Suppressed silicate weathering recorded by seawater lithium isotopic compositions in the terminal Proterozoic: insights from the Chigebrak Formation in Keping area, NW Tarim Basin

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We report lithium (Li), carbon (C), and strontium (Sr) isotope compositional variations of carbonate leachates obtained from the Chigebrak Formation (Fm.), Shiairik section, Tarim Basin, which is equivalent to the Dengying Fm. in South China. Depositonal ages are between ca. 551 Ma to ca. 542 Ma.

Lithium (Li) isotope analyses of carbonates at the base of the Chigebrak Fm. reveal modern seawater-like $\delta^7Li_{L\text{-}SVEC}$ values (+31 ‰) which decrease to +26 ‰ upsection. This correlates with initial $^{87}Sr/^{86}Sr$ ratios decreasing from modern seawater-like values (0.7091) to a nadir of 0.7085 and a negative carbon isotope excursion falling from +7 ‰ to +1 ‰. The modern seawater-like values indicate similar oceanic conditions as today. The high δ^7Li and $^{87}Sr/^{86}Sr$ values at the base are consistent with the proposed elevated global topography and erosion dominated weathering regime at that time. A strong relative incorporation of Li into secondary minerals and the liberation of radiogenic Sr isotopic signatures in continental crust during silicate weathering is indicated, which creates high riverine δ^7Li and $^{87}Sr/^{86}Sr$.

The observed decline of Li and Sr isotopic compositions at the Shiairik section may indicate a decrease of continental erosion, resulting in a suppression of continental silicate weathering. Coeval the relatively enhanced oxidation of dissolved organic carbon (DOC) might produce the observed negative carbon isotopes excursion. As another possible consequence, suppressed silicate weathering may have further resulted in insufficient nutrient flux to the oceans that could lead to weakening marine productivity, further contributing to a negative carbon isotope excursion. Moreover, the suppressed silicate weathering could be linked to a reduction of atmospheric CO_2 concentrations, presumably caused by the rise of photosynthetic bacteria. The related rise of oxygen stimulated the oxidiation of DOC.