

New foraminiferal species from the Kapp Toscana Group (Carnian to Bathonian) of central Spitsbergen

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Abstract

The foraminiferal succession of the Upper Triassic to Lower Jurassic Kapp Toscana Group in central Spitsbergen (Juvdalen section) contains 67 benthic foraminiferal species. The quantitatively highly dominant agglutinated suborder Textulariina is represented by 34 species, while the subordinate calcareous suborder Lagenina comprises 33 species. Five agglutinated taxa, which are abundant in the investigated assemblages, are described herein for the first time and named: *Ammodiscus multispirus* n.sp., *Ammodiscus subremotus* n.sp., *Ammobaculites parvulus* n.sp., *Trochammina sublobata* n.sp. and *Verneuilinoides brevis* n.sp. All of these species occur in sediments deposited in marginal marine (deltaic and coastal) to shallow shelf environments of restricted nature.

Keywords: Benthic foraminifera; Taxonomy; Late Triassic and Early Jurassic; Spitsbergen

INTRODUCTION

Late Triassic to Early Jurassic foraminiferal assemblages of the Barents Sea region developed mainly in paralic environments. Sediments deposited in these shallow water conditions are the main constituents of the Kapp Toscana Group, which is comprised of shallow shelf, marginal marine and deltaic strata (Mørk *et al.* 1999; Nagy & Berge, 2008), which are of considerable commercial importance owing to their petroleum reservoir potential.

The foraminiferal stratigraphy and facies of siliciclastic marginal marine deposits are poorly documented particularly in the Boreal Realm, although this microfossil group clearly possesses significant stratigraphic and paleoenvironmental potential (e.g., Tappan, 1951; Nagy & Seidenkrantz, 2003; Nagy & Berge, 2008). The paucity of knowledge about these types of foraminiferal facies might be due to the low diversity agglutinated nature of paralic assemblages having a tendency to reduced preservation owing to diagenetic compression. Other factors making the study of these assemblages cumbersome are the occasionally high degree of cementation of the sampled beds that requires intensive laboratory treatment, locally common barren samples of freshwater origin, and the presence of coarse-grained beds, which are often both densely cemented and barren.

This study is part of a long-term project dealing with Mesozoic foraminiferal assemblages of the Barents Sea region.

The purpose of this paper is the definition and documentation of new species, and hence to contribute to future biostratigraphic and biofacies studies.

STUDIED SUCCESSION IN CENTRAL SPITSBERGEN

The material used in this study was collected from the Kapp Toscana Group, which is extensively exposed in central Spitsbergen and widely distributed in the subsurface of the Barents Sea. The described specimens mainly come from the Juvdalen section, which comprises the entire Kapp Toscana Group. In addition, some specimens from the Festning-en section are included. The studied material is further supplemented by samples from the Marhøgda and Drønbeen sections (Fig. 1).

The Kapp Toscana Group ranges in age from early Carnian to Bathonian (Fig. 2). In the Juvdalen section it attains a thickness of 350 m and comprises three formations (in ascending order): 1) The Tschermakfjellet Formation (early to middle Carnian) is a marine shelf shale to prodelta shale-siltstone-sandstone succession showing an overall upwards-coarsening development. Its foraminiferal assemblages contain both calcareous and agglutinated species with upwards-decreasing diversity values in accordance with increasing deltaic impact (Nagy *et al.* 2011). 2) The DeGeerdalen For-

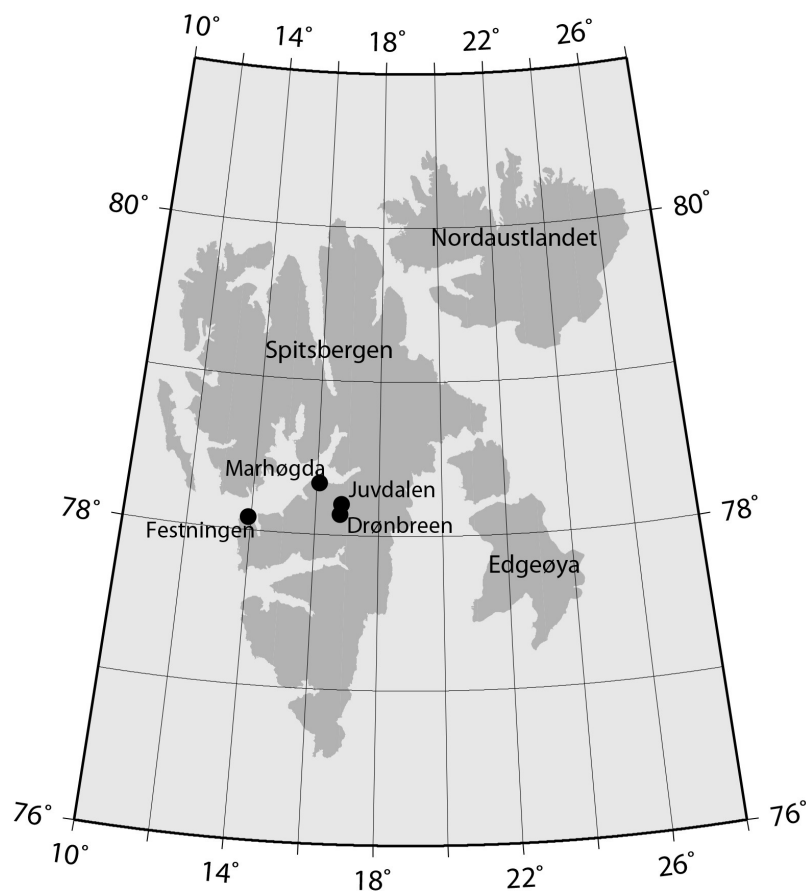


Figure 1. Map showing location of the sections mentioned in the text. The main basis of the study are the sections at Juvdalen and Festningen.

mation (late Carnian to early Norian) is a succession of interbedded shales, siltstones and sandstones deposited in highly brackish marginal marine waters and delta plain freshwater environments. It contains impoverished foraminiferal assemblages of agglutinated taxa with extremely low diversities followed by an interval of virtually barren samples. 3) The Knorringfjellet Formation (Norian to Bathonian) is a condensed succession of shales and sandstones including extensive hiatuses. It was deposited in hyposaline waters with tendency to hypoxic bottom conditions. Its foraminiferal association is composed of exclusively agglutinated taxa and reveals low diversities (Nagy & Berge, 2008).

In the Juvdalen succession 67 foraminiferal species are recorded, of which 34 belong to the suborder Textulariina and 33 to Lagenina. Their assemblage composition and biofacies significance will be discussed in detail in a separate paper. The state of preservation of agglutinated taxa is variable, ranging from non-compressed to heavily compressed under diagenesis. The laboratory processing (disintegration) of samples followed the tenside method (Nagy, 2005).

In the present paper, five common to abundant agglutinated species of the Kapp Toscana assemblages are described the first time. The generic classification follows the scheme of Loeblich & Tappan (1987). All the described species are illustrated by scanning electron micrographs (SEM) and light micrographs (LM).

SYSTEMATIC DESCRIPTIONS

Family AMMODISCIDAE Reuss, 1862

Subfamily AMMODISCINAE Reuss, 1862

Genus *Ammodiscus* Reuss, 1862

Ammodiscus multispirus n.sp.

Plate 1, figs 1-6

Holotype. Plate 1, Figure 1, is from sample S1-p23-86, Juvdalen. Specimen is deposited at the Paleontological Museum, University of Oslo.

Derivation of name. multi = many, numerous and spira = circular whorl, convolution.

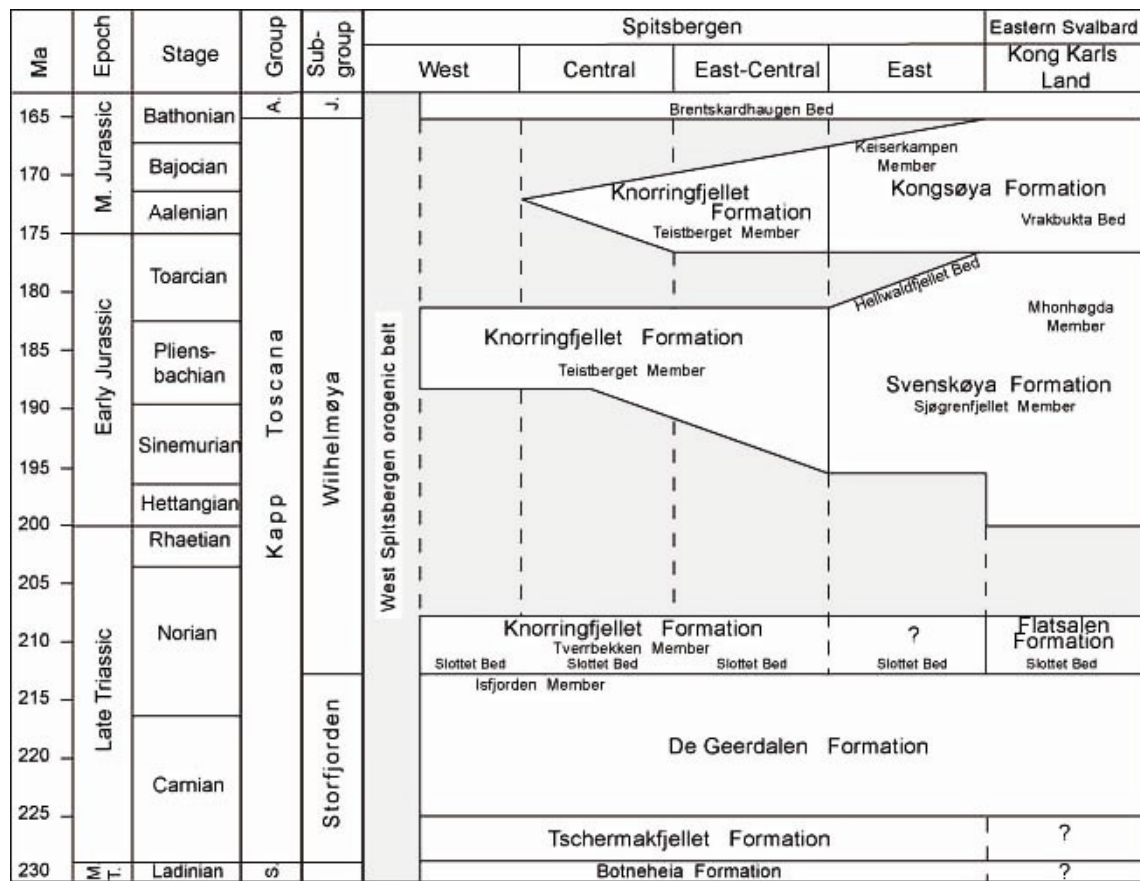


Figure 2. Stratigraphical scheme of the Kapp Toscana Group across Spitsbergen from west to east.

Description. Test discoidal of medium to small size, circular in outline, with rounded peripheral margin, composed of a proloculus followed by a long planispirally coiled tubular second chamber of 8 to 10 whorls; proloculus is very small and sometimes difficult to recognize; tubular chamber has a small cross-sectional area, which increases in width very slowly; whorls only poorly overlap each other and sutures are slightly depressed; central part of test slightly depressed on both sides; aperture formed by the open end of the tubular chamber; wall thin, finely arenaceous but with a roughened surface and composed of white to grayish-brownish quartz grains. The test of some specimens is oval in outline, a feature ascribed to diagenetic deformation.

Dimensions. Based on measurements of 96 specimens from 10 samples (in mm):

	Mean	Minimum	Maximum
Main diameter	0.31	0.18	0.42

Remarks. *Ammodiscus multispirus* n.sp. differs from any other species of this genus by being relatively small and

having a high number of whorls formed of a narrow tubular chamber with very fine-grained but roughly finished wall. It is most similar to the following small to medium sized species: *Ammodiscus yonsnabensis* Nagy *et al.* (1983) from the lower Bajocian of Yorkshire has a smaller diameter (0.15–0.29 mm), less whorls (3–5) with relatively larger chamber cross-section and a more depressed central test area. *Ammodiscus macilentus* (Mjatluk, 1970) was originally described from the Eocene of the Eastern Carpathians. Compared to this new species, *A. macilentus* has a larger test diameter (up to 0.5 mm), fewer whorls (7–8), a more distinct and translucent central test area and a thinner but more roughened wall. *Ammodiscus tenuiculus* Subbotina (1960), first recorded from the Oligocene of Ukraine, has a smaller diameter (0.15–0.16 mm) and fewer whorls (7–8).

Occurrence and age. *Ammodiscus multispirus* n.sp. appears in silty shales and siltstones of the Tschermakfjellet and DeGeerdalen formations; at some horizons the species is quite abundant. Its known stratigraphic range is Early Carnian to Early Norian.

Type locality. Juvdalen, central Spitsbergen.

Type level. Tschermakfjellet Formation, sample 26 m above base of section (Fig. 3).

Ammodiscus subremotus n.sp.

Plate 1, figs 7-12

Ammodiscus aff. *yonsnabensis* Nagy & Berge 2008, Fig. 8, Image 4, 5.

Holotype. Plate 1, Figure 9, is from sample S1-p105-86, Juvdalen. Specimen is deposited at the Paleontological Museum, University of Oslo.

Derivation of name. sub = under, below and remotus = distant, remote

Description. Test very small and discoidal, with a circular outline and sub-parallel flanks, composed of a proloculus and a tubular evolute planispirally coiled second chamber of 3 to 6, commonly 4 to 5 whorls; central part of test only indistinctly depressed; proloculus is small and difficult to ascertain; tubular chamber increases very slowly in cross-sectional area; whorls poorly overlap each other and sutures are weakly depressed; aperture formed by the open end of the tubular chamber; wall thin and finely arenaceous but with a roughened surface; grayish-white to brownish in color.

Dimensions. Based on measurements of 130 specimens (in mm):

	Mean	Minimum	Maximum
Main diameter	0.16	0.09	0.22

Remarks. It is apparent from the dimensions given above that *Ammodiscus subremotus* n.sp. is one of the smallest known species of *Ammodiscus*, and is very uniform in size. It is similar to *Ammodiscus yonsnabensis* Nagy *et al.* (1983) from the Bajocian of Yorkshire by its general appearance. It differs, however, from that species in being smaller in size, having slightly more whorls, a more flattened test and a smaller tubular chamber cross-sectional area. Furthermore, in *A. yonsnabensis* the width of the tubular chamber increases more rapidly and the last whorl is distinctly wider than the previous ones.

By its small number of whorls, *Ammodiscus subremotus* n.sp. is similar to *Ammodiscus francisi* (Wall, 1960) from the Jurassic of Saskatchewan, which consists of ca. 4 whorls. The Canadian species is, however, larger in diameter (average 0.27 mm) and has a distinctly larger tubular chamber width. *Ammodiscus subremotus* n. sp. differs from *Ammodiscus multispirus* n.sp. in being much smaller, hav-

ing fewer whorls, and being nearly planar centrally.

Occurrence and age. The distribution of *Ammodiscus subremotus* n.sp. in Spitsbergen appears to be restricted to the Knorringfjellet Formation mudstones siltstones and sandstones where it is usually abundant in the finer-grained lithologies. The species is common to dominant in several sections exposing this formation including Festningen in western Spitsbergen, as well as Marhøgda, Drønbreen and Juvdalen in central Spitsbergen. Its stratigraphic range is Norian to Toarcian.

Type level. Knorringfjellet Formation, sample 336 m above base of section (Fig. 3).

Family LITUOLIDAE de Blainville, 1827

Subfamily *AMMOMARGINULININAE* Podobina, 1978

Genus *Ammobaculites* Cushman, 1910

Ammobaculites parvulus n.sp.

Plate 2, figs 1-7

Derivation of name. parvulus = small

Description. Test small, closely coiled, sub-circular to ovoid in outline; coiling planispiral with 1 to 2 whorls visible on both sides and surrounding a moderately open and deep umbilical area; 6 to 9 slightly inflated chambers of nearly equal length and breadth compose the last whorl; sutures slightly radiating and slightly depressed, with tendency to be obscured by sand grains; last chamber shows a tendency to uncoiling; wall brownish to grayish in color of medium to coarse quartz grains; aperture a circular areal opening.

Dimensions. Based on measurements of 42 specimens from 5 samples (in mm):

	Mean	Minimum	Maximum
Main diameter	0.21	0.14	0.36

Remarks. The state of preservation of this species is strongly variable. Most tests are compressed or more irregularly deformed by diagenetic processes. The species is referred to *Ammobaculites* owing to the shape and position of its aperture and its tendency to uncoiling shown by its last-formed chamber. *Ammobaculites bivarians* Nagy & Seidenkrantz (2003) from the Lower Jurassic of Denmark shows a comparable tendency to uncoiling, by forming assemblages

where 32 to 62% of the specimens consist entirely of the planispiral stage. Uncoiled variants of the Danish species have a larger uniserial part (with up to 4 chambers), and are finer-grained and larger than the present form. *Ammobaculites fontinensis* (Terquem, 1870) appears to be another species with a tendency to develop both planispiral and uncoiled variants, as shown by Nagy & Johansen (1991), who recorded these developments from the Jurassic of the northern North Sea.

Occurrence and age. The species is observed in the silty shales from the Tschermakfjellet Formation of the Juvdalen section. Its known range is early Carnian.

Type locality. Juvdalen, central Spitsbergen.

Type level. Tschermakfjellet Formation, sample 2 m above base of section (Fig. 3).

Family TROCHAMMINIDAE Schwager, 1877

Subfamily TROCHAMMININAE Schwager, 1877

Genus *Trochammina* Parker and Jones, 1859

Trochammina sublobata n.sp.

Plate 2, figs 8-12

Holotype. Plate 2, Figure 11, is from sample S1-p8-86. Specimen is deposited at the Paleontological Museum, University of Oslo.

Derivation of name. sub = under, nearly and lobatus = lobate periphery, divided into lobes.

Description. Test small, free, trochospirally coiled, with sub-circular to sub-elliptical outline and lobate periphery; spiral side slightly convex with 2 to 2.5 visible whorls; umbilical side nearly plan with open and somewhat depressed umbilicus; chambers inflated, gradually increasing in size, commonly 5 chambers per whorl, but can vary between 4 and 6; sutures straight, nearly radiate on the umbilical side and oblique on the spiral side; wall agglutinated with medium-sized quartz grains giving a granular surface and a brown color.

Dimensions. Based on measurements of 65 specimens from 7 samples (in mm):

	Mean	Minimum	Maximum
Main diameter	0.22	0.14	0.42

Remarks. The tests of this species are often flattened or

more irregularly deformed by diagenetic compression. By its general appearance, *Trochammina sublobata* n.sp. resembles *Trochammina squamataformis* Kaptarenko-Chernousova (1959) from the Lower Jurassic of the Dnjeper-Donets Basin, but differs by having a coarser wall and considerably smaller test. *Trochammina rostovzevi* Levina (in Dain 1972) from the Jurassic of Western Siberia is larger in size (diameter 0.28–0.55 mm), has more chambers and is finer-grained than the present species.

Small size is a diagnostic feature of several *Trochammina* species and *Trochammina sublobata* n.sp. is comparable to several of these: *Trochammina omskensis* Kosyreva (in Dain 1972) from the late Jurassic of Western Siberia (diameter of 0.07–0.23 mm) is more fine-grained and has more chambers in the last whorl (6–7) than the new species; *Trochammina annae* Levina (in Dain 1972) from the late Jurassic of Western Siberia has a slightly smaller (diameter 0.14–0.24 mm), a more fine-grained test, more chambers per whorl, a more open umbilicus and a less lobate periphery; *Trochammina minutissima* Levina (in Dain 1972) from the late Jurassic of Western Siberia is coarser-grained, has a more lobate periphery and a slightly smaller test (diameter 0.17 mm).

Occurrence and age. The species is observed in silty shales and siltstones of the Tschermakfjellet and DeGeerdalen formations. Its stratigraphic range is Early Carnian to Early Norian.

Type locality. Juvdalen, central Spitsbergen

Type level. Tschermakfjellet Formation, sample 5 m above base of section (Fig. 3).

Family VERNEUILINIDAE Cushman, 1911

Subfamily VERNEUILINOIDINAE Suleymanov, 1973

Genus *Verneuilinoides* Loeblich and Tappan, 1949

Verneuilinoides brevis n.sp.

Plate 2, figs 13-17

Holotype. Plate 2, Fig. 13, is from sample S1-p15-86. Specimen is deposited at the Paleontological Museum, University of Oslo.

Derivation of name. brevis = short

Description. Test free, elongate, flaring, tapering towards proloculus; chambers triserially arranged, 5 to 7 along the long axis, increasing continuously but relatively fast in size during growth; sutures distinct and depressed; proximal part of test with tendency to bend to varying degree; wall agglutinated of fine to medium-grained material, with a rough-

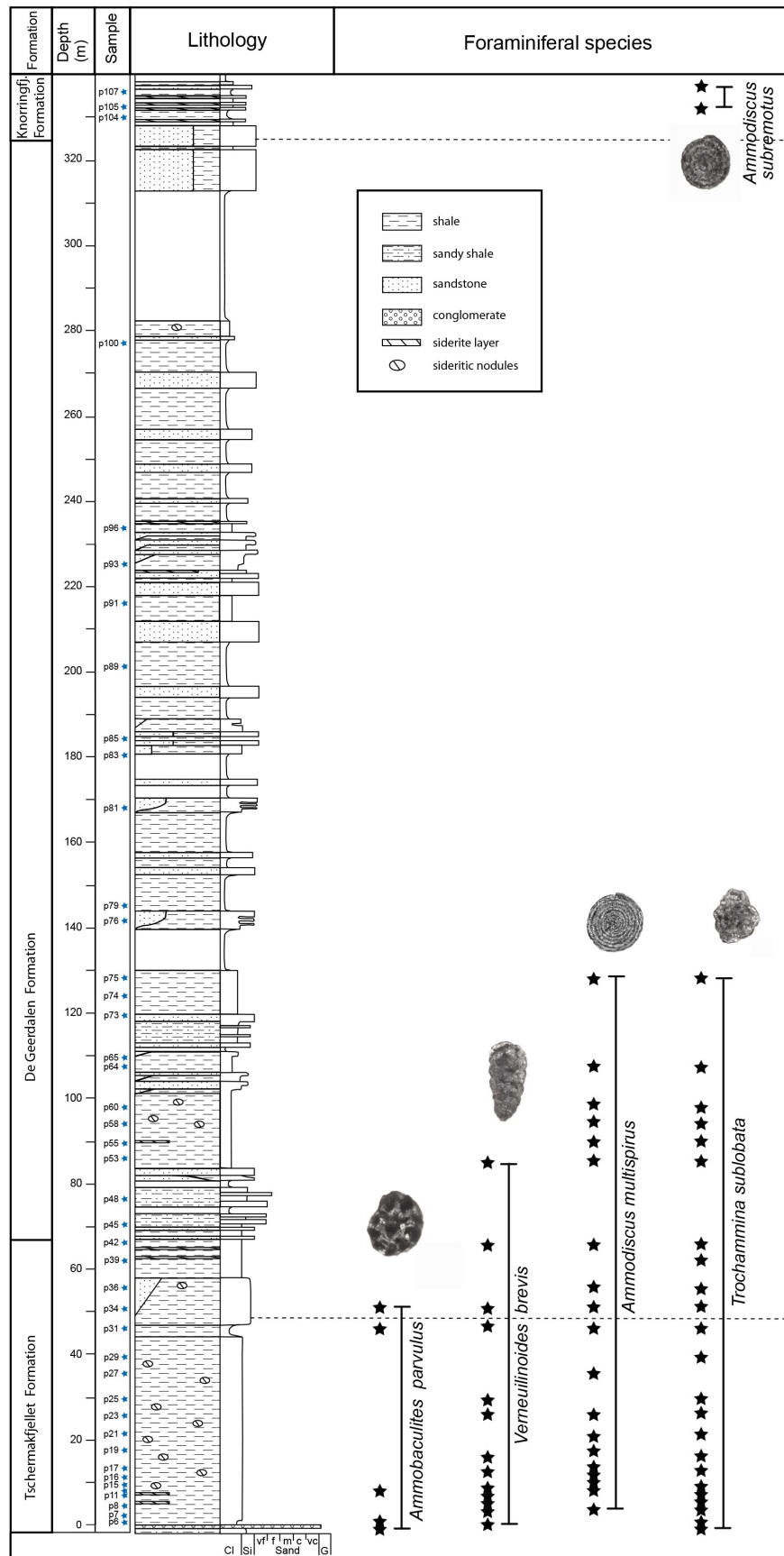


Figure 3. The Juvdalen section showing occurrences of the new species marked by their sample positions (stars) and ranges.

ened surface and a brownish color; aperture an interiomarginal low arch at the base of the last chamber.

Dimensions. Based on measurements of 41 specimens from 6 samples (in mm):

	Mean	Minimum	Maximum
Length	0.26	0.18	0.40
Width	0.14	0.11	0.28

Remarks. The tests are usually compressed by diagenetic processes, but show a trilobite outline. *Verneuilinoides subvitreus* Nagy & Johansen (1991) from the Jurassic of the northern North Sea differs from *Verneuilinoides brevis* n.sp. in having a longer (0.22–0.55 mm) and narrower test containing more chambers (6–9 along the long axis) and slightly expanded final chambers. Furthermore, the new species has a less pointed proximal part with a tendency to bend, and its wall is comparatively coarser.

Verneuilinoides kirillae Dain & Kuznetsova (1971), from the lower Volgian of the Volga Region, is similar to the new species by its flaring test. The Russian species has, however, a shorter test, less chambers (4–5 along the long axis) and a more blunted initial end.

Occurrence and age. The specimens were derived from grey silty shales from the Juvdalen section in central Spitsbergen. The stratigraphic range is Carnian to Norian.

Type locality. Juvdalen, central Spitsbergen

Type level. Tschermafjellet Formation, sample 9 m above base of section (Fig. 3).

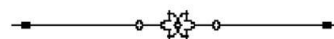
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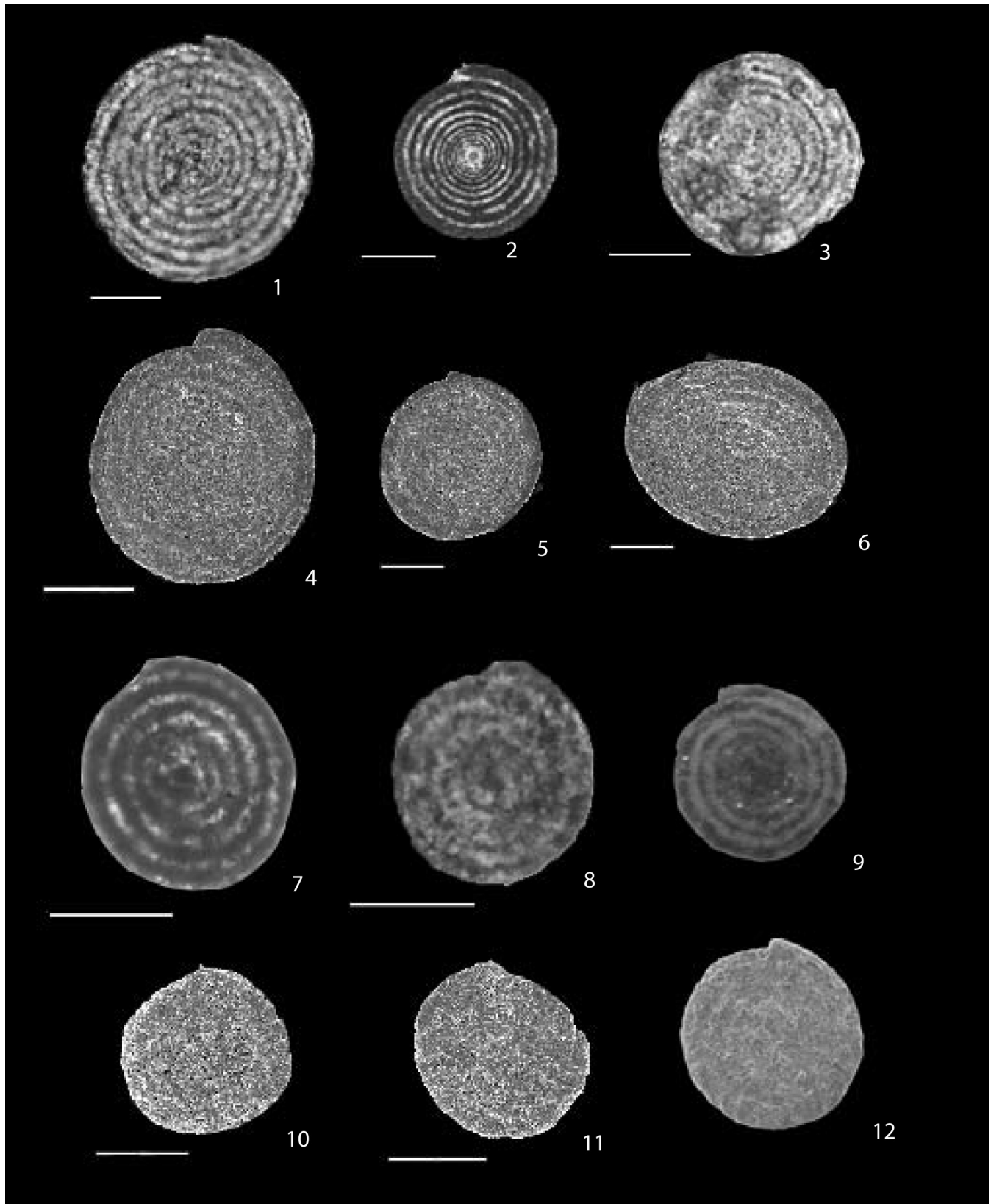


Plate 1. SEM: scanning electron micrographs; LM: light micrographs; Scale bars = 100 μ m. **1 – 6. *Ammodiscus multispirus* n. sp.:** 1 Holotype, sample S1-p23-86 (Juvdalen), LM; 2. Specimen filled with pyrite, sample S1-p15-86 (Juvdalen), LM; 3. Paratype, sample S1-p53-86 (Juvdalen), LM; 4 – 6. Three paratypes, sample S1-p15-86 (Juvdalen), SEM. **7 – 12. *Ammodiscus subremotus* n. sp.:** 7. Paratype, sample S1-p105-86 (Juvdalen) LM; 8. Paratype, sample S1-p105-86 (Juvdalen), LM; 9. Holotype, sample S1-p105-86 (Juvdalen), LM; 10 – 12. Three paratypes, sample S1-p105-86 (Juvdalen), SEM.

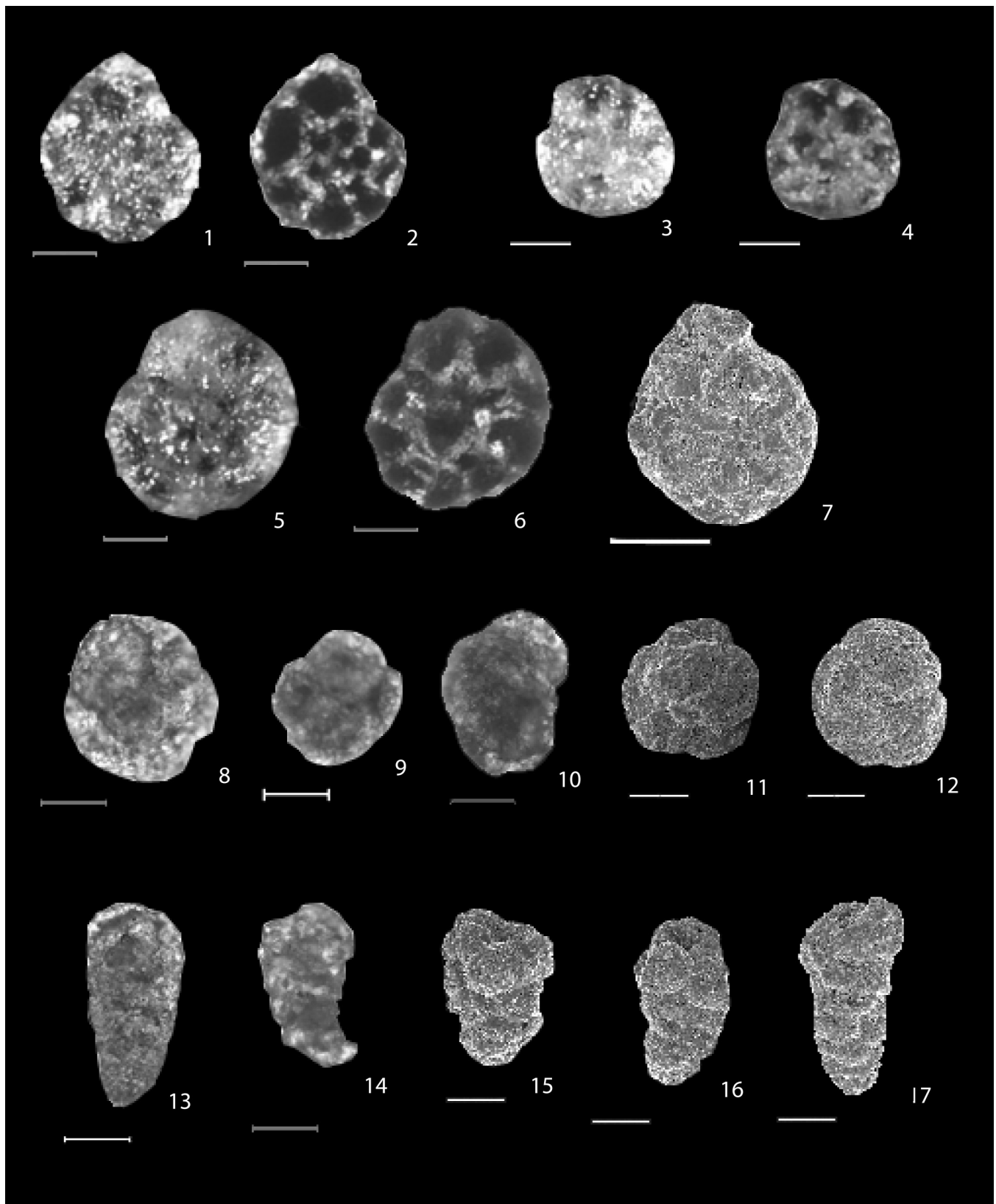


Plate 2. SEM: scanning electron micrographs; LM: light micrographs; scale bar = 100µm. **1 – 7. *Ammobaculites parvulus* n. sp.:** **1 – 2.** Holotype, sample S1-p7-86 (Juvdalen), LM; **3 – 4.** Paratype, sample S1-p7-86 (Juvdalen), LM; **5 – 6.** Paratype, sample S1-p7-86 (Juvdalen), LM, **7.** Paratype, sample S1-p7-86, SEM. **8 – 12. *Trochammina sublobata* n. sp.,** **8** Paratype, spiral side, sample S1-p23-86 (Juvdalen), LM; **9.** Paratype, spiral side, sample S1-p17-86 (Juvdalen), LM; **10.** Paratype, spiral side, sample S1-p17-86 (Juvdalen), LM; **11.** Holotype, spiral side, sample S1-p8-86 (Juvdalen), SEM; **12.** Paratype, umbilical side, sample S1-p8-86 (Juvdalen), SEM.