Publications of the Institute of Geophysics, Polish Academy of Sciences
Geophysical Data Bases, Processing and Instrumentation
vol. 452 (P-4), 2025, pp. 81–83
DOI: 10.25171/InstGeoph_PAS_Publs-2025-013
SVALGEOBASE II: Tectono-thermal evolution of Svalbard, geological workshop, Svalbard 2024

Architecture of the Caledonian Fold Belt South of Murchisonfjorden, Western Nordaustlandet

Karsten PIEPJOHN[1,✉], Nikola KOGLIN[2], and Frithjof BENSE[2]

[1]Hannover, Germany

[2]Federal Institute for Geosciences and Natural Resources (BGR), Hannover, Germany

✉ karsten.piepjohn@gmx.de

At the south coast of Murchisonfjorden in western Nordaustlandet, a complete sequence of the Neoproterozoic to Lower Paleozoic Murchisonfjorden and Hinlopenstretet supergroups is exposed (Fig. 1; Fairchild and Hambrey 1984; Knoll and Swett 1990, Harland et al. 1993, Halverson et al. 2004, Dallmann 2015). The lower part of the succession is composed of km-thick dark grey siltstones and white and red quartzites of the Tonian Frankliniansundet and Celsiusberget groups. The clastic formations are overlain by limestones of the Tonian Roaldtoppen Group and again clastic deposits and diamictites of the Cryogenian/Ediacaran Polarisbreen Group. The youngest part of the sedimentary succession consists of dolostones and limestones of the Cambrian–Ordovician Oslobreen Group. In Nordaustlandet, the Oslobreen Group is represented by the Kapp Sparre Formation at Sparreneset and Krossøya (Fig. 1). The entire succession is characterized by very low-grade metamorphic conditions. Sedimentary structures like cross-bedding and ripple marks as well as Neoproterozoic fossils are still well preserved (Anderson et al. 2022).

The deformation of the Neoproterozoic and Lower Paleozoic sedimentary succession is dominated by intense folding between Hinlopenstretet in the WSW and Skarberget in the ENE (Fig. 1). In the western part (Fig. 2), the structural architecture is characterized by a km-scale anticline-syncline pair with subvertical axial planes, deformed the clastic deposits and limestones of the Oslobreen, Polarisbreen, and Roaldtoppen groups (Fig. 2). Similar upright synclines and anticlines in eastern Ny-Friesland west of Hinlopenstretet were observed (Piepjohn et al. 2019). Towards the east, the structural architecture is characterize by two major WSW-vergent fold-structures at Roaldtoppen and Fargefjellet mainly in clastic deposits and thick quartzites of the Celsiusberget and Franklinsundet groups with subvertical fore limbs and a wide, almost horizontal back limb between Skarberget and Søre Franklinbreen in the east (Fig. 2). These observations suggest that the shift in fold geometry from west to east may be

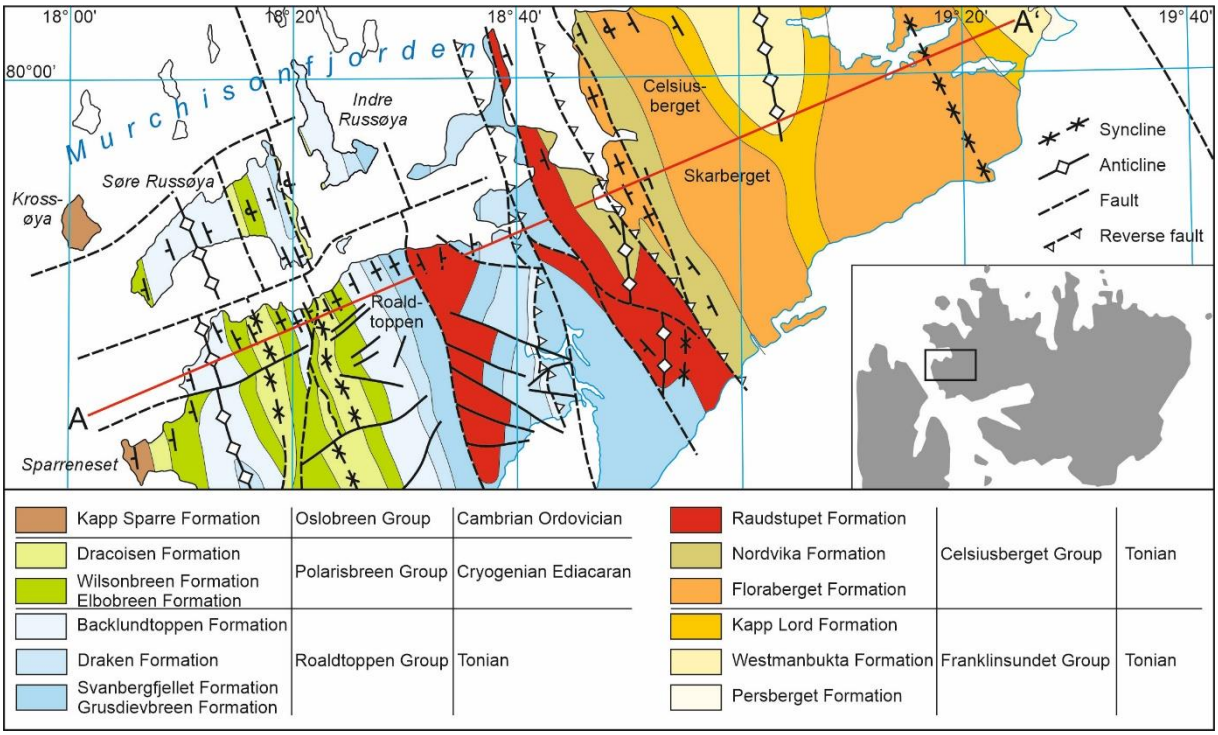

Fig. 1. Geological Map of northern Gothiahalvøya in western Nordaustlandet south of Murchisonfjorden, modified from Kulling (1934), Flood et al. (1969), Hoffman et al. (2012), and own field work.

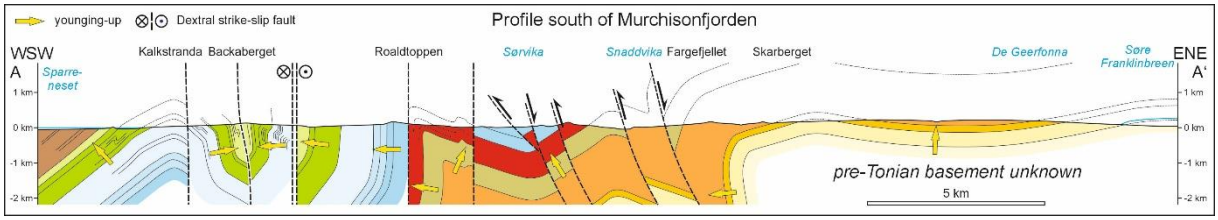

Fig. 2. Geological cross section through the folded Neoproterozoic to Lower Paleozoic Murchisonfjorden and Hinlopenstretet supergroups of western Nordaustlandet between Sparreneset in the WSW and Søre Franklinbreen in the ENE. For location of cross section and legend see Fig. 1.

related to differences in lithological competence, particularly related to the presence of thick quartzites in the eastern part of the succession. The ENE-dipping short limb between the two short limbs is truncated by several steeply ENE-dipping, brittle reverse fault, which have been partly reactivated by extensional movements (Fig. 2).

The NNW-SSE orientation of large-scale F1-fold-structures indicates a general WSW-ENE shortening. The sandstones and siltstones of the Franklinsundet Group, Nordvika Formation and Raudstuped Formation are affected by an intense fracture-cleavage S1, which mostly dips towards ENE. S1 cleavage planes are less developed in the quartzites of the Floraberget Formation and mostly absent in the limestones of the Roaldtoppen Group.

The deformation in the western part of Nordaustlandet is relatively simple and characterized only by phase D1 with ENE-WSW shortening, represented by km-scale F1-folds, an ENE-dipping fracture-cleavage S1 and the formation of steeply ENE-dipping, west-directed zones of reverse and thrust faults related to the Caledonian compression. The WSW-directed tectonic transport is supported by the cross-cutting relation of bedding/cleavage, the orientation of the reverse faults and the orientation of parasitic folds in the fold limbs.

After the Caledonian shortening, the western part of Nordaustlandet was affected by NNW-SSE striking faults (D2), which cut through the F1-fold structures and short limbs and are characterized by brittle strike-slip tectonics, similar to the structural evolution of eastern Ny-Friesland west of Hinlopenstretet (Piepjohn et al. 2019).

References

Anderson, R.P., G.O. Wedlake, T.M. Gibson, A.E.G. Millikin, K. Piepjohn, N.J. Tosca, A.D. Rooney, and J. Strauss (2022), New multicellular microfossil eukaryotes from the ca. 950–820-million-year-old Veteranen Group of Svalbard, *Geol. Soc. Am. Abstr*. **54**, 381462.

Dallmann, W.K. (2015), *Geoscience Atlas of Svalbard*, Norsk Polarinstitutt Rapport, 148, 292 pp.

Fairchild, I.J., and M.J. Hambrey (1984), The Vendian succession of northeastern Spitsbergen: Petrogenesis of a dolomite-tillite association, *Precambrian Res*. **26**, 2, 111–167, DOI: 10.1016/0301-9268(84)90042-1.

Flood, B., D.G. Gee, A. Hjelle, T. Siggerud, and T.S. Winsnes (1969), *The Geology of Nordaustlandet, Northern and Central Parts*, Skrifter No. 146, Norsk Polarinstitutt, Oslo, 139 pp. and map 1:250 000 scale.

Halverson, G.P., A.C. Maloof, and P.F. Hoffman (2004), The Marinoan glaciation (Neoproterozoic) in northeast Svalbard, *Basin Res*. **16**, 3, 297–324, DOI: 10.1111/j.1365-2117.2004.00234.

Harland, W.B., M.J. Hambrey, and P. Waddams (1993), *Vendian Geology of Svalbard*, Skrifter No. 193, Norsk Polarinstitutt, Oslo, 130 pp.

Hoffman, P.F., G.P. Halverson, E.W. Domack, A.C. Malooff,, N.L. Swanson-Hysell, and G.M. Cox (2012), Cryogenian glaciations on the southern tropical paleomargin of Laurentia (NE Svalbard and East Greenland), and a primary origin for the upper Russøya (Islay) carbon isotope excursion, *Precambrian Res*. **206-207**, 137–158, DOI: 10.1016/j.precamres.2012.02.018.

Knoll, A.H., and K. Swett (1990), Carbonate deposition during the late Proterozoic Era: an example from Spitsbergen, *Am. J. Sci*. **290-A**, 104–132.

Kulling, O. (1934), Scientific results of the Swedish-Norwegian arctic expedition in the summer of 1931. Part XI, *Geogr. Ann. Stockh*. **16**, 161–254, DOI: 10.2307/520104.

Piepjohn, K., W.K. Dallmann, and S. Elvevold (2019), The Lomfjorden Fault Zone in eastern Spitsbergen (Svalbard). **In:** K. Piepjohn, J.V. Strauss, L. Reinhardt, and W.C. McClelland (eds.), *Circum-Arctic Structural Events: Tectonic Evolution of the Arctic Margins and Trans-Arctic Links with Adjacent Orogens*, Geological Society of America Bulletin, Vol. 541, 95–130, DOI: 10.1130/2019.2541(06).

Received 6 February 2025
Accepted 13 February 2025