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A fossil wood from the Cambay Shale Formation of Mangrol Lignite Mine, Gujarat

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ABSTRACT

Mangrol Lignite Mine, an extension of the Vastan Lignite Mine, belongs to the Cambay Shale Formation of the early Eocene age and is situated near Surat, Gujarat. As it is a newly opened mine, an extensive field work has been undertaken for the collection of plant fossil material to know the floristic composition of the lignite of this mine. A fossil wood, collected from this mine, is systematically described. It belongs to the family Euphorbiaceae and has been put under the organ genus *Euphorbioxylon*. This becomes the first record of any plant megafossil from this mine.

Key-words: Cambay Shale Formation, Early Eocene, Eubhorbiaceae, Magrol lignite mine.

INTRODUCTION

Mangrol lignite mine (21^0 26' 56" N; 73^0 07'54" E) is situated about 30 km northeast of Surat, Gujarat (Text Figure 1A). The mine can be approached from the national highway (NH-8) connecting Kim Four Road Junction (Kim Char-Rasta) that lies between Surat and Bharuch to Mumbai and Ahmedabad. The subsurface beds of the mine belong to the Cambay Shale Formation which is considered to be early Eocene in age (Sahni et al. 2004). The Mangrol mine is considered as an extension to the Vastan lignite mine as shale-lignite sequence of both the mines lies directly over the Deccan Trap in the southern Cambay Basin. This mine is poorly explored as far as the animal and plant remains are concerned. Therefore, a field trip was made to collect fossils and one of us (HS) collected a few wood pieces from there. The preservation of these woods is quite poor, though one of them is satisfactorily preserved to reveal structural details.

MATERIAL AND METHODS

The Mangrol lignite deposit forms a part of the Vastan–Mangrol– Valia lignite block of the Cambay basin. The area is mainly occupied by sub surface Eocene group of rocks, underlain by the Deccan Traps igneous rocks/basalts and overlain by the alluvium (Text- Figure 1A). The total thickness of lignite in the Mangrol mine varies from 6–8 m (Singh et al. 2013) and wood bearing horizon is just above the carbonaceous shale (Text-Figure 1B). To study the xylotomical characters the cross (CS), tangential longitudinal (TLS) and radial longitudinal (RLS) sections of the fossil were prepared by the standard method of cutting, grinding, polishing and mounting in Canada balsam. The thin sections were examined under the high power light microscope. The identification of the fossil was made after its comparison with a large number of modern woods, both from thin sections and published literature. The anatomical terms used in describing it are those adopted by Wheeler et al. (1986) and International Association of Wood Anatomists (1989). The figured slides are housed in the museum of the Birbal Sahni Institute of Palaeosciences, Lucknow.

SYSTEMATIC DESCRIPTION

Family **Euphorbiaceae**

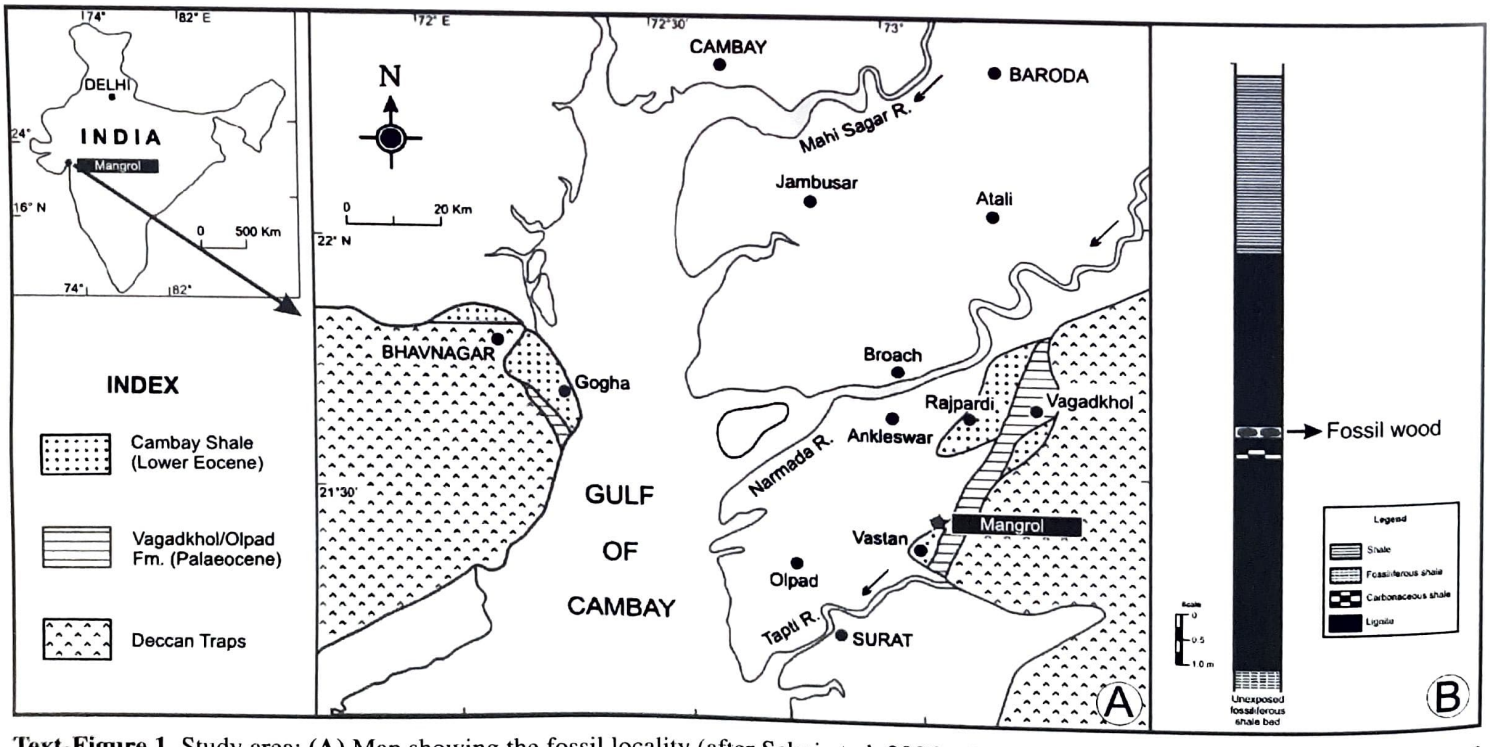
Genus ***Euphorbioxyon* Felix 1887**

Species ***Euphorbioxylon* sp.**

(Pl. 1, figs. a–e)

Description: Wood diffuse porous. Growth rings not observed. Vessels round to oval, mostly small, tangential diameter range 54–89 µm, solitary and in radial multiples of 2 to 3, 5–8 per sq mm, evenly distributed, tylosed; vessel elements with horizontal to oblique ends; perforations simple. Axial parenchyma apotracheal, thin (1 to 2 celled) broken to continuous bands. Rays predominantly uniseriate, occasionally biseriate, 11–14 per mm; mostly made up of procumbent cells with 1 or 2 rows of square cells, about 18–27 µm in width and 6–13 cells or 160–453 µm in height; ray tissue weakly heterogeneous, procumbent cells 17–40 µm in radial length and 13–33 µm in tangential height; square cells about 32 µm in tangential height and about 28 µm in radial length. Fibres aligned in radial rows, polygonal in cross section, moderately thick walled, non septate.

Affinities: The fossil is characterized by diffuse porous wood, tylosed vessels, simple perforation plates, vasicentric to aliform to thin bands of axial parenchyma, predominantly uniseriate rays and moderately thick walled non septate fibres aligned in radial rows. Apparently, these anatomical features indicate its affinities with the modern genus *Endospermum* Benth. of the family Euphorbiaceae (Pearson & Brown 1932, Metcalfe & Chalk 1950, Kribs 1959, Miles 1978, Ilic 1991, http://insidewood.lib.ncsu.edu/). As due to poor preservation the minute details of the fossil can not be observed, it has been put under the organ genus *Euphorbioxylon* and described as *Euphorbioxylon* sp. This genus was instituted by Felix (1887) for the fossil woods showing anatomical similarities with the modern genera of the family Euphorbiaceae. To date 18 species of the fossil genus have been described from all over world (http://insidewood.lib.ncsu.edu/). From India, two fossil woods, namely *Euphorbioxylon kräuseli* (Prakash) Mädel (1962) (syn. *Bridelioxylon kräuseli* Prakash) and *E. sagarense* Mahabale & Deshpande (1963) have been described from the Deccan Intertrappean beds of Madhya Pradesh. The former is different from the present fossil in having almost negligible to scanty paratracheal parenchyma and broad rays, while the latter can be differentiated in having scanty paratracheal parenchyma against the



Text-Figure 1. Study area: **(A)** Map showing the fossil locality (after Sahni et al. 2006). **(B)** Litholog of the mine showing the position of fossil wood log (modified after Singh et al. 2013).

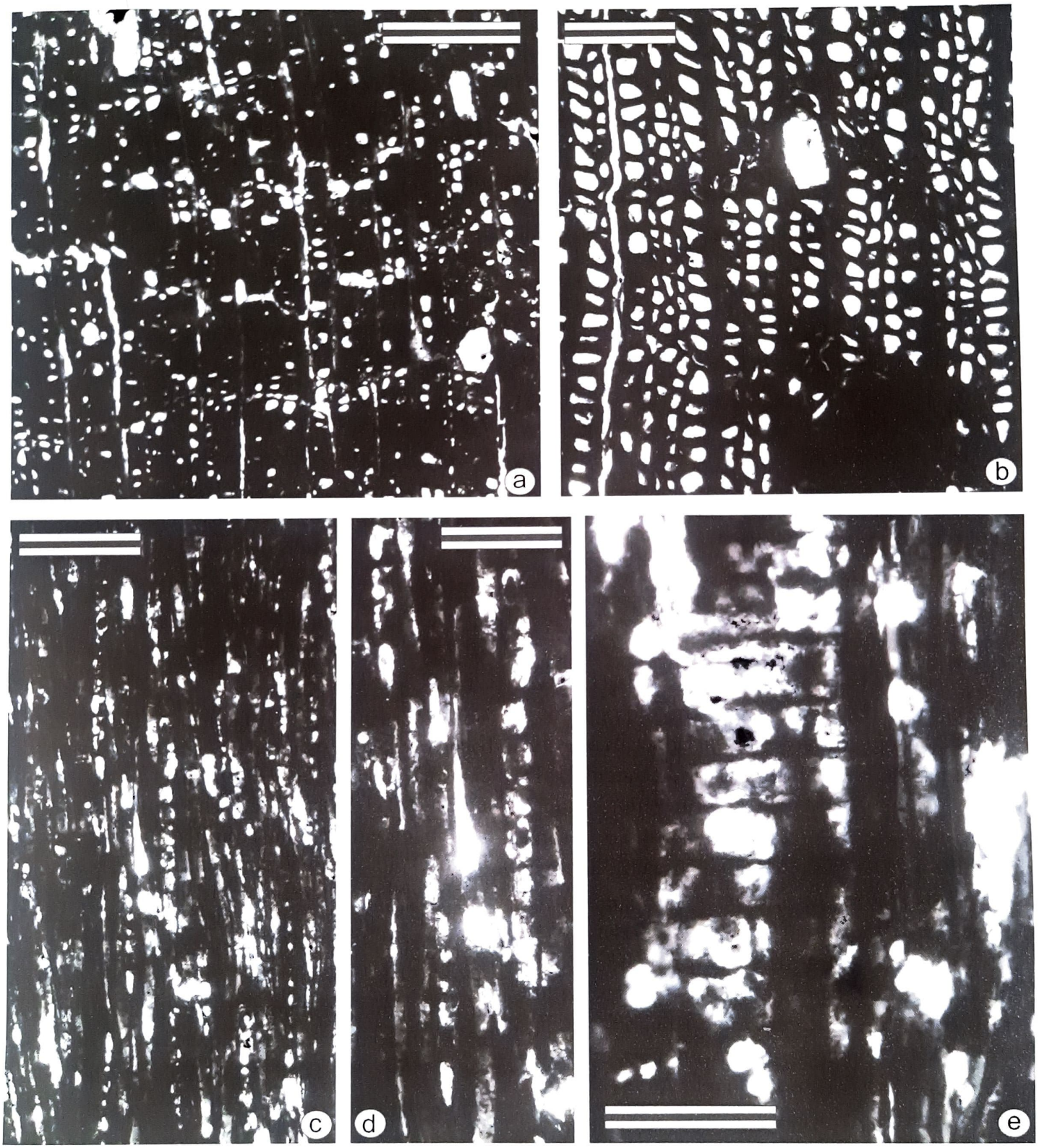


PLATE 1

***Euphorbioxylon* sp.**: **a.** Cross section of the fossil wood in low power showing shape, size and distribution of vessels and axial parenchyma (Scale = 200 µm). **b.** Cross section of the fossil wood in high power showing vasicentric to aliform to thin bands of axial parenchyma (Scale = 100 µm). **c.** Tangential longitudinal section of the fossil in low power showing predominantly uniseriate rays (Scale = 200 µm). **d.** Tangential longitudinal section of the fossil in high power showing structure of rays (Scale = 100 µm). **e.** Radial longitudinal section of the fossil showing weakly heterogeneous ray tissue (Scale = 100 µm).

apotracheal, thin (1 to 2 celled) broken to continuous bands in the present fossil.

Holotype: Specimen no. BSIP 41172.

Horizon: Cambay Shale Formation.

Locality: Mangrol lignite mine, Surat district, Gujarat.

Age: Early Eocene.

DISCUSSION

All the lignite mines of the Cambay Basin i.e., Vastan, Rajpardi, Tarkeshwer and Mangrol belong to early Eocene age (Sahni et al. 2004). Two of them, namely Vastan (Singh et al. 2010, Rao et al. 2013) and Rajpardi (Samant & Phadtare 1997, Shukla et al. 2013) were explored in detail for floral and faunal records. However, only a few ostracods, pollen, woods and fruits were described from the Tarkeshwar mine (Singh et al. 2012, Nagori et al. 2013, Shukla & Mehrotra 2016, Singh et al. 2016). Although a multidisciplinary study (petrographical, palynological and palynofacies) has been made from the Mangrol Lignite Mine to characterize and assess the depositional conditions (Singh et al. 2013), no megafossil has yet been described from there. Therefore, the present fossil becomes the first record of it from this mine. The recovered palynomorphs from the mine indicate that a tropical to sub-tropical climatic condition was present there during the deposition (Singh et al. 2013). A rich plant megafossil assemblage has been retrieved from the nearby Vastan Lignite Mine which includes *Melanorrhoea* Wall. and *Swintonia* Griff. of the Anacardiaceae (Singh et al. 2015), *Annona* Linn. of the Annonaceae (Prasad et al. 2014), *Calophyllum* Linn. of the Calophyllaceae, *Combretum* Loefl. and *Terminalia* Linn. (Singh et al. 2010, 2015) of the Combretaceae, *Diospyros* Linn. of the Ebenaceae (Singh et al. 2015), *Lagerstroemia* Linn. of the Lythraceae (Singh et al. 2010, 2015), *Pterospermum* Schreb. of the Malvaceae (Singh et al. 2015), *Aglaia* Lour. of the Meliaceae (Guleria et al. 2009), *Ziziphus* Mill. of the Rhamnaceae (Singh et al. 2010), *Gardenia* J. Ellis and *Anthocephalus* A. Rich. of the Rubiaceae, *Sarcomelicope* Engler of the Rutaceae and *Schleichera* Lour. of the Sapindaceae (Singh et al. 2015), besides a palm (Prasad et al. 2013). Their presence indicates tropical warm and humid climate favouring luxurious growth of rain forest in the region during the period of deposition.

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REFERENCES

Felix J. 1887. Untersuchungen über fossile hölzer. III. Zeitschrift der Deutschen Geologischen Gesellschaft 9: 517-528.

Guleria J.S., Sahni A., Shukla A. & Singh H. 2009. A *Teredolites* infested fossil wood from the Lower Eocene sediments of the Vastan Lignite Mine of Gujarat, western India. Palaeobotanist 58: 93-100.

Ilic J. 1991. CSIRO atlas of hard woods. Springer, Berlin.

International Association of Wood Anatomists (IAWA). 1989. IAWA list of microscopic features for hardwood identification. IAWA new series 10: 219-332.

Kribs D.A. 1959. Commercial foreign woods on the American Market. Pennsylvania State University, Pennsylvania.

Mädel E. 1962. Die fossilen Euphorbiaceen-Hölzer mit besonderer Berucksichtigung neuer Funde aus der Oberkreide Sud-Afrikas. Senck. Leth. 43: 283-321.

Mahabale T.S. & Deshpande S.R. 1963. *Euphorbioxylon sagarense* spec. nov., a fossil wood from Sagar (M. P.) belonging to the family Euphorbiaceae. Journal of the Indian Botanical Society (Maheshwari Comm. Vol.) 42A: 102-109.

Metcalfe C.R. & Chalk L. 1950. Anatomy of the dicotyledons. Vol. 1 and 2. Clarendon Press, Oxford.

Miles A. 1978. Photomicrographs of world woods. Building Research Establisment Report, London.

Nagori M.L., Khosla S.C. & Jakhar S.R. 2013. Middle Eocene Ostracoda from the Tadkeshwar Lignite Mine, Cambay Basin, Gujarat. Journal of the Geological Society of India 81: 514-520.

Pearson R.S. & Brown HP. 1932. Commercial timbers of India. Vol. 1 and 2. Government of India Central Publication Branch, Calcutta.

Prasad M., Singh H., Singh S.K., Mukherjee D. & Estrada Ruiz E 2013. Early Eocene arecoid palm wood, *Palmoxylon vastanensis* n. sp. from Vastan Lignite, Gujarat, India: its palaeoenvironmental implications. Journal of the Palaeontological Society of India 58: 115–123.

Prasad M., Singh H. & Singh S.K. 2014. Early Eocene *Annona* fossils from Vastan Lignite Mine, Surat District, Gujarat, India: age, origin and palaeogeographic significance. Current Science 107: 1730-1735.

Rao M.R., Sahni A., Rana R.S. & Verma P. 2013. Palynostratigraphy and depositional environment of Vastan Lignite Mine (Early Eocene), Gujarat, western India. Journal of Earth System Science 122: 289-307.

Sahni A., Rana R.S., Loyal R.S., Saraswati P.K., Mathur S.K., Tripathi S.K.M., Rose K.D. & Garg, R. 2004. Western margin Palaeocene–Lower Eocene lignites: biostratigraphic and palaeoecological constraints. *Proceedings of the 2nd Conference,* Association of Petroleum Geologists, (Khajuraho), Oil & Natural Gas Corporation, Technical Session III: pp. 1–22.

Sahni A., Saraswati P.K., Rana R.S., Kumar K., Singh H., Alimohammadian H., Sahni N., Rose K.D., Singh L. & Smith T. 2006. Temporal constraints and depositional palaeoenvironments of the Vastan Lignite Sequence, Gujarat: analogy for the Cambay Shale hydrocarbon source rock. Indian Journal of Petroleum Geology 15: 1-20.

Samant B. & Phadtare N.R. 1997 Stratigraphic palyno-flora of the Early Eocene Rajpardi lignite, Gujarat and the lower age limit of the Tarkeswar Formation of South Cambay Basin, India. Palaeontographica B245: 1-108.

Shukla A. & Mehrotra R.C. 2016. *Holigarna* (Anacardiaceae) from the early Eocene of western India and its palaeogeographical and palaeoclimatological significance. Journal of the Geological Society of India 87: 520-524.

Shukla A., Mehrotra R.C. & Guleria J.S. 2013. A fossil wood of *Gluta* L. (Anacardiaceae) from the Early Eocene sediments of Gujarat, western India. Palaeobotanist 62: 65-70.

Singh A., Thakur O.P. & Singh B.D. 2012. Petrographic and depositional characteristics of Tadkeshwar lignite deposits (Cambay Basin), Gujarat. Journal of the Geological Society of India 80: 329-340.

Singh A., Mahesh S., Singh H., Tripathi S.K.M. & Singh B.D. 2013. Characterization of Mangrol lignite (Gujarat), India: Petrography, palynology, and palynofacies. International Journal of Coal Geology 120: 82–94.

Singh H., Prasad M., Kishor K., Rana R.S. & Singh S.K. 2010. Fossil fruits from Early Eocene Vastan Lignite, Gujarat, India: Taphonomic and phytogeographic implications. Current Science 98: 1625-1632.

Singh H., Prasad M., Kumar K. & Singh S.K. 2015. Early Eocene macroflora and associated palynofossils from the Cambay Shale Formation, western India: Phytogeographic and palaeoclimatic implications. Palaeoworld 24: 293-323.

Singh H., Shukla A. & Mehrotra R.C. 2016. A fossil coconut fruit from the early Eocene of Gujarat. Journal of the Geological Society of India 87: 268-270.

Wheeler E.A., Pearson R.G., La Pasha C.A., Zack T. & Hatley W. 1986. Computer-aided wood identification. Bulletin North Carolina Agricultural Research Service 474: 1-96.