Towards the Structures of the Carbonate Beds Rapidly Deposited from High-Density Suspensions: Experiments with Five Fractions of Angular Grains in a Settling Column

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Towards the structures of the carbonate beds rapidly deposited from high-density suspensions: Experiments with five fractions of angular grains in a settling column

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In the Prague Synform southwest of Prague, at least two of the Devonian carbonate slope sequences contain beds which were rapidly deposited from vertically settling particles within concentrated density flows. Particularly relevant examples are displayed in Koněprusy and Suchomasty sequences of Pragian (to Pragian-Emsian) and late Emsian ages, respectively. This relates to the southernmost tectonic Koněprusy segment, and the depositional environment corresponds to lower upper parts of open-ocean carbonate slope. According to the current stratigraphic division, these sequences are roughly equivalent to the Praha and Daleje-Třebotov formations. Massive beds of the above mentioned type were deposited close to the base of the transgressive systems tract and in a very late phase of the falling-stage systems tract. The mechanism of deposition of these beds is indicated by local occurrences of arched cavities formed during rapid settling of suspended load. Rapidly thickening, wide range (polydisperse) and multi-modal suspended mixture of carbonate particles/grains is typical here. As experimentally verified, such stromatactum-pattern voidage developed in transitional settling-packing stage cannot form in low-concentration particle-laden flows and, on the other hand, neither when laminar shear takes effect on hyper-concentrated or granular flows. The relationship to surfaces close to the onlap of clinoforms (and again with regression) is indicative that the depositional area of these beds deposited during massive events was located higher upslope than the slope-erosive bypass zone or the deposition of calcisiltitic, pelagic turbidites. In this context, it is worth mentioning that skeletal material from the upper photic zone is practically absent. This means that the source areas were lying below the uppermost foreslope sands or these sands did not develop at all. If relevant gravity flows were generated by upper slope slumps, the mechanism can be compared to Breien's transitional flow where fluidized sand in the middle lower part of the down-slope transported body can rapidly settle down due to energy dissipation within a dense suspension. Other possibility relates to inner shear mixing zones, turbulent mixing of elutriated mud and differently sized porous bioclasts, uplift, separation and subsequent thickening and deposition of this material in the tail of a standard turbidity flow which moved separately down to the basin. In addition, also Kane's concept of exceeded flow capacity with rich subvertical sedimentation over the levee ridges (or bioclastic lobes) must be considered. The above mentioned conditions correspond to the fact that these specific, event-deposited beds are usually patches not larger than tens or a few hundreds of metres. The parameters of arched-cavity pattern formation were already studied in the field and verified using the experiments with three fractions (A, C and E = 0–0.25 (0.125), 0.5–1 (0.75) and 2–4 (3.5) mm, respectively; with substantial gaps in the grain-size distribution). In this case, the change in the proportions of these three markedly different-sized fractions was found responsible for the complex change in distribution of grains and primary cavities (published). However, a comparison of the structures observed in the natural sediments is required to diversify and extend the experiments. Therefore, the investigation of the relevant sedimentary bed

structures continued using various mixtures based on the selection from five differently involved or excluded grain size fractions. Thirty-one cases of the presence/absence of these five fractions were studied (A, B, C, D and E = 0–0.25 (0.125), 0.25–0.5 (0.375), 0.5–1 (0.75), 1–2 (1.5) and 2–4 (3.5) mm, respectively). Sedimentation was documented in cylinders 40 mm wide and 370 mm high. The ideal proportion of the particulates, if packed in water using strikes and vibrations to a maximum possible degree, corresponded to 100 mm, the remaining 240 mm was water and 30 mm air. After homogenization of particulate mixtures, the cylinder was closed and overturned into sedimentation position. Two parallel series of experiments were run, one with differently coloured fractions and other with colourless fractions. First approach provided an easier visualization of particle distribution in the sediment using image analysis whereas the second helped to better identify the voids. Comprehensive sets of results are illustrated in the poster. They provide another clue to understanding the different vertical successions and inner structures in these specific, event-deposited beds.

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ABSTRACTS

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