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Weathering of the Archean Continents: Effect on the Lithium Isotope Composition of the Ancient Ocean

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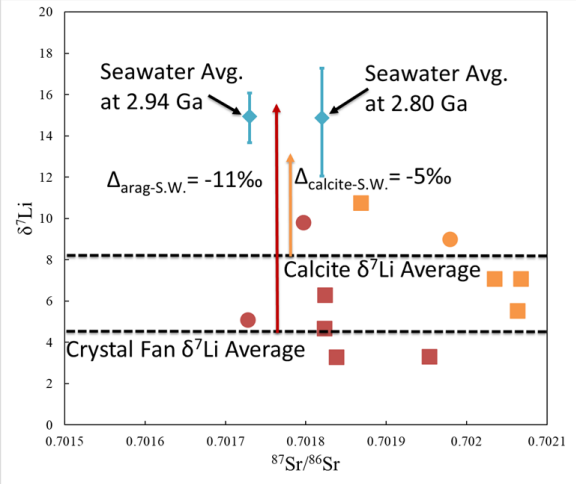

Seawater δ^7Li can help constrain global weathering, due to lithium's long residence time in the ocean and sensitivity to weathering processes [1]. Incongruent weathering results in high δ^7Li riverine fluxes to the ocean, whereas riverine δ^7Li approaches continental values during congruent weathering. We present δ^7Li variations in carbonates from the Red Lake (RL, 2.94 Ga) and Steep Rock (SR, 2.8 Ga) groups in the Superior Province, Canada, to assess Archean Ocean δ^7Li. Samples include dolomites, microbialites (calcite), and (originally aragonite) crystal fans. Carbonate Sr/Ca typically decreases during diagenesis. RL and SR carbonates show a strong negative correlation between Sr/Ca with $\delta^{44/40}$Ca and $^{87}Sr/^{86}Sr$, reflecting variable diagenetic overprinting. δ^7Li in RL and SR dolomites varies greatly (RL: -1.5-1.8‰, SR: 6.6‰). Dolomites were not used to calculate $\delta^7Li_{Archean\ Ocean}$ due to experiencing high levels of diagenesis. Microbialites from RL vary less than those from SR (RL: 7.8-9.0‰, SR: 5.5-10.7‰). Crystal fans were found to have lower δ^7Li than microbialites (RL: 5.1-9.8‰, SR: 3.3-6.3‰), consistent with an original aragonite mineralogy. e estimate Archean seawater δ^7Li by applying experimentally-determined [2] $\Delta^7Li_{aragonite-seawater}$ (and $\Delta^7Li_{calcite-seawater}$ (to the least-altered crystal fan and microbialite samples, respectively ($^{87}Sr/^{86}Sr < 0.7021$; Sr/Ca > 400 µmol/mol). $\delta^7Li_{Archean\ Ocean}$ was constrained to ~14.0- at 2.94 Ga and ~12.1-17.3 at 2.8 Ga, much lighter than modern seawater (31) [3]. Low Archean seawater δ^7Li may reflect intense global weathering of continents due to elevated atmospheric CO_2, consistent with high chemical index of alteration in Archean siliciclastic sediments [4]. Alternatively, riverine input of isotopically heavy Li may have been lower due to lower extent of subaerially exhumed crust. Future work analyzing the evolution of seawater $^{87}Sr/^{86}Sr$ and ε^{40}Ca with δ^7Li may help constrain the impact of continental emergence on seawater chemistry.

[1] Misra, M, PN Froelich (2012), *Science* 335, 818-823; [2] Marriott et al. (2004), Chem. Geol., Lithium Isotope Geochem. 212, 5–15; [3] Tomascak, P.B. (2004), *RiMG* 55, 153–195; [4] Hessler, AM, DR Lowe (2006), *Precambr. Res.* 151, 185-210,