



## **Applied glaciology and mineral resource exploitation in the Arctic: the Malmbjerg case study in East Greenland**

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Climate change, stable political conditions and increasing demand have made the Arctic attractive to extractive industries as a source of natural resources. For example, Greenland has potentially economically viable deposits of a wide range of mineral resources and oil and gas exploration is also currently ongoing. However, access to many of these resources is complicated by the presence of glaciers, the ice sheet and the associated processes, such as meltwater runoff and ice dynamic changes. Cryospheric scientists will be increasingly asked to give scientific advice on problems associated with extraction and to predict changes in glacier behaviour due to climate change or from unusual types of anthropogenic activity. Here, we use a case study from East Greenland to explore some of the glaciological problems associated with resource extraction in the Arctic.

The Malmbjerg project is a proposed open pit molybdenum mine located in the Stauning Alps (East Greenland) on a mountain at the confluence of Schuchert Glacier with a smaller valley glacier. Access to the mine site will require a road to be built and maintained across a glacier, and coarse grained rock waste resulting from the mining process will be deposited on one of the adjacent glaciers. The area is known to include surge-type glaciers and the dust load on the glaciers is expected to affect the meltwater flux. We used a range of field, numerical and remote sensing techniques to define the current glacial environment and predict changes likely to result from mining activity, as well as to quantify cryospheric processes that may affect mining activity. These include the possibility of a glacial surge, changes in ice flow, changes in the pattern of ablation across the glacier and associated changes in the local hydrology. The results of the scientific work that we present here provide a baseline indicator of the local glacier system and are also relevant to other glaciers in the region in terms of climatic indicators, thermal regime and dynamic behaviour of the glaciers. Cooperation between industrial and research partners will likely develop further as natural resources in arctic regions become increasingly accessible, with valuable scientific and applied results.