Paper Number: 4673

High-resolution trace metal analysis of a stromatolite deposited during the end-Triassic extinction event.

Petryshyn, V.P.[1,2], Lalonde, S.[1], Greene, S.E.[3], Ibarra, Y.[4], Gammariello, R.[2], Corsetti, F.A.[5], Bottjer, D.J.[5] , and Tripati, A.E.[1,2]

[1]European Institute of Marine Studies (IUEM), Domaines Océaniques, Université de Bretagne Occidentale. 29280 Plouzané, France. v.petryshyn@gmail.com

[2]Department of Earth, Planetary, and Space Sciences, University of California, Los Angeles. Los Angeles, CA, USA

[3]School of Geographical Sciences, University of Bristol. Bristol, United Kingdom

[4]Department of Earth System Science, Stanford University. Stanford, CA, USA

[5]Department of Earth Sciences, University of Southern California, Los Angeles, CA, USA

The end-Triassic mass extinction is one of the most severe biotic crises in the history of our planet. It has been hypothesized that the extinction was triggered by the rapid emplacement of the Central Atlantic Magmatic Province (CAMP) [1], a large igneous province related to the initial rifting of the supercontinent Pangaea around 200 million years ago. As a result of CAMP volcanism, a massive amount of carbon dioxide (CO_2) [2], sulfur dioxide, hydrogen sulfide, and other volatiles were released into the atmosphere, causing global climate changes and a mass extinction [3].

A notable deposit of carbonate stromatolites (microbialite) known as the Cotham Marble (CM) is found in the uppermost Triassic strata of the Cotham Member of the Lilstock Formation in the Southwest United Kingdom. During deposition, the CM would have been located in the shallow Tethys sea between the paleocontinents of Laurasia and Gondwana, though its exact geographical position (e.g. open vs. restricted basin) is debated. The CM microbialites alternate between fine continuous lamination, and a dendritic structure that is infilled with other material. In the dendritic facies, we find an acme of algal prasinophytes assiginable to *Tasmanites*. Prasinophytes are also present in abundance at other boundary intervals around Europe [4]. This prasinophytes spike, coupled with chemostratigraphic and sedimentological evidence, suggests that the CM may represent the mass extinction interval and capture part of the carbon cycle perturbation. Thus, these relatively undeformed microbialites present an opportunity to study the shallow ocean response to the mass injection of CO_2 and other volatiles.

Clumped isotope paleothermometry of the microbialites reveals a distinct difference between laminated and dendritic microfacies, with the laminated portions growing at 33.6 ± 4.3°C, and dendritic portions growing at 21.9 ± 1.8°C. High-precision trace element data from weak leaching of carbonate reveal rare earth element (REE) spectra broadly similar to modern seawater, with positive La anomalies, supra-chondritic Y/Ho ratios, and mild light-to-heavy REE enrichment. However, unlike oxic modern seawater, the microbialites display true positive Ce anomalies that tend to be pronounced in laminated microfacies and weak-to-absent in dendritic microfaces. Y/Ho ratios are similar between the two microfacies, suggesting that changes in basinal restriction may not have been an important factor. The REE data point to variable ambient redox conditions characterized by water column anoxia and perhaps even stratification during the growth of the laminated microfacies bearing positive Ce anomalies.

References:
[1] Blackburn et al., 2013, *Science* v. 340, p. 941-945
[2] Schaller et al., 2011, *Science*, v. 331, p.1404-1409
[3] Richoz et al., 2012, *Nature Geosciences,* v.5, p 662-667
[4] Ibarra et al., 2015, *Scientific Reports,* doi:10.1038/srep19808