

Holocene beach buildup and coastal aeolian sand incursions off the Nile littoral cell

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Israel's coastal plain is abundant with sand originating from the Nile littoral cell. The inland windblown loose sand has formed 3-6 km wide lobe-like sand and dune fields currently comprised of foredunes, linear and northeasterly facing transverse and parabolic dunes that are currently stabilized by vegetation. This study reviews the architecture and history of these dune fields aiming to: (a) Date the timings of beach accretion, and sand and dune incursions. (b) Discriminate between natural and human-induced forcing factors of sand mobilization and stabilization in time and space. (c) Present a model of the dunescape development. (d) Assess scenarios of sand transport in the future characterized by intense human impact and climate change. Luminescence ages, radiocarbon dates and relative ages from previously published geological and archaeological reports, historical texts, together with new optically stimulated luminescence (OSL) ages and stratigraphic and sedimentological data are analyzed.

The deposition, mobilizations and preservation of the sand bodies, initially induced by the decline in sea level rise at 6-4 ka, were later controlled by historic land-use intensity and modern land-use/negligence practices. At ~6 ka, beach sand buildup rapidly started. Where aeolianite ridges bordered the coast, pulses of sand with biogenic carbonate grains unconformably draped the ridges and rapidly consolidated into a distinct sandy calcarenite unit. Further east, sand sheets and low dunes partly pedogenized following their incursion, but did not cement. The water retention capacities of the sand sheets enabled the establishment of a sand-stabilizing vegetation cover that probably became an attractive environment for fuel and grazing.

The growing Hellenistic-Roman-Byzantine (~2.4-1.3 ka) populations probably led to increased consumption and massive destruction of sand stabilizing vegetation, enabling sand erodibility and mobilization during winter storms. The sand gradually expanded to the current limits of today's dune fields. The gradual but unsteady post-Byzantine demographic drop enabled reestablishment of natural vegetation and rapid regosol development. This drop occurred differentially along the coast due to governance and land-use practices.

We suggest that dune construction mainly evolved around the 19th century from the existing sand sheets and low dunes that intermittently developed since 6-5 ka. Human (Bedouin grazing influx and ethnic settlements) destruction of vegetation, in conjunction with the rapid 19th-20th century population growth made the sand prone to "in situ" transverse and linear dune formation in response to powerful winds further supported by increased storminess at this time. Inland dune mobilization and the artificial establishment of vegetated foredunes along the coast in the 1930's-1940's partly scalped the sand deposits by the coast.