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Asynchronous changes in carbon cycling and vegetation over an expanded Triassic-Jurassic boundary succession

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Considered one of the five largest crises that affected life during the Phanerozoic, the end-Triassic mass-extinction event is estimated to have caused the disappearance of several marine families (23%) and genera (50%) on a global scale. In the terrestrial realm regional to supraregional losses of vertebrate families (up to 42%) and plant species (up to 95%) have been recorded. The event is associated with major perturbations in the carbon cycle recorded in stable carbon isotope records globally, with bulk organic C-isotope records in many areas (e.g. UK, USA, Spain, Austria, and British Columbia) showing two rapid negative excursions, the "initial" and "main" excursions, that bracket the boundary. The negative C-isotope excursions are generally attributed to the effects of outgassing of ^{12}C-enriched CO_2 from the flood basalts of the Central Atlantic Magmatic Province (CAMP). However, when studied in detail organic C-isotope records from various areas show variability in magnitude and timing of individual excursions, and in some areas (e.g. Greenland, Hungary and Canada) the recognition of two negative excursions is less clear. During the Triassic and Jurassic large accommodation space and relatively high sedimentation rates in the Danish Basin resulted in an expanded succession across the T/J boundary, perhaps the most complete marine clastic T/J succession in NW Europe. Here, we present new high resolution palynological and organic C-isotope data across the T/J boundary from a cored clastic succession (Stenlille) in the Danish Basin. In the Stenlille succession the organic C-isotope record is characterized by three negative excursions marked by shifts in the magnitude of –2.0 ‰ to –3.5 ‰. Palynological data provide evidence of major and partly coeval shifts in the marine and terrestrial palynofloras, including temporary disappearance of dinoflagellate cysts, major decline in conifers, cycads and ginkgos, and proliferation of ferns. However, these changes are not synchronous to the shifts in C-isotope values. Other significant features of the Danish Basin T/J boundary succession that are evident from the Stenlille record and from more proximal to terrestrial T/J boundary records from Sweden include increased erosion and reworking, changes in fluvial style and temporary loss of peat-forming vegetation. All these features are similar to those recorded in numerous terrestrial sections over the Permian-Triassic boundary of Gondwana, and this possibly indicates similar causes and consequences for these two mass-extinction events.