

Yedoma and muck – New cryolithological studies of permafrost deposits in the Klondike Goldfields (Central Yukon, Canada)

Schirrmeister, L.¹, Opel, T.², Seemann, F.¹, Porter, T.³, Strauss, J.¹, Meyer, H.² and Froese, D.⁴

¹ Alfred Wegener Institute, Permafrost Research Section, ² Alfred Wegener Institute, Polar Terrestrial Environmental Systems Section

³ University of Toronto, Department of Geography, Geomatics and Environment, ⁴ University of Alberta, Department of Earth and Atmospheric Sciences

Introduction



The Klondike Goldfields south of Dawson City is the easternmost Yedoma region of former Beringia and has been well studied over the last 25 years by Canadian scientists.

During the summer of 2023, a small Canadian-German team visited this area to sample mining exposures. The goal was to conduct studies on frozen sediments and ground ice to reconstruct past environmental conditions.

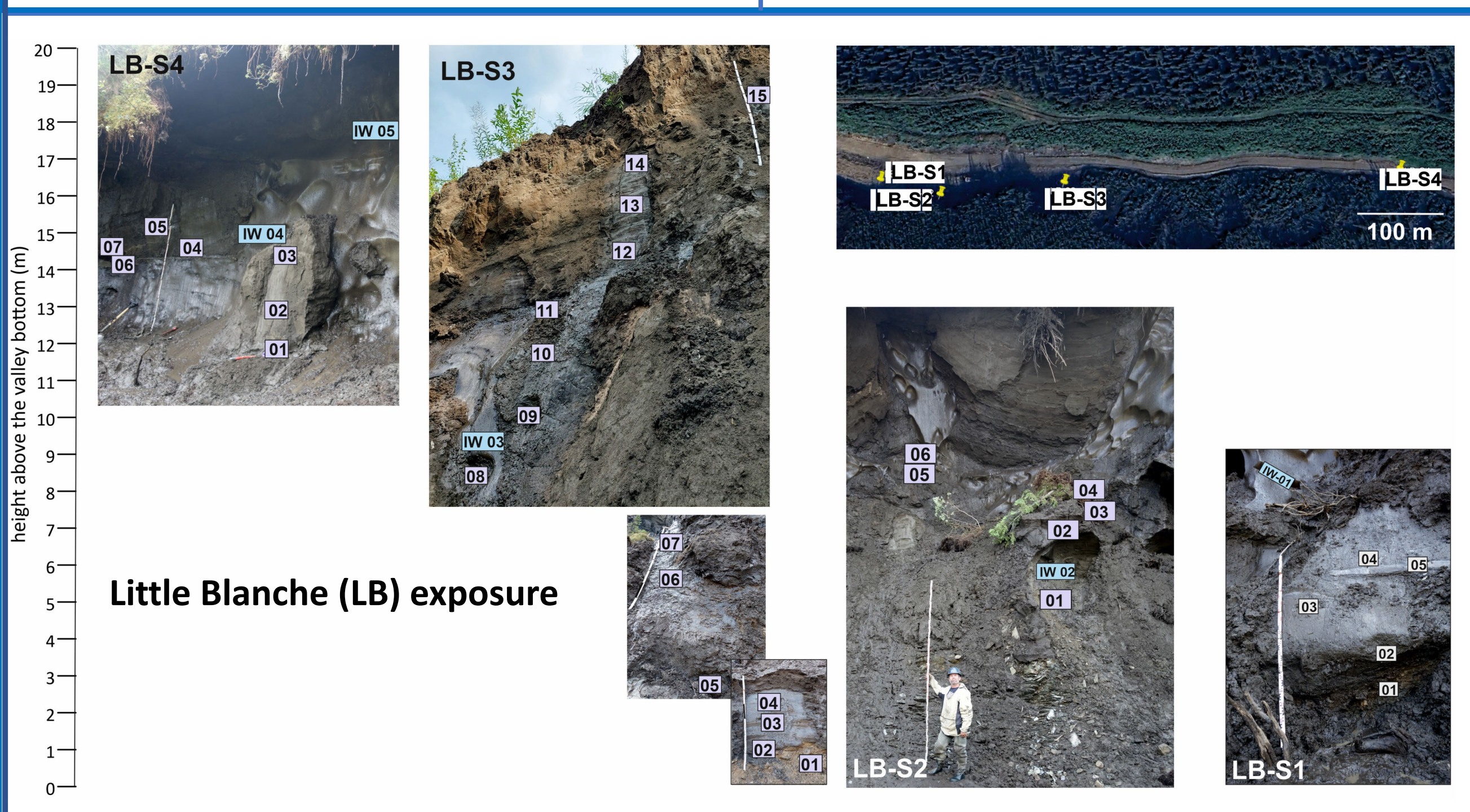
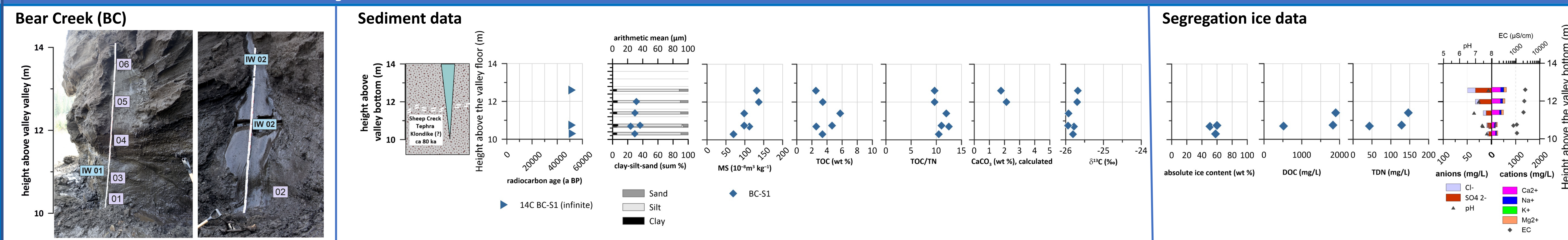
For gold mining, ice-rich permafrost overlying gold-bearing gravel is thawed with water cannons and removed with excavators. This gives the short-term opportunity to examine fresh permafrost walls. The frozen sediment was cleaned, and ice and sediment structures were described, followed by sediment sampling with an axe and hammer.

Detailed profiles were sampled at three sites: Bear Creek (BC), Little Blanche Creek (LB), and Whitman Gulch (WG) (Fig. 1).

The samples were transported frozen to Germany for further analysis at the AWI Research Unit in Potsdam. This involved numerous sediment and ground ice parameters.

The study area of the Klondike Goldfields in the Canadian Yukon Territory and the study sites (Bear Creek, Little Blanche, Whitman Gulch)

Fieldwork and analytical results



Bear Creek :

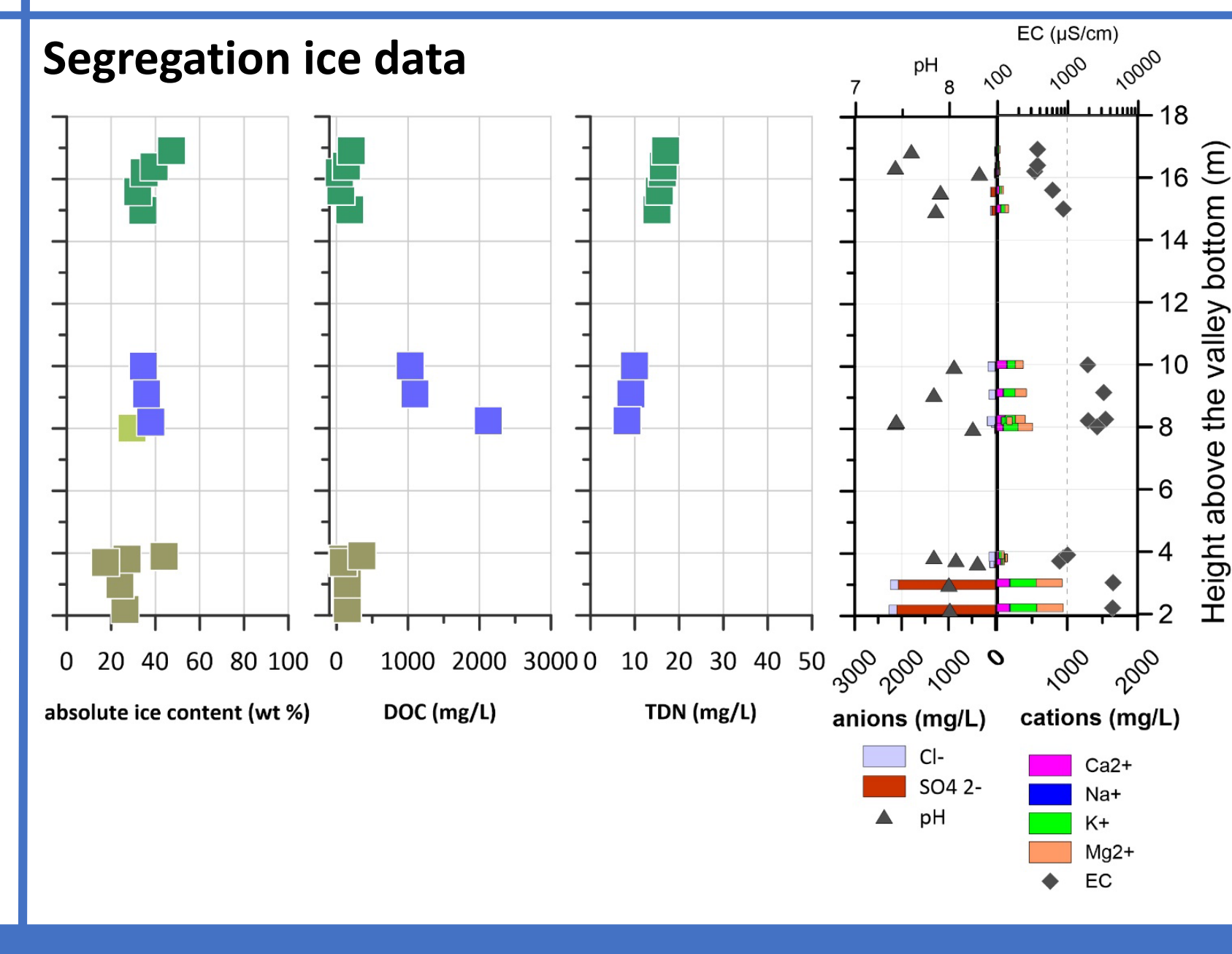
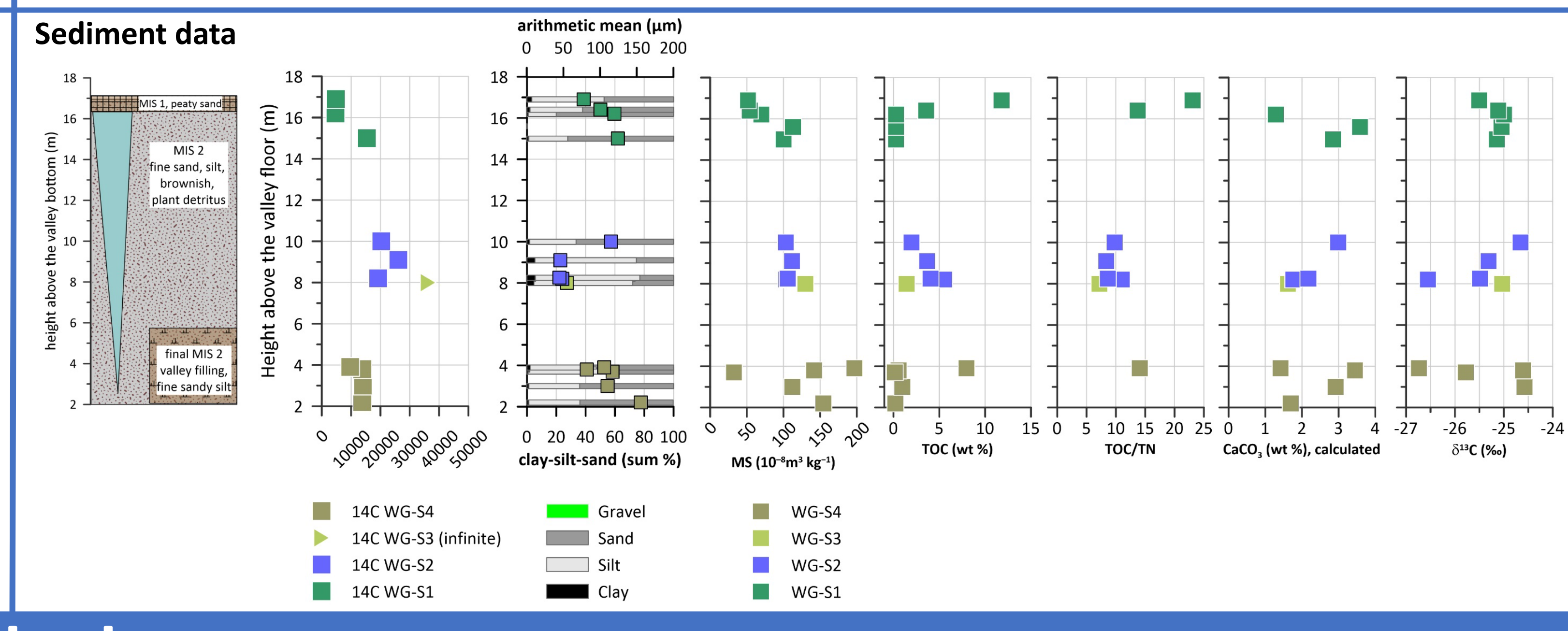
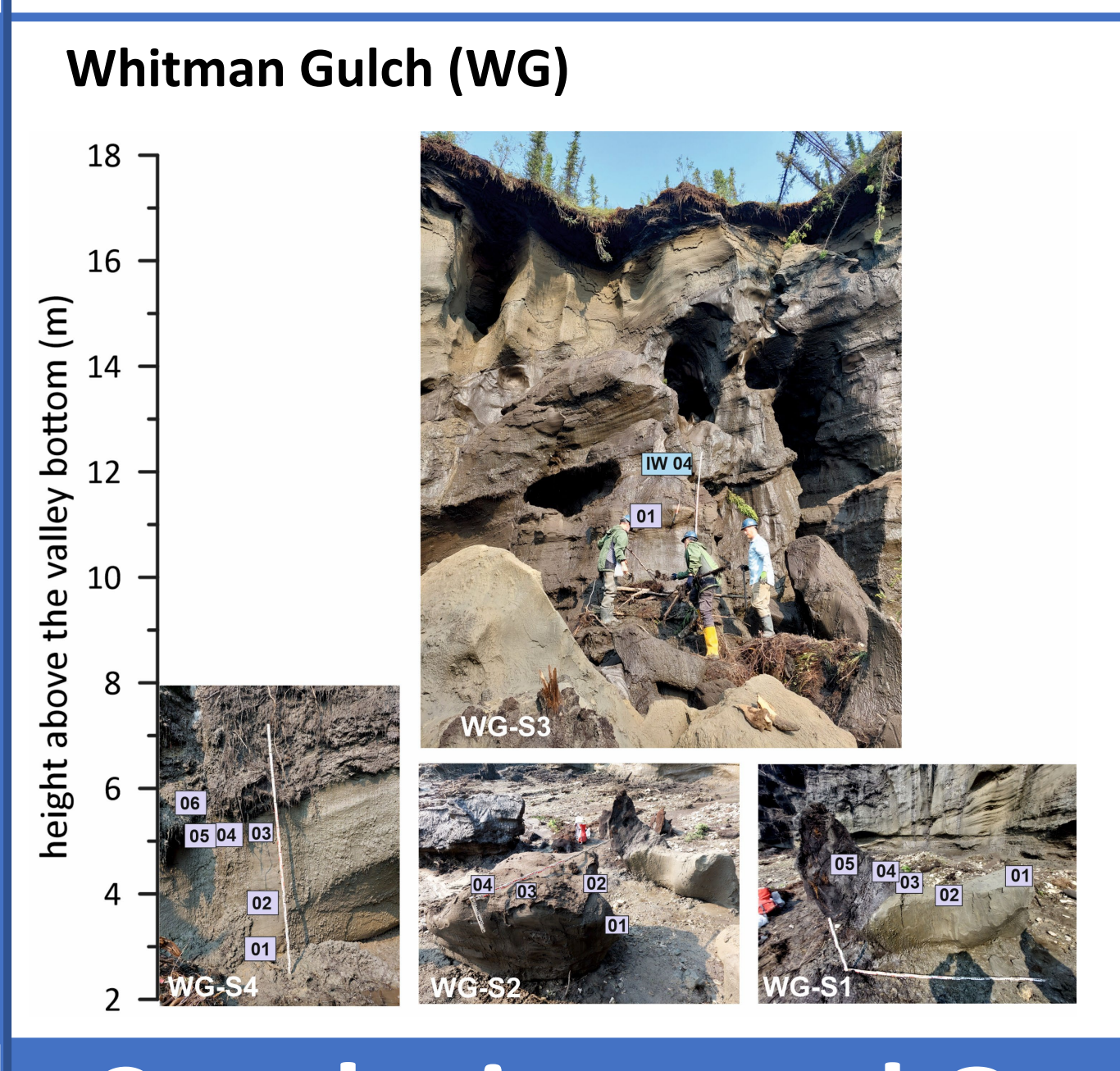
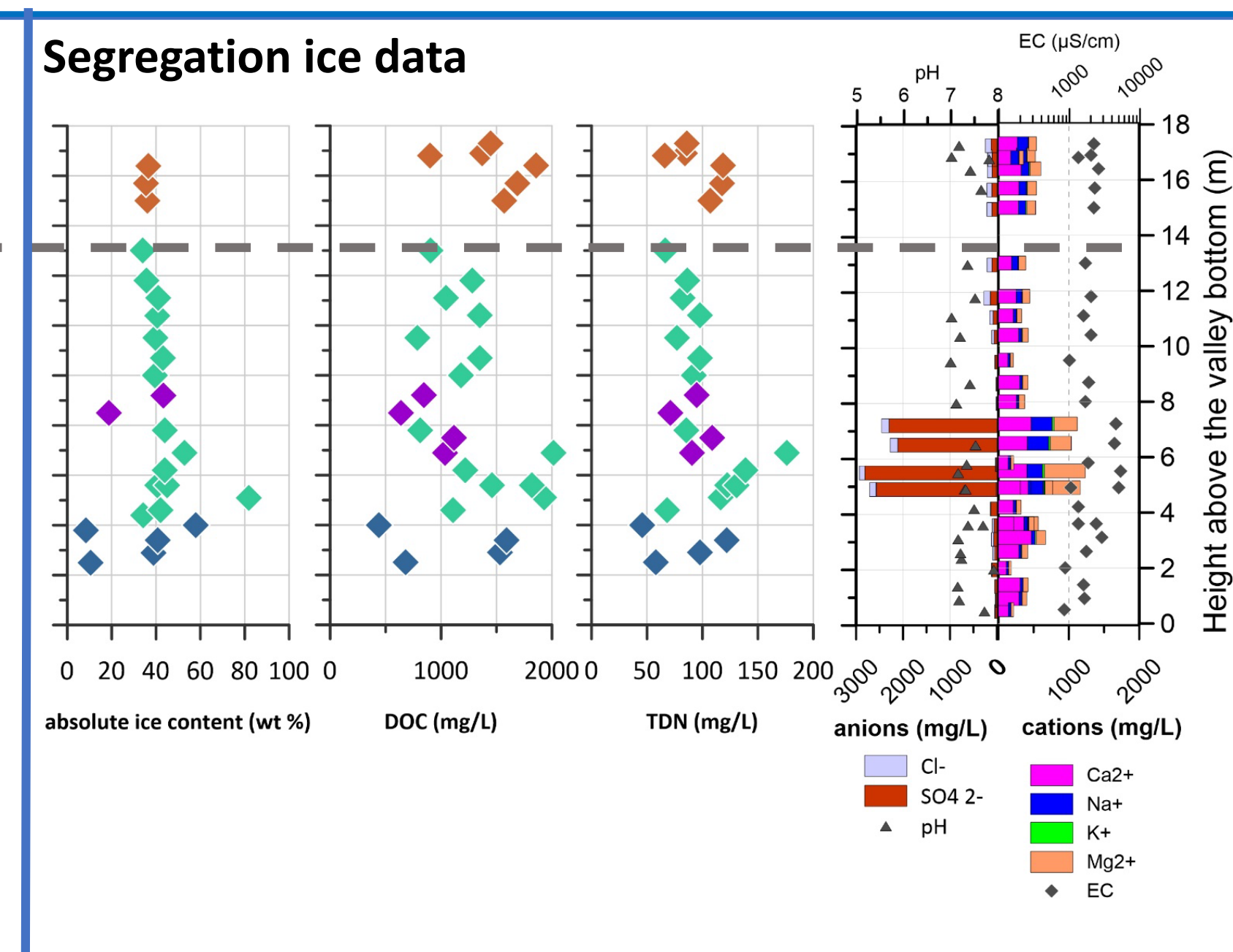
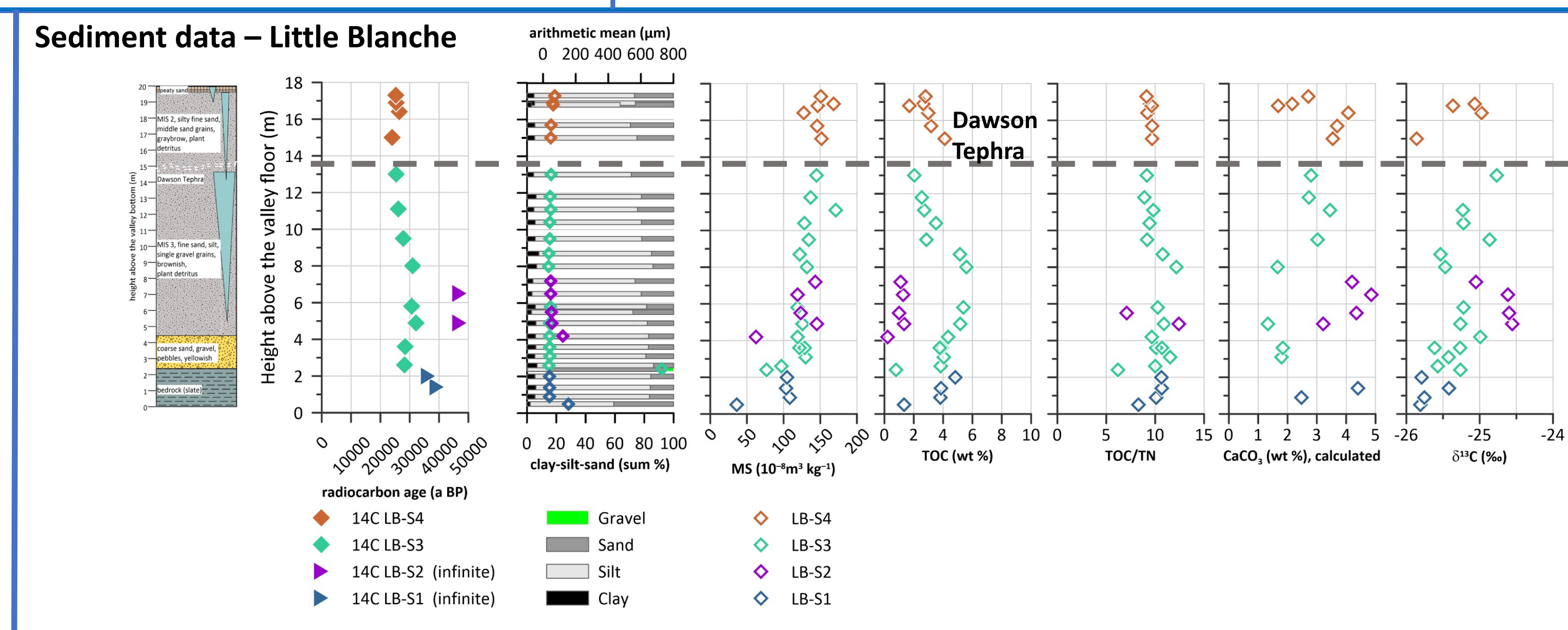
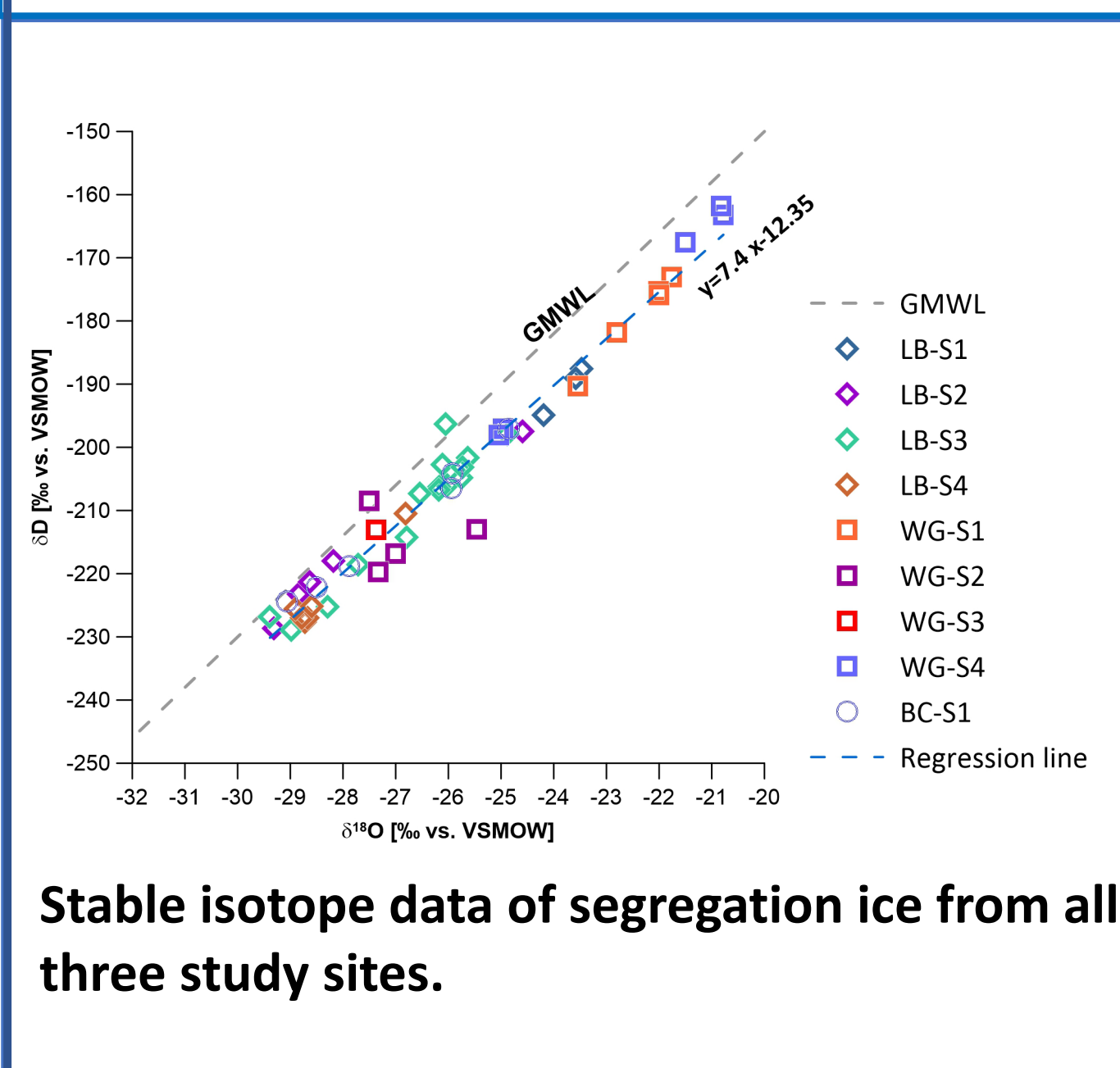
- Classification of Sheep Creek Tephra Klondike (kind information from B. Jensen) and infinite ¹⁴C-ages suggest an lower MIS 5a horizon
- Above a horizon without ice wedges (studied in 2019 by Trevor Porter) belong to the MIS 4
- Sediment dominated by silt, MS rises from 50 to 140 10⁻⁸m³kg⁻¹ (i.e. the mineralogical composition has changed)
- Most sediment and segregation-ice data are in similar ranges as other ice-rich permafrost sites in Alaska and Siberia.

Little Blanche

- Four sub-profiles (LB-S1 to LB-S4) along a trail were studied.
- The Dawson tephra (Aleutian volcanoes about 24 ka BP) is a very good stratigraphic time marker
- The lower parts belong to the MIS 3 Interstadial, and the upper part to the MIS 2 Stadial, which is the typical for Yedoma Ice Complex
- The sediment consists mostly of fine sandy silt, with some gravel grains in the lowermost part above the bedrock. The mass-specific magnetic susceptibility gradually increases upwards from 36 to 171 10⁻⁸m³ kg⁻¹. This means that the mineralogical composition of the sediment changes. The LB-S2 sub-profile highlights a number of higher data (TOC, CaCO₃, δ¹³C, EC, and ion contents)

Whitman Gulch

- Classified to the end of MIS 2 (Lateglacial) and the MIS 1 (Holocene).
- Fine sand and silt, partly with peaty layers and ground squirrel nests
- pH values of segregation ice of 7 to 8 do not scatter as wide as in the other exposures
- Remarkable very high SO₄²⁻ content of segregation ice in the lowest horizon of a Lateglacial to early Holocene valley filling



Conclusions and Outlook

- The three study sites provided an impression of the environmental conditions in the Klondike area between MIS 5a and MIS 1.
- Local stratigraphies are highly dependent on predefined older valley morphologies, and correlations between study sites are difficult.
- The Sheep Creek Tephra Klondike and the Dawson Tephra indicate good stratigraphic orientations.
- Regarding the sediment composition and the segregation ice parameters, the studied deposits largely correspond to the typical picture of the circumarctic Yedoma Ice Complex deposits.
- Ongoing analyses of ice-wedge stable isotopes, biomarkers (*n*-alkanes, GDGTs), and luminescence dating will complement the presented data.
- The existing sample set enables also paleoecological studies in the future (e.g. pollen, large plant remains, chironomid, cladocera, ostracod, and mollusk communities).

References (examples)

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