Geophysical Research Abstracts
Vol. 14, EGU2012-3062, 2012
EGU General Assembly 2012

Constraints on continental crustal mass loss via chemical weathering using lithium and its isotopes

R.L. Rudnick and X.M. Liu
Dept. Geology, University of Maryland, United States (rudnick@umd.edu)

The continental crust has an "intermediate" bulk composition that is distinct from primary melts of peridotitic mantle (basalt or picrite). This mismatch between the "building blocks" and the "edifice" that is the continental crust points to the operation of processes that preferentially remove mafic to ultramafic material from the continents. Such processes include lower crustal recycling (via density foundering or lower crustal subduction – e.g., relamination, Hacker et al., 2011, EPSL), generation of evolved melts via slab melting, and/or chemical weathering. Stable isotope systems point to the influence of chemical weathering on the bulk crust composition: the oxygen isotope composition of the bulk crust is distinctly heavier than that of primary, mantle-derived melts (Simon and Lecuyer, 2005, G-cubed) and the Li isotopic composition of the bulk crust is distinctly lighter than that of mantle-derive melts (Teng et al., 2004, GCA; 2008, Chem. Geol.). Both signatures mark the imprint of chemical weathering on the bulk crust composition. Here, we use a simple mass balance model for lithium inputs and outputs from the continental crust to quantify the mass lost due to chemical weathering. We find that a minimum of 15%, a maximum of 60%, and a best estimate of $\sim$40% of the original juvenile rock mass may have been lost via chemical weathering. The accumulated percentage of mass loss due to chemical weathering leads to an average global chemical weathering rate (CWR) of $\sim 1\times10^{10}$ to 2×10^{10} t/yr since 3.5 Ga, which is about an order of magnitude higher than the minimum estimates based on modern rivers (Gaillardet et al., 1999, Chem. Geol.). While we cannot constrain the exact portion of crustal mass loss via chemical weathering, given the uncertainties of the calculation, we can demonstrate that the weathering flux is non-zero. Therefore, chemical weathering must play a role in the evolution of the composition and mass of the continental crust.