Calcareous nannofossils at the Triassic-Jurassic boundary: stratigraphic and paleoceanographic characterizations

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In this study, calcareous nannofossils were identified for the first time in the uppermost Triassic sequence of the Lombardy Basin (Southern Calcareous Alps, Italy). The new data and their correlation with available datasets for the Triassic-Jurassic boundary (TJB) interval made it possible to date the upper Zu Limestone and the Malanotte Formation. Two zones were recognized: the NT2b (latest Triassic) and the NJT1 (earliest Jurassic). Two species were found to be good markers for constraining the TJB interval: *Prinsiosphaera triassica* and *Schizosphaerella punctulata*. Nannofossil data were calibrated with C isotopic chemostratigraphy that was obtained for carbonate and organic matter. A size reduction in *P. triassica* and a decline in the abundance of Triassic nannofossils was detected soon after the precursor carbon isotope excursion (CIE) and culminated during the initial negative CIE, which is characterized by the lowest nannofossil abundances and small-sized *P. triassica*. The extinction of Triassic nannofossils occurred in distinctive steps within the initial negative CIE, while the Jurassic species *S. punctulata* was first observed at the base of the main negative CIE. The latest Triassic nannofossil decline in abundance, reduction in size, and series of extinctions represent a progressive deterioration that is associated with the Central Atlantic magmatic province (CAMP) volcanism. Our findings are consistent with nannofossil changes at supraregional scale and indicate that the massive CAMP flood basalts were preceded by initial volcanic pulses. We speculate that a combination of climate change, fertilization, and ocean acidification began to influence the calcification process prior to the initial negative CIE. Nannoplankton extinctions were not simultaneous, which might imply a limited capacity for adaptation in the early stages of their evolutionary history.

In addition, some possible new morphotypes were identified in the Rhaetian, which may be useful in characterizing Late Triassic assemblages, particularly the mass extinction at the TJB boundary interval.