Mg isotope composition of the upper oceanic crust at ODP Holes 504B and 896A, Costa Rica Rift

A. BEAUMAIS[1*], D.A.H. TEAGLE[1], R.H. JAMES[1], C.R. PEARCE[2], J.A. MILTON[1], J.C. ALT[3]

[1]Ocean and Earth Science, University of Southampton, Southampton, SO14 3ZH, UK
(*correspondence: a.beaumais@soton.ac.uk)
[2]National Oceanography Centre, University of Southampton Waterfront Campus, Southampton, SO14 3ZH, UK
[3]Earth and Environmental Sciences, The University of Michigan, Ann Arbor, MI 48109-1005,USA

Alteration of the oceanic crust is thought to be the principal sink of Mg in seawater, but the effect of this process on the Mg isotope (δ^{26}Mg) composition of the oceans remains unclear. Here we present the first measurements of Mg isotopes in altered oceanic crust from ODP Holes 504B and 896A, located in 5.9 Ma crust, 200 km south of the intermediate spreading rate Costa Rica Rift. Hole 504B penetrates: (i) A volcanic section, consisting of partially altered basalt that was open to seawater circulation under oxic-suboxic conditions at temperatures of <150°C. (ii) A transition zone, characterized by mixing between upwelling hydrothermal fluid and seawater between 100 and 350°C. (iii) A sheeted dike complex consisting of diabase partially altered to greenschist facies minerals. Hole 896A penetrates volcanic rocks altered at low temperature (<100 °C) under oxic-suboxic conditions.

The overall range in δ^{26}Mg values is -0.53 to -0.05‰; significantly greater than the range observed in unaltered mid-ocean ridge basalts (MORB: -0.25 ± 0.06‰ [1]). δ^{26}Mg values decrease with depth in the volcanic sections of both Holes 504B and 896A. The highest δ^{26}Mg values are found in saponite-bearing basalts at the top of the volcanic sections of both holes, and are attributed to the preferential incorporation of heavy Mg isotopes into secondary clays (Mg-saponite). Lower δ^{26}Mg values recorded in the deeper part of the volcanic section may be a result of fluid-rock interaction with isotopically lighter evolved seawater, or may reflect the precipitation of carbonates that preferentially incorporate lighter Mg isotopes. The transition zone is characterised by MORB-like to relatively high δ^{26}Mg values in the chlorite-smectite bearing basalts. The sheeted dike complex yields a narrow range of MORB-like δ^{26}Mg values suggesting that limited fractionation occurs during high-temperature alteration and that the fluids have very low Mg concentrations.

[1] Teng et al., (2010) GCA 74, 4150-4166.