Goldschmidt 2025 Abstract
https://doi.org/10.7185/gold2025.30303

Enhanced continental weathering or reverse weathering in the aftermath of Cryogenian glaciations?

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The Cryogenian Period comprises two episodes of global glaciation separated by a non-glacial interval. The end of the Sturtian (ended ~660 Ma) and the Marinoan (~ 635 Ma) glaciations are time intervals during which global mean temperature and atmospheric pCO2 increased rapidly from icehouse to super-greenhouse conditions, representing some of the most profound paleoclimatic shifts in Earth's history. It has been suggested that climatic recovery from the post-glacial extreme greenhouse conditions was rapid, largely due to accelerated and intensified silicate weathering and associated CO_2 removal (1, 2) facilitated by the availability of highly reactive glacial 'rock flour'. On the other hand, there is also emerging evidence that the initial phase of deglaciation was accompanied by extensive marine authigenic clay formation (3–5), fuelled by the enhanced delivery of weathering products to the ocean. Importantly, recent modelling efforts suggest that CO_2 released by reverse weathering reactions may have greatly delayed the climatic recovery (4).

Our current understanding of the silicate weathering response to Cryogenian deglaciation is limited by the small number of sections where these questions have been examined to date, as well as a reliance on Li and Mg isotope analyses of the non-carbonate aluminosilicate fraction (2, 4). Since the detrital silicate fraction only preserves a local continental weathering record, and because the Li or Mg isotope 'fingerprint' of marine authigenic clays has not been robustly determined to date, a global picture has yet to emerge.

Our study aims to address this gap, examining Cryogenian/Ediacaran deglacial intervals in three widely geographically dispersed Australian sections. We employ an ensemble of geochemical, petrographic and mineralogical tools to assess the extent to which compositional shifts in the aluminosilicate fraction of post-glacial mudstones reflect changes to continental weathering vs marine reverse weathering.

(1) Penman *et al.*, *Geology* **47**, 317 (2019).

(2) Wei *et al.*, *Earth and Planetary Science Letters* **539**, 116244 (2020).

(3) Han *et al.*, *Earth and Planetary Science Letters* **626**, 118524 (2024).

(4) Li *et al.*, *Precambrian Research* **364**, 106279 (2021).

(5) Yin *et al.*, *Earth and Planetary Science Letters* **623**, 118423 (2023).