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Decapod assemblages from the Aptian-Albian transition of the eastern Maestrat Basin (Iberian Chain)

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ABSTRACT

Two decapod (Arthropoda: Malacostraca: Decapoda) assemblages from two newly discovered localities near Torreblanca (Castelló, Valencian Country, Spain), situated in the Orpesa Sub-basin of the Maestrat Basin, are described. The first assemblage exhibits a diverse fauna of lobsters, including erymoids, glypheoids and nephropoids representatives of five different genera, some of them reported for the first time in Iberia, as well as brachyuran crabs, primarily palaeocorystoids, including one new species, *Paranecrocarcinus xivertensis*. It is assigned to the uppermost Aptian of the Benassal Formation. The second assemblage, found in the lower Albian Escucha Formation, showcases an exceptional richness of exquisitely preserved complete remains of a new genus and species of axiidean ghost shrimp, *Cretagourretia salasi*, along with some palaeocorystoids, also representatives of a new species, *Joeranina tausi*, within a varied community of invertebrates and plants. This work investigates the paleoenvironment in which these assemblages thrived, and explores their faunal similarities with other decapod assemblages from the nearby Garraf Basin, as well as more distant ones such as the Basque-Cantabrian Basin and the Isle of Wight. An ammonite occurrence, likely belonging to the genus *Roberticeras*, has been identified in the upper Aptian Benassal Formation. Additionally, the juvenile stage of the ammonite *Parengonoceras bassei* from the lower Albian Escucha Formation is reported and described for the first time. The study provides valuable insights into reconstructing coastal to marine environments and the associated biota that developed in the Maestrat Basin during the Aptian-Albian transition.

KEYWORDS **Decapods. Ammonites. Systematics. Lower Cretaceous. Maestrat Basin.**

INTRODUCTION

Early Cretaceous decapod assemblages in the western margin of the Maestrat Basin have been recently documented by Garcia-Penas *et al.* (2023). In the more open-marine platform settings of the Morella and Salzedella sub-basins (see Salas *et al.* in Martín-Chivelet *et al.*, 2019), in the central part of the Maestrat Basin, diverse faunas of decapod crustaceans have been also reported (see Ossó *et al.*, 2018; Ossó *et al.*, 2023, p. 22; Van Straelen, 1927; and references therein).

However, very few decapods, such as the common glypheoid *Atherfieldastacus magnus* (M'Coy, 1849), reported by Van Straelen (1927) as *Meyeria bolivari*, and by Vía Boada (1975) as *Mecochirus magnus*, have been described from the eastern part of the basin (Orpesa Sub-basin; Fig. 1). Herein, we describe two taxonomically rich, and previously unknown, decapod assemblages from the Orpesa Sub-basin.

The first assemblage was recovered in Alcalà de Xivert and is assigned to the uppermost Aptian of the Benassal Formation (Fm.). This assemblage presents an unexpected variety of lobsters, such as the erymoids *Eryma* sp., *Palaeastacus* aff. *sussexiensis* (Mantell, 1824) and *Enoploclytia* sp., the nephropoid *Hoploparia* aff. *longimana* (M'Coy, 1849), and the glypheoid *Atherfieldastacus magnus*, in addition to the palaeocorystoid brachyurans *Necrocarcinus mariae* Ossó, van Bakel and Artal, 2023, *Paranecrocarcinus xivertensis* n. sp., *Joeranina gaspari* van Bakel, Guinot, Artal, Jagt and Fraaije, 2012, and one indeterminate brachyuran. It is noteworthy that the genera *Eryma* Meyer, 1840 and *Palaeastacus* Bell, 1850, are reported herein for the first time in Iberia.

The second assemblage was collected in the lower Albian Escucha Fm. of Torreblanca. This assemblage presents an extraordinary abundance of well-preserved near-complete individuals of the axiidean ghost shrimp *Cretagourretia salasi* n. gen., n. sp. as well as several individuals of *Joeranina tausi* n. sp.

In total, eleven species of decapods are reported in the present work, one axiidean, four astacideans, one glypheidean, and five brachyuran species, of which three are described as new. It is worth mentioning that Albian decapods from the Maestrat Basin have been rarely cited hitherto, with the exception of *Cenomanocarcinus* sp. reported by Ossó (2017, pp. 274-276, fig.2) from the *Leymeriella tardefurcata* Biozone of the Escucha Fm. (early Albian) of Traiguera in the Salzedella Sub-basin (Fig. 1).

Both decapod assemblages share several taxa with other known Aptian and Albian decapod assemblages of different basins from the Tethys and boreal realms, such as the Garraf Basin in Catalonia, and in particular with those of siliciclastic-rich environments of the Basque-Cantabrian Basin of Cantabria and Navarre (Spain), or the Isle of Wight (United Kingdom) (*cf.* Klompmaker, 2013, apps. A, B).

Additionally, the possible presence of the newly described ammonite *Roberticeras* Latil, Murphy and Rodda, 2023, is reported from the uppermost Aptian of Alcalà de Xivert outcrop. Besides, the juvenile stage of the ammonite *Parengonoceras bassei* (Bataller, 1954), from the lowermost Albian of Torreblanca outcrop, is reported and described for the first time.

GEOLOGICAL SETTING

The fossil decapod were collected in the Orpesa Sub-basin, a southeastern depocentre of the Maestrat Basin (E Iberian Chain; Fig. 1A-B). This Mesozoic basin originated due to two distinct rifting cycles during the Kimmeridgian–Berriasian and Barremian–early Albian. The rifting episodes were related to the spreading of the North Atlantic and the opening of the Bay of Biscay, respectively (García-Senz and Salas, 2011; Salas *et al.*, 2010). The rifting processes resulted in the differentiation of the Maestrat Basin into nine sub-basins, including the Orpesa Sub-basin studied herein, as well as the Galve, Morella, El Perelló, La Salzedella, Oliete, Las Parras, Cedramán, and Penyagolosa

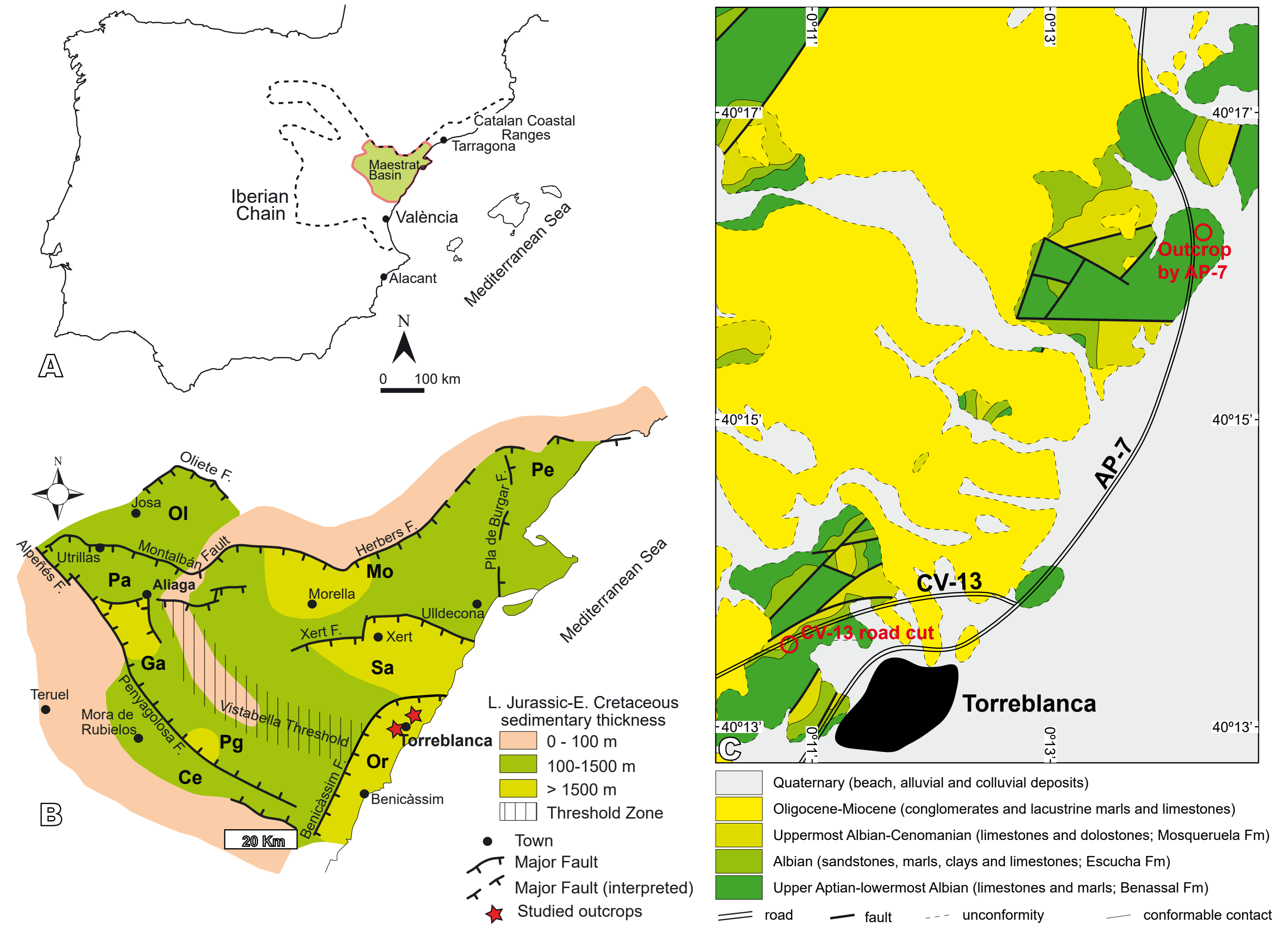

FIGURE 1. A) Location of the Maestrat Basin within the Iberian Peninsula and the Iberian Chain. B) Structural map of the Maestrat Basin during the Late Jurassic-Early Cretaceous, illustrating its compartmentalization into nine sub-basins: Orpesa (Or), La Salzadella (Sa), El Perelló (Pe), Morella (Mo), Penyagolosa (Pg), Cedramán (Ce), Galve (Ga), Las Parras (Pa), and Oliete (Ol). The map also displays the sedimentary thickness accumulated during this period and indicates the locations of the two outcrops where Early Cretaceous decapod remains were found. Modified from Salas *et al.* in Martín-Chivelet *et al.* (2019). C) Geological map of the area north of the town of Torreblanca (Comarca of La Plana Alta), where the Early Cretaceous decapod remains were collected. The sampled localities correspond to an outcrop located near the AP-7 highway in Alcalà de Xivert and a road cut along CV-13 in Torreblanca. Modified after Esnaola Gómez and Martín Fernández (1972).

sub-basins (Fig. 1B; Salas et al. in Martín-Chivelet et al., 2019). The Orpesa Sub-basin recorded a marine to continental sedimentary infilling of Late Jurassic–Early Cretaceous age, consisting of a mixed carbonate-siliciclastic succession exceeding 1.5km in thickness (Fig. 1B). During the late Eocene–early Miocene, the Maestrat Basin underwent tectonic inversion as a result of the Alpine orogeny, forming the eastern part of the Iberian Chain (Fig. 1B; Guimerà, 1994, 2018).

The lithostratigraphic units containing decapod remains are identified as the Benassal and Escucha fms. (Canérot et al., 1982; Salas, 1987; Figs. 1C; 2). In the study area, the Benassal Fm. primarily consists of marine to transitional marls, limestones, and sandy limestones that contain orbitolinids such as *Mesorbitolina texana* (Roemer, 1849), along with rudists and other molluscs. The Escucha Fm. is mainly formed by an alternation between marine to transitional limestones, marls, sandy limestones and sandstones. The sandstones commonly exhibit cross-bedding and are locally ferruginous and rich in muscovite. The limestones and sandy limestones are characterized by the presence of red algae, oysters and orbitolinids. The upper section of the Benassal Fm., where fossil decapod have been found, dates to the late Aptian–earliest Albian (Martín-Martín et al., 2013), whereas the Escucha Fm. is early Albian in age (Garcia et al., 2014) (Figs. 1C; 2). On the other hand, the base of the Benassal Fm., which crops out in the Galve and Morella sub-basins (Fig. 1B), is latest early Aptian in age (Bover-Arnal et al., 2014, 2016; Moreno-Bedmar et al., 2012).

The early Albian coastal siliciclastic-influenced deposits found in the Orpesa Sub-basin (Fig. 1B) have also

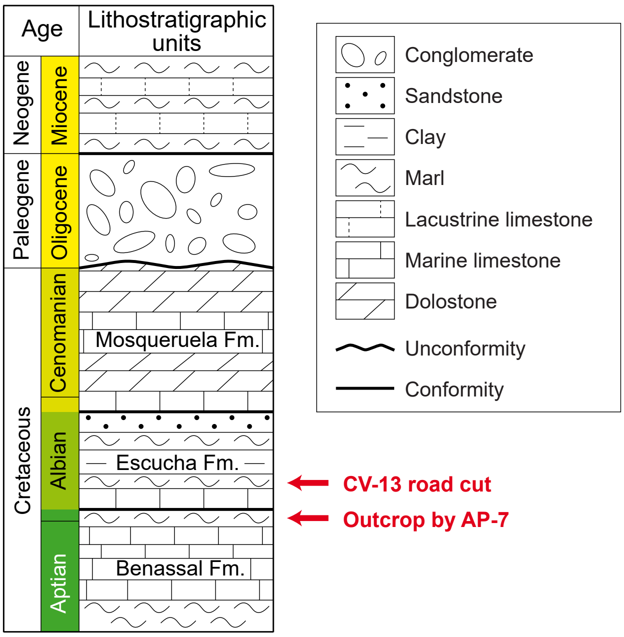

FIGURE 2. Chronostratigraphic framework of the upper Aptian–Miocene succession of the northern Orpesa Sub-basin based on Esnaola Gómez and Martín Fernández (1972), Canérot *et al.* (1982), Salas (1987), Martín-Martín *et al.* (2013), Garcia *et al.* (2014) and Bover-Arnal *et al.* (2016, 2022). The stratigraphic position of the decapod remains collected from the two studied outcrops is indicated.

been previously referred to in the literature as the Maestrat Sandstones Fm. (*e.g.* Canérot et al., 1982; Esnaola Gómez and Martín Fernández, 1972). This mixed siliciclastic-carbonate succession corresponds to a more marine transitional lateral equivalent of the coal-bearing Escucha Fm. (Canérot et al., 1982). In this paper, to simplify the stratigraphic nomenclature of the Maestrat Basin, we refer to the Albian siliciclastic-influenced succession, where decapod specimens were collected, as the Escucha Fm., following Garcia et al. (2014) (Figs. 1C; 2).

The lithostratigraphic unit underlying the Benassal Fm. does not crop out in the area but corresponds to the upper lower Aptian platform carbonates with rudists and corals of the Villarroya de los Pinares Fm. (Bover-Arnal et al., 2016, 2022; Canérot et al., 1982). Overlying the Escucha Fm. there is a succession of uppermost Albian-Cenomanian limestones and dolostones that would correspond to the Mosqueruela Fm. (Canérot et al., 1982). Above that, there is an unconformity overlain by Oligocene conglomerates and Miocene lacustrine marls and limestones (Figs. 1C; 2).

MATERIAL AND METHODS

The fossil decapod were recovered from two Lower Cretaceous sedimentary successions, located to the north of Torreblanca (Fig. 1B; Comarca of La Plana Alta). These twoOne outcrop is situated by the AP-7 highway section in Alcalà de Xivert and the other by the CV-13 roadcut in Torreblanca (Fig. 1C; Comarca of Baix Maestrat). The coordinates for the CV-13 roadcut section are 40º 13’ 27”N and 0º 10’ 36”E, and those for the AP-7 section are 40º 16’ 11” N and 0º 14’ 13”E. Both successions were logged bed-by-bed and sampled. A total of 9 thin sections, prepared from 7 limestone samples, were examined under a petrographic microscope to characterize their textures –which are described here according to Dunham (1962)–, and to identify the skeletal and non-skeletal components. The stratigraphic section logged along the AP-7 outcrop is 25m in thickness, and the CV-13 road cut section is 10m thick (Fig. 3). Almost two hundred and more than forty decapod remains were collected by the AP-7 highway section and the CV-13 roadcut, respectively, being selected the most representative specimens for the present study. The specimens from AP-7 were prepared using a WEN Pneumatic Engraving pen and needles. Specimens from CV-13 were coated with a 25 percent solution of acrylic fixer Dyrup Uracryil and water. Photographs were taken under cold light with a Canon PowerShot G11 camera; specimens were dry. The repository of all specimens is the Museu de la Universitat de València d’Història Natural (Valencia, Spain), under acronym MGUV for the geological collections.

RESULTS

Petrology and stratigraphy of the studied successions

Outcrop by AP-7 section

The lower and middle parts of the section (from metre 0 to metre 16.5; Fig. 3A) are siliciclastic influenced and made up of alternating sandy limestones (Fig. 4A-B), limestones, marls and red clays. The sandy limestones (Fig. 4A) and the limestones, which also contain abundant quartz grains (Fig. 4B) and show packstone and grainstone textures, occur bioturbated and are characterized by the presence of elliptical to rounded ferruginous grains made up of a pelitomorphic matrix (Fig. 4C). Other non-skeletal grains include peloids and coated grains (Fig. 4C). The main skeletal components identified in the limestone and sandy limestone beds include fragments of gastropods (Fig. 4B), oysters, other molluscs, echinoids, corals, bryozoans, serpulids and red algae. Scarce ammonites were also collected from the packstone-grainstone bed between metre 5.5 and metre 8.5. This bed was the only stratigraphic interval of the section that yielded fossil decapod (Fig. 3A).

The upper part of the section (from metre 16.5 to metre 25) lacks siliciclastic influence and exhibits nodular to massive wackestone and packstone limestones rich in

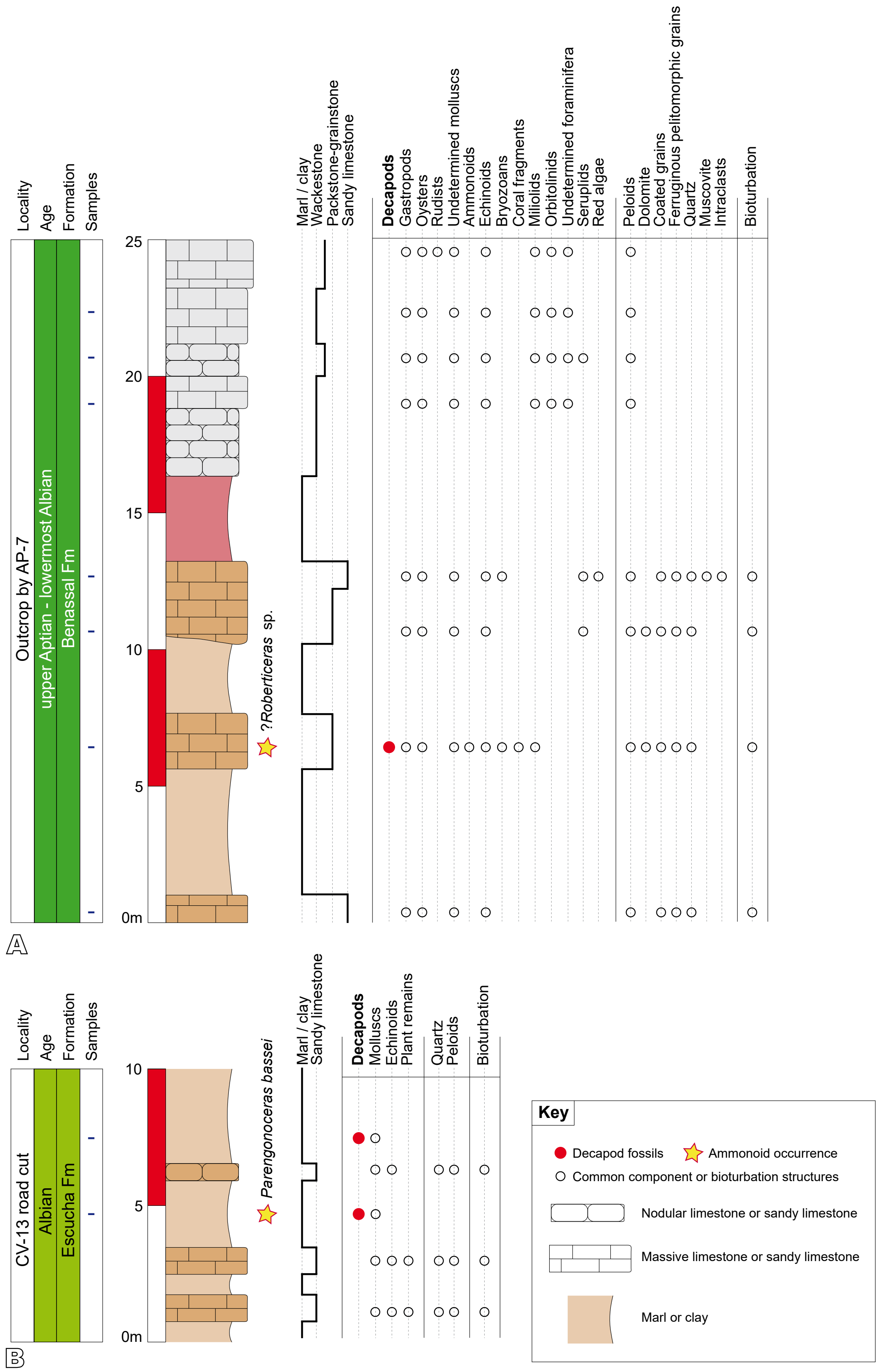

FIGURE 3. Chronostratigraphic framework of the upper Aptian–Miocene succession of the northern Orpesa Sub-basin based on Esnaola Gómez and Martín Fernández (1972), Canérot *et al.* (1982), Salas (1987), Martín-Martín *et al.* (2013), Garcia *et al.* (2014) and Bover-Arnal *et al.* (2016, 2022). The stratigraphic position of the decapod remains collected from the two studied outcrops is indicated. A) Outcrop by AP-7 highway in Alcalà de Xivert. B) Outcrop by CV-13 road cut in Torreblanca.

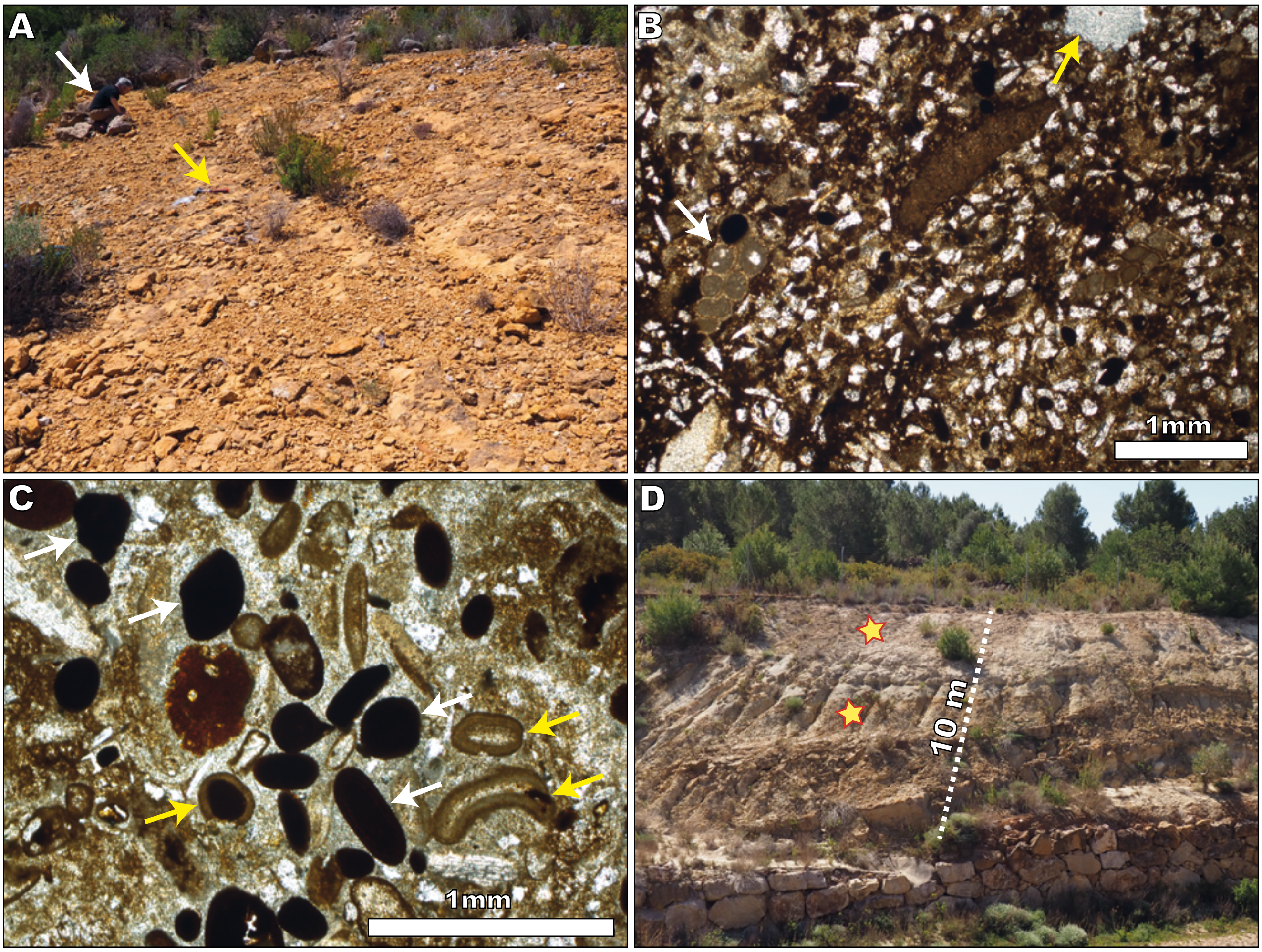

FIGURE 4. Outcrop views and petrological features of the studied deposits. A) Outcrop by AP-7 section in Alcalà de Xivert: top stratigraphic surface of the limestone bed that yielded decapod remains (see Fig. 3A). Palaeontologist (white arrow) and hammer (yellow arrow) for scale. B) Photomicrograph of the sandy limestone bed at the base of the outcrop by AP-7 section (see Fig. 3A), exhibiting abundant quartz grains and a section of a gastropod shell (white arrow) and an echinoid plate (yellow arrow). C) Photomicrograph of the packstone-grainstone bed containing decapods in the outcrop by AP-7 section (see Fig. 3A). Note the abundance of ferruginous grains made up of a pelitomorphic matrix (white arrows), as well as the presence of coated grains (yellow arrows). D) Panoramic view of the CV-13 road cut section in Torreblanca (see Fig. 3B). The marl intervals containing fossil decapod are indicated with a star.

orbitolinids (Fig. 3A). Other common components include peloids, serpulids, miliolids, other benthic foraminifera, brachiopods, gastropods, oysters, rudists, other molluscs, and echinoids (Fig. 5A-G).

CV-13 road cut section

The succession logged along the CV-13 road cut consists of an alternation between nodular to massive limestones, marly limestones, sandy limestones and marls (Figs. 3B; 4D). The limestones and sandy limestones exhibit bioturbation structures and include abundant quartz, as well as peloids and skeletal components such as plant remains and fragments of molluscs and echinoids. The fossil decapod analysed were recovered from the marly intervals between metres 3.5 and 6.0, and 6.5 and 10 (Fig. 3B). Bivalves, gastropods, ammonites, echinoids, fish scales, shark teeth, ophiuroids, and plant remains were also recognised within these marly levels (Fig. 5H-M).

Ammonite taxonomic notes and biostratigraphic analysis (by J.A. Moreno-Bedmar)

In the current work, five ammonite specimens belonging to two taxa were studied. One poorly preserved specimen comes from the uppermost part of the Benassal Fm.. It corresponds to an internal calcareous mold/cast with ferruginous grains. The ammonite is strongly compressed with an oval whorl section displaying a rounded venter. Ornamentation appears absent due to the poor preservation,

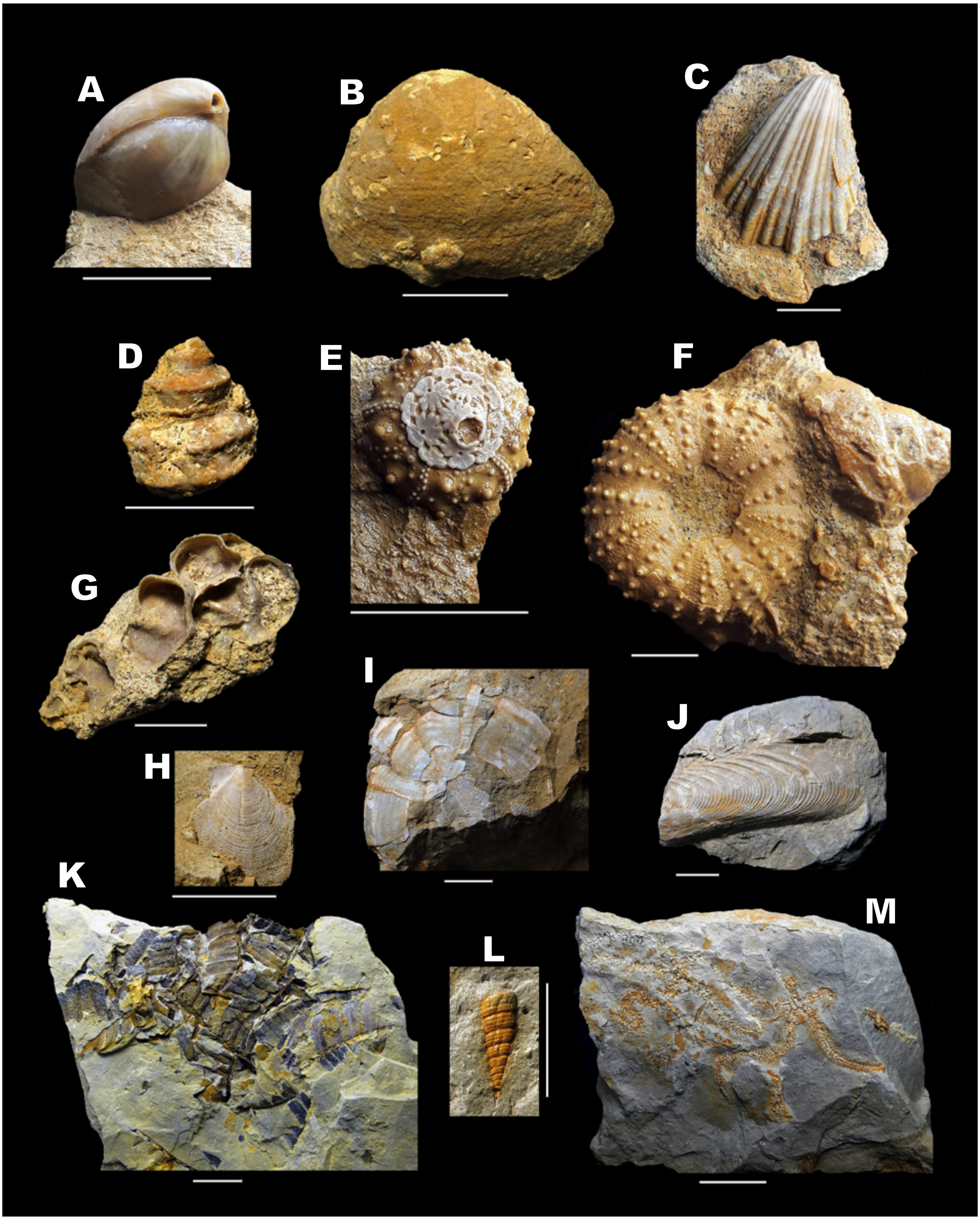

FIGURE 5. A-G: Fauna associated to the decapod assemblage from the outcrop by AP-7 section in Alcalà de Xivert. A) Brachiopod (J. Vicente Taus priv. coll.); B) MGUV -40120, undetermined bivalve, with incrusted coral ?*Actinoseris* sp.; C) MGUV-40139, *Neithea* sp.; D) MGUV-40121, gastropod; E) *Leptosalenia* sp. (M. Vicente Taus priv. coll.); F) *Tetragramma* sp. (J. Vicente Taus priv. coll.); G) MGUV-40122, oysters. H-M: Fauna associated with the decapod assemblage from the outcrop by CV-13 road cut section in Torreblanca. H) MGUV-40155, undetermined pectinid; I) MGUV-40156, undetermined echinoid; J) MGUV-40157, undetermined bivalve; K) MGUV-40158, plants; L) MGUV-40159, undetermined gastropod; M) ophiuroids (M.Vicente Taus priv. coll.). Scale bar is equal to 10mm. Photographs A, E, F and M by M. Vicente Taus; B-D and G-L by À. Ossó.

the shell resembling smooth. As can be seen in Figure 6B (arrow), part of a constriction is preserved. One suture line is observable (Fig. 6A), but is poorly preserved. Finally, the siphon may be observed in the middle part of the venter (Fig. 6B). The characteristics of this ammonite correspond to the desmoceratid subfamily Uhligellinae. The recently described genus *Roberticeras* (Latil *et al.*, 2023) closely matches this specimen. However, the generic identification cannot be definitively confirmed, and it is determined here as ?*Roberticeras* sp. The genus ranges from the lower Albian to the basal middle Albian (Latil *et al.*, 2023). Knowledge of this genus is still limited due to its recent erection, and an uppermost Aptian age for its first representatives cannot be ruled out. This age range aligns well with the age assignment of the uppermost part of the Benassal Fm., ranging from the uppermost Aptian (*e.g.* Garcia *et al.*, 2014) to the lowermost Albian (*e.g.* Martín-Martín *et al.*, 2013).

The other four specimens (Fig. 6C-K) come from the lowermost part of the Escucha Fm. These four specimens belong to the species *Parengonoceras bassei* (Bataller, 1954). Bataller originally assigned the species to the subgenus *Platiknemiceras*, he erected. This genus was validated by Casey (1961), who, however, recognized its strong affinity to genus *Parengonoceras*. The authoritative figure of Raymond Casey led several authors to adopt the combination of *Platiknemiceras bassei* (*e.g.* Bujtor, 2010; Bulot, 2010; Calzada and Urquiola, 1992; Martínez *et al.*, 1994; Moreno-Bedmar *et al.*, 2008). However, Latil (2011) considered that this species should be attributed to genus *Parengonoceras*, and this perspective is currently accepted (*e.g.* Garcia *et al.*, 2014; Giraud *et al.*, 2021; Latil and Aly, 2012; Latil and Jaillard, 2024; Moreno-Bedmar *et al.*, 2017). From a specific standpoint, *Parengonoceras bassei* is an easily recognizable species. Two of the specimens studied herein (Fig. 6C, K) exhibit, nicely preserved, the characteristic species ribbing. The specimen illustrated in Figure 6D-G exhibits a pyritic nucleus (currently oxidized), where ribbing is not well-preserved, but the suture line can be clearly observed (Fig. 6G). Another remarkable aspect of this specimen is the iridescent remains of the nacre shell seen in Figure 6G. Two views of this specimen were drawn (Fig. 6H-I) to depict the ontogenetic development of the juvenile specimen, which was completely unknown to date. The innermost whorls display alternating tuberculation (Fig. 6E, I) that quickly disappears in a completely smooth and flat, to slightly concave, ventral region (Fig. 6D, H). From a biostratigraphic standpoint, the range of *Parengonoceras bassei* is well-established to the early Albian (*e.g.* Garcia *et al.*, 2014; Giraud *et al.*, 2021; Latil, 2011; Latil and Aly, 2012; Moreno-Bedmar *et al.*, 2008; Moreno-Bedmar *et al.*, 2017). This age-assignment perfectly matches with the Albian age-assignment of the lower part of the Escucha Fm. (*e.g.* Garcia *et al.*, 2014; Moreno-Bedmar *et al.*, 2008).

SYSTEMATIC PALAEONTOLOGY

(by À. Ossó, S. Charbonnier, M. Hyžný, B. van Bakel, and J. Devillez)

We follow the higher classification scheme of brachyuran crabs proposed by Guinot (2019) (see also Guinot *et al.*, 2013; Jagt *et al.*, 2015).

Abbreviations: P1-P5, pereiopods 1 to 5. s1–s6, pleonal somites 1 to 6.

Class: Malacostraca LATREILLE, 1802
Order: Decapoda LATREILLE, 1802
Infraorder: Astacidea LATREILLE, 1802
Superfamily: Erymoidea VAN STRAELEN, 1925
Family: Erymidae VAN STRAELEN, 1925

GENUS *Eryma* MEYER, 1840

TYPE SPECIES: *Macrourites modestiformis* SCHLOTHEIM, 1822, subsequent designation by Glaessner (1929: 150).

Species included (only Early Cretaceous species from Europe, after Devillez *et al.*, 2016, Devillez *et al.*, 2021): *Eryma glaessneri* VAN STRAELEN, 1936; *E. multicavatus* (BELL, 1863); and *E. vocontii* DEVILLEZ, CHARBONNIER, HYŽNÝ AND LEROY, 2016.

Eryma sp.
Figure 7A-D

Locality. Outcrop by AP-7 section, Alcalà de Xivert (Comarca of Baix Maestrat, Valencian Country, Spain).

Stratigraphical horizon. Benassal Fm., upper Aptian (Lower Cretaceous) of Orpesa Sub-Basin (Maestrat Basin).

Studied material and measurements (in mm). Two specimens remains. One fragment of right side of an isolated carapace, partially preserving cuticle, MGUV-40124, length= 21.5, height= 21.5, and one decorticated P1 chela, MGUV-40125, length= 18.5, height = 14.

Description. *Carapace*. Carapace very incomplete; deep and wide cervical groove, strongly inclined dorsally, slightly inclined ventrally; short gastro-orbital groove, originating as a median inflexion of cervical groove; deep and wide postcervical groove, almost straight or very slightly concave forward, joined to branchiocardiac groove at carapace mid-height, with a straight ventral extension; deep and wide branchiocardiac groove, almost straight with a slight inflexion towards its junction with hepatic groove; deep and narrow hepatic groove, concavo-convex, joined to

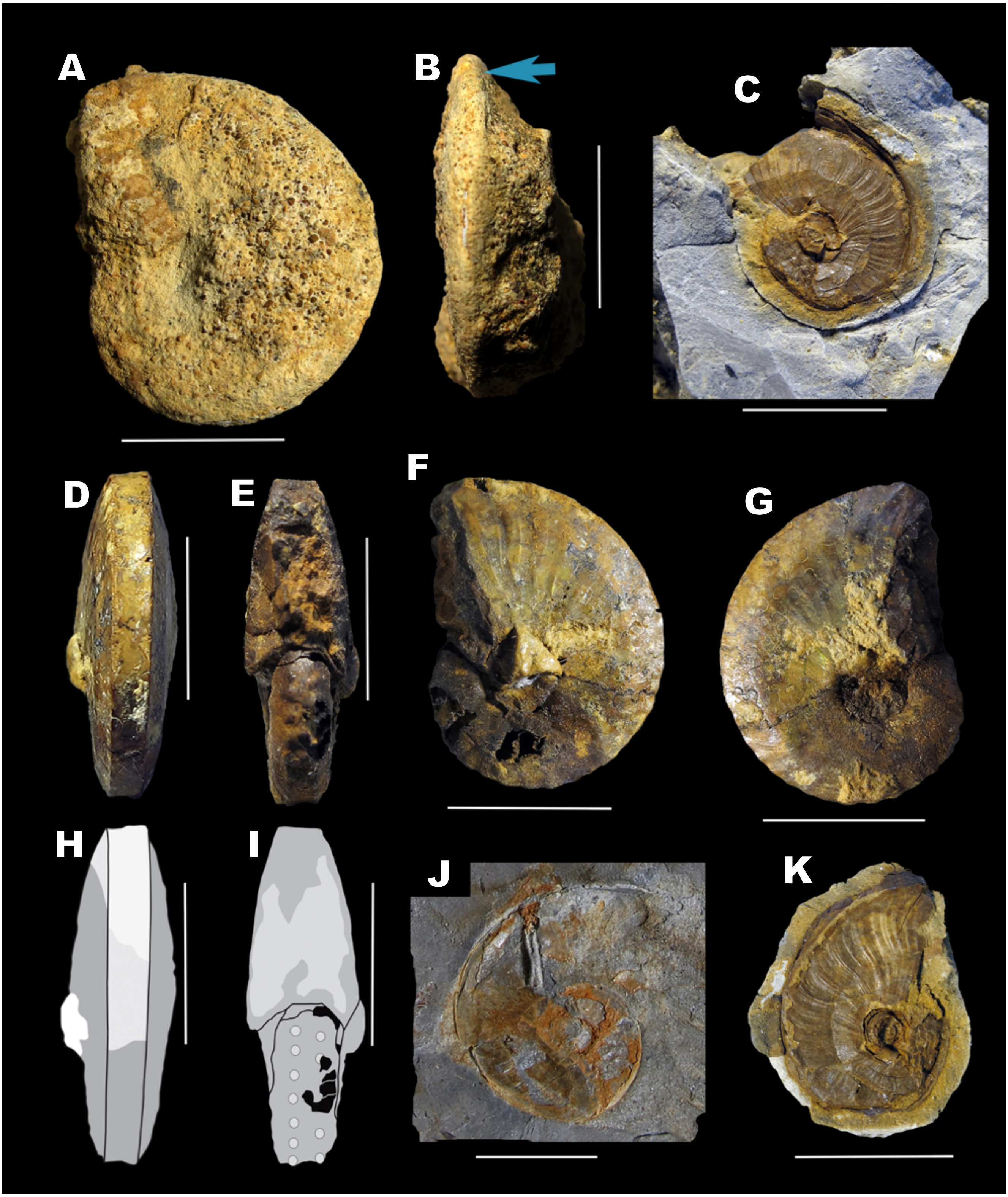

FIGURE 6. A, B: MGUV-4123, ?*Roberticeras* sp. from the outcrop by AP-7, Benassal Fm., upper Aptian (Lower Cretaceous) of Alcalà de Xivert (Valencian Country, Spain). A) Lateral view; B) ventral view, blue arrow indicates part of a constriction. C-K: *Parengonoceras bassei* (Bataller, 1954), from the outcrop by CV-13, Escucha Fm., lower Albian (Lower Cretaceous) of Torreblanca (Valencian Country, Spain). C) MGUV-4160, lateral view. D-G: MGUV-40161, D) ventral view; E) frontal view; F) left lateral view; G) right lateral view; H-I: line drawings of ventral and frontal views of MGUV-40161; J) MGUV-40162, right lateral view; K) MGUV-40163, lateral view. Scale bars equal to 10mm, except for D-I that is equal to 5mm. Line drawings by J.A. Moreno-Bedmar. Photographs by À. Ossó.

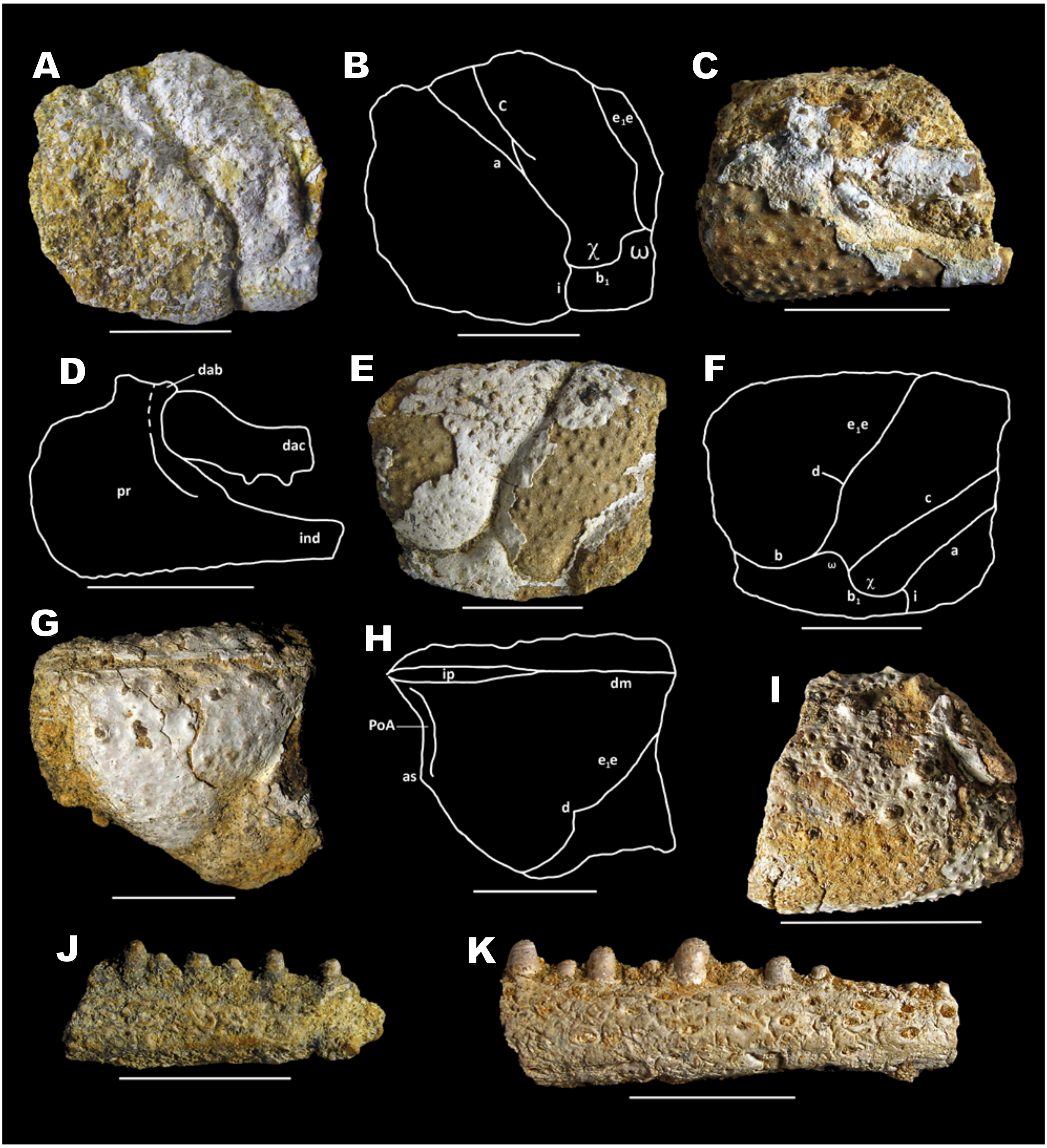

FIGURE 7. A-K: decapods from the outcrop by AP-7, Benassal Fm., upper Aptian (Lower Cretaceous) of Alcalà de Xivert (Valencian Country, Spain). A-D: *Eryma* sp., A) MGUV-40124, right side of carapace; B) interpretative line drawing; C) MGUV-40125, right chela, outer side; D) interpretative line drawing. E-I: *Palaeastacus* aff. *sussexiensis* (MANRELL, 1824), E) MGUV-40126, left side of carapace; F) interpretative line drawing; G) MGUV-40127, left side of carapace; H) interpretative line drawing; I) MGUV-40128, left chela of P1. J, K: *Enoploclytia* sp., J) MGUV-40129, dactylus; K) MGUV-40130, dactylus. Abbvreviations: a= branchiocardiac groove; as= antennal spine; b= antennal groove; b_1= hepatic groove; c= postcervical groove; d= gastro-orbital groove; dab= dactylar bulge; dac= dactylus; dm= dorsal midline; e_1e= cervical groove; i= inferior groove; ind= index; ip= intercalated plate; PoA, postorbital area; pr= propodus; χ= attachment site of adductor testis muscle; ω= attachment site of mandibular muscle. Scale bar equal to 10mm. Line drawings by S. Charbonnier. Photographs by À. Ossó.

cervical groove; slightly inflated ω and χ areas; deep and wide inferior groove, curved forward, joined to hepatic groove.

Ornamentation of carapace. Carapace densely covered by small tubercles.

Thoracic appendages. Chelate P1 (very incomplete); subrectangular propodus (incomplete proximally), compressed dorso-ventrally, covered by small tubercles; narrow dactylar bulge, inflated, posteriorly delimited by deep and narrow groove; thin fingers, only preserved proximally; occlusal margin with small conical teeth closely spaced.

Remarks. The studied specimens are assigned to *Eryma* based on the typical groove pattern of carapace (*e.g.* Devillez and Charbonnier, 2017, fig. 1a), and the general morphology of P1 chela (*e.g.* Devillez and Charbonnier, 2021, fig. 1e). Since they are only fragments, it is impossible to propose a specific assignment and we identified them as *Eryma* sp. These fragments constitute the first report of *Eryma* in the Iberian Peninsula. The genus is rare in the Early Cretaceous, only known in Europe by a few specimens found in United Kingdom, Germany and southeast of France. This new occurrence extends the distribution of *Eryma* towards the south of Western Europe (see Devillez *et al.*, 2016; Devillez *et al.*, 2021).

GENUS *Palaeastacus* BELL, 1850

TYPE SPECIES: *Astacus sussexiensis* MANTELL, 1824, subsequent designation by Glaessner (1929: 189).

Species included (only Early Cretaceous species from Europe, after Devillez *et al.*, 2016): *Palaeastacus loryi* (VAN STRAELEN, 1923); and *P. sussexiensis* MANTELL, 1824.

Palaeastacus aff. ***sussexiensis*** (MANTELL, 1824)
Figure 7E-I

Synonymies list (until 2023): see Sasaki, 2023, pp. 4844-4846.

Locality. Outcrop by AP-7 section, Alcalà de Xivert (Comarca of Baix Maestrat, Valencian Country, Spain).

Stratigraphical horizon. Benassal Fm., upper Aptian (Lower Cretaceous) of Orpesa Sub-Basin (Maestrat Basin).

Studied material and measurements (in mm). Two fragments of carapaces and one P1 chela corresponding to decorticated elements and internal moults. Left side of carapace, MGUV-40126, length= 24, height= 23. Carapace, MGUV-40127, length= 25.5, height= 20. Chela of P1, MGUV-40128, length= 13, height= 12.

Description. *Carapace*. Fusiform intercalated plate; deep cervical groove, joined to dorsal margin and to antennal groove; deep antennal groove; short gastro-orbital groove originating as a slight median inflexion of cervical groove; postcervical and branchiocardiac grooves subparallel; postcervical groove shallowing ventrally, joined to hepatic groove; narrow branchiocardiac groove, strongly inclined, joined to hepatic groove; concavo-convex, narrow hepatic groove, joined to cervical groove; inflated ω area; flat χ area; deep inferior groove, joined to hepatic groove.

Ornamentation of carapace. Carapace densely covered by rounded tubercles in branchial region and widely spaced coarse tubercles in cephalic region; row of tubercles parallel to intercalated plate in gastric region.

Thoracic appendages. Chelate P1; short, slightly globose P1 propodus, covered by small tubercles and some widely spaced coarse tubercles.

Remarks. The studied specimens are assigned to *Palaeastacus*, based on the typical groove pattern of the carapace (*e.g.* Devillez *et al.*, 2016, fig. 1g) and the general morphology of the fragment of P1 chela (*e.g.* Devillez *et al.*, 2016, fig. 1h). The ornamentation of carapace and P1 chela (dense rounded tubercles associated to some large coarse tubercles) is very similar to that observed on the type species. As the studied specimens correspond to fragments of partially decorticated carapaces and isolated propodus, it is difficult to be completely affirmative with the specific assignment and we tentatively identified them as *Palaeastacus* aff. *sussexensis*.

After Devillez *et al.* (2017) and Devillez and Charbonnier (2022), *Palaeastacus sussexiensis* is a well-known species, represented by numerous fossils, mainly from the Upper Cretaceous chalk fms. of southeast United Kingdom. It has also a wide stratigraphic range (Aptian to Turonian) associated to a wide geographic distribution from Antarctica to Europe (UK, France and Germany). If this identification is confirmed, the studied specimens will expand the European palaeobiogeographical distribution of *Palaeastacus sussexiensis* to the Iberian Peninsula.

Family: Enoploclytiidae DEVILLEZ, CHARBONNIER AND BARRIEL, 2019

GENUS ***Enoploclytia*** M'COY, 1849

TYPE SPECIES: *Astacus leachii* MANTELL, 1822, by original designation.

Species included (only Early Cretaceous species from Europe, after Devillez *et al.*, 2017): *Enoploclytia augustobonae* DEVILLEZ, CHARBONNIER, HYŽNÝ AND lEROY, 2016 and *E. seitzi* GLAESSNER, 1932.

Enoploclytia sp.
Figure 7J, K

Locality. Outcrop by AP-7 section, Alcalà de Xivert (Comarca of Baix Maestrat, Valencian Country, Spain).

Stratigraphical horizon. Benassal Fm., upper Aptian (Lower Cretaceous) of Orpesa Sub-Basin (Maestrat Basin).

Studied material and measurements (in mm). Two isolated dactylus. MGUV-40130, length= 28, height= 9; MGUV-40129, length= 19, height= 7.5.

Description. P1 dactylus, straight; occlusal margin armed with tronconical teeth; outer and inner surfaces covered by small tubercles.

Discussion. The general morphology of the P1 dactylus, with the occlusal margin bearing sharp and slender teeth is typical of the P1 chela of *Enoploclytia* (*e.g.* Devillez *et al*., 2016, fig. 1j). A specific attribution is impossible due to the very incomplete nature of the specimen. Garassino *et al.* (2009) already reported fragments of chelae attributed to *Enoploclytia* sp. in the Aptian of the neighbouring Garraf Basin (Catalonia). Considering the extreme rarity of the genus during the Early Cretaceous, this second report reinforces its presence in the Early Cretaceous of the Iberian Peninsula.

Superfamily: Nephropoidea DANA, 1852
Family: Nephropidae DANA, 1852

GENUS ***Hoploparia*** M'COY, 1849

TYPE SPECIES: *Astacus longimanus* G.B. SOWERBY, 1826, subsequent designation by Rathbun (1926: 129).

Species included (only Early Cretaceous species from Europe, after Tshudy and Sorhannus, 2003): *Hoploparia aspera* HARBORT, 1905; *H. dentata* (ROEMER, 1841); *H. edwardsii* (ROBINEAU-DESVOIDY, 1849); *H. longimana* (SOWERBY, 1826): *H. minima* DE TRIBOLET, 1876; *H. pelseneeri* (VAN STRAELEN, 1936) and *H. triboleti* BORISSJAK, 1904.

Hoploparia aff. ***longimana*** (G.B. SOWERBY, 1826)
Figure 8A-P

Synonymies list (until 2023): see Sasaki, 2023, pp. 4229-4231.

Locality. Outcrop by AP-7 section, Alcalà de Xivert (Comarca of Baix Maestrat, Valencian Country, Spain).

Stratigraphical horizon. Benassal Fm., upper Aptian (Lower Cretaceous) of Orpesa Sub-Basin (Maestrat Basin).

Studied material and measurements (in mm). Twenty-eight out of one hundred remains, have been selected for the present study, three carapaces corresponding to internal molts, one pleon, and chelae remains (P1 palms and dactyli). MGUV-40133, carapace length= 23, carapace height= 12. MGUV-40132, carapace length= 15.5, carapace height= 8. MGUV-40131, carapace length= 15.5, carapace height= 8. One partial pleon, MGUV-40134, length= 15, height= 9. Propodi, MGUV-40135 to MGUV-40138 and MGUV-40185 to MGUV-40204, not measured.

Description. *Carapace*. Subcylindrical carapace (specimen MGUV-40133); elongate rostrum, dorsally flat with median groove (distal extremity not preserved); relatively deep ocular incision, rimmed, delimited ventrally by strong antennal spine; strong postorbital spine located in center of ocular incision; antennal region with tuberculate antennal carina; strong postantennal spine close to buccal groove and aligned with antennal carina; deep, subvertical, cervical groove, starting at mid-height and joined ventrally to curved antennal groove; antennal groove divided into two divergent distal branches; elongate, straight, subhorizontal gastro-orbital groove, joined to cervical groove near its dorsal extremity; subvertical buccal groove; deep postcervical groove joined to dorsal margin, subvertical dorsally and curved ventrally, joined to intercervical groove; short urogastric groove, subvertical, sligthly incurved, joined to postcervical groove and dorsal margin; concave intercervical groove interrupted before joining cervical groove; branchiocardiac groove with two parts: dorsal extension parallel to dorsal margin, subhorizontal, and slightly curved downwards before joining postcervical groove, ventral extension subvertical, joined ventrally to suprahepatic and hepatic grooves; concave suprahepatic groove, interrupted before joining cervical groove; concave hepatic groove, joined to cervical and antennal grooves; short inferior groove, slightly concave, directed forward and interrupted before joining ventral margin; slightly sinuous posterior margin with thin marginal carina.

Ornamentation of carapace. Carapace uniformly covered with small granules, larger on dorsal surface especially in gastric and cardiac regions; granules arranged more transversely in cardiac region.

Pleon. Pleon poorly preserved, with subrectangular somites in dorsal view.

Thoracic appendages. Only P1 chela preserved, with occlusal margins of propodus and dactylus bearing large

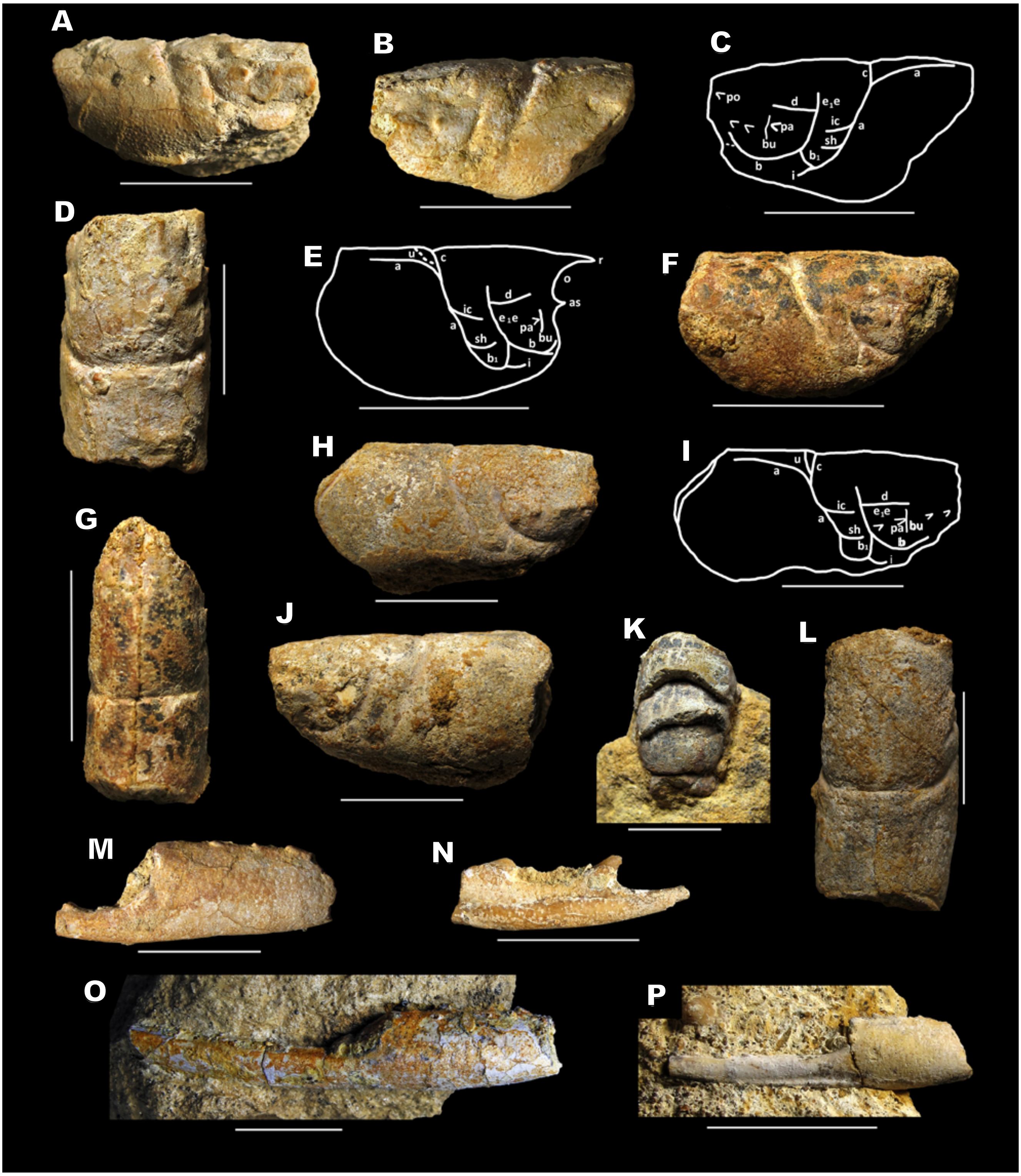

FIGURE 8. A-P: *Hoploparia* aff. *longimana* (G.B. SOWERBY, 1826) from the outcrop by AP-7, Benassal Fm., upper Aptian (Lower Cretaceous) of Alcalà de Xivert (Valencian Country, Spain). A-D: MGUV-40131, A) right side of carapace; B) left side of carapace; C) interpretative line drawing; D) dorsal view of carapace. E-G: MGUV-40132, E) interpretative lined drawing; F) right side of carapace; G) dorsal view of the carapace. H-J, L: MGUV-40133, H) right side of carapace; I) interpretative line drawing; J) left side of carapace; L) dorsal view of the carapace. K) MGUV-40134, pleonal somites dorsal view. M) MGUV-40135, right propodus, inner side. N) MGUV-40136, dactylus of left propodus. O) MGUV-40137, right propodus, inner side. P) MGUV-40138, left propodus, outer side. Abbreviations: a= branchiocardiac groove; ac= antennal carina; as= antennal spine; b= antennal groove; bu= buccal groove; b_1= hepatic groove; c= postcervical groove; cd= cardiac groove; d= gastro-orbital groove; e_1e= cervical groove; gc= gastro-orbital carina; i= inferior groove; ic= intercervical groove; o= orbital incision; pa= postantennal spine; po= postorbital spine; pr= propodus; r= rostrum; sh= suprahepatic groove; u= urogastric groove. Scale bar equal to 10mm. Line drawings by S. Charbonnier. Photographs by À. Ossó.

tubercles; P1 propodus stout, with ventral margin armed with four to five pairs of large spines, and dorsal margin carinate and smooth; P1 palms with inner and outer surface covered with small granules.

Discussion. The studied specimens are assigned to *Hoploparia* based on the typical groove pattern of carapace (*e.g.* Charbonnier and Garassino 2022, figs. 12, 14). The Early Cretaceous species of *Hoploparia* from Europe are numerous and most of them have been never revised since their original description. For instance: *H. minima* (Valanginian, France), *H. aspera* (Valanginian, Germany), *H. edwardsii* and *H. dentata* (Valanginian, Hauterivian, Aptian; France, Germany), *H. triboleti* (Albian, Russia) and *H. longimana* (Albian, United Kingdom). The studied species differs from *H. minima* by their elongate propodus (short in *H. minima* after the original figure). The type material of *H. edwardsii* is probably lost and the original figures are quite imaginative, which prevents any serious comparison. Our examination of one of the two syntypes of *Hoploparia aspera* (figured by Harbort 1905: pl. 2, fig. 5) shows that the carapace is much higher than the studied specimens. *Hoploparia dentata* shows strong spines on ventral and dorsal margins of P1 palm (*e.g.* Stolley, 1924, t. 13, figs. 12, 13), whereas the studied specimens bear only strong spines on ventral margin. After the original figures, *Hoploparia triboleti* bears P1 propodus with curved outer margin (straight in studied specimens), and very strong molariform teeth on the occlusal margin of index (small teeth in studied specimens). Finally, the studied specimens shared several morphological characters with the type species *H. longimana*: general morphology of the carapace and P1 chela, granular ornamentation of the carapace and P1 palm. As the studied specimens correspond to partially decorticated carapaces and isolated propodi, it is difficult to be completely affirmative with the specific assignation and we tentatively identified them as *Hoploparia* aff. *longimana*. If this identification is confirmed, the studied specimens will expand the palaeobiogeographical distribution of *H. longimana*, and will highlight connection between the British islands and the Iberian Peninsula.

Records of *Hoploparia* in the Early Cretaceous of the Iberian Peninsula have been reported previously. For instance, in the Garraf Basin, Vía (1951, pp. 157-160, text. figs. I-III, figs. 1-3) reported and described *Homarus* (*Hoploparia*) cfr. *dentatus* from the Albian of Marmellar (Catalonia); as well as a chela attributed to *Homarus* (*Hoploparia*) *edwardsi* (see Vía 1951, pp. 161-162, text-fig. IV, fig. 4 from the Aptian of Casa Alta (Catalonia), that has been subsequently identified as *Hoploparia* sp. by Ossó *et al.* (2023, p. 7; fig. 5A, B). In the Maestrat Basin, García-Penas *et al.* (2023, pp. 5-6; fig.. 5A-G, t. 1) reported *Hoploparia* sp. from the Aptian of Miravete de la Sierra (Aragon), in the Galve Sub-basin. Both, the specimens from Marmellar and those from Miravete de la Sierra can be considered conspecific with those of Alcalà de Xivert described herein. In the northern Iberian Peninsula, remains of *Hoploparia* sp. have been reported from Albian localities of the Basque-Cantabrian Basin (López-Horgue, 2009; López-Horgue and Bodego, 2017). The possible presence of *Hoploparia longimana* in the Early Cretaceous of South America is not considered herein, given the fragmentary condition of the material reported by Aguirre Urreta (1982) and Aguirre-Urreta (1989) which precludes a proper identification.

Infraorder: Glypheidea ZITTEL, 1885
Superfamily: Glypheoidea ZITTEL, 1885
Family: Mecochiridae VAN STRAELEN, 1925

GENUS ***Atherfieldastacus*** SIMPSON *in* ROBIN, CHARBONNIER, MERLE, SIMPSON, PETIT AND FERNANDEZ, 2016)

TYPE SPECIES: *Meyeria magna* M'COY, 1849 by original designation.

Species included: *Atherfieldastacus magnus* (M'COY, 1849), *A. rapax* (HARBORT, 1905) and *A. schwartzi* (KITCHIN, 1908).

Atherfieldastacus magnus (M'Coy, 1849)
Figure 9A-F

Synonymies list (until 2023): see Sasaki, 2023, pp. 4772-4774; references therein to *A. mexicanus* (RATHBUN, 1935) must be included as junior synonym of *A. magnus*.

2023 *Atherfieldastacus magnus* (M'Coy, 1849); Chény, Charbonnier and Audo, p. 149.

Locality. Outcrop by AP-7 section, Alcalà de Xivert (Comarca of Baix Maestrat, Valencian Country, Spain).

Stratigraphical horizon. Benassal Fm., upper Aptian (Lower Cretaceous) of Orpesa Sub-Basin (Maestrat Basin).

Studied material and measurements (in mm). Four samples three-dimensionally preserved. Two complete specimens preserving carapace, pleon and pereopod remains, one complete carapace, and remains of pleonal somites. MGUV-40143, complete body, length= 83, carapace length= 5.5, carapace height= 28. MGUV-40141, complete body, length= 35, carapace length= 24.5, carapace height= 17. MGUV-40140, carapace length= 44, carapace height= 22. MGUV-40142, pleonal somites, length= 27, height= 21.5.

Description. *Carapace*. Subcylindrical, compressed laterally, beveled in cross-section; length about twice

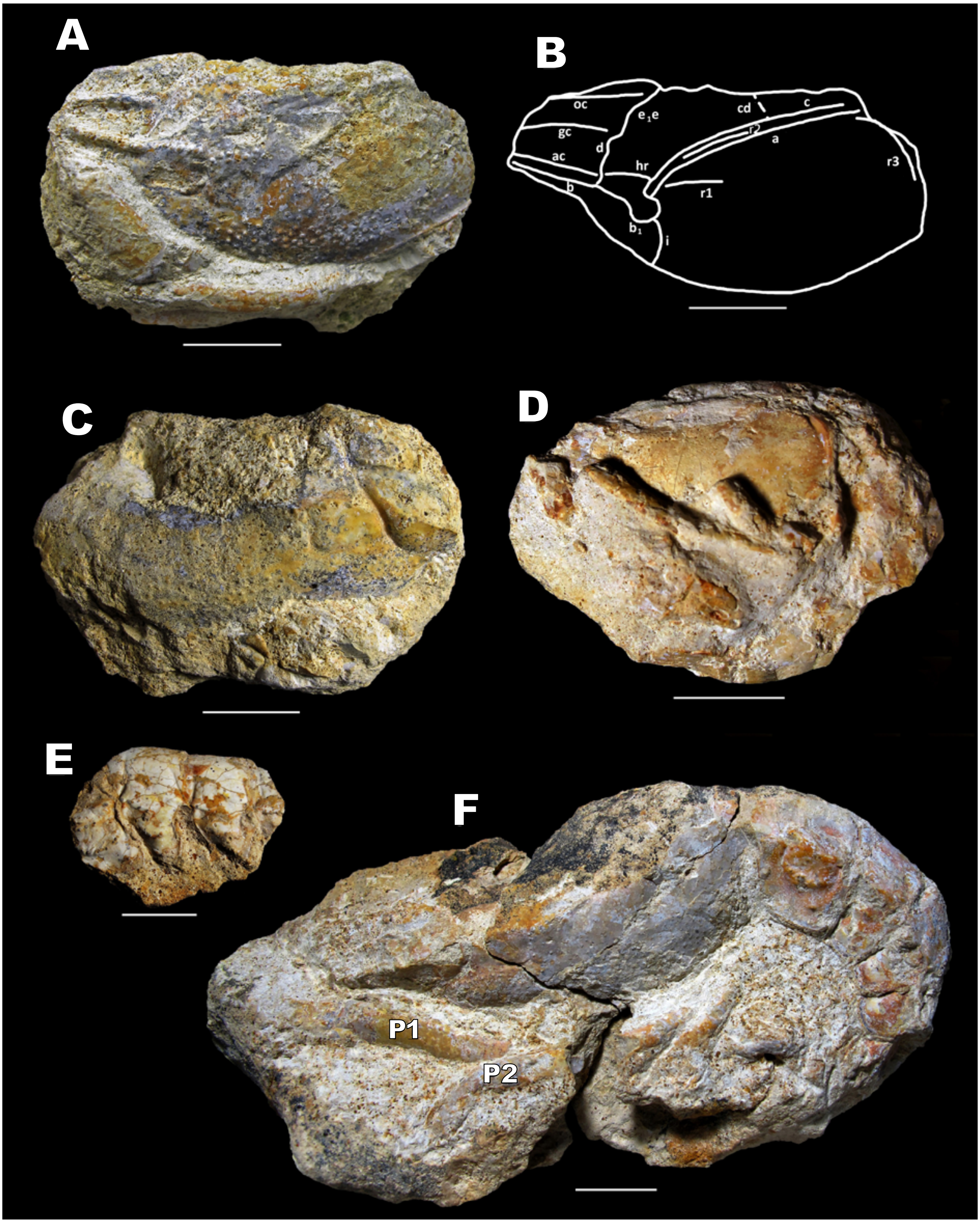

FIGURE 9. A-F: *Atherfieldastacus magnus* (M'COY, 1849) from the outcrop by AP-7, Benassal Fm., upper Aptian (Lower Cretaceous) of Alcalà de Xivert (Valencian Country, Spain). A-C: MGUV-40140, A) left lateral view of carapace; B) interpretative drawing; C) right lateral view of carapace. D) MGUV-40141, left lateral view of carapace and partial pleon. E) MGUV-40142, pleonal somites. F) MGUV-40143, left lateral view of carapace, pleon, and telson. Abbreviations: a= branchiocardiac groove; ac= antennal carina; b= antennal groove; bu= buccal groove; b$_1$= hepatic groove; c= postcervical groove; cd= cardiac groove; d= gastro-orbital groove; e$_1$e= cervical groove; gc= gastro-orbital carina; hr= hepatic ridge; i= inferior groove; oc= orbital carina; spine; P1-P2= pereiopods 1 and 2; r1= hepatic ridge; r2= dorsal ridge; r3= branchial ridge. Scale bar equal to 10mm. Line drawings by S. Charbonnier. Photographs by À. Ossó.

height. Rostrum not preserved. Branchial region with three branchial ridges; ventral branchial ridge extending hepatic ridge, well-marked; medial and dorsal branchial ridges faintly marked; cervical groove oblique, deep, delimiting narrow cephalic region; cephalic region with three parallel spiny carinae: orbital, gastric and antennal carinae; antennal groove deep; gastro-orbital groove short, originating as slight inflexion of cervical groove at level of gastro-orbital carina; post-cervical and branchiocardiac groove parallel, barely marked, directed towards posterior margin; cardiac groove not preserved; inferior groove barely marked; hepatic groove shallow and flexed towards posterior. Branchial region strongly granulated in the lower half.

Ornamentation of carapace. Regions evenly covered by small spiny tubercles, more densely in lower branchial areas; upper branchial area smooth.

Pleon. Pleon short. Very short pleonal somite s1, triangular in lateral view; s2-s5 with bevelled cross-section; s6 smallest; s2-s5 with three rows of granules; lower margins rounded and posterior margins straight; pleura with serrated edges. Telson present on the opposite side of the concretion, showing uropodal endopod and exopod.

Thoracic appendages. Only remains of P1 and P2 present.

Discussion. The studied specimens are assigned to *Atherfieldastacus* based on the typical groove pattern of carapace, as defined by Robin *et al.* (2016). The shape and distribution of the three cephalic carinae, as well as the three branchial ridges and morphology of the pleonal somites, match with the diagnosis of *Atherfieldastacus magnus* (*e.g.* González-León *et al.*, 2018).

The presence of this species in the Early Cretaceous of Iberia, in particular in the Maestrat Basin, is not a novelty since it has been mentioned for a long time. For instance, Vilanova y Piera (1863) reported it (as *Oncopareia granulosa* Bell, 1858) from the Aptian of Josa (Oliete Sub-basin). As well, Van Straelen (1927) reported it (as a new species: *Meyeria bolivari*) precisely from outcrops in two of the municipalities studied herein: Torreblanca and Alcalà de Xivert (Orpesa Sub-basin). Subsequently, Vía Boada (1975) revised the specimens from the three Maestrat localities mentioned above and confirmed their conspecificity with the specimens of the Aptian of the Isle of Wight (UK). Recently, *Atherfieldastacus magnus* has been repeatedly reported from the Oliete Sub-basin, northwestern of the Maestrat Basin (*e.g.* Ferratges *et al.*, 2021; García-Penas *et al.*, 2023). López-Horgue (2009) reported *Atherfieldastacus magnus* also from the Aptian and Albian outcrops of the Basque-Cantabrian Basin, halfway between the Maestrat Basin and the aforementioned Isle of Wight (see also López-Horgue and Bodego, 2017). Westward, *Atherfieldastacus magnus* has been recognized and reported in diverse localities of America, as in Mexico and Colombia, and eastward, in Tibet, from the Valanginian to the Albian (see González-León, 2019, and references therein), showing thus an extraordinary cosmopolitism and persistence through time.

Infraorder: Axiidea SAINT LAURENT, 1979
Family: Ctenochelidae MANNING AND FELDER, 1991

GENUS ***Cretagourretia*** new genus
urn:lsid:zoobank.org:act:913AFA33-2CE4-41D7-BC02-0A2F6BA6D7C4

Etymology. The genus name is a combination of Cretaceous and *Gourretia* DE SAINT LAURENT, 1973, referring to the Cretaceous age and the extant ghost shrimp genus which is morphologically close to the newly described taxon.

TYPE SPECIES: *Cretagourretia salasi* by monotypy.

Diagnosis. As the type species.

Remarks. The newly described genus is assigned to the Ctenochelidae based on numerous morphological similarities with extant genera classified within this family. These similarities concern features of dorsal carapace, pleon, uropods and pereiopods. Nevertheless, *Cretagourretia* n. gen. exhibits a unique set of characters not present in any other callianassoid ghost shrimp (*sensu* Poore *et al.*, 2019).

On the dorsal carapace of *Cretagourretia* n. gen. there is a distinct cardiac prominence; this character is present in *Ctenocheles* KISHINOUYE, 1926, *Ctenocheloides* ANKER, 2010, *Dawsonius* MANNING AND FELDER, 1991, and several species of *Paragourretia* SAKAI, 2004 (Poore *et al.*, 2019). In *Ctenocheles*, the carapace has a distinct blade-like rostrum (Manning and Felder, 1991; Poore *et al.*, 2019), which seems to be missing in *Cretagourretia* n. gen. (as far as can be stated from imperfect preservation). Besides the cardiac prominence, *Ctenocheloides* features a prominence in the postfrontal area (Anker, 2010, fig. 1D); postfrontal area is smooth in *Cretagourretia* n. gen.

The pleon of *Cretagourretia* n. gen. has the second pleomere the longest, character shared with many callianassoid ghost shrimps (Dworschak *et al.*, 2012). As for representatives of Ctenochelidae, *Dawsonius* exhibits triangular lateral projections on the pleomere 6 which are unique for the respective genus (Poore *et al.*, 2019). In *Cretagourretia* n. gen., the pleomere 6 exhibits well-developed pleural lobes, similar to those of pleomeres 5, 4 and 3; thus, pleomeres 3-6 are of similar width, whereas in in extant ctenochelid genera, pleomeres 3-5 are wider than pleomere 6 (*e.g.* Anker, 2010, fig. 2; Le Loeuff and Intès 1974, figs. 5a, 6a; Ngoc-Ho, 1991, fig. 6a; Poore *et al.*, 2019, fig. 16).

As far as chelipeds are concerned, *Cretagourretia* n. gen. is similar to *Dawsonius*, GOURRETIA DE SAINT LAURENT, 1973 and *Paragourretia*. As for P1 major claw, *Cretagourretia* n. gen. shares with these genera an evenly tapering propodus, carpus 2.5-times shorter than manus with rounded proximo-lower margin, oval merus and ischium with serrated lower margin (Poore *et al.*, 2019). *Cretagourretia* n. gen. shares with *Paragourretia* linear pereopod 3 propodus; in *Dawsonius* and *Gourretia*, P3 propodus is oval (Poore and Ahyong, 2023; Poore *et al.*, 2019). As for pereopod 1 major propodus, *Cretagourretia* n. gen. is closest to *Gourretia*: both genera exhibit relatively robust fixed finger with a large tooth on the occlusal margin. *Cretagourretia* n. gen., however, does not have a hook/spine on the lower margin of P1 merus, which is often present both in major and minor claws of *Gourretia* (*e.g.* Blanco Rambla and Liñero Arana, 1994, figs. 8, 9; Le Loeuff and Intès 1974: figs. 4, 6; Ngoc-Ho, 2003, fig. 21; Sakai, 2004, fig. 5). *Cretagourretia* n. gen. differs from *Dawsonius*, *Gourretia* and *Paragourretia* in the morphology of P1 minor claw: in *Cretagourretia* n. gen., the fixed finger is bent downward, whereas it is straight in the extant genera discussed above. Interestingly, the fixed finger is bent downward also in P1 major claw of *Ctenocheles* and *Ctenocheloides* (Poore and Ahyong, 2023, figs. 9.19k, l; Poore *et al.*, 2019, fig. 17a, b). Such a morphology seems somehow related to the development of pectinate dentition which is also present in one of the claws of *Kiictenocheloides* SAKAI, 2013 (see Komai, 2013, fig. 5). The minor claw of *Cretagourretia* n. gen., however, does not possess pectinate dentition; the teeth are small, simple and uniform. In *Gourretia* they are sharp and directed proximally (Poore *et al.*, 2019), quite unlike those in *Cretagourretia* n. gen.

Cretagourretia salasi n. sp.
Figures 10A-C; 11A-F
urn:lsid:zoobank.org:act:83E076EC-0DFF-4277-8720-BD72737DDD21

Type locality. Outcrop by CV-13 roadcut, Torreblanca (Comarca of La Plana Alta, Valencian Country, Spain)

Stratigraphical horizon. Escucha Fm., lower Albian (Lower Cretaceous) of Orpesa Sub-Basin (Maestrat Basin).

Etymology. The species epithet honours the geologist Ramon Salas, to whom this volume is dedicated, and whose outstanding contributions to the geology of the Maestrat Basin have paved the way for the researchers who have followed him.

Studied material and measurements (in mm). From about thirty specimens, corresponding to isolated chelipeds and (near-) complete individuals, seventeen have been selected for the present study. Holotype, MGUV-40164, length (body and chelipeds)= 34.5. Paratypes: MGUV-40165, length (cheliped)= 25, height= 6; MGUV-40166, length (cheliped)= 25, height= 8; MGUV-4167 (cheliped) length= 33.5, height= 8; MGUV-40168a, b, length (body and chelipeds)= 25; MGUV-40169a, b, length (body and chelipeds)= 36; MGUV-4170, length (body and chelipeds)= 20.5; MGUV-40171, length (body and chelipeds)= 20; MGUV-1787, length (body and chelipeds)= 19.5. Specimens MGUV-4177 to MGUV-40184 not measured.

Diagnosis. Carapace with dorsal oval; cardiac prominence present; cervical groove clearly delimited; linea thalassinica complete; pleomere 2 longest; pleomeres 3–6 with well-developed pleural lobes; uropodal exopod and endopod oval; pereiopods 1 unequal and dissimilar, lateral surfaces smooth; lower margin of major P1 ischium serrated; major P1 merus two times longer than high, lower margin with serrated blade; major P1 carpus distinctly shorter than merus; major P1 manus approximately 2.5 times longer than carpus, upper margin converging distally; major P1 fixed finger occlusal margin with proximal tooth; major P1 dactylus occlusal margin with two broadly spaced teeth; minor P1 fixed finger bent downward, fingers with uniform dentition; P3 propodus linear.

Description. Carapace about the same length as first three pleomeres combined; frontal region not well preserved; dorsal oval moderately developed; postfrontal area of dorsal carapace smooth; posterior area of dorsal carapace with distinct cardiac prominence; cervical groove clearly delimited; linea thalassinica running along complete length of carapace; lateral flanks (branchiostegites) without discernible grooves.

Pleon well-developed; pleomere 2 longest; pleomeres 3–6 equally wide, with well-developed pleural lobes; telson poorly preserved; uropodal exopod and endopod oval, with longitudinal medial carinae.

Pereiopods 1 (P1) chelate, unequal in size and dissimilar in shape, lateral surfaces smooth (without tuberculation); major claw robust, much larger than minor claw. Major P1 ischium slender, highest distally, lower margin serrated; merus two times longer than high, upper margin straight, lower margin with slightly convex serrated blade; carpus distinctly shorter than merus, upper margin straight, proximo-lower margin rounded; manus approximately 2.5

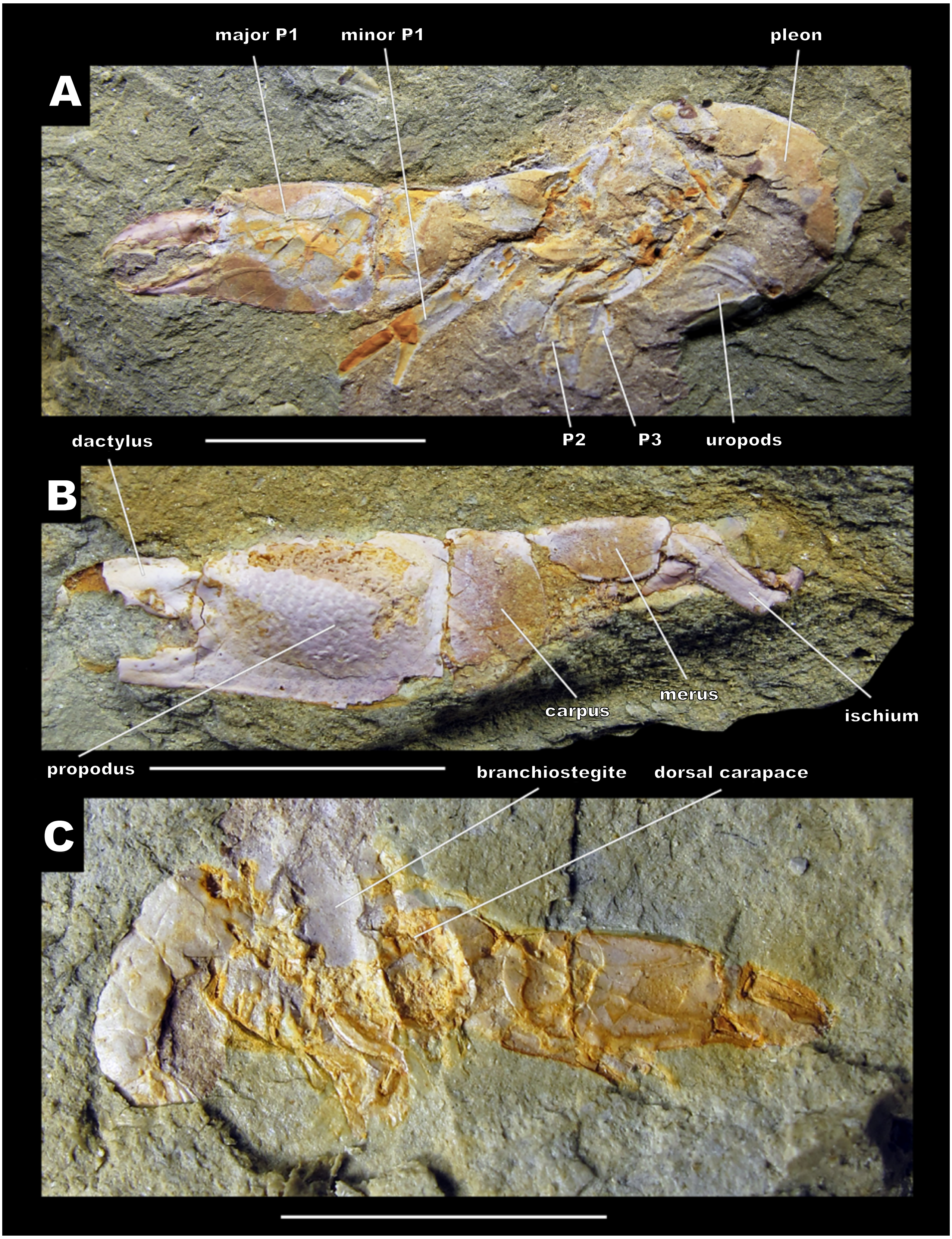

FIGURE 10. *Cretagourretia salasi* n. gen., n. sp., from the outcrop by CV-13, Escucha Fm., lower Albian (Lower Cretaceous) of Torreblanca (Valencian Country, Spain). A) holotype, MGUV-40164, near-complete individual; B) paratype, MGUV-40165, right major cheliped preserved in inner lateral aspect; C) paratype, MGUV-4172, near-complete individual. Abbreviations: P1-P3= pereiopods. Scale bar equal to 10mm. Photographs by À. Ossó.

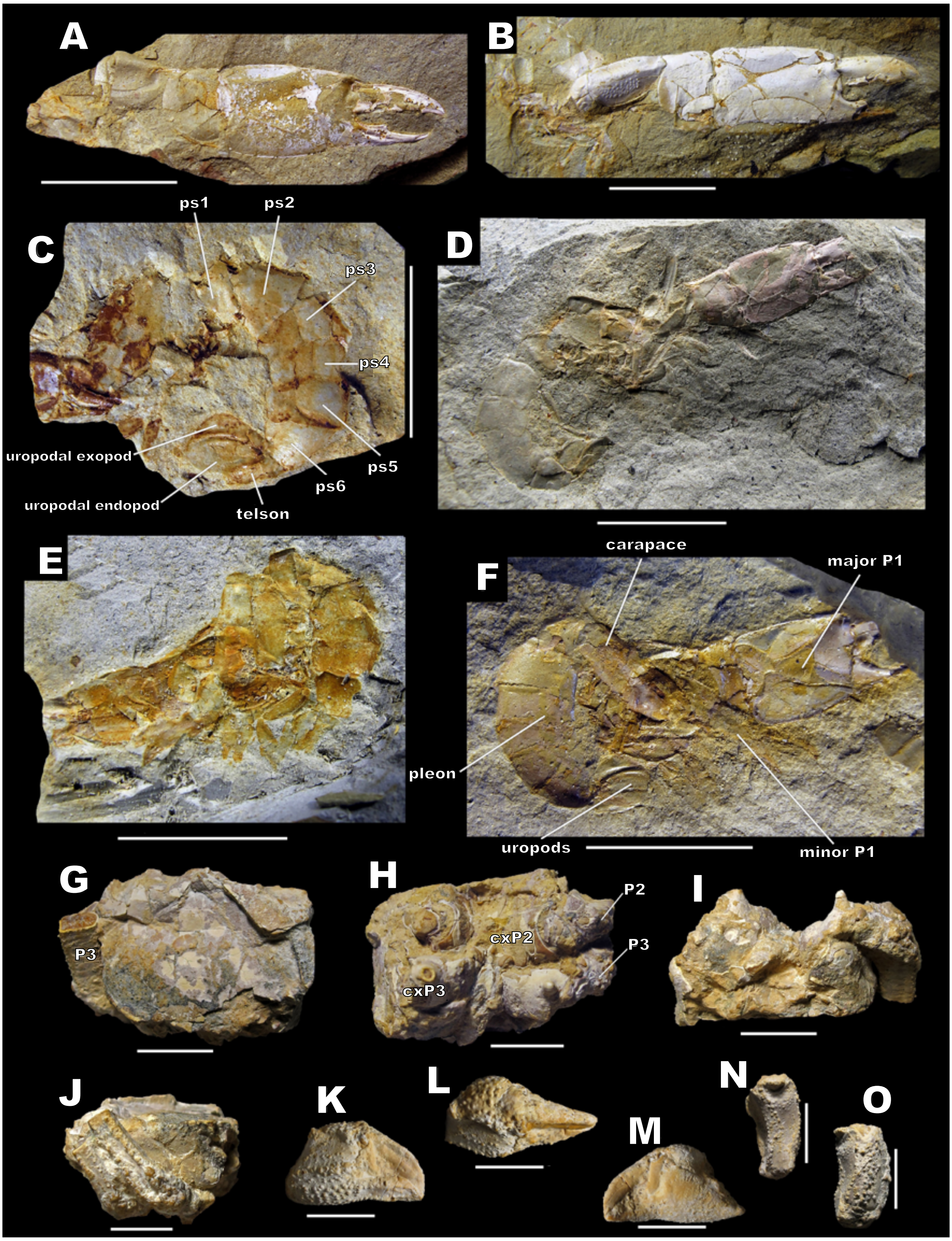

FIGURE 11. *Cretagourretia salasi* n. gen., n. sp., from the outcrop by CV-13, Escucha Fm., lower Albian (Lower Cretaceous) of Torreblanca (Valencian Country, Spain). A) paratype MGUV-40166, right major cheliped preserved in outer lateral aspect; B) paratype, MGUV-4167, right major cheliped preserved in outer lateral aspect; C) paratype, MGUV-40171, dorsal carapace with pleon; D) paratype, MGUV-40169a, near-complete individual; E) paratype, MGUV-4170, near-complete individual; F) paratype (counterpart), MGUV-40168b, near-complete individual. G-O: MGUV-40144a-c, podotremata indeterminate from the outcrop by AP-7, Benassal Fm., upper Aptian (Lower Cretaceous) of Alcalà de Xivert (Valencian Country, Spain). K) dorsal view of the partial carapace, MGUV-40144a; L) ventral view of carapace; M) posterior view of carapace; N) left lateral view of carapace; O) outer side of the right propodus MGUV-40144c; P) upper margin of right propodus; Q) inner side of right propodus; R) inner side of the left merus MGUV-40144b; S) outer side of left merus. Abbreviations: cxP2, P3= coxa pereiopods; P1-P3= pereiopods; ps= pleonal somite. Scale bar equal to 10mm. Photographs by À. Ossó.

times longer than carpus, upper margin converging distally, lower margin straight and finely serrated; fixed finger half as long as manus, occlusal margin with distinct proximal tooth, tip pointed, lateral surface with row of distinct setal pores; dactylus robust, upper margin curved, occlusal margin with two broadly spaced teeth, tip bent. Minor P1 ischium and merus similar to major P1; carpus slightly shorter than manus; manus approximately two times longer than high, lower margin concave at junction with fixed finger; fixed finger slightly bent downward, occlusal margin with small, uniformly sized teeth; dactylus long, slender, tip bent.

Pereiopods 2 (P2) chelate; ischium short; merus robust, approximately three times longer than high, highest at mid-length; carpus vase-shaped, highest distally; manus very short, higher than long; fingers short and stout. Pereiopods 3 (P3) simple; carpus elongate, tapering distally, highest at two thirds of length; propodus linear, approximately three times longer than high, with small heel proximally; dactylus short.

Pereiopods 4 (P4) simple; merus elongate; carpus oval; propodus two times longer than high; dactylus short.

Pereiopods 5 (P5) insufficiently preserved.

Remarks. In the studied material consisting of tens of specimens, no major variation is observed as the morphology concerns. The slight variation can be identified in the shape of major P1 fingers; this type of variation fits well the intraspecific variation of ghost shrimps as documented in many extant and fossil taxa (Hyžný and Klompmaker, 2015 and references therein). No distinct morphotypes have been observed.

The specimens of *Cretagourretia salasi* n. gen. et n. sp. are often preserved as near-entire individuals with pleon, carapace and appendages still intact. In these cases, the chelipeds are positioned anteriorly to the rest of the body, while the carapace is often flipped over and pleon is bent inward so that the telson points anteriorly. Such specimens can be interpreted as moults as discussed by Hyžný and Klompmaker (2015). Other specimens include detached major P1 chelipeds, which are otherwise fairly complete and thus represent cheliped disassociation units *sensu* Bishop and Williams (2005; see also Hyžný and Klompmaker, 2015). The species is known only from its type locality.

Infraorder: Brachyura LATREILLE, 1802
Section: Podotremata GUINOT, 1977

Podotremata gen. et sp. indet.
Figure 11K-S

Locality. Outcrop by AP-7 section, Alcalà de Xivert (Comarca of Baix Maestrat, Valencian Country, Spain).

Stratigraphical horizon. Benassal Fm., upper Aptian (Lower Cretaceous) of Orpesa Sub-Basin (Maestrat Basin).

Studied material and measurements (in mm). One partial dorsal and ventral crushed carapace, preserving cuticle, and an isolated right merus and propodus. Carapace MGUV-40144a, carapace length= 21, width= 28; merus, MGUV-40144b, length= 17, height= 9.5; propodus, MGUV-40144c, length= 21, height= 12.

Description. Carapace probably subquadrate, frontal and posterior margins not preserved. Dorsal surface flattened, smooth, except minute granulation on the lateral edges. Lateral margins subparallel, sharp-edged. Posterolateral corner rounded. Lateral sides of carapace subvertical, perpendicular to dorsal surface. Regions not defined. Cervical or branchial groove well marked at the left lateral side of carapace. Sterno-pleonal depression strongly sunken. Thoracic sternum extremely narrow, remains of sternites barely visible Anterior sternites preserved as a conspicuously narrow crown. Remains of what appears to be the buccal cavity, broad subrectangular, deep. Basis and coxa of P2, P3, extremely strong; coxa of P3 bearing a medial conical, acute spine upwardly directed, probably involved in pleonal holding. Merus of P2 and P3, long, robust, subrectangular in section, with outer edges spiny. Merus of right cheliped strong, subtrapezoidal in section, edge areas granulated. Propodus of right cheliped strong; palm subtrapezoidal, outer side strongly convex and granulated, mainly in its proximal half, below a longitudinal medial spiny carina; upper margin broad, flattened, strongly granulated; lower margin broadly convex in section; inner side convex, smooth; dactyli robust, as long as the palm, dactylus strongly curved; pollex slightly curved downward.

Remarks. The fragmentary condition of the remains seriously hampers a systematic approach beyond of the brachyuran condition of this fossil, indicated by the presence of a thoracic sternum, shape of its partial dorsal carapace and shape of pereiopods and cheliped remains. The parallel and sharp-edged margins, and the vertical lateral walls of the carapace, strongly recall those of the some Longodromitidae SCHWEITZER AND FELDMANN, 2009, such as *Antarctiprosopon* SCHWEITZER AND FELDMANN, 2011 (*e.g.* Schweitzer *et al.*, 2012, fig. 3a-d), *Cuchiadromites* OSSÓ, VAN BAKEL AND FERRATGES, 2021 (see Ossó *et al.*, 2021, fig. 2), or *Garrafosopon* OSSÓ, VAN BAKEL AND ARTAL, 2023 (see Ossó *et al.*, 2023, fig. 7F-I), but whose sterno-pleonal features are unknown, and the dorsal surface is strongly rugose and irregular. A combination of a narrow thoracic sternum, robust coxae, and poorly differentiated dorsal regions, are also seen in the dakoticancroid *Ibericancer* ARTAL, GUINOT, VAN BAKEL AND CASTILLO, 2008, but in any case, its thoracic sternum, albeit narrow, is broader than the remains herein examined, and its propodi are much slenderer and more elongated (see Artal *et al*., 2008, figs. 4-10). Another dakoticancroid *Avitelmessus grapsoideus* Rathbun, 1923 (see Rathbun, 1923, pl. 1, pl. 2, fig. 4), presents a cheliped very similar to that one of the studied remains, but its thoracic sternum is much broader if compared with the extremely narrow sternum of our specimen. For the time being, we leave these remains in open nomenclature.

Subsection: Gymnopleura BOURNE, 1922
Superfamily: Palaeocorystoidea LŐRENTHEY, *in* LŐRENTHEY AND BEURLEN, 1929
Family: Necrocarcinidae FÖRSTER, 1968
Subfamily: Necrocarcininae FÖRSTER, 1968

GENUS ***Necrocarcinus*** BELL, 1863

TYPE SPECIES: *Orythia labeschii* EUDES-DESLONGCHAMPS, 1835, by subsequent designation of Withers (1928: 456).

Species included: (*sensu* VAN BAKEL *et al*., 2022). *Necrocarcinus bodrakensis* LEVITSKYI, 1974; *N. christinae* VAN BAKEL, OSSÓ AND JACKSON, 2022; *N. davisi* BISHOP, 1985; *N. gorbenkoi* MYCHKO, SCHWEITZER, FELDMANN AND SHMAKOV, 2023; *N. inornatus* BRETON AND COLLINS, 2011; *N. labeschii* EUDES-DESLONGCHAMPS, 1835 [as *Orythia labeschii*]; *N. mariae* OSSÓ, VAN BAKEL AND ARTAL, in Ossó *et al*., 2023; *N. olsonorum* BISHOP AND WILLIAMS, 1991; *N. rathbunae* ROBERTS, 1962; *N. senonensis* SCHLÜTER, in VON DER MARCK AND SCHLÜTER, 1868; *N. tauricus* ILYIN AND ALEKSEEV, 1998; *N. texensis* RATHBUN, 1935; *N. undecimtuberculatus* TAKEDA AND FUJIYAMA, 1983 and *N. woodwardii* BELL, 1863.

Necrocarcinus mariae OSSÓ, VAN BAKEL AND ARTAL, in Ossó *et al*., 2023
Figure 12A-C

2022 *Necrocarcinus* n. sp.; Ossó, van Bakel, Artal and Moreno-Bedmar, p. 81, fig. 2I.
2023 *Necrocarcinus* sp.; García-Penas *et al.,* t. 1.
2023 *Necrocarcinus*; Mychko, Schweitzer, Feldmann and Shmakov, p. 38.
2023 *Necrocarcinus mariae* Ossó, Van Bakel and Artal, in Ossó *et al*., pp. 18-20, fig. 8E-H.

Locality. Outcrop by AP-7 section, Alcalà de Xivert (Comarca of Baix Maestrat, Valencian Country, Spain).

Stratigraphical horizon. Benassal Fm., upper Aptian (Lower Cretaceous) of Orpesa Sub-Basin (Maestrat Basin).

Studied material and measurements (in mm). Two almost complete dorsal carapaces, partially preserving cuticle. MGUV-40146, length= 13.5, width=16. MGUV-40145, length= 11, width= 12.

Diagnosis. See Ossó *et al.* (2023, pp. 18, 19).

Description. Small sized carapace, rounded subpentagonal outline, slightly convex in both directions, slightly wider than long; maximum width in anterior half of carapace at level of epibranchial spine; regions well-marked by eleven prominent tubercles and grooves. Front and rostrum not well preserved but appear to be projected beyond orbits. Orbits small, rounded, directed forwards; supraorbital margin raised, bearing two fissures; outer orbital spine strong, prominent. Anterolateral margins broadly arched, concave in lateral view, armed with five spines, last one (epibranchial) the largest, fine dentition is observed between the fourth and fifth spine. Posterolateral margins straight to slightly convex, converging backwards, finely spinose; a post-epibranchial spine is placed immediately adjacent to the epibranchial spine. Posterior margin convex. Dorsal regions defined by grooves and marked by eleven tubercles: three gastric, six branchial, one urogastric and one cardiac. Hepatic region depressed, smooth, with one minuscule spine at the base of outer orbital spine; small and prominent sub-hepatic tubercle. Mesogastric region subpentagonal elongate bearing one tubercle at the posterior portion. Protogastric lobes slightly swollen, bearing a prominent central tubercle each. Urogastric region demarcated from meso-metagastric region by cervical groove and two gastric pits; reniform, widely V-shaped, bearing an axial tubercle. Cardiac region broad, swollen, with an axial tubercle. Epibranchial region defined by oblique swelling and bearing a prominent and acute tubercle. Mesobranchial region slightly swollen with a medial tubercle. Metabranchial region flattened, bearing a prominent tubercle. The branchial tubercles are aligned longitudinally forming two parallel lines in the posterior half of carapace. Intestinal region transversely narrow, depressed, smooth. Cervical, branchial and branchiocardiac grooves well marked. Sterno-pleonal elements and appendages not preserved.

Remarks. The general shape, and the presence of diagnostic characters such as the eleven dorsal tubercles and the post-epibranchial spine in the two described specimens, matches perfectly with the diagnosis of the recently described *Necrocarcinus mariae*, from the Aptian of the neighboring Garraf Basin (see Ossó *et al*., 2023) and can be assigned to that species with confidence. The differences of *N. mariae* with all the known species listed above, were established in Ossó *et al* (2023, pp. 19, 20). However, a new species of *Necrocarcinus* should be added to the species list, the recently described *N. gorbenkoi,* from the Cenomanian Lyamino Fm. of Moscow

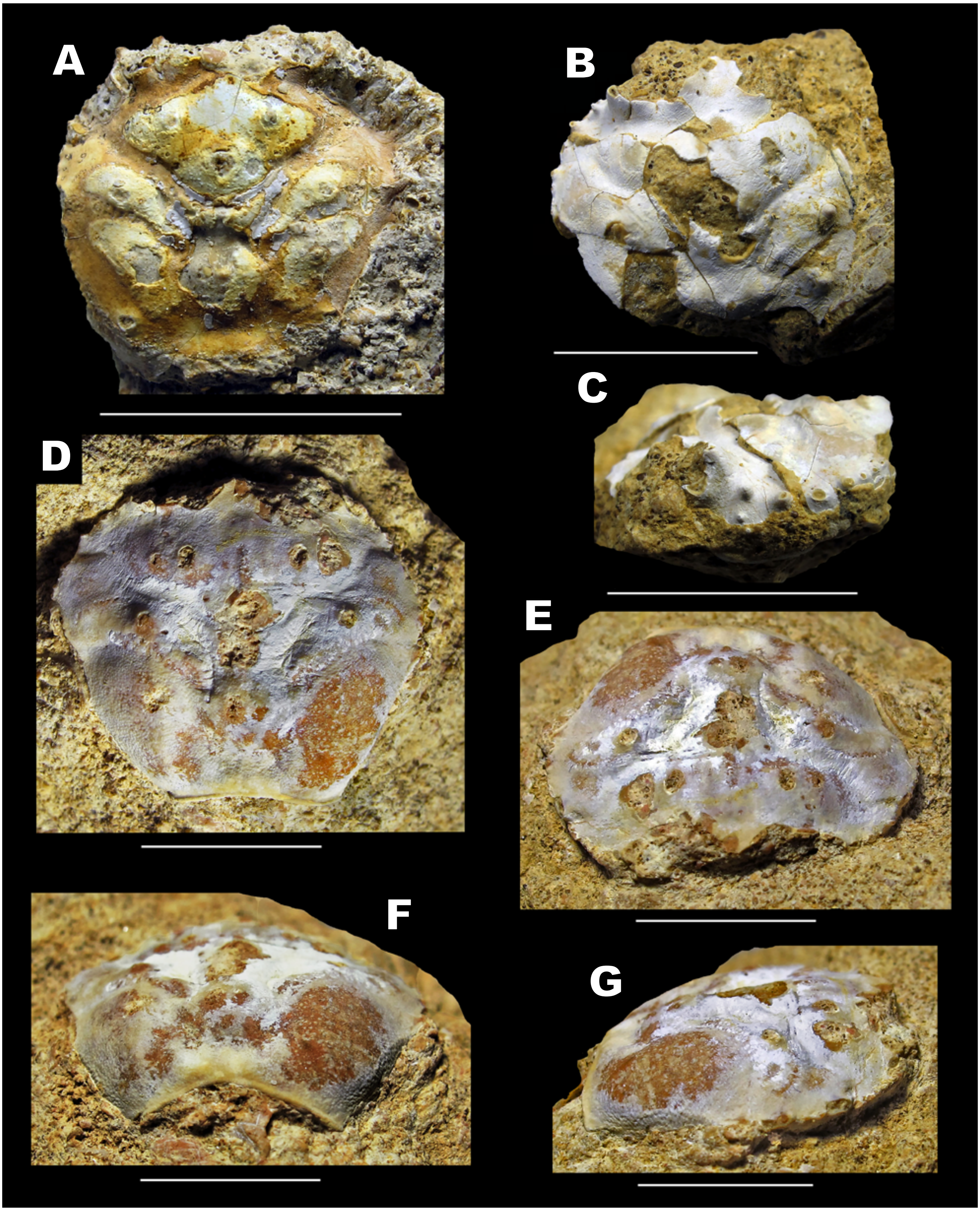

FIGURE 12. A-G: decapods from the outcrop by AP-7, Benassal Fm., upper Aptian (Lower Cretaceous) of Alcalà de Xivert (Valencian Country, Spain). A-C: *Necrocarcinus mariae* OSSÓ, VAN BAKEL AND ARTAL, in Ossó *et al*., 2023. A) MGUV-40145, dorsal view; B) MGUV-40146, dorsal view; C) left lateral view. D-G: *Paranecrocarcinus xivertensis* n. sp. D-G) MGUV-40147, D) dorsal view; E) frontal view; F) posterior view; G) right lateral view. Scale bar equal to 10mm. Photographs by À. Ossó.

Oblast (Russia). The poorly preservation of the holotype of *N. gorbenkoi* hinders a proper comparison with *N. mariae.* However, *N. gorbenkoi* has been diagnosed by having two protogastric tubercles *vs*. only one in *N. mariae*; also, the authors indicated that *N. gorbenkoi* possesses only one branchial tubercle, albeit it seems to have two, one epibranchial and one mesobranchial (see Mychko *et al*., 2023, figs. 2, 6a, t. 2). In any case, *N. mariae* has three branchial tubercles, which differentiate both species.

Mychko *et al.* (2023, p. 38) referred to *N. mariae* as possibly related to *N. brodakensis,* but this species presents thirteen dorsal tubercles instead of the eleven of *N. mariae*. Also, *N. brodakensis* has a more granular cuticle, lacks the diagnostic post-epibranchial spine, and has a more ovate carapace outline instead of subpentagonal as in *N. mariae* (compare Mychko *et al*., 2023, figs. 3a, b, 6b).

The presence of *Necrocarcinus mariae*, originally described in the Garraf Basin (Catalonia) in the Orpesa Sub-basin (Valencian Country), expands its paleobiogeography to the south-west and its stratigraphic rank to the upper Aptian, thus consolidating this taxon as one of the oldest representatives of the genus.

Subfamily: Paranecrocarcininae FRAAIJE, VAN BAKEL, JAGT AND ARTAL, 2008

GENUS ***Paranecrocarcinus*** VAN STRAELEN, 1936

TYPE SPECIES: *Paranecrocarcinus hexagonalis* VAN STRAELEN, 1936, by monotypy.

Species included: *Paranecrocarcinus balla* VAN BAKEL, GUINOT, ARTAL, FRAAIJE AND JAGT, 2012; *P. hexagonalis* VAN STRAELEN, 1936; *P. libanoticus* FÖRSTER, 1968 and *P. mozambiquensis* FÖRSTER, 1970.

Paranecrocarcinus xivertensis n. sp.
Figure 12D-G
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Type locality. Outcrop by AP-7 section, Alcalà de Xivert (Comarca of Baix Maestrat, Valencian Country, Spain).

Stratigraphical horizon. Benassal Fm., upper Aptian (Lower Cretaceous) of Orpesa Sub-basin (Maestrat Basin).

Etymology. Demonym of Alcalà de Xivert, the outcrop locality.

Studied material and measurements (in mm). One dorsal carapace lacking rostrum and part of supraorbital margins, cuticle barely preserved. MGUV-40147, holotype, length= 19, width= 21.

Diagnosis. Dorsal carapace rounded subhexagonal, gently arched in both directions, maximum width at slightly anterior of half the carapace length; fronto-orbital width about 0.60. Front protruding beyond orbits; supraorbital margins with two fissures; post-frontal slits present. Anterolateral margins gently arched, with numerous small spines, notched by cervical groove; posterolateral margins slightly convex; posterior margin strongly concave, rimmed. Regions moderately defined, generally swollen; mesogastric region with one tubercle on posterior portion; protogastric lobes with two tubercles each; urogastric region broadly V-shaped; cardiac region diamond shaped. Epibranchial region with one tubercle; meso- and metabranchial regions forming two swollen parallel longitudinal ridges. Sterno-pleonal elements and appendages unknown.

Description. Dorsal carapace rounded subhexagonal, moderately arched in both directions, cuticle finely granulated, maximum width at slightly anterior of half the carapace length; fronto-orbital width about 0.60. Front not preserved but appears to be protruding beyond orbits; orbits directed forwards, supraorbital margins slightly raised, remains of two fissures present. Anterolateral margins gently arched, notched by cervical groove, weakly concave in lateral view, armed with numerous small, blunt spines, scar of broken epibranchial spine suggests it was larger but not very developed. Posterolateral margins slightly convex, backwards converging, edge rounded in cross section, defined by a fine rim of granules. Posterior margin strongly concave in both dorsal and posterior views, rimmed, about 0.50 of carapace width. Regions moderately defined, generally swollen. Hepatic region small, swollen, crescent-shaped. Epigastric region flattened, presents two post-frontal slits. Mesogastric region elongate subpentagonal, presents remains of one tubercle on its posterior portion. Protogastric lobes slightly swollen, with two laterally contiguous tubercles each. Urogastric region slightly swollen, broadly V-shaped. Cardiac region diamond shaped, slightly swollen, with three small tubercles, two anterior and one posteriorly placed. Epibranchial region broadly arched, formed by one inner lobe adjacent to the branchiocardiac groove, medial portion inflated bearing one tubercle, and a lateral crescent-shaped thin ridge ending at level of the epibranchial spine; meso- and metabranchial regions fused, swollen, forming two swollen parallel longitudinal blunt ridges weakly converging posteriorly. Intestinal region defined by two transversely contiguous swellings. Cervical groove shallow, weakly defined, gastric pits present; branchial groove shallow, defined by muscle scars; branchiocardiac grooves deep. Sterno-pleonal elements and appendages not preserved.

Remarks. The rounded subhexagonal outline, the gently arched and finely spiny anterolateral margins, the shallow and faintly defined cervical and branchial grooves, and the possible presence of two post-frontal slits, match well with the diagnosis of *Necrocarcinidae* proposed by Van Bakel *et al.* (2012, pp. 58-60), and in particular with that of *Paranecrocarcininae* (see Fraaije *et al*., 2008, p. 201; Schweitzer *et al.,* 2018, p. 12). The presence of the two minute post-frontal slits that the studied specimen shows, could concur with the fact that the common post-frontal slits in that family, do not penetrate through the cuticle, which is practically absent in the specimen, which could justify the diminutive size of those slits, rather than a product of erosion or preservation (see Schweitzer *et al*., 2018, p. 12). The absence of prominent tubercles on most of the dorsal regions, and by having smooth posterolateral margins, precludes its assignment to *Necrocarcininae* (see Van Bakel *et al*., 2021, t. 1). The tuberculate dorsal carapace of *Pseudonecrocarcinus* FÖRSTER, 1968, discards the assignment of our specimen to that genus (*e.g.* Schweitzer *et al*., 2018, pp. 12-14, fig. 7.3a-d). Instead, the aforementioned features of the studied specimen, fit well with the diagnosis of *Paranecrocarcinus* (*e.g.* Schweitzer *et al*., 2018, p. 12, fig. 6.1). Relationship with members of *Orithopsidae* SCHWEITZER, FELDMANN, FAM, HESSIN, HETRICK, NYBORG AND ROSS, 2003 is excluded since that family is diagnosed as having a strongly spinose fronto-orbital margin, anterolateral margins short, and sometimes an axial ridge, feature not seen in the studied specimen (see Schweitzer *et al*., 2018, p. 8, figs. 5, 6). We consider that placement in *Paranecrocarcinus* is appropriate, until additional specimens appear that can confirm such placement.

Comparison with all the assigned *Paranecrocarcinus* species result as follow. *Paranecrocarcinus balla*, from the Cenomanian of Sarthe (France) differs from *P. xivertensis* n. sp. in having a narrower fronto-orbital margin, about 0.53, which is smaller than the posterior margin, which does not occur in *P. xivertensis* n. sp.; as well it has two pairs of post-frontal slits instead of two minute pits; anterolateral margin not notched by cervical groove, and posterolateral margin sharp-edged instead of rounded in cross section; one mesobranchial tubercle, not present in the new species; and cervical and branchial grooves barely visible, instead of weakly marked in *P. xivertensis* n. sp, separates both species. (see Van Bakel *et al*., 2012, pp. 60-62, fig., 19A, C, E, G). *P. hexagonalis*, the type species of the genus, from the Hauterivian of Yonne (France), has more prominent and medially placed protogastric tubercles and the branchial ridges not so clearly marked than in *P. xivertensis* n. sp., as well as the anterolateral margins not notched by the cervical groove, and the postfrontal slits are longitudinal and clearly visible, which differs from the proposed new species (see Förster, 1968, pl. 13, fig. 2; Van Bakel *et al*., 2021, fig. 6E; Van Straelen, 1936, pl. 4, figs. 6, 7). *P. libanoticus*, from the Cenomanian of Hadjoula (Lebanon), of which only a single specimen is known, albeit possible additional specimens reported from France and UK by Breton and Collins (2011, p.149, 150, fig. 9), has the anterolateral margins poorly preserved, which makes the comparison with our specimen difficult; however, the tubercles in the dorsal regions are larger than in the new species, and the absence of two swollen parallel longitudinal ridges in *P. xivertensis* n. sp. differentiate both species (see Charbonnier *et al*., 2017, pp. 189, 190, figs. 420, 421; Förster, 1968, fig. 2, pl. 13, fig. 1). *P. mozambiquensis*, from the lower Cenomanian of Maputo (Mozambique), clearly differs from *P. xivertensis* n. sp. in having more arched anterolateral margins, only one tubercle in each protogastric lobe, and stronger meso- metagastric tubercle undifferentiated from the urogastric region (see Förster, 1970, figs. 2B, 3B, pl. 17, fig. 4; Schweitzer *et al*., 2018, fig. 7.1). In view of the aforementioned differences, the proposal of a new species, within *Paranecrocarcinus*, for the studied specimen seems appropriate.

Family: Palaeocorystidae LŐRENTHEY *in* LŐRENTHEY AND BEURLEN, 1929

GENUS ***Joeranina*** VAN BAKEL, GUINOT, ARTAL, JAGT AND FRAAIJE, 2012

TYPE SPECIES: *Corystes broderipii* MANTELL, 1844, by designation of Van Bakel *et al*., 2012.

Species included: *Joeranina broderipii* (MANTELL, 1844) [as *Corystes*]; *J. colombiana* BERMÚDEZ, GÓMEZ-CRUZ AND VEGA *in* BERMÚDEZ, GÓMEZ-CRUZ, HYŽNÝ, MORENO-BEDMAR, BARRAGÁN, SÁNCHEZ AND VEGA, 2013; *J. gaspari* VAN BAKEL, GUINOT, ARTAL, JAGT AND FRAAIJE, 2012; *J. goshourajimensis* KARASAWA AND KOMATSU, 2013; *J. harveyi* (WOODWARD, 1896) [as *Palaeocorystes*]; *J. houssineaui* VAN BAKEL, 2013; *J. japonica* (JIMBÔ, 1894) [as *Eucorystes japonicus*]; *J. kerri* (LUQUE, FELDMANN, SCHWEITZER, JARAMILLO AND CAMERON, 2012) [as *Notopocorystes*]; *J. paututensis* (COLLINS AND WIENBERG RASMUSSEN, 1992) [as *Notopocorystes* (*Cretacoranina*)]; *J. platys* (SCHWEITZER AND FELDMANN, 2002) [as *Eucorystes*]; *J. syriaca* (WITHERS, 1928) [as *Notopocorystes syriacus*].

Joeranina gaspari VAN BAKEL, GUINOT, ARTAL, JAGT AND FRAAIJE, 2012

Figure 13A-G

2012 *Joeranina gaspari*; Van Bakel, Guinot, Artal, Jagt and Fraaije, p. 40, figs. 11C, E–F; 12A–D.

2014 *Joeranina gaspari* Van Bakel *et al.,* 2012; Karasawa *et al*., p. 242, t. S2.

2017 *Joeranina gaspari* Van Bakel *et al.*, 2012; López-Horgue and Bodego, pp. 9, 10, 22.

2022 *Joeranina gaspari* Van Bakel *et al.*, 2012; López-Horgue *et al.*, t. 1, figs. 5.2, 3, 5, 6.

Locality. Outcrop by AP-7 section, Alcalà de Xivert (Comarca of Baix Maestrat, Valencian Country, Spain).

Stratigraphical horizon. Benassal Fm., upper Aptian (Lower Cretaceous) of Orpesa Sub-Basin (Maestrat Basin).

Studied material and measurements (in mm). Seven specimens, from fragmented to complete dorsal carapaces, partially preserving cuticle. MGUV-40152, length= 20.5, width= 15.5. MGUV-40152, length= 15.5, width= 13.5. MGUV-40154 length= 21, width= 17.5. MGUV-40149, length= 18.5, width= 13. MGUV-40148, length= 14.5, width= 12. MGUV-40153 length= 16, width= 12. MGUV-40150, length= 18, width= 17.

Description. Carapace longitudinally ovate, transversely convex, flattened longitudinally, longer than wide, maximum width at anterior half of carapace, at last anterolateral (epibranchial) tooth level; fronto-orbital margin very broad, about 75 percent of maximum carapace width. Rostrum narrow, elongated, projected beyond the orbits, bifid, with two distal and two subdistal spines. Orbits broad, two deep supraorbital fissures, the inner ones more opened; supraorbital spine blunt subtriangular; extraorbital spines conical, acute, forwardly directed. Anterolateral margin short, slightly convex, armed with three spines, two at hepatic level and one at epibranchial level. Posterolateral margins longer, weakly convex, sharp and weakly rimmed, entire. Posterior margin short, about 60 percent of carapace width, concave. Dorsal surface finely and densely granulated. Dorsal regions barely defined. Anterior portion of mesogastric region narrow elongated, bounded by shallow grooves. Protogastric lobes barely marked. Urogastric region faintly marked, broadly V-shaped, limited anteriorly by the cervical groove, and posterolaterally by the branchiocardiac grooves, without separation with the cardiac region. Cardiac region flattened, faintly marked, subhexagonal in shape. Intestinal region elongated. Hepatic region with two prominent elongated suborbital protuberances. Epibranchial regions weakly defined between the cervical groove and traces of branchial grooves. Meso- and metabranchial regions indistinguishable from one another. Cervical groove well-defined, complete, medially interrupted and broadly U-shaped, laterally as an inverted V-shape, notching carapace margin. Branchiocardiac grooves deep. Branchial scars visible when cuticle is eroded. Axial carina weakly marked. Sterno-pleonal elements and appendages not preserved.

Remarks. The elongated ovate dorsal carapace, broad fronto-orbital margin, with a narrow and bifid rostrum, short anterolateral margins with two spines, and weakly axial carina, that the reported specimens present, matches well with the diagnosis of *Joeranina* (see Van Bakel *et al.*, 2012, p. 36). And in particular with the diagnosis of *J. gaspari* from the late Albian of Egiarreta (Navarre, Spain) (see Van Bakel *et al.*, 2012, p. 40, figs. 11C; E–F; 12A–D). Indeed, although minimal differences can be observed between the Navarrese specimens and the Valencian ones reported herein, they are not enough to stablish a different species. In the studied specimens, the upper margin of the supraorbital tooth is straight, instead of triangular as in the Navarrese specimens, and the axial carina is even less marked. As well, the posterolateral margin appears to be entire, albeit a glimpse of a minute blunt node at the anterior quarter of the margin could be present, instead of having a small, forwardly directed spine, as the original diagnosis indicates. Those apparent subtle differences could be due to an ontogenic state of the Valencian specimens, given its smaller size in comparison with the Navarrese ones (compare Van Bakel *et al.*, 2012; López-Horgue *et al.*, 2022), or simply a preservational artifact due their incompleteness.

Joeranina tausi n. sp.

Figure 14H-K

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Type locality. Outcrop by CV-13 roadcut, Torreblanca (Comarca of La Plana Alta, Valencian Country, Spain).

Stratigraphical horizon. Escucha Fm., lower Albian (Lower Cretaceous) of Orpesa Sub-Basin (Maestrat Basin).

Etymology. The specific epithet honors Manuel Vicente Taus, from Alcalà de Xivert (Castelló, Spain), who recovered the fauna studied herein.

Studied material and measurements (in mm). Four specimens, represented by internal molds of dorsal carapaces, and some appendages preserved on soft marls, flattened on a bedding plane, cuticle not preserved. MGUV-40176, holotype, length= 11, width= 8. Paratype MGUV-40173a, b, length= 4.5, width=3. Paratype MGUV-40174, length= 10, width= 7.5. Paratype MGUV-.40175 length= 9, width= 7.5.

Diagnosis. Small carapace, longitudinally ovate, transversely convex, flattened longitudinally, longer than wide, ratio length/width about 0.80, maximum width at anterior half of carapace; fronto-orbital margin broad. Rostrum narrow, elongated, bifid. Orbits broad, two supraorbital fissures, supraorbital

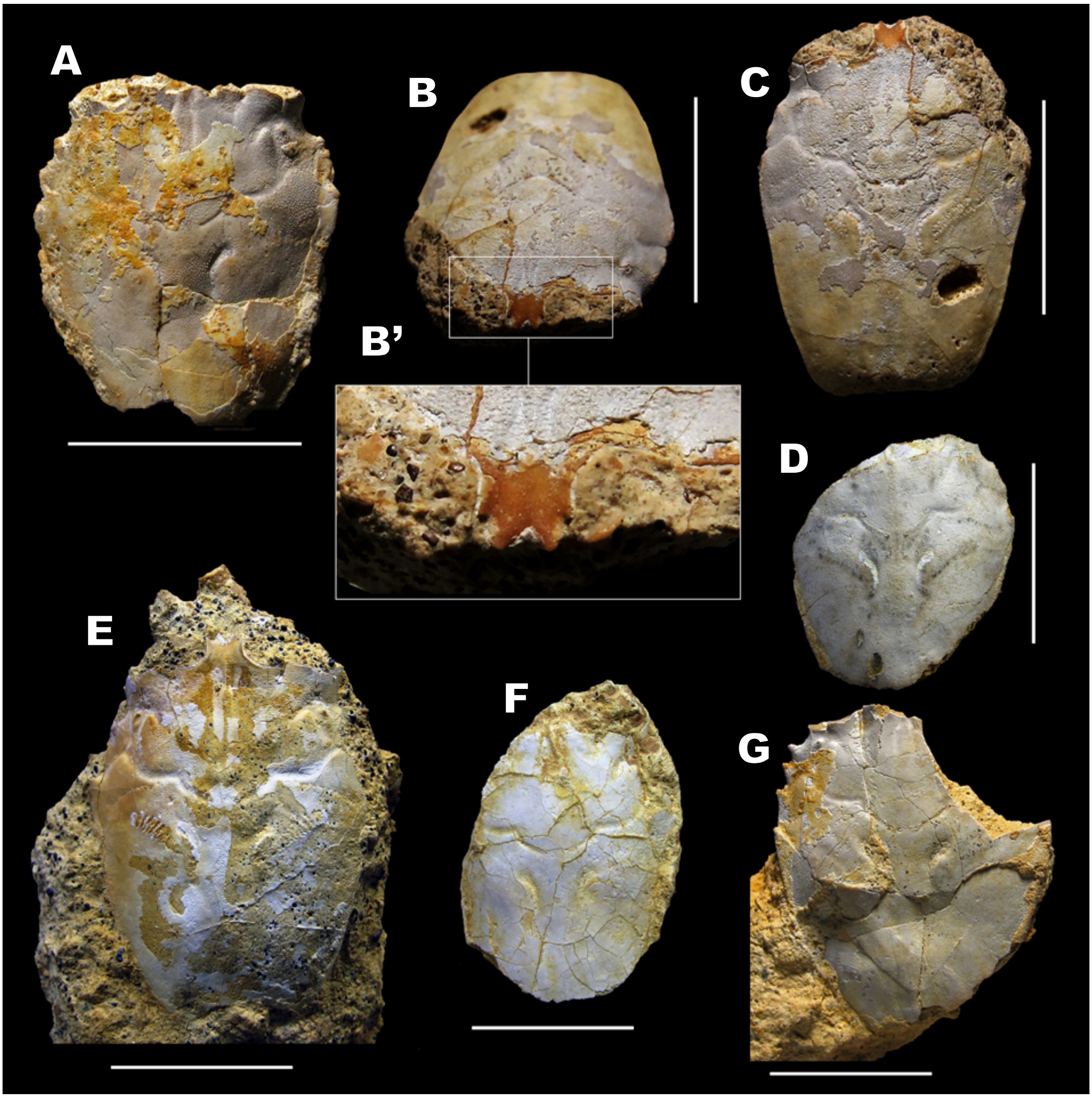

FIGURE 13. A-G: *Joeranina gaspari* VAN BAKEL, GUINOT, ARTAL, JAGT AND FRAAIJE, 2012, from the outcrop by AP-7, Benassal Fm., upper Aptian (Lower Cretaceous) of Alcalà de Xivert (Valencian Country, Spain). A) MGUV-40148, dorsal view; B-B’: MGUV-40149, B) frontal view; B’) close-up of rostrum; C) dorsal view. D) MGUV-40151, dorsal view. E) MGUV-40152, dorsal view. F) MGUV-40153, dorsal view. G) MGUV-40154, dorsal view. Scale bar equal to 10mm. Photographs by À. Ossó.

spine acute subtriangular; extraorbital spines conical, acute, forwardly directed. Anterolateral margin short, bearing three spines. Posterolateral margins longer, entire. Posterior margin about 40 percent of maximum carapace width, concave. Dorsal regions barely defined. Cervical groove broadly U-shaped, laterally less marked. Branchiocardiac grooves deep. Axial carina weakly marked at the anterior half of carapace. P2-P4 ambulatory legs long, flattened.

Description. Small carapace, longitudinally ovate, transversely convex, flattened longitudinally, smooth, longer than wide, ratio length/width about 0.80, maximum width at anterior half of carapace; fronto-orbital margin broad. Rostrum narrow, elongated, projected beyond the orbits, bifid, remains of subdistal spines. Orbits broad, two supraorbital fissures; extraorbital spines conical, acute, forwardly directed. Anterolateral margin short, slightly convex, armed with three spines. Posterolateral margins

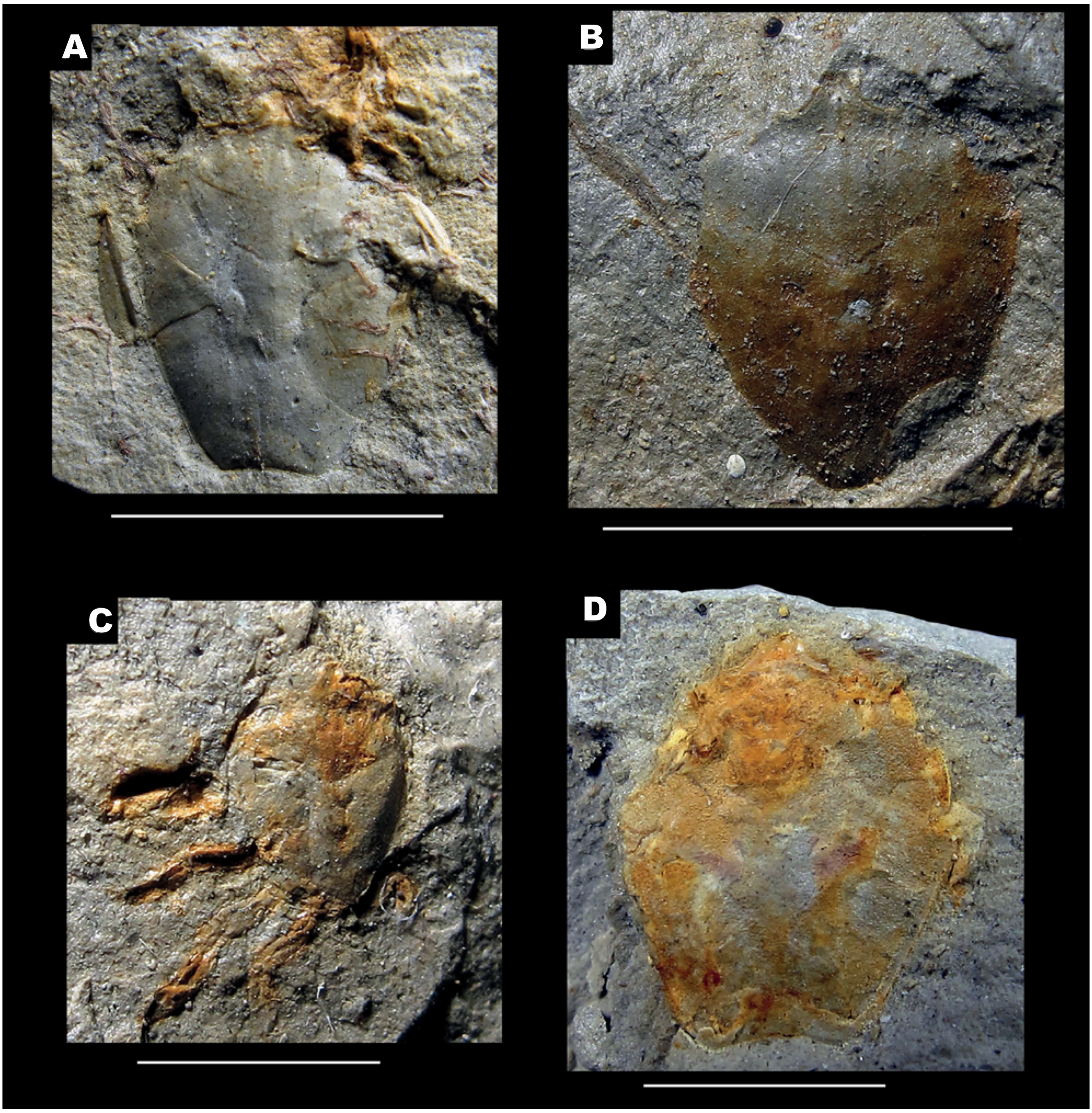

FIGURE 14. A-D: *Joeranina tausi* n. sp., from the outcrop by CV-13, Escucha Fm., lower Albian (Lower Cretaceous) of Torreblanca (Valencian Country, Spain). A) holotype, MGUV-40176, dorsal view; B) paratype, MGUV-40175, dorsal view; C) paratype, MGUV-40173a, dorsal view. D) paratype, MGUV-40174, dorsal view. Scale bar equal to 10mm, except for B and C that is equal to 5mm. Photographs by À. Ossó.

longer, convex, entire. Posterior margin very short, about 40 percent of carapace width, concave. Dorsal regions barely defined. Anterior portion of mesogastric region narrow elongated, bounded by very shallow grooves ending at the basis of the rostrum. Protogastric lobes indistinguishable from posterior portion of mesogastric region. Urogastric region barely marked, broadly reniform, limited anteriorly by the cervical groove, and posterolaterally by the branchiocardiac grooves, separated from the cardiac region by a very shallow transverse groove. Cardiac region elongated, weakly inflated. Intestinal region elongated. Hepatic region with one weak suborbital protuberance. Epibranchial regions weakly defined. Meso- and metabranchial regions indistinguishable from one another. Cervical groove complete, more visible medially and broadly U-shaped, laterally less marked. Branchiocardiac grooves deep. Axial carina weakly marked only at the anterior half of carapace. Sterno-pleonal elements are not preserved. P1 not preserved, P2-P4 ambulatory legs long, flattened.

Remarks. The preservation as internal molds of the specimens of *Joeranina tausi* n. sp., doesn't help in order to compare them with other *Joeranina* species. Nevertheless, compared with *J. gaspari*, the closest, both geographically and stratigraphically, *J. tausi* nov. sp. differs in having a wider carapace, shorter posterior margin, urogastric and cardiac regions well separated, hepatic protuberances weakly marked, cervical groove defined medially and the axial carina only marked anteriorly (compare Fig. 12A-H). Similar differences apply to *J. broderipii,* from the Albian of France and England (*e.g.* Van Bakel *et al*., 2012, fig. 11A, B, D), *J. kerri,* from the upper Aptian of Colombia (see Luque *et al*., 2012, fig. 4A, B), and *J. colombiana,* from the middle Albian of Colombia (see Bermúdez *et al*., 2013, figs. 6L; 7A-K). *J. goshourajimensis, J. paututensis,* and *J. syriaca* from the Late Cretaceous of Japan, Greenland and Syria respectively, present a more sculpted carapace, with regions and grooves more distinctly marked, and the latter features a longer rostrum than *J. tausi* nov. sp. (see Collins and Wienberg Rasmussen, 1992, fig. 17A, B; Karasawa and Komatsu, 2013, figs. 3, 4; Withers, 1928, pl. 13, figs. 1-3). *Joeranina harveyi* and *J. japonica*, from the Upper Cretaceous of British Columbia (Canada) and Hokkaido (Japan), respectively, exhibits much longer and acute anterolateral and fronto-orbital spines than *J. tausi* nov. sp. (see Jimbô, 1894, pl. 9, fig. 7; Woodward, 1896, fig. 4). *J. houssineaui*, from the upper Cenomanian of France, differs from *J. tausi* nov. sp. in having a narrower fronto-orbital margin, a more elongated and narrower dorsal carapace, and more distinctly marked hepatic and protogastric protuberances (see Van Bakel, 2013, figs.1, 2). *J. platys* presents a similar broad carapace outline, with a narrow posterior margin, weakly marked hepatic protuberances, and smooth dorsal surface, similar as in *J. tausi* nov. sp., but differs in having well-defined branchial, cervical, gastro-hepatic grooves, not well marked or absent in the new species (see Schweitzer and Feldmann, 2002, figs. 15, 16).

REMARKS ON PALAEOENVIRONMENT AND PALAEOBIOGEOGRAPHY

In the AP-7 outcrop of Alcalà de Xivert, the limestones and sandy limestones with packstone and grainstone textures including coated and ferruginous grains (Fig. 4C) that make up the stratigraphic record of the basin indicate near coastal platform top carbonate environments. The terrigenous and nutrient inputs favoured the establishment of a rich and varied decapod community dominated by lobsters, some of which were found within burrows. The availability of nutrients derived from the continent possibly contributed to make of this reduced in extent outcrop the richest Cretaceous lobster locality of Iberia known to date.

On the other hand, the presence of marly lithologies and of well-preserved plant remains (Fig. 5H) in the CV-13 roadcut outcrop of Torreblanca indicates a muddy coastal depositional environment. In this outcrop, the faunal assemblage is dominated by axiidean shrimps. The original fine-grained sediments of the setting permitted the preservation after burial of the delicate cephalothoracic and pleonal elements of the axiideans that are usually not preserved in the fossil record (Hyžný and Klompmaker, 2015).

As noted in Ossó *et al.* (2023, p. 24), palaeobiogeographical analysis of decapod assemblages of different Iberian basins, in particular the Maestrat Basin, must be treated with caution, since every novel work reports either new taxa or the discovery of previous described taxa hitherto unknown in these new localities.

For instance, the palaeocorystoid *Necrocarcinus mariae* described from the Aptian of the Garraf Basin, has been also reported herein in the AP-7 outcrop, in Alcalà de Xivert (see Fig. 11A-C). Also, *Rathbunopon tarraconensis* OSSÓ, VAN BAKEL, FERRATGES-KWEKEL AND MORENO-BEDMAR, 2018, originally described from the northern Maestrat Basin (see Ossó *et al.*, 2018 figs. 7, 8), has been recently recognized in the Orpesa Sub-basin (work in progress) and even further south in the Aptian of the Province of Murcia (southeast of Spain). As well as *Pithonoton lluismariaorum* OSSÓ, VAN BAKEL, FERRATGES-KWEKEL AND MORENO-BEDMAR, 2018, from the same locality, also has been recently reported from the north-western part of the Maestrat Basin (see García-Penas *et al.*, 2023, fig. 7A, B; Ossó *et al.*, 2018, figs. 9; 10A-I). Similarly, *Joeranina gaspari* (Fig. 13A-G), firstly described from the Albian of the Basque-Cantabrian basin of Navarre (north of Spain), has been reported in the present study. *Palaeastacus* aff. *sussexiensis* (Fig. 7E-I) and *Hoploparia* aff. *longimana* (Fig. 8A-P) also occur in the Aptian record of the Isle of Wight (U.K.) (*e.g.* Klompmaker, 2013, appendix B). The reported *Palaeastacus* and *Eryma* genera (Fig. 7A-D, 7E-I respectively) show widespread occurrences throughout the North hemisphere of Europe and America (*e.g.* Devillez and Charbonnier, 2022) but had never been reported hitherto in Iberia. On the other hand, the cosmopolitan glypheoids *Atherfieldastacus magnus* (Fig. 9A-F) and *A. rapax* (HARBORT, 1905) are clamorous examples of the wide geographical distribution of some genera and species during the Early Cretaceous (see González-León *et al.*, 2017, 2019).

Cretagourretia salasi represents one of the few Early Cretaceous occurrences of the Ctenochelidae. Together with *Dawsonius tigris* FRANŢESCU, 2014 from the Albian of Texas, USA (Franţescu, 2014), and *Ctenocheles madagascariensis* SECRÉTAN, 1964 from the Albian-Cenomanian of Madagascar (Charbonnier *et al.*, 2012), and thus it represents the oldest occurrence of the respective family.

CONCLUSIONS

The present work increases knowledge of Early Cretaceous decapods from the Tethys, in particular from the Aptian and Albian of the eastern Maestrat Basin. The two reported decapod assemblages presented herein show a relative faunal similarity with other decapod assemblages from different regions and basins, such as the Garraf Basin, and in particular with assemblages from siliciclastic-rich environments of the Basque-Cantabrian Basin or the Isle of Wight. A total of eleven taxa are reported and described, nine from the uppermost Aptian and two from the lowermost Albian, from which one is a new genus and three are new species. The Aptian locality of Alcalà de Xivert constitutes the richest known Cretaceous lobster locality of Iberia, where five lobster genera have been recognized, two of which are recorded for the first time in the Iberian Cretaceous. The Albian locality of Torreblanca, yielded numerous well-preserved near-complete axiidean shrimps, representing one of the oldest occurrences of the Ctenochelidae.

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