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Nile Delta shoreline changes : aerial photographic study of a 28-year period

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ABSTRACT
Airphotographic analysis is used to detect erosional and accretionary changes, and to define coastal features along some stretches of the Nile Delta coast of Egypt. Two series of aerial photographs, taken in 1955 and 1983 were applied to three unstable coastal zones: the Rosetts and Damietta promontories, and the Burullus-Baltim sector. Comparison of the two successive photo surveys serve to monitor the impact of the Nile River control and the coastal dynamic regime. The study reveals that the outer margin of both Rosetta and Damietta promontories seem to be the most eroded areas. These promontories are retreating due to the cut off the sediment supply after damming the river. The estimated highest rate of erosion during the 28-year period is: 114, 9 and 31 meters per year, respectively, at Rosetta, Baltim and Damietta sectors. Remarkable accretionary patterns are also coupled with shoreline erosion, as has been noticed on the eastern side of the two promontories, and to the west of Burullus inlet. Moreover, photographic analysis helps to detect some salient coastal features such as the ancient coastal sand ridges east of the Rosetta and Damietta promontories, and a distinct spit southeast of the Damietta promontory.

DISCUSSION
A comparison of the set of 1955 and 1983 aerial photographs and maps constructed based on these indicates that during the 28 year study period, the outer margin of the Rosetta and Damietta promontories have been eroded (Fig.1 a&c). The highest erosion rates are 114 and 31 m per year, respectively. The Burullus-Baltim sector along the coastal zone of the delta ie erosional, with greatest rate of 9m per year (Fig. 1b). This investigation of airphotographic analysis is also coupled with earlier coastal dynamic factors (waves, littoral currents and tides) affecting the coast in this region published by others Manohar, 1976; Quelennec and Manohar, 1977; Khafagy and Manohar 1979; Fanos, 1986). The coastal processes affecting the two promontories appears to operate in a similar manners: much of the eroded materials from the tip of the Rosetta and Damietta promontories is transported easward by littoral drift and accreted on the the eastern parts of the promontories. Moreover, there has been formation of a spit on the same (eastern) side of the Damietta promontories. Also of note in the 1983 aerial photos is the shoaling of the entrance of Burullus inlet and the mouth of the Rosetta Nile branch a phenomenon which caused navigational problems particulary to fishing boats.
In summary, it can be ascertained that the observed erosional and accretionary patterns along the three investigated sectors resulted from the interaction of the prevailing coastal processes and decrease of sediment supply from the Nile River upon completation of the Aswan High Dam in 1964.

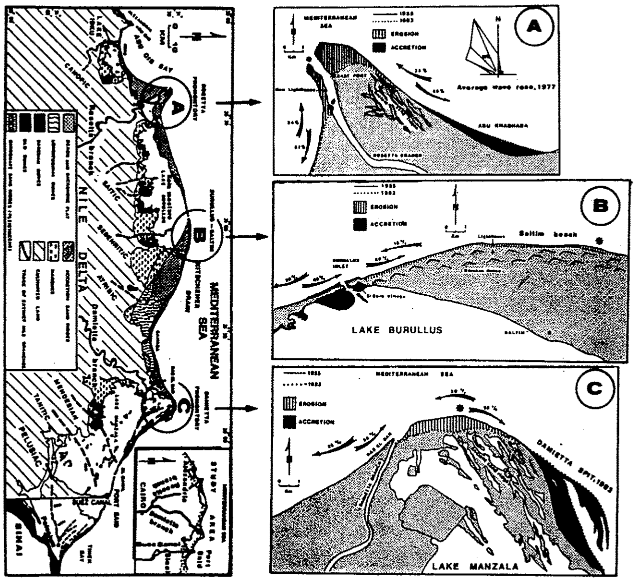

Figure 1. Shoreline changes at the three study areas during the 28-year period, from 1955 and 1983. Points (*) denote the highest rate of erosion, 114, 9, and 31 meters per year respectively at Rosetta, Baltim and Damietta sectors. Arrows indicate the directions of dominant littoral currents; the frequency is denoted by the percentages.

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The oblique oceanic spreading along the Dead Sea Rift

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Recent geological and geophysical investigations of the Dead Sea rift indicate that the rift was formed by oblique tectonic offsets, consisting of both normal and strike-slip components. Most geological and geophysical observations are apparently conformable with both offsets, such as the occurrence of normal and strike-slip faults along and within the rift, the sedimentological evidence of the subsidence rate of the rift floor, the occurrence of mesozoic basement underneath the rift-fill, the thinned crust and the anomalously low seismic velocity in the upper mantle underneath the rift, the southward increase in heat flow and the ENE-WSW trending in situ extensional stress in the rift and its western margin. The quantitative rates of horizontal and vertical displacements are not known, but updated geological and geophysical evidence suggests extensional opening of 15-20 km, lateral displacement of approximately 10, km and crustal thinning of 25-30 percent.

Some of the important geological evidence from the rift seems inconclusive, such as the solutions of earthquakes focal mechanisms, which are poorly constrained, or the lengths of the intra-rift basins, which are unrelated to the strike-slip displacement. Inconclusive also is the significance of the occurrence of contemporaneous, isofacial sedimentary sequences at the facing flanks of the rift, with the eastern occurrences located some 100 km north of their corresponding sites on the western flank. This finding could be attributed to the depositional NNE-SSW sedimentary facies trend that commonly prevailed in the region from the Triassic to the present.

Studies in the northern Red Sea and the Suez rift showed that the extensional tectonic regime of the northern Red Sea prevailed there continuously since the early Miocene. The Suez rift became tectonically inactive in the late Miocene, and the northern extension of the Red Sea spreading center jumped eastwards and formed the Dead Sea rift in the early Pliocene. An arcuate system of rifts in the northern Red Sea changes its trend northward from NNW-SSE to NNE-SSW, and continuously extends from the Red Sea into the Gulf of Elat. These rifts are interpreted as products of an extensional tectonic regime, and suggest that the axis of the northern Red Sea incipient spreading center extends into the Gulf of Elat. This interpretation is conformable with observations from the central Jordan valley and from the Sea of Galilee, that indicate the unlikelihood that large lateral offset occurred along the Dead Sea rift there.

The discussion concerning the tectonic origin of the Dead Sea rift is far from settled, but it seems that the available data are compatible with the model suggesting that the rift is an incipient spreading center extending from the Red Sea, the separation across this young spreading center is oblique, but the lateral offsets are secondary to the vertical displacements.