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The Story Behind Calciturbidites: Linking Single Grains to Analogue Flume Experiments

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ABSTRACT

In this study we analyse processes involved in gravity-induced depositional processes in marine carbonate environments, ranging from single grain settling analyses up to analogue flume experiments. So far research on the hydraulics of bioclastic sands has either been species-specific or based on a single sand population. For this study carbonate sediments were analysed originating from different carbonate factories, e.g. tropical reef crest sands (Tahiti), two tropical back-reef populations (Bahamas), two peri-platform mud environments (Bahamas) and cool-water sands (Italy).

The aforementioned carbonate sediments were analysed for their variations in hydrodynamic behaviour based on shape analysis and settling tube experiments. The analysis showed that density and grain size are not the sole parameters controlling the falling velocity of a settling particle. Evidence is provided that velocity is (co-) dependent on particle shape, which was categorised by zingg shapes classes based on elongation and flattening of the individual grain. The shape analysis showed evidence for retention of form, roundness and surface textures at smaller grain sizes, possibly related to the skeletal nature of bioclastic particles. Subsequent implications for vertical- and lateral sorting, primary porosity and permeability, and size-shape dependent falling modes, during density flow transport are discussed. In addition, a new sequential set of falling modes will be evaluated dependent on Reynolds number and shape.

The settling tube experiments with tropical reef sands and peri-platform mud mixtures showed that the resulting carbonate deposits are more heterogeneous when compared with their siliciclastic counterparts and that suppressed hindered settling occurs at lower sediment concentrations.

The flume experiments showed grain-size sorting that to some extent could be related to the settling tube experiments. Specific sorting processes related to grain shape and densities were observed that deviate from what is observed in siliciclastic environments. Additional experiments are planned to explore this part of the gravity-induced processes in carbonates.