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A continental Arc volcanism trigger for OAE2?

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The geological record is punctuated by intervals of widespread oceanic anoxia and organic carbon (OC) sequestration known as Oceanic Anoxic Events (OAEs). The latest Cenomanian aged OAE (OAE2, ≈94 Myr ago), defined by a positive carbon isotope excursion (CIE), is considered the best developed and most widespread of the OAEs, showing evidence of deep-water anoxia and black shale deposition across the Atlantic and Tethyan realms. Massive submarine volcanism, typically attributed to the emplacement of the Caribbean Large Igneous Province (LIP), is currently considered the most likely trigger for OAE2 despite several discrepancies with this scenario including that: A) the timing of OAE2 onset and major pulses of LIP volcanism are not clearly aligned [1], B) the magnitude and emission rate of volcanogenic CO_2 required to reproduce the CIE in carbon cycle models are difficult to reconcile with LIP volcanism [2], and C) ~60% of the OC burial during OAE2 required to explain the magnitude of the CIE is 'missing' [3], requiring elevated OC burial in distal, open marine settings that are geographically distant from LIP-derived nutrients inputs.

Massive explosive subaerial volcanism immediately preceding OAE2 offers an alternative explanation. We present coupled detrital ε_{Nd} and $^{87}Sr/^{86}Sr$ records from three IODP sites spanning the proto-Atlantic Basin which all show an abrupt shift towards a common isotopic endmember at the onset of OAE2, matching volcanic ash from the late Cretaceous continental Arcs of North America but incompatible with a LIP provenance. These isotope shifts are closely timed with rapid warming from existing sea surface temperature records. Furthermore, abundant bentonites in the latest Cenomanian of the Western Interior Seaway have been reported and we observe an increased abundance of volcanogenic smectite in the OAE2 interval. We therefore propose that the widespread deposition of volcanic ash from this subaerial volcanism would have fertilized wide expanses of the end-Cenomanian oceans, acting together with climate warming and the down-stream effects of LIP volcanism to drive increased carbon sequestration.

[1] Li et al., (2022). *EPSL* 578, 117331.

[2] Papadomanolaki et al., (2022), *Geology,* http://dx.doi.org/10.1130/g49649.1

[3] Owens et al., (2018), *EPSL* 499, 83-94.