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Decoding the PETM record in a virtually uninterrupted Palaeocene-Eocene shallow carbonate ramp succession (Adriatic Carbonate Platform, Slovenia)

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The Palaeocene-Eocene Thermal Maximum (PETM) represents one of the most rapid and extreme global warming events in the Cainozoic, characterised by an abrupt and short-lived increase of surface temperatures of 4-8 °C. PETM was associated with a pronounced negative carbon isotope excursion (CIE) recorded globally in different depositional settings from palaeosols to deep-sea sediments. The CIE is related to a geologically instantaneous (5-10 ky) massive release of ^{13}C-depleted carbon to the ocean-atmosphere system. Because of its global occurrence and relatively short duration (∼100 ky), the CIE has been selected as a criterion defining the Palaeocene-Eocene (P/E) boundary.

Shallow-water carbonate platform record of PETM is rather limited due to a paucity of complete sections covering the P/E boundary interval. Furthermore, the discrete nature of early Palaeogene shallow benthic zones (SBZ), based on larger benthic foraminifera (LBF) with restricted palaeoenvironmental/depth distribution, strongly affects stratigraphic resolution in different parts of a depositional system.

The northern part of the Adriatic Carbonate Platform in SW Slovenia provides an outstanding long-term carbonate platform system, spanning from the lower Palaeocene to the middle Eocene, composed of aggradational ramp sequence. The P/E interval has been studied in several well-exposed motorway sections in the Kras region [1] integrating LBF biostratigraphy and carbon and oxygen isotope stratigraphy. Facies successions correspond to inner and mid-ramp settings. P/E boundary has been defined with the first appearance of true alveolinids (base of SBZ5) coupled with a prominent (1‰ - 6‰) negative excursion in δ^{13}C, in beds overlying Assilina-larger miliolid facies (SBZ4). Recent re-examination of the motorway outcrops [2] has identified apparent erosion surface corresponding to the boundary between SBZ4 and SBZ5. The surface does not show any diagnostic features of subaerial exposure, however, evidence of possible seafloor dissolution indicates a probable gap corresponding to the lower part of SBZ5.

Here we present a facies analysis of a recently drilled, fully recovered core, located about 10 km from the motorway sections. Although palaeogeographically close to the previously studied sections, the P/E boundary in the core is not self evident and abrupt but characterised by 10-15 m thick succession of interchanging, m-thick layers of of Alveolina-dominated facies and small rotaliid-echinoderm debris packstone facies without obvious discontinuities. Preliminary stable isotope analysis of bulk-rock carbonate sampled along 50 m long core section has not revealed any clear isotope excursion. Potential indication of PETM is represented by a distinctive, ∼5 m thick bioturbated (mottled) bioclastic unit with very rare LBF. Additional higher resolution stable isotope sampling has been performed for this critical core interval to decipher the onset of CIE and the P/E boundary.

[1] Zamagni J, Mutti M, Ballato P, Košir A (2012) The Paleocene-Eocene thermal maximum (PETM) in shallow-marine successions of the Adriatic carbonate platform (SW Slovenia). Geological Society of America Bulletin 124:1071-1086.

[2] Weiss AM, Martindale RC, Košir A, Oefinger J (2017) A Possible Late Paleocene-Early Eocene Ocean Acidification Event Recorded in the Adriatic Carbonate Platform. Abstract PP23B-2270, AGU Annual Meeting, New Orleans.