Abstract Volume
16th Swiss Geoscience Meeting

Bern, 30th November – 1st December 2018

12. Geomorphology for a habitable planet

b
UNIVERSITÄT
BERN

sc | nat
Swiss Academy of Sciences
Akademie der Naturwissenschaften
Accademia di scienze naturali
Académie des sciences naturelles

P 12.8
An ice-free Northwest Passage: What are the consequences for exploration and exploitation of mineral resources and other raw materials in Greenland and in the Canadian Arctic?

Denis M. Schlatter [1°], Hannah S. R. Hughes [2], Ronald Schenkel [3], Isabella Pasqualini [4] and Nathalia S. Brichet [5]

[1] *Helvetica Exploration Services GmbH, Carl-Spitteler-Strasse 100, CH-8053 Zürich*
(° denis.schlatter@helvetica-exploration.ch; http://www.helvetica-exploration.ch)
[2] *Camborne School of Mines, University of Exeter, Tremough Campus, Penryn, UK*
[3] *Sailcoach, Letzistrasse 50, CH-8006 Zürich*
[4] *École Nationale Supérieure d'Architecture de Versailles, 5, avenue de Sceaux - BP 20674 // 78006 Versailles Cedex*
[5] *Saxo-Instituttet, Københavns Universitet, Karen Blixens Plads 8, 2300 København S, Denmark*

Since the days when the father of plate tectonics, Alfred Wegener carried out his West Greenland expedition and established his station "Eismitte" on the inland-ice in the early 1930s, the effects of climate change has caused the melting of sea-ice and the retreat of glaciers. Glaciers that once extended to the sea are now melting and have retreated for several hundred meters (Fig. 1). The same effects can also be seen along the Northwest Passage that has become ice-free for the first time in recorded history. In contrast, the Northwest Passage was ice-bound during Sir John Franklin's expedition in 1848, which famously ended in the loss of the ships "Erebus" and "Terror" in the vicinity of King William Island located west of Baffin Island in Nunavut, Canada (Fig. 2). In this contribution we show how the opening of the Northwest Passage could represent an efficient Europe - Asia shipping trade route linking the Atlantic Ocean with the Pacific Ocean through the Arctic Ocean.

There are known occurrences of gold, diamonds, copper, zinc, lead, nickel, rare earth minerals, molybdenum, titanium and iron in North and West Greenland as well as the Canadian Arctic, and the opening of the Northwest Passage will signal increased mineral exploration and exploitation for commodities in these areas. Examples of large past and active mineral mines that are located in the Arctic include the Polaris zinc mine, the Nanisivik zinc-lead mine, the Mary River iron mine, the Raglan nickel mine or the Ekati and Diavik diamond mines (Fig. 2). Recent research has also shown that mud and glacial rock flour produced by the Greenland Ice Sheet (GRIS) is highly valued as a cropland additive due to its fertilizing properties for improving arable land quality and the CO_2 capture (Sarkar et al. 2018). Another direct consequence of the melting of the GRIS is the substantial fresh water resources that will be released by the ice melting and that may be captured before this water reaches the salty ocean waters – thus the GRIS melting may present drinking water resources. The GRIS has been losing mass of about 262 Gt/year in recent years and this is explained by recent increase in atmospheric and oceanic temperatures and it is estimated that the melting of the GRIS was larger in recent years, than during any previous period since measurements were made over the last 150 years (van As et al. 2016).

Climate change and the related and expected future consequences to the GRIS and the Arctic ice represent a negative change from a global perspective, yet there are likely to be beneficiaries such as shipping companies that could utilize a sea ice-free Northwest Passage making such routes logistically feasible and profitable. This would open up further exploration for mineral resources and other raw materials in the Arctic, with access via the Northwest Passage and other Arctic sea routes bringing commodities to market and the prospect of wealth to these Arctic areas. But we ask, what are the socioeconomic and environmental factors at play in this scenario and should this be viewed as a positive side-effect of ice loss caused by the global warming?

Figure 1. Quamarvjuk Fjord, West Greenland: in 1930 (left picture, from J. Georgi), and in 2012 (right picture, from D. Schlatter).

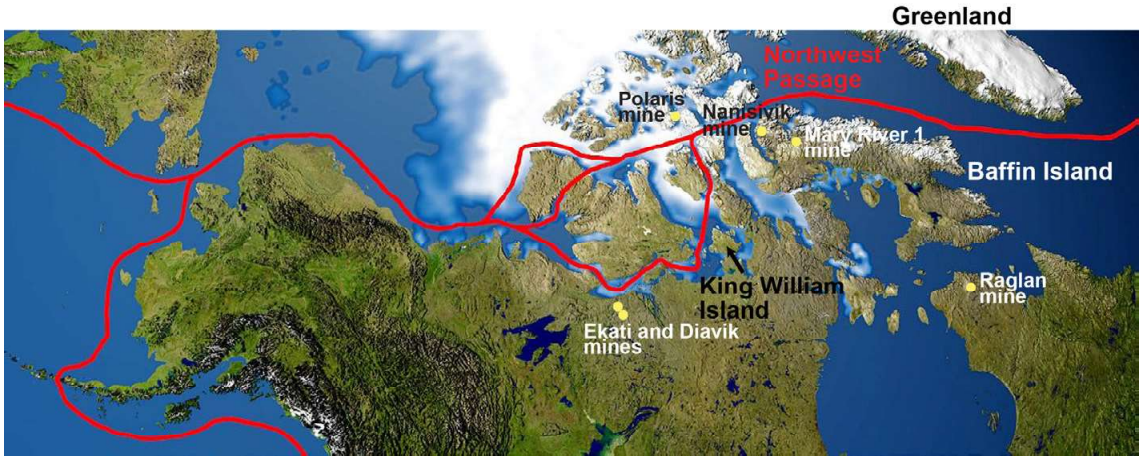

Figure 2. Northwest Passage route(s) shown in red, and location of the King William Island where Sir John Franklin's expedition met a tragic ending after becoming trapped in the ice. Shown on the map are also locations of mines. (Map from Wikipedia).

REFERENCES

van As, D., Fausto, R.S., Cappelen, J., van de Wal, R.S.W., Braithwaite, R.J., Machguth, H. & the PROMICE project team. 2016: Placing Greenland ice sheet ablation measurements in a multi-decadal context. Geological Survey of Denmark and Greenland Bulletin 35: 71-74

Sarkar, S.R., Rose, N.M., Hassenkam, T. & Rosing, M. 2018: Glacial rock flour as an agent for soil improvement. Goldschmidt Conference, 2018, Boston. https://goldschmidt.info/2018/abstracts/abstractView?id=2018003280, 1 page