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Evidence for post last-glacial-maximum punctuated sea level rise found on the eastern Mediterranean coast of Israel

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The eustatic sea level curve for the eastern Mediterranean presents a general trend characterized by rapid post last-glacial-maximum rise (20,000 years ago), slowing approximately 6000 years ago and stabilizing at current sea-level 4000 years ago. Sea level evidence from portions of the Israeli coastline, suggest minimal to no hydro-glacio-isostatic influence on the local relative sea level curve, and no tectonic offsets for at least the past two thousand years. Recently, a submerged series of relict wave cut notches and erosional pits were identified along a sequence of coastal sites located approximately 20 km from one another (Michmoret, Olga, Caesarea, Dor) at 3 m and 6 m water depths. The features were carved into an upper-Pleistocene to Holocene eolianite sandstone, the age of which was previously constrained by OSL measurements to MIS 1-3. Elsewhere, similar features are widely used as sea-level markers. In this study, at some of the sites, we found a coinciding 3 m to 6 m submerged cliff with overhanging upper part, morphology that is comparable to the morphology of the modern coastal cliff. These submerged features should either suggest a tectonic offset, which is not favorable for the study area, or they might suggest that sea level rise has not been gradual, but rather punctuated, exhibiting pulses of sea level rise followed by periods of sea level stagnation. For the study site, the last stagnation took place at a few meters below current sea-level and enabled the development of the observed wave induced morphology within the eolianite. At present sea level, similar features exist and are being actively formed within the same host rock. At some of the sites, artificially-cut archaeological features from about the last 2000 years present with notches or erosional pits thereby providing insight into the period of time required for their creation due to their archaeological associations.
Sea level rise might impacts the coastline significantly, with ramifications ranging from erosion, undermining littoral infrastructure, infiltrating aquifers, and a wide set of issues associated to reshaping the landscape. In the area studied, for example, this manifests itself in the carving of the current coastal cliff into the long-shore eolianite sand dunes. If sea-level rise occurs following a punctuated pattern, preparations for its occurrence are dramatically different on a geographical and temporal scale than preparations for an anticipated gradual sea level rise. For monitoring and conservation efforts, awareness of the nature and timing of sea-level rise will assist in modeling and estimating coastal changes as well as better understanding the morphology of submerged habitats. In addition, these findings contribute greatly to the discussion of whether the eastern Mediterranean experienced tectonic activity during the recent Holocene.