Constraints on the global Mg cycle from Mg isotopic composition of altered oceanic crust

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Alteration of ocean crust not only modifies compositions of seawater and the upper oceanic, but also regulates longterm climate change by uptake of carbon. Ultimately, the altered oceanic crust (AOC) is recycled into the mantle by subduction, making an important contribution to mantle heterogeneity. Thus, knowledge of the composition of AOC is pivotal to understanding the cycling of elements and its impact on the composition of the Earth's mantle.

To investigate the behavior of Mg isotopes during low-temperature alteration of oceanic crust and to further understand its role in the global Mg cycle, we measured the Mg isotopic compositions of a set of samples of AOC recovered from the Ocean Drilling Program Hole 801C, the reference site for old crust (～170 Ma) subducting in the Pacific. The measured δ^{26}Mg values range from -1.70‰ to 0.21‰, deviating from that of pristine oceanic basalts (-0.25 ± 0.07‰)[1], indicating large Mg isotope fractionation during low temperature alteration of the oceanic crust. A weighted average δ^{26}Mg value of 0.00 ± 0.09‰ is estimated for the AOC at Site 801, implying that low-temperature alteration of oceanic crust drives the ocean to a lighter Mg isotopic composition, and thus requires additional carbonate precipitation to maintain a steady-state Mg isotopic composition of seawater. A mass balance calculation suggests that the Mg output flux due to low-temperature alteration of the oceanic crust equals ～12% of the annual Mg riverine input, indicating that AOC is a significant sink of Mg in seawater. Our study further highlights that recycling of AOC with highly variable δ^{26}Mg along with overlying marine sediments into the mantle through subduction may generate mantle Mg isotopic heterogeneity on a local scale.

[1] Teng et al., (2010) *Geochim. Cosmochim. Acta* 74, 4150-4166.