

The hidden potential of Active-layer Detachments?

Biogeochemistry of Active-layer Detachment Failures on Qikiqtaruk, Canada



Sophia Weise,
Jens Strauss,
Hugues Lantuit
Alfred-Wegener-Institute Potsdam, University of Potsdam
sophia.weise@awi.de



INTRODUCTION

Recent years have been unusually warm and dry. Consequence: frequent active layer detachments and accelerating permafrost degradation. This terrain disturbance is expected to alter soil conditions and dynamics, with potential consequences for local biodiversity and carbon cycling.

Lewkowicz, A. G., & Harris, C. (2005). Frequency and magnitude of active-layer detachment failures in discontinuous and continuous permafrost, northern Canada. *Permafrost and Periglacial Processes*, 16(1), 115–130.

AIM

Determine the ALD's potential for greenhouse gas emissions and to estimate decomposition rates. Allowing a first assessment of changing soil parameters.

How: Analysing the biogeochemistry of ALDs.



FIELD SITE

- Canada's westernmost Arctic island
- Formed by uplifted sediments from Herschel Basin (last ice age)
- Bedrock: Sandstone & shale, overlain by fine sands, silts from marine and beach deposits.
- Surface: Thin glacial sediment layer, with ice-rich permafrost & tussock tundra vegetation.

Burn, C. R. (2012). *Herschel Island Qikiqtaruk: A natural and cultural history of Yukon's Arctic island*. University of Calgary Press.

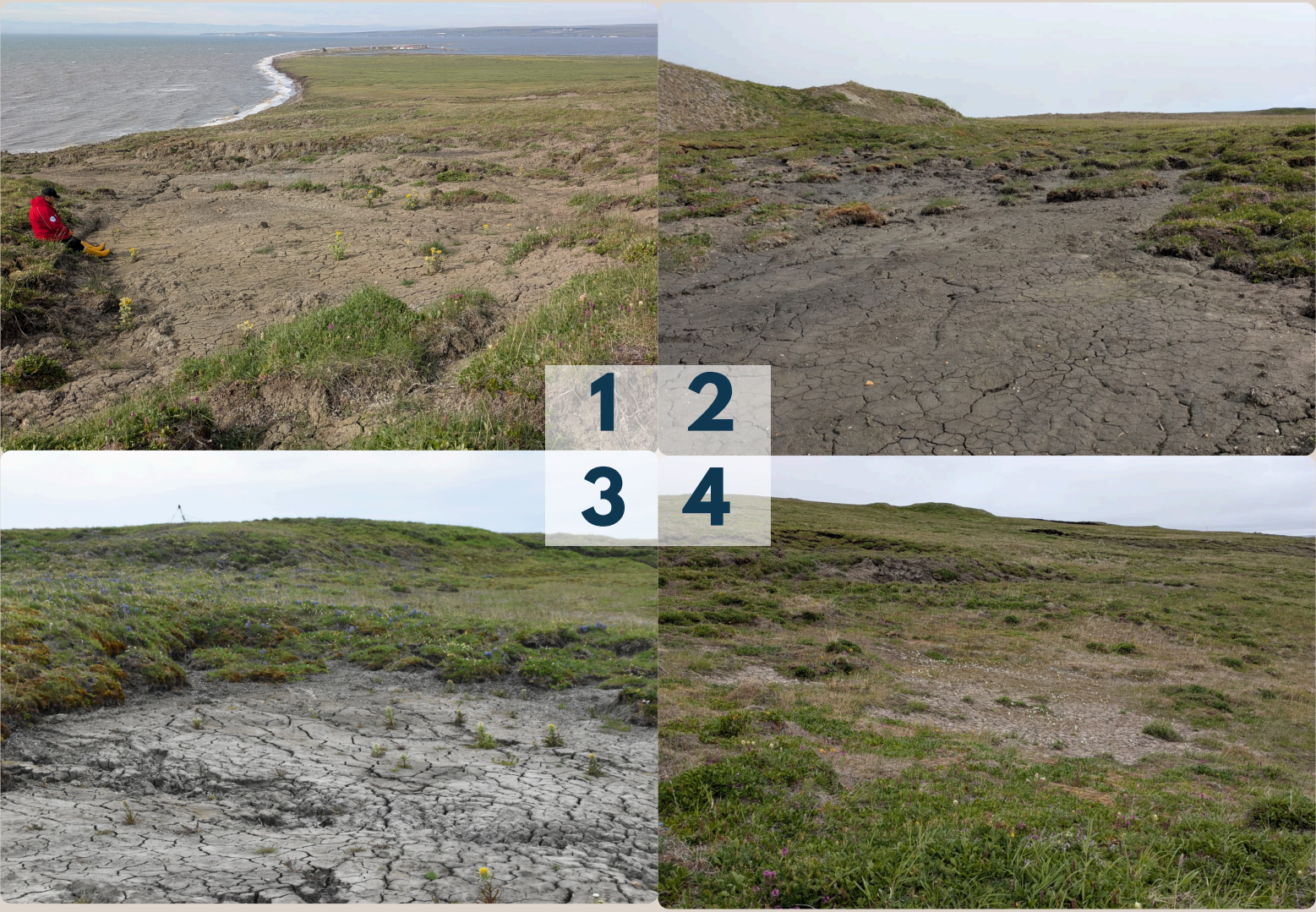
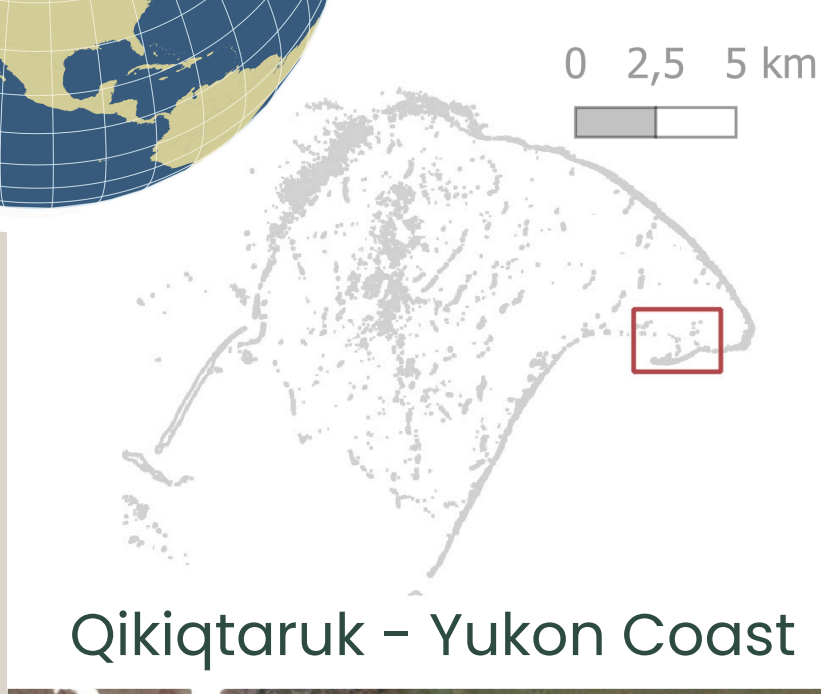
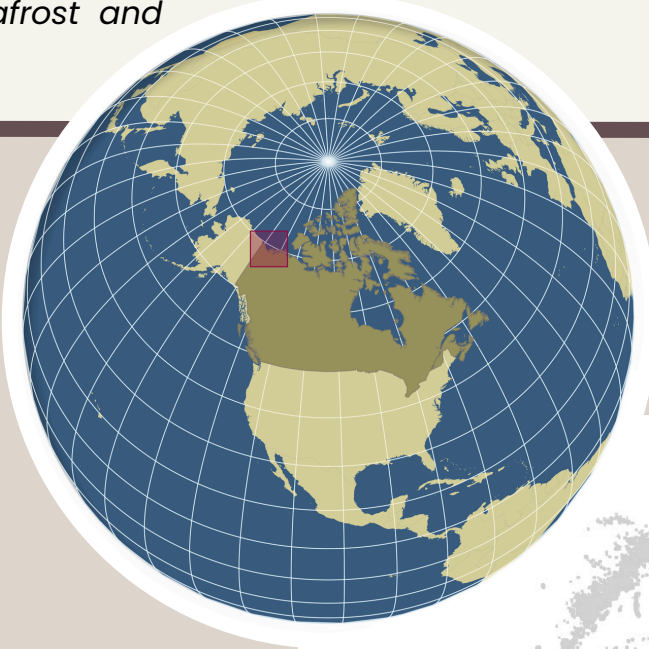


Fig.1: Four sites on Qikiqtaruk. ALD1 & 4 coastal, ALD2 & 3 inland. Site4 is older with regrowing vegetation, used to compare post-event soil parameters.



QIKIQTARUK

Fig.2: Map of the four sampling locations on Qikiqtaruk (69° 35'20" N, 139° 05' 20" W). Located near to the Camp on the spit, at Pauline Cove.

METHODS

At each ALD location, 3 sampling points were chosen (Fig.3). We took samples from different depths.

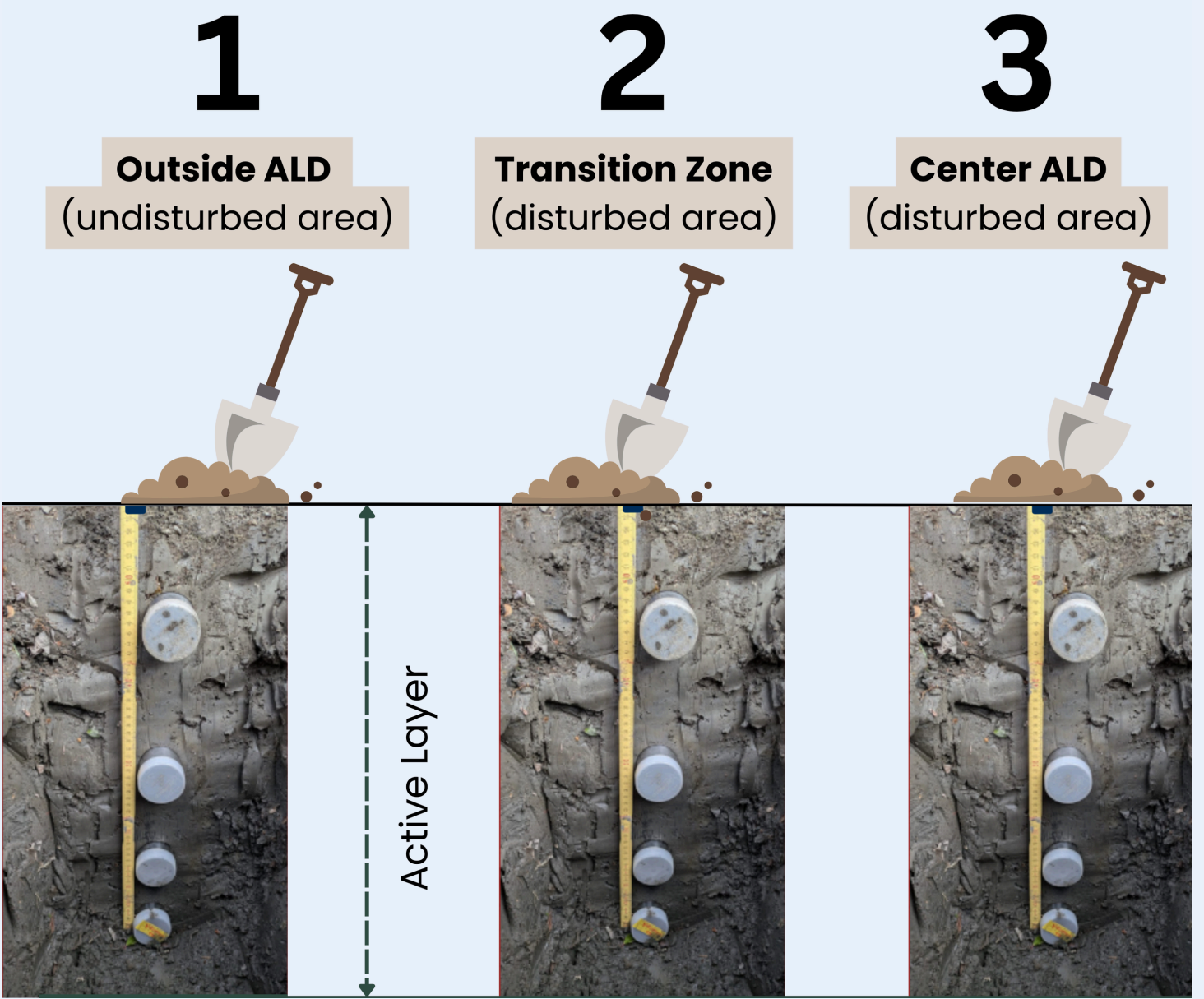


Fig.3: Procedure at an ALD: Pick three spots: (1) outside the ALD (undisturbed), (2) on the ALD edge, and (3) well inside the ALD (disturbed). Dig at each spot until you reach permafrost. Sample every 10-30 cm.

Laboratory analyses include (1) **Grain size distribution**, (2) **elemental composition (C, N, Hg)**, (3) **stable carbon isotopes ($\delta^{13}C$) and lipid biomarkers** (alkanes, fatty acids, alcohols).

RESULTS AND THE ROADMAP FROM HERE ON OUT

GAME PLAN

- **Biomarkers:** Provide information about the decomposition rate and potential microbial activity
- **Grain Size:** Very fine samples, often with smaller stones embedded. Analysis is currently being carried out in the laboratory.
- **$\delta^{13}C$:** Determining the origin and age of organic materials
- Comparing results to other tundra regions and ALD research

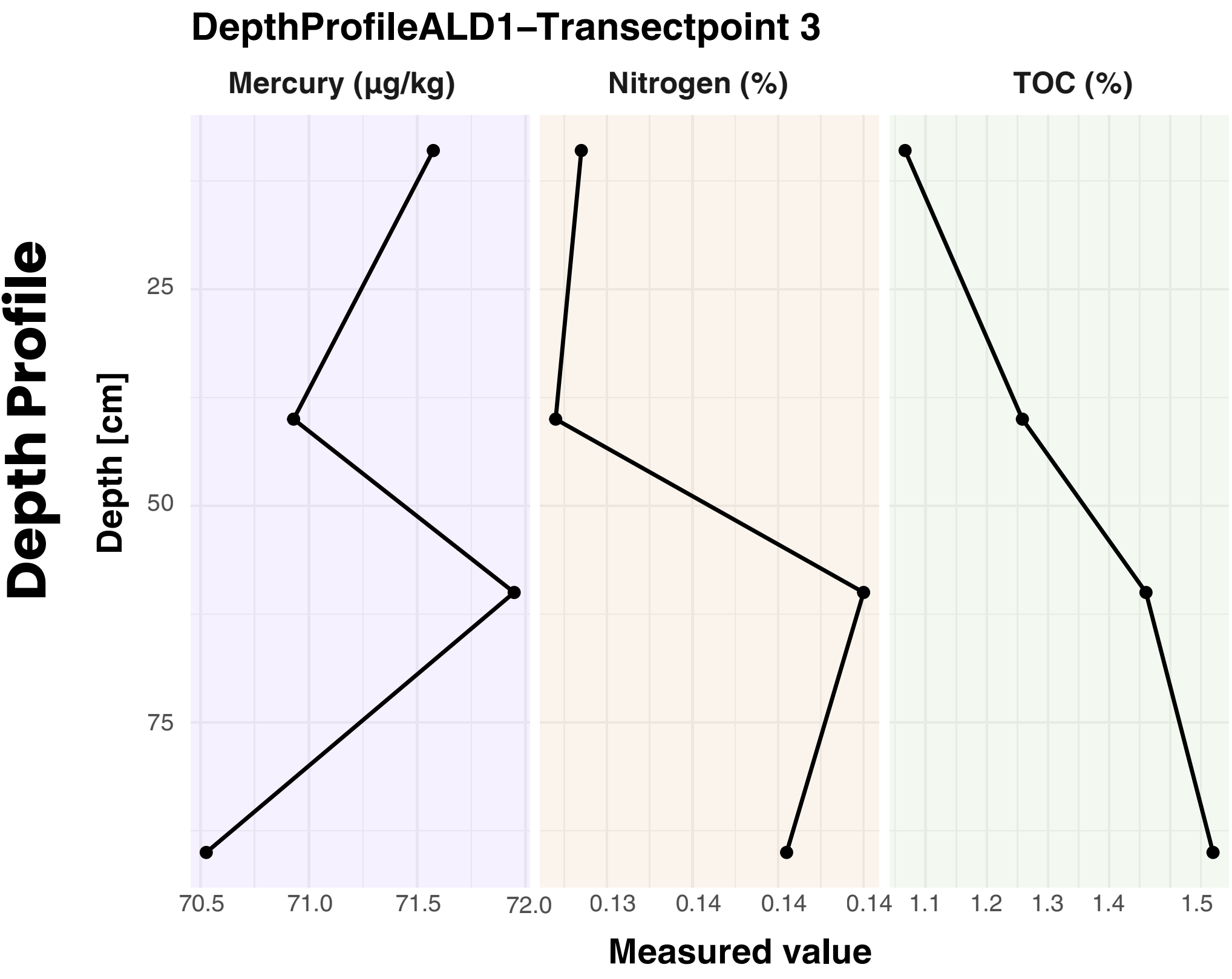


Fig.4: Sampling Active Layer. ALD 2 – Transect point 3. There, I have just completed the description of the soil profile – and gained some truly 'deep insights'.

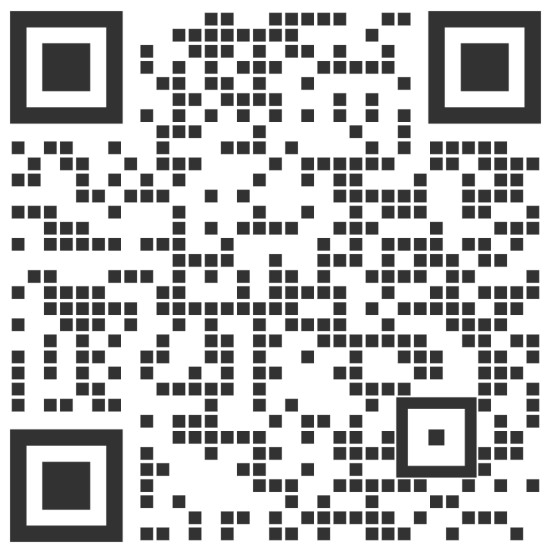


Fig.5: Digging up a profile. Very sticky – like play dough.

ELEMENTAL ANALYSES



Scan to see all results:

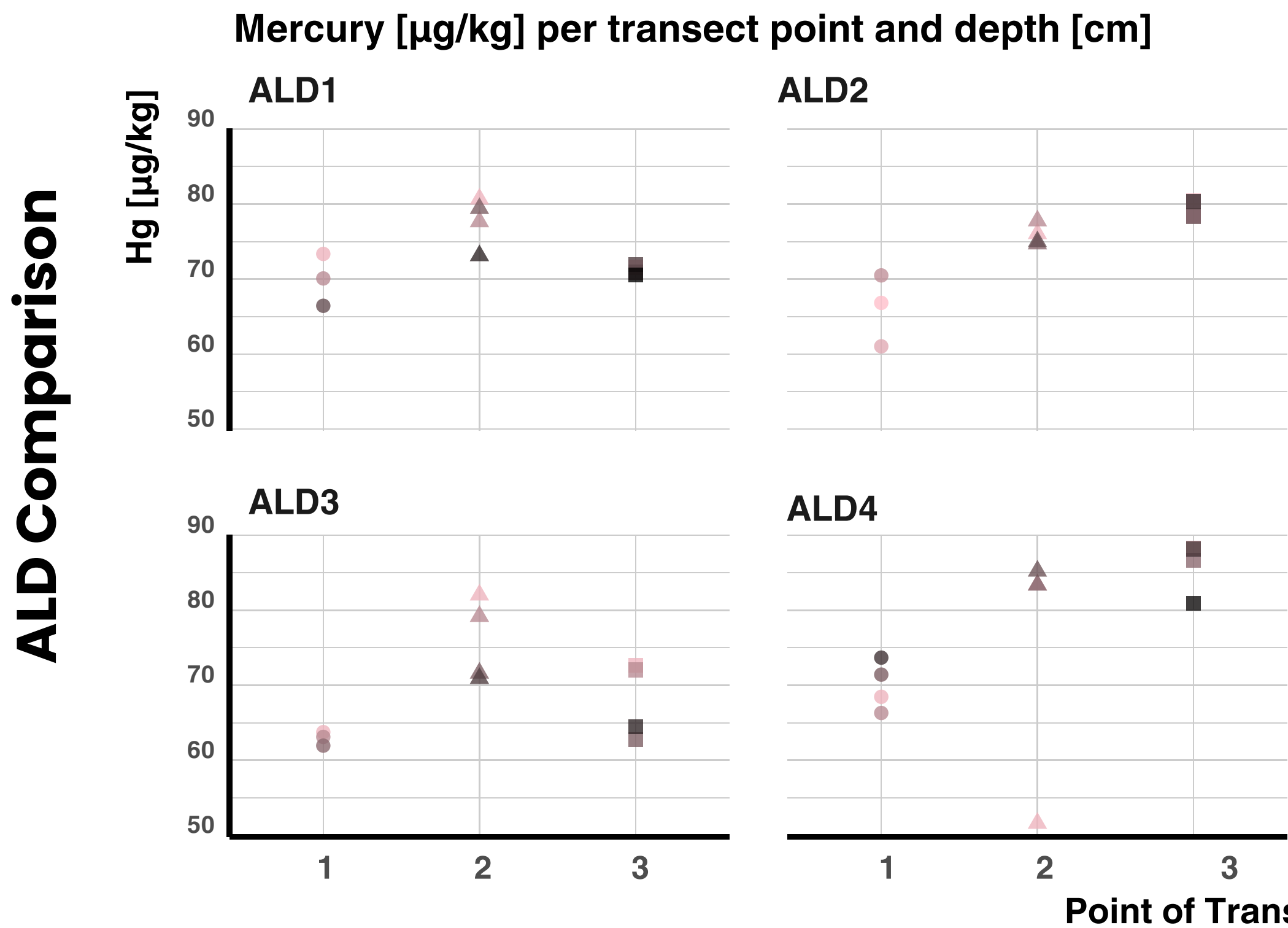


Open questions:

A question specifically about nitrogen: are the values simply low, or has nitrogen already been utilised by microbes?

At present, I cannot yet assess whether my values are comparatively low or normal. To do so, I will refer to comparisons from similar analyses in the next step.

Any correlations between the analyzed parameters?



IN A NUTSHELL

- Active layer detachments will occur more frequently as a result of anthropogenic climate change.
- Initial results show that soil parameters are changing. Mercury levels, for example, are higher in the centre of the ALD, but there are no clear trends for organic carbon and nitrogen.
- The question is whether general conclusions can ultimately be drawn. Can this local study lead to general conclusions? Hopefully, the remaining analyses will provide the answer.

Questions that came to mind during the expedition and that still occupy my thoughts:

How can polar science minimize emissions without limiting access to critical Arctic sites?

Does researcher privilege perpetuate colonial dynamics, where locals bear climate burdens but gain little from global science?