Acta Geologica Polonica, Vol. 58 (2008), No. 4, pp. 473-478

Novocrania turbinata (Brachiopoda) from the Early Pliocene of the Azores (Portugal)

ANDREAS KROH[1], MARIA ALEKSANDRA BITNER[2] & SÉRGIO P. ÁVILA[3]

[1]*Natural History Museum Vienna, Department of Geology & Palaeontology, Burgring 7, 1010 Vienna, Austria. E-mail: andreas.kroh@nhm-wien.ac.at*
[2]*Instytut Paleobiologii PAN, ul. Twarda 51/55, PL-00-818 Warszawa, Poland. E-mail: bitner@twarda.pan.pl*
[3]*Departamento de Biologia, Universidade dos Açores, Rua da Mãe de Deus, Apartado 1422, 9501 - 801 Ponta Delgada, Açores, Portugal. E-mail: avila@notes.uac.pt*

ABSTRACT:

KROH, A., BITNER, M.A. & ÁVILA, S.P. 2008. *Novocrania turbinata* (Brachiopoda) from the Early Pliocene of the Azores (Portugal). *Acta Geologica Polonica*, **58** (4), 473-478. Warszawa.

Novocrania turbinata (POLI, 1795) is documented from the Early Pliocene strata of Santa Maria Island (Azores, Portugal), extending the range of this species to the central Northern Atlantic Ocean. This record increases the meagre brachiopod fauna known from the Pliocene of the Azores, which so far consisted only of *Terebratulina retusa* (LINNAEUS, 1758). It may also represent an example of a thermophilic species that disappeared locally due to Late Pliocene-Pleistocene climate deterioration.

Key words: Craniiform brachiopod, Pliocene, Azores, Northern Atlantic Ocean, New Record, Spatial Range Extension.

INTRODUCTION

Brachiopods are common members of shallow water communities in Miocene and Pliocene sediments of the Mediterranean or Central Paratethys (e.g. TADDEI RUGGIERO 1994; BITNER & DULAI 2004). Despite this, only *Terebratulina caput-serpentis* (LINNAEUS, 1758) [a junior synonym of *T. retusa*] was reported from the Azores so far (BRONN *in* HARTUNG 1860, p. 128, pl. 19, figs 16a-d; DA VEIGA FERREIRA 1955, p. 16, pl. 8, figs. 62, 64). The Recent fauna of the Azores, in contrast, includes ten species of brachiopods (FISCHER & OEHLERT 1891; ZEZINA 2006; LOGAN & *al*. in press), many of which occur at greater depths only.

Here we describe new brachiopod material belonging to the species *Novocrania turbinata* (POLI, 1795) collected on Santa Maria Island in the course of the 3rd and 4th workshops "Palaeontology in the Atlantic Islands" (June 2006 and June 2007).

STUDY AREA

The Azorean Archipelago is a relatively young group of volcanic islands. Pre-Pleistocene sedimentary deposits are found only on Santa Maria, the south-easternmost and oldest of the nine islands (MADEIRA & *al*. 2007). Published radiometric data range from 3.2 to 8.1 Ma (SERRALHEIRO & MADEIRA 1990). The sedimentary rocks of Santa Maria are grouped in two units: the Touril Complex and the Facho-Pico Alto Complex (SERRALHEIRO 2003). The fossiliferous marine sediments (predominantly sandstone and calcarenite) belong to the former. The age of these sediments was a matter of

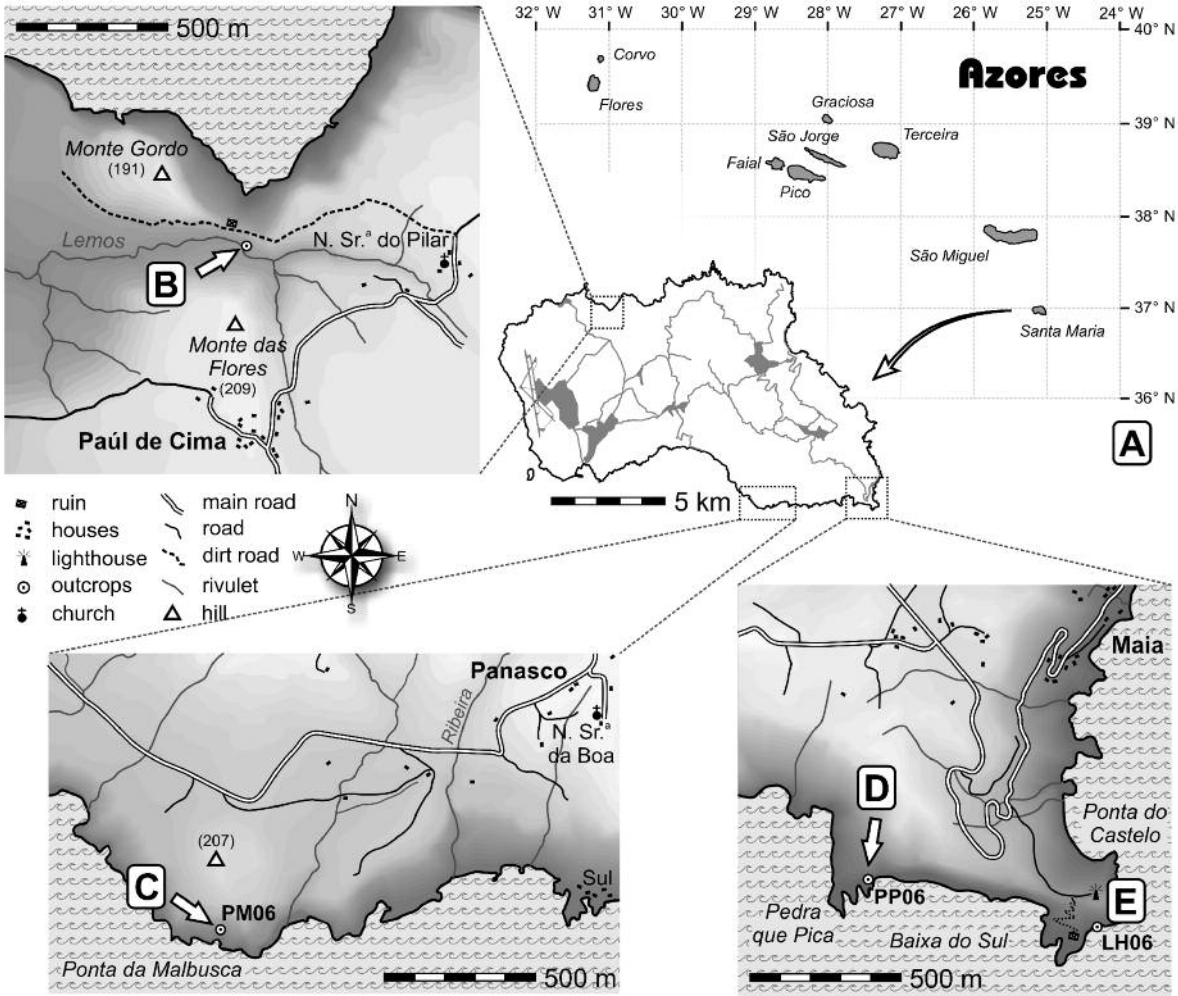

Fig. 1. Position of the sections investigated: Cré (B), Malbusca (C), Pedra-que-Pica (D), and Ponta do Castelo (E). Inset (A) shows their location on Santa Maria, and the location of this island in the Azores Archipelago

considerable debate, but was recently constrained to Early Pliocene (SERRALHEIRO & MADEIRA 1990; KIRBY & *al*. 2007; JANSSEN & *al*. 2008), albeit the presence of Late Miocene strata in other sections cannot be ruled out completely. In addition to the older sedimentary deposits, Pleistocene wave cut platforms with sands and gravel occur occasionally along the coast.

The outcrops studied are scattered along the coastal areas of Santa Maria (Text-fig. 1). Four different sections yielded brachiopod material: Pedra-que-Pica, Malbusca, Ponta do Castelo and Cré (Text-fig. 1). The first three are located along the south-eastern coast, the last in the north-east, close to the embayment Baía da Cré. The base of the sections (where exposed) is formed by a volcanic conglomerates and lavas, belonging to the underlying Anjos Complex. The upper limits of all three sections are erosive and covered by basalt flows (Pedra-que-Pica, Malbusca), pillow lavas (Ponta do Castelo) or volcanic conglomerates (Cré). A more detailed description of the individual sections and their correlation is outside the scope of this paper and will be published elsewhere.

At Cré the fossils described here were found in a bed of bioturbated, lithic sandstone, approximately four metres above the erosive relief at the base of the section. They co-occur with a rich assemblage of holoplanktonic molluscs dominated by *Cavolinia marginata* (BRONN *in* REISS, 1862), for which an Early Pliocene (Zanclean) age is given by JANSSEN & *al*. (2008). At Pedra-que-Pica the brachiopods are incorporated into a dense mollusc coquina close to the base of the sections. This coquina is dominated by oysters and pectinids, with subsidiary amounts of echinoids and coralline red algae. Stable Sr-isotope measurements on calcitic mollusc shells yielded an age estimation of 5.51±0.21 Ma (KIRBY & *al*. 2007). At Malbusca the situation is very similar to Pedra-que-Pica, the coquina differing only in its larger amount of

rhodoliths. At Ponta do Castelo the uppermost part of the section is the most fossiliferous, yielding both aragonitic and calcitic molluscs, as well as echinoids, red algae and the brachiopods studied here. No age data are available for this outcrop so far. Although it cannot be shown beyond doubt at present, the sedimentary sequences at Ponta do Castelo, Malbusca and Pedra-que-Pica are tentatively correlated with the Cré outcrops and assumed to represent more or less contemporaneous deposits.

SYSTEMATIC PALAEONTOLOGY

Superfamily Cranioidea MENKE, 1828
Family Craniidae MENKE, 1828
Genus *Novocrania* LEE & BRUNTON, 2001
Novocrania turbinata (POLI, 1795)
(Text-fig. 2a-f)

1795. *Anomia turbinata*; J.X. POLI, p. 189-190, pl. 30, figs. 15, 21-24.
1988. *Neocrania turbinata* (POLI); C.H.C. BRUNTON, pp. 152-154, figs 1, 2.
2001. *Neocrania turbinata* (POLI); A. LOGAN & S.L. LONG, pp. 72-74, figs 8.3/9-20.

MATERIAL: 7 dorsal valves from Pedra-que-Pica (DBUA-F 461-1 to 461-7), 1 dorsal valve from Cré (DBUA-F 432, DBUA-F 464), 1 dorsal valve from Ponta do Castelo (DBUA-F 433), Santa Maria Island, Azores. An additional dorsal valve from Malbusca (DBUA-F 465) is only tentatively referred to this species, because of its more delicate structure and apparent absence of the pallial sinuses. The material is deposited in the palaeontological collection of the Department of Biology of the University of the Azores.

DESCRIPTION: The dorsal valves show large, distinct, and slightly depressed posterior muscle scars. The anterior muscle scars are distinctly elevated, kidney-shaped and prominent. The brachial retractor scars are not well separated from the adductor scars. Brachial protractor muscle scars indistinct, small, beak-like. In the anterior half of the valves moderately well developed mantle canals can be observed. The outer surface of the available specimens is either worn or covered by adhering sediment but seems to have been ornamented by largely irregular, but distinct growth lines.

REMARKS: *N. turbinata* is very similar to *N. anomala* (MÜLLER, 1776) and has been placed into the synonymy

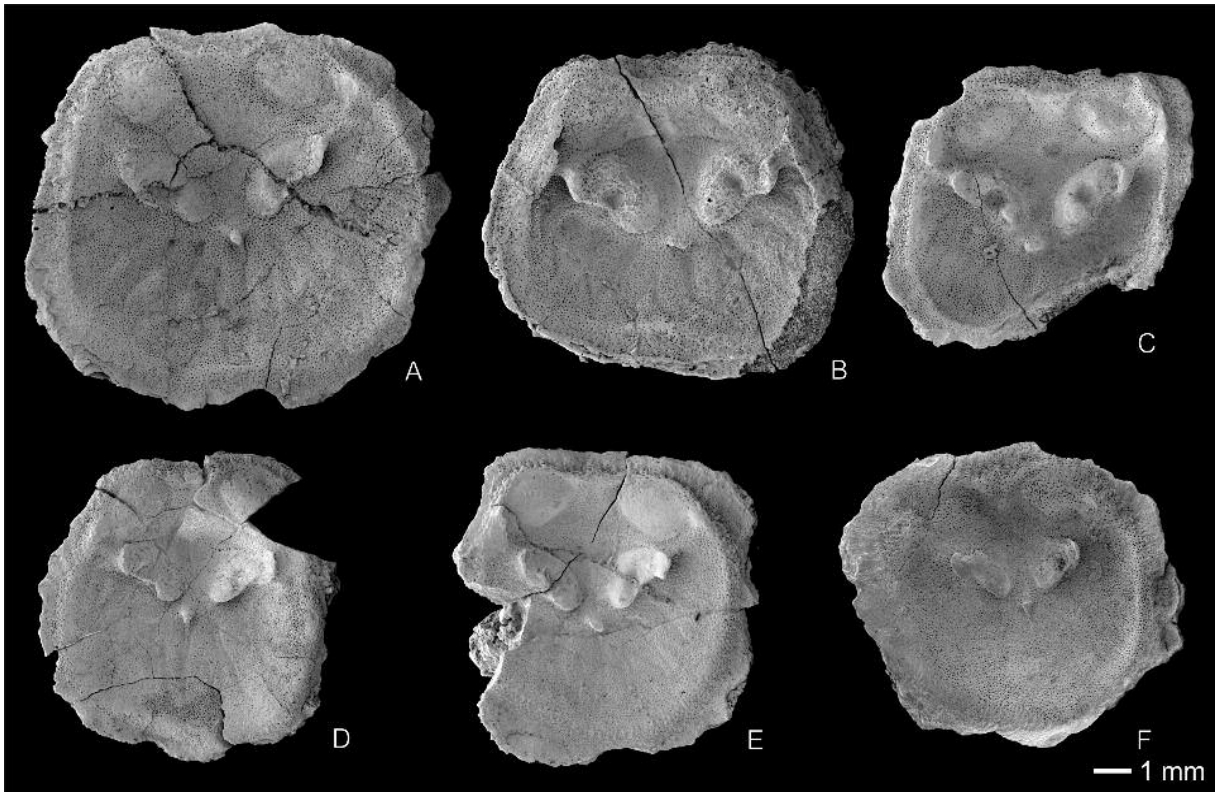

Fig. 2. *Novocrania turbinata* (POLI, 1795), dorsal valves from the Late Miocene/Early Pliocene of Pedra-que-Pica, St. Maria (A: DBUA-F 461-1, B: DBUA-F 461-2, C: DBUA-F 461-3, D: DBUA-F 461-4, E: DBUA-F 461-5); *Novocrania* sp. from Malbusca, St. Maria (F: DBUA-F 465)

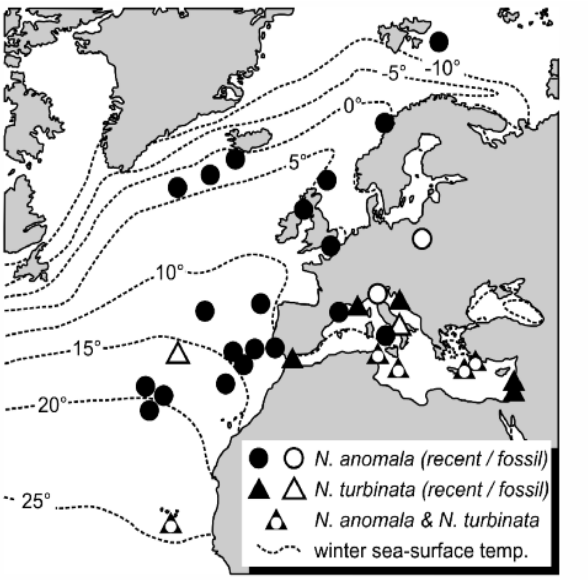

Fig. 3. Distribution of *Novocrania anomala* (circles) and *N. turbinata* (triangles) in the Mediterranean and the NE Atlantic Ocean. Solid symbols represent extant records, open symbols fossil occurrences. Data from BRUNTON & CURRY (1979), ZEZINA (1985, 2000, 2006), BRUNTON (1988), LOGAN & LONG (2001), GASPRAD (2003), LOGAN (1998), LOGAN & *al*. (in press)

of this species by some authors (e.g. LOGAN 1979). However, BRUNTON (1988), who re-described and illustrated *N. turbinata*, considered the differences in the development and placement of the dorsal muscle scars sufficient to separate *anomala* and *turbinata*. As shown recently (LOGAN & LONG 2001), the two species can be distinguished from each other by features of the muscle scars of the brachial/dorsal valves. The main differences are: 1) the inflation of the anterior adductor scars in *N. turbinata*; 2) the clear separation of the brachial retractor scars from the adductors in *N. anomala*; and 3) the prominent, medially divided brachial protractor scars in *N. anomala*.

N. turbinata can be distinguished from the contemporaneous craniid species *Ancistrocrania abnormis* (DEFRANCE in HOENIGHAUS, 1828) and "*Crania*" *badensis* MICHALIK & ZÁGORŠEK, 1986 by its lack of a median septum and the different shape of the brachial protractor muscle scar (POPIEL-BARCZYK & BARCZYK 1990; BITNER 1990).

OCCURRENCE (Text-fig. 3): Today this species occurs at shallow depths (10-150 m) in the south-east North Atlantic Ocean, ranging from the Cape Verde Islands as far northwards as the Strait of Gibraltar. Within the Mediterranean it is widespread along the southern and northern coasts, co-occurring with its congener *N. anomala* in Tunisia, Malta and the Aegean Sea (BRUNTON 1988; LOGAN & LONG 2001). According to LOGAN & *al*. (2004: Tab. 1), *N. turbinata* was reported also from the Miocene of Italy.

CONCLUSIONS

Ten brachiopod species are known from the Azorean region today, but no species of *Novocrania* is among them. *N. anomala* has been reported from the seamounts towards the south (LOGAN 1998) and east of the Azores (GASPARD 2003). Today *N. turbinata* is generally restricted to more southerly regions (the Cape Verde Islands and off the north-western African coast) and the Mediterranean. Based on the present day spatial and bathymetrical distribution, *N. turbinata* appears to prefer warmer conditions than *N. anomala*. It seems probable that *N. turbinata*, like many thermophilic species (e.g. *Gigantopecten latissimus*, *Manupecten pesfelis, Hinnites crispus*) disappeared from the Azores due to a series of cooling events starting in the mid-Pliocene and continuing in the Pleistocene (RAFFI & MONEGATTI 1993; LANDAU & *al*. 2007). The present record extends the spatial and temporal range of the species *Novocrania turbinata* and increases the number of species known from the Early Pliocene of the Azores. It may also represent a non-molluscan example of the local disappearance of thermophilic taxa from the Azores since the Pliocene.

Acknowledgements

This research was supported by the EU grant, SYNTHESYS Project AT-TAF-2610, to M.A. BITNER. S.P. ÁVILA was supported by grant SFRH/BPD/22913/2005 (FCT - Fundação para a Ciência e Tecnologia) of the Portuguese government. Fieldwork was carried out together with Michael X. KIRBY (Florida Museum of Natural History), Mário CACHÃO and Carlos Marques da SILVA (both Universidade de Lisboa). The production of the SEM images at the Institute of Palaeontology (University of Vienna) is gratefully acknowledged.

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Manuscript submitted:
Revised version accepted: