**Supporting Information**

# Late Paleocene fossils from the Cerrejón Formation, Colombia, are the earliest record of Neotropical Rainforest

Scott L. Wing, Fabiany Herrera, Carlos A. Jaramillo, Carolina Gómez-Navarro, Peter Wilf, Conrad C. Labandeira

This file contains supporting information on the Cerrejón paleoflora and the fossil and living samples to which we compare it, as well as additional details on the methods and results of our analyses. The sections are on: 1) stratigraphy and depositional environments of the Cerrejón Formation and stratigraphic positions of the megafloral collections (Fig. S1); 2) source, collecting methods, and data for the modern and fossil comparative collections mentioned in the article (Tables S1 – S4); 3) floristic similarity of the Cerrejón paleoflora to modern Amazonian forests (Table S5); 4) analysis and comparison of diversity and evenness of the Cerrejón paleoflora with other fossil assemblages and modern Neotropical litter samples (Table S6); 5) estimates of leaf mass per area for the Cerrejón megaflora (Table S7), 6) insect herbivory frequency and diversity at Cerrejón and other Paleocene sites (Tables S8 and S9); and, 5) botanical affinities and morphological features of the megafossil morphotypes recovered from the Cerrejón Formation (Tables S10, S11; Figs. S2-S96).

## Stratigraphy and Sedimentology of the Cerrejón Formation

Paleocene strata in the northernmost Andes record a regional progradation of depositional environments from shallow-marine to continental conditions(1). This shift in deposition is recorded in the ~1-km-thick Cerrejón Formation because of the high rate of subsidence (~300m of compacted thickness/My) and increasing influx of synorogenic detritus from the west(2-4) (Fig. S1). The Cerrejón Formation overlies and intergrades with the Manantial Formation, which consists of fossiliferous packstones and wackestones interbedded with calcareous sandstones and mudstones that accumulated in a shallow-marine platform(3). Dominance of siliciclastic mudstones and sandstones interbedded with thin-to-medium beds of coal marks the lower 50 m of the Cerrejón Formation. Sedimentary structures in this interval include flaser, wavy, ripple and lenticular laminations that suggest deposition in lower tidal flats. Most of the Cerrejón Formation consists of a depositional cycle of three parts. The lowest part is fossiliferous black shale and laminated black mudstone with thin lenticular laminae of sandstone (interpreted as anoxic lagoonal, or flooded coastal-plain environments) and/or flaser-laminated sandstones (interpreted as subtidal deposits). These clastic beds overlie or underlie thick coal seams. The middle part of the type section includes slightly bioturbated mudstones and sandstones with flaser and heterolithic lamination and dispersed plant remains, interpreted as deposits of subtidal and tidal flats. Both coarsening- and fining-upward trends in grain size are common. Coal seams have variable thickness in this part of the succession. The upper part of the type section is dominated by fine-grained, massive to lenticularly-laminated, bioturbated mudstones and siltstones with abundant plant remains, which are cut by thick to very thick massive to cross-bedded sandstones (interpreted as coastal plains crossed by channels). Medium to thin coal seams are common in the upper part of the section.

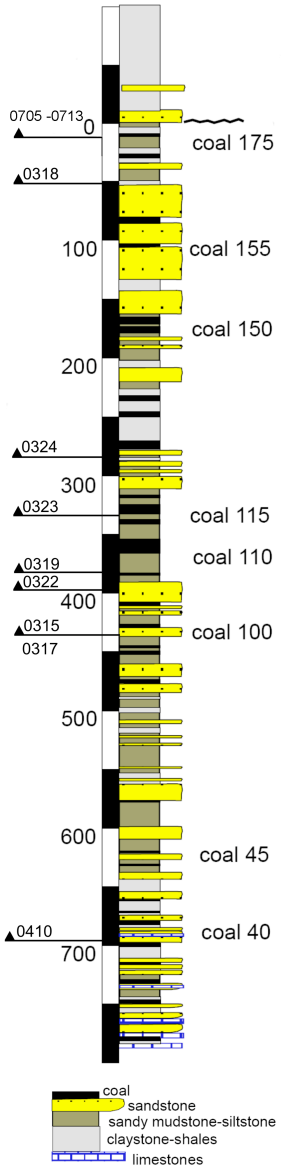



**Figure S1. Stratigraphic column of the Cerrejón Formation showing lithology and stratigraphic positions of the plant megafossil localities. Modified from Jaramillo et al.(4)**

## Modern and fossil comparative collections

Seven modern leaf samples were collected for comparison with the Cerrejón leaf fossils, four from the lower Rio Negro drainage in Brazil and three from Barro Colorado Island (BCI) in Panama (Fig. 1, Tables S1-S4). All modern samples were taken in the local dry season. Two of the Rio Negro samples (Waterfall and Stingray) were collected as grab samples from leaf packs that had accumulated on point bars of side channels <20 m in width. Sample DAB was taken from four 1-$m^2$ quadrats spaced at 20 m intervals along the shore of a major channel bar in the Rio Negro. Sample Barcelos was *in situ* litter from a 0.5 $m^2$ quadrat on a forested island. One of the Barro Colorado leaf samples came from the wet lake shore, the other two were from the moist forest understory. Leaves from the modern litter samples were preserved similarly to the Cerrejón fossils (e.g., leaf shape and primary through fourth order veins were visible), and characters of shape and venation were used to segregate the leaves into morphotypes that were the basis of the diversity and evenness calculations. Data for the modern samples are given in Tables S3 and S4.

Fossil leaves at the Cerrejón mine were collected from 16 sites, each site being a volume of rock with lateral extent of a few meters and vertical extent of a few decimeters. Sites 0317 and 0705 were collected both selectively (0317 and 0708) and in an unbiased field censuses (0317Ce and 0705Ce). Data for the Cerrejón sites are given in Table S2.

Quaternary to Recent comparative pollen samples come from three previously published sites: Lagoa das Patas, Brazil(5); Pantano de Monica 1, Colombia(6); and Laguna Piusbi 1, Colombia(7) (locations in Fig. 1). Lagoa das Patas data were downloaded from the Latin American Pollen Database at http://www.ncdc.noaa.gov/paleo/pollen.html. Data for Monica and Piusbi were kindly provided by H. Behling. Original data for Cerrejón pollen samples were published by Jaramillo and others(4), and are available online at http://www.palydisks.palynology.org/.

**Table S1. Information on fossil and comparative modern samples.**

| Organ | Location | # sites/ samples | # spec. | Age | Data Source |
|---|---|---|---|---|---|
| Leaves | Cerrejón Fm., Colombia | 9 | 2191 | middle - late Paleocene | Table S2 |
| | Barro Colorado Is., Panama | 3 | 672 | modern litter | Table S4 |
| | Rio Negro, Brazil | 7 | 1048 | modern litter | Table S3 |
| | W. Bijou Crk., CO, USA | 4 | 1548 | early Paleocene (Puercan) | Barclay et al (8) |
| | Great Divide Basin, WY, USA | 13 | 8695 | middle - late Paleocene (Tiffanian) | Gemmill & Johnson (9) |
| | Green River Basin, WY, USA | 10 | 4216 | late Paleocene (Clarkforkian) | Wilf (10) |
| | Green River Basin, WY, USA | 5 | 3295 | early Eocene (Wasatchian) | Wilf (10) |
| | Bighorn Basin, WY, USA | 22 | 6633 | early Eocene (Wasatchian) | Wing et al. (11) |
| | Castle Rock, CO, USA | 5 | 1015 | early Paleocene (Torrejonian) | Ellis et al. (12), Wilf et al. (13) |
| | Palacio de los Loros, Argentina | 2 | 2298 | early Paleocene | Iglesias et al. (14) |
| Pollen | Cerrejón Fm., Colombia | 74 | 10925 | middle - late Paleocene | Jaramillo et al. (4) |
| | Lagoa das Patas, Brazil | 49 | 18750 | Quaternary-Holocene | Colinvaux et al.(5), Latin American Pollen Database |
| | Monica, Colombia | 17 | 5777 | Quaternary-Holocene | Behling et al.(6); Behling, personal comm. |
| | Piusbi, Colombia | 57 | 19006 | Quaternary-Holocene | Behling et al(7); Behling personal comm. |

**Table S2. Cerrejón fossil collections**

| taxa | 0315 | 0317 | 0317Ce | 0318 | 0319 | 0322 | 0323 | 0324 | 0410 | 0705 | 0705Ce | 0706 | 0707 | 0708 | 0709 | 0710 | 0711 | 0712 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CJ1 | 100 | 32 | 86 | 6 | 2 | 17 | 2 | 0 | 13 | 6 | 7 | 2 | 0 | 14 | 1 | 0 | 3 | 2 |
| CJ10 | 0 | 2 | 1 | 8 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CJ108 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CJ109 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CJ11 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| CJ12 | 6 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CJ13 | 13 | 1 | 6 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CJ15 | 4 | 14 | 19.5 | 4 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 1 |
| CJ16 | 0 | 0 | 0 | 1 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CJ17 | 2 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CJ18 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CJ19 | 5 | 8 | 22.5 | 3 | 3 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 2 | 0 | 0 | 0 | 0 |
| CJ2 | 1 | 4 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| CJ20 | 6 | 0 | 3 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CJ21 | 1 | 0 | 2.5 | 4 | 0 | 0 | 0 | 5 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CJ22 | 34 | 12 | 17.5 | 8 | 16 | 0 | 2 | 0 | 0 | 3 | 36 | 4 | 0 | 21 | 0 | 0 | 3 | 8 |
| CJ23 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CJ24 | 0 | 28 | 46.5 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| CJ25 | 2 | 12 | 1 | 48 | 1 | 0 | 3 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 2 | 0 |
| CJ26 | 0 | 6 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 8 | 97 | 9 | 0 | 12 | 0 | 0 | 1 | 2 |
| CJ27 | 0 | 2 | 5 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CJ28 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CJ3 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 4 | 8 | 1 | 1 | 10 | 1 | 1 | 0 | 0 |
| CJ30 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CJ32 | 3 | 2 | 6 | 27 | 2 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 3 | 6 | 0 | 0 | 0 |
| CJ33 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CJ34 | 0 | 0 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 0 | 0 | 8 | 0 | 0 | 0 | 0 |
| CJ36 | 7 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CJ37 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CJ38 | 0 | 1 | 0 | 19 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12 | 0 | 0 | 0 | 1 |
| CJ4 | 1 | 19 | 44 | 2 | 0 | 0 | 0 | 0 | 0 | 1 | 8 | 2 | 0 | 3 | 0 | 2 | 4 | 5 |
| CJ40 | 1 | 0 | 3.5 | 32 | 2 | 0 | 2 | 0 | 0 | 0 | 3 | 0 | 0 | 1 | 0 | 0 | 1 | 0 |
| CJ41 | 0 | 0 | 1.5 | 4 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CJ42 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CJ43 | 0 | 0 | 0 | 0 | 57 | 1 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CJ46 | 0 | 0 | 1 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CJ47 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| CJ48 | 2 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 2 | 6 | 3 | 0 | 22 | 1 | 0 | 0 | 0 |
| CJ49 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CJ5 | 0 | 13 | 34.5 | 0 | 2 | 0 | 0 | 0 | 2 | 0 | 0 | 1 | 0 | 3 | 0 | 0 | 0 | 0 |
| CJ50 | 2 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| CJ53 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CJ54 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CJ55 | 0 | 13 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CJ56 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CJ57 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 3 | 8 | 0 | 2 | 0 | 0 |
| CJ58 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CJ59 | 0 | 3 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CJ6 | 3 | 25 | 47 | 28 | 0 | 5 | 1 | 0 | 0 | 13 | 5 | 0 | 2 | 1 | 0 | 0 | 1 | 4 |
| CJ60 | 0 | 2 | 3 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CJ61 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CJ62 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CJ63 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CJ64 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CJ65 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CJ66 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CJ67 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CJ68 | 0 | 8 | 61 | 32 | 0 | 0 | 5 | 0 | 0 | 4 | 8 | 0 | 0 | 6 | 0 | 0 | 0 | 0 |
| CJ76 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 478 | 13 | 0 | 7 | 0 | 0 | 5 | 3 |
| CJ8 | 29 | 1 | 4 | 3 | 1 | 0 | 1 | 0 | 0 | 0 | 8 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| CJ80 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 5 | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| CJ81 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 22 | 1 | 1 | 20 | 1 | 1 | 0 | 2 |
| CJ82 | 0 | 2 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 1 | 57 | 4 | 0 | 12 | 7 | 1 | 18 | 0 |
| CJ83 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 |
| CJ84 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Locality coordinates: **0315** - 11.135° N 72.570° W; **0316** - 11.133° N 72.570° W; **0317** - 11.135° N 72.570° W; **0318** - 11.128° N 72.555° W; **0410** - 11.085° N 72.688° W; **0705** - 11˚07'49.4N 72˚34'60.5W; **0707** - 11˚07'47.8N 72˚34'60.3W; **0708** - 11˚07'49.8N 72˚34'61.5W; 0709 - 11˚07'38.43N 72˚34'48.48W; **0710** - 11˚07'45.3N 72˚34'55.98W; **0711** - 11˚07' 49.4N 72˚ 34' 61.5W; **0712** - 11˚07'49.8N 72˚34'60.5W

**Table S3. Rio Negro, Brazil litter samples.**

| Leaf morphotype | WATERFALL | BARCELOS | STINGRAY | DAB1 | DAB2 | DAB3 | DAB4 |
|---|---|---|---|---|---|---|---|
| MTDAB1=RN14 | 0 | 0 | 3 | 3 | 0 | 3 | 6 |
| MTDAB2(=MTDAB12) | 0 | 0 | 0 | 4 | 4 | 1 | 0 |
| MTDAB3=BLL15 | 0 | 36 | 0 | 2 | 1 | 1 | 3 |
| MTDAB4 | 0 | 0 | 0 | 3 | 2 | 2 | 1 |
| MTDAB5 | 0 | 0 | 0 | 1 | 0 | 2 | 0 |
| MTDAB6=BLL1 | 0 | 5 | 0 | 1 | 1 | 0 | 0 |
| MTDAB7 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| MTDAB8=SW8=BLL3=RN9 | 3 | 2 | 14 | 6 | 1 | 10 | 98 |
| MTDAB9 | 0 | 0 | 0 | 2 | 0 | 3 | 4 |
| MTDAB10 | 0 | 0 | 0 | 2 | 0 | 0 | 4 |
| MTDAB11=BLL24 | 0 | 3 | 0 | 3 | 7 | 0 | 7 |
| MTDAB13 | 0 | 0 | 0 | 2 | 2 | 1 | 1 |
| MTDAB14=BLL20 | 0 | 6 | 0 | 1 | 1 | 3 | 1 |
| MTDAB15 | 0 | 0 | 0 | 1 | 1 | 0 | 1 |
| MTDAB16 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| MTDAB17 | 0 | 0 | 0 | 2 | 0 | 1 | 0 |
| MTDAB18=BLL7=RN4 | 0 | 7 | 3 | 1 | 1 | 0 | 3 |
| MTDAB19 | 0 | 0 | 0 | 1 | 1 | 0 | 0 |
| MTDAB20 | 0 | 0 | 0 | 0 | 2 | 1 | 2 |
| MTDAB21 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| MTDAB22 | 0 | 0 | 0 | 0 | 1 | 1 | 0 |
| MTDAB23 | 0 | 0 | 0 | 0 | 1 | 1 | 0 |
| MTDAB24 | 0 | 0 | 0 | 0 | 1 | 0 | 2 |
| MTDAB25 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| MTDAB26 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| MTDAB27=SW26=BLL25=RN18 | 2 | 4 | 22 | 0 | 1 | 0 | 0 |
| MTDAB28=BLL17 | 0 | 1 | 0 | 0 | 1 | 0 | 0 |
| MTDAB29 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| MTDAB30 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| MTDAB31 | 0 | 0 | 0 | 1 | 1 | 1 | 0 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| MTDAB32 | 0 | 0 | 0 | 0 | 1 | 0 | 2 |
| MTDAB33 | 0 | 0 | 0 | 0 | 0 | 3 | 2 |
| MTDAB34 | 0 | 0 | 0 | 0 | 0 | 2 | 0 |
| MTDAB35=SW25=RN12 | 6 | 0 | 29 | 0 | 0 | 1 | 4 |
| MTDAB36 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| MTDAB37 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| MTDAB38 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| MTDAB39 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| MTDAB40 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| MTDAB41 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| MTDAB42 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| MTDAB43 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| MTDAB44 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| MTDAB45 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| MTDAB46 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| MTDAB47 | 0 | 0 | 0 | 0 | 2 | 0 | 2 |
| SW1=BLL9 | 51 | 2 | 0 | 0 | 0 | 0 | 0 |
| SW2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| SW3 | 12 | 0 | 0 | 0 | 0 | 0 | 0 |
| SW4 | 4 | 0 | 0 | 0 | 0 | 0 | 0 |
| SW5 | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| SW6 | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| SW7 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| SW9 | 6 | 0 | 0 | 0 | 0 | 0 | 0 |
| SW10 | 5 | 0 | 0 | 0 | 0 | 0 | 0 |
| SW11 | 5 | 0 | 0 | 0 | 0 | 0 | 0 |
| SW12=BLL16 | 3 | 2 | 0 | 0 | 0 | 0 | 0 |
| SW13 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| SW14 | 25 | 0 | 0 | 0 | 0 | 0 | 0 |
| SW15 | 24 | 0 | 0 | 0 | 0 | 0 | 0 |
| SW16 | 66 | 0 | 0 | 0 | 0 | 0 | 0 |
| SW17 | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| SW18 | 9 | 0 | 0 | 0 | 0 | 0 | 0 |
| SW19=RN19 | 2 | 0 | 1 | 0 | 0 | 0 | 0 |
| SW20 | 9 | 0 | 0 | 0 | 0 | 0 | 0 |
| SW21 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| SW22 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| SW23 | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| SW24 | 11 | 0 | 0 | 0 | 0 | 0 | 0 |
| SW27 | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| SW28 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| SW29 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| SW30 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| SW31 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| SW32 | 3 | 0 | 0 | 0 | 0 | 0 | 0 |
| SW33 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| SW34 | 48 | 0 | 0 | 0 | 0 | 0 | 0 |
| BLL2=RN8 | 0 | 71 | 37 | 0 | 0 | 0 | 0 |
| BLL4 | 0 | 4 | 0 | 0 | 0 | 0 | 0 |
| BLL5 | 0 | 2 | 0 | 0 | 0 | 0 | 0 |
| BLL6 | 0 | 6 | 0 | 0 | 0 | 0 | 0 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| BLL8 | 0 | 12 | 0 | 0 | 0 | 0 | 0 |
| BLL10 | 0 | 18 | 0 | 0 | 0 | 0 | 0 |
| BLL11 | 0 | 5 | 0 | 0 | 0 | 0 | 0 |
| BLL12=RN20 | 0 | 9 | 1 | 0 | 0 | 0 | 0 |
| BLL13 | 0 | 20 | 0 | 0 | 0 | 0 | 0 |
| BLL14 | 0 | 7 | 0 | 0 | 0 | 0 | 0 |
| BLL18 | 0 | 3 | 0 | 0 | 0 | 0 | 0 |
| BLL19 | 0 | 2 | 0 | 0 | 0 | 0 | 0 |
| BLL21 | 0 | 6 | 0 | 0 | 0 | 0 | 0 |
| BLL22 | 0 | 19 | 0 | 0 | 0 | 0 | 0 |
| BLL23 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| BLL26=RN21 | 0 | 12 | 1 | 0 | 0 | 0 | 0 |
| BLL27 | 0 | 3 | 0 | 0 | 0 | 0 | 0 |
| BLL28 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| RN2 | 0 | 0 | 27 | 0 | 0 | 0 | 0 |
| RN3 | 0 | 0 | 3 | 0 | 0 | 0 | 0 |
| RN5 | 0 | 0 | 20 | 0 | 0 | 0 | 0 |
| RN6 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| RN7 | 0 | 0 | 3 | 0 | 0 | 0 | 0 |
| RN10 | 0 | 0 | 2 | 0 | 0 | 0 | 0 |
| RN11 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| RN15 | 0 | 0 | 3 | 0 | 0 | 0 | 0 |
| RN16 | 0 | 0 | 12 | 0 | 0 | 0 | 0 |
| RN17 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| RN22 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| RN23 | 0 | 0 | 4 | 0 | 0 | 0 | 0 |
| RN26 | 0 | 0 | 3 | 0 | 0 | 0 | 0 |
| RN27 | 0 | 0 | 2 | 0 | 0 | 0 | 0 |
| RN28 | 0 | 0 | 2 | 0 | 0 | 0 | 0 |
| WATERFALL - 61.740° W 1.408° S, submerged leaf pack in small side-channel | | | | | | | |
| BARCELOS - 62.937° W 0.940° S, in situ leaf litter forest understory | | | | | | | |
| STINGRAY - 61.110° W 2.00° S, submerged leaf pack in small side-channel | | | | | | | |
| DAB - 62.530° W 1.152° S, Shore of channel bar in main channel of Rio Negro | | | | | | | |

**Table S4. Barro Colorado Island, Panama litter samples**

| Leaf Morphotype | BCI-D | BCI-B | BCI-C | SUM |
|---|---|---|---|---|
| B1 | 0 | 22 | 0 | 22 |
| B11 | 0 | 39 | 0 | 39 |
| B14 | 0 | 14 | 0 | 14 |
| B15 | 0 | 2 | 0 | 2 |
| B16 | 0 | 3 | 0 | 3 |
| B19 | 0 | 3 | 0 | 3 |
| B2 | 0 | 70 | 0 | 70 |
| B20 | 0 | 20 | 0 | 20 |
| B22 | 0 | 3 | 0 | 3 |
| B23 | 0 | 1 | 0 | 1 |
| B24 | 0 | 1 | 0 | 1 |
| B25 | 0 | 3 | 0 | 3 |
| B28=C18 | 0 | 9 | 6 | 15 |
| B29 | 0 | 2 | 0 | 2 |

| | | | | |
|---|---|---|---|---|
| B3 | 0 | 2 | 0 | 2 |
| B31 | 0 | 1 | 0 | 1 |
| B32 | 0 | 2 | 0 | 2 |
| B33 | 0 | 1 | 0 | 1 |
| B34 | 0 | 2 | 0 | 2 |
| B35=C8 | 0 | 1 | 1 | 2 |
| B36=C15 | 0 | 14 | 12 | 26 |
| B37=C9 | 0 | 24 | 1 | 25 |
| B4=C20 | 0 | 18 | 2 | 20 |
| B5 | 0 | 1 | 0 | 1 |
| B6=C6 | 0 | 1 | 1 | 2 |
| B7 | 0 | 1 | 0 | 1 |
| B8 | 0 | 1 | 0 | 1 |
| B9 | 0 | 4 | 0 | 4 |
| C1 | 0 | 0 | 121 | 121 |
| C10 | 0 | 0 | 2 | 2 |
| C11 | 0 | 0 | 8 | 8 |
| C12 | 0 | 0 | 2 | 2 |
| C13 | 0 | 0 | 3 | 3 |
| C14 | 0 | 0 | 19 | 19 |
| C16 | 0 | 0 | 1 | 1 |
| C17 | 0 | 0 | 17 | 17 |
| C19 | 0 | 0 | 2 | 2 |
| C23 | 0 | 0 | 1 | 1 |
| C26 | 0 | 0 | 1 | 1 |
| C27 | 0 | 0 | 1 | 1 |
| C28 | 0 | 0 | 1 | 1 |
| C29 | 0 | 0 | 1 | 1 |
| C3 | 0 | 0 | 3 | 3 |
| C30 | 0 | 0 | 1 | 1 |
| C32 | 0 | 0 | 1 | 1 |
| C5 | 0 | 0 | 36 | 36 |
| C51 | 0 | 0 | 2 | 2 |
| C7 | 0 | 0 | 1 | 1 |
| D1=B13 | 24 | 7 | 0 | 31 |
| D10 | 1 | 0 | 0 | 1 |
| D11 | 4 | 0 | 0 | 4 |
| D12=C31 | 1 | 0 | 16 | 17 |
| D13 | 1 | 0 | 0 | 1 |
| D15 | 1 | 0 | 0 | 1 |
| D15 | 2 | 0 | 0 | 2 |
| D16=C50 | 2 | 0 | 3 | 5 |
| D17 | 1 | 0 | 0 | 1 |
| D18 | 1 | 0 | 0 | 1 |
| D19 | 1 | 0 | 0 | 1 |
| D2 | 16 | 0 | 0 | 16 |
| D20=C21 | 10 | 0 | 3 | 13 |
| D21=C22 | 1 | 0 | 1 | 2 |
| D22 | 2 | 0 | 0 | 2 |
| D23=B17=C25 | 1 | 12 | 2 | 15 |
| D24 | 1 | 0 | 0 | 1 |

| | | | | |
|---|---|---|---|---|
| D25 | 5 | 0 | 0 | 5 |
| D26 | 5 | 0 | 0 | 5 |
| D27 | 2 | 0 | 0 | 2 |
| D28=B12 | 1 | 6 | 0 | 7 |
| D29=B30 | 2 | 2 | 0 | 4 |
| D3 | 3 | 0 | 0 | 3 |
| D30 | 1 | 0 | 0 | 1 |
| D32 | 1 | 0 | 0 | 1 |
| D4=C24 | 5 | 0 | 7 | 12 |
| D5 | 1 | 0 | 0 | 1 |
| D6 | 1 | 0 | 0 | 1 |
| D7 | 1 | 0 | 0 | 1 |
| D8 | 1 | 0 | 0 | 1 |
| D9 | 2 | 0 | 0 | 2 |
| BCI-D | 09° 09' 47" N, 79° 50' 15" W, near Bahia des Frijoles | | | |
| BCI-B | 09° 25' N, 79° 50' W, understory | | | |
| BCI-C | 09° 09' N, 79° 50' W, understory | | | |

**Floristic similarity of the Cerrejón paleoflora to modern Amazonian forests**

We compared the Cerrejón flora with 73 modern South American forest sites of 0.1 hectare published by Phillips and others(15). The following sites were removed from the analysis because they are not tropical: Jejuimi, Martin, Mirador, Parqueer, Puyehue, Riachuel, and Salta. To facilitate comparison of the fossil and modern sites some adjustments were made to the taxonomic categories. The families Bombacaceae, Sterculiaceae, Tiliaceae, and Malvaceae sensu stricto were lumped in Malvaceae sensu lato. The fern families Aspleniaceae, Cyatheaceae, Dicksoniaceae, and Polypodiaceae were lumped in the category "ALL FERNS." The conifer families Podocarpaceae and Cupressaceae were lumped in the category "CONIFERS." The families Musaceae, Marantaceae, Strelitziaceae, Costaceae, and Zingiberaceae were lumped in the order Zingiberales. The families Caprifoliaceae, Onagraceae, Lardizabalaceae, Eucryphiaceae, Aextoxicaceae had zero occurrences following the removal of sites named above, and were therefore removed from the analysis.

For the Cerrejón flora the fern genera *Salvinia*, *Acrostichum*, and *Lygodium* were removed from the analysis because, based on living relatives, they are unlikely to have had stem diameters >2.5 cm dbh, and therefore would not appear in Gentry's plots. The fern *Stenochlaena* was left in because it is sometimes a very large climber (leaves up to 1.5 m long, plants reaching 20 m into canopy of trees). Conservative estimates and best guesses for the taxonomic affinities of each fossil morphotype are given in Table S10. Abundance data from Cerrejón were collected at sites SW0317 and 0705 (see Fig. S1 for stratigraphic level and Table S2 for abundance data).

We quantified the similarities between all pairs of living and fossil sites by converting proportional diversity and proportional abundance values to rank orders and calculating Spearman's rank order correlation coefficient between all pairs of sites using R(16) (Table S1). Shared absences were ignored. Spearman's rank order correlation coefficient scales from -1 to 1. Table S5 gives summary statistics for correlation coefficients and Figure 3 shows the distribution of correlation coefficients and the position of the mean value of all comparisons of the Cerrejón flora with the Gentry plots using the conservative (red line) and best guess (green line) family identifications.

**Table S5. Floristic comparison of Cerrejón megaflora and extant Neotropical Rainforest**

| | Comparisons using proportion of stems or leaves per family | | | |
|---|---|---|---|---|
| | min | mean | max | median |
| All 72 Gentry plots to one another | -1.00 | 0.35 | 0.91 | 0.39 |
| Gentry plots to Cerrejon (conservative) | -0.80 | 0.22 | 1.00 | 0.25 |
| Gentry plots to Cerrejon (best guess) | -0.60 | 0.20 | 1.00 | 0.22 |

| | Comparisons using proportion of species per family | | | |
|---|---|---|---|---|
| | min | mean | max | median |
| All 72 Gentry plots to one another | -0.67 | 0.38 | 1.00 | 0.41 |
| Gentry plots to Cerrejon (conservative) | -0.20 | 0.41 | 1.00 | 0.40 |
| Gentry plots to Cerrejon (best guess) | -0.19 | 0.30 | 0.92 | 0.29 |

**Diversity of the Cerrejón paleoflora compared with other fossil and living samples**

We compared the diversity and evenness of fossil leaf samples from Cerrejón with taphonomically similar samples from the Paleocene and Eocene of North America and with tropical litter samples from Panama and Brazil (Tables 1, S2-S4, and S6). Rarefied richness at 100 specimens was calculated for each sample using the method of Hurlbert(17), and the software packages BioDiversity Pro Beta (http://www.nhm.ac.uk/zoology/bdpro)(18), and PAST version 1.22 (http://folk.uio.no/ohammer/past/index.html)(19). Evenness of the relative abundance distribution for each sample was quantified using Hurlbert's probability of interspecific encounter (*PIE*), which is a form of Simpson's Index (D) that is corrected for sample size using the following formula from Olszewski(20):

$$PIE = \frac{N}{N-1}\left(1 - \sum_{i=1}^{S} p_i^2\right)$$

where $N$ is the number of specimens in the sample, $S$ is the number of species, and $p_i$ is the proportion of specimens belonging to the $i$th species.

Table S6 shows that the rarefied richness ($S_{100}$) and evenness (*PIE*) of Cerrejón megafloral samples is significantly greater (with $\alpha$=0.01) than the mid-latitude Paleocene-Eocene samples as a group (excluding the Castle Rock flora). The Cerrejón leaf samples are significantly less rich ($S_{100}$) than the modern tropical litter samples and Castle Rock samples ($\alpha$=0.05). The evenness (*PIE*) of the Cerrejón leaf samples is not significantly different from that of the tropical litter samples and the fossil collections from Castle Rock. Cerrejón pollen samples have significantly lower diversity ($S_{100}$) and evenness (*PIE*) than pollen samples from the Monica and Piusbi cores.

For each group of samples from a site (here we use site to indicate a limited area and temporal span) we also partitioned richness ($S$) and evenness ($D$) into within sample (*alpha*) and among sample (*beta*) components using the method of Lande(21)(Table 1). We calculated $S_{\text{beta}}$ from equation (8) of Lande:

$$S_{total} - \overline{S}_{alpha} = \sum_j q_j (S_t - S_j)$$

Where samples are $1 \ldots j$, $\overline{S}_{alpha}$ is the mean number of species per sample, $S_j$ is the number of species in the $j$th sample, and $q_j$ is the proportional weight given to the $j$th sample. We calculated sample weights as:

$$q_j = \ln(x_j) / \ln(\sum_j N)$$

where $N$ is the number of specimens in a sample, because the number of species in a sample is approximately linearly correlated with the log of the number of specimens.

The measure of evenness, Simpson's Index ($D$) is given, as above, by:

$$D = 1 - \sum_{i=1}^{S} p_i^2$$

where species are 1…S, and $p_i$ is the proportion of specimens that belong to species $i$. Simpson's Index was also partitioned into within site (*alpha*) and among site (*beta*) components following Lande(21):

$$D_{total} = \overline{D}_{alpha} + d^2$$

where $\overline{D}_{alpha}$ = mean Simpson's D of all samples at the site, and $d^2 = \sum_j q_j \lambda_j - \sum_i \overline{p}_i^2$ where $\lambda$ equals the sums of the $p_i^2$ for all species. Additive diversity partitioning and significance tests of differences in floral diversity and similarity were performed in R(16).

**Table S6. Significance tests of rarefied richness ($S_{100}$) and evenness (PIE) for leaves and pollen**.

**LEAF SAMPLES**

| Richness ($S_{100}$) - p values for Mann-Whitney tests of differences in median | | | |
|---|---|---|---|
| | Cerrejón | Tropical litter | Mid-latitude Paleocene |
| Tropical litter | 0.01 | - | - |
| Mid-latitudePaleocene | 2.44E-05 | 2.00E-05 | - |
| Castle Rock | 2.53E-03 | 0.02 | 2.52E-04 |
| Evenness (PIE) - *p* values for Mann-Whitney tests of differences in median | | | |
| | Cerrejón | Tropical litter | Mid-latitude Paleocene |
| Tropical litter | 0.51 | - | - |
| Mid-latitudePaleocene | 1.31E-03 | 3.11E-06 | - |
| Castle Rock | 0.16 | 0.51 | 2.52E-04 |

**POLLEN SAMPLES**

| Richness ($S_{100}$) - *p* values for Mann-Whitney tests of differences in median | | | |
|---|---|---|---|
| | Cerrejón | Lagoa das Patas | Monica |
| Lagoa das Patas | 6.25E-11 | - | - |
| Monica | 7.70E-10 | 2.65E-07 | - |
| Piusbi | 2.20E-16 | 9.36E-07 | 2.83E-04 |
| Evenness (PIE) - *p* values for Mann-Whitney tests of differences in median | | | |
| | Cerrejón | Lagoa das Patas | Monica |
| Lagoa das Patas | 5.96E-14 | - | - |
| Monica | 3.87E-04 | 0.30 | - |
| Piusbi | 1.71E-10 | 4.10E-03 | 0.63 |

white cells significant at $\alpha$=0.01

yellow cells significant at $\alpha$=0.05 but not $\alpha$=0.01

gray cells not significant at $\alpha$=0.05

all significance tests use Holm-Bonferroni correction for multiple tests

**Leaf mass per area of Cerrejón leaves**

Leaf mass per area (LMA) was estimated using methods described by Royer et al. (22). Prediction intervals were derived using the procedure in Table 2 of that publication, and species and site (i.e., the whole-flora) LMA were estimated following procedures and equations in Fig 2A. For the Cerrejón flora we used only specimens for which both margins of the petiole were preserved and for which leaf area could be reasonably estimated either by digital reconstruction and measurement of photos or by multiplying 2 * leaf length * leaf width/3 (23). Results are shown in Table S7 below.

**Table S7. Leaf mass per area (LMA) estimates for Cerrejón.**

| Species | *N* | $PW^2$/leaf area, species mean | species LMA, $g/m^2$ | site LMA, $g/m^2$ | 95% PI, top | 95% PI, bottom |
|---|---|---|---|---|---|---|
| CJ01 | 9 | 0.0012 | 91 | | 119.1 | 69.1 |
| CJ25 | 8 | 0.0011 | 87 | | 115.6 | 64.9 |
| CJ15 | 5 | 0.0011 | 86 | | 124.5 | 60.1 |
| CJ22 | 5 | 0.0008 | 76 | | 108.8 | 52.5 |
| CJ05 | 4 | 0.0015 | 98 | | 148.0 | 65.5 |
| CJ08 | 4 | 0.0010 | 83 | | 125.4 | 55.5 |
| CJ02 | 3 | 0.0018 | 104 | | 167.1 | 65.2 |
| CJ19 | 3 | 0.0020 | 108 | | 173.6 | 67.8 |
| CJ04 | 2 | 0.0010 | 84 | | 149.9 | 47.4 |
| CJ06 | 2 | 0.0006 | 69 | | 122.8 | 38.9 |
| CJ13 | 2 | 0.0009 | 80 | | 142.8 | 45.2 |
| CJ16 | 2 | 0.0010 | 83 | | 146.9 | 46.5 |
| CJ28 | 2 | 0.0011 | 88 | | 156.5 | 49.5 |
| CJ38 | 2 | 0.0028 | 125 | | 222.2 | 70.2 |
| CJ43 | 2 | 0.0006 | 70 | | 124.4 | 39.4 |
| CJ10 | 1 | 0.0013 | 93 | | 210.3 | 41.4 |
| CJ12 | 1 | 0.0029 | 126 | | 283.8 | 55.8 |
| CJ17 | 1 | 0.0004 | 62 | | 139.0 | 27.4 |
| CJ18 | 1 | 0.0002 | 44 | | 99.2 | 19.5 |
| CJ21 | 1 | 0.0018 | 106 | | 238.5 | 47.0 |
| CJ24 | 1 | 0.0006 | 70 | | 158.8 | 31.3 |
| CJ32 | 1 | 0.0014 | 95 | | 213.2 | 42.0 |
| CJ50 | 1 | 0.0006 | 71 | | 159.2 | 31.3 |
| CJ55 | 1 | 0.0007 | 74 | | 166.8 | 32.8 |
| Site mean for N>1 | 15 | 0.0012 | | 92 | 103.0 | 82.1 |
| Site mean, all species | 24 | 0.0012 | | 91 | 100.0 | 82.0 |

Notes: PW = petiole width at or near insertion to lamina in mm. Leaf area measured in $mm^2$. PI = prediction interval.

**Frequency and diversity of insect herbivory at Cerrejón compared with other Paleocene floras**

Insect damage was tabulated by PW and CCL as the presence or absence on each leaf of 26 discrete insect damage morphotypes (DTs) defined and figured by Labandeira et al. (24, 25). Observations (Tables S8, S9) were made on identified, non-fragmentary dicot leaves only. North American sites and data are from Wilf et al. (13) and references therein. Samples in S8 and S9 are not precisely the same as in Table 1 but have very similar temporal and spatial coverage. Values at 400 leaves are means of 5000 random resamples of 400 leaves each, without replacement, and errors are ± 1 sigma. The four functional feeding groups (FFGs) are external feeding, mining, galling, and piercing-and-sucking; oviposition is excluded.

**Table S8. Insect herbivory from mid-latitude North American Paleocene sites and at Cerrejón, bulk floras.**

| Sample | Location | Repository | Age, Ma | Leaf specimens | Leaf species | %Leaves with damage | %Leaves with mines | DTs | #DTs at 400 leaves | Mine DTs | #Mine DTs at 400 leaves | #FFGs at 400 leaves |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cerrejón | Guajira, Colombia | INGEOMINAS, Bogota | 58-60 | 507 | 39 | 50.1 ± 2.2 | 0.4 ± 0.3 | 26 | 24.4 ± 1.3 | 2 | 1.6 ± 0.6 | 3.8 ± 0.5 |
| Clarkforkian | Washakie Basin, Wyoming | USNM 41270, 41300 | 56.5 | 749 | 10 | 28.3 ± 1.6 | 1.2 ± 0.4 | 27 | 20.7 ± 2.1 | 5 | 3.3 ± 1.0 | 2.8 ± 0.4 |
| Lur'd Leaves | Polecat Bench, Bighorn Basin, Wyoming | USNM 42042 | 57.5 | 1360 | 15 | 14.9 ± 1.0 | 0.1 ± 0.1 | 26 | 16.9 ± 2.3 | 1 | 0.5 ± 0.5 | 3.1 ± 0.7 |
| Skeleton Coast | Polecat Bench, Bighorn Basin Wyoming | USNM 42041 | 59 | 835 | 7 | 34.9 ± 1.6 | 0.2 ± 0.2 | 19 | 16.5 ± 1.2 | 1 | 0.7 ± 0.4 | 2.2 ± 0.7 |
| *Persites* Paradise | Great Divide Basin, Wyoming | USNM 41687 | 59 | 963 | 10 | 33.5 ± 1.5 | 0 | 22 | 17.5 ± 1.7 | 0 | 0 | 3.0 ± 0.0 |
| Kevin's Jerky | Washakie Basin, Wyoming | USNM 41691 | 59 | 1319 | 7 | 30.2 ± 1.3 | 0 | 24 | 18.5 ± 1.6 | 0 | 0 | 3.0 ± 0.1 |
| Haz-Mat | Washakie Basin, Wyoming | USNM 41694 | 59 | 749 | 4 | 37.0 ± 1.8 | 0.4 ± 0.2 | 18 | 15.8 ± 1.2 | 1 | 0.9 ± 0.3 | 3.9 ± 0.3 |
| Castle Rock lower layer | Denver Basin, Colorado | DMNH 2689, 2690, 2698, 2699, 2720, 2731, 2733, 2748 | 63.8 | 2309 | 130 | 6.1 ± 0.5 | 0.1 ± 0.1 | 24 | 12.2 ± 1.8 | 2 | 0.4 ± 0.5 | 2.3 ± 0.5 |
| Mexican Hat | Powder River Basin, Montana | USNM 42090 | 64.4 | 2219 | 16 | 35.1 ± 1.0 | 2.6 ± 0.3 | 31 | 23.5 ± 1.8 | 6 | 3.1 ± 0.9 | 4.0 ± 0.0 |
| Pyramid Butte | Williston Basin, North Dakota | DMNH 427 | 65.5 | 549 | 23 | 24.6 ± 1.8 | 0.5 ± 0.3 | 17 | 15.8 ± 1.0 | 2 | 1.6 ± 0.5 | 3.0 ± 0.2 |

*Notes*: DT = insect damage type (morphotype); FFG = functional feeding group (24). The four FFGs are external feeding, mining, galling, and piercing-and-sucking (oviposition excluded). Data from identified, non-fragmentary dicot leaves only. North American sites and data from (13) and references therein; most samples are not precisely the same as in Table 1 but have very similar temporal and spatial coverage. Values at 400 leaves are means of 5000 random resamples of 400 leaves each, without replacement, methods of (13). Indicated errors are ± 1 sigma, methods of (13).

**Table S9. Insect herbivory from mid-latitude North American Paleocene sites and at Cerrejón, plant species-site pairs with at least 25 specimens.**

| Species | Affinity | Leaf specimens | %Leaves with damage | %Leaves with mines | DTs | #DTs at 25 leaves | Mine DTs | #Mine DTs at 25 leaves | #FFGs at 25 leaves |
|---|---|---|---|---|---|---|---|---|---|
| **Cerrejón** | | | | | | | | | |
| dicot sp. CJ01 | Fabaceae | 105 | 56.2 ± 4.8 | 0 | 15 | 10.3 ± 1.7 | 0 | 0 | 1 ± 0 |
| dicot sp. CJ25 | Malvales | 44 | 43.2 ± 7.5 | 0 | 9 | 8.4 ± 0.7 | 0 | 0 | 1 ± 0 |
| dicot sp. CJ06 | Menispermaceae | 41 | 39.0 ± 7.6 | 0 | 10 | 8.6 ± 1 | 0 | 0 | 1 ± 0 |
| dicot sp. CJ22 | Lauraceae | 37 | 59.5 ± 8.1 | 0 | 9 | 8.2 ± 1 | 0 | 0 | 1.7 ± 0.5 |
| dicot sp. CJ43 | unknown | 33 | 39.4 ± 8.5 | 0 | 9 | 8.1 ± 0.9 | 0 | 0 | 1 ± 0 |
| dicot sp. CJ15 | ?Anacardiaceae | 26 | 42.3 ± 9.7 | 0 | 10 | 9.8 ± 0.5 | 0 | 0 | 1 ± 0 |
| **Clarkforkian** | | | | | | | | | |
| "*Ampelopsis*" *acerifolia* | ?Cercidiphyllaceae | 81 | 24.7 ± 4.8 | 1.2 ± 1.2 | 9 | 4.7 ± 1.5 | 1 | 0.3 ± 0.5 | 1.3 ± 0.5 |
| *Corylites* sp. | Betulaceae | 524 | 31.7 ± 2 | 1.3 ± 0.5 | 18 | 5.2 ± 1.5 | 3 | 0.3 ± 0.5 | 1.3 ± 0.4 |
| Lauraceae sp. FW3 | Lauraceae | 84 | 8.3 ± 3 | 0 | 5 | 2.0 ± 1.1 | 0 | 0 | 0.9 ± 0.3 |
| Magnoliaceae sp. FW7 | Magnoliaceae | 27 | 29.6 ± 8.8 | 0 | 5 | 4.8 ± 0.4 | 0 | 0 | 2 ± 0.1 |
| **Lur'd Leaves** | | | | | | | | | |
| "*Ampelopsis*" *acerifolia* | ?Cercidiphyllaceae | 139 | 23.0 ± 3.6 | 0 | 9 | 4.3 ± 1.3 | 0 | 0 | 1.2 ± 0.4 |
| *Browniea serrata* | Nyssaceae | 81 | 48.1 ± 5.6 | 2.5 ± 1.7 | 17 | 9.3 ± 2.1 | 1 | 0.5 ± 0.5 | 2.3 ± 0.8 |
| *Cercidiphyllum genetrix* | Cercidiphyllaceae | 34 | 20.6 ± 6.9 | 0 | 6 | 4.7 ± 1.1 | 0 | 0 | 1 ± 0 |
| *Davidia antiqua* | Cornales | 29 | 31.0 ± 8.6 | 0 | 5 | 4.8 ± 0.4 | 0 | 0 | 1 ± 0 |
| *Persites argutus* | Lauraceae | 763 | 9.6 ± 1.1 | 0 | 14 | 2.6 ± 1.6 | 0 | 0 | 1.1 ± 0.5 |
| *Platanus raynoldsi* | Platanaceae | 47 | 25.5 ± 6.4 | 0 | 6 | 4.4 ± 0.9 | 0 | 0 | 1 ± 0 |
| *Zizyphoides flabella* | Trochodendraceae | 205 | 9.8 ± 2.1 | 0 | 9 | 2.7 ± 1.5 | 0 | 0 | 1.1 ± 0.4 |
| **Skeleton Coast** | | | | | | | | | |
| *Browniea serrata* | Nyssaceae | 179 | 49.2 ± 3.7 | 0 | 9 | 5.8 ± 1.1 | 0 | 0 | 1 ± 0 |
| *Cercidiphyllum genetrix* | Cercidiphyllaceae | 530 | 28.3 ± 2 | 0.4 ± 0.3 | 16 | 5.2 ± 1.5 | 1 | 0.1 ± 0.3 | 1.1 ± 0.3 |
| *Platanus raynoldsi* | Platanaceae | 57 | 33.3 ± 6.2 | 0 | 7 | 4.8 ± 1.1 | 0 | 0 | 1 ± 0 |
| dicot sp. SC1 | unknown | 48 | 47.9 ± 7.2 | 0 | 9 | 7.0 ± 1.2 | 0 | 0 | 1 ± 0 |
| ***Persites* Paradise** | | | | | | | | | |
| *Cercidiphyllum genetrix* | Cercidiphyllaceae | 36 | 36.1 ± 8 | 0 | 6 | 5.2 ± 1.5 | 0 | 0 | 1.1 ± 0.4 |
| *Corylites* sp. | Betulaceae | 296 | 60.5 ± 2.8 | 0 | 19 | 8.2 ± 2 | 0 | 0 | 2.1 ± 0.6 |
| *Persites argutus* | Lauraceae | 582 | 18.4 ± 1.6 | 0 | 12 | 3.1 ± 1 | 0 | 0 | 1 ± 0.2 |
| **Kevin's Jerky** | | | | | | | | | |
| *Averrhoites affinis* | ?Sapindales | 893 | 30.5 ± 1.5 | 0 | 19 | 5.5 ± 1.7 | 0 | 0 | 2.3 ± 0.5 |
| *Beringiaphyllum cupanioides* | Cornales | 272 | 34.9 ± 2.9 | 0 | 18 | 6.6 ± 1.8 | 0 | 0 | 1.6 ± 0.6 |
| *Celtis aspera* | Celtidaceae | 148 | 20.9 ± 3.3 | 0 | 8 | 4.6 ± 1.4 | 0 | 0 | 1 ± 0 |
| **Haz-Mat** | | | | | | | | | |
| *Cercidiphyllum genetrix* | Cercidiphyllaceae | 568 | 41.7 ± 2.1 | 0.5 ± 0.3 | 18 | 7.0 ± 1.6 | 1 | 0.1 ± 0.3 | 2.9 ± 0.6 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| *Juglandiphyllites glabra* | Juglandaceae | 78 | 15.4 ± 4.1 | 0 | 4 | 2.7 ± 0.8 | 0 | 0 | 1 ± 0.1 |
| *Platanus raynoldsi* | Platanaceae | 102 | 26.5 ± 4.4 | 0 | 10 | 5.6 ± 1.5 | 0 | 0 | 2.3 ± 0.6 |
| **Castle Rock** | | | | | | | | | |
| dicot sp. CR043 | ?Lauraceae | 225 | 4.4 ± 1.4 | 0 | 9 | 1.2 ± 1.1 | 0 | 0 | 0.7 ± 0.5 |
| dicot sp. CR013 | unknown | 224 | 2.7 ± 1.1 | 0 | 6 | 0.9 ± 1.1 | 0 | 0 | 0.6 ± 0.6 |
| dicot sp. CR023 | unknown | 126 | 4.8 ± 1.9 | 0 | 3 | 1.2 ± 0.9 | 0 | 0 | 0.7 ± 0.4 |
| "*Artocarpus*" *lessigiana* | ?Lauraceae | 123 | 6.5 ± 2.2 | 0 | 6 | 1.7 ± 1.1 | 0 | 0 | 0.9 ± 0.3 |
| dicot sp. CR167 | Cornaceae | 120 | 10.8 ± 2.8 | 0 | 8 | 2.6 ± 1.5 | 0 | 0 | 1.2 ± 0.5 |
| dicot sp. CR006 | unknown | 98 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| dicot sp. CR018 | Rhamnaceae | 79 | 10.1 ± 3.4 | 0 | 7 | 3.2 ± 1.5 | 0 | 0 | 1 ± 0.2 |
| dicot sp. CR005 | ?Juglandaceae | 72 | 1.4 ± 1.4 | 0 | 2 | 0.7 ± 0.9 | 0 | 0 | 0.4 ± 0.5 |
| *Platanites marginata* | Platanaceae | 68 | 7.4 ± 3.2 | 0 | 4 | 2.0 ± 1.1 | 0 | 0 | 0.9 ± 0.3 |
| dicot sp. CR033 | unknown | 67 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| "*Zizyphus*" *fibrillosus* | ?Piperaceae | 57 | 5.3 ± 3 | 0 | 6 | 2.9 ± 2 | 0 | 0 | 0.8 ± 0.4 |
| dicot sp. CR042 | unknown | 54 | 7.4 ± 3.6 | 0 | 7 | 3.5 ± 2.4 | 0 | 0 | 0.9 ± 0.3 |
| dicot sp. CR059 | unknown | 48 | 4.2 ± 2.9 | 2.1 ± 2.1 | 4 | 2.1 ± 1.4 | 1 | 0.5 ± 0.5 | 1.3 ± 0.8 |
| dicot sp. CR074 | unknown | 46 | 8.7 ± 4.2 | 0 | 6 | 3.6 ± 1.8 | 0 | 0 | 1.5 ± 0.6 |
| dicot sp. CR058 | unknown | 43 | 7.0 ± 3.9 | 0 | 3 | 1.8 ± 0.8 | 0 | 0 | 0.9 ± 0.2 |
| dicot sp. CR017 | ?Lauraceae | 35 | 2.9 ± 2.8 | 0 | 1 | 0.7 ± 0.5 | 0 | 0 | 0.7 ± 0.5 |
| dicot sp. CR116 | unknown | 33 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| dicot sp. CR070 | unknown | 31 | 6.5 ± 4.4 | 0 | 2 | 1.6 ± 0.5 | 0 | 0 | 1.6 ± 0.5 |
| dicot sp. CR087 | unknown | 28 | 10.7 ± 5.8 | 0 | 4 | 3.6 ± 0.7 | 0 | 0 | 1 ± 0 |
| cf. *Sassafras* sp. CR010 | Lauraceae | 28 | 17.9 ± 7.2 | 0 | 5 | 4.5 ± 0.6 | 0 | 0 | 1 ± 0 |
| dicot sp. CR092 | ?Juglandaceae | 27 | 11.1 ± 6 | 0 | 2 | 1.9 ± 0.3 | 0 | 0 | 1 ± 0 |
| dicot sp. CR032 | unknown | 26 | 3.8 ± 3.8 | 0 | 1 | 1.0 ± 0.2 | 0 | 0 | 1 ± 0.2 |
| **Mexican Hat** | | | | | | | | | |
| *Cercidiphyllum genetrix* | Cercidiphyllaceae | 214 | 39.7 ± 3.3 | 1.4 ± 0.8 | 17 | 7.6 ± 1.8 | 2 | 0.3 ± 0.5 | 2.8 ± 0.7 |
| *Juglandiphyllites glabra* | Juglandaceae | 393 | 18.8 ± 2 | 1 ± 0.5 | 19 | 4.5 ± 1.7 | 3 | 0.3 ± 0.5 | 1.8 ± 0.7 |
| Lauraceae sp. MHL2 | Laurales | 87 | 35.6 ± 5.1 | 0 | 16 | 9.1 ± 1.7 | 0 | 0 | 2.5 ± 0.5 |
| *Platanus raynoldsi* | Platanaceae | 1174 | 37.6 ± 1.4 | 3.5 ± 0.5 | 27 | 8.3 ± 2 | 3 | 0.7 ± 0.7 | 2.6 ± 0.8 |
| "*Populus*" *nebrascensis* | Trochodendrales | 84 | 35.7 ± 5.2 | 1.2 ± 1.2 | 14 | 7.5 ± 1.7 | 1 | 0.3 ± 0.5 | 2.3 ± 0.8 |
| *Zizyphoides flabella* | Trochodendraceae | 230 | 42.6 ± 3.3 | 3 ± 1.1 | 18 | 8.1 ± 2 | 2 | 0.6 ± 0.6 | 2.8 ± 0.7 |
| **Pyramid Butte** | | | | | | | | | |
| *Paranymphaea crassifolia* | ?Nymphaeales | 62 | 19.4 ± 5 | 0 | 10 | 6.1 ± 1.7 | 0 | 0 | 1.4 ± 0.5 |
| "*Populus*" *nebrascensis* | Trochodendrales | 211 | 17.5 ± 2.6 | 0.9 ± 0.7 | 9 | 2.6 ± 1.1 | 1 | 0.2 ± 0.4 | 1.3 ± 0.5 |
| *Browniea serrata* | Nyssaceae | 204 | 31.4 ± 3.2 | 0 | 14 | 5.5 ± 1.7 | 0 | 0 | 1.2 ± 0.4 |

Notes: DT = insect damage type (morphotype); FFG = functional feeding group (24). The four FFGs are external feeding, mining, galling, and piercing-and-sucking (oviposition excluded). Data from identified, non-fragmentary dicot leaves only. North American sites and data from (13) and references therein; most samples are not precisely the same as in Table 1 but have very similar temporal and spatial coverage. Values at 25 leaves are means of 5000 random resamples of 25 leaves each, without replacement, methods of (13). Indicated errors are ± 1 sigma, methods of (13).

**Morphological features and botanical affinities of Cerrejón megafossil morphotypes**

The majority of Cerrejón megafossils are leaves, and leaves also make up the bulk of floral diversity (Table S10). The 2191 leaf specimens were studied at magnifications of 6x - 60x under a Zeiss SZ-10 microscope with attached camera. Segregation of morphotypes and description of leaf architectural features were carried out according to the *Manual of Leaf Architecture* (26). Botanical affinities of the leaves were determined after extensive comparison with cleared leaves of living plants in the National Cleared Leaf Collection held in the Department of Paleobiology, National Museum of Natural History, Smithsonian Institution. Also we carried out an extensive comparison with leaves in the herbarium of the Smithsonian Tropical Research Institute in Panama. "Conservative" estimates of family-level affinity are those based on one or several foliar characters that are unique to the living family to which the fossil is assigned. "Best-guess" estimates are those for which the characters are less distinctive, but still consistent with assignment to an extant family, or related group of extant families.

**Table S10. Cerrejón megafossils.**

| Non-monocot Angiosperm Leaves | | | | |
|---|---|---|---|---|
| **Morphotype** | **Margin** | **Size Range(27)** | **Family (if known)** | **Subfamilial Taxon or Best Guess Family** |
| CJ24 | T | Notophyll – macrophyll | Euphorbiaceae | Euphorbiaceae |
| CJ25 | T | Microphyll – macrophyll | Malvaceae | Malvaceae |
| CJ26 | T | Notophyll – macrophyll | Malvaceae | Malvoideae |
| CJ27 | T | Notophyll – macrophyll | indet dicot | indet dicot |
| CJ48 | T | Mesophyll | Salicaceae | Salicaceae |
| CJ4 | T | Microphyll – mesophyll | indet dicot | Violaceae |
| CJ32 | T | Microphyll – macrophyll | indet dicot | Violaceae |
| CJ34 | T | Notophyll – mesophyll | Anacardiaceae | Anacardiaceae |
| CJ43 | T | Mesophyll – macrophyll | indet dicot | Elaeocarpaceae |
| CJ56 | T | Mesophyll – megaphyll | indet dicot | Salicaceae |
| CJ6 | E | Notophyll – macrophyll | Menispermaceae | *Menispermites cerrejonensis* |
| CJ82 | E | Notophyll – macrophyll | Menispermaceae | *Menispermites guajiraensis* |
| CJ109 | E | Macrophyll | Menispermaceae | *Menispermites horizontalis* |
| | E | | Menispermaceae | *Menispermites cordatus* |
| CJ11 | E | Mesophyll – macrophyll | Malvaceae | Sterculioideae |
| CJ53 | E | Mesophyll | indet dicot | indet dicot |
| CJ5 | E | Microphyll – macrophyll | Lauraceae | Lauraceae |
| CJ36 | E | Notophyll – mesophyll | Malvaceae | Tilioideae, Bombacoideae |
| CJ54 | E | Mesophyll | indet dicot | indet dicot |
| CJ84 | E | Mesophyll | indet dicot | indet dicot |
| CJ1 | E | Notophyll – macrophyll | Fabaceae | Fabaceae |
| CJ2 | E | Notophyll – mesophyll | Meliaceae | Meliaceae |
| CJ8 | E | Notophyll – macrophyll | indet dicot | Sapotaceae |
| CJ10 | E | Mesophyll | indet dicot | Euphorbiaceae |
| CJ12 | E | Mesophyll | indet dicot | Moraceae |
| CJ13 | E | Mesophyll – macrophyll | indet dicot | Apocynaceae |
| CJ15 | E | Mesophyll – megaphyll | indet dicot | indet dicot |

| | | | | |
|---|---|---|---|---|
| CJ16 | E | Mesophyll | indet dicot | indet dicot |
| CJ17 | E | Mesophyll | indet dicot | Malvaceae |
| CJ18 | E | Mesophyll | indet dicot | indet dicot |
| CJ19 | E | Microphyll – mesophyll | Fabaceae | Fabaceae |
| CJ20 | E | Mesophyll – macrophyll | indet dicot | indet dicot |
| CJ21 | E | Mesophyll | indet dicot | indet dicot |
| CJ22 | E | Notophyll – macrophyll | Lauraceae | Lauraceae |
| CJ28 | E | Mesophyll | indet dicot | indet dicot |
| CJ30 | E | Mesophyll | indet dicot | Fabaceae |
| CJ33 | E | Microphyll | indet dicot | indet dicot |
| CJ37 | E | Mesophyll | indet dicot | indet dicot |
| CJ38 | E | Notophyll – mesophyll | Fabaceae | Fabaceae |
| CJ40 | E | Microphyll – macrophyll | indet dicot | Fabaceae |
| CJ41 | E | Mesophyll – macrophyll | indet dicot | indet dicot |
| CJ50 | E | Mesophyll | indet dicot | Annonaceae |
| CJ55 | E | Microphyll – mesophyll | Fabaceae | Fabaceae |
| CJ58 | L.M | Mesophyll | indet dicot | Araliaceae |
| CJ76 | E | Nanophyll | Fabaceae | Fabaceae |
| CJ83 | E | Macrophyll | indet dicot | indet dicot |
| **Monocot Leaves** | | | | |
| **Morphotype** | **Margin** | **Size Range** | **Family (if known)** | **Subfamily or best guess** |
| CJ3 | E | Mesophyll – megaphyll | Araceae | *Montrichardia aquatica* |
| CJ23 | E | Notophyll - Macrophyll | Araceae | *Petrocardium wayuuorum* |
| CJ108 | E | Macrophyll | Araceae | *Petrocardium cerrejonense* |
| CJ62 | L.M | Macrophyll | indet monocot | Amaryllidaceae |
| CJ47 | E | Mesophyll | Araceae | Araceae |
| CJ49 | E | Macrophyll | Zingiberales | Zingiberales |
| CJ59 | E | Notophyll | indet dicot | indet dicot |
| CJ63 | L.M | Megaphyll | Araceae | Araceae |
| CJ64 | E | Mesophyll | indet monocot | Araceae |
| CJ65 | L.M | Megaphyll | Zingiberales | Zingiberales |
| CJ67 | E | Macrophyll - Megaphyll | Arecaceae | Coryphoideae, Calamoideae |
| CJ68 | E | Macrophyll - Megaphyll | Arecaceae | Arecaceae |
| CJ80 | E | Macrophyll | Araceae | Araceae |
| **Fern Leaves** | | | | |
| **Morphotype** | **Margin** | **Size Range** | **Family (if known)** | **Subfamily or best guess** |
| CJ42 | E | Microphyll | Salviniaceae | *Salvinia* |
| CJ57 | T | Mesophyll | Blechnaceae | *Stenochlaena?* |
| CJ61 | E | Microphyll | Schizaeaceae | *Lygodium* |
| CJ66 | E | Notophyll - Macrophyll | Pteridaceae | *Acrostichum?* |

| | | | | |
|---|---|---|---|---|
| CJ81 | T | Notophyll - Macrophyll | indet fern | indet fern |
| | | | | |
| **Conifer branch** | | | | |
| CJ60 | | | Coniferales | Coniferales |
| **FRUITS, SEEDS, FLOWERS** | | | | |
| **Morphotype** | **Margin** | **Size Range** | **Family (if known)** | **Subfamily or best guess** |
| CJ69 | | | Arecaceae | Arecoideae |
| CJ70 | | | Arecaceae | *Nypa* |
| CJ71 | | | Arecaceae | cf. *Cocos* |
| CJ72 | | | indet fruit | indet fruit |
| CJ73 | | | indet fruit | indet fruit |
| CJ74 | | | indet seed | indet seed |
| CJ75 | | | indet fruit | indet fruit |
| CJ77 | | | indet flower | indet flower |
| CJ78 | | | indet flower | indet flower |
| CJ79 | | | Fabaceae | Fabaceae |
| CJ85 | | | Menispermaceae | Menispermaceae |
| CJ86 | | | indet fruit | indet fruit |
| CJ87 | | | indet | indet |
| CJ88 | | | Icacinaceae | Icacinaceae |
| CJ89 | | | indet fruit | indet fruit |
| CJ90 | | | indet fruit | indet fruit |
| CJ91 | | | indet | indet |
| CJ92 | | | indet | indet |
| CJ93 | | | indet fruit | indet fruit |
| CJ94 | | | indet fruit | indet fruit |
| CJ95 | | | indet fruit | indet fruit |
| CJ96 | | | indet seed | indet seed |
| CJ97 | | | indet | indet |
| CJ98 | | | Fabaceae | Fabaceae |
| CJ99 | | | Fabaceae | Fabaceae |
| CJ100 | | | Fabaceae | Fabaceae |
| CJ101 | | | indet fruit | indet fruit |
| CJ102 | | | indet fruit | indet fruit |
| CJ103 | | | Fabaceae | Fabaceae |
| CJ104 | | | indet fruit | indet fruit |
| CJ105 | | | indet fruit | indet fruit |
| CJ106 | | | Fabaceae | Fabaceae |
| CJ107 | | | Fabaceae | Fabaceae |

Twenty of the thirty-one families we have identified among the Cerrejón megafossils are documented in the Paleocene of tropical South America for the first time, and new infrafamilial lineages are documented within two additional families. Table S11 summarized the additions to the Paleocene Neotropical flora by Cerrejón Formation megafossils, with new families in bold lettering.

**Table S11.**

| | Family | Cerrejón | Previous records | Result |
|---|---|---|---|---|
| **1** | **Amaryllidiaceae** | 1 leaf type | none | New family |
| **2** | **Anacardiaceae** | 1 leaf type | none | New family |
| 3 | Annonaceae | 1 leaf type | Pollen*: Proxapertites tertiaria, Longapertites microfoveolatus*(28); not recently revised | |
| **4** | **Apocynaceae** | 1 leaf type | none | New family |
| 5 | Araceae | 5 leaf types, documenting *Montrichardia*, two species of *Petrocardium*, and two Araceae incertae sedis(29) | Pollen*: Echimonocolpites ruedae*(28); moved to Araceae(30) | Infra-familial lineages |
| **6** | **Araliaceae** | 1 leaf type | none | New family |
| 7 | Arecaceae | 2 leaf types, 2 fruit types, 1 inflorescence type documenting *Nypa*, and subtribes Cocoeae and Euterpeinae(31) | Pollen: *Mauritiidites, Gemmastephanocolpites, Retimonocolpites microreticulatus, Psilamonocolpites*(32)*; Proxapertites operculatus & P. cursus* revised and moved to Araceae(33) Fruit: *Nypa pernambucensis*(34) | Infra-familial lineages |
| **8** | **Blechnaceae** | 1 leaf type documenting *Stenochlaena* | Monolete spores(32) | New family |
| **9** | **Caprifoliaceae** | 1 leaf type | none | New family |
| **10** | **Coniferales** | 1 leaf type | | |
| 11 | Ctenolophonaceae | none | Pollen: *Ctenolophonites lismae, Verrustephanocolpites rugulatus*(28, 35); not recently revised | |
| **12** | **Elaeocarpaceae** | 1 leaf type | none | New family |
| 13 | Euphorbiaceae | 1 leaf type | Pollen: *Psilatricolpites operculatus*(36); not recently revised | |
| 14 | Fabaceae | 6 leaf types, 4 fruit types | Pollen: *Sindora*-like(37); doubtful - not recently revised[8] | Diversity in family |
| **15** | **Salicaceae** | 1 leaf type | none | New family |
| **16** | **Icacinaceae** | 1 fruit type | none | New family |
| **17** | **Lauraceae** | 2 leaf types | none | New family |
| **18** | **Schizaeaceae** | 1 leaf type documenting *Lygodium* | Trilete spores(32) | New family |
| 19 | Malvaceae | Three leaf types | Pollen: *Bombacacidites annae*(38, 39); not recently revised | Diversity in family |
| 20 | Melastomataceae | none | Pollen: *Heterocolpites palaeocenica*(28); not recently revised | |

| | | | | |
|---|---|---|---|---|
| **21** | **Meliaceae** | 1 leaf type | none | New family |
| **22** | **Menispermaceae** | 4 leaf types(40) | none | New family w/ diversity |
| **23** | **Moraceae** | 1 leaf type | none | New family |
| 24 | Myrtaceae | none | Pollen: *Syncolporites lisama, S. poricostatus*(28, 37); not recently revised | |
| 25 | Proteaceae | none | Pollen: *Retidiporites magdalenensis, Echitriporites trianguliformis*(28, 36); not recently revised | |
| 26 | Pteridaceae | 1 leaf type documenting *Acrostichum* | Trilete spores(28, 32) | New family |
| **27** | **Salviniaceae** | 1 leaf type documenting *Salvinia* | none | New family |
| **28** | **Sapotaceae** | 1 leaf type | none | New family |
| **29** | **Theaceae** | 1 leaf type | none | New family |
| **30** | **Violaceae** | 1 leaf type | none | New family |
| **31** | **Zingiberales** | 2 leaf types | none | New family |

**Supplemental Information References**


1. Villamil T (1999) Campanian-Miocene tectonostratigraphy, depocenter evolution and basin development of Colombia and western Venezuela. *Palaeogeography, Palaeoclimatology, Palaeoecology* 153:239-275.
2. Bayona G*, et al.* (2004) Important Paleotectonic and Chronostratigraphic Considerations of the Late Paleocene in the Northernmost Andes as Constrained by Paleocene Rocks in the Cerrejón Coal Mine, Guajira, Colombia. in *III Convencion Tecnica ACGGP* Bogota).
3. Etayo-Serna F (1979) Moluscos de una capa del Paleoceno de Manantial (Guajira). *Boletín de Geología* 13:5-55.
4. Jaramillo C*, et al.* (2007) Palynology of the Upper Paleocene Cerrejón Formation, Northern Colombia. *Palynology* 31:153-189.
5. Colinvaux PA, De Oliveira PE, Moreno JE, Miller MC, & Bush MB (1996) A Long Pollen Record from Lowland Amazonia: Forest and Cooling in Glacial Times. *Science* 274:85-88.
6. Behling H, Berrio JC, & Hooghiemstra H (1999) Late Quaternary pollen records from the middle Caquetá river basin in central Colombian Amazon. *Palaeogeography, Palaeoclimatology, Palaeoecology* 145:193-213.
7. Behling H, Hooghiemstra H, & Negret AJ (1998) Holocene History of the Chocó Rain Forest from Laguna Piusbi, Southern Pacific Lowlands of Colombia. *Quaternary Research* 50:300-308.
8. Barclay RS, Johnson KR, Betterton WJ, & Dilcher DL (2003) Stratigraphy and megaflora of a K-T boundary section in the eastern Denver Basin, Colorado. *Rocky Mountain Geology* 38:45 - 71.
9. Gemmill CE & Johnson KR (1997) Paleoecology of a Late Paleocene (Tiffanian) Megaflora from the Northern Great Divide Basin, Wyoming. *Palaios* 12:439-448.
10. Wilf P (2000) Late Paleocene-early Eocene climate changes in southwestern Wyoming: Paleobotanical analysis. *Geological Society of America Bulletin* 112:292-307.
11. Wing SL, Alroy J, & Hickey LJ (1995) Plant and mammal diversity in the Paleocene to early Eocene of the Bighorn Basin. *Palaeogeography Palaeoclimatology Palaeoecology* 115:117-155.
12. Ellis B, Johnson KR, & Dunn RE (2003) Evidence for an in situ early Paleocene rainforest from Castle Rock, Colorado. *Rocky Mountain Geology* 38:73-100.
13. Wilf P, Labandeira CC, Johnson KR, & Ellis B (2006) Decoupled plant and insect diversity after the end-Cretaceous extinction. *Science* 313:1112-1115.
14. Iglesias A*, et al.* (2007) A Paleocene lowland macroflora from Patagonia reveals significantly greater richness than North American analogs. *Geology* 35:947-950.

15. Phillips O, James M, & Gentry A (2002) *Global Patterns of Plant Diversity: Alwyn H. Gentry's Forest Transect Data Set* (Missouri Botanical Garden Press, St. Louis) 319 p.
16. R DCT (2007) *R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria.*
17. Hurlbert SH (1971) The nonconcept of species diversity: a critique and alternative parameters. *Ecology* 52:577-586.
18. McAleece N, Lambshead PJD, Paterson GLJ, & Gage JD (1997) BioDiversity Pro Beta ), Beta.
19. Hammer Ø, Harper DAT, & Ryan PD (2001) PAST: Paleontological Statistics Software Package for Education and Data Analysis. *Palaeontologia Electronica* 4:1-9.
20. Olszewski TD (2004) A unified mathematical framework for the measurement of richness and evenness within and among multiple communities. *Oikos* 104:377-387.
21. Lande R (1996) Statistics and partitioning of species diversity, and similarity among multiple communities. *Oikos* 76:5–13.
22. Royer DL*, et al.* (2007) Fossil leaf economics quantified: calibration, Eocene case study, and implications. *Paleobiology* 33:574-589.
23. Cain SA & Castro GM (1959) *Manual of vegetation analysis* (Harper and Row, New York).
24. Labandeira CC, Wilf P, Johnson KR, & Marsh F (2007) *Guide to Insect (and Other) Damage Types on Compressed Plant Fossils. Version 3.0* (Smithsonian Institution, Washington, D.C.) p 25. http://paleobiology.si.edu/insects/index.html
25. Wilf P & Labandeira CC (1999) Response of plant-insect associations to Paleocene-Eocene warming. *Science* 284:2153-2156.
26. Ellis, B, Daly, DC, Hickey, LJ, Johnson, KR, Mitchell, JD, Wilf, P, and Wing, SL (2009) *Manual of Leaf Architecture*. Cornell University Press, Ithaca. 190 p.
27. Webb LJ (1959) A Physiognomic Classification of Australian Rain Forests. *Journal of Ecology* 47:551-570.
28. Van der Hammen T & Garcia M (1966) The Paleocene pollen flora of Colombia. *Leidse Geologische Mededelingen* 35:105-166.
29. Herrera F, Jaramillo C, Dilcher DL, Wing SL, & Gómez-N. C (2008) Fossil Araceae from a Paleocene Neotropical rainforest in Colombia. *American Journal of Botany* 95:1-16.
30. Hesse M & Zetter R (2007) The fossil pollen record of Araceae. *Plant Systematics and Evolution* 263:93 – 115.
31. Gómez-N. C, Jaramillo CA, Herrera FA, Callejas R, & Wing SL (2009) Palms (Arecaceae) from a Paleocene rainforest of northern Colombia. *American Journal of Botany* 96:1300-1312.
32. Colmenares OA & Teran L (1993) A biostratigraphic study of Paleogene sequences in southwestern Venezuela. *Palynology* 17:67-89.
33. Zetter R, Hesse M, & Frosch-Radivo A (2001) Early Eocene zona-aperturate pollen grains of the *Proxapertites* type with affinity to Araceae. *Review of Palaeobotany and Palynology* 117:267-279.
34. Dolianiti E (1955) Frutos de Nipa no Paleoceno de Pernanbuco. *Brasil. Bol. Div. Geol.Mineral.Minist. Agric.* 158:1–36.
35. Van der Kaars WA (1983) A palynological-paleoecological study of the lower Tertiary Coal-bed sequence from El Cerrejón (Colombia). *Geologia Norandina* 8:33–48.
36. Gonzalez-Guzman AE ( 1967) *A palynological study of the Upper Los Cuervos and Mirador Formations (Lower and Middle Eocene; Tibu Area, Colombia)*. (E. J. Brill., Leiden, The Netherlands).
37. Herendeen P, Crepet W, & Dilcher D (1992) The fossil history of the Leguminosae: Phylogenetic and biogeographic implications. *Advances in Legume Systematics, Part 4, the Fossil Record*, eds Herendeen P & Dilcher D (Kew Publishing), pp 303–316.
38. Germeraad JH, Hopping CA, & Muller J (1968) Palynology of Tertiary sediments from tropical areas. *Review of Palaeobotany and Palynology* 6:189-198.
39. Jaramillo CA & Dilcher DL (2001) Middle Paleogene palynology of central Colombia, South America: a study of pollen and spores from tropical latitudes. *Palaeontographica Abt B* 258:87–213.
40. Doria G, Jaramillo C, & Herrera F (2008) Menispermaceae from the Cerrejón formation, middle to late Paleocene, Colombia. *American Journal of Botany* 95:954–973.

# CERREJON FLORA

Morphotype Name: *incertae sedis* | Morphotype #: CJ1

Major Plant Group: DIC | Organ Type: Leaf | Morphotyper: | Type loc. #: | Type spec. #:

Plant Family/order: Fabaceae | Loca:

## Section I. Leaf Characters

Leaf Attachment:
Leaf Arrangement:
Leaf Organization:
Leaflet Organization:
Leaflet Attachment:
Petiole Features: petiole base pulvinulate

### Features of the Blade

Position of Blade Attachment: marginal
Laminar Size (smallest): notophyll
Laminar Size (largest): macrophyll
Laminar L:W Ratio:
Laminar Shape: elliptic to obovate; oblong
Medial Symmetry: symmetrical
Base Symmetry: basal width asymmetrical
Lobation: unlobed
Margin Type: untoothed
Margin Features:
Apex Angle: acute to obtuse
Apex Shape: straight; rounded
Base Angle: obtuse to acute
Base Shape: convex; rounded
Terminal Apex Features:
Surface Texture:
SurficialGlands:
Stomata:
Cuticle Features:

## Section III. Teeth

Tooth Spacing:
# of Orders:
Teeth/cm:
Sinus Shape:
Tooth Shape:
Tooth Shape:
Principal Vein:
Accesory Vein:
Principal Vein Termination:
Course of Accesory Vein:
Features of the Tooth Apex:

## Similar Morphotypes

## Section II. Venation

1° Vein Framework: pinnate
Naked Basal Veins: absent
# of Basal Veins: 1-3
Agrophic Veins: absent

Major 2° Vein Framework (costal): eucampt. becoming brochid. distally | #: 19-22 pairs
Interior Secondaries: absent
Minor 2° Course: simple brochidodromous
Perimarginal Veins:
Major 2° Spacing (costal): regular, increasing medially only, and sometimes irregular
Variation of 2° Vein Angle (costal): smoothly increasing proximally; uniform
Major 2° Vein Attachment (costal): excurrent

Inter-2° Vein Proximal Course:
Inter-2° Vein Lenght:
Inter-2° Vein Distal Course:
Inter-2° Vein Frequency:

Intercostal 3° Vein Fabric: percurrent
Course of Percurrent 3°: opposite straight; opposite convex
Angle of Percurrent 3°: obtuse
Intercostal 3° Vein Angle Variability: consistent
Epimedial 3°: opposite percurrent
Admedial Course: obtuse to midvein; perpendicular to midvein
Exmedial Course: parallel to intercostal 3°
Exterior 3° Course: looped

Quaternary Vein Fabric: alternate percurrent

Quinternary Vein Fabric: irregular reticulate

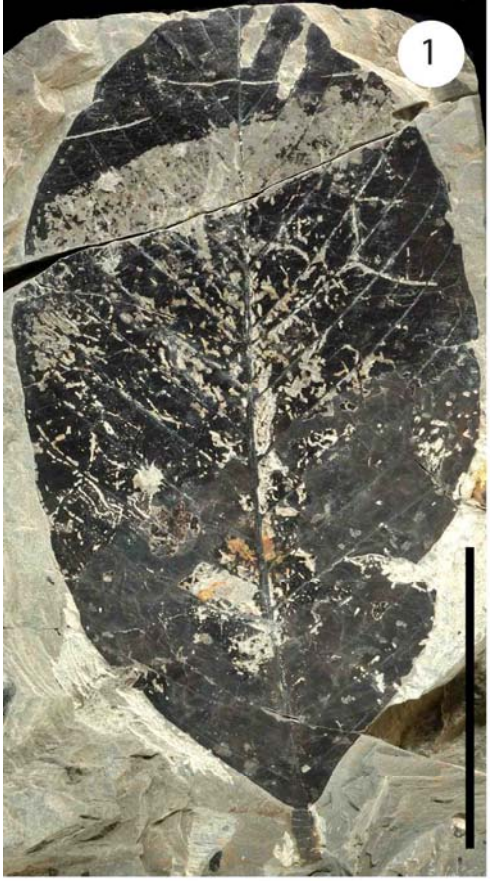
Areolation: present
F.E.V.s Course:
F.E.V.s Terminae:
Marginal Ultimate Venation:

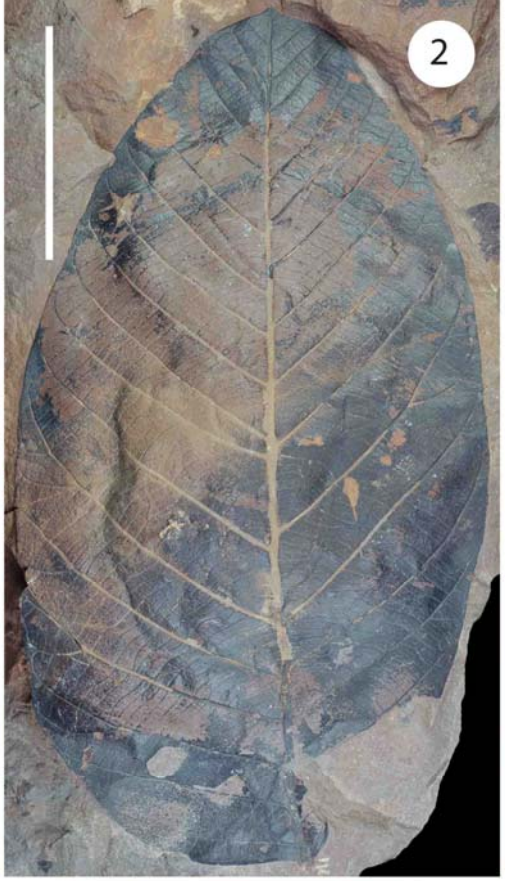
## Diagnostic Features

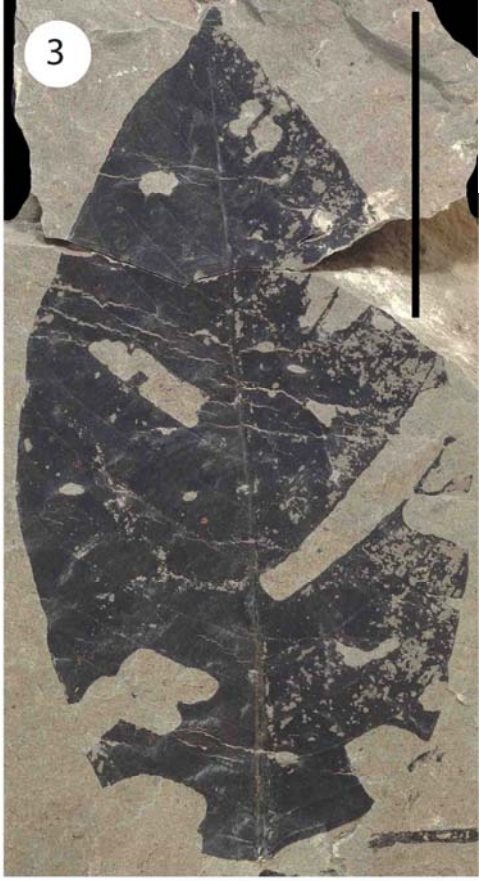
Petiolule transversely striated, short and pulvinate. Base width to extension asymmetrical. Secondary vein angle to midvein smoothly increasing proximally to uniform. Minor secondaries looping at low angles near margin. Tertiaries closely spaced and mostly opposite percurrent.

## Description

Only one specimen has been found attached to the branch showing a petiole base pulvinulate. Petiolule transversely striated, short (ranging from 0.9 o 1.2 cm). Laminar size notophyll to macrophyll (the biggest specimen is ~28 cm long). Leaflets elliptic, oblong and obovate, being the first one more abundant. Leaves medially symmetrical. Base width to extension asymmetrical. Unlobed. Margin entire. Apex angle acute to obtuse. Apex shape straight, acuminate (with and without drip tip) to rounded. Base angle obtuse to acute. Base shape convex to rounded. Primary vein framework pinnate. Number of basal veins 1 to 3. Major secondary vein framework eucamptodromous becoming brochidodromous distally (19-22 pairs). It is common having minor secondary veins looping (simple brochidodromous) at low angles near margin. Major secondary vein spacing mostly regular, but also increasing medially only and sometimes irregular. Variation of secondary vein angle to midvein smoothly increasing proximally to uniform. Secondary vein attachment to midvein excurrent. Tertiary vein fabric mostly opposite percurrent, closely spaced (0.14-0.25 cm measured at the center of the intercostal area) with courses straight and convex. Angle of percurrent tertiaries obtuse. Epimedial tertiaries mostly opposite percurrent; admedial course perpendicular to obtuse; exmedial course parallel to intercostal tertiaries. Exterior tertiary vein course looped. Quaternary vein fabric mostly alternate percurrent. Quinternary vein fabric irregular reticulate. Areolation present.


1


2


3


4


5


6


7

**CERREJON FLORA** | Morphotype Name: *incertae sedis* | Morphotype #: CJ2

Major Plant Group: DIC | Organ Type: Leaf | Morphotyper: | Type loc. #: | Type spec. #:

Plant Family/order: Meliaceae | Loca:

## Section I. Leaf Characters

Leaf Attachment:
Leaf Arrangement:
Leaf Organization:
Leaflet Organization:
Leaflet Attachment:
Petiole Features: short

### Features of the Blade

Position of Blade Attachment: marginal
Laminar Size (smallest): notophyll
Laminar Size (largest): mesophyll
Laminar L:W Ratio:
Laminar Shape: elliptic
Medial Symmetry: asymmetrical
Base Symmetry: basal insertion asymmetrical
Lobation: unlobed
Margin Type: untoothed
Margin Features:
Apex Angle: acute
Apex Shape: acuminate
Base Angle: obtuse
Base Shape: complex
Terminal Apex Features: falcate
Surface Texture:
SurficialGlands:
Stomata:
Cuticle Features:

## Section III. Teeth

Tooth Spacing:
# of Orders:
Teeth/cm:
Sinus Shape:
Tooth Shape:
Tooth Shape:
Principal Vein:
Accesory Vein:
Principal Vein Termination:
Course of Accesory Vein:
Features of the Tooth Apex:

## Similar Morphotypes

## Section II. Venation

1° Vein Framework: pinnate
Naked Basal Veins:
# of Basal Veins:
Agrophic Veins:

Major 2° Vein Framework (costal): eucampt. becoming brochid. distally # 18-23 pairs
Interior Secondaries:
Minor 2° Course:
Perimarginal Veins: fimbrial vein
Major 2° Spacing (costal): gradually increasing proximally
Variation of 2° Vein Angle (costal): smoothly increasing proximally
Major 2° Vein Attachment (costal): excurrent

Inter-2° Vein Proximal Course:
Inter-2° Vein Lenght:
Inter-2° Vein Distal Course:
Inter-2° Vein Frequency:

Intercostal 3° Vein Fabric: percurrent
Course of Percurrent 3°: opposite sinuous
Angle of Percurrent 3°: obtuse
Intercostal 3° Vein Angle Variability: consistent
Epimedial 3°: mixed opp/alt
Admedial Course: perpendicular to midvein acute to midvein
Exmedial Course: parallel to intercostal 3° basiflexed
Exterior 3° Course: looped

Quaternary Vein Fabric: irregular reticulate

Quinternary Vein Fabric:

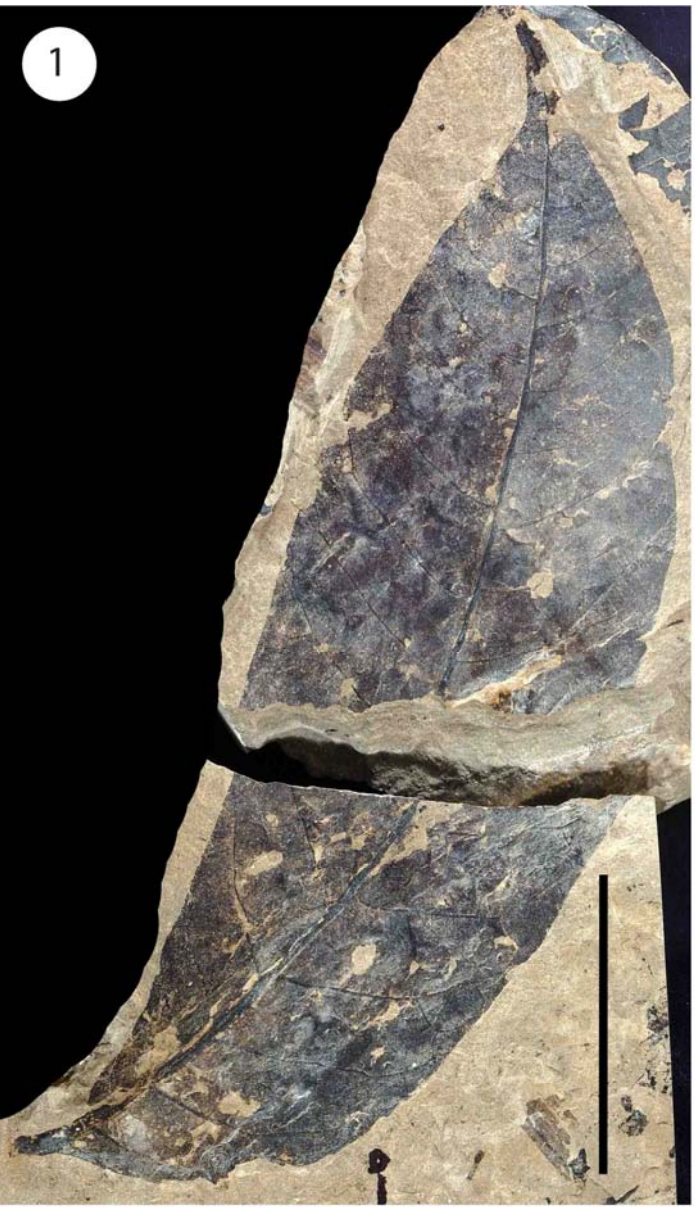
Areolation:
F.E.V.s Course:
F.E.V.s Terminae:
Marginal Ultimate Venation:

### Diagnostic Features

Leaf medially asymmetrical. Basal insertion asymmetrical. Apex acuminate (falcate). Secondary veins eucamptodromous becoming brochidodromous distally. Epimedial tertiary vein mixed opp/alt percurrent. Fimbrial vein thick.

### Description

Petiole short (~0.7 cm). Blade attachment marginal. Laminar size notophyll to mesophyll (the biggest specimen is ~22 cm long and 6 cm wide). Laminar shape elliptic. Leaf medially asymmetrical. Basal insertion asymmetrical. Unlobed. Margin entire. Apex angle acute and shape acuminate (falcate). Base angle obtuse and shape complex. Primary vein framework pinnate. Major secondary vein framework eucamptodromous becoming brochidodromous distally (18 to 23 pairs of veins). Fimbrial vein thick. Major secondary vein spacing gradually increasing proximally (from 0.3 to 1.5 cm). Variation of secondary vein angle smoothly increasing proximally (~90°). Major secondary vein attachment excurrent. Intercostal tertiary vein fabric mostly opposite percurrent. Course of percurrent tertiaries sinuous. Angle of percurrent tertiaries obtuse and consistent. Epimedial tertiary vein mixed opp/alt percurrent; admedial course perpendicular to acute to midvein; exmedial course parallel to intercostal tertiaries to basiflexed. Exterior tertiary vein course looped. Tertiaries very thin compared to secondaries. Quaternary vein fabric hard to see but probably irregular reticulate.


1

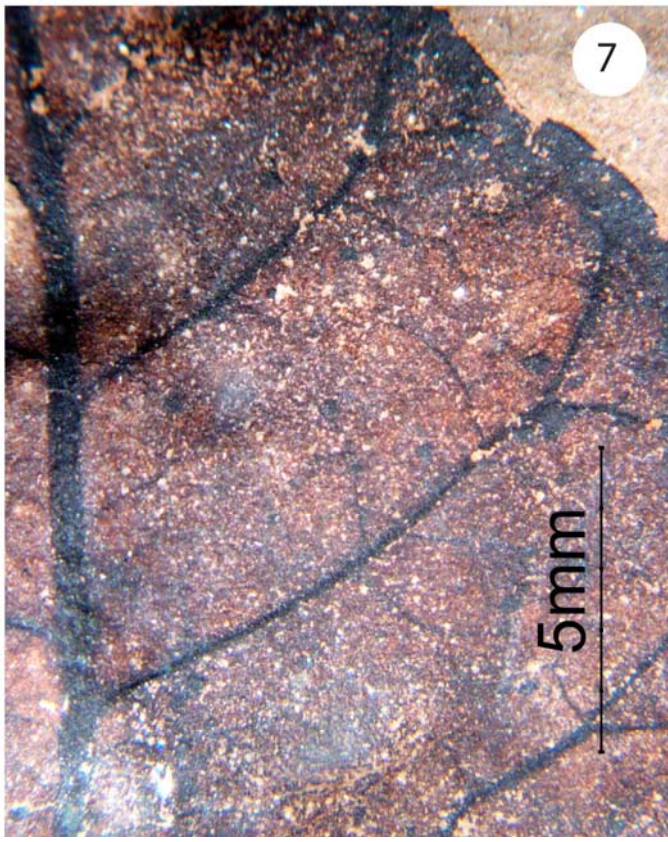

2


3


4


5


6
5mm


7
5mm

**CERREJON FLORA** | Morphotype Name: *Montrichardia aquatica* | Morphotype #: CJ3

Major Plant Group: MON | Organ Type: Leaf | Morphotyper: | Type loc. #: | Type spec. #:

Plant Family/order: Araceae | Loca:

## Section I. Leaf Characters

Leaf Attachment:
Leaf Arrangement:
Leaf Organization:
Leaflet Organization:
Leaflet Attachment:
Petiole Features:

### Features of the Blade

Position of Blade Attachment: marginal
Laminar Size (smallest): mesophyll
Laminar Size (largest): megaphyll
Laminar L:W Ratio:
Laminar Shape:
Medial Symmetry: symmetrical
Base Symmetry: symmetrical
Lobation: unlobed
Margin Type: untoothed
Margin Features:
Apex Angle: obtuse
Apex Shape: rounded
Base Angle: reflex
Base Shape: cordate, sagittate
Terminal Apex Features:
Surface Texture:
SurficialGlands:
Stomata:
Cuticle Features:

## Section III. Teeth

Tooth Spacing:
# of Orders:
Teeth/cm:
Sinus Shape:
Tooth Shape:
Tooth Shape:
Principal Vein:
Accesory Vein:
Principal Vein Termination:
Course of Accesory Vein:
Features of the Tooth Apex:

## Similar Morphotypes

## Section II. Venation

1° Vein Framework: pinnate
Naked Basal Veins: present
# of Basal Veins: 5
Agrophic Veins:

Major 2° Vein Framework (costal): simple brochidodromous #:
Interior Secondaries:
Minor 2° Course:
Perimarginal Veins: intramarginal secondary
Major 2° Spacing (costal): decreasing proximally
Variation of 2° Vein Angle (costal): smoothly decreasing proximally
Major 2° Vein Attachment (costal): decurrent

Inter-2° Vein Proximal Course:
Inter-2° Vein Lenght:
Inter-2° Vein Distal Course:
Inter-2° Vein Frequency:

Intercostal 3° Vein Fabric: reticulate irregular
Course of Percurrent 3°:
Angle of Percurrent 3°:
Intercostal 3° Vein Angle Variability:
Epimedial 3°: reticulate
Admedial Course:
Exmedial Course:
Exterior 3° Course: variable

Quaternary Vein Fabric: irregular reticulate, freely ramifying

Quinternary Vein Fabric: irregular reticulate, freely ramifying

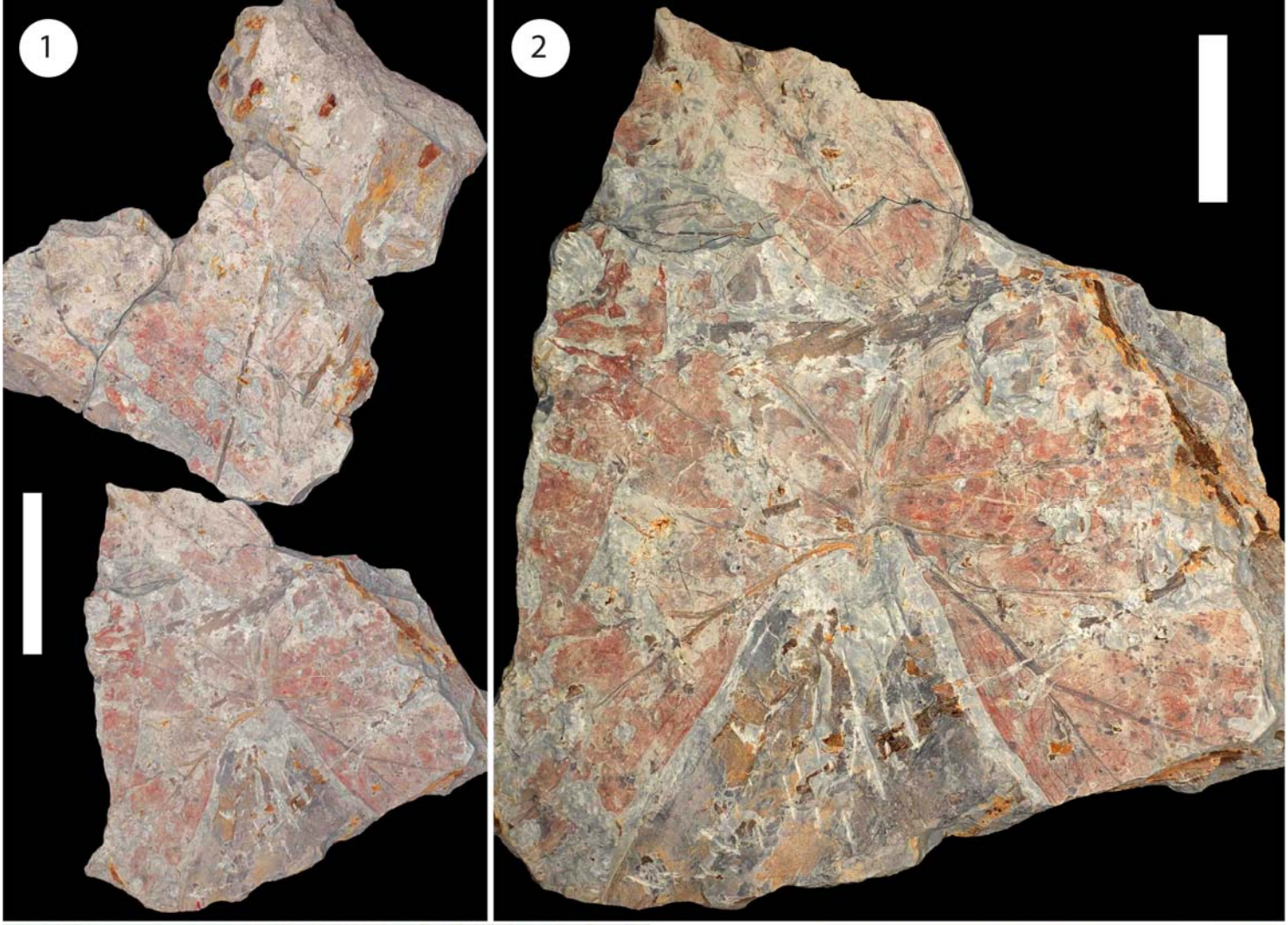
Areolation: poor development
F.E.V.s Course:
F.E.V.s Terminae:
Marginal Ultimate Venation:

## Diagnostic Features

Leaf apex rounded. Margin entire. Cordate or sagittate base. Each basal lobe fed by a secondary vein that branches several times. Naked basal veins. Midrib and secondary veins stout and multistranded. Secondary veins crowded basally and attached to the midrib at very obtuse angles proximally (~90-100°) and decreasing distally to ~45°. Secondaries merging into several collective veins in a complex brochidodromous pattern. Tertiary veins attached to the midrib and secondaries at angles between 20° and 45° to form a network of intercostal venation. Higher order veins strongly irregular polygonal reticulate with wandering courses and vein junctions at variable angles.

## Description

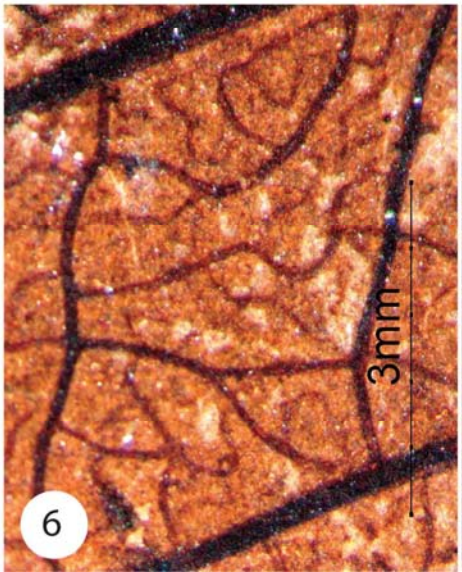
Maximum length measured on the specimens is ~56 cm, and maximum width measured at the posterior division ~26 cm. Margin entire. Leaf apex rounded. Midrib multistranded and up to 1.5 cm wide. Leaf base cordate or sagittate. The basal lobes are fed by the most basal secondary veins; these secondary veins are very well-developed and form part of the leaf margin at the base as naked basal veins, the two basal secondary veins also dichotomize within the lobes several times to form minor secondaries that have perpendicular courses with respect to the midrib and very obtuse angles basally. Secondary veins are multistranded, very thick and decurrent on the midrib. Secondary veins crowded basally and four veins depart from the petiole insertion. Secondary veins branch in a complex brochidodromous pattern, never reaching the margin. Secondary veins on the anterior division are attached to the midrib at very obtuse angles, proximally ~90-100° but decreasing distally to ~45°. The course of the secondary veins is straight to slightly up curved exmedially. Tertiary veins are very decurrent on the midrib and secondary veins at angles between 20° and 45°. Tertiary vein spacing is 1-6 mm. Tertiary veins join to form an intercostal vein network, and are joined exmedially to the secondaries by higher order veins, forming a system of collective veins very close to margin. The course and spacing in between the collective veins are very irregular. Higher order veins are irregular polygonal reticulate with wandering courses (sinuous, angular, or straight) and connections at variable angles.

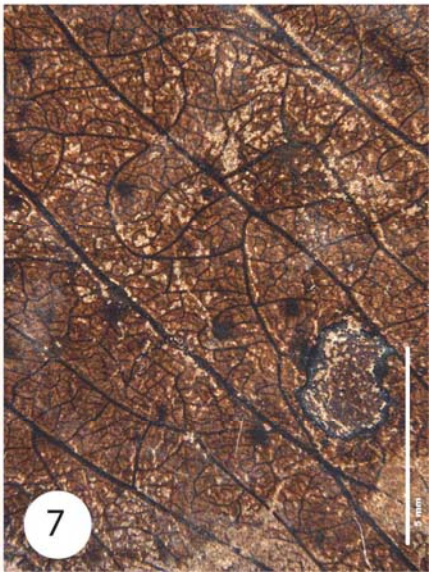

1
2


3


4


5


3mm
6


7

**CERREJON FLORA** | Morphotype Name: *incertae sedis* | Morphotype #: CJ4

Major Plant Group: DIC | Organ Type: Leaf | Morphotyper: | Type loc. #: | Type spec. #:

Plant Family/order: | Loca:

## Section I. Leaf Characters

Leaf Attachment:
Leaf Arrangement:
Leaf Organization:
Leaflet Organization:
Leaflet Attachment:
Petiole Features:

### Features of the Blade

Position of Blade Attachment: marginal
Laminar Size (smallest): microphyll
Laminar Size (largest): mesophyll
Laminar L:W Ratio:
Laminar Shape: oblong | elliptic
Medial Symmetry: symmetrical
Base Symmetry: symmetrical
Lobation: unlobed
Margin Type: crenate
Margin Features:
Apex Angle: acute
Apex Shape: straight
Base Angle: acute
Base Shape: decurrent
Terminal Apex Features:
Surface Texture:
SurficialGlands:
Stomata:
Cuticle Features:

## Section II. Venation

1° Vein Framework: pinnate (thick)
Naked Basal Veins: absent
# of Basal Veins: 1
Agrophic Veins: absent

Major 2° Vein Framework (costal): semicraspedodromous | # >17 pairs
Interior Secondaries:
Minor 2° Course: semicraspedodromous
Perimarginal Veins: thin fimbrial vein
Major 2° Spacing (costal): decreasing proximally
Variation of 2° Vein Angle (costal): smoothly decreasing proximally
Major 2° Vein Attachment (costal): decurrent

Inter-2° Vein Proximal Course: parallel to major secondaries
Inter-2° Vein Lenght: <50% of subjacent secondary
Inter-2° Vein Distal Course: basiflexed
Inter-2° Vein Frequency: ~1 per intercostal area

Intercostal 3° Vein Fabric: percurrent
Course of Percurrent 3°: opposite sinuous | opposite straight
Angle of Percurrent 3°: obtuse | perpendicular
Intercostal 3° Vein Angle Variability: decreasing exmedially
Epimedial 3°: mixed opp/alt
Admedial Course: perpendicular to midvein
Exmedial Course: parallel to intercostal 3°
Exterior 3° Course: terminating at margin

Quaternary Vein Fabric: irregular reticulate | regular reticulate

Quinternary Vein Fabric: irregular reticulate | regular reticulate

Areolation: good development
F.E.V.s Course: mostly unbranched | 1-branched
F.E.V.s Terminae:
Marginal Ultimate Venation:

## Section III. Teeth

Tooth Spacing: regular
# of Orders: one
Teeth/cm: 2-3
Sinus Shape: rounded
Tooth Shape: cv/cv
Tooth Shape:
Principal Vein: present
Accesory Vein: present
Principal Vein Termination: on distal flank
Course of Accesory Vein:
Features of the Tooth Apex:

## Similar Morphotypes

CJ32

## Diagnostic Features

Decurrent base. Semicraspedodromous secondaries (>17 pairs). Secondary spacing and angle decreasing proximally. Tertiary veins opposite percurrent (at ~90° exmedially). Intersecondaries ~1 per intercostal. Quaternary and quinternary vein fabric irregular to regular reticulate. Margin crenate. Teeth with long proximal flanks.

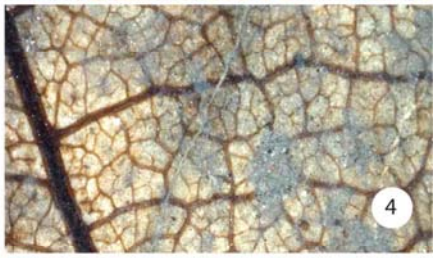
## Description

Blade attachment marginal. Laminar size microphyll to mesophyll (the biggest specimen is ~14 cm long and ~4 cm wide). Laminar shape mostly oblong, but sometimes elliptic. Leaves medially and basally symmetrical. Unlobed. Apex angle acute and shape straight. Base angle acute and shape decurrent. Primary vein framework pinnate and thick. Major secondary vein framework semicraspedodromous (>17 pairs of veins). Minor secondary veins course semicraspedodromous. Fimbrial vein thin. Major secondary vein spacing smoothly decreasing proximally (1.5 cm to 0.3 cm). Variation of secondary vein angle smoothly decreasing proximally (from ~70° to 30-45°). Major secondary vein attachment decurrent. Intersecondary vein proximal course parallel to major secondaries; length <50% of subjacent secondary; intersecondary vein distal course basiflexed; frequency ~1 per intercostal area. Intercostal tertiary vein fabric opposite percurrent with courses sinuous to straight (spaced from 0.2 to 0.4 cm). Angle of percurrent tertiaries obtuse to perpendicular. Intercostal tertiary vein angle variability decreasing exmedially. Epimedial tertiaries mixed opp/alt percurrent; admedial course perpendicular to midvein; admedial course parallel to intercostal tertiaries. Exterior tertiary vein course terminating at margin. Quaternary and quinternary vein fabric irregular to regular reticulate. Areolation development good. F.E.V.s mostly unbranched to 1-branched. Margin crenate; tooth spacing regular; number of orders one; teeth/cm 2-3/cm; sinus shape rounded; tooth shape cv/cv; principal and accessory veins present; principal vein termination on distal flank; teeth with long proximal flanks.

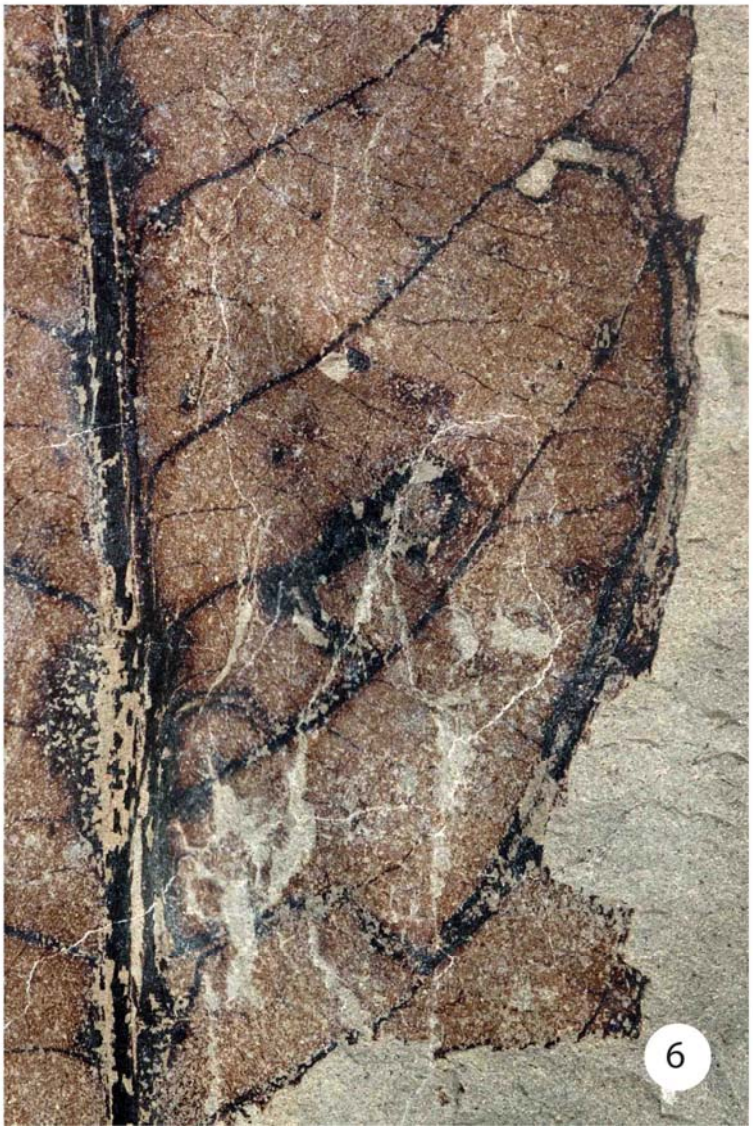

1


2


3


4


5


6


7


8

**CERREJON FLORA** | Morphotype Name: *incertae sedis* | Morphotype #: CJ5

Major Plant Group: DIC | Organ Type: Leaf | Morphotyper: | Type loc. #: | Type spec. #:

Plant Family/order: Lauraceae | Loca:

## Section I. Leaf Characters

Leaf Attachment: petiolate
Leaf Arrangement:
Leaf Organization: simple
Leaflet Organization:
Leaflet Attachment:
Petiole Features: long and thick

### Features of the Blade

Position of Blade Attachment: marginal
Laminar Size (smallest): microphyll
Laminar Size (largest): macrophyll
Laminar L:W Ratio:
Laminar Shape: elliptic
Medial Symmetry: symmetrical
Base Symmetry: symmetrical
Lobation: unlobed
Margin Type: untoothed
Margin Features:
Apex Angle: obtuse
Apex Shape: rounded
Base Angle: obtuse
Base Shape: convex | concavo-convex
Terminal Apex Features:
Surface Texture:
SurficialGlands: laminar
Stomata:
Cuticle Features:

## Section II. Venation

1° Vein Framework: pinnate to acrodromous basal or suprabasal
Naked Basal Veins: absent
# of Basal Veins: 1 to 3
Agrophic Veins: simple

Major 2° Vein Framework (costal): simple brochidodromous | #: 4-6 pairs
Interior Secondaries: absent
Minor 2° Course: simple brochidodromous
Perimarginal Veins: intramarginal secondary (proximally) | fimbrial vein
Major 2° Spacing (costal): abruptly increasing proximally (for pinnate leaves)
Variation of 2° Vein Angle (costal): uniform | one pair acute basal secondaries
Major 2° Vein Attachment (costal): excurrent

Inter-2° Vein Proximal Course:
Inter-2° Vein Lenght:
Inter-2° Vein Distal Course:
Inter-2° Vein Frequency:

Intercostal 3° Vein Fabric: percurrent
Course of Percurrent 3°: mixed opp/alt
Angle of Percurrent 3°: acute
Intercostal 3° Vein Angle Variability: consistent | basally concentric
Epimedial 3°: mostly opposite percurrent
Admedial Course: perpendicular to midvein | parallel to subjacent secondary
Exmedial Course: parallel to intercostal 3° | basiflexed
Exterior 3° Course: looped

Quaternary Vein Fabric: alternate percurrent

Quinternary Vein Fabric:

Areolation:
F.E.V.s Course:
F.E.V.s Terminae:
Marginal Ultimate Venation:

## Section III. Teeth

Tooth Spacing:
# of Orders:
Teeth/cm:
Sinus Shape:
Tooth Shape:
Tooth Shape:
Principal Vein:
Accesory Vein:
Principal Vein Termination:
Course of Accesory Vein:
Features of the Tooth Apex:

## Similar Morphotypes

CJ36
CJ84

## Diagnostic Features

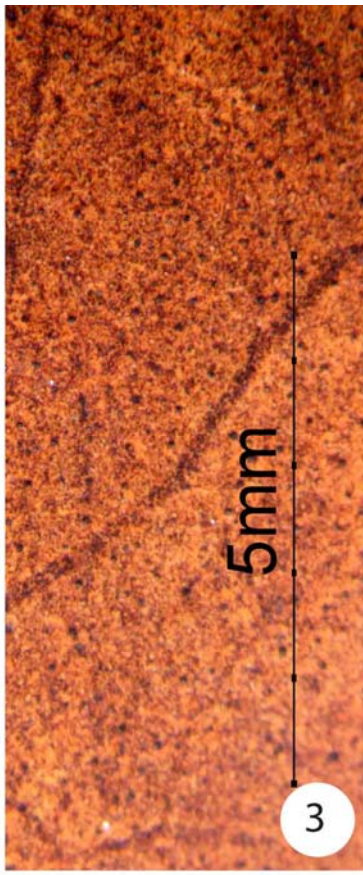
Pinnate (with one pair acute basal secondaries) to acrodromous basal or suprabasal. Major and minor secondary veins simple brochidodromous. Agrophic veins simple. Intramarginal secondary (proximally) and fimbrial veins. Intercostal tertiaries mixed opp/alt percurrent. Laminar resin glands.

## Description

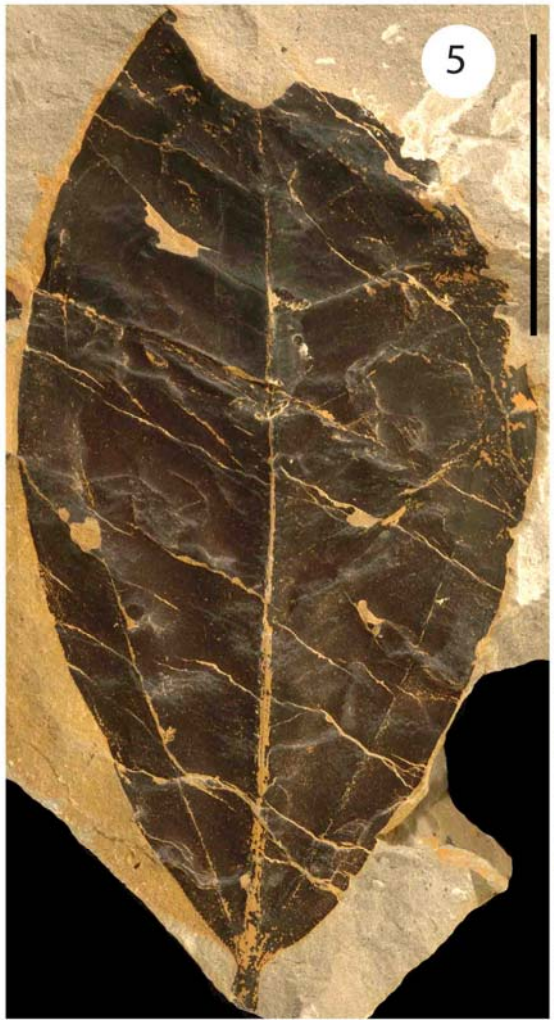
Leaf attachment petiolate. Leaf organization simple. Petiole long and thick. Blade attachment marginal. Laminar size from microphyll to macrophyll (the biggest specimen is ~22 cm long and ~15 cm wide). Laminar shape elliptic. Leaf medially and basally symmetrical. Unlobed. Margin untoothed. Apex angle obtuse and shape rounded. Base angle obtuse and shape from convex to concavo-convex. Laminar resin glands. Primary vein framework from pinnate to acrodromous basal or suprabasal. Number of basal veins from 1 to 3. Agrophics veins simple. Major secondary vein framework simple brochidodromous (4 to 6 pairs of veins). Minor secondary course simple brochidodromous. Intramarginal secondary (proximally) and fimbrial veins. Major secondary spacing abruptly increasing proximally (for pinnate leaves). Variation of major secondary angle to midvein from uniform (27° to 34°) to one pair acute basal secondaries. Major secondary attachment to midvein excurrent. Intercostal tertiary vein fabric mixed opp/alt percurrent (spaced from 0.14 to 0.7 cm, being more crowded proximally). Angle of percurrent tertiaries acute. Intercostal tertiary vein angle variability consistent and basally concentric. Epimedial tertiaries mostly opposite percurrent; admedial course from perpendicular to parallel to subjacent secondary; exmedial course from parallel to intercostal tertiaries to basiflexed. Exterior tertiary course looped. Quaternary vein fabric alternate percurrent.


1


2


5mm
3


4


5


6


7

**CERREJON FLORA** | Morphotype Name: *Menispermites cerrejonensis* | Morphotype #: CJ6

Major Plant Group: DIC | Organ Type: Leaf | Morphotyper: | Type loc. #: ONLY 0318 | Type spec. #:

Plant Family/order: Menispermaceae | Loca:

## Section I. Leaf Characters

Leaf Attachment: petiolate
Leaf Arrangement:
Leaf Organization: simple
Leaflet Organization:
Leaflet Attachment:
Petiole Features: petiole base pulvinate

### Features of the Blade

Position of Blade Attachment: marginal
Laminar Size (smallest): notophyll
Laminar Size (largest): macrophyll
Laminar L:W Ratio:
Laminar Shape: obovate
Medial Symmetry: symmetrical
Base Symmetry: symmetrical
Lobation: unlobed
Margin Type: untoothed
Margin Features:
Apex Angle: acute
Apex Shape: straight | acuminate
Base Angle: obtuse to reflex
Base Shape: cordate-truncate | rounded
Terminal Apex Features:
Surface Texture:
Surficial Glands:
Stomata: anomocytic
Cuticle Features:

## Section III. Teeth

Tooth Spacing:
# of Orders:
Teeth/cm:
Sinus Shape:
Tooth Shape:
Tooth Shape:
Principal Vein:
Accesory Vein:
Principal Vein Termination:
Course of Accesory Vein:
Features of the Tooth Apex:

## Similar Morphotypes

CJ82

## Section II. Venation

1° Vein Framework: actinodromous basal
Naked Basal Veins: absent
# of Basal Veins: 5-7
Agrophic Veins: compound

Major 2° Vein Framework (costal): simple brochidodromous | # 3-5 pairs
Interior Secondaries: absent
Minor 2° Course: simple brochidodromous
Perimarginal Veins: fimbrial vein
Major 2° Spacing (costal): abruptly increasing proximally
Variation of 2° Vein Angle (costal): uniform
Major 2° Vein Attachment (costal): excurrent

Inter-2° Vein Proximal Course:
Inter-2° Vein Lenght:
Inter-2° Vein Distal Course:
Inter-2° Vein Frequency:

Intercostal 3° Vein Fabric: percurrent
Course of Percurrent 3°: mixed opp/alt
Angle of Percurrent 3°: perpendicular | obtuse
Intercostal 3° Vein Angle Variability: decreasing exmedially
Epimedial 3°: mixed opp/alt
Admedial Course: perpendicular to midvein | obtuse to midvein
Exmedial Course: parallel to intercostal 3°
Exterior 3° Course: terminating at margin

Quaternary Vein Fabric: regular reticulate

Quinternary Vein Fabric: regular reticulate

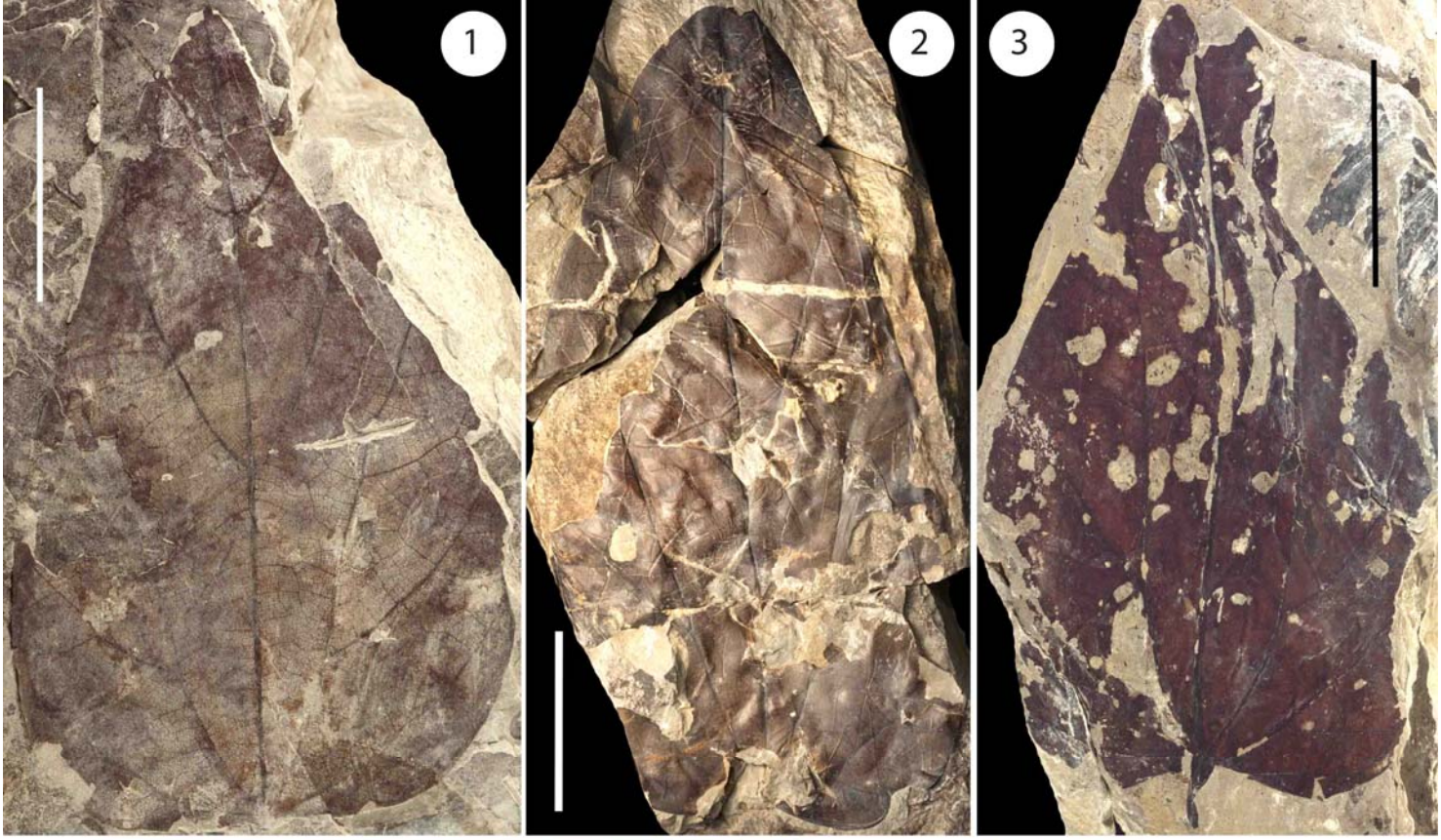
Areolation: paxillate
F.E.V.s Course: absent | unbranched
F.E.V.s Terminae:
Marginal Ultimate Venation:

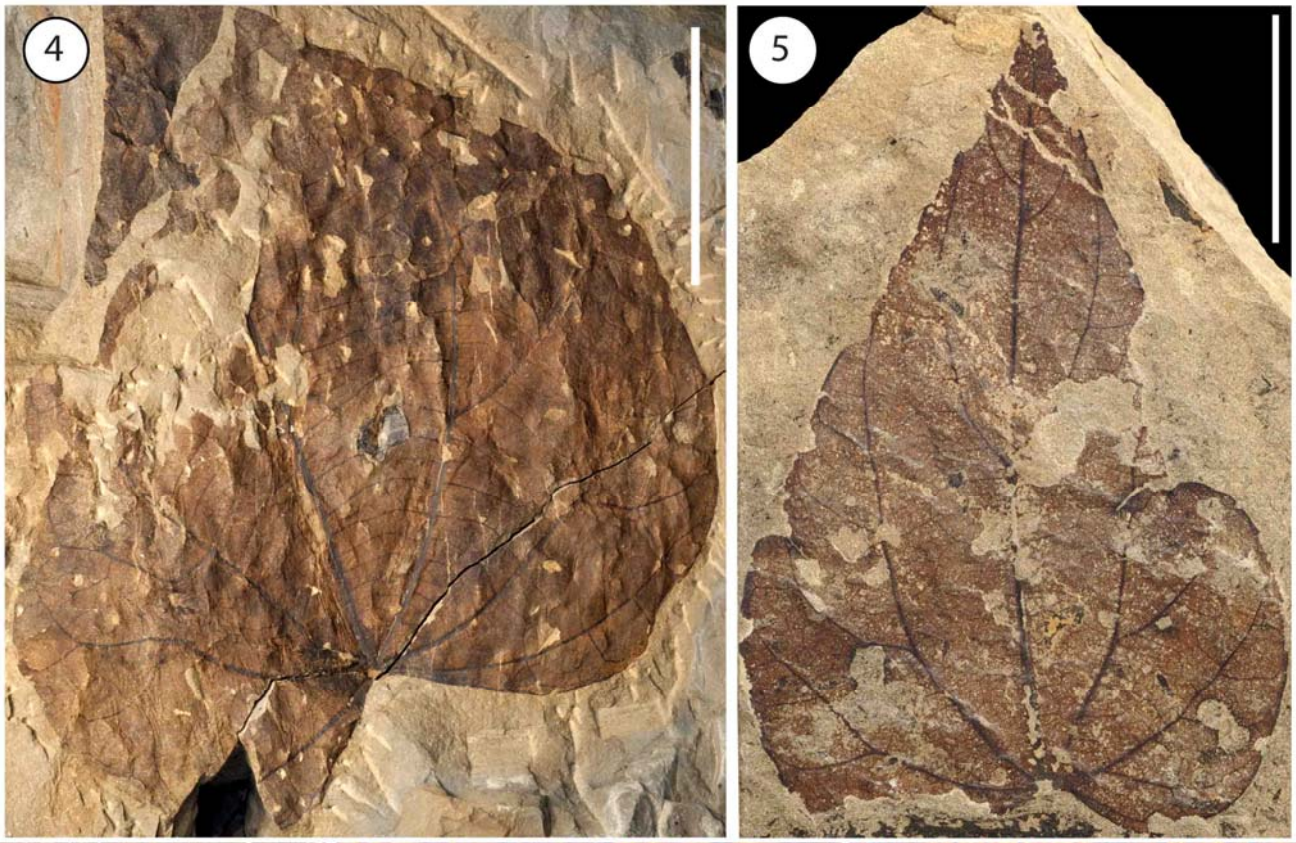
## Diagnostic Features

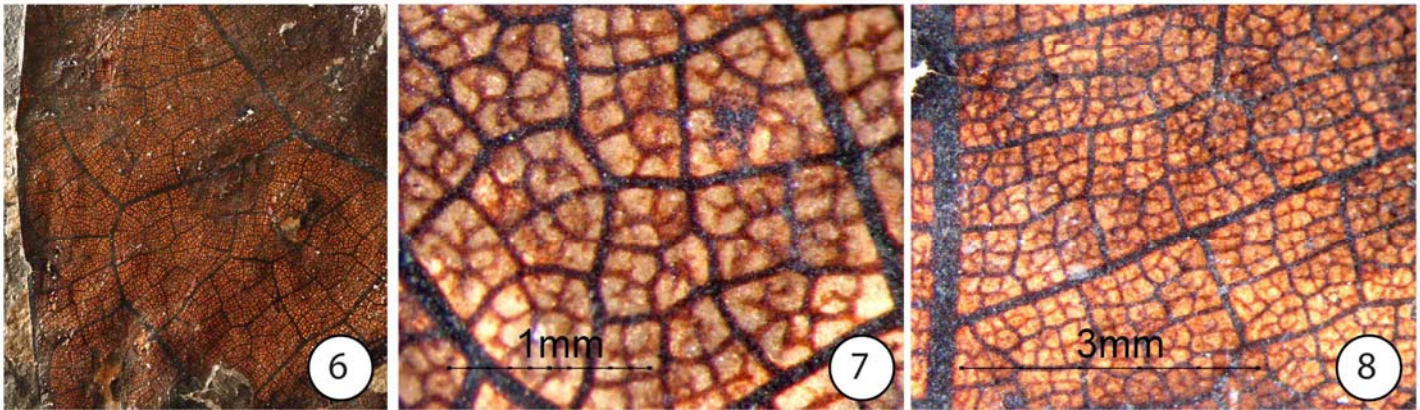
Petiole base pulvinate. Laminar shape obovate. Base shape from cordate to truncate. Primary vein basal actinodromous (5 veins). Agrophic vein compound. Major and minor secondaries simple brochidodromous. Few costal secondaries (3-5). Intercostal tertiary veins mixed opp/alt percurrent. Quaternary and quinternary vein fabric regular reticulate. Areolation paxillate.

## Description

Leaf attachment petiolate. Leaf organization simple. Petiole base pulvinate. Blade attachment marginal. Laminar size from Notophyll to macrophyll (the biggest specimen is >15 cm long and ~18 cm wide). Laminar shape obovate. Leaf medially and basally symmetrical. Unlobed. Margin entire. Apex angle acute. Apex shape straight to acuminate. Base angle obtuse to reflex. Base shape from cordate, rounded, to truncate. Primary vein framework actinodromous basal; first pair of lateral primaries extending about two-thirds the blade and separated ~30°-50° from the mid-primary; the second pair of lateral primaries separated ~40°-70° from the mid-primary. Number of basal veins 5 to 7. Agrophic veins compound. Major secondary vein framework simple brochidodromous (3-5 pairs of veins). Minor secondary course simple brochidodromous. Fimbrial vein conspicuous. Major secondary vein spacing abruptly increasing proximally. Variation of secondary vein angle uniform with a course curved toward margin. Secondary vein attachment excurrent. Intercostal tertiary vein fabric mixed opp/alt percurrent, spaced from 0.2 to 1.5 cm. Angle of percurrent tertiaries from perpendicular to obtuse. Intercostal tertiary vein angle variability decreasing exmedially. Epimedial tertiaries mixed opp/alt percurrent; admedial course perpendicular to obtuse to midvein; exmedial course parallel to intercostal tertiaries; exterior tertiary course terminating at margin. Quaternary and quinternary vein fabric regular reticulate. Areolation paxillate, 4-5 sided. F.E.V.s course from absent to unbranched. Shape of epidermal cells is irregular, with sinuous anticlinal walls at the areoles, and rectangular, with straight anticlinal walls at the veins. Anomocytic stomata, with four cells adjacent to the guard cells not differentiated in any way from the normal epidermal cells, and a diffuse pattern of distribution, probably only present at the abaxial surface.


1
2
3


4
5


1mm
3mm
6
7
8

**CERREJON FLORA** | Morphotype Name: *incertae sedis* | Morphotype #: CJ8

Major Plant Group: DIC | Organ Type: Leaf | Morphotyper: | Type loc. #: | Type spec. #:

Plant Family/order: | Loca:

## Section I. Leaf Characters

Leaf Attachment:
Leaf Arrangement:
Leaf Organization:
Leaflet Organization:
Leaflet Attachment:
Petiole Features: short and thick

### Features of the Blade

Position of Blade Attachment: marginal
Laminar Size (smallest): nanophyll
Laminar Size (largest): macrophyll
Laminar L:W Ratio:
Laminar Shape: obovate | elliptic
Medial Symmetry: symmetrical
Base Symmetry: symmetrical
Lobation: unlobed
Margin Type: untoothed
Margin Features:
Apex Angle: obtuse
Apex Shape: convex | rounded
Base Angle: obtuse
Base Shape: concavo-convex | decurrent
Terminal Apex Features:
Surface Texture:
SurficialGlands:
Stomata:
Cuticle Features:

## Section III. Teeth

Tooth Spacing:
# of Orders:
Teeth/cm:
Sinus Shape:
Tooth Shape:
Tooth Shape:
Principal Vein:
Accesory Vein:
Principal Vein Termination:
Course of Accesory Vein:
Features of the Tooth Apex:

## Similar Morphotypes

CJ83

## Section II. Venation

1° Vein Framework: pinnate (thick)
Naked Basal Veins: absent
# of Basal Veins:
Agrophic Veins: absent

Major 2° Vein Framework (costal): eucamptodromous | # 17-20 pairs
Interior Secondaries:
Minor 2° Course:
Perimarginal Veins: absent
Major 2° Spacing (costal): decreasing proximally
Variation of 2° Vein Angle (costal): smoothly increasing proximally
Major 2° Vein Attachment (costal): excurrent

Inter-2° Vein Proximal Course: perpendicular to midvein to parallel major secondaries
Inter-2° Vein Lenght: <50% of subjacent secondary (very short)
Inter-2° Vein Distal Course: perpendicular to subjacent major secondary to reticulating
Inter-2° Vein Frequency: <1 per intercostal area

Intercostal 3° Vein Fabric: percurrent
Course of Percurrent 3°: opposite straight to sinuous | opposite chevroned
Angle of Percurrent 3°: obtuse
Intercostal 3° Vein Angle Variability: decreasing exmedially
Epimedial 3°: opposite percurrent
Admedial Course: parallel to subjacent secondary
Exmedial Course: basiflexed | parallel to intercostal 3°
Exterior 3° Course:

Quaternary Vein Fabric: alternate percurrent

Quinternary Vein Fabric: regular reticulate

Areolation: good development
F.E.V.s Course:
F.E.V.s Terminae:
Marginal Ultimate Venation:

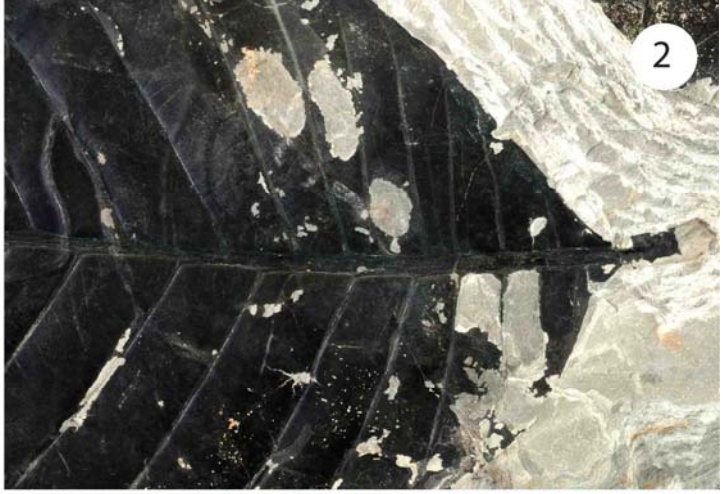
## Diagnostic Features

Secondary vein spacing decreasing proximally. Secondary vein angle increasing proximally (to ~90°). Intersecondaries very short and variable. Intersecondaries and tertiaries much thinner than secondaries. Tertiary vein having commonly curses chevroned.

## Description

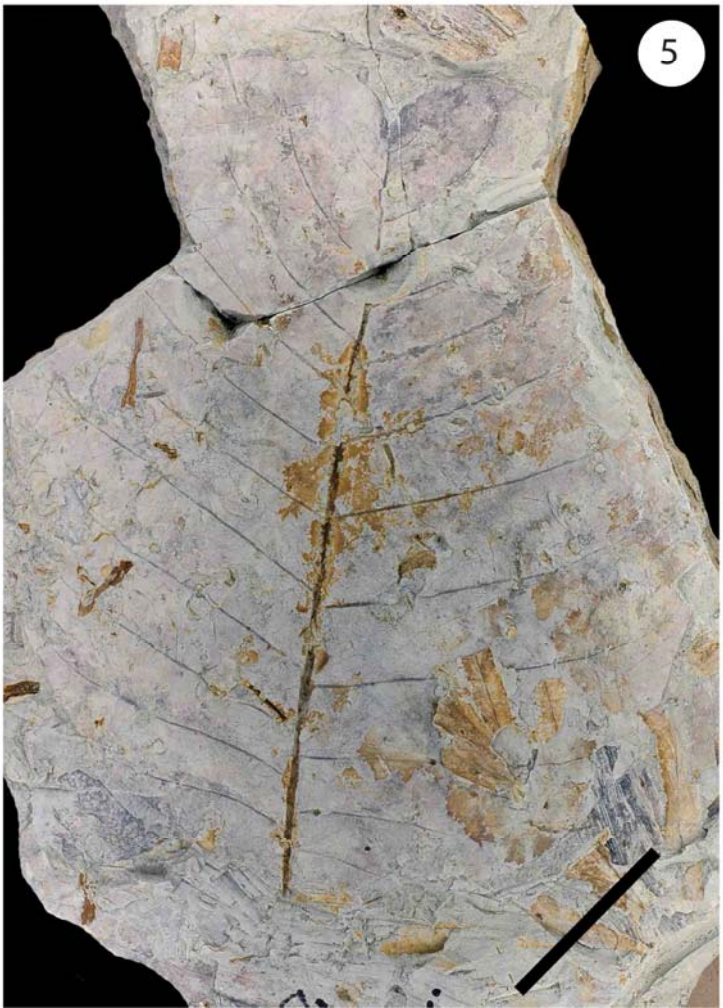
Petiole short and thick. Blade attachment marginal. Laminar size nanophyll to macrophyll (the biggest specimen is ~22 cm long and ~13 cm wide). Laminar shape obovate to elliptic. Leaves medially and basally symmetrical. Unlobed. Margin entire. Apex angle obtuse. Apex shape convex to rounded. Base angle obtuse. Base shape concavo-convex and decurrent. Primary vein framework pinnate and thick. Major secondary vein framework eucamptodromous (17-20 pairs of veins). Major secondary vein spacing decreasing proximally (from 1.5 cm to 0.5 cm). Variation of secondary vein angle smoothly increasing proximally (from 45° to ~90°). Major secondary vein attachment excurrent. Intersecondary vein proximal course perpendicular to midvein to parallel to major secondaries; length <50% of subjacent secondary (very short); intersecondary distal course perpendicular to subjacent major secondary or reticulating; frequency <1 per intercostal area. Intercostal tertiary vein fabric opposite percurrent with chevroned, straight, and sinuous courses (spaced from 0.2 to 0.3 mm). Angle of percurrent tertiaries obtuse. Intercostal tertiary vein angle variability decreasing exmedially. Epimedial tertiaries opposite percurrent; admedial course parallel to subjacent secondary; exmedial course basiflexed to parallel to intercostal tertiaries. Intersecondary and tertiary veins much thinner than secondaries. Quaternary vein fabric alternate percurrent. Quinternary vein fabric regular reticulate. Areolation development good.


1


2


3


4
5mm


5


6

**CERREJON FLORA** | Morphotype Name: *incertae sedis* | Morphotype #: CJ10

Major Plant Group: DIC | Organ Type: Leaf | Morphotyper: | Type loc. #: | Type spec. #:

Plant Family/order: | Loca:

## Section I. Leaf Characters

Leaf Attachment:
Leaf Arrangement:
Leaf Organization:
Leaflet Organization:
Leaflet Attachment:
Petiole Features: long >5cm

### Features of the Blade

Position of Blade Attachment: marginal
Laminar Size (smallest): mesophyll
Laminar Size (largest):
Laminar L:W Ratio:
Laminar Shape: elliptic
Medial Symmetry: asymmetrical to symmetri.
Base Symmetry: symmetrical
Lobation: unlobed
Margin Type: untoothed
Margin Features:
Apex Angle: obtuse
Apex Shape: convex
Base Angle: obtuse
Base Shape: rounded | concavo-convex
Terminal Apex Features: retuse (sometimes)
Surface Texture:
SurficialGlands:
Stomata:
Cuticle Features:

## Section II. Venation

1° Vein Framework: pinnate (thick)
Naked Basal Veins: absent
# of Basal Veins: 1-3
Agrophic Veins: absent

Major 2° Vein Framework (costal): festooned brochidodromous | # 6-8 pairs
Interior Secondaries:
Minor 2° Course: simple brochidodromous
Perimarginal Veins: fimbrial vein
Major 2° Spacing (costal): decreasing proximally
Variation of 2° Vein Angle (costal): smoothly increasing proximally
Major 2° Vein Attachment (costal): deflected

Inter-2° Vein Proximal Course:
Inter-2° Vein Lenght:
Inter-2° Vein Distal Course:
Inter-2° Vein Frequency:

Intercostal 3° Vein Fabric: reticulate irregular
Course of Percurrent 3°:
Angle of Percurrent 3°:
Intercostal 3° Vein Angle Variability:
Epimedial 3°: mixed opp/alt (poorly organized)
Admedial Course:
Exmedial Course:
Exterior 3° Course:

Quaternary Vein Fabric: irregular reticulate

Quinternary Vein Fabric: irregular reticulate

Areolation: good development
F.E.V.s Course: absent
F.E.V.s Terminae:
Marginal Ultimate Venation:

## Section III. Teeth

Tooth Spacing:
# of Orders:
Teeth/cm:
Sinus Shape:
Tooth Shape:
Tooth Shape:
Principal Vein:
Accesory Vein:
Principal Vein Termination:
Course of Accesory Vein:
Features of the Tooth Apex:

## Similar Morphotypes

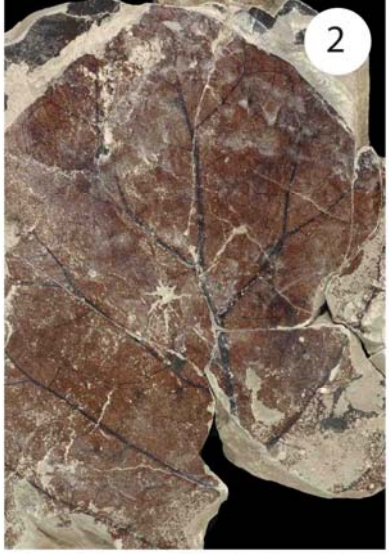
## Diagnostic Features

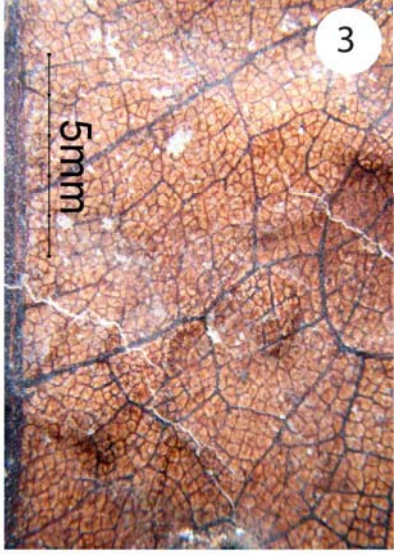
Primary vein being deflected at each secondary juncture. Secondary veins festooned brochidodromous. Secondary spacing decreasing proximally. Intercostal tertiaries mostly irregular reticulate. Epimedial tertiaries mostly opp/alt percurrent (poorly organized). Areolation development good.

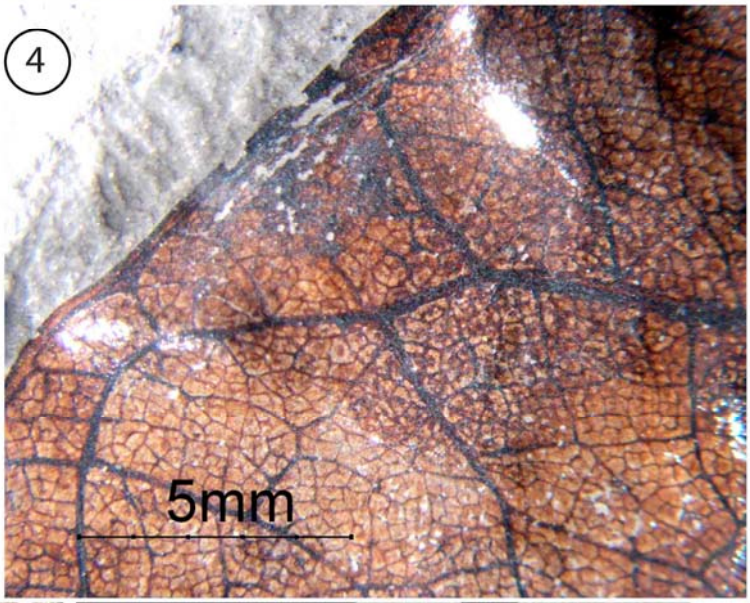
## Description

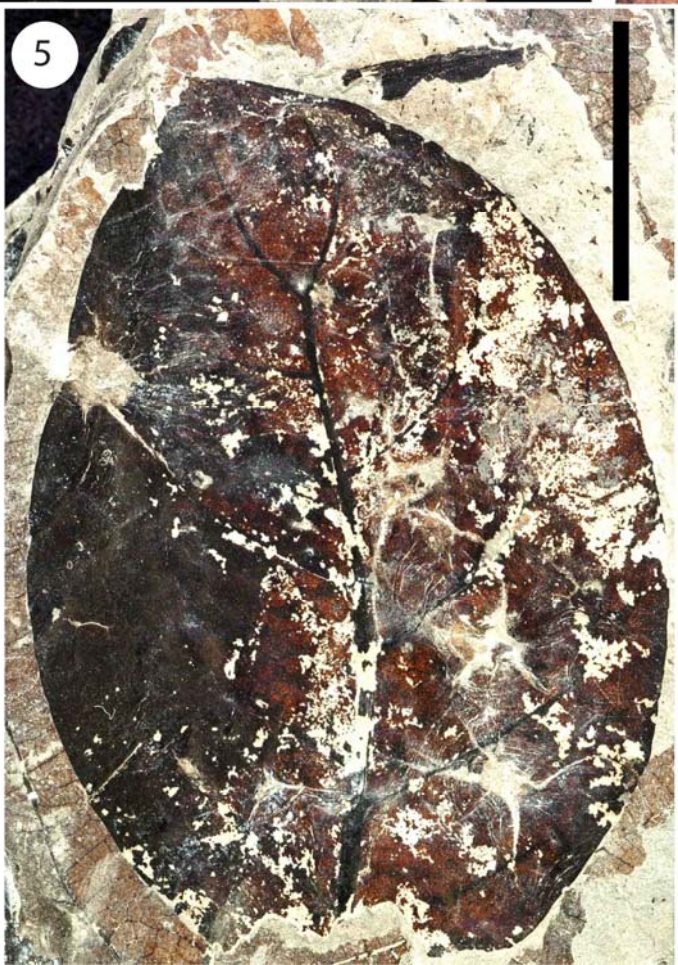
Petiole long (>5 cm). Blade attachment marginal. Laminar size mesophyll (the biggest specimen is ~14 long and 8 cm wide). Laminar shape elliptic. Leaves mostly medially asymmetrical, but also symmetrical. Base symmetrical. Unlobed. Margin entire. Apex angle obtuse and shape convex. Base angle obtuse. Base shape rounded to concavo-convex. Terminal apex features retuse (sometimes). Primary vein framework pinnate and thick. Number of basal veins 1 to 3. Major secondary vein framework festooned brochidodromous (6-8 pairs of veins). Minor secondary vein course simple brochidodromous. Fimbrial vein. Major secondary vein spacing decreasing proximally (from ~2.7 cm to 0.5 cm). Variation of secondary vein angle smoothly increasing proximally (from ~45° to ~70°). Major secondary vein attachment deflected. Intercostal tertiary vein fabric irregular reticulate. Epimedial tertiaries mixed opp/alt percurrent (poorly organized). Quaternary and quinternary vein fabric irregular reticulate. Areolation development good. F.E.V.s absent.


1


2


3
5mm


4
5mm


5


6

**CERREJON FLORA** | Morphotype Name: *incertae sedis* | Morphotype #: CJ11

Major Plant Group: DIC | Organ Type: Leaf | Morphotyper: | Type loc. #: | Type spec. #:

Plant Family/order: | Loca:

## Section I. Leaf Characters

Leaf Attachment:
Leaf Arrangement:
Leaf Organization:
Leaflet Organization:
Leaflet Attachment:
Petiole Features:

### Features of the Blade

Position of Blade Attachment: marginal
Laminar Size (smallest): mesophyll
Laminar Size (largest): macrophyll
Laminar L:W Ratio:
Laminar Shape: elliptic?
Medial Symmetry:
Base Symmetry:
Lobation: palmately lobed
Margin Type: untoothed
Margin Features:
Apex Angle: acute (measured on a lobe)
Apex Shape: straight
Base Angle: obtuse
Base Shape: sligthly cordate
Terminal Apex Features:
Surface Texture:
SurficialGlands:
Stomata:
Cuticle Features:

## Section III. Teeth

Tooth Spacing:
# of Orders:
Teeth/cm:
Sinus Shape:
Tooth Shape:
Tooth Shape:
Principal Vein:
Accesory Vein:
Principal Vein Termination:
Course of Accesory Vein:
Features of the Tooth Apex:

## Similar Morphotypes

## Section II. Venation

1° Vein Framework: actinodromous basal
Naked Basal Veins: present
# of Basal Veins: 5-7
Agrophic Veins: simple

Major 2° Vein Framework (costal): simple brochidodromous # 8-10 pairs
Interior Secondaries: present
Minor 2° Course: simple brochidodromous
Perimarginal Veins:
Major 2° Spacing (costal): gradually increasing proximally
Variation of 2° Vein Angle (costal): uniform
Major 2° Vein Attachment (costal): excurrent

Inter-2° Vein Proximal Course:
Inter-2° Vein Lenght:
Inter-2° Vein Distal Course:
Inter-2° Vein Frequency:

Intercostal 3° Vein Fabric: percurrent
Course of Percurrent 3°: opposite convex | opposite chevroned
Angle of Percurrent 3°: obtuse
Intercostal 3° Vein Angle Variability:
Epimedial 3°:
Admedial Course:
Exmedial Course:
Exterior 3° Course:

Quaternary Vein Fabric:

Quinternary Vein Fabric:

Areolation:
F.E.V.s Course:
F.E.V.s Terminae:
Marginal Ultimate Venation:

## Diagnostic Features

Palmately lobed (three lobes). 5 to 7 basal veins. Base shape slightly cordate. Naked basal veins present. Interior secondaries present. Tertiary veins opposite percurrent with courses sinuous to chevroned.

## Description

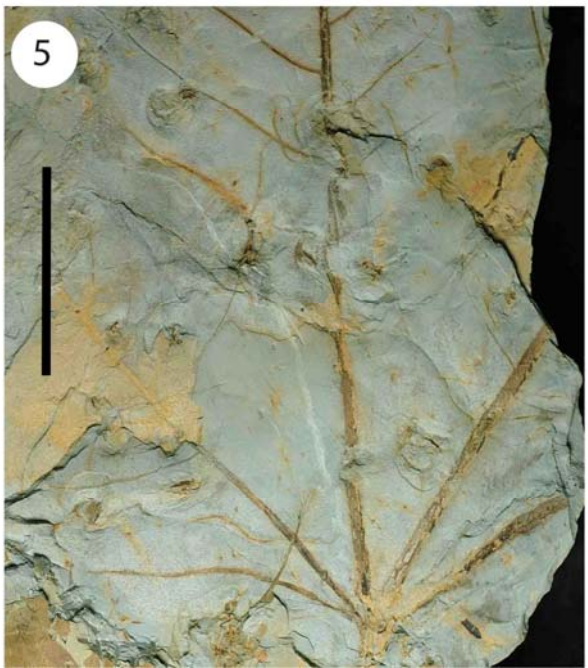
Blade attachment marginal. Laminar size mesophyll to macrophyll (the biggest specimen is ~16 cm long, wide not preserved). Laminar shape apparently elliptic. Palmately lobed (three lobes). Margin entire. Apex angle acute and shape straight. Base angle obtuse and shape slightly cordate. Primary vein framework basal actinodromous. Naked basal veins present. Number of basal veins 5 to 7. Agrophic veins simple. Major secondary vein simple brochidodromous (8-10 pairs of veins). Interior secondaries present. Minor secondary veins simple brochidodromous. Major secondary vein spacing gradually increasing basally (from 0.5 cm to 2cm); there is a gap between the most basal costal secondaries and the basal primaries. Variation of secondary vein angle uniform (~60°). Major secondary vein attachment excurrent. Intercostal tertiary vein fabric opposite percurrent with courses convex and chevroned. Angle of percurrent tertiaries obtuse.


1


2


3


4


5

**CERREJON FLORA** | Morphotype Name: *incertae sedis* | Morphotype #: CJ12

Major Plant Group: DIC | Organ Type: Leaf | Morphotyper: | Type loc. #: | Type spec. #:

Plant Family/order: | Loca:

## Section I. Leaf Characters

Leaf Attachment:
Leaf Arrangement:
Leaf Organization:
Leaflet Organization:
Leaflet Attachment:
Petiole Features: thick and long

### Features of the Blade

Position of Blade Attachment: marginal
Laminar Size (smallest): mesophyll
Laminar Size (largest):
Laminar L:W Ratio:
Laminar Shape: elliptic
Medial Symmetry: symmetrical
Base Symmetry: symmetrical
Lobation: unlobed
Margin Type: untoothed
Margin Features:
Apex Angle: obtuse
Apex Shape:
Base Angle: obtuse
Base Shape: convex
Terminal Apex Features:
Surface Texture:
SurficialGlands: laminar black dots
Stomata:
Cuticle Features:

## Section III. Teeth

Tooth Spacing:
# of Orders:
Teeth/cm:
Sinus Shape:
Tooth Shape:
Tooth Shape:
Principal Vein:
Accesory Vein:
Principal Vein Termination:
Course of Accesory Vein:
Features of the Tooth Apex:

## Similar Morphotypes

## Section II. Venation

1° Vein Framework: pinnate
Naked Basal Veins:
# of Basal Veins:
Agrophic Veins: absent

Major 2° Vein Framework (costal): eucamptodromous | # >8 pairs
Interior Secondaries:
Minor 2° Course: simple brochidodromous
Perimarginal Veins: fimbrial vein
Major 2° Spacing (costal): decreasing proximally
Variation of 2° Vein Angle (costal): uniform
Major 2° Vein Attachment (costal): excurrent

Inter-2° Vein Proximal Course:
Inter-2° Vein Lenght:
Inter-2° Vein Distal Course:
Inter-2° Vein Frequency:

Intercostal 3° Vein Fabric: admedially ramified trunked | opposite percurrent (exmedially)
Course of Percurrent 3°:
Angle of Percurrent 3°: perpendicular (exmedially)
Intercostal 3° Vein Angle Variability:
Epimedial 3°: ramified
Admedial Course: perpendicular to midvein
Exmedial Course:
Exterior 3° Course: looped

Quaternary Vein Fabric: irregular reticulate

Quinternary Vein Fabric: irregular reticulate

Areolation:
F.E.V.s Course:
F.E.V.s Terminae:
Marginal Ultimate Venation:

## Diagnostic Features

Pinnate. Major secondary vein spacing decreasing proximally. Intercostal tertiary veins trunked admedially ramified; exmedially opposite percurrent. Epimedial tertiaries ramified. Laminar black dots.

## Description

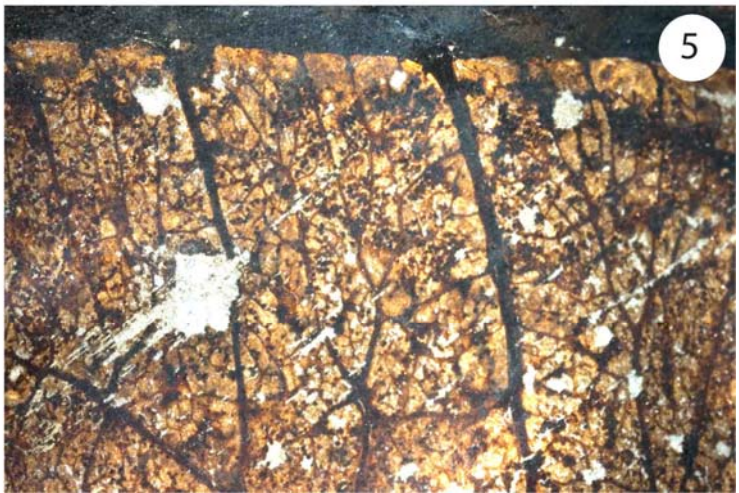
Petiole thick and long. Blade attachment marginal. Laminar size mesophyll (the biggest specimen is >11 cm long and ~8 cm wide). Leaves medially and basally symmetrical. Unlobed. Margin entire. Apex angle obtuse. Base angle obtuse and shape convex. Laminar black dots. Primary vein framework pinnate. Major secondary vein framework eucamptodromous (> 8 pairs of veins). Minor secondary vein course simple brochidodromous. Fimbrial vein. Major secondary vein spacing decreasing proximally (from 2 cm to 0.5 cm). Variation of secondary vein angle uniform. Major secondary vein attachment excurrent. Intercostal tertiary vein fabric trunked admedially ramified; exmedially the tertiaries become opposite percurrent. Angle of percurrent tertiaries near margin perpendicular. Epimedial tertiary veins ramified; admedial course perpendicular to midvein. Exterior course looped. Quaternary and quinternary vein fabrics irregular reticulate.


1


2


3


4


5

# CERREJON FLORA

Morphotype Name: *incertae sedis* | Morphotype #: CJ13

Major Plant Group: DIC | Organ Type: Leaf | Morphotyper: | Type loc. #: | Type spec. #:

Plant Family/order: | Loca:

## Section I. Leaf Characters

Leaf Attachment:
Leaf Arrangement:
Leaf Organization:
Leaflet Organization:
Leaflet Attachment:
Petiole Features: petiole base pulvin(ul)ate

### Features of the Blade

Position of Blade Attachment: marginal
Laminar Size (smallest): mesophyll
Laminar Size (largest): macrophyll
Laminar L:W Ratio:
Laminar Shape: elliptic
Medial Symmetry: symmetrical
Base Symmetry: symmetrical
Lobation: unlobed
Margin Type: untoothed
Margin Features:
Apex Angle: obtuse
Apex Shape: acuminate
Base Angle: obtuse
Base Shape: concavo-convex
Terminal Apex Features:
Surface Texture:
SurficialGlands: laminar black dots
Stomata:
Cuticle Features:

## Section III. Teeth

Tooth Spacing:
# of Orders:
Teeth/cm:
Sinus Shape:
Tooth Shape:
Tooth Shape:
Principal Vein:
Accesory Vein:
Principal Vein Termination:
Course of Accesory Vein:
Features of the Tooth Apex:

## Similar Morphotypes

## Section II. Venation

1° Vein Framework: pinnate
Naked Basal Veins: absent
# of Basal Veins:
Agrophic Veins: absent

Major 2° Vein Framework (costal): eucampt. becoming brochid. distally | #: 13-15 pairs
Interior Secondaries:
Minor 2° Course: simple brochidodromous
Perimarginal Veins:
Major 2° Spacing (costal): decreasing proximally and distally
Variation of 2° Vein Angle (costal): smoothly increasing proximally
Major 2° Vein Attachment (costal): excurrent

Inter-2° Vein Proximal Course:
Inter-2° Vein Lenght:
Inter-2° Vein Distal Course:
Inter-2° Vein Frequency:

Intercostal 3° Vein Fabric: percurrent
Course of Percurrent 3°: opposite sinuous to convex | opposite straight
Angle of Percurrent 3°: obtuse | perpendicular
Intercostal 3° Vein Angle Variability: decreasing exmedially | basally concentric
Epimedial 3°: opposite percurrent
Admedial Course: perpendicular to midvein
Exmedial Course: parallel to intercostal 3°
Exterior 3° Course: looped

Quaternary Vein Fabric: alternate percurrent

Quinternary Vein Fabric: freely ramifying

Areolation: poor development
F.E.V.s Course: mostly 2 or more branched
F.E.V.s Terminae:
Marginal Ultimate Venation:

## Diagnostic Features

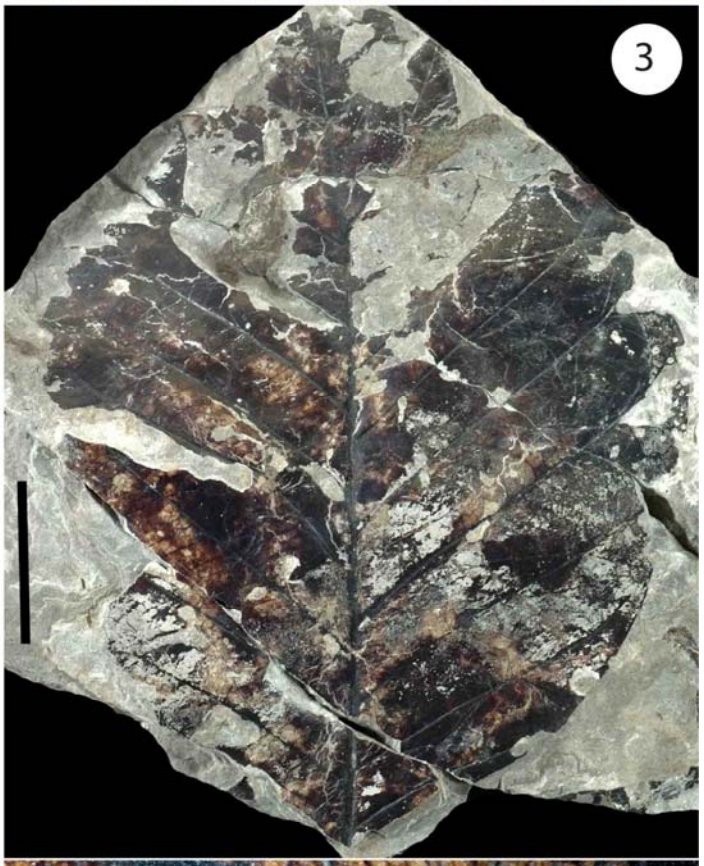
Petiole base pulvin(ul)ate. Base shape concavo-convex. Major secondary spacing decreasing proximally and distally. Secondary vein angle increasing proximally. Costal secondaries diverging from one another exmedially with a course almost sinuous. Tertiary veins opposite percurrent. Quinternary veins freely ramifying. F.E.V.s 2 or more branched. Laminar black dots.

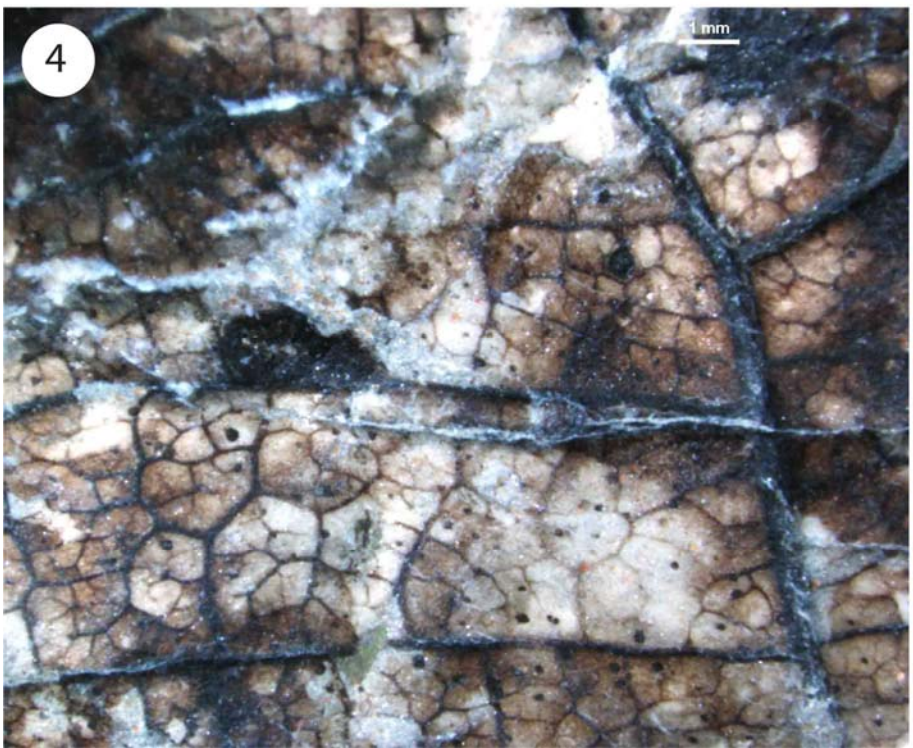
## Description

Petiole base pulvin(ul)ate. Blade marginal. Laminar size mesophyll to macrophyll (the biggest specimen is ~17 cm long and 16 cm wide). Laminar shape elliptic. Leaves medially and basally symmetrical. Unlobed. Margin entire. Apex angle obtuse and shape acuminate (short drip tip). Base angle obtuse and shape concavo-convex. Laminar black dots. Primary vein framework pinnate. Major secondary vein framework eucamptodromous becoming brochidodromous distally (13-15 pairs of veins). Minor secondary vein course simple brochidodromous. Major secondary spacing decreasing proximally and distally (from 0.5 cm to 2.0 cm). Variation of secondary vein angle smoothly increasing proximally (from ~40° to ~60°). Costal secondaries diverging from one another exmedially with a course almost sinuous. Major secondary vein attachment excurrent. Intercostal tertiary vein fabric opposite percurrent with courses sinuous, convex, to straight (spaced from 0.2 to 0.4 cm). Angle of percurrent tertiaries obtuse to perpendicular. Intercostal tertiary vein angle variability decreasing exmedially and basally concentric. Epimedial tertiary veins opposite percurrent; admedial course perpendicular to midvein; exmedial course parallel to intercostal tertiaries. Exterior tertiary vein course looped. Quaternary vein fabric alternate percurrent. Quinternary vein fabric freely ramifying. Areolation development poor. F.E.V.s mostly 2 or more branched.


1


2


3


4
1 mm


5

**CERREJON FLORA** | Morphotype Name: *incertae sedis* | Morphotype #: CJ15

Major Plant Group: DIC | Organ Type: Leaf | Morphotyper: | Type loc. #: | Type spec. #:

Plant Family/order: | Loca:

## Section I. Leaf Characters

Leaf Attachment:
Leaf Arrangement:
Leaf Organization:
Leaflet Organization:
Leaflet Attachment:
Petiole Features: thick and short

### Features of the Blade

Position of Blade Attachment: marginal
Laminar Size (smallest): notophyll
Laminar Size (largest): megaphyll
Laminar L:W Ratio:
Laminar Shape: obovate | elliptic
Medial Symmetry: asymmetrical to symmetrical
Base Symmetry: symmetrical
Lobation: unlobed
Margin Type: untoothed
Margin Features:
Apex Angle: obtuse
Apex Shape: convex | rounded
Base Angle: acute to obtuse
Base Shape: straight-cuneate | convex
Terminal Apex Features:
Surface Texture:
SurficialGlands:
Stomata:
Cuticle Features:

## Section III. Teeth

Tooth Spacing:
# of Orders:
Teeth/cm:
Sinus Shape:
Tooth Shape:
Tooth Shape:
Principal Vein:
Accesory Vein:
Principal Vein Termination:
Course of Accesory Vein:
Features of the Tooth Apex:

## Similar Morphotypes

## Section II. Venation

1° Vein Framework: pinnate (very thick)
Naked Basal Veins: absent
# of Basal Veins:
Agrophic Veins: absent

Major 2° Vein Framework (costal): eucamptodromous | # 18-23
Interior Secondaries:
Minor 2° Course:
Perimarginal Veins: thick fimbrial vein
Major 2° Spacing (costal): decreasing proximally and distally
Variation of 2° Vein Angle (costal): uniform
Major 2° Vein Attachment (costal): excurrent

Inter-2° Vein Proximal Course:
Inter-2° Vein Lenght:
Inter-2° Vein Distal Course:
Inter-2° Vein Frequency:

Intercostal 3° Vein Fabric: percurrent
Course of Percurrent 3°: mixed opp/alt
Angle of Percurrent 3°: obtuse
Intercostal 3° Vein Angle Variability: consistent
Epimedial 3°: mixed opp/alt
Admedial Course: perpendicular to midvein
Exmedial Course: parallel to intercostal 3°
Exterior 3° Course:

Quaternary Vein Fabric: alternate percurrent | irregular reticulate

Quinternary Vein Fabric: irregular reticulate

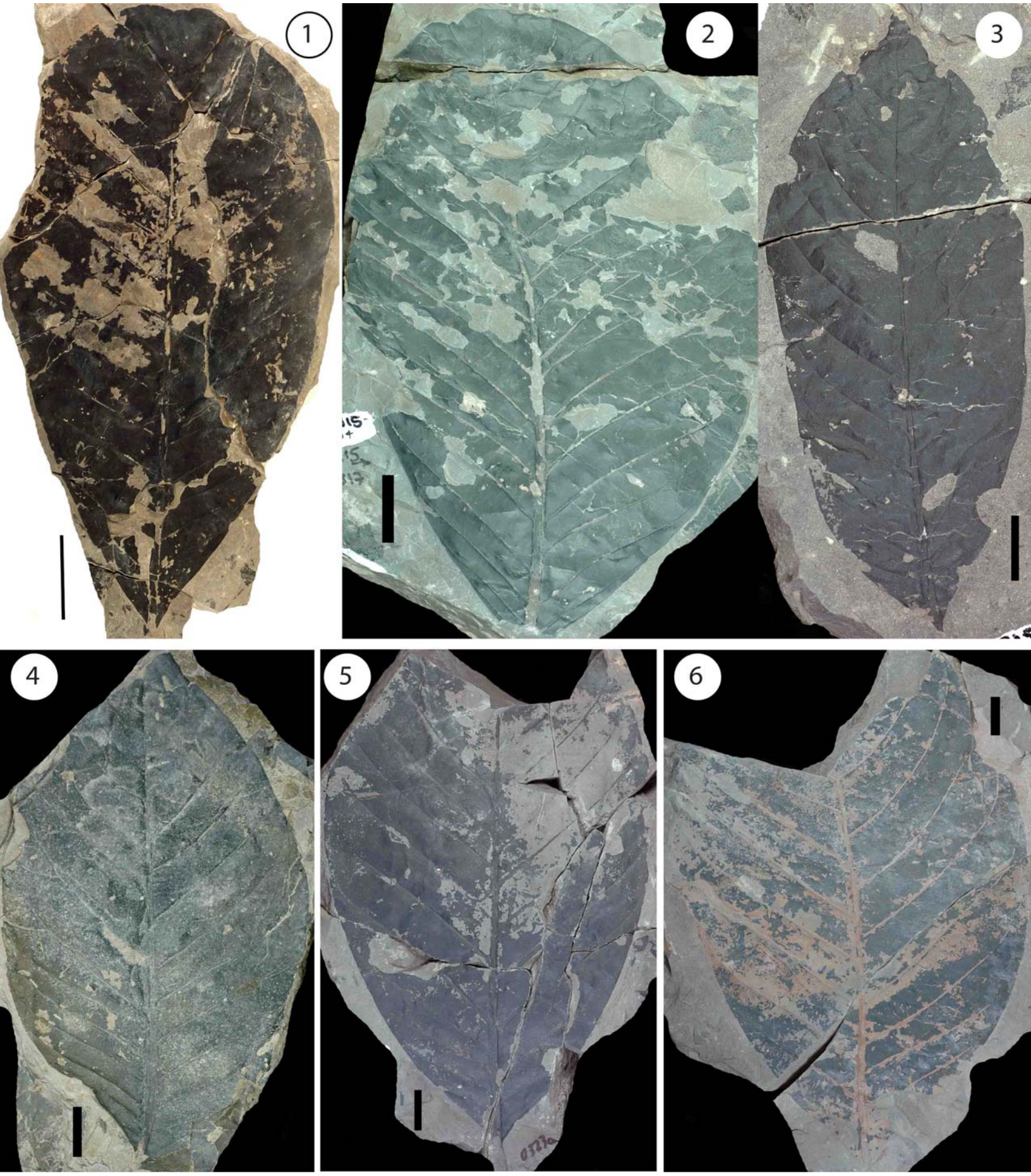
Areolation: moderate development
F.E.V.s Course:
F.E.V.s Terminae:
Marginal Ultimate Venation:

## Diagnostic Features

Laminar shape frequently obovate. Secondary veins constantly eucamptodromous (18-23 pairs of veins). Secondary vein spacing decreasing proximally and distally. Secondary vein angle acute and uniform. Tertiary veins mixed opp/alt percurrent. Thick fimbrial vein.

## Description

Petiole short and thick. Blade attachment marginal. Laminar size notophyll to megaphyll (the biggest specimen is ~40 cm long and ~25 cm wide). Laminar shape mostly obovate but also elliptic. Frequently leaves medially asymmetrical, but also symmetrical. Unlobed. Margin entire. Apex angle obtuse. Apex shape convex to rounded. Base angle acute to obtuse. Base shape straight-cuneate to convex. Primary vein framework pinnate (very thick). Major secondary veins framework eucamptodromous (18-23 pairs of veins). Thick fimbrial vein. Major secondary vein spacing decreasing proximally and distally (from 0.5 cm to 4 cm). Variation of secondary vein angle uniform (45° to 55°). Major secondary vein attachment excurrent. Intercostal tertiary vein fabric mixed opp/alt percurrent. Angle of percurrent tertiaries obtuse. Intercostal tertiary vein angle variability consistent. Epimedial tertiary veins mixed opp/alt percurrent; admedial course perpendicular to midvein; exmedial course parallel to intercostal tertiaries. Quaternary vein fabric alternate percurrent to irregular reticulate. Quinternary vein fabric irregular reticulate. Areolation development apparently moderate.


1
2
3
4
5
6

**CERREJON FLORA** | Morphotype Name: *incertae sedis* | Morphotype #: CJ16

Major Plant Group: DIC | Organ Type: Leaf | Morphotyper: | Type loc. #: | Type spec. #:

Plant Family/order: | Loca:

## Section I. Leaf Characters

Leaf Attachment:
Leaf Arrangement:
Leaf Organization:
Leaflet Organization:
Leaflet Attachment:
Petiole Features: long >4 cm

### Features of the Blade

Position of Blade Attachment: marginal
Laminar Size (smallest): notophyll
Laminar Size (largest): mesophyll
Laminar L:W Ratio:
Laminar Shape: ovate
Medial Symmetry: symmetrical
Base Symmetry: symmetrical
Lobation: unlobed
Margin Type: untoothed
Margin Features:
Apex Angle: acute
Apex Shape: straight
Base Angle: obtuse
Base Shape: cordate
Terminal Apex Features:
Surface Texture:
SurficialGlands:
Stomata:
Cuticle Features:

## Section III. Teeth

Tooth Spacing:
# of Orders:
Teeth/cm:
Sinus Shape:
Tooth Shape:
Tooth Shape:
Principal Vein:
Accesory Vein:
Principal Vein Termination:
Course of Accesory Vein:
Features of the Tooth Apex:

## Similar Morphotypes

CJ28
CJ50

## Section II. Venation

1° Vein Framework: pinnate
Naked Basal Veins: absent
# of Basal Veins: 3-5
Agrophic Veins: absent

Major 2° Vein Framework (costal): eucamptodromous | # 10-13 pairs
Interior Secondaries:
Minor 2° Course:
Perimarginal Veins: fimbrial vein
Major 2° Spacing (costal): decreasing proximally
Variation of 2° Vein Angle (costal): abruptly increasing proximally
Major 2° Vein Attachment (costal): excurrent

Inter-2° Vein Proximal Course:
Inter-2° Vein Lenght:
Inter-2° Vein Distal Course:
Inter-2° Vein Frequency:

Intercostal 3° Vein Fabric: percurrent (closely spaced)
Course of Percurrent 3°: opposite sinuous | opposite straight
Angle of Percurrent 3°: obtuse | perpendicular
Intercostal 3° Vein Angle Variability: decreasing exmedially
Epimedial 3°: opposite percurrent
Admedial Course: obtuse to midvein | perpendicular to midvein
Exmedial Course: parallel to intercostal 3°
Exterior 3° Course:

Quaternary Vein Fabric: reticulate

Quinternary Vein Fabric:

Areolation:
F.E.V.s Course:
F.E.V.s Terminae:
Marginal Ultimate Venation:

## Diagnostic Features

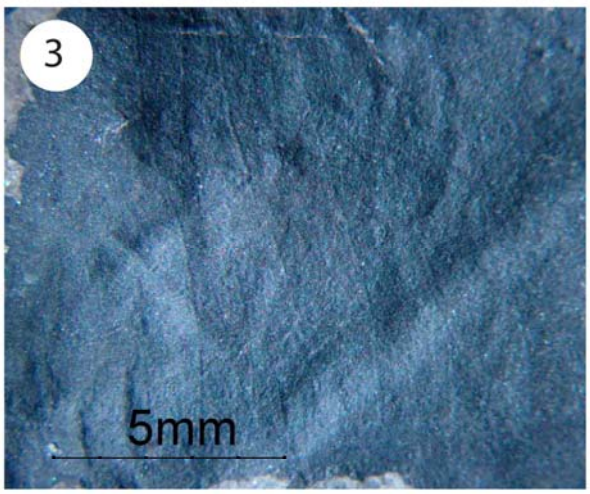
Laminar shape ovate. Base shape cordate. Pinnate. Secondaries eucamptodromous, 3 to 4 pairs crowded proximally. Secondary vein angle abruptly increasing proximally (from ~45° to ~110°). Tertiary veins opposite percurrent, at obtuse angles and very closely spaced (from 0.9 to 1.2).

## Description

Petiole long (> 4cm). Blade attachment marginal. Laminar size notophyll to mesophyll (the biggest specimen is ~15 cm long and ~8.5 cm wide). Laminar shape ovate. Leaves medially and basally symmetrical. Unlobed. Margin entire. Apex angle acute and shape straight. Base angle obtuse and shape cordate. Primary vein framework pinnate. Number of basal veins from 3 to 5. Major secondary vein framework eucamptodromous (10 to 13 pairs of veins). Fimbrial vein. Major secondary vein spacing decreasing proximally (from ~1.5 cm to 0.3 cm). Variation of secondary vein angle abruptly increasing proximally (from ~45° to ~110°). Major secondary vein attachment excurrent. Intercostal tertiary vein fabric opposite percurrent with sinuous to straight courses (closely spaced from 0.9 to 1.2 mm). Angle of percurrent tertiaries obtuse to perpendicular. Intercostal tertiary vein angle variability decreasing exmedially. Epimedial tertiary veins opposite percurrents. admedial course from obtuse to perpendicular to midvein; exmedial course parallel to intercostal tertiaries. Quaternary vein fabric reticulate.

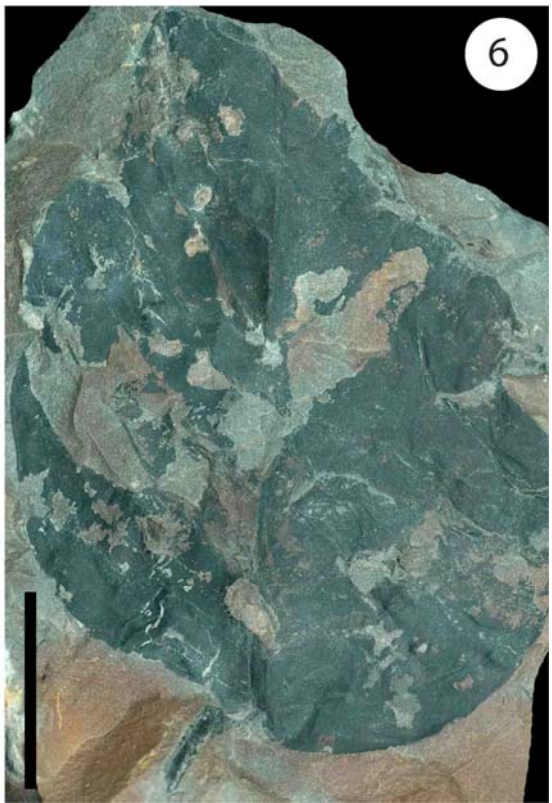

1


2


3
5mm


4


5


6

**CERREJON FLORA** | Morphotype Name: *incertae sedis* | Morphotype #: CJ17

Major Plant Group: DIC | Organ Type: Leaf | Morphotyper: | Type loc. #: | Type spec. #:

Plant Family/order: | Loca:

## Section I. Leaf Characters

Leaf Attachment:
Leaf Arrangement:
Leaf Organization:
Leaflet Organization:
Leaflet Attachment:
Petiole Features: long >2.5

### Features of the Blade

Position of Blade Attachment: marginal
Laminar Size (smallest): mesophyll
Laminar Size (largest):
Laminar L:W Ratio:
Laminar Shape: elliptic
Medial Symmetry: symmetrical
Base Symmetry: symmetrical
Lobation: unlobed
Margin Type: untoothed
Margin Features:
Apex Angle:
Apex Shape:
Base Angle: obtuse
Base Shape: cordate
Terminal Apex Features:
Surface Texture:
SurficialGlands:
Stomata:
Cuticle Features:

## Section III. Teeth

Tooth Spacing:
# of Orders:
Teeth/cm:
Sinus Shape:
Tooth Shape:
Tooth Shape:
Principal Vein:
Accesory Vein:
Principal Vein Termination:
Course of Accesory Vein:
Features of the Tooth Apex:

## Similar Morphotypes

CJ82

## Section II. Venation

1° Vein Framework: pinnate
Naked Basal Veins:
# of Basal Veins: 5
Agrophic Veins: compound

Major 2° Vein Framework (costal): simple brochidodromous # >6 pairs
Interior Secondaries:
Minor 2° Course: simple brochidodromous
Perimarginal Veins:
Major 2° Spacing (costal): decreasing proximally
Variation of 2° Vein Angle (costal): smoothly increasing proximally
Major 2° Vein Attachment (costal): excurrent

Inter-2° Vein Proximal Course:
Inter-2° Vein Lenght:
Inter-2° Vein Distal Course:
Inter-2° Vein Frequency:

Intercostal 3° Vein Fabric: percurrent
Course of Percurrent 3°: mixed opp/alt
Angle of Percurrent 3°: obtuse
Intercostal 3° Vein Angle Variability:
Epimedial 3°: mixed opp/alt
Admedial Course: perpendicular to midvein
Exmedial Course: parallel to intercostal 3°
Exterior 3° Course:

Quaternary Vein Fabric: alternate percurrent

Quinternary Vein Fabric: regular reticulate

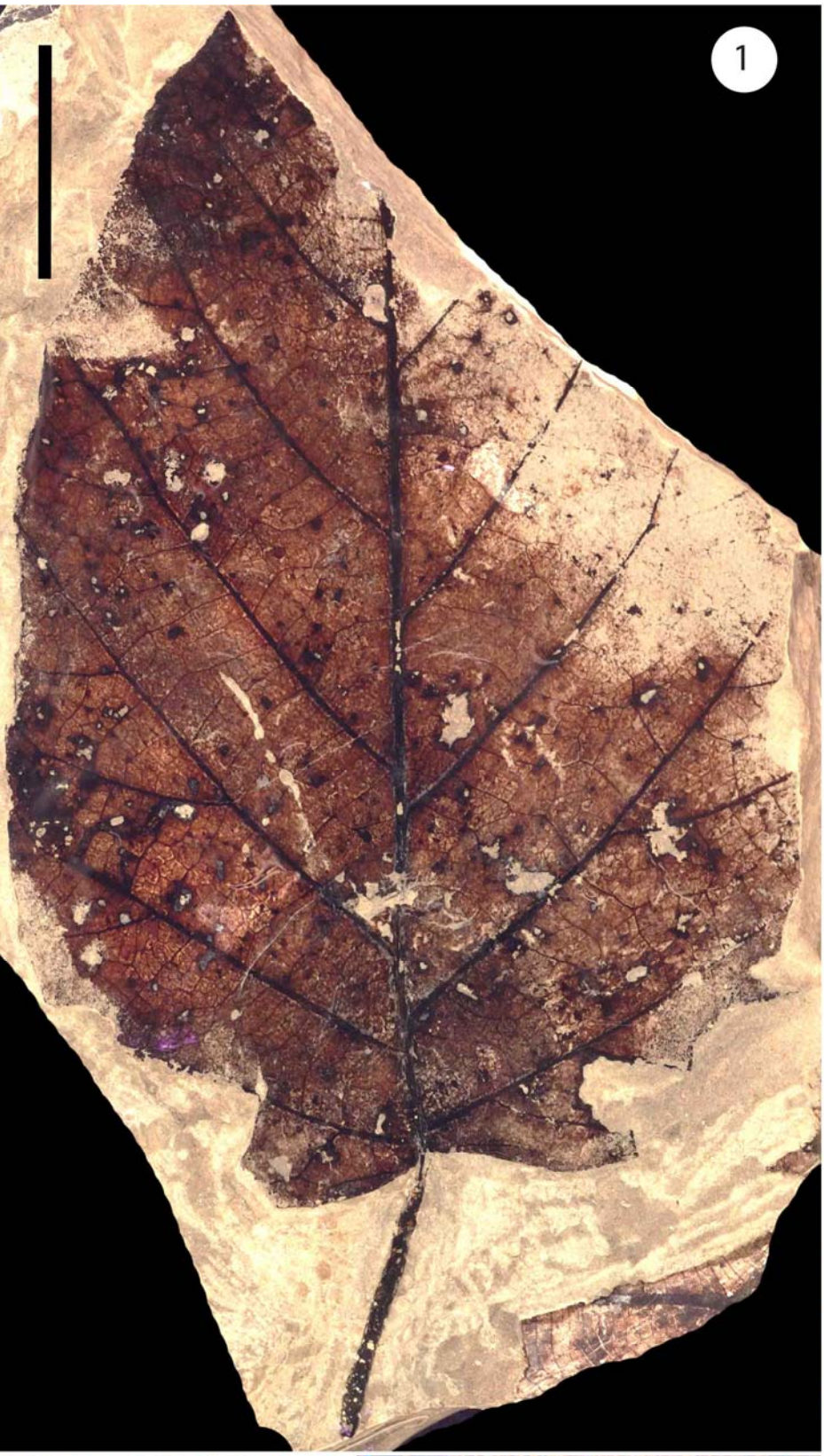
Areolation: good development
F.E.V.s Course:
F.E.V.s Terminae:
Marginal Ultimate Venation:

## Diagnostic Features

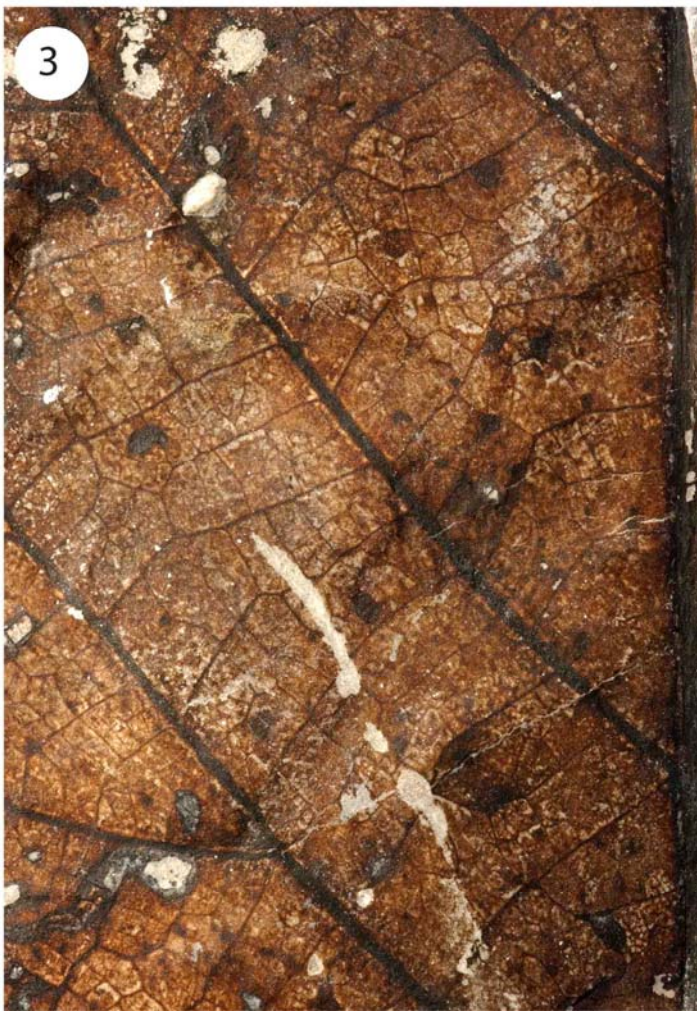
Pinnate. Base cordate. Secondary vein spacing decreasing proximally. Tertiary veins mixed opp/alt percurrent.

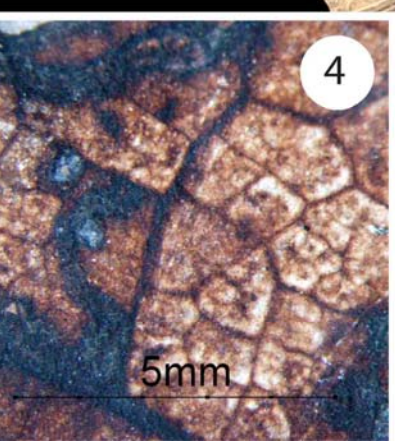
## Description

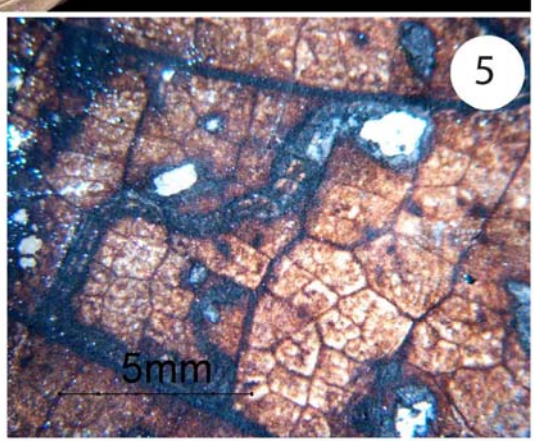
Petiole >2.5 cm. Blade attachment marginal. Laminar size mesophyll (the specimen is ~11 cm long and 7 cm wide). Laminar shape elliptic. Leaf medially and basally symmetrical. Unlobed. Margin entire. Base angle obtuse and shape cordate. Primary vein framework pinnate. Number of basal veins 5. Agrophic veins compound. Major secondary vein framework simple brochidodromous (>6 pairs of veins). Minor secondary vein course simple brochidodromous. Major secondary spacing decreasing proximally (from 2.0 cm to 0.7 cm). Variation of secondary vein angle smoothly increasing proximally (from ~38° to ~64°). Major secondary vein attachment excurrent. Intercostal tertiary vein fabric mixed opp/alt percurrent (spaced from 0.3 to 0.8 cm). Angle of percurrent tertiaries obtuse. Epimedial tertiary veins mixed oop/alt percurrent; admedial course perpendicular to midvein; exmedial course parallel to intercostal tertiaries. Quaternary vein fabric alternate percurrent. Quinternary vein fabric regular reticulate. Areolation development good.


1


2


3


4
5mm


5
5mm

**CERREJON FLORA** | Morphotype Name: *incertae sedis* | Morphotype #: CJ18

Major Plant Group: DIC | Organ Type: Leaf | Morphotyper: | Type loc. #: | Type spec. #:

Plant Family/order: | Loca:

## Section I. Leaf Characters

Leaf Attachment:
Leaf Arrangement:
Leaf Organization:
Leaflet Organization:
Leaflet Attachment:
Petiole Features: 2.7 cm long

### Features of the Blade

Position of Blade Attachment: marginal
Laminar Size (smallest): mesophyll
Laminar Size (largest):
Laminar L:W Ratio:
Laminar Shape: oblong
Medial Symmetry:
Base Symmetry:
Lobation: unlobed
Margin Type: untoothed
Margin Features:
Apex Angle:
Apex Shape:
Base Angle: obtuse
Base Shape: convex | decurrent
Terminal Apex Features:
Surface Texture:
SurficialGlands:
Stomata:
Cuticle Features:

## Section III. Teeth

Tooth Spacing:
# of Orders:
Teeth/cm:
Sinus Shape:
Tooth Shape:
Tooth Shape:
Principal Vein:
Accesory Vein:
Principal Vein Termination:
Course of Accesory Vein:
Features of the Tooth Apex:

## Similar Morphotypes

## Section II. Venation

1° Vein Framework: pinnate
Naked Basal Veins: absent
# of Basal Veins: 3
Agrophic Veins: absent

Major 2° Vein Framework (costal): eucamptodromous | # >10 pairs
Interior Secondaries:
Minor 2° Course:
Perimarginal Veins:
Major 2° Spacing (costal): gradually increasing proximally
Variation of 2° Vein Angle (costal): smoothly increasing proximally | one pair acute basal secondaries
Major 2° Vein Attachment (costal): excurrent

Inter-2° Vein Proximal Course:
Inter-2° Vein Lenght:
Inter-2° Vein Distal Course:
Inter-2° Vein Frequency:

Intercostal 3° Vein Fabric: percurrent
Course of Percurrent 3°: opposite sinuous
Angle of Percurrent 3°: obtuse | perpendicular
Intercostal 3° Vein Angle Variability:
Epimedial 3°: opposite percurrent
Admedial Course: perpendicular to midvein
Exmedial Course: parallel to intercostal 3°
Exterior 3° Course:

Quaternary Vein Fabric: reticulate

Quinternary Vein Fabric:

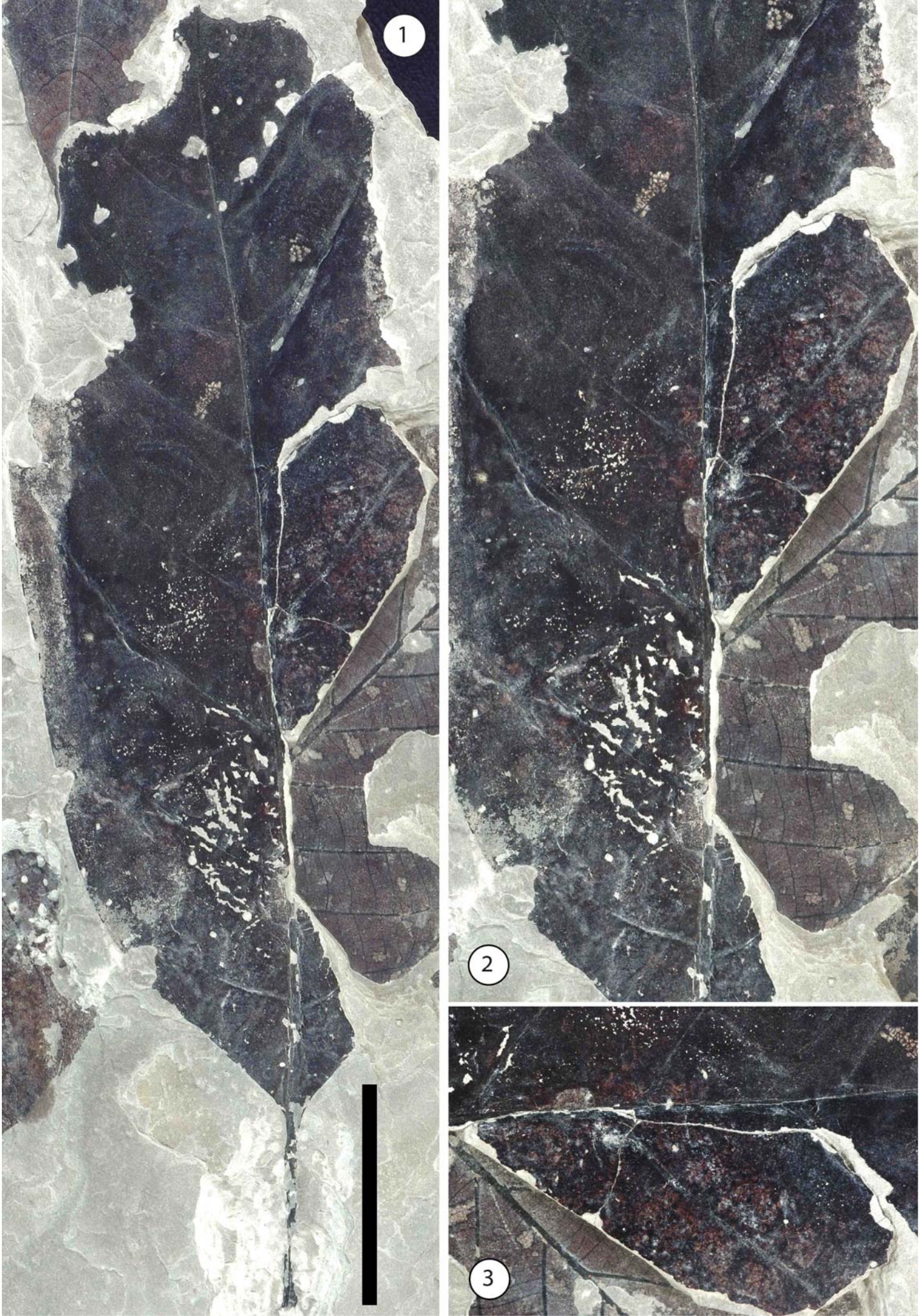
Areolation:
F.E.V.s Course:
F.E.V.s Terminae:
Marginal Ultimate Venation:

## Diagnostic Features

Laminar shape oblong. Base shape convex and decurrent. Secondary vein angle and spacing increasing proximally. One pair of acute basal secondaries. Tertiary veins opposite percurrent.

## Description

Petiole 2.7 cm long. Blade attachment marginal. Laminar size mesophyll (the specimen is ~16 cm long and ~6 cm wide). Laminar shape oblong. Unlobed. Margin entire. Base angle obtuse. Base shape convex and decurrent. Primary vein framework pinnate. Number of basal veins 3. Major secondary vein framework eucamptodromous (>10 pairs of veins). Major secondary vein spacing gradually increasing proximally (from ~1 cm to 2.0 cm). Variation of secondary vein angle smoothly increasing proximally (from ~42°to ~73°); one pair of acute basal secondaries. Major secondary vein attachment excurrent. Intercostal tertiary vein fabric opposite percurrent with courses sinuous. Angle of percurrent tertiaries obtuse to perpendicular. Epimedial tertiary veins opposite percurrent; admedial course perpendicular to midvein; exmedial course parallel to intercostal tertiaries. Quaternary vein fabric reticulate.


1
2
3

**CERREJON FLORA** | Morphotype Name: *incertae sedis* | Morphotype #: CJ19

Major Plant Group: DIC | Organ Type: Leaf | Morphotyper: | Type loc. #: | Type spec. #:

Plant Family/order: Fabaceae | Loca:

## Section I. Leaf Characters

Leaf Attachment:
Leaf Arrangement:
Leaf Organization:
Leaflet Organization:
Leaflet Attachment:
Petiole Features: petiole base pulvinulate

### Features of the Blade

Position of Blade Attachment: marginal
Laminar Size (smallest): microphyll
Laminar Size (largest): mesophyll
Laminar L:W Ratio:
Laminar Shape: elliptic | oblong
Medial Symmetry: symmetrical
Base Symmetry: symmetrical
Lobation: unlobed
Margin Type: untoothed
Margin Features:
Apex Angle: acute
Apex Shape: straight
Base Angle: acute to obtuse
Base Shape: rounded | convex
Terminal Apex Features:
Surface Texture:
SurficialGlands:
Stomata:
Cuticle Features:

## Section III. Teeth

Tooth Spacing:
# of Orders:
Teeth/cm:
Sinus Shape:
Tooth Shape:
Tooth Shape:
Principal Vein:
Accesory Vein:
Principal Vein Termination:
Course of Accesory Vein:
Features of the Tooth Apex:

## Similar Morphotypes

CJ55

## Section II. Venation

1° Vein Framework: pinnate
Naked Basal Veins: absent
# of Basal Veins:
Agrophic Veins: absent

Major 2° Vein Framework (costal): mixed brochidodromous-eucamptodromous | #: >13
Interior Secondaries:
Minor 2° Course:
Perimarginal Veins:
Major 2° Spacing (costal): regular - crowded
Variation of 2° Vein Angle (costal): smoothly increasing proximally
Major 2° Vein Attachment (costal): decurrent

Inter-2° Vein Proximal Course: parallel to major secondaries
Inter-2° Vein Lenght: >50% of subjacent secondary
Inter-2° Vein Distal Course: parallel to subjacent major secondary to basiflexed
Inter-2° Vein Frequency: >1 per intercostal area

Intercostal 3° Vein Fabric: reticulate irregular
Course of Percurrent 3°:
Angle of Percurrent 3°:
Intercostal 3° Vein Angle Variability:
Epimedial 3°: reticulate
Admedial Course:
Exmedial Course:
Exterior 3° Course: looped

Quaternary Vein Fabric: irregular reticulate

Quinternary Vein Fabric:

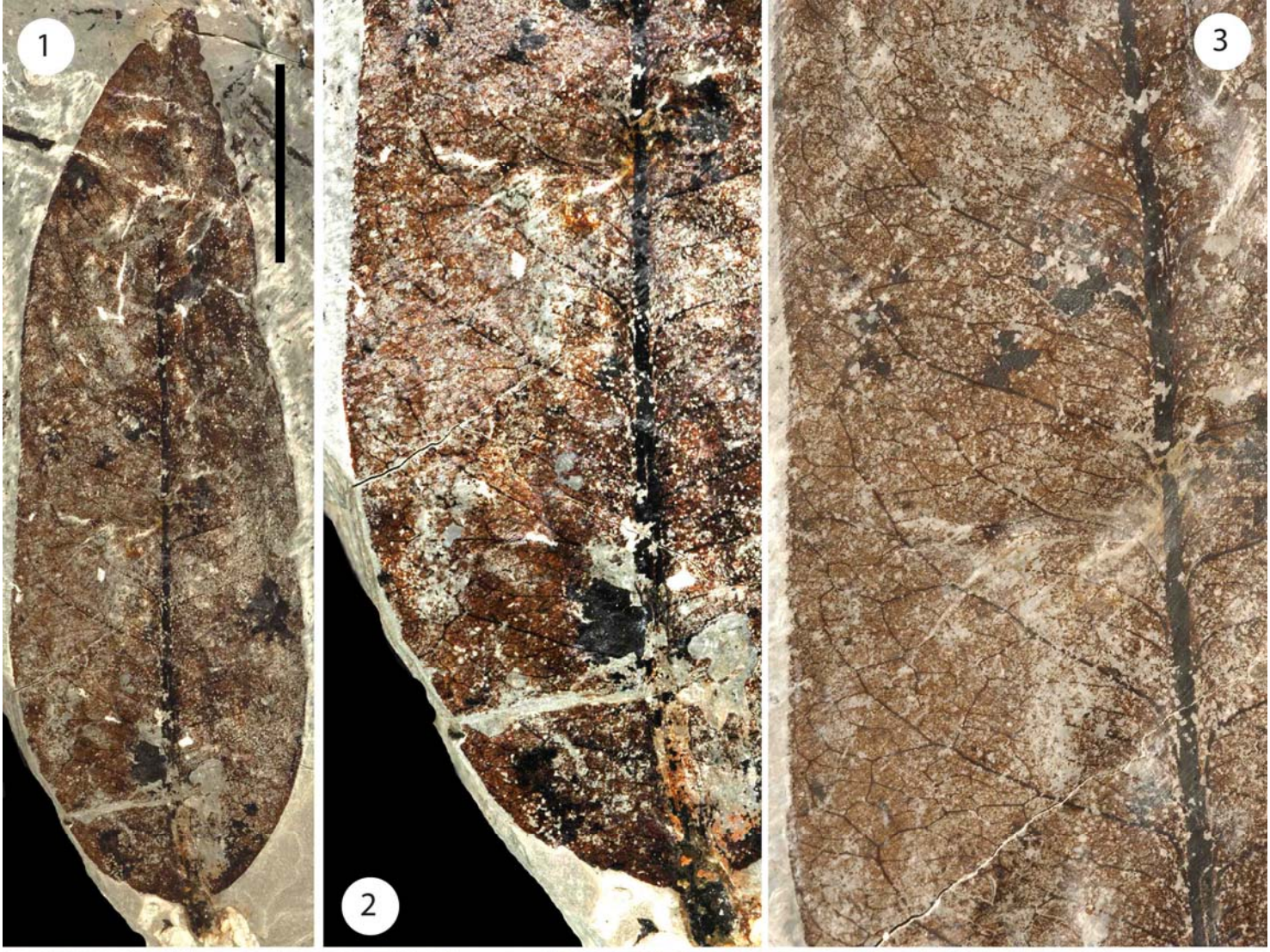
Areolation: present
F.E.V.s Course:
F.E.V.s Terminae:
Marginal Ultimate Venation:

## Diagnostic Features

Petiole base pulvinulate. Secondary veins mixed from brochidodromous to eucamptodromous. Intersecondary frequency >1 per intercostal area. Secondaries, intersecondaries and tertiaries strongly decurrent on primary. Tertiary veins are irregular reticulate.

## Description

Petiole base pulvinulate (0.4 to 0.6 cm long). Blade attachment marginal. Laminar size microphyll to mesophyll (the biggest specimen is 16.3 cm long and 4.4 cm wide). Laminar shape elliptic to oblong. Medially and basally symmetrical leaves. Margin entire. Apex angle acute and shape straight. Base angle acute to obtuse and shape convex to rounded. Primary vein framework pinnate. Major secondary vein framework mixed: brochidodromous to eucamptodromous (> 13 pairs of veins). Major secondary spacing regular and closely spaced (0.6 to 1.1 cm). Variation of secondary vein angle smoothly increasing proximally. Major secondary and tertiary veins attachment to midvein strongly decurrent. Intersecondary veins proximal course is parallel to major secondaries; length is >50% of the subjacent secondary; distal course parallel to subjacent major secondary to basiflexed; intersecondary vein frequency >1 per intercostal area. Intercostal and epimedial tertiary vein fabric irregular reticulate. Exterior tertiary vein course looped. Quaternary vein fabric irregular reticulate. Areolation present.


1
2
3


4
5
6
7

**CERREJON FLORA** | Morphotype Name: *incertae sedis* | Morphotype #: CJ20

Major Plant Group: DIC | Organ Type: Leaf | Morphotyper: | Type loc. #: | Type spec. #:

Plant Family/order: | Loca:

## Section I. Leaf Characters

Leaf Attachment:
Leaf Arrangement:
Leaf Organization:
Leaflet Organization:
Leaflet Attachment:
Petiole Features:

### Features of the Blade

Position of Blade Attachment:
Laminar Size (smallest): mesophyll
Laminar Size (largest):
Laminar L:W Ratio:
Laminar Shape: elliptic
Medial Symmetry: symmetrical
Base Symmetry: symmetrical
Lobation: unlobed
Margin Type: untoothed
Margin Features:
Apex Angle: acute
Apex Shape: acuminate | convex
Base Angle: acute
Base Shape: convex
Terminal Apex Features:
Surface Texture:
SurficialGlands:
Stomata:
Cuticle Features:

## Section III. Teeth

Tooth Spacing:
# of Orders:
Teeth/cm:
Sinus Shape:
Tooth Shape:
Tooth Shape:
Principal Vein:
Accesory Vein:
Principal Vein Termination:
Course of Accesory Vein:
Features of the Tooth Apex:

## Similar Morphotypes

CJ22

## Section II. Venation

1° Vein Framework: pinnate
Naked Basal Veins:
# of Basal Veins: 3
Agrophic Veins: absent

Major 2° Vein Framework (costal): eucamptodromous | # 10-12
Interior Secondaries:
Minor 2° Course: simple brochidodromous
Perimarginal Veins:
Major 2° Spacing (costal): irregular
Variation of 2° Vein Angle (costal): inconsistent
Major 2° Vein Attachment (costal): decurrent

Inter-2° Vein Proximal Course:
Inter-2° Vein Lenght:
Inter-2° Vein Distal Course:
Inter-2° Vein Frequency:

Intercostal 3° Vein Fabric: percurrent
Course of Percurrent 3°: mixed opp/alt (minutely irregular course)
Angle of Percurrent 3°: obtuse | perpendicular
Intercostal 3° Vein Angle Variability: decreasing exmedially
Epimedial 3°: mixed opp/alt
Admedial Course: parallel to subjacent secondary | perpendicular to midvein
Exmedial Course: basiflexed
Exterior 3° Course: looped

Quaternary Vein Fabric: irregular reticulate

Quinternary Vein Fabric: irregular reticulate

Areolation: poor development
F.E.V.s Course:
F.E.V.s Terminae:
Marginal Ultimate Venation:

## Diagnostic Features

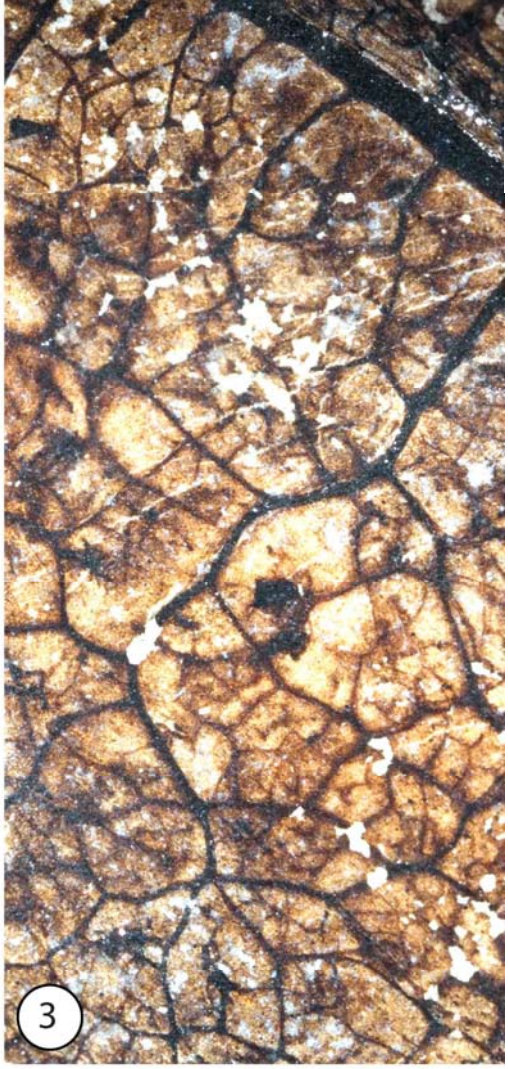
Pinnate. Secondary veins eucamptodromous. Secondary vein spacing irregular. Variation of secondary vein angle inconsistent. Tertiary veins mixed opp/alt percurrent. Quaternary and quinternary vein fabric irregular reticulate.

## Description

Laminar size mesophyll (the biggest specimen is ~15 cm long and ~6 cm wide). Laminar shape elliptic. Leaves medially and basally symmetrical. Unlobed. Margin entire. Apex angle acute. Apex shape acuminate to convex. Base angle acute and shape convex. Primary vein framework pinnate. Number of basal veins 3. Major secondary vein framework eucamptodromous (10-12 pairs of veins). Minor secondary vein courses simple brochidodromous. Major secondary vein spacing irregular. Variation of secondary vein angle inconsistent. Major secondary vein attachment decurrent. Intercostal tertiary vein fabric mixed opp/alt percurrent (spaced from 0.2 to 0.3). Angle of percurrent tertiaries obtuse to perpendicular. Intercostal tertiary vein angle variability decreasing exmedially. Epimedial tertiaries mixed opp/alt percurrent; admedial course parallel to subjacent secondary to perpendicular to midvein; exmedial course basiflexed. Exterior tertiary vein course looped. Quaternary and quinternary vein fabric irregular reticulate. Areolation development poor.


1


2


3


4


5

**CERREJON FLORA** | Morphotype Name: *incertae sedis* | Morphotype #: CJ21

Major Plant Group: DIC | Organ Type: Leaf | Morphotyper: | Type loc. #: | Type spec. #:

Plant Family/order: | Loca:

## Section I. Leaf Characters

Leaf Attachment:
Leaf Arrangement:
Leaf Organization:
Leaflet Organization:
Leaflet Attachment:
Petiole Features:

### Features of the Blade

Position of Blade Attachment: marginal
Laminar Size (smallest): mesophyll
Laminar Size (largest):
Laminar L:W Ratio:
Laminar Shape: elliptic
Medial Symmetry: symmetrical
Base Symmetry: symmetrical
Lobation: unlobed
Margin Type: untoothed
Margin Features:
Apex Angle: acute
Apex Shape: acuminate
Base Angle: obtuse
Base Shape: concavo-convex | decurrent
Terminal Apex Features:
Surface Texture:
SurficialGlands:
Stomata:
Cuticle Features:

## Section III. Teeth

Tooth Spacing:
# of Orders:
Teeth/cm:
Sinus Shape:
Tooth Shape:
Tooth Shape:
Principal Vein:
Accesory Vein:
Principal Vein Termination:
Course of Accesory Vein:
Features of the Tooth Apex:

## Similar Morphotypes

CJ16

## Section II. Venation

1° Vein Framework: pinnate
Naked Basal Veins: absent
# of Basal Veins:
Agrophic Veins: absent

Major 2° Vein Framework (costal): eucamptodromous | # 10-12 pairs
Interior Secondaries:
Minor 2° Course:
Perimarginal Veins: fimbrial vein
Major 2° Spacing (costal): slightly decreasing proximally
Variation of 2° Vein Angle (costal): uniform
Major 2° Vein Attachment (costal): excurrent

Inter-2° Vein Proximal Course:
Inter-2° Vein Lenght:
Inter-2° Vein Distal Course:
Inter-2° Vein Frequency:

Intercostal 3° Vein Fabric: exmedially ramified | admedially ramified
Course of Percurrent 3°:
Angle of Percurrent 3°:
Intercostal 3° Vein Angle Variability: decreasing exmedially
Epimedial 3°: ramified
Admedial Course: perpendicular to midvein
Exmedial Course: parallel to intercostal 3°
Exterior 3° Course: terminating at margin

Quaternary Vein Fabric: irregular reticulate | freely ramifying

Quinternary Vein Fabric:

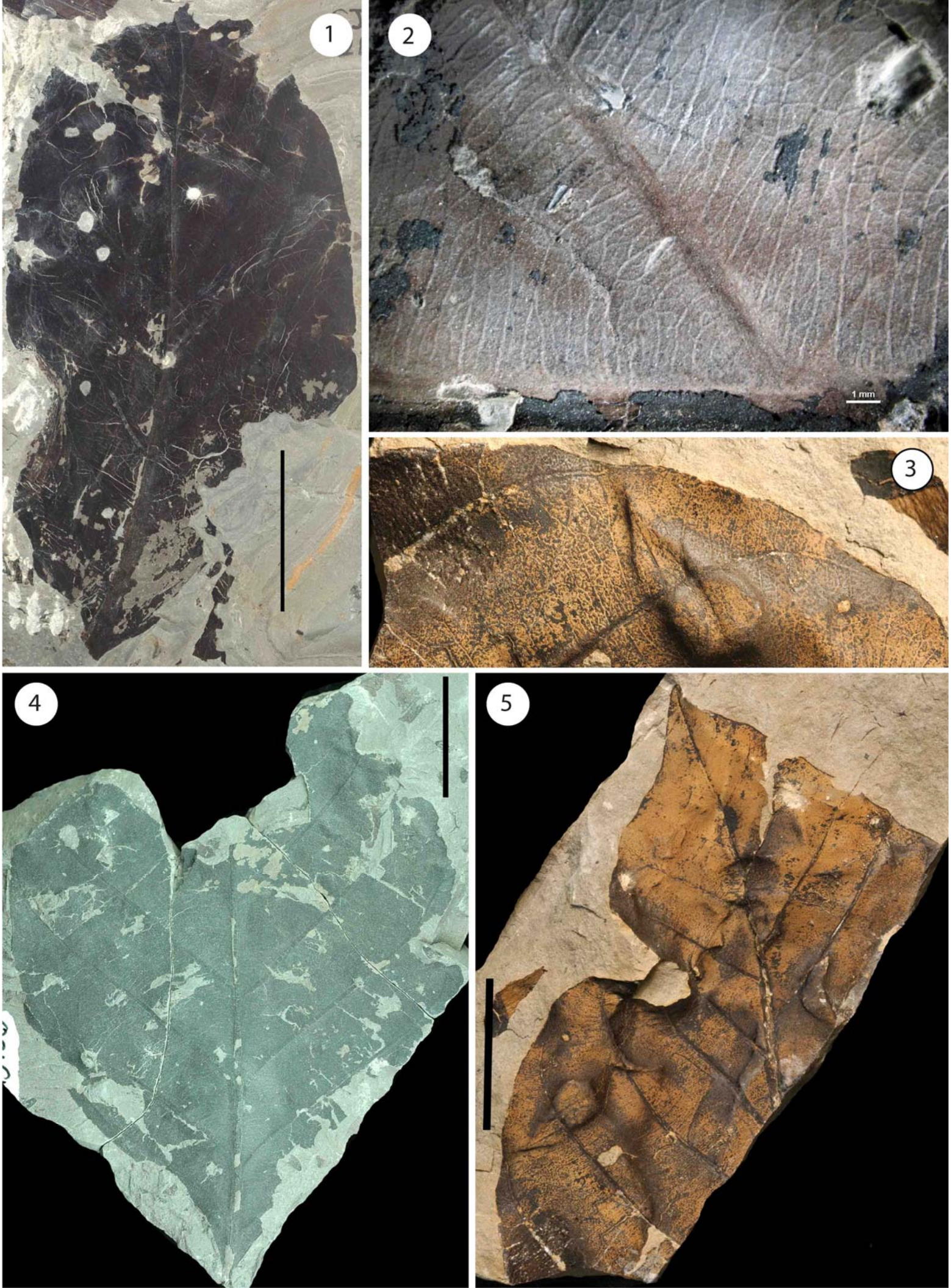
Areolation:
F.E.V.s Course:
F.E.V.s Terminae:
Marginal Ultimate Venation:

## Diagnostic Features

Base shape concavo-convex and decurrent. Tertiary veins exmedially and admedially ramified; very closely spaced (<1.2 mm). Epimedial tertiaries with admedial course perpendicular to midvein. Quaternary vein fabric irregular reticulate and freely ramifying.

## Description

Blade attachment marginal. Laminar size mesophyll (the biggest specimen is ~15 cm long and ~6 cm wide). Laminar shape elliptic. Leaves medially and basally symmetrical. Unlobed. Margin entire. Apex angle acute and shape acuminate. Base angle obtuse. Base shape concavo-convex and decurrent. Primary vein framework pinnate. Major secondary vein framework eucamptodromous (10-12 pairs of veins). Thick fimbrial vein. Major secondary vein spacing slightly decreasing proximally. Variation of secondary vein angle mostly uniform. Secondary vein attachment excurrent. Intercostal tertiary vein fabric exmedially and admedially ramified (tertiary branching is oriented toward the leaf margin, toward midvein and in between intercostals; veins closely spaced at <1.2 mm). Intercostal tertiary vein angle variability decreasing exmedially. Epimedial tertiaries ramified; admedial course perpendicular to midvein; exmedial course parallel to intercostal tertiaries. Exterior tertiary vein course terminating at margin. Quaternary vein fabric irregular reticulate and freely ramifying.


1
2
1 mm
3
4
5

**CERREJON FLORA** | Morphotype Name: *incertae sedis* | Morphotype #: CJ22

Major Plant Group: DIC | Organ Type: Leaf | Morphotyper: | Type loc. #: | Type spec. #:

Plant Family/order: Lauraceae | Loca:

## Section I. Leaf Characters

Leaf Attachment: petiolate
Leaf Arrangement:
Leaf Organization: simple
Leaflet Organization:
Leaflet Attachment:
Petiole Features: short

### Features of the Blade

Position of Blade Attachment: marginal
Laminar Size (smallest): notophyll
Laminar Size (largest): macrophyll
Laminar L:W Ratio:
Laminar Shape: elliptic
Medial Symmetry: symmetrical
Base Symmetry: symmetrical
Lobation: unlobed
Margin Type: untoothed
Margin Features:
Apex Angle: obtuse and acute
Apex Shape: rounded | acuminate
Base Angle: acute to obtuse
Base Shape: convex | decurrent
Terminal Apex Features:
Surface Texture:
SurficialGlands: laminar
Stomata:
Cuticle Features:

## Section III. Teeth

Tooth Spacing:
# of Orders:
Teeth/cm:
Sinus Shape:
Tooth Shape:
Tooth Shape:
Principal Vein:
Accesory Vein:
Principal Vein Termination:
Course of Accesory Vein:
Features of the Tooth Apex:

## Similar Morphotypes

CJ20

## Section II. Venation

1° Vein Framework: pinnate
Naked Basal Veins: absent
# of Basal Veins: 1 to 3
Agrophic Veins: absent

Major 2° Vein Framework (costal): eucamptodromous | # 7-14 pairs
Interior Secondaries: absent
Minor 2° Course:
Perimarginal Veins:
Major 2° Spacing (costal): decreasing proximally
Variation of 2° Vein Angle (costal): smoothly decreasing proximally | one pair acute basal secondaries
Major 2° Vein Attachment (costal): basally decurrent

Inter-2° Vein Proximal Course: parallel to major secondaries
Inter-2° Vein Lenght: <50% of subjacent secondary
Inter-2° Vein Distal Course: perpendicular to subjacent major secondary to basiflexed
Inter-2° Vein Frequency: <1 per intercostal area

Intercostal 3° Vein Fabric: percurrent
Course of Percurrent 3°: mixed opp/alt
Angle of Percurrent 3°: obtuse | perpendicular
Intercostal 3° Vein Angle Variability: decreasing exmedially
Epimedial 3°: mostly opposite percurrent
Admedial Course: perpendicular to midvein | acute to midvein
Exmedial Course: parallel to intercostal 3° | basiflexed
Exterior 3° Course: looped

Quaternary Vein Fabric: alternate percurrent

Quinternary Vein Fabric: irregular reticulate

Areolation: moderate development
F.E.V.s Course: mostly 2 or more branched
F.E.V.s Terminae: simple
Marginal Ultimate Venation: looped

## Diagnostic Features

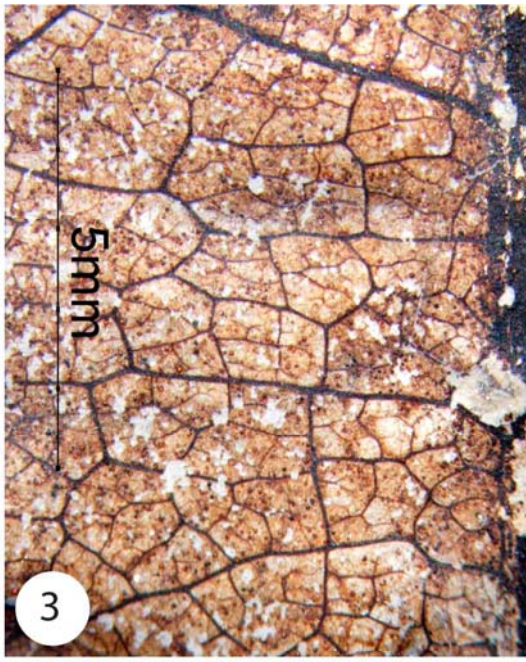
Pinnate. Eucamptodromous, mostly having one pair acute basal secondaries. Major secondary vein attachment basally decurrent. Intersecondary frequency <1 per intercostal area. Quaternary vein fabric alternate percurrent. Laminar resin glands.

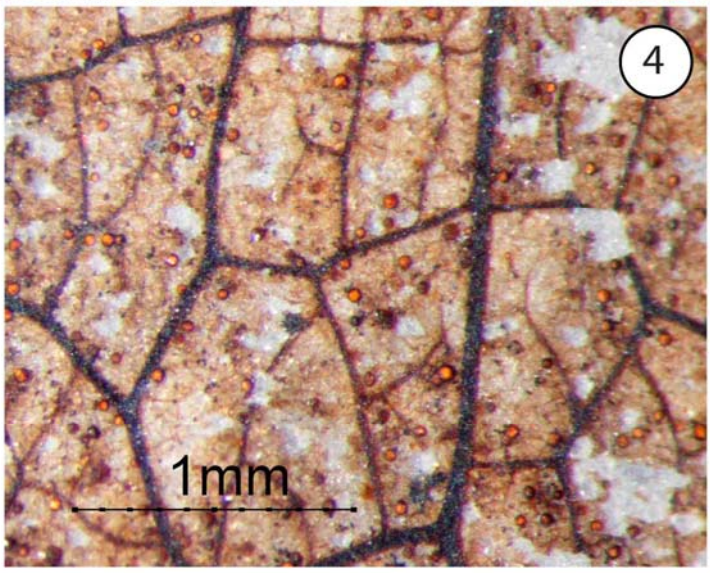
## Description

Leaf attachment petiolate. Leaf organization simple. Petiole short. Blade attachment marginal. Laminar size notophyll to macrophyll (the biggest specimen is >18 cm long and ~12 cm wide). Laminar shape elliptic. Leaf medially and basally symmetrical. Unlobed. Margin untoothed. Apex angle obtuse to acute. Apex shape rounded to acuminate. Base angle acute to obtuse. Base shape convex, concave to decurrent. Laminar resin glands (sizes from 0.02 to 0.06 mm). Primary vein framework pinnate. Number of basal veins 1 to 3. Major secondary vein framework eucamptodromous (7 to 14 pairs of veins, spaced from 0.8 cm to 1.2 cm). Major secondary spacing decreasing proximally. Variation of major secondary angle to midvein smoothly decreasing proximally (from ~29° to ~54°) to having one pair acute basal secondaries. Major secondary vein attachment basally decurrent. Intersecondary proximal veins with course parallel to major secondaries; length <50% of subjacent secondary; distal course perpendicular to subjacent major secondary to basiflexed; frequency <1 per intercostal area. Intercostal tertiary vein fabric mixed opp/alt percurrent (spaced from 0.2 cm to 0.3 cm). Angle of opposite percurrents obtuse to perpendicular. Intercostal tertiary vein angle variability decreasing exmedially. Epimedial tertiaries mostly opposite percurrent; admedial course perpendicular to acute to midvein; exmedial course parallel to intercostal tertiaries to basiflexed. Exterior tertiary course looped. Quaternary vein fabric alternate percurrent. Quinternary vein fabric irregular reticulate. Areolation development moderate. F.E.V.s course mostly 2 or more branched, terminae simple. Marginal ultimate venation looped.


1


2


5mm
3


4
1mm


5


6


7

**CERREJON FLORA** | Morphotype Name: *Petrocardium wayuuorum* | Morphotype #: CJ23

Major Plant Group: MON | Organ Type: Leaf | Morphotyper: | Type loc. #: | Type spec. #:

Plant Family/order: Araceae | Loca:

## Section I. Leaf Characters

Leaf Attachment:
Leaf Arrangement:
Leaf Organization:
Leaflet Organization:
Leaflet Attachment:
Petiole Features:

### Features of the Blade

Position of Blade Attachment:
Laminar Size (smallest): notophyll
Laminar Size (largest):
Laminar L:W Ratio:
Laminar Shape: oblong
Medial Symmetry: symmetrical
Base Symmetry: symmetrical
Lobation: unlobed
Margin Type: untoothed
Margin Features:
Apex Angle:
Apex Shape:
Base Angle: reflex
Base Shape: cordate? | sagittate?
Terminal Apex Features:
Surface Texture:
SurficialGlands:
Stomata:
Cuticle Features:

## Section III. Teeth

Tooth Spacing:
# of Orders:
Teeth/cm:
Sinus Shape:
Tooth Shape:
Tooth Shape:
Principal Vein:
Accesory Vein:
Principal Vein Termination:
Course of Accesory Vein:
Features of the Tooth Apex:

## Similar Morphotypes

CJ108

## Section II. Venation

1° Vein Framework: pinnate
Naked Basal Veins: present
# of Basal Veins: probably 5
Agrophic Veins: absent

Major 2° Vein Framework (costal): eucamptodromous | #:
Interior Secondaries:
Minor 2° Course:
Perimarginal Veins: intramarginal secondary
Major 2° Spacing (costal): decreasing proximally
Variation of 2° Vein Angle (costal): abruptly increasing proximally
Major 2° Vein Attachment (costal): decurrent

Inter-2° Vein Proximal Course: parallel to major secondaries
Inter-2° Vein Lenght: >50% of subjacent secondary
Inter-2° Vein Distal Course: perpendicular to subjacent major secondary to basiflexed
Inter-2° Vein Frequency: >1 per intercostal area

Intercostal 3° Vein Fabric: percurrent
Course of Percurrent 3°: mixed opp/alt
Angle of Percurrent 3°: obtuse | perpendicular
Intercostal 3° Vein Angle Variability: decreasing exmedially
Epimedial 3°: mixed opp/alt
Admedial Course: perpendicular to midvein | obtuse to midvein
Exmedial Course: basiflexed | acroflexed
Exterior 3° Course: looped

Quaternary Vein Fabric: irregular reticulate | regular reticulate
Quinternary Vein Fabric:

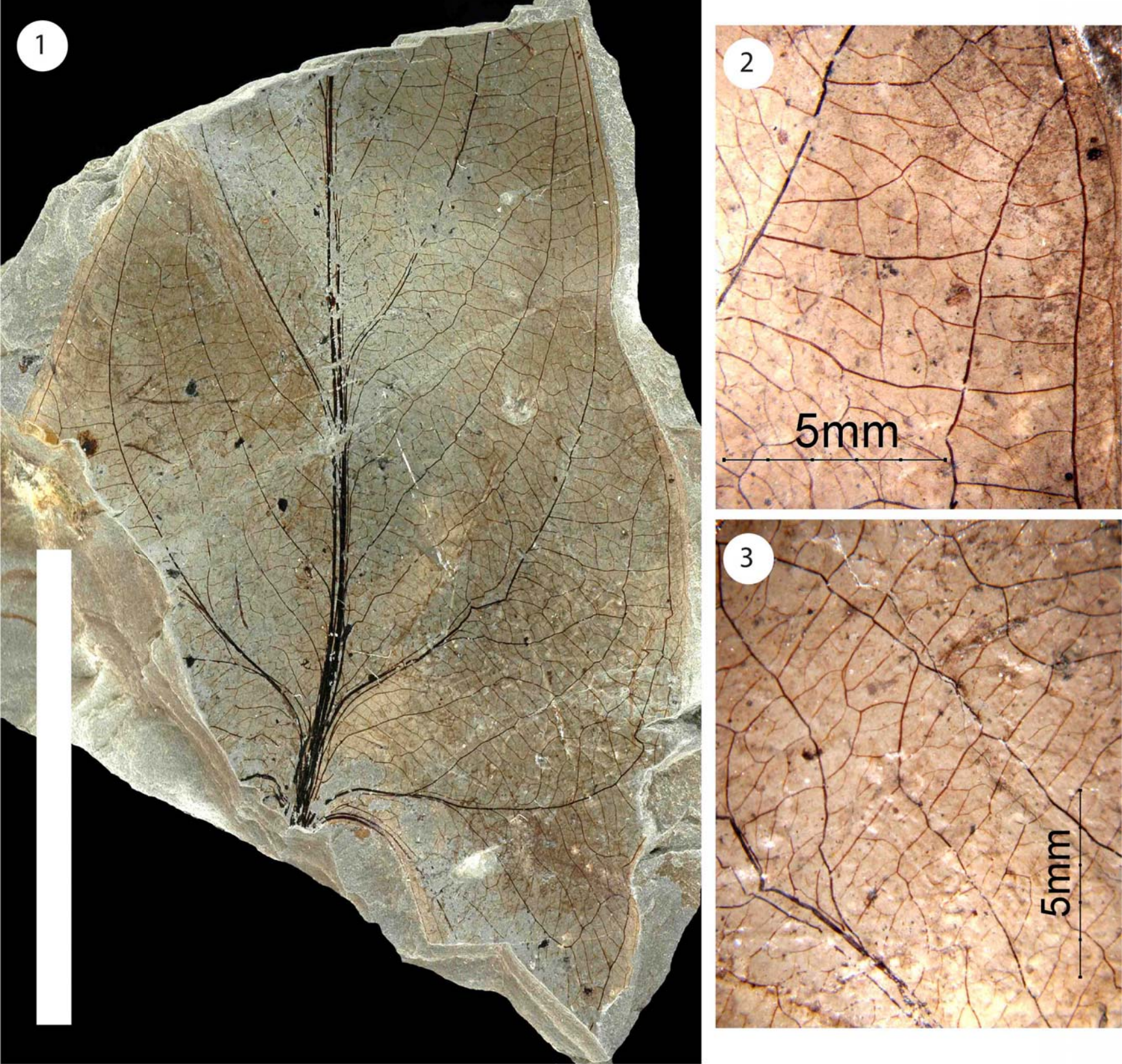
Areolation:
F.E.V.s Course:
F.E.V.s Terminae:
Marginal Ultimate Venation:

## Diagnostic Features

Laminar shape ovate. Margin entire. Base incompletely preserved, but either cordate or sagittate. Naked basal veins. Midrib multistranded. Two collective veins running near the margin. Secondary veins eucamptodromous. Intersecondary veins present and parallel to secondaries. Tertiary veins mixed opposite/alternate percurrent, but exmedially they merge perpendicularly with the innermost collective vein. Higher order veins irregular polygonal to orthogonal reticulate.

## Description

Laminar shape ovate. Laminar size notophyll (the specimen is >6.2 cm long and ~3.8 cm wide). Margin entire. Posterior division of the blade not completely preserved but the presence of laminar tissue proximal to the petiole attachment shows the base is cordate or sagittate. Naked basal veins form part of the margin near the petiole. Anterior division of the blade longer than posterior division. Midrib multistranded; the specimen preserves 6 pairs of secondary veins on the right side of the blade. The most basal secondary vein curves in a proximal direction and feeds the basal lobe. The next most basal secondary is oriented almost perpendicular to the midrib for much of its course, and forms the middle collective vein, and displaces toward the margin a minor and outer collective vein that arises from the posterior division of the blade. The third secondary vein curves distally to parallel the margin, forming the inner collective vein. The rest of the secondary veins are strongly eucamptodromous and ascend from the midrib at angles between 29° to 35°. One or two intersecondary veins are present between each pair of secondaries and have courses almost parallel to the secondaries. Both secondary and intersecondary veins are strongly decurrent on the midrib and follow a course that curves toward the margin distally. The tertiary veins are mixed opposite/alternate percurrent, but exmedially most tertiaries are opposite percurrent and are oriented perpendicular to the midrib, except for those developed in the basal lobe which tend to be parallel to the midrib. Higher order veins are irregular polygonal to orthogonal reticulate.


1
2
5mm
3
5mm

**CERREJON FLORA** | Morphotype Name: *incertae sedis* | Morphotype #: CJ24

Major Plant Group: DIC | Organ Type: Leaf | Morphotyper: | Type loc. #: | Type spec. #:

Plant Family/order: Euphorbiaceae | Loca:

## Section I. Leaf Characters

Leaf Attachment:
Leaf Arrangement:
Leaf Organization:
Leaflet Organization:
Leaflet Attachment:
Petiole Features: long

### Features of the Blade

Position of Blade Attachment: marginal
Laminar Size (smallest): notophyll
Laminar Size (largest): macrophyll
Laminar L:W Ratio:
Laminar Shape: elliptic | ovate
Medial Symmetry: symmetrical
Base Symmetry: symmetrical
Lobation: unlobed
Margin Type: crenate
Margin Features:
Apex Angle: acute
Apex Shape: straight
Base Angle: obtuse
Base Shape: cordate | truncate
Terminal Apex Features:
Surface Texture:
SurficialGlands:
Stomata:
Cuticle Features:

## Section III. Teeth

Tooth Spacing: irregular
# of Orders: two
Teeth/cm: 0-3
Sinus Shape: rounded
Tooth Shape: cv/cv | cc/cc
Tooth Shape:
Principal Vein: present
Accesory Vein: present
Principal Vein Termination: at apex of tooth
Course of Accesory Vein: convex
Features of the Tooth Apex: non-specific

## Similar Morphotypes

## Section II. Venation

1° Vein Framework: actinodromous basal (three veins)
Naked Basal Veins: absent
# of Basal Veins: 3
Agrophic Veins: compound

Major 2° Vein Framework (costal): mixed: semicraspedodromous to brochidodro. | # 10-14 pairs
Interior Secondaries:
Minor 2° Course: semicraspedodromous
Perimarginal Veins: fimbrial vein
Major 2° Spacing (costal): gradually increasing proximally and irregular
Variation of 2° Vein Angle (costal): uniform
Major 2° Vein Attachment (costal): decurrent

Inter-2° Vein Proximal Course: parallel to major secondaries
Inter-2° Vein Lenght: <50% of subjacent secondary
Inter-2° Vein Distal Course: perpendicular to subjacent major secondary
Inter-2° Vein Frequency: <1 per intercostal area

Intercostal 3° Vein Fabric: percurrent
Course of Percurrent 3°: opposite straight | opposite sinuous
Angle of Percurrent 3°: obtuse
Intercostal 3° Vein Angle Variability: basally concentric | consistent
Epimedial 3°: mixed opp/alt
Admedial Course: perpendicular to midvein
Exmedial Course: parallel to intercostal 3°
Exterior 3° Course: terminating at margin

Quaternary Vein Fabric: alternate percurrent

Quinternary Vein Fabric:

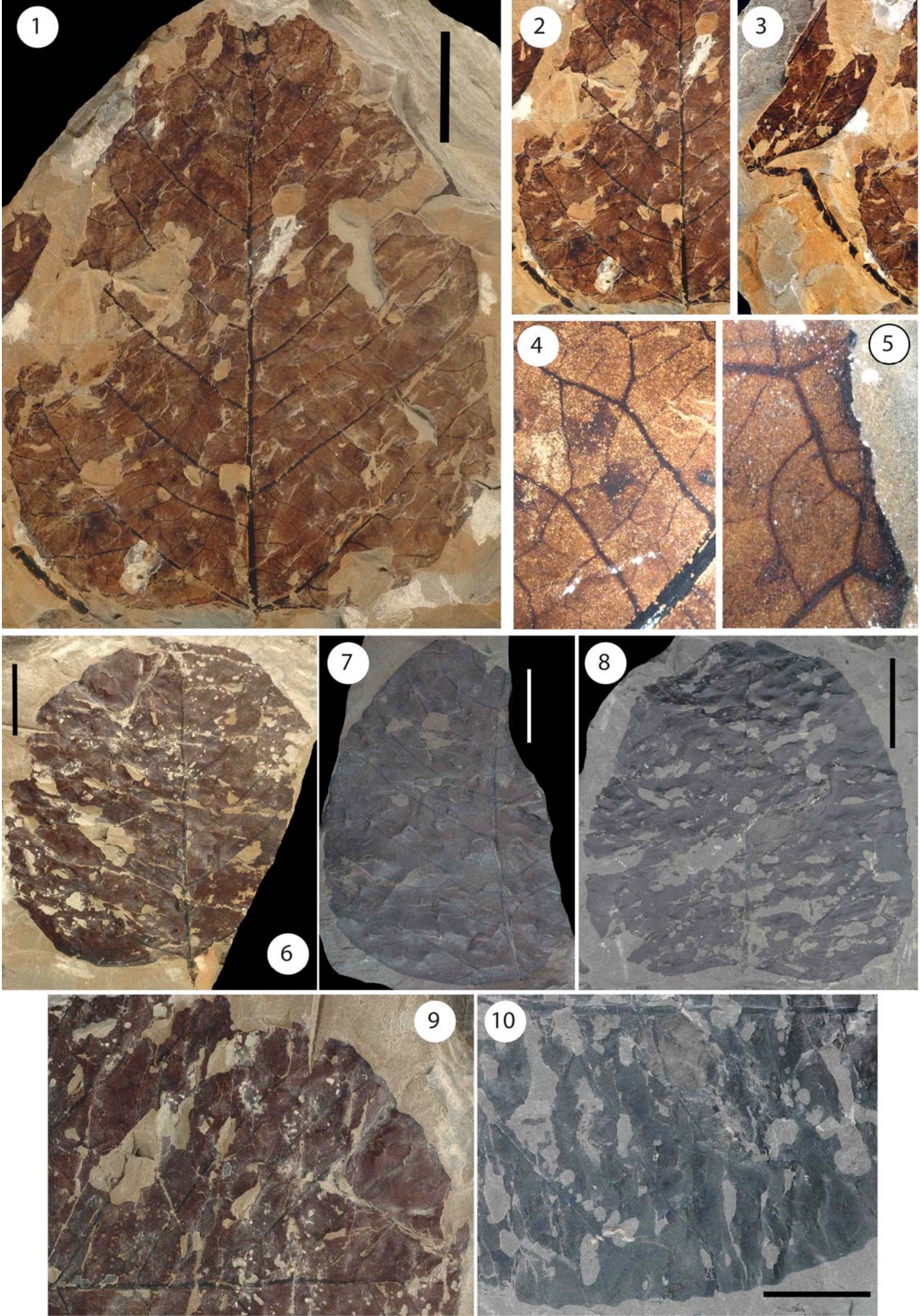
Areolation:
F.E.V.s Course:
F.E.V.s Terminae:
Marginal Ultimate Venation:

## Diagnostic Features

Petiole long. Base shape from truncate to cordate. Primary veins basal actinodromous (three veins). Secondary veins mixed: semicraspedodromous (predominantly) and brochidodromous. Major secondary vein spacing with a tendency to increase proximally but also irregular. Margin crenate, teeth mostly fed by agrophic veins.

## Description

Leaf attachment petiolate. Petiole very long (>10 cm). Blade attachment marginal. Laminar size notophyll to macrophyll (the biggest specimen is 18 cm long and 15 wide). Laminar shape elliptic to ovate. Leaf medially and basally symmetrical. Unlobed. Apex angle acute and shape straight. Base angle obtuse. Base shape cordate to truncate. Primary vein framework basal actinodromous (three veins). Number of basal veins three. Agrophic veins compound. Major secondary vein framework mixed: semicraspedodromous (predominantly) and brochidodromous (10 to14 pairs of veins). Minor secondary vein course semicraspedodromous. Fimbrial vein. Major secondary vein spacing with a tendency to increase proximally but also irregular (spaced from 0.5 to 2 cm). Variation of secondary vein angle uniform. Major secondary vein attachment excurrent. Intersecondary veins rare; proximal course parallel to major secondaries; distal course perpendicular to subjacent secondaries; length <50% and intersecondary frequency <1 per intercostal area. Intercostal tertiary vein fabric opposite percurrent with courses straight to sinuous (spaced from 0.1 to 0.4 cm). Angle of percurrent tertiaries obtuse. Intercostal tertiary vein angle variability consistent to basally concentric. Epimedial tertiary veins mostly mixed opposite/alternate percurrent; admedial course perpendicular to midvein; exmedial course parallel to intercostal tertiaries. Exterior tertiary vein course terminating at margin. Quaternary vein fabric mostly alternate percurrent. Margin crenate; tooth spacing irregular; order of teeth two (the bigger ones fed by agrophic veins); teeth/cm 0-3/cm; sinus shaped; tooth shape cv/cv and cc/cc; principal vein present; accessory veins present; principal vein termination at the apex of the tooth; course of accessory vein convex.


1
2
3
4
5
6
7
8
9
10

**CERREJON FLORA** | Morphotype Name: *incertae sedis* | Morphotype #: CJ25

Major Plant Group: DIC | Organ Type: Leaf | Morphotyper: | Type loc. #: | Type spec. #:

Plant Family/order: Malvaceae | Loca:

## Section I. Leaf Characters

Leaf Attachment: petiolate
Leaf Arrangement:
Leaf Organization:
Leaflet Organization:
Leaflet Attachment:
Petiole Features: petiole base pulvinate

### Features of the Blade

Position of Blade Attachment: marginal
Laminar Size (smallest): microphyll
Laminar Size (largest): macrophyll
Laminar L:W Ratio:
Laminar Shape: ovate | elliptic
Medial Symmetry: symmetrical
Base Symmetry: symmetrical
Lobation: unlobed | pseudo-lobed
Margin Type: serrate
Margin Features:
Apex Angle: acute
Apex Shape: straight
Base Angle: reflex, obtuse to acute
Base Shape: cordate-truncate | concavo-convex
Terminal Apex Features: mucronate
Surface Texture:
SurficialGlands: laminar black dots
Stomata:
Cuticle Features:

## Section III. Teeth

Tooth Spacing: regular
# of Orders: one or two
Teeth/cm: 1-2
Sinus Shape: rounded
Tooth Shape: cc/cc | st/st
Tooth Shape:
Principal Vein: present
Accesory Vein: present to absent
Principal Vein Termination: at apex of tooth
Course of Accesory Vein: straight or concave
Features of the Tooth Apex: mucronate

## Similar Morphotypes

CJ36

## Section II. Venation

1° Vein Framework: actinodromous basal
Naked Basal Veins: absent
# of Basal Veins: 5-9
Agrophic Veins: simple to compound

Major 2° Vein Framework (costal): mixed: craspedodromous to semicraspedodromous | #: 6-8
Interior Secondaries:
Minor 2° Course: craspedodromous to semicraspedodromous
Perimarginal Veins:
Major 2° Spacing (costal): increasing proximally
Variation of 2° Vein Angle (costal): uniform
Major 2° Vein Attachment (costal): excurrent

Inter-2° Vein Proximal Course:
Inter-2° Vein Lenght:
Inter-2° Vein Distal Course:
Inter-2° Vein Frequency:

Intercostal 3° Vein Fabric: percurrent
Course of Percurrent 3°: opposite | opposite sinuous
Angle of Percurrent 3°: obtuse | perpendicular
Intercostal 3° Vein Angle Variability: consistent | decreasing exmedially
Epimedial 3°: opposite percurrent
Admedial Course: perpendicular to midvein
Exmedial Course: parallel to intercostal 3°
Exterior 3° Course: absent | terminating at margin

Quaternary Vein Fabric: alternate percurrent | irregular reticulate

Quinternary Vein Fabric: irregular reticulate

Areolation:
F.E.V.s Course:
F.E.V.s Terminae:
Marginal Ultimate Venation:

## Diagnostic Features

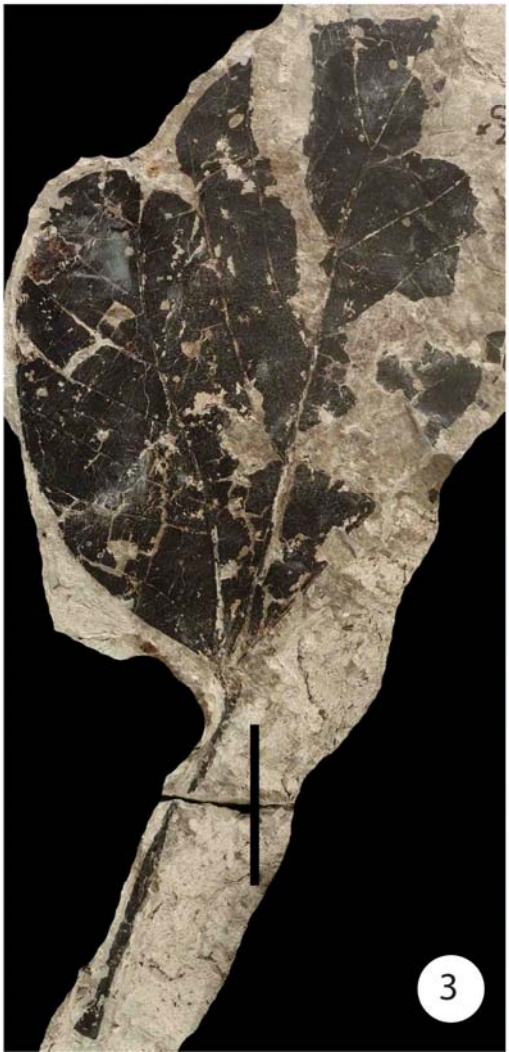
Primary veins basal actinodromous (5-9 veins). Base shape highly variable from concavo-convex, cordate, and truncate. Major secondary and agrophic veins craspedodromous to semicraspedodromous (straightened course). Tertiary veins opposite percurrent. Margin serrate with the apex of the tooth mucronate.

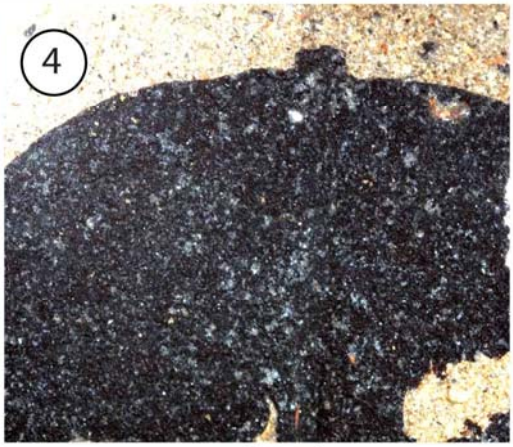
## Description

Leaf attachment petiolate. Petiole long (>8 cm) with pulvinate base. Blade attachment marginal. Laminar size microphyll to macrophyll (the biggest specimen is ~19 cm long and 9.4 wide). Laminar shape elliptic to stronglyovate. Leaves medially and basally symmetrical. Unlobed (sometimes having pseudo-lobes). Apex angle acute. Apex shape straight, rounded, to acuminate. Base angle reflex, obtuse to acute. Base shape concavo-convex, cordate, to truncate. Terminal apex features sometimes mucronate. Surficial black dots. Primary vein framework basal actinodromous. Number of basal veins 5 (common for concavo-convex bases) to 9 (common for cordate-truncate bases). Agrophic veins simple to compound. Major secondary vein framework craspedodromous to mixed: craspedodromous and semicraspedodromous (from 6 to 8 costal veins with a straightened course). Minor secondary course craspedodromous to semicraspedodromous. Major secondary spacing gradually increasing proximally (from 0.7 to 1.5 cm) and leaving a gap with the basal primaries. Variation of secondary vein angle uniform and acute. Major secondary vein attachment excurrent. Intercostal tertiary vein fabric percurrent with courses straight to sinuous (spaced from 0.3 to 0.8 cm). Angle of percurrent tertiaries obtuse to perpendicular. Intercostal tertiary vein angle variability consistent to decreasing exmedially. Epimedial tertiaries opposite percurrent; admedial course perpendicular to midvein; exmedial course parallel to intercostal tertiaries. Exterior tertiary course absent to terminating at margin; Quaternary vein fabric alternate percurrent to irregular reticulate. Quinternary vein fabric irregular reticulate. Margin serrate; tooth spacing regular; one to two orders of teeth (when having two orders the first one corresponds to a tooth formed by a primary vein, like a pseudo lobe); teeth/cm 1-2/cm; sinus shape rounded; tooth shape cc/cc to st/st; principal vein present; accessory veins absent to present; principal vein termination at apex of tooth; course of accessory vein straight to concave; tooth apex mucronate.


1


2


3


4


5


6

**CERREJON FLORA** | Morphotype Name: *incertae sedis* | Morphotype #: CJ26

Major Plant Group: DIC | Organ Type: Leaf | Morphotyper: | Type loc. #: | Type spec. #:

Plant Family/order: Malvaceae | Loca:

## Section I. Leaf Characters

Leaf Attachment: petiolate
Leaf Arrangement:
Leaf Organization:
Leaflet Organization:
Leaflet Attachment:
Petiole Features: petiole base pulvinate

### Features of the Blade

Position of Blade Attachment: marginal
Laminar Size (smallest): notophyll
Laminar Size (largest): macrophyll
Laminar L:W Ratio:
Laminar Shape: ovate
Medial Symmetry: symmetrical
Base Symmetry: symmetrical
Lobation: unlobed | pseudo-lobe
Margin Type: dentate | crenate
Margin Features:
Apex Angle: acute
Apex Shape: straight
Base Angle: reflex
Base Shape: cordate
Terminal Apex Features:
Surface Texture:
SurficialGlands:
Stomata:
Cuticle Features:

## Section III. Teeth

Tooth Spacing: regular
# of Orders: two to three
Teeth/cm: 6-7
Sinus Shape: rounded
Tooth Shape: cv/cv
Tooth Shape:
Principal Vein: present
Accesory Vein: present
Principal Vein Termination: at apex of tooth
Course of Accesory Vein: variable
Features of the Tooth Apex: variable

## Similar Morphotypes

## Section II. Venation

1° Vein Framework: actinodromous basal
Naked Basal Veins: absent
# of Basal Veins: 7-9
Agrophic Veins: compound

Major 2° Vein Framework (costal): craspedodromous | # 2-4
Interior Secondaries:
Minor 2° Course: craspedodromous
Perimarginal Veins:
Major 2° Spacing (costal): increasing proximally
Variation of 2° Vein Angle (costal): uniform
Major 2° Vein Attachment (costal): excurrent

Inter-2° Vein Proximal Course:
Inter-2° Vein Lenght:
Inter-2° Vein Distal Course:
Inter-2° Vein Frequency:

Intercostal 3° Vein Fabric: percurrent (admedially) | reticulate irregular (exmedially)
Course of Percurrent 3°: opposite sinuous | mixed opp/alt
Angle of Percurrent 3°: obtuse
Intercostal 3° Vein Angle Variability: basally concentric
Epimedial 3°: opposite percurrent
Admedial Course: perpendicular to midvein
Exmedial Course: parallel to intercostal 3°
Exterior 3° Course: terminating at margin

Quaternary Vein Fabric: alternate percurrent | irregular reticulate

Quinternary Vein Fabric: irregular reticulate

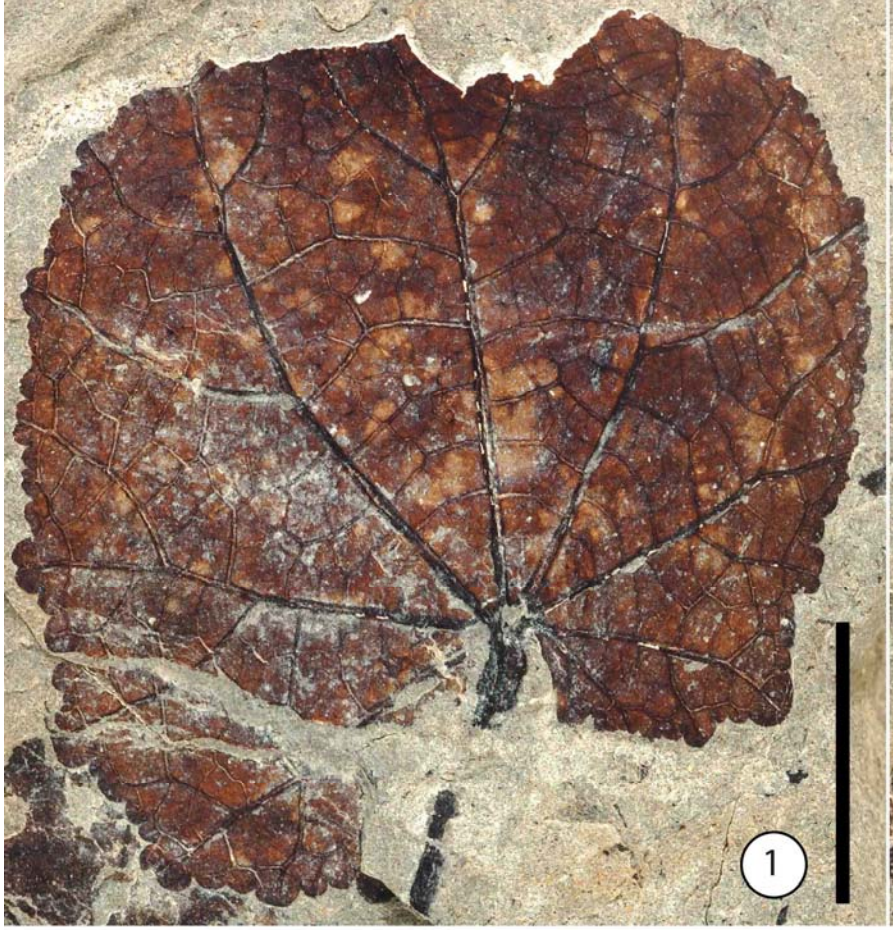
Areolation:
F.E.V.s Course:
F.E.V.s Terminae:
Marginal Ultimate Venation:

## Diagnostic Features

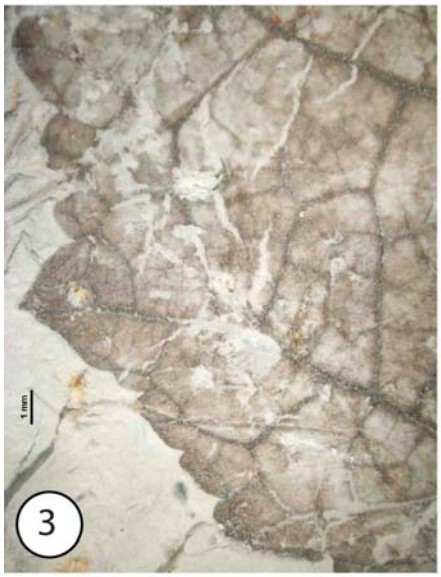
Primary veins basal actinodromous (7). Major and minor secondary veins craspedodromous. Tertiary veins percurrent (admedially) and irregular reticulate (exmedially). Margin dentate to crenate; 6-7 teeth/cm tooth shape cv/cv with apexes foraminate or rounded.

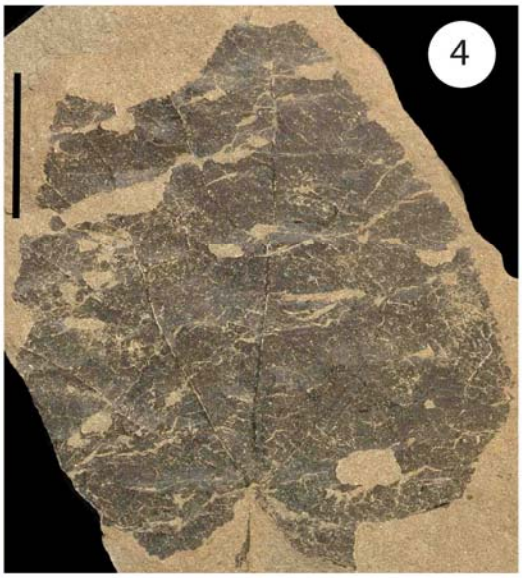
## Description

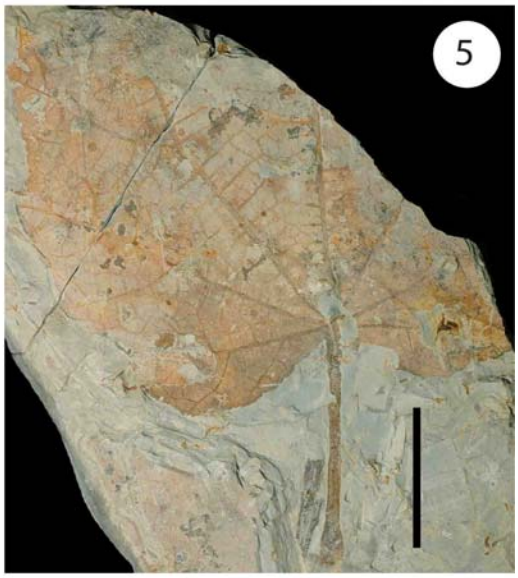
Leaf attachment petiolate. Petiole long (>6 cm) and with a base pulvinate. Blade attachment marginal. Laminar size notophyll to macrophyll (the biggest specimen is ~14 cm long and ~12 wide). Laminar shape ovate. Leaves medially and basally symmetrical. Unlobed (sometimes having pseudo-lobes). Apex angle acute and shape straight. Base angle reflex and shape cordate. Primary vein framework basal actinodromous (veins separated from 30° to 45°). Number of basal veins 7 to 9. Agrophic veins compound. Major secondary vein framework craspedodromous (2-4 pairs of veins). Minor secondary course craspedodromous. Major secondary vein spacing increasing proximally and leaving a gap with the basal primaries. Variation of secondary vein angle uniform and acute. Major secondary vein attachment excurrent. Intercostal tertiary vein fabric percurrent (admedially) and irregular reticulate (exmedially). Course of percurrent tertiaries opposite sinuous to mixed opp/alt (spaced from 0.3 to 0.7 cm). Angle of percurrent tertiaries obtuse. Intercostal tertiary vein angle variability basally concentric. Epimedial tertiaries opposite percurrent; admedial course perpendicular to midvein; exmedial course parallel to intercostal tertiaries. Exterior tertiary course terminating at margin. Quaternary vein fabric alternate percurrent to irregular reticulate. Quinternary vein fabric irregular reticulate. Margin dentate to crenate; tooth spacing regular; from two to three orders of teeth (if three orders are present, the first one is formed by a primary vein); teeth/cm 6-7/cm; sinus shape rounded; tooth shape cv/cv (almost symmetrical); principal vein present and terminating at apex; the biggest teeth (those formed from a primary vein or a agrophic vein) generally with apexes foraminate, the remaining teeth have rounded apexes.


1


2


1 mm
3


4


5


6


7

**CERREJON FLORA** | Morphotype Name: *incertae sedis* | Morphotype #: CJ27

Major Plant Group: DIC | Organ Type: Leaf | Morphotyper: | Type loc. #: | Type spec. #:

Plant Family/order: | Loca:

## Section I. Leaf Characters

Leaf Attachment:
Leaf Arrangement:
Leaf Organization:
Leaflet Organization:
Leaflet Attachment:
Petiole Features: long

### Features of the Blade

Position of Blade Attachment: marginal
Laminar Size (smallest): notophyll
Laminar Size (largest): macrophyll
Laminar L:W Ratio:
Laminar Shape: ovate
Medial Symmetry: symmetrical
Base Symmetry: symmetrical
Lobation: unlobed
Margin Type: crenate
Margin Features:
Apex Angle: acute
Apex Shape: straight | acuminate
Base Angle: obtuse
Base Shape: cordate
Terminal Apex Features:
Surface Texture:
SurficialGlands:
Stomata:
Cuticle Features:

## Section III. Teeth

Tooth Spacing: regular
# of Orders: 1
Teeth/cm: 5-7
Sinus Shape: rounded
Tooth Shape: cv/cv
Tooth Shape:
Principal Vein: present
Accesory Vein: present
Principal Vein Termination: variable
Course of Accesory Vein:
Features of the Tooth Apex: non-specific

## Similar Morphotypes

CJ48

## Section II. Venation

1° Vein Framework: actinodromous basal
Naked Basal Veins: present
# of Basal Veins: 5
Agrophic Veins: compound

Major 2° Vein Framework (costal): semicraspedodromous | #: 5-7
Interior Secondaries:
Minor 2° Course: semicraspedodromous
Perimarginal Veins:
Major 2° Spacing (costal): regular
Variation of 2° Vein Angle (costal): smoothly decreasing proximally
Major 2° Vein Attachment (costal): excurrent

Inter-2° Vein Proximal Course:
Inter-2° Vein Lenght:
Inter-2° Vein Distal Course:
Inter-2° Vein Frequency:

Intercostal 3° Vein Fabric: percurrent
Course of Percurrent 3°: opposite sinuous | opposite straight
Angle of Percurrent 3°: obtuse | perpendicular
Intercostal 3° Vein Angle Variability: decreasing exmedially
Epimedial 3°: opposite percurrent
Admedial Course: perpendicular to midvein
Exmedial Course: parallel to intercostal 3°
Exterior 3° Course:

Quaternary Vein Fabric: regular reticulate

Quinternary Vein Fabric: irregular reticulate

Areolation: moderate development
F.E.V.s Course:
F.E.V.s Terminae:
Marginal Ultimate Venation:

## Diagnostic Features

Laminar shape ovate. Primaries basal actinodromous with naked basal veins. Secondaries semicraspedodromous. Secondary vein spacing regular. Quaternary vein fabric regular reticulate. Quaternary vein fabric irregular reticulate. Margin crenate.

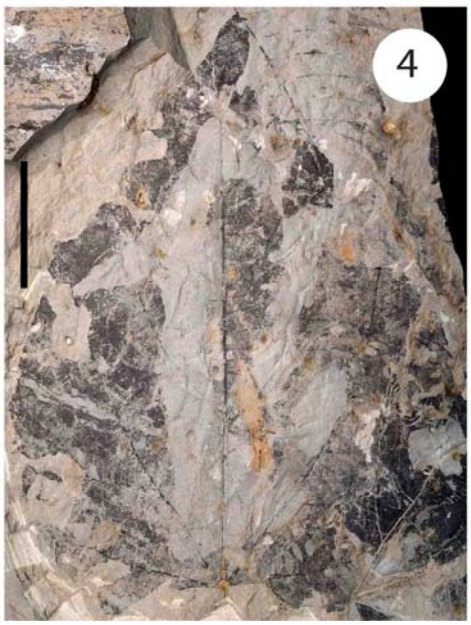
## Description

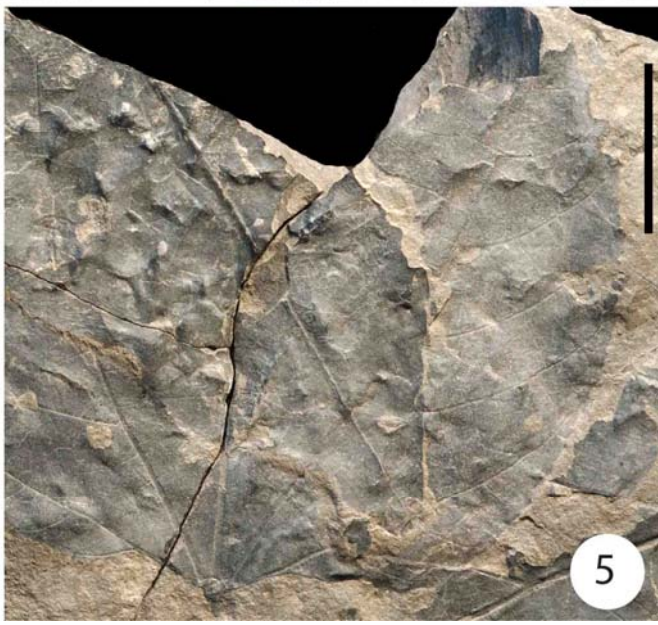
Petiole long (>4 cm). Blade attachment marginal. Laminar size notophyll to macrophyll (the biggest specimen is ~25 cm long and ~18 cm wide). Laminar shape ovate. Leaves medially and basally symmetrical. Unlobed. Apex angle acute. Apex shape straight to acuminate. Base shape obtuse and shape cordate. Primary vein framework basal actinodromous. Naked basal veins present. Number of basal veins 5. Agrophic veins compound. Major secondary vein framework semicraspedodromous (5-7 pairs of veins). Minor secondary vein course semicraspedodromous. Major secondary vein spacing regular; there is a gap formed by the most basal costal veins and the primaries. Variation of secondary vein angle decreasing proximally (from ~65° to ~42°). Major secondary vein attachment excurrent. Intercostal tertiary vein fabric mostly opposite percurrent with courses sinuous to straight (spaced from 1.2 cm to 0.5 cm). Angle of percurrent tertiary vein obtuse to perpendicular. Intercostal tertiary vein angle variability decreasing exmedially. Epimedial tertiary veins opposite percurrent; admedial course perpendicular to midvein; exmedial course parallel to intercostal tertiaries. Quaternary vein fabric regular reticulate. Quaternary vein fabric irregular reticulate. Areolation development moderate. Margin crenate. Tooth spacing regular; number of orders one; teeth/cm 5-7/cm; sinus shape rounded; tooth shape cv/cv; principal and accessory veins present; principal vein termination variable (at apex of tooth, on distal and proximal flanks); features of the tooth apex non-specific.


1


2


3


4


5

**CERREJON FLORA** | Morphotype Name: *incertae sedis* | Morphotype #: CJ28

Major Plant Group: DIC | Organ Type: Leaf | Morphotyper: | Type loc. #: | Type spec. #:

Plant Family/order: | Loca:

## Section I. Leaf Characters

Leaf Attachment:
Leaf Arrangement:
Leaf Organization:
Leafleet Organization:
Leaflet Attachment:
Petiole Features: thick

### Features of the Blade

Position of Blade Attachment: marginal
Laminar Size (smallest): mesophyll
Laminar Size (largest):
Laminar L:W Ratio:
Laminar Shape: elliptic | ovate
Medial Symmetry: symmetrical
Base Symmetry: symmetrical
Lobation: unlobed
Margin Type: untoothed
Margin Features:
Apex Angle:
Apex Shape:
Base Angle: obtuse
Base Shape: cordate
Terminal Apex Features:
Surface Texture:
SurficialGlands:
Stomata:
Cuticle Features:

## Section III. Teeth

Tooth Spacing:
# of Orders:
Teeth/cm:
Sinus Shape:
Tooth Shape:
Tooth Shape:
Principal Vein:
Accesory Vein:
Principal Vein Termination:
Course of Accesory Vein:
Features of the Tooth Apex:

## Similar Morphotypes

CJ16
CJ50

## Section II. Venation

1° Vein Framework: pinnate
Naked Basal Veins: absent
# of Basal Veins: 3
Agrophic Veins: absent

Major 2° Vein Framework (costal): eucamptodromous | # 12-13
Interior Secondaries:
Minor 2° Course: simple brochidodromous
Perimarginal Veins:
Major 2° Spacing (costal): abruptly decreasing proximally and gradually distally
Variation of 2° Vein Angle (costal): smoothly increasing proximally
Major 2° Vein Attachment (costal): excurrent

Inter-2° Vein Proximal Course:
Inter-2° Vein Lenght:
Inter-2° Vein Distal Course:
Inter-2° Vein Frequency:

Intercostal 3° Vein Fabric: percurrent
Course of Percurrent 3°: opposite sinuous | opposite straight
Angle of Percurrent 3°: obtuse | perpendicular
Intercostal 3° Vein Angle Variability: decreasing exmedially | increasing proximally
Epimedial 3°: opposite percurrent
Admedial Course: perpendicular to midvein | obtuse to midvein
Exmedial Course: parallel to intercostal 3°
Exterior 3° Course: looped

Quaternary Vein Fabric: irregular reticulate | regular reticulate

Quinternary Vein Fabric: freely ramifying | irregular reticulate

Areolation: poor development
F.E.V.s Course:
F.E.V.s Terminae:
Marginal Ultimate Venation:

## Diagnostic Features

Pinnate. Base cordate. Major secondary vein spacing decreases proximally (abruptly) and gradually (distally). Tertiary spacing increasing exmedially from ~1.2 mm to ~3.2 mm. Quaternary vein fabric irregular to regular reticulate. Quinternary vein fabric freely ramifying to irregular reticulate. Higher order veins very thin compared to secondary and tertiary veins.

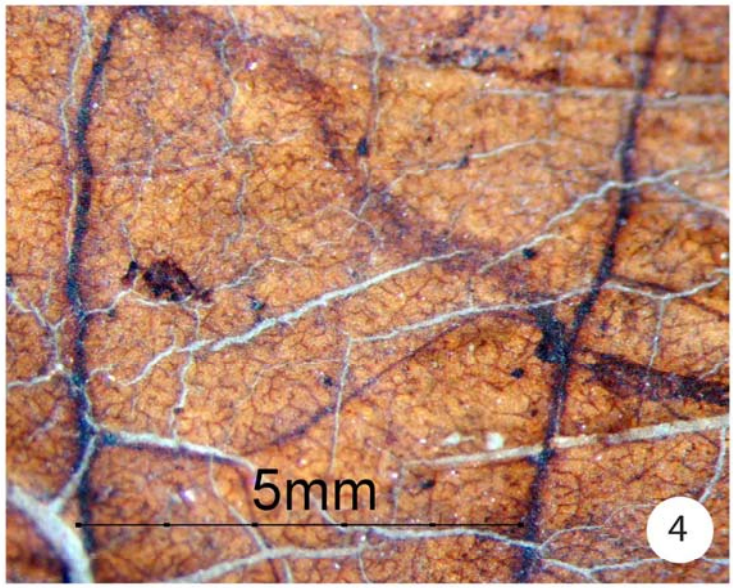
## Description

Petiole thick. Blade attachment marginal. Laminar size mesophyll (the biggest specimen is ~20 cm long and ~10 cm wide). Laminar shape elliptic to ovate. Leaves medially and basally symmetrical. Unlobed. Margin entire. Base angle obtuse. Base shape cordate. Primary vein framework pinnate. Number of basal veins 3. Major secondary vein framework eucamptodromous (12-13 pairs of veins). Minor secondary veins course simple brochidodromous. Major secondary vein spacing abruptly decreasing proximally (having two pairs of secondaries crowded at the petiole insertion) and gradually decreasing distally. Variation of secondary vein angle smoothly increasing proximally (from ~30° to ~70°). Major secondary vein attachment excurrent. Intercostal tertiary vein fabric opposite percurrent with courses sinuous to straight (the tertiary spacing increasing exmedially from ~1.2 mm to ~3.2 mm). Angle of percurrent tertiaries obtuse to perpendicular. Intercostal tertiary vein angle variability decreasing exmedially and increasing proximally. Epimedial tertiary veins opposite percurrent; admedial course perpendicular and obtuse to midvein; exmedial course parallel to intercostal tertiaries. Exterior tertiary course looped. Quaternary vein fabric irregular to regular reticulate. Quinternary vein fabric freely ramifying to irregular reticulate. Higher order veins very thin compared to secondary and tertiary veins. Areolation development poor.


1


2


5mm
3


5mm
4


5


6

**CERREJON FLORA** | Morphotype Name: *incertae sedis* | Morphotype #: CJ30

Major Plant Group: DIC | Organ Type: Leaf | Morphotyper: | Type loc. #: | Type spec. #:

Plant Family/order: | Loca:

## Section I. Leaf Characters

Leaf Attachment:
Leaf Arrangement:
Leaf Organization:
Leaflet Organization:
Leaflet Attachment:
Petiole Features:

### Features of the Blade

Position of Blade Attachment: marginal
Laminar Size (smallest): mesophyll
Laminar Size (largest):
Laminar L:W Ratio:
Laminar Shape: ovate
Medial Symmetry: asymmetrical
Base Symmetry: asymmetrical
Lobation: unlobed
Margin Type: untoothed
Margin Features:
Apex Angle:
Apex Shape:
Base Angle: obtuse
Base Shape:
Terminal Apex Features:
Surface Texture:
SurficialGlands:
Stomata:
Cuticle Features:

## Section III. Teeth

Tooth Spacing:
# of Orders:
Teeth/cm:
Sinus Shape:
Tooth Shape:
Tooth Shape:
Principal Vein:
Accesory Vein:
Principal Vein Termination:
Course of Accesory Vein:
Features of the Tooth Apex:

## Similar Morphotypes

## Section II. Venation

1° Vein Framework: pinnate
Naked Basal Veins: absent
# of Basal Veins:
Agrophic Veins: absent

Major 2° Vein Framework (costal): eucampt. becoming brochid. distally | # 14-16 pairs
Interior Secondaries:
Minor 2° Course: simple brochidodromous
Perimarginal Veins:
Major 2° Spacing (costal): irregular
Variation of 2° Vein Angle (costal): abruptly increasing proximally | inconsistent
Major 2° Vein Attachment (costal): excurrent

Inter-2° Vein Proximal Course: parallel to major secondaries
Inter-2° Vein Lenght: <50% of subjacent secondary
Inter-2° Vein Distal Course: parallel to subjacent major secondary
Inter-2° Vein Frequency: <1 per intercostal area

Intercostal 3° Vein Fabric: percurrent
Course of Percurrent 3°: opposite sinuous (disorganized)
Angle of Percurrent 3°: obtuse
Intercostal 3° Vein Angle Variability: inconsistent
Epimedial 3°: opposite percurrent
Admedial Course: perpendicular to midvein | obtuse to midvein
Exmedial Course: parallel to intercostal 3°
Exterior 3° Course: looped

Quaternary Vein Fabric: irregular reticulate

Quinternary Vein Fabric: irregular reticulate

Areolation: present
F.E.V.s Course:
F.E.V.s Terminae:
Marginal Ultimate Venation:

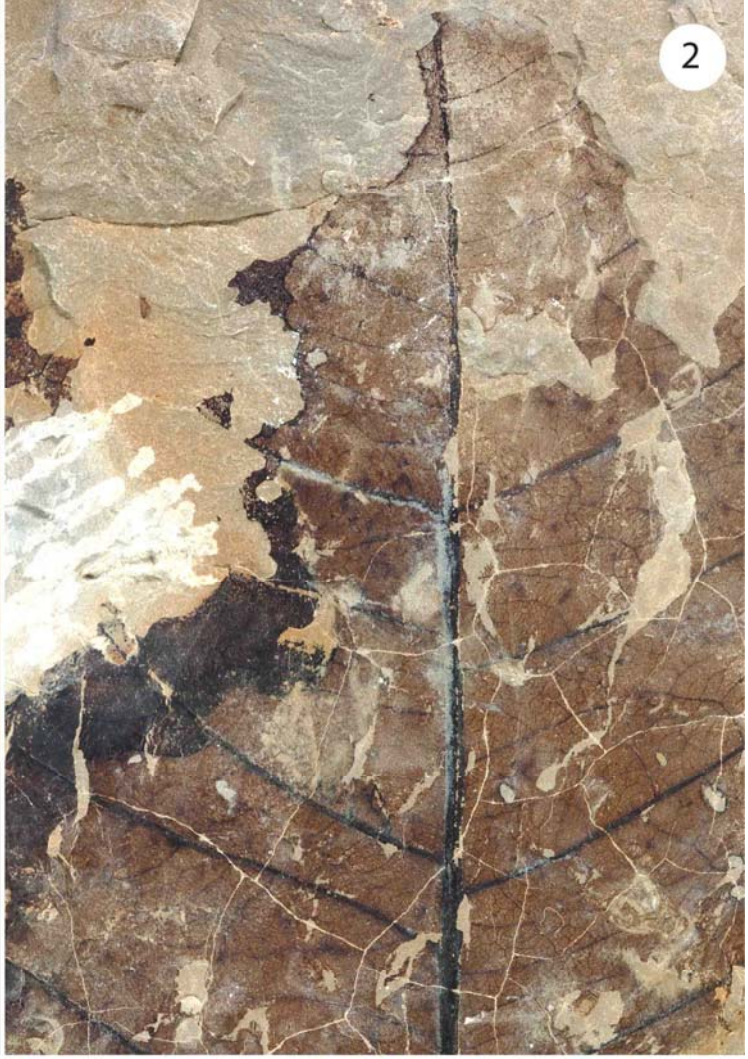
## Diagnostic Features

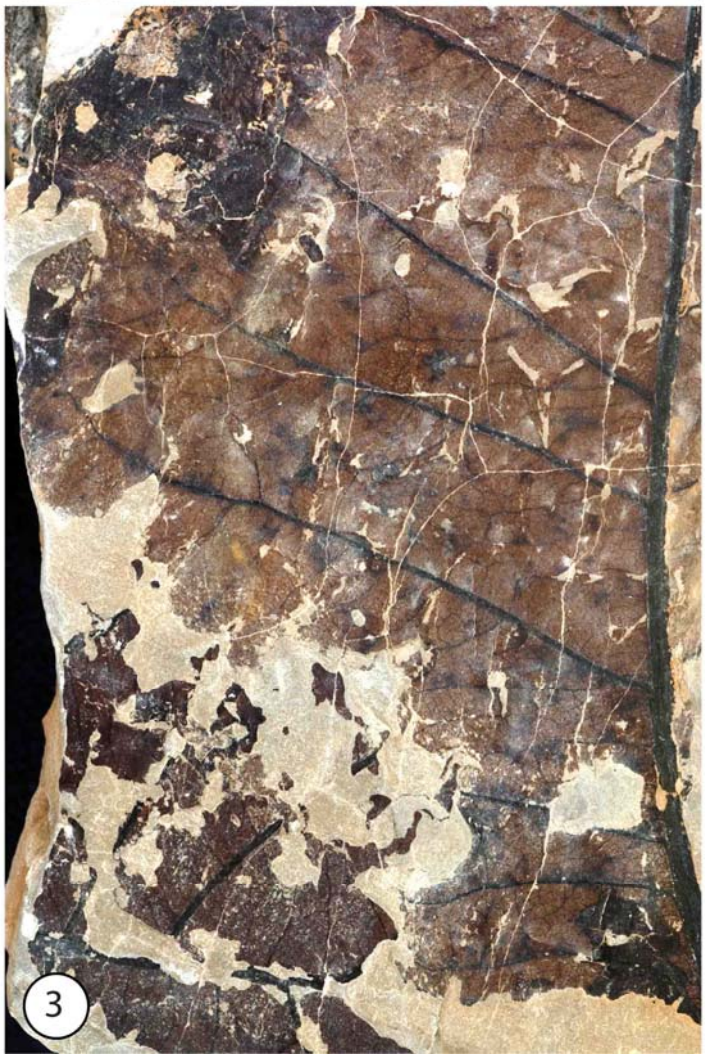
Leaf apparently medially and basally asymmetrical. Secondary vein spacing irregular. Secondary vein angle abruptly increasing proximally (from ~60° to ~90°) and inconsistent. Intersecondary veins parallel to secondaries. Tertiaries opposite percurrent with courses highly sinuous and disorganized. Quaternary and quinternary vein fabric irregular reticulate.

## Description

Blade attachment marginal. Laminar size mesophyll (the specimen is ~16 cm long and ~10 cm wide). Laminar shape ovate. Leaf apparently medially and basally asymmetrical. Unlobed. Margin entire. Primary vein framework pinnate. Major secondary vein framework eucamptodromous becoming brochidodromous distally (14-16 pairs of veins). Minor secondary veins course simple brochidodromous. Major secondary vein spacing irregular. Variation of secondary vein angle abruptly increasing proximally (from ~60° to ~90°) and inconsistent. Major secondary vein attachment excurrent. Intersecondary veins proximal course parallel to major secondaries; length <50% of subjacent secondary; distal course parallel to subjacent major secondary; frequency <1 per intercostal area. Intercostal tertiary vein fabric opposite percurrent with courses highly sinuous and disorganized. Angle of percurrent tertiaries obtuse. Intercostal tertiary vein angle variability inconsistent. Epimedial tertiaries opposite percurrent; admedial course perpendicular and obtuse to midvein; exmedial course parallel to intercostal tertiaries. Exterior tertiary vein course looped. Quaternary and quinternary vein fabric irregular reticulate. Areolation present.


1


2


3


4

**CERREJON FLORA** | Morphotype Name: *incertae sedis* | Morphotype #: CJ32

Major Plant Group: DIC | Organ Type: Leaf | Morphotyper: | Type loc. #: | Type spec. #:

Plant Family/order: | Loca:

## Section I. Leaf Characters

Leaf Attachment:
Leaf Arrangement:
Leaf Organization:
Leaflet Organization:
Leaflet Attachment:
Petiole Features: long (>9 cm) and thick

### Features of the Blade

Position of Blade Attachment: marginal
Laminar Size (smallest): microphyll
Laminar Size (largest): macrophyll
Laminar L:W Ratio:
Laminar Shape: elliptic
Medial Symmetry: symmetrical
Base Symmetry: symmetrical
Lobation: unlobed
Margin Type: crenate
Margin Features:
Apex Angle: acute
Apex Shape: straight
Base Angle: acute
Base Shape: convex | decurrent
Terminal Apex Features:
Surface Texture:
SurficialGlands:
Stomata:
Cuticle Features:

## Section III. Teeth

Tooth Spacing: irregular
# of Orders: one
Teeth/cm: 0 to 4-5
Sinus Shape: rounded
Tooth Shape: cv/cv
Tooth Shape:
Principal Vein: present
Accesory Vein: present
Principal Vein Termination: on distal flank
Course of Accesory Vein: straight or concave
Features of the Tooth Apex:

## Similar Morphotypes

CJ4

## Section II. Venation

1° Vein Framework: pinnate
Naked Basal Veins: absent
# of Basal Veins:
Agrophic Veins: absent

Major 2° Vein Framework (costal): semicraspedodromous | # 20-24 pairs
Interior Secondaries:
Minor 2° Course: semicraspedodromous
Perimarginal Veins:
Major 2° Spacing (costal): regular to slightly decreasing proximally
Variation of 2° Vein Angle (costal): smoothly decreasing proximally | uniform
Major 2° Vein Attachment (costal): excurrent

Inter-2° Vein Proximal Course:
Inter-2° Vein Lenght:
Inter-2° Vein Distal Course:
Inter-2° Vein Frequency:

Intercostal 3° Vein Fabric: percurrent
Course of Percurrent 3°: opposite convex | opposite straight
Angle of Percurrent 3°: obtuse | perpendicular
Intercostal 3° Vein Angle Variability: decreasing exmedially
Epimedial 3°: opposite percurrent
Admedial Course: obtuse to midvein
Exmedial Course: parallel to intercostal 3°
Exterior 3° Course: terminating at margin

Quaternary Vein Fabric: mostly opposite percurrent

Quinternary Vein Fabric: irregular reticulate

Areolation:
F.E.V.s Course:
F.E.V.s Terminae:
Marginal Ultimate Venation:

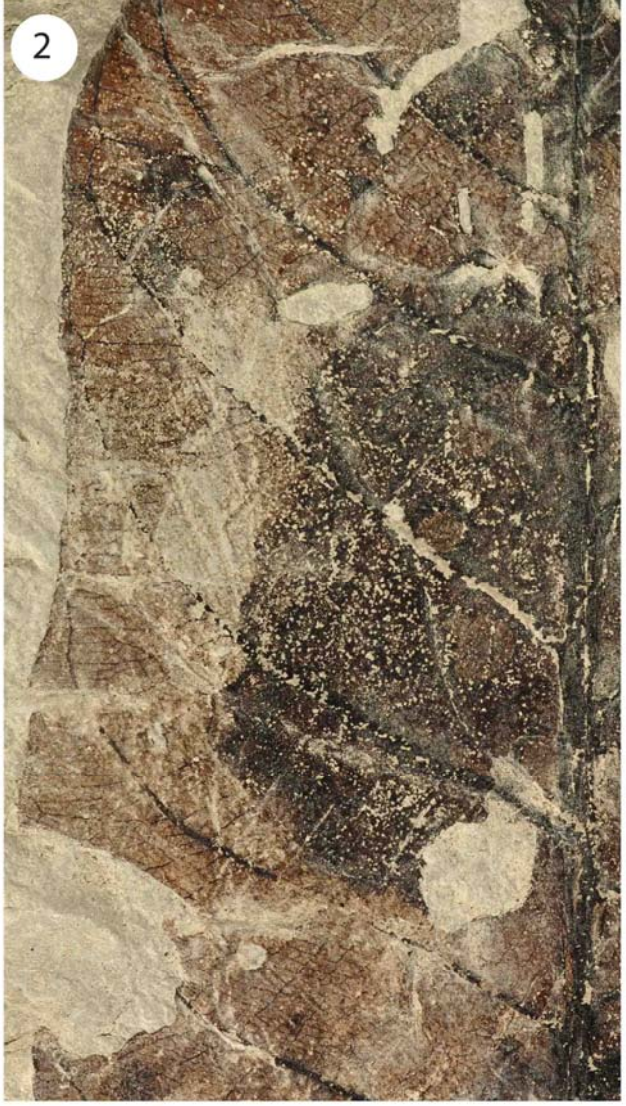
### Diagnostic Features

Base shape convex and decurrent. Major secondary vein spacing regular to slightly decreasing proximally. Tertiary veins opposite percurrent (spacing increasing exmedially). Epimedial tertiary veins with admedial course obtuse to midvein. Quaternary veins mostly opposite percurrent. Margin crenate. Teeth having long proximal flanks.

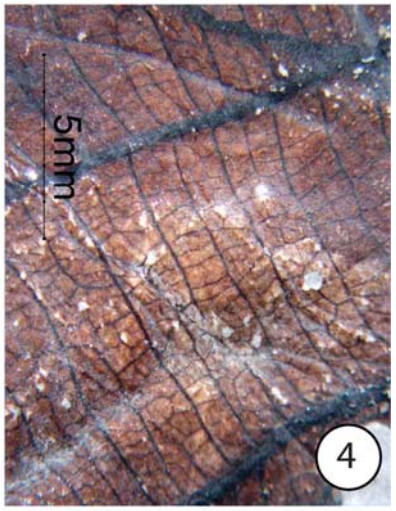
### Description

Petiole long (>9 cm) and thick. Blade attachment marginal. Laminar size microphyll to macrophyll (the biggest specimen is >20 cm long and ~15 cm wide). Laminar shape elliptic. Leaves medially and basally symmetrical. Unlobed. Apex angle acute and shape straight. Base angle acute. Base shape convex and decurrent. Primary vein framework pinnate. Major secondary vein framework semicraspedodromous (20-24 pairs of veins). Minor secondary vein course semicraspedodromous. Major secondary vein spacing regular to slightly decreasing proximally. Variation of secondary vein angle smoothly decreasing proximally (45° to 90°) to almost uniform (45° to 52°). Major secondary vein attachment excurrent. Intercostal tertiary vein fabric opposite percurrent with courses convex to sinuous; tertiary vein spacing increasing exmedially (from 0.5 mm to 3 mm) . Angle of percurrent tertiary veins obtuse to perpendicular. Intercostal tertiary vein angle variability decreasing exmedially. Epimedial tertiary veins opposite percurrent; admedial course obtuse to midvein; exmedial course parallel to intercostal tertiaries. Exterior tertiary course terminating at margin. Quaternary vein fabric mostly opposite percurrent. Quaternary vein fabric irregular reticulate. Margin crenate; tooth spacing irregular; number of orders one; teeth/cm 0 to 4-5/cm; sinus shape rounded; tooth shape cv/cv; principal and accessory veins present; principal vein termination on distal flank; course of accessory vein straight or concave; teeth with long proximal flanks.

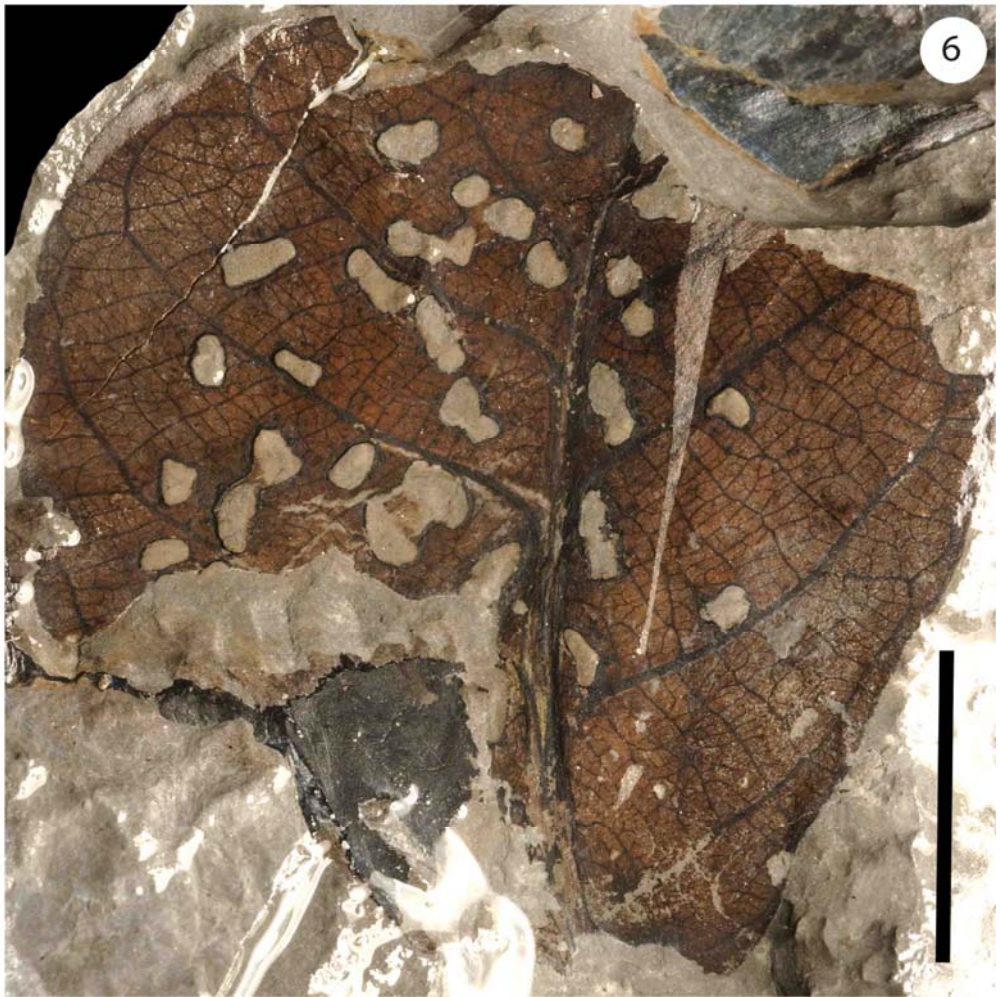

1


2


5mm
3


5mm
4


5


6

**CERREJON FLORA** | Morphotype Name: *incertae sedis* | Morphotype #: CJ33

Major Plant Group: DIC | Organ Type: Leaf | Morphotyper: | Type loc. #: | Type spec. #:

Plant Family/order: | Loca:

## Section I. Leaf Characters

Leaf Attachment:
Leaf Arrangement:
Leaf Organization:
Leaflet Organization:
Leaflet Attachment:
Petiole Features:

### Features of the Blade

Position of Blade Attachment:
Laminar Size (smallest): microphyll
Laminar Size (largest):
Laminar L:W Ratio:
Laminar Shape: elliptic
Medial Symmetry: symmetrical
Base Symmetry:
Lobation: unlobed
Margin Type: untoothed
Margin Features:
Apex Angle: obtuse
Apex Shape: rounded?
Base Angle:
Base Shape:
Terminal Apex Features:
Surface Texture:
SurficialGlands:
Stomata:
Cuticle Features:

## Section III. Teeth

Tooth Spacing:
# of Orders:
Teeth/cm:
Sinus Shape:
Tooth Shape:
Tooth Shape:
Principal Vein:
Accesory Vein:
Principal Vein Termination:
Course of Accesory Vein:
Features of the Tooth Apex:

## Similar Morphotypes

## Section II. Venation

1° Vein Framework: pinnate
Naked Basal Veins: absent
# of Basal Veins:
Agrophic Veins: absent

Major 2° Vein Framework (costal): hemieucamtodromous # 2-3
Interior Secondaries: absent
Minor 2° Course:
Perimarginal Veins:
Major 2° Spacing (costal): decreasing proximally
Variation of 2° Vein Angle (costal): uniform
Major 2° Vein Attachment (costal): decurrent

Inter-2° Vein Proximal Course:
Inter-2° Vein Lenght:
Inter-2° Vein Distal Course:
Inter-2° Vein Frequency:

Intercostal 3° Vein Fabric:
Course of Percurrent 3°:
Angle of Percurrent 3°:
Intercostal 3° Vein Angle Variability:
Epimedial 3°:
Admedial Course:
Exmedial Course:
Exterior 3° Course:

Quaternary Vein Fabric:

Quinternary Vein Fabric:

Areolation:
F.E.V.s Course:
F.E.V.s Terminae:
Marginal Ultimate Venation:

## Diagnostic Features

Laminar shape elliptic. Secondary veins hemieucamtodromous (2-3 pairs of veins). Secondary vein spacing deceasing proximally. Secondary vein angle uniform. Secondary vein attachment decurrent.

## Description

Laminar size microphyll (the specimen is ~4.6 cm long and ~2.9 cm wide). Laminar shape elliptic. Leaf medially symmetrical. Unlobed. Margin entire. Apex angle obtuse and shape probably rounded. Primary vein framework pinnate. Major secondary vein framework hemieucamtodromous (2-3 pairs of veins). Major secondary vein spacing deceasing proximally. Variation of secondary vein angle uniform (proximally at 27° and distally at 21°). Major secondary vein attachment decurrent.


1

**CERREJON FLORA** | Morphotype Name: *incertae sedis* | Morphotype #: CJ34

Major Plant Group: DIC | Organ Type: Leaf | Morphotyper: | Type loc. #: | Type spec. #:

Plant Family/order: Anacardiaceae | Loca:

## Section I. Leaf Characters

Leaf Attachment:
Leaf Arrangement:
Leaf Organization:
Leaflet Organization:
Leaflet Attachment:
Petiole Features: short

### Features of the Blade

Position of Blade Attachment: marginal
Laminar Size (smallest): notophyll
Laminar Size (largest): mesophyll
Laminar L:W Ratio:
Laminar Shape: elliptic | ovate
Medial Symmetry: symmetrical
Base Symmetry: symmetrical
Lobation: unlobed
Margin Type: crenate | serrate
Margin Features:
Apex Angle: acute
Apex Shape: acuminate
Base Angle: obtuse
Base Shape: concavo-convex | truncate
Terminal Apex Features:
Surface Texture:
Surficial Glands:
Stomata:
Cuticle Features:

## Section III. Teeth

Tooth Spacing: irregular
# of Orders: one
Teeth/cm: 1-2/cm
Sinus Shape: rounded
Tooth Shape: cc/cv | cv/cv
Tooth Shape:
Principal Vein: present
Accesory Vein:
Principal Vein Termination: on distal flank
Course of Accesory Vein:
Features of the Tooth Apex:

## Similar Morphotypes

## Section II. Venation

1° Vein Framework: pinnate
Naked Basal Veins: absent
# of Basal Veins: 1-3
Agrophic Veins: absent

Major 2° Vein Framework (costal): craspedodromous | # > 16 pairs
Interior Secondaries: absent
Minor 2° Course: craspedodromous
Perimarginal Veins:
Major 2° Spacing (costal): decreasing proximally
Variation of 2° Vein Angle (costal): smoothly increasing proximally
Major 2° Vein Attachment (costal): excurrent

Inter-2° Vein Proximal Course:
Inter-2° Vein Lenght:
Inter-2° Vein Distal Course:
Inter-2° Vein Frequency:

Intercostal 3° Vein Fabric: percurrent
Course of Percurrent 3°: opposite sinuous | opposite straight
Angle of Percurrent 3°: obtuse
Intercostal 3° Vein Angle Variability: consistent
Epimedial 3°: opposite percurrent
Admedial Course: perpendicular to midvein
Exmedial Course: reticulating (only one vein) | parallel to intercostal 3°
Exterior 3° Course: terminating at margin

Quaternary Vein Fabric: alternate percurrent

Quinternary Vein Fabric: irregular reticulate

Areolation: good development
F.E.V.s Course:
F.E.V.s Terminae:
Marginal Ultimate Venation:

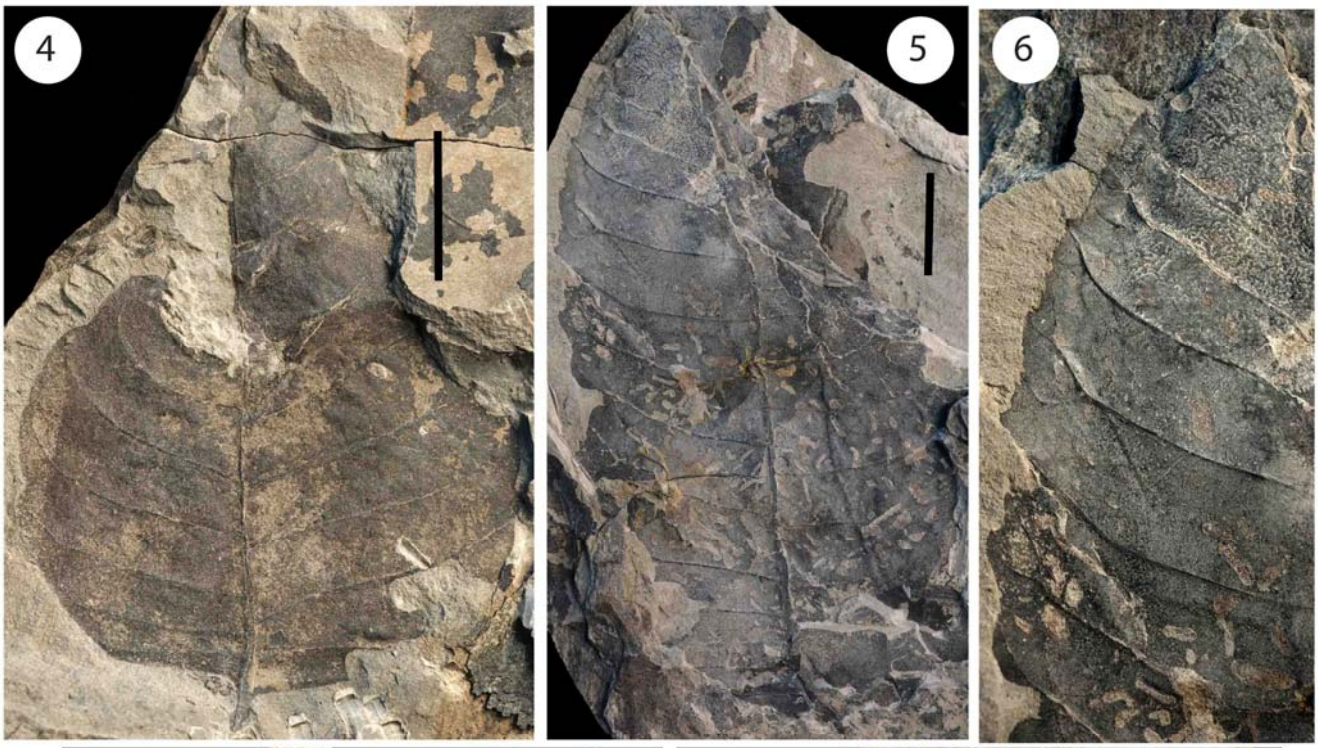
## Diagnostic Features

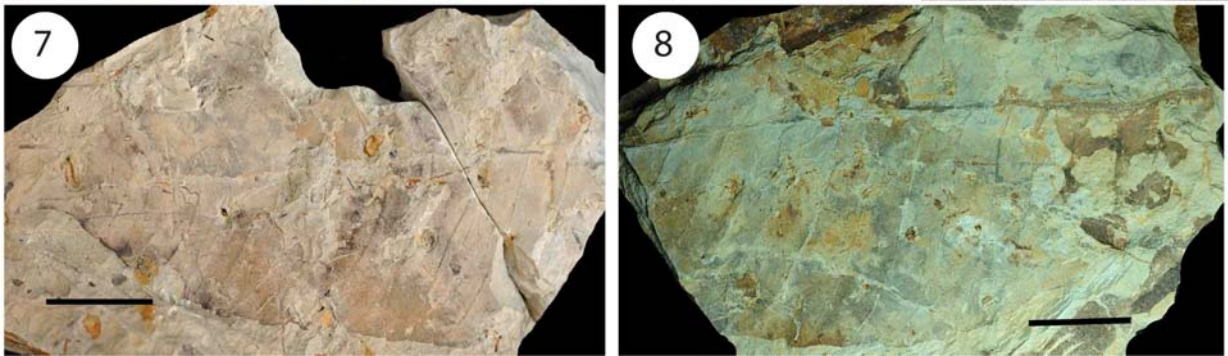
Secondary veins craspedodromous (> 16 pairs) and at ~90° proximally. Epimedial tertiary veins thin, opposite percurrent, and with the exmedial course reticulating (only one vein). Margin crenate and serrate. Teeth having long proximal flanks. Principal vein termination of the teeth on distal flank or at nadir of superjacent sinus.

## Description

Petiole short. Blade attachment marginal. Laminar size notophyll to mesophyll (the biggest specimen is 11.6 cm long and 6.6 cm wide). Laminar shape elliptic to ovate. Leaves medially and basally symmetrical. Unlobed. Apex angle acute and shape acuminate. Base angle obtuse. Base shape concavo-convex to truncate. Primary vein framework pinnate. Number of basal veins from 1 to 3. Major secondary vein framework craspedodromous (> 16 pairs of veins). Minor secondary vein course craspedodromous. Major secondary vein spacing decreasing proximally (from 0.8 cm to 0.3 cm). Variation of secondary vein angle smoothly increasing proximally (at ~90°). Major secondary vein attachment decurrent. Intercostal tertiary vein fabric mostly opposite percurrent with sinuous to straight courses. Angle of percurrent tertiaries obtuse. Intercostal tertiary vein angle variability consistent. Epimedial tertiaries opposite percurrent; admedial course perpendicular to midvein; exmedial course from reticulating (only one vein) to parallel to intercostal tertiaries. Exterior tertiary vein course terminating at margin. Tertiary veins are very thin compared to secondaries, and additionally they thinning during their course. Quaternary vein fabric alternate percurrent. Quinternary vein fabric irregular reticulate. Areolation development good. Margin crenate and serrate; tooth spacing irregular; order of teeth one; teeth/cm 1-2/cm; sinus shape rounded; tooth shape cc/cv and cv/cv; principal vein present; principal vein termination on distal flank or at nadir of superjacent sinus; the proximal flank of the teeth longer than the distal flank.


1
2
3


4
5
6


7
8

**CERREJON FLORA** | Morphotype Name: *incertae sedis* | Morphotype #: CJ36

Major Plant Group: DIC | Organ Type: Leaf | Morphotyper: | Type loc. #: | Type spec. #:

Plant Family/order: Malvaceae | Loca:

## Section I. Leaf Characters

Leaf Attachment: petiolate
Leaf Arrangement:
Leaf Organization:
Leaflet Organization:
Leaflet Attachment:
Petiole Features: petiole base pulvinate

### Features of the Blade

Position of Blade Attachment: marginal
Laminar Size (smallest): notophyll
Laminar Size (largest): mesophyll
Laminar L:W Ratio:
Laminar Shape: elliptic
Medial Symmetry: symmetrical
Base Symmetry: symmetrical
Lobation: unlobed
Margin Type: untoothed
Margin Features:
Apex Angle: acute to obtuse
Apex Shape: straight
Base Angle: obtuse
Base Shape: truncate | convex
Terminal Apex Features:
Surface Texture:
Surficial Glands:
Stomata:
Cuticle Features:

## Section III. Teeth

Tooth Spacing:
# of Orders:
Teeth/cm:
Sinus Shape:
Tooth Shape:
Tooth Shape:
Principal Vein:
Accesory Vein:
Principal Vein Termination:
Course of Accesory Vein:
Features of the Tooth Apex:

## Similar Morphotypes

CJ25
CJ84

## Section II. Venation

1° Vein Framework: actinodromous basal
Naked Basal Veins: absent
# of Basal Veins: 3
Agrophic Veins: simple

Major 2° Vein Framework (costal): simple brochidodromous | # 3-5
Interior Secondaries: absent
Minor 2° Course: simple brochidodromous
Perimarginal Veins:
Major 2° Spacing (costal): gradually increasing proximally
Variation of 2° Vein Angle (costal): uniform
Major 2° Vein Attachment (costal): excurrent

Inter-2° Vein Proximal Course:
Inter-2° Vein Lenght:
Inter-2° Vein Distal Course:
Inter-2° Vein Frequency:

Intercostal 3° Vein Fabric: percurrent
Course of Percurrent 3°: opposite straight, convex | opposite sinuous
Angle of Percurrent 3°: obtuse
Intercostal 3° Vein Angle Variability: decreasing exmedially | basally concentric
Epimedial 3°: opposite percurrent
Admedial Course: perpendicular to midvein
Exmedial Course: parallel to intercostal 3°
Exterior 3° Course: looped

Quaternary Vein Fabric: alternate percurrent

Quinternary Vein Fabric: irregular reticulate

Areolation: moderate development
F.E.V.s Course:
F.E.V.s Terminae:
Marginal Ultimate Venation:

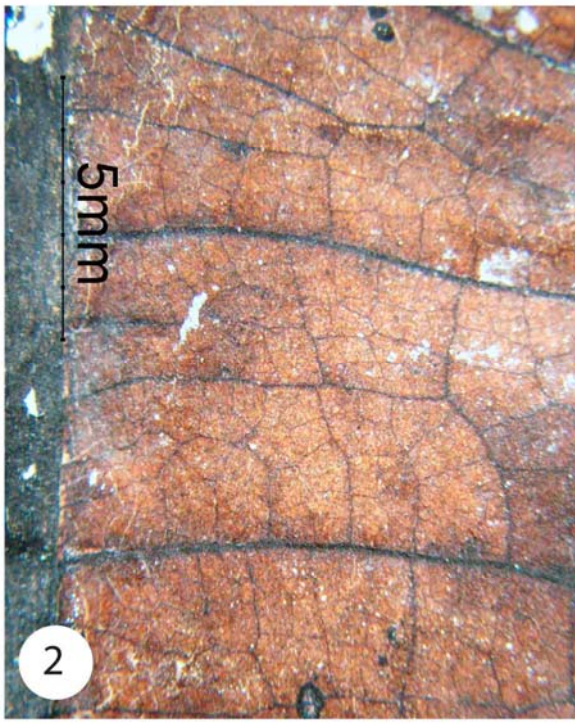
## Diagnostic Features

Basal actinodromous (3 veins only). Major and minor secondaries brochidodromous looping very close to margin. Costal secondaries widely spaced and curved exmedially. Intercostal tertiary veins opposite percurrent, but the tertiaries that fill the area of the agrophic veins are alternate percurrent.

## Description

Leaf attachment petiolate. Petiole long (>5 cm) and with base pulvinate. Blade attachment marginal. Laminar size notophyll to mesophyll (the biggest specimen is ~17 cm long and ~12 cm wide). Laminar shape elliptic. Leaves medially and basally symmetrical. Unlobed. Margin entire. Apex angle acute to obtuse. Apex shape straight. Base angle obtuse. Base shape truncate to convex. Primary vein framework basal actinodromous (only three veins at the petiole insertion). Agrophic veins simple. Major secondary vein framework simple brochidodromous. Costal secondaries looping very close to margin (3-5 pairs of veins widely spaced and curved exmedially). Major secondary vein spacing increasing proximally and leaving a gap with the basal primaries. Variation of secondary vein angle uniform. Major secondary vein attachment excurrent. Intercostal tertiary vein fabric opposite percurrent (spaced from 0.2 to 1.1 cm) with courses sinuous, convex and straight. Intercostal tertiary vein angle variability decreasing exmedially (to almost 90° near margin) and basally concentric. Epimedial tertiaries opposite percurrent; admedial course perpendicular to midvein; exmedial course parallel to intercostal tertiaries. Exterior tertiary vein course looped. Tertiary veins that fill the area of the agrophic veins are alternate percurrent. Quaternary vein fabric alternate percurrent. Quinternary vein fabric irregular reticulate. Areole development moderate.


1


5mm
2


3

**CERREJON FLORA** | Morphotype Name: *incertae sedis* | Morphotype #: CJ37

Major Plant Group: DIC | Organ Type: Leaf | Morphotyper: | Type loc. #: | Type spec. #:

Plant Family/order: | Loca:

## Section I. Leaf Characters

Leaf Attachment:
Leaf Arrangement:
Leaf Organization:
Leaflet Organization:
Leaflet Attachment:
Petiole Features: short

### Features of the Blade

Position of Blade Attachment: marginal
Laminar Size (smallest): mesophyll
Laminar Size (largest):
Laminar L:W Ratio:
Laminar Shape:
Medial Symmetry:
Base Symmetry:
Lobation: unlobed
Margin Type: untoothed
Margin Features:
Apex Angle:
Apex Shape:
Base Angle: obtuse
Base Shape: convex?
Terminal Apex Features:
Surface Texture:
SurficialGlands:
Stomata:
Cuticle Features:

## Section III. Teeth

Tooth Spacing:
# of Orders:
Teeth/cm:
Sinus Shape:
Tooth Shape:
Tooth Shape:
Principal Vein:
Accesory Vein:
Principal Vein Termination:
Course of Accesory Vein:
Features of the Tooth Apex:

## Similar Morphotypes

CJ22

## Section II. Venation

1° Vein Framework: pinnate
Naked Basal Veins: absent
# of Basal Veins:
Agrophic Veins: absent

Major 2° Vein Framework (costal): eucamptodromous # 5-6 pairs
Interior Secondaries:
Minor 2° Course: simple brochidodromous
Perimarginal Veins:
Major 2° Spacing (costal): decreasing proximally and distally
Variation of 2° Vein Angle (costal): uniform
Major 2° Vein Attachment (costal): excurrent

Inter-2° Vein Proximal Course:
Inter-2° Vein Lenght:
Inter-2° Vein Distal Course:
Inter-2° Vein Frequency:

Intercostal 3° Vein Fabric: percurrent
Course of Percurrent 3°: opposite convex, sinuous | opposite straight
Angle of Percurrent 3°: perpendicular
Intercostal 3° Vein Angle Variability: consistent
Epimedial 3°: opposite percurrent
Admedial Course: perpendicular to midvein | acute to midvein
Exmedial Course: parallel to intercostal 3°
Exterior 3° Course: looped

Quaternary Vein Fabric: alternate percurrent

Quinternary Vein Fabric: irregular reticulate

Areolation:
F.E.V.s Course:
F.E.V.s Terminae:
Marginal Ultimate Venation:

## Diagnostic Features

Secondary veins eucamptodromous (few costal veins, 5-6 pairs). Secondary vein spacing decreasing proximally and distally. Secondary vein angle uniform. Tertiary veins opposite percurrent with courses convex to sinuous (admedially) and straight (exmedially). Angle of percurrent tertiary veins mostly perpendicular.

## Description

Petiole short. Blade attachment marginal. Laminar size mesophyll (the specimen is ~8 cm long and ~3 cm wide). Unlobed. Margin entire. Base angle obtuse. Base shape probably convex. Primary vein framework pinnate. Major secondary vein framework eucamptodromous (5-6 pairs of veins). Minor secondary vein course simple brochidodromous. Major secondary vein spacing decreasing proximally and distally (ranging from ~1 cm to ~2.8 cm). Variation of secondary vein angle uniform (from ~30° to ~37°). Major secondary vein attachment excurrent. Intercostal tertiary vein fabric opposite percurrent with courses convex to sinuous (admedially) and straight (exmedially) (tertiaries spaced from 1.4 mm to 3.5 mm). Angle of percurrent tertiary veins mostly perpendicular. Intercostal tertiary vein angle variability consistent. Epimedial tertiary veins opposite percurrent; admedial course perpendicular and acute to midvein; exmedial course parallel to intercostal tertiary veins. Exterior tertiary course looped. Quaternary vein fabric alternate percurrent. Quinternary vein fabric irregular reticulate.


1


2


3
5mm

# CERREJON FLORA

Morphotype Name: *incertae sedis* | Morphotype #: CJ38

Major Plant Group: DIC | Organ Type: Leaf | Morphotyper: | Type loc. #: | Type spec. #:

Plant Family/order: Fabaceae? | Loca:

## Section I. Leaf Characters

Leaf Attachment:
Leaf Arrangement:
Leaf Organization:
Leafleft Organization:
Leaflet Attachment:
Petiole Features: petiole base pulvinulate

### Features of the Blade

Position of Blade Attachment: marginal
Laminar Size (smallest): notophyll
Laminar Size (largest): mesophyll
Laminar L:W Ratio:
Laminar Shape: elliptic
Medial Symmetry: symmetrical
Base Symmetry: symmetrical
Lobation: unlobed
Margin Type: untoothed
Margin Features:
Apex Angle: acute
Apex Shape: convex
Base Angle: obtuse
Base Shape: convex | rounded
Terminal Apex Features:
Surface Texture:
SurficialGlands:
Stomata:
Cuticle Features:

## Section III. Teeth

Tooth Spacing:
# of Orders:
Teeth/cm:
Sinus Shape:
Tooth Shape:
Tooth Shape:
Principal Vein:
Accesory Vein:
Principal Vein Termination:
Course of Accesory Vein:
Features of the Tooth Apex:

## Similar Morphotypes

CJ8

## Section II. Venation

1° Vein Framework: pinnate
Naked Basal Veins: absent
# of Basal Veins: 1-3
Agrophic Veins: absent

Major 2° Vein Framework (costal): eucamptodromous | # 10-14 pairs
Interior Secondaries:
Minor 2° Course: simple brochidodromous
Perimarginal Veins: fimbrial vein
Major 2° Spacing (costal): decreasing proximally
Variation of 2° Vein Angle (costal): smoothly increasing proximally
Major 2° Vein Attachment (costal): excurrent | decurrent

Inter-2° Vein Proximal Course: parallel to major secondaries
Inter-2° Vein Lenght: ~50% of subjacent secondary
Inter-2° Vein Distal Course: perpendicular to subjacent major secondary
Inter-2° Vein Frequency: ~1 per intercostal area

Intercostal 3° Vein Fabric: percurrent
Course of Percurrent 3°: opposite straight | opposite sinuous
Angle of Percurrent 3°: obtuse | perpendicular
Intercostal 3° Vein Angle Variability: decreasing exmedially
Epimedial 3°: mixed opp/alt
Admedial Course: obtuse to midvein
Exmedial Course: parallel to intercostal 3°
Exterior 3° Course: looped

Quaternary Vein Fabric: alternate percurrent

Quinternary Vein Fabric: irregular reticulate

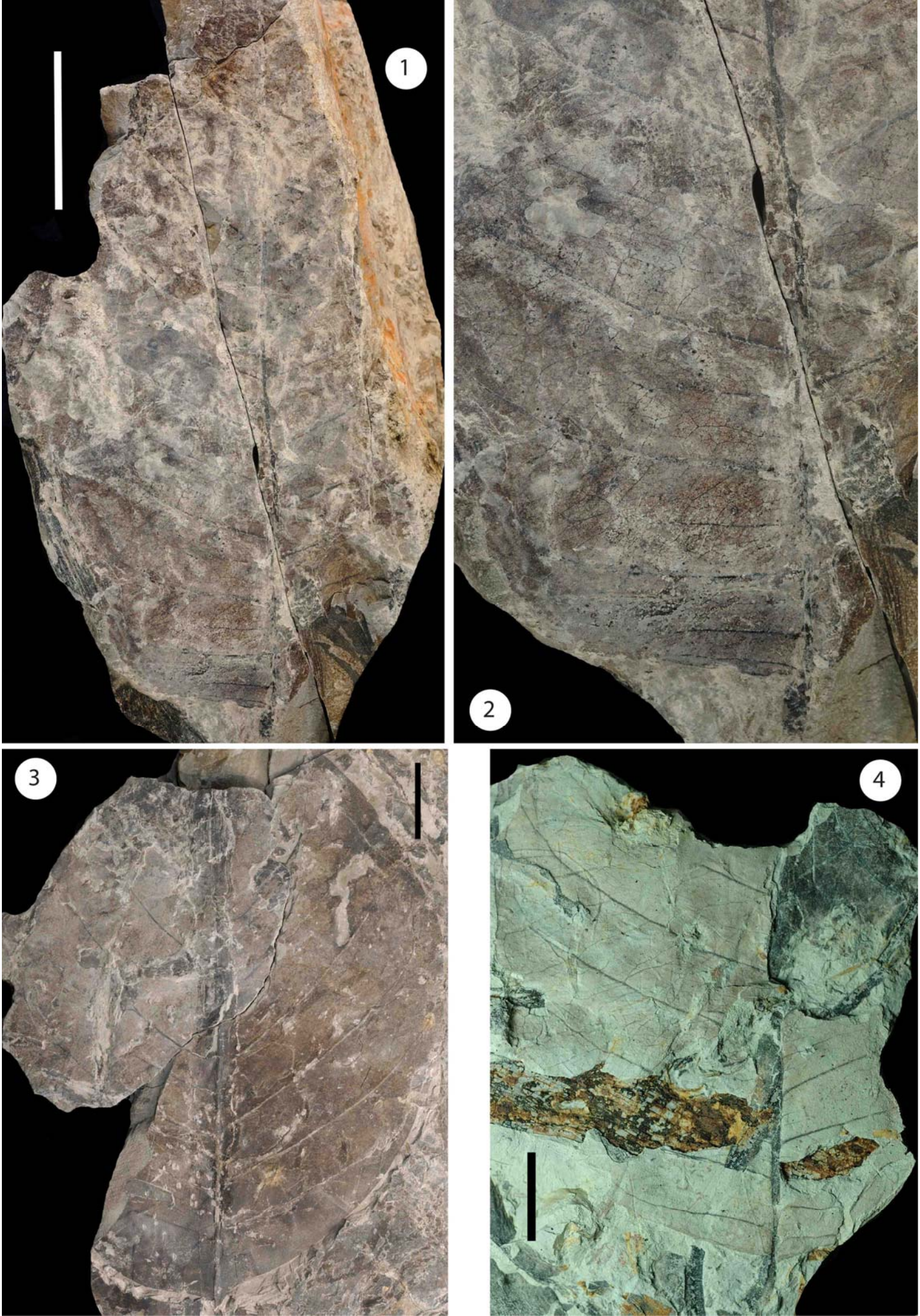
Areolation:
F.E.V.s Course:
F.E.V.s Terminae:
Marginal Ultimate Venation:

## Diagnostic Features

Petiole base pulvinulate and striated. Secondary vein spacing decreasing proximally. Secondary vein angle smoothly increasing proximally (from ~45° to ~90°). Intersecondary veins with a length ~50% of subjacent secondary and frequency ~1 per intercostal area. Intercostal tertiary vein fabric opposite percurrent with straight to sinuous courses.

## Description

Petiole base pulvinulate and striated. Blade attachment marginal. Laminar size notophyll to mesophyll (the biggest specimen is ~16 cm long and ~13 cm wide). Laminar shape elliptic. Leaves medially and basally symmetrical. Unlobed. Margin entire. Apex angle acute and shape convex. Base angle obtuse. Base shape convex to rounded. Primary vein framework pinnate. Number of basal veins 1-3. Major secondary vein framework eucamptodromous (10-14 pairs of veins). Minor secondary veins course simple brochidodromous. Fimbrial vein. Major secondary vein spacing decreasing proximally (ranging from 2.5 cm to 0.5 cm). Variation of secondary vein angle smoothly increasing proximally (from ~45° to ~90°). Major secondary vein attachment excurrent to decurrent. Intersecondary vein proximal course parallel to major secondaries; length ~50% of subjacent secondary; distal course perpendicular to subjacent major secondary; frequency ~1 per intercostal area. Intercostal tertiary vein fabric opposite percurrent with courses straight to sinuous. Angle of percurrent tertiaries obtuse to perpendicular. Intercostal tertiary vein angle variability decreasing exmedially. Epimedial tertiary veins mixed opp/alt percurrent; admedial course obtuse to midvein; exmedial course parallel to intercostal tertiaries. Exterior course looped. Tertiary and intersecondary veins decurrent on midvein. Quaternary vein fabric alternate percurrent. Quinternary vein fabric irregular reticulate.


1
2
3
4

**CERREJON FLORA** | Morphotype Name: *incertae sedis* | Morphotype #: CJ40

Major Plant Group: DIC | Organ Type: Leaf | Morphotyper: | Type loc. #: | Type spec. #:

Plant Family/order: | Loca:

## Section I. Leaf Characters

Leaf Attachment:
Leaf Arrangement:
Leaf Organization:
Leaflet Organization:
Leaflet Attachment:
Petiole Features: long

### Features of the Blade

Position of Blade Attachment: marginal
Laminar Size (smallest): microphyll
Laminar Size (largest): macrophyll
Laminar L:W Ratio:
Laminar Shape: ovate | elliptic
Medial Symmetry: symmetrical
Base Symmetry: symmetrical
Lobation: unlobed
Margin Type: untoothed
Margin Features:
Apex Angle: acute to obtuse
Apex Shape: straight | convex
Base Angle: obtuse
Base Shape: cordate - convex | rounded
Terminal Apex Features: mucronate
Surface Texture:
SurficialGlands:
Stomata:
Cuticle Features:

## Section III. Teeth

Tooth Spacing:
# of Orders:
Teeth/cm:
Sinus Shape:
Tooth Shape:
Tooth Shape:
Principal Vein:
Accesory Vein:
Principal Vein Termination:
Course of Accesory Vein:
Features of the Tooth Apex:

## Similar Morphotypes

## Section II. Venation

1° Vein Framework: pinnate
Naked Basal Veins: absent
# of Basal Veins: 3-5
Agrophic Veins: simple to compound

Major 2° Vein Framework (costal): simple brochidodromous | # 5-8
Interior Secondaries:
Minor 2° Course: simple brochidodromous
Perimarginal Veins: fimbrial vein
Major 2° Spacing (costal): decreasing proximally
Variation of 2° Vein Angle (costal): abruptly increasing proximally
Major 2° Vein Attachment (costal): excurrent

Inter-2° Vein Proximal Course:
Inter-2° Vein Lenght:
Inter-2° Vein Distal Course:
Inter-2° Vein Frequency:

Intercostal 3° Vein Fabric: percurrent
Course of Percurrent 3°: opposite sinuous | opposite convex, straight
Angle of Percurrent 3°: perpendicular | obtuse
Intercostal 3° Vein Angle Variability: decreasing exmedially | increasing proximally
Epimedial 3°: opposite percurrent
Admedial Course: perpendicular to midvein | acute to midvein
Exmedial Course: parallel to intercostal 3°
Exterior 3° Course: looped

Quaternary Vein Fabric: mixed percurrent | irregular reticulate

Quinternary Vein Fabric: irregular reticulate

Areolation: good development
F.E.V.s Course:
F.E.V.s Terminae:
Marginal Ultimate Venation:

## Diagnostic Features

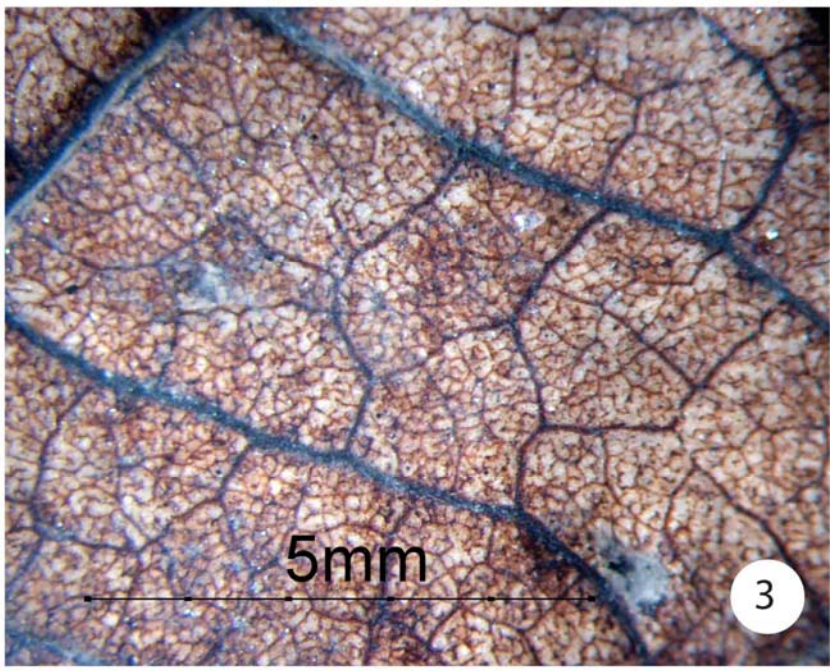
Pinnate. Base cordate. Secondaries brochidodromous. Secondary spacing decreasing proximally. Secondary vein angle abruptly increasing proximally. Tertiaries opposite percurrent with course strongly sinuous. Tertiary angle decreasing exmedially and increasing proximally. Quaternaries mixed opp/alt percurrent to irregular reticulate. Quinternaries irregular reticulate. Areolation development good (tiny and rounded areoles).

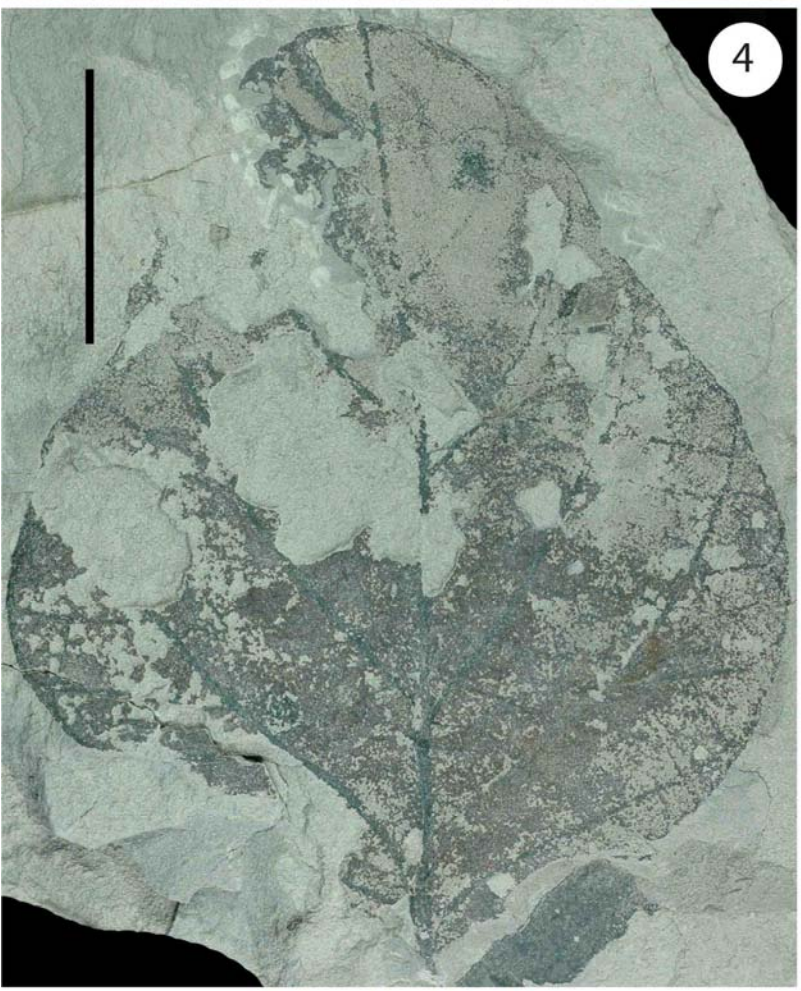
## Description

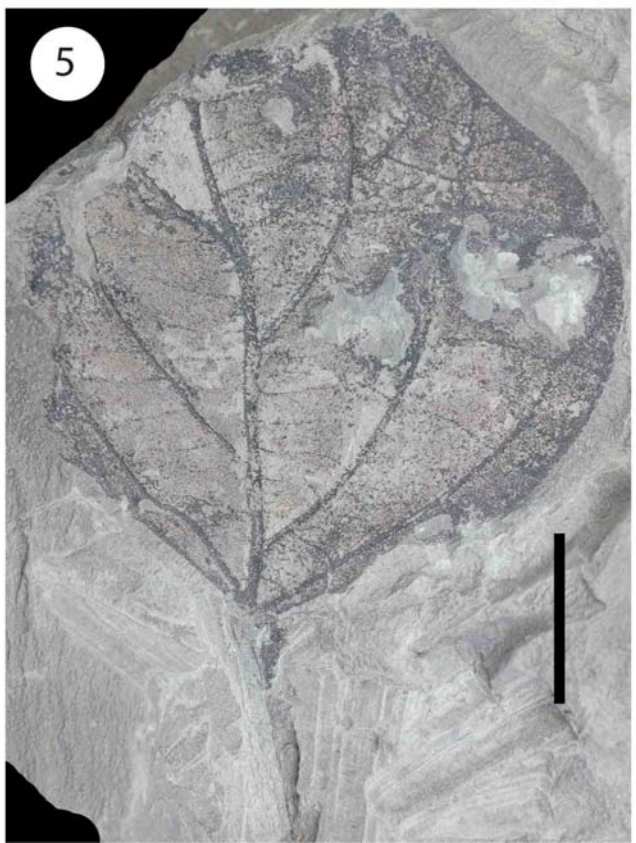
Petiole long (>4 cm). Blade attachment marginal. Laminar size microphyll to macrophyll (the biggest specimen is >15 cm long and ~15 cm wide). Laminar shape ovate to elliptic. Leaves medially and basally symmetrical. Unlobed. Margin entire. Apex angle acute to obtuse. Apex shape straight to convex. Base angle obtuse. Base shape cordate, convex to rounded. Terminal apex features sometimes mucronate. Primary vein framework pinnate. Number of basal veins 3-5. Agrophic veins simple to compound. Major secondary vein framework simple brochidodromous (5-8 pairs of veins). Minor secondary vein course simple brochidodromous. Fimbrial vein. Major secondary vein spacing decreasing proximally. Variation of secondary vein angle abruptly increasing proximally; for leaves with cordate bases the angle varies from ~60° to ~90°; for leaves with convex-rounded bases the angle varies from ~25° to ~52°. Major secondary vein attachment excurrent. Intercostal tertiary vein fabric opposite percurrent with courses sinuous (strongly), convex and straight (spaced from 1.5 mm to ~4 mm). Angle of percurrent tertiary veins perpendicular to obtuse. Intercostal tertiary vein angle variability decreasing exmedially and increasing proximally. Epimedial tertiary veins opposite percurrent; admedial course perpendicular and acute to midvein; exmedial course parallel to intercostal tertiaries; Exterior course looped. Quaternary vein fabric mixed opp/alt percurrent to irregular reticulate. Quinternary vein fabric irregular reticulate. Areolation development good (tiny and rounded areoles).


1


2


5mm
3


4


5

**CERREJON FLORA** | Morphotype Name: *incertae sedis* | Morphotype #: CJ41

Major Plant Group: DIC | Organ Type: Leaf | Morphotyper: | Type loc. #: | Type spec. #:

Plant Family/order: | Loca:

## Section I. Leaf Characters

Leaf Attachment:
Leaf Arrangement:
Leaf Organization:
Leafleet Organization:
Leaflet Attachment:
Petiole Features:

### Features of the Blade

Position of Blade Attachment: marginal
Laminar Size (smallest): mesophyll
Laminar Size (largest): macrophyll
Laminar L:W Ratio:
Laminar Shape: ovate | elliptic
Medial Symmetry: symmetrical
Base Symmetry: symmetrical
Lobation: unlobed
Margin Type: untoothed
Margin Features:
Apex Angle: acute
Apex Shape: straight | acuminate
Base Angle: obtuse
Base Shape: cordate | rounded
Terminal Apex Features:
Surface Texture:
SurficialGlands:
Stomata:
Cuticle Features:

## Section III. Teeth

Tooth Spacing:
# of Orders:
Teeth/cm:
Sinus Shape:
Tooth Shape:
Tooth Shape:
Principal Vein:
Accesory Vein:
Principal Vein Termination:
Course of Accesory Vein:
Features of the Tooth Apex:

## Similar Morphotypes

## Section II. Venation

1° Vein Framework: pinnate
Naked Basal Veins: absent
# of Basal Veins: 5
Agrophic Veins: absent

Major 2° Vein Framework (costal): eucamptodromous | # 6-8 pairs
Interior Secondaries:
Minor 2° Course: simple brochidodromous
Perimarginal Veins: fimbrial vein
Major 2° Spacing (costal): abruptly decreasing proximally
Variation of 2° Vein Angle (costal): smoothly increasing proximally
Major 2° Vein Attachment (costal): decurrent

Inter-2° Vein Proximal Course: parallel to major secondaries
Inter-2° Vein Lenght: >50% of subjacent secondary
Inter-2° Vein Distal Course: basiflexed
Inter-2° Vein Frequency: <1 per intercostal area

Intercostal 3° Vein Fabric: percurrent
Course of Percurrent 3°: opposite sinuous | opposite convex
Angle of Percurrent 3°: perpendicular | obtuse
Intercostal 3° Vein Angle Variability: increasing proximally
Epimedial 3°: opposite percurrent
Admedial Course: perpendicular to midvein | acute to midvein
Exmedial Course: parallel to intercostal 3°
Exterior 3° Course: looped

Quaternary Vein Fabric: irregular reticulate

Quinternary Vein Fabric:

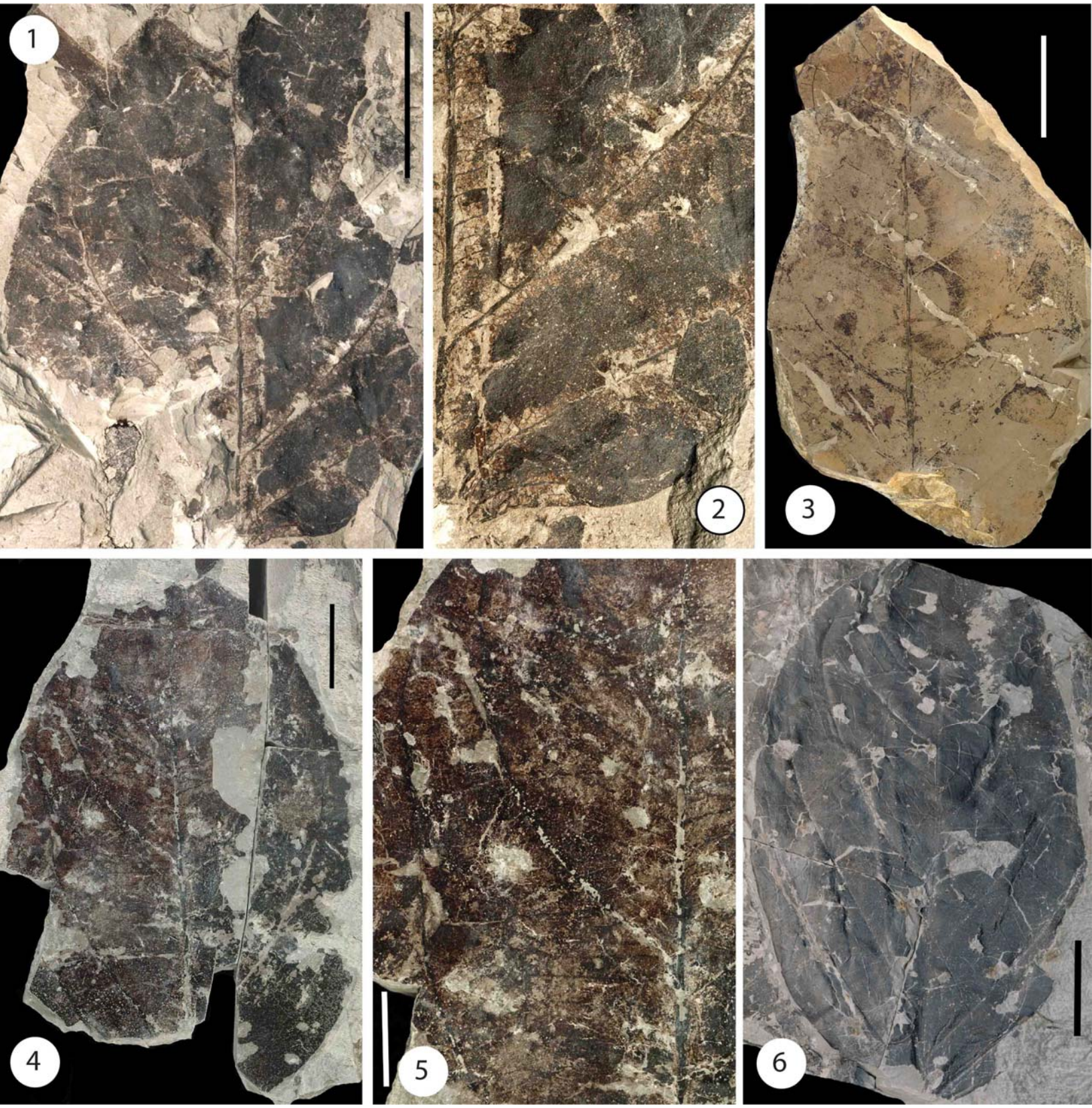
Areolation:
F.E.V.s Course:
F.E.V.s Terminae:
Marginal Ultimate Venation:

## Diagnostic Features

Secondaries eucamptodromous (6-8 pairs). Secondary spacing abruptly decreasing proximally with a relative long space between basal 2-3 and more distal secondaries. Intersecondary veins with length >50% and frequency <1. Epimedial tertiaries opposite percurrent, decurrent, perpendicular and acute to midvein. Tertiary angle increasing proximally.

## Description

Blade attachment marginal. Laminar size mesophyll to macrophyll (the biggest specimen is ~13 cm long and ~9 cm wide). Laminar shape ovate to elliptic. Leaves medially and basally symmetrical. Unlobed. Margin entire. Apex angle acute. Apex shape straight to acuminate. Base angle obtuse. Base shape cordate to rounded. Primary vein framework pinnate. Number of basal veins 5. Major secondary vein framework eucamptodromous (6-8 pairs of veins). Minor secondary vein course simple brochidodromous. Fimbrial vein. Major secondary vein spacing abruptly decreasing proximally (varying from ~1 cm to ~3 cm, relative long space between basal 2-3 and more distal costal secondaries). Variation of secondary vein angle smoothly increasing proximally (from ~40° to ~60°; and having a pair of secondaries at the petiole insertion at ~90° to midvein). Major secondary vein attachment decurrent. Intersecondary vein proximal course parallel to major secondaries; length >50% of subjacent secondary; distal course basiflexed; frequency <1 per intercostal area. Intercostal tertiary vein fabric opposite percurrent with courses sinuous to convex (spaced from ~2 mm to ~7 mm). Angle of percurrent tertiary veins perpendicular to obtuse. Intercostal tertiary vein angle variability increasing proximally. Epimedial tertiary veins opposite percurrent; admedial course perpendicular and acute to midvein (the angle decreasing distally); exmedial course parallel to intercostal tertiaries. Exterior tertiary vein course looped. Tertiary veins attachment decurrent. Quaternary vein fabric irregular reticulate.


1
2
3
4
5
6

**CERREJON FLORA**

Morphotype Name: *Salvinia sp.* | Morphotype #: CJ42

Major Plant Group: PTE | Organ Type: Leaf | Morphotyper: | Type loc. #: | Type spec. #:

Plant Family: Salviniaceae | Genus: *Salvinia* | Loca:

### Rhizome Characters

Rhizome Type:
Rhizome Lenght:
Special Features:

### Frond Characters

Frond Type:
Frond Attachment:
F. Organization: simple
Petiole Features:
Laminar Size (smallest): nanophyll
Laminar Size (largest): microphyll

### Features of the Pinnae

Pinnae Attachment:
Frond Shape: elliptic
Base Symmetry: symmetrical
Lobation: unlobed
Margin Type: untoothed
Margin Features:
Apex Angle: obtuse
Apex Shape: emarginate
Base Angle: obtuse
Base Shape: cordate
Surface Texture:
Scales & Hairs:

### Teeth Features

Tooth Spacing:
# of Orders:
Teeth/cm:
Sinus Shape:
Tooth Shape:
Tooth Shape:
Principal Vein:
Accesory Vein:
Principal Vein Termination:
Course of Accesory Vein:
Features of the Tooth Apex:

### Similar Morphotypes

### Venation of the Pinnae and/or Pinnule

1° Costa Framework: pinnate
# of Basal Costa:
Costule Framework:
# of Basal Costa:

Major 2° Vein Framework:
Interior Secondaries:
Perimarginal Veins:
Major 2° Spacing:
Variation of 2° Vein Angle:
Major 2° Vein Attachment:

Areolation: quadrangular
Veinlets Course:
Veinlets Terminae:
Marginal Ultimate Venation:

### Sporangia

Sori and Indusia:
Sorus Position:

### Vascular Bundles

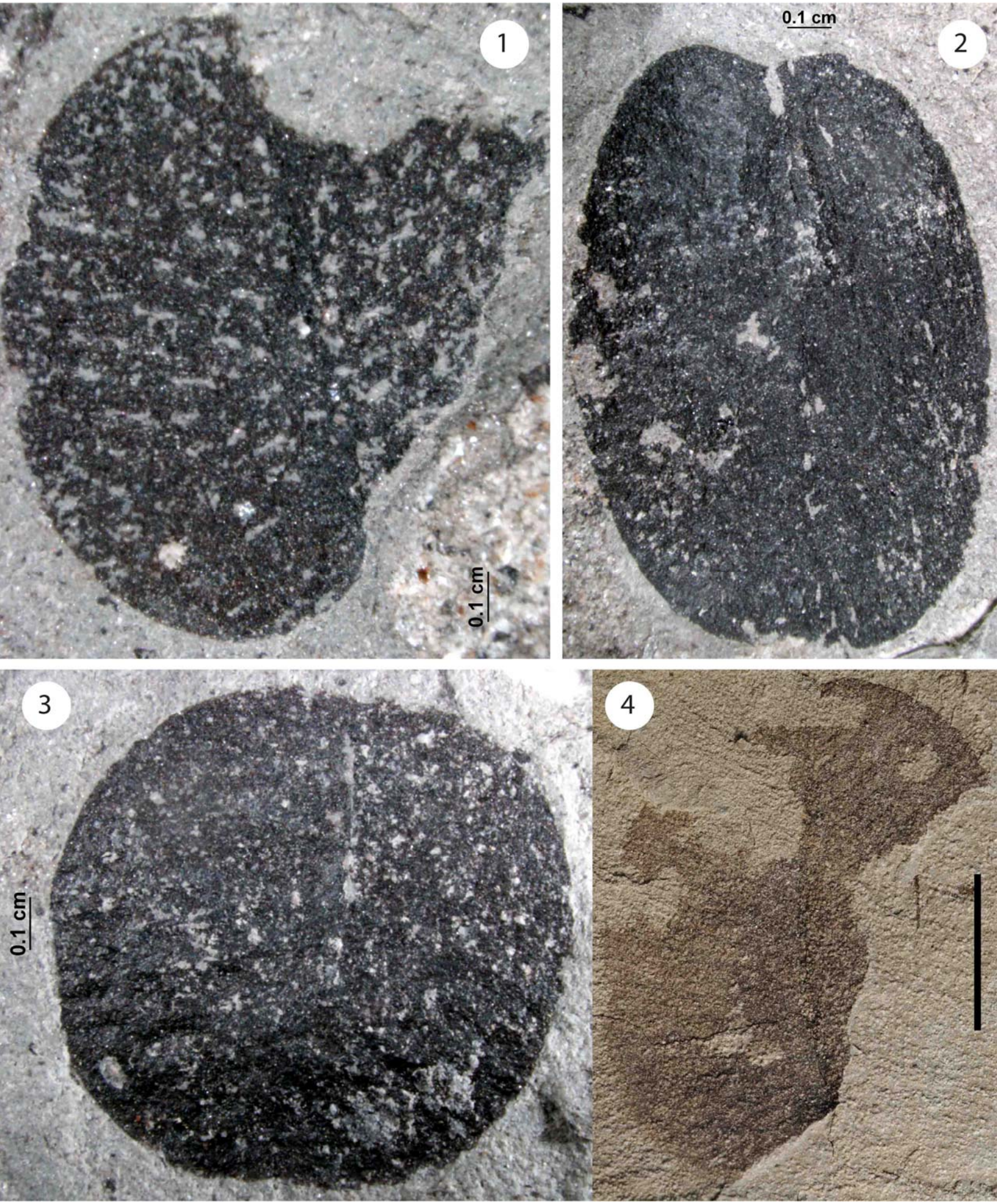
Type:

### Diagnostic Features

Frond organization simple. Frond shape elliptic. Apex emarginate and base cordate. Higher order veins forming quadrangular areolation.

### Description

Frond organization simple. Laminar size nanophyll to microphyll. The frond shape is elliptic and symmetrical. The base and apex shapes are indistinguishable on the specimens, but they are cordate or emarginate respectively. Margin entire. Costa framework pinnate, thin and sometimes is slightly curved. Higher order venation is characterized by a quadrangular areolation that forms rows from costa to the margin; these rows are oriented at >90° proximally respect to costa and decrease at acute angles near apex.


1
0.1 cm
2
0.1 cm
3
0.1 cm
4

**CERREJON FLORA** | Morphotype Name: *incertae sedis* | Morphotype #: CJ43

Major Plant Group: DIC | Organ Type: Leaf | Morphotyper: | Type loc. #: | Type spec. #:

Plant Family/order: | Loca:

## Section I. Leaf Characters

Leaf Attachment:
Leaf Arrangement:
Leaf Organization:
Leafleet Organization:
Leaflet Attachment:
Petiole Features:

### Features of the Blade

Position of Blade Attachment: marginal
Laminar Size (smallest): notophyll
Laminar Size (largest): macrophyll
Laminar L:W Ratio:
Laminar Shape: elliptic | ovate
Medial Symmetry: asymmetrical
Base Symmetry: asymmetrical
Lobation: unlobed
Margin Type: crenate | serrate
Margin Features:
Apex Angle: obtuse
Apex Shape: convex | acuminate
Base Angle: obtuse
Base Shape: concavo-convex | convex - complex
Terminal Apex Features:
Surface Texture:
SurficialGlands:
Stomata:
Cuticle Features:

## Section III. Teeth

Tooth Spacing: irregular
# of Orders: one
Teeth/cm: 0-3
Sinus Shape: rounded
Tooth Shape: cv/cv | cv/cc
Tooth Shape: rt/rt
Principal Vein: present
Accesory Vein: present
Principal Vein Termination: on distal flank
Course of Accesory Vein: convex looped
Features of the Tooth Apex: foraminate -none

## Similar Morphotypes

## Section II. Venation

1° Vein Framework: pinnate
Naked Basal Veins: absent
# of Basal Veins: 1-3
Agrophic Veins: compound

Major 2° Vein Framework (costal): craspedodromous | # 12-15 pairs
Interior Secondaries:
Minor 2° Course: craspedodromous
Perimarginal Veins: fimbrial vein
Major 2° Spacing (costal): decreasing proximally and distally - irregular
Variation of 2° Vein Angle (costal): smoothly increasing proximally
Major 2° Vein Attachment (costal): excurrent

Inter-2° Vein Proximal Course:
Inter-2° Vein Lenght:
Inter-2° Vein Distal Course:
Inter-2° Vein Frequency:

Intercostal 3° Vein Fabric: percurrent
Course of Percurrent 3°: opposite sinuous and convex | opposite straight
Angle of Percurrent 3°: obtuse | perpendicular
Intercostal 3° Vein Angle Variability: decreasing exmedially | increasing proximally
Epimedial 3°: opposite percurrent
Admedial Course: perpendicular to midvein | obtuse to midvein
Exmedial Course: parallel to intercostal 3°
Exterior 3° Course: terminating at margin | looped

Quaternary Vein Fabric: mixed percurrent | irregular reticulate

Quinternary Vein Fabric: irregular reticulate

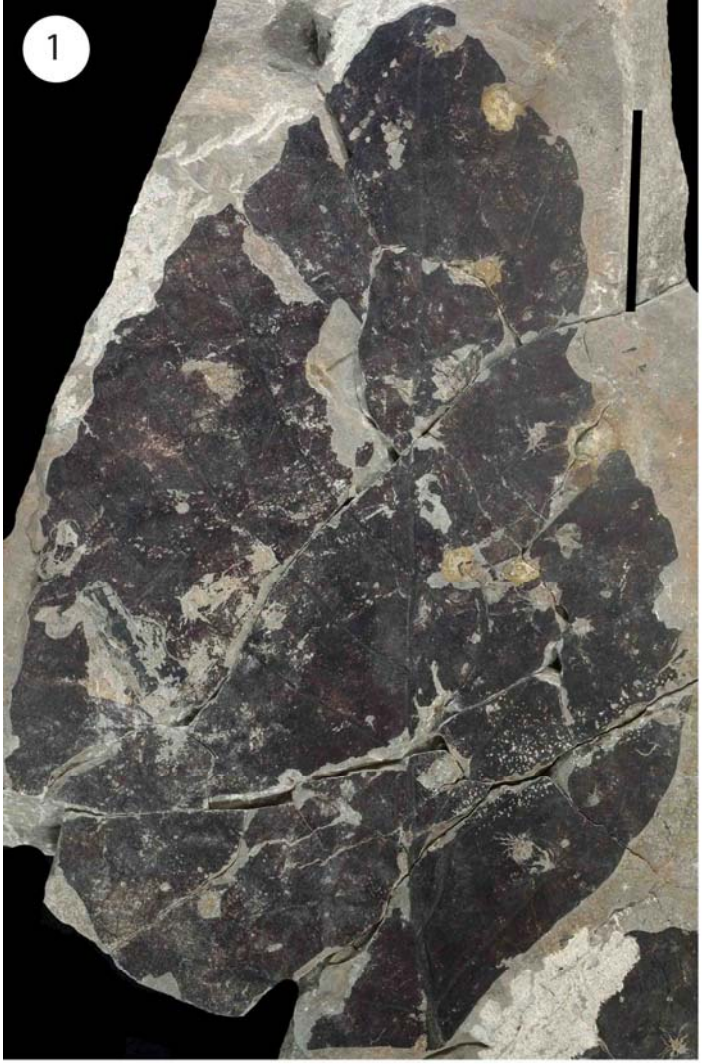
Areolation: moderate development
F.E.V.s Course:
F.E.V.s Terminae:
Marginal Ultimate Venation:

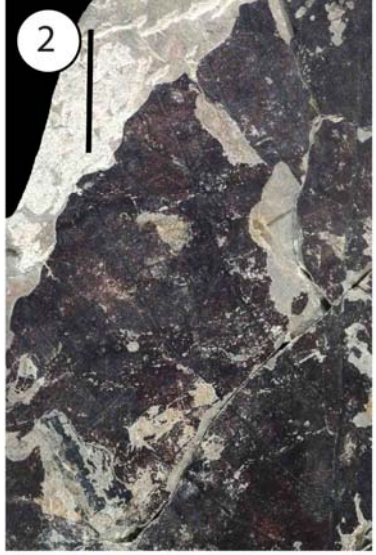
### Diagnostic Features

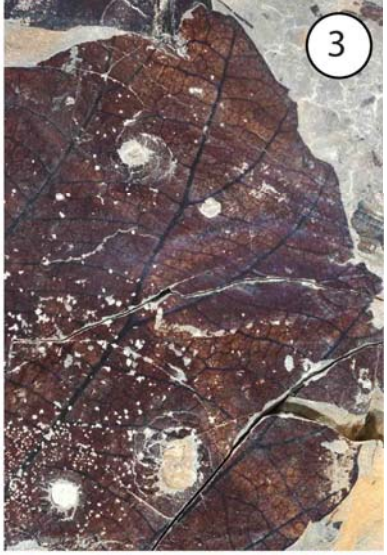
Leaves medially and basally asymmetrical. Secondaries craspedodromous with agrophic veins compound. Secondary vein angle increasing proximally. Tertiaries opposite percurrent. Tertiary vein angle decreasing exmedially and increasing proximally. Margin crenate/serrate. Tooth shape cv/cv, cv/cc, and rt/rt. Tooth apex foraminate to none.

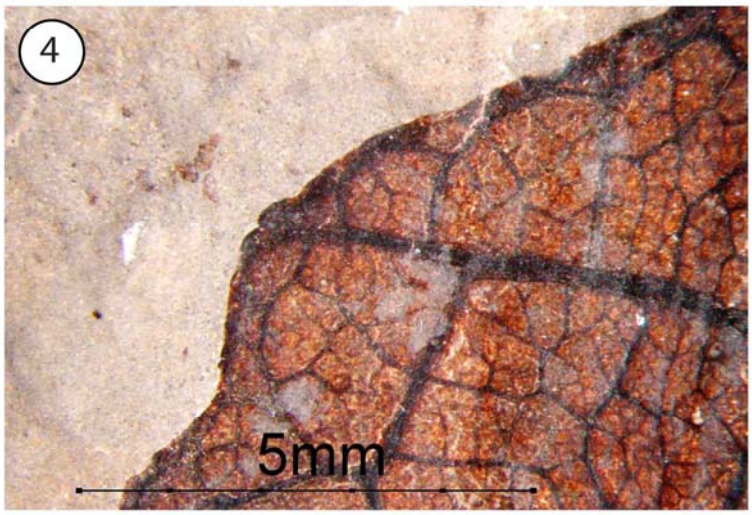
### Description

Blade attachment marginal. Laminar size notophyll to macrophyll (the biggest specimen is >20 cm long and ~16 cm wide). Laminar shape elliptic to ovate. Leaves medially and basally asymmetrical. Unlobed. Apex angle obtuse. Apex shape convex to acuminate. Base angle obtuse. Base shape concavo-convex, convex to complex. Primary vein framework pinnate. Number of basal veins 1 to 3. Agrophic veins compound. Major secondary vein framework craspedodromous (12-15 pairs of veins). Minor secondary veins course craspedodromous. Fimbrial vein. Major secondary vein spacing decreasing proximally and distally to irregular. Variation of secondary vein angle smoothly increasing proximally (from ~30° to ~80°). Major secondary vein attachment excurrent. Intercostal tertiary vein fabric opposite percurrent with courses sinuous, convex and straight (spaced from 1 mm to 6 mm). Angle of percurrent tertiary veins obtuse to perpendicular. Intercostal tertiary vein angle variability decreasing exmedially and increasing proximally. Epimedial tertiary veins opposite percurrent; admedial course perpendicular and obtuse to midvein; exmedial course parallel to intercostal. Exterior tertiary vein course terminating at margin and looped. Quaternary vein fabric mixed opp/alt percurrent to irregular reticulate. Quinternary vein fabric irregular reticulate. Areolation development moderate. Margin crenate/serrate; tooth spacing irregular; number of orders one; teeth/cm 0/3 cm; sinus shape rounded; tooth shape cv/cv, cv/cc, and rt/rt; principal and accessory vein present; principal vein termination on distal flank; course of accessory vein convex-looped; features of the tooth apex foraminate to none; basal teeth with long proximal flanks.

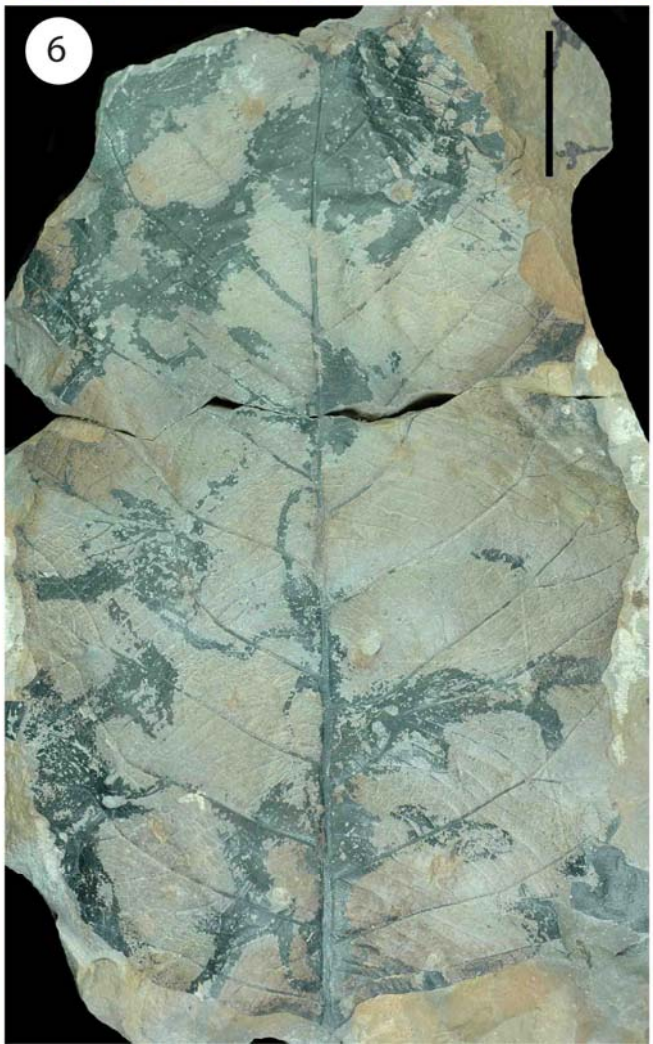

1


2


3


4
5mm


5


6

**CERREJON FLORA** | Morphotype Name: *incertae sedis* | Morphotype #: CJ47

Major Plant Group: MON | Organ Type: Leaf | Morphotyper: | Type loc. #: | Type spec. #:

Plant Family/order: Araceae | Loca:

## Section I. Leaf Characters

Leaf Attachment:
Leaf Arrangement:
Leaf Organization:
Leaflet Organization:
Leaflet Attachment:
Petiole Features:

### Features of the Blade

Position of Blade Attachment:
Laminar Size (smallest): mesophyll
Laminar Size (largest):
Laminar L:W Ratio:
Laminar Shape:
Medial Symmetry:
Base Symmetry:
Lobation:
Margin Type: untoothed
Margin Features:
Apex Angle:
Apex Shape:
Base Angle:
Base Shape:
Terminal Apex Features:
Surface Texture:
SurficialGlands: laminar
Stomata:
Cuticle Features:

## Section III. Teeth

Tooth Spacing:
# of Orders:
Teeth/cm:
Sinus Shape:
Tooth Shape:
Tooth Shape:
Principal Vein:
Accesory Vein:
Principal Vein Termination:
Course of Accesory Vein:
Features of the Tooth Apex:

## Similar Morphotypes

CJ49
CJ64

## Section II. Venation

1° Vein Framework: pinnate?
Naked Basal Veins:
# of Basal Veins:
Agrophic Veins:

Major 2° Vein Framework (costal): parallelodromous | #:
Interior Secondaries:
Minor 2° Course:
Perimarginal Veins: intramarginal secondary
Major 2° Spacing (costal): regular
Variation of 2° Vein Angle (costal): inconsistent
Major 2° Vein Attachment (costal): decurrent

Inter-2° Vein Proximal Course:
Inter-2° Vein Lenght:
Inter-2° Vein Distal Course:
Inter-2° Vein Frequency:

Intercostal 3° Vein Fabric: reticulate irregular
Course of Percurrent 3°:
Angle of Percurrent 3°:
Intercostal 3° Vein Angle Variability:
Epimedial 3°:
Admedial Course:
Exmedial Course:
Exterior 3° Course:

Quaternary Vein Fabric:

Quinternary Vein Fabric:

Areolation:
F.E.V.s Course:
F.E.V.s Terminae:
Marginal Ultimate Venation:

## Diagnostic Features

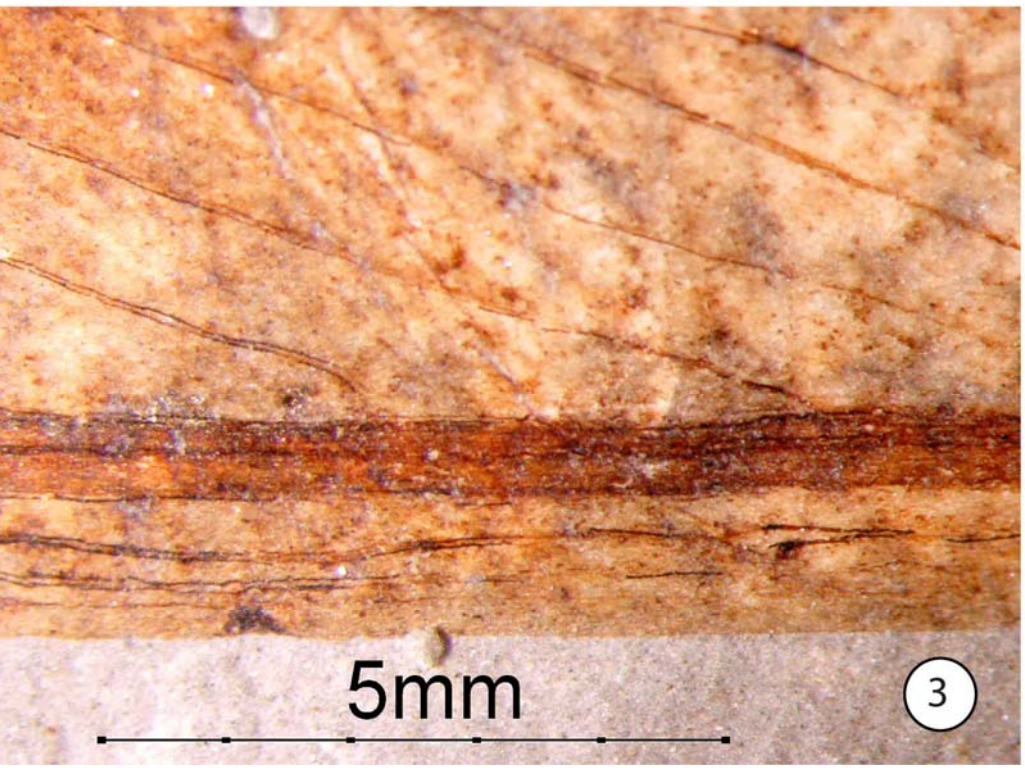
Midrib multistranded. Secondary vein framework parallelodromous, numerous, closely spaced and decurrent on midrib. Several intramarginal veins, but just one collects the secondaries, steeply and at very obtuse angles. Very small laminar black dots.

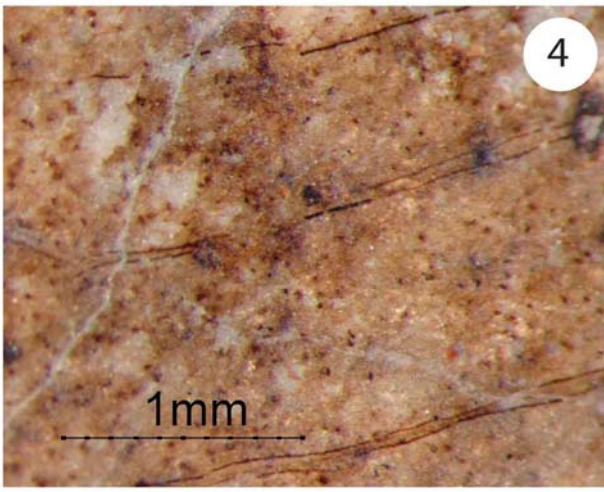
## Description

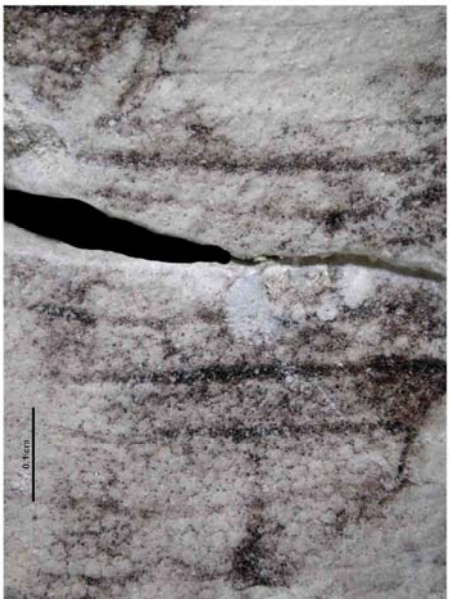
Laminar size mesophyll (the specimen is >9 cm long and ~7 cm wide). Margin entire. Laminar black dots. Midrib multistranded, possibly pinnate. Major secondary vein framework parallelodromous, very numerous, closely spaced (from 0.6 mm to 1.05 mm, measured exmedially) and decurrent on midrib. The angle of the secondaries inconsistent, very acute on primary (<20°), then the angle increases to ~60° to finally decreases again when the veins ascending exmedially. Intramarginal vein (~0.6 mm of thickness) collects the secondary veins steeply at very obtuse angles. From two to three very thin, minor outermarginal veins parallel the main intramarginal. The leaf tissue measured from the intramarginal to the physical margin does not exceed 1.08 mm. Tertiary vein framework irregular reticulate, rounded in shape that varies in size from 0.16 to 0.3 mm.


1


2


5mm
3


4
1mm


5

**CERREJON FLORA** | Morphotype Name: *incertae sedis* | Morphotype #: CJ48

Major Plant Group: DIC | Organ Type: Leaf | Morphotyper: | Type loc. #: | Type spec. #:

Plant Family/order: Theaceae | Loca:

## Section I. Leaf Characters

Leaf Attachment:
Leaf Arrangement:
Leaf Organization:
Leaflet Organization:
Leaflet Attachment:
Petiole Features: short

### Features of the Blade

Position of Blade Attachment: marginal
Laminar Size (smallest): notophyll
Laminar Size (largest): mesophyll
Laminar L:W Ratio:
Laminar Shape: ovate
Medial Symmetry: symmetrical
Base Symmetry: symmetrical
Lobation: unlobed
Margin Type: serrate | crenate
Margin Features:
Apex Angle: acute
Apex Shape: acuminate
Base Angle: obtuse
Base Shape: cordate
Terminal Apex Features:
Surface Texture:
Surficial Glands:
Stomata:
Cuticle Features:

## Section III. Teeth

Tooth Spacing: regular
# of Orders: one
Teeth/cm: 3-4/cm
Sinus Shape: rounded
Tooth Shape: cc/cc
Tooth Shape:
Principal Vein: present
Accesory Vein:
Principal Vein Termination: on distal flank
Course of Accesory Vein:
Features of the Tooth Apex: spherulate

## Similar Morphotypes

CJ27

## Section II. Venation

1° Vein Framework: actinodromous basal (3 veins)
Naked Basal Veins: absent
# of Basal Veins: 3-5
Agrophic Veins: simple

Major 2° Vein Framework (costal): semicraspedodromous | # 2-4
Interior Secondaries:
Minor 2° Course: semicraspedodromous
Perimarginal Veins:
Major 2° Spacing (costal): gradually increasing proximally
Variation of 2° Vein Angle (costal): uniform
Major 2° Vein Attachment (costal): slightly decurrent

Inter-2° Vein Proximal Course:
Inter-2° Vein Lenght:
Inter-2° Vein Distal Course:
Inter-2° Vein Frequency:

Intercostal 3° Vein Fabric: percurrent
Course of Percurrent 3°: opposite convex | opposite sinuous
Angle of Percurrent 3°: perpendicular | obtuse
Intercostal 3° Vein Angle Variability: consistent
Epimedial 3°: opposite percurrent
Admedial Course: perpendicular to midvein | acute to midvein
Exmedial Course: parallel to intercostal 3°
Exterior 3° Course:

Quaternary Vein Fabric: irregular reticulate

Quinternary Vein Fabric:

Areolation:
F.E.V.s Course:
F.E.V.s Terminae:
Marginal Ultimate Venation:

## Diagnostic Features

Basal actinodromous, the three primary veins running up to 2/3 of the blade at very acute angles. Few costal secondary veins (2 to 4) located distally and leaving a big gap with the basal veins. Agrophic veins simple and going up to 2/3 of the blade. Margin serrate to crenate (cc/cc). Teeth with spherulate apexes.

## Description

Petiole short. Blade attachment marginal. Laminar size notophyll to mesophyll (the biggest specimen is ~15 cm long and 8.5 cm wide). Laminar shape ovate. Leaves medially and basally symmetrical. Unlobed. Apex angle acute and shape acuminate. Base angle obtuse and shape cordate. Primary vein framework basal actinodromous (three main veins). The two exterior primary veins running up to 2/3 of the blade at very acute angles. Naked basal veins absent. Number of basal veins 3 to 5. Agrophic veins simple and going up to 2/3 of the blade. Major secondary vein framework semicraspedodromous (2 to 4 pairs of veins). Minor secondary veins semicraspedodromous. Major secondary vein spacing increasing proximally; there is a big gap between the costal secondaries and the basal primaries. Variation of the secondary vein angle uniform. Major secondary vein attachment slightly decurrent. Intercostal tertiary vein fabric opposite percurrent with courses sinuous and convex. Angle of percurrent tertiaries perpendicular to obtuse. Intercostal tertiary vein angle variability consistent. Epimedial tertiaries opposite percurrent; admedial course perpendicular to midvein; exmedial course parallel to intercostal tertiaries. Quaternary vein fabric irregular reticulate. Margin serrate to crenate; tooth spacing regular; order of teeth one; teeth/cm 3/4 cm; sinus shape rounded; tooth shape cc/cc; principal vein present terminating on distal flank; tooth apex spherulate (with a prominent and spherical projection at the apex).


1

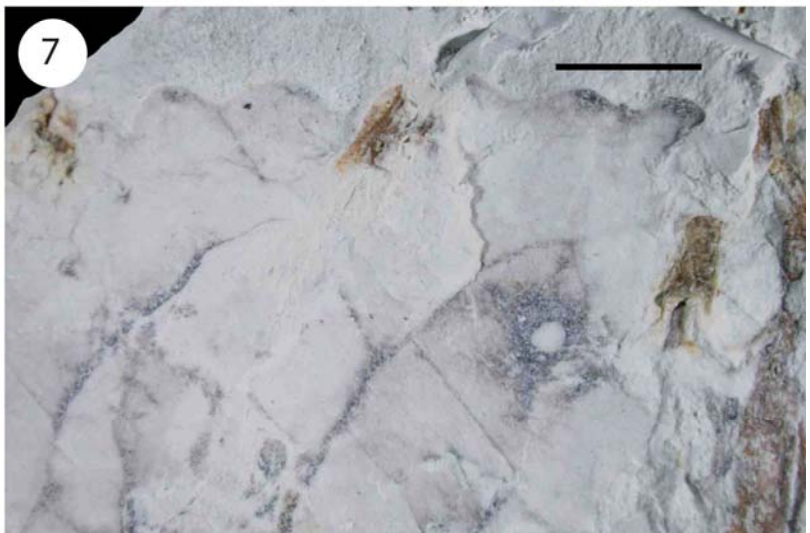

2


3


4
5mm


0.1 cm
5


0.01 cm
6


7

**CERREJON FLORA** | Morphotype Name: *incertae sedis* | Morphotype #: CJ49

Major Plant Group: MON | Organ Type: Leaf | Morphotyper: | Type loc. #: | Type spec. #:

Plant Family/order: | Loca:

## Section I. Leaf Characters

Leaf Attachment:
Leaf Arrangement:
Leaf Organization:
Leaflet Organization:
Leaflet Attachment:
Petiole Features:

### Features of the Blade

Position of Blade Attachment:
Laminar Size (smallest): mesophyll
Laminar Size (largest): macrophyll
Laminar L:W Ratio:
Laminar Shape:
Medial Symmetry:
Base Symmetry:
Lobation: unlobed
Margin Type: untoothed
Margin Features:
Apex Angle:
Apex Shape:
Base Angle: obtuse
Base Shape: decurrent
Terminal Apex Features:
Surface Texture:
SurficialGlands:
Stomata:
Cuticle Features:

## Section III. Teeth

Tooth Spacing:
# of Orders:
Teeth/cm:
Sinus Shape:
Tooth Shape:
Tooth Shape:
Principal Vein:
Accesory Vein:
Principal Vein Termination:
Course of Accesory Vein:
Features of the Tooth Apex:

## Similar Morphotypes

CJ64

## Section II. Venation

1° Vein Framework: pinnate, multistranded
Naked Basal Veins:
# of Basal Veins:
Agrophic Veins:

Major 2° Vein Framework (costal): parallelodromous | #:
Interior Secondaries:
Minor 2° Course:
Perimarginal Veins:
Major 2° Spacing (costal): smoothly decreasing proximally
Variation of 2° Vein Angle (costal): uniform
Major 2° Vein Attachment (costal): decurrent

Inter-2° Vein Proximal Course:
Inter-2° Vein Lenght:
Inter-2° Vein Distal Course:
Inter-2° Vein Frequency:

Intercostal 3° Vein Fabric: parallelodromous
Course of Percurrent 3°:
Angle of Percurrent 3°:
Intercostal 3° Vein Angle Variability:
Epimedial 3°:
Admedial Course:
Exmedial Course:
Exterior 3° Course:

Quaternary Vein Fabric: parallelodromous

Quinternary Vein Fabric: parallelodromous

Areolation:
F.E.V.s Course:
F.E.V.s Terminae:
Marginal Ultimate Venation:

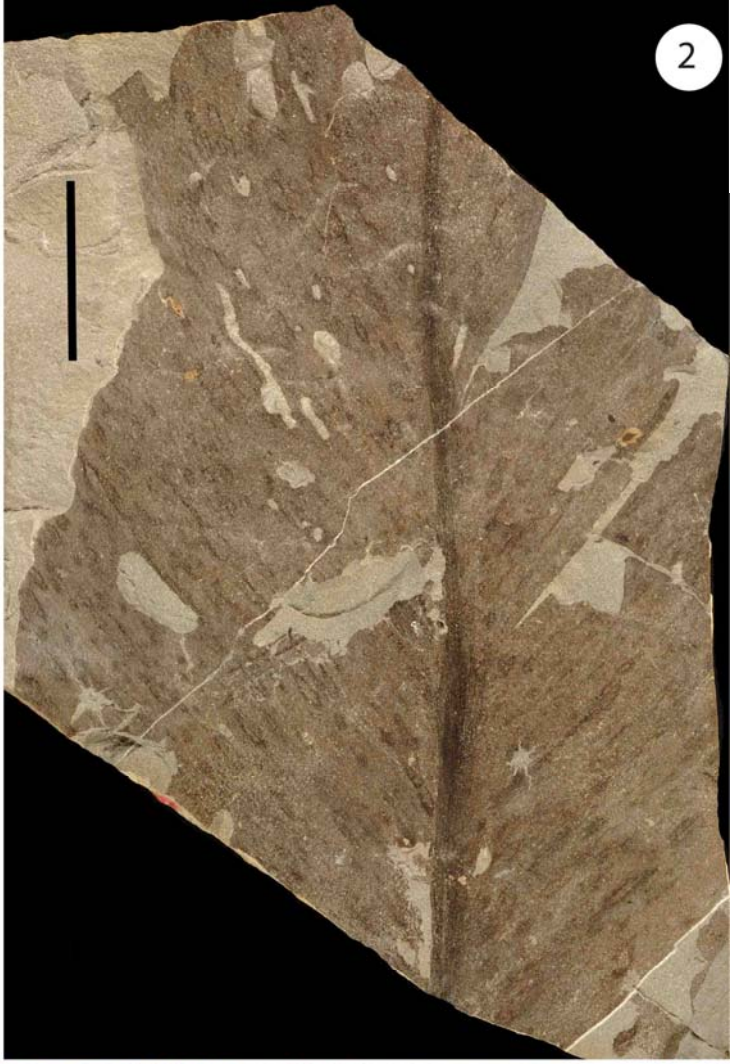
## Diagnostic Features

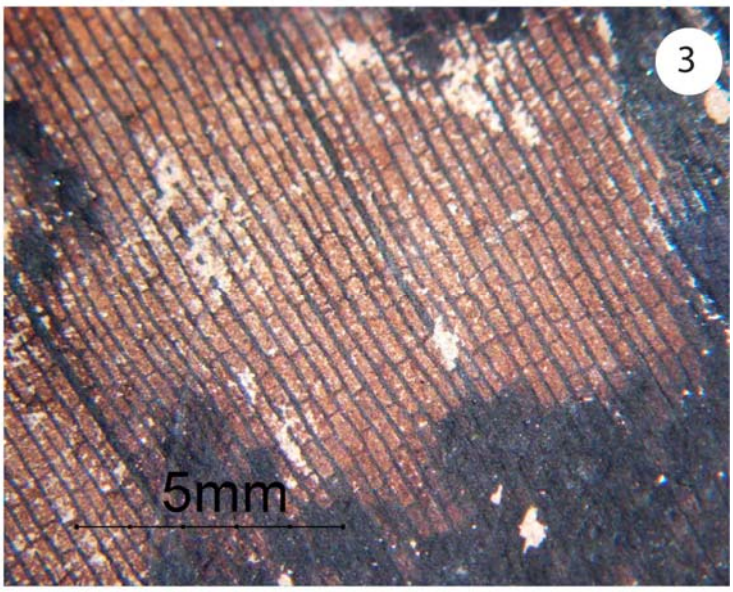
Blade decurrent. Midrib multistranded. Secondary veins parallelodromous (not multistranded). Three subsets of closely spaced veins that alternate and parallel the secondaries. Tiny crossveins lying at 90° on the secondaries and subsets of veins form rectangular areoles without F.E.V.s

## Description

Laminar size mesophyll to macrophyll (the biggest specimen is ~22.3 cm long and ~7.3 cm wide). Margin entire. Base shape decurrent. Midrib pinnate, multistranded and very thick (~0.5 cm) compared to minor vein orders. Major secondary vein framework parallelodromous (not multistranded). Major secondary vein spacing smoothly decreasing proximally (from 1 to 2 cm). Three subsets of veins parallel and alternate in between each pair of secondaries. These subsets of veins are recognized by their width, and independently of their order the spacing ranges from 0.2 to 0.4 mm. The first order lies in the middle of the secondaries and is composed by one single vein. The second subset lies between the secondaries and the first subset and is composed for two veins. The third order constitutes the remainder and majority of veins. Tiny crossveins lying at 90° on the secondaries and subsets of veins form rectangular areoles without F.E.V.s


1


2


3
5mm


4

**CERREJON FLORA** | Morphotype Name: *incertae sedis* | Morphotype #: CJ50

Major Plant Group: DIC | Organ Type: Leaf | Morphotyper: | Type loc. #: | Type spec. #:

Plant Family/order: | Loca:

## Section I. Leaf Characters

Leaf Attachment:
Leaf Arrangement:
Leaf Organization:
Leaflet Organization:
Leaflet Attachment:
Petiole Features:

### Features of the Blade

Position of Blade Attachment: marginal
Laminar Size (smallest): mesophyll
Laminar Size (largest):
Laminar L:W Ratio:
Laminar Shape: elliptic
Medial Symmetry: symmetrical
Base Symmetry: symmetrical
Lobation: unlobed
Margin Type: untoothed
Margin Features:
Apex Angle:
Apex Shape:
Base Angle: obtuse
Base Shape: cordate
Terminal Apex Features:
Surface Texture:
SurficialGlands:
Stomata:
Cuticle Features:

## Section III. Teeth

Tooth Spacing:
# of Orders:
Teeth/cm:
Sinus Shape:
Tooth Shape:
Tooth Shape:
Principal Vein:
Accesory Vein:
Principal Vein Termination:
Course of Accesory Vein:
Features of the Tooth Apex:

## Similar Morphotypes

CJ16
CJ28

## Section II. Venation

1° Vein Framework: pinnate
Naked Basal Veins: absent
# of Basal Veins: 3-5
Agrophic Veins: absent

Major 2° Vein Framework (costal): eucamptodromous | # >11 pairs
Interior Secondaries:
Minor 2° Course: simple brochidodromous
Perimarginal Veins:
Major 2° Spacing (costal): decreasing proximally and distally
Variation of 2° Vein Angle (costal): smoothly increasing proximally
Major 2° Vein Attachment (costal): excurrent

Inter-2° Vein Proximal Course:
Inter-2° Vein Lenght:
Inter-2° Vein Distal Course:
Inter-2° Vein Frequency:

Intercostal 3° Vein Fabric: percurrent
Course of Percurrent 3°: opposite convex - straight | opposite sinuous
Angle of Percurrent 3°: obtuse | perpendicular
Intercostal 3° Vein Angle Variability: decreasing exmedially | increasing proximally
Epimedial 3°: opposite percurrent
Admedial Course: perpendicular to midvein
Exmedial Course: parallel to intercostal 3°
Exterior 3° Course: looped

Quaternary Vein Fabric: alternate percurrent

Quinternary Vein Fabric: irregular reticulate

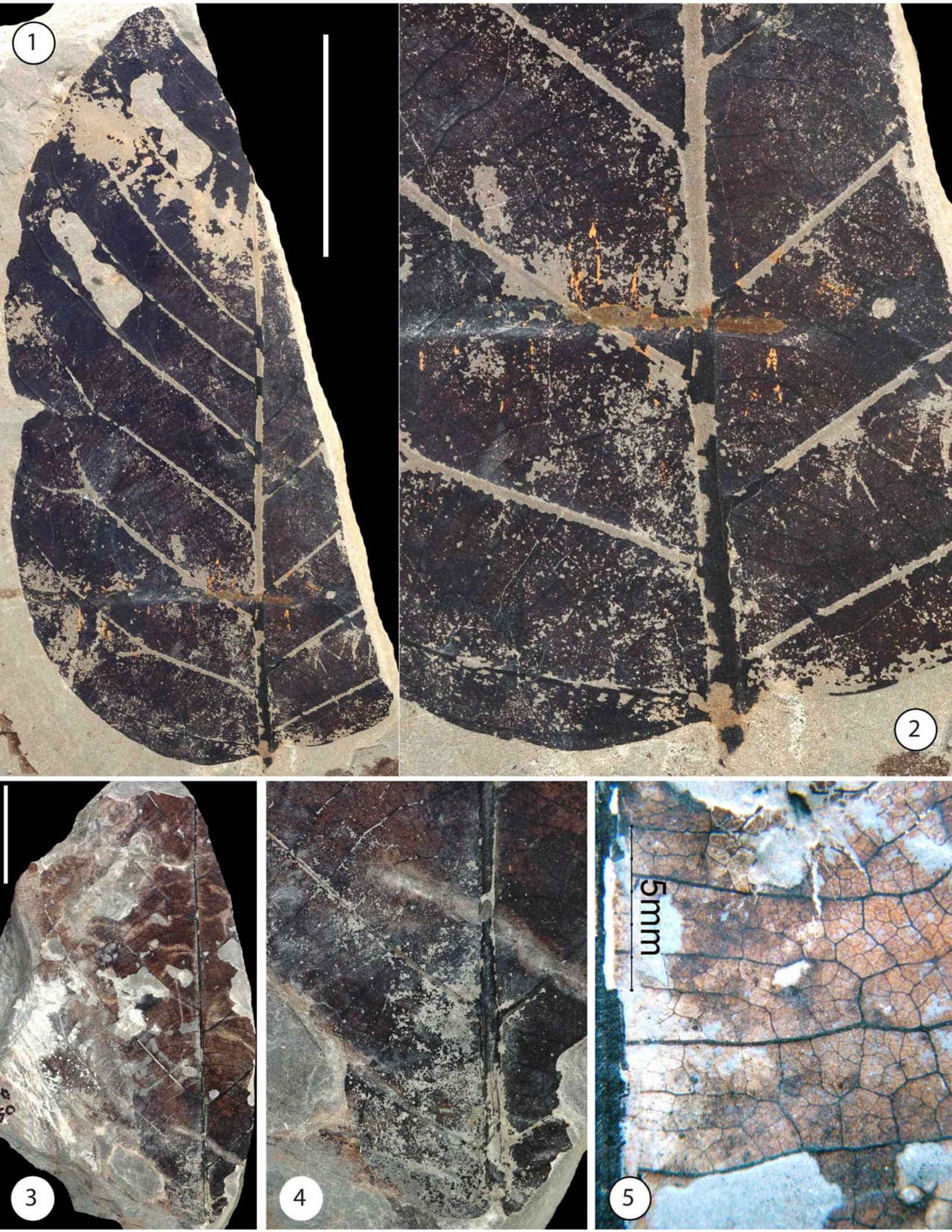
Areolation: poor development
F.E.V.s Course: mostly unbranched | mostly 2 or more branched
F.E.V.s Terminae:
Marginal Ultimate Venation:

## Diagnostic Features

Pinnate. Base shape cordate. Secondaries eucamptodromous (>11 pairs). Secondary vein spacing decreasing proximally and distally. Secondary vein angle smoothly increasing proximally (from ~48° to ~75°). Tertiaries opposite percurrent with courses convex, sinuous, and straight. Quaternaries alternate percurrent. F.E.V.s course unbranched to 2 or more branched.

## Description

Blade attachment marginal. Laminar size mesophyll (the biggest specimen is >17 cm long and ~11 cm wide). Laminar shape elliptic. Leaves medially and basally symmetrical. Unlobed. Margin entire. Base angle obtuse and shape cordate. Primary vein framework pinnate. Number of basal veins 3-5. Major secondary veins eucamptodromous (>11 pairs of veins). Minor secondary vein course simple brochidodromous. Major secondary vein spacing decreasing proximally and distally (varying from 0.5 cm to 3 cm). Variation of secondary vein angle smoothly increasing proximally (from ~48° to ~75°). Major secondary vein attachment excurrent. Intercostal tertiary vein fabric opposite percurrent with courses convex, sinuous, and straight (spaced from 0.2 mm to 7 mm). Angle of percurrent tertiary veins obtuse to perpendicular. Intercostal tertiary vein angle variability decreasing exmedially and increasing proximally. Epimedial tertiary veins opposite percurrent; admedial course perpendicular to midvein; exmedial course parallel to intercostal tertiaries. Exterior tertiary vein course looped. Quaternary vein fabric alternate percurrent. Quinternary vein fabric irregular reticulate. Areolation development poor. F.E.V.s courseunbranched to 2 or more branched.


1
2
3
4
5
5mm

**CERREJON FLORA** | Morphotype Name: *incertae sedis* | Morphotype #: CJ53

Major Plant Group: DIC | Organ Type: Leaf | Morphotyper: | Type loc. #: | Type spec. #:

Plant Family/order: | Loca:

## Section I. Leaf Characters

Leaf Attachment:
Leaf Arrangement:
Leaf Organization:
Leaflet Organization:
Leaflet Attachment:
Petiole Features:

### Features of the Blade

Position of Blade Attachment: marginal
Laminar Size (smallest): mesophyll
Laminar Size (largest):
Laminar L:W Ratio:
Laminar Shape:
Medial Symmetry:
Base Symmetry:
Lobation:
Margin Type: untoothed
Margin Features:
Apex Angle:
Apex Shape:
Base Angle:
Base Shape:
Terminal Apex Features:
Surface Texture:
SurficialGlands: laminar black dots
Stomata:
Cuticle Features:

## Section III. Teeth

Tooth Spacing:
# of Orders:
Teeth/cm:
Sinus Shape:
Tooth Shape:
Tooth Shape:
Principal Vein:
Accesory Vein:
Principal Vein Termination:
Course of Accesory Vein:
Features of the Tooth Apex:

## Similar Morphotypes

## Section II. Venation

1° Vein Framework: actinodromous basal
Naked Basal Veins:
# of Basal Veins: 3
Agrophic Veins:

Major 2° Vein Framework (costal): simple brochidodromous | #:
Interior Secondaries:
Minor 2° Course:
Perimarginal Veins:
Major 2° Spacing (costal):
Variation of 2° Vein Angle (costal):
Major 2° Vein Attachment (costal): excurrent

Inter-2° Vein Proximal Course:
Inter-2° Vein Lenght:
Inter-2° Vein Distal Course:
Inter-2° Vein Frequency:

Intercostal 3° Vein Fabric: percurrent
Course of Percurrent 3°: opposite convex | opposite sinuous
Angle of Percurrent 3°: obtuse | perpendicular
Intercostal 3° Vein Angle Variability:
Epimedial 3°: opposite percurrent
Admedial Course: perpendicular to midvein
Exmedial Course: parallel to intercostal 3°
Exterior 3° Course: looped

Quaternary Vein Fabric: mixed percurrent | irregular reticulate

Quinternary Vein Fabric: freely ramifying

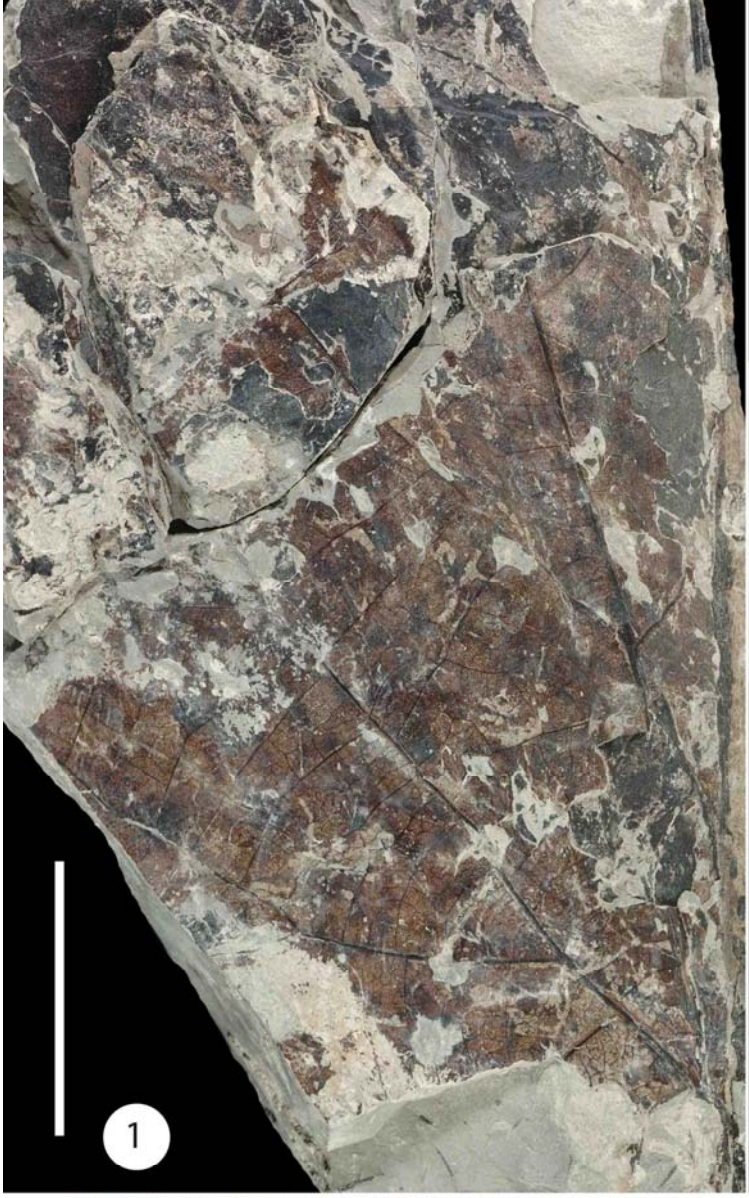
Areolation: poor development
F.E.V.s Course: 1-branched | 2 or more branched
F.E.V.s Terminae:
Marginal Ultimate Venation:

## Diagnostic Features

Primaries basal actinodromous. Tertiary veins opposite percurrent with courses sinuous to convex. Quaternaries mixed opp/alt percurrent to irregular reticulate. Quinternaries freely ramifying. Areolation development poor. F.E.V.s 1-branched to 2 or more branched. Abundant laminar black dots.

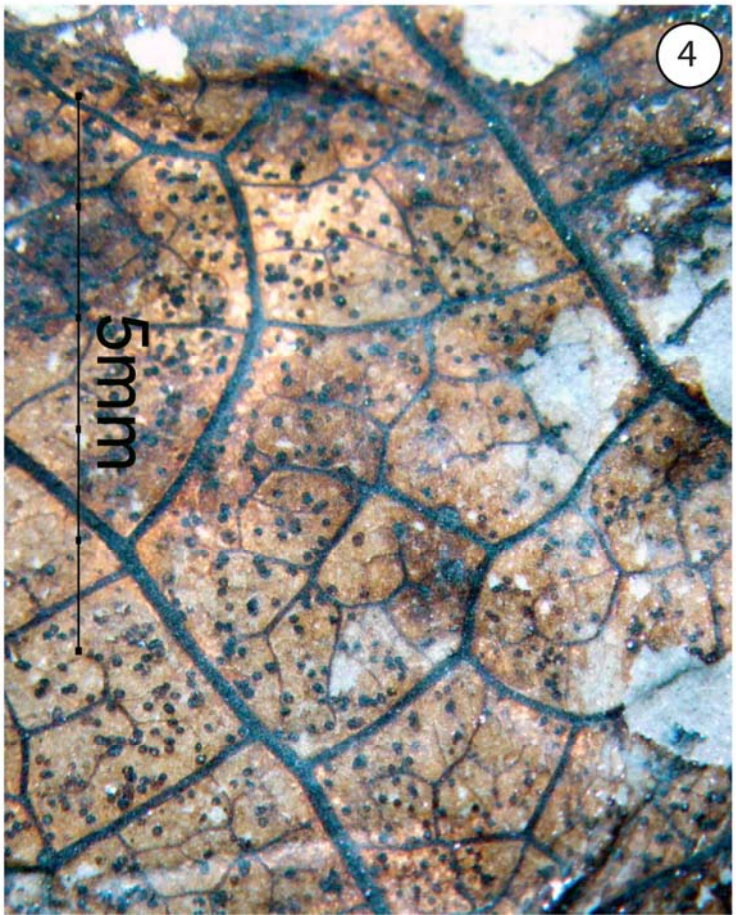
## Description

Blade attachment marginal. Laminar size mesophyll (the specimen is > 13 cm long and > 8 cm wide). Margin entire. Laminar black dots (very abundant). Primary vein framework basal actinodromous. Number of basal veins 3. Major secondary vein framework simple brochidodromous. Major secondary vein attachment excurrent. Intercostal tertiary vein fabric opposite percurrent with courses convex to sinuous. Angle of percurrent tertiary veins obtuse to perpendicular. Epimedial tertiary veins opposite percurrent; admedial course perpendicular to midvein; exmedial course parallel to intercostal tertiaries. Exterior tertiary vein course looped. Quaternary vein fabric mixed opp/alt percurrent to irregular reticulate. Quinternary vein fabric freely ramifying. Areolation development poor. F.E.V.s 1-branched to 2 or more branched.


1


2


3


4
5mm

**CERREJON FLORA** | Morphotype Name: *incertae sedis* | Morphotype #: CJ54

Major Plant Group: DIC | Organ Type: Leaf | Morphotyper: | Type loc. #: | Type spec. #:

Plant Family/order: | Loca:

## Section I. Leaf Characters

Leaf Attachment:
Leaf Arrangement:
Leaf Organization:
Leaflet Organization:
Leaflet Attachment:
Petiole Features: petiole base sheathing?

### Features of the Blade

Position of Blade Attachment: marginal
Laminar Size (smallest): notophyll
Laminar Size (largest): mesophyll
Laminar L:W Ratio:
Laminar Shape: oblong
Medial Symmetry: symmetrical
Base Symmetry: symmetrical
Lobation: unlobed
Margin Type: untoothed
Margin Features:
Apex Angle: acute
Apex Shape: convex straight
Base Angle: acute
Base Shape: straight-cuneate decurrent
Terminal Apex Features:
Surface Texture:
SurficialGlands:
Stomata:
Cuticle Features:

## Section III. Teeth

Tooth Spacing:
# of Orders:
Teeth/cm:
Sinus Shape:
Tooth Shape:
Tooth Shape:
Principal Vein:
Accesory Vein:
Principal Vein Termination:
Course of Accesory Vein:
Features of the Tooth Apex:

## Similar Morphotypes

## Section II. Venation

1° Vein Framework: parallelodromous (3-5 veins)
Naked Basal Veins: absent
# of Basal Veins: 5?
Agrophic Veins: absent

Major 2° Vein Framework (costal): simple brochidodromous (exmedially) #:
Interior Secondaries:
Minor 2° Course:
Perimarginal Veins: marginal secondary
Major 2° Spacing (costal):
Variation of 2° Vein Angle (costal):
Major 2° Vein Attachment (costal):

Inter-2° Vein Proximal Course:
Inter-2° Vein Lenght:
Inter-2° Vein Distal Course:
Inter-2° Vein Frequency:

Intercostal 3° Vein Fabric: percurrent
Course of Percurrent 3°: opposite straight
Angle of Percurrent 3°: perpendicular
Intercostal 3° Vein Angle Variability: consistent
Epimedial 3°:
Admedial Course:
Exmedial Course:
Exterior 3° Course:

Quaternary Vein Fabric: irregular reticulate

Quinternary Vein Fabric:

Areolation:
F.E.V.s Course:
F.E.V.s Terminae:
Marginal Ultimate Venation:

## Diagnostic Features

Petiole base sheathing (?). Base shape straight-cuneate and decurrent. Primaries parallelodromous (3-5 veins). Secondaries simple brochidodromous (veins that looped exmedially only). Tertiaries straight opposite percurrent. Tertiary vein angle perpendicular. Quaternaries irregular reticulate.

## Description

Petiole base sheathing (?). Blade attachment marginal. Laminar size notophyll to mesophyll (the biggest specimen is ~15 cm long and 2.5 cm wide). Laminar shape oblong. Leaves medially and basally symmetrical. Unlobed. Margin entire. Apex angle acute. Apex shape convex to straight. Base angle acute. Base shape straight-cuneate and decurrent. Primary vein framework parallelodromous (3-5 veins, spaced from ~0.3 mm to ~0.5 mm). Number of basal veins 5 (?). Major secondary vein framework simple brochidodromous (veins that looped exmedially only). Marginal secondary vein thin. Intercostal tertiary vein fabric opposite percurrent with courses straight (spaced from ~1 mm to ~5 mm). Angle of percurrent tertiary veins perpendicular. Intercostal tertiary vein angle variability consistent. Quaternary vein fabric irregular reticulate.


1
2
3
4

**CERREJON FLORA** | Morphotype Name: *incertae sedis* | Morphotype #: CJ55

Major Plant Group: DIC | Organ Type: Leaf | Morphotyper: | Type loc. #: | Type spec. #:

Plant Family/order: Fabaceae | Loca:

## Section I. Leaf Characters

Leaf Attachment:
Leaf Arrangement:
Leaf Organization: compound
Leaflet Organization: opposite
Leaflet Attachment: petiolulate
Petiole Features: petiole base pulvinulate

### Features of the Blade

Position of Blade Attachment: marginal
Laminar Size (smallest): microphyll
Laminar Size (largest): mesophyll
Laminar L:W Ratio:
Laminar Shape: elliptic
Medial Symmetry: symmetrical
Base Symmetry: width and extension asymmetr.
Lobation: unlobed
Margin Type: untoothed
Margin Features:
Apex Angle: acute
Apex Shape: straight
Base Angle: obtuse
Base Shape: complex
Terminal Apex Features:
Surface Texture:
SurficialGlands:
Stomata:
Cuticle Features:

## Section III. Teeth

Tooth Spacing:
# of Orders:
Teeth/cm:
Sinus Shape:
Tooth Shape:
Tooth Shape:
Principal Vein:
Accesory Vein:
Principal Vein Termination:
Course of Accesory Vein:
Features of the Tooth Apex:

## Similar Morphotypes

CJ19

## Section II. Venation

1° Vein Framework: pinnate
Naked Basal Veins: absent
# of Basal Veins: many - crowded
Agrophic Veins: absent

Major 2° Vein Framework (costal): simple brochidodromous | #: >9
Interior Secondaries:
Minor 2° Course:
Perimarginal Veins:
Major 2° Spacing (costal): abruptly decreasing proximally
Variation of 2° Vein Angle (costal): inconsistent
Major 2° Vein Attachment (costal): decurrent

Inter-2° Vein Proximal Course: parallel to major secondaries
Inter-2° Vein Lenght: >50% of subjacent secondary
Inter-2° Vein Distal Course: parallel to subjacent major secondary
Inter-2° Vein Frequency: >1 per intercostal area

Intercostal 3° Vein Fabric: reticulate irregular
Course of Percurrent 3°:
Angle of Percurrent 3°:
Intercostal 3° Vein Angle Variability:
Epimedial 3°: reticulate
Admedial Course:
Exmedial Course:
Exterior 3° Course: looped

Quaternary Vein Fabric: irregular reticulate

Quinternary Vein Fabric:

Areolation: moderate development
F.E.V.s Course: mostly unbranched
F.E.V.s Terminae:
Marginal Ultimate Venation:

## Diagnostic Features

Opposite leaflets. Petiolule pulvinate and very short. Base shape complex-asymmetrical. Secondary veins brochidodromous and crowded proximally. At one side of the leaf base two to four secondaries rising up to the middle of the blade at very acute angles. All orders of veins decurrent to primary.

## Description

Leaf organization compound. Leaflet organization opposite. Leaflet attachment petiolulate, pulvinate and very short (0.1 cm). Blade attachment marginal. Laminar size (leaflets) microphyll to mesophyll (the biggest leaflet is ~13 long and ~4 cm wide). Laminar shape elliptic. Basal width and extension strongly asymmetrical. Unlobed. Margin entire. Apex angle acute and shape straight. Base angle obtuse and shape complex. Primary vein framework pinnate. Basal veins numerous and crowded. Major secondary vein framework simple brochidodromous (>9 pairs of veins). Major secondary vein spacing abruptly decreasing proximally, veins strongly crowded (spaced from 0.2 to 0.5 cm). Variation of secondary vein angle inconsistent: at one side of the leaf base there are from two to four secondaries rising up to the middle of the blade at very acute angles; at the other side of the leaf base the secondaries smoothly decrease their angle. Major secondary and tertiary veins attachment to midvein decurrent. Intersecondaries with proximal and distal courses parallel to major secondaries; length >50% of the subjacent secondary; frequency >1 per intercostal area. Intercostal tertiary and epimedial vein fabrics irregular reticulate. Exterior tertiary vein course looped. Quaternary vein fabric irregular reticulate. Areolation development moderate. F.E.V.s mostlyunbranched.


1
2
3
4
5
6
7
5mm

**CERREJON FLORA** | Morphotype Name: *incertae sedis* | Morphotype #: CJ56

Major Plant Group: DIC | Organ Type: Leaf | Morphotyper: | Type loc. #: | Type spec. #:

Plant Family/order: | Loca:

## Section I. Leaf Characters

Leaf Attachment:
Leaf Arrangement:
Leaf Organization:
Leaflet Organization:
Leaflet Attachment:
Petiole Features:

### Features of the Blade

Position of Blade Attachment: marginal
Laminar Size (smallest): mesophyll
Laminar Size (largest): megaphyll
Laminar L:W Ratio:
Laminar Shape: elliptic
Medial Symmetry:
Base Symmetry:
Lobation: unlobed
Margin Type: serrate
Margin Features:
Apex Angle:
Apex Shape:
Base Angle: obtuse
Base Shape: cordate
Terminal Apex Features:
Surface Texture:
SurficialGlands: laminar glands (?)
Stomata:
Cuticle Features:

## Section III. Teeth

Tooth Spacing: irregular
# of Orders: one
Teeth/cm: <1
Sinus Shape: rounded
Tooth Shape: cc/cc
Tooth Shape:
Principal Vein: present
Accesory Vein: present
Principal Vein Termination: at apex of tooth
Course of Accesory Vein:
Features of the Tooth Apex:

## Similar Morphotypes

## Section II. Venation

1° Vein Framework: pinnate (very thick)
Naked Basal Veins: absent
# of Basal Veins: 5
Agrophic Veins: compound

Major 2° Vein Framework (costal): mixed: craspedodromous and cladodromous # >7 pairs
Interior Secondaries:
Minor 2° Course: craspedodromous
Perimarginal Veins:
Major 2° Spacing (costal): widely spaced (1 cm to 6 cm)
Variation of 2° Vein Angle (costal): decreasing proximally (?)
Major 2° Vein Attachment (costal): excurrent

Inter-2° Vein Proximal Course:
Inter-2° Vein Lenght:
Inter-2° Vein Distal Course:
Inter-2° Vein Frequency:

Intercostal 3° Vein Fabric: percurrent
Course of Percurrent 3°: mixed opp/alt | opposite straight - sinuous
Angle of Percurrent 3°: obtuse
Intercostal 3° Vein Angle Variability:
Epimedial 3°: mixed opp/alt
Admedial Course: perpendicular to midvein
Exmedial Course: parallel to intercostal 3°
Exterior 3° Course:

Quaternary Vein Fabric: irregular reticulate

Quinternary Vein Fabric: irregular reticulate

Areolation:
F.E.V.s Course:
F.E.V.s Terminae:
Marginal Ultimate Venation:

## Diagnostic Features

Base shape cordate. Pinnate (very thick). Basal veins 5. Secondaries mixed: craspedodromous and cladodromous. Agrophic veins compound. Tertiaries mixed opp/alt percurrent (mostly opp percurrent with courses straight to sinuous). Margin serrate. Teeth/cm <1. Tooth shape cc/cc. Principal vein termination at apex of tooth.

## Description

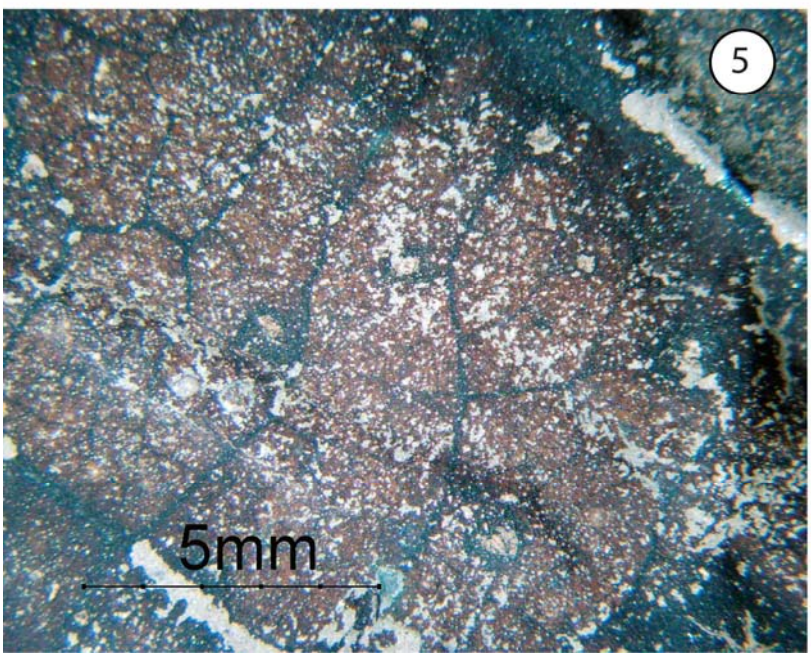
Blade attachment marginal. Laminar size mesophyll to megaphyll (the biggest specimen is > 20 cm long and ~30 cm wide). Laminar shape elliptic. Unlobed. Base angle obtuse and shape cordate. Laminar glands (?). Primary vein framework pinnate (very thick). Number of basal veins 5. Agrophic veins compound. Major secondary vein framework mixed: craspedodromous and cladodromous (> 7 pairs of veins). Minor secondary vein course craspedodromous. Major secondary vein spacing unknown, but widely spaced (from 1 cm to 6 cm). Variation of secondary vein angle decreasing proximally (?) (the angle measured proximally is ~60°). Major secondary vein attachment excurrent. Intercostal tertiary vein fabric mixed opp/alt percurrent (mostly opposite percurrent with courses straight to sinuous and spaced from 0.3 cm to 1 cm). Angle of percurrent tertiary veins obtuse. Epimedial tertiary veins mixed opp/alt percurrent; admedial course perpendicular to midvein; exmedial course parallel to intercostal tertiaries. Quaternary and quinternary vein fabric irregular reticulate. Margin serrate; tooth spacing irregular; number of orders one; teeth/cm <1/cm; sinus shape rounded; tooth shape cc/cc; principal and accessory vein present; principal vein termination at apex of tooth.

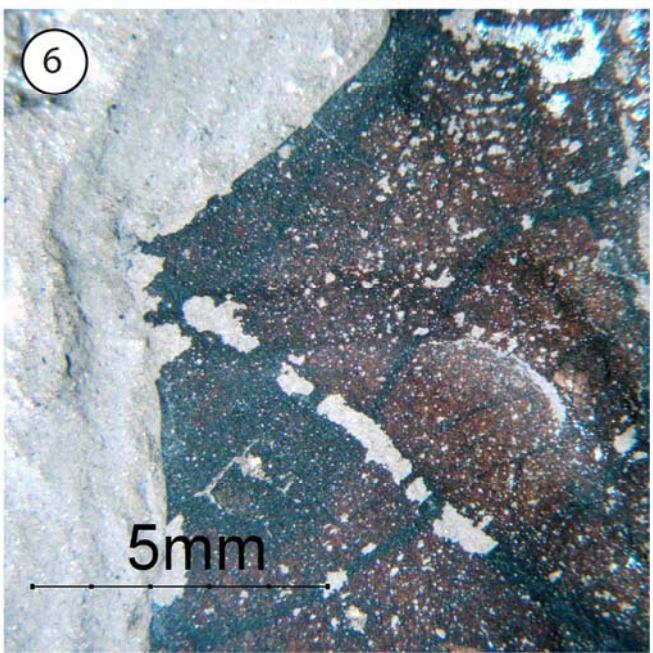

1


2


3


4


5
5mm


6
5mm

**CERREJON FLORA** | Morphotype Name: *Stenochlaena sp.* | Morphotype #: CJ57

Major Plant Group: PTE | Organ Type: Leaf | Morphotyper: | Type loc. #: | Type spec. #:

Plant Family: Blechnaceae | Genus: *Stenochlaena* | Loca:

### Rhizome Characters

Rhizome Type:
Rhizome Lenght:
Special Features:

### Frond Characters

Frond Type:
Frond Attachment:
F. Organization: 1-pinnate, pinnae alternate
Petiole Features:
Laminar Size (smallest): mesophyll
Laminar Size (largest): megaphyll

### Features of the Pinnae

Pinnae Attachment: petiolate or sessile
Frond Shape: oblong | elliptic
Base Symmetry: basal insertion asymmetrical
Lobation: unlobed
Margin Type: serrate
Margin Features:
Apex Angle: acute
Apex Shape: acuminate | drip tip
Base Angle: obtuse
Base Shape: complex
Surface Texture:
Scales & Hairs:

### Teeth Features

Tooth Spacing: irregular
# of Orders: one
Teeth/cm: variable, 1-7/cm
Sinus Shape: rounded
Tooth Shape: cc/st | cc/cv
Tooth Shape:
Principal Vein: absent
Accesory Vein: present
Principal Vein Termination:
Course of Accesory Vein: straight
Features of the Tooth Apex: spinose

### Similar Morphotypes

### Venation of the Pinnae and/or Pinnule

1° Costa Framework: pinnate
# of Basal Costa: many and crowded secondaries
Costule Framework:
# of Basal Costa:

Major 2° Vein Framework: craspedodromous
Interior Secondaries: absent
Perimarginal Veins:
Major 2° Spacing: regular - crowded
Variation of 2° Vein Angle:
Major 2° Vein Attachment: excurrent

Areolation: present
Veinlets Course: absent
Veinlets Terminae:
Marginal Ultimate Venation:

### Sporangia

Sori and Indusia:
Sorus Position:

### Vascular Bundles

Type:

### Diagnostic Features

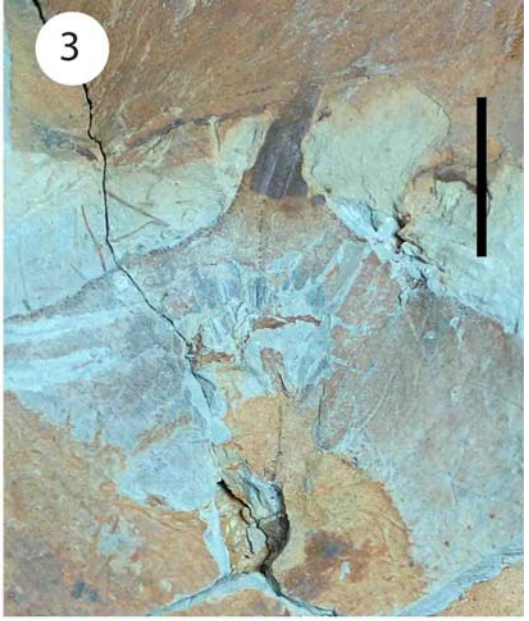
Frond organization 1-Pinnate, pinnae alternate. Pinnae with basal insertion asymmetrical and base shape complex. Secondary veins craspedodromous and closely spaced. Higher order veins very tiny from rounded to elongated areoles. Teeth cc/st and cc/cv.

### Description

Frond organization 1-Pinnate, pinnae alternate. Laminar size of the fronds and the pinnae either from nanophyll to megaphyll. Pinnae attachment petiolate or sessile. Pinnae laminar shape oblong to elliptic. Basal insertion asymmetrical. Apex angle acute and shape acuminate with and without drip tip. Base angle obtuse and shape complex. Costa framework pinnate (thick and straight). Secondary veins craspedodromous, crowded proximally, very numerous, very closely spaced (0.3-0.6 mm), with rare and low angle dichotomy, and excurrent on costa. Higher order veins are formed by tiny and rounded to elongated areoles without veinlets. Margin type serrate (cc/st and cc/cv); tooth spacing irregular; number of orders one, teeth/cm variable, between 1-7/cm; sinus shape rounded, teeth have long proximal flanks; principal vein absent, but more than one accessory vein enters the tooth with courses straight; features of the tooth apex apparently spinose.


1


2


3


4


5


6


7


8


9
1mm

**CERREJON FLORA** | Morphotype Name: *incertae sedis* | Morphotype #: CJ58

Major Plant Group: DIC | Organ Type: Leaf | Morphotyper: | Type loc. #: | Type spec. #:

Plant Family/order: | Loca:

## Section I. Leaf Characters

Leaf Attachment:
Leaf Arrangement:
Leaf Organization:
Leaflet Organization:
Leaflet Attachment:
Petiole Features:

### Features of the Blade

Position of Blade Attachment:
Laminar Size (smallest): mesophyll
Laminar Size (largest):
Laminar L:W Ratio:
Laminar Shape:
Medial Symmetry:
Base Symmetry:
Lobation:
Margin Type:
Margin Features:
Apex Angle:
Apex Shape:
Base Angle:
Base Shape:
Terminal Apex Features:
Surface Texture:
SurficialGlands:
Stomata:
Cuticle Features:

## Section III. Teeth

Tooth Spacing:
# of Orders:
Teeth/cm:
Sinus Shape:
Tooth Shape:
Tooth Shape:
Principal Vein:
Accesory Vein:
Principal Vein Termination:
Course of Accesory Vein:
Features of the Tooth Apex:

## Similar Morphotypes

## Section II. Venation

1° Vein Framework: pinnate
Naked Basal Veins:
# of Basal Veins:
Agrophic Veins:

Major 2° Vein Framework (costal): # :
Interior Secondaries:
Minor 2° Course:
Perimarginal Veins:
Major 2° Spacing (costal): decreasing proximally (?)
Variation of 2° Vein Angle (costal):
Major 2° Vein Attachment (costal): ~decurrent

Inter-2° Vein Proximal Course: acute to midvein
Inter-2° Vein Lenght: <50% of subjacent secondary
Inter-2° Vein Distal Course: basiflexed
Inter-2° Vein Frequency: <1 per intercostal area

Intercostal 3° Vein Fabric: percurrent | reticulate irregular
Course of Percurrent 3°: mixed opp/alt
Angle of Percurrent 3°:
Intercostal 3° Vein Angle Variability:
Epimedial 3°: reticulate | opposite percurrent
Admedial Course: acute to midvein
Exmedial Course: basiflexed
Exterior 3° Course:

Quaternary Vein Fabric: irregular reticulate

Quinternary Vein Fabric: freely ramifying

Areolation: lacking
F.E.V.s Course: branching equal (dichotomous) | 2 or more branched
F.E.V.s Terminae:
Marginal Ultimate Venation:

## Diagnostic Features

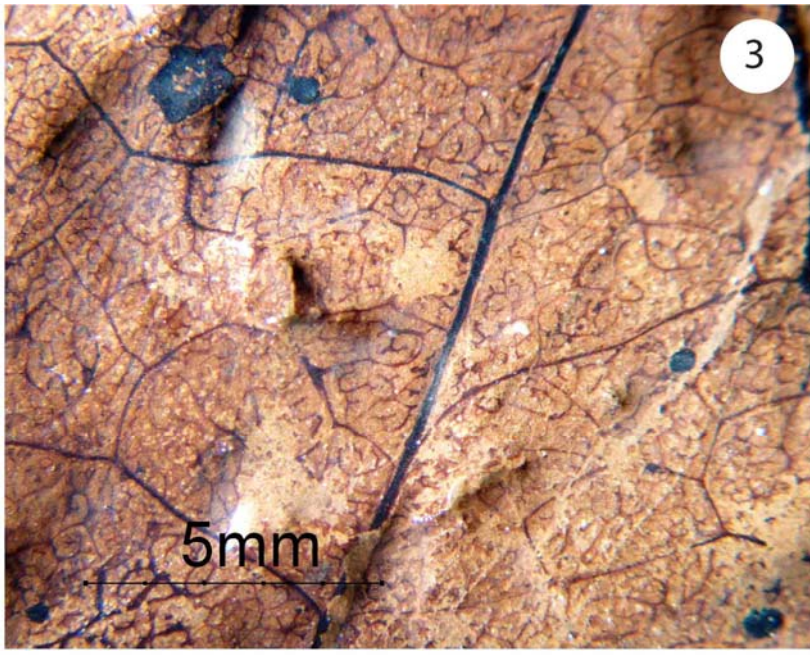
Pinnate. Secondaries and tertiaries decurrent to midvein (tertiaries also decurrent to secondaries). Intersecondaries proximal course acute to midvein and frequency <1 per intercostal area. Tertiaries mixed opp/alt percurrent to irregular reticulate. Quaternaries irregular reticulate. Quinternaries freely ramifying. Areolation lacking. F.E.V.s dichotomous.

## Description

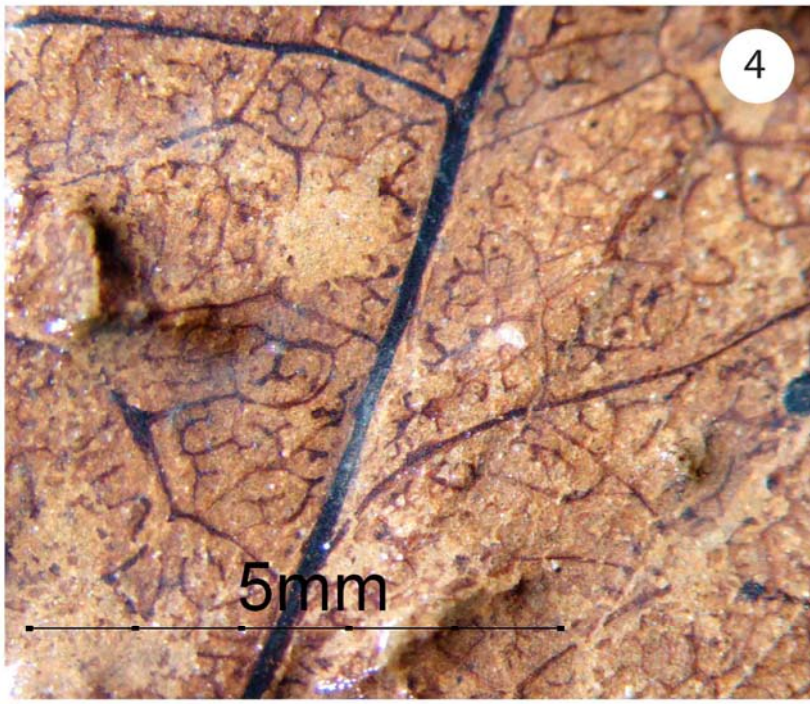
Laminar size mesophyll (the specimen is >10 cm long and >9 cm wide). Primary vein framework pinnate. Major secondary vein spacing decreasing proximally (?) (spaced from 2.8 cm to 1.7 cm). Major secondary vein attachment approximately decurrent. Intersecondary vein proximal course acute to midvein; length <50% of subjacent secondary; distal course basiflexed; frequency <1 per intercostal area. Intercostal tertiary vein fabric mixed opp/alt percurrent (highly disorganized) to irregular reticulate. Epimedial tertiary veins opposite percurrent to irregular reticulate; admedial course acute to midvein; exmedial course basiflexed. Tertiary vein attachment decurrent to midvein and secondaries. Quaternary vein fabric irregular reticulate. Quinternary vein fabric freely ramifying. Areolation lacking. F.E.V.s course branching equal (dichotomous) to 2 or more branched.

1

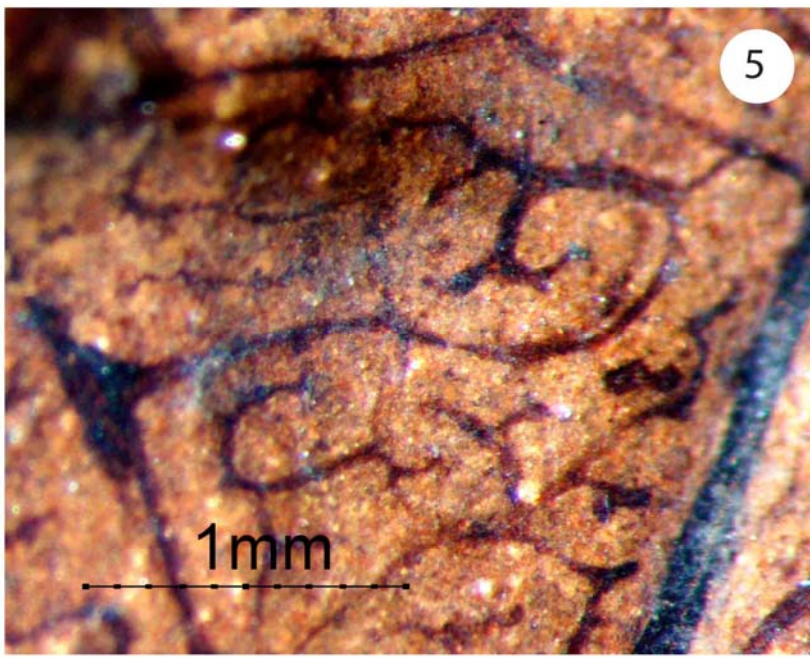
2




3




4




5

**CERREJON FLORA** | Morphotype Name: *incertae sedis* | Morphotype #: CJ59

Major Plant Group: MON | Organ Type: Leaf | Morphotyper: | Type loc. #: | Type spec. #:

Plant Family/order: | Loca:

## Section I. Leaf Characters

Leaf Attachment:
Leaf Arrangement:
Leaf Organization:
Leaflet Organization:
Leaflet Attachment:
Petiole Features:

### Features of the Blade

Position of Blade Attachment:
Laminar Size (smallest): notophyll
Laminar Size (largest):
Laminar L:W Ratio:
Laminar Shape: elliptic
Medial Symmetry:
Base Symmetry:
Lobation: unlobed
Margin Type: untoothed
Margin Features:
Apex Angle: obtuse
Apex Shape: rounded
Base Angle: obtuse
Base Shape: rounded
Terminal Apex Features:
Surface Texture:
SurficialGlands:
Stomata:
Cuticle Features:

## Section III. Teeth

Tooth Spacing:
# of Orders:
Teeth/cm:
Sinus Shape:
Tooth Shape:
Tooth Shape:
Principal Vein:
Accesory Vein:
Principal Vein Termination:
Course of Accesory Vein:
Features of the Tooth Apex:

## Similar Morphotypes

## Section II. Venation

1° Vein Framework: flabellate
Naked Basal Veins:
# of Basal Veins:
Agrophic Veins:

Major 2° Vein Framework (costal): freely ramified | #:
Interior Secondaries:
Minor 2° Course:
Perimarginal Veins:
Major 2° Spacing (costal):
Variation of 2° Vein Angle (costal):
Major 2° Vein Attachment (costal):

Inter-2° Vein Proximal Course:
Inter-2° Vein Lenght:
Inter-2° Vein Distal Course:
Inter-2° Vein Frequency:

Intercostal 3° Vein Fabric:
Course of Percurrent 3°:
Angle of Percurrent 3°:
Intercostal 3° Vein Angle Variability:
Epimedial 3°:
Admedial Course:
Exmedial Course:
Exterior 3° Course:

Quaternary Vein Fabric:

Quinternary Vein Fabric:

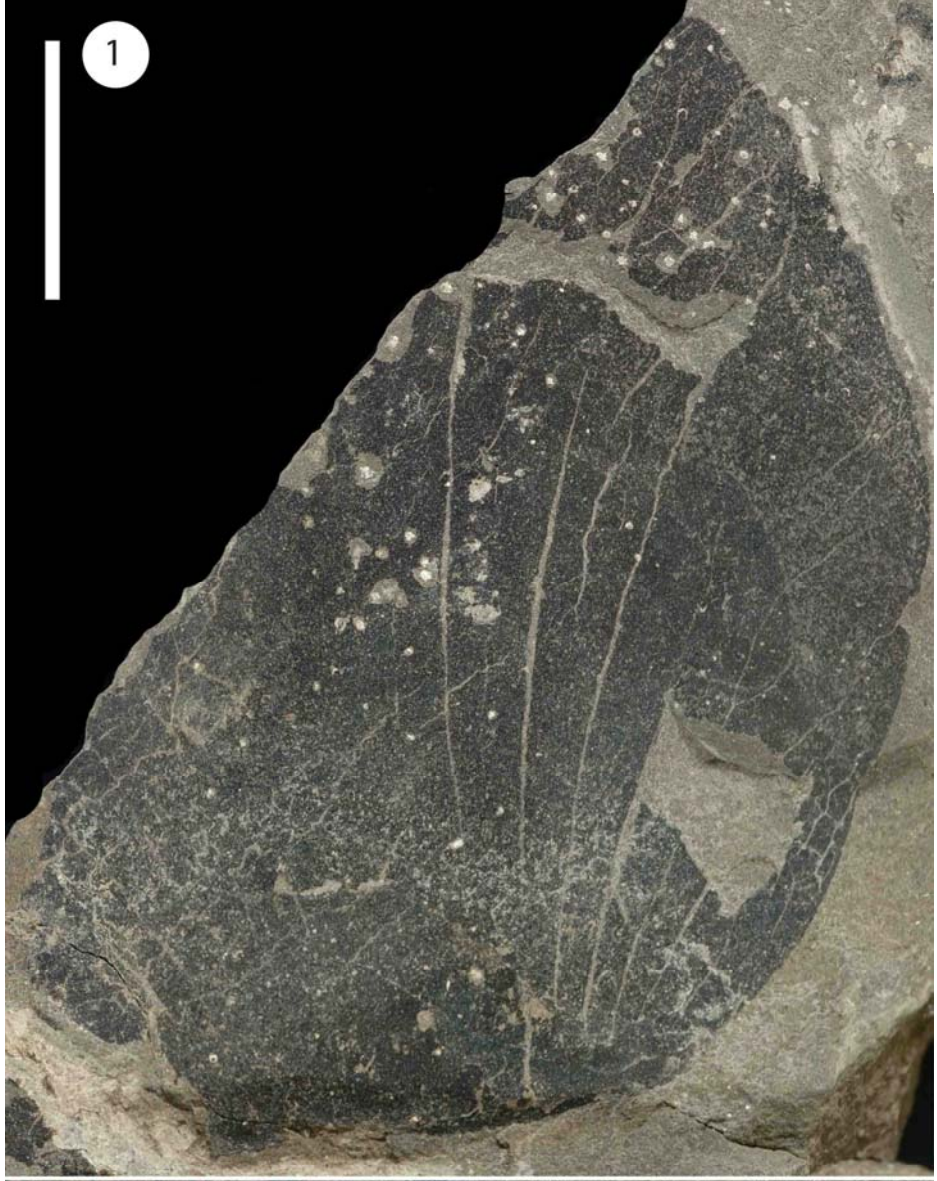
Areolation:
F.E.V.s Course:
F.E.V.s Terminae:
Marginal Ultimate Venation:

## Diagnostic Features

Flabellate. Secondary veins freely ramified.

## Description

Laminar size notophyll (the biggest specimen is 6 cm long and 5.4 cm wide). Laminar shape elliptic. Unlobed. Margin entire. Apex and base angle obtuse. Base and apex rounded. Primary vein framework flabellate, many thin veins (>12) that diverge radially from the base and reach the margin distally. Secondary vein framework apparently freely ramified.


1


2

**CERREJON FLORA**

Morphotype Name: *Brachyphyllum sp.*

Morphotype #: CJ60

Major Plant Group: CON

Organ Type: Leaf

Morphotyper:

Type loc. #:

Type spec. #:

Plant Family:

Genus: *Brachyphyllum*

Loca:

## *Shoot Form-Genera*

### 1. *Brachyphyllum*

Shoot bearing leaves spirally. Leaf composed of a basal cushion tapering into a minute free part, total length of free part (beyond leaf cushion) less than width of cushion, or total height of leaf (outwards from shoot) less than width of leaf cushion.

### 2. *Pagiophyllum*

Shoot with spirally arranged leaves. Leaves contracting gradually from the broad basal cushion, free part spreading, broader than thick, its length exceeding the width of its own basal cushion.

### 3. *Cyparissidium*

Shoot bearing leaves spirally. Free part of leaf contracting gradually from basal cushion, somewhat flattened, oppressed to stem, its length - exceeding width of its basal cushion.

### 4. *Geinitzia*

Shoot bearing spirally arranged leaves. Leaf contracting gradually from the cushion, needle-like, free part not flattened, spreading.

### 5. *Elatocladus*

Shoot bearing leaves spirally (rarely opposite). Leaf elongated, dorsiventrally flattened, diverging from stem; at base strongly contracted and forming a short petiole attaching it to basal cushion. Lamina with a single vein.

### 6. *Cupressinocladus*

Shoot bearing leaves in decussating pairs or in alternating whorls. Leaves small and scale like or longer, dorsiventrally flattened and spreading, not constricted basally into a petiole.

### 7. *Pityocladus*

Long shoots bearing short shoots; short shoots bearing numerous crowded needle-like leaves.

### 8. *Podozamites*

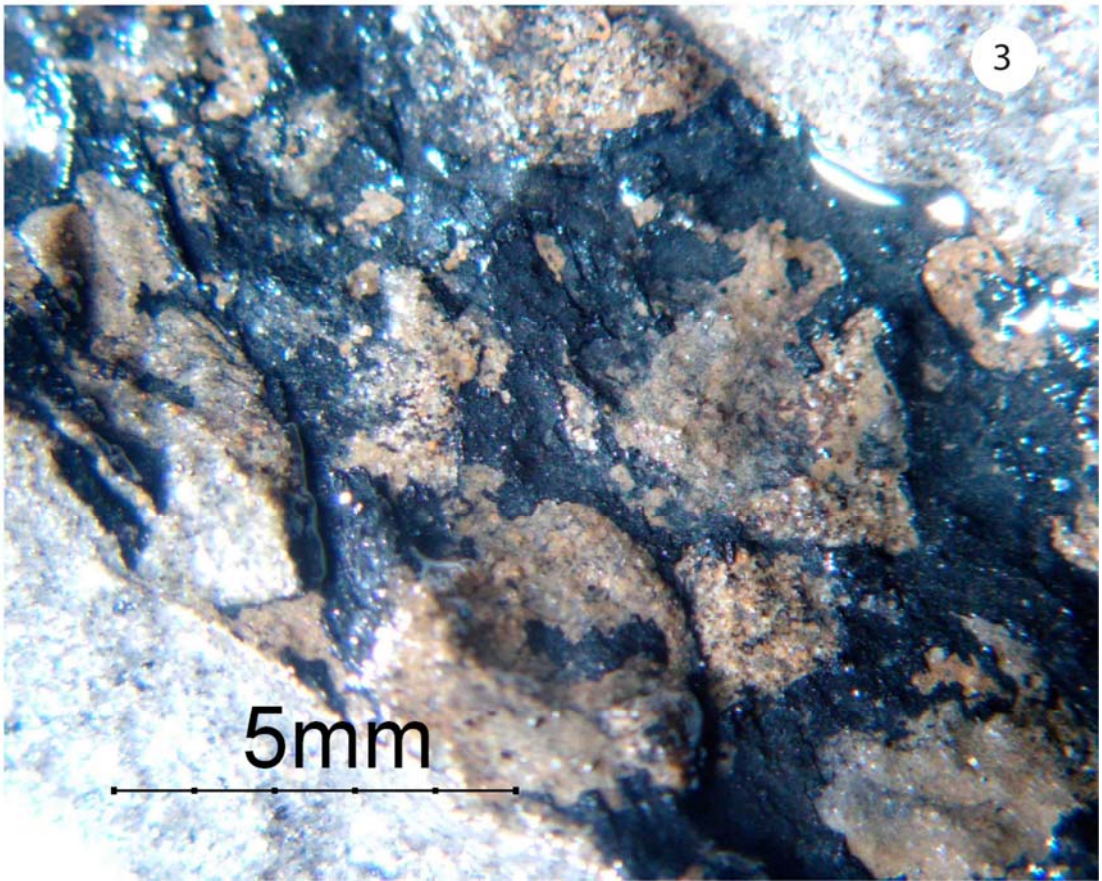
Leaves borne on caducous rather long shoots of limited growth, leaves borne alternately or spirally. Leaves lanceolate with a narrow base, vascular bundles branching at leaf base, numerous and parallel in middle region, converging at apex.

## *Description*

**The fossils consist of fragments of compressed shoots, the longest one is ~11.1 cm long, and its maximum width reaches ~0.9 cm. Leaves spirally arranged, scale-like, crowded and slightly overlapped alone the axis. Maximum length of the scales is ~5-8 mm and maximum width is ~4-5 mm. The free part of the leaf less than width od cushion of the leaves.**


1


2


3
5mm

**CERREJON FLORA**

Morphotype Name: *Lygodium sp.* | Morphotype #: CJ61

Major Plant Group: PTE | Organ Type: Leaf | Morphotyper: | Type loc. #: | Type spec. #:

Plant Family: Lygodiaceae | Genus: *Lygodium* | Loca:

### Rhizome Characters

Rhizome Type:

Rhizome Lenght:

Special Features:

### Frond Characters

Frond Type:

Frond Attachment: petiolate

F. Organization: simple?

Petiole Features: 3 mm

Laminar Size (smallest): microphyll

Laminar Size (largest):

### Features of the Pinnae

Pinnae Attachment:

Frond Shape: elliptic?

Base Symmetry: symmetrical

Lobation: palmately lobed

Margin Type: untoothed

Margin Features:

Apex Angle:

Apex Shape:

Base Angle: acute

Base Shape: concave

Surface Texture:

Scales & Hairs:

### Teeth Features

Tooth Spacing:

# of Orders:

Teeth/cm:

Sinus Shape:

Tooth Shape:

Tooth Shape:

Principal Vein:

Accesory Vein:

Principal Vein Termination:

Course of Accesory Vein:

Features of the Tooth Apex:

### Similar Morphotypes

### Venation of the Pinnae and/or Pinnule

1° Costa Framework: palmate - actinodromous basal

# of Basal Costa: 4-5

Costule Framework:

# of Basal Costa:

Major 2° Vein Framework: dichotomizing

Interior Secondaries:

Perimarginal Veins:

Major 2° Spacing: regular - crowded

Variation of 2° Vein Angle:

Major 2° Vein Attachment:

Areolation:

Veinlets Course:

Veinlets Terminae:

Marginal Ultimate Venation:

### Sporangia

Sori and Indusia:

Sorus Position:

### Vascular Bundles

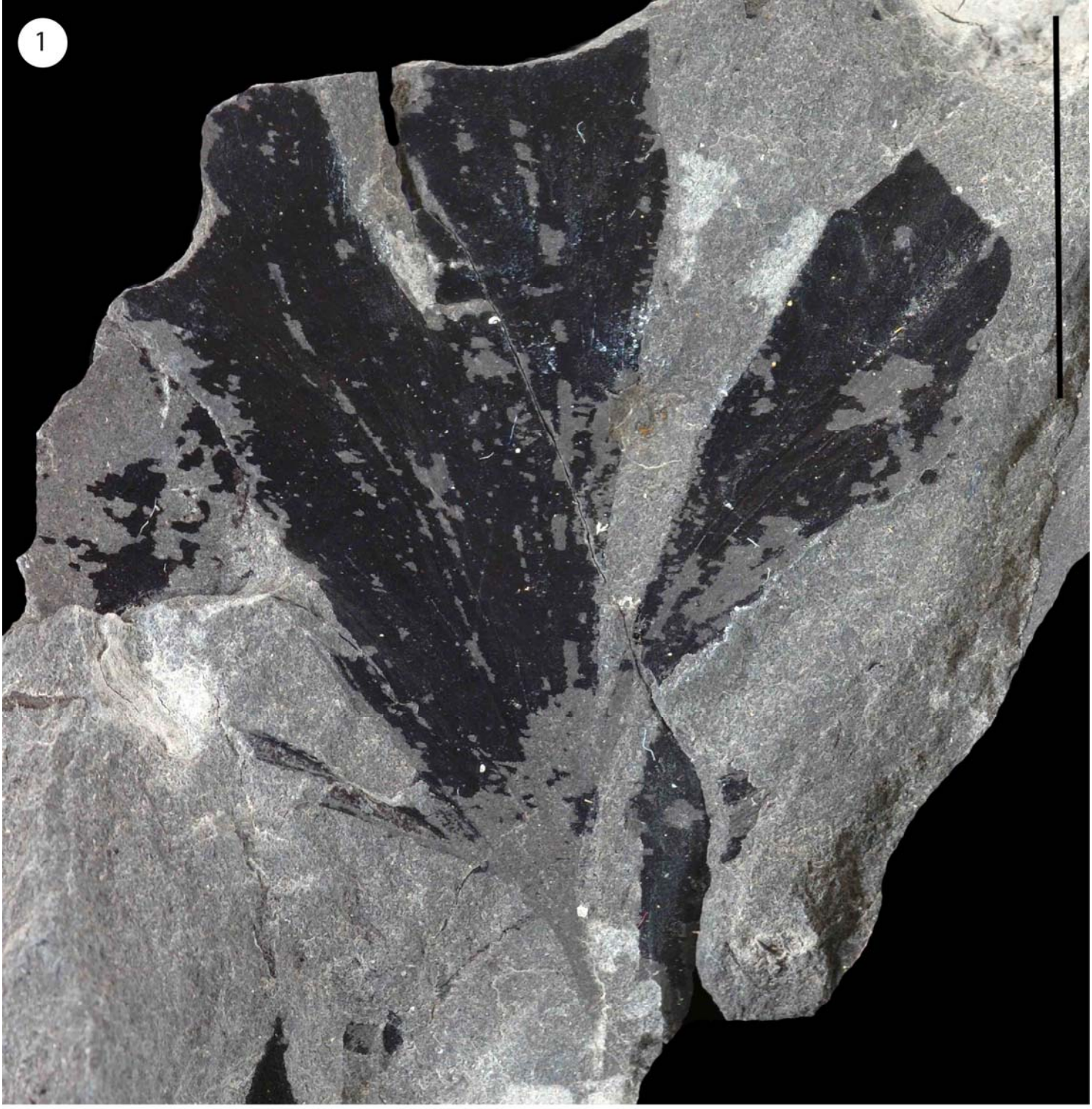
Type:

### Diagnostic Features

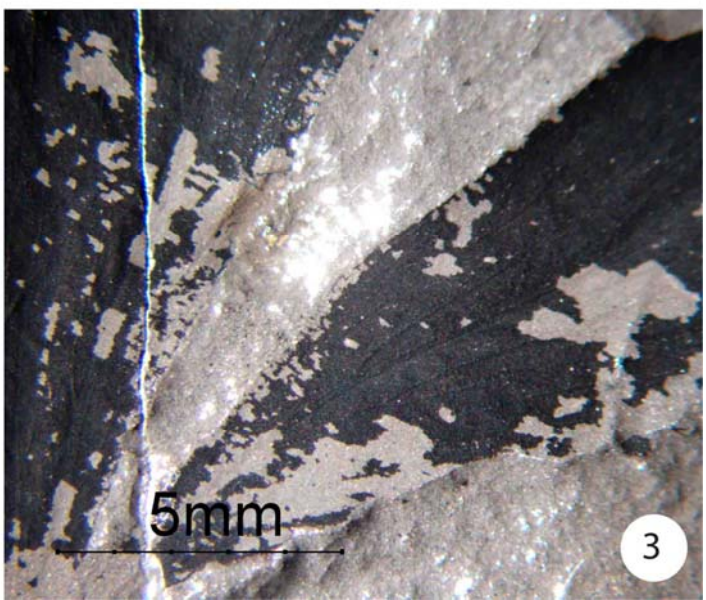
Lobate frond. The palmate venation consist of several costae with an actinodromous pattern. Many secondary veins of equal gauge dichotomizing toward apex.

### Description

Incomplete pinnae. Laminar size microphyll (the specimen is ~2.6 cm long and ~2.9 cm wide). The base of the pinnae is decurrent and a short petiole is preserved (~3 mm long). Frond venation palmate (basal actinodromous) with four or five asymmetrical lobes; the basal sinus of the lobes incised either from the base of the blade or from more apical sides; the lobes diverge from one another at ~50° to 60°. Margins of the lobes are entire. Secondary veins are dichotomizing (more than three times at very low angles <30°), thin and closely spaced (0.3-0.4 mm).


1


5mm
2


5mm
3

**CERREJON FLORA** | Morphotype Name: *incertae sedis* | Morphotype #: CJ62

Major Plant Group: MON | Organ Type: Leaf | Morphotyper: | Type loc. #: | Type spec. #:

Plant Family/order: | Loca:

## Section I. Leaf Characters

Leaf Attachment:
Leaf Arrangement:
Leaf Organization:
Leaflet Organization:
Leaflet Attachment:
Petiole Features:

### Features of the Blade

Position of Blade Attachment:
Laminar Size (smallest): macrophyll
Laminar Size (largest):
Laminar L:W Ratio:
Laminar Shape:
Medial Symmetry:
Base Symmetry:
Lobation:
Margin Type:
Margin Features:
Apex Angle:
Apex Shape:
Base Angle:
Base Shape:
Terminal Apex Features:
Surface Texture:
SurficialGlands: laminar
Stomata:
Cuticle Features:

## Section III. Teeth

Tooth Spacing:
# of Orders:
Teeth/cm:
Sinus Shape:
Tooth Shape:
Tooth Shape:
Principal Vein:
Accesory Vein:
Principal Vein Termination:
Course of Accesory Vein:
Features of the Tooth Apex:

## Similar Morphotypes

## Section II. Venation

1° Vein Framework:
Naked Basal Veins:
# of Basal Veins:
Agrophic Veins:

Major 2° Vein Framework (costal): parallelodromous | #:
Interior Secondaries:
Minor 2° Course:
Perimarginal Veins:
Major 2° Spacing (costal):
Variation of 2° Vein Angle (costal):
Major 2° Vein Attachment (costal):

Inter-2° Vein Proximal Course:
Inter-2° Vein Lenght:
Inter-2° Vein Distal Course:
Inter-2° Vein Frequency:

Intercostal 3° Vein Fabric: parallelodromous
Course of Percurrent 3°:
Angle of Percurrent 3°:
Intercostal 3° Vein Angle Variability:
Epimedial 3°:
Admedial Course:
Exmedial Course:
Exterior 3° Course:

Quaternary Vein Fabric: mixed percurrent | opposite percurrent

Quinternary Vein Fabric: irregular reticulate

Areolation:
F.E.V.s Course:
F.E.V.s Terminae:
Marginal Ultimate Venation:

## Diagnostic Features

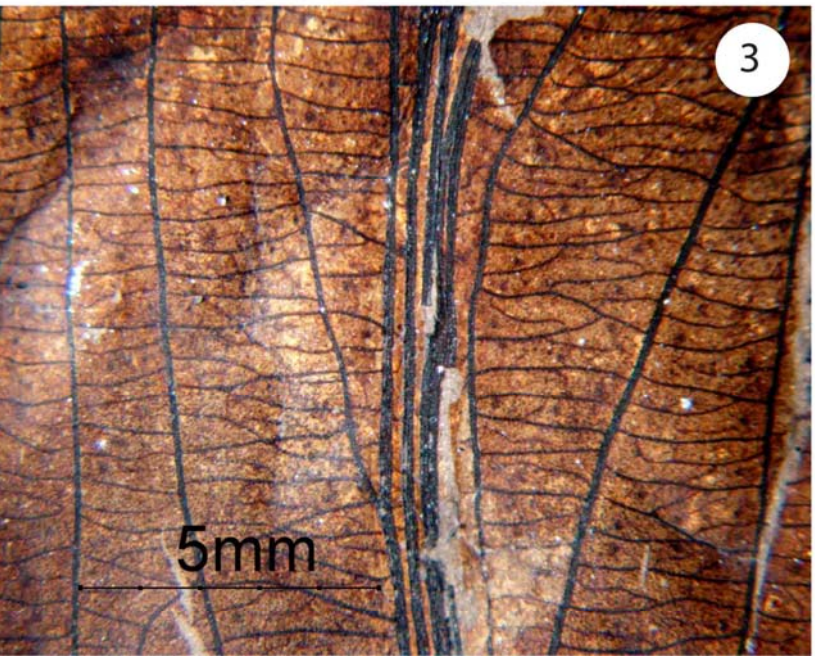
Secondaries parallelodromous and multistranded. Tertiary veins parallelodromous and decurrent on secondaries. Quaternary veins mostly opposite percurrent and dominantly perpendicular to secondaries and tertiaries. Higher order veins irregular reticulate. Laminar and abundant black dots.

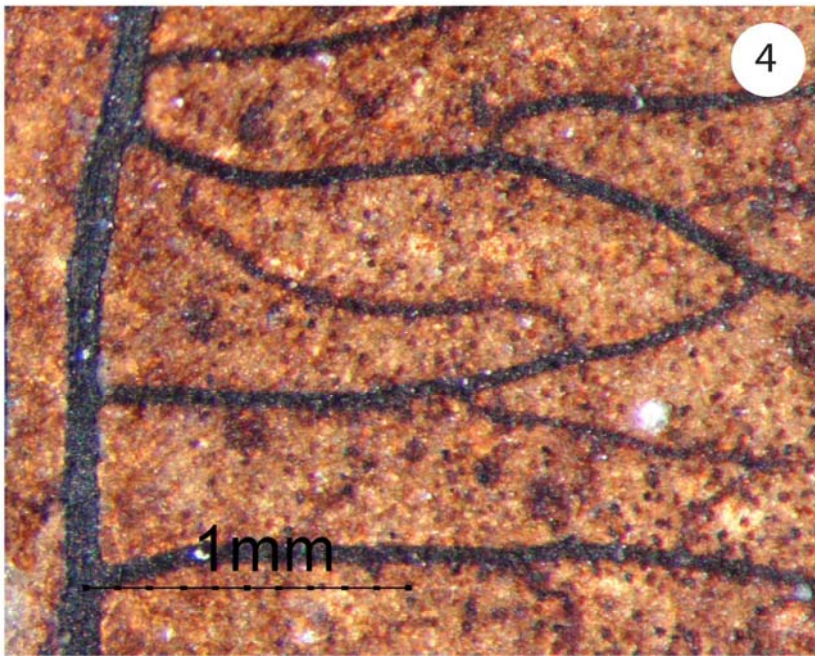
## Description

The fossil lacks margin, base, apex, and apparently primary venation. Laminar size macrophyll (>15 cm long and >10.3 cm wide). Laminar and abundant black dots. Secondary vein framework parallelodromous and multistranded. Tertiary veins framework parallelodromous, decurrent on secondaries, their spacing varies from 2 mm to 3 mm. Quaternary veins mixed opp/alt percurrent, but mostly opposite that are dominantly perpendicular to secondaries and tertiaries. Quaternary vein spacing range from 0.5 mm to 1.2 mm. Higher order veins irregular reticulate.


1


2


3
5mm


4
1mm

**CERREJON FLORA**

Morphotype Name: *incertae sedis* | Morphotype #: CJ63

Major Plant Group: MON | Organ Type: Leaf | Morphotyper: | Type loc. #: | Type spec. #:

Plant Family/order: Araceae | Loca:

## Section I. Leaf Characters

Leaf Attachment:
Leaf Arrangement:
Leaf Organization:
Leaflet Organization:
Leaflet Attachment:
Petiole Features:

### Features of the Blade

Position of Blade Attachment:
Laminar Size (smallest): megaphyll
Laminar Size (largest):
Laminar L:W Ratio:
Laminar Shape:
Medial Symmetry:
Base Symmetry:
Lobation:
Margin Type:
Margin Features:
Apex Angle:
Apex Shape:
Base Angle:
Base Shape:
Terminal Apex Features:
Surface Texture:
SurficialGlands:
Stomata:
Cuticle Features:

## Section III. Teeth

Tooth Spacing:
# of Orders:
Teeth/cm:
Sinus Shape:
Tooth Shape:
Tooth Shape:
Principal Vein:
Accesory Vein:
Principal Vein Termination:
Course of Accesory Vein:
Features of the Tooth Apex:

## Similar Morphotypes

## Section II. Venation

1° Vein Framework: pinnate? - stout
Naked Basal Veins:
# of Basal Veins:
Agrophic Veins:

Major 2° Vein Framework (costal): multistranded and thick | #:
Interior Secondaries:
Minor 2° Course:
Perimarginal Veins:
Major 2° Spacing (costal):
Variation of 2° Vein Angle (costal):
Major 2° Vein Attachment (costal): decurrent

Inter-2° Vein Proximal Course:
Inter-2° Vein Lenght:
Inter-2° Vein Distal Course:
Inter-2° Vein Frequency:

Intercostal 3° Vein Fabric: ramified
Course of Percurrent 3°:
Angle of Percurrent 3°:
Intercostal 3° Vein Angle Variability:
Epimedial 3°:
Admedial Course:
Exmedial Course:
Exterior 3° Course:

Quaternary Vein Fabric: freely ramifying

Quinternary Vein Fabric:

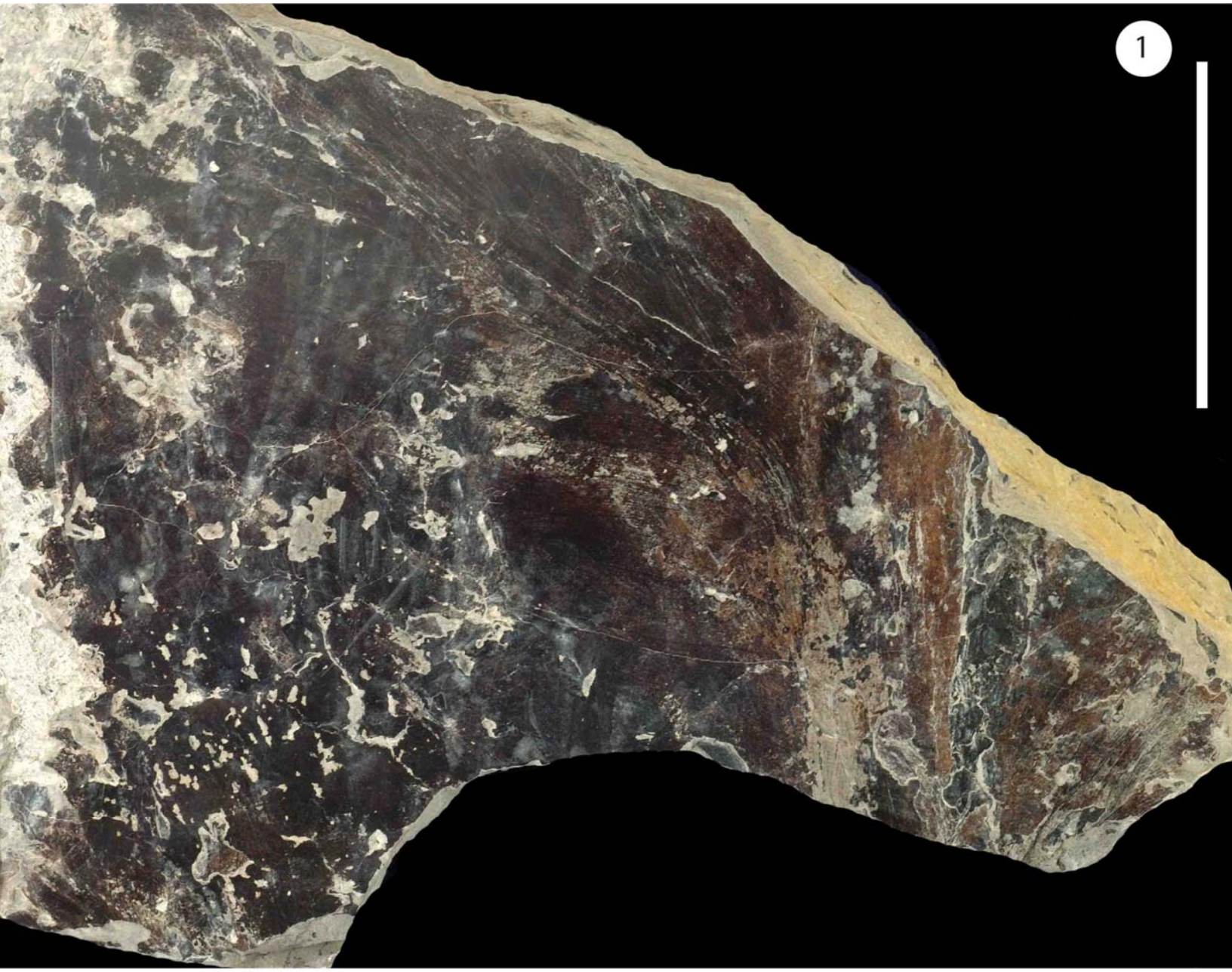
Areolation:
F.E.V.s Course:
F.E.V.s Terminae:
Marginal Ultimate Venation:

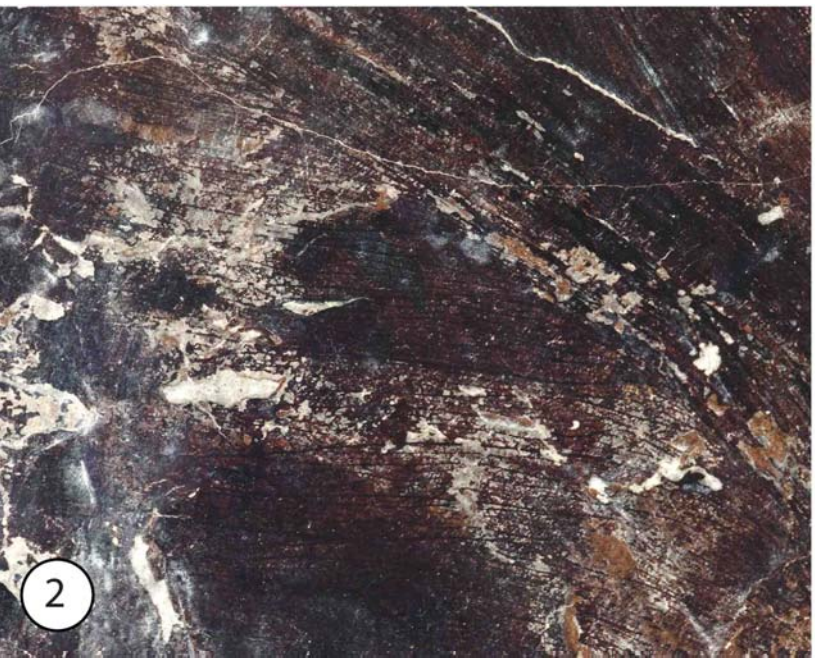
## Diagnostic Features

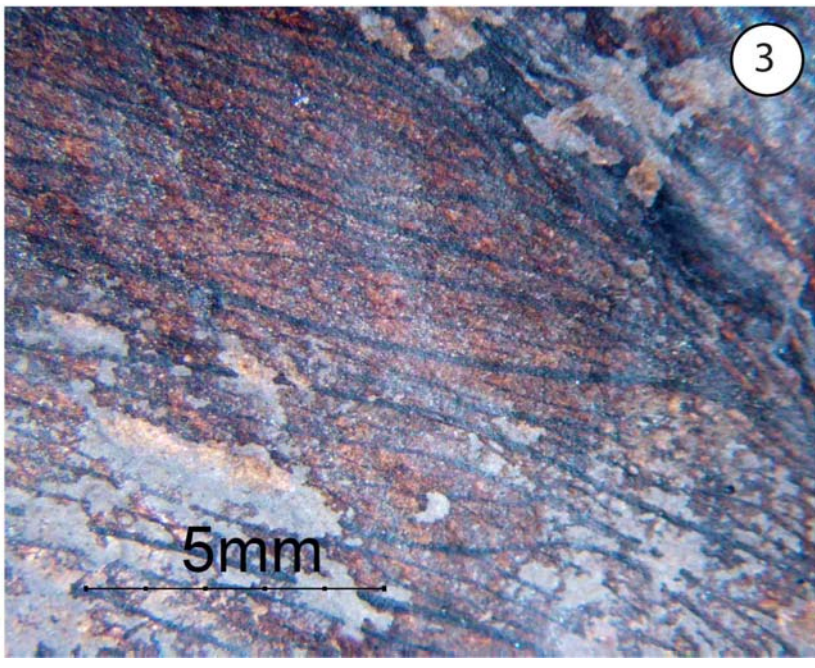
Midrib stout. Secondary veins thick, multistranded and decurrent on midvein. Tertiary and higher order veins semi-parallelodromous, exmedially ramified, with irregular paths and spacing, and depart from the secondaries at very acute angles.

## Description

Fragment of a very likely megaphyll leaf (~14 cm long and ~17 cm wide). The fossil lacks the base, apex and the margin. Midrib stout (~2.5 cm wide) and multistranded. Major secondary vein framework unknown, but the veins are thick, multistranded, decurrent on midrib, and depart at ~50° from the midrib. Tertiary and higher order veins are very thin compared to secondaries. These veins are decurrent, semi-parallelodromous, exmedially ramified, with irregular paths and spacing, and depart from the secondaries at very acute angles (not parallel to secondaries).


1


2


3
5mm

**CERREJON FLORA** | Morphotype Name: *incertae sedis* | Morphotype #: CJ64

Major Plant Group: MON | Organ Type: Leaf | Morphotyper: | Type loc. #: | Type spec. #:

Plant Family/order: | Loca:

## Section I. Leaf Characters

Leaf Attachment:
Leaf Arrangement:
Leaf Organization:
Leaflet Organization:
Leaflet Attachment:
Petiole Features:

### Features of the Blade

Position of Blade Attachment: marginal
Laminar Size (smallest): mesophyll
Laminar Size (largest):
Laminar L:W Ratio:
Laminar Shape:
Medial Symmetry:
Base Symmetry:
Lobation:
Margin Type: untoothed
Margin Features:
Apex Angle:
Apex Shape:
Base Angle: acute
Base Shape: decurrent
Terminal Apex Features:
Surface Texture:
SurficialGlands:
Stomata:
Cuticle Features:

## Section III. Teeth

Tooth Spacing:
# of Orders:
Teeth/cm:
Sinus Shape:
Tooth Shape:
Tooth Shape:
Principal Vein:
Accesory Vein:
Principal Vein Termination:
Course of Accesory Vein:
Features of the Tooth Apex:

## Similar Morphotypes

CJ49

## Section II. Venation

1° Vein Framework: pinnate - multistranded
Naked Basal Veins:
# of Basal Veins:
Agrophic Veins:

Major 2° Vein Framework (costal): parallelodromous | #:
Interior Secondaries:
Minor 2° Course:
Perimarginal Veins:
Major 2° Spacing (costal):
Variation of 2° Vein Angle (costal):
Major 2° Vein Attachment (costal):

Inter-2° Vein Proximal Course:
Inter-2° Vein Lenght:
Inter-2° Vein Distal Course:
Inter-2° Vein Frequency:

Intercostal 3° Vein Fabric: parallelodromous
Course of Percurrent 3°:
Angle of Percurrent 3°:
Intercostal 3° Vein Angle Variability:
Epimedial 3°:
Admedial Course:
Exmedial Course:
Exterior 3° Course:

Quaternary Vein Fabric:

Quinternary Vein Fabric:

Areolation:
F.E.V.s Course:
F.E.V.s Terminae:
Marginal Ultimate Venation:

## Diagnostic Features

Midrib pinnate and multistranded. Secondaries strongly decurrent (not multistranded) on midrib, their spacing is wide. Three subsets of veins that alternate and parallel the secondaries are present.

## Description

Laminar size mesophyll (>11 cm long and ~5.5 cm wide). Midrib pinnate, multistranded and thick. Secondary vein framework parallelodromous (not multistranded) and decurrent on midrib. Secondary vein spacing varies from 0.9 to 1 cm. Three subsets of veins that alternate and parallel the secondaries. These subsets of veins are recognized by their width, and independently of their order the spacing ranges from 1.2 to 1.5 mm.


1


2

**CERREJON FLORA** | Morphotype Name: *incertae sedis* | Morphotype #: CJ65

Major Plant Group: MON | Organ Type: Leaf | Morphotyper: | Type loc. #: | Type spec. #:

Plant Family/order: Zingiberales | Loca:

## Section I. Leaf Characters

Leaf Attachment:
Leaf Arrangement:
Leaf Organization:
Leaflet Organization:
Leaflet Attachment:
Petiole Features:

### Features of the Blade

Position of Blade Attachment:
Laminar Size (smallest): macrophyll
Laminar Size (largest): megaphyll
Laminar L:W Ratio:
Laminar Shape: oblong?
Medial Symmetry:
Base Symmetry:
Lobation: unlobed
Margin Type: untoothed
Margin Features:
Apex Angle:
Apex Shape:
Base Angle:
Base Shape:
Terminal Apex Features:
Surface Texture:
SurficialGlands:
Stomata:
Cuticle Features:

## Section III. Teeth

Tooth Spacing:
# of Orders:
Teeth/cm:
Sinus Shape:
Tooth Shape:
Tooth Shape:
Principal Vein:
Accesory Vein:
Principal Vein Termination:
Course of Accesory Vein:
Features of the Tooth Apex:

## Similar Morphotypes

## Section II. Venation

1° Vein Framework: pinnate
Naked Basal Veins:
# of Basal Veins:
Agrophic Veins:

Major 2° Vein Framework (costal): #:
Interior Secondaries:
Minor 2° Course:
Perimarginal Veins: intramarginal secondary
Major 2° Spacing (costal):
Variation of 2° Vein Angle (costal):
Major 2° Vein Attachment (costal): decurrent

Inter-2° Vein Proximal Course:
Inter-2° Vein Lenght:
Inter-2° Vein Distal Course:
Inter-2° Vein Frequency:

Intercostal 3° Vein Fabric: parallelodromous
Course of Percurrent 3°:
Angle of Percurrent 3°:
Intercostal 3° Vein Angle Variability:
Epimedial 3°:
Admedial Course:
Exmedial Course:
Exterior 3° Course:

Quaternary Vein Fabric: parallelodromous

Quinternary Vein Fabric: freely ramifying

Areolation:
F.E.V.s Course:
F.E.V.s Terminae:
Marginal Ultimate Venation:

## Diagnostic Features

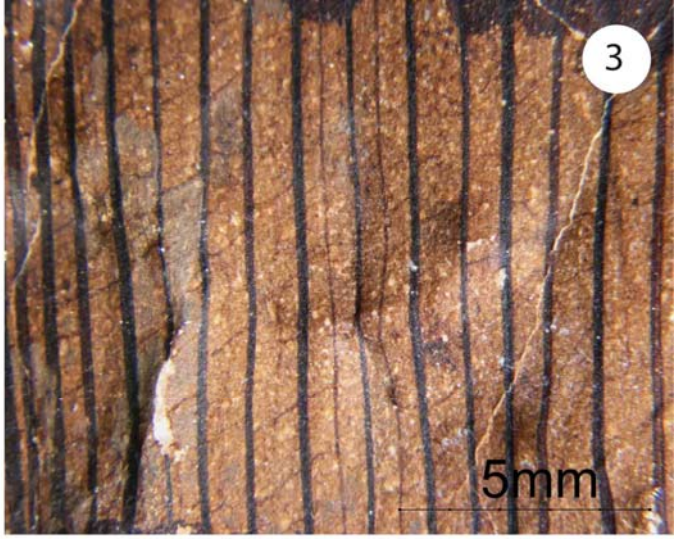
Midrib and secondaries are stout and multistranded. Two subsets of closely spaced veins that alternate and parallel the secondaries are present. Secondaries and the rest of vein orders are strongly crowded and decurrent on midvein. Two kind of higher order veins: crossed veins lying at variable angles and veins more or less parallel to the two subsets of veins.

## Description

Leaf size macrophyll to megaphyll (the biggest specimen is ~30 cm long and 15 cm wide). Margin entire. Primary vein framework probably pinnate. Laminar shape apparently oblong. Midrib and secondary veins stout and multistranded; 12 secondaries are preserved on the biggest specimen. Secondary vein spacing from 2.1 cm to 5.2 cm. Variation of major secondary angle to midvein from 60° to 70°, then the angle decrease exmedially. Two subsets of parallelodromous and closely spaced veins that alternate in between the secondaries. These subsets are recognized by their width, and independently of their order the spacing ranges from 0.7 mm to 1.4 mm. The first subset appears from 4 to 6 times in between a pair of secondaries. The second subset constitutes the majority of veins. Two very thin types of higher order venation: veins that cross the subsets at oblique angles, and veins with an irregular course, parallel to the subsets.


1


2


3
5mm


4
5mm


5

**CERREJON FLORA** | Morphotype Name: *Acrostichum sp.* | Morphotype #: CJ66

Major Plant Group: PTE | Organ Type: Leaf | Morphotyper: | Type loc. #: | Type spec. #:

Plant Family: Pteridaceae | Genus: *Acrostichum* | Loca:

### Rhizome Characters

Rhizome Type:
Rhizome Lenght:
Special Features:

### Frond Characters

Frond Type:
Frond Attachment:
F. Organization:
Petiole Features:
Laminar Size (smallest): notophyll
Laminar Size (largest): mesophyll

### Features of the Pinnae

Pinnae Attachment:
Frond Shape: elliptic
Base Symmetry:
Lobation: unlobed
Margin Type: untoothed
Margin Features:
Apex Angle:
Apex Shape:
Base Angle:
Base Shape:
Surface Texture:
Scales & Hairs:

### Teeth Features

Tooth Spacing:
# of Orders:
Teeth/cm:
Sinus Shape:
Tooth Shape:
Tooth Shape:
Principal Vein:
Accesory Vein:
Principal Vein Termination:
Course of Accesory Vein:
Features of the Tooth Apex:

### Similar Morphotypes

### Venation of the Pinnae and/or Pinnule

1° Costa Framework: pinnate
# of Basal Costa:
Costule Framework:
# of Basal Costa:

Major 2° Vein Framework: reticulodromous
Interior Secondaries:
Perimarginal Veins: fimbrial vein
Major 2° Spacing: regular - crowded
Variation of 2° Vein Angle: apparently uniform
Major 2° Vein Attachment: slightly decurrent

Areolation:
Veinlets Course: absent
Veinlets Terminae:
Marginal Ultimate Venation:

### Sporangia

Sori and Indusia:
Sorus Position:

### Vascular Bundles

Type:

### Diagnostic Features

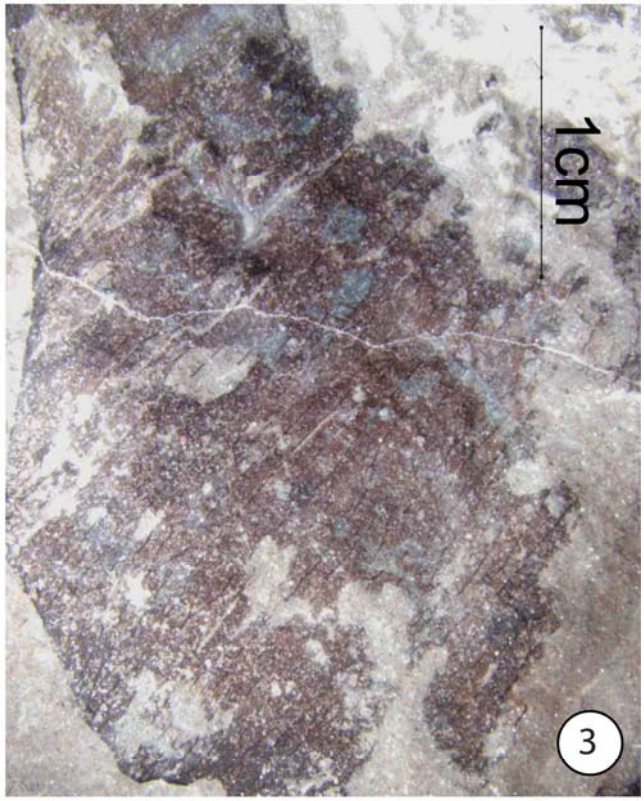
Frond organization unknown. Costa framework pinnate. Margin entire. Secondary veins reticulodromous that anastomose to form small polygonal areoles without veinlets.

### Description

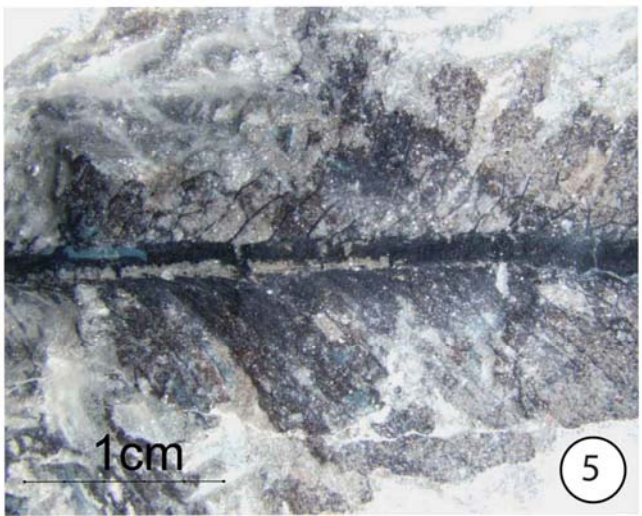
Frond organization unknown. Laminar size from nanophyll to mesophyll. Frond shape elliptic. Margin entire. Costa framework pinnate, very thick (0.3-0.4 cm) compared to secondaries (<0.1 cm). Secondary veins reticulodromous, weekly decurrent on costa, closely spaced (from 0.07 to 0.13 cm), and arise from the costa from 40° to 60°. Fimbrial vein. Polygonal areoles become smaller near costa and at the margin, but more elongated in between. The areoles are 3-5 sided free of veinlets, and their sizes range from 05-1.0 cm x 0.07-0.13 cm.


1


2
1cm


1cm
3


4


1cm
5

**CERREJON FLORA** | Morphotype Name: *incertae sedis* | Morphotype #: CJ67

Major Plant Group: MON | Organ Type: Leaf | Morphotyper: | Type loc. #: | Type spec. #:

Plant Family/order: Arecaceae | Loca:

## Section I. Leaf Characters

Leaf Attachment:
Leaf Arrangement:
Leaf Organization:
Leaflet Organization:
Leaflet Attachment:
Petiole Features:

### Features of the Blade

Position of Blade Attachment:
Laminar Size (smallest): mesophyll
Laminar Size (largest): megaphyll
Laminar L:W Ratio:
Laminar Shape:
Medial Symmetry:
Base Symmetry:
Lobation:
Margin Type: untoothed
Margin Features:
Apex Angle:
Apex Shape:
Base Angle:
Base Shape:
Terminal Apex Features:
Surface Texture:
SurficialGlands:
Stomata:
Cuticle Features:

## Section III. Teeth

Tooth Spacing:
# of Orders:
Teeth/cm:
Sinus Shape:
Tooth Shape:
Tooth Shape:
Principal Vein:
Accesory Vein:
Principal Vein Termination:
Course of Accesory Vein:
Features of the Tooth Apex:

## Similar Morphotypes

## Section II. Venation

1° Vein Framework:
Naked Basal Veins:
# of Basal Veins:
Agrophic Veins:

Major 2° Vein Framework (costal): parallelodromous | #:
Interior Secondaries:
Minor 2° Course:
Perimarginal Veins:
Major 2° Spacing (costal):
Variation of 2° Vein Angle (costal):
Major 2° Vein Attachment (costal):

Inter-2° Vein Proximal Course:
Inter-2° Vein Lenght:
Inter-2° Vein Distal Course:
Inter-2° Vein Frequency:

Intercostal 3° Vein Fabric: parallelodromous
Course of Percurrent 3°:
Angle of Percurrent 3°:
Intercostal 3° Vein Angle Variability:
Epimedial 3°:
Admedial Course:
Exmedial Course:
Exterior 3° Course:

Quaternary Vein Fabric: freely ramifying

Quinternary Vein Fabric:

Areolation:
F.E.V.s Course:
F.E.V.s Terminae:
Marginal Ultimate Venation:

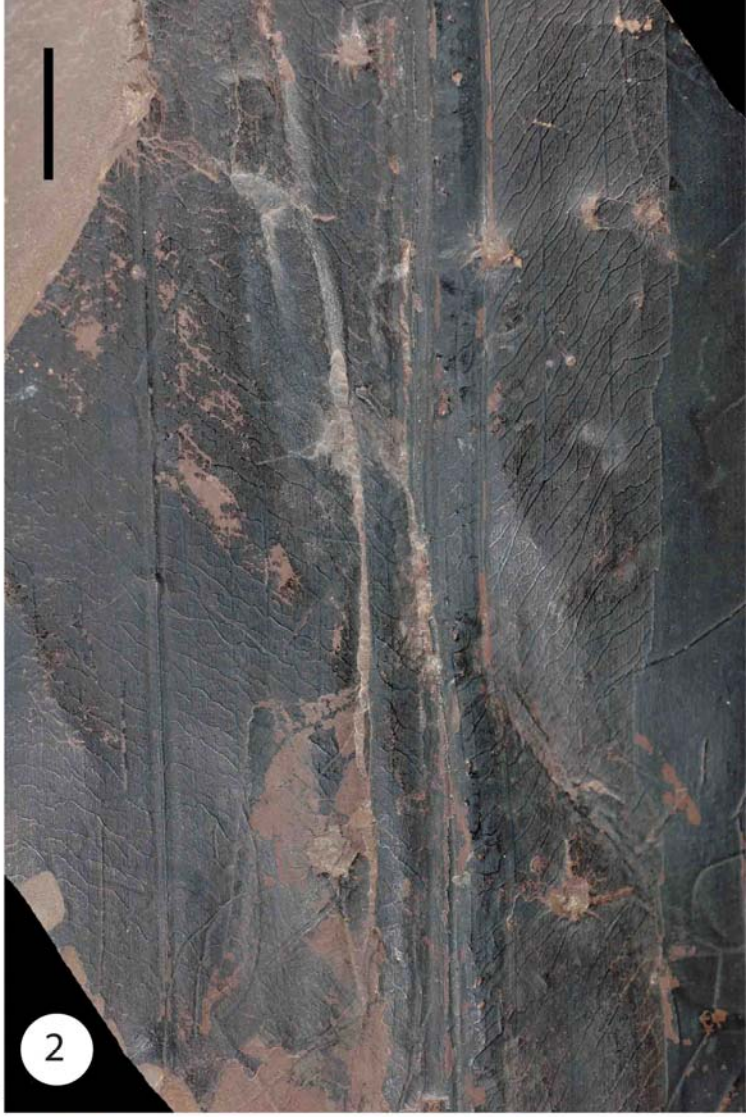
## Diagnostic Features

Costapalmate or palmate leaves. Margin entire. Segments wide with a midvein. Four orders of parallel veins. Crossveins wide, strikingly sinuous, with an irregular course, parallel to one another.

## Description

Fragments of costapalmate or palmate leaves. Margin Entire. Segments ~51.6–112 mm wide with a midvein 1.5 mm wide. Parallel to the midvein, there are veins of four orders: first order veins 1.17–1.6 mm wide, separated by 38-38.29 mm; second order veins 0.8-1.1 mm wide; primary and secondary veins separated by 0.2 mm approximately; third order veins 0.1-0.2 mm wide, separated by 2.0–3.44 mm. Tertiary and secondary veins separated by 6–8 mm. Fourth order veins very thin, almost indiscernible, separated by 0.2 mm and approximately seven in number between two third order veins. Crossveins 0.10–0.12 mm wide, strikingly sinuous, with an irregular course, parallel to one another between each other, spaced 1-5 mm apart and joining the middle or primary veins decurrently at a 45° angle. Away from their decurrent junction with thicker veins, the crossveins bend to cross the secondary veins at an almost straight angle; they can connect two primaries or a primary and a lesser order vein. Crossveins are not always visible, only in some leaf fragments where partial decomposition took place.


1


2


3


4

**CERREJON FLORA** | Morphotype Name: *incertae sedis* | Morphotype #: CJ68

Major Plant Group: MON | Organ Type: Leaf | Morphotyper: | Type loc. #: | Type spec. #:

Plant Family/order: Arecaceae | Loca:

## Section I. Leaf Characters

Leaf Attachment:
Leaf Arrangement:
Leaf Organization: compound
Leaflet Organization: opposite to semialternate
Leaflet Attachment: sessile
Petiole Features:

### Features of the Blade

Position of Blade Attachment:
Laminar Size (smallest): mesophyll
Laminar Size (largest): megaphyll
Laminar L:W Ratio:
Laminar Shape:
Medial Symmetry:
Base Symmetry:
Lobation:
Margin Type: untoothed
Margin Features:
Apex Angle:
Apex Shape:
Base Angle:
Base Shape:
Terminal Apex Features:
Surface Texture:
SurficialGlands:
Stomata:
Cuticle Features:

## Section III. Teeth

Tooth Spacing:
# of Orders:
Teeth/cm:
Sinus Shape:
Tooth Shape:
Tooth Shape:
Principal Vein:
Accesory Vein:
Principal Vein Termination:
Course of Accesory Vein:
Features of the Tooth Apex:

## Similar Morphotypes

## Section II. Venation

1° Vein Framework: pinnate
Naked Basal Veins:
# of Basal Veins:
Agrophic Veins:

Major 2° Vein Framework (costal): parallelodromous | #:
Interior Secondaries:
Minor 2° Course:
Perimarginal Veins:
Major 2° Spacing (costal):
Variation of 2° Vein Angle (costal):
Major 2° Vein Attachment (costal):

Inter-2° Vein Proximal Course:
Inter-2° Vein Lenght:
Inter-2° Vein Distal Course:
Inter-2° Vein Frequency:

Intercostal 3° Vein Fabric: parallelodromous
Course of Percurrent 3°:
Angle of Percurrent 3°:
Intercostal 3° Vein Angle Variability:
Epimedial 3°:
Admedial Course:
Exmedial Course:
Exterior 3° Course:

Quaternary Vein Fabric:

Quinternary Vein Fabric:

Areolation:
F.E.V.s Course:
F.E.V.s Terminae:
Marginal Ultimate Venation:

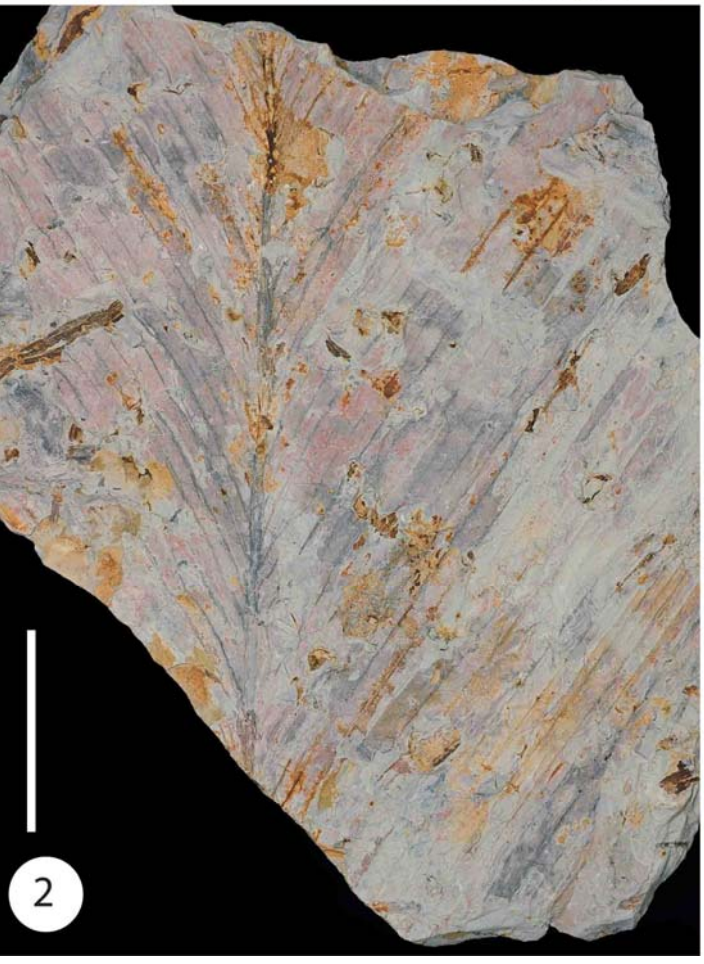
## Diagnostic Features

Pinnate leaves. Margin entire. Rachis stout with a longitudinal ridge. Leaflets are plicate, regularly arranged in one plane, opposite to semialternate. Two orders of parallel veins. Transverse veinlets are not evident.

## Description

Fragments of pinnate leaves. Margin entire. Rachis stout (~23 mm wide at the base and 7-17 mm wide in more apical fragments) with a longitudinal ridge. Leaflets are plicate, regularly arranged in one plane, opposite to semialternate, separated by 8–42 mm at their insertions. Each leaflet has a prominent midrib 0.5–0.7 mm wide, and two orders of parallel veins separated by 1–2.3 mm. Transverse veinlets are not evident. Small cuticle fragments were extracted from two specimens, and consisted of two types: Cuticles with stomata, cells isodiametric to rectangular (mainly), with straight walls of 4-6 sides, 13.4-29.0µm long and 10.8-16.1 µm wide, longitudinally to diagonally extended (near to the stomata); trichomes absent; stomata in non distinctive lines. Guard cells 21.78-25.52 µm long and 5.72-8.58 µm wide; lateral subsidiary cells 25.96-32.56 µm long and 2.64-10.56 µm wide; terminal subsidiary cells without lobes, 9.46-14.96µm long and 12.54-17.38 µm wide. Cuticles without stomata, cells with 4 to 6 sides, rectangular to isodiametric with straight walls, 10.12–34.32µm long and 8.14–20.02 µm wide.


1


2


3


4


5

**CERREJON FLORA**

Morphotype Name: *incertae sedis* | Morphotype #: CJ76

Major Plant Group: DIC | Organ Type: Leaf | Morphotyper: | Type loc. #: | Type spec. #:

Plant Family/order: Fabaceae | Loca:

## Section I. Leaf Characters

Leaf Attachment:
Leaf Arrangement: opposite
Leaf Organization: pinnately compound-twice
Leaflet Organization: opposite-even-pinnate
Leaflet Attachment: petiolulate
Petiole Features: petiole base pulvinulate

### Features of the Blade

Position of Blade Attachment: marginal
Laminar Size (smallest): leptophyll
Laminar Size (largest): nanophyll
Laminar L:W Ratio:
Laminar Shape: elliptic / oblong
Medial Symmetry: symmetrical
Base Symmetry: width and insertion asymmet.
Lobation: unlobed
Margin Type: untoothed
Margin Features:
Apex Angle: acute
Apex Shape: convex / rounded
Base Angle: obtuse
Base Shape: complex / rounded
Terminal Apex Features:
Surface Texture:
SurficialGlands:
Stomata:
Cuticle Features:

## Section III. Teeth

Tooth Spacing:
# of Orders:
Teeth/cm:
Sinus Shape:
Tooth Shape:
Tooth Shape:
Principal Vein:
Accesory Vein:
Principal Vein Termination:
Course of Accesory Vein:
Features of the Tooth Apex:

## Similar Morphotypes

## Section II. Venation

1° Vein Framework: pinnate
Naked Basal Veins:
# of Basal Veins:
Agrophic Veins:

Major 2° Vein Framework (costal): #:
Interior Secondaries:
Minor 2° Course:
Perimarginal Veins:
Major 2° Spacing (costal):
Variation of 2° Vein Angle (costal):
Major 2° Vein Attachment (costal):

Inter-2° Vein Proximal Course:
Inter-2° Vein Lenght:
Inter-2° Vein Distal Course:
Inter-2° Vein Frequency:

Intercostal 3° Vein Fabric:
Course of Percurrent 3°:
Angle of Percurrent 3°:
Intercostal 3° Vein Angle Variability:
Epimedial 3°:
Admedial Course:
Exmedial Course:
Exterior 3° Course:

Quaternary Vein Fabric:

Quinternary Vein Fabric:

Areolation:
F.E.V.s Course:
F.E.V.s Terminae:
Marginal Ultimate Venation:

## Diagnostic Features

Compound leaf (twice pinnately compound) with leaflet organization opposite (even). Laminar size of the leaflets from leptophyll to nanophyll. Leaflets with a very short petiolule and base assymetrical. The internal venation of the leaflets is not well preserved, but a primary vein is observed only.

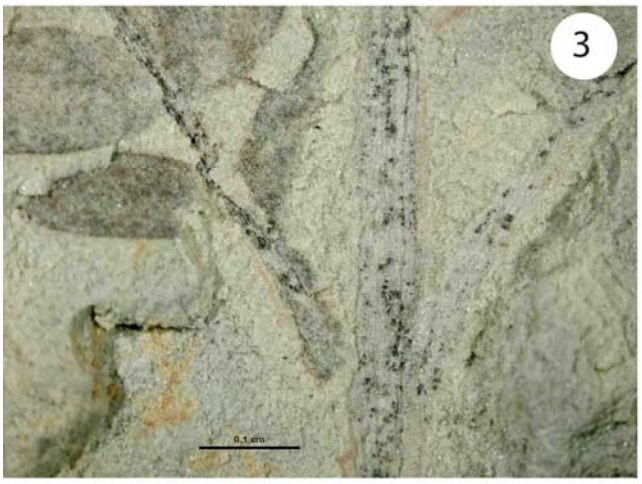
## Description

Leaf arrangement opposite. Leaf organization twice pinnately compound. Leaflet organization opposite-even (62 pairs of leaflets were counted in the longest rachis). Leaflet attachment petiolulate and base pulvinulate. Blade attachment marginal. Laminar size (leaflets) leptophyll to nanophyll (0.2 to 0.6 cm long). Laminar shape elliptic to oblong. Leaflets medially symmetrical. Base symmetry with insertion and extension asymmetrical. Margin entire. Apex angle acute. Apex shape convex to rounded. Base angle obtuse. Base complex, rounded to convex. Primary vein framework pinnate and thick. None other venation features are preserved.


1


2

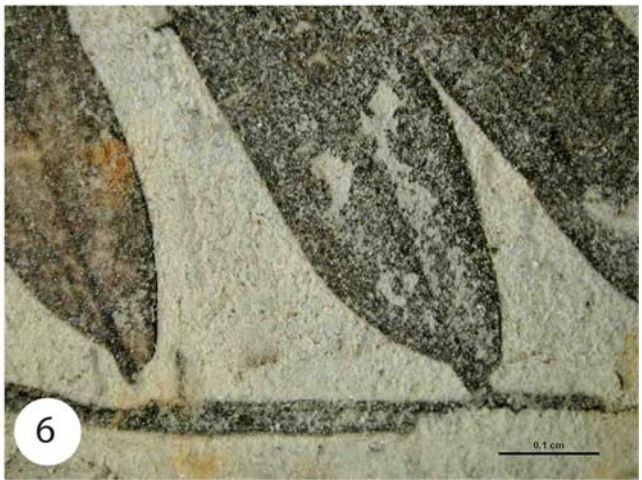

4


3
0.1 cm


7


5


8


6
0.1 cm

**CERREJON FLORA** | Morphotype Name: *incertae sedis* | Morphotype #: CJ80

Major Plant Group: MON | Organ Type: Leaf | Morphotyper: | Type loc. #: | Type spec. #:

Plant Family/order: Araceae | Loca:

## Section I. Leaf Characters

Leaf Attachment: petiolate
Leaf Arrangement:
Leaf Organization:
Leaflet Organization:
Leaflet Attachment:
Petiole Features:

### Features of the Blade

Position of Blade Attachment: marginal
Laminar Size (smallest): mesophyll
Laminar Size (largest): megaphyll
Laminar L:W Ratio:
Laminar Shape:
Medial Symmetry:
Base Symmetry:
Lobation:
Margin Type:
Margin Features:
Apex Angle:
Apex Shape:
Base Angle: reflex
Base Shape: cordate
Terminal Apex Features:
Surface Texture:
SurficialGlands:
Stomata:
Cuticle Features:

## Section III. Teeth

Tooth Spacing:
# of Orders:
Teeth/cm:
Sinus Shape:
Tooth Shape:
Tooth Shape:
Principal Vein:
Accesory Vein:
Principal Vein Termination:
Course of Accesory Vein:
Features of the Tooth Apex:

## Similar Morphotypes

## Section II. Venation

1° Vein Framework: pinnate
Naked Basal Veins: present
# of Basal Veins: 3-5
Agrophic Veins:

Major 2° Vein Framework (costal): multistranded | #:
Interior Secondaries:
Minor 2° Course:
Perimarginal Veins:
Major 2° Spacing (costal): decreasing proximally
Variation of 2° Vein Angle (costal): smoothly increasing proximally
Major 2° Vein Attachment (costal): decurrent

Inter-2° Vein Proximal Course:
Inter-2° Vein Lenght:
Inter-2° Vein Distal Course:
Inter-2° Vein Frequency:

Intercostal 3° Vein Fabric: parallelodromous
Course of Percurrent 3°:
Angle of Percurrent 3°:
Intercostal 3° Vein Angle Variability:
Epimedial 3°:
Admedial Course:
Exmedial Course:
Exterior 3° Course:

Quaternary Vein Fabric: irregular transverse veins

Quinternary Vein Fabric:

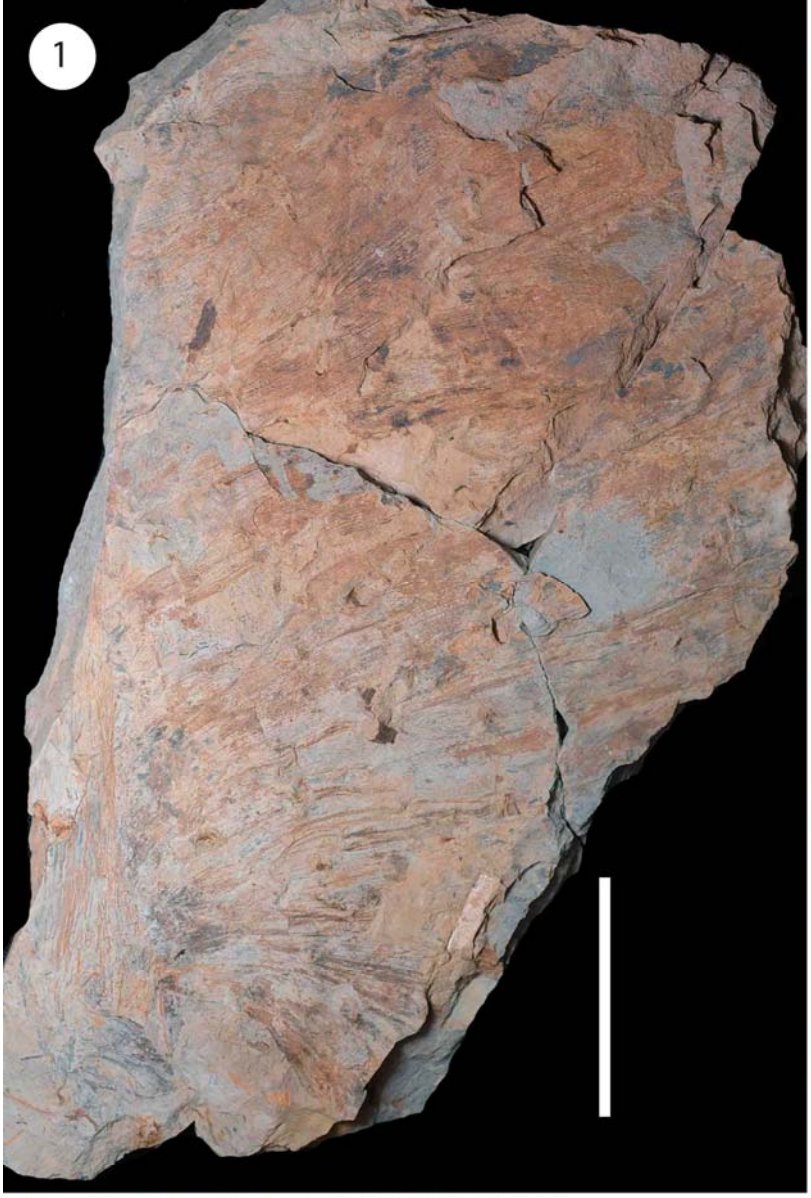
Areolation: lacking
F.E.V.s Course:
F.E.V.s Terminae:
Marginal Ultimate Venation:

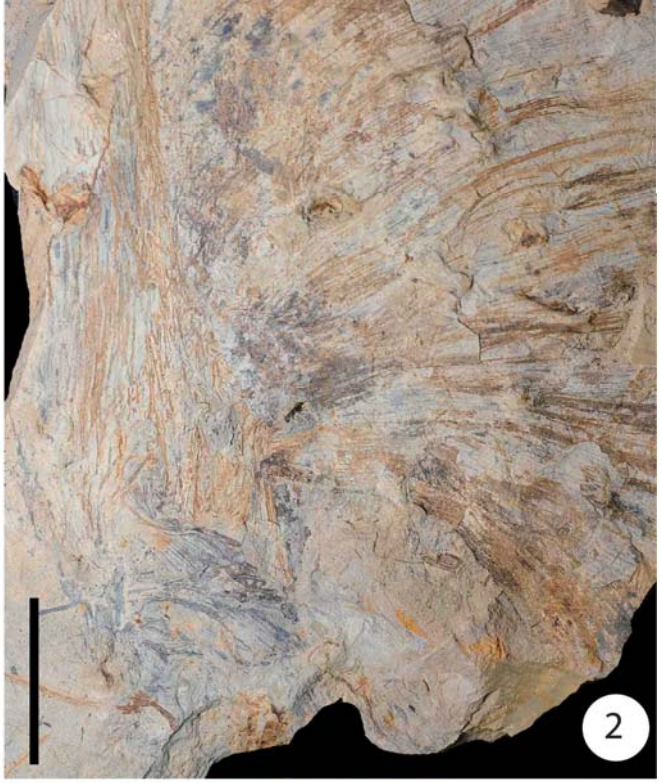
## Diagnostic Features

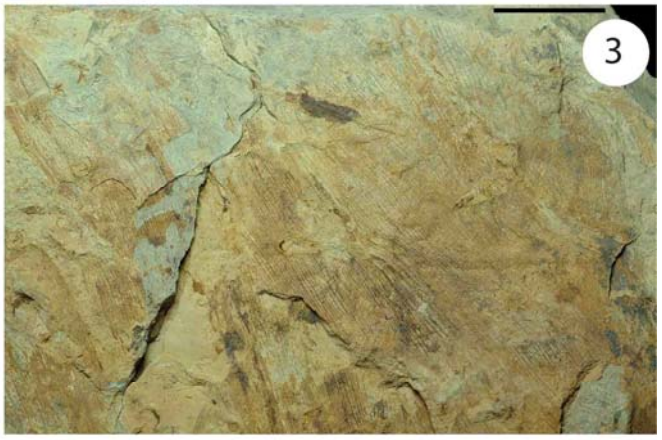
Midrib stout and multistranded. Base shape cordate. Secondaries multistranded and decurrent on midvein. Tertiary veins parallelodromous and closely spaced. Secondaries and tertiaries are crossed by irregular transverse veins.

## Description

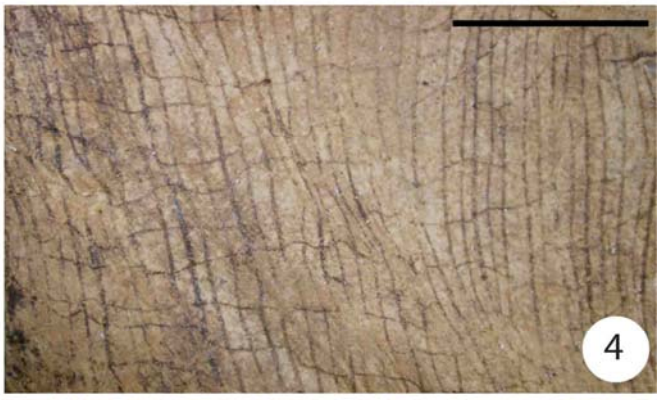
Leaf attachment petiolate. Blade attachment marginal. Laminar size from mesophyll to megaphyll (the biggest specimen is ~24 cm long and ~15 cm wide). Base angle reflex and shape cordate, where the basal lobes are fed by the most basal secondary veins. Midrib stout (2.5 cm wide) and multistranded. Primary vein framework pinnate. Naked basal veins. Number of basal veins from 3 to 5. Secondary vein framework unknown, but the veins are thick, multistranded, and their spacing decrease proximally (from 1.6 to 2.0 cm). Variation of major secondary angle to midrib smoothly increasing proximally (from ~68° distally to >100° proximally). Secondary and tertiary vein attachment to midrib decurrent. Tertiary vein framework parallelodromous (also parallel to secondaries) and closely spaced (from 0.3 mm to 0.8 mm). The secondary and tertiary veins are crossed by strong irregular veins; the spacing and angles of these cross veins are very variable.

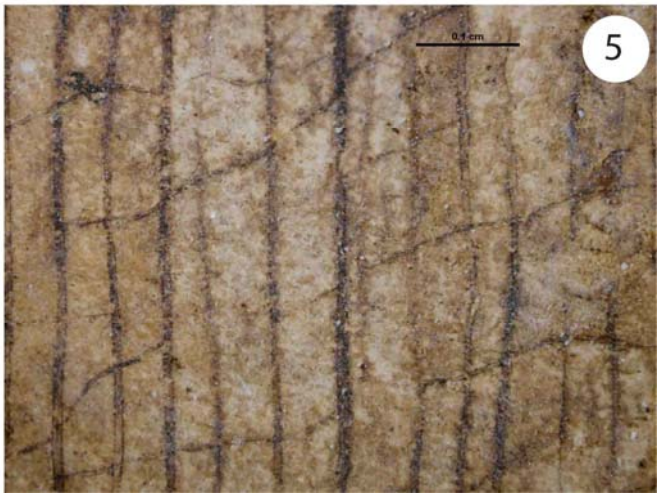

1


2


3


6


4


0.1 cm
5

**CERREJON FLORA** | Morphotype Name: *incertae sedis* | Morphotype #: CJ81

Major Plant Group: PTE | Organ Type: Leaf | Morphotyper: | Type loc. #: | Type spec. #:

Plant Family: | Genus: | Loca:

### *Rhizome Characters*

Rhizome Type:
Rhizome Lenght:
Special Features:

### *Frond Characters*

Frond Type:
Frond Attachment:
F. Organization: pinnatisect to pinnatifid
Petiole Features:
Laminar Size (smallest): mesophyll
Laminar Size (largest): macrophyll

### *Features of the Pinnae*

Pinnae Attachment: sessile
Frond Shape: oblong
Base Symmetry: asymmetrical
Lobation: unlobed | lobed
Margin Type: serrate
Margin Features:
Apex Angle:
Apex Shape:
Base Angle: acute
Base Shape: decurrent
Surface Texture:
Scales & Hairs:

### *Teeth Features*

Tooth Spacing: irregular
# of Orders: one
Teeth/cm: variable, 1-4/cm
Sinus Shape: angular
Tooth Shape: st/st | st/cv
Tooth Shape:
Principal Vein: absent
Accesory Vein: present
Principal Vein Termination:
Course of Accesory Vein: straight
Features of the Tooth Apex: non-specific

### *Similar Morphotypes*

### *Venation of the Pinnae and/or Pinnule*

1° Costa Framework: pinnate
# of Basal Costa:
Costule Framework:
# of Basal Costa:

Major 2° Vein Framework: craspedodromous
Interior Secondaries:
Perimarginal Veins:
Major 2° Spacing: regular - crowded
Variation of 2° Vein Angle:
Major 2° Vein Attachment: decurrent to excurrent

Areolation: lacking
Veinlets Course:
Veinlets Terminae:
Marginal Ultimate Venation:

### *Sporangia*

Sori and Indusia:
Sorus Position:

### *Vascular Bundles*

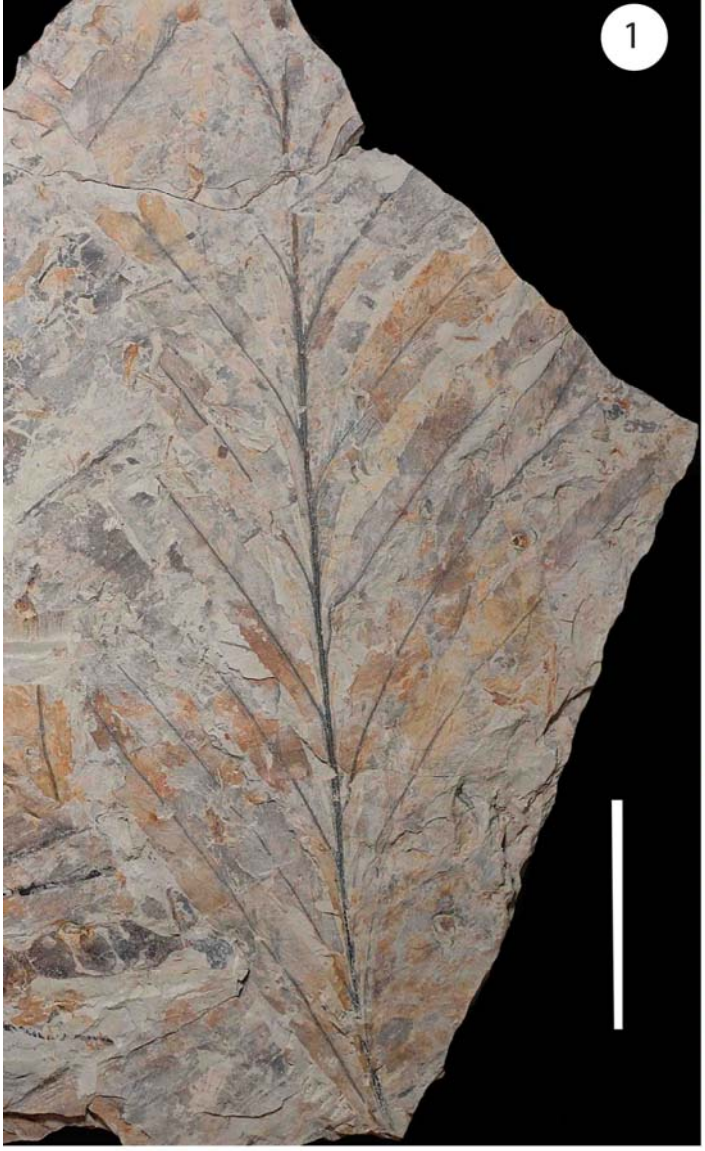
Type:

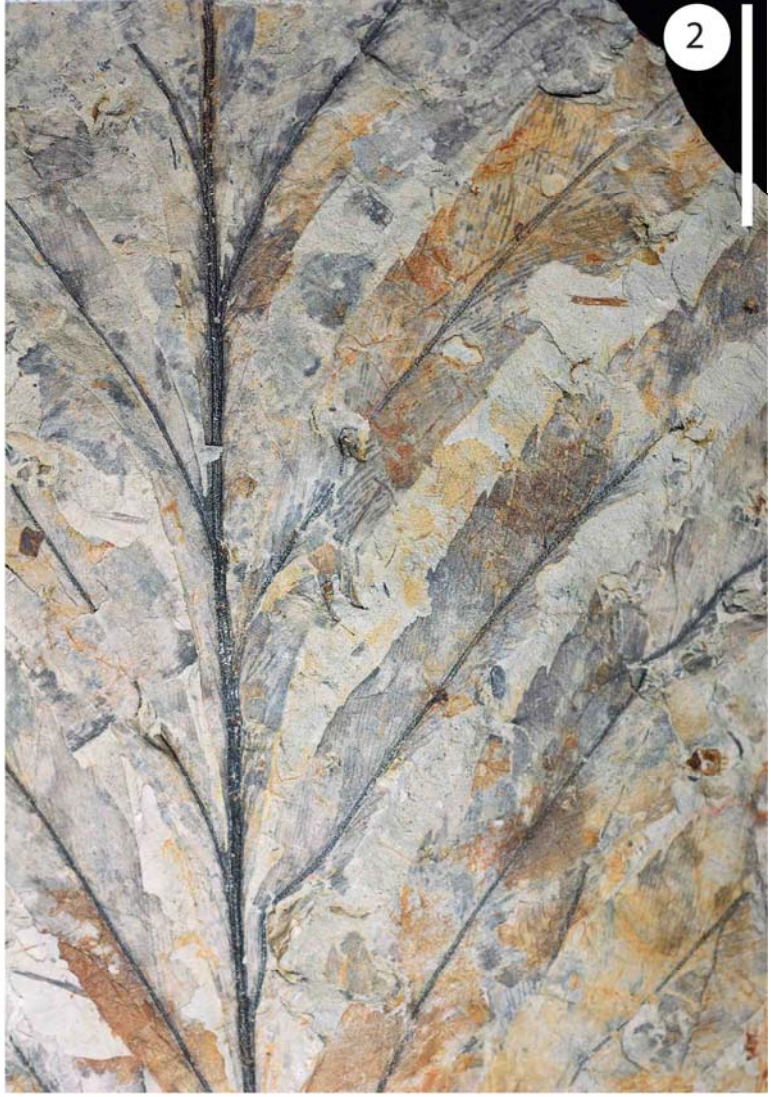
### *Diagnostic Features*

Frond organization varies from pinnatisect (more proximally) to pinnatifid (more distally). Pinnae oblong (up to ~17 cm long). Secondaries craspedodromous and closely spaced. Lacking areolation. Teeth st/st and st/cv.

### *Description*

Frond organization varies from pinnatisect (more proximally) to pinnatifid (more distally). Frond size mesophyll to macrophyll. Pinnae organization mostly alternate. Pinnae attachment sessile. Frond shape of the pinnae oblong (the longest specimen is ~17 cm). Pinnae base shape asymmetrical and strongly decurrent. Secondary veins craspedodromous, numerous, closely spaced (0.3 to 0.4 mm), with rare and low angle dichotomy near costa, and decurrent or excurrent on costa. Lacking areolation. Margin serrate; teeth (st/st and st/cv) with long proximal flanks; tooth spacing irregular; number of orders one; teeth/cm variable, 1-4/cm; sinus shape angular; principal vein absent, but more than one accessory vein enters the tooth with courses straight; features of the tooth apex non-specific.


1


2


3


4

**CERREJON FLORA** | Morphotype Name: *Menispermites guajiraensis* | Morphotype #: CJ82

Major Plant Group: DIC | Organ Type: Leaf | Morphotyper: | Type loc. #: | Type spec. #:

Plant Family/order: Menispermaceae | Loca:

## Section I. Leaf Characters

Leaf Attachment:
Leaf Arrangement:
Leaf Organization:
Leaflet Organization:
Leaflet Attachment:
Petiole Features: long (commonly preserved)

### Features of the Blade

Position of Blade Attachment: marginal
Laminar Size (smallest): microphyll
Laminar Size (largest): macrophyll
Laminar L:W Ratio:
Laminar Shape: ovate | elliptic
Medial Symmetry: symmetrical
Base Symmetry: symmetrical
Lobation: unlobed
Margin Type: untoothed
Margin Features:
Apex Angle: acute
Apex Shape: acuminate
Base Angle: reflex
Base Shape: cordate | rounded
Terminal Apex Features:
Surface Texture:
SurficialGlands:
Stomata:
Cuticle Features:

## Section III. Teeth

Tooth Spacing:
# of Orders:
Teeth/cm:
Sinus Shape:
Tooth Shape:
Tooth Shape:
Principal Vein:
Accesory Vein:
Principal Vein Termination:
Course of Accesory Vein:
Features of the Tooth Apex:

## Similar Morphotypes

CJ6
CJ17

## Section II. Venation

1° Vein Framework: actinodromous basal
Naked Basal Veins: absent
# of Basal Veins: 5-7
Agrophic Veins: compound

Major 2° Vein Framework (costal): simple brochidodromous | # 8-11 pairs
Interior Secondaries: absent
Minor 2° Course: simple brochidodromous
Perimarginal Veins: fimbrial vein
Major 2° Spacing (costal): gradually increasing proximally
Variation of 2° Vein Angle (costal): uniform
Major 2° Vein Attachment (costal): decurrent

Inter-2° Vein Proximal Course:
Inter-2° Vein Lenght:
Inter-2° Vein Distal Course:
Inter-2° Vein Frequency:

Intercostal 3° Vein Fabric: percurrent
Course of Percurrent 3°: opposite straight | opposite sinuous
Angle of Percurrent 3°: obtuse
Intercostal 3° Vein Angle Variability: increasing exmedially | basally concentric
Epimedial 3°: opposite percurrent
Admedial Course: perpendicular to midvein
Exmedial Course: parallel to intercostal 3°
Exterior 3° Course: looped

Quaternary Vein Fabric: alternate percurrent

Quinternary Vein Fabric: regular reticulate

Areolation: good development
F.E.V.s Course: absent | mostly unbranched
F.E.V.s Terminae:
Marginal Ultimate Venation:

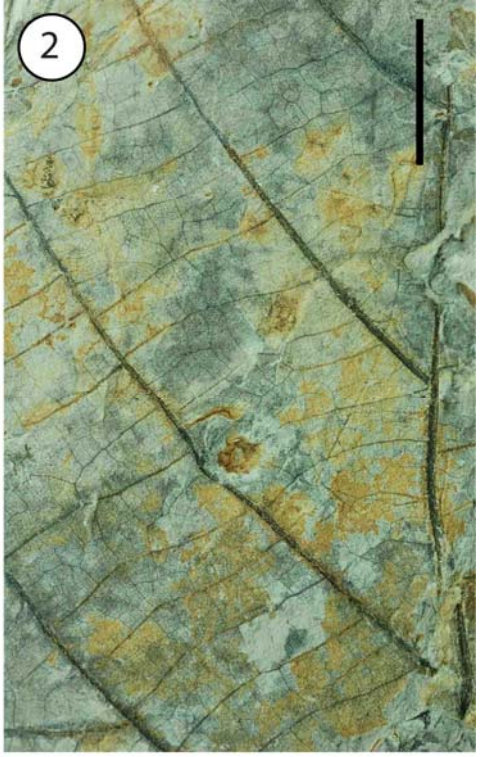
## Diagnostic Features

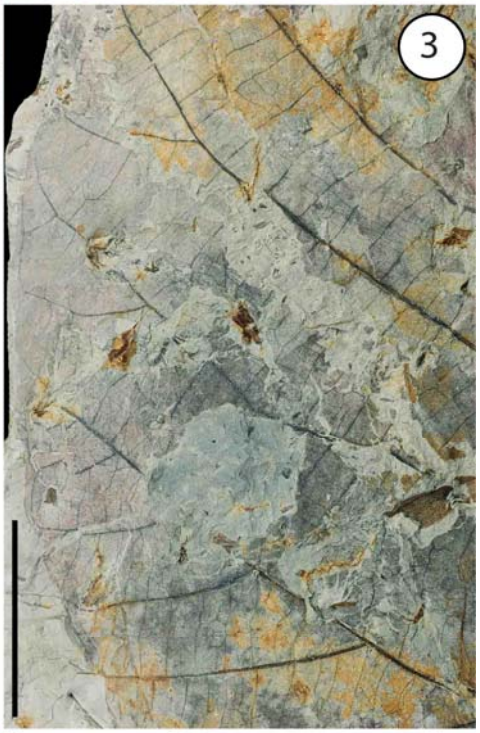
Petiole long and commonly preserved. Base shape from cordate to rounded. Primaries basal actinodromous (5 veins). Agrophic veins compound. Major and minor secondaries simple brochidodromous. From 8 to 11 pairs of costal secondaries with an angle uniform to midvein and a course straight toward margin. Tertiary veins strongly opposite percurrent. Quaternary vein fabric alternate percurrent. Quinternary vein fabric regular reticulate. Areolation development good.

## Description

Petiole long and commonly preserved. Blade attachment marginal. Laminar size from microphyll to macrophyll (the biggest specimen is >30 cm long and ~28 cm wide). Laminar shape ovate to elliptic. Leaf medially and basally symmetrical. Unlobed. Margin entire. Apex angle acute and shape acuminate. Base angle reflex to obtuse and shape from cordate to rounded. Primary vein framework basal actinodromous (5 pairs). Number of basal veins from 5 to 7. Agrophic veins compound. Major secondary vein framework simple brochidodromous (8 to 11 pairs of veins). Minor secondary veins simple brochidodromous. Fimbrial vein. Major secondary vein spacing gradually increasing proximally. Variation of secondary vein angle uniform (from 46° to 58°) with a course more or less straight toward margin. Major secondary vein attachment excurrent. Intercostal tertiary vein fabric opposite percurrent with straight and sinuous courses (spaced from 0.2 to 0.8 cm). Angle of percurrent tertiaries obtuse. Intercostal tertiary vein angle variability increasing exmedially to basally concentric. Epimedial tertiaries opposite percurrent; admedial course perpendicular to midvein; exmedial course parallel to intercostal tertiaries. Exterior tertiary veins course looped. Quaternary vein fabric alternate percurrent. Quinternary vein fabric regular reticulate. Areolation development good. F.E.V.s course absent to mostly unbranched.


1


2


3


4


5


6

**CERREJON FLORA** | Morphotype Name: *incertae sedis* | Morphotype #: CJ83

Major Plant Group: DIC | Organ Type: Leaf | Morphotyper: | Type loc. #: | Type spec. #:

Plant Family/order: | Loca:

## Section I. Leaf Characters

Leaf Attachment:
Leaf Arrangement:
Leaf Organization:
Leaflet Organization:
Leaflet Attachment:
Petiole Features:

### Features of the Blade

Position of Blade Attachment:
Laminar Size (smallest): macrophyll
Laminar Size (largest):
Laminar L:W Ratio:
Laminar Shape: elliptic
Medial Symmetry: symmetrical
Base Symmetry:
Lobation: unlobed
Margin Type: untoothed
Margin Features:
Apex Angle: obtuse
Apex Shape: convex
Base Angle:
Base Shape:
Terminal Apex Features:
Surface Texture:
SurficialGlands: laminar resin glands (abundant)
Stomata:
Cuticle Features:

## Section III. Teeth

Tooth Spacing:
# of Orders:
Teeth/cm:
Sinus Shape:
Tooth Shape:
Tooth Shape:
Principal Vein:
Accesory Vein:
Principal Vein Termination:
Course of Accesory Vein:
Features of the Tooth Apex:

## Similar Morphotypes

CJ8

## Section II. Venation

1° Vein Framework: pinnate
Naked Basal Veins:
# of Basal Veins:
Agrophic Veins: absent

Major 2° Vein Framework (costal): simple brochidodromous | # >20 pairs
Interior Secondaries:
Minor 2° Course: simple brochidodromous
Perimarginal Veins: fimbrial vein
Major 2° Spacing (costal): decreasing proximally
Variation of 2° Vein Angle (costal): smoothly increasing proximally
Major 2° Vein Attachment (costal): excurrent

Inter-2° Vein Proximal Course:
Inter-2° Vein Lenght:
Inter-2° Vein Distal Course:
Inter-2° Vein Frequency:

Intercostal 3° Vein Fabric: percurrent
Course of Percurrent 3°: opposite sinuous - convex | opposite straight
Angle of Percurrent 3°: obtuse | perpendicular
Intercostal 3° Vein Angle Variability: decreasing exmedially | increasing proximally
Epimedial 3°: opposite percurrent
Admedial Course: perpendicular to midvein | obtuse to midvein
Exmedial Course: parallel to intercostal 3°
Exterior 3° Course: looped

Quaternary Vein Fabric: alternate percurrent

Quinternary Vein Fabric: irregular reticulate

Areolation: good development
F.E.V.s Course: mostly 1-branched
F.E.V.s Terminae:
Marginal Ultimate Venation:

## Diagnostic Features

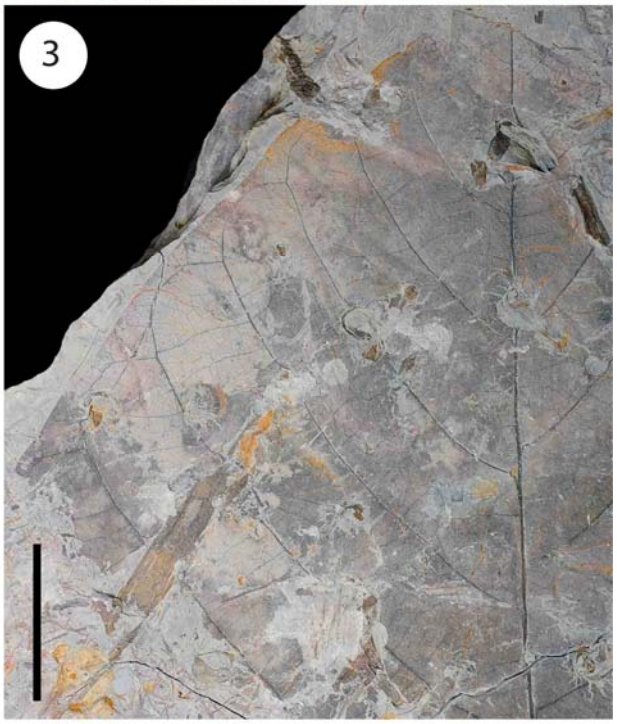
Pinnate (very thick). Laminar resin glands (abundant). Secondaries brochidodromous (> 20 pairs of veins). Secondary spacing decreasing proximally. Secondary angle smoothly increasing proximally (from ~45° to ~90°). Tertiaries opposite percurrent. Tertiary vein angle decreasing exmedially and increasing proximally. Areolation development good.

## Description

Laminar size macrophyll (the biggest specimen is >30 cm long and ~27 cm wide). Laminar shape elliptic. Leaves medially symmetrical. Unlobed. Margin entire. Apex angle obtuse. Apex shape convex. Laminar resin glands (abundant). Primary vein framework pinnate (very thick). Major secondary vein framework simple brochidodromous (> 20 pairs of veins). Minor secondary vein course simple brochidodromous. Fimbrial vein. Major secondary vein spacing decreasing proximally (from 3 cm to 1 cm). Variation of secondary vein angle smoothly increasing proximally (from ~45° to ~90°). Major secondary vein attachment excurrent. Intercostal tertiary vein fabric opposite percurrent with courses sinuous, convex and straight (spaced from 0.3 cm to 1 cm). Angle of percurrent tertiaries obtuse to perpendicular. Intercostal tertiary vein angle variability decreasing exmedially and increasing proximally. Epimedial tertiary veins opposite percurrent; admedial course perpendicular and obtuse to midvein; exmedial course parallel to intercostal tertiaries. Exterior tertiary vein course looped. Quaternary vein fabric alternate percurrent. Quinternary vein fabric irregular reticulate. Areolation development good. F.E.V.s course mostly 1-branched.


1


2


3


4


5


6

**CERREJON FLORA** | Morphotype Name: *incertae sedis* | Morphotype #: CJ84

Major Plant Group: DIC | Organ Type: Leaf | Morphotyper: | Type loc. #: | Type spec. #:

Plant Family/order: | Loca:

## Section I. Leaf Characters

Leaf Attachment:
Leaf Arrangement:
Leaf Organization:
Leaflet Organization:
Leaflet Attachment:
Petiole Features:

### Features of the Blade

Position of Blade Attachment:
Laminar Size (smallest): mesophyll
Laminar Size (largest):
Laminar L:W Ratio:
Laminar Shape: elliptic
Medial Symmetry: symmetrical
Base Symmetry: symmetrical
Lobation: unlobed
Margin Type: untoothed
Margin Features:
Apex Angle: obtuse
Apex Shape: convex
Base Angle: obtuse
Base Shape: convex
Terminal Apex Features:
Surface Texture:
SurficialGlands:
Stomata:
Cuticle Features:

## Section III. Teeth

Tooth Spacing:
# of Orders:
Teeth/cm:
Sinus Shape:
Tooth Shape:
Tooth Shape:
Principal Vein:
Accesory Vein:
Principal Vein Termination:
Course of Accesory Vein:
Features of the Tooth Apex:

## Similar Morphotypes

CJ36

## Section II. Venation

1° Vein Framework: actinodromous basal
Naked Basal Veins: absent
# of Basal Veins: 3
Agrophic Veins: absent

Major 2° Vein Framework (costal): simple brochidodromous | # 3 pairs
Interior Secondaries:
Minor 2° Course: simple brochidodromous
Perimarginal Veins:
Major 2° Spacing (costal): gradually and slightly increasing proximally
Variation of 2° Vein Angle (costal): uniform
Major 2° Vein Attachment (costal): excurrent

Inter-2° Vein Proximal Course: perpendicular to midvein
Inter-2° Vein Lenght: >50% of subjacent secondary
Inter-2° Vein Distal Course: perpendicular to subjacent major secondary
Inter-2° Vein Frequency: ~1 per intercostal area

Intercostal 3° Vein Fabric: reticulate irregular
Course of Percurrent 3°:
Angle of Percurrent 3°:
Intercostal 3° Vein Angle Variability:
Epimedial 3°: mixed opp/alt
Admedial Course: perpendicular to midvein
Exmedial Course: parallel to intercostal 3°
Exterior 3° Course: looped

Quaternary Vein Fabric: alternate percurrent | irregular reticulate

Quinternary Vein Fabric: irregular reticulate

Areolation: good development
F.E.V.s Course:
F.E.V.s Terminae:
Marginal Ultimate Venation:

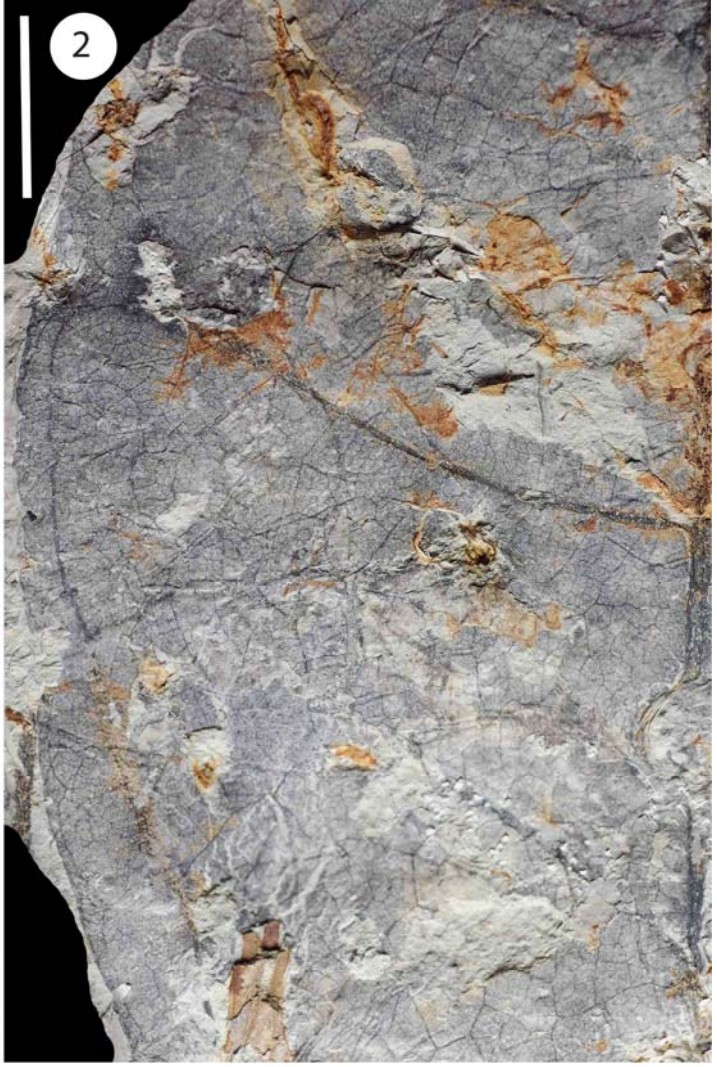
## Diagnostic Features

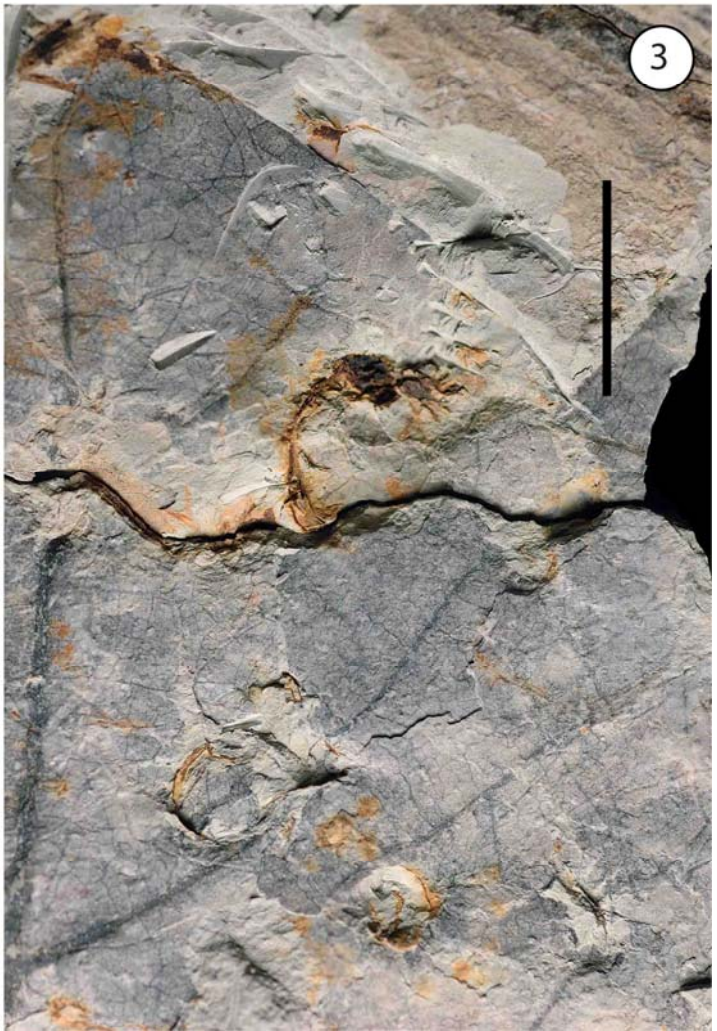
Primaries basal actinodromous (3 veins). Secondaries brochidodromous (3 pairs of veins). Agrophic veins absent. Intersecondary proximal course perpendicular to midvein; length >50%; frequency ~1 per intercostal area. Intercostal tertiary veins irregular reticulate. Epimedial tertiaries mixed opp/alt percurrent. Quaternaries alternate percurrent to irregular reticulate.

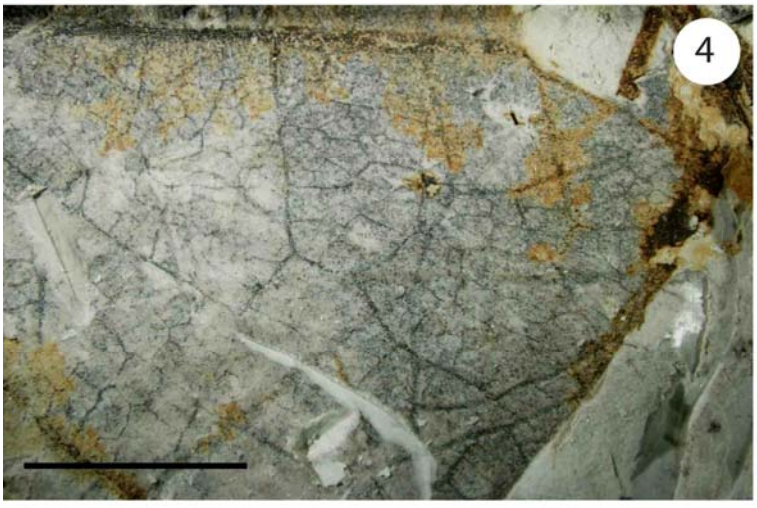
## Description

Laminar size mesophyll (the specimen is ~12 cm long and ~7 cm wide). Laminar shape elliptic. Leaves medially and basally symmetrical. Unlobed. Margin entire. Apex angle obtuse. Apex shape convex. Base angle obtuse. Base shape convex. Primary vein framework basal actinodromous (three veins). Number of basal veins 3. Agrophic veins absent. Major secondary vein framework simple brochidodromous (3 pairs of veins). Minor secondary vein course simple brochidodromous. Major secondary vein spacing gradually and slightly increasing proximally; there is a gap of ~5 cm between the most basal costal secondaries and the basal primaries. Variation of secondary vein angle uniform. Major secondary vein attachment excurrent. Intersecondary vein proximal course perpendicular to midvein; length >50% of subjacent secondary; distal course perpendicular to subjacent major secondary; frequency ~1 per intercostal area. Intercostal tertiary vein fabric irregular reticulate. Epimedial tertiary veins mixed opp/alt percurrent; admedial course perpendicular to midvein; exmedial course parallel to intercostal tertiaries. Exterior course looped. Quaternary vein fabric alternate percurrent to irregular reticulate. Quinternary vein fabric irregular reticulate. Areolation development good.


1


2


3


4


5

**CERREJON FLORA** | Morphotype Name: *Petrocardium cerrejonense* | Morphotype #: CJ108

Major Plant Group: MON | Organ Type: Leaf | Morphotyper: | Type loc. #: | Type spec. #:

Plant Family/order: Araceae | Loca:

## Section I. Leaf Characters

Leaf Attachment:
Leaf Arrangement:
Leaf Organization:
Leaflet Organization:
Leaflet Attachment:
Petiole Features:

### Features of the Blade

Position of Blade Attachment:
Laminar Size (smallest): macrophyll
Laminar Size (largest):
Laminar L:W Ratio:
Laminar Shape:
Medial Symmetry:
Base Symmetry:
Lobation: unlobed
Margin Type: untoothed
Margin Features:
Apex Angle:
Apex Shape: straight | acuminate
Base Angle:
Base Shape:
Terminal Apex Features:
Surface Texture:
SurficialGlands:
Stomata:
Cuticle Features:

## Section III. Teeth

Tooth Spacing:
# of Orders:
Teeth/cm:
Sinus Shape:
Tooth Shape:
Tooth Shape:
Principal Vein:
Accesory Vein:
Principal Vein Termination:
Course of Accesory Vein:
Features of the Tooth Apex:

## Similar Morphotypes

CJ23

## Section II. Venation

1° Vein Framework: pinnate?
Naked Basal Veins:
# of Basal Veins:
Agrophic Veins: compound

Major 2° Vein Framework (costal): eucamptodromous | #:
Interior Secondaries:
Minor 2° Course:
Perimarginal Veins: intramarginal secondary | fimbrial vein
Major 2° Spacing (costal):
Variation of 2° Vein Angle (costal):
Major 2° Vein Attachment (costal): decurrent

Inter-2° Vein Proximal Course: parallel to major secondaries
Inter-2° Vein Lenght: >50% of subjacent secondary
Inter-2° Vein Distal Course: perpendicular to subjacent major secondary
Inter-2° Vein Frequency: >1 per intercostal area

Intercostal 3° Vein Fabric: reticulate regular
Course of Percurrent 3°:
Angle of Percurrent 3°:
Intercostal 3° Vein Angle Variability:
Epimedial 3°: reticulate
Admedial Course: parallel to subjacent secondary | acute to midvein
Exmedial Course: basiflexed
Exterior 3° Course: terminating at margin

Quaternary Vein Fabric: irregular reticulate

Quinternary Vein Fabric:

Areolation:
F.E.V.s Course:
F.E.V.s Terminae:
Marginal Ultimate Venation:

## Diagnostic Features

Leaf apex acuminate. Midrib stout and multistranded. Secondary veins eucamptodromous with basal pairs forming agrophic veins. One collective vein running very close to margin. Intersecondary veins. Tertiary and higher order veins reticulate. Fimbrial vein.

## Description

Blade is >9.5 cm long and >24.3 cm wide. Margin entire. Leaf apex acuminate. Midrib stout and multistranded. Five pairs of secondary veins (preserved on the anterior division of the blade) which depart the midrib at about ~50° proximally, shifting to <20° near the apex. Secondary veins branch at ~45° and arch apically. One or two pairs of intersecondary veins are present for each pair of secondaries, and their courses are more or less parallel to the secondaries. Secondary and intersecondary veins are strongly decurrent on midrib. Agrophic veins present. A collective vein runs very close (~0.5 mm) to margin. Tertiary veins form polygons of different shapes and sizes. Higher order veins also form irregular polygons measuring between 5 mm and 8 mm in length and width. A fimbrial vein runs along the margin.


1


2
5mm


3
5mm

**CERREJON FLORA** | Morphotype Name: *Menispermites horizontalis* | Morphotype #: CJ109

Major Plant Group: DIC | Organ Type: Leaf | Morphotyper: | Type loc. #: | Type spec. #:

Plant Family/order: Menispermaceae | Loca:

## Section I. Leaf Characters

Leaf Attachment:
Leaf Arrangement:
Leaf Organization:
Leaflet Organization:
Leaflet Attachment:
Petiole Features:

### Features of the Blade

Position of Blade Attachment:
Laminar Size (smallest): macrophyll
Laminar Size (largest):
Laminar L:W Ratio: 1:1
Laminar Shape: ovate
Medial Symmetry: symmetrical
Base Symmetry:
Lobation: unlobed
Margin Type: untoothed
Margin Features:
Apex Angle: acute
Apex Shape: straight
Base Angle:
Base Shape:
Terminal Apex Features:
Surface Texture:
SurficialGlands:
Stomata:
Cuticle Features:

## Section III. Teeth

Tooth Spacing:
# of Orders:
Teeth/cm:
Sinus Shape:
Tooth Shape:
Tooth Shape:
Principal Vein:
Accesory Vein:
Principal Vein Termination:
Course of Accesory Vein:
Features of the Tooth Apex:

## Similar Morphotypes

CJ6
CJ82

## Section II. Venation

1° Vein Framework: actinodromous basal
Naked Basal Veins:
# of Basal Veins: probably 5
Agrophic Veins: simple

Major 2° Vein Framework (costal): simple brochidodromous # 5-7 pairs
Interior Secondaries: present
Minor 2° Course: simple brochidodromous
Perimarginal Veins: fimbrial vein
Major 2° Spacing (costal): decreasing proximally
Variation of 2° Vein Angle (costal): inconsistent
Major 2° Vein Attachment (costal): excurrent

Inter-2° Vein Proximal Course:
Inter-2° Vein Lenght:
Inter-2° Vein Distal Course:
Inter-2° Vein Frequency:

Intercostal 3° Vein Fabric: percurrent
Course of Percurrent 3°: mixed opp/alt
Angle of Percurrent 3°: obtuse
Intercostal 3° Vein Angle Variability: increasing exmedially
Epimedial 3°: mixed opp/alt
Admedial Course: perpendicular to midvein
Exmedial Course: parallel to intercostal 3°
Exterior 3° Course: looped

Quaternary Vein Fabric: mixed percurrent

Quinternary Vein Fabric: irregular reticulate

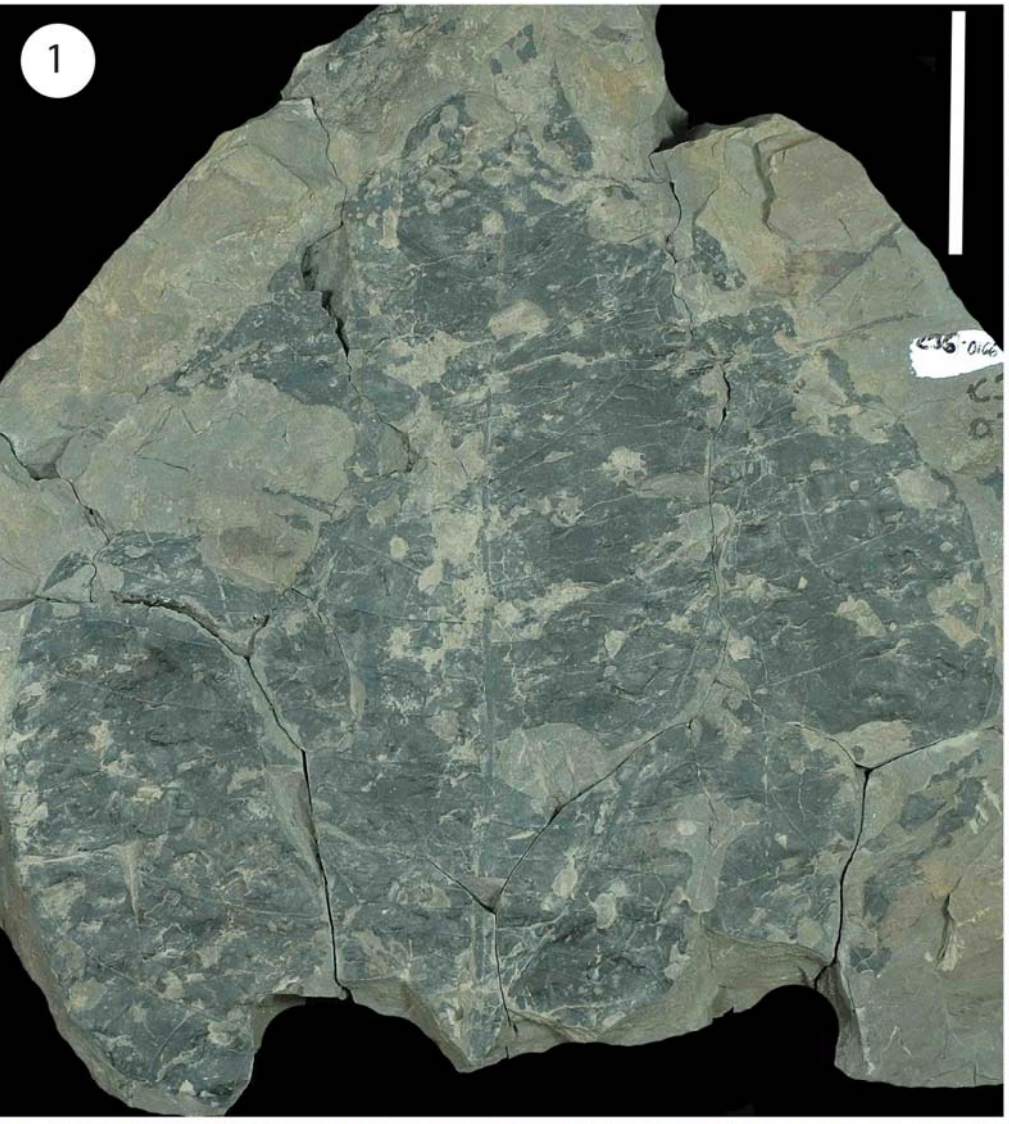
Areolation: present
F.E.V.s Course:
F.E.V.s Terminae:
Marginal Ultimate Venation:

## Diagnostic Features

Basal actinodromous. Agrophic veins simple. Interior secondaries present, abundant (>15 pairs of veins), and perpendicular to primaries. Major and minor secondaries simple brochidodromous. Intercostal tertiary vein fabric mixed opp/alt percurrent.

## Description

Laminar size macrophyll (the specimen is >25 cm long and ~23 cm wide). Laminar L:W ratio 1:1. Laminar shape ovate. Leaf medially symmetrical. Unlobed. Margin entire. Apex angle acute and shape straight. Primary vein framework basal actinodromous, probably 5 veins at the petiole insertion. Agrophic veins simple. Major secondary vein framework simple brochidodromous (5-7 pairs, spaced from 1 cm to 2 cm). Interior secondaries present and abundant (>15 pairs of veins), these veins are perpendicular to primaries, spaced from 0.5 to 1.2 cm, and have straight to sinuous courses. Minor secondary vein course simple brochidodromous. Fimbrial vein conspicuous. Major secondary veins spacing gradually decreasing proximally (including interior secondaries). Variation of secondary vein angle to midvein inconsistent (60°-90°, including interior secondaries). Secondary vein attachment excurrent. Intercostal tertiary vein fabric mixed opp/alt percurrent. Angle of percurrent tertiaries obtuse. Intercostal tertiary angle variability increasing exmedially. Epimedial tertiaries mixed opp/alt percurrent; admedial course perpendicular to midvein; exmedial course parallel to intercostal tertiaries. Exterior tertiary course looped. Areolation present.


1


2


3


4


2 cm

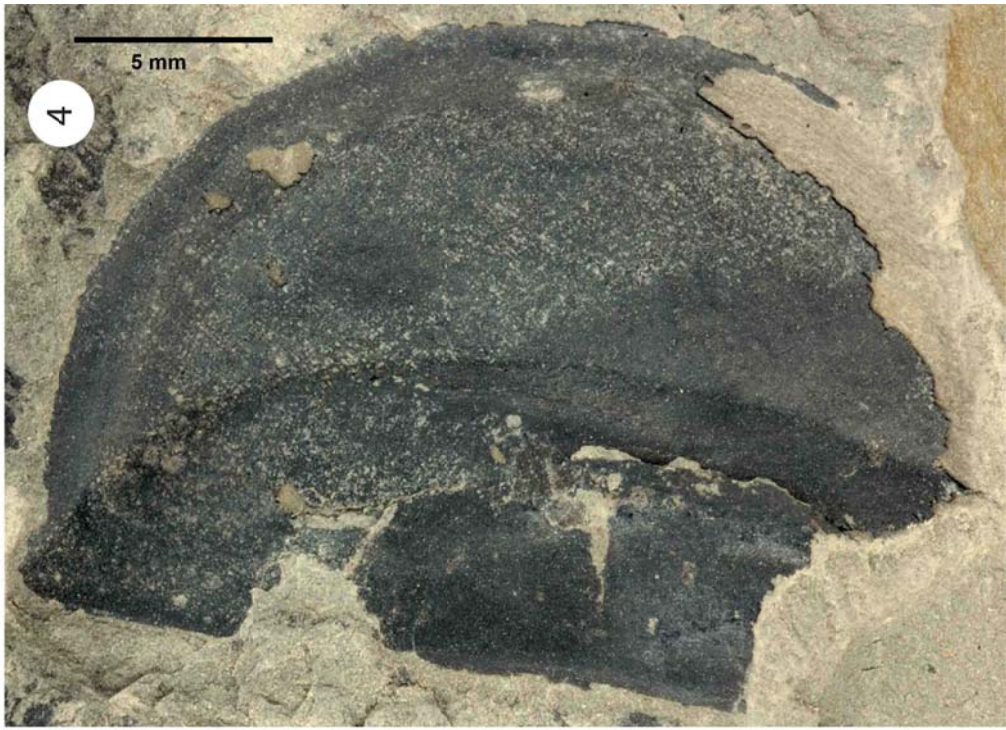
5 cm

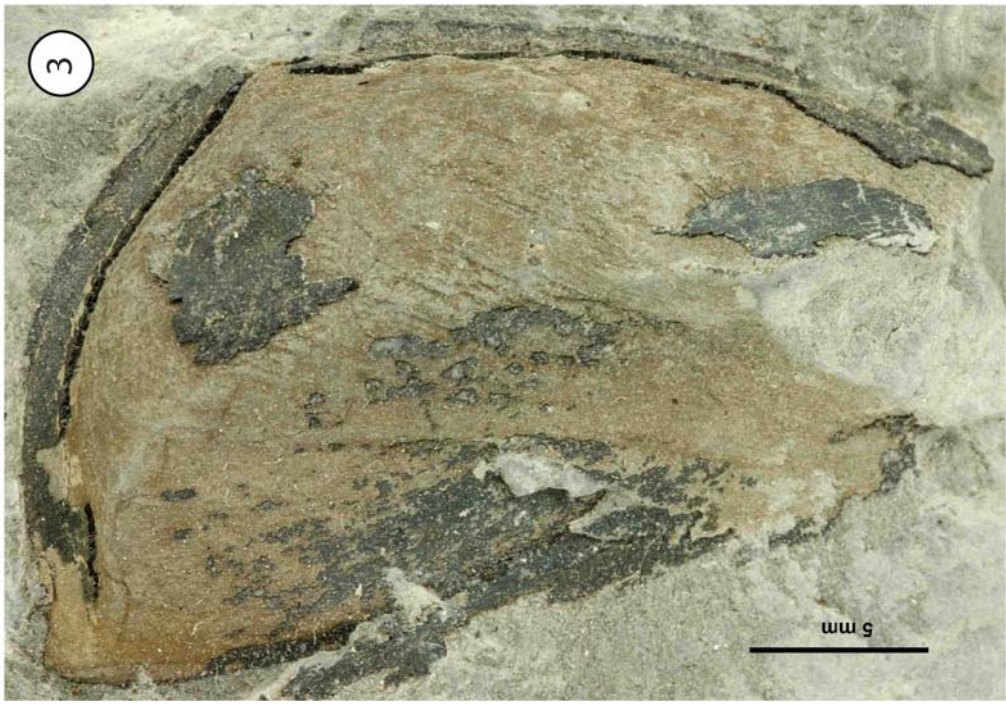

1
5 mm
2
5 mm
3
5 mm
4
5 mm
5
5 mm
6
5 mm


1
2 cm

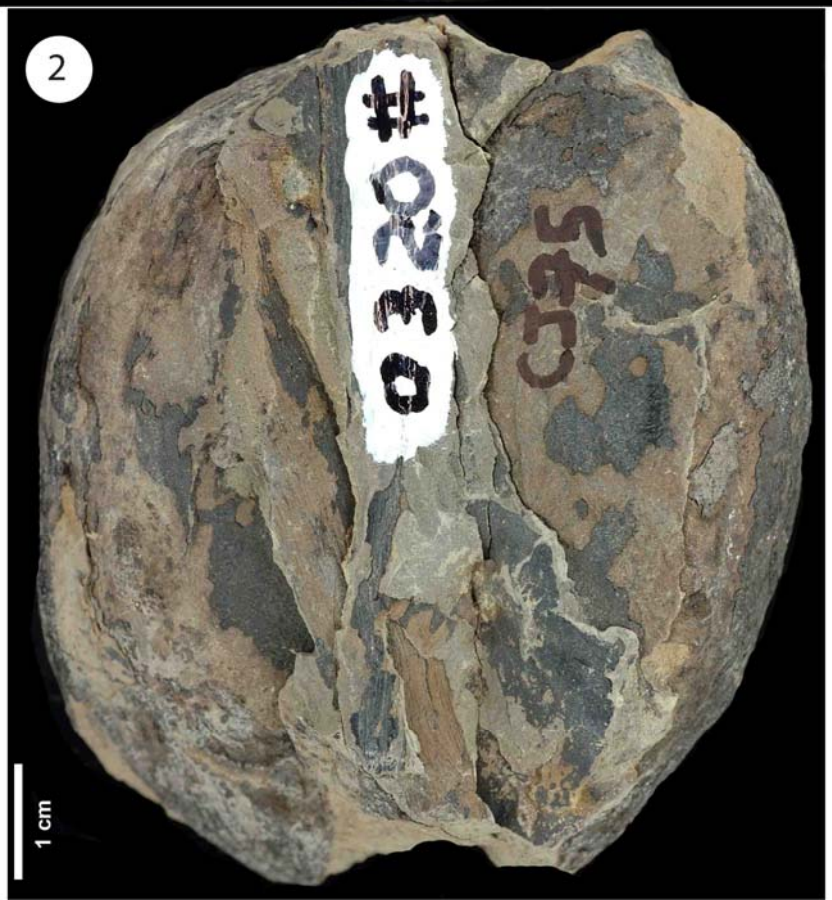

5 mm
2

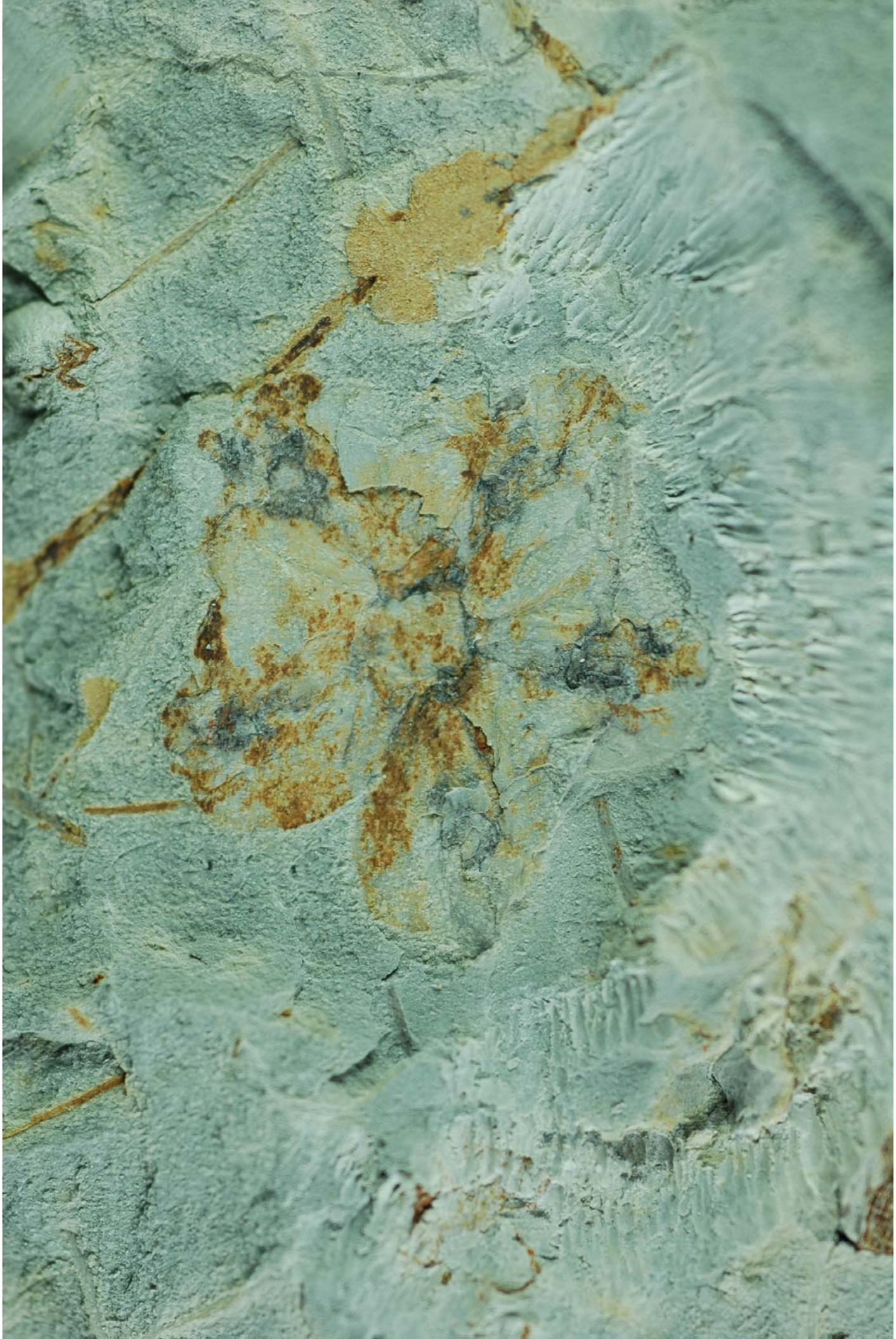

1
5 mm


5 mm
4


3
5 mm


1 cm
1


2
1 cm



1
3 mm


2
3 mm


3
3 mm

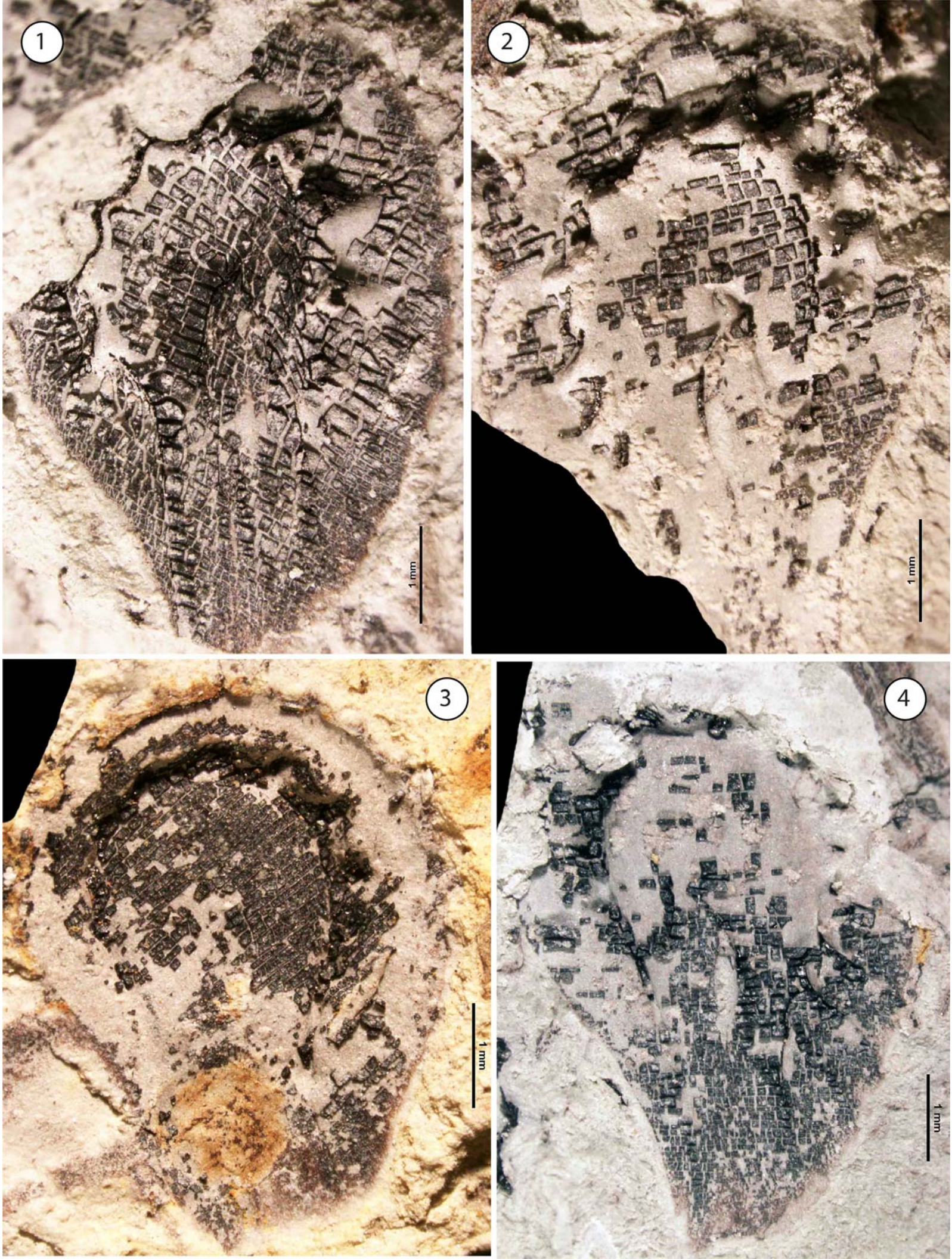

4
3 mm


5
3 mm


6
3mm


7
3 mm

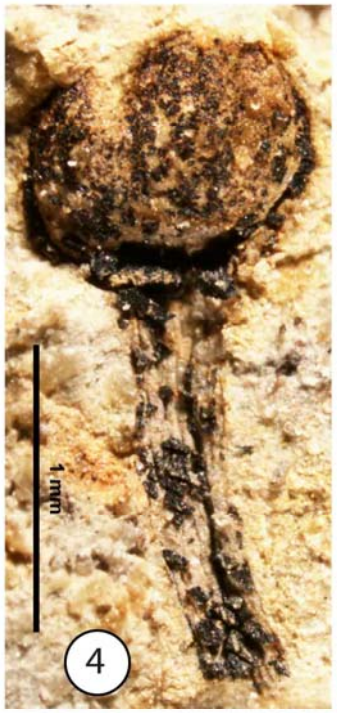

8
3 mm


1
1 mm
2
1 mm
3
1 mm
4
1 mm


1
5 mm


1 mm
2

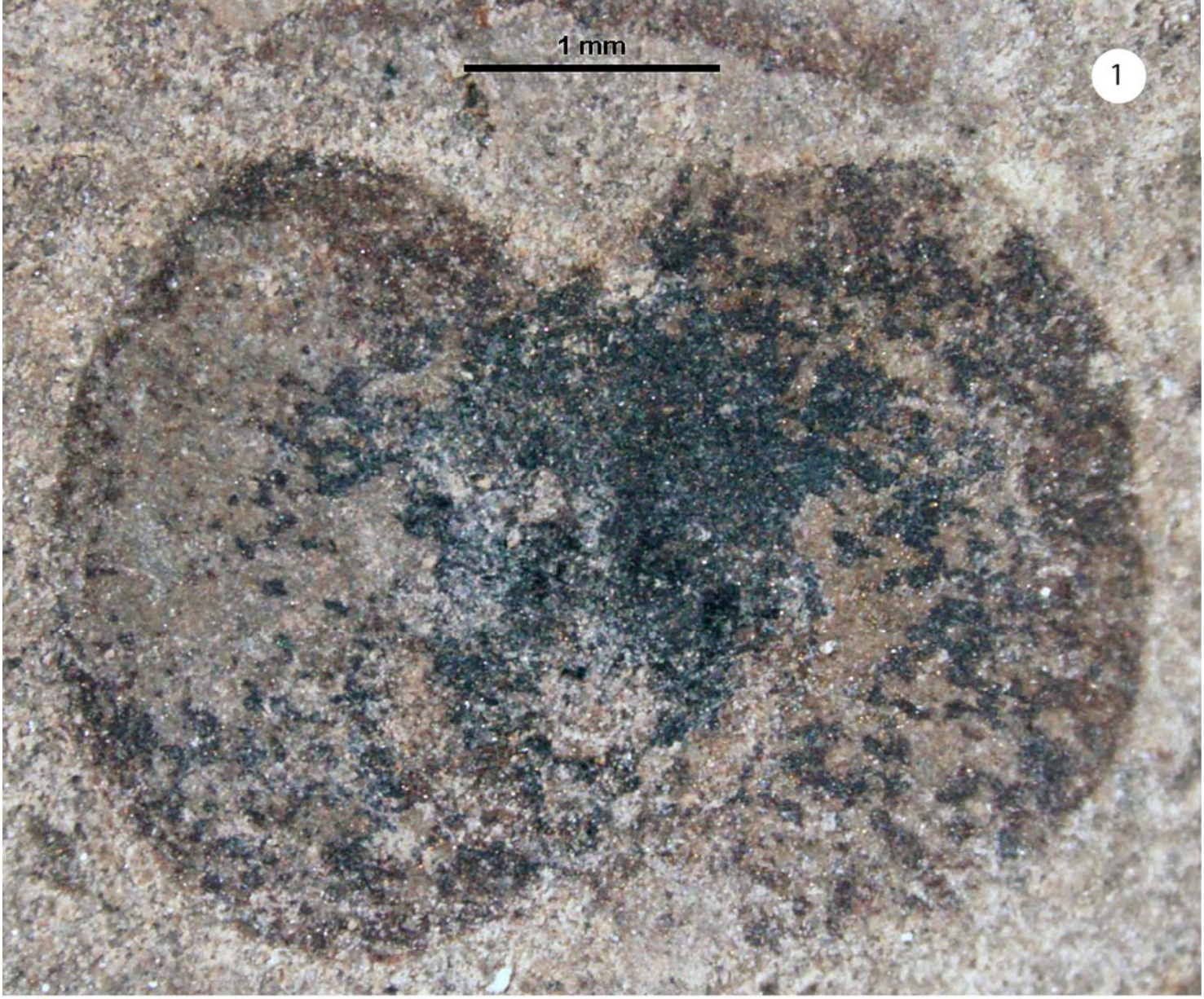

1 mm
3

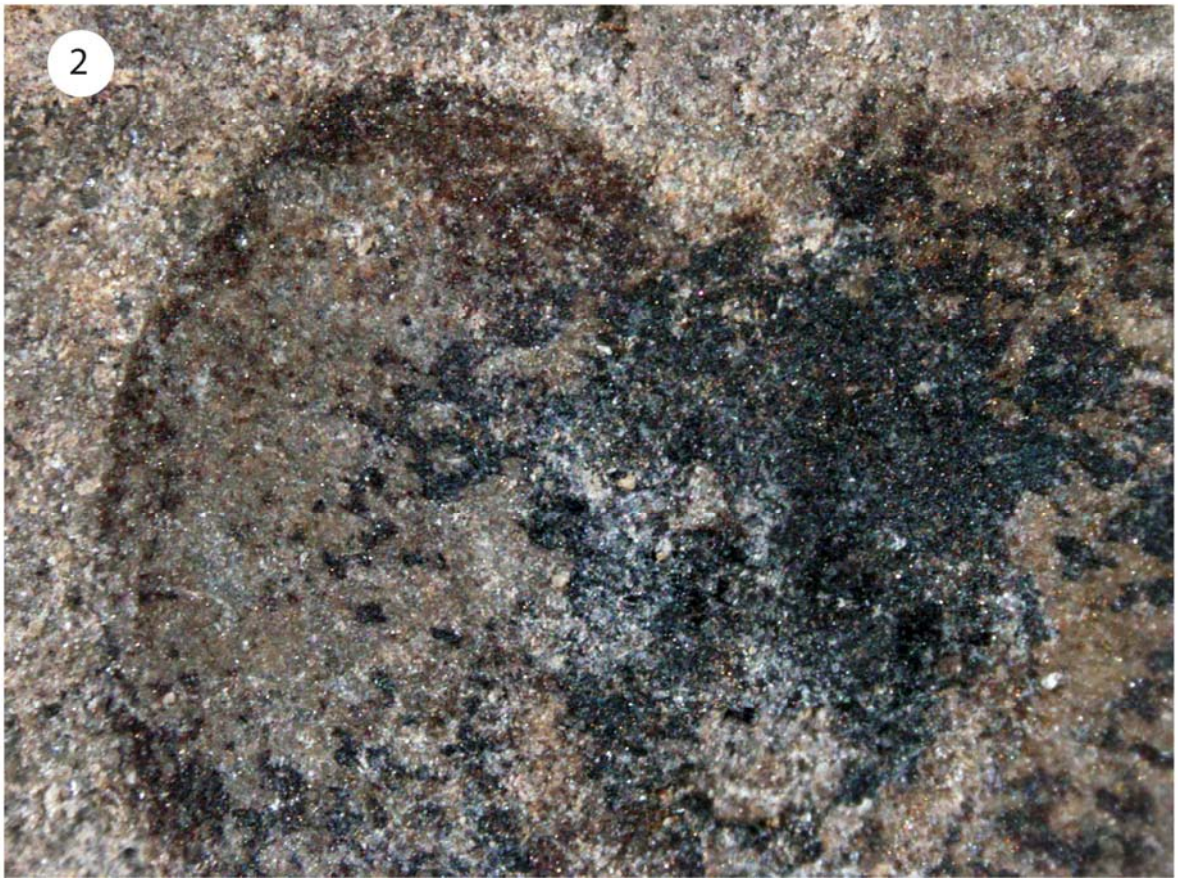

1 mm
4


1 mm
5

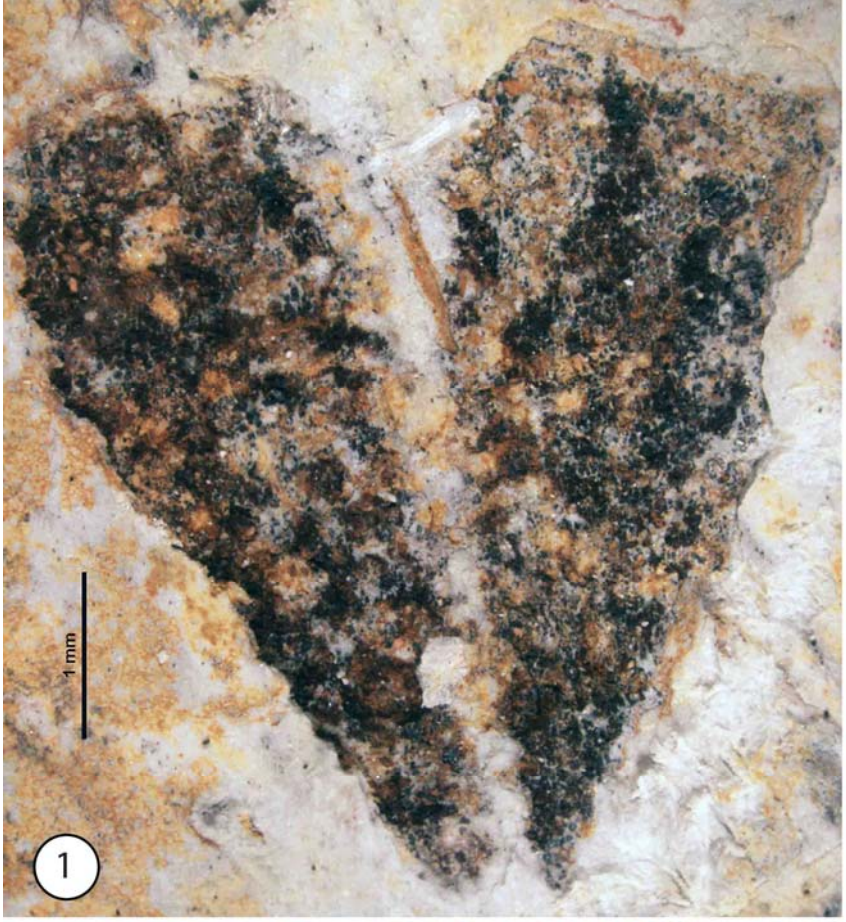

2 mm
6

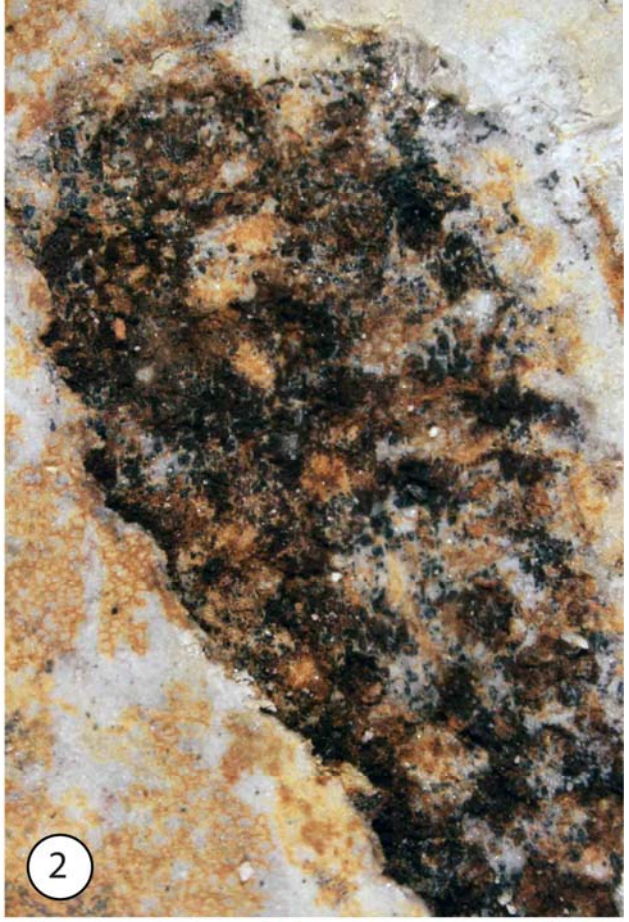

7

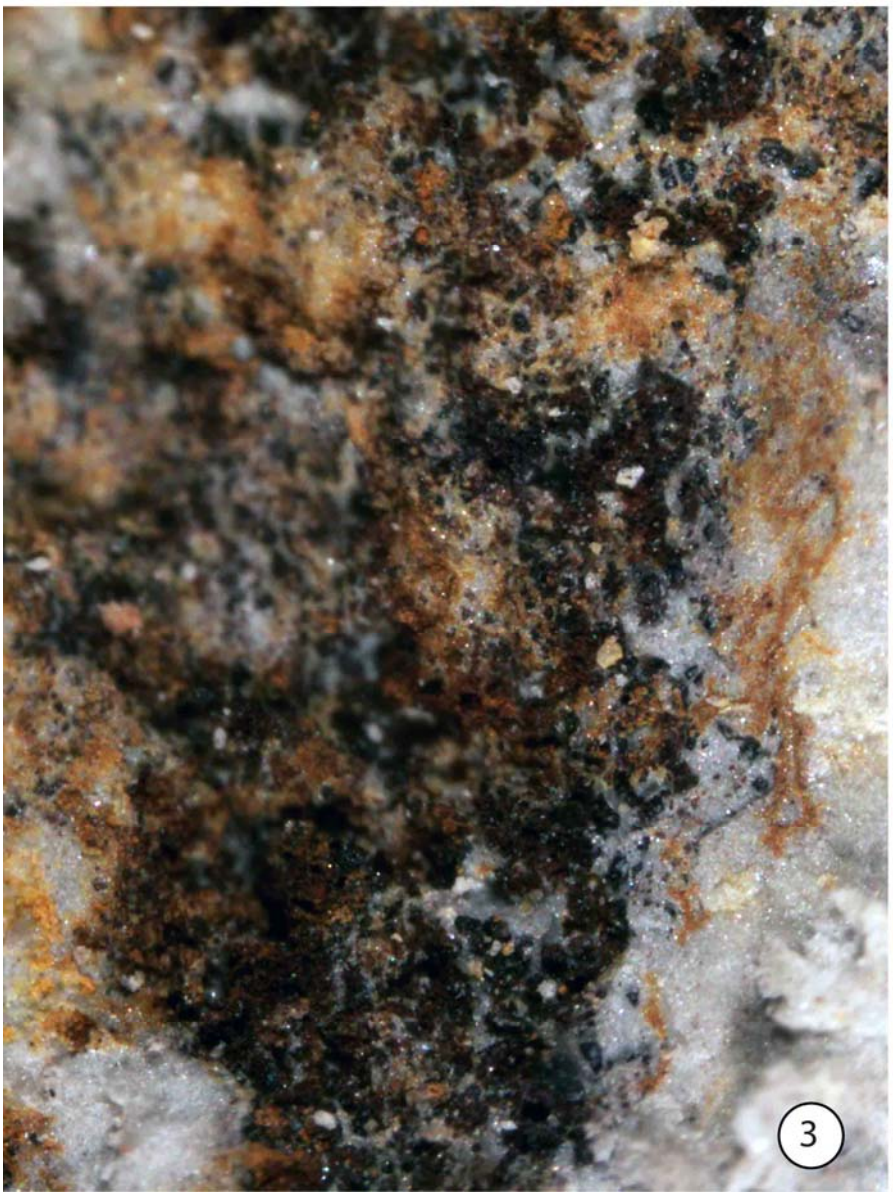

1 mm
1


2

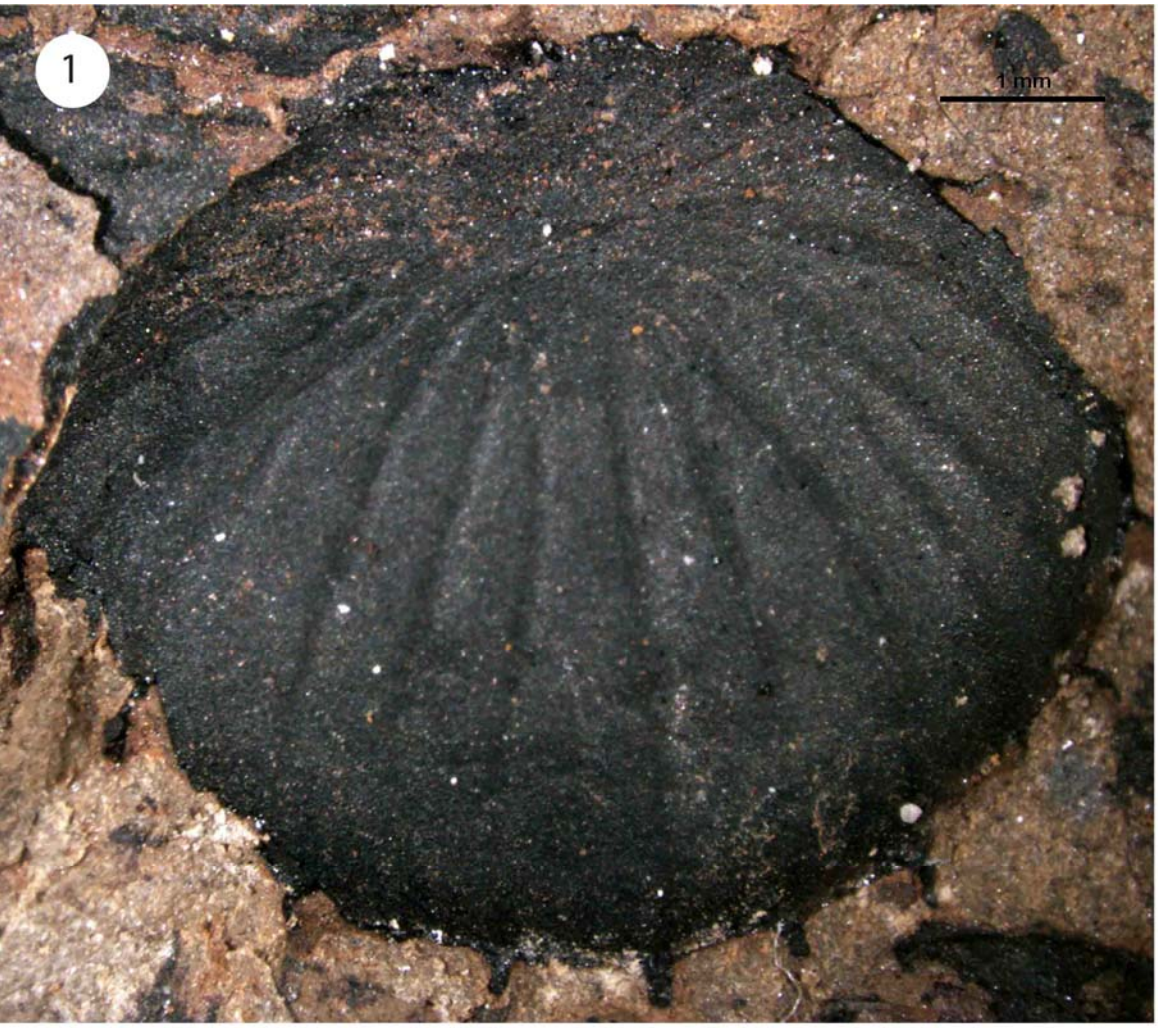
1
1 mm


1 mm
1


2


3


4


1
1 mm

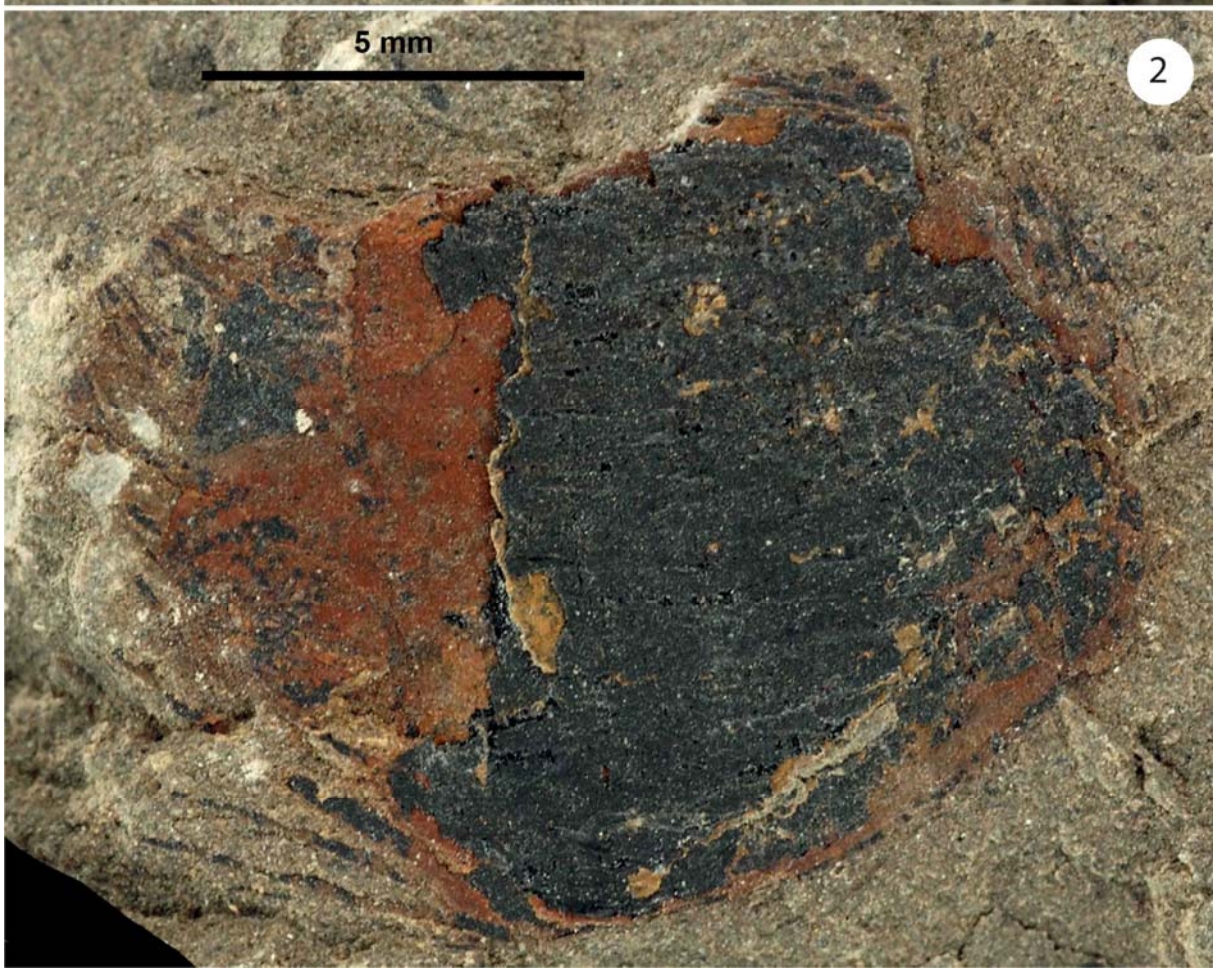

2


3
1 mm


4
1 mm


1
5 mm

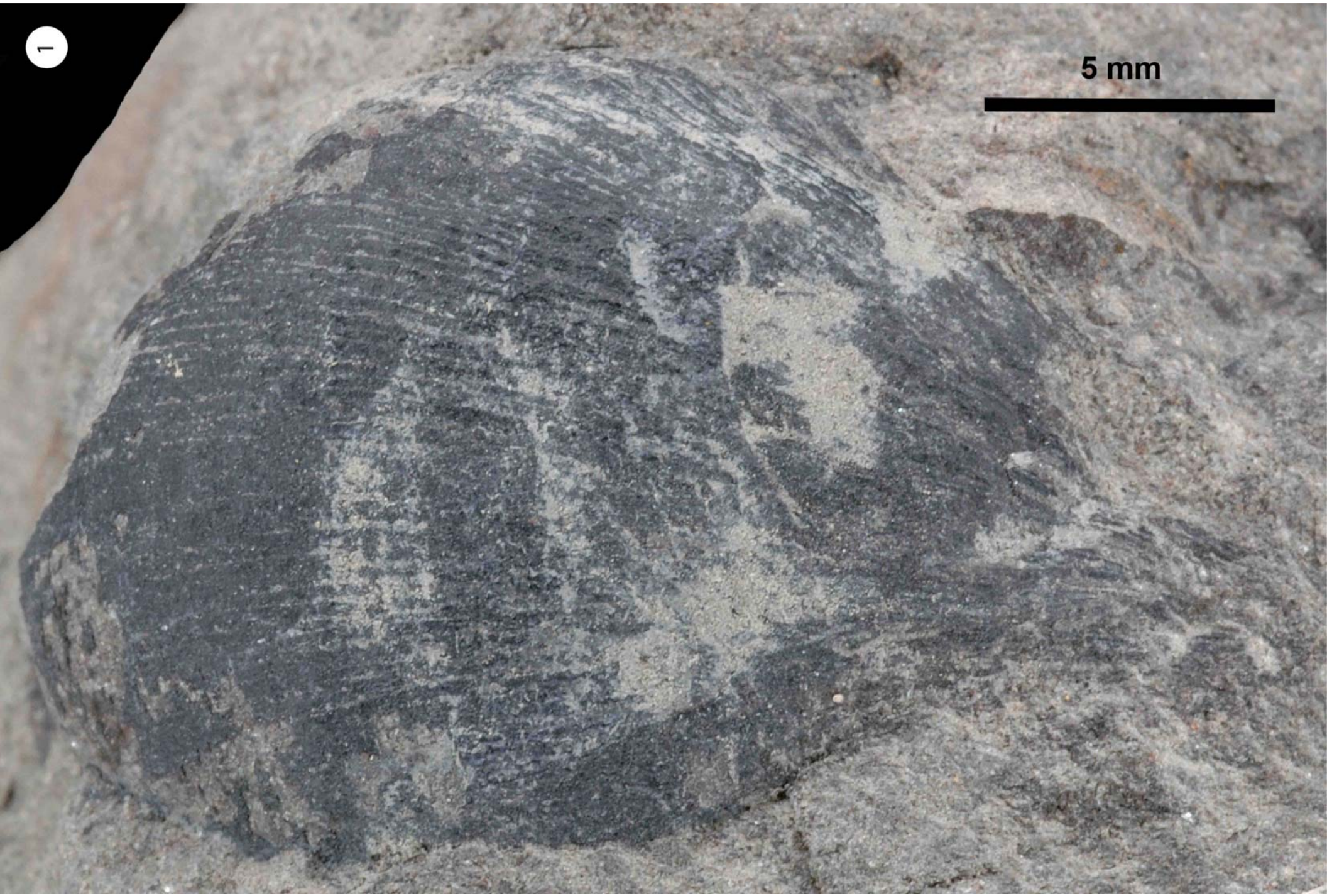

1
5 mm

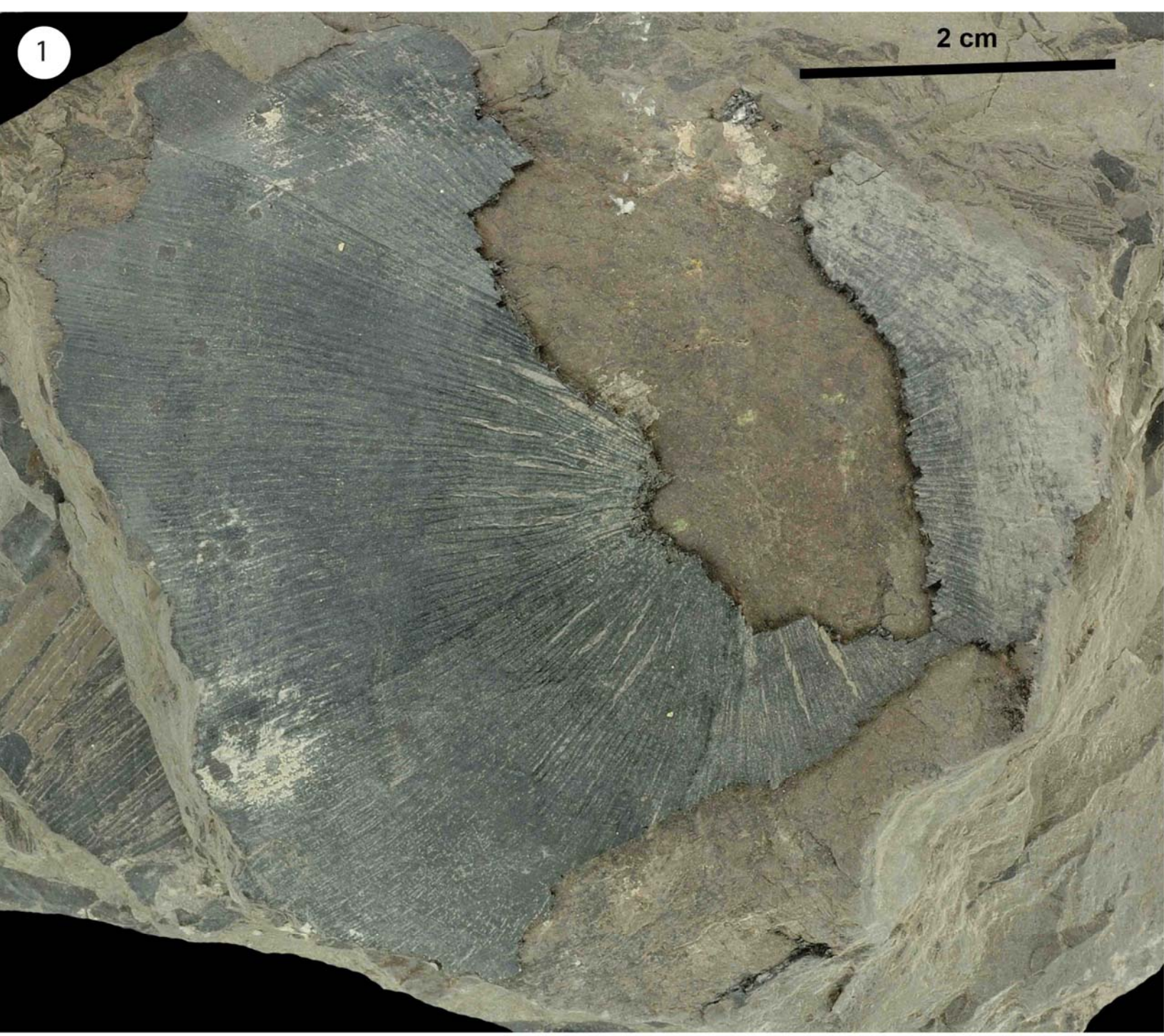

5 mm
2


5 mm
1


2


2
5 mm


1
5 mm

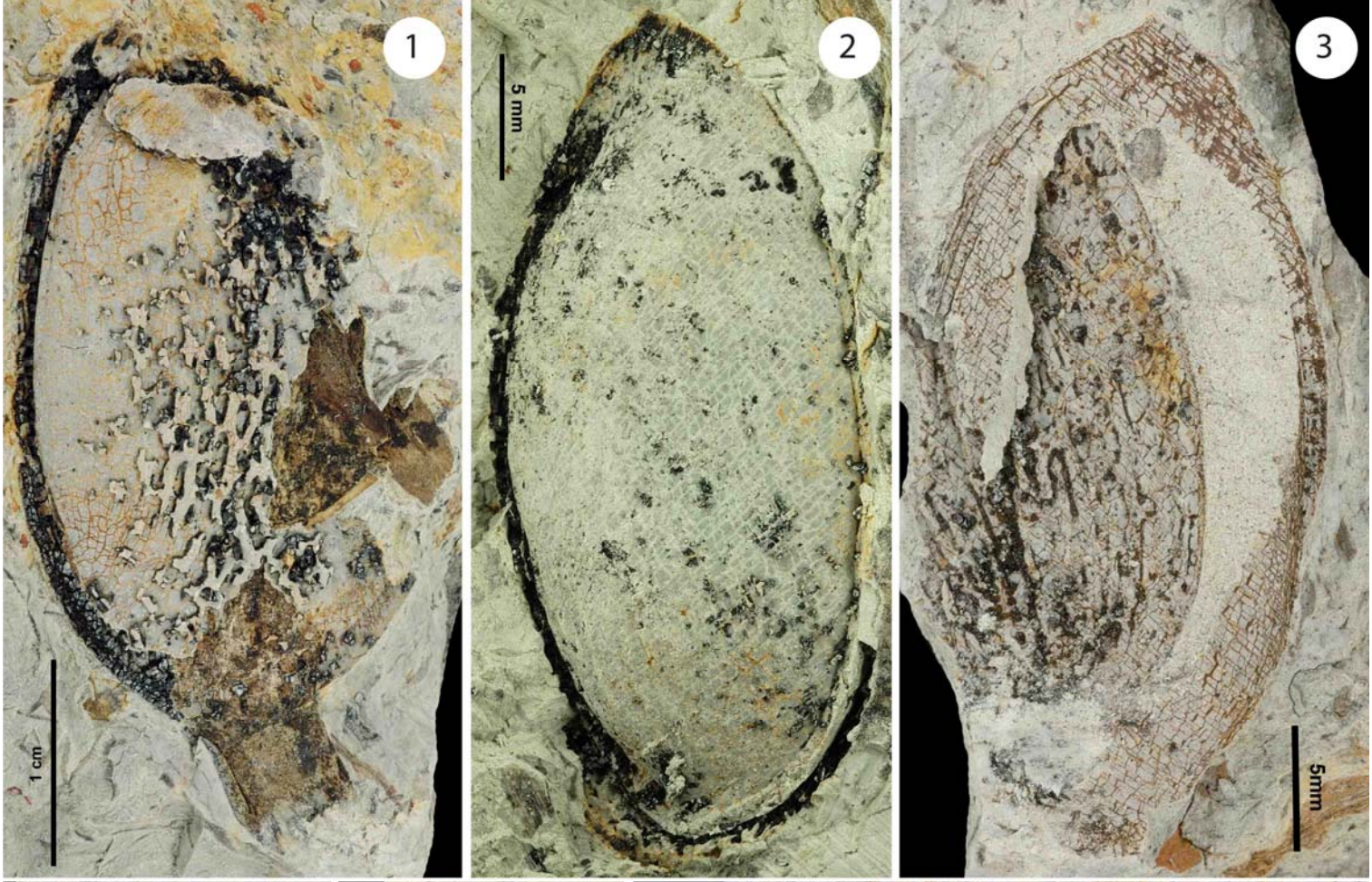

1
2 cm


2


3


1
5 mm

1
5 mm


1
1 cm

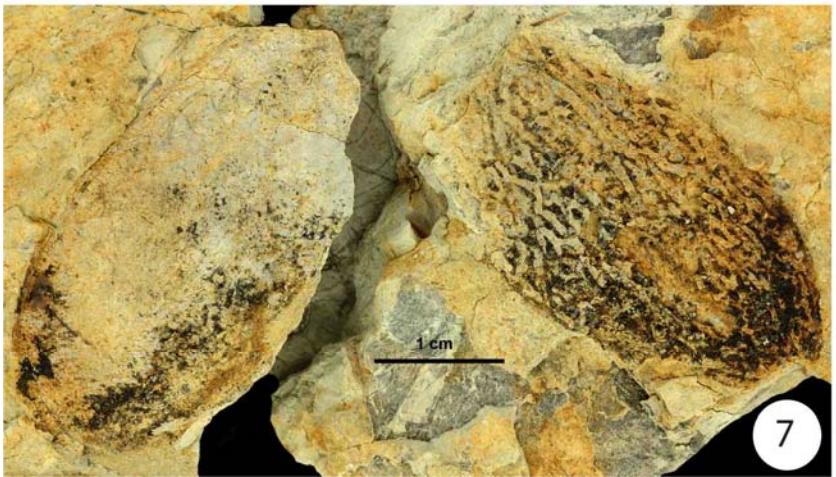

2
5 mm

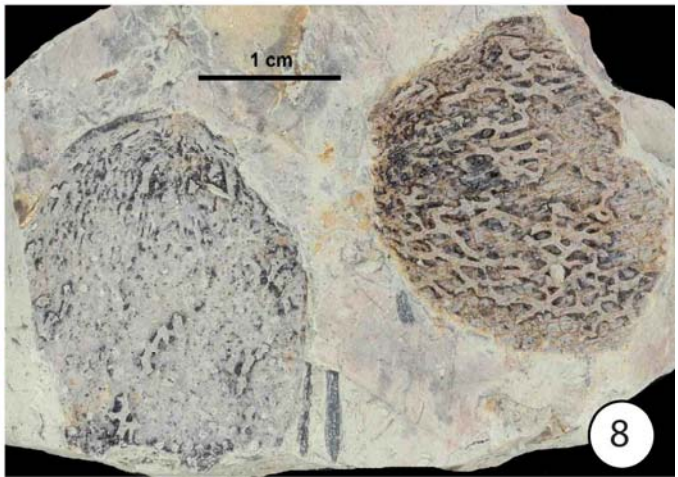

3
5mm

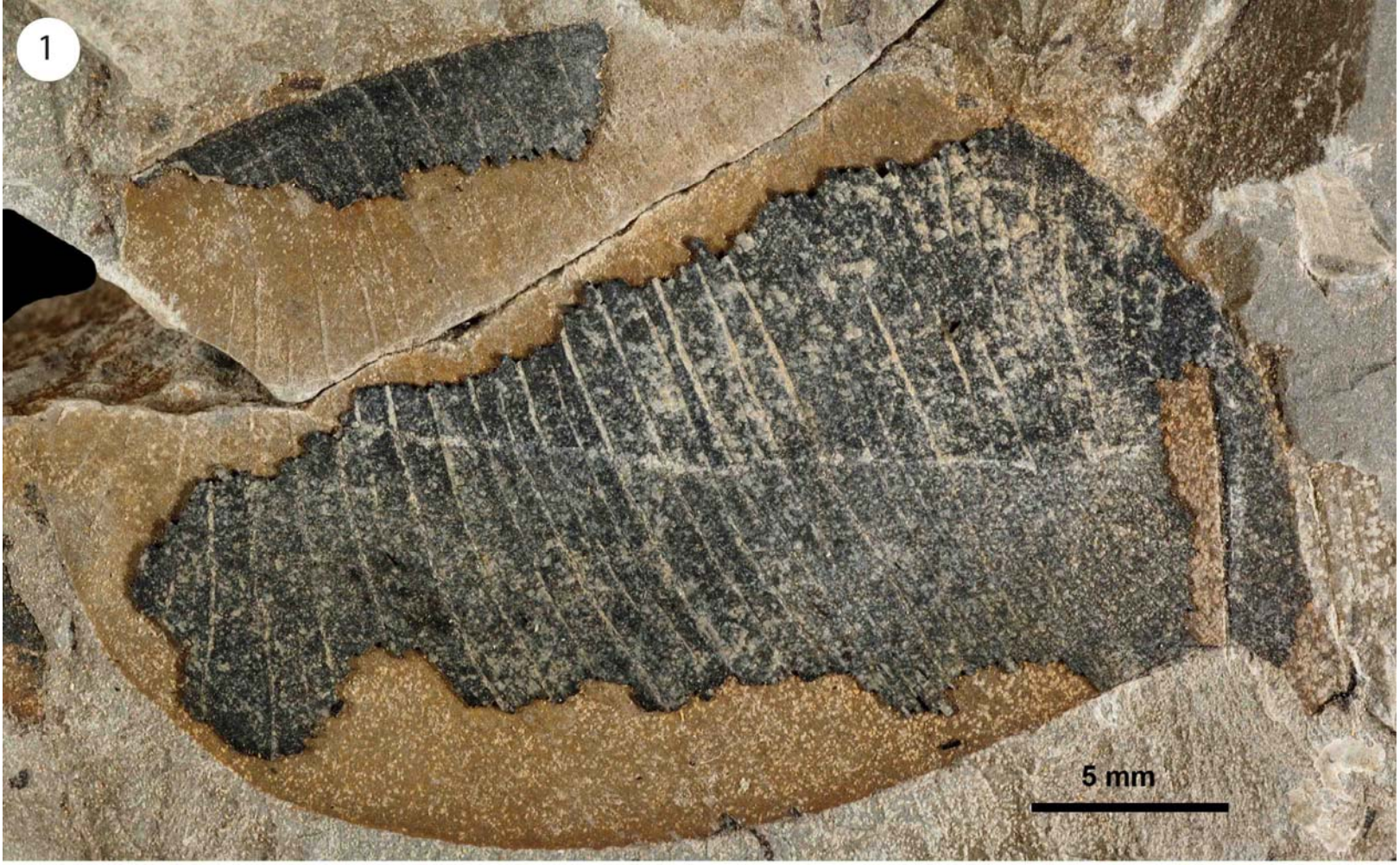

4


5


6
1 cm


1 cm
7


1 cm
8


1
5 mm

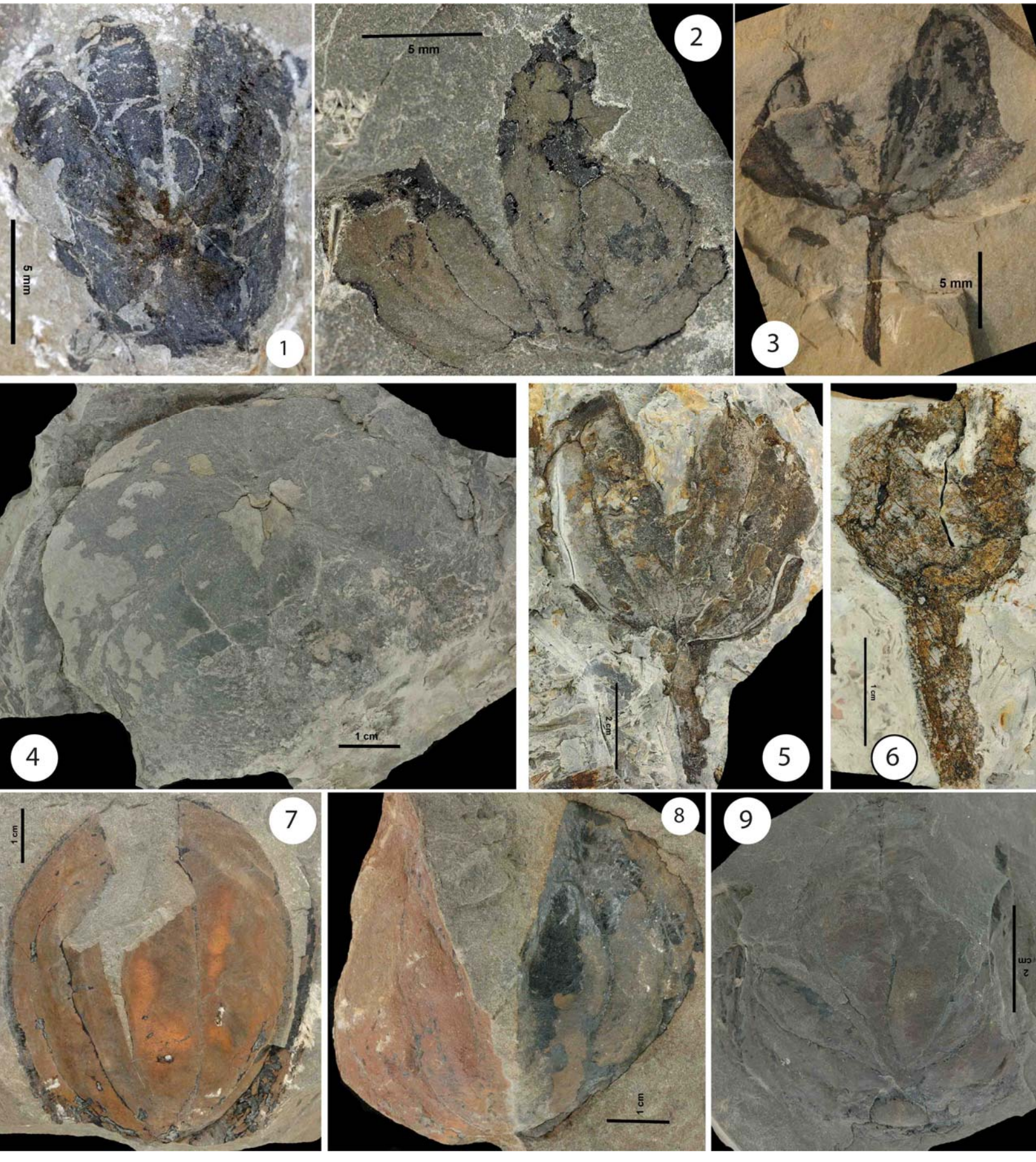

2
5 mm


3
5 mm

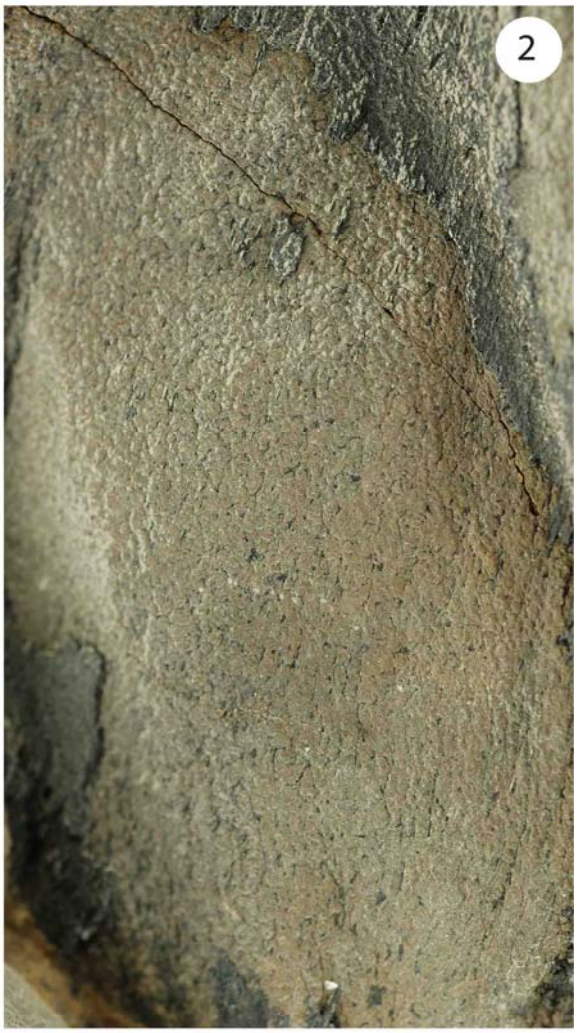

2 cm
1

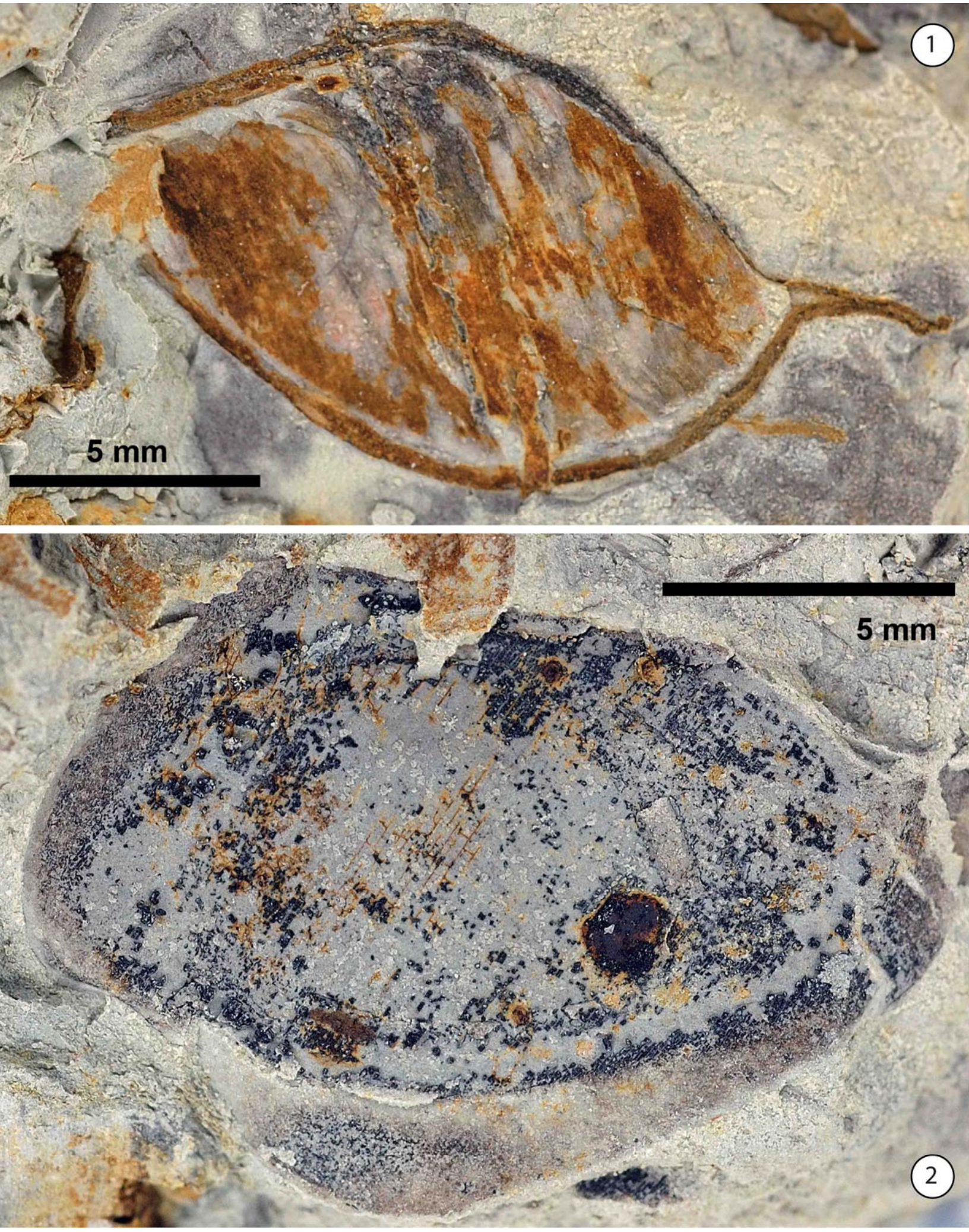

2


2 cm
3

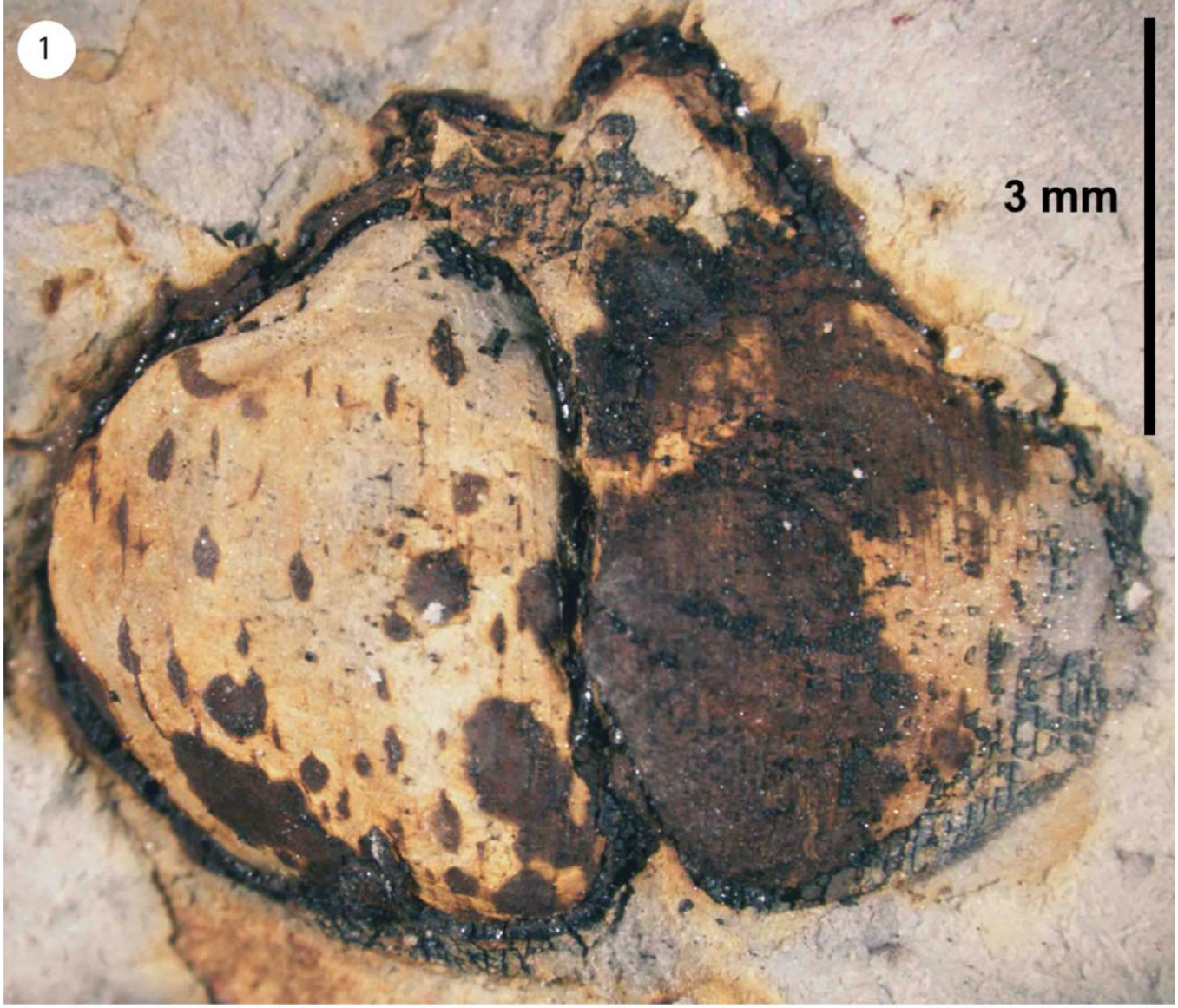

1
5 mm
2
5 mm
3
5 mm
4
1 cm
5
2 cm
6
1 cm
7
1 cm
8
1 cm
9
2 cm


1
1 cm


2


1
5 mm
5 mm
2


1
3 mm


1
3 mm


2
3 mm

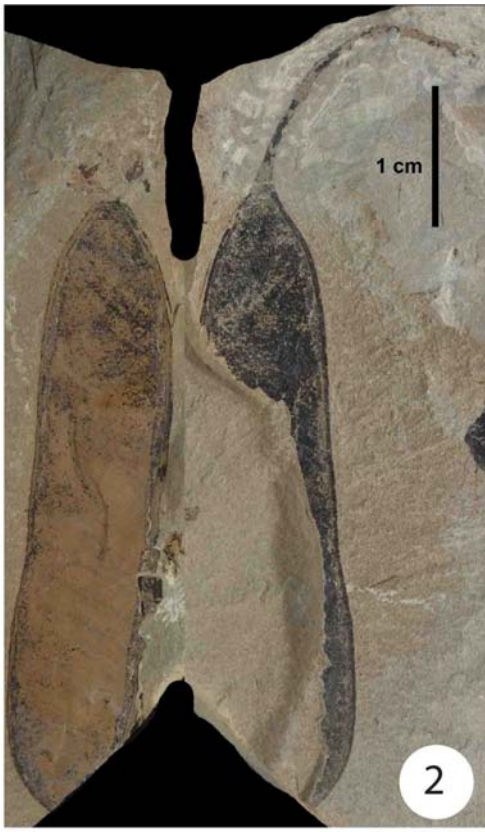

5 mm
1

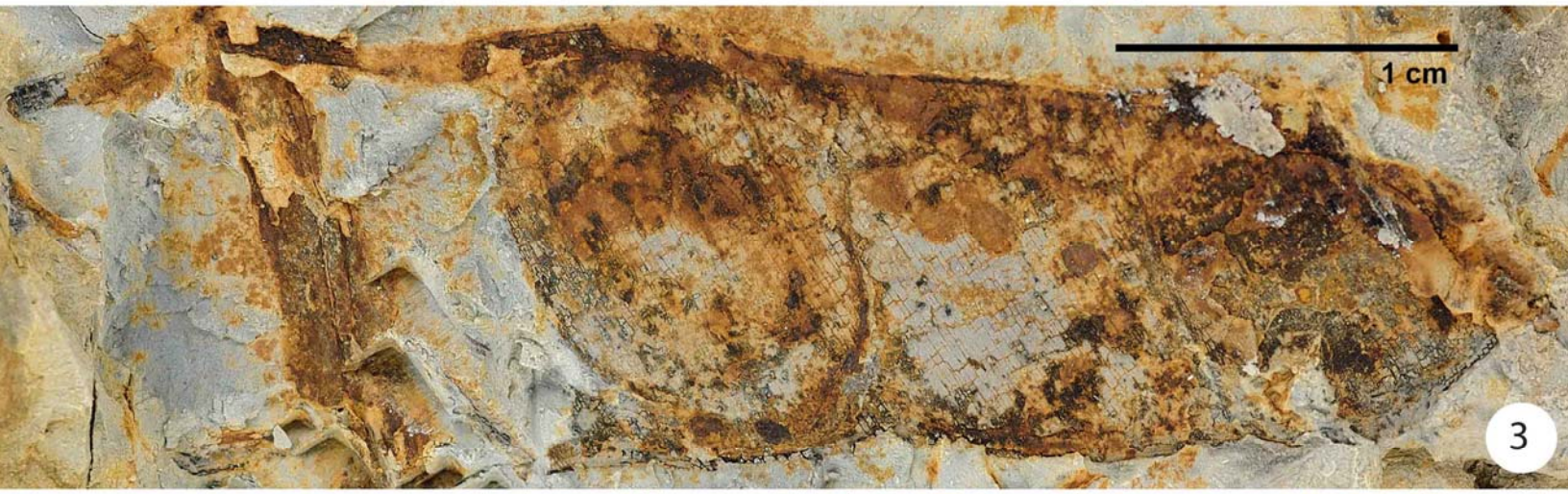

5 mm
2

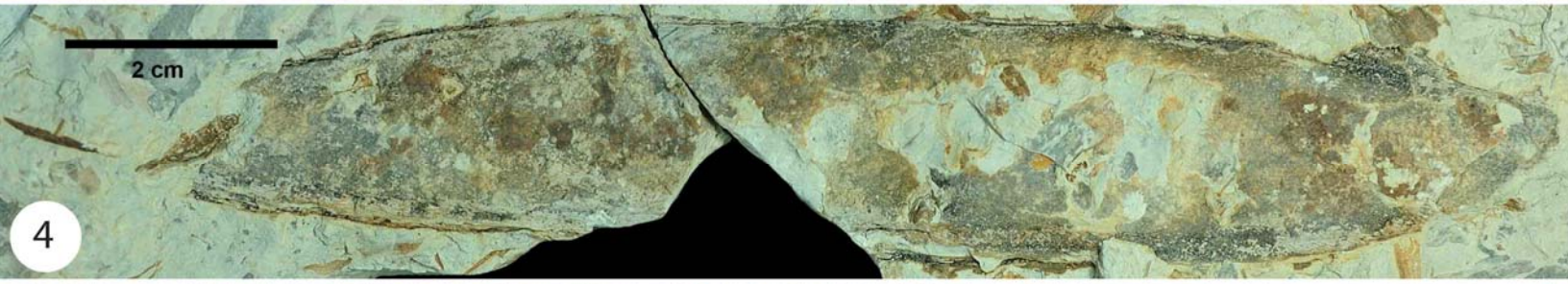

5 mm
3

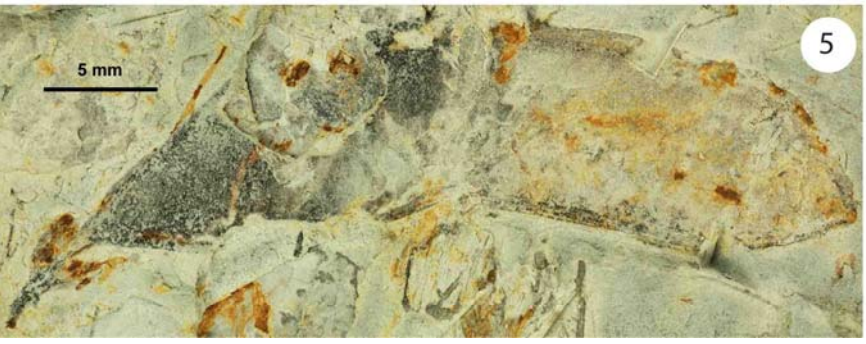

5 mm
4


2 cm
1


1 cm
2


1 cm
3


2 cm
4


5 mm
5


1 cm
6