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The evolution of Chabahar beach ridge system in SE Iran in response to Holocene relative sea level changes

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ABSTRACT

The Chabahar Strandplain (CHS) stretches along the Chabahar bay at a width of more than 5 km along the northern coast of the Gulf of Oman and SE Iran; an area that has been subjected to tectonic uplift as a part of the Makran accretionary prism. The CHS comprises of beach ridges, inter-ridge swales, sand dunes, tidal channels and fluvial deposits. We present the first documentation of the spatial distribution and the internal architecture of the CHS based on topographic surveys, sediment percussive coring, trenching and ground penetrating radar (GPR) transects. Radiocarbon dating on marine shells from foreshore deposits of 8 representative beach ridges yielded ages between 4800 and 270 cal. years BP at respective distances of 4800 to 670 m from the present shoreline. We interpret the boundary between the foreshore (beach) and the foredune deposits as indicator of past sea levels by analogy to present shore processes. This boundary is readily recognizable in sediment profiles from cores and trenches as well as GPR reflectors. Based on the age model and depositional features, we estimate relative sea level fall of up to 15 m over the past 4800 years. Considering that the eustatic sea level changes for this period are negligible for the Makran coast, this relative sea level fall is related to tectonic uplift across the coastal Makran. The elevation of palaeo-shorelines with similar ages decrease from east to west of the CHS, which suggest that alongshore variations in uplift rates are likely related to different movements of coastal fault blocks.

1. Introduction

The low-relief coastal areas of the world are under ongoing threat of sea level rise (Church et al., 2013). The knowledge of past relative sea level changes is essential for understanding coastal evolution and trends of future sea level changes. Beach ridges are among common landforms in prograding coasts and have the potential to provide high-resolution records of coastal processes, the position of former shoreline and relative sea level changes (Otvos, 2000; Goy et al., 2003; Anthony, 2009; Tamura, 2012).

A beach ridge is defined as a relict, elongate body of sand or gravel-sized sediment that stretches parallel or semi-parallel to the shoreline (Otvos, 2000). A strandplain, also referred to as beach-ridge system, corresponds to a coastal plain characterized by a series of beach ridges separated by shallow swales. It consists of surficial and subsurface sediments and structures with a worldwide distribution across all latitudes and continents (Scheffers et al., 2012). Understanding the internal architecture of strandplain is essential for interpretation of the origin, formational processes and the position of former shorelines.

Holocene strandplains have been studied in many coastal environments including those in Australia (Bristow and Pucillo, 2006; Oliver et al., 2017), New Zealand (McSaveney et al., 2006) north America (Moore et al., 2004; Billy et al., 2014, 2015), South America (Hesp et al., 2005), Northern Europe (Brückner and Schellmann, 2003; Clemmensen and Nielsen, 2010), Southern Europe (Goy et al., 2003), west Africa (Anthony, 1995) and eastern coast of Japan (Tamura et al., 2008, 2010; Tamura, 2012). Most studies have focused on reconstruction of past relative sea level changes based on strandplain deposits (Searle and Woods, 1986; Tanner, 1988; Thompson, 1992; Thompson and Baedke, 1995; Blum et al., 2003; Rodriguez and Meyer, 2006; Tamura et al., 2008; Clemmensen and Nielsen, 2010). The application of geophysical subsurface profiling techniques, in particular, along with topographic and sedimentological studies are of great importance in integrated studies of strandplains. Ground-penetrating radar (GPR) techniques have been especially found useful in recent beach ridge studies (Van Heteren et al., 2000; Jol et al., 2002; Nott et al., 2009; Clemmensen and Nielsen, 2010; Tamura et al., 2008, 2010, 2017; Billy et al., 2014; Oliver et al., 2017).

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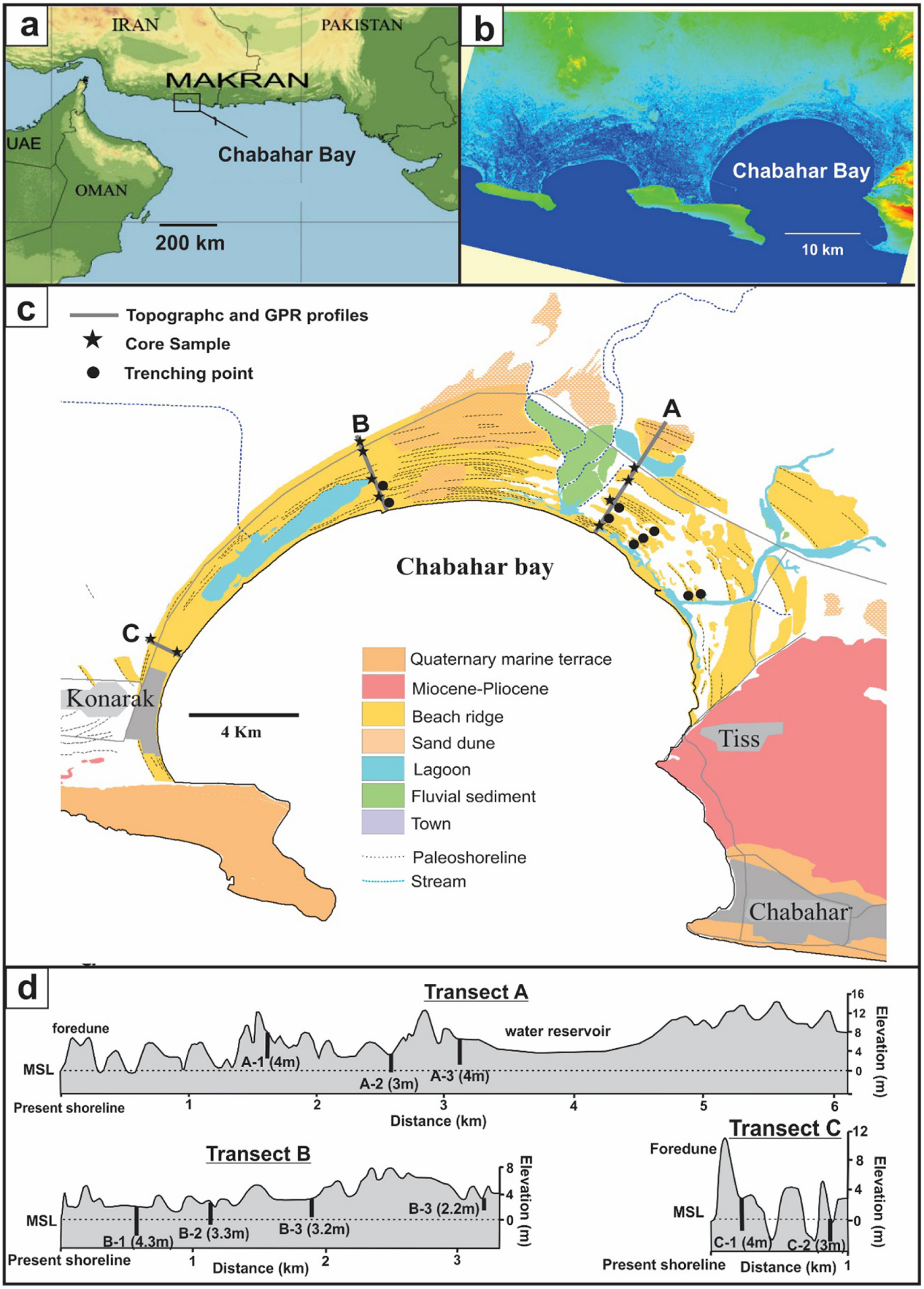

Fig. 1. (a) Location map of the study area. (b) Spot-DEM digital elevation model of Chabahar bay and adjacent area. (c) Geomorphologic map of the Chabahar strandplain with position of three coastal transect and sediment sampling sites. (d) Topographic profile of three studied transects with position of collected sediment cores.