CHAPTER 8

CLAY MINERALOGY

8.1. PROCEDURES:

X-Ray diffraction pattern obtained from 001 is most important for identification of clay minerals. Such pattern gives peak at 7 Å for two sheet mineral kaolinite, at 10 Å for three-sheet illite and at 14 Å for four sheet chlorite and 17 Å for expanded montmorillonite (Brooks & Ferrall 1970, p.858 and Weaver 1958, p.263).

Quantitative estimation of the clay minerals is very difficult, as it is complicated by the diffractive ability of the clay minerals depending on composition, grain size, orientation and degree of crystallinity. However quantitative estimations are made basing on the peaks, that is reflected from the (001) plane. For quantitative estimation of the relative amount of each mineral component, method of Brooks & Ferrall (1970, p.858) is followed. For this purpose the maximum peak height of the (001) reflection of each mineral and two additional peak height measurements taken at 0.4°020 interval on either side of the maximum peak height are added up. This method of measuring peak intensity is rapid and correlates very well with the measurements of the peak area.
Again as the kaolinite and chlorite curves overlap, it is usually difficult even to estimate the relative amounts present unless one of them greatly predominates. The 2.38Å kaolinite peak is approximately \(1/10\) as large as the 7Å kaolinite peak and the 4.75Å chlorite peak is approximately \(1/5\) as large as the 7Å chlorite peak (Leaver 1958, p.271).

As the 7Å chlorite and kaolinite are of about equal intensity, it is possible from the 2.38Å and 4.75Å peak to obtain some estimate of the relative amounts of kaolinite and chlorite.

Following clay minerals are identified in the sandstones of the Mahadek Formation with the help of X-Ray diffraction - kaolinite, illite and montmorillonite.

8.2. RESULTS:

The clay minerals of the lowermost member of the area were subjected to various treatments for clay mineral identification. The very strong basal reflections at about 7.4Å (001) and 3.61Å to 3.65Å (002) which do not change after glycolation but destroy when heated to about 600°C indicate the minerals to be of kaolinite group. The basal reflections at about 3.32Å to 3.4Å (003) which remain unaltered when heated and glycolated prove to be minerals of hydrous mica group (Fig.28A).
Moderate basal reflection at about $7.3^\circ$ (001) which does not alter with glycolation but tends to destroy when heated to about $600^\circ$C is proved to be a mineral of kaolinite group. Other basal reflections at $3.14^\circ$ and $3.3^\circ$ (003) which do not change even with glycolation and heat treatment is the hydrous mica group and quartz (Fig. 28F).

The basal reflection at $15.35^\circ$ (001) which is not developed with glycol treatment but found to exposed at $7.95^\circ$ when heated to about $600^\circ$C is said to be mineral of montmorillonite group (Fig. 28C).

Reflection at $3.3^\circ$ which remains constant under all treatments is found to be minerals of hydrous mica group. While the weak basal reflection at about $3.57^\circ$ (002) which does change when heated to about $600^\circ$C but remains unaltered when glycolated, is said to be mineral of kaolinite group. Again, weak reflections ranging from $3.7^\circ$ to $3.85^\circ$ increase in intensity when treated with ethylene glycol but tends to destroy when heated to about $600^\circ$C is found to be minerals of the same kaolinite group.

The strong basal reflections at $7.5^\circ$ (001) and $3.60^\circ$ (002) which tend to increase in intensity when glycolated but tend to destroy when heated to about $600^\circ$C is said to be minerals of the kaolinite group (Weaver 1958, pp. 263-266) (Fig. 28D).
Basal reflection at 10\(^\circ\) (001) which remains almost constant under heat and glycol treatment is found to be mineral of hydrous mica group (Weaver 1958, pp.263-266). Strong basal reflections at 7.1\(^\circ\) (001) and 3.6\(^\circ\) (002) which do not alter when glycolated but tend to destroy when heated to 600\(^\circ\)C is found to be the minerals of the kaolinite group (Weaver 1958, pp.264-265). Basal reflections at about 3.3\(^\circ\) (003) which remain constant under glycolation and heat treatment is considered as mineral of the hydrous mica group (illite) (Fig.28E).

Following the method of Brooks and Ferral (1970, pp.858-859) for the estimation of relative percentages of different clay mineral component on the basis of (001) reflection, the distribution of clay minerals in the sandstones of the Mahadek Formation are estimated and found to be as follows (Table 17).

1. The bottommost member i.e. the arkosic sandstone without fossils possesses the clay minerals about cent percent kaolinite with a minor amount of illite.

2. The Echinoid bearing buff coloured medium to coarse grained sandstone houses about 99% kaolinite and minor amount of illite.

3. The Nautilus bearing steel grey coloured coarse grained sandstone is represented by about cent percent montmorillonite, with a minor amount of kaolinite and illite.
(4) Yellowish-brown coloured medium to fine grained sandstone without fossils is characterised by the clay mineral composition about cent percent kaolinite with minor amount of illite.

(5) Orthoquartzitic sandstone at the top of the formation includes the clay mineral as follows - About 86.88% kaolinite and 13.11% illite.

8.3. SUMMARY:

Kaolinite, illite, montmorillonite and chlorite are the representatives of clay minerals in the sandstones of the Cretaceous Formation. Amongst them kaolinite predominates over the others.

The study of the clay minerals throw much light upon the provenance and environment of deposition.

The predominance of kaolinite clay mineral throughout the area of study indicates that the environment of deposition was continental or nearshore. Kaolinite can not survive longer in the sea because kaolinite reacts significantly with water. Further the analytical data suggest that kaolinite is slowly lost during diagenesis under marine conditions, perhaps being changed to an illitic or chloritic clay mineral (Mankin and others 1970, p.803).

Kaoline with some percentage of illite and chlorite along with some sea water dwelling organisms indicates that
the area under study was influenced by marine transgression/regression whereby some percentage of kaolinite was probably transferred to illite and chlorite.

The presence of montmorillonite in the Nautilus bearing sandstone member was undoubtedly carried into the sea e.g. depositional site by rivers following primary stage of weathering on the land and other originated by alteration of volcanic ash.

Further, predominance of kaolinite indicates the provenance to be graintic or gneissic rocks.