The Role of High- and Low-Temperature Alteration of Oceanic Crust on the marine Calcium Budget

Responsible: Anton Eisenhauer, Folkmar Hauff, Klas S. Lackschewitz

Hydrothermal fluid flows at mid ocean ridges are known to contribute significantly to the oceanic budget of the divalent cations like Ca, Sr and Mg, respectively. However, the quantification of the contribution of hydrothermal sources to the ocean Ca mass balance, in particular with regard to high- and low-temperature alteration of oceanic crust is still poorly constrained. In order to better understand chemical processes during water-rock interaction and their influences on ocean inventory of Ca, the role of high- and low-temperature alteration of oceanic crust for the marine calcium budget will be investigated within the frame of the DFG Priority Program SPP 1144 'From Mantle to Ocean: Energy-, Material- and Life Cycles at Spreading Axes'. The program started with a Meteor expedition (M60/3) at the beginning of 2004 to the Logatchev hydrothermal field at 14°45'N on the Mid-Atlantic Ridge. This site is characterized by active hydrothermal systems hosted by ultramafic rocks and thus providing active serpentinization. Therefore, samples from this site are suited for the purpose of this study. Samples were recovered mainly by TV-Grab and the ROV Quest, equipped with a special device for the uptake of fluid samples.

Fluid samples are supposed to be mixtures of the contribution of two fluid endmembers, seawater and pure hydrothermal fluids. This can be inferred by our analyses of the Ca and Sr isotopic composition. Our first results show that $^{44}Ca/^{40}Ca$ ratios of the samples are inversely correlated to the relative amount of hydrothermal fluids.

Samples with lowest contribution of hydrothermal fluids are close to the seawater endmember whereas samples with large contribution of hydrothermal fluids show a much lower $^{44}Ca/^{40}Ca$ value relative to seawater. Radiogenic Sr isotope ratios in the samples follow the Ca isotope trend line, which is interpreted as mixing.

Our first results from divalent cation variations confirm existing models that the interaction between oceanic crust and seawater during hydrothermal alteration induces substantial changes of the Ca budget and the isotope composition. Further efforts will focus on the identification of the Ca isotope value of the hydrothermal endmember.