



End-Permian and mid-Early Triassic terrestrial ecosystem turnovers – a comparison

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The major biotic turnovers including the end-Permian extinction event as well as the Triassic-Jurassic, and the Cretaceous-Palaeogene boundary events are associated with short term terrestrial ecosystem perturbations marked by intermittent pteridophyte dominance (McElwain and Punyasena, 2007). These so called fern or spore spikes have been interpreted to reflect stressed ecosystems due to environmental changes (e. g. van de Schootbrugge et al., 2009).

The end-Permian extinction event corresponds to the most pronounced biotic crisis in Earth history with a loss of about 90% of all marine species (Raup, 1979). The impact of this event on terrestrial ecosystems is still controversially discussed. The palynological records from Norway across this event show that the composition of terrestrial ecosystems changed dramatically on a 10ka scale. They document a pronounced spore spike closely related to the PTB negative carbon isotope excursion (Hochuli et al., 2010), which has also been documented in Greenland records (Looy et al., 2001; Stemmerik et al., 2001).

New Early Triassic palynological data from Pakistan (Salt Range and Surghar Range) demonstrate that spore spikes are not only associated with the mentioned mass extinctions but also with the end-Smithian extinction event. During this event ammonoids and conodonts were the clades that suffered the most dramatic losses, documented in the cosmopolitan faunas of the Anasibirites/Wasatchites beds of the late Smithian (Brayard et al., 2006; Orchard et al., 2007; Brühwiler et al., 2010). For conodonts it was even the biggest crisis in the Triassic (Goudemand, et al. 2008). This end-Smithian extinction event is preceded by a pronounced spore spike in the middle Smithian. Similar to the end-Permian floral event the middle Smithian spore spike is associated with a negative isotope excursion and is succeeded by a major marine faunal extinction event of the late Smithian.

The recurrent patterns observed at the end-Permian and in the middle-late Smithian suggest a common scenario for the abiotic/biotic changes. A possible trigger of the environmental stress and associated terrestrial ecosystem upheavals might be massive injections of gases of volcanic origin. Compared to the end-Permian event, the end-Smithian event had probably a somehow reduced impact; however, it is preserved at numerous sites and can be more precisely documented. Therefore the end-Smithian crisis represents the closest analogue for the less well understood end-Permian event.

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