Goldschmidt 2025 Abstract
https://doi.org/10.7185/gold2025.31907

Disentangling the silicate weathering, reverse weathering and cap carbonate deposition during the transition from Marinoan Snowball Earth to Ediacaran greenhouse

XINYANG CHEN[1], JUN HU[2], BIAO LI[1], ZHIGUANG XIA[1], SHICHAO AN[3], WEIQIANG LI[3] AND CHAO LI[1]

[1]Chengdu University of Technology
[2]China University of Geosciences (Wuhan)
[3]Nanjing University

The transition from the Marinoan (ca. 650 to 635 Ma) glaciation to the ensuing Ediacaran is accompanied by marked changes in global climate, oxygen levels, and biological diversification. It has been proposed that silicate weathering was significantly enhanced during the deglaciation owing to early build-up of atmospheric CO_2. Additionally, marine authigenic clay formation (reverse weathering) could have played important roles in the carbon cycle during the Precambrian due to much higher seawater silica content. Recent modeling work suggests that seafloor weathering during the Snowball period may supply additional alkalinity. But large-scale carbonate deposition only occurred after the onset of the deglaciation. Alternatively, the alkalinity produced by seafloor basalt weathering during the glacial period could have been consumed by enhanced authigenic clay formation. Melting of the Snowball generated substantial alkalinity and cations, subsequently caused the marine system to switch from dominated clay formation to carbonate deposition. The key to disentangle the intricate balance between silicate weathering-reverse weathering-carbonate deposition lies in finding proper geochemical proxies. Here we provide stable potassium (K) and magnesium (Mg) isotope records of sedimentary strata from South China that include fine-grained silicate rocks of the Nantuo Formation deposited during the deglaciation of the Marinoan Snowball event and silicates from the overlying Doushantuo Formation. The K isotopes of bulk rock (from -1.0 to -0.8‰) are significantly lower, while the bulk Mg isotopes (-0.16 to 0.66‰) are much higher than the average upper continental crust. The extracted clay fraction displayed nearly identical K isotopes values with the bulk rock, suggesting that K was mostly hosted in the clays. In contrast, the Mg isotopes are generally higher in the clay fraction, perhaps due to the presence of carbonate clasts in the bulk rock. In combination with major-trace elements, XRD and SEM analyses, we developed an interpretive framework for the temporal and spatial variations in continental weathering and reverse weathering and their influence on the ocean chemistry. Together, these data will result in a better understanding of the co-evolution of life and environment in such harsh conditions.