



Sulfur isotope fractionation during microbial sulfate reduction associated with anaerobic methane oxidation

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Short sediment cores were recovered from the Hydrate Ridge during cruise 143 of RV SONNE in August 1999 by the use of a TV-guided multicoring device. Sediment at station 173 (760 m water depth) was covered by a dense bacterial mat of *Beggiatoa* sp., and sediment at station 185 (785 m water depth) was recovered from a mussel field of bivalves *Calyplogena* sp.. Pore waters were analyzed for the concentrations and isotopic composition of dissolved S species (H₂S, sulfate), and chloride. The sediments were additionally analyzed for the contents in TOC, acid volatile sulfide (AVS), CrII-reducible S (pyrite, S⁰), and corresponding 34S/32S ratios. The vertical abundance of free and aggregate-related sulfate-reducing bacteria (SRB) was quantified by FISH. Sulfate reduction rates (SRR) were measured using the 35S-radiotracer technique. Due to bacterial sulfate reduction (BSR) associated with anaerobic methane oxidation (AMO) at stations 173 and 185 a depletion of the pore waters in dissolved sulfate took place within the first 5-10 cm and a corresponding increase in dissolved bisulfide up to more than 10 mM. Extremely high SRR were measured in the surface sediments (up to more than 5000 nmol cm⁻³ d⁻¹) with corresponding high numbers of SRB. The community in the first cm of the sediment was dominated by *Desulfosarcina/Desulfococcus* sp.. BSR caused dissolved sulfate at stations 173 and 185 to become significantly enriched in 34S (up to +56 per mil). H₂S, AVS (essentially H₂S), and CrII-reducible S were enriched in 32S, accordingly. An apparent sulfur isotope enrichment factor of about -30 per milles is estimated from coexisting pore water sulfate and AVS of surface sediments. 34S/32S discrimination and corresponding cellular SRR are similar to results from pure culture studies. Below about 5 cm (Site 173) or 10 cm (Site 185) the delta34S values of H₂S / AVS reached or even exceeded

the isotopic composition of seawater sulfate (up to +25 per mil; Site 173), in agreement with a limited supply rate of sulfate from the sediment-water interface. Most pyrite was formed within the first 5 cm of the sediments, but additional pyritization still took place in deeper sediment sections. Based on the sulfur isotope data $\text{AVS}/\text{H}_2\text{S}$ contributes to the deeper pyrite formation.