# Mg isotope fractionation during fluid-ultramafic rock interaction

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Riverine and ocean waters are enriched in $^{24}$Mg compared to the homogenous chondritic Mg isotope composition of the Earth's mantle [1] requiring a fractionation step that is generally attributed to continental crust weathering [2,3].

Here we present new observations indicating that both weathering and hydrothermal alteration of ultramafic rocks strongly influence the Mg isotope ratio of their alteration fluids. Weathering of the serpentinized peridotite ($\delta^{26}$Mg (DSM3)=-0.11±0.05‰) on the continental crust causes significant enrichment of $^{24}$Mg in the local runoff ($\delta^{26}$Mg=-1.36±0.24 ‰) that precipitates equally $^{24}$Mg enriched hydrous Mg-carbonate minerals. The Mg isotope ratio of weathering rinds around pristine peridotite does not balance the preferential removal of $^{24}$Mg by the local runoff.

In contrast, hydrothermal serpentinite carbonation results in the formation of magnesite with a Mg isotope ratio ($\delta^{26}$Mg=-0.95±0.15 ‰) similar to ocean water, while talc preferentially incorporates $^{26}$Mg ($\delta^{26}$Mg=0.17±0.08 ‰) [4]. Invariant Mg isotope ratios of coexisting serpentine and olivine indicate that serpentinization does not fractionate Mg isotopes. Our observations suggest that the ocean water Mg isotopic composition may not only be altered by addition of $^{24}$Mg from continental weathering but also due to hydrothermal processes on the ocean floor involving formation of talc and Mg-carbonate. Carbonate precipitation during oceanic crust alteration may represent sink balancing the addition of $^{24}$Mg from continental runoff. Additionally, the formation of recently discovered submarine, talc dominated hydrothermal vents at the Von Damm Vent Field [5] may effectively sequester $^{26}$Mg from seawater that interacted with gabbro and peridotite prior to its discharge into the ocean and may thus represent a missing link in the global Mg cycle.

[1] Teng *et al.*, (2007) *EPSL* **26**, 84-92. [2] Tipper *et al.*, (2006) *EPSL* **247**, 267-279. [3] Wimpenny *et al.*, (2010) *GCA* **74**, 5259-5279. [4] Beinlich *et al.* (2014) *EPSL* **392**, 166-176. [5] Hodgkinson *et al.* (2015) *Nature Comm.* **6**, 10150.