Postglacial permafrost depositional history of Grøndalen, West Spitsbergen

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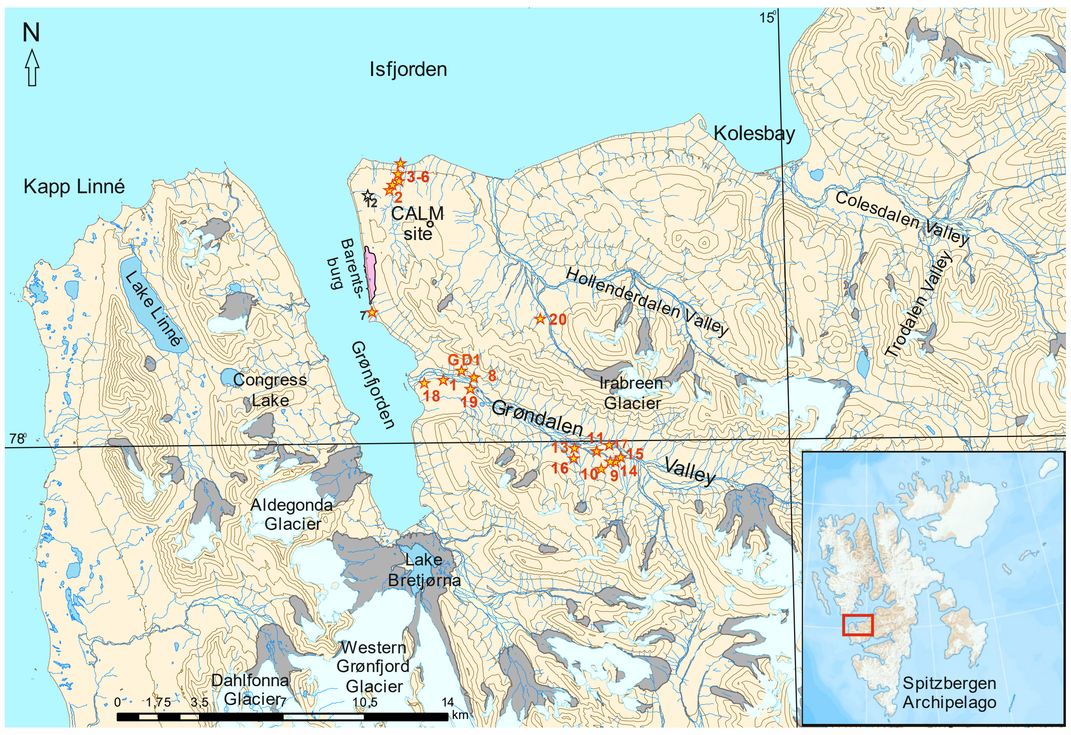


Position of the study area and of the individual study sites in West-Spitsbergen at the Isfjorden, the Grønfjorden, in the Grøndalen and the Iradalen valleys.

The postglacial landscape evolution on the western coast of Nordenskiöld Land (West Spitsbergen) was studied in the framework of the Russian Scientific Arctic Expedition on Spitsbergen (RAE-S) between 2016 and 2021.

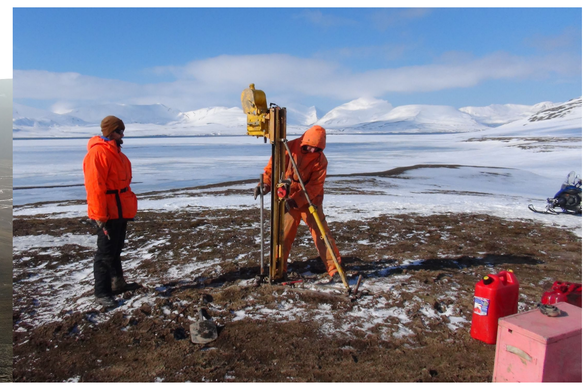
The drill transect near Barentsburg stretches over 20 km and comprises 19 drill locations reaching from 5 to 25 m depths below surface on the marine terraces at Isfjorden, along the Grønfjorden, and in the Grøndalen and in the Iradalen valleys.

Permafrost cores were taken with a portable gasoline powered rotary drilling rig (UKB 12/25). Core segments of 30-50 cm length were cryolithologically descripted and photographed.

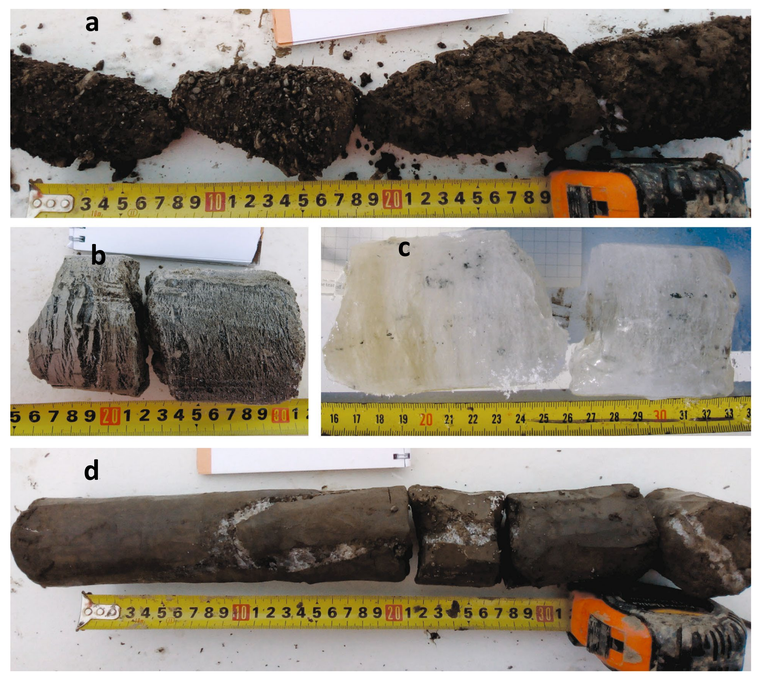
Analyses of gravimetric moisture/ice content and ion content of water extracts were carried out already in the Barentsburg Station. Further studies of grain-size distribution, mass-specific magnetic susceptibility, organic components (TOC, TC, TN, $\delta^{13}C$) and radiocarbon dating were undertaken at the AWI.

Core location Bbg-7 at Kap Finneset (Grønfjorden)

Grøndalen Valley, view over the group of pingos (Fili, Kili, Oin, Gloin)

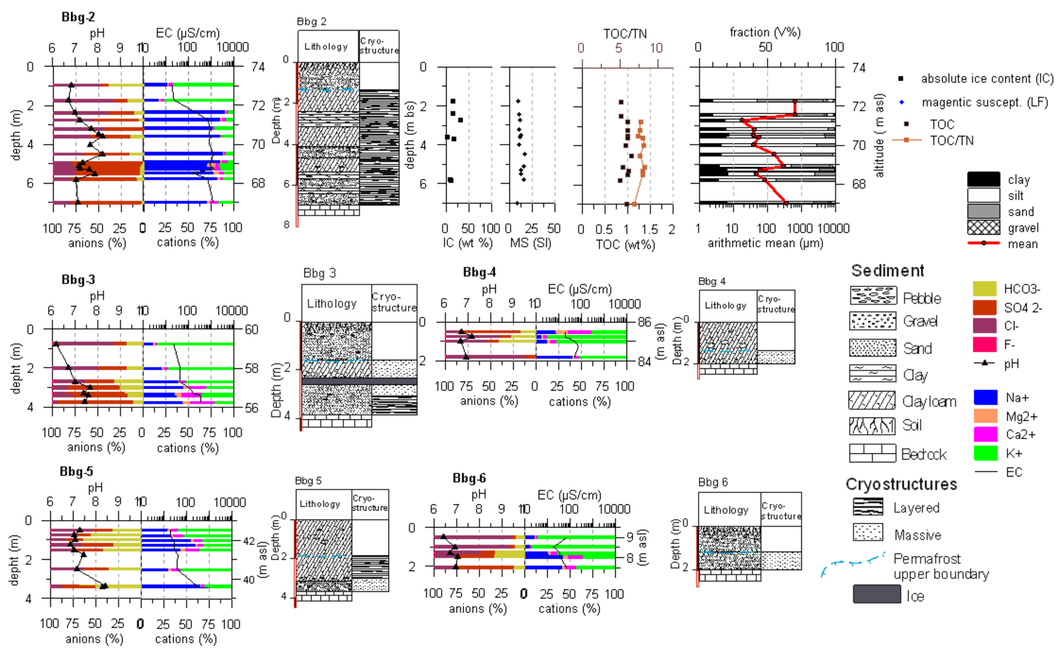


Drilling of the core Bbg-8

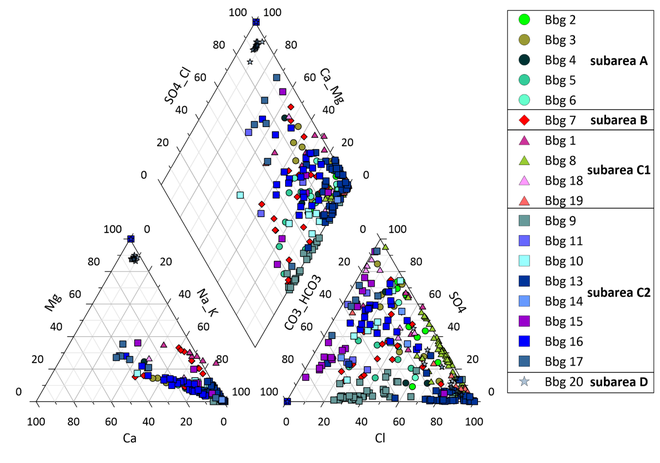


Permafrost core examples:

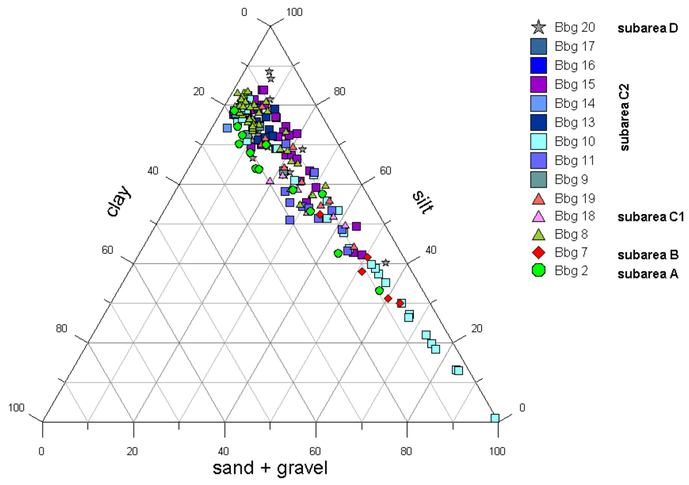
(a) Gravel of massive cryogenic structure (Bbg-15, pingo Kili), 2.8–3.2 m bs; (b) Ice oversaturated deposits (Bbg-16, at pingo Nori), 3.4–3.6 m bs; (c) injection ice (pingo Nori, Bbg-9), 17.5–17.7 m bs; (d) Loam with a subvertical ice schlier (Bbg-15, pingo Kili), 11.2–11.6 m bs.



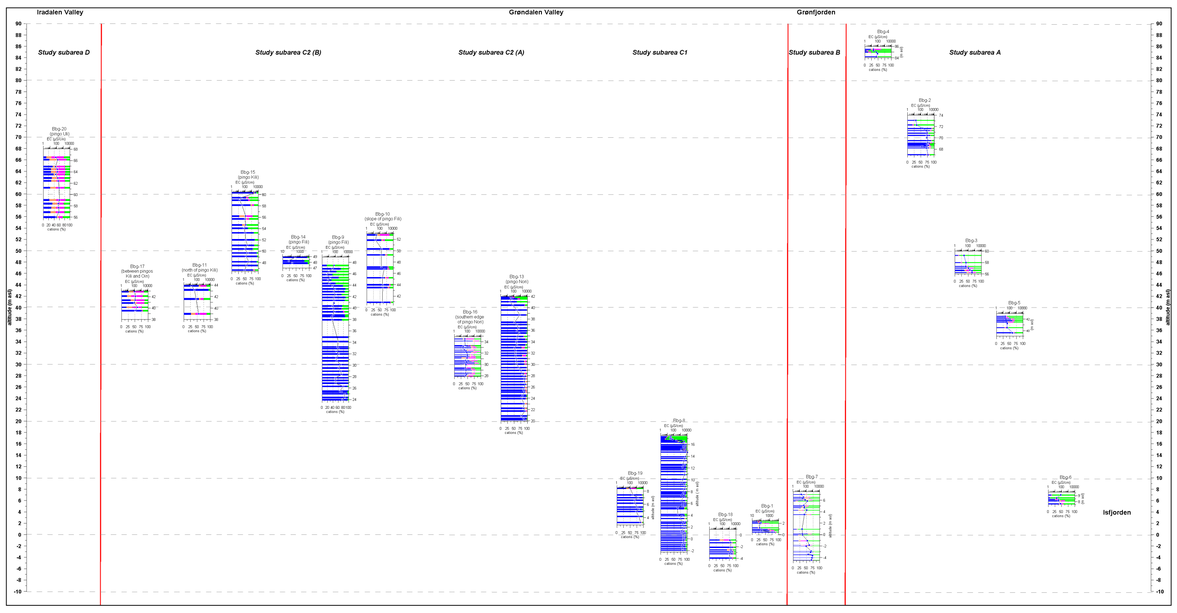
Data example: Cryolithological profiles, hydrochemical and sedimentological data from the study subarea A (Isfjord terraces)



Hydrochemical Piper diagram of all permafrost deposits water extracts showing in the diamond graph Na-Cl but also Ca-Mg-SO_4 and sometimes Na-HCO_3 dominance, mostly Na+K dominance for cations, and no specific focus for anions



Clay – silt – (sand + gravel) diagram of all studied cores showing a wide range from coarse grained sandy gravelly (fluvial) to fine grained silty (alluvial) deposits



Comparison of electrical conductivity and cation data from all studied cores showing salty layers with higher EC values (1.2 mS/cm at 70 m asl, Bbg-2 to max. 12 mS/cm at 15 m asl, Bbg-8)

Stage	Time	Indicators	References
Slope and alluvial deposition, pingo deformation	until now	Granulometry, thaw lakes on pingo tops	This study Demidov et al (2019) Demidov et al. (2022)
Pingo formation	since about 5 cal ky BP (?), before 1938	Aerial imagery analysis	Demidov et al. (2019) Demidov et al. (2020,2021, 2022)
Periglacial fluvial and alluvial deposition	Since about 5 cal kyr BP	Granulometry, water extracts (fresh water)	this study
Marine transgression	11.2-10.7 cal ky BP (max. 64 m asl), 7.1-6.4 cal ky BP (12.5 m asl)	^{14}C dating of shells and whalebones; Salty (EC >1 mS/cm) water extracts of permafrost deposits from 10 to 72 asl	Landvik et al. (1987) this study
Deglaciation started	Between 15.0 and 13.8 cal ky BP (12.3 ± 0.19 ky BP)	Marine shells above late Weichselian till below Linné Lake, west of Grønfjorden	Mangerud & Svendsen (1990)

Stages, periods and indicators of landscape history in the study area

References

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