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Speciation of Fe, Mn, Zn, Cu and Pb in the Inner-Shelf Sediments off Alexandria

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A chemical speciation study for the bottom sediments of the coastal belt off Alexandria has been conducted for iron, manganese, zinc, copper and lead. The purpose of the search is to demonstrate in which forms these metals are chemically associated, as well as, to differentiate between the residual metals (natural background) and non-residual ones (man-made sources of pollution). To acheive these objectives, twelve bottom samples were collected along the coastal water off

Table(1): Ranges and averages for different metal extracts(ppm)

Fraction / Metal	Exchangable (EXCH) range	aver.	Carbonate (CARB) range	aver.	Easly reducible (EASR) range	average	Organic matter (ORGS) range	average	Residual (RESD) range	average
Fe	8.87-22.2	12.97	8.89-37.72	24.65	16.29-33.85	25.24	15.28-36.95	25.24	997.59-1881.95	1482
Mn	N.D*-2.2	1.48	6.5-14.3	9.79	3.0-18.8	4.77	N.D.-4.85	1.85	85-166.3	125.58
Zn	1.0-2.2	1.79	4.98-21.1	9.85	N.D.-4.35	2.77	N.D.-4.35	2.87	25.83-93.73	49.83
Cu	N.D.-3.56	1.31	3.0-5.88	4.84	N.D.-2.2	8.43	N.D.-5.75	1.46	5.73-39.85	14.11
Pb	N.D.-7.52	2.69	6.25-22.5	11.82	N.D.-12.5	4.89	N.D.-7.58	1.34	27.29-65.8	48.5

* Not Detected.

Alexandria city. Following the procedures described by Tessier et al.(1979) and Rapiń and Forstner(1983), the suspensions of fine fraction sediments (0.250-0.125 mm) were sequentially fractionated to determine the levels of different metals in the following geochemical fractions: exchangeable (EXCH), carbonate (CARB), easily reducible (EASR), organic matter including sulphides (ORGS) and residual (RESD). The total metal contents in sediments (TOT) was determined after digesting the sediments with concentrated HNO3. pH, organic carbon, total carbonate and Fe-Mn oxides were estimated for correlation with the different forms of

Table(2): Ranges and averages for the total concentrations(TOT) of investigated metals(ppm).

Metal	Range	Average
Fe	1457.8-3813.4	2296.4
Mn	125 - 288	182.29
Zn	48.93-148.23	74.56
Cu	16.88-62.88	29.42
Pb	43.23-127.2	71.52

metal associations. This study revealed that the recorded high levels of metals obsrved in the investigated area are due to natural phenomena, as well as anthropogenic inputs. The levels of different metal extracts, and the total metal concentrations are shown in tables 1 and 2. Results showed that the recorded levels of the examined metal fractions are represented in the following sequence: RESD>EASR=ORGS>CARB>EXCH for iron,
RESD>CARB>EASR>ORGS>EXCH for manganese,
RESD>CARB>EASR>ORGS>EXCH for zinc,
RESD>CARB>ORGS>EXCH>EASR for copper
and finally RESD>CARB>EASR>EXCH>ORGS for lead.
The characteristic high content in the residual fractions for the different metals emphasises the strong influence of water discharge and sediment influx from the river Nile into the Mediterranean Sea (UNEP,1984). This mean that, considerable amounts of heavy metals are transported naturally into the Mediterranean as background contribtions. Among the non-residual metal fractions, the carbonate associated metals showed noticeably high concentrations of Fe, Mn, Zn, Cu and Pb in comparsion with the other extractions. This could be attributed to the prevalence of carbonate materials in the investigated area(El-Wakeel and El-Sayed,1978; Nasr et al.1988 and 1989) which offer favourable conditions for the heavy metals to be associated with them. The non-residual metal forms (man-made sources) represent 5.88% of the total extractable fractions for iron, 12.85% for manganese, 25.44% for zinc, 38.98% for copper and 31.06% for lead. These figures reflect a quite evident pollution with zinc, copper and lead in the investigated area. Correlation matrix has been carried out to highlight the interrelationship among different studied parameters.

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