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COMPOSITIONAL VARIABILITY OF SUSPENDED SEDIMENT UNDER BREAKING WAVES

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1. Introduction

The distribution of the sand particles under breaking waves in a vertical profile can give helpful insights for the understanding of selective grain entrainment and transport. Since sand is generally composed by various types of particles with different physical properties it is natural that each type has a unique response to the hydrodynamic forcing mechanisms. For this reason the compositional spectrum that characterizes each coastal environment reveal different proportions of its components and give distinctive perceptions on the particle sorting processes.

Based on suspended sediment samples collected by streamer traps at several beaches of the Portuguese west coast, this work aims to describe the compositional variability of suspended sediment under breaking waves using, as an example, the results obtained at Saúde beach (Caparica).

2. Methods

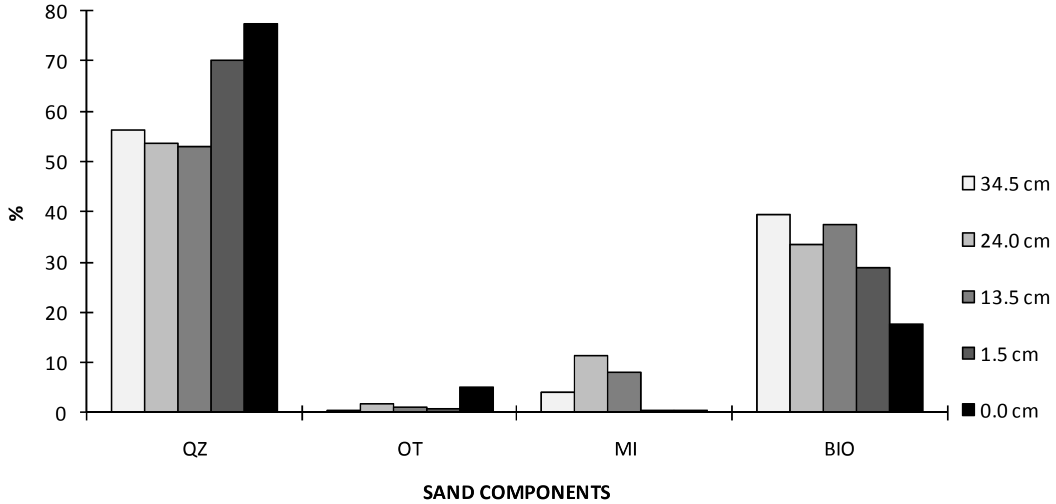
The sediments were collected at several heights from the bottom using a small streamer trap based on the Kraus (1987) model. The opening of the used streamer bags is 30 cm wide by 4.5 cm high, and the distance between adjacent streamer bags is 10 to 12 cm. Streamer bags were approximately 120 cm long and a mesh size of 0.1 mm. An additional bottom sediment sample was also collected. Samples were sieved at 0.5 ϕ interval; mean and sorting were computed using the moment method (McManus, 1988). For each sand fraction, about 300 particles were identified and counted using a binocular microscope. Sand components were classified in quartz, biogenic particles, mica and other terrigenous.

3. Results

Figure 1 displays the results of the compositional analysis performed through the water column: figure 1A refers to the sand components distribution while figure 1B represents the mean grain size variation for each component from the bottom (0.0 cm) towards the upper level (34.5 cm). The compositional results show that quartz is the dominant component followed by biogenic particles, mica and other terrigenous. At the bottom quartz represents over 77 % of the total sand, biogenic particles represent 17 % and the other terrigenous attain a maximum of 5 %. In contrast, at higher levels quartz represents only slight above 50 % of the total sand while biogenic particles reach its maximum representative values, just below 40 %. Mica occurrence is only relevant at these upper levels while other terrigenous particles are almost absent. Sand collected by the sediment trap has a general trend to be finer towards the top, decreasing about 0.5 ϕ from the deeper bag (placed at 1.5 cm from the bottom) to the upper most bag (positioned at 34.5 cm from the bottom). The same trend is also observed for the two major sand components - quartz and biogenic particles, which registered a monotonous decrease in mean grain size, of about 0.3 and 0.7 ϕ, respectively. This behavior does not extend to mica and other terrigenous as mean grain size does not show any consistent variation with the distance from the bed. The finer mica particles were collected by the two middle streamer bags (13.5 and 24.0 cm), while in case of other terrigenous particles the finer particles were found at the bottom.

4. Discussion

The results obtained in the scope of this work show that the sand composition is not uniform along the water column. Lower levels are dominated by the terrigenous components (quartz and others) whereas at upper levels is possible to observe an increase in the biogenic and mica components (figure 1A). Analogous vertical variations can also be detected in the textural signature of the suspended sediment. In what concerns mean grain size results are in agreement with previous studies performed at breaker zone (e.g. Wang *et al.*, 1998) which have found a slightly decreasing vertical profile distribution. This can be indicative that the turbulence generated by the breaking waves can suspend sand particles high into water column, in what can be considered a low selective process, as grain size differences between bottom and upper levels does not exceed 1ϕ. Despite the relatively low grain size vertical gradients, the analysis of the specific variation of each sand component can give valuable insights on the suspension mechanisms (figure 1B). While the quartz variation mimics the sand behavior, the biogenic component is not only coarser but also shows a larger vertical gradient, with grain size differences of about 0.7ϕ; this behavior might be related with shape effects due to the elongate or platy characteristics of the shells as also notice by Wang *et al.* (1998). Mica shows an irregular pattern with finer particles present at mid water levels



A **B**

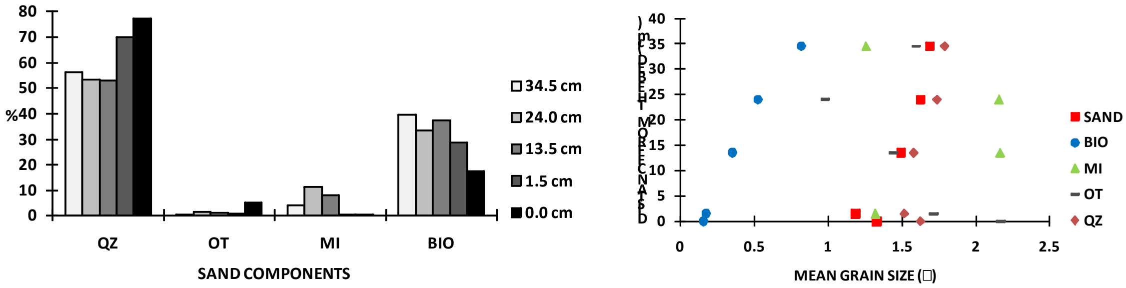


Fig. 1. A: distribution pattern of the main sand components along the water column from the bottom (0.0 cm) up to the upper level (34.5 cm). QZ – quartz, OT – other terrigenous, MI – mica and BIO – biogenic; B: Mean grain size variation of the sand and its main components along the water column (data obtained at Saúde beach, Caparica, Portugal).

6. References

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