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Modelling controls on the lithium cycle through time and their implications for past climate change events

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Lithium isotopes have gained prominence in the field of climate change over the last decade due to their ability to trace silicate weathering processes – the main pathway for CO_2 draw down from the atmosphere [1, 2]. An understanding of past and present changes to the climate can be inferred from lithium isotopes, as the light ^{6}Li isotope is preferentially removed by the formation of secondary minerals (e.g. clays) leaving river waters to deliver isotopically heavy ^{7}Li to the oceans. As carbonate-forming cations are also taken up by clays [3], an isotopically heavier seawater Li signal may indicate extensive clay formation and cation retention on the continents, resulting in inefficient CO_2 sequestration (i.e. a diminished silicate weathering feedback). However, this picture can be complicated by the fact that both marine authigenic clay formation and the alteration of oceanic crust also remove ^{6}Li, enriching the ocean in ^{7}Li [4].

Here we model the lithium cycle through deep time to the present day, assessing the possible primary controls on the long-term record. We start with the simplest of isotope mass balance techniques before moving on to investigating certain paleo-climatic events using a more complex box model which couples the carbon, silicon and lithium cycles together, allowing us to examine the multifaceted relationship between these cycles and the impact on past climate change. In particular, we investigate the impact of clay formation and rock weatherability on climatic recovery rates and processes.

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