Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.37539

Heterogenous lithium isotope records in carbonate and siliciclastic archives in the Early Triassic: evaluating a highly perturbed lithium cycle

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Following the end-Permian mass extinction, temperatures remained elevated for ~5 Myr, suggesting a fundamental restructuring of the Earth's climate system. Both a weak silicate weathering feedback and CO_2 release from enhanced marine authigenic clay precipitation are proposed to have sustained elevated temperatures during the Early Triassic. The lithium isotope (δ^7Li) proxy can reveal the roles of terrestrial and marine reverse weathering in maintaining elevated Early Triassic temperatures. We present the first δ^7Li values from Upper Permian to Middle Triassic carbonate strata from the Panthalassa Ocean and the western Tethys Ocean. At the Permian/Triassic boundary, carbonate δ^7Li values in these records, along with previously published data from the eastern Tethys, are consistently below 0‰, and remain low in the Early Triassic. Differences in carbonate δ^7Li values among sections are interpreted as the combined influence of diagenetic alteration and carbonate mineralogy on the isotopic fractionation from co-eval seawater. In the Early Triassic, we observe a large difference between carbonate δ^7Li values and published siliciclastic records following the extinction. Even after accounting for carbonate diagenesis, these paired records imply Li isotope fractionation between carbonate minerals, authigenic marine clay, and seawater that are distinct from modern marine environments. Inferred minimum and maximum constraints on seawater δ^7Li values from these Early Triassic records are also incompatible. We hypothesize that a reduced oceanic Li reservoir—and thus, short residence time—may account for the anomalous Early Triassic δ^7Li records, implying a simultaneous increase in continental weathering and marine clay authigenesis. Heterogeneous seawater δ^7Li records in the Early Triassic could be, therefore, a potential symptom of perturbed carbon-silica cycling that permitted elevated temperatures to persist far longer than the typical timescale for the silicate weathering feedback on Earth's climate.