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Large-scale intertidal polygonal features of the Abu Dhabi coastline

STEPHEN LOKIER and THOMAS STEUBER
The Petroleum Institute, P.O. Box 2533, Abu Dhabi, United Arab Emirates (E-mail: slokier@pi.ac.ae)

ABSTRACT

This study provides the first quantitative description of modern giant polygons. These large-scale, up to 166 m diameter, sedimentological features are described here in detail from the intertidal zone of the Arabian Gulf near Abu Dhabi. These features form by the displacive carbonate cementation of carbonate sand below a 3 to 5 cm thick cover of unconsolidated sediment. The oxygen isotopic composition of cements is consistent with precipitation from evaporated sea water. Cementation proceeds via a poorly consolidated layer that grades downward into an 8 to 14 cm thick, well-cemented grainstone. The margins of this expanding hardground form the overlapping borders of the polygons. Tepee structures at the borders of polygons are only occasionally preserved, as supporting sediment is removed by strong tidal currents and high-energy events, such as storms, that erode the unsupported tepees. These observations have clear implications for the use of tepees in the interpretation of ancient polygons and their associated environments. When preserved in the sedimentary record, tepee structures are interpreted to indicate lower energy depositional environments than that observed in this study.

Keywords Arabian Gulf, carbonate hardground, intertidal, polygon, tepee structures, UAE.

INTRODUCTION

The southern shore of the Arabian Gulf comprises an extremely low-angle ramp setting characterized by supratidal evaporite precipitation passing offshore through a laterally extensive intertidal setting into subtidal carbonate deposition (Evans *et al.*, 1964; Alsharhan & Kendall, 2003). The shoreline is partially isolated from the more open marine conditions of the Arabian Gulf by a number of peninsulas and offshore islands (Fig. 1).

This study provides the first quantitative description of the distribution and morphology of very large-scale peritidal polygons that were identified over an extensive area during ongoing research into the sedimentological, depositional and diagenetic setting of the Abu Dhabi coastline. Large-scale polygons up to 166 m wide were identified from satellite images as occurring in the intertidal zone over an area measuring approximately 6·5 km long by 1·2 km wide. Kendall & Skipwith (1969) identified similar-scale polygons on intertidal sand flats 12 km to the west of the present study area. The Kendall and Skipwith study briefly described polygons that apparently bear distinct morphological differences from those described here.

Polygons have previously been described as ubiquitous features of the Abu Dhabi sabkha (Kendall & Skipwith, 1968; Kendall & Warren, 1987; Whittle *et al.*, 1998; Alsharhan & Kendall, 2003) and, indeed, of a number of other Recent depositional environments including the subtidal Arabian Gulf (Shinn, 1969), the intertidal flats and coastal salinas of Australia (Ferguson *et al.*, 1982; Warren, 1982) and the Great Basin playas of North America (Neal *et al.*, 1968; Warren, 2006). Polygons have also been widely described from the stratigraphic record, with examples from the Palaeozoic (Assereto & Kendall, 1977; Warren, 1983), Mesozoic (Assereto & Kendall, 1971; Smith, 1974; Bellamy, 1977; Tucker, 1981) and Cenozoic (Lugli *et al.*, 1999) being common.

Many of the previous studies of polygons, at all scales, have concentrated on the tepee structures

