Factors controlling the chemical composition of the Egyptian continental shelf sediments

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The factors controlling the chemical composition of the sediments are the relative proportions of the component minerals of the sea sediments which exert a fundamental control on their chemical composition (RILEY & CHESTER, 1971). Considering the present work for areas under the direct influence of fresh water discharge from the river Nile and drainage waters, it is useful to understand the processes and factors controlling the chemical composition of sediments.

The river Nile is the major source of the metal input in the eastern Mediterranean basin. However, irrigation projects associated with the Aswan High Dam prevent almost completely the discharge of fresh water from the Nile into the sea (SUMMERHAYES *et al.*, 1978).

The present study of the shelf sediments off the Nile Delta between Agami (Alexandria, west) and Arish (east; Fig. 1) is confined to investigate the distribution of the different chemical constituents as well as to define the different factors controlling the chemical composition of the sediments.

A total of 27 surface sediment samples were collected, prepared and subjected for total chemical analysis. The results of the determined major and minor elements [with averages of : Si (20.59%); Al (6.57%); Fe (5.84%); Ca (11.27%); Mg (1.84%); Na (1.36%); K (1.01%); P (0.07%); Ti (0.82%); Ba (0.02%); Sr (0.16%); S (0.29%); Mn (0.09%); Zr (0.02%); V (0.016%); Cr (0.014%); Zn (94.27ppm); Pb (82ppm); Ni (73.8ppm); Cu (40.12ppm) and Co (37.4ppm)] were statistically analyzed. The employed R-mode Factor analysis was used to interpret the interelement associations in the studied shelf sediments. This analysis grouped related elements into a limited number of factors on the basis of their similar behavior. Each factor represents a different geochemical association, possibly caused by mineralogical variations in the sediments. Two Factors were produced (Table 1).

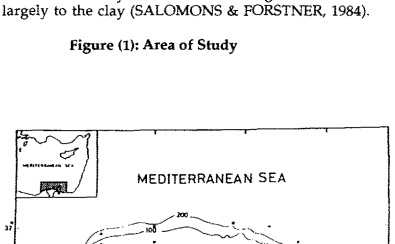
Factor I appears to be a clay factor. It accounts for 76.3 % of the total variance (Eigenvalue = 17.27). It shows a strong association of Al, Fe, Si, Na, K, Mg, Ni, Mn, Ti, Zn and Zr, the elements highly concentrated in clay sediments. Factor II appears to be a carbonate factor. It accounts for 10.6 % of the variance (Eigenvalue = 2.2) and shows an association of Ca, Sr and S, the elements which are highly present in the carbonate sediments.

The mineralogical characteristics of the studied samples reveal that heavy minerals especially opaque, mainly magnetite and ilmenite are particularly abundant at Rosetta mouth, where exploitation visibility studies have been made for ilmenite, zircon, rutile and monazite at Cape Burollus and Damietta sediments gives rise to the high incorporation of elements within the studied sediments. The high association of Fe and trace elements with Factor I is due to the incorporation of Fe with clay minerals. Fe is acting a carrier substance for many trace metals as it fix them largely to the clay (SALOMONS & FORSTNER, 1984).

Table (1): Factor Matrix

Element	Factor I	Factor II
Al	.91088	.44594
Na	.90997	
Fe	.90551	
Si	.90209	
Zn	.86319	.43804
Ni	.86234	.48410
K	.85655	.47533
Pb	.84234	
Mn	.82380	
Co	.81908	.51574
Ti	.79039	.53442
Cr	.77667	.52685
Mg	.77639	
Cu	.77594	
P	.76228	
S		-.93735
Ca		-.90705
V		-.90193
Ba	.47109	.77063
Sr	-.49839	-.76119
Zr	-.64065	.73709

Figure (1): Area of Study



Factor II has high negative loadings for Ca, Sr and S due to the association of these elements with the carbonate sediments covering a limited area to the west of the studied area. Dominant carbonate minerals (aragonite, calcite and Mg-calcite) were found in the carbonate sediments (EL SAMMAK, 1987). The origin of Sr in this area is the product of shell disintegration (EL SAYED, 1985). Ca is closely related to Sr due to the geochemical similarities between them and is highly present in the calcareous test of organisms. S in the sedimentary rocks associates with gypsum and limestone and may be contributed from some skeletons.

The employed factor analysis clarified the factors controlling the elemental composition of the studied area the relationships between mineralogy and geochemistry as well as the interelement associations of the studied elements.

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