A non-planktotrophic haloceratid (Gastropoda) from the Meteor seamount group, central North Atlantic

Un haloceratido (Gastropoda) no-planctotrófico de las montañas submarinas del grupo Meteor, Atlántico Norte central

Serge GOFAS*

Recibido el 2-VII-2018. Aceptado el 13-VII-2018

ABSTRACT

A small species found in three seamounts of the Meteor group (Great Meteor, Hyères and Irving) is described in the genus *Haloceras*, although the generic placement is tentative. It is strikingly different from all known North Atlantic gastropods but is compared to distantly similar species of *Haloceras*, one fossil from the European Pliocene and others Recent or fossil from the Indo-Pacific region.

RESUMEN

Una pequeña especie encontrada en tres montes submarinos del grupo Meteor (Great Meteor, Hyères e Irving) se describe en el género *Haloceras*, aunque la ubicación genérica es tentativa. Es muy diferente de todos los gasterópodos conocidos del Atlántico Norte, pero se lo compara con especies lejanamente similares de *Haloceras*, una fósil del Plioceno europeo y otras vivientes o fósil en la región Indo-Pacífica.

INTRODUCTION

Seamounts are remarkable features of the submarine topography, characterized by an elevation of more 1000 m above the surrounding sea floor (Staudigel *et al*. 2010)). From a biogeographic point of view, they are isolated as would be aerial islands, because organisms living there are not able to live on the surrounding bathyal or abyssal bottoms and arrived on the seamounts through long-distance dispersal events. The habitat of seamounts is distinctive due to its peculiar hydrological and sedimentary dynamics, and the fact that they conserve extensive hard substrate outcrops in a depth interval where soft substrates usually predominate (Wilson & Kaufmann 1987; Rogers 1994).

There has been in the recent years a growing interest in the biological exploration of seamounts (Stocks 2004, Stocks, Boehlert & Dower 2004), both as a model for marine speciation in an insular context, and as a frontier in the knowledge of marine biological diversity. From what is already known, high levels of endemism in the fauna and a large proportion of undescribed species can be expected from the exploration of seamounts (Wilson & Kaufmann 1987; Rogers 1994; Stocks 2004).

* Departamento de Biología Animal, Facultad de Ciencias, Universidad de Málaga, E-29071 Málaga, Spain. Correspondence: sgofas@uma.es

In the Central North Atlantic, the Meteor group of seamounts originated from the activity of a hotspot beneath the mid-Atlantic oceanic lithosphere. Flat-surfaced structures, or the flattened plateaus of the seamounts are believed to have formed near sea-level (TUCHOLKE & SMOOT 1990). Age determinations indicate that he oldest structure in the area would be the deep Cruiser plateau at the base of Irving/Cruiser seamount (50-76 m.y.) now subsided in more than 2000 m and that the seamounts, following the reconstruction of plate movement, have younger ages (Irving, 17 m.y.; Meteor 11-16 m.y.). The seamounts are intraplate structures, so that their distance from the mainland or from each other has remained unchanged since their formation. Dispersal is therefore the sole process for benthic life to colonize them. Physiographic and oceanographic settings relevant for molluscan distributions have been summarized in Gofas (2007) and will not be repeated here.

Species-level studies in the Meteor group of semounts have covered several molluscan families such as Trochidae (VILVENS & SWINNEN 2003), Triforidae (GOFAS 2003), Ranellidae (GOFAS & BEU, 2003), Fasciolariidae (GOFAS 2000), Muricidae (HOUART 1996; OLIVERIO & GOFAS, 2006), Pyramidellidae (PEÑAS & ROLÁN 1999), Pectinidae (DIJKSTRA & GOFAS 2004).

WARÉN & BOUCHET (1991) erected the family Haloceratidae for a group of rare deep-water gastropods. They recognized seventeen named and three unnamed living species, most of them from the Indo-Pacific realm and most of them with a protoconch morphology indicating a long-lived planktotrophic larva. This paper deals with a remarkable undescribed species from the Great Meteor Seamount which is believed to belong to this family.

MATERIALS AND METHODS

Material from the North Atlantic seamounts was collected during *Seamount 2*, conducted in January/February 1993 by the author with R/V *Le Suroit* visiting the Great Meteor, Hyères, Irving, Plato, Atlantis and Tyro seamounts (69 dredge hauls and 16 beam trawl operations shallower than 1000 m, see GOFAS 1993).

In the *Seamount* cruises and other MNHN surveys, the coarse fractions, usually above 10 mm, were mostly sorted on board to phyla, then sorted to species level in the lab. The finer fractions were preserved on board, and later sieved on 5 mm, 2 mm, 1 mm and 0.5 mm sieves, and sorted under a stereomicroscope. A provisional listing of molluscs were made for the depth interval shallower than 500 m, recording several thousand specimens representing 182 species in the Meteor group seamounts. Most of the specimens and species are in the size range 1-5 mm and the largest part consisted of shells only. The material from *Seamount 2* is deposited in MNHN.

The protoconch morphology provides a clue to the type of larval development (JABLONSKI & LUTZ 1980). The protoconch is interpreted as indicating planktotrophic development when multispiral (typically > 2 whorls with a differentiated protoconch 1 and protoconch 2) and as non-planktotrophic when it is paucispiral (typically 1-1 1/2 whorl with only one unit).

SYSTEMATICS

Family HALOCERATIDAE Warén & Bouchet, 1991

Genus *Haloceras* Dall, 1899

Type species: *Cithna cingulata* Verrill, 1884, by monotypy. Grammatical gender: neuter as formed from Greek κέρας (given as example in ICZN Art. 30.1.2).

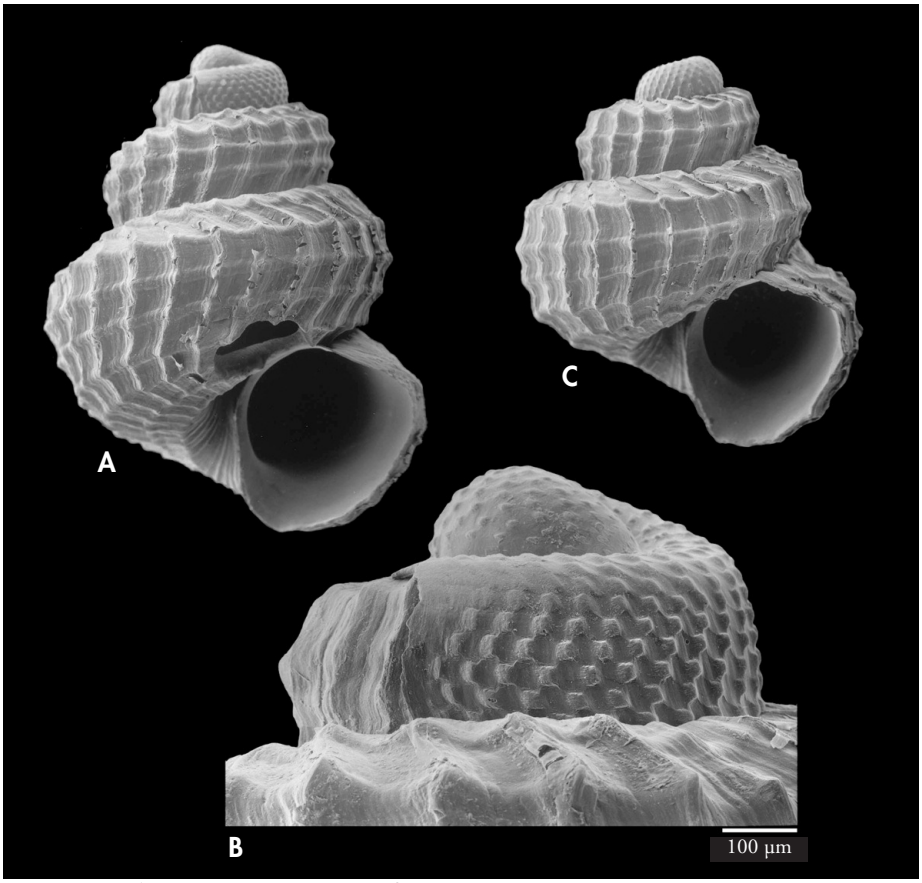

Figure 1. *Haloceras meteoricum* n. sp. from *Seamount* 2 DW 152, Great Meteor seamount (30°02.0'N, 28°22.1'W, 470 m). A: holotype (2.50 x 1.92 mm); B: protoconch of the holotype; C: paratype (2.00 x 1.74 mm).
Figura 1. Haloceras meteoricum *n. sp. de Seamount 2 DW 152, monte submarino Great Meteor (30°02,0'N, 28°22,1'W, 470 m). A: holotipo (2,50 x 1,92 mm); B: protoconcha del holotipo; C: paratipo (2,00 x 1,74 mm).*

Haloceras meteoricum n. sp. (Figure 1)

Type material: Holotype (shell, 2.50 × 1.92 mm, MNHN-IM-2000-34142) and 10 paratypes (shells, MNHN-IM-2000-34143) from *Seamount 2* sta. DW152, in MNHN.
Other material examined: Great Meteor Seamount — *Seamount 2* sta. DW143 (30°09.9'N, 28°28.1'W, 330 m), 5 sh.; DW152, 90 sh. (includes type material); DW179 (30°00.6'N, 28°43.6'W, 730 m), 1 sh. Hyères Seamount — *Seamount 2* sta. DW182 (31°23.2'N, 28°53.5'W, 480 m), 80 sh.; DW188 (31°30.0'N, 28°59.5'W, 310 m), 1 sh. . Irving Seamount — *Seamount 2* sta. DW208 (32°03.9'N, 27°53.9'W, 790 m), 2 sh.; DW209 (31°59.2'N, 27°55.9'W, 460 m), 1 sh.; DW225 (32°08.6'N, 28°10.7'W, 1035 m), 1 sh. Not found on Atlantis bank despite intensive sampling in the appropriate depth range.
Type locality: Great Meteor seamount (30°02.0'N, 28°22.1'W, 470 m).
Derivatio nominis: The species is named after its type locality.

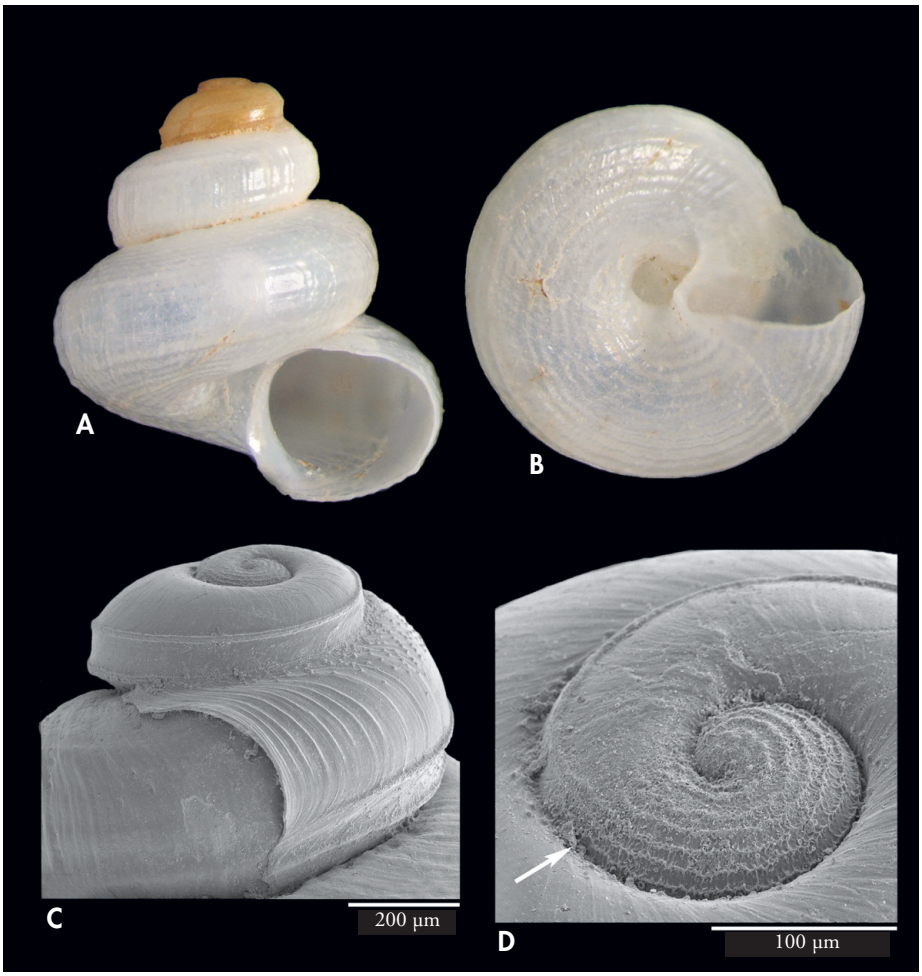

Figure 2. *Haloceras carinatum* (Jeffreys, 1883), off NW Gran Canaria (*Seamount 2* sta. DW130, 28°08.95'N, 15°53.1'W, 660 m). A, B: shell in apertural and umbilical view (2.3 mm x 2.07 mm); C: protoconch of the same shell; D: detail of Protoconch 1. The arrow points to the limit Protoconch I/Protoconch II.

Figura 2. Haloceras carinatum *(Jeffreys, 1883), Noroeste de Gran Canaria (*Seamount 2 *sta. DW130, 28°08,95'N, 15°53,1'W, 660 m). A, B: concha en vista apertural y umbilical (2.3 mm x 2.07 mm); C: protoconcha de la misma concha; D: detalle de la Protoconcha 1. La flecha indica el límite Protoconcha I/Protoconcha II.*

Description: Shell small, solid, rissoiform, consisting of 1 1/4 protoconch and 2 to 2 3/4 teleoconch whorls. Protoconch 500 µrn in diameter, without a distinct Protoconch I and Protoconch II, with a strong sculpture of closely set tubercles, aligned spirally in about 10 rows, and also aligned along two different oblique directions so as to form a quincuncial pattern. Protoconch/teleoconch discontinuity very sharp, slightly detached from the following whorl. Teleoconch whorls convex, shouldered, with a moderately deep suture. Sculpture consists of axial ribs and spiral cords forming a cancellate pattern. Axial ribs are eleva-

ted, very flexuous, much narrower than the interspaces and they overrun the spiral cords, forming sharp tubercles at the intersections. Spiral cords about half as broad as the interspaces, not very elevated, 8 on the last whorl, one very weak just next to the suture, one along the shoulder of the whorls, one circling the umbilicus and five more, also narrower than the interspaces, in between. Umbilicus narrow and deep, sharply delimited by the last abapical spiral cord, fluted by prolongation of the axial ribs. Aperture irregularly rounded. Outer lip thin, simple, broadly receding in the upper half so as to make the aperture opisthocline. Parietal edge of aperture thin, appressed to the previous whorl only over a short distance, continuous with the columellar edge which thickens towards the base. Colour entirely white. Dimensions 2.50 × 1.92 mm (holotype).

REMARKS

This species does not resemble any previously described gastropod from the North Atlantic or elsewhere but is similar in shape and general aspect to the Pliocene *Haloceras contribulis* Bertolaso & Palazzi, 2000, from bathyal Pliocene rocks in Emilia, NW Italy and *H.* aff. *contribulis*, recorded from the Early Pliocene fauna at Estepona, S Spain, by LANDAU *ET AL.* (2004: 78). The fossil species is almost twice as large, has a flat surface between the suture and the shoulder without a subsutural cord, and has a differently construed abapical area with a much narrower umbilicus surrounded by a broad, flat area with fine spiral threads, instead of having spiral cords similar to those of the adapical part of the whorl. Above all, the protoconchs are very different. The protoconch of *H. contribulis* is claimed by BERTOLASO & PALAZZI (2000) to have two whorls with differentiated Protoconch I and Protoconch II, denoting a planktotrophic larval development. This is not so obvious from their Figure 5, where the protoconch appears to have somewhat less than two whorls and the Protoconch I/Protoconch II limit is not as conspicuous as it is on Recent species e.g. *Haloceras carinatum* (Jeffreys, 1883) known to be planktotrophic (WARÉN & BOUCHET, 1991: 126, and herein Figure 2). Anyway, the protoconch of *H. contribulis* has a very different sculpture of fine spiral threads, not of tubercles.

The most similar Recent species are *Haloceras japonicum* Okutani, 1964 from the northern Pacific Ocean and *Haloceras phaeocephalum* Warén & Bouchet, 1991, described from off New South Wales. These are also relatively tall-spired species with few prominent, narrow spiral cords on the periphery of the last whorl. The protoconch of the former is not known, but WARÉN & BOUCHET (1991: 143) illustrated brooded embryos, a little more than 1 mm in diametre (for an adult shell nearly 6 mm high), with a sculpture of quincuncially arranged tubercles. The protoconch of the new species, lacking a Protoconch II, is definitely homologous to these embryos and the sculpture is similar although in *H. japonicum* the tubercles are smaller, more numerous and do not form so definite spiral rows. *Haloceras phaeocephalum* differs in having more numerous spirals, becoming more delicate towards the periumbilical area, and has a narrower umbilicus. The protoconch is also very different, with 2.3 whorls, a small (230 μm for an adult size of 3.33 mm) Protoconch I and thin spiral threads on both Protoconch I and Protoconch II, more similar that of the Pliocene *H. contribulis*. The fossil *Haloceras maxwelli* Beu & Marshall, 2011, from the Eocene of New Zealand, belongs to the same species group as *H. contribulis*, also has a protoconch of more than two whorl, but has a considerably taller and more pointed shell.

Without any live collected specimen, a definitive supraspecific placement is not final. The proposed placement as a species of *Haloceras* agrees with general shell morphology of several species discussed herein and with the embryos of

H. japonicum. However a strikingly similar protoconch sculpture is seen in species of the family Vermiculariidae (e.g. *Stephopoma nucleogranosum* Verco, 1904, see BIELER & SIMONE, 2005: 161). There, the granules are not neatly arranged in spiral rows but the protonch is likewise undifferentiated and has a slightly detached, very well marked termination. The case of the present species is like much of those collected on the seamounts, represented by large quantities of shells but very few living specimens.

AKNOWLEDGEMENT

The scanning electron micrographs were taken by Gregorio Caballero at University of Málaga.

BIBLIOGRAPHY

BERTOLASO L. & PALAZZI S. 2000. Un probabile rappresentante della famiglia Haloceratidae Warén & Bouchet, 1991 nel Pliocene emiliano. *Bollettino Malacologico*, 34: 23–26.

BEU A.G. & MARSHALL B.A. 2011. New Cenozoic records of genera and families from New Zealand (Mollusca, Gastropoda): highlights from Phillip Maxwell's collection. *New Zealand Journal of Geology & Geophysics*, 54 (1): 13-34.

BIELER R. & SIMONE L.R.L. 2005. Anatomy and morphology of *Stephopoma nucleogranosum* Verco, 1904 (Caenogastropoda: Siliquariidae) from Esperance Bay, Western Australia In Wells F.E., Walker D.I. & Kendrick GA. (Eds.): *The Marine Flora and Fauna of Esperance, Western Australia*. Western Australian Museum, Perth.

DIJKSTRA H.H. & GOFAS S. 2004. Pectinoidea (Bivalvia: Propeamussiidae and Pectinidae) from some northeastern Atlantic seamounts. *Sarsia*, 89 (1): 33–78.

GOFAS S. 1993. Mission Océanographique *Seamount 2*. Compte-rendu et liste des stations. [MNHN, unpublished report]. 30 pp.

GOFAS S. 2000. Four species of the family Fasciolariidae (Gastropoda) from the North Atlantic seamounts. *Journal of Conchology*, 37 (1): 7–16.

GOFAS S. 2003. An endemic radiation of *Trituba* (Mollusca, Gastropoda) on the North Atlantic seamounts. *American Malacological Bulletin*, 17 (1-2): 45–63.

GOFAS S. 2005. Geographical differentiation in *Clelandella* (Gastropoda: Trochidae) in the northeastern Atlantic. *Journal of Molluscan Studies*, 71: 133–144.

GOFAS S. 2007. Rissoidae (Mollusca: Gastropoda) from northeast Atlantic seamounts. *Journal of Natural History*, 41 (13–16): 779–885

GOFAS S & BEU A. 2003. Tonnoidean Gastropods of the North Atlantic seamounts and the Azores. *American Malacological Bulletin*, 17 (1-2): 91–108.

HOUART R. 1996. Description of new species of Muricidae (Gastropoda) from New Caledonia, the Philippine Islands, the Northeast Atlantic, and West Africa. *Apex*, 11 (2): 59-75.

JABLONSKI D. & LUTZ R.A. 1980. Molluscan larval shell morphology. Ecological and paleontological applications. In Rhoads D.C. & Lutz R.A. (Eds.) *Skeletal growth of aquatic organisms*. New York: Plenum Press. p 323–377.

LANDAU B, MARQUET R & GRIGIS M. 2004. The early Pliocene Gastropoda (Mollusca) of Estepona, southern Spain. Part 2: Orthogastropoda, Neotaenioglossa. *Palaeontos*, 4: 1–108.

OLIVERIO M. & GOFAS S. 2006. Coralliophiline diversity at mid-Atlantic Seamounts (neogastropoda, Muricidae, Coralliophilinae). *Bulletin of Marine Science*, 79 (1): 205-230

PEÑAS A. & ROLÁN E. 1999. Pyramidellidae (Gastropoda, Heterostropha) de la misión oceanográfica "*Seamount 2*". *Iberus*, supplement 5: 151–199.

ROGERS A.D. 1994. The biology of seamounts. *Advances in Marine Biology*, 30: 305–350.

STAUDIGEL H., KOPPERS A. A. P., LAVELLE J.W., PITCHER T.J.P. & SHANK T.M. 2010. Defining the word "seamount". *Oceanography*, 23 (1): 20–21.

STOCKS K.I. 2004. SeamountsOnline, an Online information system for seamount biology. In Vanden Berghe E. (Ed.): *The Colour of Ocean Data. International symposium on oceanographic data and information management with special attention to biological data*. 2002 Nov 25-27; Brussels. IOC Workshop Report 188: 77–89. Available: http://seamounts.sdsc.edu/Stocks/COD_MS.pdf via the Internet. Accessed 2006 Apr 27.

STOCKS K.I., BOEHLERT G.W. & DOWER J.F. 2004. Towards an international field program on seamounts within the Census of Marine Life. *Archive of Fishery and Marine Research*, 51 (1-3): 320–327.

TUCHOLKE B.E. & SMOOT N.C. 1990. Evidence for age and evolution of Corner seamounts and Great Meteor seamount chain from multibeam bathymetry. *Journal of Geophysical Research*, 95 (B11): 17,555–17,569.

VILVENS C. & SWINNEN F. 2003. Description of *Calliostoma heutgeni* n. sp. (Gastropoda: Trochidae: Calliostomatidae). *Novapex*, 4 (4): 119–123.

WARÉN A. & BOUCHET P. 1991. Mollusca Gastropoda: Systematic position and revision of *Haloceras* Dall, 1889 (Caenogastropoda, Haloceratidae fam. nov.). In Crosnier A. *et al*. (Ed.): Résultats des Campagnes MUSORSTOM 7. *Mémoires du Muséum National d'Histoire Naturelle*. Série A, Zoologie. 150: 111-161.

WILSON R.R. & KAUFMANN R.S. 1987. Seamount biota and biogeography. In Keating B.H., Fryer P., Batiza R. & Boehlert G.W. (Eds.): *Seamounts, Islands and Atolls*. Geophysical Monograph 43. Washington: American Geophysical Union. p 319–334.