



Climate warming during and in the aftermath of the End-Permian mass extinction (Arne Richter Award for Outstanding ECSs Lecture)

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The end-Permian mass extinction saw the most catastrophic diversity loss in the Phanerozoic. The extinction event was accompanied with a rapid temperature raise from 25 °C to 32 °C across the Permian-Triassic boundary, suggesting a warming climate might have played an important role in the extinction event. This high amplitude warming of ~8-10 °C is seen in South China, Iran and Armenia, pointing to a true global signature. Oxygen isotope data measured from conodont phosphate in South China suggest that the temperature continued to increase in the Early Triassic and reached the first thermal maximum in the late Griesbachian. The late Griesbachian Thermal Maximum accompanied with the extinction of many Permian holdovers, such as the conodont *Hindeodus* and the ammonoid *Otoceras*. The following substage, the Dienerian, saw a 3-4 °C temperature decrease which coincides with a transient recovery pulse in which several groups began to diversify. The early and middle Smithian represent a relatively stable high temperature plateau but the late Smithian saw a further 2°C temperature increase to produce sea surface temperatures that exceeded 40°C. The Late Smithian Thermal Maximum coincided with major diversity loss of marine nektons such as conodont and ammonoid and minor extinctions among many other groups such as bivalves and gastropods. The Spathian saw an initial cooling trend followed by relatively stable temperatures in the middle part and further cooling at the end of this stage and stabilization of temperatures in the earliest Middle Triassic. High amplitude temperature changes may have played a vital role in controlling the pace of recovery in the aftermath of the end Permian mass extinction.