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Depositional evolution of the Lower Khuzestan plain (SW Iran) since the end of the Late Pleistocene

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ABSTRACT

A detailed sedimentological investigation of sixty-six cores supported by radiocarbon age determination enabled the reconstruction of the depositional environmental evolution since the end of the Late Pleistocene in the Iranian part of the Mesopotamian plain. Both fluvial and estuarine environments have been identified on the basis of the sediment characteristics and their between-core stratigraphic correlations. At the end of the Late Pleistocene the fluvial behaviour allowed only the deposition of sand. Prior to 12400–12040 yr cal BP the palaeohydraulics changed by which heterolithic fluvial facies were deposited. Shortly after 12400 - 12040 yr cal BP an erosional phase caused the incision of depressions most probably because of a climate change to further arid conditions. In the early Holocene, mud-dominated river systems filled the depressions; a situation that lasted at least until 7900 - 7700 yr cal BP. After this period tides invaded via the active channels in the downstream part of the area, which turned into an estuarine environment for a period of about 2000–2500 years. Tidal influence diminished and stopped around 5000 yr cal BP because of progradation. Fluvial processes dominated again the sedimentary environment in the study area, except at the southern margin of it where tides controlled, although very locally, the environment.

1. Introduction

Mesopotamia is a key region for the archaeology of the Middle East. Geomorphological and to a lesser extent geological investigations have been undertaken since the early 20th century to reveal the Holocene sedimentary development of the low-lying plain. The major points of interest of the researchers were related to the anthropogenic impact on the landscape changes, and the sea-level history of the Persian Gulf. However, all investigations were carried out in the Iraqi part of Mesopotamia. For an overview, see Baeteman et al. (2004/2005), Heyvaert and Baeteman (2007) and Bogemans et al. (2017). The Lower Khuzestan plain in SW Iran, however, also belongs to Mesopotamia. Here proper geological investigations like in Iraq were non-existent, and the sometimes contrasting ideas about the development of the plain were inferred from historical sources and surface observations.

In an attempt to meet this void the Holocene depositional evolution and in particular the extension of the Persian Gulf has been investigated in a project combining geo-environmental reconstructions and archaeological data in the Lower Khuzestan plain (Baeteman et al., 2004/2005; Gasche and Paymani, 2005; Heyvaert and Baeteman, 2007). The plain was hitherto an uncharted territory; therefore a large area was surveyed. The study area extended from the Persian Gulf to the Ahwaz and Agha Jari anticlines (Fig. 1). It was surveyed by means of 54 hand-operated cores reaching depths between 4 and 7 m. The results of this project showed that the Persian Gulf extended at least 80 km north of the present coastline at around 8000 yr cal BP. Tidal flats developed and shifted rapidly inland. Until 7000 yr cal BP the lower lying areas were largely wetlands sensitive to inundations by estuaries and rivers. The intertidal environments evolved into salt marshes as a result of the rapid sea-level rise in combination with a high sediment input. The palaeogeographical maps show a tidal flat environment as far as 120 km north of Khorramshahr. The abundance of evaporites in the sedimentary record made the authors conclude that coastal sabkhas replaced the salt marshes indicating a climate change toward a more arid setting probably around 4500 cal BP, an age that was put forward by Aqrawi (2001). Around 1350 - 1250 yr cal BP according to Baeteman et al. (2004/2005) but around 2500 yr cal BP

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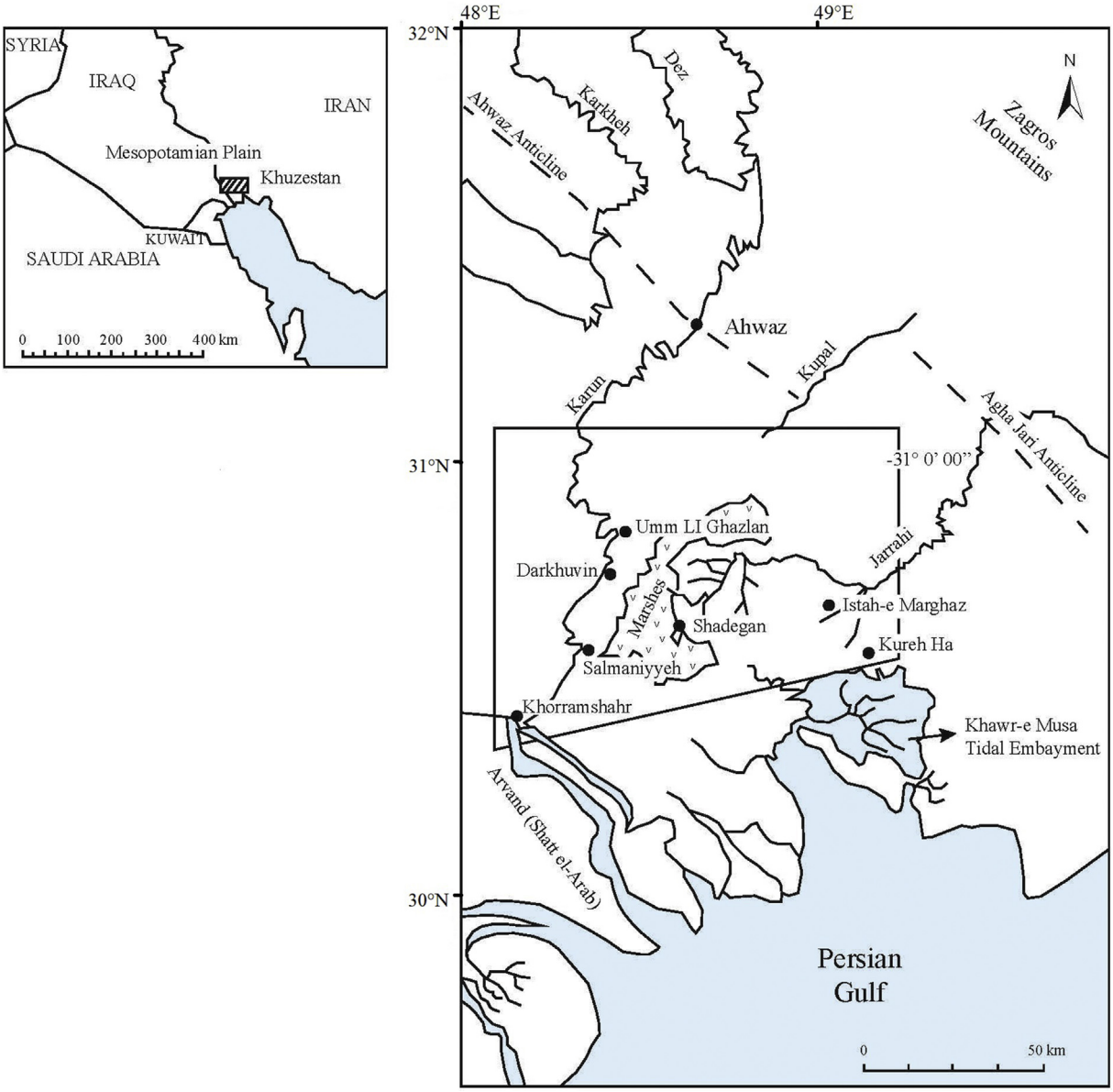

Fig. 1. General location of the study area in relation to the Persian Gulf and neighbouring countries with indication of the cited cities in the text.

according to Heyvaert and Baeteman (2007) the coast started to prograde whereby the sabkhas were replaced by a floodplain.

The contribution and impact of the fluvial systems on the depositional environments, however, was not sufficiently acknowledged. The major part of the Holocene record was interpreted as tidal deposits, despite the ubiquitous presence of the rivers Karun and Jarrahi in the landscape in this part of the Lower Khuzestan plain (Fig. 1). With respect to the rivers, additional investigations have been carried out using remote-sensing techniques and textual sources (Verkinderen, 2009; Walstra et al., 2010a, 2010b; Dupin, 2011). These studies, investigating mainly the impact of human activities on the landscape, were restricted to the detection of changing watercourses since antiquity, and did not discuss the evolution of the depositional environments during the Holocene.

To investigate the Holocene depositional evolution of the Lower Khuzestan plain a joint project with the Geological Survey of Iran was launched in 2013. The objective was to determine the effect of terrestrial and littoral processes as well as the impact of external forces on the nature and dynamics of the sedimentary systems. Therefore, the southern part of the Lower Khuzestan plain, where during the Holocene terrestrial and littoral processes met and interacted, was selected as study area. This paper presents the results of fieldwork campaigns carried out in 2013, 2014 and 2015 revealing the reconstruction of the sedimentary environmental evolution since the end of the Late Pleistocene, but with the main accent on the evolution during the Holocene.

2. Setting

The study area belongs to the Mesopotamian Plain, a large foreland basin of the Zagros Mountains (Sharland et al., 2001; Konyuhov and Maleki, 2006). The Zagros Mountains, located northeast of the area, originated from the collision of the Arabian and Eurasian plates. They are the sediment source of the rivers Karun, Kupal and Jarrahi. The Zagros Mountains and the Khuzestan plain are characterized by a very intense seismicity, but the seismic magnitude is low. Consequently the created deformations are