First record of a lauraceous wood from the Palaeogene sediments of western India

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ABSTRACT


A fossil wood of Lauraceae resembling those of the modern genera Cinnamomum Spreng. and Litsea Lam. is described from the Vagadkhol Formation of Bharuch District, Gujarat considered to be Palaeocene-Early Eocene in age. This is the first record of a fossil wood of this family from western India. In view of the meagre fossil records known from the Palaeogene sediments of western India, the present finding becomes important as it enriches the palaeo-floristics. Its presence, along with the already described fossils indicates warm and humid conditions in the region during the depositional period in contrast to the present day dry climate.

Key-words—Fossil Wood, Lauraceae, Palaeocene-Early Eocene, Palaeoclimate, Vagadkhol Formation, Western India.

INTRODUCTION

The Cenozoic rocks of Gujarat Mainland have a small exposure in the Cambay Basin (an intracratonic basin) near Jhagadia-Tarkeshwar area. A large part of this basin is covered by the alluvium of Sabarmati, Mahisagar, Narmada and Tapi rivers. The detailed structural geology as well as stratigraphy of the basin is described by various workers (Mathur et al., 1968; Chandra & Chowdhray, 1969; Kathiara, 1969; Sudhakar et al., 1970; Sudhakar & Basu, 1973; Bhandari & Raju, 1991). The age of the entire sedimentary sequence of the basin ranges from Palaeocene to Pliocene. The general stratigraphy of the sequence is provided in Fig. 1 (Sudhakar & Basu, 1973). The present fossil wood belongs to the Vagadkhol Formation consisting of whitish, yellow, grey to greyish green variegated clays, conglomerates and minor bands of coarse sandstones (Merh, 1995) (Fig. 1).

So far, only a few fossil leaves and a fossil wood belonging to the families Anonaceae, Combretaceae, Lythraceae, Rutaceae and Sapindaceae were described from this formation (Singh et al., 2011). In view of the meagre palaeobotanical work from the region, the present finding becomes important not only because this is the first fossil wood of the family Lauraceae being described from western India, but also due
to its palaeoclimatic implications, along with the earlier described taxa.

**MATERIAL AND METHODS**

The material for the present study consists of permineralized woods collected from the west of Sarasia Dungar of Maljipura Village (Lat. 21º42’26” N: Long. 73º10’46” E) situated near Rajpardi Lignite Mine (Fig. 2). The fossil woods were petrified and found along a small river.

The specimen was sectioned transversely and longitudinally (both radially and tangentially) and the slides were prepared by the standard method of grinding, polishing and mounting in canada balsam (Lacey, 1963). The type slides are housed in the Museum of the Birbal Sahni Institute of Palaeobotany, Lucknow (India). The thin sections were examined under the high power light microscope. The fossil wood was compared with the modern woods both from thin sections and published literature for the identification. The anatomical terms used in describing it are those adopted by Wheeler *et al.* (1986) and International Association of Wood Anatomists (1989).

**SYSTEMATICS**

**Family—Lauraceae**

**Genus—Laurinoxylon** Felix, 1883

*Laurinoxylon deomaliensis* Lakhanpal *et al.*, 1981

(Pl. 1.1-5)

*Description*—Wood diffuse porous. Growth rings indistinct. Vessels small to large, solitary or in radial multiples of 2-3, circular to oval in shape, t.d. 95-230 µm, r.d. 125-300 µm, heavily tylosed (Pl. 1.1-2); vessel elements 140-550 µm long with truncate or slightly inclined ends; perforations simple; intervessel pits bordered, 8-12 µm in diameter, alternate to opposite with linear to lenticular apertures. Axial parenchyma paratracheal, scanty to vasicentric, forming 1-3 celled thick sheath around the vessels (Pl. 1.2); cells thin walled, 25-40 µm in diameter. Rays 1-4 (mostly 2-3) seriate (Pl. 1.3), 4-35 cells or 104-742 µm high, homocellular to heterocellular; ray tissue heterogeneous (Pl. 1.5). Fibres thick walled and separte. Oil cells scattered among parenchyma and fibre cells, 24-52 µm in diameter (Pl. 1.2, 4).

*Figured specimen*—Specimen No. BSIP 40111.

*Horizon & locality*—Vagadkhol Formation; Maljipura Village near Rajpardi Lignite Mine, Bharuch District, Gujarat.

*Age*—Palaeocene-Early Eocene.

*Affinities*—The characteristic features of the fossils such as heavily tylosed vessels, scanty to vasicentric parenchyma, 1-4 (mostly 2-3) seriate heterogeneous rays, septate fibres and oil cells indicate its affinity with the modern woods of the family Lauraceae. The genera of this family are anatomically very similar and tough to be distinguished (Metcalfe & Chalk, 1950; Stern, 1954; Desch, 1957). After making comparison with the modern woods from thin sections as well as literature (Pearson & Brown, 1932; Metcalfe & Chalk, 1950; Kribs, 1959; Miles, 1978; Ilic, 1991), some of the genera of the family, viz. *Cinnamomum* Spreng., *Litsea* Lam., *Nothophoebe* and *Persea* Mill. were found close to the fossil. However, a critical examination of their thin sections reveals that the fossil shows near resemblance with *Cinnamomum* and *Litsea*. *Persea* can be differentiated in having comparatively more parenchyma, while *Nothophoebe* differs in having greater septation of fibres. As fossil leaf of *Cinnamomum*, *C. eokachchhensis* Lakhanpal *et al.* (1984) was described from western India belonging to same age as that of the present fossil, this increases the possibility of the present fossil being closer to *Cinnamomum* rather than *Litsea*.

Felix (1883) instituted an organ genus *Laurinoxyylon* to accommodate fossil woods showing resemblance with the modern genera of the family Lauraceae. Awasthi and Mehrtra (1990) enlisted six species of *Laurinoxyylon* described from various horizons of India. Since then three more species, namely *L. siwalicus* (Prasad, 1990), *Laurinoxyylon* sp. (Awasthi & Jafar, 1990) and *L. dilcheri* (Tiwari & Mehrtra, 2000) have been described from the Tertiary sediments of India.

<table>
<thead>
<tr>
<th>Formation</th>
<th>Lithology</th>
<th>Age</th>
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<tbody>
<tr>
<td>Alluvium</td>
<td>Soil and recent alluvium</td>
<td>Recent and Sub-recent</td>
</tr>
<tr>
<td>Amaravati</td>
<td>Nummulitic limestone and marl, calcareous bentonitic variegated clay, unfossiliferous</td>
<td>Late Eocene</td>
</tr>
<tr>
<td>Cambay Shale</td>
<td>Greenish grey, whitish clay and brown fissile shale, clay and marl with carbonaceous zone including lignite seam with vertebrate, invertebrate and plant remains</td>
<td>Early Eocene</td>
</tr>
<tr>
<td>Vagadkhol</td>
<td>Variegated clay</td>
<td>Palaeocene</td>
</tr>
<tr>
<td>Deccan Trap</td>
<td>Basalt</td>
<td>Late Cretaceous</td>
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</tbody>
</table>

Fig. 1—Generalized stratigraphy of the Cambay Basin (after Sudhakar & Basu, 1973).
The fossil wood was compared with the described species of *Laurinoxylon* and found close to *L. deomaliensis* (Lakhanpal et al., 1981). However, rays in the above species are mostly biseriate in comparison to mostly 2-3 seriate rays in the present fossil. As it is a minor difference which comes under variation, it has been kept under the same species. The other fossil species, i.e. *Laurinoxylon tertiariun* (Prakash & Tripathi, 1974), *L. deccanensis* (Bande & Prakash, 1980), *L. namsangensis* (Lakhanpal et al., 1981), *L. varkalaensis* (Awasthi & Ahuja, 1982), *L. naginimariense* (Awasthi & Mehrotra, 1990), *L. siwalicus* (Prasad, 1990), *Laurinoxylon* sp. (Awasthi & Jafar, 1990) and *L. dilcheri* (Tiwari & Mehrotra, 2000) are different mainly in having oil cells in the xylem rays.

**DISCUSSION**

Lauraceae comprising of about 45 genera and approximately 2000-2500 species, is economically important family as it provides medicines, timber, edible fruits (e.g. *Persea americana* Mill.), spices (e.g. *Cinnamomum cassia* (L.) J. Presl, *C. subavenium* Miq., *Laurus nobilis* Cav.) and perfumes. Most of the genera of this family are aromatic evergreen trees or shrubs, widely distributed in the tropical to subtropical regions of the world (Mabberley, 1997). The two comparable genera, i.e. *Cinnamomum* and *Litsea* are evergreen to deciduous elements distributed in tropical and subtropical regions of North America, Central America, South America, Asia, Oceania and Australasia. *Cinnamomum* needs an ecosystem of high humidity and cloud forests. Lauraceae was present on the entire Indian subcontinent since the Cenozoic time (Awasthi & Mehrotra, 1990).

A few fossil leaves and a fossil wood have recently been described from the Vagadkhol Formation by Singh et al. (2011), viz. *Polyalthia palaeosimiarum* Awasthi & Prasad (Anonaceae), *Terminalia palaeocatappa* Awasthi & Mehrotra; *T. panandhroensis* Lakhanpal & Guleria (Combretaceae), *Lagerstroemia patelii* Lakhanpal & Guleria (Lythraceae), *Gardenia vagadkholia* Singh et al. (Rubiaceae), *Acronychia siwalica* Prasad (Rutaceae) and *Schleicheroxylon bharuchense* Singh et al. (Sapindaceae).

The modern counterparts of the earlier described taxa, along with the present finding are evergreen to deciduous elements presently growing in the tropical to sub-tropical environment (Singh et al., 2011) and their presence indicates the existence of warm and humid climate during the depositional period in western India in comparison to the present day dry conditions. This drastic change in the environment is due to the collision of the Indian and Eurasian plates in the Palaeogene that caused the uplift of Himalaya and Tibetan Plateau, responsible for the evolution of monsoon system (Zachos et al., 2001). In the present time the poor monsoon pattern in western India is not favourable for the growth of evergreen to deciduous elements (Shukla et al., 2012, 2013).

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REFERENCES


PLATE 1

Laurinoxylon deomaliensis Lakhanpal et al., 1981

1. Cross section of the fossil showing heavily tylosed vessels arranged in radial multiples of 2-3.

2. Enlarged cross section of the fossil showing tylosed vessels and oil cells scattered among the fibre cells (marked with arrows).

3. Longitudinal section of the fossil showing long xylem rays.

4. Radial section of the fossil showing oil cells adjacent to the vessel elements (marked with arrows).

5. Radial section of the fossil showing heterogeneous ray tissue.
PLATE 1