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SVERDRUP CHANNEL

by

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ABSTRACT (U)

This technical note assesses the available physical and environmental information on Sverdrup Channel.

RÉSUMÉ (U)

Dans ce rapport on discute les charactéristiques environmentales de la région du Canal de Sverdrup.

TABLE OF CONTENTS

SVERDRUP CHANNEL

INTRODUCTION

Sverdrup Channel is the body of water which separates Meighen Island from the western side of Axel Heiberg Island. The Pilot of Arctic Canada (1) describes its boundaries as being "from the unnamed point Lat. 79° 23' N., Long. 95° 08' W., 46 miles north-northwest to Bad Weather Cape, westward to Perley Island, southward along the east side of Meighen Island to Departure Point, east-southeastward to the Fay Islands and on to the point of origin" (Fig. 1).

HISTORY

The eastern side of Sverdrup Channel was first recorded by Capt. Otto Sverdrup in May 1900 (2) I p 398, the western side by Vilhjalmur Stefansson in June 1916, (3) p 528. The first crossing of the channel may well have been made by Dr. Frederick Cook in 1908, authenticated by a map published in a Chicago paper in 1909 (4) but not claimed by Cook (5). This question has recently been reviewed by Gibbons (6). Dr. H.K.E. Kruger crossed Sverdrup Channel in April 1930, his last note having been found in Stefansson's Discovery Cairn on Meighen Island in 1957 (7) p 194. Mr. Wally Herbert crossed the northern border of the channel from Cape Northwest to Meighen Island in May 1967 (8) p 102. Since then a number of traverses have been made by Defence Research Board parties (1970, 1972 and 1973) and by oil company seismic parties (1973).

Meighen Island has been occupied during the summer months since 1959 by parties conducting glaciological studies supported by the Polar Continental Shelf Project of the Department of Energy Mines and Resources.

OCEANOGRAPHY

HYDROGRAPHY

No formal hydrographic surveys of Sverdrup Channel have been made. The only data available consist of two wire soundings taken along the northern boundary in 1970 (Station No. 06, 337 metres and Station No. 07, 428 metres) (Fig. 1).

TEMPERATURE AND SALINITY

The water passing through Sverdrup Channel is of Arctic Ocean origin, its temperature profile (Figs. 2 and 3) is similar to that obtained off the mouth of Rens Fiord (Fig. 4). The density profile (Fig. 5) should apply to the channel.

CURRENT

Only one set of current measurements have been taken (Fig. 6). A progressive vector plot indicates the surface flow to be in a south-easterly direction with a tidal reversion amounting to one third of the inflow. A maximum velocity of 0.5 knots was obtained at a depth of 2.32 metres below the base of the ice cover.

TIDE

Tidal data for Sverdrup Channel is not available. Although Fig. 6 indicates a marked tidal component in the water movement through the channel the ice cover along the eastern shoreline of Meighen Island, around the Fay Islands and in Li Fiord gives no indication of tidal cracking, hinging or flooding.

ICE COVER

The most important characteristic of Sverdrup Channel is that it appears to have a perennial ice cover or "plug". Sverdrup (2) p 408 describes the ice south of Cape Northwest as "going up and down in waves" topography characteristic of multi-year sea ice and similar to the ice cover of the north end of Nansen Sound up to 1972 (9).

Stefansson (4) p 523 describes the northern boundary of the ice covering Sverdrup Channel in 1916 as seen from a 200-foot elevation on Meighen Island "the shore floe was plainly indicated by both rough ice and occasional patches of open water. It did not run in a straight line towards Cape Thomas Hubbard but curved in well towards Heiberg Island", this same line is indicated in aerial photography taken in 1950 and in 1959. The 1950 photography shows the southern boundary of the plug extending south east from a point between North Fiord and Middle Fiord to the Fay Islands then north west to meet Meighen Island seven miles north of departure point.

In 1970 the northern boundary terminated at the cliffs below Cape Northwest. A 1972 survey following the boundaries indicated them to be as shown in the 1950 photography, new ice having extended along the northern edge in a sweeping curve to a point five miles west of the Rum Islands.

Fig. 7 shows the junction of this band of two-year-old ice and the 1970 northern edge of the plug. Fig. 8 shows the more confused southern limit of the plug between the Fay Islands and Meighen Island.

The topography of the ice is in the form of "waves" lying parallel to the prevailing north-west winds. Drifts forming in the lee

of irregularities on the ice cover increase the albedo of the area causing hummocks to "grow" downwind. Wave action on the melt pools between the hummocks cause these too to extend downwind as well as undercutting the sides of the hummocks to produce a marked "square wave" cross section.

The ice has developed to greater than 5 metres in thickness. Spot measurements are included on Fig. 1. Fig. 9 illustrates the length of auger and extensions required in obtaining ice cores for the salinity profiles given in Fig. 10.

The thick layer of ice forms a floating dam across the mouth of Li Fiord, backing up a layer of fresh water indicated by temperature profiles (Figs. 11 and 13) and density profile (Fig. 12). This feature is absent in Middle Fiord (Figs. 14 and 15) and in Expedition Fiord (Figs. 16 and 17).

The fiords north-east of Sverdrup Channel exhibit a fresh water layer similar to that in Li Fiord but this is caused by a massive ridge of Arctic Ocean ice which has formed along the unprotected west side of Axel Heiberg Island (Figs. 18 to 25). This same pressure has caused grounded sea ice to build up to considerable heights on the shoals north of Perley Island (Fig. 26).

WEATHER

Continuous synoptic weather information is not available for the Sverdrup Channel area. Isachsen on Ellef Ringes Island is the nearest weather station, weather data from Meighen Island is available for the spring and summer months from 1960 to 1971. Generally the weather after freeze-up may be taken as similar to that at Isachsen, with the Meighen Island weather representative of the spring and summer ablation period. A brief comparison of Isachsen and Meighen Island weather is given in Fig. 27, and in references (10) and (11).

TRANSPORTATION

Sverdrup Channel is not readily accessible to surface vessels and the topography of its ice cover is not suitable for landing STOL aircraft.

Good landing areas are available along the east side of Meighen Island and on re-frozen leads north and south of the ice edge in the spring.

After freeze-up over-ice transport by snowmobile or tractor is good in the north-west - south-east direction. The steep-sided hummocks make east-west travel difficult (in 1970 a 3-hour snowmobile crossing was made with loaded sleds). A description of summer travel over similar ice is given by Stefansson (3) p 527.

A useful analysis of weather conditions at Isachsen and Meighen Island for planning air support for operations on Meighen Island is given by MacKay (10).

The following map sheets are available for the area:

Meighen Island North	560 B	Scale 1:250,000
Meighen Island South	69 H	Scale 1:250,000
Middle Fiord	59 G	Scale 1:250,000
and for STOL airstrip selection		
Meighen Island N ½ (69G-H, 560B (Parts)		Scale 1:50,000
Meighen Island S ½ (69G-H (Parts)		Scale 1:50,000

CONCLUSION

The thick perennial ice cover bridging Sverdrup Channel provides a convenient platform for conducting long-term oceanographic measurements, hydrographic sounding and the study of multi-year sea ice development.

Because of the effect which the ice cover of the channel has on its adjoining waters it is felt that the eastern boundary should be moved north to exclude Middle Fiord and include Li Fiord.

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10. MacKay, D.K. and Arnold, K.C., Access to Meighen Island N.W.T., 1965, Arctic Vol. 18, No. 3.

11. Temperature and Precipitation, 1941-1970. The North - Y.T. and N.W.T., Atmospheric Environment Service, Dept. of the Environment, Ottawa.

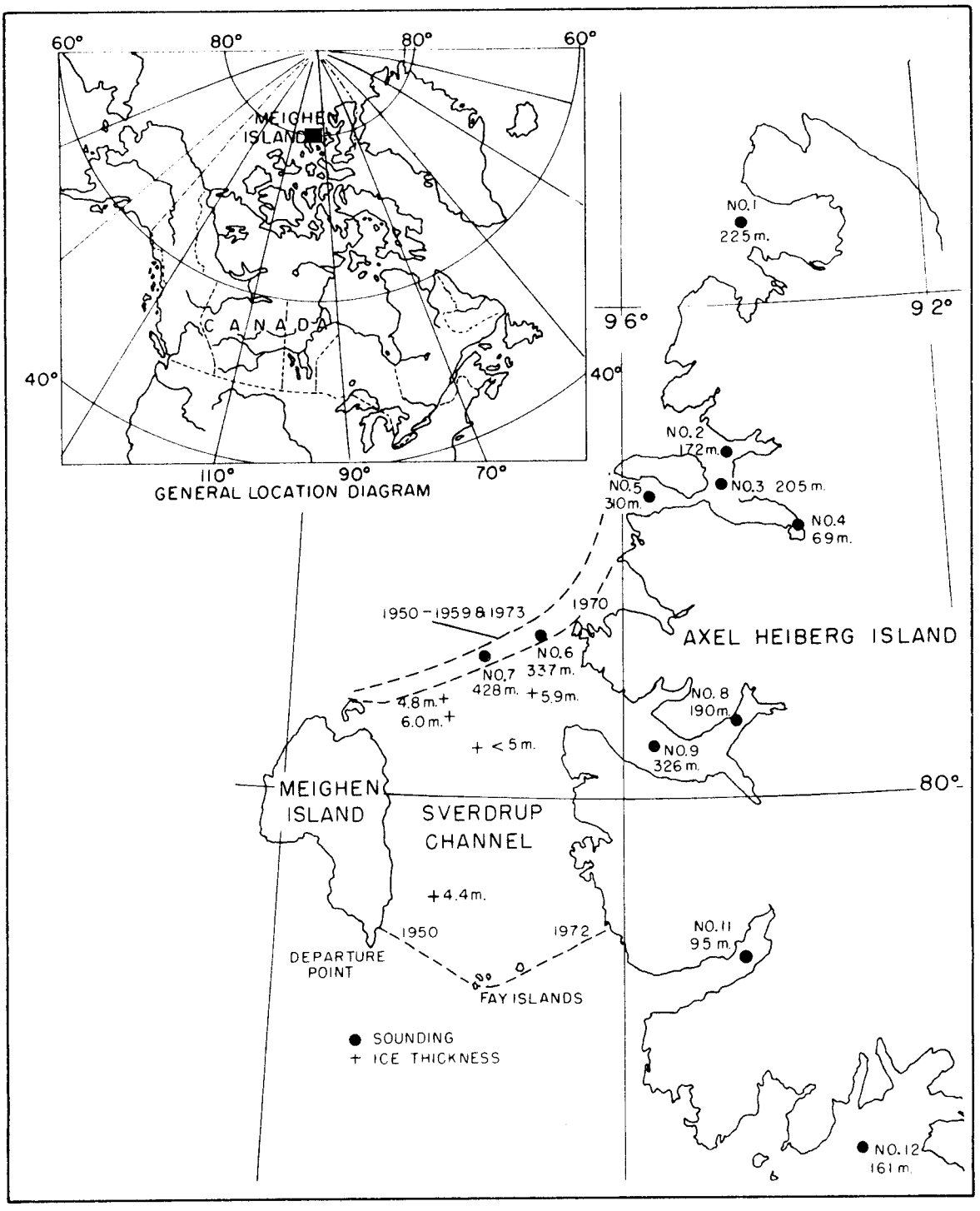

Fig. 1 Map of Sverdrup Channel and its surrounding waters.

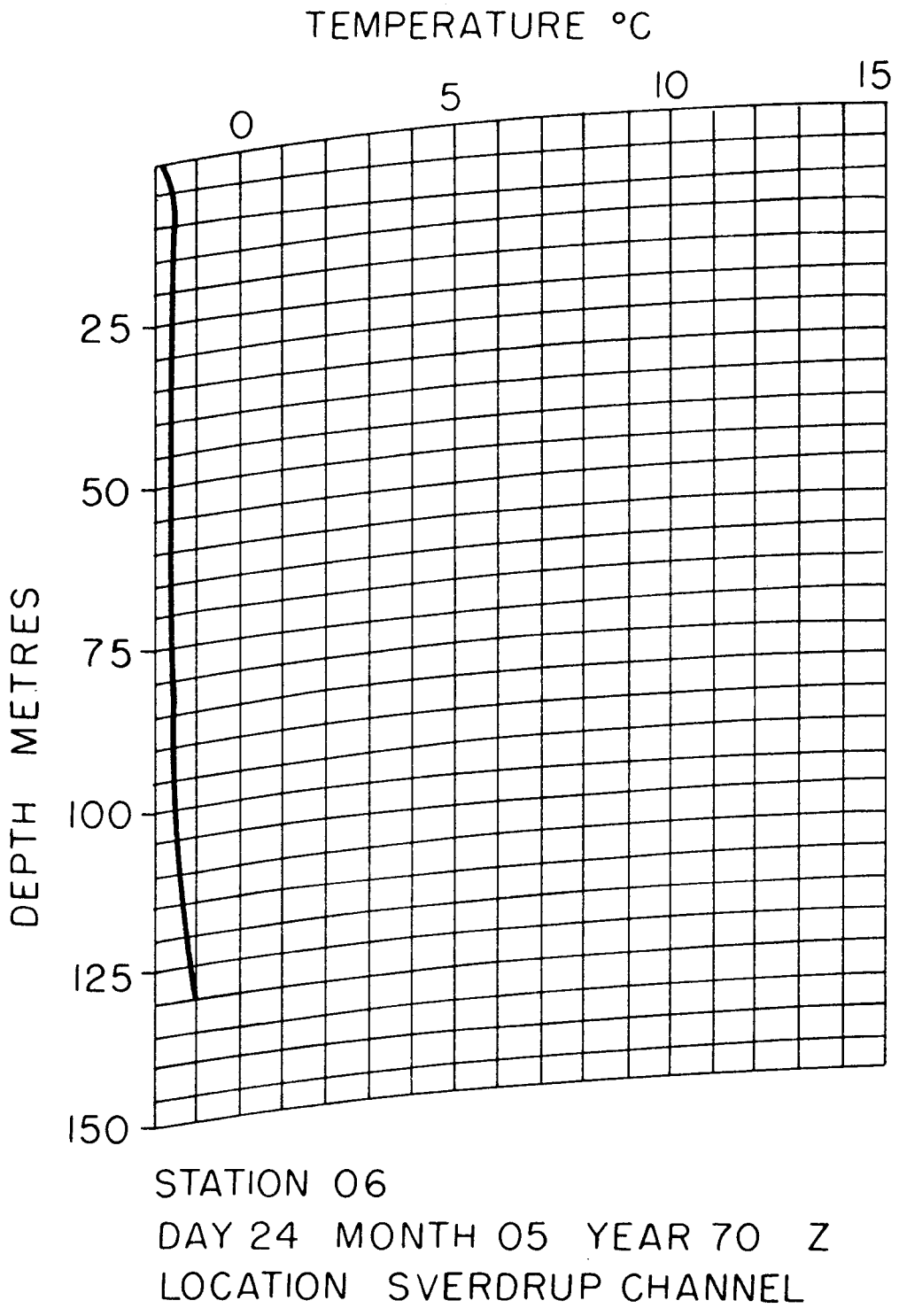

Fig. 2 Sverdrup Channel, temperature profile, Station No. 6.

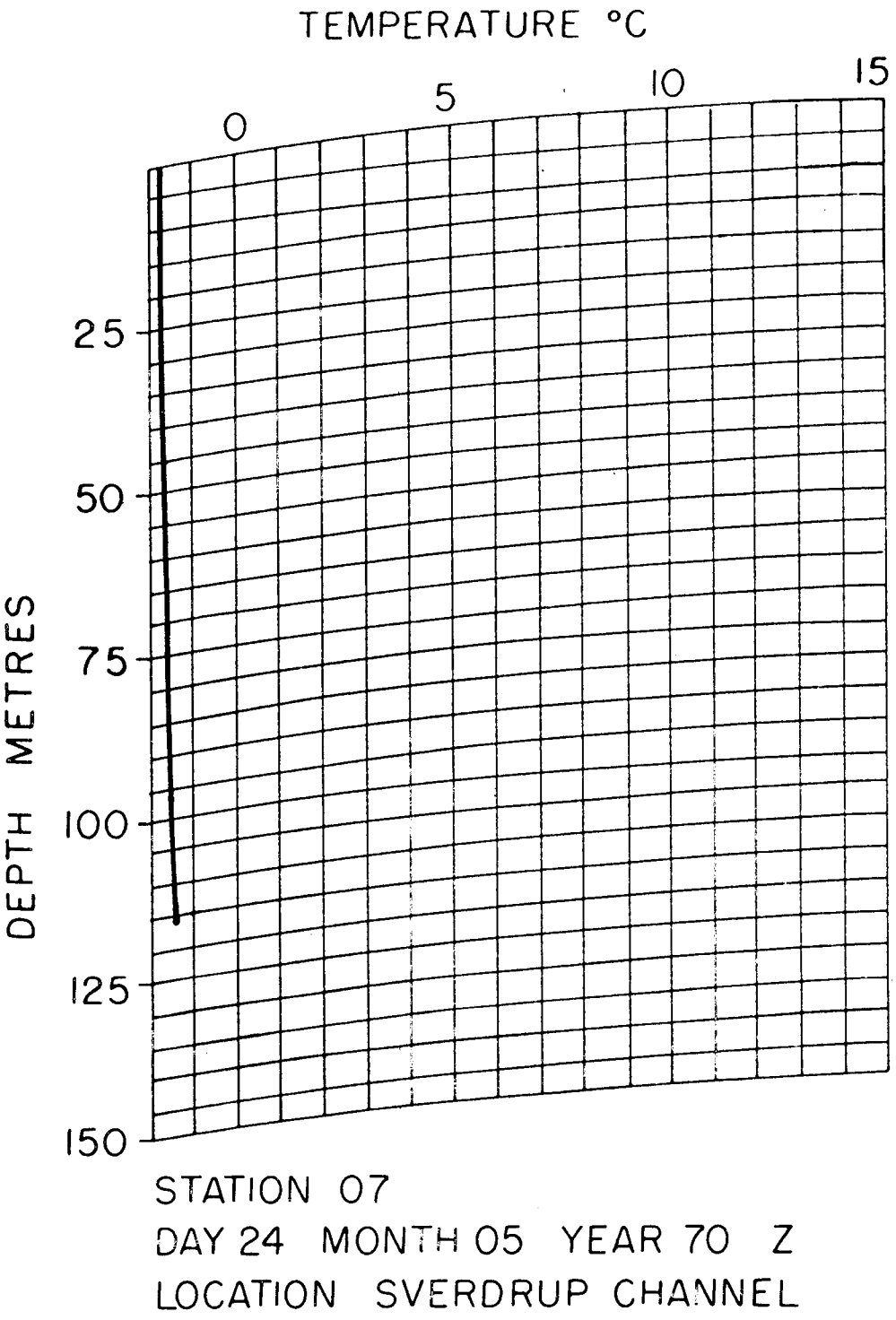

Fig. 3 Sverdrup Channel, temperature profile, Station No. 7.

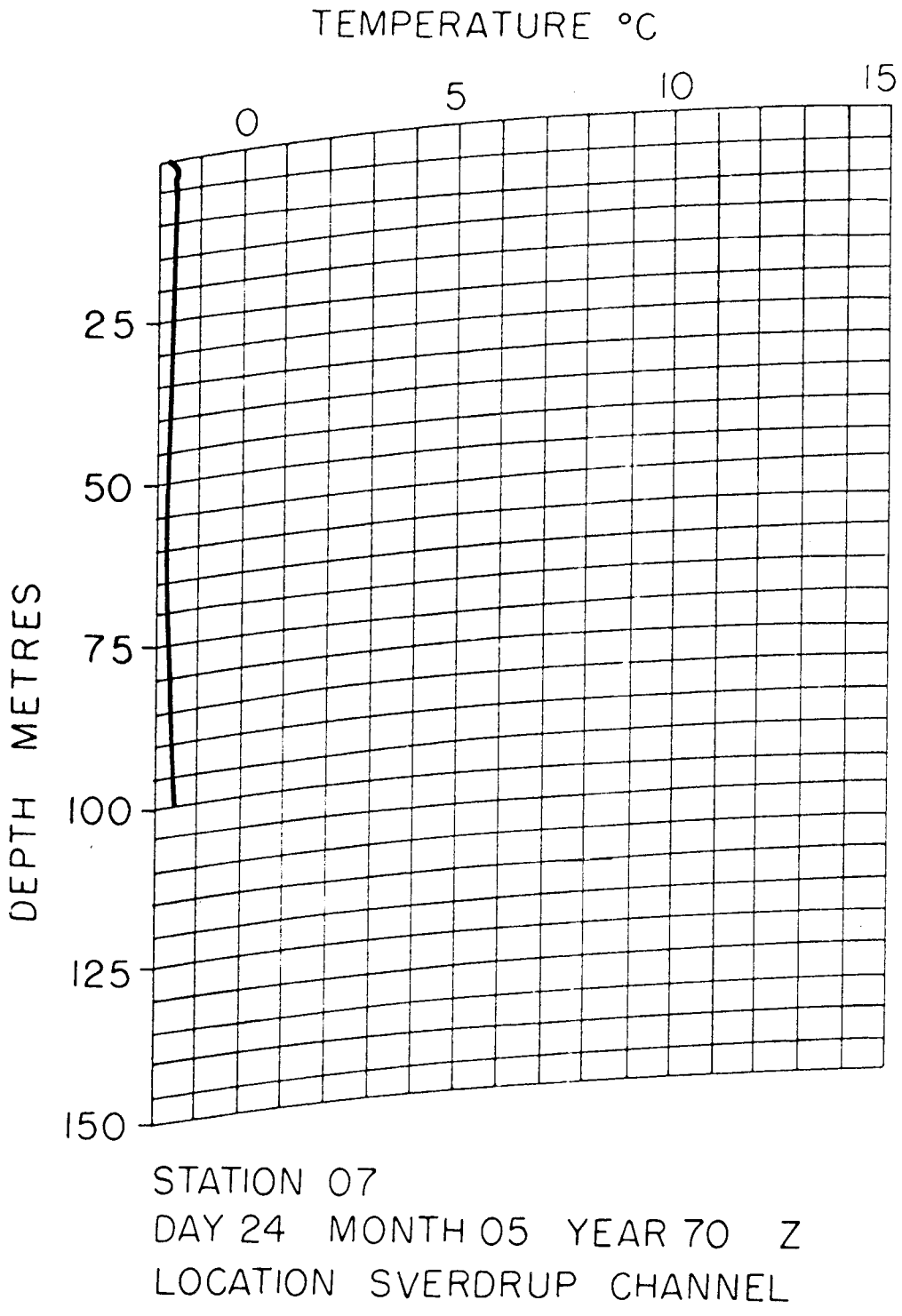

Fig. 4 Sverdrup Channel, temperature profile, Station No. 01.

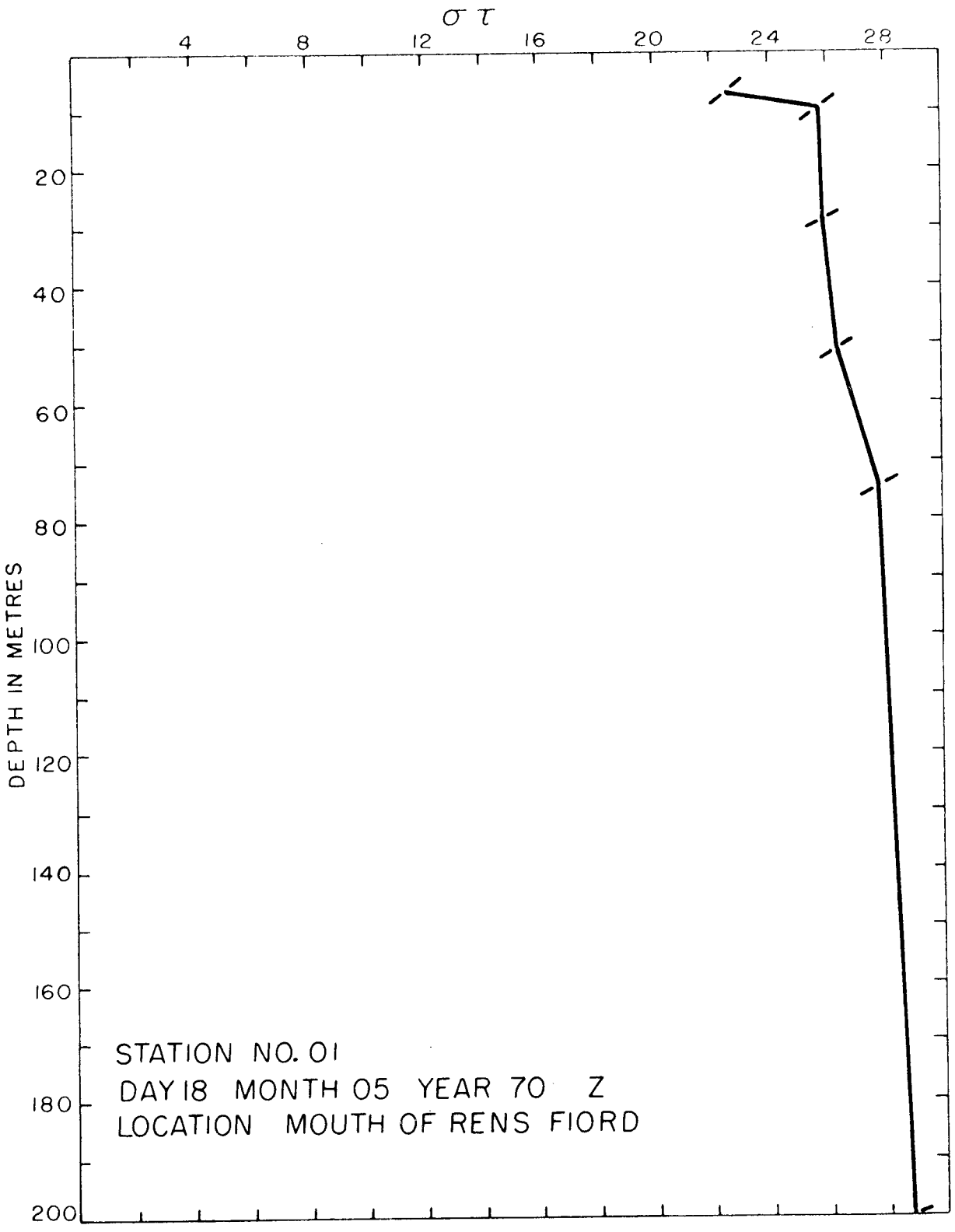

Fig. 5 *Off the mouth of Rens Fiord, density profile, Station No. 01.*

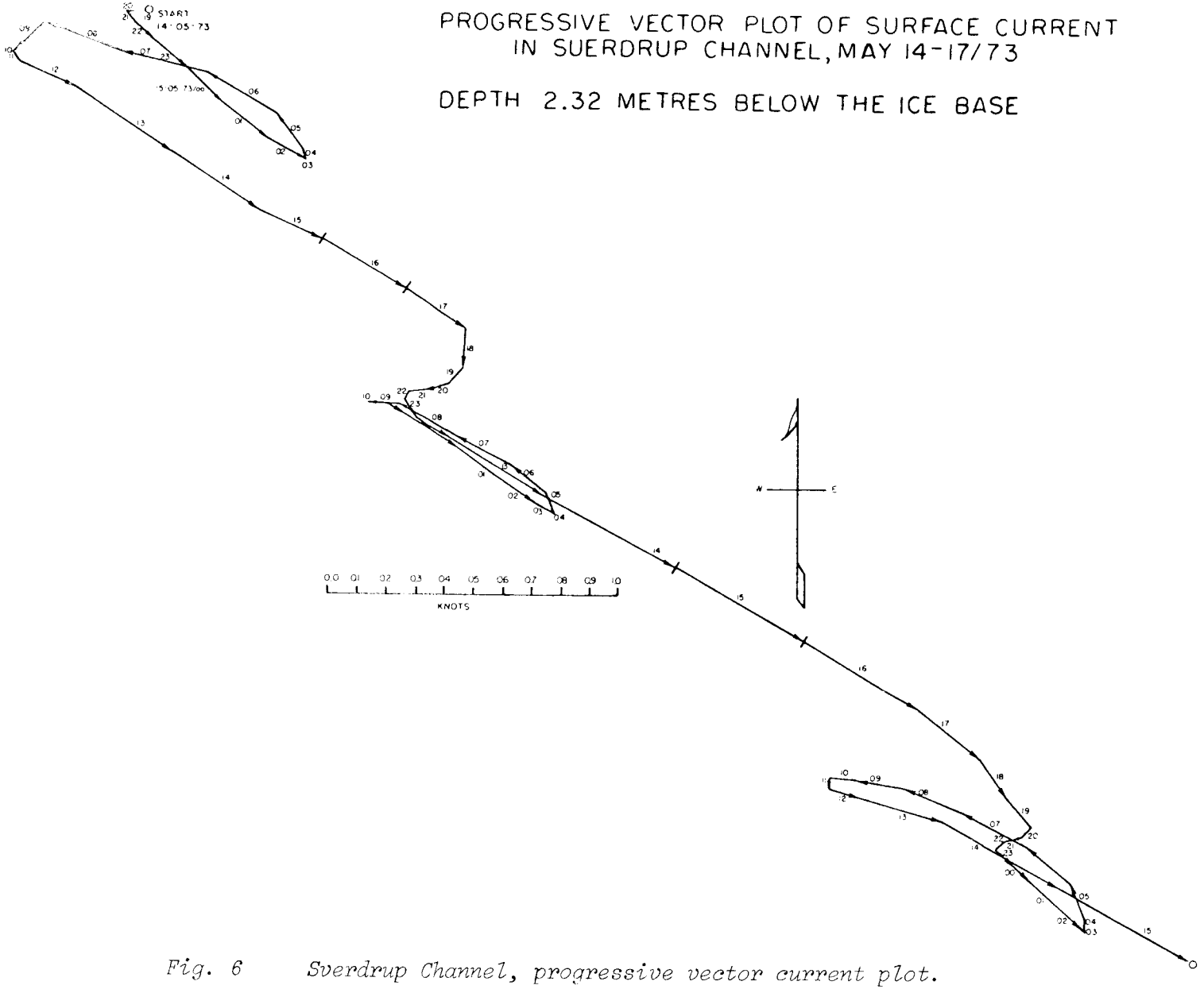

Fig. 6 Sverdrup Channel, progressive vector current plot.

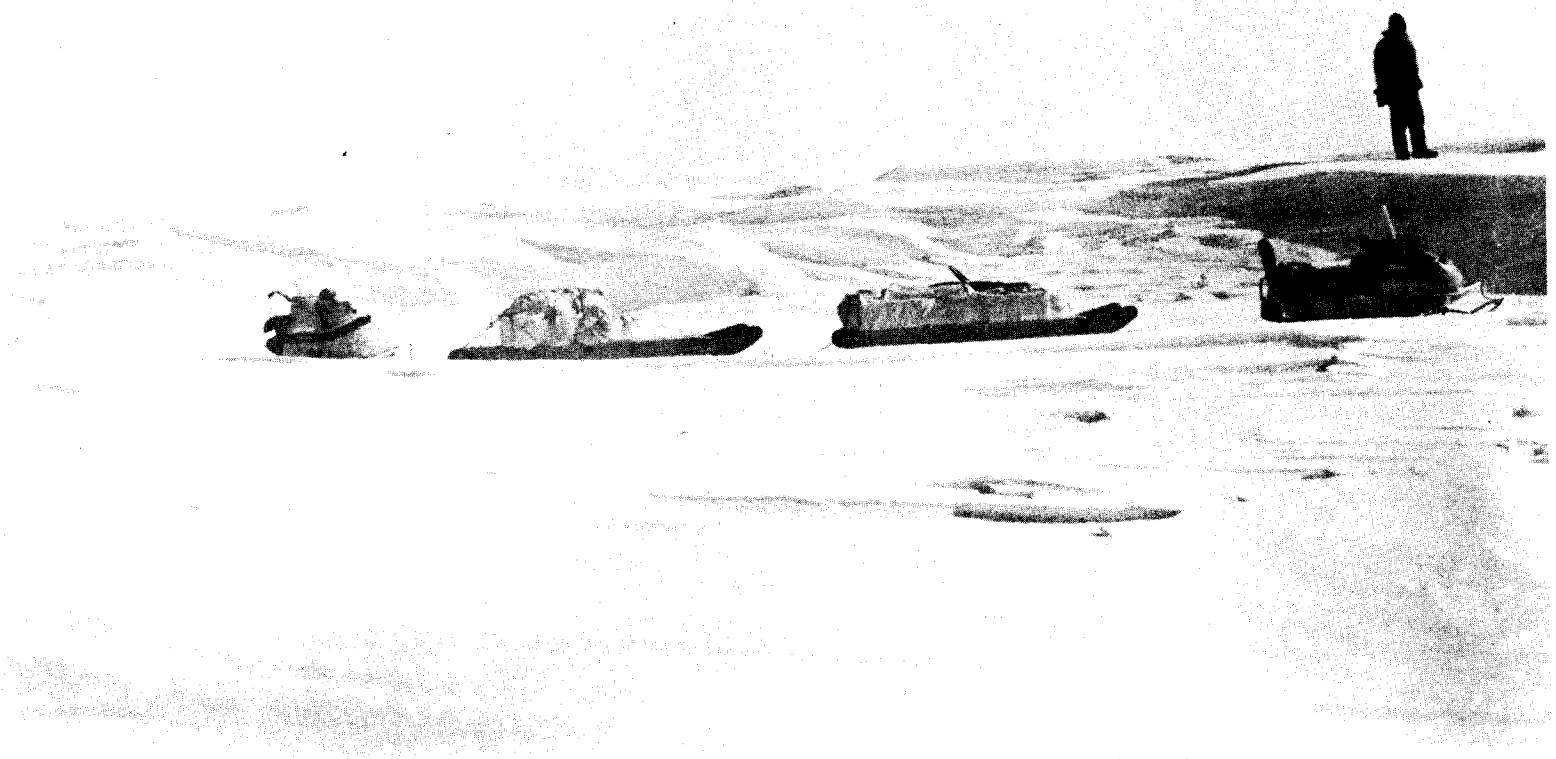

Fig. 7. Ice typical of the northern boundary of the plug.

Fig. 8 Ice typical of the southern boundary of the plug.

Fig. 9 Ice auger and extensions required to obtain cores from six metre thick ice.

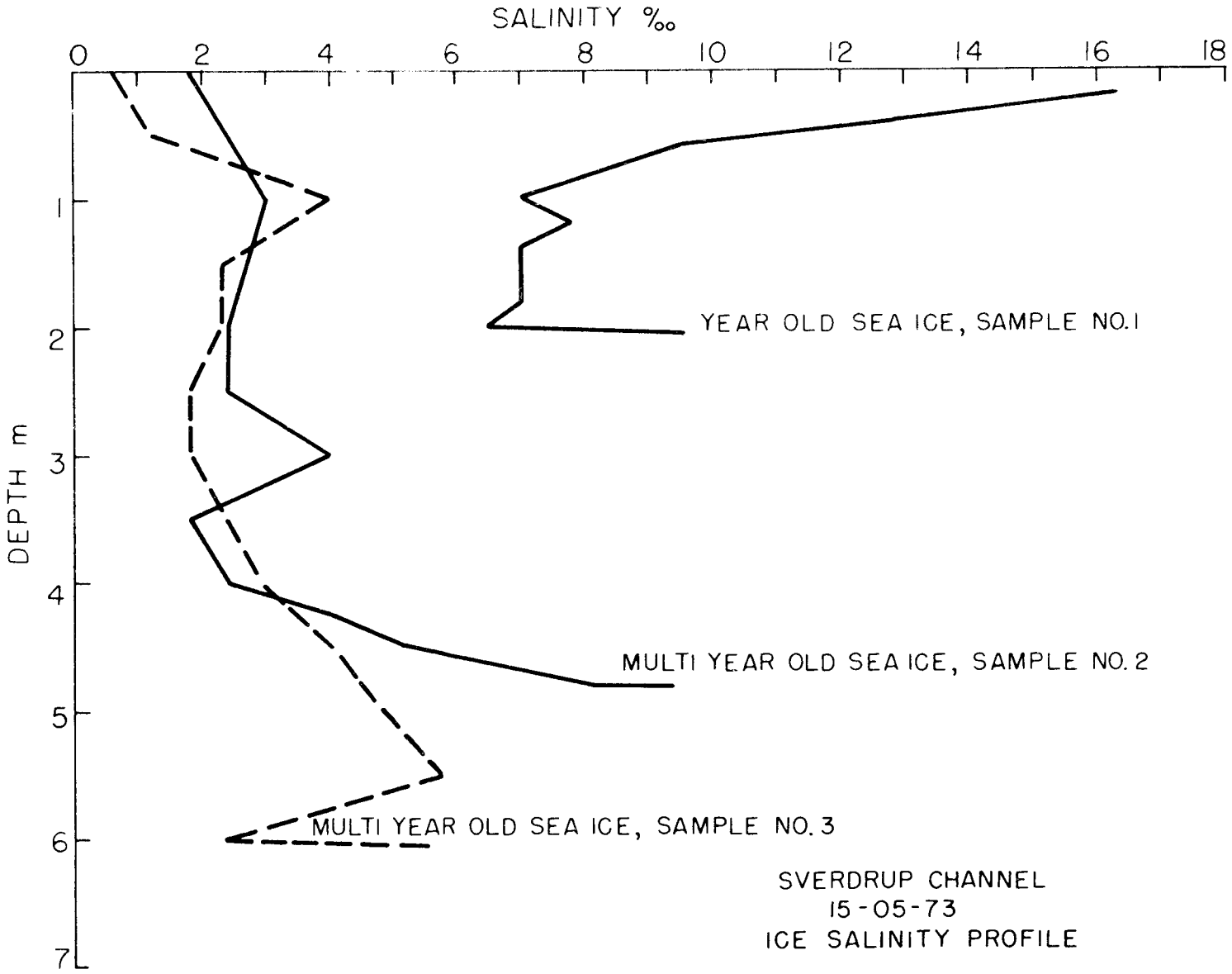

Fig. 10 Sverdrup Channel, ice salinity profiles.

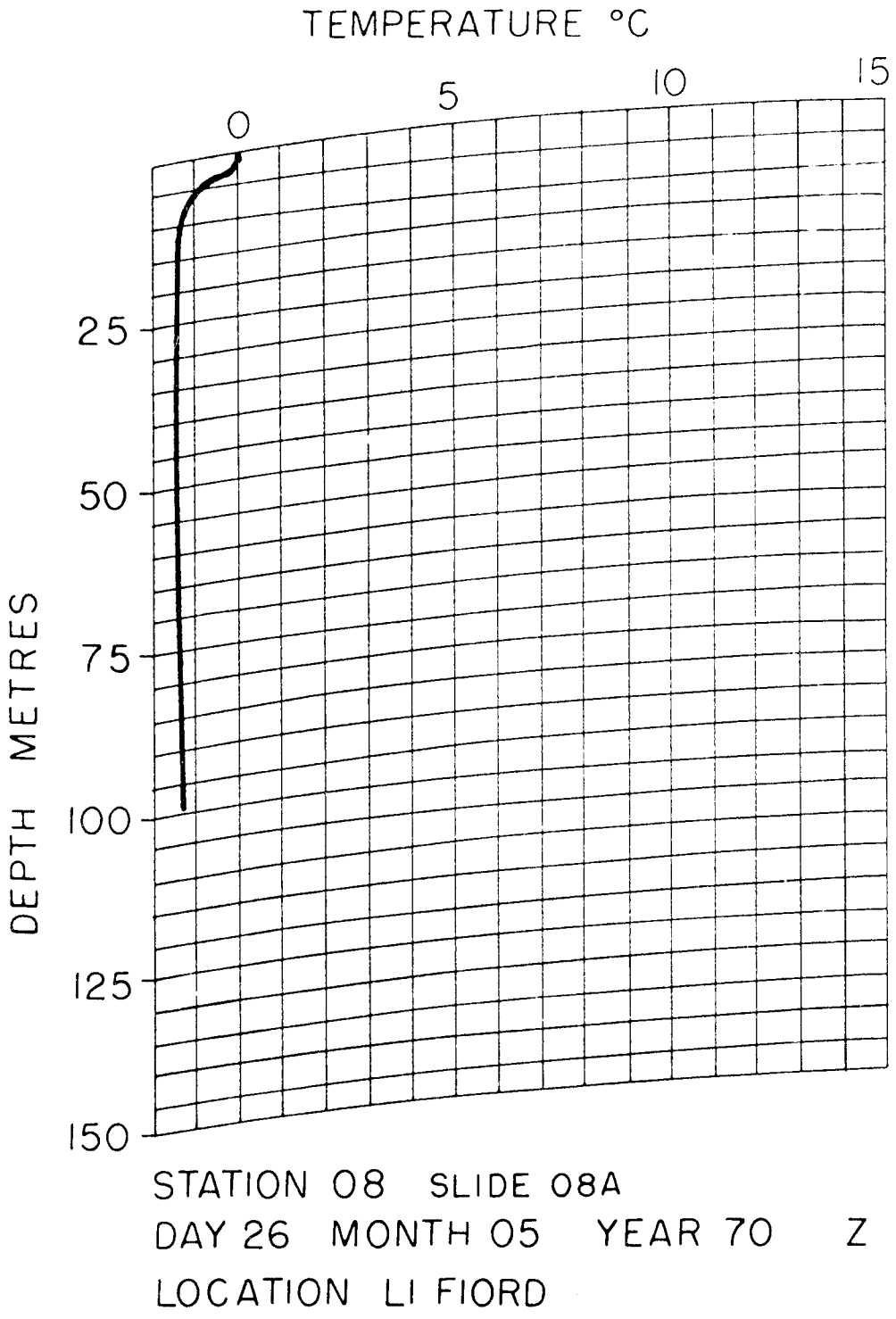

Fig. 11 Li Fiord, temperature profile, Station No. 08.

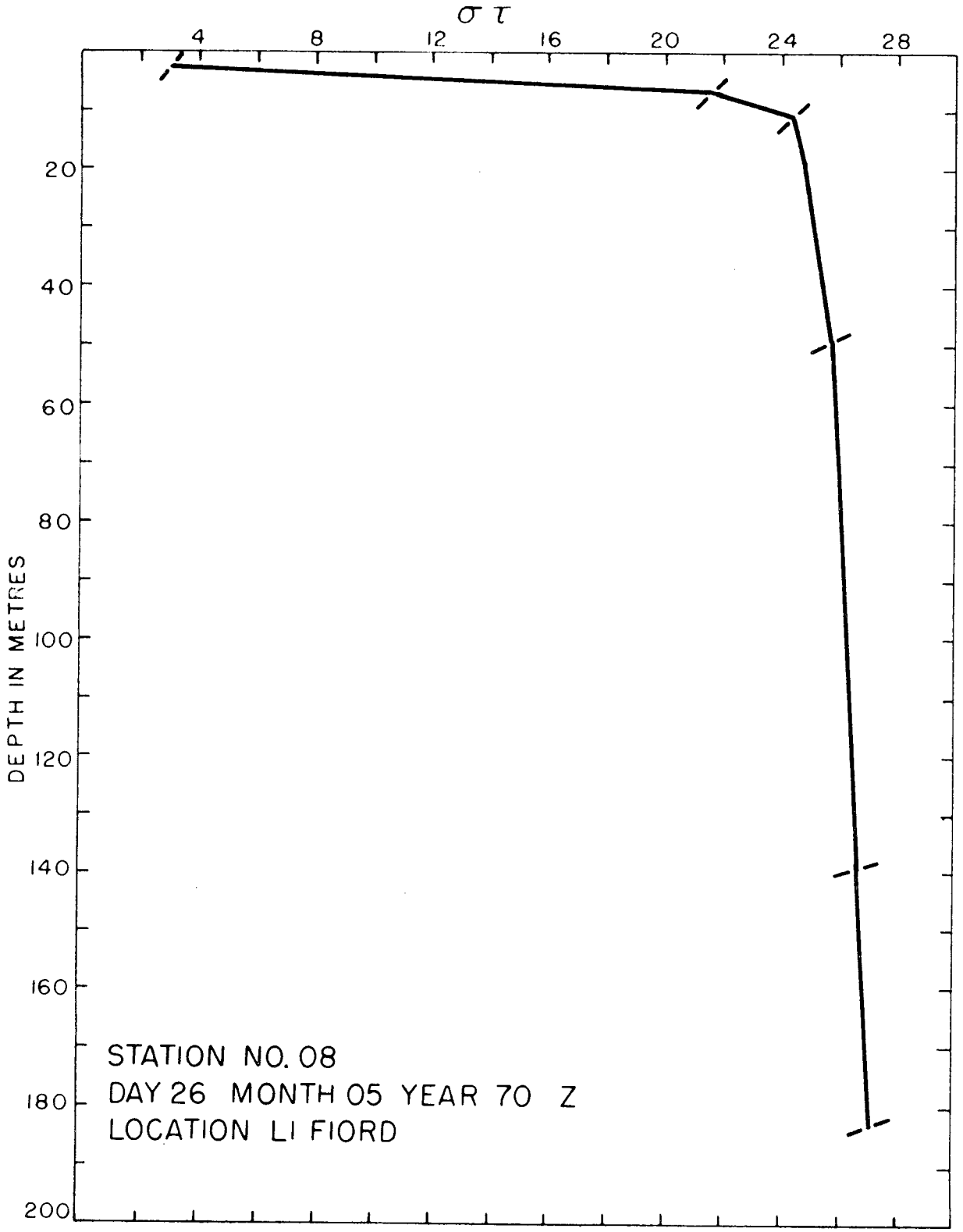

Fig. 12 Li Fiord, density profile, Station No. 08.

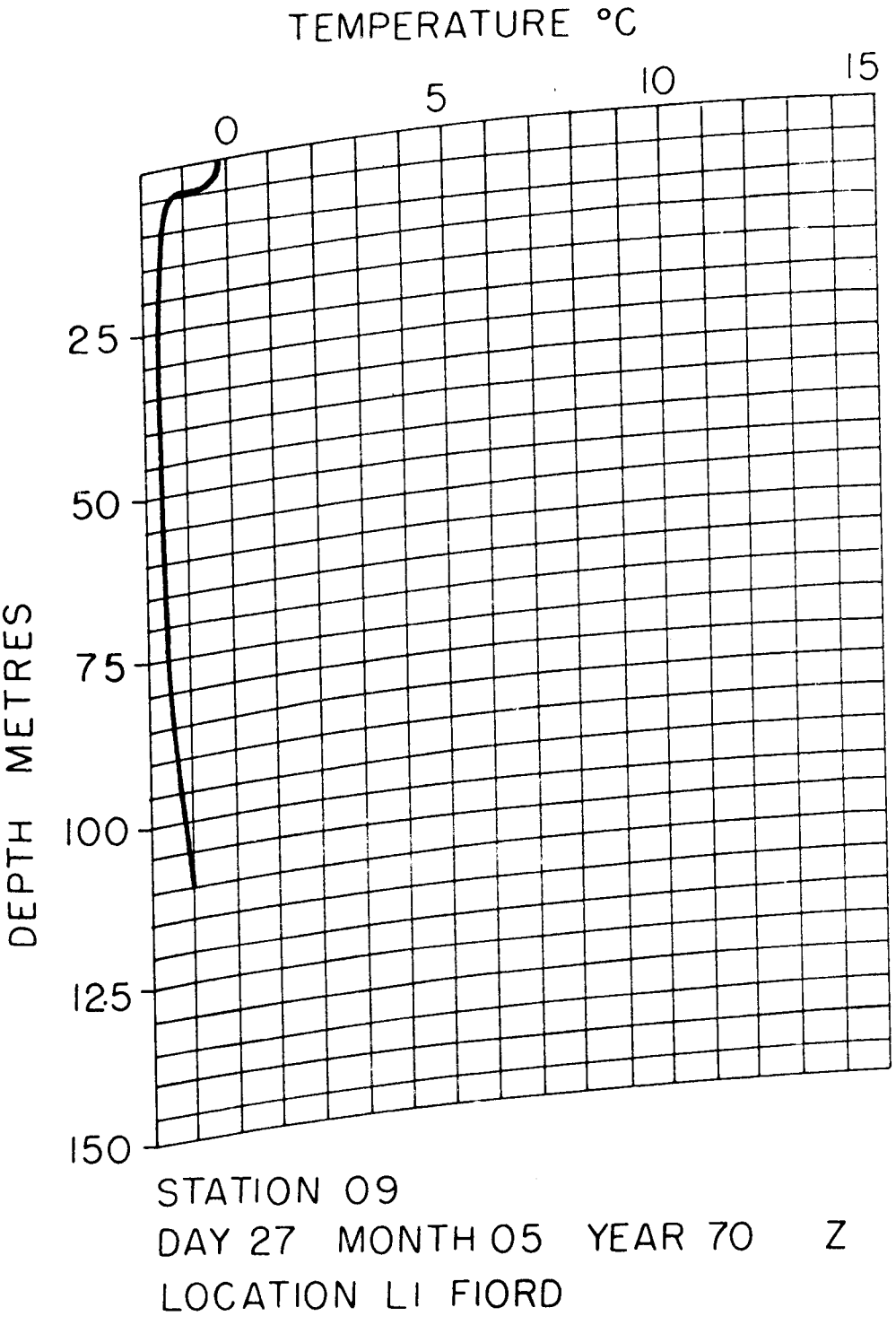

Fig. 13 Li Fiord, temperature profile, Station No. 09.

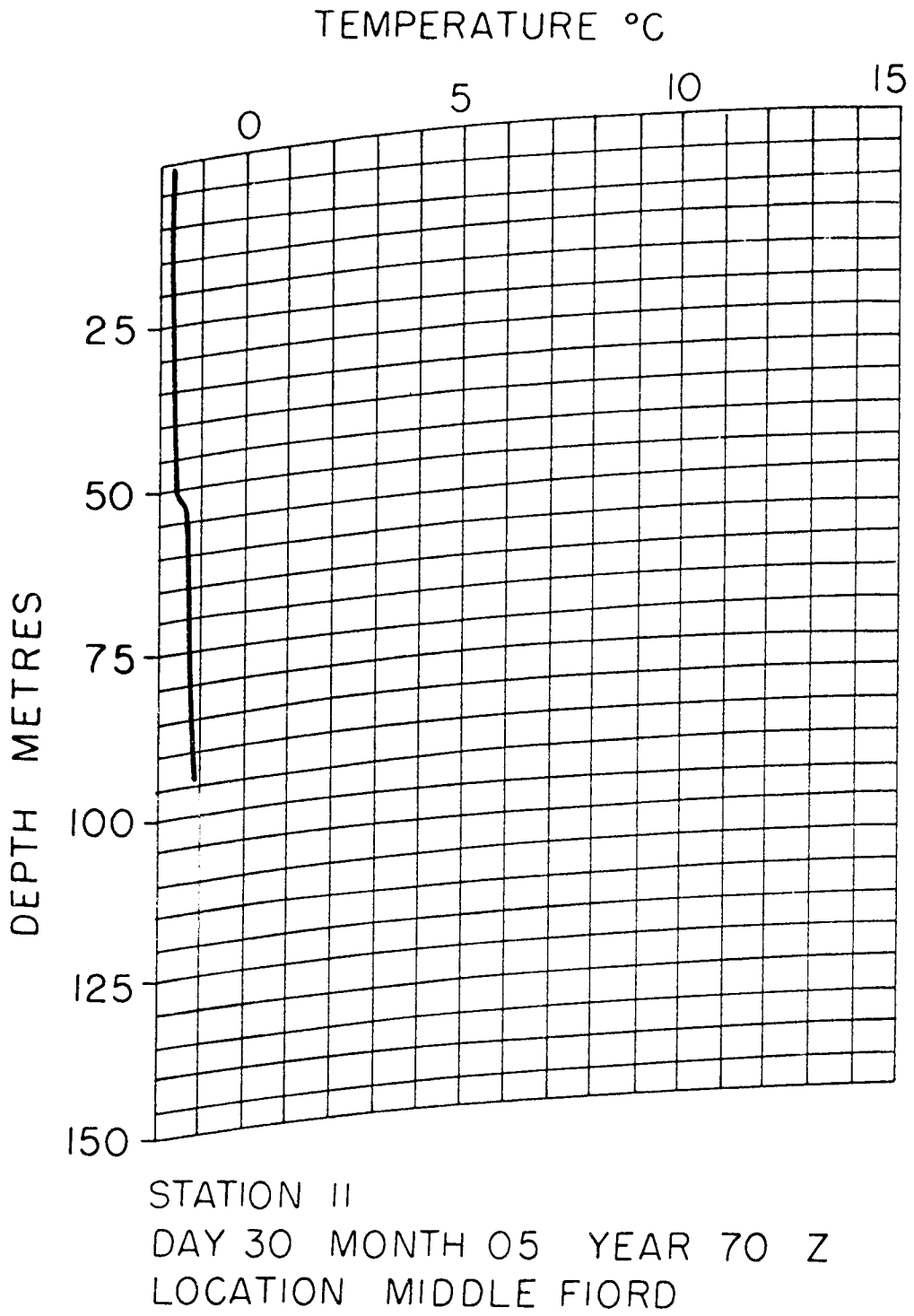

Fig. 14 Middle Fiord, temperature profile, Station No. 11.

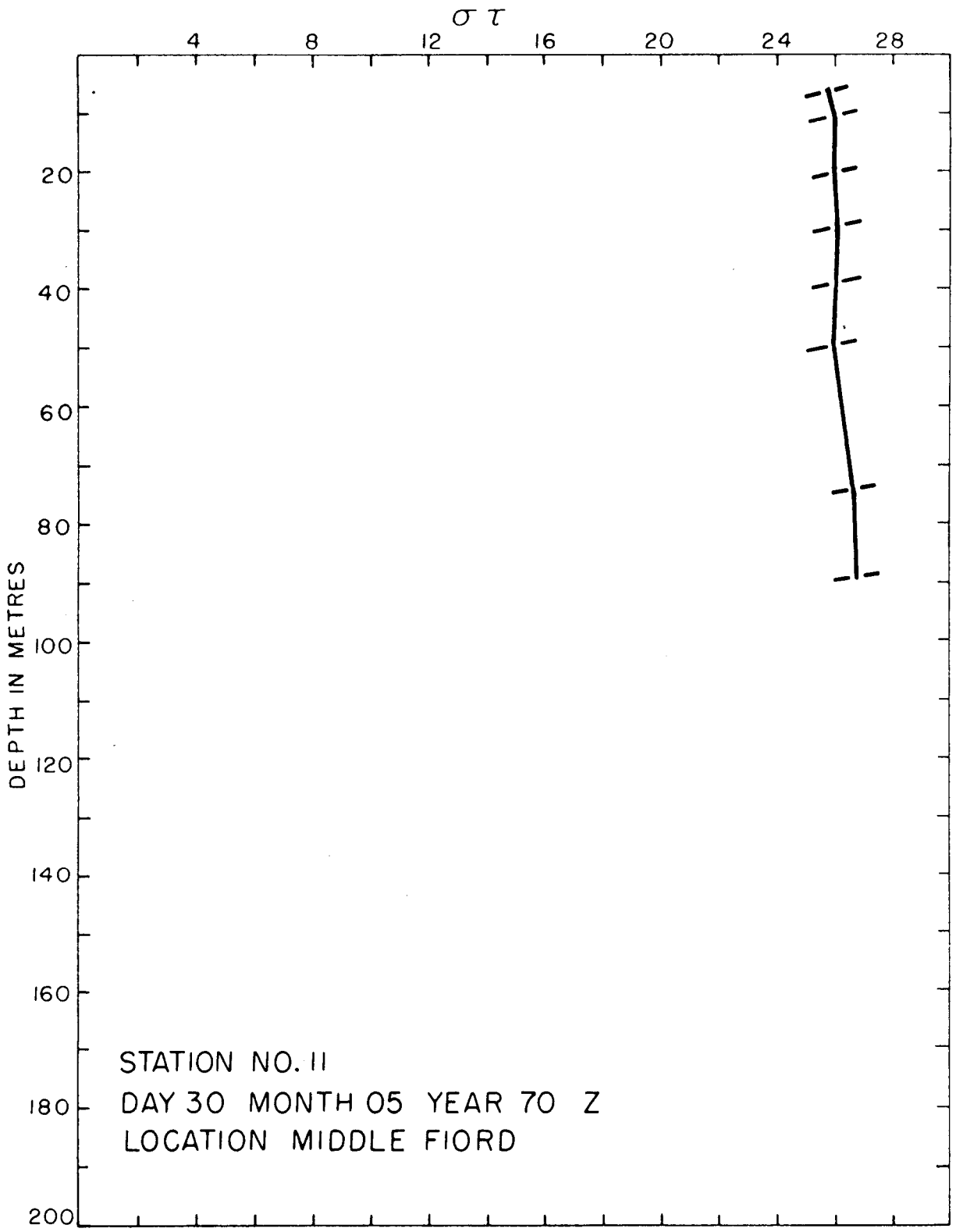

Fig. 15 Middle Fiord, density profile, Station No. 11.

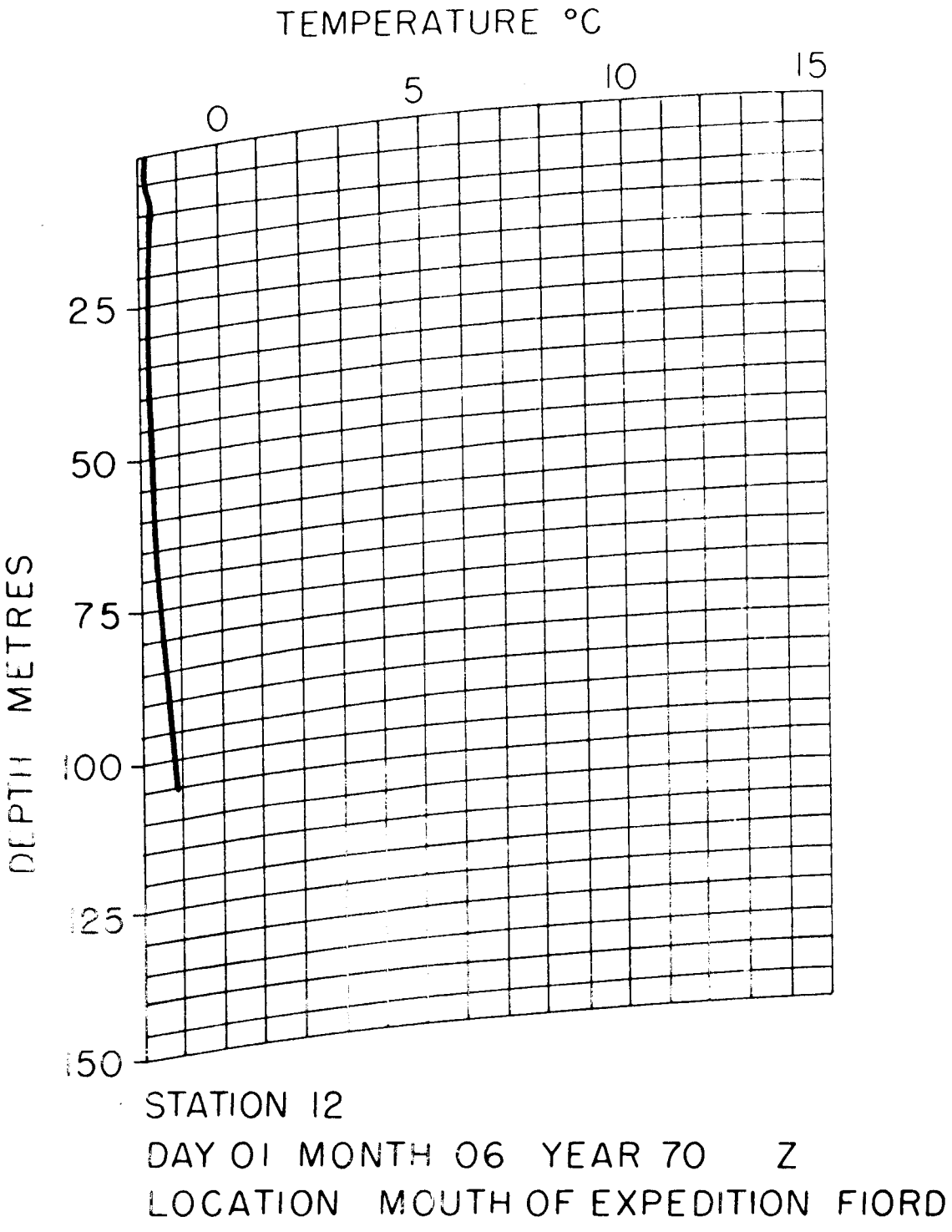

Fig. 16 Mouth of Expedition Fiord, temperature profile, Station No. 12.

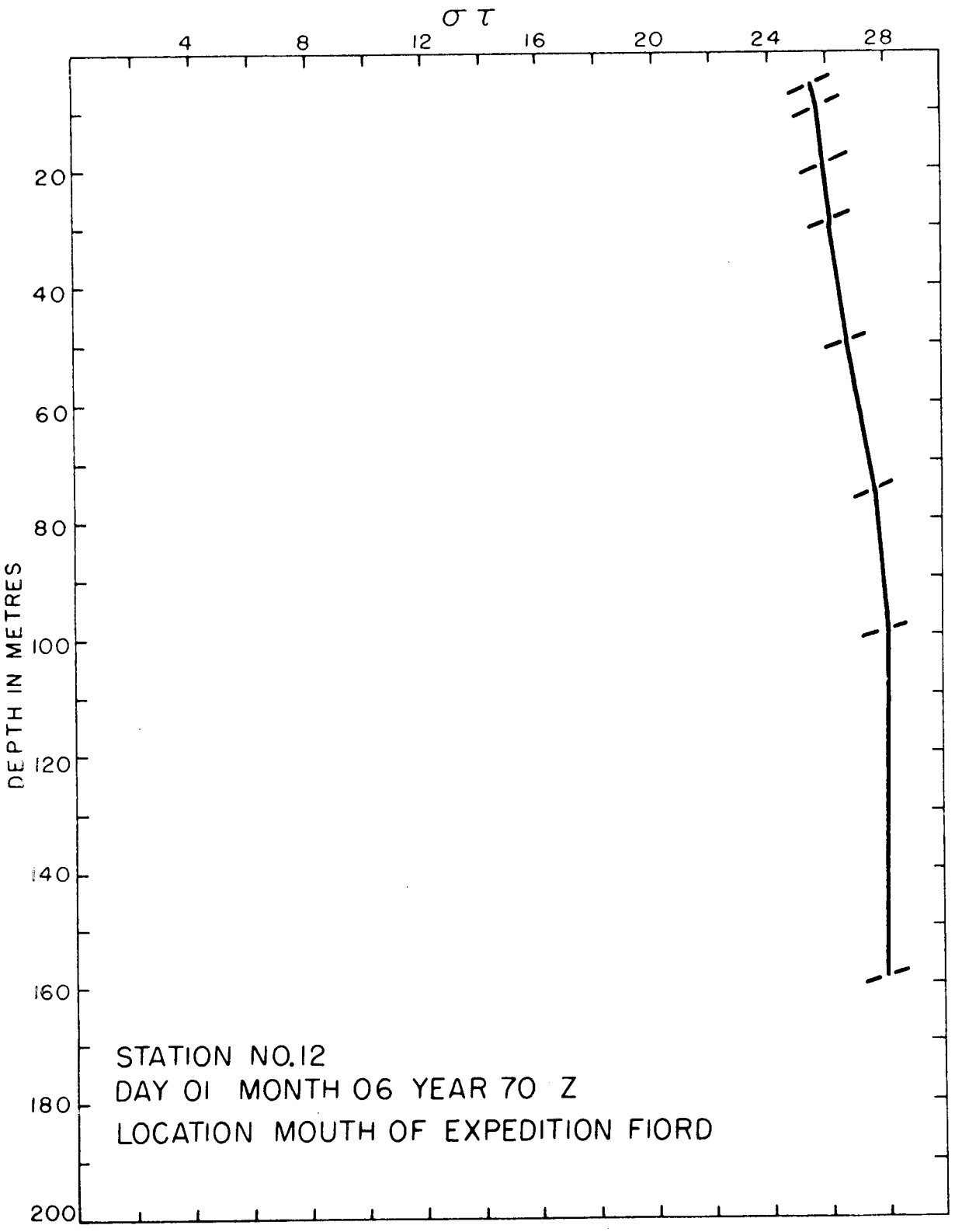

Fig. 17 Mouth of Expedition Fiord, density profile, Station No. 12.

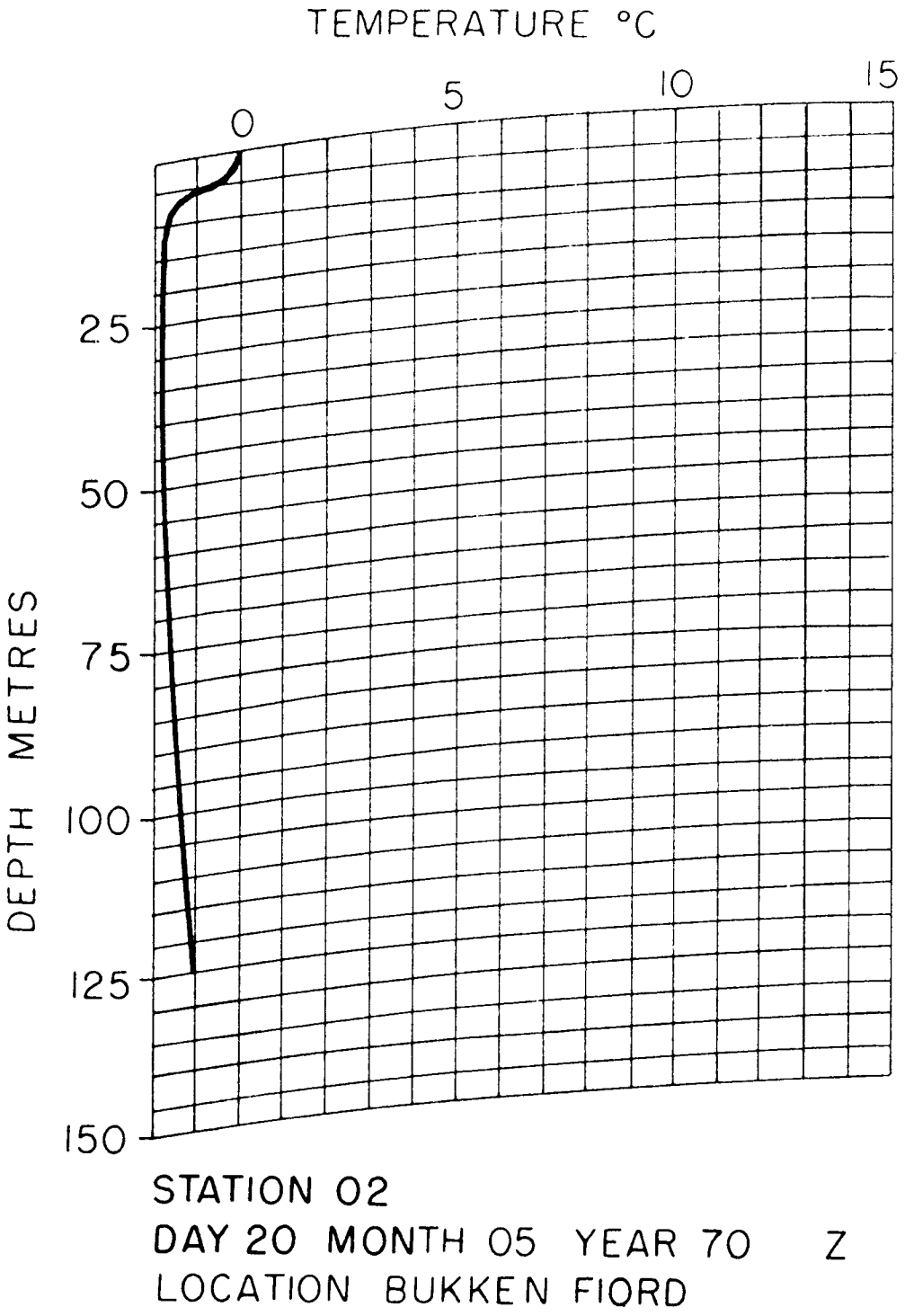

Fig. 18 Bukken Fiord, temperature profile, Station No. 02.

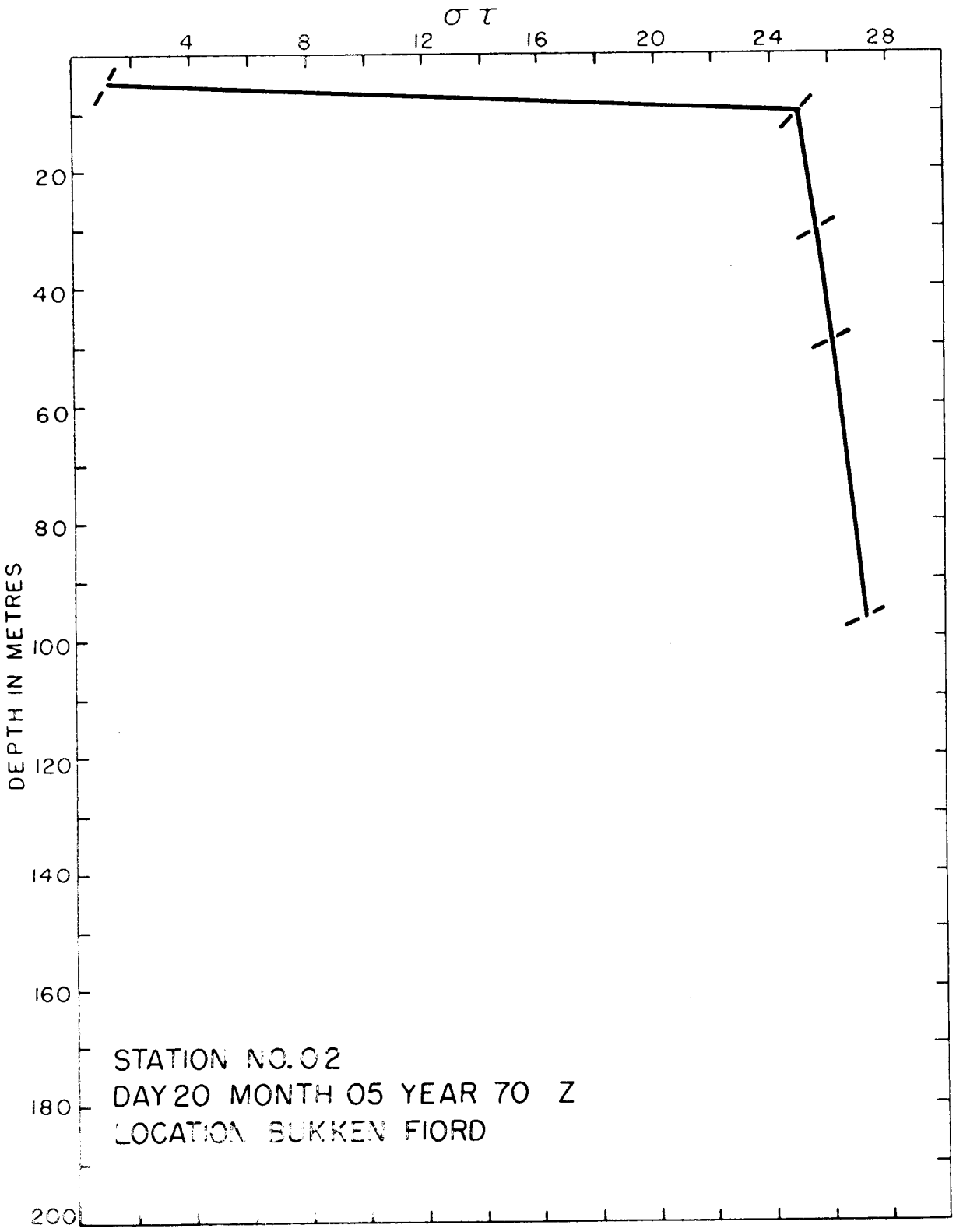

Fig. 19 Bukken Fiord, density profile, Station No. 02

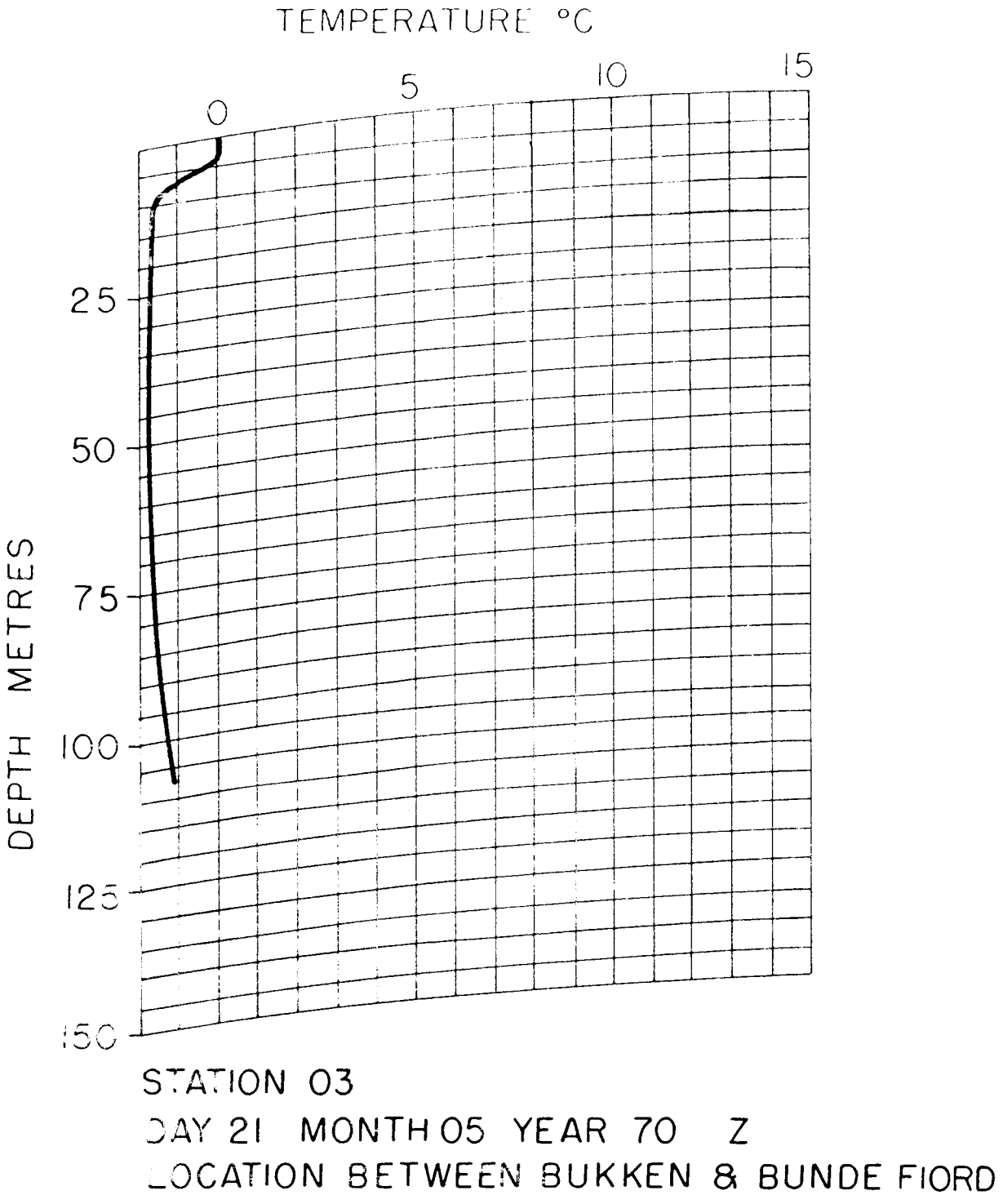

Fig. 20 Strait separating Bukken and Bunde Fiords, temperature profile, Station No. 03.

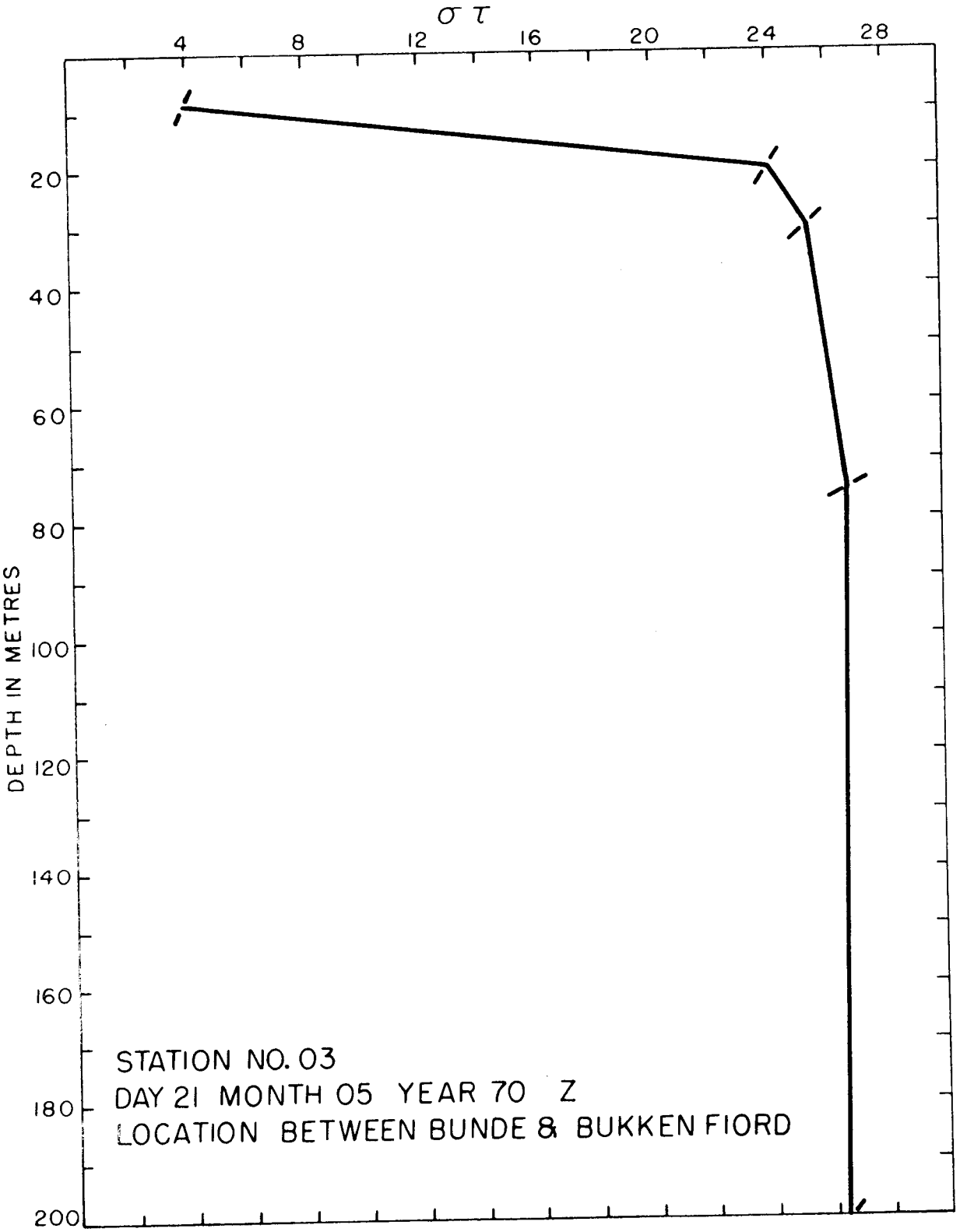

Fig. 21 *Strait separating Bukken and Bunde Fiords, density profile, Station No. 03.*

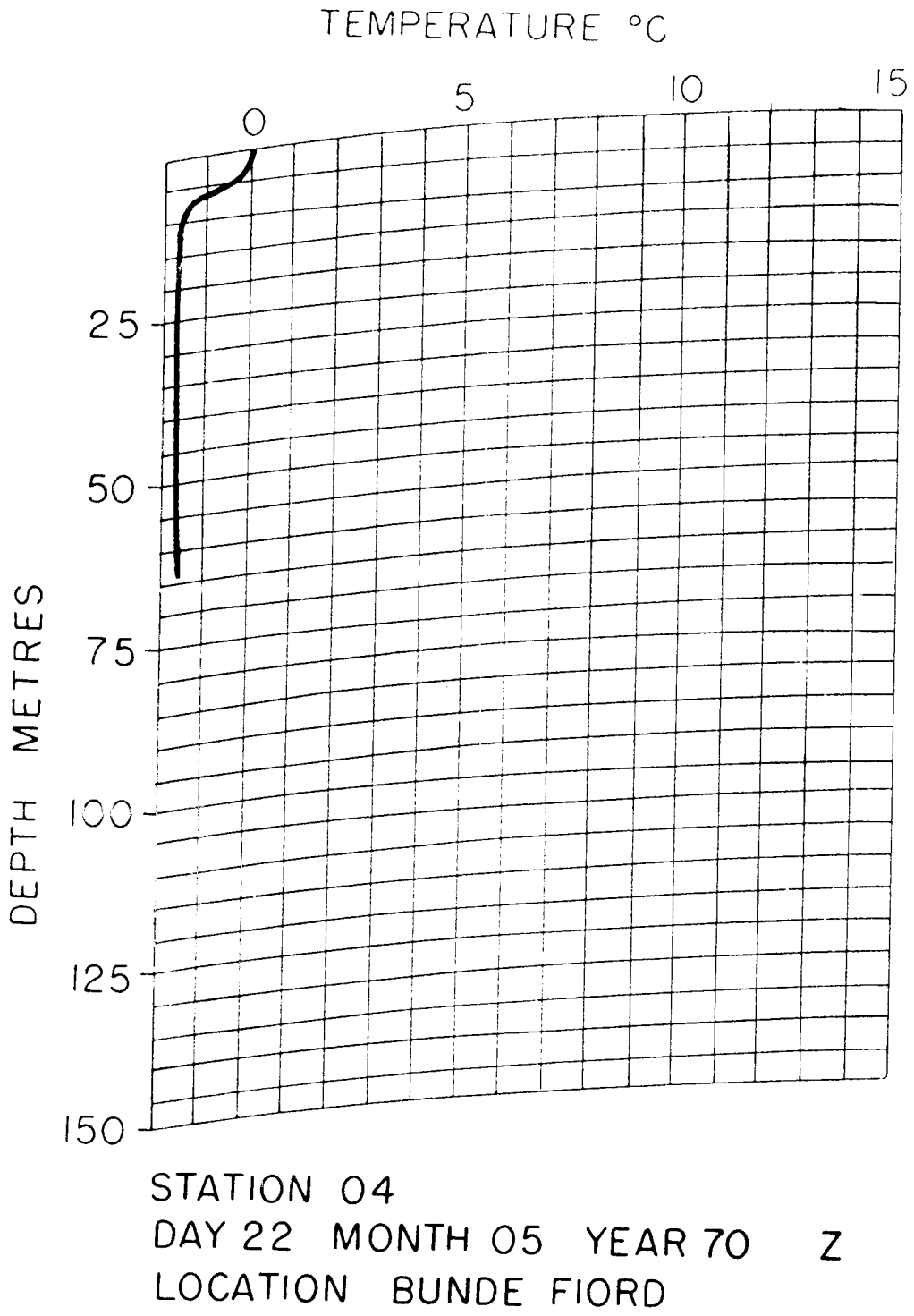

Fig. 22 Bunde Fiord, temperature profile, Station No. 04.

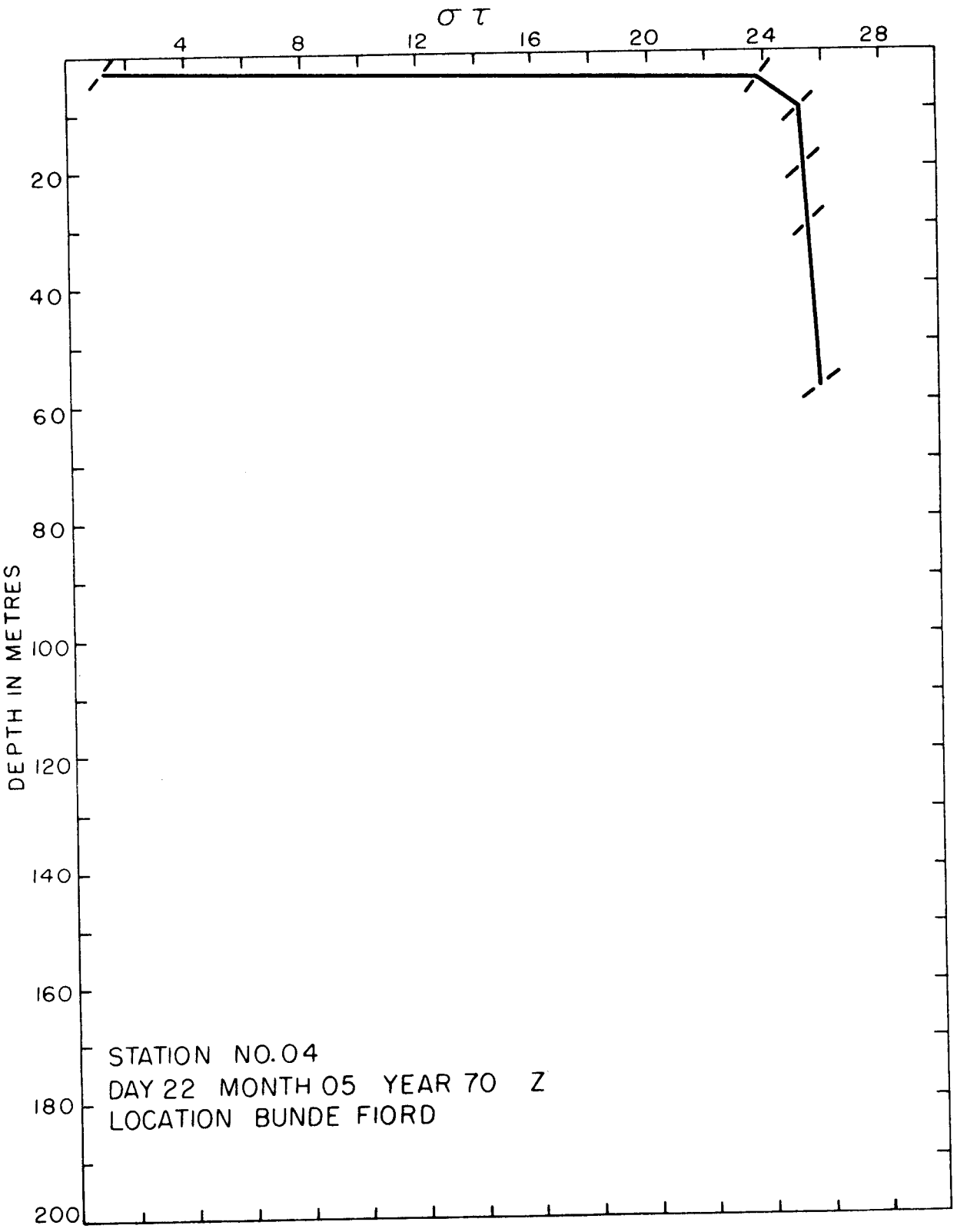

Fig. 23 Bunde Fiord, density profile, Station No. 04.

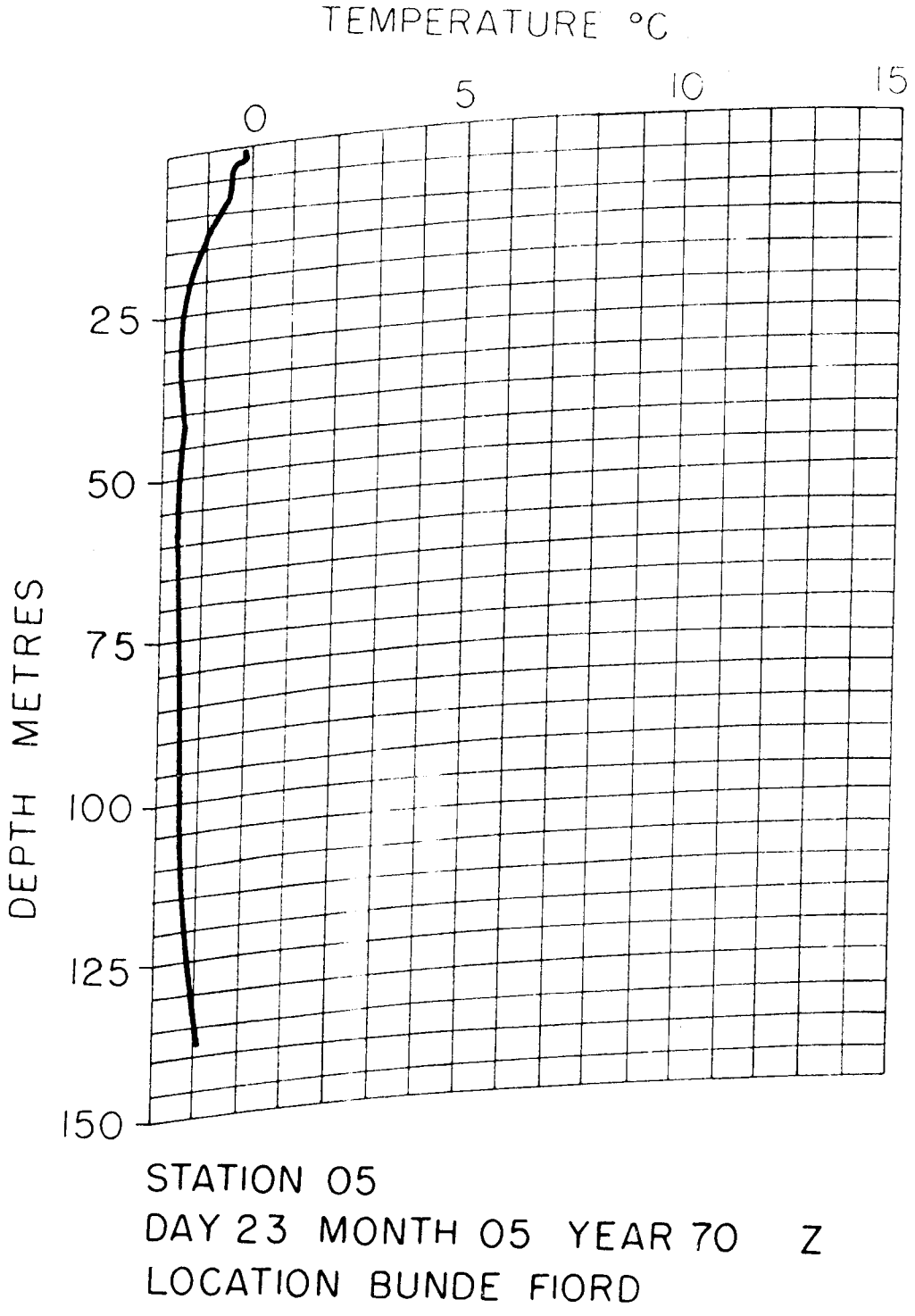

Fig. 24 Bunde Fiord, temperature profile, Station No. 05.

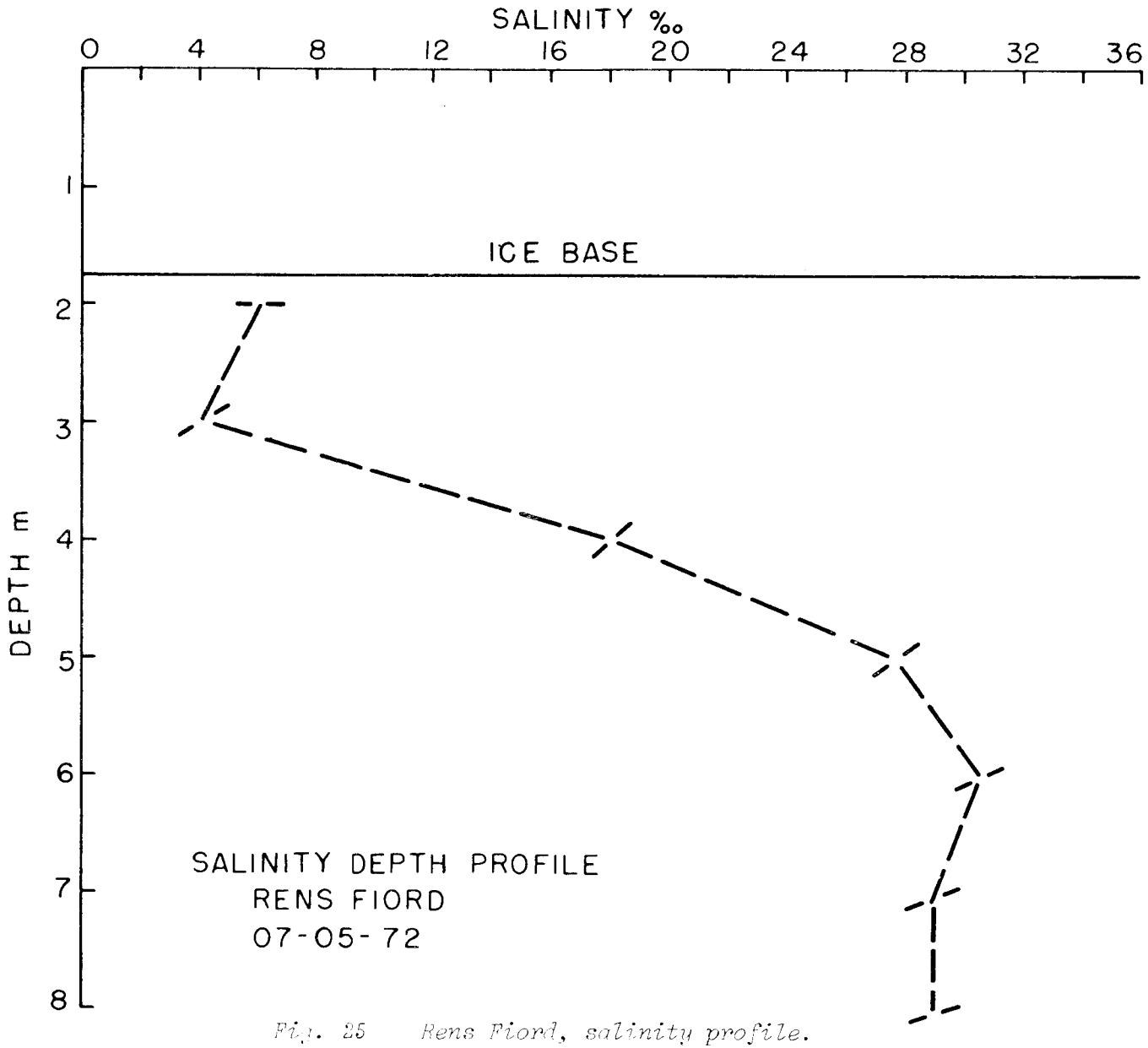

Fig. 25 Rens Fiord, salinity profile.

Fig. 26 Grounded sea ice north of Perley Island

Table 1. A brief comparison of Isachsen and Meighen Island weather records.[1,2,3]

	1960		1961		1962	
	Isachsen	Meighen*	Isachsen	Meighen†	Isachsen	Meighen††
	A: *Percentage of days with condition occurring*					
Freezing temperatures						
June	73	82	100	100	69	92
July	45	76	100	97	29	61
August	58	58	77	84	75	87
Precipitation						
June	41	27	83	47	61	31
July	52	28	80	24	29	29
August	32	13	55	52	63	57
Obstruction to vision (visibility ⅝ mile or less)						
June	5	68	16	90	27	69
July	16	72	32	94	16	48
August	39	74	0	81	54	87
Winds over 18 m.p.h.						
June	32	32	52	77	65	62
July	29	17	32	84	13	6
August	15	13	45	58	54	35
	B: *Percentage of observations when fog was reported*					
June	15	47	54	52	22	61
July	18	47	43	75	6	24
August	21	69	42	65	35	68

Notes: 1960: Record 9-30 June (22 days) *Irregular observations — 45% of complete record
1962: Record 5-30 June (26 days) †Regular 3-hourly observations
1962: Record 1-23 Aug. (23 days) ††Regular 6-hourly observations

ooo ISACHSEN	LATITUDE 78 47 N				LONGITUDE 103 32 W			ELEVATION	63 FT ASL				
TEMP. MOYENNE QUOTIDIENNE (DEG F)	-31.2	-33.5	-29.9	-14.0	11.0	30.5	37.9	34.0	16.1	- 2.9	-18.8	-26.5	- 2.3 3
TEMPERATURE MAX. QUOTIDIENNE MOYENNE	-24.7	-27.2	-23.3	- 7.1	16.5	34.4	42.3	38.1	21.3	3.8	-12.1	-20.1	3.5 3
TEMPERATURE MIN. QUOTIDIENNE MOYENNE	-37.7	-39.7	-36.3	-20.9	5.5	26.5	33.3	29.9	10.9	- 9.6	-25.4	-32.9	- 8.0 3
TEMPERATURE MAXIMALE	25	24	17	30	36	62	72	58	39	32	25	26	72 3
NOMBRE D'ANNEES EN RECORD	22	22	22	22	23	23	23	23	23	23	22	22	
TEMPERATURE MINIMALE	-63	-64	-65	-50	-21	6	25	8	-21	-42	-53	-60	-65 3
NOMBRE D'ANNEES EN RECORD	22	22	22	22	23	23	23	23	23	23	23	23	
NOMBRE DE JOURS DE GEL	31	28	31	30	31	26	17	22	30	31	30	31	338 3
HAUTEUR DE PLUIE MOYENNE (POUCES)	0.00	0.00	0.00	0.00	T	0.09	0.60	0.60	0.06	T	0.00	0.00	1.35 3
CHUTE DE NEIGE MOYENNE	0.9	0.9	1.0	1.5	3.7	2.1	2.1	2.4	5.8	4.1	1.7	0.9	27.1 3
PRECIPITATION TOTALE MOYENNE	0.09	0.09	0.09	0.15	0.36	0.30	0.83	0.86	0.61	0.39	0.17	0.09	4.03 3
PLUIE MAXIMUM EN 24 HEURES	0.00	0.00	0.00	0.00	T	0.74	0.60	0.80	0.42	0.01	0.00	0.00	0.80 3
NOMBRE D'ANNEES EN RECORD	22	22	22	22	23	23	23	23	23	23	23	23	
CHUTE DE NEIGE MAXIMUM EN 24 HEURES	1.0	2.2	3.2	2.8	2.5	2.3	3.4	2.5	7.8	4.3	2.5	2.1	7.8 3
NOMBRE D'ANNEES EN RECORD	22	22	22	22	23	23	23	23	23	23	23	23	
PRECIPITATION MAXIMUM EN 24 HEURES	0.10	0.22	0.19	0.18	0.24	0.74	0.60	0.80	0.78	0.43	0.25	0.21	0.80 3
NOMBRE D'ANNEES EN RECORD	22	22	22	22	23	23	23	23	23	23	23	23	
NOMBRE DE JOURS AVEC PLUIE MESURABLE	0	0	0	0	0	1	6	6	*	*	0	0	13 3
NOMBRE DE JOURS AVEC NEIGE MESURABLE	4	3	4	5	9	5	3	5	11	9	5	4	67 3
NBRE DE JRS AVEC PRECIPITATION MBLE.	4	3	4	5	9	6	8	11	12	9	5	4	80 3
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR TYPE

Fig. 27 A comparison of Isachsen and Meighen Island weather.

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13. ABSTRACT

ABSTRACT (U)

This Technical Note assesses the available physical and environmental information on Sverdrup Channel.

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