

1 **Supplement to Seemann et al.**

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4 Table S1: Characteristics of coring sites on the Barrow Peninsula.

	Upland	DLB	West Twin Lake	East Twin Lake*	Thermokarst lagoon	Elson lagoon
Coring date	2022.04.21	2022.04.22	2022.04.19	2022.04.20	2022.04.20	2022.04.21
Latitude	71.27637	71.2772	71.27396	71.2753	71.2632	71.29008212
Longitude	-156.45296	-156.44311	-156.49699	-156.45296	-156.42355	-156.47186
Elevation (m a.s.l.)	3.3	2.9	2.0	2.4	0.0	0.0
Area (ha)	n/a	105.1	130.6	127.6	80.1	12,500
Sediment core length (m)	2.04	1.42	0.23	1.38*	0.46	1.10
Sediment physical state	frozen	frozen	unfrozen	unfrozen	unfrozen	semi-frozen
Coring device	SIPRE	SIPRE	Push	Vibra	SIPRE	SIPRE
Waterbody depth (m)	n/a	n/a	1.81	1.75	0.94	1.16
Ice thickness (m)	n/a	n/a	1.75	1.46	0.94	1.16
Total water depth (m)	n/a	n/a	1.81	1.75	0.94	1.16
Liquid water temperature (°C)	n/a	n/a	0.04	0.30	-12.7	-
Liquid water electrical conductivity (mS cm ⁻¹)	n/a	n/a	0.002	12.0	20.2	-

5 *East Twin Lake core 118 cm compressed

Table S2: Upland core photograph and description (picture: Fabian Seemann). In the top-left of the photograph, the top of the core is visible and in the bottom-right the core bottom is located. The core is split in halves and cleaned in a climate chamber to reveal colors, structures and properties.





Photograph	Depth (cm)	Description
	0-3	Recent vegetation, dark brown.
	3-12	Light brown layers, ice lenses of 1 cm length between 4-8 cm, massive ice between 8-12 cm, silty, peat band of 2 cm diameter at 7 cm depth.
	12-38	Ice-rich, dark/light brown cryoturbated, organic-rich, few macro plant remains at 27 cm, silty peat.
	38-69	Silty light grey, ataxitic, macro plant remains.
	69-83	ice-rich, dark brown, organic-rich, cryoturbation at 77-82 cm.
	83-133	Light-grey silty, no organic remains visible, very ice-rich, reticular ice lenses.
	133-174	Grey (darker than above), silty, reticula and lenticula ice lenses, ice bands.
	174-193	Darker than above, very ice-rich (50 %), silty, thick lenses (1 cm chaotically orientated), no organics visible.
	193-204	Ataxitic with sediment inclusions.


Table S3: West Twin Lake core photograph and description (picture: Fabian Seemann).

Photograph	Depth (cm)	Description
	0-23	Blackish brown, poorly decomposed organic matter, no minerals visible, drier downwards.


15 Table S4: East Twin Lake core photograph and description (pictures: Fabian Seemann). The core is compressed
16 by 118 cm due to vibration during coring.

Photograph	Depth (cm)	Description
	0-15	Dark brown, macro-remains, poorly decomposed, high water content, no minerals visible.
	15-22	Lighter brown to grey-ish, fine minerals, poorly decomposed organics, macro-remains.
	22-27	Black/brown (organics), grey-blue-ish (minerals).
	27-51	High water content, fine sand, silty, yellow-ish, grey, few macro remains.
	51-60	As above but more oxidized, more orange, lower water content, woody macro remains at 59 cm.
	60-80	Black-ish, dark grey to medium grey, less water content, no plant macro remains, visible fines (clayey silt).
	80-93	Dark grey-ish, black, coarser as above, oxidized, organic inclusions (brown grey).
	93-108	Continuation of brownish-grey silty material.
	108-128	Dark, blackish-grey, silty and denser.
	128-138	Same color but less dense, more water due to higher pore space.
		

19 Table S5: Drained Lake Basin core photograph and description (pictures: Fabian Seemann).

Photograph	Depth (cm)	Description
	0-14	Water saturated peat, 8-14 cm partly decomposed peat, black/brown.
	14-18	Less water saturated, more peat than water, first sediment inclusions.
	18-21	Transition peat to silt, brown grey, diagonal macro-lense (3*0.5 cm horizontal wavy micro-lenses).
	21-29	Brown grey, silt, horizontal macro-lense 1*0.5 cm, two large vertical cracks (6 cm long, 0.5 cm wide).
	29-33	Pure peat (sec. Lake phase prob.), brown to light brown.
	33-79	Ich-rich, lenticula (max. 0.5 cm thick), also reticula structure, at 39 cm (1*1 cm) organic inclusion, at 45-52 cm and 62-71 thicker ice lense.
	79-93	Cryoturbated horizon, black-brown (org.)-grey (sandy silt) turbations, 90-93 cm black band, thin ice-lenses 1 mm, 3 cm long.
	93-97	Sandy-silt band, ice band 1 mm horizontal 5 cm long, more smaller ice bands vertical + horizontal, at 96-97 cm black circular structure (1 cm diameter).
	97-104	Brown matrix with macro remains, sandy silt, mixed with black (highly decomposed) fine silts.
	104-107	Sandy silt, grey, macro remains, few micro-lenses.
	107-115	Dark black, highly decomposed.
	115-122	Brown grey, sandy silt, black dots of 0.5 cm, structureless.
	122-131	As above, less black, ice-rich along the core-side.
	131-142	Sandy silt, with micro-lenses (horizontal, few vertical), like above concerning ice content.

22 Table S6: Semi-open thermokarst lagoon core photograph and description (pictures: Fabian Seemann).

Photograph	Depth (cm)	Description
	0-2	Grey, brown, fines.
	2-9	Black, loose organics, ice-bands without orientation 1 mm.
	9-11	Brown grey, fines, organic-rich, vertical ice-bands 1 mm.
	11-12	Grey, silt band.
	12-23	Like at 2-9 cm, fine laminated, black, organic-rich.
	23-31	Laminated with wider (4-5 mm), vertical ice-bands, greyish black.
	31-40	Laminated, wider than above, no ice-bands.
	40-43	Black, brown, laminated.
	43-46	Black dots, not laminated.

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Table S7: Elson Lagoon core photograph and description (pictures: Fabian Seemann).


Photograph	Depth (cm)	
	0-6	Dark brown, fine laminated, un-orientated 2 mm ice-bands.
	6-9	3-4 mm thick ice-bands, un-orientated, more ice than above, brown.
	9-16	Unfrozen structureless, dark brown.
	16-27	Horizontal laminations, 3-4mm, black, brown, grey, silty; at 16-24 cm horizontal ice bands 1 mm thick, at 24-27 cm un-orientated ice-bands.
	27-31	3 laminations: light brown, grey.
	31-36	Horizontal ice-bands 2-4 mm wide.
	36-37	Finer than above, thin horizontal ice-bands.
	37-44	Horizontal ice-bands, laminated, coarser than above, silty.
	44-63	Un-orientated ice-bands 1-3 mm wide, light brown grey, laminations.
	63-65	Very fine laminations, brighter downwards, fine vertical ice-bands.
	65-66	Like at 44-63 cm but darker.
	66-78	Ice-bands 1 mm wide from vertical to horizontal (cryoturbated?), dark dots in bright silt.
	78-93	Laminations dark black, brown, sand (at 79 cm, 84 cm) microlenses vertical and horizontal (potentially through deformation).
	93-98	Sandy silt to silty sand transition, brownish grey, lighter than above.
	98-101	Sand layer, 3 rounded pebbles (diameter 2 cm), 1 pebble of granite (?).
	101-110	Sediment layers of 0.5 cm brown, grey, black, slightly; u-shaped (deformation by corer?), silty sand, sandy silt.

Table S8: Radiocarbon data.

AWI MICADAS sample ID*	Sample label	Depth (cm)	Material dated	¹⁴ C age (yr BP)	+/-	Calibrated age 2s range (yr cal BP)**	Mean calibrated age (yr cal BP)
12524.1.1	BRW22-UL 5-14	7.5	Plant remains	-157	54		modern
12525.1.1	BRW22-UL 25-30	27.5	Plant remains	5,734	69	6,392-6,675	6,534
12526.1.1	BRW22-UL 50-55	52.5	Plant remains	5,931	72	6,604-6,946	6,775
12527.1.1	BRW22-UL 70-80	75	Plant remains	6,105	73	6,785-7,165	6,975

12528.1.1	BRW22-UL 98-106	102	Plant remains	6,074	76	6,777-7,159	6,968
12529.1.1	BRW22-UL 123-128	125.5	Plant remains	6,394	77	7,161-7,430	7,296
12530.1.1	BRW22-UL 180-192	186	Bulk sediment	11,413	32	13,179-13,347	13,263
12520.1.1	BRW22-WTL 3-13	8	Plant remains	2,285	60	2,121-2,432	2,277
12521.1.1	BRW22-ETL 3-13	8***	Plant remains	2,810	64	2,765-3,075	2,920
12522.1.1	BRW22-ETL 70-80	75***	Bulk sediment	23,542	60	27,596-27,863	27,730
12523.1.1	BRW22-ETL 116-126	121***	Bulk sediment	38,823	194	42,371-42,761	42,566
12531.1.1	BRW22-DLB 19-22	20.5	Plant remains	709	57	623-729	676
12532.1.1	BRW22-DLB 26-35	30.5	Plant remains	1,311	30	1,242-1,294	1,268
12533.1.1	BRW22-DLB 50-55	52.5	Plant remains	2,129	107	1,865-2,342	2,104
12534.1.1	BRW22-DLB 70-77	73.5	Plant remains	9,348	87	10,255-10,768	10,512
12535.1.1	BRW22-DLB 105-110	107.5	Plant remains	8,842	36	9,723-9,968	9,846
12536.1.1	BRW22-DLB 131-142	136.5	Bulk sediment	29,541	87	33,877-34,376	34,127
12540.1.1	BRW22-SOL 16-21	18.5	Plant remains	6,369	142	6,949-7,514	7,232
12541.1.1	BRW22-SOL 41-46	43.5	Plant remains	4,096	114	4,290-4,860	4,575
12537.1.1	BRW22-EL 0-4	2	Plant remains	4,811	111	5,308-5,753	5,531
12538.1.1	BRW22-EL 34-39	36.5	Plant remains	4,694	114	5,046-5,605	5,326
12539.1.1	BRW22-EL 74-78	76	Plant remains	5,312	84	5,929-6,224	6,077

* AWI MICADAS sample number based on Mollenhauer et al.(2021).

** Radiocarbon calibration was conducted using Calib 8.20 software and the IntCal 20 calibration curve (Reimer et al., 2020; Stuiver and Reimer, 1993).

***East Twin Lake core 118 cm compressed

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References

- Mollenhauer, G., Grotheer, H., Gentz, T., Bonk, E., and Hefter, J.: Standard operation procedures and performance of the MICADAS radiocarbon laboratory at Alfred Wegener Institute (AWI), Germany, Nuclear Instruments and Methods in Physics Research Section B: Beam Interactions with Materials and Atoms, 496, 45–51, <https://doi.org/10.1016/j.nimb.2021.03.016>, 2021.
- Reimer, P. J., Austin, W. E. N., Bard, E., Bayliss, A., Blackwell, P. G., Ramsey, C. B., Butzin, M., Cheng, H., Edwards, R. L., Friedrich, M., Grootes, P. M., Guilderson, T. P., Hajdas, I., Heaton, T. J., Hogg, A. G., Hughen, K. A., Kromer, B., Manning, S. W., Muscheler, R., Palmer, J. G., Pearson, C., Plicht, J. van der, Reimer, R. W., Richards, D. A., Scott, E. M., Southon, J. R., Turney, C. S. M., Wacker, L., Adolphi, F., Büntgen, U., Capano, M., Fahrni, S. M., Fogtmann-Schulz, A., Friedrich, R., Köhler, P., Kudsk, S., Miyake, F., Olsen, J., Reinig, F., Sakamoto, M., Sookdeo, A., and Talamo, S.: The IntCal20 Northern Hemisphere Radiocarbon Age Calibration Curve (0–55 cal kBP), Radiocarbon, 62, 725–757, <https://doi.org/10.1017/RDC.2020.41>, 2020.
- Stuiver, M. and Reimer, P. J.: Extended 14C Data Base and Revised CALIB 3.0 14C Age Calibration Program, Radiocarbon, 35, 215–230, <https://doi.org/10.1017/S0033822200013904>, 1993.