

Weathering tracers of the environmental changes across the Archean and Proterozoic transitions in the Earth history

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Weathering is a controlling factor in so-called “Critical Zone”, the near-surface environment where water, rock, air, and life meet in a dynamic interplay that generates soils, sustains ecosystems, and shapes landscapes (Brantley et al 2007). This, in turn, allows quantification of feedbacks between climate, tectonics and weathering over billions of years on Earth and beyond.

Paleosols as remains of ancient soils are of special interest for understanding the coevolution of atmosphere/lithosphere in symbiosis with biota (Och, Shields-Zhou 2012). The weathering has played intriguingly important role in the evolution of Earth hallmarked with two milestones. First, the Archean-Proterozoic transition when Great Oxygenation Event (GOE) occurred at 2.3 Ga (Holland 2006). Secondly, the Proterozoic-Phanerozoic transition (ca 1.0–0.5 Ga) marked by significant environmental changes: reconstruction of biogeochemical cycles, global glaciations followed by transient greenhouse periods, final oxygenation of atmosphere and the emergence of multicellular animal life, however, mechanisms behind all these changes are still heavily debated.

Oxygenation of the atmosphere during GOE when the O₂ reached 1% of the present atmospheric level (PAL) caused significant enhancement in continental weathering rates by oxidation of terrestrial sulphides and formation of acidic surface waters, and boost in nutrients inflow to the oceans. GOE was followed by a poorly explained collapse in atmospheric O₂. Mn-leaching of paleosols and Cr-isotope signatures suggest level of atmospheric O₂ in the Mesoproterozoic as low as <0.1% PAL (Lyons et al 2014). These conditions might have lasted until early Neoproterozoic (1.0-0.8 Ga) when Neoproterozoic Oxygenation Event (Och, Shields-Zhou 2012) started as suggested by a significant shifts in oceanic chemistry (Guilbaud et al 2015).

I review and discuss the weathering indicators as recording the environmental conditions across these important time-periods in the Earth

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