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Rapid response of chemical weathering to deglacial and Meghalayan climate change from Li isotopes in Brazilian speleothems

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Chemical weathering is a critical process in the global carbon cycle; it delivers nutrients to the ocean and draws down atmospheric carbon dioxide. However, the response of chemical weathering to climate variability remains poorly quantified. Although records of long-term changes in global weathering can be obtained from ocean sediments, weathering of the Earth surface is spatially highly variable. Novel approaches to reconstruct terrestrial weathering at a catchment scale are therefore required to gain a better understanding of how climate mediates chemical weathering processes, as well as to constrain the composition of weathering inputs to the ocean.

Here we use lithium (Li) isotopes in speleothems from Central Eastern and Northeastern Brazil to explore past changes in regional weathering processes in response to rapid late Pleistocene climate variability. A previous study of Li isotopes in speleothems from Israel has indicated a temperature control on weathering [1], whereas the new records from Brazil provide an opportunity to assess the effects of precipitation changes during the deglaciation and soil erosion during the Holocene, which were independently reconstructed using other proxies [2,3].

A deglacial record spanning 0-28 ka BP from Central Eastern Brazil reveals variability in δ^7Li from -1 to +4 ‰ that was coupled to millennial-scale climate oscillations. These data suggest that moisture availability exerts a control on weathering congruence (i.e., rock dissolution versus clay formation) in the overlying soils and karst. Much larger Li isotope changes, ranging from -9 to +9 ‰, are recorded in a Holocene record from Northeastern Brazil. Here, an abrupt Li isotope excursion at ~4.5 ka BP coincides with the transition into the arid Meghalayan period and appears to have been linked to a major episode of soil erosion.

Overall, these new records indicate a close and rapid coupling between local climate, soil formation, and chemical weathering processes, while also informing on potential mechanisms influencing past changes in seawater Li isotope compositions.

[1] Pogge von Strandmann et al. (2017), *EPSL* 469, 64-74.

[2] Strikis et al. (2018), *PNAS* 115, 3788-3793.

[3] Utida et al. (2020), *QSR* 250, 106655.