



Impacts, volcanism, sea-level and climate fluctuations: a multi-causal scenario for the Phanerozoic extinctions

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Mass extinctions in the Phanerozoic are closely related with severe climate changes and sea-level fluctuations. The consistent association of large magmatic provinces (LIPs and CFBPs) with all but one (end-Ordovician) of the five major Phanerozoic mass extinctions suggests that volcanism played a major role. Faunal and geochemical evidence from the end-Permian, end-Devonian, end-Cretaceous and Triassic/Jurassic transition suggests that the biotic stress was due to a lethal combination of tectonically induced hydrothermal and volcanic processes, leading to eutrophication in the oceans, global warming, sea level transgression and ocean anoxia. It must be concluded that major magmatic events and their long-term environmental consequences are major contributors, though not the sole causes of mass extinctions. Sudden mass extinctions, such as at the K/T boundary, may require the coincidence of major volcanism and a very large impact. Mass extinction is therefore the culmination of many factors which contributed to high-stress environmental conditions, including longterm perturbations (volcanism, e.g. Deccan traps for the end-Cretaceous, cooling, sea-level fluctuations) and short terms events (impacts). No single kill mechanism can really be identified.