The cryptobiotic foraminifer *Troglotella? panormitana* n. sp. from the Valanginian of Sicily, Italy.

Mode of life of the genus *Troglotella* Wernli & Fookes, 1992

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ABSTRACT - The cryptobiotic foraminifer *Troglotella incrustans* Wernli & Fookes, 1992 from the Upper Tithonian of the Madonie Mountains (Sicily) and *Troglotella? panormitana* n. sp. from the Valanginian of Monte Pellegrino near Palermo (Sicily) are described. A new interpretation of the mode of life of *T. incrustans* is presented and compared with previous theories. The embryo settled on the surface of the substrate, bored a tunnel, and after having reached a certain depth bioactivity in a downwards direction ceased. A series of uniserially arranged post-embryonic chambers was then formed in an upwards direction towards the substrate surface. Subsequent to this growth stage, irregular epilithic chambers were formed. However, the possibility that the growth of the test may have sometimes begun at the base of a pre-existing cavity cannot be excluded.


INTRODUCTION

The cryptobiotic foraminifer *Troglotella incrustans*, instituted by Wernli & Fookes (1992) on the basis of Kimmeridgian material from SE France, has been discussed by numerous authors (e.g., Schlagintweit, 2012; therein previous references).

In the past we have already discussed the mode of life of the genus *Troglotella* (Cherchi & Schroeder, 2004, 2007, Cherchi et al., 2012). Previous interpretation is complemented here by the analysis of new well-preserved material from the Tithonian of the Madonie Mountains and the Valanginian of Mt. Pellegrino near Palermo (Sicily). Moreover, a new species (*T.? panormitana*), probably belonging to this genus, is described in this paper.

PROVENANCE OF THE MATERIAL

The samples containing *Troglotella* come from two localities of Sicily (Italy) (Fig. 1):

1. Thin sections J 109, J 301, J 309 with *Troglotella incrustans* Wernli & Fookes, 1992. Area between Pizzo Carbonara and M. Mufara (Madonie Mountains). The exact locality is marked in a map published by Bucur et al. (1996, fig. 1). This material, received several years ago from Prof. B. Senowbari-Daryan, is stored in the Institute of Paleontology, Erlangen-Nürnberg University. According to Bucur (1996), the age of the samples is Upper Tithonian.

2. Thin section MP 598, figured by Montanari (1964, pl. 2, fig. 1) as “Microfacies dei calcari detritici di Pno Camarrone.” This locality is situated in the southern part of Mt. Pellegrino, north of Palermo (Montanari, 1964, fig. 3). The thin section, stored in the Dipartimento di Scienze della Terra e del Mare, Palermo University, contains the specimens described here under the name *Troglotella? panormitana* n. sp. Unfortunately, the exact stratigraphic position of this sample, dated by Montanari as “Valanginiano”, is unknown. It comes probably from the “zona a *Trocholina alpina*” (Montanari, 1964, p. 11; see also Camoin, 1983).

SYSTEMATICS

Genus *Troglotella* Wernli & Fookes, 1992

*Type species - Troglotella incrustans* Wernli & Fookes, 1992

*Troglotella incrustans* Wernli & Fookes, 1992

Pl. 1, figs 1-7

1992 *Troglotella incrustans* n. gen., n. sp. - Wernli & Fookes, Pl. 1, figs 1-15; Pl. 2., figs 1-11.

1996 *Troglotella incrustans* Wernli & Fookes, 1992 - BUCUR et al., Pl. 2, fig. 3; Pl. 5, figs 6, 9-10.

Material - Thin sections J109, J301, J309 (Senowbari-Daryan Collection).
Description - In adult tests of *T. incrustans* two ontogenetic stages can be differentiated: (1) an uniserial stage, which may be followed (2) by a group of irregularly arranged chambers (Pl. 1, fig. 1, left specimen).

1. The uniserial stage is in the form of a small, curved horn, whose width continuously increases in the course of ontogenesis (Pl. 1, figs 1-5). In our sections this stage is composed of up to seven chambers (up to fourteen chambers in the material studied by Wernli & Fookes, 1992). The oldest chamber with subcircular outline, visible in Pl. 1, figs 3-4, could perhaps be interpreted as a proloculus. It has the same outline as the first chamber of two specimens, represented by Wernli & Fookes (1992, pl. 1, fig. 15), which we regard as proloculi. The postembryonic chambers are subcylindrical with rounded edges and vaulted lateral parts of the wall, whose diameter gradually increases during ontogenesis. Consequently, they are at first sometimes higher than wide (Pl. 1, fig. 1-left specimen), but generally essentially wider than high (Pl. 1, figs 2-5). Neighbouring chambers are connected by a simple, central and relatively large aperture (diameter up to 0.07 mm) in the slightly vaulted septum. Only exceptionally the edge of the septum around the aperture is curved in direction of growth, forming a small neck (Wernli & Fookes, 1992, pl. 2, fig. 10).

Fig. 1 - Location of sites with *Troglotella incrustans* Wernli & Fookes, 1992 (Monte Pellegrino, Palermo: arrow A) and *T.? panormitana* n. sp. (Madonie Mts.: arrow B). Carbonate Platform (Panormide) units from Zarcone & Di Stefano (2010, fig. 1, modified).

**EXPLANATION OF PLATE 1**


Fig. 1 - Two specimens, the left colonizing an *Entobia* chamber (E). Thin section J 303 l.
Fig. 2 - Longitudinal section through the uniserial stage. Thin section J 303 l.
Fig. 3 - Longitudinal section through the uniserial stage showing the transition to the irregular growth stage. Thin section J 303 l.
Fig. 4 - Longitudinal section through the uniserial stage. Thin section J 301 l.
Fig. 5 - Longitudinal section of a specimen colonizing an *Entobia* chamber (E). The arrow points to a tabula. Thin section J 109.
Fig. 6 - Longitudinal section through the irregular growth stage. Thin section J 303 l.
Fig. 7 - Longitudinal section through the irregular growth stage. Thin section J 303 l.

Scale bar in all figures = 0.2 mm.
In the following growth stage, the chambers are irregularly vesicular or bag-shaped (Pl. 1, figs 6-7). In the Madonie Mountains specimens, they seem to be uniserially arranged (Pl. 1, figs 1, 6), although in the final part, an incipient digitation cannot be excluded. The very large apertures (Pl. 1, fig. 7) with a diameter of up to 0.15 mm could be oval or slit-like. In some specimens, depicted by Wernli & Fookes (1992, e.g., pl. 1, fig. 2), this growth stage consists of a cluster of completely irregularly arranged chambers.

**Troglotella? panormitana n. sp.**

Pl. 2, figs 1-7; Fig. 2

1964 “Microfacies dei calcei detritici” - **MONTANARI**, Pl. II, fig. 1.

**Derivation of name** - Panormus (Latin), ancient name of Palermo.

**Holotype** - Somewhat oblique longitudinal section (Montanari Collection MP 598), shown in Pl. 2, fig. 3. The thin section is stored in the Dipartimento di Scienze della Terra e del Mare, Palermo University.

**Type locality** - Piano Camarrone, Monte Pellegrino near Palermo (Sicily, Italy).

**Age** - “Valanginiano”.

**Material** - Twelve specimens in thin-section MP 598.

**Diagnosis** - The uniserially arranged chambers are globose to subglobular, showing a simple and terminal aperture which is located at the end of a collar-like projection.

**Description** - The longitudinal sections of T.? panormitana (Pl. 2, figs 1-3) reveal that the slender calcareous test is straight or slightly curved. It is made of at least nine chambers, which are uniserially arranged. The form of the chambers, whose diameter increases during the ontogenesis, is globose to subglobular. The simple, rounded and terminal aperture is located at the end of a short collar-like projection of the chambers (Pl. 2, fig. 2).

The initial stage of the test is not preserved. However, a small specimen (Pl. 2, fig. 4), made of a proloculus (diameter: 0.12 mm) and two subsequent chambers with crescent-shaped outline, could perhaps be interpreted as the first growth stage of this species.

A single specimen (Pl. 2, fig. 7) differs from the other ones by dimensions and form of the chambers. These are more or less cylindrical with rounded edges, attaining a diameter up to 0.3 mm. The position and the character of the apertures are the same as in the other forms. The oldest chambers visible in Pl. 2, fig. 7, whose arrangement is not clear, seem to be essentially smaller than the subsequent ones and could belong to the initial stage. For these reasons, this specimen could represent a microspheric form.

**Remarks** - Troglotella? panormitana n. sp. differs from T. incrustans Wernli & Fookes by the morphology of the chambers and above all by the aperture. The character of the initial stage is not clear. For these reasons, we include the new species into the genus *Troglotella* only with reservation.

**MODE OF LIFE**

Wernli & Fookes (1992) (Fig. 3A) regarded *Troglotella incrustans* as a “calcicavicole” foraminifer living during the juvenile (rectilinear) stage in pre-existing microperforations, but later during the adult stage spreading out over the surface of the substrate. The authors exclude the interpretation of *Troglotella* as a boring foraminifer, because a continuous deepening of the bore-hole presupposes that the protoplasma covers the whole surface of the test, extending from the aperture to the apex, that is unknown in morphologically comparable imperforate foraminifera.

According to Schmid (1996) (Fig. 3B), the embryo bored the surface of the substratum shifting downwards, while postembryonic chambers were added simultaneously in the opposite direction. The continuous deepening of the bore-hole at the apex of the increasing rectilinear growth stage was realized by etching pseudopodia, situated in the space between the bore-hole wall and the test, and extending from the aperture of the respective
**EXPLANATION OF PLATE 2**


- Fig. 1 - Somewhat oblique longitudinal section.
- Fig. 2 - Somewhat oblique longitudinal section.
- Fig. 3 - Somewhat oblique longitudinal section. Holotype.
- Fig. 4 - ?Initial stage.
- Fig. 5 - Tangential longitudinal section.
- Fig. 6 - Longitudinal section.
- Fig. 7 - Longitudinal section. ?Microspheric form.

Scale bar in Fig. 7 (same for all figures) = 0.2 mm.
of young bioeroding foraminifera (Vénec-Peyré, 1987). Settlement of individuals on shell fragments and echinoid spines occurs more frequently in the depressions between the striae than elsewhere (Vénec-Peyré, 1996). Cymbaloporella tabellaeformis preferred heavy spinose shells and “occupied the flat areas between the nodules 1.5 times as often as it occupied the apex” (Smyth, 1988). Previous examples suggest that also the embryo of Troglotella may select morphological depressions of biogenic or abiogenic origin upon the substrate as favourable points of settlement.

2. Now the embryo starts its boring activity downwards producing a narrow tunnel, and after reaching a certain depth this process stops.

3. The next phase is characterized by the formation of an uniserial series of postembryonic chambers, which were added in the opposite direction (upwards). The continuously enlargement of the chambers during this phase causes an increasing widening of the originally narrow tunnel by etching activity of the plasma. The lateral parts of the chamber walls are in relatively close contact with the surrounding substrate. However, it is sometimes difficult to decide whether the boring...
activity of *Troglotella* began at the base of a pre-existing microperforation (theory of Wernli & Fookes, 1992) or upon the surface of the substrate. An argument in favour of the first possibility could be the existence of a tunnel distinctly exceeding the diameter of the test and/or a morphologically very irregular tunnel wall.

4. Subsequent to the uniserial growth stage, *Troglotella* spreads out over the surface of the substrate forming irregular chambers. This adult part of the test is sometimes located in the lower part of large hollows showing a concave lower side and a convex upper side. Comparable hollows, already figured by Schmid & Leinfelder (1996, pl. 1, figs 3-4) from the Tithonian of southern Germany and Portugal, are overlain by a micritic crust with alveolar structure. These authors interpreted the ensemble as a loftusiid foraminifer such as *Pseudocyclammina litus*us. However, Cherchi & Schroeder (2006) have shown that this interpretation is unacceptable; they demonstrated that the micritic crusts are colonies of calcified cyanobacteria, whereas the hollows were interpreted (Cherchi & Schroeder, 2010) in comparable ensembles from the Upper Triassic and Lower Cretaceous as trace fossils of boring sponges belonging to the ichnogenus *Entobia*. In our material, embryos of *Troglotella* entered the empty chambers through the radial aperture canals connecting the chambers with the surface of the calcimicrobial crust and began to bore. However, as Schmid & Leinfelder (1996, pl. 1, fig. 4) had already pointed out, the boring activity was sometimes suppressed and the *Troglotella* tests developed within the sheltering *Entobia* chambers.

*Troglotella panormitana* lived in a calcareous substrate with fenestral fabrics (Fig. 2). An epilithic growth stage upon the substrate surface was not observed.

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