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RESEARCH ARTICLE

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ABSTRACT

The present study was carried out in order to study about the clay minerals and their interaction in the coastal environments of Arasalar river estuary at Karaikal. The clay minerals composition of coastal and estuarine sediments is of broad interest because ofits sensitivity as an indicator of environmental change (Lanson, 1997). Clay minerals of surficial sediments have been used widely as afirst order guideto the source, environment and the transportpaths of fine grained sediments. Sampling was done for two years at 3 different stations during 8 seasons starting from premonsoon-2011 to summer-2013. The sediments less than two micron size are classified as clay, have plate like crystals withlayeredlattice structures showinghighionexchange capacity.Owingto this property, clay minerals have animportant role in the nature of sedimentation, chemistry and deposition of sediments. This simplified ion exchange process is complicated by various factors like, quality and typeof cations presents in solution,pH, Eh, type of clay mineral, size etc., this process further gets intricate when river born clay comes into contact with estuarine waters. During the studyperiod, illite was most abundant clay mineral in the sediments ofthe Arasalar riverestuary.It varied from70.01 to 87.39%. The higher percentageofillite was observedduring monsoon and premonsoonseasons. Kaolinite+Chlorite peak reflecting the second dominant minerals over the other minerals.Itranged from 9.76 to26.88% and the higher percentage was observed during premonsoonand summer seasons. Montmorillonite content varied from 0.81 to 3.12%. It is found in higher concentration during premonsoon and monsoon seasons. The concentration gibbsite varied from0.65 to 6.03% and the higher percentage ofthe gibbsite was observed duringpostmonsoon season. Thus in the present study the concentration of clay mineralslike illite, kaolinite, chlorite, montmorillonite, gibbsite and their seasonal variations givesa lead in deciphering the source ofsedimentsand their interaction of Physico chemical parameters during different seasons were discussed.

INTRODUCTION

The coasts separate continents from seas and may develop in various geomorphic and sedimentological variants. There are many excellent works dealing with the classification and types of coast. Widely accepted classifications are those of Valentine (1952) and Shepard (1963, 1976). The coastal zone of India is important in view of its productive eco systems, concentration of population and for exploitation of renewable and non-renewable natural resources (Nayak *et al.*, 1996). The coastal vegetation plays an important roll in the deltaic environment by enhancing the sedimentation and stabilization of the seashore and sea bottom. It provides habitat and nursery areas for many commercially important fish and crustaceans (Robertson and Duke, 1987) and plays an important roll in chemical buffering, water quality maintenance and storage of genetic materials (Saenger *et al.*, 1983) besides contributing considerable amount of organic matter (Odum and Heatel, 1972; Day *et al.*, 1973; Prakash *et al.*, 1973; Boto 1982; Untawale and Jagtap, 1991) thereby increasing the productivity of the coastal waters.

Description of the Study Area

The Arasalar estuary is situated at karaikal (Lat.79° 52' E Long.10° 55'N) of Bay of Bengal. The arasalar is a tributary of the river Cauvery, having a total run of 24 km. It enters Karaikal region, a little east of Akalanganni. It forms the natural boundary line separating Niravi Commune from Tirunallar on the north-west and Karaikal on the north east. The Nattar, branching off from Arasalar at Sakkotai in Thanjavur District, runs a distance of 11.2km in a south-easterly direction across Nedungadu and Kottucheri Communes before emptying itself into the sea. The Vanjiar fed by the

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Arasalar, takes its course along the northern boundary of Tirunallar Commune, drops on a south-easterly curve towards Karaikal Commune and merges with the Arasalar, south-east of Karaikal town after covering a distance of about 9 km. The Nular, also fed by the Arasalar, runs a distance of 13.77 km. before it joins Vanjiar northeast of Karaikal town. The study area comprises of estuarine and coastal environment. The estuarine environment from the mouth of the river in downstream to fresh water in upstream direction extends about 9 km. The coastal environment comprises of beach and near shore from the mouth of river. Totally 3 samples were collected. Station 1 is situated nearby mouth of the estuary (marine zone), station 2 and 3 in a mixed environment.

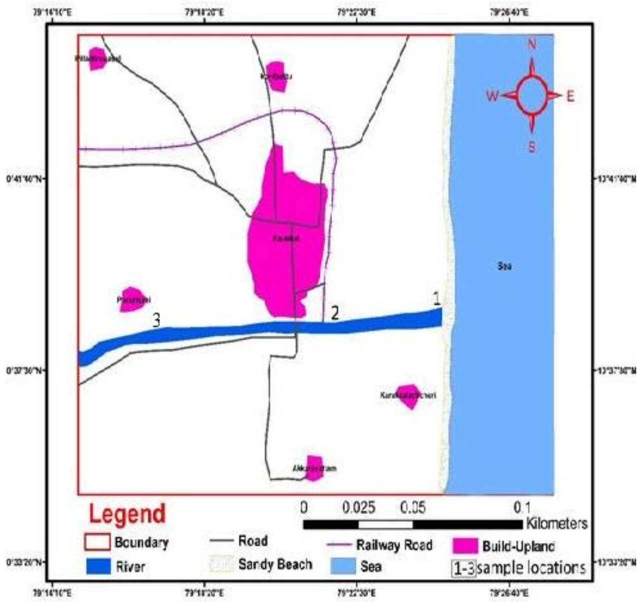


Figure 1 Location and sampling map of the study area

MATERIALS AND METHODS

Sediments were collected using a grab sampler. The samples were collected from Karaikal coasts during the period of two years (2011-2013) covering all the seasons. About 2 Kg. of sediment samples are collected using grab sampler. These samples were taken to the lab for the XRD analysis. The X-raydiffraction analysis is avaluable tool in determining the mineralogy of sediments and rocks especially for clay minerals. Notonlycanmineral species be identified, but in some cases asemi quantitative determination ofmineralphasescan also be made. Indeed it is the mostimportant technique in evaluating the chemical composition is some solid solution series.. The fortysediment samples were selected for the clay mineral studies in both environments. The sampling stations were represented as 1, 2, and3 respectively.

RESULT AND DISCUSSION

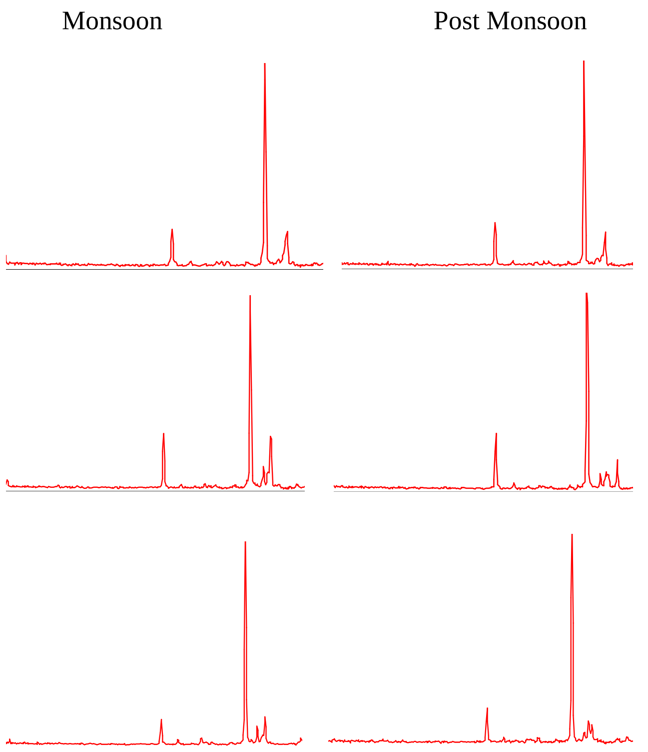
Illite(I)

During the studyperiod, illite was most abundant clay mineral in the sediments ofthe Arasalar riverestuary.It varied from70.01 to 87.39%. The higher percentage ofillite was observed during monsoon and premonsoonseasons.This relatestothe illite is the most dominant mineralspecies ofclayminerals inthe quaternary sediments of the studyarea. Relatively higher concentration ofillite was observed at the mouth region (station - 1) when compared to the estuary (station - 2) and freshwater zone (station - 3). This may be attributed to the formation of this mineralfrommontmorillonite. Itisobservedthatsalinityis highestat this place. Montmorillonite was converted to illite by absorbing more potassium ions form saline waters. A similar type of transformation have also been reported in Cauvery deltaic sediments (Seralathan, 1979, Seralathan and Seetaramaswamy, 1982, Vaithiyanathan *et. al.*, 1992). Grim *et. al.*, (1949), Grim (1950, 1968) and Griffin and Ingram (1955) have stated that kaolinite is unstable in alkaline waters and therefore it would tend to alter to illite or chlorite inestuarine and marine environments.

Table1 Showing the seasonal percentage of clay minerals from 2011-2013

2011-2012								
Seasons/	**Monsoon**				**Post monsoon**			
Stations	**I**	**K+C**	**M**	**G**	**I**	**K+C**	**M**	**G**
1	93.22	16.36	3.06	2.33	86.17	23.34	-	2.78
2	86.03	26.11	3.58	2.57	85.02	26.49	-	3
3	80.03	13.78	2.21	2.61	81.66	16.42	-	
	Summer				**Pre-monsoon**			
1	90.06	15.7	-	3.57	92.01	22.72	-	2.63
2	81.26	24.32	2.94	9.94	88.44	18.96	2.59	4.3
3	83.31	24.38	4.79	2.21	86.21	21.64	7.27	15.65
2012-2013								
Seasons/	**Monsoon**				**Post monsoon**			
Stations	**I**	**K+C**	**M**	**G**	**I**	**K+C**	**M**	**G**
1	92.16	16.13	4.44	5.47	90.72	18.11	-	4.32
2	85.12	12.75	-	-	86.32	17.58	-	-
3	82.65	21.73	6.25	-	81.02	19.58	-	-
	Summer				**Pre-monsoon**			
1	93.01	24.96	-	-	93.01	24.77	9.64	-
2	89.36	20.22	6.12	4.29	90.32	24.63	3.2	-
3	81.43	12.58	3.87	3.98	82.16	15.19	7.16	-

I-Illite, -K+C-Kaolinite+Chlorite, M-Montmorillonite, G- Gibbsite



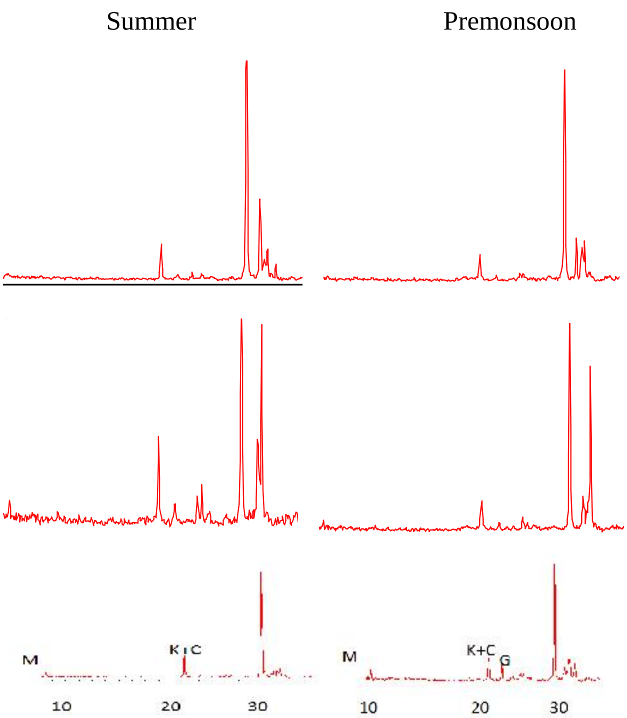
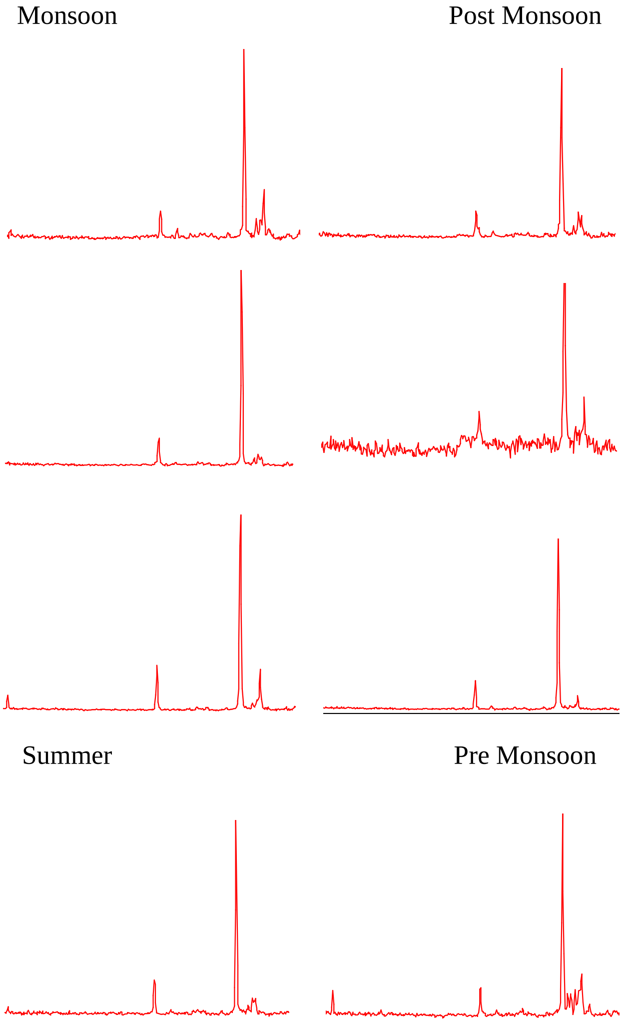


Figure.2 XRD Patterns of estuarine region during 2011-2012



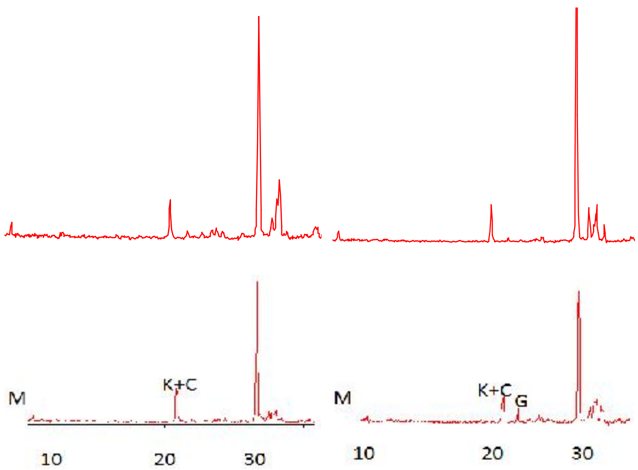


Figure.3 XRD Patterns of estuarine region during 2012-2013

Kaolinite+Chlorite(K+C)

Kaolinite+Chlorite peak reflecting the second dominant minerals over the other minerals. Itranged from 9.76 to 26.88%. The higher percentage of kaolinite+chlorite was observed during premonsoon and summer seasons. In general, the Cauveryriver systemdrains mainly through metamorphicrockscomposed of quartz and feldspar which are comparatively resistant to weathering (Subramanian *et. al.*, 1985). Itis notedthat active chemical weathering ofthe feldspar and micas takesplace where ariver flowing over a methmorphic terrain leadingto the formation of kaolinite+chlorite.

The significantpointtobe noticed is the presence of substantial amount of biotite in the source rocks. Under normalchemical weathering conditions biotite isvery vulnerable to weathering and easily altered into chlorite (Gibbs, 1977 and Yang, 1988). Fromthe above clarification it may be inferred that the kaolinite and chlorite formation is mainly controlled by the drainage basin rocktypes (Mohan and Damodaran, 1992 and Ramanathan *et. al.*, 1994). The source rocks aregneiss and schists, shales and quaternary sediments and their weathering products in tropical humid climate brought by major river Cauvery along with tributaries likeTirumlairajan and Arasalar. Apart from the river source, strong current and wave action on the quaternary sediments

Montmorillonite(M)

In the studyarea, montmorillonite content varied from 0.81 to 3.12%. It is found in higher concentration during premonsoon and monsoon seasons. This indicates the source rocks which have considerable amount of magnesium content, released upon weathering, leadingto the formation to the formation of montmorillonite as alteration product (Grim,1968). Theincreased content of montmorillonite insediments related tothe difference inthe salinityofwater. As explained by Gibbs (1977), montmorillonite has the smallest size, this would also help montmorillonite toremain in suspension for long time than kaolinite and enrichin concentration.

Gibbsite(G)

During the studyperiod, the concentration gibbsite varied from0.65 to 6.03%. The higher percentage ofthe gibbsite was observed duringpostmonsoon season. Gibbsiteis mostimportant productof silicate alterationinlateriticsoils wherein intense leaching results in complete dislocation and the octahedral layer remains free and eventually crystallizing to gibbsite. The higher percentage ofgibbsite may be due to the weatheringofgneissicrock andquaternary sediments andalsothe sameminerals brought by the various rivers of the studyarea. Asimilar observation for the concentration of gibbsite was made by Bukahari and Nayak (1996) in Mandovi estuary and Gingele *et. al*., (2001) inIndonesia and Australiancoast. The mineralogicalstudy indicates the major groups of minerals present in the sediment arequartz, feldspar, mica, pyroxeneand amphibole. These minerals are derived fromthe Precambrian granitesand gneisses fromthe catchment area. Fromthe above discussion, itisconcludedthat the clay minerals are mainly derived from the weathering and alteration of river sediments and their source rocks. Their distribution inthe estuarineand beach environmentsdependsmainly on the differential flocculationand size segregation.

SUMMARY AND CONCLUSION

The present study was carried out in order to study about the clay minerals and their interaction in the coastal environments of Arasalar river estuary at Karaikal. The clay minerals composition of coastal and estuarine sediments is of broad interest because ofits sensitivity as an indicator of environmental change (Lanson, 1997). Clay minerals of surficial sediments have been used widely as afirst order guideto the source, environment and the transportpaths of fine grained sediments. Ssamplings were done for two years at 3 different stations during 8 seasons starting from premonsoon-2011 to summer-2013. During the studyperiod, illite was most abundant clay mineral in the sediments ofthe Arasalar riverestuary.It varied from70.01 to 87.39%. The higher percentageofillitewasobservedduring monsoon and premonsoonseasons.

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