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Supplement of

The cryostratigraphy of thermo-erosion gullies in the Canadian High Arctic demonstrates the resilience of permafrost

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S1. Calculation of thaw front depth (TFD) from temperatures recorded by thermistor cables.

TFD was interpolated linearly using ground temperature of the two depths encompassing 0°C on 29 July 2017 and 30 July 2018. Temperature values were recorded with thermistor cables at 0 cm, 10 cm, 20 cm, 30 cm, 40 cm, 80 cm, 120 cm, 160 cm, 200 cm, and 300 cm.

S2. Calculation of volumetric ice content (VIC) and weighted average VIC and OMC.

Volumetric ice content (VIC; $cm^3_{ice}\ cm^{-3}_{soil}$ (Phillips et al., 2015)) was calculated using:

$$VIC = m_w\ (V_t\ \rho_{ice})^{-1}$$

where m_w is the mass of water in the sample, V_t is the total volume of the frozen sample, and ρ_{ice} is the density of ice, 0.917 g cm^{-3} (Andersland and Ladanyi, 2004). The frozen samples were vacuum sealed in plastic bags to determine their total volume (V_t) using the water displacement method (Strauss et al., 2013). After, the samples were weighted, dried in an oven at 105°C until dry, and reweighted to determine the water content (m_w).

To obtain continuous VIC for the complete length of the boreholes, VIC values were assumed to be the same for the entirety of a given cryostructure where they were sampled. When multiple VIC values for the same cryostructure were available, the weighted average VIC (VIC_{wa}) was calculated and used instead. OMC and soil composition values were calculated in a similar manner to VIC: they were assumed to be the same for the entirety of the corresponding stratigraphic layer and when multiple values for the same layer were available, the weighted average OMC (OMC_{wa})/soil composition were used.

Table S1. Thaw front depth measured on 29 July 2017 and 30 July 2018 with probing at different locations in the two thermo-erosion gullies (TEG1 and TEG2) and by linear interpolation from ground temperature measurements at two reference stations in undisturbed conditions (BYLOTPD and IP-A).

Site	Position	Thaw front depth 29 July 2017	Thaw front depth 30 July 2018
TEG1_TFD1	Shoulders	22	25
	Slopes	42	39
	Bottom of gully channel	42	28
TEG1_TFD2	Shoulders	41	52
	Slopes	53	52
	Bottom of gully channel	41	39
TEG1_TFD3	Shoulders	27	
	Slopes	44	
	Bottom of gully channel	40	

TEG1_TFD4	Shoulders	14	
	Slopes	46	
	Bottom of gully channel	33	
TEG2_TFD1	Shoulders		44
	Slopes		27
	Bottom of gully channel		53
TEG2_TFD2	Shoulders		34
	Slopes		30
	Bottom of gully channel		53
TEG2_TFD3	Shoulders		44
	Slopes		35
	Bottom of gully channel		62
BYLOTPD	Undisturbed polygon	22	26
IP-A	Undisturbed polygon	34	34

Table S2. Proportion of the types of sediments composing the cryostructures in all boreholes from thermo-erosion gullies R05 and R08. The proportion was calculated by dividing the total length of a type of sediment within a cryostructure by the total length covered by the cryostructure.

Types of sediment in each cryostructure	Proportion (%)
Crustal	
Silty sandy gravel	81.0
Gravelly silty sand	19.0
Ice veins	
Sandy silt	100.0
Interstitial	
Silty sand	67.6
Sandy silt	29.7
Sandy silt, peaty	2.7
Interstitial visible	
Silty sand	79.3
Sandy silt	15.5
Gravelly silty sand	5.2
Layered	
Sandy silt	63.0
Silty sand	37.0
Lenticular	
Sandy silt	100.0
Lenticular (ice lens)	
Sandy silt	73.8
Sandy silt, peaty	12.3
Silty sand	10.8
Silty sandy gravel	3.1
Organic matrix	
Sandy silt, peaty	60.3
Silty sand, peaty	39.7
Poorly defined (transitional)	
Sandy silt	60.9
Silty sand, peaty	21.8
Silty sand	12.6
Sandy silt, peaty	4.6
Reticulate	
Sandy silt	85.5
Gravelly sandy silt	7.8
Silty sand	4.9
Silty sand, peaty	1.8
Suspended	

Sandy silt	68.4
Silt	15.1
Silty sand	13.8
Gravelly silty sand	1.8
Silty sand, peaty	0.9

Table S3. Proportion of cryostructures in all cores, in each core, each thermo-erosion gully (TEG1 and TEG2), and for the geocryological layers.

Site	Proportion of cryostructure (%)										
	IV	IIL	Len	Cru	In	PD	Iv	Sus	Lay	Org	Re
All	0.9	1.9	2.1	2.5	4.3	5.1	7.9	13.2	17.4	18.5	26.2
TEG1	0.8	2.3	1.1	4.9	6.9	4.6	14	6.6	15.4	20.9	22.6
TEG1-1$_{Undist}$	0	1.5	0	52.3	16.9	0	21.5	0	0	0	7.7
TEG1-2$_{Undist}$	0	2.7	0	0	0	0	20.9	0	36.4	13.6	26.4
TEG1-3$_{Undist}$	0	0	0	0	0	0	0	0	47.9	52.1	0
TEG1-1$_{Drained}$	0	0	0	0	50.7	0	0	15.1	0	34.2	0
TEG1-2$_{Drained}$	0	1.9	0	0	0	3.8	22.6	32.1	0	14.2	25.5
TEG1-3$_{Drained}$	0	0.5	0	0	12.1	0	8.2	0	38.5	28.6	12.1
TEG1-1$_{Slope}$	0	2.7	0	7.1	0	18.8	21.4	0	0	18.8	31.3
TEG1-2$_{Slope}$	6.5	9.3	8.4	0	0	13.1	20.6	1.9	10.3	16.8	13.1
TEG1-3$_{Slope}$	0	0	0	0	0	0	5.3	9.5	0	9.5	75.8
TEG2	0.9	1.5	3.2	0	1.8	5.6	1.9	19.7	19.4	16.2	29.8
TEG2-1$_{Undist}$	0	0	9.8	0	0	2.7	0	26.8	2.7	15.2	42.9
TEG2-2$_{Undist}$	0	0	0	0	0	0	0	19.2	34.6	37.5	8.7
TEG2-1$_{Drained}$	8.3	8.3	5.2	0	0	0	0	5.2	7.3	38.5	27.1
TEG2-2$_{Drained}$	0	0	0	0	2	7	0	0	45	25	21
TEG2-1$_{Slope}$	0	3	5	0	0	16	0	17	4	21	34
TEG2-2$_{Slope}$	0	0	6.7	0	6.7	0	0	34.4	26.7	0	25.6
TEG2-3$_{Slope}$	0	2	0	0	0	6.9	8.9	0	29.7	0	52.5
TEG2$_{BGC}$	0	0	0	0	4.6	9.8	4.6	43.1	11.1	0	26.8
Frozen AL	0	2.5	6.5	4.7	8.6	14.4	16.5	0	0	42.8	4
Transient L	3.1	1.1	3.1	9.3	6.2	5.8	16.2	0	2.2	23	30.1
Intermediate L	0	1.8	1.9	0	0	2.8	1.2	30.2	27.9	2.3	31.9
Buried IL	0	4.6	0	0	0	0	2.5	16.6	38.5	4.9	32.9
Permafrost	2.3	0	0	2.3	10.2	5.1	11.1	1.7	6.8	33.8	26.7

Cryostructures: IV = Ice vein, IIL = Isolated ice lens, Len = Lenticular, Cru = Crustal, In = Interstitial, PD = Poorly defined, Iv = Interstitial visible, Sus = Suspended, Lay = Layered, Org = Organic matrix, Re = Reticulate

Geocryological layers: Frozen AL = Frozen part of the active layer, Transient L = Transient layer, Intermediate L = Intermediate layer, Buried IL = Buried intermediate layer

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