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A new genus and species of Tanaidacea (Crustacea, Apseudomorpha) from the Upper Cretaceous (Cenomanian-Turonian) of Gara Sbaa, southeastern Morocco

Un género y especie nueva de Tanaidacea (Crustacea, Apseudomorpha) del Cretácico Superior de Gara Sbaa, sureste de Marruecos

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ABSTRACT

We report *Afroapseudes cretacicus* n. gen., n. sp. (Tanaidacea Dana, 1849; Apseudomorpha Sieg, 1980) from the Upper Cretaceous (Cenomanian-Turonian) of the Gara Sbaa layers (southeastern Morocco). The new species is considered as a possible lineage between the Jurassic and the more recent Paleogene Apseudomorpha, partially covering the wide gap of tanaidacean fossil records between Mesozoic and Cenozoic forms. At the same time, this results to be the first fossil record of a tanaidacean from Africa, enlarging the scarce knowledge on the real diversity and distribution of this poorly reported crustacean group during the geological times.

Keywords: Peracarida, Malacostraca, Tanaidacea, Cenomanian-Turonian, N Africa, taxonomy.

RESUMEN

Reportamos *Afroapseudes cretacicus* n. gen., n. sp. (Tanaidacea Dana, 1849; Apseudomorpha Sieg, 1980) del Cretácico Superior (Cenomaniano-Turoniano) de los estratos de Gara Sbaa (sureste de Marruecos). El nuevo taxón es considerado como un posible linaje intermedio entre Apseudomorpha del Jurásico y sus más recientes representantes del Paleógeno, cubriendo parcialmente el amplio margen de registros fósiles de formas de tanaidáceos entre el Mesozoico y el Cenozoico. Al mismo tiempo, este resulta ser el primer registro fósil de un tanaidáceo de África, ampliando el escaso conocimiento sobre la verdadera diversidad y distribución de este grupo de crustáceos, escasamente reportado durante el tiempo geológico.

Palabras clave: Peracarida, Malacostraca, Tanaidacea, Cenomaniano-Turoniano, N Africa, taxonomía.

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1. Introduction

The crustacean minor fauna from the Gara Sbaa (southeastern Morocco) Cretaceous layers is still very poorly reported and known. Purpose of this study is to report two tanaidaceans (Peracarida), representing the first record from the Cretaceous of Africa.

Representatives of Peracarida inhabit many different environments mainly terrestrial, marine, freshwater, and brackish water. Tanaidacea is a peracaridan ingroup of small body sized benthic crustaceans having epifaunal (surface dwellers) or infaunal (burrowing in sediment) lifestyle, having a relatively scarce fossil record despite their massive occasional abundance at some localities (Malzahn, 1970; Heard *et al.*, 2020). Indeed, finding of fossil tanaidaceans are therefore usually isolated remains or fragmentary body parts. According to Shädel *et al.*, (2019) “the identification of isolated parts or fragmentary fossils is challenging in various aspects and many remains of tanaidaceans are probably not recognized as such”.

Currently, there are 30 formally described fossil species of tanaidaceans, extending from the Lower Carboniferous to the Miocene (Shädel *et al.*, 2019; Heard *et al.*, 2018). Most of these species are known from inclusions in amber of the Cretaceous (Albian to Turonian) and Neogene (Vonk and Schram, 2007; Sánchez-García *et al.*, 2015, 2016, 2017; Heard *et al.*, 2018) whereas the remaining fossils come from non-amber sites. Among these, several species were described from the Lower Cretaceous layers of Hannover (Germany) (Schram *et al.*, 1986) and from Chiapas, Mexico (Heard *et al.*, 2020).

This new report represents the first fossil record of a tanaidacean from N Africa, enlarging the knowledge on their diversity and distribution during their evolutionary history.

2. Geological setting and fossil assemblage

The Gara Sbaa *Lagerstätte* is a spatially restricted laminated Plattenkalk located in southeastern

Morocco along the ‘Hamada des Kem Kem’, close to the Algerian border (Garassino *et al.*, 2008; Martill *et al.*, 2011) 26 km south-southwest of Tafaout village. The Gara Sbaa *Lagerstätte* overlies the Cenomanian fluvial siliciclastics of the Kem Kem Beds which are famous for their dinosaur body fossils and trackways (Sereno *et al.*, 1996; Dal Sasso *et al.*, 2005; Ibrahim *et al.*, 2014a, 2014b) and represents a marine transgression, marked by the appearance of the ammonite *Neolobites* Fisher, 1882, and transition to a shallow restricted carbonate lagoon environment (Cavin *et al.*, 2010; Martill *et al.*, 2011).

The strata are late Cenomanian-early Turonian in age and contain a diverse vertebrate and invertebrate biota that has occasionally been referred to as the ‘Agoult assemblage’ (Cavin *et al.*, 2010) subject of several studies for its diverse fish fauna (Murray *et al.*, 2013). The fish assemblage shows affinities with the Middle Cretaceous ichthyofauna from South America and Lebanon, sharing taxa at generic level. Moreover, the co-occurrence of terrestrial plant and insect, with marine fish and crustaceans suggest that salinities were close to normal marine conditions (Martill *et al.*, 2011). Numerous marine arthropods as one limulid (Lamsdell *et al.*, 2020), several decapods (Garassino *et al.*, 2006, 2008; Guinot *et al.*, 2008; Garassino and Pasini, 2018; Pasini and Garassino, 2020), and one isopod crustacean assigned to a species previously reported from the Turonian of Brazil (Corbacho *et al.*, 2018), were previously reported from the bulk of the invertebrate Gara Sbaa biota, attesting the faunal affinities between Africa and South America.

3. Material

Two almost complete specimens, lacking first cheliped and partial pleotelson, gathered from a 60-70 cm section of sublithographic laminated limestones occurring at the 180 cm thick strata of the Gara Sbaa *Lagerstätte*. The specimens are preserved partially compressed, but retaining some three-dimensional remnants of the original

cuticle preserved as a white calcareous layer. This layer is split between the part and counterpart of each specimen and fluoresces under ultraviolet light. The studied material was part of the specimens collected during field research carried out in October 2006 by one of the authors (G.P.) in collaboration with the Department of Invertebrate Paleontology of the Museo di Storia Naturale di Milano. The specimens are housed in the invertebrate paleontological collection of the Museo di Storia Naturale di Milano, Italy (MSNM).

Abbreviations: *lcxp*: carapace length; *wcxp*: carapace width; *P-1-P-5*: pereopods 1-5; *perxl*: pereon length; *perxw*: pereon width; *plxl*: pleon length; *plxw*: pleon width; *P1-P6*: pleonites 1-6; *P1-P6*: pereonites 1-6; *Tl*: total length (excluding pleotelson).

4. Systematic palaeontology

Order Tanaidacea Dana, 1849
Suborder Apseudomorpha Sieg, 1980
Superfamily and family indeterminate
Genus *Afroapseudeus* nov.

Type species: *Afroapseudes cretacicus* n. gen., n. sp., by monotypy

Etymology: From Africa, where the specimens were collected and Apseudomorpha lineage. Gender: masculine.

Diagnosis: Body elongate, slightly narrowing posteriorly; sub-pentagonal carapace wider than long and sub-triangular rostrum; eyes rounded, apparently without peduncle; antennulae base rectangular elongate; pereon longer but narrower than carapace; pereonites similar in width and size each than other; P1-P6 with wrinkled furrows dorsally; sub-rectangular P1 and P2 with convex lateral margins and dorsolateral vaults; sub-trapezoidal P3-P6 with convex lateral margins and posterior marginal lateral process; P-1-P-2 elongate meri, slightly longer than combined carpus plus propodus with short, curved fossorial dactylus; pleon narrower than pereon and 2.8 times shorter

than pereon; P11-P15 narrow than pereonites, all similar in size and shape, wider than long with acute lateral margins; elongate pleotelson narrower than P11-P15.

Afroapseudes cretacicus n. gen., n. sp.

Figures 1 and 2

Etymology: From the Upper Cretaceous, age of the studied specimens.

Diagnosis: as for the genus.

Holotype: MSNM i27639a, b (part and counterpart – dorsal view).

Paratype: MSNM i27090a, b (part and counterpart – in ventral view).

Material and measurements: Two specimens preserved in part and counterpart (MSNM i27639a, b (in dorsal view): *lcxp*: 2 mm (including rostrum); *wcxp*: 3 mm; *perxl*: 5 mm; *perxw*: 2.5 mm; *plxl*: 1.8 mm; *plxw*: 2 mm; *Tl*: 8.8 mm (excluding the pleotelson) – MSNM i27090a, b (in ventral view): *lcxp*: 2 mm; *wcxp*: 3 mm; *perxl*: 5.5 mm; *perxw*: 2.4 mm; *plxl*: 2 mm; *plxw*: 2 mm; *Tl*: c. 9.5 mm, (excluding the pleotelson).

Note: the following description is based on the dorsal characters preserved on the type specimen counterpart (preserving the original cuticle), whereas the ventral parts are based on the paratype part three-dimensionally preserved.

Description: Nearly complete body, elongate, flattened dorsoventrally, slightly narrowing posteriorly.

Carapace – Sub-pentagonal carapace with rounded lateral margins, wider than long; cephalic region with moderately elongate sub-triangular rostrum with wide base, terminating in an obtuse pointed tip slightly downward directed with a distal median slight longitudinal groove; rostral lateral margins slightly convex; small, rounded eyes, eye-lobes apparently not present; short anterolateral pointed triangular process frontally directed; rounded branchial regions (corresponding to the fused thoracic somites 1-2) vaulted dorsally and flattened ventrally, wider than the cephalic region; convex lateral margins of branchial regions,

tapering to the anterolateral pointed process/spine; almost straight carapace posterior margin slightly sinuous; fusion of cephalon and vestigial thoracic somite 1-2, indicated by pair of lateral notches, connected by a transverse concave suture; posterior half of carapace wider than pereon.

Carapace appendages – Short antennulae located laterally at the basis of both sides of rostrum; first antennular segment elongate; first cheliped not

preserved with rounded basis observable in ventral view at nearly 1/3 of the posterior carapace margin length.

Pereon – Sub-rectangular pereon 2.5 times longer than carapace in dorsal view, narrower than carapace; sub-rectangular P1-P2 with a pair of dorsolateral vaults and convex lateral margins; sub-trapezoidal P3-P6 with slightly convex lateral margins and posterior marginal lateral process;

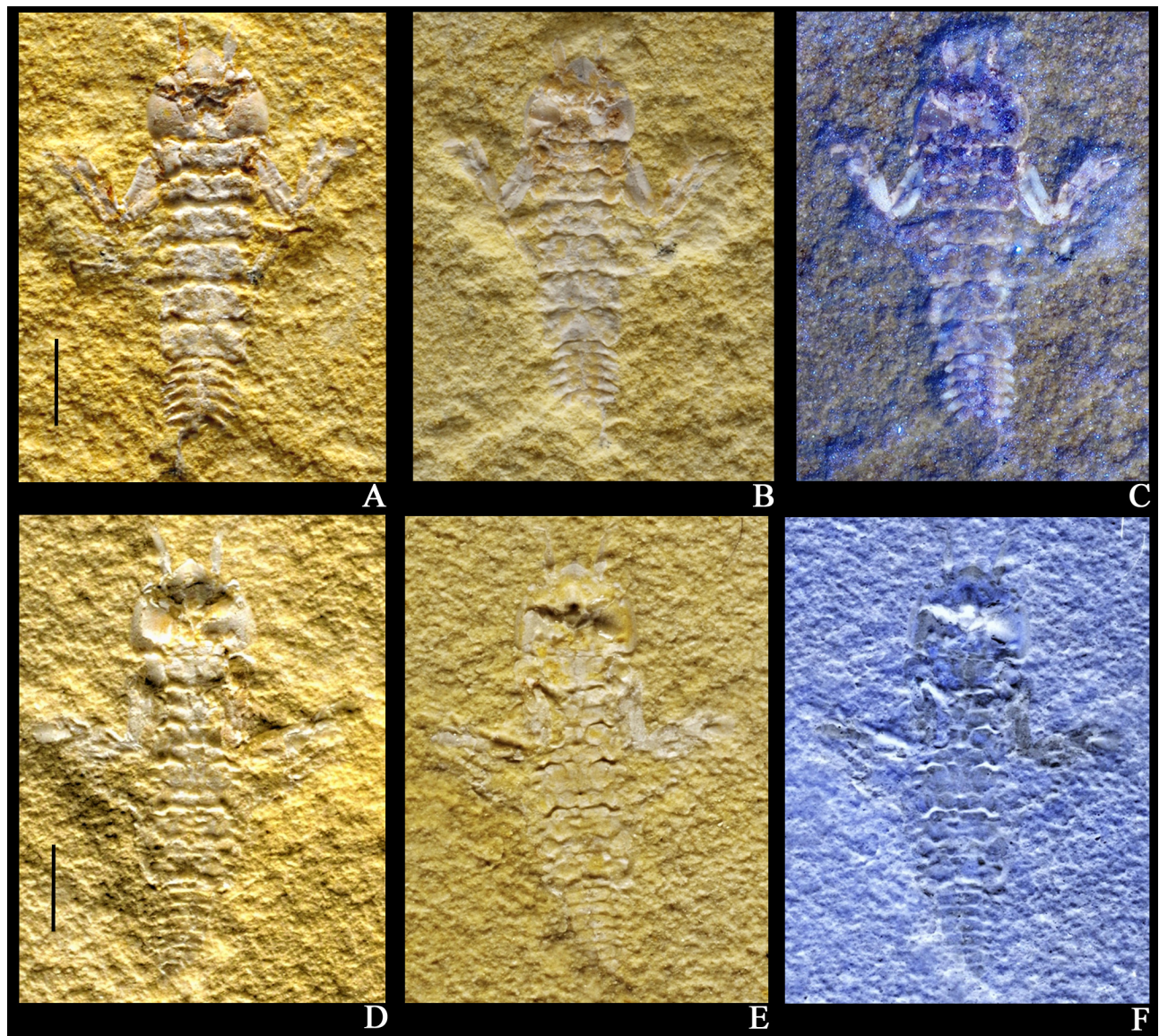


Figure 1 *Afroapseudes cretacicus* n. gen., n. sp. MSNM i27639, holotype: part (A), counterpart (B), counterpart, UV light (C). MSNM i27090, paratype: part (D), counterpart (E), counterpart, UV light (F). Scale bar equals 2 mm.

P1-P6 wider than long, similar in width and size each than other, with transversally wrinkled furrows dorsally; P1-P6 flattened ventrally, smooth at the middle with a longitudinal axial furrow and with bossed, kidney-shaped structures on both the lateral sides.

Pereon appendages – Pereiopods partially preserved, exposed along the pereonites lateral sides; P-1-P-2 elongate meri, slightly longer than combined carpus plus propodus with short, curved distal fossorial-like ?dactylus (as preserved).

Pleon – Pleon narrow than pereon; nearly 2.8 times shorter than pereon; P11-P15 narrow than P1-P6; P11-P15 in dorsal view equal in size, flattened ventrally, much wider than long with lateral margins produced into acute, curved posteriorly processes convex posteriorly; pleopods not preserved.

Pleotelson – Poorly preserved; pleotelson seems elongate, narrow than P11-P15, with convex lateral sides (as preserved); uropods not observables.

Discussion: Schram *et al.*, (1986) summarized and revised the available information on fossil Tanaidacea representing three suborders: Anthracocaridomorpha Sieg, 1980 (fossil), Apseudomorpha Sieg, 1980, and Tanaidomorpha Sieg, 1980 (both fossil and recent). Based on Schram *et al.* (1986), the studied specimens are assigned to the Apseudomorpha Sieg, 1980 for their general body features as the truly diagnostic pointed rostrum, presence of a distinct anterolateral process, pleonites produced into acute lateral processes, and the dorsoventrally flattened body, usually more flattened than in other suborders. Based on Schram *et al.* (1986) and Heard *et al.* (2020), the fossil Cretaceous record includes only three species assigned to the Apseudomorpha, *Carlclausus emersoni* Schram, Sieg and Malzahn, 1986 (Jurapseudidae Schram, Sieg and Malzahn, 1986), *Cretitanais giganteus* (Malzahn, 1979) (Cretatanaidae Schram, Sieg and Malzahn, 1986) and *Protoapseudoides espinalensis* Heard and Morales-Núñez, 2020 (Protoapseudoidae Heard and Morales-Núñez, 2020), the first two from Germany and last one from Mexico. For the general body features and characters of the carapace structure, we can

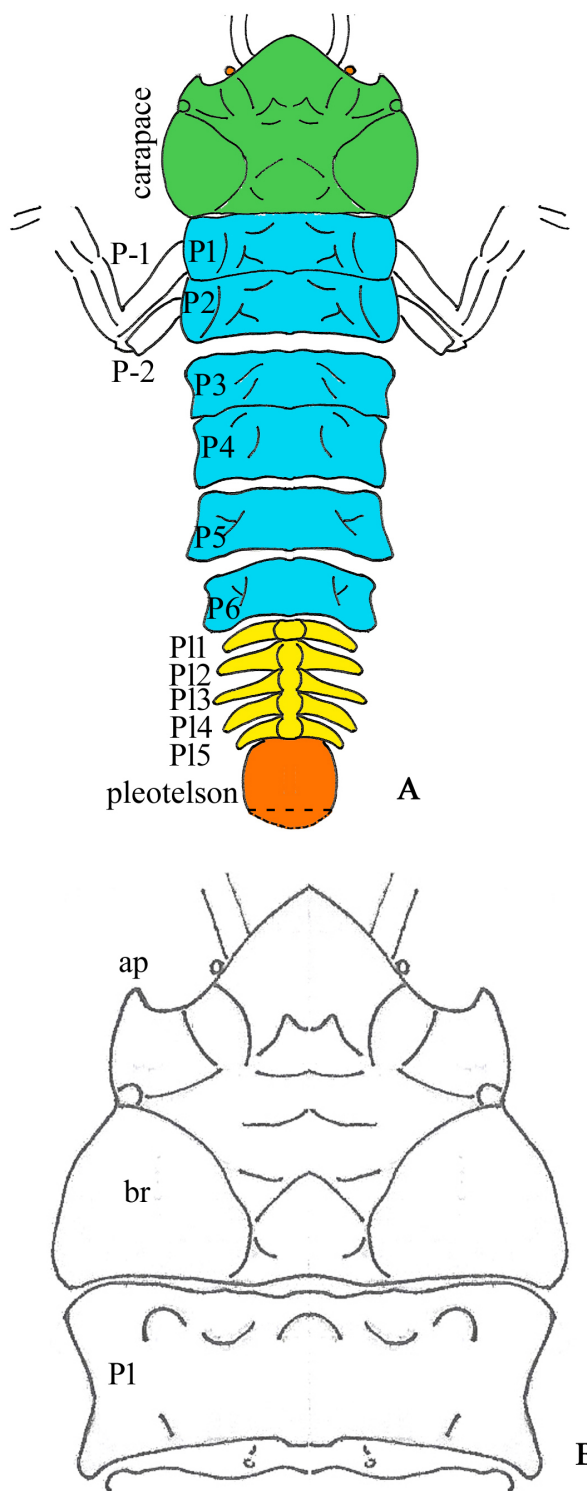


Figure 2 *Afroapseudes cretacicus* n. gen., n. sp. A) line drawing of the body. Carapace (green); pereonites 1-6 (blue); pleonites 1-5 (yellow); pleotelson (orange, partially preserved). B) line drawing of the carapace. Abbreviations – ap: anterolateral process; br: branchial region; P1: pereonite 1.

confidently exclude that the studied specimens belong to the Cretatanaidae. *Carlclausus* is based on a specimen lacking the frontal carapace. Our specimens are also different from *Protoapseudoides* in shape of carapace, pereon and pleon, cephalon being longer and nearly square (except for rostrum), pereonites turning narrower posteriorly and narrower pleonites with not so acute lateral extensions.

We can simply remark that *Carlclausus emersoni* shows some pleonal features having several generic affinities with the studied specimens like pereonites 1 and 2 with convex lateral margins lacking projection, P3-P6 with lateral projections and short pleonites 1-5 with lateral margins produced into acute, elongated processes as others Jurassic species ascribed to Jurapseudoidea *sensu* Schram *et al.*, (1986), similar also in the general carapace arrangement. At the same time, among the other younger fossil species reported to date *Barapseudes prima* Quayle, 2016 (Apseudidae Leach, 1814) from the middle Eocene of UK, shows thoracic and pleonal generic features resembling those of *Afroapseudes cretacicus* n. gen., n. sp. So, we assign herein *Afroapseudes cretacicus* n. gen., n. sp. to the Apseudomorpha in having (except their notably different geological age) a different outline and ornamentation of the thorax, shape, and respective proportions of the pereonites respect to those of the most similar representatives of the Jurapseudidae and Apseudidae.

Due to the lacking of some diagnostic features of the cephalic appendages, first cheliped, telson, and uropods, we are unable to establish for the new genus the belonging superfamily and family. The morphological similarities and the shared characters with the compared families allows to suppose that the new taxon would be hypothetically considered as a possible lineage between the Jurassic and the more recent Paleogene Apseudomorpha. The question would be perhaps resolved after discovery of new fossil taxa shortening the wide fossil gape among the Jurassic to Paleogene forms.

Finally, we point out that the species is randomly gathered into the Gara Sbaa laminate

layers associated with the crustaceans and fish fauna, not uncommon but usually not recognized or collected by the local diggers due their small size, mainly focused on the commercial vertebrate fish fauna; the specimens were commonly incomplete, partially imbedded in the layers and nearly impossible to prepare, or simply poorly preserved; notably the pleotelson were badly preserved or absent in all the specimens (c. twelve) observed directly on the field (G.P. pers. ob., 2006).

5. Paleoenvironmental remarks

In our opinion *Afroapseudes cretacicus* n. gen., n. sp., may be considered as inhabit the soft sediments (perhaps with fossorial behaviors), deposited in shallow marine waters representing a marine transgression, possibly transitional to a restricted carbonate lagoon environment with temporary/seasonal supply of freshwater from the nearby land.

Due to the present scarcity of fossils records from the worldwide Cretaceous, we can only remark that the most similar environmental conditions seem to be those reported for the Albian (Lower Cretaceous) outcrops of Chiapas, Mexico, considered as “*deposits accumulated within a shallow lagoon or estuary with occasional freshwater influence*” (Vega *et al.*, 2006) from which *Protoapseudoides espinalensis* was reported.

Contributions of authors

Field work and collecting: G.P. and A.G. Concept and systematics: G.P. and A.G. Review of references and morphology: F.V.

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Conflicts of interest

The authors state that there are no conflicts of interest.

References

- Cavin, L., Tong, H., Boudad, L., Meister, C., Piuze, A., Tabouelle, J., Aarab, M., Amiot, R., Buffetaut, E., Dyke, G., Hua, S., Le Loeuff, J., 2010, Vertebrate assemblages from the early Late Cretaceous of southeastern Morocco: an overview: *Journal of African Earth Sciences*, 57, 391-412. <https://doi.org/10.1016/j.jafrearsci.2009.12.007>
- Corbacho, L., Morrison, S., Alonso, M., 2018, First mention of *Unusuropode castroi* Duarte & Santos, 1962 (Crustacea: Isopoda) in the Upper Cretaceous of Gara es Sbâa Lagerstätte, South-Eastern Morocco: *Earth Sciences*, 7, 288-292. <https://doi.org/10.11648/j.earth.20180706.16>
- Dal Sasso, C., Maganuco, S., Buffetaut, E., Mendez, M.A., 2005, New information on the skull of the enigmatic theropod *Spinosaurus*, with remarks on its size and affinities: *Journal of Vertebrate Paleontology*, 25, 888-896. [https://doi.org/10.1671/0272-4634\(2005\)025\[0888:nio tso\]2.0.co;2](https://doi.org/10.1671/0272-4634(2005)025[0888:nio tso]2.0.co;2)
- Dana, J.D., 1849, *Conspectus Crustaceorum quae in Orbis Terrarum Circumnavigatione, Carolo Wilkes e Classe Reipublicae Foederatae Duce, lexit et descripsit*: American Journal of Sciences and Arts, Series 2, 8, 424-428.
- Fischer, P., 1882, *Manuel de Conchyliologie ou histoire naturelle des Mollusques vivants et fossiles: Fascicule IV*: Paris, Masson, 305-416.
- Garassino, A., De Angeli, A., Pasini, G., 2008, New decapod assemblage from the Upper Cretaceous (Cenomanian-Turonian) of Gara Sbaa, southeastern Morocco: *Atti della Società italiana di Scienze naturali e del Museo civico di Storia naturale in Milano*, 149(1), 37-67.
- Garassino, A., Pasini, G., 2018, Amazighopsidae, a new family of decapod macruran astacideans from the late Cretaceous (Cenomanian-Turonian) of Gara Sbaa, Southeastern Morocco: *Natural History Sciences: Atti della Società italiana di Scienze naturali e del Museo civico di Storia naturale in Milano*, 5(1), 11-18. <https://doi.org/10.4081/nhs.2018.358>
- Garassino, A., Pasini, G., Dutheil, D.B., 2006, *Cretapenaeus berberus* n. gen., n. sp. (Crustacea, Decapoda, Penaeidae) from the Late Cretaceous (Cenomanian) of southeastern Morocco: *Atti della Società italiana di Scienze naturali e del Museo civico di Storia naturale in Milano*, 147(1), 3-17.
- Guinot, D., De Angeli, A., Garassino, A., 2008, Marocarcinidae, a new eubrachyuran family, and *Marocarcinus pasinii* n. gen., n. sp. from the Upper Cretaceous (Cenomanian-Turonian) of Gara Sbaa, southeastern Morocco (Crustacea, Decapoda, Brachyura): *Atti della Società italiana di Scienze naturali e del Museo civico di Storia naturale in Milano*, 149(1), 25-36.
- Heard, R.W., Serrano-Sánchez, M.L., Vega, F.J., 2018, Early Miocene Tanaidacea (Crustacea: Malacostraca) preserved in amber from Chiapas, Mexico, with the preliminary descriptions of new taxa: *Neues Jahrbuch für Geologie und Paläontologie, Abhandlungen*, 288(1), 107-120. <https://doi.org/10.1127/njgpa/2018/0726>
- Heard, R.W., Morales-Núñez, A.G., Serrano-Sánchez, M.L., Coutiño, M.A., Barragán,

- R., Vega, F.J., 2020, A new family, genus and species of Tanaidacea (Crustacea; Apseudomorpha) from the Lower Cretaceous (Aptian) of Chiapas, Mexico: Systematic revisions, including designation of two new Paleozoic families, and paleoenvironmental observations: *Journal of South American Earth Sciences*, 102 (2020), 102609. <https://doi.org/10.1016/j.jsames.2020.102609>
- Ibrahim, N., Sereno, P.C., Dal Sasso, C., Maganuco, S., Fabbri, M., Martill, D.M., Zouhri, S., Myhrvold, N., Iurino, D.A., 2014a, Semiaquatic adaptations in a giant predatory dinosaur: *Science*, 345, 1613-1616. <https://doi.org/10.1126/science.1258750>
- Ibrahim, N., Varricchio, D.J., Sereno, P.C., Wilson, J.A., Dutheil, D.B., Martill, D.M., Baidder, L., Zouhri, S., 2014b, Dinosaur footprints and other ichnofauna from the Cretaceous Kem Kem Beds of Morocco: *PLoS ONE*, 9(3), e90751. <https://doi.org/10.1371/journal.pone.0090751>
- Lamsdell, J.C., Tashman, J.N., Pasini, G., Garassino, A., 2020, A new limulid (Chelicerata, Xiphosurida) from the Late Cretaceous (Cenomanian-Turonian) of Gara Sbaa, southeast Morocco: *Cretaceous Research*, 106, 104230. <https://doi.org/10.1016/j.cretres.2019.104230>
- Leach, W.E., 1814, Crustaceology, in Brewster, D. (ed.), *The Edinburgh encyclopaedia*, 383-437.
- Malzahn, E., 1970, Die Scherenassel *Ophthalmopseudes friedericianus* im Dogger von Hildesheim: *Berichte der Naturhistorischen Gesellschaft Hannover*, 114, 61-73.
- Malzahn, E., 1979, *Apseudes giganteus* – die erste Scherenassel aus der Kreide: *Annalen des naturhistorischen Museum in Wien*, 82, 67-81.
- Martill, D.M., Ibrahim, N., Brito, P.M., Baidder, L., Zouhri, S., Loveridge, R., Naish, D., Hing, R., 2011, A new plattenkalk Konservat Lagerstätte in the Upper Cretaceous of Gara Sbaa, south-eastern Morocco: *Cretaceous Research*, 32(4), 433-446. <https://doi.org/10.1016/j.cretres.2011.01.005>
- Murray, A.M., Wilson, M.V.H., Gibb, S., and Chatterton, B.D.E., 2013, Additions to the Late Cretaceous (Cenomanian/Turonian) actinopterygian fauna from the Agout locality, Akrabou Formation, Morocco, and comments on the palaeoenvironment, in Arratia, G., Shultze, H.P., Wilson, M.V.H. (eds.), *Mesozoic Fishes 5 – Global diversity and evolution*: München, Germany, Verlag Dr. Friedrich Pfeil, 525-548.
- Pasini, G., Garassino, A., 2020, A spiny lobster (Decapoda, Achelata) from the Upper Cretaceous (Cenomanian-Turonian) of Gara Sbaa, southeastern Morocco: *Palaeodiversity*, 13, 83-88. <https://doi.org/10.18476/pale.v13.a8>
- Quayle, W.J., 2016, A new fossil record of a tanaidacean (Crustacea, Peracarida), from the Eocene Barton clay formation of the Hampshire basin: *Bulletin of Mizunami Fossil Museum*, 42, 29-37.
- Sánchez-García, A., Delclòs, X., Engel, M.S., Bird, G.J., Perrichot, V., Peñalver, E., 2017, Marsupial brood care in Cretaceous tanaidaceans: *Scientific Reports*, 7, 4390. <https://doi.org/10.1038/s41598-017-04050-8>
- Sánchez-García, A., Peñalver, E., Bird, G.J., Perrichot, V., Delclòs, X., 2016, Palaeobiology of tanaidaceans (Crustacea: Peracarida) from Cretaceous ambers: extending the scarce fossil record of a diverse peracarid group: *Zoological Journal of the Linnean Society*, 178(3), 492-522. <https://doi.org/10.1111/zoj.12427>
- Sánchez-García, A., Peñalver, E., Pérez-de la Fuente, R., Delclòs, X., 2015, A rich and diverse tanaidomorph (Crustacea: Tanaidacea) assemblage associated with Early Cretaceous resin-producing forests in North Iberia: palaeobiological implications: *Journal of Systematic Palaeontology*, 13(8),

- 645-676. <https://doi.org/10.1080/14772019.2014.944946>
- Sereno, P.C., Dutheil, D.B., Iarochene, M., Larsson, H.C.E., Lyon, G.H., Magwene, P.M., Sidor, C.A., Varricchio, D.J., Wilson, J.A., 1996, Predatory dinosaurs from the Sahara and Late Cretaceous faunal differentiation: *Science*, 272, 986-991. <https://doi.org/10.1126/science.272.5264.986>
- Schram, F.R., Sieg J., Malzahn E., 1986, Fossil Tanaidacea: *Transactions of the San Diego Society of Natural History*, 21(8), 127-144.
- Shädel M., Pazinato P.G., van der Wal, S., Haug, J.T., 2019, A fossil tanaidacean crustacean from the Middle Jurassic of southern Germany: *Palaeodiversity*, 12, 13-30. <https://doi.org/10.18476/pale.v12.a2>
- Sieg, J., 1980, Sind die Dikonophora eine polyphyletische Gruppe?: *Zoologischer Anzeiger*, 205, 401-416.
- Vega, F.J., García-Barrera, P., Perrilliat, M. del C., Coutiño, M.A., Mariño-Pérez, R. 2006, El Espinal, a new plattenkalk facies locality from the Lower Cretaceous Sierra Madre Formation, Chiapas, southeastern Mexico: *Revista Mexicana de Ciencias Geológicas*, 23(3), 323-333.
- Vonk, R., Schram, F.R., 2007, Three new Tanaid species (Crustacea, Peracarida, Tanaidacea) from the Lower Cretaceous Álava amber in northern Spain: *Journal of Paleontology*, 81(6), 1502-1509. <https://doi.org/10.1666/05-020.1>