A late quaternary stratigraphic type-sequence in the Northern Nile Delta

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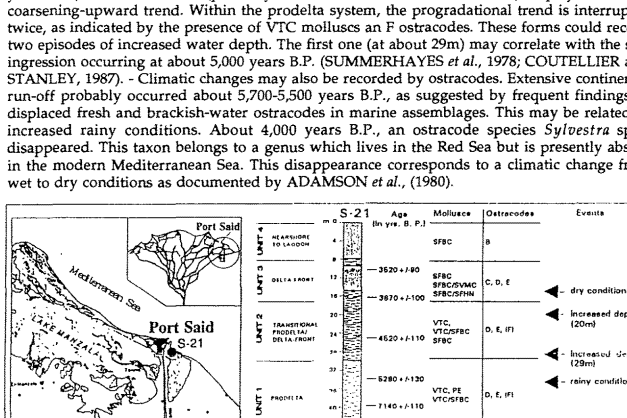
Introduction and purpose. The Nile Delta Project is a multi-disciplinary research program initiated at the Smithsonian's National Museum of Natural History in 1985. Its goal is the interpretation of geological and environmental changes which have affected the Nile Delta in Egypt over time (STANLEY, 1990). This can best be achieved by means of analysis of continuous subsurface core sections. Consequently, 87 borings have been recovered across the northern Delta during five expeditions, from 1985 to 1990. These borings range in lenght from 15 to 60 m., and comprise stratigraphic sections dated from about 35,000 years to the present. Special attention is being paid to the evolution of the northern Nile Delta during the past 10,000 years. In their focus on the northeastern Delta, BERNASCONI *et al.*, (1991) and PUGLIESE and STANLEY (1991) have selected boring S-21 as the most representative and complete stratigraphic sequence, displaying an entire progradational series from about 8,000-7,500 years B.P. to the present. This Holocene deltaic sequence is separated from underlying late Pleistocene sands by an unconformity; these sediments have been petrologically analyzed. From core-bottom to core-top, PUGLIESE and STANLEY (1991) recognize a progradational sequence which consists of prodelta (46-30 m), transitional prodelta/delta-front (30-17 m), delta-front (17-8 m), shallow nearshore bars, coastal ridges, and lagoon (8 m-core top) facies.

Faunae. Most mollusc and ostracode species recovered and identified in boring S-21 live in modern Mediterranean deltaic-related settings. Taking this into consideration, one can apply modern environmental data to the study of this deltaic sequence. Molluscs are clustered by BERNASCONI *et al.*, (1991) in different fossil communities, comparable to several modern Mediterranean biocoenoses and/or ecotones (*sensu* PERES and PICARD, 1964). Of note, two major paleobiocoenoses are recognized, i.e. VTC (Terrigenous Mud Biocoenosis) and SFBC (Fine Well Sorted Sands Biocoenosis). Several subordinate fossil communities are also present: PE (Heterogeneous Community), and transitional VTC/SFBC, SFBC/SVMC (Superficial Muddy Sand in Sheltered Areas Biocoenosis), and SFBC/SFHN (Superficial Fine Sand Biocoenosis). PUGLIESE and STANLEY (1991) highlighted 6 (A-F) groups of ostracode species as markers of well-defined deltaic settings. Group A corresponds to fresh-water species; Group B to brackish-water species; Group C to marine nearshore (normally with vegetation) species; Group D to marine nearshore without vegetal meadow species; Group E to marine nearshore with vegetal meadow/open marine, with or without vegetal meadow species; Group F to open marine species. Group A is represented by displaced specimens only. Another Group (M=miscellaneous) is represented only by allochthonous marine and brackish water juveniles.

Interpretation and conclusions. On the basis of the above letter-coded faunae and their related settings, four units have been identified in boring S-21, from bottom to top :

- Unit 1 (46-30 m), silty clays with VTC, PE, VTC/SFBC mollusc communities and ostracodes of groups D, E, and, subordinately, F characterize prodelta settings;
- Unit 2 (30-17 m), clayey silts with the same above ostracode faunae and VTC, VTC/SFBC and SFBC molluscs indicate transitional prodelta/delta-front settings;
- Unit 3 (17-8 m), sands and interbedded clayey silts with ostracodes of groups C, D and E, and SFBC mollusc community denote delta-front facies;
- Unit 4 (8 m to core-top), sands with very rare mollusc SFBC communities and ostracodes of Group B, sometimes with displaced juveniles of marine species, indicate nearshore to lagoon settings.

Environmental interpretation of the units 1 and 2 is based mainly on petrological data, since the fossil assemblages are quite similar in both units. However, two observations can be made on the basis of fossils : 1) ostracodes of Group F associated with the VTC molluscan biocoenosis at core depths of 29 and 20 m indicate episodes of increased depth during this period; 2) the exclusive presence of ostracodes of Group E in some core intervals indicates vegetaded seafloors. In Unit 3, at about 13 m core depth, the combined presence of C, D, E ostracodes, and SFBC mollusc paleocommunity indicate clayey silty vegetated seafloors of proximal delta-front. Overlying sands with SFBC and SFBC/SFHN mollusc communities and only allochthonous juvenile valves of ostracodes characterize seafloors close to a river mouth. In Unit 4, lagoonal settings are easily recognizable at the core-top by the exclusive presence of the ostracode species *Cyprideis torosa* (Group B), which can also tolerate extreme evaporitic conditions. A sebhka environment is also suggested by the presence ot gypsum/halyte. Besides serving to refine the environmental evolution, paleontological data shed light on geological/environmental and climatic events : since their origin (8,000-7,500 years B.P.) the deltaic lobes (probably of the Pelusiac branch of the Nile) display a constant coarsening-upward trend. Within the prodelta system, the progradational trend is interrupted twice, as indicated by the presence of VTC molluscs an F ostracodes. These forms could record two episodes of increased water depth. The first one (at about 29m) may correlate with the sea-ingression occurring at about 5,000 years B.P. (SUMMERHAYES *et al.*, 1978; COUTELLIER and STANLEY, 1987). - Climatic changes may also be recorded by ostracodes. Extensive continental run-off probably occurred about 5,700-5,500 years B.P., as suggested by frequent findings of displaced fresh and brackish-water ostracodes in marine assemblages. This may be related to increased rainy conditions. About 4,000 years B.P., an ostracode species *Sylvestra* sp. 1 disappeared. This taxon belongs to a genus which lives in the Red Sea but is presently absent in the modern Mediterranean Sea. This disappearance corresponds to a climatic change from wet to dry conditions as documented by ADAMSON *et al.*, (1980).



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