Deposition and erosion properties of fine sediments from an area of saltpans in the Ria de Aveiro lagoon

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Introduction: Saltpans are areas of saltmarsh converted to evaporation ponds for salt production. Saltpans were in existence in Portuguese estuaries in the Roman period and perhaps earlier, and there is increasing recognition of their importance for nature conservation [1]. In the Ria de Aveiro, a shallow lagoon in NW Portugal, there has been a widespread abandonment of salt production since the 1970s-1980s. Saltpan walls are traditionally made of natural sediment, and can rapidly deteriorate if not properly maintained. Therefore, as part of a wider study on fine sediment dynamics in the Ria de Aveiro, an investigation has been conducted into the deposition and erosion properties of local sediment and the role of tidal currents in the observed deterioration.

Methods: Surface sediment was collected from an abandoned saltpan wall, at mid-tide level, in a small channel. Grain-size analysis showed that 80% of the material was fine-grained (<0.063 mm) and 20% coarse-grained [2]. Prior to testing, the sediment was sieved through a 1 mm mesh. Sediment properties were studied in an annular flume. The flume at LNEC has a diameter of 3.7 m, a height of 0.4 m and a width of 0.3 m. Experiments were conducted under varying tidal conditions (duration of 7.5 hours) and 24-hour constant conditions (duration of 11 days), up to an estimated mean flow velocity of 0.65 m s^{-1} and bed shear stress of 0.7 Pa. During each experiment, suspended sediment concentrations were determined gravimetrically.

Results: Results obtained under tidal conditions showed a clear relation between the maximum suspended sediment concentrations and the maximum velocities. A time lag was also observed between the period of zero velocity (slack water) and the minimum concentrations. Results obtained under 24-hour constant velocities allowed suspended sediment concentrations to approach equilibrium. As flow velocity decreased, partial deposition occurred for a range of bed shear stress values, a pattern probably related to the grain-size distribution of the initial sediment. Similarly, as velocity increased, partial erosion was also observed (Fig. 1). In these longer experiments, an estimated bed shear stress increase from 0.1 to 0.2 Pa was required to initiate sediment erosion. The bed shear stress value corresponding to 50% deposition was estimated at 0.17 Pa, while the value equivalent to 50% erosion was estimated at 0.28 Pa [3].

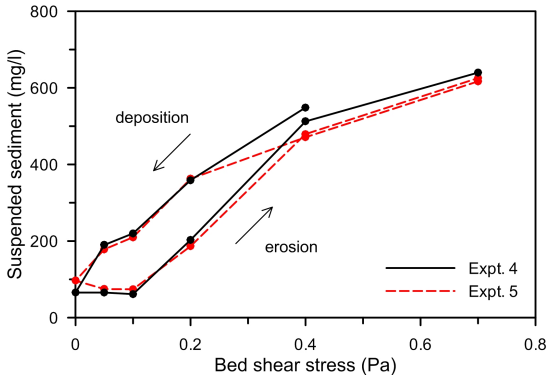

Fig. 1: Suspended sediment as a function of bed shear stress in long-duration experiments.

Discussion: The results are consistent with what has been observed in experiments with fine sediments from other coastal systems [4]. Regarding the local conditions, velocity measurements in situ indicate that a shear stress of 0.2 Pa can be attained in the channel axis, but bed stresses should be lower along the margins [5]. Therefore, in the absence of maintenance, tidal currents may play a role in the deterioration of saltpan walls, but the importance of this factor should not be overstated. Other factors such as waves (including wakes) and meteorological events are probably as important.

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