Resolving history of the early Paleoproterozoic time

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Transition from anoxic to oxygenated Earth's surface environments in the early Paleoproterozoic (2.5-2.0 Ga) was accompanied by a number of equally dramatic changes. Geochronologic and stratigraphic data helps constrain cause and effect relationships among these events. The low-latitude positioned supercontinent Kenorland was impacted by a number of magmatic events resulting in emplacement of LIPs between ~2.50 and 2.42 Ga in association with the protracted supercontinent rifting. Intense chemical weathering of juvenile magmatic rocks under low-latitude conditions and enhanced biological productivity related to a large terrestrial P flux likely led to CO_2 drawdown and, ultimately, to glaciations. Rises and falls in atmospheric and ocean oxygenation were closely coupled to the Huronian glaciations, with oxygenation events leading to and reducing conditions restricted to the Snowball Earth glaciations and their immediate aftermaths. This period marked by dramatic surface redox fluctuations and three glaciations ended up with the ~2.36-2.32 Ga magmatic activity at high latitudes and irreversible surface oxygenation. Extensive magmatic activity at ~2.22 Ga at low latitudes affected all continents and initiated the breakup of the supercontinent; in South Africa, it is associated with a glaciation, which is not yet recognized on other continents. Carbon isotope values in sedimentary carbonates, reflecting global organic carbon burial, began to fluctuate before the first Huronian glaciation with the progressively increasing magnitude with the decreasing age. Large, positive carbon isotope excursions occurred between the second and third Huronian glaciations, at ~2.32 Ga, and, finally, between ~2.22 and 2.1 Ga (as the long-lasted, large-magnitude Lomagundi Excursion). The Lomagundi Excursion was followed by a deoxygenation event inferred to be due to either decreased terrestrial nutrient (P) flux or chemical weathering of organic-rich shales deposited during the Lomagundi Excursion. Short-lived carbon isotope excursions might have continued after the end of the Lomagundi Excursion. Tantalizingly, similar events and temporal trends are also observed in the Tonian leading to the Neoproterozoic oxygenation event. It seems likely that tectonic and magmatic activity rather than evolution of life and surface conditions determined long-term changes in climate and composition of the atmosphere and ocean at both ends of the Proterozoic.