

PATAGONIA'S DIVERSE BUT HOMOGENEOUS EARLY PALEOCENE FORESTS: ANGIOSPERM LEAVES FROM THE DANIAN SALAMANCA AND PEÑAS COLORADAS FORMATIONS, SAN JORGE BASIN, CHUBUT, ARGENTINA

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APPENDIX 2: Key to angiosperm leaf/leaflet morphotypes from the Danian Salamanca and Peñas Coloradas formations, San Jorge Basin, Chubut, Argentina. With two organizational paths: by key numbers and by major leaf shape (subtitles in parentheses).

1_ Venation reticulate (non-monocot)	2
1'_ Venation parallel (monocot)	52
2_ Blade unlobed.....	3
2'_ Blade palmately lobed.....	41
3_ Margin untoothed (or with scattered/isolated teeth)	4
3'_ Margin toothed	18
4_ Intramarginal vein absent	5
4'_ Intramarginal vein well developed	16
5_ Agrophic veins absent, and primary vein pinnate,	6
5'_ Agrophic veins present and/or primary veins actinodromous	13
6_ Secondary venation terminating at the margin	7
6'_ Secondary venation not terminating at the margin (brochidodromous, eucamptodromous, reticulodromous)	9
7_ Secondary venation semicraspedodromous or festooned semicraspedodromous, sometimes craspedodromous at leaf base, with marginal crenations very small and irregularly spaced	
..... Morphotype SA049 (Figures 27E-F, 29A-K)	

7'_ Secondary veins dichotomize or reticulate before margin, margin untoothed	8
8_ Secondary venation reticulodromous, tertiary venation dichotomizing admedially, fourth-order veins dichotomizing	Morphotype SA050 (Figures 29L-O, 31A-D)
8'_ Secondary venation festooned brochidodromous, tertiary venation alternate percurrent, fourth-order veins regular polygonal reticulate	Morphotype SA063 (Figures 33E, 34G-I)
9_ Fimbrial and intersecondary veins both absent	10
9'_ Fimbrial and intersecondary veins both present.....	11
10_ Tertiary veins opposite percurrent, margin wavy or scattered toothed	Morphotype SA041 (Figures 19L-M, 23A-I)
10'_ Tertiary veins reticulate, margin untoothed	17
11_ Base wide-rounded, apex convex or retuse, petiole/petiolule pulvinate/pulvinate, secondary veins thin	Morphotype SA045 (Figures 24H-L, 25J)
11'_ Base decurrent or convex, apex acuminate (drip-tip) or retuse, petiole/petiolule not pulvinate/pulvinate, secondary veins not notably thin	12
12_ Secondary venation reticulodromous or slightly brochidodromous, tertiary veins random reticulate, leaf rank < 3.....	Morphotype SA046 (Figures 25I, 26A-F)
12'_ Secondary venation festooned weak-brochidodromous, tertiary veins opposite percurrent, leaf rank >2	Morphotype SA077 (Figures 38A-D, 40C)
13_ Base asymmetric, fimbrial vein restricted to leaf base	Morphotype SA078 (Figures 35E-H, 40E)
13'_ Base symmetric, marginal ultimate venation looped	14
14_ Tertiary and 4 th order venation opposite percurrent	Morphotype SA066 (Figures 33F, 34L-M)
14'_ Tertiary and 4 th order venation regular polygonal reticulate	15

- 15_ Three basal veins, secondary vein angle variable, idioblast (dark dots) present
 **Morphotype SA010** (Figures 12, 13)
- 15'_ Five basal veins, secondary vein angle uniform, resin dots absent
 **Morphotype SA073** (Figures 36A-E, 39E)
- 16_ Blade narrow elliptic, secondary venation festooned brochidodromous to brochidodromous,
 secondary veins densely spaced **Morphotype SA016**
 (Figures 16A-E, 19F-I)
- 16'_ Blade ovate, secondary venation brochidodromous, secondary veins not densely spaced
 **Morphotype SA060** (Figures 33C-D, 34AC)
- 17_ Blade microphyll to notophyll, secondary venation brochidodromous, fimbrial vein present
 **Morphotype SA056** (Figures 31L, 32A-C)
- 17'_ Blade macrophyll, secondary venation weakly brochidodromous to reticulodromous,
 fimbrial vein absent **Morphotype SA067** (Figures 33G, 34D-F)

(margin toothed, blade unlobed)

- 18_ Fimbrial vein present 19
- 18'_ Fimbrial vein not developed 26
- 19_ Primary venation suprabasal acrodromous; teeth large (length >4 mm) and irregularly
 spaced, freely ending veinlets (FEVs) associated with idioblasts (dark dots) ..
 **Morphotype SA057** (Figures 31I, 32D-G)
- 19'_ Primary venation pinnate, teeth small to crenate and uniformly spaced, resin dots absent
 20
- 20_ Agrophic veins present, primary venation acrodromous, margin smoothly crenate ...
 **Morphotype SA069** (Figures 33H-I, 34J-K)
- 20'_ Agrophic veins absent primary venation not acrodromous, margin dentate or serrate
 21

21_ Teeth in two orders, triangular, tooth apex spherulate	22
21'_ Teeth simple, tooth apex spinose	23
22_ Length:width ratio > 3:1, intersecondary veins strong	Morphotype SA051 (Figures 27G-I, 30A-G)
22_ Length:width ratio < 3:1, intersecondary veins strong	Morphotype SA054 (Figures 30M-30P, 31G-H)
23_ Secondary venation semicraspedodromous, length:width ratio < 6:1	24
23'_ Secondary venation cladodromous or craspedodromous, length:width ratio > 6:1	25
24_ Secondary venation craspedodromous to apically semicraspedodromous, fourth-order veins alternate percurrent, tooth shape concave/retroflexed or straight/retroflexed	Morphotype SA020 (Figures 18, 19A-E)
24'_ Secondary venation semicraspedodromous, fourth-order veins regular polygonal reticulate, tooth shape concave/concave or concave/flexuous	Morphotype SA001
(Figure 1)	
25_ Base symmetrical, primary vein stout, secondary vein course straight and regular, cladodromous secondary venation	Morphotype SA053 (Figures 30H-J, 31E-F)
25'_ Base asymmetrical, primary veins not thickened, secondary vein course curved craspedodromous secondary venation	Morphotype SA076 (Figures 37A-D, 40A-B)
(blade unlobed, margin dentate, fimbrial vein not developed)	
26_ Blade oblong	27
26'_ Blade elliptic or ovate	28
27_ Blade symmetrical, apex acuminate, intersecondary veins absent, tertiary vein angle obtuse to primary	Morphotype SA052 (Figures 27J, 28J-K)

27_ Blade base asymmetrical, apex straight, intersecondary veins weak, tertiary vein angle perpendicular to primary	Morphotype SA070 (Figures 35A-F, 39A-B)
28_ Teeth compound (or in two size order), with significant size variation	29
28'_ Teeth simple or with minimal size variation	33
29_ Base truncate, tooth apex glandular with a fused callosity	Morphotype SA074 (Figures 36F-H, 39F-G)
29'_ Base not truncate, tooth apex simple.....	30
30_ Secondary vein angle markedly differs on either side of primary, tertiary vein angle obtuse to primary	Morphotype SA004 (Figure 7)
30'_ Secondary vein angle not markedly different on either side of primary, tertiary veins perpendicular to primary	31
31_ Secondary venation cladodromous, leaf rank low, fimbrial vein present, low leaf rank (2r)	Morphotype SA059 (Figures 32K-M, 33A-B)
31'_ Secondary venation craspedodromous, leaf rank high, marginal ultimate venation looped, high leaf rank (4r)	32
32_ Leaf simple, base decurrent, lateral branch of tooth principal vein runs to the basal flank of the supradjacent tooth	Morphotype SA008 (Figure 9)
32'_ Leaf compound, (leaflet) base cuneate, lateral branch of tooth principal vein runs to supradjacent sinus	Morphotype SA043 (Figures 24A-24G, 25E-F)
33_ Primary venation acrodromous	Morphotype SA048 (Figures 27B-D, 28A-G)
33'_ Primary venation pinnate	34
34_ Secondary venation semicraspedodromous or festooned semicraspedodromous, teeth small.....	35
34'_ Secondary venation craspedodromous or weakly brochidodromous	36

35_ Tooth apex glandular, teeth uniformly developed, leaf rank >2	
.....	Morphotype SA005 (Figure 8)
35'_ Secondary venation semicraspedodromous to festooned semicraspedodromous, teeth more developed toward apex, leaf rank < 3	Morphotype SA049
(Figures 27E-F, 29A-29K)	
36_ Secondary venation weakly brochidodromous, tertiary veins opposite percurrent, margin undulate, tooth spacing irregular	10
36'_ Secondary venation craspedodromous, teeth more or less uniformly spaced	37
37_ Secondary veins basally congested, tertiary vein angle increasing basally, teeth spinose	Morphotype SA002 (Figure 6)
37'_ Secondary veins not basally congested, tertiary vein angle uniform	38
38_ Agrophic veins present	39
38'_ Agrophic veins absent	40
39_ Teeth glandular, secondary veins not forking	43
39'_ Teeth simple, flanks flexuous/flexuous, secondary veins forking	32
40_ Teeth distinctly asymmetrical with glandular apices, secondary vein spacing increasing toward middle of blade	Morphotype SA044 (Figures 23J-23O, 25G-H)
40'_ Teeth symmetrical or slightly asymmetrical, large with simple apex, secondary veins regularly spaced	Morphotype SA042 (Figures 16F-M, 25A-D)
(palmately lobed)	
41_ Margin dentate	42
41'_ Margin untoothed	46
42_ Blade trilobate (or unlobed) ovate, three basal veins	43

42'_Blade 3-5 lobate, five basal veins, tooth apex simple	44
43_ Fimbrial vein thin, teeth small not recurved, Intersecondary and interior secondary veins present (may be thin)	Morphotype SA009 (Figures 10, 11)
43' Fimbrial vein strong, teeth recurved Intersecondary and interior secondary veins absent	Morphotype SA047 (Figures 26G-L, 27A)
44_ Fimbrial vein present	Morphotype SA068 (Figures 33J, 35G-K)
44' Marginal ultimate venation looped	45
45_ Base concavo-convex, cordate or cuneate, agrophic veins compound	Morphotype SA035 (Figures 19J-K, 20)
45'_Base wide-rounded to truncate, agrophic veins simple	Morphotype SA075 (Figures 37A-D, 40AB)
(blade lobed, margin entire)	
46_ Petiole insertion peltate eccentric	47
46'_Petiole insertion marginal	48
47_ Lobes wide and shallow, lobe apex convex, seven basal veins	Morphotype SA040 (Figures 21D, 22J-M)
47'_ Lobes deeply incised and ovate to elliptic, lobe apex straight, five basal veins,	Morphotype SA055 (Figures 21E-F, 30K-L)
48_ Blade three-lobed, primary venation suprabasal actinodromous, secondaries thin, perpendicular to primary	Morphotype SA058 (Figures 31J-K, 32H-J)
48'_ Blade with more than three lobes, primary venation basal actinodromous or palinactinodromous	49
49_ Base decurrent, lobes simple, secondaries thin and consistently straight	Morphotype SA014 (Figures 14, 15A-D)

49'_Base lobate, cordate or rounded, lobes compound, secondaries curved	50
50_Lobes elongate, base rounded or barely cordate	Morphotype SA019 (Figures 15E-I, 17)
50'_Lobes wide, leaf base lobate	51
51_Basal veins 7, primary venation palinactinodromous, secondary venation brochidodromous	Morphotype SA038 (Figures 21C, 22H-I)
51'_Basal veins 9, primary venation actinodromous, secondary venation festooned brochidodromous	Morphotype SA039 (Figures 21A-B, 22A-G)
(parallel venation, with or without midvein)	
52_ Three orders of veins. Segment venation flabellate.....	53
52'_ Two orders of veins. Venation not radially diverging	54
53_ Midvein absent, parallel veins radiating from a basal point, margin entire	Morphotype SA065 (Figures 40D , 41F-G)
53'_ Midvein present and massive, secondary veins arise from the midvein, cladodromous secondary venation (really no parallel venation), margin serrate	Morphotype SA053 (figures 30H-J, 31E-F)
54_ Blade wide, entire; high-order veins transverse; fibers accompanying veins	Morphotype SA061 (Figures 40G, 41H-4K)
54'_ Blade divided into segments, minor veins parallel or obliquely oriented, fibers not observed	55
55_ Segments parallel, not keeled, segments up to 5 cm in width	Morphotype SA032
(Figure 41A-C)	
55'_ Segments fused and radiating, plicate with a keel, rectangular in section, 2 mm in width	Morphotype SA072 (Figures 40F, 41D-E)