CHAPTER 6

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The geochemical studies carried out on the three tropical lakes’ sediments show that the rift valley lakes are dominated by mainly alkali feldspar, while in the lake Kolleru, the sediments the quartz is dominant followed by other feldspar minerals. Carbonate minerals, in particular calcite was identified in some site in the lake Kolleru sediments.

The textural characteristic of the sediments indicated that the lake Naivasha sediments have high silt, the lake Nakuru sediments are dominated by silt and fine sand while the lake Kolleru sediments are dominated by medium sand and coarse sand. The statistical data indicated that the sediments of the rift valley lakes are poorly sorted due to their proximity sources relative to the Lake Kolleru sediments which are better sorted.

The sediment chemistry of the rift valley lakes is mainly controlled by silicate weathering while that of the lake Kolleru is controlled by both silicate and carbonate weathering.

The grain size has an influence on the trace element distribution. With the exception of Ni, higher trace element content was observed in the lower grain size than in the larger grain sizes in all the three lake sediments. Increase in Ni concentration with increasing grain size has been attributed to its association with silicate minerals.

Fe and Mn concentration did not vary much with the grain size. It can therefore be concluded that all the grain sizes seem to control the distribution of Fe in these lakes.
High concentration of these elements in more coarse fractions is due to the increase of Fe-Mn coating on larger grains.

The results of acid digestion of the bulk samples indicated the dominance of the iron content i.e. Fe was the major element in all the three lake while Cd had the lowest concentration.

The order of trace element abundance in the study area was however different, with the rift Valley lake showing an almost similar trend;

Fe > Mn > Zn > Ni > Cu > Pb > Cd for the Lake Naivasha;
Fe > Mn > Zn > Ni > Pb > Cu > Cd for the Lake Nakuru, while that of the Lake Kolleru followed the order;
Fe > Mn > Zn > Pb > Cu > Ni > Cd during non-monsoon season and
Fe > Mn > Pb > Zn > Ni > Cu > Cd during monsoon season.

Generally, the Lake Nakuru has much higher elemental content than the other lakes while the lake Kolleru has generally lowest element content. The high elemental content in the rift valley lake is due to metal rich source rock and partly due to pollution.

The major elements sodium and potassium dominates in all the three lakes with lower content of both the calcium and magnesium content. Potassium containing minerals are more abundant in the rift valley region than the sodium containing minerals and due to its high susceptibility to weathering.

Enrichment factor indicated that there is no enrichment in Fe and Mn in all the lakes. However the lakes are generally enriched with Cd, Pb and Cu which indicates an anthropogenic source. The rift valley ales are also highly enriched with Zn, and Ni.

Use of geoaccumulation index however indicated that all the studied lakes pose a pollution risk with respect to Cd and Pb. Other elements (Zn, Cu and Ni) indicate only moderate pollution risk but may be potential pollutants in future. All the lakes are not polluted with respect to Fe and Mn.
Factor analysis confirmed multiple source for certain elements. The factor analysis indicate that the major element concentration in all the three lakes have a natural weathering source. The factor analysis further indicates that Ni, in the Lake Naivasha has a natural weathering source rather than pollution source whereas Cd and Pb have anthropogenic source which include industrial agricultural and sewage effluents.

Generally the trace elements showed a decreasing trend in the vertical profiles of the sediment cores. This trend points to the anthropogenic input into the lakes in the recent past. Occasional increase in element content observed at certain depths is attributed to the irregular inputs of the metals and their remobilization and diagenetic changes.

The sequential extraction procedure also revealed that the lithogenic (residual) phase is the major sink for most metals in the rift valley lakes while water soluble fraction contributed insignificant amounts.

Cd is the most mobile metal since it presents the highest percentages in the acid soluble fraction and the lowest in the residual fraction. Therefore we can expect that the exchange of this element between the sediment and the water column will take place easily.

The lake Naivasha seems to contain a significant amount of lead in both the exchangeable and organic fraction.

The lake Kolleru has much higher amounts of metals in the non residual fraction. This is followed closely by the Lake Naivasha with the Lake Nakuru having the lowest amounts.

The high alkaline nature of the Lake Nakuru prevents leaching of metals from the sediments and makes the sediments a sink for metals.
Mn seems to be associated more with the carbonates phase in the Lake Kolleru as indicated by the presence of significant amount obtained in this phase during the sequential extraction procedure.

The seven step procedure has effectively differentiated the elements associated with the Mn-oxide from those associated with the Fe-oxide. It has shown that Ni and Cd are associated more with Mn-oxide while Zn, Pb are more associated with Fe-oxide phases in the non-residual phases.

The amorphous Fe-oxide phase accounted for a very small fraction of the metals as most of the elements are associated with the crystalline phase.

Phosphorus fractionation of sediments in these lakes indicate that the fraction containing “authigenic apatite plus CaCO$_3$ – bound P plus biogenic apatite” accounts for the major portion of phosphorus. The reactive P is the major fraction in the total P in all the lakes.

In the lake Kolleru, very high fraction of exchangeable P was found relative to the rift valley lakes where the exchangeable fraction was very low. Phosphorus in organic matter oxide phase seems to be less important in the studied lakes.

In general, the rift valley lakes are more concentrated in nutrients and metals relative to the Lake Kolleru. However availability of these elements is much higher in the Lake Kolleru than the rift valley lakes.