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

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ABSTRACT

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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 palaeofloristics. 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.

पश्चिमी भारत के पैलियोजीन अवसादों से प्राप्त लारेसीमय काष्ठ का पहला अभिलेख

अनुमेहा शुक्ला, आर. सी. मेहरोत्रा एवं जे. एस. गुलेरिया

सारांश

जिला भरुच, गुजरात में वगडखोल शैलसमूह से प्राप्त *सिन्नामोमम* स्प्रेंग. एवं *लिस्टिया* लैम. आधुनिक वंश के उन लारेसी की वर्णित जीवाश्म काष्ठ आयु में पुरानूतन-प्रारंभिक आदिनूतन मानी गई है। पश्चिमी भारत से इस परिवार की जीवाश्म काष्ठ का यह पहला अभिलेख है। पश्चिमी भारत के पैलियोजीन अवसादों से ज्ञात अल्प जीवाश्म अभिलेखों के मद्देनज़र मौजूदा प्राप्ति महत्वपूर्ण हो जाती है क्योंकि यह पुरापादपअध्ययन को समृद्ध करती है। पहले से ही वर्णित जीवाश्मों के साथ इसकी विद्यमानता आज की जलवायु के मुक़ाबिले निक्षेपणीय अवधि के दौरान क्षेत्र में कोष्ण एवं आर्द्र स्थितियां इंगित करती है।

संकेत-शब्द—जीवाश्म काष्ठ, लारेसी, पुरानूतन-प्रारंभिक आदिनूतन, पुराजलवायु, वगडखोल शैलसमूह, पश्चिमी भारत।

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 & Chowdhary, 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. 21°42'26" N: Long. 73°10'46" 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 septate. 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 fossil wood 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 *Laurinoxylon* to accommodate fossil woods showing resemblance with the modern genera of the family Lauraceae. Awasthi and Mehrotra (1990) enlisted six species of *Laurinoxylon* described from various horizons of India. Since then three more species, namely *L. siwalicus* (Prasad, 1990), *Laurinoxylon* sp. (Awasthi & Jafar, 1990) and *L. dilcheri* (Tiwari & Mehrotra, 2000) have been described from the Tertiary sediments of India.

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

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 tertiarum* (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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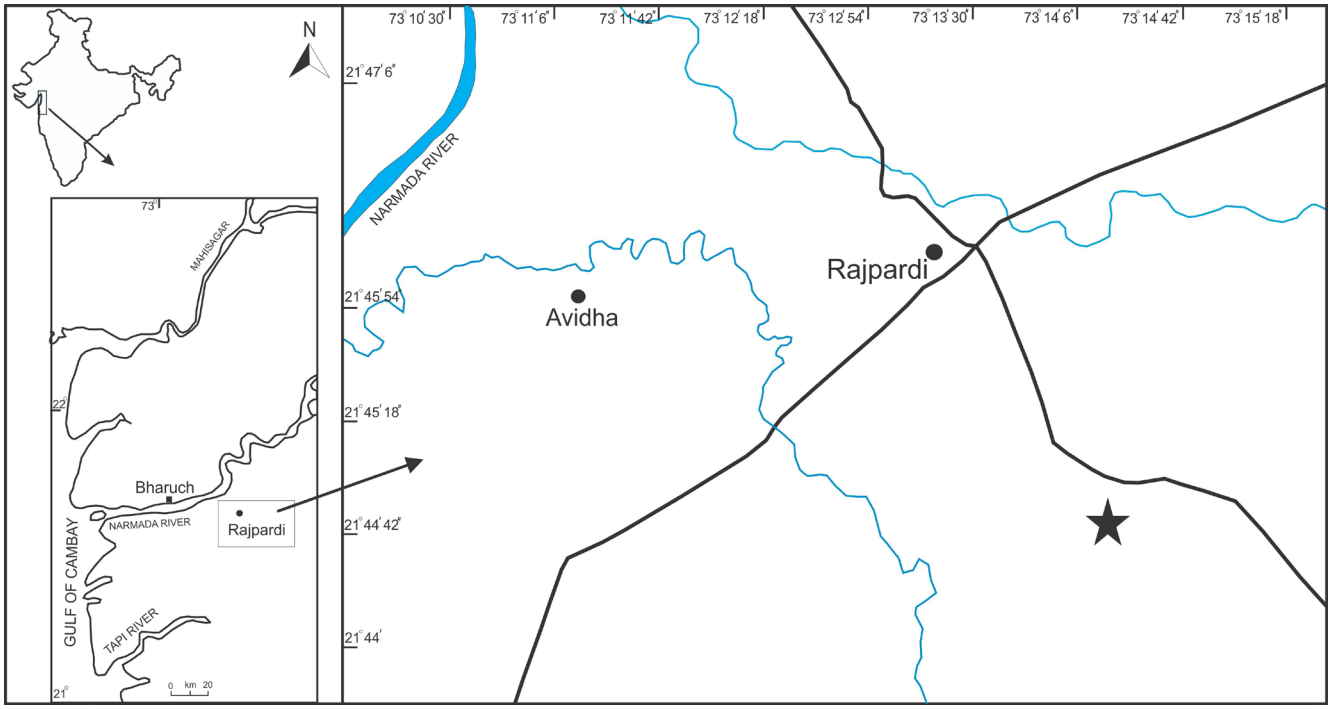

Fig. 2—Map showing the fossil locality (marked with star).

REFERENCES

Awasthi N & Ahuja M 1982. Investigations of some carbonized woods from the Neogene of Varkala in Kerala Coast. Geophytology 12: 245-259.

Awasthi N & Jafar SA 1990. First fossil wood (Lauraceae) from Baratang, Andaman-Nicobar Islands, India. Current Science 59: 1243-1244.

Awasthi N & Mehrotra RC 1990. Some fossil woods from Tipam Sandstone of Assam and Nagaland. Palaeobotanist 38: 277-284.

Bande MB & Prakash U 1980. Four new fossil dicotyledonous woods from the Deccan Intertrappean beds near Shahpura, Mandla District, M.P. Geophytology 10: 268-271.

Bhandari A & Raju DSN 1991. Tertiary sea level change and transgression/ regression cycles in Cambay, Kutch and Rajasthan basins: A review. *In*: Pandey J & Banerjee V (Editors)— Proceedings of the Conference on International Exploration Research, Achievements and Prespectives: Keshav Dev Malviya Institute of Petrolium Exploration, Dehradun: 169-177.

Chandra PK & Chowdhary LR 1969. Stratigraphy of the Cambay Basin. Bulletin of Oil & Natural Gas Commission 6: 37-50.

Desch HE 1957. Manual of Malayan timbers. Malaysian Forest Records 15: 1-338.

Felix J 1883. Untersuchungen uber fossil Holzer 1. Zeitschrift der Deutschen Geologischen Gesellschaft 85: 59-91.

Ilic J 1991. CSIRO atlas of hardwoods. Springer, Berlin.

International Association of Wood Anatomists 1989. IAWA list of microscopic features for hardwood identification. International Association of Wood Anatomists Bulletin New Series 10: 219-332.

Kathiara RS 1969. Lignite deposit in Bhuri area, Broach District, Gujarat. Mineral Wealth 4: 1-5.

Kribs DA 1959. Commercial foreign woods on the American market. Pennsylvania State University, Pennsylvania.

Lacey WS 1963. Palaeobotany technique. *In*: Carthey JD & Duddington I (Editors)—Viewpoint in Biology 2: 202-243. Butterworths, London.

Lakhanpal RN, Guleria JS & Awasthi N 1984. The fossil floras of Kachchh. III-Tertiary megafossils. Palaeobotanist 33: 228-319.

Lakhanpal RN, Prakash U & Awasthi N 1981. Some more dicotyledonous woods from the Tertiary of Deomali, Arunachal Pradesh, India. Palaeobotanist 27: 232-252.

Mabberley DJ 1997. The plant book II. A portable dictionary of vascular plants. Cambridge University Press, Cambridge.

Mathur LP, Rao KLN & Chaube AN 1968. Tectonic framework of Cambay Basin. Bulletin of Oil & Natural Gas Commission 5: 7-28.

Merh SS 1995. Geology of Gujarat. Geological Society of India, Bangalore.

Metcalfe CR & Chalk L 1950. Anatomy of the dicotyledons. 1 & 2. Clarendon Press, Oxford.

Miles A 1978. Photomicrographs of world woods. Department of the Environment Building Research Establishment, London.

Pearson RS & Brown HP 1932. Commercial timbers of India. 1 & 2. Government of India, Central Publication Branch, Calcutta.

Prakash U & Tripathi PP 1974. Fossil woods from the Tertiary of Assam. Palaeobotanist 21: 305-316.

Prasad M 1990. Occurrence of a lauraceous wood in the Siwalik sediments of India. Geophytology 19: 191-192.

Shukla A, Mehrotra RC & Guleria JS 2012. *Cocos sahnii* Kaul: A *Cocos nucifera* L.-like fruit from the Early Eocene rainforest of Rajasthan, western India. Journal of Biosciences 37: 769-776.

Shukla A, Mehrotra RC & Guleria JS 2013. African elements from the upper Cenozoic sediments of western India and their palaeoecological and phytogeographical significance. Alcheringa 37: 1-8.

Singh H, Prasad M, Kumar K & Singh SK 2011. Palaeobotanical remains from the Palaeocene-lower Eocene Vagadkhol Formation, western India and their palaeoclimatic and phytogeographic implications. Palaeoworld 20: 332-356.

Stern WL 1954. Comparative anatomy of xylem and phylogeny of Lauraceae. Tropical Woods 100: 1-72.

Sudhakar R & Basu DN 1973. A reappraisal of the Palaeocene stratigraphy of the southern Cambay Basin. Bulletin of Oil & Natural Gas Commission 10: 55-76.

Sudhakar R, Khan S & Ahmed EA 1970. Deformation of Tertiary and Quaternary sediments of Cambay Basin, south of Mahisagar. Bulletin of Oil & Natural Gas Commission 7: 33-40.

Tiwari RP & Mehrotra RC 2000. Fossil woods from the Tipam Group of Mizoram, India. Tertiary Research 20: 85-94.

Wheeler EA, Pearson RG, La Pasha CA, Zack T & Hatley W 1986. Computer-aided wood identification: References manual. North Carolina Agricultural Research Service Bulletin 474: 1-96.

Zachos J, Pagani M, Sloan L, Thomas E & Billups K 2001. Trends, rhythms and aberrations in global climate 65 Ma to present. Science 292: 686-693.

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.

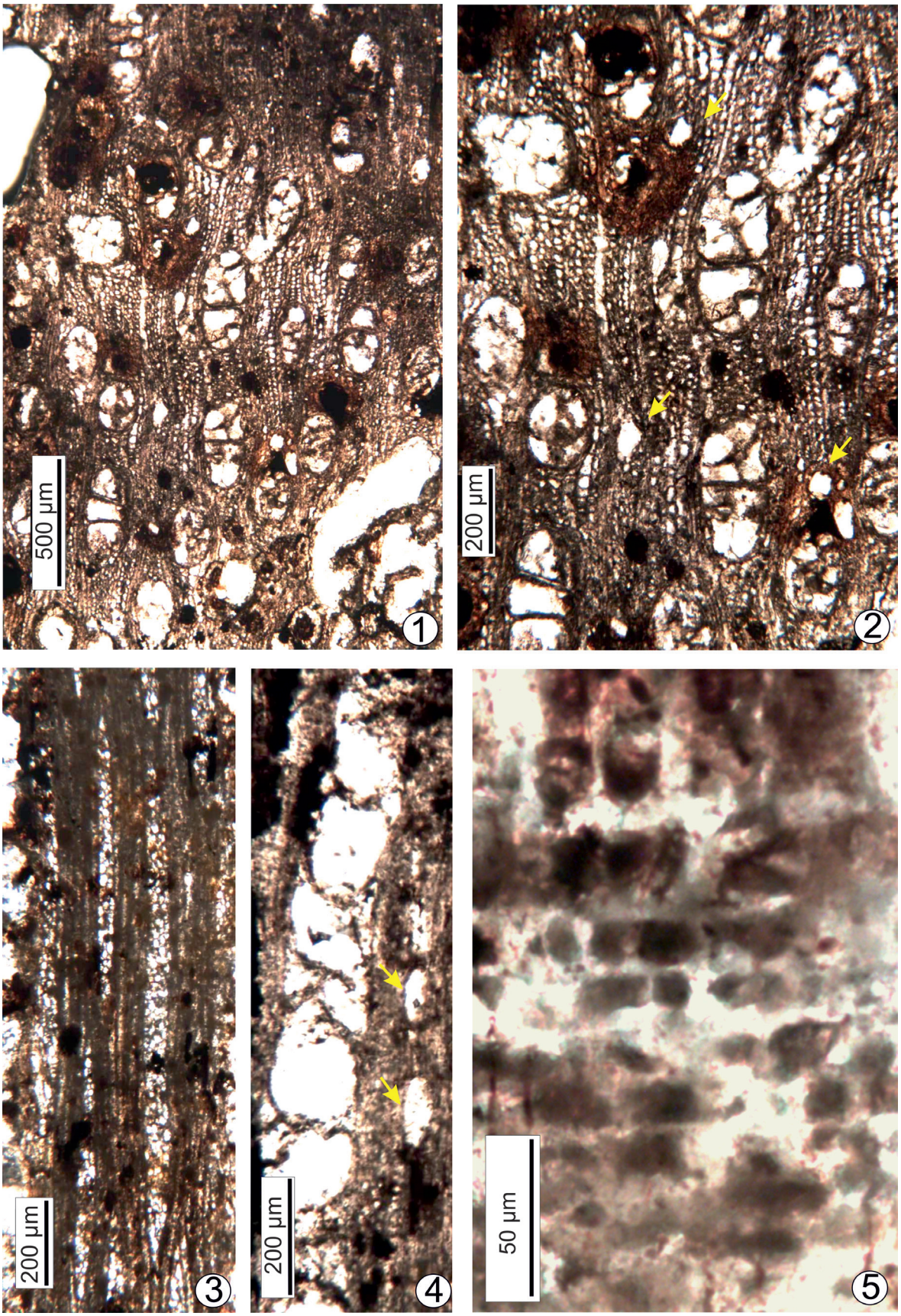

PLATE 1