DEEP-SEA NEWSLETTER

No. 6, June 1982

INTERNATIONAL DEEP-SEA BIOLOGY SYMPOSIUM

La Jolla, California - 4-6 November 1981

One day in late 1979 John Gage and Bob Hessler were wandering along the beach in La Jolla, California, on the edge of the Pacific Ocean. Inspired by sea, the Scripps atmosphere, the discussions during the previous days and the awareness of the many close friendships and relationships prevailing within the circles of deep-sea biologists, John proposed a gathering for these dedicated persons, a suggestion which was promptly approved by Bob.

In the February 1980 issue of the Deep-Sea Newsletter it was annonced that Bob Hessler was willing to host such a meeting at Scripps in November 1981, provided it was kept informal. There would be papers, but no published proceedings. Further details and announcements appeared in the two following issues of the D.-S.N., urging people to participate.

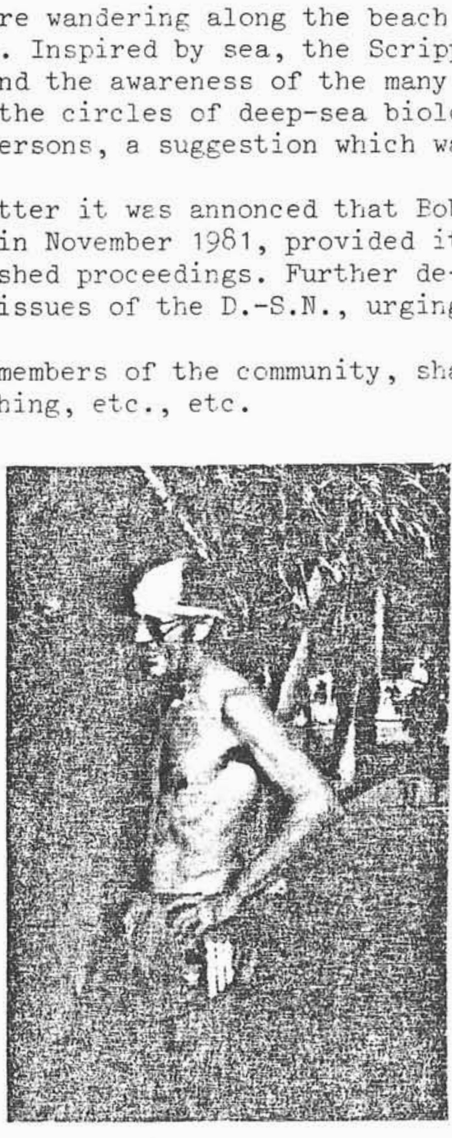
However, deep-sea biologists are busy and active members of the community, sharing their working time between cruises, research, teaching, etc., etc.

It was therefore gratifying that no less than about 65 had been able to follow Bob's invitation. Of course the great majority were Americans, but several non-US countries were represented by 1-5 participants, including Australia, Canada, Denmark, France, Germany (FRG), Norway, Sweden, South Africa and United Kingdom.

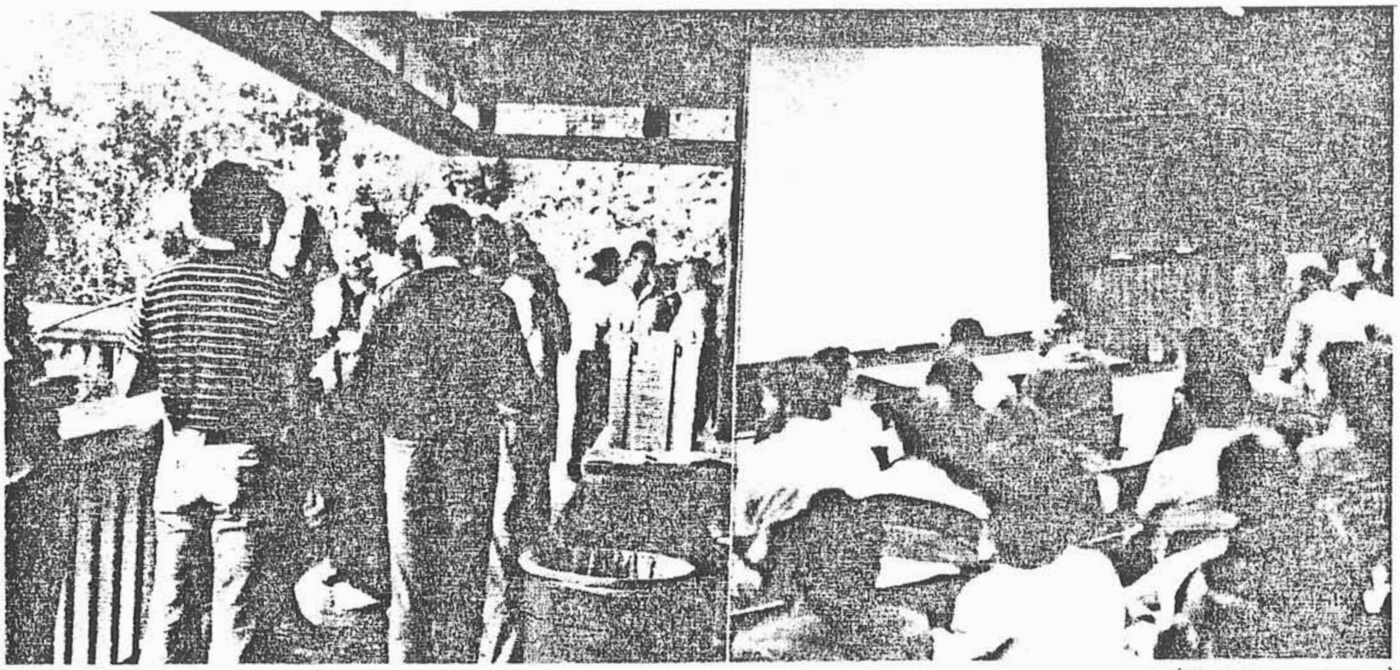
Accomodation had been arranged for in La Jolla hotels or hostels, several of them overlooking the Pacific and most within walking distance of Scripps (along the cliffs and beach!).

Bob Hessler's introductory remarks in the morning, 4 November, set the tone for the whole meeting. He hoped that these three days would allow the participants lots of opportunity to interact informally and that conversation and discussion would be as important as the benefit which came out of the formal talks.

The way Bob had arranged the meeting and the free and easy atmosphere contributed greatly to reaching this goal.



The host...
(Cutler phot.)



(Cutler phot.)

In the morning there were six 20-minutes talks, each followed by a 5-10 minutes discussion, and there were two coffee breaks. These were spent on the high-level balconies surrounding the Biology Department auditorium, with a marvellous view of the Scripps Campus and the Pacific.

Morning sessions

The titles of the 19 morning talks (which had been randomly chosen from a total of 34 offered talks) were as follows:

4 Nov.: V. Tunnicliffe: Space competition in the deep epilithic benthos.
O. Pfannkuche: Comparative measurements of oxygen uptake rates (shipboard technique) by the deep-sea benthos from the NE Atlantic, Arctic Basin and central Red Sea.
K. Nealson: Microbial activities on metals in deep-sea sediments.
K. Smith: Metabolism of a bathyal benthic boundary layer community.
H. Flügel: Recent biological and ecological investigations on the Pogonophora (beard worms) of the European continental slope and the Norwegian trench.
M. Rex: Planktotrophic development in deep-sea gastropods.

5 Nov.: T. Brattegard: Ecological studies on suprafauna of the Norwegian Sea.
L. Snider: The infauna of the central North Pacific.
W. and L. Pequegnat: Differential vertical distribution of the dominant macroepifaunal species in the deep Gulf of Mexico.
F. Grassle: Colonization in the deep sea.
K. Fauchald: Polychaete systematics and the deep sea; recent results on onuphids and the level of endemism in the deep sea.
G. Rowe: Deep-sea food chains.

6 Nov.: J. Childress: Near-bottom pelagic sea cucumbers in the deep sea off southern California.
B. Hecker: Epifaunal assemblages on the outer continental margin of the eastern United States.
H. Weikert: On the distribution of zooplankton and micronekton in relation to habitat zones in the central Red Sea.
P. Jumars: Scent-finding and following strategies in deep-sea bottom boundary layer flows.
J. Gage: Growth strategies in the deep-sea benthos.
A. Carey: Megafauna of Cascadia Basin and eastern Tufts Abyssal Plain.
R. George: Some hypotheses concerning colonization and speciation in eutrophic deep-sea environment.

Afternoon sessions

The first and the third afternoon were devoted to informal discussions on issues brought out in the morning talks or on new topics. Besides there were equally informal presentations of a number of exciting discoveries, data, slides and movies, particularly by persons who had not had an opportunity to speak during the morning sessions.

From memory and from my scattered notes I am able to list the following contributions, excusing omissions and possible errors in the titles, most of which were presented only orally in wide-ranging varieties of the English language.

A. Carey: Beam trawl and megafauna sampling.
C. Smith: Invertebrate relationship to kelp in the Catalina Basin.
T. Brattegard: Presentation of "Håkon Mosby".
M. Sibuet: Feeding in deep-sea holothurians.
J. Deming: Barophilic bacteria in deep-sea holothurians.
D. Thistle: Introduction to: High Energy in the Benthic Boundary Layer (HEBBLE).
K. Wishner: Near-bottom zooplankton in the HEBBLE area.
G. Wilson: Reproductive strategies in deep-sea isopods.
J. Gordon: Deep-sea demersal fish in the Rockall Trough and the Porcupine Bight.
G. Somero & J. Siebenaller: Enzymic determinants of respiration rates and distribution patterns.
J. Cutler: Zoogeography of sipunculids and pogonophorans.
H. Sanders: Analysis of zoogeography in prosobranch gastropods.

Several of the contributors attracted others to present additional data or to show a few slides which in most cases were relevant to the topic under consideration.

The third afternoon had been set aside to a presentation of the latest news from the hydrothermal vent community. Amongst the contributors were Hessler, Grassle and Sanders, J. McLean, Woodwick, Ken Smith, Felbeck and J. Baross. They spoke on the faunal composition and the community (accompanied by a film and remarkable slides taken from the "Alvin"), on particular animals (such as the limpets, the giant clam, the vestimentiferan and the enteropneust), and finally on the nitrogen cycle.

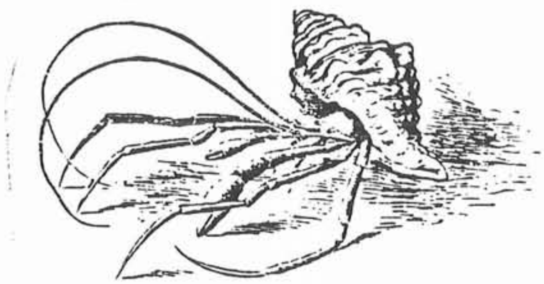
Both popular and scientific vent articles and papers have been published. But here we witnessed probably the first general updating survey, and it was executed by several of the biological key persons. As the hours went it struck me that this was all so new and extraordinary and exciting that what we experienced that afternoon might best be compared with the feeling of the members of the Royal Society in Edinburgh and London, when Wywille Thompson and John Murray gave them an account of the unknown world which had been revealed by the "Challenger"...

Finally, at the end of each day when the sun was setting we all gathered on the balconies for continued talks, with wine, beer and cheese adding to everyone's well-being.

At the end of the last day's afternoon session sincere words of thanks and appreciation were expressed to Bob Hessler and his collaborators and students for making this gathering such a pronounced success. We all agreed that there was a general demand for a continuation of similar informal and informative meetings for deep-sea biologists in future.

Torben Wolff

P.S. Hjalmar Thiel has already informed me that he would be willing to arrange such a meeting in Hamburg. Those interested in participating are urged to tell him which month they would prefer either in late 1983, in 1984 or in early 1985. His address is given below.



The Deep-Sea Newsletter distributors

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FRANCE:	Dr. Lucien Laubier, Centre Océanologique de Bretagne, Boite Postale 337, F-29273 Brest Cedex.
GERMANY (FRG):	Dr. Hjalmar Thiel, Universität Hamburg, Inst. f. Hydrobiologie und Fischereiwissenschaft, Zeiseweg 9, D-2000 Hamburg 50.
HOLLAND:	Dr. Jaap van der Land, State Museum of National History, Raamsteeg 2, Leiden.
JAPAN:	Dr. M. Horikoshi, Ocean Research Institute, University of Tokyo, Minamiday 1-15-1, Nakano-ku, Tokyo 164.
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U.S.S.R.:	Dr. Nina Vinogradova, Inst. of Oceanology, Academy of Sciences, 23 Krasikova Street, Moscow 117218.

We should like to broaden future distribution, preferably to other European countries. Suggestions in this respect are welcome.

Final Cruise of the SUBTROPEX UPWELLING PROGRAM

During January and February this year we were on "Meteor" cruise 60 - SUBTROPEX '8s off NW-Africa. This was the final cruise within our upwelling programme. Our working group was supplemented by 4 microbiologists: V. Enoksson and M.-O. Samuelsson from Department of Marine Microbiology, University of Gothenburg, and H.-J. Rüger and T.L. Tan from Institut für Meeresforschung Bremerhaven. We were further joined by G. Schriever, Zoological Museum, Kiel University, who studies harpacticoids, and by geologists from Kiel University, working on problems mainly not related to ours. We sampled along 5 transects between 35° and 17°N, on a shelf station and in 400, 800, and 1200 m depth.

While former cruises were primarily devoted to the investigation of standing stocks and biomass, this time we concentrated on activity measurements as shipboard respiration, ATP-AEC, ETS and nitrogen turnover, chemical components in the sediment, meio- and macrofauna. We got valuable sample series, but the cruise was not fully successful. Sandy sediments, even in depths of 400 and 800 m on two of the transects, gave us a hard time to bring up good samples. The series of shelf samples is rather worthless because of the sandy sediments. Additional loss of time was due to an accident which made a further port call necessary.

During this cruise we lost a fotosled an a box corer. The loss of the box corer seems to be of general interest, because with a simple security wire this could have been prevented. After Reineck had invented the box corer in the early sixties, it was regularly used on "Meteor" and other research ships. This was the first time that a box corer was lost, and it happened by the partition of the closing wire. Today I know that this has happened to other scientists as well, but it never occurred to us that an extra security would be necessary. We were lucky to have Jim Watson from Dunstaffnage Marine Research Laboratory, Scottish Marine Biological Association, Oban, with us. He taught us how to use a safety wire, as it is being done already on the "Challenger". This security wire connects the corer head with the deep-sea wire. It has to be somewhat longer than the closing wire. During lowering the wire is loosely tied to the grab in some narrow loops, and during closing the ties break and the safety wire runs parallel to the closing wire. In case the closing wire breaks, the security line takes over and retrieves the box corer and possibly a good sample. Without this arrangement we had also lost our second box corer, since the closing wire broke once again later on.

Hjalmar Thiel, Hamburg

Meiofauna Studies in the Rockall Trough

The Scottish Marine Biological Association's Dunstaffnage Marine Research Laboratory has been developing a multiple corer to take undisturbed core samples for meiofauna from RRS "Challenger" in the deep sea of the Rockall Channel and on the continental shelf. Based on the principle of the Craib (1965) corer, the multiple corer slowly lowers an array of core tubes into the sediment. It provides an alternative to taking samples with a large box corer, which are usually disturbed, and subsequent subsampling with small core tubes on board ship.

Originally designed to take 4 cores simultaneously, each of 25 sq cm, the corer has recently been adapted to take 12 cores at each sampling, usually with 100% success. The corer may incorporate a reversing thermometer, bottom water sampler, current direction indicator and a deep-sea camera to monitor the sampling process. The sampler is now providing a great deal of material for both microbiological and meiofaunal studies by various other institutions and for geological studies of Foraminifera by University College of Wales, Aberystwyth.

The Association's meiofauna programme is a study of the biology of the harpacticoid copepods of the deep sea and shelf. Seasonal samples have been taken from a 3000 m deep station in the Rockall Trough, and a 150 m deep station on the continental shelf 50 miles south of Barra Head, Scotland, in March, May, July, September and November 1975 and in February, April, June, July and October 1976. Twice yearly samplings in 1977, 1978 and 1979 and annual samplings in 1980 and 1981 are providing data on long-term changes in the meiofauna. For comparison, annual or biennial samplings have been taken at a routine station at 5000 m on the Porcupine Abyssal Plain since 1975. The material is providing many new harpacticoid species.

The multiple corer's ability to take undisturbed samples without wafing aside any surface layers of sediment has revealed the presence of patches of very flocculent material at various sampling stations in the deep sea, particularly at the 3000 m Rockall Trough station, at various stations in the Porcupine Seabight and, to a lesser extent, at 5000 m depth on the Porcupine Abyssal Plain. Varying in thicknesses up to 2 cm and of unknown area, these patches appear to consist mostly of fine particulate material but contain the remains of planktonic diatoms, such as Coscinodiscus and various coccolithophores, and the remains of crustacean carapaces, probably from planktonic copepods.

Peter Barnett - Bernard Hardy - Jim Watson

Scottish Marine Biological Association

Dunstaffnage Marine Research Laboratory, P.O. Box 3, Oban, Argyll, U.K.

Reference

Craib, J.S. (1965). A sampler for taking short undisturbed cores. - J. Cons. perm. int. Explor. Mer, 30: 34-39.

Deep-Sea Cruises from Tromsø, Norway

Since the summer of 1979 the University of Tromsø has undertaken annual investigations on the bottom fauna and pelagic fishes in the Norwegian Sea adjacent to Tromsø and northern Nordland counties. The cruises have been performed with the use of the University's ship, R/V "Johan Ruud", and each has lasted for about a week. Scientific participants have been Per Pethon, Zoological Museum, University of Oslo and ourselves.

Totally 93 benthic stations have been sampled with dredge or detritus sledge; varying from 100 to 2400 m, most of them between 1000 and 2000 m.

The bottom hauls have yielded a rich material of benthic invertebrates which in part has been distributed to Norwegian specialists for identification. Among the animals found is a probably new species of Pogonophora.

Deep pelagic trawl hauls were taken in 1980 and 1981. The new records of luminous fishes were published in Sarsia 66.

The next cruise will take place in 1982. A grant from the Norwegian Council for Science and the Humanities has made it possible to equip "Johan Ruud" with a new wire measuring 5000 m. With this wire we hope to sample depths of 3000 m or below.

Torleif Holthe
Institute of Biology and Geology
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N-9000 TROMSØ

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Trondhjem Biol. Station
N-7001 TRONDHEIM

"HÅKON MOSBY" - the new oceanographic research vessel of the University of Bergen, Norway

In September 1980 the shipbuilder A.S. Mjellem & Karlsen (Bergen, Norway) delivered a new, modern research vessel to the University of Bergen.

"HÅKON MOSBY" is intended to serve research needs within most disiplines of oceanography. It will primarily operate in the N.E. Atlantic, i.e. the fjords and coastal waters of Norway, the North Sea, the Norwegian Sea and the Barents Sea.

The vessel is a stern trawler built as an open shelter-decker with extended forecastle. It can accommodate 25 persons, including 13 scientists.

Above the boat-deck level there is a hydraulic boom (4 m, 3 tons) on the starboard casing. Bottom trawl and pelagic trawl are kept on a large, double, hydraulic drum mounted between the casings.

On the boat-deck level there is a trawl-eye winch with 2000 m of 7 mm Ø cable. On each of the crane towers at the stern there is a 5.5 ton-metre hydraulic arm. Hydraulic A-frame is situated on the starboard side.

The main winch on the shelter-deck takes 7000 m of 12 and 14 mm Ø wire. The hydrographical winch takes 7000 m of 4 mm Ø wire, and the CTD winch 6000 m of 7 mm Ø cable. A large 22 ton-metre hydraulic arm is situated between the starboard casing and the stern. The aft part of the shelter-deck gives about 100 m^2 of open, unobstructed work-space. Between the casings is deck-space for a container laboratory, e.g. an isotope laboratory.

The two large trawl-winches (1500 m of 22 mm Ø) are situated on the main deck, one on each side and just behind the casings. Between these and aft of them is a large storage space of c. 30 m^2 or 60 m^3. From this area there is direct access to mechanical, electrical and carpenter's/boatswain's workshops and stores.

Bridge: Integrated navigation system consisting of Magnavox Dual Channel Satellite Navigator, Decca Navigator, Loran C Navigator, Simrad Doppler Speed Log, and Simrad Distance Log. Detailed information displayed on monitor. Decca RM 926 radar and Decca 218 radar. Skipper radio direction finder. 50 kHz echosounder for navigation. Slave recorder for 38 kHz Simrad EK 400 echosounder. 21 kHz Simrad ST sonar. Simrad trawl-eye recorder. Microtechnica Sirius M 12 gyrocompass. Decca/Arcas 450G autopilot. For communication Skanti TRP 5000, Simrad PK VHF, Skipper 758 and Simrad RW.

Observation centre, port side, 36 m^2, 14 instrument racks, 8 m of work bench, chart-table. 3.5-7 kHz Ore 1036 echosounder, 12 kHz Simrad EK 400 echosounder, 38 kHz Simrad EK 400 echosounder with slave recorder and connection to slave recorder on the bridge. 120 kHz Simrad EK 400 echosounder. Oscilloscope HP 1741. Echo signal preprosessor Simrad QX. Digital echo integrator Simrad QD. Hewlett Packard 1000 computers (one for the integrated navigation system, the other for all other uses) with disk and tape stations. Magnavox ship velocity sensor. Loran C Micrologic. CTD Neil Brown deck unit. 2 strip-chart recorders, 1 XY-recorder, 1 printer, 1 terminal with screen, 1 terminal with printer. Instrumentation for magnetometry, gravimetry and acoustic profiling. 1 navigation monitor screen.

Laboratory 1, suitable for coarse work, starboard side, 16 m^2.

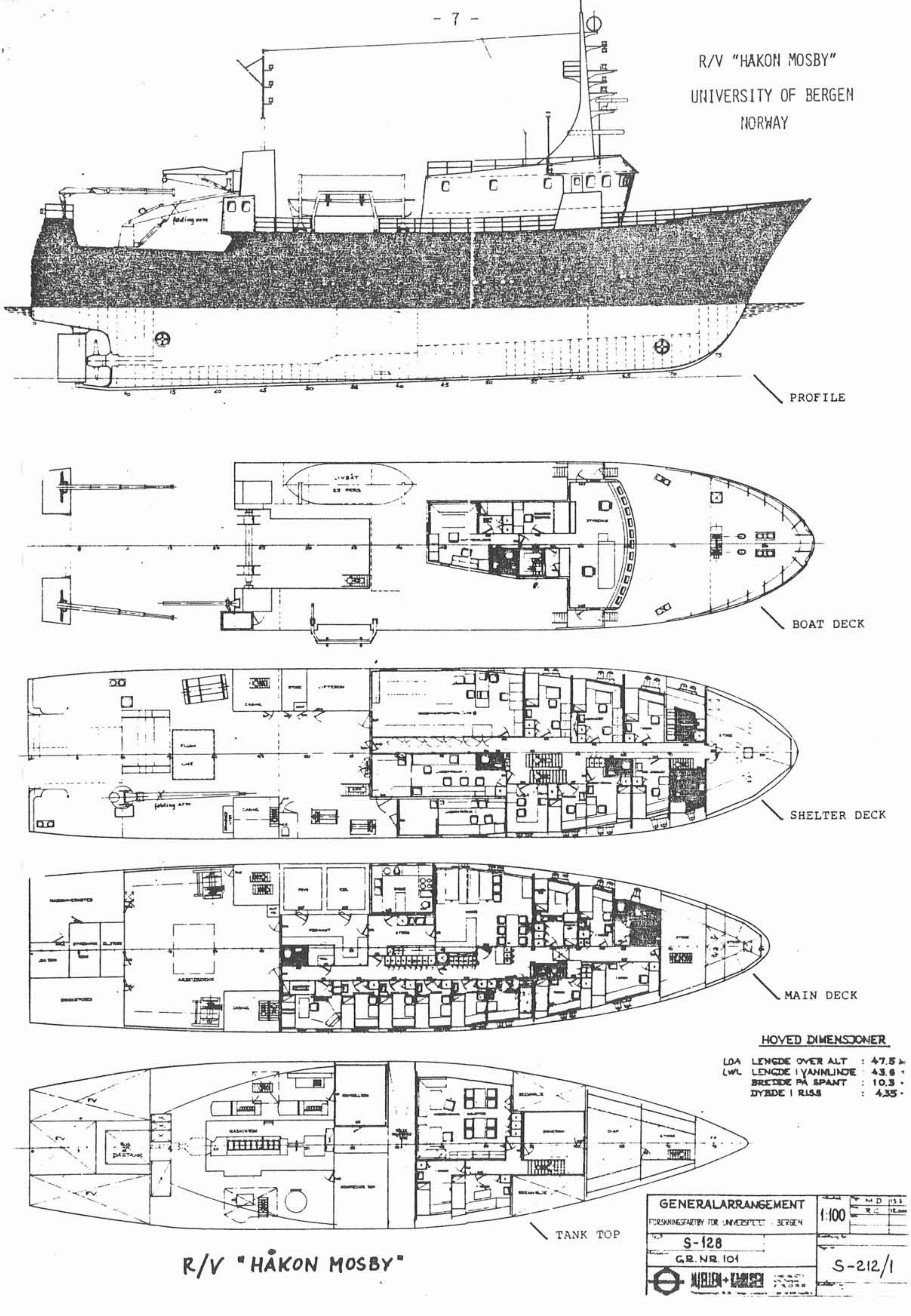
Laboratory 2, suitable for hydrography and finer work, midship, window connection with Lab. 1, 22 m^2.

Laboratory 3, suitable for clean work, starboard side, 6 m^2.

A large library/classroom is situated on the tank top deck.

Supplementary description

Construction material: hull of steel, deck house of aluminium.
Screw type: Normo 68/4 controllable pitch propeller, 4 blades.

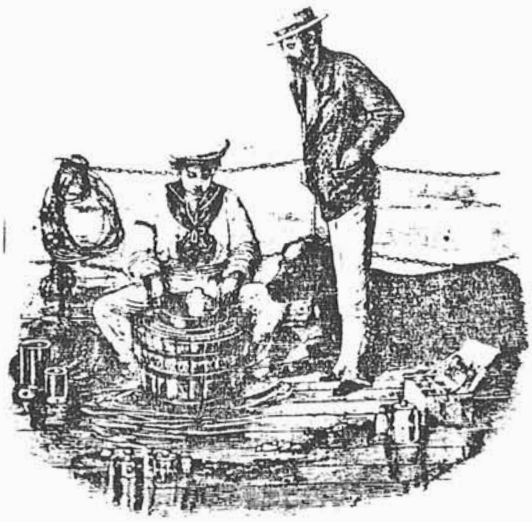

R/V "HAKON MOSBY"
UNIVERSITY OF BERGEN
NORWAY
folding arm
PROFILE
LIVBÅT
BOAT DECK
FLUSH
folding arm
SHELTER DECK
MAIN DECK
MASKINROM
DÅSTANK
TANK TOP
HOVED DIMENSJONER
LOA LENGDE OVER ALT : 47.5 m
LWL LENGDE I VANNLINJE : 43.6
BREDDE PÅ SPANT : 10.3
DYBDE I RISS : 4.35
GENERALARRANGEMENT
FORSKNINGSFARTØY FOR UNIVERSITETET I BERGEN
1:100
S-128
GR. NR. 101
S-212/1
R/V "HÅKON MOSBY"

Length overall: 47.50 m. Length at the waterline: 43.60 m. Breadth: 10.30 m. Draft, maximum: 4.30 m. Depth, shelter-deck: 6.50 m. Depth, main deck: 4.35 m. Displacement (full load, summer waterline): 950 tons. Gross: 499 GRT.

Operating capabilities

Range: 6500 nautical miles.
Calculated endurance: 21 days. Performance: by 1981 240 days.
Speed: cruising 11-12 knots, maximum 13 knots, minimum possible 0.1 knot.
Power: main engine rating maximum 1700 BHP, continuous 1500 BHP, manufacturer Normo LDMCB-9, 4-stroke.
Auxiliaries: 2 Volvo Penta, each continuous 231 BHP, each supplying c. 160 kVA.
Capacities: fresh water 29 m^3, fuel 103 m^3, ballast (fuel or water) 93 m^3, smaller tanks for lubes and hydraulic oils. Storage space: no hold but c. 60 m^3 on main deck and 4 store rooms with a total of c. 100 m^3. Galley stores: dry 30 m^3, chilled 11 m^3, frozen 11 m^3.

Special features
Side thrusters of type Brunvoll SPO-200, hydraulic, 200 HP, 1 near the bow, 1 near the stern.
Stabilizer: Flume system.
De-icing: masts, deck-house and boat-deck.
Fresh-water maker: 5-6 tons per day.


SIFTING DEPOSIT.

R/V DANA, Denmark

The vessel was commissioned 6 February 1981 for the Danish Institute of Fisheries and Marine Research. The base port is Hirtshals, NW Jutland. Classification: Det norske Veritas. +1.A1.Ice 1A*Deep Sea Fishing, Sterntrawler, EO. Service area: World wide.

Length o.a.: 78,43 m. Length w.l.: 68,93 m. Breadth: 14,7o m. Depth, upper deck: 9,4o m. Draft c.w.l.: 5,7o m. Draft max.: 5,93 m. Corresp. deadweight: 900 t. Fuel oil capacity: 557 cu.m. Freshwater capacity: 93 cu.m. Ballast water capacity: 450 cu.m. Cruising range (12 knots): 14,000 naut. miles. Tonnage 2484 grt.

Two B&W Alpha diesel main engines, one bow and one stern thruster. Trial speed: 15,5 knots, corresp. output: 2 x 2320 BHP.

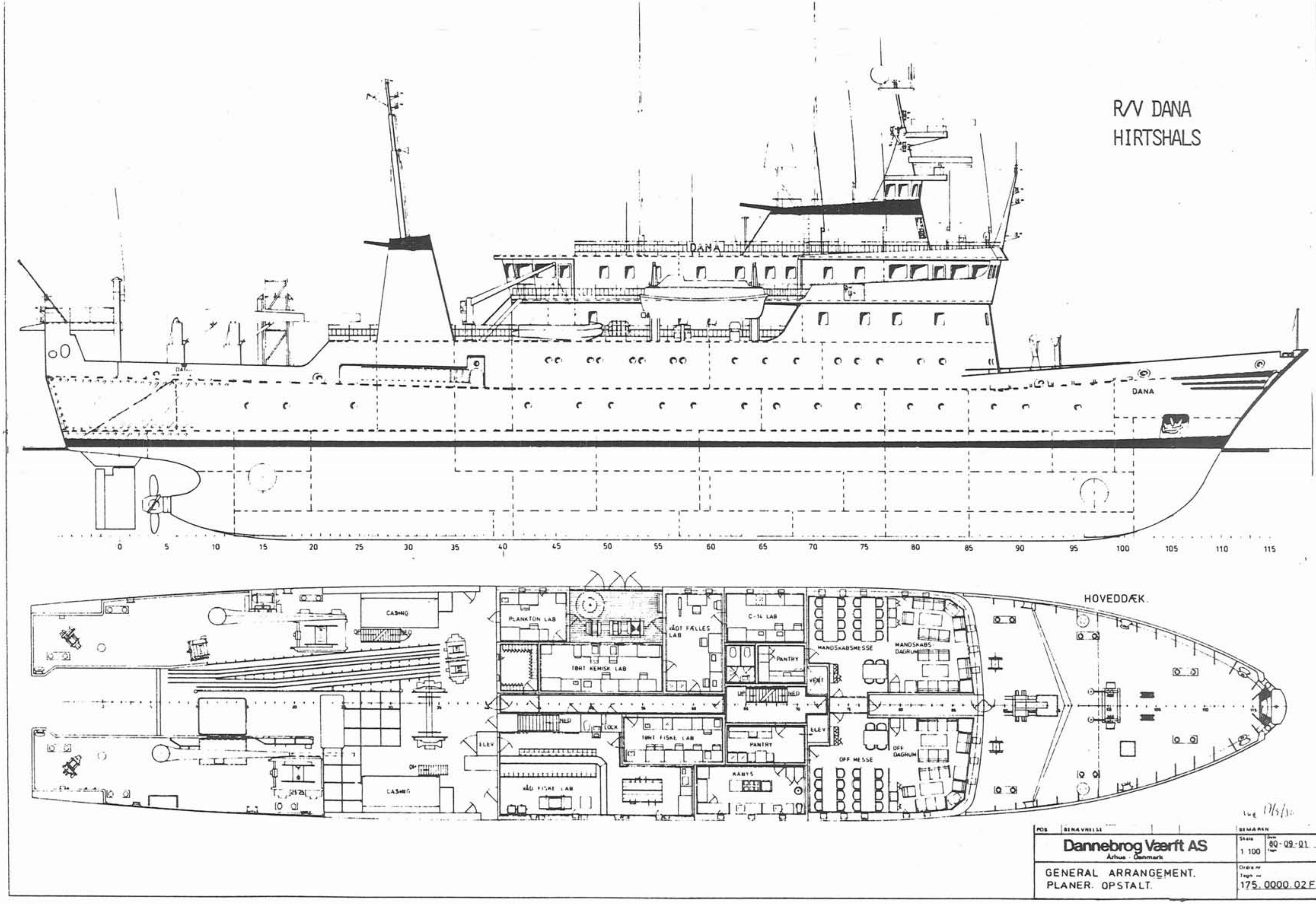
Accomodation: 10 scientists and 29 officers and crew in single cabins with private bath and toilet.

The six main physical, chemical and biological laboratories are located at the main deck to ensure optimal working conditions and easy access to the trawl deck and midship hydrographic winch area. The acoustic detector room and the electronic data processing room are situated at the bridge deck to ensure easy communication with the wheelhouse and fishery bridge. Two separate aquaria rooms (temp. adjustment from 2^{o} - 25^{o}C) are located at first tween deck.

The chemistry laboratory contains the following instruments: Autophotometric analyser, spectrophotometer, spectroflourometer, salinometer, titrator, microbalances, recorder for quantameters. The automatic instrumentation is connected to the chemical front-end processor and the two Edp-terminals.

The carbon 14 laboratory is arranged in accordance with instrumental regulations for isotope laboratories class B.

Two main trawl winches, capacity of pull 30 tons (empty drum), two Bridle winches and three auxiliary winches. Two net drums, capacity of pull 25 and 6 tons, and of volume 10 and 6 cu.m, one plankton winch, 4000 m cable, and winch for the submerged sonar unit, cable 500 m. Two hydraulic cranes. 10 tons balance pounder on the working deck. Conveyor belts to the wet fish lab, or overboard.



R/V DANA
HIRTSHALS
DANA
HOVEDDÆK.
PLANKTON LAB
TØRT KEMISK LAB
VÅDT FÆLLES LAB
C-14 LAB
PANTRY
MANDSKABSMESSE
MANDSKABS DAGRUM
OFF MESSE
OFF DAGRUM
TØRT FISKE LAB
VÅD FISKE LAB
KABYS
ELEV
LOCK
CASING
Dannebrog Værft AS
Århus · Danmark
GENERAL ARRANGEMENT.
PLANER. OPSTALT.
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As appears from the previous pages, contributions to this issue have - in spite of the Editor's efforts - been rather few (but most welcome!).
We are therefore delighted with the fulfilment of a plea for a preliminary report on the very recent investigation of hydrothermal vents at 21°N (East Pacific Rise) which was the first in-depth biological study of this site. On Bob Hessler's request, Ken Smith, chief scientist of the cruise, allowed us to use his report to the US National Science Foundation, which is a well-rounded description of what was learned. In addition, we received a pre-expedition "Fact Sheet" announcement from the Scripps Public Affairs Office which we believe is of considerable general interest; most of its contents is therefore given here.

FACT SHEET: Biology of the Hydrothermal Vents at 21°N East Pacific Rise (EPR)

A multifaceted biological program will study the ecology and physiology of the deep-sea hydrothermal vent communities at 21° north of the equator. The program involves some 45 investigators from 21 institutions, including participants from France and Mexico. It is divided into four main areas of study: microbial ecology, faunal ecology, ecological physiology, and ecological energetics. Total funding from the National Science Foundation is approximately $ 1,7 million.

The EPR is a spreading center, or chain of undersea active volcanoes, thousands of miles long, stretching off the west coast of South America and Central America from the Antarctic Circle to Mexico. The center is at the boundary of two of the earth's jigsaw-puzzle-like plates, which are separating at a rate of about 6 cm per year and creating new sea floor.

Nearly two dozen vent communities have been located at the 21°N EPR site at depths of about 2,600 m. Pressures at such depths are 260 atmospheres. Vent water temperatures, the warmest recorded at vent sites to date, range from 3° to 350°C, and surrounding waters are about 2°C.

Extraordinary life forms and geological structures surround the sites of the hydrothermal vents. Sea anemones, worms, crabs, large clams, and giant tube worms are attracted to the vents by not only the warmth of the hydrothermal fluids but by the concentrated food supply as well. The mounds and chimneys (called smokers) are composed of sulfides of zinc, iron, and copper and sulfates of calcium and magnesium, leaving no doubt that the vents have a key role in the chemistry of the oceans. Results of hydrothermal vent research are revolutionizing concepts of ocean circulation and mineral deposition and challenging theories of life in the deep sea through the discovery of a food chain that does not depend on photosynthesis.

Cruise Information

Dates:	Leg 1 - April 13-28 Leg 2 - May 2-18	Port Calls:	Depart San Diego Layover Mazatlan Arrive San Diego	April 13 April 28-May 1 May 18
Ships:	R/V Melville, SIO R/V Lulu & DSRV Alvin, WHOI R/V New Horizon, SIO	Alvin dives:	10 per leg	

Program Outline

Microbial Ecology--This component is primarily concerned with the chemoautotrophic activity of microorganisms associated with the vent communities and their isolation, as well as their physiological and ecological description. This includes open vent water bacteria and symbiotic, or internal, bacteria that live within vestimentiferan (tube) worms and other autotrophic host organisms. Microscopy and isolation techniques will be used to identify the microorganisms and ATP assays to determine biomass. Microbial growth rates will be examined using labeled adenine incorporation into RNA. Carbon dioxide and nitrogen fixation rates and analyses of the reduced carbon compounds produced will be intensively studied.

Faunal Ecology--Ecological studies of the faunal populations include identification and distribution, gut contents analyses, colonization experiments, and genetic studies. Collections and photographic documentation will be used to determine distribution and abundance of fauna around the vent system with respect to temperature, substrate, and other parameters. The food of the dominant species will be determined by gut content analysis and carbon isotope studies for comparison with food sources. Reproductive and dispersal potential and settling rate experiments will be conducted to evaluate colonization. Genetic studies will be made to further describe colonization events and compare findings to other vent community sites.

Ecological Physiology--These studies focus on the adaptations developed by the vent organisms to successfully inhabit such an environment. In situ, metabolism, excretion, and oxygen consumption tests will be conducted and samples will be brought to the surface in temperature-isolated chambers and kept alive on ship in pressurized containers. Tolerance adaptation to pressure and temperature will be examined on enzyme, tissue, and organismic levels. Adaptation to high concentrations of hydrogen sulfide and metals in the vent water will be examined on organismic and tissue bases. Structural and functional properties of respiratory pigments will be extensively studied. The chemoautotrophic activity of vestimentiferan (tube) worms will also be examined in conjunction with microbial studies.

Ecological Energetics--The main emphasis of this component is to determine the food energy demands of the populations of the vent communities and compare these with estimates of food produced locally by chemosynthetic microorganisms. Energy demands of faunal populations will be estimated from in situ respiration and growth measurements. These demands will be compared to production values determined for the chemosynthetic microorganisms.

Participants

I: Investigator; S: Student; T: Technician.
MBL: Mar. Biol. Lab., Woods Hole; SIO: Scripps Inst. of Oceanogr.: UCSB: Univ. Calif., Santa Barbara; WHOI: Woods Hole Inst. of Oceanogr.
The projects known to the Editor have been added.

K. Smith	I	SIO	
R. Hessler	I	SIO	Community Structure and Small Scale Distribution of Benthic Megafauna
W. Smithey	I	SIO	Community Structure and Small Scale Distribution of Benthic Megafauna
R. Baldwin	I	SIO	
J. Edelman	I	SIO	
G. Somero	I	SIO	Physiology
H. Felbeck	I	SIO	Physiology
J. Childress	I	UCSB	
A. Arp	S	UCSB	
A. De Bevoise	S	UCSB	
C. Fisher	S	UCSB	Metabolism of Vent Animals
J. Favuzzi	T	UCSB	
M. Price	T	UCSB	
W. Lowell	T	UCSB	
G. Wienhausen	I	UCSB	Water Chemistry
H. Sanders	I	WHOI	Benthic Macrofauna
F. Grassle	I	WHOI	Benthic Ecology of Soft Sediments
I. Williams	T	WHOI	Benthic Ecology of Soft Sediments
S. Mills	T	WHOI	Benthic Ecology of Soft Sediments
H. Jannasch	I	WHOI	Microbiology
C. Wirsen	I	WHOI	Microbiology
D. Nelson	I	WHOI	Microbiology
J. Waterbury	I	WHOI	Microbiology
P. Comita	T	WHOI	Water chemistry for R. Gagosian
G. Nigrelli	T	WHOI	Water chemistry for R. Gagosian

C. Berg	I	MBL	Life History Studies of Molluscs
J. Grassle	I	MBL	Population Genetics of Species
M. Jones	I	Smithsonian	Vestimentiferans
S. Gardiner	I	Smithsonian	
C. van Dover	I	Smithsonian	Decapods
R. Lutz	I	Rutgers Univ.	Biol. Analysis of Molluscan Shells
D. Karl	I	Univ. Hawaii	Microbiology
J. Tuttle	I	Univ. Maryland	Microbiology
J. Baross	I	Oregon State Univ.	Microbiology
G. Roesijadi	I	Battelle Pac. NW Labs	Trace Elements in Calyptogena
O. Calvario	I	Univ. Nac. Auton. Mexico	
J. Contreras	I	Com. Intersecr. Invest. Oc., Mexico	
M. Roux	I	Centre Oceanol. Bretagne, France	Stable Isotopes in Bivalves
A. Fiala-Medioni	I	Univ. P. M. Curie, France	Feeding Structures in Bivalves
A. Dinet	I	CNEXO, France	Meiofauna
F. Gaill	I	CNEXO, France	Actinarians

L. Ford	Photographer	SIO	J. Boaz	Resident Tech.	SIO
C. Colgan	Public Relations	SIO	M. Moore	Computer Tech.	SIO
V. Cullen	Public Relations	WHOI	M. Kleinschmidt	Volunteer	SIO

Equipment

DSRV Alvin--The Deep Submergence Research Vehicle Alvin is a Navy-owned national oceanographic facility, supported by the National Science Foundation, the Office of Naval Research, and the National Oceanic and Atmospheric Administration and operated by Woods Hole Oceanographic Institution. Designed specifically for oceanographic research, Alvin has made some 1,000 dives to depths as great as two miles over the past 15 years. Alvin's 7-foot (2.1 meter) diameter pressure sphere has a 1.93-inch (4.9-centimeter) thick titanium alloy hull. The sphere accommodates a pilot and two scientific observers as well as instrumentation and life support equipment for endurance up to 72 hours. It has a 25-foot (7.6-meter) titanium frame and two remotely controlled mechanical arms with associated sample trays and jars. It is designed to be versatile with respect to the weight, space, and power requirements of portable scientific equipment. Cruising speed is 1 knot; full speed is 1.5 knots; cruising range is 5 miles. The precision transponder Alvin navigational system will be used to expeditiously locate the vent sites with Alvin and to accurately place free vehicle instrumentation deployed from the surface ships.

Time Lapse Camera-- Photographs will be taken of the vent community to assess the extent to which the fauna visibly react to the temperature and current fluctuations of the vent environment.

In situ Respirometers--One respirometer will be placed in the vent plume area to measure the respiration rates of individual vestimentiferan specimen. Another, called the slurp gun, will be used to obtain samples of small marine animals, including copepods, amphipods, nematodes, and polychaetes, and measure the aggregate respiration rates.

Water Pumping Filtration System--This in situ sampling pump can be placed directly in the vent plume or at any other vent site to sample large quantities of water and particulate material for extended periods of time.

Laboratory High Pressure Aquarium--This consists of a flowing water system maintained at bottom pressures for monitoring various chemicals, including oxides, hydrogen sulfide, and carbon dioxide.

Microbiological Syringe Samplers--The syringe sampler array will conduct a variety of metabolic studies at the vent sites. The radioisotope carbon-14 will be used to interpret the fixation rates of carbon dioxide. The transformation of radioactive sulfur-35 will be studied as well as the incorporation of tritium (H^3) labeled adenine into stable RNA (ribonucleic acid). Both short-term (5-8 hours) and long-term (2-3 days) incubations are planned.

History of Hydrothermal Vent Exploration

Benthic (deep-ocean) spreading centers have been of intense interest to oceanographers from several U.S. and foreign institutions since the late 1960s. In the plate-tectonics theory that has become the organizing principle of geology, the spreading centers play a vital role. At such centers, molten rock wells up from the mantle of the earth, filling cracks and generating new sections of oceanic crust, which move outward from the fracture zones. This provides passageways for the near-freezing seawater to circulate deep in the earth's crust, where it is heated and then percolated up through the crust, leaching minerals and gases as it circulates back to the ocean. The chemicals in the hot water vents support an unusual type of marine life, apparently independent of photosynthesis. Chemosynthesis, the use of energy from chemical reactions, fuels the vent communities. Large populations of bacteria thrive on the hydrogen sulfide-rich water, and in turn, serve as a food source for the other vent animals.

This chronology of vent exploration highlights work at 21°N EPR and contains important discoveries made at other vent sites. Primary funding for this research has been from the National Science Foundation, with other funding from the Office of Naval Research, the U.S. Geological Survey, the National Geographic Society, other public and private agencies, and the governments of several nations.

Prior 1975--In 1968, Scripps's expedition Tiptow initiated fine-scale studies of geological processes off the southern tip of Baja California at a section of the crest of the East Pacific Rise at about 20° north utilizing Deep Tow, a deeply towed instrument system developed by Scripps and outfitted with sophisticated electronic equipment. Scripps's South Tow Expedition in 1972 used Deep Tow for studies of the width and dynamics of the Galápagos Spreading Center near the equator about 400 miles (640 kilometers) west of Ecuador. During the cruise, scientists observed more than 80 dead or dying fish floating on the surface indicating a deep-ocean fish "kill" believed to be caused by small earthquakes associated with hydrothermal activity. In 1974, Scripps's expedition Cocotow continued geological investigations with Deep Tow at both locations.

1976--Scripps's Pleiades Expedition again surveyed the Galápagos Spreading Center with Deep Tow, which had been outfitted to collect water samples for measurements of water chemistry, temperature, pressure, and light transmission. Ten areas of warm water were located and samples of hot water "spikes" were collected for analyzation of primordial gases, primarily helium isotopes. Presence of these natural tracers provided evidence that the hot springs were heated by molten rock from within the earth. It was determined that an upwelling of magma from the earth's interior was taking place as the slow spreading of the center caused rifts in the ocean floor. Photographs of giant clams on the sea floor, associated with possible hydrothermal activity, were taken by Deep Tow.

1977--The multi-institutional F DRAKE Expedition utilized Deep Tow to do further geological mapping at the EPR site in preparation for submersible operations and to collect water samples from the area.

Oregon State University's Galápagos Hydrothermal Expedition conducted surveys of the Galápagos site utilizing the submersible Alvin of Woods Hole Oceanographic Institution (WHOI). At sunless depths of about 9,000 feet (2,800 meters), scientists located five benthic communities near the hot water vents or plumes. Clusters of unusual, colorful marine organisms were found to be thriving in the 52° F (11° C) water, while few existed in the surrounding 36° F (2° C) water. Mounds of multicolored mineral deposits abounded, with manganese, nickel, and copper.

1978--CNEXO's (Centre National pour l'Exploitation des Oceans) CYAMEX Expedition, utilizing the French submersible Cyana at depths of about 8,200 feet (2,500 meters), located dead communities of marine life and mounds of leached minerals, along with unusual volcanic formations called "black smokers," at the 21°N EPR site.

1979--Jan.-Feb. WHOI's Galápagos Hydrothermal Expedition marked the first time biologists surveyed the area. Several additional living communities were located with the Alvin. Studies of the metabolism of the benthic life were conducted and samples were collected.

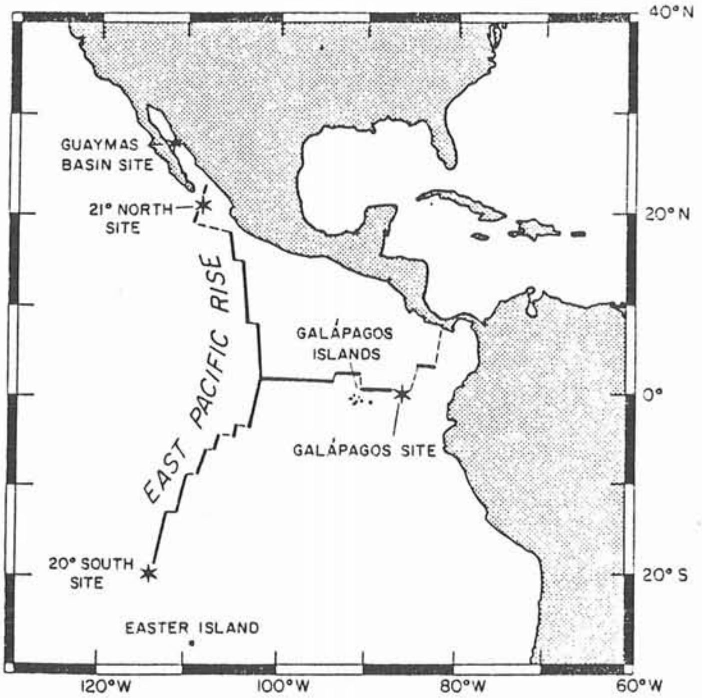
April. Scripps's Indomed Expedition, utilizing the Alvin, located living vent communities at the 21°N EPR site for the first time. Benthic animal life, similar to species discovered at Galápagos, were observed at some two dozen vents. Compounds of copper, iron, zinc, cobalt, and cadmium were found. Vent temperatures in excess of 660° F (350° C) were measured.

Nov.-Dec. Alvin dives are again conducted at the Galápagos site for biological experiments and sampling.

1980--March. CNEXO's Sea Rise Expedition from Mazatlan to Tahiti aboard R/V Jean Charcot conducted box surveys, water sampling, photography, and mapping in the eastern Pacific near the 21°N EPR site.

August. A Scripps geological expedition, utilizing Deep Tow, found vent communities in the mile-deep Guaymas Basin in the Gulf of California, Baja California, Mexico. This was the first such discovery in a semi-enclosed gulf basin. The basin is an extension of the EPR.

SITES OF HYDROTHERMAL VENT COMMUNITIES



Scripps Institution of Oceanography
University of California, San Diego

1981--April. A vent community was located at a site a few hundred miles from Easter Island in an area 20° south of the equator on the EPR during a Scripps geological/geochemical expedition. Some marine animals not found at previous sites were photographed, including gray tube worms, starfish, gastropods, and an unknown growth on lava pillows.

Sept. U.S. Geological Survey scientists collected ocean-floor and water samples at a hydrothermal vent site some 270 miles west of Newport, Oregon. This is the first such find in U.S. coastal waters.

Nov.-Dec. During Scripps's Pluto Expedition geologists and geochemists will utilize Alvin to conduct sampling operations and make photographic surveys with the Woods Hole ANGUS camera sled at the 21°N EPR site and in the Guaymas Basin.

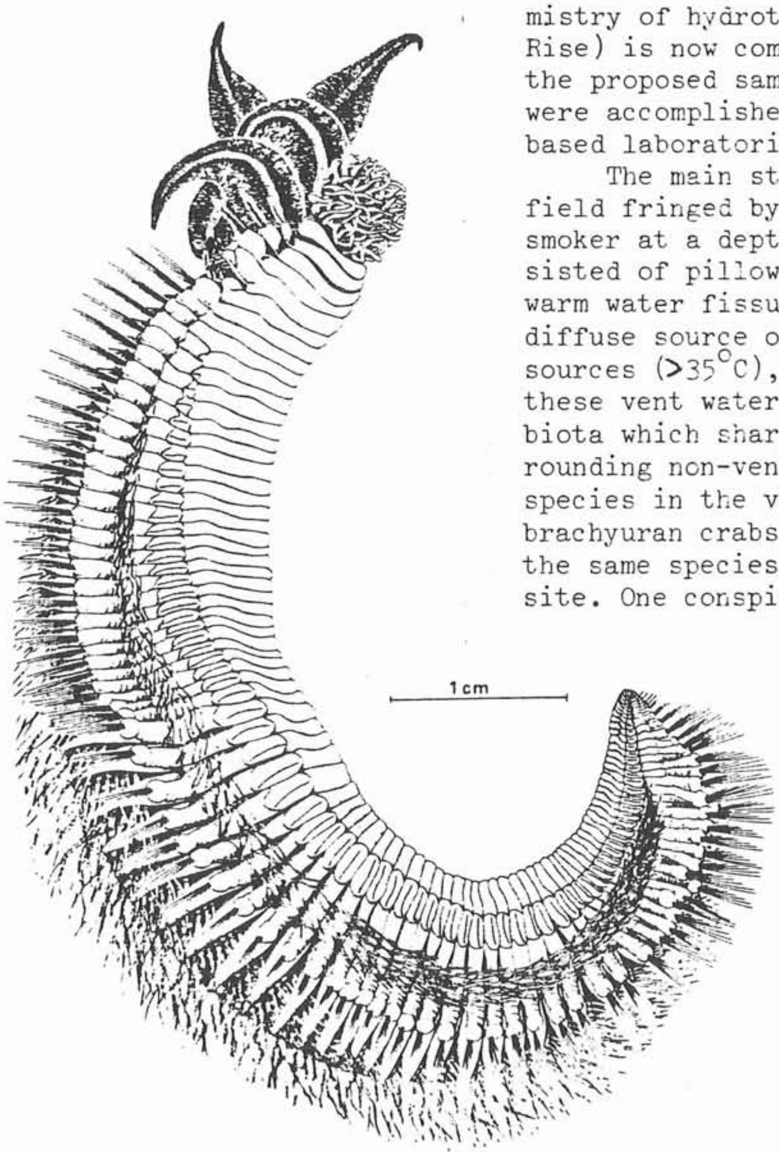
Recent Hydrothermal Vent Investigations

Oasis Expedition (Legs 1 and 2) (11 April - 19 May 1982)

The Oasis expedition to study the biology and chemistry of hydrothermal vents at 21°N (East Pacific Rise) is now completed with 19 Alvin dives. Most of the proposed sampling, measurements and experiments were accomplished with much work remaining at shore based laboratories.

The main study area was a pillow basalt clam field fringed by a large white smoker and black smoker at a depth of 2615 m. The clam field area consisted of pillow basalt profusely interlaced with warm water fissures (5°-25°C). In contrast to this diffuse source of vent water were hot water point sources (>35°C), white and black smokers. All of these vent water sources had a distinct associated biota which sharply contrasted with life of the surrounding non-vent areas. The visually dominant faunal species in the vent area were clams, vestimentiferans, brachyuran crabs, and galatheid crabs, many being the same species as identified at the Galapagos Rift site. One conspicuous species absent at 21°N site but present in Galapagos was the mytilid mussel.

The clam, Calyptogena magnifica, was limited in distribution to the warm water fissures in the pillow basalt area. Galatheid crabs were a prominent species in this area where the pillows were patchily encrusted with serpulid polychaetes and small gastropods. White smokers were generally inhabited by the vestimetiferan tubeworm, Riftia pachyptila and several species of alvinellid polychaetes. Brachyuran crabs were prevalent on the white smokers to the suspected exclusion of galatheid crabs. The



An ampharetid polychaete, the pompeii worm Alvinella pompejana from four hydrothermal vent sites in the East Pacific.

21°N vent fish occurred in all the vent areas, seeking protected crevices and overhangs in the irregular hard substrate. Both brachyuran and galatheid crabs and the vent fish are carnivores feeding on vestimentiferans and gastropods. Talus slope sediments at the base of black smokers contained polychaetes and small bivalves. Holothurians were observed on the chimneys of the black smokers.

Smaller, less conspicuous animals associated with clam field fissures and white smokers exhibit an apparent low diversity. A single species of polychaete and amphipod were ubiquitous in both areas.

More than 300 vestimentiferans, nearly 200 clams and numerous alvinellid worms were collected, together with a large variety of microorganisms and smaller numbers of the white 21°N vent fish and the invertebrates observed.

The macroplankton in the water column immediately above the vent fields consisted of copepods, eggs and zoeal stages of the galatheid and brachyuran crabs. There was conspicuous absence of molluscan eggs and larvae in the plankton, supporting the hypothesis of benthic, lecithotrophic development in _Calyptogena magnifica_.

Calyptogena magnifica is immersed in warm water which has a temperature range of 10°C and confirms temperature ranges inferred from previous oxygen isotope studies of shells from the same area. There are differential dissolution rates of aragonite and calcite in the shell of this clam as expected with the vent depth being below the aragonite and above the calcite compensation depth. Measureable growth rates of the _Calyptogena_ shell were obtained _in situ_ over a period of 3.5 weeks.

Morphological studies revealed the clam not to be a typical filter feeder. These animals lack a branchial food grove, have no mucous net formation and have a diminutive digestive tract with few contents. The importance of symbotic bacterial associations as a food source in these animals is suggested.

The vestimentiferan tubeworm, _Riftia pachyptila_ are smaller, less linear and with fewer juvenile and young adults at the 21°N site than at the Galapagos site although they are conspecific. _Riftia_ also tended to clump together by sex at 21°N.

Galatheid and brachyuran crabs at 21°N when compared exhibited several unique differences. There were no gravid brachyurans suggesting either seasonal reproduction or inhibition due to parasitism or disease. This is in contrast to the galatheid crab populations in which many females were in gravid state exhibiting apparent synchrony in embryonic development. Larval stages of galatheids were prevalent in vent plankton samples while only one brachyuran zoea was collected.

Calyptogena and _Riftia_ exhibited significant uptake rates of amino acids, hydrogen sulfide and methane in animals maintained in laboratory pressure aquaria. Freshly excised trophosome tissue from _Riftia_ consumes methane, hydrogen sulfide and oxygen and evolves carbon dioxide. High molecular weight blood protein(s) in both _Calyptogena_ and _Riftia_ are capable of binding with hydrogen sulfide to prevent poisioning of aerobic metabolic processes in these animals.

Enumeration, classification and turnover rate measurements of microorganisms were conducted in vent waters evolved from warm water fissures and hot water white and black smokers. Attempts were made to isolate sulfur and methane oxidizing bacteria from both decompressed and undecompressed water samples. _In situ_ incubation experiments were conducted to determine metabolic oxidation of sulfide and carbon dioxide incorporation and adenine incorporation rates as a measure of microbial growth. Activity rate measurements of thermophilic bacteria were examined in hot water and rocks from black smokers. Specific rate measurements were made of N_2 fixation, denitrification, nitrification and methane oxidation.

Enrichment studies and activity rate measurements were conducted on proposed symbiotic bacteria associated with the dominant megafauna such as _Riftia_, _Calyptogena_ and alvinellid polychaetes.

The final results of this expedition must await many months of analyses in shore based laboratories. This report represents only preliminary observations and measurements made during the expedition.

Kenneth L. Smith, Project Coordinator

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THE DEADLINE FOR THE NEXT ISSUE OF D.-S.N. IS 1 FEBRUARY 1983

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