

Linkage between Massive Volcanic Events and Global Extreme Climatic Events in the Cretaceous Period

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Causal linkages between massive volcanic events and extreme climatic events have long been discussed. However, little has been understood about the mechanisms of these linkages. Recent developments of heavy metal isotope analyses such as lead (Pb) and osmium (Os) enable us to reconstruct detailed volcanic events from marine sedimentary records. Based on these isotopic records, we have investigated temporal relationship between massive volcanic events associated with large igneous provinces (LIPs) and Mesozoic extreme events such as Triassic-Jurassic mass extinction, and mid-Cretaceous Oceanic Anoxic Events (OAEs). We present an overview of our recent works on 1) end-Triassic mass extinction (200 Ma), 2) Early Aptian OAE-1a (120 Ma) and 3) end-Cenomanian OAE-2 (94 Ma) and their linkages with Central Atlantic Magmatic Province, Ontong Java Plateau and Caribbean/Madagascar LIPs, respectively.

Marine sediments deposited across the early Aptian OAE-1a show two prominent negative shifts of seawater osmium isotopic ratios, suggesting duplicate inputs of unradiogenic osmium from the mantle. The lead isotopic record suggests that the main part of the Ontong Java Plateau was formed by deep submarine eruptions. On the other hand, marine sediments deposited across the end-Cenomanian OAE-2 interval indicate an abrupt shift of Pb isotopic ratios, suggesting an increased supply of volcanic Pb via subaerial eruption. Our data indicate strong consistency between magmatic events and extreme climatic events for both OAE-1a and OAE-2, although the eruption processes differ. A more precise discussion of the causal mechanisms between these events will be presented in the near future.