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A contemporary look at the sedimentary system of the coastal sabkha of Abu Dhabi (UAE): Primary deposition vs. early diagenesis

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More than half a century ago, the Abu Dhabi coastline was subject to intensive research efforts by institutions from all over the world. This activity was mostly related to the onset of oil exploration in the region and the hypothesis that the modern Abu Dhabi Sabkha provides a direct analogue to the ancient deposits of the hydrocarbon-bearing Arab Formation. While research initially concentrated on a characterisation of the bulk depositional system, focus has recently shifted to answer more specific questions such as the role of microbial mats in the formation of dolomite. Through this shift to a smaller scale, the remainder of the sabkha, including its microbial mats, was neglected and little further activity was undertaken to characterise the coastal sabkha using modern, state-of-the-art, research tools and methods. This paper will not attempt to reinvent the wheel with respect to the work of the early researchers; we will instead present an updated model of the sedimentary system of the coastal sabkha of Abu Dhabi. This model will focus on establishing the relationship and controlling factors between primary deposits of the carbonate ramp system and secondary early diagenetic precipitates.

Initial results show that primary deposits of the UAE's carbonate ramp are equivalent to carbonate mudstones, packstones, grainstones, and occasional rudstones with a packstone matrix, that form above a Holocene to Recent hardground. These deposits occur mostly in a subtidal to lower intertidal setting, landward of which they are gradually being covered by a green cyanobacterial layer that binds the primarily unconsolidated sediment. Further landward, in the middle and upper intertidal zones, these cyanobacterial layers grade into more complex microbial mat layers of potentially highly diverse bacterial and algal faunal composition. Microbial mat layers in the upper intertidal and the lower supratidal zones are increasingly interspersed with gypsum crystals and white hydrophilic anhydrite layers. In the subsurface, the subtidal and intertidal carbonate lithologies are successively being replaced by gypsum crystals, and ultimately form a gypsum sand to gravel, the primary texture of which is unrecognisable. A shallow buried microbial mat hosts cm-scale gypsum crystals. These crystals contain embedded low-Magnesium carbonate grains (gastropods, benthic foraminifera) that are evident of selective preservation of low-Mg calcite during the formation of gypsum. Additionally, the preservation of primary layering within those gypsum crystals, shown by the before-mentioned carbonate grains, is evidence for the formation of these gypsum crystals through direct replacement of primary aragonitic sediment.