a b c d

5 mm 1 mm 100 µm 100 µm

e f g h

200 µm 200 µm 200 µm 200 µm

i j k m

200 µm 100 µm 200 µm 100 µm

n o p

50 µm 50 µm 20 µm

Fig. 6. Micrographs of cuticles

Micrographs of cuticles from morphotype ES11. **a.** Macrophotograph of specimen on the rock showing cuticle preservation. **b.** Micrograph of cuticle removed from the rock showing the midvein and attachment of the secondary veins. **c.** Light microscopy (LM) photograph of a fraction of the midvein. **d.** Epifluorescence microscopy (EF) photograph the stomata present on top of the same fraction of the midvein shown in image *c*. **e.** (LM) photograph of a fraction of a secondary vein. **f.** (EF) photograph the stomata present along the sides of the same fraction of the secondary vein shown in image *e.* **g.** (LM) photograph of another fraction of a secondary vein. **h.** (EF) photograph the stomata present along the sides of the same fraction of the secondary vein shown in image *g.* **i.** Stomata present on the midvein. **j.** Stomata present on the midvein. **b-j.** Inferred adaxial side. **k.** Midvein and lamina epidermal cells. **m.** Epidermal cells from lamina and minor veins. **n.** Close-up of a stoma, showing epicuticular waxes. **o.** Close-up of a stoma, showing epicuticular waxes and perpendicular striations on the stoma. **p.** SEM photograph showing possibly epicuticular waxes. **k–p.** Inferred abaxial side of the leaf. All photographs were taken from sample STRI-ID-45224.

Morphotype ES20

Figure 7a

Locality: 430134

Morphotype exemplar: 45003

Other specimens studied: 44997, 45016, 44992, 44992, 44992, 44992, 44995, 44995, 44995, 45012, 45013, 44994, 45010, 45015, 45003, 45001, 44999, 45000, 45017, 45008, 45009, 44998, 45004, 45014, 44996, 35667, 35667, 36165, 35661, 35652, 35658, 35557, 36165, 45006, 45007, 45005, 35557, 45002, 44993, 45011

Description: The leaf attachment is petiolate. The blade attachment is marginal. The laminar size is nanophyll to microphyll; the laminar L:W ratio is 1.7:1; the laminar shape is elliptic, with medial and basal symmetry. The lamina is unlobed and untoothed. The apex is angle is acute and the shape is acuminate. The base angle is obtuse and the shape is convex to straight-cuneate. Primary venation is pinnate with 3 basal veins. Major secondaries are festooned brochidodromous. The minor secondary course is simple brochidodromous, major secondary

spacing is regular with a uniform and decurrent attachment. Intersecondary veins are parallel to major secondaries, with lengths shorter than 50% of subjacent secondary; these are basiflexed and do not join subjacent secondaries at right angles, and they do not occur at all the intercostal areas. The intercostal tertiary veins are alternate percurrent, acute to the midvein, with a vein angle increasing exmedially. The epimedial tertiaries are alternate percurrent, and have a proximal course parallel to subjacent secondary, its distal course is basiflexed, and have an exterior tertiary course looped. Quaternary vein fabric is alternate percurrent. Quinternary vein fabric is reticulate. Areolation is well developed. Freely ending veinlets, two or more with dichotomous branching, with tracheoid idioblasts termination.

Morphotype ES21

Figure 7b

Locality: 430134

Morphotype exemplar: 45114

Other specimens studied: 45107, 45109, 45106, 45105, 45104, 45112, 45114, 45110, 45111, 45108, 45113, 45448

Description: The leaf attachment is petiolate. The blade attachment is submarginal. The laminar size is microphyll; the laminar L:W ratio is 2:1; the laminar shape is elliptic, with medial and basal symmetry. The lamina is unlobed and untoothed. The base angle is reflex and the shape is auriculate. Primary venation is pinnate with 5 basal veins; the agrophic veins are simple. Major secondaries are festooned brochidodromous. The minor secondary course is simple brochidodromous. The intercostal tertiary veins are opposite to mixed percurrent, obtuse to the midvein, with a consistent vein angle. The epimedial tertiaries are opposite percurrent, and have

a proximal and distal course parallel to intercostal tertiary. Quaternary vein fabric is mixed percurrent. Quinternary vein fabric is possibly reticulate. Areolation is moderately developed.

Morphotype ES22

Figure 7c

Locality: 430134

Morphotype exemplar: 45127

Other specimens studied: 35364, 36161, 35667, 35669, 45119, 45129, 45122, 45124, 45123, 45117, 45115, 45125, 35624, 45116, 45121, 45127, 45118, 45128, 45120, 45126

Description: The blade attachment is marginal. The laminar size is nanophyll to microphyll; the laminar L:W ratio is 1:1; the laminar shape is elliptic, with medial and basal symmetry. The lamina is unlobed and untoothed. The apex is acute and the shape is acuminate. The base angle is obtuse and the shape is rounded. Primary venation is pinnate with 5 basal veins. Major secondaries are simple brochidodromous. The minor secondary course is simple brochidodromous. The intercostal tertiary veins are exmedially ramified. The epimedial tertiaries are ramified, and have a proximal course parallel to subjacent secondary. Quaternary vein fabric is irregular reticulate. Areolation is poorly developed.

Morphotype ES23

Figure 7d

Locality: 430134

Morphotype exemplar: 45189

Other specimens studied: 35661, 45190, 35669, 45191, 45189

Description: The blade attachment is marginal. The laminar size is microphyll; the laminar L:W ratio is 1.3:1; the laminar shape is elliptic, with medial and basal symmetry. The lamina is unlobed and untoothed. The apex is obtuse and the shape is rounded. The base angle is obtuse and the shape is rounded. Primary venation is pinnate. Major secondaries are simple brochidodromous. Intersecondary veins are parallel to major secondaries, with lengths shorter than 50% of subjacent secondary; these are basiflexed and do not join subjacent secondaries at right angles, and they do not occur at all the intercostal areas. The intercostal tertiary veins are mixed percurrent, obtuse to the midvein, with a consistent vein angle. The epimedial tertiaries are opposite percurrent, and have a proximal course perpendicular to the midvein, its distal course is basiflexed. Quaternary vein fabric is mixed percurrent. Quinternary vein fabric is irregular reticulate. Areolation is well developed. Freely ending veinlets are mostly one branched, with tracheoid idioblasts termination.

Morphotype ES24

Figure 7e

Locality: 430134

Morphotype exemplar: 44951

Other specimens studied: 44951, 44952, 44955, 44953, 44956, 44954

Description: The laminar size is microphyll; the laminar L:W ratio is 3:1; the laminar shape is elliptic, with medial symmetry. The lamina is unlobed and untoothed. The surface has red glands. Primary venation is pinnate. Major secondaries are festooned brochidodromous with spacing gradually increasing proximally, with uniform secondary angle and a decurrent attachment. The minor secondary course is simple brochidodromous. The intercostal tertiary veins are mixed percurrent, obtuse to the midvein, with an inconsistent vein angle. The epimedial

tertiaries are opposite percurrent, and have a proximal course parallel to subjacent secondary to the midvein, its distal course is basiflexed. Quaternary vein fabric is alternate percurrent. Quinternary vein fabric is reticulate. Areolation is moderately developed. Freely ending veinlets are mostly unbranched, with simple termination.

Morphotype ES26

Figure 7f

Locality: 430134

Morphotype exemplar: 45166

Other specimens studied: 45166

Description: The leaf attachment is petiolate. The blade attachment is marginal. The laminar size is microphyll; the laminar L:W ratio is 1.5:1; the laminar shape is elliptic, with medial and basal symmetry. The lamina is unlobed and toothed. The base angle is obtuse and the shape is obtuse. Primary venation is pinnate. Major secondaries are craspedodromous with irregular spacing and decurrent attachment. Marginal secondary vein present. The minor secondary course is craspedodromous. The intercostal tertiary veins are sinuous opposite percurrent, obtuse to the midvein, with consistent vein angles. Quaternary vein fabric is mixed percurrent.

Tooth spacing regular, with one teeth order; 1 to 1.5 teeth per cm; with rounded sinus shape. Tooth has a convex/convex shape, and a spherulate apex shape; principal vein is probably present.

Morphotype ES28

Figure 7g

Locality: 430134

Morphotype exemplar: 35662

Other specimens studied: 35662, 45183, 45184, 45188, 45187, 45186, 35360, 36102, 36102, 45182, 45178, 45180, 45179, 45181, 45185

Description: The leaf attachment is petiolate. The blade attachment is marginal. The laminar size is microphyll; the laminar L:W ratio is 2:1; the laminar shape is oblong, with medial and basal symmetry. The lamina is unlobed and untoothed. The base angle is acute and the shape is concavo-convex. Primary venation is pinnate. Major secondaries are festooned brochidodromous. The minor secondary course is simple brochidodromous. Intersecondary veins are parallel to major secondaries, with lengths longer than 50% of subjacent secondary, and there is more than one per intercostal areas. The intercostal tertiary veins are irregular reticulate. The epimedial tertiaries are reticulate, and have a proximal course acute to the midvein. Exterior tertiary course is looped. Quaternary vein fabric is irregular reticulate.

Morphotype ES29

Figure 7h

Locality: 430134

Morphotype exemplar: 35624

Other specimens studied: 45135, 35549, 35624, 45134, 45131, 45130, 45136, 45133, 45132, 45137

Description: The laminar size is microphyll; the laminar L:W ratio is >4:1; the laminar shape is linear , with medial symmetry. The lamina is unlobed and untoothed. Primary venation is pinnate. Major secondaries are eucamptodromous. The minor secondary course is simple brochidodromous. The intercostal tertiary veins are alternate percurrent, obtuse to the midvein.

The epimedial tertiaries are reticulate, and have a proximal course parallel to subjacent secondary veins and a distal course basiflexed. Quaternary vein fabric is irregular reticulate.

Morphotype ES30

Figure 7i

Locality: 430134

Morphotype exemplar: 44991

Other specimens studied: 44989, 35661, 44986, 35654, 35654, 44984, 44991, 44990, 44987, 44988, 44985, 35556

Description: The leaf attachment is petiolate. The blade attachment is marginal. The laminar size is microphyll; the laminar L:W ratio is 1.7:1; the laminar shape is elliptic, with medial and basal symmetry. The lamina is unlobed and untoothed. The base angle is obtuse and the shape is decurrent to convex. Primary venation is pinnate, with 4 basal veins. Major secondaries are eucamptodromous, with irregular spacing and uniform angle and decurrent attachment. Intersecondary veins are parallel to major secondaries, with lengths shorter than 50% of subjacent secondary; these are basiflexed and do not join subjacent secondaries at right angles, and they do not occur at all the intercostal areas. The intercostal tertiary veins are alternate percurrent, acute to the midvein, with a vein angle increasing exmedially. The epimedial tertiaries are alternate percurrent, and have a proximal course parallel to subjacent secondary, and a distal course is parallel to intercostal tertiary. Quaternary vein fabric is possibly alternate percurrent.

Morphotype ES31

Figure 7j

Locality: 430134

Morphotype exemplar: 45138

Other specimens studied: 35622, 35652, 35658, 35658, 35661, 45138, 45139, 45140, 45141, 45142, 45143, 45144, 45145, 45146

Description: The leaf attachment is petiolate. The blade attachment is marginal. The laminar size is nanophyll to microphyll; the laminar L:W ratio is 1.5:1; the laminar shape is ovate, with medial and basal symmetry. The lamina is unlobed and untoothed. The apex is acute and the shape is straight. The base angle is obtuse and the shape is rounded. Primary venation is pinnate with 3 basal veins. Major secondaries are festooned brochidodromous, with irregular spacing, uniform angle and excurrent attachment. The minor secondary course is craspedodromous. Intersecondary veins are parallel to major secondaries, with lengths longer than 50% of subjacent secondary; these are reticulating exmedially, and there is one per intercostal area. The intercostal tertiary veins are mixed percurrent, obtuse to the midvein, with a consistent vein angle. The epimedial tertiaries are opposite percurrent, and have a proximal course parallel to subjacent secondaries, its distal course is basiflexed; exterior tertiary course is looped. Quaternary vein fabric is irregular reticulate.

Morphotype ES32

Figure 7k

Locality: 430134

Morphotype exemplar: 45149

Other specimens studied: 45148, 45147, 45149, 35651, 35651, 45150

Description: The leaf or leaflet attachment is petiolate. The blade attachment is marginal. The laminar size is leptophyll; the laminar L:W ratio is 2:1; the laminar shape is elliptic, with medial and basal symmetry. The lamina is unlobed and untoothed. The apex is obtuse and the shape is rounded. The base angle is obtuse and the shape is rounded. Primary venation is pinnate. Major secondaries are festooned brochidodromous. The minor secondary course is simple brochidodromous. Intersecondary veins are parallel to major secondaries, with lengths longer than 50% of subjacent secondary; these are basiflexed and do not join subjacent secondaries at right angles, and they do not occur at all the intercostal areas. The intercostal tertiary veins are exmedially ramified. The epimedial tertiaries are ramified, and have a proximal course acute to the midvein.

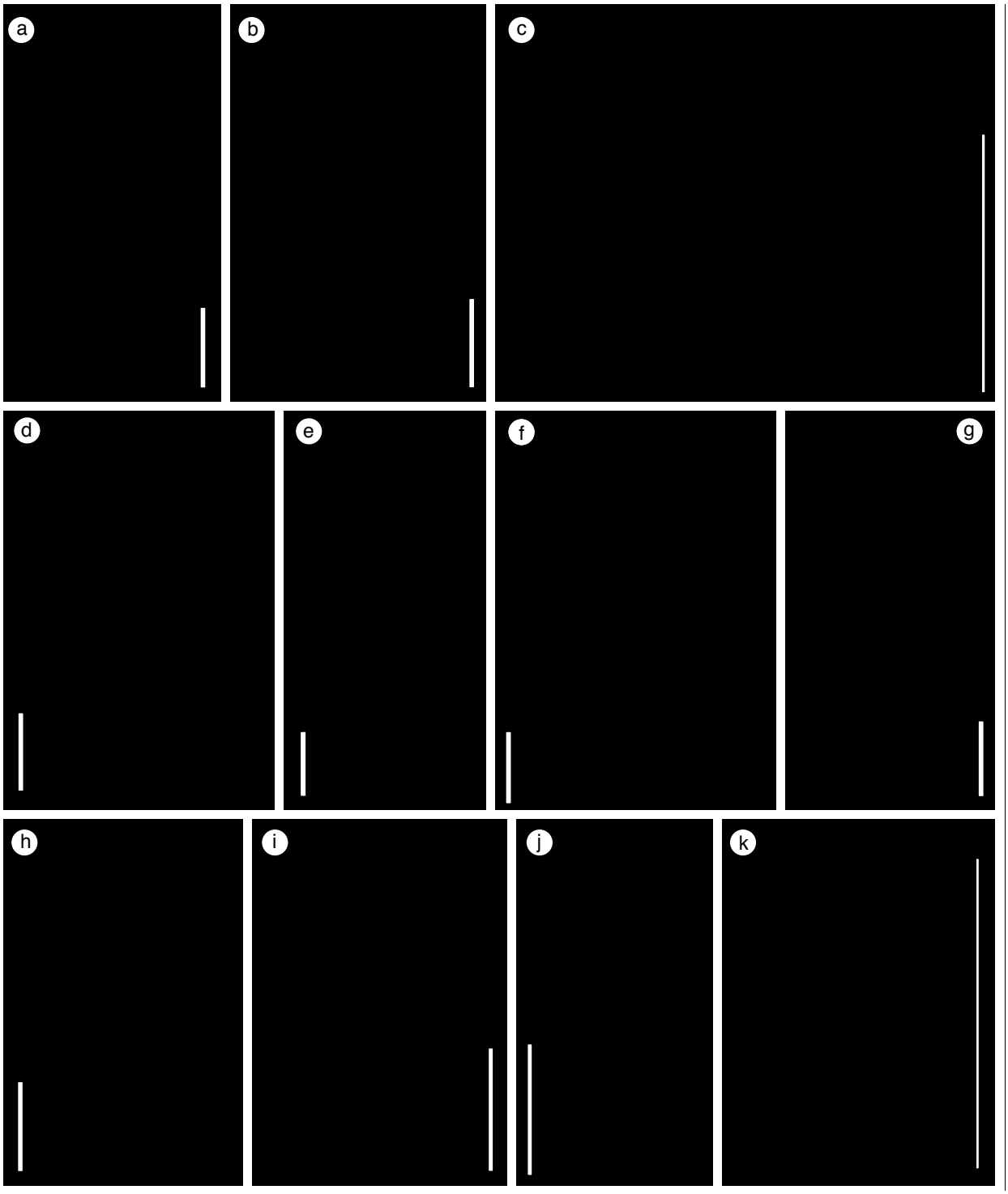

Fig. 7. Fossil leaf morphotype exemplars

Fossil leaf morphotype exemplars from the Esmeraldas Formations. **a.** ES-20, STRI-ID-45003, **b.** ES-21, STRI-ID-45114. **c.** ES-22, STRI-ID-45127. **d.** ES-23, STRI-ID-45189. **e.** ES-24, STRI-ID-44951. **f.** ES-26, STRI-ID-45166. **g.** ES-28, STRI-ID-35662. **h.** ES-29, STRI-ID-

35624. **i.** ES-30, STRI-ID-44991. **j.** ES-31, STRI-ID-45138. **j.** ES-32, STRI-ID-45149. All scales = 1 cm.

Morphotype ES33

Figure 8a

Locality: 430134

Morphotype exemplar: 45156

Other specimens studied: 35549, 36102, 45151, 45152, 45152, 45153, 45154, 45155, 45157, 45158

Description: The blade attachment is marginal. The laminar size is leptophyll to nanophyll; the laminar L:W ratio is 3:1; the laminar shape is oblong, with medial symmetry and basal asymmetry. The lamina is unlobed and untoothed. The apex is obtuse and the shape is rounded. The base angle is obtuse and the shape is rounded to slightly cordate. Primary venation is pinnate. Major secondaries are festooned brochidodromous. The intercostal tertiary veins are irregularly reticulate.

Remarks: The ES33 morphotype share with Fabaceae the leptophyll to nanophyll size of leaflets, with basal asymmetry, with rounded apex.

Morphotype ES34

Figure 8b

Locality: 430134

Morphotype exemplar: 45162

Other specimens studied: 35553, 45159, 45160, 45161, 45163, 45164, 45165

Description: The leaf attachment is petiolate. The blade attachment is marginal. The laminar size is nanophyll; the laminar L:W ratio is 2:1; the laminar shape is elliptic, with medial and basal symmetry. The lamina is unlobed and untoothed. The base angle is obtuse to reflex and the shape is rounded to cordate. Primary venation is pinnate. Major secondaries are festooned brochidodromous with a wavy course. The intercostal tertiary veins are irregular reticulate.

Morphotype ES35

Figure 8c

Locality: 430134

Morphotype exemplar: 45170

Other specimens studied: 35557, 35624, 45171, 45172, 45173

Description: The laminar shape is possibly elliptic or oblong, with medial symmetry. The lamina is unlobed and untoothed. Primary venation is pinnate. Major secondaries are simple brochidodromous. The intercostal tertiary veins are sinuous opposite percurrent, obtuse to the midvein. Quaternary vein fabric is alternate percurrent.

Morphotype ES36

Figure 8d

Locality: 430134

Morphotype exemplar: 45167

Other specimens studied: 45168, 45169

Description: The laminar shape is possibly elliptic or oblong; the lamina has medial symmetry, is unlobed and toothed. The laminar size is possibly notophyll. Primary venation is pinnate. Major secondaries are semicraspedodromous, with decurrent attachment. The intercostal

tertiary veins are sinuous opposite percurrent, obtuse to the midvein. Quaternary vein fabric is alternate percurrent.

Tooth spacing is regular, with one teeth order; 7 to 8 teeth/cm; sinus shape rounded. Tooth shape is convex to straight at the proximal flank, and straight to concave at the distal flank.

Morphotype ES37

Figure 8e

Locality: 430134

Morphotype exemplar: 45101

Other specimens studied: 45099, 45100, 45102, 45103

Description: The laminar shape is ovate, with medial symmetry. The lamina is unlobed and toothed. The laminar size is microphyll; the laminar L:W ratio is 1–2:1. The apex angle is acute. Primary venation is pinnate. Major secondaries are semicraspedodromous with an acute angle. The intercostal tertiary veins are alternate percurrent, and are obtuse to the midvein. Quaternary vein fabric is alternate percurrent.

Tooth spacing is regular, with one tooth order; there are approximately 12 teeth/cm; sinus shape angular. The tooth shape is convex/convex cv/cv.

Morphotype ES41

Figure 8f

Locality: 110026

Morphotype exemplar: 45237

Other specimens studied: 45289

Description: The leaf is possibly compound and the following description might represent a leaflet. The lamina attachment is petiolate. The petiole is thick possibly pulvinulate. The blade attachment is marginal. The laminar size is nanophyll; the laminar L:W ratio is 2.7:1; the laminar shape is elliptic, with medial and basal asymmetry. The lamina is unlobed and untoothed. The apex angle is acute with a straight shape. The base angle is obtuse and the shape is rounded. Primary venation is pinnate. Major secondaries are brochidodromous.

Remarks: ES41 shares with Fabaceae the nanophyll size of leaflets, with medial and basal asymmetry, with straight apex.

Morphotype ES42

Figure 8g

Locality: 110026

Morphotype exemplar: 45236

Description: The leaf is compound. The leaflet laminar size is nanophyll; the laminar L:W ratio is 2.4:1; the laminar shape is elliptic, with medial symmetry. The lamina is unlobed and untoothed. The apex angle is reflexed and the shape is emarginate. The base shape is possibly rounded. Primary venation is pinnate. Major secondaries are brochidodromous. Marginal vein is present and conspicuous. Intersecondary veins are parallel to subjacent secondaries, with lengths longer than 50% of subjacent secondary; these join subjacent secondaries, and they do not occur at all the intercostal areas. The intercostal tertiary veins are possibly alternate percurrent.

Remarks: ES42 shares with Fabaceae the nanophyll size of leaflets, elliptic lamina shape, and emarginate apex.

Morphotype ES43

Figure 8h

Locality: 110026

Morphotype exemplar: 35269

Other specimens studied: 35106, 35160, 35205, 35216, 35225, 35234, 35270, 35275, 36084, 36085, 36085, 36088, 36088, 36089, 45238, 45239, 45240, 45266, 45267, 45268, 45269, 45270, 45271, 45272, 45273, 45274, 45275, 45276, 45277, 45278, 45279, 45280, 45281, 45282, 45284, 45285, 45286, 45287

Description: The leaf attachment is petiolate. The blade attachment is marginal. The laminar size is notophyll to mesophyll; the laminar L:W ratio is 1.5:1; the laminar shape is ovate, with medial and basal symmetry. The lamina is unlobed and toothed. The apex angle is acute and the shape is straight. The base angle is reflex and the shape is cordate. Primary venation is actinodromous with more than three basal veins; the agrophic veins are compound. Major secondaries are semicraspedodromous. Interior secondaries are present. The minor secondary course is semicraspedodromous. The intercostal tertiary veins are mostly opposite percurrent, perpendicular to the midvein. Quaternary vein fabric is alternate percurrent.

Tooth spacing slightly irregular, with one tooth order; around seven teeth per cm; sinus shape is angular. Tooth shape is straight/straight.

Morphotype ES44

Figure 8i

Locality: 110026

Morphotype exemplar: 35272

Other specimens studied: 36084, 36089, 45247, 45248, 45249

Description: The leaf attachment is petiolate. The blade attachment is marginal. The laminar size is microphyll and mesophyll; the laminar L:W ratio is 1.7:1; the laminar shape is ovate, with medial and basal symmetry. The lamina is unlobed and untoothed. The base angle is obtuse and the shape is rounded. Primary venation is actinodromous with three strong basal veins; the agrophic veins are simple. Major secondaries are simple brochidodromous. Interior secondaries are present. The minor secondary course is simple brochidodromous. The intercostal tertiary veins are opposite percurrent, acute to perpendicular to the midvein. The epimedial tertiaries are opposite percurrent, and have a proximal course acute to the midvein, its distal course is parallel to intercostal tertiary. Quaternary vein fabric is alternate percurrent.

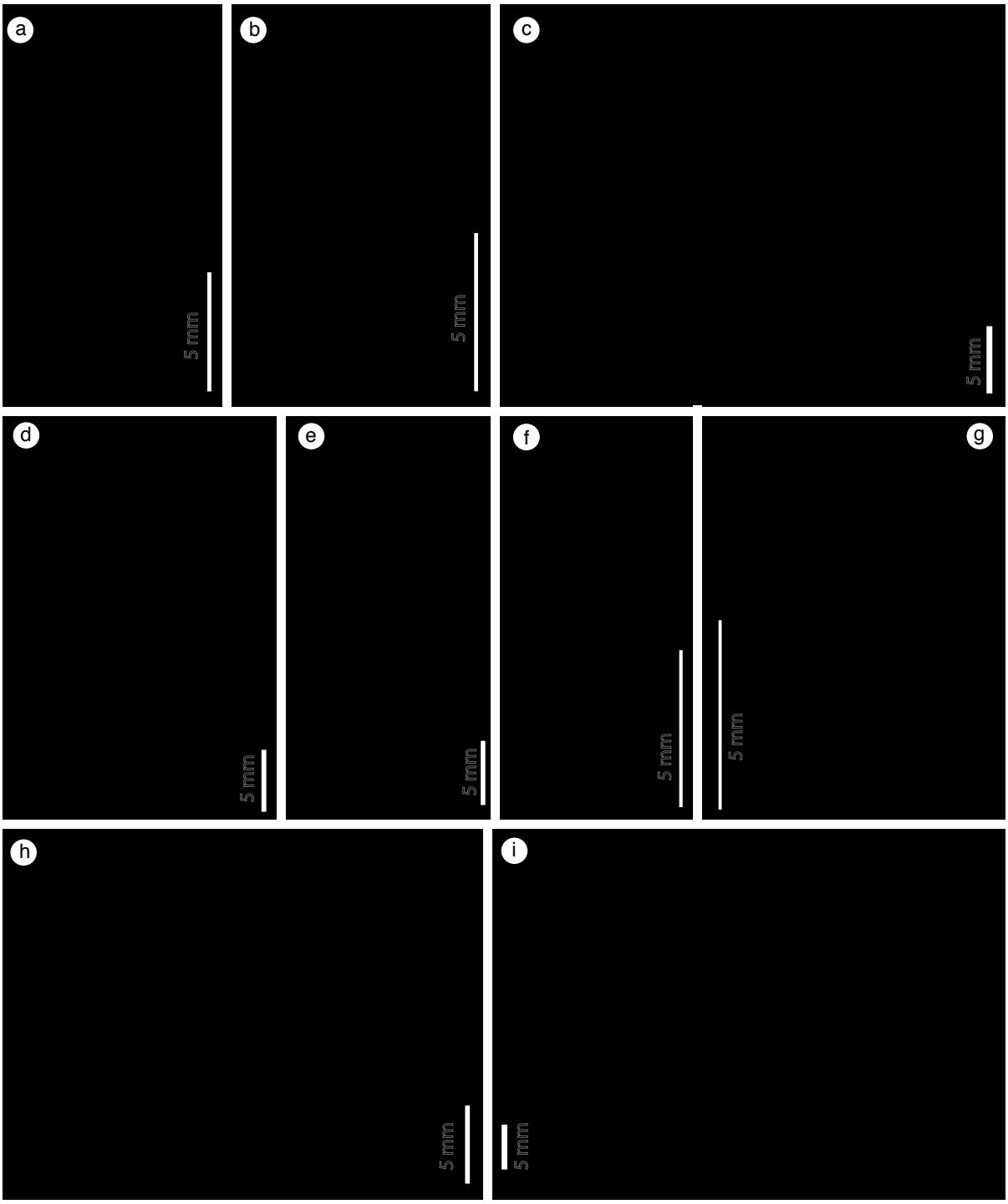

Fig. 8. Fossil leaf morphotype exemplars

Fossil leaf morphotype exemplars from the Esmeraldas Formations. **a.** ES33, STRI-ID-45156, **b.** ES34, STRI-ID-45162. **c.** ES35, STRI-ID-45170. **d.** ES36, STRI-ID-45167. **e.** ES37, STRI-ID-45101. **f.** ES41, STRI-ID-45237. **g.** ES42, STRI-ID-45236. **h.** ES43, STRI-ID-35269. **i.** ES44, STRI-ID-35272. All scales = 0.5 cm.

Morphotype ES45

Figure 9a

Locality: 110026

Morphotype exemplar: 45242

Other specimens studied: 35159, 35209, 36088, 45241, 45243, 45245, 45246, 45288

Description: The blade attachment is marginal. The laminar size is notophyll; the laminar L:W ratio is 1.8:1; the laminar shape is ovate, with medial and basal symmetry. The lamina is unlobed and toothed. The apex angle is acute and the shape is possibly straight. The base angle is obtuse and the shape is possibly rounded. Primary venation is actinodromous with three major basal veins; the agrophic veins are compound. Major secondaries are brochidodromous. Interior secondaries are present. The minor secondary course is craspedodromous. The intercostal tertiary veins are opposite percurrent, perpendicular to the midvein. The epimedial tertiaries are opposite percurrent. Quaternary vein fabric is alternate percurrent.

Tooth spacing regular, with one tooth order; around 10 teeth/cm; sinus shape rounded. Tooth shapes; and flexuous/straight. Principal vein present; terminates present tooth apex.

Morphotype ES46

Figure 9b

Locality: 110026

Morphotype exemplar: 45254

Other specimens studied: 35096, 45252, 45253

Description: The leaf attachment is petiolate. The blade attachment is marginal. The laminar size is microphyll; the laminar L:W ratio is 1.8:1; the laminar shape is elliptic, with medial and basal symmetry. The lamina is unlobed and untoothed. The apex angle is reflex and the shape is emarginate. The base angle is obtuse and the shape is rounded. Primary venation is pinnate. Major secondaries are brochidodromous. Intersecondary veins are present, with lengths shorter than 50% of subjacent secondary. The intercostal tertiary veins are possibly reticulated.

Morphotype ES47

Figure 9c

Locality: 110026

Morphotype exemplar: 45250

Other specimens studied: 35260, 35271, 35400, 45251

Description: The blade attachment is marginal. The laminar size is microphyll to mesophyll; the laminar L:W ratio is 2.1:1; the laminar shape is ovate, with medial and basal symmetry. The lamina is unlobed and untoothed. The apex angle is acute. The base angle is acute. Primary venation is pinnate. Major secondaries are brochidodromous and have a decurrent attachment. Intersecondary veins are parallel to subjacent secondaries, with lengths shorter than 50% of subjacent secondary; these are reticulating, and they do not occur at all the intercostal areas. The intercostal tertiary veins are alternate percurrent, obtuse to the midvein. The epimedial tertiaries are alternate percurrent. Quaternary vein fabric is alternate percurrent.

Morphotype ES48

Figure 9d

Locality: 110026

Morphotype exemplar: 46652

Other specimens studied: 35203, 35204, 35220, 35223, 35227, 35267, 35280, 35403, 45228, 45257, 45258, 45259, 45260, 45261, 45262, 45264, 45265, 45290, 45291, 45292, 45303, 45304

Description: The leaf attachment is petiolate, possibly pulvinate. The blade attachment is marginal. The laminar size is microphyll; the laminar L:W ratio is 2.1:1; the laminar shape is elliptic, with basal asymmetry. The lamina is unlobed and untoothed. The apex angle is reflex and the shape is emarginate. The base angle is obtuse and the shape is rounded. Primary venation is pinnate. Major secondaries are festooned brochidodromous. Intersecondary veins are parallel to subjacent secondaries, with lengths longer than 50% of subjacent secondary; these are reticulating distally, and they do not occur at all the intercostal areas. The intercostal tertiary veins are alternate percurrent.

Monocots

At least four monocot morphotypes were recognized, however, due to the high degree of incompleteness of these specimens they were not described but they are illustrated in Fig. 9e–h. They are recognized as monocots because they have parallelodromous and closely spaced veins.

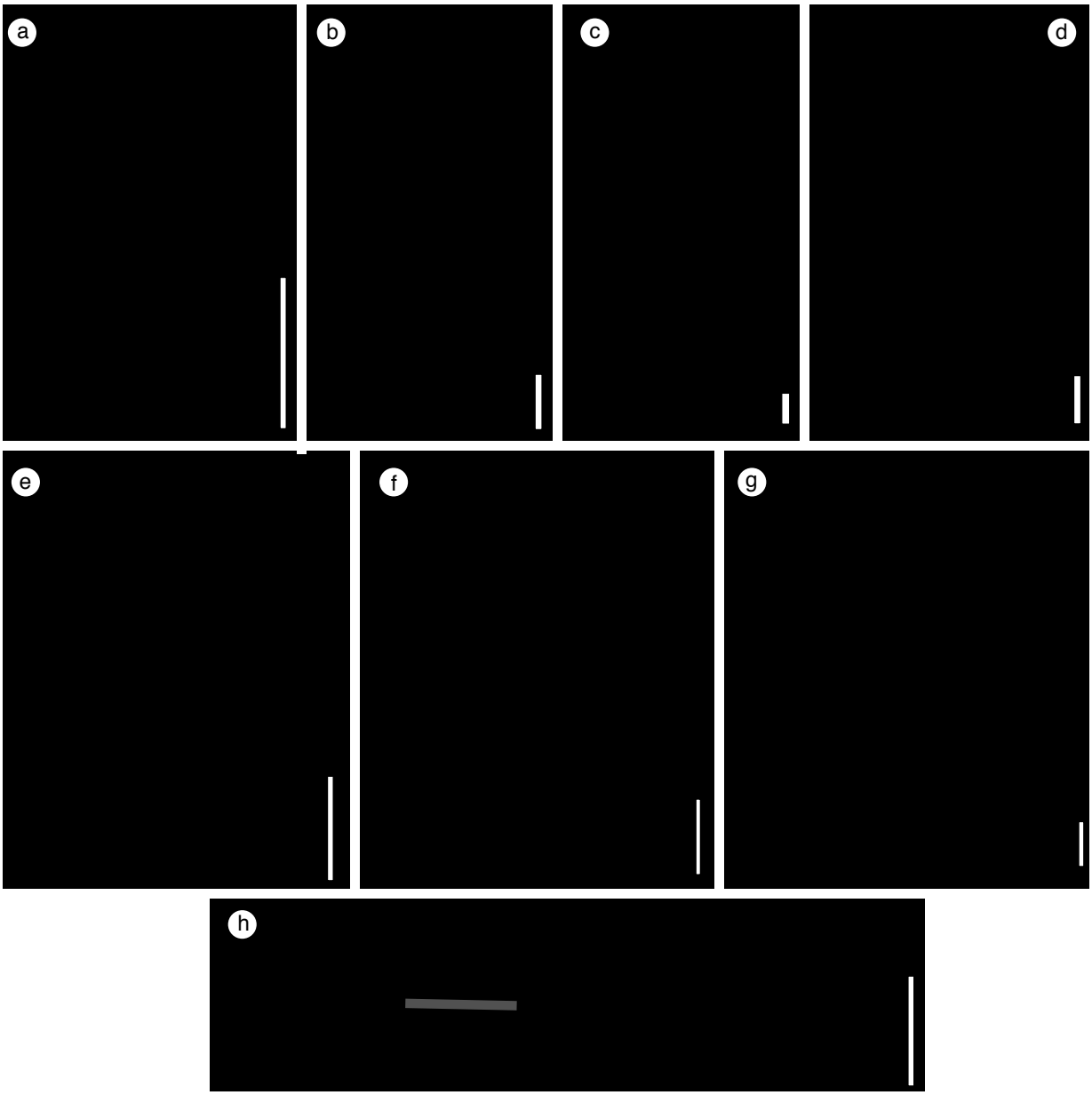

Fig. 9. Fossil leaf morphotype exemplars

Fossil leaf morphotype exemplars from the Esmeraldas Formations and monocot morphotypes. **a.** ES45, STRI-ID-45242, **b.** ES46, STRI-ID-45254. **c.** ES47, STRI-ID-45250. **d.** ES48, STRI-ID-46652. **e–h.** monocot morphotypes. All scales = 0.5 cm.

Ferns

Morphotype ES49

Figure 10

Salvinia sp.

Systematic affinity. Class Filicopsida; Order Salviniales; Family Salviniaceae; Genus Salvinia; Species *incertae sedis*.

Locality: 430134

Morphotype exemplar: 35515

Other specimens studied: 35660, 36164

Description: These fossils consist on detached floating leaf compressions. Shape of floating leaves varies between oblong and ovate; width is 6.2 mm and length is 7 mm (only one specimen was found complete), base of lamina is cordate and apex is rounded (Fig. 10). Primary vein narrows distally. Floating leaves have 28 secondary veins, which are alternate, have straight courses, and remain parallel to each other from base to apex (Fig. 10). Angle between primary and secondary veins increases towards base of lamina; proximal secondary veins have an angle between 110° and 80°; middle secondary veins have an angle between 60° to 50° and distal secondary veins between 50° to 38° (Fig. 10). Areoles have hexagonal shape in outline; its width ranges from 0.4 mm to 0.7 mm, and its length ~ 0.2 mm to 0.4 mm. Usually, there is 1 tubercle per areole is 1, but sometimes there are 2 (Fig. 10). Tubercles are arranged in parallel rows that follow orientation of secondary veins. See details and comparisons in Pérez et al. (2017)

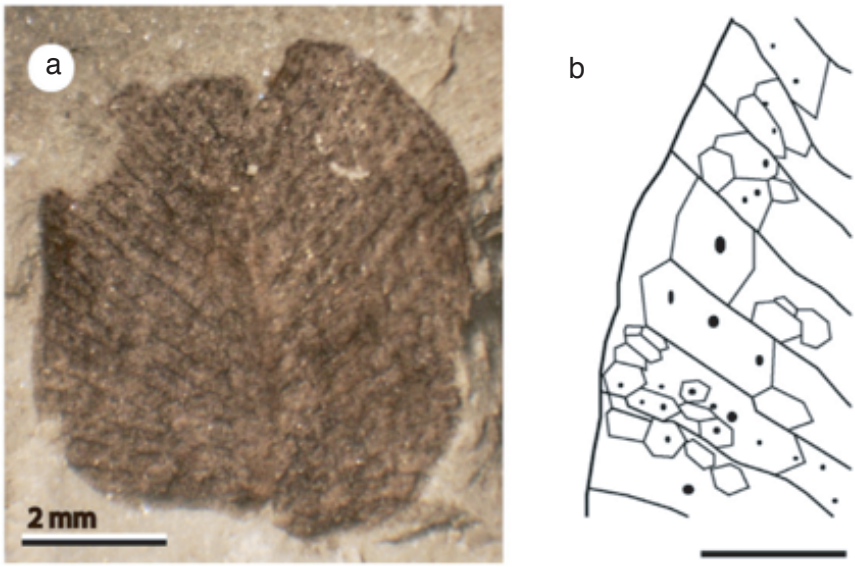

Fig. 10. Morphotype ES49.

Morphotype ES49. Macrofossil of *Salvinia* sp. 1 from the Esmeraldas Formation. STRI-35515. **a.** Floating leaf showing primary and secondary veins. STRI-35515. **b.** Drawing showing hexagonal areolas with one, two or three tubercles inside. STRI-35515.

Reproductive structures

Dicot Angiosperms

Morphotype ES50

Figure 11

Systematic affinity. Class Magnoliopsida; Order, Family, Genus and species *incertae sedis.*

Locality: 430134

Morphotype exemplar: 35554

Description: This morphotype is known from one specimen. The flowers have radial symmetry and have a diameter of 6.2 mm (from a top view). The perianth is well differentiated into calyx and corolla. The calyx is formed of five quincuncially arranged distinct sepals. From its insertion to its tip, the sepals measure between 1.9 and 2.2 (mean 2.1 mm) of length and

between 1.4 and 1.8 (mean 1.6 mm) of width. The calyx cells are isodiametric. The corolla is not preserved completely, but the bases of the petals are evident and these alternate with the sepals. The floral disc is 2.14 mm of diameter.

Fig. 11. Morphotype ES50.

Flower compression STRI-ID-35554. **a.** Macro-photograph. **b.** Stereoscopic epifluorescence photograph. **c.** Sepal close-up.

Morphotype ES51

Figure 12

Systematic affinity. Class Magnoliopsida; Order, Family, Genus and species *incertae sedis*.

Locality: 430134

Morphotype exemplar: 46599

Other specimens studied: 46600

Description: This morphotype is known from two specimens found in the same piece of rock, together with sample 36163. The flowers have radial symmetry. The differentiation between calyx and corolla could not be clearly determined, but it is probable (due to the location of the whorl) that the parts observed correspond to petals. The corolla is formed of five valvate

distinct petals. The corolla is one whorled gamopetalous and campanulate; form the base of the flower to the base of the petal lobes the corolla measures 2.6 mm and its width is 2.02 mm; the lobes are valvate and measure between 1.2 and 1.8 (mean 1.4 mm) in length and 0.7 and 0.9 (mean 0.8 mm) in width. From its insertion to its tip, the petals measure between 1.2 and 1.8 (mean 1.4 mm) of length and between 0.7 and 0.9 (mean 0.8 mm) of width. The corolla cells are isodiametric. There are 5 stamens and during anthesis, the stamens are exserted with respect to the perianth. The anthers are between 0.5 and 0.6 (mean 0.56 mm) in length and between 0.31 and 0.37 (mean 0.34 mm) in width.

Fig. 12. Morphotype ES51.

Morphotype ES51. Flower compressions. **a.** Macro-photograph STRI-ID-46600. **b.** Macro-photograph STRI-ID-46599. **c.** Stereoscopic epifluorescence photograph petal close-up STRI-ID-46599.

Morphotype ES52

Figure 13

Stephania palaeosudamericana?

Systematic affinity. Class Magnoliopsida; Order Ranunculales, Family Menispermaceae, Genus *Stephania*; Species cf. *Stephania palaeosudamericana*

Locality: 110026

Morphotype exemplar: 43991

Description: The description was based on one specimen. Endocarp has in length 9.6 mm and in width 6.7 mm. The stylar scar is inferred to be basal, based on the shape of the endocarp. Endocarp curvature is dorsoventral with a crescent and obovate shape. One limb is possibly broader and has also a broader dorsal ridge. The condyle is not preserved but based on the inferred basal stylar scar, the codyle is deduced to be planar and compressed bilaterally. Ridging of the endocarp is only observed to be transverse**.** Endocarp wall is 1.2 mm in thickness (measured from the locule cast to the middle proximal side of the endocarp) and woody, based on its coaly preservation. The endocarp has a perforation that is complete, obovate and is 3.8 mm in length and 2.6 mm wide. The endocarp has conspicuous intrusive ribs within the locule that deforms the seed (>15 intrusive ribs). The funicular vascular supply possibly enters the locule ventrally. Endosperm is present and smooth.

Fig. 13. Morphotype ES52.

Morphotype ES52. Endocarp compression STRI-ID-43991. e: endosperm; p: perforation; r: ribs; s: spines; vn: ventral notch

Notes: The Menispermaceae seed is described following the terminology Wefferling et al., (2013). Two methods were used for the identification of the seeds. As a first approximation, we used the key for fruit and seed characters of Menispermaceae (Wefferling et al., 2013). Further comparisons were done based on the matrices compiled by Herrera et al. (2011) and Wefferling et al. (2013).

Systematic affinity with *Stephania palaeosudamericana*: The results from the first analysis done following the key of Wefferling et al. (2013) suggested a systematic affinity with the SPACC clade, which includes the genera: *Stephania, Perichasma, Antizoma, Cyclea* and

Cissampelos. The affinity with this clade is supported by the presence of an endocarp with dorsoventral curvature, dorsal ridging, condyle, endosperm, a locule with hippocrepiform shape, and a ventral vascular trace. Further comparisons within the SPACC clade were done using the character matrices included in Wefferling et al. (2013) and Herrera et al. (2011) studies. The fossil described here differs from *Perichasma* and *Antizoma* by the presence of only longitudinal ridging, which is in this fossil is observed to be only transverse. The new fossil also differs from *Antizoma* and *Cyclea* by the presence ribs, which are conspicuous in the fossil. *Cissampelos* is also different because it has endocarps that are often imperforate, and also has two lateral and dorsal crests, which are not present in the fossil.

None of the characters described allowed the separation of the new fossil described here from the extant genus *Stephania* and the fossil species *Stephania paleosudamericana*. *Stephania paleosudamericana* (Herrera et al. 2011) only differs from our description by characters related to the size, including the total size, the perforation size, the wall thickness and the number of ribs. We consider that these size-related characters can be highly affected by the developmental stage of the endocarps, the preservation of the fossils and possible intraspecific variation, and therefore are not sufficient grounds to name a new fossil species. If further collections from the Esmeraldas Formation reveal that there are more differences between this Eocene record and the Paleocene *S. paleosudamericana* fossil, a new species or morphogenus should be named.

Morphotype ES53

Figure 14

Solanaceae

Systematic affinity. Class Magnoliopsida; Order Solanales, Family Solanaceae, Tribe Physalinae*;* Genus and species *incertae sedis*

Locality: 430134

Morphotype exemplar: 36163

This morphotype was described based on one specimen of a compressed fruit with a preserved surrounding calyx (Martínez and Deanna, 2019; Deanna et al., *in prep*.).

Fig. 14. Morphotype ES53.

Morphotype ES53. Fruit compression STRI-ID-36163.

Morphotype ES54

Figure 15

cf. *Deviacer*

Systematic affinity. Class Magnoliopsida; Order, Family, Genus and species *incertae sedis*

Locality: 430134

Morphotype exemplar: 35663

Other specimens studied: 44918, 44919, 44920, 44921, 44922, 44923, 35663

Description: The fossil specimens represent a fruit with a single proximal locule and a distal wing. The description was based on 7 specimens. The fruit has an average length of 17.6 mm from the pedicel attachment to the wing tip. Three specimens were found to be complete, so direct measurements of total length were done on these specimens and ranged between 15 to 23 mm. The broadest point of the fruit is located in the wing area and is on average 8 mm in width; there was a strong variability found in the wing width, with values that ranged between 6–11 mm. The ratio of the fruit length and width is 2:1. The wing is between 8 to 16 mm in length from the distal margin of the locule to the distal margin of the wing, and is between 6 to 11 mm in width at its broadest point. The locule is oval in shape, and has a length of 6 mm and a width 2.4 mm. The total length and width ratio is 4.5. The fruit has a faintly preserved style remnant located at end of the locule and beginning of the wing (Fig. 16a,b). The fruit has a constriction at the proximal side of the locule that could represent the attachment to the calyx (Fig. 16b). The locule has dense parallel venation (Fig. 16a). The boundary between the locule and the wing is transitional and then there is not a clear demarcation line between the two. The wing has dense parallel major venation with stronger veins investing the backbone of the wing and terminating at the distal side of the wing. Towards the distal side of the wing the veins are more spread and diminish in thickness. The primary veins have dichotomous branching. The minor venation is parallel. The fossils have a smooth margin along the wing.

Fig. 15. Morphotype ES54.

Morphotype ES54. Samara compression STRI-ID-35663. **a.** Macro-photograph of the fruit. **b.** Sketch showing venation details. Upper arrow shows the presence of a presence of a faint style remnant. Lower arrow shows a constriction that could represent the attachment to the calyx **c.** Macro-photograph of the counterpart. **d.** Sketch showing venation details of the counterpart.

Morphotype ES55

Figure 16a

Legume pod 1

Systematic affinity. Class Magnoliopsida, Order Fabales, Family Fabaceae, Genus and species *incertae sedis*

Locality: 430134

Morphotype exemplar: 44942

Other specimens studied: 35065, 35146, 35178, 35206, 36085, 45293, 45294, 45295, 45296

Description: This morphotype was described based on fruit fragments because the specimens were not complete. The valve had a width of 18.2 mm and a length larger than 33.8 mm. The outline is smooth. Constrictions were not observed. At least three possible grooves run transversely across the valve at near right angles to the main vein. The style remnant is located towards the middle of the valve and has a length of 0.8 mm and a width of 1.54 mm.

Morphotype ES56

Figure 16b

Legume pod 2

Systematic affinity. Class Magnoliopsida, Order Fabales, Family Fabaceae, Genus and species *incertae sedis*

Locality: 430134

Morphotype exemplar: 44940

Other specimens studied: 35065, 35146, 35178, 35206, 36085, 45293, 45294, 45295, 45296

Description: This morphotype was described based on fruit fragments because the specimens were not complete. The valve had a width of 11.6 mm and a length larger than 16 mm. The outline is smooth. Constrictions were not observed. A thick vein encircles the valve. External to this vein on one side of the valve there is a narrow keel (up to 1.1 mm wide). At least five possible grooves run transversely across the valve at near right angles to the main vein. The style remnant is located towards one axis of the valve and has a length of 1.2 mm and a width of 0.48 mm.

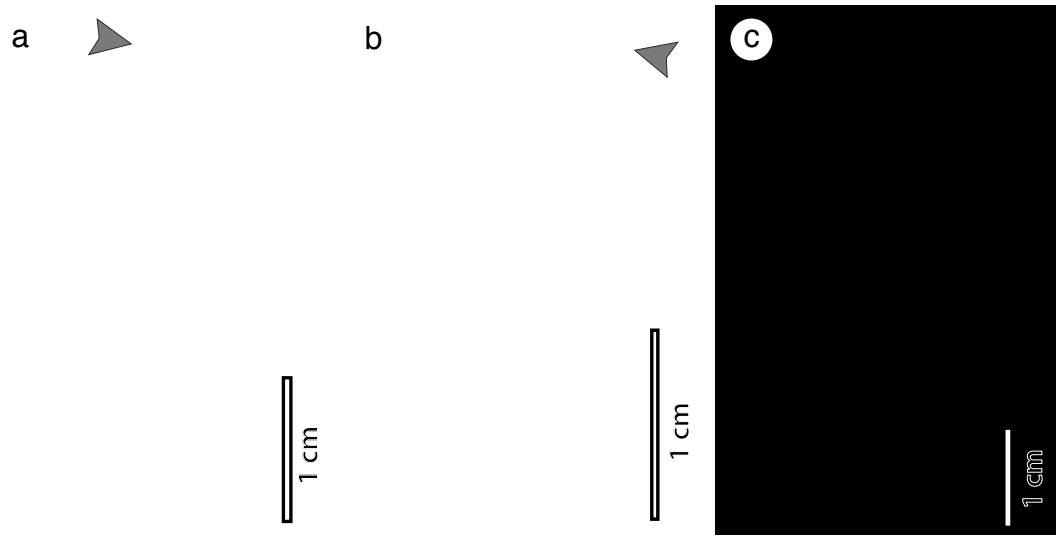

Fig. 16. Legume pods.

Legume pods. **a.** ES55, STRI-ID-44942. **b.** ES56, STRI-ID-44940. **c.** Fragment of a possible legume pod (not described).

Monocot Angiosperms

Morphotype ES57

Figure 17

Cyperaceae? Achene

Systematic affinity. Class Liliopsida; Order Poales; Family cf. Cyperaceae Genus and species *incertae sedis*

Locality: 430134

Morphotype exemplar: 44948

Other specimens studied: 35441, 35551, 35656, 35665, 35671, 36085, 36152, 44944, 44945, 44946, 44947

Description: This achene morphotype is described based on 12 specimens. The holotype has 3D preservation, therefore most of the description is based on this specimen. The description was done following Jiménez-Mejías and Martinetto (2013) terminology. The fruit shape is elliptic, with a length and width of 1.3 and 1.42 mm, respectively; the L:W ratio is 1.1:1. What is interpreted as the callus remnant has a width of 0.27 mm. The base is winged, the wing has a length of 1.12 mm and a width of 0.62 mm. The pericarp is thin and has a thickness of 0.02 mm. The seed coat has transverse ridges with polygonal shape. The tubercle is very thick and covers approximately the entire apical part of the seed, has a width of 1.30 mm and a thickness of 0.64 mm. The achene is inflated. The two structures coming out from the tubercle are interpreted here as possible style or stigma remnants. In most of the specimens two asymmetrical appendages were observed, only a few had one. In the holotype one appendage was 4.2 mm in length and 0.8 in width, the other had the same width and a length of 1.8 mm.

Fig. 17. Morphotype ES57.

Morphotype ES57. Fruit compression STRI-ID-44948. **a.** Macro-photograph of the fruit. **b.** Macro-photograph of the fruit counterpart. **c.** SEM photograph showing the seed coat with transverse ridges with polygonal shape. **d.** SEM photograph for the counterpart.

Notes: This fossil morphotype shares with achenes from the Cyperaceae family; the presence of a seed with elliptical shape, a seed-coat with transverse ridges, and a thick tubercle. The affinity is however uncertain, because none of the extant specimens observed have similar appendages to those borne from the tubercle as observed in the holotype.