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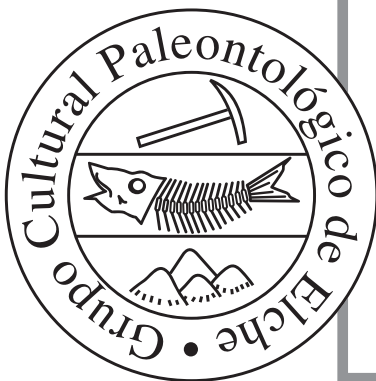


## VIII EJIP



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# NEW TETRAPOD FOOTPRINTS FROM THE PERMIAN OF THE PYRENEES (CATALONIA, SPAIN): PRELIMINAR RESULTS

## NUEVAS PISADAS DE TETRÁPODOS DEL PÉRMICO DE LOS PIRINEOS (CATALUNYA, ESPAÑA): RESULTADOS PRELIMINARES

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### ABSTRACT

Permian tetrapod footprints from the Iberian Peninsula are known from two areas: Ribera d'Urgellet (South Pyrenees) and Peña Sagra (Cantabrian Mountains, in Spain). Here we report the presence of new footprints from the first mentioned area. Two units are recognized in the region, separated by an angular unconformity. The lower unit yields tetrapod ichnites. It was dated as Upper Permian (Thuringian) by chronostratigraphic (palynology) studies, although further work is needed to confirm and precise this age. Four morphotypes are briefly described and tentatively assigned to *Chelichnus*, *Varanopus*, *Dromopus* and *Dimetropus*. The potential trackmakers of these ichnites are caseids, captorhinomorphs, araeoscelidians and pelycosaurians. Future work should confirm the parataxonomical assignments and the potential trackmakers.

**Keywords:** Iberian Peninsula, Permian, Pyrenees, footprints, tetrapod.

### RESUMEN

Las huellas de tetrápodos del Pérmico de la Península Ibérica son conocidas en dos áreas: Ribera d'Urgellet (vertiente sur de los Pirineos) y Peña Sagra (Cordillera Cantábrica). Aquí describimos la presencia de nuevas pisadas en la primera de las áreas. Se reconocen dos unidades en la región, separadas por una discordancia angular. La unidad inferior conserva las icnitas de tetrápodos. Esta unidad se dató como Pérmico Superior (Thuringiense) en base a estudios cronoestratigráficos (palinología), aunque futuros estudios deben confirmar y precisar esta edad. Cuatro morfotipos son brevemente descritos y tentativamente asignado a los icnogéneros *Chelichnus*, *Varanopus*, *Dromopus* y *Dimetropus*. Los potenciales creadores de estas huellas fueron caseidos, captorhinomorphos, araeoscelidians y pelicosaurios. Un futuro trabajo debe confirmar estas asignaciones, así como los potenciales autores de las icnitas.

**Palabras clave:** Península Ibérica, Pérmico, Pirineos, huellas, tetrápodos.

### 1. INTRODUCTION

The Permian-Triassic event was the biggest extinction on the Earth history. More than 90% of the life disappeared. For this reason, Permian-Triassic Boundary (PTB) has received a great attention by palaeontologists, in order to understand the cause of this massive extinction and the patterns of the biotic recovery along the Triassic.

In the Iberian Peninsula and Balearic Islands, vertebrate remains from the Permian and Lower Triassic are poorly known. On one hand, osteological record of Upper Permian is only known from the scarce remains from Menorca (Pretus and Obrador, 1987). On the other hand, indirect evidence has been reported from two areas, to

date: Ribera d'Urgellet area (South Pyrenees) and Peña Sagra (Cantabrian Mountains). Among the Lower Triassic, palaeontological evidence is lacking (López-Gómez *et al.*, 2005; Díez *et al.*, 2005). Two possibilities could explain it: the presence of a stratigraphic hiatus in the earliest Triassic or by palaeoenvironmental conditions (mainly arid climate) that prevented optimal conditions for life and their preservation during the Olenekian (Bourquin *et al.*, 2007). In sum, due to the scarcity of vertebrate evidence during the Permian and the first steps of the Triassic, any finding is important to enlarge our knowledge of this temporal range.

Here, we preliminary report new tetrapod footprints found in the Palanca de Noves locality (Ribera d'Urgellet,

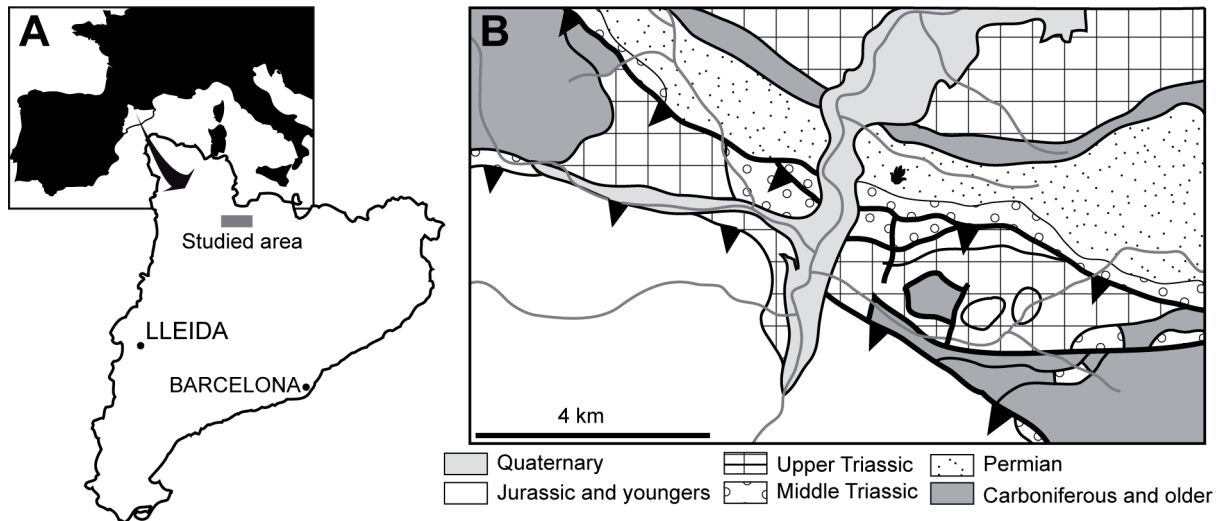


Figure 1. Location and geological overview of the study area. (A) Position of the facies studied here. (B) Simplified geological map. The tetrapod footprint locality is indicated.

Alt Urgell, Lleida province), discussing their tentative systematic assignment and testing the potential trackmakers of the tetrapod ichnites.

## 2. BACKGROUND

The unique study in Ribera d'Urgellet area (Lleida province) reported the presence of several tetrapod footprints in the Palanca de Noves locality. Ichnites were recognized as two big ichnoforms referred, with doubts, to labyrinthodonts/cotylosaurs and to chirotheriids. These footprints appear impressed in laminated shales with abundant mudcracks which were interpreted as an overflow deposits developed in the border of the alluvial channels and representing distal areas of the alluvial fans with low slope (Robles and Llompart, 1987).

Among Peña Sagra area (Cantabria), tetrapod footprints represent a different ichnoassociation; first reference comes from Pico Paraes (Sagra Fm.). Medium-sized footprints assigned to *Hyloidichnus major*, *Limnopus* cf. *zeilleri*, cf. *Laoporus* and cf. *Salichnium* were described together with plants (e.g. *Supaia*) and invertebrate traces as *Scoyenia*, *Ancorichnus* and *Skolithos* (Martínez-García *et al.*, 1994; Gand *et al.*, 1997). Gand *et al.* (1997) interpreted the area as flood plains alternatively dry and wet where captorhinomorphs (suggested trackmaker of *Hyloidichnus major*) and temnospondyls (possibly *Limnopus* cf. *zeilleri* tracemaker) lived. Recent findings in the same formation and maybe similar levels provided large ichnites referred to *Brontopus giganteus* with a dicynodont as possible trackmaker as suggested (Demathieu *et al.*, 2008). Nevertheless, the age of the ichnites remains controversial; the former ichnites described were dated as Early Permian (Leonardian) while the latter, *Brontopus* ichnites, as uppermost Middle - Upper Permian.

## 3. GEOLOGICAL SETTINGS

Palanca de Noves is placed at the south of the village of La Seu d'Urgell, in Ribera d'Urgellet (Alt Urgell, Lleida

province, South Pyrenees) in the cross-section of the Segre River (Fig.1). This area is strongly tectonized as consequence of Pyrenean growth, which favoured the exhumation of old geological material to the surface. Two units have been described, which are limited by an angular unconformity placed between them (Robles and Llompart, 1987). The lower stratigraphic unit is 160 m in thickness while the upper unit is 190 m. In sum, this siliciclastic succession is about 350 m and it was interpreted as alluvial succession deposited under arid conditions. The tetrapod ichnites were found at the lower unit. In particular, the previously described prints are 116 m below the angular unconformity while the new footprints (here described) are in close but different stratigraphic levels.

The age of each unit remains open to debate. It has been suggested to be Upper Permian and Middle Triassic respectively; palynological analysis in Palanca de Noves locality dated the base of the succession as Thuringian (Broutin *et al.*, 1988), later confirmed by other authors (Calvet *et al.*, 1993). But it should be noted that the term "Thuringian" is no longer accepted as chronostratigraphical unit (Diez *et al.*, 2005; Lucas *et al.*, 2006) requiring further work to confirm and precise the age of each unit with confidence.

## 4. DESCRIPTION

Recent fieldwork discovered 13 isolated footprints belonging to at least four different morphotypes; there are no complete trackway and just two manus-pes sets are present. (Fig. 2).

### 4.1. MORPHOTYPE A (FIG. 2A)

We tentatively assign seven single footprints to morphotype A. These small ichnites are preserved as moulds on two different layers on the same slab being two of them arranged in a set manus-pes. Just three digits are impressed; the fingertips are curved lightly outwards. Regarding the manus-pes set, the manus impression (4 mm

in length and 5 mm in width) is slightly smaller than the pes impression (7 mm in length and 4 mm in width) and the manus-pes distance is 15 mm.

The other five footprints are poorly preserved; just one of them is tetradactyl. The average length of the tracks is 5 mm and 4 mm in width. The attribution of these footprints to an ichnogenus is difficult due to the incomplete digit impressions and to the lack of a trackway. Nevertheless some analogies are comparable with the ichnogenus *Chelichnus* Jardine 1850, a typical Upper Permian track.

#### 4.2. MORPHOTYPE B (FIG. 2B)

One set manus-pes of pentadactyl, plantigrade and small footprints preserved as counter moulds. Digits are thin and strongly arcuated inward showing well impressed claw marks in both. The manus is 22 mm (in length and width) and the digits length increase from I to IV being II and V similar; the angle between the digits I and V is 102°. The pes (poorly preserved) is incomplete, measuring 24 mm in length and 22 mm in width. The manus is not overstepped by the pes and the distance between them is 26 mm. The finding of just two tracks makes difficult a certain attribution to an ichnogenus but the general morphology seems to be close to the morphology of *Varanopus* Moodie 1929.

#### 4.3. MORPHOTYPE C (FIG. 2C)

We assign three poorly impressed footprints to this morphotype. All the ichnites are isolated and preserved as counter moulds. Two of these ichnites are incomplete; one shows five digit impressions (pentadactyl) and semiplantigrady (40 mm in length and 45 mm in width) with long and thin digits. The digit length decreases from IV to I (23 mm to 15 mm), and the digit V is rotated outwards. The angle I-V is 130° and the I-IV is 72°. This morphotype is probably referable to the ichnogenus *Dromopus* Marsh, 1894, but the poor preservation and the lack of a trackway does not allow a certain attribution.

#### 4.4. MORPHOTYPE D (FIG. 2D)

The last footprint belongs to a relatively large reptile. The footprint is poorly preserved as a mould but the digit pads and the claw-marks are still well recognizable. The track measures 180 mm length x 179 mm width. The digit IV is the longest one (138 mm), the III measures 126 mm and the angle between the digits I-IV is 58°. The lack of the digit V and the finding of just one footprint referable to this morphotype make difficult its attribution to an ichnospecies or to a trackmaker, although the predominance of the digit IV and the general morphology suggest an affinity to the ichnogenus *Dimetropus* Romer and Price 1940.

### 5. TRACKMAKERS

The potential trackmakers of the four morphotypes here described should be taking with caution due to the absence

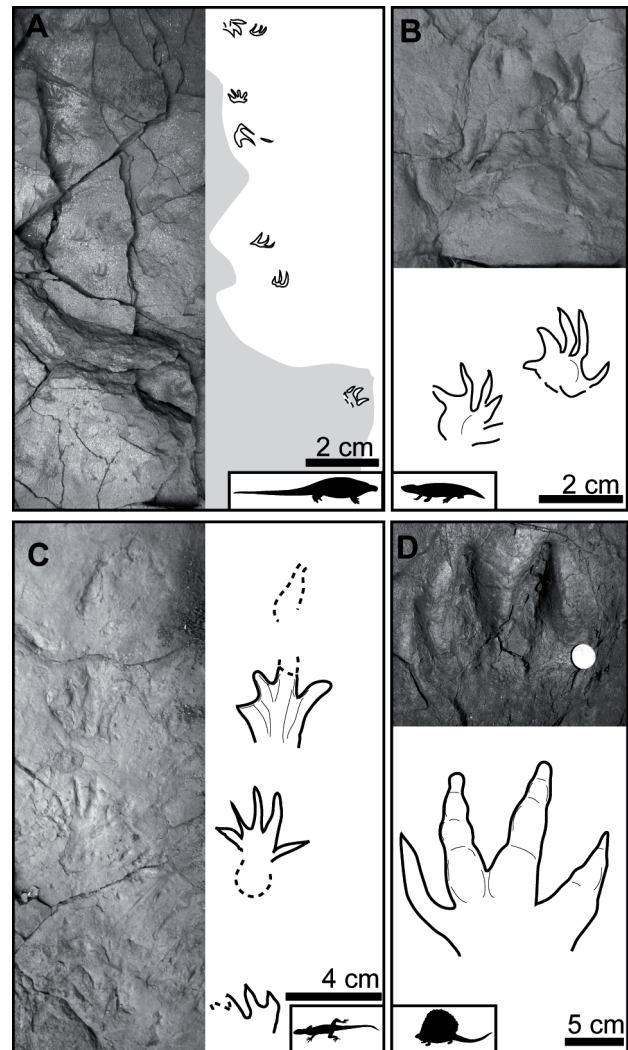


Figure 2. Tetrapod ichnites from the Permian of Palanca de Noves locality herein described and the possible tracemakers of each morphotype.

of trackways; more footprints are needed to assign with confidence the different morphotypes to an ichnospecies and the potential tetrapods who produced them.

Nevertheless, following previous inferences (e.g. Haubold, 1971; Gand and Durand, 2006), we suggest, with caution, that the trackmaker of morphotype A, here tentatively referred to the ichnogenus *Chelichnus*, could be the synapsid caseids. Captorhinomorphs were possibly also present as suggested by the morphotype B (*Varanopus*). The evidence of diapsid araeoscelidians in the ecosystem corresponds to the presence of the morphotype C (*Dromopus*) while the pelycosaurians possibly left the footprint of morphotype D (*Dimetropus*).

### 6. CONCLUSIONS

Palanca de Noves locality yielded greater tetrapod ichnofauna diversity than previously reported. All the tetrapod ichnites come from the lower unit, dated as Thuringian by palynology. Following Robles and Llompart (1987), we interpret the area as alluvial succession deposited under arid conditions. Here, we tentatively assign the four morphotypes herein described to *Chelichnus*

(morphotype A), *Varanopus* (morphotype B), *Dromopus* (morphotype C) and *Dimetropus* (morphotype D). The animals that left these footprints may be caseids, captorhinomorphs, araeoscelidians and pelycosaurians, respectively. Captorhinomorphs are also supposed to be present in the Permian of Peña Sagra while the presence of the other groups could represent the first indirect evidence in the Permian of Iberian Peninsula.

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