

**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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Following the Lucky Strike 1993 cruise and the DIVA 1 geological cruise (May 1994), 26 biological dives were completed with the submersible Nautilie 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 ultrathermophilic bacteria and (b) structure of microbial communities associated with hydrothermal plumes.
3. Study of nitrogen, sulphur and carbon metabolic pathways in the symbiosis between mussels and chemoautotrophic bacteria.
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 genetics (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 an undescribed mussel species distinct from all previously observed deep-sea mytilids (Craddock et al., in press). At this site, nearly all individuals were infested by one to three commensal polynoid worms belonging to *Branchyolynoe 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 site within an active zone and there is spatial segregation at any given site (Comtet, pers. comm.). 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 (Chevaldonné 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 mytilid shells. An Ampharetid polychaete belonging to a new taxa of Samythinini, generically distinct from *Amphisamytha* (Desbruyères, pers. comm.) 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 *Cataetys*. A pink fish tentatively attributed to *Onogadus* was observed living in cracks within mussel beds. Several rat-tail fish, deep-sea sharks, and chimaeroids 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 281°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, ophiuroids and crabs (including a geryon red crab belonging to *Chaceon affinis*) were also present. Abundant bathyal faunas were observed at the periphery of the site including pandalid shrimps (*Plesionika* sp.), fish (*Etmopterus pusillus*, *Lepidion schmidtii*, *Epigonus telescopus*, *Synaphobranchus* sp., *Photostomias* sp., *Scorpaena* sp., *Malacocephalus laevis*, *Beryx*

splendens, *Neocyttus helgae* ...), squid (*Omastrephes 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 methylotrophic bacteria (Fiala Médioni, pers. comm.) as do mytilids from Snake Pit (Cavanaugh et al., 1992). Enzyme studies showed that the gills, but no other tissues of the mussels, contained methanol dehydrogenase (an enzyme found in methane-oxidizing bacteria), adenylyl sulphate 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 (Felbeck, 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.

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