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Volcanic influences on the global carbon cycle during the Early Aptian Oceanic Anoxic Event

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The Mesozoic Era was marked by numerous environmental perturbations and mass extinction events, several of which featured an abrupt increase in global temperatures and the development of widespread marine anoxia (an Oceanic Anoxic Event or OAE). One such OAE took place during the opening part of the Aptian Stage (Early Cretaceous: ∼121 Ma), and is referred to as OAE 1a. Global warming related to carbon emissions associated with the emplacement of the Ontong Java Ocean Plateau is commonly proposed as a major cause of the OAE; however, the causal mechanism and chain of events between carbon release and marine anoxia remain debated. A key issue in determining the trigger of OAE 1a is matching the timing of any volcanism to the onset of the OAE, as although both the High Arctic and Ontong Java eruptions during the Aptian have been precisely dated, the age of the OAE itself remains relatively poorly constrained.

Previous studies of sedimentary trace-metal enrichments and osmium (Os) and lead isotopes have supported major magmatic activity during, and potentially in the lead up to, OAE 1a. A recent study of mercury (Hg) concentrations from 3 sedimentary records in the Tethyan realm was also used to make this argument. Here, we present new Hg data for a number of other records of this event, including the first study of an OAE 1a record outside of the Tethys, in the mid-Pacific mountains, which is more proximal to the Ontong Java Plateau. We also directly correlate the Hg trends with Os-isotope records from the same sedimentary archives to compare the two proxies, as Os isotopes clearly indicate the occurrence of major volcanism and/or basalt-seawater interaction during the OAE. By contrast, our Hg trends show considerable variation: the Pacific record document the best match between the Hg and Os proxies of volcanism, whereas the Tethyan sites show several Hg peaks in sediments both within and below the OAE level and associated Os-isotope shift. The variability in Hg trends with respect to records of OAE 1a and the documented changes in the oceanic Os inventory may be related to one or both of the style of volcanism (subaerial vs submarine and local volcanics vs Ontong Java magmatism) and the proximity of those sediments to those eruptions (proximal vs distal), as has been previously proposed for the later Cenomanian–Turonian OAE.