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ΠΡΑΚΤΙΚΑ



Quaternary geology, tectonics and submerged landscapes of the Farasan continental shelf, Saudi Arabia, South Red Sea: Preliminary results

Sakellariou, D.¹, Bailey, G.², Rousakis, G.¹, Panagiotopoulos, I.¹, Morfis, I.¹, Georgiou, P.¹, Momber, G.², Alsharekh, A.³, Kalogirou, S.¹, Stavrakakis, S.¹, Al Nomani, S.⁴, Meredith-Williams, M.²

¹ Institute of Oceanography, Hellenic Centre for Marine Research, sakell@hcmr.gr, rousakis@hcmr.gr

² Department of Archaeology, University of York, York, YO1 7ep, UK, geoff.bailey@york.ac.uk, garry.momber@hwtma.org.uk

³ Department of Archaeology, King Saud University, P.O. Box 2627, Riyadh, 7524-12372, Kingdom of Saudi Arabia, asharekh@hotmail.com

⁴ Saudi Geological Survey, P.O. Box 54141, Jeddah, 21514, Kingdom of Saudi Arabia, nomani.sm@sqs.org.sa

Abstract

A joint archaeological and geoscientific exploration of the continental shelf of Farasan Islands, Saudi Arabia, South Red Sea, was conducted in May–June 2013 aboard HCMR's Research Vessel AEGAE0 with the aim of exploring systematically the submerged landscapes. The region is regarded as one of the primary pathways of dispersal for early human populations expanding out of Africa during the Pleistocene. Preliminary interpretation of the data provides insights into the underlying geology and its effect on the palaeo-geomorphology. Numerous lakes existed on the exposed Farasan continental shelf during the Pleistocene low sea-level stands, making it thus an attractive area for prehistoric humans.

Keywords: faulting, sea-level-changes, exposed land, prehistory

1. Introduction

A joint archaeological and geoscientific exploration of the continental shelf of Farasan Islands, Saudi Arabia, South Red Sea (Fig. 1), was conducted in May–June 2013 aboard HCMR's Research Vessel AEGAE0 with the aim of exploring systematically the submerged landscapes and targeting features of significance in relation to their archaeological potential. This project has been developed as an international and interdisciplinary collaboration arising directly out of the SPLASHCOS COST Action (www.splashcos.org; Bailey & Sakellariou, 2012) and within the ERC-funded project DISPERSE (Bailey et al., 2012). This work builds on two strands of earlier investigation, one concerned with the impact of sea level change and submerged landscapes on the potential connections between Africa and Arabia and the dispersal of early humans expanding out of Africa during the Pleistocene (Bailey et al., 2007; Lambeck et al. 2011), the other with the impact of active tectonics on the early landscapes of human evolution (King & Bailey, 2006; Bailey & King, 2011; Bailey et al., 2011).

The main objectives of the cruise were to reconstruct the broad outlines of the now-submerged landscape and identify specific locations that might have preserved archaeological evidence of past human settlement when sea level was lower than present and to understand the underlying Quaternary geology and the role of active tectonics in the dynamic changing of the coastal/submerged landscape.

2. Materials and methods

The marine survey comprised a wide variety of geological-geophysical techniques: (1) Multi-beam bathymetry by using two hull-mounted systems (20kHz and 180 kHz), (2) High-resolution sub-bottom profiling with a 3.5 kHz pinger, (3) Deep-towed, 110/410 kHz, digital side scan sonar imaging, (4) Deep penetrating airgun 10ci seismic profiles, (5) Gravity coring, 3–5m long, (6) Box coring, 40 x 40 x 60 cm and (8) ROV dives to visually inspect sites selected from the bathymetric, acoustic and profiling data.

Two areas (FARASAN 1 and FARASAN 2) and two seismic transects (TRANSECT 1 and TRANSECT 2) were systematically surveyed (Fig. 1). The data set comprised about 500 sq. km of seabed morphology mapped with the multi-beam systems, 170 nautical miles of airgun seismic profiles, and 250 nautical miles of 3.5kHz sub-bottom profiles and 140 nautical miles (260 km) of side-scan sonar

lines were acquired. 18 gravity cores and 2 box-cores were recovered and 5 dives of the Max Rover ROV were accomplished.

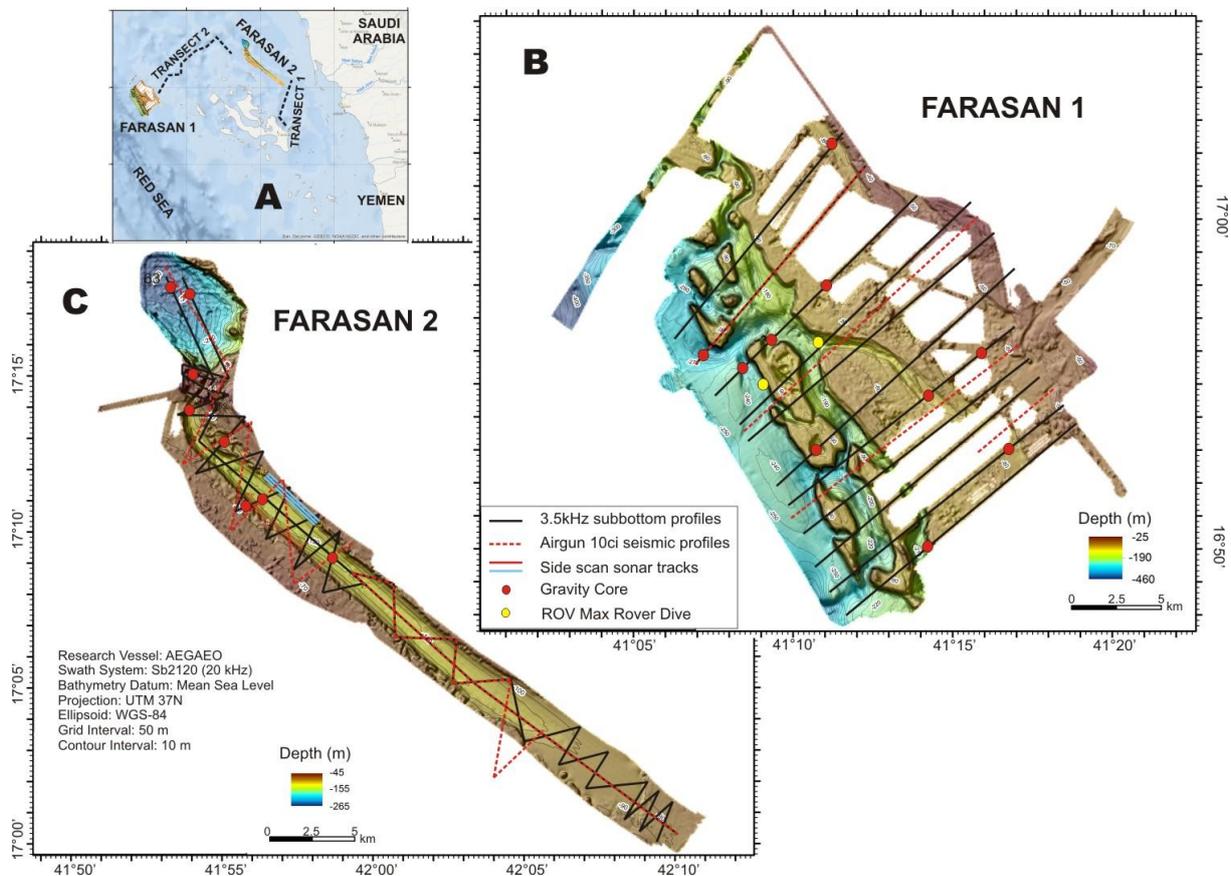


Fig. 1. Location map (A) of the survey areas Farasan 1, Farasan 2 and Transects 1 and 2 in the Farasan Archipelago, Southeast Red Sea. Swath bathymetry and location of seismic and subbottom profiles, side scan sonar track-lines, cores and ROV dives in the areas Farasan 1 (B) and Farasan 2 (C).

3. Results

Preliminary interpretation of the geophysical data in area Farasan 1 (Fig. 1) indicates two prominent terraces at about 70–80m and 38–40m depth on the shelf and one, locally preserved terrace at 120m depth on the slope. The outer edge of the continental shelf is controlled by normal faults trending NW–SE, parallel to the rifting axis of the Red Sea. Elongate ridges, running parallel to and off the shelf edge, are characterized by steep faulted slopes and flat, 80–90m shallow tops (Fig. 1). They were exposed above sea-level during Pleistocene low sea-level periods, forming thus a series of flat islands, the "prehistoric Farasan Archipelago", separated from the palaeo-coastline by deep troughs (Fig. 2). Holocene sediment deposition on the shelf is very limited. Sedimentological description of cores indicates lacustrine-type sedimentation below the Holocene marine drape in the isolated depressions on the 80m deep terrace.

Area Farasan 2 comprises a 120m deep, elongate basin bounded by NW–SE trending normal faults (Fig. 1) and incised on the 70–75m shallow, prominent terrace of the inner shelf. One more morphological terrace has been mapped along the flanks of the basin at about 112m depth. Gravity coring in the basin penetrated the presumably Holocene, marine drape and recovered gypsum fragments from its substrate at about 2–2.5m below the seafloor. A narrow gorge on the seafloor, at the north-western tip of the valley-like basin, connects it with a >200m deep, circular depression which hosts a >250m thick sedimentary sequence. Preliminary laboratory analyses on sediment cores

from the deep depression reveal lacustrine-type sedimentation below the 1–2m thick marine silt deposits. This observation indicates that the numerous deep and shallow depressions, which have formed due to evaporite solution on the shelf and occur along NW–SE trending faults, were probably lakes during Pleistocene low sea-level stands (Fig. 2). This type of landscape might have served both as an attractor of human settlement and as a favorable location for the preservation of archaeological evidence.

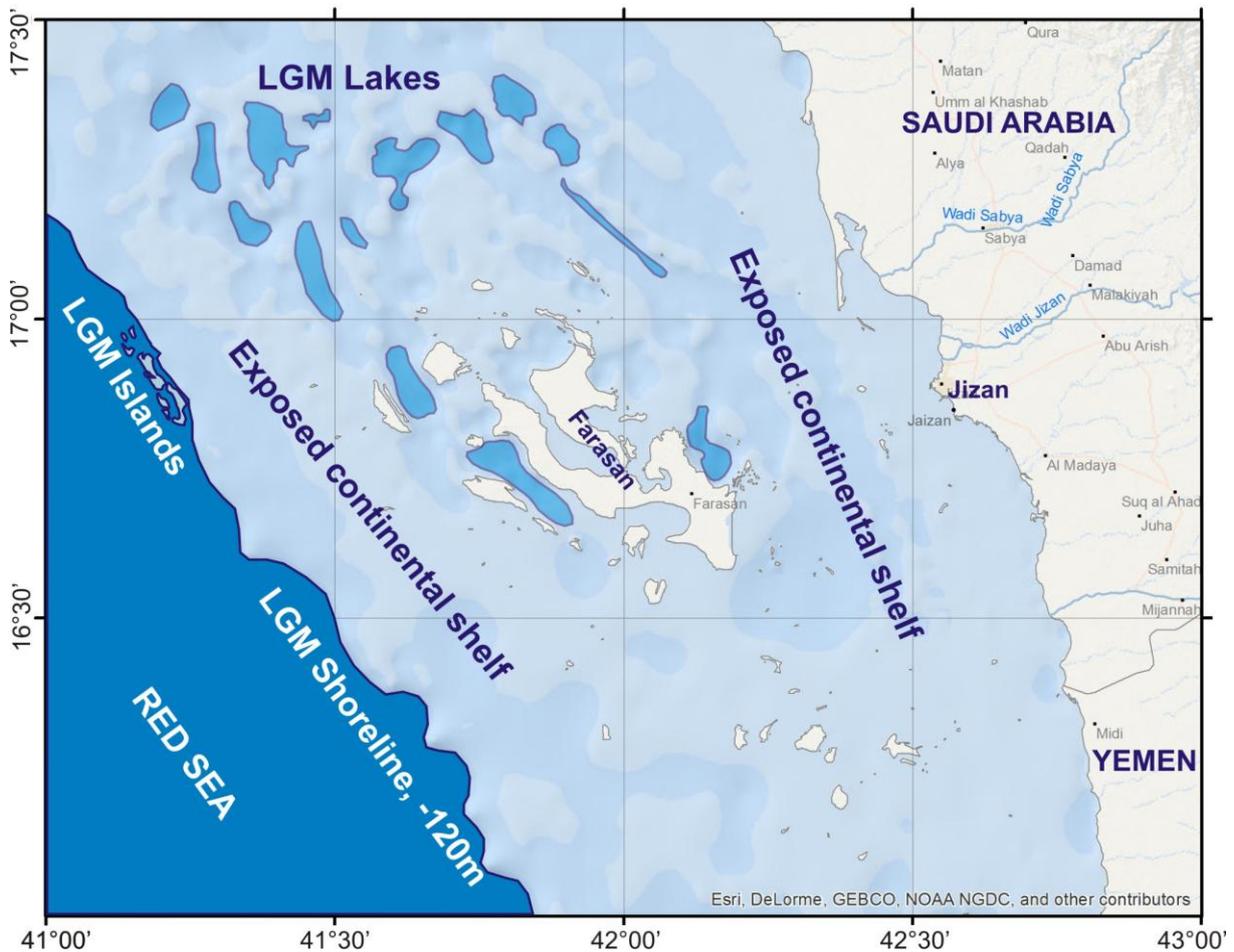


Fig. 2. Palaeogeographic reconstruction of the Farasan continental shelf during the Last Glacial Maximum (LGM).

4. Conclusions/Discussion

This is one of the first attempts anywhere in the world to apply a suite of underwater techniques to the purposeful and systematic exploration of a submerged land surface across the whole depth range of the continental shelf exposed at maximum lowering of sea level. Our strategy of investigation, and the techniques we have used to implement it, have proved a successful starting point, and have clarified ways in which improvements in approach and the deployment of additional technologies can be applied in future work. It is clear that a landscape with interpretable features of geological structure, geomorphology, topography, and potential for human settlement lies now submerged on the extensive shelf region surrounding the Farasan Islands, and that this forms a promising basis for future investigations.

5. Acknowledgements

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