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Research papers

A reconstruction of the fossil palm *Sabalites longirhachis* (Unger) J. Kvaček et Herman from the Maastrichtian of Pyrenees

Josep Marmi [a,*], Bernard Gomez [b], Carles Martín-Closas [c], Sheila Villalba-Breva [c]

[a] Institut Català de Paleontologia, Campus de la Universitat Autònoma de Barcelona, 08193, Bellaterra, Catalonia, Spain
[b] UMR 5125 PEPS, Université Lyon 1, 69622, Villeurbanne cedex, France
[c] Departament d'Estratigrafia, Paleontologia i Geociències Marines, Universitat de Barcelona, c/ Martí i Franquès s/n, 08028, Barcelona, Catalonia, Spain

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ABSTRACT

Fragmented leaf laminas were the only organ known of the fossil palms *Sabalites longirhachis* (Unger) J. Kvaček et Herman. Recently, isolated leaves of *S. longirhachis*, palm logs and rooting systems have been found associated in Fumanya, a new Maastrichtian locality from the Southern Pyrenees. This has allowed proposing a taphonomy-based hypothesis of the habit and paleoecology of these extinct palms.
Fossil leaves are represented by complete laminas bearing petioles attached. Leaves and logs are parautochthonous at the base of the first coal seam of the stratigraphic succession. Rooting systems provide evidence for autochthony in coal layers formed at the top of lacustrine limestones. The tree bearing *S. longirhachis* leaves is reconstructed as relatively slender, of up to 14 m high, showing a smooth trunk with adventitious roots at the base and a crown keeping the marcescent leaves attached. The rooting system consisted of straight radial rootlets of about 1.5 m in total diameter. Taphonomic and facies analyses carried out in Fumanya suggest that the habitats colonized by this species were small peat mires at the lakeshores of freshwater alkaline lakes.

1. Introduction

The fossil record of plants is mainly composed of fragmentary remains, with organs detached one from each other or even fragmented, making whole plant reconstructions a difficult task for paleobotanists. Since the very beginning of paleobotany, hypotheses were proposed to understand the complete body of fossil plants, mainly based on exceptionally well-preserved fossils showing anatomical connections or on repeated taphonomic associations of the different organs. Although misleading interpretations were proposed by the past, whole plant reconstructions continue to be one of the main goals of paleobotanical research. They contribute to a more complete understanding of plant evolution, help to correct mistakes in systematic paleobotany and are the basis for paleoecological and paleobiogeographical studies (Kvaček, 2008).

Some groups of fossil plants are more prone to be found with their organs attached, since they were living in the very same depositional setting in which they were later buried, such as in peat mires. However, land plants showing anatomically connected organs are extremely rare in most depositional settings and whole plant reconstructions can be only carried out hence based on taphonomic hypotheses. This is the case of most palms, which normally grow outside but sometimes not far from areas with a high sedimentation rate.

The evolutionary history of Arecaceae probably began in the Early Cretaceous, according to molecular data (Janssen and Bremer, 2004). The earliest unequivocal palm fossils are from the lower Upper Cretaceous (Harley, 2006). During the latest Cretaceous, palms were widely present in the Pantropical and part of the North Temperate Realms (Horrell, 1991). By this time, there is a range of variation within each organ category indicating that the family was already a well established lineage (Harley, 2006). Palm pollen grains, leaves and stems are particularly abundant in the fossil record. Records of fruits, rhizomes and roots are scarcer and rachillae, inflorescences or individual flowers are rare (Harley, 2006). Among the earliest megafossil palm remains there are leaves with long petiole bearing costapalmate lamina of *Sabalites longirhachis* (Unger) J. Kvaček et Herman. *Sabalites longirhachis* is known from the upper Santonian–Maastrichtian of southwestern, central and eastern Europe (Saporta and Marion, 1885; Tuzson, 1908, 1914; Kvaček and Herman, 2004; Marmi et al., 2008). The gross morphology and cuticular features of *S. longirhachis* were described by Kvaček and Herman (2004) and Marmi et al. (2008). However, other vegetative organs (e.g. stems and roots) as well as reproductive structures (e.g. flowers, seeds and fruits) of this fossil palm species were completely unknown so far.

In the Iberian Peninsula, Schulp and Brokx (1999) mentioned for the first time "well-preserved palm leaves" at the "titanosaur megatrack" localities from the Early Maastrichtian of Fumanya

* Corresponding author. Fax: +34 93 586 83 33.
E-mail address: josep.marmi@icp.cat (J. Marmi).

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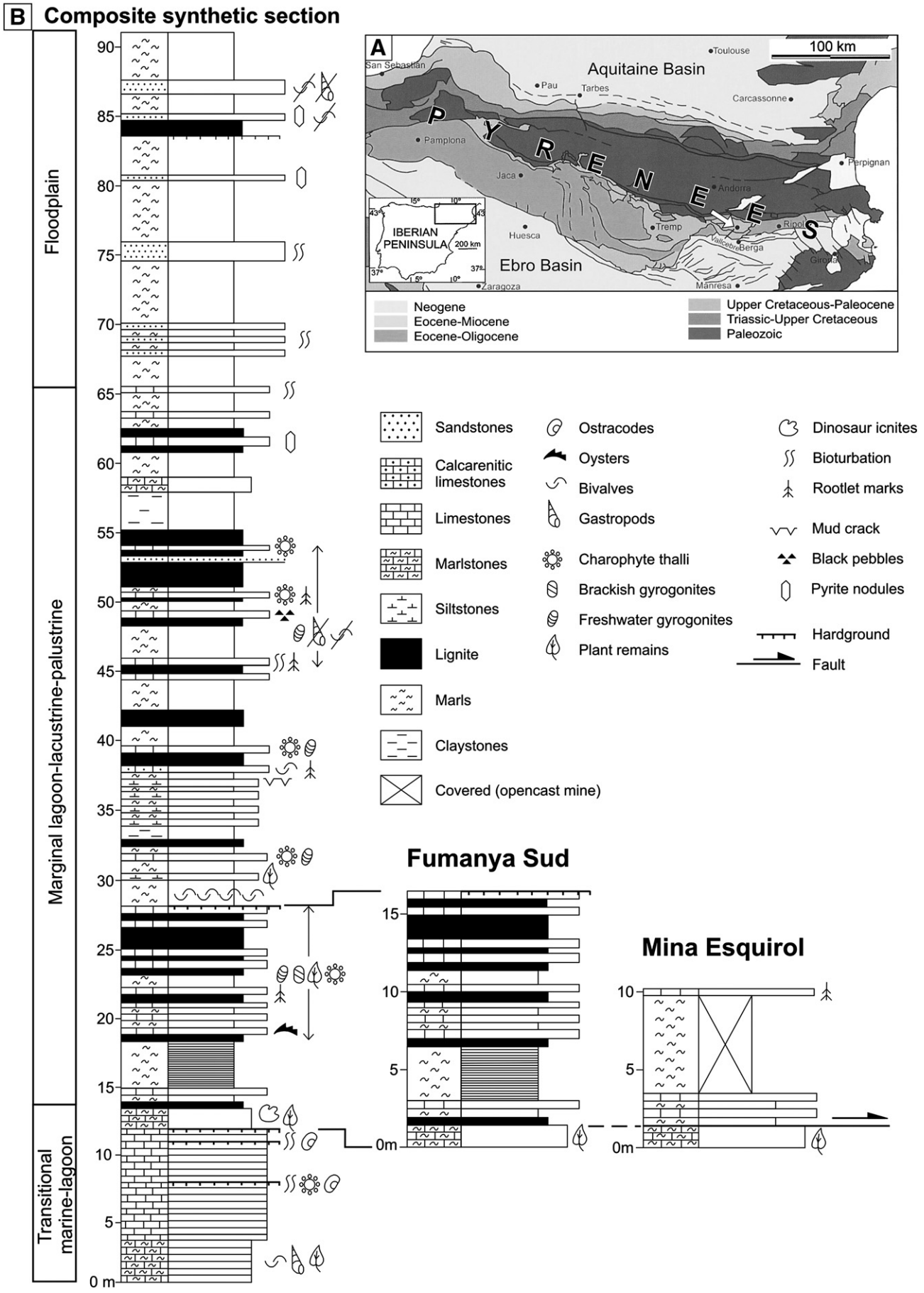
B Composite synthetic section
Floodplain
Marginal lagoon-lacustrine-palustrine
Transitional marine-lagoon
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0 m
A
100 km
Toulouse
San Sebastian
Pau
Tarbes
Aquitaine Basin
Carcassonne
PYRENEES
Pamplona
Perpignan
Jaca
Andorra
Tremp
Ripoll
Huesca
Vallcebre
Berga
Ebro Basin
Girona
Manresa
Zaragoza
IBERIAN PENINSULA
200 km
Neogene
Eocene-Miocene
Eocene-Oligocene
Upper Cretaceous-Paleocene
Triassic-Upper Cretaceous
Paleozoic
Sandstones
Calcarenitic limestones
Limestones
Marlstones
Siltstones
Lignite
Marls
Claystones
Covered (opencast mine)
Ostracodes
Oysters
Bivalves
Gastropods
Charophyte thalli
Brackish gyrogonites
Freshwater gyrogonites
Plant remains
Dinosaur icnites
Bioturbation
Rootlet marks
Mud crack
Black pebbles
Pyrite nodules
Hardground
Fault
Fumanya Sud
15
10
5
0m
Mina Esquirol
10
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0m