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XRD and SEM Analysis of Tapti River Sediment: A Case Study

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ABSTRACT

During the present investigation the sediments of the Tapti River have been analyse by the XRD and SEM techniques. In this investigation the minerals found are Quartz, Kaolinites, Calcite, Vermiculite, Polygorskite, Micas and Gibbsite. The minerals introduced in aquatic system or into sediment as a result of weathering of soil and rocks which change the composition of minerals due to various activity of human such as mining, metallargical industries, various manufacturing process of metals & non-metals, organic matter, and physical factors like , pH, electrical conductivity, and also it is depend upon adsorption, desorption phenomenon of sediments.

INTRODUCTION

In most of the rivers contaminated sediment has become one of the most environmental issues. Both natural and human activities effect the composition of the sediment (1). Sediment can act as a major pollutant reservoir for heavy metals that will often bio accumulate through the food chain (2). In order to study pollution by sediment we must have to carry out mineralogical study on the sediment.

The sediment is generally constitutes dominate, and are called mineral soils. These minerals in soil or sediment are found in a coarse fraction (3). The more dominate primary minerals which commonly occur in soil or sediment along with their differentiating characteristics (3). One of the forms of silica is quartz it is generally found abundantly in sediment. Usually the dominant mineral of fine sand and coarse silt fraction of soils it is occasionally found in clay fraction. (4). It may be noted that 95 percent of the minerals are light minerals and the heavy minerals constitute a small fraction of quartz, feldspar and micas minerals (5).

The most widely occurring clay minerals in soil or sediments are kaolinite which is simplest of all the clay minerals (6). Quartz is useally a important mineral because of the formation of soil from highly siliceous material, quartz may be accumulated in the eluvisl horizens. On the other hand quartz may be absent in the clay fraction of the highly wheathered oxisols(7).

The Tapti river originates from high range of Satpura mountain at Multai in Madhya Pradesh

of central India as a small stream it passes through state Madhya Pradesh,Maharashtra and Gujrat. Large number of tributaries of varying dimensions merge their identity with this river.Tapti river respectively worshiped by millions of Indians.Tapti and its tributaries constitutes large river system in India and finaly meet arebean sea near Surat. Number of industries located along the bank of Tapti river and discharge their effluent to river.There are long standing complaints about water pollution causing fish mortality and also serious damages to the agricultural crop resulting in extensive unemployment in region of Tapti river.

MATERIALS AND METHODS

1. Experimental:

1.1. Extraction and Concentration of Sediments:

After collection of sediment sample from these two station located on Tapti river i.e. Surat and Prakasha, 500 gm fine powdered sediments sample was taken in a one litre measuring cylinder and mixed with one litre of distilled water, then this soil solution is shaken for 30 minutes with the help of mechanical shaker. After proper shaking kept this soil solution over night and next day the supernent liquid was separated with help of pipette in to a plastic bottles. This liquid sample is concentrated with the help of centrifugation on centrifugal machine at 4000 rpm for 10 min. Then these centrifuged samples were stored in a glass bottle.

1.2. Preparation of sediment sample for XRD:

More popular method of mounting sample for X-ray analysis is the preparation of oriented sample on microscopic glass slide or an porous ceramic plates. A clay suspension is made properly and pipetted onto the slide. So that approximately 15-25 mg of clay is transferred per 10 cm^2 . After sample has been allowed to dry at room temperature. It is ready for analysis with a direct recording X-ray spectrometer, in which X-ray pattern are printed on charts. The result are normally shown in terms of 2θ values. Evaluation of sediments mineralogy of the sample was carried out at "Sophisticated Instrumentation Centre for Applied Research & Testing" (SICART), Vallabh Vidyanagar, Anand (Gujarat).

1.3. SEM : (Scanning Electron Microscopy) :

SEM analysis was carried out on the phillips XL -30 electron microscope equiped with energy dispersive micro analysis system at SICART, Vallabh Vidyanagar, Anand (Gujarat)

RESULTS AND DISCUSSION

The results of sediment samples obtained during the course of present study are given in table 1 and 2. The XRD diffractogram and SEM photograph are being presented in figure 1-4.

Table - 1 General Characteristics and minerals observed by XRD analysis in Tapti river sediments

Sample	Sites of sample collection	General Characteristics	Main Mineral Observed
1	Prakasha (Maharashtra)	Depth-10cm	Kaolinite, vermiculite, micas/ qurtz, palygorskite. little- gibbsite. vermiculite, feldspar qurtz, palygorskite. little-
2	Surat (Gujrat)	Depth-10cm	Kaolinite, quartz, micas, palygorskite. little-chlorite, vermiculite,gibbsite, feldspar

2.1. X - ray diffraction:

The XRD result of sediments samples of Tapti river indicates that the dominant minerals are Quartz, Kaolinite, and Metahalloysite little-Gibbsite, Vermiculite, Palygarikite etc at station

Prakasha and the minerals - Quartz, Kaolinite, Metahalloysite Polygorskite, are dominant and little Gibbsite, Vermicultie, Cholrite, Illite, Smectites etc at station surat were found.

Kaolinite in fig: 1 (Diffractogram) exhibit characteristic diffraction at an angle $2\theta = 12.4^0$. The latter corresponds after conversion to a d(001) spacing of $7.162A^0$. The second - order diffraction is at $2\theta = 25^0$, which corresponds to a d spacing of 3.570 A^0 (7). Kaolinite in fig: 2 (Diffractogram) exhibit characteristic diffraction at an angle $2\theta = 12.4^0$ the latter corresponds after conversion to a d (001) spacing of 7.146 A^0. The second order diffraction is at $2\theta = 25^0$ which corresponds to a d spacing of 3.561 A^o.

X-ray diffractogram (peak) at $2\theta = 26.6^0$ correspond to the quarts minerals at a spacing 3.338 A^0. These types of corresponding 2 θ values and d-spacing observed at sediment sample of prakasha station. The X-ray diffraction peak $2\theta = 26.7^0$ correspond to the d spacing value 3.332 A^0 which suggest the presence of quartz qualitatively with the mineral quartz there is dense possibility of presence of micas about these d-spacing values.

X-ray diffraction peak at $2\theta lk,m = 21^0$ value corresponds to the d spacing value 4.245 A^0 suggest presence of palygorskite, because it is dignostic peak for palygorskite at prakasha station sediment. Another peak of station surat sediments shows at $2\theta = 21^0$ reading corresponds to a d spacing of 4.237 A^0 which is the dignostic peak for palygorskite (1).

X-ray diffraction pattern at $2\theta = 6.1^0$ reading corresponds to a d-spacing of 14.407 A^0 value which suggest the presence of vermicullite at station prakasha Tapti river sediment and diffraction peak at $2\theta = 6.3^0$ reading corresponds to a d-spacing value 14.167 A^0 may suggesting the presence of vermiculite and chlorite collectively.

Little peaks at various values of 2θ and corresponding d-spacing value suggesting the presence of number of other minerals such as -Gibbsite, vermiculite, chlorites Gypsum, feldspars etc (5). Kaolinite mineral can be found by neosynthesis from the product of hydrolytic decomposition of feldspars and other primary minerals. This mineral (Kaolinite) formed by the conversion of smectite and vermiculite in to kaolinite fallowing hydroxy interlying in the expandable mineral or mixed layering between 2:1 and 1:1 layers.

The XRD analysis of sediments sample collected from two stations 1) Prakasha, 2) Surat were clearly reveals the presence of Quartz, Kaolinite, Micas, Vermiculite, Palygorskite minerals. The geochemistry of these minerals are being changed with the weathering or climatic change .

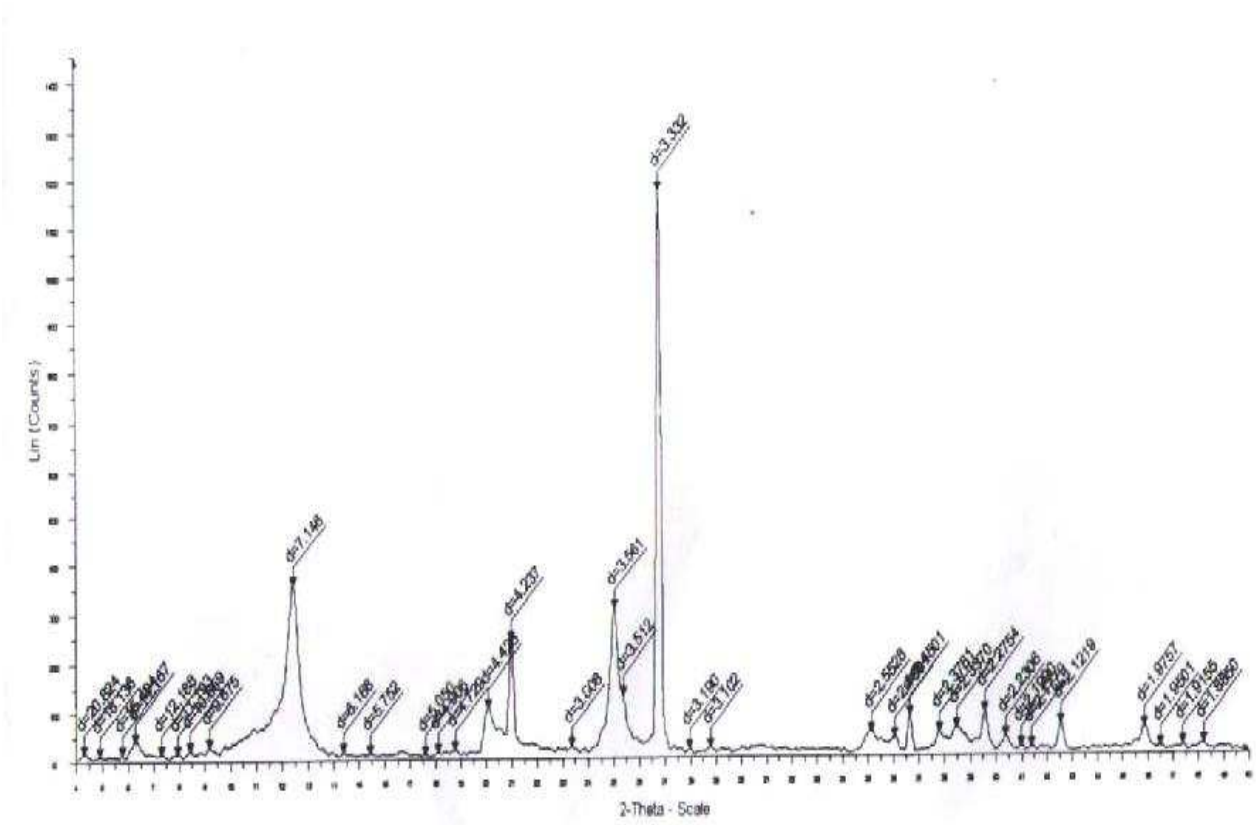

Fig.1.XRD diagram of > 2 µm fraction of Tapti river basin sediment,top ,depth 0-20 cm at station Surat.

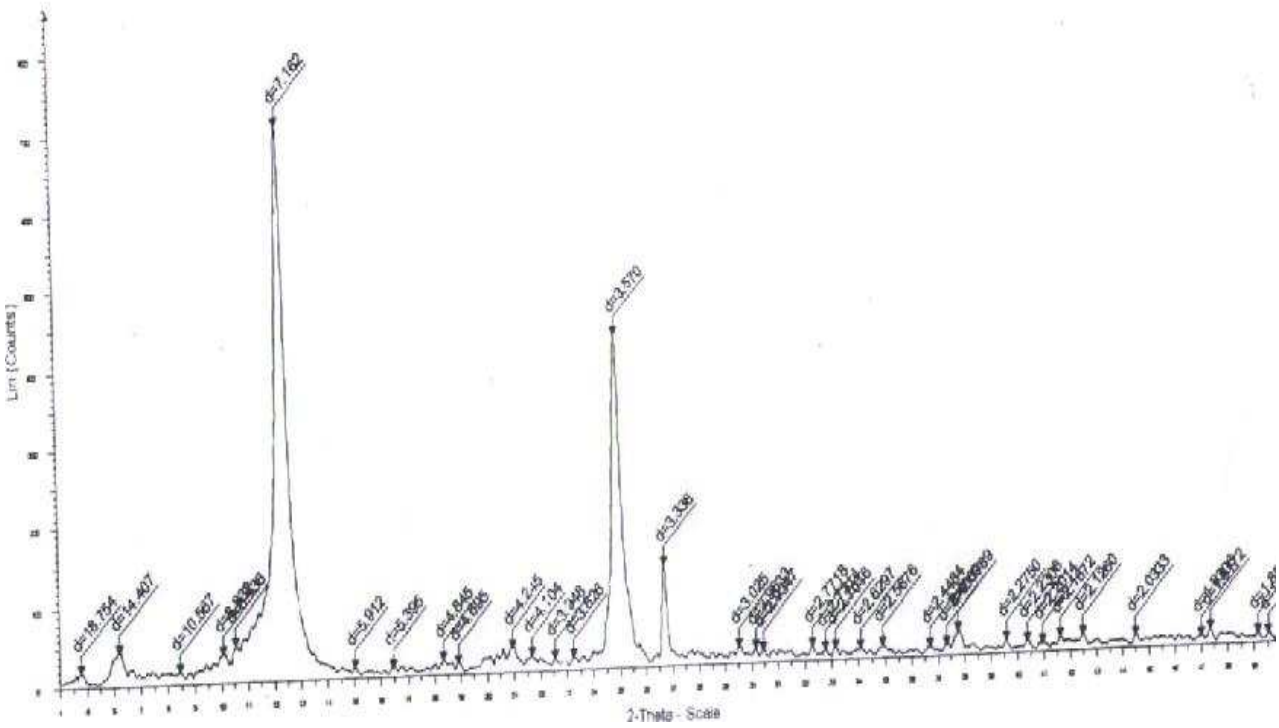

Fig.2.XRD diagram of > 2 µm fraction of Tapti river basin sediment,top ,depth 0-20 cm at station Prakasha.

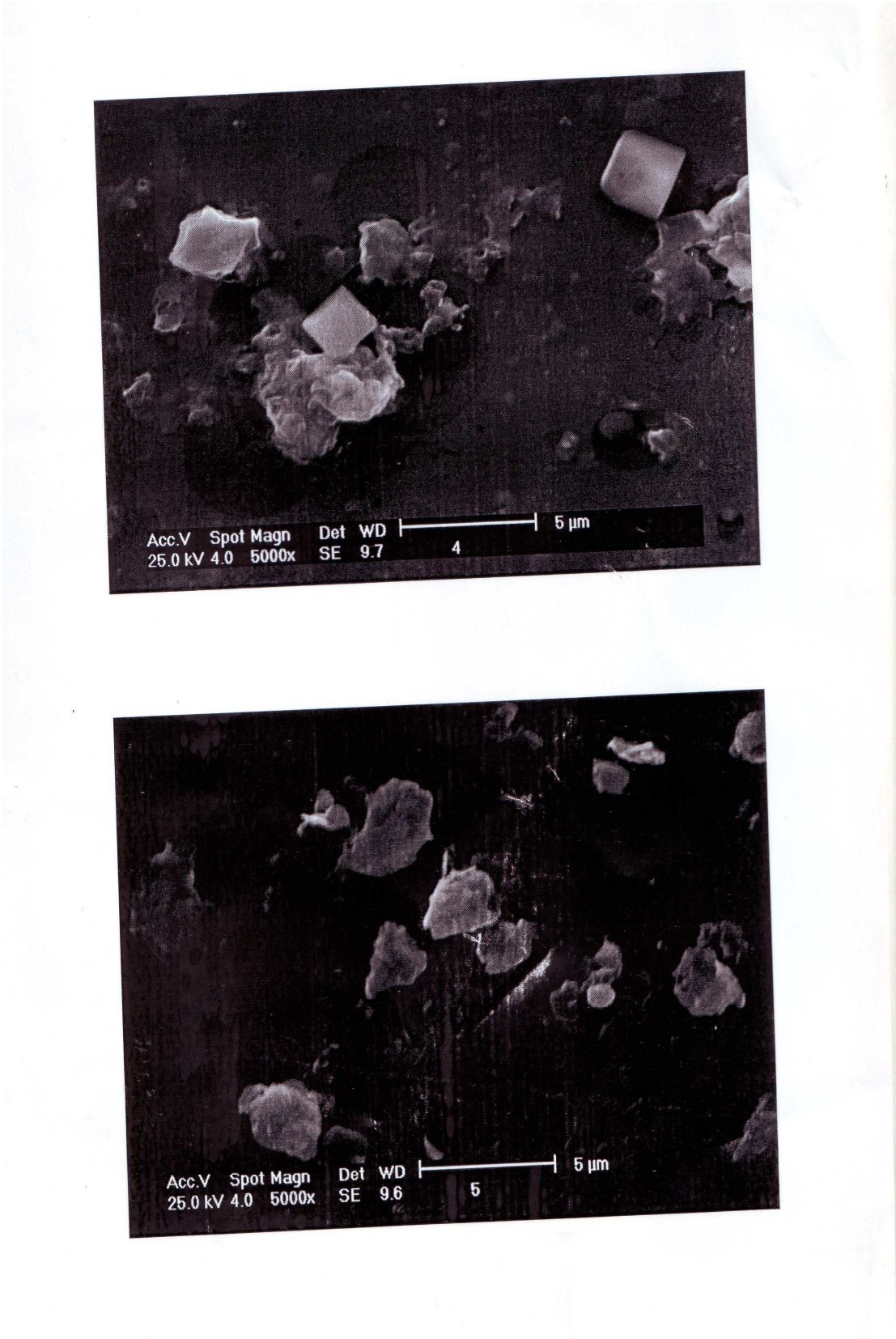

Fig. 3.SEM photograph of Tapti river basin sediment top horizon 0.20 cm at sampling station Surat.

Fig.4. SEM photograph of Tapti river basin sediment top horizon 0.20 cm at sampling station Prakasha.

2.2. SEM :

Out of the XRD analysis of the sediments sample of Tapti river from two different stations such as Prakasha and Surat, we have charecterise sediment samples by Scanning Electron microscopy (SEM) . Because particle size less than 0.2 micron can not be resolved under the ordinary microscope and hence can not be seen. The arrangement of particle size average of the obtained liquid phase was investigated by SEM. Figure 3 and 4 show the microscopy of typical clay particles size from different sediments. There are different spacing (different clay minerals) in the same crystal (8). Confurming the presence of interstratified clay. SEM photograph clearly indicates the presence of Quartz, Kaolinite, Micas, Vermiculite, Calcite, Polygorskaite, and little

Gibbsite, Chlorite, Feldspars. These results also demonstrate the goodness of the particle size separation method. Prakasha and Surat station sediments were chemically analysed for different parameters. This analysis clearly reveals that some of the parameters value have been found to be higher. This analysis also support the presence of detected minerals. The utility of the SEM of the surface texture to decipher different sedimentary environment has now been very well established.

The careful study and investigation of Tapti river sediment from two station 1) Prakasha and 2) Surat indicates that the sediment indicates that the sediment sample contain quartzs, kaolinite, calcite, vermiculite, palygorskite, micas, gibbsite, minerals.

CONCLUSION

X-ray diffraction analysis is the best and easily available technique for the identification and semiquantification of all minerals present in the clay rich rocks. Accurate quantitative mineral analysis is important in petralogical study, engineering and industrial application of rocks and soil that contain clay minerals. Whereas mineral identification is relatively simple and unambiguous if modern software and good mineral data are available. The main analytical difficulties is quantitative mineral analysis of rock and soil X-ray diffraction technique are related to the chemical and structural characteristics of clay minerals. The utility of scanning electron microscopy (SEM) of surface texture to decipher different sedimentery environment has now been very well established.

During the present investigation the minerals found are Quartz, Kaolinites, Calcite, Vermiculite, Polygorskite, Micas and Gibbsite. The minerals introduced in aquatic system or into sediment as a result of weathering of soil and rocks which change the composition of minerals due to various activity of human.

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