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A preliminary study of sulfide mineral formation in methane-rich, marine sediments associated with anaerobic methane oxidation, Cascadia continental margin, offshore Oregon.

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Within gas hydrate settings, sulfide mineralization in marine sediments is likely controlled by two microbially-mediated, sulfate-depleting processes: anaerobic methane oxidation (AMO) and sulfate reduction. If large amounts of methane are delivered to the sulfate-methane interface (SMI), predominantly by diffusion, larger amounts of solid sulfide sulfur should occur there as dissolved sulfide combines with iron, forming an authigenic precipitate. We measure the amount of diagenetic sulfide sulfur at three locations in the Hydrate Ridge vicinity by extracting the bulk sedimentary sulfide-phase minerals (S^0 , FeS, and FeS₂) through chromium reduction, precipitating sulfide sulfur as silver sulfide, and gravimetrically determining concentration. Two of three sites show authigenic sulfide sulfur levels of approximately 0.27 and 0.7 weight percent (wt %) sulfur, occurring immediately above the SMI. Lower concentrations of 0.12 and 0.41 wt % sulfur, respectively, occur below the SMI. The remaining site has no discernable pattern to the vertical distribution of sulfide sulfur concentration, but shows peak amounts of 0.52 wt % sulfur above the SMI. At the first two sites, we infer peak amounts of sulfide sulfur are precipitated due to the production of sulfide sulfur via AMO. We can test this interpretation by determining the sulfur isotopic composition ($\delta^{34}S$) of the bulk sulfide minerals. Sulfide sulfur forming at the SMI should also be enriched in heavy sulfur relative to sulfide minerals forming in the sediments above. If these sulfur isotopic enrichments are unique to methane-rich settings associated with gas hydrates, then these diagenetic fingerprints can be recognized in the rock record.

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