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Expendable Bathythermograph (XBT) Measurements in the Western Alboran Sea, October 1982

¿DONDE VA?

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ABSTRACT

USNS BARTLETT dropped 152 expendable bathythermographs (XBT) in the western Alboran Sea during 6-18 October 1982 as part of an international oceanographic research project entitled ¿Donde Va?. The XBT data were taken to obtain synoptic temperature sections across the inflowing Atlantic Jet and the Alboran Gyre, and in the Strait of Gibraltar. XBT data were also used to increase the resolution of standard hydrographic (CTD: conductivity-temperature-depth profiler) sections. A plot of temperature versus depth for each XBT drop to 200 dbar (temperatures below 200 dbar were nearly constant) is shown.

ACKNOWLEDGMENTS

The officers and crew of USNS BARTLETT (T-AGOR-13), A. Rashkin, Master, enthusiastically supported our work. In addition to Bergin and Kinder, members of the scientific party who contributed to these measurements were Donald Burns, Louis Banchero, Stephen Sova, Richard Myrick, Henry Perkins, Kim Saunders and Ruth Preller. Code 422 CS of the Office of Naval Research, under Dr. Dennis Conlon, funded this work under Program Element 61153N.

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EXPENDABLE BATHYTHERMOGRAPH (XBT) MEASUREMENTS IN THE WESTERN ALBORAN SEA, OCTOBER 1982

1. Introduction. The XBT data reported here comprise a portion of an international scientific investigation of the interactions of mesoscale flow in the Alboran Sea with inflow through the Strait of Gibraltar. The title adopted for the multinational program is ¿Donde Va?; NORDA's portion, sponsored by the Office of Naval Research, is entitled, "Mesoscale Flow Dynamics in the Strait of Gibraltar and Alboran Sea."

The second of two ¿Donde Va? field periods occurred during October 1982 when four ships, four aircraft, shore-based radar, and shore-based meteorological stations cooperated in an intense measurement effort. As one part of this effort USNS BARTLETT dropped 152 expendable bathythermographs (XBT). This note presents the XBT data.

2. Cruise Plan. The cruise plan had six objectives:

- Recovery of five current meter moorings that were deployed in June;
- CTD (conductivity-termperature-depth profiler) and XBT sections across the jet and gyre;
- Velocity profiling sections across the jet and gyre;
- Time-series CTD and velocity profiles to investigate tidal phenomena;
- Obtain meteorological data (especially airsondes); and
- Obtain aerosol concentration data.

The XBT data (Fig. 1) were obtained to increase the spatial resolution of the thermal field between CTD stations, and to obtain rapid measurements (nearly-synoptic) of the thermal field. Additionally, XBT's were occasionally dropped individually for a variety of purposes. The XBT's were used to increase resolution along hydrographic lines near Gibraltar, between Cape Akaili and

Marbella, between Point Jagerschmidt and Malaga, and west of Alboran Island (Fig. 2). Rapid XBT (only) sections were obtained south of Malaga (133-157, Fig. 3), south of Estepona (276-290, Fig. 4), and in the Strait of Gibraltar (302-342, Fig. 5). The CTD sections were designed to cross the historical position of the jet and anticyclonic gyre (Cano and Castillejo, 1972; Lanoix, 1974; Cheney and Doblar, 1982; and Philipe and Harang, 1982). We also monitored satellite imagery provided by M. Philipe of the Centre de Meteorologie Spatiale, Lannion, France, and processed at NORDA by P. La Violette, and used a numerical model of the circulation (Preller and Hurlburt, 1982) to aid in the selection of locations. Preliminary results from a June cruise (Kinder et al., 1983) also influenced track planning. The final XBT section through the Strait of Gibraltar was designed to sample the rapid fluctuations that are tidally excited within the Strait (Lacombe and Richez, 1982).

3. Measurements. The XBT data acquisition system used during ¿Donde Va? was developed by the Ocean Technology Division of NORDA. It is designed to collect, condition, record, and graphically present a digital temperature time series obtained from the probe-measured analog signal.

The system hardware consists of:

1) the XBT launch apparatus,
2) electronic circuitry to amplify and condition the temperature sensor signal,
3) an analog-to-digital converter,
4) a small computer (controller) used to control data collection, apply temperature calibrations, record the digital data, and plot the results.

A more complete description of the hardware system is given by Holland et al. (1980).

Controller software used during Donde Va? was written by the Physical Oceanography Branch of NORDA. It provided for the collection of discrete temperature data from SIPPICAN T-7 XBT's at a sampling frequency of 20 samples/sec (50 msec/sample), over a period of 2.5 minutes (corresponding to approximately 950 meters of depth). The system was adjusted to deliver temperature resolution over the range of $4^{o}C$ to $30^{o}C$. Immediately following each XBT drop a digital data file consisting of select cruise information, time and date of the drop, position of the drop, and the calibrated temperatures was recorded on tape. Plots of temperature vs. depth were generated for both logging of the raw data and monitoring of system performance.

The full temperature range of $4^{o}C$ to $30^{o}C$ is represented digitally by 2000 discrete values; hence a system least significant bit resolution of $0.013^{o}C$ (0.005%). Tests conducted on the system, excluding the temperature probes, indicated an accuracy within $0.003^{o}C$, i.e. within resolution limits. SIPPICAN T-7 probes are reported to have a temperature accuracy on the order of $\pm 0.1^{o}C$. Another potential source of temperature error is due to the thermistor equilibration response time, SIPPICAN Corp. reports a time constant of 100 msec for T-7 probes.

An empirical formula relating XBT depth to elapsed descent time (Perkins, 1980) has been used for some time by the Physical Oceanography Branch; it appears to yield reasonable probe depths when compared to coincident CTD casts. The operational implementation of the XBT depth-time relationship is as follows:

$$Z(t) = 6.427t - 0.00025t^2$$

with: $Z(t)$ = depth of probe in meters at time t

t = elapsed time in seconds since probe release.

No estimation is currently available regarding the accuracy of the depth-time formula.

4. Navigation. Station positions were determined by a combination of radar and visual lines of position near land, and by satellite and Omega farther than 20 km or so from land. Omega fixes had large biases, and were corrected to the closest (in time) satellite fix. Visual and radar fixes are estimated accurate to better than 0.5 km; satellite fixes to 0.5 km; and Omega fixes to 2.0 km. The estimate for Omega is conservative, and Omega was often stable for long periods and thus more accurate. The relative spacing accuracy of stations fixed by Omega is probably better than 1.0 km.

5. Discussion. Each XBT profile is plotted as temperature vs. depth (Figures 6-152), except for three XBT failures and two data logging errors (Table 2). Some of the plots show questionable aspects of the data (e.g. the high wavemaker jiggle in the station 101 profile, Fig. 6), but all seem to have some useful information.

The plots range from 0-200 m and 12-23^{o}C. Below 200 m the temperature changes are small, approaching the accuracy of the temperature probe (0.1^{o}C). Although the T-7 XBT's used have a depth range greater than 700 m, the important and clearly measurable temperature differences occur within the upper 200 m of the Alboran Sea. In this regard, the deepest temperature provides a crude test of XBT performance. At 200 m the temperature should always lie between 13^{o}C and 14^{o}C: in June 1982 hydrographic data from the northern half of our study region the 200 m temperature had a range of 13.11^{o}C to 13.68^{o}C.

Many stations in the southern half of the area had a thick (up to 50 m) and warm (>21^{o}C) surface mixed layer overlaying a strong thermocline (e.g. Station 109, Fig. 10). In the northern half of the area, the mixed layer was typically much thinner and cooler (e.g. Station 133, Fig. 21), or non-existent (e.g. Staton 289, Fig. 110). The vertical temperature differences were smaller and the thermocline typically much weaker. These features are a direct consequence of the near-geostrophic balance of the inflowing Atlantic Jet and the Alboran Gyre, which requires that the isopycnals (and thus isotherms) slope upward from the center part of the Sea (center of the Gyre) toward the Spanish Coast (crossing the eastward flowing Jet and Gyre). Flow is weaker toward the Moroccan Coast, thus the isotherm slopes are less from the center southward. Gallagher et al. (1981) have aptly called the shallow thermal structure a warm bowl, with the center coincident with the gyre center.

Some of the profiles also show thermal finestructure, either discrete layers of constant temperature water (e.g. Station 149, Fig. 37) or temperature inversions (e.g. Station 119, Fig. 14). Similar finestructure is visible in the CTD profiles from June (Kinder et al., 1983) when the temperature inversions were density-compensated or nearly so.

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Table 1. Station positions

Cast numbers appear in the form SSSCCC where SSS is a three digit number that corresponds to a geographic location (station number) and CCC is intended to be a three digit number that is consecutive throughout the cruise ("cast number"). At a time series station, only one number is assigned to the entire suite of data which may consist of many profiles (yo-yos). Anomalies:

010010 refers to both a velocity profile and XBT

SSS 227 - SSS 266 were skipped by mistake

Many cast numbers were assigned to sensors other than XBTs.

DR - dead reckoning (no fix within 15 minutes)

S - satellite fix

O - Omega fix

R - radar fix

V - visual fix

CAST	TIME	JULIAN DAY	LATITUDE (N)	LONGITUDE (W)	SOURCE	DEPTH (m)	COMMENTS
101027	1632	6 OCT 279	35 34.3	5 07.7	0	190	
103029	1714	6 OCT 279	35 36.7	5 02.7	S	337	
105031	2129	6 OCT 279	35 37.6	5 00.6	0	392	
107033	2306	6 OCT 279	35 40.7	4 56.7	0	472	
109035	0049	7 OCT 280	35 44.3	4 51.3	S	553	
111037	0235	7 OCT 280	35 46.2	4 46.9	S		Bad XBT
111038	0247	7 OCT 280	35 46.2	4 46.9	0	809	Bad XBT
113040	0533	7 OCT 280	35 51.8	4 42.0	0	1139	
115042	0801	7 OCT 280	35 57.4	4 41.6	0	1166	
117044	0925	7 OCT 280	36 03.0	4 39.7	0	1136	
119046	1142	7 OCT 280	36 06.2	4 34.7	0	1052	
121048	1306	7 OCT 280	36 11.6	4 40.5	0		Bad XBT
121049	1308	7 OCT 280	36 11.7	4 40.1	0	970	
123051	1411	7 OCT 280	36 14.5	4 40.8	0	891	
125053	1526	7 OCT 280	36 16.5	4 41.7	0	1015	
127055	1632	7 OCT 280	36 18.8	4 43.0	0	741	
129057	1758	7 OCT 280	36 22.9	4 45.0	0	300	
131059	1849	7 OCT 280	36 25.0	4 46.7	0	192	
133061	2345	8 OCT 281	36 40.2	4 17.7	0	73	

CAST	TIME	JULIAN DAY	LATITUDE (N)	LONGITUDE (W)	SOURCE	DEPTH (m)	COMMENTS
134062	0000	9 OCT 282	36 37.4	4 18.4	0	182	
135063	0015	9 OCT 282	36 35.1	4 17.2	0	252	
136064	0030	9 OCT 282	36 32.6	4 16.4	0	326	
137065	0045	9 OCT 282	36 30.0	4 16.6	0	406	
138066	0100	9 OCT 282	36 27.7	4 17.0	0	489	
139067	0115	9 OCT 282	36 25.4	4 17.3	0	602	
140068	0125	9 OCT 282	36 23.6	4 17.0	0	639	
141069	0135	9 OCT 282	36 22.1	4 16.9	0	681	
142070	0145	9 OCT 282	36 20.5	4 17.1	0	695	
143071	0200	9 OCT 282	36 17.8	4 16.7	0	781	
144072	0215	9 OCT 282	36 15.2	4 16.4	0	869	
145073	0230	9 OCT 282	36 13.0	4 17.1	0	1082	
146074	0245	9 OCT 282	36 10.4	4 17.3	S	1169	
147075	0300	9 OCT 282	36 08.1	4 17.2	0	1272	
148076	0315	9 OCT 282	36 05.7	4 16.4	DR	1281	
149077	0330	9 OCT 282	36 03.3	4 15.5	0	1288	
150078	0340	9 OCT 282	36 01.7	4 15.3	0	1323	
151079	0350	9 OCT 282	36 00.1	4 15.3	0	1305	
152080	0400	9 OCT 282	35 58.4	4 14.6	0	1296	
153081	0410	9 OCT 282	35 56.9	4 14.1	0	1349	

CAST	TIME	JULIAN DAY	LATITUDE (N)	LONGITUDE (W)	SOURCE	DEPTH (m)	COMMENTS
154082	0420	9 OCT 282	35 55.3	4 13.9	O	1360	
155083	0430	9 OCT 282	35 53.5	4 13.7	S	1396	
156084	0440	9 OCT 282	35 52.5	4 13.4	O	1405	
157085	0450	9 OCT 282	35 50.3	4 12.8	O	1286	Data lost
165093	0933	10 OCT 283	36 14.2	5 15.5	DR	250	
165094	0944	10 OCT 283	36 13.3	5 14.4	DR	250	
165095	0949	10 OCT 283	36 13.0	5 15.3	DR	250	
165096	0952	10 OCT 283	36 12.9	5 13.3	DR	250	
165097	1005	10 OCT 283	36 12.2	5 15.1	DR	250	
167099	1049	10 OCT 283	36 10.2	5 14.5	O	399	
169101	1222	10 OCT 283	36 07.6	5 12.6	O	754	
171103	1331	10 OCT 283	36 05.0	5 11.8	S	825	
173105	1457	10 OCT 283	36 01.5	5 07.8	O	631	
175108	1651	10 OCT 283	35 57.9	5 06.3	O	520	
177110	1815	10 OCT 283	35 54.7	5 05.6	O	464	
179112	1945	10 OCT 283	35 53.6	5 09.6	DR	475	
181114	2050	10 OCT 283	35 53.1	5 12.4	S		
183116	2156	10 OCT 283	35 52.7	5 19.0	O	300	
193127	1403	11 OCT 284	35 41.0	4 28.7	O	1453	
194128	1413	11 OCT 284	35 41.7	4 27.1	O	1422	

CAST	TIME	JULIAN DAY	LATITUDE (N)	LONGITUDE (W)	SOURCE	DEPTH (m)	COMMENTS
195129	1432	11 OCT 284	35 44.5	4 24.7	0	1471	
197131	1549	11 OCT 284	35 46.4	4 20.4	0	1480	
198132	1607	11 OCT 284	35 48.0	4 18.6	DR	1432	
199132	1621	11 OCT 284	35 49.2	4 17.2	0	1425	
201135	1831	11 OCT 284	35 52.9	4 14.8	S	1380	
202136	1900	11 OCT 284	35 55.6	4 17.5	0	1365	
203137	1914	11 OCT 284	35 57.1	4 17.5	0	1190	
205139	2005	11 OCT 284	35 59.9	4 16.7	0	1280	
206140	2018	11 OCT 284	36 01.2	4 16.9	0	1280	Data lost
207141	2031	11 OCT 284	36 02.7	4 17.1	0	1327	
209143	2204	11 OCT 284	35 06.3	4 17.6	0	1281	
211145	2303	11 OCT 284	36 08.4	4 17.9	0	1224	
213147	0017	12 OCT 285	36 12.0	4 17.1	0	1116	
223157	1611	12 OCT 285	35 52.1	4 04.8	0	1360	
225159	1715	12 OCT 285	35 50.7	3 59.2	0	1066	
227161	1855	12 OCT 285	35 50.4	3 53.2	0	1130	
228162	1906	12 OCT 285	35 50.7	3 49.6	S	1210	
229163	1916	12 OCT 285	35 51.1	3 48.1	0	1318	
231165	2026	12 OCT 285	35 51.5	3 45.1	S	1418	
232166	2044	12 OCT 285	35 51.4	3 40.9	S	1418	

CAST	TIME	JULIAN DAY	LATITUDE (N)	LONGITUDE (W)	SOURCE	DEPTH (m)	COMMENTS
233167	2050	12 OCT 285	35 51.5	3 40.3	S	1420	
235169	2210	12 OCT 285	35 52.8	3 38.7	S	1500	
236170	2226	12 OCT 285	35 53.4	3 34.4	DR	1600	
237171	2236	12 OCT 285	35 53.2	3 32.3	0	1600	
239174	0019	13 OCT 286	35 52.5	3 28.4	0	1515	
240175	0034	13 OCT 286	35 53.6	3 27.0	0	1373	
241176	0053	13 OCT 286	35 54.8	3 25.5	S	1308	
243178	0201	13 OCT 286	35 56.9	3 21.2	0	1286	
263199	0507	15 OCT 288	36 17.3	4 49.0	S	728	Mooring 12
264200	0850	15 OCT 288	36 12.3	4 48.1	S	858	Mooring 13
265201	0916	15 OCT 288	36 13.5	4 48.7	0	844	Mooring 13
266202	0939	15 OCT 288	36 13.0	4 49.8	0	807	Mooring 13
267203	1149	15 OCT 288	36 08.1	4 46.4	0	911	Bad XBT
268204	1204	15 OCT 288	36 08.1	4 46.2	0	911	Bad XBT
269205	1215	15 OCT 288	36 08.3	4 46.1	0	911	Mooring 14
270206	1513	15 OCT 288	36 01.8	4 43.1	0	1010	Mooring 15
275211	0636	16 OCT 289	35 55.9	4 40.1	0	1058	
276212	1145	16 OCT 289	35 53.3	4 53.0	0	812	
277213	1200	16 OCT 289	35 55.7	4 53.7	0	908	
278214	1215	16 OCT 289	35 58.2	4 54.4	0	908	

CAST	TIME	JULIAN DAY	LATITUDE (N)	LONGITUDE (W)	SOURCE	DEPTH (m)	COMMENTS
279215	1230	16 OCT 289	35 59.6	4 55.0	0	908	
280216	1245	16 OCT 289	36 02.8	4 55.6	0	889	
281217	1300	16 OCT 289	36 05.1	4 55.3	S	871	
282218	1315	16 OCT 289	36 07.3	4 55.1	0	871	
283219	1330	16 OCT 289	36 09.8	4 55.6	0	853	
284220	1345	16 OCT 289	36 11.5	4 55.9	0	829	
285221	1400	16 OCT 289	36 13.4	4 56.6	0	792	
286222	1415	16 OCT 289	36 15.2	4 57.8	S	536	
287223	1430	16 OCT 289	36 17.0	5 00.1	0	435	
288224	1445	16 OCT 289	36 18.5	5 00.7	0	326	
289225	1500	16 OCT 289	36 20.9	5 00.7	0	245	
290226	1518	16 OCT 289	36 23.8	5 01.0	0	80	
Cast Numbers 227-266 not used							
302278	1606	18 OCT 291	36 07.9	5 12.1	RV		
303279	1611	18 OCT 291	36 07.5	5 12.4	RV		
304280	1616	18 OCT 291	36 07.2	5 12.9	RV		
305281	1621	18 OCT 291	36 06.6	5 13.1	RV		
306282	1625	18 OCT 291	36 06.2	5 13.7	RV		
307283	1630	18 OCT 291	36 05.7	5 14.4	RV		
308284	1635	18 OCT 291	36 05.2	5 14.8	RV	844	

CAST	TIME	JULIAN DAY	LATITUDE (N)	LONGITUDE (W)	SOURCE	DEPTH (m)	COMMENTS
309285	1640	18 OCT 291	36 04.8	5 15.2	RV	848	
310286	1645	18 OCT 291	36 04.4	5 16.6	RV	850	
311287	1650	18 OCT 291	36 04.0	5 16.0	RV	844	
312288	1655	18 OCT 291	36 03.4	5 16.5	RV	844	
313289	1700	18 OCT 291	36 02.8	5 17.0	RV	850	
314290	1705	18 OCT 291	36 02.3	5 17.2	RV	854	
315291	1710	18 OCT 291	36 01.8	5 17.5	RV	849	
316292	1715	18 OCT 291	36 01.8	5 18.2	RV	844	
317293	1720	18 OCT 291	36 01.8	5 19.0	RV	846	
318294	1725	18 OCT 291	36 01.2	5 19.4	RV	848	
319295	1730	18 OCT 291	36 00.7	5 19.8	RV	844	
320296	1735	18 OCT 291	36 00.6	5 20.3	RV	837	
321297	1740	18 OCT 291	36 00.6	5 20.7	RV	846	
322298	1746	18 OCT 291	36 00.4	5 21.3	RV	858	
323299	1750	18 OCT 291	36 00.2	5 21.6	RV	886	
324300	1755	18 OCT 291	35 59.9	5 22.3	RV	915	
325301	1810	18 OCT 291	35 59.3	5 23.6	RV		
326302	1820	18 OCT 291	35 59.1	5 24.3	RV	921	
327303	1830	18 OCT 291	35 58.5	5 25.3	RV		
328304	1840	18 OCT 291	35 58.1	5 25.8	RV		

CAST	TIME	JULIAN DAY	LATITUDE (N)	LONGITUDE (W)	SOURCE	DEPTH (m)	COMMENTS
329305	1850	18 OCT 291	35 57.7	5 26.5	RV		
330306	1900	18 OCT 291	35 57.5	5 27.4	RV	965	
331307	1910	18 OCT 291	35 57.2	5 28.0	RV	893	
332308	1920	18 OCT 291	35 57.1	5 28.7	RV	823	
333309	1930	18 OCT 291	35 56.4	5 29.5	RV	646	
334310	1940	18 OCT 291	35 55.9	5 30.6	RV	514	
335311	1950	18 OCT 291	35 55.5	5 31.6	RV	461	
336312	2000	18 OCT 291	35 55.3	5 32.7	RV	434	
337313	2010	18 OCT 291	35 54.8	5 33.7	RV	395	
338314	2020	18 OCT 291	35 54.1	5 34.8	RV	97	
339315	2030	18 OCT 291	35 53.4	5 36.3	RV	158	
340316	2040	18 OCT 291	35 53.0	5 37.9	RV	353	
341317	2050	18 OCT 291	35 52.7	5 39.4	RV	360	
342318	2100	18 OCT 291	35 52.4	5 40.8	RV	92	

Table 2. Data problems

STATION	PROBLEM
111037	XBT Failure
111038	XBT Failure
121048	XBT Failure
157085	Data tape overwritten (Operator error)
206140	Data tape overwritten (Operator error)

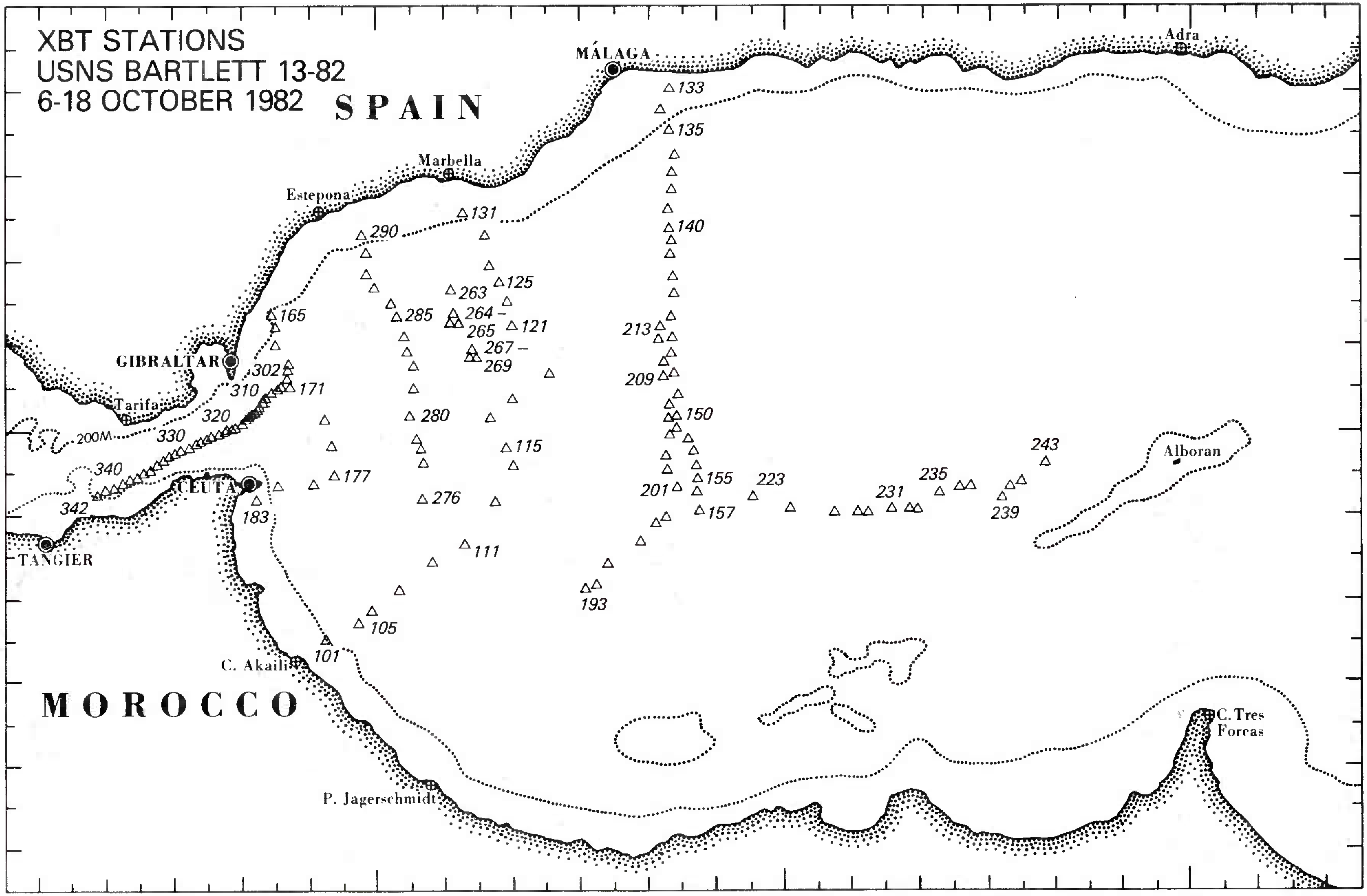


Figure 1. Location of XBT drops

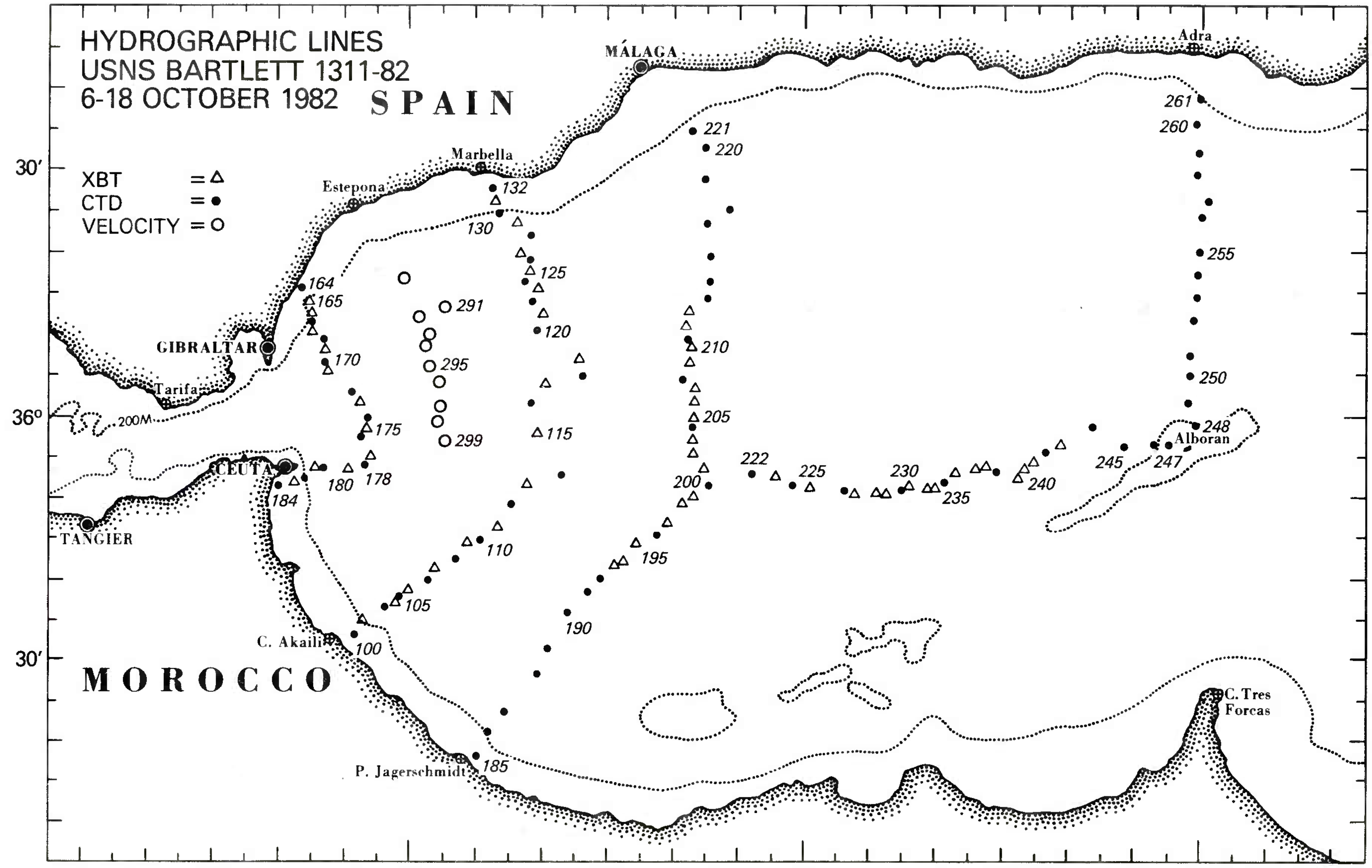


Figure 2. Hydrographic lines, including CTD, XBT, and velocity profiler measurements

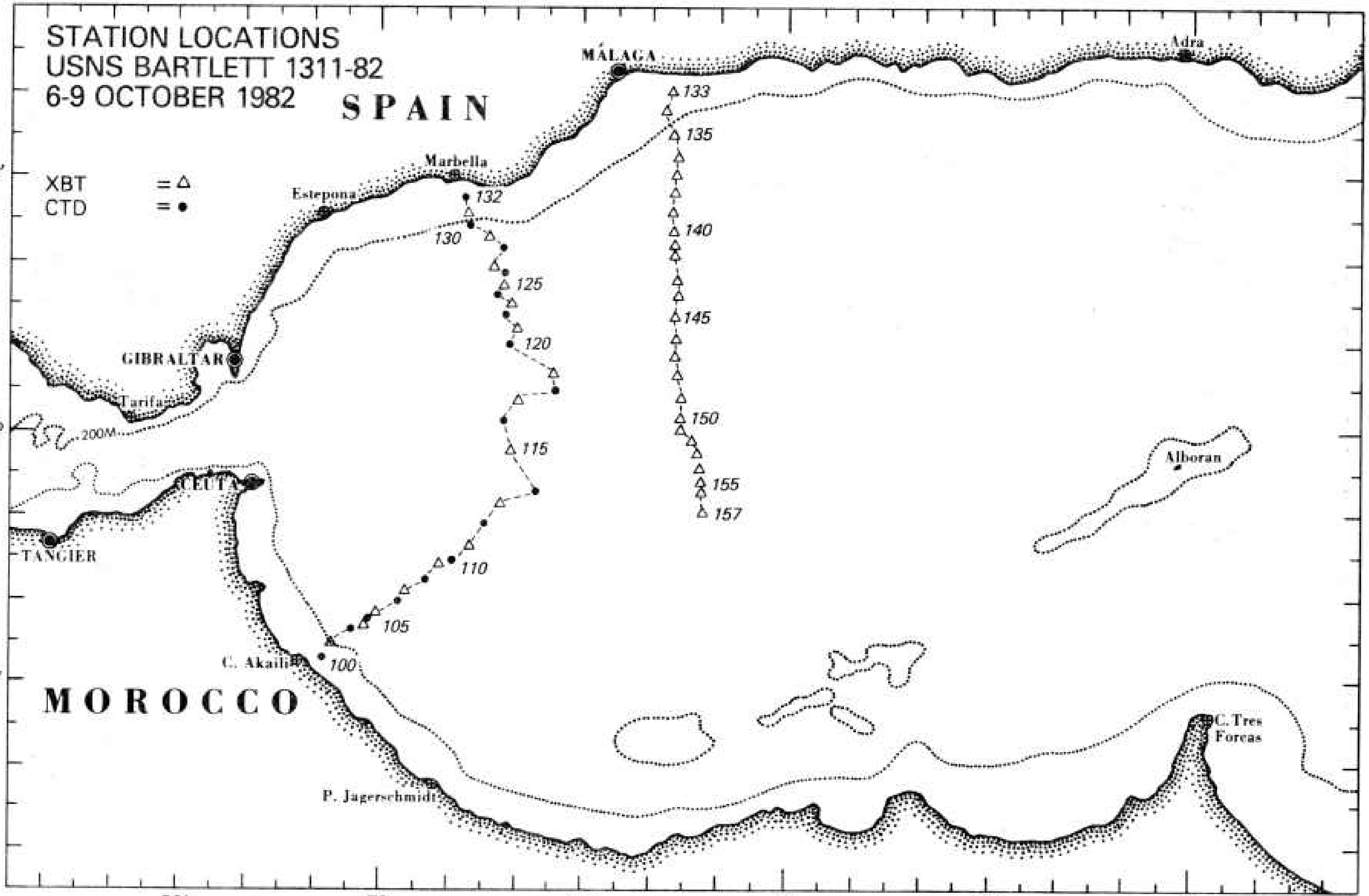


Figure 3. XBT Section South from Malaga

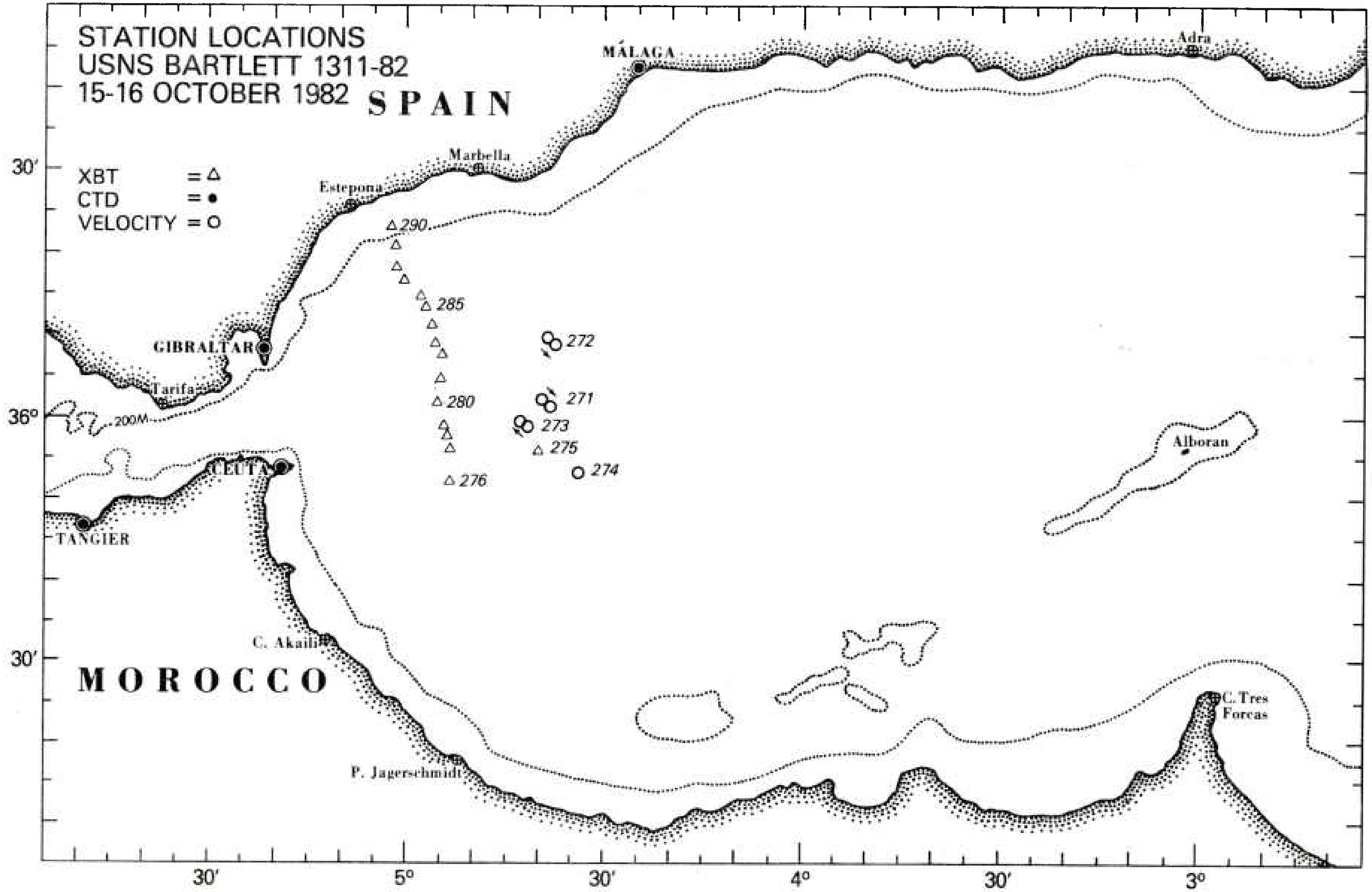


Figure 4. XBT Section South from Estepona

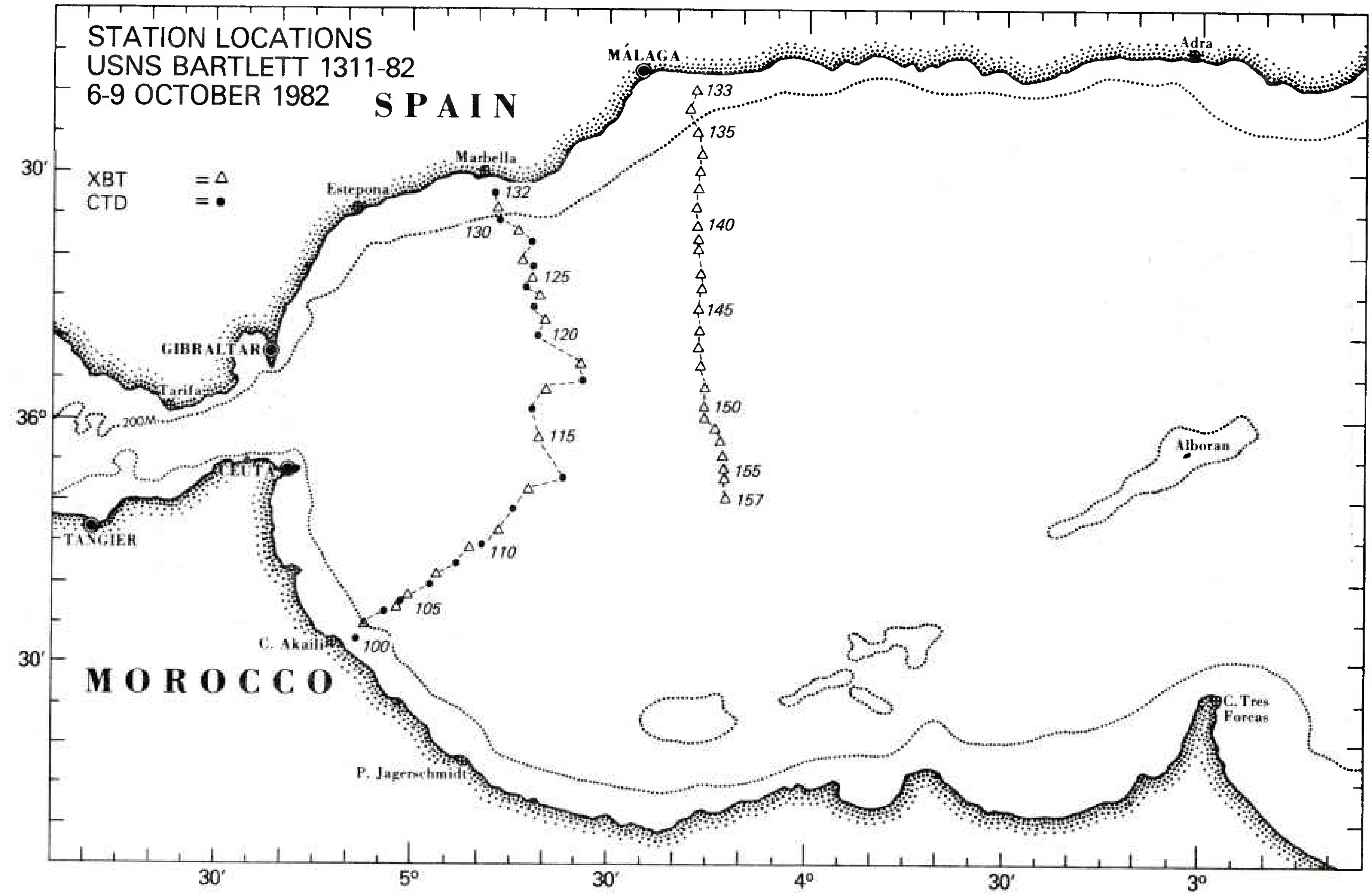


Figure 3. XBT Section South from Malaga

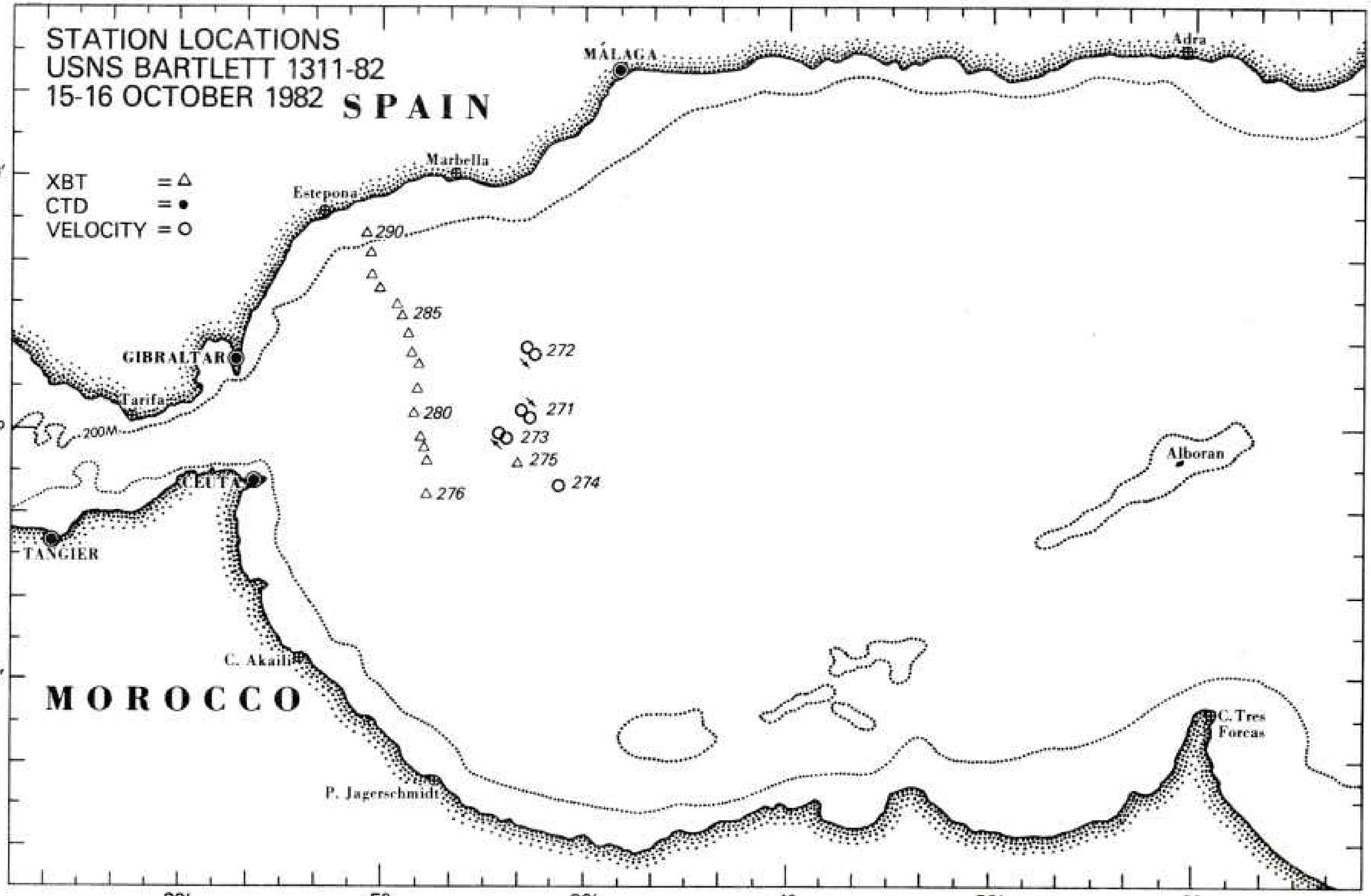


Figure 4. XBT Section South from Estepona

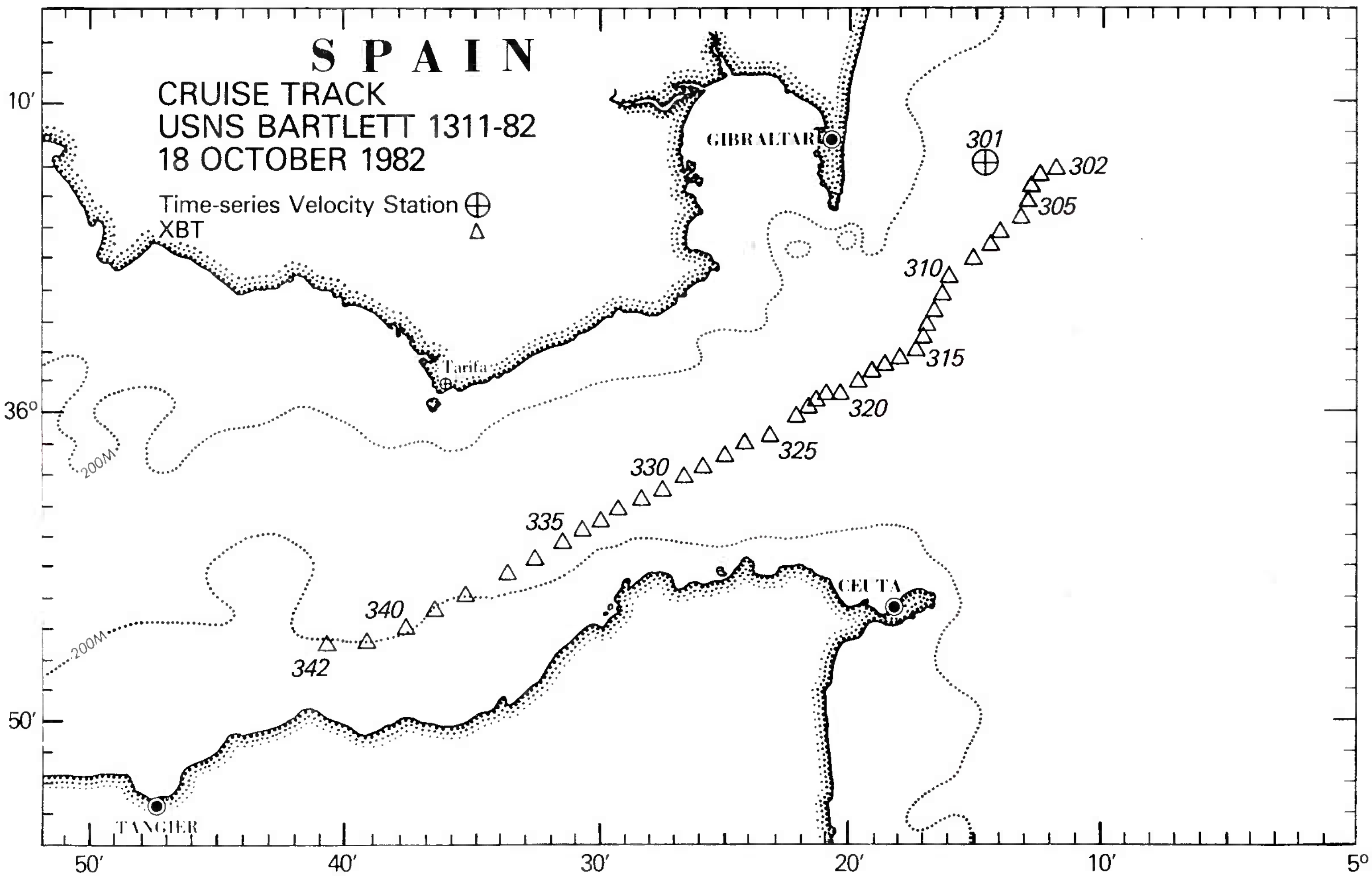
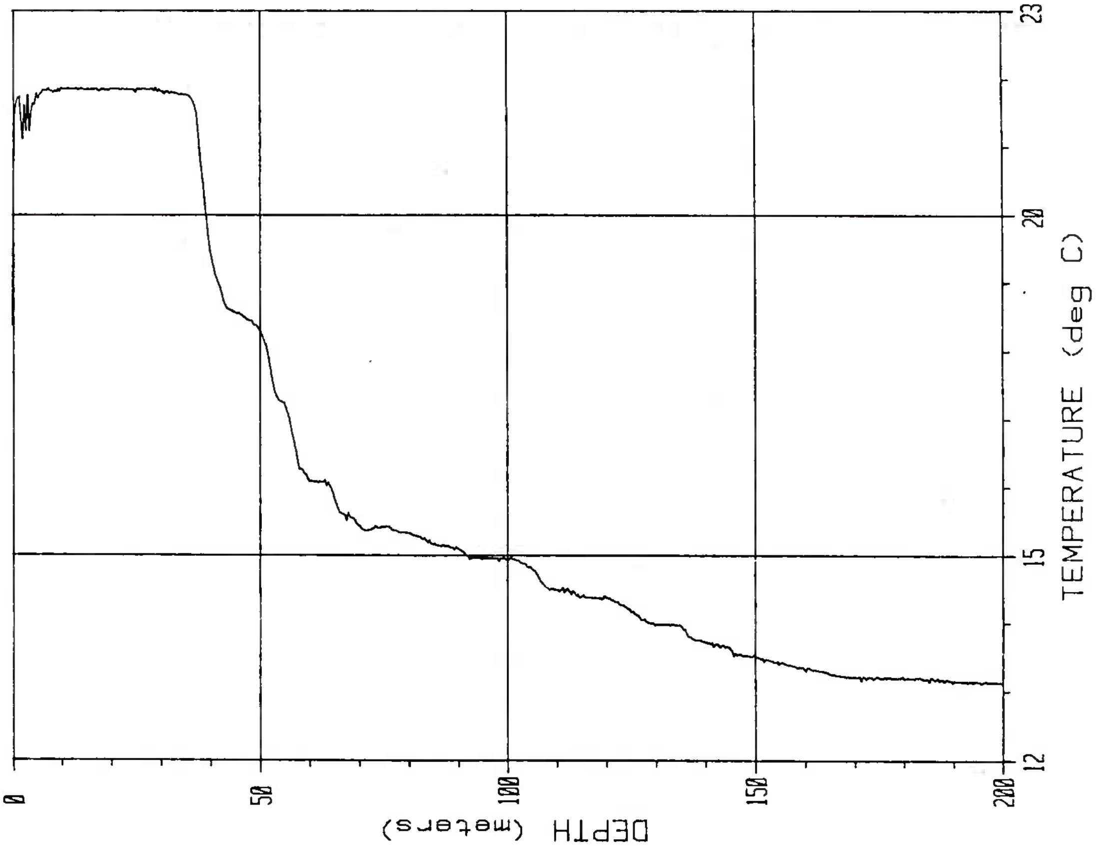


Figure 5. XBT Section through the Strait of Gibraltar

Figures 6-152. Temperature vs. depth for XBT Stations 101-342



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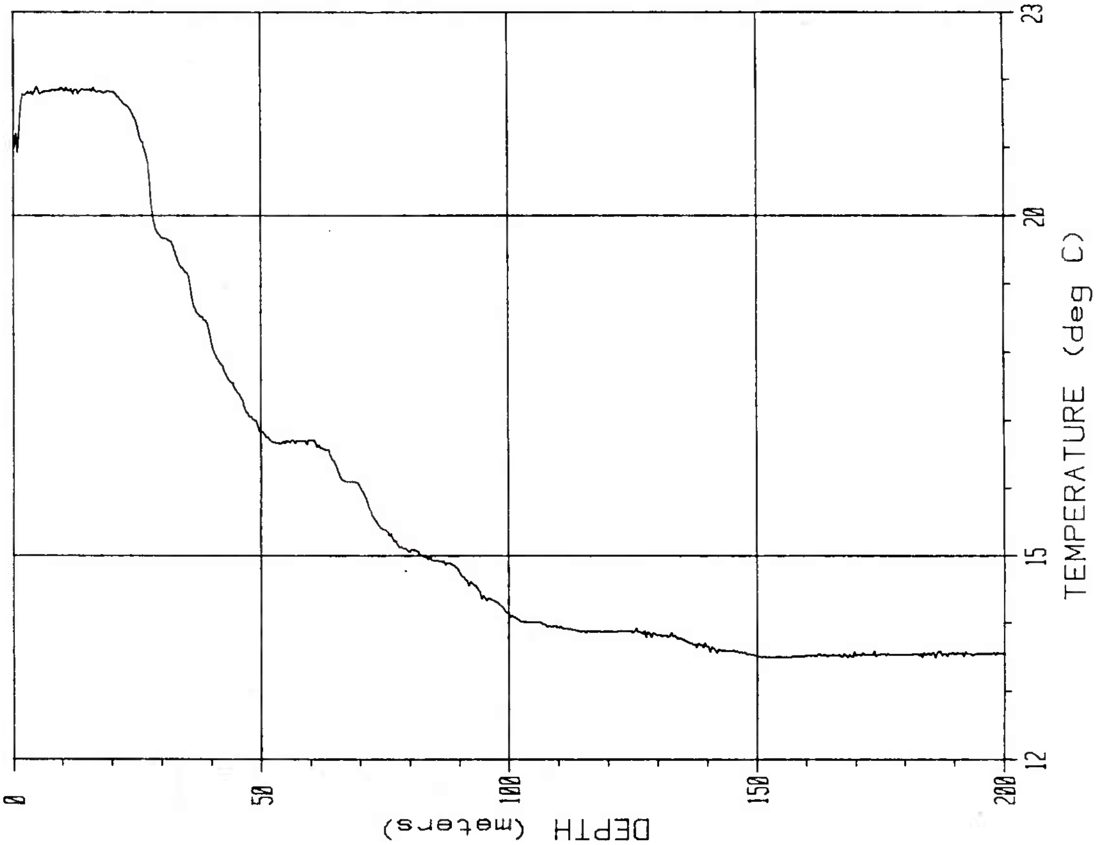

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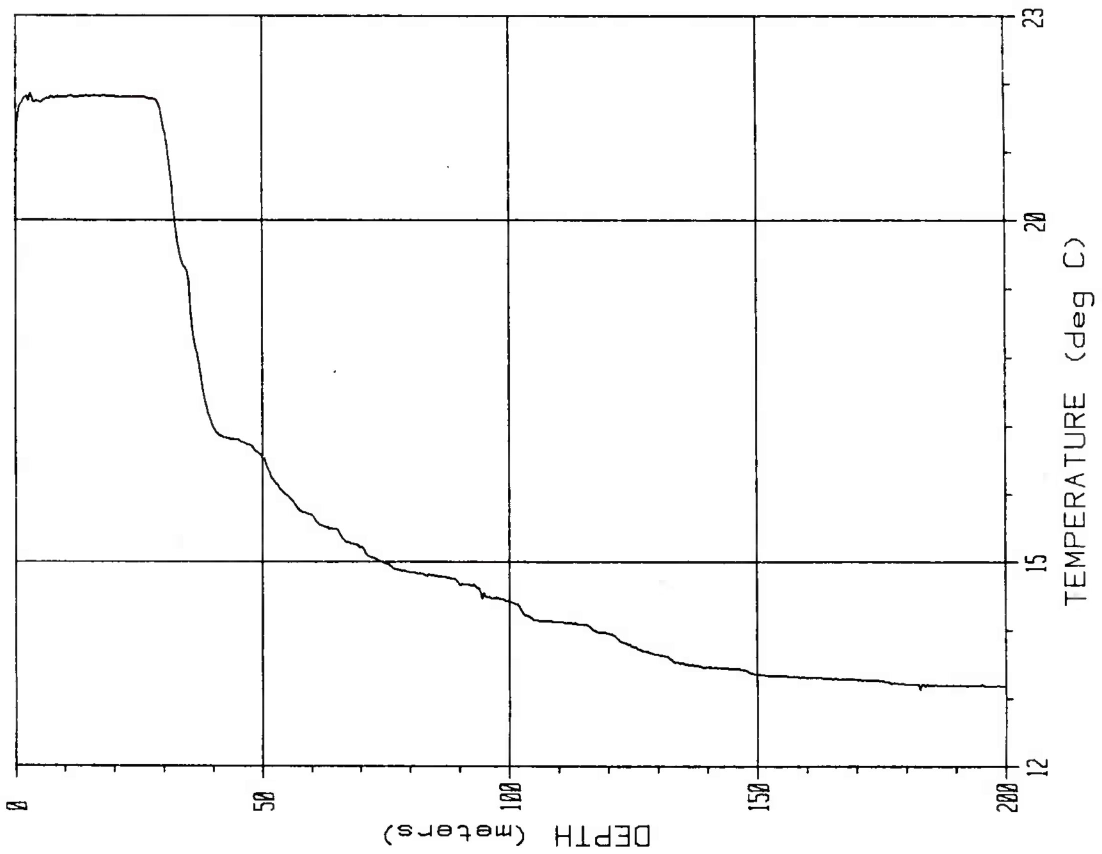

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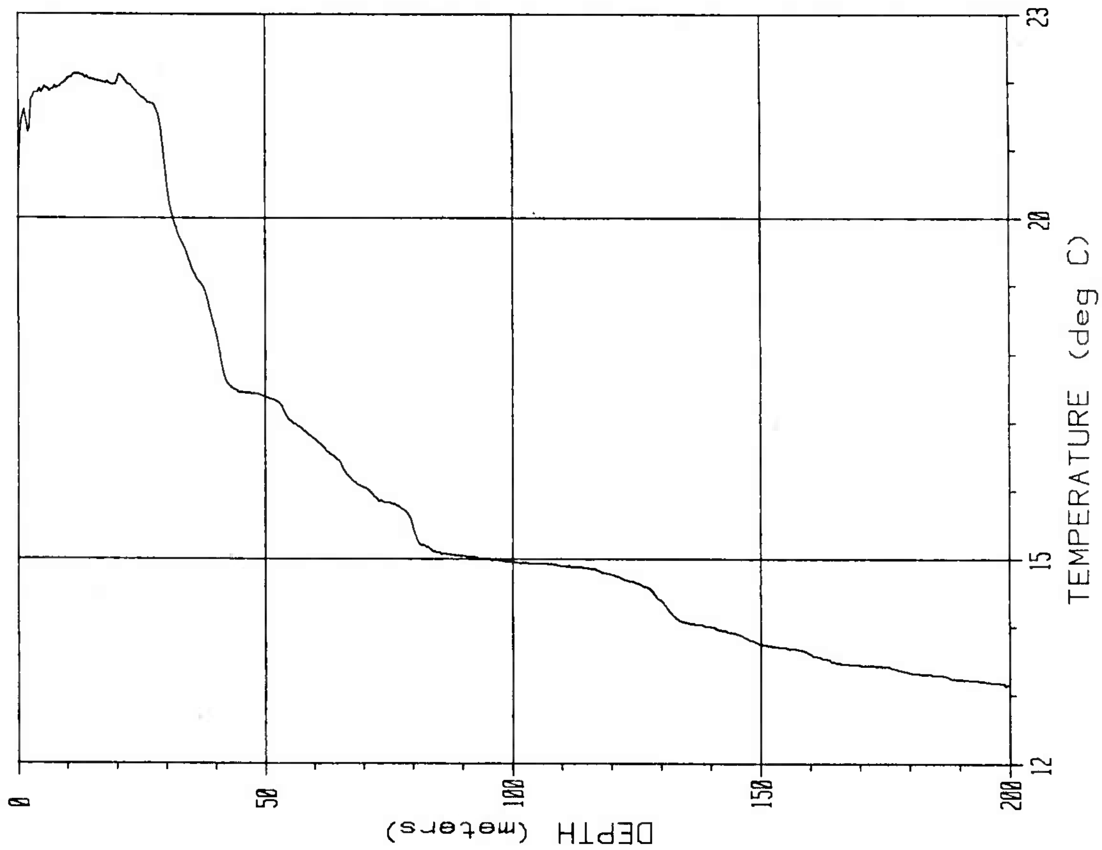

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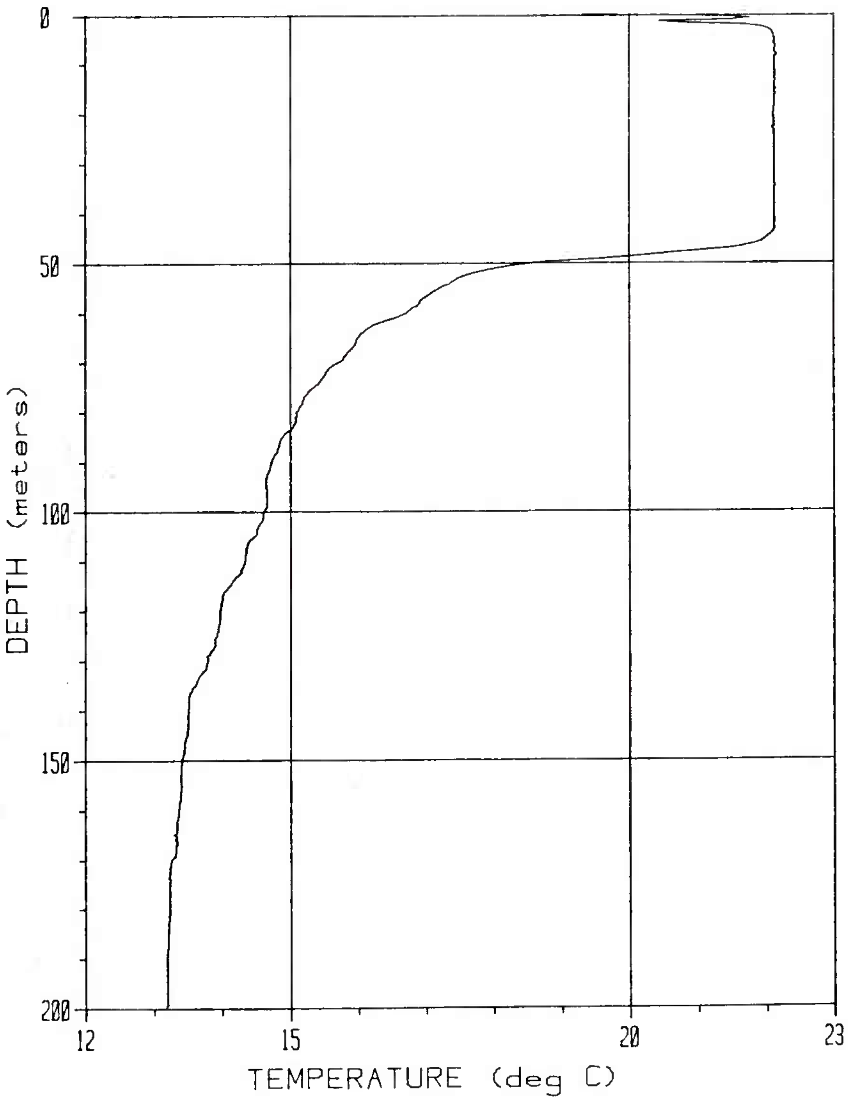

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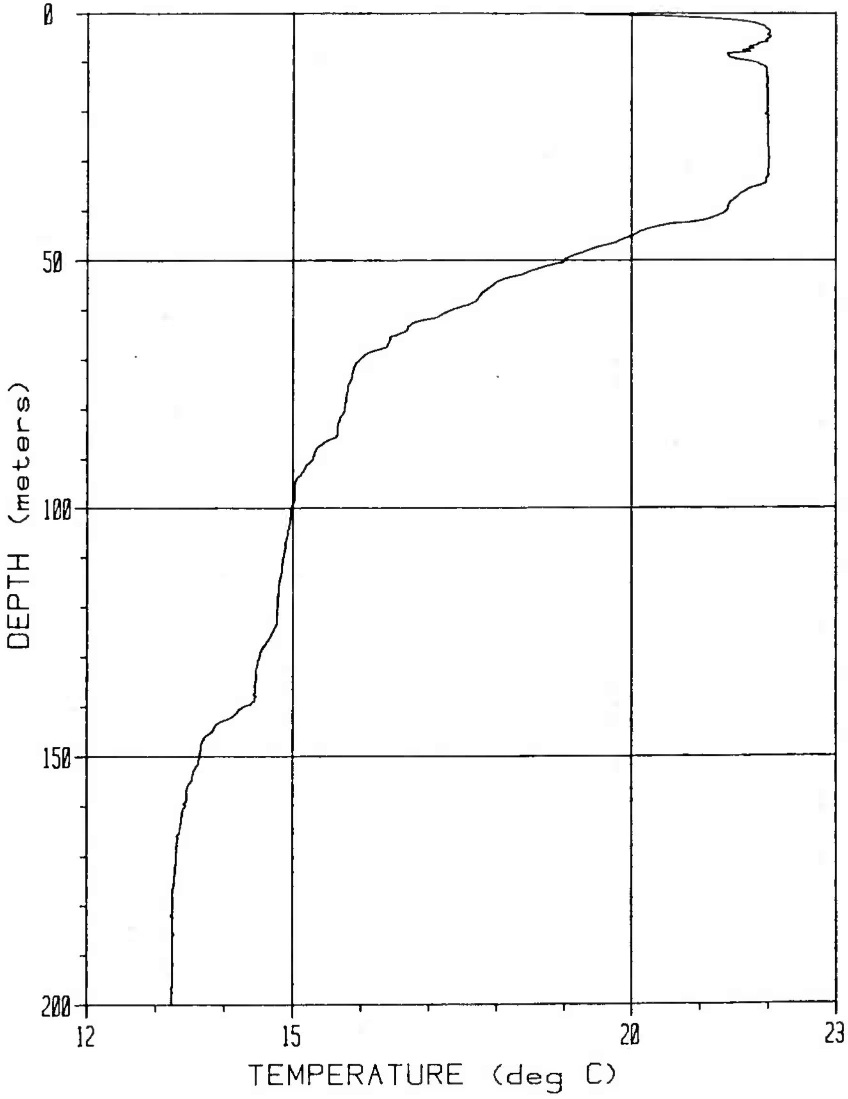

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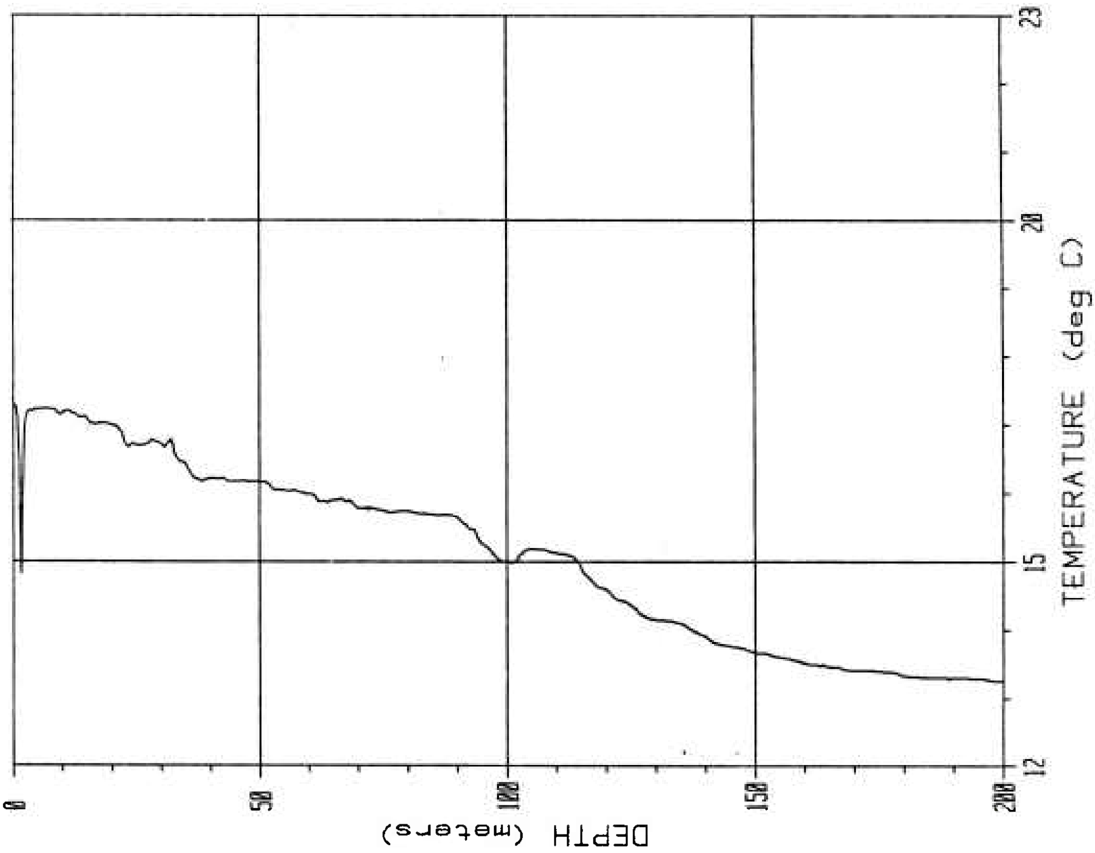
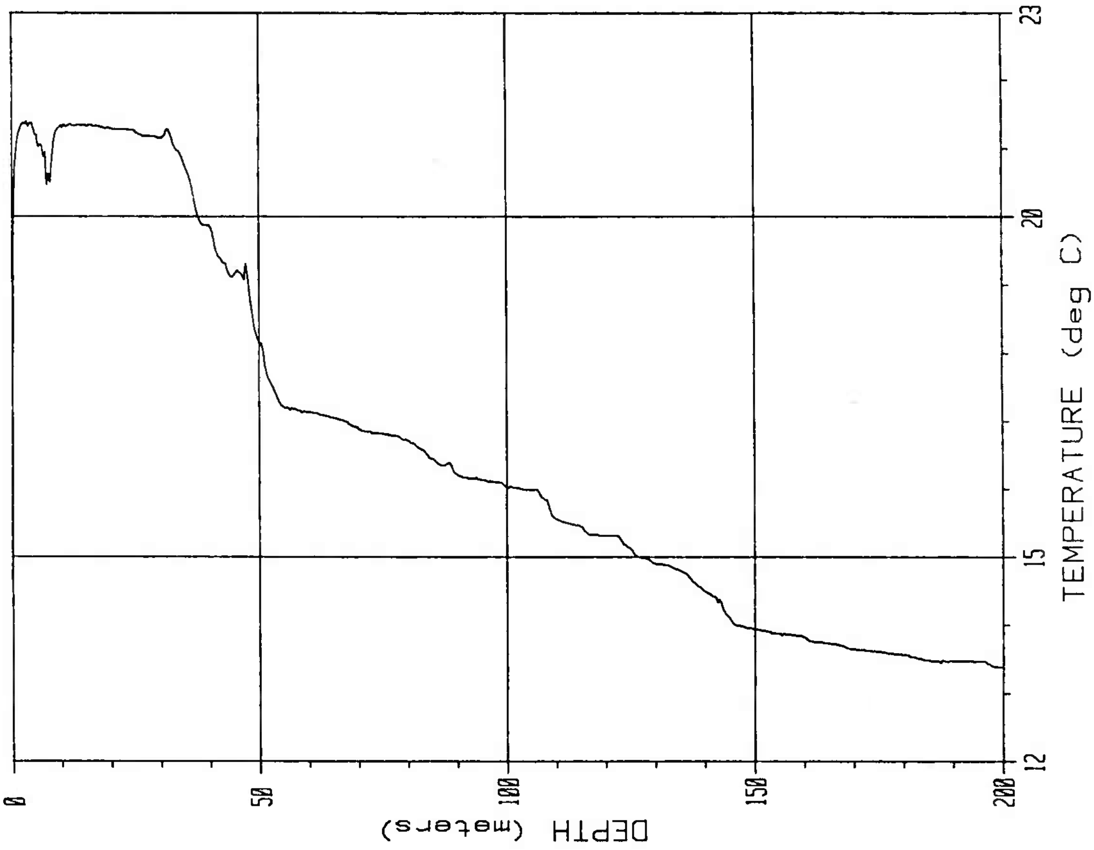


STATION # 117Ø44



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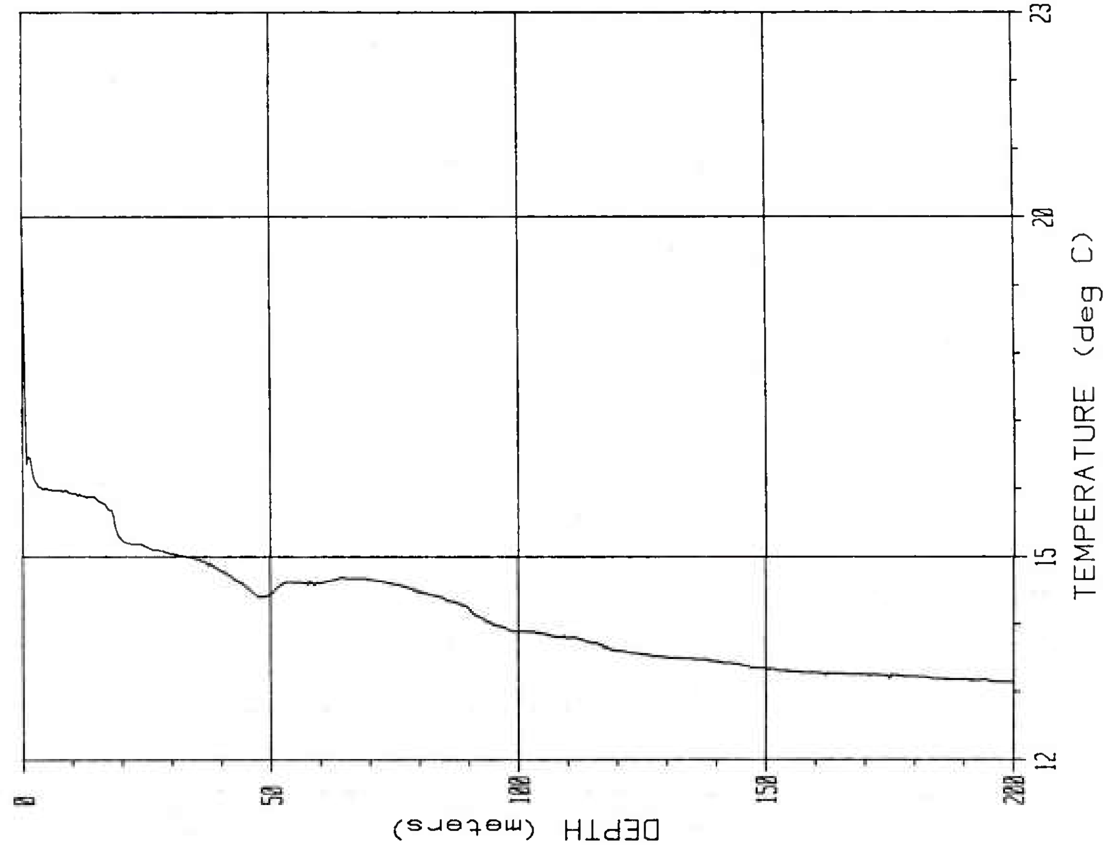

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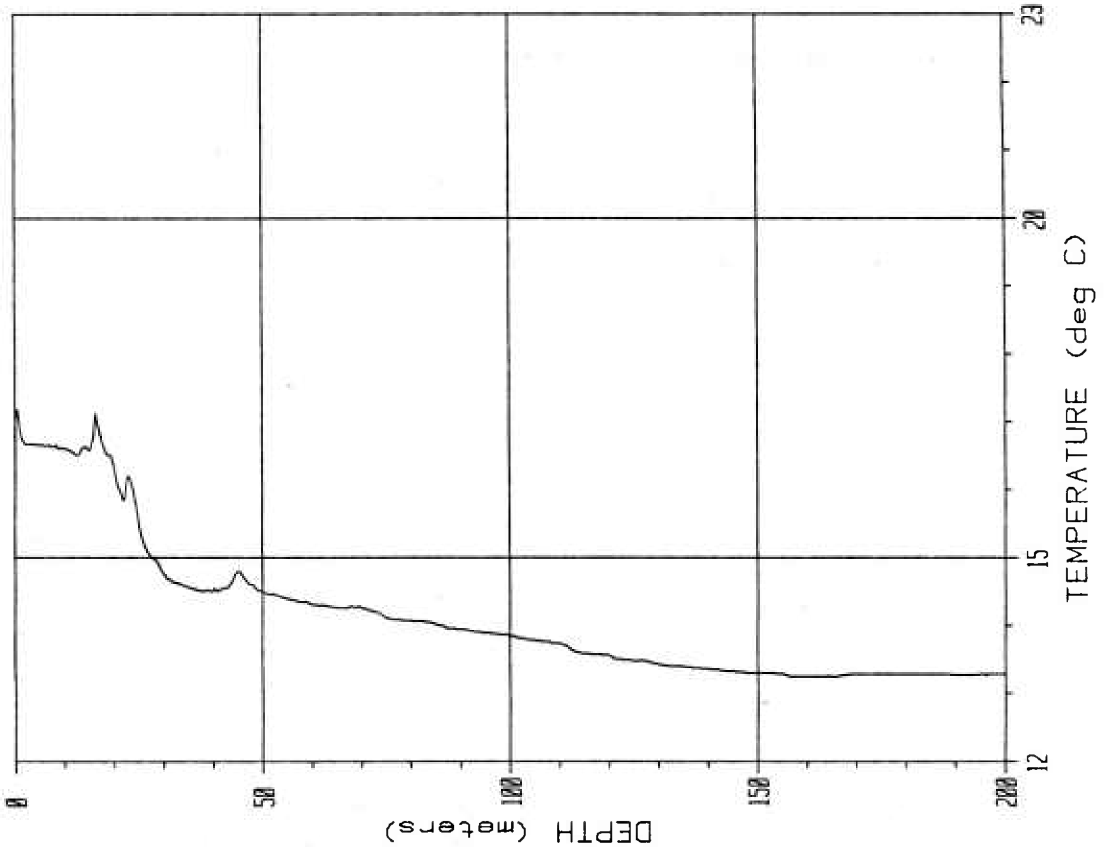

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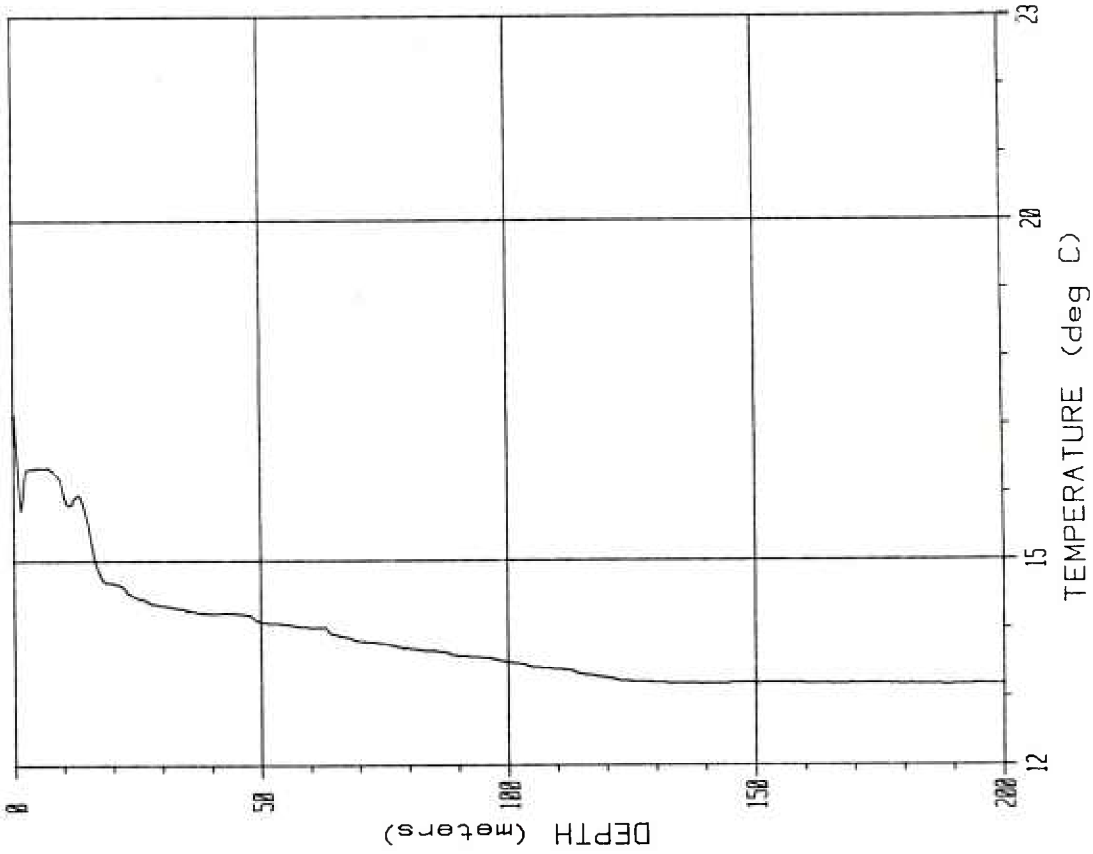

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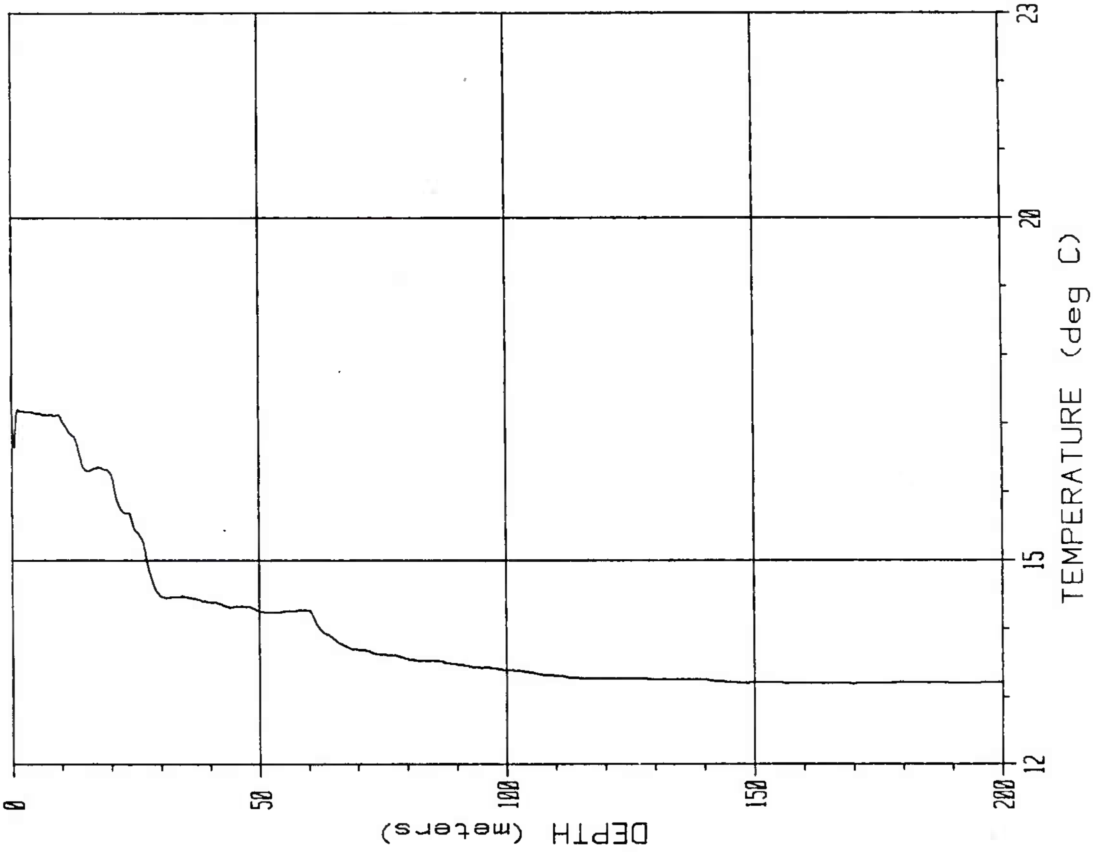

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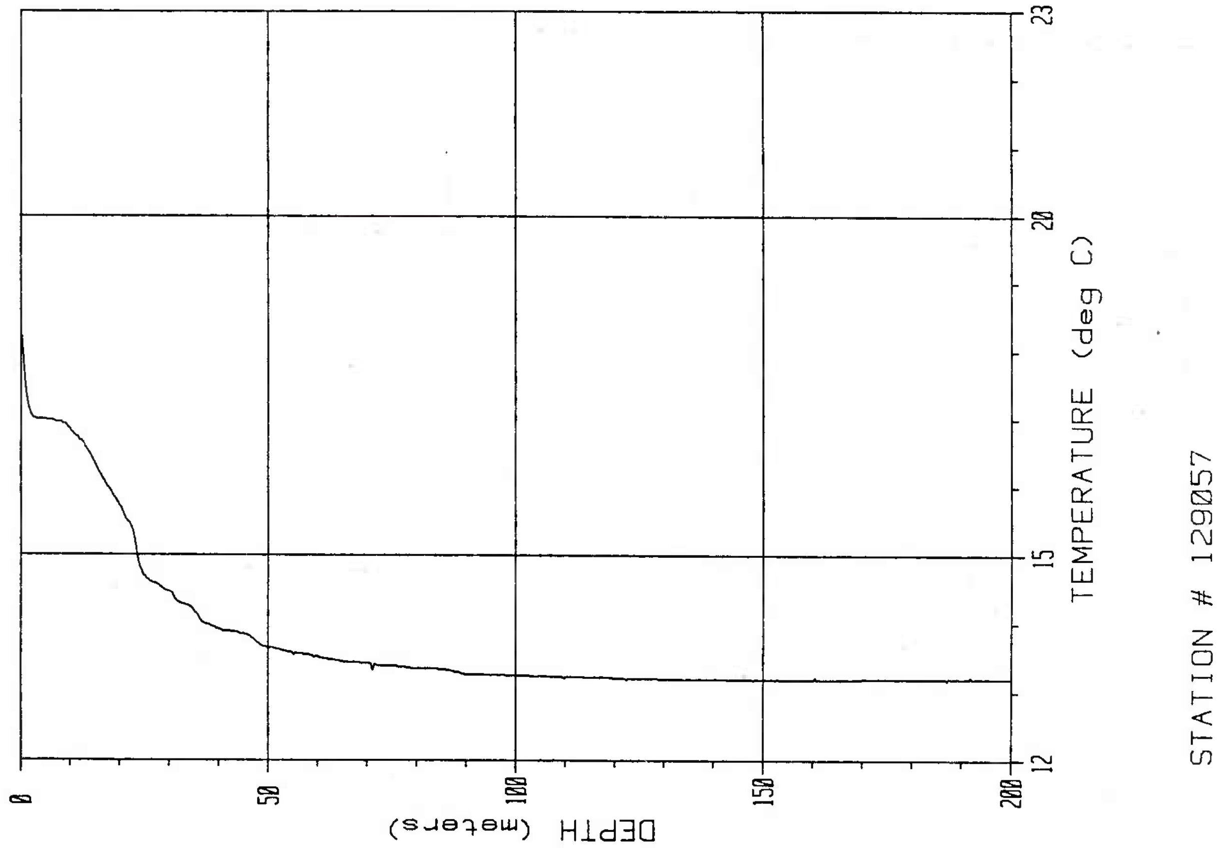
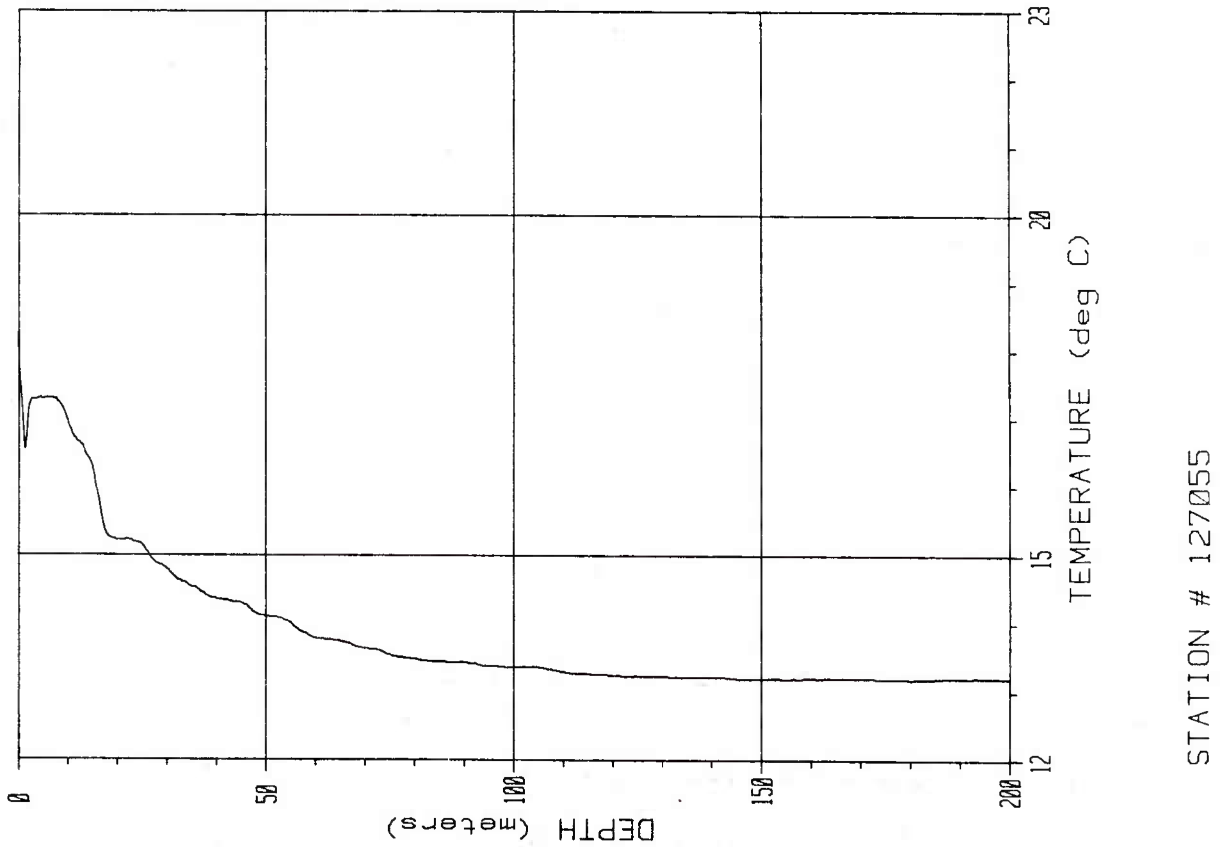
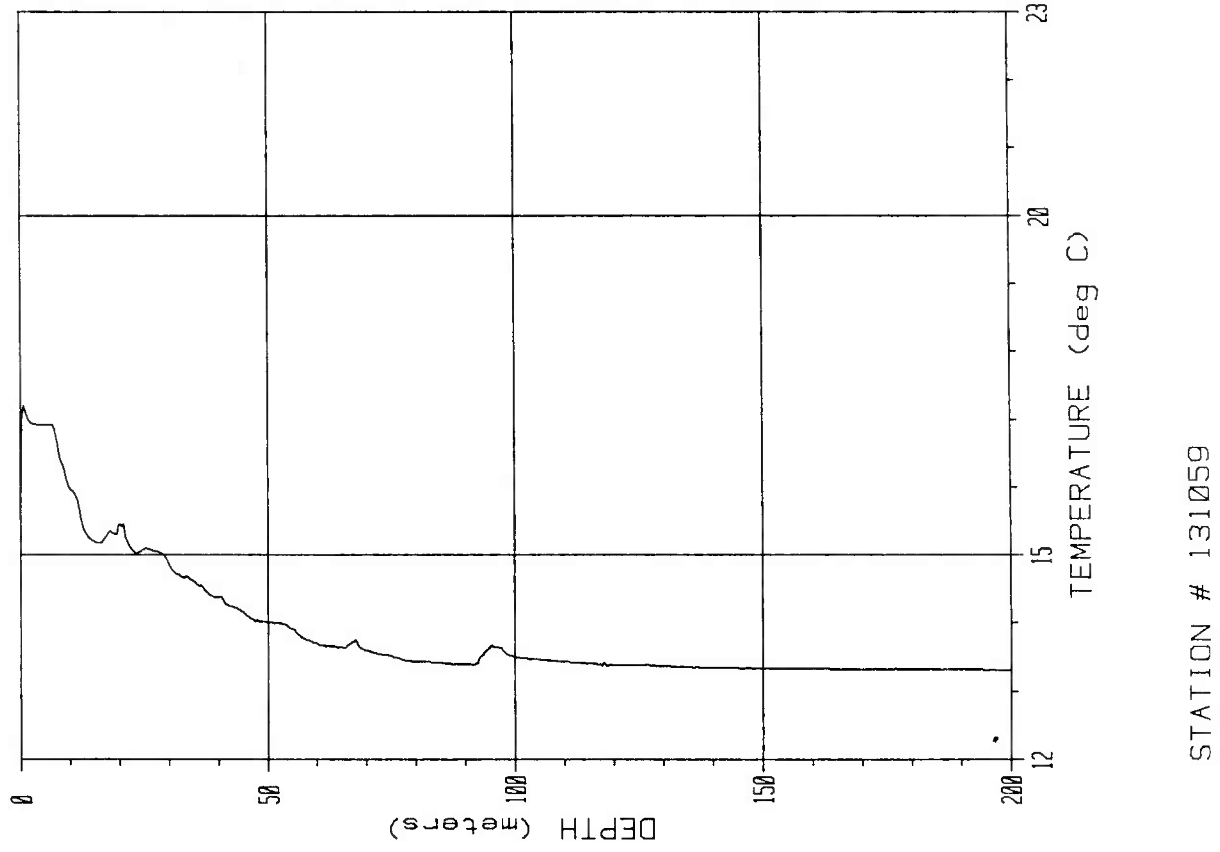
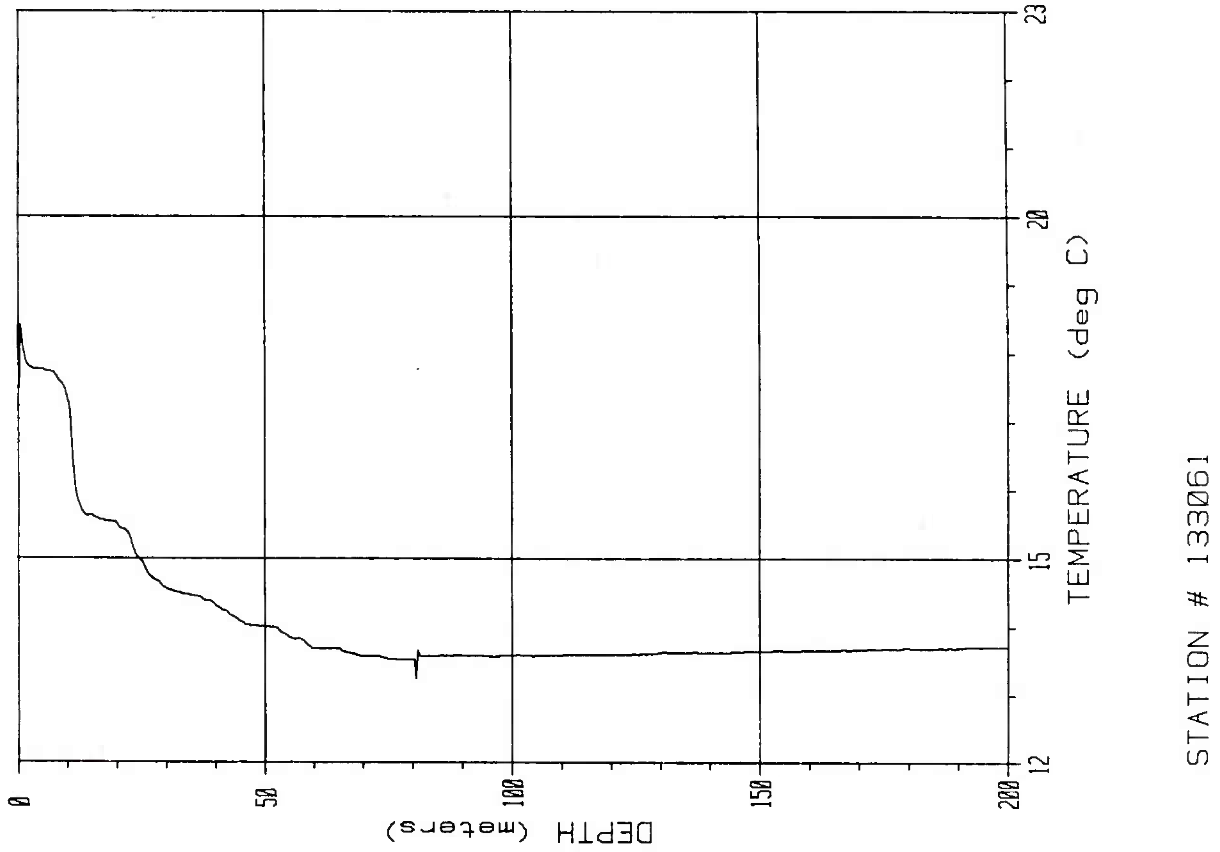


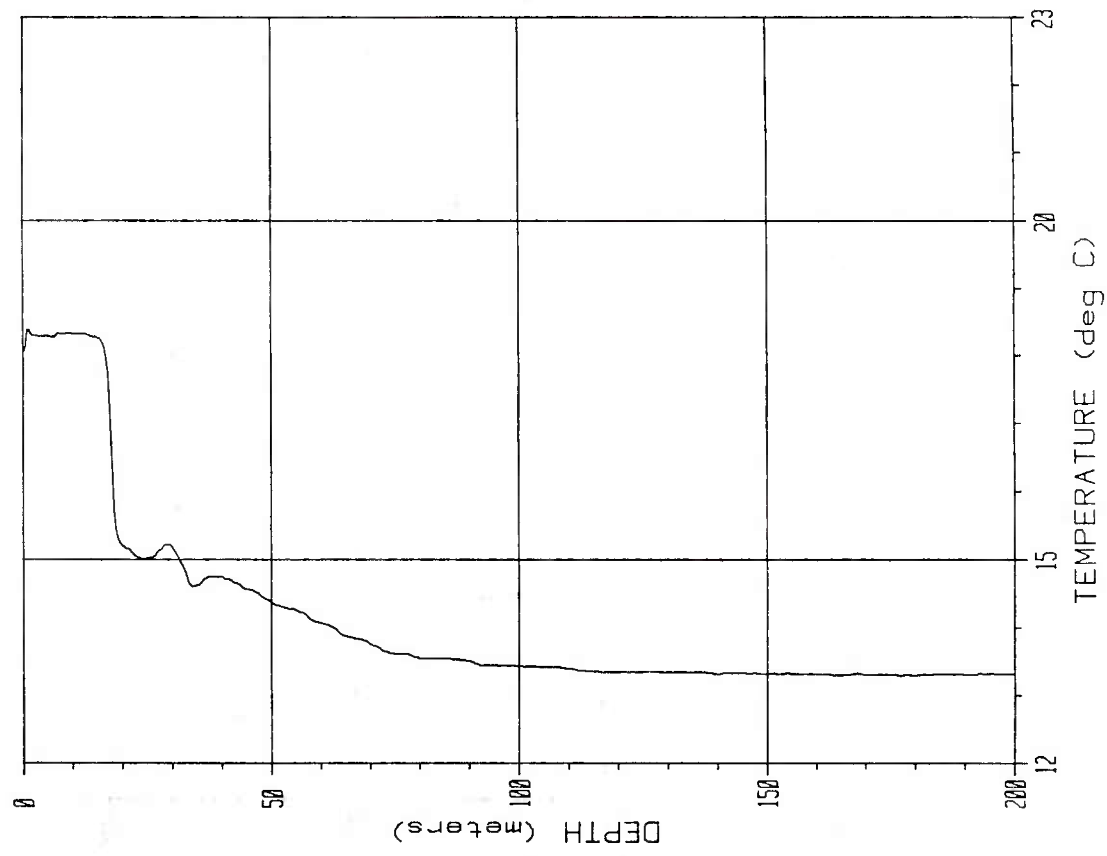
DEPTH (meters)
0
50
100
150
200
TEMPERATURE (deg C)
12
15
20
23
STATION # 129057



DEPTH (meters)
0
50
100
150
200
TEMPERATURE (deg C)
12
15
20
23
STATION # 127055


DEPTH (meters)
0
50
100
150
200
TEMPERATURE (deg C)
12
15
20
23
STATION # 131059


DEPTH (meters)
0
50
100
150
200
TEMPERATURE (deg C)
12
15
20
23
STATION # 133061



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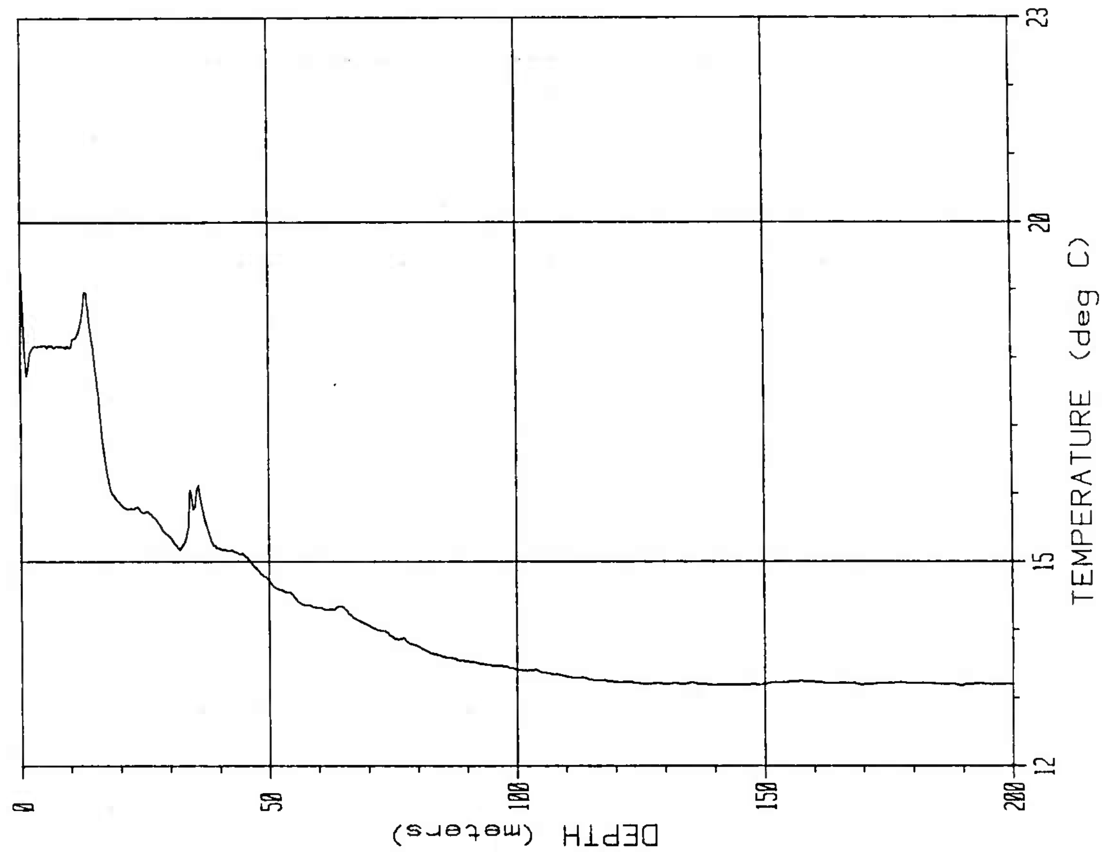

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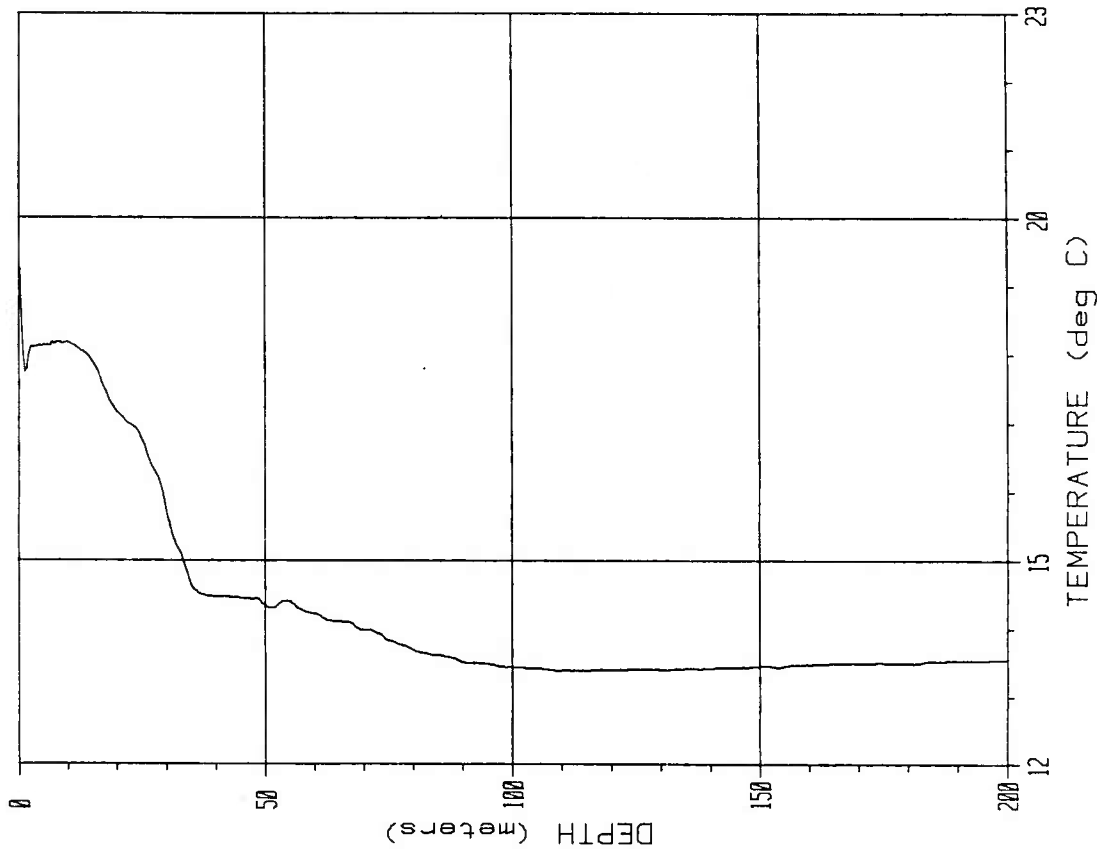

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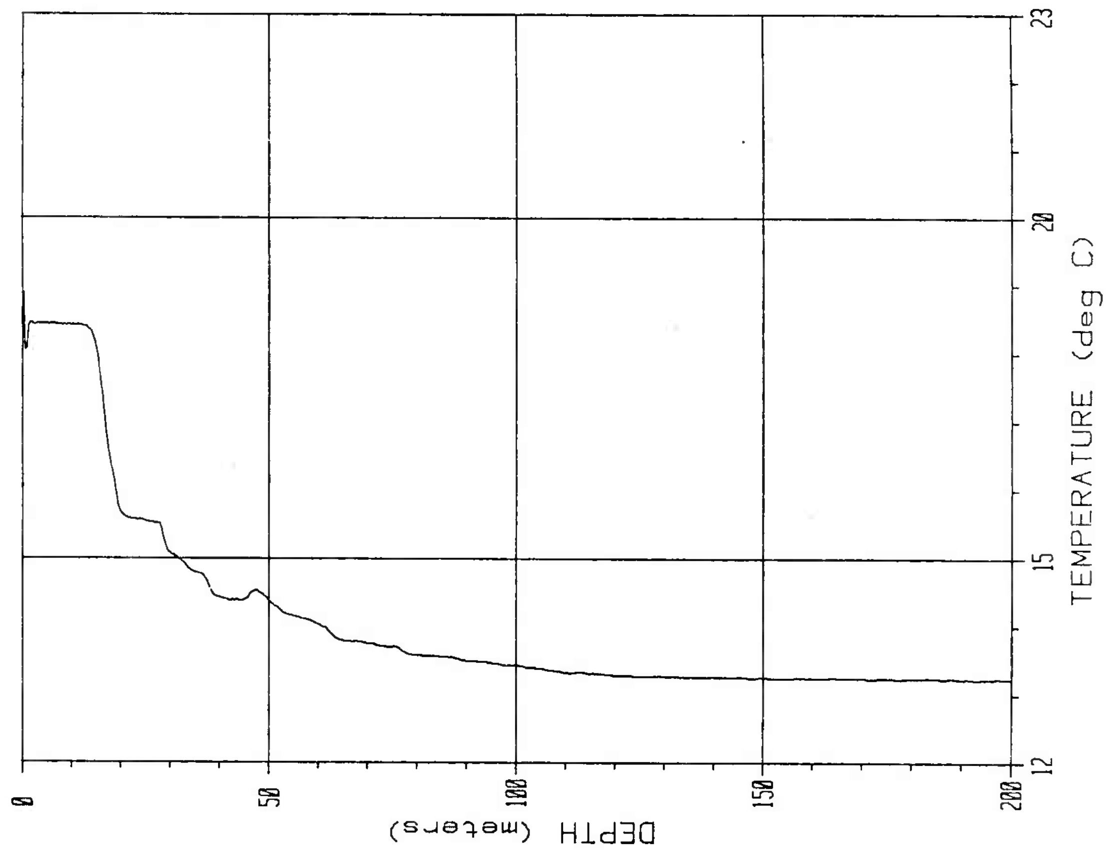

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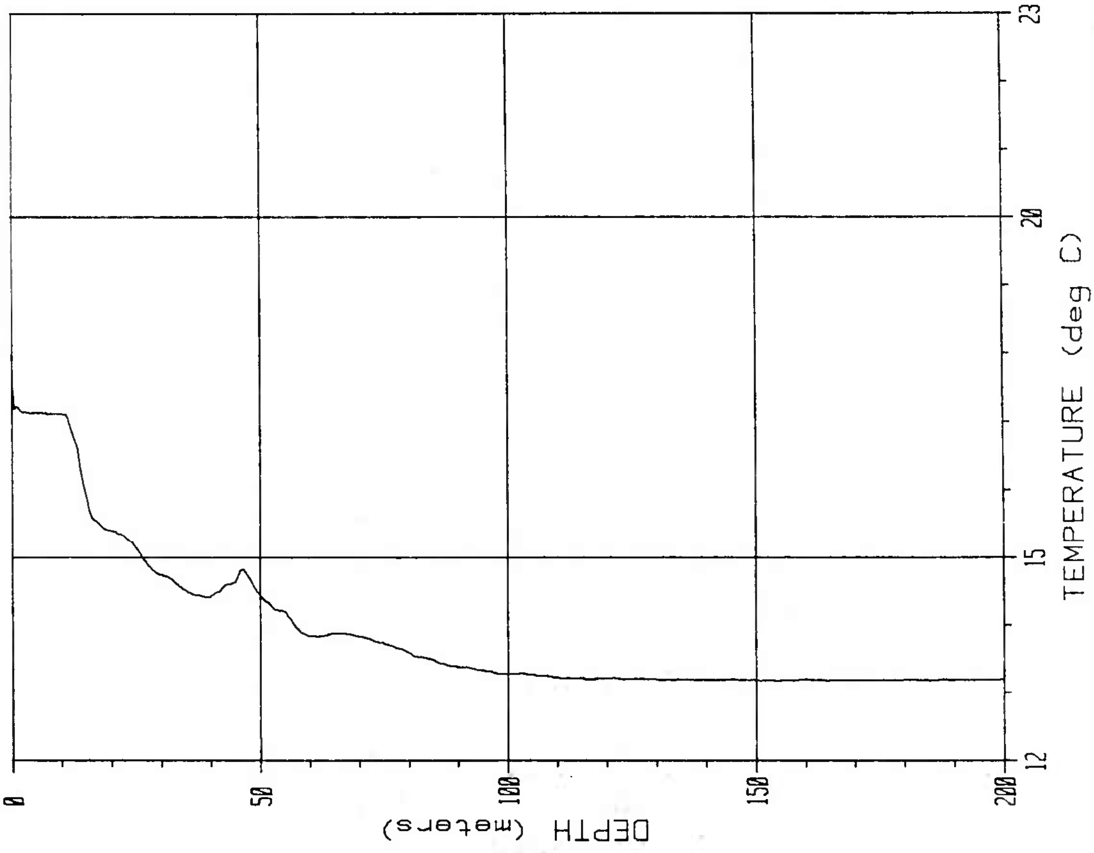

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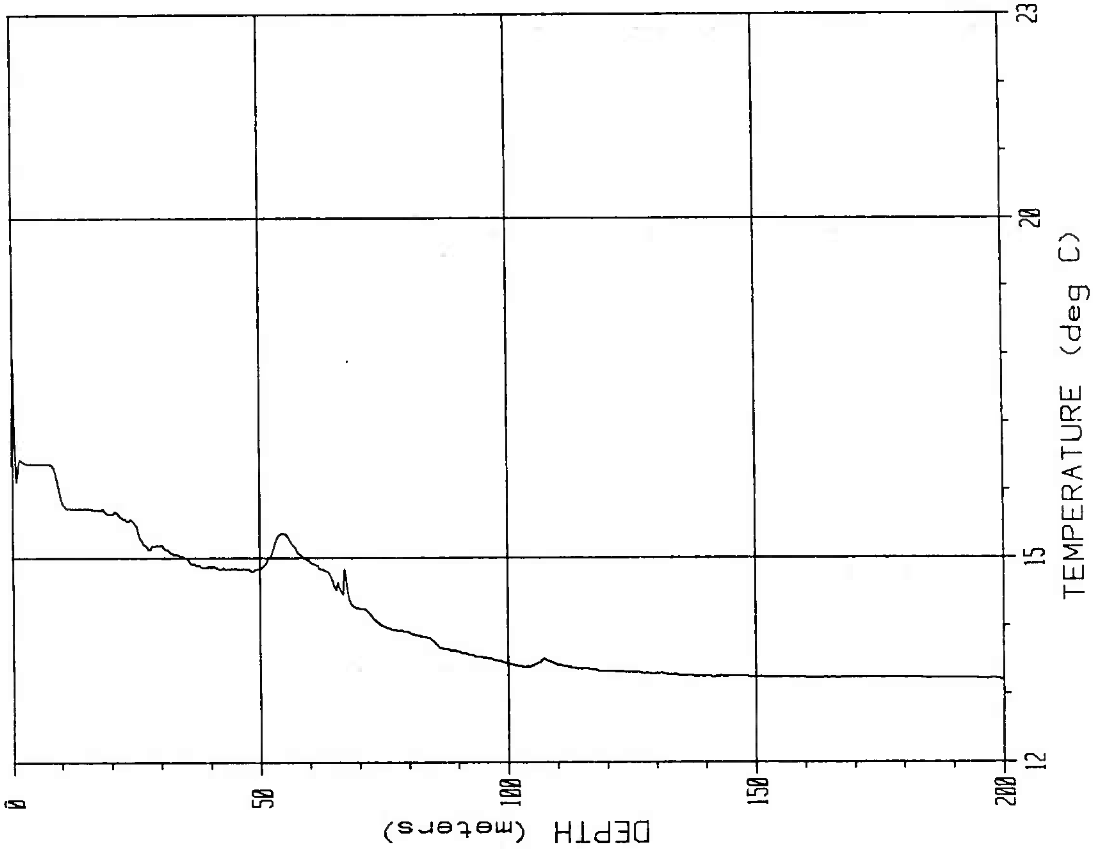

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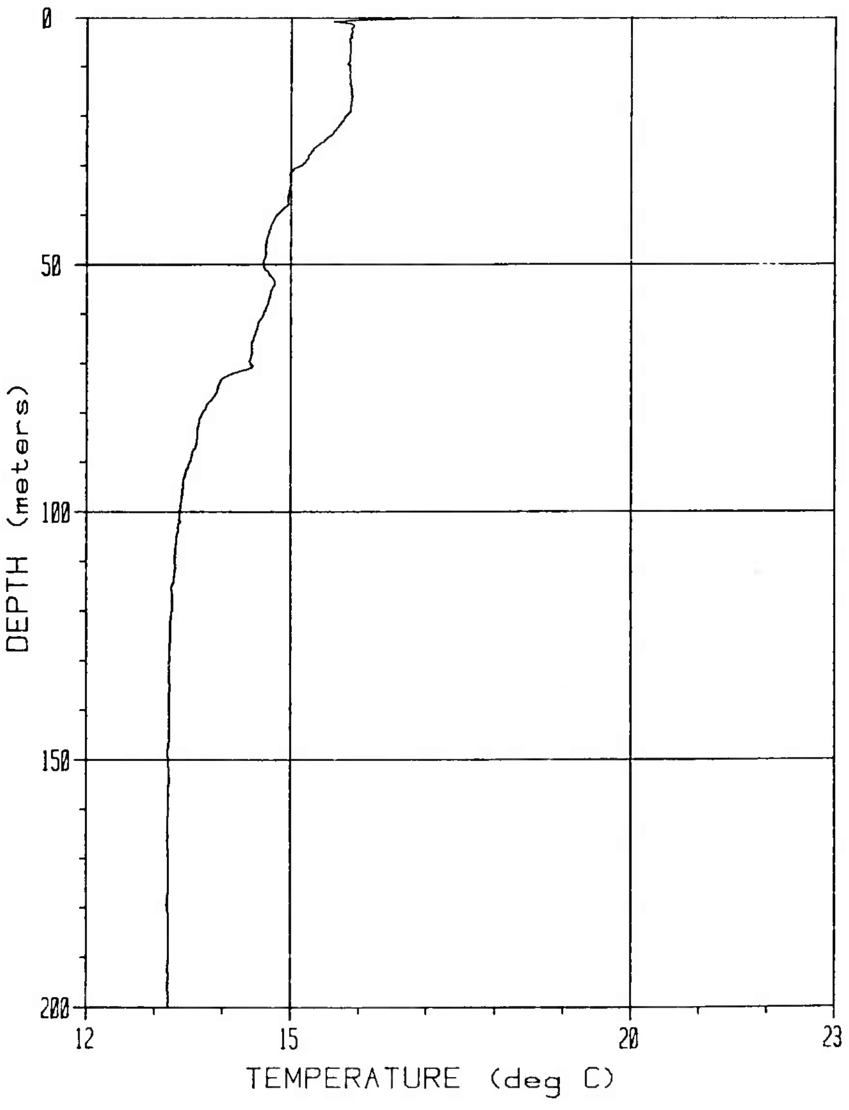

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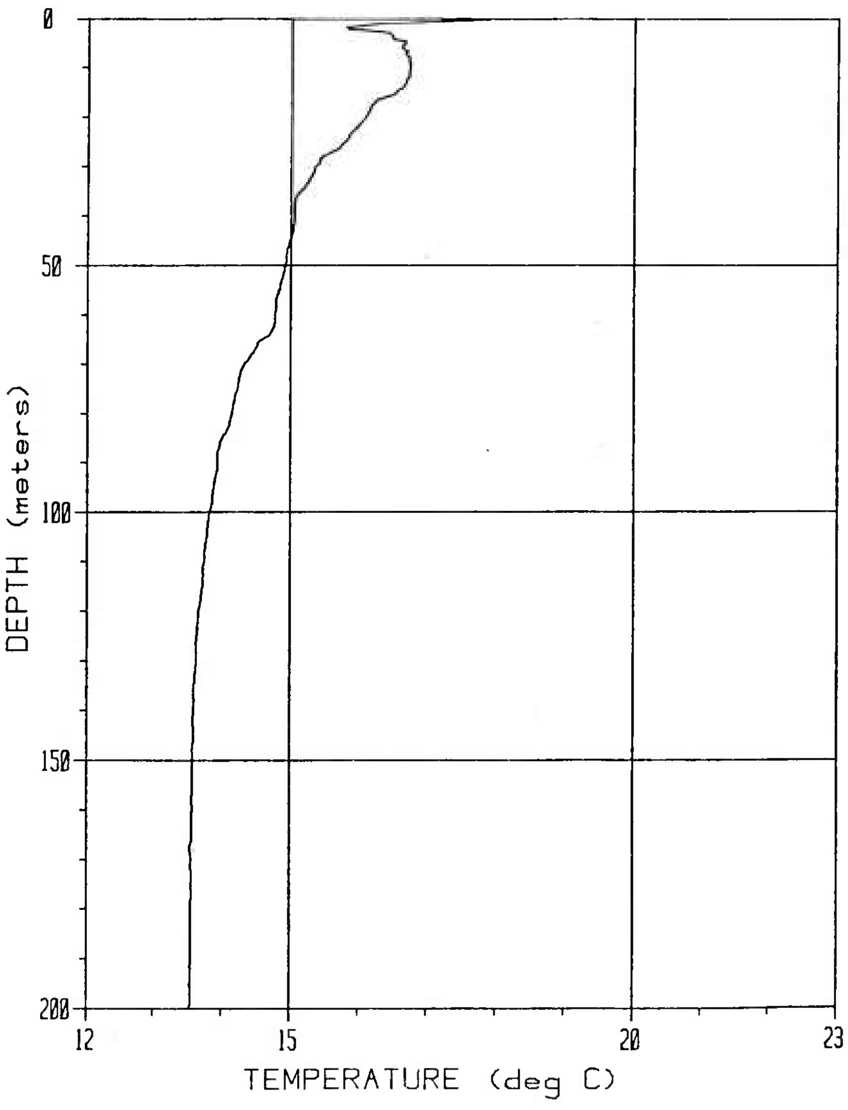

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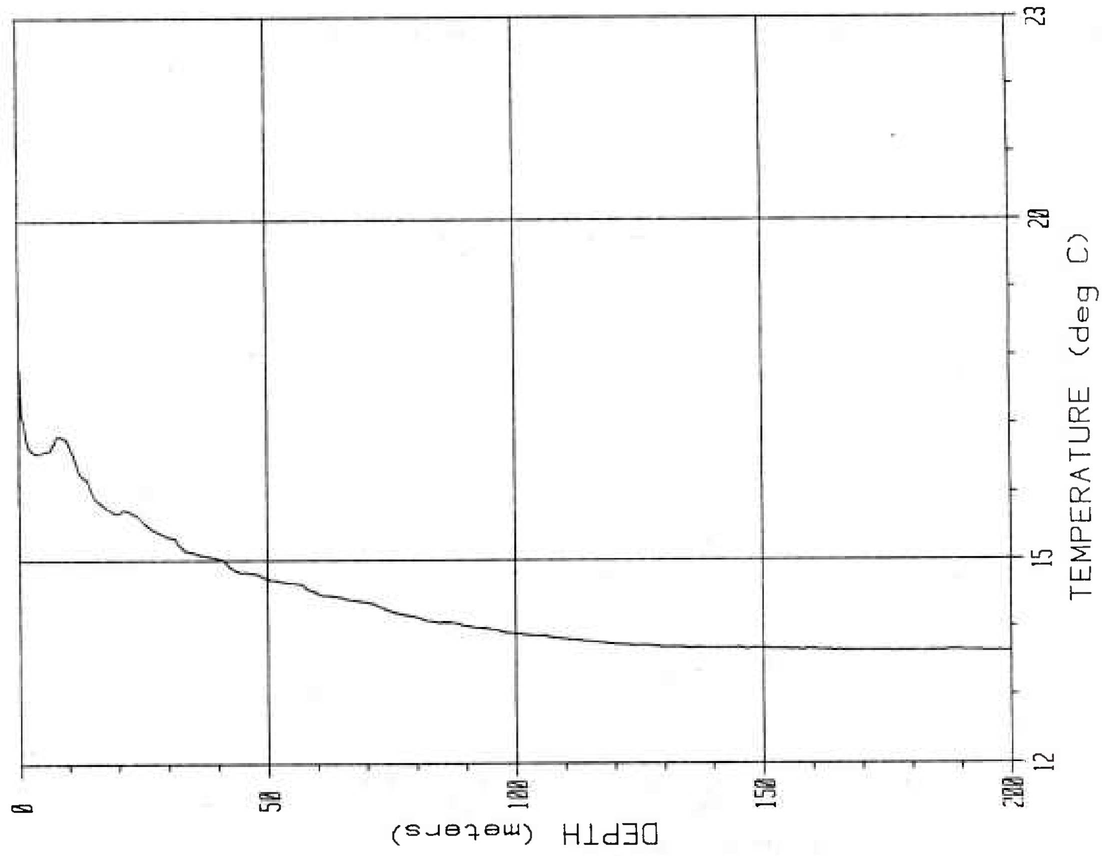

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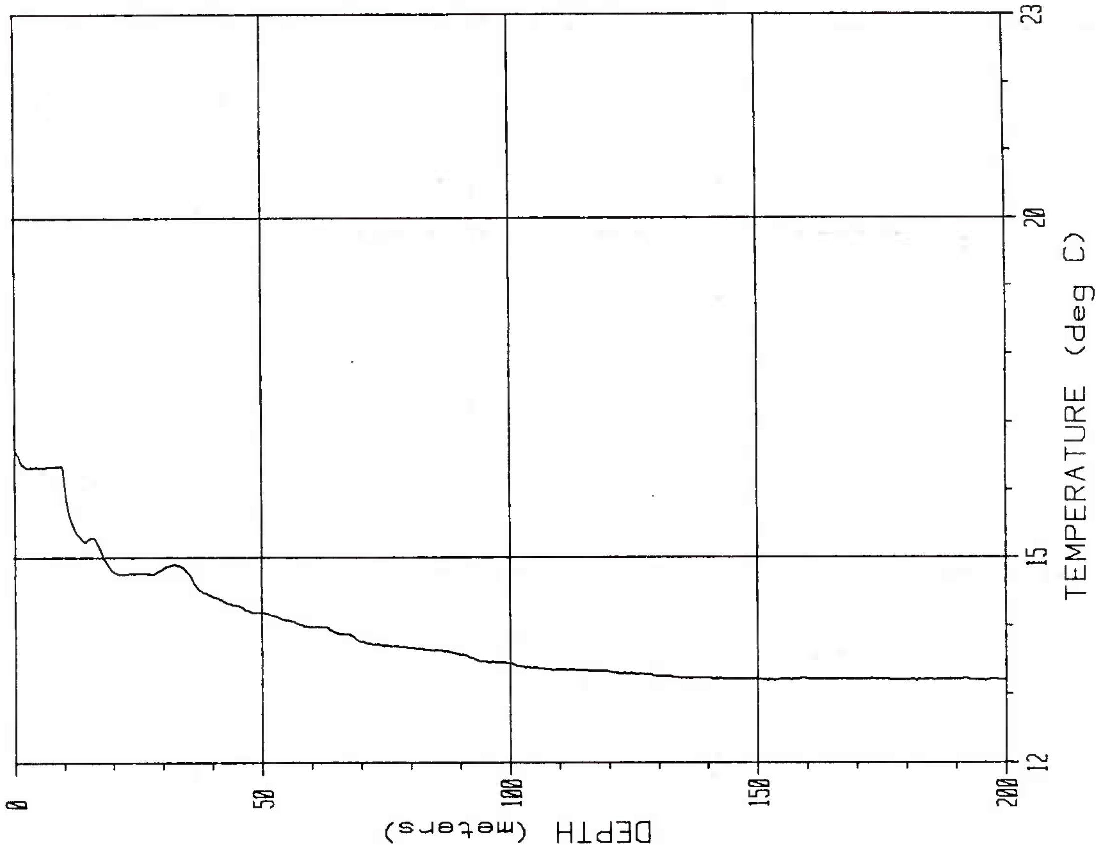

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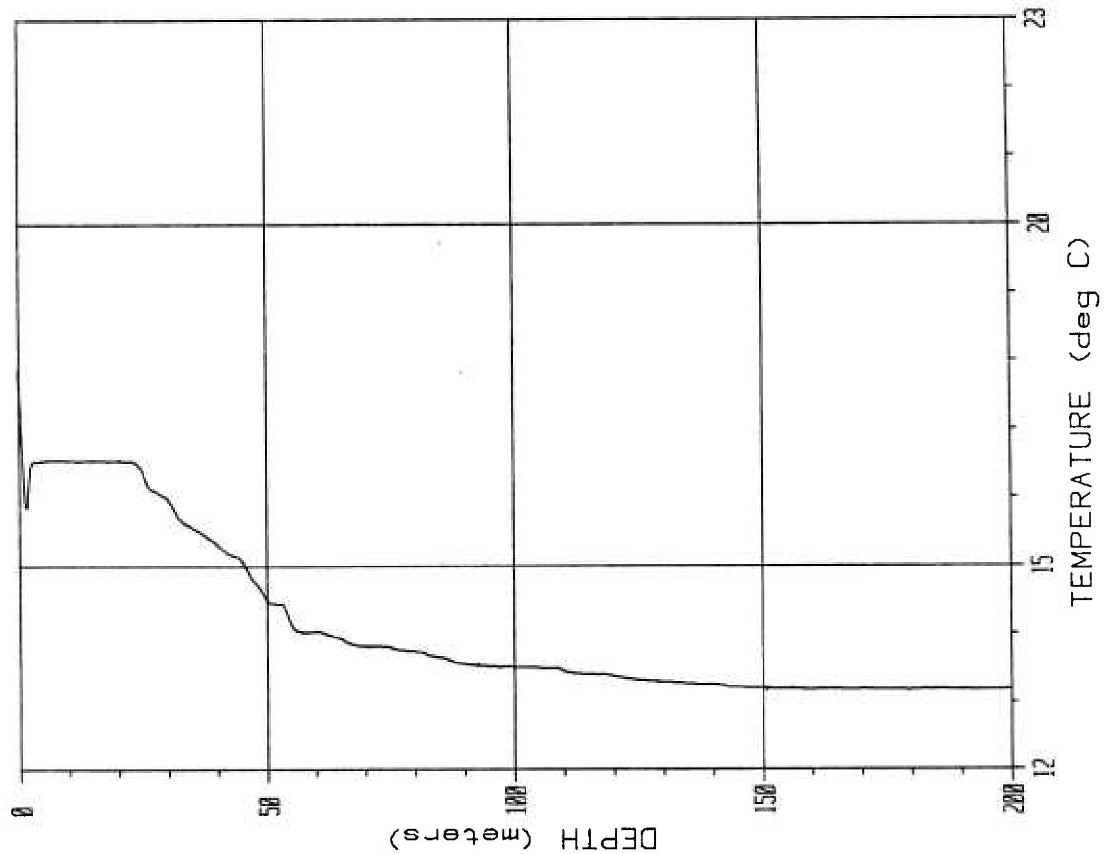

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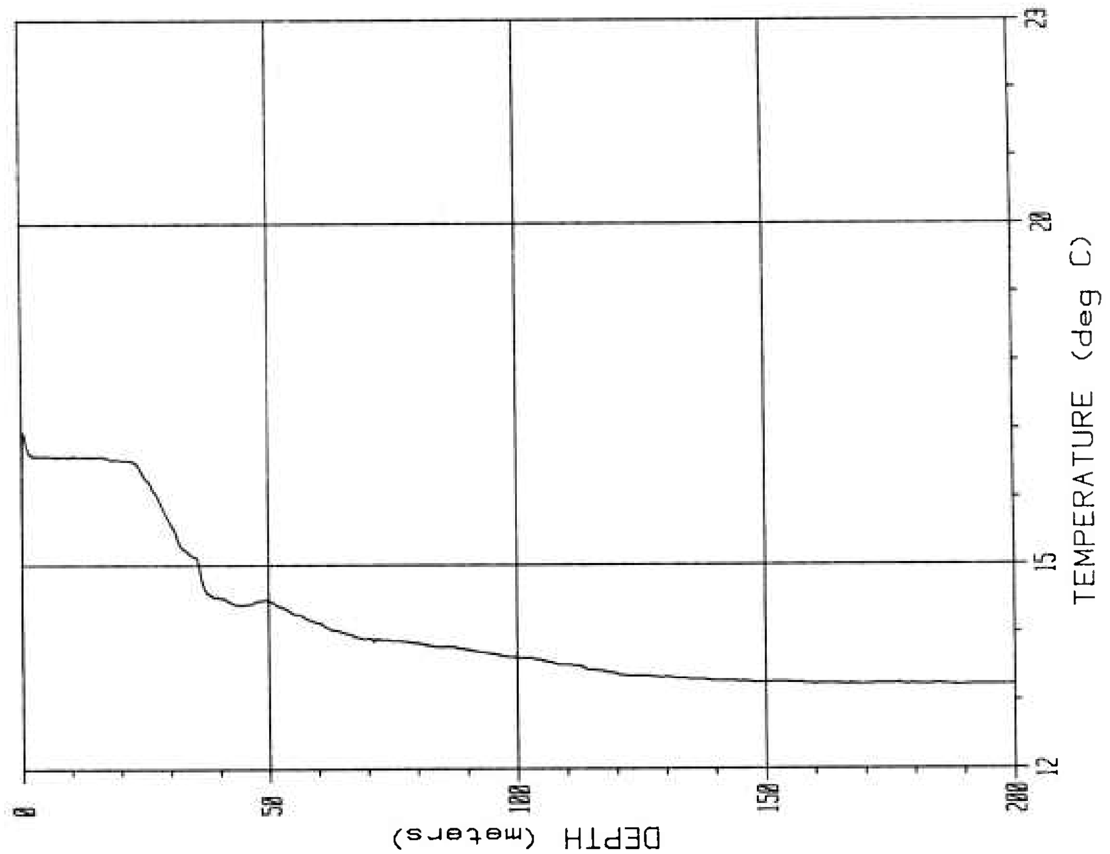

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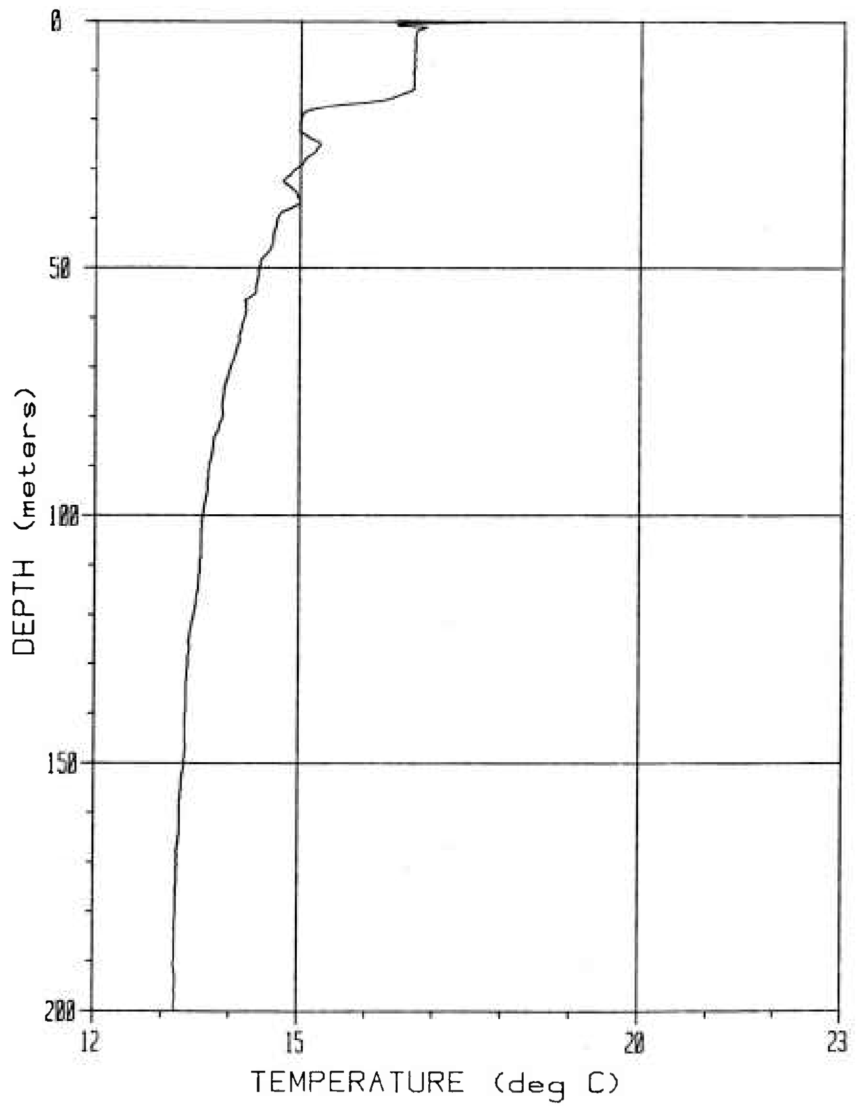

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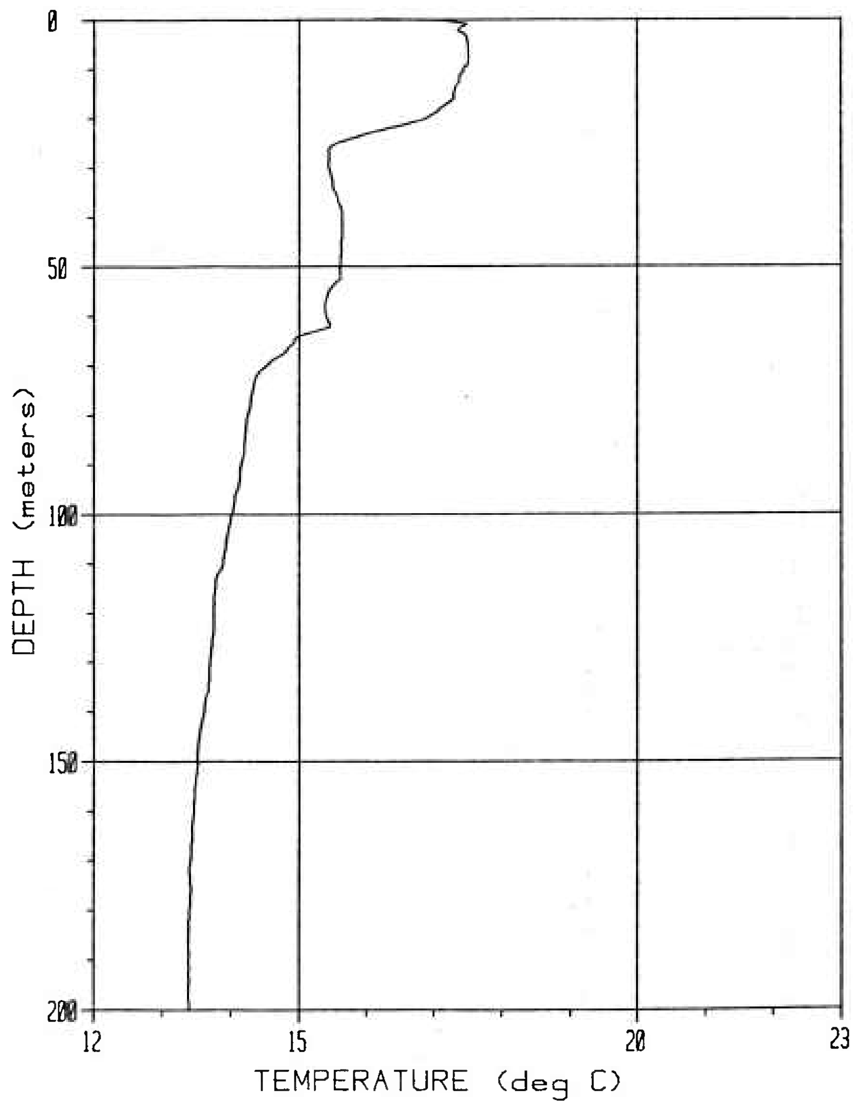

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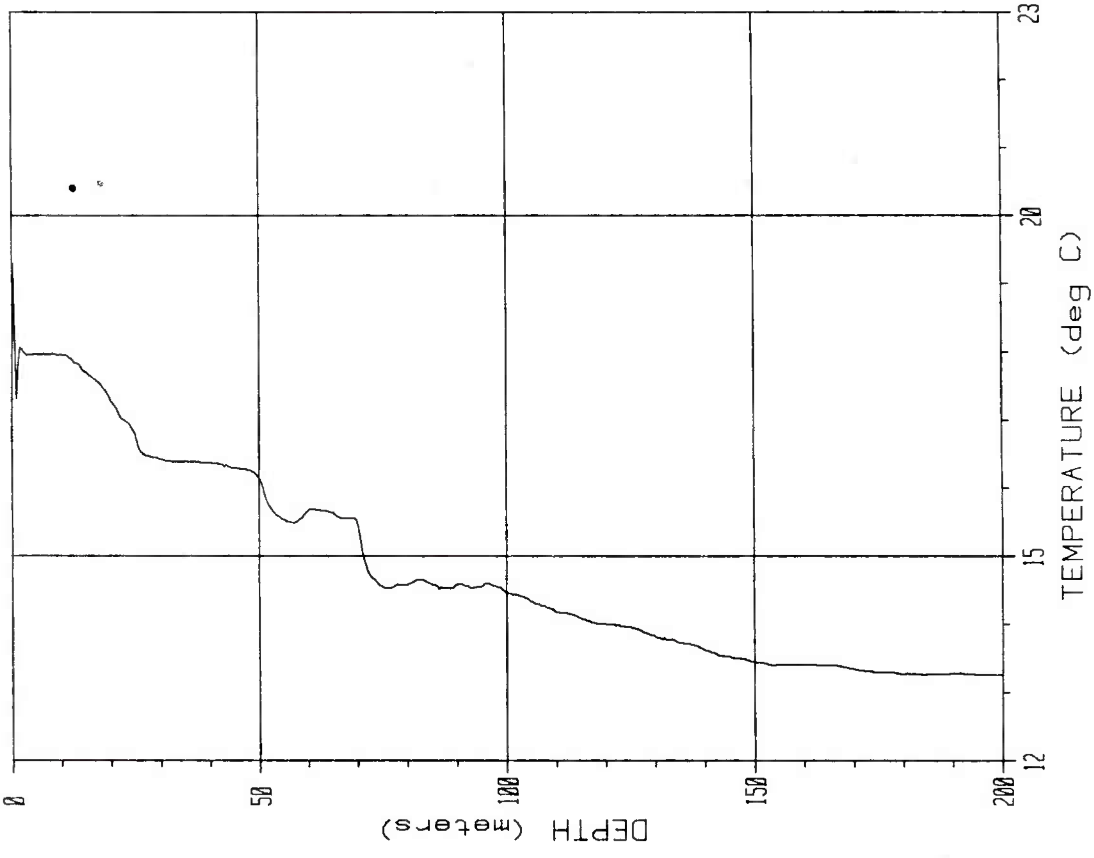

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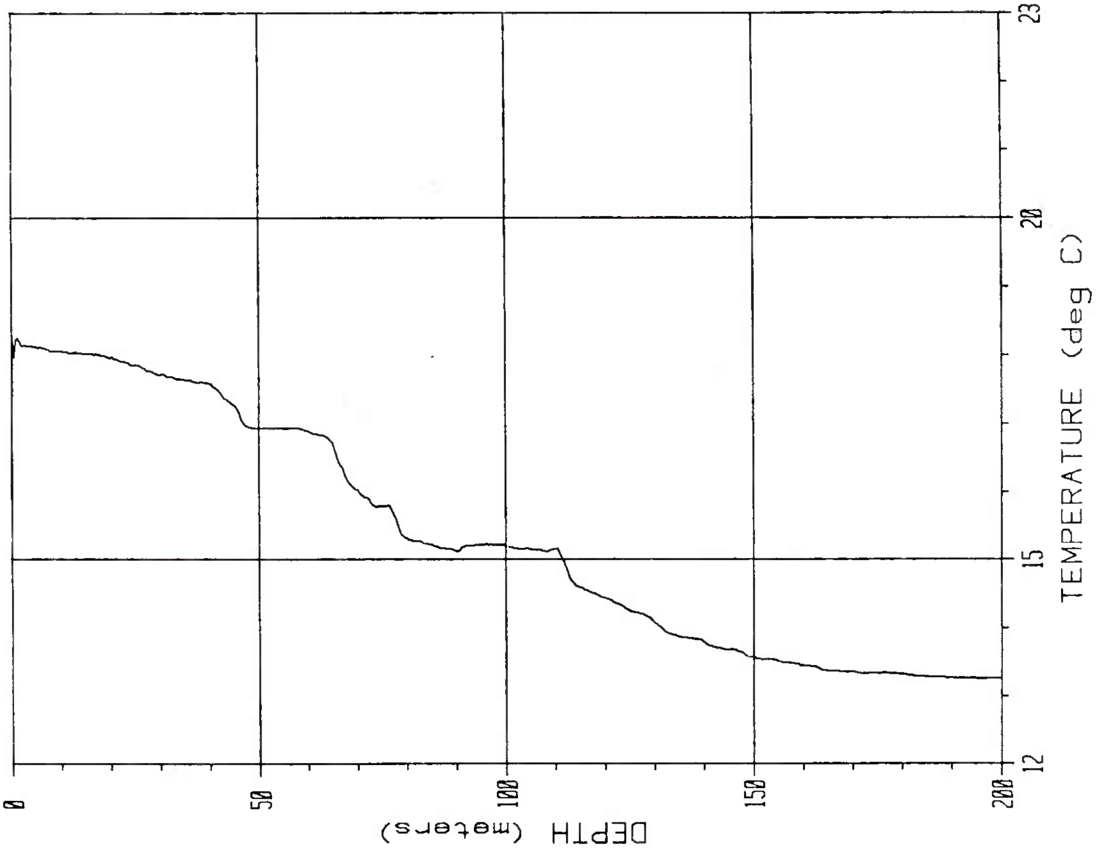

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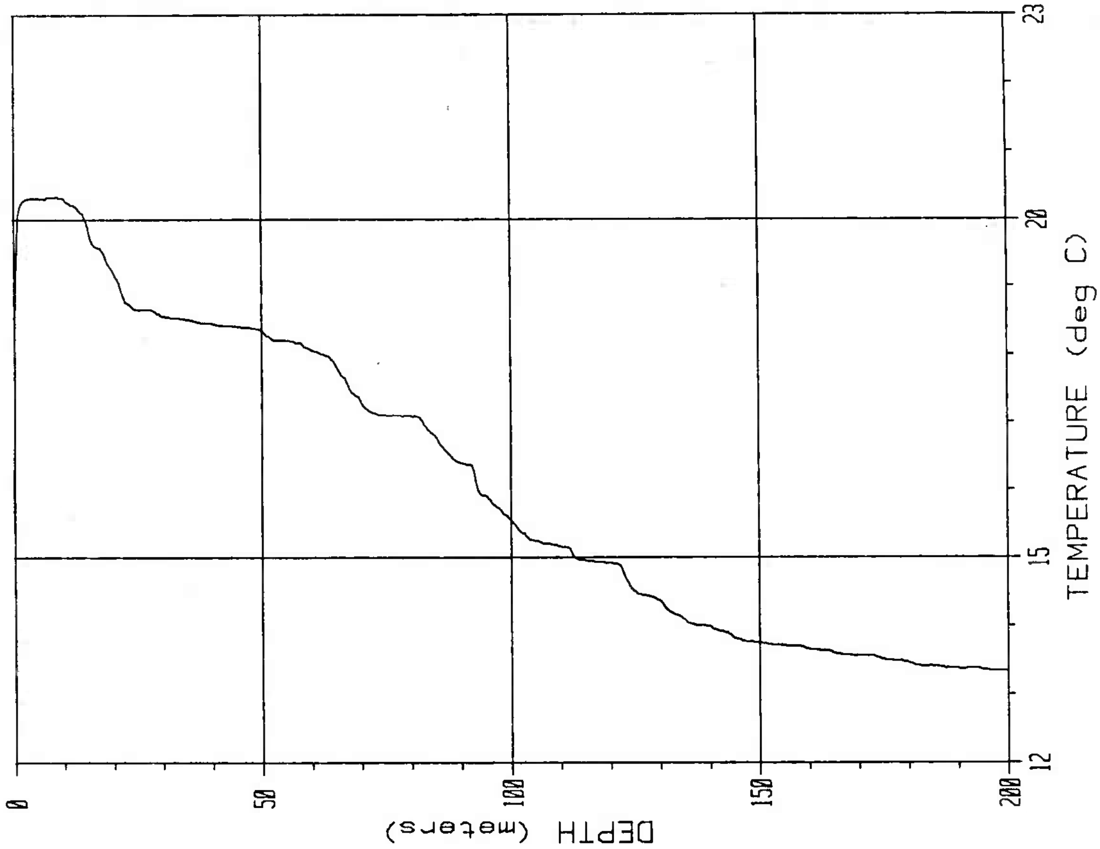

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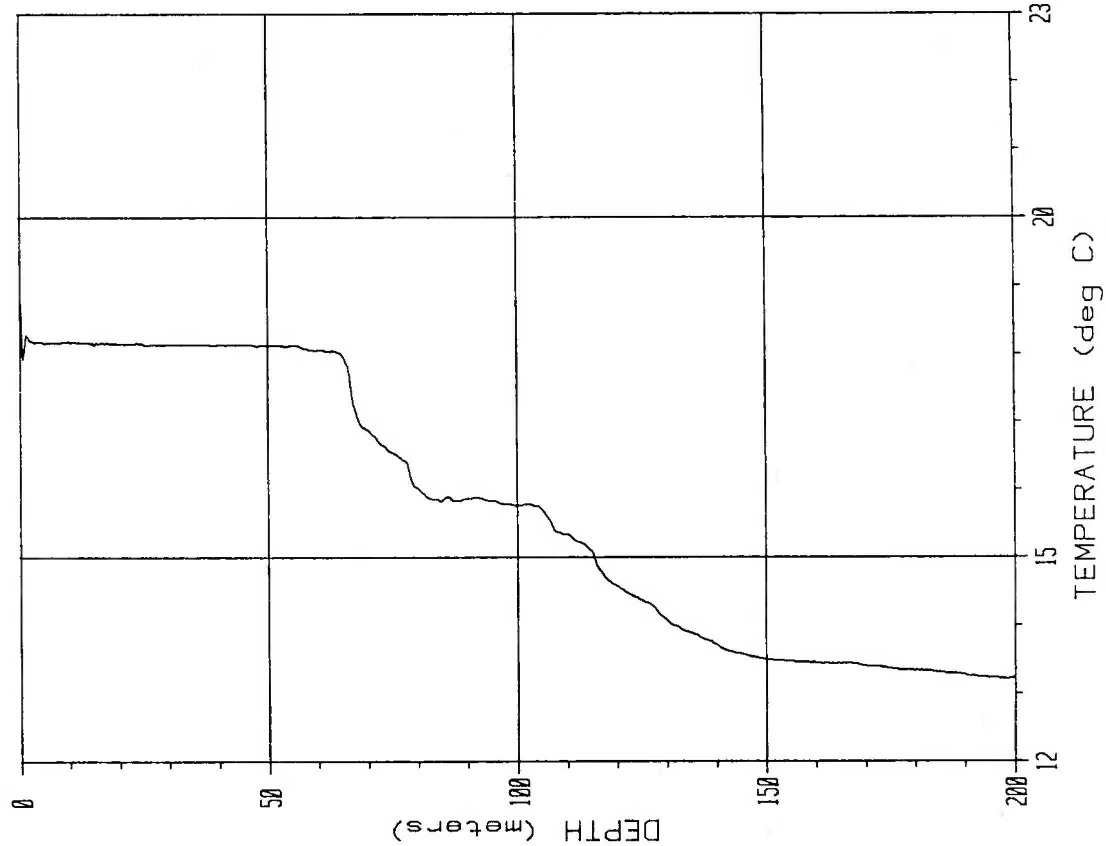

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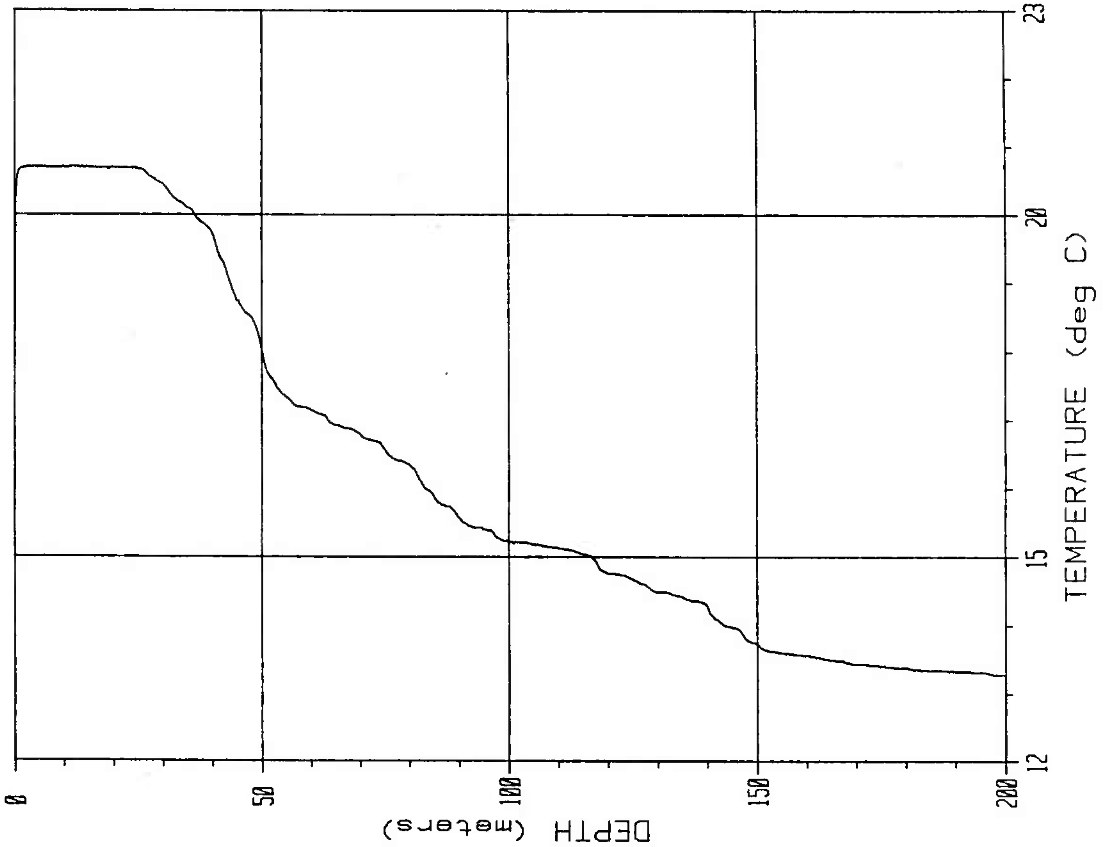

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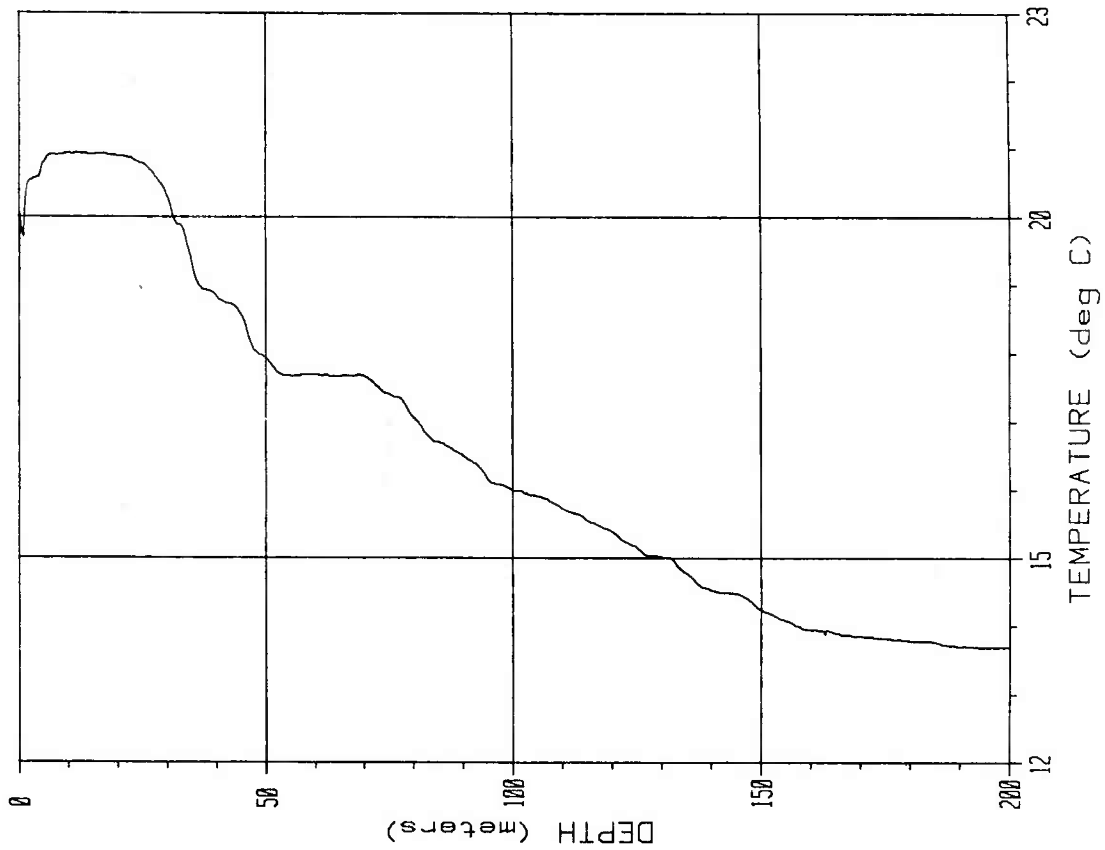

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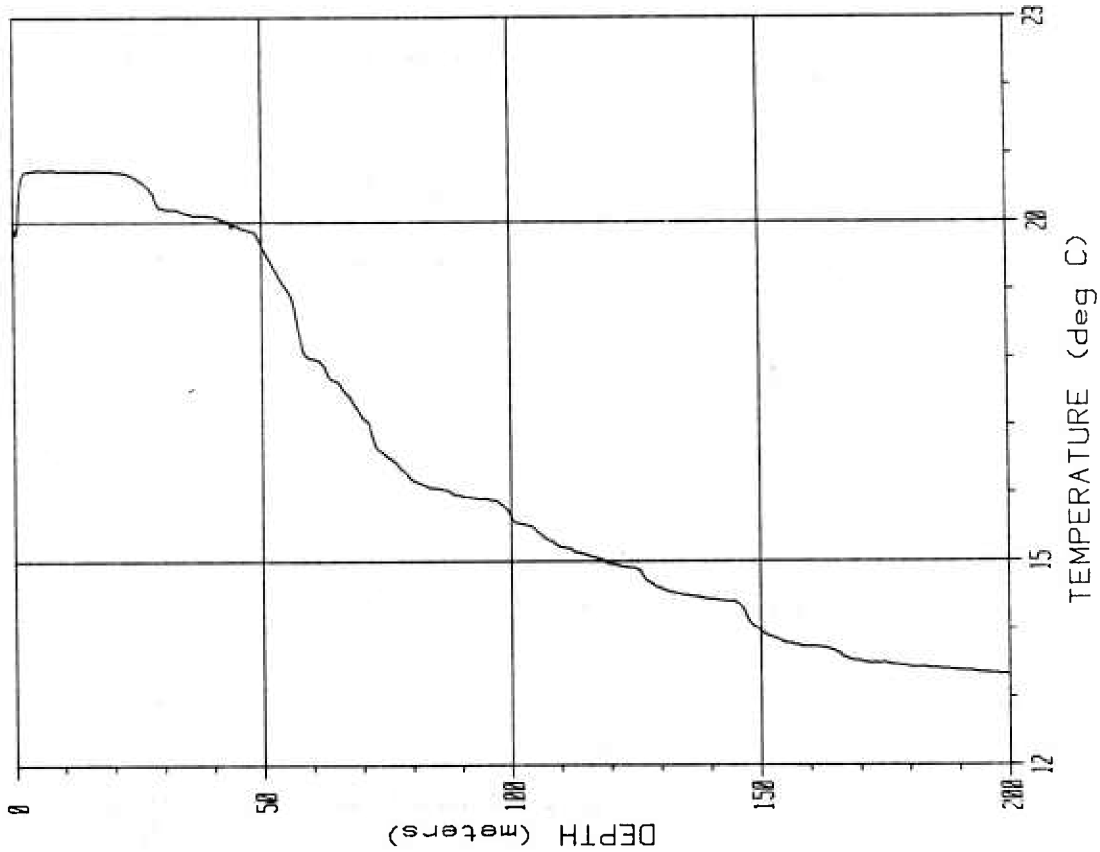

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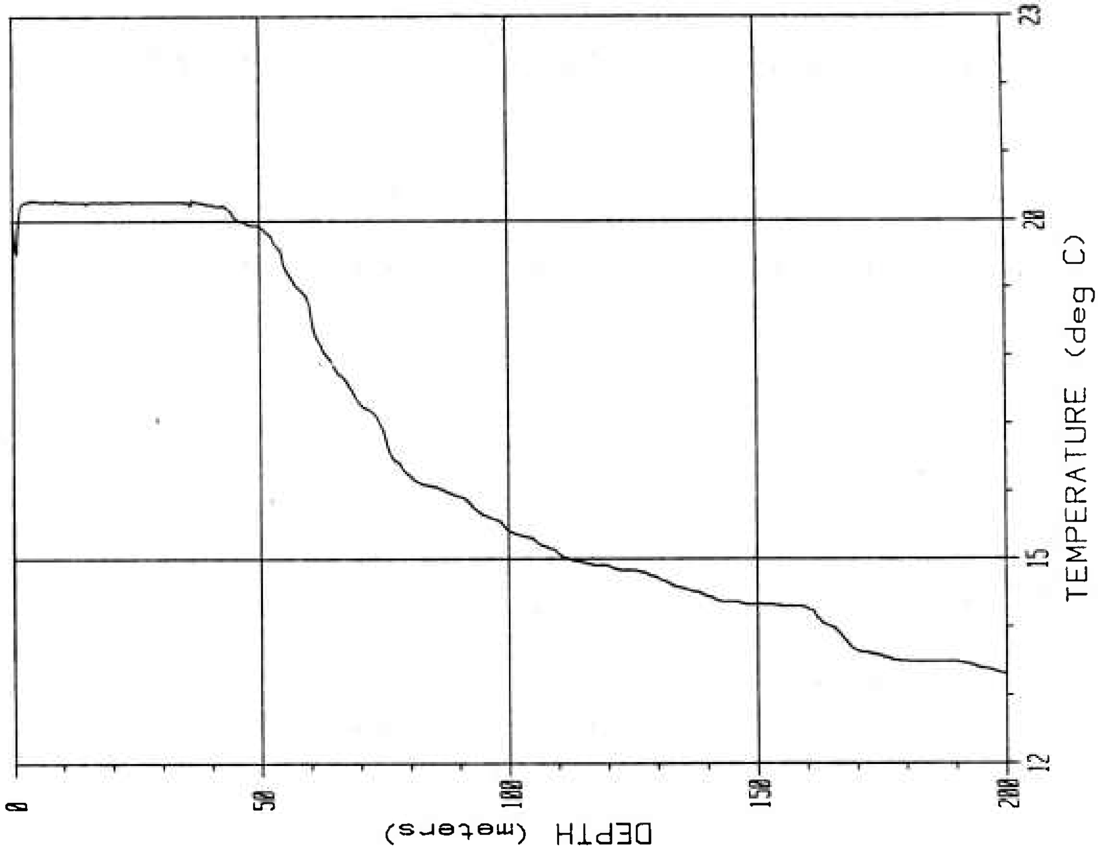

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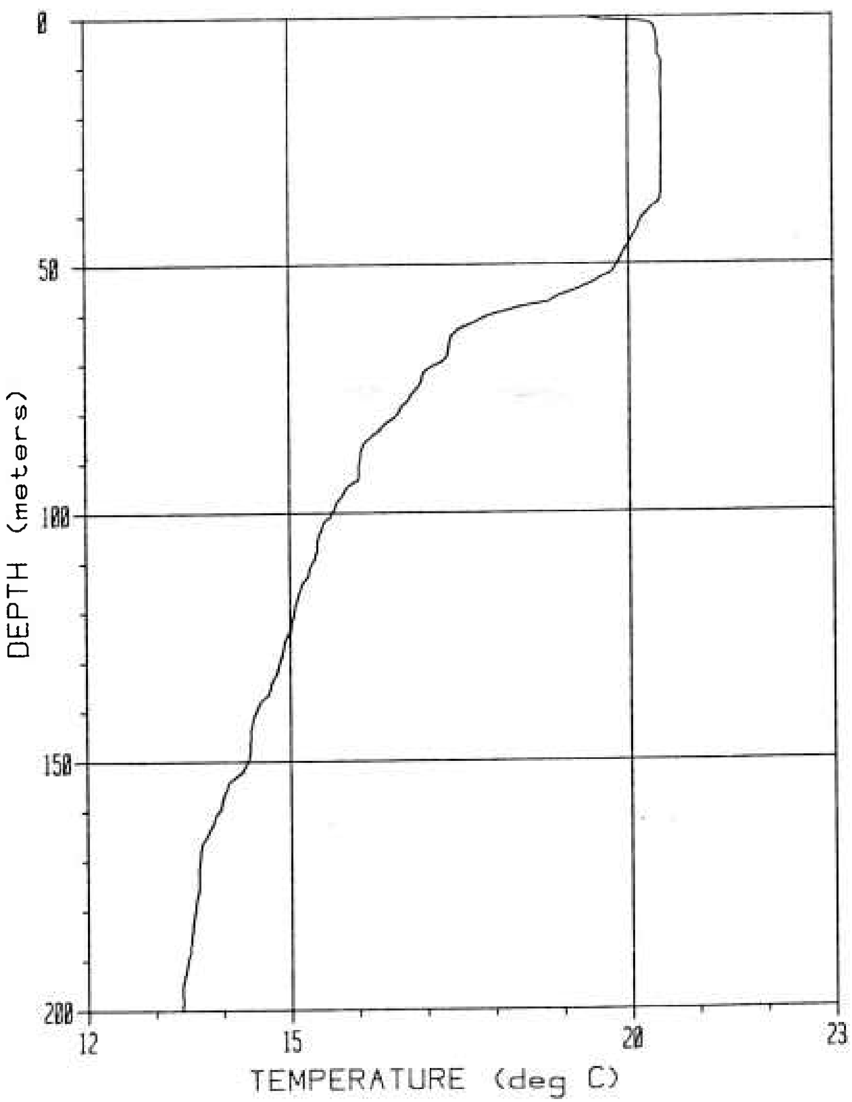

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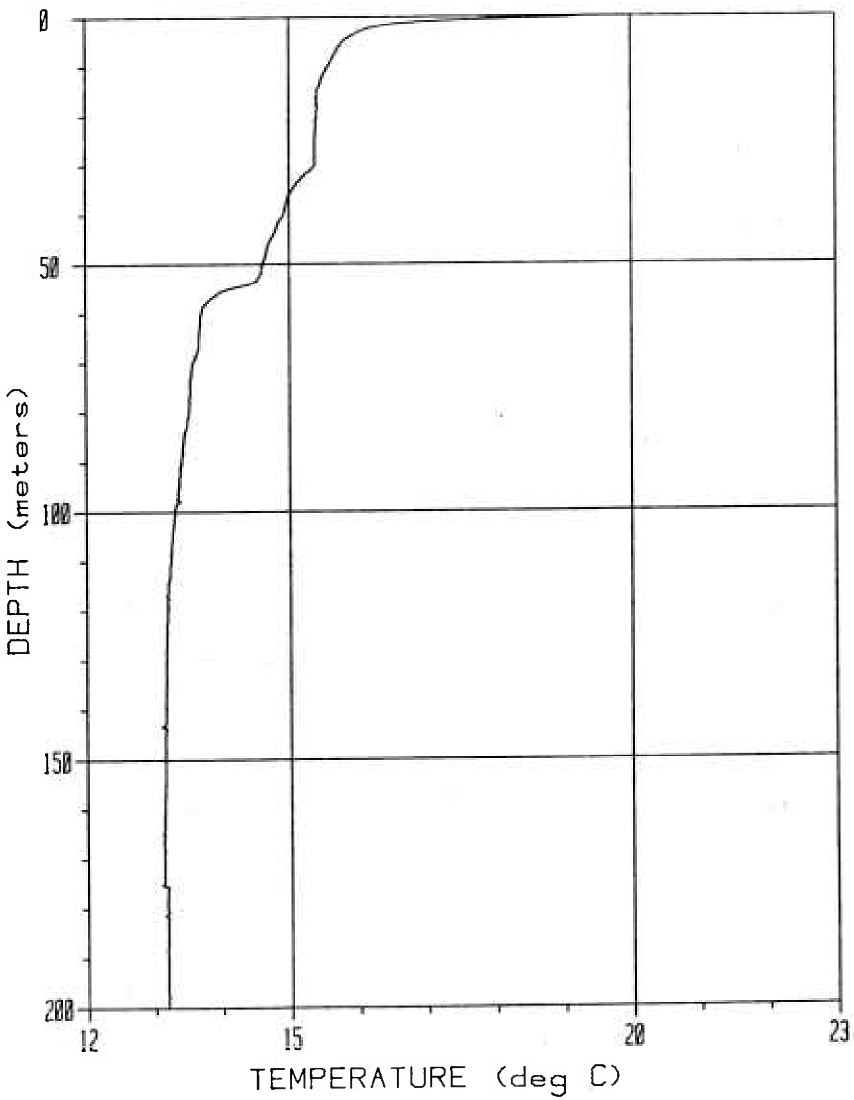

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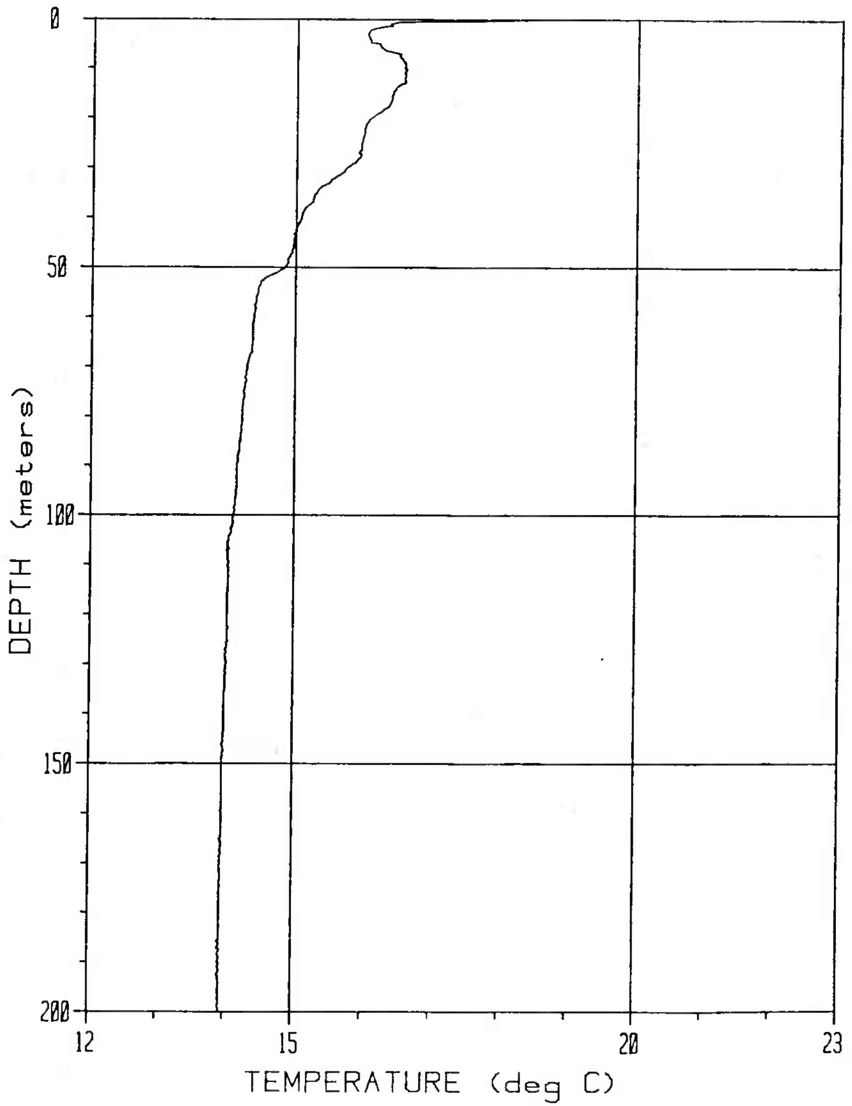

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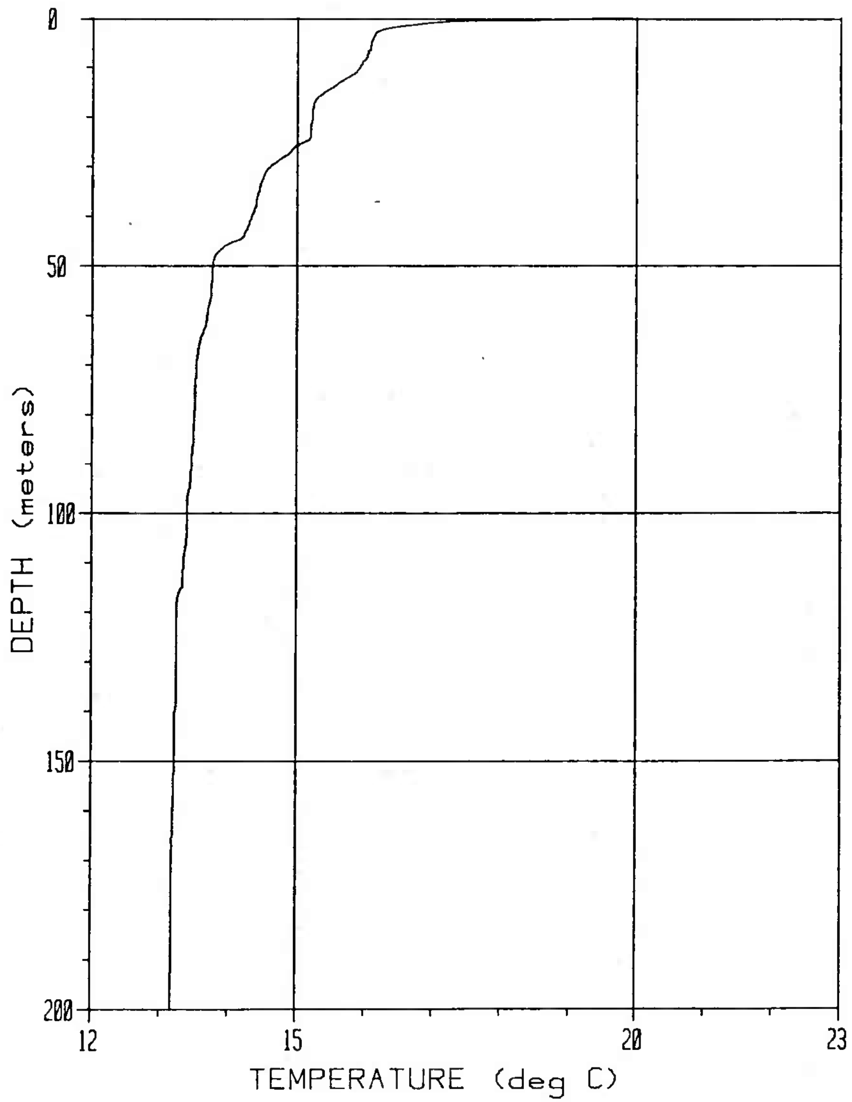

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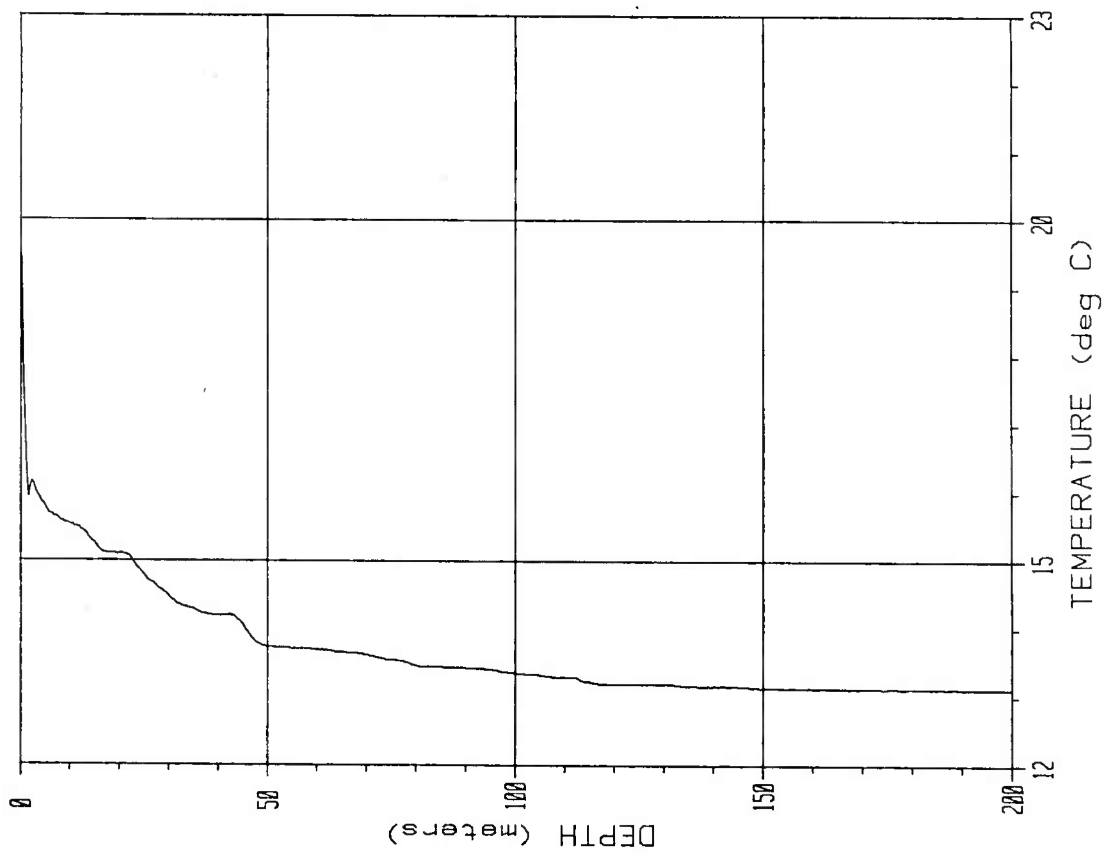

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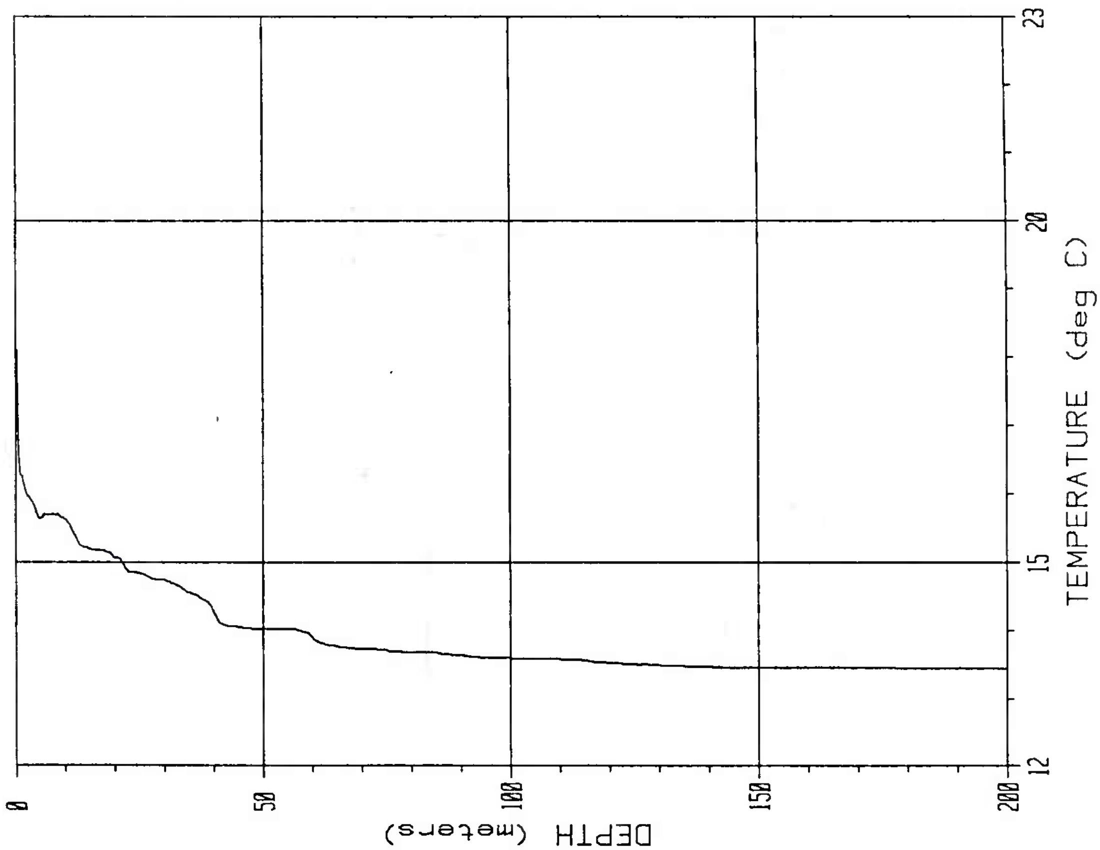

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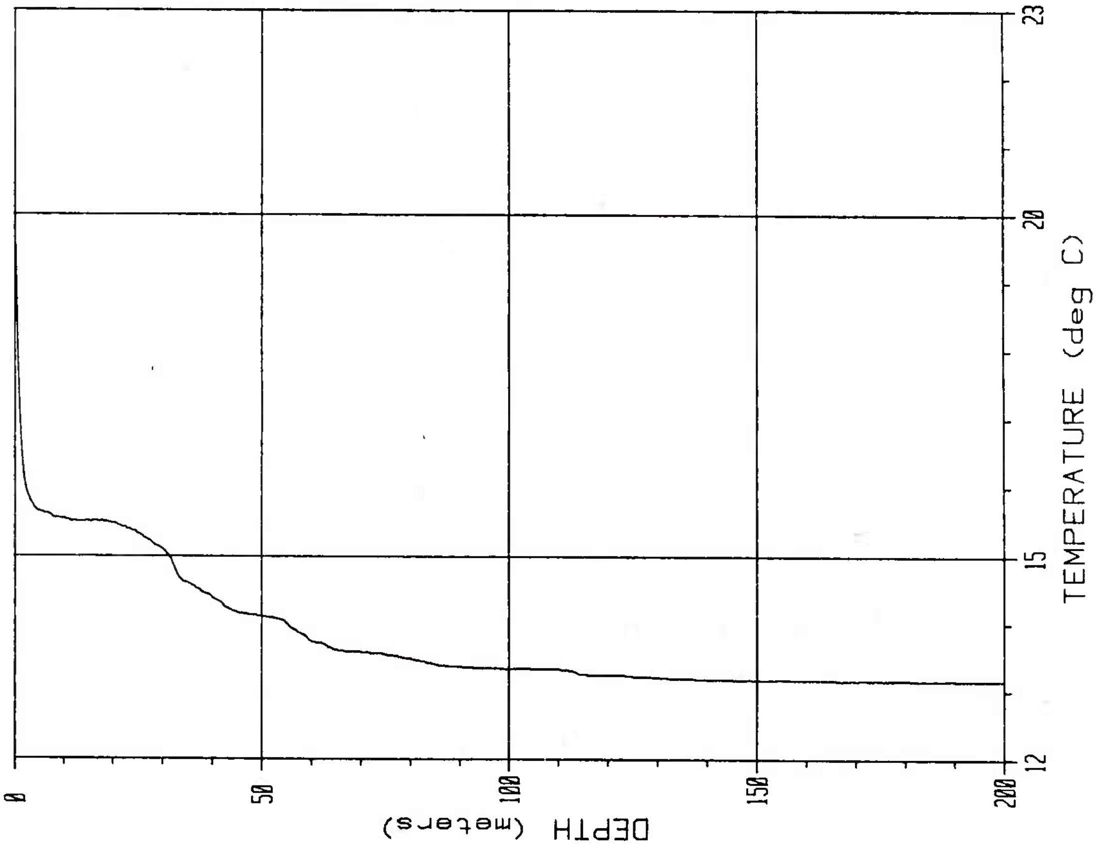

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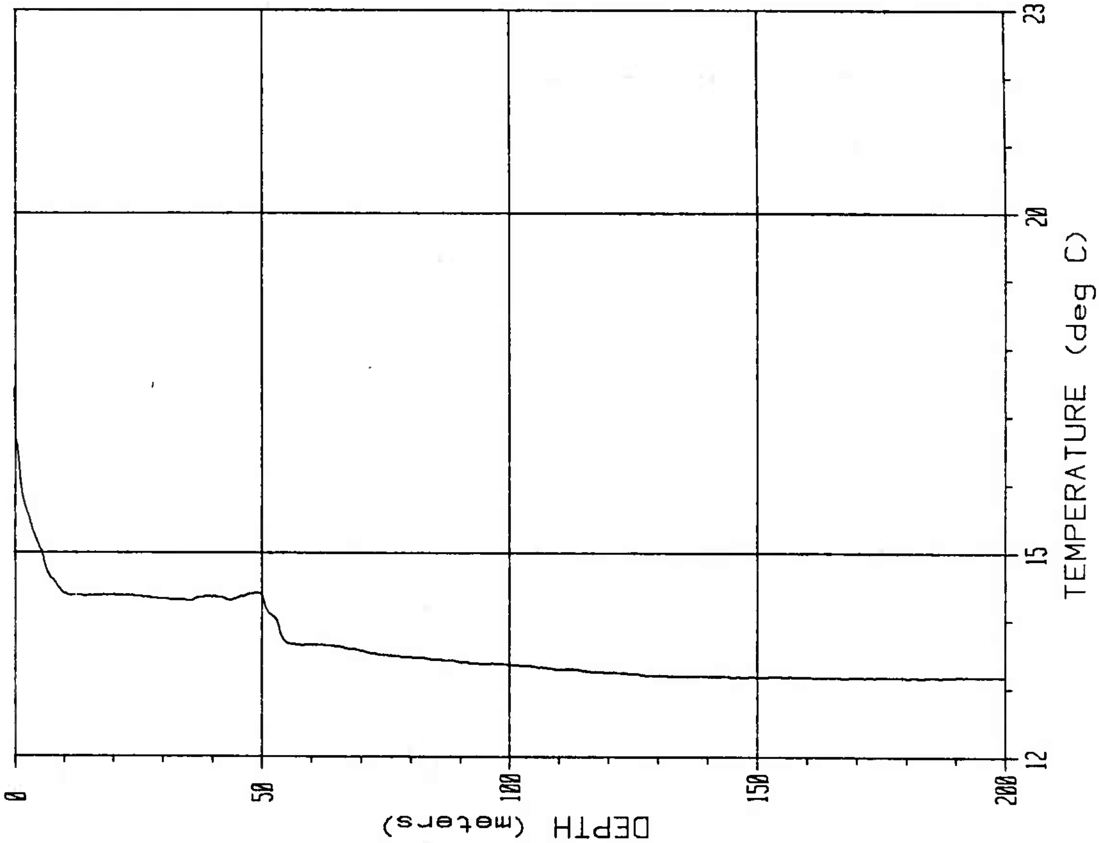

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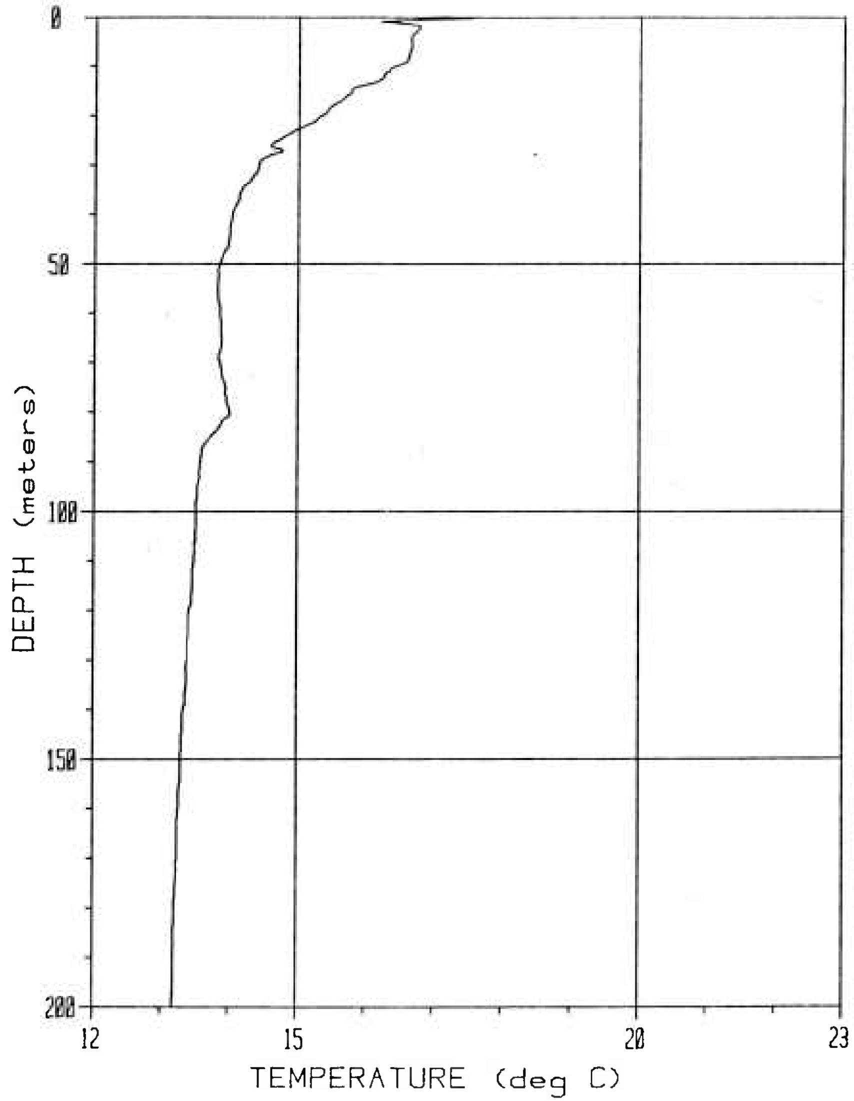

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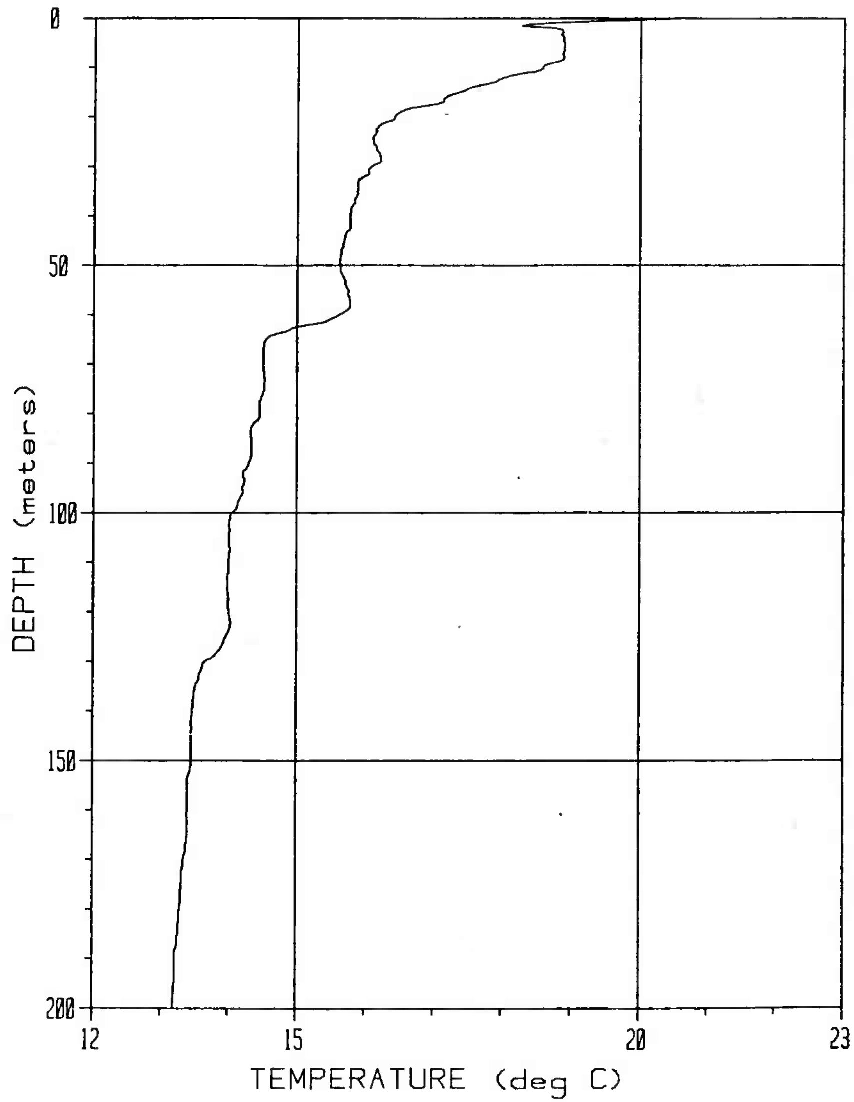

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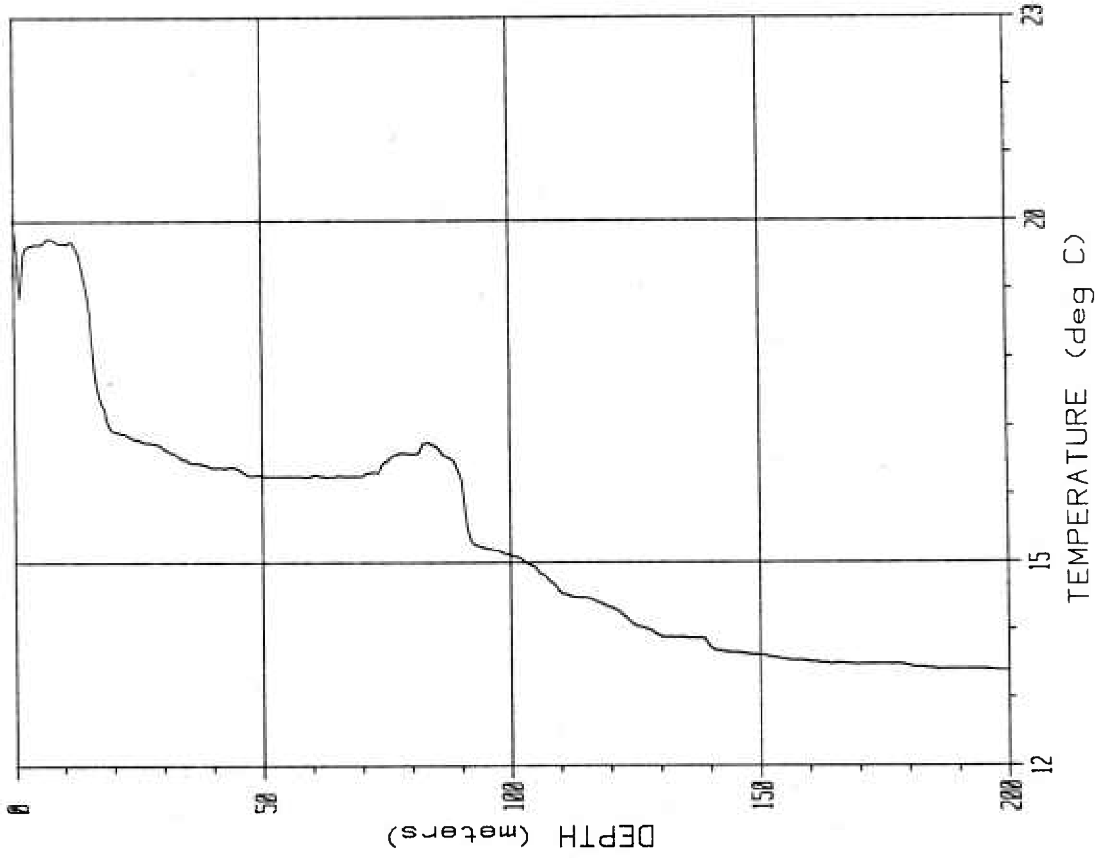

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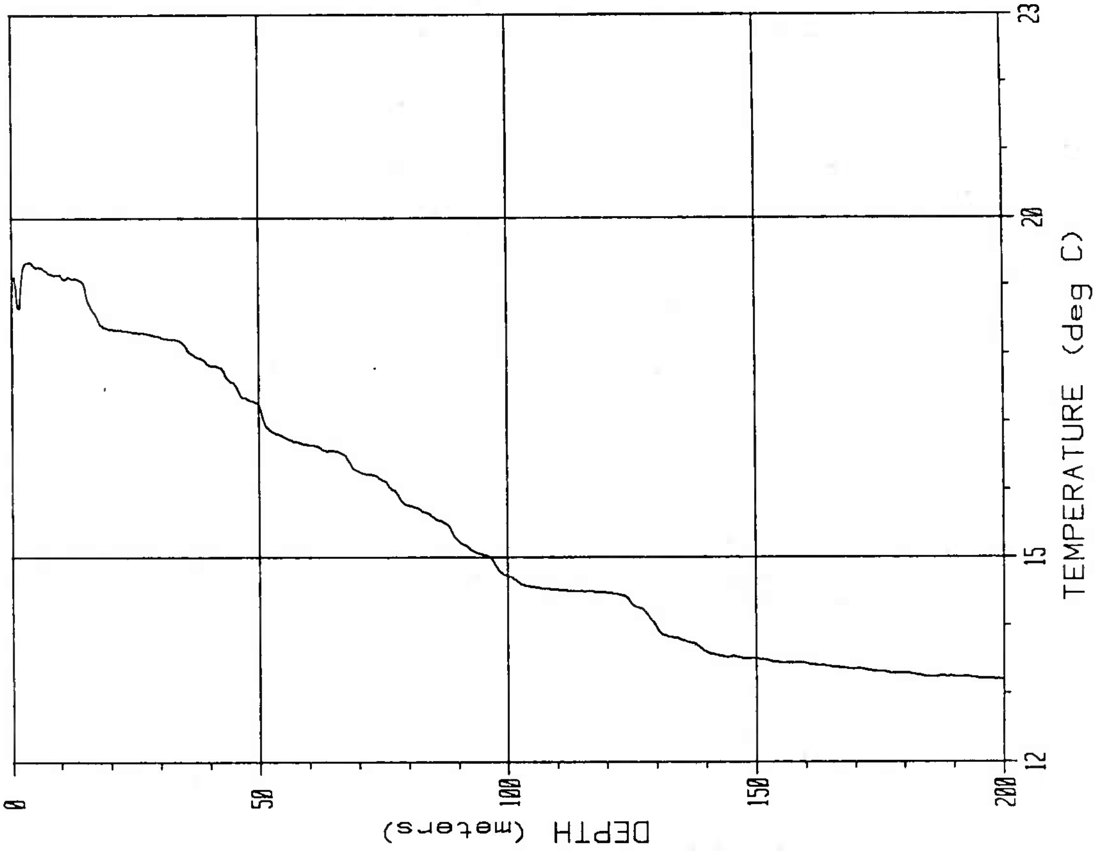

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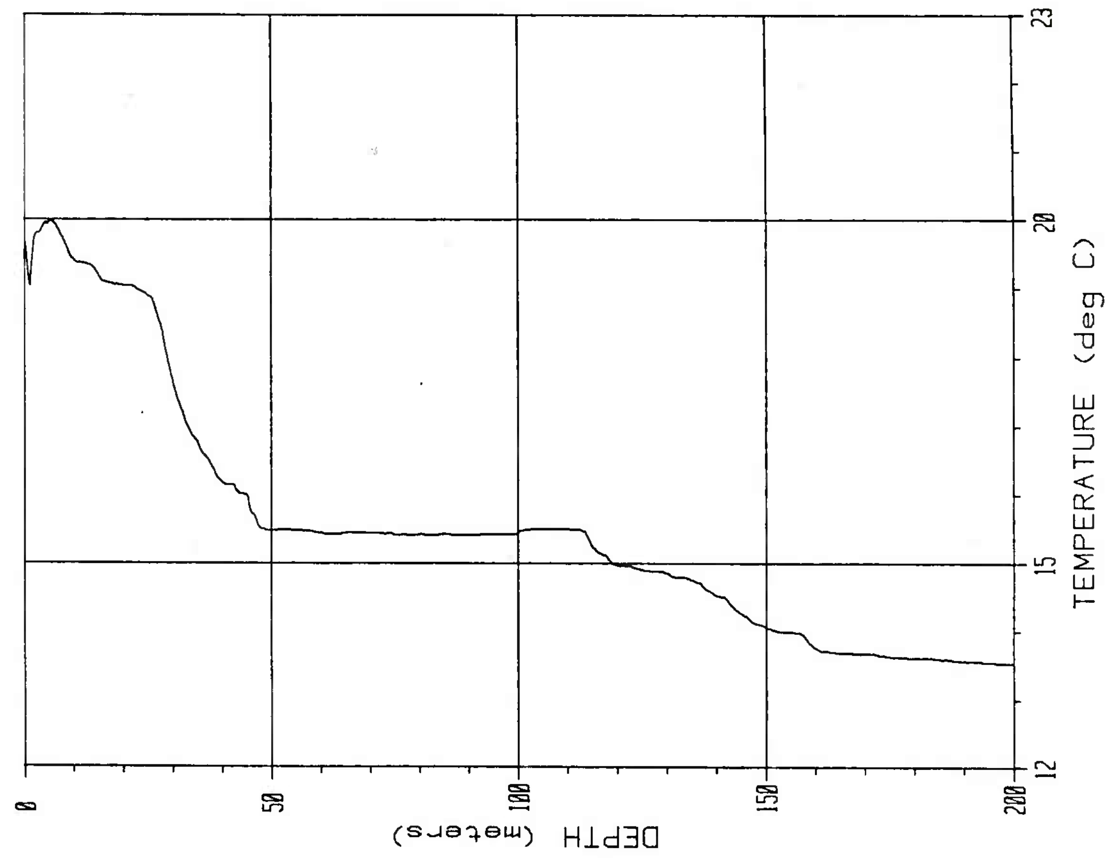

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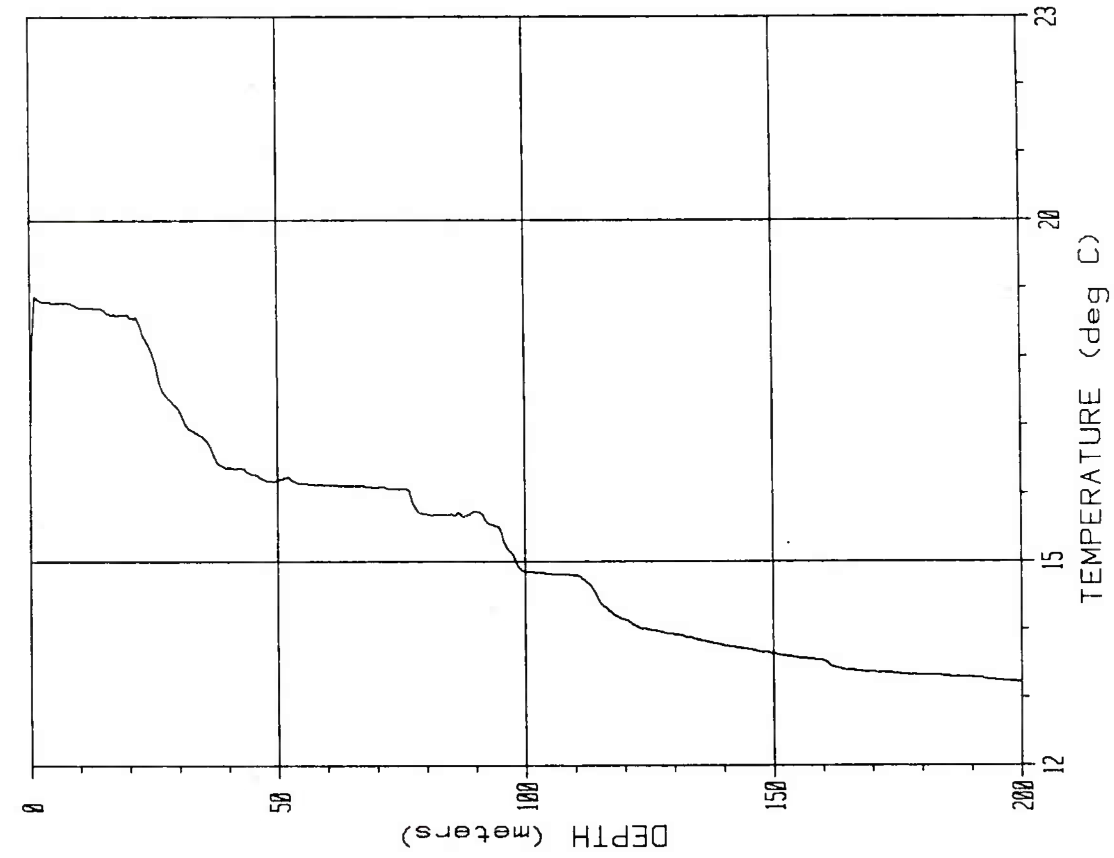

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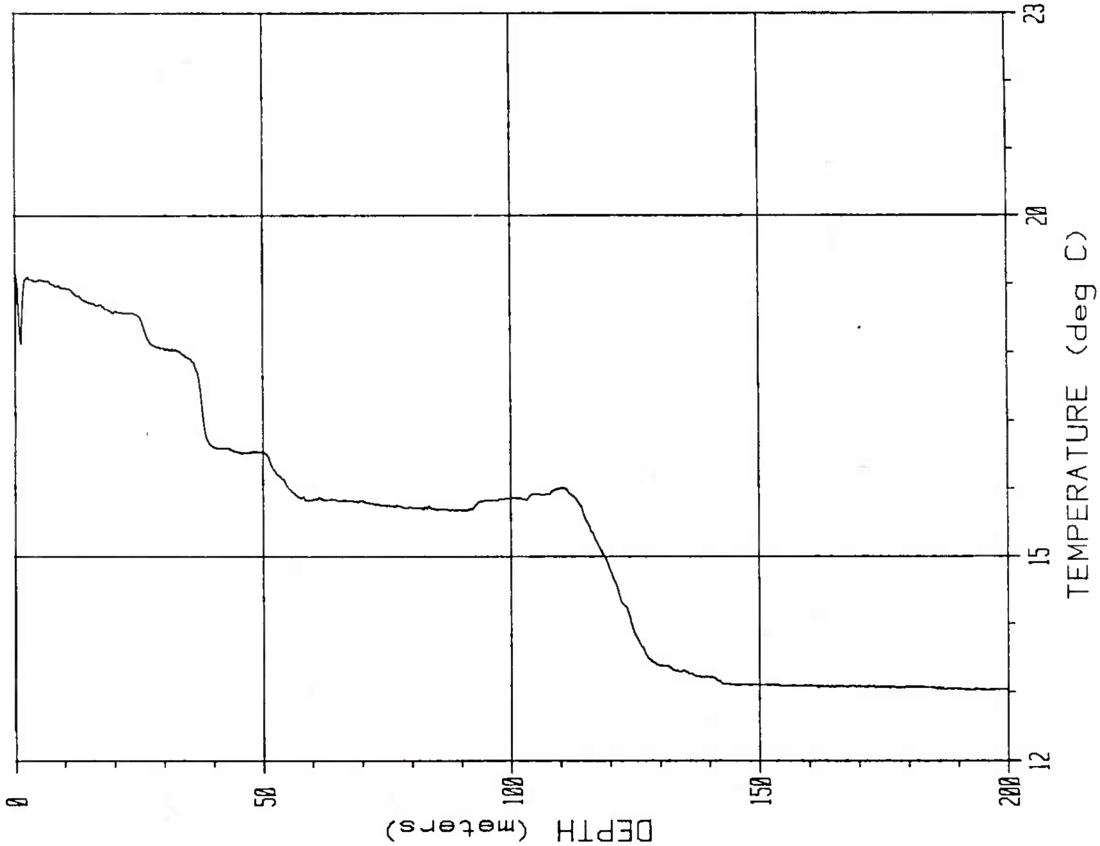

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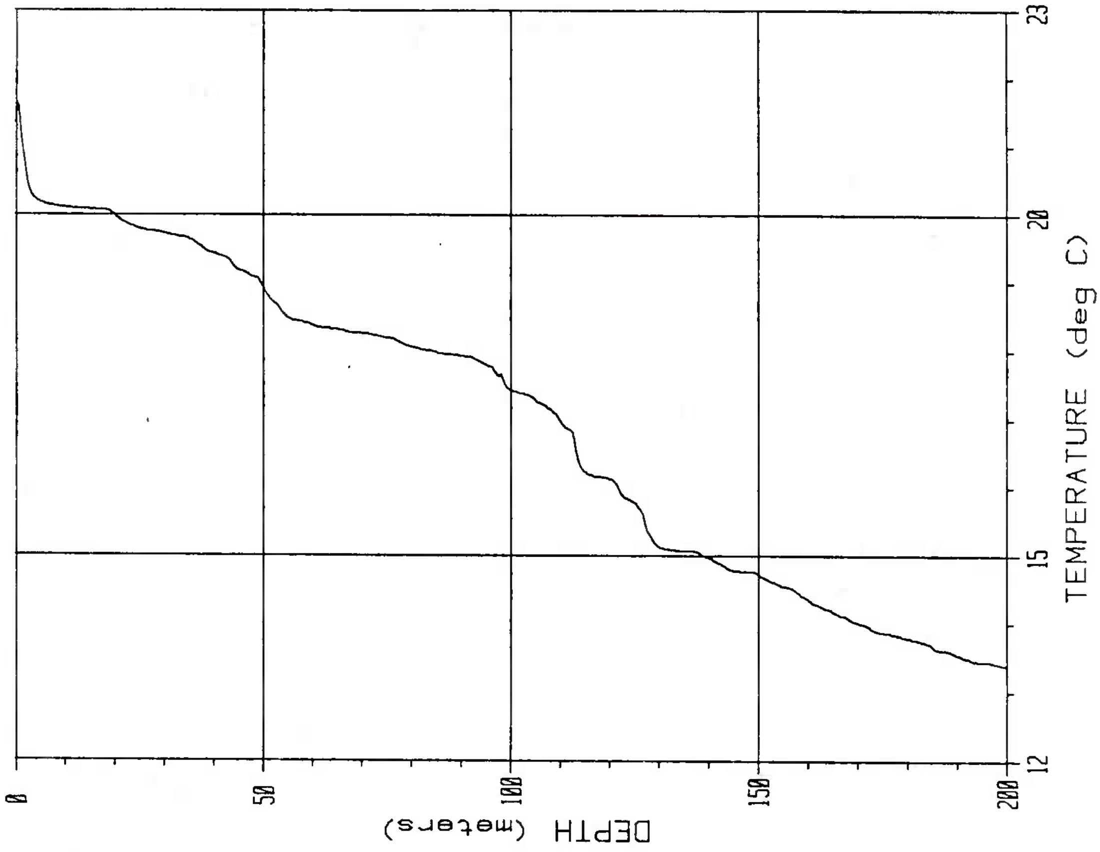

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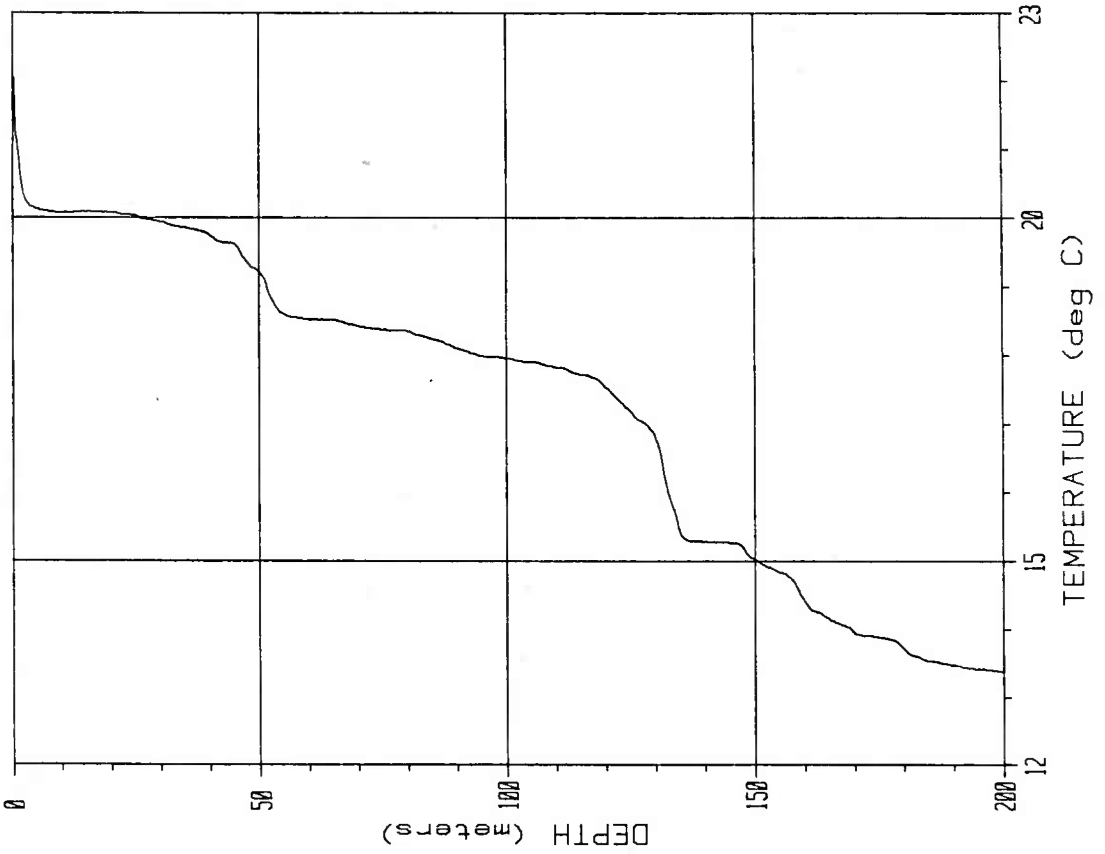

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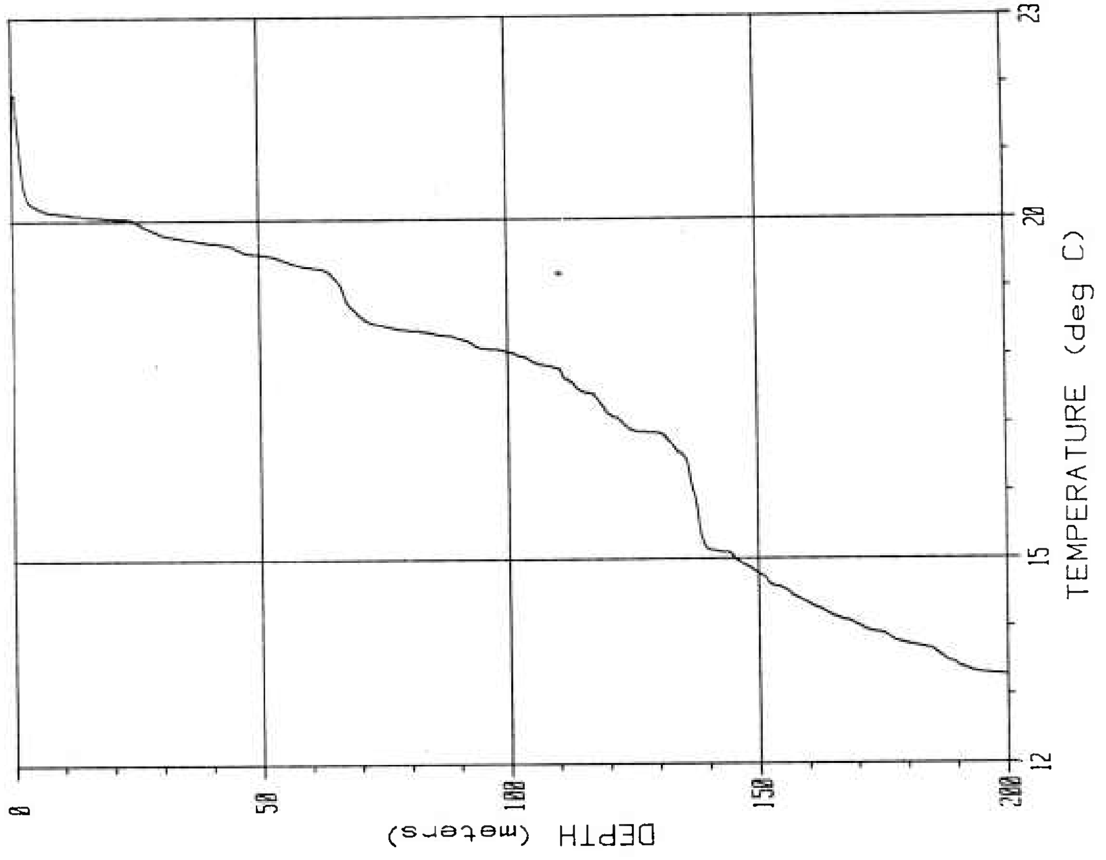

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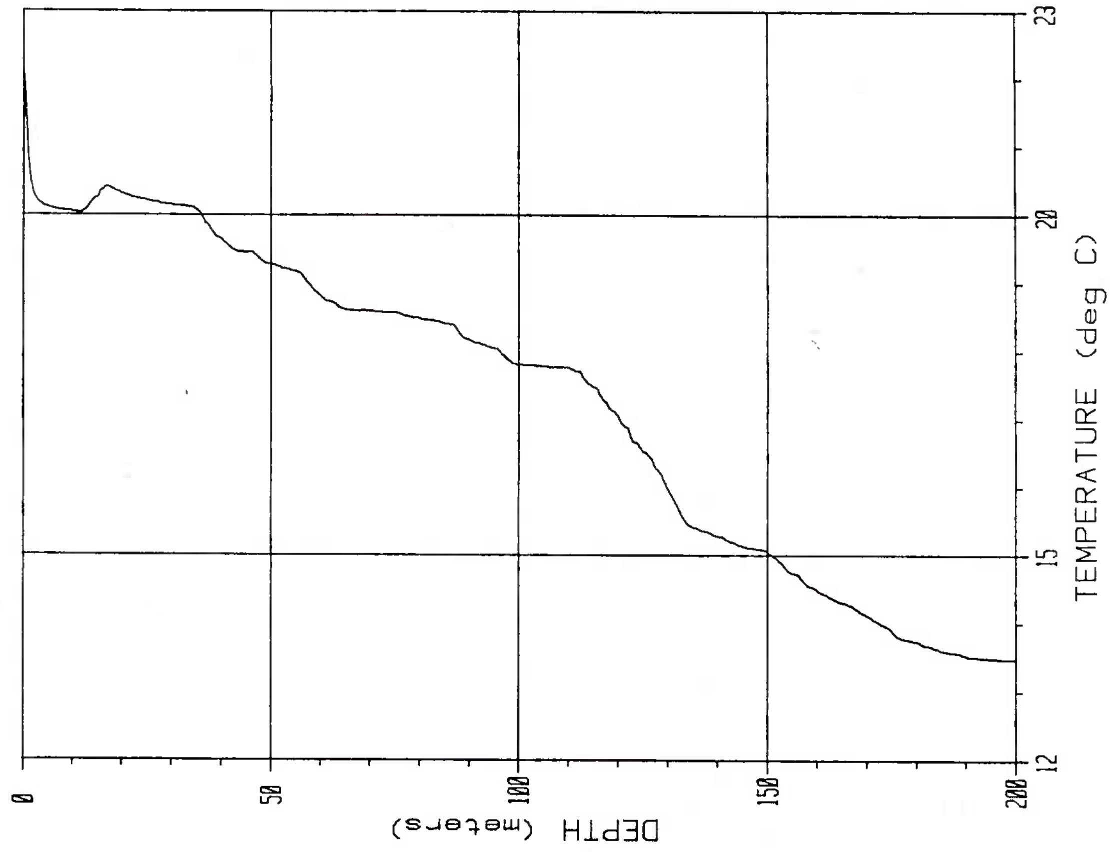

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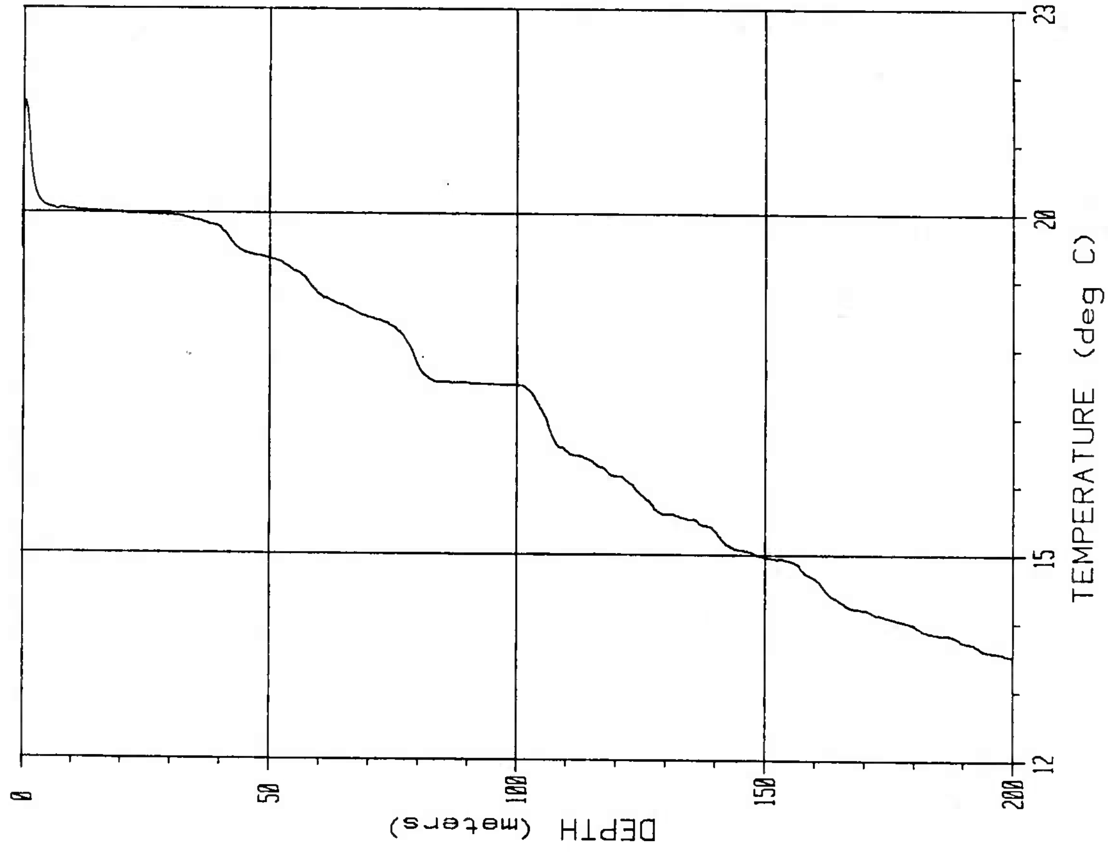

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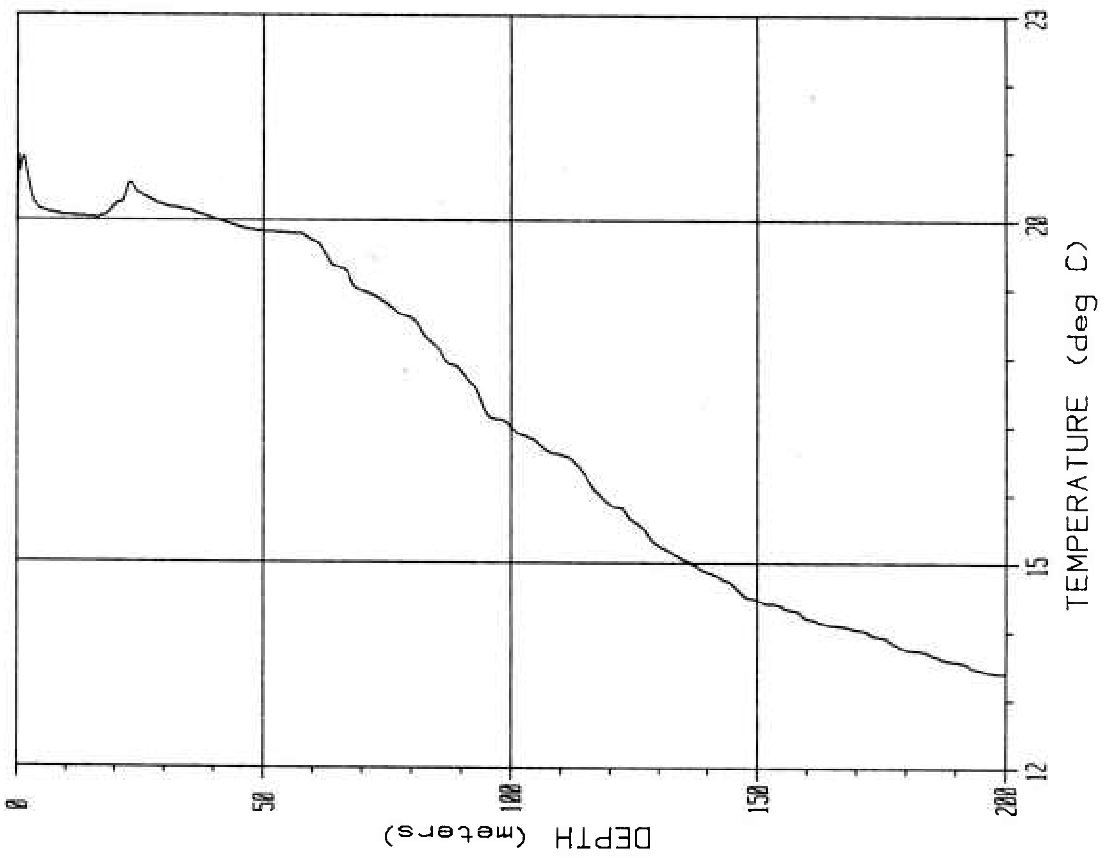

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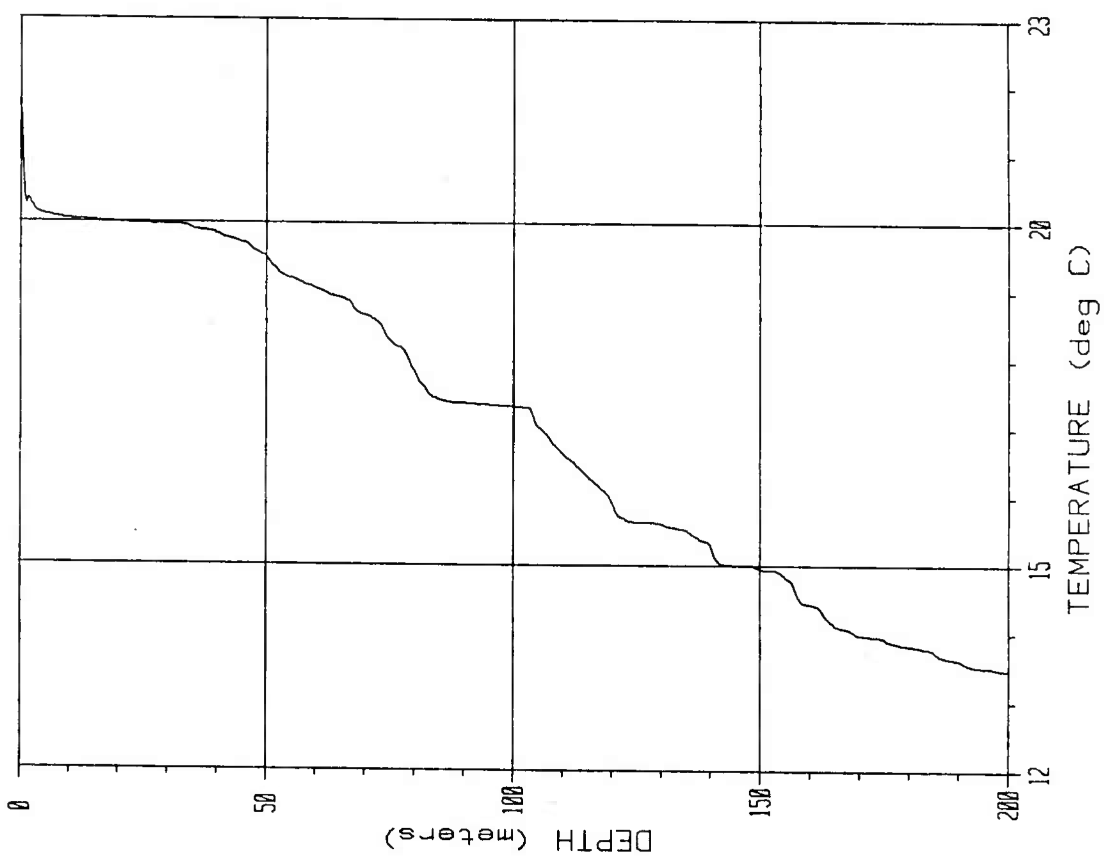

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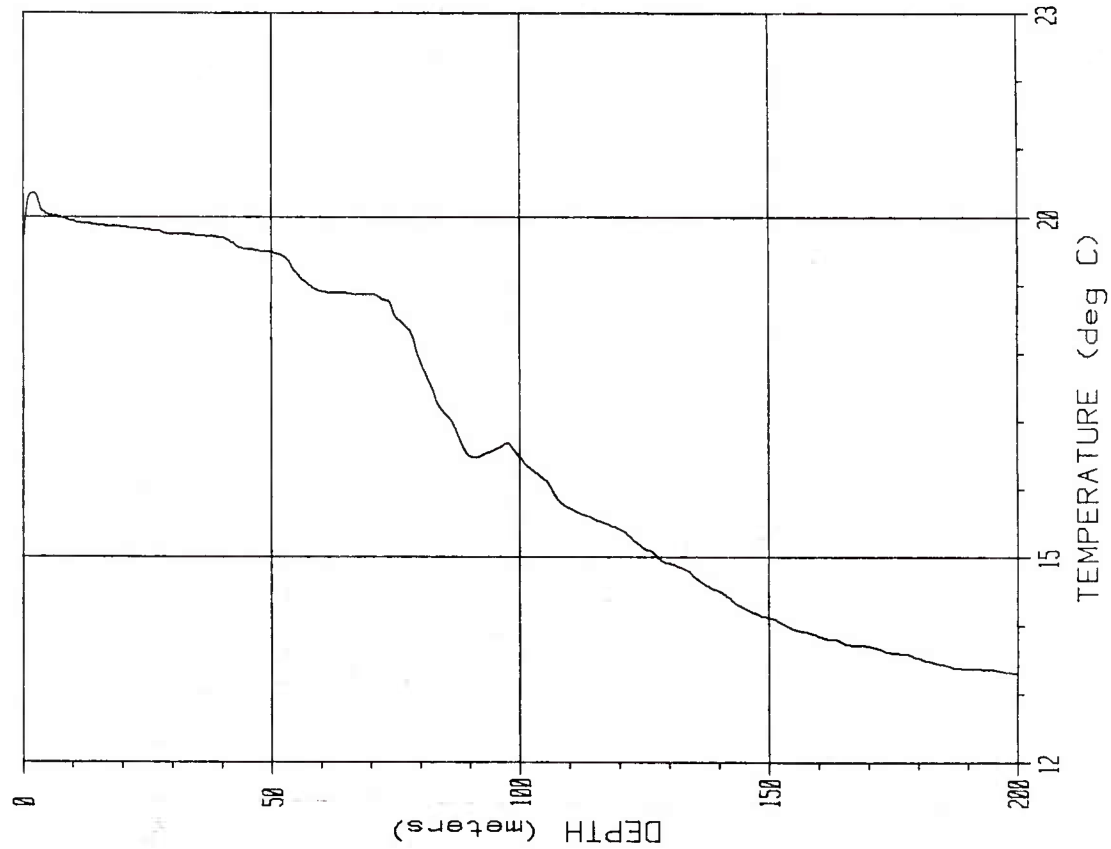

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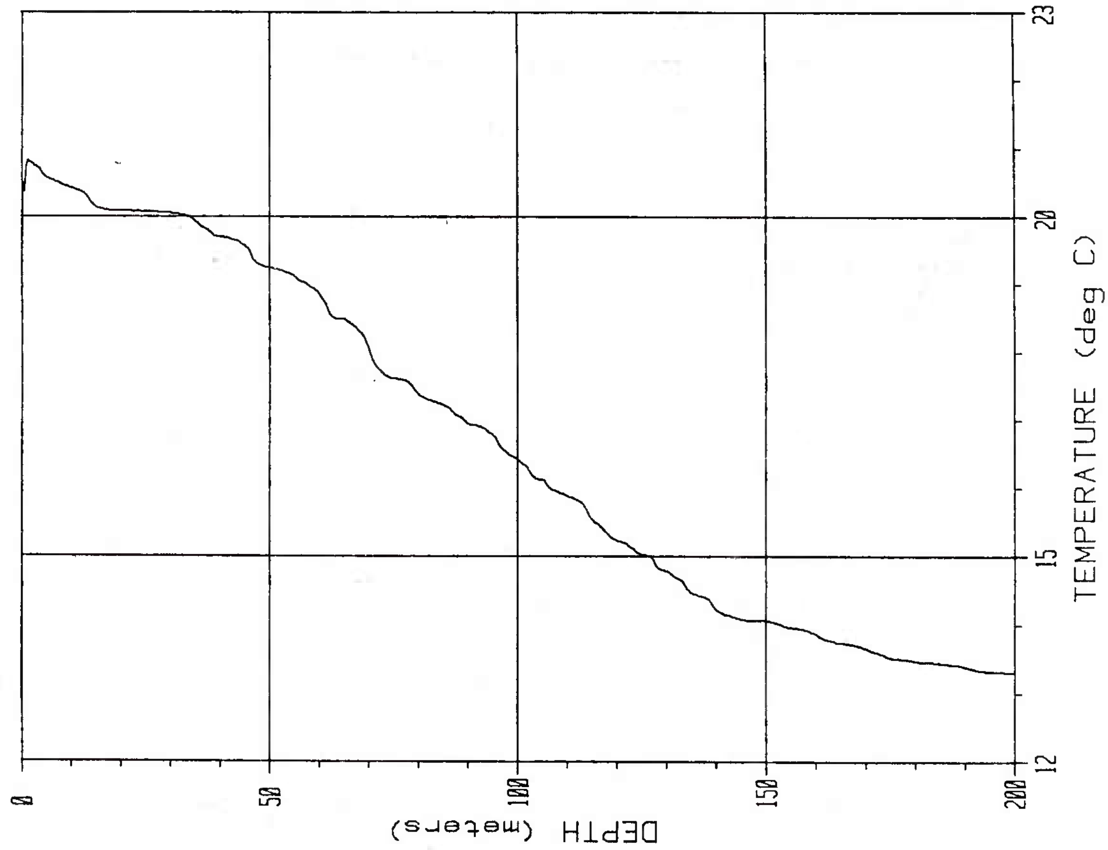

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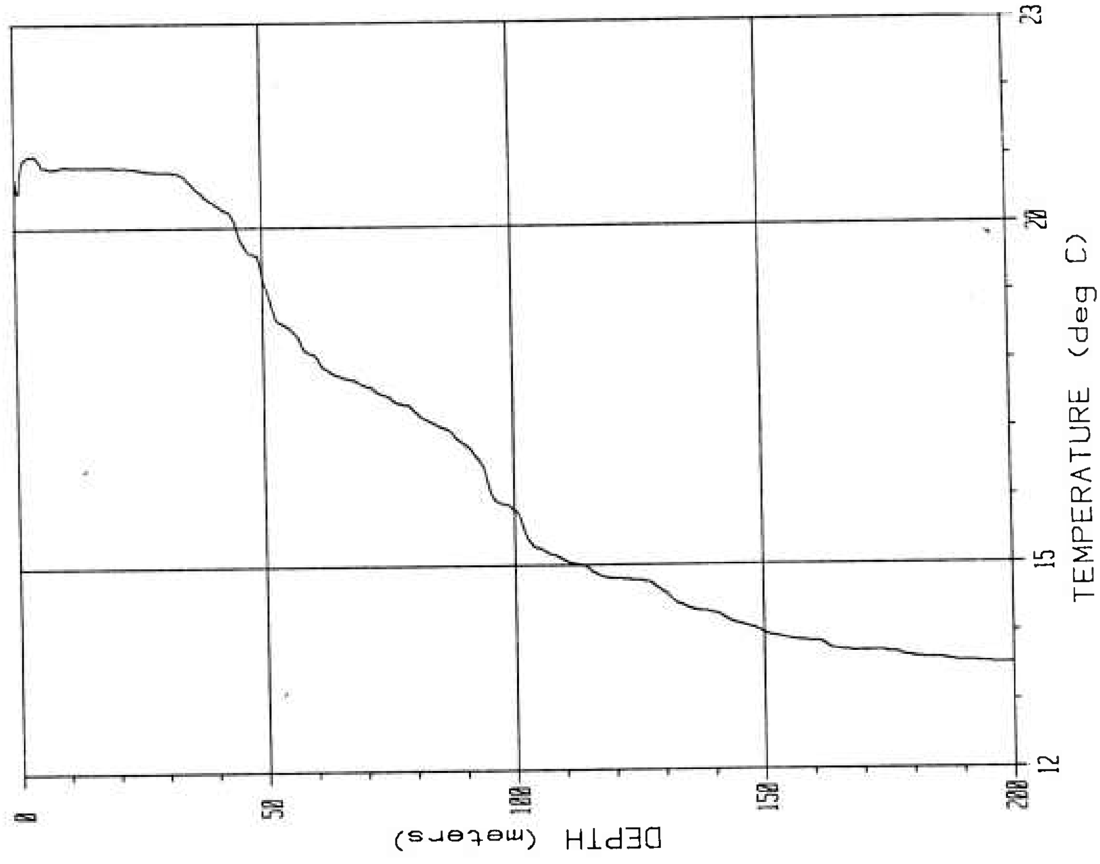

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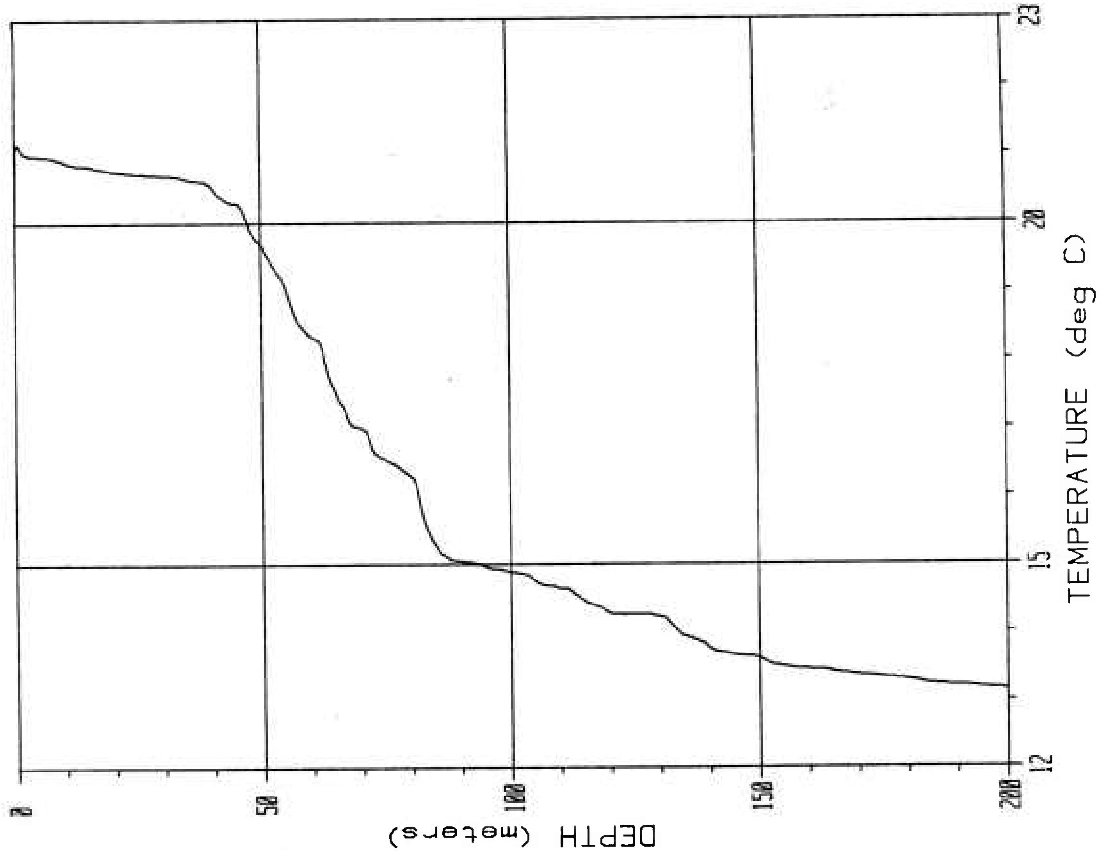

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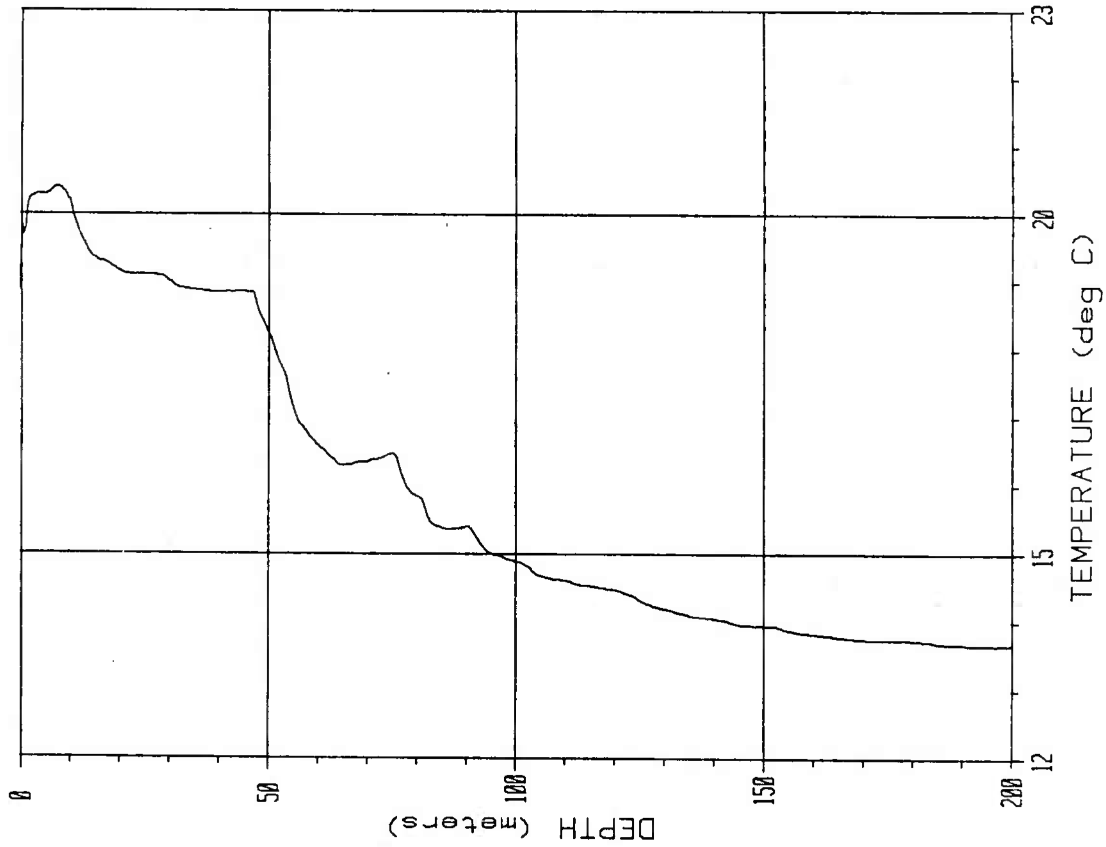

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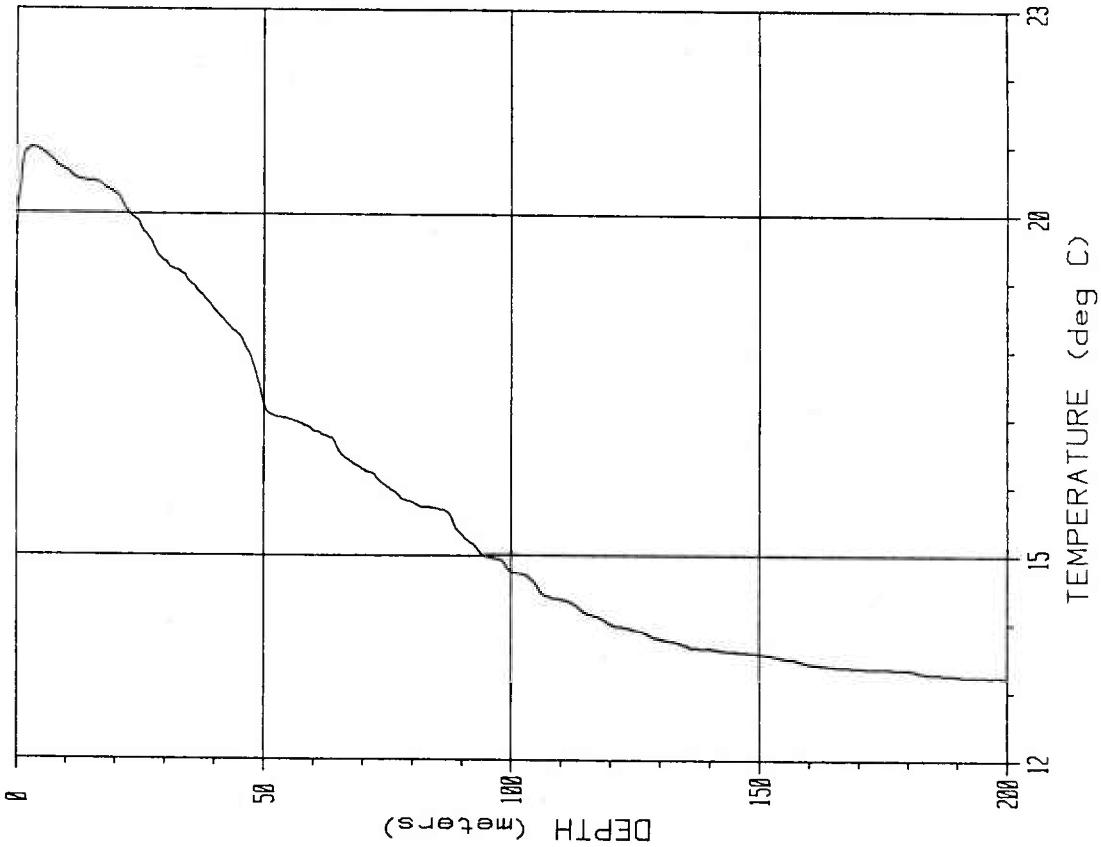

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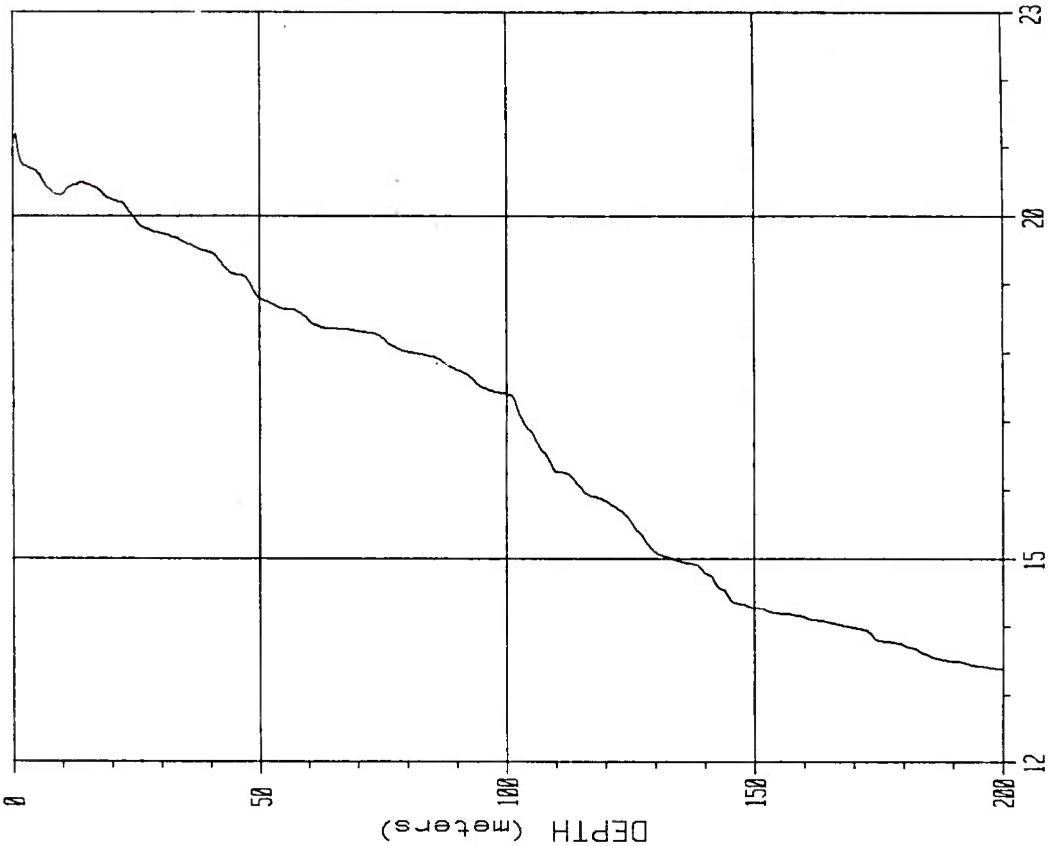

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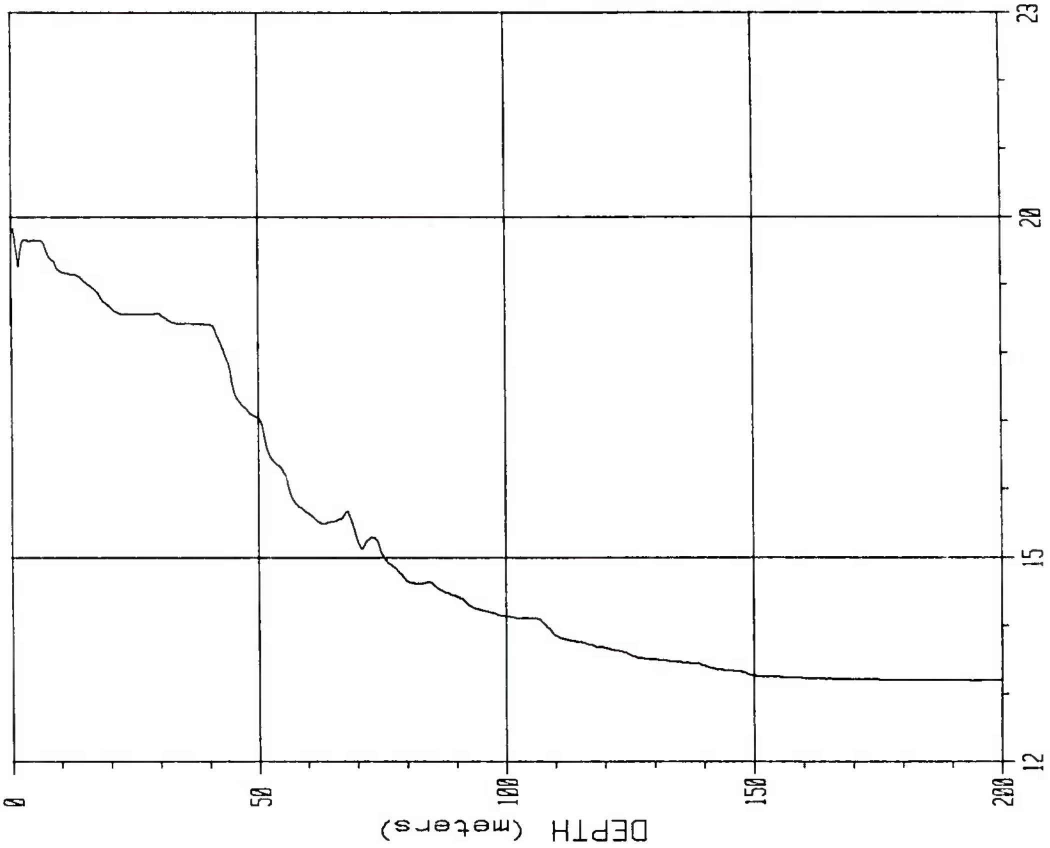

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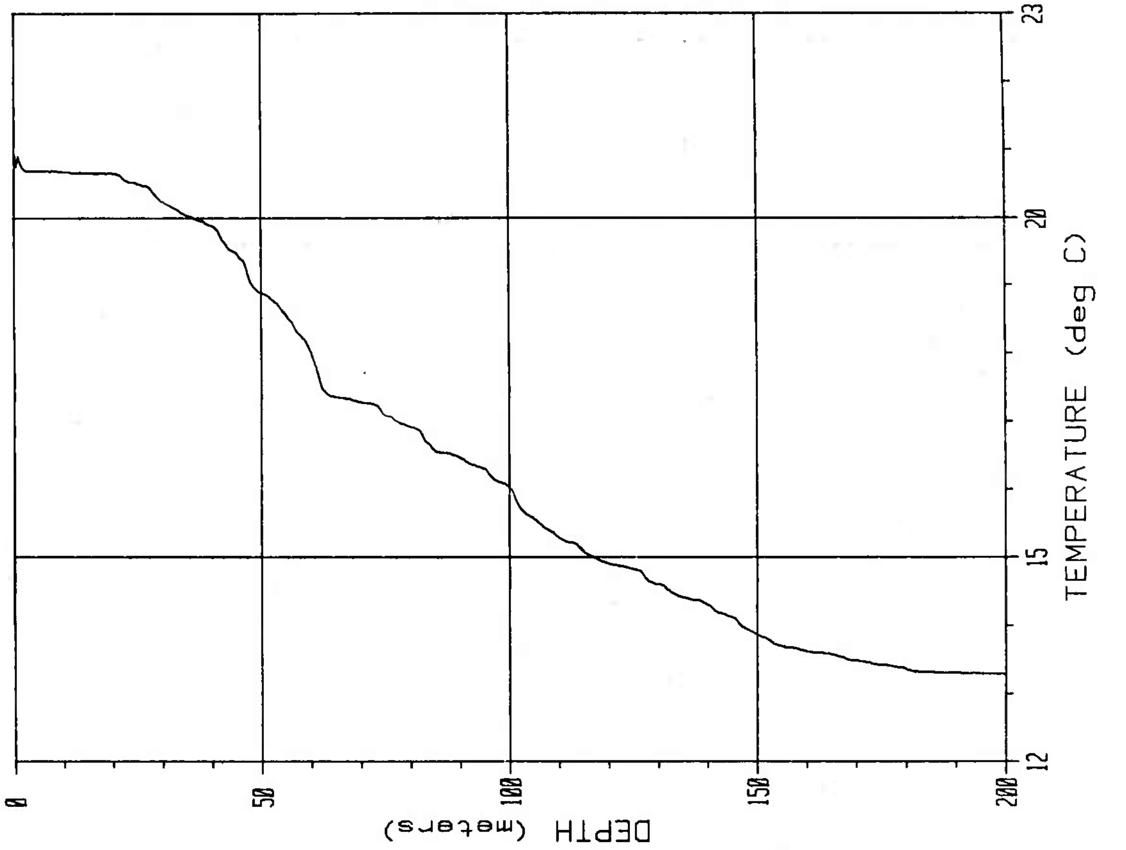

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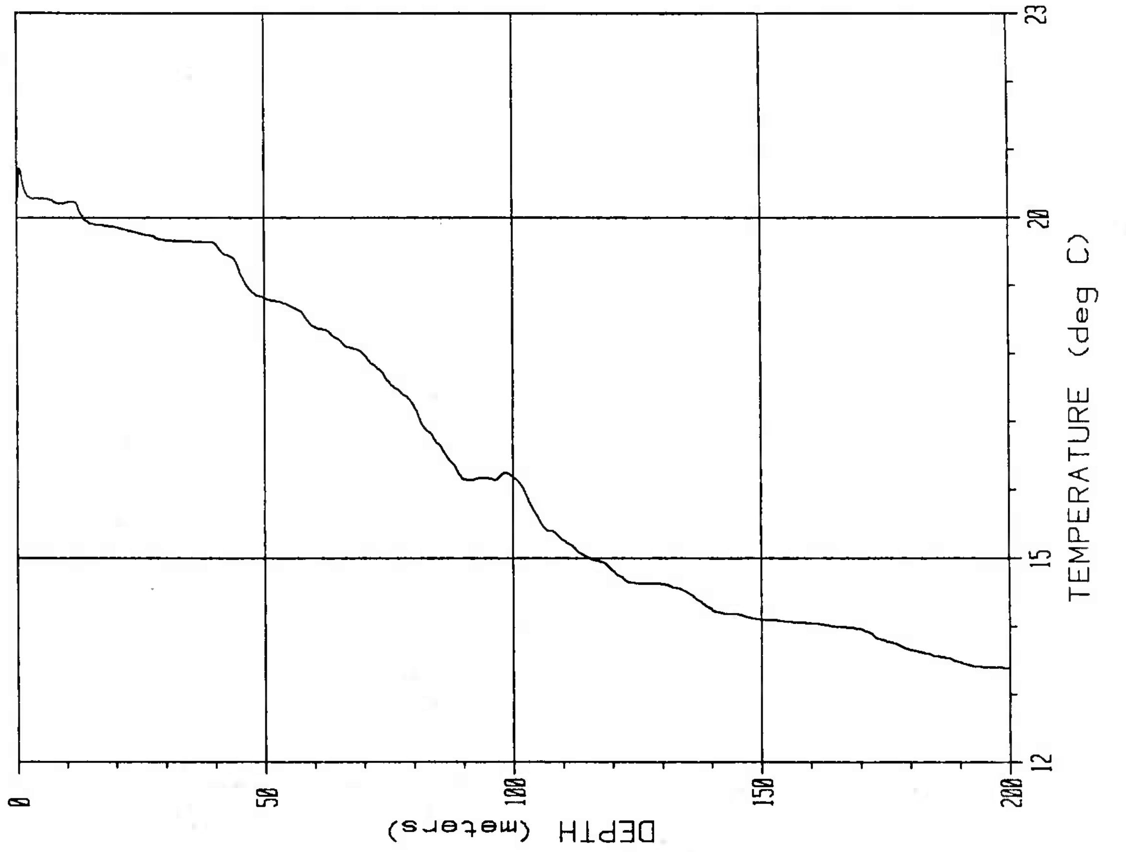

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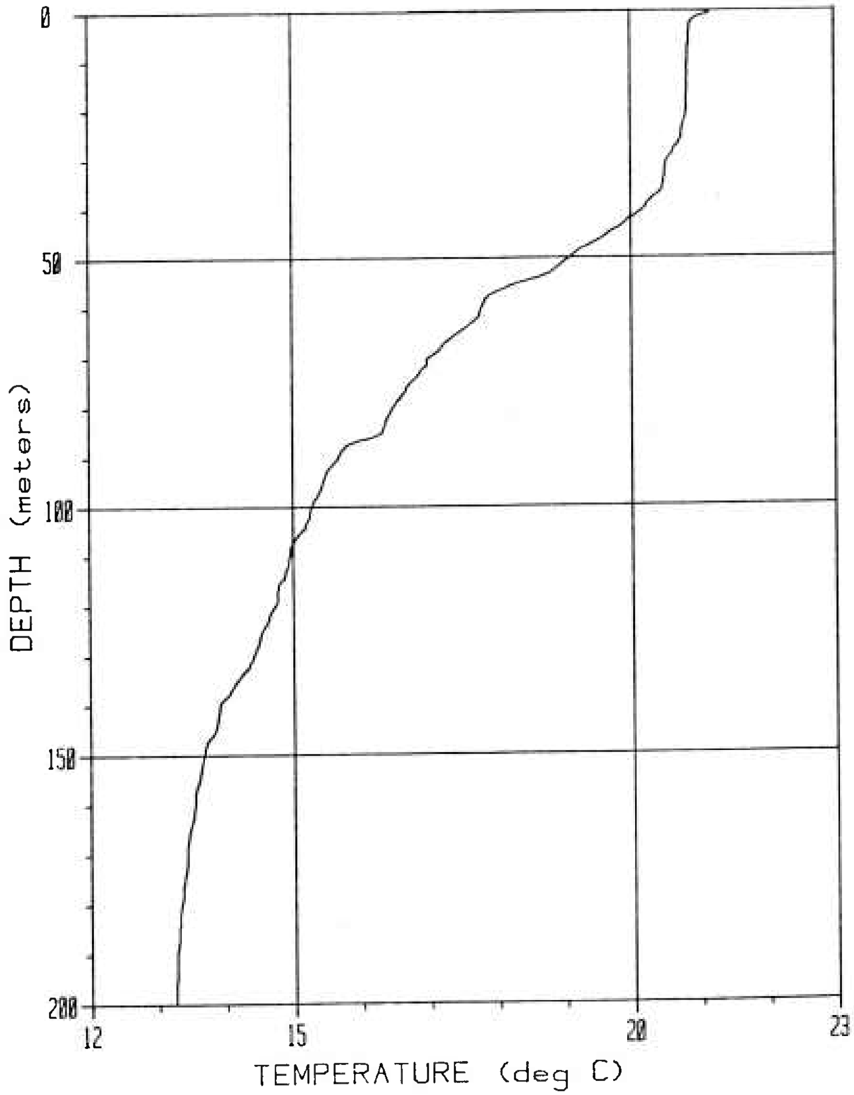

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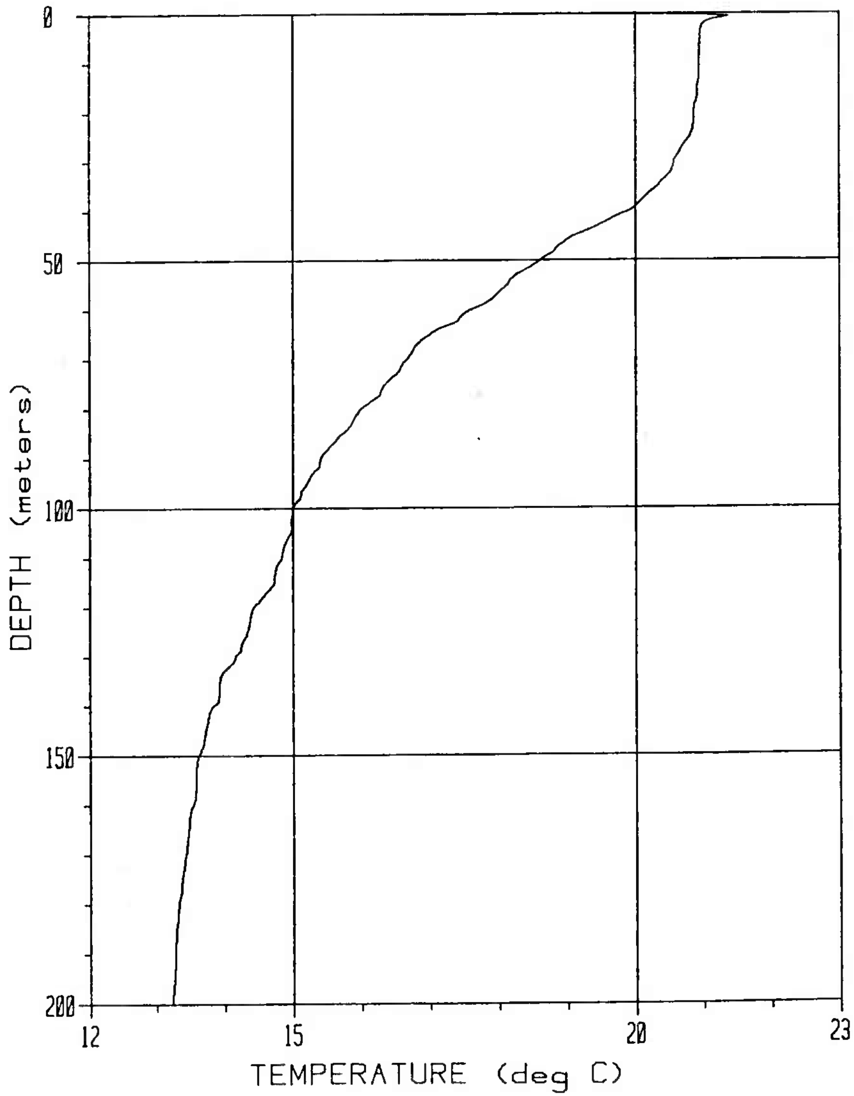

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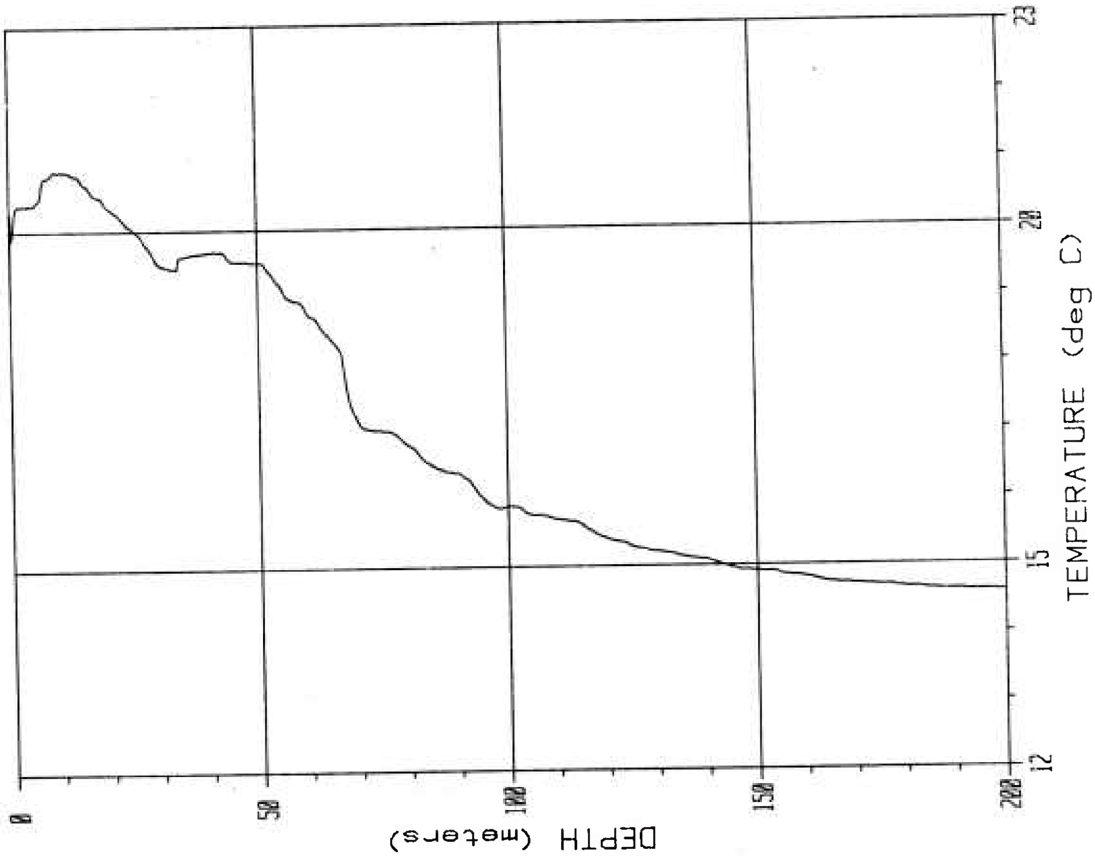

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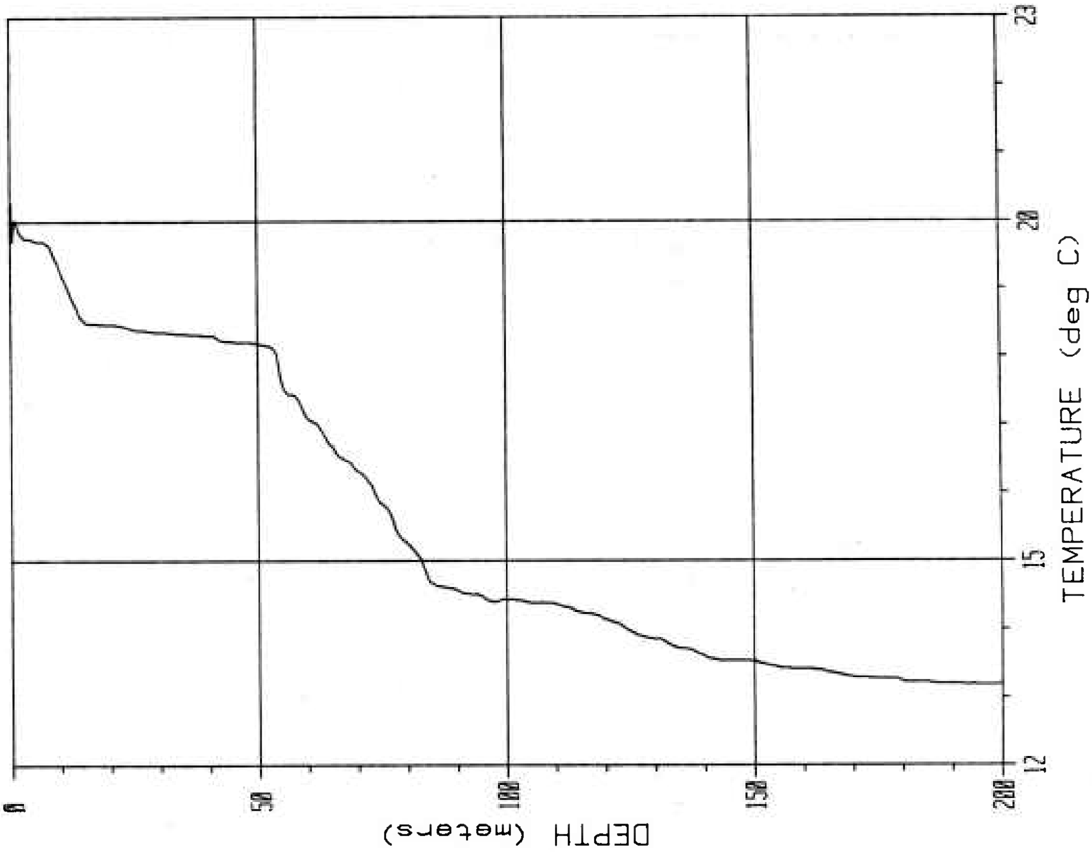

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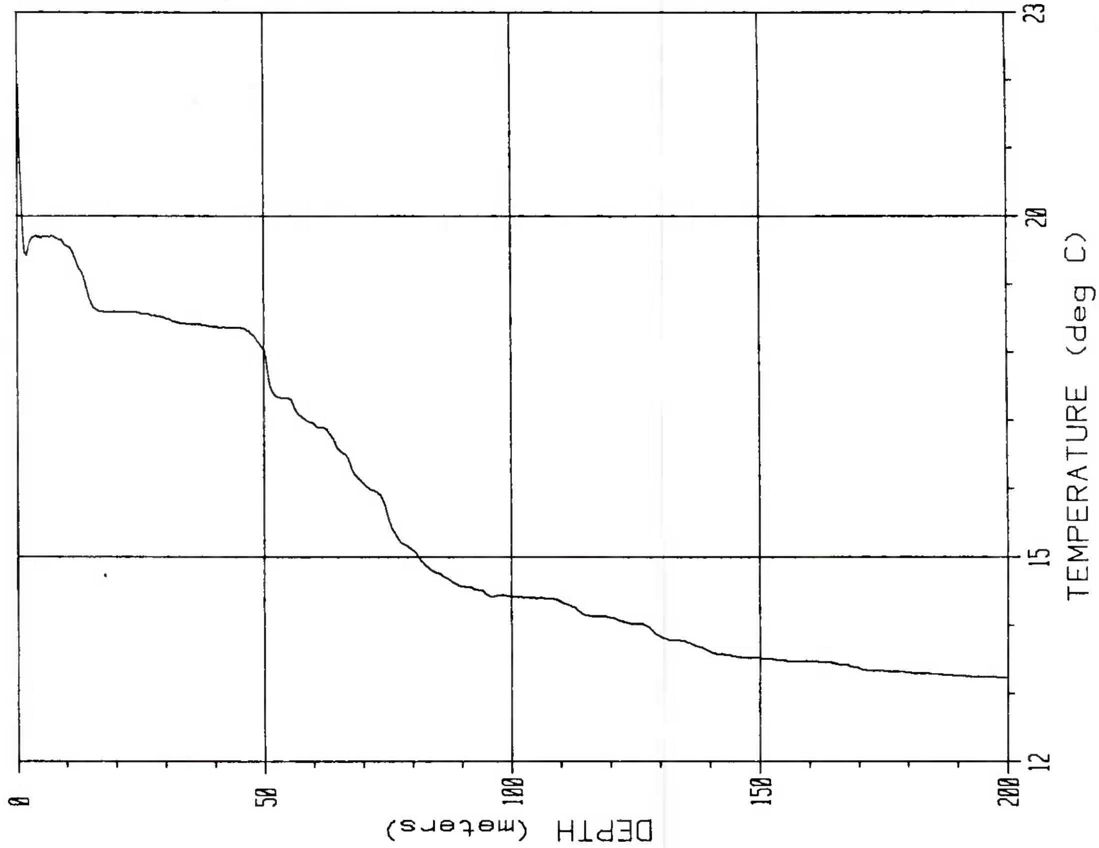

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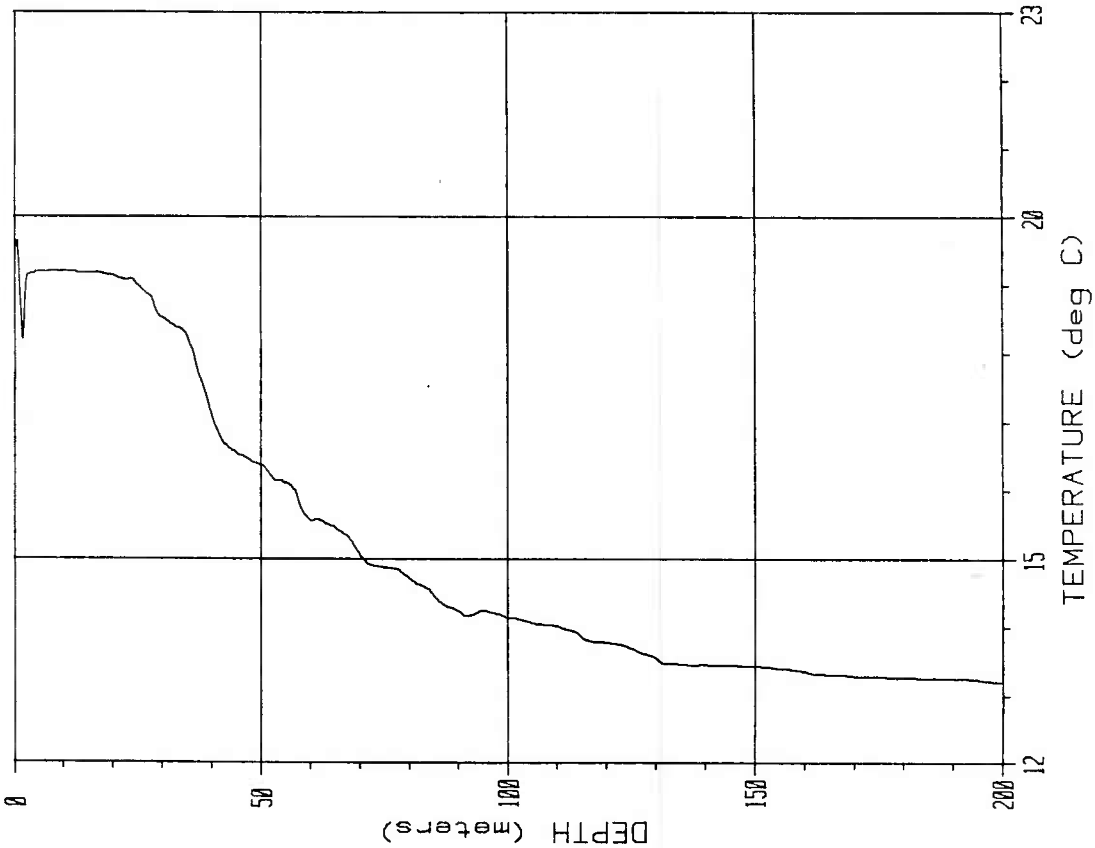

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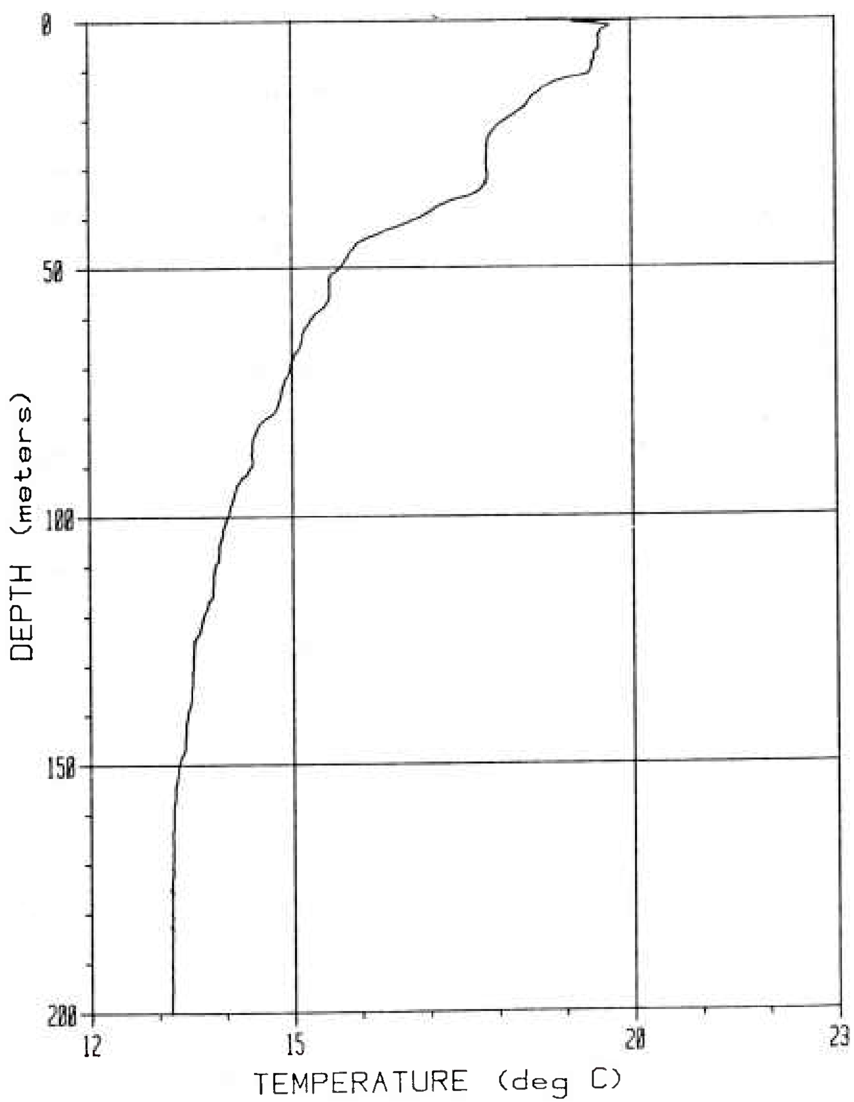

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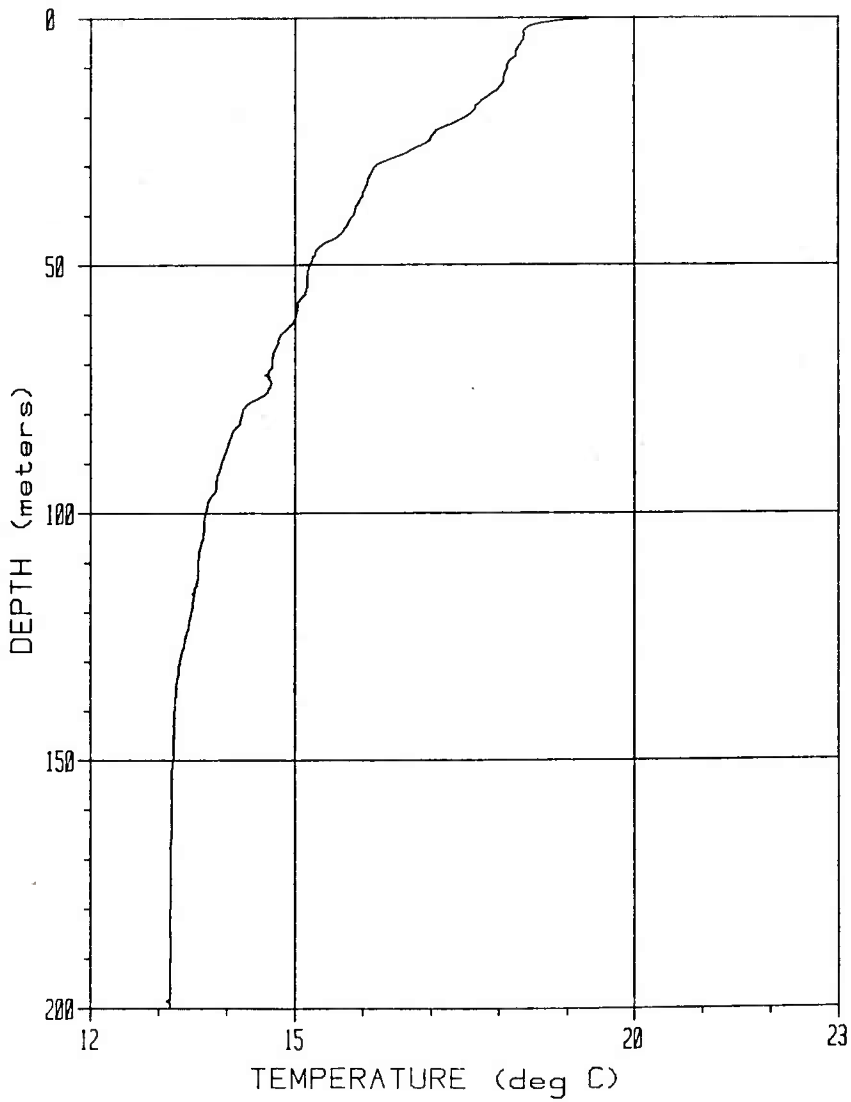

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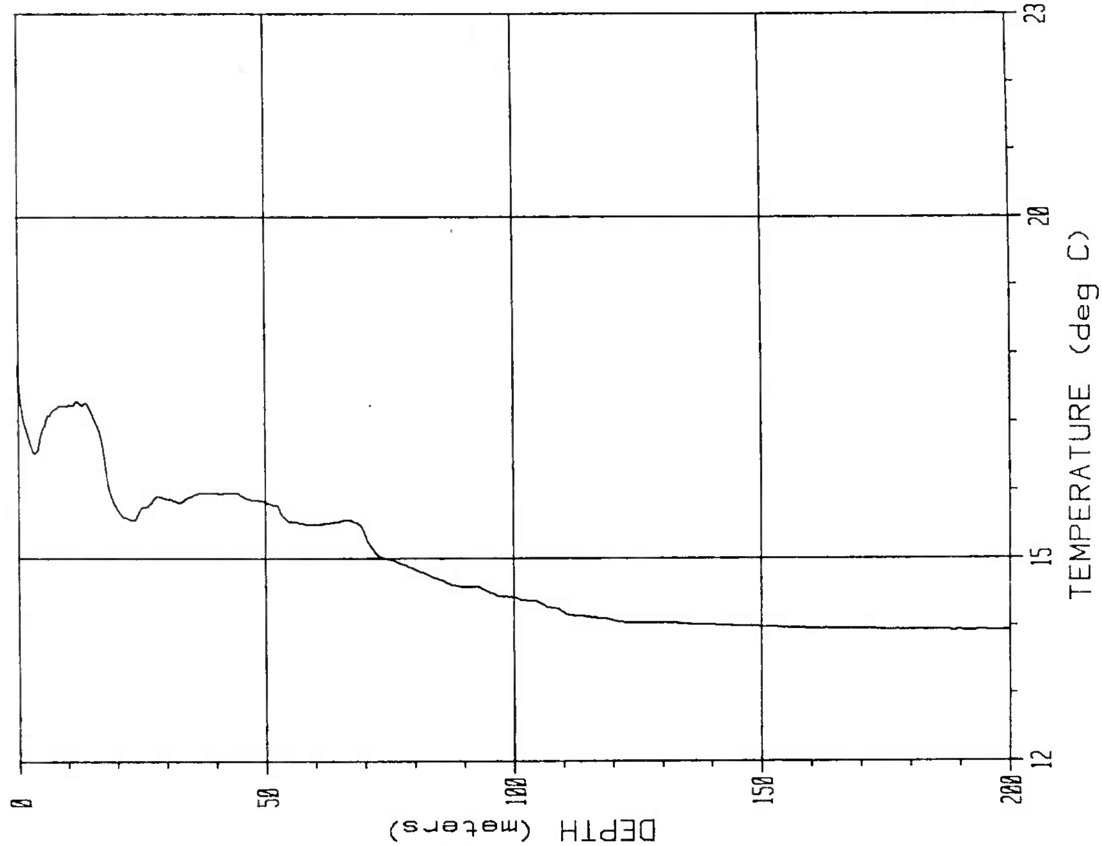

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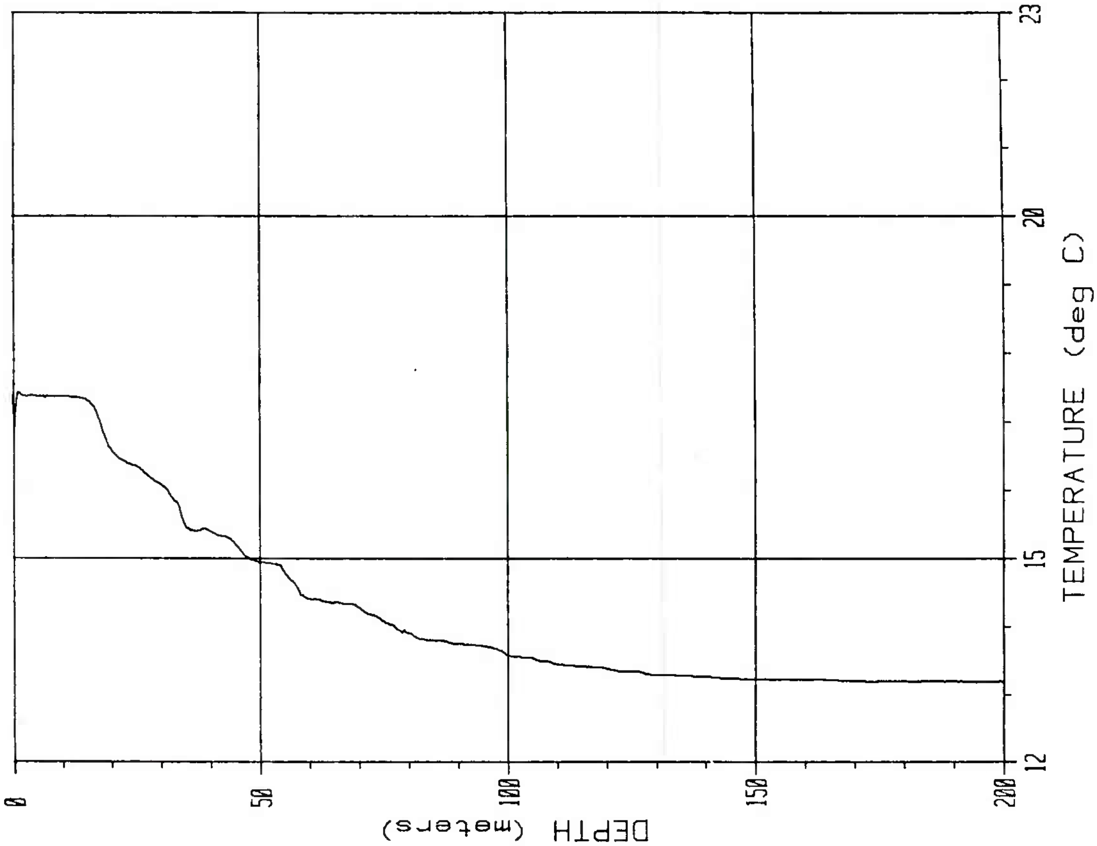

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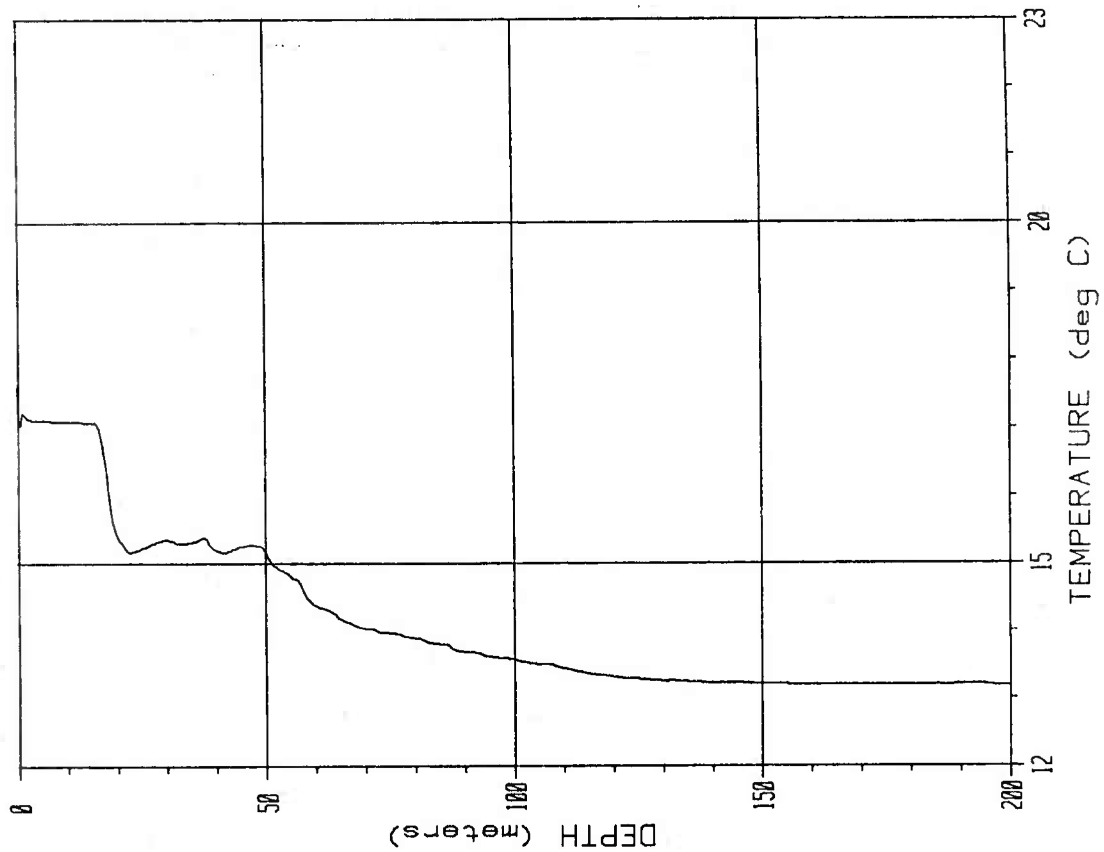

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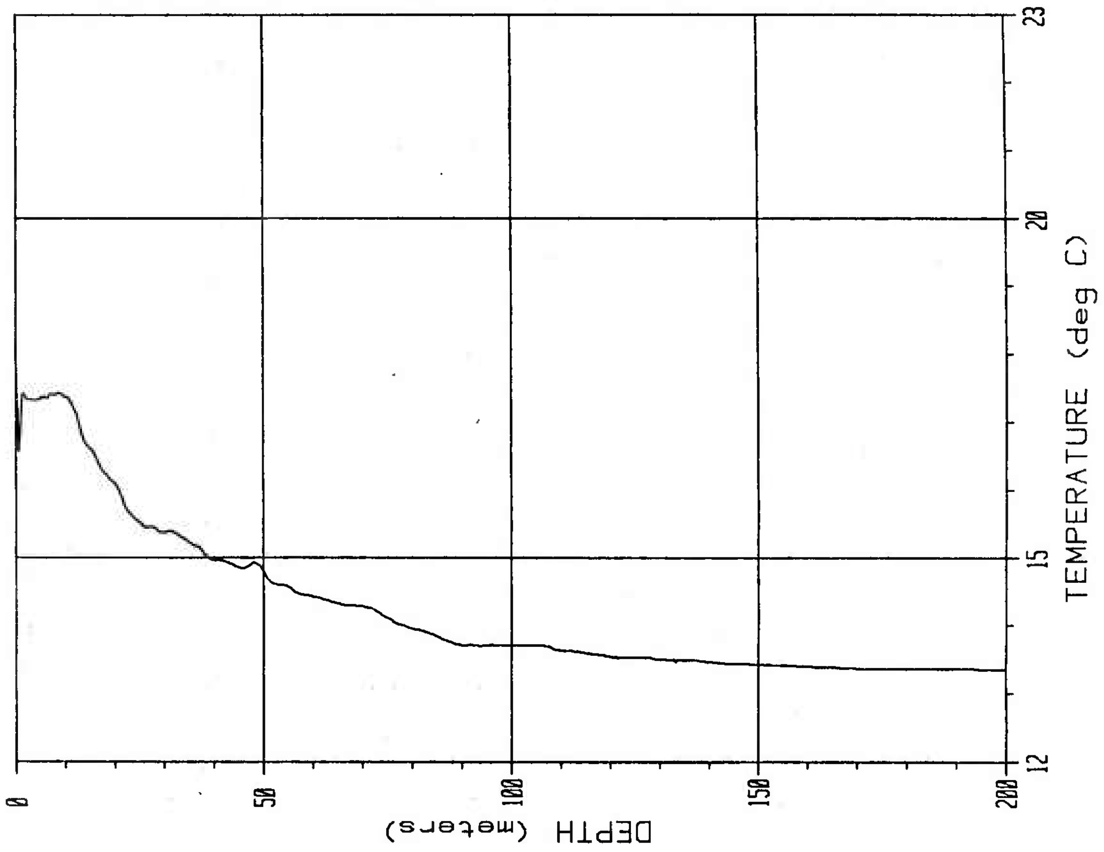

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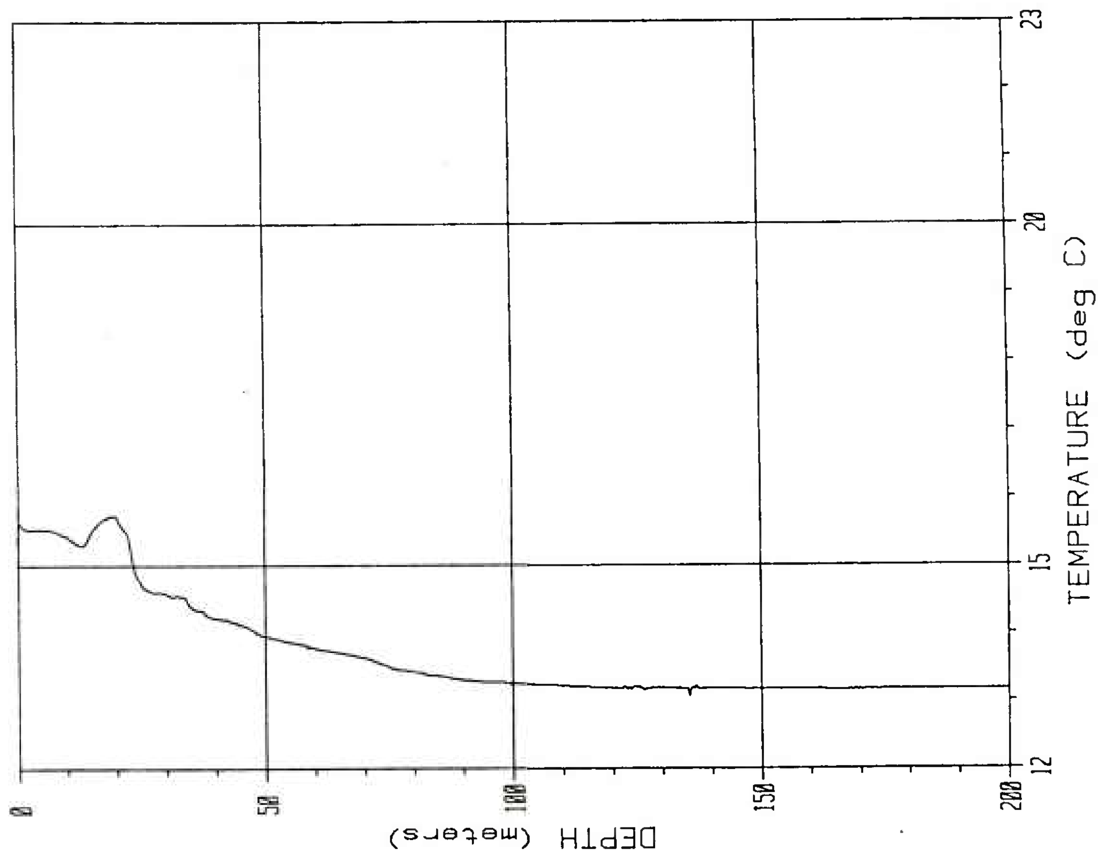

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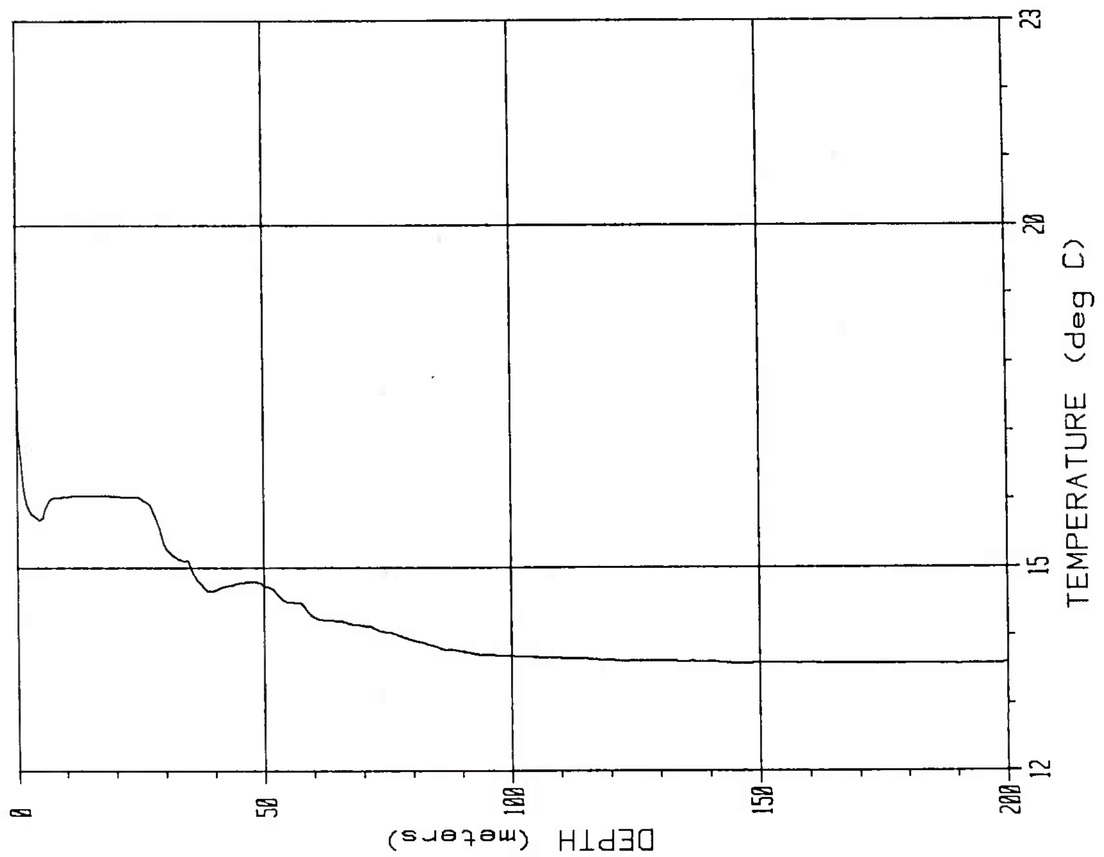

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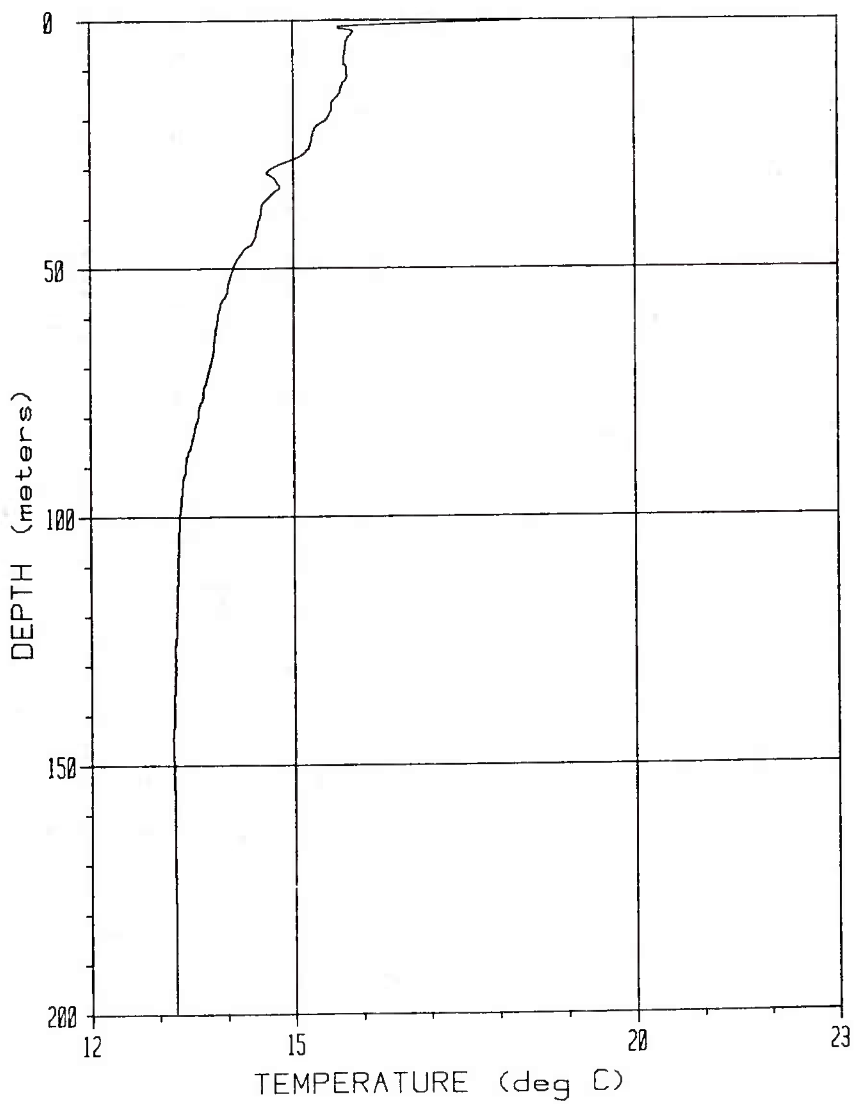

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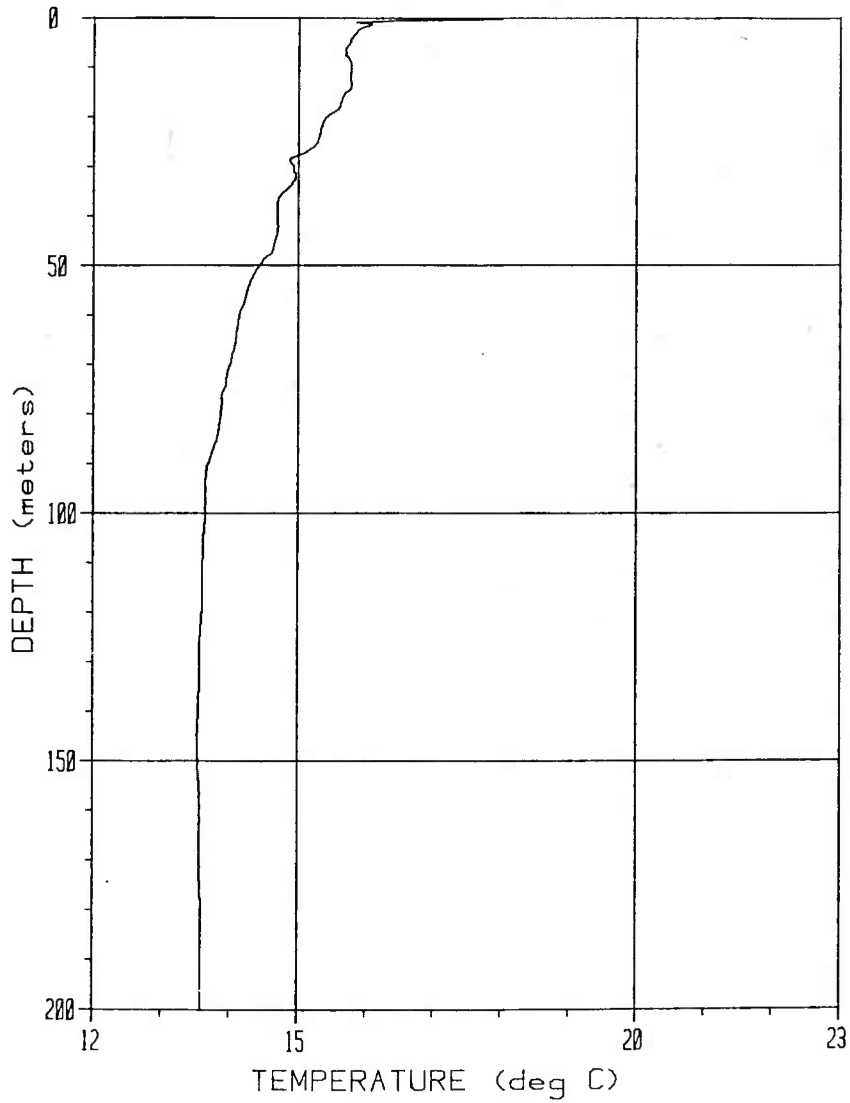

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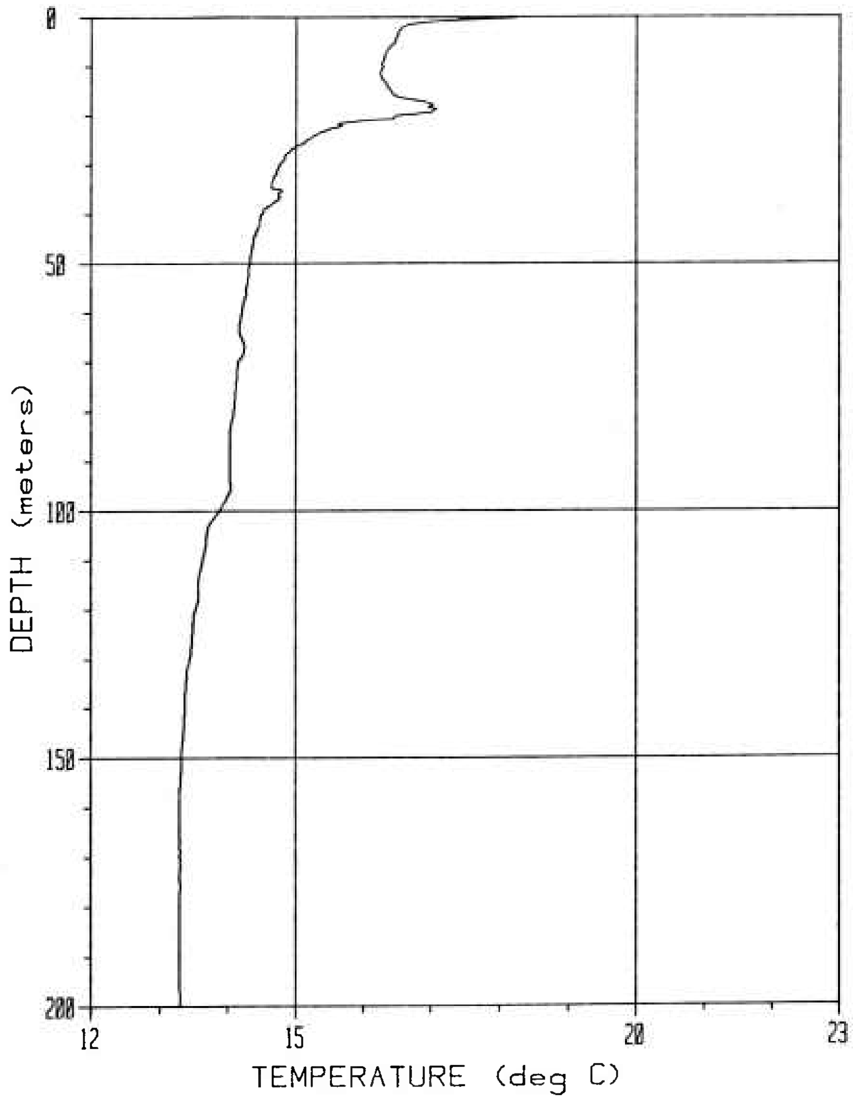

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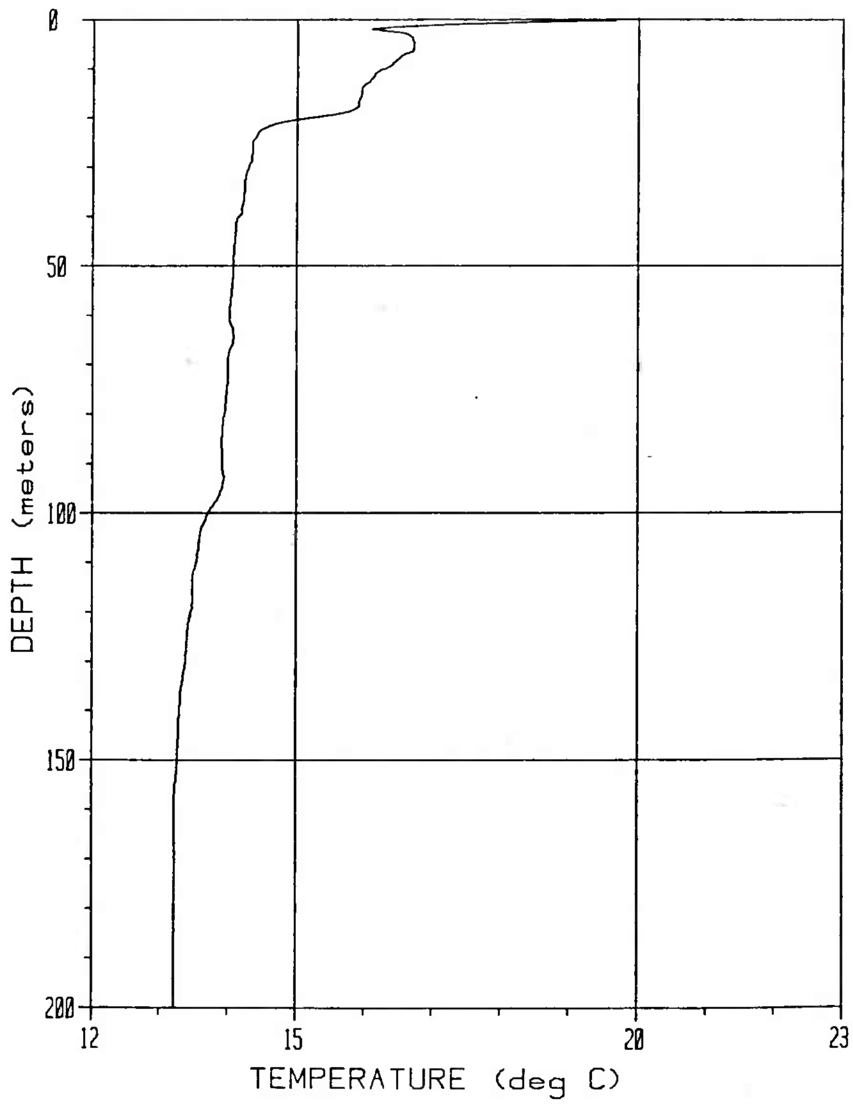

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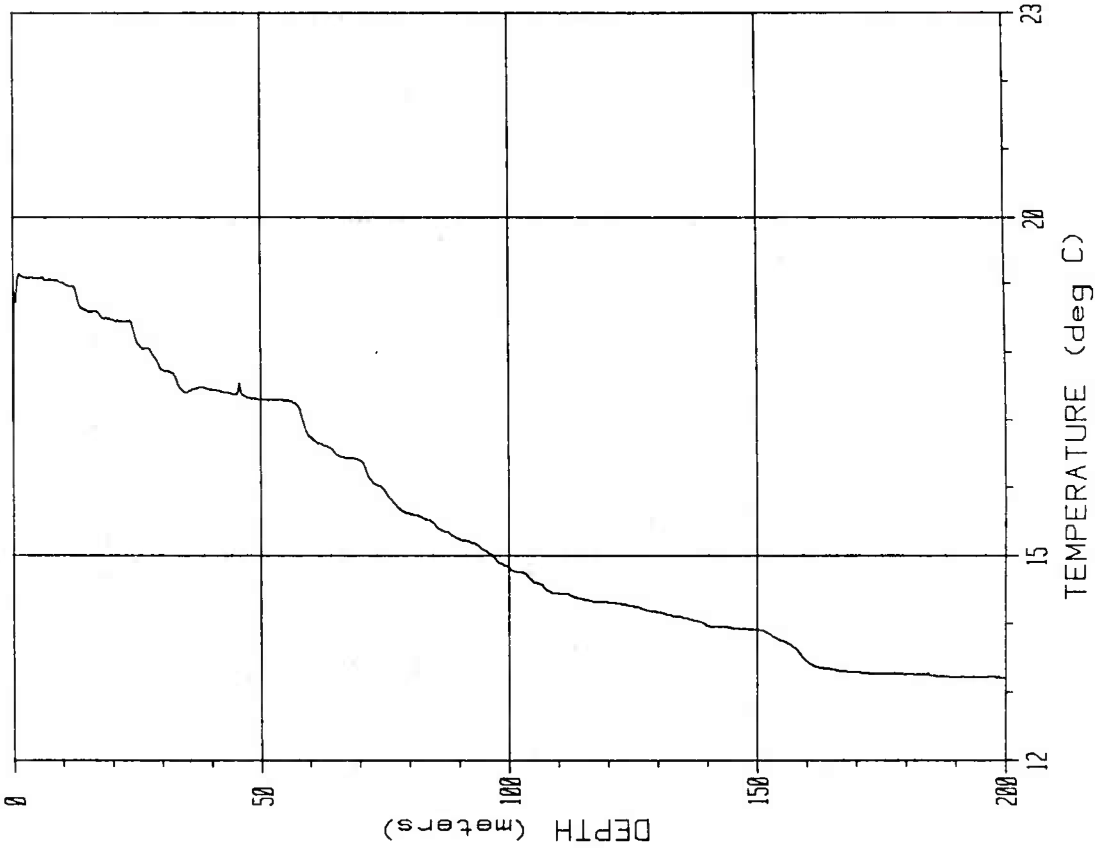

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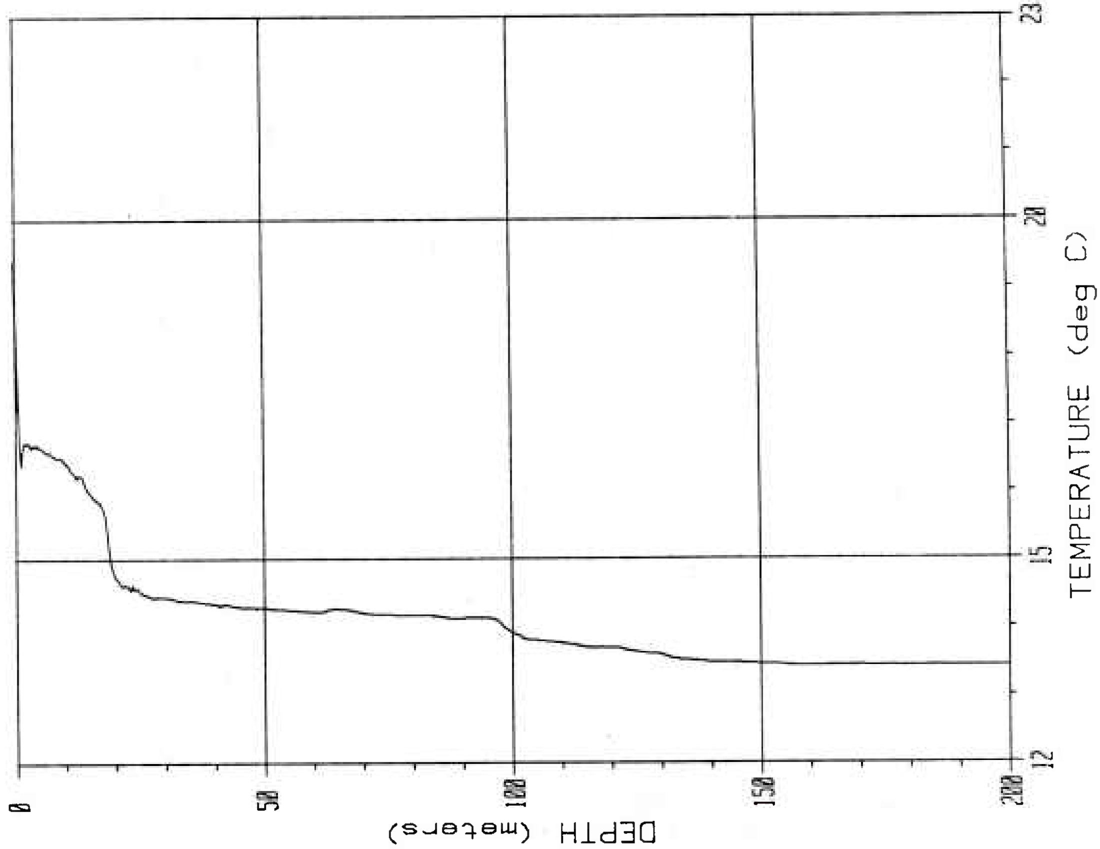

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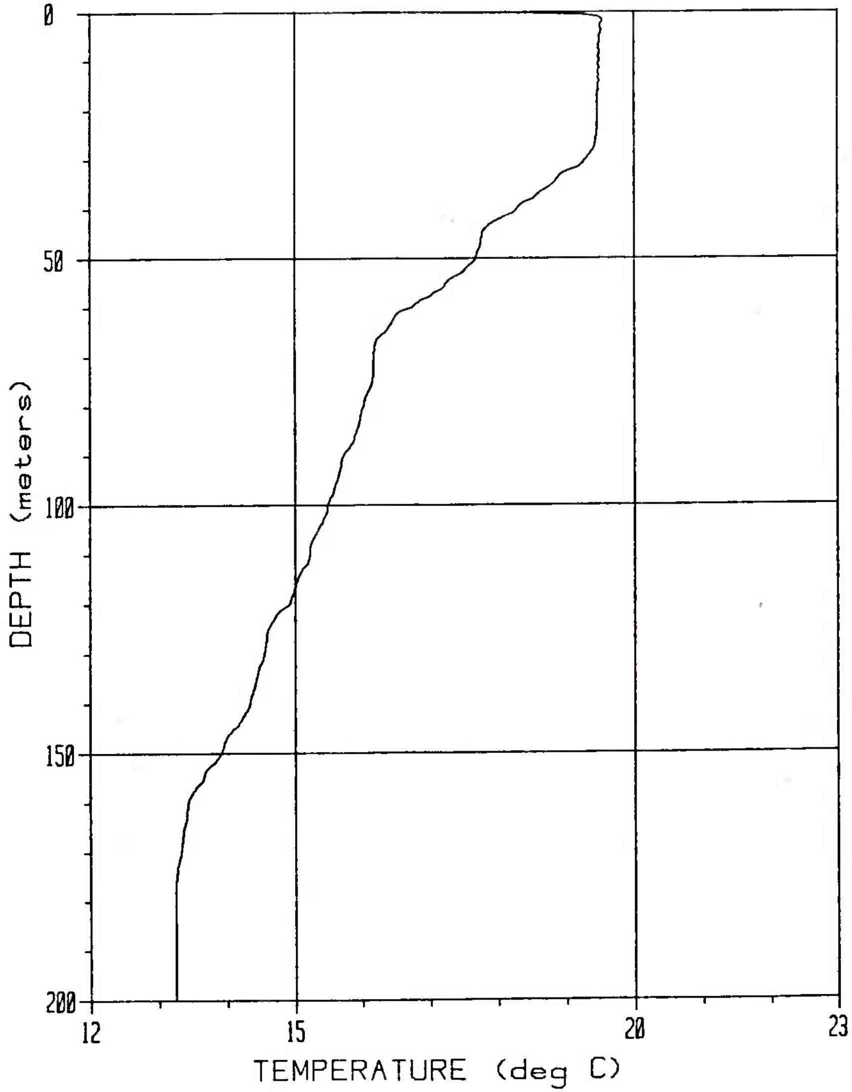

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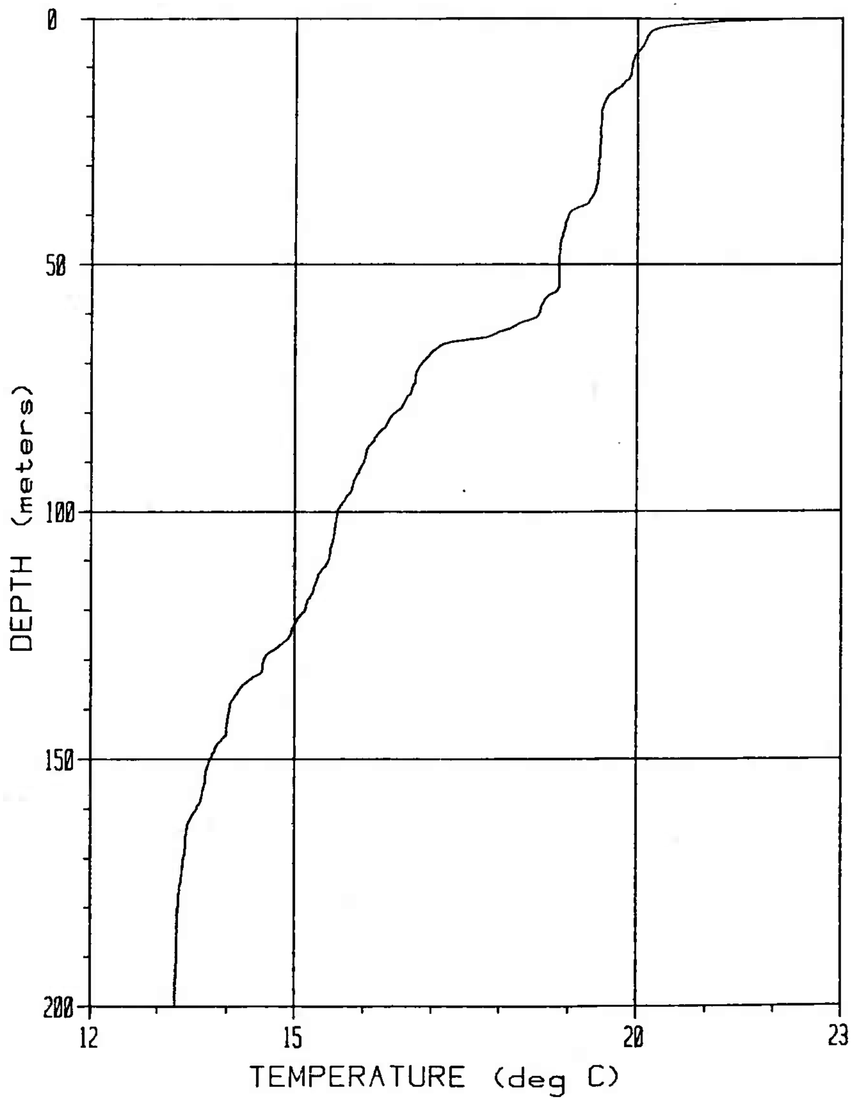

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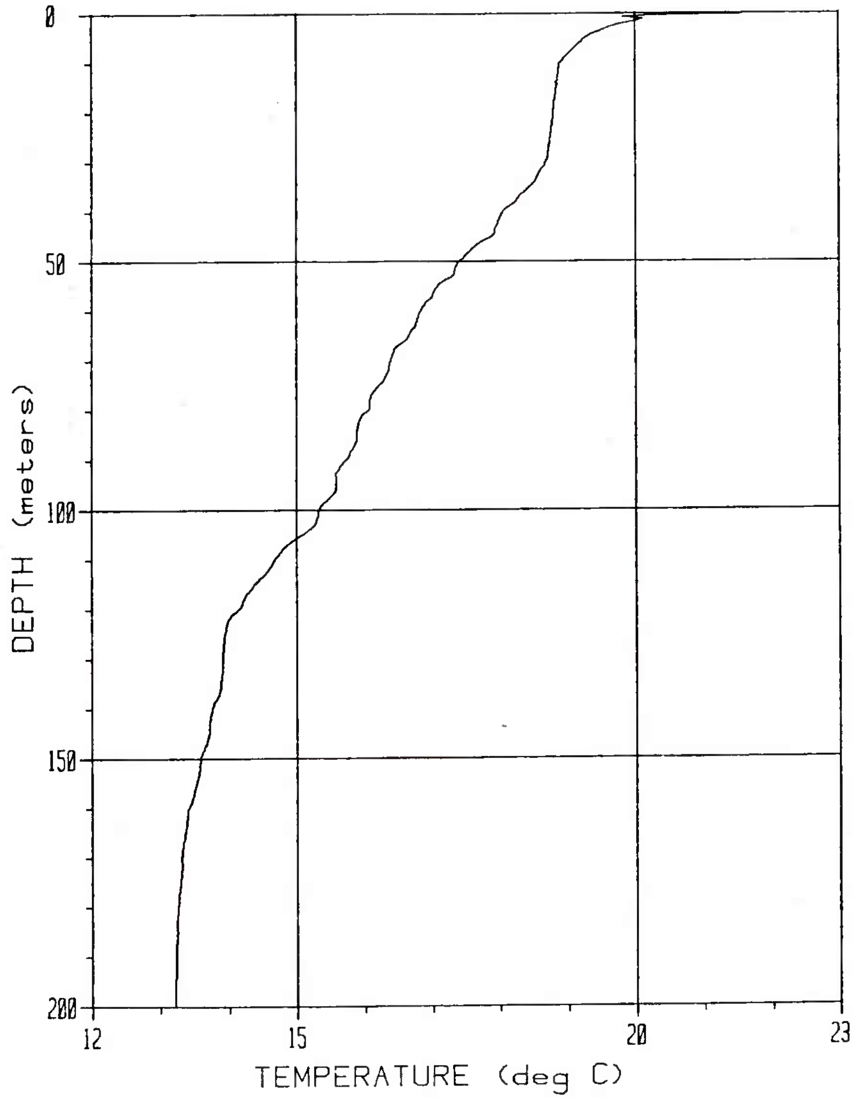

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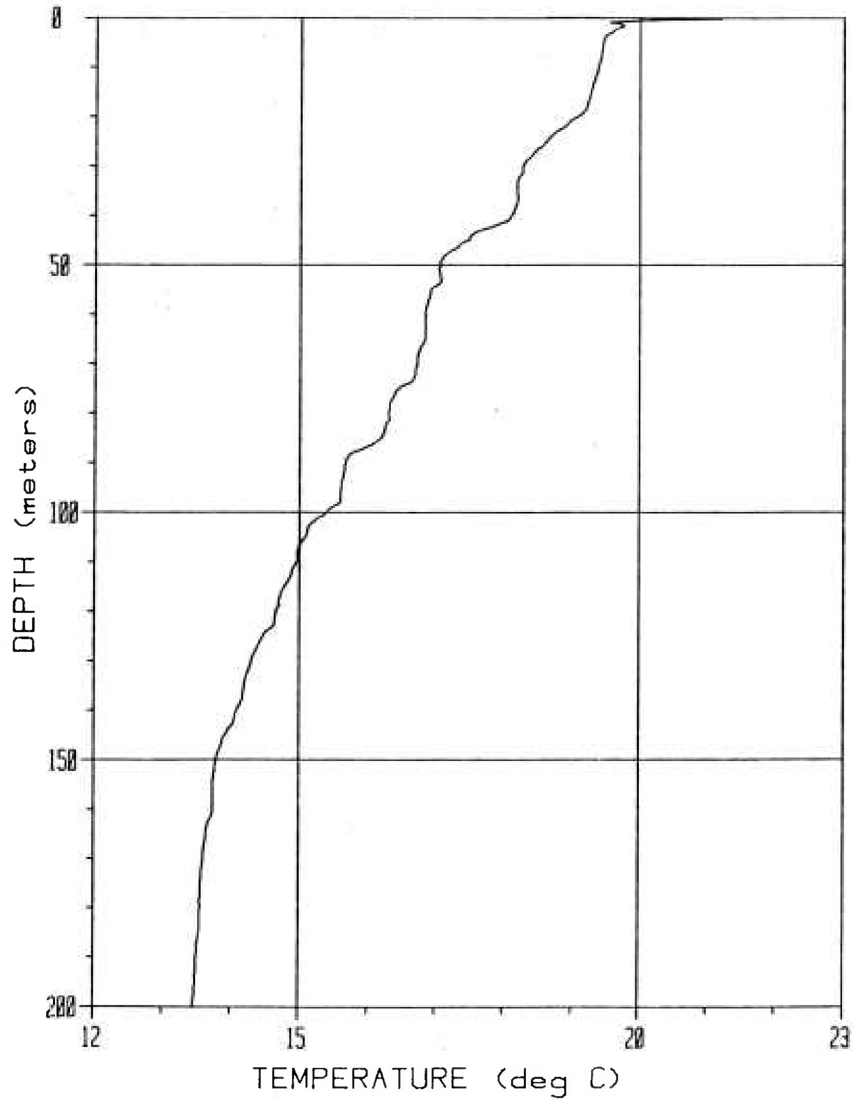

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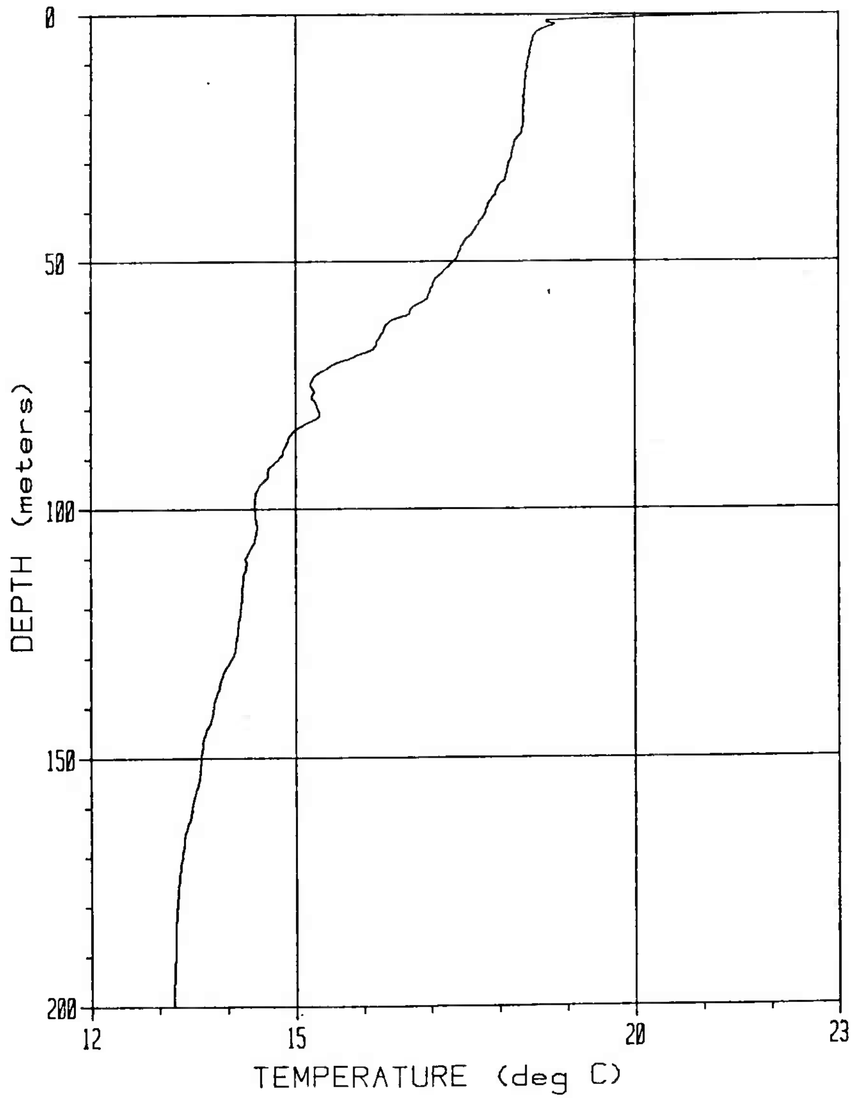

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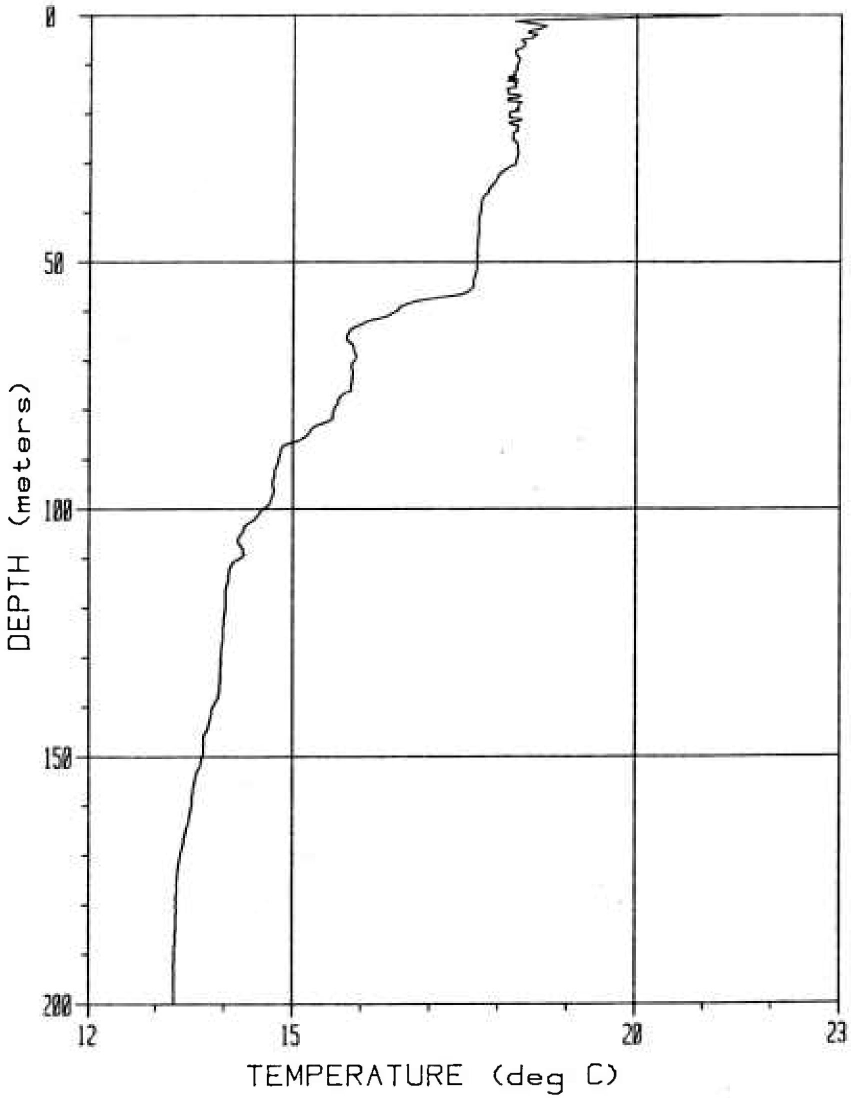

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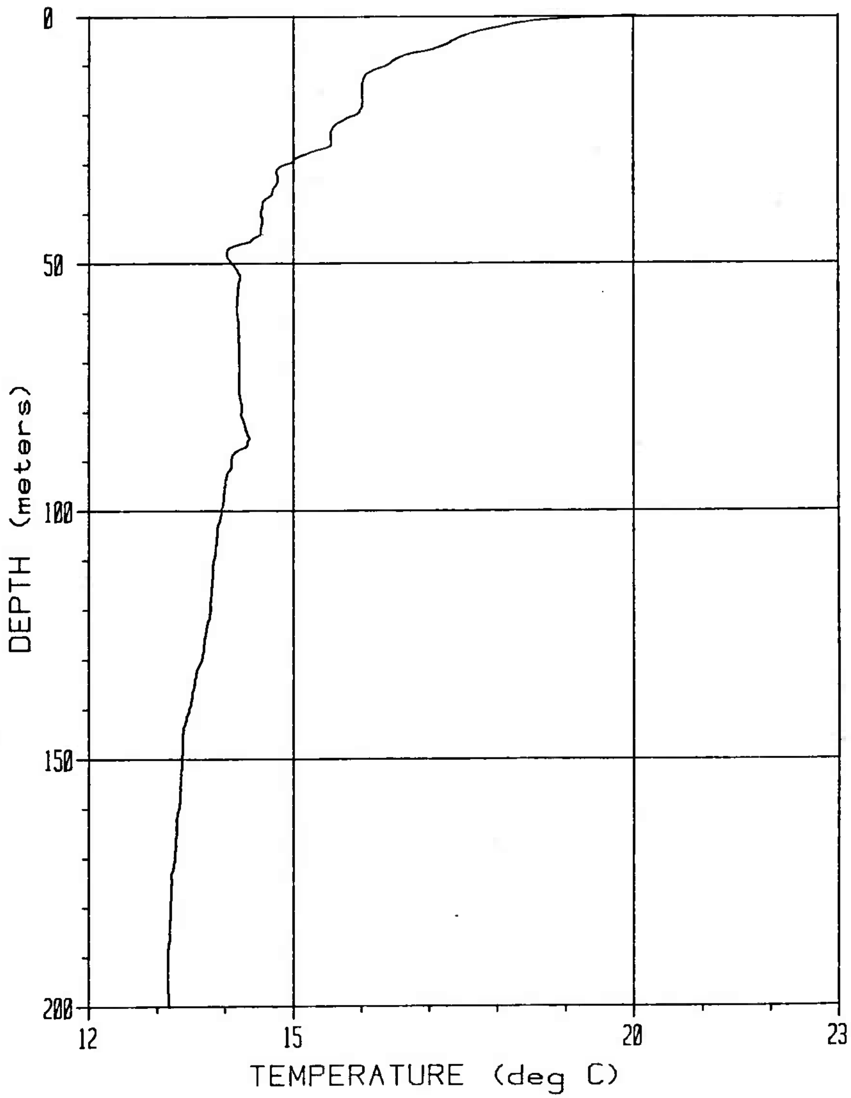

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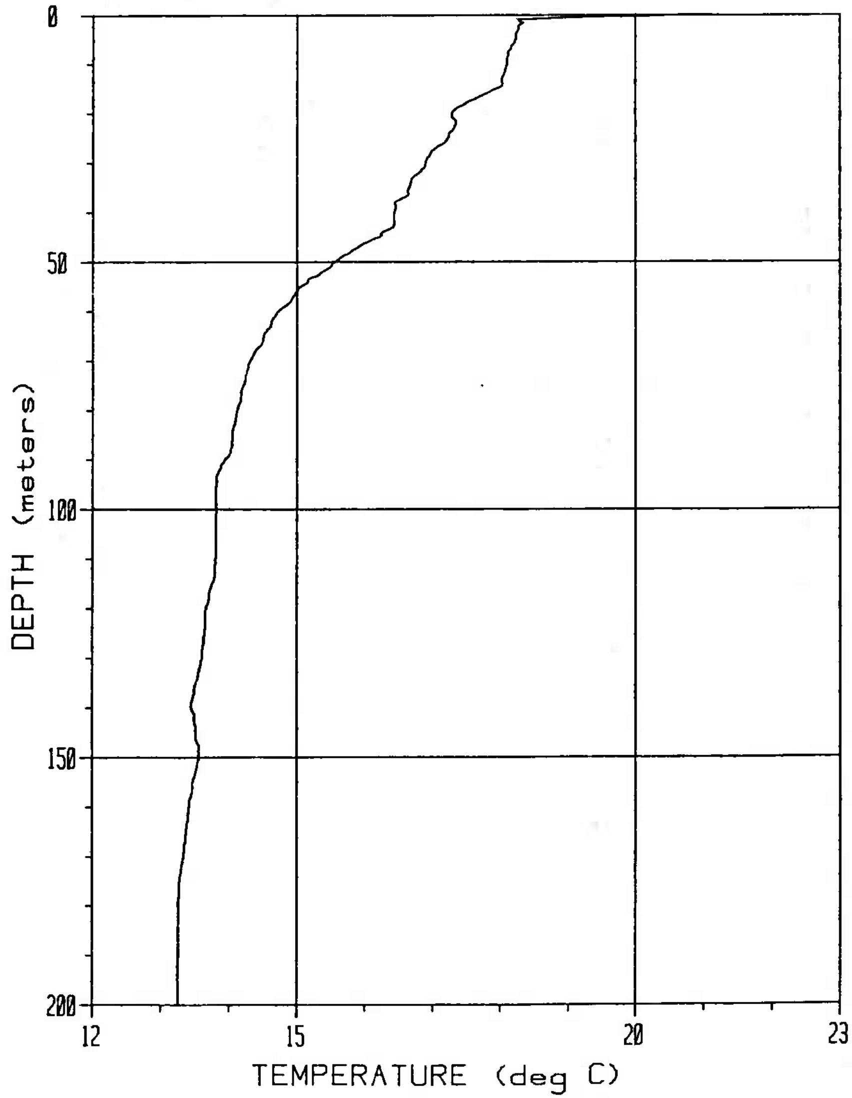

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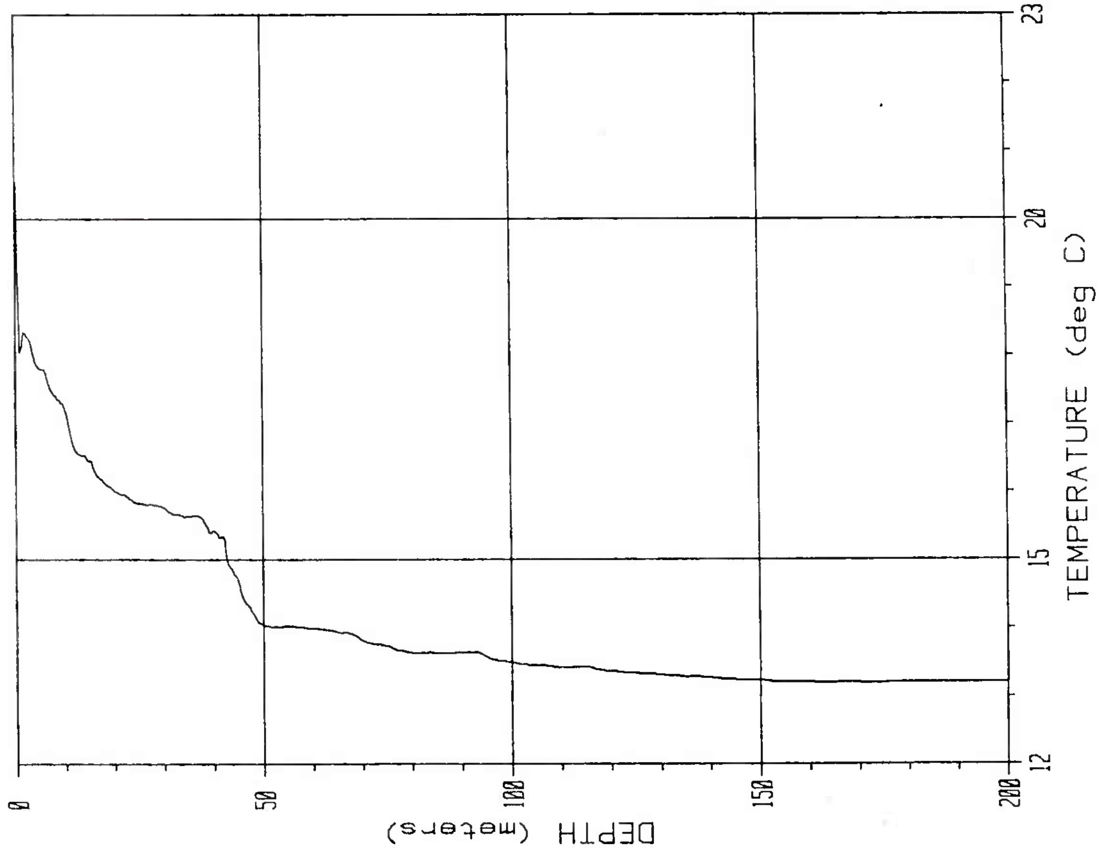

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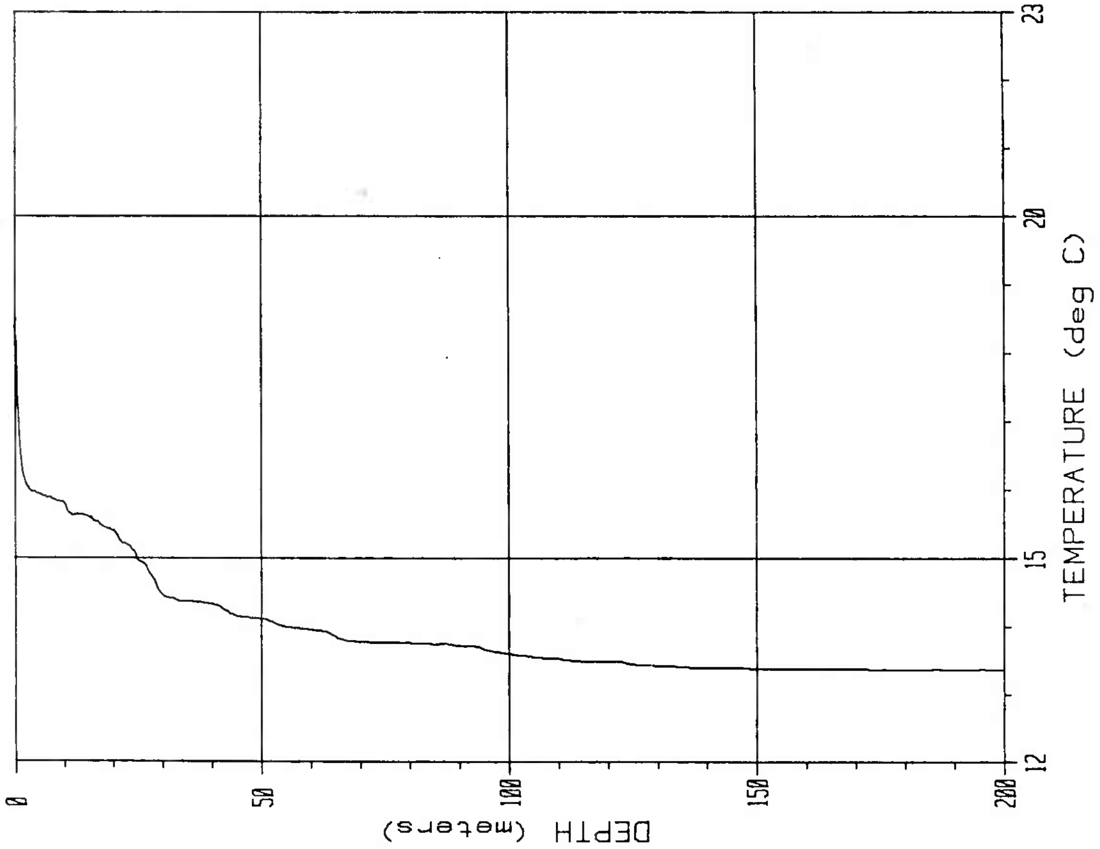

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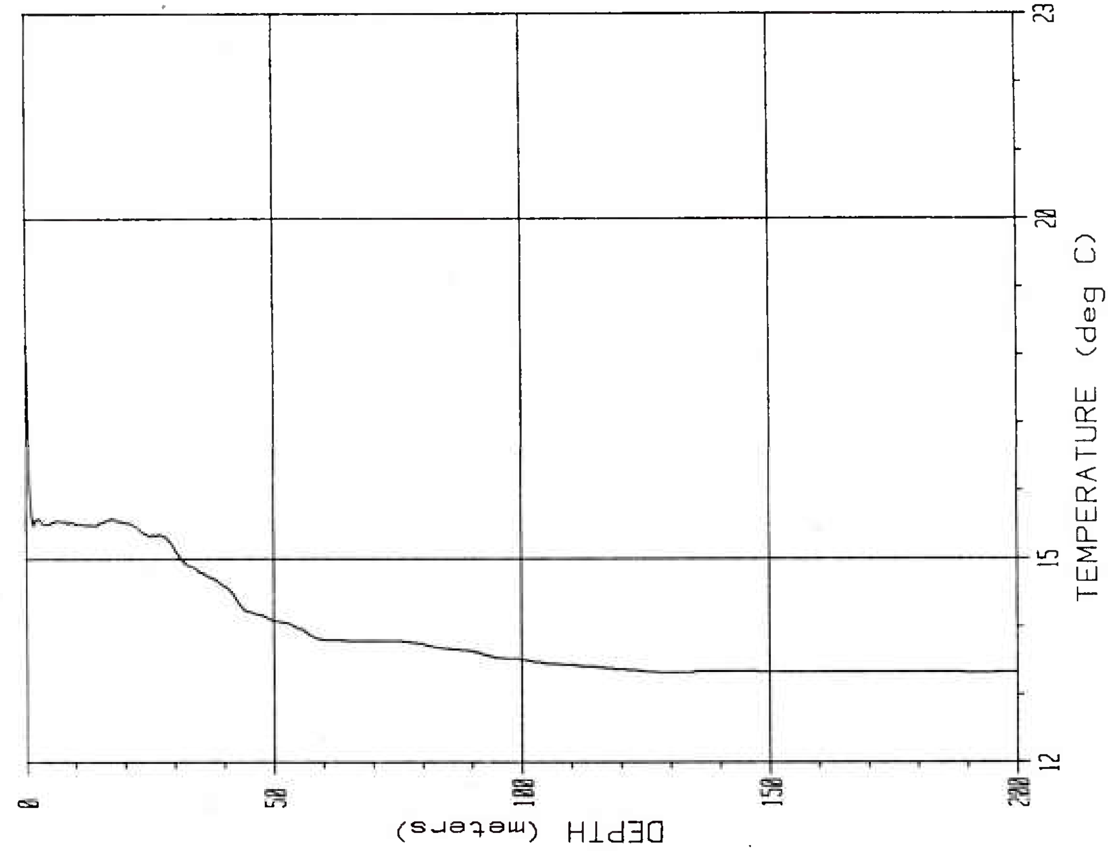

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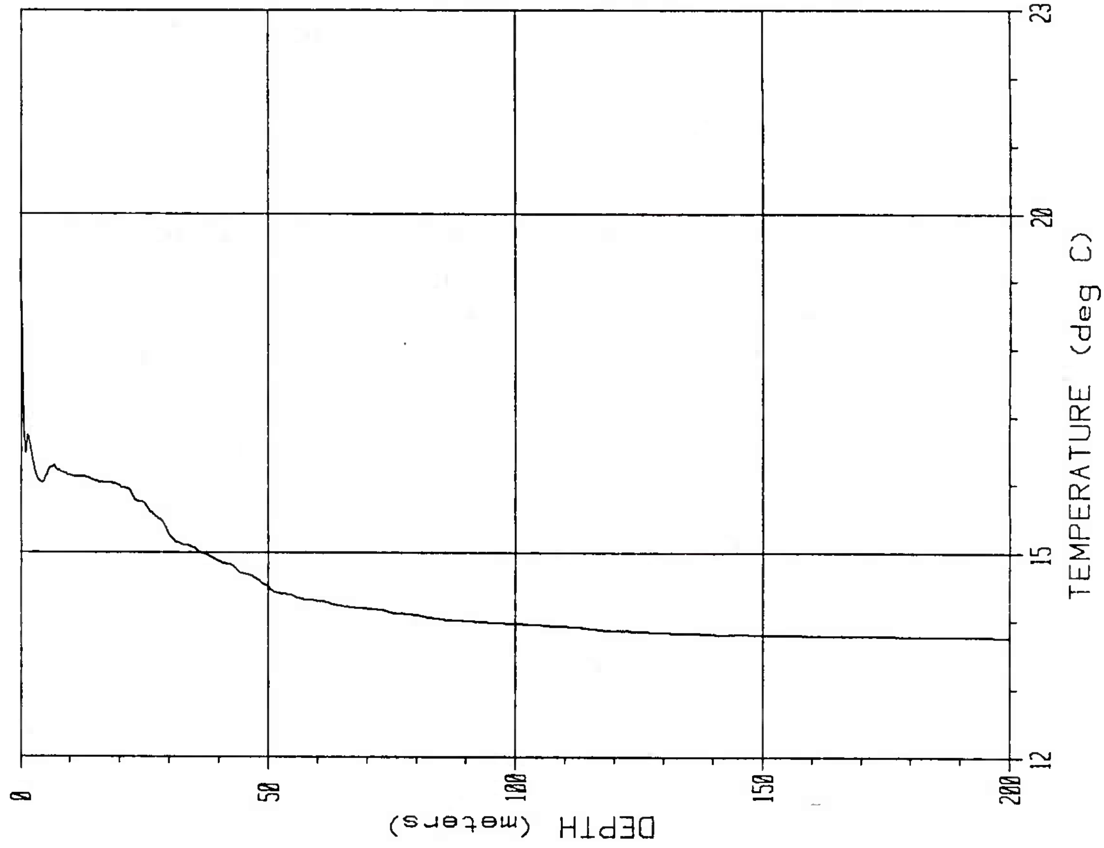

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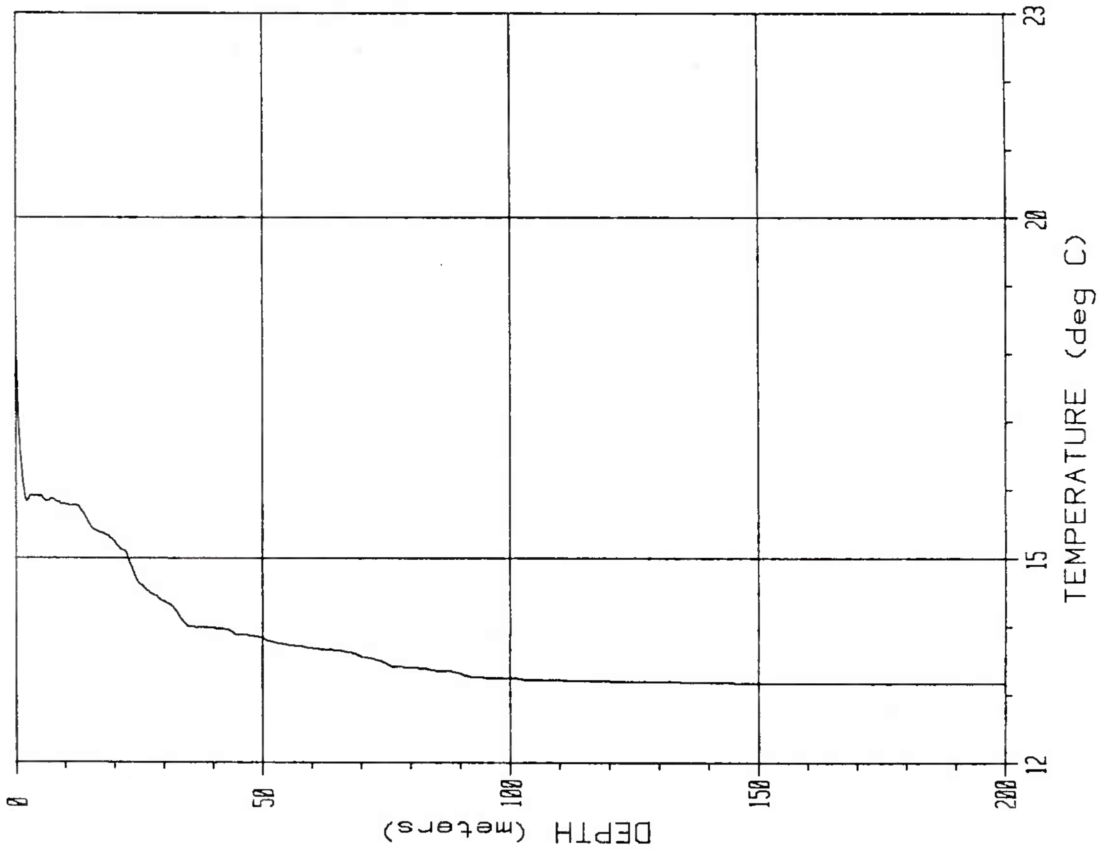

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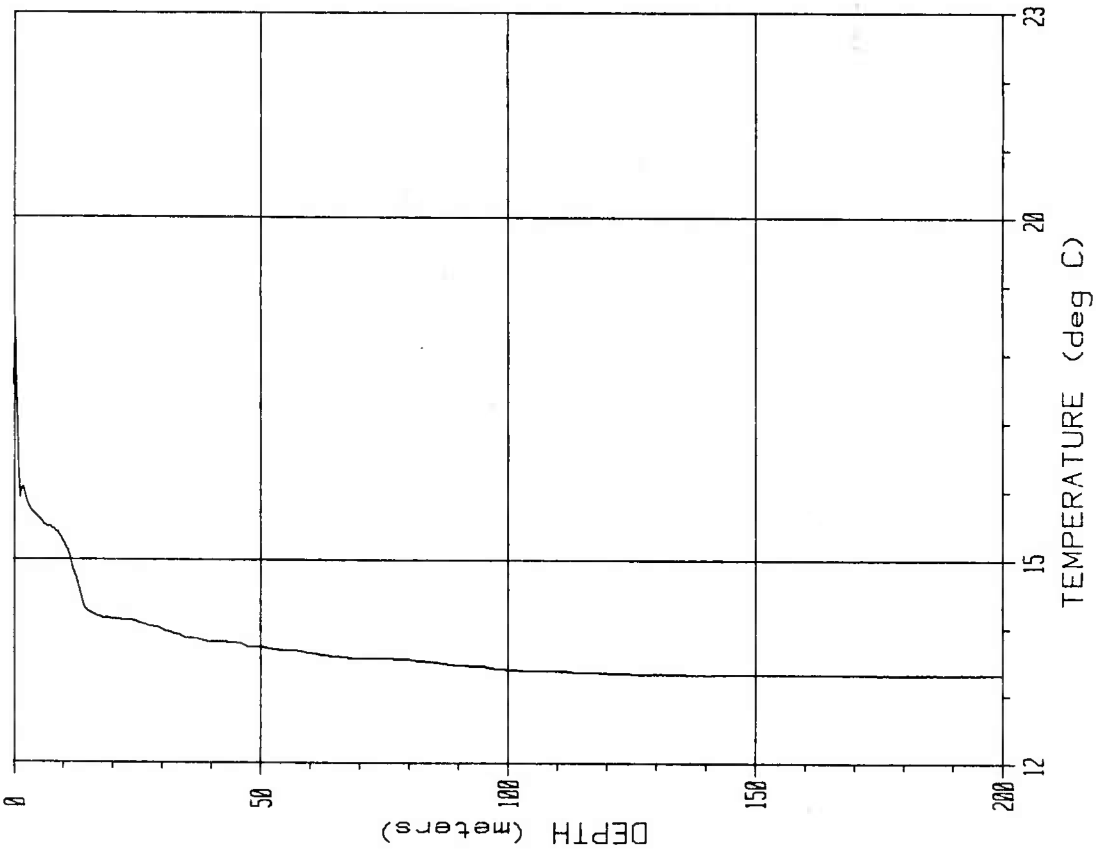

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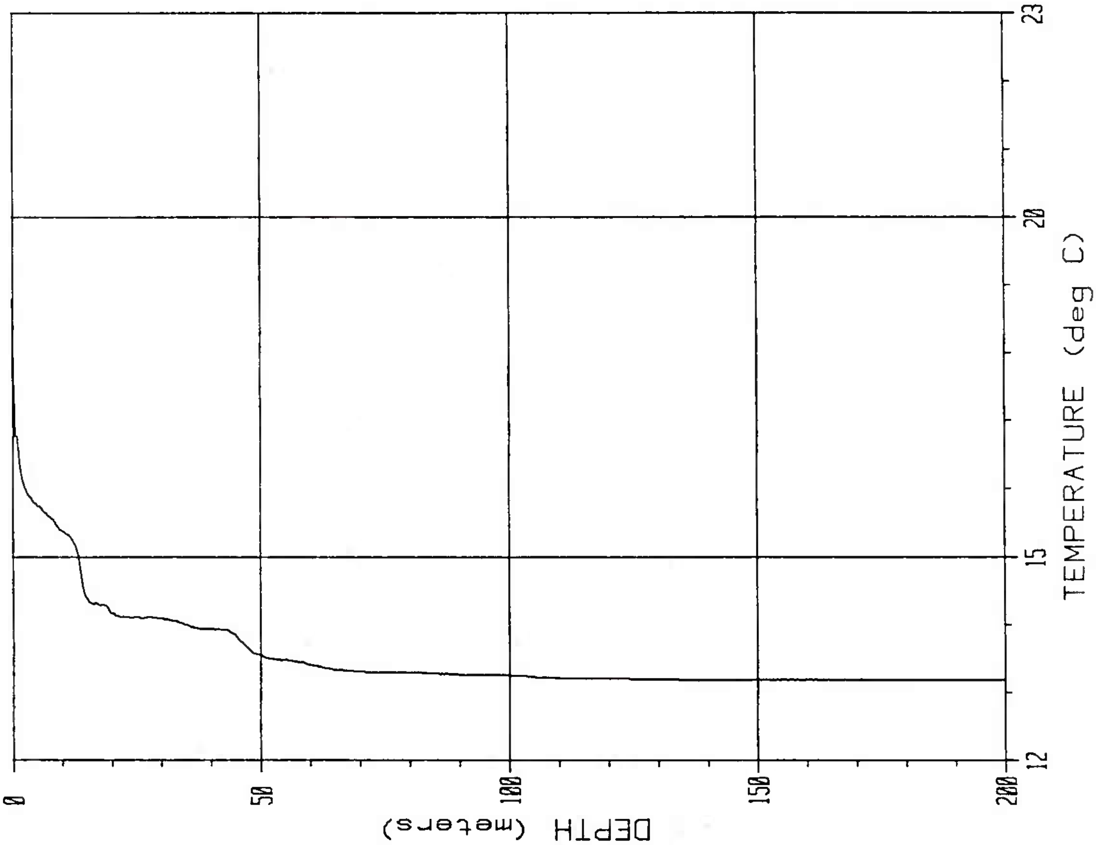

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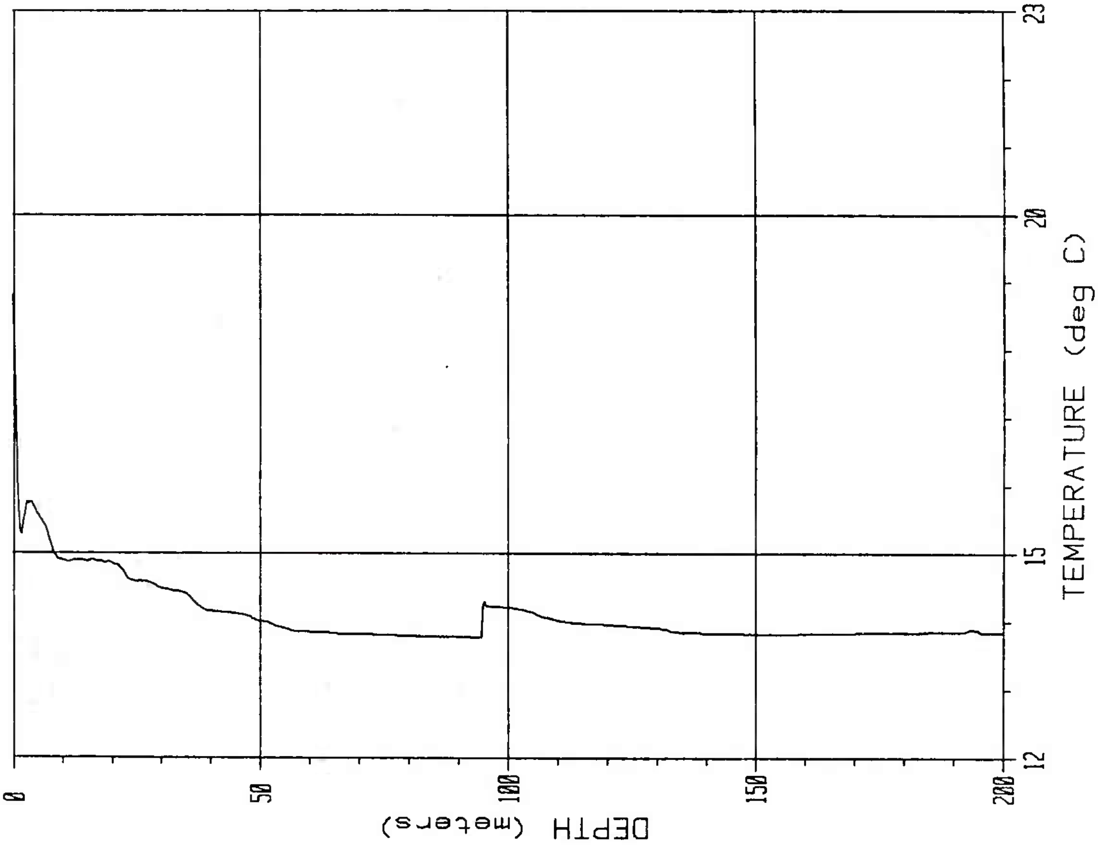

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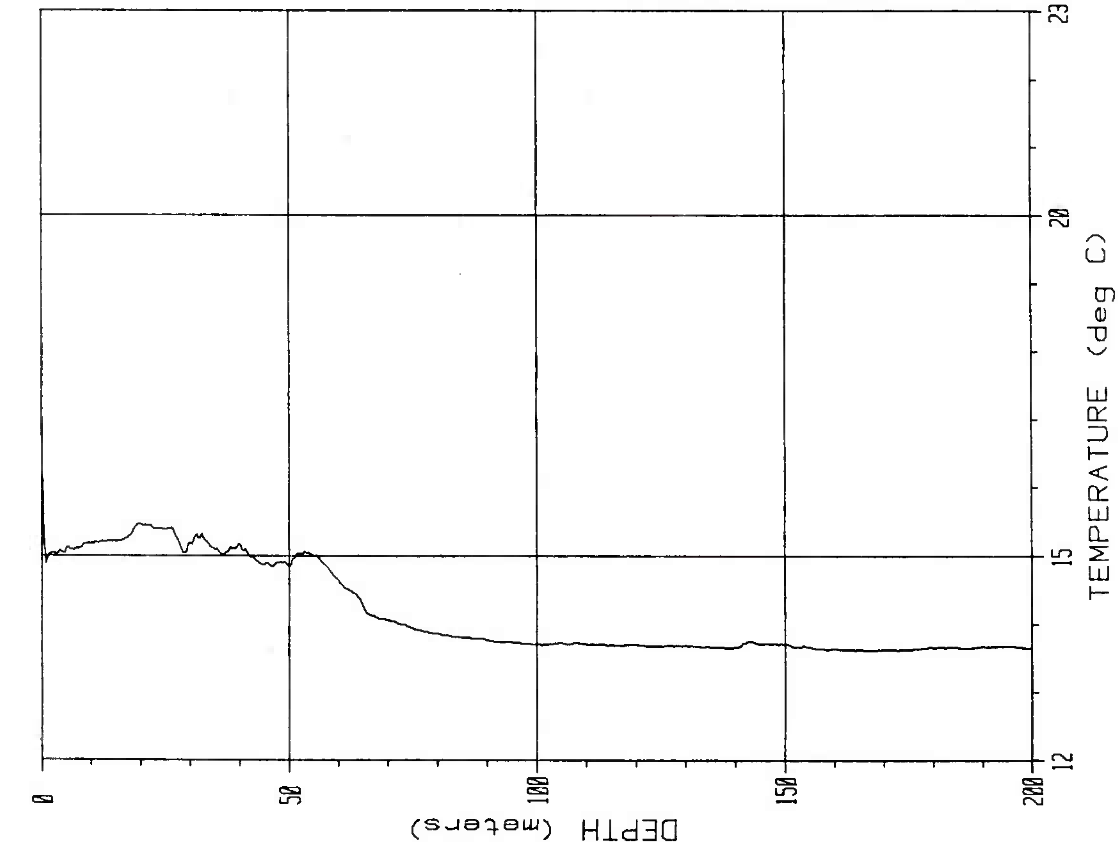

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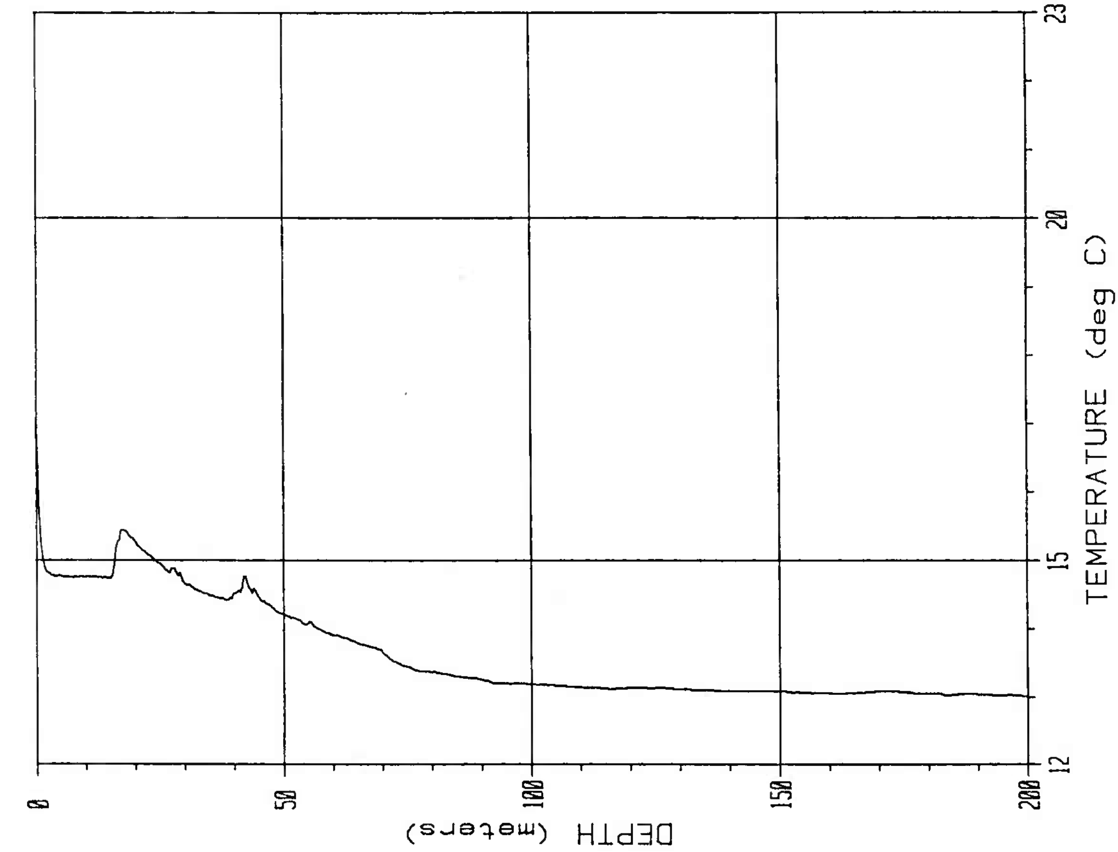

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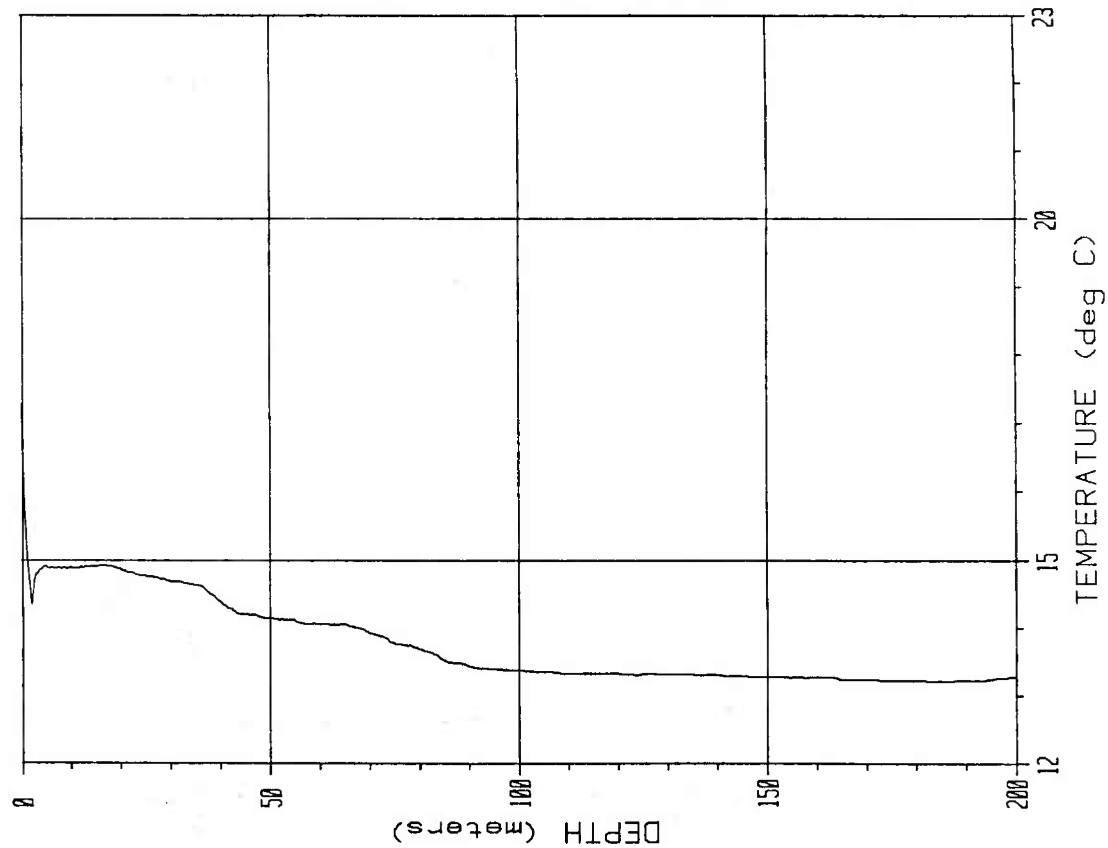

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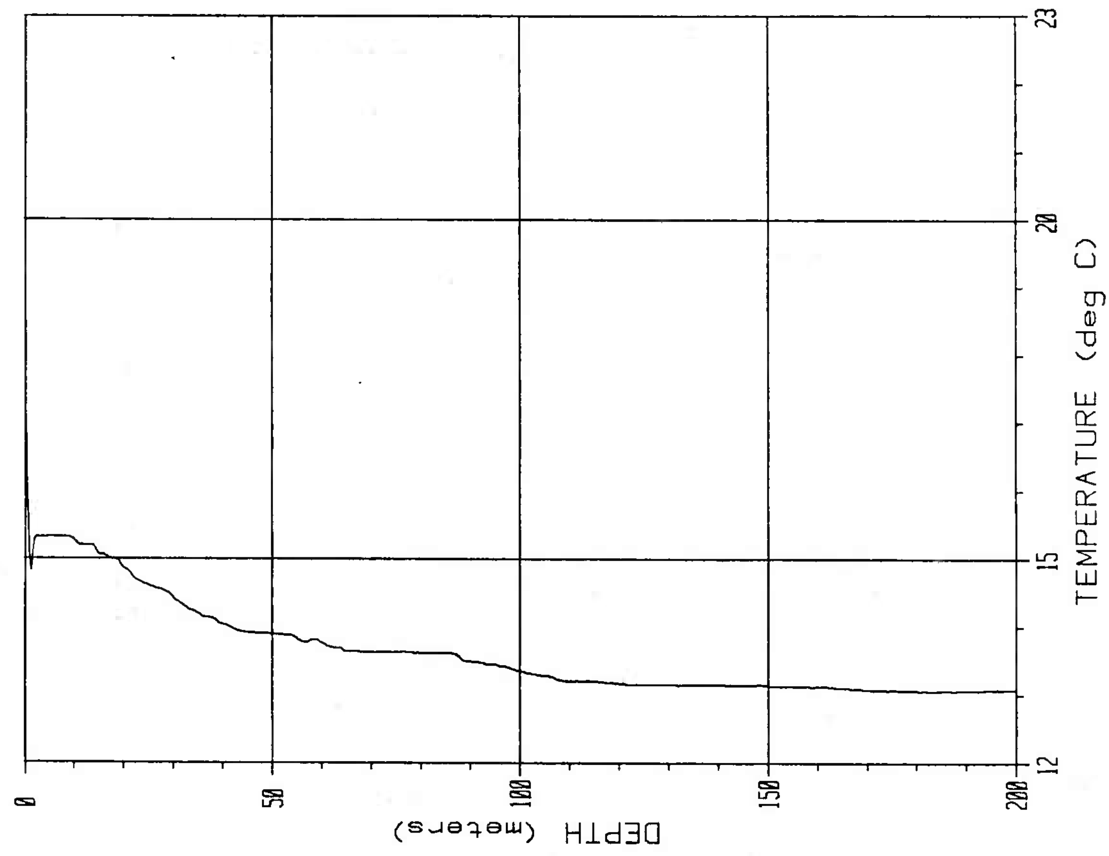

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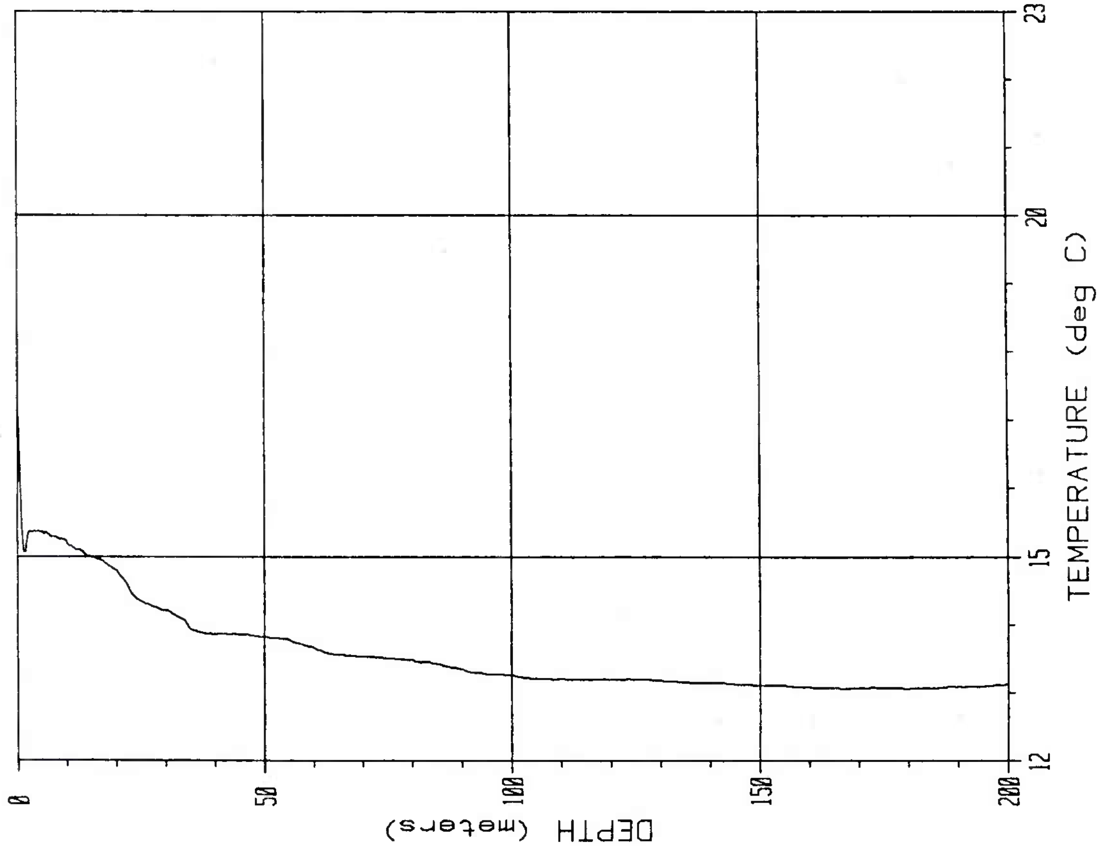

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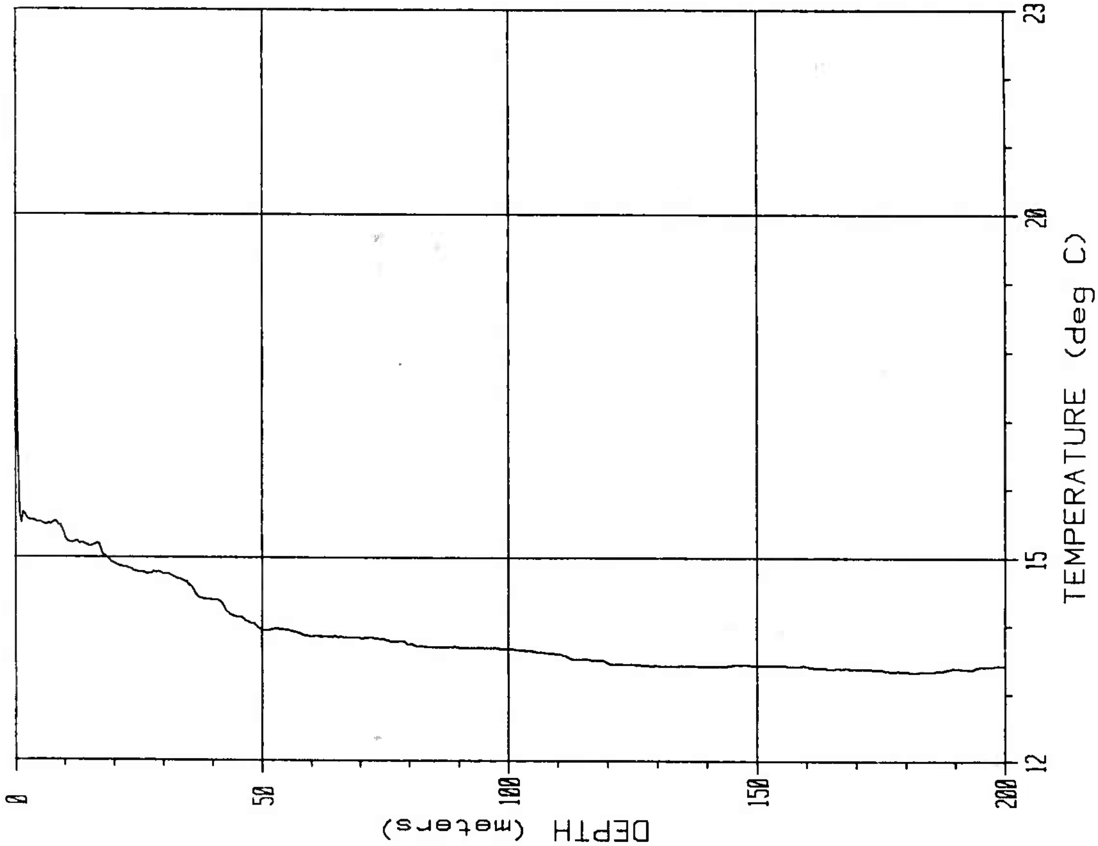

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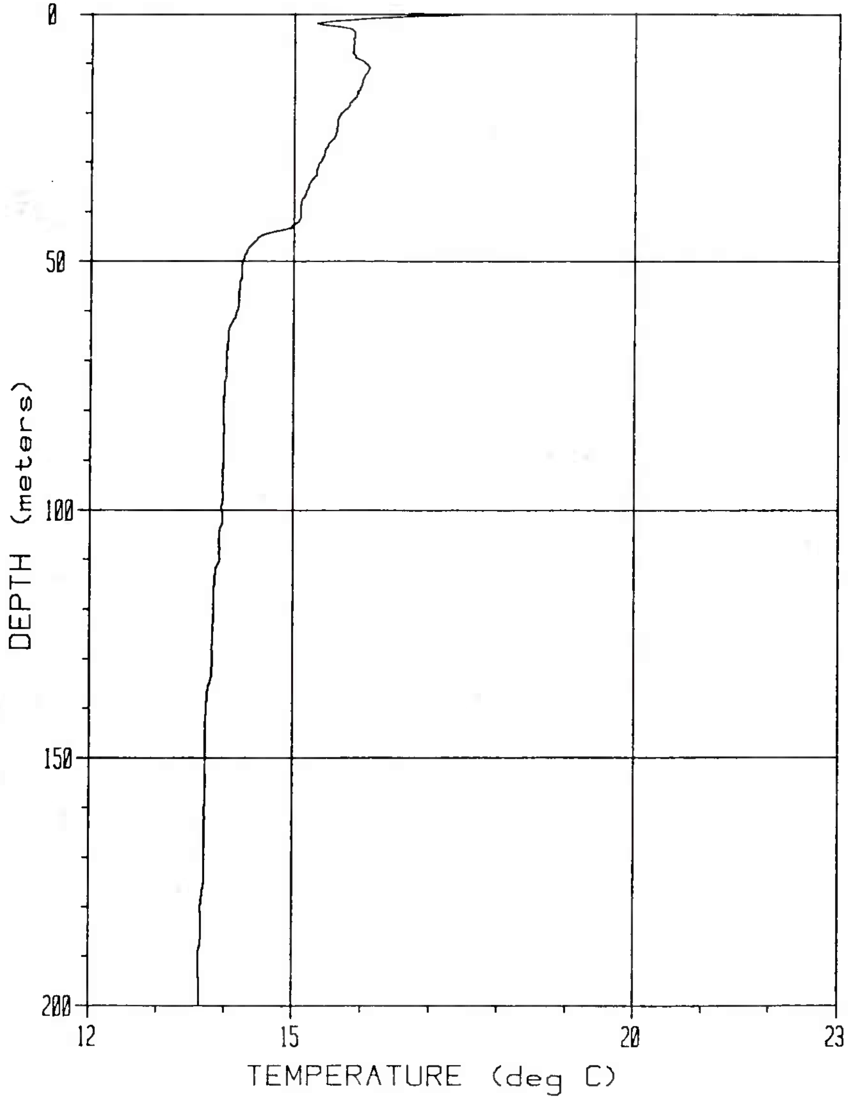

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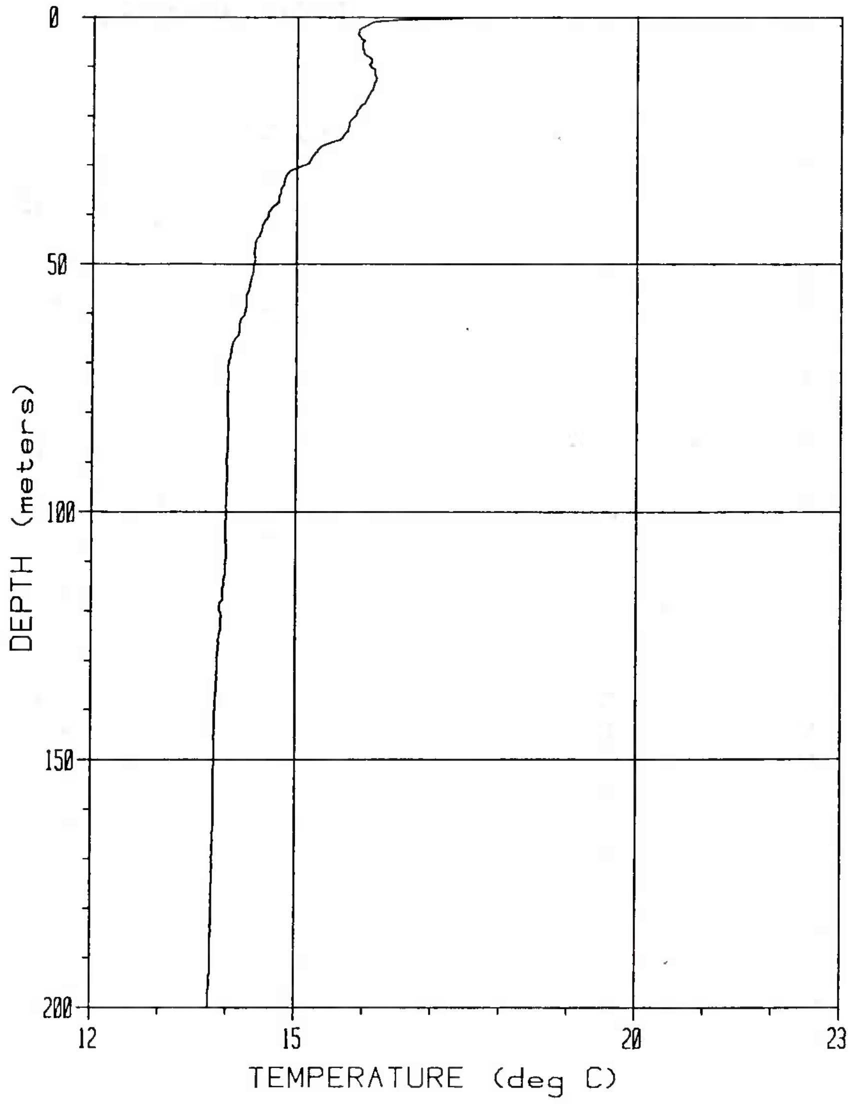

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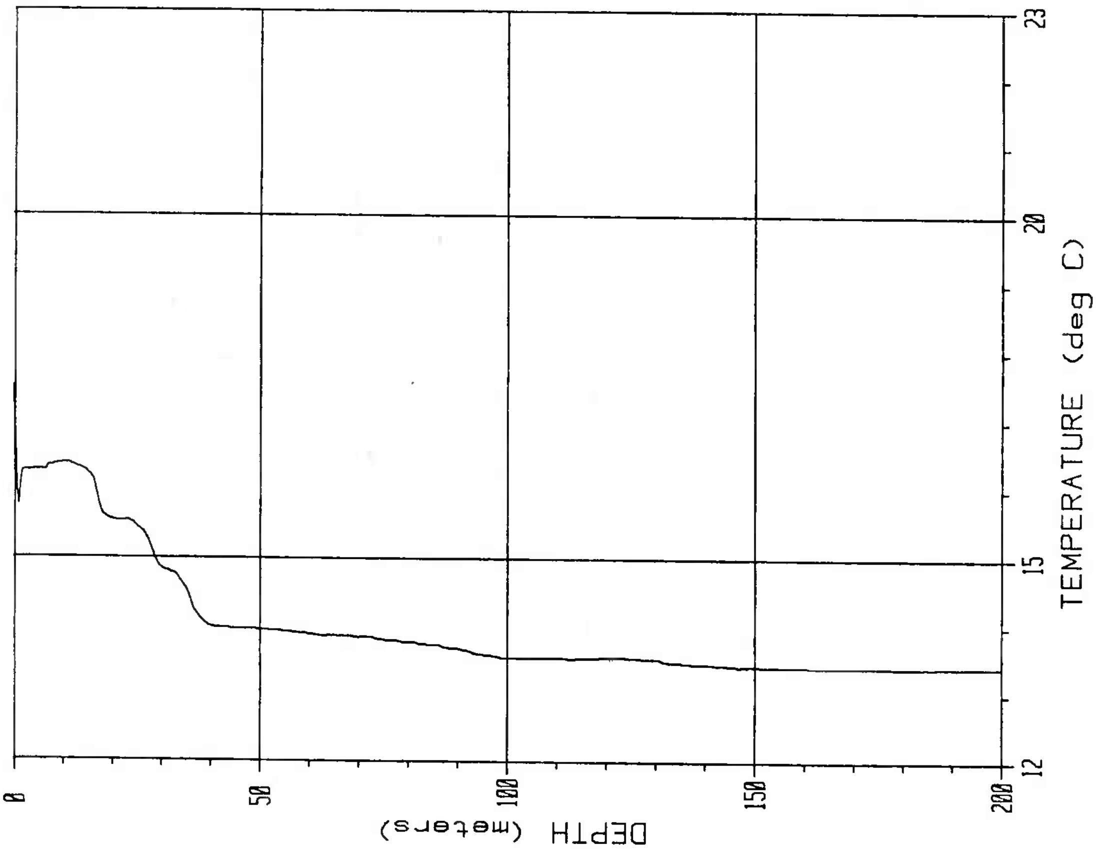

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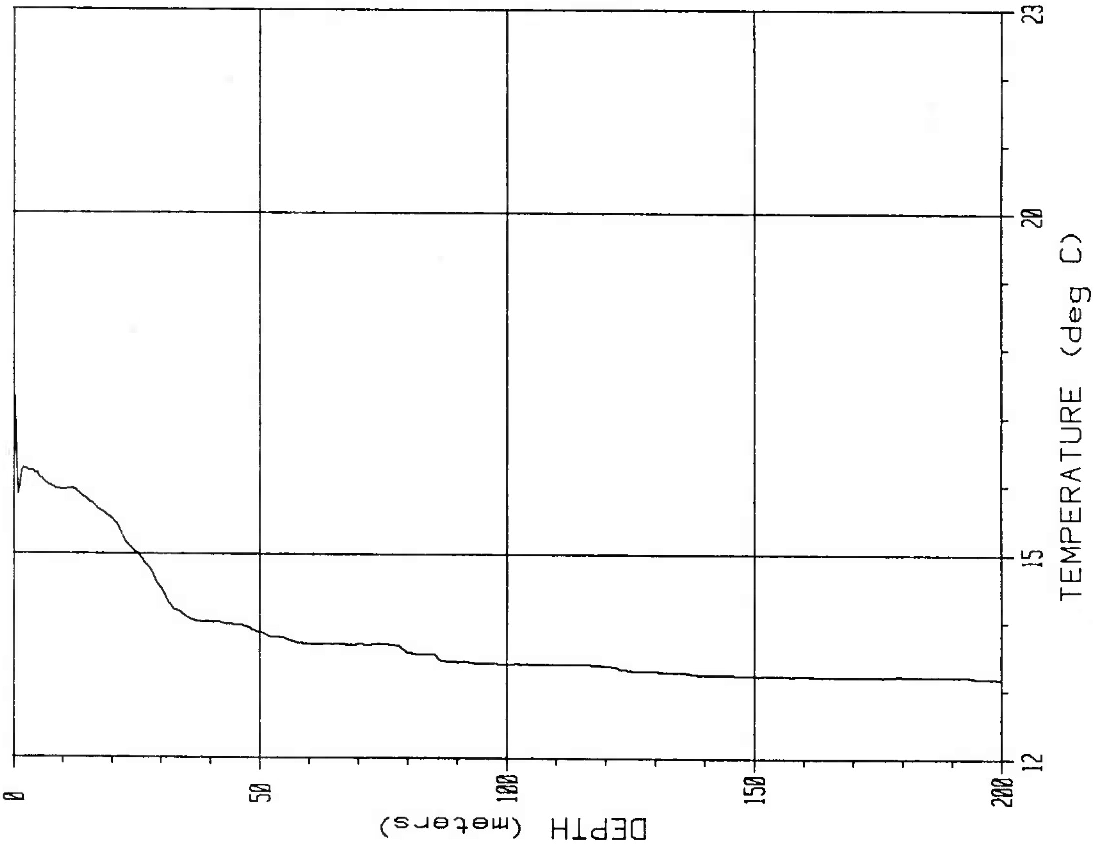

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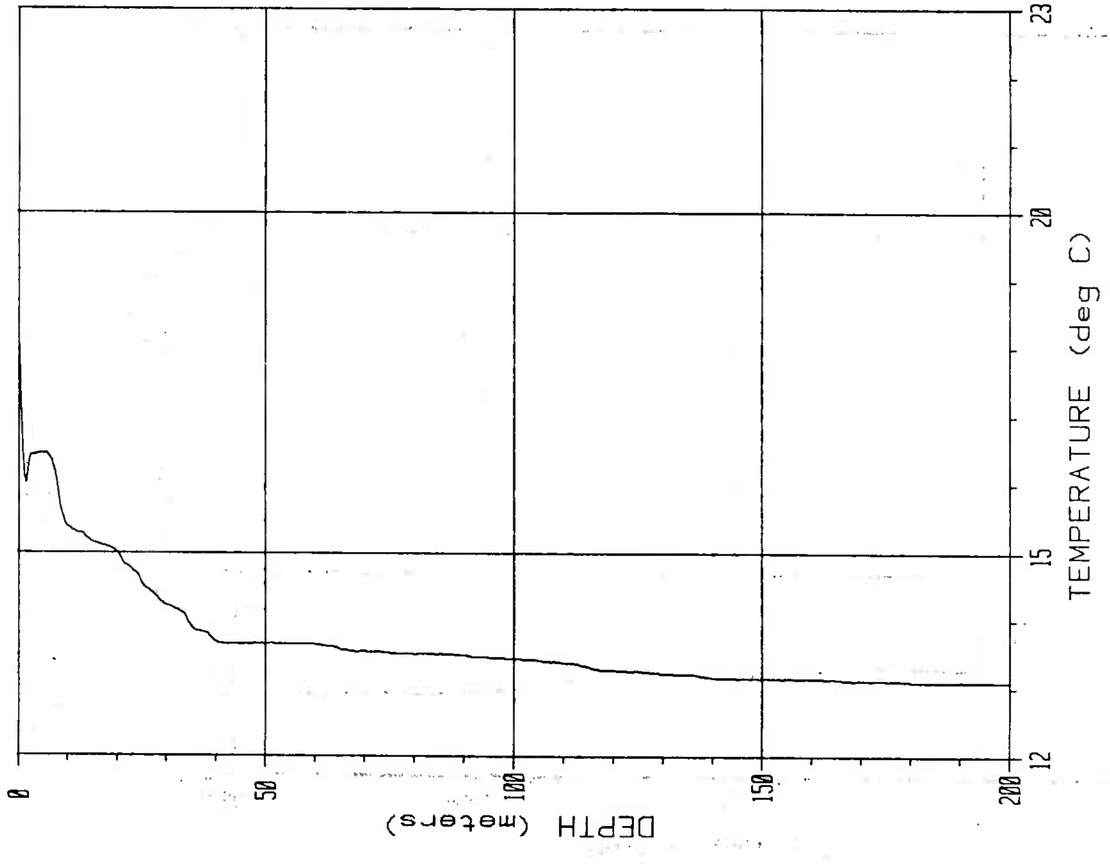

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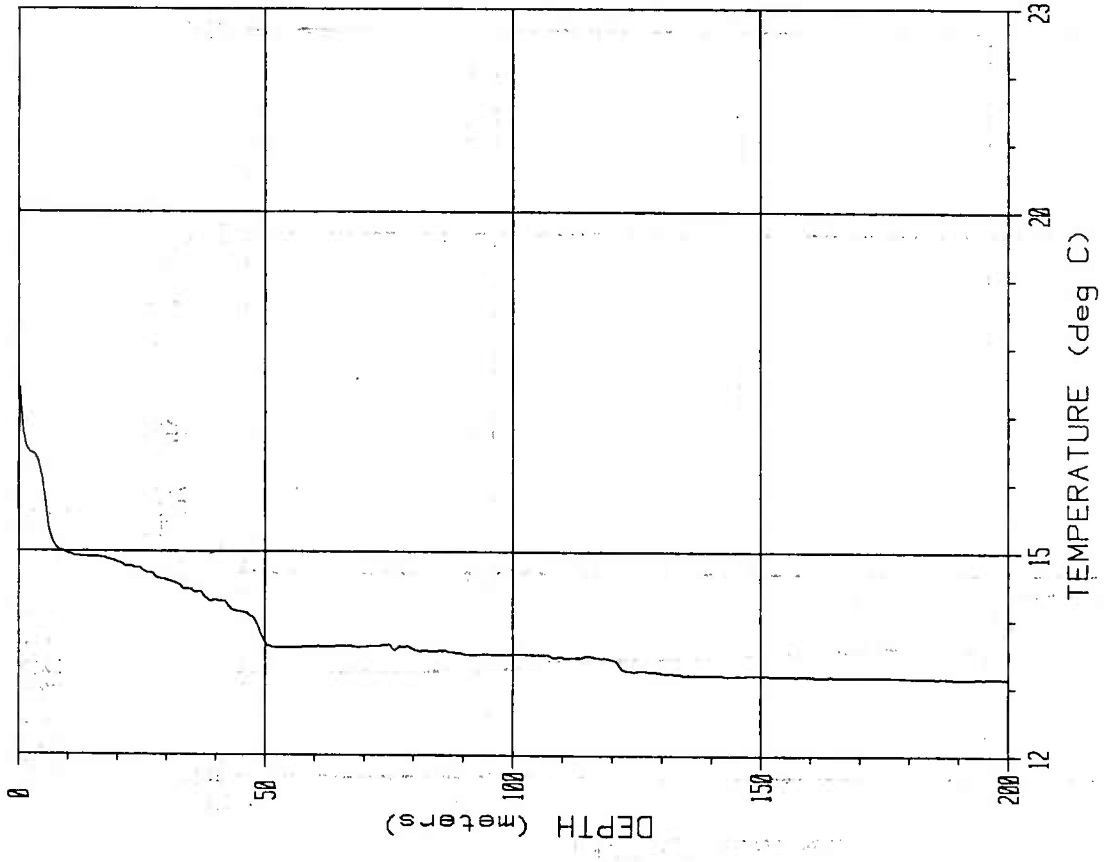

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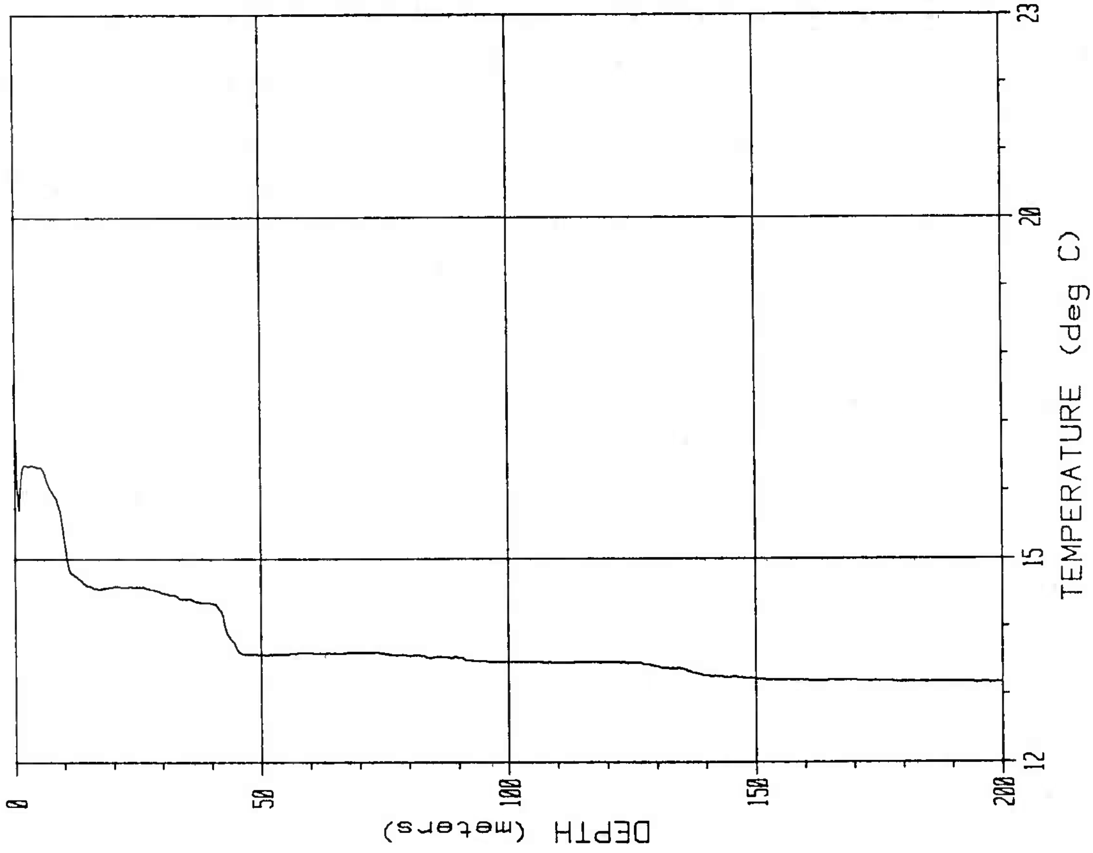

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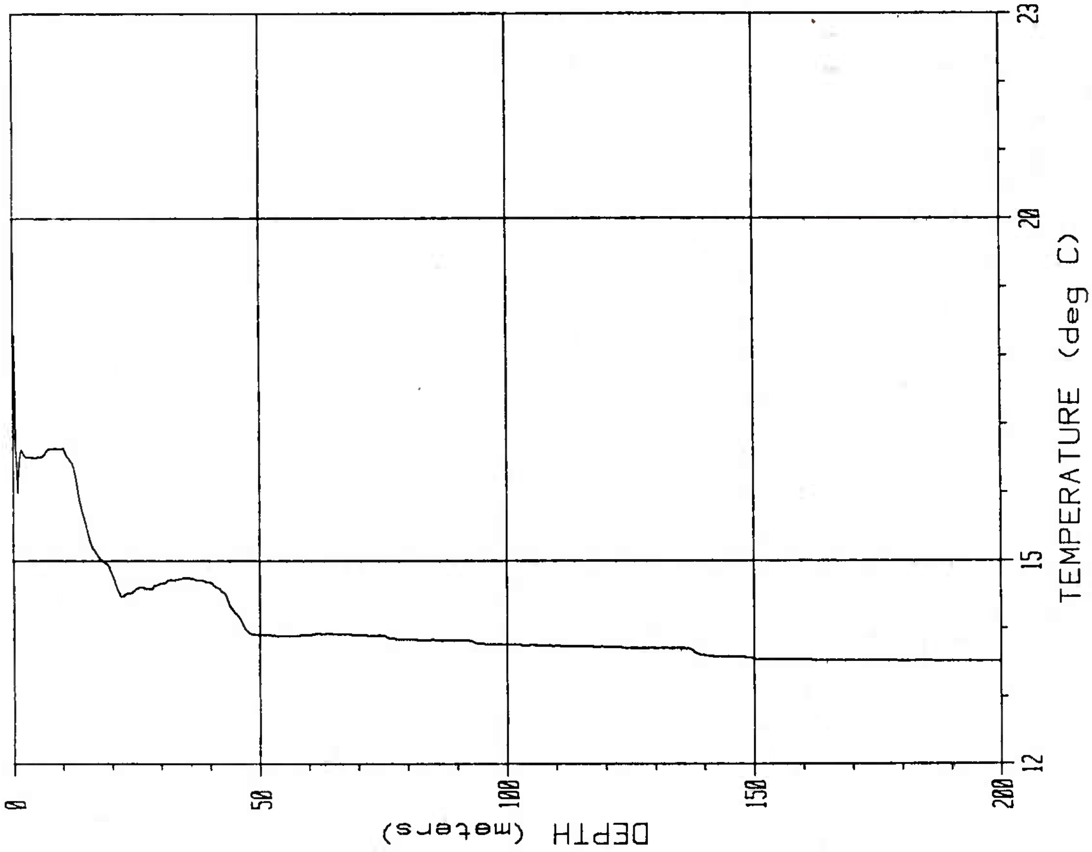

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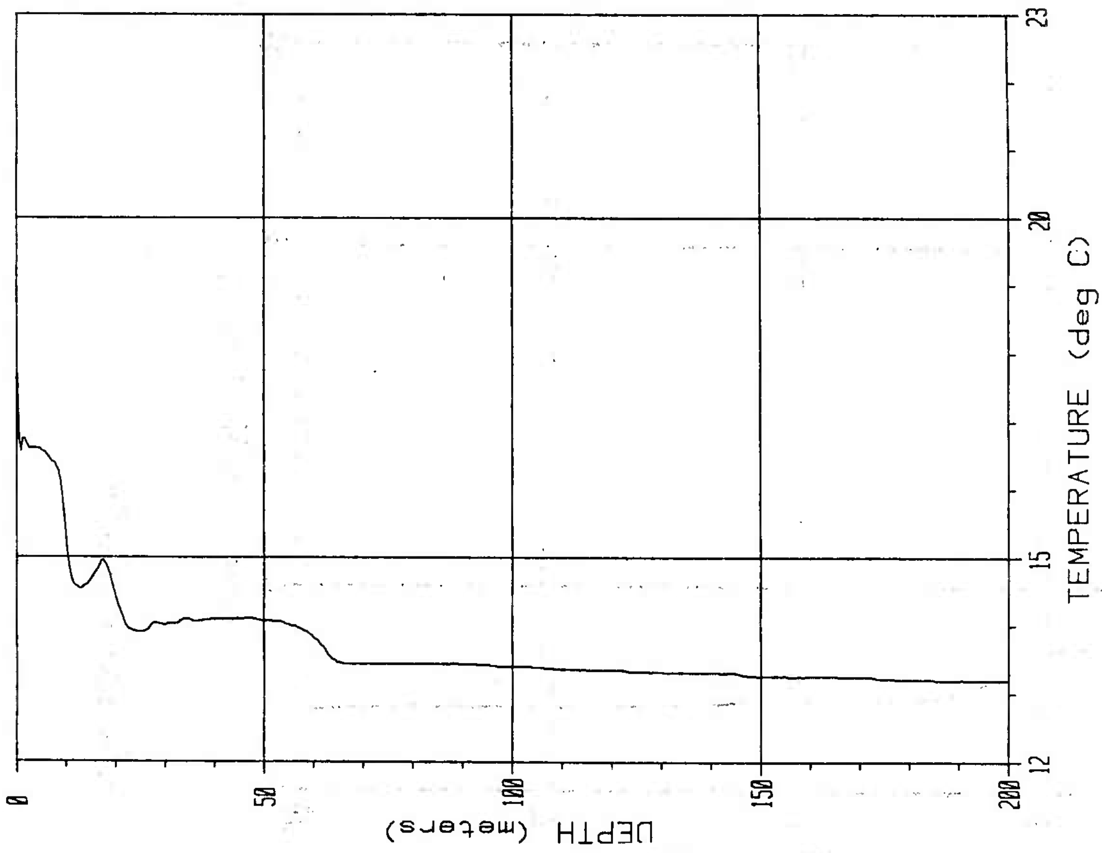

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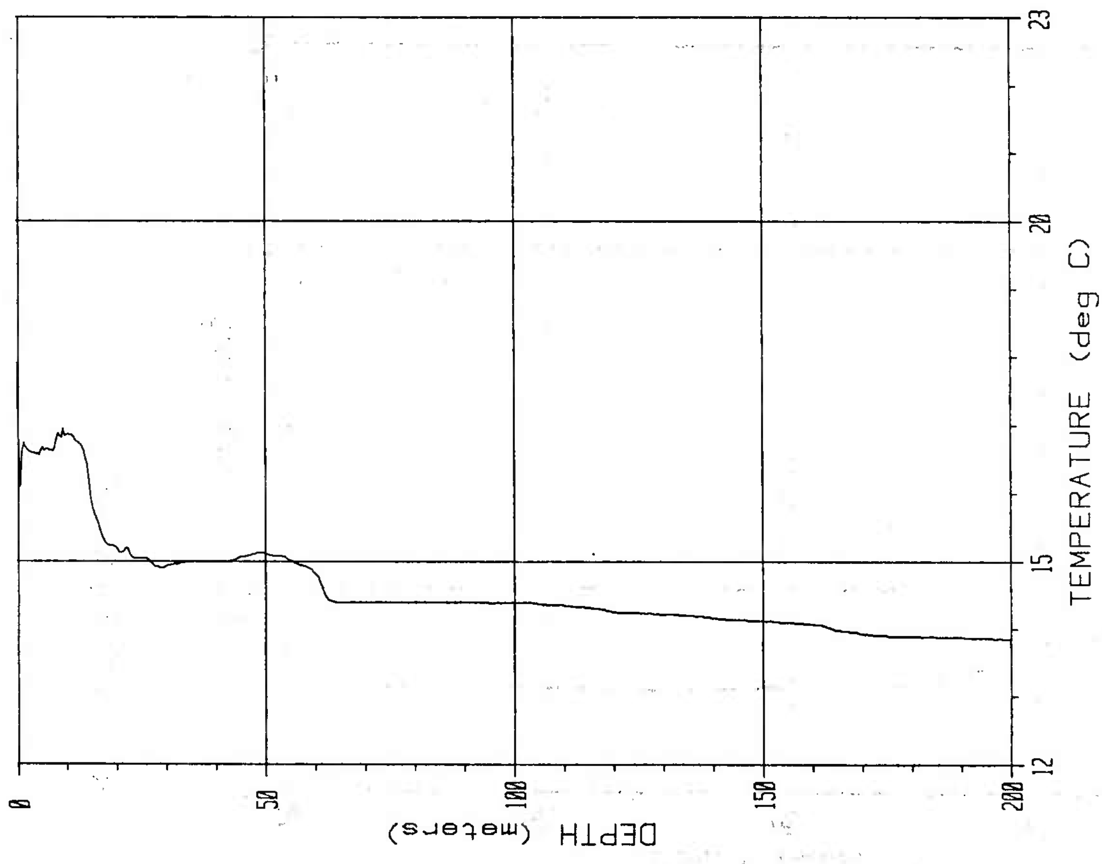

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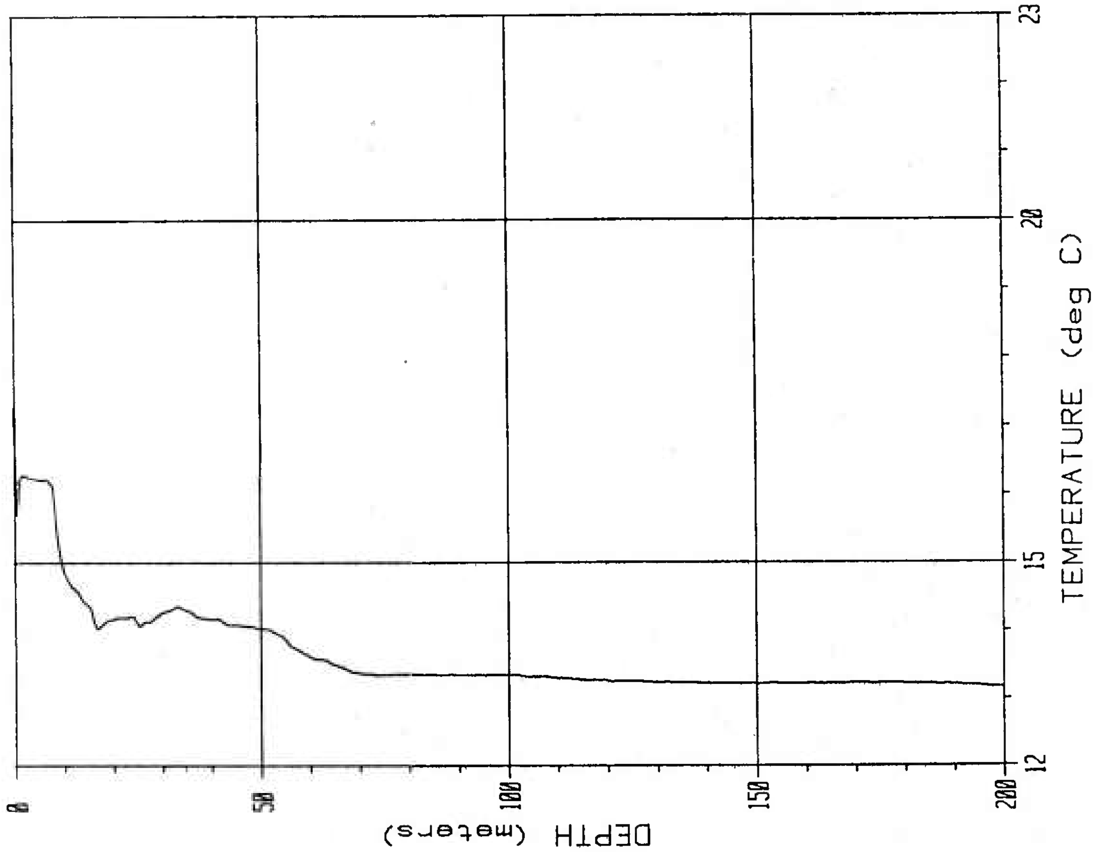

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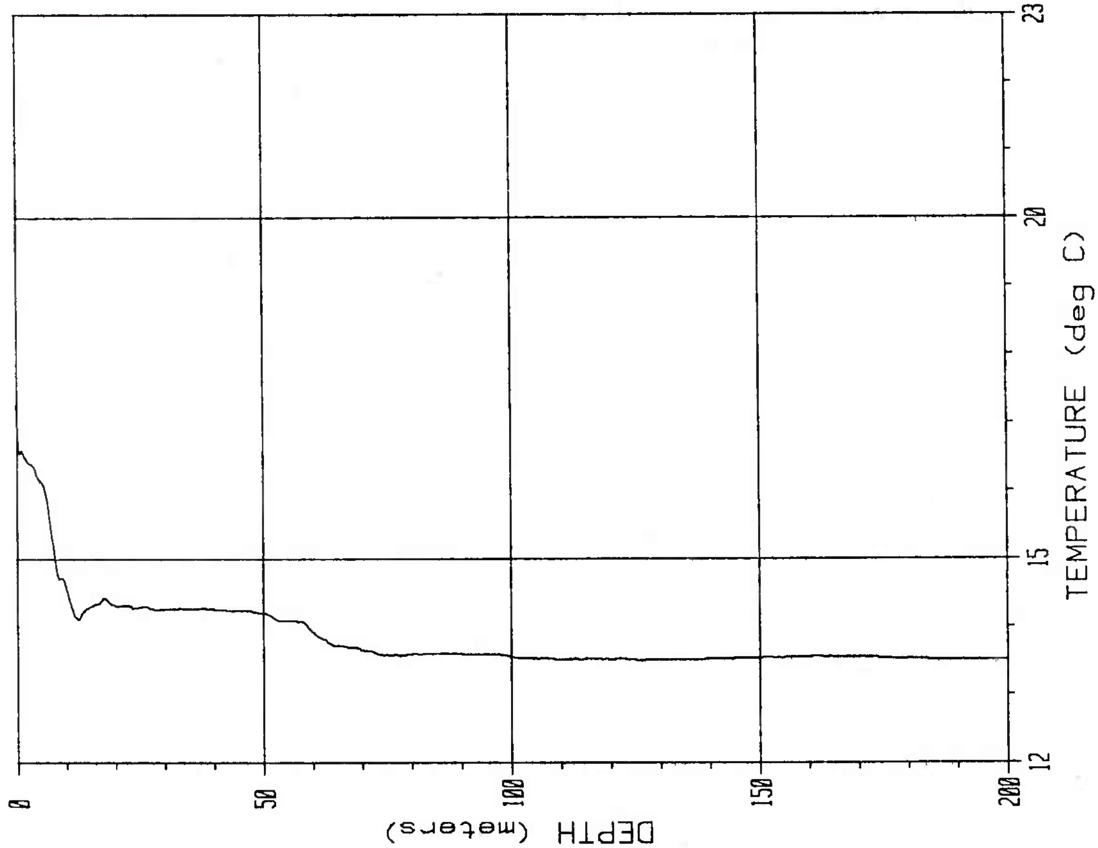

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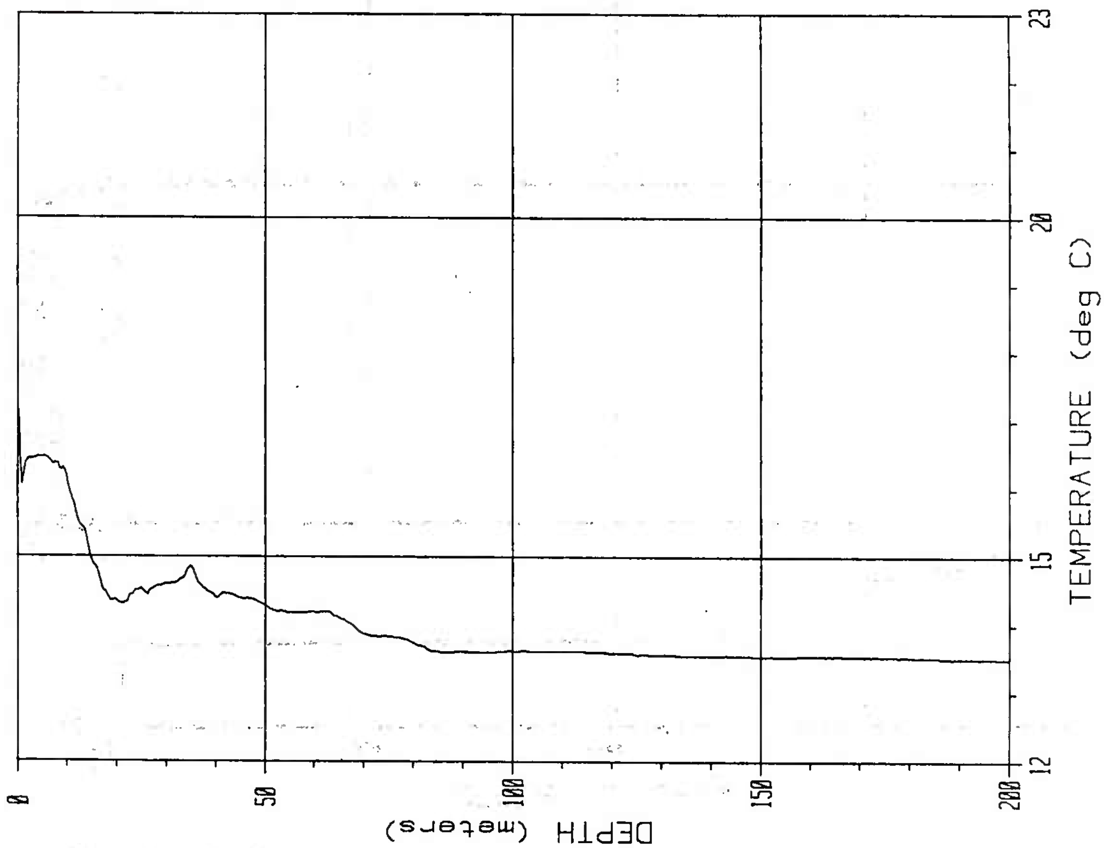

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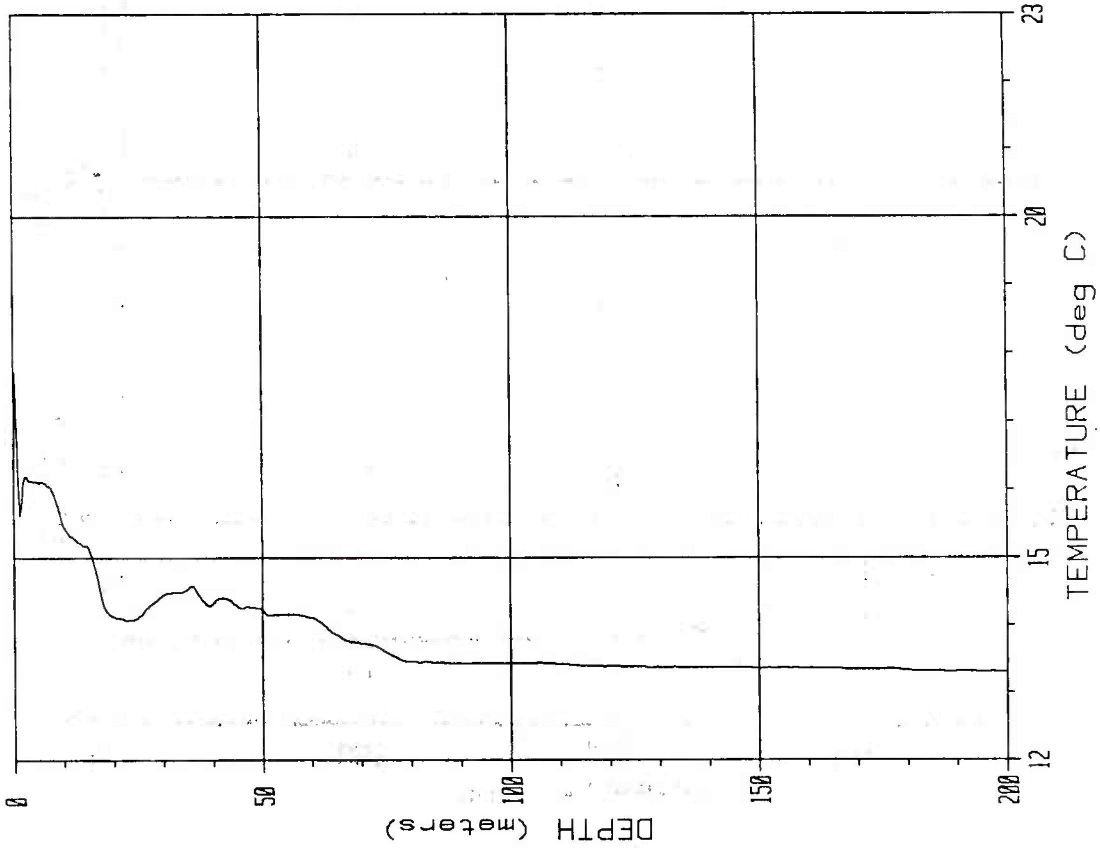

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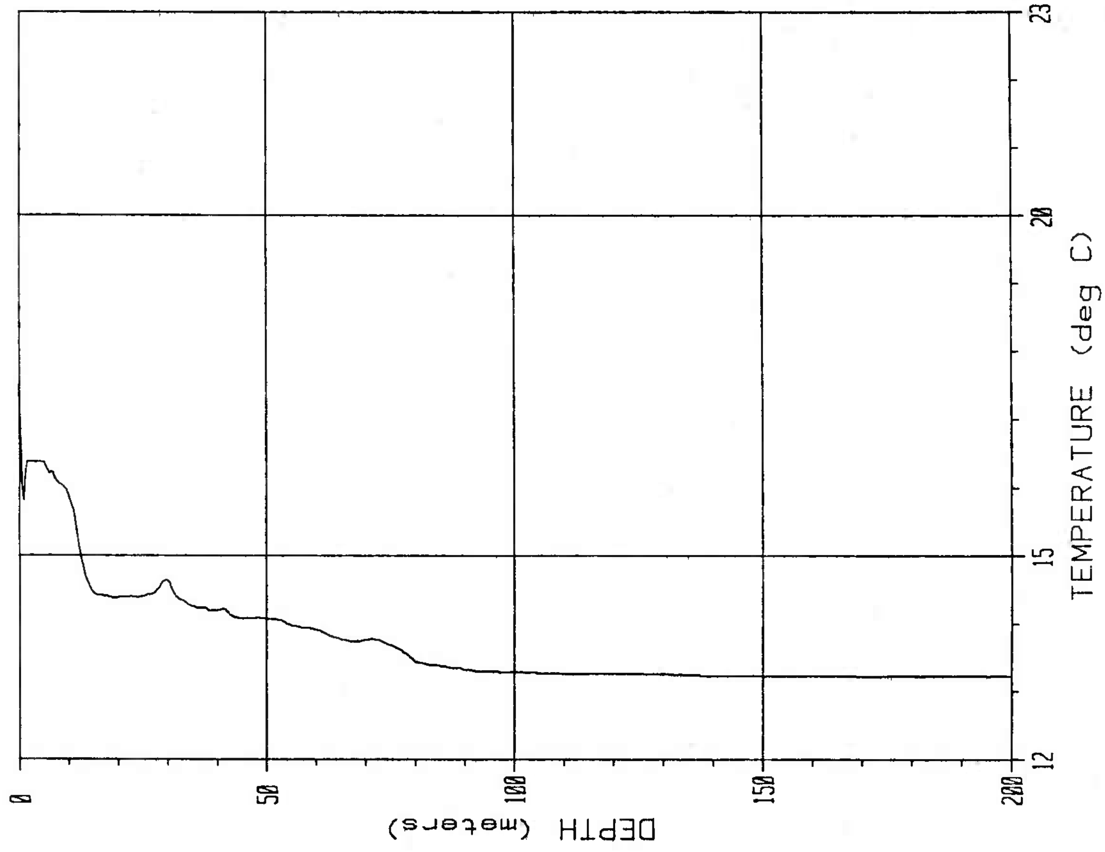

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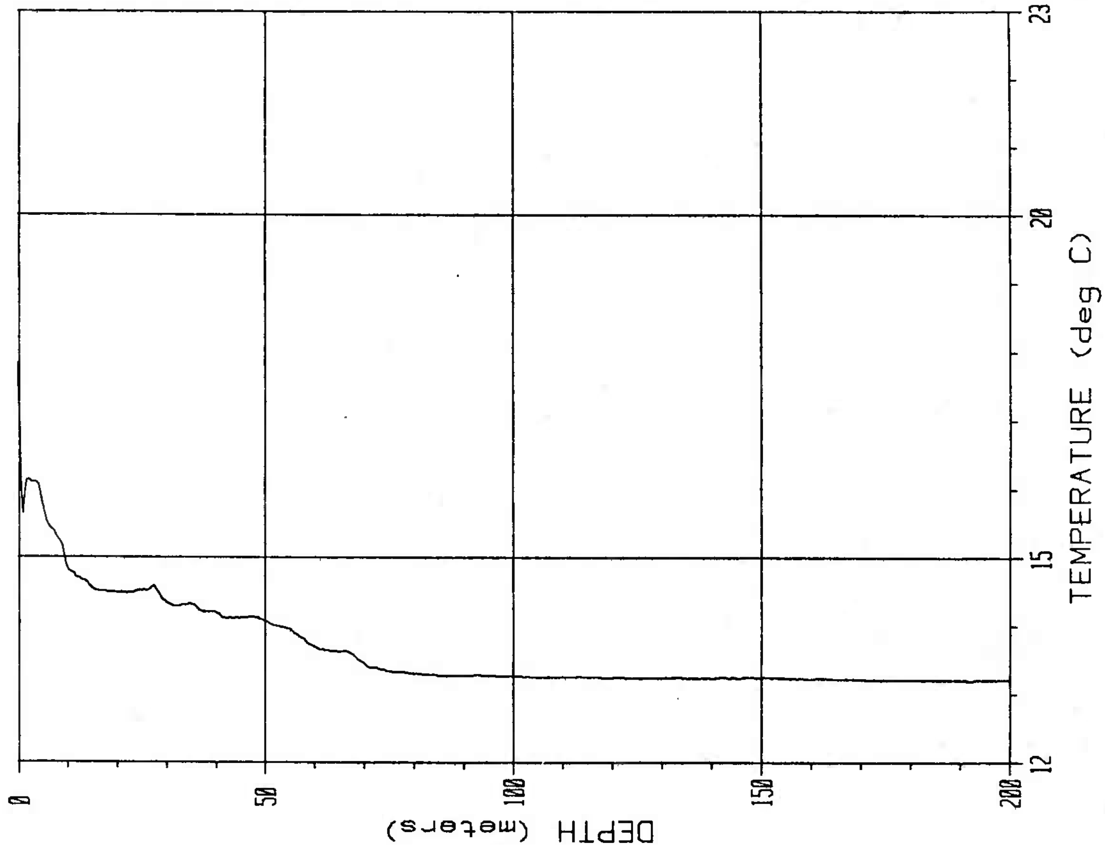

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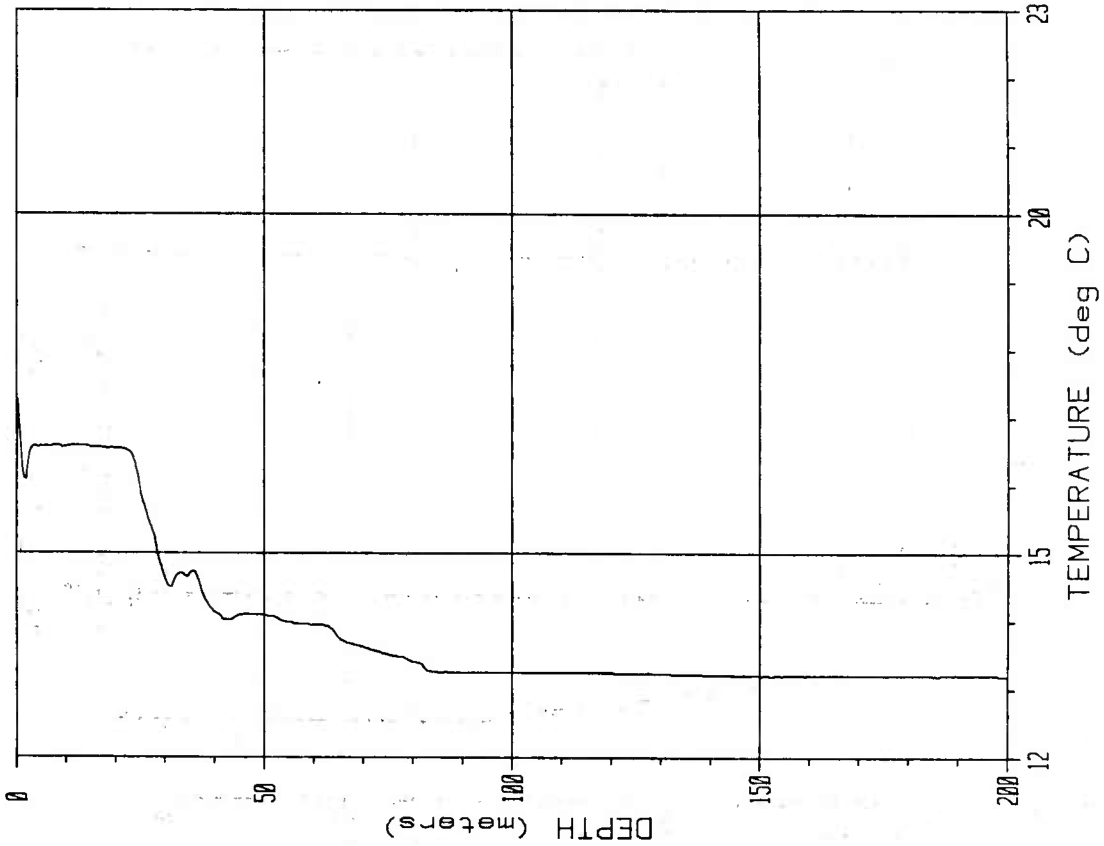

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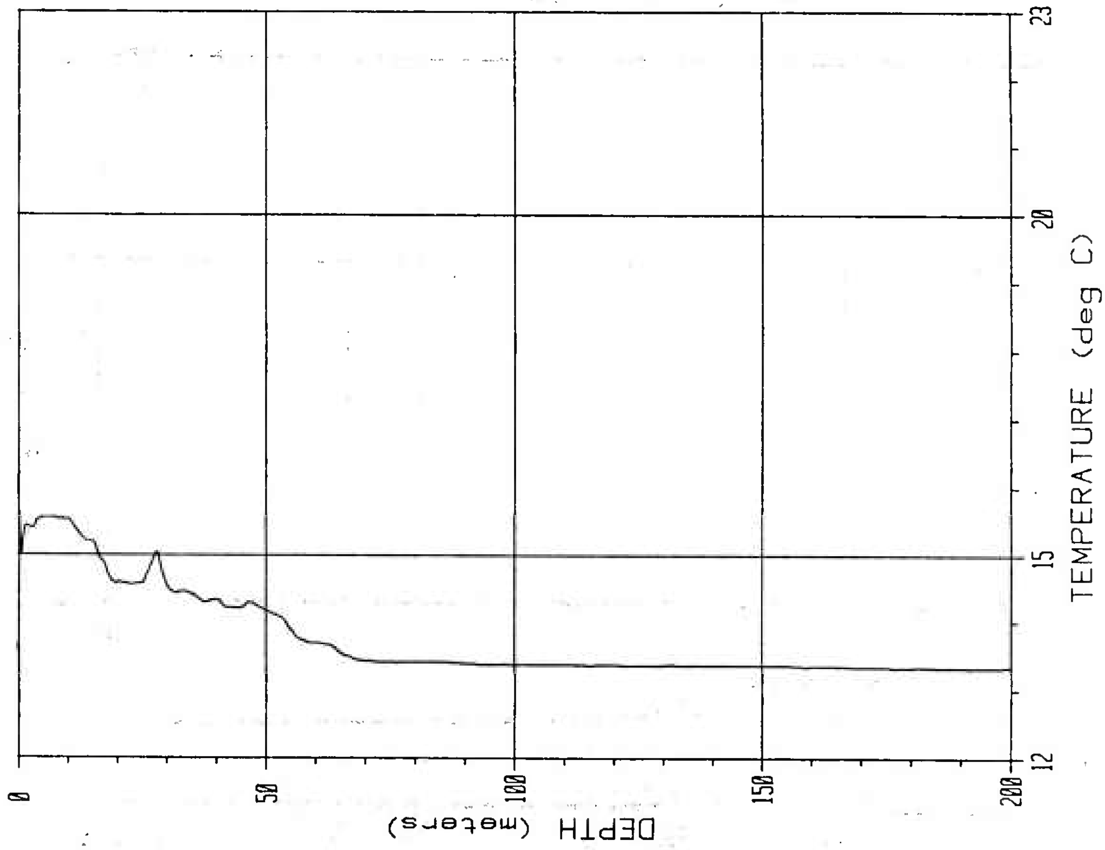

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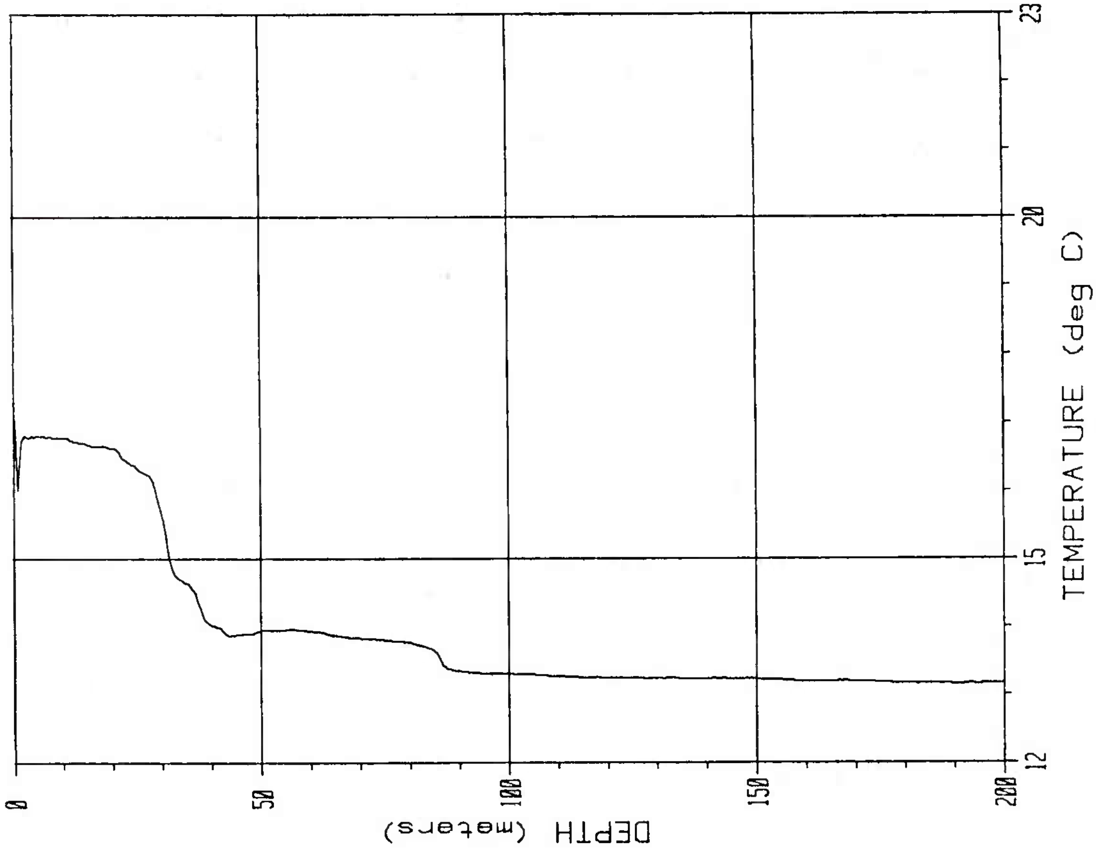

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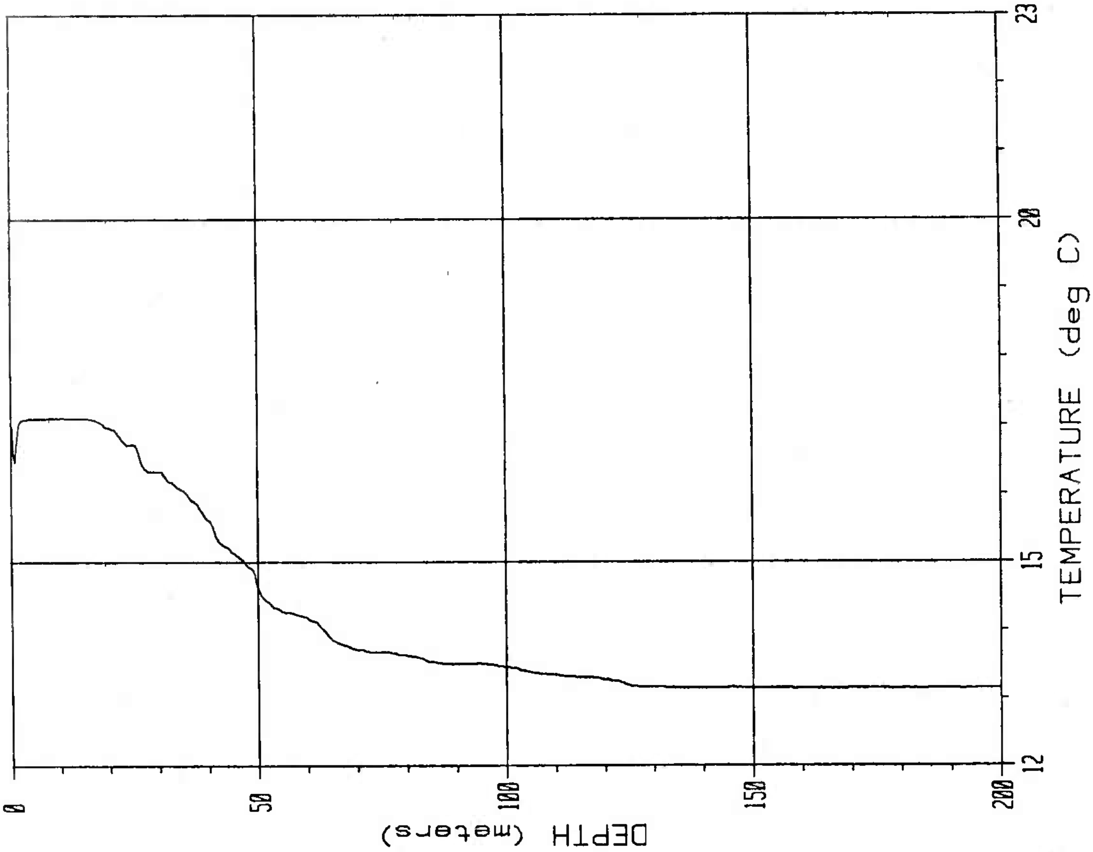

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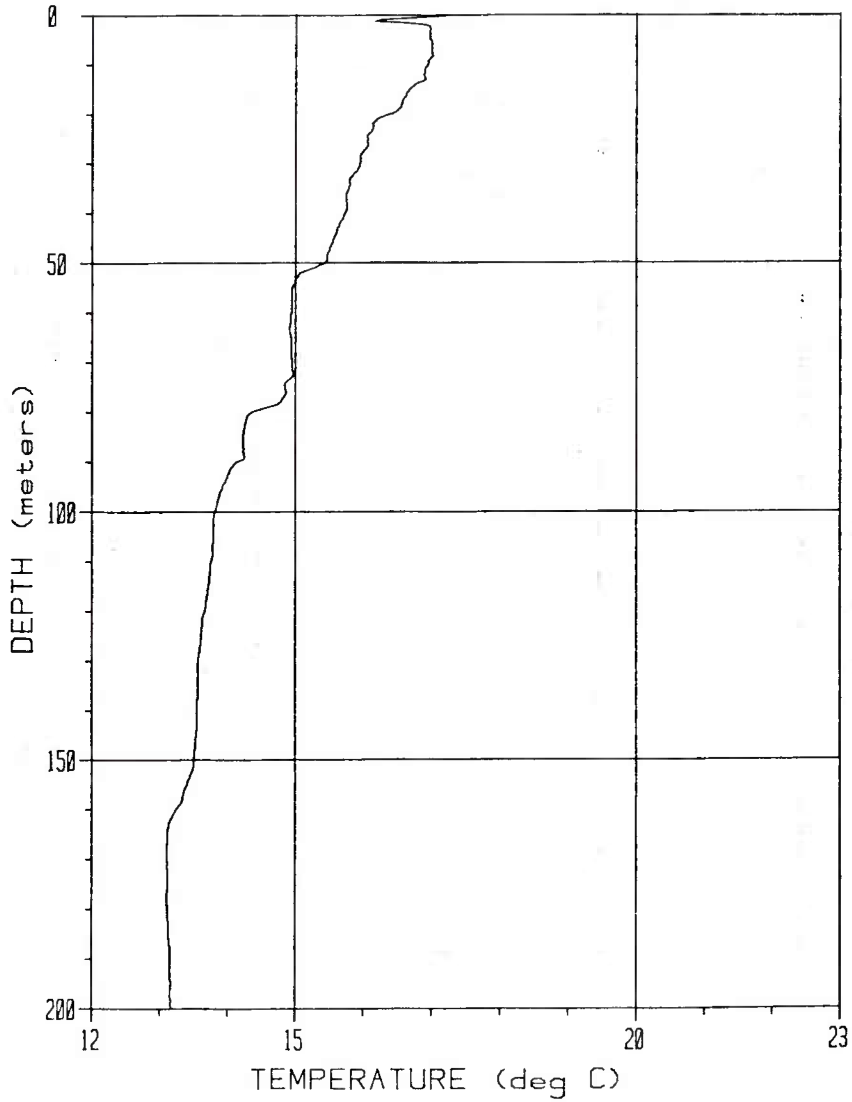

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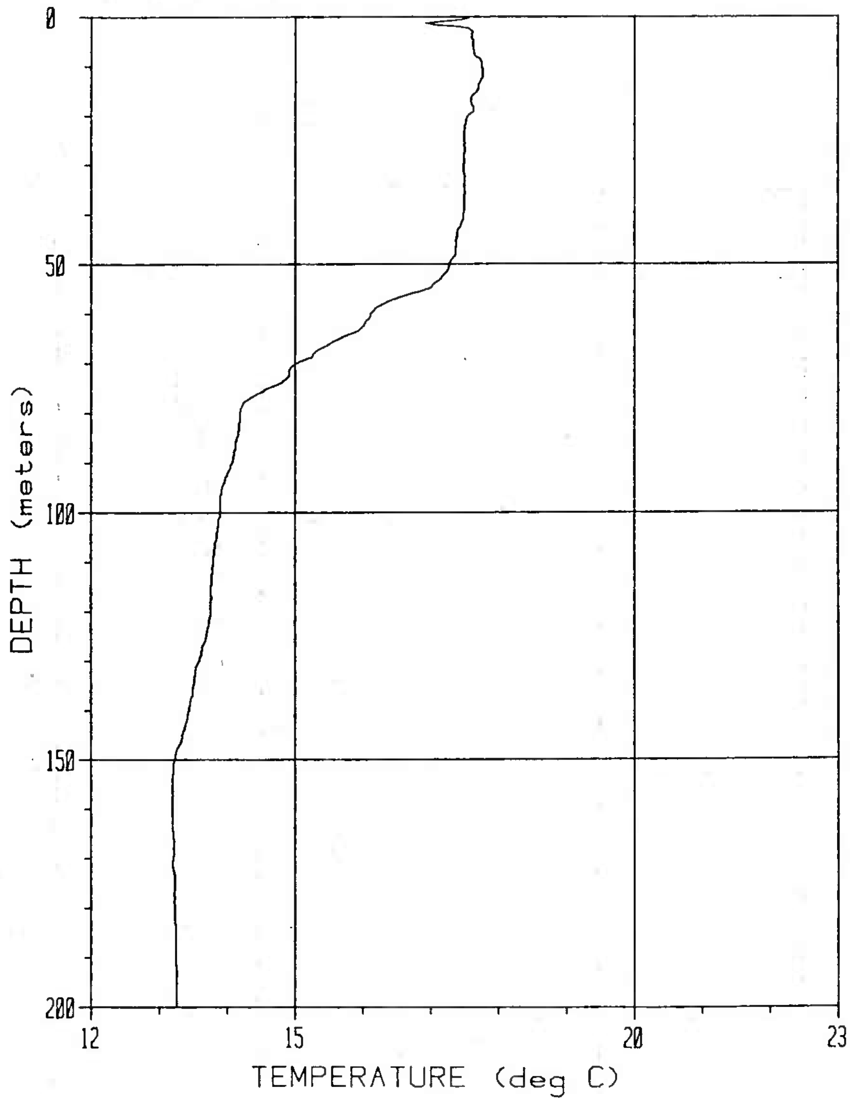

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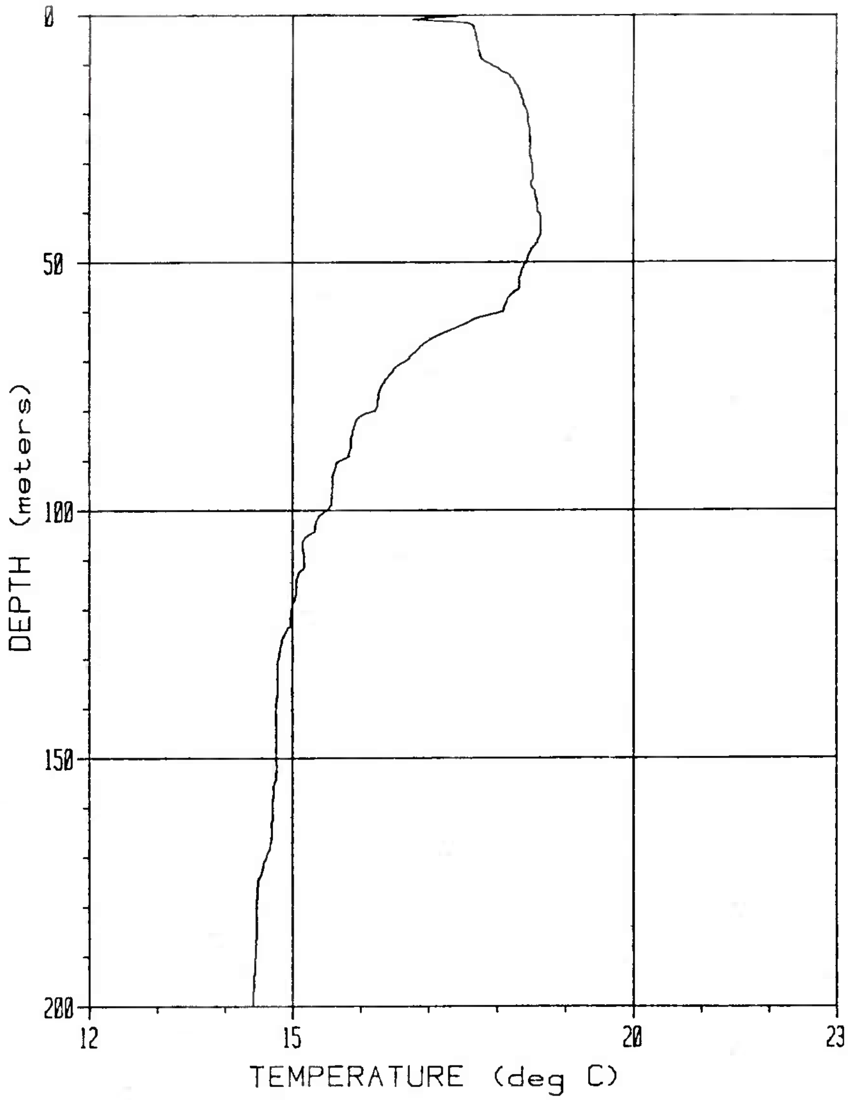

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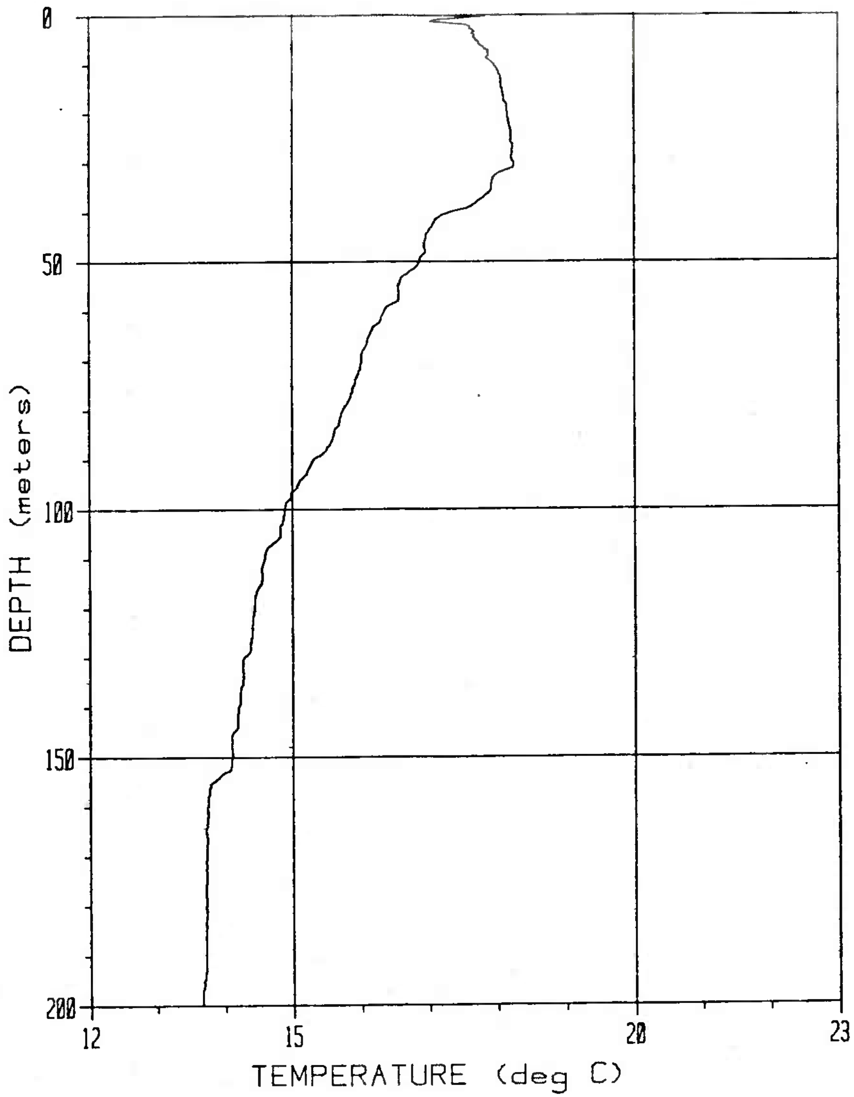

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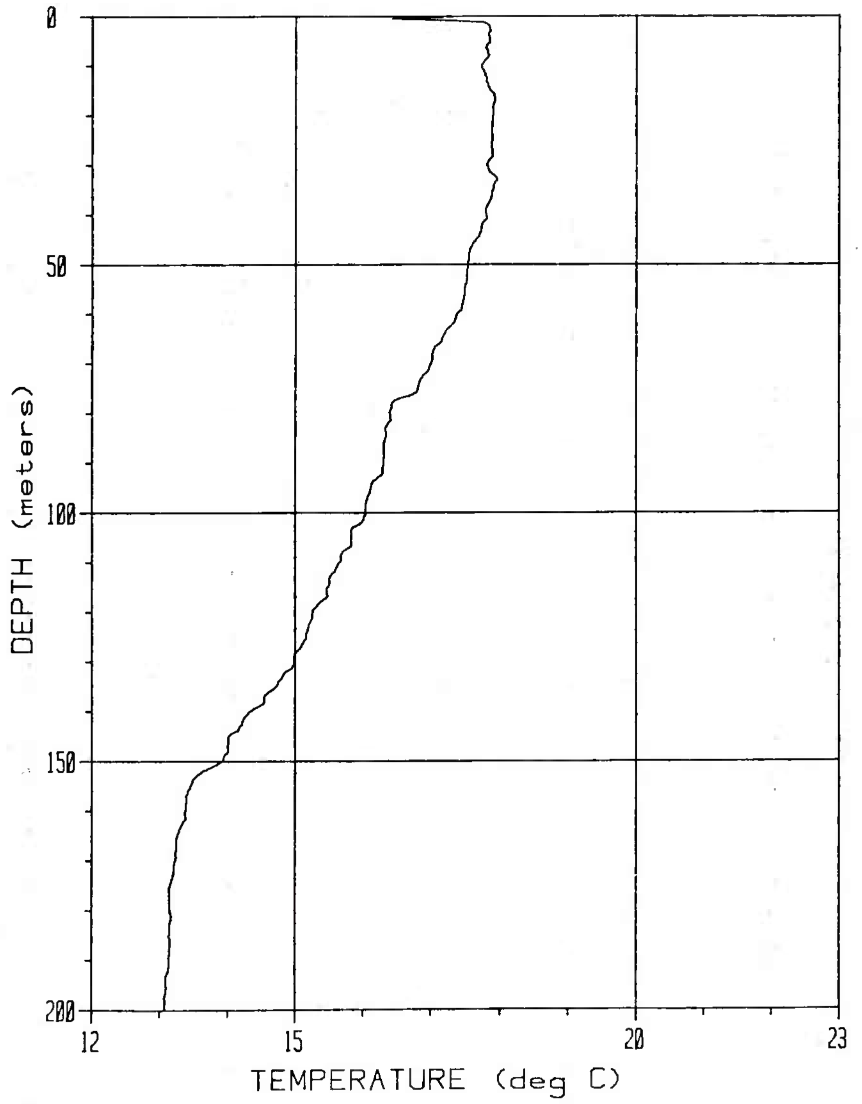

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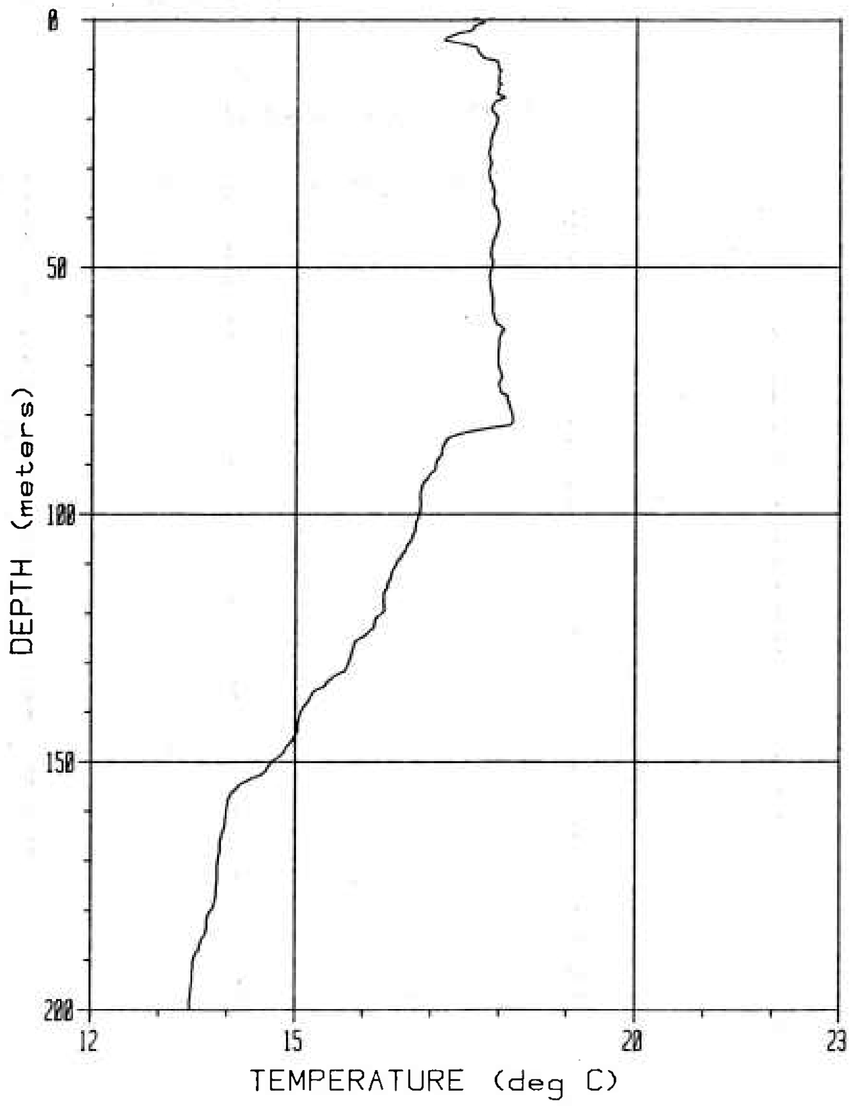

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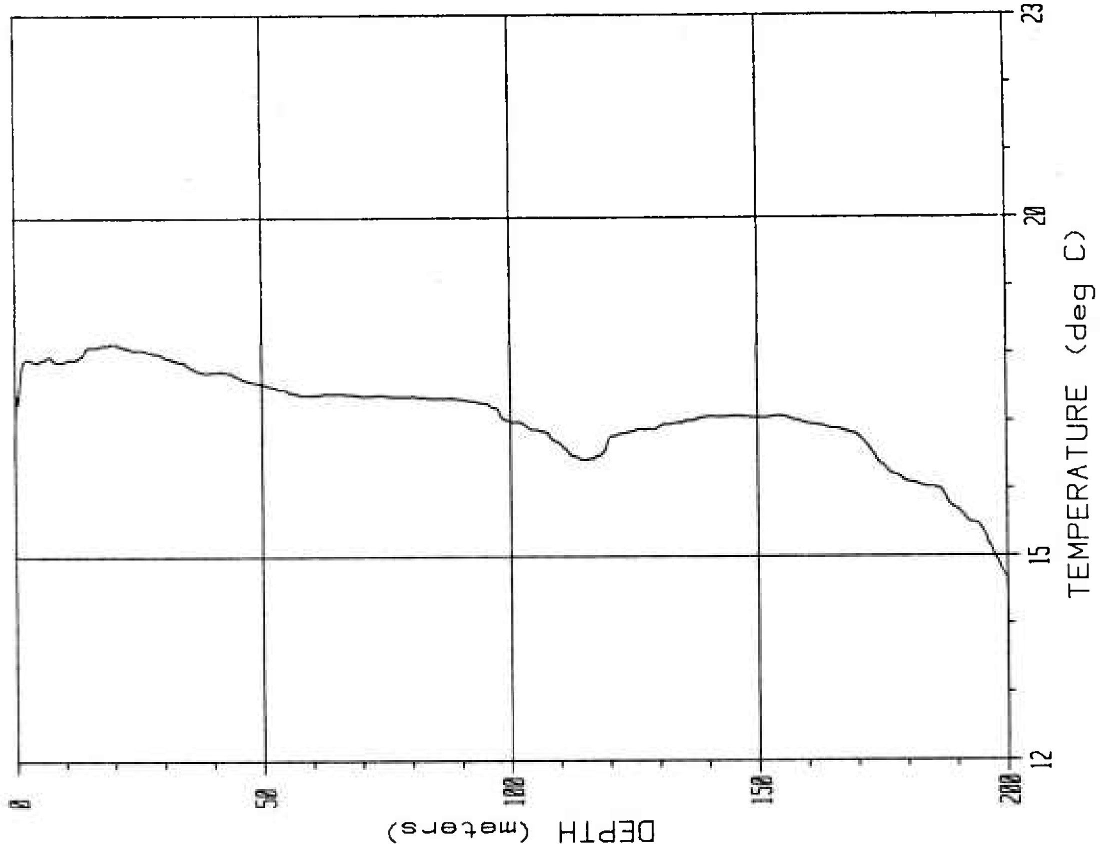

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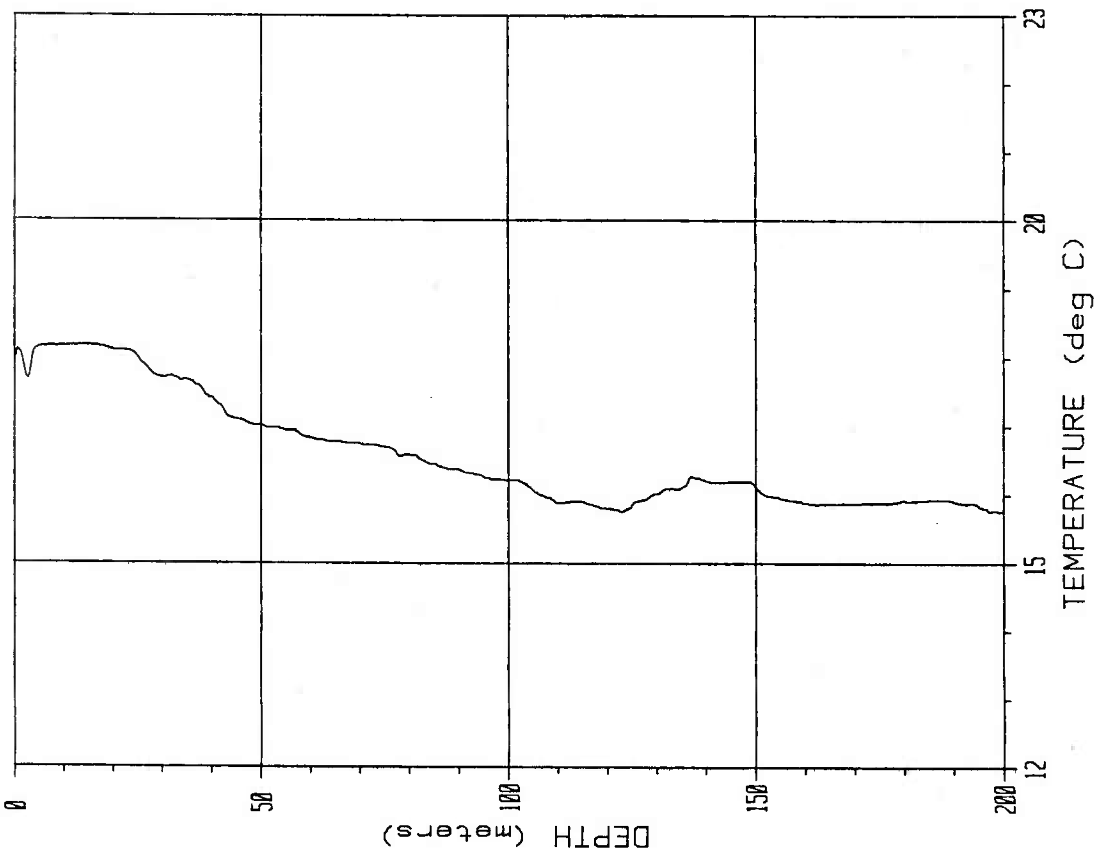

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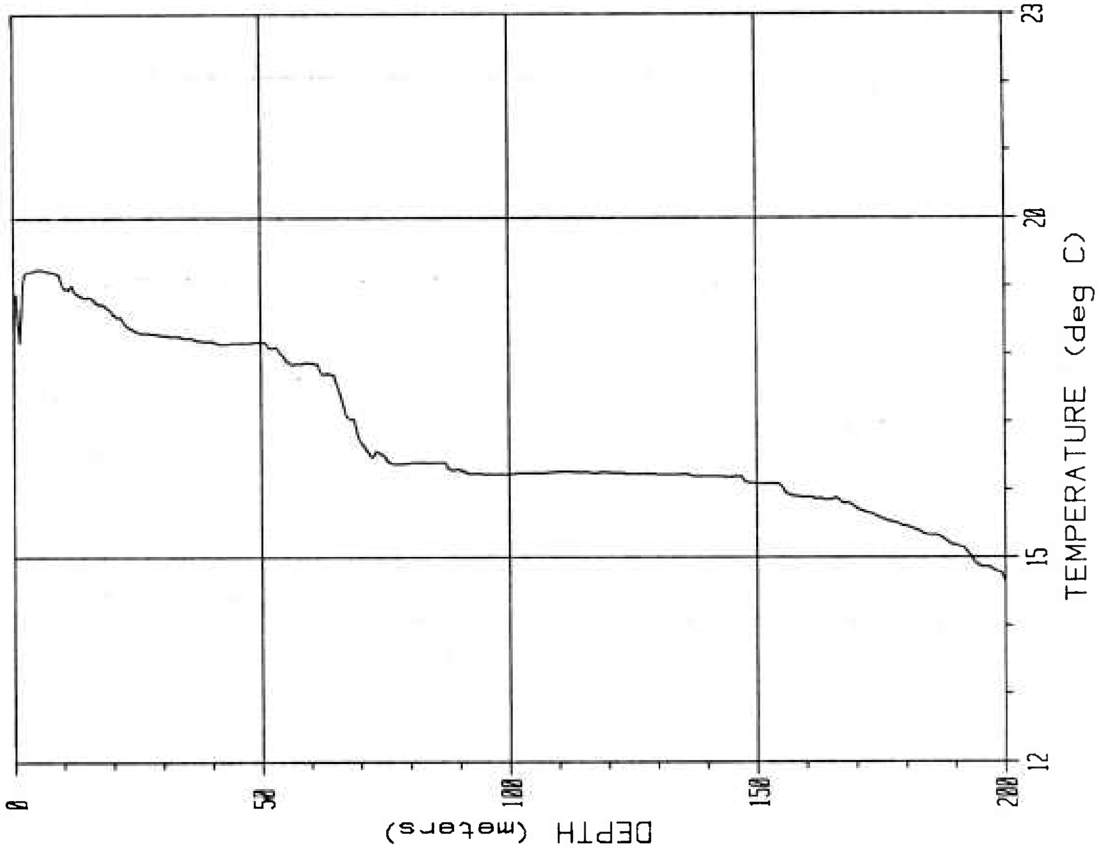

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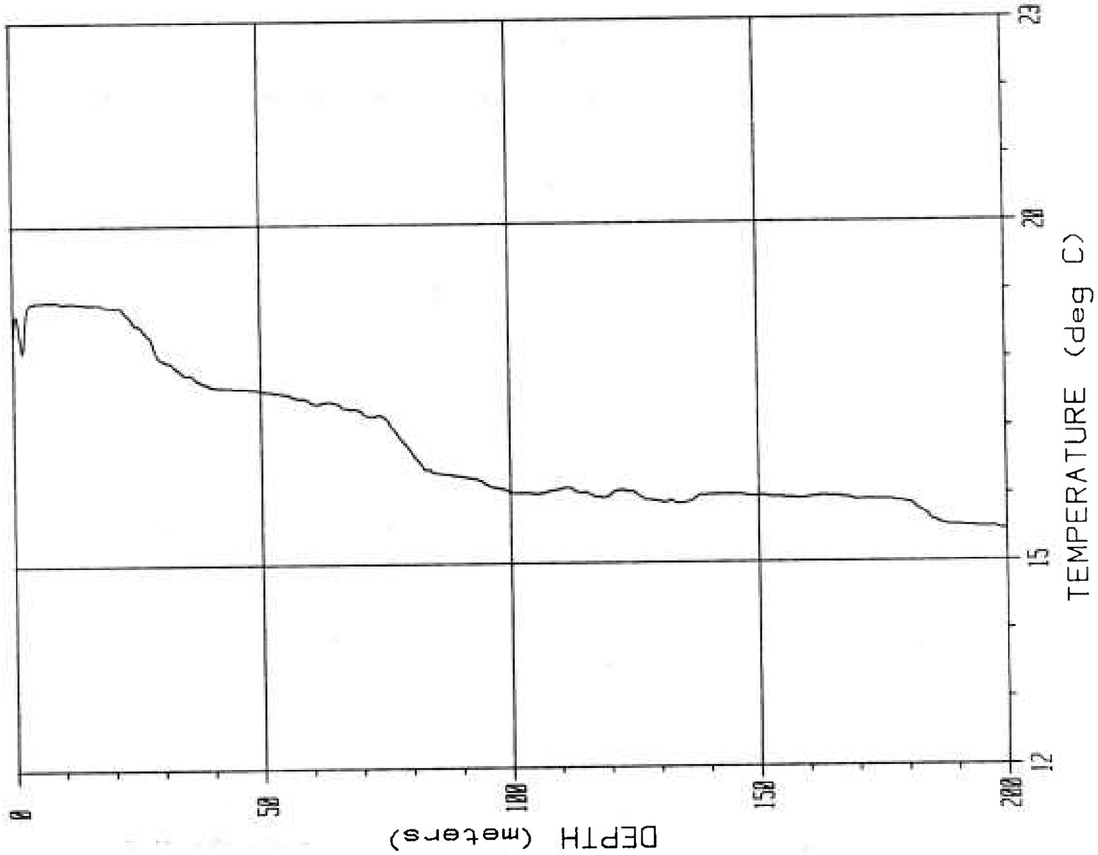

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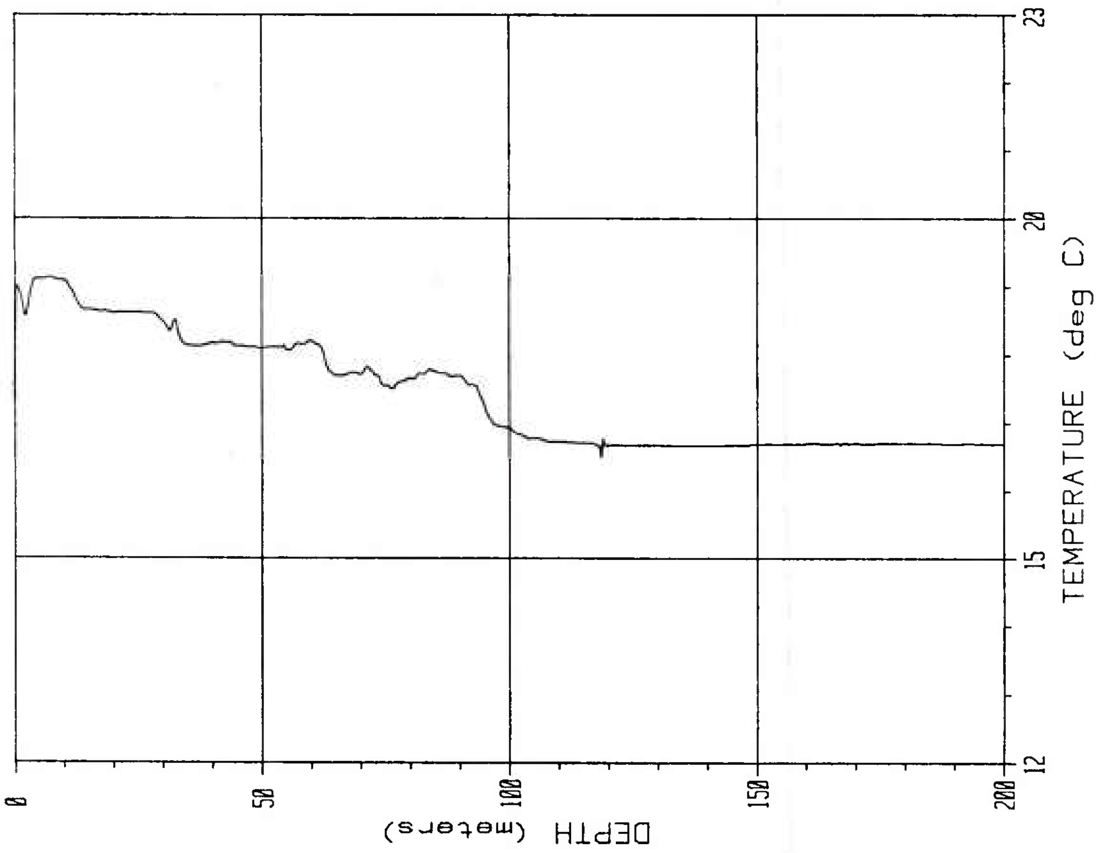

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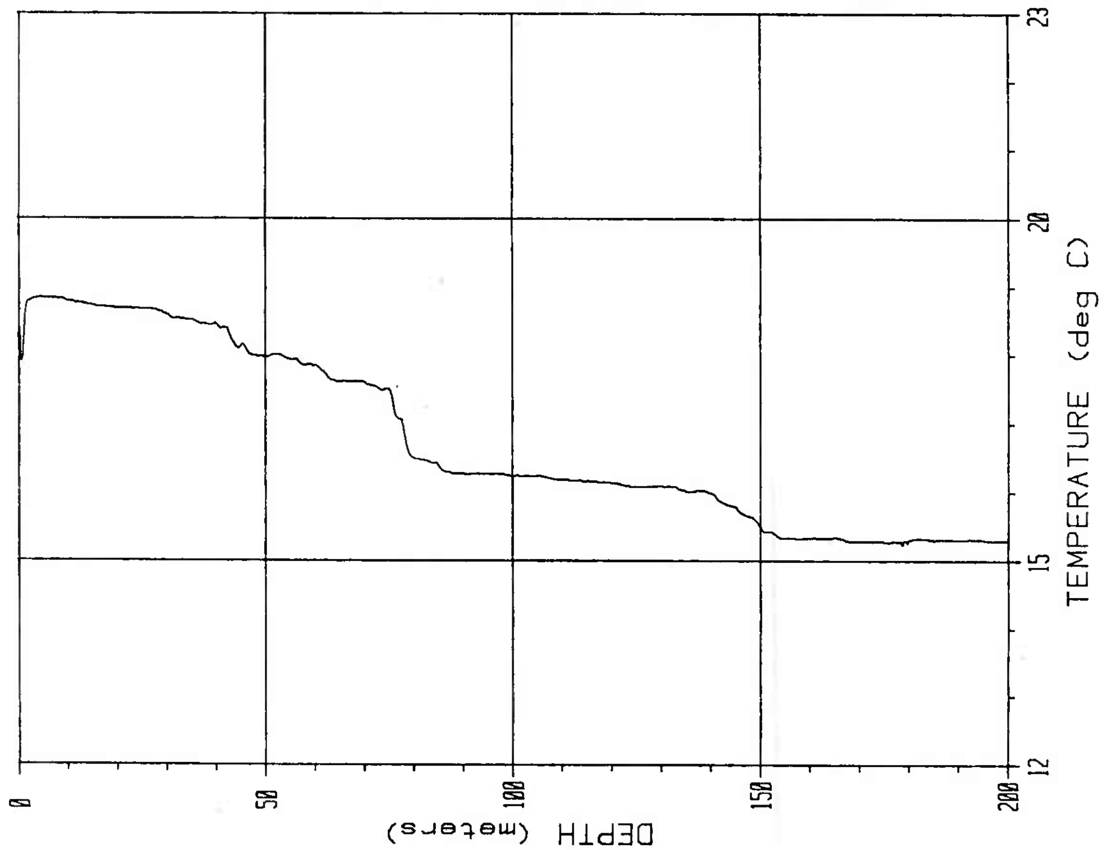

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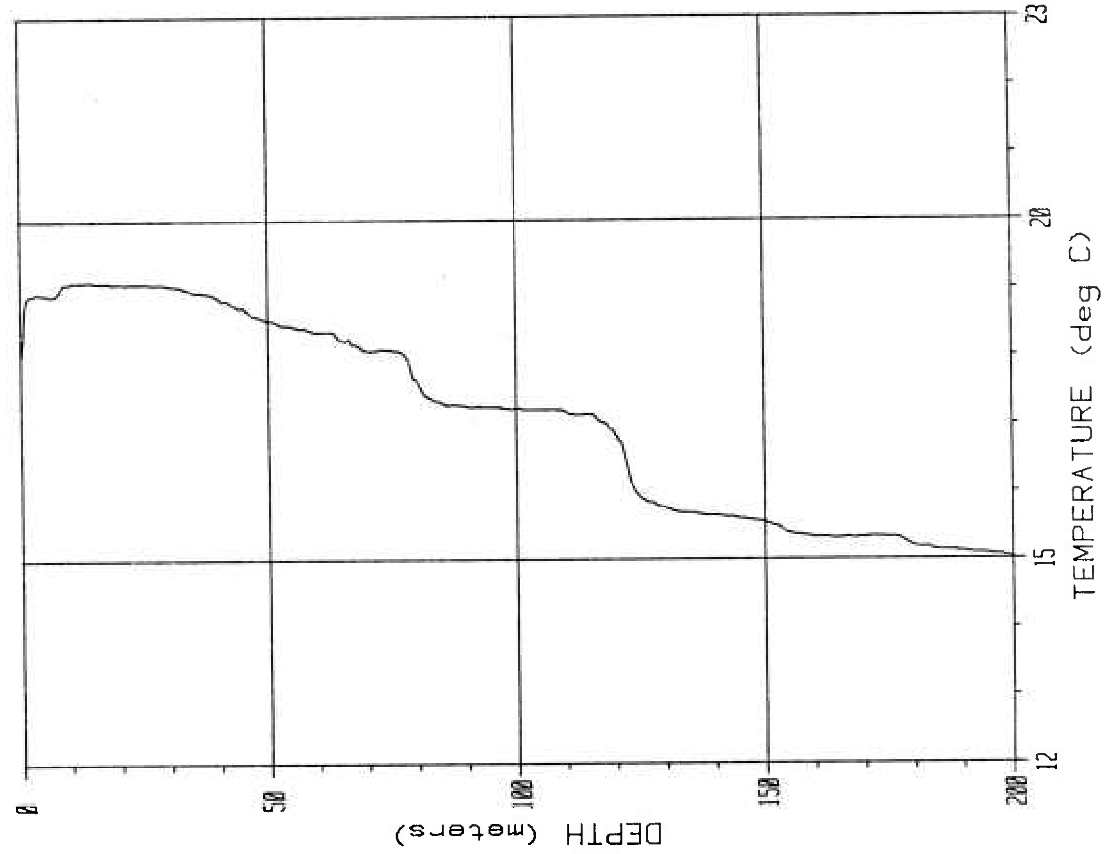

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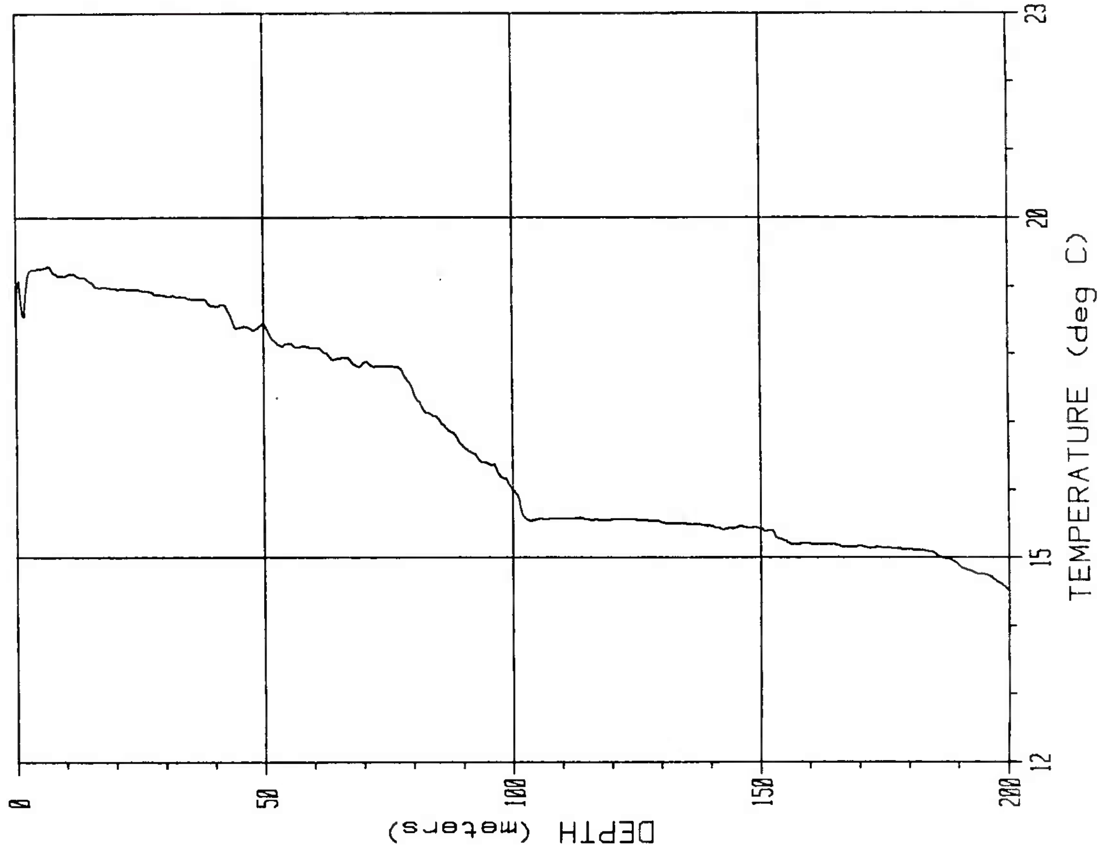

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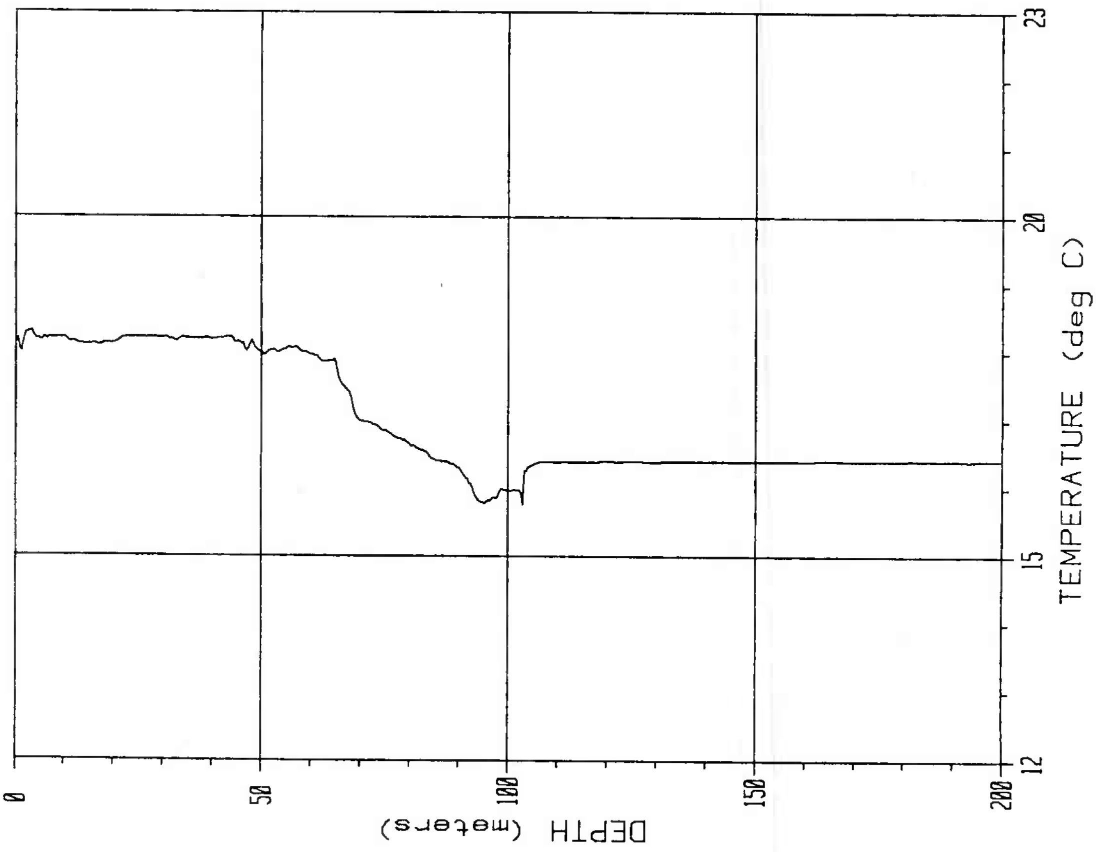

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20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

USNS BARTLETT dropped 152 expendable bathythermographs (XBTs) in the western Alboran Sea during 6-18 October 1982 as part of an internation oceanographic research project entitled ¿Donde Va?. The XBT data were taken to obtain synoptic temperature sections across the inflowing Atlantic Jet and the Alboran Gyre, and in the Strait of Gibraltar. XBT data were also used to increase the resolution of standard hydrographic (CTD: conductivity-temperature-depth profiler) sections. A plot of temperature versus depth for each XBT drop to 200 dbar (temperatures below 200 dbar were nearly constant) is shown.

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