Geoarchaeology of the ancient ports of the Persian Gulf

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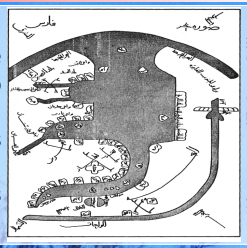
Context and Issues

The fourteen century map of The Persian Gulf by Mostafavy

Despite a rich history and a wealth of in situ archaeological remains, our understanding of the civilization and maritime trade of the Persian Gulf is limited to just a handful excavations and voyagers' texts. These limited data are insuffiecient to answer key questions such as the foundation of ancient ports, their use and demise, in addition to the impacts of natural disasters (e.g. relative sea-level changes, climate change).

In recent years, several studies have been conducted on the Arabian side of the Persian Gulf, looking at RSL changes and palaeo-environmental reconstructions. Similar data are lacking from the Iranian side, despite its rich archaeological record. This provides the context for the present study, looking at the geoarchaeology of Iran's ancient harbours.

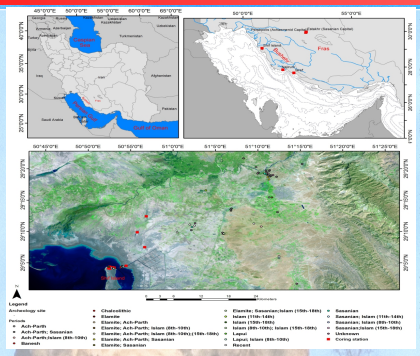


10th-century map of The Persian Gulf by Ibn Hawqal

Field work and maping

Site selection

Because of its rich archaeological record (in particular the Achaemenid (550-330 BC), Sasanian (224-651 AD) and early Islamic periods) and ancient harbors, Bushehr province has been selected for this investigation. Therefore, we selected 13 sampling stations on Shif Island, Angali plain, Najirum and Siraf that contained the most important ancient harbours and sedimentary



Position of study area, Heritage relicts distribution (Carter et al., 2011) and coring stations in Shif Island and Angali plain

Ancient harbor relict located in Shif Island

Sasanian-Islamic ancient wall in Siraf

Sampling

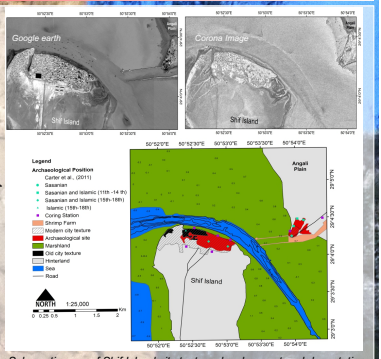
We used Vibrocorer (Cobra) instrument for coring in Selected stations.

It is a reliable instrument for achieving hole samples from 1 to 11 meter depths.

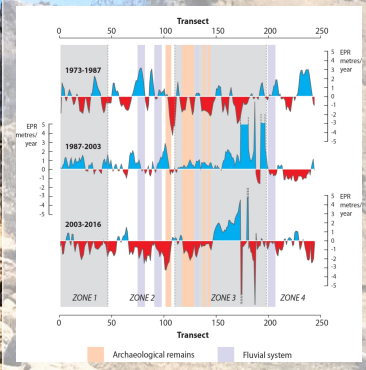
GIS and RS

(Geography Information System and Remote Sensing)

Natural (RSL changes and costal erosion) and anthropogenic (urban and industrial developments) processes have significant impacts on the destruction of cultural heritage along the coasts and hinterland of the Persian Gulf. In order to quantify this destruction, we used GIS and RS methods together with fieldwork. High- and medium-resolution images of different satellites have been employed to quantify this destruction through time (Corona, Landsat series and google earth). The calibration of the images was done using field observations. Satellite imagery and GIS mapping allowed us to evaluate past, present and future damage to ancient harbour remains. According to our results, 70% of the Siraf coastline is presently undergoing erosion and 90% Shif Island heritage relicts have been disturbed by local populations for construction purposes. 10% of the remains are presently buried beneath the urban fabric.



Schematic map of Shif Island city texture development and devastation of Sasanian-Islamic remains during last five decades via Corona and Google satellite images

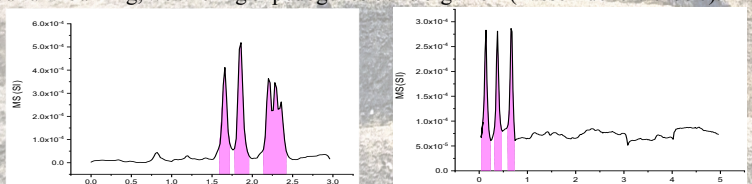


Histogram of erosion (red)/accretion (blue) for the three periods in Siraf shoreline. The Shoreline positions have been extracted by Landsat time series analysis

Laboratory Analysis

Magnetic susceptibility

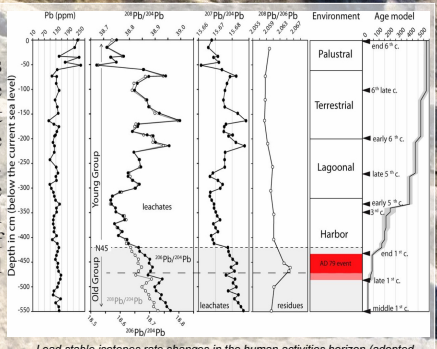
Magnetic susceptibility is a non-destructive method that detect magnetic grain distribution along the sediment core. It is a proxy to process present and or enrichment magnetic minerals in the sediments with different sources such as natural and/or cultural burning, weathering or pedogenesis and organism (Fassbinder et al. 1990).



Anomaly of magnetic grains along two of the studied sites. The MS results represented probably impacts of human activities in the three different times. The primary results could help us to targeted sub-sampling from the important horizons.

Lead stable isotopes

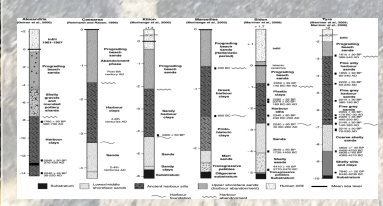
Natural lead is very rare in the earth's crust and is classified as a trace metal. Its presence in at archaeological sites can be attributed to a mineral fusion. Therefore, using lead stable radiogenic isotopes is a powerful tool to reconstruct the history of metallurgic activities in coastal areas (Veron et al., 2006).



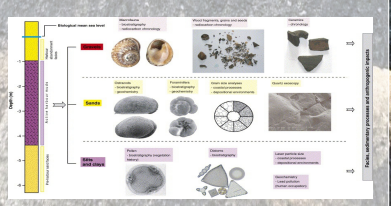
Lead stable isotopes rate changes in the human activities horizon (adopted Delile et al., 2015)

Sediment Analysis

Sediment color, texture, granulometry, stratigraphy and biostratigraphy are employed to reconstructing depositional environment and evaluate human societies impacts upon sediment depositional environments and marine ecosystem in coastal zones (Marriner and Morhange, 2007).



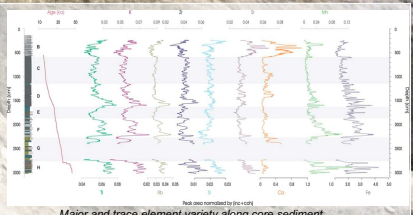
Lithostratigraphy of the ancient harbors and anthropogenic facies (adopted Marriner and Morhange, 2006)



Facies, sedimentary processes and anthropogenic impacts: research tools used in the study of ancient harbor sequence (adopted Marriner and Morhange, 2007)

X-ray core scanner

This high-resolution geochemical instrument (millimeter scale) can be employed to analyse major and trace elements changes along the core. These data will help to probe environmental changes and human occupation markers(Veron et al., 2018).



Major and trace element variety along core sediment (adapted Kylander et al., 2011)

Conclusion

The results of this study will help us to answer fundamental archaeological questions on the northern site of the Persian Gulf with regards to the waxing and waning of civilization, and natural environmental changes and hazards. Furthermore, these data will help to evaluate natural and/or anthropogenic impacts on the cultural heritage and help in adopting suitable management solutions.

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