The Ca isotope composition of altered MORB

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The alteration of oceanic crust by hydrothermal fluids affects the chemistry of island arc lavas, mantle reservoirs and the oceans. Understanding the chemical and mineralogical changes in ocean crust during alteration is necessary for developing quantitative models for geochemical cycles in the solid earth and oceans. Despite several decades of research, questions such as the mass balance of radiogenic Sr in the oceans are still not definitively answered. To develop a better understanding of ocean crust alteration we conducted a preliminary study of variably altered oceanic basalts from ODP cores 417A, 417D and 418A on the southern end of the Bermuda Rise in the western Atlantic.

We report Ca isotope ($\delta^{44/40}$Ca), $^{87}Sr/^{86}Sr$ and concentrations of K, Rb, Sr, Ca on whole rock powders. Additionally $\delta^{18}O$ and $\delta^{13}C$ were determined on the carbonate fraction. Whole rock concentrations of CaO (5.6-42 wt%) are well correlated with CO_2 concentrations (0.4-30 wt%; r^2=0.95) but poorly correlated with K (270-27,000 ppm), Rb (2-35 ppm) and Sr (35-135 ppm) concentrations. Sr isotope ratios corrected to magmatic age $^{87}Sr/^{86}Sr_{120Ma}$ = 0.7038-0.7066 lie between fresh MORB 0.7025 and Cretaceous seawater 0.7075. $\delta^{44/40}Ca_{whole\ rock}$ varies between +0.05 and +0.8 relative to bulk silicate earth (BSE). Cretaceous seawater was likely +0.7+/-0.1, meaning that the altered samples span 100% of the MORB-seawater compositional range. For comparison the $^{87}Sr/^{86}Sr$ has a maximum exchange of ~85% between seawater and MORB. The $\delta^{44/40}$Ca and $^{87}Sr/^{86}Sr$ values are not well correlated; three samples with the most radiogenic Sr span the entire range of observed $\delta^{44/40}$Ca.

Results so far indicate that there is substantial modification of oceanic crust Ca isotopes as well as Sr. Future measurements of acetic acid leachates and residues will help constrain the degree to which Ca and Sr are exchanged during silicate mineral alteration compared to secondary carbonate precipitation, and allow us to evaluate whether the altered MORB Ca isotope signature could be preserved in arc lavas or ocean island basalts.