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Ficoxylon fusiforme (Moraceae), a New Species from Upper Cretaceous Nubian Sandstone in Southern Egypt

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A NEW species of *Ficoxylon* Kaiser (Moraceae) is described from Upper Cretaceous Nubian Sandstone in the Aswan area, southern Egypt. The new species is designated *Ficoxylon fusiforme*. This is the third report of a Cretaceous wood attributed to *Ficoxylon* spp. worldwide, the other two being *F. cretaceum* Schenk and?*F.* sp. of Kräusel, both also from Egypt. Species of *Ficoxylon* are common in the tertiary, from the Paleocene to the Pliocene. An emended generic diagnosis is proposed for *Ficoxylon*, which was erected in 1880 with few details. The new species is compared with the 18 currently recognized species of *Ficoxylon*/*Ficus*. It is distinguished by a combination of characters: predominantly solitary, few, relatively wide vessels; axial parenchyma bands 3–8 cells wide; 2–7 seriate, spindle-shaped, closely spaced, and slightly heterocellular rays; and thin-walled, nonseptate fibers. Comments are made on the Egyptian fossil remains of Moraceae and on all Egyptian Cretaceous wood taxa reported to date. Preliminary biogeographic and climatic implications are made.

Keywords: Aswan area, Egypt, *Ficoxylon*, Late Cretaceous , Moraceae, Nubian Sandstone.

Introduction

The Cretaceous flora of Egypt was first studied by Unger (1858) who described and illustrated the gymnosperm wood *Dadoxylon aegyptiacum* from Gebel Garra (west Aswan). Subsequently, more than 100 Egyptian Cretaceous plant fossils have been described (e.g., Kräusel, 1939; El-Saadawi & Farag, 1972; Vaudois-Miéja & Lejal-Nicol, 1987; El-Saadawi & Kedves, 1991; Youssef et al., 2000; Kamal El-Din, 2003; Kedves et al., 2004a, b; Youssef & El-Saadawi, 2004; Kamal El-Din et al., 2006, among others). Twenty of these are petrified woods, including 7 gymnosperms, 2 monocots, and 11 dicots. All have been assigned to families and genera except two (Farafra Oasis wood 1FO and Farafra Oasis wood 6FO) that have been described and illustrated by Kamal El-Din et al. (2006) but not assigned to specific families (Table 1).

This paper is a contribution to the study of Cretaceous woods from Egypt and describes one new morphospecies of *Ficoxylon* from Upper Cretaceous Nubian Sandstone in the Aswan area, southern Egypt.

Materials and Methods

The locality from which the material examined in this study was collected lies along the road between Aswan and Abu-Simbel, at latitude 23°47′3.3″N and longitude 32°31′55.18″E, where the Upper Cretaceous Nubian Sandstone outcrops (Fig. 1). The name Nubian Sandstone was first proposed by Russeger (1837) to designate the clastic sequence of sediments that rest over the Pre-Cambrian basement rocks and underlie the Maastrichtian fossiliferous phosphate beds (Duwi Formation) in southern Egypt (Tawadros, 2011). This sequence consists of six formal formations that are, from bottom to top, the Six Hills, Abu Ballas, Sabaya, Maghrabi, Taref, and Quesir formations (Hermina, 1990). Paleobotanically, the Nubian Sandstone is considered one of the most

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important fossiliferous sequences. The hitherto known Cretaceous flora of this sequence consists of petrified woods, impressions of leaves, and casts of fruits belonging to ferns, gymnosperms, and angiosperms that are predominantly dicots (El-Saadawi et al., 2020).

In March 2016, four specimens of petrified wood were collected from the Taref Formation, which contains abundant petrified woods and other plant remains. The age of this formation has been dated as Turonian by Barthel & Boettcher (1978) and Klitzsch et al. (1979), late Turonian–Coniacian by Van Houten et al. (1984), and Santonian–Campanian by Ward & McDonald (1979) (Tawadros 2011).

Thin sections in the transverse (TS), tangential (TLS), and radial (RLS) planes were prepared using conventional rock cutting and grinding techniques (e.g., Jones & Rowe, 1999). Three of them (TF-ZN.P02, TF-ZN.P03, TF-ZN.P04) were poorly preserved, only allowing identification of the specimens as gymnosperms. The fourth specimen (TF-ZN.P01), a dicot, was found to be well enough preserved to observe anatomical details. The specimens and the slides are deposited in the paleobotanical collection of Wagieh El-Saadawi Laboratory, Botany Department, Faculty of Science, Ain Shams University, Egypt. The anatomical description of the dicot fossil wood follows the terminology of the IAWA Hardwood Feature List (IAWA Committee 1989), and its botanical affinities were determined using the family descriptions of Metcalfe & Chalk (1950) and by searching the Insidewood online database (Insidewood 2004-onward). The systematics follow the APG III (2009) Classification System, and the fossil species names and synonyms follow Gregory et al. (2009).

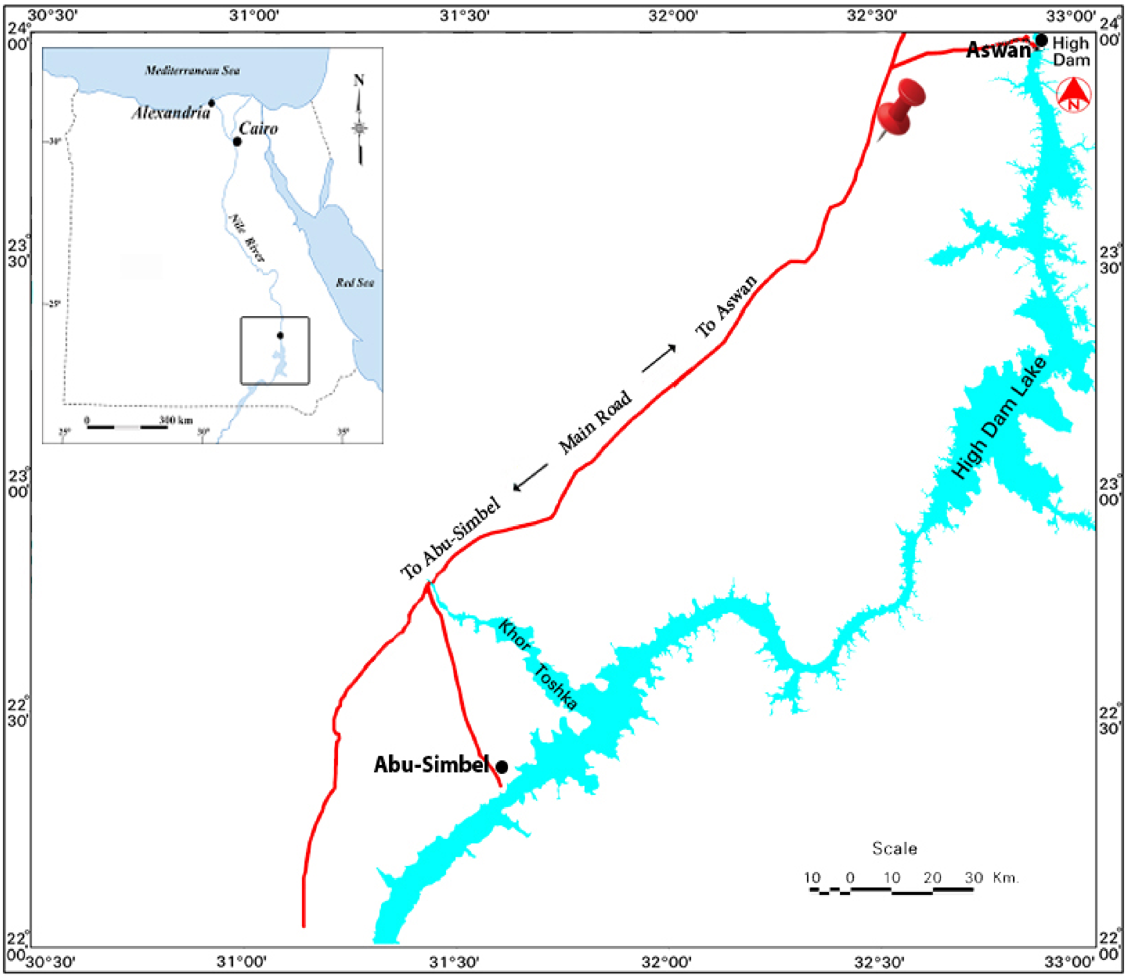

Fig. 1. Map showing the locality where the Upper Cretaceous Nubian Sandstone outcrops (indicated by a pin) [Aswan and Abu-Simbel desert road, southern Egypt]

TABLE 1 . A systematic list of the 20 xylotypes, hitherto, known from the Cretaceous of Egypt and their localities (based on: 1- Unger, 1858; 2- Schenk, 1883; 3- Kräusel & Stromer, 1924; 4- Kräusel, 1939; 5- Youssef et al., 2000; 6- Kamal El-Din, 2003; 7- Kedves et al., 2004a; 8- Kedves et al., 2004b; 9- Youssef & El-Saadawi, 2004; 10- Kamal El-Din et al., 2006)

Family/Xylotype	Locality	Reference
GYMNOSPERMS		
Araucariaceae Henkel & Hochstetter		
Agathoxylon lifiyii Youssef et al.	Kharga Oasis, Wadi Gabgaba	5
Agathoxylon sp. of Kedves et al.	Kharga Oasis	8
?Araucariaceae Henkel & Hochstetter		
Dadoxylon aegyptiacum Unger	Nubian Sandstone, Regenfeld, zone between Regenfeld and Dakhla Oasis, Gebel Dabadib (Kharga Oasis), Wadi Halfa (Nubian Sandstone), Dabha at the Nile (Nubian Sandstone), El-Kâb (south Egypt, Nubian Sandstone), Gebel El-Harra (Bahariya Oasis), Ain El-Häss (Bahariya Oasis), Gebel Garra (west Aswan), east Aswan, north Eastern Desert	1, 2, 3, 4
Cupressaceae Bartlett		
? *Cupressinoxylon* sp. of Kräusel	Gebel Hufhuf, Bahariya Oasis	3
Podocarpaceae Endlicher		
cf. *Podocarpoxylon* sp. of Kedves et al.	Aswan area, west Nasser Lake	7
Podocarpaceae? Endlicher		
Metapodocarpoxylon sp. of Youssef & El-Saadawi	Kharga Oasis	9
Protophyllocladoxylon leuchsi Kräusel	Gebel Dabadib, Kharga Oasis	4
MONOCOTS		
Arecaceae Schultz-Sch. (Palmae Juss.)		
Palmoxylon stromeri Kräusel	Wadi Hammam	3, 4
P. zitteli Schenk	Dakhla Oasis	2, 3, 4

TABLE 1 . Cont.

Family/Xylotype	Locality	Reference
EUDICOTS		
Celastraceae R.Br.		
Celastrinoxylon celastroides (Schenk) Kräusel	south Farafra zone between Regenfeld and Ammonites Hill, Farafra Oasis (Hefhuf Formation)	2, 4, 6
?*Celastrinoxylon* sp.	Gebel Garra (west Aswan), Bahariya Oasis (Gebel Hefhuf Formation)	4
Combretaceae R.Br.		
Terminalioxylon intermedium (Kräusel) Mädel-Angeliewa & Müller-Stoll	Regenfeld south Dakhla Oasis, zone between Regenfeld and Dakhla Oasis, Gebel Garra (west Aswan), Bahariya Oasis (Gebel Hefhuf Formation)	4
Ebenaceae Gürke		
Ebenoxylon ebenoides (Schenk) Edwards	zone between Regenfeld and Ammonites	2, 4
Malvaceae Juss.		
Hibiscoxylon niloticum Kräusel	Dakhla Oasis	4
Moraceae Link		
Ficoxylon cretaceum Schenk	Farafra Oasis, Gebel Garra (west Aswan)	4, 6
? *Ficoxylon* sp.	Regenfeld south Farafra Oasis, Nubian Sandstone	4
Proteaceae Juss.		
Proteoxylon chargeense Kräusel	Kharga Oasis	4
Theaceae Mirb. ex. Gawl.		
Schimoxylon dachalense (Kräusel) Kramer	Dakhla Oasis	4
Anacardiaceae/Lauraceae/Moraceae		
Unnamed dicot wood 1FO of Kamal El-Din et al.	Farafra Oasis	10
Unknown family		
Unnamed dicot wood 6FO of Kamal El-Din et al.	Farafra Oasis	10

Results

Systematic description

Order **Rosales** Bercht. & J. Presl (1820)

Family **Moraceae** Gaudich (1835), nom. cons.

Genus ***Ficoxylon*** Kaiser 1880 emend. El-Noamani Z.M.

The genus *Ficoxylon* Kaiser, 1880 was erected without a diagnosis; only the type species, *F. bohemicum*, was described. Kaiser indicated that *Ficoxylon* wood is distinguished by banded axial parenchyma alternating with bands of fibers, relatively wide vessels that are irregularly scattered, and with crystalliferous cells in parenchyma, as in the present-day genus *Ficus*.

A diagnosis for the genus *Ficoxylon* is proposed here, based on the description of the type species and features that occur in the other species assigned to this taxon.

Generic diagnosis: Wood with indistinct growth rings, diffuse-porous. Vessels solitary or in short radial multiples of 2–3 (–4), tangential vessel diameter averages >100µm, vessels few (average ≤5/mm^2), tyloses present, perforation plates exclusively simple. Intervessel pits small to large, alternate, crowded, polygonal, or rounded; vessel-ray pits with much reduced borders. Axial parenchyma abundant, arranged in regular bands of more than three cells wide alternating with bands of fibers. Rays multiseriate, rarely uniseriate, commonly more than four cells wide, sheath cells sometimes present, homocellular or heterocellular, nonstoried. Fibers without distinctly bordered pits, predominantly nonseptate, mostly very thin to thin-walled. Crystalliferous parenchyma cells present.

Type species: ***Ficoxylon bohemicum*** (Schleiden) Kaiser 1880; Oligocene, Bohemia, Czech Republic.

Synonyms: Ungerites tropicus Schleiden in Schmid & Schleiden 1855; *Ficoxylon tropicum* (Schleiden) Felix 1883.

The original description of the type species is provided with translation for reader reference.

Diagnosis of Ficoxylon bohemicum

Ligni strata concentrica inconspicua (amplissime?). Radii medullares homomorphi, confertissimi, maximi, pluriseriales, corpore maximo elongato. Vasa amplissima (0.143–0.278 mm), breviarticulata, irregulariter disposita, plerumque 2–3 (raro 7–8) natim connatim, dissepimentis obsoletis. Parietes verticales eorum poris areolatis magnis, confertis, spiraliter dispositis (saepe polygonatis) obsiti. An vasa minima tracheides? Cellulae ligni parenchymatosae (metatracheales) in taenias tangentiales, simul et vasa et cellulas crystallophoras continentes, coalitae. Taeniae complures in Strato quoque annuali, cum taeniis cellularum prosenchymatosarum subpachyticharum alternantes (Kaiser, 1880, p. 499).

Growth ring boundaries indistinct; rays homogenous, multiseriate, wide, and very long; large vessels (0.143–0.278mm), irregularly distributed, usually in short radial multiples of 2–3 (rarely 7–8), mostly 2; intervessel pits large, dense, spirally arranged (often polygonal); metatracheal parenchyma in tangential bands; crystals occur in parenchyma cells [Translated by the author from Latin].

Species: ***Ficoxylon fusiforme*** El-Noamani, Z.M. sp. nov. (Figs. 2, 3)

Specific diagnosis: Vessels mostly solitary and rarely in radial multiples of two, tyloses present; perforation plates simple with slightly oblique end walls; axial parenchyma abundant, paratracheal parenchyma narrow vasicentric, apotracheal parenchyma in 3–8 seriate, continuous and discontinuous tangential bands; fibers libriform, nonseptate, very thin-walled; rays 2–7 (mostly 4–5) seriate, spindle-shaped in tangential view, closely spaced, slightly heterocellular. Crystals not observed.

Holotype: TF-ZN.P01, a loose fragment of 10 cm in length and 3.5 cm in diameter.

Type locality: Road between Aswan and Abu-Simbel (Aswan area, southern Egypt).

Stratigraphic horizon: Nubian Sandstone, Taref Formation.

Age: Late Cretaceous.

Derivation of name: The specific epithet "*fusiforme*" is for the spindle-shaped rays.

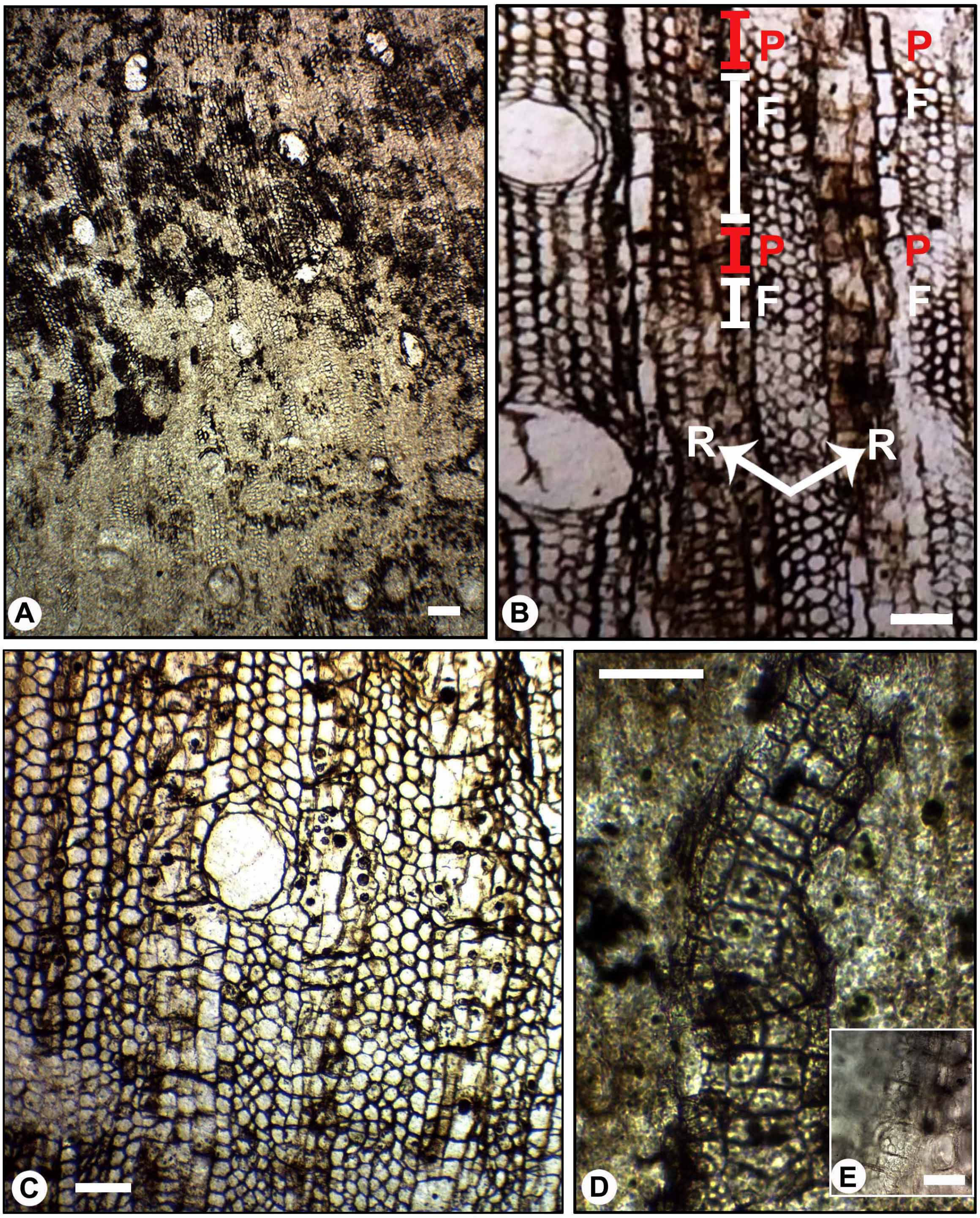

Fig. 2. ***Ficoxylon fusiforme*** **El-Noamani Z.M. sp. nov. – A: Diffuse-porous wood, vessels predominantly solitary, occasional radial multiples, TS. – B & C: Axial parenchyma bands (P) alternating with fiber bands (F) and wide multiseriate rays (R), TS. – D & E: Vessel-ray parenchyma pits, RLS. Scale bars= 200µm in A; 100µm in B, C, D; 50µm in E**

Repository: The paleobotanical collection of Wagieh El-Saadawi Laboratory, Botany Department, Ain Shams University, Cairo, Egypt.

Description: Growth rings indistinct; wood diffuse-porous, vessels predominantly solitary, rarely in groups of two, randomly arranged, solitary vessel oval in outline in TS section, vessel tangential diameter range 100–190µm, mean 150µm, vessel radial diameter range 160–260µm, mean 210µm, vessel frequency 2–6 per mm², mean 4 per mm². Perforation plates simple with slightly oblique end walls. Thin-walled tyloses present. Intervessel pits alternate, small–medium (5–7µm) with angular outline. Vessel-ray parenchyma pits with much reduced borders to apparently simple, pit outline rounded, 10–14µm across. Vessel element length could not be measured because the abundant thin-walled tyloses obscured vessel element end walls. Fibers libriform, nonseptate, very thin-walled. Axial parenchyma narrow vasicentric, sheaths 1–2 cells thick and in bands of more than 3 cells wide (3–8 cells), continuous in some parts and discontinuous in others. Axial parenchyma strands of 2–11 (mostly 5–8) cells. Rays spindle-shaped, 2–7 (mostly 4–5) seriate, closely spaced, 12–15 per mm, nonstoried, ray height 7–24 (mostly 15–16) cells; ray height range 175–1050µm, mean 750µm; slightly heterocellular, with procumbent body cells and one row of square marginal cells of nearly similar height. Mineral inclusions not observed.

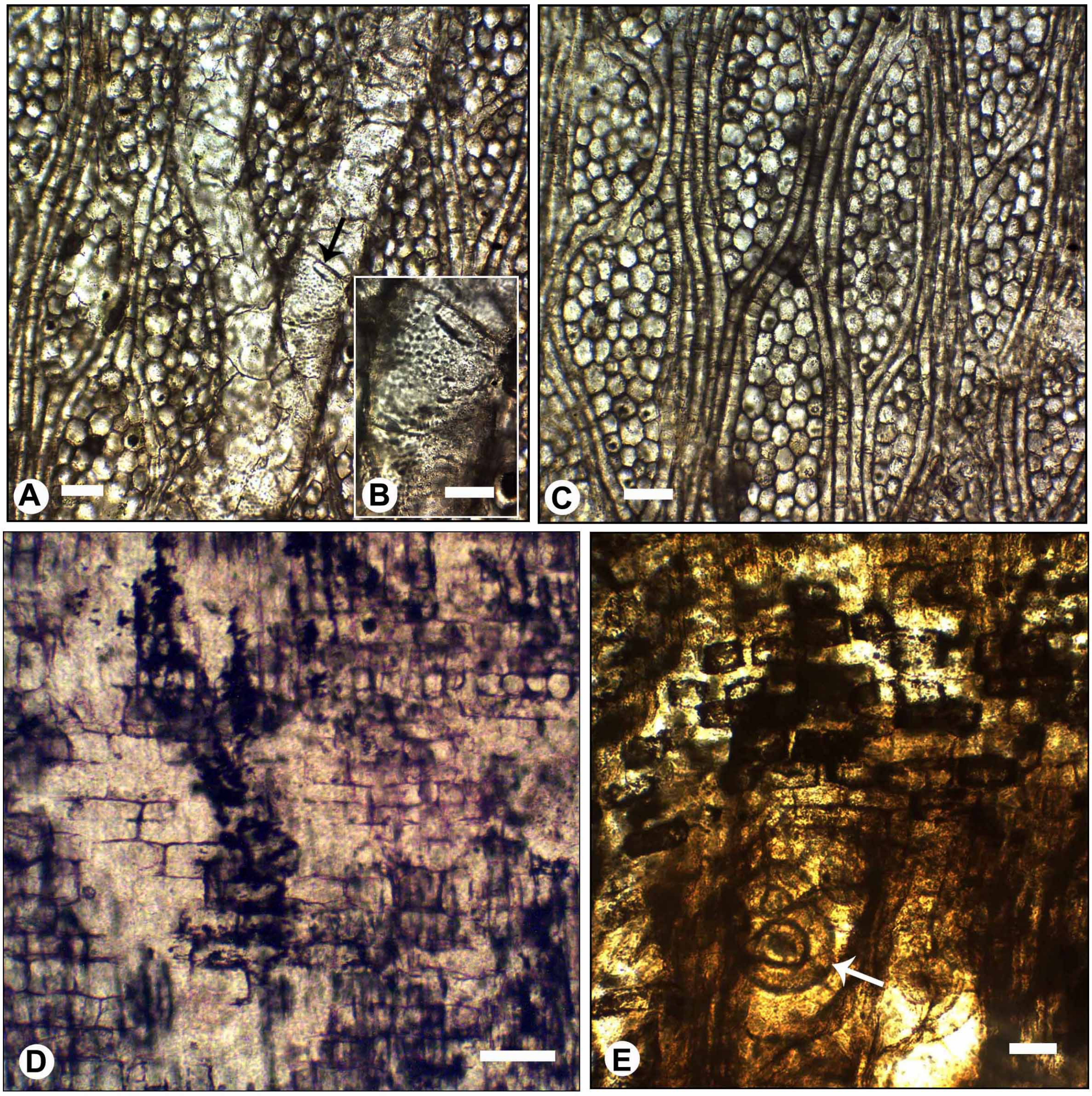

Fig. 3. ***Ficoxylon fusiforme*** **El-Noamani Z.M. sp. nov. – A: Vessel elements filled with tyloses with oblique end wall (arrow), crowded intervessel pitting, TLS. – B: Details of alternate intervessel pits, TLS. – C: Multiseriate rays and axial parenchyma strands of 5–8 cells, TLS. – D: Rays composed of procumbent body cells with one row of square marginal cells, RLS. –E: Ooid-like accretionary structure inside the vessel element (arrow), RLS. Scale bars= 100µm in A, C, D, E; 50µm in B**

This species has ooid-like accretionary structures in the vessels. These structures have a circular shape (diameter 93–122µm) either solitary with one nucleus or compound with two nuclei, surrounded by 2–3 concentric rings (Fig. 3E). There may be confusion between the identification of ooid-like accretionary structures and tyloses that form inside the vessels; the difference is that ooids are composed of concentric accretionary layers of limonite admixed with amorphous silica (Bera & Banerjee, 1990), whereas tyloses originate as natural outgrowths from a neighboring ray or axial parenchyma cell through a pit in a vessel wall (IAWA Committee, 1989) (see Fig. 3A, E). This is the first record of such structure in Egyptian fossil woods.

Discussion

Affinities and comparisons

The most obvious character of this Nubian Sandstone fossil wood is the banded axial parenchyma of more than three cells wide that occurs in members of 60 families (Metcalfe & Chalk 1950; Insidewood 2004-onward).

A search of the Insidewood database was done for these features: diffuse-porous wood (5p), vessels with medium to large size and low frequency (24p, 46p), simple perforation plates (13p), alternate intervessel pits (22p), vessel-ray pits with much reduced borders (30a, 300p), thin-walled tyloses (56p), axial parenchyma bands more than three cells wide (83a, 85p, 301r), multiseriate rays commonly more than four cells wide (98p), and thin-walled, nonseptate fibers (65a). The result of the search indicated affinities with the family Moraceae, in particular with the extant genus *Ficus* L., which is characterized by few, relatively wide vessels and broad axial parenchyma bands more than 3 cells wide (3–8). Its features are consistent with the fossil wood genus *Ficoxylon*, which is characterized mainly by diffuse-porous wood, few, wide vessels, exclusively simple perforation plates, abundant tyloses, and axial parenchyma bands of more than three cells wide.

To date, worldwide, there are 18 valid reports of fossil woods resembling *Ficus*, described as species of *Ficoxylon* and *Ficus*, ranging in age from the Cretaceous to the Neogene (Gregory et al., 2009; Bernabei et al., 2010; Jolly-Saad et al., 2010; Licht et al., 2014; Jud & Dunham, 2017) (Table 2). These species can be categorized into two groups based on ray width. The first group has narrow rays (1–3 or at most 4 cells wide) and includes 11 species: *Ficoxylon blanckenhorni* Kräusel, *F. cretaceum* Schenk, *F.* sp. cf. *cretaceum* Schenk, *F. guettarense* Fessler-Vrolant, *F. kalagarhensis* Prasad, *F. mogaungense* Licht *et al.*, *F. saurinii* Boureau, *F.* sp. of Hofmann,? *F.* sp. of Kräusel, *F.* sp. of Selmeier, and *Ficus koek-noormaniae* Jud. The storied rays of *F. saurinii* Boureau and ring porous wood of *Ficoxylon* sp. of Hofmann (1952) indicate that these woods were erroneously assigned to the genus *Ficoxylon*, as these are not features of the description of the type species by Kaiser (1880) and are not features of modern *Ficus* wood.

The second group has wider rays (>4 cells wide) and includes 7 species: *Ficoxylon angustiparenchymatosum* Shimakura, *F. bajacaliforniense* Martínez-Cabrera, Cevallos-Ferriz & Poole, *F. bohemicum* (Schleiden) Kaiser, *F. helictoxyloides* Platen, *F. zirkelii* Hofmann, *F.* sp. of Jolly-Saad, and *Ficus* sp. of Bernabei et al. The Nubian Sandstone wood falls into this second group. Its rays (2–7 seriate) are narrower than those of *F. bohemicum*, *F. helictoxyloides*, and *F. zirkelii*. *Ficoxylon angustiparenchymatosum*, *F. bajacaliforniense*, and *F.* sp. of Jolly-Saad differ in having prismatic crystals in axial parenchyma cells. The Egyptian wood described herein most closely resembles the *Ficus* sp. of Bernabei et al. (2010), but it has narrower and higher rays (rays 2–7 cells wide, 7–24 cells high).

The present wood differs from the other Egyptian records of *Ficoxylon* (*F. blanckenhorni* Kräusel, *F. cretaceum* Schenk, and?*Ficoxylon* sp. of Kräusel 1939) in having a combination of predominantly solitary vessels with low frequency (2–6/mm^2), 2–7 multiseriate rays and very thin-walled fibers. On the basis of these anatomical differences, a new species, *Ficoxylon fusiforme*, is proposed for this Nubian Sandstone wood.

Biogeographic and climatic considerations

Moraceae is a cosmopolitan family of 40 genera and approximately 1217 species with a center of diversity in subtropical to tropical regions and a limited spread in temperate regions (Stevens 2001-onward; Gardner *et al.* 2017). *Ficus* L. is the largest genus among the family (>800 species) and has a pantropical distribution with a few species extending into the semi-warm temperate zone (Zerega et al., 2005). The fossil records of Moraceae include woods, leaves, fruits, flowers, and pollen, dating back to the Late Cretaceous and extending to the Quaternary with most occurrences in the Neogene (Burn & Mayle 2008; Gardner *et al.* 2017). The validity of some records, especially those describing leaves and pollen, is problematic and needs reevaluation (Burn & Mayle, 2008; Boonchai et al., 2015; Gardner et al., 2017). The fossil wood record of Moraceae comprises seven genera, viz.: *Artocarpoxylon* Mehrotra, Prakash & Bande, *Cudranioxylon* Dupéron-Laudoueneix, *Ficoxylon* Kaiser, *Moroxylon* Selmeier, *Myrianthoxylon* Koeniguer, *Soroceaxylon* Franco, and *Welkoetoxylon* Boonchai, Manchester & Wheeler; in addition to some species assigned to three modern genera *Antiaris* Lesch., *Ficus* L., and *Maclura* Nutt (Gregory et al., 2009; Boonchai et al., 2015; Jud & Dunham, 2017). *Ficoxylon* is the most widely distributed, reported from North Africa (Egypt, Tunisia), tropical Africa (Ethiopia, Mali), North America (USA), Central America (Mexico, Panama), tropical South America (Colombia), Central South Asia (India, Myanmar), temperate Asia (Japan), and Europe (Czech Republic, Germany, Italy) (Table 2).

The Egyptian moraceous fossil record goes as far back as the Cretaceous and extends to the Quaternary (El-Saadawi et al., 2020). In addition to the fossil records of *Ficoxylon* from Egypt, many fossil leaves thought to be Moraceae have been reported from different Egyptian strata, viz.: *Dicotylophyllum balli* Seward, *D. egyptiacum* Seward, *D. panandhroensis* Lakhanpal & Guleria, *D.* sp. Darwish & Awad, *Ficophyllum* sp. Klitzsch & Lejal-Nicol, *F.* sp. Lejal-Nicol, *Ficus ingens* (Miquel) Miquel, *F. leucopteroides* Engelhardt, *F. salicifolia* Vahl, *F.* cf. *salicifolia* Vahl, *F. stromeri* Engelhardt, cf. *F. pandurifolia* Berry, *F. sycomorus* L., *F.* sp. Darwish, *F.* sp. Darwish & Attia, and *F.* sp. Darwish & Awad. These records have been reported from 23 sites of different stratigraphical units ranging in age from Cretaceous to Quaternary (El-Saadawi et al., 2020). However, the older reports were based exclusively on general leaf morphology and superficial resemblance to their modern analogies. Therefore, these reports should not be accepted uncritically and need review using details of venation pattern as per Jones & Rowe (1999).

Thus far, families Weichseliaceae, Cycadaceae, Williamsoniaceae,? Araucariaceae, Podocarpaceae, Arecaceae, Poaceae, Potamogetonaceae, Annonaceae, Araliaceae, Celastraceae, Combretaceae, Ebenaceae, Fabaceae, Magnoliaceae, Moraceae, Nelumbonaceae, Proteaceae, and Salicaceae have been recognized from the study area (El-Saadawi et al., 2020). The present-day distribution of these families, with few exceptions, is mainly in tropical and subtropical regions of the world (Stevens 2001-onward), which supports the existence of a tropical climate in this region during the Cretaceous period.

According to Wheeler & Baas (1991), the anatomical features of Nubian Sandstone wood (absence of distinct growth rings, diffuse-porous wood, simple perforation plates, relatively few wide vessels, and abundant axial parenchyma) also indicate a tropical nonseasonal climate in accord with the climate favored by its modern counterpart *Ficus*, as mentioned earlier. However, making paleoclimate inferences based on a single wood species is risky. Consequently, it would be necessary to collect large quantities of petrified woods along with other plant remains (leaves, fruits, seeds, pollen, etc.) from different Cretaceous localities to provide a complete picture of the paleoclimate that prevailed during the Cretaceous period in Egypt.

Conclusion

A new species of fossil angiosperm wood, *Ficoxylon fusiforme* sp. nov., is described from Upper Cretaceous Nubian Sandstone in the Aswan area, southern Egypt. It represents the fourth record assigned to the genus *Ficoxylon* from Egypt and the third record of this genus from the Cretaceous period worldwide. The new species is distinguished from other fossil woods ascribed to *Ficoxylon/Ficus* by the combination of predominant solitary vessels with low frequency (2–6/mm^2); 2–7 multiseriate, spindle-shaped, closely spaced and slightly heterocellular rays; and very thin-walled, nonseptate fibers. The attribution of the Nubian Sandstone moraceous species to the fossil genus *Ficoxylon*, in addition to the two earlier Late Cretaceous species (*F. cretaceum* &? *F.* sp. of Kräusel), supports the belief that *Ficus* might be one of the earliest genera in the family. The present record is indicative of a tropical climate in the region during the Late Cretaceous.

TABLE 2. Comparison of anatomical wood features between various species of *Ficoxylon* and *Ficus* recorded up till now worldwide with their geological and geographical distribution

Taxon/ Synonym(s)	Reference(s)	Age	Country	Vessel density / mm²	Parenchyma band width	Ray				
						Width (cells)	Height (cells)	Density / mm	Composition	Sheath cells
Ficoxylon angustiparenchymatosum Shimakura	Shimakura (1937)	?Tertiary	Japan	2–5	2–3	1–6	2–50	17–24	Heterocellular	Absent
F. bajacaliforniense Martinez-Cabrera et al.	Martínez-Cabrera et al. (2006)	Miocene	Mexico	0–6 (3)	5–12	2–8	NA	4–8	Homocellular	Present
F. blanckenhorni Kräusel [=part of *Ficoxylon schenki* Blanckenhorn]	Blanckenhorn (1901) Kräusel (1939) Lemoigne et al. (1974)	NA Oligocene/Miocene Miocene	Egypt Egypt Ethiopia	5–20	Up to 6	1–2	NA	NA	Homocellular	Absent
F. cretaceum Schenk [=part of *Ficoxylon schenki* Blanckenhorn; part of *Nicolia oweni* (Carruthers) Schuster]	Schenk (1883) Kräusel (1939) Boureau (1949) Lemoigne et al. (1974) Fessler-Vrolant (1979) Kamal El-Din (2003) Darwish et al. (2016)	Cretaceous Cret, Oligo, Oligo/ Mio, Mio Paleocene Miocene Oligocene Late Cretaceous Oligocene	Egypt Egypt Mali Ethiopia Tunisia Egypt Egypt	6–12 (–18)	3–5	1–2	4–50	12	Homocellular	Absent
F. sp. cf. *cretaceum* Schenk	Pons (1969)	Miocene	Colomiba	NA	NA	1–3	NA	NA	Homocellular	Absent
F. fusiforme sp. nov.	The present work	Late Cretaceous	Egypt	2–6 (4)	3–8	2–7	7–24	12–15	Weakly heterocellular	Absent
F. guettarense Fessler-Vrolant	Fessler-Vrolant (1976)	Oligocene	Tunisia	5–20	NA	1–3	NA	12–16	Heterocellular	Absent
F. helictoxyloides Platen	Platen (1908)	Miocene/Pliocene	USA	NA	Up to 5	> 12	Up to 100	NA	Heterocellular	Present
F. kalagarhensis Prasad	Prasad (1993)	Miocene	India	3–7	NA	3–4	NA	NA	NA	Absent
F. mogaungense Licht et al.	Licht et al. (2014)	Eocene	Myanmar	8–11 (10)	3–9	1–3	NA	NA	Heterocellular	Absent
F. saurinii Boureau	Boureau (1950)	NA	Cambodia	NA	NA	1–3	NA	NA	Heterocellular	Absent
F. tropicum (Schleiden) Felix [=*Ungerites tropicus* Schleiden *F. bohemicum* (Schleiden) Kaiser]	Schmid & Schleiden (1855) Kaiser (1880) Felix (1883)	NA Tertiary NA	Czechia	2–3 (7–8)	NA	3–15	Very long	NA	Homocellular	Absent
F. zirkelii Hofmann	Hofmann (1884)	NA	NA	NA	NA	5–15	40–70	NA	Homocellular	Absent

TABLE 2. Cont.

Taxon/ Synonym(s)	Reference(s)	Age	Country	Vessel density / mm²	Parenchyma band width	Ray				
						Width (cells)	Height (cells)	Density / mm	Composition	Sheath cells
F. sp. Hofmann	Hofmann (1952)	Oligocene/Pliocene	Austria	NA	3–6	1–2	5–50	NA	Weakly heterocellular	Absent
F. sp. Jolly-Saad	Jolly-Saad et al. (2010)	Pliocene	Ethiopia	5	3–6 cells	1–6	14–60	NA	Heterocellular	Absent
?*F.* sp. Kräusel	Kräusel (1939) Beauchamp et al. (1973)	Late Cretaceous Late Cretaceous/ Eocene	Egypt Ethiopia	5–13	1–2; up to 10	1–2	NA	NA	Homocellular	Absent
F. sp. Selmeier	Selmeier (1957)	Miocene	Germany	NA	NA	2–3	8–17	NA	Heterocellular	Absent
Ficus koek-noormaniae Jud	Jud & Dunham (2017)	Oligocene/Miocene	Panama	1.3–2.2 (1.7)	4–6	1–5	NA	3–6	Heterocellular	Present
Ficus sp. Bernabei et al.	Bernabei et al. (2010)	Eocene	Italy	2	6–8	3–5	15–40	NA	Heterocellular	Absent

NA: Data not available.

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Ficoxylon fusiforme نوع جديد ينتمي للفصيلة التوتية من طبقات العصر الطباشيري العلوي بتكوين Nubian Sandstone، جنوب مصر

زينب محمد النعماني
معمل السعداوي - قسم النبات - كلية العلوم - جامعة عين شمس - القاهرة - مصر.

استهدف هذا البحث تعريف نوع جديد من جنس *Ficoxylon* التابع للفصيلة التوتية من طبقات العصر الطباشيري العلوي بتكوين Nubian Sandstone، جنوب مصر. ولهذا النوع أهمية خاصة حيث يعد الثالث عالمياً لهذا الجنس في طبقات العصر الطباشيري والتي يندر فيها تسجيل أنواع من هذا الجنس حيث أنه لم يسجل منها سابقاً على مستوي العالم سوى نوعان فقط وهما *Ficoxylon cretaceum*، *F.* sp. وكلاهما مسجل من مصر، بينما تم تسجيل باقي الأنواع التابعة لهذا الجنس خلال الفترة من الباليوسين حتى البليوسين العصر الثالث. تم تعديل الوصف التشخيصي لجنس *Ficoxylon* والتي وضعها كايزر بشكل مختصر عام 1880 ليشتمل على صفات تشريحية أشمل وأدق. واشتملت المعالجة التصنيفية لهذ النوع على وصف تفصيلي وصور توضيحية ومقارنات تفصيليه توضح أوجه الاختلاف مع الأنواع المسجلة سابقا تحت جنس *Ficoxylon* واتضح من هذه المقارنة أن هذا النوع الجديد انفرد بمجموعة من الصفات التصنيفية المميزة منها: سيادة الأوعية الخشبية الفردية الواسعة نسبياً وقليلة الكثافة، الخلايا البارنشيمية المرتبة في صفوف من 3-8 خلية لكل صف، الخلايا الشعاعية المرتبة في شكل مغزلي والمتقاربة من بعضها والتي يتراوح سمكها من 2-7 خلية، خلايا الألياف غير المقسمة ذات الجدر الرقيقة. تم التعليق على أنواع البقايا الحفرية النباتية التابعة للعائلة التوتية التي تم تسجيلها حتي الآن من مصر وكذلك تم إعداد قائمة بكل أنواع الخشب الحفري المسجل من طبقات العصر الطباشيري بمصر. تم اعطاء نبذة عن التوزيع الجغرافي القديم لجنس *Ficoxylon* وكذلك الظروف المناخية القديمة المستنتجة من صفات الخشب الحفري المدروس في هذا البحث.