Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.36850

The Great Oxidation Episode: Earth System change triggered by endogenic evolution

ANDREY BEKKER

University of California, Riverside

The Great Oxidation Episode (GOE) was the most dramatic change in Earth's evolution from largely anoxic to oxygenated surface redox conditions between ca. 2.45 and 2.06 Ga ago. While at first it was considered to be a single, secular change, subsequent studies have shown multiple rises and falls in atmospheric oxygen in association with severe glaciations between ca. 2.45 and 2.22 Ga before the irreversible transition to the oxygenated atmosphere. The amplitude of these oscillations as well as triggering mechanisms are still uncertain and debated.

The GOE corresponds to the protracted rifting of the low-latitude positioned Superia Supercraton and emplacement of multiple Large Igneous Provinces worldwide between ca. 2.5 and 2.45 Ga. The lead to the GOE is also marked by an extensive episode of massive banded iron formation deposition. Associated delivery of reductants with extensive magmatism seems to contradict the notion of a gradual transition to the oxygenated world and requires instead an abrupt change, potentially triggered by tectonics and magmatism. Coupling between oscillating atmospheric oxygen levels and glaciations has been explained mechanistically by oxidation of atmospheric methane, triggering Snowball Earth conditions. Sulfate evaporite of the ca. 2.4 Ga Duitschland Formation in South Africa, deposited after the second Paleoproterozoic glaciation, and ca. 2.32 Ga Gordon Lake Formation of Canada, deposited after the third Paleoproterozoic glaciation, suggest significant increases in ocean oxidation and buildup of seawater sulfate reservoir during interglacial time intervals.

The last Paleoproterozoic glaciation ended with an irreversible transition to oxygenated atmosphere, long-term greenhouse conditions, and longest and largest carbon isotope excursion in seawater composition, the Lomagundi carbon isotope excursion, between ca. 2.22 and 2.06 Ga. This event has been linked to high delivery of nutrient from the continents, triggered by oxidative weathering, and led to high relative burial rate of organic carbon and further surface oxygenation.