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Lithium Isotopes as Tracers of Authigenic Clay Formation in the South Pacific Gyre: Implications for Cenozoic Climate

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Lithium isotopes could be powerful tracers of authigenic clay formation in marine sediments, a process that affects seawater chemistry and may play a role in the global carbon cycle. In-situ authigenic clay formation in marine sediments is at times accompanied by the consumption of seawater alkalinity and the release of CO_2 back to the ocean-atmosphere system, a reaction known as “reverse weathering.” Consequently, marine clay authigenesis could play a critical role in the global carbon cycle and climate regulation over geological timescales. Previous studies[1,2,3] have employed various geochemical proxies and models to explain the relationship between authigenic clays and Cenozoic climate, yet they yield conflicting conclusions. While $\delta^{26}Mg$ analyses and multivariate sediment models of marine sediments suggest a decline in authigenic clay formation over the Cenozoic[1], seawater $\delta^{7}Li$ records and mass balance models imply a potential increase in reverse weathering over the Cenozoic[3]. In this study, we apply Li isotope measurements and mass balance models to reconstruct the Li budget and history of clay authigenesis in marine sediments. We analyzed $\delta^{7}Li$ compositions of bulk marine sediments from the South Pacific Gyre (SPG), collected during Integrated Ocean Drilling Program (IOPD) Expedition 329. The SPG sites are ideal study locations because the cores preserve records of basin evolution, and lower sedimentation rates minimize the dilution of authigenic phases by detrital material. Our results demonstrate that sediment $\delta^{7}Li$ records in the SPG are responsive to changes in sediment sources and diagenetic processes throughout the evolution of the basin over the last 100 million years. These records effectively track authigenic reactions, namely volcanic ash alteration and/or reverse weathering type reactions, both of which modulate seawater alkalinity and therefore remain significant to the global carbon cycle.

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