

Revision of the planktonic foraminifera *Pseudothalmanninella klausii* (LEHMANN, 1966) and *Globotruncanella semsalensis* (CORMINBOEUF, 1961) and first scanning electron microscope (SEM) images of the holotypes

Silvia SPEZZAFERRI¹ & Michèle CARON¹

Abstract

The planktonic foraminifera *Rotalipora klausii* LEHMANN, 1966 and *Globotruncana? semsalensis* CORMINBOEUF, 1961, were figured only by drawings and the specimens were never made publicly available, although deposited in the collections of the Department of Geosciences, Fribourg, Switzerland. We present here for the first time their Scanning Electron Microscope documentation and comparison with the original drawings. We complete the morphological descriptions and, accordingly, we emend the generic attribution of both species.

Since its first description *Rotalipora klausii* has acquired a great importance as phylogenetic and biostratigraphic marker for the Late Albian. Its generic attribution is made according to the recent revision of the polyphyletic group of Rotaliporids as *Pseudothalmanninella klausii*.

Globotruncana? semsalensis was first described in a rich planktonic foraminiferal assemblage of Upper Campanian. This species was disregarded for long time because of some disturbing resemblances with the *Praeglobotruncana* lineage. The present study proves the validity of this species and attributes it to the genus *Globotruncanella*.

Key words: Planktonic foraminifera, holotypes, Cretaceous, genus revision

Résumé

Révision des espèces de foraminifères planctoniques *Pseudothalmanninella klausii* (LEHMANN, 1966) and *Globotruncanella semsalensis* (CORMINBOEUF, 1961) et premières images des holotypes au microscope électronique à balayage (SEM). - Les espèces des foraminifères planctoniques *Rotalipora klausii* LEHMANN, 1966 et *Globotruncana? semsalensis* CORMINBOEUF, 1961, ont été figurées seulement par des dessins et les spécimens n'ont jamais été accessibles au public, bien que déposés dans les collections du Département de Géosciences, Fribourg, Suisse.

Nous présentons ici pour la première fois leur documentation au Microscope Electronique à Balayage accompagnée des dessins originaux. Nous complétons les descriptions morphologiques et, en accord avec ces observations, nous émendons les attributions génériques des deux espèces.

Depuis sa première description *Rotalipora klausii* a acquis une grande importance comme marqueur phylogénétique et biostratigraphique pour l'Albien supérieur. Son attribution générique est faite en accord avec la révision récente du groupe polyphylétique des Rotaliporids à savoir *Pseudothalmanninella klausii*.

Globotruncana? semsalensis a été décrite dans un riche assemblage de foraminifères planctoniques du Campanien supérieur. Cette espèce a été négligée pendant longtemps à cause de certaines ressemblances troublantes avec la lignée des *Praeglobotruncana*. L'étude présentée ici prouve la validité de cette espèce et la rattache au genre *Globotruncanella*.

Mots-clés: Foraminifères planctoniques, holotype, Crétacé, révision des genres.

I. INTRODUCTION

Presently, the Mesozoic Planktonic Foraminifera Working Group (of which the 2 authors are members), chaired by B. HUBER of the Smithsonian Institution, is engaged in the compilation of the on-line dictionary of Mesozoic planktonic foraminifera in the framework of the Chronos initiative (US-NSF Project). The dictionary includes the Scanning Electron Microscope (SEM) images of the

holotypes of all the Cretaceous species. Consequently, some disregarded and/or neglected holotypes have been sought and some of them rediscovered in ancient collections.

The holotypes of *Rotalipora klausii* LEHMANN, 1966 and *Globotruncana? semsalensis* CORMINBOEUF, 1961 deposited in the collections of Cretaceous planktonic foraminifera of the Department of Geosciences of the University of Fribourg were neglected for long time.

¹ University of Fribourg, Department of Geosciences, Earth Sciences, Chemin du Musée 6, CH-1700 Fribourg, Switzerland. E-mails: silvia.spezzaferrri@unifr.ch, michele.caron@unifr.ch

However, the increasing stratigraphic and phylogenetic importance of the two species recently urged the availability of their SEM images. We present here their first SEM documentation and compare them with the original drawings of KLAUS, 1959 (according designation by LEHMANN, 1966) and CORMINBOEUF, 1961). This revision proves the validity of both species and clarify their generic attribution.

II. SYSTEMATICS

Pseudothalmaninella klausi (LEHMANN, 1966)

Pl. I, figs 1a-c, 2a-c

History: The species was erected by LEHMANN, 1966, in his study on the coastal basin of Tarfaya, Morocco, where he documents a rich Late Albian-early Cenomanian planktonic foraminiferal fauna found in the Puerto Cansado well. He identified many specimens that could be clearly distinguished from the well known species *Thalmaninella ticinensis* (GANDOLFI) because of their more numerous chambers and higher trochospire. However, he designated as holotype of this new species (that he called *Rotalipora klausi*) a specimen documented in a publication of KLAUS (1959, pl. II, figs 2a-c), where it was identified as *Rotalipora* (*Thalmaninella*) *multiloculata* and justified his decision so that "... it is more judicious to choose a more accessible type-locality, that is not the case for the Puerto Cansado well."

The type specimen of KLAUS was deposited in the collection of Cretaceous planktonic foraminifers at the Department of Geosciences, Fribourg, and is documented here.

Type reference: *Rotalipora klausi* LEHMANN 1966, designated in KLAUS, 1959, pl. II, fig. 2a-c, specimen K.1516c, and figured under the name "*Rotalipora* (*Thalmaninella*) *multiloculata* (MORROW)".

Hypotypes: Illustrated in LEHMANN, 1966, figs 1a, j, k, l, m, n and pl. 2, fig. 4.

Repository: The holotype is now deposited at the Natural History Museum of Basel with the reference number NMB-C39016. The repository of the LEHMANN's hypotypes from Morocco is unknown.

Original description: Biconvex test formed by three trochospiral whorls, more convex on the spiral side than on the umbilical side. Eight to nine chambers are present in the last whorl and have roughly the same size. The test outline is moderately lobate. Umbilical sutures are radial with accessory aperture located in the narrow umbilicus. The primary aperture is interiomarginal, umbilical-extraumbilical. See KLAUS's drawings of the holotype, Pl. I, figs 2a-c.

Genus revision: The revision of the genus of this species is based on observation of the holotype (Pl. I, figs 1a-c). Nine chambers are present in the last whorl and are arranged in a high trochospire. The spiral side shows a

circular outline, chambers slowly increase in size as added; a beaded keel is present in all chambers of the last whorl, it is visible but smoother in the last chamber; spiral sutures are curved and raised except between the 3 last chambers where they are radial and depressed. On the umbilical side, sutures are radial and depressed. Periumbilical ridges are well developed on the four first chambers; the fourth periumbilical ridge raises exceptionally on the suture with the previous chamber. The umbilical area is narrow; the three first supplementary apertures are placed deeply in the umbilical depression; the supplementary aperture of the last chamber is well visible in the umbilical area.

This species is here attributed to the genus *Pseudothalmaninella*, based on the newly emended definition of this genus given by GONZALEZ DONOSO *et al.* (2007) as it possesses the characters of *Pseudothalmaninella*. In particular, it displays a spiroconvex profile with low whorl expansion rate; eight to nine chambers are present in the last whorl; the keel is present in all the chambers of the last whorl; the umbilicus is narrow and bordered by periumbilical ridges on the first four chambers; the sutures are radial and depressed; all supplementary apertures are present in umbilical position.

Remarks: *P. klausi* is considered by GONZALEZ DONOSO *et al.* (2007), as an intermediate form between *P. ticinensis* (GANDOLFI) and *P. tehamaensis* (MARIANOS & ZINGULA).

Comparison: This species is larger, with more numerous chambers and with a higher trochospire with respect to *Pseudothalmaninella ticinensis*. Although umbilical sutures are depressed, *P. klausi* differs from *P. ticinensis* by having periumbilical ridges (not represented in the drawing of KLAUS, but clearly visible in the SEM photographs of the holotype). It differs from *P. tehamaensis* in having depressed umbilical sutures although periumbilical ridges are present on the four first chambers of the last whorl.

Type locality: La Forclaz Pass, slope of the Dent de Bourgoz, Prealpes Medianes of Fribourg, Switzerland.

Age: Late Albian.

Accompanying assemblage: *Pseudothalmaninella ticinensis*, *Thalmaninella appenninica*, *Planomalina buxtorfi* and other species as shown in Fig. 1.

Reference biozone: *Th. appenninica* Zone.

Geographic distribution: Alps (Western Tethys); Morocco (North Atlantic) and Tunisia (Tethys).

Globotruncanella semsalensis (CORMINBOEUF, 1961)

Pl. I, figs 3a-c, 4a-c; Pl. II, figs 1a-c, 2a-c, 3a-c

History: The samples studied by CORMINBOEUF (1961) were taken in the "Wildflych subalpin" Zone outcropping in the Semsales region, Canton of Fribourg, Switzerland. The age of this formation is Middle Oligocene in age. However, the section studied by CORMINBOEUF (1961)

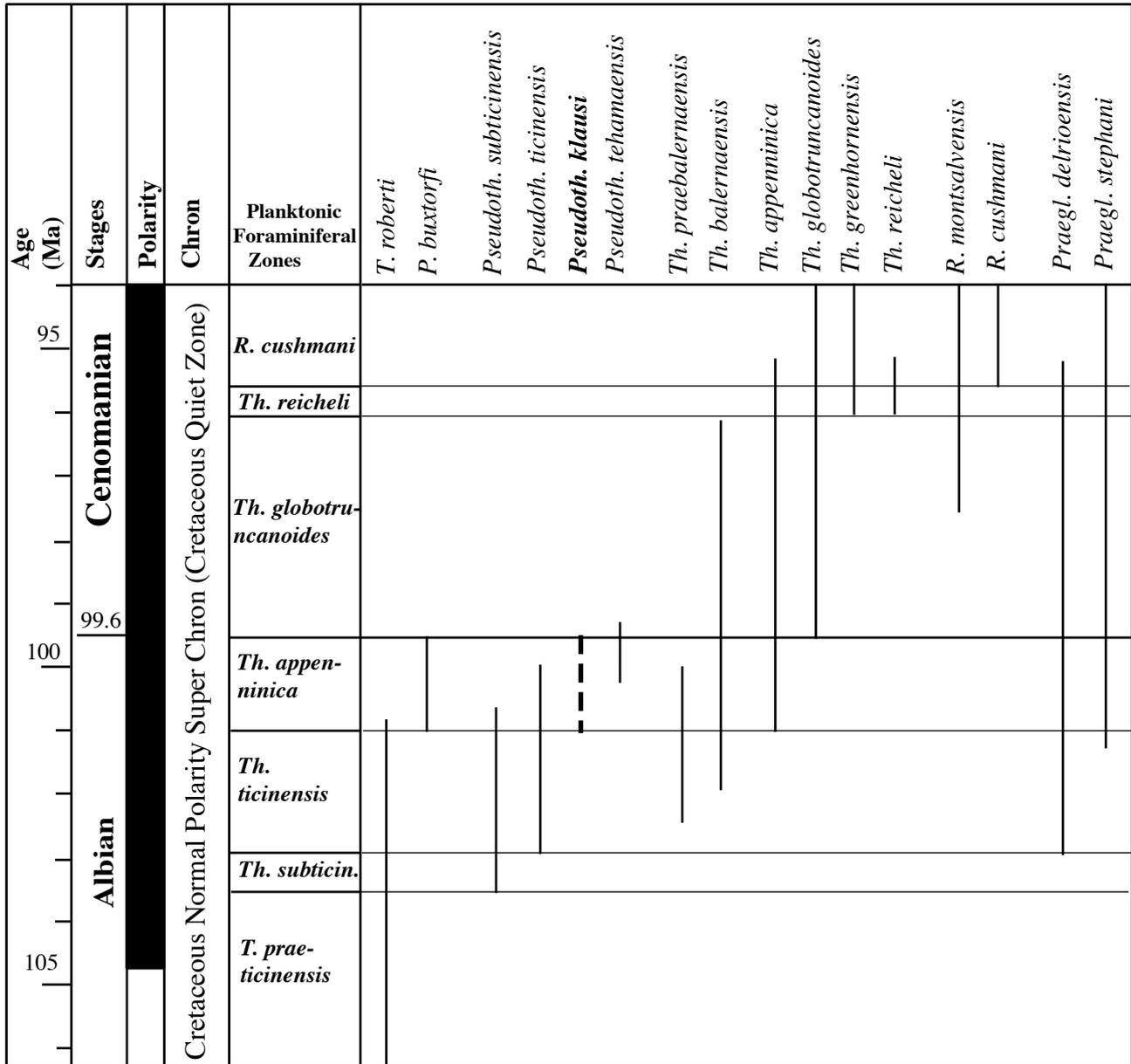


Fig. 1: Distribution of genera and species of planktonic foraminifera: *Pseudothalmaninella klausi* (LEHMANN) from Late Albian, according to KLAUS (1959), GONZALEZ DONOSO *et al.* (2007), ROBASYNSKI & CARON (1995) and PREMOLI SILVA & VERGA (2004). Time scale from OGG *et al.* (2004). *T.* = *Ticinella*; *P.* = *Planomalina*; Pseudoth. = *Pseudothalmaninella*; *Th.* = *Thalmaninella*; *R.* = *Rotalipora*; Praegl. = *Praeglobotruncana*,

situated in an old state quarry 1.5 km north-east of “Ruisseau de la Cierne”, is an olistolith about 20 m thick and comprises an alternation of white-grey micritic limestones and calcareous marls (CHUNGKHAM & CARON, 1996, p. 503). In the lower part of the section limestones are predominant and contain an assemblage including *Belemnitella mucronata* (SCHLOTH) var. *minor* JELETSKY and *Belemnitella cf. langei* JELETSKY, which corresponds to the *Bostrychoceras polyplacum* ammonite Zone, according to CORMINBOEUF (1961). The level of grey-

green marls, just below the *B. mucronata* layer, contains a rich association of Upper Campanian planktonic foraminifera from the *G. aegyptiaca*-*G. falsostuarti* Zone. CORMINBOEUF (1961) described *Globotruncana ? semsalensis* from this level.

The original material studied by CORMINBOEUF (1961) was deposited in the collection of Cretaceous planktonic foraminifera at the Department of Geosciences, Fribourg. The collection was recently revised following the suggestion of the Mesozoic Planktonic Foraminifera

Working Group with the aim to search and complete the data set for all type specimens present in the collection and never made available by the author.

Type reference: *Globotruncana? semsalensis* CORMINBOEUF, 1961, Pl. II, figs 1a-c; sample C 314.

Paratypes: CORMINBOEUF, 1961, Pl. II, figs 2a-c, 3a-c; sample C 314.

Repository: The holotype is presently deposited at the Natural History Museum of Basel with the reference number NMB- C39017, together with the two paratypes illustrated by CORMINBOEUF (1961) in Pl. II, figs 2a-c and 3a-c, and with a washed residue from a sample taken in the same type level and containing a rich assemblage of planktonic foraminifera.

Original description (simplified): The test is trochoidal and lobate. Generally six chambers are present in the last whorl. They are compressed and slowly increasing in size as added. The last-formed chamber can be larger, the same size or even smaller than the penultimate chamber. Pustules are rounded, slightly elongate, or spine-like, they are densely present on the two sides of the test. On the first chambers of the last whorl they are thick, gradually becoming thinner in the following chambers so that the last chamber(s) may be more or less smooth. The spiral side is convex. In the second whorl, chambers have a flat or slightly convex surface with thick rounded, spiky or slightly elongate pustules concentrating along the periphery and roughly shaping spiral and septal ridges. This ornamentation often remains present in the two or three first chambers of the last whorl; then it disappears, resulting in septal sutures depressed, radial, or curved in frontward direction. The spiral side of the chambers of this last whorl is weakly to moderately convex. On the umbilical side chambers are strongly inflated; sutures are radial and depressed. Strong and thick pustules are present on the first chambers of the last whorl, either randomly distributed or aligned in the coiling direction or perpendicular to that direction and, in this case, appearing like short costae spreading out from the umbilical edge toward the margin. In some specimens, one or two rows of pustules set in the coiling direction, become stronger on the two or three first chambers of the last coil and double or triple the already existing peripheral row. The primary aperture is umbilical but it often extends slightly toward the edge. It is covered by a tegillum directed toward the umbilicus, each tegillum is provided with a main aperture in the front and with one or two secondary

apertures in the back. The infralaminar apertures (main and secondary) may have – or not – a thin lip. Each tegillum partly or totally extends over the tegillum of the preceding chamber, the tegillum of the last chamber sometimes seals the whole umbilicus. Secondary infralaminar apertures are not present. See drawings of CORMINBOEUF (1961), Pl. I, figs 4a-c.

Genus revision: The revision of the genus of this species is based on the SEM images of the holotype (Pl. I, figs 3a-c) and on drawings of the 2 paratypes (Pl. II, figs 2a-c, 3a-c)

Six chambers are present in the last whorl. Chamber arrangement is trochospiral with very variable height (Pl. II, figs 1-3). It is low in the holotype profile to high in the second paratype. The spiral side shows a lobate outline; chambers are slowly increasing in size as added; strong pustules are present on the surface of the first chambers of the last whorl, thicker and concentrated along the peripheral row; this ornamentation disappears progressively on the last two chambers, the last one being always smooth, but exceptionally smaller as in the holotype (Pl. II, figs 1a-c).

On the two inner whorls, the peripheral double row of pustules underlines the raised spiral sutures, continuing on the 2 first chambers of the last whorl; the 4 last chambers being inflated, the spiral sutures are depressed. On the umbilical side, sutures are radial and depressed. The pustules are more densely distributed on the 4 first chambers of the last whorl, the last one being smooth. The umbilicus is one third of the test diameter; smaller and deeper in the highly spiroconvex paratype (Pl. II, fig. 3c). The umbilical area is covered by a complex system of portici; above the primary aperture, each chamber develops a large porticus towards the umbilicus, extending over the porticus of the preceding chamber. Two or three successive portici are distinct in the umbilical area, particularly well developed in the paratype shown in Pl. II, fig. 2c, in which they resemble a tegilla.

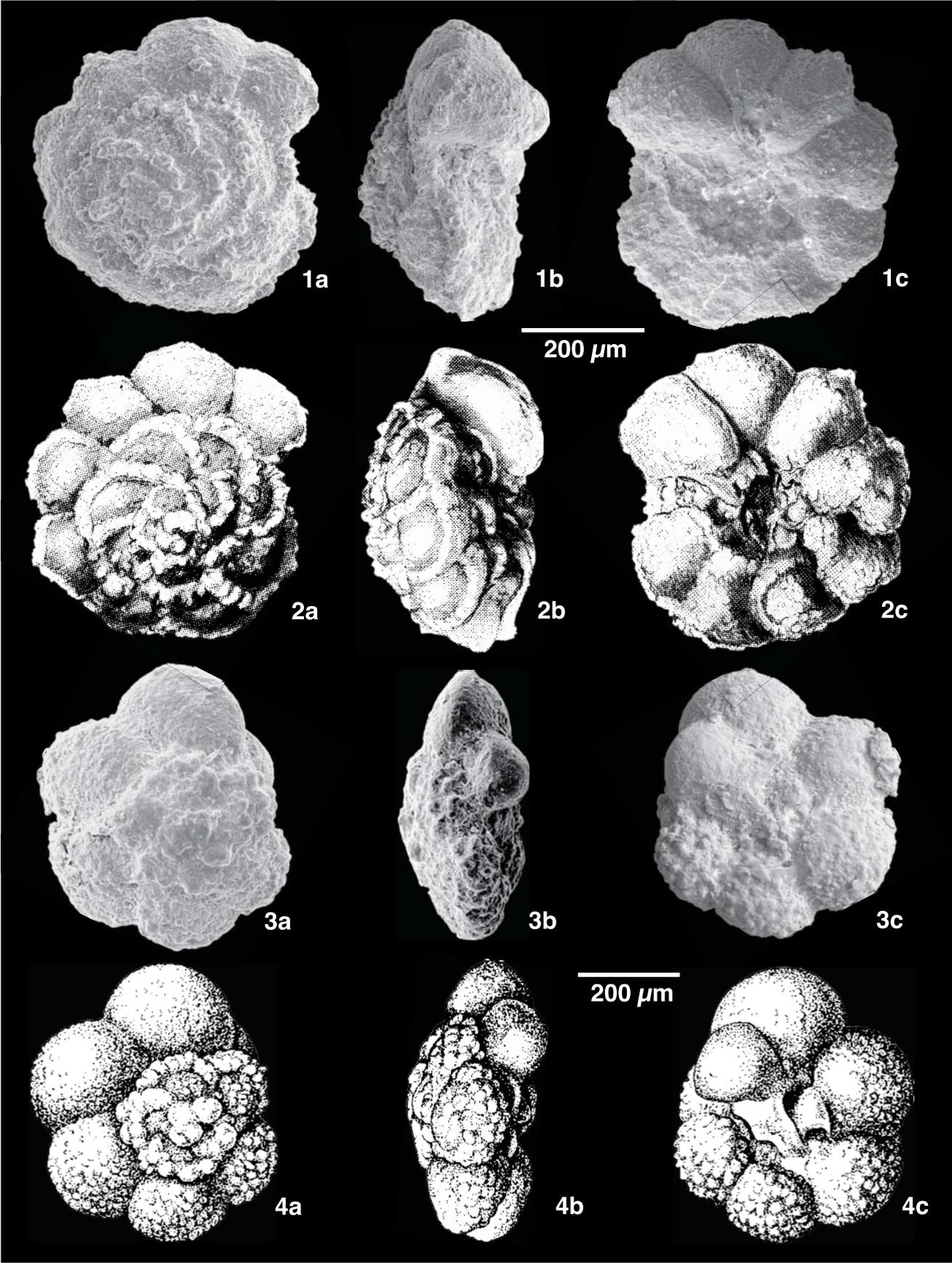
Remarks: According to the characteristic features well visible on the holotype and paratype specimens, this species is now attributed to the genus *Globotruncanella*. The thick rounded pustules concentrating along the periphery and roughly shaping spiral and septal ridges and the presence of large portici covering the umbilicus (and not of a tegilla), places this species as an intermediate between *Globotruncanella havanensis* (Voorwijk), with less pustulous wall texture and *G. pshadae* (KELLER) with keeled periphery.

Plate I

Figs 1a-c: *Pseudothalmaninella klausii* (LEHMANN), SEM images of the holotype.

Figs 2a-c: KLAUS's (1959) drawing of the holotype.

Figs 3a-c: *Globotruncanella semsalensis* (CORMINBOEUF), SEM images of the holotype. Figs 4a-c. CORMINBOEUF's (1961) drawing of the holotype. a = Spiral view, b = side view, c = umbilical view.



Comparison: *Globotruncanella semsalensis*, holotype and two paratypes (Pl. II), differ from the members of the *Praeglobotruncana delrioensis* - *P. stephani* - *P. gibba* lineage in having strong pustulose chamber surfaces, sometimes forming a meridional pattern, in having the periphery which never develops a double keel and in

showing large portici (firstly described as “tegilla” by the author himself, CORMINBOEUF, 1961).

Type locality: “Carrière de l’Etat”, Semsales, Canton of Fribourg, Switzerland.

Age: Late Campanian.

Accompanying assemblage: *Rugoglobigerina* ssp.,

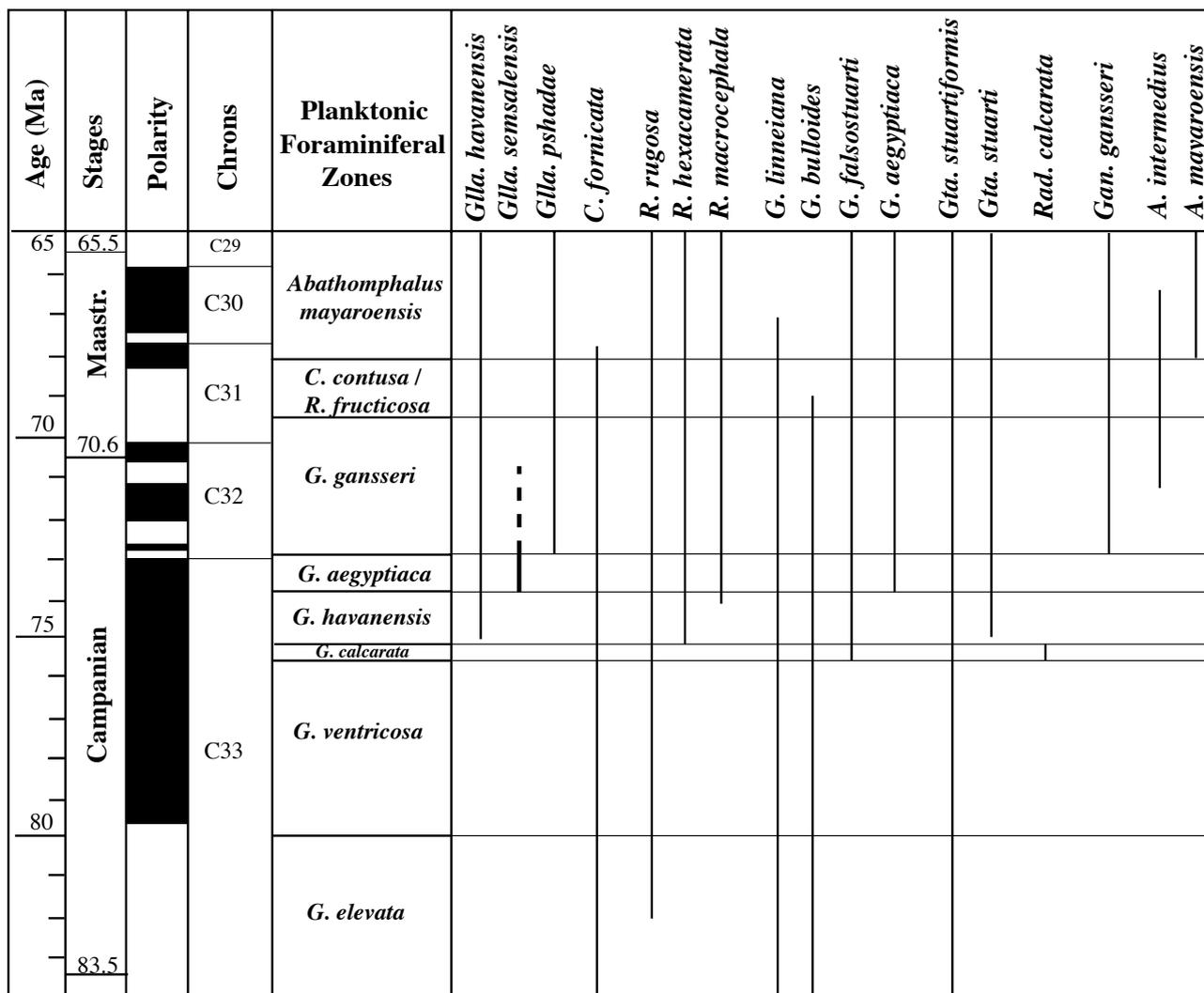
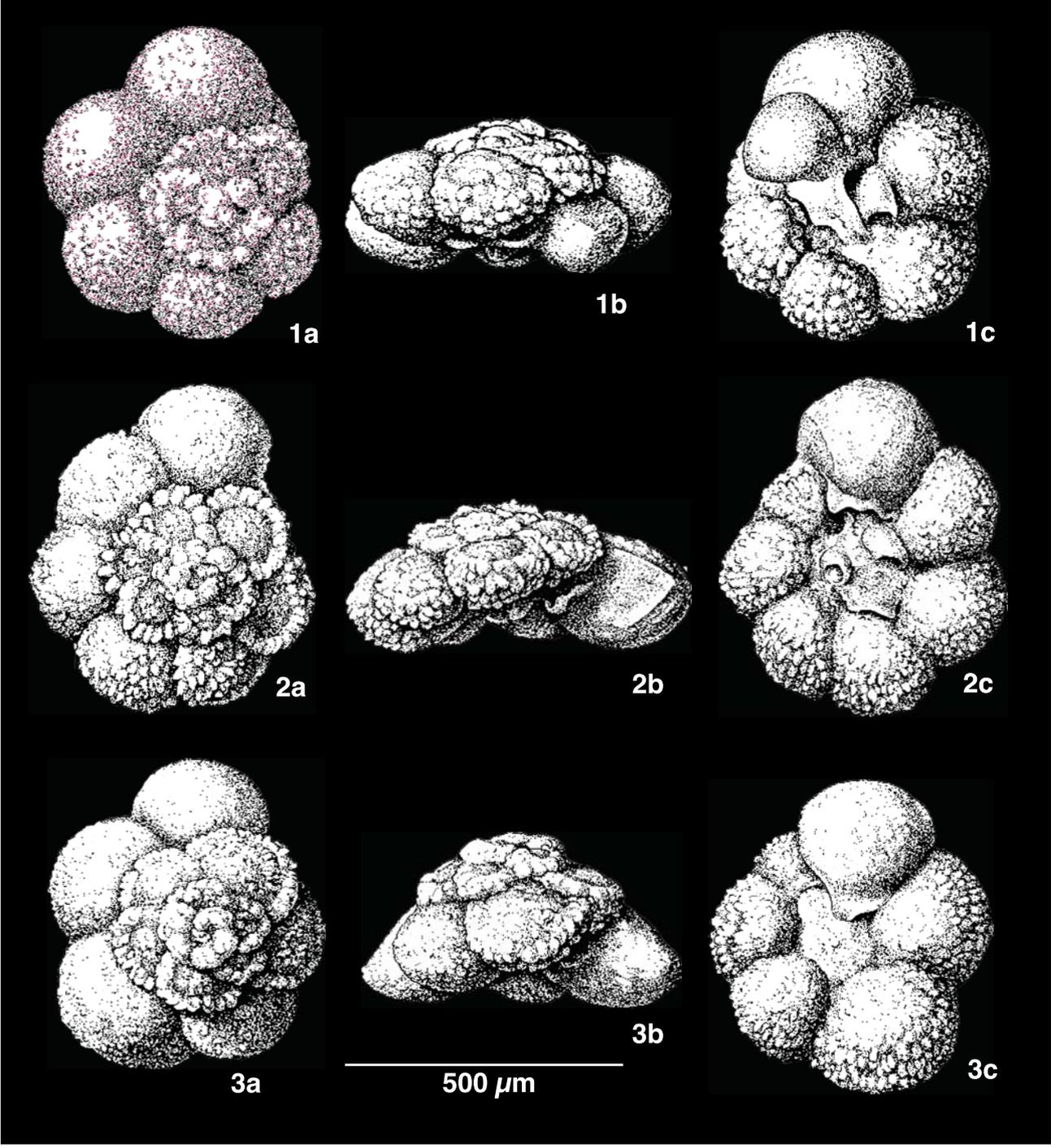


Fig. 2: Distribution of genera and species of planktonic foraminifera: *Globotruncanella semsalensis* (CORMINBOEUF) from Upper Campanian, according to CORMINBOEUF (1961), ROBASZYNSKI & CARON (1995) and PREMOLI SILVA & VERGA (2004). Time scale from OGG *et al.* (2004). *Glla.* = *Globotruncanella*; *R.* = *Rugoglobigerina*; *G.* = *Globotruncana*; *Gta.* = *Globotruncanita*; *Rad.* = *Radotruncana*; *Gan.* = *Gansserina* and *A.* = *Abathomphalus*.

Plate II

- Figs 1a-c: *Globotruncanella semsalensis* (CORMINBOEUF, 1961), drawings of the holotype.
- Figs 2a-c: *Globotruncanella semsalensis* (CORMINBOEUF, 1961), drawings of the 1st paratype.
- Figs 3a-c: *Globotruncanella semsalensis* (CORMINBOEUF, 1961), drawings of the 2nd paratype.



Globotruncana linneiana, *G. bulloides*, *G. falsostuarti*, *G. aegyptiaca*, *Globotruncanita stuartiformis* and other species as shown in Fig. 2.

Reference biozone: *G. aegyptiaca*/*G. falsostuarti* Zones.

Geographic distribution: Alps (Western Tethys).

III. CONCLUSIONS

We document the first SEM images of the holotypes of *Rotalipora klausi* LEHMANN, 1966 and *Globotruncana? semsalensis* CORMINBOEUF, 1961, and we compare them with the original drawings. Based on these new observations we are able to revise the two genera and attribute them to *Pseudothalmanninella* and *Globotruncanella* respectively. The revision has been necessary because since their first description, both *Pseudothalmanninella klausi* and *Globotruncanella semsalensis* have acquired a great importance as phylogenetic and biostratigraphic markers, for the Late Albian (*P. klausi*) and for the Late Campanian (*G. semsalensis*).

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