Quaternary International 392 (2016) 203–212

Contents lists available at ScienceDirect

Quaternary International

journal homepage: www.elsevier.com/locate/quaint

Evolutionary trend of paleoshorelines in the Coastal Makran zone (Southeast Iran) since the mid-Holocene

Mohammadreza Gharibreza

Soil Conservation and Watershed Management Research Institute, P.O.Box:13445-1136, Tehran, Iran

A R T I C L E I N F O

Article history:
Available online 10 July 2015

Keywords:
Coastal Makran
Evolutionary trend
Mid-Holocene
Paleoshorelines
Coastal progradation
Paleo-geographical features

A B S T R A C T

The Coastal Makrn (CM) is the outermost part of the Makran zone, which is one of few intact areas to study the evolutionary trend of raised beaches and also to estimate the rate of coastal progradation since the late Holocene. The Makran zone is an accretionary wedge that has formed by the subduction of oceanic crust of Arabian Plate under the Eurasian Plate. The CM range in Iran is located between the eastern corner of the Hormuz Strait and the middle of the Guwader Bay at the Iran–Pakistan boundary. This research method utilized remote sensing (RS) techniques and geographic information system (GIS), field survey and radiocarbon dating of fossils The data indicate the effective limit of the Flandrian transgression (18,000 BP) and paleo-geographical features in the mid-Holocene. Sequences and time periods of fossil beach development and the mean rate of shoreline mobility and uplift in omega-shaped bays were obtained. Coastal progradation from the oldest fossil beach in the Kerian area started from 4329 ± 64 Cal BP, and in Chabahar and Guwader Bay from 5438 ± 87 Cal BP and 5389 ± 58 Cal BP, respectively. Different rates of uplift result from tectonic movements of various scales. Development of fossil beaches in the Chabahar and Pozm Bays since the mid-Holocene coincided with a clear increase in rate of uplift from 0.71 mm y^{-1} to 5.02 mm y^{-1}. The highest rate of uplift of fossil beaches (5.02 mm y^{-1}) occurred at Darango Bay. Tombolos were identified as a main paleo-geographic feature of the CM zone in the early Holocene. Such landforms were gradually converted to Omega-shaped bays from the mid-Holocene. Developments of Omega-shaped bays are continuously in progress by a regional mechanism, in which wave regimes and sediment supply from hinterlands are relatively stable. Paleogeographic features of the area in the mid-Holocene were built based on land progradation rate, tectonic events, and trend of sea level changes.

1. Introduction

Makran is a well-known structural zone of parallel accretionary wedges, which developed due to the subduction of Arabian Plate crust below the Oman Abyssal Plain and under the Eurasian continent. These wedges include the Coastal Makran (CM), Outer Makran, Inner Makran, and North Makran, and two pull-apart basins (Hamun-e-Jazmurian and Hamun-e-Mashkol) (Fig. 1). The Makran accretionary wedge stretches from Iran to central Pakistan along the south coast of this area. The modern Makran accretionary prism developed since the Late Miocene (Platt et al., 1988). The onshore part or CM zone is comprised of a uniform belt of deformed Cenozoic terrigenous and mud sediments. Most of the 500 km broad accretionary wedge is exposed onshore in Pakistan and Iran (Schlüter et al., 2002).

The Iranian range of CM is located between 25°15′–30′N, and 59°15′–61°21′E (Fig. 1). The geomorphology of the area includes marine terraces, fossil beaches, and headlands. The well-recognizable geomorphic landforms in the area includes omega-shaped bays (Tang, Pozm, Chabahar, and Guwader) and some curved bays (Gurdim, Ramin and Beris) (Fig. 2). Coastal Makran is an active morphodynamic zone because of monsoon storm waves, neo-tectonic movements, and erodible marine terraces. The CM involves the neo-tectonic area undergoing uplift (Falcon, 1974; Page et al., 1979; Vita-Finzi, 1979, 1987; Reyss et al., 1999). Previous studies mainly focused on uplifting of marine terraces, and few studies (Lambeck, 1996; Gharibreza and Motamed, 2006) focused on raised beaches and tried to identify paleogeographical features. McCall (1985), Gharibreza et al. (2003), Platt (1988), Vita-Finzi (1979), and Smith et al. (2012) have recognized three important

E-mail address: gharibreza4@yahoo.com.

http://dx.doi.org/10.1016/j.quaint.2015.06.030
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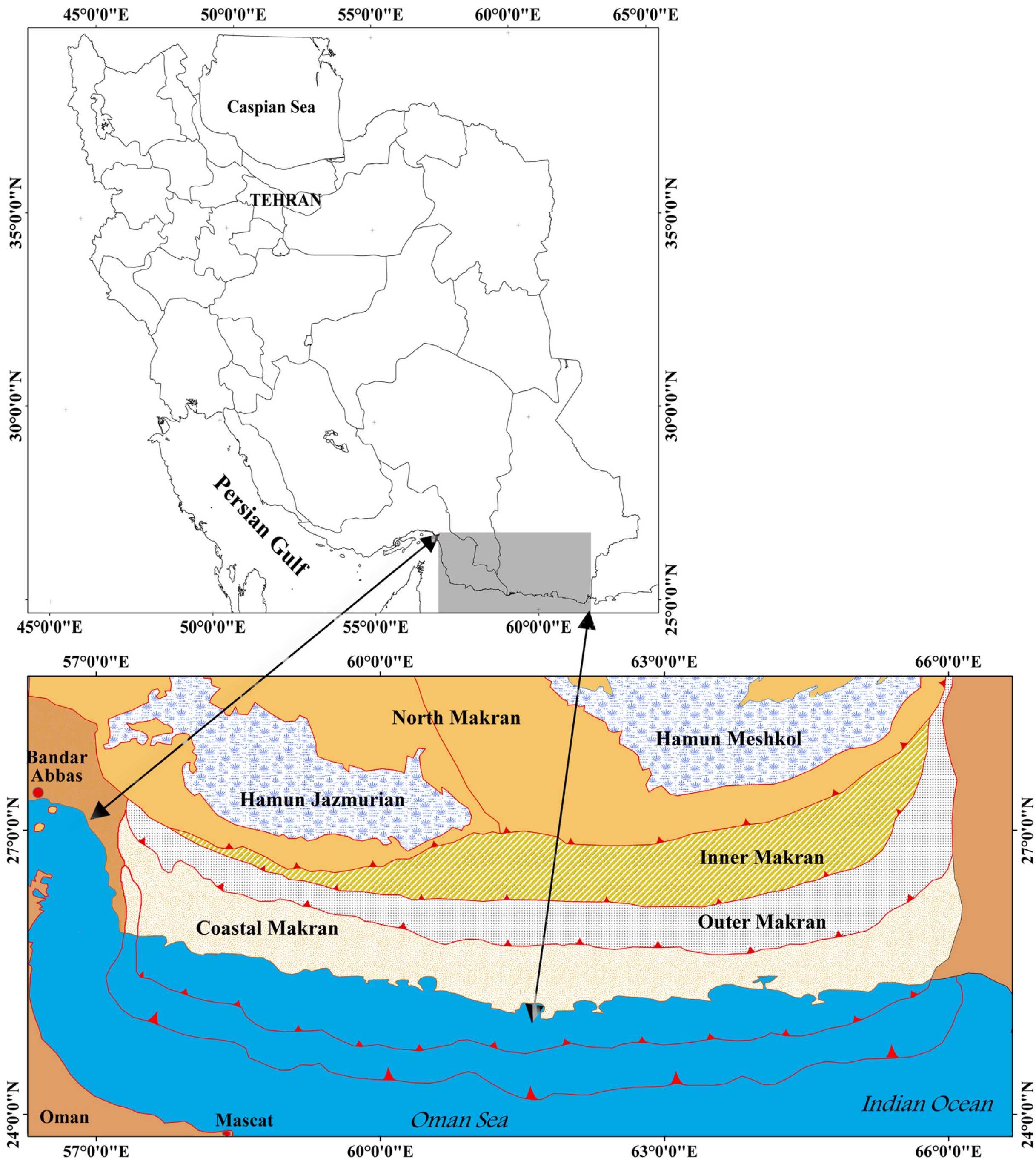

Fig. 1. Makran structural zone with study area thrust system faults (after Haghipour et al., 2013).

fault systems which contribute to shaping the structure of the CM zone.

Marine terraces at Jask, Konarak, Chabahar, and Guwader were dated by Page et al. (1979) and Vita-Finzi (1987, 1979) using ^{14}C. Pirazzoli (1991) and Ruggiero et al. (2013) stated that un-reworked articulate fossils in the well-preserved paleoshorelines are suitable materials for ^{14}C dating. Vita-Finzi (1987), Walker (2005), Gharibreza and Motamed (2006), Page et al. (1979), and Heyvaert and Baeteman (2007) have studied coastal evolutionary trends of the Persian Gulf and the CM zone.

Vita-Finzi (1979) reported that near Chabahar, at least 19 marine terraces are distinguishable between the present sea level and 246 m, where fossilized corals were rare. In situ shells around 4 m asl were dated to 3670 ± 50 BP. Oysters at higher elevations had been radiocarbon dated between 28 and 30 ka BP. Another marine terrace at 3.5 m elevation at Guwader, near the Pakistan border, was dated by Vita-Finzi (1979) at 25.97 ± 0.3 ka BP. A similar age (23.6 ± 0.65 ka BP) was reported by Snead (1993) from a rocky headland of Jask in the western part of the CM zone. In addition, he studied a 29 m high marine terrace near the high-water mark, dated 3960 ± 100 and 5410 ± 110 BP. Two shell samples near Jask 1.3 m above the high-water mark were dated 6595 ± 125 and 4870 ± 100 B P by Vita-Finzi (1979).