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Terrestrial ecosystems during and following the end-Permian mass extinction – or from spore spike to spore spike

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The impact of the end-Permian mass extinction on terrestrial ecosystems is still debated. It has been suggested that the destruction of forests left a low-diversity vegetation behind, which was dominated by pioneering plants unvaried for a time interval of 4-5 Ma (Looy et al., 1999).

Here we present an alternative view of the Early Triassic vegetation history based on the palynofloral records of the Permian-Triassic boundary succession in Norway, and the well-dated Upper Permian to Middle Triassic successions of Pakistan and South Tibet.

In Norway, the end-Permian floral succession is marked by a distinct spore spike, which is associated with the end-Permian mass extinction and coincides with the negative carbon isotope shift that has been reported from numerous other Permian-Triassic boundary sections. Its contemporaneous equivalent in Greenland has been interpreted as signal for terrestrial ecosystem destabilisation and the onset of a long recovery time dominated by pioneering lycopods (Looy et al., 1999; 2001). In contrast, the high resolution record from Norway shows that the end-Permian spore spike is immediately followed by the recovery of gymnosperms. Correlation with the Permian-Triassic stratotype section in Meishan (South China) suggests a recovery time of some 10 ka (Hochuli et al., 2010).

Preliminary results from a new Permian-Triassic boundary section in Pakistan (Amb, Salt Range) do not indicate an end-Permian spore spike so far, however, higher spore abundances close to the Permian-Triassic boundary have been observed from single occurrences at Narmia and Chitta-Landu (Surghar Range). The new results from Amb suggest a gradual floral change reflected in the increasing dominance of lycopod spores towards the Dienerian. In Pakistan palynofloras dominated by lycopod spores and low numbers of pteridosperm and conifer pollen prevail from the Dienerian until the early Smithian and are also known from the early Smithian of South Tibet. In Pakistan these assemblages are followed by a pronounced spore spike in the middle Smithian. Similar to the patterns of the end-Permian record, the middle Smithian spore spike coincides with a negative carbon isotope excursion and is followed by the late Smithian marine extinction event. The recurrent Early Triassic negative carbon isotope excursions have been interpreted to reflect volcanically induced CO_2 pulses (Payne and Kump, 2007), thus environmental perturbations in phases of volcanic degassing might be the common cause for both of these events.

In Pakistan and South Tibet palynofloras of early Spathian age (~2 Ma after the end-Permian extinction event) are characterised by increasing abundance of gymnosperm pollen (conifers and pteridosperms) associated with reduced numbers of lycopod spores indicating the onset of terrestrial ecosystems stabilisation.

The described palynofloral patterns are complex and closely related to the changes in the carbon isotope record, which suggests that the floral recovery dynamics were linked to the environmental conditions.

REFERENCES

Hochuli, P. A., Hermann, E., Vigran, J.O., Bucher, H. & Weissert, H. 2010: Rapid demise and recovery of plant ecosystems across the end-Permian extinction event. Global Planet. Change, 74,144-155.

Looy, C. V., Brugman, W. A., Dilcher, D. L. & Visscher, H. 1999: The delayed resurgence of equatorial forests after the Permian-Triassic ecologic crisis. Proc. Natl. Acad. Sci. USA, 96, 13857-13862.

Looy, C. V., Twitchett, R. J., Dilcher, D. L., Van Konijnenburg-Van Cittert, J. A. H., Visscher, H. 2001: Life in the end-Permian dead zone. Proc. Natl. Acad. Sci. USA, 98, 7879-7883.

Payne, J. L. & Kump, L. R. 2007: Evidence for recurrent Early Triassic massive volcanism from quantitative interpretation of carbon isotope fluctuations. Earth Planet. Sci. Lett., 256, 264-277.