Early Triassic epeiric ramp setting in the southern Dinarides (Croatia)

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In the southern part of the Dinarides in Croatia the Early Triassic depositional sequence at Plavno locality was investigated by means of litho-, bio- and chemostratigraphy. Succession represents the most important depositional characteristics of the Early Triassic in the whole Dinaridic region i.e. a deposition in an overall shallow, flat, extensive environment with a developement of only slightly deeper depositional conditions in Olenekian. Leanage with any deep basinal facies have not been found neighteher in the Dinaridic nor in neighbouring regions. The Plavno sequence represents almost complete Early Triassic succession of the appreciable thickness (ca 1.000 m) and can be correlated to the well known carbonate ramp successions in the Italy (Southern Alps) and in Hungary (Bükk Mts). Plavno sedimentary succession begins with the oldest rocks determined by the presence of conodont *Isarcicella isarcica* and *I. stechei* (Aljinović et al. 2011) and ends with the continous transition to Anisian strata.

Along the section a continuous $_{13}$C-isotope curve was able to achive and served as a powerfull tool to established chemostratigraphic boundaries according to the similarities with the Early Triassic successions in India and Iran. The characteristic three minima on the transitional Permian-Triassic-Boundary have not been identified. In the oldest strata the curve remains at low values and steadily increases towards the Griesbachian-Dienerian boundary. Around that boundary a minor, short, negative excursion has been noticed. In the Dienerian the $_{13}$C-values increase with several short, negative inflections and with a steepening of the slope towards the Dienerian-Smithian boundary (DSB) as in many sections. Around that boundary a prominent maximum of +5‰ in shallow water carbonate sections occurs followed by a steep and continuous drop to low, often negative values in the Smithian. Just before the Smithian-Spathian boundary (SSB) a steep rise to a second maximum occurred. It is followed by a saw-tooth shaped decline in the Spathian and a gentle increase to a rounded peak at the Spathian-Anisian boundary (SAB).

In lithological sense Plavno succession has characteristic threefold division: 1) carbonates representing the oldest Early Triassic strata (lower part of Griesbachian); 2) dominantly red clastics (shale, siltstones and sandstones) with intercalation of ooid/oncoid or bioclastic grainstones (upper Griesbachian, Dienerian and Smithian) and 3) dominantly grey carbonaceous lime mudstones, marls and calcisiltites with ammonoids representing Spathian-Anisian strata. Deposition at the beginning of Griesbachian is represented by ca 40 m thick pale yellow macrocrystalline subhedral dolomites. The primary structures were obliterated by dolomitization processes. Only ghosts of rare microspheres (after Kershow et al., 1999) and ostracods can be observed. Presence of Earlandia and Cornuspira was noticed in this interval pointing to the stressful conditions related to the end Permian mass extinction. Initial transgression at the beginning of Early Triassic had an important role in deposition and resulted in drowning of the extensive Permian evaporitic complexes and establishment of overall shallow marine conditions.

The upper part of Griesbachian is represented by strong siliciclastic input and deposition of thin piles of grey or red shales, siltstones and sandstones. Deposition in the Dienerian and

Smithian is still characterized by red siliciclastics and rare intercalation of thin-bedded oolitic/oncolitic and bioclastic grainstones. Hummocky cross strata, often present in red clastics, witness importance of storms in a depositional environment. Presence of load casts as well as abundant casts of bivalve shells suggest quick deposition of terrigenous material and instant burring of epifauna during storms. Abundant trace fossils preserved in shale beds point to the intensive life activity in an overall shallow depositonal conditions. The thickness of beds and particularly the thickness of oolitic grainstones increases toward the upper part of Smithian. In the Spathian deposition of lime mudstones and marls prevail. A deposition does not differ significantly even at the boundary toward Anisian. Two Spathian intervals bear ammonoid fauna. The role of storms can be recognized as coarse grained bioclastic lag accumulated at the base of storm lime mud beds, gradded bioclastic calcisiltites sometimes with redeposited oolitic material, gutter casts and hummocky cross stratified beds. Presence of ammonoids implies deposition in slightly deeper environment and a connection with the unrestricted open sea. A deposition in slightly deeper depositional environment where established due to transgression at the beginning of Spathian. Even in this deeper environment storms have significant role assuming deposition within storm and fair weather wave influence. Intensive bioturbation suggest colonization by organisms between storms. Therefore the nature and distribution of facies within Plavno depositional succession represents low-energy deposition on a broad scale that is best described as an epeiric ramp model of Lukasik et al., (2000) and differs that of the Early Triassic sections in the Southern Alps and Bükk Mt. interpreted as ramp (Brandner et al., 2012; Haas et al., 2007).
An epeiric ramp is defined here as having a very low bathymetric slope (negligible in its inner regions), no grainy shoreface facies, water depths of tens of meters, a width of many hundreds of kilometers and depositional processes dominated by storms. Wave energy is minimal, resulting in a proximal ramp zone with well-bioturbated shales. There is no barrier shoals separating the subtidal mid-ramp from the back-barrier lagoon and tidal flat regions of the inner ramp (as interpreted for Early Triassic in Southern Alps e.g. Brandner et al., 2012 Haas et al., 2007). In Plavno section there are only minor, local thin skeletal oncolith/ooid/ /bioclastic shoals developed possibly within a tidal facies regime across a nearly flat sea floor extending for hundreds to thousands of kilometers or at the contact of proximal and distal parts of epeiric ramp. Storm waves influences all facies of the epeiric ramp.

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