

Palaeoenvironmental and stratigraphic aspects of animal traces and plant remains in Spanish Permian red beds (Peña Sagra, Cantabrian Mountains, Spain).

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Palaeoenvironmental and stratigraphic aspects of animal traces and plant remains in Spanish Permian red beds (Peña Sagra, Cantabrian Mountains, Spain) Consequences

paléoenvironnementales et stratigraphiques de traces animales et de restes végétaux dans les formations rouges permienne de Peña Sagra (Montagnes Cantabriques, Espagne)

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### Abstract

Various vertebrate and invertebrate traces and plants remains have been discovered in the Permian of Pico Paraes (Cantabrian Mountains). They occur in the Sagra Formation, a 400 m thick unit consisting of a vertical alternation of channels with conglomeratic sandstones and fossiliferous red siltstones with a caliche horizon at the top. The most

common trace is *Hyloidichnus major* which is attributed to approximately 50 cm long Captorhinomorphs. Other tracks provisionally assigned to *Limnopus* could also indicate the presence of Temnospondyls. The bedding planes with traces also show some tracks of *Isopodichnus* cf. *minutus* which is ascribed to small triopsid crustaceans. Like the footprints, these are sometimes cut off by insect burrows like cf. *Steinichnus*, *Scoyenia gracilis*, *Ancorichnus* sp. or *Skolithos*. These fossiliferous levels have also yielded conchostracans, unidentifiable plant stems and a rather well-preserved frond of *Supaia* sp. The fossil association and sedimentological features suggest that the Sagra Formation is a floodplain deposit; the water depth was limited and fluctuated. Longer drier intervals also occurred. The vegetation was meso-xerophilous. The occurrence of the ichnoplacement *Hyloidichnus major* and *Supaia* in the Permian of France (Lodève basin) and North America (Grand Canyon, U.S. A) suggests that the Sagra Formation can be correlated with the Rabejac Formation of the Lodève basin. Based on comparisons with the *Supaia*-bearing Hertmit Shale, the Sagra Formation might be dated as early Leonardian, or even Artinskian when the Leonardian can indeed be correlated with the Artinskian + Kungurian.

## Résumé

Dans la Cordillère cantabrique (NW de l'Espagne), diverses traces de vertébrés et d'invertébrés, des empreintes végétales ont été découvertes dans le Permien du Pico Paraes et plus précisément dans la Formation de Sagra, d'épaisseur de 400 m qui est constituée par l'alternance verticale de grès conglomératiques chenaillés et de siltites fossilifères rouges avec un niveau de caliche dans sa partie supérieure. La trace de pas la plus commune est *Hyloidichnus major*. Elle a un rapport avec des reptiles captorhinomorphes longs d'une cinquantaine de cm. Quelques ichnites, rapprochées avec doute de *Limnopus* pourraient témoigner aussi de la présence de temnospondyles. Sur les dalles à empreintes de vertébrés, existent quelques pistes *Isopodichnus* cf. *minutus* dues à de petits crustacés triopsidés. Avec les traces de vertébrés, elles sont parfois recoupées par des terriers cf. *Steinichnus*, *Scoyenia gracilis*, *Ancorichnus* sp., ou *Skolithos*. Ces niveaux fossilifères ont livré également des conchostracés, des tiges indéterminables et une feuille de *Supaia* sp., par contre, bien conservée. À partir de l'interprétation paléoenvironnementale des fossiles et de diverses figures sédimentaires associées, nous avons suggéré, durant la sédimentation de la Formation de Sagra, l'existence d'un milieu aquatique peu profond,

souvent exondé, type plaine d'inondation fluviale. Le climat devait être alternant avec des périodes de sécheresse assez longues mais toutefois compatibles avec une végétation méso-xérophile composée de conifères et de *Supaia* sp. La répartition verticale de l'ichnopopulation *Hyloidichnus major* et de *Supaia* dans le Permien français et américain (Hermit Shale Formation, USA) conduit à corréliser la Formation de Sagra avec celle de Rabejac du bassin de Lodève, en France. En partant de l'âge de la Formation de Hermit Shale à *Supaia*, celui de la Formation de Sagra pourrait être Léonardien inférieur voire artinskien si on retient l'équivalence Léonardien = Artinskien + Kungurien.



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## Keywords

Spain; Cantabria; Sagra Formation; Vertebrate and Invertebrate Traces; Plant Remains; Early Leonardian

## Mots-clés

Espagne; Cantabrie; Formation de Sagra; Traces de Vertébrés et d'invertébrés; Empreintes végétales; Léonardien Inférieur

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