EGU2020-13304
https://doi.org/10.5194/egusphere-egu2020-13304
EGU General Assembly 2020

Links between temperature changes and oceanic-plateau emplacement during the Cenomanian–Turonian Oceanic Anoxic Event (OAE 2)

Lawrence Percival[1], Niels van Helmond[2], David Selby[3,4], Steven Goderis[1], and Phillipe Claeys[1]
[1]Vrije Universiteit Brussel, Analytical Environmental Geochemistry Group (AMGC), Brussels, Belgium (corresponding author: lawrence.percival@vub.be)
[2]Department of Earth Sciences, Utrecht University, Utrecht, The Netherlands
[3]Department of Earth Sciences, Durham University, Durham, UK
[4]School of Earth Resources, China University of Geosciences, Wuhan, Hubei, China

The Cenomanian–Turonian boundary interval (~94 Ma) was marked by a period of climatic turbulence, and featured the widespread expansion of strongly oxygen-depleted conditions across a large part of the global ocean; collectively these environmental degradations are referred to as an oceanic anoxic event or OAE (specifically OAE 2 for this time interval). Extremely high sea-surface temperatures are documented for several regions during OAE 2, likely beginning at the onset of the event, but a shift towards colder conditions during the early stages of the OAE (the Plenus Cold Event or PCE) is also recorded in several locales, before a return to a very warm climate during the latter part of the crisis. The overarching high temperatures are thought to have resulted from major volcanic activity during the emplacement of one or more oceanic plateaus, as evidenced by a globally documented shift in osmium-isotope ratios to very unradiogenic values just below the base of OAE strata that indicates a very large flux of mantle-like osmium to the open ocean at that time. Intriguingly, the PCE cooling has been shown as likely non-synchronous globally, suggesting a local control in addition to/instead of global forcing; whilst the high temperatures associated with OAE 2 appear to have continued long after the OAE itself ceased.

This study presents new osmium-isotope data from the New Jersey shelf of the proto-North Atlantic (ODP Leg 174AX: Bass River), correlating the results with a previously generated sea-surface temperature dataset from the same site. These results are then compared with other temperature archives and osmium records of oceanic-plateau activity for OAE 2. The new data indicate intense oceanic-plateau activity prior to and in the earliest stages of the OAE, with a decline in mantle-osmium output before the end of the event, consistent with previous findings. However, when the osmium data are directly correlated with temperature records, both at Bass River and other sites, they clearly show that not only were high sea-surface temperatures maintained after the OAE, but also after oceanic-plateau activity (and presumably associated volcanism and CO_2 emissions) fell. Thus, a reduction in mantle carbon output did not manifestly

result in an immediate reduction of atmospheric CO_2. Moreover, the beginning of the osmium recovery broadly correlates with the end of the PCE cooling at all locations where both osmium and temperature trends have been studied. Consequently, although the PCE cooling was not globally synchronous and its precise timing at individual locations was likely controlled by local processes, some feature of the oceanic-plateau development allowed the cooling spells to occur when plateau activity was most intense, before a reduction in that intensity stymied the spread of cold conditions and resulted in the restoration of high temperatures in the latter stages of the OAE and beyond. These data highlight the need for further work to understand the complexity of and nuances in the relationships between large-scale volcanism and major climate/environment perturbations, both for OAE 2 and for other events.