Slope processes and associated risks to local residents and tourists in Tasiapik Valley, Umiujaq (Nunavik)

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Introduction

This project focuses on scree slope development during the Holocene period on Hudson Bay cuestas in Nunavik. Located near the Inuit community of Umiujaq and at the edge of Tursujuq National Park, the study site includes hillsides in the Tasiapik Valley (Figure 1). Rock falls have been common occurences since the last deglaciation, about 7600 years ago. Screes have formed at the base of the rock walls (Figure 2). Nowadays, slope processes represent a potential danger for local people and visitors who travel on the road to Lake Tasiujaq. The main objective of this research is to to document the gravity processes that affect the slopes of the valley and to assess the risk of debris falling onto the road.

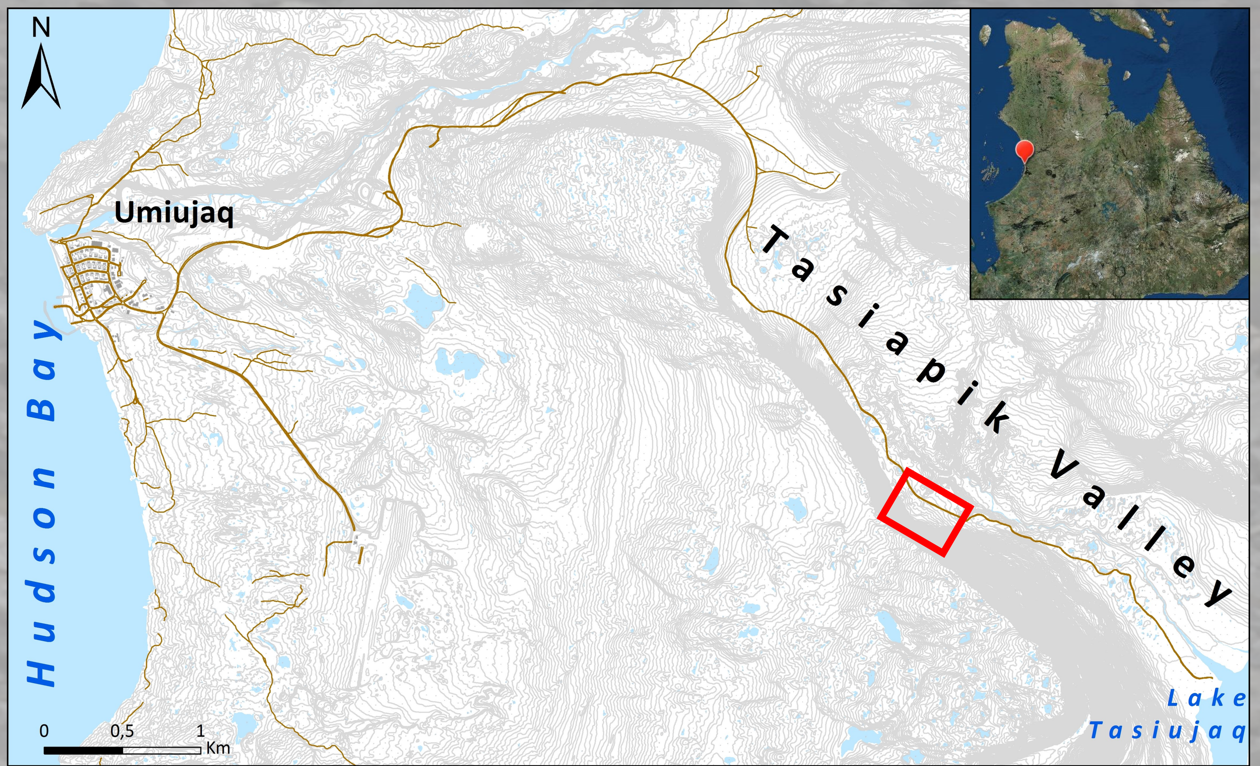

Figure 1 : Location of study site (red) in Tasiapik Valley (Source: MERN, 2011).

To reach this goal, our fieldwork focussed on various parameters such as the height of the rock wall, the lithology and size of the debris on the scree, and the topography and geological setting of the talus. The topography of the talus was surveyed along many transects using a differential GPS (Figure 3).

Figure 2 : Top view of the studied talus slope (S. Veilleux, 2016).

Figure 3: DGPS survey and debris sampling on a talus slope (Þ. Sæmundsson, 2017).

Preliminary results

Topography

The scree slope is mostly concave with a mean angle of 22,6°, ranging between 27° and 19°. However, the southern part of the talus shows a complex topography ; the upper slope is linear and the lower slope is more chaotic (Figure 4). The concavity of the profiles shows that there is debris remobilization on the talus., whereas a virtualy traight profile indicates that the repose angle of particles has almost been reached.

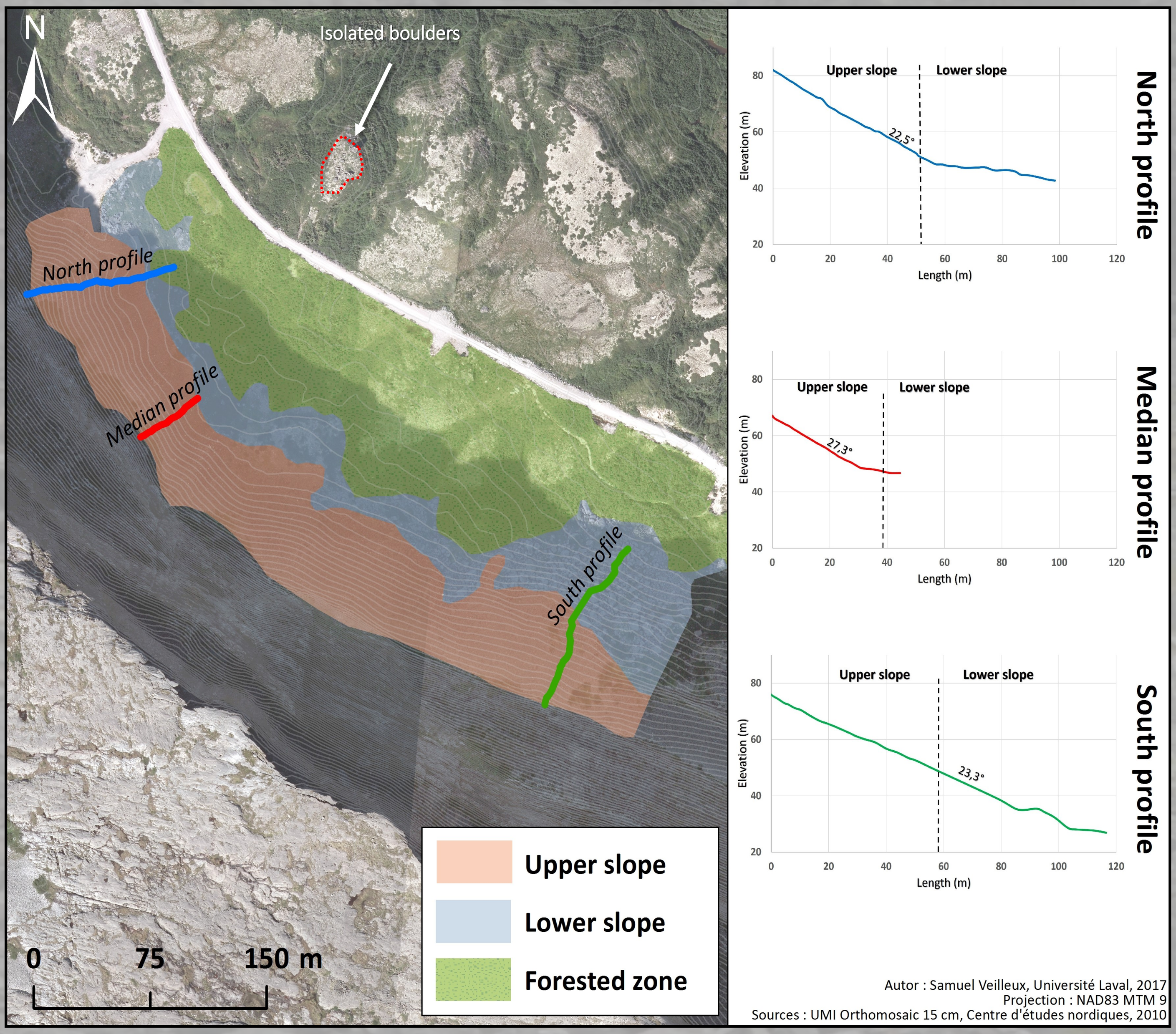

Figure 4 : Talus topography at the north, median and south profiles, and spatial distribution of the upper and lower slope, and the forested zone.

Debris size and petrography

80% of the debris on the upper slope consists sedimentary rocks (limestone, dolomite, sandstone, quartz arenite) with mean size ranges from 12 to 72 cm (Figure 5). Debris accumulated on the talus after falling from a lesser height. Their smaller size and angular shape cause them to become trapped in depressions.

The lower slope is characterized by bigger debris, ranging from 22 to 84 cm, and a larger proportion of basalt boulders, representing between 14 to 46% of the total debris. However, only basalt boulders were found on the lower slope at the southernmost profile, their size ranging from 1 to 17 m. Basalt blocks fall from the top of the rockface and have a greater rolling capacity because of their size, making them more likely to reach the lower slope. The chaotic topography described earlier is attributable to the size of the boulders and the large crevasses between them, as shown on figure 6a.

Vegetation cover

The vegetation covering the debris surface has been described and its coverage estimated. A thin strip of herbaceous plants and shrubs covers the upper slope beneath the rock wall. Lichens and mosses are very abundant from the top to the base of the talus ; the mean estimated coverage percentage on the debris reaches 60%. The percentage of debris coverage decreases to 30% at the prominent debris cone that has formed under a recent notch in the rock wall at the median profile. The coverage percentage increases near the base, reaching 42% due to debris remobilization (Figure 5).

The vegetation is more diversified near the bottom of the talus, as herbaceous plants, shrubs and even black spruces are covering the boulders (Figure 6a). Boulders are partially or completely covered under a layer of mosses and lichens on the ground in the forested area. Some of the spruce trees show evidences of collision with a debris (Figure 6b).

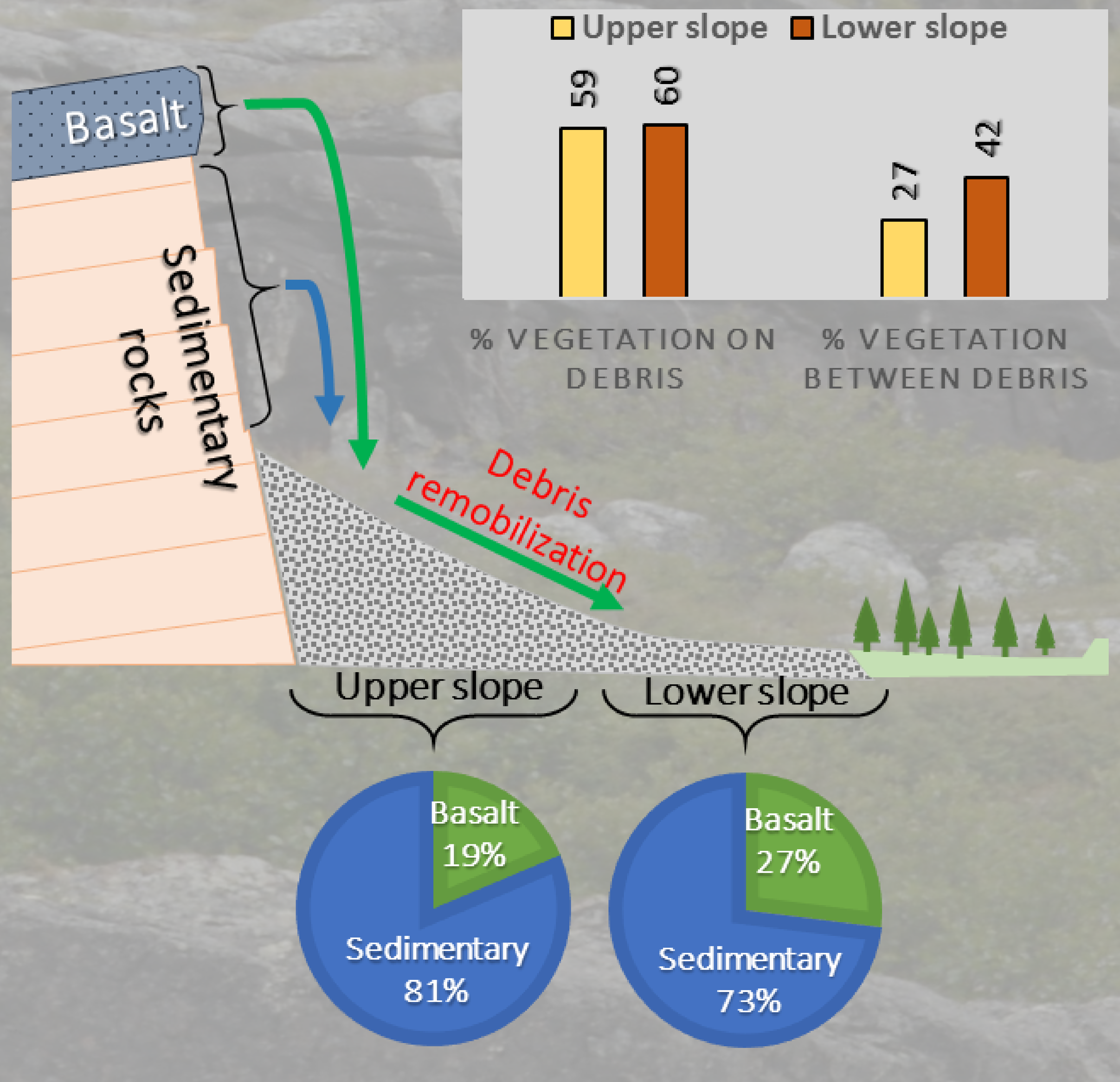

Figure 5 : Rock fall dynamic and debris remobilization, according to the lithologic fractions of the debris and the vegetation coverage.

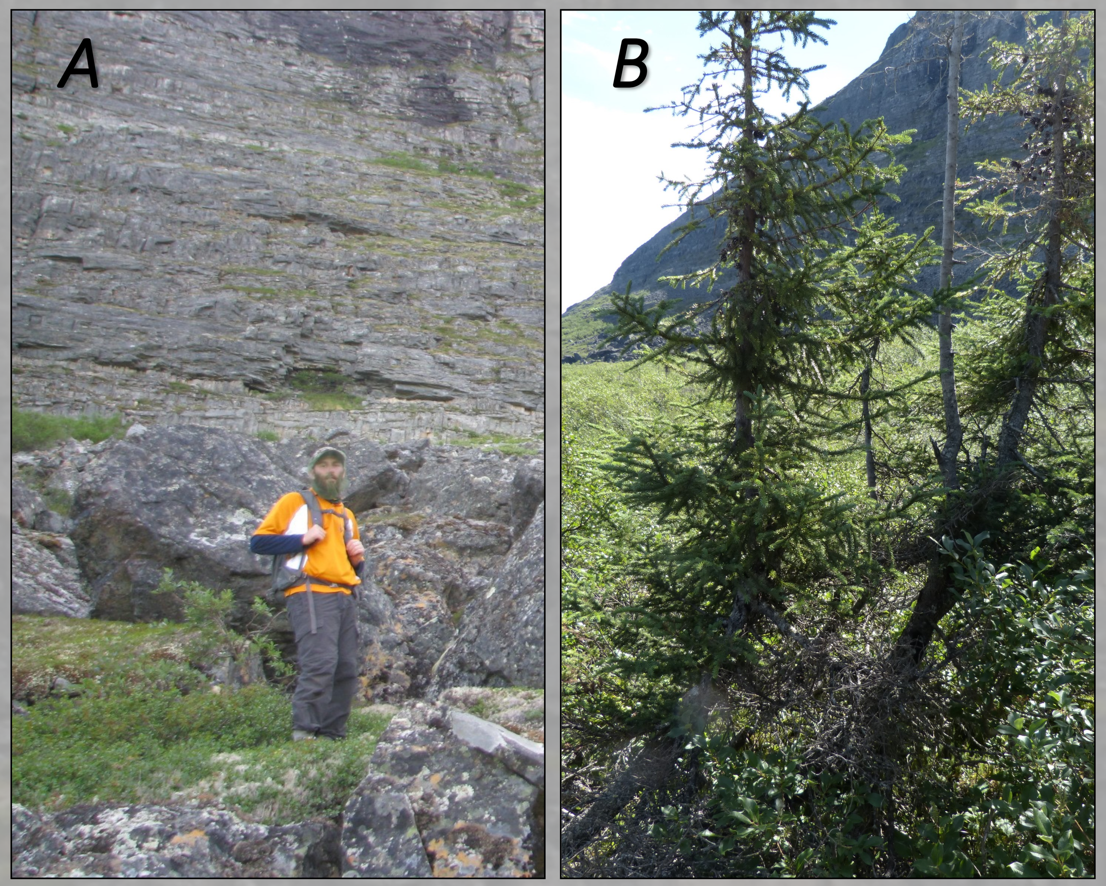

Figure 6 : Abundant vegetation (mosses, herbaceous, shrubs) on lower slope at the southernmost profile (A) (N. Bhiry, 2016); Tilted spruces below lower slope at the northernmost profile (B) (A. Decaulne, 2016).

Figure 7 : Uplifted blocks due to frost heave at the top of the cuesta (A) ; Network of hexagonal cracks in basalt bedrock (B) ; Basalt monolith at the top of the cuesta on the verge of falling (C) (S.Veilleux, 2017).

Conclusions and future work

At this moment, risk exposure is difficult to demonstrate as we do not know the dynamic of the slope on a short term period. However, basalt boulders may represent the most serious hazard because they are likely to be transported over longer distances than sedimentary rock debris. Basalt fall events seem to be rarer than sedimentary rock fall events, but far more important in terms of debris volume.

Future work will focus on the triggering causes of the slope processes throughout the valley. Slopes geomorphology will be used to study gravity processes and the geomorphic agents that control the rock fall dynamic, and activity models will be applied to the slope evolution in the region. Para- and periglacial agents are most probable causes that will be further studied in this project (Figure 7). Additional taluses have been investigated during summer 2017 and we are currently analyzing the data.

References

Hillaire-Marcel, C. (1976). La déglaciation et le relèvement isostatique sur la côte est de la baie d'Hudson. *Cahiers de géographie du Québec*, 20(50), 185-220.

Statham, I. (1976). A scree slope rockfall model. *Earth Surface Processes and Landforms*, 1(1), 43-62.

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