Holocene Sedimentation on the Western Egyptian Shelf

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The Egyptian shelf in the Mediterranean Sea exhibits two sedimentary regimes: (1) The Western desert-fronting shelf; (2) The Nile delta-front with its down-current (easterly) field of influence. The transition zone lies at Alexandria near longitude 30E.

Much work has been focused on the Nile-influenced shelf, while data from the Western shelf are just beginning to appear. Specifically, studies in the Arabs Bay have discovered a regime of abiotic carbonate sedimentation producing modern aragonite oolites and aragonite mud.

ARABS BAY

The Arabs Bay shelf lies W of Alexandria. For 120 km, from Point Abukir to El Alamein, shelf width is 18-20 km; a distinct shelf edge runs at 80 m depth (44 fm). The area is 2,500 km^2, with no less than 700 km^2 (28%) in the littoral zone inside the 15 m (8 fm) depth contour. The Bay is closed to bed-load sediment input from W by morphological constraints at El Hekma and El Daba. Net transport is setting E, leaving the Arabs Bay shelf unaffected by Nile delta material. The result is a sea-floor starved for allochtonous sediments.

Bedrock belongs to the Marmarica Formation, a Middle Miocene sequence of calcarenites capped by Pliocene limestone (El Shazly, 1977). It has been tectonically stable at least since the close of the Lower Pleistocene (Fairbridge, 1972).

Sea levels during the last 300,000 years generally have been lower than today, giving the Western shelf a long history of subaerial exposure. The last regression dropped below -80 m about 18,000 BP (Milliman & Emery, 1968; Thunell, 1979), remaining low for 7,000 years.

Around 11,000 BP the sea rose again over the shelf edge in the last Holocene transgression. It passed the -15 m depth contour as recently as 8,000-6,000 years ago. The wedge of biogenic carbonates produced during this last transgression is on the order of 0.5 m in the off-littoral; even less in the littoral.

SHAMMAMA BANKS OOLITE

The Shammama Banks off El Alamein are a littoral oolite field 5x24 km in size. Main morphological elements are seven submarine ridges, 10-15 km in length and several hundred meters in width, pointing SE. These are hydrodynamic bed-forms rising from barren rock floor at water depths of 12-15 m, running through the breaker zone and terminating in the shoreface.

The bank material is pure oolite sand, both in the ridges and on inter-ridge seafloor. Median grain size is 600 µm. The tail of material smaller than 250 µm (possible desert sand) is <1%.

The oolite is virtually 100% carbonate. A sample of 10 g left a residue of 20 mg after dissolution in dilute HCl (=carbonate content 99.8%). The residue consists mainly of clear quartz <63 µm from intragranular hollows in the ooids.

The ooid cortex phase consists of concentrically laminated aragonite enclosing a nucleus phase entirely of Mg-calcite and aragonite (no low-Mg calcite, no quartz). This indicates a direct marine supply of nuclei from off-littoral shell sands. It is noteworthy that terrigenous sand from the Sahara has no real part in the littoral sedimentation here, neither as grains as such, nor as nuclei for ooid growth.

The bulk C-14 age of the cortex phase is 800 yr BP. Petrographic analysis shows oolitization in progress: Skeletal components (echinoderm needles, small gastropods) occur in a series of transformation steps, from intact to thickly overgrown and rounded. For each skeletal category, the amount of transformed grains far outweighs the number of intact specimens. The picture is that of a low supply of biogenic products continuously exposed to cortical growth, thus forming ooid grains.

Landward and longshore sediment transport builds an oolite beach and coastal oolite dune reaching eastward to Alexandria. A radiocarbon age of weakly cemented dune material was 2,100 BP; the age of off-littoral shell sand from 20 m water depth 1,500 BP. This whole coastal sequence is, in fact, much younger than the Egyptian pyramids.

Off Point Agami, 80 km down-current (east) of the oolite banks, a pure aragonite mud of zero radiocarbon age accumulates at depths of 25-50 m (El-Sayed, in preparation). The coast-parallel current here fans out in a plume with very little momentum. Isotopic data indicate an abiotic origin of the mud.

THE NORTH AFRICAN OOLITE BELT

Arabs Bay emerges as the eastern end of a great North African Oolite Belt, extending 2,200 km from the Gulf of Gabès to the Nile delta. The NAO Belt is one of the world's major oolite fields. It borders the south coast of two basins - the Ionian and the Levantine - occupying half the length of the Mediterranean Sea, between longitudes 10E and 30E.

The coast is marked by a sequence of oolite dunes, running virtually uninterrupted the whole distance (Fabricius & Klingele, 1970; Emelyanov, 1972).

Off Djerba island in the Gulf of Gabès, relict oolites occur down to 13 m water depth, mixed with biogenic carbonates. Their radiocarbon ages are 6,000-30,000 yr BP (Fabricius et al., 1970; Blanpied & Bellaiche, 1981). Fabricius and co-workers state specifically that Tunisian ooids are not forming at the present time. They infer that the last period of oolitization terminated at the onset of a mid-Holocene cooler climate.

Emelyanov (1972) has one observation from the shelf in the innermost Gulf of Sidra, Libya. His sample No. 742 from 36 m water depth is described as oolitic sand with median grain size 550 µm and carbonate content 90%. In contrast to what is found in Arabs Bay, "heavy minerals (ore minerals, hornblende) often form the nuclei of ooliths, which then have a specific gravity above 2.9" (ibid., p. 371).

So far, Arabs Bay is the only area in the Mediterranean Sea where oolitization in progress has been observed. Conditions conducive to the process are: total absence of a terrigenous influx; high summer water temperatures (26 °C) and salinities (40 per mil); and a wide, shallow littoral zone exposed to strong water turbulence facilitating transport and degassing.

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