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Editorial: Processes controlling development of periglacial and paraglacial landscapes in rapidly changing polar regions: Part 2

Mateusz C. Strzelecki, Marek Kasprzak, Piotr Owczarek and Łukasz Stachnik

Alfred Jahn Cold Regions Research Centre, Institute of Geography and Regional Development, University of Wroclaw, pl. Uniwersytecki 1, 50-137 Wroclaw, Poland

<mateusz.strzelecki@uwr.edu.pl> <marek.kasprzak@uwr.edu.pl>
<piotr.owczarek@uwr.edu.pl> <lukasz.stachnik@uwr.edu.pl>

This special issue is a scientific tribute to the founders and researchers working at Stanislaw Baranowski Polar Station of the University of Wroclaw, which in 2021 celebrated its 50th anniversary (1971–2021). It was named after Stanisław Baranowski (1935–1978) – its founder and renown glaciologist, who tragically died after an accident in King George Island in 1978.

We are glad that submitted contributions represent very diverse scientific disciplines. In the first part of this special issue, we highlighted contributions from climatological, glaciological and hydrological studies. In this second part, we are presenting studies that focus on geomorphological, pedological and ecological topics. Most of these studies were logistically supported by our Station, which over the last few decades became an important platform for multidisciplinary research on climate change impacts, hopefully fulfilling the scientific mission envisaged by its founder Stanislaw Baranowski.

Stanislaw Baranowski Polar Station, located on Wedel Jarlsberg Land on the west coast of Spitsbergen, the largest island in the Svalbard Archipelago (Fig. 1), is an excellent focal point and logistical facility for the development of diverse environmental studies in the Brattegg Valley. Paper by Wołoszyn and Kasprzak (2023) summarized key information on geological, geomorphological and environmental factors controlling landscape transformation after the rapid retreat

of the Bratteggbreen glacier in the last 40 years. One of the novel results extracted from remote sensing analyses are the calculations of the rates of vegetation cover expansion and detailed mapping of Bratteggbreen recession.

Korabiewski (2023) presented interesting contribution to cold region pedological research. His study documented processes responsible for soil formation along uplifted marine terraces in Kvartsittsletta. Particular attention

Fig. 1. Stanislaw Baranowski Polar Station in Spitsbergen in 2021 after 50 years of service to the polar researchers from the University of Wroclaw and their Polish and international partners. Photos by Marek Kasprzak.

was paid on the periglacial processes such as solifluction and cryoturbation in soil development and spatial difference between old (high) terraces existing in periglacial conditions for several millennia and younger terraces exposed from the sea in the last 2000 years.

Debris cones with large debris flow tracks are one of the most characteristic features of slopes in the south-western Spitsbergen. Particularly well-developed forms are visible on the slopes in the close vicinity of the Stanislaw Baranowski Polar Station in the Gullichsenfjellet and Jens Erikfjellet massifs. Due to their abundance and morphological diversity, debris cones and debris flows that shape them are reliable sources of information about both the current state of the natural environment and its changes in the past. There is a significant increase in interest in these forms in the context of using modern ground-based and remote-sensing methods for the analysis of contemporary dynamics of polar environments (Owczarek *et al.* 2013; Tomczyk 2021; Senderak *et al.* 2021). Despite the numerous works on debris cones, further research is needed due to the dynamically changing Arctic environment as a result of rapid warming. There are still open questions as to how the dynamics of mass movements shaping the

debris cones will change with increasing permafrost degradation or the influence of interlocking biotic, climatic, and lithological factors.

The work by Latocha-Wites and Parzóch (2023) exemplifies the use of morphological features of debris cones as indicators of environmental change on the basis of 81 such forms located in the vast area between the Skoddefjellet and Jens Erikfjellet. They conclude that detailed analyses of the diversity of landform assemblages within debris cones, including main forms associated with debris flows, give information about the regional and local dynamics of geomorphic processes related to lithology, slope exposure and gradient. However, they highlight the need for multidisciplinary research on debris cones including modern dating methods. This can be compared with a study from the Brattegg Valley carried out by Senderak (2023). He presents a specific methodological approach to study the mechanisms of material transport on the talus slopes and underlined the need for detailed sediment granulometric measurements. The study of clast size allows the reconstruction of the dynamics of talus cone development and the identification of the main processes shaping each morphological zone from the distal to the proximal parts. This helps to improve our knowledge of the process-relief relationship and to reliably reconstruct former environments, based on the "debris cone archives".

Last but not least, Jędryczka *et al.* (2023) presented the results of an aerobiological study, which has so far been conducted to a limited extent in the Svalbard Archipelago. The authors conducted their measurements at Calypsobyen *ca.* 60 km to the north from Baranowski Station during the two summer seasons of 2014 and 2015, and their focus was pine pollen. Using GIS analysis, they determined the trajectory of pollen grain movement and proved that its grains found in pine-free Spitsbergen can originate from a number of terrestrial areas in Europe and North America, including Scandinavia, Iceland, Siberia and northern Canada. Pollen grains were transported by air masses over distances exceeding 2000 km.

In conclusion to most contributions presented in this volume, the rapid transformation of paraglacial and periglacial landscapes are among the strongest effects of climate warming in cold regions (Ballantyne 2002; Mercier 2008; Knight and Harrison 2014). The retreat of glaciers exposes new areas where different geomorphological processes operate and erase the effects of glaciation (Mercier *et al.* 2009; Strzelecki *et al.* 2018, 2020; Kavan and Strzelecki 2023). Important role is played by the permafrost, which interacts with subaerial processes in post-glacial landscape modification (Oliva and Ruiz-Fernandez 2015; Dobiński and Kasprzak 2022).

As for the years to come, Stanislaw Baranowski Polar Station established in summer 1971 in the forefield of the retreating Werenskioldbreen glacier became an important refence site to document a wide range of processes transforming glacial, periglacial and paraglacial landscapes in SW part of Spitsbergen, the major island of the Svalbard Archipelago. In 2022, the Station became a key

research facility of recently established Alfred Jahn Cold Regions Research Centre at the University of Wroclaw. We are more than confident that in coming years the Station will serve new generations of polar researchers educated and trained at our university and bring progress in studies of cold region landscapes together with our national and international partners.

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