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Geomorphological evolution of the dynamic Abu Dhabi coastline

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The Abu Dhabi coastline provides an ideal setting for studying sedimentation processes in an arid depositional environment directly analogous to that of many of the region's Mesozoic petroleum reservoirs. This coastline displays a low-angle ramp geometry with supratidal evaporite precipitation passing offshore, through a broad carbonate-evaporite intertidal setting with complex depositional facies geometries, into a subtidal carbonate depositional environment. The coast is locally protected from open marine conditions by a number of peninsulas and offshore shoals and islands associated with the east-west trending Great Pearl Bank.

This offers an ideal setting for studying the effects of relative sea-level fluctuations on sedimentary systems and shoreline morphology. A late Holocene progradation rate of 0.75 m/yr has previously been established for the Abu Dhabi Sabkha system (Lokier and Steuber, 2008) however we conjecture that the system has now entered a broadly retrogradational phase. By applying current estimates of global sea level rise of 3.3 mm/yr derived from satellite altimetry and tide gauges (Cazenave and Nerem, 2004; Leuliette et al., 2004), we calculate present day marine transgression of the Abu Dhabi shoreline at a rate of 8.25 m/yr.

This study utilised 7 years of fieldwork observations and satellite imagery to establish numerous lines of evidence for active retrogradation over an area of Abu Dhabi coastline lying between Al Dabb'iya in the east and Abu al Abyad in the west. The landward advance of spits and beach ridge systems was monitored at several locations with rates of retrogradation of up to 28 m per year being recorded in some instances. These are significantly greater than those predicted from sea-level rise and may indicate a local subsidence.

The landward and seaward limits of microbial mat belts are strongly controlled by their location in the intertidal zone. The seaward side of the Recent microbial mat belt in the Abu Dhabi Sabkha is being eroded while the landward side is backstepping over gypsum sands indicative of the uppermost intertidal to lower supratidal zone. From field observations we conclude that the preservation of microbial mats during the transgressive phase is unlikely as they are particularly susceptible destruction once they enter the marine environment.

The study identified a number of erosive features. There has been a significant increase in denudation of the microbial mat. With the destruction of the protecting mats the unlithified underlying sediment has become increasingly susceptible to erosion. Erosion of upper intertidal zone sediments is significant at a number of locations. In some cases this erosion has reached the aeolian beach ridges marking the commencement of the supratidal zone. In the lowermost intertidal zone, erosion of the hardground and other facies has been observed. Clasts from the hardground have been transported landward onto the surface of the sabkha where they are incorporated into other facies.
From our observations we conclude that the current sedimentary regime of the Abu Dhabi coastline is regressive associated with the current marine transgression of the Quaternary sabkha system. From a sequence stratigraphic perspective, the current system would be identified as an unconformity or flooding surface prior to the onset of a parasequence.

References

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