Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.38177

Great Oxidation triggered by Palaeoproterozoic Snowball Earth

COLIN GOLDBLATT[1] AND JULIA HORNE[1,2]

[1]University of Victoria
[2]Carleton University

The Palaeoproterozoic Great Oxidation event was the biggest chemical change in Earth history, and occurred at the same time as low-latitude ``Snowball Earth" glaciations. Yet which of these events caused the other remains controversial: a decline in methane associated with the Great Oxidation is often cited as the trigger of glaciation, despite weak support for this. Here, we use a coupled geochemical-climate model including Earth's C, N, O, and P cycles to model the Earth's evolution through the Great Oxidation and Palaeoproterozoic glaciations for the first time. We show that the Great Oxidation was triggered by Snowball Earth glaciation, which itself was caused by a decline in carbon dioxide levels. Methane levels actually increase across the Great Oxidation, driven by an increase in productivity and decomposition. We demonstrate that the mechanism causing glaciations is the short-term positive feedback between declining temperatures and increasing solubility, which crashes atmospheric carbon dioxide. When combined with tectonic changes, we can produce repeating glacial and oxygenation events across the Palaeoproterozoic. Oxygen levels oscillate with climate, driven by changing continental weathering and primary production. Our work illustrates that atmospheric oxygenation was a complex event triggered by global glaciation. We demonstrate for the first time a mechanism for glacial instigation by carbon dioxide, reorienting our understanding of these unique climate catastrophes.