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***Globigerina triloba* REUSS, 1850 – Designation of a neotype**

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(With 3 plates)

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Abstract

To clarify taxonomical problems, a neotype for *Globigerina triloba* REUSS, 1850 is designated from type locality saltmine Wieliczka near Krakow, Poland. The stratigraphic level belongs to the Badenian, Middle Miocene. The species is characterized by three closely coiled chambers in the final whorl and secondary apertures along the spiral sutures. The species belongs therefore to the genus *Globigerinoides* CUSHMAN, 1927. The wall texture is coarsely cancellate.

Keywords: Foraminifera, Microfossils, Miocene, Globigerina, Neotype Designation

Zusammenfassung

Um die taxonomischen Probleme rund um *Globigerina triloba* REUSS, 1850 zu klären wurde ein Neotyp designiert. Der Neotyp stammt von der Typuslokalität: der Salzmine Wieliczka, bei Krakow in Polen, aus dem Badanium (Mittel-Miozän). Die Art ist durch drei eng gewundene Kammern im letzten Umgang und die Sekundäraperturen entlang der Spiralsutur charakterisiert. Basierend auf diesen Merkmalen ist sie in die Gattung *Globigerinoides* CUSHMAN, 1927 zu stellen. Die Wandtextur ist grob cancellat.

Keywords: Foraminifera, Microfossils, Miocene, Globigerina, Neotype Designation

Introduction

Based on secondary apertures along the spiral suture of specific globigerinids CUSHMAN (1927) created the new genus *Globigerinoides* with the type species *Globigerina rubra* d'ORBIGNY (1839). This subdivision of *Globigerina* was refused by HOFKER (1959), but kept by all later authors. *Globigerina triloba* (REUSS 1850) is an important species within the development of the genus *Globigerinoides*. BANNER & BLOW (1960) selected a lectotype for *Globigerina quadrilobata* d'ORBIGNY (1846) from the collection in Paris and defined it as *Globigerinoides*. This species was described from the Middle Miocene of

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Vienna, locality Nussdorf. In their discussion they made this species as the central species of *Globigerinoides* and considered *G. triloba* only as subspecies. This opinion to place the species *quadrilobatus* in *Globigerinoides* was not followed by BANDY (1964) as in the original figures of d'ORBIGNY (1846) no secondary apertures are visible. The taxonomic status of *G. quadrilobatus* was clarified by the revision of d'ORBIGNY's material (PAPP & SCHMID 1985). Later authors used both forms as distinct different species of *Globigerinoides*.

Within the evolutionary lineage of the genus *Globigerinoides* the earliest species was described by BLOW & BANNER (1962) from the Aquitanian, *Globorotalia kugleri* Zone (sensu BOLLI 1957) of Trinidad as *Globigerinoides quadrilobatus primordius*. This species was recorded also from the Oligocene *Globigerina ciperoensis* Zone (sensu BOLLI 1957) of Trinidad (LAMB & STAINFORTH 1976). To clarify the status of *G. triloba* in relation with similar species and in the evolution of the genus *Globigerinoides* since the Oligocene, it is necessary to select a neotype of *Globigerina triloba*. Such a definition makes a comparison with other species possible by the arrangement of chambers, the position of secondary apertures and, most important by the wall texture with the distribution of pores and spine bases.

Historical remarks on *Globigerina triloba*

August Emanuel von REUSS died in Vienna on November 26, 1873. He was Professor for mineralogy at the University of Vienna, but was one of the most distinguished palaeontologists of his time (BARTENSTEIN 1961). On Oktober 27, 1882 the custos of the palaeontological collections of the museum in Vienna, Theodor FUCHS made a proposal to the director to buy the micropaleontological collection of REUSS, consisting of Foraminifera, Ostracoda, and Bryozoa (Memorandum an die Indendanz des k. k. Naturhistorischen Hof-Museums, Z. 207a). The heirs of REUSS had already an offer of 4,000 ft. (florins) from the Natural History Museum in Brussels but were convinced to sell the collection for 3,000 ft. to the Vienna museum. A catalogue to the collection is mentioned in this proposal. Only in 1891 the purchase was settled by the ministry (Obersthofmeisteramt), and Ms. Marie von REUSS sold it for 2,000 ft. The acquisition of the collection (Acq. no. 37 from May 20, 1891) is mentioned in the journal "Annalen des Naturhistorischen Museums in Wien" (Anonymous 1891). The REUSS collection contained 6,765 numbers, mostly little glass bottles numbered on the cork plugs, with 3,212 type species. Many of those species are important in the field of micropaleontology. All the collection is preserved but can not be used as the catalogue to the numbers is missing. In 1894 LIENEN-KLAUS revised some ostracoda from northwestern Germany and had access to material from the REUSS collection. Probably at that time he had access to the catalogue. But in the thirties of last century the catalogue was missing already. Some sediment residues of the original samples of REUSS have been preserved.

The problem of identification of most of the species described by REUSS makes it necessary to define neotypes for important species. One of such cases is the definition of

Globigerina triloba REUSS (1850). This species has been described from the Middle Miocene of Felső Lapugy, Siebenbürgen (= Lapugiu de Sus, Bega Basin, Transylvania, Romania), from the salt mine at Wieliczka, Poland, from the Vienna Basin in Austria (Baden, Möllersdorf, Grinzing, Steinabrunn) and from the Styrian Basin, Austria (Wurzing, Rohitsch). It is mentioned by REUSS also from the sands of Castell Arquato near Parma, Italy (Pleistocene).

Discussion

The stratigraphically earliest species of *Globigerinoides*, *G. primordius* was believed to have evolved from *Globigerina praebulloides* BLOW in the Aquitanian (BLOW & BANNER 1962; BANNER & BLOW 1965). This opinion was followed by KELLER (1981), who recorded this species from the uppermost planktonic foraminiferal zone P22 to lower Zone N4 (sensu BLOW 1969), across the Paleogene-Neogene boundary. According to KELLER (1981) the lineage *G. praebulloides* – *G. primordius* terminated with the extinction of *G. primordius* in the Early Miocene. Another evolutionary lineage was proposed by JENKINS (1965) from *Globigerina woodi woodi* to *G. woodi connecta* to *Globigerinoides trilobus* within the upper part of Zone N5. In DSDP Site 292 from the northwestern Pacific KELLER (1981) found this development earlier, already at the base of the Miocene. According to KELLER, starting from *Globigerina connecta* JENKINS at a first step *Globigerinoides trilobus immaturus* LEROY evolved, followed by *G. trilobus trilobus* (REUSS), ending with *Globigerinoides sicanus* DE STEFANI (correctly *Praeorbulina*).

A differentiation in two groups of *Globigerinoides* was proposed by KENNETT & SRINIVASAN (1983). Group A should be derived from *Globigerina* sensu stricto, evolving in *G. primordius* – *G. altiapertura* – *G. obliquus* up to *G. bulloideus*. Group B should come from *Zeaglobigerina* (i. e. *woodi* stock) and evolves in the *G. trilobus* – *G. ruber* direction. BOLLI & SAUNDERS (1985) discuss the first appearance of *Globigerinoides* in the Oligocene in contrast to the explosive evolution of the *G. trilobus* group at the Oligocene-Miocene boundary. As an ancestor of *trilobus* the species *G. primordius* was considered. The investigations of the Paleogene-Neogene Boundary in the Piemont Basin showed the first appearance of *G. trilobus* sensu stricto co-inciding with the last occurrence of *Paragloborotalia kugleri* (BOLLI), a marker for the P/N boundary (IACCARINO et al. 1997, p. 43).

Designation of a neotype

Globigerina triloba REUSS, 1850

valid name: *Globigerinoides trilobus* (REUSS, 1850)

(Pl. 1, Figs 1–2; Pl. 3, Fig. 1)

1850 *Globigerina triloba* REUSS – p. 374, Pl. 47, Figs 11 a–e.

1857 *Globigerina triloba* REUSS – EGGER, p. 282, Pl. 11, Figs 11–13.

1867 *Globigerina triloba* REUSS – REUSS, p. 99.

- non 1875 *Globigerina triloba* REUSS – HANTKEN, p. 69, Pl. 8, Fig. 1.
 non 1884 *Globigerina bulloides* var. *triloba* REUSS – BRADY, p. 595, Pl. 79, Figs 1–2, Pl. 81, Figs 2–3.
 1942 *Globigerinoides triloba* (REUSS) – CORYELL & MOSSMANN, p. 238, Pl. 36, Figs 29–30.
 1951 *Globigerinoides triloba* (REUSS) – MARKS, p. 71.
 1962 *Globigerinoides triloba* (REUSS) – BLOW, p. 62, Text-figs 1–3.
 1975 *Globigerinoides quadrilobatus trilobus* (REUSS, 1850). – STAINFORTH et al., p. 310, Figs 138/1–5.
 1981 *Globigerinoides trilobus* (REUSS) – JENKINS et al., p. 262, Pl. 1, Figs 3–5.
 1983 *Globigerinoides triloba* (REUSS) – KENNETT & SRINIVASAN, p. 62, Pl. 13, Figs 1–3.
 1998 *Globigerinoides trilobus* (REUSS) – CÍCHA et al., p. 102, Pl. 36, Figs 1–3.

Locus typicus: Saltmine Wieliczka near Krakow, Poland.

Stratigraphy: Middle Miocene, Badenian, probably Wielician stage of the Central Paratethys (LUCZKOWSKA 1978).

Neotype: NHMW 2011/0341/0001, Micropalaeontological Collection of the Department of Geology & Palaeontology, Natural History Museum Vienna, selected from original material of A.E. REUSS, collection number 1867/0034/0037.

Description: umbilical side with three chambers visible, rapidly increasing in size with distinct incised sutures, umbilicus flat, aperture a low arch with a small lip; lateral view broadly rounded; spiral side: three chambers in the final and four in the penultimate whorl, with indistinct chambers in the innermost part, low arched secondary apertures along the sutures. Wall texture is coarsely cancellate with polygonal ridges around funnel shaped pores (Pl. 3, Fig. 1). According to the presence of secondary apertures along the spiral sutures *G. triloba* belongs to the genus *Globigerinoides*.

Dimensions: maximum length 0.49 mm; maximum width 0.35 mm.

Remarks: The specimen of EGGER (1857) from the Early Miocene of the Bavarian Molasse Basin has a general similarity with *G. trilobus*. He mentioned the missing secondary aperture, but discussed the cancellate wall texture. In the case of HANTKEN (1875) a very compact specimen from the Late Eocene with three chambers is figured. It does not show any aperture and can not be identified, probably a *Subbotina*. For the specimens of BRADY (1884) the taxonomical position and synonymies are discussed by JONES (1994). The first attribution of *Globigerina triloba* to the genus *Globigerinoides* was given by CORYELL & MOSSMANN (1942). BLOW (1962) stated *G. trilobus* as a central form in the evolutionary lineage to *Orbulina*, and that the species evolved already in the late Oligocene in Trinidad and Venezuela. According to more recent observations, *G. trilobus* appears around the Oligocene-Miocene boundary (SPEZZAFERRI 1994; IACCARINO et al. 1997).

Topotype specimens have been published already by STAINFORTH et al. (1975) from Wieliczka, Poland, by JENKINS et al. (1981) from Lapugy (Romania) and Baden (Austria), from where it was reported also by MARKS (1951) and CÍCHA et al. (1998). To select a neotype, type material of A.E. REUSS (1867) from Wieliczka, Poland was chosen. The phial from the material published by REUSS consisted of five specimens of *G. triloba* and two specimens of different globigerinas: *Globigerina diplostoma* REUSS, *Globoturbotalita woodi* (JENKINS). The best preserved specimen was selected.

A remarkable variability within *G. trilobus* is observed. This concerns the coiling with three to three and a half chambers in the final whorl, and the width of the aperture. For comparison further specimens from Wieliczka, Middle Badenian, Wielician (Pl. 2, Figs 1–2; Pl. 3, Fig. 1), from Lapugy (= Lapugiu de Sus), Bega Basin, Transylvania, Romania, Middle Miocene, Early Badenian are figured (Pl. 1, Fig. 3, Pl. 2, Figs 7–9) as well as some from the old brickyards in Baden, Austria, Vienna Basin, Early Badenian, Upper Lagenidae Zone (Pl. 1, Figs 4–8; Pl. 3, Figs 3, 5), and from Wien – Nussdorf, Middle Badenian (Pl. 2, Figs 5–6). A study of SZCZETCHURA (1984) shows a series of *G. trilobus* from different horizons of the Central Paratethys in the evolution from *Globigerinoides* to *Orbulina*.

For *Globigerinoides quadrilobatus* (D'ORBIGNY) from the type locality Wien – Nussdorf, Grünes Kreuz the difference to *G. trilobus* is given by the elongate chambers in coiling direction and the wide primary aperture in an umbilical position (Pl. 2, Figs 3–4). Wall texture in all specimens of *trilobus* (Pl. 3, Figs 1–4) and *quadrilobatus* (Pl. 3, Fig. 6) is coarsely cancellate. In contrast to Middle Miocene *Globigerinoides* the investigated specimens of *G. primordius* from Trinidad show a distinctly finer cancellation of the wall (Pl. 2, Figs 10–12, Pl. 3, Figs 7–8).

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Plate 1

Figs 1–2: *Globigerina triloba* REUSS, umbilical and spiral view; Wieliczka, saltmine, Poland, Middle Miocene, Badenian. **Neotype**, original Material of A.E. REUSS, from collection number 1867–XXXIV-37. Inv. No. NHMW 2011/0341/0001.

Fig. 3: *Globigerinoides trilobus* (REUSS), umbilical side; Felső Lapugy, Siebenbürgen (= Lapugiu de Sus), Bega Basin, Transylvania, Romania, sample coll. A.E. REUSS, Middle Miocene, Early Badenian. Inv. No. NHMW 2011/0341/0002.

Figs 4 and 7: *Globigerinoides trilobus* (REUSS), umbilical and spiral view; Baden old brickyards, level no. 5, colln Naturhist. Museum Wien 1860, Middle Miocene, Badenian, Baden Formation, Upper Lagenidae Zone. Inv. No. NHMW 2011/0341/0007.

Fig. 5: *Globigerinoides trilobus* (REUSS), spiral side with distinct secondary apertures; Baden old brickyards, level no. 5, colln Naturhist. Museum Wien 1860, Middle Miocene, Badenian, Baden Formation, Upper Lagenidae Zone. Inv. No. NHMW 2011/0341/0005.

Fig. 6: *Globigerinoides trilobus* (REUSS), lateral view; Baden old brickyards, level no. 5, colln Naturhist. Museum Wien 1860, Middle Miocene, Badenian, Baden Formation, Upper Lagenidae Zone. Inv. No. NHMW 2011/0341/0006.

Fig. 8: *Globigerinoides trilobus* (REUSS), umbilical side; Baden old brickyards, level no. 5, colln Naturhist. Museum Wien 1860, Middle Miocene, Badenian, Baden Formation, Upper Lagenidae Zone. Inv. No. NHMW 2011/0341/0004.

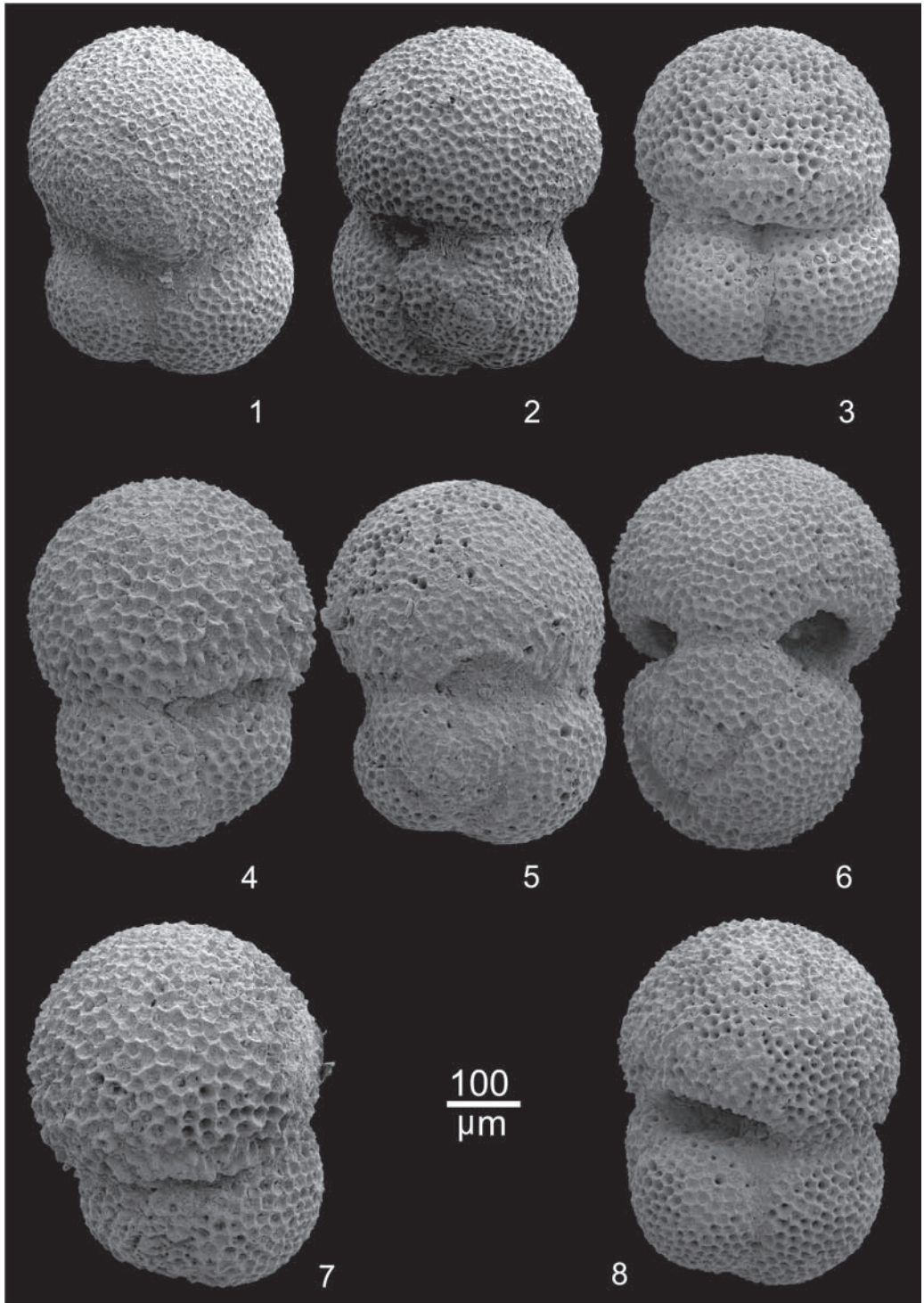


Plate 2

Figs 1–2: *Globigerinoides trilobus* (REUSS), umbilical and spiral sides; Wieliczka, Poland, saltmine, Rarancza tunnel (48 m), Skawina Formation, Middle Miocene, Middle Badenian, Wielicien substage. Inv. No. NHMW 2011/0341/0015.

Fig. 3: *Globigerinoides quadrilobatus* (d'ORBIGNY), umbilical side; Wien – Nussdorf, Grünes Kreuz, coll. A.E. REUSS, Middle Miocene, Middle Badenian, Zone of agglutinated Foraminifera. Inv. No. NHMW 2011/0341/0016.

Fig. 4: *Globigerinoides quadrilobatus* (d'ORBIGNY), spiral side; Wien – Nussdorf, Grünes Kreuz, coll. A.E. REUSS, Middle Miocene, Middle Badenian, Zone of agglutinated Foraminifera. Inv. No. NHMW 2011/0341/0017.

Fig. 5: *Globigerinoides trilobus* (REUSS), umbilical side; Wien – Nussdorf, Grünes Kreuz, coll. A.E. REUSS, Middle Miocene, Middle Badenian, Zone of agglutinated Foraminifera. Inv. No. NHMW 2011/0341/0018.

Fig. 6: *Globigerinoides trilobus* (REUSS), spiral side; Wien – Nussdorf, Grünes Kreuz, coll. A.E. REUSS, Middle Miocene, Middle Badenian, Zone of agglutinated Foraminifera. Inv. No. NHMW 2011/0341/0019.

Fig. 7: *Globigerinoides trilobus* (REUSS), spiral side; Felső Lapugy, Siebenbürgen (= Lapugiu de Sus), Bega Basin, Transylvania, Romania, coll. A.E. REUSS, Middle Miocene, Early Badenian. Inv. No. NHMW 2011/0341/0003.

Figs 8–9: *Globigerinoides trilobus* (REUSS), umbilical and spiral side; Felső Lapugy, Siebenbürgen (= Lapugiu de Sus), Bega Basin, Transylvania, Romania, coll. A.E. REUSS, Middle Miocene, Early Badenian. Inv. No. NHMW 2011/0341/0020.

Fig. 10: *Globigerinoides primordius* BLOW & BANNER, umbilical side; Trinidad, Oropuche area, coll. J.-P. BECKMANN no. 234.452–G.105, Late Oligocene, upper *Globigerina ciperoensis* Zone. Inv. No. NHMW 2011/0341/0013.

Fig. 11: *Globigerinoides primordius* BLOW & BANNER, spiral side with secondary apertures; Trinidad, La Romaine, sample HMB 407, coll. H.M. BOLLI, Aquitanian, *Globorotalia kugleri* Zone, near topotype. Inv. No. NHMW 2011/0341/0009.

Fig. 12: *Globigerinoides primordius* BLOW & BANNER, umbilical side; Trinidad, La Romaine, sample HMB 407, coll. H.M. BOLLI, Aquitanian, *Globorotalia kugleri* Zone, near topotype. Inv. No. NHMW 2011/0341/0008.

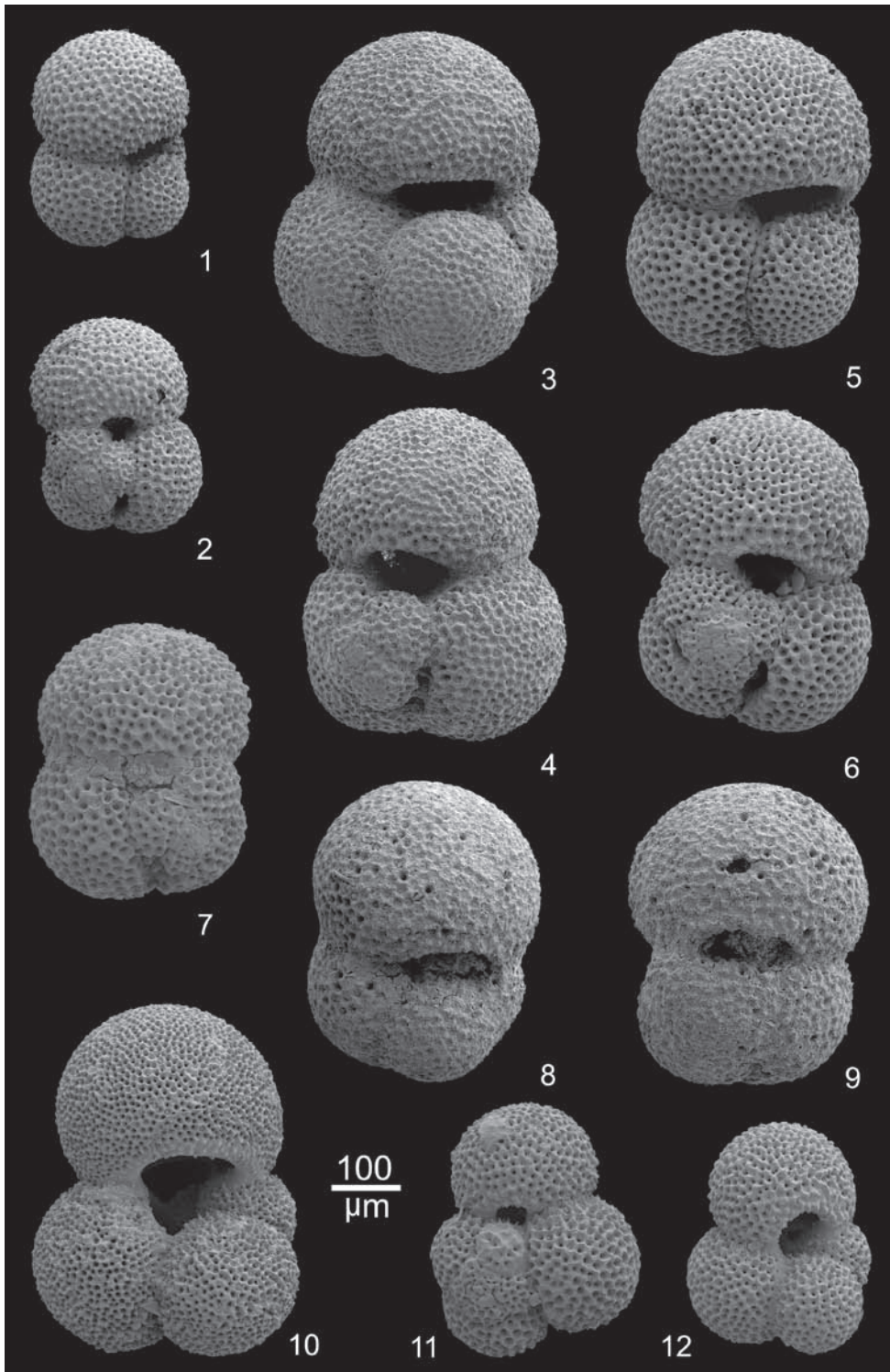


Plate 3

Fig. 1: *Globigerina triloba* REUSS, cancellate wall texture of final chamber; Wieliczka, saltmine, Poland, Middle Miocene, Badenian, Wielician substage. **Neotype**, original Material of A.E. REUSS, from collection number 1867/0034/0037, Inv. No. NHMW 2011/0341/0001 (comp. Pl. 1, Fig. 1).

Fig. 2: *Globigerinoides trilobus* (REUSS), cancellate wall texture of final chamber; Wieliczka, Poland, saltmine, Rarancza tunnel (48 m), Skawina Formation, Middle Miocene, Middle Badenian, Wielicien substage. Inv. No. NHMW 2011/0341/0015 (comp. pl.2, Fig. 1).

Fig. 3: *Globigerinoides trilobus* (REUSS), cancellate wall texture of final chamber; Baden old brickyards, level no. 5, colln Naturhist. Museum Wien 1860, Middle Miocene, Badenian, Baden Formation, Upper Lagenidae Zone. Inv. No. NHMW 2011/0341/0007 (comp. Pl. 1, Fig. 4).

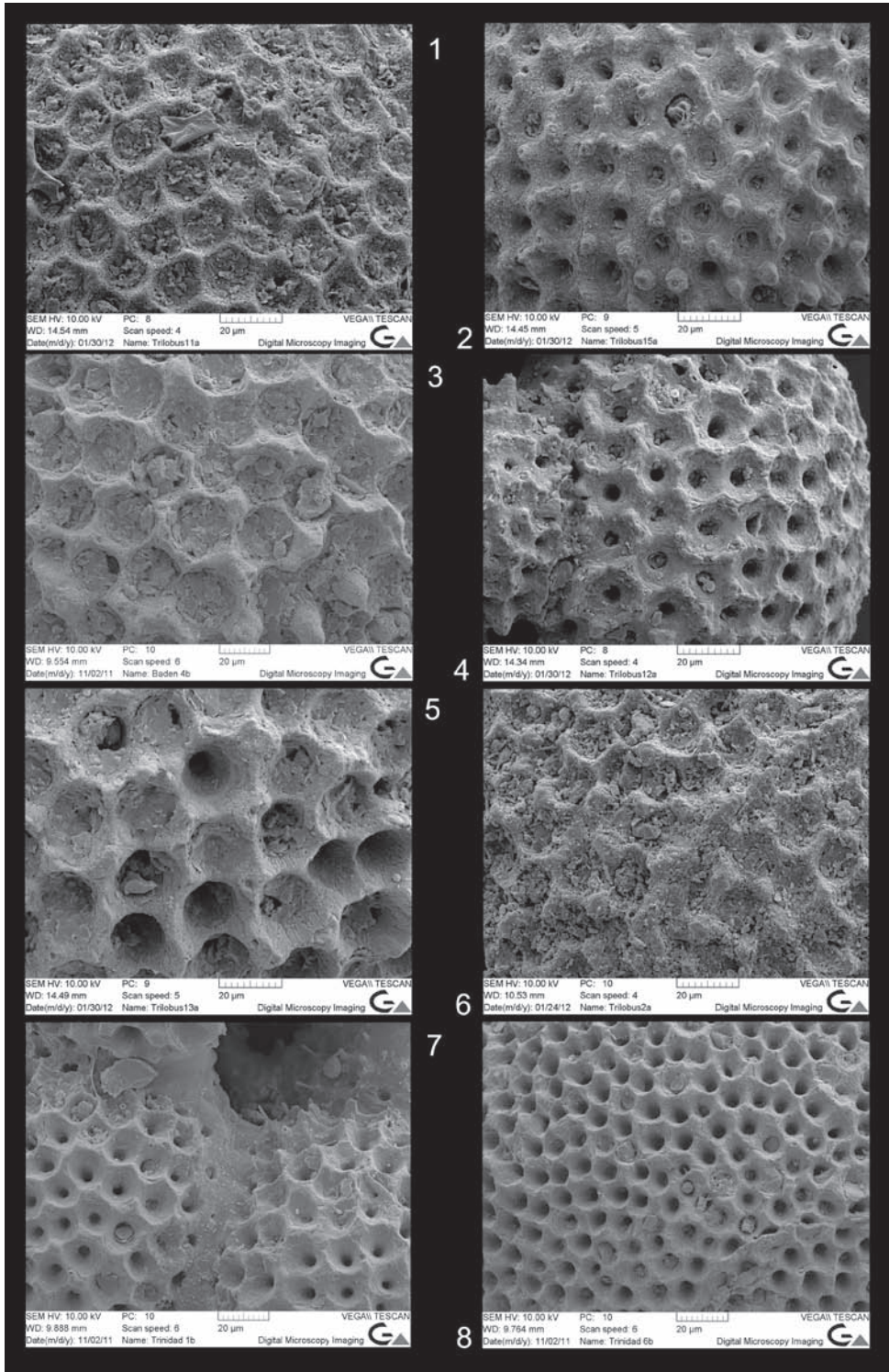
Fig. 4: *Globigerinoides trilobus* (REUSS), cancellate wall texture of pre-last chamber, spiral side; Wieliczka, Poland, saltmine, Rarancza tunnel (48 m), Skawina Formation, Middle Miocene, Middle Badenian, Wielicien substage. Inv. No. NHMW 2011/0341/0015 (comp. pl.2, Fig. 2).

Fig. 5: *Globigerinoides trilobus* (REUSS), cancellate wall texture of final chamber, spiral side; Baden old brickyards, level no. 5, colln Naturhist. Museum Wien 1860, Middle Miocene, Badenian, Baden Formation, Upper Lagenidae Zone. Inv. No. NHMW 2011/0341/0007 (comp. Pl. 1, Fig. 7).

Fig. 6: *Globigerinoides quadrilobatus* (d'ORBIGNY), cancellate wall texture of final chamber; Wien – Nussdorf, Grünes Kreuz, coll. A.E. REUSS, Middle Miocene, Middle Badenian, Zone of agglutinated Foraminifera. Inv. No. NHMW 2011/0341/0016 (comp. Pl. 2, Fig. 3).

Fig. 7: *Globigerinoides primordius* BLOW & BANNER, cancellate wall texture of final chamber; Trinidad, La Romaine, sample HMB 407, coll. H.M. BOLLI, Aquitanian, *Globorotalia kugleri* Zone, near topotype. Inv. No. NHMW 2011/0341/0008 (comp. Pl. 2, Fig. 12).

Fig. 8: *Globigerinoides primordius* BLOW & BANNER, cancellate wall texture of final chamber; Trinidad, Oropuche area, coll. J.-P. BECKMANN no. 234.452–G.105, Late Oligocene, upper *Globigerina ciperoensis* Zone. Inv. No. NHMW 2011/0341/0013 (comp. Pl. 2, Fig. 10).



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