Geophysical Research Abstracts, Vol. 9, 01798, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-01798

Oceanic anoxia and mass extinctions

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The temporal link between oceanic anoxic events and mass extinctions has been well established in the past decade although it is intriguing to note that not all such oceanographic phenomena coincide with extinction losses. This talk will attempt to explain the variability of this link using the examples of the end-Permian, early Jurassic and Cretaceous events. The Permo-Triassic boundary interval was marked by the development of anoxic waters over a vast geographic area and extending through much of the water column. This was associated with a major transgression and the spread of deep-water anaerobic facies, although anoxic conditions also expanded into shallow-water settings clearly above fair-weather wave base. Indeed, it has been proposed that the oceans leaked hydrogen sulphide into the atmosphere during this interval. This provides a mechanism for the contemporaneous terrestrial extinctions and may also go some way to explaining the great magnitude of the end-Permian extinction. Supporting evidence for these severe environmental conditions comes from pyrite petrographic studies of both shallow and deep marine strata.

The Early Jurassic (Toarcian) record has many similarities with the end-Permian including extinction losses associated with the spread of anoxic facies during transgression and the development of a distinctive black shale in the oceanic record. However, most extinction losses were at the species and generic level and there is no evidence for the collapse of primary productivity seen at the end of the Permian. The key difference may lie in the diachroneity of the anoxic spread (different seaways became anoxic at different times thus reducing the global impact) and the failure of anoxic conditions to reach peritidal depths although it may at times have reached the photic zone. Cretaceous oceanic anoxic events, such as that at the Cenomanian/Turonian boundary, like the Toarcian example were again not truly synchronous in every basin and examples of shallow-water developments of anoxic facies are rare. It is the intensity and synchroneity of the end-Permian oceanic anoxic event that is therefore seen to be a key

factor that explains its severe effect on the world's biota. The low values of atmospheric oxygen levels in the Permian-Triassic no doubt also exacerbated the intensity of marine anoxia. As for the ultimate cause of these oceanographic phenomena, much work has pointed the finger of blame at frequently contemporaneous, large flood basalt eruptions although the detailed timing and cause-and-effect mechanisms are not fully understood.