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What drove phosphorus burial during Oceanic Anoxic Event 2 ?

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The latest Cenomanian Oceanic Anoxic Event 2 (OAE 2) represents one of the most important global environmental changes to have occurred during the Phanerozoic. Over the past four decades, identifying the precise trigger has been subject of much debate. Recent reconstructions of the phosphorus (P) accumulation record have provided new perspectives in this regard. P is an element that is incorporated into organic matter as well as various mineral phases, the formation of which is often dependent on the concentration of oxygen in the depositional environment.

Previous research has shown P accumulation peaking globally at the onset of OAE 2, a period of time that saw a rapid increase in primary productivity, inferred from δ13C records. Initially, this data was thought to have reflected a simple pulse of detrital-P, but this idea was excluded, at least in Tethyan sediments, when it became obvious that the peak in P was occurring independently of other proxies that indicate detrital fluctuations. It was concluded that the peak in P burial was a result of the increased production of organic matter, followed by a shutdown in P burial brought about by increasing anoxic conditions.

However, this explanation does not work in Cenomanian-Turonian sediments deposited within consistently oxic conditions, as it was common in more eastern parts of the Tethys (e.g. Tibet, Sinai). We present data that suggest that P distribution pattern were, indeed, mediated by variations in detrital input. The correspondence of detrital flux proxies with the gradual late Cenomanian sea-level transgression, points to the increased distance of continental P point sources as the main cause of the decline in P accumulation in the region. Using mineralogy, we also note a significant climatic shift from humid to more arid conditions, which may have also decreased the chemical erosion of phosphate minerals, further dampening the P signature in offshore settings.

The evidence of detrital-P being the likely cause of P fluctuations in the Eastern Tethys does not negate the idea that anoxia was the principal driver of these fluctuations in the organic-rich Western Tethys. However an explanation is required to explain why the P accumulation signatures are mirrored in both oxic and anoxic sedimentary successions. ‘Eustatic/climatic’ and ‘productivity/anoxic’ models may have both operated simultaneously in different parts of the world depending on local conditions, both producing similar trends in P accumulation.