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Toarcian Ocean Anoxic Event (TOAE) recording in shallow environment : example from Central Atlas, Morocco

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The Toarcian Ocean Anoxic Event (TOAE) took place in the early Jurassic (~183 My) and is characterised by the widespread deposition of organic matter-rich black shales in deep basins, and by a negative carbon isotope excursion reflecting profound environmental changes. This event is well documented in the sedimentary record of deeper marine settings, in which the TOAE is marked by the presence of organic-rich shales. However, the recording of the TOAE in shallower environments is less common, due to incomplete sediment records, to sea-level fluctuations and the lack of good biostratigraphy markers.

Here we present data gathered from a new extremely shallow section in Morocco (Dadès Gorges, Central Atlas), which was located along the northern Gondwana margin. This section consists of alternating dolomitic limestones and paleosols, associated with the presence of several dinosaur tracks and other sedimentary features such as stromatolites, ripple marks, mud cracks and fossil roots. This section shows a significant increase in mercury (Hg) located just below a negative excursion in ¹³C_{carbonate} isotopes (-3 ‰) that we attributed to the TOAE-NCIE, which coincides with several cyclical episodes of emersion. Bulk rock and clay mineralogy indicate an increase in weathering intensity in the upper part of the section marked by higher phyllosilicates quartz and kaolinite contents.

The upper part of the section shows a gradual decrease in the number of carbonate banks coinciding with an increase of clay-rich intervals. The carbonate banks interbedded with the clay levels are almost entirely composed of an accumulation of stromatolites reflecting even more extreme conditions, which coincide with the TOA-NCIE.

These results confirm the presence of the TOAE-NCIE even in the most shallow environments of the Tethys. The observed Hg anomalies have been globally recorded and are probably linked with the volcanic activity from the Karoo Ferrar province. This marker combined with stable isotopes is therefore a very promising correlative tool.