



## A palaeoenvironmental analysis of Permian sediments in Minorca (Balearic Islands, Spain) with new palynological and megafloral data

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### ABSTRACT

Plant fossils are rarely preserved within the Upper Permian of western Europe as the majority of continental deposits consists of siliciclastic redbeds. Because organic matter such as plant debris and palynomorphs is destroyed by oxidizing conditions, these red sedimentary facies were often considered as “devoid of life”. This paper presents new palaeobotanical data from the Upper Permian strata of Minorca (Balearic Islands, Spain). In addition, a rich and diverse “Thuringian” palynoflora was recovered from the Permian sediments, and several megafloral taxa are recorded. Additionally, a detailed sedimentological analysis of the studied section is provided. The Permian succession shows a general evolution from a ponded floodplain environment to sand-sheet rivers flowing across a semi-arid alluvial plain. Additionally, new palaeobotanical elements, added to the study of palaeosols, allow reconstruction of Late Permian plant growth within the terrestrial environment, as well as a palaeoenvironment reconstruction of the preserved sedimentary interval. At the transition between ponds and alluvial plain deposits, root systems surprisingly similar to those known in extant mangroves are described for the first time within Permian deposits. As there are no other palaeobotanical remains preserved in association, the type of plant that inhabited this environment remains conjectural.

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### 1. Introduction

In western Europe, continental Upper Permian biostratigraphy is challenging, as favourable conditions for the preservation of fossil plants and organic matter are rare. The sedimentary record of this period consists most often of red (heavily oxidized) siliciclastic rocks. Oxidation destroys organic matter, in plant compressions as well as palynomorphs. However, rare reduced horizons observed as dark grey lenses intercalated in these red facies are known to produce palynomorphs and sometimes fossil plant remains preserved as carbonized compressions. These horizons provide the opportunity to obtain a very discontinuous and punctuated image of the local flora. In addition to the sedimentological study undertaken by Linol et al. (2009), the present paper focuses on the description of palaeoenvironment and palaeobotanical remains at the Cala del Pilar section on the

Island of Minorca. The new data contrast with previous Upper Permian palaeobotanical information from the Balearic islands (Bourrouilh, 1973; Rosell et al., 1990; Broutin et al., 1992) and the Iberian Peninsula (Diez et al., 2005), because they consist of diverse palynological associations. The new elements consist of a palynoflora showing a greater taxonomic diversity than the ones previously described from Cala del Pilar, a megafloral assemblage composed mainly of conifer fragments (reported for the first time in the study area), and various palaeosols including a new type of facies.

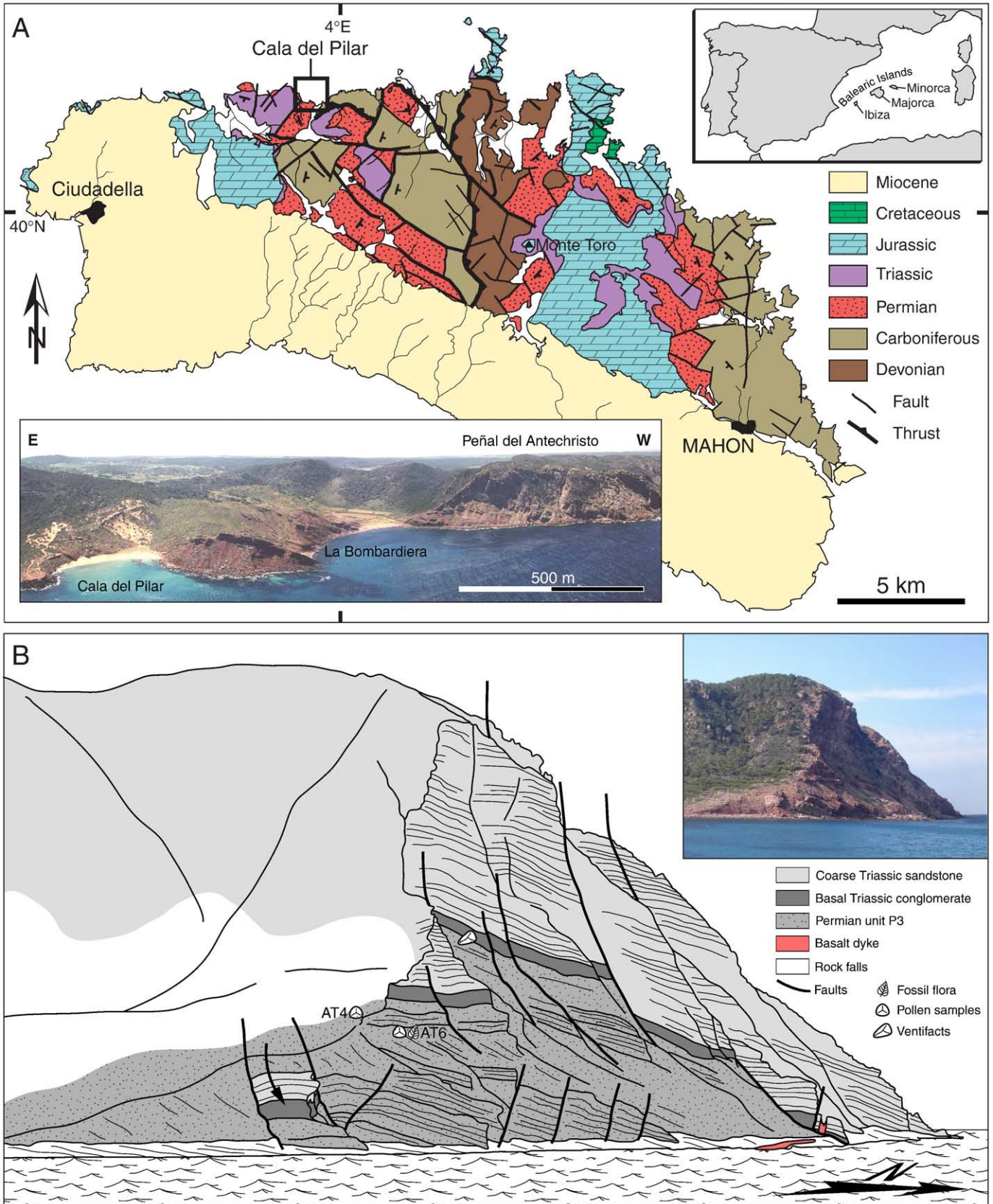
### 2. Geological settings and interpretation

#### 2.1. Cala del Pilar

Large exposures of the Permo-Triassic rocks are accessible in the northern part of the Island of Minorca. Fairly exhaustive sedimentological studies of this particular succession were published by Rodríguez-Perea et al. (1987), Rosell et al. (1988), Rosell and Gómez-Gras (1990); and Gómez-Gras (1993). The studied outcrops extend from the eastern side of the beach of Cala del Pilar up to the Peñal del Antechristo (Fig. 1).

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**Fig. 1.** A: Geological map of the Island of Minorca with study area (after Linol et al., 2009). The Permo-Triassic section of Cala del Pilar is located on the northern part of the coast presented in the aerial picture in the lower left hand side of the figure. The succession is presented starting from the Carboniferous/Permian unconformity on the very left (East), and up to the Triassic “Buntsandstein” facies on the right (West). B: Exposure of the eastern part of Peñal del Antechristo. Outline of the different rock formations is sketched and palynological samples, fossil flora and ventifacts are shown in their sedimentological and geographical position.

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