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Reconstructing inundation of the AD 1755 tsunami from sediment transport modeling and sedimentological studies

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The AD 1755 tsunami was the most destructive tsunami that affected the Atlantic coasts of Europe in historical times. Previous work, however, has not elucidated the succession of events during the tsunami. Important questions remain regarding the number of inundation and backwash phases as relates to deposition of sandy sediments recovered in the sedimentary record.

Based on detailed geomorphological, geochemical, mineralogical and sedimentary studies of four low-lying coastal areas in the Algarve (Martinhal, Boca do Rio, Alcantarilha and Salgados) it was possible to establish sediment sources, transport paths and, tentatively, define typically 3 major sub-units within the AD 1755 tsunami deposits. The sediment source of this deposit is likely the dune and/or beach based on mineralogical and grain-size comparisons with modern surface samples. Furthermore, GPR profiles collected in the adjacent dune fields (in Alcantarilha and Salgados) establish the run-up (approximately 6m above msl) in this specific coastal sector.

Tsunami deposits from AD1755 mostly consist of massive or normally-graded, landward thinning layers of shell-rich sand with an erosive base within the mud-dominated lowlands. Landward of the foredune, the AD1755 deposit is roughly 10 cm thick and thins in the landward and alongshore directions until it disappears a few hundred meters from the coast (with the exception of Boca do Rio where it exceeds 1km).

Numerical models of tsunami inundation and sedimentation can provide useful insights into the dynamics of palaeotsunamis. In this work we present results from a 1D cross shore model used to test flow height controls on deposit thickness and also to detect the sediment source of the AD1755 deposit. Four possible sediment sources were tested (nearshore, beach, dune and lagoon) using synthetic, long-period waves to simulate the AD1755 tsunami. The combination of geological studies with numerical modeling of inundation and sediment transport produces a more accurate and detailed description of the AD1755 tsunami and will contribute to better hazard assessments.

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