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Benkovac Stone – Storm Influenced Shallow Shelf Sediments of Promina Group

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Introduction

Promina Group represent a significant, aproximately 2000 m thick carbonate–clastic succession in southern Croatia. It was deposited in a complex sedimentary basin, ranging from deep-marine to shallow-marine and alluvial conditions, during the Middle–Late Eocene to Early Oligocene. Within this succession, 30 m thick, thin bedded Upper Eocene Benkovac Stone layers outcrop in a very narrow and long zone in the vicinity of Benkovac town. Due to its good quality, and decorative look they are exploited as building and decorative stone.

Sedimentary features

Intimate interbedding of carbonate sandstones and fine–grained sediments is the typical feature of the Benkovac Stone.

Detailed study of logs enabled identification of 6 carbonate sandstone facies: (1) Parallel laminated to hummocky cross and flat laminated sandstones, (2) Hummocky cross to flat laminated sandstones, (3) Convolute laminated sandstones, (4) Amalgamated sandstones, (5) Normal graded thin sandstones, (6) Wave-rippled sandstones with 3 subfacies (A – Sandstones with migrating wave ripples, B – Sandstones with climbing wave ripples and C – Sandstones with pinch and swell lamination).

Fine-grained facies consists of calcareous mudstones and thin, from few mm to 1 cm thick silty streaks. The streaks form vary from flat to undulatory, and lens- or pinch-swell like. They were deposited under the influence of waves, geostrophic currents and density-induced flows, which have been active during the predepositional and depositional phase in the shore area, above and below the storm wave base.

Trace fossils

Trace fossils are the most diverse in calcareous mudstones, where they form decorative textures on upper bed surfaces. Grazing traces are dominant, often showing well-organized patterns (*Helminthoida*, *Palaeodictyon*). Feeding burrows (e.g. *Chondrites*) are scarce, as well as dwelling burrows within beds. Therefore, a degree of bioturbation is sparse to moderate (1–3 sensu REINECK, 1963). The most of the determined ichnotaxa belong to *Zoophycos* and *Nereites* ichnofacies. Some recent papers (ORR, 2003) suggest that water energy is the dominant factor influencing the distribution of ichnotaxa, instead of the water depth. This could explain the peculiar ichnofacies in Benkovac stone, where "deep-water" ichnotaxa are associated with shallow-water sedimentary textures.

Facies interpretation

Due to the great numbers of available processes and factors, simple and straightforward interpretation of facies is not possible. However, on the basis of detailed outcrop analysis and interpretation founding on complex hydraulic setting it is possible to achieve the following conclusions:

1) All carbonate sandstone beds (except thin normal graded beds) display evidence of wave oscillations. Therefore various intimately combined currents have been active during their deposition (MYROW & SOUTHARD, 1991, 1996; WALKER et al., 1983);

2) Sedimentation in an open and broad shallow-marine (shelfal) micro-tidal environment was strongly influenced by frequent storm processes;

3) The major part of Benkovac Stone was deposited in offshore–transitional zone (between fairweather wave base and stormweather wave base), whereas considerably smaller part of layers (moderately bioturbated mudstones interbedded by thin normal graded sandstone beds and silty streaks) was sedimented in offshore zone (below storm wave base);

4) Shelf environment was steadily, but not amply fed by sands and finer material.

Benkovac Stone succession represents shelfal deposition within a broad and long-term braided-delta depositional setting during its retrogradational (wave-dominated) phase.

References

MYROW, P.M. & SOUTHARD, J.B. (1991): Combined-flow model for vertical stratification sequences in shallow marine storm-deposited beds.– J. Sedim. Petrol., 61, 202–210.

MYROW, P.M. & SOUTHARD, J.B. (1996): Tempestite deposition.– Journal of Sedimentary Research, 66/5, 875–887.

ORR, P.J. (2003): Bathymetric indicators.– In: BRIGGS, D.E. & CROWTHER (eds.): Palaeobiology II. Blackwell Science Ltd. 2nd ed., 475–478.

REINECK, H.E. (1963): Sedimentgefüge im Bereich der südlichen Nordsse.– Abh. Senckenber. Naturforsch. Ges., 505, 135 p.

WALKER, R.G, DUKE, W.L. & LECKIE, D.A. (1983): Hummocky stratification: Significance of its variable bedding sequences: Discussion and reply.– Geological Society of America Bulletin, 94, 1245–1251.