Publications of the Institute of Geophysics, Polish Academy of Sciences
Geophysical Data Bases, Processing and Instrumentation
vol. 452 (P-4), 2025, pp. 77–79
DOI: 10.25171/InstGeoph_PAS_Publs-2025-012
SVALGEOBASE II: Tectono-thermal evolution of Svalbard, geological workshop, Svalbard 2024

Neoproterozoic Diamictites of Polarisbreen Group (Nordauslandet, Svalbard) – Paleomagnetic and Petrographic Investigations

Szczepan BAL[1,✉], Krzysztof MICHALSKI[1], Geoffrey MANBY[2], Krzysztof NEJBERT[3], Jarosław MAJKA[4,5], Justyna DOMAŃSKA-SIUDA[3], Aleksandra HOŁDA-MICHALSKA[6], and Jiři SLÁMA[7]

[1]Institute of Geophysics, Polish Academy of Sciences, Warsaw, Poland

[2]Department of Earth Sciences, Natural History Museum, London, Great Britain

[3]Faculty of Geology, University of Warsaw, Warsaw, Poland

[4] Department of Earth Sciences, Uppsala University, Uppsala, Sweden

[5] Faculty of Geology, Geophysics and Environmental Protection, AGH University of Krakow, Kraków, Poland

[6]Institute of Paleobiology, Polish Academy of Sciences, Warsaw, Poland

[7]Institute of Geology, Czech Academy of Sciences, Prague, Czech Republic

✉ sbal@igf.edu.pl

Our research unveils new palaeomagnetic and petrographic results from 50 independently oriented samples representing Cryogenian Polarisbreen Group diamictites. These findings, collected in 2022 from the Neoproterozoic sequence of Murchisonfjord, represent a significant advancement in our understanding of the palaeomagnetic record preserved in rocks formed during the Cryogenian glaciations (e.g. Halverson et al. 2004, 2018a,b, 2022; Hoffman et al. 2012; Millikin et al. 2022). The sampling includes two sites from the Petrovbreen Member of the Elbobreen Formation and six sites from the Wilsonbreen Formation.

Our principal component analyses (PCA) have revealed a substantial contribution from a post-folding, high-inclination palaeomagnetic component, which demagnetised up to 320 °C. The calculated palaeopole falls within the Late Cretaceous–Palaeogene–Neogene sector of the Baltica Apparent Polar Wander Path (APWP), suggesting a possible link between remagneti-

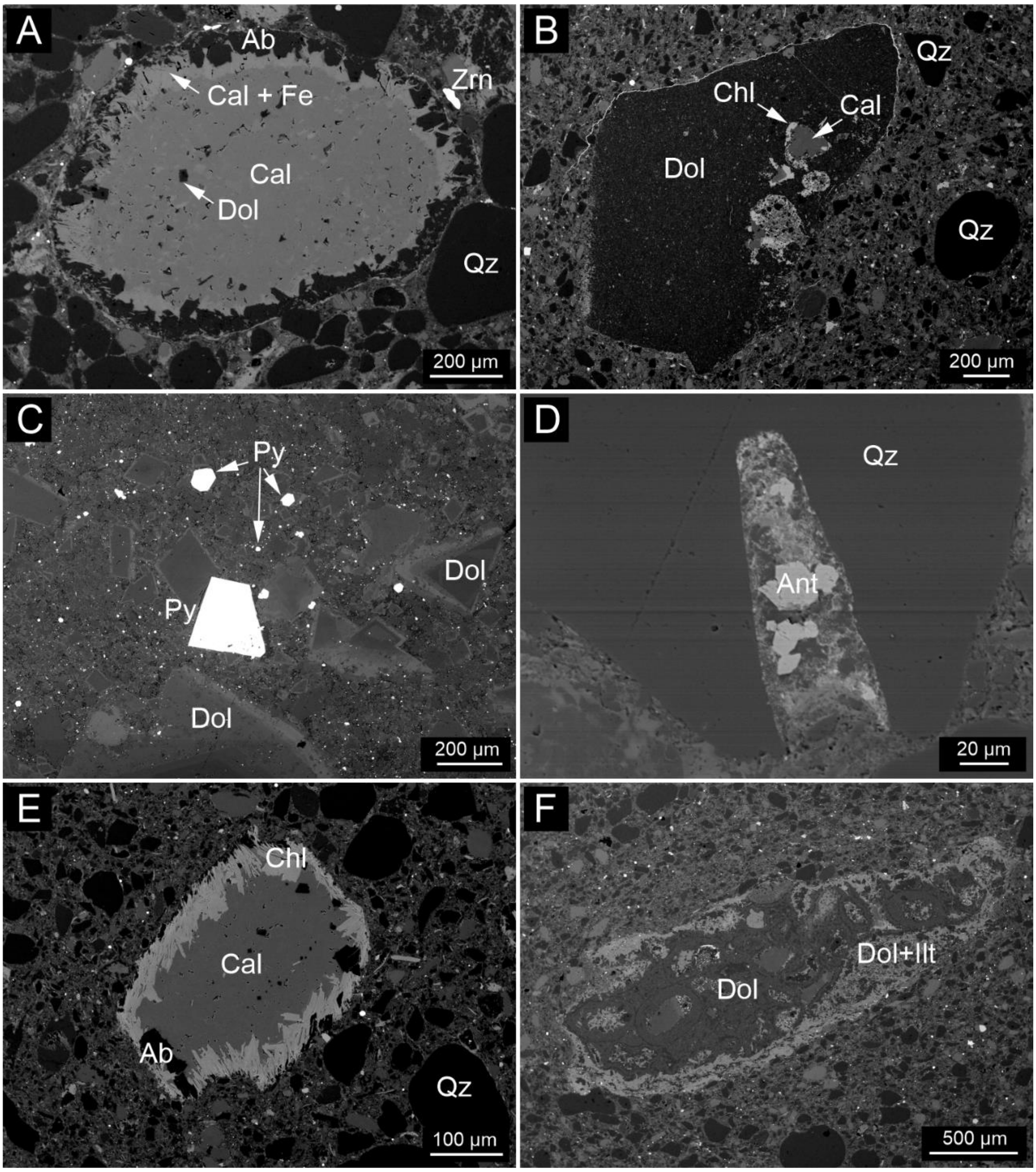

Fig. 1. Backscattered electron (BSE) images of Cryogenian diamictites of Murchisonfiord (Nordaustlandet): A – Calcite clast with a recrystallised rim of diagenetic albite (outer rim), Fe-rich calcite (inner rim), dolomite replacing calcite inside, and a visible zircon (Wilsonbreen Fm); B – Dolomicrite clast with chlorite and secondary calcite enclosures (Wilsonbreen Fm); C – Large euhedral pyrite between dolomite crystals in the matrix, with Fe-rich dolomite overgrowing dolomite (Petrovbreen Mb); D – Secondary Ti-oxides (anatase) in quartz (Wilsonbreen Fm); E – Micritic calcite clast with outer chlorite and albite overgrowths (Wilsonbreen Fm); F – Dolomitic clast with a rim composed of dolomite and clay minerals (illite) (Wilsonbreen Fm). Abbreviations: Ab – albite, Ant – anatase, Cal – calcite, Chl – chlorite, Dol – dolomite, Fe – iron, Ilt – clay minerals, Py – pyrite, Qz – quartz, Zrn – zircon.

sation and Late Cretaceous Svalbard magmatism (e.g. Senger et al. 2014). Great circle analyses indicate an additional contribution from a low-inclination component, potentially associated with Caledonian remagnetisation (cf. Michalski et al. 2023).

Our detailed petrographic and mineralogical investigations have unveiled unique diagenetic overprints in both diamictite units. The mineral association observed in the analysed rocks, suggests that they did not undergo low-grade metamorphism. The observed mineral overgrowths (Fig. 1A) and evidence of mineral alterations (Fig. 1B) indicate significant fluid flow through sediment pore spaces, potentially during the processes of compaction and lithification. Fe phases are predominantly represented by pyrite (Fig. 1C) and Fe-dolomite. Fe-Ti oxides are exclusively present as secondary diagenetic anatase (Fig. 1D), which formed simultaneously with the diagenetic mineral association, including chlorite group minerals (chamosite), albite, calcite (Fig. 1E), Fe-dolomite, clay minerals (illite) (Fig. 1F), and quartz. No ferromagnetic (sensu lato) minerals were identified during integrated optical and SEM-EDS investigations, but the presence of magnetite in the analysed rocks was confirmed by saturation isothermal remanent magnetisation (SIRM) experiments.

This study is part of the NEOMAGRATE project, a substantial research endeavor funded by the Polish National Science Centre (NSC) and spanning from 2022 to 2026. The project, titled “Rate of Tectonic Plate Movement in the Neoproterozoic – Verification of the Neoproterozoic True Polar Wander Hypothesis”, is a testament to our commitment and the resources invested in advancing our understanding of Earth’s history.

References

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.x.

Halverson, G.P., M. Kunzmann, J.V. Strauss, and A.C. Maloof (2018a), The Tonian-Cryogenian transition in Northeastern Svalbard, *Precambrian Res.* **319**, 79–95, DOI: 10.1016/j.precamres.2017.12.010.

Halverson, G.P., S.M. Porter, and T.M. Gibson (2018b), Dating the late Proterozoic stratigraphic record, *Emerg. Top. Life Sci.* **2**, 2, 137–147, DOI: 10.1042/ETLS20170167.

Halverson, G.P., C. Shen, J.H.F.L. Davies, and L. Wu (2022), A Bayesian approach to inferring depositional ages applied to a late Tonian reference section in Svalbard, *Front. Earth Sci.* **10**, 798739, DOI: 10.3389/feart.2022.798739.

Hoffman, P.F., G.P. Halverson, E.W. Domack, A.C. Maloof, 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.

Michalski, K., G.M. Manby, K. Nejbert, J. Domańska-Siuda, and M. Burzyński (2023), Palaeomagnetic investigations across Hinlopenstretet border zone: from Caledonian metamorphosed rocks of Ny Friesland to foreland facies of Nordaustlandet (NE Svalbard), *J. Geol. Soc.* **180**, 1, DOI: 10.1144/jgs2021-167.

Millikin, A.E.G., J.V. Strauss, G.P. Halverson, K.D. Bergmann, N.J. Tosca, and A.D. Rooney (2022). Calibrating the Russøya excursion in Svalbard, Norway, and implications for Neoproterozoic chronology, *Geology* **50**, 4, 506–510, DOI: 10.1130/G49593.1.

Senger, K., J. Tveranger, K. Ogata, A. Braathen, and S. Planke (2014), Late Mesozoic magmatism in Svalbard: A review, *Earth-Sci. Rev.* **139**, 123–144, DOI: 10.1016/j.earscirev.2014.09.002.

Received 10 February 2025
Accepted 18 February 2025