

Available at http://internationaljournalofresearch.org/

e-ISSN: 2348-795X

/olume 02 Issue 02 February 2015

Clay Mineralogy of Surface Sediments of Kolakkudi Lake, Musiri Taluk, Tiruchirapalli District.Tamil Nadu, India.

Sivasamandy.R¹, Dr. Ramesh.R²

- 1. Research Scholar, PG & Research Department of Geology, National College (Autonomous), Trichy-1
- Associate Professor, PG & Research Department of Geology, National College (Autonomous), Trichy-1

sivasamandygeologist@gmail.com.

ABSTRACT

The clay and non-clay minerals have been identified by XRD analysis. Illite is the most dominant component in the clay mineral assemblages. The purpose of this paper is to discuss the distribution of clay minerals in the surface sediments of lacustrine from the viewpoint of clay stability. The clay mineralogy of these sediments indicates that the most common mineral observed in all samples is illite. The other minerals namely kaolinite. *montmorillonite* are occurring in minor amounts. The clay minerals are believed to be derived from the hinterland lithology composed of Charnokites with associated acidic and basic rocks.

INTRODUCTION

Clay mineral formation and transformation in the soil are slow processes and depend upon

weathering environment, which in turn is mainly controlled by climate and drainage conditions of the landscape. In this paper an attempt is made to identify the clay minerals from XRD, their semi-quantitative estimation and to find out the relationship between clay minerals. Clay minerals of beach sediments have been used widely as a first order guide to the source, environment and the transport paths of fine grained sediments. (Grim, 1988, Biscay, 1965, Griffin. et.al, 1968 and Hashimi and Nair, 1989). Variation in clay mineral abundance, therefore, is a tool for deciphering sediment sources and transport vectors to an area. In this study, the spatial distribution in the clay minerals within this area to determine the relative influence of adjacent land geology and climate on the dispersal and distribution of clay minerals, and to identify the sources of sediments in this region.



Available at http://internationaljournalofresearch.org/

p-ISSN: 2348-6848

e-ISSN: 2348-795X

February 2015

/olume 02 Issue 02

STUDY AREA

The study area forms a part of Toposheet 58 I/8 situated in the Tiruchirapalli district of Tamilnadu. It falls between Latitude $78^0 22'37''$ E' to' Longitude $11^0 01'19$ N. The study area is nearby Kolakkudi village. (Figure.1). In the lake, sampling was carried out on a series of transects spaced 1km apart. On each transect, collection sites were equally spaced at about 200 m apart. At each station five to twelve samples have been collected and the samples were mixed thoroughly. The coordinates of the collection sites were determined using a handheld GPS unit.

METHODOLOGY

A total of 12 surface sediment samples, spaced 200 metres, have been sampled along this lacustrine section. Each sample was taken from the uppermost sand layer in order to preserve the textural signature of the last depositional event. The fine fractions (<63 μ m) were extracted by wet sieving of the total sediment. The clay fractions (<2 μ m) were analysed on orientated aggregates mounted on glass slides, each one with 1 ml of concentrated suspension of this

fraction, which benefits the clay minerals basal (001) X-ray reflections. These slides were dried at room temperature (glycolated and heated at 500OC. The clay mineralogy has been determined by X-ray Diffraction (XRD), using PANALYTICAL Phillips X'Pert PW3040/60 equipment, with the X'Pert 2.0 and Profit software. The semi quantification of the clay mineral assemblages was undertaken measuring the peak areas on the obtained difratograms and the peak intensities being corrected using specific "reflection powers" as recommended by **BARAHONA** (1974), **SCHULTZ** (1964), THOREZ (1976), MELLINGER (1979) and PEVEAR and MUMPTON(1989). Therefore, for the semi quantification of the identified main clay minerals, peak areas of the specific XRD reflections were calculated and weighted by empirically estimated factors (GALHANO et al., 1999; OLIVEIRA et al., 2002)

RESULTS AND DISCUSSION

In Oriented Clay Mineral XRD analysis at the measuring ranging between 20 –320, diffraction results were obtained after the samples were (i) air dried (ii) glycolated and dried up and (iii) heated at 550oC. When the air-dried samples were diffracted; peaks were developed on the



p-ISSN: 2348-6848

e-ISSN: 2348-795X

February 2015

/olume 02 Issue 02

diffractogram. These diffractograms revealed three main clay minerals namely illite which appeared in all samples, kaolinite which was seen in all samples except samples 06 and 07 and montmorillonite which appeared in samplesO3 and O4.The results from oriented air dried samples above were not enough to confirm the clay mineral groups obtained. Identification and hence confirmation of these clay minerals was achieved from the differences on the diffractograms obtained by glycolating the samples, drying them, then diffraction process carried out; and by heating the samples at 550 oC for two hours prior to the diffraction process. Presentation of these results is given in figures3 and Table 1 for all samples. Diffraction results [Figure. 3 & Table. 1]show that some of the diffractogram peaks in all samples were not affected by the two prescribed treatments. This behaviour of stability in chemical treatment (glycolated) and heat transformation (at 550 oC) was shown by illite. This happened at d-spacing equals to 10.082 Å and 3.342 Å (sample 01) 10.221 Å and 3.337 Å (sample 02); 9.947 Åand 3.342 Å (sample 04); 10.082 Å and 3.333 Å (sample 05); 4.481 Å and 3.333 Å(sample 06); and 4.481 Å and 3.342 Å(sample 07). When the samples were glycolated, dried and diffracted

some peaks were shifted in some samples. But on heating the samples at 550 oC followed by diffraction, these shifted peaks collapsed. This characteristic of altering the diffraction patterns which is a characteristic of kaolinite group (Lagaly1981) was observed in samples 01, 02, 03,04 and 05. This was observed at d-spacing values of 7.185 Å and 3.574 Å (sample 01); 7.185 Å and 3.579 Å (sample 02); 7.297 Å and 4.437 Å (sample 03); 7.185 Å and 3.574 Å (sample 04); and 7.094 Å and 3.562 Å (sample 05).For samples that were glycolated and dried, the diffraction patterns showed that peaks of samples 03 and 04 were widened and shifted (Table 1). But on heating the samples at 550oC, the peaks collapsed. This occurred at d spacing values of 16.078 Å and 3.024 Å(sample 03) and 15.081 Å (sample 04).Such observations are typical characteristic of montmorillonite clays (Lagaly 1981).Kaolinite a non-swelling mineral in water can be made to swell by using intercalation compounds (Bühmann et al. 1985). The intercalation compounds are compounds, which insert atoms or molecules as guest molecules between the layers of the host structure without disrupting the chemical bonds of the host materials. Ethylene glycolin this case is the intercalation compound which inserts its



p-ISSN: 2348-6848

e-ISSN: 2348-795X Volume 02 Issue 02

February 2015

molecules into the interlayer of kaolinite. X-ray diffraction results show inverted diffractogram peaks for samples that were glycolated and dried. The observation potrayed by kaolinite after both chemical and heat treatment is a tool to distinguish minerals of kaoline sub groups. instance kaolinite -serpentine group For minerals are characterized by 7Å reflections (Bühman 1998). The heat treatment (550 oC) causes the collapse of the kaolinite structures, while serpentine structures are not affected. As a consequence an X-ray pattern recorded after the treatment of kaolinite will show no reflection but serpentines will do. So in this case a kaolin mineral is kaolinite since no reflection was observed. (Table 1and Figures 2b -8b).Similarly the same happened in montmorillonite (Smectite) which is a swelling mineral (Brindley 1966, Byrne1954), on glycolating the mineral, dried up followed by X-ray diffraction the diffractogram peaks were shifted and widened. But on heating at 550oC the peaks collapsed. The difference between kaolinite and montmorillonite is observed in chemical treatment that is when samples are glycolated, where kaolinite diffractogram peaks are shifted while montmorillonite peaks widen and shift (Table 1). But when clays are subjected to heat

treatment at 550oC they both collapsed. The reasonable explanation for this is that heat treatment at550 oC collapses swelling minerals by dehydrating the interlayer material. As a result the swelling clay minerals are destroyed or transformed. Apparently, illite is a clay minerals which is not easily affected by chemical and heat treatments (Bühman 1998) For example, it is less subjected to transformation. This is why the diffractogram peaks of the three processes namely drying the sample in air, glycolating and heat treatments revealed by X-ray analysis are The results almost the same. for the identification of minerals by ethylene glycol and heat treatment from the XRD analysis are supported by Infrared analysis (Table 2). The absorption bands due to OH stretching vibration at 3694 and 3825cm-1 are found in all samples except sample03, 06 and 07, this is a characteristic property of kaolinite group mineral (Nakamoto 1962; Newmann 1987). However, for reasons which are yet to be investigated the 3694 cm-1 peak is not observed in sample 01. Other bands, which suggest the presence of kaolinite, appear at 694 cm-1 and ca 430 - 470 cm-1 in all samples except samples 06 and 07, all these results are supported by XRD analysis. The broad bands found at 3455 cm-1 (sample01);



e-ISSN: 2348-795X

February 2015

Volume 02 Issue 02

3463 cm-1 (Sample 02); 3600 cm-1(Sample 03); 3440 cm-1 (sample 05) and weak band at 3632 cm-1 (Sample 06); 3610cm-1 (Sample 07) are characteristics of illite(Van der Marel and Beutelspacher 1976; Wilson 1987). The presence of illite is also supported by a strong absorption at 532 –539 cm-1 which appears in all samples. These results are confirmed by XRD analysis. In clay samples 02, 03 and 04 there is one broad band centered at 3432 cm-1, which signifies the presence of both kaolinite and montmorillonite. The observation of these minerals (kaolinite and montmorillonite) is suppoted by strong peaks which appear between 1010 and 1033 cm-1 in all samples and was also observed by Kirk -Othmer(1879) in his work. Contradictory results are given by XRD analysis which show that montmorillonite is found in samples 03 and04 only, thus warranting for this peak to be assigned to a different vibration which is not due to montmorillonite. Weak broad bands in vicinity of 1400 cm-1which due to some impurities present are shifted to 1396, 1411, 1426, 1457, and 1380 cm-1 for samples 01, 02, 03, 04, and 05 respectively are due to the presence of nitrate ions (Nakamoto 1962). On the other hand, a peaks centred near 800 cm-1, which appears in all samples, represent quartz.

The peaks centred between 2930 cm-1 and 2360 cm-1 are due to the presence of KBrdisc used as a "matrix" and therefore are not diagnostic of any mineral.

CONCLUSIONS

The results of this investigation demonstrate how ethylene glycol and heat treatment were useful for the identification of clay minerals in our samples. The study of clay minerals indicates that the illite is the most abundant clay mineral. It is believed the hinterlands Charnokite are the source for these clay minerals. The distribution patterns of kaolinite. montmorillonite and illite the clay minerals produced due to chemical weathering of the sedimentary rocks. The increased contents of Illite and montmorillonite in the lacustrine sediments are prostrated to mainly from a contribution of the Kolakkudi Lake.

ACKNOWLEDGEMENT

I thankful to the authorities of National center for Earth Science Studies, Thiruvanathapuram for extending the lab facilities to carryout this work.

REFERENCES



Available at http://internationaljournalofresearch.org/

p-ISSN: 2348-6848

e-ISSN: 2348-795X

February 2015

Volume 02 Issue 02

Brindley GW 1966 Ethylene glycol and glycerol complexes of smectites and vermiculites.

Clay miner 6: 237 – 256.

Bühmann C, Fey MV and Villiers JM 1985Aspects of the X-ray identification of swelling clay minerals in soils and sediments *South African Journal of Science* 81:505 – 509

Bühmann D 1998 The Phylosilicates of clays and their X-ray identification. Lecture notes prepared for the X-ray diffraction (XRD) course, 1st – 14th March 1998 at SEAMIC, in Daressalaam.

Byrne PJS 1954 some observations on montmorillonite organic complexes. *Clays miner*. 2: 241 – 253.

Kirk – Othmer 1979 Encyclopaedia of Chemical Technology. John Wiley and Sons Inc. New York.

Lagaly G 1981 characterization of clays by organic compounds *Clay Miner* 16:1 -21. Nakamoto K. 1962 Infrared Spectra of Inorganic

and Coordination compounds. Wiley. New York.

Newman ACD 1987 Chemistry of Clays and Clay minerals Mineralogical Society Monograph 6. London.

Skoog DA and West DM 1980 Principles of Instrumental Analysis 2nd Edn, Holt – Saunders International Editions.

Tobia SK and Sayre EV 1974 Recent Advances and Technology of materials. Bishay A. Edn vol 3. Plenum New York.

Van der Marel HV and Beutelspacher H 1976 Atlas of Infrared Spectroscopy of

Clay Minerals and their Admixtures. Elsevier Scientific Publishing Company. New York.

Wilson MJ 1987 A handbook of Determinative Methods in clay Mineralogy. Chapman and Hall, New York.



Available at http://internationaljournalofresearch.org/

p-ISSN: 2348-6848

e-ISSN: 2348-795X

Volume 02 Issue 02









e-ISSN: 2348-795X

Available at http://internationaljournalofresearch.org/

Volume 02 Issue 02

Table.1.X-ray Diffraction pattern value of Kolakkudi Lake samples								
S.No.	Station No.	D-Spacing(A ⁰)	Relative Intensity	Name of the clay Mineral				
		3.03	83.43	Montmorillonite				
1	KLKD-1	3.35	100.00					
		1.98	6.06	Illite				
		3.35	100.00					
2	KLKD-2	3.03	25.34	Montmorillonite				
		2.59	14.73	Kaolinite				
		3.35	100.00					
3	KLKD-3	2.27	6.78	Illite				
		3.48	7.11	Kaolinite				
		3.02	15.34	Montmorillinite				
		3.35	100.00	Illite				
4	KLKD-4	4.50	10.74	Kaolinite				
		3.03	30.54	Montmorillonite				
		3.35	100.00	Illite				
5	KLKD-5	3.03	49.30	Montmorillonite				
		2.59	26.63	Kaolinite				



e-ISSN: 2348-795X Volume 02 Issue 02

		3.35	100.00	
6	KLKD-6	2.28	10.31	Illite
		2.59	9.97	Kaolinite
		3.03	36.75	Montmorillonite
		3.35	100.00	
7	KLKD-7	2.28	15.61	Illite
		15.17	15.62	Montmorillonite
		2.59	17.17	Kaolinite
		4.49	3.45	
		3.35	100.00	Illite
8	KLKD-8	3.02	24.41	Montmorillonite
		2.59	6.96	Kaolinite
		3.35	100.00	
9	KLKD-9	2.27	14.24	Illite
		3.02	63.14	Montmorillonite
		3.35	100.00	Illite
10	KLKD-10	2.28	13.56	
		4.50	17.42	Kaolinite
		3.03	60.53	Montmorillonite
		3.35	100.00	
11	KLKD-11	2.28	16.03	Illite



p-ISSN: 2348-6848

e-ISSN: 2348-795X

Available at http://internationaljournalofresearch.org/

Volume 02 Issue 02

		3.03	40.76	Montmorillonite
		3.65	10.25	Kaolinite
		3.35	100.00	
12	KLKD-12	2.28	8.70	Illite
		4.47	13.67	Kaolinite
		3.03	27.62	Montmorillonite





Available at http://internationaljournalofresearch.org/

p-ISSN: 2348-6848

e-ISSN: 2348-795X

Volume 02 Issue 02





Available at http://internationaljournalofresearch.org/

p-ISSN: 2348-6848

e-ISSN: 2348-795X

Volume 02 Issue 02

February 2015

Figure .3. X-Ray Diffractograms Pattern Diagram of Representative Kolakkudi Lake Samples.