Crab carapaces preserved in nautiloid shells from the Upper Paleocene of Huesca (Pyrenees, Spain)

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ABSTRACT

Carapaces of three species of crab, found within specimens of the nautiloid Eutrephoceras, are described from the Upper Paleocene of Huesca (Pyrenees, Spain). This is the first record of the use by crabs of empty cephalopod shells for moulting from the Cenozoic; this phenomenon may have been more widespread.

Key words: crab, nautiloids, inquilinism, Paleocene, Pyrenees, Spain.

RESUMEN

Caparazones de tres especies de cangrejos, encontrados dentro de especímenes del nautiloideo Eutrephoceras, son descritos del Paleoceno Superior de Huesca (Pirineos, España). Este es el primer registro del uso por cangrejos de conchas vacías de cefalópodos en el proceso de muda en el Cenozoico; este fenómeno pudo haberse presentado también en otros periodos de tiempo.

Palabras clave: cangrejo, nautiloideos, inquilinismo, Paleoceno, Pirineos, España.

INTRODUCTION

Paleogene strata in the central Pyrenees (Spain) have yielded comparatively rich decapod crustacean faunas (*e.g.*, Via, 1969; Artal and Via, 1988; Fraaye, 1995). During fieldwork in the Tremp area in recent years, the authors noted the occurrence of well-preserved gastropods and decapod crustaceans within nautiloid shells in the Paleocene-Eocene Ager Formation. Although there are numerous reports of extant decapod crustaceans which use live and/or dead organisms as a host or refuge (*e.g.*, Morton, 1989; Feldmann *et al.*, 1996), fossil examples are much rarer. From Palaeozoic deposits, a number of trilobites that apparently sought shelter within nautiloid cephalopods have been described by Davis *et al.* (2001), and suites of decapod crustaceans within Mesozoic ammonite and nautiloid shells have been recorded by Fraaye and Jäger (1995) and Schulz (2002). A recent find of a nautiloid shell from the Turonian (Upper Cretaceous) of NW Germany with a brachyuran preserved inside will be described shortly. The three examples of nautiloid/decapod crustacean associations highlighted below are first examples known from Cenozoic strata known to the authors.

DESCRIPTION OF SPECIMENS

All specimens studied originate from a small ravine about 3 km northwest of Puebla de Roda, to the north of the road leading to the small town of Carrasquero. Deposits exposed here are within the Ager Formation; the section is

situated between sections Y and X as described by Gaemers (1978). That author mentioned numerous fragmentary decapod remains as well as the nautilid *Eutrephoceras* sp. from the *Fasciolites moussoulensis* (alveolinid foraminifer) Unit about 3 km north of La Puebla de Roda, assigning to this unit a latest Paleocene age.

Specimen 1

The smallest specimen of *Eutrephoceras* (MAB reg. nr. k2401) has a diameter of 65 mm and contains a relatively small (maximum carapace length and width: 15 and 17 mm respectively) carapace of *Glyphithyreus wetherelli* (Bell, 1858) in the anterior half of the body chamber (Figure 1.1).

Glyphithyreus is a common and widely distributed genus in the Lower Eocene, with records from Belgium, Denmark, Germany, Italy, Spain, UK, Egypt, and Senegal (Remy and Tessier, 1954; Via, 1969; Glaessner, 1969; Karasawa and Schweitzer, 2004).

Via (1969) described one specimen of *Glyphithyreus wetherelli* from the province of Catalonia, while Solé and Via (1989), in their compilation of Catalonian decapod crustaceans, referred to six specimens, one of them from Puebla de Roda, very near to the outcrop which produced the present specimen.

Specimen 2

The second nautiloid, also assigned to *Eutrephoceras*, is only partially preserved. It had a reconstructed diameter of about 300 to 400 mm. A single, broken piece of a larger carapace of *Eocarpilius* sp. (B. van Bakel personal communication) (MAB reg.nr.k2402) is seen to lie between the second and fifth phragmocone chambers (in part damaged), counting from the body chamber. The third and fourth septa have been broken away (Figure 1.2).

The preserved portion of the carapace comprises the frontal and left anterolateral regions; the estimated width would have been 80 mm, its length was about 50 mm.

Specimen 3

The third example is a carapace of *Palaeocarpilius* (B. van Bakel, personal communication) (MAB reg.nr. k2403), situated in the anterior half of a wide body chamber of an *Eutrephoceras*, with a largest diameter of around 43 mm (Figure 1.3).

DISCUSSION

Within the subfacies XIIa of the Paleocene-Eocene in the Tremp Basin, as recognised by Gaemers (1978), the high diversity and common presence of large conchs of *Eutrephoceras* aff. *lamarcki* (Deshayes, 1835) are notable. Gaemers's subfacies XIIa comprises grey biomicritic irregular to nodular bedded limestones and marls wich have yielded the following fossil groups: Foraminifera (*Nummulites*, *Operculina*, Miliolida), epifaunal bivalves (*Spondylus*, Chamidae, Pectinidae, Ostreidae), infaunal bivalves (Cardiidae, Carditidae, Lucinidae, *Crassatella*, *Fimbria*), epifaunal gastropods (Cypraeidae, *Xenophora*, *Clavilithes*, *Rostellaria*, Naticidae), terebratulid brachiopods, corals, regular and irregular echinoids, bryozoans, serpulids, fish remains, and *Conocrinus*. This diverse fauna is indicative of a warm, shallow marine setting.

Sheltered preservation (*i.e.*, hiding during ecdysis) is the most likely explanation for the occurrence of decapod crustaceans found within cephalopod shells discussed by Fraaye and Jäger (1995), Davis *et al.* (2001) and Schulz (2002) and described herein.

Whereas ammonoid cephalopods and other molluscs (*e.g.*, Inoceramidae and rudists) became extinct at the end of the Cretaceous, nautiloid cephalopods, inclu-

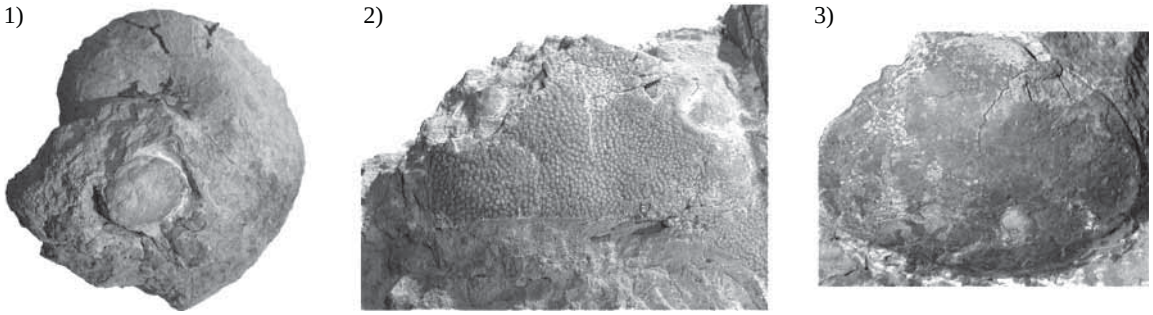

Figure 1. 1: *Eutrephoceras* (MAB k2401) with *Glyphithyreus wetherelli* (Bell, 1858) in the anterior half of the body chamber, X0.8. 2: *Eutrephoceras* (MAB k2402) with piece of carapace of *Eocarpilius* sp., X0.8. 3: *Eutrephoceras* (MAB k2403) with *Palaeocarpilius* sp. in the anterior half of the body chamber, X1.0.

ding *Eutrephoceras*, survived perturbations across the Cretaceous-Paleogene (K/Pg) boundary (Stilwell and Grebneff, 1996). During the later Mesozoic, decapod crustaceans became adapted to living in empty ammonite conchs, but they had to find other shelters in the post-Cretaceous period to hide in during ecdysis. Pagurids (hermit crabs), for instance, changed from ammonite shells to gastropods (Fraaije, 2003) and it appears that brachyurans changed at least in part from ammonites to nautiloid shells. After a crisis during the Early Paleocene, the nautiloids recovered in the Late Paleocene–Early Eocene and expanded to high latitudes (Dzik and Gazdzicki, 2001). After this short-lived explosion, nautiloid abundance and species richness dwindled again and brachyurans were faced with another change, this time to larger gastropods. Some examples of such a link, of Pliocene age, were supplied by van Bakel *et al.* (2004); a perfectly preserved sand crab found within a Miocene gastropod from France (Fraaije *et al.*, in prep) is another instance. Sometime during the Cenozoic, the brachyurans also adapted to live within (inquilinism) live hosts such as mussels and brachiopods (*e.g.*, Feldmann *et al.*, 1996).

The crab *Glyphithyreus* and the nautiloid *Eutrephoceras* both had a worldwide distribution during the Late Paleocene–Early Eocene, so it is likely that the present report of a moult of that crab within *Eutrephoceras* will lead to more finds from other regions. There appears to be a size-correlation, in which smaller crabs used smaller nautiloid shells and larger ones preferred larger conchs.

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REFERENCES

Artal, P., Via, L., 1988, *Xanthilites macrodactylus pyrenaicus* (Crustacea, Decapoda) nueva subespecies del Ilerdiense medio del Pirineo de Huesca: Batalleria, 2, 57-61.

Bakel, B.W.M. van, Jagt, J.W.M., Fraaije, R.H.B., Wille, E.R.H., 2004, Piacenzian (Pliocene) decapod crustacean faunules from northwest Belgium: Bulletin of the Mizunami Fossil Museum, 30(2003), 97-108.

Bell, T., 1858, A monograph of the fossil malacostracous Crustacea. Part 1, Crustacea of the London Clay: Palaoentographical Society of London, Monography, 1858, 1-44.

Davis, R. A., Fraaye R.H.B., Holland, C.H., 2001, Trilobites within nautiloid cephalopods: Lethaia, 34, 37-45.

Deshayes, G.P. 1835, Mollusques, *in* Bory de Saint-Vincent, M., Expédition scientifique de Morée, Travaux de la Section des Sciences Physiques (1832-1836), t. 3, 1. ptie. Zoologie, 1. sect. Animaux vertébrés, mollusques et polypiers: Paris, Strasbourg, F.G. Levrault, 81-203.

Dzik, J., Gazdzicki, A., 2001, The Eocene expansion of nautilids to high latitudes: Palaeogeography, Palaeoclimatology, Palaeoecology, 172, 297-312.

Feldmann, R.M., MacKinnon, D.L., Endo, K., Chirino-Galvez, L., 1996, *Pinnotheres laquei* Sakai (Decapoda: Pinnotheridae), a tiny crab commensal with the brachiopod Laques rubellus (Sowerby) (Terebratulida; Laquridae): Journal of Paleontology, 70, 303-311.

Fraaye, R.H.B., 1995, A new raninid crab, *Peudorogueus rangiferus* (Decapoda, Crustacea), from the Eocene of Spain: Estudios Geológicos, 51, 65-67.

Fraaije, R.H.B., 2003, The oldest in situ hermit crab from the Lower Cretaceous of Speeton, UK: Palaeontology, 46, 53-57.

Fraaye, R.H.B., Jäger, M., 1995, Decapods in ammonite shells; examples of inquilinism from the Jurassic of Germany and England: Palaeontology, 38, 63-75.

Gaemers, P.A.M., 1978, Biostratigraphy, palaeoecology and palaeogeography of the mainly marine Ager Formation (Upper Paleocene-Lower Eocene) in the Tremp Basin, Central-South Pyrenees, Spain: Leidse Geologische Mededelingen, 51, 151-231.

Glaessner, M.F., 1969, Decapoda, *in* Moore, R.C. (ed.), Treatise on Invertebrate Paleontology, Part R, Arthropoda 4(2): Boulder and Lawrence, Geological Society of America and University of Kansas Press, pp. R400-R566, R626-628.

Karasawa, H., Schweitzer, C.E., 2004, Revision of the genus *Glyphityreus* Reuss, 1859 (Crustacea, Decapoda, Brachyura, Xanthoidea) and recognition of a new genus: Paleontological Research, 8, 143-154.

Morton, B., 1989, Partnerships in the sea; Hong Kong's marine symbiosis: Hong Kong, Hong Kong University Press, 124 pp.

Remy, J.M., Tessier, F., 1954, Décapodes nouveaux de la partie ouest du Sénégal: Bulletin de la Societé Géologique de France, 6(4), 185-191.

Schulz, M., 2002, Krebse aus dem Oberen Muschelkalk von Osthessen und Thüringen. Teil 1, *Pseudopemphix alberti* (H. v. Meyer, 1840): Veröffentlichungen aus dem Naturkundemuseum Erfurt, 21, 15-38.

Solé, J., Via, L., 1989, Crustacis Decàpodes fòssils dels Països Catalans: Batalleria, 2, 23-42.

Stilwell, J.D., Grebneff, A., 1996, Records of Nautiloidea (Mollusca: Cephalopoda) across the Cretaceous-Tertiary boundary in Otago and Chatham Islands, New Zealand: New Zealand Journal of Geology and Geophysics, 39, 83-91.

Via, L., 1969, Crustáceos decapodos del Eoceno español: Pirineos, 91-94, 1-479.

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