Tracing palaeo-weathering via lithium isotopes

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Chemical weathering of continental silicates is a dominant driving force of the long-term carbon cycle. However, the controlling aspects of silicate weathering are still uncertain, and therefore the forcings of the long-term carbon cycle reamin unclear.

Lithium isotopes are a more unambiguous weathering tracer than more traditional radiogenic isotopes. Li is almost entirely situated in silicates, rather than carbonates, and its isotopic fractionation in rivers is demonstrably due to the ratio of primary rock dissolution to secondary mineral formation, also termed the intensity or congruency of silicate weathering.

Lithium isotopes therefore have potential in examining how weathering and CO_2 drawdown respond to short periods of rapid climate change. We present marine carbonate and clay data from a series of climate warming events (post-Marinoan deglaciation, and the Toarcian, Aptian and Cenomanian-Turonian Oceanic Anoxic Events) and global cooling events (the Ordovician Guttenberg excursion, and the Hirnantian glaciation). These time periods allow us to examine the response of Li isotopes, and hence the response of global weathering processes, to global temperature changes.

In general, negative δ^7Li excursions accompany warming events, and positive excursions accompany cooling events. Modelling of the data shows the reponse of the weathering cycle to climate. In addition, there is an overall shift in baseline δ^7Li values from the early Palaeozoic, implying a change in global continental clay formation, possibly in reponse to the colonisation of the land by plants.