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An articulated sauropterygian marine reptile from the Middle Triassic of the South-Iberian Palaeomargin, Betic Cordillera, Southeastern Spain

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LETHAIA

A new Triassic small marine reptile has been found in the locality of Cehegín (Murcia, Southeastern Spain). The fossil remains mainly comprise moulds of the bones and some osseous fragments still embedded in the rock. These correspond to an articulated sauropterygian, being distinguishable the cervical vertebrae in one rock, while the other rock preserves the middle-inferior part of the body, being differentiated some dorsal, sacral and caudal vertebrae, the ribs, the gastralia, part of one forelimb, part of the hindlimbs and some pelvic elements that can be also intuited. The moulds of dorsal vertebrae, the ribs and the gastralia are overlapped, but it can be distinguished that the ribs are pachiostotic and the gastral ribs are constituted by different components (partite gastral ribs). The features of this reptile permit to refer it to Eosauropterygia. This discovery constitutes the most complete sauropterygian found, to date, in the South-Iberian Palaeomargin of the Tethys, and adds new information about the diversity and palaeogeographical distribution of Sauropterygia in the Middle Triassic, indicating that it was greater than previously believed. □ *Middle Triassic, Eosauropterygia, marine reptile, Betic Cordillera, Muschelkalk*

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Marine reptiles were abundant and diverse in the Middle Triassic marine ecosystems of Western Tethys, both in the Alpine Domain and in the Germanic Basin, forming part of the Tethyan Bioprovince and the Germanic Bioprovince, summarized by Rieppel (2000), Motani (2009) and Diedrich (2012). In the Alpine Triassic, in addition to Sauropterygia, Ichthyosauria and Thalattosauria have also been recorded (e.g. Müller 2005; Dalla Vecchia 2006, 2008; Kolb *et al.* 2011). The Besano Formation from the Monte San Giorgio (Southern Alps of Switzerland and Italy) is especially rich in marine reptiles (e.g. Tschanz 1989; Beardmore & Furrer 2016; Rieppel 2019). In the Germanic Basin, from the Muschelkalk deposits, the most abundant reptiles in shallow marine sediments were Sauropterygia (e.g. Rieppel 2000; Klein *et al.* 2015).

Along the Iberian Palaeomargin, with Germanic facies (today outcropping in the Pyrenean Cordillera, Catalonian Coastal Range, the Iberian Range, the Betic External Zones and the Algarve Basin), the record of marine reptiles is also relatively rich but most of the reported remains consist of isolated elements (e.g. Kuhn-Schnyder 1966; Westphal 1976; Sanz 1976, 1980, 1983a,b; Sanz *et al.* 1993; Alafont 1992, 1999; Alafont & Sanz 1996; Sanz *et al.* 1993; Rieppel & Hagdorn 1998; Niemeyer 2002; Rubio *et al.* 2003; Quesada & Aguera González 2005; Quesada *et al.* 2009; Fortuny *et al.* 2011; Reolid *et al.* 2014; de Miguel Chaves

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et al. 2015, 2016, 2017a, b, 2020; Berrocal-Casero & Castaninha 2015; Berrocal-Casero *et al.* 2018; Campos & Mateus 2018; Márquez-Aliaga *et al.* 2019). Among them, the first Triassic Sauropterygia remains from the Triassic of the Subbetic domain (External Zones of the Betic Cordillera), was recently described by Pérez-Valera *et al.* (2019). Only one record of sauropterygians in the Iberian Peninsula comes from Alpine facies, being an isolated rib from the Ladinian of the Alpujarride Complex (Betic Internal Zones; Reolid & Reolid 2020). Recently, a sauropterygian remain from the uppermost Triassic of the westernmost part of the South-Iberian Palaeomargin has been also recovered (Reolid *et al.* 2022).

The aim of this work is to report the record of an articulated specimen of sauropterygian from the Middle Triassic of the Subbetic (Betic Cordillera). In addition, this work aims to reconstruct the palaeoenvironment inhabited by this marine reptile.

Geological setting and stratigraphy

The fossil remains studied here were found in the Betic Cordillera (Southeastern Spain). The Betic Cordillera is geographically located in the southern part of the Iberian Peninsula (Fig. 1) and comprises the northern branch of the Betic-Rif Orogen, an arcuate structure where the Betic and Rif cordilleras are connected by the so-called Gibraltar Arc, being the westernmost part of the Alpine, peri-Mediterranean fold belts.

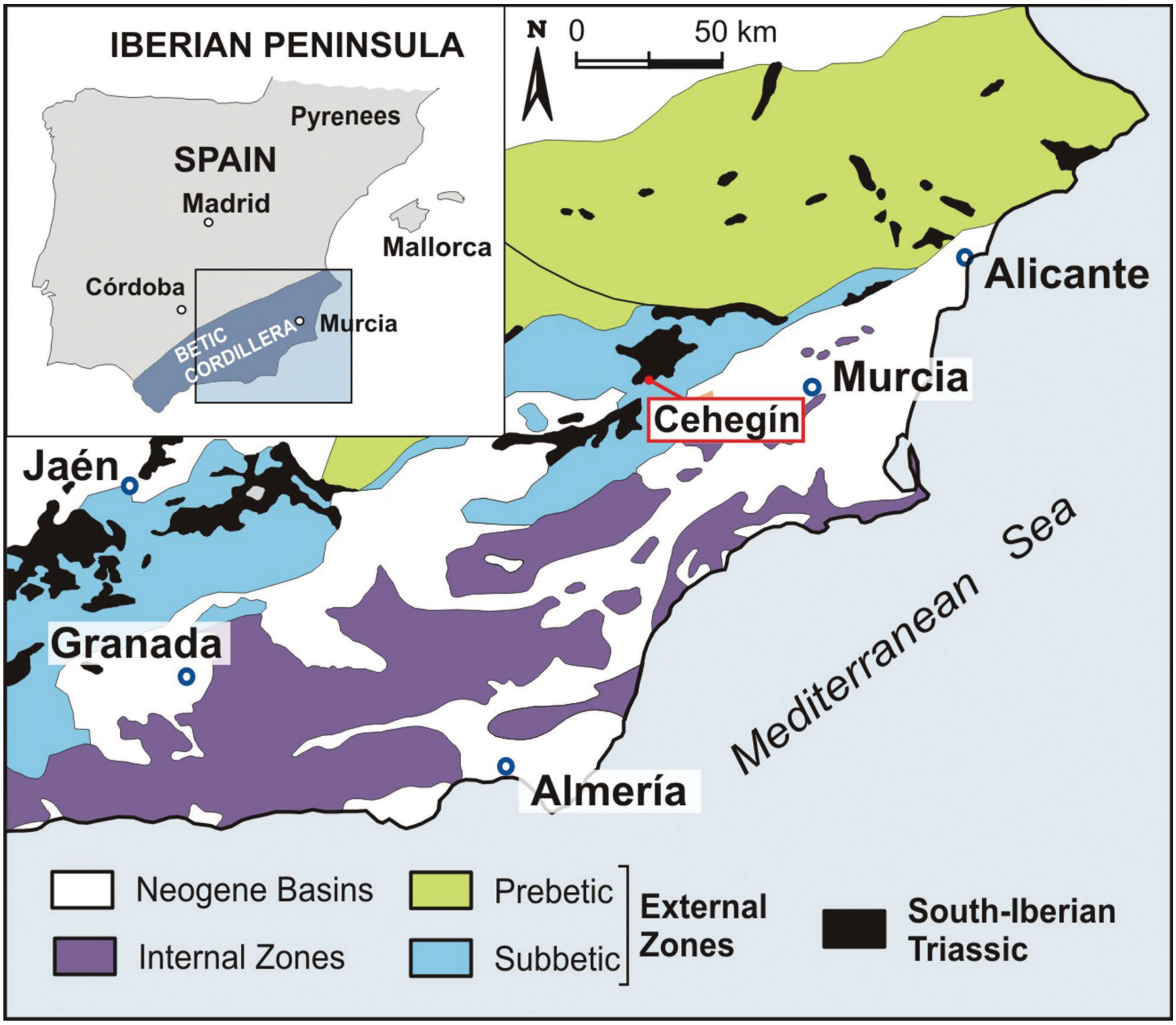

Fig. 1. Geological sketch of the southeastern sector of the Betic Cordillera, with detail of the South-Iberian Triassic and the locality of Cehegín (Southeastern Spain).

The External Zones of the Betic Cordillera are composed of Triassic to Miocene, non-metamorphic rocks resulting from folding and thrusting of the South-Iberian Palaeomargin sediments due to the westward migration and collision of the Mesomediterranean (Alboran) Terrain (Balanyá & García-Dueñas 1987) in Miocene times (e.g. Hermes 1985), constituting the Internal Zones (Fig. 1). The External Zones are subdivided in Prebetic and Subbetic according to criteria of proximality-distality to the palaeomargin in the Mesozoic, mainly in Jurassic and Cretaceous units (García-Hernández *et al.* 1980). The Prebetic is the more proximal area, with the predominance of shallow, coastal, marine facies. The Subbetic is the most distal area with higher abundance of hemipelagic facies. The studied fossil remains were recorded from Triassic material related to Subbetic units (Fig. 1).

The Triassic rocks of the External Zones constitute the first sediments deposited unconformably over the Palaeozoic, Variscan basement, and shows typical features of fluvio-evaporitic and shallow marine facies with diverse lithostratigraphical units, which remind the classical trilogy of Germanic facies (Buntsandstein, Muschelkalk and Keuper facies). In the Betic Cordillera, the term South-Iberian Triassic is used to refer the Triassic units in the External Zones (e.g. Pérez-López & Pérez-Valera 2007) and shows diverse lithostratigraphical units (Fig. 2A) defined from bottom to top: 1) evaporites and siliciclastic deposit (Röt, Buntsandstein facies); 2) carbonates of the Lower Muschelkalk; 3) siliciclastics and evaporites of the Middle Muschelkalk; 4) carbonates of the Upper Muschelkalk (Cehegín Formation, Pérez-Valera & Pérez-López 2008); 5) siliciclastic deposits and evaporites of the Jaén Keuper Group (Keuper facies, Pérez-López 1998); and, 6) carbonates of the Zamoranos Formation (Pérez-López *et al.* 2012). The bone remains have been found in the Lower Muschelkalk unit, near the locality of Cehegín, in the Murcia province (Southeastern Spain) (Fig. 1).

In the study region, Muschelkalk carbonates crop out widely and most of them have been assigned to the Cehegín Formation, Ladinian in age (Pérez-Valera 2015; Pérez-Valera *et al.* 2017), related mainly with siliciclastic deposits of Keuper facies (Pérez-Valera 2005; Pérez-López *et al.* 2005). However, the vertebrate remains are found in a different and less represented carbonate unit located at Las Atalayas hill, 1 km west of the locality of Cehegín (Fig. 1). The stratigraphical section of Las Atalayas is composed by a 100 m-thick succession of brown dolostones and dark limestones with some gypsum and green lutite intervals with the presence of occasional bioclastic beds (tempestites), that are deposited above the Röt Buntsandstein facies (Fig. 2B). The upper part of the Atalayas section consists of green lutites with dolomites in a gradual transition to the Middle Muschelkalk evaporites and siliciclastic deposits (Fig. 2B). Invertebrate fossil remains are scarce but the ubiquitous presence of the bivalve *Myophoria vulgaris* indicates an Anisian age, so the Atalayas section can be assigned to the carbonates of the Lower Muschelkalk (Escudero-Mozo *et al.* 2015). The overall facies association of Las Atalayas section indicates a very shallow marine environment, mostly subtidal, but with occasional presence of stromatolites and evaporites at top of the section, typical of intertidal and supratidal zones, showing a complete marine transgressive-regressive cycle as described in the Lower and Middle Muschelkalk of the Iberian Basin (Escudero-Mozo *et al.* 2015).

The bones appear in a dm-thick, brown, fine-grained dolostone interval, near the top of the Lower Muschelkalk unit (Fig. 2C, D). This interval could be deposited under lagoon conditions or in a pond environment. The absence of high-energy deposits (i.e. tempestites or shoals deposits) and the exceptional presence of articulated bones in the marine reptile suggest a low-energy setting related to the nearshore. Similar facies have been described in the Lower Muschelkalk of Eastern Iberia (Pérez-López *et al.* 2021).

Material and methods

The specimen under discussion was found in two rocks (Muschelkalk carbonates) that were forming part of a wall in the city of Cehegín (Murcia province, Spain). Currently, these rocks with the embedded marine reptile are housed at the '*Museo Arqueológico de Cehegín*' and are assigned to the collection number MC-2500 and MC-2501. This material has been studied at the museum and several photographs were taken under different light conditions to differentiate the form of the bones and the moulds. The specimen has been bibliographically compared to other Triassic sauropterygians from the Western Tethys. Moreover, intensive fieldwork has been carried out in the quarries from which the mentioned rocks come, to determine the stratigraphical position of the specimen. In concrete, the quarries are located in the Las Atalayas hill, Cehegín (Murcia province, Spain; see Geographical and Geological context above). In this place, a stratigraphical section has been carried out (Fig. 2) and the facies, the sedimentary structures, the invertebrate (as bivalves) and the vertebrate remains have been studied. Special attention has been taken to one level that contains vertebrate remains (Fig. 2),

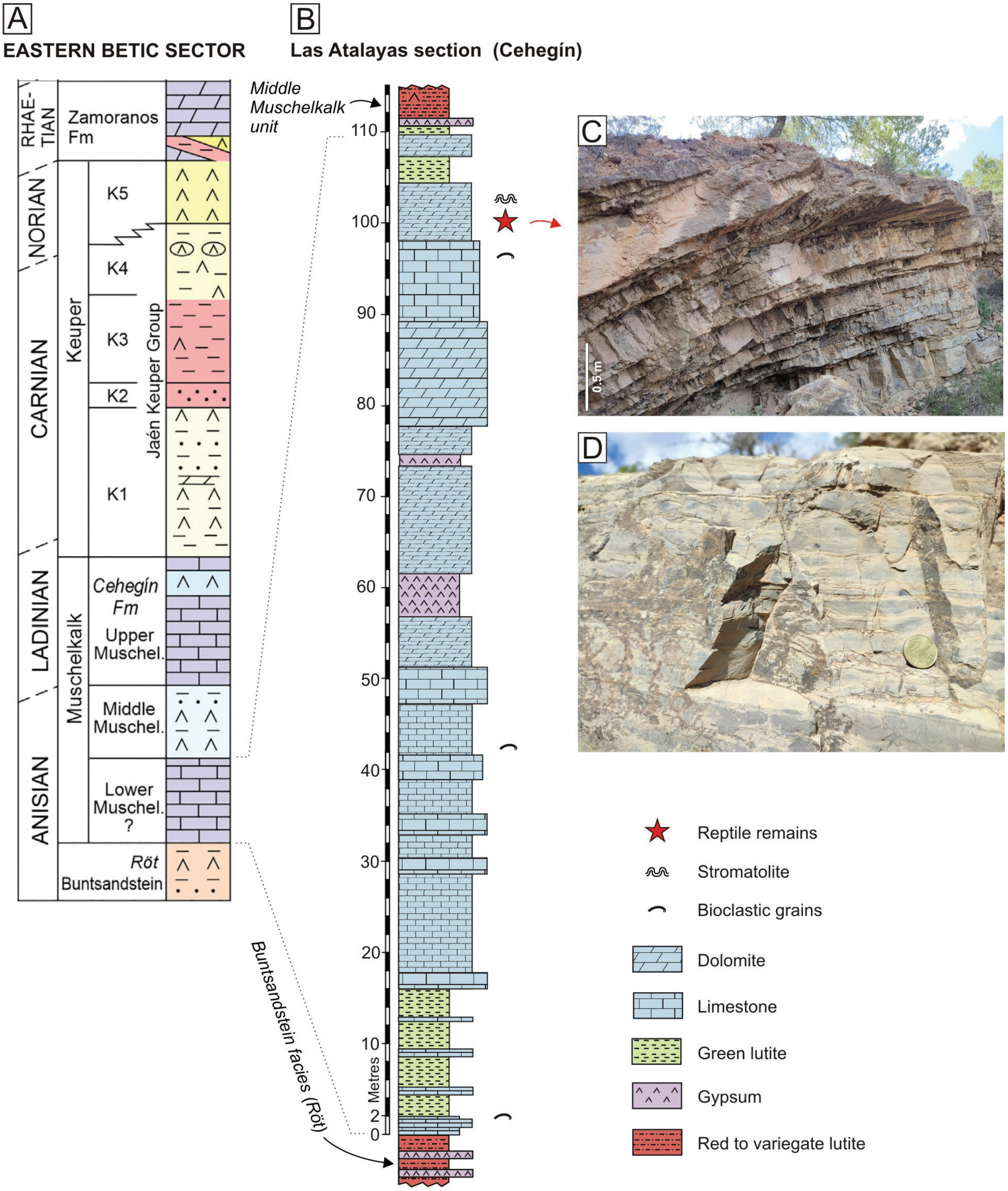

Fig. 2. General stratigraphical context and details of the Middle Triassic of Las Atalayas section in Cehegín (Spain). A, general stratigraphy of the South-Iberian Triassic (modified from Ortí *et al.* 2022). B, stratigraphical section of the Middle Triassic in Las Atalayas section. C, aspect of the abandoned quarry where the reptile remains were discovered. D, detail of the carbonates (dolomicrite) in the bone-rich levels.

allowing to determine the stratigraphical position of the specimen studied.

Description of the material

The vertebrate remains are included in two dolomicrite rock fragments (MC-2500, MC-2501). Although some bone fragments are still embedded in the rocks, the remains correspond mainly to moulds of the bones of an incomplete articulated skeleton of a sauropterygian of more than 40 cm long. In detail, 10 cm of the cervical region (cervical vertebrae) can be distinguishable in MC-2500 (Fig. 3), and 26 cm of the middle-inferior part of the body (some dorsal, sacral and caudal vertebrae, the ribs, the gastralia, part of one forelimb, part of the hind limbs, several pelvic elements, carpals and other bones) are preserved in MC-2501 (Figs 4–7).

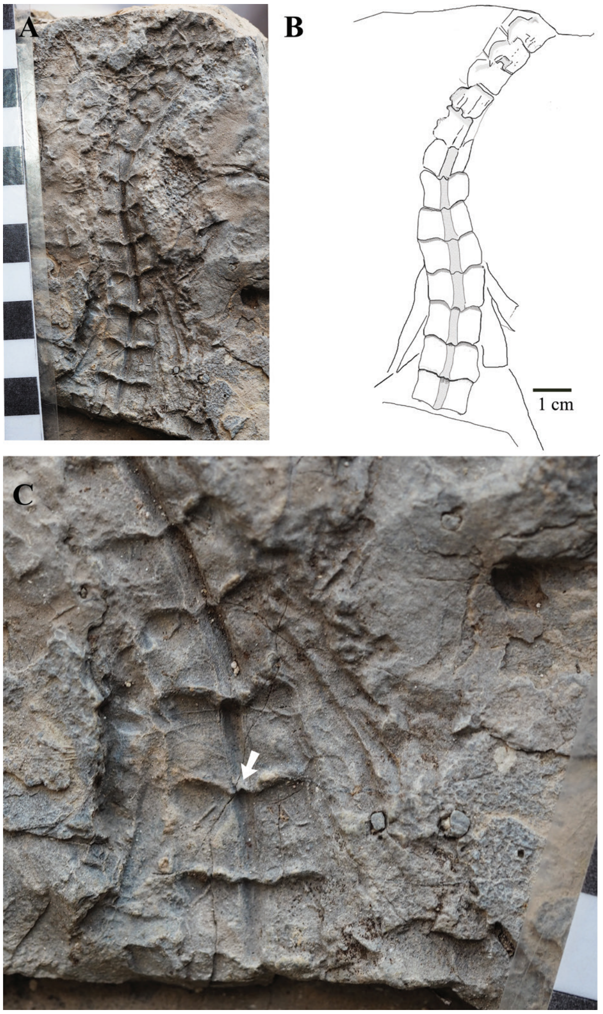

Fig. 3. General view and details of the sauropterygian fossil remains embedded in the rock fragment MC-2500, from the Middle Triassic of Cehegín (Spain). A, picture of the moulds. B, drawing of the cervical vertebrae. C, detail of some of the cervical vertebrae moulds in which can be observed that, at the base of the following neural spine, a tonguelike process fits onto this shelf of the following vertebra (indicated by white arrows). Scale bar: 1 cm (each square corresponds to 1 cm in A).

Vertebrae and ribs

Although the vertebrae consist mainly in moulds of the dorsal part of an articulated vertebrate or part of the fragmented vertebra still embedded in the rock, some features can be distinguished. The thickness of the distinguishable vertebra is 10 mm and the maximum width of some of the preserved centra is 13 mm. The moulds of 13 articulated cervical vertebrae show neural arches with a low neural spine (Fig. 3). The size of the cervical vertebrae slightly and gradually increases from front to back. The bigger vertebra is 15 mm wide and 7 mm thick. The neural spines seem to remain low throughout the cervical region, represented by little more than a longitudinal ridge on the dorsal surface of the neural arch. At the base of the following neural spine, a tongue-like process (*sensu* Rieppel 1989) fits onto this shelf of the following vertebra seems to be distinguished (Fig. 3).

The main parts of the dorsal vertebrae are poorly preserved and the moulds of the vertebra, the ribs and the gastralia are overlapped (Figs 4, 5A–D). The sacral vertebrae are difficult to distinguish. However, two vertebrae are apparently fused, possibly forming part of the sacral region that seems to be formed by more than three vertebrae. Some moulds of the dorsal ribs are distinguishable, being wider proximally (pachyostosis) (Fig. 5A, B). Two or three gastral ribs per vertebral segment can be inferred in some parts of the vertebrate mould (Fig. 5C, D). Each gastral rib is formed by different elements: a medium, slightly angulated rib flanged by slightly curved and overlapping elements on either side. As the gastral ribs of the studied specimen seem to be formed by 5 elements (one central and two lateral to each side, Fig. 5D), the mode of the preservation of these gastral ribs as overlapped moulds led to a possible doubt, because some elements of these gastral ribs could be hidden.

Limbs

A part of the left forelimb is preserved, including the incomplete left humerus, a part of the radius and part of the ulna and some metacarpal (Fig. 6). The humerus shows 38 mm length (but it is incomplete) and 15 mm wide. The element is curved with a concave medial (preaxial) margin. The mark of the entepicondylar foramen seems to be present and well

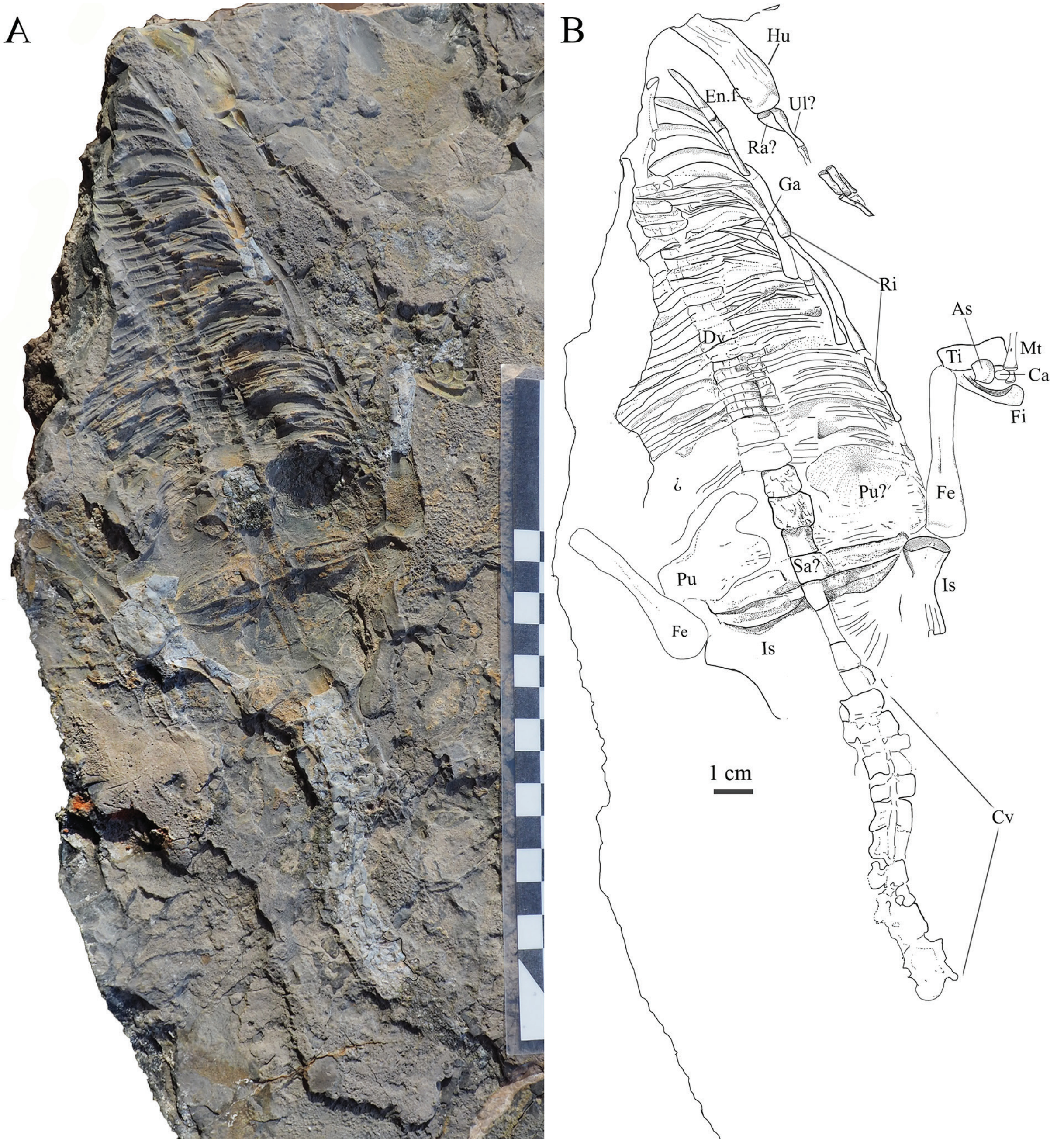

Fig. 4. General view of the sauropterygian fossil remains embedded in the rock fragment MC-2501, from the Middle Triassic of Cehegín (Spain). A, photograph of the sauropterygian remains embedded in the rock. B, drawing of the reptile indicating the distinguishable bones of the specimen. Dv: dorsal vertebrae, Cv: caudal vertebrae, Ri: ribs, Ga: gastralia, Hu: humerus, Ent.f: entepicondylar foramen, Ul?: ulna?, Ra: radius?, Fe: femur, Ti: tibia, Fi: fibula, As: astragalus, Mt: metatarsals, Ca: calcaneus, Pu?: pubis?, Is: ischium. Scale bar: 1 cm (each square corresponds to 1 cm in A).

set off from the distal articular facet, indicating that the specimen could be adult. A distinct ectepicondylar groove seems to be present. The mould of the radius is incompletely exposed, but seems to show a total length of 24 mm. Three moulds of metacarpals are visible, showing 10 mm in length (Fig. 6).

The preserved (as moulds) hindlimb elements include femora, one tibia, one fibula, the astragalus, the calcaneus and several autopodial elements (Fig. 7). The femur is 60 mm in length, wider or expanded proximally, being 12 mm wide in the anterior part of the bone and 8 mm wide in the middle part. The mould of the fibula is preserved. It is 24 mm wide, being wider and rounded distally. The tibia is sturdier and wider than the fibula. The fibula is also easily distinguished from the tibia by its pronounced

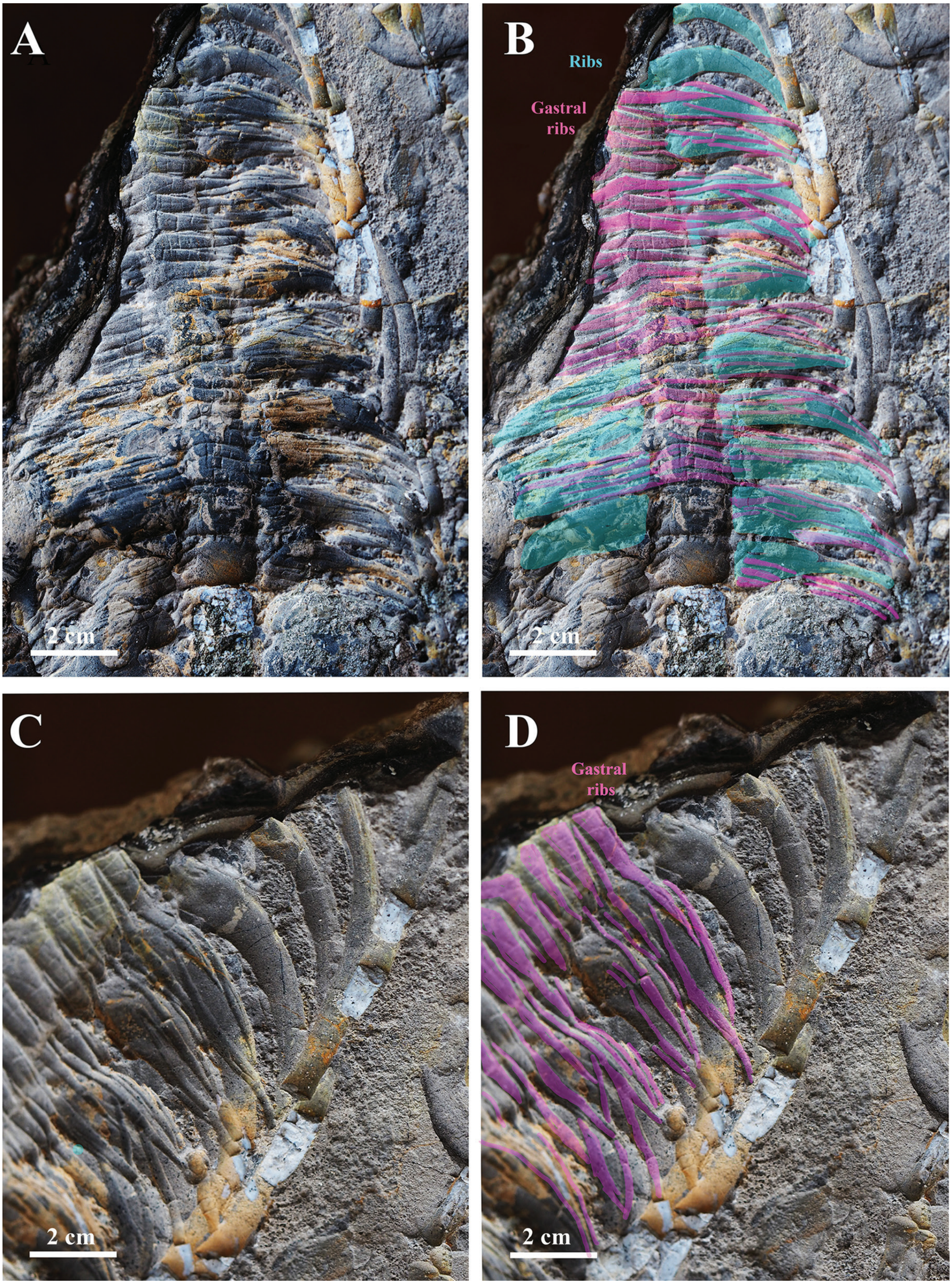

Fig. 5. Details of the sauropterygian fossil remains embedded in the rock fragment MC-2501, from the Middle Triassic of Cehegín (Spain). A, vertebrae and ribs of the studied reptile. The moulds of the vertebrae, the ribs and the gastralia are overlapped. B, in the same image, the ribs have been highlighted in blue, while the gastral ribs have been coloured in pink. C, detail of some moulds of the ribs and gastralia. D, in the same images, the gastral ribs have been coloured in pink. The ribs show pachyostosis, while the gastral ribs are clearly composed of different elements (partite gastral ribs). Scale bar: 2 cm.

Fig. 6. Detail of the sauropterygian fossil remains embedded in the rock fragment MC-2501, from the Middle Triassic of Cehegín (Spain). Mould of the hindlimb. Hu: humerus; En.f?: entepicondylar foramen; Ul: ulna; Ra: radio; Mc: metacarpals. Scale (each square): 1 cm.

curvature, which contrasts with the rather straight tibia. The interosseal space is defined by the weakly concave lateral edge of the tibia and the strongly concave medial edge of the fibula (Fig. 7). The proximal and distal expansions of the tibia are of about equal width, whereas the distal expansion of the fibula tends to be a little wider than the proximal expansion. The astragalus is consistently larger than the calcaneus. It shows a circular outline and lies distal to the tibia. The calcaneus is of an essentially circular outline and lies distal to the fibula. Only the area of contact between astragalus and calcaneus may be flattened on both bones. In the metatarsal series, only one can be well recognized, showing the proximal head markedly expanded (Fig. 7).

Pelvic elements

On the pelvic girdle, the ilium is difficult to differentiate. The moulds of the two ischia seem to be preserved in articulation, but only a part is well distinguished. The left ischium shows rod-shape acetabular portion, but the expansion of the distal part is poorly differentiated. In the right ischium, a part of the bone can be distinguished in the anterior part of the mould. The length of the ischium is 27 mm and its proximal width is 13 mm.

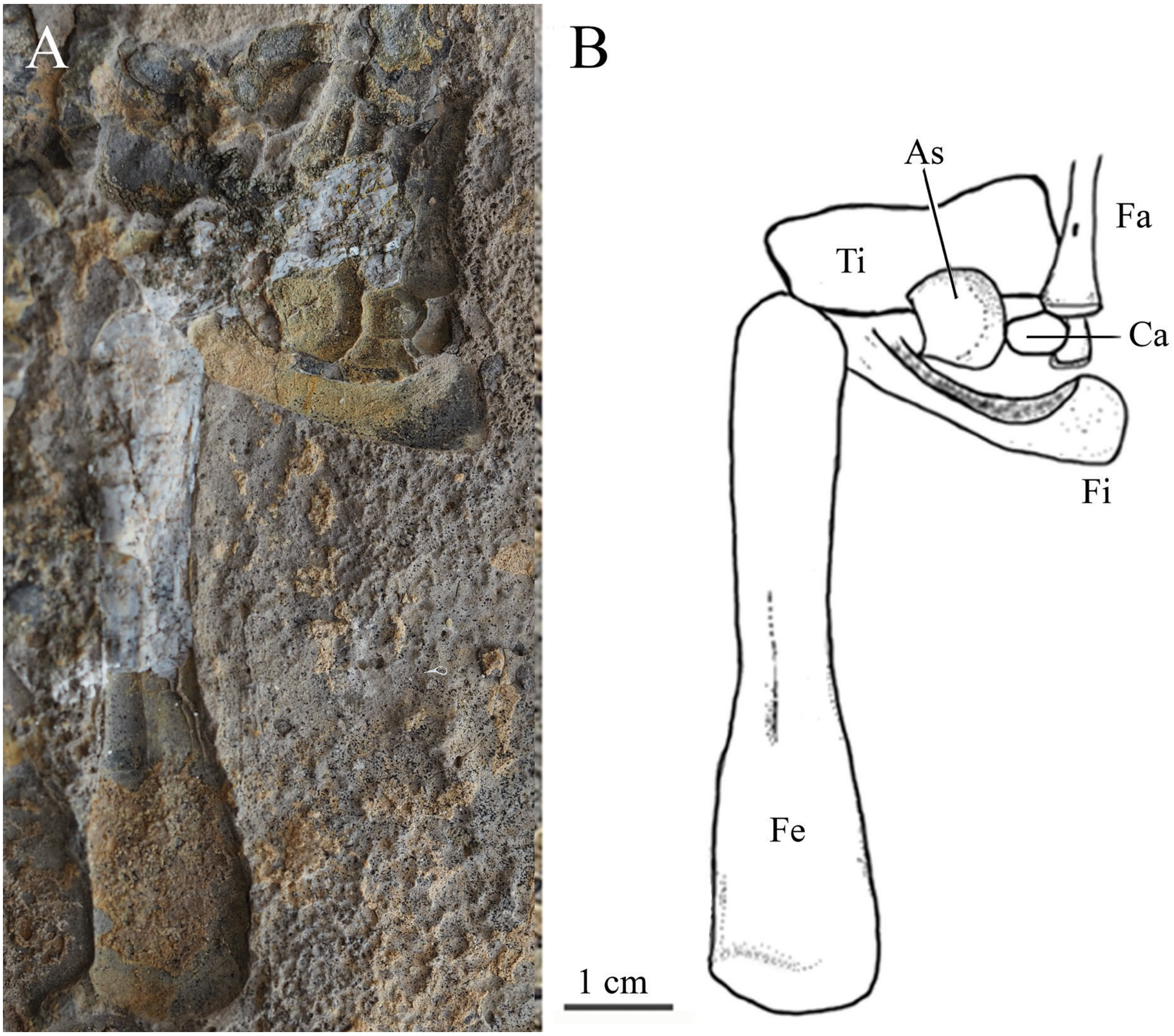

Fig. 7. Details of the sauropterygian fossil remains embedded in the rock fragment MC-2501, from the Middle Triassic of Cehegín (Spain). A, moulds and part of fragmented bones of the hindlimb embedded in the rock. B, drawing of the differenced distinguishable bones that compose the hindlimb. Fe: femur; Ti: tibia; Fi: fibula; As: astragalus; Ca: calcaneus; Mt: metatarsals. Scale bar: 1 cm.

The pubis is difficult to distinguish, but it seems to be composed of broad elements. In the region corresponding to the pubis, a hole can be distinguished, possibly for its ventral concavity. In the right pubis, the shape of the bone, with part of the bone still embedded can be differentiated. It shows 31 mm length, being its proximal width of 20 mm (Fig. 4).

Discussion

The studied specimen is especially relevant within the record of marine vertebrates of the Mesozoic of the South-Iberian Palaeomargin due to articulated specimens are absent in the Betic Cordillera (except for the record of a marine turtle of Oxfordian, Slater *et al.* 2011). From a taphonomic point of view, the sedimentary conditions for the preservation of these remains needed a rapid burial after the accumulation of the organism in the seafloor. The record of tempestite beds in the Atalayas section of the Cehegín Formation points to this type of processes for a rapid burial. A long exposure in the seafloor would favoured the bioestratinomic disarticulation and transport of the bones due to the activity of scavengers and currents. The burial occurred when almost part of the soft tissue was potentially present, favouring the articulation of most of the bones composing the skeleton.

Morphological analysis is rendered difficult due to the peculiarities of preservation, being the fossil mainly composed by the mould of the bones. The reptile here described shows features compatible to

Superorder Sauropterygia (a monophyletic group of Mesozoic marine reptiles that comprises the orders Placodontia and Eosauropterygia; Rieppel 1994; Table 1) because of the curvature of the humerus (Figs 4, 5). According to Rieppel (1994), the sauropterygian humerus appears 'curved' in adult individuals due to a distinct angulation along its anterior margin (related to the deltopectoral crest on its ventral surface) and an evenly concave posterior margin. Moreover, the gastral rib basket is well developed in all stem-group sauropterygians (Rieppel 2000). Placodonts (armoured and unarmoured) can be discarded because they had robust bodies that were rather square-shaped in cross section and the upper limb bones (humeri and femora) tend to be fairly slender and their ribs are thick and heavy (Peyer & Kuhn-Schynder 1955; Scheyer *et al.* 2012). Considering the mentioned features, the specimen here described corresponds to Eosauropterygia.

Table 1. Systematics of the Sauropterygia considered

Sauropterygia Owen, 1860
Eusauropterygia Tschanz,1989
Eosauropterygia Rieppel, 1994
Pachypleurosauria Nopcsa, 1928
Genus *Anarosaurus* Dames, 1980
Anarosaurus pumilo Dames, 1980
Dactylosaurus Gürich, 1884
Serpianosaurus Rieppel, 1989
Neusticosaurus Seeley, 1882
Nothosauria Seeley 1882
Genus *Nothosaurus* Hunter, 1834
Nothosaurus raabi Schröder, 1914
Nothosaurus giganteus (Münster, 1834)
Nothosaurus mirabilis Münster, 1834
Nothosaurus haasi Rieppel *et al., 1997*
Nothosaurus tchernovi Haas, 1980
Genus *Paranothosaurus* Peyer, 1939
Lariosauridae Lydekker,1889
Genus *Lariosaurus* Curioni, 1847
Lariosaurus balsami Curioni, 1847
Lariosaurus buzzii Tschanz, 1989
Lariosaurus sanxiaensis Cheng, *in* Chen et al. 2016
Genus *Ceresiosaurus* Peyer, 1931

As preserved as moulds, the cervical vertebrae show low and lined neural spines, and seem to remain low through the cervical region (Fig. 3). A short neural spine is characteristic of some nothosaurs as *Nothosaurus giganteus*, *Lariosaurus* and pachypleurosaurs (Rieppel 1995; Rieppel *et al.* 2003). Other eusauropterygians with high neural spines like *Pistosaurus*, the *Notosaurus* species of the Upper Muschelkalk (*N. mirabilis*, *N. haasi*, *N. tchernovi*) and *Ceresiosaurus* (see Rieppel 2000) can be discarded.

The position of the entepicondylar foramen at some distance from the distal articular surface of the humerus also indicates a mature individual (Rieppel 1994). Small to medium-sized adult Sauropterygia could correspond to the genus *Lariosaurus* and Pachypleurosauria. Besides their size, both groups show low neural spines, pachiostosis in the dorsal ribs (that could be present or absent in *Lariosaurus*) and partite gastral ribs composed by three or five components (see Rieppel & Kebang 1995; Rieppel 1998, 2000).

Comparison with Lariosaurus

In *Lariosaurus*, the cervical ribs are present through the cervical vertebral column, with the probable exception of the atlas (Peyer 1933, 1934; Rieppel 1998), but in specimen MC-2501, only some cervical ribs can be inferred (Fig. 3). In *Lariosaurus*, rib pachyostosis is variably expressed, but appears to be reduced with increasing size, being distinct in juvenile (Kuhn-Schnyder 1987; Renesto 1993) as well as most intermediate-sized, but it is weak or absent in the large specimens (Rieppel 1998). *Lariosaurus* shows four or more sacral vertebrae. However, the specimen shows the mould of possible 2 fused sacral ribs (Fig. 4), but the total number of sacral vertebrae and ribs is difficult to know because of the overlapped elements just preserved as moulds.

The specimen from Cehegín shows two or three gastral ribs per vertebral centrum, being each rib composed by different segments (Fig. 5). In *Lariosaurus*, two gastral ribs per vertebral centrum can be also found and each gastral rib composed of three or five elements: a medium, slightly angulated rib flanged by two slightly curved and overlapping elements on either side (e.g. *Lariosaurus buzzii* from the Anisian/Ladinian of Monte San Giorgio, Switzerland, Alpine Domain; Tschanz *et al.* 1989). However, gastral ribs composed by three or five elements have been also described in pachypleurosaurs, as discussed below, and other sauropterygians as *Nothosaurus* and *Paranothosaururs* (Sanz 1976), as for example in *Nothosaurus raabi* from the Germanic basin (Rieppel & Wild 1996; Rieppel 2000), so the partite gastral ribs are not a diagnostic feature.

In the genus *Lariosaurus,* the proximal end of the humerus is narrower than the mid half of the distal end (Rieppel *et al.* 2003), a feature that cannot be observed because the humerus of this specimen is incomplete (Fig. 6). The preserved portion of the humerus shows a midsection which seems larger than the distal head and the curved shaft, being similar to the humerus of some lariosaurs (e.g. humerus HFUT YZS-16-01 of *Lariosaurus sanxiaensis* described by Li & Liu 2020), but it is too incomplete to confirm it. As the humerus is incomplete, it is difficult to determine if the femur is longer than the humerus. The femur of the here described specimen is more expanded or broadened in the proximal head than in the distal, as has been described in some *Lariosaurus* (e.g. Tschanz 1989, Rieppel 2003, Liu *et al.* 2014), but again, this feature occurs in some pachypleurosaurs, as discussed below.

The tibia of the specimen from Cehegín (MC-2501) is shorter, but broader than the fibula, as occurs in *Lariosaurus buzzii* (Tschanz *et al.* 1989, fig. 7f-g). In MC-2501, the fibula is slightly curved and broadened at both ends. The difference in size between the tibia and the fibula is more marked in the specimen considered here and the fibula is more curved than in *L. buzzii*. The ischium of the studied specimen from Cehegín seems to be posteriorly expanded in a bladelike fashion, being also the pubis and ischium similar shape compared to those of *L. buzzii* (Tschanz 1989, fig. 6f, 6g). These similarities between the specimen studied here and *L. buzzii* from the Alpine Domain have to be considered from a palaeobiogeographical point of view, considering that the latest species is unknown in the Iberian Palaeomargin.

Comparing to *Lariosaurus* from the Iberian Peninsula, some species of the genus have been previously identified in Ladinian deposits of Montral-Alcover (Tarragona, Spain), being the majority of the specimens classifed as *Lariosaurus balsami* (Sanz 1976, 1983a; Sanz *et al.* 1993), a species widely distributed in the Ladinian deposits throughout the Alpine Triassic (Rieppel & Hagdorn 1998). The specimen of *L. balsami* M-501 described by Sanz (1980, plate 3.2; specimen considered a possible different species by Rieppel & Hagdorn 1998) seems to show pachiostosis in the proximal region of the ribs, as occur in specimen MC-2501, but differs of the specimen from Cehegín because in M-501 the femur is not proximally expanded. The specimens M-506 and M-507 described by Sanz (1980, plates. 3.4, 3.6 and 3.8) show a well-defined interosseous space, and in M-507 the tibia is shorter than the fibula, as occurs in MC-2501, but in the latest specimen the tibia is much broader and the fibula is more curved.

Although some features can be common with *Lariosaurus*, the absence of diagnostic features like the number of sacral vertebrae and ribs, ilium, ulna (only visible a part) and carpals does not allow assigning the specimen to this genus with confidence.

Comparison with Pachypleurosauria

The small size of the reptile and the pachyostosis of the dorsal ribs point to affinities with pachypleurosaurs. The skull, interclavicles, radio and ulna are not preserved in the studied specimen (MC-2500 and MC-2501), but other features described by some authors for pachypleurosaurs can be compared. As has been described before, at the base of the following neural spine of the cervical vertebrae, a tonguelike process (an extension with tongue shape) fits (or connects) with the following vertebra (Fig. 3, see white arrows). This structure has been described by Rieppel (1989, fig. 6a) for pachypleurosaurs, and has been also observed in some of them (e.g. Kuhn-Schnyder 1959; Carroll & Gaskill 1985; Rieppel 1989). Regarding the possible cervical ribs, some of them have been identified in some pachypleurosaurs like *Anarosaurus* (Rieppel 1995).

Partite gastral ribs composed by three or five elements have been frequently described in pachypleurosaurs. Tripartite gastral ribs have been also described in *Dactylosaurus* from the Anisian and *Serpianosaurus* from the Anisian-Ladinian boundary, both of Monte San Giorgio, Switzerland, and *Neusticosaurus* from the Ladinian of Western Europe (Sander 1989, Rieppel 1989, 2000; Sander 1989). In *Anarosaurus pumilio* from the Anisian of the Germanic basin, and probably in some specimens of *Serpianosaurus* (e.g. the specimen T 3371 from the Monte San Giorgio; age and locality uncertain), the gastral ribs are composed by 5 elements each (Rieppel 1989; Rieppel & Kebang 1995), as seems to show the specimen from Cehegín (Fig. 5D). However, the incorporation of five elements in a gastral rib is regarded as representative of the plesiomorphic condition and thus cannot be diagnostic (Rieppel 1989; e.g. the nothosaur *Lariosaurus*, which also includes small representatives, has 5-part gastral ribs as well, as discussed above; and *Nothosaurus* as *N. raabi*; see also Rieppel & Wild 1996). Considering other comparable features with *Anarosaurus pumilo*, the pubis of the latest taxon is different in shape to the specimen considered here, being more elongated (Rieppel 1995, fig. 6).

Klein (2010) considered that the humerus of nothosaurs and pachypleurosaurs is different. In the "pachypleurosaur" humerus type, the preaxial proximal side forms a planar, nearly rectangular surface. In some specimens, this surface slightly descends towards the dorsal side, but is not as asymmetrical as in the "nothosaur" type. This criterion is difficult to apply because the humerus mould is incomplete. As indicated above, the preserved portion of humerus shows a midsection which seems larger than the distal head and the curved shaft, being more similar to the humeri of lariosaurs/nothosaurs rather than to those of any pachypleurosaur. However, it is not enough for attempting any further assignment. The femur with expanded proximal ends has been described in the pachypleurosaurid *Neusticosaurus* (Sander 1989), being similar to the femur of the specimen MC-2501 here described.

Considering pachypleurosaurs from the Iberian Record, some of the material of *Lariosaurus balsami* recorded in Mont-ral-Alcover (Tarragona, Spain) was reclassified as Pachypleurosauridae indet. by Rieppel & Hagdorn (1998, pp. 82, 83; specimen M-509). This specimen (M-509) is very small and shows a slender femur compared to MC-2501. Other features cannot be compared because of the absence of some elements in the specimen under consideration. Other Spanish pachypleurosaur remains have been identified in the Anisian of Aiguafreda (Barcelona), in the Triassic (Anisian to Ladinian) of Valdemenca (Cuenca), Bienservida (Albacete) and Villarodrigo (Albacete), the Ladinian of Riba de Santiuste (Guadalajara) and the Carnian of Vilanova de la Sal (Lleida) (e.g. de Miguel Chaves *et al*. 2020), but most of them corresponding to isolated remains that cannot be comparable with the remains considered here. The shape of the pachypleurosaur pubis of the specimen IPS-51362, from Vilanova de la Sal (Fortuny *et al*. 2011), is similar in shape to the pubis of specimen MC-2501.

Sander *et al*. (2014) emphasized the extensive similarity of numerous postcranial elements among eosauropterygians. It is necessary more diagnostic information to provide a more specific classification because the anterior part of the reptile is lost, being absent the head, coracoids, clavicles and the right forelimb, and because of the state of preservation of the preserved parts (mainly moulds) difficult to differentiate some features that could be indicative, as the number of sacral ribs.

Conclusions

The Middle Triassic marine reptile from Cehegín (Murcia, Spain) considered here corresponds to the most complete Sauropterygia from the Betic Cordillera, providing a new record of these little known reptiles in this area. This is a small-medium sized specimen and seems to show low neural spines, pachiostotic ribs, gastral ribs composed by different (seemly 5) overlapped segments (partite gastral ribs), curved (but incomplete) humerus, tibia shorter, but broather, than the fibula, and the ischium posteriorly expanded in a blade like a fashion. Some of these features are usually observed in the genus *Lariosaurus* and in the Pachypleurosauria, but the absence of diagnostic elements makes it more carefully to refer to it just to Eosauropterygia. The affinities of the specimen with eosauropterygians from the Alpine domain open a new research area considering possible faunal affinities between this domain and South-Iberian Palaeomargin during the Anisian.

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