Colonization of contaminated sediments: Implications in recovery of mass extinctions events

Francisco J. Rodríguez-Tovar[1]*
and Francisco J. Martín-Peinado[2]

[1]Department of Stratigraphy and Paleontology, University of Granada, Spain (*correspondence: fjrtovar@ugr.es)
[2]Department of Soil Science, University of Granada, Spain

Biotic recovery after past bio-events is one of the difficult questions to interpret from mass extinction events. One of the recently proved useful approaches is the comparison with similar unfavourable environmental conditions in recent examples. To interpret the biotic recovery after the K-Pg impact event, characterized by an ejecta layer with high values in Ir as well as by positive anomalies of platinum-group elements and other elements (Zn, As, Cu, Ni, Co, Cr, Fe, etc.), the study of a contaminated area at the Tinto river has been conducted.

The marsh area of the Tinto river, next to the estuary of Huelva (SW Spain), is characterized by high concentrations of heavy metals accumulated in soils and sediments. These elements come from the draining and lixiviation of the river in relation to the Iberian Pyrite Belt, one of the most important polymetallic sulphide formation in Europe that has been exploited by human mining since ancient times. High concentrations of Zn, As, Cu and Tl, were found in the sediments of the marsh areas of two close locations (Palos de la Frontera, and Moguer). Values up to 1688 ppm of Zn, and 125 ppm of As were registered in the surface layer of the sediments; these levels are 2.2 and 2.5-fold, respectively, above the ecotoxicological levels reported in the bibliography. These concentrations should convert the substrate as inhabitable by organisms, but evidences of trace makers were found in this adverse media. Presence of biota colonizing into this high-polluted substrate prevents on a direct interpretation of the dramatic effect of some past bio-events based exclusively in the presence of high levels of toxic components.

The results agree with the recent ichnological evidence of a rapid colonization of the K-Pg boundary ejecta layer, classically interpreted as an inhabitable substrate, by organisms with a high independence with respect to substrate composition.

Paleoarchean barites record microbial reduction of a well-mixed marine sulfate reservoir

Desiree L. Roerdink[1], Paul R.D. Mason,
James Farquhar[2] and Thomas Reimer[3]

[1]Department of Earth Sciences, Utrecht University, The Netherlands (roerdink@geo.uu.nl, mason@geo.uu.nl)
[2]Department of Geology and ESSIC, University of Maryland, College Park, USA (jfarquha@glue.umd.edu)
[3]Bernard-May-Str. 43, Wiesbaden, Germany (tobareim@alice.de)

Bedded barites from the Barberton greenstone belt (South-Africa) preserve a unique record of atmospheric, oceanic and microbial processes involved in the formation and evolution of the Paleoarchean (3.6-3.2 Ga) marine sulfate reservoir [1, 2]. Here, we present multiple sulfur isotope data from the ca. 3.5 Ga Londozi barite deposit in Swaziland, and the ca. 3.4 Ga Vergelegen, 3.26 Ga Stentor and 3.26-3.23 Ga Barite Valley deposits in South Africa. Individual deposits show relatively homogeneous mass-independent signatures ($\Delta^{33}S$, $\Delta^{36}S$) that support a significant contribution of sulfate from photochemical reactions in a low-oxygen atmosphere. Barites are enriched in ^{34}S (average $\delta^{34}S$ = 4.9‰) relative to the inferred composition of atmospheric sulfate ($\delta^{34}S \approx$ -0.5‰), suggesting an important role for global-scale microbial sulfate reduction as a ^{34}S-depleted sink. Modeling shows that variations in $\delta^{34}S$ per deposit can also be linked to active basin-scale biological reduction processes. Observation of relatively constant $\Delta^{33}S$ and $\Delta^{36}S$ in individual deposits and in barites of similar age from other cratons suggests that sulfate accumulated in a well-mixed oceanic sulfate pool, with a residence time similar to or slightly longer than the millenial timescale of barite formation. This global sulfate reservoir fed basins where barite precipitated and sulfate was microbially reduced, with minimal contributions from re-oxidation of sulfide and other sources of juvenile sulfur. Our results demonstrate that sulfate reducing micro-organisms played an important role in the early sulfate cycle similar to modern times, but with considerably less sulfide oxidation than seen in for example the Neoarchean [3].

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