

*Supplement of*

**From fibrous plant residues to mineral-associated organic carbon – the fate of organic matter in Arctic permafrost soils**

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**Table S1:** Basic properties of bulk soil samples and result of the fractionation: pH (measured in H<sub>2</sub>O), EC ( $\mu\text{S cm}^{-1}$ ), bulk density ( $\text{g cm}^{-3}$ ), C ( $\text{mg g}^{-1}$ ), N ( $\text{mg g}^{-1}$ ), C/N ratio and the distribution of SOM fractions ( $\text{mg g}^{-1}$ ) for the bulk soil samples of all analyzed depth layers. The particulate organic matter fractions are free (fPOM), occluded (oPOM) and small occluded (oPOMs) particulate organic matter.

depth	pH	EC	bulk density	C	N	C/N ratio	distribution of SOM fractions						
							particulate OM fractions			mineral-associated OM fractions			
							fPOM	oPOM	oPOMs	clay-sized	silt-sized	sand-sized	
cm	(H <sub>2</sub> O)	$\mu\text{S cm}^{-1}$	$\text{g cm}^{-3}$	$\text{mg g}^{-1}$	$\text{mg g}^{-1}$		$\text{mg g}^{-1}$						
core 1	11-22	5.5	69	0.3	55.2	1.6	36	107.6	5.9	4.4	98.4	192.3	591.5
	22-30	6.5	153	0.3	61.9	2.2	29	103.6	16.5	9.0	141.6	294.2	435.1
	30-40	6.2	87	0.4	32.9	1.4	24	36.4	14.0	9.5	113.5	257.6	568.9
	40-50	6.0	98	0.3	48.9	1.5	33	89.7	13.4	7.4	138.3	286.5	464.6
	50-62	5.4	69	0.6	47.5	1.9	25	70.6	12.1	12.1	134.5	243.9	527.8
	62-75	5.3	87	0.4	60.3	2.4	25	91.2	19.2	17.7	181.7	311.8	378.4
core 2	30-40	5.1	117	0.4	95.8	2.8	34	223.7	27.0	5.4	171.7	314.8	257.4
	40-50	5.1	174	0.3	109.8	3.6	31	260.6	20.8	13.1	244.5	336.8	124.2
	50-60	5.1	240	0.2	144.0	3.8	38	295.0	22.9	218.4	122.5	247.2	94.1
	60-70	4.9	203	0.4	61.7	2.4	26	99.2	57.8	267.2	101.3	395.6	79.0
core 3	11-20	6.6	85	0.5	45.8	1.3	37	62.8	52.5	82.3	37.2	182.4	582.8
	20-30	6.1	75	0.9	31.6	1.3	25	30.2	30.0	116.0	43.7	255.1	525.0
	40-50	5.8	134	0.4	47.9	2.1	23	169.6	20.5	176.4	97.7	305.2	230.6
	59-68	6.0	76	0.9	52.2	2.0	26	115.6	11.1	125.4	60.1	316.6	371.2
	68-80	5.8	124	0.4	135.7	4.3	32	206.8	71.7	167.1	124.8	301.6	128.1
core 4	0-10	5.5	76	0.4	56.2	3.3	17	155.5	6.6	18.2	119.6	197.0	503.0
	10-20	5.8	66	0.6	33.2	1.5	22	75.7	3.0	3.9	121.8	241.9	553.7
	20-30	5.6	82	0.6	37.6	2.0	19	50.2	8.9	12.7	148.6	315.8	463.9
	30-40	5.6	125	0.4	77.8	3.1	25	202.0	15.2	15.8	176.8	265.5	324.7
	40-50	6.0	73	0.9	33.5	2.2	15	16.2	8.7	22.8	163.5	366.1	422.8
	50-60	5.7	121	0.7	84.5	6.3	13	10.6	34.3	111.7	214.5	439.6	189.3
	60-70	5.5	161	0.3	85.5	6.3	14	11.3	37.2	125.5	216.7	467.0	142.2
	70-79	5.6	147	0.3	91.7	6.8	14	13.7	30.2	133.0	231.6	479.3	112.2

**Table S2:** Properties of SOM fractions: C per fraction (mg C (soil g)<sup>-1</sup>), N per fraction (mg N (soil g)<sup>-1</sup>), C/N ratio,  $\delta^{13}\text{C}$  (‰ V-PDB) and  $\delta^{15}\text{N}$  (‰ air N<sub>2</sub>) for free particulate (fPOM), occluded particulate (oPOM), small occluded particulate (oPOMs) and clay-sized mineral-associated organic matter (MAOM).

depth	cm	fPOM					oPOM					oPOMs					clay-sized MAOM				
		C per fraction mg C (soil g) <sup>-1</sup>	N per fraction mg N (soil g) <sup>-1</sup>	C/N ratio	$\delta^{13}\text{C}$ ‰ V-PDB	$\delta^{15}\text{N}$ ‰ air N <sub>2</sub>	C per fraction mg C (soil g) <sup>-1</sup>	N per fraction mg N (soil g) <sup>-1</sup>	C/N ratio	$\delta^{13}\text{C}$ ‰ V-PDB	$\delta^{15}\text{N}$ ‰ air N <sub>2</sub>	C per fraction mg C (soil g) <sup>-1</sup>	N per fraction mg N (soil g) <sup>-1</sup>	C/N ratio	$\delta^{13}\text{C}$ ‰ V-PDB	$\delta^{15}\text{N}$ ‰ air N <sub>2</sub>	C per fraction mg C (soil g) <sup>-1</sup>	N per fraction mg N (soil g) <sup>-1</sup>	C/N ratio	$\delta^{13}\text{C}$ ‰ V-PDB	$\delta^{15}\text{N}$ ‰ air N <sub>2</sub>
core 1	11-22	765.9	361.4	76	-26.9	1.4	41.2	28.6	52	-26.2	1.3	19.4	45.6	15	-27.3	1.0	147.2	453.4	12	-27.0	1.8
	22-30	641.6	366.3	51	-28.2	0.7	108.3	56.4	55	-27.8	1.0	36.0	61.2	17	-28.0	0.9	188.8	428.7	13	-28.1	1.8
	30-40	437.1	164.1	64	-26.5	0.9	174.1	61.9	68	-26.4	0.9	69.7	106.8	16	-27.5	0.8	270.3	534.2	12	-27.2	1.7
	40-50	674.8	311.1	71	-26.8	0.9	106.7	51.5	67	-25.8	1.2	27.6	54.1	17	-27.1	1.0	152.2	445.9	11	-27.2	2.1
	50-62	588.3	305.4	49	-28.3	0.8	105.6	42.2	64	-28.0	1.4	50.5	90.6	14	-28.4	1.1	222.2	470.2	12	-28.5	-0.4
	62-75	533.1	300.3	44	-26.0	1.0	134.6	56.1	60	-25.3	1.0	76.7	114.4	17	-26.9	1.1	218.4	438.0	13	-26.9	1.1
core 2	30-40	780.3	508.2	53	-26.8	0.8			<i>outlier</i>			13.7	31.5	15	-27.3	0.9	118.0	358.2	11	-27.8	1.6
	40-50	722.0	438.5	50	-27.1	0.9	71.7	35.0	63	-26.5	1.1	30.7	55.5	17	-26.9	0.7	158.2	424.3	11	-27.5	1.6
	50-60	674.6	384.9	66	-26.3	1.0	58.5	40.1	55	-26.4	1.1	194.7	367.6	20	-26.5	1.8	64.4	176.0	14	-26.0	3.2
	60-70	538.8	226.8	61	-25.7	0.7			<i>outlier</i>			265.7	514.4	13	-26.6	2.8	92.7	161.5	15	-26.9	3.4
core 3	11-20	527.0	356.4	51	-27.3	-0.3			<i>outlier</i>			222.9	341.7	22	-26.0	1.8	76.7	167.7	16	-24.1	2.9
	20-30	373.9	229.3	41	-26.9	0.8			<i>outlier</i>			394.5	469.5	21	-25.8	2.3	99.1	175.8	14	-25.5	3.0
	40-50			<i>outlier</i>			165.4	33.3	113	-25.3	0.7	427.7	387.5	25	-25.0	2.4	131.3	194.7	15	-25.1	2.3
	59-68	608.3	463.1	35	-25.8	0.7	82.1	33.9	64	-26.2	0.7	216.3	293.9	19	-25.6	2.9	59.4	118.5	13	-25.5	3.1
	68-80	499.3	283.3	56	-25.6	1.0	195.8	142.7	43	-25.7	1.3	228.1	386.5	19	-25.6	1.3	65.1	147.5	14	-25.4	2.3
core 4	0-10	543.0	385.7	24	-27.9	0.4	50.6	23.7	37	-26.9	1.5	105.7	141.3	13	-28.2	0.2	250.7	371.2	12	-27.7	0.3
	10-20	645.9	329.3	43	-27.3	1.2	34.5	18.2	42	-27.0	2.4	21.4	27.0	18	-27.7	1.3	249.3	480.9	12	-28.0	1.4
	20-30	419.3	199.1	39	-30.2	1.3	102.1	54.2	35	-30.4	2.4	94.3	108.4	16	-30.1	1.5	311.7	506.3	11	-30.4	1.6
	30-40	616.2	390.3	39	-30.6	0.2	81.9	35.1	58	-30.4	0.7	63.0	87.9	18	-30.0	0.6	208.3	416.6	13	-29.7	1.0
	40-50	157.0	85.6	28	-30.1	-0.2	114.3	60.0	29	-30.6	0.2	224.7	202.4	17	-30.6	0.3	431.4	522.9	12	-31.2	0.6
	50-60	52.5	27.6	25	-30.2	0.3	178.3	127.6	19	-30.1	0.6	456.1	466.9	13	-31.1	0.1	275.0	319.1	12	-31.3	0.3
	60-70	55.1	34.3	22	-31.2	0.0	190.1	140.4	18	-30.5	0.6	473.8	481.6	13	-31.5	-0.0	223.7	263.7	12	-31.8	0.4
	70-79	63.6	39.6	22	-30.4	0.5	147.9	104.3	19	-30.0	0.7	479.7	485.8	13	-31.2	0.2	249.2	289.96	11.7	-31.6	0.2

**Table S3:** Decomposition proxies obtained by <sup>13</sup>C CP-MAS NMR spectroscopy per depth layer for free particulate (fPOM), occluded particulate (oPOM), small occluded particulate (oPOMs) and clay-sized mineral-associated organic matter (MAOM).

depth cm	fPOM		oPOM		oPOMs		clay-sized MAOM		
	a/oa ratio	70-75/52-57 ratio	a/oa ratio	70-75/52-57 ratio	a/oa ratio	70-75/52-57 ratio	a/oa ratio	70-75/52-57 ratio	
core 1	11-22	0.15	9.71	0.16	9.40	0.59	2.55	0.47	2.07
	22-30	0.15	6.96	0.16	8.68	0.58	2.49	0.52	2.26
	30-40	0.13	7.95	0.09	14.95	0.57	2.56	0.46	2.33
	40-50	0.12	11.38	0.12	10.27	0.63	2.23	0.62	2.06
	50-62	0.18	5.90	0.12	12.39	0.61	2.44	0.49	2.58
	62-75	0.21	5.21	0.10	11.57	0.61	3.15	0.47	2.53
core 2	30-40	0.18	5.80		<i>outlier</i>	0.54	2.68	<i>nd</i>	<i>nd</i>
	40-50	0.17	5.87	0.10	8.79	0.47	2.81	<i>nd</i>	<i>nd</i>
	50-60	0.12	7.36	0.14	5.68	0.34	2.77	<i>nd</i>	<i>nd</i>
	60-70	0.16	4.87		<i>outlier</i>	0.39	1.83	<i>nd</i>	<i>nd</i>
core 3	11-20	0.14	5.64		<i>outlier</i>	0.25	3.07	<i>nd</i>	<i>nd</i>
	20-30	0.16	4.21		<i>outlier</i>	0.26	2.65	<i>nd</i>	<i>nd</i>
	40-50		<i>outlier</i>	0.08	8.58	0.19	3.20	0.40	1.88
	59-68	0.25	3.80	0.09	5.81	0.28	2.77	<i>nd</i>	<i>nd</i>
	68-80	0.13	5.46	0.16	4.02	0.38	2.80	<i>nd</i>	<i>nd</i>
core 4	0-10	0.21	4.18	0.22	6.48	0.50	2.70	0.43	2.17
	10-20	0.08	5.27	0.21	4.28	0.67	2.42	0.47	1.71
	20-30	0.11	5.17	0.30	4.36	0.68	2.27	<i>nd</i>	<i>nd</i>
	30-40	0.16	4.88	0.09	9.38	0.48	3.15	<i>nd</i>	<i>nd</i>
	40-50	0.34	3.16	0.29	4.64	0.75	2.12	0.53	1.85
	50-60	0.32	3.75	0.39	3.79	0.55	2.50	<i>nd</i>	<i>nd</i>
	60-70	0.57	2.21	0.41	3.63	0.58	2.52	<i>nd</i>	<i>nd</i>
	70-79	0.38	4.34	0.42	3.83	0.55	2.65	<i>nd</i>	<i>nd</i>

Figure S1: Exemplary  $^{13}\text{C}$  CP-MAS NMR spectra of fPOM, oPOM, oPOMs and clay-sized MAOM fraction of one depth layer.

