



First Mention of *Unusuropode castroi* Duarte & Santos, 1962 (Crustacea: Isopoda) in the Upper Cretaceous of Gara es Sbâa Lagerstätte, South-Eastern Morocco

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Abstract: This article presents an isopod that arrived at the Geological Museum of the Seminary, Barcelona (Spain) a few years ago, as part of the material compiled by the first author of this article (J C) in an outcrop of Gara es Sbâa (Morocco). This isopod is identified as *Unusuropode castroi*, is the first reference to this species outside of Brazil and also represents the first formal description of *Unusuropode castroi* in Africa. Gara es Sbâa, is located in the region of Kem Kem (southeast of Morocco) and is presented as a new locality for the isopod *Unusuropode castroi*, from the Upper Cretaceous (Cenomanian / Turonian), previously described only in the Turonian of the Apodi Group, Arenito Açu, state of Ceará Brazil. With this new isopod the statement of Martill *et al.* [1] is reinforced, indicating the affinities between the faunas of South America and Morocco during the Cretaceous. This document presents the two types of *Unusuropode castroi* differentiated by their size that also appear in Brazil, described by Duarte and Santos [2] as possible sexual dimorphism (see table 1 and figure 5, images b – c).

Keywords: Isopoda, Cretaceous, Gara es Sbâa, Kem Kem, Morocco

1. Introduction

The Isopoda is poorly represented in the fossil record, with very few specimens, usually poorly preserved or incomplete. For this reason, the group has received little attention although they are easily recognized. Some years ago, a well preserved specimen from Gara es Sbâa, Morocco arrived at the Geological Museum of the Seminary, Barcelona (Spain) as a part of the material collected by the first author of this paper (JC) from an outcrop where most fossils have already been studied. Now that specimen has been identified as *Unusuropode castroi*, this occurrence is the first reference to this species outside of Brazil.

1.1. Localities

The species has only been cited in its type locality:

Turonian of the Apodi Group, Arenito Açu, Ceará State (Brazil) [2].

1.2. Historical Background

The Kem Kem plain is located in the southeast of Morocco and it is well-known for its large diverse fossil deposits from the Upper Cretaceous period. It presents important outcrops with fossils of dinosaurs [3 - 6], pterosaurs [7 - 9], crocodiliforms [10, 11], amphibia [12], turtles [13], fishes [14 - 16], plant remains [1] and insects [17].

Much of the upper perimeter of the Gara es Sbâa hill (also known as Gara Sba, Gara Es Sba or Gara Sbaa) is completely full of trenches made by fossil collectors who sell them mainly to the distributors of Arfoud and Rissani.

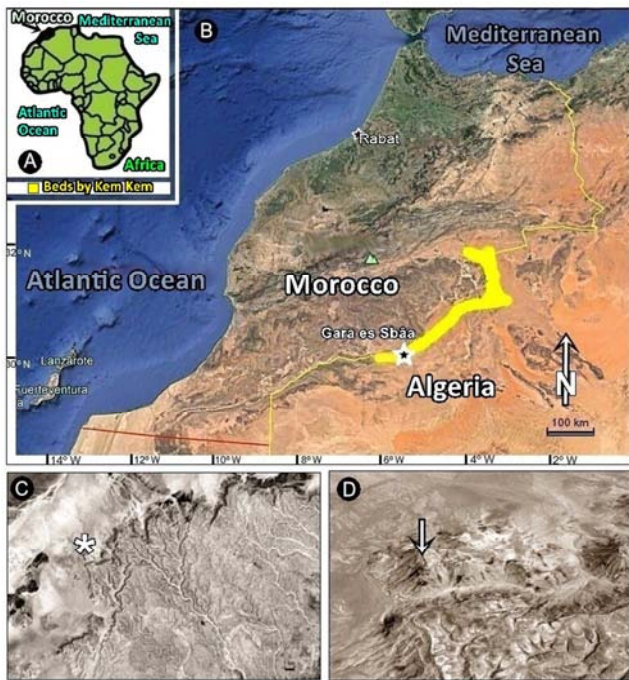


Figure 1. A: Location of Morocco in the African continent. B: Map of Morocco with the indication of the layers of Kem Kem [3] and the location of Gara es Sbâa. C: The asterisk indicates the locality. D: The arrow indicates the exact location of the outcrop. Pictures B-D have been obtained from Google Earth and modified accordingly.



Figure 2. Southeast of Morocco. A: View of Gara es Sbâa. B: Partial view of the Kem Kem plain.

1.3. Geographical and Geological Settings

Origin the specimens: The lithology consists of fine-grained, horizontally laminated beds of partly dolomitized lithographic limestone with occurrences of silica nodules and layers belonging to Upper Cretaceous (Cenomanian /

Turonian).

The studied locality is placed on the top of a low hill known as Gara es Sbâa, with an elevation of 965 meters and the following coordinates: 30° 30' 28.41'' N; 4° 50' 33.93'' W. Gara es Sbâa is placed next to the Kem Kem plain, at about 30 km South of Tafraoute, in the southeast part of Morocco, next to the border with Algeria. (Figures 1, 2).

System	Series	Stages
Cretaceous	Upper	Maastrichtian
		Campanian
		Santonian
		Coniacian
		Turonian *
		Cenomanian
	Lower	Albian
		Aptian
		Barremian
		Hauterivian
		Valanginian
		Berriasian

Figure 3. Stratigraphy of Upper Cretaceous from Morocco. The asterisk indicates the stratigraphic position of the type-locality.

Concerning the fossils that have been found in this outcrop of Gara es Sbâa, the most frequent fishes are *Agoultichthys chattertoni* Murray & Wilson (2009), *Belonostomus* sp., *Cladocycus* sp., a new species of *Pygnodus*, *Saurorhamphus* sp. and *Rhynchodercetis* sp., *Diplomystus* sp. and a similar form to *Ellimmichthys*, some undetermined teleosts, *Lusitanichthys* sp., *Ellimmichthys* and *Diplomystus*. This fish assemblage has affinities with the Middle Cretaceous ichthyofaunas found in South America and Lebanon, including taxa in common at generic level [1]. The invertebrates found are insects, crustaceans, decapods and bivalves. Plant remains have also been found.

2. Materials and Methods

Six complete specimens are presented: three adults and three juveniles (see Table 1 for their measurements). All specimens are repositated at the Geological Museum of the Seminary, Barcelona (Spain) under the references MGSB84515 (length: 7,10 mm), MGSB84516 (length: 11,68 mm), MGSB84617 (length: 6,49 mm), MGSB84519 (length: 8,98 mm) and MGSB84520 (length: 10,92 mm) and MGSB84827 (9,75 mm). The specimen MGSB84515, which appears figured in Figure 5 (b), is very similar to that presented in Figure 1b, page 60 in [2] (Figure 4).

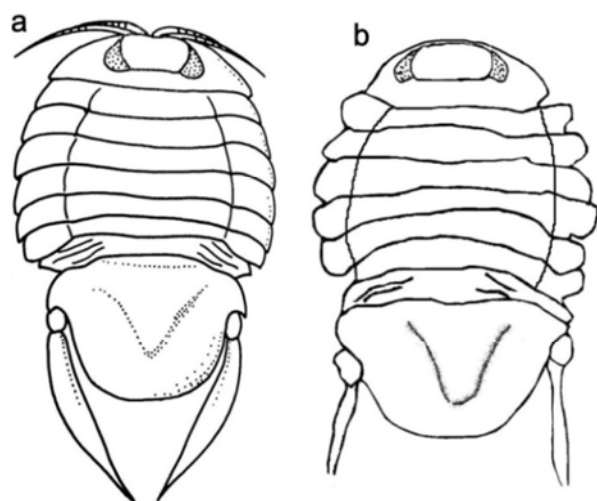


Figure 4. *Unusuropode*. a: Line drawing of *U. castroi* from Brazil. b: *U. castroi* from Morocco, drawing of the specimen n° MGSB 84827.

2.1. Preparation and Treatment of Specimens

All the specimens presented in this study have been obtained and carefully prepared by Moroccan specialists for the first author (JC). A Canon digital camera, model EOS 1100 D, has been used to photograph the specimens. The GPS coordinates were recorded utilizing a Garmin GPS model Foretrex 401.

2.2. Systematic Paleontology

ORDER ISOPODA Latreille, 1817

SUBORDER FLABELLIFERA G. O. Sars, 1882

FAMILY SPHAEROMIDAE White, 1847

Genus *Unusuropode* Duarte & Santos, 1962

Type species: *Unusuropode castroi* Duarte & Santos, 1962

1969 *Unusuropode* Duarte & Santos: [18]

2008 Undetermined isopod [19] p. 40 and 42, figure 5

2011 Crustacea, Isopoda [1] p. 441 and 444, figure 13 B.

2013 Isopods [20] p. 543.

Diagnosis- The body is convex, smooth, oblong-oval or rounded. The cephalon is fused to the first thoracic segment, being wider in the posterior part and with marked posterolateral angles and the frontal border emarginated. Eyes are large, with a triangular shape and numerous ocelli, and are placed in the lateral back corners of the cephalon. Thoracic segments of similar width. Separate epimeres with the greater width than height and acute posterior angles. The pleotelson width is $1\frac{1}{2}$ greater than its length, very convex and with a strong median elevation with a triangular shape. The exopodites are smooth, long and lanceolate, exceeding $\frac{2}{3}$ the length of the pleotelson [2].

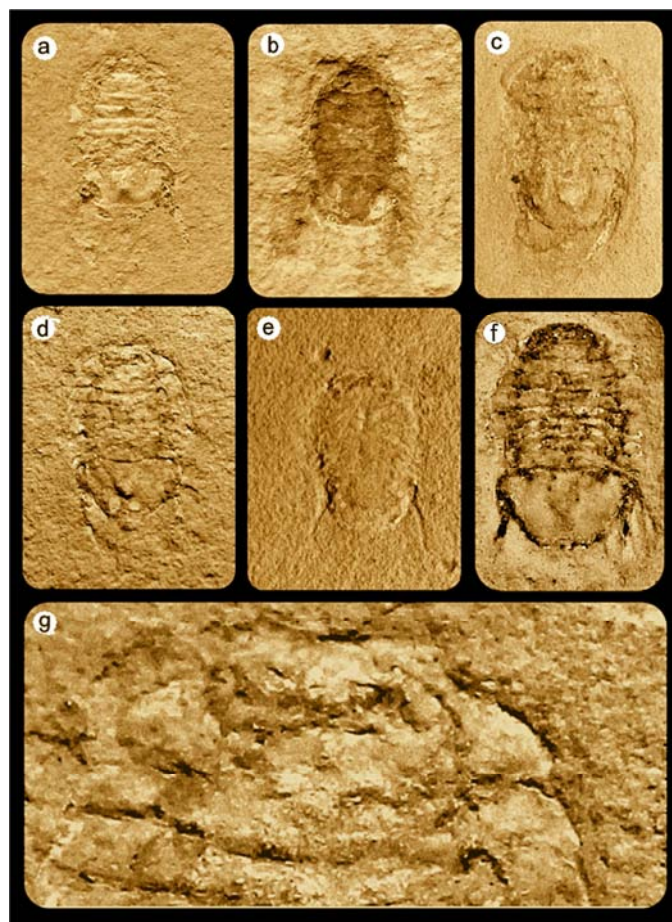


Figure 5. *Unusuropode castroi*, Upper Cretaceous (Cenomanian/Turonian) from Gara es Sbâa, Kem Kem region, Morocco. Dorsal view of the specimens a (MGSB84516), b (84515), c (84520), d (84519), e (84517) and f (84827); g: enlarged view of the cephalon of specimen n° 84519 (figure d).

Table 1. Measurements of two specimens included in this study. They are indicated in tenths of mm (with an approximation of $\pm 0,1$ mm). The disposition used by [21] has been applied. These two specimens have been chosen considering the proposal of sexual dimorphism presented in [2], page 60. Abbreviations: L = length, W = width, To = total length (measurements have been taken from the symmetry axis of the fossil), Ce = cephalon, Pe = pereon, Pl = pleon, Pt = pleotelson, P= pereionites.

Specimen number	To	Ce	Pe	Pt	Pl	P1	P2	P3	P4	P5	P6	P7
MGSB84515	Small specimen											
L	72,1	4,0	28,9	25,9	27,8	12,4	4,2	4,3	4,4	4,5	4,5	4,5
W	49,5	17,2	37,2	38,0	37,1	36,8	37,0	37,2	37,5	37,4	37,3	37,3
MGSB84520	Large specimen											
L	109,2	4,6	38,2	33,0	40,6	15,2	5,5	7,5	7,0	6,9	6,9	6,5
W	76,8	27,9	59,7	53,8	53,8	38,7	51,4	57,5	57,5	56,3	55,5	54,6

3. Conclusion

Gara es Sbâa (plain of Kem-Kem) in southeastern Morocco, it is presented as a new location for *Unusuropode castroi*, this study represents the first fossil isopod described formally in Morocco. With the discovery of this species of isopods in Morocco, it is affirmed by the affinity between the African continent and the South American continent.

This document presents the two types of *Unusuropode castroi* differentiated by their size that also appear in Brazil, as a possible sexual dimorphism.

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