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Past climate and continentality inferred from ice wedges at Batagay megaslump in the Northern Hemisphere's most continental region, Yana Highlands, interior Yakutia

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Table S1. Studied ice wedges.

Photograph	**Ice-wedge features**
Ice wedge B17-IW1 **Batagay megaslump – Lower Ice Complex**	
	Width: ~0,5 m Visible vertical extension: ~1 m Colour: dirty grey Ice veins: partly detectable, width up to 1 cm Sediment content: very little to little Organic content: very little Bubble content: very high; very small bubbles (<0.5 mm); often rather cloudy; following the ice veins Remarks: truncated; upper left part partly degraded → shoulder + pool ice

Ice wedge B17-IW6

Batagay megaslump – Upper Ice Complex

Width: ~0.5 m
Visible vertical extension: ~ 1.5 m
Colour: grey
Ice veins: clearly detectable, up to 1 cm wide
Sediment content: high (sandy ice wedge)
Organic content: very little
Bubble content: very little to medium; some spherical bubbles up to 2 mm in diameter; some elongated bubbles up to 2 cm long and 1-2 mm in diameter; very small bubbles in centre of veins

Ice wedge B17-IW5

Batagay megaslump – Upper Ice Complex

Width: ~1.6 m
Visible vertical extension: > 5 m
Colour: clear, grey ice
Ice veins: clearly detectable, partly with sediment inclusions, about 1 cm wide
Sediment content: little to medium
Organic content: very little
Bubble content: medium to high; spherical bubbles 2-3 mm in diameter, elongated bubbles up to 1 cm long and 1-2 mm in diameter; very small cloud-like bubbles in centre of veins
Remarks: none

Composite wedges B17-IW2 (left) and B17-IW3 (right)

Batagay megaslump – Upper Sand unit

Width: 0.2-0.3 m (left) and 0.2m (right), respectively

Visible vertical extension: ~3m

Colour: grey

Ice veins: partly detectable; up to 0.5-1 cm wide, very thin sand veins

Sediment content: high to very high (composite wedges)

Organic content: not detectable

Bubble content: very little; very small bubbles

Remarks: truncated; both wedges unite downwards into one wedge.

Ice wedge B17-IW4

Batagay megaslump – Upper Sand unit

Width: ~0.4 m

Visible vertical extension: ~2 m

Colour: grey

Ice veins: clearly detectable, partly with sediment in the centre, width 0.5-1 cm; very thin sand veins

Sediment content: little to medium

Organic content: very little

Bubble content: medium to high; elongated bubbles up to 2 cm long and about 1mm in diameter; very small bubbles in centres of ice veins

Remarks: cut ~45° to growth direction

Ice wedge A17-IW3

Adycha river – Late Holocene river bank

Width: ~0.3 m

Visible vertical extension: ~3m

Colour: milky white

Ice veins: clearly detectable, up to 1 cm wide

Sediment content: little

Organic content: little

Bubble content: very high; some spherical bubbles up to 1 mm in diameter; many small, partly elongated bubbles along ice veins

Remarks: Cut about 45° to growth direction

Table S2. Stable-isotope data of the studied ice wedges incl. samples excluded from further analysis.

Sample ID	$\delta^{18}O$ (‰)	δD (‰)	*d* (‰)	Comments
B17-IW1				
B17-IW1-01	-33.15	-258.3	6.9	
B17-IW1-02	-33.19	-257.9	7.5	
B17-IW1-03	-33.09	-256.7	8.0	
B17-IW1-04	-33.16	-257.3	8.0	
B17-IW1-05	-33.04	-255.0	9.4	
B17-IW1-06	-32.91	-254.8	8.5	
B17-IW2				
B17-IW2-01	-32.47	-242.8	16.9	
B17-IW2-02	-32.87	-249.3	13.7	
B17-IW2-03	-33.04	-250.2	14.1	
B17-IW2-04	-32.95	-247.9	15.7	
B17-IW3				
B17-IW3-01	-31.60	-236.4	16.4	
B17-IW3-02	-32.14	-244.2	12.9	
B17-IW4				
B17-IW4-01	-29.71	-223.9	13.8	
B17-IW4-02	-29.88	-226.7	12.4	
B17-IW4-03	-30.10	-229.6	11.2	
B17-IW4-04	-29.91	-229.3	10.0	
B17-IW4-05	-30.03	-229.4	10.8	
B17-IW4-06	-29.94	-228.2	11.3	
B17-IW4-07	-30.01	-223.7	16.5	Excluded (distinctly elevated *d* excess)
B17-IW4-08	-29.41	-212.9	22.3	Excluded (distinctly elevated δD and *d* excess)
B17-IW5				
B17-IW5-01	-33.50	-260.8	7.3	

B17-IW5-02	-34.37	-267.5	7.4	
B17-IW5-03	-34.52	-269.4	6.8	
B17-IW5-04	-34.67	-269.7	7.7	
B17-IW5-05	-34.21	-265.6	8.1	
B17-IW5-06	-34.04	-264.6	7.7	
B17-IW5-07	-34.63	-268.8	8.2	
B17-IW5-08	-35.43	-274.9	8.5	
B17-IW5-09	-35.97	-279.0	8.8	
B17-IW5-10	-36.17	-280.6	8.7	
B17-IW5-11	-36.06	-280.3	8.2	
B17-IW5-12	-35.07	-270.2	10.3	
B17-IW6				
B17-IW6-01	-33.91	-251.4	19.9	Excluded (distinctly elevated δD and *d* excess)
B17-IW6-02	-35.52	-274.3	9.8	
B17-IW6-03	-35.43	-274.9	8.5	
B17-IW6-04	-34.99	-268.8	11.1	
B17-IW6-05	-34.27	-259.7	14.4	
B17-IW6-06	-33.19	-246.3	19.2	Excluded (distinctly elevated δD and *d* excess)
A17-IW3-01	-25.73	-200.1	5.7	Excluded (high sediment content, elevated $\delta^{18}O$ and δD)
A17-IW3-02	-28.15	-220.5	4.7	
A17-IW3-03	-28.42	-221.8	5.6	
A17-IW3-04	-28.84	-225.7	5.1	
A17-IW3-05	-29.15	-228.0	5.2	
A17-IW3-06	-29.62	-230.9	6.0	
A17-IW3-07	-30.40	-236.6	6.6	
A17-IW3-08	-29.79	-231.1	7.3	
A17-IW3-09	-28.63	-223.9	5.1	

A17-IW3-10	-28.26	-221.7	4.4	
A17-IW3-11	-28.56	-223.1	5.5	

Table S3. Stable isotope data of Marine Isotope Stage 3 ice wedges in northeast Siberia showing mean values of $\delta^{18}O$. δD and *d* and respective standard deviations.

Site ID.	Site	°N	°E	Age [ka ^{14}C BP]	$\delta^{18}O$ [‰]	δD [‰]	*d* [‰]	N	Reference	profile ID
1	Western Laptev Sea. Mamontov Klyk	73.6	117.1	27.2	-30.5±0.7	-241.5±6.2	2.2±0.6	4	Magens (2005)	MAK-IW-18
2	Lena Delta. Nagym	72.9	123.2	>54.5 to 44.2	-29.3±0.3	-228.2±3.1	5.8±0.9	12	Schirrmeister et al. (2003)	Nag6-20-I
3	Lena Delta. Khardang	73.0	124.2	>52.1 to 28.1	-30.1±1.3	-239.3±9.0	1.6±2.2	10	Schirrmeister et al. (2011)	Kha-3-I
4	Lena Delta. Kurungnakh	72.3	126.3	50.0 to 31.9	-31.6±0.6	-247.6±4.0	5.3±1.2	11	Schirrmeister et al. (2003); Wetterich et al. (2008)	Bkh3-I-3. Bkh IW II
5	Lena Delta. Sobo Sise	72.5	128.3	47.7 to 26.9	-29.7±1.1	-230.7±8.7	7.2±0.9	16	Opel (unpublished)	SOB14-IW3
6	Central Laptev Sea. Bykovsky	72.0	129.3	50 to 30	-30.8±1.6	-242.8±11.4	3.7±1.7	145	Meyer et al. (2002a). Meyer/Opel (unpublished)	MKh 3 (2 horizontal transects. 1 vertical transect). LD10-18
7	Central Laptev Sea. Muostakh	71.6	130.0	46.8 to 28.3	-31.9±1.2	-250.4±9.4	5.1±0.9	85	Meyer/Opel (unpublished)	MUO12-IW7. MUO12-IW8
8	Central Laptev Sea. Buor Khaya	71.6	132.2	>48.0 to 30.1	-31.2±1.0	-245.0±7.8	4.5±0.7	26	Schirrmeister et al. (2017)	Buo-04. BK8
9	New Siberian Islands. Belkovsky	75.4	135.6	47.7 to >39.8	-31.3±0.4	-243.2±4.6	7.0±2.2	21	Schirrmeister/ Meyer (unpublished)	BEL-IW-1
10	New Siberian Islands. Stolbovoy	74.1	136.1	>50.0 to >40.8	-31.7±0.4	-248.0±4.9	5.3±1.9	16	Schirrmeister/ Meyer (unpublished)	STO-IW-1

11	New Siberian Islands. Kotel'ny	74.7	138.5	52.8 to 35.4	-29.8±1.0	-232.4±9.7	5.6±2.5	17	Schirrmeister/ Meyer (unpublished)	KYS-IW-1
12	New Siberian Islands. Bol'shoy Lyakhovsky	73.3	141.5	53.8 to 29.0	-31.0±1.2	-240.9±11.0	6.8±2.4	196	Wetterich et al. (2014); Meyer et al. (2002b); Opel et al. (2017)	LYA-R9-1. LYA-R8-1. TZ-2-5. TZ-2-4. TZ-2-2. R10-1. R10-2. TZ-3-1. L7-18
13	Dmitry Laptev Strait. Oyogos Yar	72.7	143.5	48.5 to 32.2	-30.8±1.3	-240.8±10.9	5.9±1.7	150	Opel et al. (2017)	Oy7-01-4. Oya-IW6. Oya-IW2. Oy7-06-IW1. Oya-IW-5. Oy7-06-IW2. Oy7-08 IW1. Oy7-08-IW3. Oya-IW3. Oya-IW4
14	New Siberian Islands. Novaya Sibir	75.1	146.7	>51.7 to >38.3	-33.5±0.6	-260.7±6.2	7.0±1.4	5	Schirrmeister/ Meyer (unpublished)	NSI-IW-4
15	Lower Kolyma. Duvanny Yar	68.6	159.1	>46.7 to 32.2	-32.6±1.00	-256.9±9.9	3.7±2.0	9	Strauss (2010)	DY-01. DY-05
16	Yana Highlands. Batagay	67.6	134.8	47.6 to 24.9	-34.9±0.9	-271.0±6.4	8.1±0.9	12	this study	B17-IW5
16	Yana Highlands. Batagay	67.6	134.8	undated	-35.7	-276.0	9.2	59	Vasil'chuk et al. (2017)	IW no. 2
17	Central Yakutia Aldan River. Tanda	63.3	131.7	undated	-30.5±0.3	-234.4±2.6	9.5±0.5	10	Schirrmeister (unpublished)	Tan-I
18	Central Yakutia. Aldan River. Mamontova Gora	63.0	134.0	46.7 to 34.0	-30.5±0.6	-236.6±4.8	7.6±0.6	18	Popp et al. (2006)	MGO-I

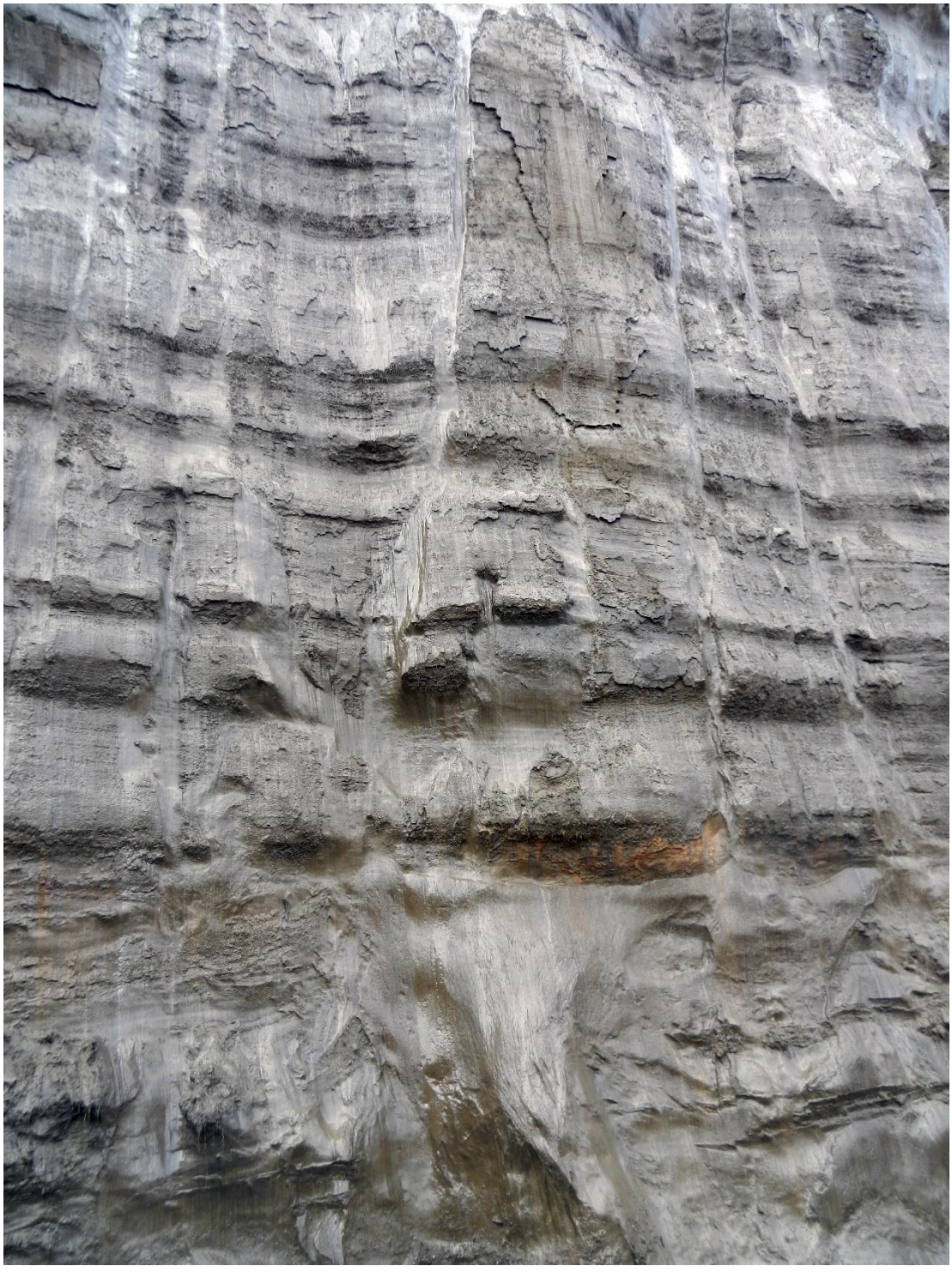

Figure S1. Erosional contact between Lower Ice Complex and Lower Sand.

Figure S2. Transition of Lower Sand unit to Upper Ice Complex showing different kinds of ice-wedge toes.

Figure S3. Transition from Upper Ice Complex to Upper Sand showing the upward tapering of the wide syngenetic ice wedges. the subvertical and downslope orientation of the narrow syngenetic composite wedges. as well as complexity of wedge shoulders. thaw unconformities and narrowing ice wedges.

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