Geophysical Research Abstracts
Vol. 21, EGU2019-13923, 2019
EGU General Assembly 2019

The rise and fall of Archean bedded barite: a record of emergent crustal weathering and biosphere development

Desiree Roerdink (1), Cédric Hamelin (1), Yuval Ronen (1), Helen King (2), and Paul Mason (2)

(1) Department of Earth Science, University of Bergen, Bergen, Norway (desiree.roerdink@uib.no), (2) Department of Earth Sciences, Utrecht University, Utrecht, The Netherlands

Changes in the abundance of sedimentary sulfate minerals through time have been used as key evidence for the evolution of the atmosphere and hydrosphere. However, the presence of bedded barite ($BaSO_4$) in the Paleoarchean rock record (3.6-3.2 Ga) seems contradictory with low-sulfate oceans at this time. Large volcanic eruptions, evaporation or magmatic inputs have been proposed as mechanisms for local sulfate enrichments, but none of these models provide an intrinsic reason for the scarcity of barite in the Meso- and Neoarchean. Here, we use Sr isotope data from six 3.52-3.20 Ga barite occurrences to explain the formation of these sulfate deposits in the Paleoarchean, and propose a novel explanation for their subsequent paucity. We report a steep secular $^{87}Sr/^{86}Sr$ trend that records global seawater evolution and indicates the onset of crustal weathering fluxes into the marine environment at 3.6 Ga. Correlation with sulfur isotope anomalies ($\Delta^{33}S$) indicates that this input of material from emerging evolved crust was coupled to an additional source of sulfate from land. We argue that subaerial microbially-assisted oxidation of sulfide resulted in the formation of marine sulfate oases, where elevated sulfate levels enabled precipitation of barite coupled with sulfur isotope fractionation during microbial sulfate reduction. Marine sulfate oases likely persisted in the Meso- and Neoarchean, but we show that a more evolved biosphere could have suppressed large-scale barite deposition through production of crystal growth inhibiting phosphonate species. Our results suggest that interactions between a co-evolving geosphere and biosphere triggered the rise and fall of Archean bedded sulfate deposits.