

## Charcoalified Wood of *Hopenium pondicherriensis* (Dipterocarpaceae) from Neyveli Lignite Formation

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**Abstract.** The Neyveli lignite is one of the largest brown coal field of India, Cuddalore district of Tamil Nadu. The lignite is one of tertiary formation found in the Neyveli. So far many mega and micro fossils reported from this formation. The Neyveli lignite well preserved and recognizable entities are mainly woody and non-woody tissues of different angiosperm plants, spore and pollen, cuticles of leaves, resins, fungal spores and fungal fruiting bodies. The present study is about the charcoalified angiospermic wood is identified as *Hopenium pondicherriensis* (Dipterocarpaceae). This is a first report of *Hopenium pondicherriensis* from the Neyveli formation.

### Introduction

Neyveli lignite, the single largest brown coal field. So far known in India lies in the Cuddalore district of Tamil Nadu, India. It is roughly estimated that around 3000 million tons of lignite reserve spread beneath an area of 300 sq. km. with an average thickness of 23 m of seams [3]. Until recently the lignite was considered to be a part of the Cuddalore Formations. However, Siddhanta [9] divided the Cuddalore Formations into two parts and named the lower part, which includes lignite, as the Neyveli Formation and the retained the term Cuddalore Formation for the upper part. The Neyveli Formations consists of semi consolidated sand stones and clay beds with occasional limestone intercalations followed by carbonaceous clay (above 1m thick) and brownish block lignite (up to 23m thick). It is overlain by the Cuddalore Formation (60 to 120m thick), which is made up of ferruginous, arkosic, semiconsolidated sand stone exhibiting some herring tone types cross laminations. The contact between the two Formations is marked by erosional unconformity [9]. The age of the Neyveli lignites (belonging to the Neyveli Formation) has remained a subject of dispute. Until 1973 these deposits were believed to be of Miocene age. However, Venkatachala [10], Deb et al. [4] and Siddhanta [9] on the basis of palynological and geological evidences inferred a Palaeocene - Eocene age. The lignite contains well preserved and recognizable entities of mainly woody and nonwoody tissues of different angiosperm plants, spores and pollens, cuticles of leaves, resins, fungal spores and fungal fruiting bodies [6].

### Materials and Method

The charcoalified angiospermic wood were collected from the Neyveli lignite sediments of Mine-I A, Tamil Nadu, located at the Cuddalore District. A piece of charcoalified wood was placed in Sodium hypochlorite (for softening). The length of time necessary for this should be empirically tested. Sections (TS, TLS & RLS) were prepared using razor blade. The sections were immersed in sodium hypochlorite solution to get the transparency. After cleaning, sections were immersed in a solution of 1% safranin for 3–5 minutes. Then rinsed in water, 50 % alcohol and then 96 % alcohol until excess stain was removed. Dehydrated sections then immersed in xylene before being mounted on glass slides in Canada balsam. Olympus Trinocular Microscope magnification was used to observe the fossil materials and slides. Microphotographs were taken using Olympus SLR Camera attached with Trinocular Microscope.

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**Observation**

Class: Dicotyledons

Family: Dipterocarpaceae

Genus: *Hopenium* Awasthi.

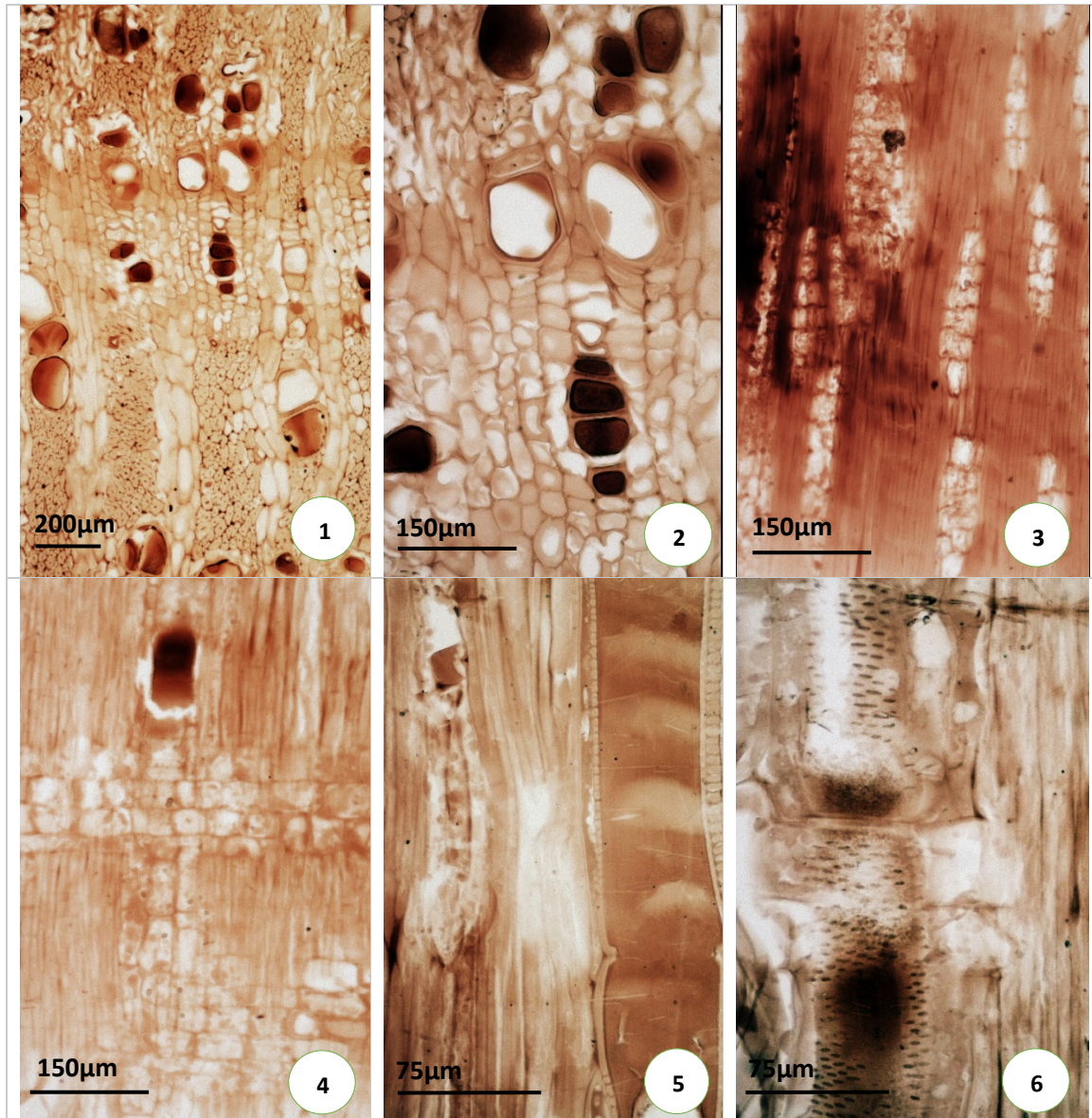
Species: *Hopenium pondicherriensis* Awasthi.

**Description (Plate 1)**

Wood diffuse porous. Growth rings in distinct. Vessels solitary to radial multiples of 2–5, circular to oval in shape, evenly distributed, tangentially 55–102  $\mu\text{m}$  in diameter, radially 60–112  $\mu\text{m}$  in diameter; vessel elements 220–512  $\mu\text{m}$  long; perforation plate simple; inter vessels pits horizontally elliptical, alternate with narrow apertures. Vasicentric tracheids present. Axial parenchyma paratracheal and apotracheal. Paratracheal parenchyma intermingled with vasicentric tracheids, forming a thick sheath around the vessels. Apotracheal parenchyma in the form of tangential bands enclosing gum canals and are thin walled. Rays 2–6 seriate, 4–45 cells high; ray tissue heterogeneous; rays hetero cellular. 2 to 3 seriate rays consist of erect cells, whereas the others are multiseriate rays consists of both procumbent and erect cells. Fibers thick walled, 15–20  $\mu\text{m}$  wide, non-septate. Gum canals vertical, circular, arranged in tangential rows, 90–124  $\mu\text{m}$  in diameter.

**Affinities**

The characteristic features of the present wood are, small vessels, they are in radial multiples, presence of vasicentric tracheids, gum canals vertical and heterocellular rays. These features indicated that the present wood is having affinity with the family Dipterocarpaceae. The genera of this family were assigned into two groups based on the arrangement of gum canals (Ghosh, 1956) (i) Gum canals always in concentric rings (eg. *Shorea* Roxb., *Doona* Thwaites., *Hopea* Roxb., *Parashorea* Kurz., *Pantacme* A.DC., *Balanocarpus* Bedd, and *Dryobalanops* C.f. Gaertn) and (ii) Gum canals diffuse and in short tangential rows in *Anisoptera* Korth., *Dipterocarps* Gaert.f., *Vatica* L. *Vateria* L. and *Cotylelobium* Pierre. The present fossil wood possessing gum canals in concentric rings, so it is placed in the first category. Among the genera of the first category, the fossil shows the best resemblance to the genus *Hopea* Roxb. Fossil wood resembles with wood of living genus *Hopea* placed under the genus *Hopenium* Awasthi.



**Figure 1.** *Hopenium pondicherriensis* TS, 2. *Hopenium pondicherriensis* TS enlarged, 3. *Hopenium pondicherriensis* TLS, 4. *Hopenium pondicherriensis* RLS, 5. *Hopenium pondicherriensis* companion cell, 6. *Hopenium pondicherriensis* vessel elements.

### Discussion

In the present work charcoaliified fossil wood belonging to the family Dipterocarpaceae (*Hopenium pondicherriensis*) were analysed. The fossil wood were recovered from the lignite samples collected from neyveli lignite mines. So far five Dipterocarpaceous woods (Table 1) namely *H. payangadiensis*, *H. pondicherriense*, *H. neyveliensis*, *H. kalagarhensis*, and *H. prenutansoides* also reported from various Tertiary deposits of India. Among these, two species (*H. neyveliensis*, *H. pondicherriense*) reported from Tertiary Formations of Tamil Nadu. *Hopenium neyveliensis* only reported from Neyveli Formation [2] differ from the present specimen in having closely spaced parenchyma bands. The present wood more closely related *Hopenium pondicherriense* reported from the Cuddalore Formation. So it is assigned to this species.

**Table 1.** Five Dipterocarpaceous woods.

S. No	Species	Locality	Age	Reference
1	<i>H. payangadiensis</i> Awasthi & Srivastava	Payangadi Super Clay Mine, Kannur District, Kerala.	Miocene	Awasthi and Srivastava [1]
2	<i>H. pondicherriense</i> (Awasthi) Prasad	Lower Siwalik Formation, Uttar Pradesh and Cuddalore Series, Pondicherry.	Miocene-Pliocene	Prasad [8]
3	<i>H. neyveliensis</i> Awasthi	Neyveli Formation, Tamil Nadu.	Miocene.	Awasthi [2]
4	<i>H. kalagarhensis</i> Prasad & Prakash	Lower Siwalik Series, Uttar Pradesh.	Middle Miocene-Pliocene	Prasad and Prakash [7]
5	<i>H. prenutansoides</i> Prasad & Prakash	Lower Siwalik Series, Uttar Pradesh.	Middle Miocene-Pliocene	Prasad and Prakash [7]

## Conclusion

The observation of present work charcoalfied wood of *Hopenium payangadiensis*, (Dipterocarpaceae). This is the first report of *Hopenium pondicherriensis* from the Neyveli lignite formation. Based on the fossil floral elements collected from Neyveli lignite the palaeovegetation palaeoclimate and the age of this region during the tertiary period was worked out.

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