

Copper Speciation in the Sediments of the Nile River Delta Lakes in Egypt

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A five step sequential extraction scheme (Tessier *et al.*, 1979) was applied to surficial sediments collected during the period 1982-1989 from four northern Nile River delta lakes in Egypt namely Lake Mariut, L. Edku, L. Burullus and L. Manzalah to illustrate the different species of Cu associated with their sedimentary phases. Cu concentration in each phase was determined using a Perkin Elmer AAS. Almost, the summation of sequential extracts showed a good agreement (within 6%) with the total metal concentration. The accuracy was tested against NBS standard River Material 1645 and concentrations were within 3-5% of certified values. Triplicates showed high reproducibility not exceeding 10%.

Information for the sampled lakes as well as the average concentrations of the different Cu species are shown in Table 1.

Table 1. Area, depth range, trophic status, flushing time and mean Cu species concentrations ($\mu\text{g/g}$) as well as organic matter (%) and Cu/Al ratio in the Nile delta lakes.

LAKE	MARIUT 1986	EDKU 1989	BURULLUS 1988	MANZALAH (1982/83)
AREA (Km^2)	70	115	370	700
DEPTH (cm)	90-150	50-150	50-200	100
TROPHIC STATUS	Hypereutrophic	Mesotrophic	Mesotrophic	Eutrophic
FLUSHING TIME (d)	ND	21	42	38
Exchangeable *	1.03±0.54	0.16±0.04	0.34±0.1	0.67±0.3
Carbonate *	1.20±0.25	0.80±0.13	3.10±0.4	1.90±0.4
Fe/Mn oxide *	6.80±0.90	9.30±1.10	5.26±0.9	12.40±3.6
Organic/sulphide *	36.40±18.3	11.80±1.50	7.50±0.8	28.10±12.6
Residual *	28.80±5.10	16.90±2.10	12.80±1.6	32.20±6.1
ORGANIC MATTER (%)	10.1	2.4	1.8	6.9
Cu/Al $\times 10^{-5}$	325	139	95	267

ND = Not determined * = $\mu\text{g/g}$

The exchangeable fraction of Cu showed no statistically significant magnitude between the different lakes. The carbonate fraction as well was only enriched in samples collected at the lake-sea connection sites where the carbonate content of sediments reached >55%. Despite the presence of Fe and Mn in considerably high concentrations in the studied lakes, the easily reducible fraction was the third in abundance. The organic and sulphide associated Cu were enriched in the sediments of Lake Mariut and Manzalah forming on the average 49% and 43% of the total Cu, respectively. Both lakes receive huge amounts of sewage discharge and are suffering from anoxia in most of their productive areas with H_2S values reaching >15 ml $\text{H}_2\text{S/l}$. Station to station variations were reflected on elevated standard deviations from the mean in both lakes. Lake Edku receives sea-derived industrial wastes which may elevate the Cu concentration at the lake-sea connection while L. Burullus is comparatively clean receiving only agricultural discharge and local sewage.

The use of CuSO_4 as an algicide in controlling aquatic plants' blooms, specially during warm season, is the main route of Cu to the northern delta lakes. The accumulation of dissolved Cu by phyto-, zooplankton as well as floating and submerged macrophytes may transfer Cu to the lake sediments after their death and decay. The Cu/Al ratio calculated for the different delta lakes showed Cu enrichment in all lakes when compared with the Cu/Al ratio of standard snail. Table 1 showed that Cu is enriched in the sediments of the delta lakes in the order : Mariut > Manzalah > Edku > Burullus.

References

Tessier, A. *et al.* (1979). Anal. Chem. (51) 7: 844-850.