diversity was much reduced within the OMZ. In the core of the zone, at around 400m, the macrofauna (>300 m) was abundant but of very low diversity with two spionid polychaetes predominating. In contrast, the macrofauna living in the depth range 100-200m, above the region of maximum oxygen depletion, was much more diverse. Diversity increased more gradually below the low-oxygen core, but the macrofaunal assemblages themselves changed rapidly with increasing bathymetric depth. For example, a tube building assemblage of spionid polychaetes and ampeliscid amphipods occurred from 650m to 750m, a cirratulid mudball dominated assemblage occurred between 830m and 900m and an ophiuroid-polychaete assemblage was encountered close to 1000m. This pattern of change was mirrored to a large extent by the foraminiferal assemblages.

One complete surprise was revealed by our box core samples and the bottom photographs obtained by Brian Bett with the IOS epibenthic sled. These showed that the zone of most intense oxygen depletion was inhabited by dense populations (Figs 3-4) of both relatively large-sized (in deep-sea terms) bivalve molluscs, including a byssal nest forming mytilid, *Amygdalum politum*, and a spider crab, identified as *Encephaloides armstrongi* that it seems was previously known only from its type locality on the slope on the west side of the Indian subcontinent. The presence of such relatively large benthos seemed contrary to the expectation of increased dominance by smaller-sized organisms!

Perhaps the most novel discovery was of a dense population of "jellyballs" (diameter up to 30 mm) loosely attached by fine fibrils to the mud surface at about 1250-1600 m, where oxygen was still somewhat depleted though strong bottom currents may prevail. These strange organisms (Fig. 5) were identified by Andy Gooday of IOSDL as most probably allogromiid foraminiferans, but of a type hitherto completely unknown. In terms of body size (volume) they must represent some of the largest protists yet discovered, being exceeded in size only by some xenophyophores. Alongside them lived other more conventional, but still large, sausage-shaped allogromiids.

Another important, though not completely unexpected finding, was of well-developed blood pigmentation, presumed to enhance the abilities of the animal to extract what little oxygen was available from its

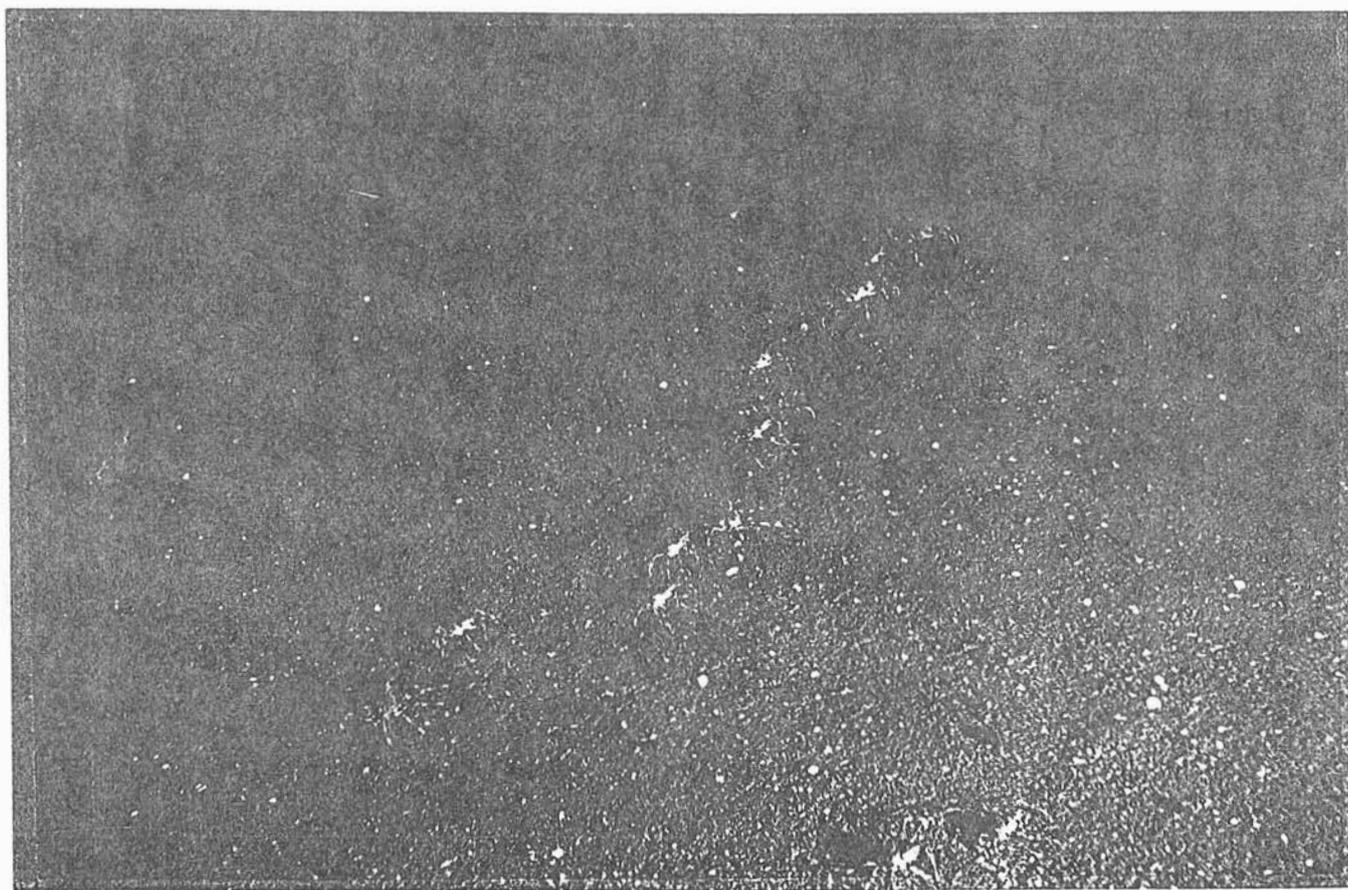


Fig. 3. Spider crabs, thought to be *Encephaloides armstrongi*, photographed at 770 m depth in the Arabian Sea from the IOSDL epibenthic sledge. Crab density in this frame is estimated at 10 indiv. m⁻², and is typical of observations made in the 600 to 800 m depth range. Note also the similar orientation of most crabs and the rough alignment of crabs in the centre of the picture; both of these features are seen on many of the photographs taken.

environment. One hope we had was to find chemosynthetic bacterial symbionts within the tissues of some of the animals living in these highly organic, but oxygen depleted, conditions. The characteristically swollen, fleshy pink modified gill lamellae of vesicomid and lucinid bivalves found in the samples by Graham Oliver (National Museum of Wales) may prove to harbour such symbionts.

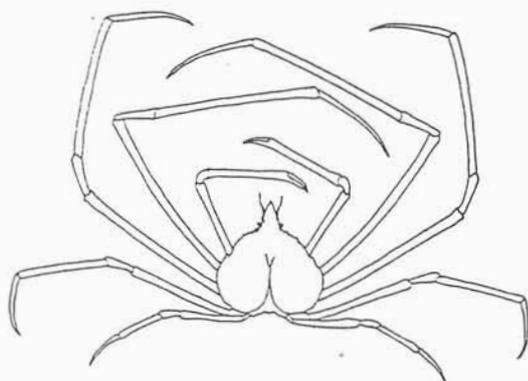


Fig. 4. The spider crab *Encephaloides armstrongi*.

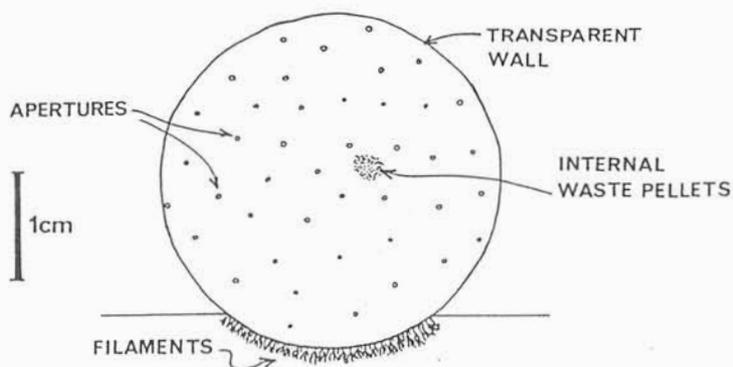


Fig. 5. The giant "jellyball" allogromiid which occurs between 1250 and 1500 m on the Oman margin. The interior of the organic sphere is fluid filled with waste pellets (stercomata) attached as a veneer to the inner surface.

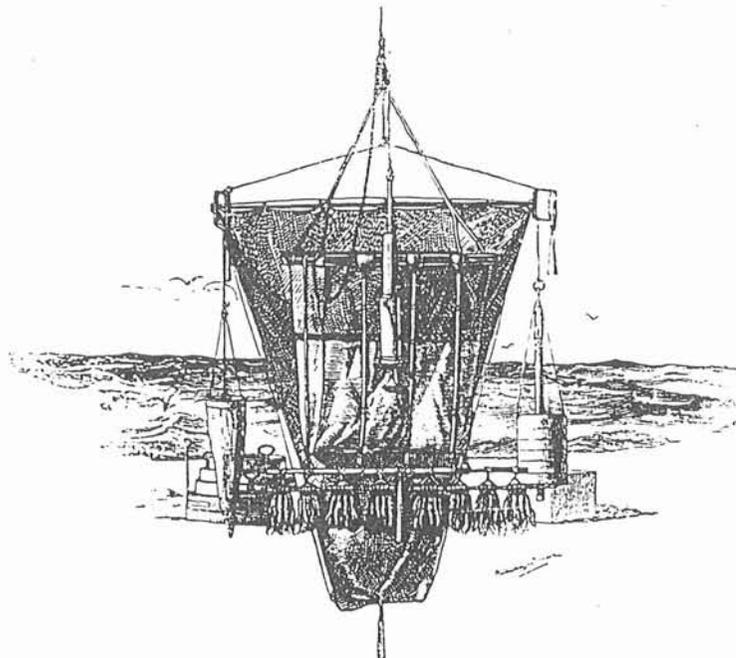
With the high organic input and influence of the OMZ in this region, one of the important tasks for the cruise was to measure directly sea bed fluxes of oxygen. These measurements were to have been undertaken *in situ* using a new benthic lander, BioSTABLE. The lander, developed by David Smallman (Dunstaffnage Marine Laboratory) and myself in conjunction with the Proudman Oceanographic Laboratory (Birkenhead) for work on the shelf edge off the west of Scotland, was completed just in time to allow us to take it to the Arabian Sea. We completed two test deployments of BioSTABLE which indicated that the benthic chamber syringe sampling system and video monitoring worked well. But on the third deployment in 400 m we failed to recover the lander after the command to come to the surface. Despite this loss, which cast a slight cloud over the cruise, the remainder of the work went so well that we all felt the cruise to have been a resounding success. By the end everyone was exhausted, but we managed to respond to an invitation to give a series of talks on the results of the cruise at a seminar kindly organised for us at the Sultan Qaboos University, Muscat on the day after we docked.

The scientific party slept well that night on the 'plane on the way home to London and beyond.

John D. Gage SAMS, Dunstaffnage Marine Laboratory, Oban, Scotland.

List of participants:

Dr Brian Bett, Institute of Oceanographic Sciences Deacon Laboratory
Dr Andrew Campbell, Queen Mary & Westfield College, University of London
Jeff Crooks, Scripps Institution of Oceanography
Nicola Debenham, Natural History Museum, London
Dr John Gage, Scottish Association for Marine Science (Cruise Leader)
Dr Andrew Gooday, Institute of Oceanographic Sciences Deacon Laboratory
Dan Hoover, Dept. of Oceanography, University of Hawaii at Manoa
Peter Lamont, Scottish Association for Marine Science
Dr Lisa Levin, Scripps Institution of Oceanography
Dr Azra Meadows, Dept. of Civil Engineering, University of Bradford
Peter Meadows, Division of Environmental and Evolutionary Biology, University of Glasgow
John Murray, Division of Environmental and Evolutionary Biology, University of Glasgow
Dr Graham Oliver, National Museum of Wales
Dr Andrew Patience, Scottish Association for Marine Science
Dr Alex Rogers, Marine Biological Association of the United Kingdom
Dr Amelie Scheltema, Woods Hole Oceanographic Institution
Dr David Smallman, Dunstaffnage Marine Laboratory
Gareth Squire, Queen Mary & Westfield College, University of London
Professor Paul Tyler, Dept. of Oceanography, University of Southampton
Dr George Wolff, Dept. of Earth Sciences, University of Liverpool
Chris Young, Dept. of Marine Sciences & Coastal Management, University of Newcastle upon Tyne
Dr Craig Young, Harbor Branch Oceanographic Institution



A MILLION SPIDER CRABS CAN'T BE WRONG !

When working with deep-sea megabenthos it is usually most convenient to quote densities per hectare to avoid too many leading zeros. However, when peak densities start to exceed one million individuals per hectare it is time to revert to smaller units.

Elsewhere in this issue of the newsletter John Gage describes some of the events and findings of RRS *Discovery* cruise 211, designed to investigate the influence of an intense oxygen minimum zone on the benthos of the Oman continental margin (NW Indian Ocean, Arabian Sea). In John's account he mentions the discovery of dense populations of a small spider crab, probably *Encephaloides armstrongi*, within the oxygen minimum.

In the context of deep-sea megabenthos, a dense population might be one, or a few, individuals per square metre - but in the case of these crabs, densities exceed 100 individuals per square metre, equivalent to one million per hectare. Preliminary analysis of three phototransects (see Fig. 1) within the oxygen minimum zone have revealed not only these incredibly high densities but also an intriguing bathymetric distribution (see Fig. 2).

The two shallower tows, covering the depth ranges 570-625 m and 740-815 m, gave similar results: maximum density of about 20 and mean density of about 10 indiv.m⁻², and in the combined total of over 200 usable photos spider crabs were absent from only one. The deeper tow, covering the range 830-1230 m, produced completely different results. Almost half of the 140 usable frames contained no spider crabs, yet within a 50 m depth band centred on 985 m, mean density reaches 70 indiv.m⁻², and maximum density 137 indiv.m⁻². High densities were also recorded towards the deepest point of the tow, with individual counts in excess of 30 indiv.m⁻².

Explaining this bathymetric distribution may be more difficult than describing it. It is tempting to speculate that the high density band close to 1000 m reflects a biologically relevant boundary between the intense oxygen minimum above and more oxic conditions below. However, this does not explain the rarity/absence of crabs immediately above and below the high density band nor their return to comparatively high densities at the upper and lower depth ranges surveyed.

This is only a preliminary analysis, and although the densities reported here are unlike to change appreciably, considerably more information can be gleaned from these films. Of particular significance may be the size distribution of the crabs - small individuals predominate in the high density zone whereas at other depths the population consists almost exclusively of large individuals.

Brian Bett, Benthic Group, IOSDL

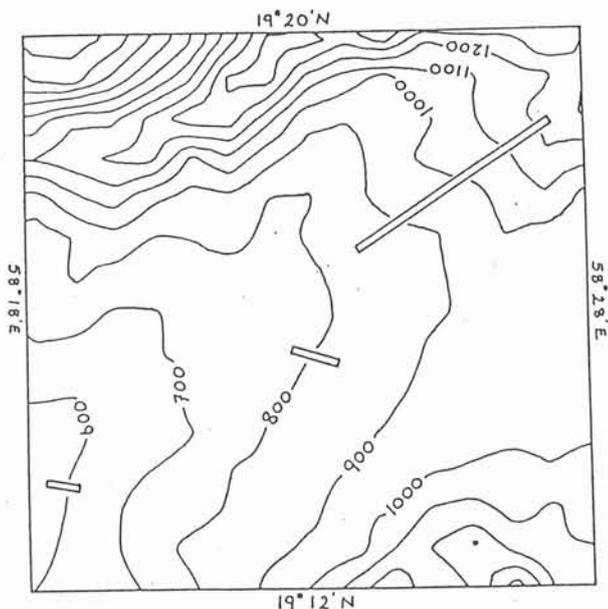


Fig. 1. Chart showing the approximate seafloor tracks of three IOSDL epibenthic sledge tows in the Arabian Sea, bathymetry is shown in 100 m contours.

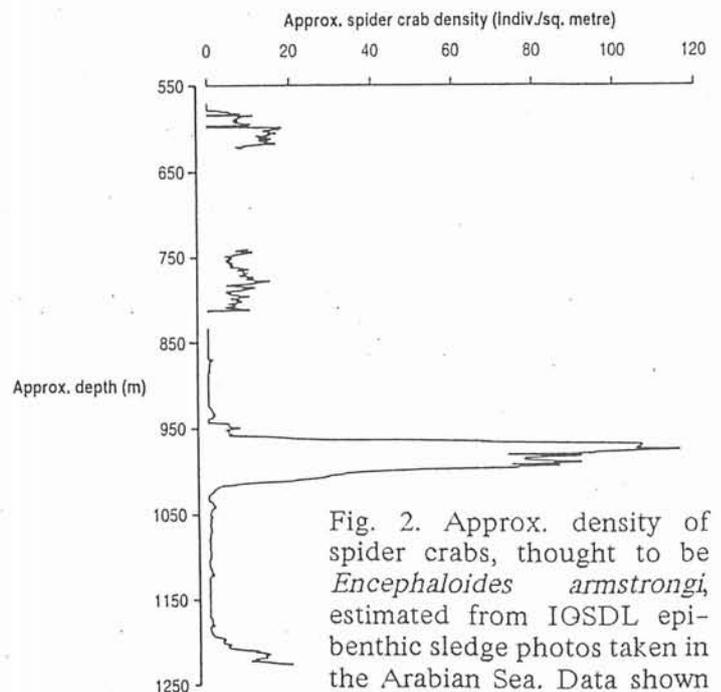


Fig. 2. Approx. density of spider crabs, thought to be *Encephaloides armstrongi*, estimated from IOSDL epibenthic sledge photos in the Arabian Sea. Data shown as 7 frame running mean density plotted against approx. depth of the sledge.

PYCNOGONIDS IN THE NORTHEASTERN ATLANTIC OCEAN

Pycnogonids feature fairly regularly in sledge and trawl samples taken in the deep sea, but rarely occur in other than very small numbers. The experience of most people who have seen such catches brought aboard will be limited to a glimpse of a large yellow *Colossendeis*, or, if you are Joel Hedgpeth, *Ascorhynchus japonicus* (Hedgpeth 1954). There is more to these samples than just *Colossendeis*, however.

For more than 20 years, the Institute of Oceanographic Sciences and the Scottish Marine Biological Association have been sampling in deep water in the eastern North Atlantic between 0° and 60°N. These efforts have resulted in well over 2000 specimens from depths in excess of 200 m, a very extensive collection by pycnogonid standards. We have used this material for an overview of the deep-water pycnogonids of the area.

The collection contains 35 species; a significant proportion of the 54 species recorded deeper than 200 m between 37° and 60°N, and the 71 species taken between 0° and 60°N. Discussions of distributions of pycnogonids are limited by the paucity of records of most species. In addition, some rarely recorded species appear to have pan-oceanic distributions, suggesting that many deep-water pycnogonids may be cosmopolitan.

Of the 54 species recorded from the northern part of the North Atlantic, 9 are currently considered to be endemic to that region, 24 have been recorded from the northwestern Atlantic, 11 from the Arctic, 5 from the Mediterranean, 11 from the South Atlantic, and 16 from other oceans. Despite the many extra-limital distributions, there appear to be realistic faunal groupings among northeastern Atlantic pycnogonids. The characteristic fauna is dominated by *Paranymphon spinosum*, several *Nymphon* and *Anoplodactylus* species, and, in the northern part of the area, by *Colossendeis clavata*. The shallow-water faunas north and south of the East Azores Fracture Zone are distinct, whereas the deeper colossendeids show a more uniform distribution. At the northern limit, some Arctic species intrude into the area. This latitudinal pattern results from the fauna having more than twice as many species in common with the NW Atlantic than with adjacent areas to the north and south.

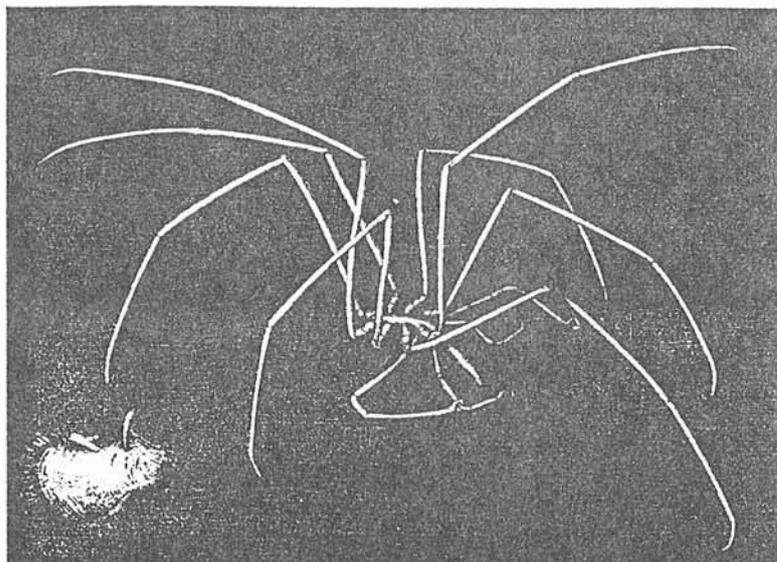
Based on changes of upper and lower species distribution limits with depth, a major change in the pycnogonid fauna at 1200–1600 m is evident. No obvious cause for this break is apparent. However, a discontinuity at about this depth has been established for other benthic groups in the area, and variously attributed to the lower boundary of the oxygen minimum layer of the Mediterranean outflow, increased tidal energy, or high energy current regimes.

A fuller account will appear in the Zoological Journal of the Linnean Society later this year.

Reference

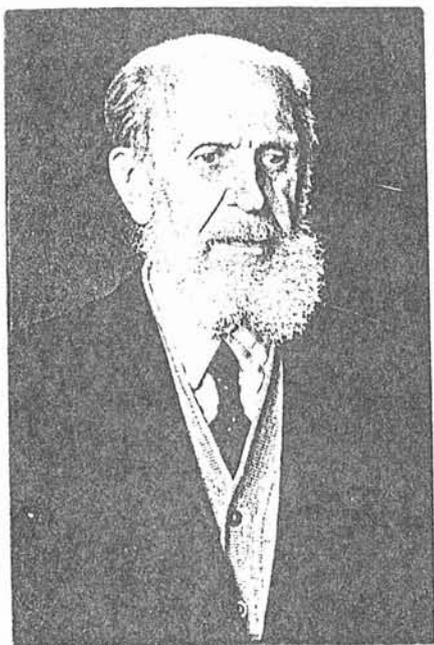
Hedgpeth, J.W., 1954. Reports on the dredging results of the Scripps Institution of Oceanography trans-Pacific Expedition, July–December, 1953. - *Systematic Zoology* 8: 147.

Mike Thurston, IOSDL, Wormley
Roger Bamber, Fawley Aquatic Research Lab, Fawley



Colossendeis collosea

GEORGII MIHAILOVICH BELYAEV (1913 - 1995)



The highly regarded and respected member of the Laboratory of Ocean Bottom Fauna in the P.P. Shirshov Inst. of Oceanology, the famous explorer of the fauna of deep-sea trenches Georgii Mihailovich Belyaev (George Belyaev for short) died on 6 January this year at the age of 81.

Originating from the family of a Tzar Russian Army general, George Belyaev completely devoted himself to the very peaceful profession of a scientist, having started in the early 1930's as a micropaleontologist at the Oil Geological Survey Institute in Moscow, studying carboniferous Foraminifera. His scientific fate was to a large extent influenced by meeting Lev A. Zenkevich, founder of Soviet Russian deep-sea biological research. In 1933 Belyaev participated in the expedition to Kola Bay, organised by Zenkevich. After this he entered the Biological Faculty of Moscow State University (MSU), and after graduating in 1940 he was elected Head of the MSU Biological Station on the White Sea. His research plans were interrupted by World War II, after which he returned to the Biological Faculty as a postgraduate, and defended his Candidate of Sciences Dissertation entitled "Osmoregulating capacities of aquatic invertebrates". In 1952 he joined the Laboratory of Benthos at the Inst. of Oceanology in Moscow, headed by Lev Zenkevich.

Belyaev's scientific activity in this period covered a broad range of subjects and geographical areas: many of the Russian seas, the first Soviet Antarctic Expedition on the R/V *Ob* in 1955-56, and numerous cruises on the famous R/V *Vitjaz*, studying the distribution in the deep sea of fossil shark teeth and squid jaws in sediments; taxonomy, evolution and ecology of echinoderms; quantitative distribution of the benthic fauna; vertical and biogeographical zonation of the ocean; history of the deep-sea fauna, and life in the trenches. The latter was his favourite realm, which he termed "ultraabyssal". Belyaev started the exploration of trenches when they were considered to be lifeless; he was trawling in many of them, including pioneer trawlings in the Mariana Trench, 11 km deep. The results were presented in 1972 as his D.Sc. Dissertation. He wrote a book on the fauna of deep-sea trenches (1966) with a revised edition in 1989 (not yet translated into English). Many ultraabyssal (hadal) animals are named "belyaevi".

Other brilliant contributions were made by George Belyaev in studies of echinoderms. In numerous publications on this subject he described a number of new species, genera and families and revised a number of taxa, such as the genus *Elpidia*, the families Myriostrochidae, Porcellanasteridae and Caymanostellidae. He was particularly excited about the latter, and with his unique knowledge of these curious sea stars he never accepted the status of Concentricycloidea as a new echinoderm class, but argued it to be an order among asteroids. Today his arguments are often ignored, but so far they have not been repudiated. Belyaev founded a group of echinoderm experts in the Shirshov Institute, who always appreciated his advice and very kind and respectful manner.

George Belyaev spent much time working on the editorial board of the main Russian zoological periodical *Zoologicheskii Zhurnal*, being the Associate Editor 1977-1989.

He was a great enthusiast, having published about 150 major papers. He worked until the last day and was always able to be surprised. George Belyaev is from the great generation of Russian pioneer deep-sea explorers to whom we are very much indebted.

Andrey Gebruk,
with other ex-students and colleagues

THE DEADLINE FOR THE NEXT ISSUE OF D.-S.N. IS 1st JANUARY, 1996

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