

GLOBAL AND LOCAL CHANGES IN ABUNDANCES AND δD AND $\delta^{13}C$ OF BIOMARKERS ACROSS THE PERMIAN-TRIASSIC BOUNDARY

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The most pronounced mass extinction in the Phanerozoic occurred near the Permian-Triassic (P/Tr) boundary (ca. 252 My ago) (Berner, 2002; Benton & Twitchett, 2003) resulting in loss of up to 95% of marine- and 75% of terrestrial species (Erwin, 1994). Volcanism, methane release from the melting of gas hydrates, bolide impact, global anoxia, oceanic overturn of stagnant deep ocean waters, and outcropping of hydrogen sulphide (Becker et al., 2004; Wignall, 2001; Krull & Retallack 2000; Wignall and Twitchett, 1996; Knoll et al., 1996; Grice et al. 2005a) are mechanisms frequently invoked and strongly debated. It has been suggested that the extinction is a “tangled web of causality” with several mechanisms contributing to the biotic crisis (Erwin, 1994; Racki and Wignall, 2005).

In the present study we focus not only on the extinction horizon but also on the prolonged recovery of the event. A multidisciplinary approach has been undertaken and includes a molecular (biomarker), stable carbon and hydrogen isotopic approach along with palynology, sedimentology, trace elements abundances and sulphur isotope studies of pyrite across the Permian-Triassic boundary and extending into the Early Triassic. Several sediment cores and samples spanning the boundary from a variety of palaeogeographical locations (Western Australia, East Greenland, Spitsbergen and Western Canada) are under investigation to establish a global data set. For the first time, biomarker abundances paired with carbon and hydrogen isotopes and sulphur isotopes of sulphides are being used to correlate events (including changes in the redox conditions) surrounding the collapse of both the marine and terrestrial ecosystems through this major crisis interval in an expanded section (40 m) from East Greenland.

Previous palynological studies on the Schuchert Dal Section have highlighted key changes in the terrestrial plant taxa through the latest Permian and earliest Triassic, displayed in the distribution of spores and pollen (e.g. Looy et al. 2001). Throughout the same period of time, significant changes are observed in the type and abundance of selected biomarkers.

Aromatic compounds (e.g. dibenzothiophene, dibenzofuran and biphenyl) and biomarkers derived from photosynthetic green sulphur bacteria are of particular interest. Recent data of the Schuchert Dal Section from samples just before the extinction horizon are characterised by high abundances of dibenzothiophene (DBT), dibenzofuran (DBF) and biphenyl (BP). We suggest that lignin derived from the woody plants present during this period could be the major source of these compounds. Just above the extinction interval, there is a dramatic decrease in the abundance of these aromatic compounds which coincides with a sudden change in $\delta^{34}\text{S}$ of sulphide minerals from -50‰ to -25‰ due to variations in the redox state of the ocean (Grice et al., 2005a). This trend is not unique to the Schuchert Dal Section as similar trends have also been observed in the Hovea-3 P/Tr section from Western Australia (Grice et al., 2005a). It is suggested that two processes are probably operating here, namely a change in redox conditions and the extinction and/or sea level transgression which could account for the absence of woody material. Further data from other sections (Spitsbergen, Western Canada) will help establish whether these processes are represented globally.

At the same time we are carrying out stable carbon and hydrogen isotopes (D/H and $^{13}\text{C}/^{12}\text{C}$) studies of selected biomarkers by compound specific isotope analyses in order to investigate appreciable changes in the biogeochemical cycling of carbon and hydrogen across the P/Tr boundary. By comparing $^{13}\text{C}/^{12}\text{C}$ and D/H of plants and algae from the land and marine realm, respectively, it is anticipated that the synchronous disturbance in oceanic and atmospheric chemistry during the end-Permian mass extinction event and its protracted recovery will be established. To support this data, D/H of kerogen (Schimmelmann et al., 2006) of selected P/Tr samples of various locations will be determined.

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