MICROFOSSIL ANALYSIS OF NEYVELI LIGNITE BY POLISHED SURFACE TECHNIQUE

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ABSTRACT

Microscopic examination of the polished surface lignite blocks has revealed well preserved microfossils. Different types of dispersed plant tissues such as parenchyma, sclerenchyma, fibres, vessels and cork cells have been recognized apart from spores and pollen, fungal remains and woody structures. The microconstitution of the lignite indicates peaty, woody, lignitic or brown coaly layers suggesting heterogeneous formation of the lignite deposit.

INTRODUCTION

SOME attempts have already been made to study microspores and microstructure of the lignite (JACOB & JACOB, 1950; RAO, 1954, 1955; NAVALE, 1961; RAMANUJAM & RAMACHAR, 1963a, b; CHANDRA, 1954, 1958; LAXMANAN & LEVY, 1956). Recently the author has also recognized an angiospermous wood structure (NAVALE, 1966) and other microstructures (NAVALE, 1965). These preliminary investigations suggest the need for systematic studies of the largest deposit of lignite in India (Neyveli — Madras State) for proper evaluation of its nature and formation, in order to utilize the only fuel resource in South India for technology and industry.

The location of the lignite deposit, its mode of occurrence, age and geological details have already been described (NAVALE, 1965).

POLISHED SURFACE TECHNIQUE

While studying the petrographic constituents of the lignite by polished surface (NAVALE, 1965), the technique resolved much of the fossil plant tissues particularly opaque constituents very clearly. This method of polished surface study of lignite is being extensively used in Europe (STACH, 1952; TEICHMULLER, 1952 and others), and some attempts have been made in India also (BANERJI, 1932; CHANDRA, 1954; NAVALE, 1965).

The method of preparation of polished surface lignite blocks is very much similar to the method adopted for hard coals (NAVALE, 1963). The lignite blocks (trimmed by cutting the required size) were impregnated with palatal resin (prepared by adding 100 g. Giesshar P and O, 5-4 g. Katalysator-paste and O, 1-0·6 ccm Beschleunigerlösung) and kept in oven until they were hardened. After cooling, grinding was done on metallic rotating plates using Carborundum powders of 80 and 100 mesh grades. Further finer grades of 220 and 600 were used on thick glass sheets. Necessary care was taken not to intermix various grades by repeated washing of blocks in water. In the next step, polishing the blocks were made by using alumina grade 1 and grade 2 on wet revolving discs covered by polishing clothes. Here also care was taken to polish separately with two different grades. Polishing was continued until blocks were free from scratches. Finally, blocks were polished on pure water to remove all polishing material. After air drying, the blocks were mounted with the help of plastacene. The microfossil analysis were made by using metallographic microscope using reflected light and oil immersion objectives.

TERMINOLOGY

Nomenclature and classification of lignite microstructures are not uniform. Although systematic international standardization of terms of hard coals has been established (LEXIQUE, 1957, 1963), yet lignite terminology of international acceptance has not been established. However, recently Nomenclature Commission of International Coal Petrology is engaging its attention for Lignite terms which will have international acceptance. Teichmuller (1950) has adopted terms based on gentic composition and recently the same method has been adopted by the author also (NAVALE, 1965). In the present study plant tissues botanically identified have been described. Classification of permanent tissues is based on characters of matured cell walls. Transitional forms may also be there.

DESCRIPTION

Plant tissues such as cells of Epidermis, Parenchyma, Sclerenchyma, Fibres, Vessels, Cork and fragments of leaves, woods, etc. have been recognized in the lignite matrix apart from Pollen and Spores, Fungal remains and Resins. Few pieces of complete sections of leaves (PL. 1, FIGS. 1 & 5) and Woods (PL. 1, FIGS. 7-8) showing the above tissues have also been found.

Epidermis (PL. 1, FIGS. 1 & 5) — Dispersed plant fragments of leaves, stems etc. consist of cells of epidermis. These cells are regular, rectangular, their outer walls being cuticalrized. Cells are invariably destroyed due to humification. They measure 5 to 8 μ in size. Cells are filled with detritus and humous ingradients. Epidermal tissue is frequently met in Attrital Type of lignite which forms an important constituent of Neyveli lignite.

Parenchyma (PL. 1, FIGS. 1 & 5) — It is one of the commonest kinds of tissue found in dispersed plant fragments (leaves etc.). The cells of this tissue may be round or oval with numerous intercellular spaces or slightly elongated cells arranged perpendicular to the surface. Cell walls are usually thin and measure about 10 μ in size when the tissue is cut in transverse plane. The cells are usually filled with humous constituents. This tissue is also common in Attrital Type of the lignite.

Sclerenchyma (PL. 1, FIG. 6) — This plant tissue, recognized in the lignite is constituted by thickened cell walls. Being purely mechanical in function, the walls are so thickened that the cell cavities are frequently almost obliterated. The cells are regular, rectangular and the size varies from 3 to 5 μ. This tissue is fairly well represented in the Attrital Type of lignite in the material investigated.

Cork (PL. 1, FIG. 2) — Fragments of Cork and Bark tissue (PL. 1, FIGS. 3 & 4) have been recognized in the detritus. These tissues are composed of rectangular cell walls, appearing somewhat polygonal in shape, in surface view. The cell walls are lignified and have lost their living contents and instead filled up with humous ingradients. This tissue is commonly observed in the Attrital Type of lignite in the material studied.

Fibres (PL. 1, FIG. 7) — Dispersed woody fragments of the lignite show fibre cells in cross and tangential polished surface views. They form the ground mass of the wood. Fibre cells in transverse section are circular to oval in shape without any intercellular spaces. Individual cells measure 3 μ and filled with humous ingradicnts. Fibres are usually lignified. Pits run through the thickness of the cell walls and are usually septate. Fibre tissue forms an important constituent in the Xyloid Type of lignite — the material investigated.

Vessels (PL. 1, FIG. 8) — Vessels are well preserved and appear as small pore to the naked eye in the polished surface of the woody lignite. They are small to medium in size and more or less oval in shape (PL. 1, FIG. 7) in cross section and diffused in the ground mass of the wood. Vessels segments are short, truncate and thick walled having annular pattern on the walls. The size of the vessel pore in cross-section measure 120 μ and the segments in tangential view range from 150 to 170 μ. This tissue also forms a dominant and conspicuous element in Xyloid Type of lignite. Recognition of such woody vessels and Fibres in abundance suggest angiospermic woody origin of the material under investigation.

In addition to diversed plant tissues, the lignite is composed of pollen and spores, abundance of fungal remains and resins.

Pollen and Spores (PL. 2, FIG. 20) — are few and seen as compressed round bodies. Due to their very small size and lack of any structural features, different forms could not be recognized by polished surface blocks. Even by maceration technique, only few pollen and spores were recovered from the samples collected. Few grains of family Caprifoliaceae, Cruciferae, Euphorbiaceae, Gentianaceae, Labiatae, Ranunculaceae, Santalaceae, Graminae, Lilliaceae, Filicineae have been recorded (NAVALE, 1961).

Fungal Spores (PL. 2, FIGS. 9-10) Teleutospores like sporogeneous bodies have been recognized in the lignite. They are moderately thick walled, dark brown colour, with one to few chambers divided by septa (PL. 2; FIGS. 9-10) having narrow opening, to contact each chambers. Shape of Teleutospores may be round, oval, elongated, slipper shaped (PAREEK, 1959).

Fungal Sclerotia (PL. 2, FIGS. 11-19) — The lignite shows few forms of Sclerotia which may be morphographically separated. Sclerotia are hard resting bodies of fungi formed to tide over unfavourable environmental conditions. They are generally thick walled.

Sclerotites crassitesta (STACH, 1952) Pl. 2, Figs. 11-13 — Thick outer walled, globular forms; size 100-200 μ; one to few chambers; externally enveloped by characteristic thick walled membrane. Such forms have been found in coals of India (CHANDRA 1954, PAREEK 1959, CHATTERJI & GHOSH 1962) and in Europe (STACH, 1952; STACH & PICKHARDT, 1957, 1962 etc.).

Sclerotites brandonianus (JEFFERY & CHYRSLER, 1905) Pl. 2, Figs. 14-17 — Oval or rounded forms, septate, many chambered and thick walled; externally not enveloped by thick walled membrane. It resembles some of the forms described in coals of India (CHANDRA, 1954; GANJU, 1955; PAREEK, 1959; CHATTERJI & GHOSH, 1962) and in Europe (STACH, 1952; STACH & PICKHARDT, 1957, 1962).

Sclerotites multicellutatus (STACH, 1953) Pl. 2, Fig. 18 — Oval or rounded forms, regular, number of cells very large; these forms resemble *Sclerotites brandonianus* except in the number of chambers which are many.

Coronasclerotes africanus (NOEL, 1958) Pl. 2, Fig. 19 — Big sized structure, 100 μ long and 70 μ large, formed by tissue of regular cells, thin membrane around each cell, but having protective outer wall of the tissue. Resembles the African species described by Noel (1958).

Even by maceration many fungal remains have been identified (RAMANUJAM, 1963; RAMANUJAM & RAMACHAR, 1963; RAO, 1954). Fruiting bodies have been compared to those of urediospores of *Milesia*, teliospores of *Puccinia*, telial heads of *Ravenelia*, *Triphragmium*, teliospores of *Uromyces* and *Xenedochus* of Uredinales group. Also fruiting bodies of *Microthriacites* (RAO, 1958), Myriothecia of Asterineae of Microthyriaceae have been recorded (RAMANUJAM, & RAMACHAR, 1963).

Resin bodies (PL. 2, FIG. 21) — Scattered, round to oval bodies of light red colour are found frequently both in polished block and maceration analyses. Woody lignite, due to decomposition of woody tissues show concentration of resin bodies.

SOME OBSERVATIONS AND CONCLUSION

Microscopic analysis of the lignite show mostly dissintegrated and decomposed plant tissues forming the ground mass of the lignite, and woody structures. Apart from detritus and plant tissues, lignitic and hard coal structures have also been recognized. These various structures suggest heterogeneous formation of the lignite namely peaty, woody, lignitic and coaly types. Since lignite deposit being Miocene in age and of low rank, fungal bodies and plant tissues are well preserved.

The fossil flora in and around the area of the deposit and abundance of fungal matter engaged in prolific activity of decay and decomposition, probably suggest warm humid conditions during the formation of the deposit (suitable condition for intensive activity of Fungi being in air under warm humid conditions). Presence of Fungi in lignite indicates, decomposition might have been partly under aerobic condition during deposition.

From all these observations it may be concluded, that the lignite shows different facies. The sequential lignification of the macro- and microfragmental plant remains of luxuriant modern flora might have been taken place in warm humid aerobic condition. Fungal bodies have played an important role in the process of degredation of vegetable matter in the early stage of humification.

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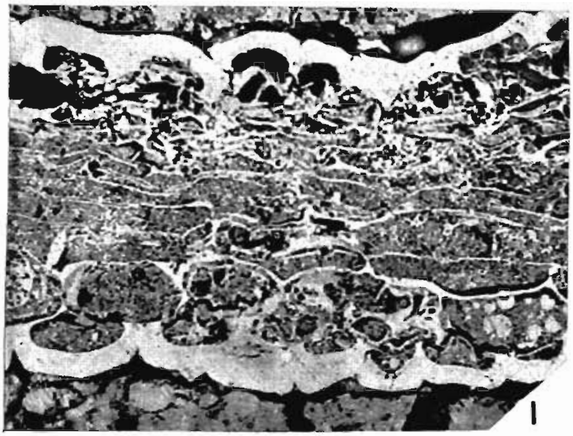
EXPLANATION OF PLATES

PLATE 1

1. Polished lignite block showing T.S. of leaf. × 240. (Note Plant tissues — *Cuticle, Epidermis, Parenchyma*).
2. *Cork* cells in detritus. × 240.
3. Another block of polished lignite showing *Bark* cells in detritus. × 240.
4. Cells of *Periderm*. × 240.
5. T.S. of an another leaf seen in polished surface lignite. × 240.
6. Cells of *Sclerenchyma*. × 240.
7. *Fibre* cells. × 240.
8. A *Vessel* in L.S. × 240.

PLATE 2

9. *Teleutospore* (three celled). × 240.
10. *Teleutospore* (two celled). × 240.
11-13. *Sclerotites crassitesta*. × 240.
14-17. *Sclerotites brandonianus*. × 240.
18. *Sclerotites multicellulatus*.
19. *Coronasclerotes africanus*. × 240.
20. Pollen grain in detritus. × 240.
21. Resin bodies. × 240.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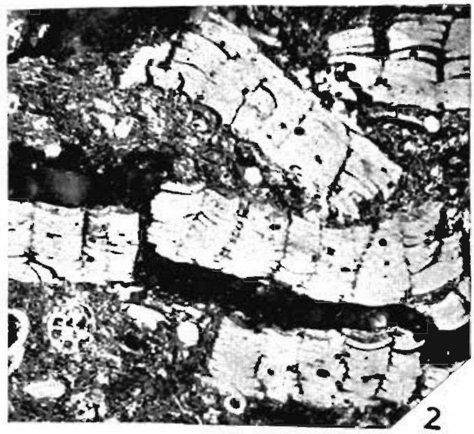
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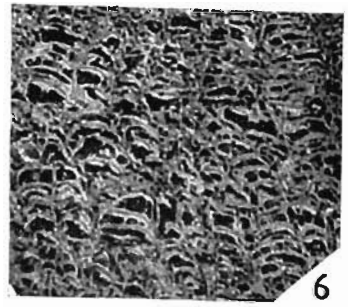
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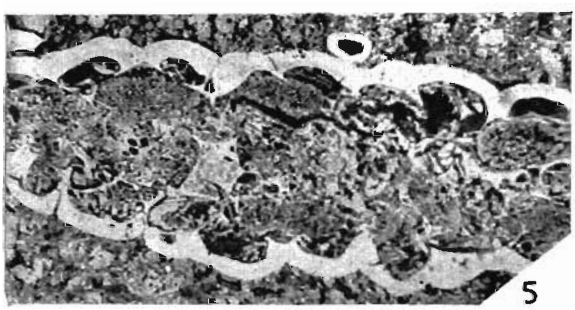
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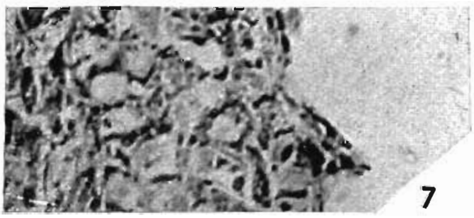
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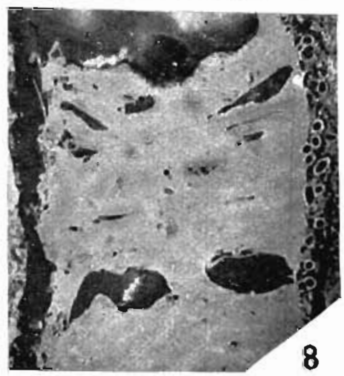
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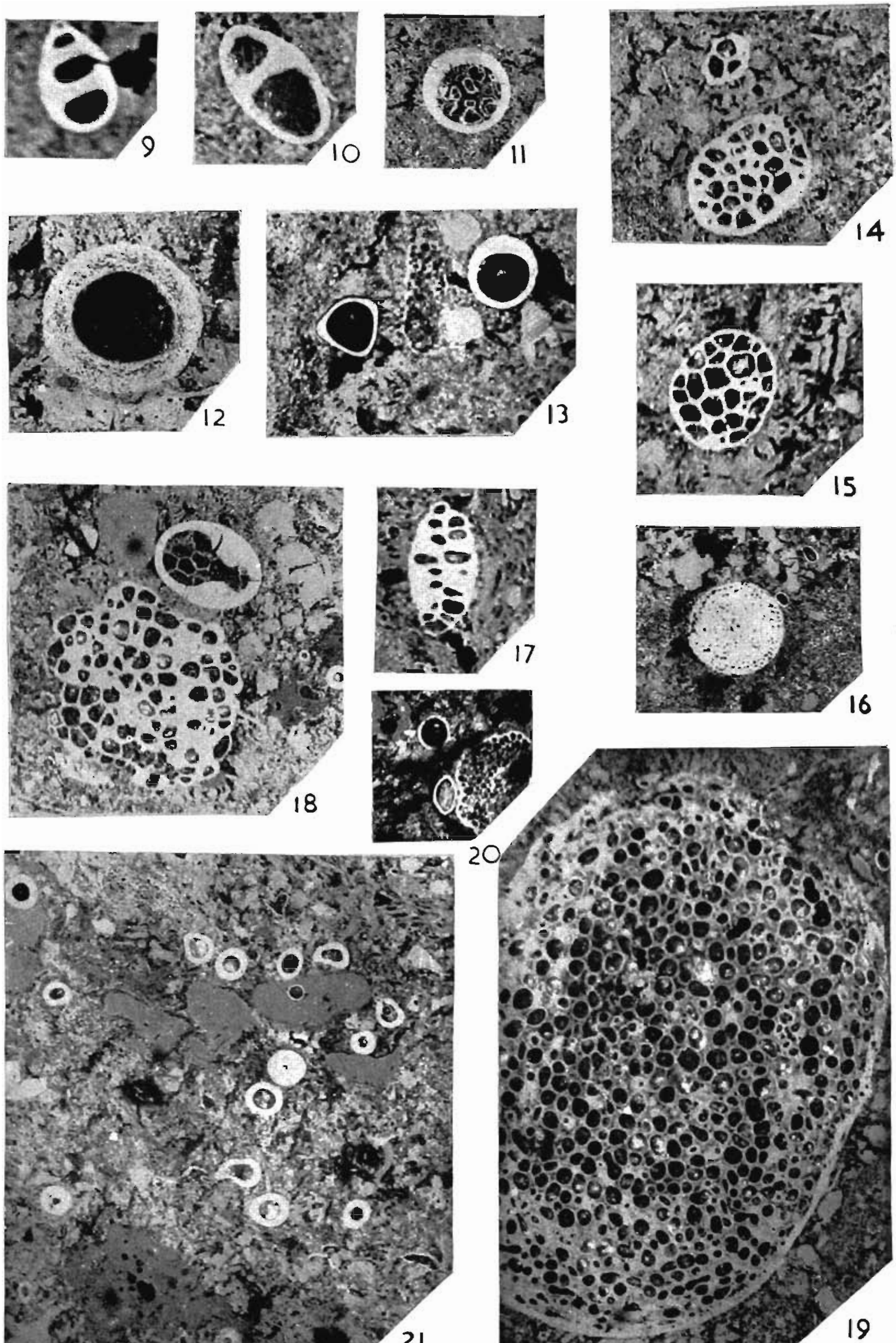
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