Enhanced silicate weathering across the Triassic-Jurassic Boundary

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Earth's climate has remained habitable and surprisingly clement for the majority of Earth's history, which can be explained by a silicate weathering-climate feedback. Traditionally, continental silicate weathering has been invoked as the main driver in climate regulation. However, seafloor weathering, or low-temperature alteration of basalts in off-axis hydrothermal systems, has also been suggested as a temperature-sensitive sink of CO_2. To advance understanding of the mechanisms regulating climate, we investigated global weathering behavior in the face of increased atmospheric pCO_2 across the relatively short-term but extreme carbon injection that occurred at the Triassic-Jurassic Boundary (TJB, ~201 Ma) when CO_2 was rapidly released from Central Atlantic Magmatic Province (CAMP) volcanism.

Using a suite of silicate weathering proxies – Li, Sr, and Os isotopes – with a stochastic mass balance model provides a new means to gauge the relative strength of the terrestrial and marine silicate weathering feedbacks. Seawater Sr and Os isotopes predominantly reflect the balance between weathering of mafic, felsic, and sedimentary rocks and contribution of juvenile mantle-derived sources, and cannot on their own differentiate between terrestrial and seafloor weathering. Following pulses of atmospheric CO_2 injection, Li isotopes (δ^7Li) in the oceans will track continental weathering intensity (likely shifting global weathering regimes and driving δ^7Li to lower values) and its sink in altered basalts (driving seawater to higher δ^7Li values). Li isotopes can, therefore, provide insight to the mode and magnitude of silicate weathering.

We present new δ^7Li records generated from marine carbonate sections spanning the TJB of the Lombardy Basin, Italy and Csővár, Hungary. Both sections display a pronounced and coherent drop in δ^7Li across the TJB, coincident with rapid release of CO_2 from CAMP. Coupled with modeling efforts, these results help to distinguish the relative importance of continental and seafloor weathering in Earth's internal thermostat.