PART - I

GEOLGY OF THE NEYVELI LIGNITE FIELD
INTRODUCTION:

The Neyveli Lignite Field is well known for Tertiary lignite (brown coal) deposit. The deposit occurs beneath the coastal plains of the South Arcot District of Tamil Nadu. Lignite was first discovered in some of the boreholes drilled by the Government of Tamil Nadu (earlier known as Madras) for irrigation purpose during the early 1930s. As the province was poor in natural fuel resources, the State Govt. took a keen interest in this discovery and requested the Geological Survey of India (in 1943) for ascertaining the lignite potential in the area. Exploratory drilling was carried out by G.S.I. during 1943-46 and subsequently during 1945-54 by State Govt. and established the existence of large quarriable deposit of lignite. Detailed geological and exploratory investigations have since been carried out to assess total lignite reserve in this field.

The Neyveli Lignite Field, about 193 Km SSW of Madras, is considered to be single largest lignite field so far known in India. The field lies between the latitudes 11°5'11°40'N and longitudes 79°25'79°40'E in the vicinity of a small village Neyveli on which it has derived its name. The field is situated 18 Km to the north of Vriddhachalam town and about 43 Km to the south-west of Cuddalore town.
on the east coast of India (Map-1). It is 800 m to the south of the Cuddalore–Vriddhachalam road and about 2 Km to the south of Neyveli Railway station on the Cuddalore–Vriddhachalam section.

The field is extended from just south of Neyveli township to Meensuriti village to the north of river Coleroon in the southern direction for a length of about 44 Km and from Aziznagar and Kammapuram in the west to Sethiatope in the east for a width of 12 km.

LITHOSTRATIGRAPHY:

The most common rock types found in the Neyveli area are granitoid gneisses, dolerites, pegmatites, limestones, calcareous sandstones, argillaceous sandstones and clays belonging to Archaean, Cretaceous and Tertiary horizons. At places, these are covered by recent deposits i.e., Kankar, alluvium and laterite. The major part of the field is occupied by the alluvium (Map – 2). Following is the lithostratigraphic sequence developed in the area (mainly based on subsurface data) as given by Subramanyam, 1969; Gowrisankaran et al., 1986.
MAP 2: GEOLOGICAL MAP OF THE NEYVELI LIGNITE FIELD, SOUTH INDIA.
Recent

Soils, alluvium, flow sand, laterite and kankar

Upper Miocene (Cuddalores)

Argillaceous sandstones, lignite, pebble bearing sandstone, grits, sands, clays and pebble bed

Probable unconformity

Eocene

Black clays, shales, grey coloured sandstones, calcareous sandstones, shales and siliceous limestones with fossils.

Unconformity

Mesozoic Cretaceous (Ariyalurs)

Shell limestones, siliceous limestones, marls etc.

Unconformity

Archaean Intrusives

Dolerites, pegmatites, quartz veins, granitoid gneisses.

Archaean

The rocks belonging to this group are exposed in the NW part of the area around Mangalam, Ulundurpettai and to the west of Villupuram. The basement rocks predominantly comprising of dark coloured bluish grey granitoid gneisses are intruded by pegmatites, quartz veins and dolerite. These gneisses consist chiefly of quartz, felspar, biotite
and hornblende. They are coarse in texture and weathered with ease. Pegmatites mainly contain quartz and felspar. Dolerites, youngest of the intrusives, are dark, hard, compact, fine textured and weather into spheroidal boulders.

Cretaceous (Ariyalur Formation):

Overlying the intrusives, the sediments of the Ariyalur Formation, represented by fossiliferous silicious limestones, calcareous sandstones and marls, are exposed in the north western part of the field along a narrow belt of about 3-8 km wide extending roughly NNE-SSW of the east of a line passing through Ulundurpettai and Mangalam on the west and west of Mari Odai on the east. These sediments are of shallow marine in origin and on palaeontological evidences dated as Cretaceous in age. The town Ariyalur, about 56 Km of Vridhachalam, is the type area for this formation. These sediments chiefly comprise light brown argillaceous sandstones and white sandstones with fossiliferous nodular calcareous shales and limestones. The Cretaceous sediments are well exposed in and around Puvanur, at few places, due to the erosion of the succeeding Cuddalore sediments.

Tertiary (Cuddalore Formation):

In fact, Tertiary sediments are not exposed anywhere in the area due to overlying soils and laterite or alluvium cappings of Cadilum, Ponniyar and Varahar rivers in northern
and Vellar and Manimukta rivers in southern parts. The sediments of the formation are exposed only on the cut faces of the mining area. More than half of the area is underlain by the sediments of this formation consisting of argillaceous, pebble bearing and ferruginous sandstones, grits and clays.

On account of the alluvial cover, the sediments of the Cuddalore Formation are exposed in detached patches. Three patches have been observed in the area (i) about 56 km long in ENE-WSW direction and 26 Km wide central patch extending between Vriddhachalam and Cuddalore, (ii) lies towards SW of the central patch and the south of Vellar river and (iii) a small patch near Pondicherry towards the NE of the area.

The Cuddalore Formation comprises following lithological attributes (Balasunder, 1968; Fig.2) -

a) Sandstones with lignite seam
b) Clays
c) Clays and sands (in alternate layers-confined aquifers)

a) **Sandstones**

It forms the top most of the Tertiary deposits in area and is commonly known as 'Cuddalore sandstones'. These
TYPICAL VERTICAL GEOLOGICAL SECTION
IN THE MINE

TEXT FIG.-2
are chiefly argillaceous but occasionally ferruginous and range in colour from white, pink, red to mottled. Sands constituting the sandstones are very fine to very coarse grained and are of sub-angular to sub-rounded in shape. The chief mineral constituents of the Cuddalore sandstones are quartz and felspar. The sandstones generally include rounded pebbles (pebble-gravel) of quartz up to one inch diameter. The thickness of these sandstones, which constitute the 'overburden' on the lignite seam, varies within the field i.e. increasing towards south-east in the dip direction.

Plant fossils preserved in Cuddalore sandstones are chiefly represented by angiospermous woods and coniferous woods at few localities.

Lignite, which has been found to occur in association with the sandstones of the Cuddalore Formation, has not been found to be exposed anywhere in the Neyveli Lignite field.

b) Clays

The clay bands are frequent in the field especially below the lignite seam. However, 2-3 clay bands have been encountered above the seam, which are fairly continuous and extensive. The clay bands below the lignite seam are not of uniform and regular nature. They vary in thick
as well as lateral extension whereas, some are only local lenses. In general, the clay bands follow the dip of the overlying litho-units. About 1.5 m thick bands of white clay is present directly above the lignite seam. The bottom of the seam is underlain by a 1.5 - 3.0 m thick grey to black coloured carbonaceous clay. Sometimes no such layer is found beneath the lignite seam.

The clays are white, grey to mottled in colour. Mottled clay is predominantly yellow or violetish in colour and has all the properties of good fire clay. The clay minerals in these clays are chiefly of Kaolinite variety.

c) Confined aquifers

From the subsurface data it has been observed that the last unit (clays and sands in alternate bands) of Cuddalore Formation forms a series of interconnected confined aquifers below the lignite seam (Subramanyam, 1969). The clay bed (1.5 - 3.0 m thick) below the lignite seam is underlain by three aquifer zones within a depth of about 285.0 m from ground level. Sometimes no clay bands are found below the lignite seam and lignite is directly underlain by aquifer zones.

The first aquifer zone is, generally, met between the depth of 67.0 and 35.4 m with varying thickness of about nil to 18.3 m. This zone comprises mostly of very fine to
very coarse sand, gravel and sand with occasional clay intercalations. The second zone (15.2-36.5 m) is met with between 85.3 and 110.0 m below the ground level and is separated from first zone by up to 6.1 m thick clay bands. The material constituting the second aquifer zone appear to be coarser than those of the first zone. The total thickness of these two aquifers varies from 27.4-36.5 m.

Below 107.0 m, generally, there is a band of grey coloured plastic clay (similar to the clay separating the top two aquifers) extending up to 121.0 m. Below this, is another thick (> 152.0 m) aquifer zone between 121.92 and 304.80 m which is fairly extensive in the lignite field. The materials of this aquifer are comparatively coarser than those of the first and second.

The western and north-western boundary of the aquifer zones are bounded by the Cretaceous and Archaean rocks whereas, the northern boundary extends up to the Archeans. There is every reason to conclude that the aquifers extend into the sea towards east whereas, the southern boundary has not been delineated (Subramanyam, 1969). The aquifers are interconnected due to the lateral thinning of the aquicludes (clay band) separating them.

Recent deposits:

Recent deposits encompass various types of soils, kankar, blown sands, laterites, lateritic gravel and river
The alluvium is mostly made up of sand and sandy clay loams. The soils derived from Cuddalore sandstones are red and sandy. The blown sands lie alongside the coast between Cuddalore and Porto Novo for a width of about 16-30 km from the east coast. Laterite and lateritic gravels overlie a large part of the area underlain by the Cuddalore sandstones. The laterites are generally ferruginous and sometimes fairly extensive.

**LIGNITE DEPOSIT**

Lignite, popularly known as brown coal, occurs in the South Arcot District of Tamil Nadu in an area of about 480 sq. Km with reserves of about 3300 million tonnes. When cored from mine it is compact, moist and massive without any earthy impurities. The colour of the lignite ranges from dark brown to black and turns lighter when dried. Exposed chunks of lignite break into small uneven blocks or flakes or even get crumbled when slight pressure is applied. The lignite is composed of plant parts particularly angiospermic woods like *Anacardioxylon*, *Shoreoxylon*, *Mesemberoxyxylon*, *Palmoxyxylon* etc. Besides this, microscopic recognizable fossil remains of plants viz., cuticle, resin, fungal spores and pollen and spores namely - *Schizaeoisporites*, *Nevvalisporites*, *Meliaspollis*, *Jacobipollenites*, *Trilatinorites*, *Margocollporites* etc. have been recognized.
The lignite seam in the area varies in thickness laterally and is virtually embedded in sandstones. It is directly underlain and overlain by clay horizons of Cuddalore Formation. The correlation of subsurface data suggests that lignite below the sandstones occurs as one major seam throughout the basin whereas, towards southern parts it splits into more than one seams. A few minor local seams have been found at few places overlying the main lignite seam. Occasionally, on the top of the lignite seam, there is a transition zone of 30 or 60 cm in which the lignite is soft and earthy whereas, the bottom part is generally well defined. Partings of dirt bands in the lignite seam are very rare.

The lignite seam is found between the depths of 1.8 - 150.0 m below ground level within the field. The seam varies in thickness from 2.0 to 22.0 m and appears to be more thickened towards south. In mining areas, the lignite occurs between the depths of about 50-100 m below the ground level and the thickness of the seam varies from 8.0 > 16.0 m. Along the line of lignite boundary and towards north-east and south of the field the thickness of the deposit is < 8.0 m (Map - 3).

The lignite bearing area is divided into three different mining areas. A mine was opened in 1957 covering an area of
MAP-3: NEYVELI LIGNITE FIELD - PARTICULARS OF THICKNESS OF LIGNITE SEAM.
about 15 sq. Km with the reserve of 240 million tonnes in the northern part of the field. II mine is situated 5 Km south of the Cuddalore-Vriddhachalam Railway line with an area of about 27 sq. Km and 390 million tonnes of lignite. The III mine is proposed further towards south of I and II mines with the total estimated reserves of 390 million tonnes in an area of about 29 sq. km. (Map-1).

The lignite-overburden ratio in the area in general, is 1:10 whereas, in the mining areas it is generally 1:16. In the north of the Cuddalore-Vriddhachalam Railway line, the lignite-overburden ratio varies from 1:25 to as low as 1:22. Towards south and east of the deposit the ratio ranges between 1:6 and 1:8. Occasionally thin sand dykes (1.0 - 2.0 cm with a maximum length of more than 5.0 m) cutting across the lignite seam (mostly at an angle) have been encountered. In appearance it looks as if a crack in lignite has been filled with fine grained dry sand.

**STRUCTURE OF THE AREA**

The Neyveli Lignite Field is more or less arch shaped with the apex towards north-east and having maximum length and width of about 44 km and 12 km respectively. A study of subsurface data does not indicate any visible faults, folds or any other major structural features in the present area.
The Cuddalore sandstones show frequent marks of current bedding suggestive of rapid pulsational sedimentation. These sandstone strata have a general dip of 5° to 8° (occasionally 20° to 25°) towards south-east and, being soft, do not show any joint. They weather easily and give rise to a characteristic bad land topography. Sandstones and clays, wherever observed on the surface, indicate a homoclinal dip of about 5° to 7° towards ESE or south-east i.e., towards the sea. Based on subsurface evidences, it has been inferred that sandstones, overlying and underlying the lignite seam, continue in the dip direction and crop out on the escarpment face and on the high ground stretching between Vriddhachalam in the S-W to Cuddalore in the N-E in an arcuate shape (Map-2).

The main lignite seam and the overlying and underlying sandstones, sands, pebble-gravel and clay beds have dips varying from 5° to 10° (sometimes even 2-3°) in a S 83° E to S25°E direction suggestive of a probable pitching synclinal fold (Subramanyam, 1969).

Although, the top and bottom surfaces of the lignite seam is somewhat uneven, there is no structural disturbances within the seam. The seam thins out to the northwest of the field. This thinning of the seam is a normal depositional or erosional feature and does not appear to be related with any faulting or folding effects. The seam has a general dip varying from 5° to 9° in S82°E to S 65° E direction, locally at few places, the dips have been found to be gentle (2-3°). Bottom of the lignite seam has a dip
Evidences of a faulted contact between the sediments of the Cretaceous (Ariyalur Formation) and the Tertiary (Cuddalore Formation), with a downthrow on the eastern side, are seen towards south of Pelandurai Anicut where the Cuddalore sandstones have been brought in abrupt juxtaposition with the fossiliferous Cretaceous limestones. It is believed to be post-Cuddalore in age (Subramanyam, 1969). Whereas, the nature of the boundary between the Archaeans and the Cretaceous in the Mangalam-Ulundurpettai area is not clear. In many places, the Cuddalores overlap the Archaeans.
MAP 4: LOCATION OF BORE-CORES NLE-27, NLE-35 AND NLE-36 IN THE MINE AREA OF NEYVELI LIGNITE FIELD, TAMIL NADU.