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The off-shore Lisbon 1755 tsunami sediments

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The RV Meteor M152 expedition mapped and sampled two transects perpendicular to the south coast of the Algarve, off Portugal, in water depths from 60 to 800 meters. The special focus was on the areas to the east of Portimão and the west of Sagres/Martinhal transects, close to the famous Martinhal, Boca do Rio and Salgados AD 1755 onshore sedimentary imprints. This part of the coast was heavily affected by tsunami inundation exactly 263 years ago on All Saints Day 1755 following a strong earthquake offshore. Shortly after the earthquake a tsunami hit the Portuguese coastline. It was one of the most consequential and impressive natural hazards ever reported destroying the Portuguese capital and many villages were destroyed along the south Portuguese coast, with the exception of Faro that was sheltered by sandbanks, whereas in Lagos the waves overtopped the city walls. Deposits of the Lisbon 1755 tsunami have been well studied along the southern Portuguese coast, but the impact of backwash, the retreating flood into the sea has not been well understood and studied. To date, very scarce information on backwash deposits is available from other areas, so this is unknown terrain, especially in these water depths. We focus on the following scientific questions: Do we find variations in thickness and sediment composition, distribution and preservation of the tsunami layer? What effects on benthic life after tsunami deposition can be observed? Can we develop a tool for the identification of historic and prehistoric tsunami deposits on the inner shelf? Can we detect predecessor events along the Algarve coast, and obtain information about timing, frequency and magnitude of these natural hazards thus extending the time-window of observation?
We collected pre- and post-tsunami deposits (the background sedimentation) along the transects for comparison, e.g. of the benthic life and its resilience. Other proxies such as geochemistry and physical properties are analyzed as well. Radiocarbon and OSL dating methods are used for establishing a geochronological framework and to estimate ages of preceding events identified macroscopically in the sediment cores. Overall, the lithostratigraphic column can be characterized as a silty-dominated sequence, likely reaching the Younger Dryas. More importantly, we detected a gravelly high-energy layer at a depth of approx. 16-25 cm depth in many cores, characterized by an erosive base, shell debris and well-rounded extra-clasts of fluvial origin. A surprising finding was a second medium to coarse sand layer at depths of around 150-180 cm with clear indications of a high-energy depositional environment (e.g. sharp erosional base, mineralogical diversified composition, macrofossil diversity, etc.). Both of the layers are found within cores of the two transects; they are preliminarily interpreted as two events, the upper is regarded as deposits of the 1755 event, whereas the lower dates younger than 4000 yrs BP.