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Biological sulfate reduction in deep subseafloor sediment of Guaymas Basin

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Sulfate reduction is the quantitatively most important process to degrade organic matter in anoxic marine sediment and has been studied intensively in a variety of settings. Guaymas Basin, a young marginal ocean basin, offers the unique opportunity to study sulfate reduction in an environment characterized by organic-rich sediment, high sedimentation rates, and high geothermal gradients (100-958°C km^{-1}). We measured sulfate reduction rates (SRR) in samples of the International Ocean Discovery Program (IODP) Expedition 385 using incubation experiments with radiolabeled $^{35}SO_4^{2-}$ carried out at in-situ pressure and temperature. Site U1548C, outside of a circular hydrothermal mound above a hot sill intrusion (Ringvent), has the highest geothermal gradient (958°C km^{-1}) of all eight sampling sites. In near-surface sediment from this site, we measured the highest SRR (387 nmol cm^{-3} d^{-1}) of all samples from this expedition. At Site U1548C SRR were generally over an order of magnitude higher than at similar depths at other sites. Site U1546D also had a sill intrusion, but it had already reached thermal equilibrium and SRR were in the same range as nearby Site U1545C, which is minimally affected by sills. The wide temperature range found in the stratigraphic section at each drill site leads to major shifts in microbial community composition with very different temperature optima. At the transition between the mesophilic and thermophilic range around 40 to 60°C, sulfate-reducing activity appears to be decreased, particularly in more oligotrophic settings but shows a slight recovery at higher temperatures.

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