Integrated stratigraphy of the Hettangian-Sinemurian (Lower Jurassic) in the Tata Geological Garden (Transdanubian Range, Hungary)

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Abstract

The Kálvária-domb (Calvary Hill) at Tata is arguably the most important Mesozoic locality in the Transdanubian Range in Hungary. During a long history of research, most studies have been focused primarily on litho- and biostratigraphy of this site, with an aim of reconstructing the sedimentary basin evolution in a western Neotethyan paleogeographic context. Thick Upper Triassic shallow marine carbonate platform deposits (Dachstein Limestone Formation) are overlain by the Lower Jurassic, increasingly open marine and pelagic *ammonitico rosso*-type Pisznice Limestone Formation above a hiatal surface that corresponds to the Triassic-Jurassic boundary (TJB). However, previous biostratigraphic results have been inconclusive about the extent of the TJB gap and the age of the onset and cessation of deposition of the Pisznice Fm. Here we present new results of stable isotope chemostratigraphy and cyclostratigraphy, develop an age model, and establish correlation to constrain the Early Jurassic evolution of the disintegrating former Dachstein platform and its successor carbonate ramp and pelagic basin.

Previously published ammonite biostratigraphy established a Hettangian-Sinemurian age of the Pisznice Formation, although the presence of Middle Hettangian and Upper Sinemurian remained questionable. Besides, a largely untapped resource of published high-resolution (5 cm spacing) microfauna and microfacies data from thin sections are available and used here. In addition, we generated carbon and oxygen stable isotope data from the topmost Dachstein Fm. and the entire Pisznice Fm., and elemental composition data from the Pisznice Fm. (excluding its lowermost part) using a hand-held XRF instrument. These datasets have been used for chemo- and cyclostratigraphy to improve age constraints and correlation.

The TJB gap explains the lack of a negative carbon isotope anomaly observed in numerous other sections worldwide. The demise of the Dachstein platform system was likely related to the end-Triassic extinction that resulted in the collapse of reef ecosystem around the platform. The top of the Dachstein Fm. is best interpreted as a submarine erosion surface. The duration of the hiatus is not likely to exceed a few hundreds of thousands of years, if our new astrochronology, biostratigraphic constraints on the Hettangian-Sinemurian boundary, and the best current estimates for the length of the Hettangian are considered. Orbitally

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controlled cyclicity is present throughout the Pisznice Fm. and is recorded in the fluctuating ratio of various carbonate components, changing elemental abundances, and stable carbon and oxygen isotopic ratios. Our astrochronology suggests that the lower part of the succession was deposited in _˜1.8 Myr. This result is consistent with previous biostratigraphic results that assigned this member to the Hettangian and the stage duration estimates in the calibrated time scale. However, upsection where stylolitic surfaces occur, the astrochronologic duration of _˜2.5–2.6 Myr contradicts the duration of _˜4 Myr expected from calibrated biostratigraphy of the Sinemurian. Interestingly, the apparent discrepancy of the missing _˜35% of biostratigraphically predicted time duration is comparable with the sedimentological considerations that suggest that up to 35–40% of the upper part of the section may have been dissolved along the stylolitic surfaces. Utilization of microfacies and geochemical data as well as the results of phase and coherence analyses can also contribute to a paleoenvironmental and depositional model that is based on detrital and biogenic elemental proxies and microfossil components. These investigations can validate, complete, and extend the prior results and provide new means of stratigraphic correlation of the Tata section with different other sections in Europe and beyond.

Keywords: Triassic/Jurassic boundary, integrated stratigraphy, astrochronology