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A high-resolution timescale of the Cenomanian–Turonian Oceanic Anoxic Event 2: constructing a $^{3}He_{ET}$ timescale across the Bonarelli Level, Italy

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The Mesozoic Era was punctuated by periods of rapid environmental change, known as Oceanic Anoxic Events (OAEs), during which a rapid rise in temperature was accompanied by an accelerated hydrological cycle, enhanced continental weathering, increased nutrient input to the oceans, intensified upwelling, increased organic productivity and expansion of marine anoxia/euxinia, all documented through a range of geochemical proxies.

However, a major issue in the study of OAEs is the absence of good temporal constraints on these proxy records, as timescales can be hard to construct over sections where environmental perturbations have resulted in rapidly changing lithologies and, potentially, sedimentation rates.

The use of extraterrestrial ^{3}He concentration as a proxy for sedimentation rate in marine sediments allows the construction of high-resolution timescales. This methodology is particularly suited for 'difficult' sections, such as those recording OAEs, because an instantaneous sedimentation rate is determined for each sample measured; timescales can therefore be constructed over sections with rapid fluctuations in lithology where the cyclical signals required for cyclostratigraphic timescales may be difficult to identify. The resolution of such a timescale is also therefore theoretically limited only by sampling density (and the mixing effects of any bioturbation).

We use this technique to construct a high-resolution timescale over the Bonarelli Level, a $\sim$1 m-thick stratigraphic unit of millimetre-laminated organic-rich black shale and radiolarian sands which is the expression of the Cenomanian–Turonian OAE 2 in central Italy, and represents a historically important and well-studied section. In order to measure helium in the extremely organic carbon rich shales of the Bonarelli Level ($>$ 30% TOC locally in some horizons), we build on previously established techniques and expand the range of lithologies to which this method has been applied to include organic-rich black shales.

Using our $^{3}He_{ET}$ timescale, we are able to provide an estimate for the time spanned by the Bonarelli Level, explore the possibility of hiatuses and condensed sedimentation at its top and base and examine the depositional rates of different lithologies. Using our new data, we reconstruct organic-carbon mass accumulation rates in detail through OAE 2 and discuss the significance of these new data for understanding palaeoceanographic conditions during this major palaeoceanographic event.