



North Pond: a natural observatory for sub-seafloor oxidant supply and metabolic reactions

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Evidence of upward transport of oxidants from basaltic aquifers to deeply buried sediments has raised questions on microbial respiration and energy cycling within the deep biosphere. Sediment ponds that occur over a vast area of sea floor on the flank of the Mid-Atlantic Ridge maybe ideal observatories to study the role of unsuspected sources of oxidants for sub-seafloor microbial life. The western flank of the Mid-Atlantic Ridge, at 22°45'N is characterized by depressions filled with sediment and surrounded by high relief topography of 7 Ma old basement. The largest depressions are 5 km to 20 km wide and sediment thickness varies but can reach 400 m (Langseth et al. 1992). They are believed to overly recharge zones for the venting of fluids that takes place locally through unsedimented young ocean crust. If we consider the sediments as boundaries overlying the hydrologically active crustal environment, then using profiles of bioactive compounds measured through the sediment layer with the goal to extract information on transport and reactions is an obvious approach to understanding the implications of subsurface transport of oxidants on metabolic activity. Recently obtained deep oxygen profiles obtained during a site survey expedition in February/March of 2009 onboard RV Maria S. Merian to North Pond, one of the larger (70 square km) and best studied sediment ponds, provided proof of this principal. North Pond is the site of the proposed IODP Expedition "677 Mid-Atlantic Microbiology". Investigations included heat-flow, single-channel seismic and bathymetry surveys, as well as gravity coring. Oxygen measurements and pore water sampling (25 cm depth intervals) were performed directly on intact sediment cores, which were subsequently sampled for microbiological analyses, as well as for incubation experiments to test for autotrophic and heterotrophic microbial activity. The entire sediment column down to > 8 m sediment depth contained oxygen. In the central part of the sediment pond oxygen decreased continuously with depth, indicating an active aerobic microbial community, while nitrate concentrations increased. In contrast, along the northern and western rims of North Pond, oxygen concentrations remained surprisingly constant with depth at values around 170 μ M. In addition, at 3 locations along the north shore oxygen profiles indicated an upward supply of oxygen from the underlying basaltic basement. Pore water nutrient profiles and incubation experiments confirmed active microbial communities throughout the sediment layer, as well as the influence of upward transport of oxidants on microbial processes in deeply buried sediments.

Langseth, M.G., K. Becker, R.P. Von Herzen, and P. Schultheiss. 1992. Heat and fluid flow through sediments on the western flank of the Mid-Atlantic Ridge: A hydrogeological study of North Pond. *Geophys. Res. Lett.* 19: 517-520.