The geomorphology of rock glaciers at Grojtøyra and Sesseggen in the Jutulsessen, Antarctica.

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Introduction

A rock glacier is as a result of perennially frozen debris and ice succumbing to the force of gravity; they occur in mountainous cold and dry climatic settings where permafrost conditions are present [1]. Due to the noticeable nature of rock glaciers in alpine areas, they have generated scientific interest, yet they remain poorly understood [2]. Owing to their permafrost composition, and dependence on temperature and precipitation, rock glaciers can be used as indicators of past climates [3,4]. Not only does the ice contain records of past climates, but the origin and distribution of the ice in rock glaciers is still much debated [2].

Temperature and moisture availability are thought to be the primary variables in controlling rock glacier dynamics, whereas the site occurrence of glaciers is thought to be determined by altitude and incidence of solar radiation[4]. Hassinger and Mayewski (1983) determined that site specific variables play more of a role in influencing the presence of rock glaciers rather than regional geologic or climatic trends. To gain a greater confidence in the use of rock glaciers to evaluate past climates, there needs to be a better understanding of the causes of responses of rock glaciers in Antarctica [4]. Noting the controlling factors of the glacier at Troll will provide further contribution to what the controlling factors are and how much of a role they play in controlling rock glaciers, particularly those in the Antarctic. Due to the relatively low precipitation in the Jutulsessen area [5], it can be expected that the rock glacier moves at a very low rate, if at all [2].

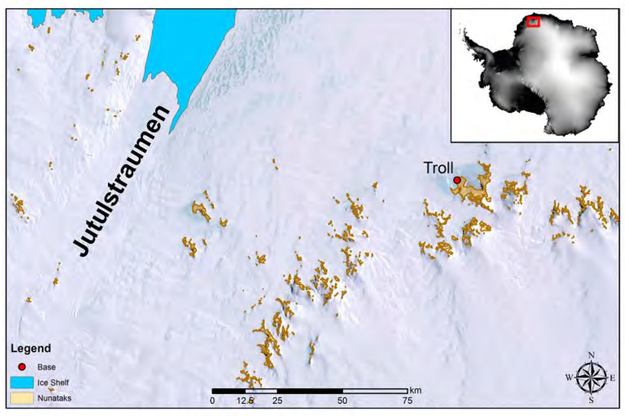

Figure 1: Location of Troll Station, Jutulsessen

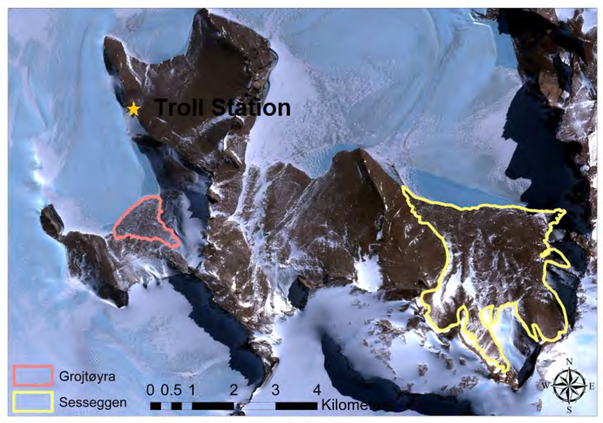

Figure 2: Extent of rock glacier at Grojtøyra

Aim

This project aims to investigate the morphology of two selected rock glaciers at Troll. The following objectives, in order to address the aim, will be undertaken at each rock glacier:

Objectives

- Establish the type of rock glacier;
- Determine whether the rock glacier is an active or static landform;
- Map the spatial extent of the rock glacier;
- Assess whether the sediment characteristics change across the glacier; and
- Determine if the water content of soil changes across the glacier.

Figure 3: View of Grojtøyra

Figure 4: View of Sesseggen

Study Sites

A number of rock glaciers have been identified in the vicinity of the Norwegian research station, Troll (72°01'S, 02°32'E), in the Jutulsessen Mountain of Dronning Maud Land, Antarctica (Fig. 1 & 2). The Jutulsessen is roughly 220 km S of the coast. Two rock glaciers have been selected for investigation, namely Grojtøyra (Fig. 3) and Sesseggen (Fig. 4). Sampling was undertaken at Grojtøyra during the 2013/2014 Austral summer, while Sesseggen will be studied during the 2014/15 Austral summer.

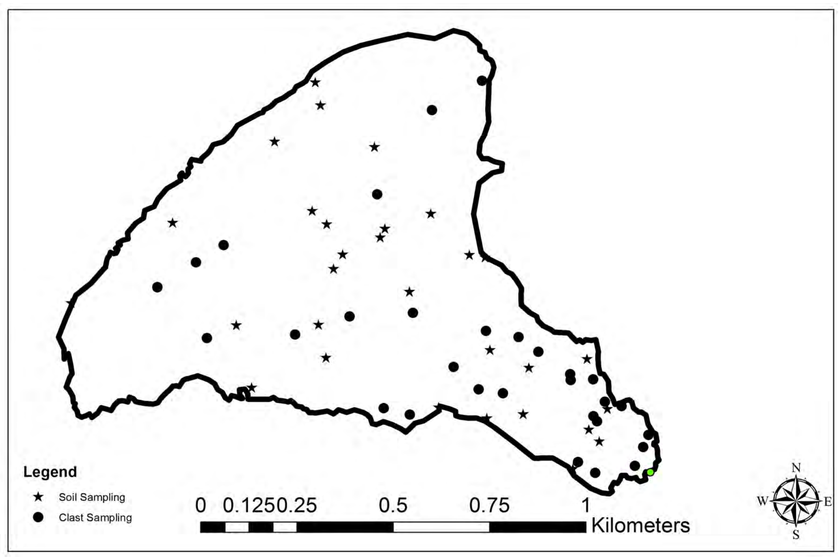

Figure 5: Soil samples collected and clasts measured at randomly selected points

Methodology

- The spatial extent and morphological characteristics of Grojtøyra were mapped.
- Soil samples for particle size and bulk density analyses were collected at 30 random points in groups of 10 in the upper, middle and lower sections of the glacier (Fig. 5).
- At 30 other random points clast size, orientation and rock hardness was recorded (Fig. 5 & 6).
- Five iButtons measuring ground surface temperature at a depth of 2.5 cm were placed randomly across the glacier, five in each of the section (Fig. 7).
- Melt water samples were collected from all of the lakes in the lower section of the glacier.
- At least three cross profiles per section and one long profile were captured and marked on rocks using a Differential Global Positioning System (DGPS) which will be re-taken in the 2014/2015 Austral summer which will allow for slope movement to be calculated (if any). From this data, a Digital Elevation Model (DEM) was created (Fig. 8).
- Other data on hydrological pathways, biological presence and individual clast characteristics were also recorded.
- A very similar methodology will be undertaken for the study of Sesseggen in the 2014/2015 Austral summer.

Figure 6: Clast orientation and hardness was recorded

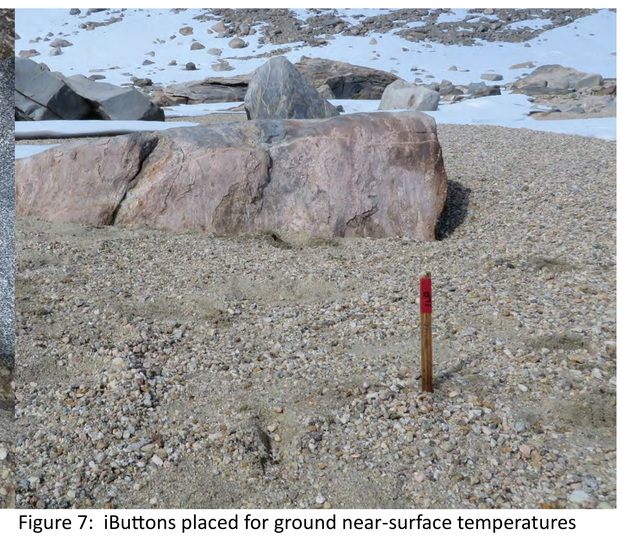

Figure 7: iButtons placed for ground near-surface temperatures

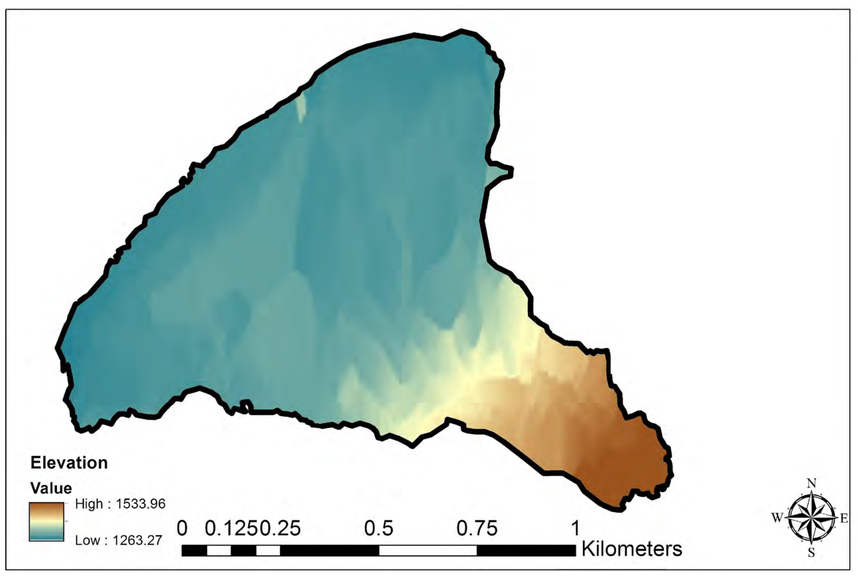

Figure 8: Approximate elevation of the rock glacier

Conclusion

The proposed research has the potential to further out understanding of rock glaciers, their development, form as well as palaeo-climates. Furthermore, the research will be new to this region of the Antarctic, contributing to the existing knowledge on rock glaciers. The project offers the opportunity for combined research by South African and Norwegian researchers and all data collected will be added to existing databases, available to other researchers.

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