Molecular Evidence for Prolonged Photic Zone Euxinia at the Meishan and East Greenland Sections of the Permian Triassic Boundary

R.E. SUMMONS[1], G.D. LOVE[1], L. HAYS[1], C. CAO[2], Y. JIN[2], S.Z. SHEN, K. GRICE[3] AND C.B. FOSTER[4]

1. EAPS Department, Massachusetts Institute of Technology, Cambridge, MA 02139, USA, rsummons@mit.edu,
2. Nanjing Institute of Geology and Palaeontology, Nanjing.
3. Curtin University of Technology, Perth.
4. Geoscience Australia, Canberra.

Shallow and deep water anoxia, euxinia, global warming, Siberian Trap volcanism, collapse and oxidation of methane hydrates, sea level change and bolide impact are among the proposed causes of the Late Permian mass extinction event. Samples from a new core drilled through the Permian-Triassic (P-Tr) Boundary at the type section at Meishan have been examined for biomarker and isotopic evidence of environmental change. Late Permian sediments from Beds 22-27 are characterized by indicators of anoxia including low Pr/Ph ratios and abundant isorenieratane derived from the precursor carotenoid isorenieratene. These latter biomarkers, derived from brown species of green sulfur bacteria (Chlorobiaceae), are considered reliable indicators of euxinic water columns where H_2S extends into the photic zone. Chlorobiaceae biomarkers range from Beds 4 to 39 and highest abundances, through Beds 24 to 27, bracket the major extinction horizon evident in ash Bed 25. Sub-maximal abundances, at Beds 30, 35 and 37 in the early Triassic, coincident with monotonous bivalve shell beds suggestive of mass mortality, indicate that pulses of photic zone euxinia occurred well after the Permian and may have caused the recovery in biodiversity to be protracted.

The prevalence of aryl isoprenoids and isorenieratane is also recorded in a recently cored borehole, Hovea-3, of the Perth Basin, Western Australia [1]. Similar biomarker patterns are present outside the Tethys realm at Kap Stosch in East Greenland. Their presence at disparate locations, worldwide, indicates that water column euxinia was pervasive during and after the extinction event and that sulfide was a key toxin.

At Meishan, a pronounced negative C-isotopic excursion of around 4 per mil for kerogen reaches a maximum near the top of bed 26. This, and roughly parallel shifts in carbonate $\delta^{13}C$, have been observed in other P-Tr sections worldwide. These excursions, and accompanying anomalies in nitrogen and sulfur isotopes, indicate there was a major reorganisation of the global C-cycle over the P-Tr Boundary. Biogeochemical anomalies found at Meishan have much in common with those observed in black shales deposited during the early Aptian, late Cenomanian and late Frasnian oceanic anoxic events. This suggests globally pervasive euxinia is not a rare phenomenon and may explain many of Earth's major mass extinctions.

[1] Grice K. et al., Science **307**, 706-709.