Tracking oxidative weathering on the early Earth: Evolutionary and ecological implications

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Abstract

The oxygenation of the atmosphere and oceans is arguably the most significant change in seawater and atmospheric chemistry in Earth history. Geochemical evidence indicates that this oxygenation occurred in two broad steps. The first increase took place between approximately 2,540 and 2,200 Ma and set the stage for oxidative weathering and oxygenation of the shallow surface ocean. The second rise occurred during the late Neoproterozoic approximately 800-541 Ma leading to oxygenation of the deep ocean and ultimately paving the way for the rise of animal life. In this light, the cycle of biologically important trace metals was strongly affected in both, continental and marine environments affecting primary productivity and limiting the ecological distribution of organisms. However, the reasons underpinning the rise of oxygen have been difficult to explain. Mysteriously, the first oxygen-producing organisms (cyanobacteria) evolved hundreds of millions of years before atmospheric oxygen levels significantly increased. Answering this question is one of the biggest challenges facing Earth scientists today. In this talk, I will present some recent ideas that might explain the cause of this delay and help to better understand the reasons behind Earth's oxygenation.