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The Holocene evolution of the beach and inland aeolian sand of the north-central Mediterranean coast of Israel

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Israel's coastal geomorphology, situated within a Mediterranean climate zone, is characterized by parallel Pleistocene aeolianite ridges, coastal cliffs of aeolianite, and sandy beaches. Lobe-like fields of predominantly stable transverse and parabolic quartz sand dunes protrude 2-7 km inland from the current Mediterranean Sea coastline. However, their migration and accumulation history is still not well-defined. This study focuses on the Holocene appearance, chronology and drivers of beach sand deposition and inland aeolian sand transport along the Caesarea-Hadera dunefield in the north-central coastal plain of Israel. In order to achieve these goals, a detailed field survey and sampling campaign was carried out along a west-east and southwest-northeast transect, loyal to the advancement orientations of the currently stable dunes and directions of dominant sand transporting winds. Beach sand, a foredune, a linear dune, and interdunes of parabolic and transverse dunes were sampled down to their aeolianite or red loam (locally named hamra) palaeosol substrate by drilling and analyzing exposed sections. The sampled sediments were sedimentologically analyzed and twenty-five were dated by optically stimulated luminescence (OSL).

The results indicate that beach sand started to accumulate rapidly around 6 ka probably in response to global sea level stabilization. Until around 4 ka, thin sand sheets encroached 2-3 km inland. Sand ages in the range of 1.2-1.1 ka (8th-9th century CE—Early Moslem period) were found throughout the study area, suggesting a major mobilization of sand, followed by stabilization around 0.6 ka and pedogenesis. By 1.2 ka, the sands had reached their current extent of 5-7 km inland, suggesting transport in a southwest-northeast orientation similar to the advancement orientation of the current transverse and parabolic dunes. The particle-size distributions of the fine to medium-sized aeolian sand showed minor variation linked to inland transport distance and age and did not significantly differ from the values of beach sand.

The spatial distribution and temporal clustering of the 1.2-1.1 ka ages does not seem stochastic. However, this age range does not coincide with any local or regional climate change or anthropogenic anomaly that could explain the enhanced sand mobility. Assuming no late Holocene change in coastal sand supply and availability, sand transport may have been due to short term climate (multi-annual) episodes of increased windiness that may have followed short-term or cumulative removal of stabilizing dune vegetation by man, a hypothesis that requires further investigation.