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Genus *Silicoplaentina* (Class Amoebina) from the Miocene Machów Formation (Krakowiec Clays) of the northern Carpathian Foredeep



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Representatives of the genus *Silicoplaentina* have been found in the Jamnica S-119 borehole and in an open pit at the Machów mine in the upper part of the Krakowiec Clays (Machów Formation). They represent the thecamoebians, which have not been previously described from the Polish part of the Carpathian Foredeep. *Silicoplaentina* species are accompanied by foraminifers of the genus *Miliammina* characteristic of the Pannonian, Sarmatian relict forms of the genera *Quinqueloculina*, *Elphidium* and *Nonion*, as well as fragments of fish, otoliths and ostracods. A Late Sarmatian foraminiferal assemblage of the *Protelphidium subgranosum* Zone, already known in earlier literature, occurs below the deposits with *Silicoplaentina*. Such a microfaunal succession may suggest that the microfossil assemblage found in the Jamnica S-119 borehole and Machów open pit comes from yet higher levels of the Krakowiec Clays than those previously described from the *Protelphidium subgranosum* Zone. A strong connection with microfauna from the Intra-Carpathian basins of the eastern Paratethys is marked in these youngest assemblages.

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Key words: Carpathian Foredeep, Miocene, Krakowiec Clays, genus *Silicoplaentina*.

INTRODUCTION

Continuing research on Miocene microfaunal assemblages from the Krakowiec Series of the northern part of the Carpathian Foredeep, has led to the discovery in its lowermost part of tests belonging to the genus *Silicoplaentina*.

These are present in two sites: in the Jamnica S-119 borehole and in an open pit at the Machów mine (Fig. 1), in marly claystones exhibiting varying textures, interbedded with sandstones or sandy siltstones. In the Jamnica S-119 borehole they occur at a depth interval of 56–117 m, and in the Machów mine at 32–35 m (Fig. 2).

Both a lack of any information regarding *Silicoplaentina* in Miocene deposits in the Polish part of the Carpathian Foredeep, and the stratigraphic importance of these organisms in the lowermost Pannonian deposits of Hungary (O. S. Schreiber *et al.*, 1985) and the Vienna Basin (R. Fuchs, O. S. Schreiber, 1988), have prompted detailed studies on the structure, taxonomy, biostratigraphy and ecology of these microfossils.

GENERAL CHARACTERISTICS OF ORGANISMS BELONGING TO THE GENUS *SILICOPLACENTINA*

Originally, Pannonian *Silicoplaentina* were described as “peculiar white discs”, “agglutinated foraminifers” (H. Fahrion, 1941), “Placentamina — group” (G. Szurovy, 1941) or “white agglutinated foraminifers” (K. Veljkovic-Zajec, 1952).

J. Kőváry in 1956 ultimately assigned ancient *Silicoplaentina* to the order Testacea within the class Amoebina assuming that they have a structure similar to modern representatives of the thecamoebians.

Connections with primitive agglutinated foraminifers has also been precluded by V. Pokorny (1958) due to differences in reproduction mode between these two groups. They differ from primitive agglutinated foraminifers only in their mode of reproduction (V. Pokorny, 1958).

The jelly-like amoeba body of modern thecamoebians (O. S. Schreiber *et al.*, 1985) possesses the ability to build a hard

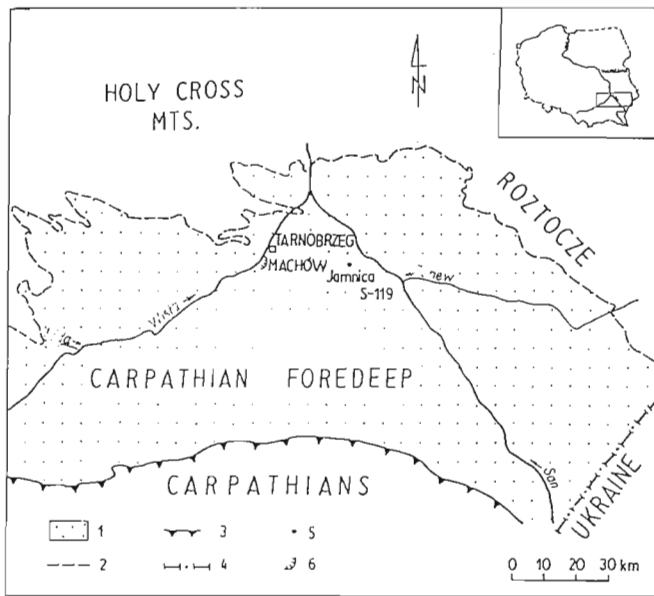


Fig. 1. Location of boreholes under study

1 — Miocene of the Carpathian Foredeep, 2 — northern extent of Miocene deposits, 3 — Carpathian thrust front, 4 — state border, 5 — borehole, 6 — outcrop of Miocene deposits

test in an endogenic or agglutinating way. Its main component is SiO₂, and sand grains and fragments of diatom tests are mainly used in the process of building.

Chemical analysis by I. Waldherr (O. S. Schreiber *et al.*, 1985) showed that thecamoebian tests are composed of 82% SiO₂, 2.02% FeO₃, 2.59% CaO, 2.29% MgO, 0.64% K₂O, 1.44% Na₂O, the remainder being organic matter.

Tests of ancient *Silicoplaentina*, probably produced similarly to other thecamoebians, are usually flattened, rarely convex. They are round, oval or elliptical in shape. They range in diameter from 0.2 to 1.3 mm. Walls are 35–75 μ thick. The outer surface of the test is unsculptured, finely granular or coarsely granular. Folds, wrinkles and concavities (Pl. II, Figs. 4, 5; Pl. III, Figs. 5a, 6; Pl. IV, Figs. 1–3) were probably formed due to compaction (O. S. Schreiber *et al.*, 1985). The foramen leading just into the test is visible on some specimens (Pl. II, Figs. 1, 3a; Pl. III, Fig. 6). Most frequently it is filled with sediment, only a concavity being observed, or it may be entirely unrecognizable (Pl. III, Fig. 1a, b, 5a). Sometimes a cross fracture reveals the interior filled with sediment (Pl. I, Figs. 7, 8). Tests of most of specimens are white or grey but they may also be brown in colour.

TAXONOMY

The genus *Silicoplaentina* from the Lower Pannonian of Hungary has been subdivided by J. Kőváry (1956) into 4 species:

1. *Silicoplaentina hungarica* (Fig. 3E): white round tests, irregularly convex, with the foramen located noncentrally on a small rise below which a semicircular concavity occurs. Diameter: 0.25–0.70 mm.

2. *Silicoplaentina majzoni* (Fig. 3C, D): discoidal tests with a furrow parallel to the test axis on one or both sides. The central part is convex or concave. The foramen is invisible. Diameter: 0.5–1.2 mm.

3. *Silicoplaentina inflata* (Fig. 3B): small test, convex on one side, slightly convex or concave on the other. The foramen is usually situated at the test's periphery. Outer surface is finely agglutinated, and frequently brown in colour. Diameter: 0.25–0.5 mm.

4. *Silicoplaentina irregularis*: forms of irregular shapes with wrinkled and grainy surfaces. Both sides are strongly flattened and the space once infilled with body is not visible. The foramen is almost always invisible. Diameter: 0.5–1.2 mm.

A variety of deformation styles resulting from sedimentary compaction causes difficulties in the application of this subdivision. That is why, in 1985, O. S. Schreiber *et al.* proposed the use of only two species: *Silicoplaentina majzoni* Kőváry, 1956 and *S. irregularis* Kőváry, 1956.

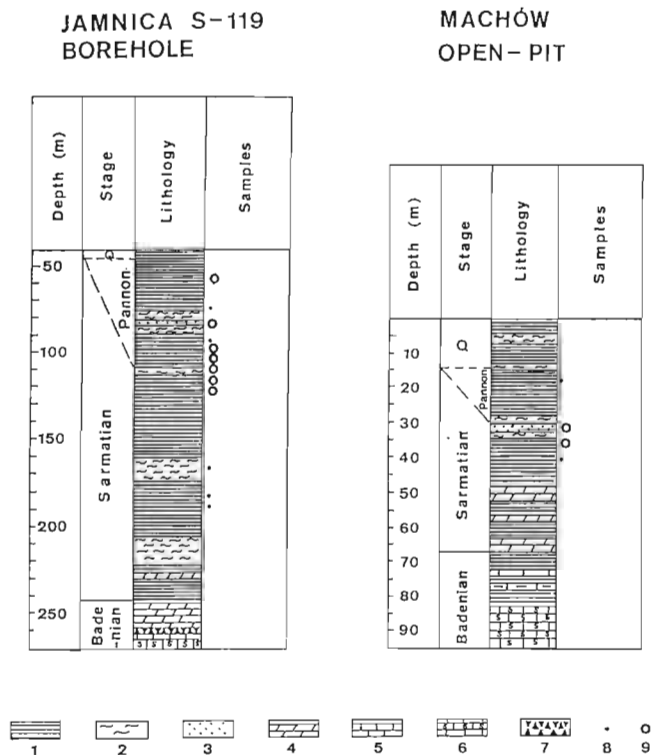


Fig. 2. Schematic lithostratigraphic sections of the boreholes studied

1 — clays, 2 — mudstones, 3 — sandstones, 4 — marls, 5 — limestones, 6 — sulphur-bearing limestones, 7 — breccias, 8 — samples lacking of *Silicoplaentina*, 9 — samples containing *Silicoplaentina*

Subkingdom **Protozoa** Goldfuss
 Subphylum **Rhizopoda** Siebold
 Class **Amoebina** Ehrenberg
 Order **Testacea** Schultze
 Genus *Silicoplaentina* Kőváry, 1956
Silicoplaentina majzoni Kőváry, 1956
 (Pl. I, Figs. 7, 8; Pl. II; Pl. III, Figs. 1–4)

1956 *Silicoplaentina majzoni* Kőváry; J. Kőváry: tab. 37, fig. 1.

1985 *Silicoplaentina majzoni* Kőváry; O. S. Schreiber *et al.*: p. 469, tab. 61, figs. 3–6, 8; tab. 62, fig. 9; tab. 63, figs. 1–11; tab. 64, figs. 1–3, tab. 65, figs. 3–6.

1992 *Silicoplaentina majzoni* Kőváry; N. Gagić: tab. 1, figs. 6a, b.

Description. — Discoidal test, round or oval in outline, white or brown in colour. Chaotically arranged siliceous grains are visible on the surface. Due to a varying degree of flattening, tests may be convex on both sides, convex-concave, flat-concave or flat on both sides. Most specimens exhibit thickened peripheries in the form of semi-circular folds. A variably situated foramen was visible in a few specimens. Diameter 0.2–1.1 mm, wall is 35–75 μ thick.

Remarks. — Due to deformation resulting from compaction *Silicoplaentina hungarica* Kőváry and *S. inflata* Kőváry are considered to be morphological varieties of the species *S. majzoni* Kőváry.

Occurrence. — Poland — northern part of the Carpathian Foredeep (Jamnica S-119, Machów) — Early Sarmatian (eastern Paratethys), Austria, Croatia, Slovakia, Slovenia; Hungary — Lower Pannonian.

Silicoplaentina irregularis Kőváry, 1956
 (Pl. III, Figs. 5, 6; Pl. IV)

1956 *Silicoplaentina irregularis* Kőváry; J. Kőváry: tab. 39, fig. 1.

1985 *Silicoplaentina irregularis* Kőváry; O. S. Schreiber *et al.*: p. 470, tab. 61, figs. 1, 2, 7, 9; tab. 62, fig. 1–8; tab. 65, figs. 2.

Description. — Discs oval or irregular in outline, light in colour. Rough surfaces with coarse siliceous grains and elongated or transverse folds or a distinct callosity at the periphery. The foramen is recognizable in few specimens. Diameter 0.7–1.5 mm; wall is 50–75 μ thick.

Occurrence. — Poland — northern part of the Carpathian Foredeep (Jamnica S-119, Machów) — Early Sarmatian (eastern Paratethys), Austria, Croatia, Serbia, Slovakia; Hungary — Lower Pannonian.

ENVIRONMENTAL REMARKS

Most modern thecamoebians inhabit shallow fresh-water basins, a few species living at greater depths. Few forms have

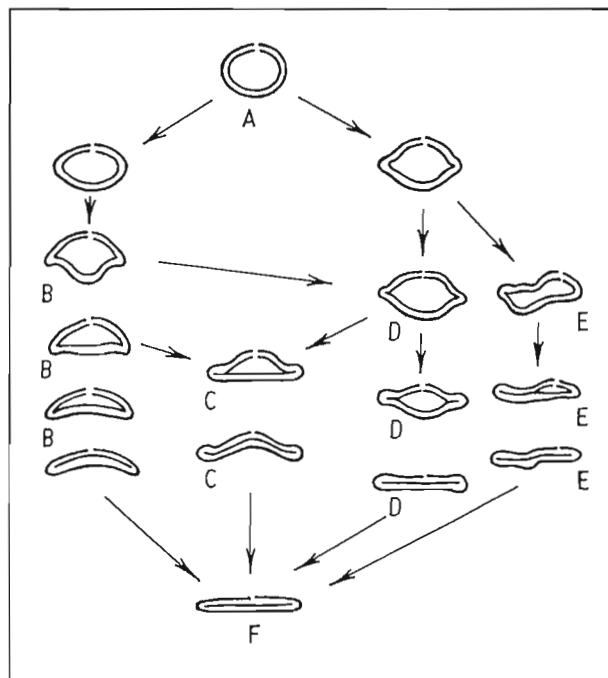


Fig. 3. Idealized scheme of deformations of *Silicoplaentina* (after O. S. Schreiber *et al.*, 1985)

A — hypothetical primary form, B — *Silicoplaentina inflata*, C, D — *Silicoplaentina majzoni*, E — *Silicoplaentina hungarica*, F — final form

been described from open-marine basins, and their taxonomic position has not been unequivocally determined (O. S. Schreiber *et al.*, 1985).

They usually live on aquatic vegetation, rarely in a bottom mud, in peat or forest mosses (A. Asioli *et al.*, 1996).

Modern thecamoebians (A. Asioli *et al.*, 1996) are considered to be easily adaptable to changing environmental conditions. Euryhaline forms from fresh-water environments which managed to adapt themselves to subsaline conditions have been recognized lately.

Some of species can tolerate both high environmental acidity (pH 3.9–4.5) and different contaminants such as sulphides, ammonium salts and nitrogen compounds.

Owing to these features, thecamoebians are employed as bioenvironmental indicators for environmental reconstructions (A. Asioli *et al.*, 1996).

In Tertiary deposits thecamoebians are represented by the genus *Silicoplaentina* which has been described from Hungary, Austria (O. S. Schreiber *et al.*, 1985; J. Kőváry, 1987), Serbia and Croatia (N. Gagić, 1992) and recently also from Poland (Jamnica S-119, Machów). Their representatives occur in sandy-marly sediments which were deposited in shallow-marine, low-salinity basins under reducing conditions, as confirmed by the high amount of sulphides, bacteriopyrite concretions, plant detritus and occurrence of specific agglutinated foraminifers — *Miliammina* and *Ammobaculites* (I. V. Venglinsky, 1975; I. Korecz-Laky, 1985, 1987; N. Gagić, 1992).

Table 1

Stratigraphic correlation of the Miocene of the Paratethys, after F. Rögl (1996)

M. A.	EPOCH	AGE	CENTRAL PARATETHYS STAGES	EASTERN PARATETHYS STAGES	BIOZONES			
					Mammal Zones	Planktonic Foraminifera	Calcareous Nanno-plankton	
5	PLIO-CENE	ZANCLEAN	DACIAN (5.6)	KIMMERIAN (5.2)	MN 14	PL1	NN13	
		MESSINIAN	PONTIAN	PONTIAN	MN 13	M14	NN12	
10	Late MIOCENE	7.1	PANNONIAN	MAEOTIAN (10.0)	MN12	M13	b	
		TORTONIAN			MN11		NN11	
					MN10		NN10	
					MN 9		NN9b	
15	Middle MIOCENE	11.5	SARMATIAN (13.0)	SAR-MATIAN	MN 8-7	M11-M8	Khersonian	
							Bessarabian	NN9a/8
							Volhynian	NN7
							Konkian	NN6
		14.8	BADENIAN	TARKHANIAN	MN 6-5	M7	Karaganian	
	LANGHIAN	Tshokrakian					NN5	
		16.4				M5		

p — stratigraphical range of deposits from borehole Jamnica S-119 and Machów open pit

STRATIGRAPHIC IMPORTANCE

Silicoplaentina microfossils are characteristic of Lower Pannonian deposits. They are most frequent in its lowermost part, whereas in the Middle Pannonian they appear only sporadically. Such a limited range causes them to be good indicators for the boundary between the Lower and Middle Pannonian (O. S. Schreiber *et al.*, 1985).

Single specimens of *Silicoplaentina* have also been noted in the Egerian, Eggenburgian and Ottnangian (I. Cicha *et al.*, 1971).

In Poland *Silicoplaentina majzoni* and *S. irregularis* come from the upper part of the Krakowiec Series (Machów Formation) (A. Garlicki, 1994) from the Jamnica S-119 borehole, depth 56–117 m, and Machów mine, depth 32–35 m (Fig. 2). Here they are accompanied by a few foraminifers characteristic of the Pannonian and represented by the genera *Miliammina* and *Nodobacurariella* (Tab. 1), rare relict Late Sarmatian forms represented largely by *Quinqueloculina*, *Elphidium*, *Nonion* as well as by fragments of fish, otoliths, ostracod fragments, molluscs, gastropods and plant detritus. A Late Sarmatian foraminiferal assemblage of the *Protelphidium subgranosum* Zone (see E. Odrzywolska-Bieñkowska, 1972; I. Czepiec, 1996; E. Łuczkowska, 1998), occurs below the deposits with *Silicoplaentina* (Fig. 2).

Such a microfaunal succession may suggest that the microfossil assemblage found in the Jamnica S-119 borehole and in the Machów open pit comes from still younger series of the Krakowiec Clays than those previously described from the *Protelphidium subgranosum* Zone (E. Odrzywolska-Bieñkowska, 1972; I. Czepiec, 1996; E. Łuczkowska, 1998). A strong connection with the microfauna from the Intra-Carpathian basins of the eastern Paratethys is observed in the youngest assemblages.

E. Gaździcka (1994) has also recognized the nannoplankton zone NN 8/9 suggesting a Pannonian age for these deposits. According to Table 1, zone NN 9a/8 is Lower Pannonian with regard to the central Paratethys area or Early Sarmatian (Bessarabian) for the eastern Paratethys.

Palaeomagnetic investigations conducted by E. Król and M. Jeleńska (1999) in the Jamnica S-119 borehole have shown a succession of changes in geomagnetic field polarity corresponding to the time span of 11–7.5 Ma, i.e. to the Pannonian (see Tab. 1).

Analyses of deposits from the Jamnica S-119 borehole and the Machów open pit carried out using different methods show a strong need to state precisely their stratigraphic position with regard to the lowermost part of the Krakowiec Clays (Machów Formation).

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RODZAJ *SILICOPLACENTINA* KÖVÁRY, 1956 Z SERII KRAKOWIECKIEJ Z PÓLNOCNEJ CZĘŚCI ZAPADLIKA PRZEDKARPACKIEGO

Streszczenie

W osadach pochodzących z młodszej serii formacji z Machowa (Jamnica S-119, Machów) stwierdzono przedstawicieli rodzaju *Silicoplaentina* reprezentujących grupę thecamoebians. Mikrofauna ta, znana z basenu pannońskiego, dotychczas nie była opisywana z polskiej części zapadlika przedkarpackiego. W badanym materiale silicoplaentynom towarzyszą charakterystyczne dla pannonu otwornice z rodzaju *Miliammina* oraz sarmac-

kie formy reliktove z rodzajów: *Quinqueloculina*, *Elphidium* i *Nonion*, jak również szczątki ryb, otolity i małżoraczki.

Współwystępowanie fauny charakterystycznej dla pannonu centralnej Paratetydy (Węgry) z fauną typową dla sarmatu wschodniej Paratetydy (Rumunia) potwierdza we wczesnym sarmacie możliwość połączeń między basenem przedkarpackim na obszarze Polski a basenami śródkarpackimi w innych częściach Paratetydy.

EXPLANATIONS OF PLATES

PLATE I

- Fig. 1. *Miliammina* sp.
a — side view, b — apertural view; depth 87 m, x 300
- Fig. 2. *Miliammina* sp.
a — side view, b — apertural view; depth 112 m, x 250
- Fig. 3. *Miliammina* sp.
Side view; depth 87 m, x 300
- Fig. 4. *Miliammina* sp.
Apertural view; depth 87 m, x 300
- Fig. 5. *Miliammina* sp.
Apertural view; depth 87 m, x 300
- Fig. 6. *Nodobaculariella* sp.
Side view; depth 118 m, x 400
- Fig. 7. *Silicoplaentina majzoni* Kőváry
Breach; depth 56 m, x 200
- Fig. 8. *Silicoplaentina majzoni* Kőváry
Breach; depth 56 m, x 300

Jamnica S-119 borehole; coll. MUZ PIG J. Paruch-Kulczycka

PLATE II

- Fig. 1. *Silicoplaentina majzoni* Kőváry
Depth 110 m, x 250
- Fig. 2. *Silicoplaentina majzoni* Kőváry
Depth 32 m, x 400
- Fig. 3a, b. *Silicoplaentina majzoni* Kőváry
Depth 117 m, x 200
- Fig. 4. *Silicoplaentina majzoni* Kőváry
Depth 110 m, x 150
- Fig. 5. *Silicoplaentina majzoni* Kőváry
Depth 105 m, x 250
- Figs. 1, 3–5 — Jamnica S-119 borehole; Fig. 2 — Machów open pit; coll. MUZ PIG J. Paruch-Kulczycka

PLATE III

Fig. 1a, b. *Silicoplaentina majzoni* Köváry
Depth 105 m, x 300

Fig. 2. *Silicoplaentina majzoni* Köváry
Depth 110 m, x 250

Fig. 3. *Silicoplaentina majzoni* Köváry
Depth 110 m, x 200

Fig. 4. *Silicoplaentina majzoni* Köváry
Depth 105 m, x 250

Fig. 5a, b. *Silicoplaentina irregularis* Köváry
Depth 110 m, x 200

Fig. 6. *Silicoplaentina irregularis* Köváry
Depth 110 m, x 150

Jamnica S-1 19 borehole; coll. MUZ PIG J. Paruch-Kulczycka

PLATE IV

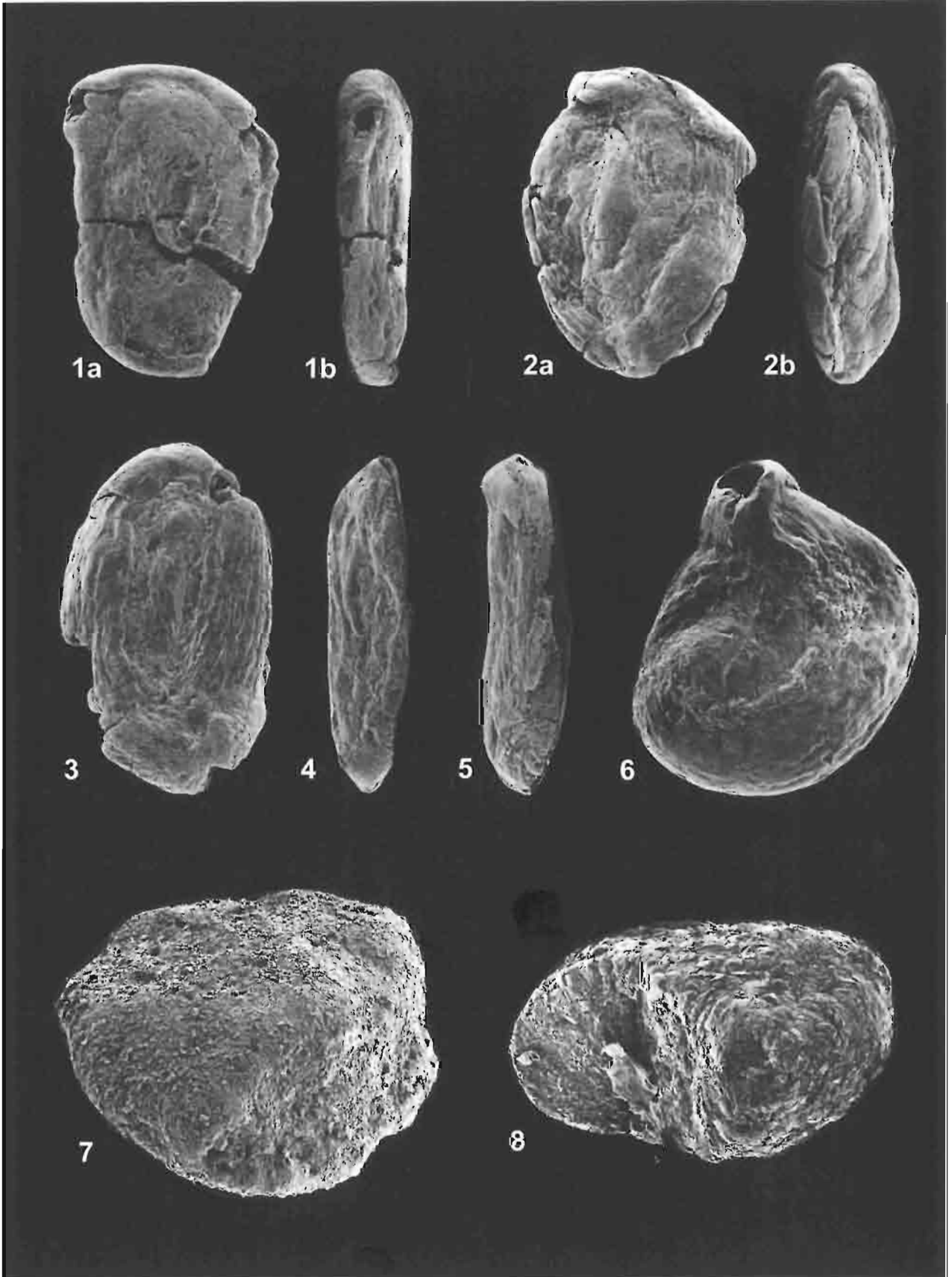
Fig. 1a, b. *Silicoplaentina irregularis* Köváry
Depth 56 m, x 160

Fig. 2a, b. *Silicoplaentina irregularis* Köváry
Depth 56 m, x 150

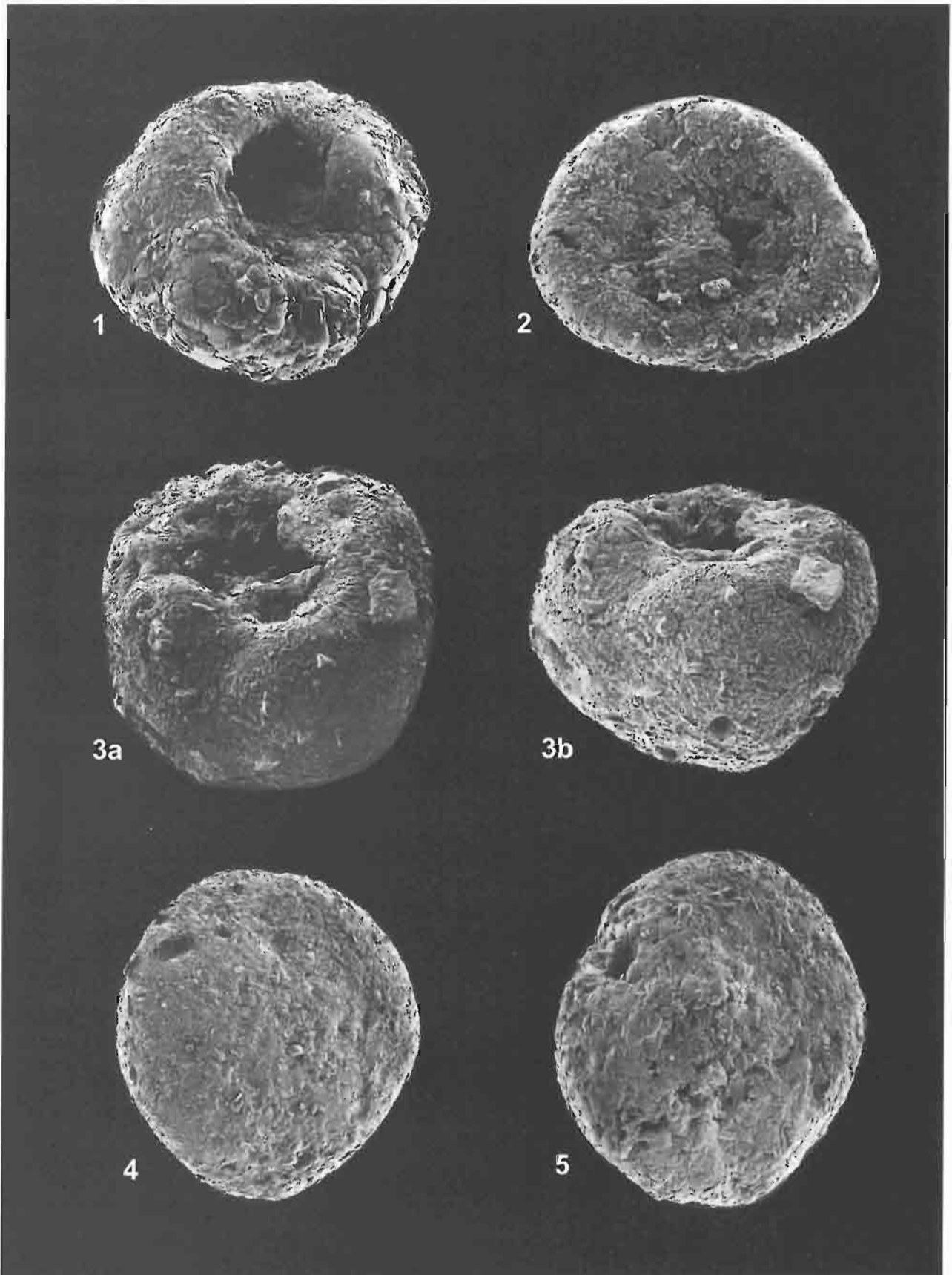
Fig. 3. *Silicoplaentina irregularis* Köváry
Depth 56 m, x 200

Fig. 4. *Silicoplaentina irregularis* Köváry
Depth 105 m, x 200

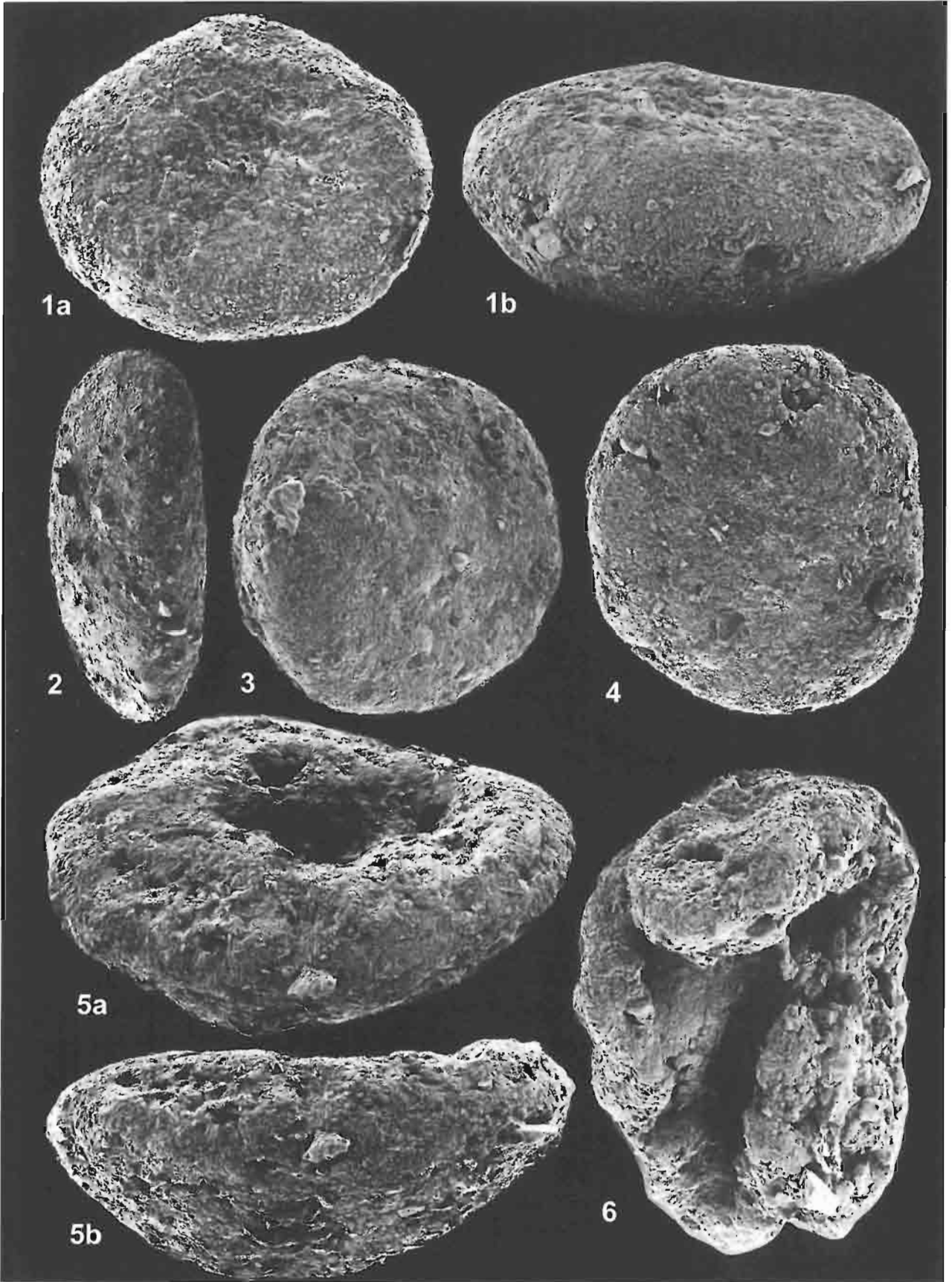
Jamnica S-1 19 borehole; coll. MUZ PIG J. Paruch-Kulczycka



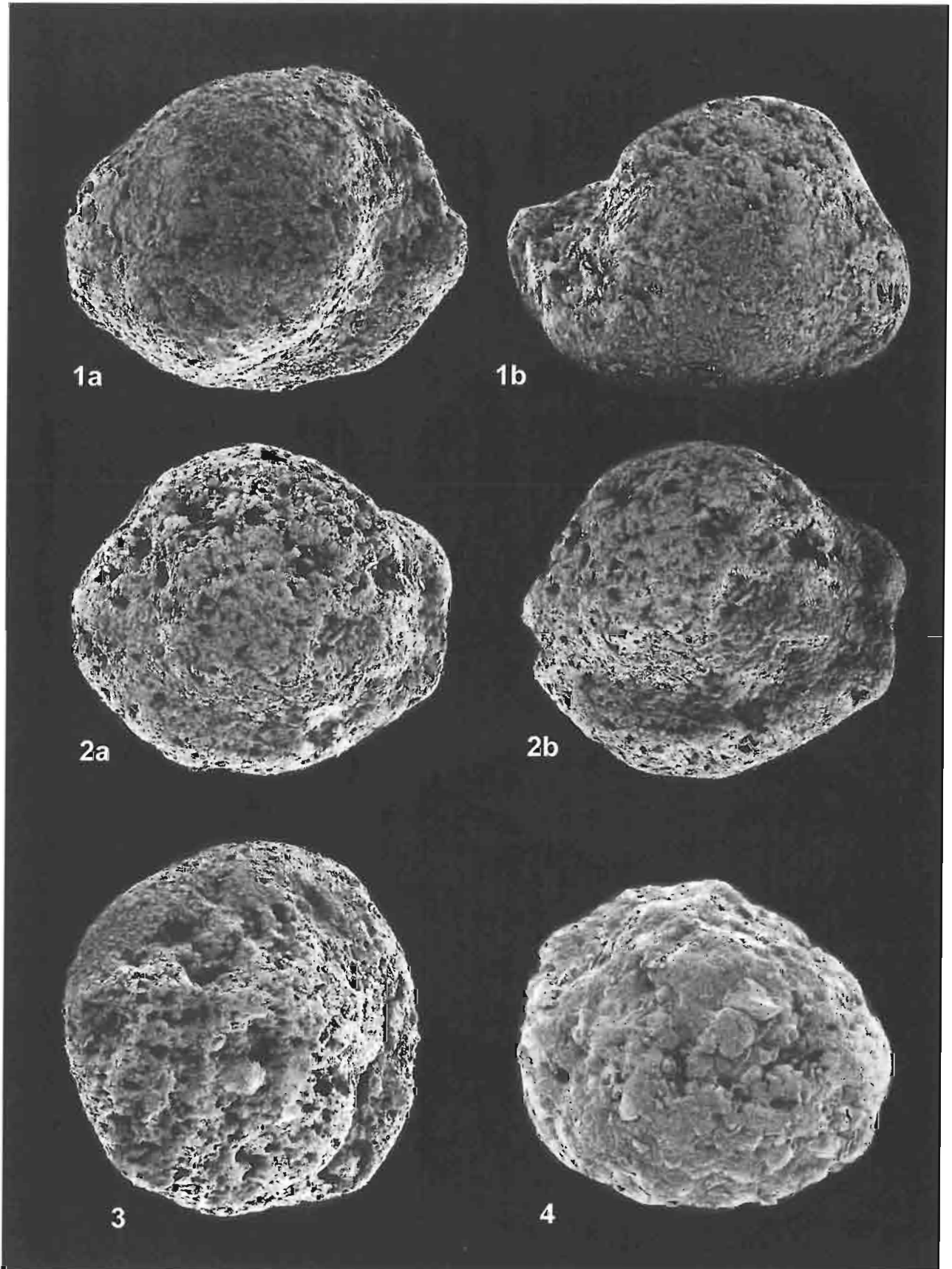
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