



Experimental determination of REE partition coefficients in cold seep carbonate phases

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Authigenic carbonates are suitable archives for investigating past circulation events of methane-rich fluids on continental margins. Tracing fluid sources at cold seeps is important for better constraining the geological context in which they are expelled. Until recently, however, the origin of the fluids was mainly inferred using the stable isotopic composition of carbon and oxygen, which allowed discrimination between biogenic versus thermogenic source. The development of new proxies is needed to bring additional information on fluid sources on continental margins, and to better constrain changes in fluid composition through time. The rare earth elements (REEs) behave as a coherent group of elements, which have been used widely to provide information on mixing between water masses and biogeochemical processes in the ocean. Early diagenetic reactions in marine sediment (e.g. degradation of organic compounds, reduction of Fe and Mn oxyhydroxides) lead to strong enrichment of the REE contents in pore waters relative to seawater (up to 100 times). As a consequence, the application of REE geochemistry to cold seep carbonates is particularly well suited for investigating fluid sources in sediments from continental margins. In order to validate this new approach, and because the incorporation of the REE during carbonate precipitation may also be dependent on their mineralogy, it is important to determine the role played by mineralogy versus fluid chemistry in controlling the REE signature of cold seep carbonates. In this regard, the knowledge of partition coefficient for REE in the main carbonate phases encountered at cold seeps (aragonite, calcite and magnesian calcite) is crucial.

In this study, we report REE partition coefficient for the carbonate phases typically found in cold seep environments (aragonite, calcite, magnesian calcite). The carbonate phases were precipitated by CO₂-diffusion technique from artificial REE-doped seawater. The precipitation was carried out at a constant pH of 8.3. The role of temperature on the degree of REE partitioning into carbonate phases was investigated through several experiments at different temperatures (10, 25 and 40°C). X-Ray diffraction patterns and Raman spectra confirmed the formation of well crystallized solids at the end of our experiments. The REE analyses for carbonate phases and both initial and final experimental batch solutions were analysed by ICP-SFMS after Tm addition (BAYON et al., 2009), whereas the Ca, Sr and Mg analyses were carried out by ICP-OES. The data presented here will be used to evaluate the potential of REEs as tracers of fluid sources at cold seeps.

References:

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