Research Article

Palynological studies of tertiary sediments of west coast of India to decipher provenance and environment of deposition

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Abstract

Tertiary sediments are deposited along the west coast in study area on basalt and covered by laterite. These sediments include carbonaceous shale, lignite and sandstone, which are rich in micro fossils and pollens. The Fungal remains, Pteridophyte spores and Angiosperm pollens are studied. The modern equivalents of these fossil pollen and spores are presently found in diversified ecologic habitats ranging from deltaic to fresh water swamps and low altitude ever green to open forests. Ecological distribution of the modern equivalents of these micro fossils indicates deltaic to swampy depositional environment. The source of pollen and lignite coal is in the Western Ghats and source rock is basalt for shale and sandstone.

Keywords: Pollen, spores, fungal remains, lignite, shale, deltaic, estuarine and swampy environments, tertiary sediments.

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INTRODUCTION

Hyde and Williams coined the term palynology, concerning the study of pollen and spores. The study and its scope in the science of biology has been discussed in India by Sahani (1948), Nair (I960 a), Mittre (1961), Srivastava (1962), The palynological aspects have been used for geological purpose such as stratigraphic problems, correlation of coal seams, stratigraphic sequence of beds and also in determining the age of formation. The possible application of spore analysis for correlation purpose has been influenced by the oil industry. However the palynological aspects can be of great help to know the provenance and paleo environment of any area, Suryawanshi (1995). The palynological evidences help to confirm the geological activities, which have taken place at the various time and space mainly along the coast. The dating of marine transgression, the submergence and emergence of coastline have also been tackled by pollen analysis. It is also helpful to know the paleoenvironment, which have occurred at the time of deposition of sediments and therefore, pollen study can help to achieve valuable information about the sediments of the coast under present investigation. The Tertiary sediments present in the area have been sandwiched at places between laterite and basalt, which are rich in pollen and spores. Identification and classification of pollens and spores can be of great help to know the exact position of these sediments and its correlation with other Tertiary of the West Coast and also to know provenance of these sediments. Detailed palynological studies have been carried out of these Tertiary sediments by following the standard procedures.

Geology of the area

The study area is a coastal belt between Jaigarh (Latitude 17^0 10' N and Longitude 73^0 25'E) to Golap-Pawas (Latitude 16^0 15' N and Longitude 73^0 10'E).This area is represented in Survey of India Toposheet No. 47 G/13,G/17,G/18 and H/15.Deccan volcanic basalt is major geological formation covered by laterite. The tertiary sediments are sandwiched between basalt and laterite. They are in pockets and exposed only in well sections. These sediments are 50 to 60 mts above mean sea level and 500 mts. east of sea coast include sandstone,

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shale, carbonaceous shale and lignite. The carbonaceous shale and lignite is rich in microfossils and pollen grains.

MATERIALS AND METHODS

The carbonaceous shale and lignite samples collected from well sections are cleaned and broken into smaller pieces. About 15 gms. of sample is subjected to Schulze solution (HNO_3 + $KClO_3$ 3:1) to digest and free pollens. The residue is then washed several times with distilled water to free schulze solution. Then treated with HF for about 12 hours to remove mineral particles, and then treated with 40% warm HCL to remove the fluorides. The acid is then decanted and all traces of acid are removed by repeated wash in distilled water. Finally, the material is treated is 3% KOH for 10 minutes. The final residue is then passed through a 150 mesh sieve in order to separate larger particles. Samples passed through sieve used for slide preparation. The lignite and carbonaceous shale samples collected from various localities were investigated for pollen studies. The most commonly found plant rnicro-fossils, particularly of ecologic and stratigraphic significance, are described in detail. The descriptive terminologies followed, are after Dilcher (1965) for fungal remains, and Punt *et al*. (1994) for pollen and spores. For each palynomorph, the detailed description is followed by the remarks pertaining to its modern affinity and ecology. These microfossils are categorized into three groups: Fungal remains, Pteridophyte spores, and Angiosperm pollen.

FUNGAL REMAINS

Genus: Callimothallus Dllcher 1965

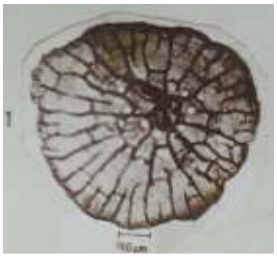

Figure 1: Callimothallus pertusus Dilcher

Description: Ascomata discoidal, rounded in shape, 78 to 90µm in diameter, non-ostiolate, variable in size, margin is smooth slightly thinning central cell nonporate, almost rectangular with concave sides and surrounded by radially elongated monoporate cells, rest of the cells are porate, pores single, rounded, about 2µm in diameter, appears to be radially arranged, peripheral outline slightly undulating, free mycelium not found.

Remarks: This genus was instituted by Dilcher (1965) to incorporate the fungal fruiting bodies having no free mycelium, round stroma, radiate ascomata, non-central dehiscence and individual cells with or without pores. In shape, size and nature of pores, the above described fruiting body closely resembles C. pertusus Dilcher. This fungus is already reported from this lignite (Phadtare and Kulkarni, 1980). These fruiting bodies are very identical to those found in the modern fungal family Microthyriaceae, which commonly grows as a epiphyllous fungus in moist tropical forests. The form genus Callimothallus is one of the well established and widely reporterd genera of fossil Microthyriaceous fungi. In Indian Tertiary deposits, it has been reported from Tura formation of Assam (Kar et. al.1970). The Edvi Lignite (Rao and Ramanujam, 1976) of South India. All these reports indicate that, the genus Callimothallus has a wide stratigraphic distribution (Paleocene to mid Miocene).

Genus: Dicellaesporites Saeffy and Dilcher, 1971

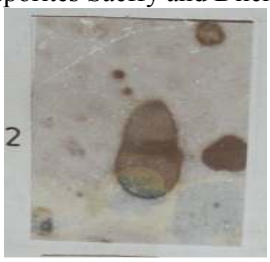

Figure 2: Dicellaesportes Sp

Description: It is a fungal spore, with two celled structure, both cells unequal, uniseptal. The spectra is thick walled. The basal cell conical with thick margined small spore. The terminal cell is hemispherical with thick walled spilate. This fungal remains is of uncertain affinity,

PTERIDOPHYTE SPORES

Genus: Cyathidites Couper 1953

Figure 3: Cyathidites australis Couper

Description: Spores triangular to sub circular in shape, sides generally concave, 35 - 40 X 40 - 50 µm in size, trilete; laesural arms distinct, 12 - 15 µm long, generally open, ends pointed; exine about 1µm thick, psilate.

Remarks: The genus Cyathidites instituted by Couper (1953) is characterized by smooth walled trilete spores having rounded triangular shape with concave sides and laesural arms longer than half the radius. It is the most

common pteridophytic spore in this lignite. It closely resembles the spores found in different species of the modern Cyathea, a chararteristic tree/fern of the tropical vegetation.

Genus: Magnastriatites Germeraad et. al.

Figure 4: Magnastriatites sp.

Description: Spores inisopolar, radially symmetrical, rounded, proximally pointed, large to very large (75-130 µm in equatorial diameter) trilete, contact area of proximal face is psilate, distal exine coarsely striate.
Remarks: This sporomorph is virtually identical with the spores of a fresh-water fern Ceratopteris. It generally grows in shallow water ponds.

Genus: Pteridacidites Sah 1967

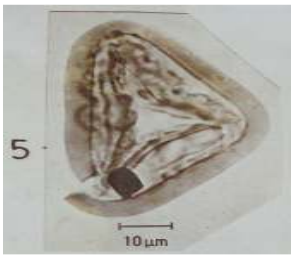

Figure 5: Pteridacidit.es sp. Plate I Photo 5

Description: Spores rounded triangular, walls almost straight, 40 µm in diameter, distinctly singulate, singulum about 3 µm wide, psilate, trilete, rays almost closed, 1µm long, extending up to the inner margin of singulum; exine about 2 µm thick, verrucate on the proximal side. verrucae appear rounded on the distal side, warty e1evations separated by widening channels giving appearance of incomplete reticulum.
Remarks: This genus enclosed the triangular to round triangular, distinctly singulate trilete spores having thick walled central body and verrucate ornamentation. This sporomorph closely resembles the spores of Pteris, commonly found in the tropical vegetation.

ANGIOSPERM POLLEN

Genus: Pellicieroipollis Sah and Kar ex Phadtare and Thakur 1990

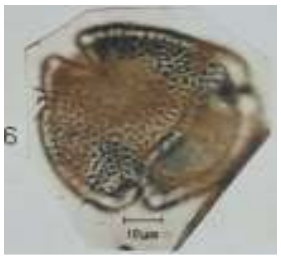

Figure 6: Pellucieroipollis langenheimii Sah and Kar 1969 P

Description: Pollen grains isopolar, triangular to sub triangular in polar view, 45 - 60µm in equatorial diameter, angulaperturate, tricolporate colpi slightly crassimarginate distinctly brevicolpate, narrow, about 5 µm wide along equator, ends acute, margins distinct, straight, bordered with thin to moderately thick margo or in some cases a row of minute brochi or a circular to transversely elliptic, around 8 µm wide, lalongate, distinctly costate: exine thick, columellate. nexine slightly thicker than sexine along the mesocolpial region; sexine semitectate, distinctly reticulate, reticulum generally heterobrochate simplibaculate.
Remarks: The above described pollen is identical to those found in extant Alangium ebenaceum of Alangiaceae. Detailed palynological investigation of the fossil pollen attributed to modern Alangium (Phadtare and Thakur, 1990) reveals that P. langenhelmii is closely comparable with the pollen of A. ebenaceum type. The Alangiurn is presently found in low land humid deciduous forests of Western Ghats.

Genus: Marginipollis Clarke and Frederiksen 1968

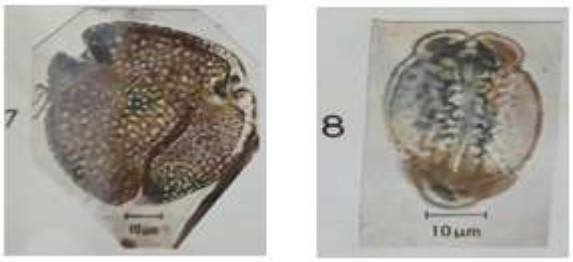

Figure 7, 8: Marginipollis kutchensis (Venkatachala *and* Kar) Kar 1985

Description: Pollen grains isonolar. prolate, sub triangular to sub circular in polar view. 28 - 35 µm diameter in polar view, 20 - 30 X 40 - 45 µm in equatorial view, trisyncolpate; colpi about 25µm long and 8µm wide in equatorial region distinctly crassimarginate margo about 3µm thick, regular smooth exine about 2µm thick, tectate, sexine thicker than nexine, areolate, lumen distinctly larger along the colpal margins.

Remarks: This fossile pollen shows undoubted resemblance with that of Barringtonia accutangula, a common tree of the coastal swamps in tropics.

Genus: Margocolporites Ramanujam ex Srivastva 1969

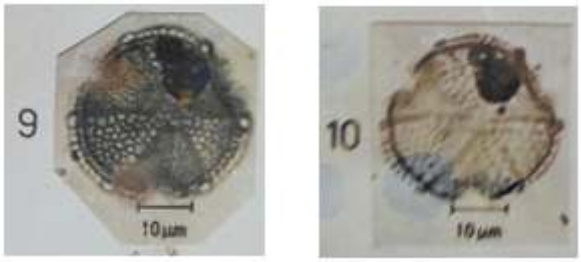

Figure 9, 10: Margorolporites tsukadai Ramanujam 1966

Description: Pollen grains isopolar, oblate spheroidal, amb circular. about 40 µm diameter in polar view, tromargocolporate; colpi eliptic with tapering ends, margocolpus finely reticulate; or a slightly lalongate, surrounded by slightly thickened sexine; exine semitectate, columllate; sexine thicker than nexine, reticulate, lumen about 2 µm wide, angular to circular, muri about. 1.5 µm thick pluribaculate.
Remarks: This palynomorph is closely comparable with pollen found in Caesalpinia of Caesalpiniaceae. This genus is commonly found in coastal dry forests of tropics.

Genus: Quilonipollenites (Rao and Ramanujam,1976)

Figure 11: Quilonipollenites crassimarginatus Phadtare and Kulkarni, 1984

Description: Pollen grains heteropolar, biconvex in polar view, planoconvex laterally, 30 - 35 X 50 – 55 µm in size, monosulcate; sulcus of 'extended' type, longer than 2/3 the circumference, distinctly crassimarginate, closed in middle and widely open on either ends; sexine thicker than nexine, exine about 2.5 µm thick, distinctly reticulate, reticulum heterobrochate, muri simplibaculate, lumen slightly angular, smooth.
Remarks: This pollen is quite common in this Lignite flora, and has already heen reported by Phadtare and Kulkarni (1984). The comparative morphology of the various species of Quilonipollenites and pollen of Eugeissona palm, clearly reveals that the above described fossil pollen is closely comparable with that of E. triste. This palm known by about 7 species (Moore, 1973), is presently restricted to the low land evergreen forests of Malaysian and Philippian islands. Though presently it is extinct, from Indian subcontinent, its fossil pollen record reveals that it was a common element of the Miocene flora of South India Rao and Ramanujam, 1976.

Genus: Anacolosidites (Cookson and Pike) Potonie 1960

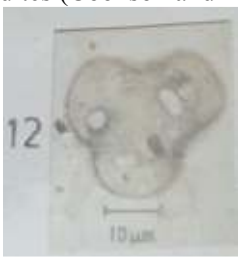

Figure 12: Anacolosidites trilobatus Venkatachala and Rawat 1972

Description: Pollen grains distinctly oblate, triangular with concave sides in polar view, amb trilobate, about 20 µm in diameter, hexaporate; three pores in each hemsphere between the pole and angles of the pollen, circular to slightly elliptic, about 2.5 µm in diameter, tenuimarginate; exine about 0.5 µm thick, slightly thicker along concavity. Sexine and nexime of same thickness, psilate.
Remarks: This pollen is quite distinct in morphology and closely resembles the pollen found in modern Anacolosa of Olacaceae. About fifteen species of this genus is found in dense humid evergreen forests of low altitudes in south India and Malaysia.

MICROFLORISTIC CONSIDERATIONS

The recovered palynological data represents variety of microfossils ranging from Dinoflagellates to spores of Fungi and Pteridophytes, and pollen as well as leaf cuticles of Angiosperms (Suryawanshi 2014). The most dominating population, however, is of the angiospermous leaf cuticles and pollen grains, representing minimum 25 genera attributed to 20 families. Amongst these familles the Palmae (Aracaceae) is represented by at least 5 genera namely Calamus, Eugeissona, Nypa, Phoenix and Sclerosperma the commonly found leaf cuticles are attributed to seven families. Based on the palynological data, it is important to note that some of the significant plant taxa, such as Ctenolophon parvifolium of Ctenolophonaceae, and Eugeissona and Sclerosperma of Palmae, presently are extinct in the Indian subcontinent. The C. parvifolius and Eugeissona are found only in Malaysian Islands, while Sclerosperma is restricted to Madagascar and tropical S. Africa. The other palm Nypa is also presently extinct from S. Indian flora, and confined exclusively to Sunderban and Andaman Islands.

CONCLUSIONS

This fungus fruiting bodies reported in lignite and carbonaceous shale grow in moist tropical forests and has wide stratigraphic distribution, while Pteridophytic spore closely resembles the spores found in different species of the modern Cyathea, a chararteristic fern of the tropical vegetation found in dense humid evergreen forests of low altitudes in south India and Malaysia. The modern equivalent of Pellucieroipollis langenheimii is Alangiurn, presently found in low land humid deciduous forests of Western Ghats and plants of Malvaceae are commonly found in the low altitude open forests. The modern equivalents of these fossil pollen and spores are presently found in diversified ecologic habitats ranging from deltaic to fresh water swamps and low altitude ever green to open forests. In present area forest is on eastern side of these deposits that is in Western Ghats. The source rock of Tertiary sediments including sandstone and shale is basalt from the neighboring area.

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REFERENCES

1. Couper R.A. (1953) Upper Mesozoic and Cainozoic Spores and Pollen Grains from New Zealand. New Zeal. Geol. Surv. Palaeontol. Bull 22: pp. 1 - 77.
2. Dilcher D.L., (1965) Epiphyllous Fungi from Eocene Deposits in Western Tennessee, U.S.A. Palaeontographica 116 B: pp. 1-54.
3. Mittre, V., (1961) Contacts of Palynology. Bull. Nat. Inst. Sci. India No. 19 pp. 2 - 14.
4. Nair, P.K.K., (1960 a) Palynology in India - A Review Ibid 2: pp. 51 - 53.
5. Phadtare, N.R., (1982) Floristic Studies on the Lignitic Beds of Ratnagiri District, Ph.D. Thesis, Univ. of Bombay, p. 275.
6. Phadtare, N.R. and Kulkarni, A.R., (1980) Palynological Investigation on Ratnagiri Lignite, Maharashtra. Geophytol. 10, pp. 158 - 170.
7. Phadtare, N.R. and Kulkarni, A.R., (1984) Affinity of the Genus Quilonipollenites with the Malasia Palm Eugeissona Griffith. Pollen at Spores, 26, pp. 217 - 226.
8. Potonie, R., (1960) Synopsis der Guttungen Sporae - Dispersae III, Beih. Geol. Jb., 39,pp. 1 – 189
9. Rao, K.P. and Ramanujam, C.G.K., (1976) A palynological Approach to the study of Quilon Beds of Kerala State in South India. Curr. Sci. 44, 730 - 732.
10. K.P. and Ramanujam, C.G.K., (1976) A palynological Approach to the study of Quilon Beds of Kerala State in South India. Curr. Sci. 44, 730 - 732.
11. Sah, S.C.D. and Kar, R.K.$_f$ (1969) Palynology of the Laki Sediments in Kutch - 3: Pollen from the Boreholes around Jhulrai, Barancla and Panandhro. Paleobotanist., 18, pp. 127 - 141.
12. Sahani, B., (1948) The Prospects of Palynology in India, Svensk. hot. Tidskr. V, 42, pp. 474 - 477.
13. Srivastavan, S.K., (1962) Palynology A Gift of Flowers, Sci. Cult. V. 28, pp. 265 - 269.
14. Suryawanshi R.A.(1995) Sedimentological and related studies of tertiary sediments exposed along the coast Dist. Ratnagiri Maharashtra Ph.D Thesis submitted to Shivaji University Kolhapur pp 207
15. Suryawanshi R.A.(2014) Use of microfossile to decipher the paleo-environment of tertiary sediments of Ratnagiri,Maharashtra,India
16. Venkatachala, B.S. and Kar, R.K., (1985) Palynology of the Tertiary Sediments of Kutch - 1: Spores and Pollen from Bore Hole No. 14, Palaeobotanist, 17, pp. 157 - 178.
17. Venkatachala, B.S. and Rawat. M.S., (1972) Palynology of the Tertiary Sediments in the Cauvery Basin - I Palaeocene - Eocene Palynoflora from the subsurface Proc.Sem. Palaeopalynol Indian Stratigr, Calcutta, pp. 292 – 335.

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