PO RIVER DELTA
PART II. SUSPENDED SEDIMENTS OFF THE MAIN MOUTH (PO DELLA PILA)

Alfredo BOLDRIN and Sandro RABITTI

Istituto di Biologia del Mare, CNR, Riva 7 Martiri 1364/a, Venezia (Italia)

The water structure in the studied area was characterized by a well marked stratification, typical of summer situations in the Northern Adriatic Sea [2]. CTD measurements (see sampling stations in Fig.1, this paper, part I) revealed three different bodies: riverine waters, middle-depth waters and bottom waters. The Total Suspended Matter (TSM) presented the highest values in the river: the mean concentration was 18.3 mg/lit, while 70% of the figure represented inorganic fraction (Fig.1). The grain size spectra were strongly marked by two modal classes (7 and 18 μm) and corresponded to 2 phytoplancton populations.

The structure observed in station 2 is rather peculiar: the particle size distribution of suspended matter near the bottom showed an increase in the coarse fraction when compared with surface sample; at the same time, the highest measured concentration (28 mg/lit, 81% of inorganic fraction) was found. According to these data, such a distribution is thought to be related to flocculation processes and suspended sediment trapping occuring in this zone. In this same latter area, a turbidity maximum at the boundary between freshwater and salt wedge was revealed and studied in detail [13]. In the prodelta zone (stations 3,4,5), hydrological measurements and vertical distribution of suspended matter showed the presence of a water dome structure near the bottom. Such a structure was characterized by high density (>26 σ_t), low transmittance (<10%), high TSM values (>9mg/lit) and low dissolved oxygen concentration (<70% of saturation). Particle size spectra revealed a noticeable increase of finer components (<5μm). These latter are believed to be of direct river input, and are normally trapped between the flocculation area and the offshore area (station 5). Alternating processes of sedimentation and resuspension, induced by hydrodynamical conditions (tide flow, bottom currents) also permit a periodical alimentation of the dome structure by means of lateral advection from the deeper and denser water layer.

The hydrological structure appeared to be regularly stratified beyond 20 mt depth, where density values at the bottom was >27 σ_t. The riverine injection layer is still recognizable at the surface, whereas the middle-depth water was characterized by maximum transmittance values (>30%, diminishing bottomward to <10%) and by lowest TSM (<2mg/lit). A progressive increase of the inorganic fraction of TSM in the water column was observed, ranging from about 50% at the surface to >75% near the bottom. Such a trend is believed to be related to the accumulation processes in the bottom layer of suspended matter settling from the diluted surface layer. This material is not only highly biologically utilized but also produced at the surface, and is transferred to the bottom layer as sedimentation of skeleton fragments, fecal pellets, etc.. Furthermore, particle size distribution and chemical composition of suspended matter is differentiated by various bio-physico-chemical processes. Particle size distribution is therefore dominated at the top of water column by phytoplancton populations (3 modal classes at 4.5, 11 and 28.5 μm). From surface to bottom, the TSM decreased regularly, but particle distribution spectra remained substantially the same, thus indicating that the surface layer is the source of the suspended solids. Conversely, in the bottom water layer, size spectra were quite different, and presented a higher TSM values. At the same time, phytoplancton peaks disappeared and the percentage of fine, inorganic particles (<6μm) strongly increased. Such variations are thought to result from two different processes: (1) bio-physico-chemical differentiation of suspended matter in the water column; (2) hydrodinamic resuspension of the fine portion of bottom sediments, as evidenced by the similarity between the particle spectra of suspended sediment 1 mt above the bottom and the uppermost veneer of bottom sediments.

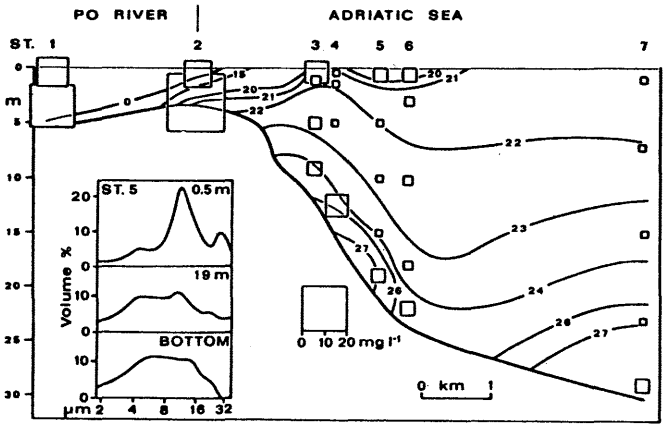

Figure 1: Density structure (σ_t units) and TSM distribution off the main mouth of Po river. Particle size spectra at surface, 1 mt above the bottom and at bottom levels in Station 5 are reported.

REFERENCES

[1] Dal Cin R. (1983) - Boll. Soc. Geol. It., No.102, 9-56.
[2] Franco P., Jeftic L. Malanotte Rizzoli P., Michelato A. & Orlic M. (1982) - Oceanol. Acta, Vol.5, No.3, 379-389.
[3] Tomadin L. (1979) - Giorn. Geol., (2)XLIII(1), 249-275.
[4] Bortoluzzi G., Frascari F. & Ravaioli M. (1986) - Mem. Soc. Geol. It., Vol.27, proceedings in press (1984).
[5] Colantoni P., Gallignani P. & Lenaz R. (1979) - Mar. Geol., 33, M41-M50.
[6] Ciabatti M. (1969) - Giorn. Geol., 34, 1-26.
[7] Gandolfi G., Mordenti A. & Paganelli L. (1982) - Jour. Sediment. Petrol., Vol.52, No.3, 797-805.
[8] Guerzoni S., Ravaioli M., Rovatti G. & Suman D. (1986) - VII Journee Etude Pollution, Lucern, CIESM, proceedings in press (1984).
[9] Albertazzi S., Bopp R.F., Frignani M., Merlin O.H., Menegazzo Vitturi L., Ravaioli M., Simpson J.H., Tassi Pelati L. & Triulzi C. (1986) - Mem. Soc. Geol. It., Vol.27, proceedings in press (1984).
[10] Frascari F., Frignani M., Giordani P., Guerzoni S. & Ravaioli M. (1986) - Mem. Soc. Geol. It., Vol.27, proceedings in press (1984).
[11] Guerzoni S., Frignani M., Giordani P. & Frascari F. (1984) - Environ. Geol. Water Sc., Vol.6, No.2, 111-119.
[12] Boldrin A., Rabitti S. & Stefanon A. (1984) - Boll. Oceanol. Teorica e Appl., Vol.2, No.4, 350-352.
[13] Nelson B.H. (1970) - In (Morgan J.P., ed.) Deltaic Sedimentation, modern and ancient, SEPM, Special Publication No.15, 152-184.

DISTRIBUTION OF ORGANIC CARBON, NITROGEN AND PHOSPHORUS IN SURFICIAL SEDIMENTS OFF THE NILE DELTA

N.M. DOWIDAR, M.A. EL-SABROUTY and A.A. EL-SAMMAK

Department of Oceanography, Faculty of Science, Alexandria University, Alexandria (Egypt)

The distribution of organic carbon, nitrogen and phosphorus was studied in surficial sediment samples from the Mediterranean shelf off the Nile Delta. The average concentrations/gm sediments were 7.61 mg carbon, 1.36 mg nitrogen and 0.12 mg phosphorus. The distribution of the three elements were highly correlated with each other and inversely correlated with mean grain size of the sediments. The average C:N:P ratio (by weight) in the whole area was 83:15.1.

As obvious, the values of organic matter content in the sediments off the Nile Delta average 1.37% is closely similar to the bottom sediments of the Mississippi Delta (0.86-1.72%)(Shepard,1956). Figure 2 shows the variations of organic matter content of the sediments with depth at the different sections. The least organic matter concentration was found in Agami sector with almost a uniform concentrations at different depths. This is clearly due to the decreased amount of the Nile flood reaching this area. The west ward flow of the Nile flood is opposed by the general eastward circulation in the area and is mostly felt away from the coast,this may explain the relative increase of organic matter content at the end of the continental shelf off Agami section. As shown in Figure 2, the concentration of organic matter is much higher in the area between Rosetta and El-Arish with a general trend of decreasing concentration with depth.The highest concentration was found off Port Said. This is clearly correlated with the general eastward circulation in the area.Beside the general circulation which transport the lithogenic and biogenic debris from off the Nile Delta, there exist local gyres and vortices in the area off Port Said and El-Tena bay,such a condition results in a heavy precipitation of the most of the sediment load carried by these currents,thus leading to the enrichment of the sediment with organic matter components. As shown in the table , the highest organic matter content occurred in the middle shelf off Port Said area which almost considers with the area of local gyre formation. As well known,the organic matter content of the sediments is inversely correlated with the mean grain size,such a relation was found highly significant ($p<0.001$) in the study area.As shown in the table , the concentrations of organic carbon, nitrogen & phosphorus in the sediment off the Nile Delta were correlated with each other and the mean grain size,suggesting acommon origin. The average C:N:P ratio(by weight) was 83:15:1 respectively.concluding that the Nile sediment is still rich in its N&P contents and may act as a source of inorganic nutrients for increasing the biological production in the area.

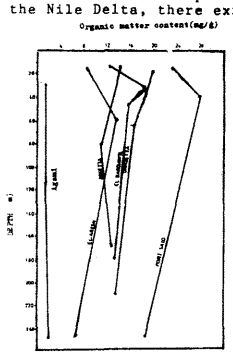

Figure 2. Relation between O.M. content of sediments and depth.

References:
Aspila,K.I.;H.Agemian & A.S.Y.Chau(1973) Analyst,March,V.101:187-197.
El-Wakeel,S.K. & J.P.Riley (1957) J.Cons.Int.Exp.Mer,22:180-83.
Folk,R.L. & W.C. Ward (1957) J.Sed.Peter. 27(1):3-27.
Niederl,J.B. & V.Niederl (1942) "Micromethods of quantitative organic analysis (2nd edition) John Wiley,N.Y.,374p.
Shepard,F.P. (1956) AAPG Bull.,40:2537-632.

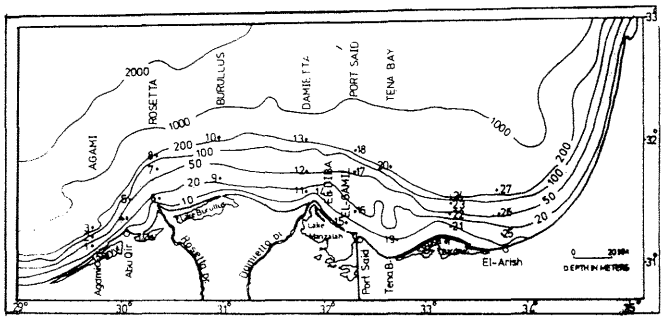

Fig 1. Area of study and stations sampled

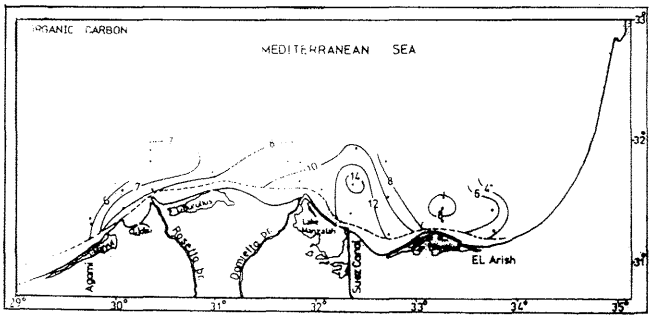

Fig 2. Distribution of Organic Carbon in the surficial sediments off the Nile Delta