Upper Permian bryozoans of central East Greenland

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The bryozoan fauna in the Upper Permian Wegener Halvø, Ravnefjeld and Schuchert Dal formations, central East Greenland is of modest diversity, with only 15 genera identified. Bryozoans are most abundant in the Wegener Halvø Formation where they are important in the formation of carbonate buildups. Robust, rigidly erect colony types dominate in buildup cores whereas delicate erect types characterize the distal parts of the buildups. Cement-dominated bryozoan buildups are found in East Greenland and in the Zechstein Basin but are not known from the contemporaneous cool-water successions of North Greenland and Svalbard. The buildups are probably formed by seawater chemistry facilitating syn-depositional cement rather than a difference in the composition of the bryozoan fauna.

Keywords: Bryozoans, Carbonate buildups, East Greenland, Permian

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The marine Upper Permian sediments in central East Greenland were deposited along the western margin of a narrow, N–S elongated, rifted seaway between Greenland and Norway. Deposition took place at times when central East Greenland was situated at ca 35ºN, midway between the Boreal Permian cool-water shelves of North Greenland, Svalbard and the Barents Shelf and the warm and arid areas of the classical Zechstein Basin of NW Europe (Figs. 1, 2; Scholle *et al.* 1993; Stemmerik 2000). Thus the East Greenland succession forms an important link between Late Permian cool- and warm-water areas, and studies of the East Greenland fauna are important for better understanding migration into the enclosed Zechstein Basin (Sørensen *et al.* 2007).

This paper gives a first, brief description of the bryozoan fauna in the Upper Permian Wegener Halvø, Ravnefjeld and Schuchert Dal formations of central East Greenland (Fig. 3). World wide bryozoans are important reef builders in the Late Palaeozoic, and several bryozoan-dominated carbonate build-ups have been described from the Wegener Halvø Formation in East Greenland (e.g. Scholle *et al.* 1991, 1993; Stemmerik 1991, 1997, 2001). Bryozoans are also locally important in the overlying Schuchert Dal Formation, particularly on the Wegener Halvø peninsula (Fig. 1). The investigated material was selected from a large collection of samples collected during several expeditions to East Greenland, simply based on density and preservation of the bryozoans. Most of the investigated bryozoans are totally embedded in well cemented matrix, while some samples expose large and well preserved colonies on bedding planes allowing also external investigations. Internal characteristics were studied in acetate peels made from oriented polished surfaces.

Permian of East Greenland

The marine Late Permian basin of East Greenland formed an elongated embayment which extended for more than 400 km N-S, from southern Jameson Land to Wollaston Forland (Fig. 1). The depositional basin was bound to the west by the post-Devonian main fault, and at the time of deposition it was landlocked towards the south. The Liverpool Land high separated the southern part of the basin from the main seaway between the northern Permian basins of North Greenland, Svalbard and the Barents Sea and the southern Zechstein Basin (Fig. 1).

Initial Permian transgression into the basin occurred following a prolonged period of uplift and erosion in the early Permian associated with a shift in tectonic style from from active rifting to more passive regional subsidence. The initial base level rise resulted in deposition of fluvial sediments of the Huledal Formation. This unit passes into a thick succession of shallow-marine, micritic, peloidal and stromatolitic limestone and dolostone, and local subaqueous gypsum of the Karstryggen Formation. The Karstryggen Formation is barren of macrofossils either because depositon took place in environments characterised by biologically stressed conditions, or, more likely, as a result of intense diagenetic alteration following a major fall in relative sea-level, which subjected the basin to a prolonged period of subaerial exposure (Scholle *et al.*, 1993). Along the basin margins, considerable topographic relief, locally in excess of 70 m, was produced by karstification and fluvial erosion during this time interval.

A second major transgression resulted in deposition of fully marine carbonates of the Wegener Halvø Formation along basin margins and over structural highs and black shales of the Ravnefjeld Formation in the central parts of the basin (Figs 1, 2, 3,). In the southern part of the basin, south of present day 72ºN, the Wegener Halvø and Ravnefjeld formations are overlain by the marine, siliciclastic-dominated Schuchert Dal Formation. The warm-water carbonates of the Wegener Halvø Formation and the time-equivalent basinal shales of the Ravnefjeld Formation are dated to the Wuchiapingian based on the presence of a low diversity conodont fauna of *Mesogondolella (Neogondolella) rosenkrantzi*, *Merrillina divergens* and *Xaniognathus*

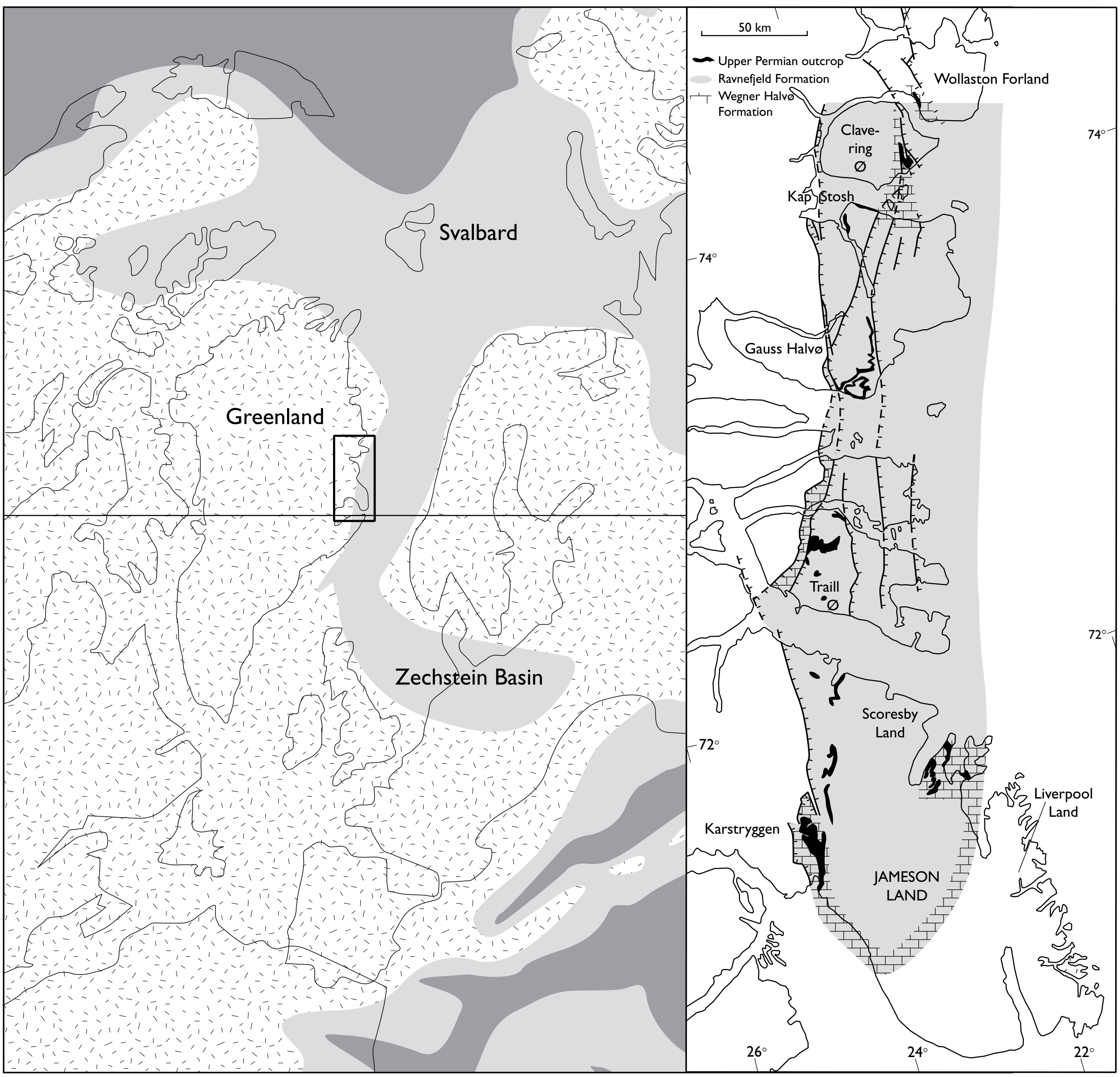
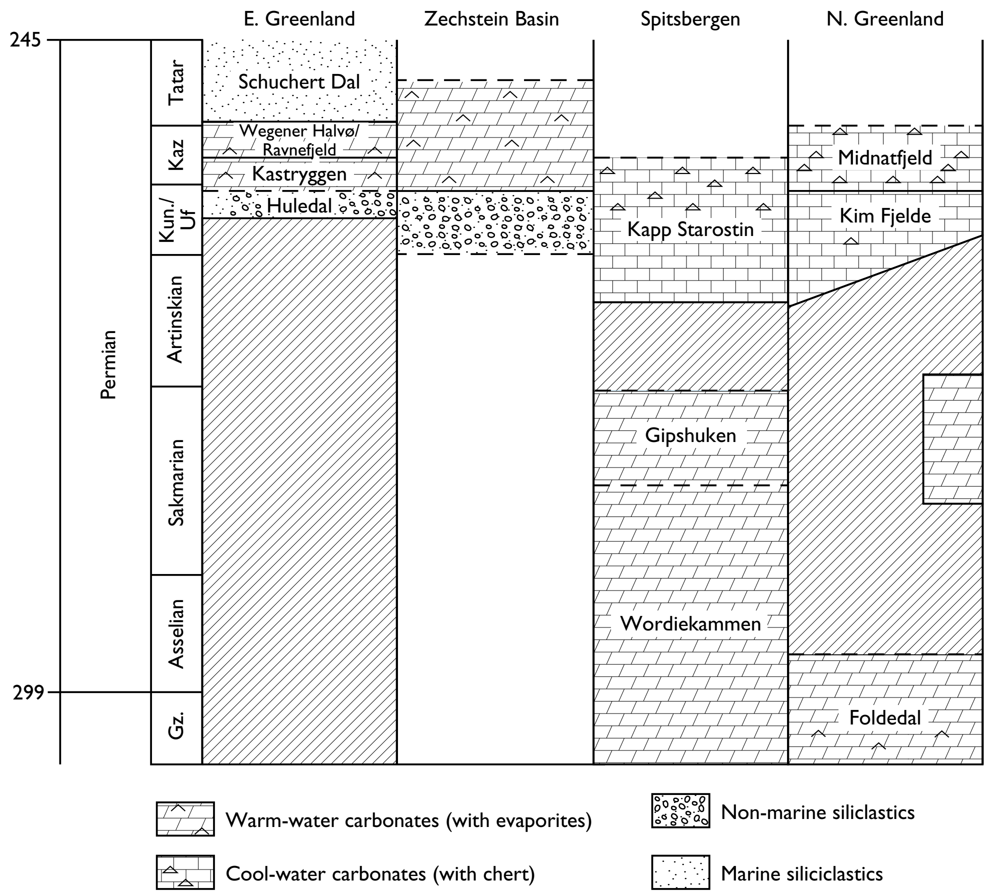


Fig. 1 Generalised Late Permian reconstruction of the north North Atlantic showing the position of the East Greenland study area relative to the Zechstein Basin and Svalbard. The East Greenland map shows the outline of the Late Permian depositional basin.

Fig. 2
Correlation of Permian lithostratigraphic units in East and North Greenland, Svalbard and the Zechstein Basin.



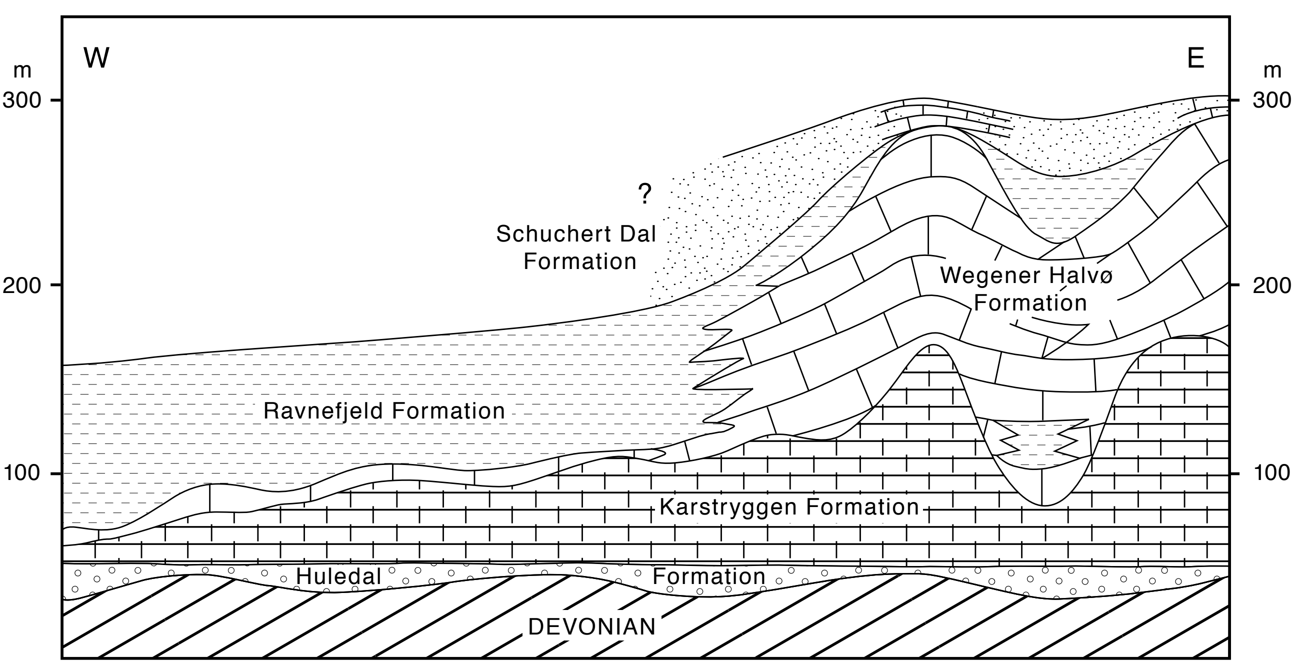


Fig. 3 Schematic cross-section showing the platform to basin variations of the Upper Permian Foldvik Creek Group. (From Stemmerik 1991).

abstractus (Rasmussen *et al.* 1990; Henderson & Mei 2000). The overlying Schuchert Dal Formation is of latest Permian age (Stemmerik *et al.* 2001). The change in depositional regime from warm-water carbonates of the upper Wuchiapingian Wegener Halvø Formation to cool-water carbonates in the Schuchert Dal Formation suggests cooling in the East Greenland region during the latest Permian, somewhat delayed in relation to the corresponding change in the Svalbard – North Greenland region.

Most bryozoans investigated are from the upper part of the Wegener Halvø Formation and the carbonate-dominated part of the Schuchert Dal Formation at Wegener Halvø peninsula. The material from the Wegener Halvø Formation mainly represents bryozoan buildup core- and flank facies, while material assigned to the Ravnefjeld Formation represents thin, distal carbonate beds embedded in black mudstones (see Scholle *et al.* 1991, 1993; Stemmerik *et al.* 1993; Stemmerik, 1995, 2001). The material from the Schuchert Dal Formation is from local carbonate ramps developed in the Wegener Halvø area.

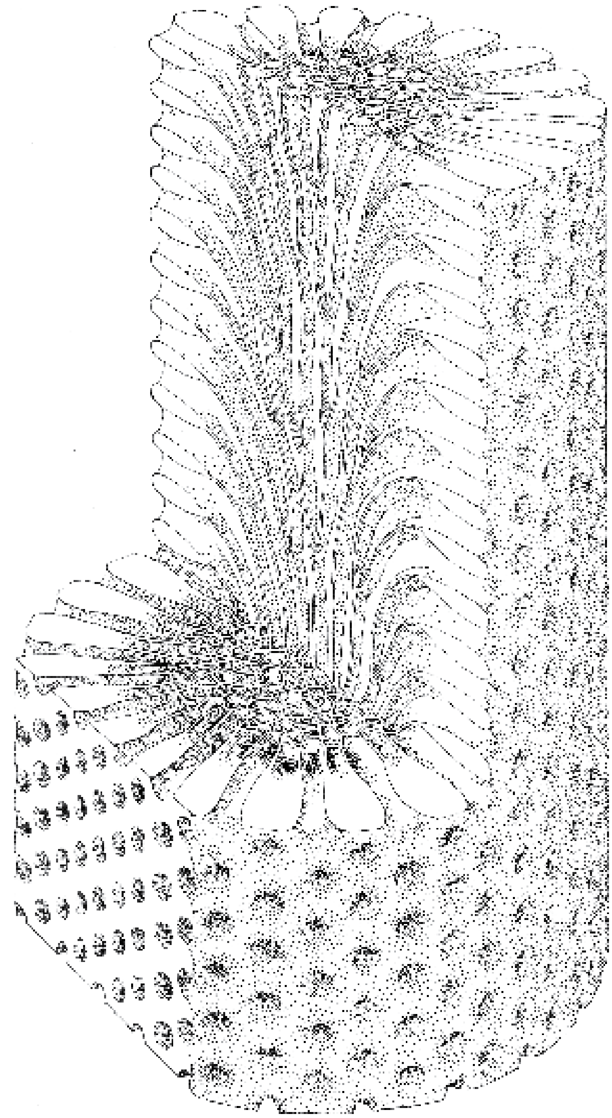


Fig. 4 Orientation of thin-sections or acetate peels in the study of Palaeozoic bryozoans (From Madsen & Håkansson 1989).

Systematic Palaeontology

The investigated bryozoan fauna of the Upper Permian Wegener Halvø, Ravnefjeld and Schuchert Dal formations in East Greenland has been assigned to 15 genera of 4 orders. In addition to these 15 genera, some fenestrate taxa related to the genus *Fenestella* are present but not identified. Peel orientation according to Figure 4.

Phylum: BRYOZOA Ehrenberg, 1831
Class: STENOLAEMATA Borg, 1926

Order: TREPOSTOMATA Ulrich, 1882

In addition to the rigidly erect taxa characterized below, indeterminable encrusting trepostomes have been encountered in some samples.

Family: DYSCRITELLIDAE Dunaeva & Morozova, 1967

Genus: ***Dyscritella*** Girty, 1911 (Plate 1A)

Dyscritella forms dendroid colonies with two types of zooids, autozooids and exilazooids, which are evenly distributed on the colony surface. The genus is characterized by having a comparatively thick exozone with evenly thickened zooid walls with large styles and very few diaphragms. In transverse section of the endozone the autozooid tubes show a triangular pattern.

Remarks: In East Greenland *Dyscritella* differs from the genus *Tabulipora* by having a thicker exozone, a smaller branch diameter, only large styles, and very few to absent diaphragms.

Dyscritella is known also from the Permian of the Russian Platform, Asia, Tasmania, North America, Patagonian shelf, Ellesmere Island, North Greenland and Svalbard (Madsen & Håkansson 1989; Ross & Ross 1990; Nakrem, 1991, 1994a, b and c; Madsen 1994;, Ernst & Nakrem 2005).

Family: LEIOCLEMIDAE

Genus: ***Paralioclema*** Morozova, 1961 (Plate 1B)

Paralioclema forms dendroid colonies. The genus is characteristic by having numerous styles also in the endozone and numerous diaphragms in the autozooid tubes in the exozone. In transverse section the autozooid tubes form a rounded to polygonal pattern in the endozone.

Remarks: In East Greenland *Paralioclema* differs from the genus *Tabulipora* by having numerous styles in the endozone, and from the genus *Dyscritella* by numerous diaphragms.

Paralioclema is also known from the Permian, Carboniferous and Triassic of the Tethyan Sea and from the Triassic of Svalbard (Ross & Ross 1990; Nakrem 2004).

Family: STENOPORIDAE Waagen & Wenzel, 1886

Genus: ***Tabulipora*** Young, 1883 (Plate 1C)

Tabulipora forms dendroid colonies with two types of zooids present, autozooids and exilazooids, which are evenly distributed on the colony surface except for maculae areas where the number of exilazooids increases. *Tabulipora* is characterized by moniliform exozonal walls, numerous ringsepta and diaphragms in the autozooid tubes and large and small styles in the walls protruding on the colony surface. In transverse section the autozooid tubes form a polygonal pattern in the endozone.

Remarks: *Tabulipora* is also known from the Permian of the Tethyan Sea, Ellesmere Island, Svalbard and North Greenland (Morozova & Kruchinina 1986;, Madsen & Håkansson 1989; Nakrem 1991, 1994a, b and c; Madsen 1994; Ernst 2000;, Ernst & Nakrem 2005)

Genus: ***Rhombotrypella*** Nikiforova, 1933 (Plate 1D)

Rhombotrypella is closely related to *Tabulipora* from which it is separated solely on the basis of the quadrate to rhombic pattern of the autozooid tubes in transverse section of the endozone formed as a result of a cyclic four-sided intrazooidal budding pattern (Boardman & McKinney, 1976). All remaining characters, two types of zooids, moniliform exozonal walls with ringsepta and diaphragms and large and small styles in the walls are identical to *Tabulipora* (Madsen & Håkansson, 1989).

Remarks: East Greenland material of *Rhombotrypella* differs from *Tabulipora* also by having a comparatively thinner exozone.

Rhombotrypella is also known from the Permian of the Russian Platform, the Patagonian shelf, Ellesmere Island, Svalbard and North Greenland (Morozova & Kruchinina 1986;, Madsen & Håkansson 1989; Ross & Ross 1990; Nakrem 1991, 1994a, b and c; Madsen 1994;, Ernst & Nakrem 2005).

Order: FENESTRATA Elias & Condra, 1957

Family: ACANTHOCLADIIDAE Zittel, 1880

Genus: ***Acanthocladia*** King, 1849

Acanthocladia forms thin branching colonies consisting of main branches with secondary branches. Autozooids are arranged in three or more rows on both main and secondary branches.

Remarks: *Acanthocladia* is also known from the Carboniferous of the Russian Platform, the American shelves and the Tethyan Sea, and from the Permian of the Tethyan Sea, the Patagonian shelf, the Zechstein Basin, Ellesmere Island, Svalbard and North Greenland (Madsen & Håkansson 1989; Ross & Ross 1990; Nakrem 1991, 1994a and b; Madsen 1994; Ernst 2001a;, Ernst & Nakrem 2005,).

Family: POLYPORIDAE Vine, 1884

Genus: ***Polypora*** M'coy, 1844 (Plate 2F)

Polypora forms reticulate colonies of more or less regular funnel-shape. The almost straight branches bifurcate frequently and are joined at regular intervals by straight dissepiments without autozooids. Autozooids usually are arranged in three or more rows along the branches, opening on one side of the colony only. Autozooid chambers are short with weakly developed hemisepta and short vestibules. Longitudinal keels between rows of autozooids are weakly developed or absent. Small styles are usually present on the obverse surface of the colony.

Remarks: *Polypora* is also known from the Patagonian shelf, Ellesmere Island, Svalbard and North Greenland during the Permian (Morozova & Kruchinina 1986;, Madsen & Håkansson 1989; Ross & Ross 1990; Nakrem 1991; 1994a, b and c; Madsen 1994;, Ernst & Nakrem 2005).

Family: FENESTELLIDAE King, 1849

Genus: ***Kingopora*** Morozova, 1970 (Plate 2D)

Kingopora forms reticulate funnel-shaped colonies with undulating branches which are joined together by anastomoses or by dissepiments. There are 2–3 rows of autozooids on branches and dissepiments. Nodes can be seen on both sides of the colony. In East Greenland *Kingopora* has an anastomosing meshwork without dissepiments.

Remarks: In East Greenland *Kingopora* differs from the genus *Polypora* by the anastomosing meshwork without dissepiments.

Kingopora is also known from the Zechstein Basin, the Russian Platform, Svalbard and Nevada during the Permian (Morozova 1970; Ross & Ross 1990; Nakrem 1991; Nakrem *et al*. 1992; Ernst 2001a).

Genus: ***Rectifenestella*** Morozova, 1974 (Plate 2C)

Rectifenestella forms reticulate funnel-shaped colonies with straight branches and straight dissepiments. Autozooids are arranged in two rows on the branches. Between the rows of apertures runs a narrow keel with a single row of intermediate nodes. The reverse surface of the colony is ribbed and has irregularly spaced nodes.

Remarks: *Rectifenestella* is also known from the Permian of the Russian Platform, the Tethyan Sea, the Zechstein Basin, Ellesmere Island and Svalbard (Ross & Ross 1990; Nakrem 1991; 1994a, b and c; Ernst 2001a;, Ernst & Nakrem 2005).

Genus: ***Spinofenestella*** Termier & Termier, 1971 (Plate 1E)

Spinofenestella forms reticulate colonies with relatively thick and wide branches and relatively thin dissepiments. Autozooids are arranged in two rows on the branches with a narrow keel and a single row of long nodes between the apertures. The reverse surface of the colony is strongly ribbed.

Remarks: In East Greenland *Spinofenestella* differs from the genus *Rectifenestella* by having longer nodes on the keel between apertures.

Spinofenestella is also known from the Permian of the Russian Platform, the Tethyan Sea and the Zechstein Basin (Ross & Ross 1990; Ernst 2001a).

Order: CRYPTOSTOMATA Vine, 1884

Family: TIMANODICTYIDAE Morozova, 1966

Genus**:** ***Timanodictya*** Nikiforova, 1938 (Plate 2B)

Timanodictya forms fairly large bifoliate colonies. Autozooids are arranged in diagonally crossed rows on branches and styles are evenly distributed on the colony surface. In transverse sections branches have a lenticular outline and the exozonal walls have very characteristic striped patterns which reflect the penetrating styles.

Remarks: *Timanodictya* is also known from the Permian of the Russian Platform, Arctic Canada, Siberia, the Tethyan Sea, North America, North Greenland and Svalbard (Ross & Ross 1990; Nakrem 1991; 1994a, b and c; Madsen 1994).

Family: ARTHROSTYLIDAE Ulrich, 1882

Genus**:** ***Permoheloclema*** Ozhgibesov, 1983 (Plate 2A)

Permoheloclema forms thin branching colonies. The branches display a very characteristic undulating pattern on the surface. Autozooids are elongate and in transverse section the exozone of the branches show a striped pattern.

Remarks: *Permoheloclema* is easily recognised on peels from East Greenland due to their small diameter and their distinct brown colouring.

Permoheloclema is also known from the Russian Platform, North America and Svalbard during the Permian (Ross & Ross 1990; Nakrem 1991; 1994a).

Order: CYSTOPORATA Astrova, 1964

Family: FISTULIPORIDAE Ulrich, 1882

Genus: ***Fistulipora*** McCoy, 1849 (Plate 2E)

Fistulipora forms massive dendroid and encrusting colonies with little or no distinction between endo- and exozone. Zooid tubes are long and apertures usually have well developed lunaria.

Remarks: In East Greenland *Fistulipora* is only found encrusting and is easily recognised through the well developed lunaria.

Fistulipora is also known from the Permian of the Patagonian shelf, the Russian Platform, the Tethyan

Sea, North America, North Greenland, Ellesmere Island, Svalbard and the Zechstein Basin (Madsen & Håkansson 1989; Ross & Ross 1990; Madsen 1994; Nakrem 1991; Ernst & Nakrem 2005;, Ernst 2007).

Family: GONIOCLADIIDAE Waagen & Pichl, 1885

Genus: ***Goniocladia*** Etheridge, 1875

Goniocladia forms reticulate colonies with polygonal fenestrules. The branches are bifoliate and undulating, joined by anastomoses or rarely dissepiments. The mesotheca protrudes as a sharp keel on the obverse side of the branch with two to three rows of autozooids arranged in on each side of the keel and apertures opening into the fenestrules. Autozooids have lunaria.

Remarks: *Goniocladia* is also known from the Permian of USA, Tasmania, the Tethyan Sea, North Greenland and Svalbard (Madsen & Håkansson 1989; Ross & Ross 1990; Madsen 1994; Nakrem 1994a, c)

Genus: ***Ramipora*** Toula, 1875 (Plate 1F)

Ramipora forms reticulate colonies with bifoliate branches. The primary branches are straight or weakly curved. The vertical mesotheca forms a keel on the obverse side of the colony. The keel is less pronounced on the reverse side of the colony. Primary branches have second and third order branches which occasionally fuse and thereby form large polygonal fenestrules. Autozooids are arranged in two or more rows on each side of the obverse mesotheca-keel with the apertures opening into the fenestrules. Autozooids have weakly developed lunaria. Colonies are massive and laminated with styles penetrating through most of the exozone.

Remarks: In East Greenland *Ramipora* differs from the genus *Goniocladia* by its almost straight primary branches compared to the undulating primary branches of *Goniocladia*, which form a meshwork with more square fenestrules.

Ramipora is also known from the Russian Platform, the Franklinian Shelf, the Tethyan Sea, Tasmania, North Greenland and Svalbard in the Permian (Madsen & Håkansson 1989; Ross & Ross 1990; Madsen 1994; Nakrem 1994a, c)

Genus: ***Ramiporidra*** Nikiforova, 1938 (Plate 2G)

Ramiporidra forms branching bifoliate colonies where secondary branches arise in opposite pairs from the primary branch without fusing. The vertical mesotheca forms a keel on the obverse side of the colony. The keel is less pronounced on the reverse side of the colony. Autozooids have weakly developed lunaria and are arranged in two or more rows on each side of the obverse keel. Microstructure is massive and laminated with styles penetrating through most of the exozone.

Remarks: *Ramiporidra* is also known from the Permian of the Tethyan Sea, Ellesmere Island, North Greenland and Svalbard (Morozova & Kruchinina 1986;, Ross & Ross 1990; Nakrem *et al.* 1992;, Madsen 1994; Ernst & Nakrem 2005).

Summary and conclusions

Bryozoans form a conspicuous element in the Upper Permian succession in East Greenland, with a clear dominance in both density and diversity in the carbonate facies of the Wegener Halvø Formation. Overall diversity is modest, with 15 genera identified in this investigation, representing all of the four bryozoan orders common in the Late Palaeozoic. However, at this preliminary stage only some of the fenestrate taxa have been identified.

Bryozoans are regularly involved in the formation of various types of organic build-ups of the Wegener Halvø Formation, ranging from cement-dominated mounds with a frame of fenestrate bryozoans to more ordinary mounds with a mixed bryozoan frame and abundant matrix (Fig. 5). Abundant bryozoans are also recorded on the flanks of the build-ups, reaching out into thin, distal carbonate beds in the Ravnefjeld muds. In mud dominated environments bryozoans are present only locally. Based on their occurrence in the most thoroughly investigated samples the distribution and dominance of individual taxa are clearly related also to variation in facies within the Wegener Halvø Formation. Thus, a gradual change in faunal composition is evident along a gradient from proximal to distal mound settings (Fig. 6), with the more robust, rigidly erect colony types dominating in the core facies and the delicate erect colony types characterizing the muddier, distal facies (Fig. 7). Comparing these East Greenland build-ups to those described from the Zechstein basin (e.g. Hollingworth & Pettigrew 1988; Ernst 2001a), it is noteworthy that the taxonomic composition of the main frame-building communities appears to be quite different. This difference could be related to the fact that various types of patch reefs dominate in East Greenland, whereas the Zechstein Basin is characterized by the development of barrier reefs with broad reefal platforms (e.g. Smith 1981; Hollingworth & Tucker 1987)

In a previous paper (Sørensen *et al.* 2007) we have discussed the biogeographical significance of the East Greenland faunas, particularly in relation to migration into the hypersaline Zechstein Basin. It is evident from these investigations that the Zechstein Basin was completely isolated from the Tethyan Ocean and was invaded exclusively through southwards migration of the northern Pangaean bryozoan fauna along the evolving North Atlantic rifted seaway (see also Ernst 2001b). Migration from the Boreal faunas into the warmer settings of East Greenland seems to have taken place without major changes in faunal composition judging from the very high degree of similarity between these faunas, with 12 of the 15 genera recognized in this investigation being recorded from the North Greenland – Svalbard region. However, major changes did take place as migration progressed further southwards into the even warmer, in part evaporitic settings of the Zechstein Basin. Only members of the orders Trepostomata and Fenestrata managed successfully to became established under the somewhat adverse conditions characterising this semi-isolated basin, and within the order Cystoporata diversity dropped dramatically, with only encrusting *Fistulipora* being recorded (Ernst 2007). No member

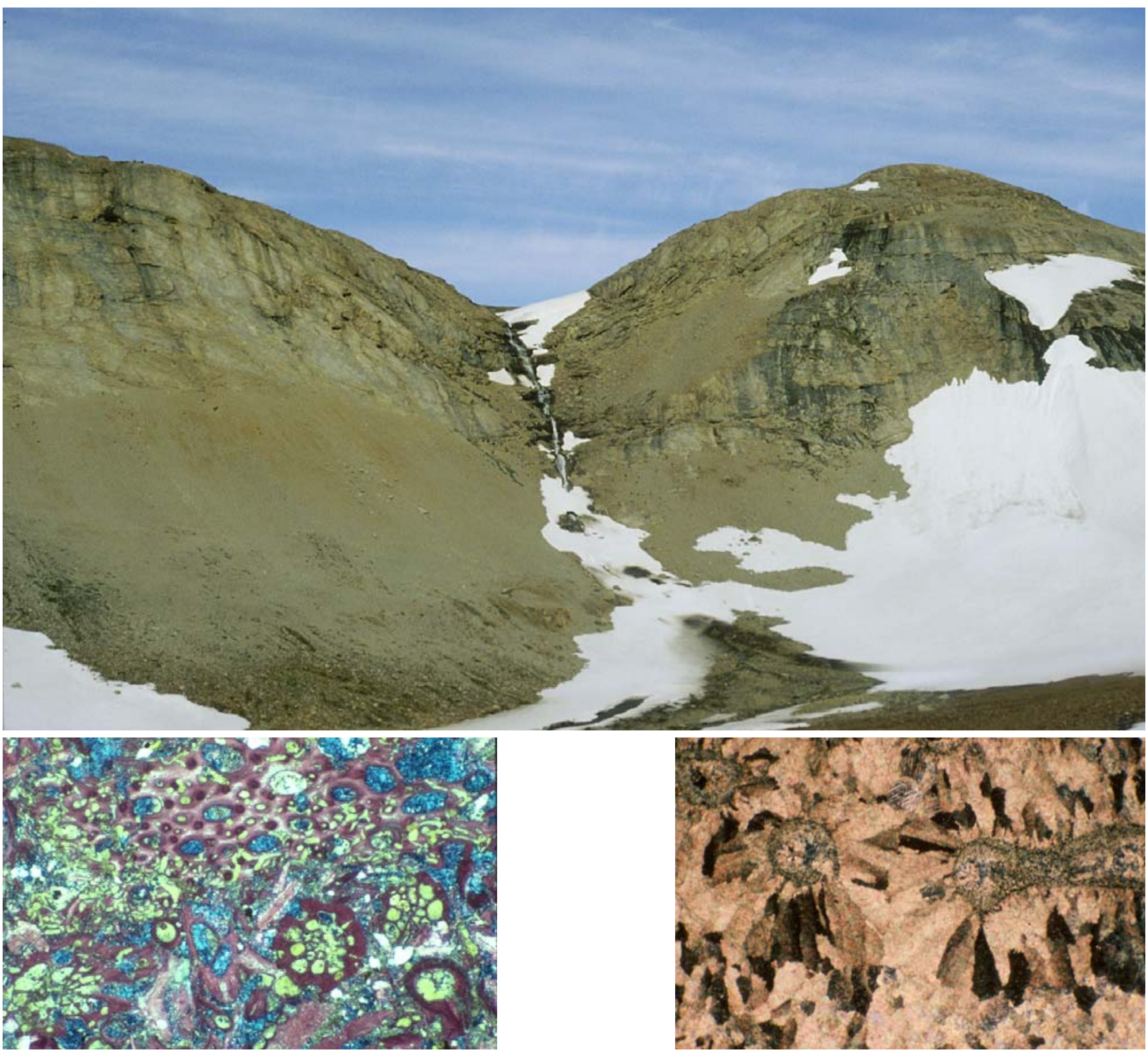


Fig. 5 Massive Wegener Halvø Formation buildups passing laterally into well-bedded flank deposits. Devondal, Wegener Halvø. Microphotographs (right) of indeterminable, undisturbed fenestrate colony completely covered with thick syntaxial cement from buildup core, and (left) bryozoan-dominated packstone from flank.

of the order Cryptostomata has so far been recorded from the Zechstein Basin.

From the distribution of bryozoan taxa along the North Atlantic rifted seaway it is therefore evident that the main environmental threshold for bryozoan distribution in the North Atlantic was located somewhere to the south of the East Greenland Basin (Fig 1; Sørensen *et al.* 2007). However, for the formation of reefs the threshold was located further to the north, between East Greenland and the Wandel Sea Basin in North Greenland. Both in East Greenland and in the Zechstein Basin bryozoans were able to support cement-dominated reefal structures, a feature which is so far not known from the contemporaneous cool-water successions of North Greenland and Svalbard. In view of the marked difference in the frame-building communities recorded in East Greenland and the Zechstein Basin it must therefore be concluded that it was the sea water ability to precipitate cement rather than the composition of the bryozoan fauna that determined the N-S distribution of reefs in the Permian North Atlantic seaway. In the unique paleogeographic constellation characterizing the seaway during the Late Permian, temperature and salinity (sea water chemistry) are the two most obvious parameters to change along the N-S gradient, with both rising towards the south. It may therefore be suggested that their combined effect facilitated the formation of syn-depositional cement well before reaching levels which seriously influenced the faunal composition.

STRATIGRAPHY	Wegener Halvø Fm							Ravnefjeld Fm		Schuchert Dal Fm.
Taxa / Samples	443496	360653a	360653b	360653c	360662	360667	303129	443483	443484	484308
Tabulipora	X	X								X
Rhombotrypella	X									
Paralioclema					•					
Dyscritella	•	X	X	X	X	X	X	X	X	
Timanodictya				•				•		
Permoheloclema			•	•	•		•	•		
Ramipora	•	•	X	X				•		•
Ramiporidra				•						
Polypora	X			•	•	•	X	X	X	
Acanthocladia							•			
Kingopora								•		
Rectifenestella								•		
Spinofenestella							•	•		
fenestellids indet.	•	•		•	X	X	X	X	X	•
Fistulipora								•		
encr. trepostomes							•			

COLONY GROWTH FORM: RIGIDLY ERECT (Arborescent: robust – delicate; Reticulate: robust – delicate); ENCRUSTING

Energy: high ← → low

X Abundant; • Present

Fig. 6 Distribution chart of the bryozoan taxa showing their abundance, growth forms, and connections with samples and the environments.

Acknowledgements

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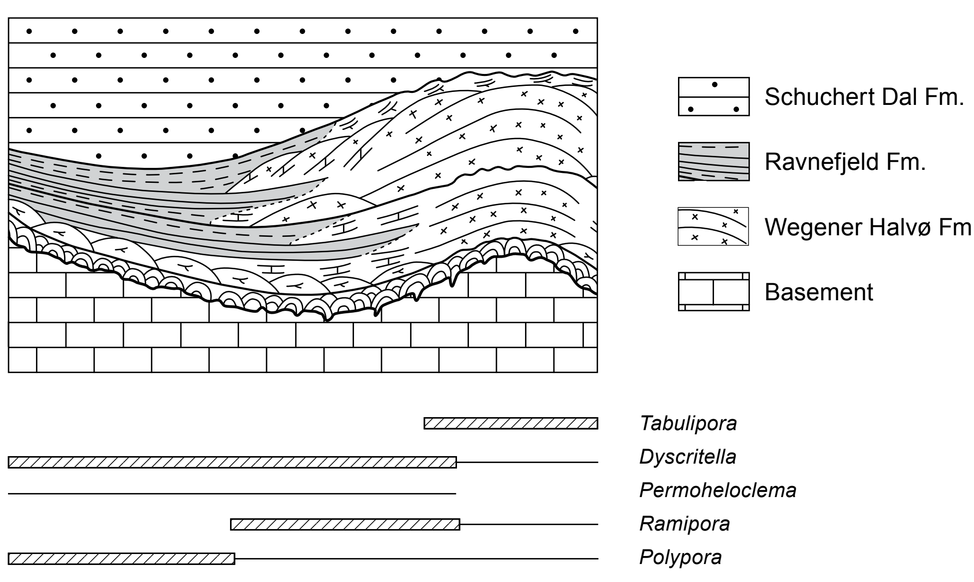
Fig. 7
Distribution of the most abundant bryozoan taxa on a typical Upper Permian reef in East Greenland (in part based on Stemmerik (2007).



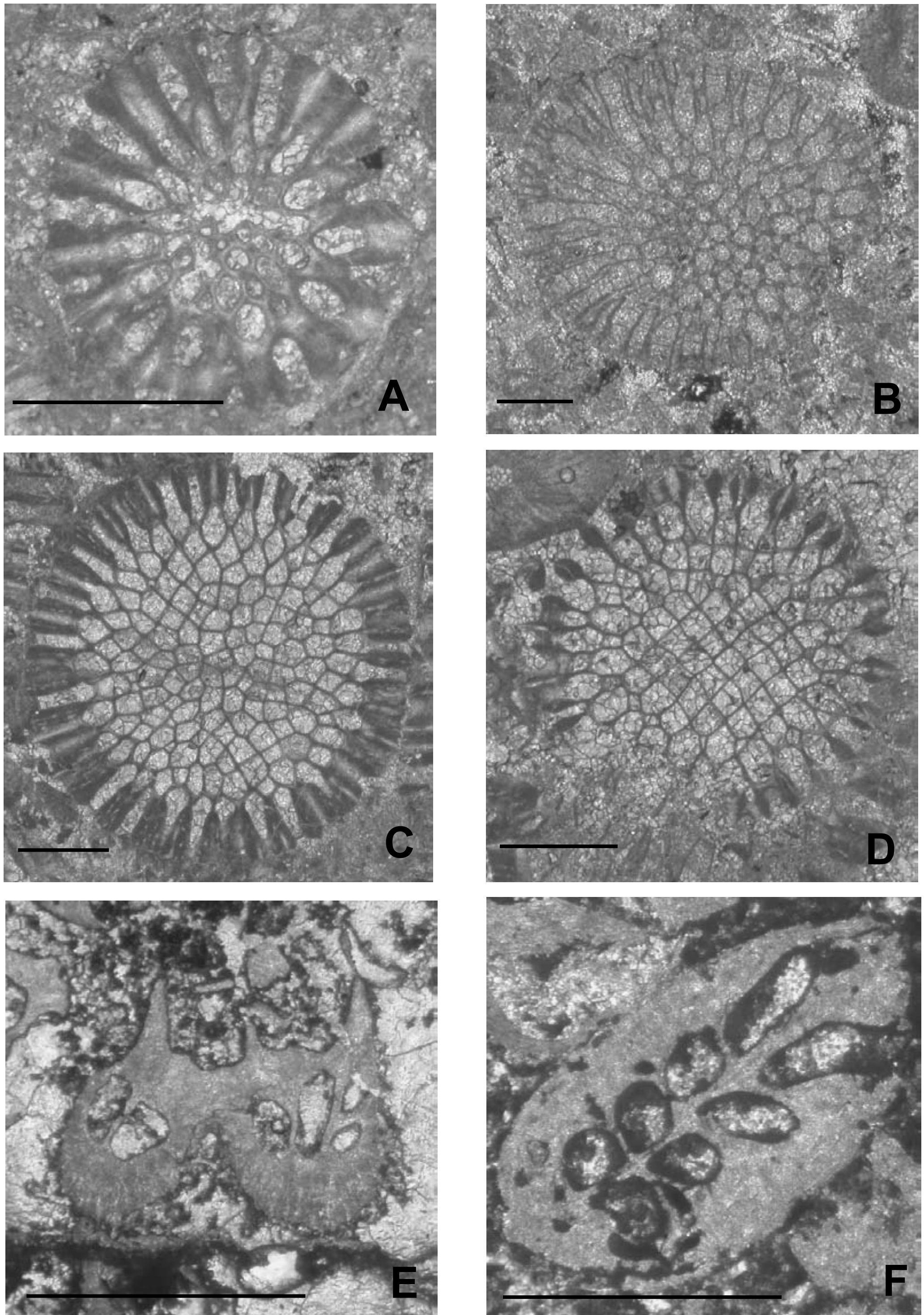


Plate 1 Wuchiapingian bryozoan fauna, East Greenland. Figured specimens are from samples kept at the Geological Survey of Denmark and Greenland. The GGU numbers refer to the sampling system at the survey. All scale bars equal 1 mm.

A *Dyscritella,* transverse section, Wegener Halvø Fm., from GGU 360653

B *Paralioclema,* transverse section, Wegener Halvø Fm., from GGU 360653

C *Tabulipora,* transverse section, Wegener Halvø Fm., from GGU 443496

D *Rhombotrypella,* transverse section, Wegener Halvø Fm., from GGU 443496

E *Spinofenestella,* transverse section, Wegener Halvø Fm., from GGU 443483

F *Ramipora,* transverse section, Wegener Halvø Fm., from GGU 360653

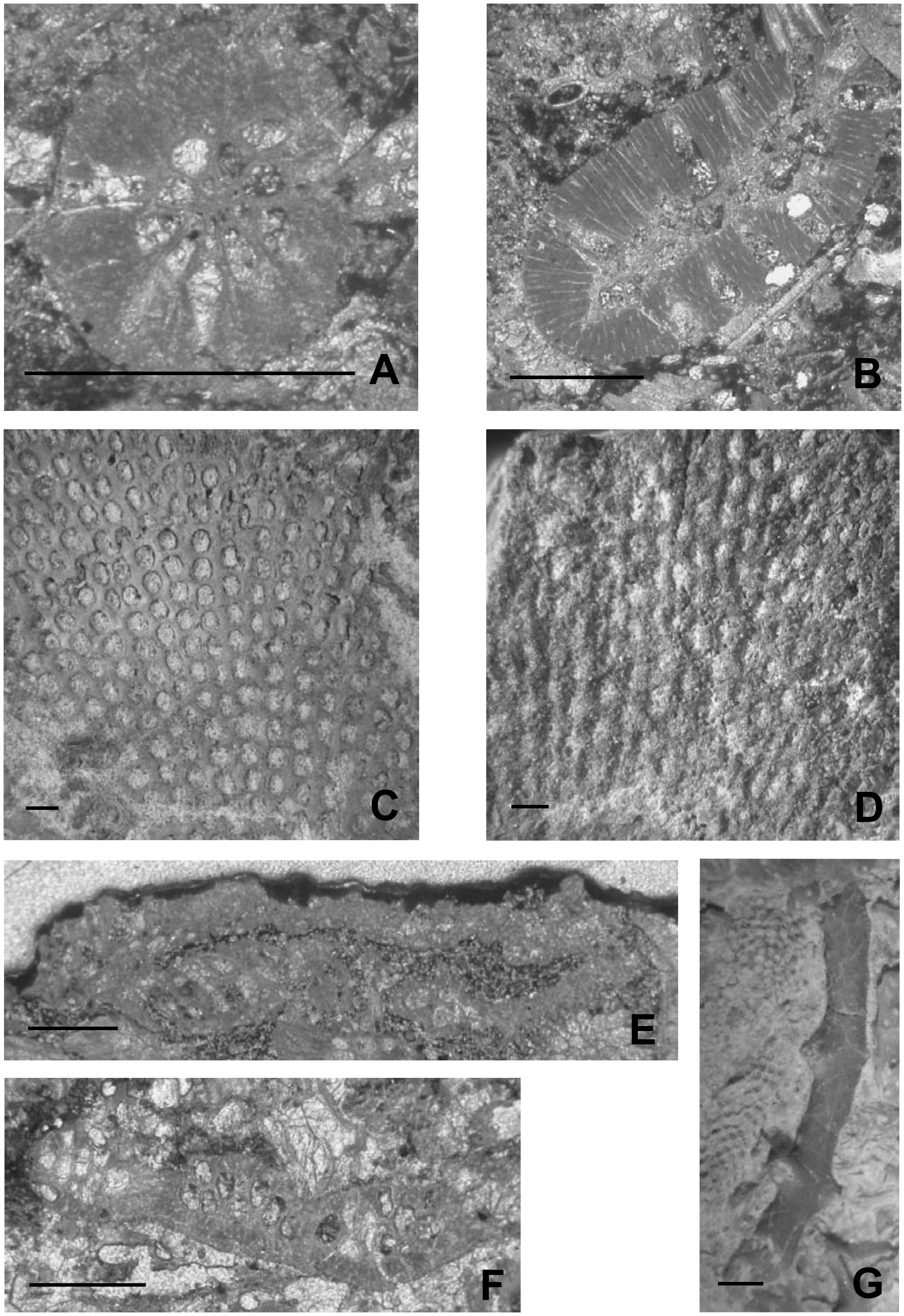


Plate 2 Wuchiapingian bryozoan fauna, East Greenland. Figured specimens are from samples kept at the Geological Survey of Denmark and Greenland. The GGU numbers refer to the sampling system at the survey. All scale bars equal 1 mm.

A *Permoheloclema,* transverse section, Wegener Halvø Fm., from GGU 360653

B *Timanodictya,* transverse section, Wegener Halvø Fm., from GGU 360653

C *Rectifenestella,* rock specimen showing the meshwork, Wegener Halvø Fm., from GGU 443483

D *Kingopora,* rock specimen showing the meshwork, Wegener Halvø Fm., from GGU 443483

E *Fistulipora,* tangential section, Wegener Halvø Fm., from GGU 360653

F *Polypora,* transverse section, Wegener Halvø Fm., from GGU 443483

G *Ramiporidra,* rock specimen, Wegener Halvø Fm., from GGU 360653

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