Pak. J. Agri., Agril. Engg., Vet. Sci., 2020, 36 (1): 1-7
ISSN: 1023-1072 (Print), ISSN: 2663-7863 (Online)
https://doi.org/10.47432/pjaaevs.2020.36.1.1

WOOD OF *BURSEROXYLON FOSSIL* FROM BARA FORMATION OF RANI KOT FORT AREA, DISTRICT JAMSHORO SINDH, PAKISTAN

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ABSTRACT

The paper describes a fossil wood identifiable as *Burseroxylon barane*sis from Bara formation of Sindh, Pakistan. Three dimension sections (transverse, radial and tangential) were prepared from the fossil wood collected from Bara formation, Ranikot. The anatomical characters such as presence of growth rings, parenchyma scanty, paratracheal, vasicentric. Rays are homogenous rays consist of procumbent cells indicate that the species belong to the family Burseraceae of petrified *Bursera* wood and are assigned name as *Burseroxylon* on the basis of form genus. This is the first record of genus *Burseroxylon* from tertiary rocks of Pakistan. Presence of diffuse porous wood indicate that the plants were growing in tropical type of climate.

Keywords: *Burseroxylon baranesis* sp.nov, *Burseraceae*, Bara formation, fossil wood, Sindh, Pakistan

INTRODUCTION

Ranikot group in the Sindh province has long been known as one of the most fascinating and classical area, both geologically and paleontologically. The fossil wood described in this paper was recovered from Bara formation of Ranikot group located near Ranikot fort area, district Jamshoro, Sindh, Pakistan. The fossil wood was found partially buried in the sand stone which is believed to belong to the Paleocene epoch of tertiary period. The study of fossil wood and its distribution pattern has been a useful tool in interpreting the nature and type of vegetation, and the ecological conditions prevailing in the past geological periods. Thus it also serves as an important indicator of past geographical conditions. Studying fossils have been critically important in the field of natural sciences. Since it helps to collect different data which consequently help to know many historical and current scientific phenomena. Among many other important informations, which can be derived from studying closely fossils, these scientific items also help scientists around the world to know about past historical facts in terms of environment, phylogeny and paleo-climatology. Some scientists, for example b Noamani and Zainab (2020), studied and reported that there are two dichotomous keys to study the angiosperm petrified wood species and it was also reported for associating it with the date from the Egyptian Strata to facilitate the tentative identification of angiosperm fossil wood specimens. Similarly, Tara *et al.* (2020) assigned new petrified wood *Saarina hagadorni* sp. nov, pyritized fossils from the Deep Spring and Wood Canyon formations from USA.

Akkemik *et al.* (2019) from Turkey, Elisabeth *et al.* (2020) from USA, found fossil wood associated with anatomical evolutionary trends in phylogeny of plants.

Pakistan has several places for scientific research. The presence of fossiliferous plant in the tertiary and quaternary rocks of Sindh was first time reported by Blanford (1879), while he was dealing with the topography of Sindh locale. Pascoe (1963) stated the silicified dicot and monocot fossil woods in the upper tertiary and quaternary rocks of Sindh area. So far fossil wood which had been identified and depicted from Sindh, and other areas of Pakistan (Khan and Rehmatullah 1968; 1971; Khan *et al.,* 1972; Khan and Rajput, 1976; Rajput and Khan, 1982; Rehmatullah *et al.* 1984 and 1984; Rajput, *et al.,* 1985; Ahmed, *et al*., 1993; Bhutto *et al.*, 1993; Ahmed *et al.* 2007a; *2007b*; Shar*. et al*., 2007; Soomro *et al.,* 2014; 2017a; 2017b). Present work provides information on the fossil woods of Bara formation. A detailed information is given in this contribution.

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MATERIALS AND METHODS

Twelve fossil woods were collected from the study area, which is located about 22 km east of Ranikot fort area (Lat. 250 54' 24"N and Long. 670 54' 38" E). The fossiliferous locality is approachable from Sunn railway station which is about 250 kilometers from Karachi, by a jeep able tract. The exposed section of the Bara formation in fort Ranikot area is 250 meters thick. It is located near Ranikot dhoro, and is composed of sandstones, shale's and minor siltstones. The fossil wood used in this study, consists of a single piece of fossil wood, which was about 5 cm long and 4 cm wide, brown in color. For anatomical investigation ground thin sectioning method was employed, using standard techniques for petrified wood (e.g. Haas and Rowe, 1999). The anatomical structures such as presence of vessels, vessel size and grouping, parenchyma distribution, size of rays and their distribution, were used in the determination of species. For the anatomical account of fossil woods most of the terms used are from Metcalf and Chalk, (1950); Easu, (1959); Fahn, (1969); Barefoot and Hankins, (1982); Wheeler *et al.* (1986).

RESULTS

Systematic positions

Division: Magnoliophyta
Family: Burseraceae Kunth
Genus: *Bursera*
Species: *B. baranesis sp. nov.*

Topography; wood diffuse porous with distinct growth ring (Plate1, Figure 2).

Vessels

Small to medium in size, mostly solitary and radial multiple of 2-3 (multiple became longer at the region of growth ring), round to oval in cross section, usually empty, rarely filled with dark color material, probably of gummy origin, unevenly distributed in the ground mass, 6-15 vessels /sq. mm (Plate 1, Figure 2-4). Vessels thin wall 2-5 µm thick, radial diameter 60-120 µm tangential diameter ranges 98-160 µm and vessels members' 120-240 µm in height with truncate end walls (Plate 1, Figure 5); perforation simple; intervessel pit pair could not be seen clearly; gum canals not seen tylosis absent.

Parenchyma

Parenchyma paratracheal scanty and vasicentric parenchyma cells thin wall round to oval in shape, 2-4 cells thick around the vessels (Plate 1, Figure 3-4).

Rays

Multiseriate xylem rays, homogeneous and homocellular present on sides of the vessels, not visible to naked eyes, composed of mostly procumbent cells, 4-7 seriate (Plate 1, Figure 1, 5), 20-180 µm wide, 11-20 cells high, 150-1600 µm high, closely spaced 3-5 per sq. mm. cells of rays filled with incomplete deposit, diameter ranges from 16-29 µm, and a small number of intercellular canals can also be seen in few xylem rays. Xylem rays showing inclination in the direction of storied organization.

Holotype

Horizon: Bara formation
Age: Middle paleocene

About 20 km east of Ranikot, Jamshoro, Sindh, Pakistan. Fossil wood TB-11, 2015 (Paleo Botany Museum, Institute of Plant Sciences, University of Sindh, Jamshoro, Sindh, Pakistan).

DISCUSSION

Comparison with living taxa

The anatomical character such as occurrence of small to medium vessels. Vasicentric, paratracheal scanty parenchyma and rare intercellular canals in the secondary wood shows its affinity with family Burseraceae. The medium size vessels, vasicentric, paratracheal parenchyma, lead to compare this fossil wood with family Anacardiaceous, Sapindaceae and Leguminaceae.

The specimen under investigation shows certain affinities to family Anacardiaceae but, in family Anacardiaceae, small to large vessels and tyloses are generally present. The occurrence of scanty parenchyma in the under investigating fossil wood shows its likeness with family Sapindaceae but in Sapindaceae wood ring porous to diffuse porous type and rays are uniseriate. The present fossil wood displays certain resemblance with few members of leguminious wood in having medium vessels size and vasicentric, paratracheal parenchyma. However, leguminous wood vary in many anatomical features as their parenchyma shows variation in size and shape which is conspicuous, the parabrachial parenchyma varieties aliform, confluent to zonate forming bands in regular sequence however, in the fossil wood described here, the paratracheal

parenchyma does not vary in type and it generally vasicentric. Leguminious rays are uniseriate to multiseriate but in this fossil wood which is under study rays are entirely multiseriate.

Among the genus of family Burseraceae, the genus *Bursera* shows close resemblance to this fossil due to the occurrence of following features viz, small to medium size vessel, scanty to vasicentric parenchyma, multiseriate and, homogeneous rays, thick wall septate fibers. Due to close affinity with the genus *Bursera,* the present specimen can be assigned to genus *Bursera.*

The genus *Bursera* comprises of about 80 species commonly found in Northern South America, tropical America, especially in West Indies, Central America and Mexico and two species spread north ward in the United States. *Bursera serata* with which the current fossil wood closely resemble is the only Indian species extending from eastern moist zone of Orissa, Bengal, Assam, Chittagong to tropical forest of lower and upper Burma.

Comparison with reported fossil wood

Previously, two fossil wood species have been reported from different localities belonging to genus organ Burseroxylon.

In the recent past Parkash and Tripathi (1975) described *Burseroxylon preseratum* from tertiary out crops of Assam India. *B.preseratum* shows similarities in vessel size and type of parenchyma but rays are uniseriate to multiseriate and hetrocellular in previously reported species, while in *B. baranesis* which is reported from Bara formation is completely multiseriate and homocellular.

Lakhanpal *et al.* (1978) described *Burseroxylon garugoides* from tertiary rocks of Arunachal Pradesh India, which has similar type of axial parenchyma but differ in size of vessels and rays which are medium to large and hetrocellular in reported form species, where in form species under investigation has small to medium vessels and rays are homocellular. As the fossil wood described in this paper shows the differences from other described species of *Burseroxylon*, therefore, it considers as new species and it is named *Burseroxylon baranesis.*

Diagnosis of the species

Diffuse porous wood with growth rings. Vessel small to medium in size with tangential diameter 98-160 µm; and radial diameter 60-120 µm, solitary and radial multiple of 2-3, occasionally paired, round to oval in shape, 6-15 per sq. mm. Tylosis like gummy deposition is present and tyloses is absent. Simple perforation, intervessel pit pair not clearly seen. Parenchyma scanty, paratracheal, vasicentric, 2-4 cells thick around the vessel. Xylem ray nearly homogenous with ray mostly of procumbent cells, multiseriate, 4-7 cells in diameter and 11-20 cells in length, showing inclination toward storied organization. In secondary wood few intercellular canals are also observed. Fibers thick wall with large lumen and simple pit, angular in transverse section 100-600 µm long.

Table1. Comparison of fossil woods related to organ genus *Bursera* along with geographical and stratigraphically information

Species	Wood	Age	Locality	Vessels	Wood parenchyma	Xylem rays	Fibers
Burseroxylon preserratµm (Parkash and Tripathi, 1975).	Diffuse porous	Upper miocecee	Assam, India	Vessels small to medium in size. 5- 20 vessels/ sq mm	Parenchyma scanty paratracheal vasicentric	Multiseriate rarely uniseriate hetrocellulr	Fibers with simple to minutely bordered pit
Burseloxylon garugoides (Lakhanpal, *et al.,* 1978).	Diffuse Porous	Miocene to Pliocene	Arunachal Pradesh, India	Vessels medium to large in size. 5 – 20 vessels /sq mm	Parenchyma scanty,paratrache al vasicentric	Exclusively multiceriate, hetrocellulr	Fibers with simple to minutely bordered pit
Burseloxylon baranesis 2009.	Diffuse Porous	Paleocene	Sindh Pakistan.	Vessels small to medium in size 6 – 15 vessels /sq mm	Parenchyma scanty,paratrache al vasicentric	Exclusively multiceriate, Homocellur.	Fibers with simple pits, bordered pits totally absent

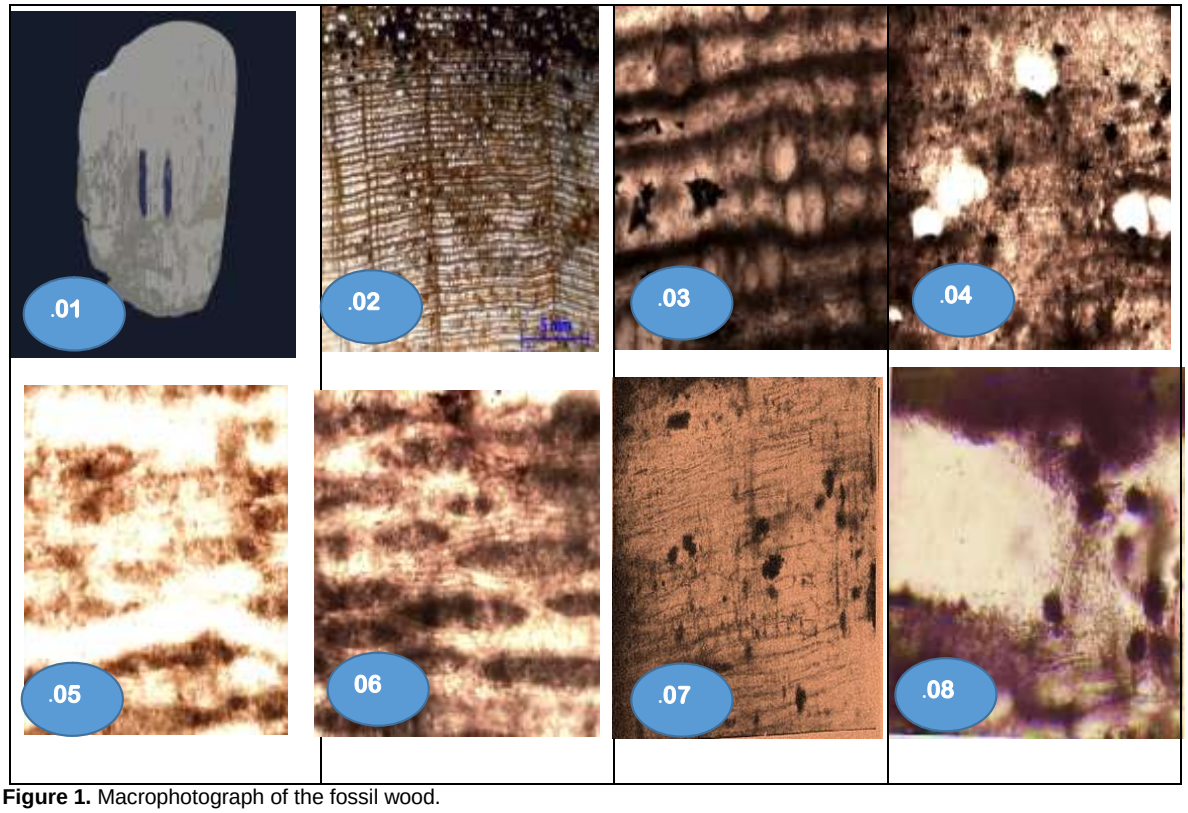
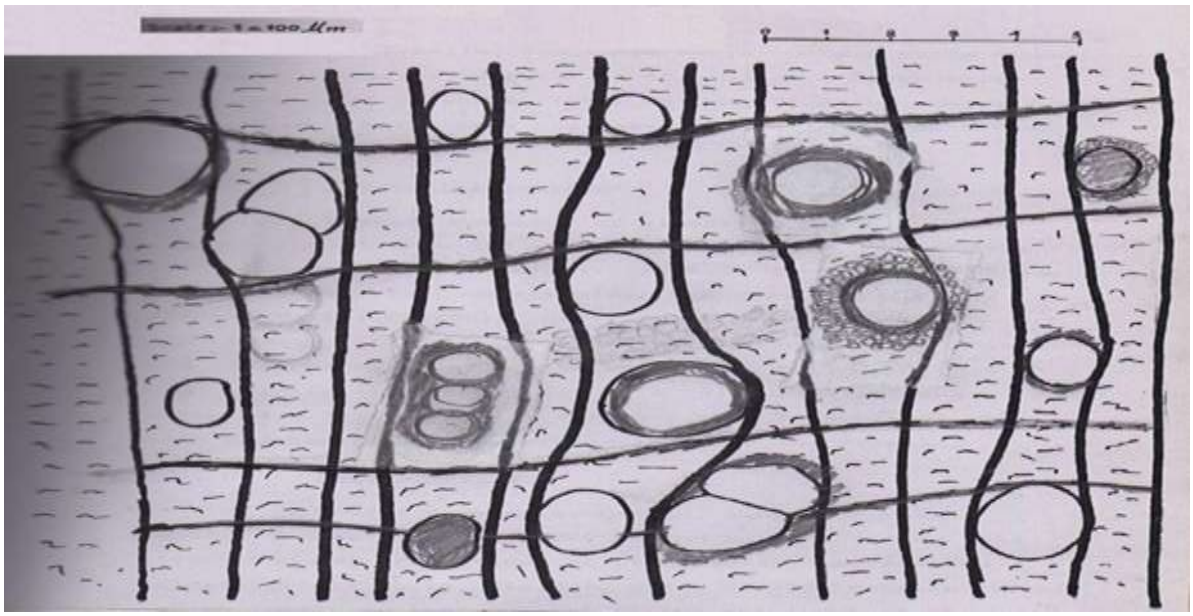


Figure 1. Macrophotograph of the fossil wood.
Figure 2. Cross section showing general distribution of vessels and parenchyma. X 30.
Figure 3. Cross section showing arrangement of vessels, parenchyma and xylem rays. X 40.
Figure 4. Cross section showing parenchyma and fibers cells. X 40.
Figure 5. Tangential longitudinal section showing general distribution of xylem rays and end walls. X 40.
Figure 6. Tangential longitudinal section showing general distribution of xylem rays with parenchyma and fibers. X 40.
Figure 7. Radial longitudinal section showing fiber ray cutting. X 160.
Figure 8. Radial longitudinal section showing septation of vessels and pits on the wall of vessels. X 600.



*Burseroxylon baranesis*sp. nov.
Plate 1. Cross Section showing general distribution of vessels, rays and parenchyma

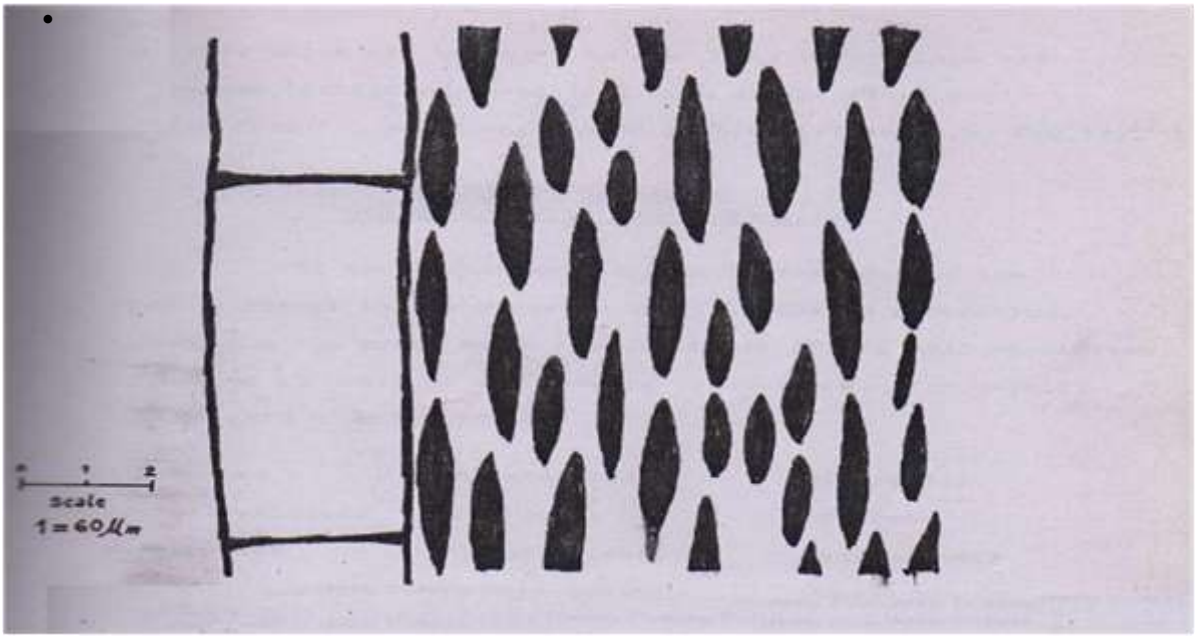


Plate 2. *Tangential Longitudinal section showing distribution of Xylem Rays and End Wall*

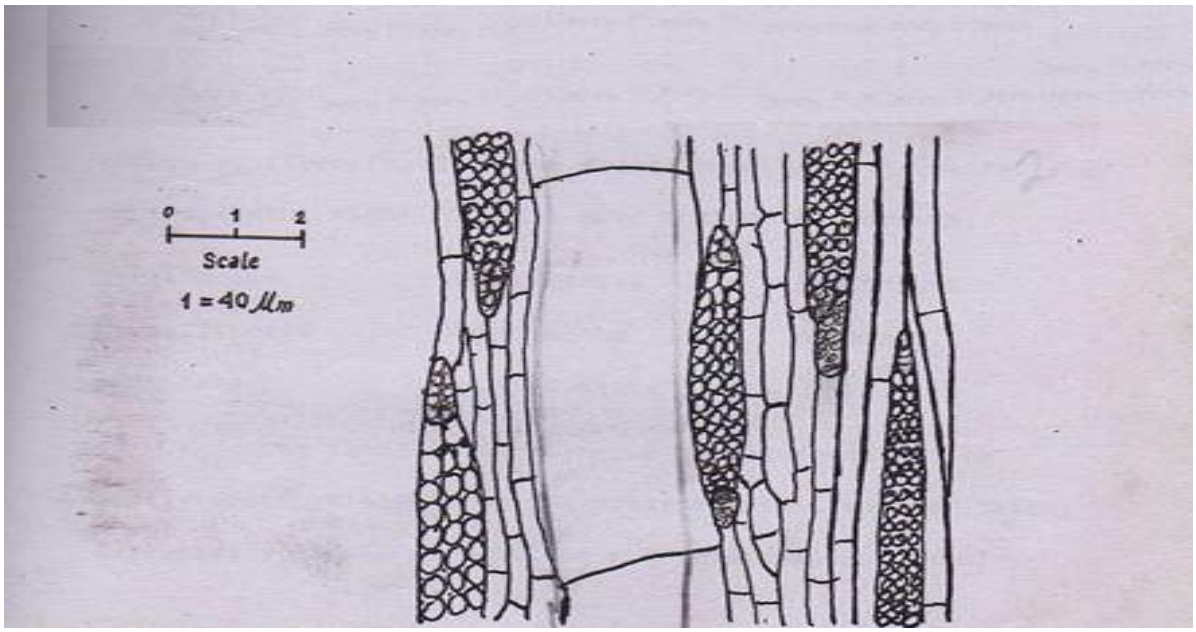


Plate 3. Tangential Longitudinal section showing enlarge xylem rays and fibres

CONCLUSION

Anatomical character such as diffuse porous wood with growth ring and other anatomical features such as scanty parenchyma indicate that the species were growing in tropical to sub-tropical type of climate. The presence of small and medium sized vessels suggest that fossil plant was inhabited in a climate with moderate rainfall. More data from studied area is needed to create a complete picture of climate and ecological conditions of the area at the time of deposition of such fossil wood.

AUTHOR'S CONTRIBUTION

J. Mangi: Manuscript writeup and Laboratory work
S. A. Khan: Helped in data collection
N. Soomro: Provided technical support
H. Naz: Helped in Laboratory work
M. Panhwer: Helped in data analylsis

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(Received: July 06, 2019; Accepted: June 30, 2020)