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Environmental controls on marine ecosystems during the early Toarcian extinction event

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The fossil record has the potential to provide valuable insights into species response to past climate change if paleontological data are combined with appropriate proxies of environmental change. In the early Toarcian (Early Jurassic, ∼183Ma ago) rapid warming coincided with a main perturbation in the carbon cycle, seal level rise, widespread deposition of organic-rich, black shales under anoxic conditions, increased weathering rates and a biotic crisis in the marine realm, with the extinction of approximately 5% of families and 26% of genera. Because of this complex suite of inter-linked environmental and oceanographic changes, a key challenge is to determine which of these were most influential in controlling specific aspects of extinction and ecological collapse. In this study we combine high resolution palaeontological and palaeoenvironmental data from the coastal sections of the Whitby Mudstone Formation in North Yorkshire, UK, to reconstruct how climate changes controlled the structure of benthic and nektonic communities through the event, over a time period of ∼1.7 Ma. We show that benthic and nektonic ecosystems became decoupled and were driven by different environmental variables. Although rapid warming has been invoked as the main trigger of this event, the palaeotemperature proxy was a poor predictor of marine community dynamics, and abiotic factors indirectly linked to temperature, such as change in seawater dissolved oxygen concentration and nutrient inputs, were more important.