New Information on the Ecology of Deep-sea vent Communities in the Azores Triple Junction Area:
Preliminary Results of the Diva 2 Cruise
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Daniel Desbruyères1, Ana-Maie Aleyse1, Elisabeth Antoine1, Georges Barbier1, Fernando Barriga2,
Manuel Biscot3, Patrick Brand4, Jean-Pierre Bruelha1, Thierry Comet1, Laurence Corne1,
Philippe Crassous1, Paul Dando1, Marie Claire Fabri1, Horst Felbeck3, François Lallier6,
Aline Fiala-Médioni1, Joao Gonçalves1, Frederic Ménard1, Jacques Kerdineff1, John Patching1,
Luis Saldanha1, and Pierre-Marie Sarradin1

1 Département «Environnement Profond», IFREMER Centre de Brest, Plouzané, France
2 Departamento de Geologia, Universidade de Lisboa, Portugal
3 Museu Municipal do Funchal, Madeira, Portugal
4 The Marine Biological Association of the UK, Citadel Hill, Plymouth, UK
5 Scripps Institution of Oceanography, UCSD, La Jolla, California, USA
6 Station Biologique de Roscoff, Université Pierre et Marie Curie, Paris VI, France
7 Laboratoire Arago, Observatoire Océanologique de Banyuls sur Mer, Université Pierre et Marie Curie, France
8 Departamento de Oceanografia e Pescas, Universidades dos Açores, PT 9900 - Horta, Faial, Açores, Portugal
9 Laboratoire de Biologie Marine, Université Pierre et Marie Curie, Paris, France
10 Microbiology Section, The Ryan Institute, University College Galway, Ireland
11 Laboratorio Maritimo da Guia, Faculdade de Ciências da Universidade de Lisboa, Portugal

Following the Lucky Strike 1993 cruise and the DIVA I geological cruise (May 1994), 26 biological dives were completed with the submersible Nautilus in these two hydrothermally active areas: 1) the Lucky Strike Site located on Mid-Atlantic Ridge (MAR) between 37°17.25’N and 37°17.65’N at 1700m water depth (Langmuir et al., 1993; Fouquet et al., in press; Van Dover et al., in prep); and 2) the Menez Gwen Site located between 37°50.45’N and 37°50.56’N at 840-870m water depth (Fouquet et al., in press).

The principal objectives of the cruise were:
1. Description of the hydrothermal vent communities, i.e. faunal composition, population structure, microdistribution and environmental conditions.
2. Microbial studies: (a) isolation of thermophilic and ultra-thermophilic bacteria and (b) structure of microbial communities associated with hydrothermal plumes.
4. Study of the transport of CO2 and O2 by blood pigments in shrimps and polynoid worms and mussel commensal.
5. Analysis of adaptation of collagen (Polynoids) and chitin (shrimps) to the vent environment.
6. Sample collection for genotypes (phylogeny and population genetics).
7. P.O.M. fluxes from vents and from the surface were measured using sediment traps.

Lucky Strike

In the Lucky Strike area, several newly discovered sites located at the periphery of the central lava lake (cf. Fouquet et al., 1994 and this issue) were surveyed. All sites were dominated by beds of undescribed mussel species distinct from all previously observed deep-sea mussels (Craddock et al., in press). At this site, nearly all individuals were infested by one to three commensal polynoid worms belonging to Branchiopolyneae seepensis. Mussels were distributed in patches of thousands of individuals, the smaller ones being located on the outer part of the beds and the largest were located in the middle (max. observed size 113 mm). Mean size of the mussels varies between patches according to their position within the site, the biggest individuals being located in the warmest areas. All the frequency distributions are plurimodal and showing 3 to 6 modes. The population structures are different from site to within an active zone and there is spatial segregation at any given site (Comet, pers. commun.). Several mussel patches were covered by thick fibrous bacterial mats. Fifteen temperature time series (from one day to two week duration) were recorded using HOBO probes (cf. Fornari, 1994) at different places within mussel beds. As previously described from other vent areas (Chevaldonna et al., 1991), temperature varies rapidly with a maximum of 18°C; and several periodicities seem to be superimposed. Shrimps were living in small swarms on smoker walls or within the mussel beds. They belong to three species, two species of Chorocaris (Van Dover et al., in prep.) and one species related to the genus Rimicaris (Lallier, pers. comm.). Bythograeid crabs belonging to the genus Segonzacia were abundant within mussel clumps and on active sulphides. Several species of limpets and coiled gastropods were found on mussels shells. An Ampharetid polychaete belonging to a new taxa of Saynithins, genetically distinct from Amphisidam sthe (Desbruyères, pers. commun.) was ob-
served dwelling in tubes on shells and sulphides. Non-vent fishes were seen penetrating into the vent areas. The most commonly observed species belongs to the genus Cassidix. A pink fish tentatively attributed to Onogadus was observed living in cracks within mussel beds. Several rat-tail fish, deep-sea sharks, and chaetognoids were observed at the periphery of the sites. Two squids belonging to Mastigoteuthis (Gonçalves, pers. comm.) were collected and video recorded around the vent area one in Lucky Strike and the other at Menez Gwen (Saldanha and Biscoito, pers. comm.). The specific diversity of the communities seems rather low as compared to EPR vent communities but of the same order as other MAR communities. Urchins (Echinus sp.; Sibuet, pers. comm.) observed at the border of several of the vents in 1993 (Van Dover et al., in prep.) were very rarely observed in 1994.

Menez Gwen

The Menez Gwen Site is situated near the top of a young volcano (Fouquet et al., this issue) and covers a 200m² area. Maximum venting temperature recorded was 28° C inside a smoker but diffuse venting (up to 25°C) occurred throughout the entire area. Sulphide mounds were covered with populations of mytilids. Mussel beds contained a mixed size range of individuals and the determination of the number of species, and whether or not they are the same mussels found at Lucky Strike, will require genetic studies. In contrast to Lucky Strike, the Menez Gwen population did not contain commensal Polynoid worms. Some clumps of mussel had numerous limpets on their shells. Bresiliid shrimps (Chorocaris sp.), serpulids, eupholoids and crabs (including a geryon red crab belonging to Chaenoceis affinis) were also present. Abundant bathyal faunas were observed at the periphery of the site including pandalid shrimps (Pleonectes sp.), fish (Engraulis acus, Lepidion sibogae, Epigonus telescopus, Synaphobranchus sp., Photostomias sp., Scorpaena sp., Malacocephalus laevis, Beryx splendens, Neocyttus helgae ...), squid (Ommastrephes pteropus?) and living and dead black coral (Anthipates sp.; Biscoito and Saldanha, pers. comm.). One of the most exciting findings was that the mussels and shrimps from the Menez Gwen Site could be kept alive and in good condition in cooled seawater at atmospheric pressure for weeks. This introduces the possibility of easily carrying out physiological experiments.

Histological studies of the endosymbionts in mussel gill tissue demonstrate that the Lucky Strike mussels contain both sulphide-oxidizing and methylothrophic bacteria (Fiala Médioni, pers. comm.) as do mytilids from Snake Pit (Cavaughan et al., 1992). Several enzymes were shown that the gills, but no other tissues of the mussels, contained methanol dehydrogenase (an enzyme found in methanol-oxidizing bacteria), adenosulphate reductase and ATP sulphurylase enzymes usually found in sulphur oxidizing bacteria. Isolated gills remove both sulphide and methane from the water at an appreciable rate (Dando, pers. comm.). Several enzymes which are part of the nitrogen metabolic pathways were tested including enzymes involved in nitrogen assimilation or dissimilation. No sign of the presence of nitrogenase was observed when glutamine and glutamate synthetases were present (Feltick, pers. comm.).

The faunal compositions of Lucky Strike and Menez Gwen vent communities differs markedly from those previously described at the Snake Pit and TAG areas (MAR). This variation may be due to isolation mechanisms such as water depth at Lucky Strike and Menez Gwen (800m) which is very much shallower than at the Snake Pit and TAG areas (3400m). Further extension of our exploration to the deeper FAMOUS area would lead us to a better understanding of the role of bathymetry as an isolating mechanism versus latitudinal gradients and isolation by transform faults and fracture zones.

References


