

III. Surface Condition of the Ice Sheet in the Mizuho Plateau- West Enderby Land Area, East Antarctica, 1969-1971

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1. Introduction

Observations of surface conditions of the ice sheet were made in the Mizuho Plateau-West Enderby Land area along the routes of JARE 10 and 11 traverses in the summers of 1969 - 1970 and 1970 - 1971 as shown in Fig. A attached to the end of this volume. These observations were carried out to study the climatological conditions of this area which were reflected on the structure of the surface snow cover of the ice sheet.

During the traverses the following observations and measurements were carried out:

- i) Observations of the relief of snow surface at intervals of 2 or 5 km along the route.
- ii) Measurements of surface hardness of the snow cover at the same intervals as above.
- iii) Measurements of vertical profile of Ram hardness in the snow cover, from the surface down to the depth of 2 m, using a Ram Sonde at intervals of 10 km.
- iv) Measurements of directions and inclinations of surface slopes of the ice sheet at intervals of 10 km, when the skyline of the ice sheet was visible.

Measurements iii) and iv) were carried out by JARE 11 only. Discussions on the results of measurement iv) will be published separately in other paper.

2. Relief of the Ice Sheet Surface

It was found that the surface of the ice sheet, generally firm, showed complex features formed by successive accumulation of snow by drifting and erosion by wind. Observations on ablation of sastrugi were made in September and November 1969 and January 1970 (Ageta, 1972).

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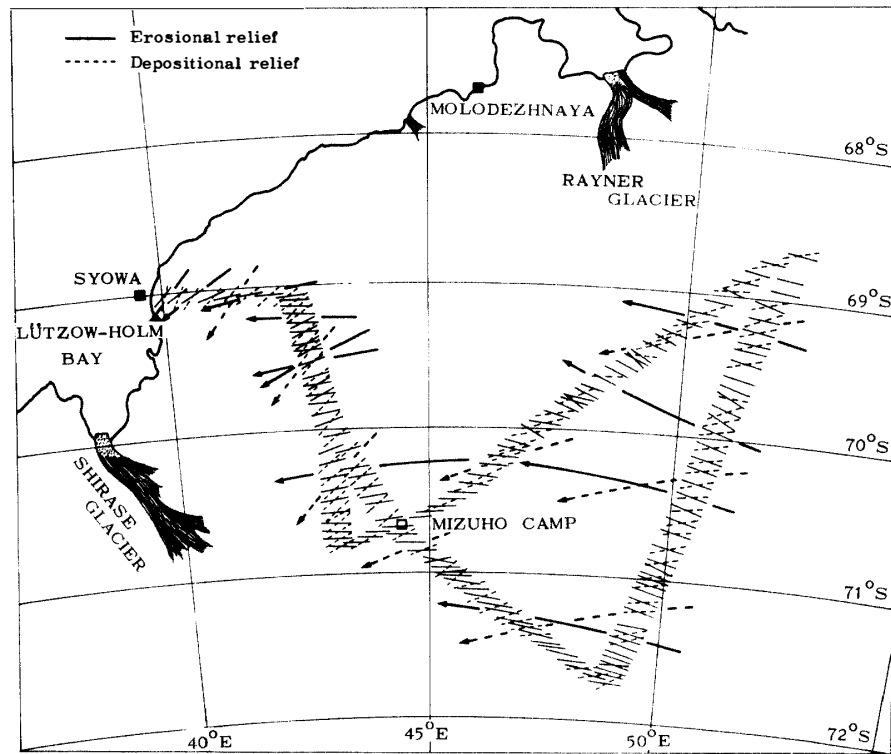


Fig. III-1. Directions of the surface reliefs, erosional and depositional, of the ice sheet, and direction of the prevailing wind in West Enderby Land, 1970 - 1971.

Generally speaking, the surface relief of the ice sheet is developed during the winter season predominantly, and smoothed during the summer season. The sastrugi grew higher than 0.7 m in winter, and became lower than 0.5 m in summer in the same area.

The surface relief of the ice sheet can be assorted into two major types: dunes formed by deposition of drifting snow, and sastrugi by wind erosion. From the results of structural studies of sastrugi it was found that the long axes of both dunes and sastrugi were parallel to the direction of wind which formed the surface relief. The directions of long axes of dunes and sastrugi are shown in Table III-1 (JARE 10) and Table III-2 (JARE 11). In Fig. III-1, observed directions of dunes and sastrugi, and course of prevailing winds inferred from those data, are given. This result shows a good agreement with that of JARE 10 (Ageta, 1971).

3. Surface Hardness of the Snow Cover

The surface hardness of the snow cover was measured with a

Kinosita's hardness gauge, and the result is shown in Tables III-1 and 2. The surface hardness of the snow cover was in the range of 2 - 30 kg/cm. In Fig. III-2, the surface hardness is plotted against the surface elevation; any evident correlation should not be found between them.

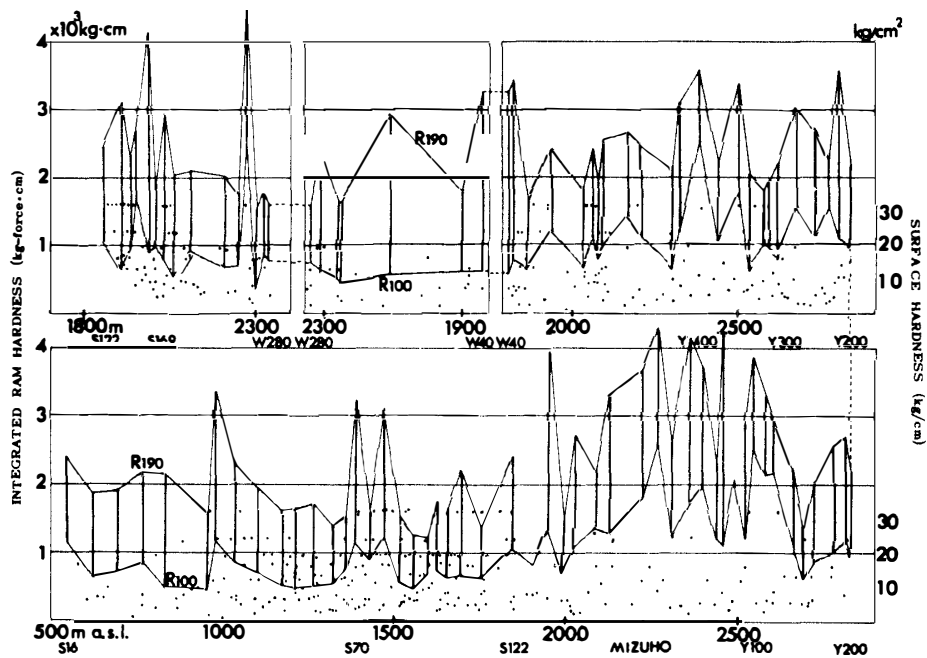


Fig. III-2. Surface hardness and integrated Ram hardness of snow cover vs. surface elevation of the ice sheet in West Enderby Land, 1970 - 1971.

(● : Surface hardness in kg/cm^2 by Kinosita's hardness gauge; R100 & R190: Integrated Ram hardness in $\text{kg}\text{-force}\cdot\text{cm}$ from the surface down to the depths of 100cm and 190cm of the snow cover respectively.)

4. Measurements of Vertical Profile of Ram Hardness in the Surface Snow

Vertical profiling of Ram hardness of snow from the surface down to a depth of 2m was made at intervals of 10 km as a complementary datum of precise stratigraphic studies of snow cover which were made at every 20 km by means of a 2m deep snow pit and/or a 2m long snow core. R100

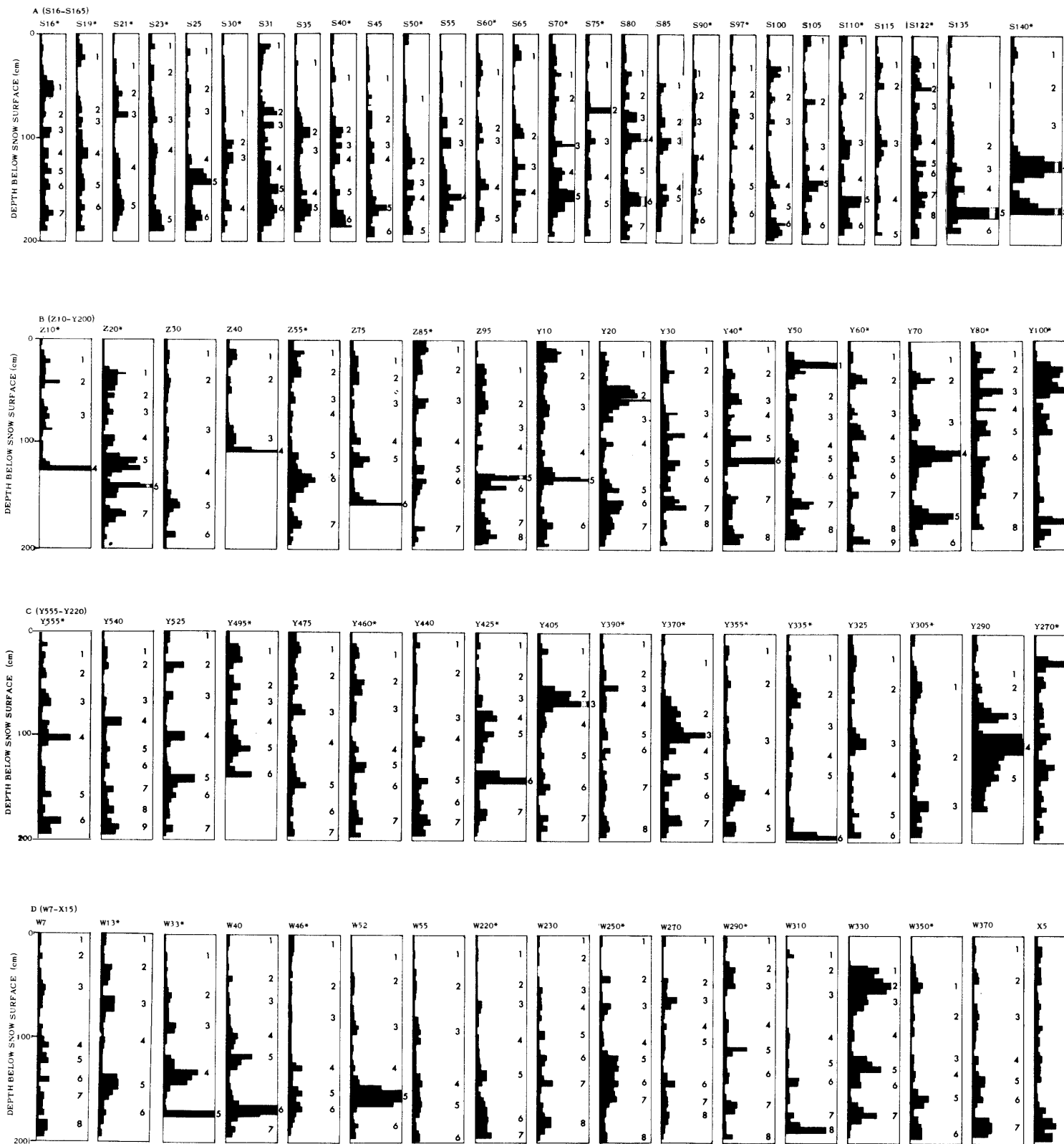
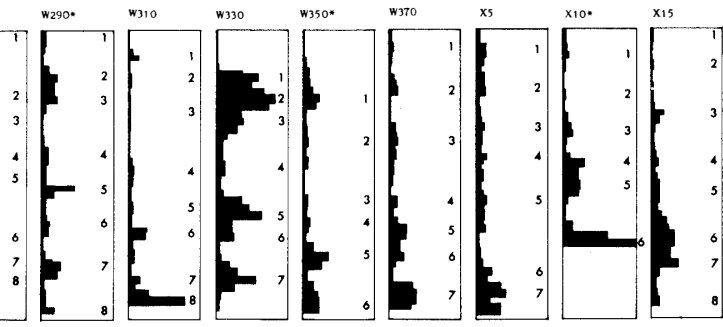
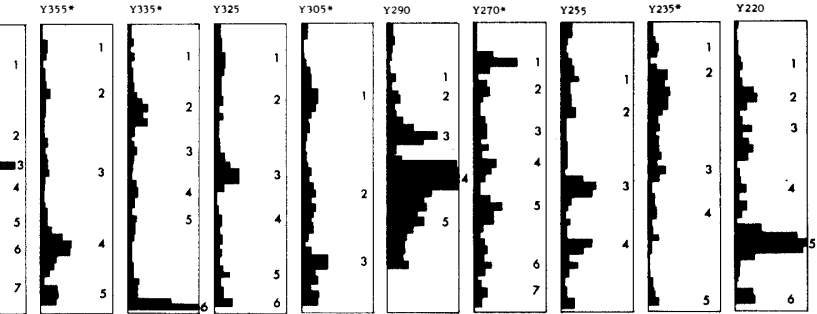
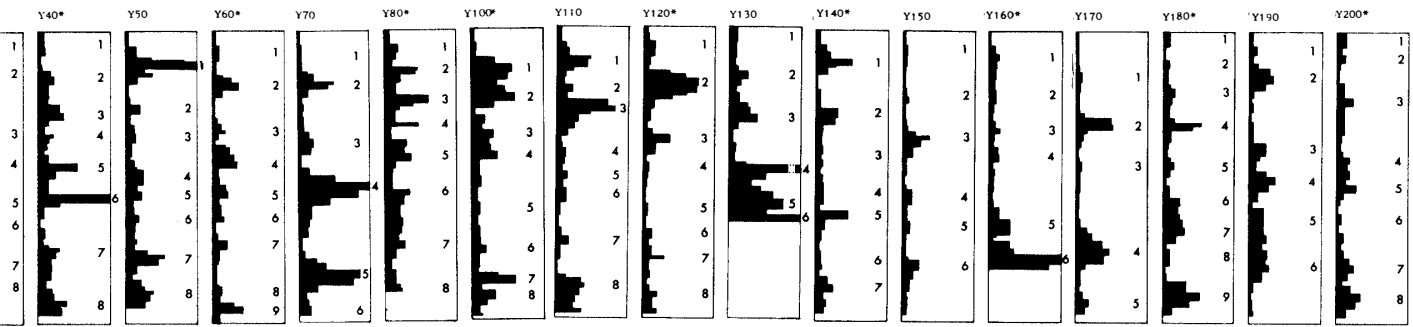
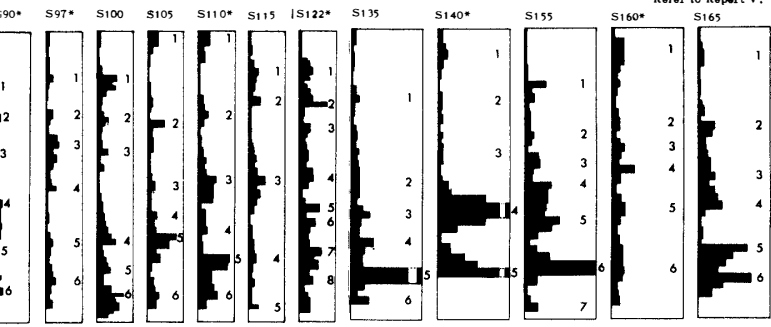


Fig. III-3. Ram hardness profile of snow cover in West Enderby Land, 1970 - 1971

*Refer to Report V.



er in West Enderby Land, 1970 - 1971.

and R190 which represent the integrated Ram hardness of the snow cover (Benson, 1962; Wagner, 1969) from the surface down to the depths of 100 cm and 190cm respectively are given in Table III-2. R100 and R190 are also plotted against the surface elevation in Fig. III-2. All results of the Ram hardness profile of the snow cover along the route of JARE 11's traverse are given in Figs. III-3, A, B, C and D. Numerals in diagrams of Fig. III-3 indicate the "key beds". The word "key bed" is used as a technical term indicating a unit structure of sedimentation of snow. Generally, a bed is composed of several elementary laminae. An elementary lamina of snow is considered to be formed by a single precipitation or deposition of drifting snow, while a bed is a set of elementary laminae which were accumulated under a similar meteorological condition such as the winter season or a period of predominant polar anticyclone. If a bed shows a characteristic property which gives information on the history of snow sedimentation, it is called a "key bed".

Numbers of the key beds at different stations do not necessarily coincide with those in Fig. III-3.

5. Measurements of the Surface Slope of the Ice Sheet

Measurements of surface slopes of the ice sheet as regards directions and inclinations were carried out together with barometric altimetry along the traverse route of JARE 11 for compiling a surface topographic map of the ice sheet in that area. Data of the surface slopes were very useful not only for determining the contour of the ice sheet surface, but also for obtaining preliminary information as to the flowing direction of the ice sheet.

As the first approach to the study of surface shape of the ice sheet, the following measurements were carried out through the oversnow traverse of JARE 11, although there was a problem of observation ranges by this method. The vertical angle of the skyline of the ice sheet was measured by a theodolite with the accuracy of one minute, in the directions of every 45° from the magnetic north at a station when the skyline of the ice sheet was visible. The results of the measurements are shown in Table III-3.

Orthogonals to the surface contours were shown in Fig. III-4 (thin solid-lines). In view of the result, this area can be divided into three subdivisional areas, I, II and III, by two ridges A and B (thick

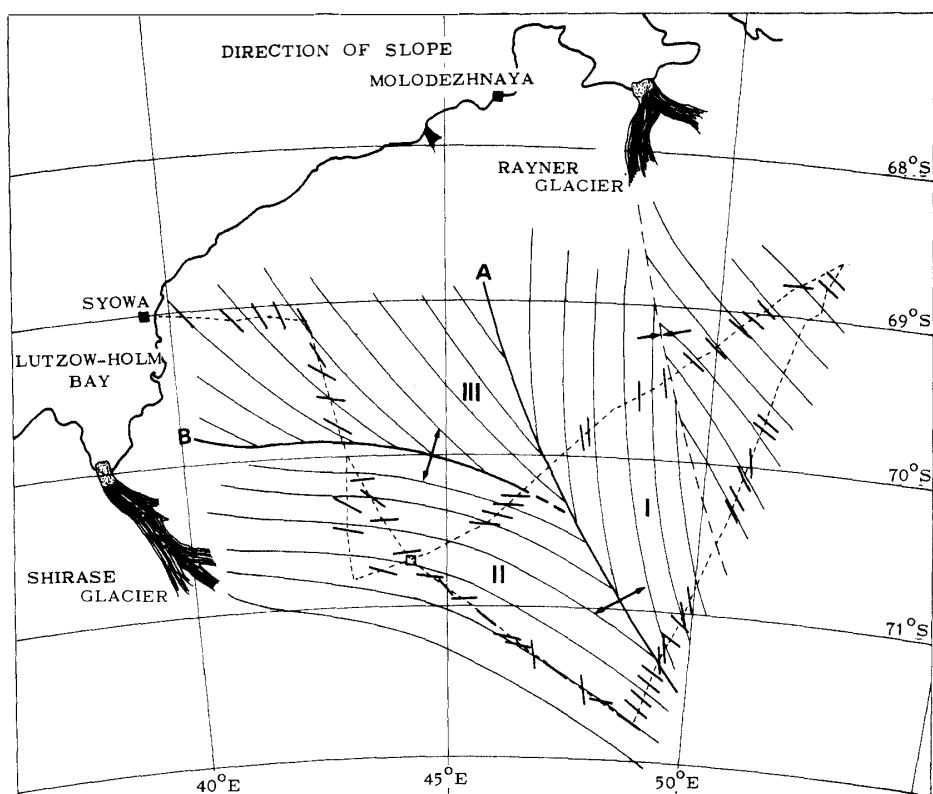


Fig. III-4. Surface slope lines and drainage areas of the ice sheet in West Enderby Land, 1970 - 1971.

(A, B : Ridge of the ice sheet surface; I, II, III : Drainage area.)

solid-lines), the existence of which is presumed from the discontinuity of the surface slope lines. If the direction of ice flow is approximately parallel to that of the surface slope (Giovinetto, 1964), those three subdivisional areas can be considered as drainage areas of the ice sheet.

References

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Table III-1. Direction of erosional relief of the snow surface, sastrugi and others, and surface hardness of the snow cover in Mizuho Plateau, 1969 - 1970.

Elevation. (A): Surface elevation of the ice sheet measured by the barometric altimetry by JARE 10 and 11 (see Report I of this volume). Direction of a relief is described in geographical direction. A soft relief was considered to be a fairly new one, its direction is given in parentheses. Surface hardness (kg/cm^2) of snow cover was measured with Kinoshita's hardness gauge.

Station No.	Elevation (A) (m)	Direction of erosional relief (Degrees true)			Surface hardness (kg/cm^2)
		September	November	January	November
S 16	553		78	(74)	16
17	583	23 83			
18	609	63			
20	653		78	84	42
22	743	73			21
25	844		75		
27	893				17
30	961	63	78	(81)	5
33	1014				3.8
35	1046		80		8.3
36	1064	83			
37	1074				4.2
39	1099				21
40	1112		83	(76)	2.2
42	1138				6.1
44	1164				4.8
45	1179		76 83		
46	1188	73-83			3.9
48	1200				5.2
50	1215		82 92	(89) 91	
51	1217	83			1.9
52	1227	83			
53	1233				5.1
55	1271		66,80,92		9.7
56	1274				4.5

Station No.	Elevation (A) (m)	Direction of erosional relief (Degrees true)			Surface hardness (kg/cm ²)
		September	November	January	November
S 58	1287				6.8
59	1307	83			
60	1332		88 100	(85) 82	16
62	1341				4.3
64	1356				4.2
65	1362		71 107		
66	1366				6.6
68	1380	73			4.7
70	1388	63 83	86 95	(82) 82	17
72	1409				6.1
74	1422				17
75	1435	73-83 103	104		
76	1444				24
78	1459				10
80	1473	82	92	(69,78) 88	15
82	1489				16
84	1518				35
85	1522	82	94	84	
86	1526				7.4
88	1543	82-102			5.7
90	1560		86	87	7.8
92	1568	62-72			28
94	1579				13
95	1588		98		
96	1594				6.6
98	1614				13
100	1630	62	78 89	(84) 85	11
102	1636	72-82			20
104	1651				4.6
105	1656		93 100		
106	1660				3.7
108	1684				72
110	1696	61 91	99	81 96	6.1
112	1736				8.1
114	1754	71-81			7.1
115	1758		92 99		
116	1763				14

Station No.	Elevation (A) (m)	Direction of erosional relief (Degrees true)			Surface hardness (kg/cm ²)
		September	November	January	November
S 118	1816				63
120	1845	81	80 85	(81)76-83	15
122	1853				3.9
124	1865	81			6.5
125	1876		79-85		
126	1883	81			3.4
128	1887				13
129	1900	81			
130	1900		79	(85) 79	11
132	1924				19
133	1923	71	70	83	
134	1917				5.2
135	1909	61 81	81 91		
136	1914				31
138	1924				72
140	1934	81	81	(89) 93	
141	1944				30
143	1946			83	7.3
145	1944		86		20
147	1954	81	82	91	13
149	1953				18
150	1971	91	84	93 99	
151	1975				32
153	1979	81	85 91	86 92	3.3
155	1992	91	87 95	89	36
157	2002				36
159	2006	91	80 93	87 95	25
160	2008	91	90 101	92	
161	2012				36
163	2025		97	94	17
165	2035	81-91			49
166	2027				
167	2027				10
169	2035				8.5
170	2034	101	91-99		
171	2026				16

Station No.	Elevation (A) (m)	Direction of erosional relief (Degrees true)			Surface hardness (kg/cm ²)
		September	November	January	November
S 173	2034				11
175	2036		100		7.8
177	2064				23
179	2062				5.5
180	2075		100		
181	2085				2.9
183	2133				17
185	2114				8.2
186	2150		101-106		
187	2158				5.4
189	2173				11
190	2180		111		
191	2183				29
193	2207				15
195	2208				7.5
196	2217		110		31
197	2240				16
199	2257				32
200	2261		102-105		
201	2260				7
203	2274				3.3
205	2303		100		15
207	2312				19
209	2317				23
210	2332		93,106,111		
211	2342				33
213	2356				12
215	2374		109		24
217	2388				4.3
219	2403				23
220	2410		111-116		
221	2422				12
223	2443				31
225	2462	103 113			25
226	2468				50
227	2473				15

Station No.	Elevation (A) (m)	Direction of erosional relief (Degrees true)			Surface hardness (kg/cm ²)
		September	November	January	November
S 229	2494				16
230	2506	101-111			
231	2511				9.9
234	2528				9.4
235	2534	107-111			
236	2550				4.0
238	2574				15
240	2591	107,115,121			
A 155	2572	99 115			
148	2553	111,120,129			
136	2508	113-117			
130	2526	115 130			
118	2527		110 128		
108	2491		115		
096	2461		118 127		
084	2447		116-129		
076	2425		117-125		
072	2429		118 129		
060	2403		118,125,130		
048	2413		114,124,130		
032	2414		96,104,117		
019	2388		108 114		
005	2280		100,118,124		
B 11	2122		95		
48	1800			(90,96),105	
C 2	1832			(78,84), 94	
5	1808			115	
10	1768			(102), 110	
15	1763			114	
21	1766			111	
25	1782			111-115	
29	1787			(100),107,112	
35	1801			124	
40	1813			(108),118,126	
45	1799			(105), 130	
50	1796			(113),128,137	

Station No.	Elevation (A) (m)	Direction of erosional relief (Degrees true)			Surface hardness (kg/cm ²)
		September	November	January	
C 55	1757			(108), 113	
60	1729			(100, 106), 112	
65	1737			(104, 109), 119	
75	1749			(103), 121	
80	1767			(101), 115, 127	
85	1794			(105, 111), 122	
90	1802			(95), 105, 126	
94	1794			(106), 118	
100	1823			(102), 112, 122	
105	1836			(96), 99, 108	
110	1889			(96), 106-110	
115	1930			108 117	
120	1984			(92), 106, 112	
125	1968			98	
130	1978			92 99	
135	1998			(94), 96, 101	
140	2002			(101), 97, 105	
145	2031			(94), 85, 91	

Table III-2. Direction of sastrugi and dune, surface hardness and integrated Ram hardness of snow cover in West Enderby Land, 1970 - 1971.

Elevation (A): Surface elevation of the ice sheet measured by the barometric altimetry by JARE 10 and 11 (see Report I of this volume).

Direction of the surface relief is described in geographical direction.

Surface hardness was measured with a Kinosita's hardness gauge in kg/cm^2 .

(I), (II) and (III) indicate the period of the measurement, as follows:

(I) From November 3 to 13, 1970

(II) From January 18 to 24, 1971

(III) From November 14, 1970 to January 17, 1971

R100 and R190 indicate the integrated Ram hardness of snow cover, in $\text{kg-force}\cdot\text{cm}$, from the surface down to the depths of 100 cm and 190 cm respectively.

Station No.	Elevation (A) (m)	Direction of relief (Degrees true)		Surf. hardness (kg/cm^2)		Integrated Ram hardness ($\text{kg-force}\cdot\text{cm}$)		
		Sastrugi	Dune	(I)	(II)	R100	R190	
S 16	553					11380	24215	
17	583				16			
18	609	23	43	43	5.4			
19	634				6.1	6880	18490	
20	653	33	63	33	5.8			
21	699				9.4	7040	18980	
22	743	43	73	43	1.3			
23	771				4.3	8410	21620	
24	811	48	78	48	3.1	19		
25	844	48	82	28	11	11	4830	21340
26	870		48		3.3	5.4		
27	893				23	7.8		
28	916		48	48		8.4		
29	935				9.4	9.4		
30	961	43	63	43	32	2.5	4470	15530
31	981				24	11	11760	34130
32	994		63	33	24	7.2		
33	1014				19	12		
34	1030		68-73	53	6.6	24		

Station No.	Elevation	Direction of relief			Surf. hardness		Integrated Ram hardness	
	(A)	(Degrees true)			(kg/cm ²)		(k-force.cm)	
	(m)	Sastrugi		Dune	(I)	(II)	R100	R190
S 35	1046				5.4	5.4	8000	22980
36	1064	43	58	43	32	4.3		
37	1074				24	16		
38	1088				24	11		
39	1099				2.1	5.8		
40	1112	53	73	33	11	19	6830	19340
41	1124				19	3.5		
42	1138	63	83		24	5.1		
43	1148				19	16		
44	1164		81	43	6.1	6.6		
45	1179		83	38	13	13	4880	16070
46	1188	68	88		11	16		
47	1184			63	2.9	5.1		
48	1200	63	83		24	19		
49	1208					13		
50	1215	63	88	63		13	4610	16300
51	1217				7.8	16		
52	1227	53	93	53	5.4	12		
53	1233				19	9.4		
54	1259	53	68		5.8	16		
55	1271				6.6	13	4720	17030
56	1274		53-63		2.5	19		
57	1276				11	7.8		
58	1287	63	93		2.6	13		
59	1307				2.4	16		
60	1332	53	83	58	2.5	11	5240	14040
61	1335				2.4	12		
62	1341	53	88		7.2	11		
63	1348				19	12		
64	1356	63	88	63	24	12		
65	1362		85	51	5.4	19	7030	15300
66	1366	63	93	63	4.8	11		
67	1363				2.2	19		
68	1380	63	73	53	12	6.6		
69	1381				9.4	13		
70	1388				3.2	16	11610	32400
71	1403				3.8	32		

Station No.	Elevation (A) (m)	Direction of relief (Degrees true)			Surf. hardness (kg/cm ²)		Integrated Ram hardness (kg-force·cm)	
		Sastrugi		Dune	(I)	(II)	R100	R190
S 72	1409	53	93	43	19	16		
73	1419				4.6	13		
74	1422	53	88	53	6.1	24		
75	1435				5.8	19	8630	15900
76	1444				32	24		
77	1451		93	53	11	19		
78	1459				2.6	19		
79	1468	53	93		32	16		
80	1473				32	19	12320	31190
81	1476				3.9	16		
82	1489	62	92		16	19		
83	1499				9.4	32		
84	1518	67	87	52	4.0	16		
85	1522				4.8	24	5030	15590
86	1526		87	47	4.8	19		
87	1534				7.2	32		
88	1543	62	82	47	32	19		
89	1551				5.8	13		
90	1560	72	87	47	5.4	13	4380	12400
91	1569				5.4	19		
92	1568	62	87	42 92	13			
93	1570				7.8	13		
94	1579	57	72	42 102	19	13		
95	1588				8.4	13		
96	1594				24			
97	1605				9.4	16	6470	12050
98	1614		82	52	11	19		
99	1618				11	32		
100	1630		77	62 92	2.1	19	7280	17610
101	1631				32	19		
102	1636			42	6.6	32		
103	1643				2.8	16		
104	1651	62	82	47	7.8	32		
105	1656				4.8	24	5910	16490
106	1660	72	102	52	7.8	19		
107	1673			47	16	19		
108	1684	67	87	47	3.5	19		

Station No.	Elevation	Direction of relief		Surf. hardness		Integrated Ram hardness	
	(A)	(Degrees true)		(kg/cm ²)		(kg-force·cm)	
	(m)	Sastrugi	Dune	(I)	(II)	R100	R190
S 109	1690			12	32		
110	1696	76		6.1	19	6320	22370
111	1724			4.3	16		
112	1736	86	41	16	32		
113	1747			4.6	32		
114	1754			2.3	13		
115	1758	71	81	7.8	32	6210	13380
116	1763			8.4	12		
117	1774			4.3	19		
118	1816	71		16	32		
119	1833			19	24		
120	1845	71	36	5.8	32		
121	1850			3.1	24		
122	1853			7.2		10540	24270
123	1859			24			
124	1865	81	51	32			
125	1876			32			
126	1883	76	91	32			
127	1886			24			
128	1887	71		32			
129	1900			16			
130	1900	71		32			
131	1907			32			
132	1924	76		32			
133	1923			13			
134	1917	71	76	51	16		
135	1909	81	51	32		5820	31240
136	1914			13			
137	1923			13			
138	1924	81	51	24			
139	1925			24			
140	1934	81	56	16		5350	
141	1944			32			
142	1945	71	91	71	24		
143	1946			8.4			
144	1946	71	51	24			
145	1944			32		9200	22770

Station No.	Elevation	Direction of relief		Surf. hardness (kg/cm ²) (III)	Integrated Ram hardness (kg-force·cm)	
	(A) (m)	(Degrees true) Sastrugi	Dune		R100	R190
S 146	1950	81		32		
147	1954			24		
148	1952	81	51	32		
149	1953			13	17010	26860
150	1971	81	56	9.4		
151	1975			19		
152	1978	81	66	13		
153	1979			11		
154	1986			16		
155	1992			8.4	8930	41620
156	1997	86	51	7.2		
157	2002			13		
158	2005		51	9.4		
159	2006			16		
160	2008		86	4.6	9840	19130
161	2012	91	61	19		
162	2020			11		
163	2025	95	66	32		
164	2034			8.4		
165	2035	91	61	24	7370	29860
166	2027			5.1		
167	2027	91	71	19		
168	2026			13		
169	2035	91	66	24		
Z 5	1894			7.2		
10	1911	71	51	7.2	8050	
15	1921			7.8		
20	1949	71	41	6.1	13600	39450
25	1971	51	91	16		
30	1997	81	51	6.1	6700	16250
35	2012			5.4		
40	2020	80	50	4.0	8120	
45	2022			2.9		
55	2026	80	50	1.9	10680	27680
65	2050			2.0		
75	2074	80		8.4	9810	

Station No.	Elevation	Direction of relief		Surf. hardness	Integrated Ram hardness		
	(A)	(Degrees true)		(kg/cm ²)	(kg-force·cm)		
	(m)	Sastrugi	Dune	(III)	R100	R190	
Z 80	2091			32			
85	2094	85	50	16	13380	22170	
90	2111			11			
95	2127	85	50	4.8	12820	33140	
100	2138			16			
Mizuho Camp	2169	85	70-95				
Y 5	2202	90	50-60	4.6			
10	2227	90	60	12	18150	36980	
15	2249	80	95	16			
20	2271	89		8.4	25460	43450	
25	2286	84		12			
30	2314	84	71	3.3	12060	26700	
35	2342	91		3.8			
40	2356	79	99	2.2	17270	41910	
45	2372	89	49	24			
50	2395	89		4.8	19360	37860	
55	2416	84	84	12			
60	2438	89	49	4.8	12020	22410	
65	2444	94	79	24			
70	2453	89	99	7.8	11150	42050	
75	2478	99		3.2			
80	2490	88		5.1	20380		
85	2511	93		12			
90	2523	98	68	16	12280	28930	
95	2523	98	78	32			
100	2545				25050	38760	
105	2562	103	63	4.8			
110	2579	98	88	2.4	21240	33020	
115	2589	103	63	6.1			
120	2603	98	78	5.1	21740	28740	
125	2609	88-93		8.4			
130	2622	98	78	32	18230		
135	2644	88	103	13			
140	2655	88	107	88	4.8	11050	22540
145	2675	97		13			
150	2693	97	97	4.8	5950	13660	

Station No.	Elevation	Direction of relief (Degrees true)		Surf.hardness (kg/cm ²)	Integrated Ram hardness (kg-force·cm)	
	(A) (m)	Sastrugi	Dune	(III)	R 100	R 190
Y 155	2702	(97x117)		24		
160	2707	107		4.3	8180	
165	2719	97		13		
170	2720	97		6.1	8560	20010
175	2709	102	82	4.8		
180	2777	112	87	13	10100	26020
185	2778	97		16		
190	2809	107-117	87	7.8	11690	27270
195	2815	111		24		
200	2819	96		19	9730	21950
205	2813	111	57	11		
210	2807	116		13		
215	2794	86 101		11		
220	2792	(96x116)		5.1	10970	36120
225	2785	(91x116)		9.4		
230	2774	(86x111)		3.9		
235	2764	(96x116)		3.9	15730	22800
240	2759	116-126	76	6.1		
245	2749	116	96-130	7.8		
250	2733	96	96	5.4		
255	2720	(86x116)	86	2.4	11540	26880
260	2699	116	86	3.2		
265	2679	106	86 116	3.3		
270	2676	115	85	32	15650	30590
275	2672	105	65	19		
280	2666	115		11		
285	2648	80 115	80 115	4.8		
290	2635	115	85	6.6	19680	
295	2643	115	75	5.4		
300	2629	90 125		16		
305	2616			16	8680	22250
310	2620	115	75	9.4		
315	2601	115	85	13		
320	2604	105	145	5.4		
325	2591	95 110		32	9620	19770
330	2585	115	85	32		

Station No.	Elevation	Direction of relief		Surf.hardness	Integrated Ram hardness	
	(A)	(Degrees true)		(kg/cm ²)	(kg-force·cm)	
	(m)	Sastrugi	Dune	(III)	R100	R190
Y 335	2577	105	65	11	9810	18070
340	2568	115	75 145	4.8		
345	2555	115	85	32		
350	2541	120	85	8.4		
355	2532	116	76	7.2	6420	20490
360	2527	116	86	7.2		
365	2514	111	76	24		
370	2503	105-115	65-75	32	17490	33910
375	2491	120	85	11		
380	2475	115	80	7.2		
385	2460	120	80	16		
390	2433	115	80 115	11	10490	21840
395	2416	115	80	5.4		
400	2399	110	80	32		
405	2388	115	85	12	25240	35870
410	2366	115	80	5.1		
415	2356	110	80 110	19		
420	2344	115	75	16		
425	2335	105	85 105	8.4	12250	31230
430	2322	106	60 106	4.0		
435	2317	101		11		
440	2306	116	96	24	6690	21480
445	2293	106	56	6.6		
450	2271	106	86	3.8		
455	2236	101	76	2.6		
460	2219	101		7.2	11030	24860
465	2208	101	76	32		
470	2204	96		4.8		
475	2181	96	76	19	14580	26850
480	2191	96	76	32		
485	2168	106		2.5		
490	2118	96	96	24		
495	2119	91	91	8.4	15590	
500	2126	66 96	66	24		
505	2126	81		6.1		
510	2108			3.9		

Station No.	Elevation	Direction of relief (Degrees true)		Surf.hardness (kg/cm ²)	Integrated Ram hardness (kg-force·cm)	
	(A) (m)	Sastrugi	Dune	(III)	R100	R190
Y 515	2091	106	76	9.4		
520	2092	96		11		
525	2107			32	9520	25590
530	2118	95		13		
535	2106	95	65	13		
540	2097	95	65-75	9.4	8030	19600
545	2099	95	75	12		
550	2095			24		
555	2086			32	10130	24470
560	2074	95	95	32		
565	2061	95	75	12		
W 1	2061	105	80	11		
2	2068	105	75	9.4		
3	2061	105	75	9.4		
5	2064	95		5.1		
6	2063	95		32		
7	2051				6840	18480
9	2032	85	55-65	7.8		
10	2019					
11	2011	91		12		
13	1962	101		24	12100	24410
15	1949	96	66	32		
16	1932	86		24		
18	1936					
19	1943	106	86	3.9		
20	1907	96	66	32		
21	1906	91	51	13		
23	1890	86 116	86	16		
24	1885	96		7.2		
25	1883	96		2.6		
26	1881	96	66	24	6590	16310
28	1871	91	56	2.6		
30	1847	91	81	5.4		
31	1858	101	81	6.6		
32	1859	101	76	7.8		
33	1851	107	67	5.1	7730	34530

Station No.	Elevation	Direction of relief		Surf.hardness	Integrated Ram hardness	
	(A)	(Degrees true)		(kg/cm ²)	(kg-force·cm)	
	(m)	Sastrugi	Dune	(III)	R 100	R 190
W 34	1864	107	72	7.8		
35	1873	107	67	13		
37	1868	117	72	24		
38	1864	102	72	24		
40	1840	112	72	7.2	6240	33200
42	1887	122	77	7.8		
43	1885	122	97	8.4		
44	1880	117 137	97 137	11		
45	1879	117		13		
46	1897				5980	17820
47	1959	112		2.2		
49	1967	112		7.8		
50	1999	107		16		
51	2019	108 113	108	4.8		
55	2107				5330	29600
205	2128	98	58	1.9		
210	2192	108 128		3.6		
215	2211	108	158	11		
220	2248	112		3.1	4200	16710
225	2255	103 128	48 78	13		
230	2254	103	103 128	4.8	5150	16370
235	2277	103	88			
240	2285	98	73	13		
250	2312	118	78	12	6270	24860
255	2316	98	78	19		
260	2338	108	68	2.0		
265	2342	98	88	8.4		
270	2339	103	68	13	7375	15825
275	2340	103	78	24		
280	2322	88	68	7.2		
285	2342	88		5.4		
290	2337	94	84	19	8190	17505
295	2330	89	69	13		
300	2322	84	64	16		
305	2312	89	69	16		
310	2301	94	69	13	3570	15150
315	2288	84	84	7.8		

Station No.	Elevation	Direction of relief		Surf.hardness	Integrated Ram hardness	
	(A)	(Degrees true)		(kg/cm ²)	(kg-force·cm)	
	(m)	Sastrugi	Dune	(III)	R 100	R 190
W 320	2291	89		16		
325	2291	89	64	3.1		
330	2287	89	69	13	25825	44835
335	2288	89		4.0		
340	2278	89	89	32		
345	2265	89	69	24		
350	2252	84	69	16	6695	17745
355	2246	84	59	7.2		
360	2223	84	64	6.1		
365	2221	84	79 109	19		
370	2209	84	64	13	6325	20265
375	2199	90	65	19		
X 1	2138	85	70	6.1		
5				16	8860	20800
6	2111	86		24		
8	2097	82	65	19		
10	2094	86	55	19	7390	
12	2111	85		9.4		
14	2069	90		24		
15				7.2	4970	20400
16	2364	95	70	24		
18	2055	90	70	32		

Table III-3. Surface slope of the ice sheet in West Enderby Land, 1970 - 1971.

Elevation (A): Surface elevation of the ice sheet determined by the barometric altimetry by JARE 10 and 11 (see Report I of this volume).

The maximum and the minimum inclinations of the skyline of the ice sheet and their geographical direction are described in minute and in degree, respectively. A positive/negative sign of inclination indicates an angle of elevation/depression. Multiple max./min. values of inclination, and/or disagreement of the downhill axis with the uphill were obtained when the surface topography was not simple.

The mean direction of the surface slope was determined from the data of the distribution of inclinations of the surface surrounding a station. The "mean direction" of a surface slope indicates the downward direction.

Station No.	Elevation (A) (m)	Latitude	Longitude	Surface slope				Mean direction (Degrees true)
				Downhill		Uphill		
				Direction (Degrees true)	Inclination (Minutes)	Direction (Degrees true)	Inclination (Minutes)	
S 20	653	69°01.5'S	40°12.1'E	314		134		314
30	961	69 03.1	40 40.	269	-36	133	+54	313
40	1112	69 04.7	41 07.	313	-33	133	+32	313
50	1215	69 04.2	41 35.	313	-22	151	+34	331
60	1332	69 04.6	42 02.	329	-28	153	+18	338
70	1388	69 06.9	42 29.	313	- 3	155	+34	335
80	1473	69 17.3	42 35.	312	-18	157	+20	333
90	1560	69 27.7	42 42.	267	-20	127	+25	302
100	1630	69 38.1	42 50.	312	-19	112	+30	294

Station No.	Elevation (A) (m)	Latitude	Longitude	Surface slope				Mean direction (Degrees true)
				Downhill		Uphill		
				Direction (Degrees true)	Inclination (Minutes)	Direction (Degrees true)	Inclination (Minutes)	
S 110	1696	69°48.5'S	42°56' E	311	-19	131	+51	311
130	1900	70 09.5	43 06.	241	-14	131	+45	241
140	1934	70 19.8	43 06.	299	-18	131	+22	299
150	1971	70 30.0	43 04.	266	-11	131	+49	283
Z 20	1949	70 10.5	43 22.1'	266	-11	86, 131	+18	266
35	2012	70 17.7	43 33.5	311	-13	131	+34	311
60	2037	70 25.4	43 46.4	268	-18	86	+28	268
80	2091	70 32.2	43 58.4	310	-21	130	+11	280
90	2111	70 36.3	44 06.4	265	-22	130	+23	287
95	2127	70 38.4	44 10.3	265	-16	85	+ 8	265
100	2138	70 40.5	44 14.1	266	- 9	130	+36	266
Y 10	2227	70 45.6	44 30.2	310	- 9	85	+22	310
20	2272	70 49.2	44 43.9	309	-11	89	+16	273
30	2314	70 52.7	44 57.2	309	-13	138	+18	318
35	2342	70 54.2	45 04.6	309	-14	129	+13	309
45	2372	70 57.7	45 17.9	264	-14	84	+18	264
55	2416	71 01.0	45 31.4	308	-16	128	+18	308
65	2444	71 04.5	45 45.3	308	-16	121	+15	308
70	2463	71 06.0	45 51.4	308, 353	-11	128	+13	308
80	2490	71 09.4	46 05.0	308	-25	128	+23	308
90	2523	71 12.6	46 18.6	308	-11	103	+10	286

Station No.	Elevation (A) (m)	Latitude	Longitude	Surface slope				Mean direction (Degrees true)
				Downhill		Uphill		
				Direction (Degrees true)	Inclination (Minutes)	Direction (Degrees true)	Inclination (Minutes)	
Y100	2545	71°15.9'S	46°32.1'E	308	- 8	105	+16	288
110	2579	71 19.1	46 46.4	353	-12	146	+ 7	347
120	2603	71 21.8	47 01.1	307	-12	123	+ 7	307
130	2622	71 25.1	47 14.9	307	- 9	127	+25	307
135	2644	71 26.8	47 21.8	307	-14	120	+14	303
145	2675	71 30.0	47 35.8	352	- 8	146	+10	352
155	2702	71 33.1	47 50.1	352	-11	127, 172	+ 4	352
165	2719	71 36.2	48 04.2	306, 261	-14	121	+15	289
170	2720	71 37.4	48 12.0	306	-14	126	+44	306
180	2770	71 40.5	48 26.4	351	-10	122	+ 7	302
190	2809	71 43.4	48 41.1	306	-13	107	+ 1	306
200	2819	71 46.2	48 56.0	36	-20	171	+ 6	306
210	2807	71 41.1	49 01.8	306	-12	126	+ 8	311
220	2792	71 36.0	49 06.7	306	- 9	126	+ 4	306
230	2774	71 30.7	49 11.3	306	- 8	126	+10	306
240	2759	71 25.5	49 17.2	350	-10	112	+ 3	305
250	2733	71 20.4	49 23.1	305	-13	170	+ 6	350
260	2699	71 15.1	49 28.2	305	-16	173	+21	353
270	2676	71 10.0	49 34.3	305	- 7	135	+11	305
280	2666	71 05.2	49 42.1	305	-16	127	+20	307
290	2635	71 00.0	49 47.6	20	-13	170	+22	350
300	2629	70 54.9	49 52.9	18	-11	170	+16	350

Station No.	Elevation (A) (m)	Latitude	Longitude	Surface slope				Mean direction (Degrees true)
				Downhill		Uphill		
				Direction (Degrees true)	Inclination (Minutes)	Direction (Degrees true)	Inclination (Minutes)	
Y305	2616	70°52.4'S	49°56.5'E	350	-12	152	+18	340
372	2491	70 16.0	50 34.4	16	-14	149	+10	328
385	2460	70 10.8	50 38.6	305	-31	147	+ 8	327
395	2416	70 05.6	50 43.0	305	-17	152	+20	332
405	2388	70 00.3	50 46.3	350	-20	185	+17	350
440	2306	69 41.9	51 00.9	216, 279	-19	234	+22	306
545	2099	68 50.3	51 52.7	261, 306	-12	234	+20	306
555	2086	68 45.0	51 57.0	306,326,351	-15	115	+23	326
W 5	2064	68 42.9	51 42.9	350	-29	80	+15	262
10	2019	68 47.7	51 25.5	260	-27	80	+28	260
18	1936	68 56.8	50 56.5	306	-31	126	+33	306
22	1909	69 01.5	50 38.5	306	-47	126	+17	306
26	1881	69 05.9	50 22.4	306	-22	126	+13	306
31	1858	69 12.7	50 04.5	307	-13	127	+34	307
37	1868	69 20.9	49 36.8			127	+12	307
44	1880	69 30.8	49 08.7	352	-27	172	+49	352
49	1967	69 36.3	48 39.6	308	- 9	173, 263	+21	353
215	2211	69 48.1	47 51.9	84	-13	235	+19	264
225	2255	69 51.7	47 40.0	354	-11	174	+45	346
230	2254	69 53.7	47 34.4	11	-11	136	+11	354
280	2344	70 13.3	46 34.4	39	-14	129	+ 7	309

Station No.	Elevation (A) (m)	Latitude	Longitude	Surface slope				Mean direction (Degrees true)
				Downhill		Uphill		
				Direction (Degrees true)	Inclination (Minutes)	Direction (Degrees true)	Inclination (Minutes)	
Y290	2337	70°17.0'S	46°22.7'E	264	-11	84	+ 4	264
300	2322	70 20.6	46 10.6	265	-16	107	+ 5	265
310	2301	70 24.3	45 59.1	310, 322	-10	104	+13	283
320	2291	70 28.2	45 47.3	265	- 7	126	+11	270
X 6	2111	70 43.4	43°56.3	265	-15	85	+14	286