

## RECOVERY FROM THE PERMIAN-TRIASSIC MASS EXTINCTION: DID ANOXIA PLAY A ROLE IN THE DELAYED MESOZOIC RADIATION?

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Recovery from mass extinctions generally occurs relatively quickly, with diversification occurring over time scales on the order of one to two million years. The recovery following the Permian-Triassic mass extinction was exceptionally long period of time, with a depauperate marine fossil record for approximately five million years before the Mesozoic radiation in the late Early Triassic. The presence of massive organic-rich, laminated, deep-water cherts throughout western North America suggests that anoxia may have been a locally suboxic to anoxic bottom water conditions, which may have contributed to this delayed Mesozoic radiation, as previously suggested (Hallam, 1991). The presence of these cherts in east-central California, the Dinwoody Formation and Phosphoria Basin (Nevada, Idaho and Montana), the Phosphoria Formation of western Alberta and eastern British Columbia, and non-marine sequences which appear to have been deposited in anoxia or anoxigenated bottom water conditions. All exhibit a lack of body fossils, and demonstrate negative carbon isotopic values from -10‰ to -20‰ (average  $\delta^{13}\text{C}$  values of +1.5‰). The broad geographic distribution of these sequences suggests that anoxia was widespread throughout the eastern margin of the supercontinent Pangea during the Lower Triassic anoxic pelagic cherts from Japan, which strongly suggest that the delayed Mesozoic radiation was the result of oceanic anoxia. Although the Permian-Triassic mass extinction would have had a significant duration of the rebound after the extinction, it appears that detrimental environmental conditions such as reduced oxygen played a significant role in delaying the Mesozoic radiation.

Hallam, A. 1991. Why was there a delayed radiation after the extinctions? *Historical Biology*, 5: 257-262.

Isozaki, Y. 1994. Superanoxia across the Permo-Triassic boundary: evidence from accreted deep-sea pelagic chert in Japan, p. 805-812. *In* A. F. Embry, B. Beauchamp and D. J. Glass (eds.), *Pangea: Global Environments and Resources*. Canadian Society of Petroleum Geologists, Calgary, Alberta, Canada.