GEOLOGY OF GREENLAND SURVEY BULLETIN 187 • 2000

Palynology and deposition in the Wandel Sea Basin, eastern North Greenland

Edited by
Lars Stemmerik

GEOLOGICAL SURVEY OF DENMARK AND GREENLAND
MINISTRY OF ENVIRONMENT AND ENERGY

Geology of Greenland Survey Bulletin 187

Keywords
Calcareous algae, Carboniferous–Paleocene, depositional environments, dinoflagellate cysts, *Groenlandella*, North Greenland, palynomorphs, palynostratigraphy, Sortebakker Formation, structural geology, *Uraloporella*, Wandel Sea Basin.

Cover
Upper Carboniferous (Moscovian) shelf carbonates and siliciclastics of the Kap Jungersen and Foldedal Formations at Depotfjeld, southern Holm Land. The yellowish cliff-forming beds are composed of shelf limestones with abundant calcareous algae (see Mamet & Stemmerik p. 79). The reddish weathering recessive units consist of fine-grained sandstone and siltstone. The thick red unit forming the top of the main ridge is a coarse-grained conglomerate at the base of the Foldedal Formation. The cliff reaches approximately 450 m above sea level. Photo: Lars Stemmerik.

Chief editor of this series: Peter R. Dawes
Scientific editor: Lars Stemmerik (in conjunction with Peter R. Dawes and W. Stuart Watt)
Publishing editor: Peter R. Dawes
Editorial secretary: Esben W. Glendal
Referees: Benoit Beauchamp (Canada), Geir Elvebakk (Norway), Eckart Håkansson (Denmark), Claus Heilmann-Clausen (Denmark), Kenneth T. Higgs (Ireland), Jon R. Ineson (Denmark), David J. McIntyre (Canada), Stefan Piasecki (Denmark), Lars Seidler (Denmark), John Utting (Canada), Reed Wicander (USA).
Graphic production and reproduction: Knud Gr@phic Consult, Odense, Denmark
Manuscripts submitted: 5 October 1997 – 8 October 1998
Final versions approved: 9 June 2000
Printed: 20 October 2000

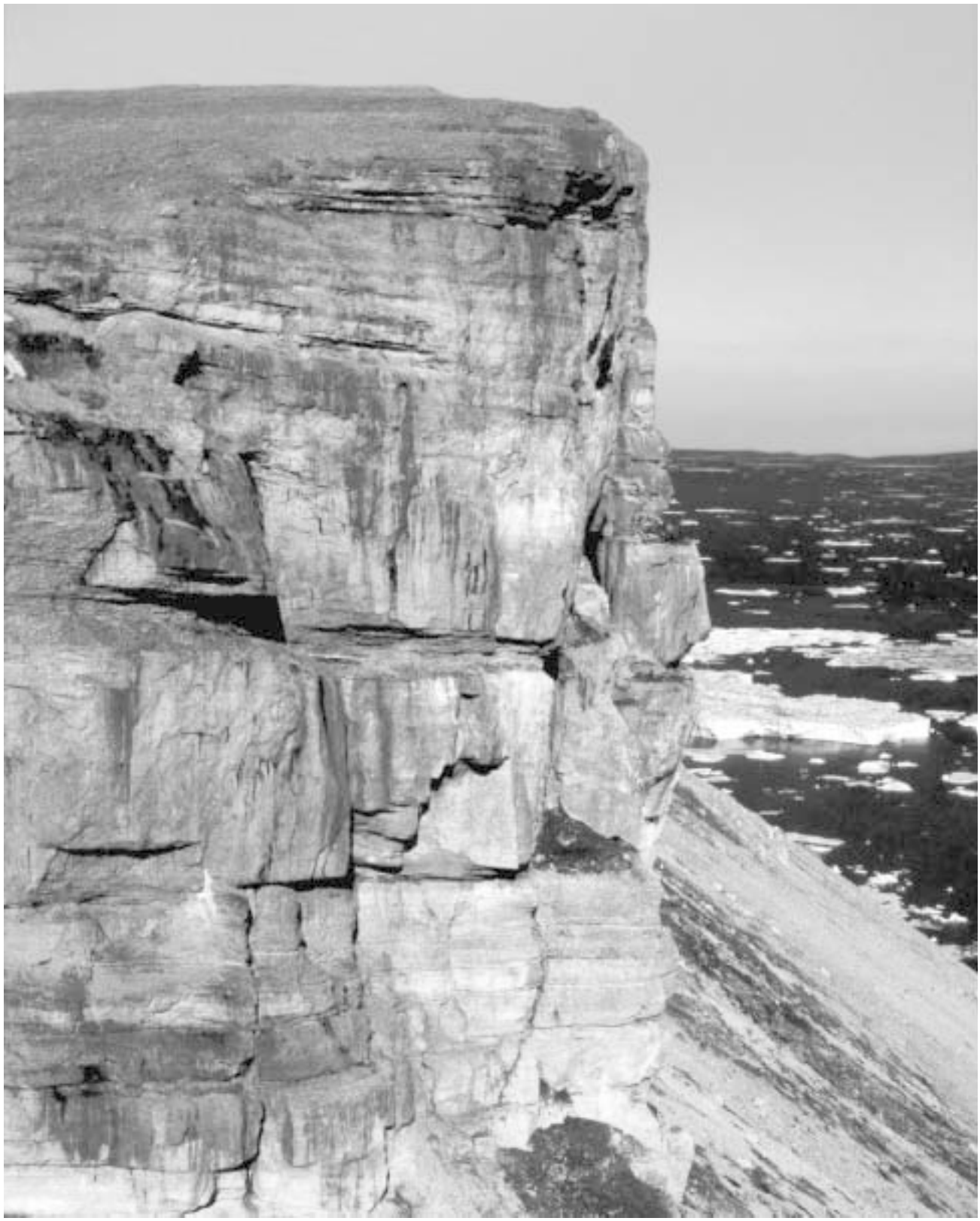
ISBN 87-7871-080-4
ISSN 1397-1905

Geology of Greenland Survey Bulletin
The series *Geology of Greenland Survey Bulletin* is a continuation of *Bulletin Grønlands Geologiske Undersøgelse* and incorporates *Rapport Grønlands Geologiske Undersøgelse.*

Citation of the name of this series
It is recommended that the name of this series is cited in full, viz. *Geology of Greenland Survey Bulletin*
If abbreviation of this volume is necessary the following form is suggested: *Geology Greenland Surv. Bull.* 187, 101 pp.

Available from
Geological Survey of Denmark and Greenland
Thoravej 8, DK-2400 Copenhagen NV, Denmark
Phone: +45 38 14 20 00, fax: +45 38 14 20 50, e-mail: geus@geus.dk
or
Geografforlaget ApS
Fruerhøjvej 43, DK-5464 Brenderup, Denmark
Phone: +45 63 44 16 83, fax: +45 63 44 16 97, e-mail: go@geografforlaget.dk

Contents



Frontispiece. Cliff-forming carbonates of the Upper Carboniferous Foldedal Formation, southern Holm Land. The carbonates are biogenic wackestones and packstones; the massive beds in the middle are parts of two tabular reef complexes. The carbonates contain abundant calcareous algae as described in the paper by Mamet & Stemmerik on pages 79–101. The cliff is approximately 100 m high.

Preface

This collection of papers adds to the understanding of the stratigraphic, depositional and structural history of the Wandel Sea Basin in eastern North Greenland (Fig. 1). Most importantly, the ages of the initial (Carboniferous) and final (Palaeogene) depositional events are now much better constrained than previously, allowing correlation with the successions in East Greenland, Svalbard and the Barents Sea.

The Wandel Sea Basin was an area of accumulation through the Early Carboniferous to the Palaeogene period, located at the margins of the stable Greenland craton where the Caledonian and Ellesmerian orogenic belts intersect (Fig. 1). Two main epochs of basin evolution have been recognised during previous studies of the basin fill: a Late Palaeozoic – Early Triassic epoch characterised by a fairly simple system of grabens and half-grabens, and a Mesozoic epoch dominated by strike-slip movements (Håkansson & Stemmerik 1989). The Mesozoic epoch only influenced that part of the basin north of the Trolle Land fault zone and its eastward extension (Fig. 1). Thus the northern and southern parts of the basin have very different structural and depositional histories, and accordingly different thermal histories and hydrocarbon potential as exemplified by the tectono-stratigraphic study of northern Amdrup Land by Stemmerik *et al.* (2000, this volume).

This study shows that the Sommerterrasserne fault is the south-eastern extension of the Trolle Land fault zone, dividing Amdrup Land into two areas with different stratigraphic and structural histories. Sediments of the Upper Permian Midnatfjeld Formation are restricted to north-east of the Sommerterrasserne fault where they are conformably overlain by Upper Jurassic sediments. In this area the Carboniferous – Upper Jurassic succession is folded in broad domal folds with NE–SW-oriented axes, whereas the Upper Palaeozoic sediments are gently dipping south-west of the fault. Folding most likely took place during the latest Cretaceous correlating with compressional events that also affected the sedimentary basins at Kilen and Prinsesse Ingeborg Halvø further to the north in the Trolle Land fault zone.

The upper age limit of the compressional event is given by the flat-lying, undeformed Thyra Ø Formation. These sediments are the youngest preserved deposits of the Wandel Sea Basin and precise dating is important for a minimum age of the youngest phases of compressional tectonism in the northern part of the basin. The formation was previously dated as Paleocene on the basis of the macroflora and rare dinoflagellates (Håkansson & Pedersen 1982; Håkansson *et al.* 1991). However, a new study (Lyck & Stemmerik 2000,

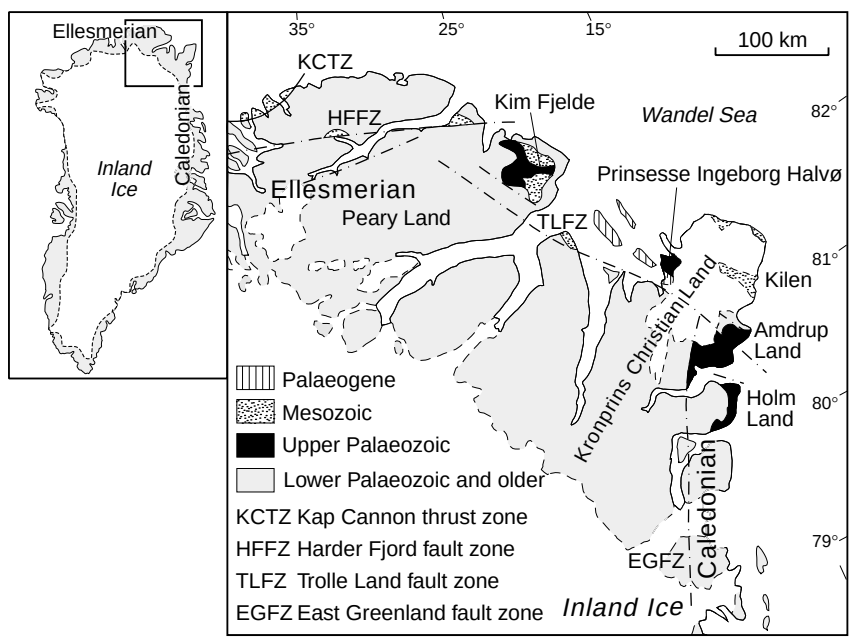


Fig. 1. Simplified map of the Wandel Sea Basin in North Greenland showing the distribution of the Upper Palaeozoic – Palaeogene sediments. The area north of the Trolle Land fault zone is deformed as the result of Mesozoic compressional events. The northernmost outcrops of the Wandel Sea Basin along the KCTZ and HFFZ are not dealt with in this bulletin. Modified after Håkansson & Stemmerik (1989).

this volume) shows a more diversified microflora of spores, pollen and dinoflagellates in the sediments. The previously suggested Paleocene age is supported by the presence of *Cerodinium speciosum* and *Spinidinium pilatum*. The occurrence of *Cerodinium markovae*, with a Paleocene–Eocene range, and *Spinidinium sagittula*, which has been reported from sediments of Early Eocene age, suggest that the Thyra Ø Formation may range into the Early Eocene. A latest Paleocene – Early Eocene age is suggested opening the possibility of an Early Paleocene age for the youngest compressional phase in the Wandel Sea Basin.

New stratigraphic and sedimentological data on the earliest phases in the evolution of the Wandel Sea Basin are presented in two papers dealing with the Sortebakker Formation (Dalhoff & Stemmerik 2000, this volume; Dalhoff *et al.* 2000, this volume). This Lower Carboniferous formation is the oldest post-Caledonian unit in the basin. It consists of more than 1000 m of fluvial deposits that so far have been regarded as Early Carboniferous in age based on a poorly preserved macro-flora. The paper by Dalhoff *et al.* (2000, this volume) provides a more precise age of the formation based on the presence of a poorly preserved but stratigraphically confined microflora in its upper part. The presence of *Tripartites distinctus, Potoniespores delicatus* and *Savitrisporites* spp. dates the succession to the late Viséan TC and NM Miospore Biozones of western Europe, and confirms correlation to time-equivalent non-marine deposits on Bjørnøya, Svalbard, East Greenland and the southern Barents Sea. Dalhoff & Stemmerik (2000, this volume) give the first detailed description of the sediments. Six facies associations are identified and together describe a fluviatile–lacustrine depositional system. Five of the associations characterise different parts of a meandering river-dominated flood plain, and the formation mostly consists of stacked, fining-upward fluvial cycles.

The final paper describes the calcareous algal flora in the marine Upper Carboniferous, Moscovian–Gzelian, carbonates of the Kap Jungersen and Foldedal Formations (*sensu* Stemmerik *et al.* 1996) in Holm Land and Amdrup Land (Mamet & Stemmerik 2000, this volume; see *Frontispiece*). Calcareous algae are found to be an important grain producer in the Moscovian shelf carbonates. The flora of 25 species, dominated by rhodophytes and chlorophytes, shows profound affinity to that of the Sverdrup Basin, Arctic Canada, belonging to the *Uraloporella* flora of the present-day northern hemisphere (Arctic Canada, Svalbard and Arctic Russia). The one new genus and species erected, *Groenlandella enigmatica* n.gen. et n.sp., is apparently endemic to the Wandel Sea Basin.

References

Dalhoff, F. & Stemmerik, L. 2000: Depositional history of the fluvial Lower Carboniferous Sortebakker Formation, Wandel Sea Basin, eastern North Greenland. In: Stemmerik, L. (ed.): Palynology and deposition in the Wandel Sea Basin, eastern North Greenland. Geology of Greenland Survey Bulletin **187**, 65–77 (this volume).

Dalhoff, F., Vigran, J.O. & Stemmerik, L. 2000: Stratigraphy and palynology of the Lower Carboniferous Sortebakker Formation, Wandel Sea Basin, eastern North Greenland. In: Stemmerik, L. (ed.): Palynology and deposition in the Wandel Sea Basin, eastern North Greenland. Geology of Greenland Survey Bulletin **187**, 51–63 (this volume).

Håkansson, E. & Pedersen, S.A.S. 1982: Late Paleozoic to Tertiary tectonic evolution of the continental margin in North Greenland. In: Embry, A.F. & Balkwill, H.R. (eds): Arctic geology and geophysics. Canadian Society of Petroleum Geologists Memoir **8**, 331–348.

Håkansson, E. & Stemmerik, L. 1989: Wandel Sea basin – A new synthesis of the late Paleozoic to Tertiary accumulation in North Greenland. Geology **17**, 683–686.

Håkansson, E., Heinberg, C. & Stemmerik, L. 1991: Mesozoic and Cenozoic history of the Wandel Sea Basin area, North Greenland. In: Peel, J.S. & Sønderholm, M. (eds): Sedimentary basins of North Greenland. Bulletin Grønlands Geologiske Undersøgelse **160**, 153–164.

Lyck, J.M. & Stemmerik, L. 2000: Palynology and depositional history of the Paleocene? Thyra Ø Formation, Wandel Sea Basin, eastern North Greenland. In: Stemmerik, L. (ed.): Palynology and deposition in the Wandel Sea Basin, eastern North Greenland. Geology of Greenland Survey Bulletin **187**, 21–49 (this volume).

Mamet, B.L. & Stemmerik, L. 2000: Carboniferous algal microflora, Kap Jungersen and Foldedal Formations, Holm Land and Amdrup Land, eastern North Greenland. In: Stemmerik, L. (ed.): Palynology and deposition in the Wandel Sea Basin, eastern North Greenland. Geology of Greenland Survey Bulletin **187**, 79–101 (this volume).

Stemmerik, L., Håkansson, E., Madsen, L., Nilsson, I., Piasecki, S., Pinard, S. & Rasmussen, J.A. 1996: Stratigraphy and depositional evolution of the Upper Palaeozoic sedimentary succession in eastern Peary Land, North Greenland. Bulletin Grønlands Geologiske Undersøgelse **171**, 45–71.

Stemmerik, L., Larsen, B.D. & Dalhoff, F. 2000: Tectonostratigraphic history of northern Amdrup Land, eastern North Greenland: implications for the northernmost East Greenland shelf. In: Stemmerik, L. (ed.): Palynology and deposition in the Wandel Sea Basin, eastern North Greenland. Geology of Greenland Survey Bulletin **187**, 7–19 (this volume).

Lars Stemmerik