Biostratigraphic constraints of the Early Toarcian Oceanic Anoxic Event: new data from calcareous nannofossil investigations of Boreal and Tethyan sections.

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Calcareous nannofossil biostratigraphy was carried out in Upper Pliensbachian – Lower Toarcian sediments, which cover the Toarcian Oceanic Anoxic Event (T-OAE) interval. In particular, semiquantitative analyses were performed on a total of 156 samples in the composite Sogno Core (Lombardy Basin, Southern Alps) representing a pelagic Tethyan section. Quantitative investigations were applied to additional 168 samples across the Amaltheenton Fm. and Posidonienschiefer Fm., from two cores of the Boreal Realm (Lower Saxony Basin, northern Germany). Primary and secondary events of the Tethyan and Boreal zonations were recognized, allowing the identifications of the NJT5, NJT6 nannofossil Zones for the Sogno Core and the NJ5, NJ6, NJ7 Zones for the German sections, respectively. The sequence of nannofossil biohorizons is generally consistent with data available for various areas at lower and higher latitudes, confirming their reproducibility and reliability for intra and inter-regional correlations. Geochemistry evidences the presence of the negative C isotopic excursion across the "Fish Level" black shale interval expression of the T-OAE in the Sogno Core. The same anomaly is recorded in the German successions at the base of the Posidonia Shale witnessing the passage from well oxygenated to predominantly anoxic conditions.

Our results show that the T-OAE C isotopic excursion recorded in the Sogno Core is excellently constrained by the first occurrence (FO) of *Carinolithus superbus* at the onset and the last occurrence (LO) of *Mitrolithus jansae* at the end. A significant decrease in abundance and size of *Schizosphaerella punctulata* (the "*S. punctulata* crisis") and an abundance drop of *M. jansae* further characterise the T-OAE perturbation. Only *S. punctulata* shows a recovery at the end of the T-OAE, while *M. jansae* barely survived the palaeoenviromental stress and disappeared soon after its termination. The extreme rareness of *S. punctulata* and the absence of *M. jansae* in the Boreal Realm prevent the recognition of the "*S. punctulata* crisis" and the *M. jansae* decline. Our study reveals the LO of *Biscutum finchii* together with the FO of *C. superbus* as an additional event approximating the onset of the C isotopic excursion exclusively in the German successions. Further events, such as the LOs of *Biscutum grandis, Crepidolithus granulatus* and *Parhabdolithus liasicus* are detected within the C isotopic anomaly exclusively in the German sections. Nannofossil biostratigraphy permits the effective dating and correlating of Early Jurassic major palaeoceanographic events and particularly of the T-OAE which are of a great importance to derive a definitive model for the Posidonia Shale deposition.