

Evolving weathering processes during the Archean Eon

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Weathering is a key component of the Earth system, linking the evolution of Earth and life by shaping biogeochemical cycles and surface environments. During the Archean Eon (4.0 to 2.5 Ga), both the nature and rates of weathering processes were dramatically different from today's, reflecting differences in mantle temperature, crustal development, atmospheric composition, and life. In general, acidic dissolution of minerals was greatly facilitated by high atmospheric $p\text{CO}_2$, but an anoxic atmosphere limited oxidative weathering; instead, reductive weathering prevailed. Limited emergence and low elevation of subaerial land limited the rates of global erosion and weathering until late in the eon. Microorganisms likely contributed to Archean weathering, but the overall contribution of biological processes was limited compared with younger times. Late Archean crustal emergence and elevation resulted in increasing global weathering and nutrient delivery to the oceans, paving the way for atmospheric transformation during the Great Oxidation Event.