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Variations in salinity and temperature during a tidal cycle in western Long Island Sound

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Approved for Distribution

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INTRODUCTION

To aid in the interpretation of CTD data collected during the EPA Estuary Program's Long Island Sound Study, temperature and salinity profiles were made during a tidal cycle at three stations along the axis of the Sound on 28 June, 1989.

METHODS

In the western Sound, measurements were made near the Throgs Neck Bridge at a station designated A2M in the Long Island Sound Study (40° 48′ 00" N; 73° 47′02" W). The New York DEP collected CTD data at station A2M, Throgs Neck, which was located by sightings to shore points, so the CTD casts were not in the same spot every time a cast was made. The second station was between Eatons Neck on Long Island Sound and Norwalk Islands in Connecticut, approximately 1/3 mile south of the Long Island Sound Study's station D3M at approximately 40° 58′ 06" N; 73° 23′07" W. Similar measurements were made simultaneously at a station in the eastern Sound by the Marine Science Institute of the University of Connecticut under the direction of Dr. W. Frank Bohlen. CTD casts were taken approximately every hour at A2M and every half hour at D3M. Data recording started simultaneously at both stations at 0730 EDT. Unfortunately, data collected at station D3M before 1000 and after 1430 was lost due to computer failure. Seas and wind were calm during the observation period.

Measurements at A2M were made with an Applied Microsystems CTD. At D3M they were made with MSRC's Seabird Seacat CTD. Calibrations and an intercomparison of these instruments are presented in MSRC Working Paper #34 (Bokuniewicz, Muller and Salerno, 1989).

RESULTS

The predicted tidal elevations for both stations are shown in Figure 1. The tide in the western Sound approximates a standing wave so that slack water occurs near times of high and low tides, the maximum tidal currents are relatively low and occur near the time of midtide. There is a persistent estuarine circulation in the western Sound with bottom water flowing westwardly into the East River.

The salinity profiles at Station A2M near the Throgs Neck Bridge are shown in Figures 2a, 2b and 2c, and the temperature profiles in Figures 3a, 3b and 3c. The water column was well mixed and there was little variation over the tidal cycle except for anomalously low salinities recorded at 1311 and 1713. Salinities at these times were about 10 ppt lower than the

salinities measured at other times. There was no corresponding temperature anomaly. The casts were repeated (Figures 4a and 4b) and it appeared that the two events were due to the advection of low salinity water past the observation boat; they were short lived and not obviously related to the phase of tide. Similar low-salinity water was occasionally found at survey stations routinely occupied for the Long Island Sound Study.

The salinity and temperature profiles near station D3M are shown in Figures 5a, b and 6a, b, respectively. A pycnocline was found at a depth of about 6 m. The depth of the pycnocline seemed to increase slowly as the tide passed through low water and then to increase quickly between 1300 and 1330 to a depth of about 14 m. Both the temperature and salinity structure changed simultaneously (Figures 7 and 8). .

CONCLUSION

The water column salinity and temperature was not modulated by the stage of the tide. Large, rapid changes occurred, however, as different water masses were advected past the stations. It may be that injections of fresher water from the numerous bays along the shore in the western Sound dominate the short-term changes in salinity.

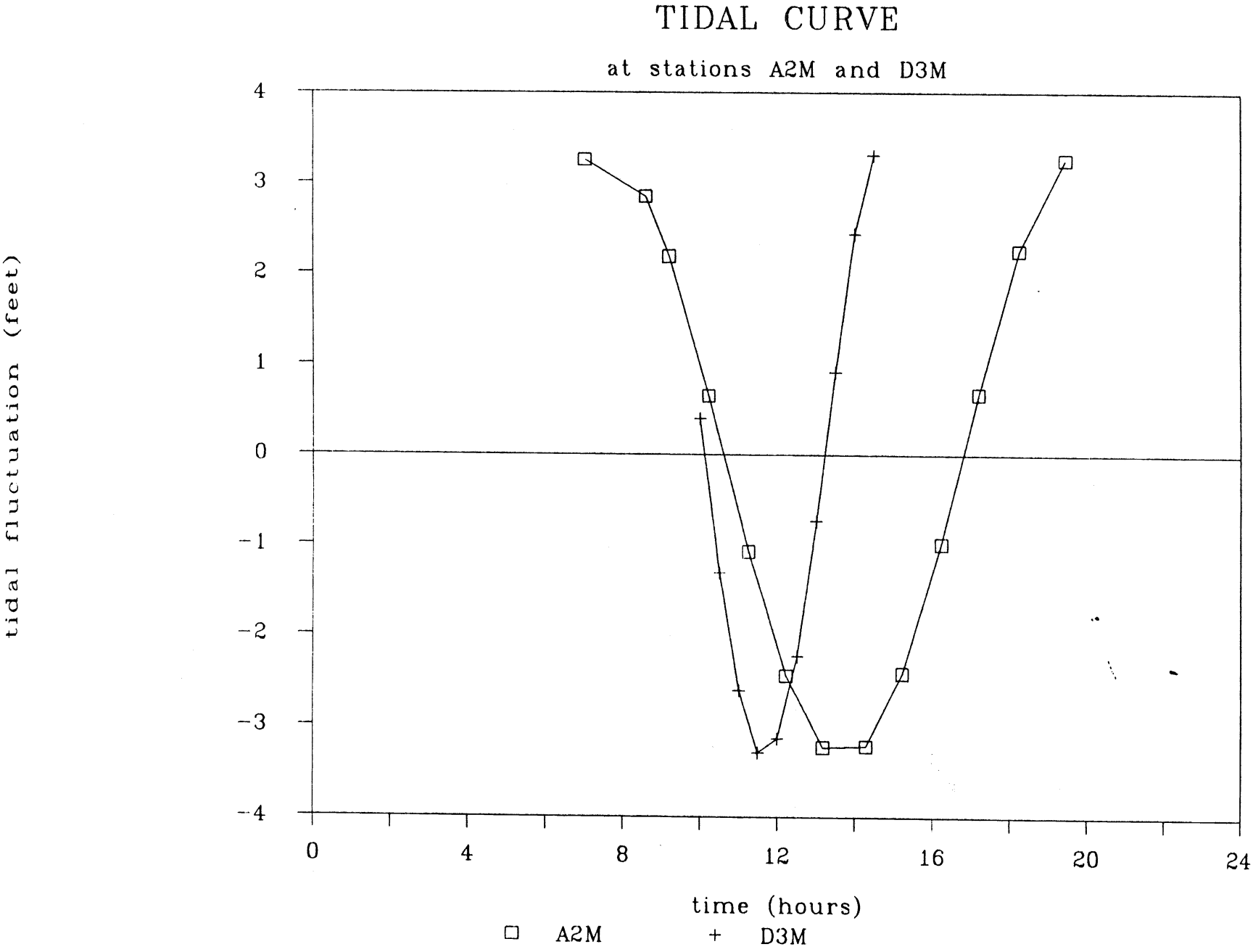

TIDAL CURVE
at stations A2M and D3M
tidal fluctuation (feet)
4
3
2
1
0
-1
-2
-3
-4
0
4
8
12
16
20
24
time (hours)
A2M
D3M

Figure 1

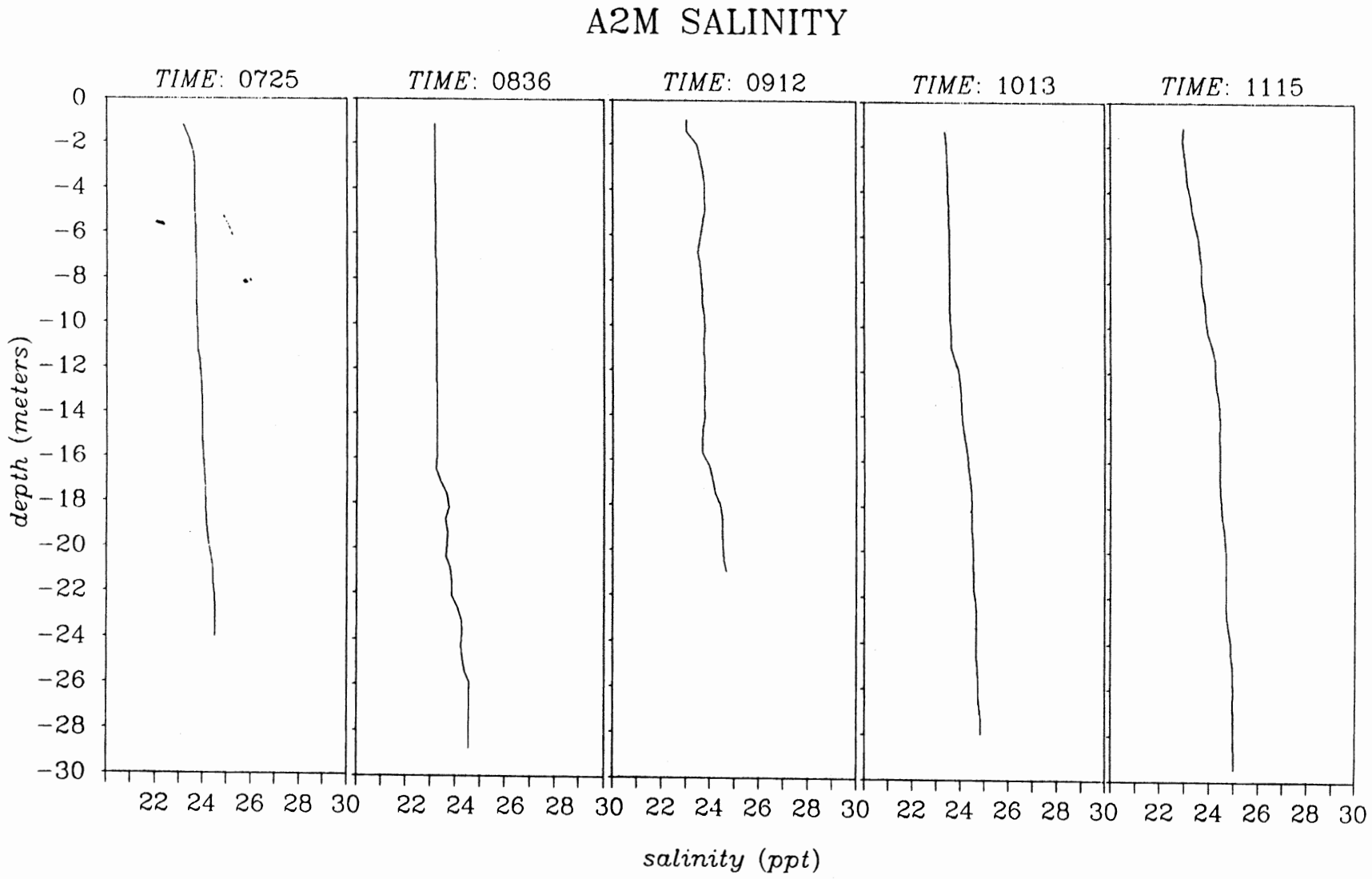

A2M SALINITY
TIME: 0725
TIME: 0836
TIME: 0912
TIME: 1013
TIME: 1115
depth (meters)
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
-30
22 24 26 28 30
salinity (ppt)

Figure 2a

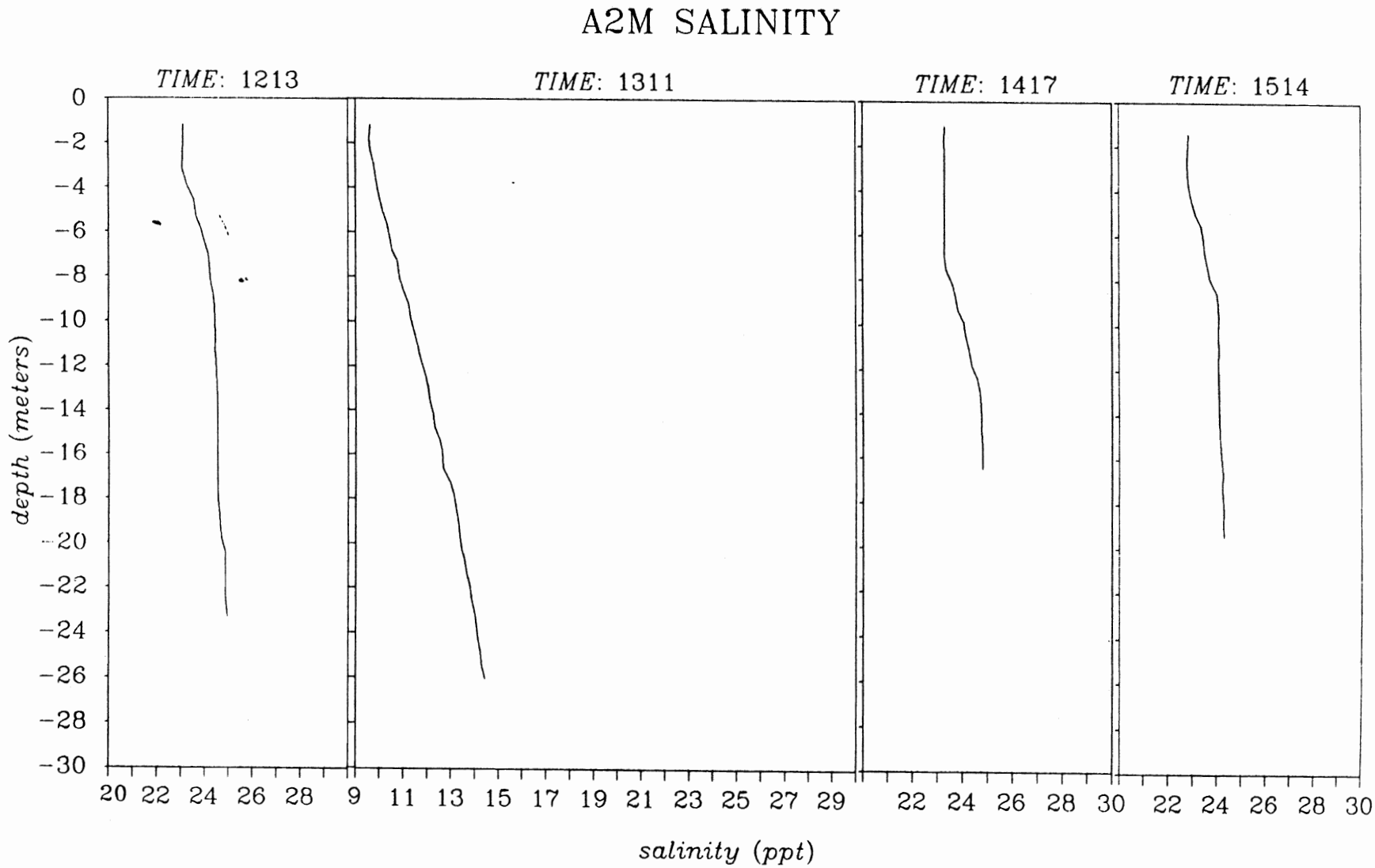

A2M SALINITY
TIME: 1213
TIME: 1311
TIME: 1417
TIME: 1514
depth (meters)
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
-30
20 22 24 26 28
9 11 13 15 17 19 21 23 25 27 29
22 24 26 28 30
22 24 26 28 30
salinity (ppt)

Figure 2b

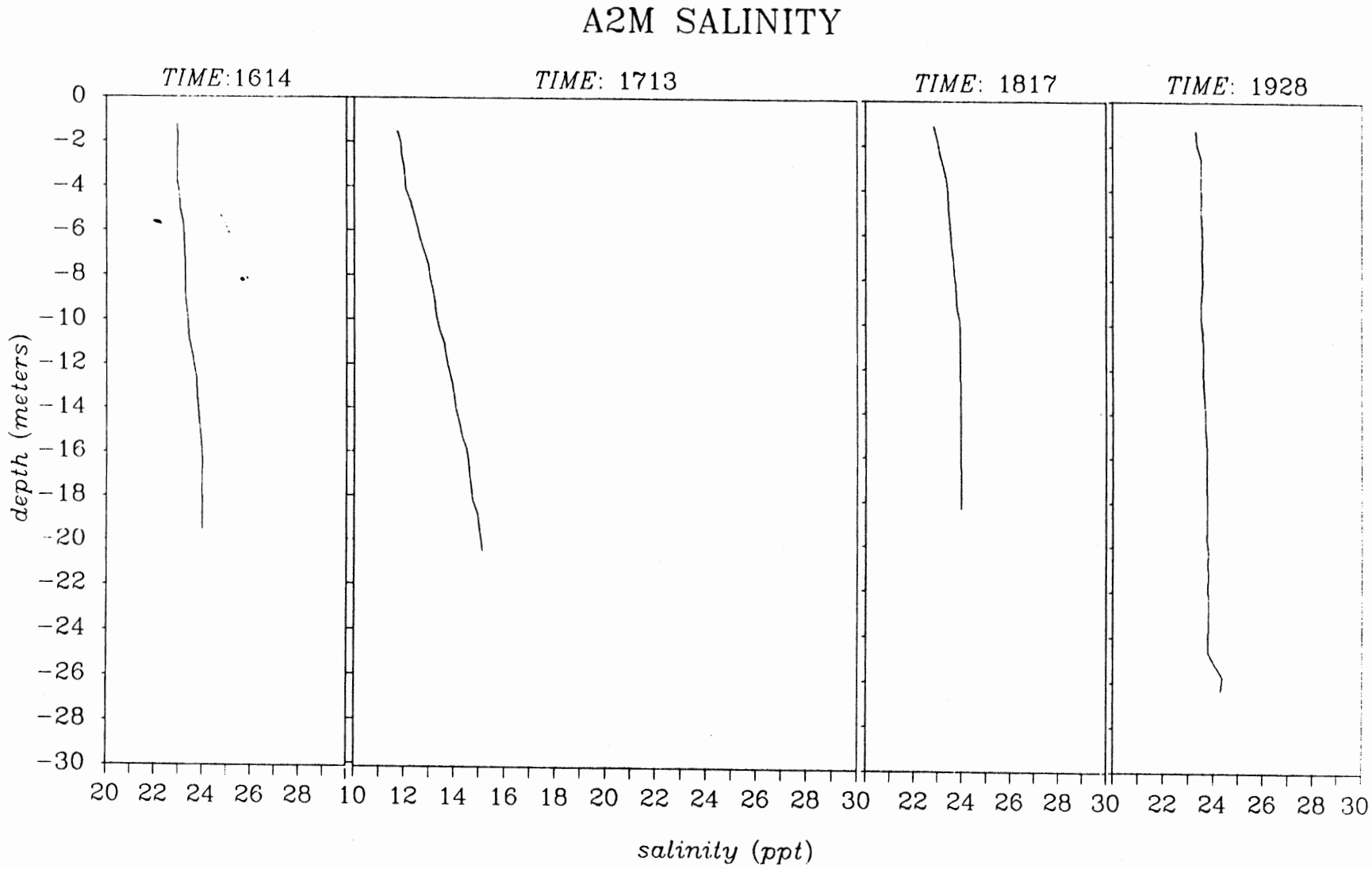

A2M SALINITY
TIME: 1614
TIME: 1713
TIME: 1817
TIME: 1928
depth (meters)
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
-30
20 22 24 26 28
10 12 14 16 18 20 22 24 26 28 30
22 24 26 28 30
22 24 26 28 30
salinity (ppt)

Figure 2c

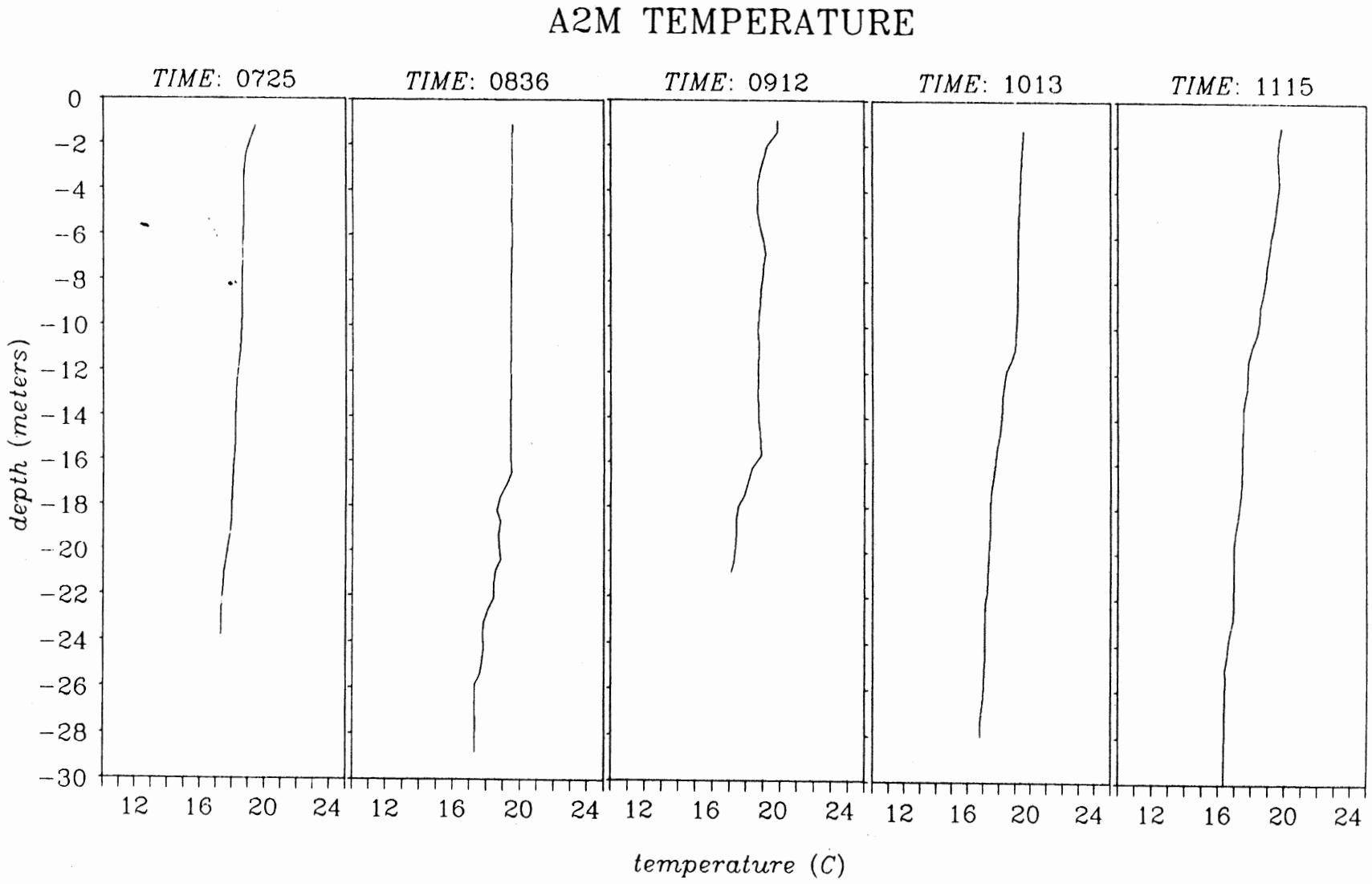

A2M TEMPERATURE
TIME: 0725
TIME: 0836
TIME: 0912
TIME: 1013
TIME: 1115
depth (meters)
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
-30
12
16
20
24
temperature (C)

Figure 3a

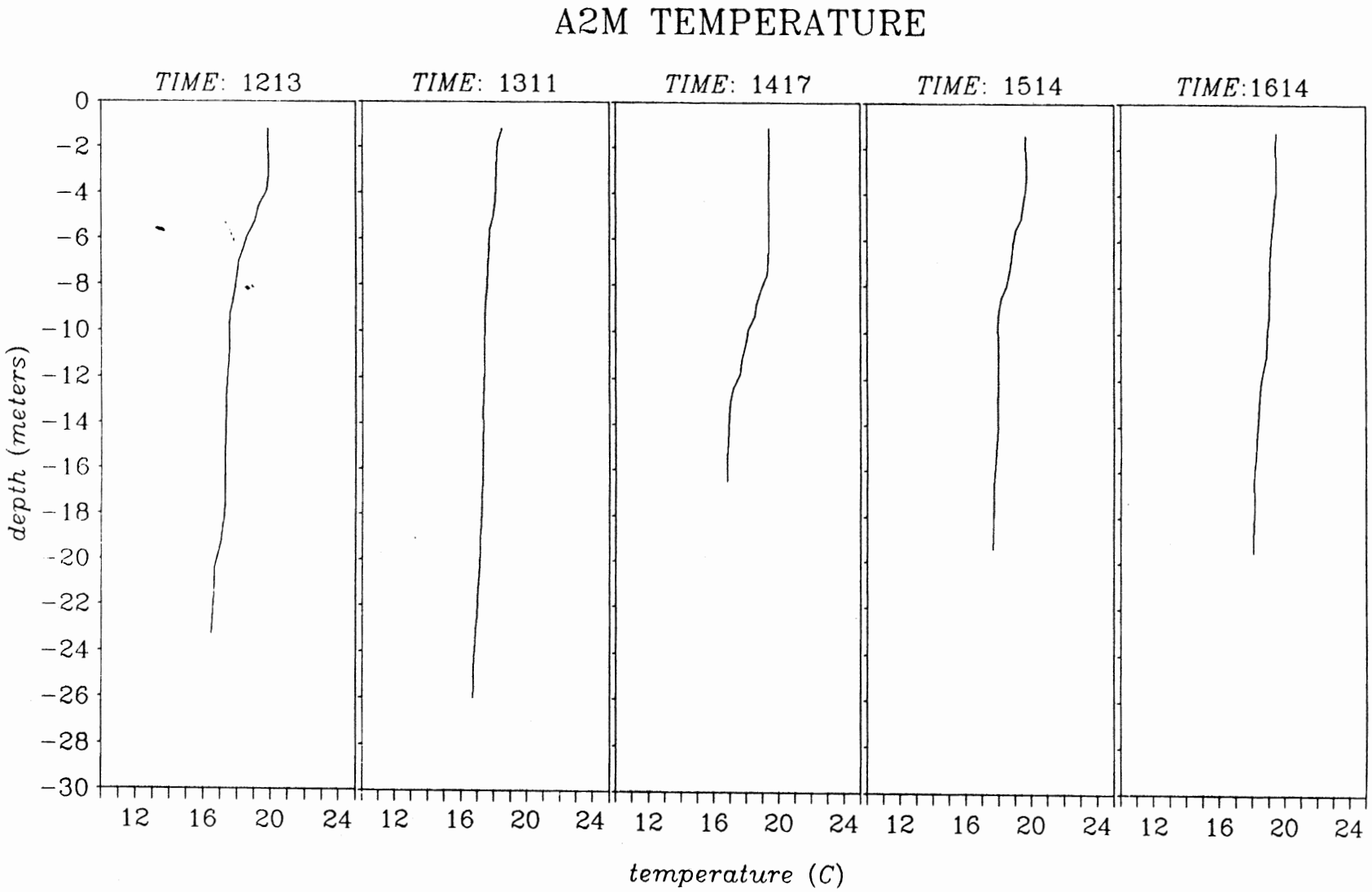

A2M TEMPERATURE
TIME: 1213
TIME: 1311
TIME: 1417
TIME: 1514
TIME:1614
depth (meters)
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
-30
12
16
20
24
temperature (C)

Figure 3b

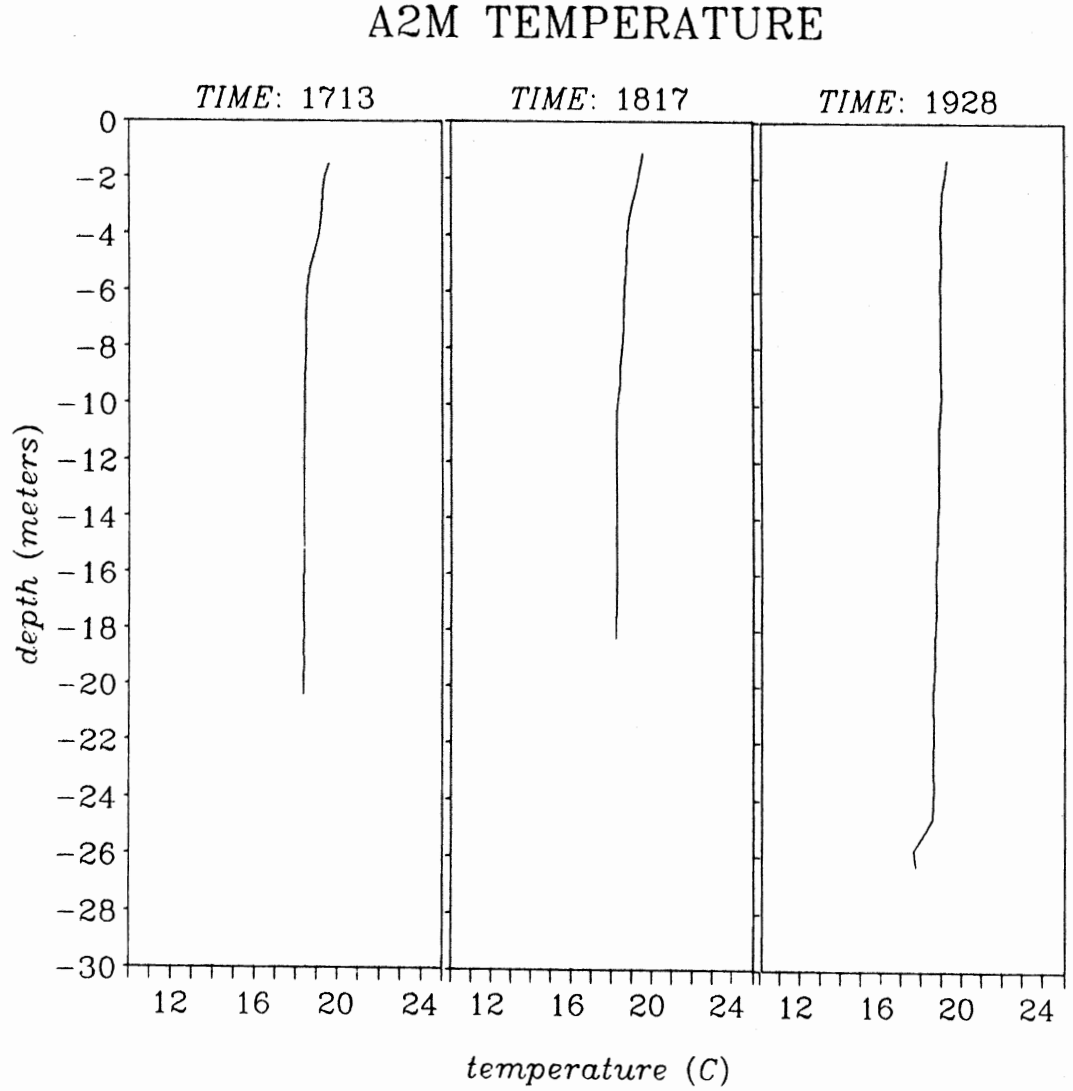

A2M TEMPERATURE
TIME: 1713
TIME: 1817
TIME: 1928
depth (meters)
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
-30
12
16
20
24
temperature (C)

Figure 2.

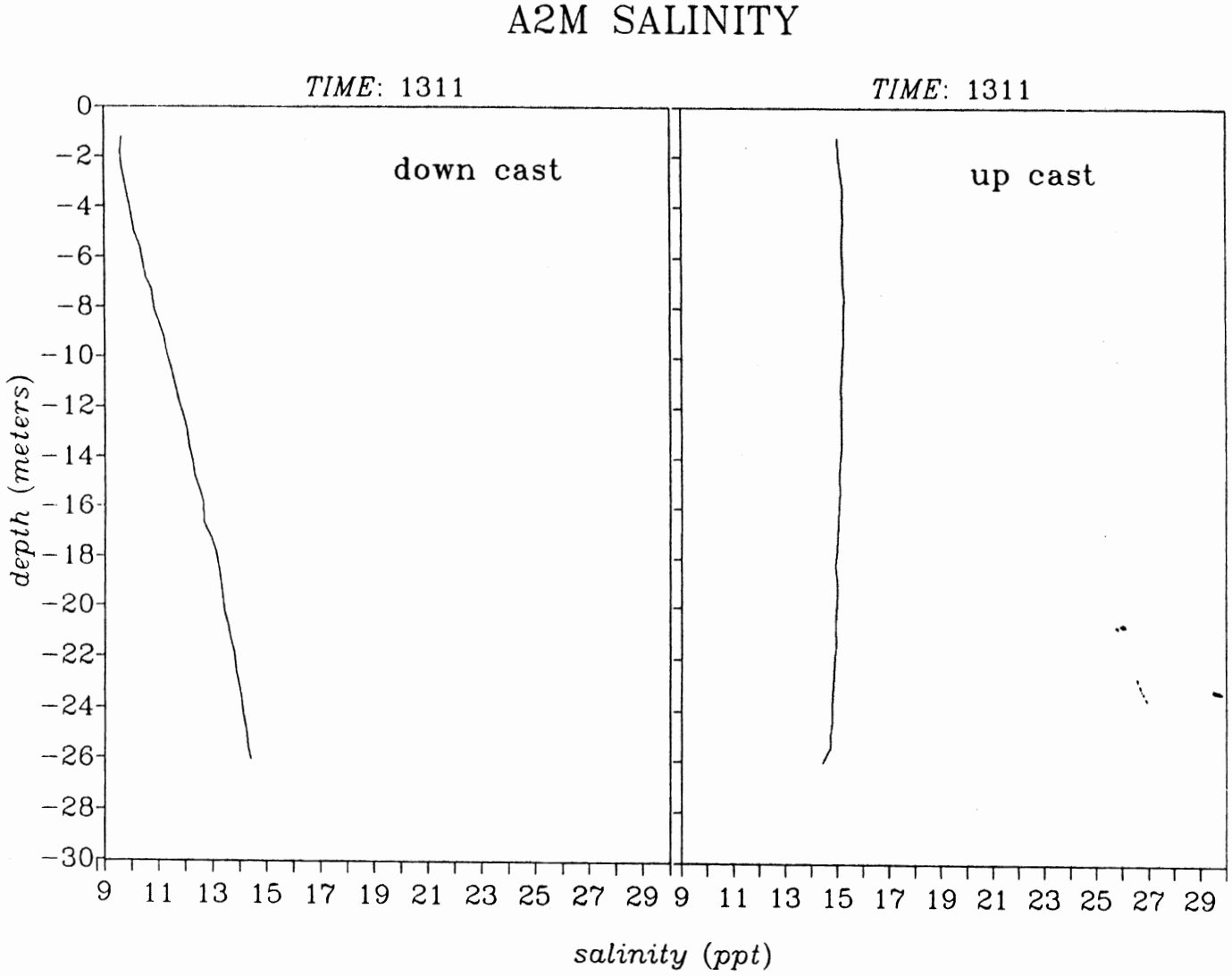

A2M SALINITY
TIME: 1311
down cast
TIME: 1311
up cast
depth (meters)
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
-30
9 11 13 15 17 19 21 23 25 27 29
9 11 13 15 17 19 21 23 25 27 29
salinity (ppt)

Figure 4a

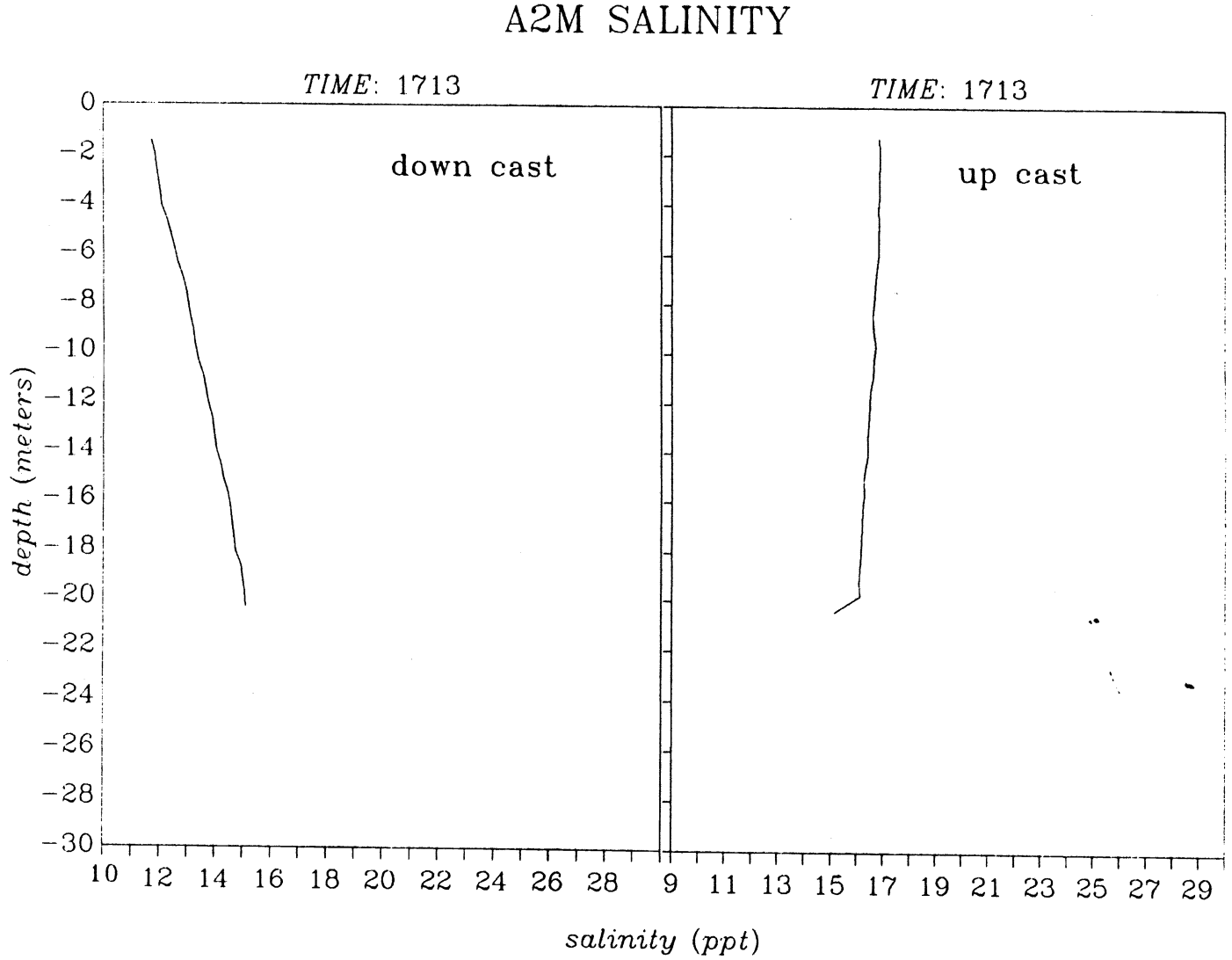

A2M SALINITY
TIME: 1713
down cast
TIME: 1713
up cast
depth (meters)
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
-30
10 12 14 16 18 20 22 24 26 28
9 11 13 15 17 19 21 23 25 27 29
salinity (ppt)

Figure 4b

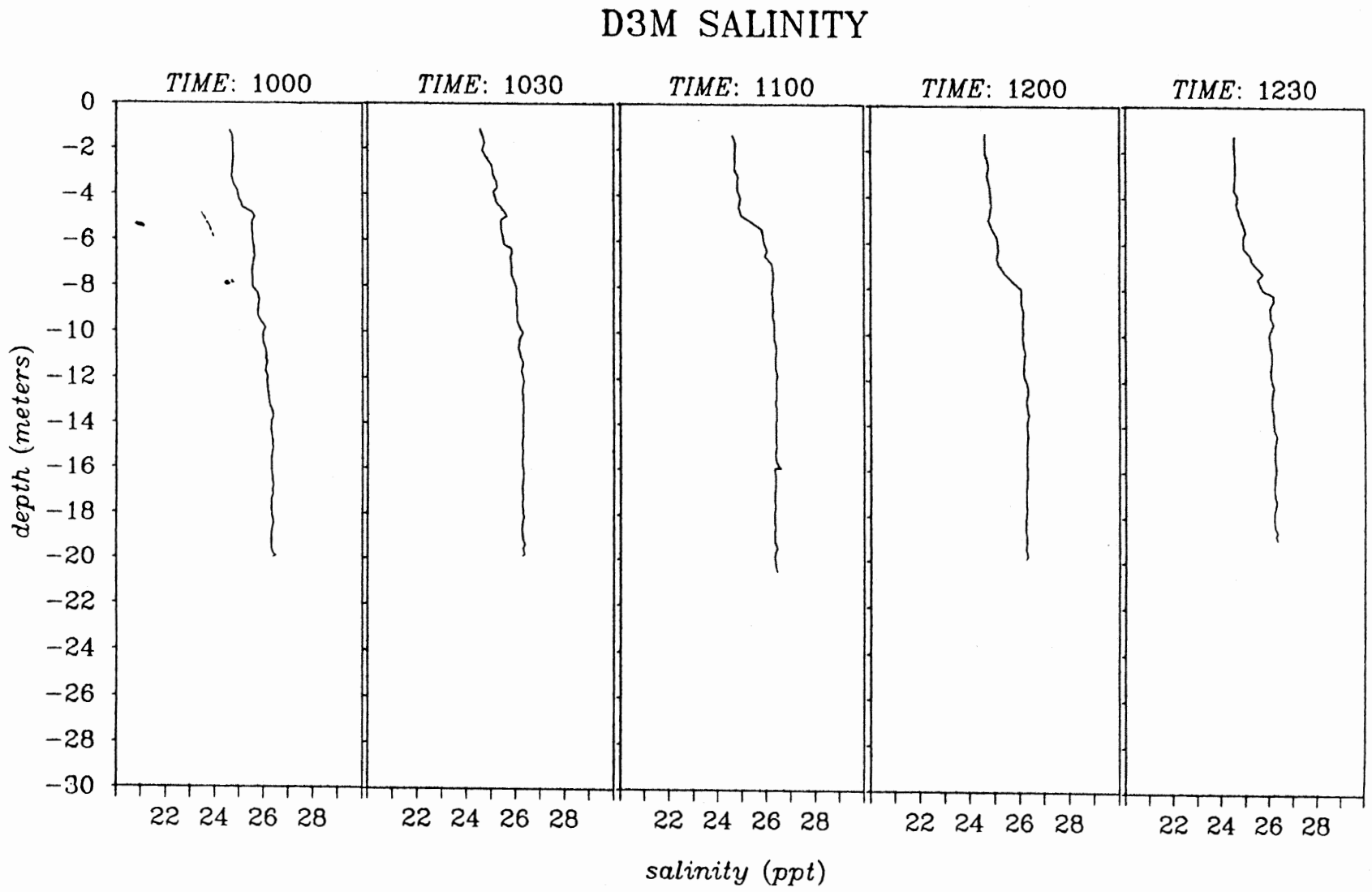

D3M SALINITY
TIME: 1000
TIME: 1030
TIME: 1100
TIME: 1200
TIME: 1230
depth (meters)
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
-30
22 24 26 28
salinity (ppt)

Figure 5a

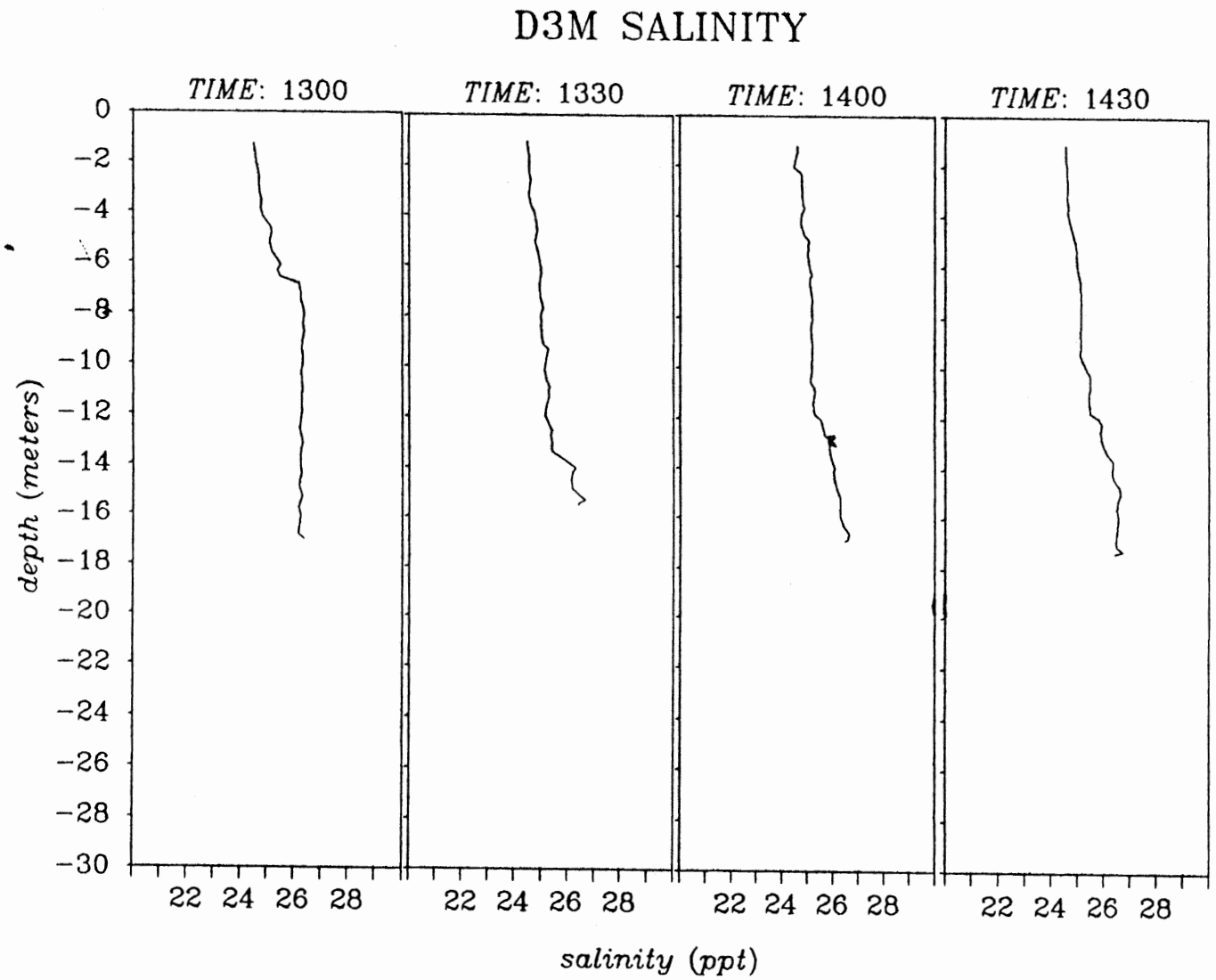

D3M SALINITY
TIME: 1300
TIME: 1330
TIME: 1400
TIME: 1430
depth (meters)
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
-30
22 24 26 28
22 24 26 28
22 24 26 28
22 24 26 28
salinity (ppt)

Figure 5b

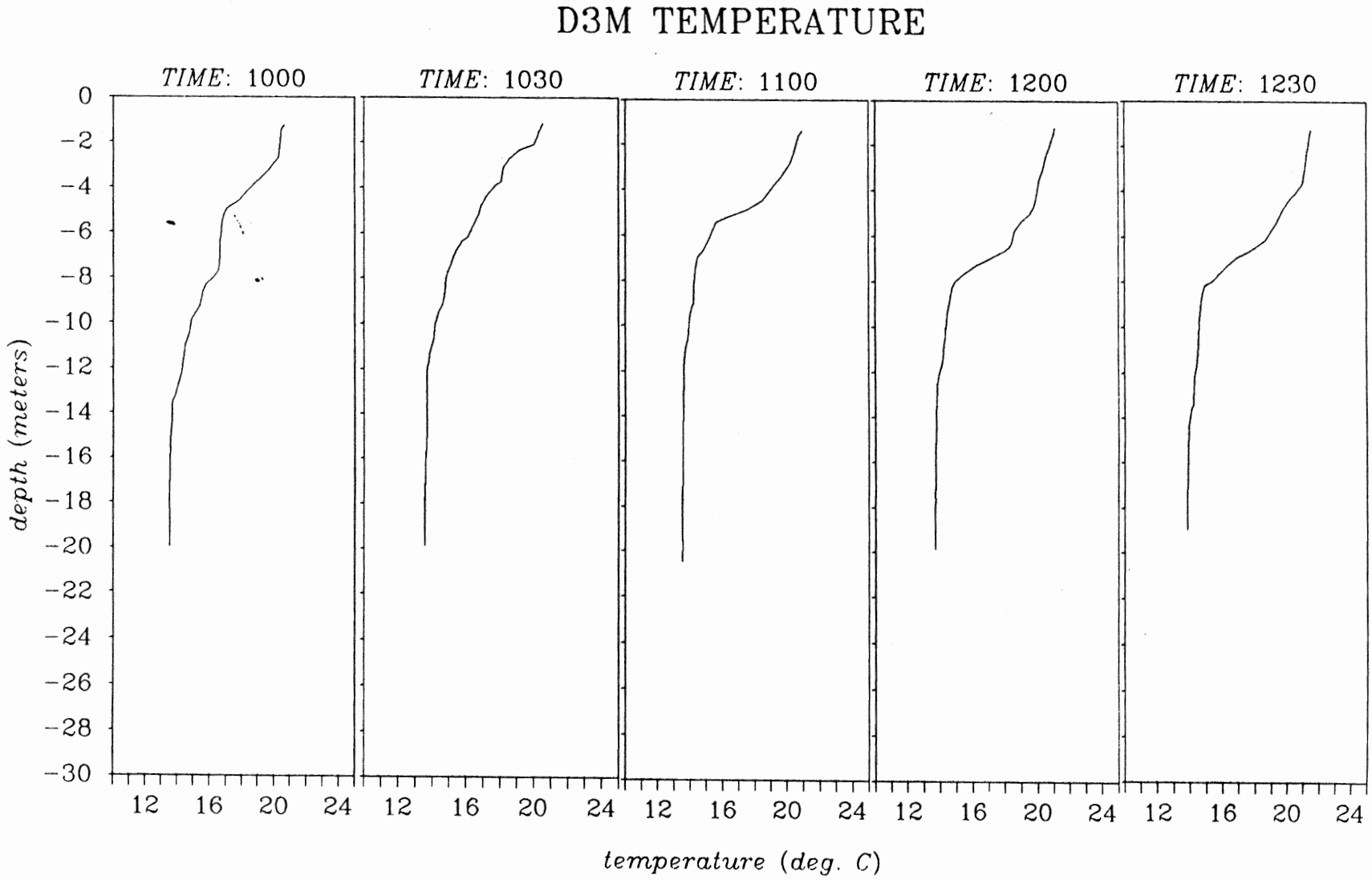

D3M TEMPERATURE
TIME: 1000
TIME: 1030
TIME: 1100
TIME: 1200
TIME: 1230
depth (meters)
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
-30
12
16
20
24
temperature (deg. C)

Figure 6a

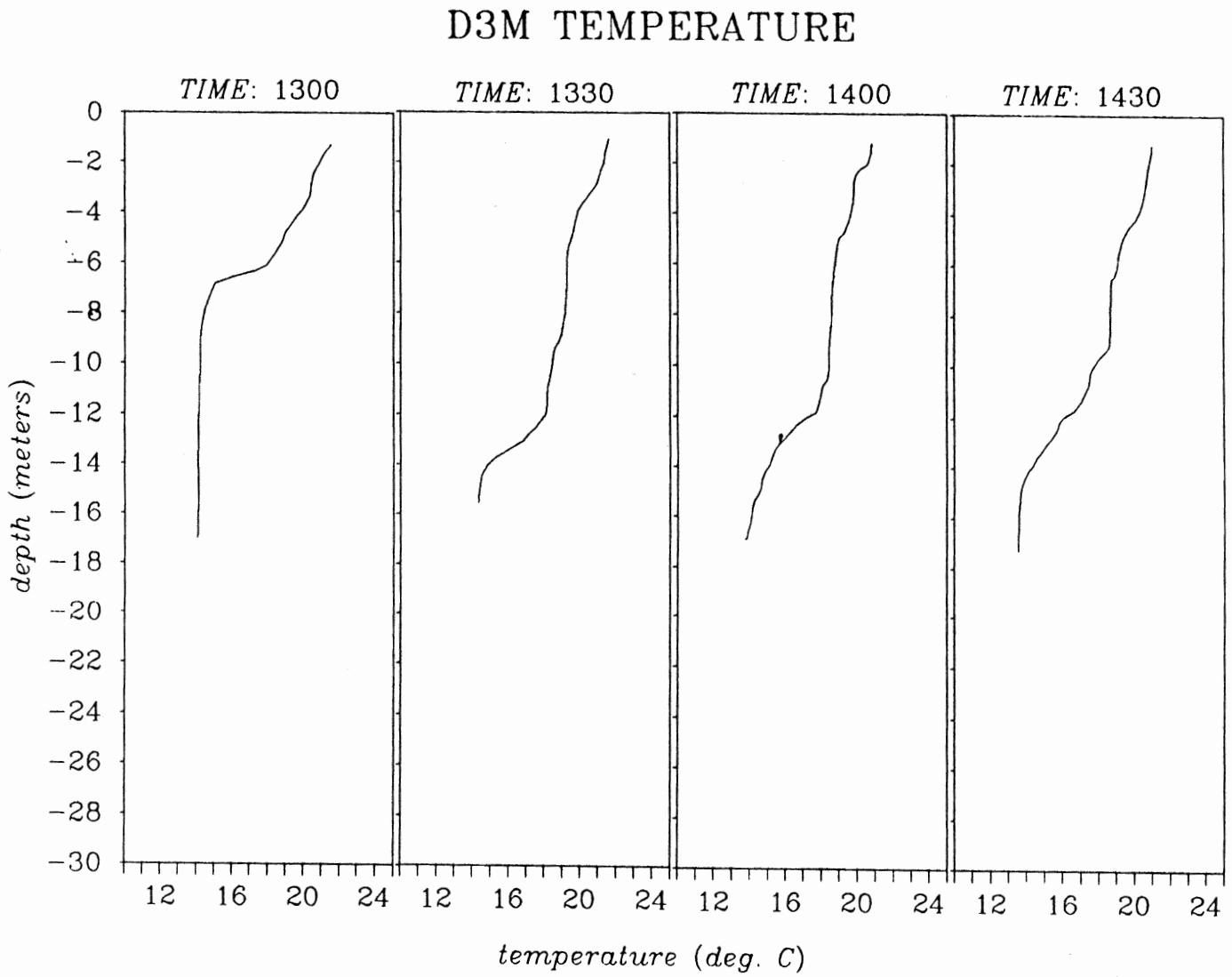

D3M TEMPERATURE
TIME: 1300
TIME: 1330
TIME: 1400
TIME: 1430
depth (meters)
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
-30
12
16
20
24
temperature (deg. C)

Figure 6b

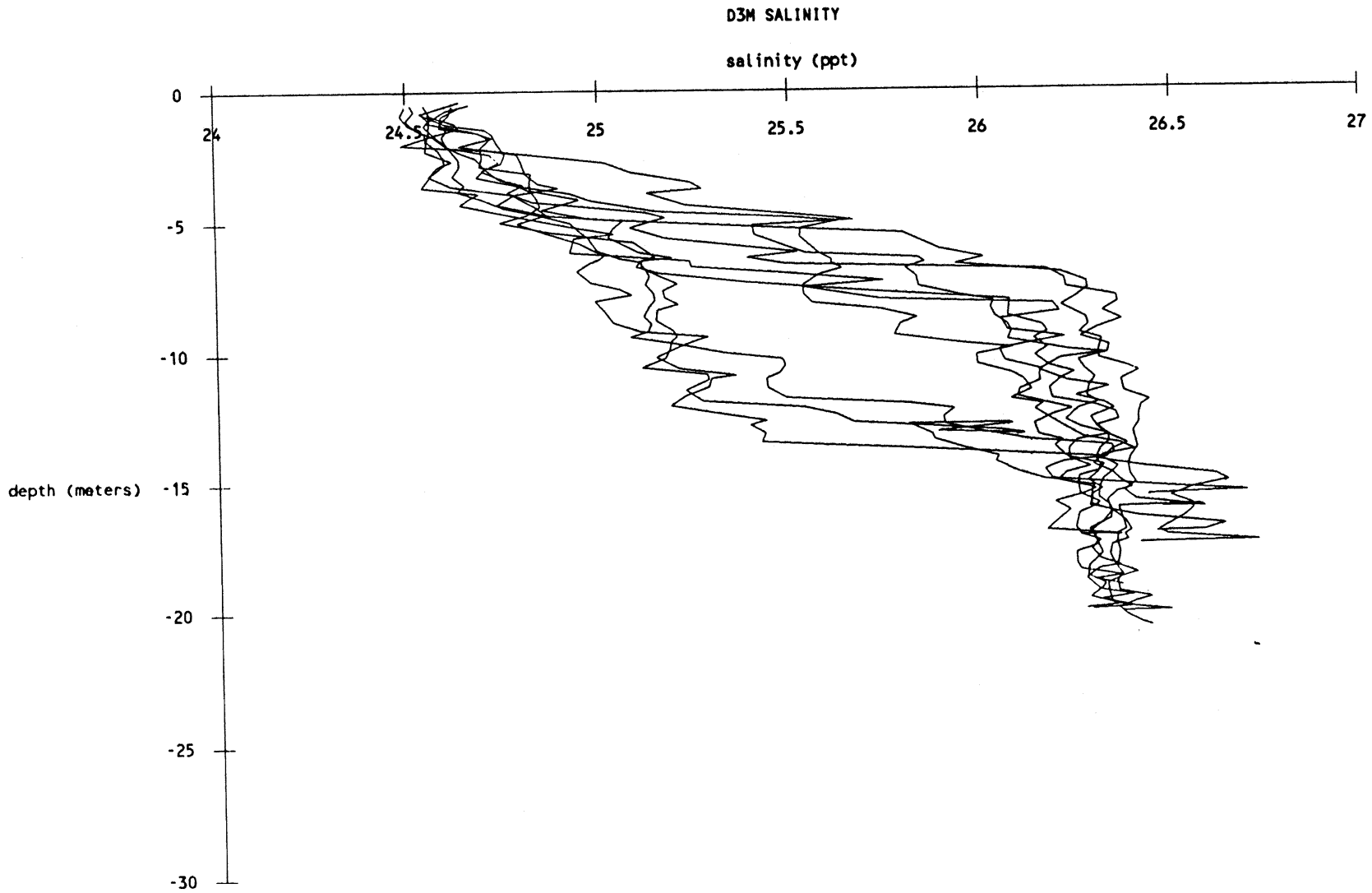
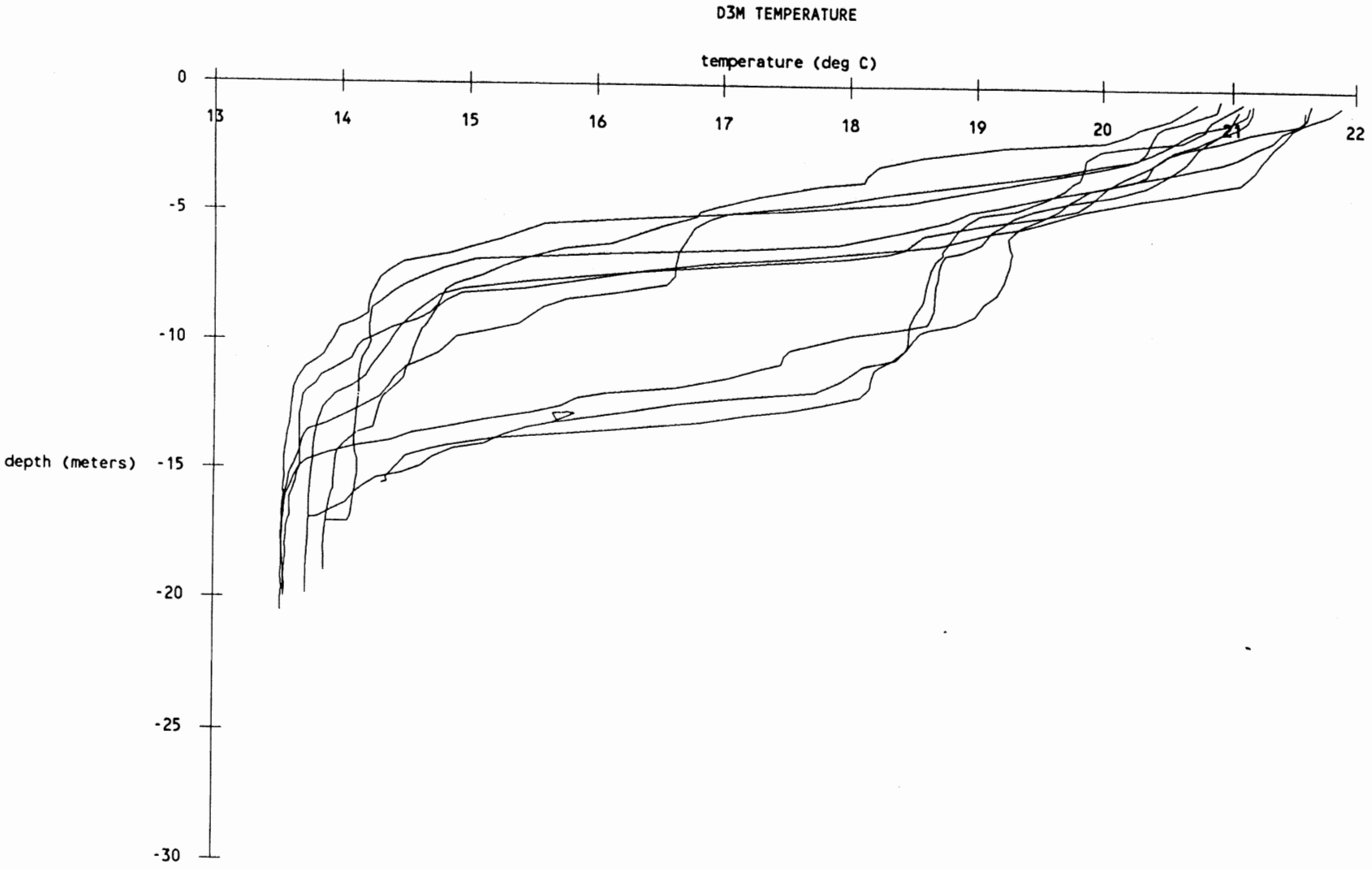
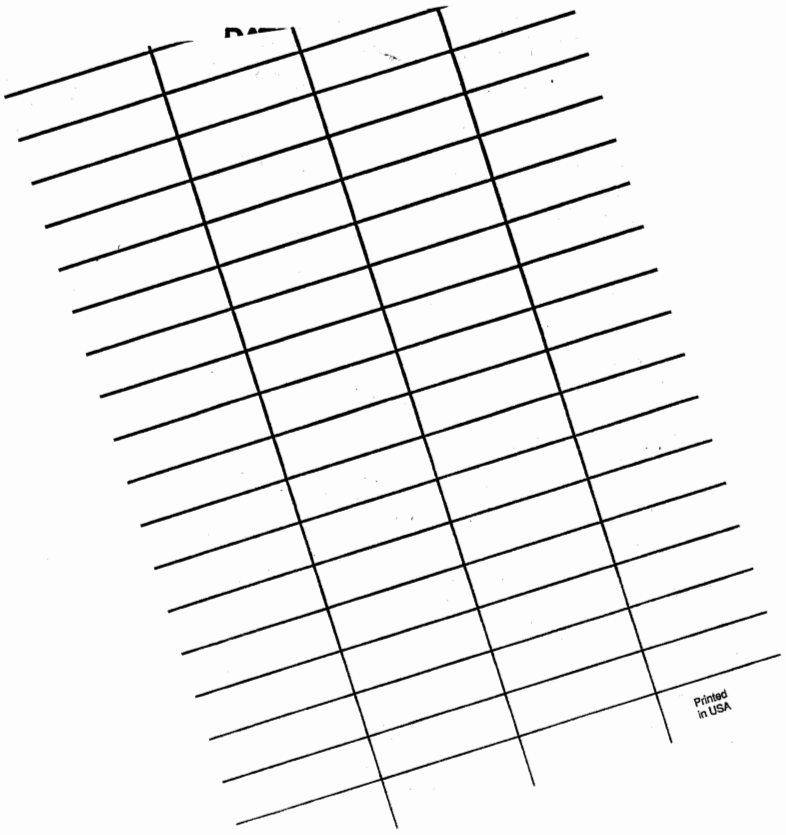

D3M SALINITY
salinity (ppt)
0
24
24.5
25
25.5
26
26.5
27
-5
-10
depth (meters)
-15
-20
-25
-30

Figure 7


D3M TEMPERATURE
temperature (deg C)
13
14
15
16
17
18
19
20
21
22
0
-5
-10
-15
-20
-25
-30
depth (meters)



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