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Stratigraphic constraints on the Jurassic carbonate platform succession of Trnovski Gozd, SW Slovenia: Strontium isotope dating of brachiopods and belemnites

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Jurassic successions of the northern part of the Friuli (a.k.a. Dinaric or Adriatic) Carbonate Platform (hereinafter FAD) are best exposed along the Trnovski Gozd Plateau in SW Slovenia. A major stratigraphic unit, known as the Trnovo (Ternowaner) oolite has been considered as a classical, textbook example of a highly productive carbonate platform system exporting oolite sediments to the adjacent deep water depositional settings, producing massive bodies of resedimented oolite, such as the Vajont Limestone of the Belluno Basin. Whereas the stratigraphy of the basinal units in the eastern southern Alps and NW Dinarides is well constrained, coeval shallow marine depositional sequences of FAD Carbonate Platform lack a reliable chronostratigraphic framework.

We performed Sr isotope analysis of brachiopod shells and belemnite rostra from two stratigraphic levels at the base and above the Trnovo oolite unit (TOU). Suitability of the fossil material was controlled by selecting skeletal parts without fractures and lacking evidence of alteration due to diagenesis and weathering. The ultrastructure of specimens was inspected in resin-embedded polished thin sections under a petrographic microscope, supported by cathodoluminescence and SEM examination, including EDS semi-quantitative elemental analysis of skeletal parts in thin sections and slabs. For chemical analysis, powdered samples were drilled from thin section wafers and analysed for $^{87}Sr/^{86}Sr$ (stratigraphy), $d^{13}C$, $d^{18}O$, Ca, Mg, Sr, Fe, Mn and Rb (diagenetic alteration control).

The elemental quantification was performed at Jožef Stefan Institute on an Agilent 8800 Triple-Quad Mass Spectrometer and Sr isotopic analysis on a Nu plasma II Multi-Collector MS. Additional $^{87}Sr/^{86}Sr$ measurements were performed at UCM Madrid on a IsotopX TIMS. The numerical values were calculated from published Sr curves.

Brachiopod species from a lumachelle directly overlying a condensed interval in the base of TOU have been considered indicative for the early Toarcian. However, $^{87}Sr/^{86}Sr$ values obtained from rynchonellid brachipod shells ranged from 0.707109 to 0.707122, corresponding to numerical ages of either 184.7 ± 0.4 Ma (late Pliensbachian) or 181.8 ± 0.5 Ma (early Toarcian). Belemnites from the Limestone with chert, an informal unit overlying TOU, yielded $^{87}Sr/^{86}Sr$ values from 0.706838 to

0.706862, that fit two intervals of the Sr isotope curve, i.e., 162.5 ± 1.9 Ma (latest Callovian-early Oxfordian) and 159.4 ± 1.7 Ma (middle to late Oxfordian), respectively. In both cases, the duality in results is caused by their proximity to the Sr curve minima.

These ages open several important questions about the geometry and depositional history of the northern FAD platform system. Despite of a limited accuracy of our results, the age range for TOU clearly spans (at least) late Toarcian and almost whole middle Jurassic, while the age of the supposedly time-equivalent basinal unit, the Vajont Limestone, falls into the late Bajocian-Bathonian interval. Furthermore, our sedimentological re-examination of the classical TOU localities has not shown characteristics of in-situ oolite production environments but, on contrary, evidence of deeper marine deposition marked by beds of carbonate mudstone, including most typical rosso-ammonitico-type facies, associated with (resedimented) oolite and crinoidal facies, similar to parts of the succession of the Vajont Limestone.