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Reconstruction of the sedimentological environment and paleo-tsunami events offshore Jisr Az-Zarka (central Israel)

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Previous research shows that cores retrieved offshore central Israel (Caesarea) have anomalous sedimentary sequences that correspond to at least three tsunami events. Identification of the tsunami horizons was carried out by quantifying the presence of a wide range of characteristics described in modern and paleotsunami analogs. In this study, a sediment core (219cm) was obtained from 15.3 m water depth, some 1.5 km to the south-west of the Crocodile River mouth, offshore the village of Jisr Az-Zarka, and ∼4 km north of Caesarea. The core was sampled at 1 cm intervals for grain size and micropaleontological analyses. XRD and XRF analyses were also performed at coarser resolution. The aim of the study was to correlate anomalous layers in the core with previously identified tsunami layers off Caesarea and to test whether their expression differs, given the impact of the river runoff and land material input. An additional aim was to study the inter-event sediments to determine broader environmental changes. This is uniquely possible here because the maximum age of the deposits (<6yBP) and depth of the collection area negate the presence of sea-level change influence; and this portion of the coastline is considered tectonically quiet for at least 2000 years; thereby negating two possible effects on the sedimentological signatures. In this new core two tsunami horizons corresponding with known Caesarea events (∼1200 yBP, perhaps 749 AD earthquake; and ∼3500 yBP 'Santorini eruption') were recognized, and, one previously unidentified event, dated by 14C to 5.6-6 ka, was discerned as well. The Nile River has been the dominant and most stable source of terrigenous components in the study area, such as siliciclastic quartz for the sand fraction and smectite – for the clays. Thus, the prevailing marine settings are dominated by these two mineralogical components. XRD analysis of nine intervals in the core determined the following clay minerals: smectite, hydromica (illite), chlorite and kaolinite. Normal marine settings are characterized by the stable relative ratios between these minerals, while the contribution from the surrounding landmass here can be detected by increase of illite and smectite.
The Santorini tsunami layer is characterized by an increment of high illite content (2.5 fold increase relative to the average content of this mineral in the core). The earliest tsunami interval is characterized by distinct increases of titanium and zirconium concentrations according to XRF analysis.
New results from this study suggest that (1) relative to other tsunami events, the Santorini eruption-age tsunami waves caused more input of terrestrial material onto the upper shelf, as indicated by the content of illite; (2) the oldest tsunami event is characterized by a significant content of titanium and zirconium elements, which are the constituents of such minerals as rutile and zircon. This is probably the result of processes of concentration of heavy minerals; (3) the increment of smectite content found downcore, which lacks tsunamigenic indicators, between 4.5 and 3.5 ky, is attributed to increased input from the land and larger river runoff, possibly the result of a more humid climate.