Goldschmidt 2024 Abstract
https://doi.org/10.46247/gold2024.22306

Lithium Isotopes in Marine Carbonates: A Triple Lens on Weathering, Hydrothermal Activity, and Reverse Weathering

PROF. XIAO-MING LIU, PH.D.

University of North Carolina at Chapel Hill

Presenting Author: xiaomliu@unc.edu

The lithium isotope composition (δ^7Li) of marine carbonates offers a unique window into the interplay of continental weathering, hydrothermal activity, and reverse weathering across geologic time. Here I present an integrated analysis of δ^7Li in marine carbonates spanning the Neogene, the Jurassic, and the Permian to early Triassic periods, and revealing insights into the dynamic processes that have determined the seawater composition through geological time.

During the Neogene period, our examination of dolostones from the South China Sea documented a significant δ^7Li increase from 24.9‰ to 30.1‰, aligning with foraminifera records and indicating a potential rise in continental silicate weathering intensity associated with the rise of Himalaya. This enhancement not only confirms dolostones as reliable proxies for ancient seawater δ^7Li but also suggests their reliability as a paleo seawater proxy. In the Jurassic period, our analysis of carbonates from the Adriatic Carbonate Platform reveals stable δ^7Li values, indicative of low Mesozoic seawater δ^7Li levels. Advanced modeling suggests that this equilibrium resulted from increased hydrothermal fluxes counterbalanced by enhanced chemical weathering, highlighting the profound influence of hydrothermal activity on the marine lithium cycle. Transitioning to the Permian-Triassic boundary, our findings reveal adjustments in seawater δ^7Li that contrast with previous models, emphasizing increasing reverse weathering to explain the trends observed. This period also witnessed fluctuations in chemical weathering rates in the early Triassic and increased hydrothermal activity in the middle-Permian. These adjustments underscore reverse weathering's key role in modulating atmospheric CO_2 levels, thereby impacting the protracted recovery following the Permian-Triassic mass extinction and illuminating the complex feedback mechanisms between lithospheric activities and earth surface changes.

Collectively, these investigations not only refine δ^7Li in marine carbonates as a proxy for past seawater composition but also broaden our understanding of the complex processes governing Earth's long-term climate and geochemical evolution. Our findings emphasize the feedback mechanisms between lithospheric and Earth surface activities that have shaped the planet's environmental history.