Barium isotope fractionation in hydrothermal vent fluids: constraints on Ba inputs to the ocean

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Hydrothermal activity plays a crucial role in seawater composition by acting as a source or sink for many elements. Barium, an element associated with biogeochemical cycles in the ocean, has a high concentration in hydrothermal fluids (> 1~100 μM) compared to that in seawater (< 0.2 μM) [1]. But precipitation of barite during mixing with seawater, and removal by metal oxide scavenging in hydrothermal plumes reduces the hydrothermal Ba input to seawater. Whether hydrothermal activity is a net source or sink of Ba to the ocean remains unclear.

Recent measurements of Ba concentrations and isotopes in the deep Atlantic [2] have suggested net addition of Ba, possibly from sediment dissolution or hydrothermal activity, and demonstrated the potential for Ba isotopes as a tracer for Ba inputs to seawater.

In this study, we measure Ba isotopes in hydrothermal fluids to investigate isotope fractionation during venting and early mixing with seawater. Preliminary data from the Rainbow hydrothermal system show an increase of $\delta^{138/134}$Ba of +0.34 ‰ between the highest [Ba] (60 μM) and the lowest [Ba] (5 μM) fluids observed in this system. Comparison with Ba, Mg, and SO_4 concentrations suggests that this reduction is primarily controlled by barite precipitation. This data also indicates that the remaining dissolved Ba in dilute hydrothermal fluids tends to be imprinted with a heavy isotope signature, which may have an impact on the seawater Ba isotope budget.

We will examine $\delta^{138/134}$Ba in hydrothermal fluids from five different vent sites in the North Atlantic and North Pacific to establish the relationship between Ba stable-isotope fractionation and Ba supply/removal processes in different venting systems. This study provides the first constraints on Ba isotope fractionation in hydrothermal fluids, allowing assessment of the use of Ba stable isotopes as a proxy for hydrothermal input to the ocean, and of the role of hydrothermal activity in the oceanic cycle of Ba and Ba isotopes.

[1] Tivey (2007) *Oceanography* (20), 50-65. [2] Hsieh and Henderson *EPSL* (in review)