



A Petrified Fossil Dicot Leaf *Acanthophyllum shibliigen. et sp. nov.* From Deccan Intertrappean Exposures of Shibla, Yeotmal District, Maharashtra State, India.

Ramteke D. D.¹ and Kapgate D. K.²

Dept. of Botany, J. M. Patel College-Bhandara (M.S.).

deeplifesc@gmail.com

Abstract:

The paper deals with the anatomical description of a fossil leaf collected from the Deccan Intertrappean sedimentary beds of the fossiliferous locality Shibla from Yeotmal district of Maharashtra. However petrified leaves showing mature and young conditions are studied for anatomical details first time from these exposures. The present fossil specimen is a nicely preserved dicotyledonous and dorsiventral leaf exposed in its transverse plane. The anatomical details were studied by taking peel sections by applying cellulose acetate peel technique. The leaf has central midrib and lateral lamina. The lateral lamina is long and continuous on both the sides forms laminar wings. Epidermis is single layered without any outgrowths like hairs or trichomes. Stomata are restricted to the upper epidermis; Sub stomatal gaps are present on upper epidermis. The Mesophyll is differentiated into palisade and spongy parenchyma, the intercellular spaces are large. Epidermal and palisade cells larger and more numerous vessels in the midrib. Vascular bundle of midrib is single, large and having crescent shaped vascular strand. It is conjoint, collateral, endarch and siphonostelic type, sclerenchymatous bundle sheath present. Presence of secretory canals in midrib and spongy tissue.

The comparison is made with the recorded fossil leaf from the Deccan Intertrappean beds of India as well as living modern taxa. The fossil leaf resembles in many characters especially to the leaf of family Acanthaceae and named as *Acanthophyllum shibliigen. et sp. nov.* the specific name after the Intertrappean beds. The presence of family indicate palaeo ecological evidence in maastrichtian age during Deccan Intertrappean episode.

Keywords:

Fossil leaf, sedimentary beds, peel technique, Acanthaceae, crescent shaped etc.

Introduction:

The fossil flora is very well known from the Deccan Intertrappean Beds of India in the form of impression, petrification and fossilized fragment forms. The number of dicotyledonous and monocotyledonous root, stem, leaves, flowers and fruits has been studied as petrification by many workers reported from the Deccan Intertrappean Sedimentary beds of Central India.

The paper deals with the anatomical description of a fossil leaf collected from the Deccan Intertrappean sedimentary beds of the fossiliferous locality Shibla (Lat. 19°58.141'N, Long. 78°40.838'E) a new locality near Pandharkawda from Yeotmal district of Maharashtra. So far, monocot roots and a dicot wood,





Sahnipushpum flower, seeds of *Indovitis*, fruits of *Graminocarpon* and other grains have been reported from this locality. However petrified leaves showing mature and young conditions are studied for anatomical details first time from this exposure.

The dicot leaves which could not be assigned to any of the modern families were described under the form genus *Phylites*(Rode,1935) and *Dicotylophyllum* (Sheikh, 1980). A few leaf impressions of modern genus *Smillaites* and *Flacourtiatites* (Nambudiri, 1970) are reported from Deccan Intertrappeanbeds. 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* (Kapgate,1999) and *Salicaceo phylum mohgaonensis* (Kapgate *et al.*, 2008); *Thalassiophyllum mahabalei* (Kokate P.S., Bobade M.B., 2010); *Marcgraviaceophyllum mohgaonse* (Kapgate and Paliwal, 2009); *Cariceophyl lumsinghpurii* (Dhabarde P.F., Sheikh M.T., 2012); *Typhophyllites ganeshii* (Kokate P.S., Upadhye E.V., 2012); *Deccanophyllites sheikhii* (Kokate P.S; 2014) are reported from the Deccan Intertrappean exposures of central India.

Material and methods:

The present fossil specimen is a nicely preserved dicotyledonous and dorsiventral leaf exposed in its transverse plane. 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 specimen with hydrofluoric acid and taking peel sections by applying cellulose acetate peel technique (Darrah, 1936; Joy *et al.*, 1956; Stewart and Tylor, 1965; Holmes and Lopez, 1986).

Description-

The present specimen is dicotyledonous and dorsiventral leaf; showing central midrib and lateral lamina (fig. 1). The lateral lamina is long and continuous on both the sides forms laminar wings. It measured up to 8.0 mmin width. It measures 3.8 mm in left side whereas 4.2 mmin right side. The lamina is 0.1 to 1.3 mm thick. The lamina shows lateral veins. The right side lamina shows one lateral vein as well as on left side lamina has single lateral vein and measures up to 1.8 to 2.00 mmin thickness. The preservation in midrib portion is clear, showing vascular bundles. The midrib region is 4.1 to 5.6. mmin thickness. (Fig. 2).

Epidermis: The present leaf covered on both the surface by single layered upper and lower epidermis. The upper epidermis is well preserved and compactly arranged especially large rectangular parenchymatous cells, one celled in thickness. Each cell is quite large and elongated, measuring 17-20 μ m in size. The lower epidermal cells are comparatively smaller in size. The upper epidermis is with stomata with large stomatal cavity (Fig. 7). The leaf is without





any other out growths such as trichomes or hairs. Few secretory canals are seen enclosed in lamina and midrib region.

Mesophyll: Mesophyll tissue is differentiated into upper palisade and lower spongy tissues. The cells of palisade tissue are well preserved, elongated, and narrow. It is 1-2 layered measures 77-80 μm in height, some chloroplasts are seen in cells of upper region in the form of dark brown color. (Fig. 4, 6). Below the upper epidermis portion of the lamina is occupied by 2-3 layers of spongy tissue. The cells of spongy tissue consist of parenchymatous cells. They are ellipsoidal in shape, loosely arranged having intercellular spaces among them. It is measuring 65-72 μm in diameter. In between palisade and spongy tissue few canals are surrounded by single layered parenchyma cells are present which may be secretory canals measuring 135-142 μm in diameter.

Midrib: The Midrib consists of ground tissue which is well preserved and consists of bundle sheath, phloem, and xylem vessels (fig. 2). Midrib measures 4.1 x 5.6 mm in size. At midrib region epidermis is somewhat thickened, it is followed by 4 to 5 layers of 86-97 μm thick fibrous sclerenchymatous stone cells. Towards the lower side followed by 5-6 layers of collenchymatous ground tissue measuring 153-176 μm thick that surrounds the vascular bundles. Few secretory canals are present in the ground tissue.

Vascular Bundles: Vascular bundle of midrib is large and having crescent shaped vascular strand including xylem vessels arranged in radial rows 0.40-0.20 mm in size. It is conjoint, collateral, endarch and siphonostelic type (fig. 3). In the center presence of parenchymatous pith measures 40-53 μm thick. The pith is covered by large and numerous triangular xylem vessels measure 40-70 μm thick, arranged in radial manner. It is differentiated into metaxylem and protoxylem. Metaxylem elements are 5 to 8 celled and measures 80-90 μm in thickness made up of rectangular to hexagonal xylem vessels. Each vessel is 35 μm to 40 μm in size. Protoxylem elements are in 3 to 4 layers and 55-65 μm thick and vessel is 45-55 μm in size.

Xylem externally surrounds by 5-6 layers of phloem tissue. The complete vascular bundle enclosed by 1-2 layered 90-95 μm thick fibrous sclerenchymatous bundle sheath.

Lateral Vein: Lateral veins are small, triangular present on both sides of lamina. Each lateral vein measures 0.18 -0.25mm in size (fig. 5). Vascular bundles of vein cut transversely and are conjoint, collateral, and endarch. Vascular bundles of lateral veins are covered by collenchymatous ground tissue.

Result and discussion:

The verifying character of the fossil leaf under the consideration is dorsiventral and therefore, belongs to dicotyledonous family.

- Epidermis is single layered without any outgrowths like hairs or trichomes.





- Stomata are restricted to the upper epidermis.
- Sub stomatal gaps are present on upper epidermis.
- Hypodermis is absent.
- Mesophyll is differentiated into palisade and spongy parenchyma, the intercellular spaces are large. Epidermal and palisade cells larger and more numerous vessels in the midrib.
- Vascular bundle of midrib is single, large and having crescent shaped vascular strand.
- It is conjoint, collateral, endarch and siphonostelic type, sclerenchymatous bundle sheath present.
- Single lateral vein on both the sides, lateral vascular bundles are conjoint, collateral and open.
- Presence of secretory canals in midrib and spongy tissue.

Comparison with Fossil Leaves-

For identification of the present petrified fossil dicot leaf comparison is made with the recorded fossil leaf from the Deccan Intertrappean beds of India such as *Aerophyllites* (Chitalay and Patil, 1970) differs in having air chambers in mesophyll tissue. *Deccanophyllum intertrappea* (Sheikh and Kolhe, 1980) resembles in having differentiation of mesophyll tissue and secretory canals but saucer shaped vascular bundle is differ 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* (Mistriet al.,1995) differs in having absence of lateral veins, secretory canals and siphonostelic vascular bundle. *Julianiophyllum sahnii* (Kapgate, 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*. *Salicaceophyllum mohgaonensis* (Kapgateet al., 2008) differ from present leaf with compact mesophyll tissue and presence of annular pitting in xylem elements. *Marcgraviaceophyllum mohgaonse* (Kapgate, 2009) of family Marcgraviaceae resembles with present leaf in general characters but differ in having presence of stomata on upper surface.

Comparison with Modern Living Taxa-

With the help of diagnostic characters observed the fossil leaf is compared with the modern leaves of dicotyledonous family Lacistemaceae, Anacardiaceae, Marcgraviaceae, Apocynaceae, Acanthaceae, Leguminosae,





Eucomiaceae, Schisandraceae, Winteraceae, Saxifragaceae (Metcalf and Chalk, 1950).

The leaf of these families resembles with present leaf in having general characters of xerophytic leaf but they differ in various respect from the present leaf such as in genus *Lacistema* of family Lacistemaceae compared in palisade 1-2 layered, lacunar spongy tissue, saucer shaped vascular bundles but widely differs in having stomata on lower epidermis, absence of secretory canals, hairs on leaf. Leaves of family Anacardiaceae consisting of 2 layers of palisade cells and a broader region of spongy tissue, vascular bundles provided with presence of secretory canal in the phloem and on the upper side of the xylem but differ in hairs, papillose epidermis, slightly interrupted ring of vascular bundles. The leaf of Apocynaceae resembles in presence of crescent shaped vascular bundle, secretory cells in palisade tissue, Epidermis is with specially large cells on the upper surface in species of *Allamanda*, *Beaumontia*, *Cerbera*, *Vinca*, *Apocyna* but differ in bicollateral vascular bundles takes away from the fossil specimen.

Leaves of Eucomiaceae resembles in having crescent shaped vascular bundle including xylem vessels arranged in radial rows, secretory cells situated in the mesophyll cells but differs from present specimen in having hairs, stomata to the lower surface. In Schisandraceae vascular bundles crescent shaped, presence of secretory element but differ in having 1-3 layered palisade parenchyma, stomata on both surface, presence of ridge cuticle. In Winteraceae leaves are glabrous, vascular bundle embedded in sclerenchyma secretory cells generally present but differ in having patches of vascular bundles. In Saxifragaceae stomata confined to the upper surface in some species of *saxifrage*, secretory cells are present but not differentiated in palisade and spongy tissue.

In Acanthaceae leaf dorsiventral, mesophyll differentiated into upper palisade and lower spongy parenchyma tissues, 1-2 layered palisade tissue found in *Acanthopsis*, *Lepidagathis*, *Barleria*, *Blepharis*, *Justicia*, *Ruellia*. The stomata are found in upper epidermis, single lateral vein at both the sides, the secretory cells are found in *Aphelandra*, *Ruellia* leaf, small prismatic crystals present throughout the mesophyll of *Andrographis echioides*, arc or crescent shaped vascular strand found in *Barleria*, *Ruellia*.

It is evident from the above comparison that the fossil leaf resembles in many characters especially to the leaf of family Acanthaceae hence the present fossil leaf is kept under the family Acanthaceae and named as *Acanthophyllum shiblii*gen. et spnov., the specific name after the Intertrappean beds.

Palaeoecological significance-

Ecologically the family is found mostly Holarctic, Paleotropical, Neotropical. Mostly found in tropical. Centered on Indomalaysia, Africa, Brazil



and Central America. The presence of family indicate palaeoecological evidence in maastrichtian age during Deccan Intertrappean episode.

Holotype: DDR/Ang. Leaf/Deposited in Dept. of Botany, JMPC. Bhandara.

Horizon: Deccan Intertrappean Series.

Locality: Shibla, Yeotmal, Maharashtra, India.

Age: Uppermost Cretaceous (Maastrichtian) - Lower Eocene.

Diagnosis: *Acanthophyllum* gen. nov.

A petrified dicotyledonous dorsiventral leaf, epidermis is single layered with stomata, without any outgrowths. Mesophyll differentiated into upper palisade and lower spongy parenchyma, single lateral vein at both the sides of leaf, lateral vein is conjoint, collateral. Secretary canal showing single layered parenchymatous cell is present in mesophyll, Secretary cells are found.

***Acanthophyllum shiblii* gen. et sp. nov.**

A leaf measuring 8.0 mm in length, lateral lamina on right side 4.2 mm and on left side 3.8 mm in length and 10-13 μ m thick. Midrib ranges 4.1 x 5.6 mm in size. Epidermis single layered, Mesophyll differentiated into palisade measuring 77-80 μ m and spongy parenchyma with intercellular spaces, measuring 65-72 μ m in diameter. Median vascular bundle is well preserved, lateral vascular bundle is conjoint, collateral and open. In mesophyll secretory canals present measuring 135-142 μ m. Stomata are confined in the upper epidermis. Metaxylem elements measuring 80-90 μ m and protoxylem 55-65 μ m in size.

Systematic Position-

Angiosperms

Dicotyledons

Acanthophyllum gen. nov.

Acanthophyllum shiblii gen. et sp. nov.

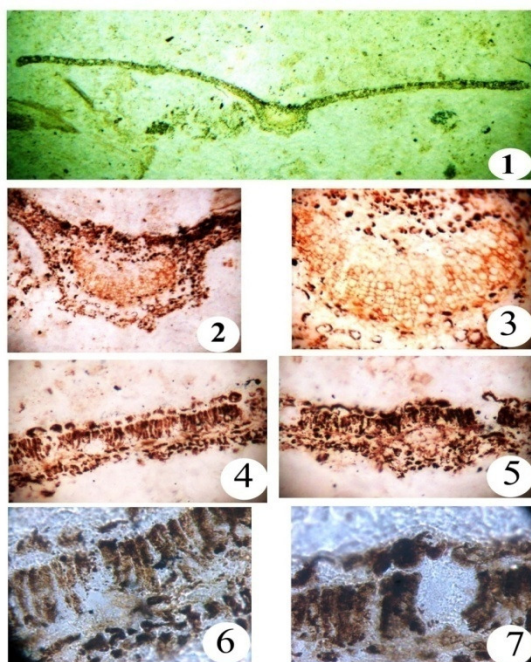


Figure. 1- Showing Petrified leaves transversely exposed on a chert (10x), **2.** Midrib showing bundle sheath, xylem and phloem (100x). **3.** Magnified view of bundle sheath and crescent shaped vascular bundle (400x). **4.** Mesophyll consisting of upper palisade tissue, lower spongy tissue and secretory canal. **5.** Well preserved lateral vein (100x). **6.** Mesophyll and palisade tissue magnified (400x). **7.** Magnified view of stomata showing guard cells and sub-stomatal cavity (400x).



References:

- Chitale S.D. and Patil G.V. (1970).** A petrified leaf from the Deccan Intertrappean beds of India. *Jour. Ind. Bot., Soc.*, **13**(2): 30-3.
- Dhabarde P.F., Sheikh M.T. and Kolhe P.D. (2012).** A Petrified leaf monocot leaf *Cariceophyllum singhpurii* from Singhpur, Tah.Sauser, Dist. Chhindwara, M.P., India. *Proceeding Nat. Con. Inno. Res. Trends in Bio. Sci Akola, M.S.*23-26
- Esau K. (1979).** Anatomy of seed plants. *J hn Wiley and Sons. Inc.* New York, 355.
- Fahn A. (1982).** Plant Anatomy 3rd Edi. *Pergamon Press*, New York, 211.
- Kapgate D.K. (1999).** A petrified dicotyledonous leaf from the Deccan Intertrappean beds of Mohgaonkalan, M.P., India. *Sci Jour.(Nag Uni)*, 10:6-13.
- Kapgate V.D., Kapgate D.K. and Sheikh M.T. (2008).** A petrified dicot leaf “*Salicaceophyllum mohgaonsis*” from Intertrappean beds of Mohgaonkalan, M.P., India. *Gond. Geol. Magz.*, 23(1):77-80.
- Kapgate D.K. and Paliwal P.D. (2009).** A petrified dicot leaf *Marcgraviaceophyllum mohgaonse*” from Deccan Intertrappean beds of Central India, India. *The Botanique* 14 (1):58-65.
- Kokate P.S., Bobade M.B. and Upadhye E. V. (2010).** A report of monocot leaf *Thalassiophyllum mahabalei* from Mohgaonkalan, M.P. India. *Bioinfolet7* (4):327-332.
- Kokate P.S., Upadhye E. and Patil G.V. (2012).** *Typhophyllites ganeshiigen.et* sp. nov., a monocotyledonous leaf from Deccan Intertrappean Beds of Mohgaonkalan, Chhindwara District, Madhya Pradesh, India. *Geophytology* 42 (1):21-26.
- Kokate P.S., Pundkar S.V. and Thorat K.M. (2014).** A report on petrified dicot Leaf *Deccanophyllites sheikhiifrom* the Deccan Intertrappean Beds of Central India.
- Metcalf C.R. and Chalk L .(1950).** Anatomy of the Dicotyledonous. *Oxford University at the Clarendon press* London, I:499 .
- Mistri P.B., Sheikh M.T. and Kapgate D.K. (1995).** A petrified dicot leaf from the Deccan Intertrappean beds of Mohgaonkalan, M.P., India. *Nag. Uni. Jour(Sci.)*. **7**:1-6.
- Nambudiri E.M.V, (1970).** Two new leaf impressions from the Deccan Intertrappeanbeds of India. *Sci. Cult.*, 36(8):479-480.
- Narkhede S.D. and Nandeshwar N.P. (2011).** Identification of new fossil monocot leaf from Deccan Intertrappeanbed of Singpur M.P. India. *BionanoFrontier* 4 (2): 333-334.
- Rode K.P. (1935).** On a dicotyledonous leaf impression “*Phyllites mohgaonse*”, sp. Nov .from the Deccan Intertrappean beds.*Proc. 22nd Ind. Sci. Congr. III*: 209.
- Sheikh M.T. (1980).** Three new dicotyledonous leaf impression from the Deccan Intertrappean beds of India. *Botanique*, 9:121-312.
- Sheikh M.T. and Kolhe P.D. (1980).** A new dicot leaf petrification from the Deccan





Intertrappean Beds of India. *Botanique* 9:179-1.

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