Nile Delta, Egypt : Effects of sea level, climate, tectonic subsidence and man

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The Nile delta, Egypt, is the focus of an international and multi-disciplinary (petrography, faunal and floral analyses, geochemistry, neotectonics, archaeology) investigation, initiated at the Smithsonian Institution in 1985. This major long-term program involves 25 specialists in 13 organizations in North America, Egypt, and Europe. Of specific interest are models of the paleogeographic evolution of this large depocenter through time. The study considers the interplay of major natural and anthropogenic factors controlling sedimentation on the basis of extensive petrological, geochemical and biogenic analyses of more than 2500 samples in nearly 100 cores. This investigation, evaluating the past 30,000 years of Nile delta evolution, enables us to define facies development during a near-complete cycle of high-low-high sealevel stands. Most borings (length to 60 m) are radiocarbon dated, and it is of special interest to archaeologists that the delta, as we know it today, began to form about 7500-7000 years ago.

The northern delta plain has been subsiding (from 0.04 to 0.50 cm/yr), and also has tilted seaward toward the northeast during this period. Sediments have accumulated at long-term averaged rates of 0.1 to 0.5 cm/year, from West to East. Marked variations in temporal and lateral lithofacies distributions and sequence thicknesses are, in part, a direct consequence of asymmetric structural lowering of the delta plain surface during the period of rapid sediment accumulation. In addition to (1) neotectonics and (2) eustatic sealevel rise (about 15 m during the past 7500 years), other factors have affected deposition: (3) a change from humid (starting about 12,500 years ago) to arid (about 5000-4000 years ago) climate which altered sediment input to the delta from East African and Ethiopian source areas and increased the development of sebkhas, and (4) strong easterly-directed longshore currents that have eroded sectors of the coast and developed extensive coastal sand ridges and dunes. Classic deltaic coarsening-upward sediment sequences consisting of open marine prodelta to coastal facies are restricted to the northeastern delta; this is largely a response to accelerated subsidence in this region. In contrast, sediment sections are reduced in thickness and comprise lithologically more irregular successions of delta plain deposits (distributary channel, marsh, lagoon) over most of the tectonically more stable north-central and northwestern sectors of the delta.

Both natural factors, such as the burial of the delta plain by rapid sedimentation and submergence resulting from tectonic subsidence and encroachment of the sea, and man's activities, such as reclamation of lagoons for agricultural purposes, are rapidly changing the configuration of the Nile delta. Our database suggests that the sea will encroach landward by as much as 30 km on the northeastern delta plain by the year 2100. Ongoing research is focusing on loss of lagoons, expansion of coastal dunes and pollution. These three aspects, plus the landward migration of saline groundwater, are of serious concern in view of Egypt's rapidly increasing population, now believed to be 55 million and increasing at a rate of 1 million every nine months.

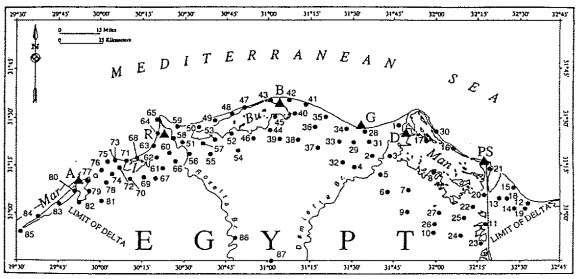

Fig. 1. Map of the northern Nile Delta, Egypt, showing the four modern lagoons: Man=Manzala; Bu=Burullus; I=Idku; and Mar=Maryut. Dots denote the position of 87 long cores collected during 5 expeditions (1985-1990). Cities and towns include : PS=Port-Said, at the northern end of the Suez Canal; D=Damietta, along the Damietta branch of the Nile; B=Baltim resort, at northeastern end of Burullus lagoon; R=Rosetta, just south of the Rosetta Promontory of the Nile; and A=Alexandria, along the northern margin of Maryut lagoon. Short cores and surficial samples will be collected in Maryut and Burullus lagoons in spring 1992, and in Burullus and Manzala lagoons in 1993.

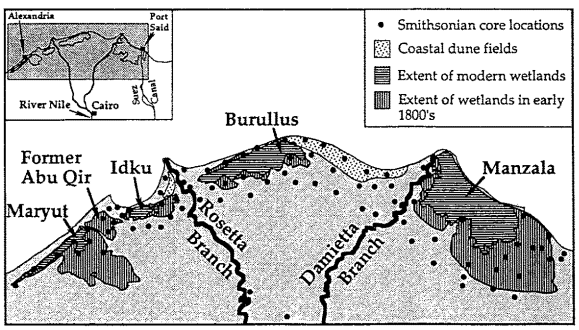

Fig. 2. Map showing the approximate extent of lagoon and associated marsh loss (> 50%) since the early 1800s of the four modern lagoons and the disappearance of Abu Qir lagoon. Also noted are the extensive coastal sand dune fields that have buried former large lagoons in the region between Burullus and Manzala lagoons during the past 2900 years (modified after STANLEY, WARNE *et al.*, 1992).