

## 14. *BOLBOFORMA* BIOSTRATIGRAPHY FROM THE SOUTHEAST GREENLAND MARGIN, HOLE 918D<sup>1</sup>

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### ABSTRACT

*Bolboforma* is a problematic marine protophytic algae present in temperate and cool regions in both northern and southern hemispheres. It is the best calcareous microfossil group for biostratigraphic correlation of middle–upper Miocene sequence at high latitudes.

*Bolboforma* was found in Hole 918D during Leg 152 in the Irminger Basin (Southeast Greenland Margin). The recovered sedimentary sequence spans the interval from the middle Eocene to the Holocene. Seventeen species were identified in the interval spanning the upper Oligocene–upper Miocene. Eight zones were recognized and correlated to planktonic foraminiferal biozones and the calcareous nannoplankton zonation. The middle and upper Miocene *Bolboforma* zones were correlated to those identified in North Atlantic Deep Sea Drilling Project and Ocean Drilling Program Holes 116, 408, 555, 642B, 643A, and 646B. *Bolboforma groenlandica* n. sp. is introduced.

### INTRODUCTION

The genus *Bolboforma* includes calcareous microfossils of uncertain origin with affinities to protophytic algae.

They are important index fossils, which supplement, mainly at high latitudes, the standard microfossil zones based on calcareous nanofossils and planktonic foraminifers. Species belonging to this group range from the upper middle Eocene to the lower Pliocene and characterize predominantly temperate and cool regions in both northern and southern hemispheres.

*Bolboforma* specimens possess a generally monocrystalline, calcitic hollow and a spheroidal or subspheroidal single chamber. They display a simple aperture generally bordered by a short neck or collar. Wall texture ranges from smooth to strongly ornamented with spines, reticulations, ridges or flanges. Usually *Bolboforma* specimens are single-chambered, although several species may encapsulate a smaller chamber producing an encystment. The cysts are smooth or more weakly ornamented than the outer test, their classification is generally difficult and the relationships between encysted and nonencysted morphotypes are still unknown (Spiegler, 1987; Spiegler and von Daniels, 1991).

During Ocean Drilling Program (ODP) Leg 152, six sites (914–919) were drilled in the Irminger Basin (Southeast Greenland Margin). *Bolboforma* was recovered only in Hole 918D (Fig.1). Hole 918D is located on the upper continental rise of the Southeast Greenland Margin, approximately 130 km from the Greenland coast (63°5.572'N, 38°38.334'W) and was drilled at a water depth of 1868.2 m. The hole was washed down through the first 253 m and then drilled with the Rotary Core Barrel (RCB) down to 1310.1 meters below seafloor (mbsf). The basement was reached at about 1206 mbsf. The cores span the interval from the middle Eocene to the Holocene.

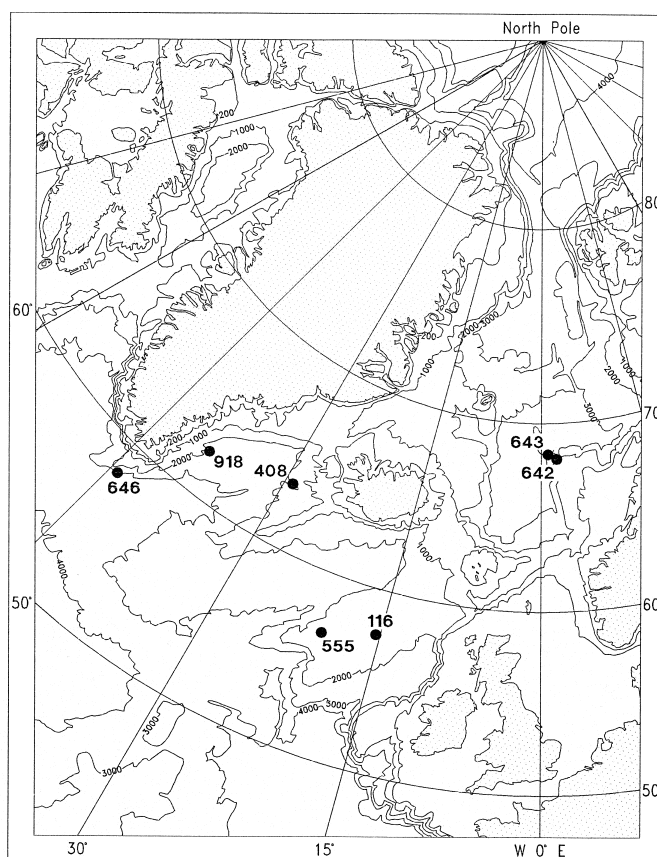


Figure 1. Location map of DSDP/ODP Holes 116, 408, 555, 642B, 643A, 646B, and 918D.

<sup>1</sup>Saunders, A.D., Larsen, H.C., and Wise, S.W., Jr. (Eds.), 1998. *Proc. ODP, Sci. Results*, 152: College Station, TX (Ocean Drilling Program).

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### MATERIALS AND METHODS

Foraminiferal samples were also used for *Bolboforma* studies. Core catchers and 1–3 samples of 10 cm<sup>3</sup> per section of each core were analyzed.

One hundred and eighty-one samples, from 505.38 mbsf down to 1188.16 mbsf were studied for *Bolboforma* (from Sample 151-918D-24R-2, 68–70 cm to Sample 151-918D-96R-3, 94–96 cm). Soft sediments were washed under running water through a 40 µm mesh sieve. Indurated sediments were soaked in distilled water and then washed. Samples were dried at room temperature in case some specimens proved to be suitable for isotope analyses. *Bolboforma* species were found in 65 samples, 36% of the total studied. Specimens of *Bolboforma* were picked from 40–150 µm and 150–250 µm size fractions. *Bolboforma* were picked in the >250 µm size fraction in only a few samples of middle Miocene sediments. The abundance of *Bolboforma* shown in the range chart (Table 1) is based on quantitative estimates. The preservation of *Bolboforma* is moderate throughout the sequence.

## BIOSTRATIGRAPHY

### Planktonic Foraminifer Biostratigraphy

Planktonic foraminifer biostratigraphy is reported in Spezzaferrri (this volume). The zonations of Blow (1979) and Spiegler and Jansen (1989) are applied to upper Oligocene to upper Miocene sediments. Miocene sediments are present in Hole 918D, but the biostratigraphic resolution of planktonic foraminifers is low at high latitudes.

Of the upper Miocene zones, only *Neogloboquadrina atlantica* dextral and *Neogloboquadrina acostaensis* are present (Samples 152-918D-24R-3, 26–28 cm, through 37R-3, 13–16 cm). Planktonic foraminifer data indicate that the upper middle Miocene Zone N15 is probably missing. The middle Miocene interval spanning Zones N9–N14 is present, but zonal boundaries are not identified (Samples 152-918D-37R-3, 58–60 cm, through 44R-3, 98–101 cm). The lower Miocene Zones N4b–N8 are identified from Samples 152-918D-44R-4, 97–100 cm, through 58R-1, 42–44 cm). Upper Oligocene Zones P22 and P21 are identified from Samples 152-918D-62R-1, 87–89 cm, through 63R-1, 93–96 cm, and from Samples 152-918D-63R-2, 34–36 cm, through 86R-2, 69–71 cm, respectively.

### Calcareous Nannoplankton Biostratigraphy

Calcareous nannoplankton biostratigraphy is reported in Wei (this volume). The zonation of Okada and Bukry (1980) is applied to Hole 918D sediments. Several zonal boundaries, however, are not clearly identified.

Section 152-918D-24R-2 is attributed to the lower Pliocene Zone CN10; the interval Zones CN9–CN7 is identified from Samples 152-918D-24R-3, 49 cm, through 37R-3, 88 cm. Samples 152-918D-37R-3, 25 cm, through 42R-6, 68 cm, contain calcareous nannofossil assemblages attributable to the interval spanning Zones CN6–CN5. The interval Zones CN4–CN3 is identified from Samples 152-918D-42R-CC through 53R-3, 77 cm. The lower Miocene Zones CN2 and CN1 are identified from Samples 152-918D-53R-4, 77 cm, through 57R-3, 34 cm. Samples 152-918D-58R-CC through 86R-2, 64 cm, yield floral assemblages attributed to the upper Oligocene undifferentiated interval spanning Zones CP19–CP17.

### *Bolboforma* Biostratigraphy

Preliminary biostratigraphic data on *Bolboforma* assemblages identified in Hole 918D are included in Larsen, Saunders, Clift, et al. (1994). The main characteristics of *Bolboforma* assemblages, their stratigraphic distribution, and the intensity of dissolution are reported here in more detail. The major events used for identifying the zonal boundaries and zones are the same used in Spiegler and von Daniels (1991), Spiegler and Müller (1992), and Grützmacher (1993). They are reported from oldest to youngest.

1. The co-occurrence of *Bolboforma spinosa* and *Bolboforma* sp. 2, aff. *B. antarctica* marks the *B. spinosa* Zone in the upper Oligocene.
2. Occurrence of *Bolboforma irregularis* in the upper Oligocene.
3. FO (first occurrence) and LO (last occurrence) of *Bolboforma* sp. 1, aff. *B. spinosa* in the lower Miocene.
4. FO of *Bolboforma reticulata* equated to the base of *B. reticulata* Zone, middle Miocene.
5. The occurrence of *Bolboforma danielsi* marks the *B. danielsi* Zone, middle Miocene.
6. The occurrence of the oblate *Bolboforma compressibadenensis* indicates the presence of the lower part of the *Bolboforma compressispinosa* Zone, upper middle Miocene.
7. The FO and the LO of *Bolboforma subfragoris* and *Bolboforma fragori* mark the uppermost middle Miocene sequence.
8. The FO of *B. laevis* marks the base of the upper Miocene.
9. The FO of *Bolboforma metzmacheri* is equated to the *B. metzmacheri* Zone, upper Miocene.
10. Occurrence of *Bolboforma groenlandica* n. sp. (see taxonomic notes), in the *B. metzmacheri* Zone, upper Miocene.

## RESULTS

The distribution of the identified species of *Bolboforma*, the identified biozones together with cysts of different *Bolboforma* taxa, and the occurrence of reworking are reported in Table 1. They are also reported in the Hole 918D log with biostratigraphic correlation of planktonic foraminifers and calcareous nannoplankton (Fig. 2).

The upper Miocene assemblages are moderately preserved and show signs of smoothing of ornamentations by abrasion. Nine samples of the 27 analyzed contain *Bolboforma*. Assemblages consist of only four species: *B. laevis*, *B. metzmacheri*, *B. groenlandica*, and *Bolboforma* sp. B, Pallant and Kaminski. *Bolboforma metzmacheri* and *B. laevis* Zones are identified from 505.38 to 600.81 mbsf and from 620.20 to 621.63 mbsf, respectively.

The stratigraphic resolution of *Bolboforma* is higher in the middle Miocene. The assemblages are richer and the specimens are better preserved than they are in the upper Miocene. *Bolboforma* has been found in 40 of the 65 analyzed samples within this interval. Eight species were identified: *B. spinosa*, *B. danielsi*, *B. reticulata*, *B. compressibadenensis*, *B. capsula*, *B. badenensis*, *B. fragori*, and *B. subfragoris*. *Bolboforma subfragoris* Zone is identified from 631.73 to 632.18 mbsf; *B. compressispinosa* Zone is identified only in Sample 152-918D-37R-3, 58–60 cm (depth = 632.18 mbsf); *B. badenensis* Zone is identified from 634.28 to 639.18 mbsf; *B. danielsi* Zone is present only in Sample 152-918D-38R-2, 114–116 cm (depth = 648.84 mbsf); and *B. reticulata* Zone is present from 641.80 to 726.15 mbsf.

The lower part of the middle Miocene and the lower Miocene are generally barren of *Bolboforma*. The lowermost Miocene assemblages are poorly preserved and *Bolboforma* is rare. Seven samples of the 44 analyzed contain *Bolboforma*. Only *B. spiralis* and very small-sized specimens of *Bolboforma* sp. 1, aff. *spinosa* were identified.

Oligocene assemblages are very poor and consist mainly of small specimens of *Bolboforma*. Only five of the 46 samples attributed to the upper Oligocene contain *Bolboforma*. Four species were identified: *B. spinosa*; *B. sp. 2*, aff. *B. antarctica*; *B. irregularis*; and *B. rotunda*.

## DISCUSSION

Qvale and Spiegler (1989) and Spiegler and von Daniels (1991) defined *Bolboforma* zones, whereas Spiegler and Müller (1992) cor-

Table 1. Stratigraphic distribution of *Bolboforma* in samples from Hole 918D plotted together with number of barren samples and reworked specimens.

Core, section, interval (cm)	<i>B. groenlandica</i> <i>Bolboforma</i> sp. B <i>B. metznacheri</i> <i>B. laevis</i> <i>B. subfragor.</i> <i>B. fragor.</i> <i>B. badenensis</i> <i>B. capsula</i> <i>B. compressibadensis</i> <i>B. reticulata</i> <i>B. danielsi</i> <i>B. spinosa</i> <i>B. spiralis</i> <i>B. sp. 1 aff. B. spinosa</i> <i>B. irregularis</i> <i>B. rotunda</i> <i>Bolboforma</i> sp. 2 <i>B. cysis</i>	Reworking	Barren samples	Zones	Epochs
24R-1, 97-99			1	?	?
24R-2, 68-70	C				e. Plio
24R-2, 120-122	C R				
24R-3, 26-28	A R R				
25R-1, 45-48	R				
25R-2, 14-16 to 28R-4, 7-9			11		
29R-1, 95-97	R F				
29R-2, 95-97	R C				
31R-1, 73-75	R				
31R-1, 95-97	F				
33R-1, 93-95	R				
34R-1, 121-122	F F				
35R-1, 68-69 to 35R-2, 66-68			2		
36R-1, 130-132	A				
36R-2, 75-78	A				
36R-2, 123-126	R				
37R-2, 14-16			1		
37R-3, 13-16	R F C				
37R-3, 58-60	A R F R R				
37R-4, 8-10	C A		X		
37R-5, 20-22			R		
38R-1, 89-100	A F		F		
38R-2, 114-116	F R		X		
38R-3, 60-62	A				
38R-4, 14-16	A F		F		
38R-4, 52-54	A F		C		
38R-5, 13-15	C C		C		
38R-5, 113-115 to 39R-1, 135-137			4		
39R-2, 16-18	R		R X		
39R-2, 93-95 to 39R-3, 94-96			3		
39R-4, 16-18	F				
39R-4, 95-97	A				
39R-5, 16-18			1		
39R-6, 0-2	R				
39R-6, 73-75	A R				
40R-1, 41-43	R				
40R-1, 79-81 to 40R-2, 125-127			3		
40R-3, 34-36	R F				
40R-3, 116-118	F F				
40R-4, 64-66	R				
40R-4, 120-122 to 41R-1, 34-36			6		
41R-1, 76-78	R				
41R-2, 63-65	A				
41R-2, 117-119			1		
41R-3, 32-34	F				
41R-3, 121-123	R				
41R-4, 34-36	R				
41R-4, 118-120	F		R		
41R-5, 38-40 to 41R-5, 102-104			2		
41R-6, 16-18	C		R		
41R-6, 78-80	R				
42R-1, 79-81	A				
42R-2, 109-11	A		R		
42R-3, 132-134	R				
42R-4, 127-129	A				
42R-5, 99-101			1		
42R-6, 95-97	A		F		
43R-1, 24-27	A R		C		
43R-1, 103-107	F		R		
43R-2, 48-52	A		R		
43R-2, 145-148	R				
44R-1, 96-98	A		F		
44R-2, 97-100	R				
44R-3, 98-101	F				
44R-4, 97-100 to 44R-5, 125-127			2		
47R-2, 95-97	F				
51R-1, 93-95 to 51R-6, 42-44			7		
52R-1, 41-44	R				
52R-1, 106-108 to 55R-2, 4-6			24		
55R-2, 88-90					
55R-3, 40-42			R		
55R-3, 66-68			R		
55R-4, 72-74			F		
55R-5, 11-13			F		
55R-5, 107-109			R		
55R-6, 31-33			R		
57R-1, 43-45 to 57R-3, 147-149			6		
58R-1, 42-44			F		
62R-1, 87-90			C		
62R-2, 77-81			R		
63R-1, 93-96 to 84R-1, 59-61			14		
86R-1, 28-30			R		
86R-2, 69-71			R F		
88R-1, 70-72 to 96R-3, 94-96			R		

Notes: Rare (R) = <3 specimens, few (F) = 3–15 specimens, common (C) = 16–50 specimens, and abundant (A) = >50 specimens.

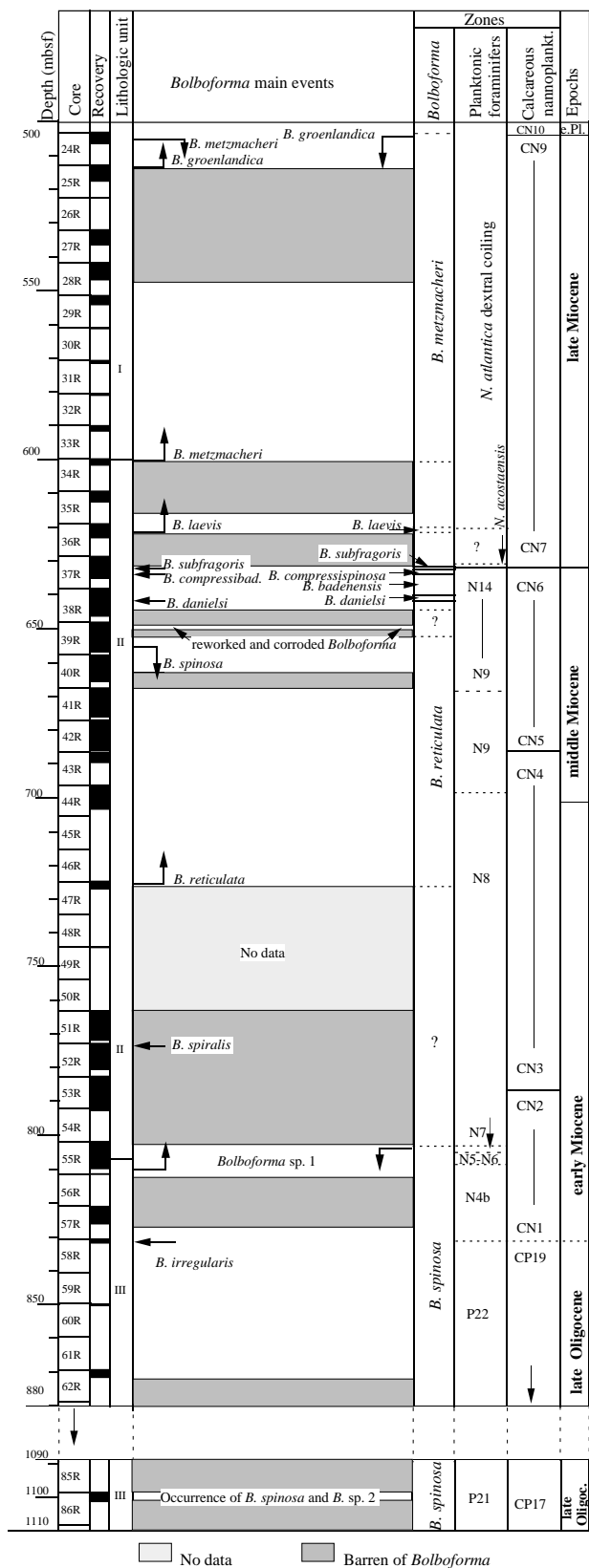


Figure 2. Depth, cores, recovery, and lithologic units plotted vs. *Bolboforma* and planktonic foraminifers and calcareous nannofossil zones identified in Hole 918D.

related the Neogene *Bolboforma* zones to nannoplankton zones. Eight of those zones are identified in Hole 918D. However, barren samples in some cases prevent clear identification of *Bolboforma* zonal boundaries. Therefore, some of the zones, especially in the upper part of the middle Miocene sequence, seem to be condensed.

*Bolboforma metzmacheri* Zone is identified from Sample 152-918D-24R-2, 68–70 cm to Sample 152-918D-34R-1, 121–122 cm. This species is present together with *B. groenlandica* n. sp. The latter form was first observed by Pallant and Kaminski (1989) in upper Miocene sediments of the Labrador Sea at Site 646 and referred to as *Bolboforma* sp. A. The other species in open nomenclature, *Bolboforma* sp. B Pallant and Kaminski, also occurs in rare abundance and poor preservation in Sections 152-918D-24X-2 through 24X-3. Both occur in the Labrador Sea along with *B. metzmacheri* in upper Miocene sediments.

The upper/middle Miocene boundary lies between *B. laevis* and *B. subfragoris* Zones (Spiegler and Müller, 1992). These zones are separated in Hole 918D by an interval barren of *Bolboforma*. Therefore, it is tentatively placed at the top of the *B. subfragoris* Zone. The latter zone is only 0.45 m thick in Hole 918D. It is from 6 to 30 m thick in the North Atlantic, which corresponds to an interval of about 1.5 m.y. (Spiegler and Müller, 1992); therefore, some portions may be missing in Hole 918D. The presence of the flat *B. compressispinosa*, in the absence of the most evolved specimen *B. compressispinosa*, indicates that the upper part of the *B. compressispinosa* Zone is probably also missing.

Reworking is documented by the abundant occurrence of corroded *B. reticulata* in the *B. compressispinosa* and *B. badenensis* Zones (Sample 152-918D-37R-4, 8–10 cm, and 38R-1, 98–100 cm, respectively) and by the occurrence of corroded *Bolboforma* spp. in Sample 152-918D-39R-2, 16–18 cm.

*Bolboforma danielsi* occurs in Sample 152-918D-38R-2, 114–116 cm. It is a distinct and excellent marker species in the upper part of the middle Miocene (about 12 Ma) in the North Atlantic and the Northwest European shelf area (Spiegler and Müller, 1992).

The presence of *B. spinosa* together with rare, poorly preserved specimens of *B. irregularis* suggests a possible late Oligocene age (Sample 152-918D-58R-1, 42–44 cm). *Bolboforma irregularis* was previously found only in the Hamburg region (Northwest Germany) in the upper Oligocene.

### CORRELATION WITH DSDP/ODP HOLES IN THE NORTH ATLANTIC

The correlation of Hole 918D with the Neogene *Bolboforma* zones identified in the North Atlantic Deep Sea Drilling Project (DSDP) and ODP Holes 408, 116, 555, 643A, and 642B is shown in Figure 3. All of the holes are equated to the base of *B. laevis* Zone, which marks the upper/middle Miocene boundary.

The upper Miocene *B. metzmacheri* and *B. laevis* Zones are present in all of these holes; however, they are reduced in thickness in some of them. The *B. metzmacheri* Zone is also present in Hole 646B in the Labrador Sea, but the marker species together with *B. groenlandica* was found in two samples only. *Bolboforma subfragoris* and *B. compressispinosa* were missing only in Hole 116 due to lack of continuous coring. The *B. badenensis* Zone is present in all of the regions.

The distinct and short-range species *B. danielsi* marks the *B. danielsi* Zone, which is missing only in the Vøring Plateau Holes 642B and 643A (Müller and Spiegler, 1993). The *B. reticulata* Zone is always present in the North Atlantic.

### CONCLUSIONS

Three main conclusions can be drawn: (1) Seventeen *Bolboforma* species and eight *Bolboforma* zones are identified in Hole 918D (East



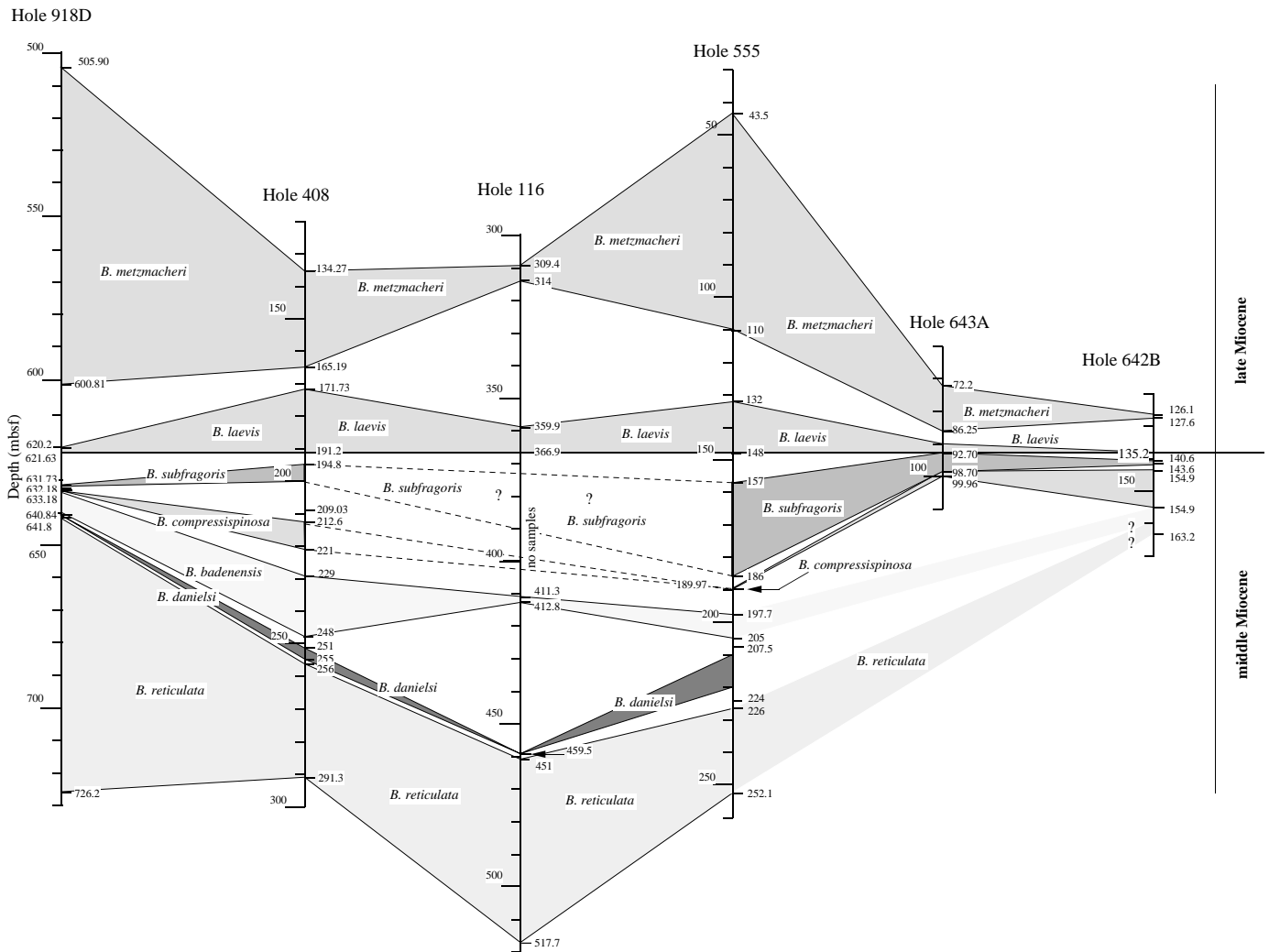


Figure 3. Correlation of the *Bolboforma* zones identified in Hole 918D with those identified and described in North Atlantic Holes 408, 555, 116, 642B, and 643A. The white pattern marks those intervals with no data, barren samples, or no recovery.

Greenland Margin); (2) *Bolboforma* is present throughout the North Atlantic and is the best calcareous microfossil group for biostratigraphic correlation of middle–upper Miocene sequences at these high latitudes; and (3) the new species *B. groenlandica* is introduced and described from the upper Miocene sediments.

**TAXONOMIC NOTES**

*Bolboforma groenlandica* Spezzaferri and Spiegelger n. sp.  
(Pl. 1, Figs. 1–2, 4)

*Bolboforma* sp. A, Pallant and Kaminski, 1989, p. 385 (pl. 1, fig 2)

**Diagnosis:** Test aborally flattened and ornamented by irregular horizontal ridges.

**Description:** Test unicamrate, subspheroidal, aborally flattened, orally distinct neck with circular aperture. Ornamented by five to seven subcontinuous horizontal ridges. Small perpendicular ridges connect the radial ridges. Around the aperture the ridges are more irregular. Cyst (Pl. 1, Fig. 4) smaller in size and more weakly ornamented.

**Remarks:** *B. subfragoris* and *B. fragori* are larger in size and more coarsely ornamented.

**Occurrences:** Irminger Basin, ODP Cores 152-918D-24R and 25R. Labrador Sea, ODP Sample 105-646B-74X-4, 10–12 cm.

**Size:** Test diameter 100–150 µm; holotype 120 µm.

**Holotype:** Pl. 1, Fig. 1.

**Isotype:** Pl. 1, Fig. 2.

Type specimens are housed in Natural History Museum Basel, Switzerland.

**Type locality:** ODP Hole 918D. 63°5.572'N;38°38.334'W, Irminger Basin.

**Type horizon:** Sequence from Samples 152-918D-24R-2, 120–122 cm, to 25R-1, 45–48 cm (505.90–513.25 mbsf), upper Miocene.

**Stratigraphic range:** Upper Miocene, *Neoglobobadrina atlantica* dextral coiling Zone (planktonic foraminifers), Zone NN11 (calcareous nannoplankton), *Bolboforma metzmacheri* Zone.

**Etymology:** From Greenland.

*Bolboforma* sp. B, Pallant and Kaminski  
(Pl. 1, Fig. 3)

*Bolboforma* sp. B, Pallant and Kaminski, 1989, p. 385 (pl. 1, fig. 3)

**Description:** Test unicamrate, subspheroidal, aborally flattened. The irregular ridges are covered by blunt (corroded?) spines.

**Remarks:** The badly preserved specimens prevent a better identification.

**Occurrence:** Rare in Samples 152-918D-24R-2, 120–122 cm, and 24R-3, 26–28 cm.

*Bolboforma* sp 1, aff. *B. spinosa* Daniels and Spiegelger, 1974 (pl. 2, figs. 5–6)

**Description:** The spheroid tests, only 100 µm in size, are irregularly covered by blunt knobs.

**Remarks:** The test of *B. spinosa* is more elongate and mostly larger. The spines are coarser.

**Occurrence:** Sections 152-918D-55R-2 through 6, lower Miocene.

*Bolboforma* sp. 2, aff. *B. antarctica* Kennett and Kennett, 1990 (pl. 2, fig. 11)

**Description:** The spheroid test is ornamented by five to six reticulations in equatorial view.

**Remarks:** The reticulation is generally more coarsely developed than in typical *B. antarctica* of the middle Eocene and resembles the upper Eocene forms from the Labrador Sea (Spiegler and von Daniels, 1991, pl. 5, fig. 6). The knowledge of Oligocene *Bolboforma* is limited.

**Occurrence:** Sections 152-918D-86R-1 through 2, upper Oligocene.

#### FAUNAL REFERENCE LIST

Type references are given for each species recognized.

- Bolboforma antarctica* Kennett and Kennett, 1990, p. 673, pl. 1, figs. 1–7.  
*Bolboforma capsula* Spiegler, 1987, p. 162, pl. 2, figs. 4–6.  
*Bolboforma badenensis* Szczechura, 1982, p. 33, pl. 6, figs. 1–4.  
*Bolboforma compressibadenensis* Spiegler. See Spiegler and von Daniels, 1991, p. 134, pl. 2, figs. 5–6.  
*Bolboforma danielsi* Murray, 1984, p. 538, pl. 1, figs. 13–15, 18–20.  
*Bolboforma fragori* Powell, 1986, p. 71, pl. 1, figs. 1–4.  
*Bolboforma irregularis* Daniels and Spiegler, 1974, p. 69, pl. 10, figs. 4–5.  
*Bolboforma laevis* Daniels and Spiegler, 1974, p. 64, pl. 7, figs. 7–9; pl. 10, fig. 6.  
*Bolboforma metzmacheri* (Clodius), 1922, p. 108, pl. 1, fig. 2.  
*Bolboforma reticulata* Daniels and Spiegler, 1974, p. 64, pl. 7, figs. 10–11.  
*Bolboforma rotunda* Daniels and Spiegler, 1974, p. 67, pl. 8, fig. 10; pl. 9, figs. 1–2.  
*Bolboforma spinosa* Daniels and Spiegler, 1974, p. 67, pl. 9, figs. 3–4.  
*Bolboforma spiralis* Daniels and Spiegler, 1974, p. 68, pl. 9, figs. 5–8.  
*Bolboforma subfragoris* Spiegler. See Spiegler and von Daniels, 1991, p. 140, pl. 11, figs. 3–6.

#### ACKNOWLEDGMENTS

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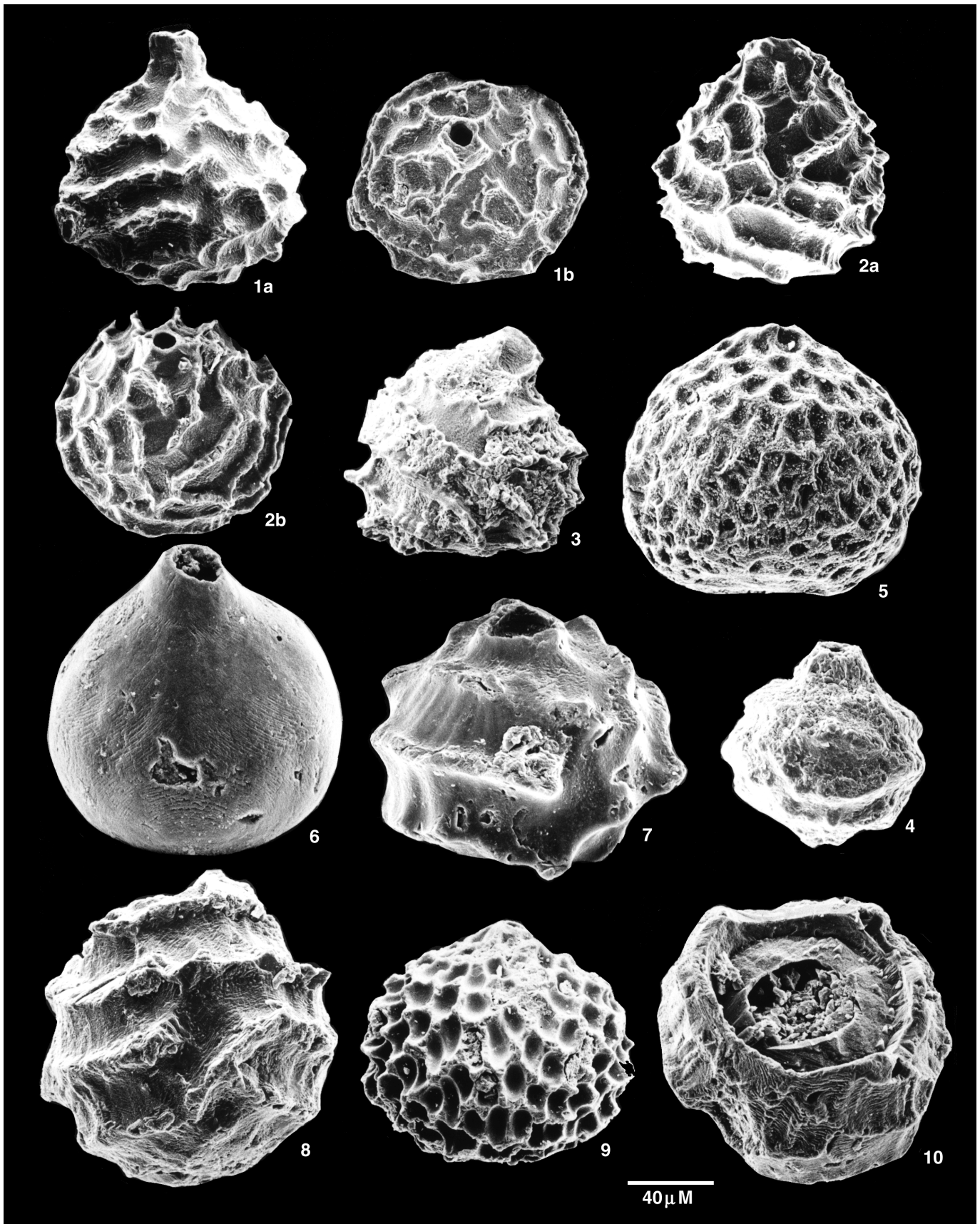


Plate 1. *Bolboforma* from East Greenland Margin. 1–2. *Bolboforma groenlandica* n. sp. 1. Holotype, Sample 152-918D-24R-2, 120–122 cm. 2. Sample 152-918D-24R-3, 26–28 cm. 3. *Bolboforma* sp. B, Pallant and Kaminski, Sample 152-918D-24R-3, 26–28 cm. 4. Cyst, probably from *Bolboforma groenlandica*, Sample 152-918D-24R-2, 68–70 cm. 5. *Bolboforma metzmacheri* (Clodius), Sample 152-918D-29R-1, 95–97 cm. 6. *Bolboforma laevis* Daniels and Spiegler, Sample 152-918D-32R-1, 95–97 cm. 7. *Bolboforma fragori* Powell, 152-918D-37R-3, 13–16 cm. 8. *Bolboforma subfragoris* Spiegler, Sample 152-918D-37R-3, 56–60 cm. 9. *Bolboforma badenensis* Szczechura, Sample 152-918D-37R-3, 16–18 cm. 10. *Bolboforma capsula* Spiegler, Sample 152-918D-37R-3, 16–18 cm.

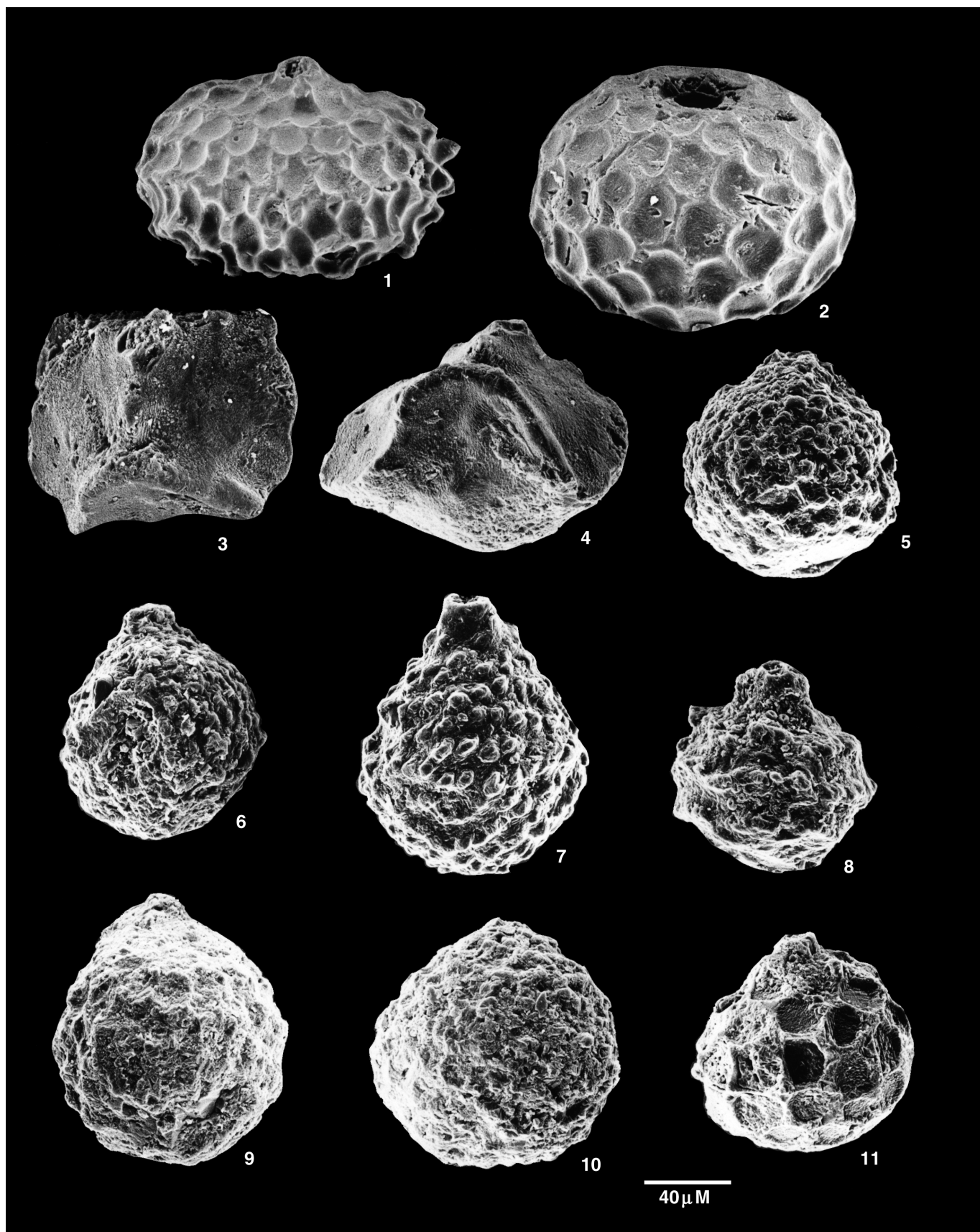


Plate 2. *Bolboforma* from East Greenland Margin. **1.** *Bolboforma compressibadenensis* Spiegler, Sample 152-918D-37R-4, 8–10 cm. **2.** *Bolboforma reticulata* Daniels and Spiegler, Sample 152-918D-37R-4, 8–10 cm. **3–4.** *Bolboforma danielsi* Murray, Sample 152-918D-38R-2, 114–116 cm. **5–6.** *Bolboforma* sp. 1, aff. *B. spinosa* Daniels and Spiegler, Sample 152-918D-55R-4, 72–74 cm. **7.** *Bolboforma spinosa* Daniels and Spiegler, Sample 152-918D-62R-1, 87–90 cm. **8.** *Bolboforma irregularis* Daniels and Spiegler, Sample 152-918D-58R-1, 42–44 cm. **9–10.** *Bolboforma rotunda* Daniels and Spiegler, Sample 152-918D-86R-1, 28–30 cm. **11.** *Bolboforma* sp.2, aff. *B. antarctica* Kennett and Kennett, Sample 152-918D-86R-1, 28–30 cm.