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Trace The Formation of Ancient Marine Authigenic Clays Using Metal Isotope Proxies

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It has been proposed that marine authigenic clay formation counterbalances the effects of silicate weathering, thereby imposing a critical control on the long-term stability of Earth's climate and ocean chemistry (e.g., pH) [1]. Formation of authigenic clay minerals requires silica as a key ingredient. Because of the absence of siliceous organisms (e.g., sponges, radiolarians) in Precambrian oceans, seawater at the time is thought to have Si concentrations much higher than today. Geochemical models, therefore, hypothesized that the Si-rich seawater could promote extensive authigenic clay formation in Precambrian oceans. However, this hypothesis remains controversial due to a lack of direct evidence that can reflect changes in the magnitude of authigenic clay formation. Marine authigenic clay formation is one of the significant ways known to be "reverse-weathering" which serves as a notable sink of many alkali elements. Isotopic signatures of marine sediments are able to be well preserved even after going through a long period of burial. In this study, we collect a series of samples from two cap carbonate sections in the earliest Ediacaran representing proximal and distal settings. Using a sequential leaching method, we remove the carbonate components and obtain the carbonate-associated silicate components which turn out to be mainly consist of marine authigenic clays. Metal isotopes of these two sections show large difference at the bottom but overlap each other in the middle and upper cap carbonate, here we recommend a well-mixed ocean with uniform geochemical compositions of seawater. Together with a previous study [2] of lithium isotope in this era, we further propose a gradual change in marine authigenic clay formation rate at the beginning of Ediacaran.

Reference

[1] Kalderon-Asaell, B., Katchinoff, J.A.R., Planavsky, N.J. et al. A lithium-isotope perspective on the evolution of carbon and silicon cycles. Nature 595, 394-398 (2021).

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