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Brief account of the chemical environment at hydrothermal vent mussel beds on the MAR

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Biological communities associated with hydrothermal activity reflect the peculiarities of the sea water composition around the vents. They are functionally dependent on the association between the macro-organisms, their symbiotic chemoautotrophic bacteria, the reduced chemicals present in the fluid (sulphide, methane...) and the oxygen of sea water (Fisher, 1990). Hydrothermal organisms are present along the mixing zone between the hot hydrothermal fluid and the cold sea water where both reduced (sulphide, methane) and oxidized (e.g. nitrate) compounds are available. This zone is subject to rapid and large spatio temporal variations of the environmental conditions as has been shown for temperature (Chevaldonné et al., 1991) and sulphide and silicate (Johnson et al., 1988). The chemical composition of the water surrounding the organisms remains yet to be adequately documented. This paper presents a summary of the results obtained on the chemical environment of the mussel clumps occurring at the Lucky Strike and Menez Gwen hydrothermal areas, Mid Atlantic Ridge, in order to elucidate the trends governing the functioning of the ecosystem and the interactions between fluid and organisms.

Water samples were collected around the communities of *Bathymodiolus* sp. hydrothermal mussels during the DIVA 2 cruise (June 1994, on the N.O. *Nadir* and *Nautile* (Desbruyères et al., 1994) in two hydrothermal fields, Lucky Strike (1700 m depth) and Menez Gwen (850 m depth), located on the Mid Atlantic Ridge (MAR) (Fouquet et al., 1995; Van Dover et al., 1996), and analysed for chemical constituents.

Sampling location.

1. At Lucky Strike, PP7 is characterized by a chimney and flange type structure with pools of hot fluids underneath the overhangs. Populations of large mussels were found on the flange near the main hot fluid exit whereas smaller individuals were present on the outer part of the flange and on the chimney edge. Mussel shells occurred on the lower part (inactive) of the chimney. Eiffel tower is a large edifice, nearly uniformly covered with dense and large mussel communities around the numerous high temperature vents and diffuse vents through numerous fissures. Large mussels appear to have preferentially settled near the fluid exits, whereas smaller ones covered the less active side of the edifice.

2. Menez Gwen was colonized by small and sporadic patches of mussels around the smokers and the fluid diffusers.

The environment surrounding the organisms consists in sea water (88-100 %) mixed with hydrothermal fluid with pH between 6.2-8, and ΣS ($H_2S + HS^-$) concentrations from 0 to 62 µmol l^{-1}. High dissolved organic carbon (DOC) concentrations (up to 600 µmol l^{-1}) suggest a highly productive ecosystem. Production of ammonium and DOC, consumption of nitrate and sulfide in the vicinity of the organisms are among the environmental changes found in relation with local biological activity. Concentrations of total dissolvable Cu (0.02 to 2.0 µmol l^{-1}) and Pb (0.9 to 20 nmol l^{-1})were high, implying that the organisms need to have efficient strategies of adaptation and detoxification.

An empirical distinction between the extreme sizes of the mussel (> 6 cm and < 3 cm) reveals that the size distribution of the communities is related to the presence of different environments: the large size classes are present closer to the fluid exits with higher ΣS concentrations than the small size classes. This could indicate differences in the growth rate related to the availability of the energy sources, competition for energy and space, and/or different settlement periods (Comtet & Desbruyères, 1998).

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References

Chevaldonné P., Desbruyères D. & Le Haître M. 1991. Time-series of temperature from three deep-sea hydrothermal vent sites. *Deep-Sea Research,* **38** (11): 1417-1430.

Comtet T. & Desbruyères D. 1998. Population structure and recruitment in mytilid bivalves from the Lucky Strike and Menez Gwen hydrothermal vent field (37°17'N and 37°50'N on the Mid-Atlantic Ridge). *Marine Ecology Progress Series,* **163** : 165-177.

Desbruyères D., Alayse A.M., Antoine E., Barbier G., Barriga F., Biscoito M., Briand P., Brulport J.P., Comtet T., Cornec L., Crassous P., Dando P., Fabri M.C., Felbeck H., Lallier F., Fiala-Medioni A., Goncalves J., Menard F., Kerdoncuff J., Patching J., Saldanha L., Sarradin P.M. 1994. New informations on the ecology of deep sea vent communities in the Azores Triple Junction Area : Preliminary results on the Diva 2 cruise (May 31, July 4, 1994). *InterRidge News,* **3** (2): 18-19.

Fisher C.R. 1990. Chemoautotrophic and methanotrophic symbioses in marine invertebrates. *Aquatic Sciences,* **2** (3, 4): 399-436.

Fouquet Y., Ondreas H., Charlou J.L., Donval J.P., Radford-Knoery J., Costa I., Lourenco N. & Tivey M.K. 1995. Atlantic lava lakes and hot vents. *Nature,* **377** : 201.

Johnson K.S., Childress J., J., Hessler R.R., Sakamoto-Arnold C.M. & Beelher C.L. 1988. Chemical and biological interactions in the Rose Garden hydrothermal vent field, Galapagos spreading centre. *Deep-Sea Research I,* **35** (10/11): 1723-1744.

Van Dover C.L., Desbruyeres D., Segonzac M., Comtet T., Saldanha L., Fiala Medioni A. & Langmuir C. 1996. Biology of the Lucky Strike Hydrothermal field. *Deep-Sea Research I,* **43** (9): 1509-1529.