

## **Sands of time: archaeo-geophysical prospection results from the Emirate of Sharjah**

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Sharjah is after Abu Dhabi and Dubai the third-largest Emirate of the United Arab Emirates. Its territories extend from the Gulf to the edges of the Rub' al-Khali, the largest sand desert of

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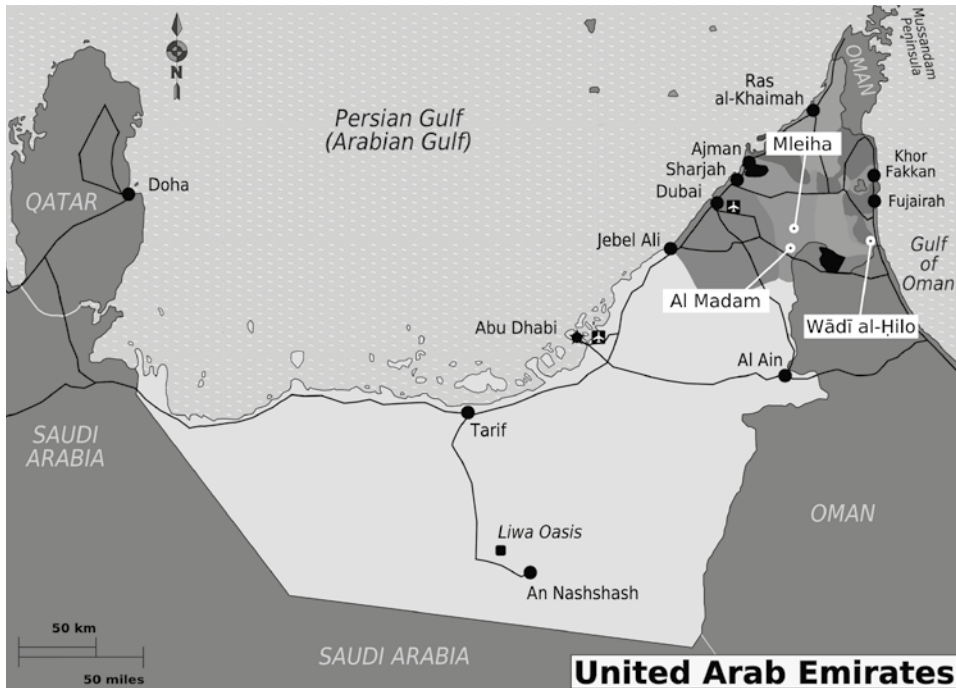


Fig. 1. Location of the investigated sites in the Emirate of Sharjah (UAE)

the world, and along the coast of the Gulf of Oman. Already in pre-Islamic times the region was criss-crossed by trade routes where merchants from the Arabian Peninsula, Mesopotamia, Sindh, India and China met. In addition, the Emirate of Sharjah is rich in Neolithic and Bronze Age sites. Three survey projects realised in the period between 2009 and 2014 are presented: the Al Madam project in cooperation with the Autonomous University of Madrid and the geophysical surveys in Mleiha and Wādī al-Hilo, both directed by the Directorate of Antiquities of Sharjah (Fig. 1).

#### AL MADAM IRON AGE SITE

Geophysical prospection works at large-scale sites started in 2009. Together with a team of archaeologists from the Autonomous University of Madrid, a hydraulic system, a *falaj* at the Iron Age site of Al Madam, was investigated. Magnetic measurements using the 8-probe gradiometer array LEA MAX were carried out on a surface of approx. 10 ha. Its objective was to localise the course of a subterranean water channel coming from the foothills of the Hajar Mountains, located 10 to 15 km further southeast.

The data revealed a fragmentary line of negative magnetisation indicating the channel itself running at a depth of 1 m to 3 m and the tops of air shafts of the *falaj*. In the area where this line disappeared in the magnetic data, several linear anomalies of assumed fills of open water channels were detected.



Fig. 2. Result of the magnetic survey in Mleiha (Sharjah, UAE) with 10-probe Fluxgate gradiometer array LEA MAX, total investigated area: 27 ha

It is presumed that the end of the *falaj* is located in an area of extensive agricultural use and that the fills reflect bifurcations of the main water supply for the distribution of water. In order to specify the characteristics of these secondary channels, GPR measurements were applied. The GPR data reflect a complex network of a water supply and distribution system. Subsequent excavations directed by Joaquín Córdoba proved this data (Cordoba 2011). Ceramic finds in the fills allowed the structures to be dated to the Iron Age. Based on these results, it emerged that already at this early time agriculture on sand by means of sophisticated irrigation systems was practised by the inhabitants of this arid region.

#### PREHISTORIC SETTLEMENT OF MLEIHA

The site of Mleiha (Jasmin 2001) is located on an agricultural inland plain at the western foot of the Hajar mountains, some 20 km south of the modern town of Al Dhaid and roughly 50 km east of the city of Sharjah. Mleiha is thought to have been one of the most important sites in the Oman Peninsula for the period of the last centuries BC. For the past two decades, the prehistoric settlement of Mleiha has been subject to investigation conducted by both national and foreign teams. Previous and ongoing systematic campaigns have led to numerous archaeological discoveries, contributing to the understanding of Mleiha's history and archaeological background. As proposed by past research results, the main period of occupation is to be situated between the 3rd century BC and the 4th century AD, divided into four principal phases of occupation. The settlement remains extend over an area of 1.5 km<sup>2</sup>.

In the course of the geophysical prospection project at Mleiha, directed by Dr. Sabah Jasim from the Sharjah Directorate of Antiquities, magnetic measurements were effected at two different large areas of a total surface of 27 ha (Fig. 2). A 10-probe gradiometer array LEA MAX was used for that investigation. The objective of the first large-scale investigation of the site of Mleiha included a considerable gain for the understanding of the overall ancient organization, as well as the detection of buried archaeological structures. The most important result of the magnetic measurements is the discovery of a large enclosure, probably made of mud brick, in the central part of the settlement. Subsequent GPR investigations in areas selected after careful analysis of the magnetic data revealed more detailed information on the detected and presumed archaeological structures. Circular and rectangular tombs as well as foundations of monumental buildings were located, using a GSSI SIR-3000 with 270 and 900 MHz antennas. The combined magnetic and GPR data proved the existence of a considerable number of as yet unidentified archaeological structures. It is expected that geophysical data together with excavation results will illuminate the process of progressive sedentarisation at a site offering water and mineral resources and well-suited for farming and animal husbandry.

#### COPPER-SMELTING SITE HLO-1 IN WĀDĪ AL-HILO

The geophysical prospection project at the Bronze Age smelting site of Wādī al-Hilo faced peculiar measuring conditions. The site named HLO-1 is located in the northern Hajar Mountains only about 15 km from the east coast. It is situated at about 350 m a.s.l. on the left-side wadi terrace at the western foot of a mountain ridge, which has an altitude of approximately 1000 m in this area (Fig. 3).



Fig. 3. View of the Bronze Age copper-smelting site HLO-1 located on a terrace of Wādī al-Hilo (Sharjah, UAE)

For several years, the archaeological site of Wādī al-Hilo has been investigated by a joint team of the Sharjah Directorate of Antiquities and the University of Tuebingen (Kutterer and Jasmin 2009; Kutterer et al. 2013). Excavations started in 2007, at a time when the potential of the site for the *in situ* preservation of installations for Bronze Age and Iron Age metal production was recognised. The discovery of dense slag accumulations containing pieces of Umm an-Nar pottery pointed to a prehistoric background of the site. The archaeological excavations unveiled the foundations of an Umm an-Nar watchtower and the stone foundations of a metal workshop.

In addition to the excavations, a geophysical prospection was carried out under the direction of the Sharjah Directorate of Antiquities in the spring of 2014. In order to localise possible sites of smelting furnaces and metal workshops, both magnetic gradiometry and GPR were applied. The main challenges for the magnetic survey were not only the stony and scrubby terrain, but also the high magnetisation of the bedrock, namely the Gabbro formations of the Semail ophiolite complex. Nevertheless, some potential spots with typical magnetic anomalies of smelting places were identified. The additional GPR measurements gave evidence that a big part of the terrace was covered by buildings, presumably of workshops and dwellings. Again, the geophysical prospection proved to be an indispensable element of survey projects at archaeological sites of all kind.

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