

MICROLOBIUSXYLON PARANAENSIS GEN. ET SP. NOV. (FABACEAE, MIMOSOIDEAE) FROM THE PLIOCENE-PLEISTOCENE OF ITUZAINGÓ FORMATION, PARANÁ BASIN, ARGENTINA

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ABSTRACT – A fossil wood with Fabaceae affinity from the Pliocene-Pleistocene sediments of Ituzaingó Formation is described. The silicified wood was collected at the Toma Vieja fossil locality, Paraná Basin, Argentina. The relationship and comparison with the nearest living relatives (NLRs) are discussed. Wood anatomical characters suggest an affinity with the genus *Microlobius* C. Presl. In South America, the genus *Microlobius* occurs in Brazil, Bolivia (Santa Cruz), Argentina (Chaco and Formosa) and Paraguay and is an important extant element of the Paraguay-Paraná system. The presence of this fossil in the Ituzaingó Formation supports the idea that the morphogenus *Microlobiusxylon* might have been an important component of seasonally dry tropical forests (SDTFs) during the Pliocene-Pleistocene. Today, this forest type has a relict distribution, occurring in isolated localities in the north of Argentina, southeast of Bolivia and Brazil, but in the past were more widespread to the east and south in South America. The presence of *Microlobiusxylon paranaensis* gen. et sp. nov. would indicate a temperate-warm climate during the Pliocene-Pleistocene.

Key words: fossil wood, Fabaceae, Mimosoideae, *Microlobiusxylon*, Ituzaingó Formation, Argentina.

RESUMO – É descrita uma madeira fóssil afim à família Fabaceae em sedimentos plio-pleistocênicos da Formação Ituzaingó. A madeira silicificada foi coletada na localidade fossilífera Toma Vieja (Paraná, Argentina). O lenho fóssil foi comparado com seu parente atual mais próximo. Sua estrutura anatômica sugere afinidade com o gênero *Microlobius* C. Presl. Na América do Sul, o gênero *Microlobius* aparece no Brasil, Bolívia (Santa Cruz), Argentina (Chaco e Formosa) e Paraguai, e é um gênero importante do sistema Paraguai-Paraná. A presença deste fóssil na Formação Ituzaingó avaliza a ideia de que o morfogênero *Microlobiusxylon* foi um membro importante das florestas tropicais sazonais (SDTFs) durante o Plio-Pleistoceno. Estas florestas são relictos em localidades isoladas no norte da Argentina e no sudeste da Bolívia e do Brasil, mas no passado estendeu-se mais para o leste e o sul da América do Sul. *Microlobiusxylon paranaensis* gen. et sp. nov. sugere a vigência de um clima temperado-cálido ao longo do Plio-Pleistoceno.

Palavras-chave: madeira fóssil, Fabaceae, Mimosoideae, *Microlobiusxylon*, Formação Ituzaingó, Argentina.

INTRODUCTION

The Ituzaingó Formation was first defined by De Alba (1953) and formalized by Herbst (1971) and Herbst *et al.* (1976). This formation has been interpreted as consisting of fluvial deposits (Herbst, 1971, 2000; Iriondo & Rodríguez, 1973; Herbst *et al.*, 1976; Iriondo, 1979, 1980; Herbst & Santa Cruz, 1985; Jalfin, 1988; Anis *et al.*, 2005; Iriondo & Kröhling, 2009). In 1846, D'Orbigny recognized these deposits as “*Tertiare Guaranien*” or “grès ferrugineux”. The Ituzaingó Formation is widely distributed in the western riverside cliff of the Paraná River, from north of Corrientes province to the south near Paraná city, in Entre Ríos province (Herbst, 2000; Anis *et al.*, 2005). In the Argentinian subsurface, it extends from the west of Corrientes and Entre Ríos to the latitude of Paraná city, to the east of Chaco and most of Santa Fe, east of Córdoba, and northern Buenos Aires province (Herbst, 2000). The sand of the Ituzaingó Formation is recycled from Mesozoic Gondwanan eolian deposits. This fluvial unit was deposited

by the divagation of the Paleoparaná river course under warm and humid climatic conditions (Iriondo, 1996).

The Ituzaingó Formation contains palynomorphs, leaf compressions and cuticles (Anzótegui, 1975, 1980; Lutz, 1993; Anzótegui & Lutz, 1987; Caccavari & Anzótegui, 1987; Garralla, 1987; Anzótegui & Acevedo, 1995; Anzótegui & Garralla, 2004; Zucol *et al.*, 2004; Lutz *et al.*, 2007). There are a few reports of fossil wood and culms in the Ituzaingó Formation, including remains assigned to the Anacardiaceae, Fabaceae (Mimosoideae), Moraceae, Rutaceae and Bambusoideae families (Lutz, 1979, 1991; Brea & Zucol, 2007; Franco, 2008a,b, 2009; Franco & Brea, 2009).

The purpose of this paper is to describe a fossil wood that has characteristics of the Mimosoideae (Fabaceae), which is a pantropical subfamily of the Fabaceae, comprising 78 genera and 3,270 species (Lewis *et al.*, 2005). The Mimosoideae are mostly tropical to subtropical in distribution, and are major components of arid and semiarid regions throughout the world (Luckow *et al.*, 2003). The ecological and distribution

characteristics of the nearest living relatives (NLRs) of this wood are used to make paleogeographic and paleoecological inferences. This fossil wood was compared with extant species from the region, especially in present-day Argentinean woods, and this silicified wood is most similar to *Microlobius* C. Presl.

MATERIAL AND METHODS

The specimen was collected in Toma Vieja fossil locality, situated on the left margin of the Paraná River, near Paraná city, Argentina (31°42'13.7''S, 60°28'41.9''W; Figure 1). In Toma Vieja locality, the Ituzaingó Formation (Pliocene-Pleistocene) is 14 m thick, and the fossiliferous level has well-preserved fossil woods. This unit is composed of sands and consolidated and unconsolidated sandstones, almost exclusively of quartz, with a granulometry that ranges from fine to coarse sands, occasionally whitish, yellowish conglomerates and, occasionally, reddish-brown and dark brownish conglomerates. Dark grey and greenish silty lens intercalations are common among the sands (Iriondo & Rodríguez, 1973; Aceñolaza & Sayago, 1980; Herbst & Santa Cruz, 1985; Iriondo *et al.*, 1998; Herbst, 2000). Tangential cross-bedding, troughs and planar bedding are common (Figure 2). Puerto Alvear Formation (Lower Pleistocene) overlies unconformably the Ituzaingó Formation and underlies unconformably the Hernandarias Formation (Middle Pleistocene), which underlies the Tezanos Pinto Formation (Upper Pleistocene-Holocene) (Figure 2).

The wood is silicified. It was thin-sectioned using techniques employed for rock specimens. The quantitative values provided in the anatomical description are averages of at least 25 measurements. The average is cited first, followed by minimum and maximum values (in parentheses). The IAWA recommendations for hardwood identification terminology (IAWA Committee, 1989) were followed and the Carlquist Comparative Wood Anatomy

(2001) was used to describe the wood anatomy. Also, Gregory's list (1994) was used for the search of the indispensable bibliography. Systematics follows the APGII (2003) classification.

The identification of the fossil wood samples was done using wood atlases and descriptions of Wagemann (1948), Metcalfe & Chalk (1950), Tortorelli (1956), Barros & Callado (1997), Richter & Dallwitz (2000), InsideWood database (2004-onwards) and Wheeler *et al.* (2004, 2007). The diagnostic anatomical characters of Fabaceae were taken from Metcalfe & Chalk (1950), Tortorelli (1956), Dimitri (1978), Baretta-Kuipers (1981), Gros (1992), Wheeler & Baas (1992), Richter & Dallwitz (2000), InsideWood database (2004-onwards) and Evans *et al.* (2006).

The specimen was studied with a Nikon Eclipse E200 microscope (using 40x, 100x, 400x and 1,000x magnification levels), and the microphotographs were taken with a Nikon Coolpix 990 digital camera.

The fossil wood and microscope slides are deposited in the Laboratorio de Paleobotánica, CICYTTP-CONICET, Diamante, Argentina, under the acronyms CIDPALBO 25, CIDPALBOmic 675.

SYSTEMATIC PALEONTOLOGY

Order FBALES Bromhead, 1838
Family FABACEAE Lindley, 1836
Subfamily MIMOSOIDEAE Lindley, 1836
Genus *Microlobiusxylon* gen. nov.

Microlobiusxylon paranaensis sp. nov.
(Figures 3-4)

Etymology. Generic epithet, *Microlobiusxylon*, refers to its resemblance to the extant genus *Microlobius*. Specific epithet, *paranaensis*, refers to Paraná city, the locality where this fossil was recovered.

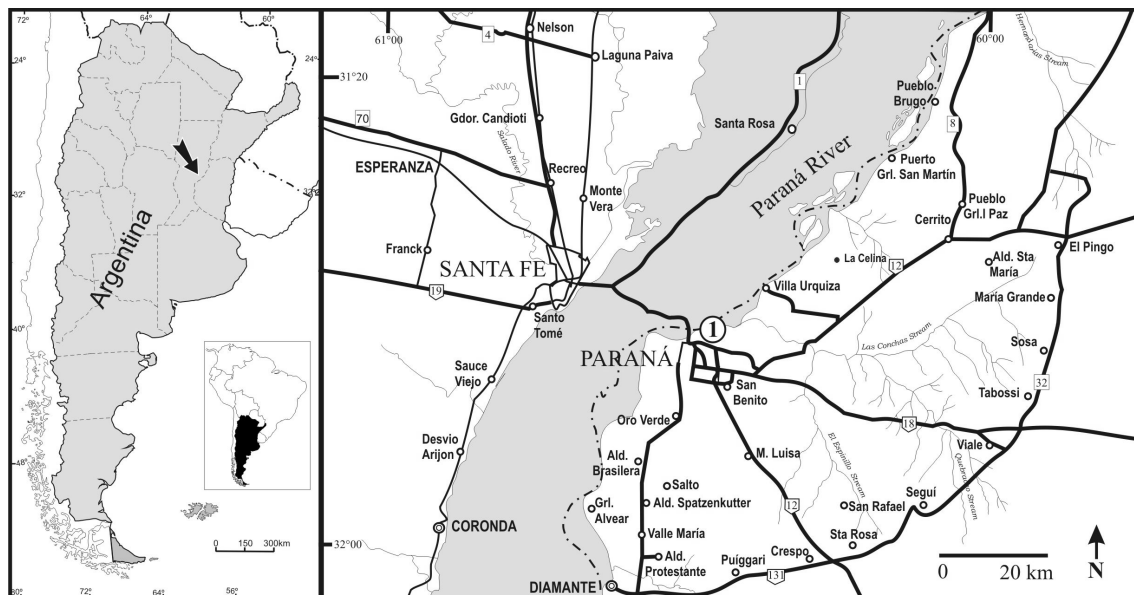


Figure 1. Location map showing the Toma Vieja fossiliferous locality (1), Entre Ríos, Argentina.

Holotype. CIDPALBO 25, CIDPALBOmic 675.

Type locality. Toma Vieja, Paraná, Entre Ríos.

Stratigraphy. Ituzaingó Formation.

Age. Pliocene-Pleistocene.

Diagnosis. Diffuse porosity; growth rings weakly delimited; vessels mostly solitary, in radial multiples of 2-3 and rarely in clusters, narrow, <30 per mm²; perforation plates exclusively simple; intervessel pits minute-small, bordered, alternate, rounded and vested; axial parenchyma very abundant, vasentric to aliform and confluent; parenchyma strand, 4-5 cells per parenchyma strand, rays homocellular composed of procumbent cells, commonly 1-2 cells wide, numerous (6-10 rays/mm) and small; non-septate fibers oval to polygonal in outline and form the ground mass. Crystals present in chambered axial parenchyma cells.

Description. This description is based on three pieces of the same fossil wood measuring 15.5 cm, 10 cm and 10.8 cm in length and 3.5 cm, 3 cm and 1.5 cm in diameter. Pith, primary xylem, outer cortex, and secondary phloem are not preserved.

Growth rings are absent or weakly delimited. Porosity is diffuse (Figure 3A). Vessels are more or less circular, with a mean wall of 8 (5-13) µm thick. Vessel elements are mostly solitary (71%); in radial multiples of 2-3 or more (20%, 6% and 1%, respectively) and rarely in clusters (1%) (Figures 3A, D, 4A-B). Vessel elements are 72 (45-115) µm in tangential diameter and 96 (55-175) µm in radial diameter. Vessel density is 20 (17-28) per mm². Vessel element length is 164 (105-250) µm. Perforation plates are exclusively simple (Figure 4C), with transverse or oblique end walls (Figure 4F). Intervessel pits minute-small, bordered, alternate, rounded and vested (Figures 4D-E). Ground tissue fibers are circular to polygonal in outline, non-septate, with a diameter of 13 (10-18) µm and a thickness of 3 (2-5) µm (Figure 3E). Vessel-ray pitting poorly preserved, possibly bordered. The axial parenchyma is vasentric, confluent and aliform (Figures 3A, D). Axial parenchyma strands of 4-5 cells. Crystals present in chambered axial parenchyma cells (Figure 3H). The rays are uniseriate or less commonly biseriate (Figures 3B-C). Height

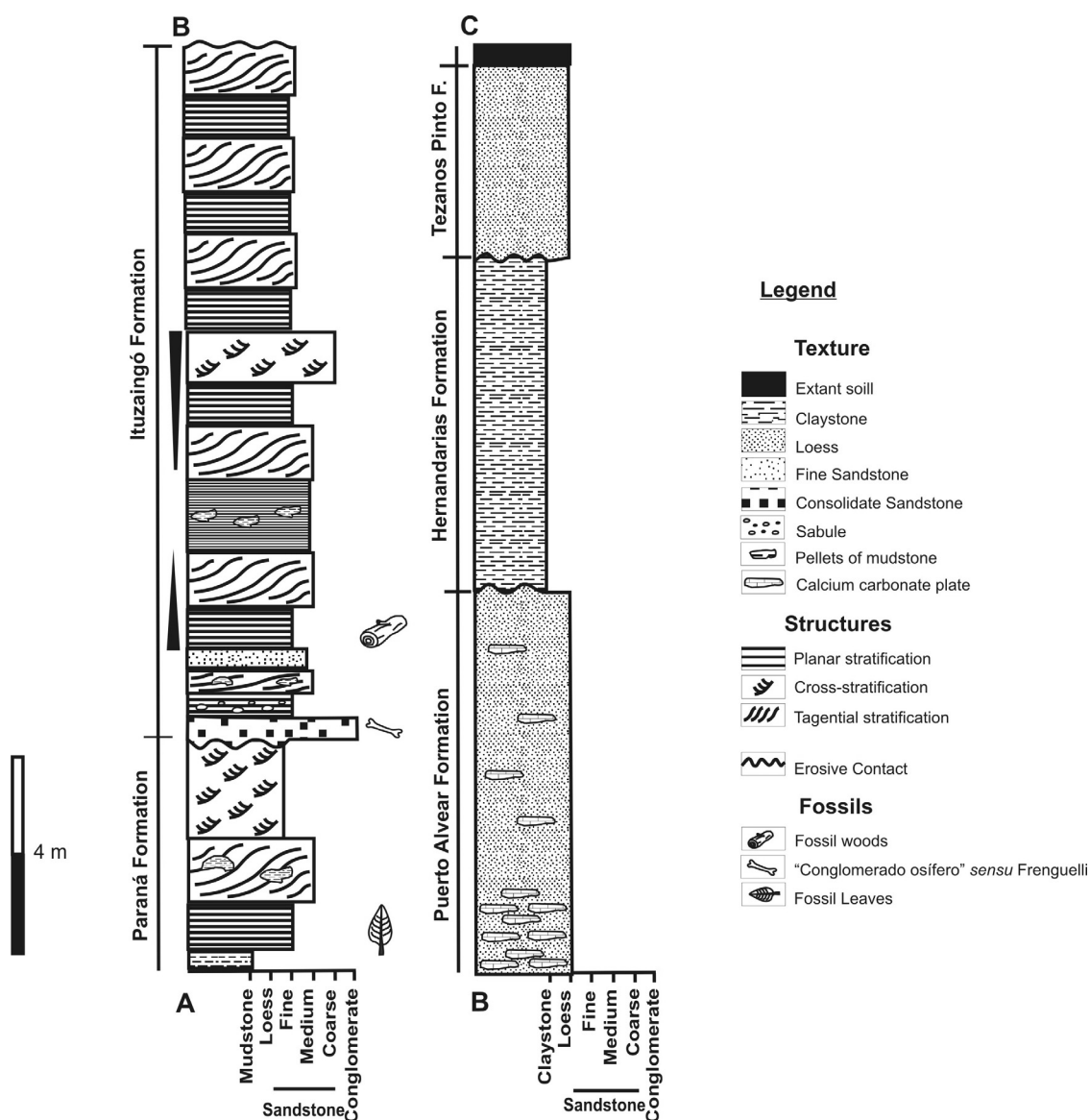


Figure 2. Schematic profile at the Toma Vieja locality, Entre Ríos, Argentina.

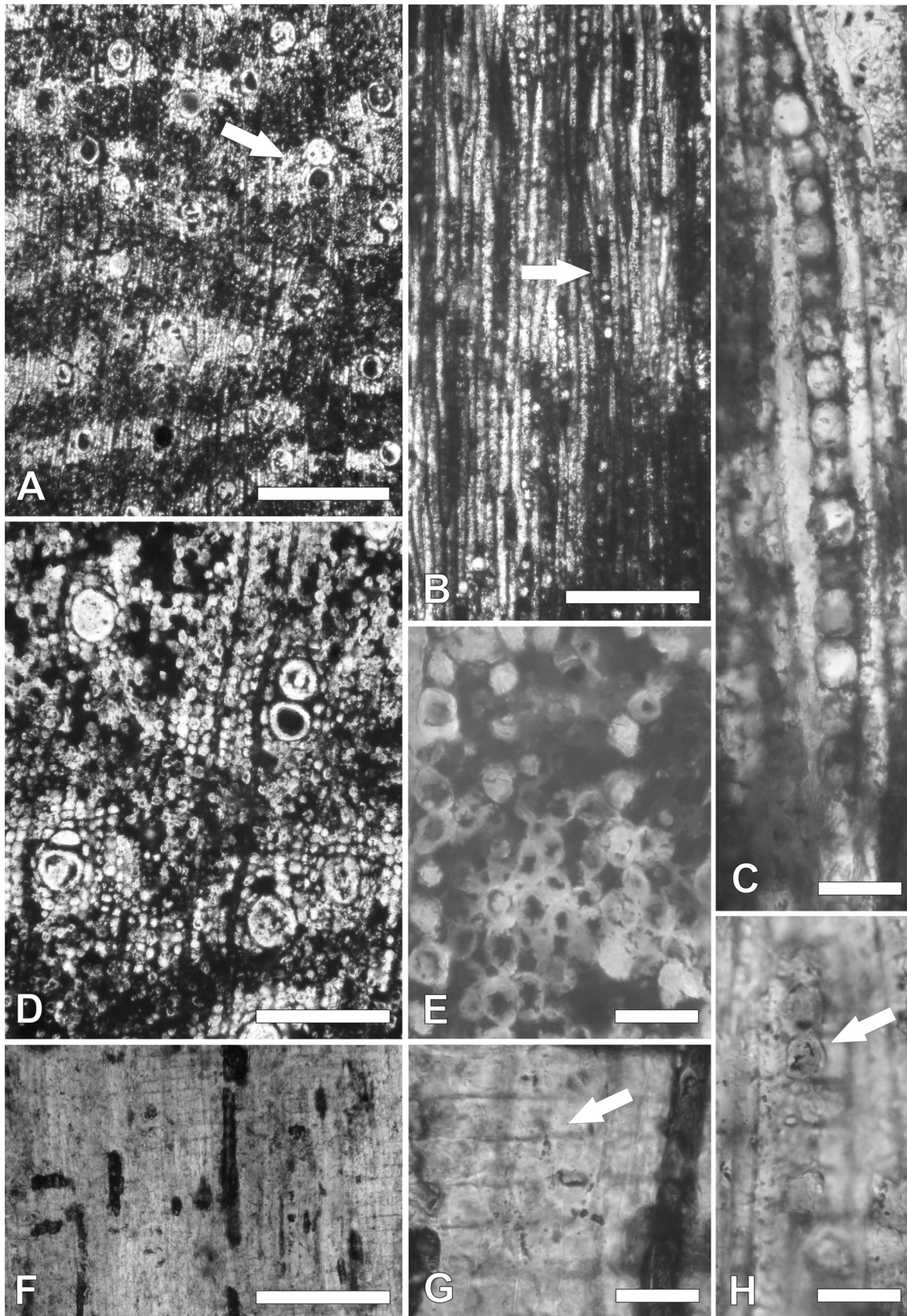


Figure 3. A-H, *Microlobiusxylon paranaensis* gen. et sp. nov. **A**, Cross section showing diffuse porous wood with randomly arranged vessels, aliform-confluent parenchyma (arrow); **B**, Tangential section showing predominantly uni- (arrow) and biseriate rays; **C**, uniseriate ray; **D**, detail showing solitary vessels and short radial multiples of vessels and confluent parenchyma; **E**, in cross section, detail of fibers; **F**, radial section showing homocellular rays; **G**, detail of procumbent ray cells (arrow); **H**, crystals in chambered axial parenchyma cells (arrow). Scale bars: A = 500 μ m; B, D, F = 200 μ m; C, E, G, H = 20 μ m.

of rays is 170 (45-520) μm and 11 (4-35) cells high. Width of rays is 13 (10-20) μm . There are 8 (6-10) rays per linear mm. Rays are homogeneous type I of Kribs and homocellular composed exclusively of procumbent cells (Figures 3F-G).

Comparison with extant species. Synapomorphies that relate this fossil wood to the Fabales are the presence of vestured pits and vessel elements with simple perforation plates (Judd *et al.*, 1999). The anatomical fossil wood characters (vessels solitary and in radial multiples; simple perforation plates; axial parenchyma abundant, confluent or banded; uniseriate rays, rarely biseriate, homocellular rays composed of procumbent cells and non-septate fibers) suggest a close affinity to the Fabaceae

family (Metcalf & Chalk, 1950; Cozzo, 1951; Tortorelli, 1956; Baretta-Kuipers, 1981; Wheeler & Baas, 1992; Barros & Callado, 1997). These features also occur in the Sapindaceae. However, the fossil wood is different with that family in the diameter of vessels and in the fibers (Metcalf & Chalk, 1950).

The specimen was compared with extant and fossil species of the Fabaceae, particularly the Mimosoideae subfamily (Tables 1-2). The combination of characters (the presence or absence of septate fibers, the presence and extent of confluent or banded axial parenchyma, and ray width; Evans *et al.*, 2006) in the Toma Vieja fossil wood is diagnostic for the Mimosoideae.

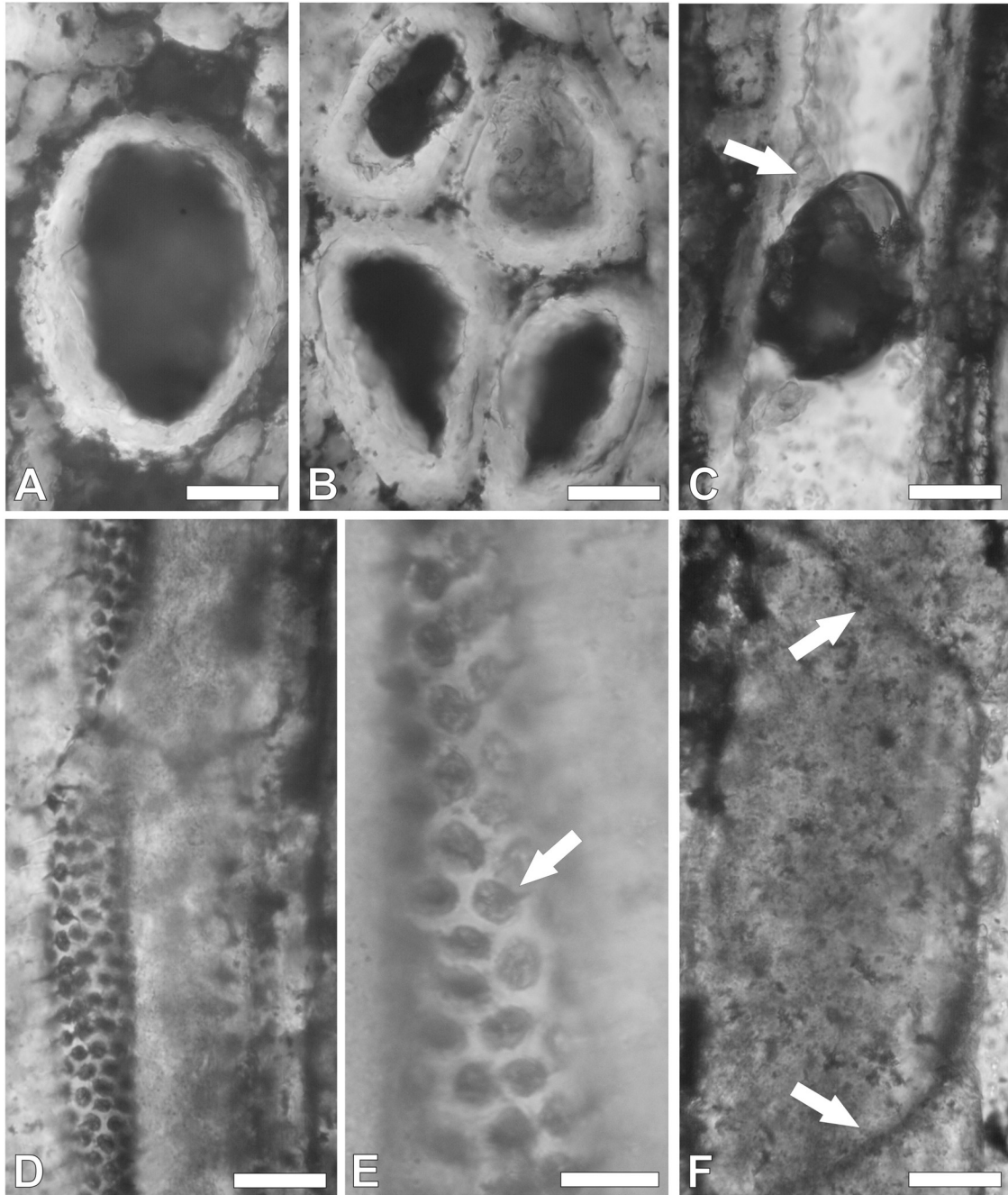


Figure 4. A-F, *Microlobiusxylon paranaensis* gen. et sp. nov. A, vessel solitary; B, vessel clusters in cross section; C, vessel with simple perforation plate (arrow) in tangential section; D, crowded alternate intervessel pits; E, detail of vestured intervessel pits (arrow); F, detail of oblique end walls (arrow). Scale bars: A-D, F = 20 μm ; E = 10 μm .

Table 1. Comparison of selected wood anatomical characters of *Microlobiusxylon paranaensis* gen. et sp. nov. and extant genera of the *Piptadenia* group, according to Evans et al. (2006), Tortorelli (1956) and Inside Wood (2004). **Abbreviations:** **Growth rings:** A, absent; I, indistinct; D, distinct; **Radial multiples:** R, rare (< 10%), O, occasional (10-30%), F, frequent (30-60%), C, common (60-80%), VC, very common (>80%); **Clusters:** R, rare (<10%), O, occasional (10-30%), F, frequent (30-60%), C, common (60-80%), VC, very common; **Septate fibers:** P, present, N, not present; **Axial parenchyma:** A, aliform; V, vasicentric; S, scanty paratracheal; C, confluent; B, banded; **Axial parenchyma confluent:** N, not seen; R, rare; O, occasional; F, frequent; C, common; VC, very common; **Number of vessels linked:** number of vessels or vessel groups tangentially included in confluent parenchyma; **Ray type:** H, homocellular, HE, heterocellular; **Crystals:** N, not seen, R, in ray cells, AP, in axial parenchyma cells, V, in vessels, F, in fibers.

Taxa	Growth rings	Tangential vessel diameter (µm)	Vessel/µm ²	Radial multiples	No of vessels	Clusters	No of vessels/cluster	Intervessel pit diameter (µm)	Fibre wall thickness	Septate fibres	Axial Parenchyma	Axial parenchyma confluent	No of vessels linked	Ray height av. No cells	Ray height (µm)	Rays/mm	Ray width	Ray Type	Crystals	Gum
<i>Anadenanthera</i> Spieg.	D	86-98	50-57	F-C	2-7	O-F	2-7	6-9	thick	N	V/A	F-VC	2-8+	11-17	246	8	1-40	H	F, A	R, AP, V
<i>Microlobius</i> Jacq.	I-A	42-110	7-30	F-C	1-4	R-C	2-4+	?	thin-thick	N	V/A/C/B	F	2- (many)	?	800	8-12	1-2(3)	H	F, A	?
<i>Mimosa</i> L.	A-I	79-112	15-50+	F/V-C	2-10	R-C	2-5 (10)	3-6	thin-thick	P/N	V-C	C-V-C	2-6+	8-130	20-250	6-15	1-3	H/He	F, A	R, AP, V, F
<i>Parapiptadenia</i> Brenan	A-D	112-123	23-30+	O/V-C	2-7	R/O-F	2-7	3-9	med-thick	P/N	V/A	O-C	2-4+	11-24	30-450	8-10	1-3	H/He	F, A	R, AP, V, F
<i>Parkia</i> R.Br.	I-D	160-241	3-9	R-F	2-5(6)	N/R-F	2-8	4-9	thin-med	N	A-C	R-V-C	2-7+	14-19	20-380	4-7	1-4	H	F, A	R, AP, V
<i>Piptadenia</i> Benth	A-D	54-170	13-50+	R-C	2-9 (15)	R-F	2-7+	4-12	thin-thick	P	V-B	N-C	2-7+	12-24	20-620	5-13	1-2(4)	H/He	F, A	R, AP, V, F
<i>Pseudopiptadenia</i> Miq.	D	142	20	O/F	2-4(7)	R/O	3-6(12)	3-6	thin-med	N	V-A	R-O	2-3	ca. 15	20-260	ca. 7	1(2)	H	F, A	R, AP, V, F
<i>Stryphnodendron</i> Martius	I-D	95-133	14-33	F-C	2-7	R/O	2-4	6-12	thin-med	N	S-A	N-O	N/2	ca. 8	20-170	9-11	1(2)	H	F, A	R, AP, V
<i>Microlobiusxylon paranaensis</i>	I-D	45-115	18-28	O-F	1-3+	R	2-3+	?	thin-thick	N	V/A/C/B	F	2- (many)	4-35	45-120	6-10	1-2	H	A	N

Table 2. Comparison of *Microlobiusxylon paranaensis* gen. et sp. nov. and *Menendoxylon vasallensis* Lutz, 1979, *M. arenensis* Lutz, 1979, *M. mesopotamiensis* Lutz, 1979, *Mimosoxylon* sp. Lutz, 1991, *Piptadenioxylon chimeloi* Suguio & Mussa, 1978 and *P. paraexcelsa* Franco & Brea, 2008 fossil woods. **Abbreviations:** see Table 1.

Morphospecies	Growth rings	Tangential vessel diameter (µm)	Vessels/mm ²	Radial multiples	Nº of vessels	Clusters	Nº of vessel/cluster	IVP diameter (µm)	Fibre wall thickness	Septate fibres	Axial Parenchyma	Axial parenchyma confluent	Ray height av. Nº cells	Ray height (µm)	Rays/mm	Ray width	Ray Type	Crystals	Gum
<i>Menendoxylon vasallensis</i>	D	59-132	30	O-F	1-6	R	2-6	?	thin-thick	N	V/S	N	4-31	171-448	13	1-2	H	N	N
<i>Menendoxylon arenensis</i>	D	52-132	17-20	R-O	1-3	N-R	?	?	thin	P	A/B	N	5-22	145-300	14	1-3	He	N	N
<i>Menendoxylon mesopotamiensis</i>	D	118-246	12-20	R-O	1-3	N	2-3	?	very thick	N	V/C	F	8-39	220-502	13	2-4	H	N	N
<i>Mimosoxylon</i> sp.	D	47-244	10-20	O	1-3	N	2-3	5-7	?	N	V/S	N	20	215-620	?	(2)3-5	H	N	N
<i>Piptadenioxylon chimeloi</i>	A	45-100	15-21	R	?	N	?	?	?	N	V	F	?	?	25-30	(1)2-3	H	N	V
<i>Piptadenioxylon paraexcelsa</i>	I-D	45-80	10-17	O-F	1-3	R	2-3	?	thin	N	V/B	N	?	47-412	6-10	(1)-2	H	N	N
<i>Microlobiusxylon paranaensis</i>	I-D	45-115	18-28	O-F	1-3+	R	2-3+	?	thin-thick	N	V/A/C/B	F	4-35	45-120	6-10	1-2	H	A	N

Although it would be difficult to identify a mimosoid plant to the genus level based solely on its wood anatomy, the fossil wood has diagnostic characters, which allow comparison with extant genera. The fossil wood is more related to the tribe Mimoseae, especially with the Piptadenia group. This group, with eight genera (Table 1), is the largest in the tribe Mimoseae, and their diagnostic anatomical characters are: vessels mostly small to medium-sized and high vessel density, radial multiples and clusters ranging from rare to common, which can be large or small; variable intervessel pit size; septate and nonseptate fibers; axial parenchyma ranging from scanty to banded, and in many cases confluent parenchyma linking many vessels leading to an almost banded appearance; rays commonly 2-3 cells wide and uniseriate rays always present (Evans *et al.*, 2006).

Microlobius C. Presl. is the most related extant genus. This species grows in Northeastern Formosa province in Argentina and is a big green foliage shrub. Usually, the following species join *Microlobius* in its natural habitat: *Tabebuia nodosa* (Griseb.) Griseb., *Diplokeleba floribunda* N. E. Br., *Astronium balansae* Engl., *Aspidosperma triternatum* Rojas Acosta, *Peltophorum dubium* (Spreng.) Taub., *Crataeva tapia* L., *Tabebuia ipe* (Mart. ex K. Schum.) Standl., *Gleditsia amorphoides* (Griseb.) Taub. and *Caesalpinia paraguariensis* (D. Parodi) Burkart (Tortorelli, 1956).

Comparisons with fossil species. The fossil record of the Leguminosae is abundant and diverse. Fossil legume fruits, leaflets, wood, flowers and pollen are known from numerous localities representing nearly all major land areas (Herendeen *et al.*, 1992).

Fossil wood legume morphogenera referable to the Mimosoideae are: *Acacioxylon* Schenk, 1883, *Adenanthoxylon* Prakash & Tripathi, 1968, *Albizinium* Prakash, 1975, *Albizioxylon* Nikitin, 1935, *Cathormion* Gros, 1990, *Dichrostachyoxylon* Müller-Stoll & Mädler, 1967, *Eucacioxylon* Müller-Stoll & Mädler, 1967, *Ingoxylon* Müller-Stoll & Mädler, 1967, *Menendoxylon* Lutz, 1979, *Metacacioxylon* Gros, 1981, *Mimosoxylon* Müller-Stoll & Mädler, 1967, *Mimosaceoxylon* Lakhanpal & Prakash, 1970, *Paraalbizioxylon* Gros, 1992, *Paracacioxylon* Müller-Stoll & Mädler, 1967, *Piptadenioxylon* Suguio & Mussa, 1978, *Tetrapleuroxylon* Müller-Stoll & Mädler, 1967 and *Anadenanthoxylon* Brea *et al.*, 2001.

The specimen studied was compared with *Menendoxylon* Lutz, 1979, *Mimosoxylon* Lutz, 1991 and *Piptadenioxylon* Suguio & Mussa, 1978 (Table 2). The most similar fossil wood is *Piptadenioxylon paraexcelsa* Franco & Brea (2008). The differences between them are in: vessels per mm², fiber wall thickness, axial parenchyma (presence of confluent parenchyma), and the frequency of uni- and biseriate rays.

The fossil wood shares anatomical features with fossil species already known. However, its morphology and anatomy present a combination of diagnostic features that allow the recognition of a new species from the Pliocene-Pleistocene in the Parana Basin, *Microlobiusxylon paranaensis*.

DISCUSSION

The Fabaceae (Leguminosae) comprise the third largest family of flowering plants and include over 18,000 species distributed throughout the world in many ecological settings, from deserts of high latitudes to seasonally dry or wet tropical forests of equatorial regions (Dimitri, 1978; Lewis *et al.*, 2005; Lavin *et al.*, 2005). They are mostly trees, shrubs or vines, sometimes with spines (Simpson, 2006; Evans *et al.*, 2006).

On the basis of vessel element features (exclusively simple perforation plates, vessel elements of relatively short length), ray structure (either homocellular composed of only procumbent cells, or with one or few marginal rows of square to slightly upright cells), axial parenchyma arrangement and abundance (frequently aliform-confluent), and common occurrence of storied structure, the Fabaceae have 'advanced' wood structure in the Baileyan sense (Wheeler & Baas, 1991, 1992).

Fabales contain 9.6% eudicot diversity (Magallón *et al.*, 1999), of which the bulk is made up of Fabaceae. The order Fabales, including Fabaceae, Polygalaceae, Quillajaceae and Surianaceae, represents a novel hypothesis emerging from angiosperm molecular phylogenies (Bello *et al.*, 2009). Despite good support for the order, molecular studies to date have suggested contradictory, poorly supported interfamilial relationships (Stevens, 2001; Bello *et al.*, 2009).

The Piptadenia group is not as homogeneous as the other Mimoseae groups; there is considerable variation among individual species of the same genus. The Piptadenia group as a whole is not monophyletic (Luckow *et al.*, 2003; Jobson & Luckow, 2007). A moderately supported polytomy includes most piptadenioid genera (*Piptadenia* Benth, *Pseudopiptadenia* Rauscher, *Microlobius* C. Presl, *Parapiptadenia* Brenan, *Mimosa* L. and *Stryphnodendron* Mart.); this group is more closely related to the *Ingeae/Acacia* s. l. (including the phyllodinous Australian acacias) clade than it is to *Anadenanthera* Speg. and *Piptadenia viridiflora* (Kunth) Benth.

The current fossil record of the Fabaceae suggests that extensive diversification took place by the Middle Eocene and that they differentiated into three subfamilies: the Caesalpinioideae, Mimosoideae and Faboideae (Papilionoideae) (Herendeen, 1992; Wheeler & Baas, 1992).

The Fabaceae are known or presumed to have reached Eurasia by the Early Paleocene (Raven & Axelrod, 1974) and probably spread from South to North America in Eocene time or subsequently (Raven & Axelrod, 1974; Herendeen, 1992). The potential for migration from South America through the Caribbean during the early Tertiary was probably greater than today (Herendeen, 1992). The age of the crown group Fabales was estimated as (90-) 87 (-84) or (75-) 72 (-69) My, with the stem group age being (109-) 104 (-99) and (92-) 89 (-86) My; Bayesian relaxed clock estimates were slightly older, *i.e.*, 100 or 112 My, respectively (Stevens, 2001).

In the Late Cenozoic, there is an increase in the number of woods with structural features that are now most common in

markedly seasonal climates. In the Pliocene, all woods are structurally equivalent to extant wood (Wheeler & Baas, 1992).

Piptadenia and *Microlobius* are related genera, and possibly the first is the ancestral one. However, they show differences that allow them to be separated one from the other (Sousa & Andrade, 1992). *Microlobius* is a genus with only one species, *Microlobius foetidus* (Jacq.) M. Sousa & G. Andrade, and with two subspecies: *Microlobius foetidus foetidus* (Jacq.) M. Sousa & G. Andrade and *Microlobius foetidus paraguensis* (Benth.) M. Sousa & G. Andrade, with a disjunct distribution (Sousa & Andrade, 1992).

Microlobius foetidus is an endemic species of the Misiones nucleus, that is, the Paraguay-Paraná system (Prado & Gibbs, 1993). It is native to southern South America: Brazil, Bolivia (Santa Cruz), Argentina (Chaco, Formosa) and Paraguay (Alto Paraguay, Central, Concepción, Presidente Hayes) (Zuloaga & Morrone, 1999; USDA, 2009).

The present-day distribution of this species is considered to comprise fragmentary remnants of the once extensive forest that probably characterized the dry climatic maxima of the Pleistocene (Prado, 2000). The extant fragments of this seasonal woodland vegetation have their main nucleus in the Caatingas, Misiones, and Piedmont areas (Prado & Gibbs, 1993).

The tropical seasonal forest region comprises at least three provinces: the Caatingas *s. l.*, the Subandean Piedmont Forests and the Paranense. The Pleistocenic Arc must have been more extensive in the geological past to areas that currently cannot be safely included as part of the tropical seasonal forest region (Prado, 2000). Seasonally dry tropical forests (SDTFs) *sensu* Prado (2000) have woody floras dominated by the Leguminosae and Bignoniaceae families (Pennington *et al.*, 2000).

This assumption is supported by the previous studies from the Cenozoic Paraná Basin (Anzótegui & Lutz, 1987; Aceñolaza & Aceñolaza, 1996; Brea & Zucol, 2007; Anzótegui & Aceñolaza, 2008; Franco, 2008a,b, 2009; Franco & Brea, 2009).

As plants are excellent tools for reconstructing paleoclimate and paleoenvironment, especially through comparison with the modern flora, the study of Fabaceae fossil wood from Ituzaingó Formation can shed new light on past floral composition and past environment and climate of the Cenozoic Paraná Basin.

FINAL CONSIDERATIONS

A new species of the Mimosoideae (Fabaceae), *Microlobiusxylon paranaensis*, is described from the Pliocene-Pleistocene Ituzaingó Formation from Toma Vieja fossil locality, Entre Ríos, Argentina. This fossil provides new evidence of Mimosoideae distribution in the past and is similar to the extant genera of the *Piptadenia* group, especially *Microlobius*.

Microlobiusxylon paranaensis might have been an important component of the seasonally dry tropical forests

(SDTFs) *sensu* Prado (2000). The presence of this fossil record from Ituzaingó Formation at the Toma Vieja fossil locality and the studies above discussed from the Cenozoic Paraná Basin support the idea that SDTFs were more widespread in the past.

The presence of *Microlobiusxylon paranaensis* would indicate a temperate-warm climate during the Pliocene-Pleistocene.

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