Sediment Analysis of the Hebbal Valley Lakes using Scanning Electron Microscopy and Energy Dispersive Spectroscopy

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ABSTRACT

The study examines the lake bed sediments of Hebbal Valley Lake. A rapid population increase accompanied by unplanned developmental works has led to the pollution of surface water, sediments of the lake and also ground water by residential, agricultural, commercial, industrial wastes or effluents. This has declined in the number of water bodies in the urban areas. The Energy Dispersive Spectroscope (EDS) and Scanning Electron Microscopy (SEM) is an advanced tool to characterize the sludge/sediments/soil samples. The EDS spectra reveal that the sediment contains predominant elements like Silica, Calcium, Aluminium, Iron, Potassium and Titanium, are present in the form of salts. The remaining portions may be carbonaceous and inert materials. From the results, it is evident that the lake sediments do not contain the toxic chemicals like Pb, Zn, Cd, Ni, Cu, Cr, and Mg and so sediments can be used as a compost along with the soil in the agricultural fields so that better yield is obtained.

It can be concluded that sediment analysis of lake soil from Hebbal valley contains predominant elements and divide of toxic chemical and it can be used as soil supplement for growing crops for better yield.

INTRODUCTION

Water is an important vital resource for domestic industrial and agricultural purposes. Though India receives good rain fall, its availability in space and time is not adequate enough to meet the various requirements of the people who are living in different regions with a proper management of available water resource. It is possible to meet the minimum requirement of the human beings. Major lakes, reservoirs and rivers of the world are now getting polluted by various ways there by posing threat to the survivability of the life systems on these water bodies.

SEDIMENT ANALYSIS

The pollutants enter into the surface bodies not only affect the surface water

source, but will also affect the ground water source and is deposited at the bottom of the lakes.

The present study was undertaken to study the chemical characterization of sediments of the Hebbal Valley Lakes. The sediment sample collected at different locations in the lake using Eckman Sediment bottom sampler. The composite sample was labeled and transferred to the laboratory for further analysis. The lake sediments were oven dried at 105^{0}C for 2 hours. The dried sample was powdered using pestle and mortar and was sieved. The sieved sample was then subjected to SEM (Scanning Electronic Microscopy) and EDS (Energy Dispersive Spectra) as per the standard procedure. The depictions are shown in Fig. 1 to Fig.10 respectively of all the five lakes.

The SEM/EDS is an advanced sophisticated tool to characterize the sludge / sediments / soil samples and also used characterize the particulate matter in Air pollution (Mirjana et al. 2006)

In Scanning electron microscopy, an electron beam is scanned across a sample's surface. When the electrons strike the sample, a variety of signals are generated and it is the detection of specific signals which produces an image or a sample's elemental composition. The three signals which provide the greatest amount of information in SEM are the secondary electrons backscattered electrons and X – Rays.

EDS is an analytical tool predominantly used for chemical characterization. Being a type of spectroscopy, it relies on the investigation of the sample through interaction between light and matter, analyzing X Rays in its particular case. Its characterization capabilities are due in the large part of the fundamental principle that each element of the periodic table has a unique electronic structure and thus a unique response to electro magnetic waves.

The Scanning Electronic Microscopy (SEM) and Energy Dispersive Spectroscopy (EDS) is very useful for studying the morphology and surface features of materials ranging from polymers to minerals and metals to archeological objects.

RESULT AND DISCUSSIONS

The sediments were analyzed through SEM / EDS for all the five lakes in the Hebbal valley. The SEM of sediments of the lakes revealed that the sediment consists of tiny particles and are cubical in shape. The SEM/EDS appears to the agglomerates of tiny particles of all the lakes shown in Figure 1- Figure 10.

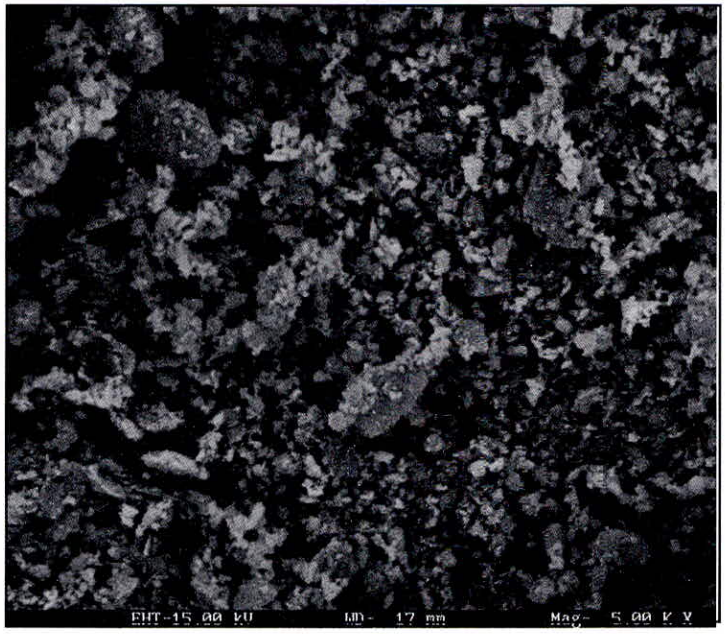

Fig. 1 : SEM of Lake Sediment of Vidyaranyapura Lake-1

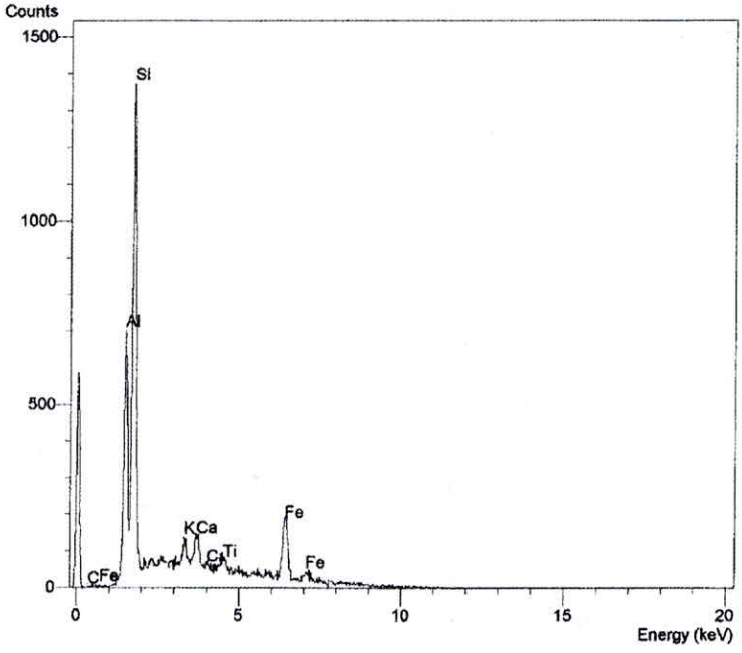

Fig. 2 : EDS of Lake Sediments of Vidyaranyapura Lake - 1

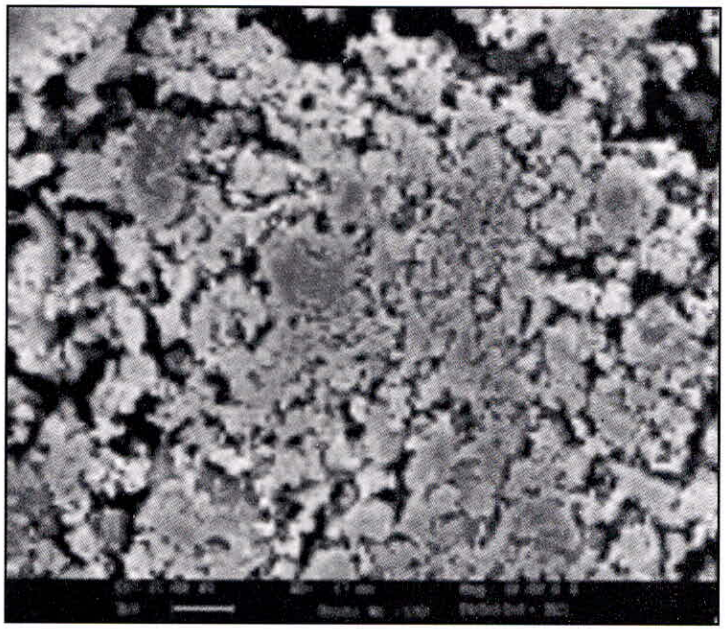

Fig. 3 : SEM of Lake Sediment of Vidyaranyapura Lake-2

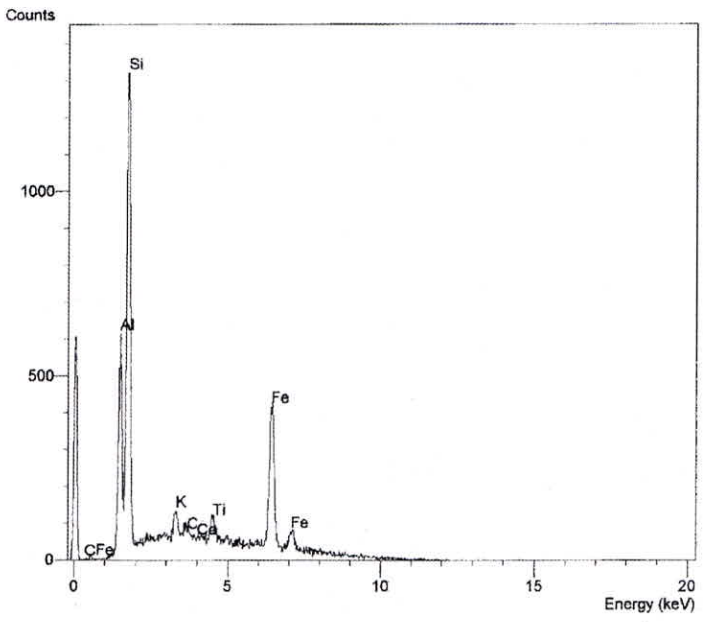

Fig. 4 : EDS of Lake Sediments of Vidyaranyapura Lake - 2

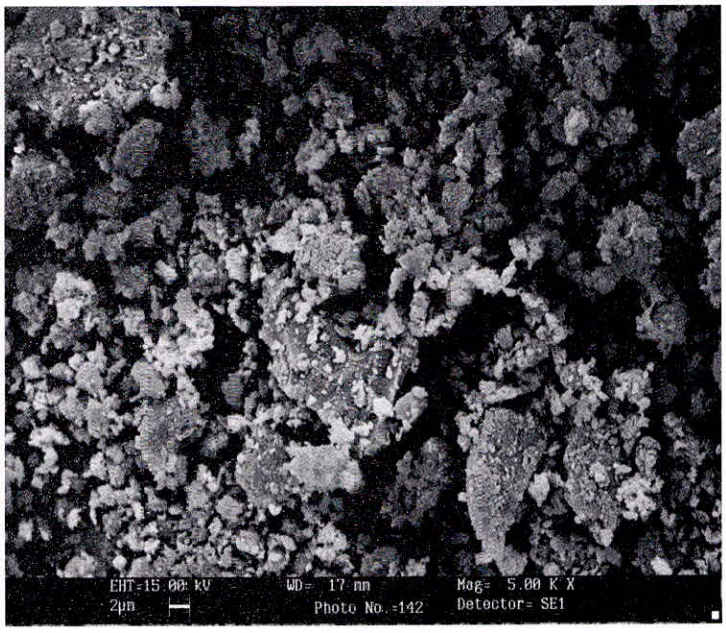

Fig. 5 : SEM of Lake Sediment of Doddabommasandra Lake

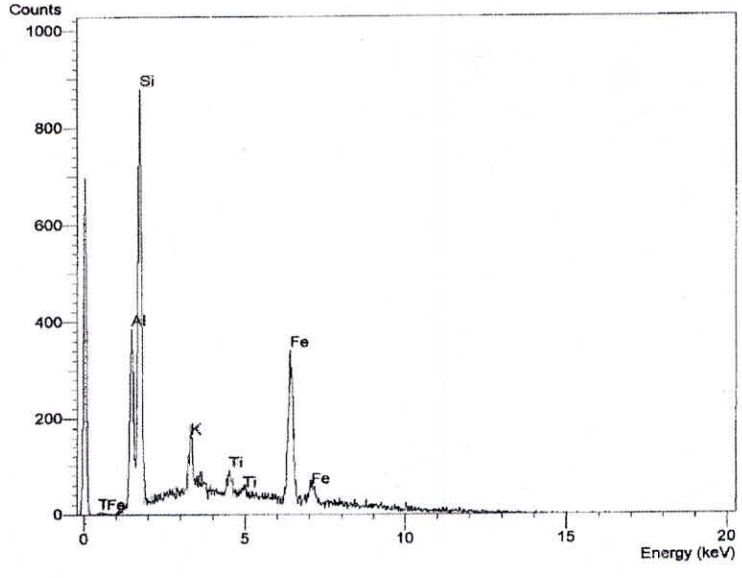

Fig. 6 : EDS of Lake Sediments of Doddabommasandra Lake

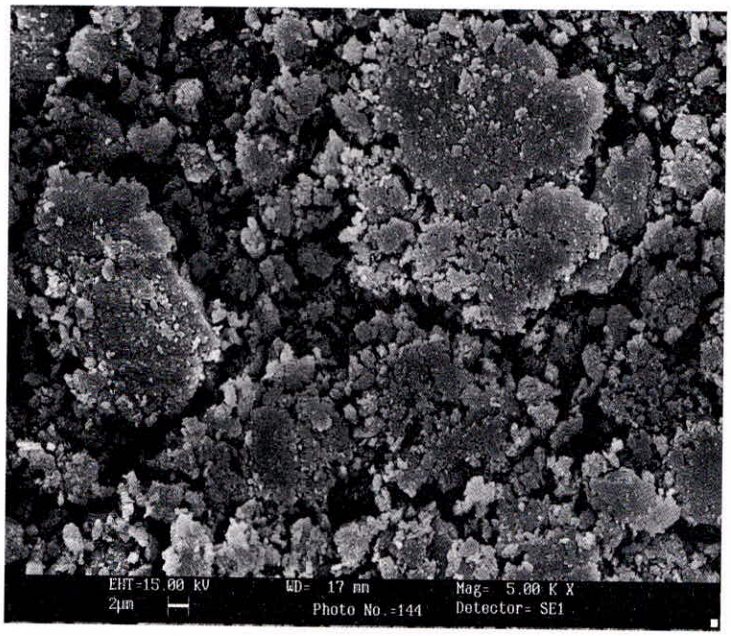

Fig. 7 : SEM of Lake Sediment of Hebbal Lake

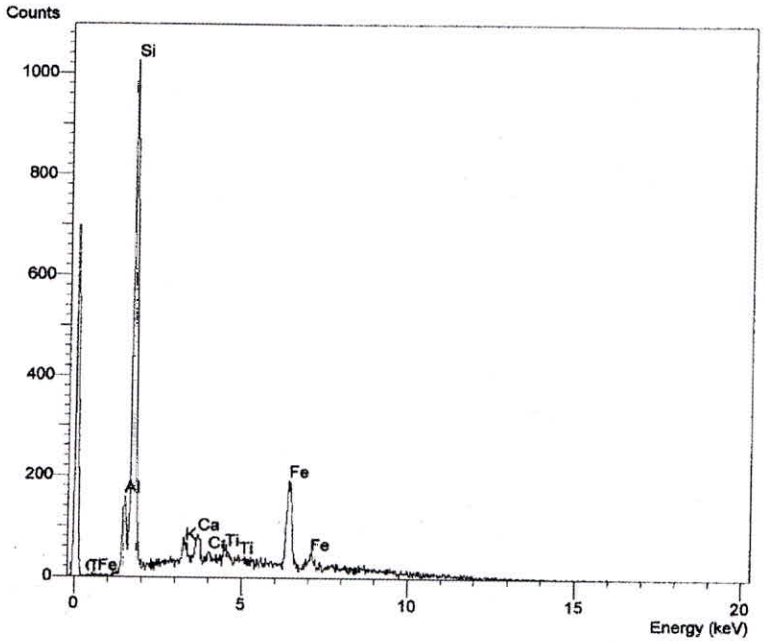

Fig. 8 : EDS of Lake Sediments of Hebbal Lake

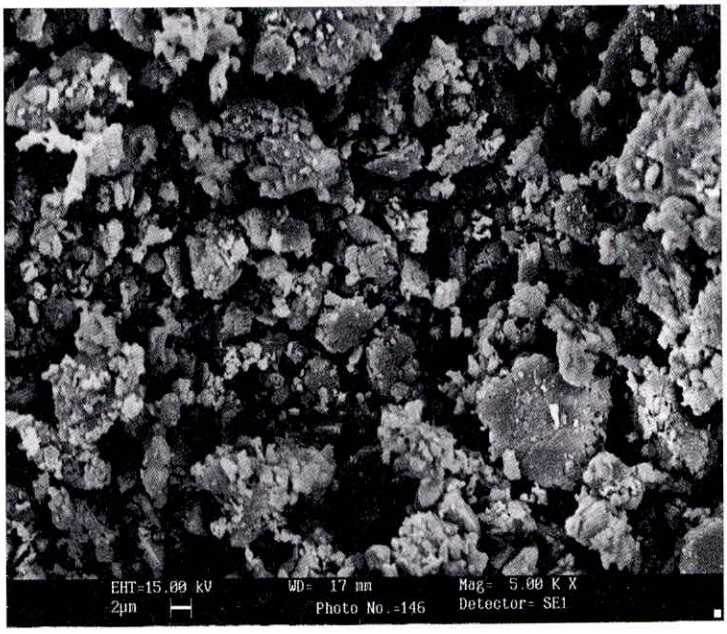

Fig. 9 : SEM of Lake Sediment of Nagavara Lake

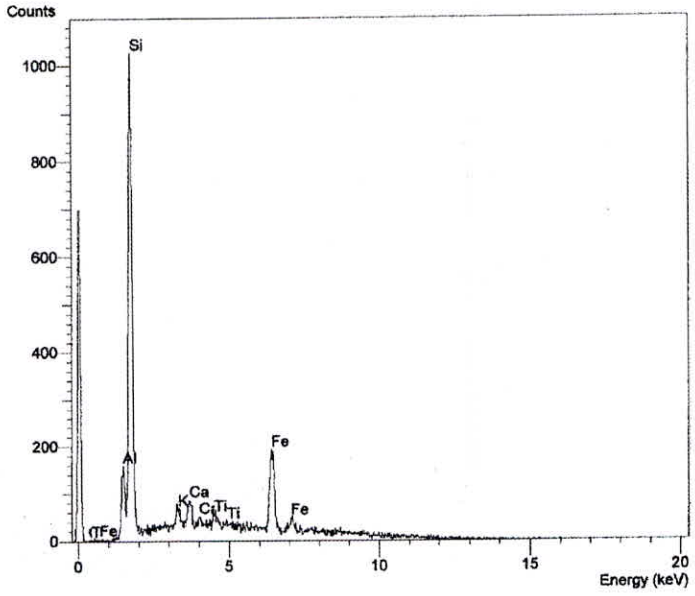

Fig. 10 : EDS of Lake Sediments of Nagavara Lake

The Energy Dispersive Spectrum of the lakes depicts the comparison of metals in the form of oxides. It was observed that in the sediments, aluminium in the form of aluminium oxide, silica in the form of quartz, iron in the form of iron oxide were predominant. The titanium and potassium were present in negligible quantities in the sediments. The diameter of the particle varied from 61.9 nm to 190.47 nm with a mean of 134 nm. From the results it is clear that silica dominated in all the lake sediments and it was followed by aluminum as shown in table 1 and table 2.

Table 1 : Element concentrations in the sediments

Vidyaranyapura lake-1		Vidyaranyapura lake-2		Doddabommasandra lake	
Element	**Atomic %**	**Element**	**Atomic %**	**Element**	**Atomic %**
Al	**24.76**	**Al**	**20.70**	**Al**	**19.14**
Si	**58.09**	**Si**	**53.73**	**Si**	**48.13**
K	**2.58**	**K**	**2.40**	**K**	**2.14**
Ca	**3.35**	**Ca**	**0.68**	**Ca**	**0.84**
Ti	**1.38**	**Ti**	**2.43**	**Ti**	**3.00**
Fe	**9.84**	**Fe**	**20.06**	**Fe**	**26.75**

Table 2 : Element concentrations in the sediments

Hebbal lake		Nagavara lake	
Element	**Atomic %**	**Element**	**Atomic %**
Al	**19.77**	**Al**	**5.68**
Si	**50.72**	**Si**	**68.20**
K	**5.22**	**K**	**2.40**
Ca	**2.31**	**Ca**	**3.84**
Ti	**21.99**	**Ti**	**1.85**
Fe	**NIL**	**Fe**	**18.03**

CONCLUSIONS

The Scanning electron micrograph of all the lakes revealed that the sediment consists of tiny particles and are cubical in shape. From the results it can be concluded that the lake sediments do not contain the toxic chemicals like Pb, Zn, Cd, Ni, Cu, Cr, and Hg. It can also be concluded that aluminum in form of aluminum oxide silica in form of quartz, Iron in the form of iron oxide were predominant and so sediments can be used as a compost along with the soil in the agricultural fields so that better yield is obtained.

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