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GEOMORPHOLOGICAL CONSTRAINING OF TSUNAMI (?) RUN-UP IN THE ALCANTARILHA COASTAL LOWLAND (CENTRAL ALGARVE, PORTUGAL)

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INTRODUCTION

The Alcantarilha lowland, partly barred by a well developed barrier, including foredunes covering Pleistocene-Holocene beachrock and aeolianite, develops across the Alcantarilha infilled estuary, the beach-dune extending further SE until the Salgados lagoon. A topographic and coring survey revealed a peculiar feature at the leeward toe of the dune ridge close to the inlet area: a sandy fan with location, shape and morphology suggesting emplacement by single or multiple overwash of the barrier tip rather than tidal forcing. Its storm or tsunami origin and age are under investigation, and the only time-constrain available at present is that it should post-date *ca*. 6600 cal BP, the most recent *in situ* aeolianite (Moura *et al*., 2007) dated so far.

METHODS, DATA SET AND RESULTS

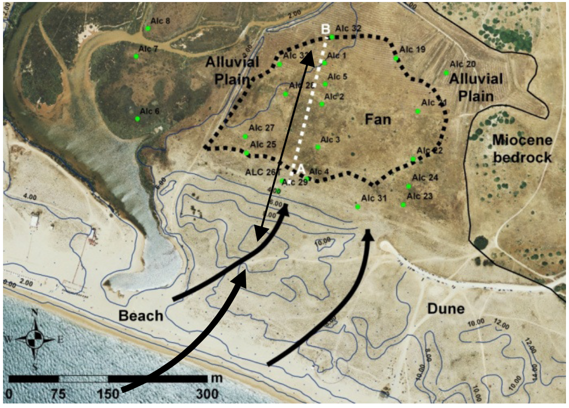

Figure 1 - Aerial photo of the Alcantarilha lowland showing the intlet, barrier and foredunes (countour lines in meters, msl), washover limit (dotted line) and location of cores and trenches (green dots). A-B – cross section in figure 2. Arrows - hypothesized flow path of wave overtopping.

The fan boundaries are distinctive in aerial photos and satellite images: it is roughly ellipsoidal, ~200 m wide and ~300 m elongated paralleling the shoreline, rising ~ 0.9-1.2 m above the surrounding floodplain surface. Detailed topography shows that its short axis aligns with SW-NE elongated (though irregular) depressions in the dune crest, which link the beach with the fan. This could have favoured funnelling of, or erosion by, water overtopping the barrier but, in either case, the fan should correspond to extreme and abrupt event(s) of coastal flooding.

18 trenches and cores were performed in the exposed area of the fan and nearby flood plain to obtain samples and data on its sedimentology, lithostratigraphy and geometry. The fan consists of well sorted and rounded sand (Fig. 2). It thins away and wedges out landwards of the apex (located near Alc29T) where it is partly covered by dune sand. Its lower boundary is undulating and marked by textural contrast between sand (fan) and underlying mud (alluvial/lagoonal); an accumulation of marine-sourced perforated pebbles showing limited lateral continuity may pinpoint this boundary near the foredune (core Alc 25, ca. 80 m westward of profile in Fig.1); mud-balls were also observed immediately above this surface in cores and trenches. As the washover was probably emplaced in a barred lagoonal/estuarine floodplain setting, the fan's northern outer belt is enclosed by low-energy sediments (not shown in Fig. 2).

DISCUSSION AND CONCLUSIONS

This coast is mesotidal, the spring tide reaching maximum elevation of 1.8 m (msl). The storm surge is much smaller than 1 m and wave heights exceeding 6 m are exceptional in SW extreme storms with a return period of 30-50 years. Andrade *et al*. (2004) used the historical record and field evidence to show that even the most extreme storms after 1860 failed to overtop the mature and wide foredune ridges of the Ria Formosa barriers (30-70 km east of the studied area). A storm origin for this washover seems unlikely because of the exceptional wave height and run-in required to cut through the dune field and cross-over this wide barrier.

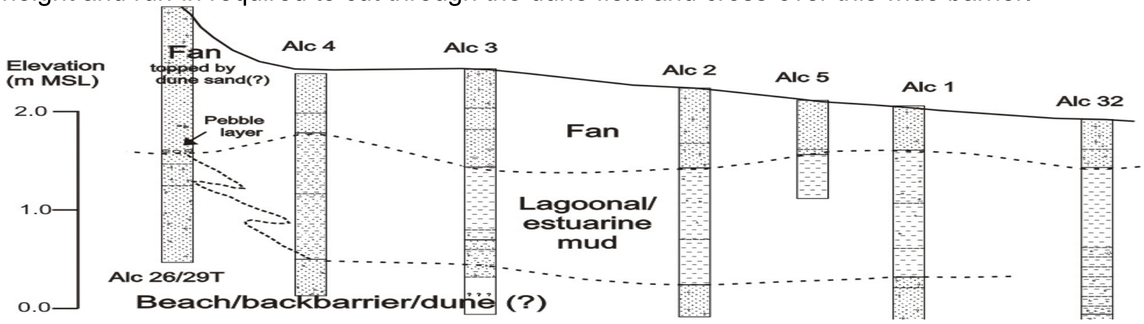

Figure 2 – Cross section A-B (see Fig.1, and text for details). Sea is towards left.

In turn, the AD 1755 tsunami extensively flooded the Alcantarilha lowland with a run-in exceeding 3 km and Costa *et al*. (2009) refers a thin sand layer embedded in the late Holocene sedimentary record of the nearby Salgados lagoon, with characteristics matching diagnostic criteria of a tsunami origin and partly sourced in the adjacent coastal dunes. This layer was constrained with ^{210}Pb and ^{137}Cs in agreement with the AD 1755 event. The sand fan in Alcantarilha shares sedimentological features with tsunami deposits in similar settings (Komatsubara *et al*.,2008) and fits the concept of *tsunami-scour fan* (Goff *et al*., 2009). We hypothesize that it could be a laterally equivalent feature of the Salgados layer, resulting from the 1755 (or other former) tsunami. The morphology of the lowland and barrier indicates that the Alcantarilha inlet should have concentrated most of the inrushing tsunami flow *ab initio*, providing a pathway for massive inundation of the lowland; however, for a sufficiently high run-up at the coast, part of the incoming wave may have also overtopped low points of the dune crest. Further sedimentological investigations and OSL datings are being carried out at present to investigate the hypothesis above.

Notwithstanding the morphology of both the foredunes and lowland favouring the preservation of washovers (Goff *et al*., 2009) this fan is unique in the Alcantarilha cell. Its well defined apex, allows constraining the elevation reached by the free-surface of the ocean just before inundation within an interval, the minimum corresponding to the height of the higher feeding channels in the dune, and maximum matching the elevation distribution elsewhere along the barrier crest. Assuming that the morphologies coeval of the overwash and present-day are similar, the run-up magnitude at the coast can be estimated in 8-10 m. This figure agrees with estimates for this region based in modelling (e.g. Gutscher *et al*., 2006) and eyewitness reports.

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