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Environmental controls on chemoautotrophic primary producers at deep-sea vents

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High biomasses and fast growth rates of dominant chemosynthetic species characterize hydrothermal ecosystems, raising the issue of their contribution to energy transfer and carbon cycling in the deep-sea. Addressing this issue, however, needs to account for the temporal instability of hydrothermal systems, both, in terms of biological colonization and habitat conditions. Volcanic eruptions on mid-ocean ridges offer the opportunity to investigate the environmental conditions favoring the successive modes of chemoautotrophic primary production (i.e. free living microbes and symbiotic invertebrates).

In that perspective, habitat-scale approaches distinguish from vent field-scale approaches based on fluid composition and provide relevant information on environmental constraints exerted at different stages of colonization focusing on parameters linked with physiological limits and available energy. Investigation of habitat physicochemical properties along a typical successional sequence of recolonization at 9°50'N EPR diffuse-flow vents, between 2006 and 2014, was performed in order to examine potential changes in environmental features associated with chemoautotrophic primary producers, from early microbial colonizers to symbiotic invertebrates.

Combined in situ measurements of temperature, pH and hydrogen sulfide were used and their variability documented over a series of assemblages characterizing recolonization stages. The distributions of mature assemblages of dominant invertebrate species associate with substantial differences in habitat conditions, pointing to a strong influence of habitat properties on potential productivity. Among the differences observed, however, the amplitude and rate of environmental fluctuation appear more important than average conditions in the succession, highlighting the role of spatial heterogeneity and temporal dynamics as a control on primary producers. Invertebrate species acting as engineer species are expected to play a primary role in the rate of organic carbon formed over the lifetime of a vent and potentially transferred to adjacent ecosystems.