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In situ measurements of O_2, H_2S, and temperature at mussel beds from the Logatchev hydrothermal vent field.

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Mussels of the genus *Bathymodiolus* (Bivalvia: Mytilidae) commonly described from hydrothermal vents at mid-ocean ridges live in dual symbiosis with sulfide- and methane-oxidizing bacteria. Both bacterial endosymbionts reside within the host's gill tissue, inside distinct bacteriocytes. Whereas much effort has been made to characterize the phylogenetical and physiological nature of both the bacteria and the host, only a few studies have attempted to investigate the biogeochemical conditions at sites where these mussels occur, most of which have not used *in situ* measuring techniques. The need for *in situ* biogeochemical surveys is, however, obvious: Hydrothermal vent fields are typically located at great depths and it can, therefore, take hours before discrete water samples are recovered and further processed on board the research vessel, hours in which multiple and complex redox processes can occur. Such samples may have little to do with the conditions that the mussels experience at the vents, and biogeochemical parameters should be measured *in situ* to gain a better understanding of how fluid gradients influence the mussel symbiosis.

Bathymodiolus puteoserpentis is a dominant macrofaunal species at both the Snake Pit and the Logatchev hydrothermal vent fields at the Mid-Atlantic Ridge. In January/February 2004 we visited the Logatchev vent field at 14˚45'N with the research vessel Meteor and the ROV Quest. To study the diversity, biomass, distribution, and the activity of endosymbiotic bacteria in *B. puteoserpentis* in relation to biogeochemical gradients, we conducted *in situ* measurements of dissolved oxygen, dissolved H_2S, and temperature using Clark type O_2 microsensors, amperometric H_2S microsensors, and a Pt100 temperature sensor. During four ROV dives, each of which explored the

vent site for approximately 6 hours, data were sampled with a resolution of one second, thus collecting datasets of around 22.000 single data points per parameter measured. The data clearly showed an increase in temperature and dissolved H_2S concentrations at sites where the mussels occurred whereas dissolved oxygen concentrations decreased, suggesting diffuse venting at these sites. Dissolved H_2S concentrations increased from 0 in the surrounding seawater to 20 - 30 μM just above the mussel beds while dissolved O_2 concentrations decreased from 170 μM in the surrounding seawater to 160 - 150 μM above the mussel beds. At all mussel sites, the temperature fluctuated noticeably, with temperatures ranging between 2.9˚C and 7.5˚C within minutes, above background values of 2.6˚C. As temperature increased, higher sulfide and lower oxygen concentrations were measured. At the rim of a smoking crater where no fauna was observed, the temperature was much higher with a maximum measured at 27.5˚C corresponding to concentrations of dissolved H_2S as high as 200 μM. At temperatures of 10˚C and higher, O_2 concentrations dropped to zero.

These results show that the Logatchev mussels have simultaneous access to both sulfide and oxygen indicating that the symbionts can oxidize sulfide with environmental oxygen. We are currently examining mussels from these sites to investigate if gradients in vent fluids influence the biomass and activity of the symbionts. These studies also show that changes in temperature are correlated to changes in O_2 and H_2S at the Logatchev mussel beds. This indicates that temperature loggers, that can record temperatures for up to 1 year, could be used as valid indicators of fluctuations in fluid gradients over longer time periods. Such long term measurements may be more representative of the energy flow from the vent fluids to the mussels than those that can be recorded during a single dive.