Geological Survey of Canada
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LANDSLIDES AND DEBRIS FLOWS IN PANGNIRTUNG FIORD, NUNAVUT
ᑎᓲᖅᑐᒥᓃᑦ ᐊᒻᒪᓗ ᕿᒪᒃᑲᒥᓃᑦ ᑎᓲᖅᑐᒥᓂᐅᔪᓐᖓᖅᑐᑦ ᐸᖕᓂᖅᑑᑉ ᑲᖏᖅᑐᐊᓗᐊᕚᖅᐸᑦᑐᑦ, ᓄᓇᕗᒻᒥ

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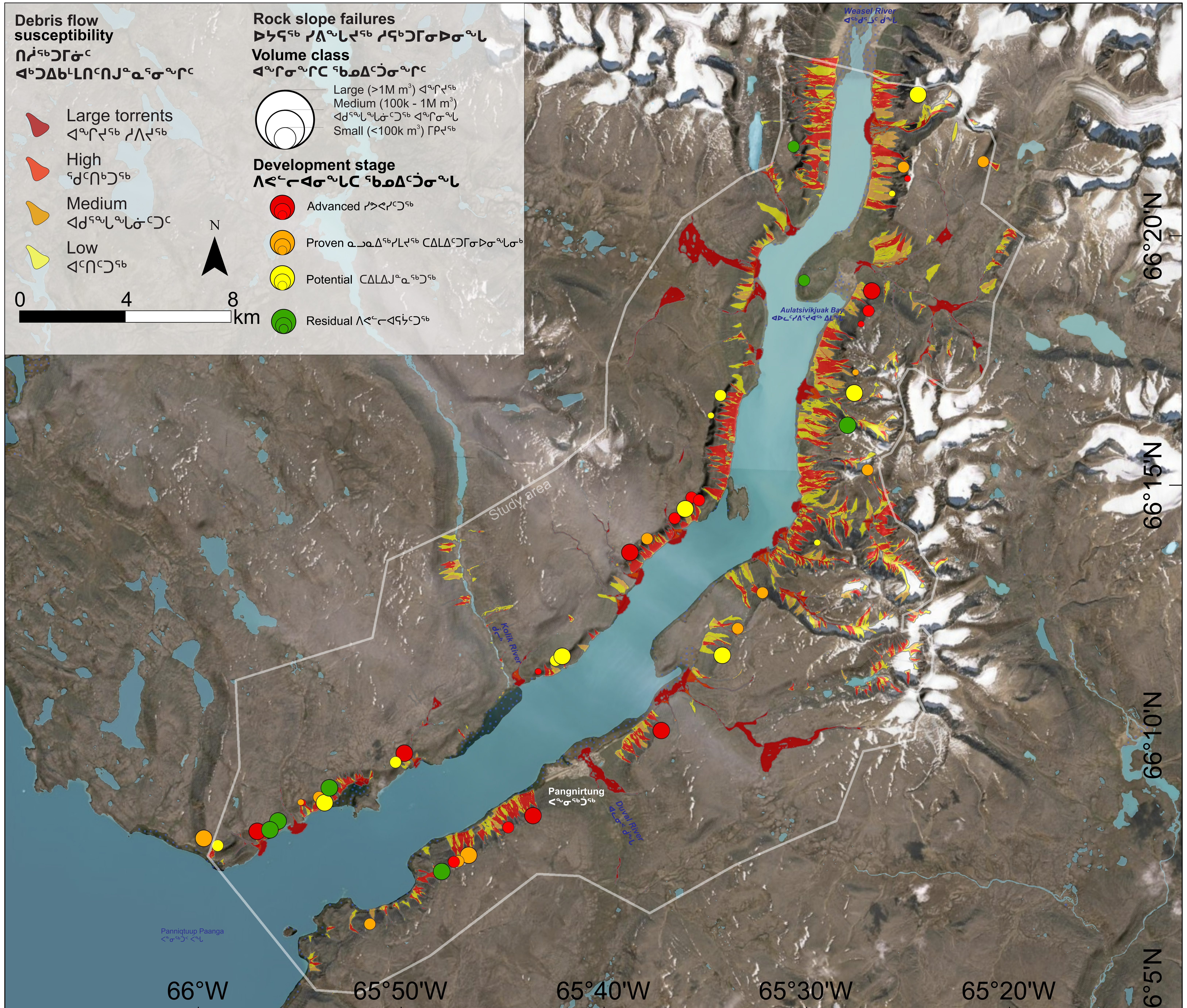

Figure 1. Debris flow susceptiblity and inventory of rock slope failures in Pangnirtung Fiord.
ᐊᔾᔨᙳᐊᖅ 1: ᓴᓂᑦ ᐃᒪᒃᑰᓲᖅ ᐊᓯᐊᓂᙵᖅᑐᓂ ᐊᒻᒪᓗ ᖃᓄᐃᑦᑑᓂᖏᑦ ᐅᔭᖅᑲᑦ ᓯᕚᖓᔪᑦ failures ᐸᖕᓂᖅᑑᑉ ᑲᖏᖅᑐᐊᓗᐊᓂ.

Background

Landslides in fiord environments represent a threat to coastal populations and infrastructure in high-latitude environments and they can trigger displacement waves (tsunamis) that can travel for long distances. In eastern Nunavut, all of the communities are situated at or near sea-level and surrounded by steep-sided slopes in fiord or fiard environments (Gosse et al., 2020). Pangnirtung Fiord is located in Cumberland Sound, southeastern Baffin Island. It is one of the largest fiords in the southern Cumberland Peninsula with a length of 43 km and a width of 1-3 km, and fiord sidewalls rising to 1500 m above sea level. The slopes are steeper near the head of the fiord, which lead to abundant colluvium deposits at their base. Apart from colluvium, the surficial geology mainly consists of exposed cliffs and glacially scoured rocks on the steep slopes, and till on the more gentle slopes.

This poster describes the distribution of landslides and debris flows in Pangnirtung Fiord. The objectives of this poster are two-fold: 1) provide a preliminary assessment of the area susceptible to debris flow processes in Pangnirtung Fiord, which includes defining potential source zones and propagation zones and 2) map the distribution of potential rock slope failures in Pangnirtung Fiord. The aim of this poster is not to address the causes of slope failures or to monitor movement of slope, but simply to illustrate the areas that are most exposed to landslide processes. We do not provide a risk assessment, which would require a thorough monitoring of slopes.

Debris flow susceptibility

Debris flow susceptibility maps were produced at the scale of Pangnirtung Fiord. They identify potential source and propagation areas for debris flows. The entire analysis is based on a 6 m digital elevation model (DEM). The debris flow susceptibility map was completed following the steps of Horton et al. (2013) using Flow-R.

The resulting susceptibility map for debris flows is illustrated in Figure 1. The susceptibility map shows the potential areas in steep streams where debris flows can occur and how far they could travel. Many streams show a high potential for debris flow occurrence, which is consistent with observations retrieved from aerial imagery (Figure 2). All of the existing debris flow deposits observed on aerial imagery correlate with a potential debris flow zone and areas with no debris flow deposits fall outside the susceptibility zones.

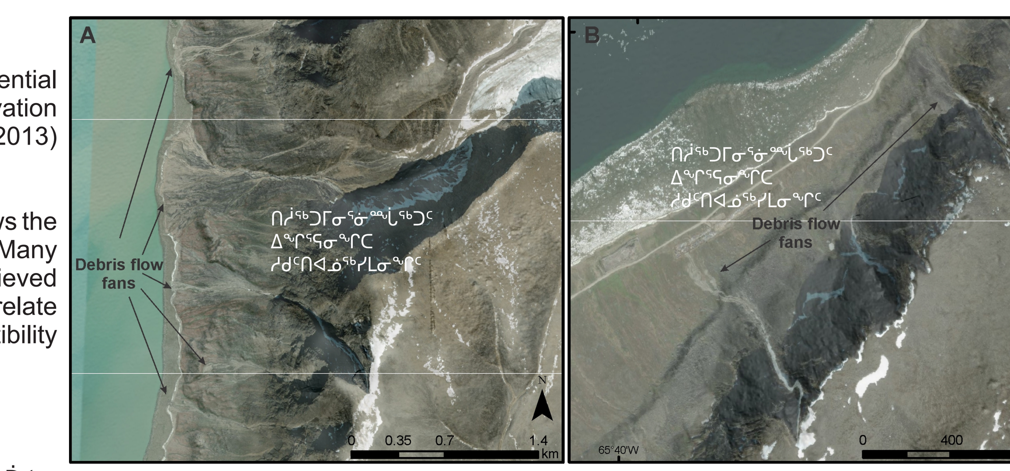

Figure 2. Examples of debris flow fans in Pangnirtung Fiord.
ᐊᔾᔨᙳᐊᖅ 2. ᐆᑦᑐᑏᑦ ᑎᓲᖅᑐᒥᓂᖅᓃᙱᖅᑐᑦ ᓅᑦᑐᒥᓂᐅᓂᖏᑦ ᑕᐅᕗᙵᖃᑦᑕᓲᑦ ᐸᖕᓂᖅᑑᑉ ᑲᖏᖅᑐᐊᓗᐊᓂ

ᑎᓲᖅᑐᒥᓂᖅᓃᙱᖅᑐᑦ ᓴᓃᑦ ᐊᑦᑐᖅᑕᐅᓂᖅᑲᒃᒪᒍᓇᖅᓂᖏᑦ

ᑎᓲᖅᑐᒥᓂᖅᓃᙱᖅᑐᑦ ᓴᓃᑦ ᓅᒃᑦᑕᖅᓂᖏᑦ ᐊᑦᑐᖅᑕᐅᓂᖅᑲᒃᒪᒍᓐᓇᖅᑐᑦ ᓄᓇᙳᐊᑦ ᐋᖅᑭᓱᖅᑕᐅᓚᐅᖅᓯᒪᕗᑦ ᐸᖕᓂᖅᑑᑉ ᑲᖏᖅᑐᐊᓗᐊ ᑕᑯᒃᓴᐅᑎᑕᐅᓗᓂ. ᓇᓗᓇᐃᖅᓯᓯᒪᔪᑦ ᓇᑭᙵᕈᓐᓇᖅᓯᖅᓯᓂᖏᓂᒃ ᐊᒻᒪᓗ ᓱᑦᑎᐊᓅᕈᓐᓇᖅᓯᖅᓯᓂᖏᑦ ᑎᓲᖅᑐᒥᓂᖅᓃᙱᖅᑐᑦ. ᑕᒪᐃᓐᓂ ᖃᐅᔨᓴᖅᓯᓂᖅ ᑐᙵᕕᖃᖅᖢᒍ 6 ᒦᑕᒥᒃ ᖃᖓᓯᐅᔭᖁᑦ ᓄᓇᖓ ᖁᑦᑎᑦᑕᓂᒃᑐᓂᖅᑕᖅᓯᖅᓂᖓᓂᒃ. ᓱᑯᑎᐊᓅᙱᖅᑐᑦ ᓴᓂᑦ ᑎᓲᖅᑐᒥᓂᖅᓃᙱᖅᑐᑎᑦ ᐊᑦᑐᖅᑕᐅᑲᒪᕆᓪᓗᐊᓇᖅᓂᖏᑦ ᓄᓇᙳᐊᖓ ᐱᔭᕇᖅᑕᐅᓚᐅᖅᓯᒪᔪᖅ ᐋᖅᑭᒃᓱᖅᓯᒪᓂᖏᑦ ᓂᕆᐅᓐᓂᐅᖃᖅᑐᓂᖃᖅᖢᑎᑦ ᐃᓱᒪᒋᔭᐅᓪᓗᑎᑦ ᖃᐅᔨᓴᖅᑐᓂ Hᐅᐊᑕᓐ ᐊᓯᙵᓗ (2013) ᐊᑐᖅᑐᑎᑦ ᓅᑉᐸᓪᓕᐊᓂᖏᑦ ᖃᓄᐃᓕᐅᖃᕐᓇᓂᖏᑦ.

ᐊᑦᑐᖅᑕᐅᑲᒪᕆᓪᓗᓇᖅᓂᖏᑦ ᓄᓇᐃᑦ ᓄᓇᙳᐊᖅ ᑎᓲᖅᑐᒥᓂᖅᓃᙱᖅᑐᑦ ᐃᖏᕐᓂᖏᑦ ᑕᑯᒃᓴᐅᑎᑕᐅᕗᖅ ᐊᔾᔨᙳᐊᖅ 1-ᒥ. ᐊᑦᑐᖅᑕᐅᑲᒪᕆᓪᓗᓇᖅᓂᖏᑦ ᓄᓇᐃᑦ ᓄᓇᙳᐊᖅ ᑕᑯᒃᓴᐅᑎᑦᑎᕗᖅ ᓯᕚᖓᔪᓂ ᑯᑦᑐᑦ ᑎᓲᖅᑐᒥᓂᖅᓃᙱᖅᑐᑦ ᑕᐅᕗᙵᕈᓐᓇᖅᑐᑎᑦ ᐊᒻᒪᓗ ᖃᓄᑎᒋ ᐅᖓᓯᓐᓂᖅᓯᒃᑐᒥ ᐃᖏᕐᕋᔪᓐᓇᖅᓂᖏᑦ. ᐊᒥᓱᑦ ᑯᑦᑐᑦ ᑕᑯᒃᓴᐅᑎᑦᑎᕗᑦ ᑎᓲᖅᑐᒥᓃᑦ ᐃᖏᕐᕋᔪᓐᓇᖅᓂᖏᓂᒃ, ᐊᔾᔨᖅᖅᑐᖅ ᑕᓪᓚ ᑕᐅᑐᑦᑐᓯᒪᔪᑦ ᖁᒻᒧᐊᑦᑎᑕᐅᓯᒪᔪᖅᑎᒍᑦ ᐊᔾᔨᙳᐊᓂ (ᐊᔾᔨᙳᐊᖅ 2). ᑕᒪᐃᓐᓂ ᑎᓲᖅᑐᒥᓂᖅᓃᙱᖅᑐᑦ ᐃᖏᕐᕋᔪᒥᓂᐅᔪᖅᑎᓪᓗᒋᑦ ᓄᖅᑲᖅᓯᒪᔪᑦ ᑕᑯᔭᒥᓂᑦ ᖁᒻᒧᐊᑦᑎᑕᐅᓯᒪᔪᖅᑎᒍᑦ ᐊᔾᔨᙳᐊᖏᑦ ᐊᔾᔨᖅᒥᔪᑦ ᑎᓲᖅᑐᒥᓂᖅᓃᙱᖅᑐᑦ ᐃᖏᕐᕋᕈᓐᓇᖅᑐᖏᑦ ᐊᒻᒪᓗ ᑎᓲᖅᑐᒥᓂᖅᓃᙱᖅᑐᑦ ᐃᖏᕐᕋᓂᙱᑦᑐᒥᓂᐅᔪᖅᑎᓪᓗᒋᑦ ᓄᖅᑲᖅᑐᒥᓃᑦ ᓯᓚᑖᓂ ᐊᑦᑐᖅᑕᐅᑲᒪᕆᓪᓗᓇᖅᓂᖏᓐᓂᙵᓪᓕᕙᖏᑦᑐᑎᑦ.

Rock slope failure inventory

An inventory of 58 rock slopes with signs of deformation were identified in the study area (Figure 1). The development stage expresses the level of certainty of the observations on the DEM and aerial imagery and is divided into 4 classes.

1) The **advanced stage**, where the rock slope shows clear signs of postglacial deformation (for example in Figure 3), includes a clear opening of the back-scarp, but also the development of one or more other morphological criteria (flank development, open internal fractures, irregular morphology, depressions, etc.).

2) The **proven stage**, where the rock face shows clear signs of postglacial deformation, includes a clear opening of the back scarp, while other morphological criteria are not present or are uncertain (flank development, open internal fractures, irregular morphology, depressions, etc.).

3) The **potential stage**, where the rock slope has a favorable structural arrangement to form an instability but shows no signs of postglacial deformation. In the potential stage, rock avalanches are observed in the immediate vicinity (with the same geological setting).

4) The **residual stage** includes rock slopes with a favorable geological setting to form an instability but there is no evidence of postglacial deformation or past rock avalanches in the immediate vicinity.

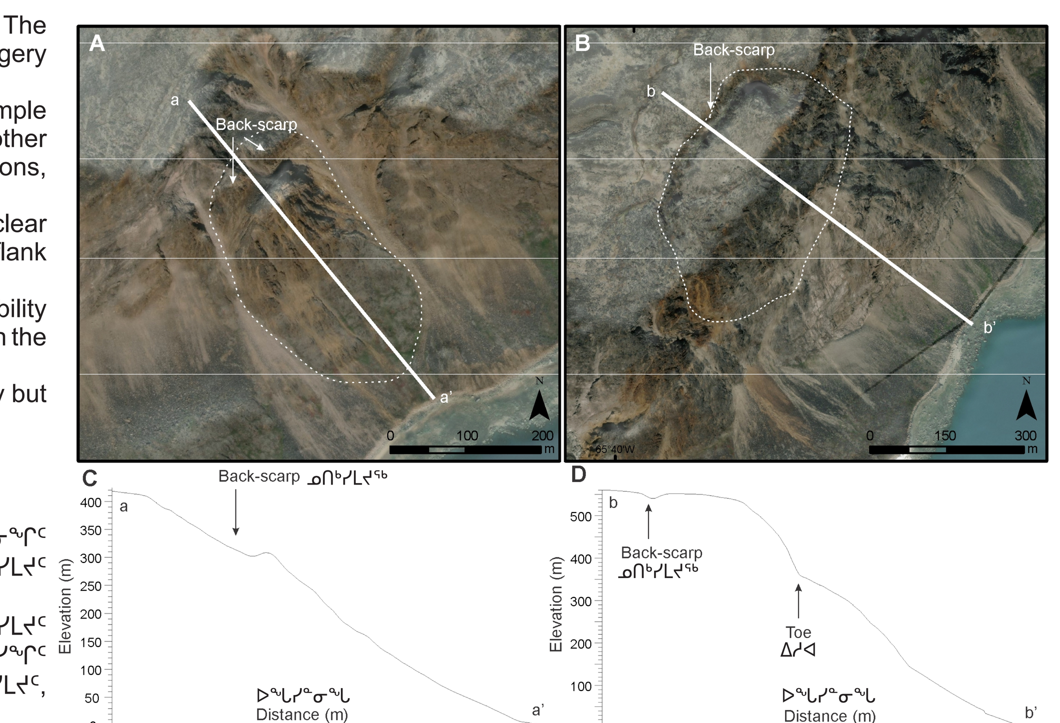

Figure 3. Examples of potential advanced rock slides in Pangnirtung Fiord.
ᐊᔾᔨᙳᐊᖅ 3. ᐆᑦᑐᑏᑦ ᐅᔭᖅ ᑎᓲᕈᓐᓇᖅᑐᑦ ᐸᖕᓂᖅᑑᑉ ᑲᖏᖅᑐᐊᓗᐊᓂ

ᐅᔭᖅᑦ ᐅᕚᖓᔪᑦ ᑎᓲᕈᓐᓇᖅᑐᑦ ᖃᓄᐃᑦᑑᓂᖏᑦ

58−ᖑᔪᑦ ᐅᔭᖅᑦ ᐊᒧᖅᑲᑦ ᓱᖃᐃᔭᖅᓯᒪᔪᑦ ᓇᓗᓇᐃᖅᑕᐅᓚᐅᖅᓯᒪᒋᕗᑦ ᖃᐅᔨᓴᕿᐅᔪᒥ (ᐊᔾᔨᙳᐊᖅ 1). ᐱᕙᓪᓕᐊᓂᖏᑦ ᑕᑯᒃᓴᐅᑎᑦᑎᒪᑕ ᖃᓄᑎᒥ ᓇᓚᐅᑖᖃᒃᓴᐅᓂᖏᑦ ᑕᐃᒪᐃᒍᓐᓇᕐᓂᖏᖕᓄᑦ ᑕᐅᑦᑕᒥᓂᕐᓂᑦ DEM ᐊᒻᒪᓗ ᖁᒻᒧᐊᑦᑎᑕᐅᓯᒪᔪᑦ ᐊᔾᔨᙳᐊᖏᑦ ᐊᒻᒪᓗ ᐊᕕᑦᑐᖅᓯᒪᓪᓗᑎᑦ ᑎᓴᒪᐃᓕᖅᑲᖓᔪᓄᑦ.

1) ᐱᕙᓪᓕᐊᓂᖅᑲᖅᓯᒪᔪᒪᓇᑦ, ᐅᔭᖅᑦ ᐊᒧᖅᑲᕈᖅᓯᒪᔪᑦ ᑕᑯᒃᓴᐅᑎᑦᑎᕗᑦ ᓱᖅᑯᐃᓇᑎᐊᖅᑐᓂᑦ ᓯᕿᐅᓚᐅᖅᑐᓄᑦ ᓱᖃᐃᔭᖅᓯᒪᔪᑦ (ᐆᑦᑑᑎᒋᓪᓗᒍ ᐊᔾᔨᙳᐊᖅ 3-ᒦᑦᑐᖅ), ᐱᖃᓯᐅᔾᔨᔾᔪᖅ ᒪᑐᐃᖅᓯᒪᓂᖏᑦ ᐃᓐᓈᕈᒥ, ᑭᓯᐊᓂᓗ ᐊᑕᐅᓯᕐᒥᒃ ᐅᖓᑖᓂᓗᓐᓂᑦ ᐊᓯᖏᑦ ᐊᓯᔾᔨᖅᓯᒪᔪᑦ (ᐅᔭᖅᑦ ᐃᓐᓈᕈᑦ ᓄᑎᒃᓯᒪᓂᖏᑦ, ᒪᑐᐃᖓᔪᑦ ᓄᑎᒃᑐᒥᓂᐅᓂᖏᖕᓄᑦ, ᐊᔾᔨᒌᙱᑦᑐᒃᑯᑏᑦ ᖃᓄᐃᑦᑐᕈᖅᓯᒪᔪᑦ, ᐃᓂᓕᐅᖅᓯᒪᔪᑦ, ᐊᓯᖏᓪᓗ).

2) ᓇᓗᓇᐃᖅᑕᐅᓯᒪᓕᖅᓂᖏᑦ ᐃᓂᖏᖕᓂᖅᑐᑎᑦ, ᐅᔭᖅᑦ ᓴᖅᑭᔮᖅᑐᑦ ᓱᖅᑯᐃᓇᖅᑐᑦ ᑕᒪᐅᓇᕿᐅᓯᒪᓂᖅᒪᑦ ᑭᖑᓂᐊᒍᑦ ᓯᕿᒻᒥᑦ ᓱᖃᑎᖅᑕᒥᓂᐅᓚᐅᖅᑐᑎᑦ, ᐱᖃᓯᐅᔾᔨᔪᑦ ᓇᓗᓇᕐᑐᒥ ᒪᑐᐃᖓᔪᖅ ᐅᔭᖅᑦ ᐃᓐᓈᕈᑦ ᓄᑎᒃᓯᒪᓂᖏᑦ, ᐊᓯᖏᑦ ᐊᓯᔾᔨᖅᑐᒥᓃᑦ ᐅᔭᖅᖏᑦ ᐃᓐᓈᕈᐃᑦ ᖃᓄᐃᓕᔪᒥᓂᐅᔪᑦ ᑕᒫᓂᒪᑎᑦ ᓇᓗᓇᐃᖅᑐᑎᓪᓗ ᖃᓄᐃᑦᑐᒥᓂᐅᒪᙳᑦ (ᐅᔭᖅᑦ ᐃᓐᓈᕈᑦ ᓄᑎᒃᓯᒪᓂᖏᑦ, ᒪᑐᐃᖓᔪᑦ ᓄᑎᒃᑐᒥᓂᐅᓂᖏᖕᓄᑦ, ᐊᔾᔨᒌᙱᑦᑐᒃᑯᑏᑦ ᖃᓄᐃᑦᑐᕈᖅᓯᒪᔪᑦ, ᐃᓂᓕᐅᖅᓯᒪᔪᑦ, ᓄᓇᖓ ᓇᖅᓴᕈᕐᔪᒃᓯᒪᔪᑦ ᐊᓯᖏᓪᓗ).

3) ᐊᓯᔾᔨᕈᓐᓇᖅᑐᖅ ᐅᔭᖅᖅ, ᐅᔭᖅᑦ ᐅᕚᖓᔪᖅ ᓈᒻᒪᑦᑐᒥᒃ ᐋᖅᑭᓱᖅᓯᒪᓕᖅᑐᖅ ᐊᓯᔾᔨᕈᓐᓇᖅᑐᓂ ᑭᓯᐊᓂᓕ ᑕᑯᒃᓴᐅᔪᖕᖏᑦᑐᖅ ᑭᖑᓂᐊᒍᑦ ᓯᕿᒻᒥᑦ ᑎᓲᖅᑐᓂᐅᓂᖓᓂᒃ (ᐊᔾᔨᖏᓂ ᓄᓇᓂ).

4) ᐱᕙᓪᓕᐊᓂᖅᑲᓂᖓ ᐅᔭᖅᑦ ᐅᕚᖓᓂᖏᑦ ᓄᓇᖓ ᖃᓄᐃᑦᑑᓂᖓ ᑎᓲᖅᐸᓪᓕᐊᔪᓐᓇᓕᖅᓯᖅᑐᖅ ᑭᓯᐊᓂ ᓇᓗᓇᐃᒃᑕᖅᑕᖅᑲᖅᑐᖅ...

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