Geology and sedimentary environments of Farasan Bank (Saudi Arabia) southern Red Sea: A combined remote sensing and field study

by

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This work is dedicated to

my parents, wife and

daughters

Abstract

The Farasan Bank lies in the southeastern Red Sea, 40km off the southwestern coast of Saudi Arabia. The Farasan Islands arise from the Farasan Bank and are separated from the coast by the Al-Banat Sea.

This study processes Landsat TM in a variety of ways in order to examine the surface geology of the Farasan Islands, and the palaeobathymetry and Recent sedimentary environments of the Farasan Bank.

The two largest islands; Farasan Al-Kabir and Sajid, have been studied in detail and their outcropping geology has been ground truthed by a series of transects, stratigraphic logs and sampling material for geological age dating.

This investigation indicates that the Farasan Islands consist of six major sedimentary/environmental units, three of these comprise Recent sediments; bioclastic sand, wet sabkha and rocks, and vegetated areas, and three are units of shallow marine reefal limestone comprising bioclastic grainstone, bioclastic rudstone and bioclastic floatstone. Present-day shallow sedimentary environments (e.g. coral reefs, sabkhas and sand dunes) have also been mapped and their distribution is related to prevailing environmental conditions. Previous borehole data indicates that the Farasan reef limestones are underlain by layers of gypsum and anhydrite, which in turn are underlain by a thick halite sequence.

The reefal limestones have been dated using 87/86 strontium isotopes and these indicate a spread of Pleistocene ages with the higher elevations on the islands exposing older rocks. The oldest limestones in the centre of the islands are reefal floatstones which accumulated in the early Pleistocene, whilst younger grainstones (late Pleistocene age) occur at lower topographic levels around the coastline indicating that the Farasan Islands have formed from progressive uplift and relative sea-level fall. A ^{14}C date from a shell midden of late Holocene age, occurring on a 2m high notch and 50m from the present day shore indicates that the uplift may be still continuing today.

The Farasan Limestone has been deformed by salt diapirism into a variety of mapped structures including salt domes, anticlinal salt ridges, solution holes and surface breccias. Bathymetric mapping down to 30m identifies seafloor salt domes and solution holes. The Al Banat Sea is considered to be a salt withdrawal basin between Farasan Bank and the Saudi Arabian coast.

The study concludes that the Farasan Bank probably initiated by differential loading of salt triggered by tectonic stretching of the overburden during the regional extension of Red Sea rifting. The extension initiated upeard movement of diapirs and northwest-southeast salt walls, and salt withdrawal from beneath the Al-Banat Sea. The salt has moved upward to form diapirs, walls and canopies that have deformed and interacted in a complex fashion with the sedimentation of the overlying coral reef limestone. The Islands were formed as a result of diapirism of Miocene salt that has controlled the sea floor and island topography from Pliocene to Recent times.