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OCEANOGRAPHIC DATA OF HALIFAX INLET

by

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SUMMARY

Temperatures and salinities were recorded in Halifax Inlet during the period from 15 July 1969 to 16 September 1971. At about the middle of each month, up to 31 stations were occupied in a one-day survey covering the area lying between Chebucto Head and Bedford Basin. The data are presented in the form of cross-section plots. Related meteorological and hydrological observations are included.

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1. INTRODUCTION

Halifax Inlet is situated on the southeast coast of the Canadian Atlantic province of Nova Scotia, approximate location $44^{\circ}41'N$ and $63^{\circ}35'W$ (Fig. 1). The City of Halifax (population 125,000) occupies the western side of the harbour, and the city of Dartmouth (population 60,000) occupies the eastern side.

In July 1969 a monthly T-S survey was started to collect data on the seasonal variations of the waters circulating in Halifax Inlet. The oceanographic data will be used to study the interaction zone between the Inlet and the continental shelf and also to assess local circulation patterns and their influence on the distribution of pollutants from various effluent sources in the system. The calculated densities are also useful for deriving draught limits for large ships intending to use the port.

2. PHYSICAL FEATURES

The Inlet is made up of three quite distinct areas (Fig. 2):

- (1) Bedford Basin - an almost landlocked somewhat lagoon-like area measuring $6\frac{1}{2} \times 2\frac{1}{2}$ km, with a maximum depth of 75 metres. The only outlet to the harbour is 350 metres wide and 20 metres deep.
- (2) Halifax Harbour is 14 km long from the seaward end of Bedford Basin to the seaward end of McNabs Island. In the navigable area the minimum depth is 23 metres. There are about 8 km of port facilities - including container handling - on the

Halifax or western side, and about 10 km of lesser, limited facilities on the Dartmouth side.

- (3) The seaward approaches lie in the bay formed by the headlands of Chebucto Head and Hartlen Point, and are about 10 km wide by 5 km long from McNabs Island. The deepest point is 50 metres near Chebucto Head.

3. SURVEY LAYOUT

A network of 29 stations, later modified to 31, was laid out in eight lines across the harbour and inlet (Fig. 2 and Table 2). The seven innermost lines were surveyed every month and the outer line was surveyed when weather conditions permitted. Twelve sets of consecutive mid-month surveys were originally scheduled but a major pollution disaster in Chedabucto Bay stopped the series in February 1970. A fresh start was made in August 1970 and the series continued through to September 1971. A total of 24 separate sets of measurements were made during the 27-month period.

4. EQUIPMENT

Initially, a Beckman RS5-3 portable conductivity salinometer was used for the T-S measurements. The accuracy of this instrument was rated at $T = \pm 0.5^{\circ}\text{C}$ and $S = \pm 0.3\text{‰}$. However, by calibrating against known temperatures and salinities an error curve was derived. The application of this correction increased the accuracies to $T = \pm 0.05^{\circ}\text{C}$ and $S = \pm 0.05\text{‰}$. Because of the time required on station (10-20 minutes), the field procedure adopted when using the RS5-3 was to begin measuring from the deepest point first, thus ensuring that these readings were exactly on station. This

also allowed the propeller disturbances to subside by the time the sensor had been raised to the upper levels.

Whenever available the N.R.C. Guildline STD was used. This instrument measures salinity either by resistivity or conductance and its design permits a high speed vertical traverse giving a profile in precise detail. The reading accuracy is rated at $T = \pm 0.02^{\circ}\text{C}$ and $S = \pm 0.04\text{‰}$. Station time: 2-4 minutes.

On one occasion, July 1971, a new instrument (the Bissett-Berman 9060 STD) was used but much of the data at mid-depth were questionable due to a marked inconsistency between the records taken at a station when the instrument was being lowered and raised.

Some of these data have been cross-checked with an RS5-3 and used, otherwise the data sheets have been marked 'area of doubtful data'.

Occasionally surface samples were taken and analyzed in the lab using a Bisset-Berman 6230 salinometer to check the various instruments, but from April 1971 onward, a surface sample was collected at every station and the analyzed result was used to supplement the data.

5. PRESENTATION OF DATA (Fig. 3-27)

Temperatures, salinities and densities have been plotted each on its own sheet. Solid line isopleths represent whole value units as defined below, half units are as dashed lines and quarter units as dotted lines. Quarter units are only used in the shallowest and deepest areas of a profile, or where the total vertical variation is small. The deep reading for each station, when shown, is written in at its correct level. The

'areas of doubtful data' (July 1971) have surface sample values shown at the top of each station.

Isotherms are drawn in units of degrees centigrade with only the even values labelled. Exceptions usually indicate a limiting value in the profile.

Salinity values are written as numbers representing parts per thousand.

Densities are shown as sigma-t (σ_t) values, thus the number 25.0 means a density of 1.0250. No correction has been applied for depth-related anomalies since only two stations are in water deeper than 60 metres.

The depth scale is in metres and is directly related to chart datum (C.D.) so, the line representing the water surface is drawn above the zero mark by the amount that the tide stage was elevated above C.D. at that time on the station.

Tidal information is from records taken by the Tides and Water Levels Section of the Department of the Environment. All high and low waters are shown for the central 21 days of each month - except February 1970 when two surveys were made, one at the beginning and one at the end of the month. An hourly tide curve, in metres, for the day of each survey is included, and shows the time spanning the survey.

The Sackville River is the only major fresh water inflow to the harbour. From March 1970 its flow rates were recorded at the Bedford gauging station (No. 01EJ001). Prior to March 1970 the discharge has been calculated from a drainage area comparison with the Roden River. No data were available for January and February 1970. The daily discharges in cubic metres per second are drawn on the data sheets and cover a period of

approximately ten days before and after the survey day. During the dry season, the river flow can diminish to less than $0.25 \text{ m}^3/\text{sec}$ which can easily be matched by local sewage outfall and run-off from inland lake regulation. The largest river flow in the two years was $86 \text{ m}^3/\text{sec}$ due to excessive precipitation from Hurricane Beth (16 August 1971).

Meteorological information was taken from CFB Shearwater records. Each wind vector drawn is the resultant, in metres per second, of four 1-hour records and is directionally oriented to the map included in each sheet.

The operating data (Table 1) lists survey times, vessels, measuring sensors, the order in which the stations were occupied, and an estimate of the distance covered.

The data is in the process of being filed with the Canadian Oceanographic Data Centre in Ottawa.

6. ACKNOWLEDGEMENT

This project was initiated by and carried out under the general supervision of Mr. H.J.A. Neu whose interested criticism in the production of this report was much appreciated.

TABLE 1 - OPERATING DATA

	<u>DATE</u>	<u>TIME AST</u>	<u>HOURS ELAPSED</u>	<u>EQPT.</u>	<u>LINES COVERED</u>	<u>VESSEL</u>
1	15.7.69	10.05-23.52	13.47	RS5	B-H	TUDLIK
2	14.8.69	05.45-19.17	13.32	RS5	B-H	TUDLIK
3	16.9.69	07.10-17.27	10.27	RS5	C-H	TUDLIK
	17.9.69	14.55-16.48	1.53	RS5	B	SIGMA-T
4	15.10.69	09.28-19.06	9.11	RS5	H-B	SIGMA-T
5	12.11.69	11.30-19.16	7.46	STD	H-A	DAWSON
6	16.12.69	09.50-15.15	5.25	STD	B-H	SIGMA-T
7	14.1.70	11.10-15.47	4.37	STD	B-H	SIGMA-T
8	2.2.70	07.55-13.48	5.53	STD	A-H	DAWSON
9	24.2.70	10.53-15.20	4.27	STD	H-B	SIGMA-T
10	14.5.70	15.10-21.20	6.10	STD	A-H	SACKVILLE
11	19.8.70	09.20-17.45	8.25	RS5	B-H	SIGMA-T
12	16.9.70	07.45-15.26	7.41	RS5	B-H	TUDLIK
13	13.10.70	13.20-23.49	10.29	RS5	H-A	DAWSON
14	16.11.70	10.05-19.41	9.36	RS5	B-H	SIGMA-T
15	15.12.70	09.44-17.25	7.41	RS5	B-H	TUDLIK
16	15.1.71	09.55-18.58	9.03	STD	H-A	SACKVILLE
17	15.2.71	09.50-16.23	6.33	RS5	H-A	SACKVILLE & SIGMA-T
18	16.3.71	09.38-17.51	8.13	RS5	B-H	TUDLIK
19	15.4.71	08.40-18.52	10.02	RS5	A-H	E.E. PRINCE
20	16.5.71	08.58-19.38	10.40	RS5	A-H	SURVEYOR II
21	15.6.71	09.05-15.44	6.39	STD	A-H	NAVICULA
22	14.7.71	09.15-16.57	7.42	STD-BB	A-H	NAVICULA
23	16.8.71	08.45-15.00	6.15	STD	H-B	NAVICULA
24	16.9.71	09.14-14.21	5.17	STD	A-H	NAVICULA

The total distance covered by survey was:

for all 31 stations - 93 km

for the inner 26 stations - 66 km

TABLE 2 - STATION LOCATIONS

	N	W
Line A	1. 44°28.90'	63°30.84'
	2. 44°29.60'	63°29.55'
	3. 44°30.96'	63°26.82'
	4. 44°32.30'	63°24.06'
	5. 44°34.20'	63°19.60'
Line B	1. 44°32.25'	63°32.10'
	2. 44°32.96'	63°30.73'
	3. 44°33.56'	63°29.33'
	4. 44°34.26'	63°27.97'
	5. 44°34.93'	63°26.60'
Line C	1. 44°35.62'	63°32.84'
	2. 44°35.75'	63°32.56'
	3. 44°35.87'	63°32.28'
	4. 44°35.93'	63°32.02'
	5. 44°37.29'	63°31.34'
	6. 44°37.42'	63°31.17'
Line D	1. 44°38.03'	63°33.64'
	2. 44°38.17'	63°33.16'
	3. 44°38.31'	63°32.21'
Line E	1. 44°40.53'	63°36.58'
	2. 44°40.62'	63°36.56'
	3. 44°40.67'	63°36.54'
Line F	1. 44°40.44'	63°38.14'
	2. 44°40.90'	63°37.52'
	3. 44°41.13'	63°37.19'
Line G	1. 44°41.20'	63°39.21'
	2. 44°41.59'	63°38.51'
	3. 44°41.99'	63°37.78'
Line H	1. 44°42.07'	63°39.36'
	2. 44°42.26'	63°39.02'
	3. 44°42.42'	63°38.73'
Line H	16 Sept. 69 to 16 Nov. 70	
	1. 44°42.16'	63°39.15'
	2. 44°42.38'	63°38.67
Line H	15 July 69 to 14 Aug. 69	
	1. 44°42.43'	63°39.39'

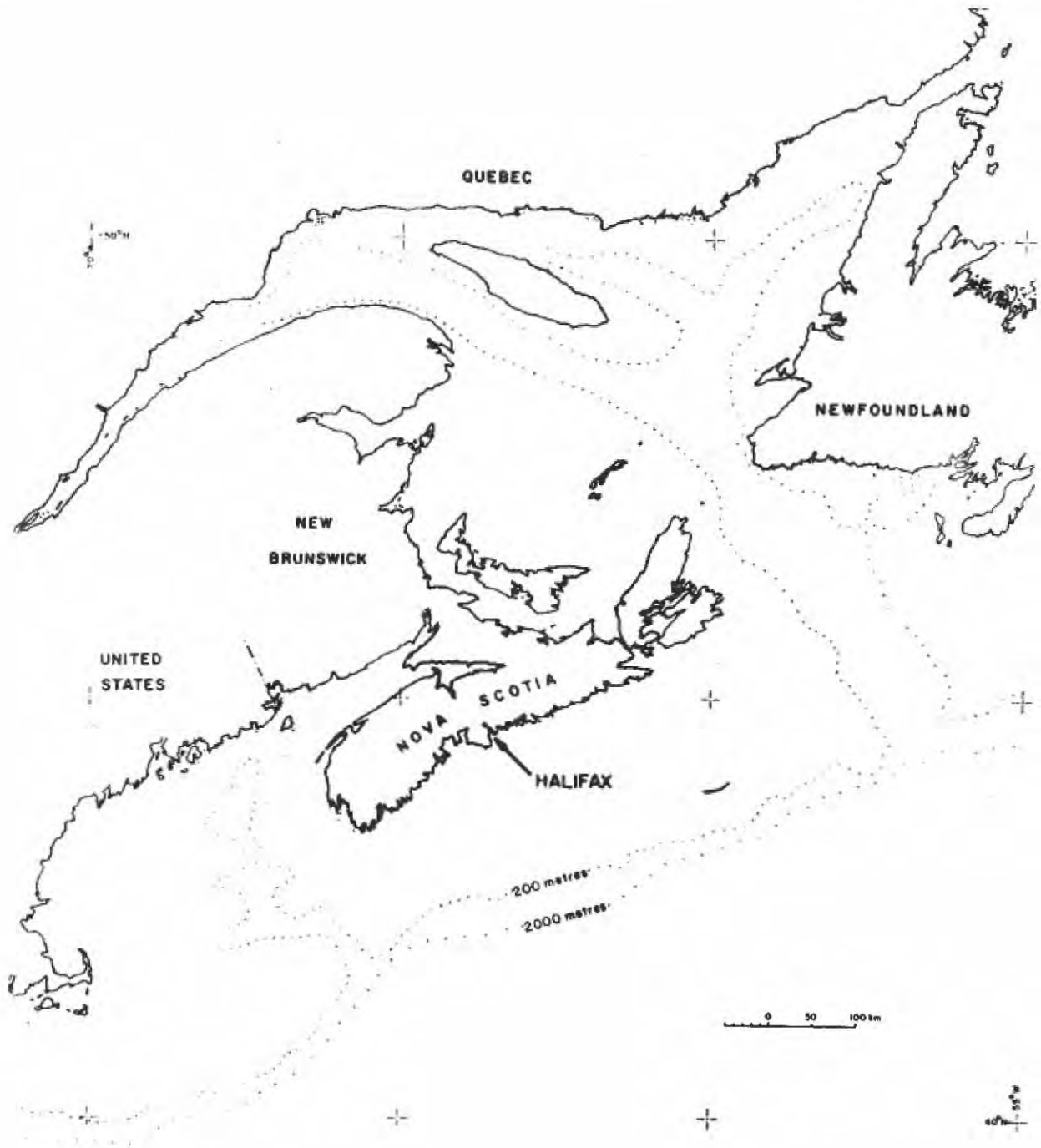


FIGURE 1: Atlantic Coastline of Canada

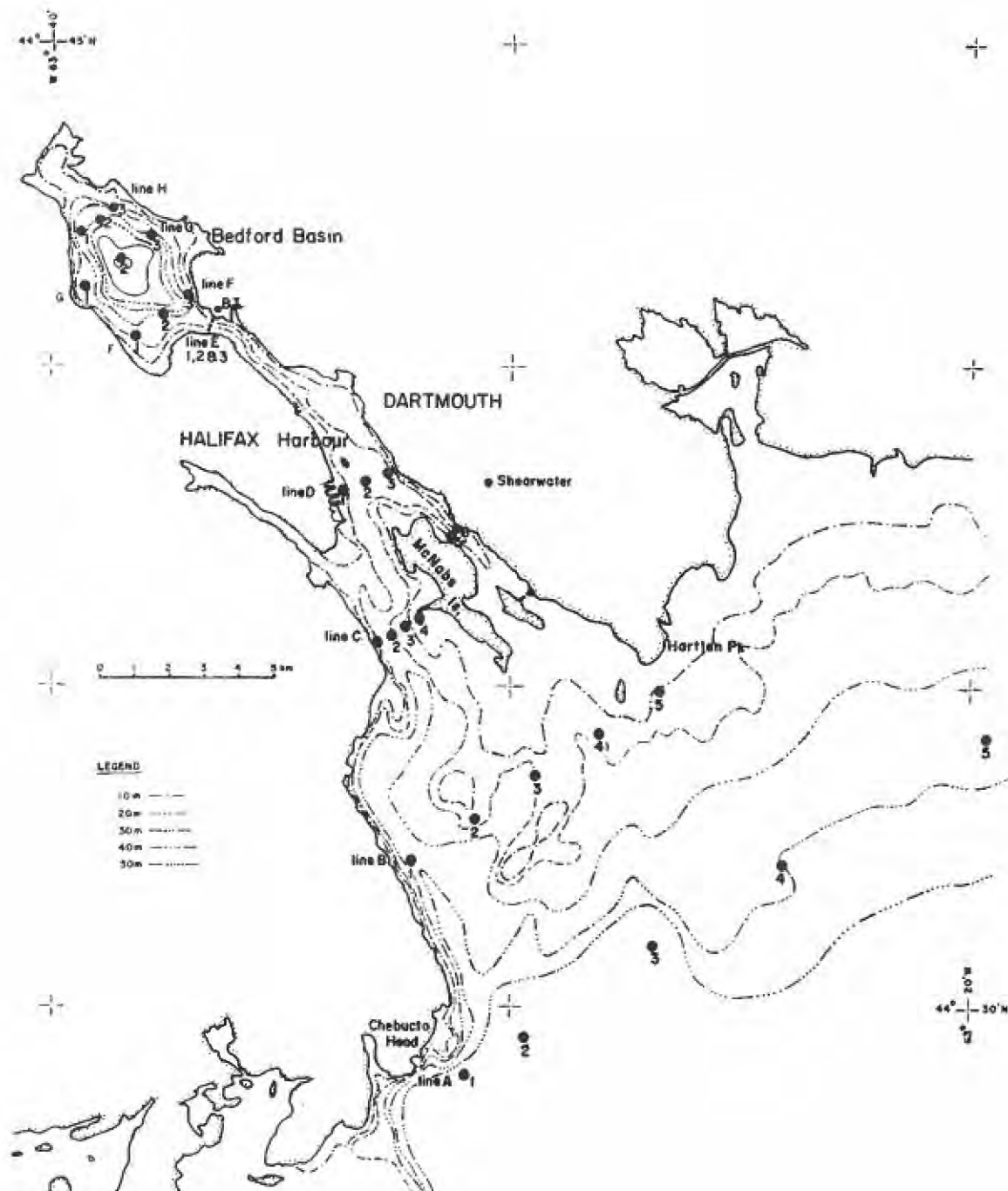


FIGURE 2: Halifax Inlet-Station Locations.



FIGURE 3(a) Temperature for 15 July 1969.

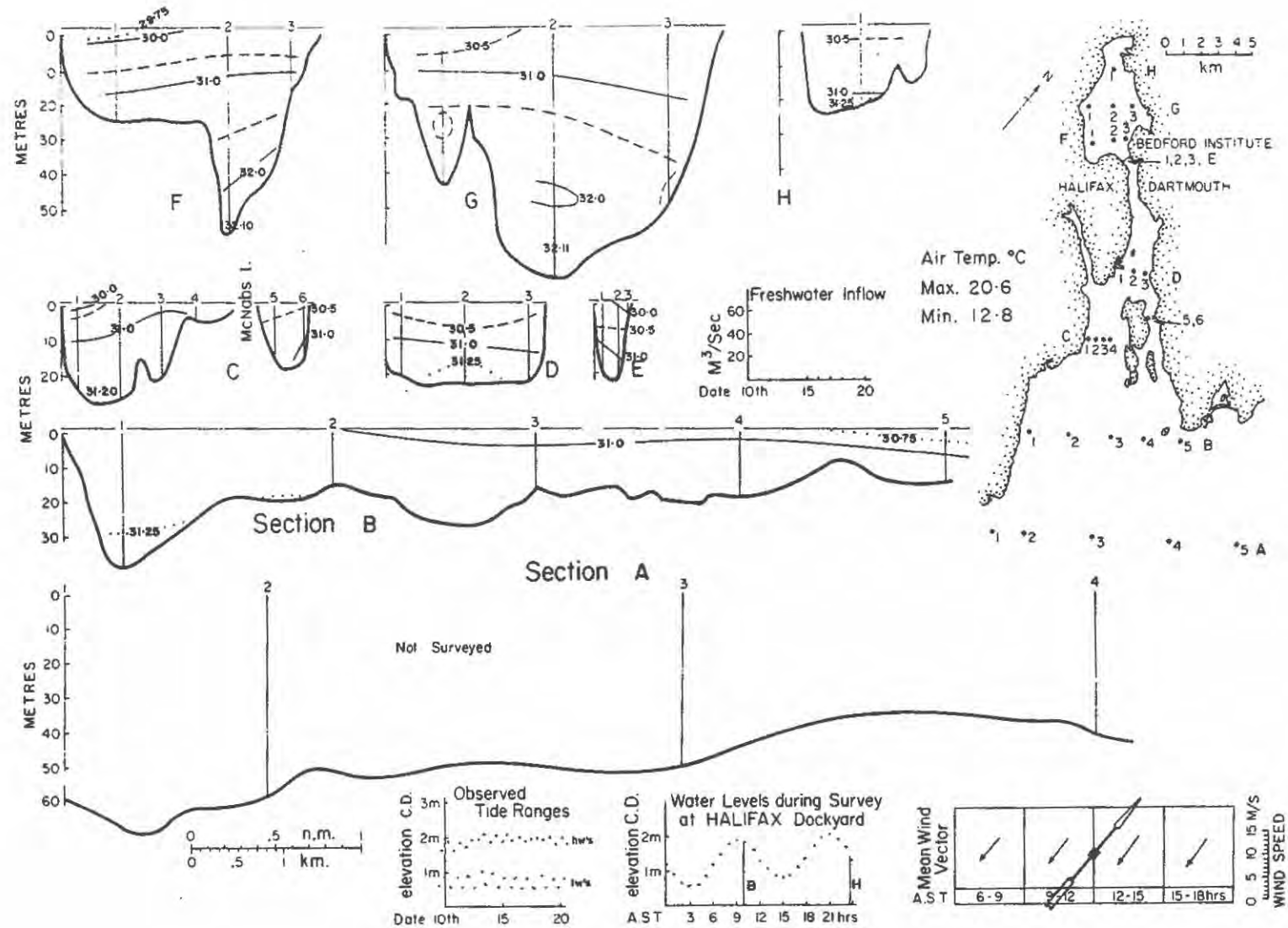


FIGURE 3(b): Salinity ‰ for 15 July 1969.

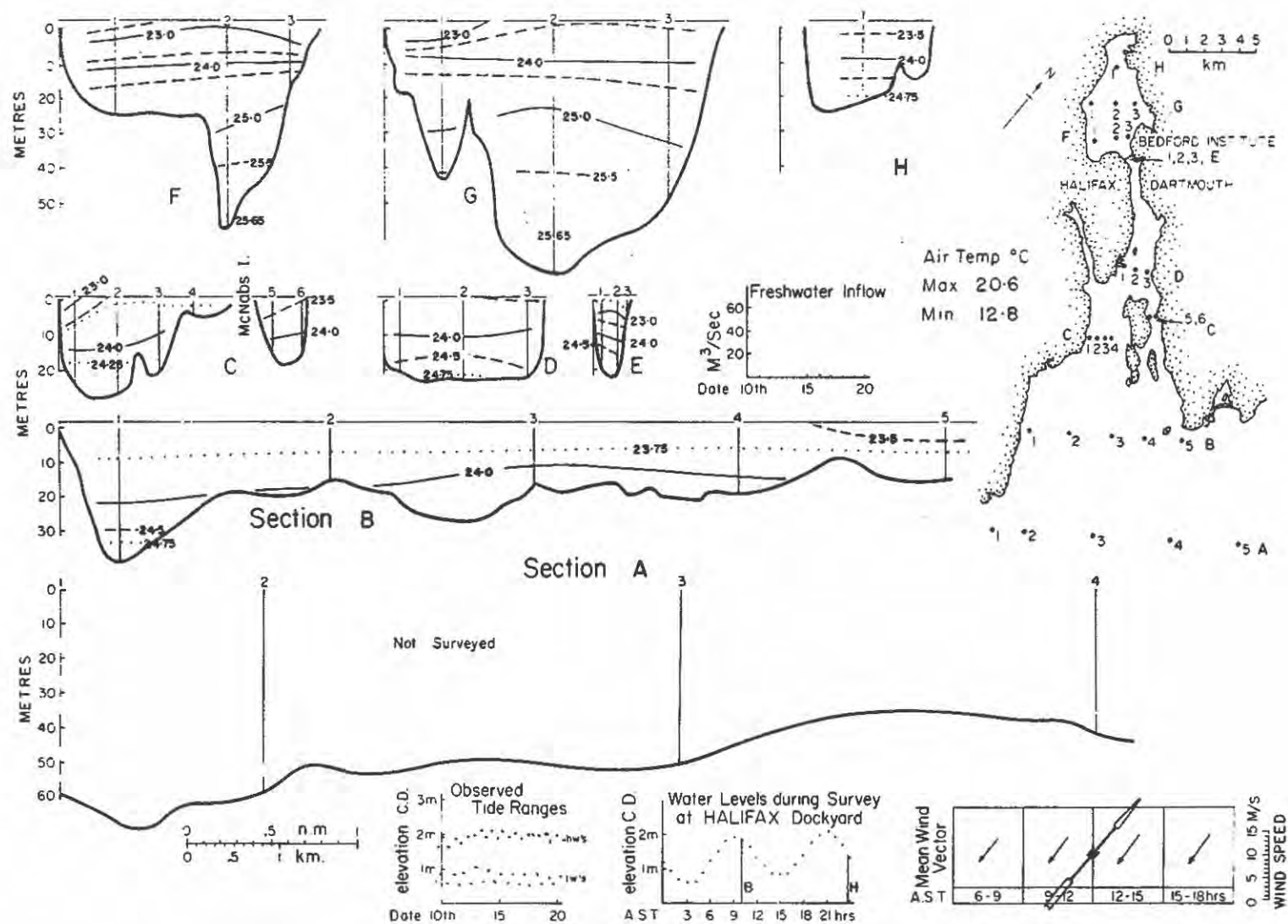


FIGURE 3(c): Sigma-t for 15 July 1969.

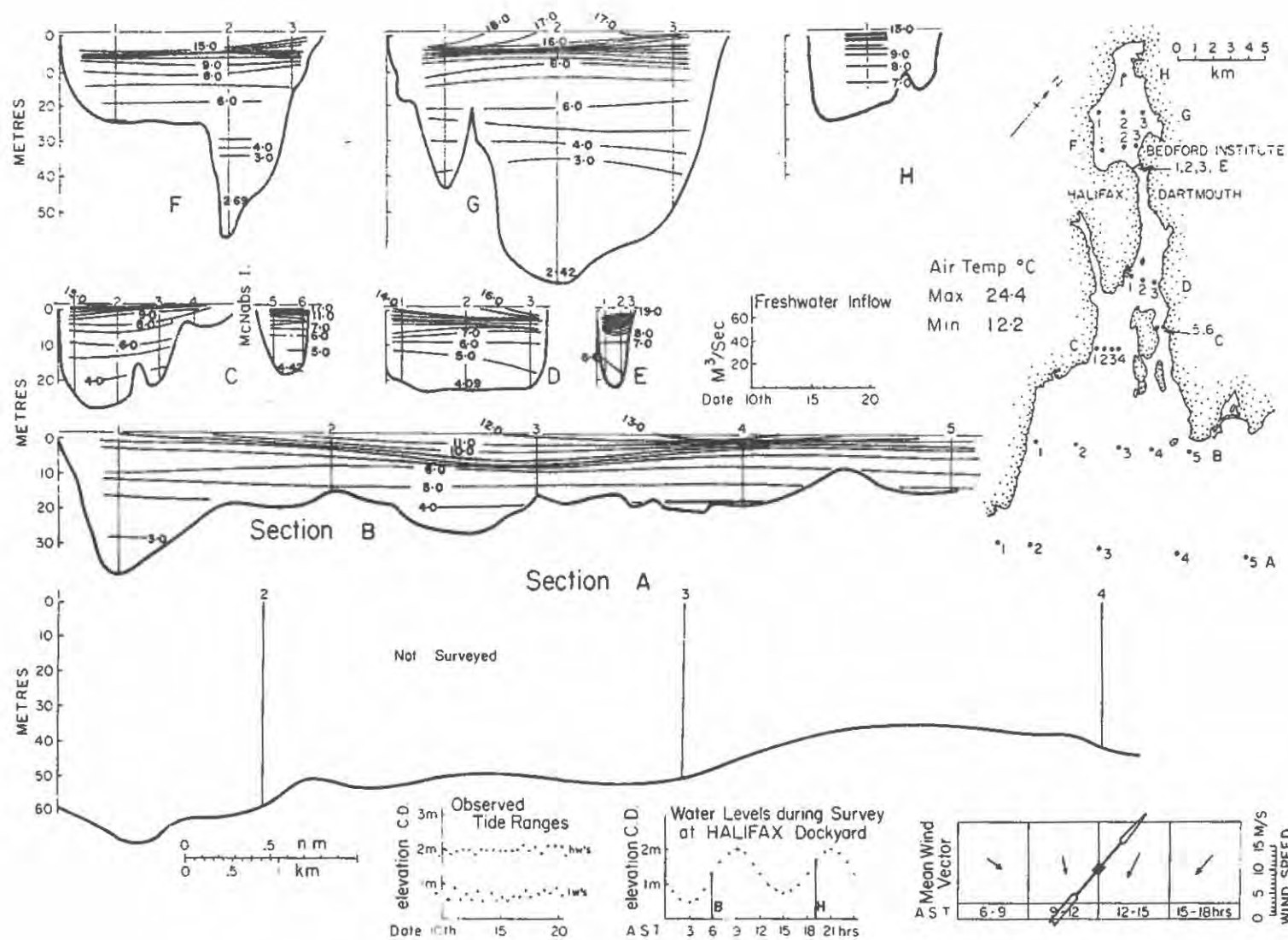


FIGURE 4(a): Temperature for 14 August 1969.

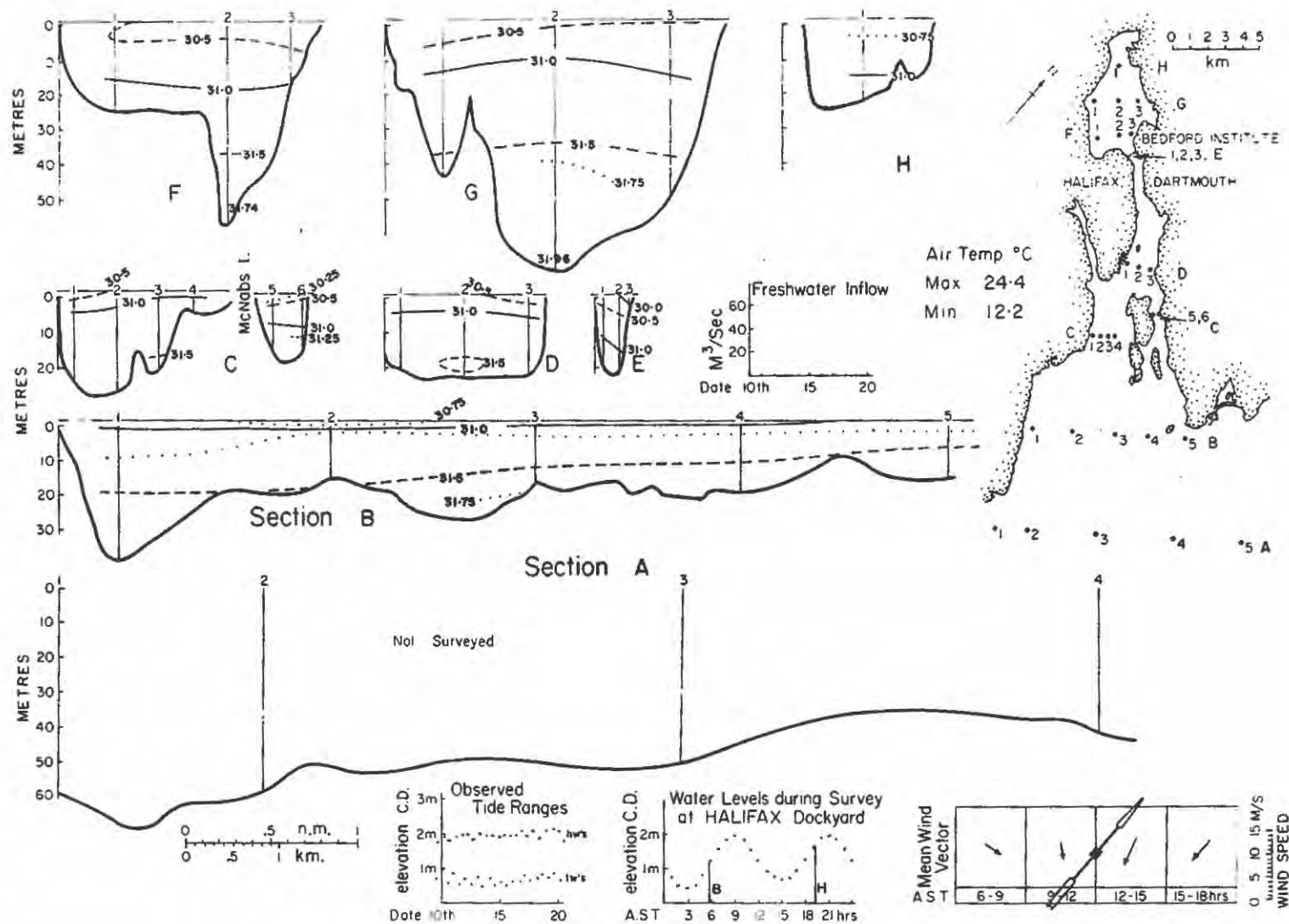


FIGURE 4(b): Salinity ‰ for 14 August 1969.

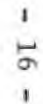


FIGURE 4(c): Density for 14 August 1969.



FIGURE 5(a): Temperature for 16 September 1969.

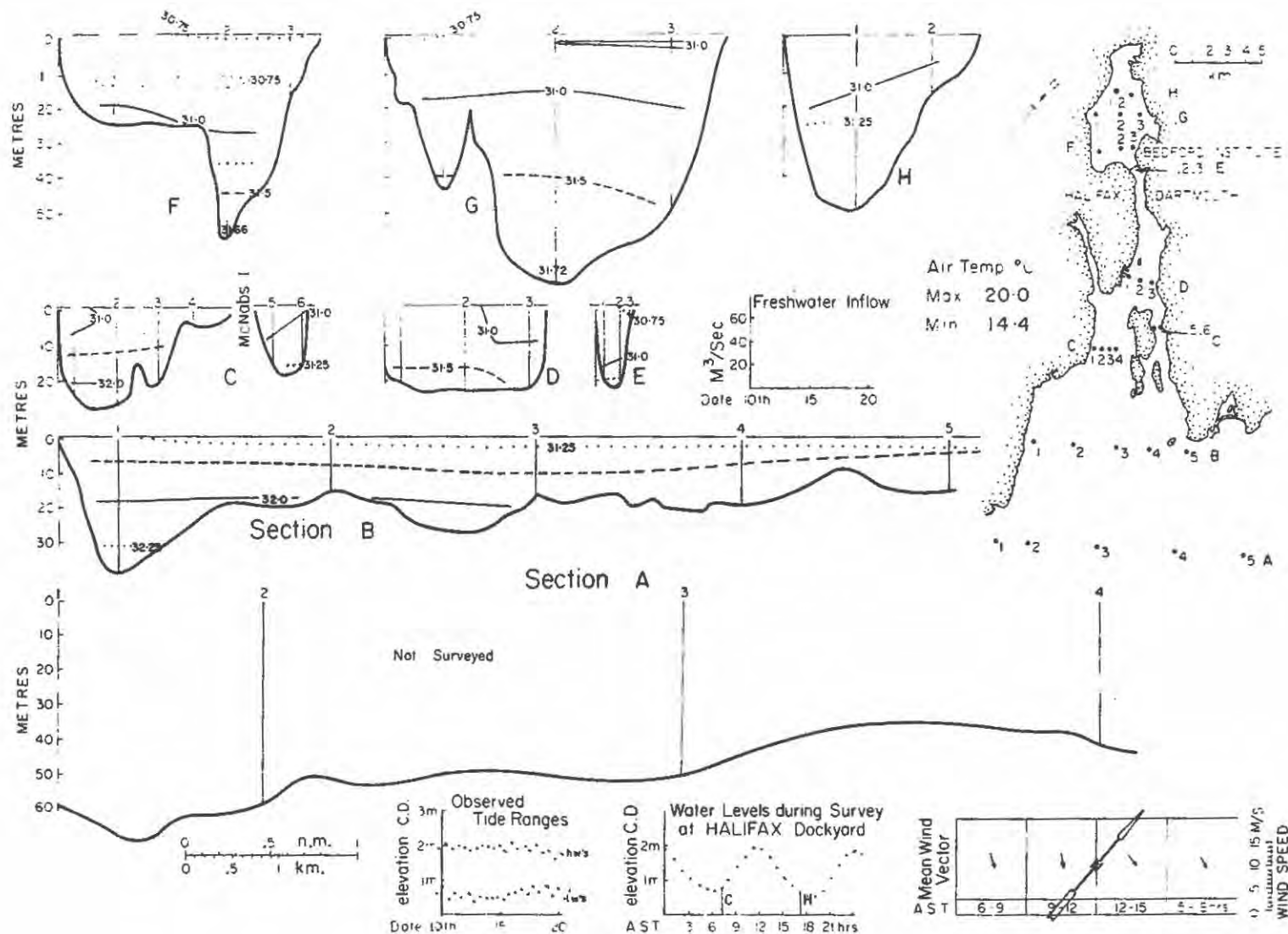


FIGURE 5(b): Salinity ‰ for 16 September 1969.

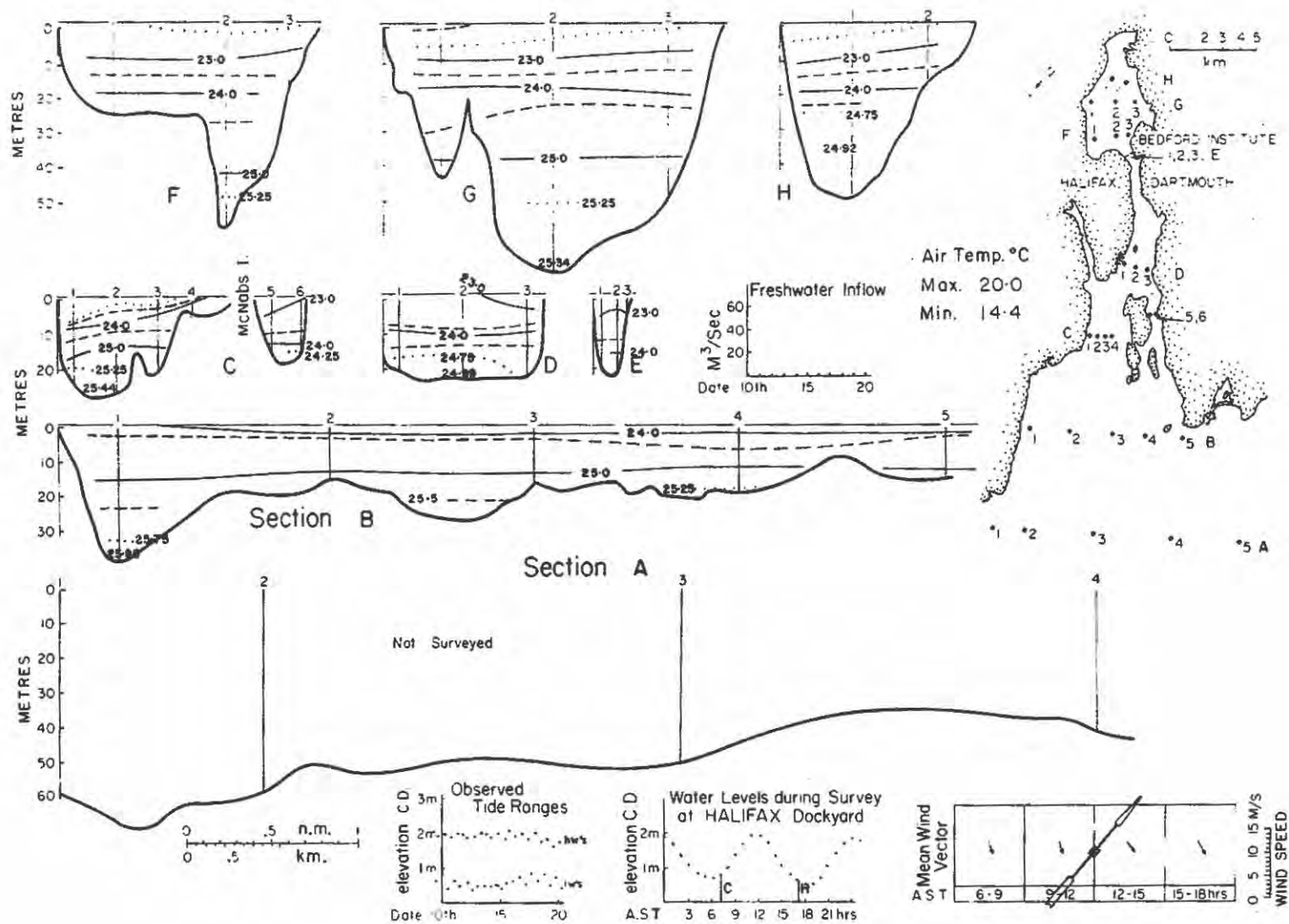


FIGURE 5(c): Density for 16 September 1969.

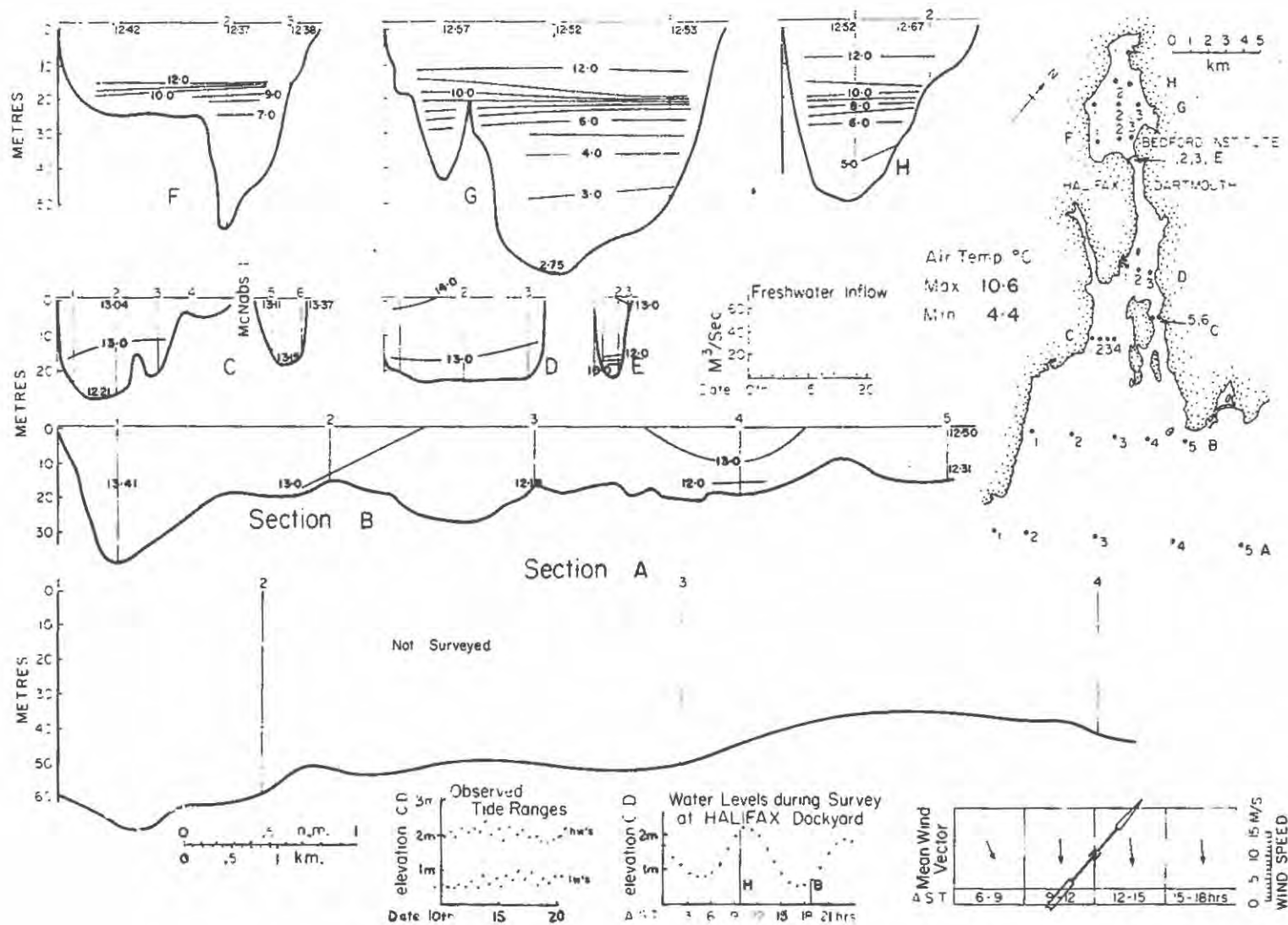


FIGURE 6(a): Temperature for 15 October 1969.

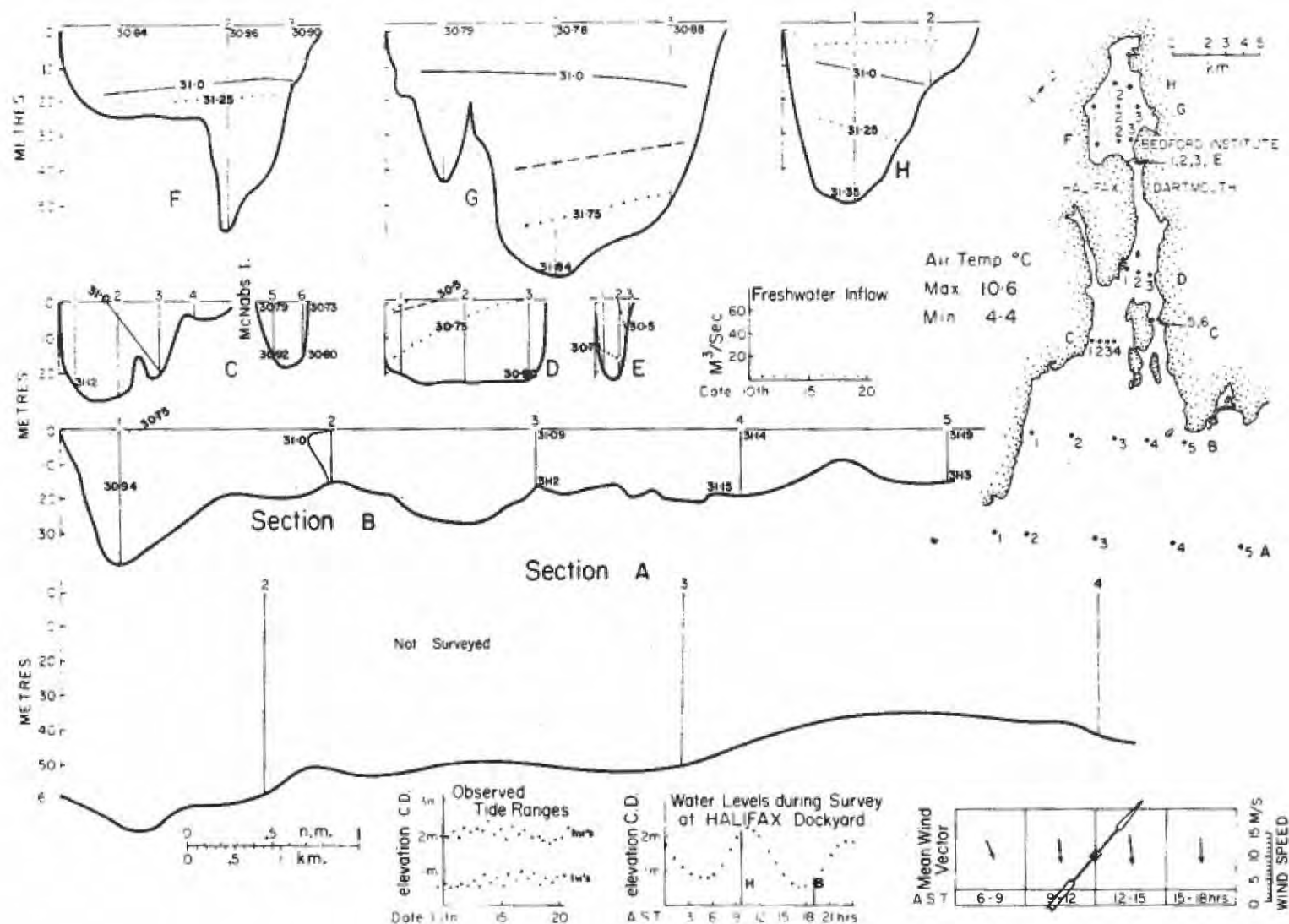


FIGURE 6(b): Salinity %, for 15 October 1969.

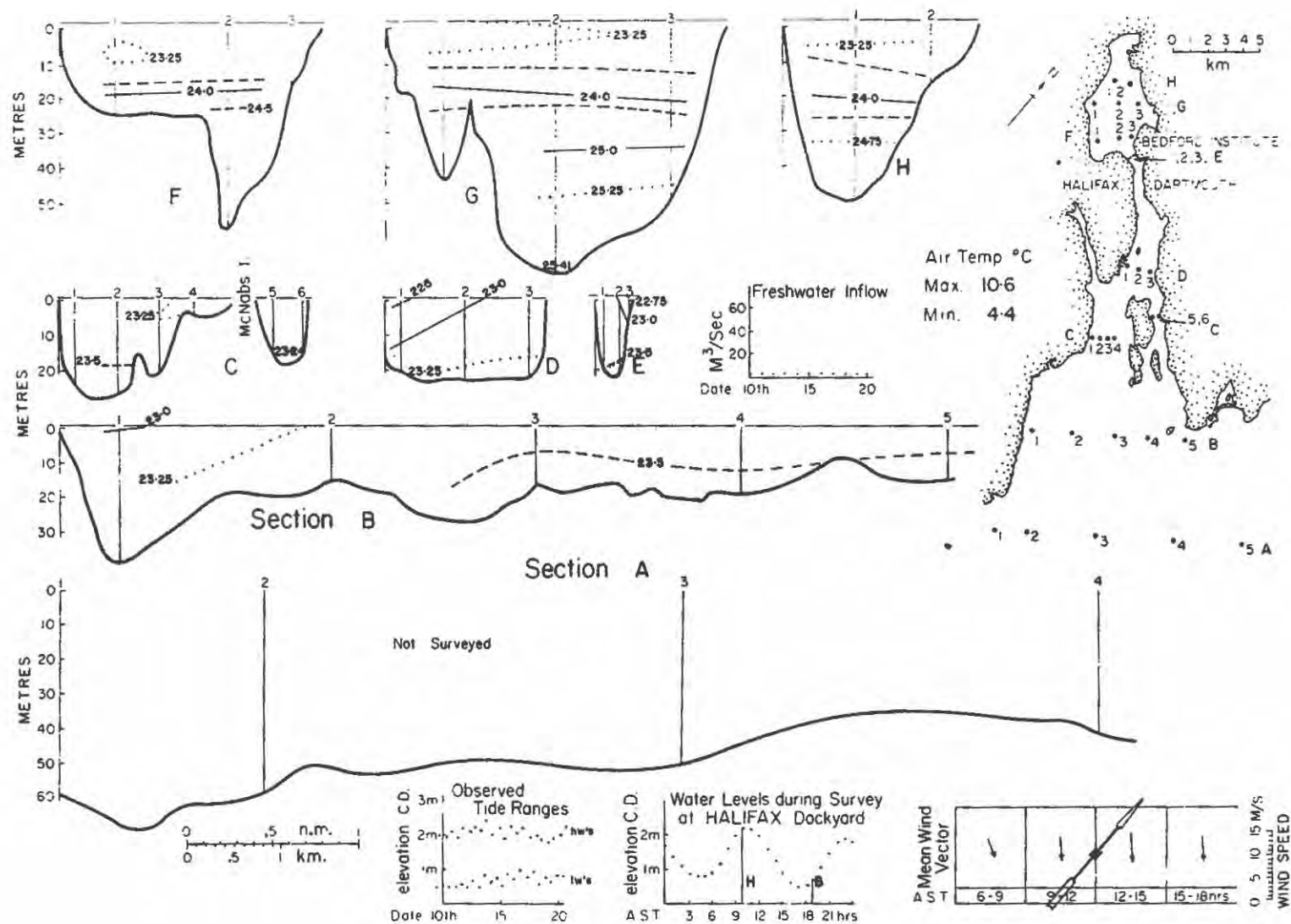


FIGURE 6(c): Density for 15 October 1969.

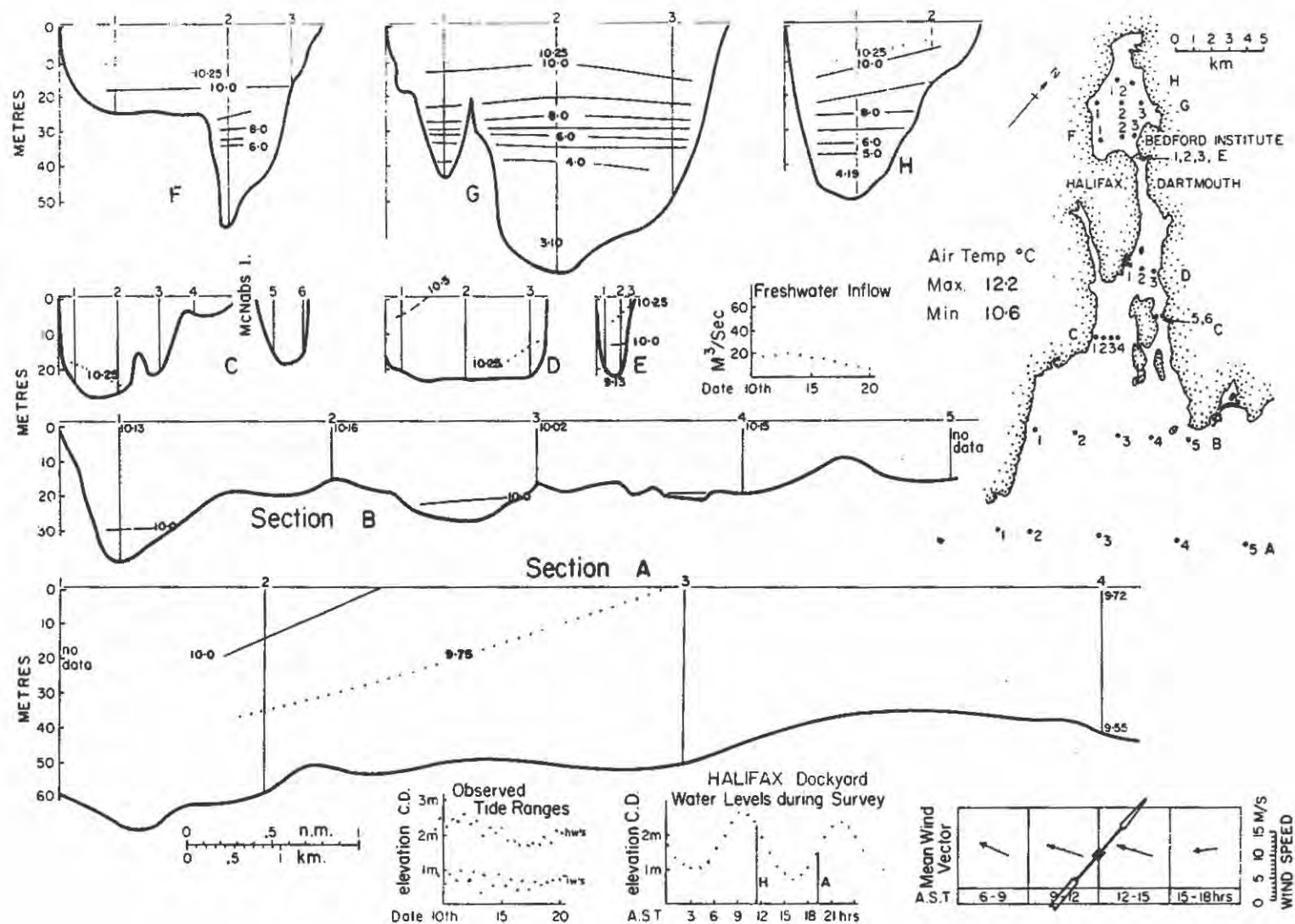


FIGURE 7(a): Temperature for 12 November 1969.

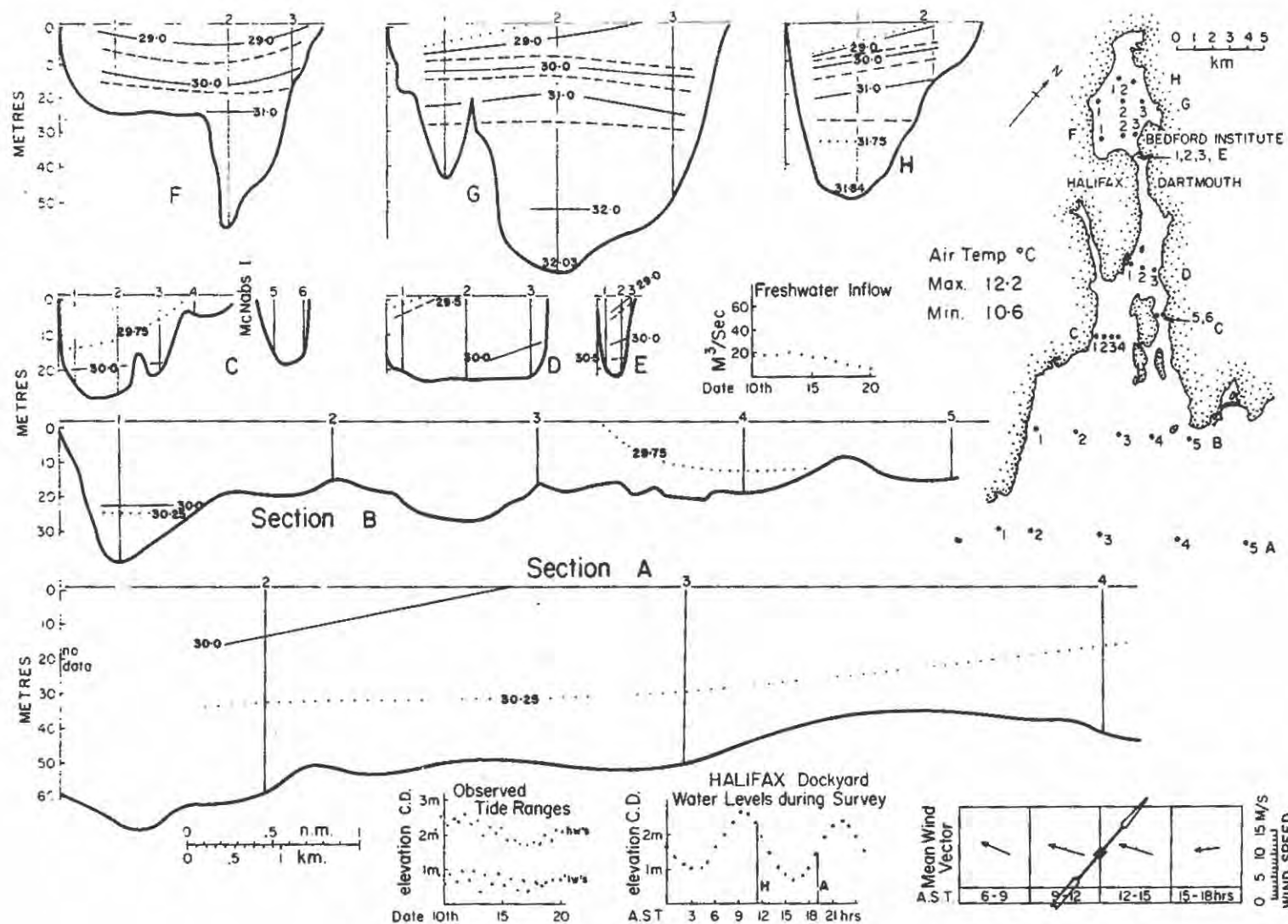


FIGURE 7(b): Salinity ‰ for 12 November 1969.

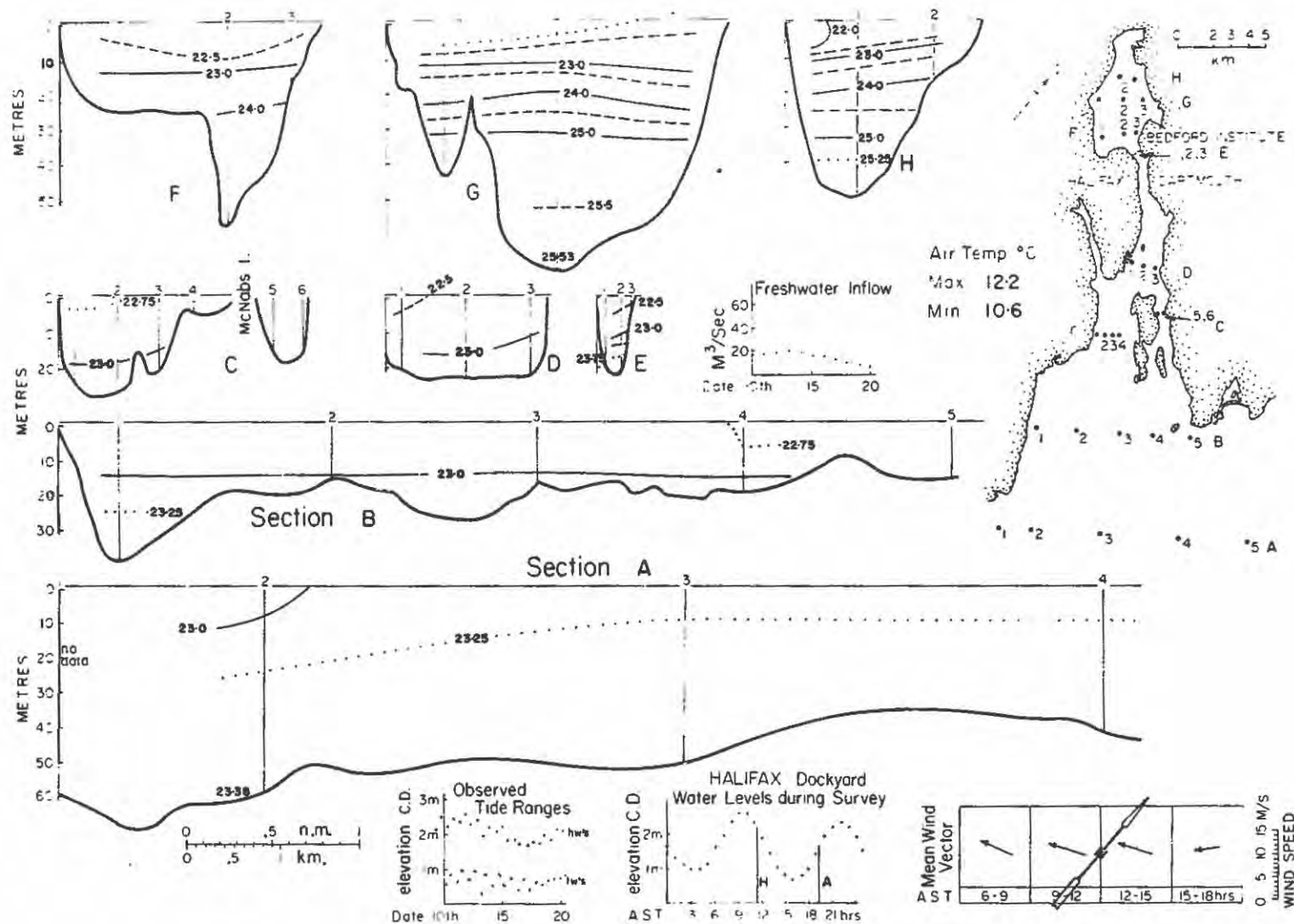


FIGURE 7(c): Density for 12 November 1969.

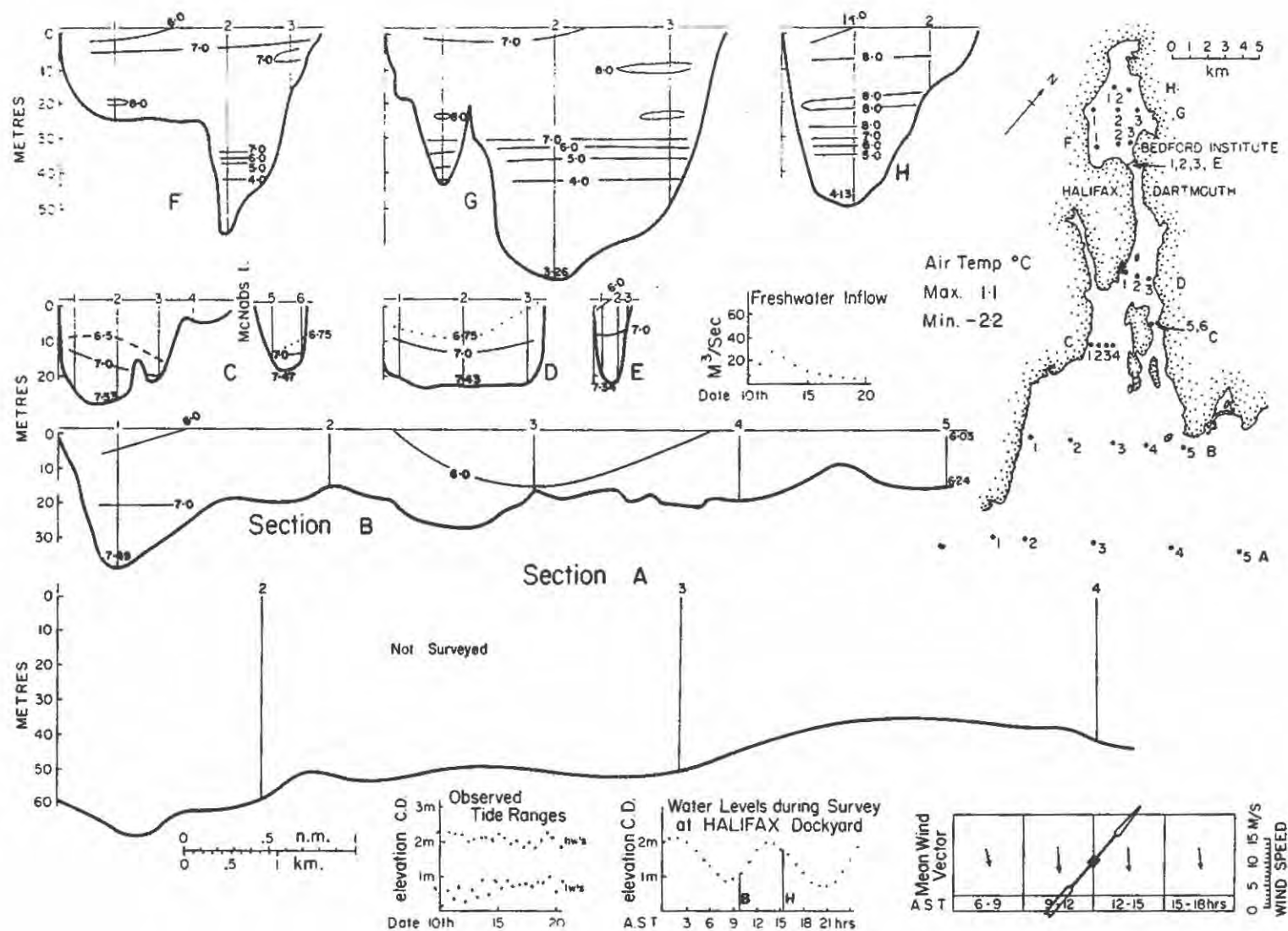


FIGURE 8(a): Temperature for 16 December 1969.

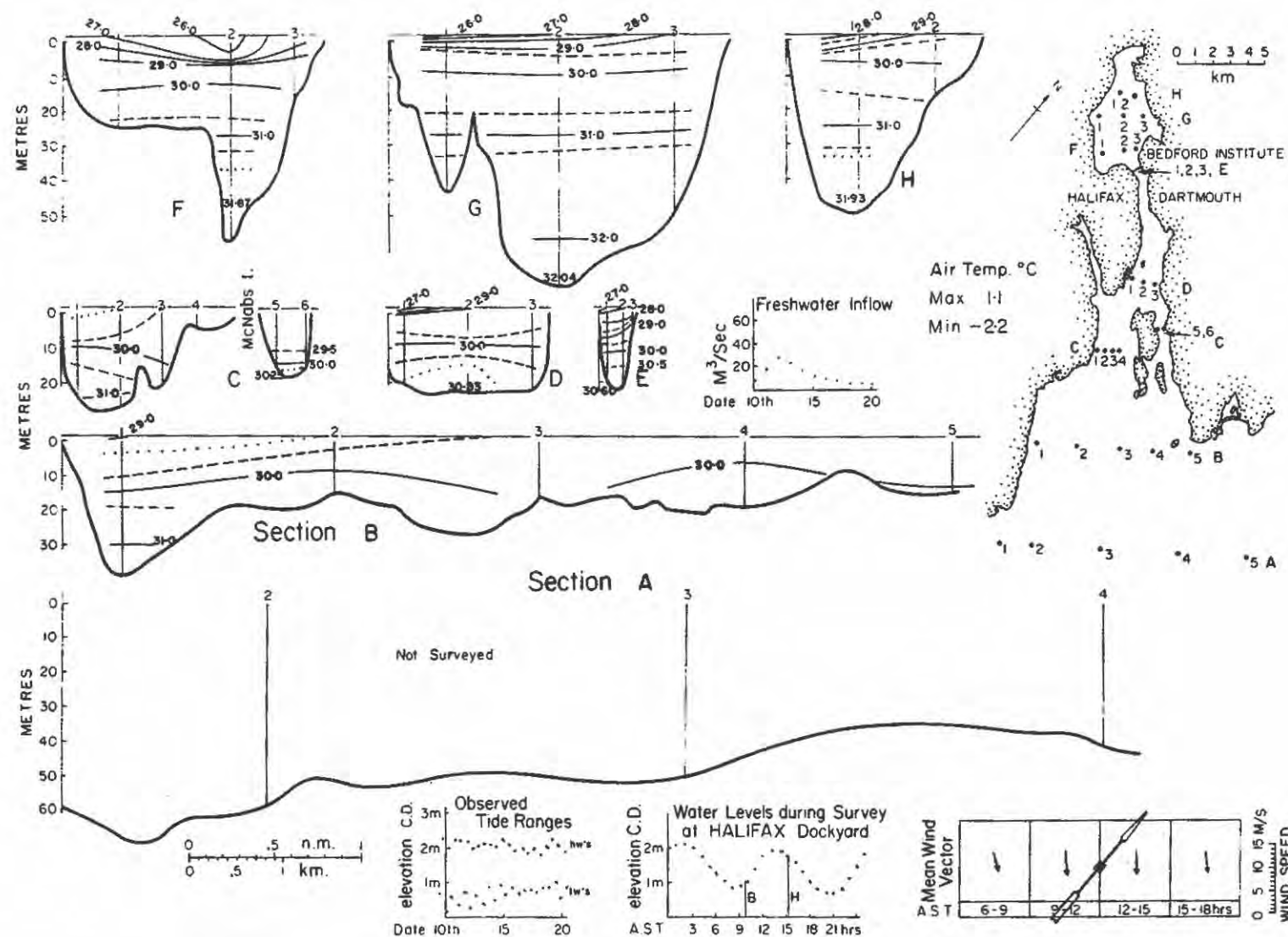


FIGURE 8(b): Salinity ‰ for 16 December 1969.

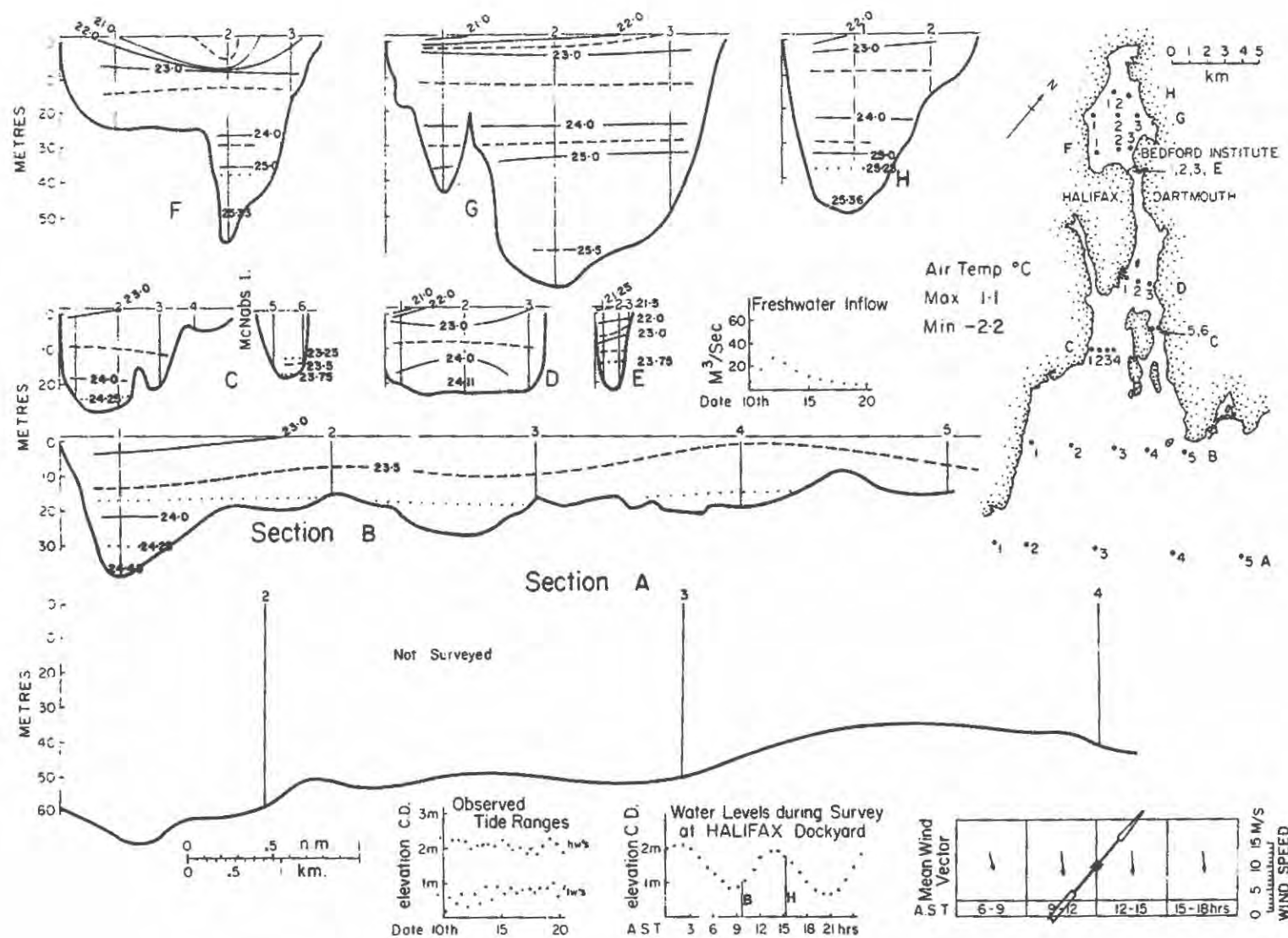


FIGURE 8(c): Density for December 1969.

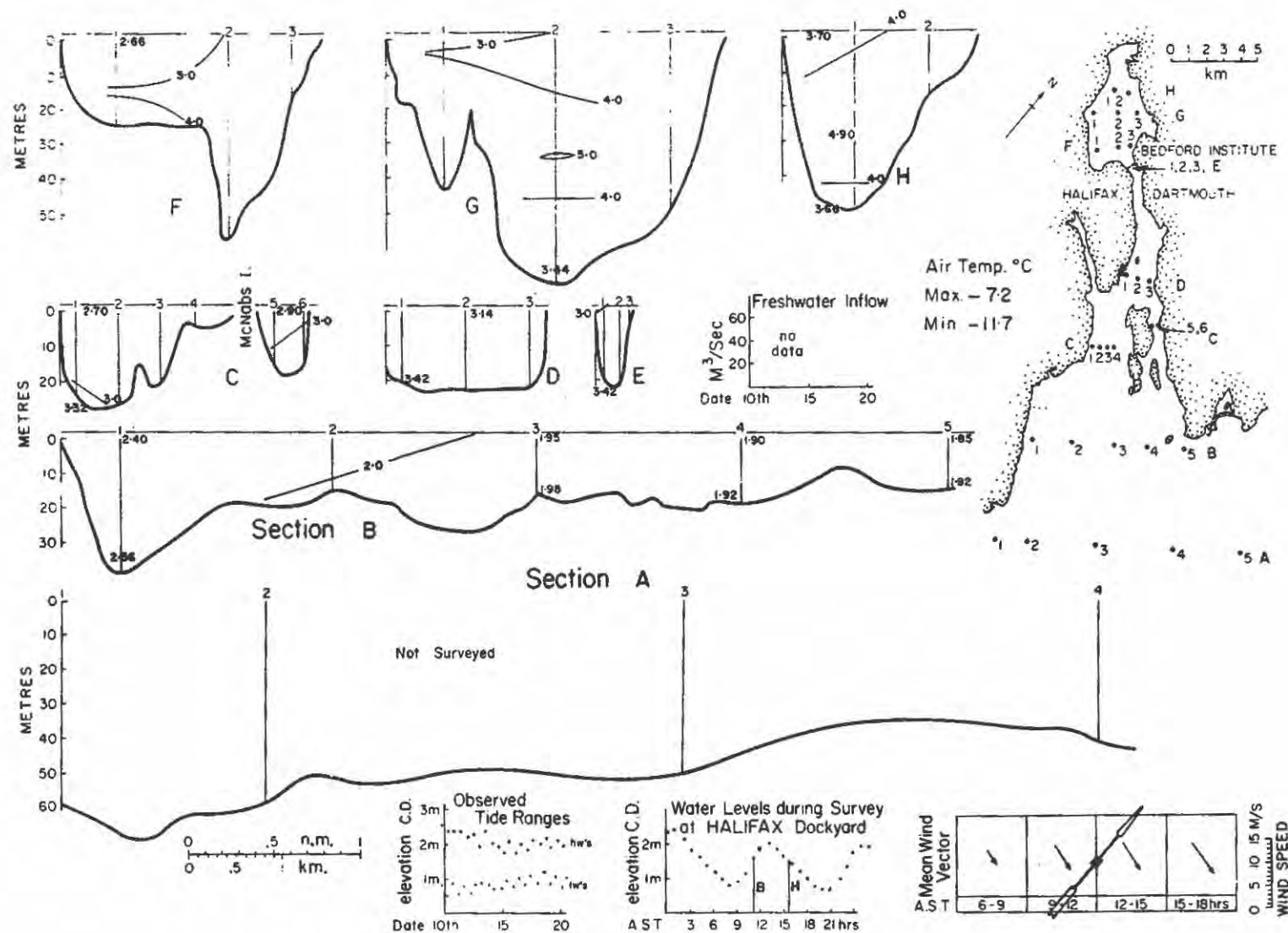


FIGURE 9(a): Temperature for 14 January 1970.

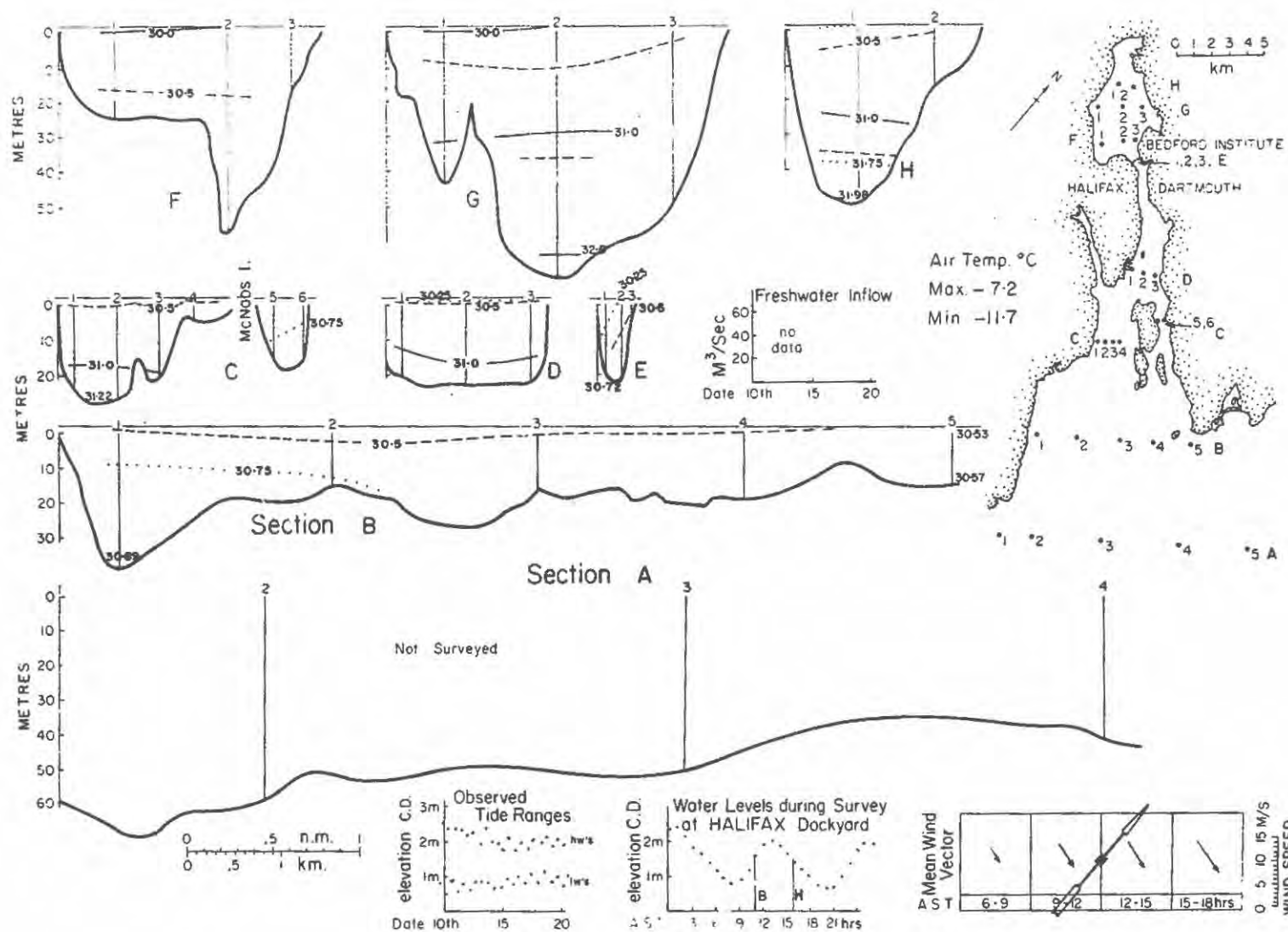


FIGURE 9(b): Salinity ‰ for 14 January 1970.



FIGURE 9(c): Density for January 1970.

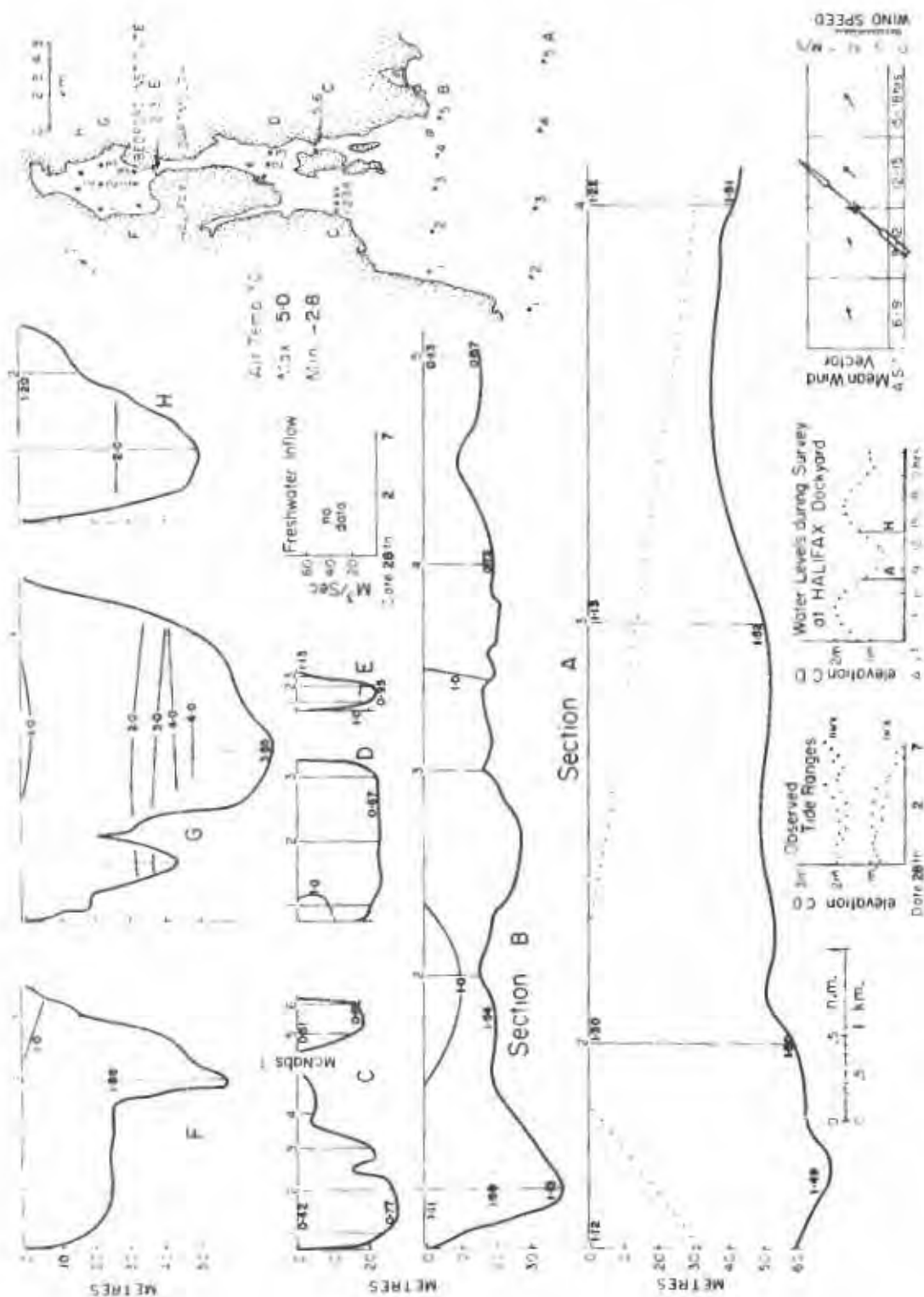


FIGURE 10(a): Temperature for 2 February 1970.

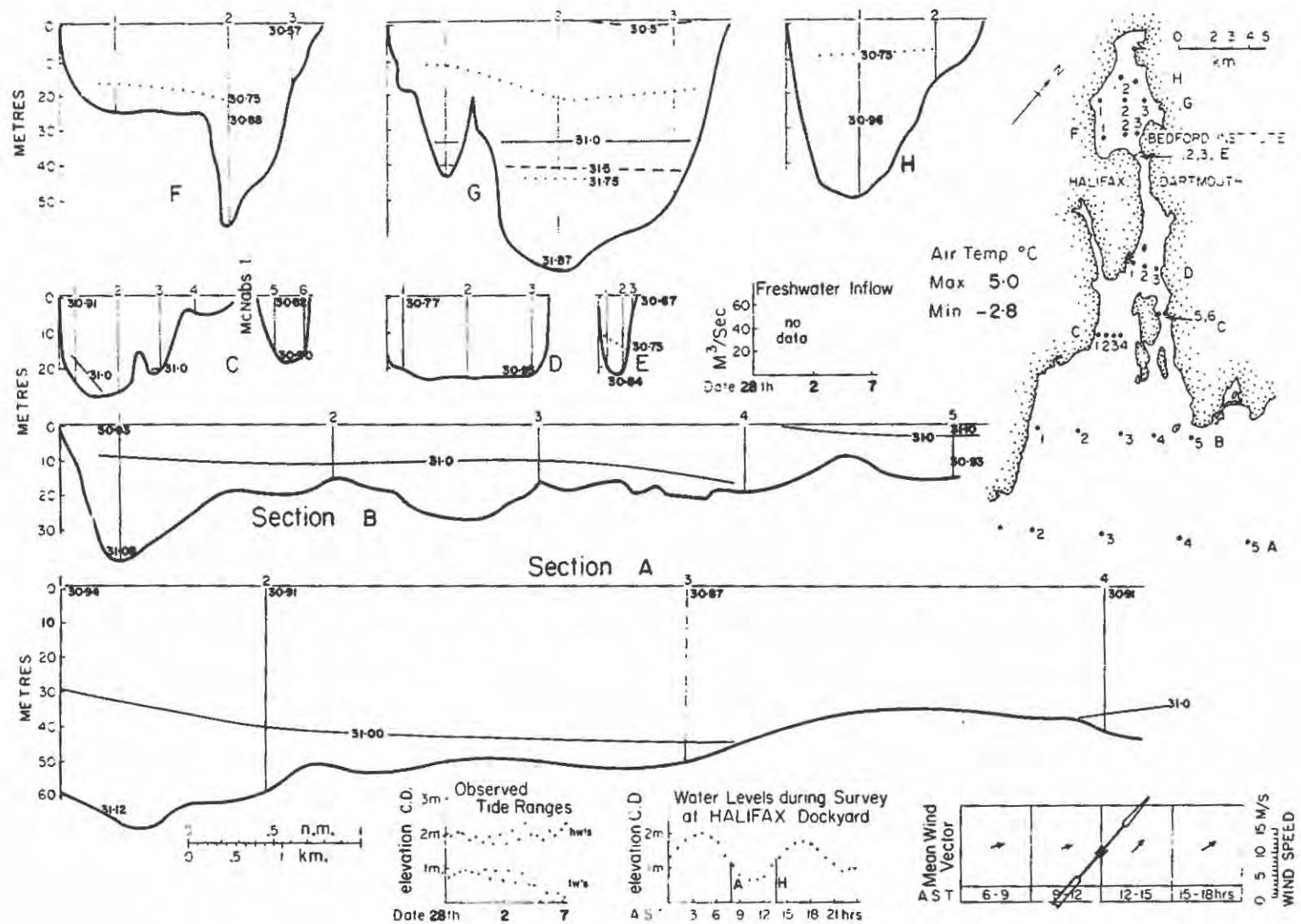


FIGURE 10(b): Salinity ‰ for 2 February 1970.

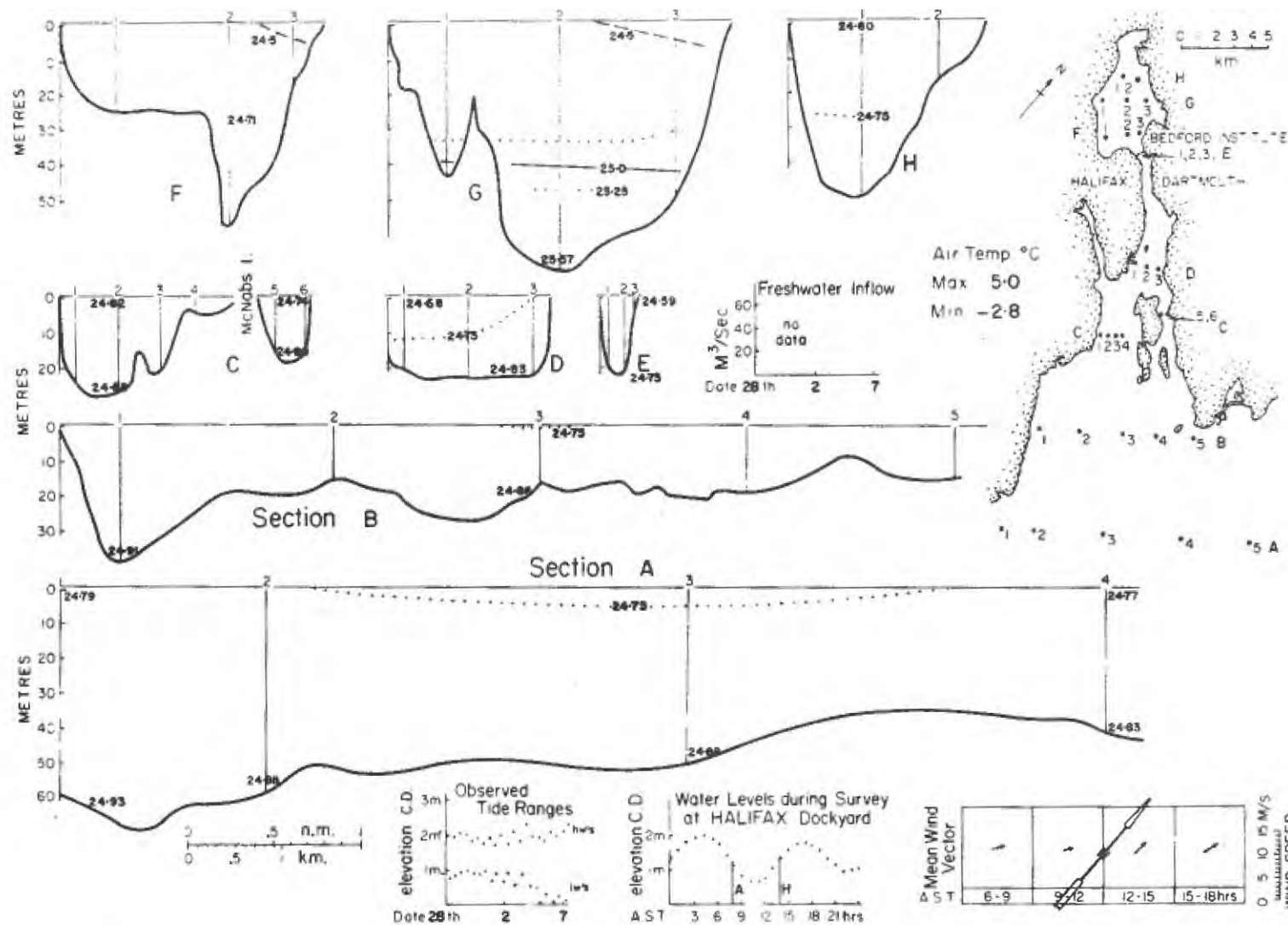


FIGURE 10(c): Density for 2 February 1970.

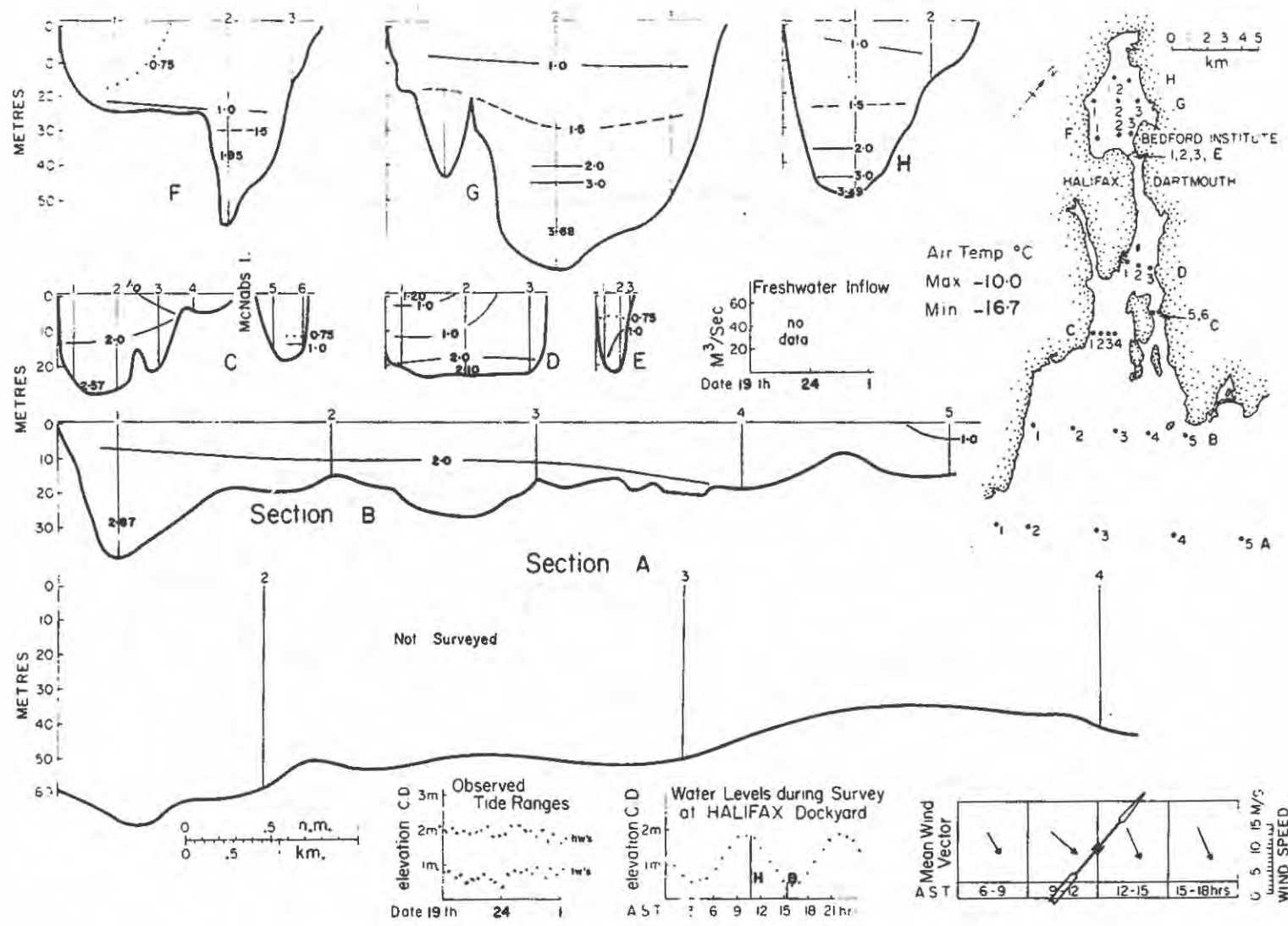


FIGURE 11(a): Temperature for 24 February 1970.

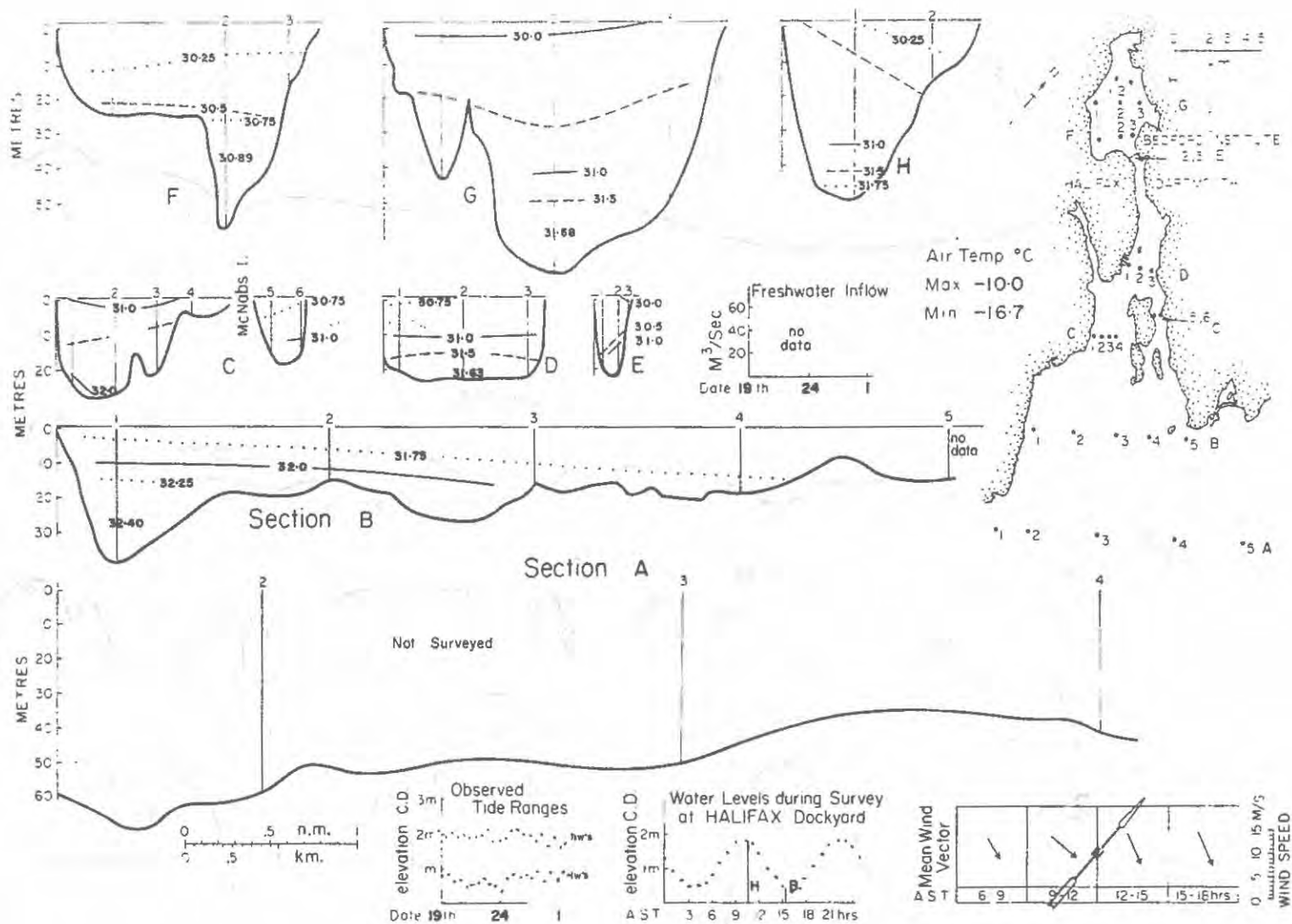


FIGURE 11(b): Salinity ‰ for 24 February 1970.

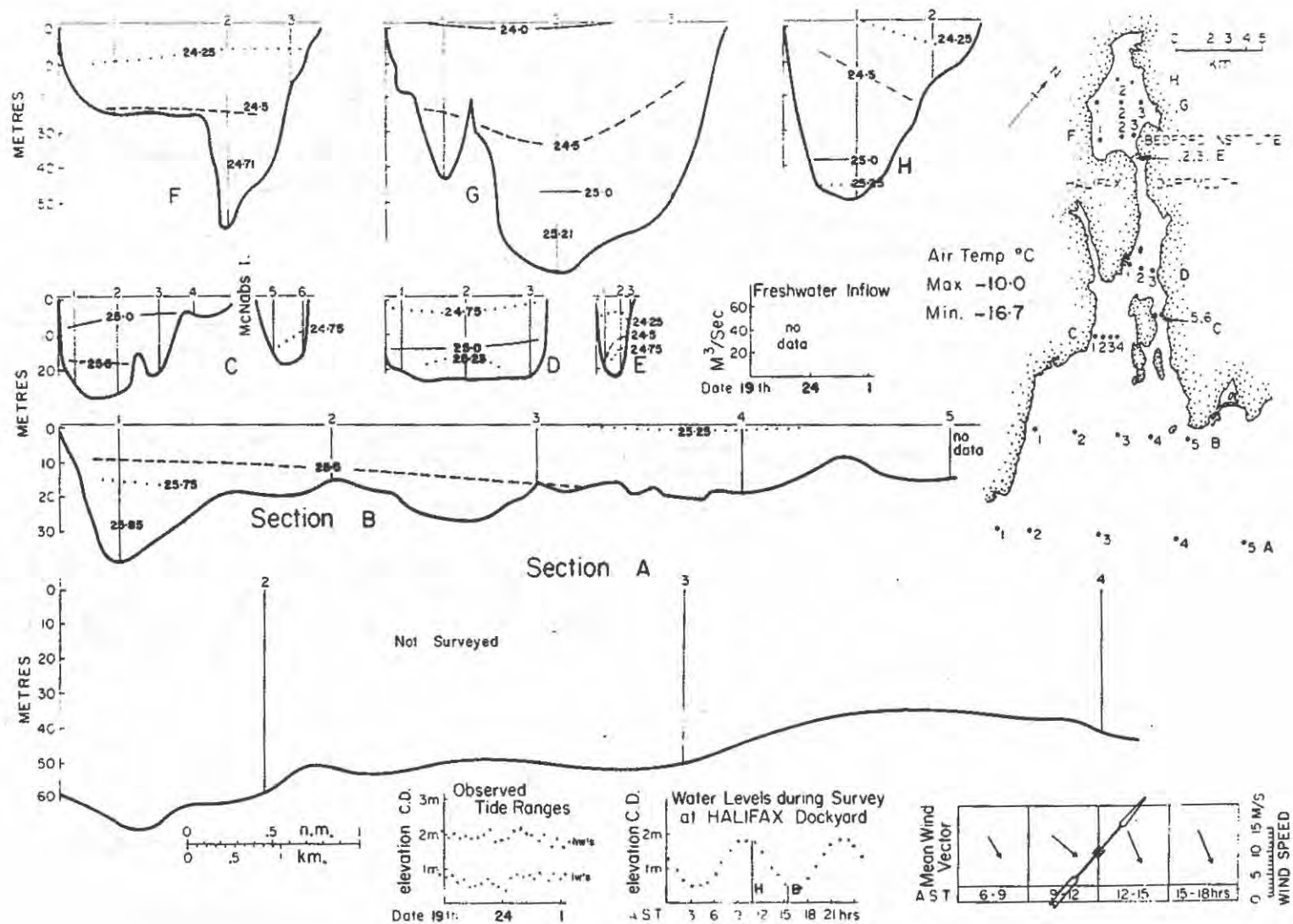


FIGURE 11(c): Density for 24 February 1970.

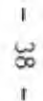


FIGURE 12(a): Temperature for 14 May 1970.

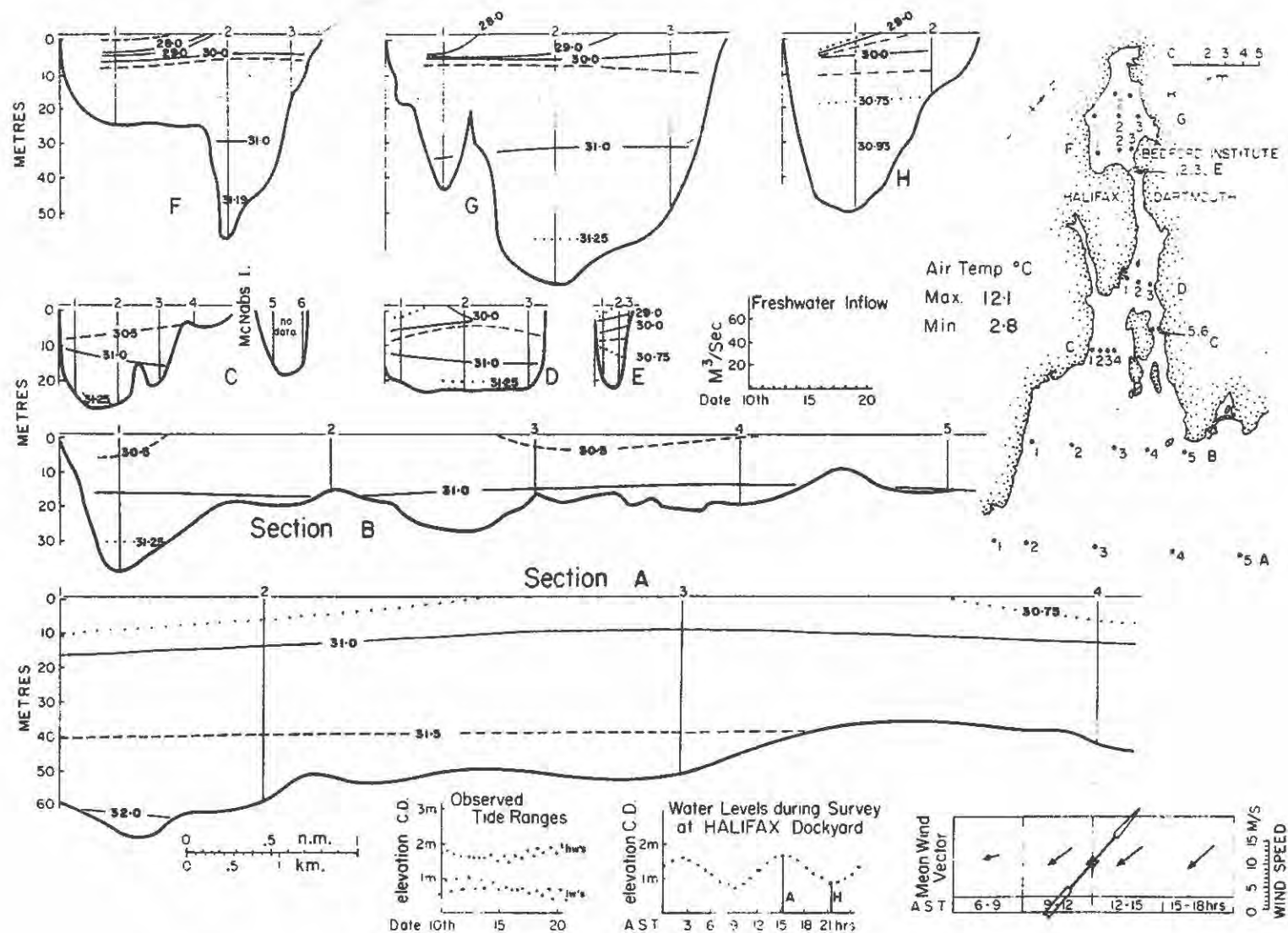


FIGURE 12(b): Salinity ‰ for 14 May 1970.

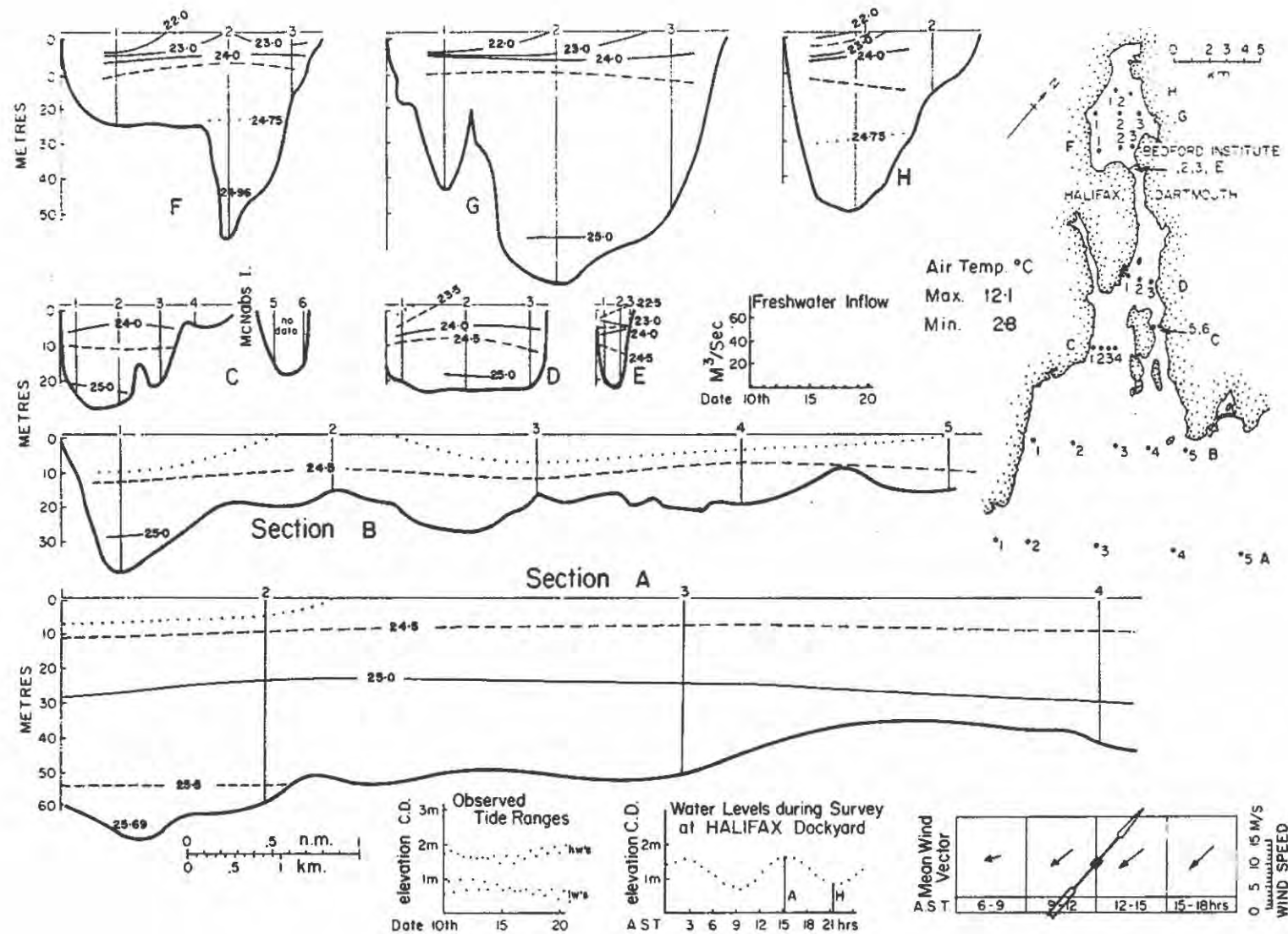


FIGURE 12(c): Density for 14 May 1970.

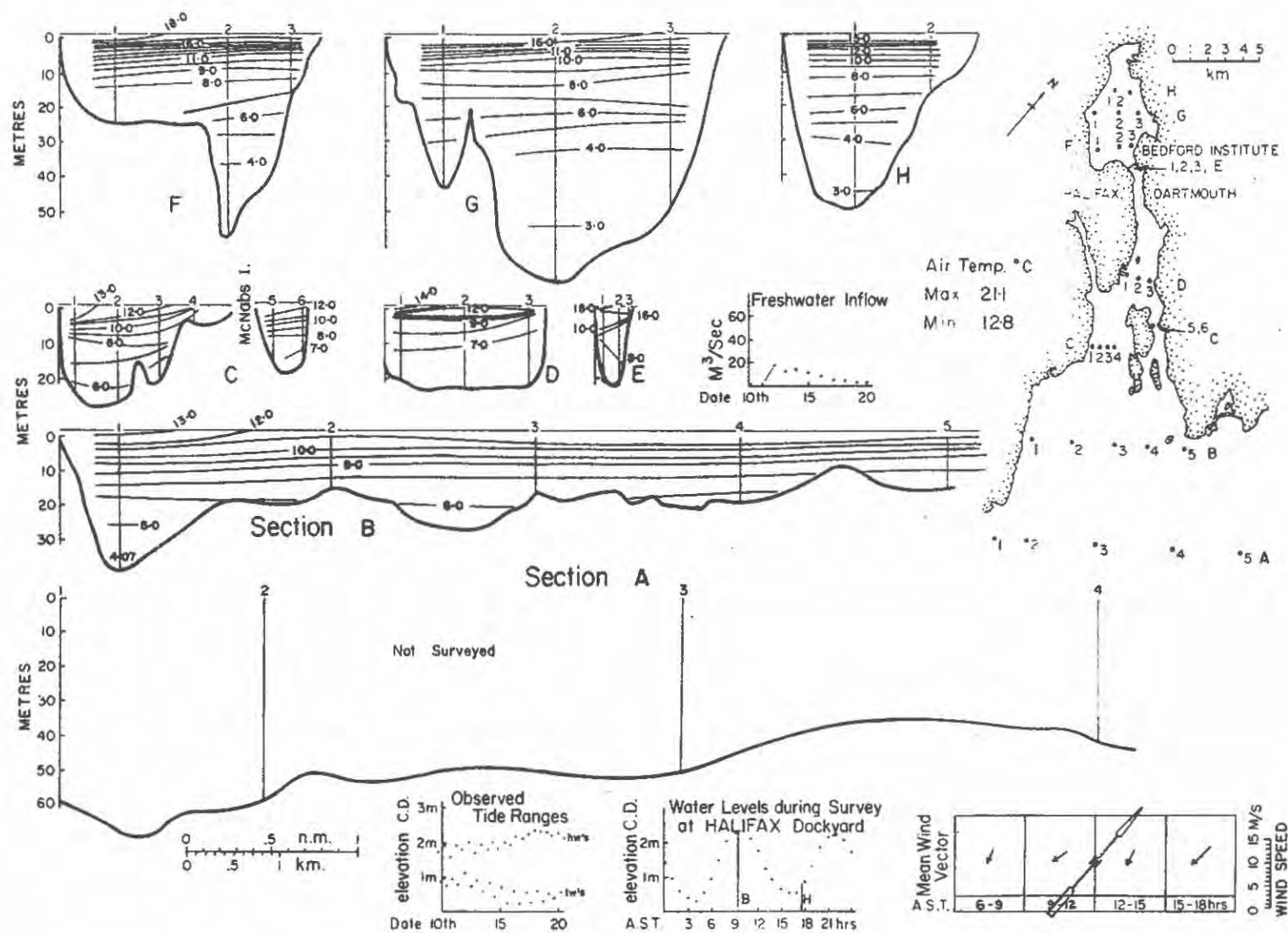


FIGURE 12(c): Temperature for 19 August 1970.

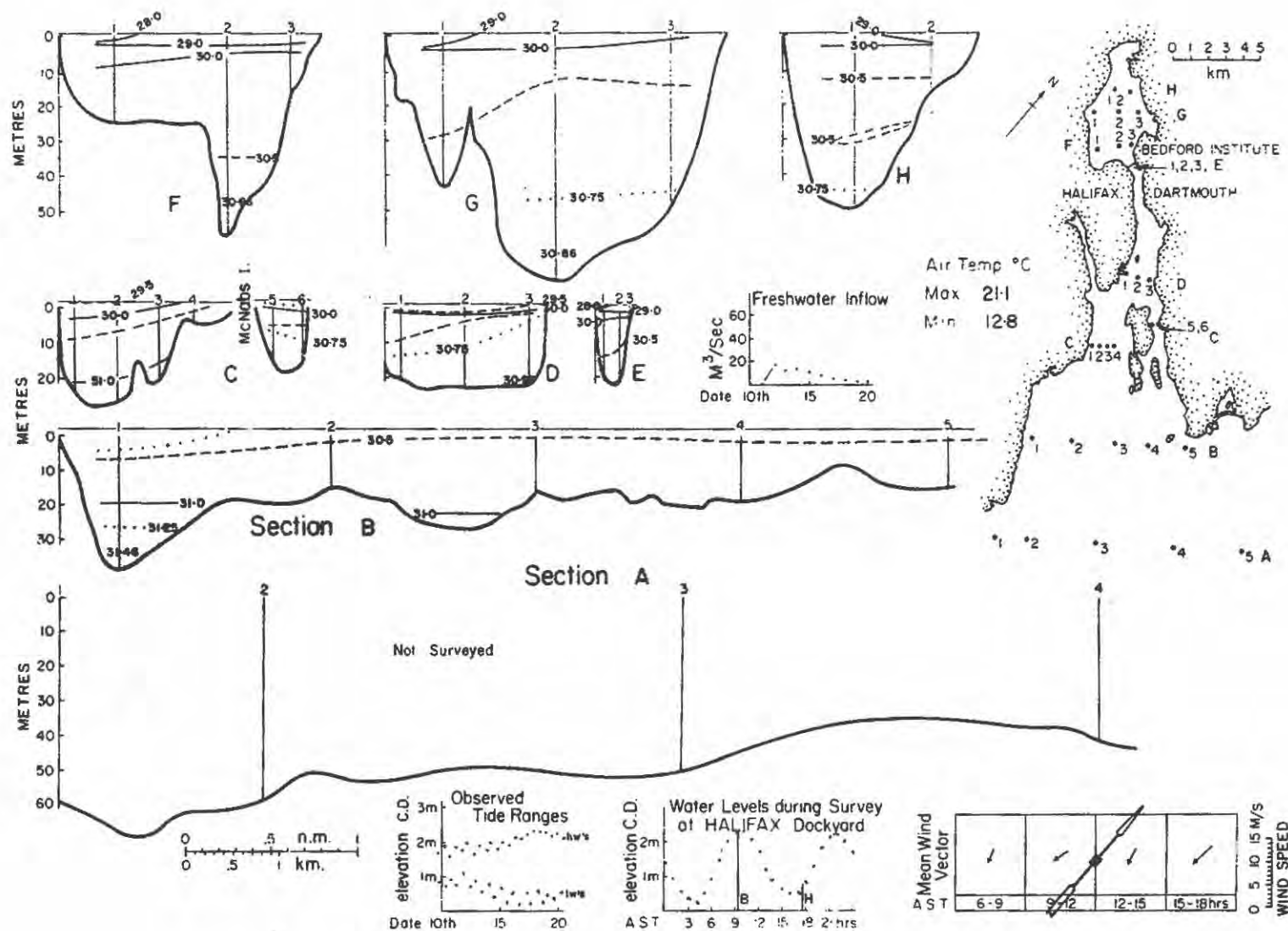


FIGURE 13(b): Salinity ‰ for 19 August 1970.

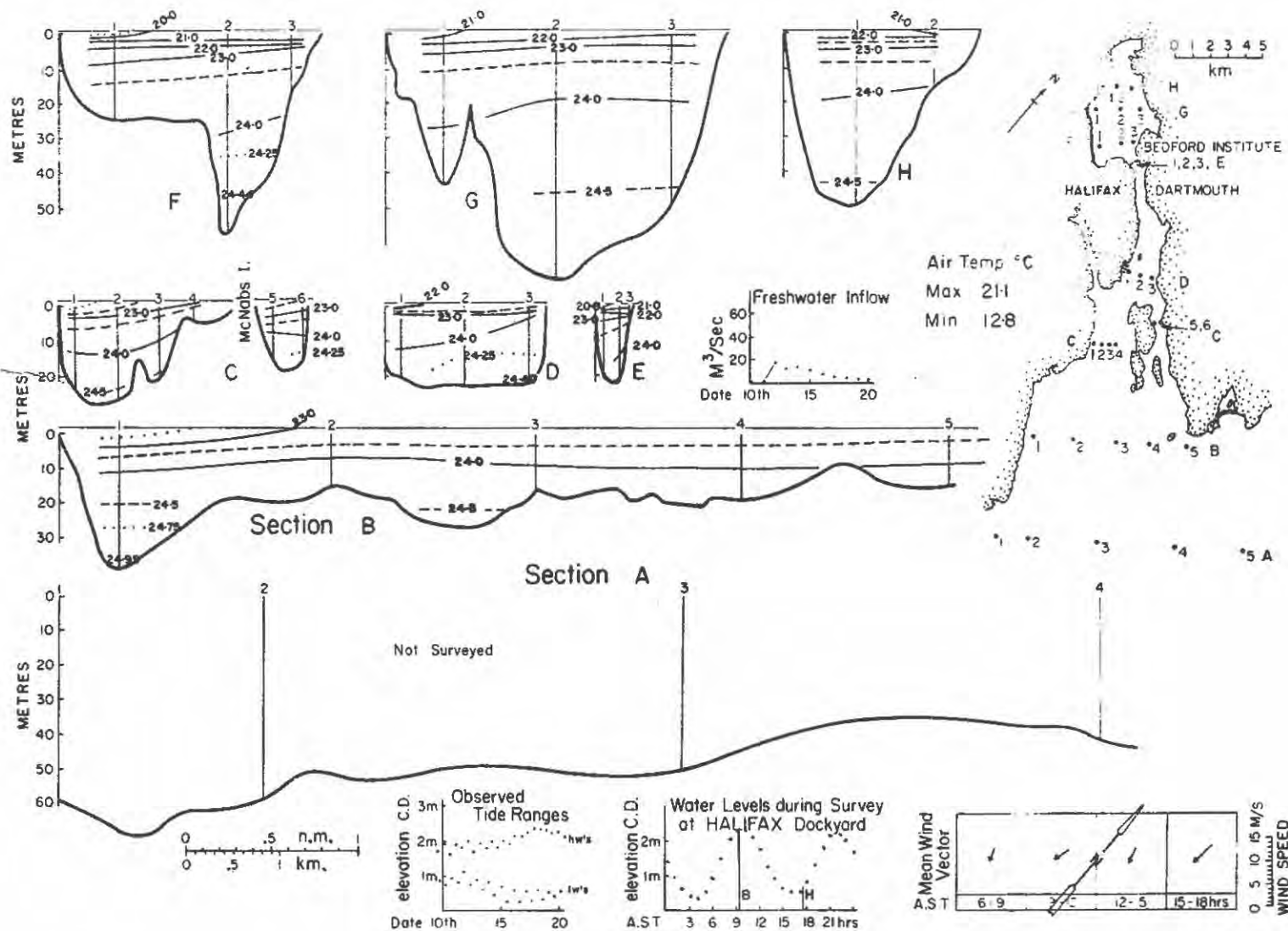


FIGURE 13(c): Density for 19 August 1970.

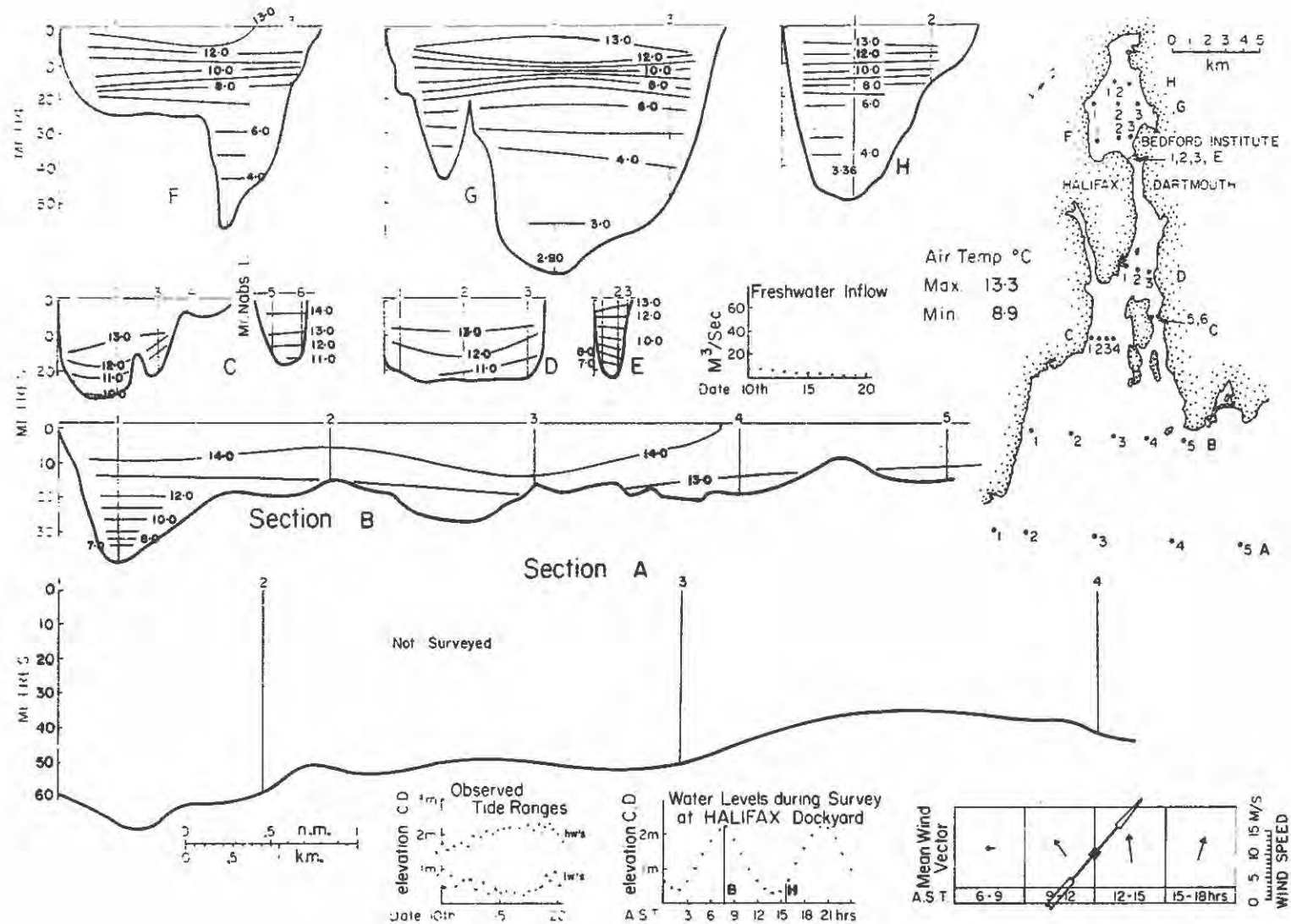


FIGURE 14(a): Temperature for 16 September 1970.

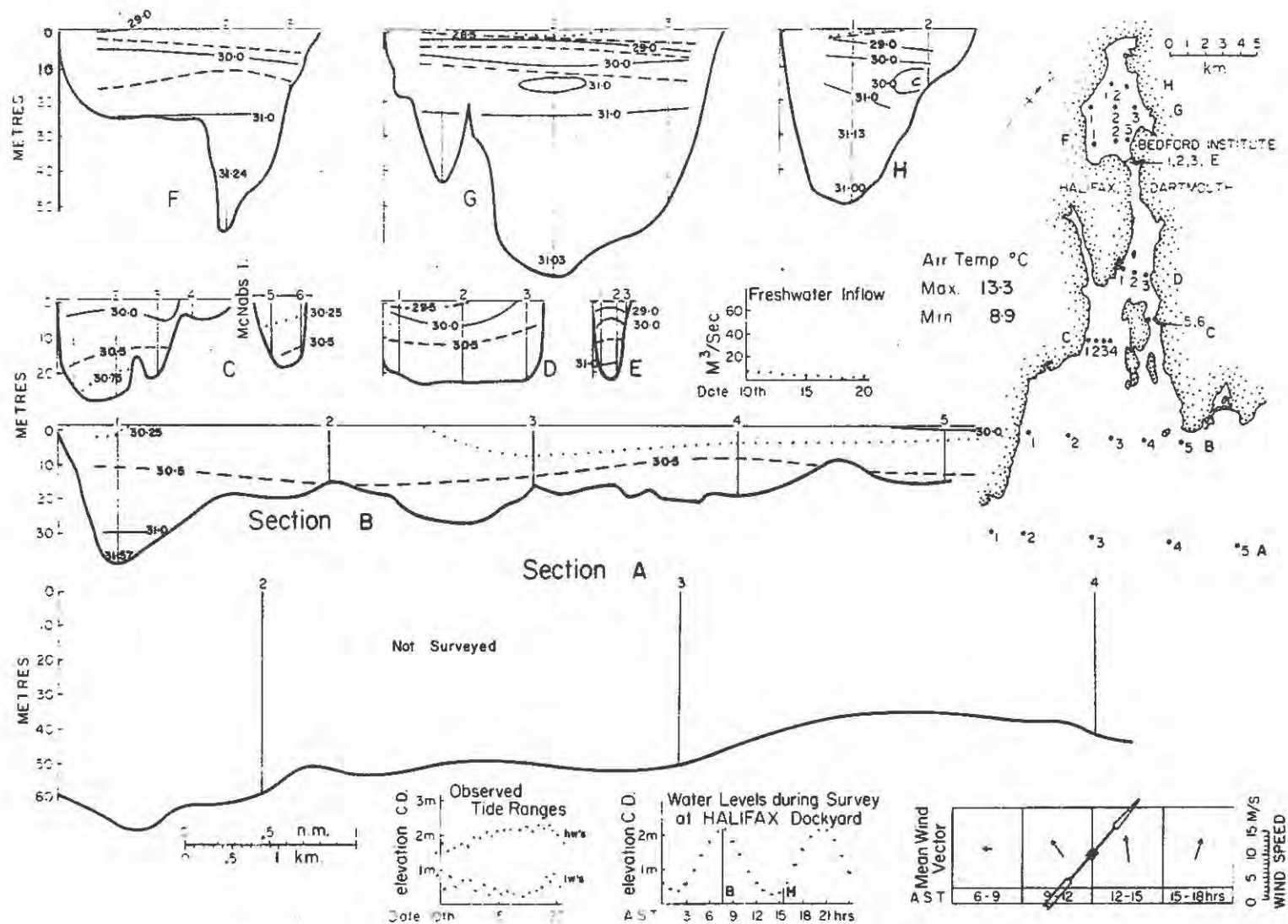


FIGURE 14(b): Salinity ‰ for 16 September 1970.

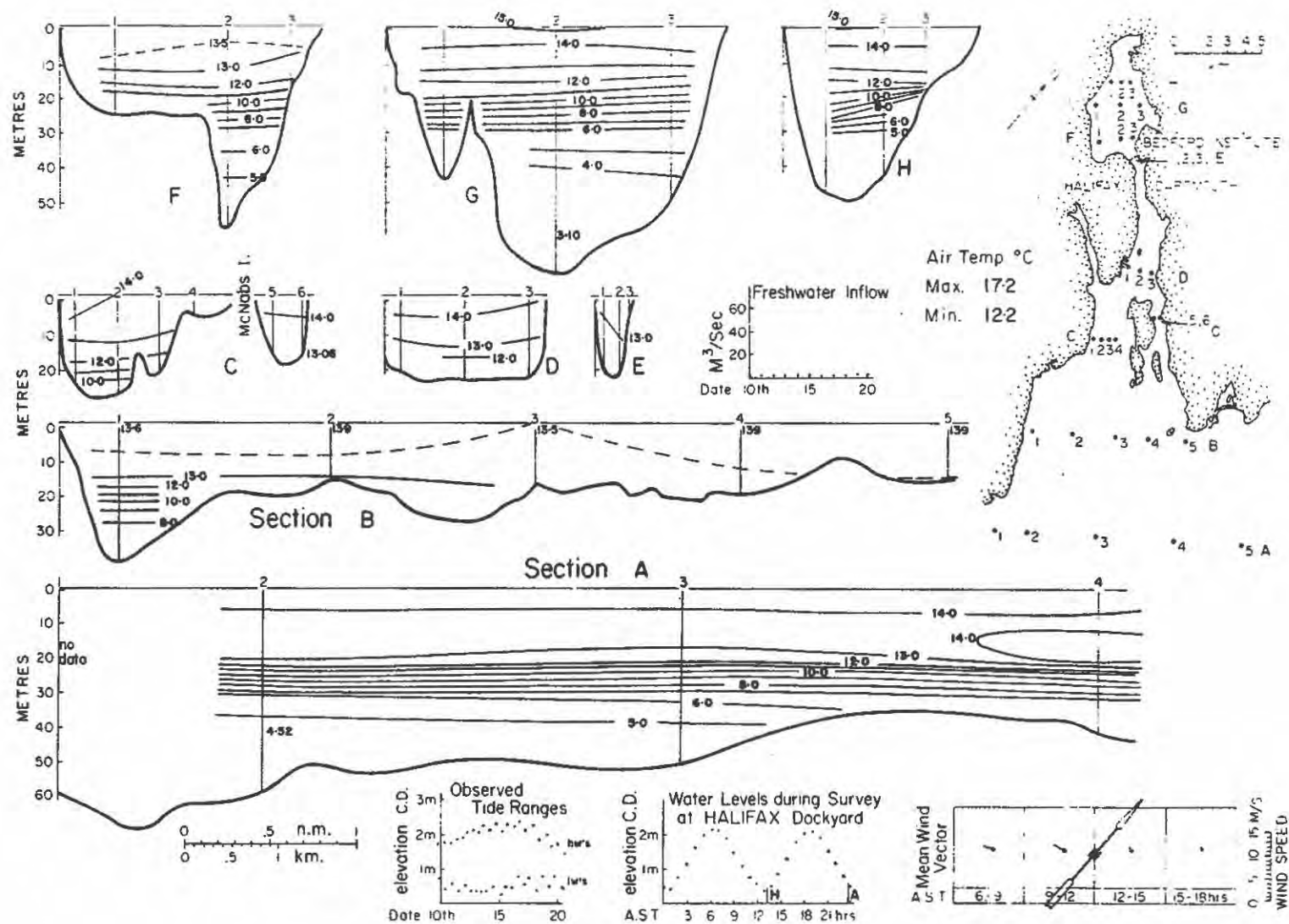


FIGURE 15(a): Temperature for 13 October 1970.

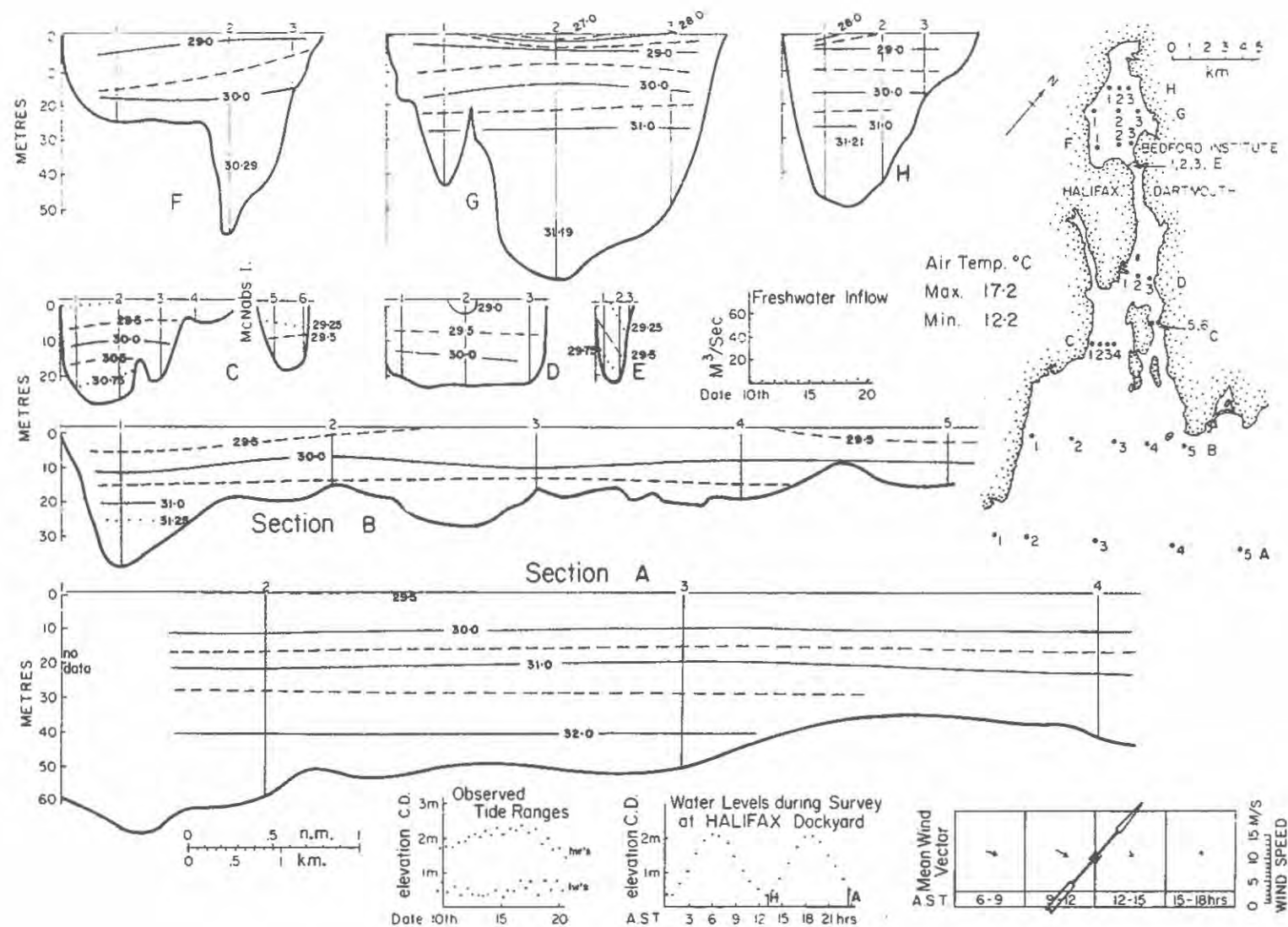


FIGURE 15(b): Salinity ‰ for 13 October 1970.

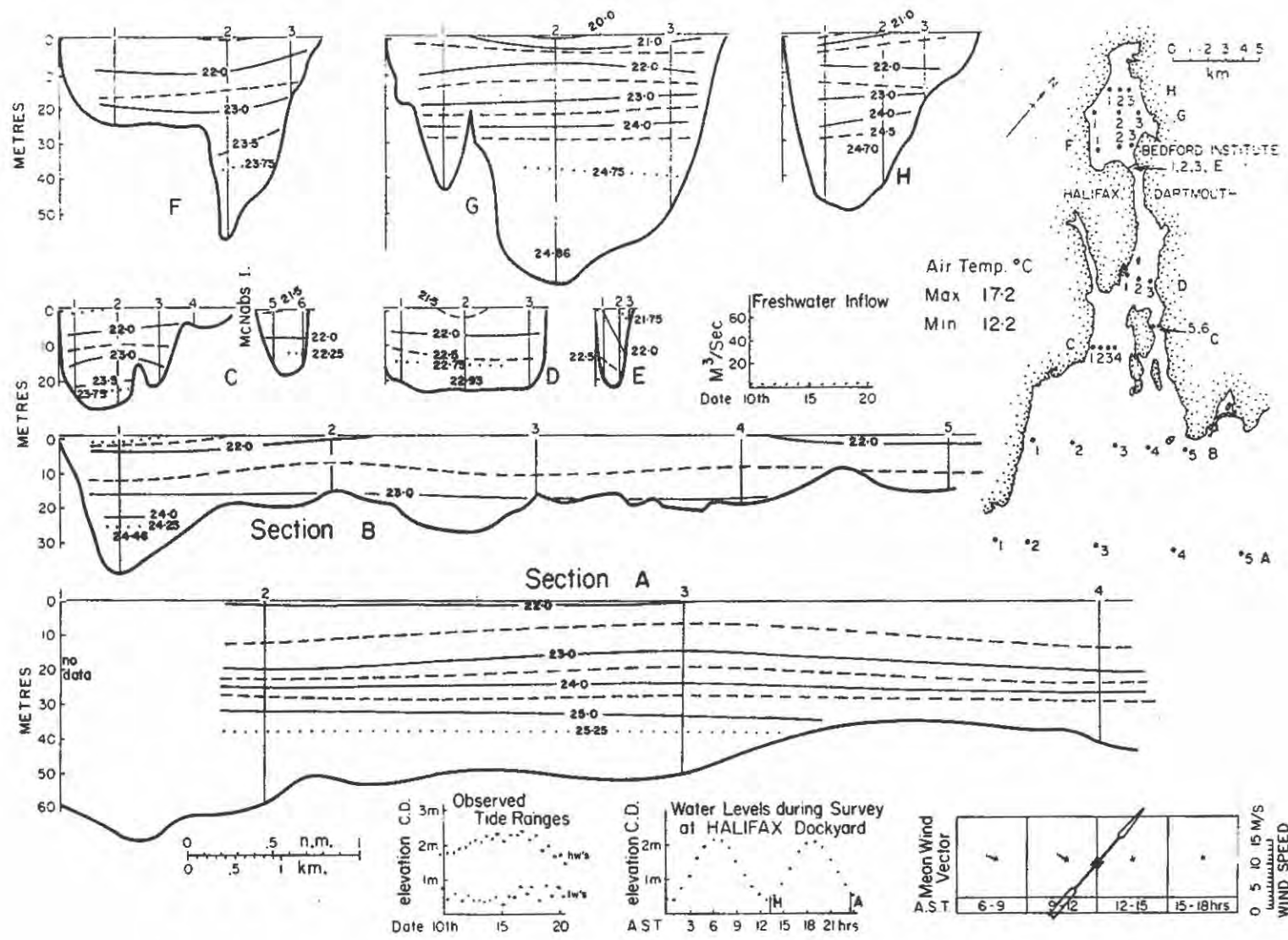


FIGURE 15(c): Density for 13 October 1970.

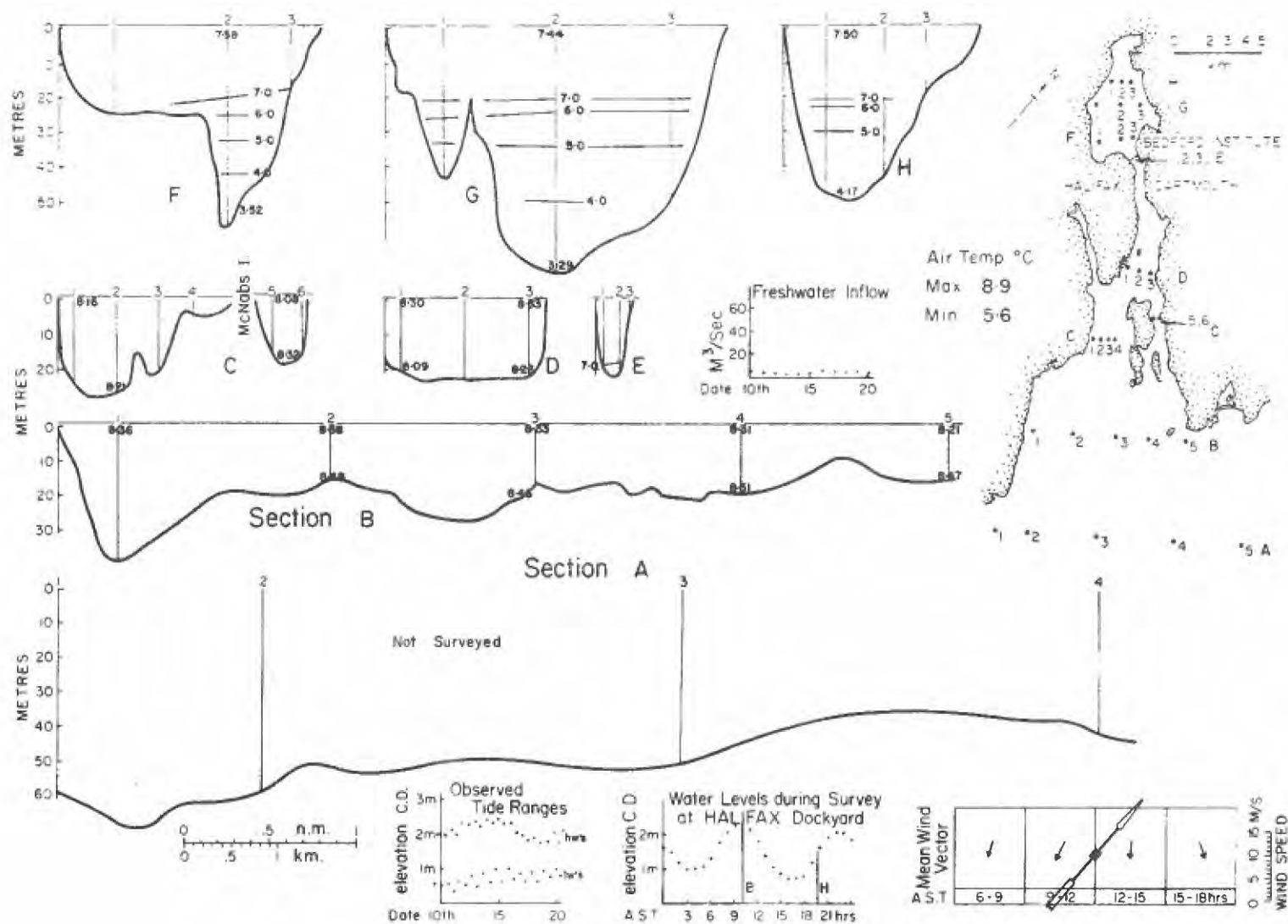


FIGURE 16(a): Temperature for 16 November 1970.

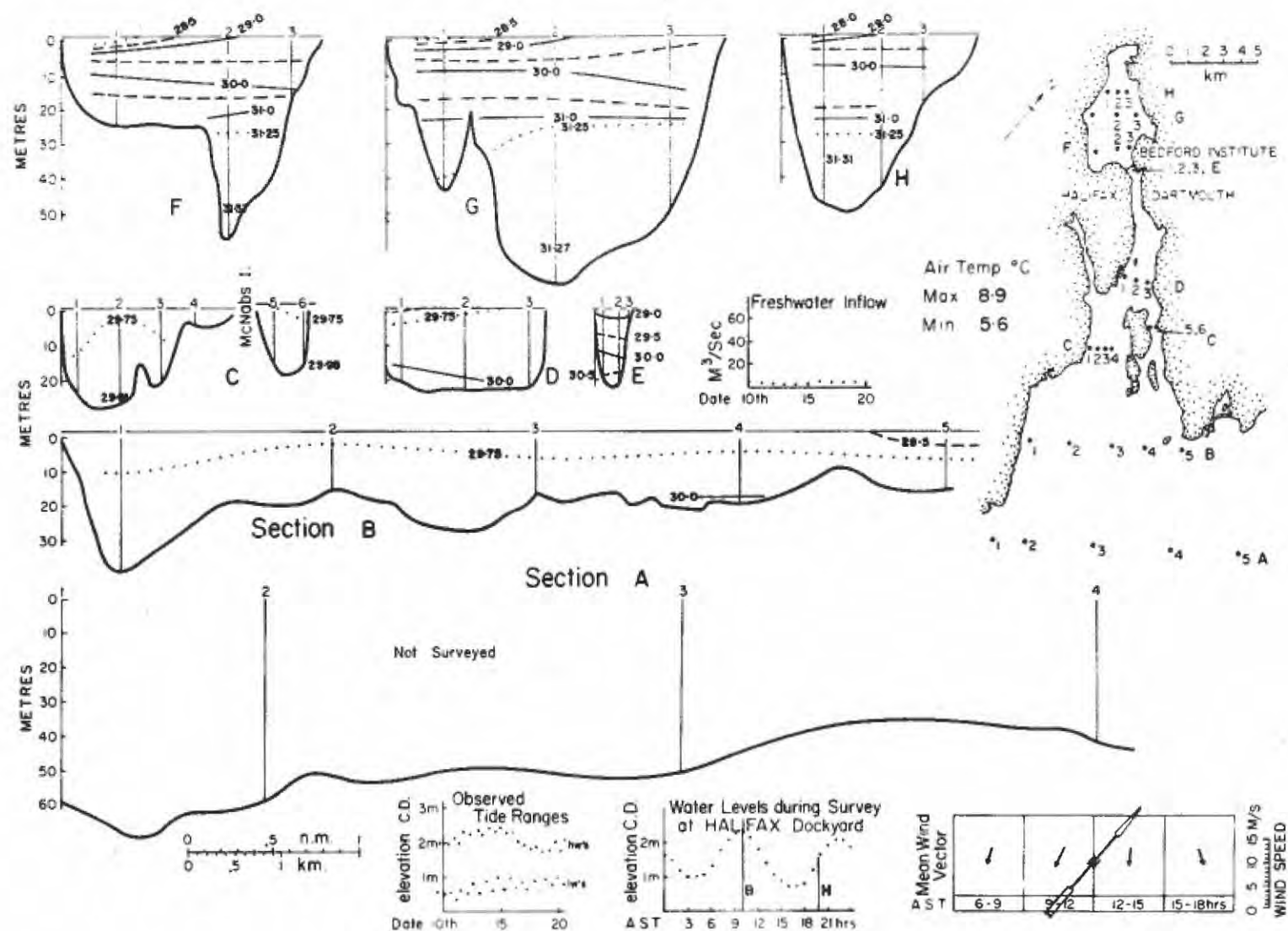


FIGURE 16(b): Salinity % for 16 November 1970.

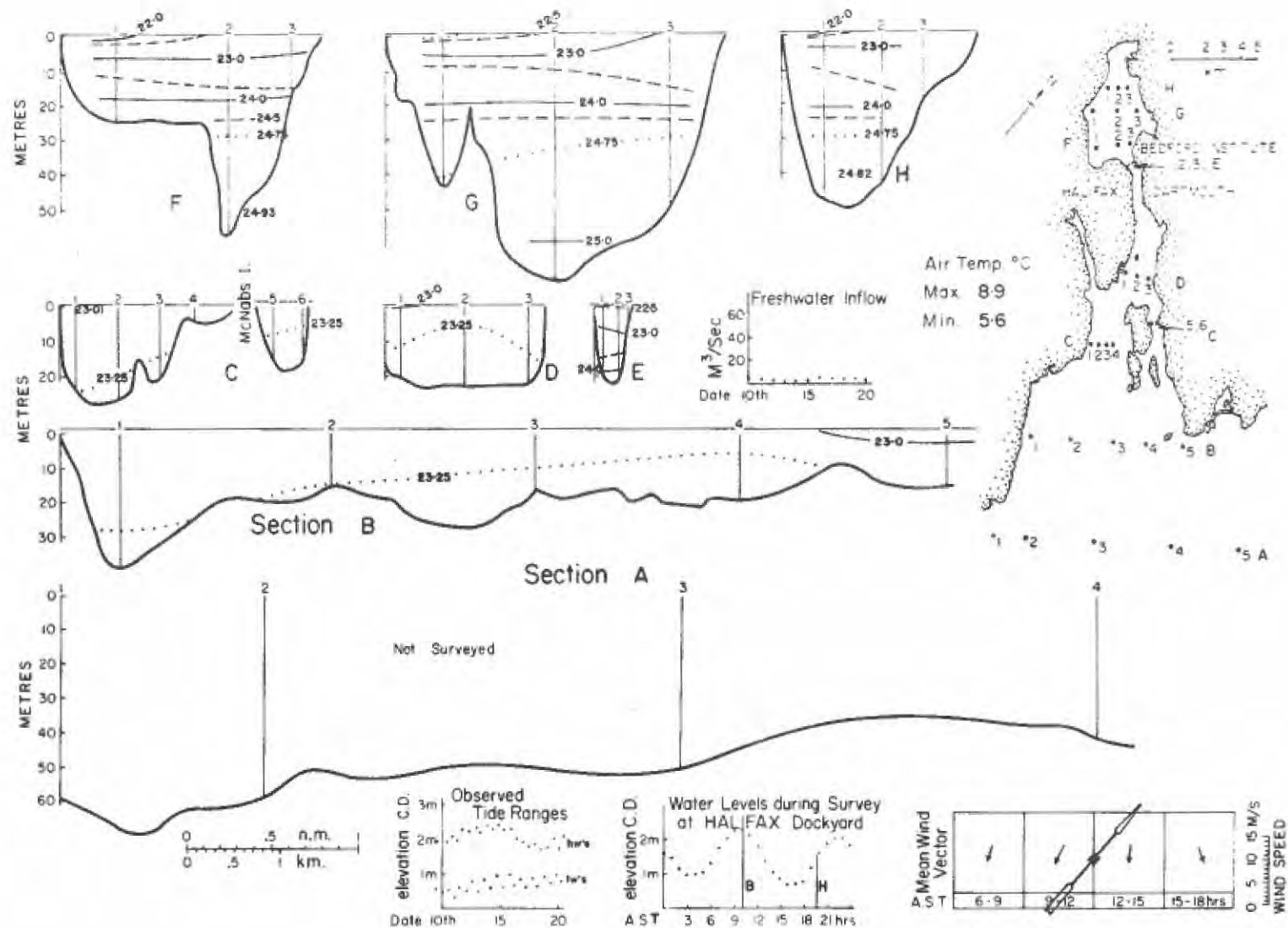


FIGURE 16(c): Density for 16 November 1970.

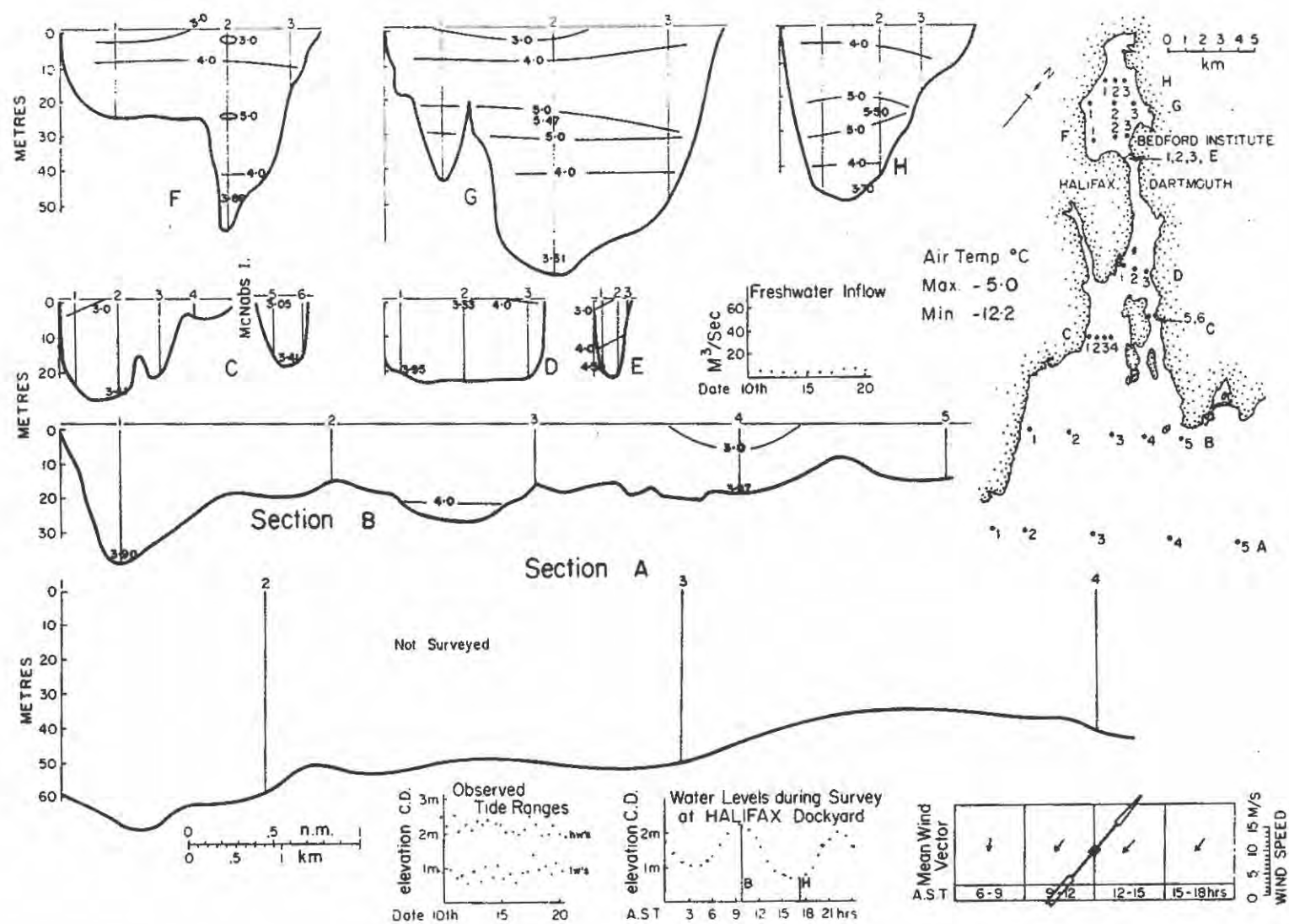


FIGURE 17(a): Temperature for 15 December 1970.

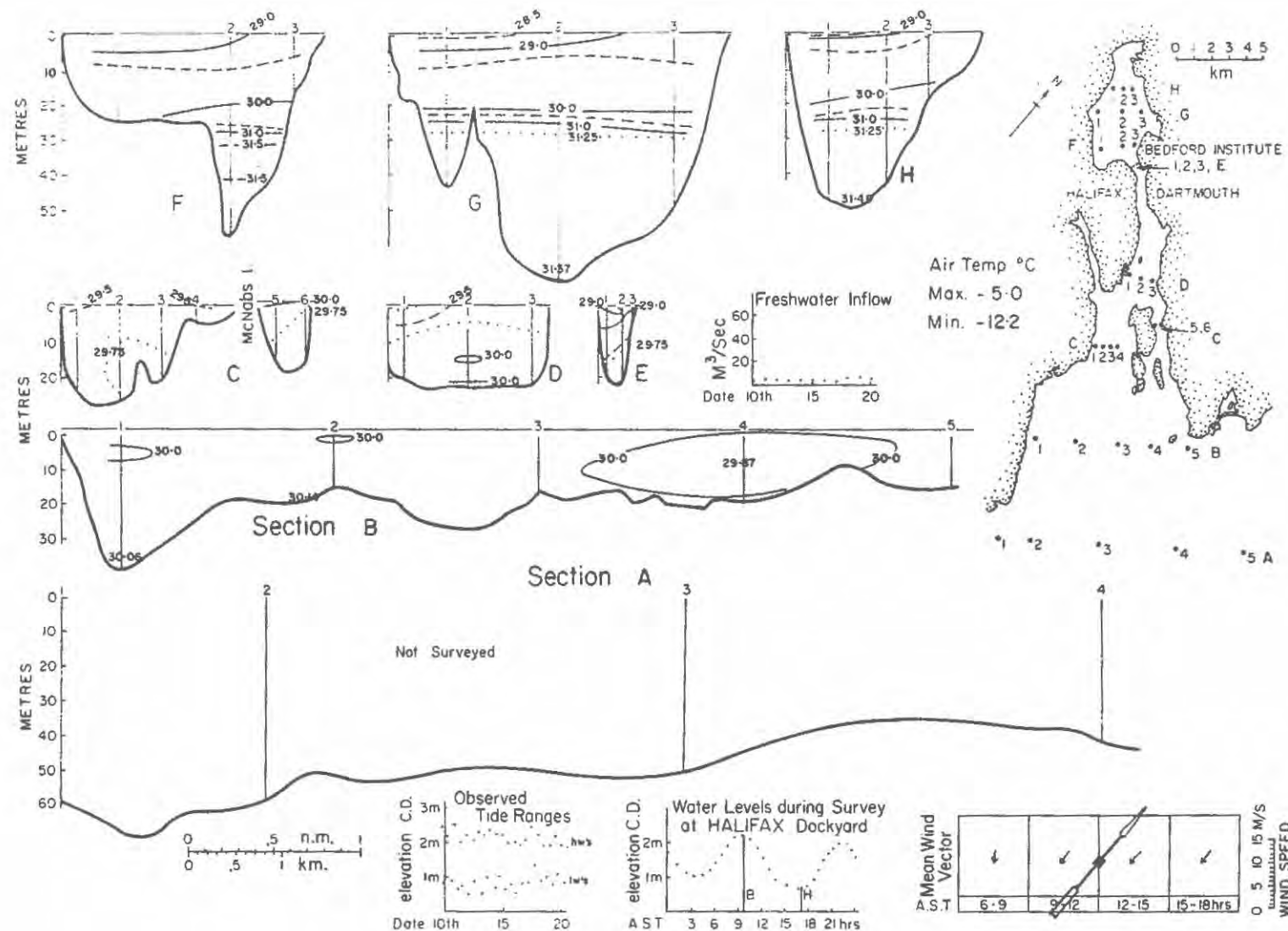


FIGURE 17(b): Salinity ‰ for 15 December 1970.

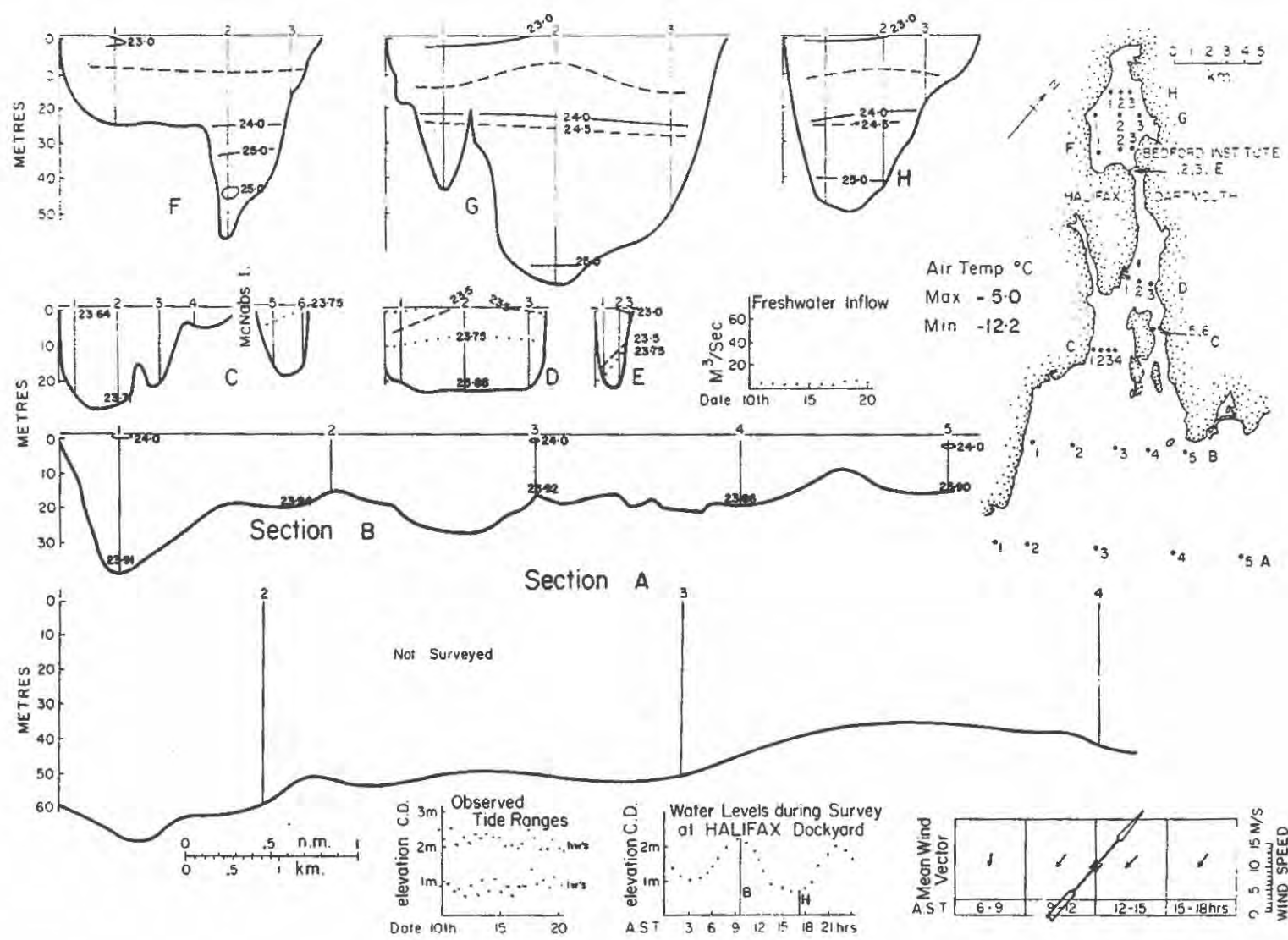


FIGURE 17(c): Density for 15 December 1970.

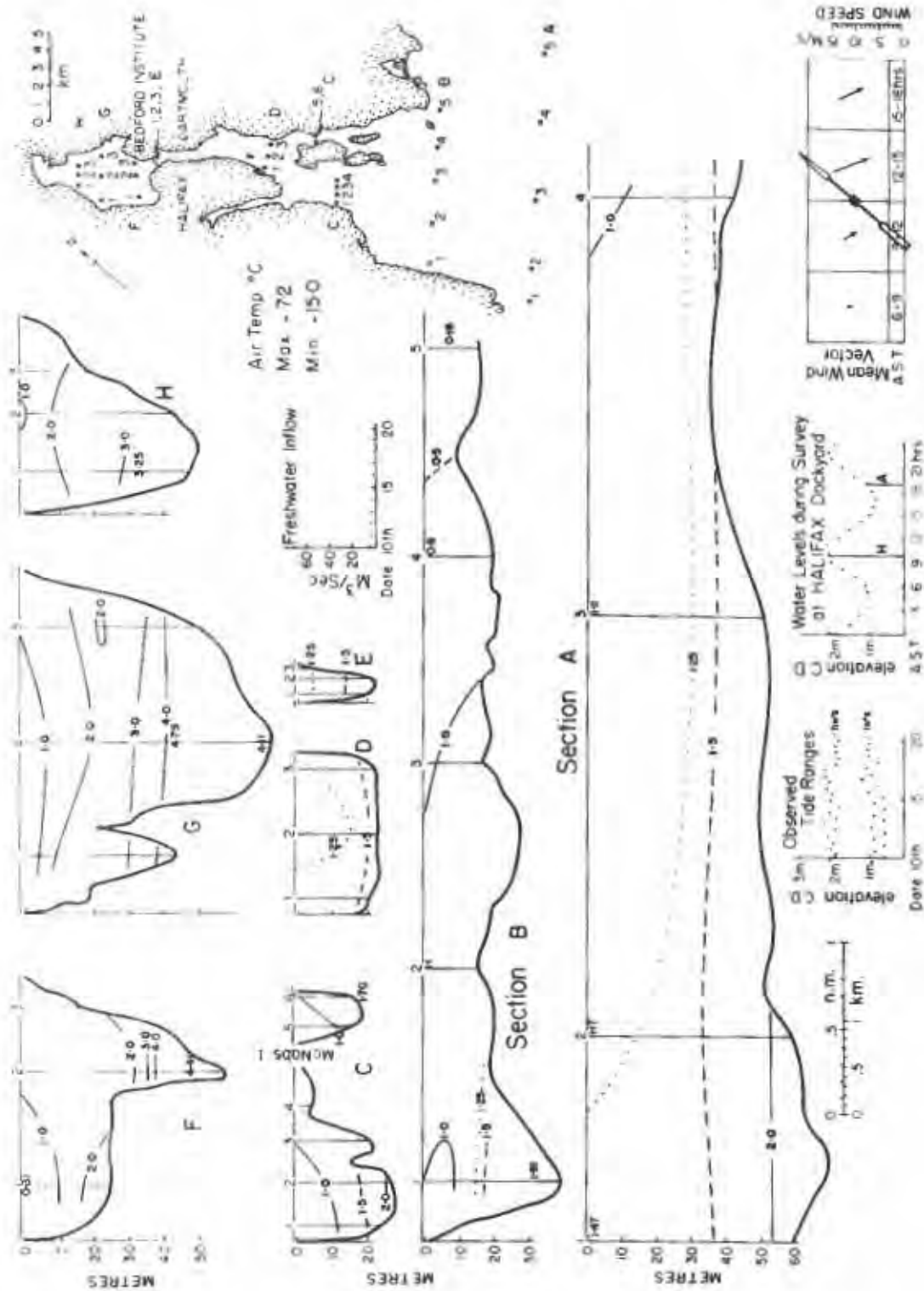


FIGURE 18(a): Temperature for 15 January 1971.

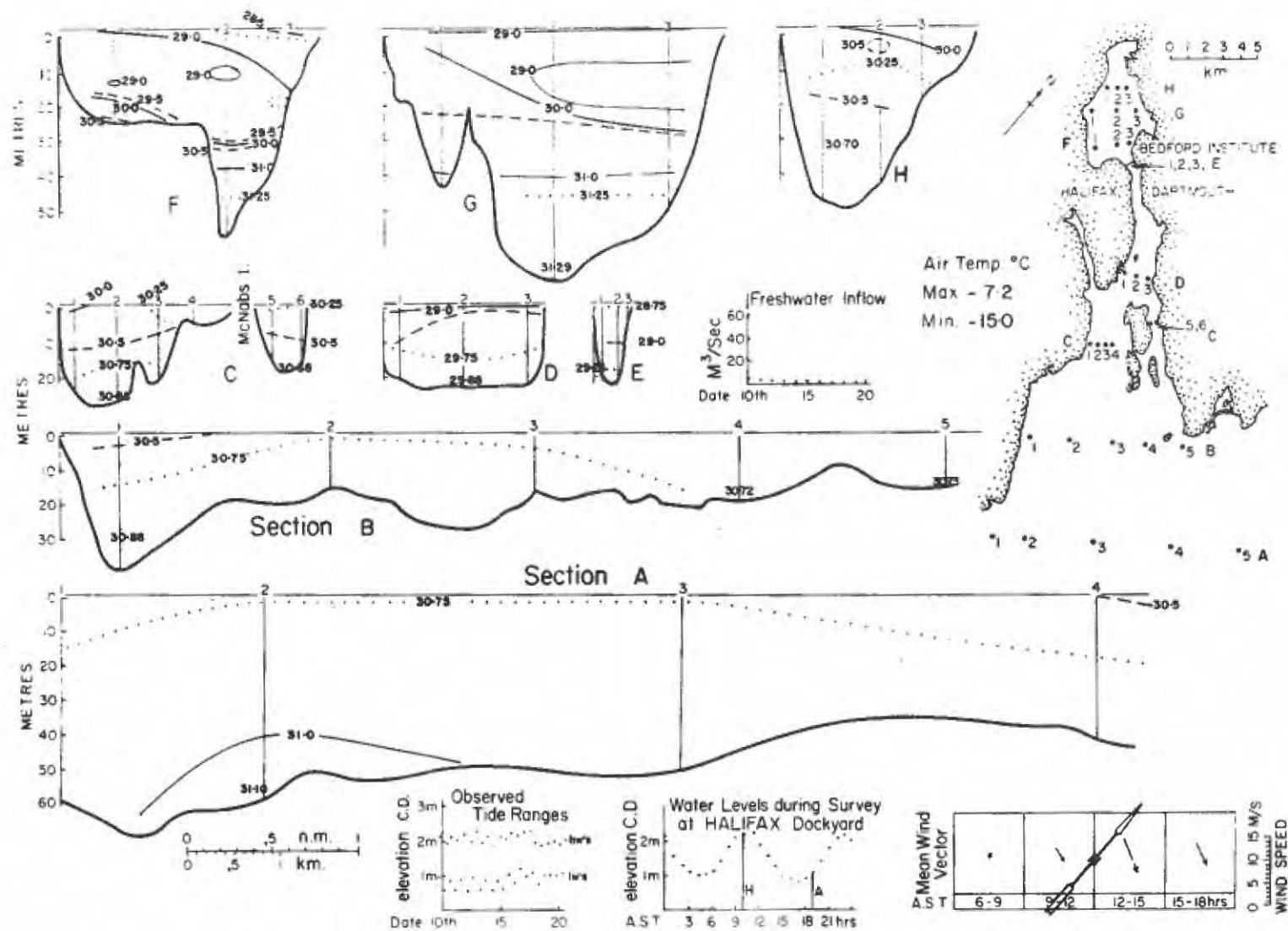


FIGURE 18(b): Salinity ‰ for 15 January 1971.

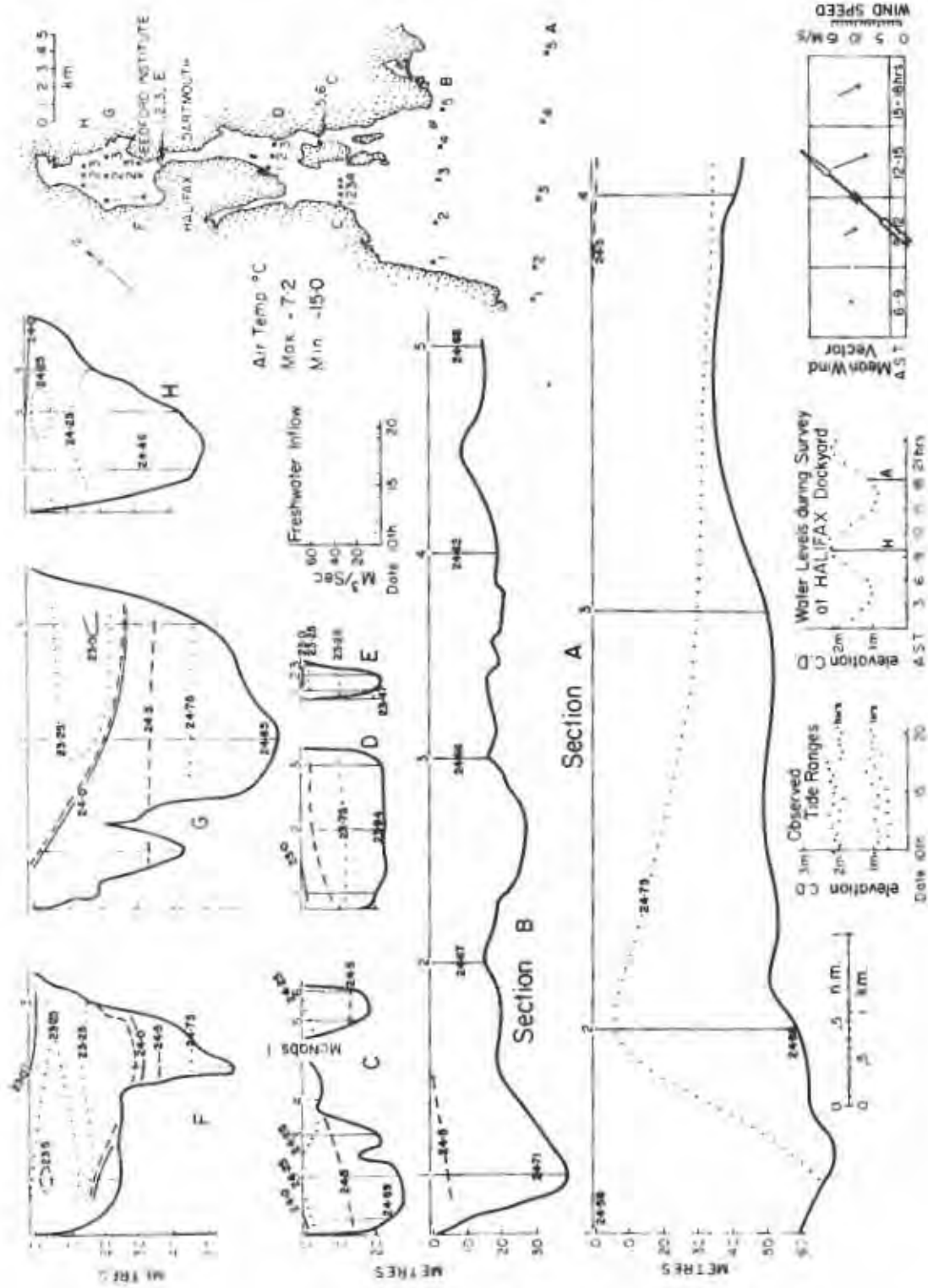


FIGURE 18(c): Density for 15 January 1971.

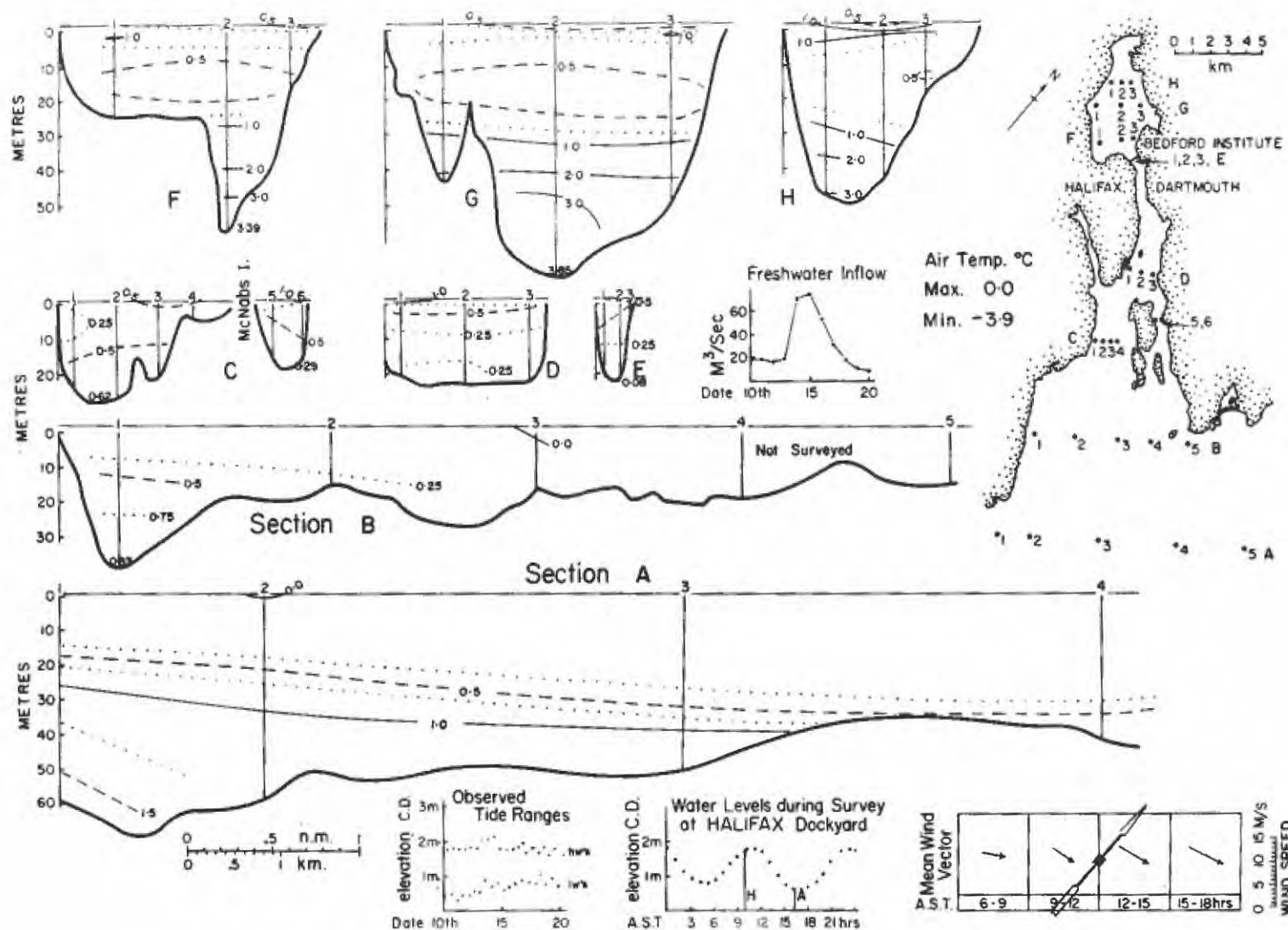


FIGURE 19(a): Temperature for 15 February 1971.

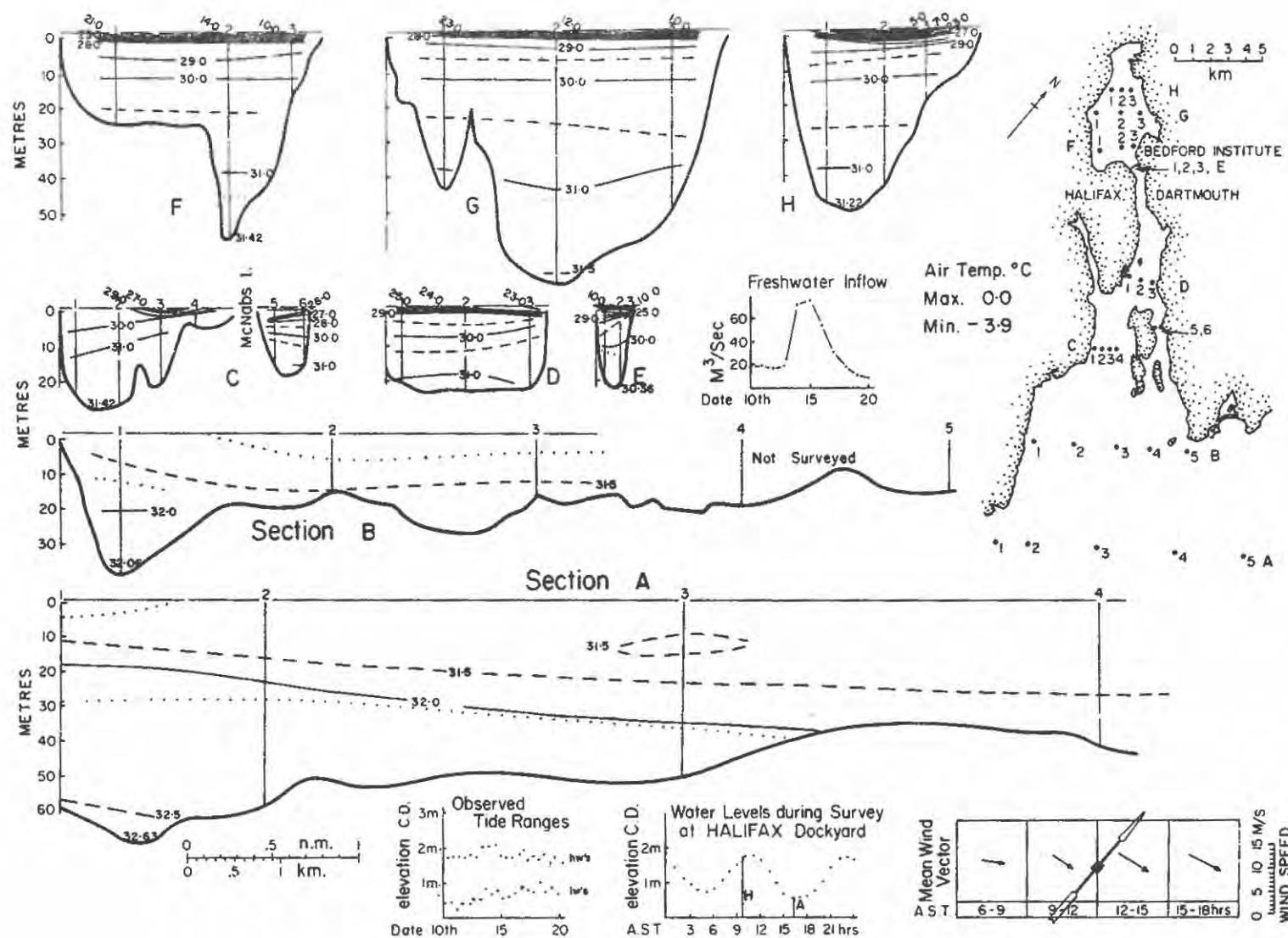


FIGURE 19(b): Salinity % for 15 February 1971.

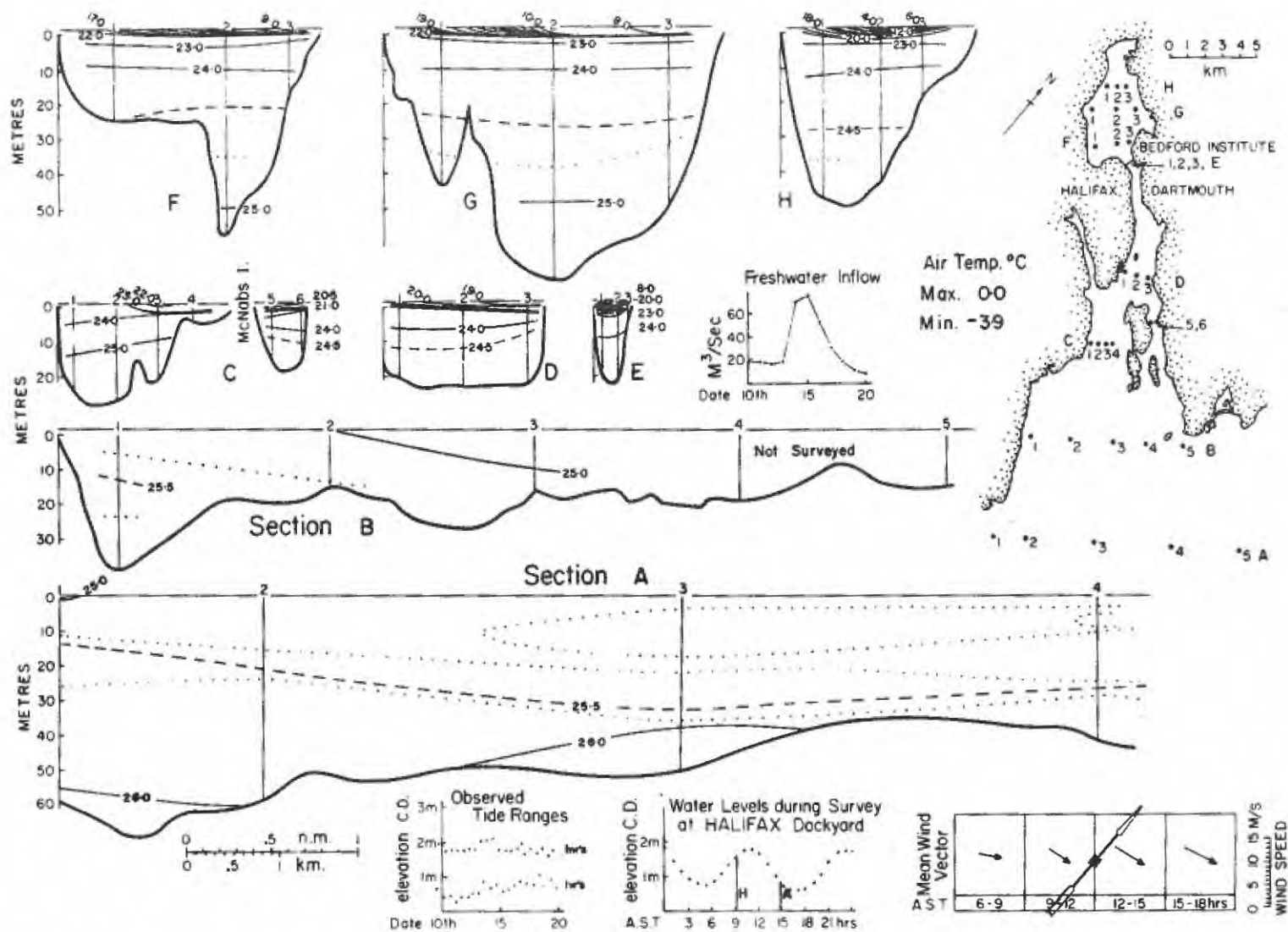


FIGURE 19(c): Density for 15 February 1971.

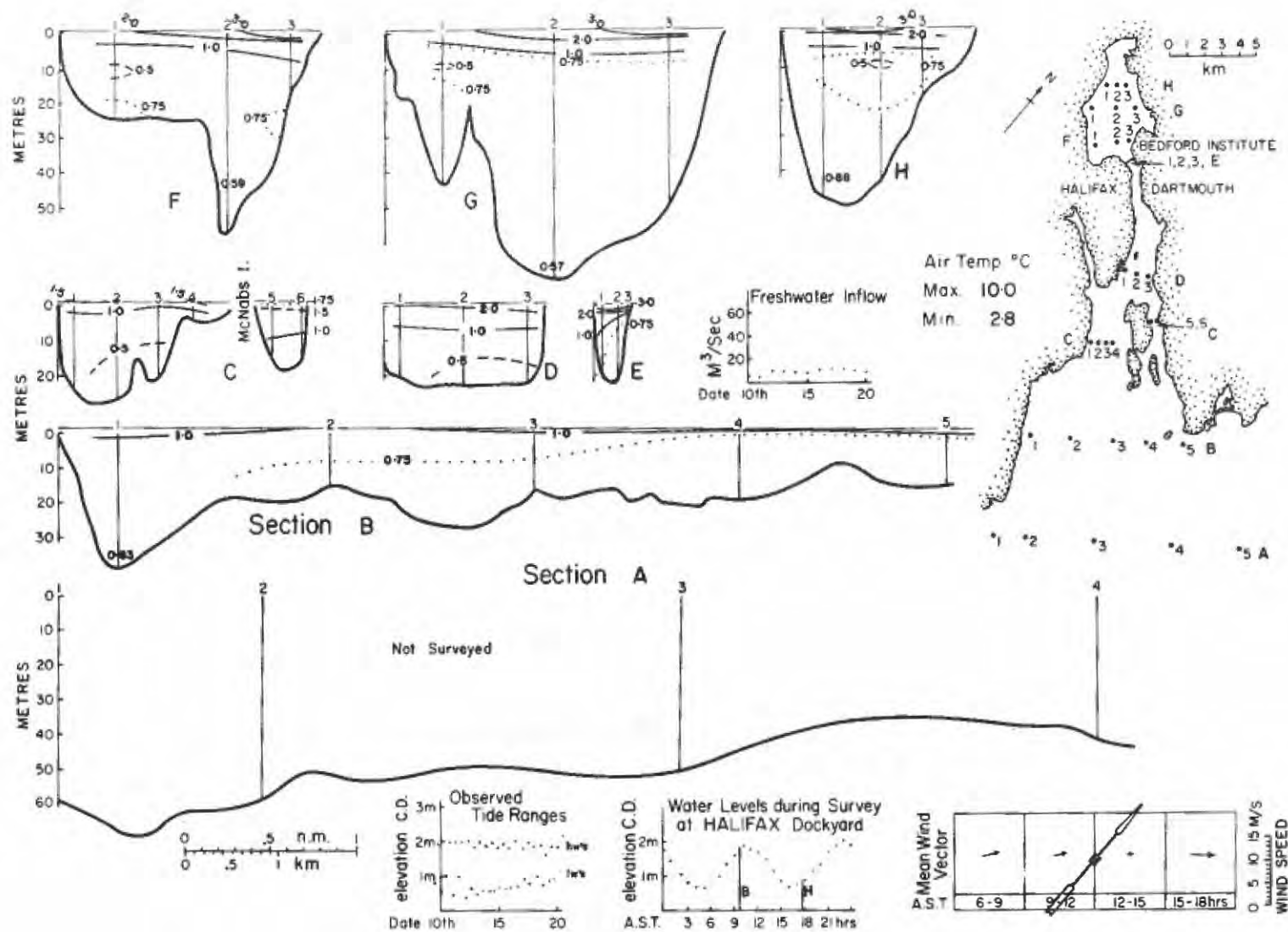


FIGURE 20(a): Temperature for 16 March 1971.

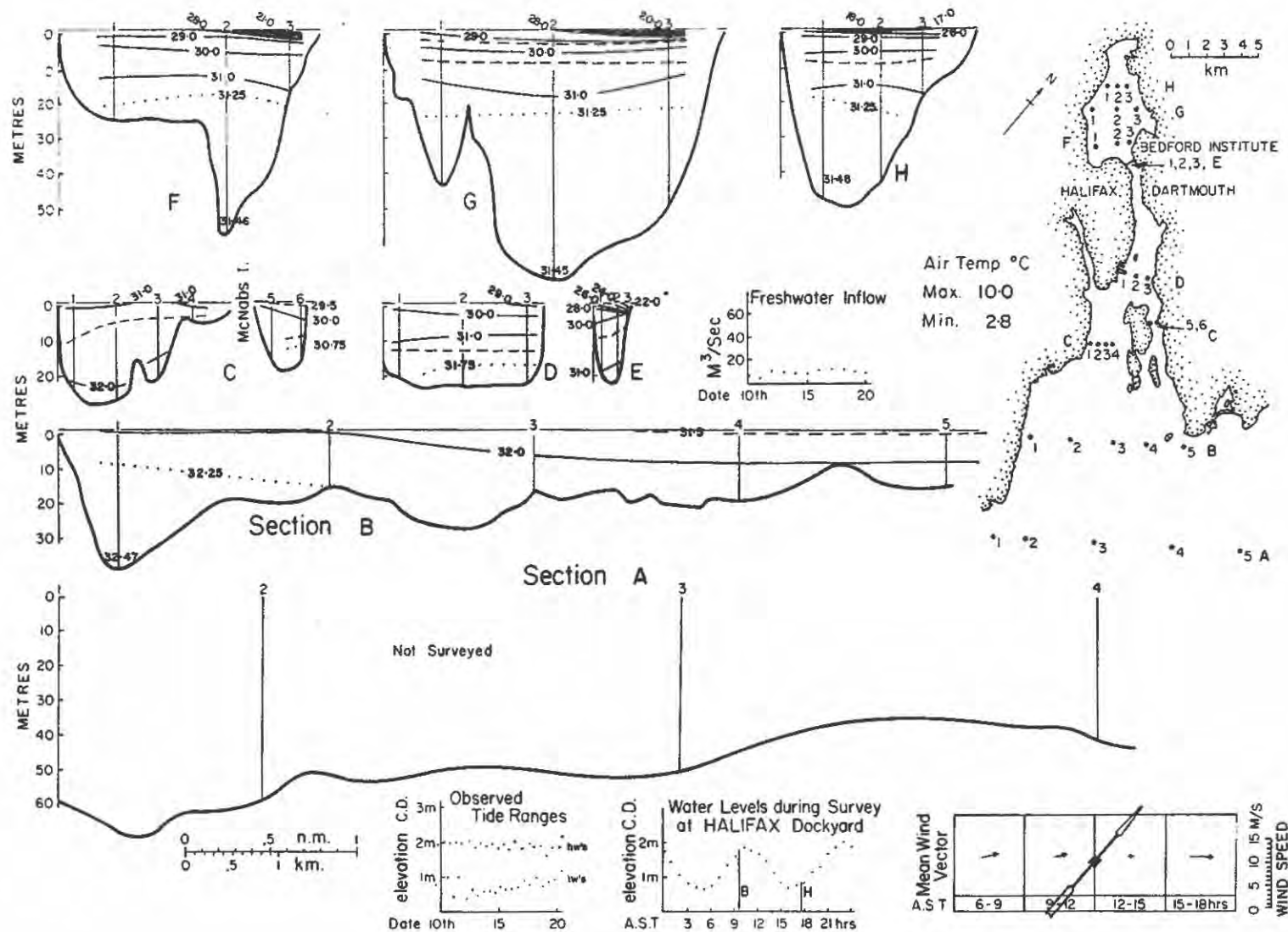


FIGURE 20(b): Salinity ‰ for 16 March 1971.

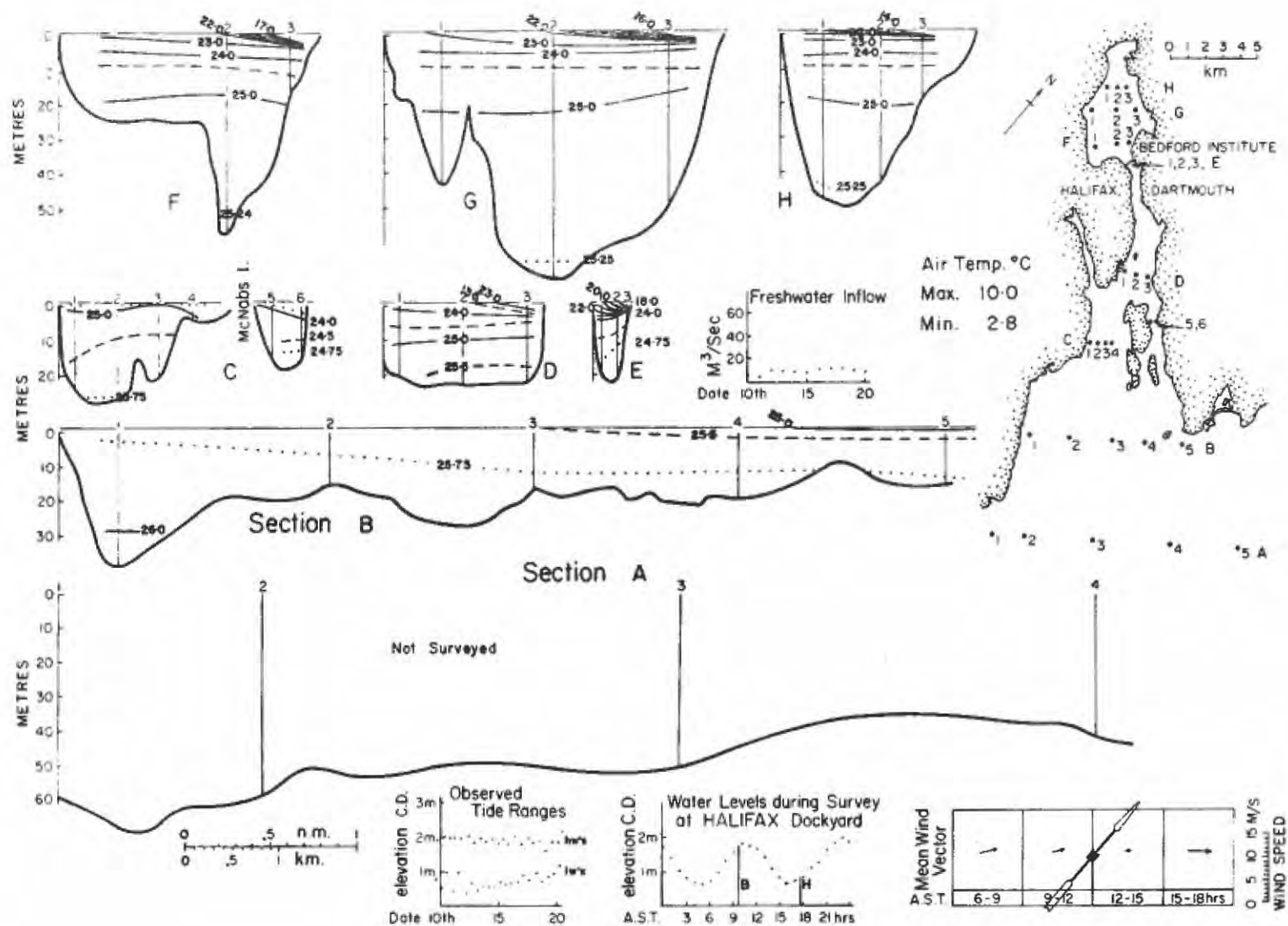


FIGURE 20(c): Density for 16 March 1971.

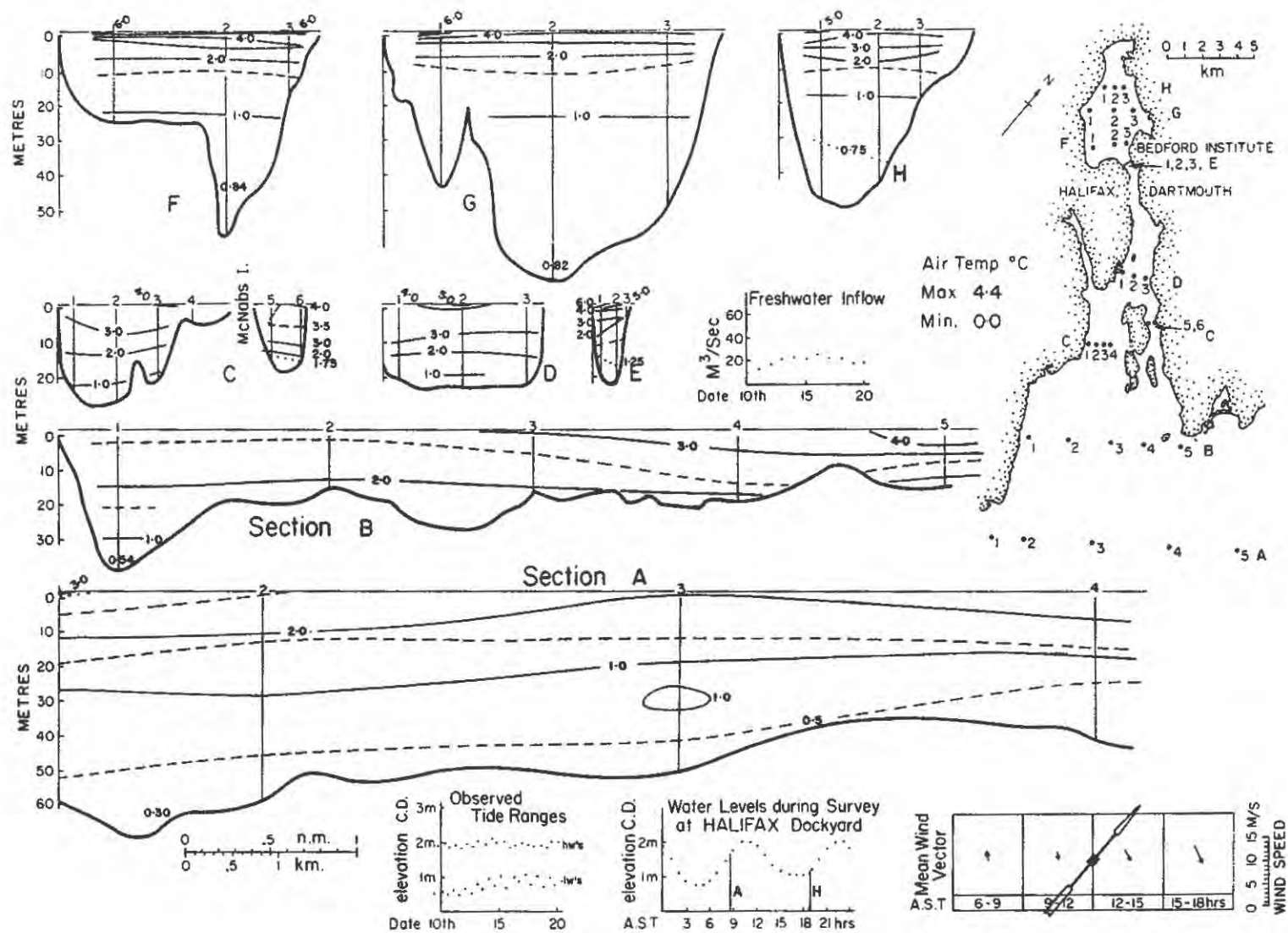


FIGURE 21(a): Temperature for 15 April 1971.

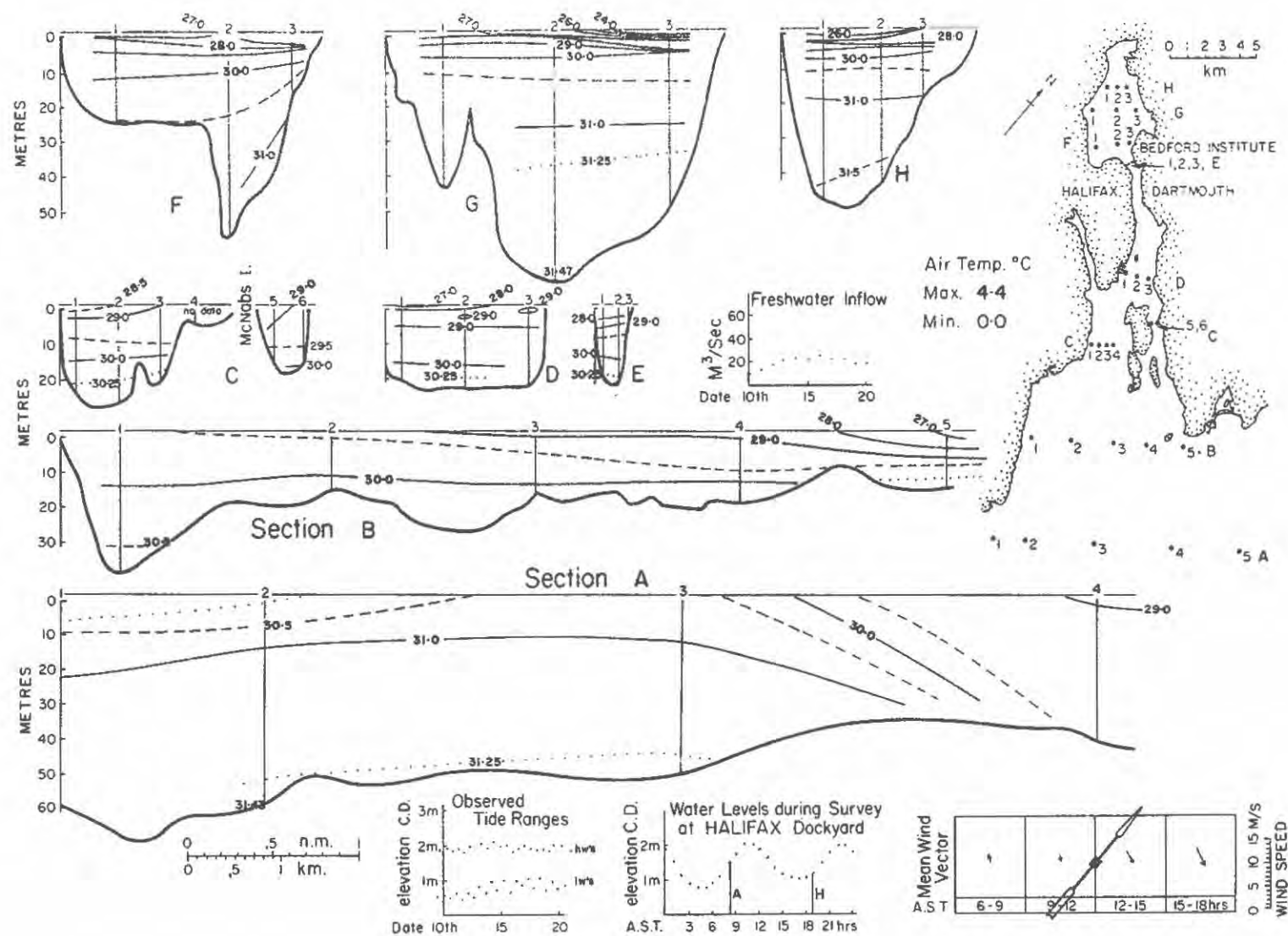


FIGURE 21(b): Salinity ‰ for 15 April 1971.

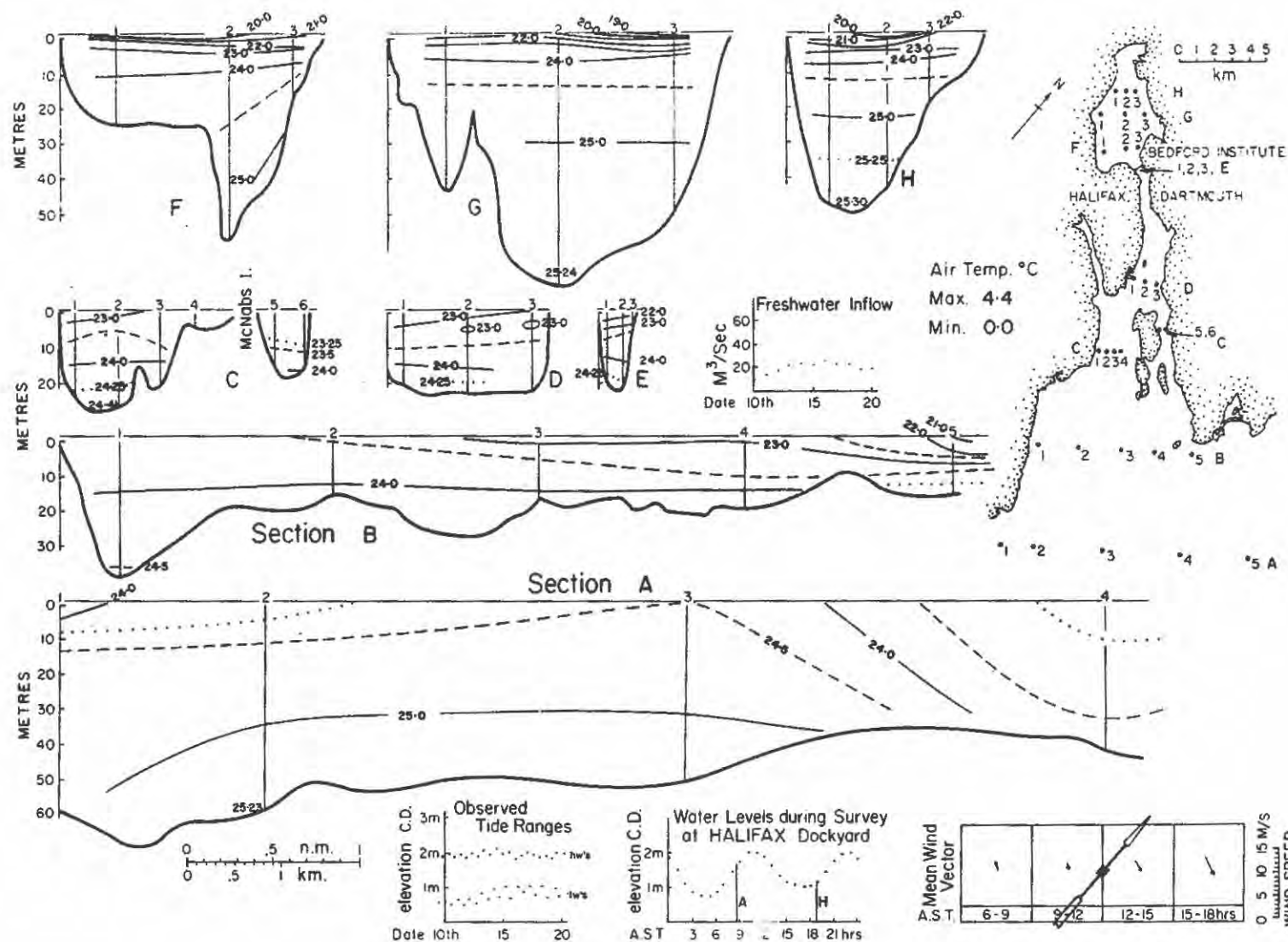


FIGURE 21(c): Density for 15 April 1971.

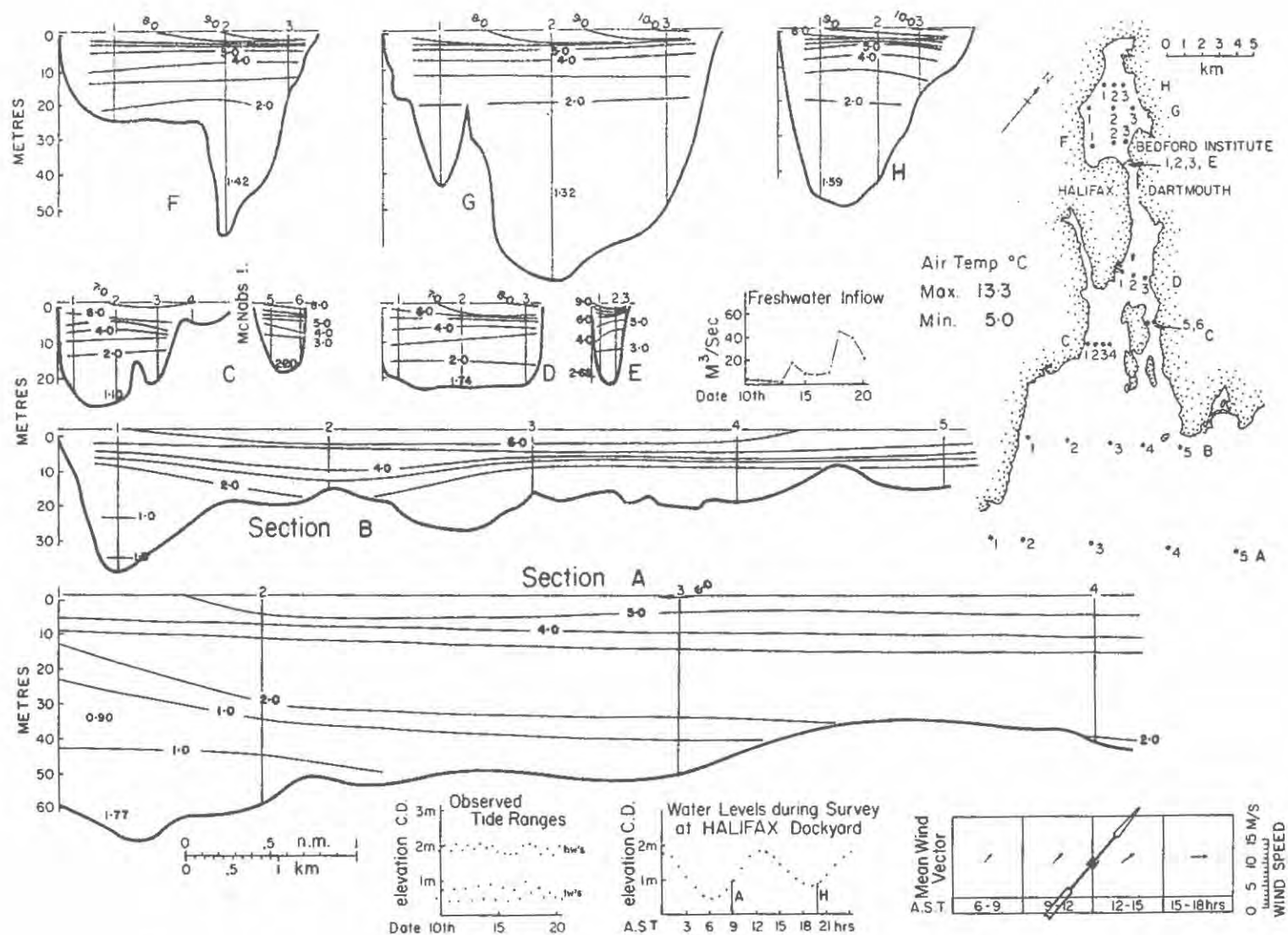


FIGURE 22(a): Temperature for 16 May 1971.

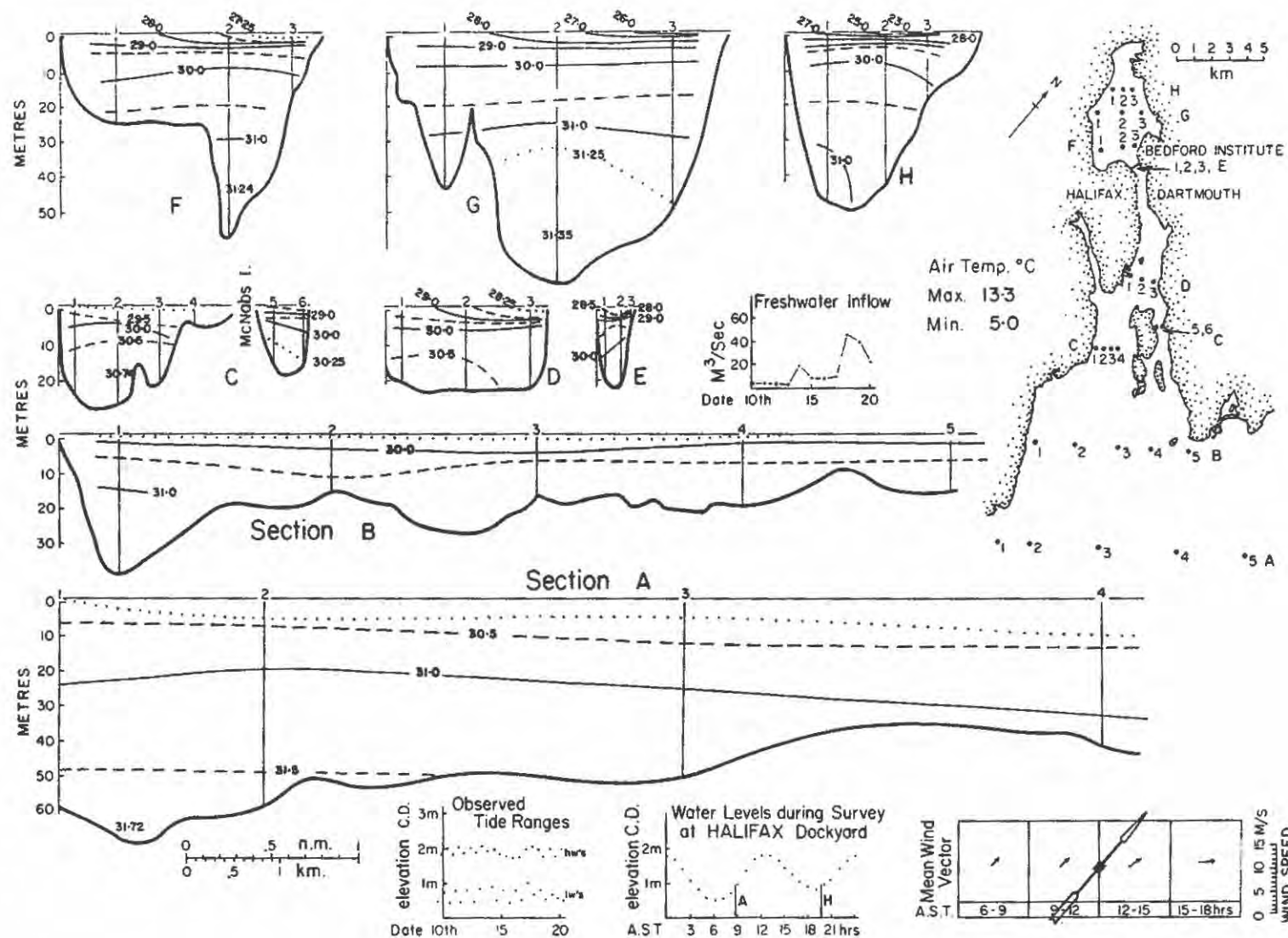


FIGURE 22(b): Salinity ‰ for 16 May 1971.

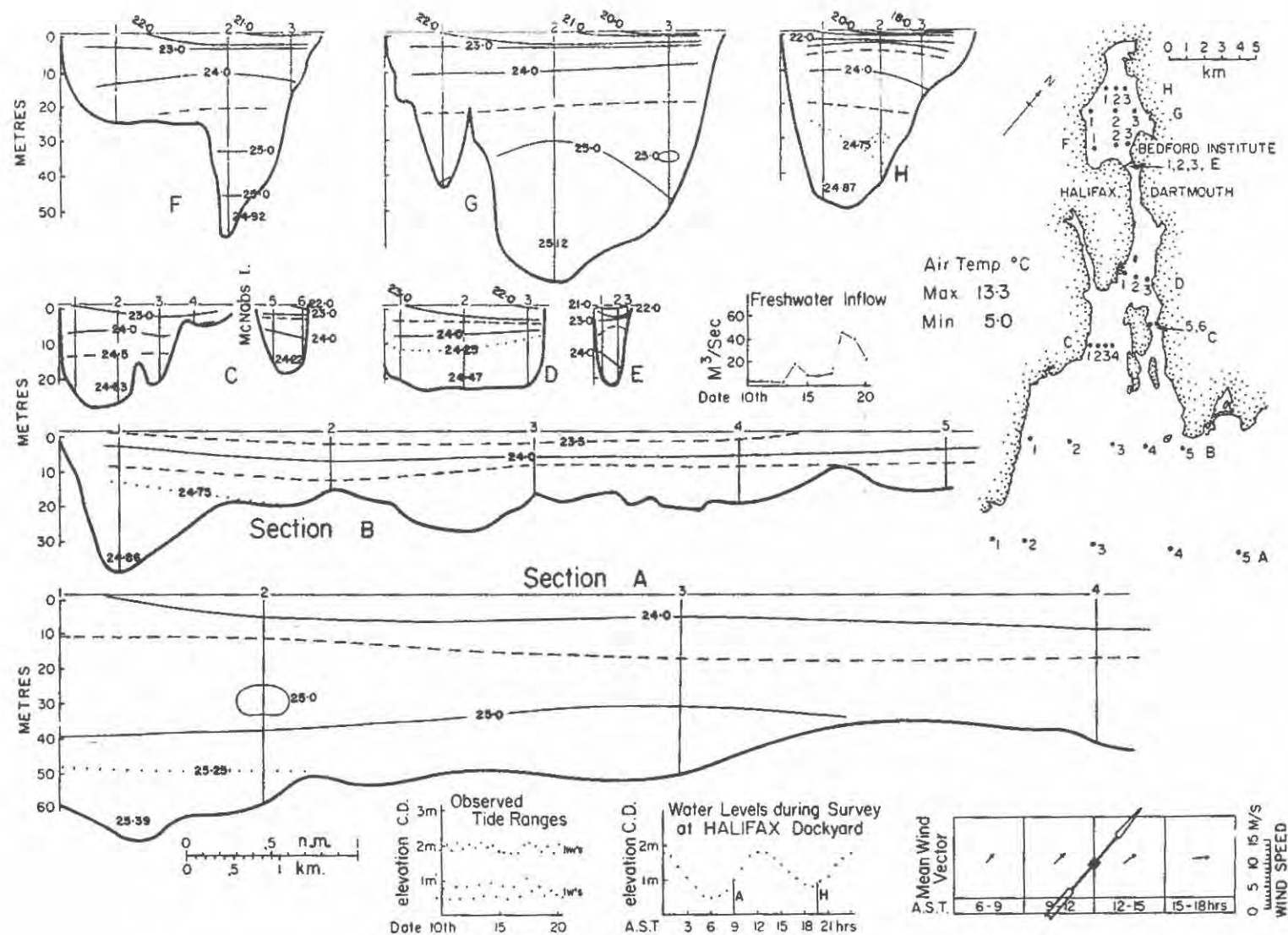


FIGURE 22(c): Density for 16 May 1971.

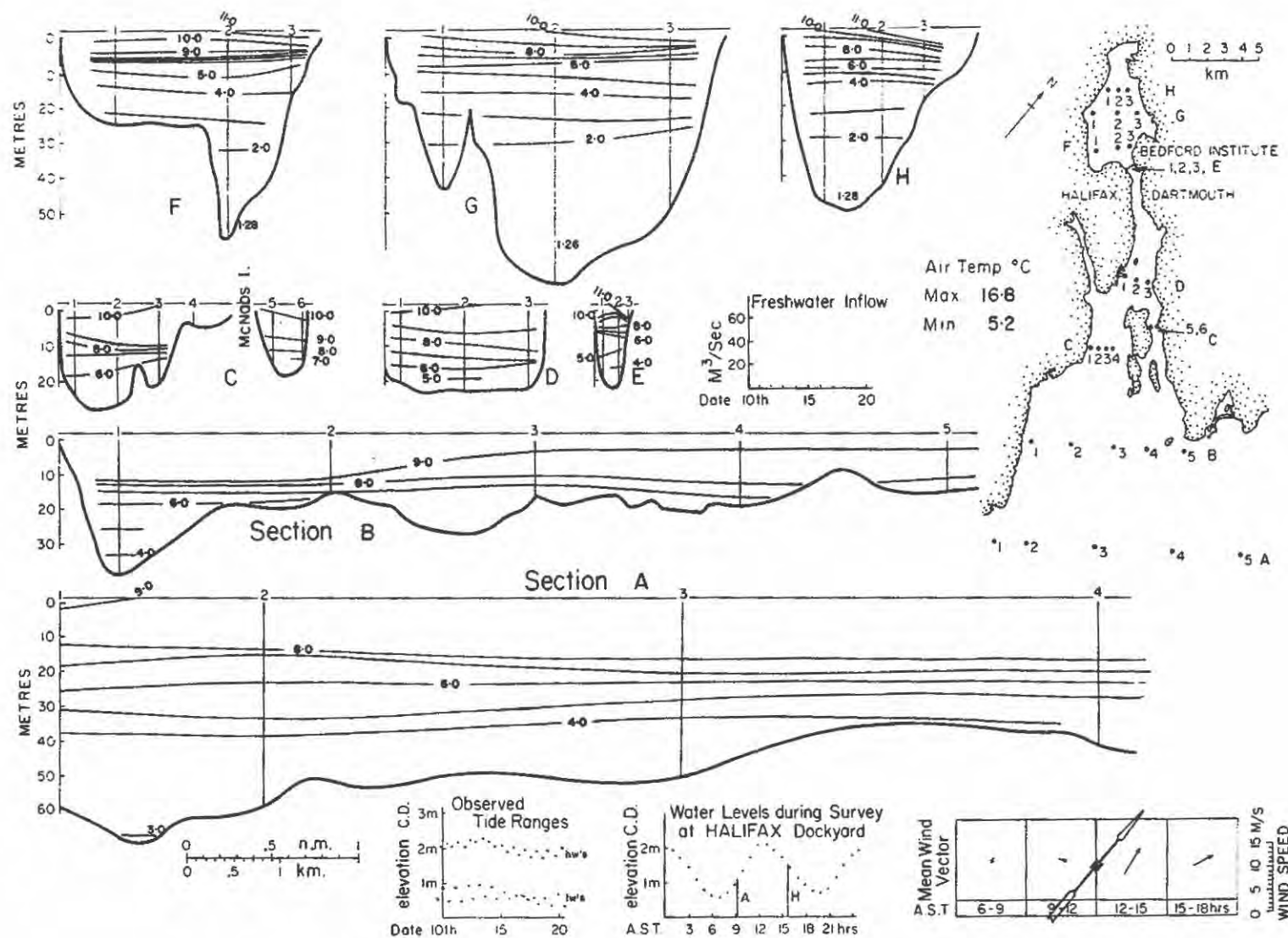


FIGURE 23(a): Temperature for 15 June 1971.

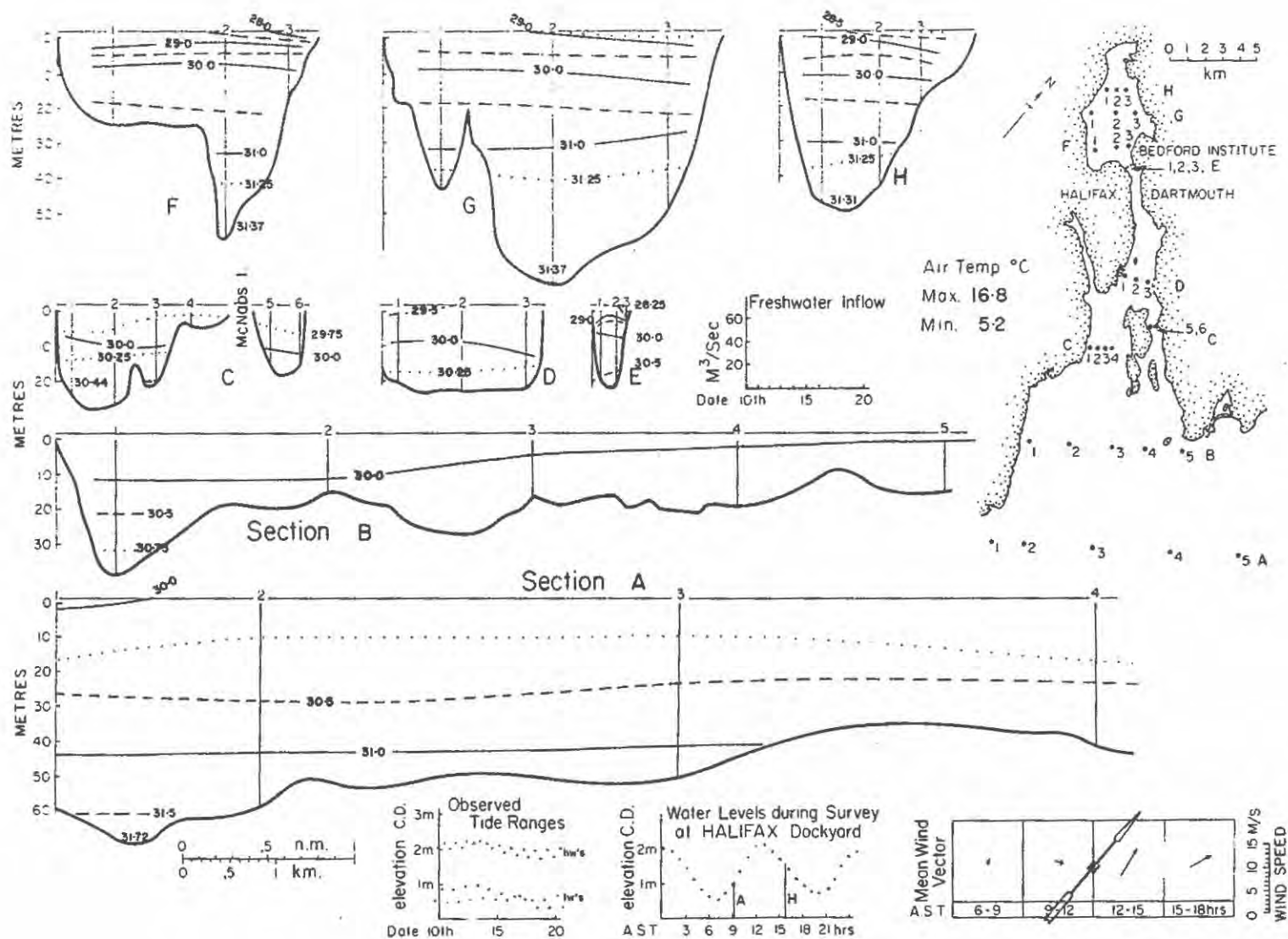


FIGURE 23(b): Salinity ‰ for 15 June 1971.

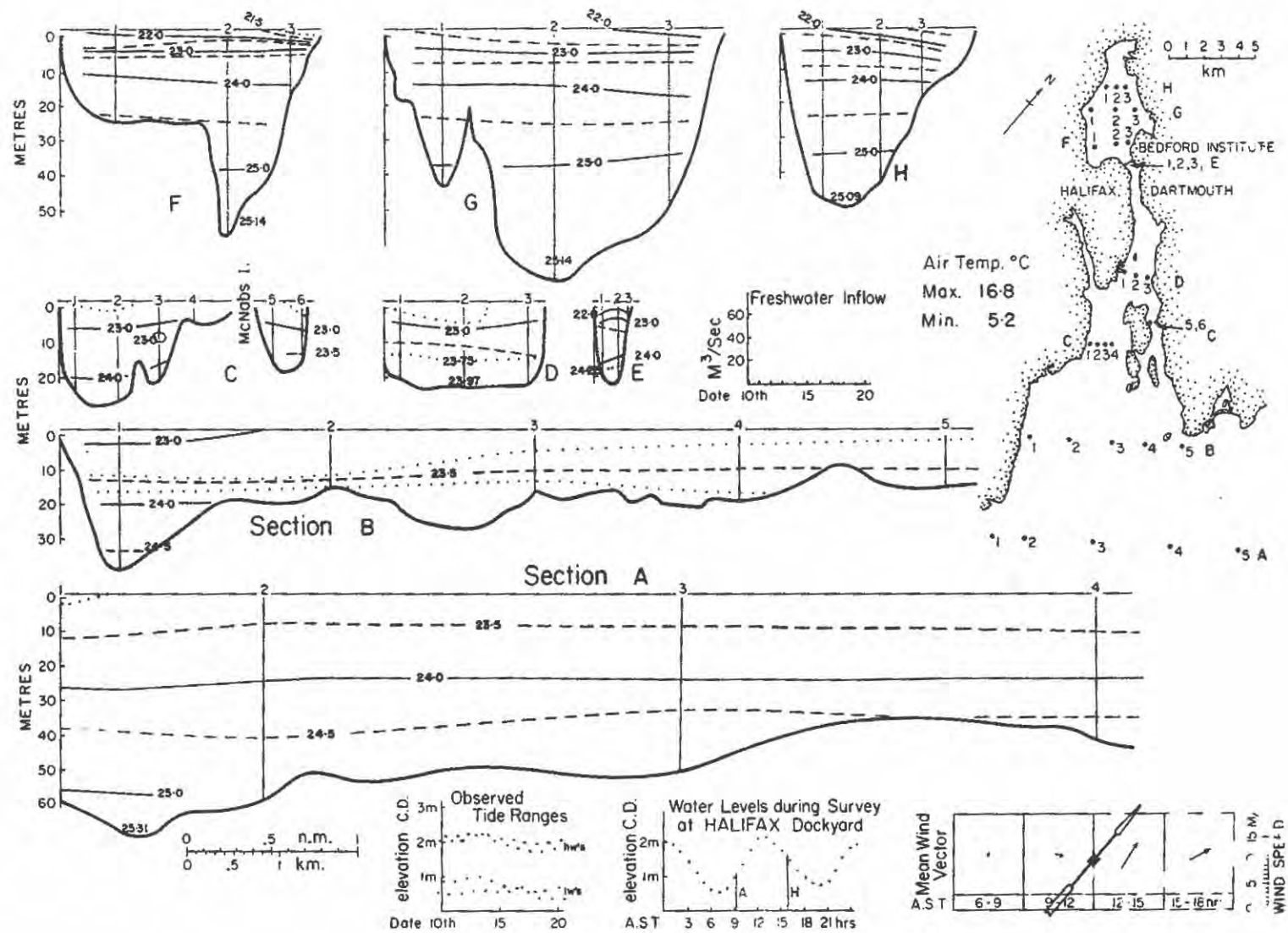


FIGURE 23(c): Density for 15 June 1971.

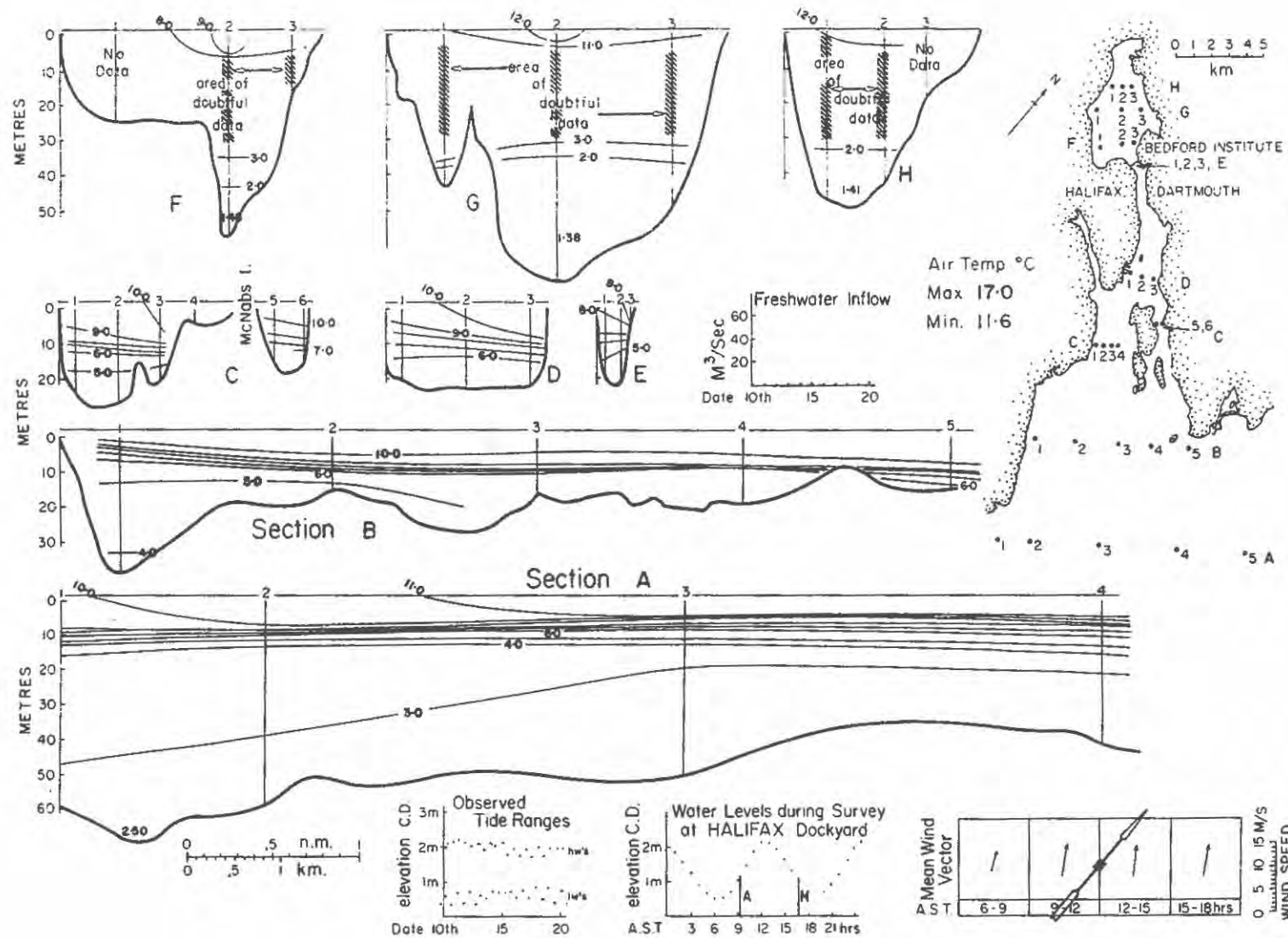


FIGURE 24(a): Temperature for 14 July 1971.

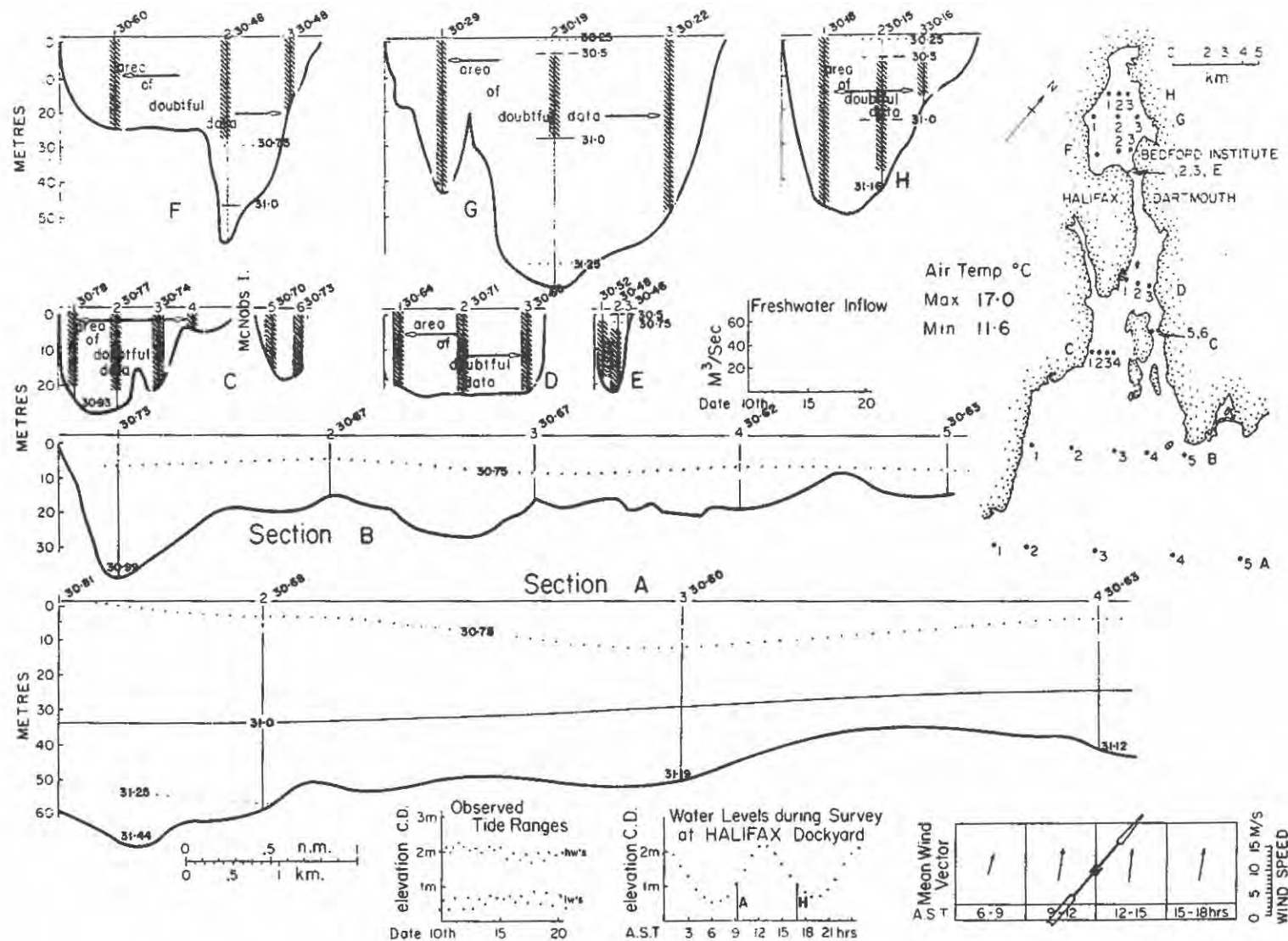


FIGURE 24(b): Salinity ‰ for 14 July 1971.

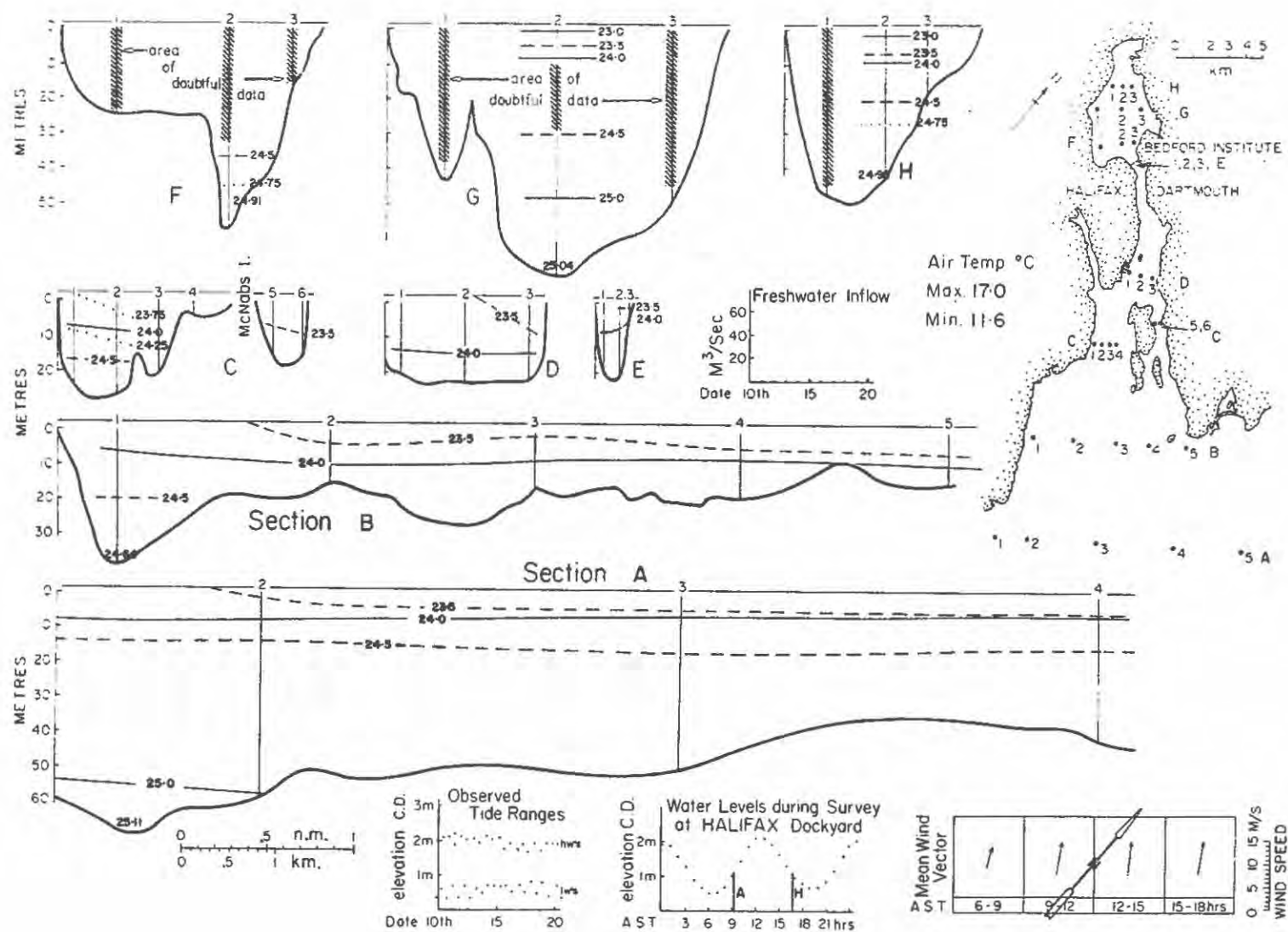


FIGURE 24(c): Density for 14 July 1971.

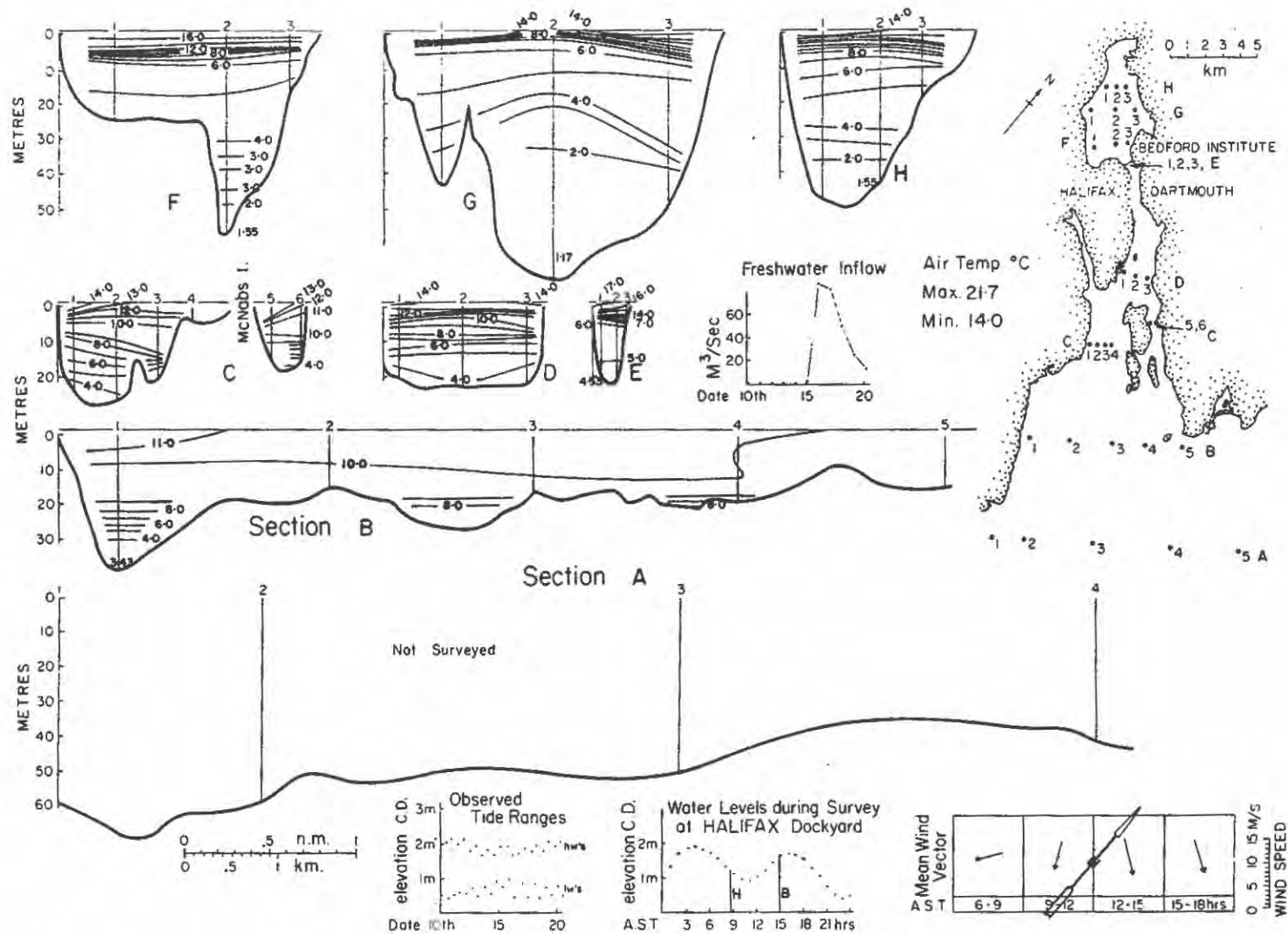


FIGURE 25(a): Temperature for 16 August 1971.

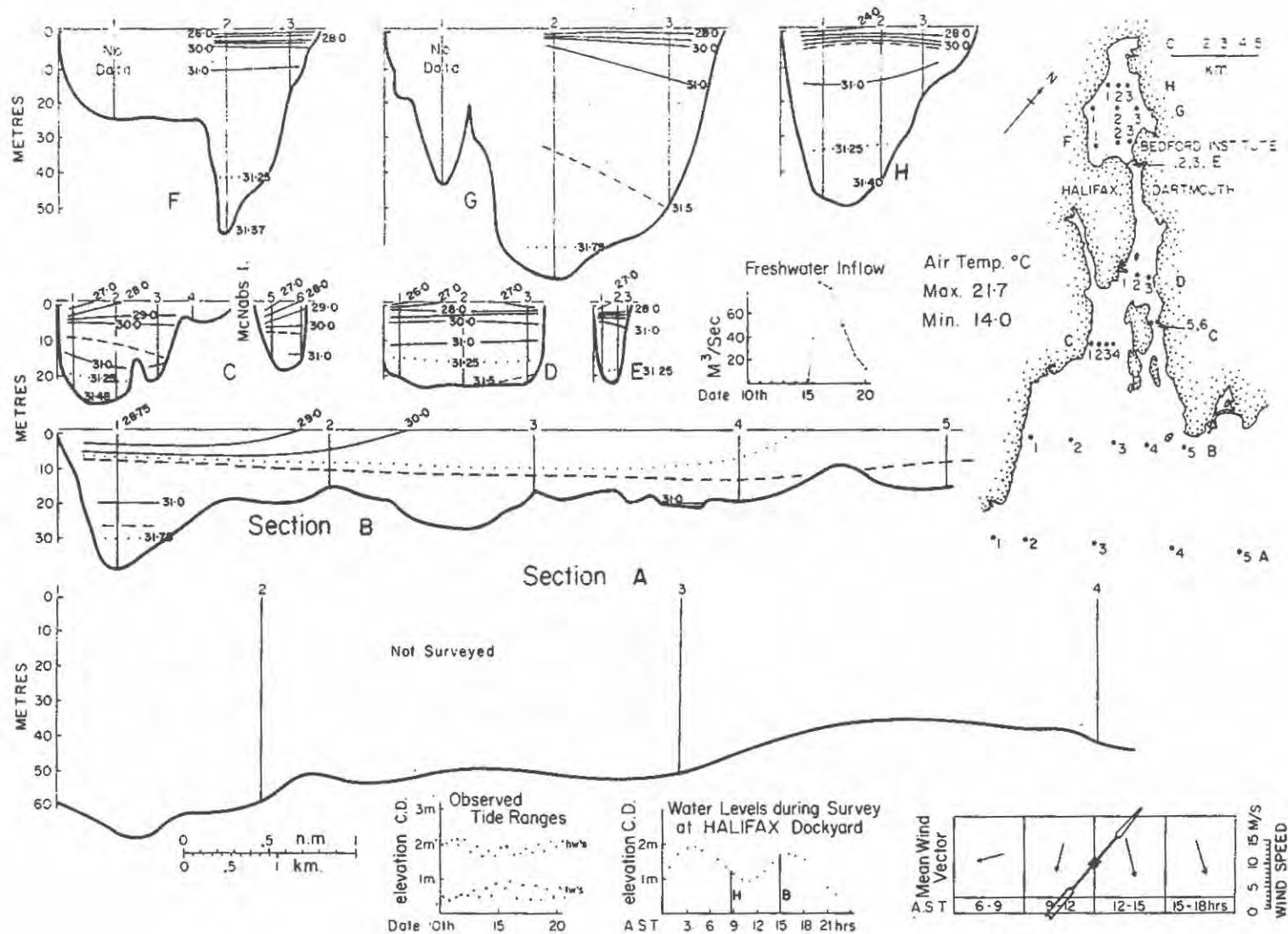


FIGURE 25(b): Salinity ‰ for 15 August 1971.

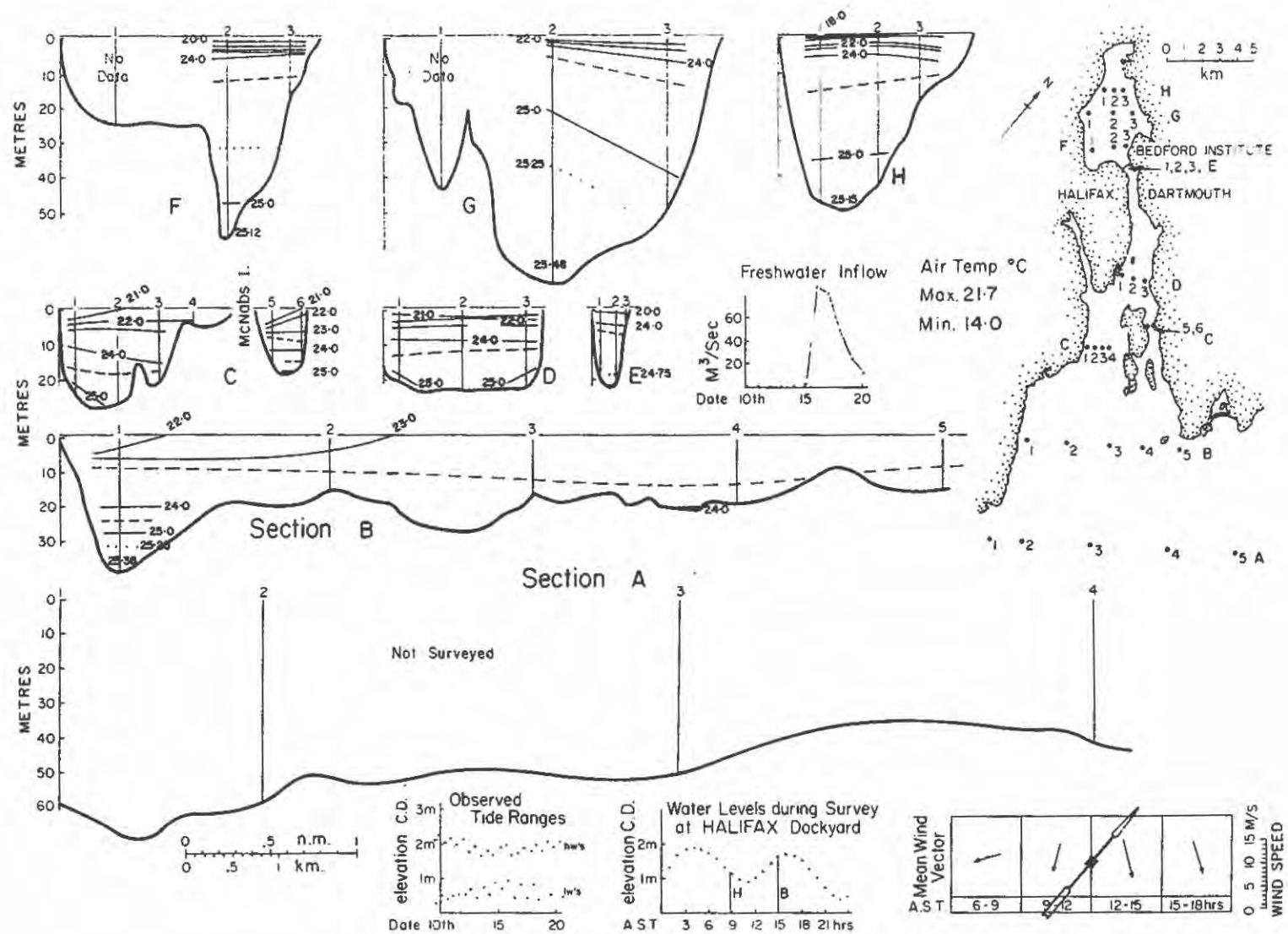


FIGURE 25(c): Density for 16 August 1971.

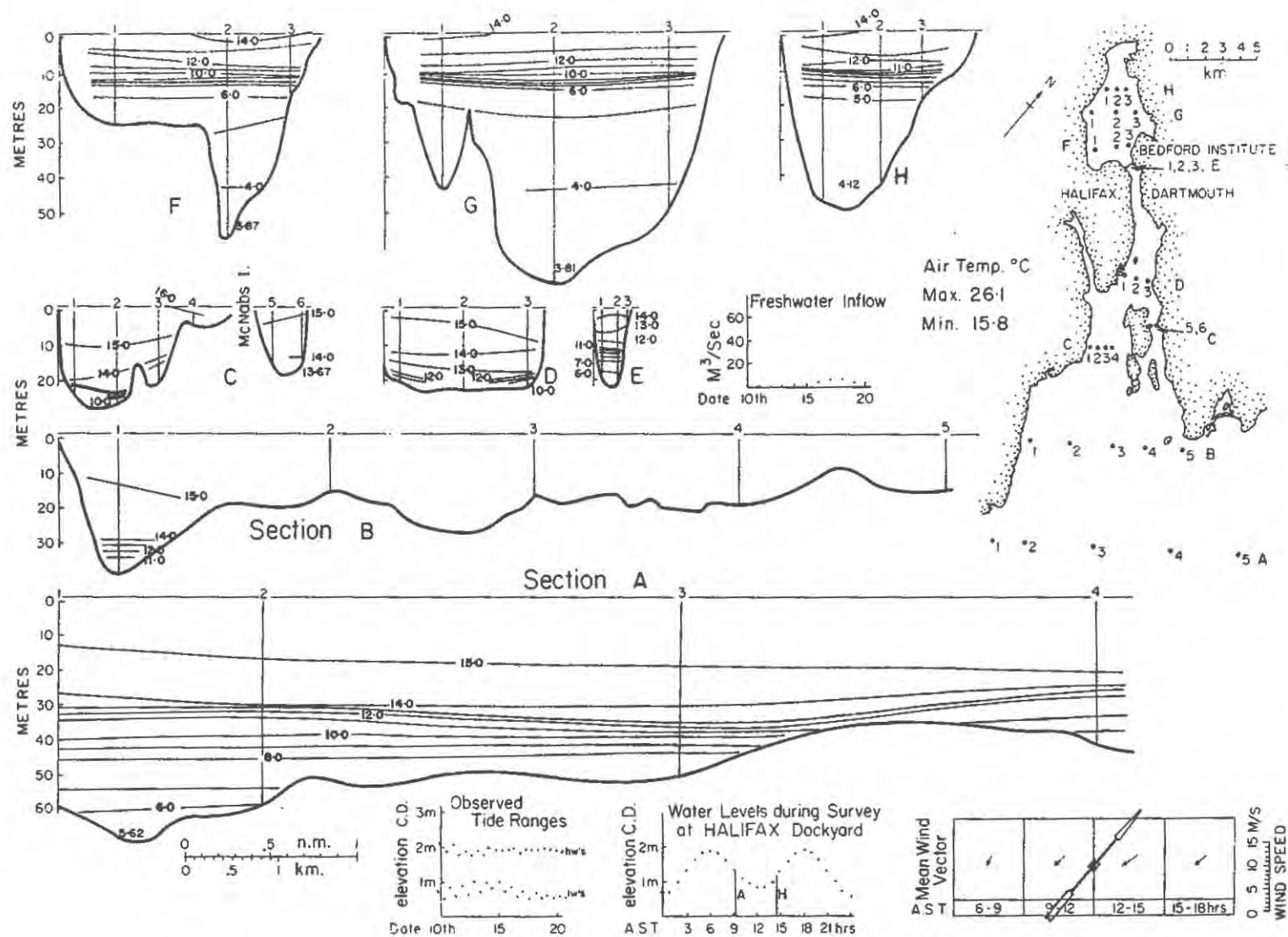


FIGURE 26 (a): Temperature for 16 September 1971.

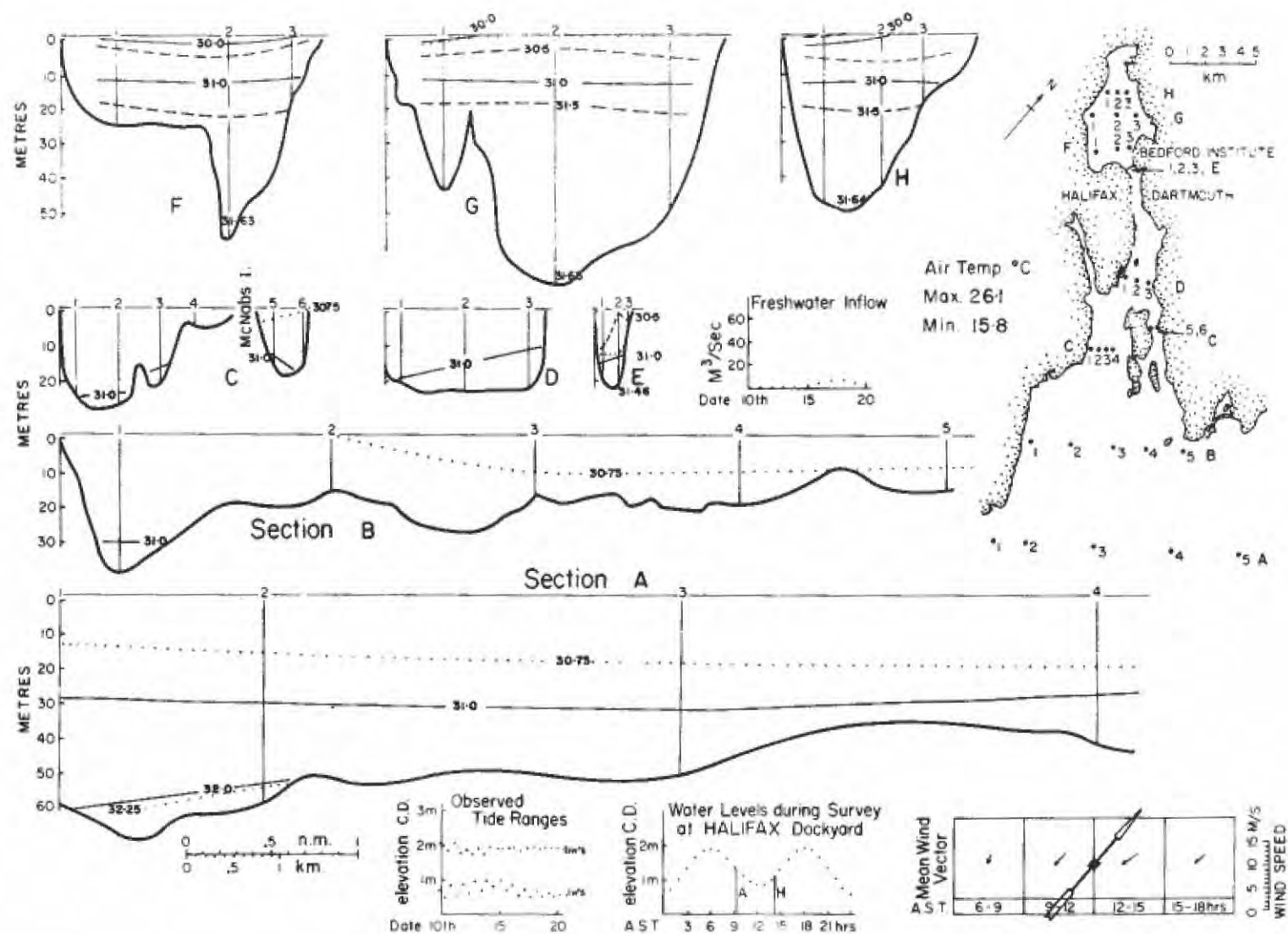


FIGURE 26(b): Salinity ‰ for 16 September 1971.

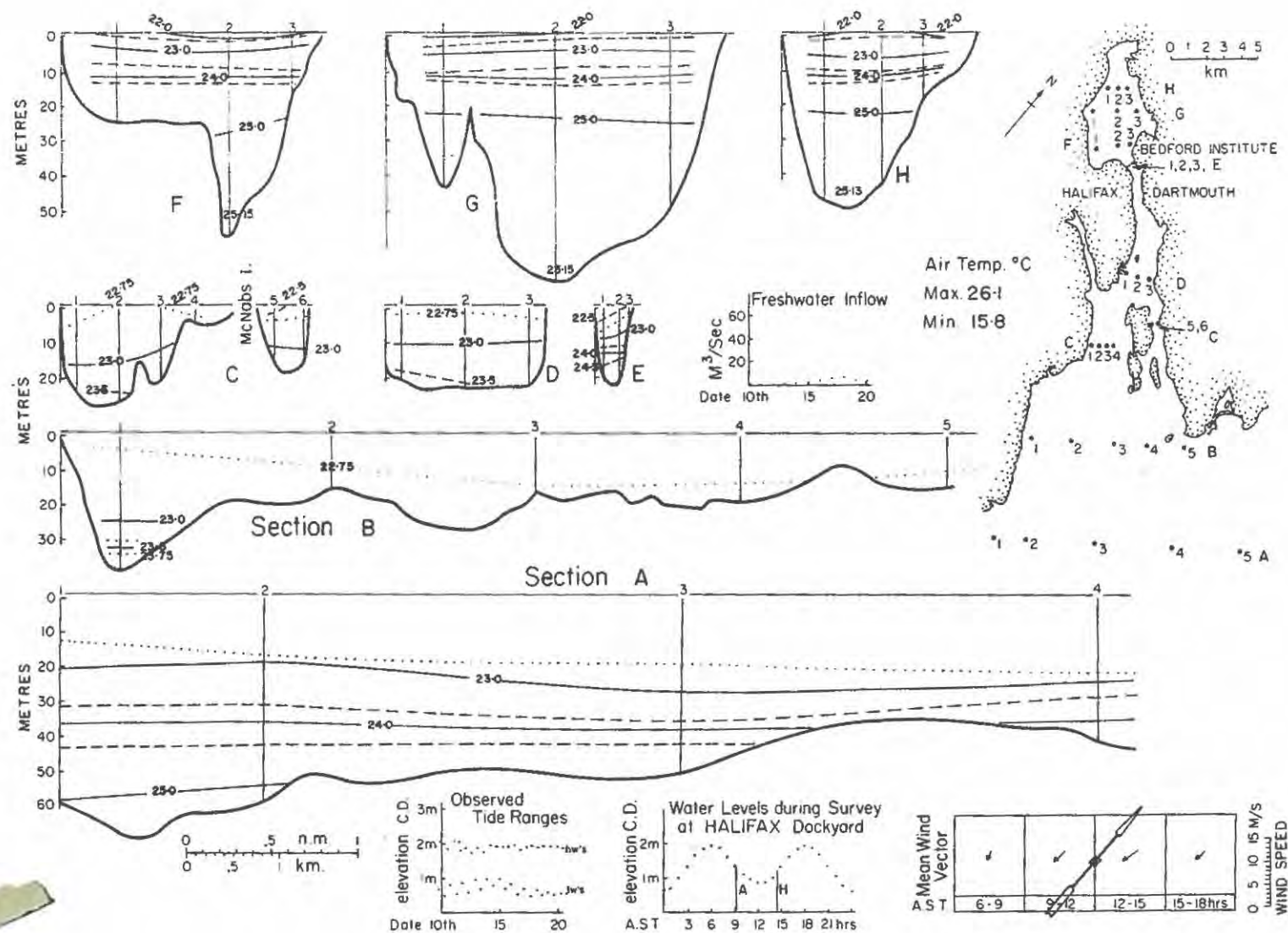


FIGURE 26(c): Density for 16 September 1971.