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High Marine Primary Productivity Following the Marinoan Glaciation: from Ba isotope evidence

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Primary productivity influences marine ecosystems and their associated biogeochemical metal cycling. After the Marinoan glaciation (~635 Ma), productivity recovered, fueling rapid morphological diversification in eukaryotes and the radiation of early metazoans through bottom-up ecological regulation. However, the timing of this post-glacial productivity rebound remains debated.

Barium isotopes ($\delta^{138}Ba$) have recently emerged as a proxy for reconstructing paleoproductivity. In this study, we present new Ba isotope data spanning glacial diamictites of the Marinoan glaciation through post-Marinoan cap carbonate deposition on the Yangtze Platform across a range of depositional environments, including outer-shelf, slope, and deep-basin facies. In deep-basin settings—and intermittently on the outer shelf—$\delta^{138}Ba$ values in glacial diamictites and carbonates are persistently offset from upper continental crust (UCC), suggesting that $\delta^{138}Ba$ in deep-water settings may provide a reliable record of contemporaneous changes in marine primary productivity.

These elevated $\delta^{138}Ba$ values could imply a globally sustained high level of marine primary productivity from the late Marinoan glaciation through the post-glacial interval. If this interpretation is correct, such productivity would have provided the material basis for the post-glacial surge in biodiversity and the radiation of metazoans with increasingly complex morphologies, metabolic strategies, and ecological adaptations. It would also have substantially altered marine elemental cycling via redox-sensitive processes and changes in organic matter export, underscoring the dual role of productivity in shaping both biological evolution and geochemical cycles in the post-glacial ocean.