DEEP-SEA NEWSLETTER

No. 12, October 1986

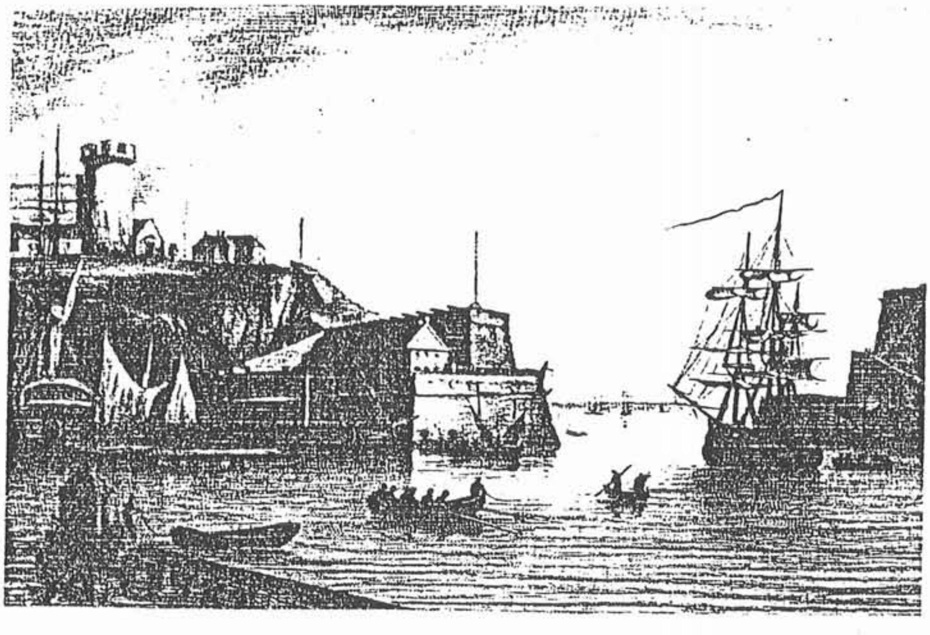
Fifth Deep-Sea Biology Symposium:

BIOLOGY AND ECOLOGY OF THE DEEP SEA: ABYSSAL, BATHYAL, HYDROTHERMAL AND COLD SEEP

Following informal talks during the symposium in Hamburg last year we are happy to extend now an invitation to hold the next symposium in June 1988 at the Centre de Brest, in Brittany, France.

The symposium will start on 26 June (Sunday evening) and last until 1 July (Friday evening). The program will consist of oral and poster presentations on recent progress in the study of deep-sea organisms and ecosystems. Papers emphasizing dynamic and multidisciplinary approaches are particularly encouraged. It is our intention to publish presented papers in a special volume of Oceanologica Acta. Papers will be subject to normal reviews by referees. Those wishing to attend the symposium are requested to fill in and forward the preliminary form on p. 2.

Myriam Sibuet



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Symposium on Deep-Sea Biology

First Announcement

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before 1 February, 1987

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   Institution:
   Address:

7. Suggestions:

Photograph of participants in the Hamburg Symposium

Almost all those attending the Hamburg Symposium participated in the happy excursion to Lübeck, and a photo appeared in Deep-Sea Newsletter No.11. Unfortunately the photo did not show all those going to Lübeck.

Following my request for information on unrecognized persons in the photo, Dr. Shirayama has sent me this additional photo, showing four colleagues who were enjoying walking along the lake side while Lisa Levin took her photo of the major group. The four persons in this photo are: Yoshihisa Shirayama, David D. Swinbanks, Laurence Guidi and Kim Juniper.

No. 10 in the large photo in D.-S.N. 11 has been identified as a (somewhat squeezed) Michael Rex and No. 5 as ? G. Davies.

T.W.

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New research project on the 'seep communities' at the slope foot of the Hatsushima Island, Sagami Bay, central Japan

Following the discoveries of the supposed 'seep communities' off Oregon-Washington in 1984 and at the foot of the Florida Escarpment in 1984, the Franco-Japanese Project 'KAIKO' 1984-1985 realized that the phenomena are universal in the subduction zones on our globe even to a depth of about 6000m (Le Pichon *et al.*, 1986; Ohta and Laubier, 1986; Laubier, Ohta and Sibuet, 1986). Now, the findings impose on marine ecologists and geochemists of the world to solve what and how the materials either squeezed from the underlying sediment or welled out from hydrothermal vents maintain so unexpectedly abundant lives in the deep-sea, and to assess to what extent the phenomena contribute to our planetary ecosystem on a global scale and in evolutionary or geological time scale.

The Hatsushima site where immense living and dead shells of *Calyptogena soyoae* cover the sea bed was found on June 5, 1984 by the Japanese deep-sea submersible 'Shinkai 2000' during a survey on deep-sea fish resources (*see* Okutani and Egawa, 1985; Horikoshi and Ishii, 1985). The site situates at the slope foot of around 1100m deep, only 1km from the east coast of the Izu Peninsula, central Japan (Fig. 1).

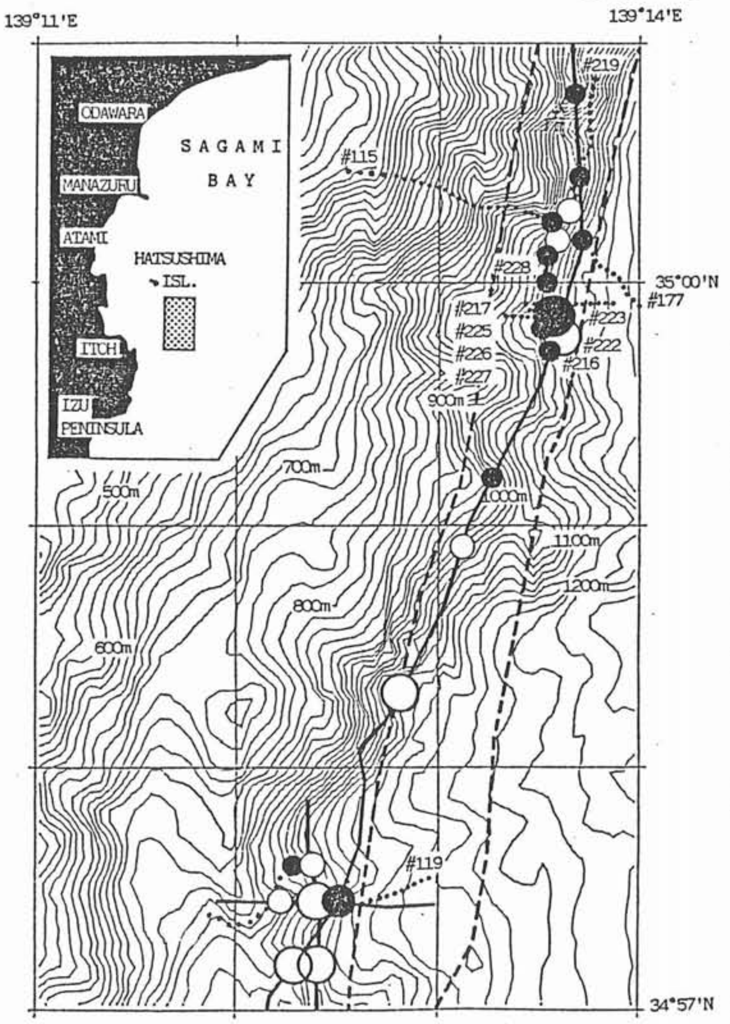

Fig. 1. Survey area and the distribution of the giant clam, *Calyptogena soyoae.*

——— : color TV survey lines
- - - - : sonar system survey lines
• • • • • • : 'Shinkai 2000' track lines
● : living colonies of the giant clam
○ : thanatocoenoses of the giant clam

Funded by a grant-in-aid from the Ministry of Education, Science and Culture, Japan, and blessed with the priority operations of 'Shinkai 2000' belonging to Japan Science and Technology Agency (to which we are greatly indebted to Dr. H. Hotta of JAMSTECH), the senior reporter (S.O.) began to organize a multi-disciplinary research party on further and lasting investigation of the 'seep communities' on the accretionary prism areas in the subduction zone.

The main purpose of this year's project was to gain the evidence of seepage at the site, and to clarify the microorganisms and chemical substances involved in chemosynthetic cycles. Main themes of investigation with use of surface vessel and nine dives of 'Shinkai 2000' were as follows; 1) precise mapping of the locality, 2) search for direct evidence of seeping by observations through the portholes of the submersible and by physico-chemical measurements of the environment, 3) chemical (inorganic and organic) analysis of water, sediments, pore water and organisms, 4) isolation and culture of various microorganisms, and 5) morphological and physiological studies of dominant and associated organisms. Personally, the main concern of the reporters was to collect the vestimentiferan worms, which were already recognized in the videotape record of the first discovery of the site.

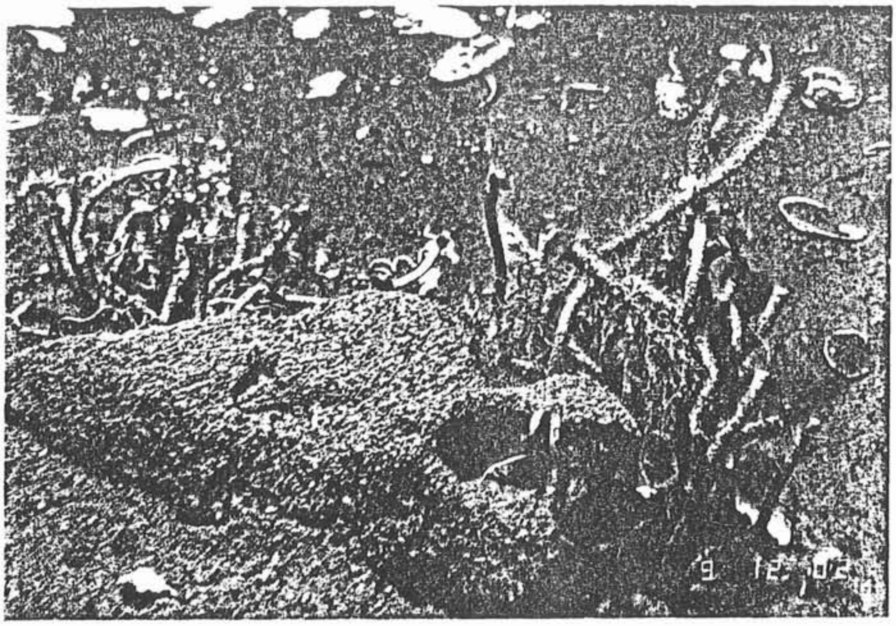

Fig. 2.
Vestimentiferan tube-worm (*Lamellibrachia* sp.) at a depth of ca. 1100m, the Hatsushima site in Sagami Bay, central Japan. It is a new record of occurrence of this genus in the Western Pacific.
(photo. J. Hashimoto)

A good start was made in this April, taking aim at the Hatsushima site. We can access the site by only a half day cruise from the Tokyo Port area, and the depth of occurrence can be easily surveyed by the Japanese deep-sea submersible. Pre-survey was carried out using 'JAMSTEC Deep Tow System', consisting of a 70kHz side scanning sonar, a 4.8kHz sub-bottom profiler, a real time color TV and a 35mm still camera. Two-day survey revealed that a large number of the colonies dominated by the giant clams extend, at least, over 7km from north to south along the escarpment. The sites were pinpointed on a 'Seambem (multi-narrow-beam bottom profiler)' map of the area already surveyed last year (Fig. 1).

Mesoscopically, these colonies are distributed rather concentrically at several specific localities between depths of 900m and 1200m, where some volcanic strata consisting of angular boulders barely escaped being sedimented at the skirt of steep slopes. No colony was found toward the flat basin floor of Sagami Bay blanketted with fine, thick sediments. The largest colony measured about 200m (E-W) by 30m (N-S). Living *Calyptogena* larger than about 90mm in shell length were crowded in the closest-packed structure buried in the sediment half to three-fourths of their shell length, whereas those of smaller and apparently younger forms buried themselves completely in the sediment only exposing their openings of short, red siphons. The highest density of the clams were crudely estimated to be several hundreds to a thousand per square meter and the standing crop to surpass 10kg / m^2 in wet weight including shells. Associated organisms were anomuran stone crab, *Paralomis multispina*, several species of buccinid gastropods, annelids and eel-like zoarcid (?) fish lying or creeping among the shells. Although tufts of vestimentiferan tube-worms were seen here and there within the clam colonies, they tended to occur in more dense patches at the very skirt of the escarpment where large rocks outcropped. A dozen of specimens were collected by a manipulator of the submersible during Dives 222 and 228, and found to be an undescribed species of *Lamellibrachia*, the first record of the genus in the Western Pacific (Fig. 2).

Temperature within the bed of colonies (30cm below the surface) showed consistently positive anomalies of 0.4 to 0.5°C compared to the ambient bottom water (2.9°). The sediments around the colonies consisted of fine olive-gray silt a few centimeters thick, underlain by black sandy silt. Ocassionally the black sublayer exposed to the surface where shell density was high. The black sandy silt primarily consisted of feldspars with minor quartz, pyroxenes and olivines, whereas in the surface fine mud, quartz predominated over feldspars, clays, and other minerals as far as X-ray diffraction pattern indicated. Sediment sample of the black sandy silt evolved H_2S of 200 ppmS when attacked with 3*N*HCl and the residue yielded 1200 to 1400 ppmS when it was decomposed by HNO_3 and HBr.

Seawater sampled at a few centimeters above a colony had no H_2S (below detection level), but contained extremely high CH_4 (over 10000 ucc / kg). No measurable anomaly was found in heavy metal content.

Gills of *Calyptogena* contained large amount of sulfur (over 3% in wet weight), one order of magnitude higher than the other tissues. Electronmicroscopy revealed many inclusion bodies within the gill cells, and many vacuoles within, if correct, the prokaryotic cells. At the margin of colonies we could recognize whitish deposits of presumable authigenic precipitation and/or bacterial mats. Hydrogen sulfide oxidizing, hydrogen oxidizing and methylotrophic bacteria were demonstrated in the

sediment and pore water, though their proportion and roles in the ecosystem remains to be solved.
The results so far obtained can't be consolidated in a simple scheme, or sometimes they seem to conflict with each other. Further studies, however, are in progress in order to clarify the origin(s) and biogeochemical role(s) of sulfur and methane, and their relation to geological settings of the study area.

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Ecology of Japan Cold Seep Benthic Communities Analysed from Photo and Video Records: Problems and Surprises

Colonies of giant clams were discovered during a Franco-Japanese submersible study of the geology of the subduction zones near Japan (see contribution by S. Ohta, above). The clams and an accompanying fauna are located at sediment pore water seeps at depths down to 6000 m. Methane-rich fluids discharging from these seeps apparently act as the energy source for clam/bacteria symbiosis. Description and taxonomic studies of these communities by French and Japanese biologists have led us to an ecological follow-up investigation. A cartographic and microcartographic approach, based mainly on video and photo documents, is being used to analyse distribution, spatial organisation and trophic structure of the visible cold seep fauna. Restricted by a paucity of environmental data (particularly geochemical) we are using microdistribution and the limited knowledge of the fauna to locate and suggest the nature of food sources at cold seep sites. This 'reverse' approach to trophic ecology is proving successful where feeding behaviour is known or can be presumed. One of the unknown and surprising members of the fauna accompanying the clams are abundant, 5 cm long, crustaceans which appear to be caprellid amphipods (not sampled). In coastal waters these animals are common, living as omnivorous browsers. Less than 20 species have been recorded at bathyal and abyssal depths (J.C.McCain, Galathea Rep. 8, 1966). We request that anyone having sampled, seen or even heard of caprellids in the deep sea, please write to us. Glossy colour photos of a Calyptogena colony near 6000 m depth are offered as a reward to all contributors!

Kim Juniper and Myriam Sibuet
IFREMER - Centre de Brest

Is Akebiconcha synonymous with Calyptogena?

As characteristic members of the benthic communities of hot vents and cold seepages, vesicomyid deep-sea bivalves of the "Calyptogena group" continue to hold the attention of deep-sea biologists. An excellent study of the giant white clam from the Galapagos Rift was made by Boas & Turner (1980). In one of the appendices to the paper, Boss (1980) threw doubt upon Akebiconcha kawamurai and Calyptogena soyoae being distinct forms. Recently, I was able to make a close examination of the shells of these two forms, especially of the hinge structure, including both the dental elements and the ligament. As a result of these studies, I believe I have arrived at a definite conclusion to this problem.

Akebiconcha kawamurai Kuroda (1943) was the first recent species of the "Calyptogena group" reported from Japanese waters. Fourteen years later a second species, Calyptogena soyoae Okutani, 1957, was described, as I wrote in a brief historical sketch of its discovery and refinding in Deep-Sea Newsletter No.11. Three or four more species, collected in the last year by the French submersible "Nautile" during the Franco-Japanese joint project "KAIKO", are ready to be described as new to science, and one or two of them are more or less closely related to Akebiconcha.

The bivalves of the "Calyptogena group", together with those of the "Vesicomya group", inhabit deep seas and as pointed out by Boss (1968), have usually been collected by research vessels. In this sence Akebiconcha kawamurai is exceptional, as it has been collected by commercial fishing lines and nets. For instance, the type specimen was reported to be collected by a longline for demersal fish from a depth of about 100 fms in the northwestern corner of Sagami Bay (off Odawara). Thereafter, several specimens were collected by commercial trawlers from deep waters off Chôshi (Chiba Prefecture, just east of Tokyo at 35°40'N). Two more recently collected specimens, illustrated by natural-sized photographs by Ozaki (1958), came from this locality, and also two specimens in my collection are labelled as "E.S. E. off Choshi, 250 m, muddy bottom". The place name "Kashima-nada", cited by Habe 1964 and Boss 1980, is the sea just north of Choshi, and is thought to indicate the same locality.

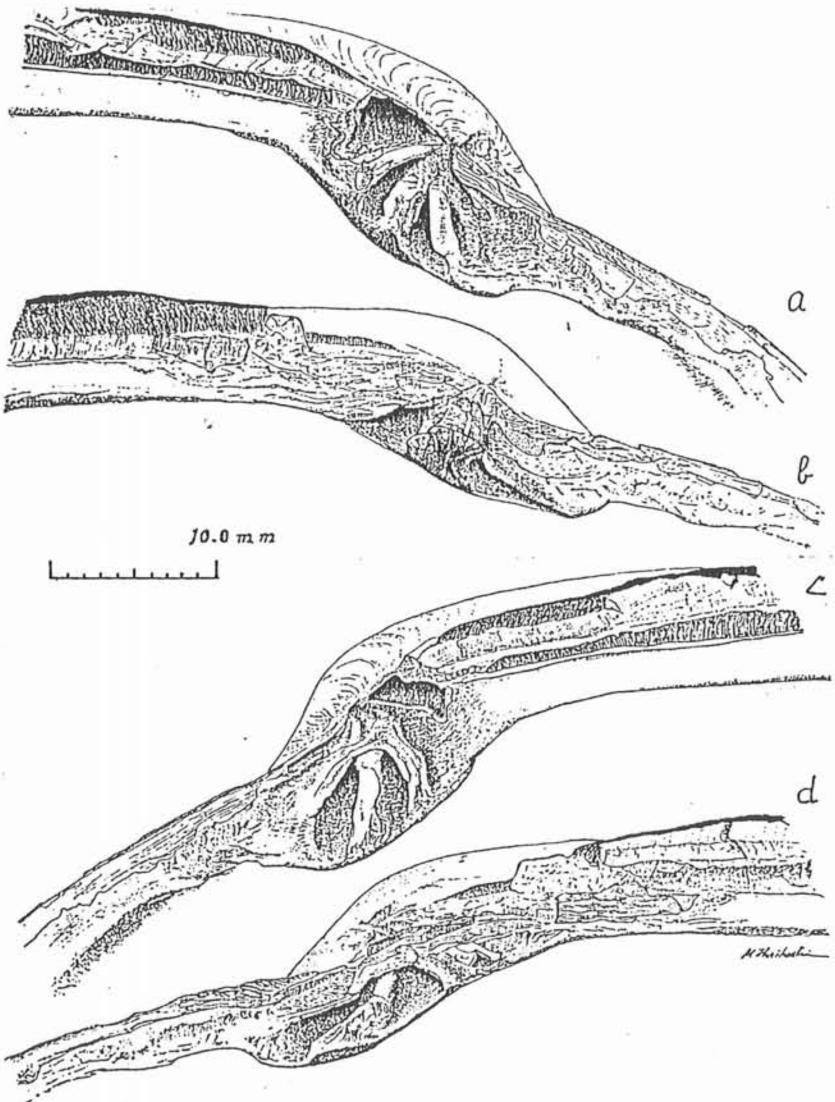

Fig. 1. Hinge structure of Akebiconcha kawamurai (a, c) and Calyptogena soyoae (b, d). a, c: left valve; b, c: right valve. Note the occurrence of the "subumbonal pit" behind the third dental element in A. kawamurai (a, c). The specimen of C. soyoae (b, c) was collected in 1984 by Dr. T. Ishii from the submersible "Shinkai 2000" of JAMSTEC.

Through activities of the Japanese submersible "Shinkai 2000" of JAMSTEC (Japan Marine Science and Technology Center), it has been possible to obtain several live specimens of Calyptogena soyoae, and to make a detailed comparison of these two forms. As pointed out by Boss 1968 and Boss & Turner 1980, the morphology of the hinge teeth is very variable even within a species, as also observed by me. However, the morphological change of dental elements during the course of growth from very young to gerontic stages is also great, and if this is borne in mind it is not difficult to work out the general pattern of the hinge structure for a given form.

In the left valve of Akebiconcha kawamurai (Fig. 1a), two dental elements of the subombonal cardinal teeth, i.e., the anterior ramus (or anterior dorsal cardinal tooth: 2a in Bernard's notation) and the posterior ramus (or posterior ventral cardinal tooth: 2b), are rather similar to each other both in size and shape throughout the growth stages, and are united only in their proximal parts even in gerontic stages. The posterior subumbonal tooth (4b) is toothlike rather than keel- or ridgelike, and radiates from the beak less obliquely than in C. soyoae. In the right valve of A. kawamurai (Fig. 1c), the subumbonal cardinal teeth have an inverted V-shape, i. e., the distal parts of the anterior and posterior rami (3a & 3b) are separated less than in C. soyoae.

In the left valve of Calyptogena soyoae, the anterior ramus (2b) of the subumbonal cardinal teeth becomes more platelike, and the posterior one (2b) becomes more squarish or pillowlike in the gerontic stage (Fig. 1b). The distal part of the suture of the two rami becomes longer in the gerontic stage, and consequently the central socket between them appears shallow when seen from above. The depth of the socket covered by the anterior ramus, however, remains deep, so that the socket can receive the well developed, ventral tooth of the right valve. The posterior subumbonal tooth (4b) radiates more obliquely from the beak, and is thinner and more keel- or ridgelike than in A. kurodai. In the right valve, the anterior and posterior rami of the subumbonal teeth are widely separated distally, so that the shape is rather like a circonflex ("∧"). The hinge plate is narrower dorsoventrally, and the ventral tooth tends to lie more obliquely than in A. kawamurai.

The most prominent difference between these two forms is that Akebiconcha kawamurai has a deeply excavated pit behind the posteromost, or third dental element, i.e., the posterior subumbonal tooth (4b) in the left valve and the posterior ramus of the subumbonal cardinal teeth (3b). The pit is a hinge structure of secondary nature, being excavated subsequently by mantle tissue. This is clearly shown by two facts: (1) cross-sections of growth layers of the shell are discernible on its side wall, and (2) the pit becomes larger and larger throughout the growth stages (Fig. 2).

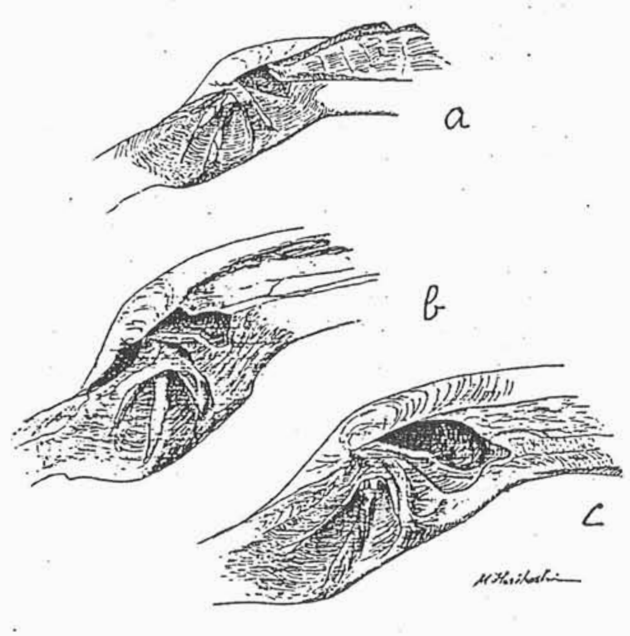

Fig. 2. Changes in size and shape of the "subumbonal pit" throughout growth stages in Akebiconcha kawamurai. a, 76 mm in shell length; b, 118.5 mm; c, 133.5 mm.

A pit of similar nature can be found in other bivalves, not only in genera of the same family, Vesicomyidae (e.g., Archivesica gigas Dall, "Vesicomya" winckworthi Prashad), but also other groups of bivalves, such as Arctica islandica (Arcticidae), and Saxidomus, Cyclina, etc. (Veneridae). Nobody has hitherto paid attention to this interesting hinge structure. I would like to call it a "subumbonal pit". Actually, Dr. T. Kuroda, an eminent and careful worker on mollusks, mentioned it in his original description of Akebiconcha kawamurai, but it was described only in his Japanese text, not in his English summary, so that it has remained unnoticed by most other workers. It says that "area behind the third tooth is broadened, and its upper portion is excavated secondarily (?) [sic]. This might be a remnant cavity of resilium which might have been dissolved away." His last sentence is incorrect, because the "subumbonal pits" are occupied by a pouch- or earlike projection on the mantle of the living animal.

The ligament of Calyptogena used to be described as massive, external, opisthodetic and parivincular (Boss & Turner 1980). However, one more characteristic feature of the ligament of this group is the occurrence of a kind of cardinal ligament (for cardinal ligament of Tellina, see Trueman 1949).

Akebiconcha kawamurai and Calyptogena soyoae differ also in the extent of development and morphological structure of the cardinal ligament. In A. kawamurai it is mainly restricted to the subumbonal region, and covers the "subumbonal pits" in between the beaks of both valves. In Calyptogena soyoae, however, it develops very extensively along the hinge line as far back as half of the length of the nymph. It also spreads downward broadly on the hinge teeth covering the dorsal half of the dental elements. The umbonal parts of both valves are firmly connected by the cardinal ligament. In the gerontic stage (Fig. 3), the umbonal parts of both valves stand far apart, with a rooflike stretch of the cardinal ligament in between. In such a case the line of attachment of the cardinal ligament becomes lower in position so far down that the apical parts of the dental elements are exposed and can be seen from the outside. This seems to be unusual among bivalves, and is rather characteristic in Calyptogena soyoae.

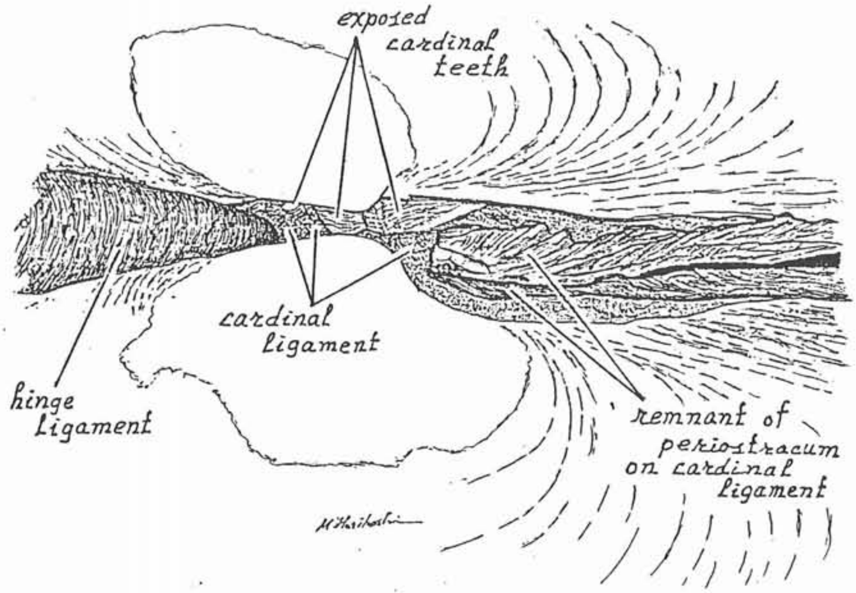

Fig. 3. Umbonal region in a gerontic specimen of Calyptogena soyoae. The specimen was collected in 1986 by Prof. H. Sakai from "Shinkai 2000" of JAMSTEC.

A more detailed description and discussion will be given in a paper which has already been submitted to the Venus, the Japanese Journal of Malacology (vol. 45, No.4).

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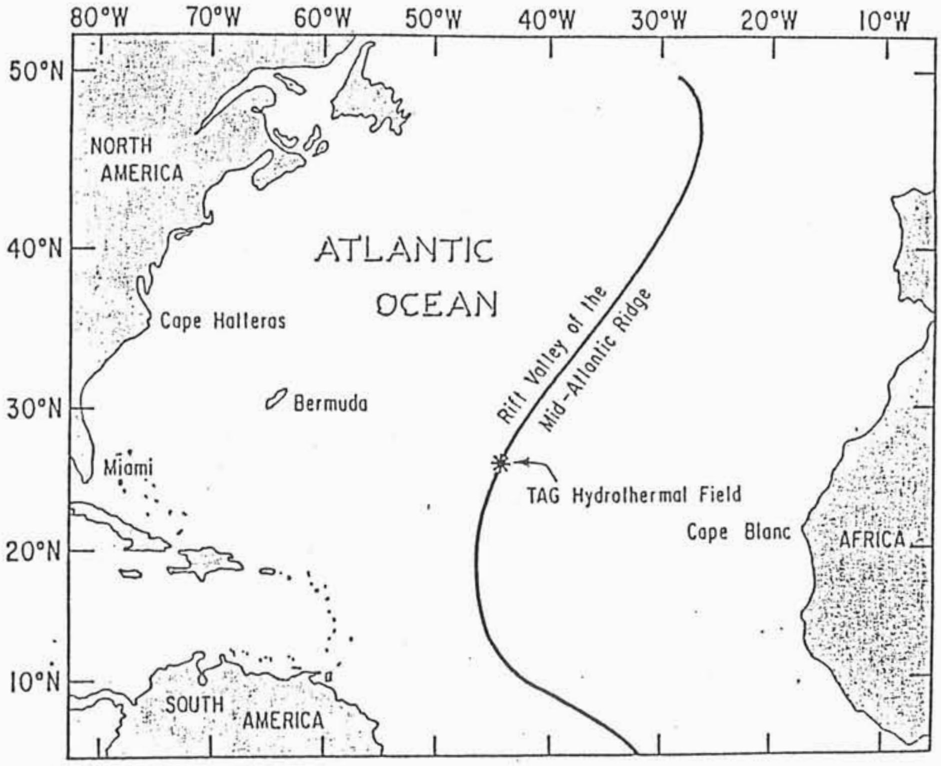
Black Smokers on the Atlantic Seafloor: Preliminary Dive Report

The first direct observations of black smoker type geysers in the Atlantic Ocean were successfully made by a team of NOAA (National Oceanic and Atmospheric Administration), WHOI (Woods Hole Oceanographic Institution), and MIT (Massachusetts Institute of Technology) scientists with the submersible ALVIN as part of a dive series on a cruise of the research vessel ATLANTIS II between May 16 and June 18, 1986. The scientific team that made these dives comprised Chief Scientist Peter Rona (NOAA); Geoffrey Thompson and Susan Humphris (WHOI); and John Edmond, Gary Klinkhammer, Andrew Campbell, and Marin Palmer (MIT). The work was supported by NOAA and the National Science Foundation (NSF).

Black smokers were previously known only in the Pacific Ocean. The black smokers observed by the scientists from the submersible are the first to be found outside the Pacific Ocean. They were discovered by a NOAA research cruise in 1985 at a site known as the TAG (Trans-Atlantic Geotraverse) Hydrothermal Field at a water depth of 3650 m in the rift valley of the Mid-Atlantic Ridge, near latitude 26°08'N, longitude 44°49'W (Rona et al. 1986). The seafloor is spreading to both sides of the Mid-Atlantic Ridge at slower rates (about 2.5 cm per year) than at the submerged volcanic mountain ranges where black smokers were initially found in the Pacific Ocean (up to 25 cm per year).



Specific results of the dives are summarized, as follows:

(1) The first dive by Peter Rona (NOAA) and John Edmond (MIT) landed directly on target. The target is a mound 250 m in diameter and 50 m high at a water depth of 3650 m in the rift valley of the Mid-Atlantic Ridge.

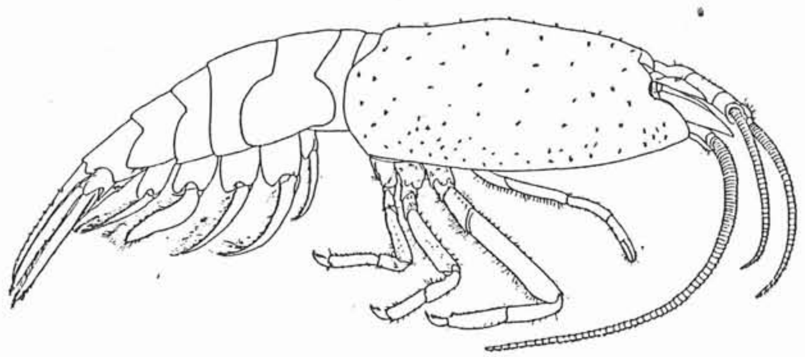
(2) Direct observations and sampling revealed that the rocks exposed on the mound are primarily polymetallic massive sulfides. The size and shape of the deposit (estimated 4.5 million metric tons), which is still growing, are similar to many economically important mineral deposits presently on land that may have originally formed in the geologic past under similar conditions on the seafloor.

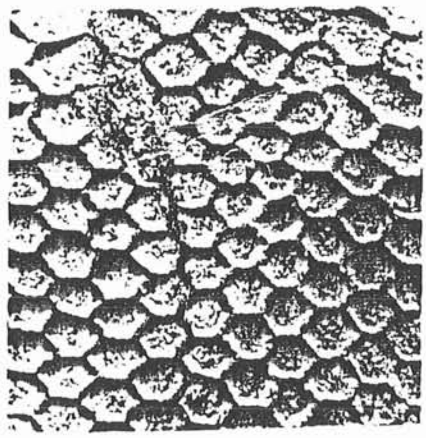
(3) A sequence of hot springs was encountered from shimmering water, to geysers discharging white smoke, to black smokers with increasing fluid temperatures from the edge to the center of the mound. A smoker venting blue-white smoke was observed for the first time. A group of black smokers situated at the center of the mound vented such a large, dense black cloud of metal particles that visibility was partially obscured, consequently limiting access by the submersible.

(4) Hot water samples were recovered and temperature measurements were made (up to 320°C) to determine the effect of the venting on the composition and temperature of the ocean.

(5) Swarms of thousands of shrimp representing a new genus were observed and sampled around the black smoker geysers (Williams & Rona 1986). A form about 5 cm in diameter composed of rows of dark dots that intersect in a hexagonal shape was recovered from the seafloor sediment about 2 km away from the mound. This form was observed on previous remotely made photographs of the deep seafloor at this site (Rona & Merrill 1978). It is hypothesized to be a living representative of a form designated Paleodictyon nodosum known only as a trace fossil preserved in sedimentary rocks that were deposited on the seafloor between 70 (Seilacher 1977) and 420 x 10^6 million years ago (Crimes & Crossley 1980).

(6) The observations made on the dives demonstrate that black smokers at this site on the Mid-Atlantic Ridge are venting at least as intensely as their counterparts in the Pacific Ocean. Such black smokers will probably be found at other sites on slow-spreading oceanic ridges in the Atlantic Ocean and western Indian Ocean, extending their distribution through ocean basins around the world. This extension of the distribution of black smoker type venting implies that such venting processes may play an even larger role than previously estimated in cooling the earth, influencing ocean composition, concentrating mineral deposits, and supporting specially adapted living organisms. Members of the scientific team that made the dives are preparing the results of their observations for presentation at the Fall Annual Meeting of the American Geophysical Union to be held in December 1986 in San Francisco.





Above: The Bresiliid shrimp Rimicaris exoculata, the predominant macro-invertebrate in heated water adjacent to the black smoker vents at TAG. (After Williams & Rona 1986). - Right: Paleodictyon regulare, Lower Tertiary (Flysch), Italy.

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News from Center of Brest (France):

Deep-Sea Ecology Investigations in the North East Atlantic

Our deep-ocean ecology programs in the North East Atlantic follow a multidisciplinary approach at permanent stations and are designed to identify and quantify deep-sea processes.

The recent "Environment Profond Impact: E.P.I." program is based on in situ and long-term observations and experiments designed to improve our knowledge of physical, sedimentological and biological mechanisms and interaction of these phenomena. This will help to answer fundamental questions on the transfer of matter in the Ocean and the fate of anthropogenic material in the deep-sea ecosystem.

The cruises E.P.I., Biocyan (Biologie Cyana) and Epaugas, undertaken since 1983 in the N.E. Atlantic, have involved deployment of free vehicles, an intensive sampling strategy and the use of manned and unmanned submersibles (Cyana and Epaulard). The terrace of Meriadzek has been chosen as a first permanent station prior to starting deeper work with the "Nautile". We also have begun similar studies in the N.E. Atlantic dumping area.

For present and future permanent stations, we have developed an integrated in situ approach to measurement, observation and experimentation. This has required the development of specific free-vehicles and specialised submersible instrumentation and tools:

1 - A long term autonomous multidisciplinary monitoring instrument: the M.A.P. (Module Autonome Pluridisciplinaire).

The M.A.P. was developed at COB in 1984. It can be left on the seabed down to 6000 m, for periods up to 12 months. It is equipped with:

- 2 current meters (at 0.50 and 100 m off bottom),
- 1 thermistor chain 100 m long (10 thermistors 10 m apart),
- a camera-flash system,
- a nephelometer which indicates the suspended matter concentration by means of optical scattering measurements.

The aim is to examine relations between these different parameters: current speed and direction, temperature profile above the bottom, particle resuspension and different events observed on photographs.

This device was first moored and recovered in 1984, on the Meriadzek Terrace (2100 m). The data are now being processed by A. Vangriesheim. Now, it is moored again in this area to get a second 6 months period of measurement. Next year, it will be placed at a greater depth in the abyssal plain.

2 - Sediment traps (prototype IFREMER and type Gardner-Rowe of Brookhaven National Laboratory).

About 12 sediment traps were moored at 200 m and 10 m above the bottom during 1984 and 1985, allowing observation of seasonal variations in the input of trophic matter at 2000 m (the data are being analysed). Comparisons of discrete data on particles collected by traps with organic carbon concentration of the superficial sediment show that nearly 90% of the organic matter input is oxidized at the water-sediment boundary, i.e., an oxygen consumption of nearly 6 ml.O_2 m^{-2} d^{-1}. This was observed on the Demerara abyssal plain at 4400 m as well as at 2000 m in the Bay of Biscay (Sibuet et al. 1984; Khripounoff et al. 1985).

3 - A long-term deep-sea colonisation module.

The free vehicle (designed by IFREMER in 1978) is used in order to follow recolonization of defaunated sediment and to study in situ degradation of different kinds of (natural and artificial) substrates. These studies are being conducted in the Bay of Biscay and in order to estimate impact in the dumping N.E. Atlantic area (joint proposal IFREMER-CEA).

The results demonstrate a variability in the colonization rate in the Bay of Biscay that can be rather slow or increased by the installation of opportunistic species following environmental events, which remained to be better observed (Desbruyères et al., in prep.).

4 - A free-vehicle closing trap has been built in 1984 at IFREMER for the program with the CEA. This two-chambered trap allows us to analyse the rate of assimila-

tion of labelled bait by amphipods after recovery. This trap was first used in the N.E. Atlantic in the dumping area. Preliminary results indicate that only about 0.50% of the organic matter contained in the gut is assimilated within 1 hour, and more than 2 weeks should be necessary for a total assimilation (S. Lafrique (thèse de 3ème cycle) and Alayse & Lafrique, in prep.).

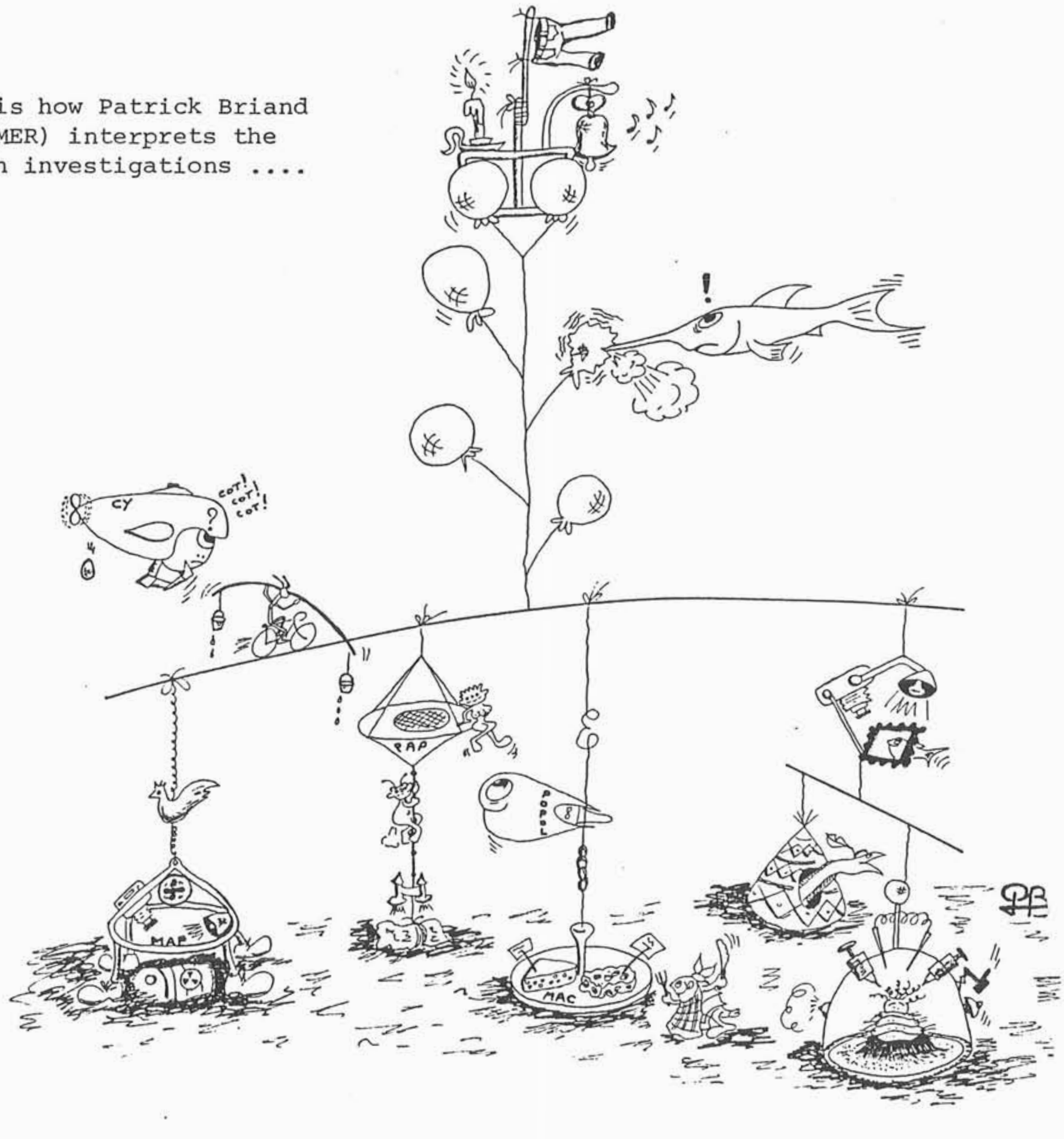
5 - In situ experimentation with Cyana begun in 1983 (cruise "Biocyan"). A corer and benthic chambers, manipulated by the arm of Cyana, allowed injection of labelled dissolved or particulate matter. In situ incubation at sediment-water interface and analyses of the biotransformation have yielded successful results showing high in situ biological activity (Sibuet et al. 1985; Cahet & Sibuet, in press).

Observation through the viewports of Cyana has revealed two notable characteristics at the interface:

1) A remarkably heterogeneous distribution of floculate and light brown material localized in burrows and around obstacles which prevent horizontal displacement of this material.
2) A highly aggregative distribution of epibenthic megafauna, particularly the holothurian Benthogone rosea and echinothurids (Sibuet, Van Praet, Dinet, in prep.).

6 - A series of continuous high quelity photographs has been obtained by the unmanned submersible Epaulard in three N.E. Atlantic areas, including the N.E. Atlantic dumping area. These surveys have allowed the first documentation of dumped containers and their surrounding environment (Sibuet et al. 1985). Further analyses of these photographs are underway and will permit a quantitative study of the distribution of epibenthic megafauna.

This is how Patrick Briand (IFREMER) interprets the French investigations ....



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Deep-Sea Questions and Demands

Has it been just from a knowledge of mythology that deep-sea realms were termed the abyssal and hadal regions? Or did this choice of words reflect a fateful insight into future developments?

Civilization has penetrated the deep sea. Trawling the abyss can be rather fascinating when the net brings up half a Japanese pottery plate, a tiny French medicine bottle, a modern beer can from somewhere, or a brick which might have been ballast o an old sailing ship. It is less exciting when every trawl collects coal and clinkers, the detritus of the relatively short steamship era. Today it may become even dangerous when pharmaceutical or radioactive wastes are recovered from fearful hadal and abyssal depths.

Have parts of the deep ocean already lived up to their names? In Greek mythology the abyssal and hadal regions were the realm of the dead, the kingdom of dreadful God Hades[1].

Can we avoid that the abyssal and hadal regions live up to their names, or can they develop into civilized regions instead?

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1. In the sincere hope that I do not jeopardize the general objective of Hjalmar Thiel's serious warning with which I fully agree I venture, for historical reasons, to explain why Anton Bruun in 1956 suggested the term hadal and hadopelagic for the environment and the fauna of the trenches with depths exceeding 6000-7000 m. If in fact hadal (derived from Hades) indicated "the kingdom of Death" this would, to put it mildly, be an improper term for a region which had been shown to be full of life. Actually, the term was proposed in the sense "the Greek underworld" which denotes the realm of those who have been buried with due rites or the place of the departed spirits. - Editor's note.

The deep sea is impacted via river and shallow sea pollution and through air-borne contamination. These effects can best be studied in coastal zones and in surface layers. Specific impacts on the deep sea derive or may derive from

Dumping of wastes: pharmaceutical drugs
chemical poisons
dredged harbour and river sediments
radioactive products

Mining activities: hydrothermal precipitates
ferro-manganese nodules and crusts.

What do we know about these impacts? We have an uncertain feeling that the effects might be destructive. Do we have good arguments to convince decision makers not to continue disturbing the deep sea? In the F.R. of Germany we have the principle of pre-care in environmental decisions: As long as it is not proven that a specific action does not influence the environment negatively it is not permitted. However, in many countries anything may be done as long as it is not proven to be deleterious.

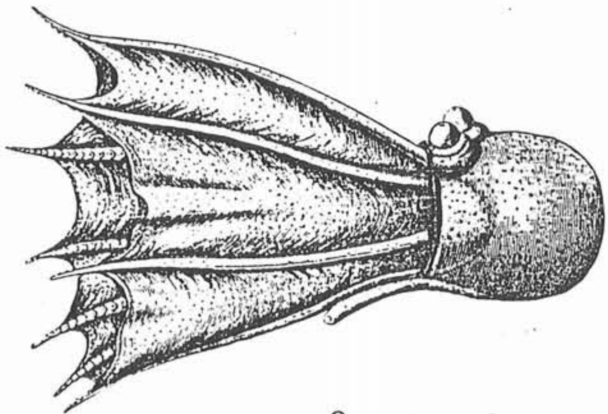
Dumping into the deep sea is a one-way action since the dumped materials cannot be retrieved. Mining the deep sea demands high developmental expenditures which would be saved in the case of deleterious impacts. Mining is a large-scale operation that will never be stopped for environmental reasons once it is started.

It was Arvid Pardo who first said that the deep sea is the common heritage of mankind, a theme which strongly influenced the new Law of the Sea. This ideal became particularly important when considering the exploitation of the deep sea. However, common heritage demands common responsibility.

Are we prepared to answer deep-sea impact questions with responsibility on the basis of sound scientific knowledge? We, at least, can claim to be abyssal specialists and we are the people who should be consulted on environmental impact problems. At best we can deny all impacting actions because of our restricted insight into deep-sea processes.

What is needed is a knowledge of processes in space and time. Deep-sea research is limited. Deep-sea research is expensive, and the resources are diminishing. The only chance to overcome this conflicting situation between research demands and activities seem to be a concentration of effort through international cooperation. This may be organized on different geographic scales, for example, oceanwide or worldwide. To make a start on a reasonably small scale I propose the establishment of a *European Deep-Sea Transect*, to focus some deep-sea research activities on specific process studies. Among other projects, these cooperative investigations could include the British Porcupine Seabight Studies, our BIOTRANS project and research on a deep-sea station partly funded by the European Communities. Who is going along with these ideas? I would be interested to receive your comments.

Hjalmar Thiel



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