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Changing weathering regimes and lithium isotopes: observations from the present, experiments, modelling and studies of the geological record

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Silicate weathering exerts a fundamental control on long-term climate by removing atmospheric CO_2. It also affects ocean chemistry and organic matter formation and burial on shorter timescales, via the delivery of nutrients and clay minerals. As such, there is a lot of interest in understanding both modern- and palaeo-weathering processes, but glaring gaps in our knowledge existed until the advent of “non-traditional” isotope systems, which have allowed us to start quantifying these processes.

Lithium isotopes provide a tracer of the various silicate weathering regimes, because clay formation causes isotopic fractionation of Li, meaning that residual surface waters become isotopically heavy. Clay formation can potentially inform on CO_2 sequestration efficiency, as continental clay formation can inhibit the transport of relevant cations (Ca, Mg) to the oceans, where they would form carbonates and ultimately sequester CO_2.

This presentation will present modern field observations of solution and solid Li isotopes, and compare them to the results of laboratory weathering experiments. In particular, the evolution of the Li isotope ratios of different solid phases (exchangeable, oxide, etc.) will be examined.

Finally, these results will be discussed in the context of past changes (both measured and modelled) in seawater Li isotopes across climatic perturbations.