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Investigating Glacial Meltwater Streams on Longyearbreen, Svalbard

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Introduction

Between the 17th June and 17th July, we travelled to **Longyearbyen**, a High Arctic town on **Svalbard** (78° N, 15° E) (Figure 1). We conducted our research on **Longyearbreen glacier** (Figure 3), studying the ***impacts of the 2022 ablation period on the meltwater streams.***

The effects of climate change are particularly marked in the Arctic, with warming occurring at twice the global average over the past 50 years[1]. Meltwater from Arctic glaciers currently accounts for ~ 35% of global sea level rise[1], as such, it is critical to quantify the impact of climate change on Arctic glacial meltwater streams, with Svalbard being a key study site.

Aims

1. **Investigate they hydrochemical variations of the meltwater streams**
   - Establish the chemical evolution and reactions that take place throughout the hydrological system
   - Identify the total proportions the hydrological drainage system pathways
   - Compare the ionic chemistry to past research to identify any changes to the hydrological system
2. **Investigate how the suspended sediment load changes in meltwater streams**
   - Determine the discharge, cross section and velocity changes
   - Analyse the differences in suspended sediment load between meltwater streams
   - Determine the effects of climate on the meltwater streams
   - Map out and identify the drainage pathways and how these may change over the course of the ablation season

Methods

Aim 1:

33 water samples takes from proglacial and supraglacial streams from the West and East sides of the glacier. The **ionic chemistry** of these samples will be analysed to determine the efficiency of the hydrological system.

Aim 2:

35 samples overall were taken from 5 sample locations across Longyearbreen glacier from proglacial and supraglacial streams. At these sample points, the **suspended sediment load (SSL), velocity**, and the **width** and **depth** of the streams were taken. Changes in climate and weather readings have been obtained from a nearby weather station.

Figure 1: Location of study site[3,4]

Figure 2:Supraglacial Meltwater Stream

Figure 3: Longyearbreen Glacier

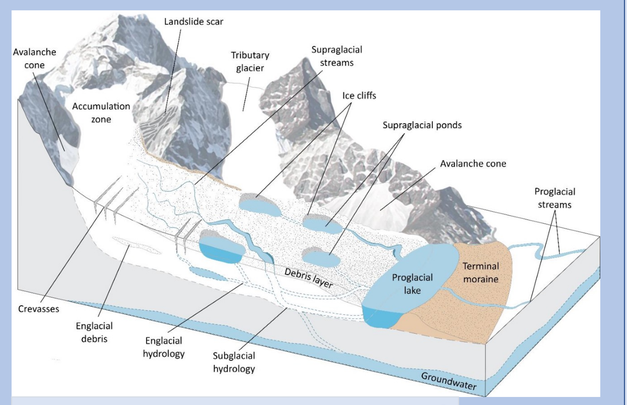

Figure 4: Model of Glacial Hydrology[2]

Expected Outcomes

Aim 1:

Over time it expected to see a decrease in ion content, indicating a more efficient stream system within the glacier. The Supraglacial streams are also likely to show lower ion contents then the proglacial streams as they have less rock-water interactions. The results of this will show the hydrological system and pathways.

Aim 2:

The suspended sediment load and discharge are both expected to increase as a response to an increase in temperature, which was seen at the weather station.

The data collected will hopefully contribute to our understanding of Arctic amplification, and how quick the response to a warming climate is from glaciated landscapes.

Conclusions

We are still in the process of laboratory work, processing our samples and analysing our data, however we are expecting to see:

- **A cold based hydrological system with little but efficient subglacial meltwater pathways**
- **Less ion acquisition compared to a temperate valley glacier**
- **An increase in the suspended sediment load as the temperature increases**
- **Temporal and spatial variations in discharge and suspended sediment load**

References

1 SWIPA (2017) Snow, Water, Ice and Permafrost in the Arctic

2 Miles, K.E., Hubbard, B., Irvine-Fynn, T.D., Miles, E.S., Quincey, D.J. and Rowan, A.V., (2020). Hydrology of debris-covered glaciers in High Mountain Asia. Earth-science reviews, 207, p.103212.

3,4 Images from https://toposvalbard.npolar.no/

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