

Paper Number: 5065

## Archaeological and geological markers reveal the time span and formation rates of the central coastal cliffs of Israel

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The majority of Israel's population is concentrated at the coastal region or close to it. The coastal cliffs of central Israel (Figure 1) (The Sharon region) have significant effect on human access to the coastline and to the marine environment. In order to sustainably manage and protect the natural, cultural, urban and industrial assets on the coast, it is important to understand the time span and rates of coastal cliffs formation and erosion. Previous studies monitored the cliffs using field observations and aerial photographs. They provided valuable information on the processes that had occurred during the last centuries. Archaeological and geological features, however, are used to identify longer processes. Underwater and coastal archaeological and geological research in recent decades revealed shipwreck, anchorages, coastal installations and natural features, which are used to calculate the formation time and erosion rates of the coastal cliffs. The *Kurkar* (Aeolian, carbonate-cemented, quartz sandstone) deposits on the Sharon coast, are poorly consolidated. Judging by their age, these sandstone deposits were formed after the last interglacial high sea stand, which occurred some 120ka BP. Thus, the coastal *Kurkar* cliffs are a product of the last postglacial sea level rise. About 6-5Ka BP sea level has reached the western fringes of the coastal *Kurkar* ridge and its erosion began. The finds suggest that the initial and main phase of the coastal cliff creation took place during a relatively short period between 5-4Ka BP (a retreat of ca 600 m within 1Ka at a rate of 0.7 m/yr). About 4Ka BP sea level has reached its present elevation and has not changed significantly since. Between the Middle Bronze age and the Hellenistic period (4Ka to 2.1Ka BP) the cliff retreated only 60 m in a rate of 0.3 m/yr. After the Hellenistic period, the cliff retreat in a significantly lower rate (30 m within 2Ka at a rate of 1.4 m/yr). Human activity and sea level rise in the last 100 years have significantly accelerated coastal erosion, cliff retreat and the formation of new cliffs.



*Figure 1: The Sharon coastal cliff and the Crusader site of Apollonia being eroded (Photo: Israel Antiquities Authority)*

