CHAPTER - VIII

ENVIRONMENT

INTRODUCTION:

In recent years much emphasis is laid on vertical sequence of sedimentary facies in order to decipher the environment. Selley (1970) adopts this approach in recognizing ancient sedimentary environments. Visher (1965), Beerbower (1965, p.32), Duff, Halam and Walton (1967) and Le Blanc (1972) recommend the study of vertical sequence of lithologies to reconstruct a detailed picture of the environment of ancient sediments. The same method is adopted to make out the environment of the Cuddalore formation. An attempt is made in this chapter to present the characteristics of the vertical sequence that throw light on the environment of the Cuddalore formation.

VERTICAL SEQUENCE:

The vertical sequence of the Cuddalore formation of Neyveli encountered in several boreholes has been presented in Figs.17 to 19 in Chapter IV. The electrical logs of the boreholes have been illustrated in Figs.20 and 21 of the same chapter. The logs suggest a repeated upward fining sequence. There are five cycles of upward fining sequence in the Cuddalore formation of the thesis area. Each cycle begins with a pebble-bearing sands or
sandstone and ends with clay layer. The first cycle is comprised of third aquifer sands with a clay layer on the top. The second cycle is represented by the second aquifer sands with a bed of clay on the top. The third cycle is constituted by first aquifer sands overlain by clay. The fourth cycle is represented by sandstones above the lignite layer terminating with clay as the upper bed. The fifth cycle is comprised of pebble-bearing sandstone, sandstones and clays that occur as outcrops around Neyveli. In all these cycles the basal beds are comprised of coarser material and display fining upward sequence. In this respect the Cuddalore formation resembles the fining upward cycles of meandering rivers described by Dixon (1921), Sundborg (1956), Bersier (1959), Allen (1962, 1965b), Allen and Friend (1968) and Meckel (1970, p. 61-65). The most striking feature of these fining upward sequences is their division into a coarse basal member and an upper pelitic member as observed by Pettijohn (1975, p. 550). According to him the thickness of the two member varies widely. In some cycles the lower member is markedly thicker than the pelitic layer and vice versa. He also states that the total thickness of a cycle is highly variable. In the thesis area the coarser lower member is usually thicker than the upper pelitic one. The coarser
sands and sandstones and the overlying clays are invariably massive. The thickness of the sands of the first cycle sediments is not exactly known for several of the boreholes have not pierced completely this layer. Only in one borehole 470 feet of the materials of the third aquifer have been penetrated. The sands of the second aquifer varies in thickness from 50 to 150 feet and the clay bed overlying it is about 20 feet thick. The sands of the first aquifer vary in thickness from 15 feet to 60 feet and they are overlain by clay layer ranging in thickness between 5 and 10 feet. This is succeeded by a lignite seam on the top of which there is again a clay layer which varies in thickness from a few inches to 4.5 feet. The sandstones of the fourth cycle varies in thickness from 43 feet to 98 feet and the clay bed overlying it is 6.5 feet thick.

The coarser sands and pebbly sandstones resemble the channel and point bar deposits and the finer members represent floodplain deposits. In the channel and point bar there are narrow intercalation of clay layers that often occur as lenses. These suggest that channel establishment and abandonment was repeated many times at a given site giving rise to superposed cycles. These cycles have
been generated by the process itself and not by outside events. Thus, these can be regarded as autocyclic sequences of Beerbower (1965, p.32) which are attributable to factors intrinsic to the fluvial regime. Of course, their superposition one upon the other is possible only by continued subsidence of the area of deposition. This is in accordance with the observation of Pettijohn (1975, p.551).

**GRAIN-SIZE DISTRIBUTION:**

The interpretation of grain size analyses by empirical study of grading characteristics of sediments from different natural environments to see what relation exists between them was initiated by Udden (1914). Wentworth (1931a) expanded this approach and in recent years this method of interpretation has been made popular by Sindowski (1957), Passega (1957, 1964), Mason and Folk (1958), Friedman (1961, 1962, 1967), Sahu (1964a, 1964b), Gees (1965), Schlee, Uchupi and Trumbull (1965), Klovon (1966), Kolduk (1968), Doeglas (1968), Visher (1969), Solohub and Klovon (1970) and Buller and McManus (1972).

Mason and Folk (1958) and Friedman (1961) have differentiated between dune and beach sands by considering the manner in which they are skewed and distinguished river
and beach sand by their manner of sorting. Miola and Weiser (1968) have found that several textural parameters are environmentally sensitive and very effective in differentiating river, beach and dune sands. They observe that parameters computed from quarter phi sieve data are very sensitive in deciphering the environment. Even half or whole phi parameters are regarded as most sensitive in differentiating environments by Moshrif (1980, p.603).

As only whole phi parameters of the borehole logs of the Cuddalore formation are available, bivariant grain-size diagrams were prepared by plotting the graphic measures of mean diameter against standard deviation and skewness against standard deviation following Miola and Weiser (1968). Fig.44, is a plot of mean diameter versus standard deviation. All the plots fall in the region of river sands of Miola and Weiser. Similarly, Fig.45, shows the plots of skewness versus standard deviation. The plots lie within the field of river sands of Miola and Weiser.

Moment parameters were computed with the aid of a computer by using the whole phi sieve data of borehole logs. Fig.46, is the plot of skewness and
FIG. 44

BIVARIANT PLOT OF MEAN DIAMETER VERSUS STANDARD DEVIATION (AFTER MIOLA AND WEISER).
1968
BIVARIANT PLOT OF SKEWNESS VERSUS STANDARD DEVIATION
(AFTER MIOLA AND WEISER) 1968
FIG. 46
BIVARIANT PLOT OF SKEWNESS VERSUS STANDARD DEVIATION
(AFTER FRIEDMAN, 1961).
standard deviation following Friedman (1961). All the plots fall in the field of river sands.

Thus all the bivariant grain-size diagrams yield typical fluvial size distribution.

**CHEMICAL FACTORS:**

Chemical factors control the precipitation of minerals. The most important among them are the Eh and the pH. The deposition of sediments under oxidizing and reducing conditions are deciphered mainly on the basis of their mineralogy. In such an analysis iron minerals are regarded as the most useful indicators of oxidizing and reducing conditions of the deposition of sediments.

In the thesis area marcasite nodules and pebbles occur associated with all the aquifer sands occurring beneath the bed of lignite and this suggests low oxidation potential during their deposition. Amidst the aquifer sands narrow layers of lignite sandwiched between thin clay layers are encountered. Even in the sandstones overlying the main lignite bed, narrow layers of lignite associated with clays are present as intercalations. These sands and sandstones are pale greyish white in colour, though magnetite grains form more than 60% of about 2% of the
heavy crop encountered in them. These mineralogical characteristics suggest their deposition under oxygen deficient conditions.

The red pebbly sandstones and red sandstones overlying the pale greyish white sandstones, on the other hand, suggest their deposition under a fully aerated environment. This is indicated by the occurrence of narrow layers enriched in haematite occurring as intercalations in the red sandstones. The red sandstones are characterized by matrix mixed with dusty haematite.

pH is another important factor in determining the precipitation of minerals. In the thesis area there is absence of carbonates in the components of the Cuddalore formation. This suggests their formation in an acid environment, but the paucity of chert in the sediments indicate that the environment was not strongly acid. The acid environment of deposition of Cuddalore formation is further suggested by the occurrence of marcasite associated with lignite and aquifer sands. The acid environment is also corroborated by the presence of only kaolinite as the clay mineral in the clays intercalated with sands and sandstones of the Cuddalore formation.
CONCLUSIONS:

The Cuddalore formation is comprised of channel, point bar and floodplain deposits. The lower sands and sandstones which are pale greyish white in colour were deposited in an oxygen deficient and an acid environment. The upper red pebbly sandstones and sandstones were deposited in an aerated and an acid environment.