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Anhydrite solubility in seawater to 200°C and to 500 bars

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Anhydrite is commonly found in high temperature submarine hydrothermal systems. It has a retrograde solubility, i.e. a temperature increase favors its precipitation. Anhydrite precipitation in off-axis hydrothermal systems may clog porosity and therefore affect the flow pattern and the thermal structure of the oceanic crust [1]. It is then needed to know the temperaure of anhydrite precipitaton with accuracy.

It is commonly accepted, after the measurements of Byshoff and Seyfried [2], that anhydrite precipitates at 150° when seawater is heated. What is overlooked is that the Bishoff-Seyfried data have been obtained at 500 bars. Our recent calculations [3] are indeed in agreement with these data at 500 bars, but they show that seawater reaches equilibrium with anhydrite at 117°C for a pressure of 20 bars.

We started experiments in which standard seawater (35 ‰ salinity) is heated to 200°C in an autoclave at 40, 200 and 400 bars. We monitor the changes in dissolved calcium and sulfate. Premiminary results confirm that anhydrite starts precipitating from seawater when the temperature reaches 120°C at 40 bars, which is in very good agreement with the calculations of anhydrite solubility in the Na-K-Ca-Mg-Ba-Cl-SO_4-H_2O system [4].

References

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4.1.71

Dynamics of methane and hydrogen sulphide in the water column and sediment of the Namibian shelf

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The coastal upwelling zone off Namibia is one of the most productive ocean margin regions on Earth. Rapid depletion of oxygen in the water column below the photic zone and fast accumulation of organic carbon with little terrestrial clastic input create an extremely liquid, organic rich, diatomaceous mud, where anaerobic mineralisation predominates. These sediments provide an ideal opportunity to study interactions between benthic mineralisation and the development of water column dysoxia and anoxia.

Rates of bacterial sulphate reduction, methanogenesis, and anaerobic methane oxidation are high in these sediments. Geochemical profiling and high-resolution sediment echosound data indicate areas with free CH_4 only a few centimeters below the surface. Modeling of pore water sulphide profiles show that sulphide produced by bacterial sulphate reduction in the top 16 cm of sediment is sufficient to account for the total hydrogen sulphide flux. However, the H_2S pool is too large to be explained by steady state diffusion across the sediment-water interface. Episodic advection of H_2S, possibly triggered by CH_4 ebullition or gas eruptions, must contribute to the H_2S flux to the water column.

The biomass of the largest known bacterium, the nitrate- and sulphur-storing species *Thiomargarita* spp. is highest in the most gas-rich areas on the shelf. In the sulphidic bottom waters, up to 55% of sulphide oxidation is mediated by the large nitrate-storing sulphur bacteria. The filamentous relatives *Beggiatoa* spp. occupy low-O_2 bottom waters on the outer shelf. While upward-diffusing H_2S was incompletely removed in sediment dominated by *Thiomargarita* spp., in *Beggiatoa*-dominated sediment, no H_2S reached the sediment surface. A three-year series of sulphate reduction, fluxes of H_2S and CH_4, and monitoring of sulfur bacteria suggests a gradual decrease in anaerobic mineralisation rates and H_2S fluxes, a change to *Beggiatoa*-dominated sediment, and on average better bottom water ventilation. These changes may well reflect basin-scale changes in hydrographic conditions, but the physical causes for these changes are currently insufficiently understood. The data indicate that subtle changes in oceanographic conditions can have a profound influence on the composition of the sulfide-oxidizing bacterial community and the resulting regulation of H_2S flux to the water column.