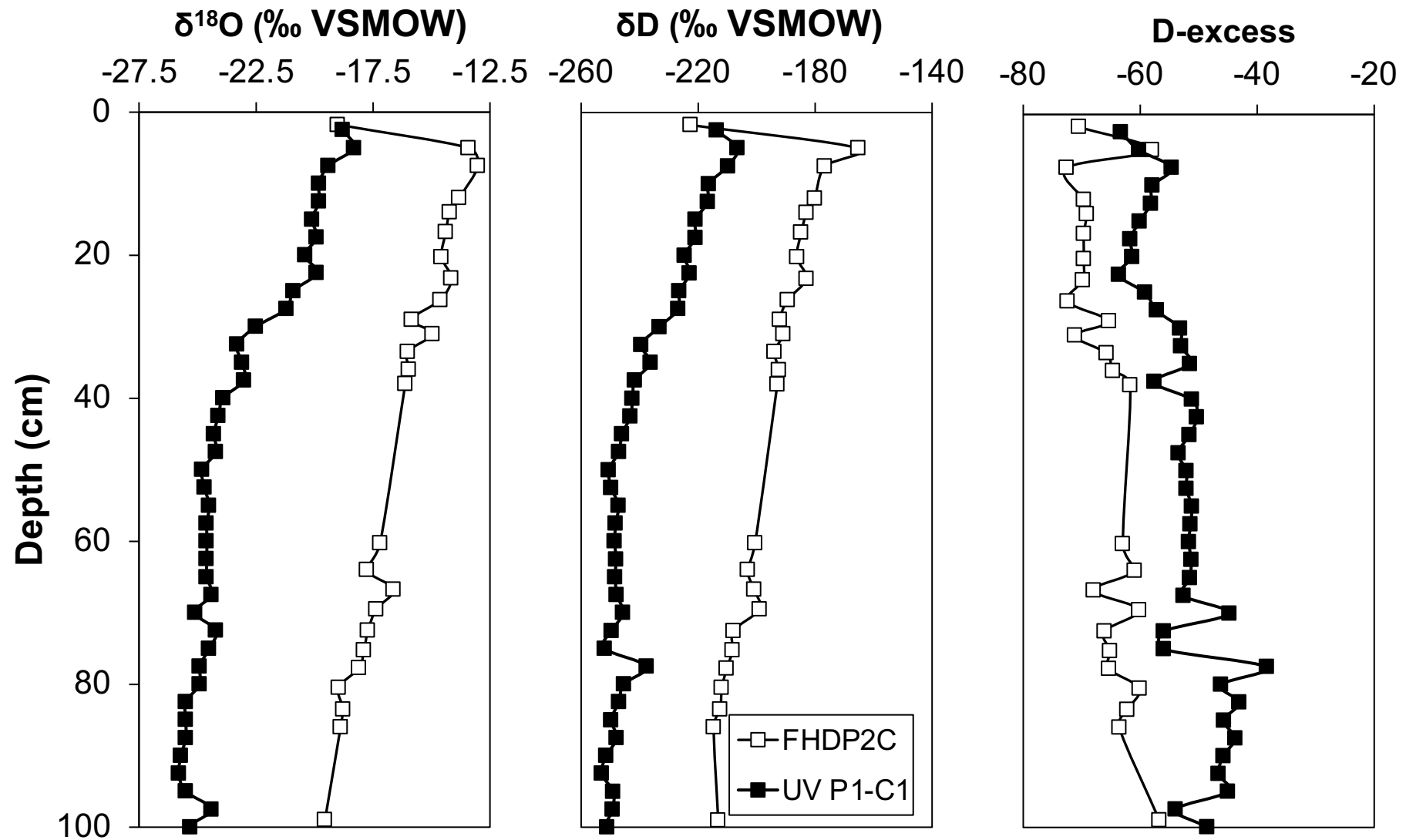


**Figure S1:** Photos of stratigraphic units 1-7 and tephra layer in core FHDP2C



**Figure S2:** Comparison between  $\delta^{18}\text{O}$ ,  $\delta\text{D}$  and D-excess profiles within the first meter of ice permafrost in (ice table at 0 cm) in University Valley site P1-C1 (Lapalme et al., 2017) and FHDP2C

**ST1: Gravimetric water content (GWC), volumetric ice content (VIC) and excess ice measured in FHDP1A**

<b>Sample ID</b>	<b>MID Depth (cm)</b>	<b>GWC (%)</b>	<b>VIC (%)</b>	<b>Excess Ice (%)</b>	<b>Cryofacies</b>
1A-C1-1	118	14.1	29.4	6.2	IRS
1A-C1-2	212.5	6.6	10.1	0.0	IPS
1A-C2-1	271.5	8.2	11.7	0.0	IPS
1A-C3-1	348.5	9.0	14.4	0.0	IPS
1A-C3-2	418	4.6	6.9	0.0	IPS
1A-C4-1	557.5	3.6	5.9	0.0	IPS
1A-C5-1	664.5	7.6	10.7	0.0	IPS
1A-C6-1	1519	6.6	7.1	0.0	IPS
1A-C6-2	1533	5.5	6.9	0.0	IPS
1A-C6-3	1551	10.0	9.5	0.0	IPS
1A-C6-4	1569	4.4	5.7	0.0	IPS
1A-C6-5	1596.5	3.5	5.6	0.0	IPS
1A-C7-1	1715.5	9.8	13.9	0.0	IPS
1A-C8-1	1790.5	5.4	7.8	0.0	IPS
1A-C9-1	1891.5	5.0	7.7	0.0	IPS
1A-C10-1	1977	10.1	14.2	0.0	IPS
1A-C10-2	2023.5	7.3	10.0	0.0	IPS
1A-C11-1	2075.5	10.0	12.4	0.0	IPS
1A-C12-1	2137.5	7.4	10.2	0.0	IPS
1A-C13-1	2247.5	6.7	9.7	0.0	IPS
1A-C13-2	2294	16.8	18.6	0.0	IPS
1A-C14-1	2378.5	6.4	11.1	0.0	IPS
1A-C15-1	2472.5	7.4	10.5	0.0	IPS
1A-C16-1	2541.5	5.8	9.2	0.0	IPS
1A-C17-1	2642.5	9.8	16.4	0.0	IPS
1A-C18-1	2716.5	8.4	14.2	0.0	IPS
1A-C19-1	2820.5	5.6	8.9	0.0	IPS
1A-C20-1	2930.5	8.3	13.9	0.0	IPS
1A-C21-1	3011.5	5.5	8.9	0.0	IPS
1A-C22-1	3115.5	5.6	8.7	0.0	IPS
1A-C23-1	3196	20.6	27.3	0.0	IRS
1A-C24-1	3288.5	24.3	31.4	0.0	IRS
1A-C24-2	3335	12.8	17.6	0.0	IPS
1A-C25-1	3410.5				

**ST2: Gravimetric water content (GWC), volumetric ice content (VIC) and excess ice measured in FHDP1B**

<b>Sample ID</b>	<b>Depth MID (cm)</b>	<b>GWC (%)</b>	<b>VIC (%)</b>	<b>Excess Ice (%)</b>	<b>Cryofacies</b>
1B-C2-1	1474.5	3.3	5.3		0 IPS
1B-C2-2	1497	7.1	9.3		0 IPS
1B-C2-3	1507	9.4	9.0		0 IPS
1B-C2-4	1526.5	4.4	5.7		0 IPS
1B-C2-5	1550	6.6	8.4		0 IPS
1B-C3-1	1580.5	9.5	9.9		0 IPS
1B-C3-2	1603	4.8	6.1		0 IPS
1B-C3-3	1621	3.4	5.3		0 IPS

**ST3: Gravimetric water content (GWC), volumetric ice content (VIC) and excess ice measured in FHDP2A**

<b>Sample ID</b>	<b>MID Depth (cm)</b>	<b>GWC (%)</b>	<b>VIC (%)</b>	<b>Excess Ice (%)</b>	<b>Cryofacies</b>
2A-C1-1	90	14.7	19.7	0.0	IPS
2A-C1-2	112.5	28.9	47.0	16.5	IRS
2A-C1-3	160	12.2	16.1	0.0	IPS
2A-C2-1	203.5	11.0	13.6	0.0	IPS
2A-C3-1	246	13.8	16.4	0.0	IPS
2A-C3-2	328	6.7	8.9	0.0	IPS
2A-C4-1	380.5	11.9	14.1	0.0	IPS
2A-C4-2	398	12.4	14.4	0.0	IPS
2A-C4-3	407	19.2	19.0	0.0	IPS
2A-C5-1	440.5	9.5	11.9	0.0	IPS
2A-C5-2	485.5	9.3	11.0	0.0	IPS
2A-C5-3	506	20.4	18.9	0.0	IPS
2A-C5-4	527	10.7	12.3	0.0	IPS
2A-C6-1	575.5	4.9	7.0	0.0	IPS
2A-C6-2	621	6.3	10.0	0.0	IPS
2A-C7-1	675.5	6.6	10.2	0.0	IPS
2A-C9-1	1044.5	5.2	7.9	0.0	IPS
2A-C9-2	1117	6.8	9.1	0.0	IPS
2A-C10-1	1170.5	4.5	7.2	0.0	IPS
2A-C10-2	1224	6.8	9.6	0.0	IPS
2A-C11-1	1271.5	6.7	9.7	0.0	IPS
2A-C11-2	1305.5	4.7	6.9	0.0	IPS
2A-C11-3	1320.5	4.0	5.7	0.0	IPS
2A-C12-1	1357	4.7	6.5	0.0	IPS
2A-C12-2	1388.5	2.6	4.2	0.0	IPS
2A-C13-1	1436	3.0	4.5	0.0	IPS
2A-C13-2	1486.5	4.0	5.7	0.0	IPS
2A-C14-1	1541	4.9	6.5	0.0	IPS
2A-C14-2	1590.5	4.0	5.8	0.0	IPS
2A-C15-1	1627	5.0	6.6	0.0	IPS
2A-C15-2	1680.5	3.4	4.9	0.0	IPS
2A-C16-1	1715	12.8	15.6	0.0	IPS
2A-C16-2	1743.5	11.1	12.7	0.0	IPS
2A-C16-3	1755.5	11.8	14.0	0.0	IPS
2A-C16-4	1775.5	12.7	14.4	0.0	IPS

**BAGGED SAMPLES**

<b>Sample ID</b>	<b>MID Depth (cm)</b>	<b>GWC (%)</b>	<b>VIC (%)</b>	<b>Excess Ice (%)</b>	<b>Cryofacies</b>
FHDP-2A-S2	408	19.2	17.9	0.0	IPS
FHDP-2A-S3	418	23.5	20.7	0.0	IPS
FHDP-2A-S4	428	13.8	16.0	0.0	IPS
FHDP-2A-S5	438	16.2	17.2	0.0	IPS
FHDP-2A-S6	648	6.2	8.6	0.0	IPS
FHDP-2A-S7	665	3.7	5.0	0.0	IPS
FHDP-2A-S8	687	5.4	6.0	0.0	IPS
FHDP-2A-S9	929	3.2	4.8	0.0	IPS
FHDP-2A-S10	1023	4.4	6.3	0.0	IPS
FHDP-2A-S11	1039	4.0	6.1	0.0	IPS
FHDP-2A-S12	1049	5.4	7.1	0.0	IPS
FHDP-2A-S13	1083	7.6	8.8	0.0	IPS
FHDP-2A-S14	1093	7.4	9.7	0.0	IPS
FHDP-2A-S15	1149	6.4	7.3	0.0	IPS
FHDP-2A-S16	1175	5.2	7.5	0.0	IPS
FHDP-2A-S17	1203	5.6	8.7	0.0	IPS

**ST4: Gravimetric water content (GWC), volumetric ice content (VIC) and excess ice measured in FHDP3A**

<b>Sample ID</b>	<b>MID Depth (cm)</b>	<b>GWC (%)</b>	<b>VIC (%)</b>	<b>Excess Ice (%)</b>	<b>Cryofacies</b>
3A-C4-1	1507	3.6	4.6	0.0	IPS
3A-C4-2	1524.5	3.5	4.6	0.0	IPS
3A-C4-3	1540.5	6.9	6.1	0.0	IPS
3A-C4-4	1575.5	5.1	4.4	0.0	IPS
3A-C5-1	1586	7.9	6.9	0.0	IPS
3A-C5-2	1604	5.4	5.7	0.0	IPS
3A-C5-3	1616.5	10.3	13.0	0.0	IPS
3A-C5-4	1641	4.6	6.8	0.0	IPS
3A-C6-1	1716.5	7.6	10.6	0.0	IPS
3A-C7-1	1795.5	12.0	15.7	0.0	IPS
3A-C7-2	1828.5	12.9	17.4	0.0	IPS
3A-C7-3	1843.5	11.7	14.7	0.0	IPS
3A-C8-1	1904.5	8.2	11.2	0.0	IPS
3A-C9-1	1990.5	7.4	10.6	0.0	IPS
3A-C9-2	2041.5	9.9	12.6	0.0	IPS
3A-C10-1	2082	8.0	10.7	0.0	IPS
3A-C10-2	2135.5	10.6	14.8	0.0	IPS
3A-C11-1	2163	5.8	9.1	0.0	IPS
3A-C11-2	2232	10.0	16.4	0.0	IPS
3A-C12-1	2274.5	15.8	19.6	0.0	IPS
3A-C12-2	2305.5	10.9	13.6	0.0	IPS
3A-C13-1	2397	9.8	13.3	0.0	IPS
3A-C14-1	2434	9.8	12.6	0.0	IPS
3A-C14-2	2462.5	9.3	13.4	0.0	IPS
3A-C14-3	2513.5	7.8	11.3	0.0	IPS
3A-C15-1	2553.5	7.4	11.3	0.0	IPS
3A-C16-1	2649.5	8.1	11.5	0.0	IPS
3A-C16-2	2711	12.0	15.0	0.0	IPS
3A-C17-1	2723	10.6	14.5	0.0	IPS
3A-C17-2	2765.5	10.6	16.0	0.0	IPS
3A-C17-3	2815.5	12.3	18.2	0.0	IPS
3A-C18-1	2856.5	12.9	19.5	0.0	IPS
3A-C18-2	2908	11.9	17.9	0.0	IPS
3A-C19-1	2954	13.7	18.1	0.0	IPS
3A-C19-2	2959	14.4	20.9	0.0	IPS
3A-C19-3	2964	13.1	19.2	0.0	IPS
3A-C20-1	3036	9.1	12.6	0.0	IPS
3A-C20-2	3091.5	9.2	12.6	0.0	IPS
3A-C21-1	3153.5	9.8	14.0	0.0	IPS
3A-C21-2	3199.5	11.3	15.8	0.0	IPS
3A-C22-1	3211.5	10.2	13.5	0.0	IPS
3A-C22-2	3225.5	13.0	14.9	0.0	IPS

3A-C22-3	3233.5	14.2	19.5	0.0 IPS
3A-C22-4	3255.5	12.1	17.6	0.0 IPS
3A-C22-5	3297.5	12.3	17.7	0.0 IPS
3A-C23-1	3307.5	11.0	14.2	0.0 IPS
3A-C23-2	3350.5	13.7	18.6	0.0 IPS
3A-C23-3	3392.5	12.5	16.0	0.0 IPS
3A-C24-1	3426.5	13.0	17.6	0.0 IPS
3A-C24-2	3477	11.0	15.2	0.0 IPS
3A-C25-1	3506	15.6	19.1	0.0 IPS
3A-C25-2	3539	14.6	20.0	0.0 IPS
3A-C25-3	3582	6.5	9.3	0.0 IPS
3A-C26-1	3669.5	10.6	12.7	0.0 IPS
3A-C27-1	3717.5	15.1	15.2	0.0 IPS
3A-C27-2	3736.5	21.7	36.2	6.7 IRS
3A-C28-1	3785.5	8.0	10.3	0.0 IPS
3A-C29-1	3896.5	7.6	10.4	0.0 IPS
3A-C30-1	3980	7.3	10.2	0.0 IPS
3A-C30-2	4035.5	10.0	12.3	0.0 IPS
3A-C31-1	4110.5	10.3	12.6	0.0 IPS
3A-C32-1	4189	14.1	15.9	0.0 IPS
3A-C32-2	4240.5	13.1	16.0	0.0 IPS
3A-C33-1	4265.5	9.8	12.1	0.0 IPS
3A-C33-2	4307	13.3	14.9	0.0 IPS
3A-C33-3	4333.75	21.8	29.1	9.6 IRS
3A-C33-4	4337	20.0	25.2	7.6 IRS
3A-C33-5	4341.5	42.3	63.6	42.3 SRI
3A-C33-6	4344.5	22.4	35.0	11.3 IRS
3A-C34-1	4411.5	12.9	14.6	0.0 IPS
3A-C35-1	4460.5	7.1	10.9	0.0 IPS
3A-C35-2	4495	11.1	14.9	0.0 IPS
3A-C35-3	4498	15.6	20.9	0.0 IPS
3A-C35-4	4511	32.8	30.8	0.0 IRS
3A-C35-5	4514.5	23.5	23.6	0.0 IPS
3A-C36-1	4544.5	15.5	21.6	0.0 IPS
3A-C36-2	4549.5	15.1	16.7	0.0 IPS
3A-C36-3	4575.5	8.2	11.4	0.0 IPS
3A-C36-4	4590.5	12.6	18.5	0.0 IPS
3A-C37-1	4686.5	6.4	8.7	0.0 IPS
3A-C38-1	4778.5	6.8	9.6	0.0 IPS
3A-C39-1	4874.5	7.3	11.2	0.0 IPS
3A-C40-1	4937	12.3	15.7	0.0 IPS
3A-C40-2	4955	13.4	15.7	0.0 IPS
3A-C40-3	4972.5	17.6	16.1	0.0 IPS
3A-C40-4	4985.5	15.2	18.6	0.0 IPS
3A-C40-5	4999.5	17.9	18.6	0.0 IPS



3A-C41-1	5011	24.1	21.5	0.0 IPS
3A-C41-2	5021.5	12.9	15.9	0.0 IPS
3A-C41-3	5032.5	1.7	2.3	0.0 IPS
3A-C41-4	5044.5	16.3	19.3	0.0 IPS

**BAGGED SAMPLES**

<b>Sample ID</b>	<b>MID Depth (cm)</b>	<b>GWC (%)</b>	<b>VIC (%)</b>	<b>Excess Ice (%)</b>	<b>Cryofacies</b>
FHDP-3A-8.5	808	2.9	4.3	0.0	IPS
FHDP-3A-9.0	858	2.1	3.1	0.0	IPS
FHDP-3A-9.5	908	1.6	2.6	0.0	IPS
FHDP-3A-10.0	958	2.3	2.8	0.0	IPS
FHDP-3A-10.5	1008	1.3	1.4	0.0	IPS
FHDP-3A-11.0	1058	1.2	1.6	0.0	IPS
FHDP-3A-11.5	1108	1.2	1.7	0.0	IPS
FHDP-3A-12.0	1158	1.2	1.9	0.0	IPS
FHDP-3A-12.5	1208	1.1	1.7	0.0	IPS
FHDP-3A-13.0	1258	1.1	1.8	0.0	IPS
FHDP-3A-13.5	1308	1.1	1.8	0.0	IPS
FHDP-3A-14.0	1358	1.6	2.1	0.0	IPS
FHDP-3A-14.5	1408	2.7	3.8	0.0	IPS
FHDP-3A-15.0	1440	2.4	3.1	0.0	IPS
FHDP-3A-15.95	1535	3.7	4.4	0.0	IPS
FHDP-3A-16.10	1553	10.5	9.9	0.0	IPS
FHDP-3A-16.55	1593	10.3	9.6	0.0	IPS

**ST5: Gravimetric water content (GWC), volumetric ice content (VIC) and excess ice measured in FHDP2C**

Sample ID	Facies	MID Depth (cm)	GWC (%)	VIC (%)	Excess Ice (%)	Cryofacies
2C-C1-1	Sandstone	34.75				
2C-C1-2	Sandstone	38	23.6	40.0	12.0	IRS
2C-C1-3	Sandstone	40.5				
2C-C1-4	Sandstone	42.75	14.8	19.3	0.0	IPS
2C-C1-5	Sandstone	45				
2C-C1-6	Interstrat. mud-sand	47	31.7	50.0	19.9	IRS
2C-C1-7	Interstrat. mud-sand	49.75	28.2	45.7	16.0	IRS
2C-C1-8	Interstrat. mud-sand	53.25	33.4	51.1	21.6	SRI
2C-C1-9	Interstrat. mud-sand	56.25				
2C-C1-10	Sandstone	59.25	39.9	64.8	41.4	SRI
2C-C1-11	Sandstone	62	36.3	61.1	35.8	SRI
2C-C1-12	Sandstone	64				
2C-C1-13	Diamict	66.5	22.9	39.5	9.4	IRS
2C-C1-14	Diamict	69	17.4	31.1	2.6	IRS
2C-C1-15	Diamict	71	16.7	28.6	0.0	IRS
2C-C1-16	Diamict	73	11.9	17.0	0.0	IPS
2C-C1-17	Diamict	75.5				
2C-C1-18	Diamict	78	10.3	16.2	0.0	IPS
2C-C1-19	Clast	81.5				
2C-C1-20	Clast	87.5				
2C-C1-21	Diamict	93.25	27.4	47.2	18.3	IRS
2C-C1-22	Diamict	97	20.6	31.7	0.0	IRS
2C-C1-23	Diamict	99.75			0	
2C-C1-24	Diamict	102.5	18.0	27.5	0.0	IRS
2C-C1-25	Diamict	105.5	27.3	65.8	56.2	SRI
2C-C1-26	Diamict	108.25	38.5	60.6	34.0	SRI
2C-C1-27	Diamict	110.75	32.0	55.0	30.9	SRI
2C-C1-28	Diamict	113.5	31.1	48.7	17.7	IRS
2C-C1-29	Diamict	116.5	20.7	31.7	0.0	IRS
2C-C1-30	Diamict	119				
2C-C2-1	Diamict	121	12.8	22.6	0.0	IPS
2C-C2-2	Diamict	123.5	10.3	14.1	0.0	IPS
2C-C2-3	Diamict	126	13.2	16.5	0.0	IPS
2C-C2-4	Diamict	128	22.7	34.3	1.7	IRS
2C-C2-5	Diamict	130	13.7	19.6	0.0	IPS
2C-C2-6	Diamict	132	15.5	26.0	0.0	IRS
2C-C2-7	Diamict	134.25	13.6	17.8	0.0	IPS
2C-C2-8	Diamict	136.75	13.9	17.6	0.0	IPS
2C-C2-9	Diamict	139.25	11.7	14.4	0.0	IPS
2C-C2-10	Diamict	141.75	11.1	14.2	0.0	IPS
2C-C2-11	Diamict	144.25	11.7	15.7	0.0	IPS
2C-C2-12	Diamict	146.75				

2C-C2-13	Diamict	149.5	11.4	14.7	0.0 IPS
2C-C2-14	Diamict	152.5	15.2	18.0	0.0 IPS
2C-C2-15	Diamict	155.5	12.4	14.6	0.0 IPS
2C-C2-16	Diamict	158.5	12.5	16.2	0.0 IPS
2C-C2-17	Diamict	161.5	11.9	15.3	0.0 IPS
2C-C2-18	Diamict	164.25	10.0	12.9	0.0 IPS
2C-C2-19	Diamict	166.75	10.1	13.9	0.0 IPS
2C-C2-20	Diamict	169.5	12.8	17.0	0.0 IPS
2C-C2-21	Diamict	172.5	12.7	16.4	0.0 IPS
2C-C2-22	Diamict	175	11.4	14.2	0.0 IPS
2C-C2-23	Diamict	177	10.7	13.4	0.0 IPS
2C-C2-24	Diamict	179.5			
2C-C2-25	Diamict	184.5	9.2	13.7	0.0 IPS
2C-C2-26	Diamict	189.25	10.2	15.5	0.0 IPS
2C-C2-27	Diamict	191.75	9.6	12.4	0.0 IPS
2C-C2-28	Diamict	195	9.3	12.4	0.0 IPS
2C-C2-29	Clast	205.5			
2C-C3-1	Clast	220.5			
2C-C3-2	Clast	233			
2C-C3-3	Diamict	246	9.6	11.9	0.0 IPS
2C-C3-4	Diamict	251	10.4	12.6	0.0 IPS
2C-C3-5	Diamict	253.5	10.3	12.3	0.0 IPS
2C-C3-6	Diamict	256.5	10.1	12.1	0.0 IPS
2C-C3-7	Diamict	259.5	7.2	9.6	0.0 IPS
2C-C3-8	Diamict	262.5	7.9	10.3	0.0 IPS
2C-C3-9	Interstrat. mud-sand	265.5	12.9	14.3	0.0 IPS
2C-C3-10	Interstrat. mud-sand	268.5	16.6	17.3	0.0 IPS
2C-C3-11	Interstrat. mud-sand	271.5	13.1	14.4	0.0 IPS
2C-C3-12	Interstrat. mud-sand	274.5	15.2	16.3	0.0 IPS
2C-C3-13	Interstrat. mud-sand	277.5	16.2	16.0	0.0 IPS
2C-C3-14	Interstrat. mud-sand	280.5	17.5	17.4	0.0 IPS
2C-C3-15	Interstrat. mud-sand	283.5	19.1	18.9	0.0 IPS
2C-C3-16	Interstrat. mud-sand	286.5	20.5	19.8	0.0 IPS
2C-C3-17	Interstrat. mud-sand	289.5	21.1	18.6	0.0 IPS
2C-C3-18	Interstrat. mud-sand	292.5	19.5	19.1	0.0 IPS
2C-C3-19	Interstrat. mud-sand	295.5	19.4	18.3	0.0 IPS
2C-C3-20	Interstrat. mud-sand	298.5	19.7	19.3	0.0 IPS
2C-C3-21	Interstrat. mud-sand	301.5	22.6	20.4	0.0 IPS
2C-C3-22	Interstrat. mud-sand	304.5	20.1	18.3	0.0 IPS
2C-C3-23	Interstrat. mud-sand	308	16.5	17.5	0.0 IPS
2C-C4-1	Interstrat. mud-sand	311.5	13.9	15.5	0.0 IPS
2C-C4-2	Interstrat. mud-sand	314.25	20.5	19.2	0.0 IPS
2C-C4-3	Interstrat. mud-sand	316.75	18.4	17.9	0.0 IPS
2C-C4-4	Interstrat. mud-sand	320			
2C-C4-5	Interstrat. mud-sand	324	14.8	15.7	0.0 IPS

2C-C4-6	Interstrat. mud-sand	327.5	16.8	17.3	0.0 IPS
2C-C4-7	Interstrat. mud-sand	330.5	17.0	17.1	0.0 IPS
2C-C4-8	Interstrat. mud-sand	333.5	18.1	16.8	0.0 IPS
2C-C4-9	Interstrat. mud-sand	336.5	18.2	17.6	0.0 IPS
2C-C4-10	Interstrat. mud-sand	339.5	18.3	18.1	0.0 IPS
2C-C4-11	Interstrat. mud-sand	342	21.6	21.5	0.0 IPS
2C-C4-12	Interstrat. mud-sand	344.25	22.0	21.0	0.0 IPS
2C-C4-13	Interstrat. mud-sand	346.75	21.7	22.3	0.0 IPS
2C-C4-14	Interstrat. mud-sand	349	14.4	17.4	0.0 IPS
2C-C4-15	Diamict	351.5	12.8	16.6	0.0 IPS
2C-C4-16	Diamict	354.5	10.0	13.8	0.0 IPS
2C-C4-17	Diamict	357.5	8.8	13.6	0.0 IPS
2C-C4-18	Diamict	360.5	8.3	13.0	0.0 IPS
2C-C4-19	Diamict	363.25	7.7	11.4	0.0 IPS
2C-C4-20	Diamict	365.75	7.5	11.1	0.0 IPS
2C-C4-21	Diamict	368.5			
2C-C4-22	Diamict	408	4.6	6.8	0.0 IPS
2C-C5-1	Clast	451.5			
2C-C5-2	Diamict	459	6.1	8.9	0.0 IPS
2C-C5-3	Diamict	463	7.0	10.2	0.0 IPS
2C-C5-4	Diamict	467	7.2	10.6	0.0 IPS
2C-C5-5	Diamict	471	9.0	12.8	0.0 IPS
2C-C5-6	Diamict	474.25	8.4	10.9	0.0 IPS
2C-C5-7	Diamict	476.75	6.4	9.2	0.0 IPS
2C-C5-8	Diamict	479.5	7.5	11.0	0.0 IPS
2C-C5-9	Diamict	482.5	9.2	12.7	0.0 IPS
2C-C5-10	Diamict	485.5	8.9	11.8	0.0 IPS
2C-C5-11	Diamict	488.5	9.9	14.0	0.0 IPS
2C-C5-12	Diamict	491.5	10.6	14.8	0.0 IPS
2C-C5-13	Diamict	494.25	11.6	14.0	0.0 IPS
2C-C5-14	Massive mudstone	496.75	16.9	17.8	0.0 IPS
2C-C5-15	Massive mudstone	499.25	16.9	18.2	0.0 IPS
2C-C5-16	Massive mudstone	501.5	18.4	19.3	0.0 IPS
2C-C5-17	Massive mudstone	503.5	19.6	20.2	0.0 IPS
2C-C5-18	Massive mudstone	506	18.8	19.7	0.0 IPS
2C-C5-19	Massive mudstone	509	18.0	19.1	0.0 IPS
2C-C5-20	Massive mudstone	511.75	18.7	19.1	0.0 IPS
2C-C5-21	Tephra	515.5	17.1	15.7	

**ST6:** Gravimetric water content (GWC), volumetric ice content (VIC) and excess ice measured in dry permafrost samples at site FHDP1-2

<b>Sample ID</b>	<b>Note</b>	<b>Depth MID (cm)</b>	<b>GWC (%)</b>	<b>VIC (%)</b>	<b>Excess Ice (%)</b>	<b>Cryofacies</b>
2-C0-1	Dry permafrost	1	2.0	2.7	0	IPS
2-C0-2	Dry permafrost	5	5.3	4.9	0	IPS
2-C0-3	Dry permafrost	10	7.2	6.0	0	IPS
2-C0-4	Dry permafrost	15	6.9	6.7	0	IPS
2-C0-5	Dry permafrost	20	10.5	10.4	0	IPS
1-C0-1	Dry permafrost	1.5	1.6	2.6	0	IPS
1-C0-2	Dry permafrost	5	2.3	3.2	0	IPS
1-C0-3	Dry permafrost	10	3.6	3.3	0	IPS
1-C0-4	Dry permafrost	15	3.4	3.6	0	IPS
1-C0-5	Dry permafrost	20	3.7	4.5	0	IPS
1-C0-6	Dry permafrost	25	3.8	4.4	0	IPS
1-C0-7	Dry permafrost	29.5	3.9	4.4	0	IPS

**ST7: Soluble ions from thawed ground ice samples in FHDP cores**

Sample ID	MID Depth (cm)	Cl (mg g <sup>-1</sup> )	Molality Cl (mmol L <sup>-1</sup> )	Cl (meq kg <sup>-1</sup> )
2C-C1-2	38	1.27	35.91	35.91
2C-C1-6	47	3.68	103.53	103.53
2C-C1-7	49.75	2.58	72.75	72.75
2C-C1-8	53.25	3.52	99.23	99.23
2C-C1-10	59.25	5.76	162.14	162.14
2C-C1-11	62	6.03	169.89	169.89
2C-C1-13	66.5	3.42	96.37	96.37
2C-C1-21	93.25	3.69	103.90	103.90
2C-C1-22	97	4.30	121.09	121.09
2C-C1-24	102.5	3.91	110.06	110.06
2C-C1-25	105.5	3.92	110.48	110.48
2C-C1-26	108.25	4.52	127.34	127.34
2C-C1-27	110.75	3.94	111.06	111.06
2C-C1-28	113.5	3.55	99.89	99.89
2C-C1-29	116.5	3.58	100.95	100.95
2C-C2-4	128	4.34	122.31	122.31
3A-C27-2	3736.5	0.14	4.08	4.08
3A-C33-4	4337	0.07	2.11	2.11
3A-C33-5	4341.5	0.08	2.37	2.37
3A-C33-6	4344.5	0.09	2.64	2.64
2A-C1-2	112.5	4.31	121.49	121.49

<b>Sample ID</b>	<b>SO4 (mg g-1)</b>	<b>Molality SO4 (mmol L-1)</b>	<b>SO4 (meq kg-1)</b>
2C-C1-2	1.16	12.08	24.16
2C-C1-6	2.02	21.08	42.15
2C-C1-7	1.56	16.20	32.41
2C-C1-8	2.12	22.09	44.17
2C-C1-10	2.84	29.59	59.18
2C-C1-11	2.58	26.89	53.79
2C-C1-13	1.28	13.33	26.66
2C-C1-21	0.95	9.86	19.72
2C-C1-22	0.59	6.15	12.30
2C-C1-24	0.71	7.39	14.79
2C-C1-25	1.29	13.43	26.87
2C-C1-26	1.10	11.43	22.86
2C-C1-27	0.43	4.53	9.06
2C-C1-28	0.55	5.68	11.37
2C-C1-29	0.37	3.88	7.75
2C-C2-4	0.77	8.02	16.04
3A-C27-2	0.17	1.78	3.57
3A-C33-4	0.09	0.91	1.81
3A-C33-5	0.17	1.74	3.47
3A-C33-6	0.08	0.82	1.64
2A-C1-2	1.67	17.40	34.80

<b>Sample ID</b>	<b>NO3 (mg g-1)</b>	<b>Molality NO3 (mmol L-1)</b>	<b>NO3 (meq L-1)</b>
2C-C1-2	0.26	4.18	4.18
2C-C1-6	0.78	12.60	12.60
2C-C1-7	0.55	8.91	8.91
2C-C1-8	0.75	12.10	12.10
2C-C1-10	1.26	20.28	20.28
2C-C1-11	1.34	21.60	21.60
2C-C1-13	0.75	12.09	12.09
2C-C1-21	0.92	14.81	14.81
2C-C1-22	1.05	16.97	16.97
2C-C1-24	0.97	15.57	15.57
2C-C1-25	1.00	16.17	16.17
2C-C1-26	1.13	18.27	18.27
2C-C1-27	1.02	16.49	16.49
2C-C1-28	0.94	15.15	15.15
2C-C1-29	0.96	15.52	15.52
2C-C2-4	1.34	21.56	21.56
3A-C27-2	0.00	0.01	0.01
3A-C33-4	0.00	0.01	0.01
3A-C33-5	0.00	0.02	0.02
3A-C33-6	0.00	0.01	0.01
2A-C1-2	1.04	16.84	16.84



Sample ID	Ca (mg g <sup>-1</sup> )	Molality Ca (mmol L <sup>-1</sup> )	Ca (meq kg <sup>-1</sup> )
2C-C1-2	0.17	4.21	8.41
2C-C1-6	0.43	10.67	21.33
2C-C1-7	0.30	7.56	15.12
2C-C1-8	0.40	9.95	19.91
2C-C1-10	0.59	14.64	29.28
2C-C1-11	0.57	14.32	28.64
2C-C1-13	0.31	7.75	15.51
2C-C1-21	0.26	6.48	12.96
2C-C1-22	0.24	6.02	12.04
2C-C1-24	0.24	6.11	12.21
2C-C1-25	0.36	8.92	17.84
2C-C1-26	0.31	7.82	15.65
2C-C1-27	0.18	4.46	8.93
2C-C1-28	0.19	4.74	9.48
2C-C1-29	0.19	4.64	9.28
2C-C2-4	0.33	8.35	16.70
3A-C27-2	0.07	1.73	3.45
3A-C33-4	0.04	1.05	2.10
3A-C33-5	0.05	1.37	2.73
3A-C33-6	0.04	0.98	1.97
2A-C1-2	0.40	10.06	20.12

<b>Sample ID</b>	<b>Mg (mg g<sup>-1</sup>)</b>	<b>Molality Mg (mmol L<sup>-1</sup>)</b>	<b>Mg (meq kg<sup>-1</sup>)</b>
2C-C1-2	0.15	6.28	12.57
2C-C1-6	0.45	18.64	37.28
2C-C1-7	0.33	13.76	27.53
2C-C1-8	0.43	17.79	35.59
2C-C1-10	0.74	30.28	60.56
2C-C1-11	0.76	31.34	62.68
2C-C1-13	0.45	18.44	36.88
2C-C1-21	0.50	20.58	41.16
2C-C1-22	0.58	24.06	48.12
2C-C1-24	0.54	22.11	44.22
2C-C1-25	0.56	22.88	45.76
2C-C1-26	0.61	24.99	49.98
2C-C1-27	0.49	20.15	40.30
2C-C1-28	0.46	18.89	37.77
2C-C1-29	0.49	20.02	40.05
2C-C2-4	0.65	26.65	53.31
3A-C27-2	0.03	1.26	2.52
3A-C33-4	0.02	0.62	1.25
3A-C33-5	0.02	0.77	1.55
3A-C33-6	0.01	0.57	1.14
2A-C1-2	0.57	23.26	46.52

Sample ID	Na (mg g <sup>-1</sup> )	Molality Na (mmol L <sup>-1</sup> )	Na (meq kg <sup>-1</sup> )
2C-C1-2	0.89	38.69	38.69
2C-C1-6	1.95	84.70	84.70
2C-C1-7	1.45	62.93	62.93
2C-C1-8	1.70	74.04	74.04
2C-C1-10	2.81	122.30	122.30
2C-C1-11	3.00	130.37	130.37
2C-C1-13	1.70	74.06	74.06
2C-C1-21	1.71	74.18	74.18
2C-C1-22	1.83	79.38	79.38
2C-C1-24	1.63	70.77	70.77
2C-C1-25	1.75	76.30	76.30
2C-C1-26	2.10	91.15	91.15
2C-C1-27	1.72	74.71	74.71
2C-C1-28	1.64	71.12	71.12
2C-C1-29	1.56	67.95	67.95
2C-C2-4	1.82	79.00	79.00
3A-C27-2	0.07	2.90	2.90
3A-C33-4	0.04	1.59	1.59
3A-C33-5	0.07	3.11	3.11
3A-C33-6	0.04	1.61	1.61
2A-C1-2	2.08	90.28	90.28

Sample ID	K (mg g <sup>-1</sup> )	Molality K (mmol L <sup>-1</sup> )	K (meq kg <sup>-1</sup> )
2C-C1-2	0.01	0.34	0.34
2C-C1-6	0.03	0.83	0.83
2C-C1-7	0.02	0.58	0.58
2C-C1-8	0.03	0.76	0.76
2C-C1-10	0.05	1.20	1.20
2C-C1-11	0.05	1.35	1.35
2C-C1-13	0.03	0.70	0.70
2C-C1-21	0.03	0.70	0.70
2C-C1-22	0.03	0.72	0.72
2C-C1-24	0.03	0.68	0.68
2C-C1-25	0.03	0.71	0.71
2C-C1-26	0.04	0.95	0.95
2C-C1-27	0.03	0.82	0.82
2C-C1-28	0.03	0.71	0.71
2C-C1-29	0.02	0.64	0.64
2C-C2-4	0.03	0.80	0.80
3A-C27-2	0.01	0.16	0.16
3A-C33-4	0.00	0.08	0.08
3A-C33-5	0.01	0.16	0.16
3A-C33-6	0.00	0.08	0.08
2A-C1-2	0.03	0.79	0.79

Sample ID	Sr (mg g <sup>-1</sup> )	Molality Sr (mmol L <sup>-1</sup> )	Sr (meq kg <sup>-1</sup> )	TDS (mg g <sup>-1</sup> )	Avg. TDS (mg g <sup>-1</sup> )
2C-C1-2	0.00	0.01	0.01	3.92	
2C-C1-6	0.00	0.02	0.04	9.34	
2C-C1-7	0.00	0.02	0.03	6.80	
2C-C1-8	0.00	0.02	0.04	8.96	
2C-C1-10	0.00	0.03	0.06	14.04	
2C-C1-11	0.00	0.03	0.06	14.34	
2C-C1-13	0.00	0.02	0.04	7.94	
2C-C1-21	0.00	0.01	0.03	8.05	
2C-C1-22	0.00	0.02	0.03	8.62	
2C-C1-24	0.00	0.02	0.03	8.02	
2C-C1-25	0.00	0.02	0.03	8.91	
2C-C1-26	0.00	0.02	0.03	9.81	
2C-C1-27	0.00	0.01	0.02	7.82	
2C-C1-28	0.00	0.01	0.02	7.34	
2C-C1-29	0.00	0.01	0.03	7.18	
2C-C2-4	0.00	0.02	0.04	9.28	<b>8.77</b>
3A-C27-2	0.00	0.00	0.00	0.49	
3A-C33-4	0.00	0.00	0.00	0.26	
3A-C33-5	0.00	0.00	0.00	0.40	
3A-C33-6	0.00	0.00	0.00	0.27	<b>0.35</b>
2A-C1-2	0.00	0.02	0.04	10.11	

**ST8: Stable isotopes from thawed ground ice samples in cores FHDP**

Sample ID	MID Depth (cm)	dD (VSMOW)	d18O (VSMOW)	D-excess
2C-C1-1	34.75	-222.6	-19.0	-70.5
2C-C1-2	38	-165.3	-13.4	-58.0
2C-C1-3	40.5	-176.6	-13.0	-72.6
2C-C1-5	45	-180.1	-13.8	-69.6
2C-C1-6	47	-182.9	-14.2	-69.2
2C-C1-7	49.75	-184.7	-14.4	-69.6
2C-C1-8	53.25	-186.2	-14.6	-69.7
2C-C1-9	56.25	-183.0	-14.1	-69.8
2C-C1-10	59.25	-189.4	-14.6	-72.4
2C-C1-11	62	-192.1	-15.8	-65.4
2C-C1-12	64	-190.8	-15.0	-71.2
2C-C1-13	66.5	-193.9	-16.0	-65.8
2C-C1-14	69	-192.3	-16.0	-64.7
2C-C1-15	71	-192.9	-16.1	-61.7
2C-C1-21	93.25	-200.5	-17.2	-63.0
2C-C1-22	97	-203.0	-17.8	-61.0
2C-C1-23	99.75	-200.9	-16.6	-68.0
2C-C1-24	102.5	-199.0	-17.4	-60.2
2C-C1-25	105.5	-207.9	-17.7	-66.1
2C-C1-26	108.25	-208.2	-17.9	-65.2
2C-C1-27	110.75	-210.2	-18.1	-65.4
2C-C1-28	113.5	-211.9	-19.0	-60.1
2C-C1-29	116.5	-212.4	-18.8	-62.2
2C-C1-30	119	-214.6	-18.9	-63.6
2C-C2-6	132	-213.1	-19.6	-56.7
2C-C4-21	368.5	-224.4	-19.8	-66.3
3A-C27-2	3736.5	-258.7	-32.6	2.5
3A-C33-3	4333.75	-270.4	-34.9	8.7
3A-C33-4	4337	-270.1	-34.8	8.7
3A-C33-5	4341.5	-279.1	-35.8	7.2
3A-C33-6	4344.5	-270.6	-34.8	7.6
2A-C1-2	112.5	-207.3	-18.3	-60.9
1A-C1-C1	118	-199.3	-18.3	-52.9