Sulfide-oxidizing bacteria dissolve carbonate minerals in marine cold seep settings

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We observed an affinity for the colonization of carbonate rocks by sulfide-oxidizing bacteria at marine methane seeps. These bacteria commonly co-occur with etch pits that suggest active dissolution. Aerobic sulfide oxidation is an acid-producing reaction that has the potential to dissolve carbonate minerals. We are investigating the mechanism(s) and rates of carbonate dissolution associated with bacterial sulfide oxidation in the laboratory using bioreactors that simulate marine conditions. These reactors contain sulfide-oxidizing bacteria growing on calcium carbonate rock chips. The bioreactors were inoculated with the sulfide-oxidizing bacterial strain, *Celeribacter baekdonensis LH4,* and run under continuous flow conditions for 21 days. The pH, alkalinity, [Ca^{2+}], and OD were monitored daily. Aragonite coupons were aseptically sampled and measured over three weeks to determine the rate of dissolution. We report the biotic and abiotic dissolution rates to be 1774.68µmol•cm^{-2}•a^{-1} and 358.56µmol•cm^{-2}•a^{-1}, respectively. Select coupons were transferred to a flow-cell at the end of the experiment to measure the pH of the biofilm using laser-scanning confocal microscopy. We observed steep pH gradients within the biofilms. Our results show that *C. baekdonesis LH4* biofilms are actively dissolving aragonite coupons by producing acidic microenvironments, even under well-buffered conditions. These results support the hypothesis that sulfide-oxidizing bacteria in marine seafloor settings can increase the rate of carbonate dissolution by decreasing the pH within the biofilm, and in the process, flux carbon from the rock reservoir to the ocean and atmospheric reservoirs.