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XRD INVESTIGATION ON CLAY MINERALS OF THE TERTIARY FORMATIONS AROUND PANRUTI, CUDDALORE DISTRICT, TAMILNADU

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A B S T R A C T

The sedimentary formations of Cuddalore district are chiefly composed of tertiary and recent alluvial deposits. The Cuddalore sandstones of the tertiaries are well developed in this district and occur in two discontinuous patches in extensive areas. The formation consists of clays, sands, sandy clays and unconsolidated sandstone mottled in colour with lignite seams. Representative clay samples were collected from the tertiary formation Panruti both from the surface outcrops, nallas and working mine sites. Mineralogy was determined by XRD. The Cay mineral assemblages are present in the formations Kaolinite, Montimorillonite, Chlorite, Muscovite and illite. The non-clay minerals identified are quartz, orthoclase and siderite. The dominance of Kaolinite indicating the sediments are mostly derived from weathering of igneous rocks like Granites, Charnockites and gnessis etc. and deposited in a fresh water Continental basin.

INTRODUCTION

The continuing and expanding interest in the clay mineral investigations in the recent years has been paid much attention on the study of various depositional environments, digenetic changes and a correlation among the sources rocks, weathering climate drainage and topography with the clay mineral suite has been tried by geologists (Das et.al., 1998). Most of the clays are inherited by weathering of parent rocks and by the removal of clay fraction from soils (Sarmin Akther et.al. 2008). Clay minerals are mainly of detrital origin and reflect the characters of the source rocks, although they are liable to be altered during the process of transportation and deposition. Variations in the clay minerals may result from the source rock modifications related to tectonism (Chamley,1989). The purpose of the present study is to identify the occurrence, source rock characteristics of the clay – rich sediments of Tertiary formations of Panruti area based on the XRD studies.

Geological Setting

Geologically, the Cuddalore District can be broadly classified into hard rock and Sedimentary formations. The sedimentary formations are chiefly composed of tertiary and recent alluvial deposits. The Cuddalore sandstones of the tertiaries are well developed in this district and occur in two discontinuous patches in extensive areas. The formation consists of white clays, sands, sandy clays and unconsolidated sandstone mottled in colour with lignite seams. In Panruti area alluvial deposits occur on the northern side, on eighter side of the Ponnaiyar and Gadilam river. Cuddalore Sandstone occurs on the southern side. The sedimentary clay deposits in the study area are generally observed as outcrop in ravine cuttings and occur below lateritic soil cover and lateritised sandstone as overburden ranging from 2 to 8mts thickness. The Study area lies within the geographical parameters of North latitudes 11º30' to 11º40' and East latitudes 79º30' to 79º50' (Fig.1).

The Clay deposits of Kangiruppu are observed in two opencast mine cuttings shows 3 to 4 mts overburden, composed lateritic soil and lateritic sandstone. The clay band show varying thickness from 5 to 10 mts. The clays are mostly white with grayish to yellowish and pink shades of colour. The clay deposits of Maligampattu are found in outcrops and in the ravine cuttings. The clay bed occurs at a depth of 6 to 9 mts from the surface. The vertical sequence of the area shows the presence of alternate banded order of superposition between clay beds and sandstone. The clay deposits of Panikuppam found exposed in the ravine cuttings and outcrops. The outcrops

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of clay lie below 1 to 3 mts thick overburden composed of lateritic soils with admixture of grits and friable sandstone. The presence of clay band with a thickness of 6 to 9 mts below the overburden in panikuppam.

MATERIALS AND METHODS

The clay minerals of the Tertiary formations of Panruti area were analysed by X-ray diffraction (XRD) technique. The representative samples were collected from study area, gently disintegrated by applying finger pressure. The clay and silt grade particles (finer than 4Ø) were separated following Krumbein and Pettijohn (1983) and was centrifused several times by which the clay fraction was allowed to dry in room temperature followed by making powder in agate mortar and made homogeneous slurry. From this homogeneous slurry, oriented mounts were prepared with the help of a pipette keeping the thickness of the mount about 0.07 to 0.12 mm. Then the slides were dried at room temperature without disturbing them.

The samples were analysed using a Philip X ray diffractometer (PAN analytical X Pert) in the Department of Earth Sciences, Pondicherry University.The samples were scanned within 20 range of 2 to 30 degree. The samples were analysed in untreated as well as after glycolation (ethylene glycol) at 60°C following the methods of Carroll (1970). The clay minerals were identified from the diffractograms with the help of values in the powder diffraction file (JCPDS)

Identification of Clay minerals

X-ray diffractograms (fig.2) of the representative clays of the Tertiary formations around Panruti area reveal the presence of Kaolinite, montmorillonite, chlorite, muscovite and Illite. The non clay minerals identified are quartz, orthoclase and siderite.

Kaolinite

It is not possible to differentiate mineral kaolinite from several other members of the kaolinite group, because the clay is nearly monomineralic. Therefore, kaolinite is used here; refer to the kaolinite group of clay minerals.

Kaolinite is a major and abundant clay mineral in the tertiary formations of Panruti. A more reliable indication of Kaolinite is recognized by the presence of the reflections at 2.38A°, although weak in intensity. Kaolinite is characterized by basal reflections at 7.14A°- 7.19A° and reflection at 3.57A°. Kaolinite is also shown by reflections at 4.46A°, 2.49A° and 2.29A°.

Montmorillonite

Montmorillonite is identified by the reflections at 2.56A°

Chlorite

Chlorite is recognized by the reflections at 2.45A°. Sometimes a detectable resolution of Kaolinite at 3.57A° and chlorite at 3.54A° occurs. No change in the chlorite peak intensities has been reported among the studied samples indicating uniform distribution of the minerals.

Muscovite

Muscovite is identified by the reflections at 3.47A° in few samples.

Illite

Illite is identified by the reflection at 4.43A°

Non Clay Minerals

The most important minerals in the non clay fraction are quartz, feldspar and siderite. The mineralogical composition of non clay minerals is described below:

Quartz

Quartz is the most abundant non clay mineral in all the studied samples and it is recognized by the characteristic reflections at 4.24A°, 3.34A°, 2.28A°.

Orthoclase

Orthoclase is identified by the reflection at 3.32A°.

Siderite

The next important non clay mineral is siderite and by using reflections at 3.59A° and 2.34A°.

DISCUSSION AND CONCLUSIONS

The results of qualitative analysis of the clay minerals in the Tertiary formation around Panruti, Cuddalore district are given in the table.1. Kaolinite, Montmorillonite, Chlorite is the dominant clay minerals followed by Muscovite.

Bahl (1964) studied the sedimentary clay beds within the upper Gondwana (Jabalpur series) in the Jabalpur area of the Satpura basin and observed that the clay fractions are essentially kaolinite together with traces of Montmorillorite and illite. The kaolinite is originated from the weathering of crystalline rocks in the source area and deposited in a freshwater of the basin. Kaolinite is possibly derived from pre-existing igneous rocks (Granitic rocks) as a product of weathering in acidic environment (Das et.al, 1998). Kaolinite is considered to be abundant in regions of intense weathering under tropical (low pH and warm temperature) conditions (Biscaye, 1965, Suraj, 1996). According to Murray (1954) acidic to neutral pH conditions are more suitable for the formation of kaolinite. Presence of kaolinite is indicative of a continental or near shore environment of deposition (parhem, 1966).

Kaolinite is the abundant mineral in the shales of Dupi Tila formation and primarily a weathering product of feldspars and other silicates produced in lower pH environments (Segali and Kuehl, 1992). A major proportion of Kaolinite owes its origin to weathering of granite and basic rocks. Presence of Kaolinite represents sub- aerial weathering for the sediments (Eslinger and Peaver, 1988).

Chlorite is the notable clay mineral in the study area. Chlorite is favoured by an alkaline environment (Chaudhri and Grewal, 1988). The parent material from which chlorite is generated are metamorphosed schist of Precambrian age and sandstone, shale of Mesozoic-Cenozoic age (Roy et.al.2004a). Chlorite in soils is mostly inherited has primary mineral from metamorphic and igneous rocks, but it may form by the alteration of ferromagnesian mineral, particularly biotite. According to Brown and Ingram (1954) both Kaolinite and Montmorillonite decrease towards marine water.

Muscovite is highly resistant to weathering and destruction during transportation. A part of muscovite may be of diagenetic origin. Illite, under increased pressure and temperature attains a gradual approximation to the composition of muscovite (Millot, 1970, Chaudhri and Grewal, 1988).From the above studies carried out, it can be concluded that the Tertiary clays of Panruti area are dominated by Kaolinite originated by the weathering of crystalline, Granitic rocks prevailing warm, humid tropical conditions and deposited in a fresh water Continental basin.

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