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In situ determination of the spatial and temporal variation in diffuse hydrothermal vent fluids above mussel beds

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The emission of hydrothermal fluids into the ambient seawater leads to steep physico-chemical gradients which can strongly vary over space and time. Methane, sulfide and hydrogen, which are diluted in the vent fluids, represent the basis for chemolithotrophic and methanotrophic life in hydrothermal ecosystems, and the physico-chemical gradients of the fluids play a major role in structuring hydrothermal-vent habitats. On the other hand, aggregations of organisms such as dense mussel beds can also influence the physico-chemical gradients at the benthic boundary layer by affecting the flow, dilution and exchange of the fluids with ambient sea water. An understanding of the spatial and temporal variability of vent fluids is a prerequisite for understanding the distribution and activity patterns of organisms and thus the interplay between biotic and abiotic process at hydrothermal habitats. High resolution in situ measurements enable us to precisely characterize gradients of temperature, O_2, pH, sulfide and hydrogen at a spatial scale of millimeters. From these measurements microhabitat structures can be identified and they provide invaluable information on how hydrothermal habitats evolve and how vent organisms maintain their energy requirements.

The main goal of this study was to investigate the physico-chemical gradients at the water-mussel bed interphase at the Logatchev vent field (14˚45'N). In situ microsensor measurements of O_2, pH, H_2S, T and, for the first time, H_2 were used to investigate the links between the geochemical energy supply from hydrothermal fluids and hydrothermal vent communities. Microsensor time records show a highly fluctuat-

ing signal over time when placed on a diffuse venting mussel bed. Also, the maximum signal change varied spatially within the same mussel field on a distance of a few decimeters. A high-resolution satellite sensor is under development as a universal ROV/submersible payload to monitor the dynamics of diffuse fluid venting with space and time at hot vents and cold seeps. This work is carried out in the framework of the German DFG-Priority Program SPP1144 “From mantle to ocean” and the 6^{th} EU project “EXOCET/D” and contributes to the goals of the InterRidge working group on ‘Biogeochemical interactions at deep sea vents’.