

SCANNING ELECTRON MICROSCOPE DOCUMENTATION OF THE LOST HOLOTYPES OF MORNOD, 1949: *THALMANNINELLA REICHELI* AND *ROTALIPORA MONTSALVENSIS*

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ABSTRACT

The species *Globotruncana (Rotalipora) reicheli* and *Globotruncana (Rotalipora) montsalvensis*, were established in 1949 by Mornod. The two holotypes were figured only by drawings and the specimens were never made publicly available. Since their first description, these two species have acquired great importance as biostratigraphic markers. However, holotypes had been considered as lost and neotypes were established and described.

Recently, these holotypes were discovered. We present here for the first time Scanning Electron Microscope images of the holotypes and compare them with the original drawings and neotypes to highlight possible similarities and differences. Generic assignment is made following a recent emendation for the polyphyletic group of rotaliporids, with the generic attribution as follows: *Thalmaninella reicheli* (Mornod) and *Rotalipora montsalvensis* Mornod.

INTRODUCTION

IMPORTANCE OF *THALMANNINELLA REICHELI* AND *ROTALIPORA MONTSALVENSIS*

Since they were first described, *Thalmaninella reicheli* and *Rotalipora montsalvensis* have acquired increasing importance as worldwide stratigraphic marker fossils for the Cenomanian at lower-to-middle latitudes. In particular, their temporal distribution, which as been cited as ~200 Ka and 2 Ma, respectively according to Premoli Silva and Verga (2004) or 500 ka and 3 Ma respectively, according to Gonzalez-Donoso and others (in press), establishes their importance for biostratigraphy. *Thalmaninella reicheli* is also the marker fossil for the *Th. reicheli* Zone.

When these species were established (Mornod, 1949), the author provided only drawings of the holotypes since the electron microscope was not in use at the time. Many scientists have attempted to obtain access to the holotypes; but the author always turned down the requests.

The absence of SEM images of the holotypes and the stratigraphic importance of the two species, led to the establishment of neotypes. Caron (1976) provided excellent SEM images of the type material (topotypes from the type locality of Montsalvens area), but provided only drawings of the neotypes, because at the time there was no guarantee for the safety of the specimens after SEM imaging.

Recently, L. Mornod passed away and his wife donated his library and samples to the Department of Geosciences, Geology and Paleontology of the University of Fribourg, where he was formerly a student. Such material included a box with the collection of foraminifers from the

Montsalvens area and the holotypes of *Globotruncana (Rotalipora) reicheli* and *Globotruncana (Rotalipora) montsalvensis* in the original slides.

Presently, the Mesozoic Planktonic Foraminifers Working Group (of which the two authors are members), chaired by B. Huber of the Smithsonian Institution, is engaged in the compilation of an on-line taxonomic dictionary of Mesozoic planktonic foraminifers in the framework of the CHRONOS initiative (US-NSF Project; <http://www.chronos.org>). Following the recommendation of the working group during its second meeting in Fribourg, Switzerland (June 2005), Gonzalez-Donoso and others (in press) proposed a redefinition of the polyphyletic group of rotaliporids. This revision includes the revision and re-description of the genera *Pseudothalmaninella*, *Thalmaninella* and *Rotalipora* based on a combination of new and old criteria. *Globotruncana (Rotalipora) montsalvensis* is assigned to the genus *Rotalipora* and *Globotruncana (Rotalipora) reicheli* is assigned to the genus *Thalmaninella*. This new classification is based on lineage affinities more than on morphological differences, making the documentation and availability of type specimens an essential requirement for its correct application.

We present here for the first time, the SEM images of these holotypes and their neotypes. We also compare them with the original drawings of Mornod (1949) and with the neotype's drawings of Caron (1976).

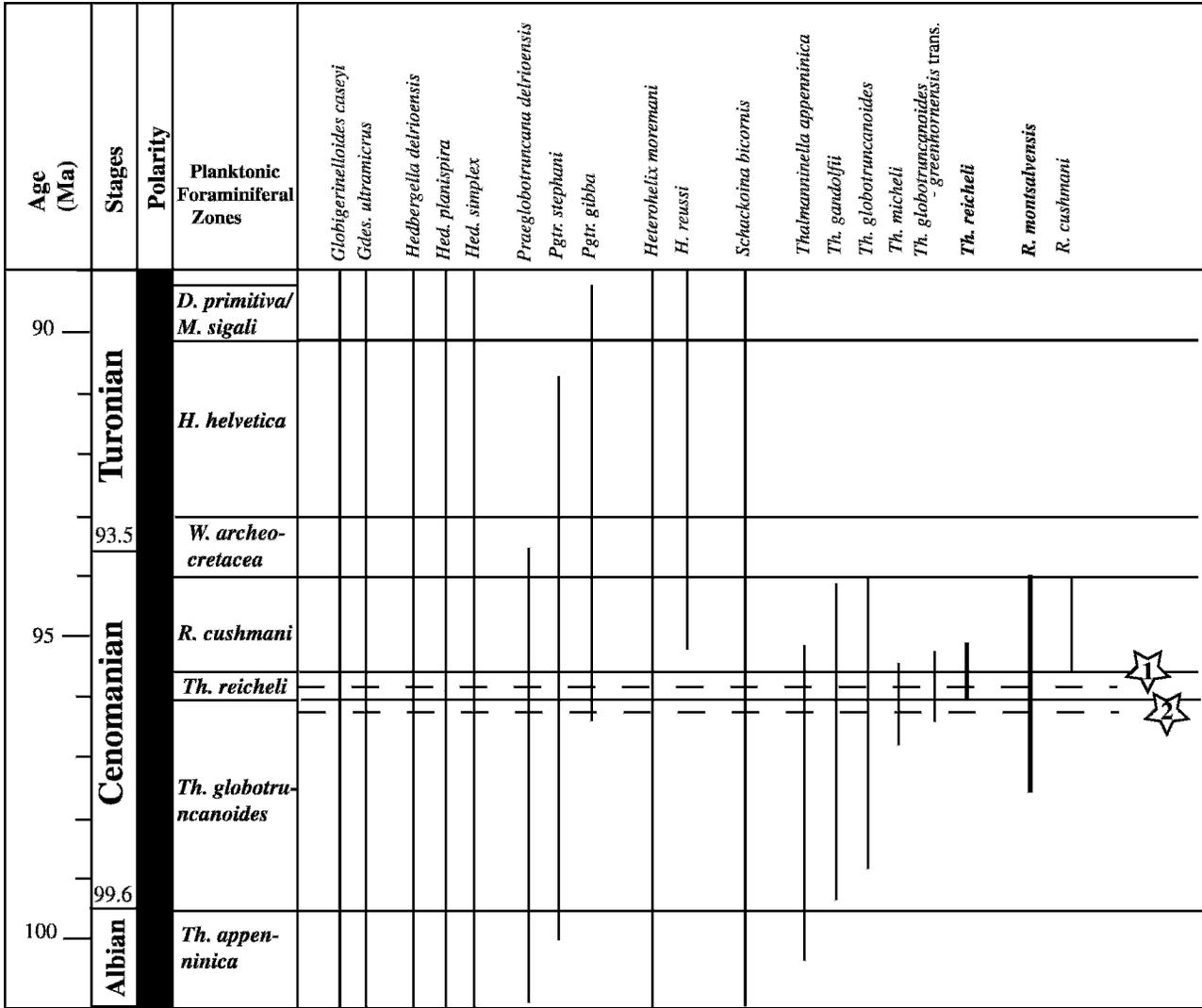
THE TYPE LOCALITY

The two species were both described from a site located along the Rio des Covayes in the Massif du Montsalvens in the Fribourg Prealpes. Being very small, the Rio des Covayes is, unfortunately, not reported on the topographic map of Gruyères (1:25000, map number 1225). The type locality of these species is ~1 km north of Cerniat as described by Mornod (1949).

The site has three outcrops that are very closed to each other: Outcrop I at about 1075 m, Outcrop II at about 1000 m and Outcrop III between 975 and 985 m of altitude. The type level of *Thalmaninella reicheli* is located at Outcrop III, level 18 and the type level of *Rotalipora montsalvensis* at Outcrop II, level 13 (Mornod, 1949).

The Upper Cretaceous sedimentary succession represents the uppermost part of the Jurassic-Cretaceous Series of the Ultrahelvetic Nappe in the Montsalvens area. Cenomanian sediments consist of dark gray, clayey chalks with greenish-blackish intercalations. Turonian sediments consist of whitish and massive chalks with clay intercalations (Caron, 1976).

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1- Stratigraphic position of the type locality of *Th. reicheli* (Mornod)
 2- Stratigraphic position of the type locality of *R. montsalvensis* Mornod

FIGURE 1. Distribution of planktonic foraminifera in the type locality of *R. montsalvensis* and *Th. reicheli*, Montsalvens area, Canton Fribourg, Switzerland. Star 1 and Star 2 mark the stratigraphic positions of *Th. reicheli* and *R. montsalvensis* in the type section, respectively. Time scale from Ogg and others (2004).

METHODS

SEM documentation of the holotypes of *Rotalipora montsalvensis* and *Thalmaninella reicheli* was obtained using the standard coating techniques for SEM samples preparation. The neotypes are deposited in the Natural History Museum of Basel. Since we did not have permission to coat the neotypes with gold, and the digital images did not show sufficient resolution, we applied an alternative methodology to obtain the SEM images.

The following procedure was applied: specimens were placed on standard glue tape on a SEM sample holder, which had been coated with an annular layer of silver paint to assure good conductivity. The neotypes were then placed in a scanning electron microscope (SEM - FEI XL30 Sirion FEG) and observed with a beam of 3 KV and a Spot 2, which are the minimum values that give reasonably good images without damaging the samples with the electron flux.

SYSTEMATIC TAXONOMY

Thalmaninella reicheli and *Rotalipora montsalvensis* are very well described and documented species; therefore the detailed diagnosis of the holotypes is here omitted. However, based on the SEM images of holotypes and neotypes in comparison with drawings we can now stabilize the main criteria for the identification of the two species.

***Thalmaninella reicheli* (Mornod, 1949)**
 Plate 1, figures 1–4

Type reference: *Globotruncana (Rotalipora) reicheli* Mornod, 1949, p. 583–584, fig. 5 (IVa–c); present article, pl. 1, figs. 1a–c, 2a–c.
 Neotype: *Rotalipora reicheli* Mornod; Caron, 1976, p. 330–331, text-figs. 2a–c.
 Topotypes: *Rotalipora reicheli* Mornod; Caron, 1976, pl. II, figs.1–5.

This species is readily recognizable by its distinct planoconvex, more or less cylindrical profile. The spiral side is flat to slightly concave (easily visible on the holotype), the umbilical side is highly convex. Mornod’s drawings of the holotype (Plate 1, figs. 2a–c) are consistent with SEM images (Plate 1, figs. 1a–c). In particular, the SEM images of the holotype and neotype (Plate 1, figs. 3a–c) have the same umbilical

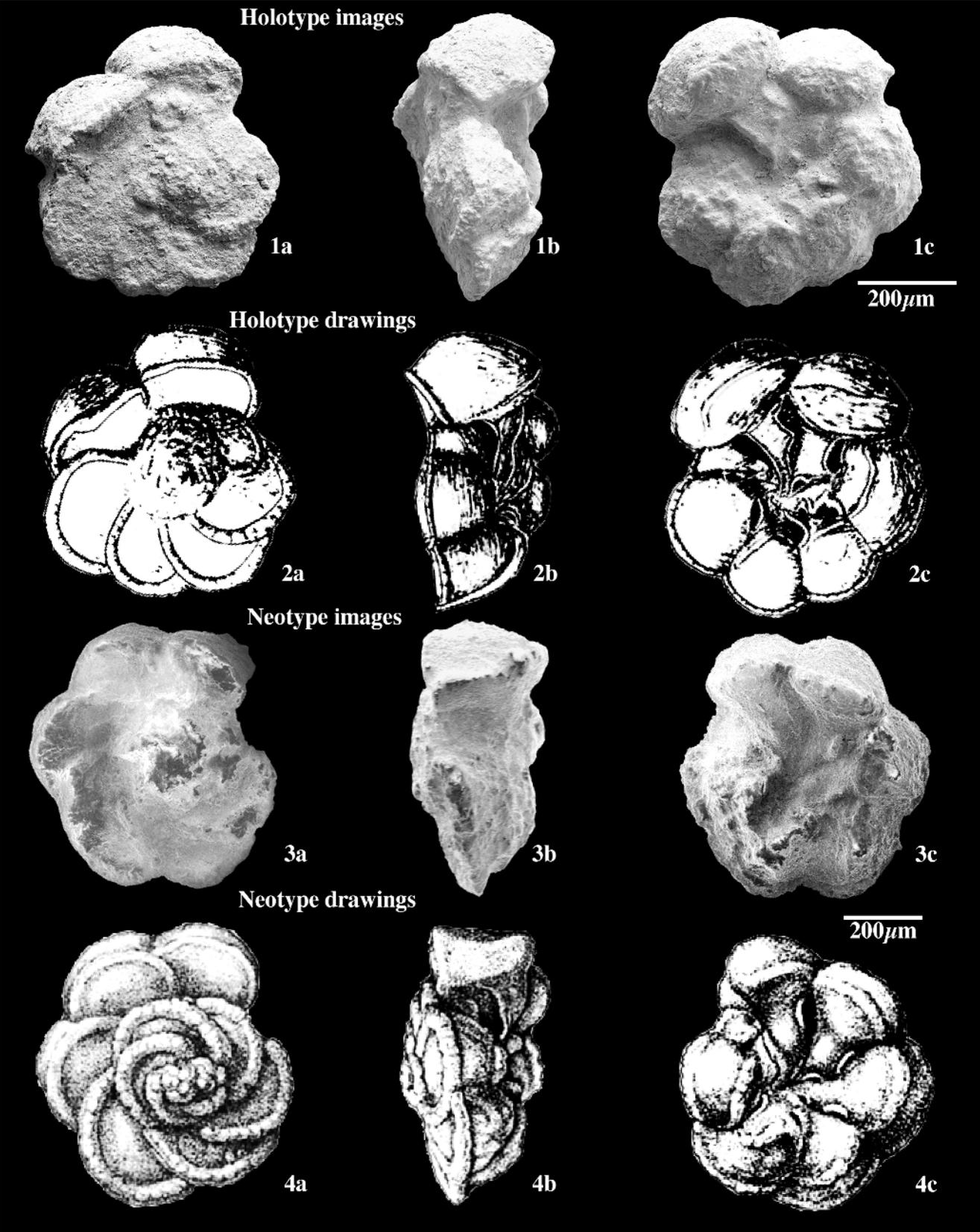


PLATE 1

Thalmanninella reicheli. 1a-c SEM images of the holotype. 2a-c Mornod (1949) drawing of the holotype. 3a-c SEM images of the neotype. 4a-c Caron (1976) drawing of the neotype.

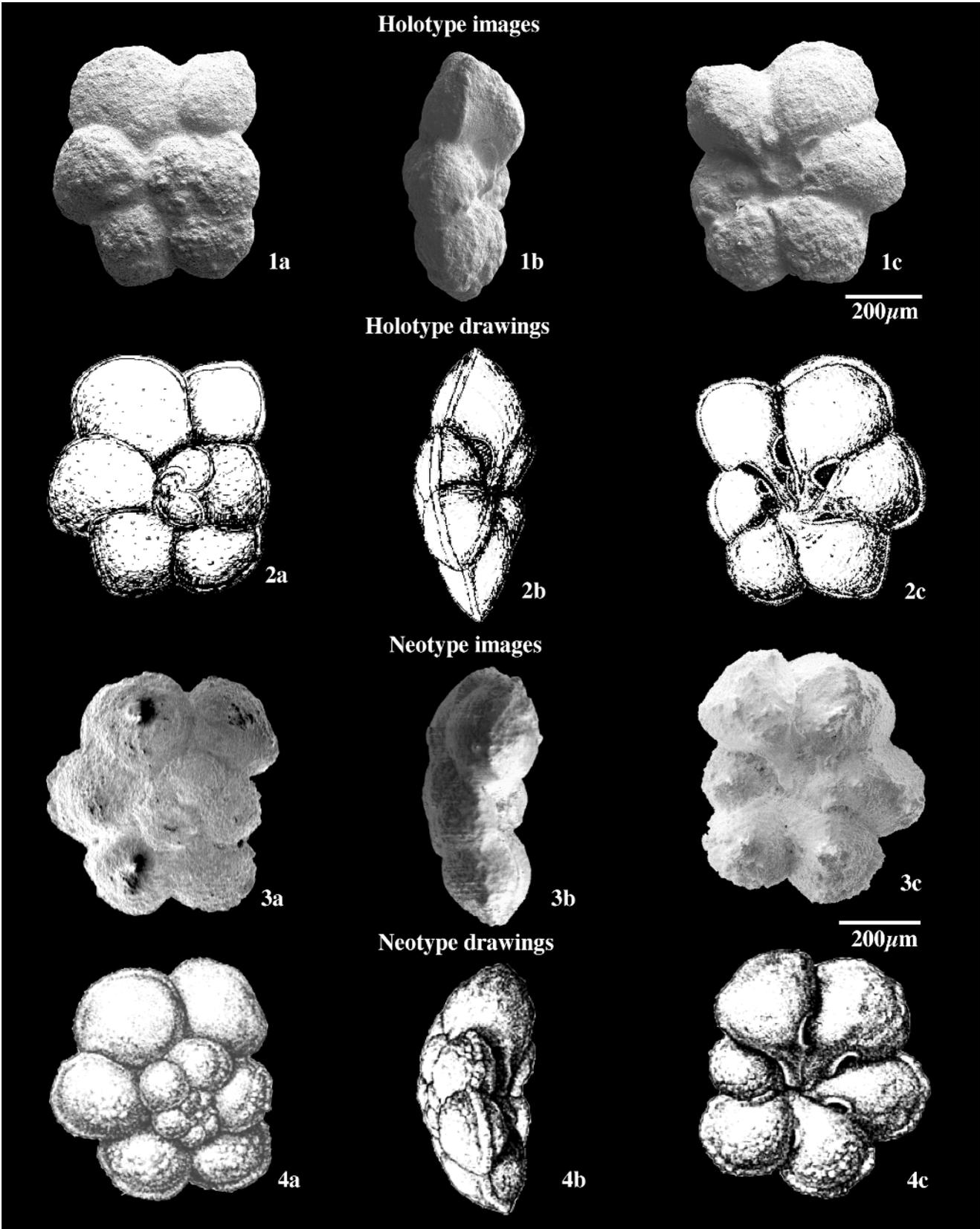


PLATE 2

Rotalipora montsalvensis. 1a–c SEM images of the holotype. 2a–c Mornod (1949) drawing of the holotype. 3a–c SEM images of the neotype. 4a–c Caron (1976) drawing of the neotype.

characters: chambers are inflated and bordered by a high, well-developed periumbilical ridge. Sutures between chambers are depressed and bordered by a distinctly visible primary aperture (sometimes appearing as a double opening as in the holotype drawing) in the large and deep umbilical depression.

Remarks: This species is often confused with *Thalmaninella micheli*. Both species display a cylindrical outline, flat spiral side with inflated chambers on the umbilical side. *Thalmaninella reicheli* differs from *Th. micheli* in having the umbilical sutures of the first chambers of the last whorl curved, raised and connected with the peri-umbilical ridges. These ridges are absent in *Th. micheli* (Gonzalez-Donoso and others, in press).

The holotype is deposited at the Natural History Museum of Basel with the reference number: NMB- C39013 and the neotype: NMB-33316.

Rotalipora montsalvensis (Mornod, 1949)

Plate 2, figures 1–4

Type reference: *Globotruncana (Rotalipora) montsalvensis* Mornod, 1949, p. 584–585, fig. 4 (1a–c); present article, pl. 2, figs. 1a–c, 2a–c.

Neotype: *Rotalipora montsalvensis* Mornod; Caron, 1976, p. 329–330, text figs. 1a–c.

Topotypes: *Rotalipora montsalvensis* Mornod; Caron, 1976, pl. I, figs. 1–6.

Mornod's drawings of the holotype (Plate 2, figs. 2a–c) are consistent with the SEM images (Plate 2, figs. 1a–c). A weak peripheral keel is barely visible because of the poor preservation of the specimen. The neotype (Plate 2, figs. 3a–c, 4a–c) and a large number of topotypes picked out from the reference sample (Caron 1976, Plate I, fig. 3; Robaszynski and others, 1979, Plate 15, fig. 1a–c) show the well-preserved peripheral keel. The axial profile is biconvex with inflated chambers, and no ornamentation is present on the spiral and umbilical sides. Intercameral sutures are straight on the umbilical side, curved on the spiral side, and depressed on both sides. The supplementary apertures are distinct in the umbilical sutures, and sometimes are doubled on the last suture.

The holotype is deposited at the Natural History Museum of Basel with the reference number: NMB-C39014 and the neotype: NMB-33315.

THE ACCOMPANYING ASSEMBLAGE

The accompanying assemblage is shown in Figure 1. *Thalmaninella reicheli* and *Rotalipora montsalvensis* are well represented. *Thalmaninella globotruncanoides*, *Th. gandolfii* and *Th. micheli* are abundant. Transitional forms between *Th. globotruncanoides* and *Th. greenhornensis* are found, as well as rare transitional forms between *Th. micheli* and *Th. reicheli*. *Praeglobotruncana stephani* and *P. gibba* are common, representing approximately 50% of the entire assemblage. Hedbergellids are small but very abundant and well-diversified; heterohelicids are very small, generally not abundant and consist of one species *Heterohelix moremani*.

These assemblages have distinct stratigraphic ranges as shown by the levels marked by the dashed lines and stars in Figure 1: Star 1 corresponds to the *Thalmaninella reicheli* type level. This rich assemblage precedes the level with the first occurrence (FO) of *Rotalipora cushmani*, and it belongs to the *Th. reicheli* Interval Range Zone (IRZ) of the mid-Cenomanian. Star 2, corresponds to the *Rotalipora montsalvensis* type level. This rich assemblage precedes the first occurrence (FO) of *Th. reicheli*. Nevertheless, the total range of *Rotalipora montsalvensis* spans the broader interval from the middle part of the early Cenomanian to the late

Cenomanian (Mornod, 1949; Caron 1976; Robaszynski and others, 1979; Robaszynski and others, 1990; Premoli Silva and Verga, 2004).

CONCLUSION

The holotypes of *Thalmaninella reicheli* and *Rotalipora montsalvensis* were recently discovered and are presented here with their first SEM images. Morphological characters in the original drawings of Mornod (1949) and Caron (1976) are consistent with those represented in the SEM photographs. Despite the importance of the discovery of these previously lost holotypes, the neotypes remain good reference specimens for the two species.

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