

Low $\delta^7\text{Li}$ regolith produced during basalt weathering: A case study from the Columbia River Basalts

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Chemical weathering may influence the bulk composition of the continental crust [1, and references therein]. Because Li isotopes fractionate significantly during continental weathering, they may provide a useful tool for evaluating the influence of weathering on crust composition and secular changes in continental weathering intensities and processes.

Li isotopes were analyzed on two ~10 m deep drill cores through bauxites developed on Columbia River Basalts in Oregon and Washington, west of the Cascade Mtns. Both profiles are strongly depleted in Li (normalized to immobile Hf) relative to fresh basalt, consistent with Li loss via leaching during weathering. However, contrary to simple leaching, Li concentrations increase upwards in the profiles, with the most intensively weathered bauxites at the tops of the profiles having higher Li than lower sections of the profiles. In addition, $\delta^7\text{Li}$ values decrease systematically towards the surface, reaching values that are 6 to 8‰ lower than those of the fresh basalt. These results cannot be explained by Li loss via equilibrium Rayleigh distillation, as this would produce a positive correlation between Li concentration and $\delta^7\text{Li}$, and the opposite is observed. These findings are remarkably similar to those for a 50 m laterite profile developed on the Deccan basalts [2], which suggests a global similarity in process. Although the latter results were attributed to mixing with an unusually isotopically light (-5‰) aeolian component, we suggest instead that the mixing occurs between Li-rich secondary minerals (e.g. clays that preferentially incorporate ⁶Li into their structure) and leached basalt deeper in the profile. This study confirms that chemical weathering of basalts, which may be the main building blocks of the continents, produces large fractionation of Li isotopes and an isotopically light regolith.

[1] Lee *et al.* (2008) *Proc. Natl. Acad. Sci. U.S.A.* **105**, 4981–4986. [2] Kisakurek *et al.* (2004) *Chem. Geol.* **212**, 27–44.

The Dupal isotope anomaly in the Paleo-Asian sub-oceanic mantle: Nd-Sr-Pb isotope evidence from ophiolites in Northern China

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It has been suggested [1] that the Dupal isotope anomaly [2] can be traced in the Paleozoic ophiolites from the Paleo-Asian Ocean (PAO), which was formed during the break up of the Rodinia Supercontinent between 1000 and 300 Ma [3]. New Sr, Nd and high-precision Pb isotope data for basalts, gabbros and plagioclase separates from the ophiolites in the E and W Junggar blocks and central Tianshan tectonic zone in the southern PAO combined with published data suggest that the PAO crust and related arc magmas indeed have a Dupal-like isotope signature. In detail, the Pb isotopic compositions of the plagioclases are more tightly clustered than those of the whole rocks, indicating that the Pb isotopic composition of the mafic rocks from the PAO ophiolites may have been compromised by alteration. Nevertheless, all samples have high ²⁰⁸Pb/²⁰⁴Pb for given ²⁰⁶Pb/²⁰⁴Pb ratios (i.e. positive $\Delta 8/4$ values), similar to Indian Ocean MORB. The trace element signatures of the mafic rocks from the W Junggar and central Tianshan ophiolites are similar to those of normal- and enriched-MORB whereas those of the E Junggar ophiolites are transitional between MORB and arc basalt. The new southern PAO samples have higher $\Delta 8/4$ than the early-Paleozoic (570Ma) ophiolites from Agardagh Tes-Chem in the northern PAO [4] and these indicate that the Dupal isotope anomaly became stronger with time and from north to south. Finally, the PAO mantle is isotopically heterogeneous and lends support to the idea that the Dupal isotope anomaly existed prior to the opening of the Indian Ocean [5]. Such a long period of existence and large-scale distribution indicate that the Dupal isotope anomaly may not simply be an attribute of certain mantle domain, but a reflection of a mantle process as well.

[1] Dupre & Allegre (1980) *Nature* **286**, 17–22. [2] Hart (1984) *Nature* **309**, 753–757. [3] Dobrestove *et al.* (1995) *International Geology Review* **37**, 335–360. [4] Pfänder *et al.* (2002) *Contributions to Mineralogy & Petrology* **143**, 154–174. [5] Xu & Castillo (2004) *Tectonophysics* **393**, 9–27.