

FOSSIL WOOD OF *SONNERATIA* FROM THE DECCAN INTER-TRAPPEAN BEDS OF MANDLA DISTRICT, MADHYA PRADESH

R. C. MEHROTRA

Birbal Sahni Institute of Palaeobotany, 53 University, Road Lucknow 226 007, India

Abstract

A fossil wood resembling *Sonneratia* is described as *Sonneratioxylon preapetalum* Awasthi, 1969 from the Deccan Intertrappean beds of Ghughua near Shahpura, Mandla District, Madhya Pradesh. It indicates coastal environment in the vicinity of Mandla during Early Tertiary. The affinities of fossil woods referred to *Sonneratia* have been critically evaluated.

Introduction

Deccan Intertrappean beds near Shahpura in Mandla District are very rich in petrified woods and fruits. The plants identified so far belong to several families of dicotyledons and palms (Bande & Prakash, 1982; Bande *et al.*, 1986; Mehrotra, 1987a, b). Further investigation of petrified material collected from Ghughua near Shahpura (23° 11' N; 80° 40' E) has revealed a wood of *Sonneratia* which is being described in the present paper.

Regarding the precise age of the Deccan Intertrappean beds near Shahpura, recently Srivastava *et al.* (1986) have dated a fossil palm wood from Silther as 54.4 ± 8.1 million years by Fission-Track dating method.

Systematic Description

Family—Sonneratiaceae

Genus—*Sonneratioxylon* Hofmann, 1952

Sonneratioxylon preapetalum Awasthi, 1969

Pl. 1, figs. 1-5

Material—A well-preserved piece of secondary wood measuring about 5 cm in length and 3.5 cm in width.

Description—Wood diffuse-porous (Pl. 1, fig. 1). Growth rings not clearly seen. Vessels mostly small to very small, rarely medium in size, t.d. 28-100 μm , r.d. 24-128 μm , solitary and in radial multiples of 2-4 (rarely 5), sometimes in tangential pairs, mostly oval to circular when solitary, with flat contact walls when in multiples, mostly 15-28 per sq mm; tyloses present (Pl. 1, figs. 1,2); vessel-members 180-640 μm long with oblique to transverse ends; perforations simple; intervessel pit-pairs bordered, opposite to alternate, medium, about 6-8 μm in diameter, somewhat circular to oval in shape with linear-lenticular apertures, vestured (Pl. 1, fig. 4). Parenchyma absent. Xylem rays closely spaced, 13-17 per mm, almost exclusively uniseriate, made up of either upright or both

upright and procumbent cells, 8-12 μm in width and 2-22 cells or 80-760 μm in height (Pl. 1, fig. 3); ray tissue heterogeneous; ray cells usually filled with dark-coloured substance, procumbent cells 40-80 μm in radial length and 24-40 μm in tangential height; upright cells 20-40 μm in radial length and 60-80 μm in tangential height (Pl. 1, fig. 5). *Fibres* semi-libriform, quadrangular to polygonal in cross section, non-septate to septate, 8-20 μm in diameter and 340-840 μm in length (Pl. 1, figs. 2, 3).

Affinities—The important anatomical characters of the fossil wood, viz., mostly small to very small vessels, absence of parenchyma, exclusively uniseriate, heterogeneous xylem rays and vested intervessel pit-pairs indicate its affinities with the wood of the modern genus *Sonneratia* L. of Sonneratiaceae (Metcalf & Chalk, 1950; Pearson & Brown, 1932). Detailed comparative study of the fossil wood with all the six species of *Sonneratia*, namely *S. acida* Linn., *S. alba* Griff., *S. apetala* Ham., *S. caseolaris* (L.) Engl., *S. griffithii* Kurz. and *S. pagatpat* Blanco was made from their thin sections and published literature (Kanehira, 1924, p. 37; Pearson & Brown, 1932, pp. 601-604; Kribs, 1959, p. 152; Kazmi, 1982, p. 41). It was found that the fossil shows close resemblance with all the species except *S. pagatpat* which is different in having parenchyma. Since all the remaining five species are xylogically similar to each other, it is not possible to identify the fossil wood beyond generic level.

Comparison with fossil species—Hofmann (1952) instituted the genus *Sonneratioxylon* for the fossil woods of *Sonneratia* and described *Sonneratioxylon prambachense* from the Oligocene of Austria. Subsequently, six more species of *Sonneratioxylon* have been described from the Tertiary deposits of India and South-east Asia. They are *S. dakshinense* from the Cuddalore Series of South India (Ramanujam, 1956), *S. preapetalum* from the Cuddalore Series (Awasthi, 1969) and from the Tertiary of South-east Asia (Kramer, 1974) and *S. dudukureense* (Rao & Ramanujam, 1966), *S. intertrappeum* (Biradar & Mahabale, 1975), *S. caeseolarioides* (Shete & Kulkarni, 1982) and *S. nawargaoensis* (Bande & Prakash, 1984) from the Deccan Intertrappean beds of India. Besides, a number of fossil woods were described from the Deccan Intertrappean beds as *Sonneratia* by Rode (1936), Verma (1950), Prakash (1957) and Shallom (1963) which have been merged with *Sonneratioxylon intertrappeum* by Biradar and Mahabale (1975). The affinities of some of these fossil woods with *Sonneratia* are doubtful. Awasthi (1969) has already shown after critical examination of the type slides that *S. dakshinense* Ramanujam is quite different from *Sonneratia*. Similarly, *S. dudukureense* Rao & Ramanujam though resembling *Sonneratia* in the absence of parenchyma and having similar vessels, differs in the possession of homogeneous xylem rays. Of the known species of *Sonneratioxylon*, *S. prambachense* Hofmann differs from the present Deccan Intertrappean wood in having parenchyma. The other four, namely, *S. preapetalum* Awasthi, *S. caeseolarioides* Shete & Kulkarni, *S. nawargaoensis* Bande & Prakash and *S. intertrappeum* Biradar & Mahabale have been found quite similar to each other and differ only in some minor characters (see Table 1), such as the presence of septate or non-septate fibres, height of xylem rays and thickness of the fibres which are considered as variable characters. Therefore, they have been merged with *Sonneratioxylon preapetalum* Awasthi (1969) which has the priority. The present fossil wood also shows close similarity with *Sonneratioxylon preapetalum* Awasthi, and hence placed under the same species.

Besides woods, roots, flowers and fruits comparable to *Sonneratia* are also known from the Deccan Intertrappean beds of Mohgaonkalan, viz., *Sonneratorhizos raoi* (Chitale, 1969), *Sahnianthus parijai* (Shukla, 1944, 1948; Chitale, 1950, 1955; Dayal 1967; Mahabale & Deshpande, 1959), *Enigmocarpon parijai* (Sahni, 1943; Dwivedi, 1956;

Table 1—Important anatomical features of *Sonneratiioxylon* Hofmann, 1952

Fossil species	Vessel	Parenchyma	Xylem rays	Fibres	Age and Locality
	2	3	4	5	6
<i>S. preapetalum</i> Awasthi, 1969	Solitary and in radial multiples of 2-4, t.d. 45-150 μm , r.d. 45-165 μm ; inter-vessel pit-pairs medium to large, vested	Absent	Usually uniseriate, occasionally biseriata; ray tissue heterogeneous	Thick-walled to thin-walled, septate	Mio-Pliocene; Cuddalore Series, South India; Upper Tertiary of South-east Asia
<i>S. intertrappeum</i> Biradar & Mahabale, 1975	Solitary as well as in radial multiples of 2-5, 64-84 μm in diameter; intervessel pit-pairs vested, alternate, 6-7 μm with linear to lenticular apertures	Absent	Uniseriate, occasionally biseriata; ray tissue heterogeneous	Thick-walled to slightly thick-walled, mostly nonseptate to sometimes septate	Early Tertiary; Deccan Intertrappean beds of Mohagaonkalan, Chhindwara District, Madhya Pradesh
<i>S. caseolarinoides</i> Shete & Kulkarni, 1982	Solitary and in radial multiples of 2-5, t.d. 49-98 μm , r.d. 49-112 μm ; intervessel pit-pairs vested, alternate with lenticular apertures	Absent	Uniseriate; ray tissue heterogeneous	Non-septate	Early Tertiary; Deccan Intertrappean beds of Nawargaon, Wardha District, Maharashtra
<i>S. nawargaensis</i> Bande & Prakash, 1984	Solitary and radial multiples of 2-5, t.d. 45-160 μm , r.d. 60-1260 μm ; intervessel pit-pairs vested, 8-10 μm in diameter, alternate with lenticular apertures	Absent	Mostly uniseriate, sometimes biseriata; ray tissue heterogeneous	Non-libriform, septate	Early Tertiary; Deccan Intertrappean beds of Nawargaon, Wardha District, Maharashtra
Present fossil wood	Solitary and in radial multiples of 2-5, t.d. 28-100 μm , r.d. 24-128 μm , intervessel pit-pairs vested, medium, opposite to alternate with linear-lenticular apertures	Absent	Almost exclusively uniseriate; ray tissue heterogeneous	Semi-libriform, non-septate to septate	Palaeocene-Eocene; Deccan Intertrappean beds of Mandla District, Madhya Pradesh

Mahabale & Deshpande, 1959; Biradar & Mahabale, 1976) and *E. sahni* (Chitale & Kate, 1977) respectively.

Regarding the geological history of *Sonneratia* on the basis of palynological records Muller (1981) is of the opinion that *Sonneratia* cannot be older than Lower Miocene. However, from the megafossil records of *Sonneratia* from the Deccan Intertrappean beds it is evident that *Sonneratia* appeared during Early Tertiary.

Sonneratia L. consists of six coastal species of trees, distributed in tropical East-Africa, Madagascar to Hainan Ryukyu Islands, Micronesia, Malaysia, New Hebrides, Solomons, North Australia and New Caledonia (Santapau & Henry, 1973; Willis, 1973). According to Santapau and Henry (1973) out of six species, three are found in India especially in Sunderbans and also along the coastal and tidal waters of Peninsular India.

The occurrence of *Sonneratia* in the Deccan Intertrappean beds of Mandla District is further indicative of coastal environment in Central India during the Early Tertiary period.

Revised specific diagnosis

Sonneratioxylon preapetalum Awasthi, 1969

1969 *Sonneratioxylon preapetalum* Awasthi, p. 256, pl. 1, figs. 1-4; pl. 2, figs. 5-10; text-figs 1-3.

1975 *Sonneratioxylon intertrappeum* Biradar & Mahabale, p. 217, pl. 1, figs. 1-15; text-figs 1-16.

1982 *Sonneratioxylon caesolarioides* Shete & Kulkarni, pp. 71-72, pl. 3, figs. 15-23; pl. 4, figs 24-31.

1984 *Sonneratioxylon nawargaoensis* Bande & Prakash, p. 109, pl. 3, figs. 11-14.

Wood diffuse-porous. *Growth rings* absent. *Vessels* usually small to very small, occasionally medium, t.d. 28-160 μm , r.d. 24-165 μm , solitary and in radial multiples of 2-5, circular to oval, 10-50 per sq mm; tyloses present; vessel-members 180-750 μm long, with usually oblique to transverse ends; perforations simple; intervessel pit-pairs bordered, alternate to opposite, 6-10 μm in diameter, circular to oval and hexagonal in shape, vestured. *Parenchyma* absent. *Xylem rays* usually uniseriate, rarely biseriate, homo- to heterocellular; ray tissue heterogeneous. *Fibres* non-libriform to libriform, septate to non-septate, 8-24 μm in diameter and 340-1150 μm in length.

Specimen—Museum No. B.S.I.P. 35941.

Horizon—Deccan Intertrappean beds.

Locality—Ghughua near Shahpura, Mandla District, Madhya Pradesh.

Age—Palaeocene-Eocene.

Acknowledgements

The author is thankful to the authorities of the Forest Research Institute, Dehradun for providing facilities to consult the Xylarium; special gratitude is expressed to Dr Ramesh Dayal of this Institute for his help. He is also grateful to Dr B.S. Venkatachala, Director, B.S.I.P., Lucknow and Dr N. Awasthi, for their constant encouragement and suggestions.

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Explanation of Plate

Plate 1

Sonneratioxylon preapetalum Awasthi, 1969

1. Cross section of the fossil wood in low power showing shape, size and distribution of the vessels. $\times 30$; B.S.I.P. Slide no. 35941-I.
2. Magnified cross section of the fossil wood showing absence of paraenchyma. $\times 80$; B.S.I.P. Slide no. 35941-I.
3. Tangential longitudinal section of the fossil wood showing structure of xylem rays and fibres. $\times 125$; B.S.I.P. Slide no. 35941-II.
4. Magnified intervessel pit-pairs of the fossil wood. $\times 660$; B.S.I.P. Slide no. 35941-II.
5. Radial longitudinal section of the fossil wood showing heterogeneous ray tissue. $\times 65$; B.S.I.P. Slide no. 35941-III.

