Two trepostome bryozoans from the Assistance Formation (Permian, Ufimian) near Lake Hazen, Ellesmere Island, Canada

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ABSTRACT

Rhombotrypella superangustata and *Dyscritellina fuglensis* (Bryozoa, Trepostomata) were found for the first time in the Assistance Formation of Ellesmere Island, Canada. Both species correlate the Roadian age of the Assistance Formation with contemporary deposits in Northern Russia and Bjørnøya, Norway. They possess robust erect colonies adapted for shallow shelf conditions with moderate energy depositional environment with low sedimentation rate and hard substrate.

KEYWORDS

Permian; Canada; Bryozoa; Taxonomy; Morphology; Stratigraphy

Introduction

Permian bryozoans of the boreal zone are abundant and diverse (e.g., Ross 1978, 1995, Ross & Ross 1990; Morozova &Krutchinina 1986; Reid & James 2010). However, our knowledge about the bryozoan faunas from the Permian of the Canadian Arctic Islands remains very restricted (e.g. Sakagami 1998; Nakrem 2005; Ernst & Nakrem 2005, 2007).

Material and methods

Material for this study was collected by Simon Kelly in the year 2009 from an isolated locality at Lake Hazen, Ellesmere Island, Canada (GPS 81.84215; -71.4382). This material including five isolated bryozoan fragments was loaned by the author for study from the Geological Collections of CASP in Cambridge (UK) in the year 2013. The locality contains rocks of the Permian Assistance Formation.

Four of the five bryozoan fragments were used for thin section preparation, in total seventeen oriented thin sections were made. Three general orientations are necessary for identification of branched trepostome bryozoans: transverse, longitudinal, and tangential. Thin sections were investigated using a binocular microscope in transmitted light. Measurements of

morphological characters were partly adopted from Anstey & Perry (1970). Statistics were summarized using arithmetic mean, sample standard deviation, coefficient of variation, and minimum and maximum values (Tables 1–2).

Repository
The material (samples and thin sections) is deposited at the Canadian Museum of Nature, Ottawa, Canada, and is part of the Nunavut Collections (registration numbers NUIF 2749, 2752–2753, 2755).

Systematic palaeontology
Phylum Bryozoa Ehrenberg, 1831
Class Stenolaemata Borg, 1926
Superorder Palaeostomata Ma, Buttler & Taylor, 2014
Suborder Amplexoporina Astrova, 1965
Family Stenoporidae Waagen & Wenzel, 1886
Genus *Rhombotrypella* Nikiforova, 1933

Type species – *Rhombotrypella astragaloides* Nikiforova, 1933, by original designation. Middle Carboniferous; Ukraine.

Diagnosis – Branched colonies with narrow exozones. Autozooecia long in endozones, having quadrate or rhombic transverse sections. Autozooecial apertures oval to rounded-polygonal. Autozooecial diaphragms restricted to exozone, rare to common, thin, straight. Ringsepta and hook-shaped hemiphragms occurring. Autozooecial walls irregularly thickened in exozones, laminated, merged, often beaded; singulum absent. Exilazooecia uncommon, short. Two types of acanthostyles present, larger ones and smaller ones between them, often arranged in regular pattern.

Remarks – *Rhombotrypella* Nikiforova, 1933 differs from *Tabulipora* Young, 1883 by quadrate to rhombic shape of autozooecia in transverse section of endozone.

Occurrence – Carboniferous to Permian; worldwide.

Rhombotrypella superangustata Morozova, 1970
Figure 1A–H; Table 1

1970 *Rhombotrypella superangustata* Morozova, p. 102–104, pl. 18, fig. 1, text–fig. 2.

Material – Single specimen NUIF 2755a-e (five thin sections).

Description – Ramose branching colony, with oval shape of transverse section, 5.1 mm wide in short axis and 9.8 mm wide in the long axis. Exozones 1.2–1.6 m wide. Endozone partly crushed. Autozooecia long in endozone, having rhombic transverse sections, bending at low angles in exozone. Autozooecial diaphragms rare to absent in exozone. Ring septa in exozone, spaced regularly within autozooecial chambers, positioned usually at the base of wall beads. Autozooecial apertures rounded-polygonal, 10–11 spaced per 1 square mm and 5 per 2 mm distance. Exilazooecia common, 4–5 spaced per 1 square mm, moderate in size. Macroacanthostyles large, having narrow indistinct cores and wide laminated sheaths, 2–5 surrounding each autozooecial aperture, 10 spaced 1 square mm. Microacanthostyles small, arranged in one-two irregular rows between macroacanthostyles. Autozooecial walls finely laminated, 0.010–0.015 mm thick in endozones. Exozonal walls showing indistinct lamination

without distinct zooecial boundaries, 0.11–0.21 mm thick, forming regular beads. Maculae not observed.

Remarks – Morozova (1970, p. 103) gave following details in the description of *Rhombotrypella superangustata*: aperture width 0.12-0.16 mm, 5-6 apertures per 2 mm distance, 3-4 macroacanthostyles per aperture, macroacanthostyle diameter 0.08-0.20 mm. Together with its internal morphology (wall structure and distribution of ring septa) these characters fit perfectly to the present material. *Rhombotrypella superangustata* Morozova, 1970 differs from *R. angustata* Linskaya, 1951 from the Lower Permian of Urals in larger macroacanthostyles (0.10–0.20 mm vs. 0.11–0.14 mm in *R. angustata*). *Rhombotrypella superangustata* differs from *R. alfredensis* Morozova in Morozova & Krutchinina, 1986 from the Kapp Starostin Formation, Permian (Ufimian) of Bjørnøya in smaller autozooecial apertures (aperture width 0.09–0.17 mm vs. 0.18–0.25 mm in *R. alfredensis*).

Rhombotrypella superangustata Morozova, 1970 is similar to the species described by Sakagami (1998, p. 72-73, figs. 3.1-3.4) as *Rhombotrypella composita* Nikiforova, 1939 from the blocks of Permian rocks of the Northern Ellesmere Island. However, that species has more abundant macroacanthostyles surrounding autozooecial apertures (2-5 in the present species and 5-6 in the material of Sakagami (1998)). The original material of *R. composita* Nikiforova, 1939 from the Lower Permian (Sakmarian-Artinskian) of Russia has less abundant (3-4 per autozooecial aperture vs. 5-6 in the material of Sakagami (1998)) and smaller macroacanthostyles (0.08 mm vs. 0.10-0.14 mm in the material of Sakagami (1998) and 0.10-0.20 mm in the material described here).

Occurrence – Upper Permian (Kazanian); Russian Platform. Assistance Formation, Permian (Ufimian); Lake Hazen, Ellesmere Island, Canada.

Family Dystritellidae Dunaeva and Morozova, 1967

Dyscritellina Dunaeva & Morozova, 1967

Type species – *Dyscritellina clivosa* Dunaeva & Morozova, 1967. Late Permian, Kazanian; Russia.

Diagnosis – Ramose, encrusting, or massive colonies with distinct exozones. Autozooecia parallel to longitudinal direction of the colony in endozone; abruptly bending outward in exozone. Diaphragms in autozooecia lacking or very rare; lacking in exilazooecia. Exilazooecia abundant, circular to angular in cross section and separated from the autozooecia and from each other by thick walls. Exceptionally large zooecial styles with wide laminated sheaths developed intrazooecially from autozooecia, often larger in diameter than autozooecia. Smaller exozonal styles between the zooecial styles usually present. Autozooecial walls thin in endozone; rapidly thickening in the exozone, indistinctly beaded, merged, no cingulum present. Maculae comprise clusters of exilazooecia or styles.

Remarks – *Dyscritellina* Morozova *in* Dunaeva & Morozova, 1967 differs from *Dyscritella* Girty, 1911 in having exceptionally large zooecial styles.

Occurrence – Permian; worldwide.

Dyscritellina fuglensis Morozova in Morozova & Krutchinina, 1986
Figure 2A–H, 3A–F; Table 2

1986 *Dyscritellina fuglensis* Morozova in Morozova & Krutchinina, p. 57–58, pl. 18. fig. 2.

Material – Four colonies and thirteen thin sections S K19559 (NUIF 2749), S K19561 (NUIF 2751a-e), S K19562 (NUIF 2752a-d), S K19563 (NUIF 2753a-d).

Description – Ramose branching colony, 8.4–11.3 mm in diameter. Endozones 1.3–4.8 mm wide, exozones 2.3–3.9 mm wide. Secondary overgrowths occurring, 0.5–1.1 mm wide. Autozooecia long in endozone, having polygonal transverse sections, abruptly bending outward in exozone. Autozooecial diaphragms absent. Autozooecial apertures rounded-polygonal, often petaloid due to indenting macroacanthostyles, 8–16 per square mm. Exilazooecia common, small, rounded polygonal, originating at the base of exozone, 6–15 per square mm. Macroacanthostyles large, having distinct wide cores and wide laminated sheaths, 2–6 surrounding each autozooecial aperture, 9–19 per square mm. Some macroacanthostyles merged, having second, smaller hyaline core (Fig. 3D, F). Microacanthostyles small, few, scattered irregularly between macroacanthostyles. Autozooecial walls granular, 0.01–0.03 mm thick in endozones. Exozonal walls merged, showing indistinct lamination without distinct zooecial boundaries, 0.05–0.14 mm thick. Indistinct, slightly elevated maculae with large macroacanthostyles and thick-walled autozooecia, 2.6–4.4 mm in diameter, spaced 5.8–7.9 mm from centre to centre.

Remarks – *Dyscritellina fuglensis* Morozova in Morozova & Krutchinina, 1986 is similar to *D. aculeata* Morozova in Morozova & Krutchinina, 1986 (? Late Permian of Russian Arctic) but differs from it in smaller macroacanthostyles (0.07–0.22 mm vs. 0.18–0.30 (up to 0.36 mm) in *D. aculeata*). *Dyscritellina fuglensis* differs from *D. ramosa* Morozova in Morozova & Krutchinina, 1986 from the Ufimian of Novaya Zemlya in larger autozooecial apertures (aperture width 0.10–0.26 mm vs. 0.09–0.16 mm in *D. ramosa*) and in less abundant macroacanthostyles (2–6 per aperture vs. 1–3 in *D. ramosa*).

Occurrence – Kapp Starostin Formation, Permian (Ufimian); Bjørnøya; Norway. Assistance Formation, Permian (Ufimian); Lake Hazen, Ellesmere Island, Canada.

Conclusions

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Disclosure statement

No potential conflict was reported by the author.

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Figure captions

Figure 1. *Rhombotrypella superangustata* Morozova, 1970 from the Assistance Formation of Lake Hazen, Ellesmere Island, Canada. **A–E.** NUIF 2755b, branch transverse section showing rhombic shape of autozooecia in endozone, ring septa and beaded walls in exozone. **F–H.** NUIF 2755a, tangential section showing autozooecial apertures, exilazooecia, macroacanthostyles and microacanthostyles.

Figure 2. *Dyscritellina fuglensis* Morozova in Morozova & Krutchinina, 1986 from the Assistance Formation of Lake Hazen, Ellesmere Island, Canada. **A**. NUIF 2749, external view of a colony showing a broken part of a branch arising from an encrusting base. **B**. NUIF 2751, part of a separate branch. **C.** NUIF 2753d, branch longitudinal section. **D–F.** NUIF 2753a, branch transverse section showing autozooecial chambers and macroacanthostyles. **G.** NUIF 2753d, branch longitudinal section showing secondary overgrowth. **H.** NUIF 2752a, branch transverse section showing autozooecial chambers and macroacanthostyles.

Figure 3. *Dyscritellina fuglensis* Morozova in Morozova & Krutchinina, 1986 from the Assistance Formation of Lake Hazen, Ellesmere Island, Canada. **A.** NUIF 2751c, branch transverse section showing autozooecial chambers and exilazooecia. **B.** NUIF 2751e, branch longitudinal section showing autozooecial chambers, exilazooecia and macroacanthostyles. **C–F.** NUIF 2752b, tangential section showing autozooecial apertures, exilazooecia, macroacanthostyles and microacanthostyles (arrows: E – microacanthostyles; D, F – fused macroacanthostyles).

Tables

Table 1. Summary of descriptive statistics for *Rhombotrypella superangustata* Morozova, 1970 (one colony). Abbreviations: N, number of measurements; X, mean; SD, sample standard deviation; CV, coefficient of variation; MIN, minimal value; MAX, maximal value.

	N	X	SD	CV	MIN	MAX
Aperture width, mm	30	0.13	0.024	19.23	0.09	0.17
Aperture spacing, mm	30	0.32	0.040	12.30	0.26	0.40
Exilazooecia width, mm	30	0.06	0.010	17.18	0.03	0.07
Macroacanthostyle diameter, mm	30	0.15	0.027	18.08	0.10	0.20
Macroacanthostyles per aperture	30	3.3	0.596	18.06	2.0	5.0
Microacanthostyle diameter, mm	30	0.044	0.008	19.08	0.025	0.060
Exozonal wall thickness, mm	20	0.15	0.027	17.72	0.11	0.21

Table 2. Summary of descriptive statistics for *Dyscritellina fuglensis* Morozova in Morozova & Krutchinina, 1986 (three colonies). Abbreviations as for Table 1.

	N	X	SD	CV	MIN	MAX
Aperture width, mm	90	0.17	0.031	18.71	0.10	0.26
Aperture spacing, mm	90	0.28	0.042	14.74	0.18	0.38
Exilazooecia width, mm	90	0.05	0.016	31.24	0.03	0.10
Macroacanthostyle diameter, mm	90	0.14	0.035	24.01	0.07	0.22
Macroacanthostyles per aperture	90	3.3	0.881	27.07	2.0	6.0
Microacanthostyle diameter, mm	27	0.036	0.009	25.79	0.025	0.055
Exozonal wall thickness, mm	50	0.08	0.025	29.20	0.05	0.14

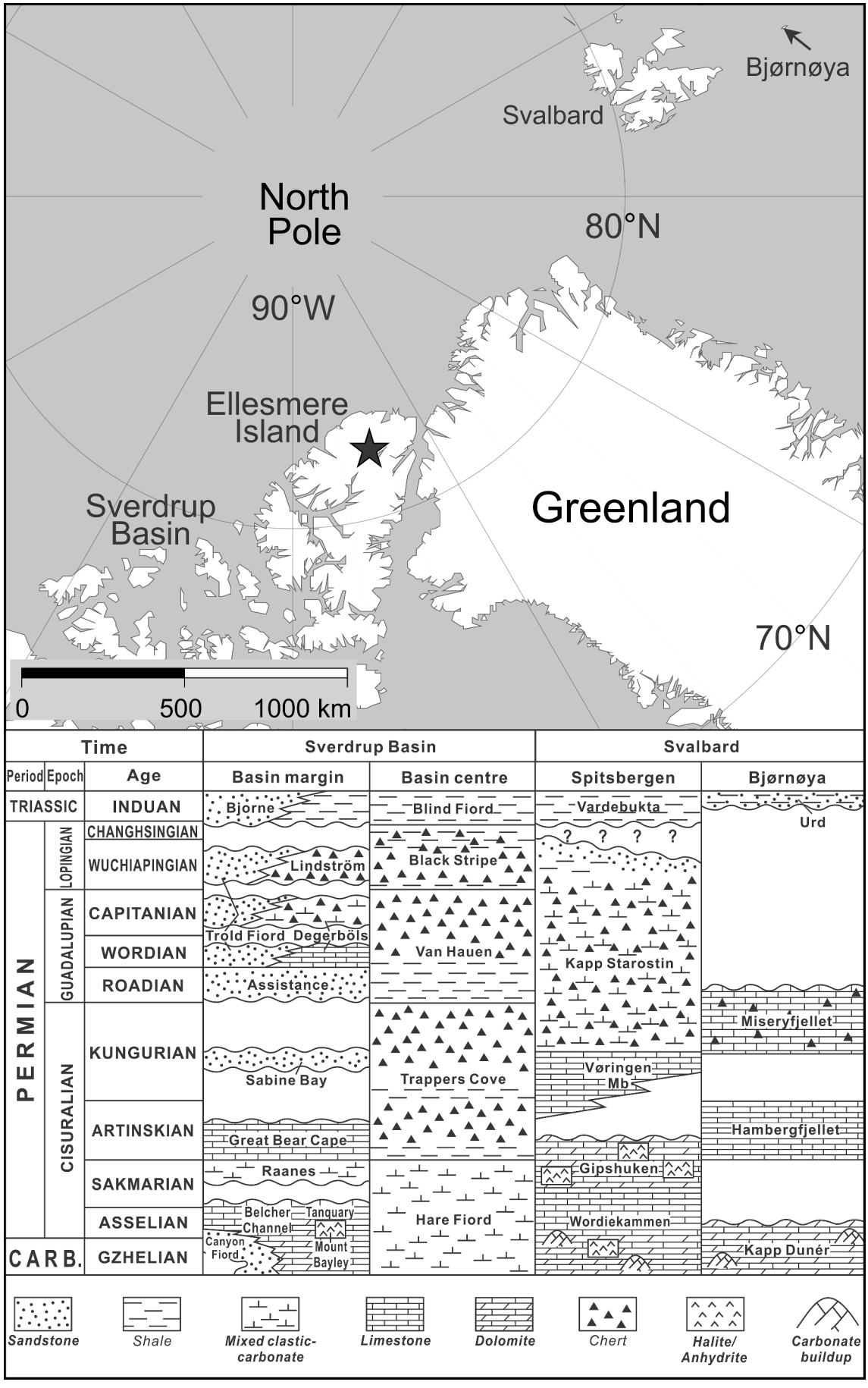
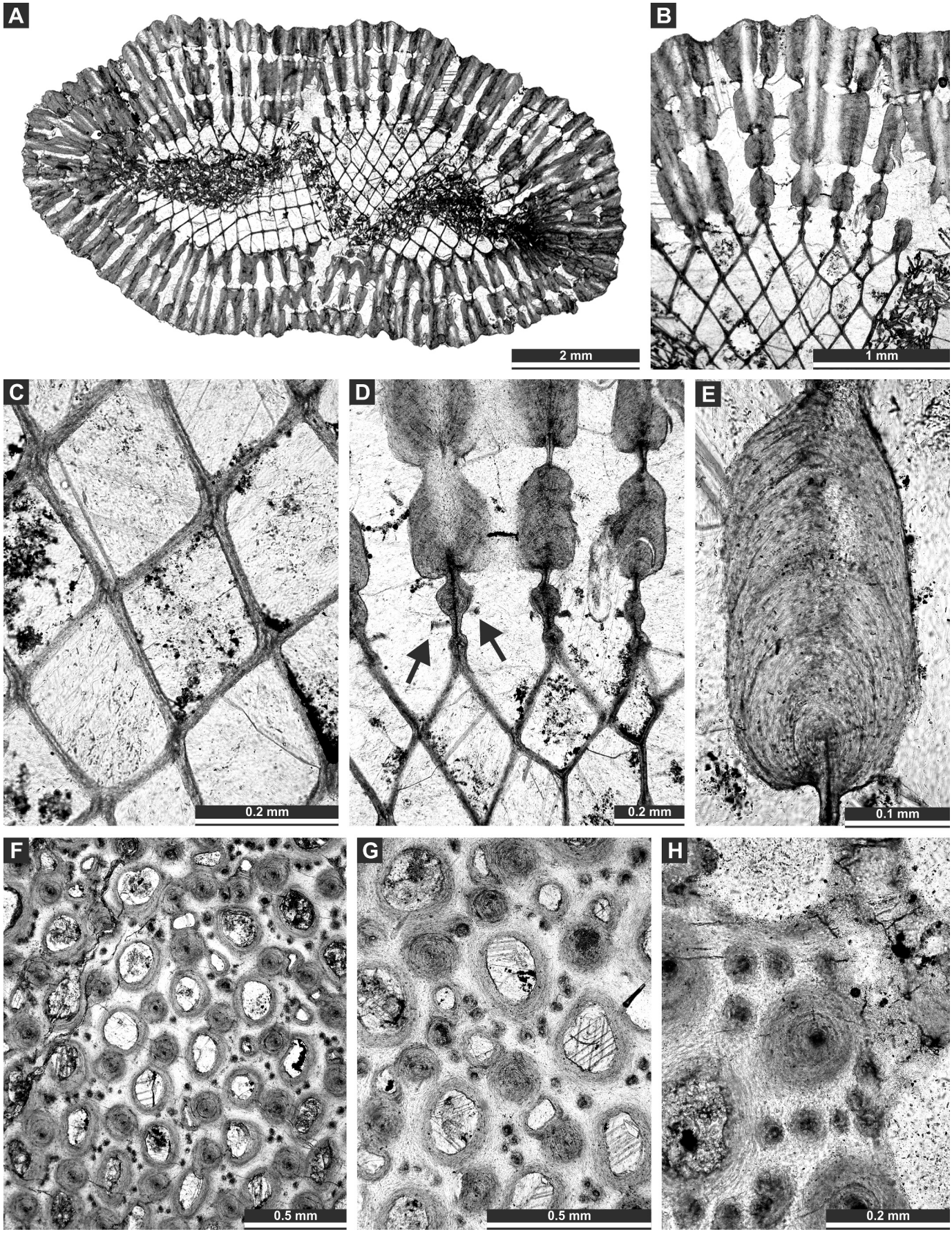


Figure 1. Map of current day Arctic, with sample location marked with an asterisk. Source data for the Sverdrup Basin from Beauchamp et al. (2009); Svalbard from Dallmann (1999).



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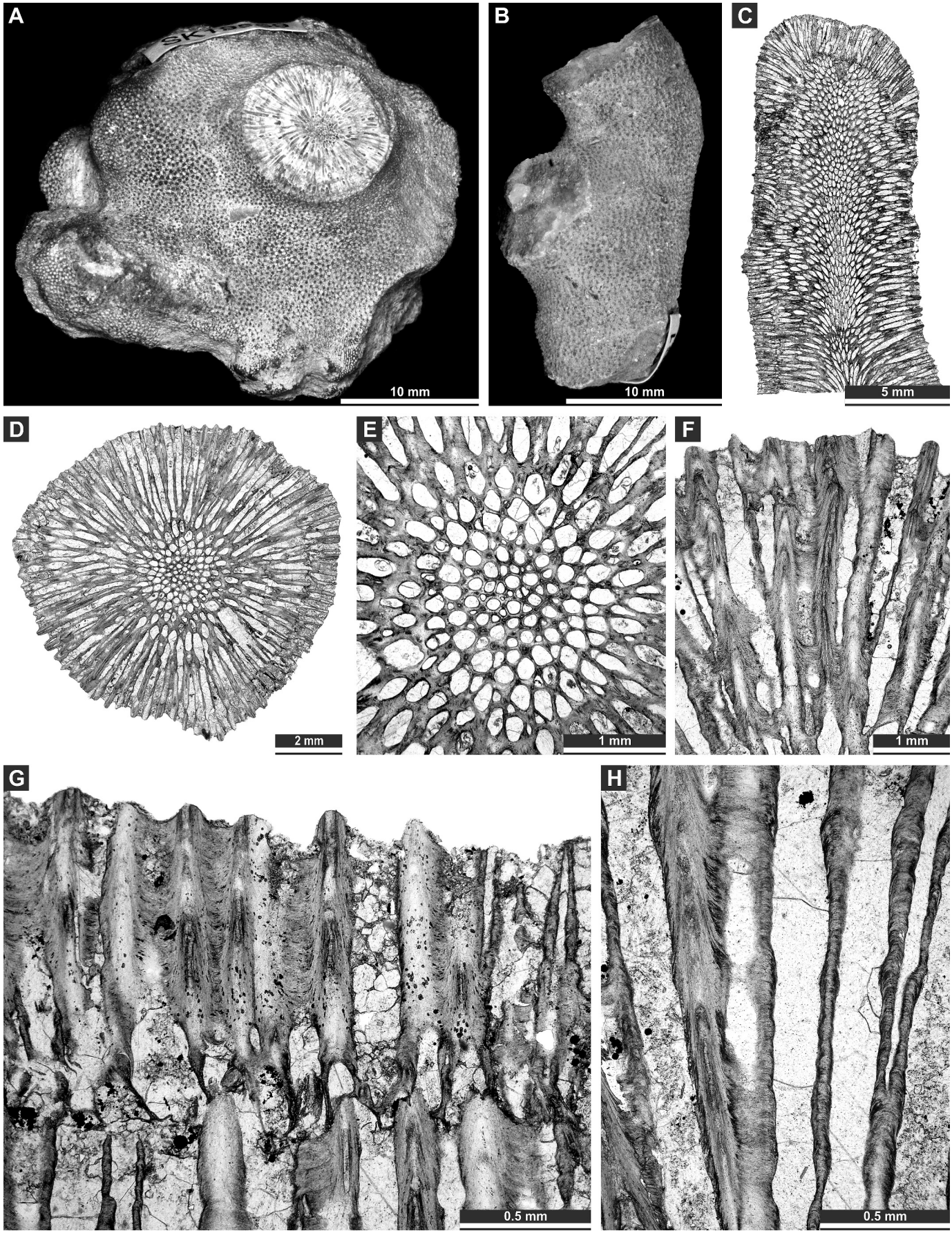

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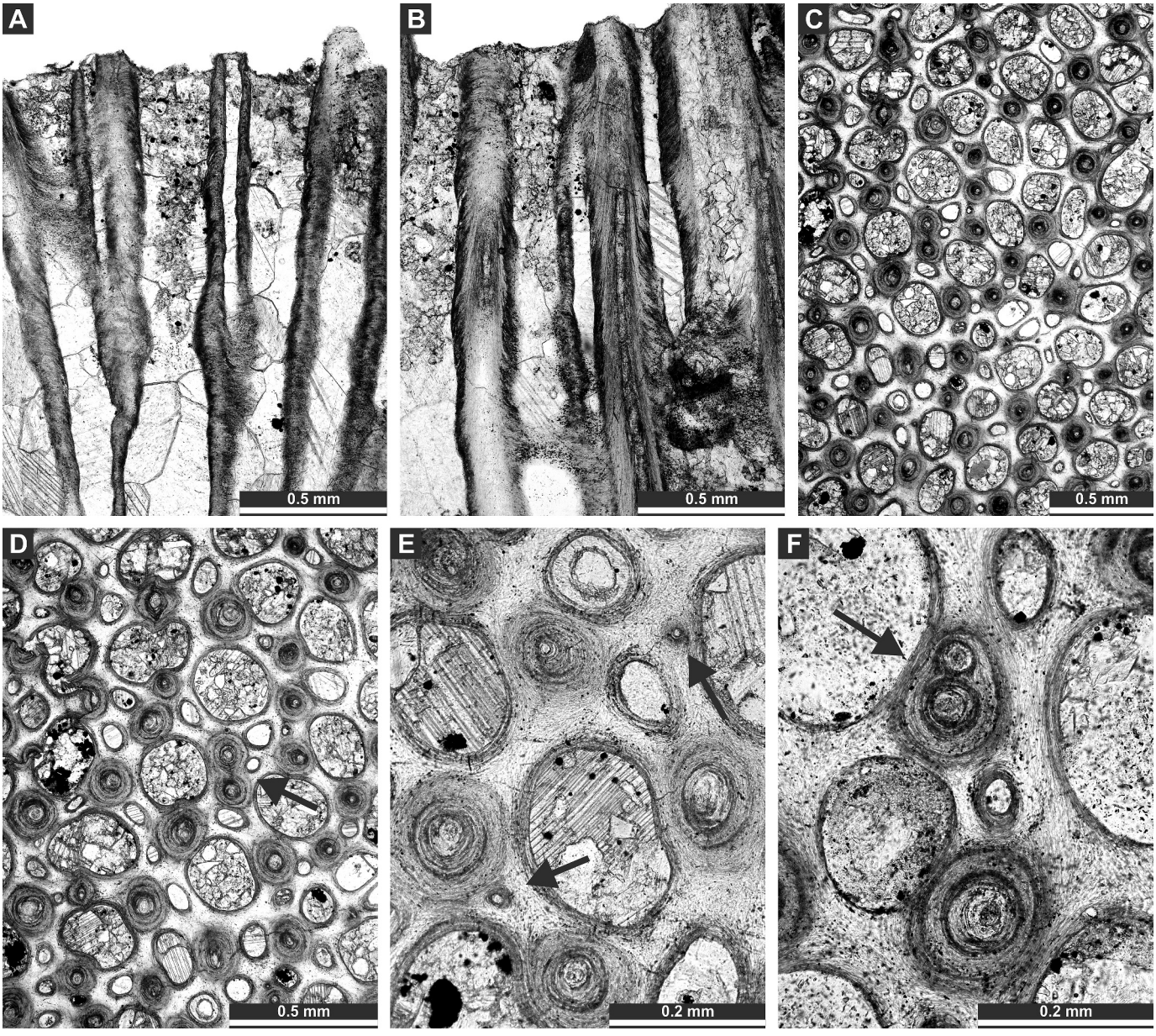

Figure 4. *Dyscritellina fuglensis* Morozova in Morozova & Krutchinina, 1986 from the Assistance Formation of Lake Hazen, Ellesmere Island, Canada. **A**. NUIF 2751 c, branch transverse section showing autozooecial chambers and exilazooecia. **B**. NUIF 2751e, branch longitudinal section showing autozooecial chambers, exilazooecia and macroacanthostyles. **C–F**. NUIF 2752b, tangential section showing autozooecial apertures, exilazooecia, macroacanthostyles and microacanthostyles (arrows: E – microacanthostyles; D, F – fused macroacanthostyles).

than autozooecia. Smaller exozonal styles between the zooecial styles usually present. Autozooecial walls thin in endozone; rapidly thickening in the exozone, indistinctly beaded, merged, no cingulum present. Maculae comprise clusters of exilazooecia or styles.

Remarks

– *Dyscritellina* Morozova in Dunaeva and Morozova, 1967 differs from *Dyscritella* Girty, 1911 in having exceptionally large zooecial styles.

Occurrence

– Permian; worldwide.

Dyscritellina fuglensis *Morozova in Morozova and Krutchinina, 1986 Figure 3A–H, 4A–F; Table 2*

1986 *Dyscritellina fuglensis* Morozova in Morozova and Krutchinina, p. 57–58, pl. 18, fig. 2.

Material

– Four colonies and thirteen thin sections S K19559 (NUIF 2749), S K19561 (NUIF 2751a-e), S K19562 (NUIF 2752a-d), S K19563 (NUIF 2753a-d).

Description

– Ramose branching colony, 8.4–11.3 mm in diameter. Endozones 1.3–4.8 mm wide, exozones 2.3–3.9 mm wide. Secondary overgrowths occurring, 0.5–1.1 mm wide.