

## Full Length Article

# A report on petrified dicot Leaf *Deccanophyllites sheikhii* from the Deccan Intertrappean Beds of Central India

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### ABSTRACT

*In vitro* studies were conducted to evaluate the efficacy of phylloplane fungi in controlling the leaf. A petrified dicot leaf having distinct midrib and lateral veins is reported from the Deccan Intertrappean Beds of Mohgaonkalan of Chhindwara District, Madhya Pradesh, India. The present petrified dicot leaf *Deccanophyllites sheikhii* is dorsiventral showing broad lamina without any hairy outgrowths. Leaf lamina consists of upper and lower palisade tissue and lower multilayered spongy parenchyma tissue. Few canals are present in this region. Vascular bundles are conjoint, collateral and open; vascular bundles are without bundle sheath. After comparing with living and reported fossil forms of dicot leaf, it is named as *Deccanophyllites* as it is collected from Deccan trap.

**Keywords:** Angiosperms, Cretaceous, Dicot leaf, Deccan Intertrappean, Petrified

### INTRODUCTION

The fossil flora of angiosperms is very well known from the Deccan Intertrappean Beds of Central India in the form of impression, petrification and fossilized fragment. The number of dicotyledonous and monocotyledonous leaves has been studied as petrification by many workers reported from these beds. The dicot leaves which could not be assigned to any of the modern families were described under the form genus *Phyllites* (Rode, 1935) and *Dicotylophyllum* (Sheikh, 1980). A few leaf impressions of modern genus *Smillaites* and *Flacourtiatites* (Nambudiri, 1970) are reported from these beds. Petrified dicot leaves reported from these beds are *Deccanophyllum intertrappea* (Sheikh and Kolhe, 1980), *Dorsiventrophyllum agasheii* (Kolhe, 1980); *Dorsiventrophyllum chitaleyii* (Mistri *et al.*, 1995); *Julianiophyllum sahnii* (Kapgata, 1999) and *Salicaceophyllum mohgaonensis* (Kapgata *et al.*, 2008); *Marcgraviaceophyllum mohgaonse* (Kapgata and Paliwal, 2009) A monocot leaf petrification of

*Aerophyllites* (Chitaley and Patil, 1970), *Thalassiophyllum mahabalei*, (Kokate, 2010); *Hydrocharitaceaphyllum patilii* (Narkhede and Nandeshwar, 2011) *Typhophyllites ganeshi* (Kokate, 2012) are also reported.

### MATERIAL AND METHODS

A piece of chert has been collected from a Mohgaonkalan, Chhindwada District, Madhya Pradesh (Lat. 21°31'–20°51' N and Long. 78°15'–79°20' E) Present fossil leaf was preserved in the silicified chert in the petrified form. After breaking the chert, the leaf was exposed in transverse section. The anatomical details were studied by etching the chert with hydrofluoric acid and taking various peel sections by applying cellulose to acetate peel technique.

The present specimen is dicotyledonous and dorsiventral leaf; having following characters- The present leaf specimen is showing central midrib and lateral lamina portion.

The lateral lamina portions are long on both the sides and preserved in folded form. The length of complete leaf is measuring about 12.3mm in length. The preservation in midrib portion is not well, but still small vascular bundles are seen (Fig.1, Plate1) . The midrib region is 1.4mm in thickness. On the right side lateral lamina shows 3.3 mm length and on left side 2.8 mm. Both lateral portions are not preserved well, but seen in folded form (Fig.1, Plate2).

#### **Epidermis**

The present leaf consists of upper and lower epidermis. The adaxial (upper) epidermis is well persevered and compactly arranged, one celled in thickness. Each cell is quite large and elongated, measuring 9µm in size. The upper epidermis is without stomata and any other outgrowths such as trichomes or hairs. The presence of thin layer of cuticle is present on upper epidermis. In abaxial (lower) epidermis is prominent and certain gaps are seen at places. They might be representing the position of stomata (Fig 1 and 2, Plate 2).

#### **Mesophyll tissue**

Mesophyll tissue is differentiated into palisade and spongy tissue. The cells of palisade tissue are not well preserved, but its position can be marked very well. Some chloroplasts are seen in cells of upper region in the form of dark brown colour. The palisade tissue is weakly developed and present in two rows. Its position is observed only above the lower epidermis, it is measuring 72 µm in size. Below the upper epidermis portion of the lamina is occupied by spongy tissue. The cells of spongy tissue consist of parenchymatous cells. They are oval to ellipsoidal in shape, loosely arranged having big intercellular spaces among them. It is measuring 92 µm in diameter. The presence of small canals is very distinct in the spongy parenchyma. Each canal is bounded by single layered thin walled parenchyma cells measuring about 134 µm in size (Fig.3 to 5, Plate 3)

#### **Midrib**

The Midrib consists of ground tissue which is not well preserved. Midrib measures 1.4x3.6 mm in size. At midrib region epidermis is somewhat thickened, it is followed by 4 to 5 layers of collenchymatous ground tissue measuring 80 µm thick that surrounds the vascular bundles. Few secretory canals are present in the ground tissue. Vascular bundle of midrib is large and triangular in

shape. But not preserved well, so tissue differentiation is not seen (Fig 1, plate 3).

#### **Lateral lamina**

Lateral lamina consists of vascular bundles measuring 0.1mm in size. Each vascular bundle is conjoint, collateral and open. The phloem is preserved towards the lower side and xylem facing towards the upper epidermis. The protoxylem facing towards upper epidermis and metaxylem elements towards lower epidermis. Protoxylem elements are small measuring 65µm in diameter and are spherical to oval in outline. Metaxylem elements are angular in outline, each measuring 94µm diameter. Phloem cells are not persevered (Fig.2, Plate3 and 5).

#### **Comparison and Discussion**

The verifying character of the fossil leaf under the consideration is dorsiventral and therefore, belongs to dicotyledonous family. Epidermis is single layered with cuticle without any outgrowths. Hypodermis is absent. Mesophyll is differentiated into palisade and spongy parenchyma (Fahn,1982) Below upper epidermis palisade tissue is weakly developed; the intercellular spaces are large, while on lower epidermis a well developed or prominent palisade tissue is present, such features are characteristics of hydromorphic leaves (Esau, 1979).

A single median vascular bundle without distinct bundle sheath, but not well persevered. Lateral vascular bundles are conjoint, collateral and open. Presence of distinct secretory canals in spongy tissue. Stomata like gaps restricted to the lower epidermis only.

#### **Comparison with fossil leaves:**

*Deccanophyllum intertrappea* (Sheikh and Kolhe, 1980) resembles in having differentiation of mesophyll tissue and secretory canals but saucer shaped vascular bundle is different from the present specimen.

The fossil specimen is compared with a fossil dorsiventral leaf *Dorsiventrophyllum agashei* (Kolhe,1980) having prominent median conjoint and collateral vascular bundle without bundle sheath, mesophyll differentiated into single layered palisade and spongy parenchyma and single layered epidermis. But in *Dorsiventrophyllum* secretory canals are present and absence of sinuous, large parenchymatous epidermal cells, triangular nature and size of vascular bundle is differing from present specimen.

*Dorsiventrophyllum chitaleyii* (Mistri *et al.*, 1995) differs in having absence of lateral veins, secretory canals and siphonostelic vascular bundle. *Julianiophyllum sahnii* (Kapgata, 1999) resemble in single layered epidermis with cuticle, differentiation of mesophyll tissue, presence of secretory canals, absence of hypodermis and any outgrowths triangular vascular bundle with pith, presence of lateral veins and shape and size of present specimen differ from *Julianiophyllum*.

The fossil leaf shows similarities with the genus *Ilex* of family Aquifoliaceae i.e. single layered epidermis with cuticle. Mesophyll with abundant intercellular spaces, vascular bundle enclosed in a ring of sclerenchyma which is absent in the present leaf. *Salicaceophyllum mohgaonensis* (Kapgata *et al.*, 2008) differ from present leaf with copact mesophyll tissue and presence of annular pitting in xylem elements. *Marcgraviaceophyllum mohgaonse* (Kapgata, 2009) of family Marcgraviaceae resembles with present leaf in general characters but differ in having presence of sclerenchymatous idioblast in mesophyll tissue.

*Thalasiophyllum mahabalei* (Kokate *et al.*, 2010); *Hydrocharitaceaphyllum patilii* (Narkhede and Nandeshwar, 2011); *Typhophyllites ganeshi* (Kokate, 2012) are all monocot leaves reported from the locality and having air chambers which are not observed in present dicot fossil leaf.

A petrified leaf *Cariceophyllum singhpurii* (Dhabarde, Sheikh and Kolhe, 2012) from Singhpur is also reported having air cavities in mesophyll tissue, but differing from present fossil leaf.

#### Comparison with living leaves-

With the help of above mention characters the fossil leaf is compared with the modern leaves of dicotyledonous family Caryocaraceae, Margraviaceae, Apocynaceae, (Metcalfe and Chalk, 1950) as their leaves are dorsiventral, having secretory canals without epidermis outgrowths and stomata mostly confined to the lower epidermis. Mesophyll differentiated into upper palisade and lower spongy parenchyma with intercellular spaces. But leaves of these families are widely differing from the present specimen as they are with thick cuticle, 1-2 layered hypodermis and vascular bundles enclosed by a complete sclerenchymatous ring.

In Apocynaceae, presence of bicollateral vascular bundle and cystolith in between palisade and spongy parenchyma, also it takes away from

the fossil specimen. Genus *Lacistema* of family Lacistemaceae resembles in having lamina dosiventral, stomata on lower surface, mesophyll 1 to 2 rows of palisade cells but differ from the present leaf because of saucer shaped vascular stards and lamina without any secretory canals.

Genus *Scheffera* of family Araliaceae similar in general characters but mainly differs in presence of abundant hairs on leaves and saucer shaped vascular bundles in midrib.

Leaves of family Caprifoliaceae in genus *Linnea* resemble in 1-2 layered palisade tissue, intercellular spaces present in the spongy tissue, stomata present on lower epidermis but mainly differs in having glandular and non glandular hairs on lamina and veins consists of bicollateral vascular bundles.

*Bergia* of family Elatinaceae resembles in absence of epidermal outgrowths and hypodermis, and presence of secretory canals but widely differ from present specimen in having stomata on both the surfaces. In the present specimen only some stomata like gaps are seen in the lower epidermis. Similarly, irregular distribution of palisade tissue and vascular bundles by a complete parenchymatous ring in *Bergia* are differing from the present specimen.

*Symplocos* of Symplocaceae resembles in leaves without any outgrowths, thick cuticle and 1-2 palisades and loosely arranged spongy tissue but differs from present leaf in presence of hypodermis and crescent shaped vascular bundles in midrib and veins.

The comparison of present specimen with family Hamamelideace shows following similarities-

The single layered epidermis with cuticle, without any outgrowths. Mesophyll differtiation into palisade and spongy parenchyma, absence of sclerenchyma around the vascular bundle. The present fossil leaf differ in Hamamelidaceae in the minor differences such as shape and size.

The fossil leaf under consideration shows that it does not have any affinities to fossil leaf specimens described so far from Deccan Intertrappean beds. As the present fossil shows number of important characters to the family Hamamelidaceae, so the fossil leaf kept under this family Hamamelidaceae The generic name is given after the series Deccan Intertrappean beds *Deccanophyllites sheikhii* a specific name given the eminent palaeobotanist Dr. M.T. Sheikh.

***Deccanophyllites sheikhii* gen. et. sp. nov.**

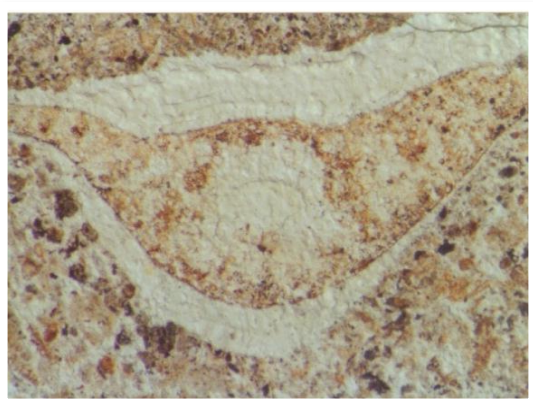


Plate - 1: The leaf exposed transversly on the fossiliferous chert, (10x1).

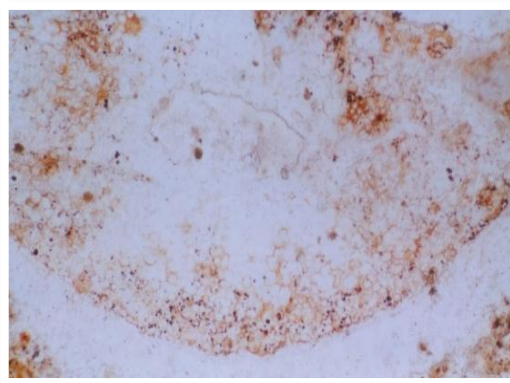


Plate - 2: T.S. of leaf as exposed on fossiliferous rock showing ill preserved median vascular bundle and lower epidermal region of leaf cellular details, (10x10).

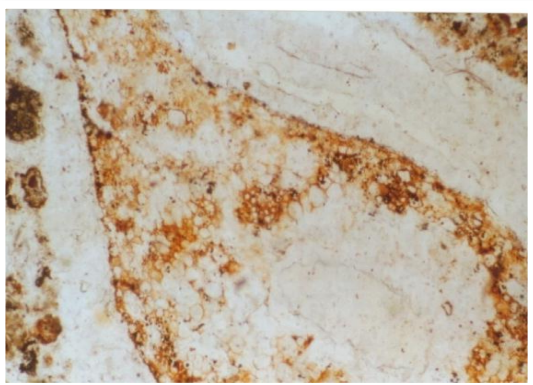


Plate - 3: Part of lamina enlarged to show palisade and spongy tissue and lateral vascular bundle,(10x4).

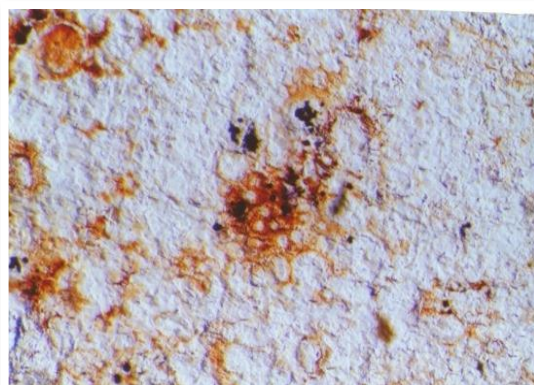


Plate - 4: Magnified vasculature showing metaxylem and protoxylem, (10x40).

**Diagnosis:**

***Deccanophyllites*** gen.nov. A petrified dicotyledonous dorsiventral leaf, epidermis is single layered with cuticle, without any outgrowths. Mesophyll differentiated into upper palisade parenchyma and spongy parenchyma between vascular bundle of lateral vein is conjoint, collateral. Secretary canals having single layered parenchymatous cell is present in mesophyll.

***Deccanophyllites sheikhii*** gen.et sp.nov.

A leaf measuring 12.3mm in length, lateral lamina on right side 3.3mm and on left side 2.8 mm in length. Midrib ranges 3.6 x 1.4mm in size. Epidermis single layered with cuticle, Mesophyll differentiated into palisade measuring 72 $\mu$  and spongy parenchyma with intercellular spaces, measuring 92 $\mu$  in diameter.

Median vascular bundle is not well preserved; lateral vascular bundle is conjoint, collateral,

triangular measuring 1mm in size. In mesophyll secretary canals present measuring 134 $\mu$ . Stomata like gaps restricted only in the lower epidermis. Meta xylem elements measuring 94 $\mu$  and protoxylem 72 $\mu$  in size.

**Holotype:** MOH/SVP/DICOT.-leaf

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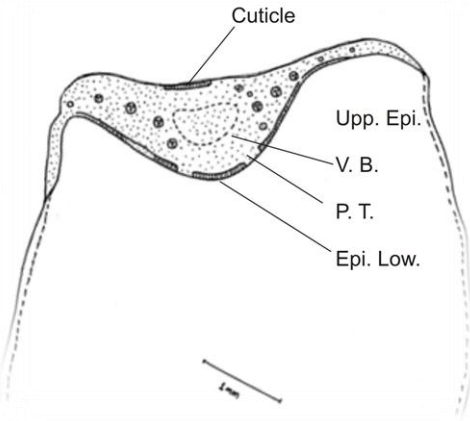
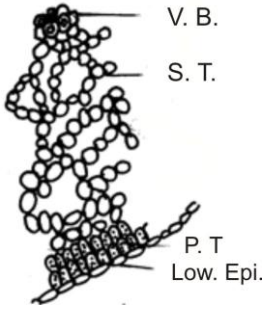
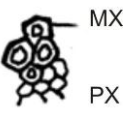
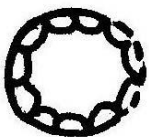
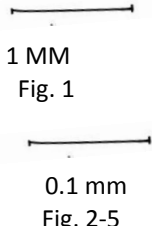
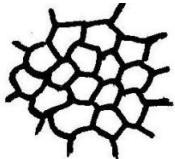
**Horizon:** Deccan Intertrappean series of India.

**Locality:** Mohgaonkalan, Dist. Chhindwara, M.P. India.

**Age:** Uppermost Cretaceous.

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 <p>Fig. 1: Dirametic presentation T.S. leaf with median vascular bundle and right arm along with vascular bundles of vein lets.</p>	 <p>Fig. 2: Mesophyll showing vascular bundle (VB), spongy tissue with intercellular spaces (ST), palisade tissue on lower epidermis (PT and LE).</p>	 <p>Fig. 3: Vascular bundle showing metaxylem (MX) and protoxylem (PX).</p>
 <p>Fig. 4: Parenchymatous cells.</p>	 <p>1 MM Fig. 1</p> <p>0.1 mm Fig. 2-5</p>	 <p>Fig. 5: Secretory canal.</p>

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