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The international project on Ocean CO_2 sequestration

CTD data report from R/V "KOK" cruise 05-99 3-8 August, 1999

Norwegian Institute for Water Research

REPORT

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Abstract

Data from 31 CTD casts at 7 different stations (locations) on the SW side of the Hawaii Islands are presented. The data were sampled during a cruise with the UH research vessel "Ka'imikai-O-Kanaloa" from 3rd to 8th August, 1999. The cruise was part of an international project with participants from USA, Canada, Japan and Norway. The main purpose was to collect ambient data on the site where an experiment with injecting some CO_2 into the deep ocean and studying the behaviour of the CO_2 plume is planned to take place. The report describes the sampling program and the post-cruise work to calibrate and quality-control the data. It also includes some preliminary analyses of the CTD data, with emphasis on the water around 800 m depth which is the expected depth of injection of the CO_2.

4 keywords, Norwegian	4 keywords, English
1.	1. CTD profiles
2.	2. Hawaii
3.	3. Keahole Pt.
4.	4. CO_2 Ocean Sequestration Project

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The international project on Ocean CO_2 sequestration

CTD data report from R/V "KOK" cruise 05-99

3-8 August, 1999

Preface

The research cruise with the Hawaiian research vessel "KA'IMIKAI-O-KANALOA" (KOK) in the waters off the SW coast of Kona in august, 1999, was a multi-diciplinary and international enterprise, involving scientists from four nations. Chief scientist for the cruise was Dr Eric Adams from MIT (Massachusetts Institute of Technology, USA), while Dr. Rick Coffin from NRL (Naval Research Laboratory, USA) was the contract responsible for the vessel. The cruise began om August 3rd, and under Eric's and Rick's supervision and guidance the cruise was successfully completed on August 8th, when the ship returned to its home port, Honolulu harbour.

The following other scientists participated and assisted in the various activities throughout the cruise: Keith Johnson, Mike Arychuk and Lisa Miller from IOS (Institute of Ocean Sciences, Canada), Yoshiaki Maeda, Yuichi Koike and Kiminori Shitashima from RITE (Research Institute of Innovative Technology for the Earth, Japan), Scott Socolofsky and Brian Crounse from MIT, Jiuang Tang and Teresa Ho from University of Hawaii, Mike Hodge, Clark Mitchel, Robert Ervin, John Pohlman and Paul Ramos from NRL and Arild Sundfjord and Lars Golmen from NIVA (Norwegian Institute for Water Research, Norway). Steve Masutani, Univ. of Hawaii, and Gerard Nihous, PICHTR (Pacific International Center for High Technology Research, USA), were on board part of the time, and co-ordinated cruise preparations and the transport and communication to shore.

Thanks are particularly due to Steve and Gerard in assisting with all the preparations for the cruise. We are also indebted to the shore personnel of the UH, the Shipboard Technical Assistance Group (STAG) of SOEST (School of Ocean and Earth Science and Technology) and not least to Ken Shultis and the rest of the crew of the KOK. We also appreciate the contribution from Einar Nygaard at Statoil, Norway, on the historical temperature data.

Bergen, 1 December, 1999
Arild Sundfjord

Contents

Summary

The plans for the International CO_2 Ocean Sequestration Project include a field experiment with the release of CO_2 at about 800 m depth and a study of the behavior of the CO_2 plume. In order to design the experiment properly, it is necessary to have information about the oceanographic conditions where the experiment will take place. As part of the preparations and detailed design of the experiment, a cruise was made at the proposed experiment site near Keahole Point on the Big Island of Hawaii during August 3-8, 1999. Chemical and biological samples were taken and two current measurement rigs were deployed. In addition, 31 CTD casts were made, yielding temperature, salinity and density profiles from the surface to around 900 meters depth. The main focus was on the planned experiment site, at a station designated as K1, about 2.5 km W of Keahole Point on the Big Island of Hawaii. Casts were also made at four locations in the vicinity of K1, and on two different transects further to the NW and SSE.

This data report describes the post-processing of the CTD data, and includes graphs of all the CTD profiles. The CTD data quality was generally quite good. There was an average offset of 0.024 psu between the salinity values calculated from the raw CTD data and water samples that were laboratory analysed for salinity.

The vertical profiles showed rapidly decreasing temperature from around 26 °C at the surface to about 8 °C at 4-500 meters. The density profiles accordingly showed a steep gradient (pycnocline) in the upper 400 meters with weaker stratification underneath. The static stability E of the water column was at a minimum at around 800 m depth. The corresponding calculated internal wave period $N/2\pi$ was around 35-40 minutes.

The results from a 24 hour series of consecutive CTD casts made at the main station K1 are presented to some detail. The short term variation of salinity, temperature and density at 800 meter depth (the proposed CO_2 injection depth) over a one hour period is also described.

Maximum variations within the 24 h series of consecutive casts at 800 m were 0.035 for salinity (average value 34.452), 0.410 °C (average 5.161 °C) for temperature, and 0.075 for density (average 27.230). The 1 hour continuous CTD-measurements at 800 m showed variations between 1/5 and 1/10 of that of the consequtive casts. Frequency analyses of the 24 h series indicated the presence of some energy at 5 and 2.5 hours period, in addition to a diurnal signal.

1. Introduction

1.1 Background and purpose

In 1997 an agreement was reached among the countries Japan, USA and Norway and (later) Canada, Australia and ABB (Asea Brown Boveri, Switzerland) to perform a CO_2 ocean sequestration experiment at a site with near-by access to deep water. This agreement was mainly based on conclusions from preparatory workshops held by the International Energy Agency (IEA) Greenhouse Gas Programme (IEA 1997). Later, detailed plans for an experiment was prepared by MIT (Adams et al, 1999). Keahole Pt. and the research facility NELHA on the W side of the Big Island of Hawaii (see **Figure 1**) stands out as the most probable candidate site for the experiment, after the site selection study by MIT (Adams and Herzog, 1998). More information about the plans for the experiment can be found on http://www.co2experiment.org.

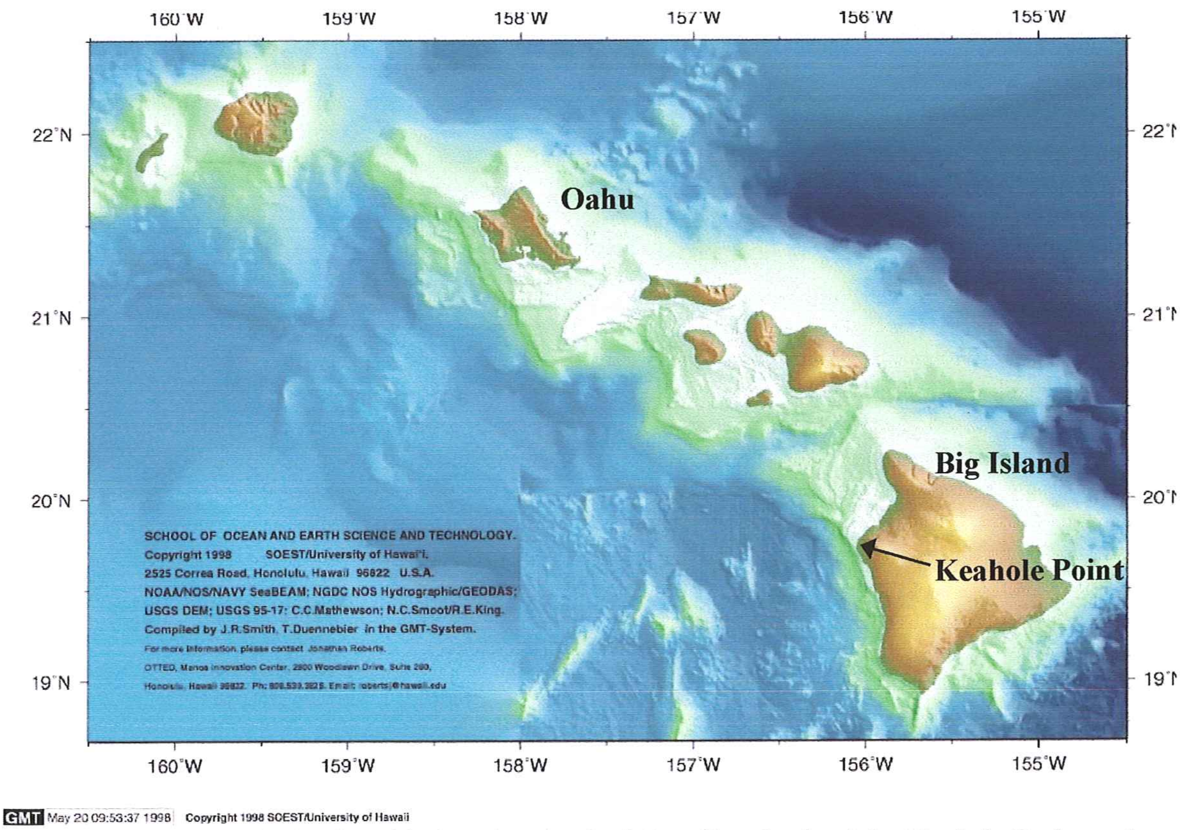

Figure 1. The Hawaii Islands, with the Big Island of Hawaii to the far right. Keahole Pt. is on the westernmost point on the Big Island.

The project calls for actions to collect data on the ambient ocean environment, prior to the injection experiment itself which is planned to take place in the year 2001. Data on local hydrography, currents and ocean chemistry are necessary for the detailed design of the experiment. In the period 3-8 August, 1999, a scientific cruise with the R/V 'Ka'imikai-O-Kanaloa' (KOK; see picture on cover page) from the University of Hawaii was made to the planned CO_2 experiment site. Various types of oceanographic data were collected, including CTD data which are the focus of this report.

The main purpose of this report is to give those being involved in the design of the CO_2 experiment reference and access to the collected data material, including the analysis of data quality and calibration. It is beyond the scope to describe the material in detail in terms of oceanographic features etc.

1.2 Stations

CTD profiles were made primarily around the 900 meter isobath. Casts were made at a total of 7 locations along a NW-SE transect from NW of Oahu towards the Loihi Seamount near the S tip of the Big Island. Special attention was given to a location designated as K1, outside Keahole Point on the west coast of the Big Island (see **Figure 2**). This is where the main experiment of the International CO_2-project is planned to take place in 2001. At this location, continuous casts were made over a 24 h period. Changes at 800 m depth (the depth of the planned CO_2 injection) were also continuously monitored over a 1 h period. Furthermore, profiles were taken at four stations in the vicinity of K1 to get an impression of local variability in the area. In total, 31 CTD casts were made on the cruise. Table 2 shows the positions of the sampling locations visited by KOK during the cruise.

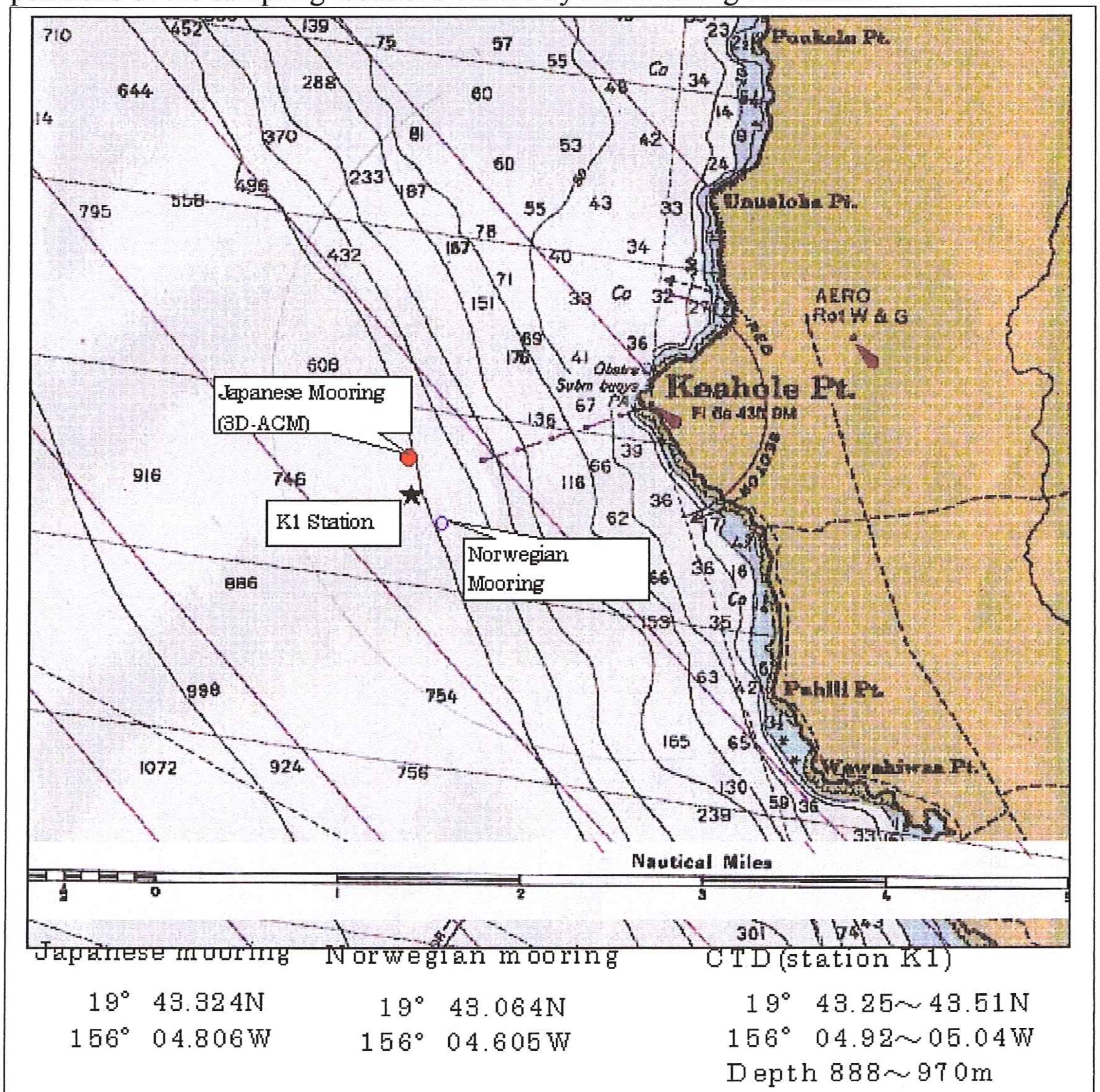

Figure 2. Chart showing the location of sampling station K1 and current measurement moorings at Keahole Pt. Depths are in fathoms. 1 fathom = 1.83 m.

1.3 The CTD instrument

The CTD (Conductivity, Temperature, Depth) instrument used was a SeaBird 911 from Seabird Electronics Inc., Bellevue (Seattle). The unit was equipped with standard sensors for measuring temperature, conductivity and pressure, in addition to a Seabird pH-meter provided by IOS, Canada. The C, T and pH sensors were all exposed to a constant water flow maintained by a pump. The CTD was fitted on a rosette with 24 Niskin water sample bottles. Table 1 shows the factory specifications for the various sensors.

Table 1. Some SeaBird factory facts about the CTD sensors for the SBE 911.

	Accuracy	Resolution	Time response
Conductivity	0.003 mmho/cm	0.0004 mmho/cm	0.04 sec
Temperature	0.002 °C	0.0002 °C	0.06 sec
Pressure	0.015% of full scale	0.001% of full scale	0.001 sec
PH	(0.1 pH)		(1 sec)

1.4 Data collection

CTD-data were collected with a sampling interval of 0.25 sec. It was decided to lower the CTD at a speed of 30 m/min to assure good data quality on the downcast. During the upcasts, where stops were made for bottle sampling, the speed was set to 60 m/min. The data of highest quality will thus be in the downcast data sets.

Table 2. Overview of the sampling locations and positions.

Station Number	**Latitude**	**Longitude**	**Station name**	**Description**
0501	21°19.46 N	158°10.92 W	B12	NW of Honolulu, Oahu Island
0502	20°54.24 N	157°33.03 W	B11	S of Oahu, on the way to Kona
0504, 0509-28	19°43.31 N	156°04.97 W	K1	Main station, W of Keahole Pt.
0505	19°47.39 N	156°07.70 W	K2	NW of K1
0506	19°41.63 N	156°10.11 W	K4	WSW of K1
0507	19°38.48 N	156°07.99 W	K3	SSW of k1
0508	19°44.24 N	156°04.47 W	K5	NE of K1
0529	19°22.01 N	155°56.01 W	L6	SE of K1, on "Loihi"-transect
0530	19°03.18 N	155°55.56 W	L7	SE, on "Loihi"-transect
0531	18°55.26 N	155°42.80 W	L8	SE, on "Loihi"-transect
0532	18°54.41 N	155°16.83 W	L9	Near Loihi Seamount, S of B.I.

2. Data quality control and post processing

2.1 Despiking

The quality control and post processing of the acquired data involved several steps. First of all, obvious instrument errors (spikes) were removed. A total of 113 spikes were found. Of these, around 30 % were on the downcasts. Considering the large overall number of scans made, this is a moderate number of instrument errors. Errors occurred in all sensors (pH, conductivity, temperature and pressure). Whenever such errors were found, the entire set of values for that particular scan was discarded. In addition, some of the data acquired near the surface at the beginning and end of each cast were also removed.

2.2 Salinity calibration

A total of 76 water samples were taken from the Niskin bottles at most stations and at preselected depths for laboratory salinity determination at IOS, Canada. (Two samples appeared to contain surface water, and have therefore been excluded from further analysis.) Samples were always taken at 800 m depth, but some also at other depths (900 m, 600 m etc). On most of the casts in the 24 h series at K1, only one sample was taken (at 800 m) from each cast.

Comparison with the CTD data (average values of 13 computed salinity values from around the moment the bottles closed) showed rather large discrepancies. See **Figure 3**. On the average, the difference between CTD salinity and lab salinity was found to be 0.024 psu (lab values being higher), ranging from (virtually) zero to 0.13995 (only one negative value of -0.00016 was found).

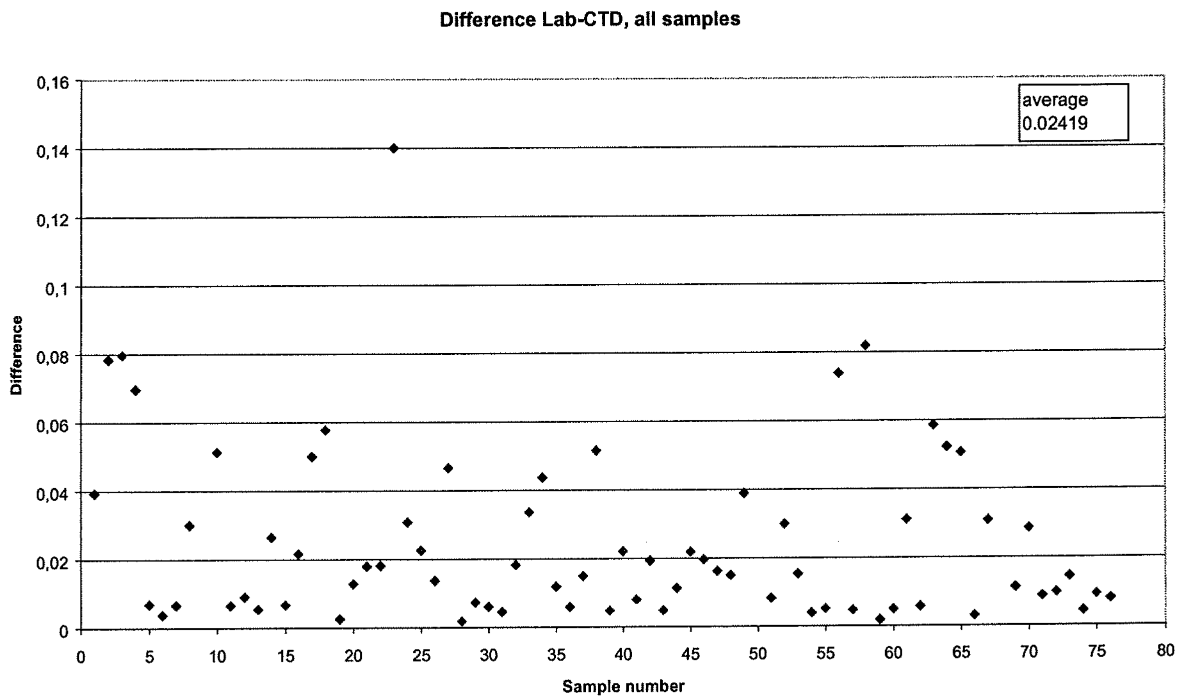

Figure 3. Difference between laboratory salinities found at IOS (Guildline lab. salinometer) and the CTD salinites versus sample number.

The sensors on the CTD were calibrated as recently as March 16, 1999, and the CTD was reinstalled in July 1999. No systematic dependency on pressure, temperature or time has been discovered in the discrepancies. It was thus decided to leave the CTD salinity data as they were, bearing in mind that they (on the average) most probably do show values on the order of 0.02 too low.

2.3 Data post-processing

After spikes were removed, the data sets were filtered using the program *wfilter* supplied with SBEs software package SeaSoft (boxcar 15 filter, for further details, see SeaSoft manual (SEA-BIRD ELECTRONICS, 1997)). Finally, the data sets were split into 1.0 m depth cells using the SeaSoft *binavg* program, and downcasts separated from the rest of the casts. All data sets are available in either raw format, with spikes removed, filtered, or averaged.

2.4 Data availability

All the CTD data are available at NIVA Norway, in the following formats; raw data (binary), converted, converted with spikes removed, converted and filtered with spikes removed, and converted, filtered, spikes removed, averaged into 1m bins (all ASCII). The data can be obtained in any of theses formats upon request.

3. Data presentation

Some selected material is presented in this chapter. All the vertical profiles of salinity, temperature and density are shown in separate graphs in the Appendix. Some tabulated data are also shown there. As an example of the CTD-profiles, the first cast made at Station K1 during the 24 hour series (KOK 0510) is shown in **Figure 4** below. The figure shows quite characteristic features for the area; rapidly decreasing temperature down to 4-500 meters, high-salinity water in the upper 200 meters, an intermediate layer with relatively low salinity, and gradually increasing salinity towards the bottom. The density profile reflects this, with a steep gradient in the upper 400 meters and then a slower density increase downwards. It is evident that temperature excerts the greatest influence on density.

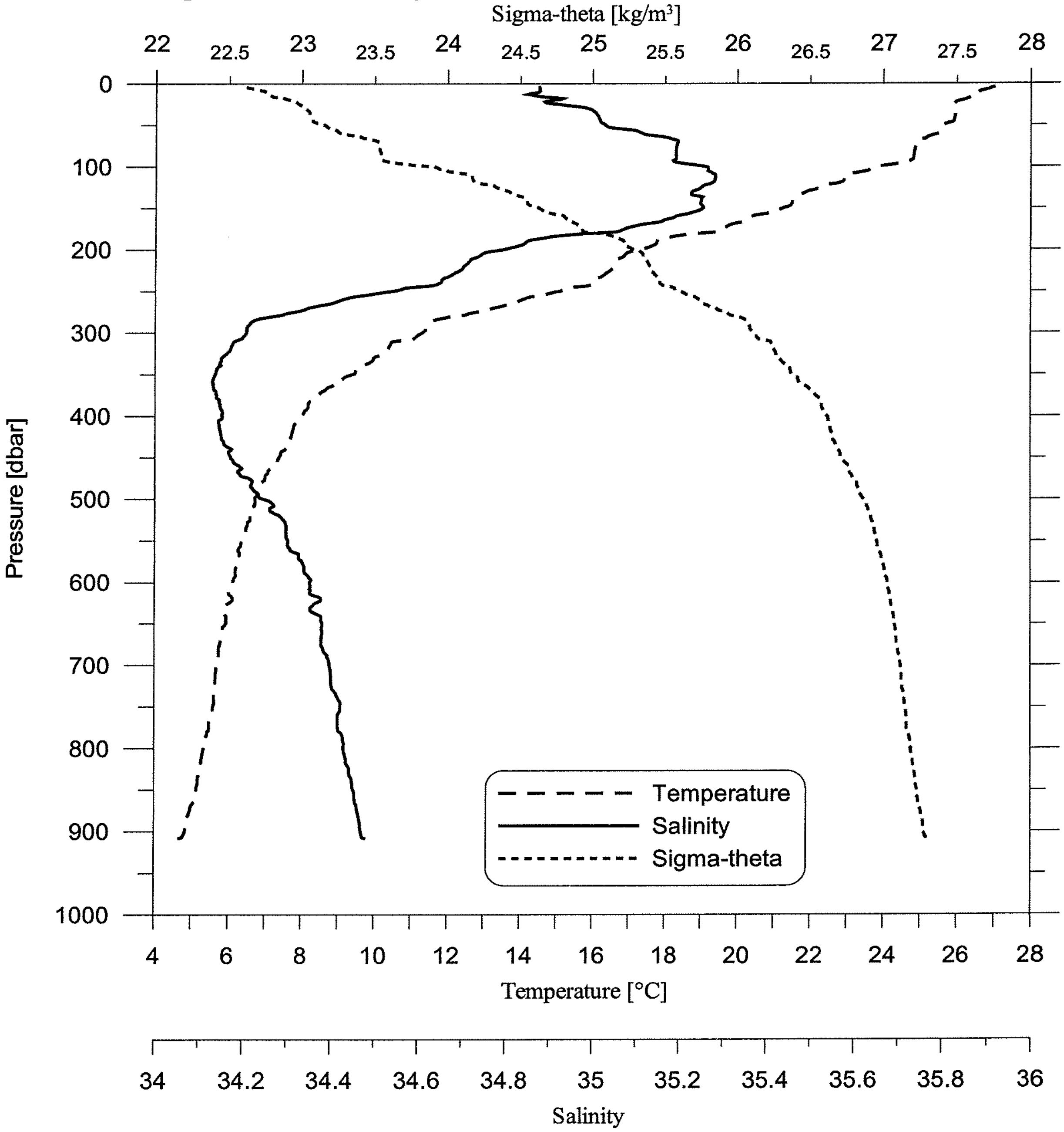

Figure 4. Temperature, salinity and density (Sigma-theta) from CTD cast number 0510.

To get an impression of the stability E of the water column, the Brunt-Väisälä frequency (N) has been calculated (using SeaBird's program BUOYANCY). The term stability expresses the resistance a water "parcel" excerts against a vertical displacement, and is found by examining the vertical density profile at a given depth. The relationship between stability E and N is given by: $E = N^2/g$ [rad^2/m] (g is the local gravitational force). Two particular CTD profiles have been examined for stability; KOK0510 and KOK0521 (see **Figure 5**). These are the profiles with the lowest and highest density at 800 m depth (during the 24 h measurement series), respectively. The highest stability values were found in the upper part of the water column, where the density increases most rapidly with increasing depth. At about 7-800 m depth the stability is at a minimum, before increasing slightly towards the bottom. This means that the future buoyant CO_2 plume can rise in the local water column without resistance from density gradients, and increasing stability towards the bottom may to some extent help preventing the diluted plume to touch the bottom. A comparison of the two profiles shows that the variability in time is greater in the top few hundred meters.

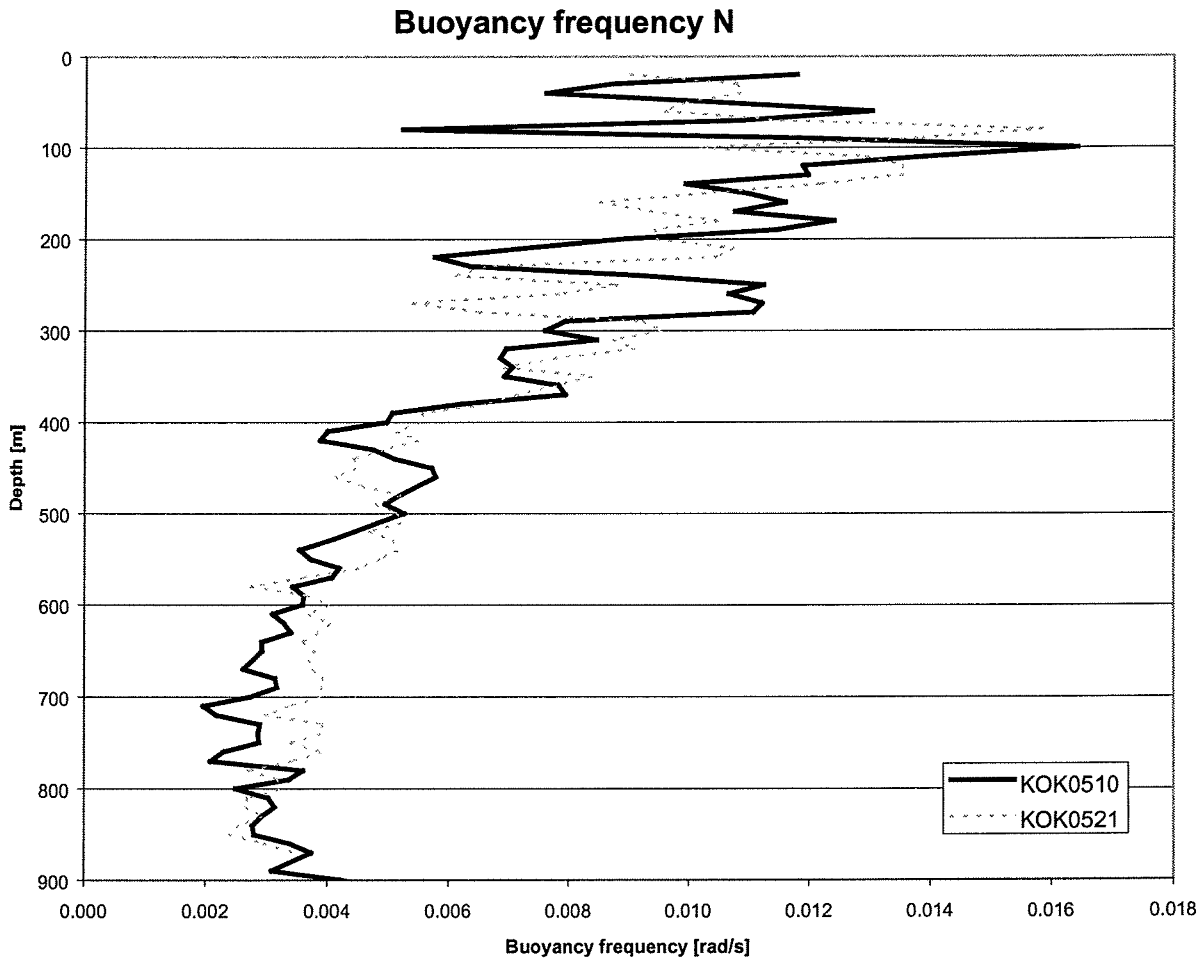

Figure 5. Brunt-Väisälä (buoyancy) frequency for CTD profiles KOK0510 and KOK0521.

The maximum (theoretical) frequency of internal waves in water with stability E is given as $N/2\pi$ [Hz]. For 800 m depth, this frequency gives a wave period of 42 minutes (N=0.0025) for KOK0510 and 33 minutes (N=0.0032) for KOK0521. For the upper water masses, the internal wave periods are typically around 8-10 minutes for the two profiles. The time between CTD casts, however, is too long for such rapid phenomena to be detected in the present data material. Analysis of the ADCP current measurements may reveal more on this.

3.1 Continuous casts over 24 hours

The data from the 24 hour CTD casts are shown in Figures 6–9 below. This gives a good representation of the conditions and short term variations at the planned location for the CO_2 experiment. In order to avoid, or at least be able to control, such problems as CO_2 hydrate formation, it is particularly important to have information about temperature variation at the depth of the CO_2 discharge.

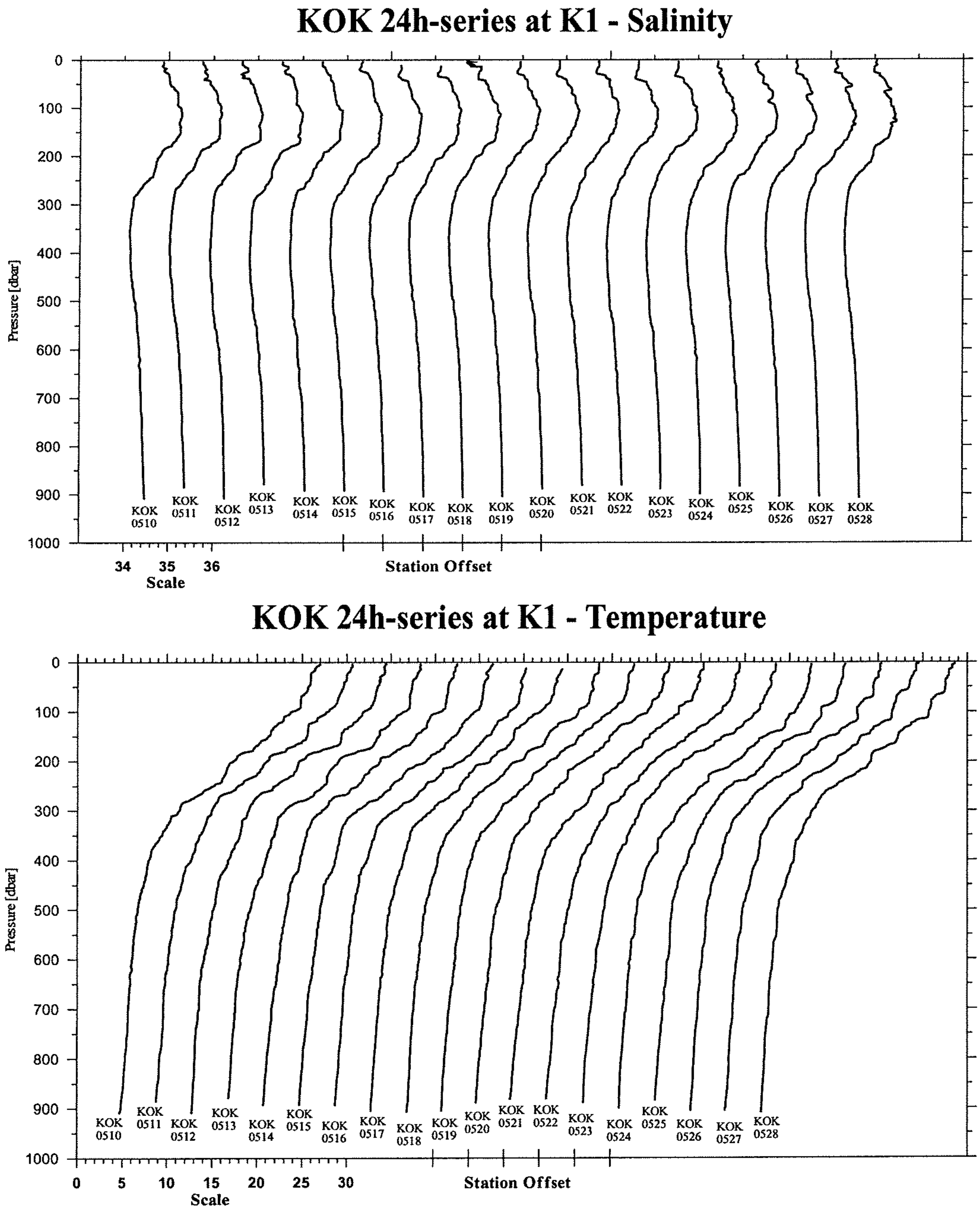

Figure 6. Nested profiles for salinity (upper frame) and temperature for the CTD stations (casts) taken on K1 during the 24 h sampling on 6 August. Data from down-casts only.

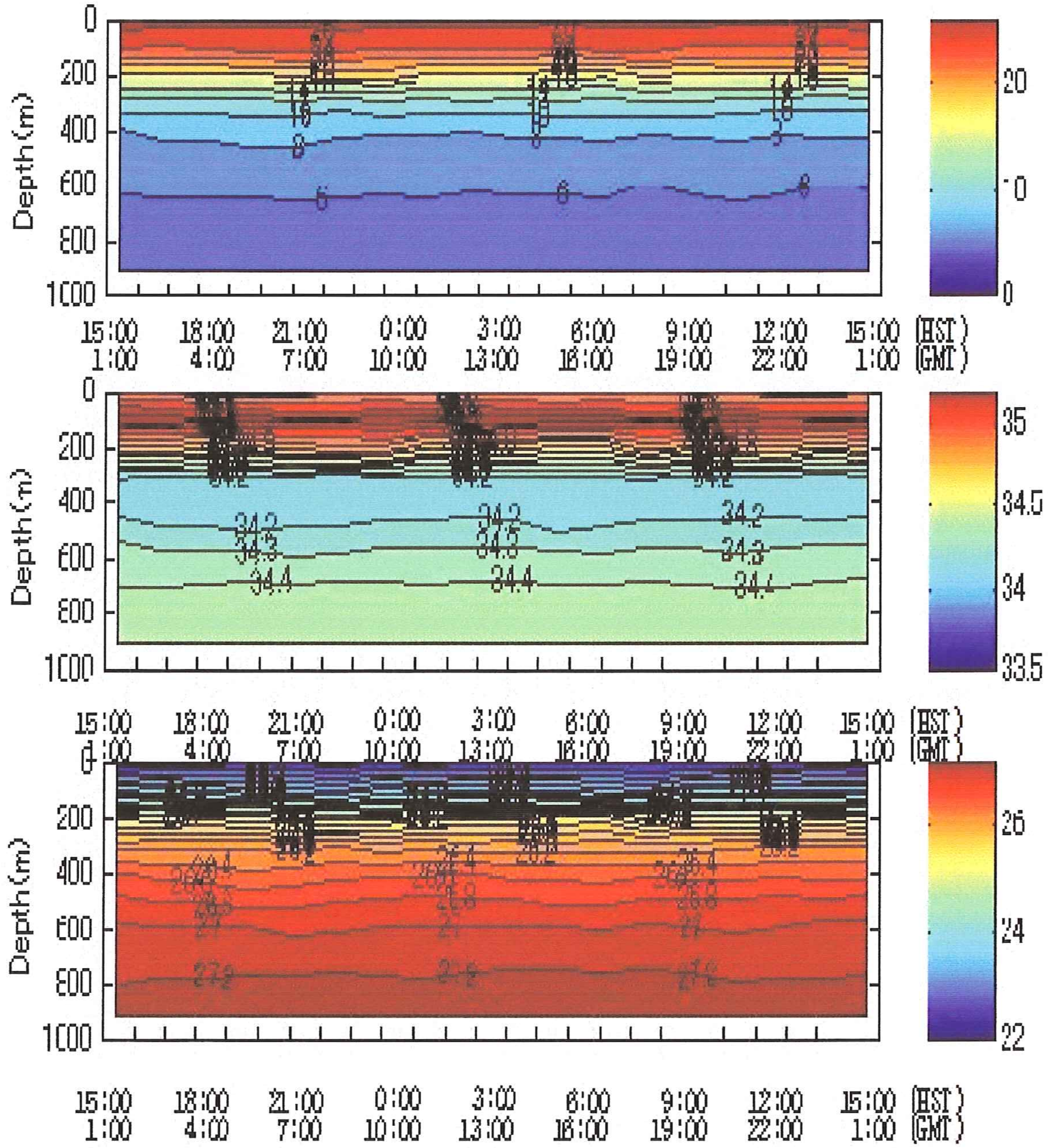

Figure 7. Contours of Temperature, Salinity and Sigma-t from the 24 h CTD casts.

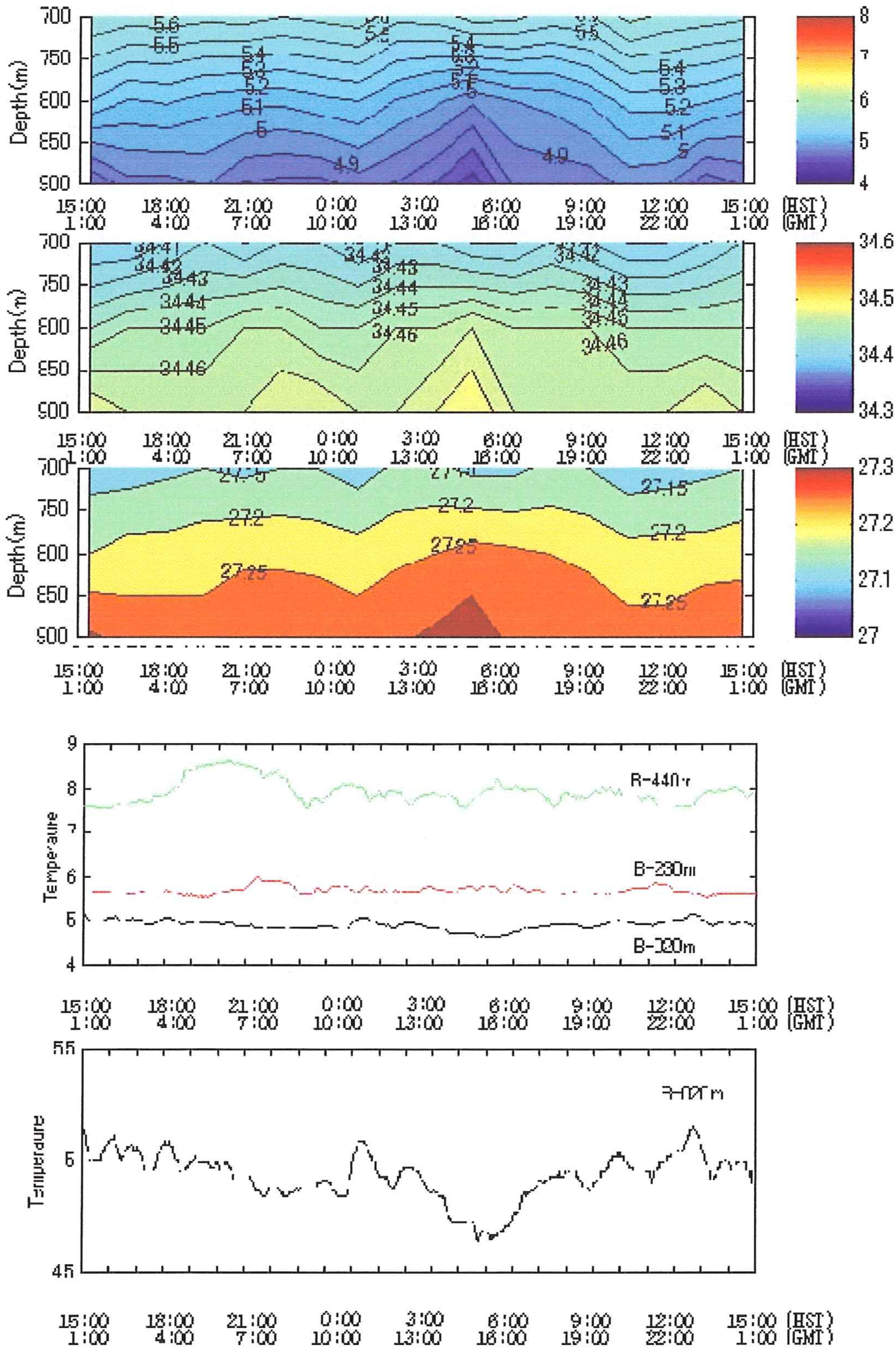

Figure 8. Contours of Temperature, Salinity and Sigma-t from the 24 hour CTD casts, 700-900 meters. For comparison, temperature from three 3D-ACMs (Acoustic Current meters) deployed in the same area at 440, 230 and 20 meters above bottom (bottom at current rig position ~ 874 m) are also shown (B-20 also on expanded scale, lower graph.)

Figure 9 a) – c) shows how CTD salinity, temperature and consequently seawater density varied over the 24 h period at K1, 800 m depth. This is the proposed depth of CO_2 discharge. Although variations are small, a common pattern for the three parameters is evident. In the first cast, S is at a minimum and T at a maximum (and therefore also density at a low). After this S increases and T drops quite rapidly, staying around intermediate levels for 6-7 hours before a new low(S)/max(t). Around 13-14 hours after the first cast, the highest S and lowest T values are recorded, before they again reach intermediate levels. At all times, density follows the S and T patterns closely. The extreme values for salinity (uncorrected) are 34.4315 (min) and 34.4663 (max), yielding a maximum variation of .0348 within the 24 h period (average being 34.4518). Corresponding values for temperature are 4.9403, 5.3503 and .4100 °C (average 5.1606 °C). Density varied between 27.1915 and 27.2664 kg/m^3 in the same period (difference = 0.0749). The occurrence of two highs and two lows for all parameters in the 24 h period may point towards a semidiurnal tidal cycle causing the differences.

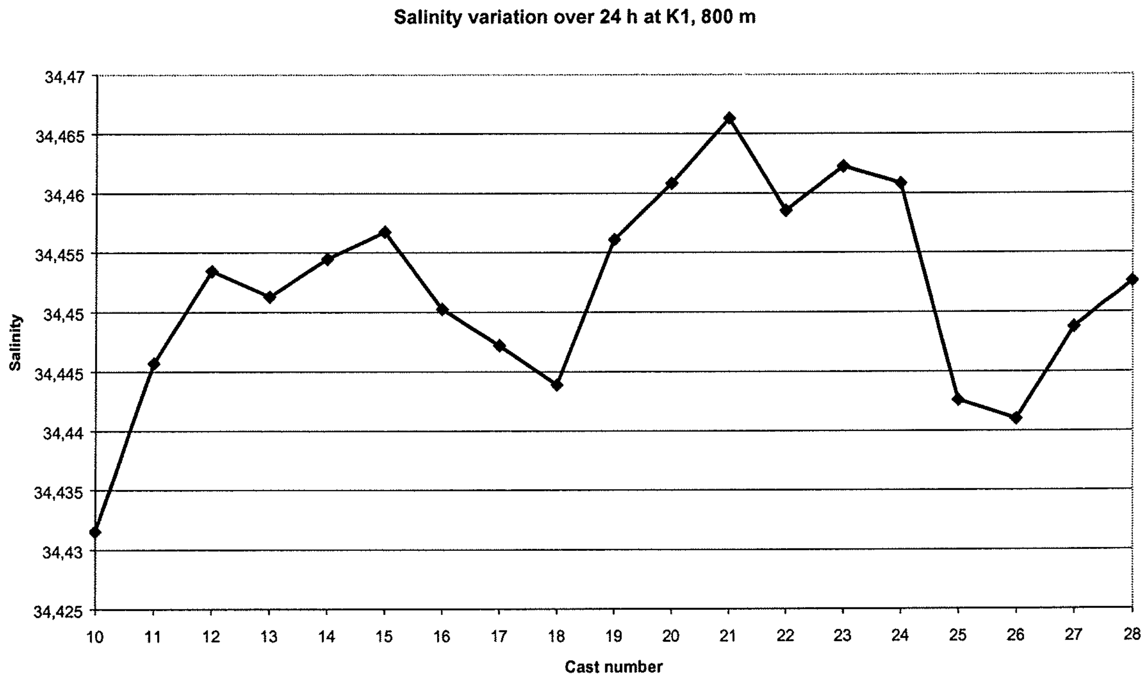

Figure 9a

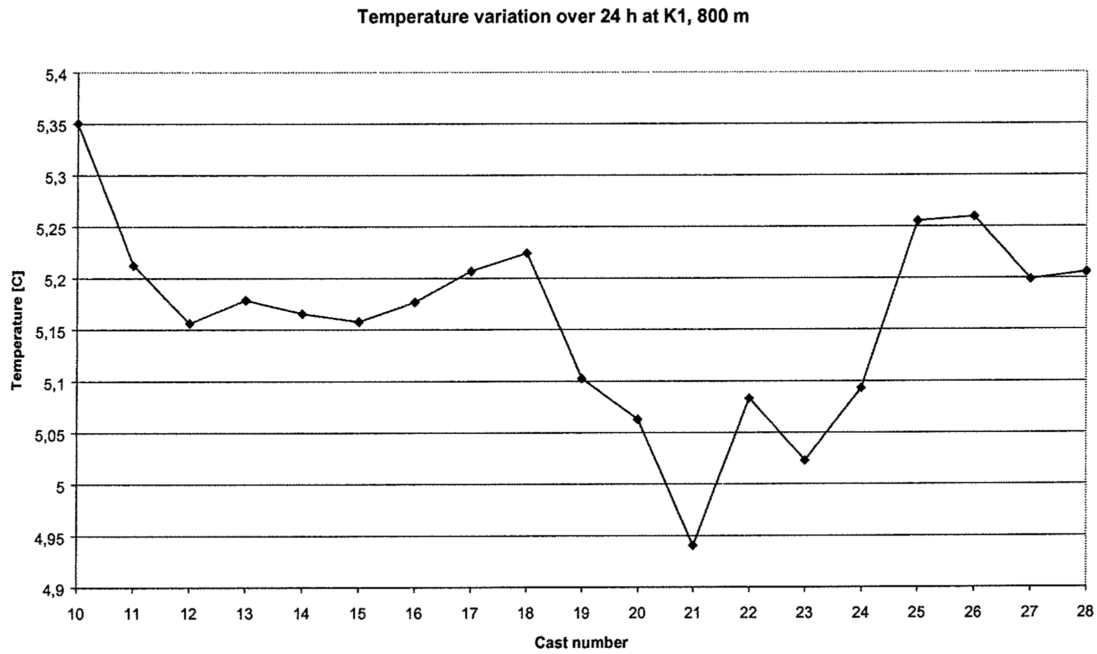

Figure 9 b.

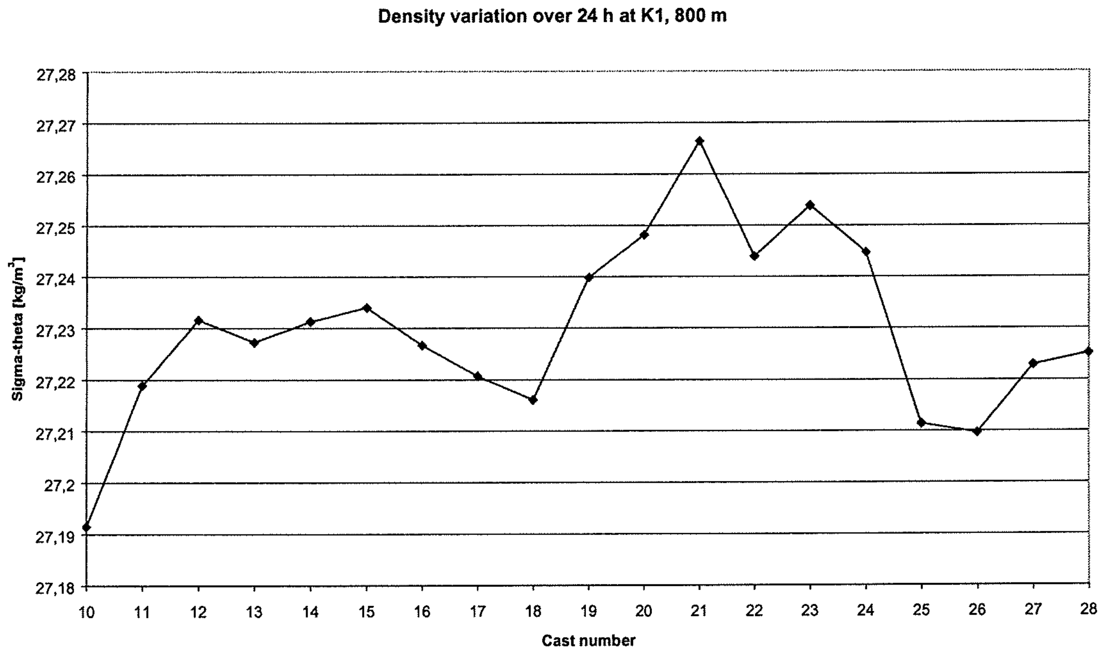

Figure 9 c.

Figure 9. Variation of a) Salinity, b) Temperature and c) Density over a 24 h period at K1, 800 m depth (values from CTD casts KOK 0510-0528, August 6-7)

Energy frequencies in the 24 hour CTD data series have also been investigated. The Sigma-t values from the 18 casts (24 hours) were interpolated into density values with one hour intervals, so as to be able to perform a Fourier analysis on equidistant data. The results are shown in the periodogram in **Figure 10**. Although the time series is short, both the graphs in

Figure 9 and the periodogram indicate the presence of a diurnal signal, possibly tide driven. Also some energy seems to be near the 5 hour period and even some at 2.5 hours.

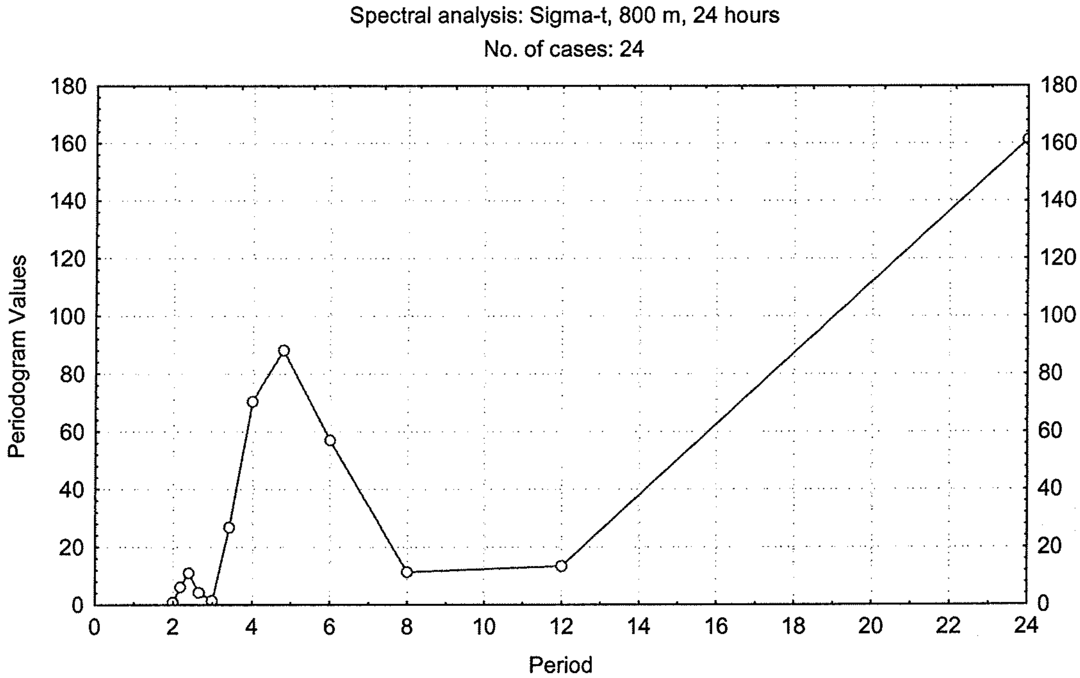

Figure 10. Periodogram for K1, 24 hour Sigma-t series.

3.2 Continuous measurements for 1 hour at 800 meters

Figure 11 shows temperature, salinity and Sigma-theta as measured by the CTD at station K1 on August 6, 1999, from 18:59 to 19:50 (UTC). Data are shown at full 4 Hz frequency. Variations are small, but still significant. For temperature they are about 1/5 of the 24 hour range and for salinity about 1/10 of the 24 hour range. Note that the values used for cast 0524 in the previous figures were taken from the downcast, whereas the data in this figure were collected during a halt at the upcast.

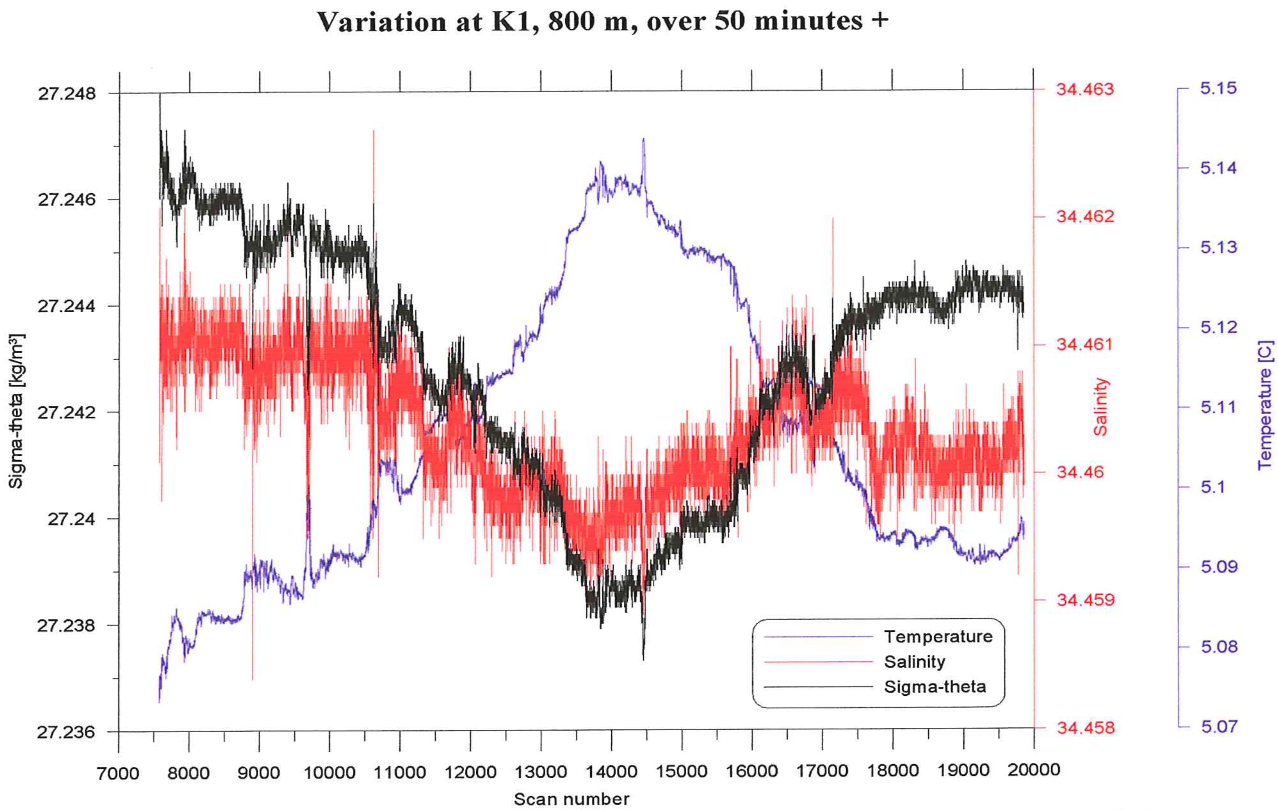

Figure 11. Salinity (red line), Temperature (blue) and density (black) from a cast at K1 (cast 0524), when the CTD was held at 800 m depth for close to 1 hour.

4. Discussion

4.1 General oceanographic conditions

Flament at al. (1996) described the general currents and hydrographic conditions in the Hawaiian waters. Surface waters are warm, with a rather strong north to south gradient, but with small annual cycles. Also temperatures tend to be highest to the west of the island chain. Highest temperatures are found in September (average 27 °C around O'ahu), lowest in March (average 24 °C at O'ahu). We should thus expect that our new surface data are reflecting something close to the annual maximum for 1999. The average surface salinity is at a maximum at 26°N (35.2 ppt), gradually declining to about 34.3 ppt at 10°N.

The winds mix the upper part of the water column. The depth (thickness) of this turbulent layer typically ranges from 120 m in winter to less than 30 m in summer. The thermocline starts at the bottom of this mixed layer, with temperatures gradually decreasing from around 20 °C to about 5 °C at 800 m (about the maximum depth we are concerned with), and further to about 1.5 °C at the deep bottom, beyond the depths of our interest in this project.

Large-scale currents below the surface layer are mainly geostrophic, but partly modulated along the island by the tides. The main direction is from east to west, with some southward intensification. Surface currents are highly influenced by the winds, forming rather complicated flow patterns with many local features. South of Hawaii average westward surface currents are about 17 cm/s, while on the north side of Hawaii averages are near 25 cm/s. Below 1000 m depth, the geostrophic currents are generally less than 5 cm/s, but their patterns are not entirely known (Flament et al. 1996).

4.2 Brief comparisons with other data

We have compiled a contour graph **Figure 12** of historical temperature data from the Hawaii area. The graph is based on monthly averages, so most variations are smoothed out. There seems to be several different isothermal layers and thermoclines, but this may partly be an artifact from the averaging and contouring process.

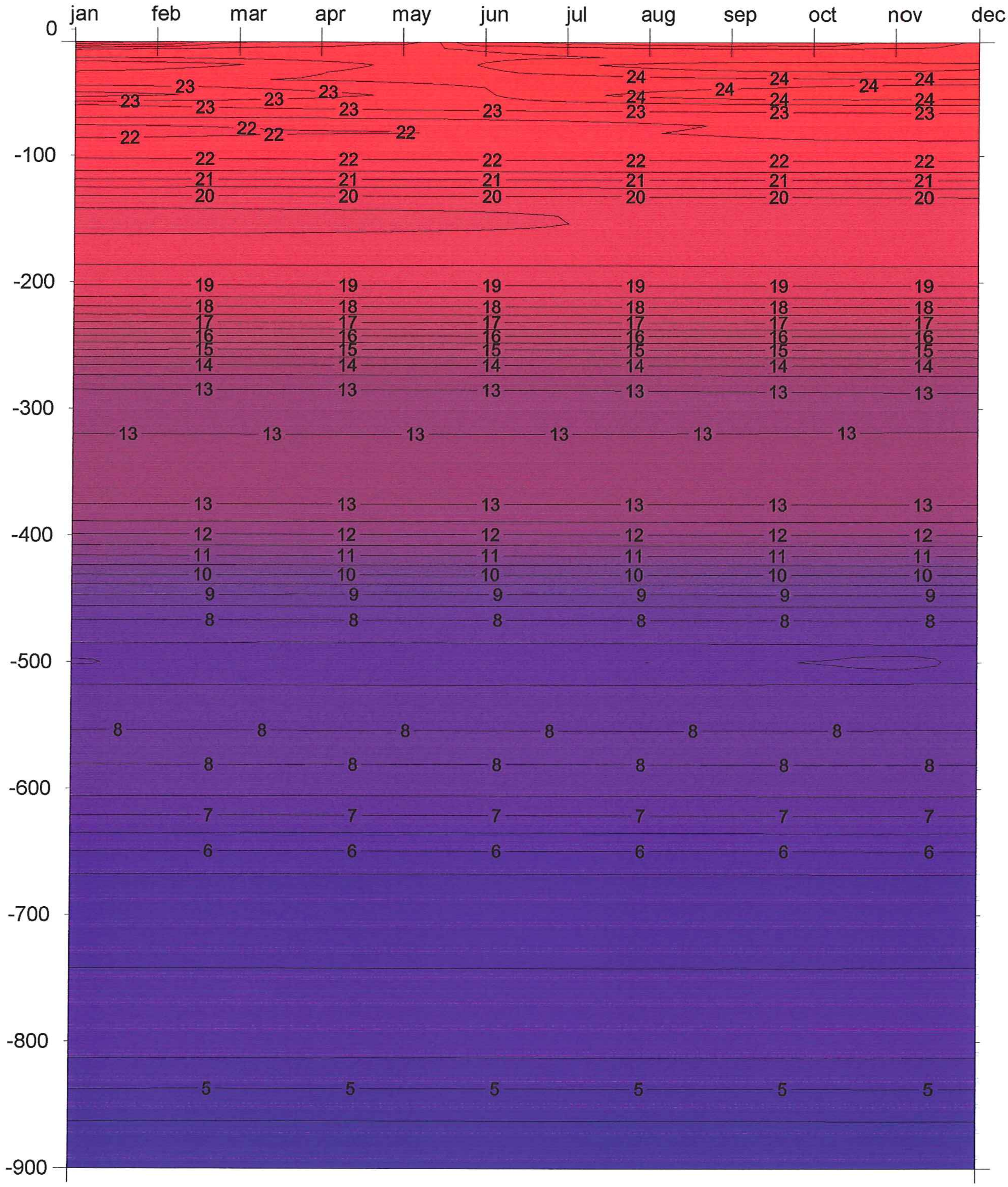

Figure 12. Historical temperature data from the Hawaii area. The data are monthly averages from 1900-1990, in the area 20-30 N and 150-160 W. Taken from the Global Temperature-Salinity Profile Program, NOAA (http://www.nodc.noaa.gov/GTSPP/gtspp-home.html).

A typical deep water profile of sea water density from August, 1989 (Adams and Herzog 1998) is shown in **Figure 13**. While the 1989 data showed a distinct surface mixed layer of about 100 m depth (actually deeper than what is usual for summer), the 1999 data show no surface mixed layer at all. Also, there are some dissimilarities within the pycnocline.

A similar comparison between temperature data show that deeper than about 550 m, temperatures were ca. 0.3 °C warmer in 1989, and about 0.1 °C colder from 350 to 550 meter depth, as compared to our data.

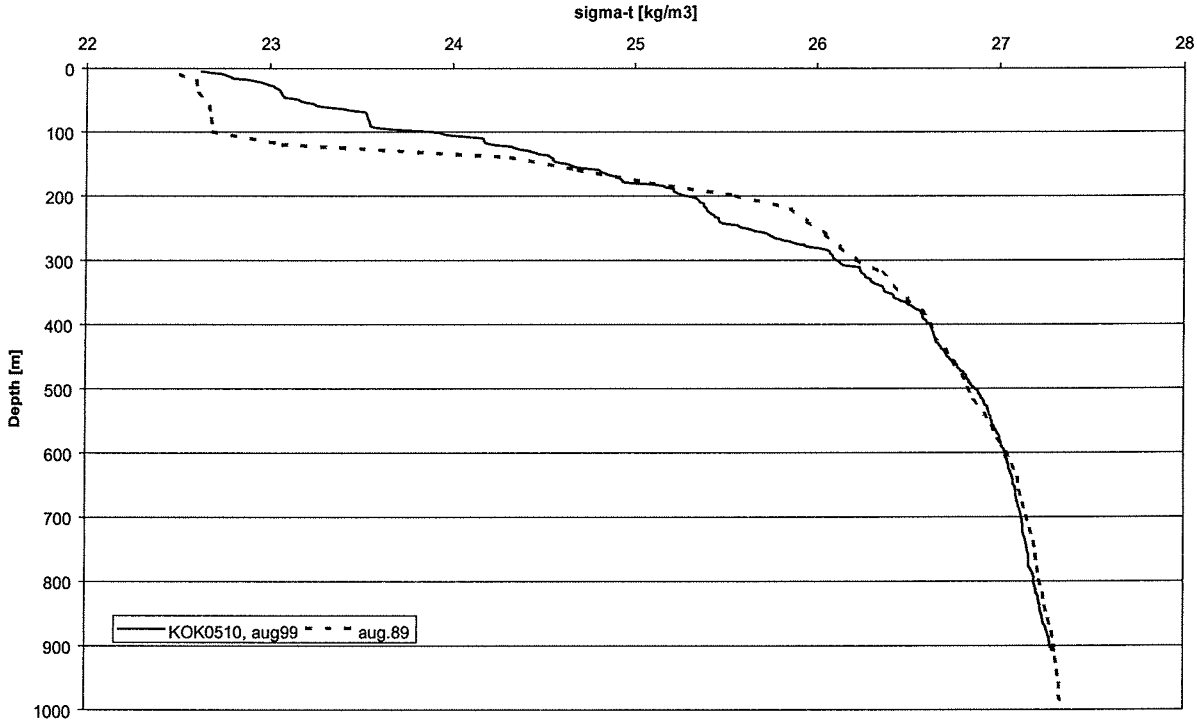

Figure 13. Sigma-t from cast made in 1989 (dashed line) and 1999 (cast # 0510, solid line).

5. References

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Appendix A. Station overview

The plotted profiles in the Appendix B and C show the Station number on top. The "time" column refers to the beginning of each CTD cast. Casts KOK0510 – 0528 are the "24 hour series".

station number	station name	latitude	longitude	date	time (UTC)
501	B12	21 19.46 N	158 10.92 W	8/3/99	11:34
502	B11	20 54.24 N	157 33.03 W	8/4/99	4:13
504	K1	19 43.33 N	156 05.01 W	8/4/99	19:26
505	K2	19 47.39 N	156 07.70 W	8/5/99	6:41
506	K4	19 41.63 N	156 10.11 W	8/5/99	9:01
507	K3	19 38.48 N	156 07.99 W	8/5/99	11:05
508	K5	19 44.24 N	156 04.47 W	8/5/99	13:09
509	K1	19 43.21 N	156 04.95 W	8/5/99	14:28
510	K1	19 43.31 N	156 04.97 W	8/6/99	1:24
511	K1	19 43.34 N	156 04.93 W	8/6/99	3:28
512	K1	19 43.33 N	156 05.01 W	8/6/99	4:39
513	K1	19 43.51 N	156 04.98 W	8/6/99	5:51
514	K1	19 43.29 N	156 04.95 W	8/6/99	6:58
515	K1	19 43.30 N	156 04.94 W	8/6/99	8:05
516	K1	19 43.29 N	156 04.95 W	8/6/99	9:06
517	K1	19 43.28 N	156 04.96 W	8/6/99	10:47
518	K1	19 43.28 N	156 94.98 W	8/6/99	11:55
519	K1	19 43.28 N	156 05.02 W	8/6/99	13:01
520	K1	19 43.27 N	156 04.97 W	8/6/99	14:05
521	K1	19 43.25 N	156 04.94 W	8/6/99	15:10
522	K1	19 43.25 N	156 05.04 W	8/6/99	16:12
523	K1	19 43.22 N	156 04.93 W	8/6/99	17:11
524	K1	19 43.27 N	156 04.97 W	8/6/99	18:59
525	K1	19 43.30 N	156 04.95 W	8/6/99	21:28
526	K1	19 43.17 N	156.04.96 W	8/6/99	22:48
527	K1	19 43.28 N	156 05.02 W	8/7/99	23:55
528	K1	19 43.35 N	156 05.22 W	8/7/99	1:03
529	L6	19 22.01 N	155 56.01 W	8/7/99	4:53
530	L7	19 03.18 N	155 55.56 W	8/7/99	7:40
531	L8	18 55.26 N	155 42.80 W	8/7/99	10:20
532	L9	18 54.41 N	155 16.83 W	8/7/99	15:10
* Station 0503 at K1 was discarded due to many sampling stops on downcast					

Appendix B. Tabulated CTD data

Data from two of the CTD-casts made in the 24 hour period and described in Chapter 3 are shown below. The values shown are 5 meter averages for the downcasts of profiles 0510 and 0521, the profiles that showed the lowest and highest values, respectively, for deep water density in this period.

KOK 0510				KOK 0521			
Depth	Temperature	Salinity	Sigma-t	Depth	Temperature	Salinity	Sigma-t
5	26.990	34.879	22.630	5	26.359	34.837	22.799
10	26.612	34.873	22.746	10	26.363	34.841	22.800
15	26.447	34.875	22.800	15	26.299	34.833	22.815
20	26.171	34.912	22.915	20	25.989	34.796	22.884
25	25.975	34.919	22.982	25	25.918	34.782	22.896
30	26.001	34.988	23.026	30	25.815	34.834	22.968
35	25.969	35.005	23.050	35	25.969	34.996	23.043
40	25.950	35.013	23.061	40	25.876	35.041	23.106
45	25.914	35.017	23.076	45	25.683	35.088	23.201
50	25.697	35.028	23.152	50	25.626	35.081	23.214
55	25.607	35.070	23.212	55	25.557	35.086	23.239
60	25.511	35.114	23.275	60	25.355	35.122	23.329
65	25.204	35.168	23.410	65	25.222	35.130	23.376
70	24.928	35.196	23.516	70	25.135	35.135	23.407
75	24.879	35.194	23.530	75	25.072	35.140	23.430
80	24.859	35.193	23.535	80	24.640	35.190	23.599
85	24.835	35.193	23.542	85	24.152	35.251	23.791
90	24.816	35.192	23.548	90	23.664	35.276	23.955
95	24.567	35.199	23.628	95	23.570	35.278	23.984
100	23.927	35.255	23.862	100	23.568	35.280	23.987
105	23.551	35.269	23.983	105	23.432	35.294	24.038
110	23.052	35.281	24.138	110	23.036	35.286	24.146
115	22.938	35.282	24.172	115	22.633	35.265	24.247
120	22.734	35.273	24.224	120	22.312	35.253	24.329
125	22.284	35.252	24.336	125	21.890	35.232	24.432
130	21.964	35.234	24.413	130	21.618	35.239	24.513
135	21.723	35.238	24.483	135	21.118	35.229	24.643
140	21.559	35.251	24.539	140	20.849	35.222	24.711
145	21.499	35.250	24.555	145	20.430	35.189	24.799
150	21.286	35.253	24.617	150	20.291	35.173	24.824
155	20.994	35.233	24.681	155	19.964	35.133	24.880
160	20.448	35.195	24.799	160	19.614	35.089	24.939
165	20.211	35.165	24.840	165	19.518	35.074	24.952
170	19.862	35.117	24.895	170	19.418	35.060	24.967
175	19.623	35.076	24.927	175	18.901	34.992	25.048
180	19.141	35.015	25.004	180	18.478	34.935	25.111
185	18.207	34.904	25.155	185	18.096	34.885	25.168
190	17.815	34.852	25.212	190	17.877	34.857	25.201
195	17.678	34.833	25.231	195	17.528	34.816	25.254
200	17.329	34.793	25.284	200	17.232	34.780	25.298
205	16.940	34.749	25.344	205	16.988	34.752	25.335
210	16.785	34.730	25.366	210	16.703	34.720	25.377

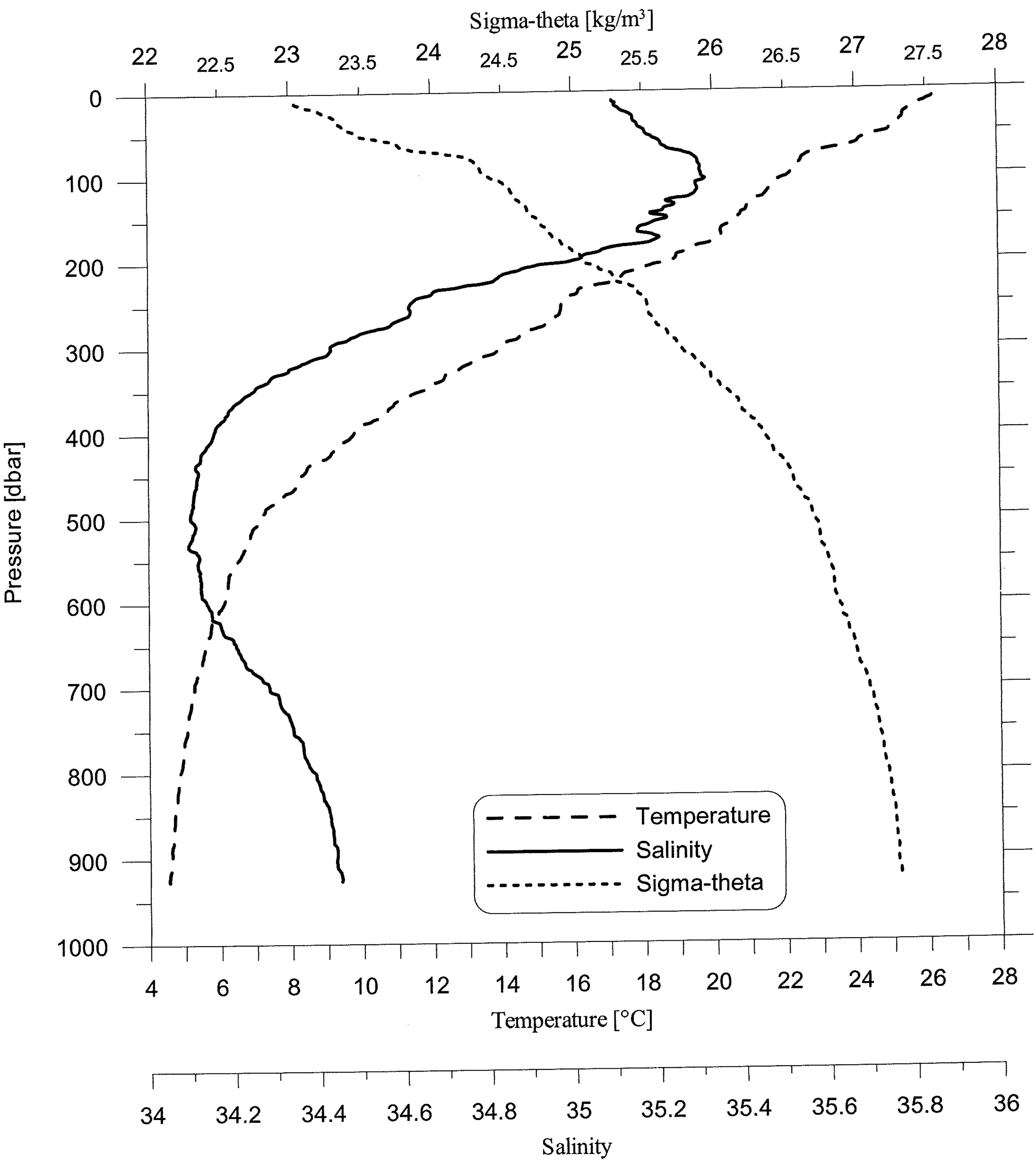
Depth	Temperature	Salinity	Sigma-t	Depth	Temperature	Salinity	Sigma-t
215	16.667	34.716	25.383	215	16.119	34.660	25.466
220	16.579	34.705	25.395	220	15.679	34.608	25.526
225	16.490	34.695	25.408	225	15.258	34.559	25.582
230	16.331	34.678	25.432	230	15.053	34.537	25.611
235	16.159	34.659	25.457	235	15.021	34.532	25.614
240	16.077	34.648	25.468	240	15.004	34.529	25.616
245	15.593	34.595	25.536	245	14.861	34.514	25.636
250	15.095	34.538	25.603	250	14.508	34.475	25.682
255	14.567	34.478	25.672	255	14.117	34.436	25.734
260	14.088	34.429	25.735	260	13.771	34.404	25.782
265	13.803	34.398	25.771	265	13.705	34.396	25.789
270	13.328	34.353	25.833	270	13.590	34.385	25.804
275	12.842	34.317	25.903	275	13.430	34.367	25.824
280	12.267	34.272	25.980	280	13.342	34.355	25.832
285	11.666	34.227	26.058	285	13.195	34.338	25.849
290	11.508	34.214	26.078	290	12.934	34.321	25.888
295	11.421	34.209	26.090	295	12.550	34.292	25.941
300	11.315	34.208	26.108	300	12.083	34.261	26.006
305	11.145	34.201	26.134	305	11.739	34.234	26.051
310	10.695	34.184	26.201	310	11.589	34.221	26.069
315	10.435	34.175	26.239	315	11.372	34.216	26.105
320	10.345	34.171	26.252	320	10.991	34.194	26.156
325	10.215	34.163	26.268	325	10.629	34.181	26.211
330	10.015	34.152	26.294	330	10.411	34.171	26.241
335	9.900	34.149	26.311	335	10.362	34.167	26.246
340	9.653	34.147	26.350	340	10.160	34.165	26.279
345	9.515	34.140	26.368	345	9.961	34.158	26.307
350	9.388	34.137	26.386	350	9.760	34.147	26.333
355	9.157	34.133	26.420	355	9.524	34.143	26.368
360	9.053	34.131	26.436	360	9.184	34.137	26.419
365	8.786	34.133	26.479	365	9.073	34.133	26.434
370	8.602	34.137	26.511	370	8.964	34.130	26.449
375	8.421	34.140	26.541	375	8.735	34.131	26.486
380	8.251	34.144	26.570	380	8.550	34.139	26.521
385	8.202	34.147	26.580	385	8.472	34.136	26.530
390	8.175	34.149	26.585	390	8.425	34.135	26.537
395	8.086	34.153	26.602	395	8.292	34.140	26.561
400	7.967	34.153	26.619	400	8.206	34.148	26.580
405	7.874	34.147	26.629	405	8.185	34.152	26.586
410	7.813	34.146	26.636	410	8.094	34.153	26.601
415	7.778	34.147	26.643	415	8.012	34.151	26.612
420	7.748	34.149	26.649	420	7.871	34.150	26.631
425	7.720	34.151	26.654	425	7.793	34.156	26.648
430	7.660	34.155	26.666	430	7.738	34.160	26.659
435	7.594	34.160	26.679	435	7.666	34.164	26.672
440	7.562	34.172	26.693	440	7.632	34.165	26.678
445	7.445	34.168	26.707	445	7.595	34.167	26.685

Depth	Temperature	Salinity	Sigma-t	Depth	Temperature	Salinity	Sigma-t
450	7.401	34.173	26.717	450	7.532	34.173	26.699
455	7.305	34.179	26.736	455	7.487	34.182	26.712
460	7.195	34.192	26.761	460	7.460	34.185	26.719
465	7.128	34.193	26.771	465	7.420	34.184	26.723
470	7.051	34.194	26.783	470	7.359	34.183	26.731
475	7.006	34.212	26.803	475	7.310	34.191	26.745
480	6.925	34.220	26.821	480	7.236	34.199	26.761
485	6.871	34.219	26.828	485	7.184	34.205	26.774
490	6.835	34.226	26.838	490	7.085	34.203	26.785
495	6.791	34.234	26.850	495	7.005	34.202	26.796
500	6.736	34.247	26.868	500	6.981	34.203	26.800
505	6.731	34.268	26.885	505	6.869	34.214	26.824
510	6.653	34.266	26.894	510	6.853	34.230	26.839
515	6.576	34.266	26.904	515	6.843	34.243	26.850
520	6.589	34.282	26.915	520	6.823	34.249	26.858
525	6.596	34.293	26.923	525	6.705	34.247	26.872
530	6.536	34.298	26.935	530	6.665	34.250	26.880
535	6.503	34.300	26.941	535	6.630	34.265	26.896
540	6.465	34.299	26.945	540	6.633	34.283	26.910
545	6.404	34.300	26.954	545	6.601	34.298	26.926
550	6.389	34.303	26.959	550	6.567	34.303	26.935
555	6.353	34.303	26.963	555	6.479	34.304	26.948
560	6.294	34.308	26.974	560	6.380	34.301	26.958
565	6.315	34.322	26.983	565	6.321	34.303	26.967
570	6.279	34.328	26.993	570	6.296	34.310	26.976
575	6.244	34.335	27.003	575	6.313	34.316	26.979
580	6.242	34.340	27.007	580	6.273	34.315	26.983
585	6.208	34.341	27.012	585	6.238	34.313	26.986
590	6.206	34.345	27.016	590	6.283	34.325	26.990
595	6.173	34.354	27.027	595	6.238	34.328	26.998
600	6.123	34.354	27.033	600	6.200	34.339	27.011
605	6.109	34.355	27.035	605	6.184	34.345	27.018
610	6.054	34.354	27.042	610	6.207	34.356	27.024
615	6.042	34.359	27.048	615	6.180	34.357	27.029
620	6.124	34.379	27.053	620	6.119	34.359	27.038
625	6.038	34.369	27.056	625	6.045	34.356	27.045
630	5.914	34.357	27.062	630	6.016	34.364	27.055
635	5.872	34.358	27.069	635	5.973	34.367	27.063
640	5.936	34.376	27.074	640	6.001	34.375	27.066
645	5.949	34.380	27.076	645	6.011	34.385	27.073
650	5.940	34.382	27.079	650	5.951	34.385	27.080
655	5.866	34.382	27.088	655	5.868	34.383	27.089
660	5.846	34.382	27.091	660	5.826	34.383	27.094
665	5.834	34.381	27.092	665	5.779	34.382	27.100
670	5.809	34.381	27.095	670	5.745	34.385	27.106
675	5.783	34.381	27.098	675	5.743	34.394	27.113
680	5.756	34.384	27.104	680	5.694	34.398	27.122

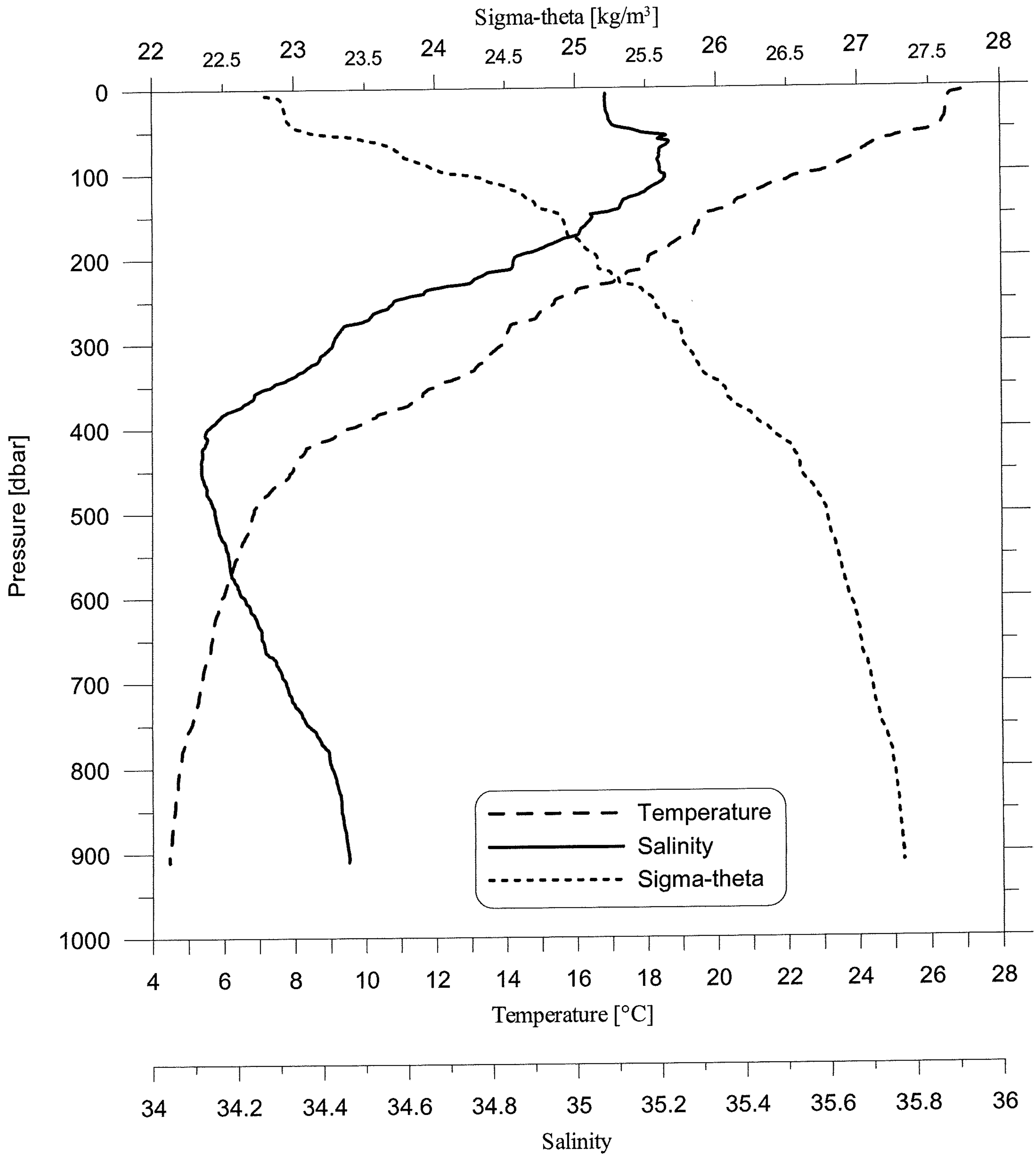
Depth	Temperature	Salinity	Sigma-t	Depth	Temperature	Salinity	Sigma-t
685	5.753	34.389	27.108	685	5.676	34.402	27.128
690	5.744	34.395	27.114	690	5.652	34.409	27.137
695	5.718	34.398	27.120	695	5.624	34.415	27.145
700	5.697	34.399	27.123	700	5.596	34.419	27.151
705	5.684	34.401	27.127	705	5.532	34.420	27.160
710	5.672	34.402	27.129	710	5.480	34.420	27.166
715	5.667	34.403	27.130	715	5.459	34.421	27.170
720	5.662	34.403	27.131	720	5.443	34.422	27.172
725	5.658	34.404	27.132	725	5.429	34.425	27.176
730	5.637	34.408	27.138	730	5.412	34.429	27.182
735	5.628	34.414	27.144	735	5.359	34.435	27.192
740	5.629	34.419	27.148	740	5.288	34.437	27.202
745	5.632	34.424	27.151	745	5.259	34.440	27.208
750	5.605	34.424	27.155	750	5.244	34.441	27.211
755	5.566	34.423	27.159	755	5.228	34.443	27.214
760	5.499	34.419	27.163	760	5.193	34.449	27.223
765	5.492	34.418	27.164	765	5.125	34.455	27.236
770	5.496	34.418	27.163	770	5.097	34.457	27.241
775	5.493	34.419	27.164	775	5.085	34.458	27.243
780	5.464	34.422	27.170	780	5.069	34.459	27.246
785	5.428	34.429	27.180	785	5.046	34.460	27.249
790	5.368	34.431	27.189	790	5.012	34.461	27.254
795	5.346	34.432	27.193	795	4.979	34.463	27.260
800	5.349	34.432	27.192	800	4.946	34.466	27.265
805	5.332	34.433	27.195	805	4.918	34.467	27.270
810	5.307	34.436	27.200	810	4.895	34.468	27.273
815	5.287	34.437	27.203	815	4.877	34.469	27.276
820	5.256	34.440	27.209	820	4.868	34.470	27.278
825	5.223	34.444	27.216	825	4.837	34.472	27.283
830	5.215	34.445	27.218	830	4.811	34.473	27.286
835	5.200	34.448	27.222	835	4.785	34.474	27.291
840	5.190	34.451	27.226	840	4.761	34.476	27.294
845	5.174	34.452	27.228	845	4.751	34.477	27.296
850	5.152	34.454	27.233	850	4.738	34.478	27.298
855	5.128	34.456	27.237	855	4.727	34.478	27.301
860	5.107	34.457	27.240	860	4.700	34.481	27.305
865	5.075	34.458	27.245	865	4.677	34.482	27.309
870	5.010	34.462	27.256	870	4.634	34.483	27.315
875	4.979	34.463	27.260	875	4.602	34.485	27.319
880	4.941	34.466	27.267	880	4.560	34.488	27.327
885	4.911	34.467	27.271				
890	4.883	34.469	27.276				
895	4.868	34.470	27.279				
900	4.847	34.471	27.282				
905	4.799	34.474	27.289				
910	4.661	34.482	27.311				

Appendix C. Plotted CTD profiles

KOK 0501

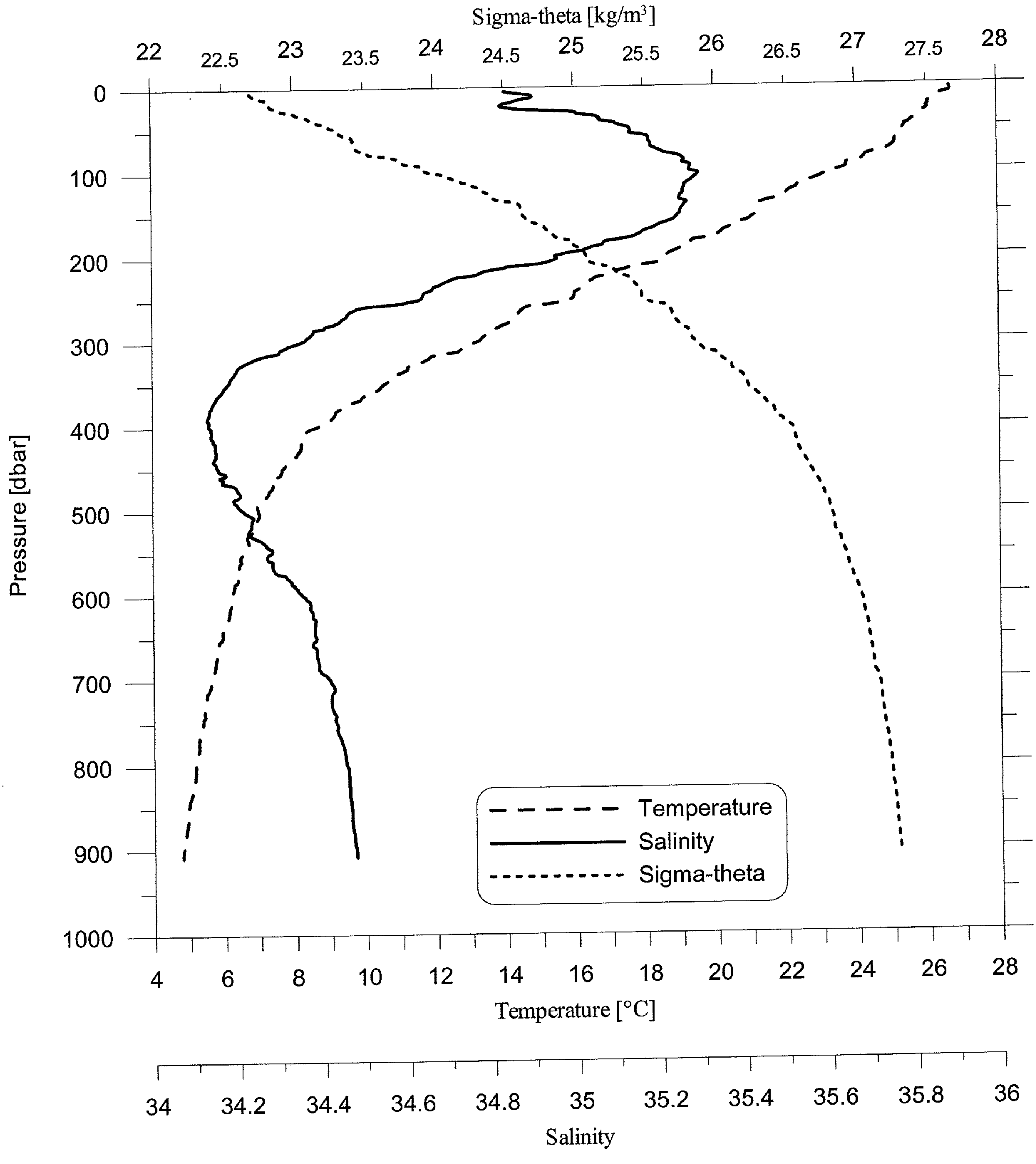

Sigma-theta [kg/m³]
22
22.5
23
23.5
24
24.5
25
25.5
26
26.5
27
27.5
28
Pressure [dbar]
0
100
200
300
400
500
600
700
800
900
1000
Temperature
Salinity
Sigma-theta
4
6
8
10
12
14
16
18
20
22
24
26
28
Temperature [°C]
34
34.2
34.4
34.6
34.8
35
35.2
35.4
35.6
35.8
36
Salinity

KOK 0502

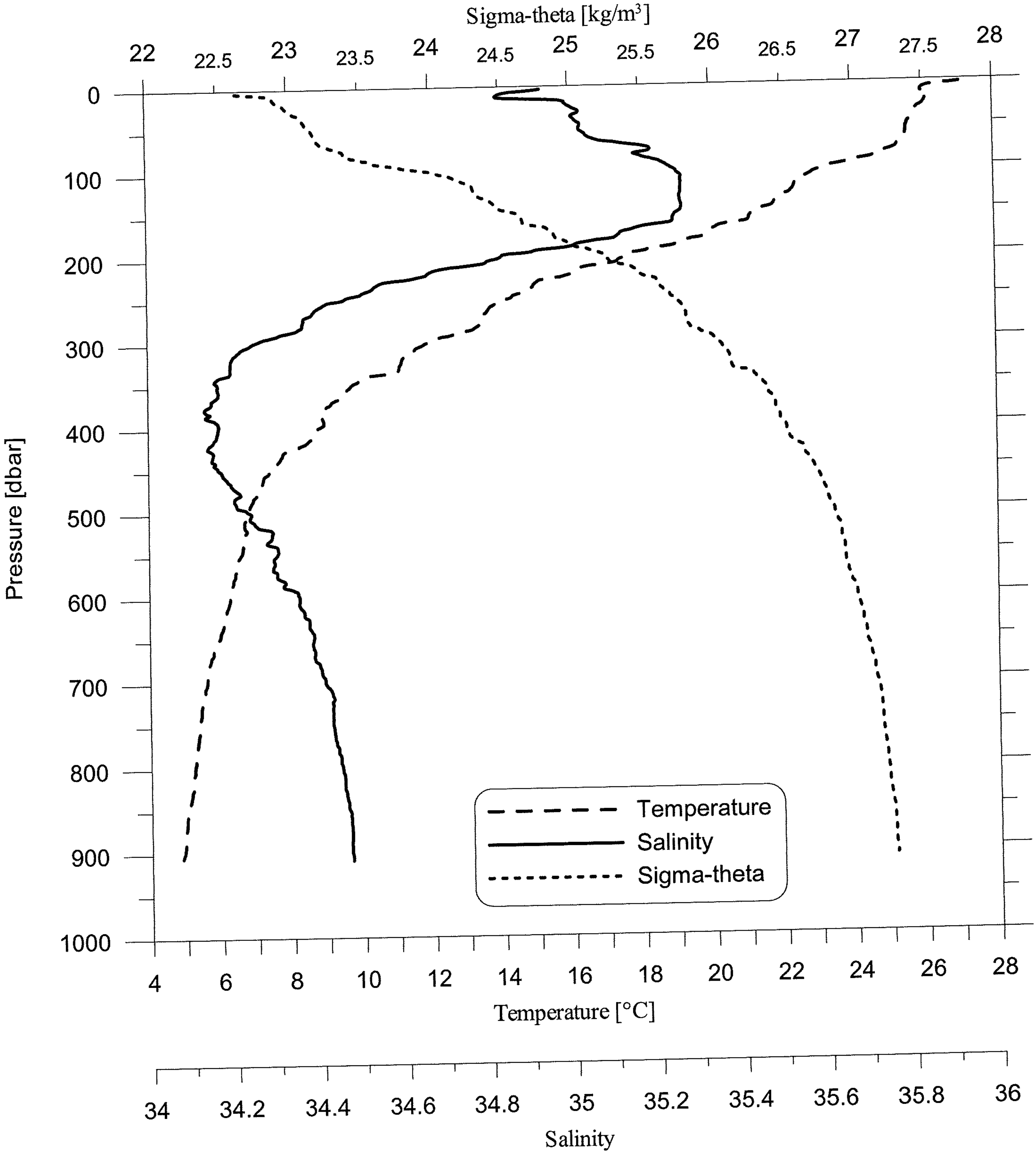


Sigma-theta [kg/m³]
22
22.5
23
23.5
24
24.5
25
25.5
26
26.5
27
27.5
28
Pressure [dbar]
0
100
200
300
400
500
600
700
800
900
1000
Temperature
Salinity
Sigma-theta
4
6
8
10
12
14
16
18
20
22
24
26
28
Temperature [°C]
34
34.2
34.4
34.6
34.8
35
35.2
35.4
35.6
35.8
36
Salinity

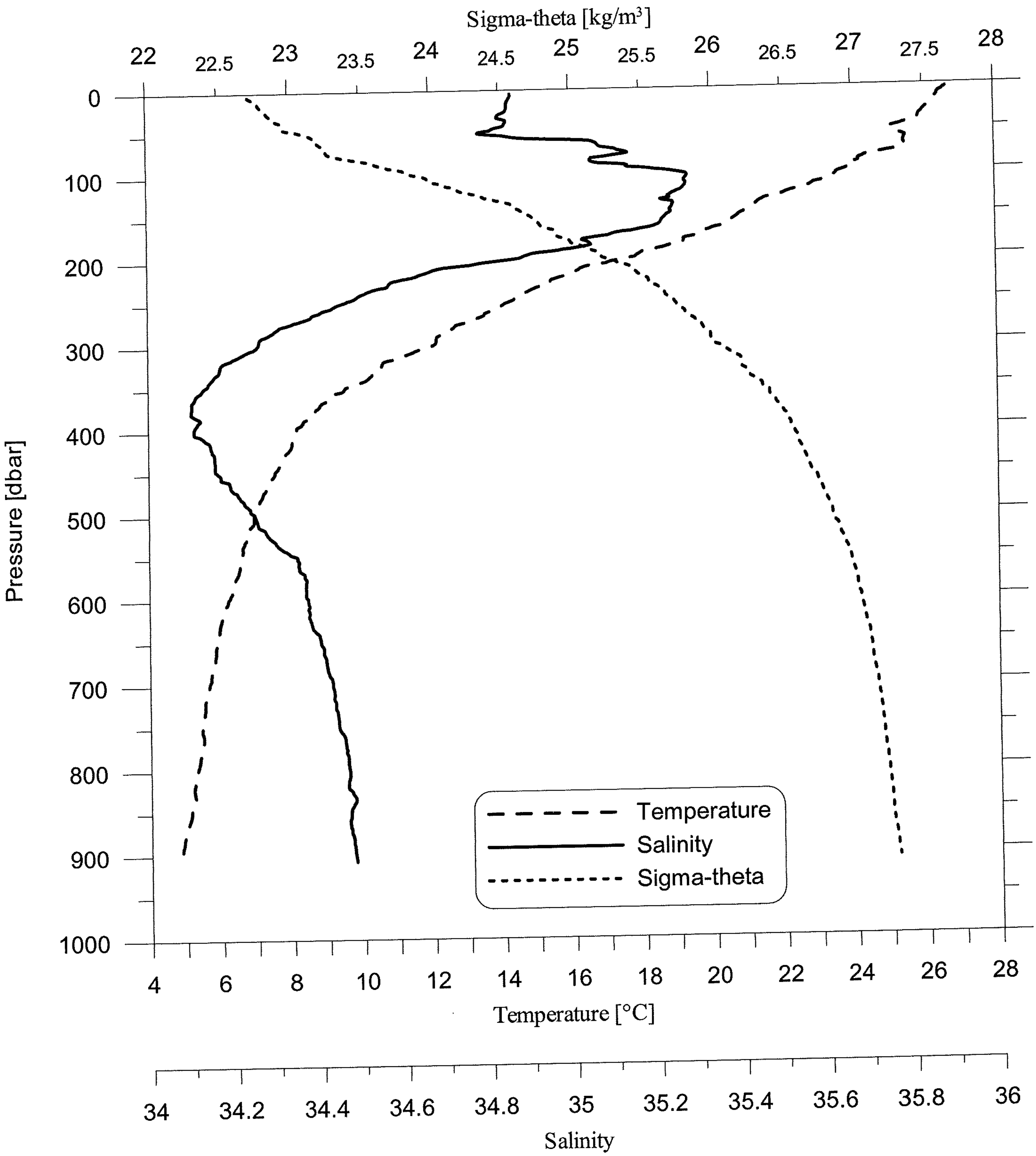
KOK 0504


Sigma-theta [kg/m³]
22
22.5
23
23.5
24
24.5
25
25.5
26
26.5
27
27.5
28
Pressure [dbar]
0
100
200
300
400
500
600
700
800
900
1000
Temperature
Salinity
Sigma-theta
4
6
8
10
12
14
16
18
20
22
24
26
28
Temperature [°C]
34
34.2
34.4
34.6
34.8
35
35.2
35.4
35.6
35.8
36
Salinity

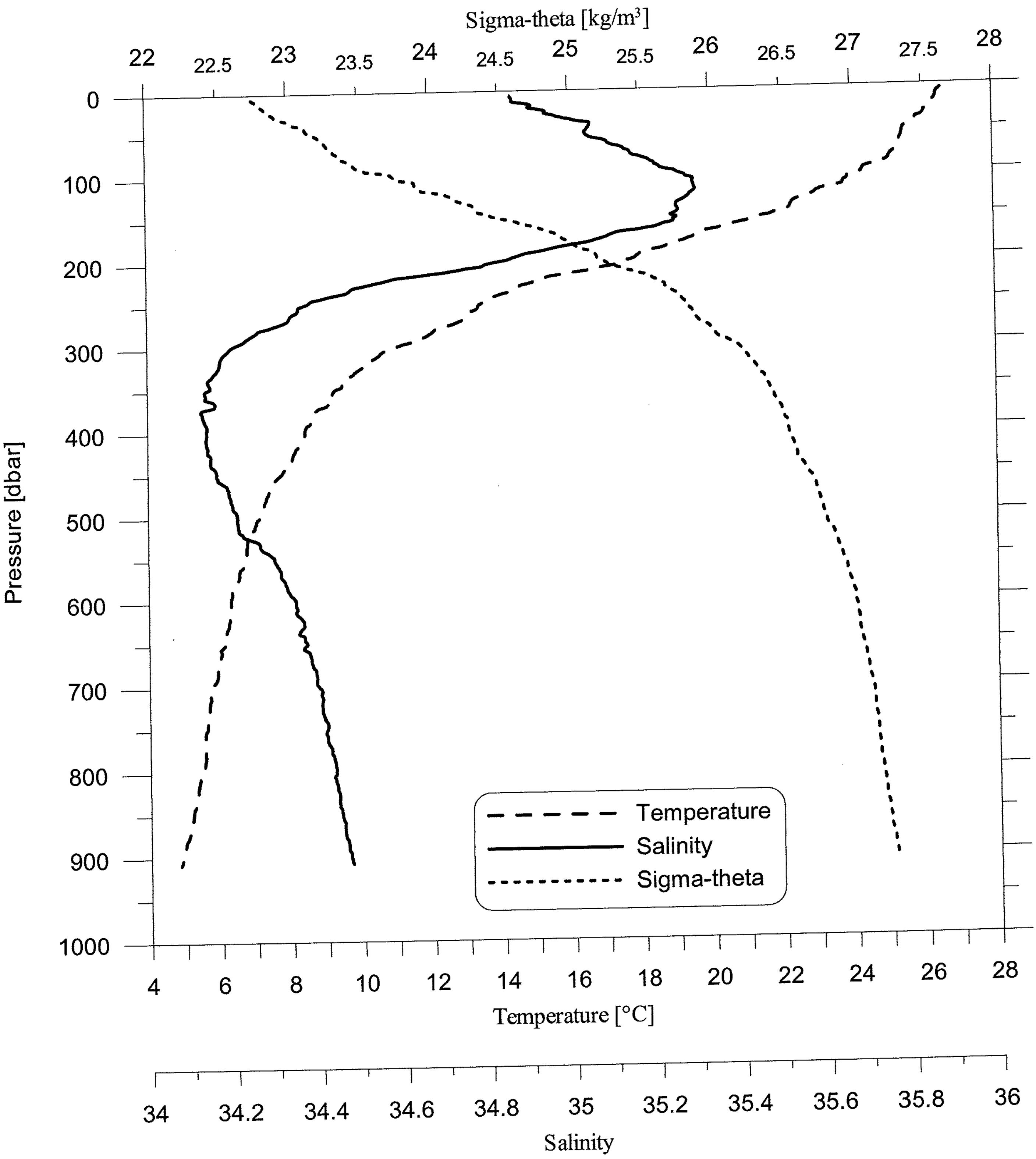
KOK 0505


Sigma-theta [kg/m³]
22
22.5
23
23.5
24
24.5
25
25.5
26
26.5
27
27.5
28
Pressure [dbar]
0
100
200
300
400
500
600
700
800
900
1000
Temperature
Salinity
Sigma-theta
4
6
8
10
12
14
16
18
20
22
24
26
28
Temperature [°C]
34
34.2
34.4
34.6
34.8
35
35.2
35.4
35.6
35.8
36
Salinity

KOK 0506

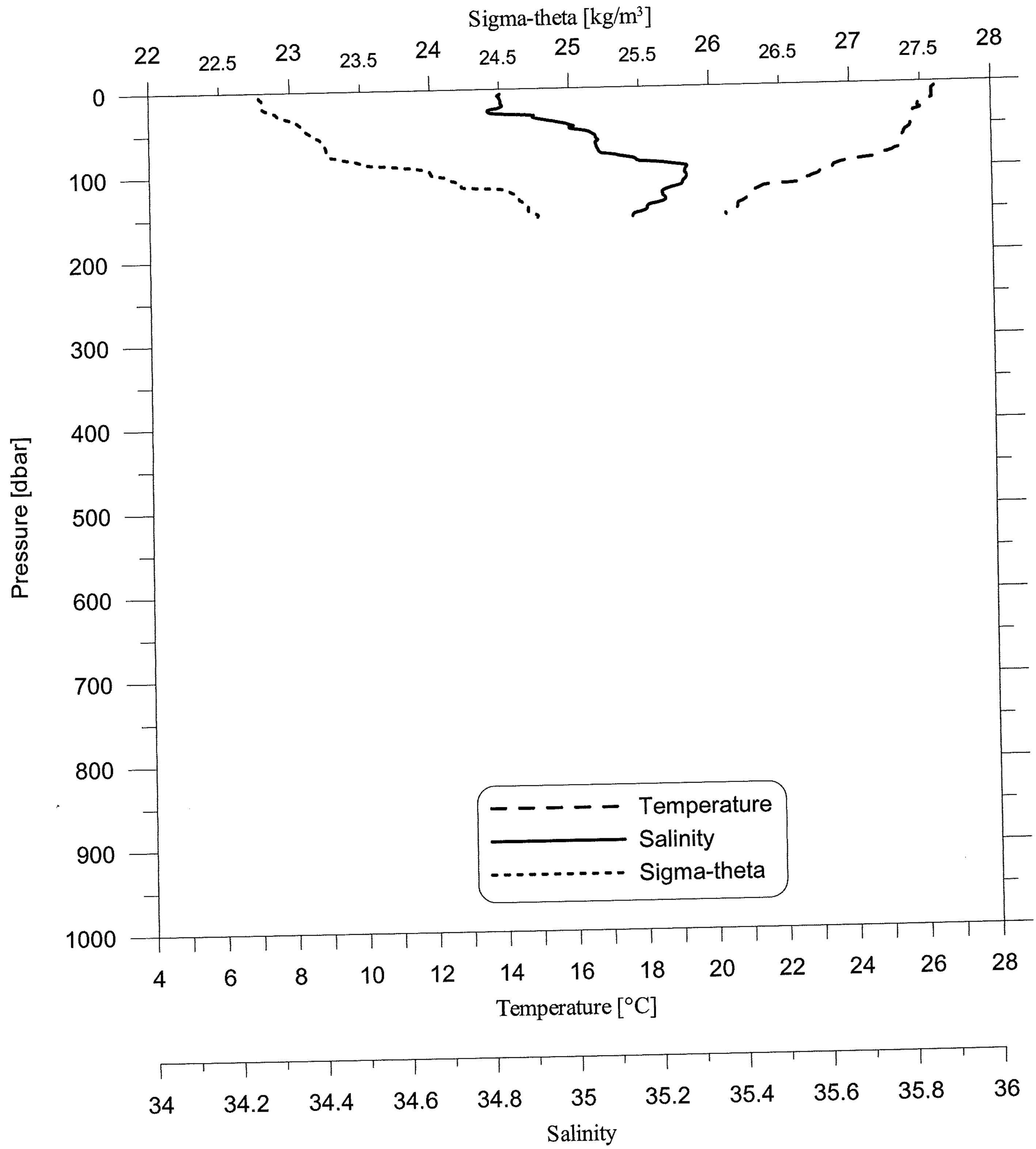

Sigma-theta [kg/m3]
22
22.5
23
23.5
24
24.5
25
25.5
26
26.5
27
27.5
28
Pressure [dbar]
0
100
200
300
400
500
600
700
800
900
1000
Temperature
Salinity
Sigma-theta
4
6
8
10
12
14
16
18
20
22
24
26
28
Temperature [°C]
34
34.2
34.4
34.6
34.8
35
35.2
35.4
35.6
35.8
36
Salinity

KOK 0507



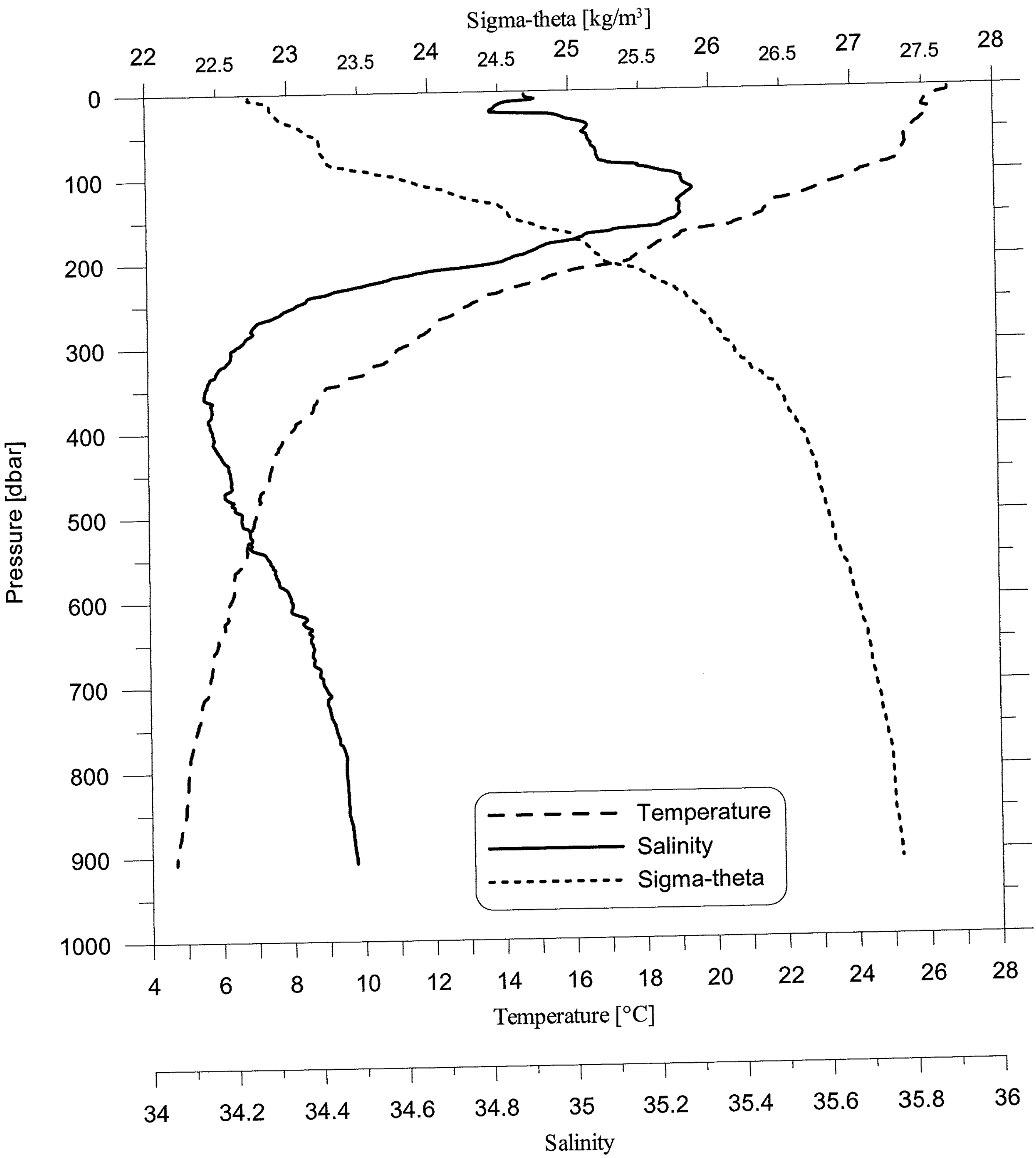
Sigma-theta [kg/m³]
22
22.5
23
23.5
24
24.5
25
25.5
26
26.5
27
27.5
28
0
100
200
300
400
500
600
700
800
900
1000
Pressure [dbar]
Temperature
Salinity
Sigma-theta
4
6
8
10
12
14
16
18
20
22
24
26
28
Temperature [°C]
34
34.2
34.4
34.6
34.8
35
35.2
35.4
35.6
35.8
36
Salinity

KOK 0508



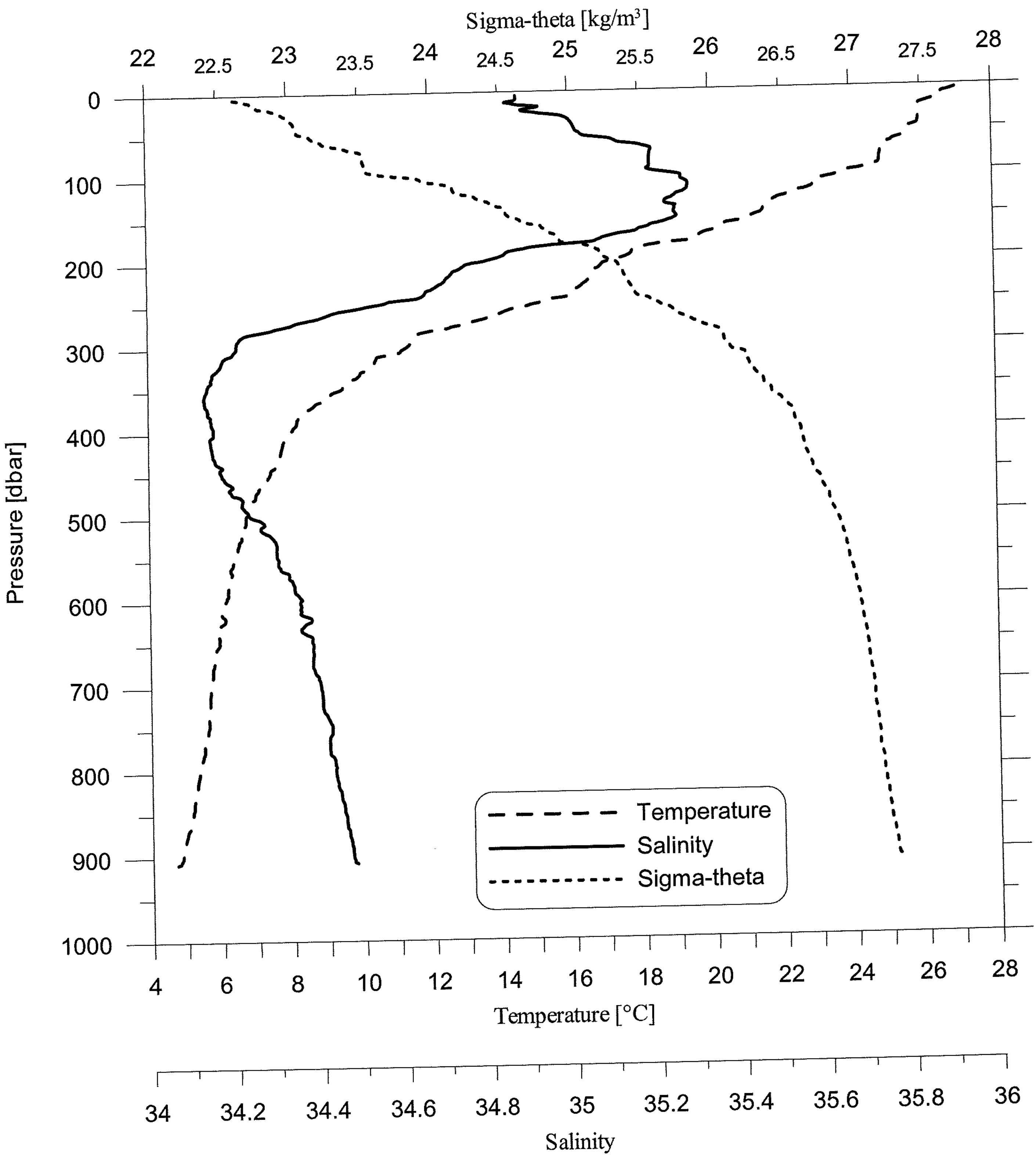
Sigma-theta [kg/m³]
22
22.5
23
23.5
24
24.5
25
25.5
26
26.5
27
27.5
28
Pressure [dbar]
0
100
200
300
400
500
600
700
800
900
1000
Temperature
Salinity
Sigma-theta
4
6
8
10
12
14
16
18
20
22
24
26
28
Temperature [°C]
34
34.2
34.4
34.6
34.8
35
35.2
35.4
35.6
35.8
36
Salinity

KOK 0509



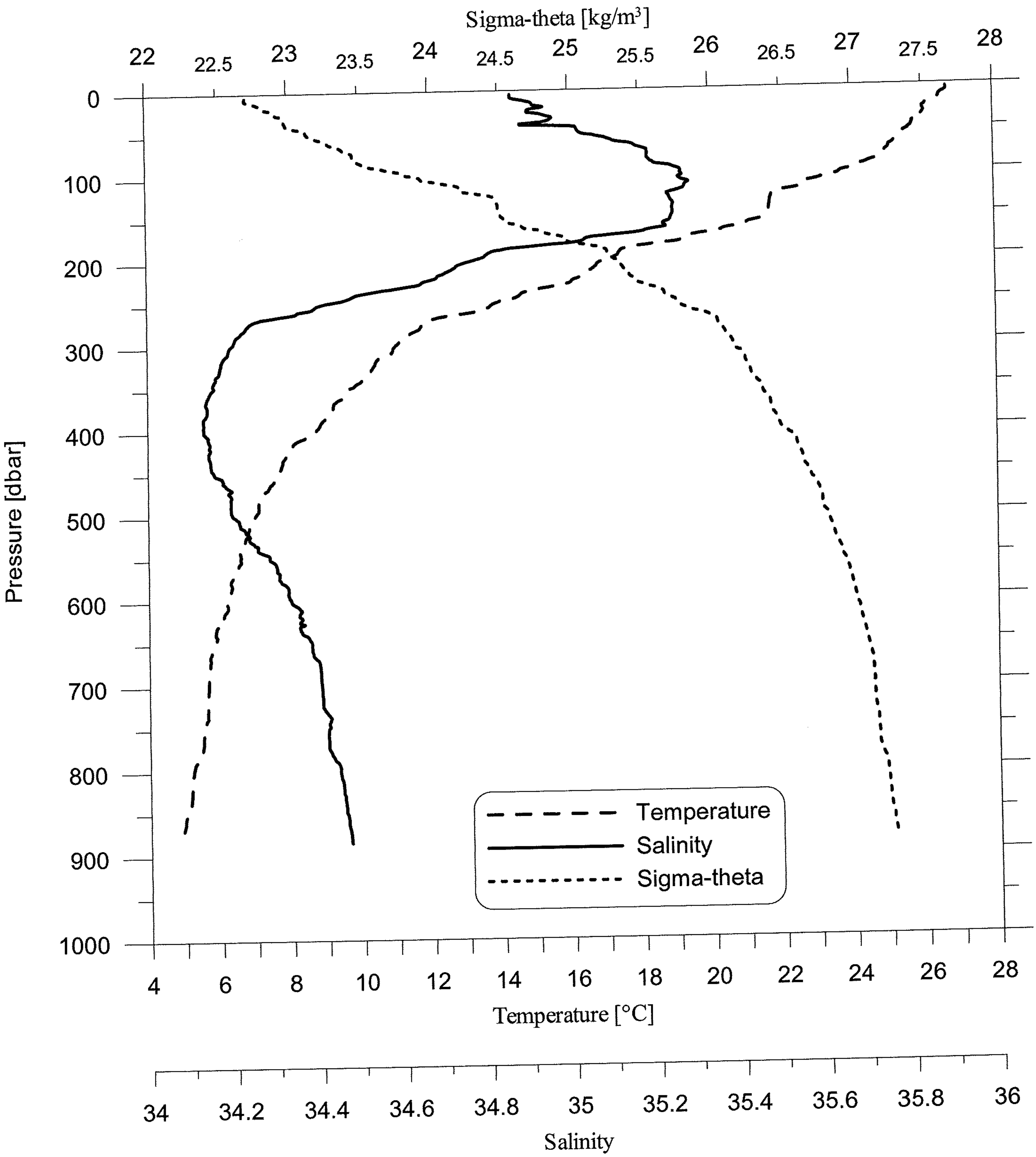
Sigma-theta [kg/m³]
22
22.5
23
23.5
24
24.5
25
25.5
26
26.5
27
27.5
28
0
100
200
300
400
500
600
700
800
900
1000
Pressure [dbar]
Temperature
Salinity
Sigma-theta
4
6
8
10
12
14
16
18
20
22
24
26
28
Temperature [°C]
34
34.2
34.4
34.6
34.8
35
35.2
35.4
35.6
35.8
36
Salinity

KOK 0510



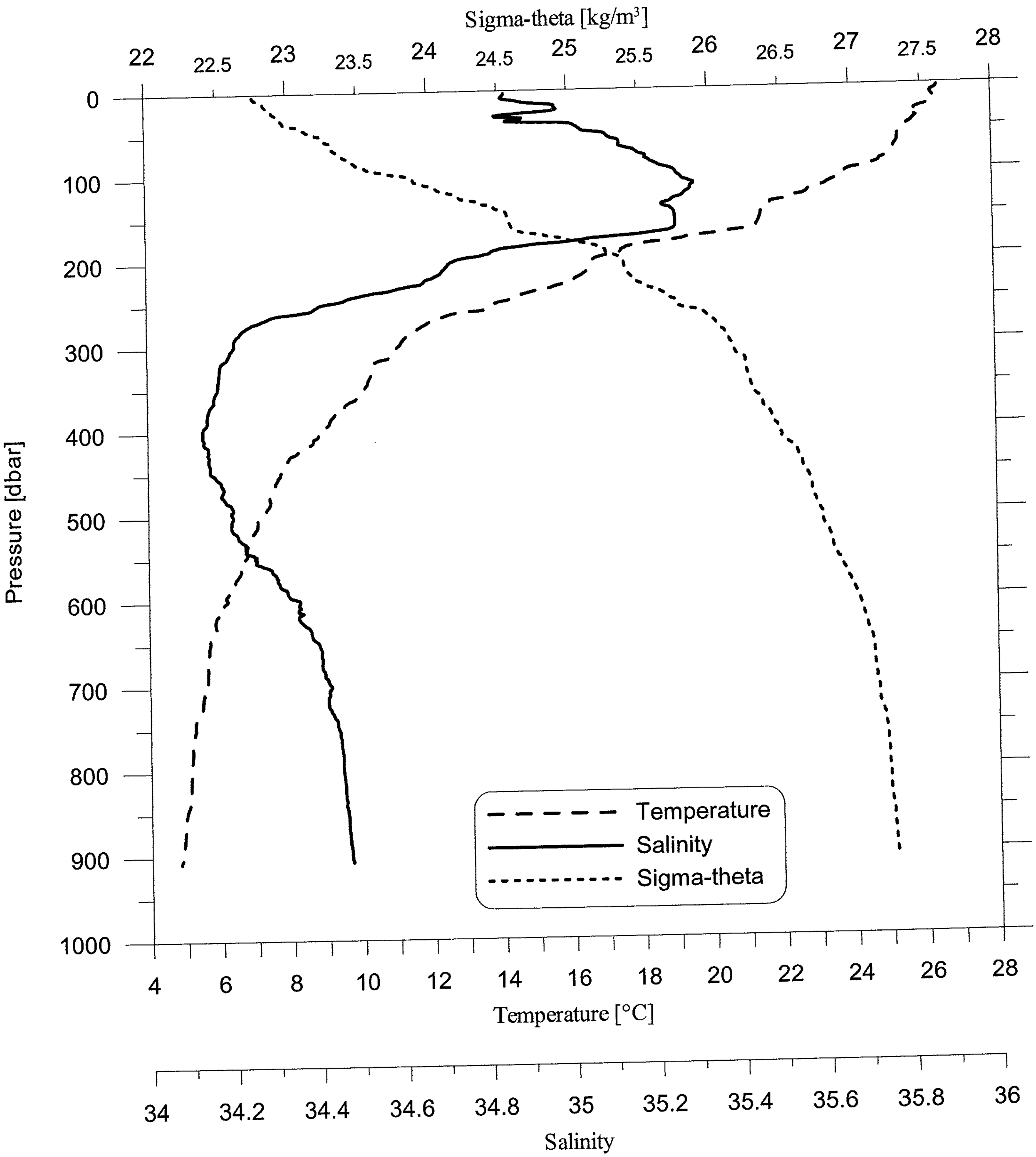
Sigma-theta [kg/m³]
22
22.5
23
23.5
24
24.5
25
25.5
26
26.5
27
27.5
28
Pressure [dbar]
0
100
200
300
400
500
600
700
800
900
1000
Temperature
Salinity
Sigma-theta
4
6
8
10
12
14
16
18
20
22
24
26
28
Temperature [°C]
34
34.2
34.4
34.6
34.8
35
35.2
35.4
35.6
35.8
36
Salinity

KOK 0511



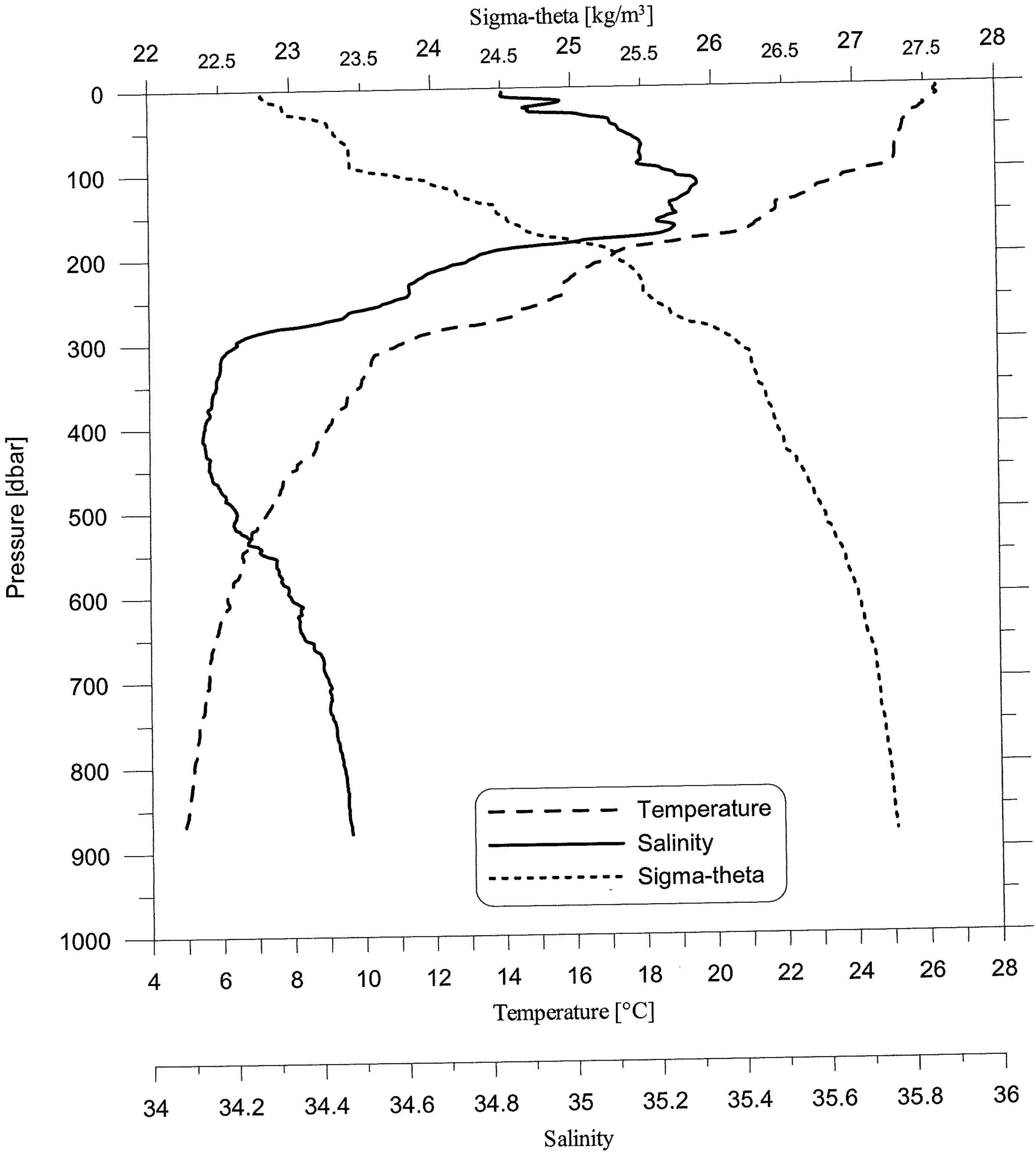
Sigma-theta [kg/m³]
22
22.5
23
23.5
24
24.5
25
25.5
26
26.5
27
27.5
28
Pressure [dbar]
0
100
200
300
400
500
600
700
800
900
1000
Temperature
Salinity
Sigma-theta
4
6
8
10
12
14
16
18
20
22
24
26
28
Temperature [°C]
34
34.2
34.4
34.6
34.8
35
35.2
35.4
35.6
35.8
36
Salinity

KOK 0512



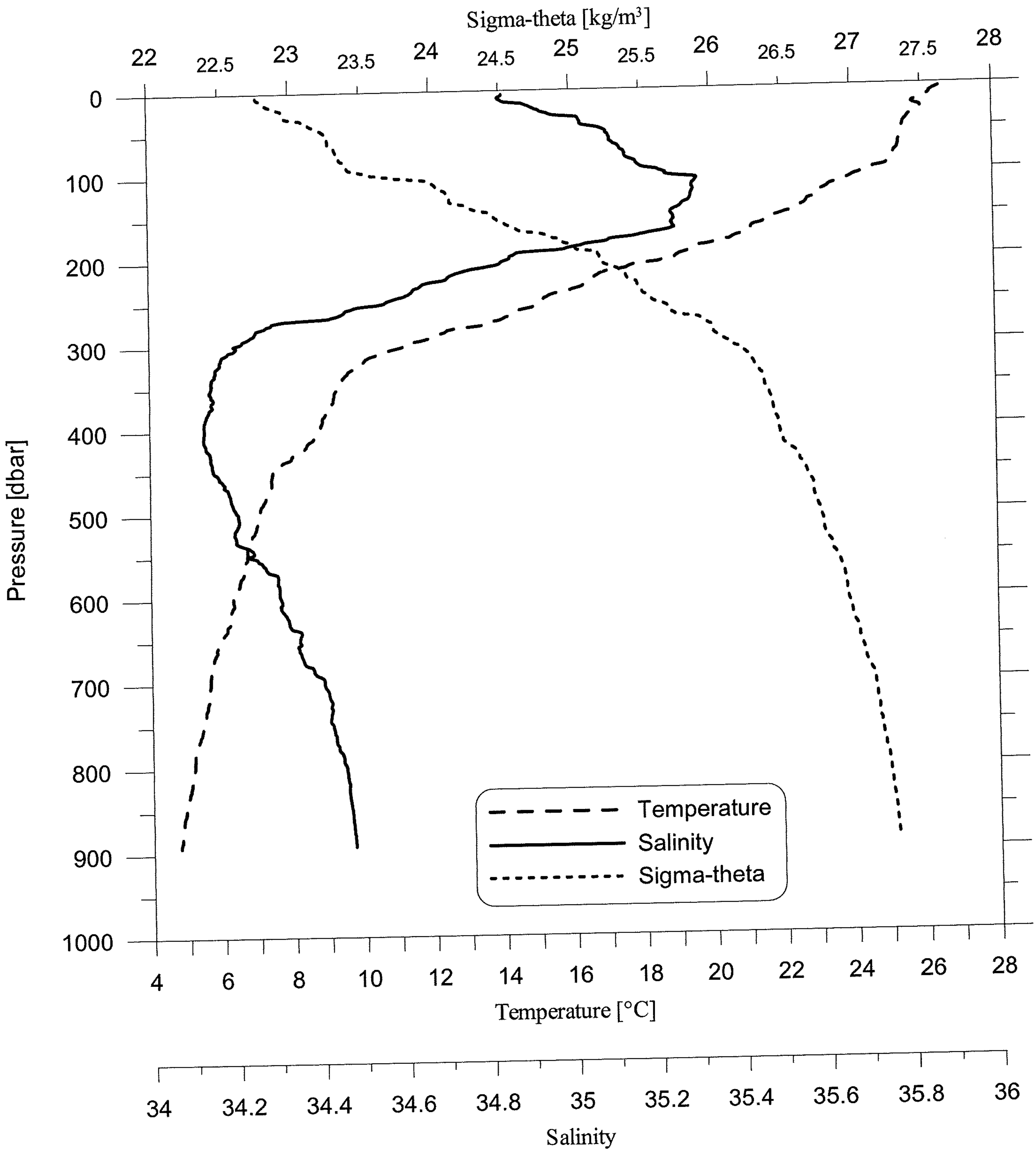
Sigma-theta [kg/m3]
22
22.5
23
23.5
24
24.5
25
25.5
26
26.5
27
27.5
28
0
100
200
300
400
500
600
700
800
900
1000
Pressure [dbar]
Temperature
Salinity
Sigma-theta
4
6
8
10
12
14
16
18
20
22
24
26
28
Temperature [°C]
34
34.2
34.4
34.6
34.8
35
35.2
35.4
35.6
35.8
36
Salinity

KOK 0513



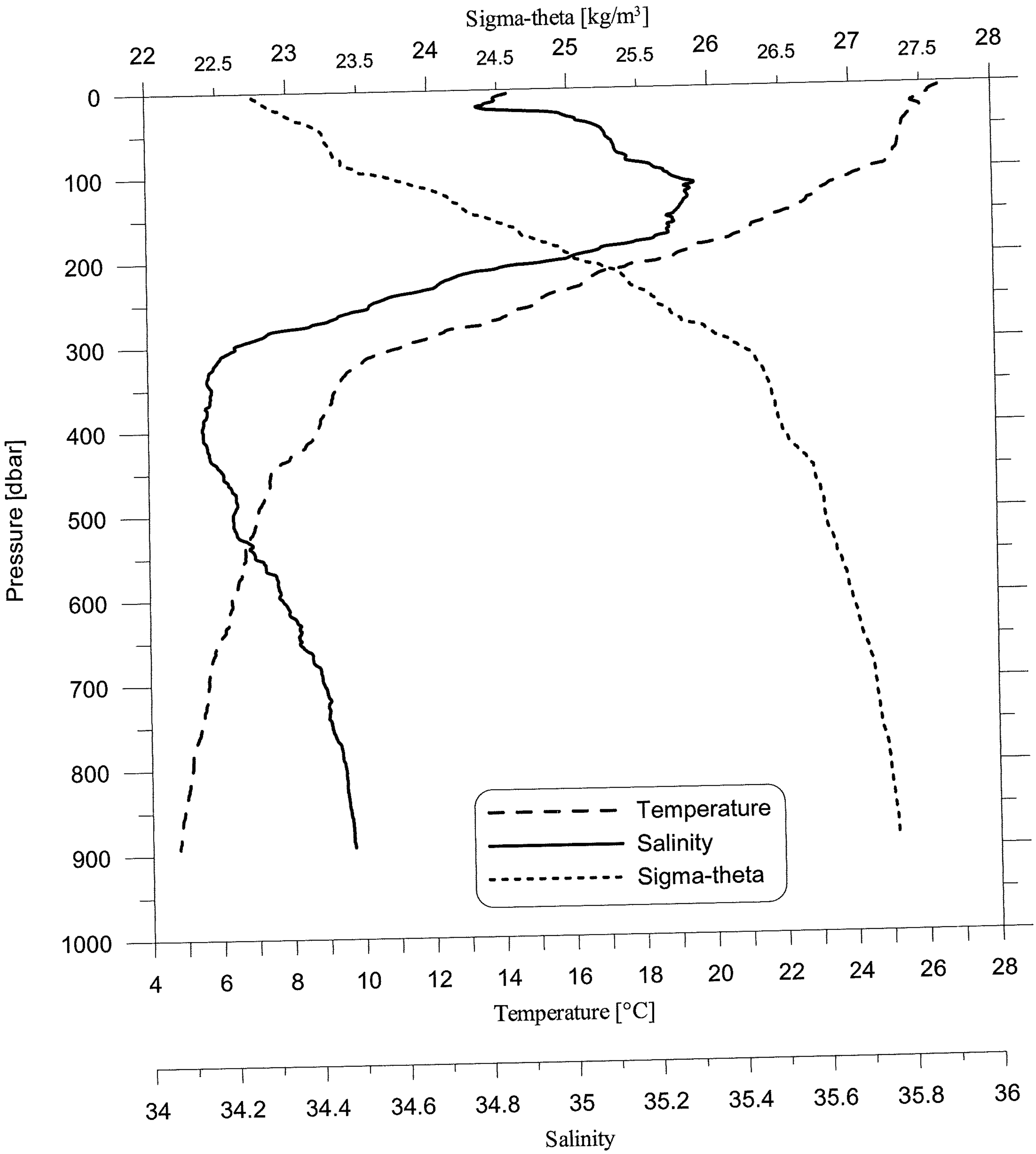
Sigma-theta [kg/m³]
22
22.5
23
23.5
24
24.5
25
25.5
26
26.5
27
27.5
28
Pressure [dbar]
0
100
200
300
400
500
600
700
800
900
1000
Temperature
Salinity
Sigma-theta
4
6
8
10
12
14
16
18
20
22
24
26
28
Temperature [°C]
34
34.2
34.4
34.6
34.8
35
35.2
35.4
35.6
35.8
36
Salinity

KOK 0514

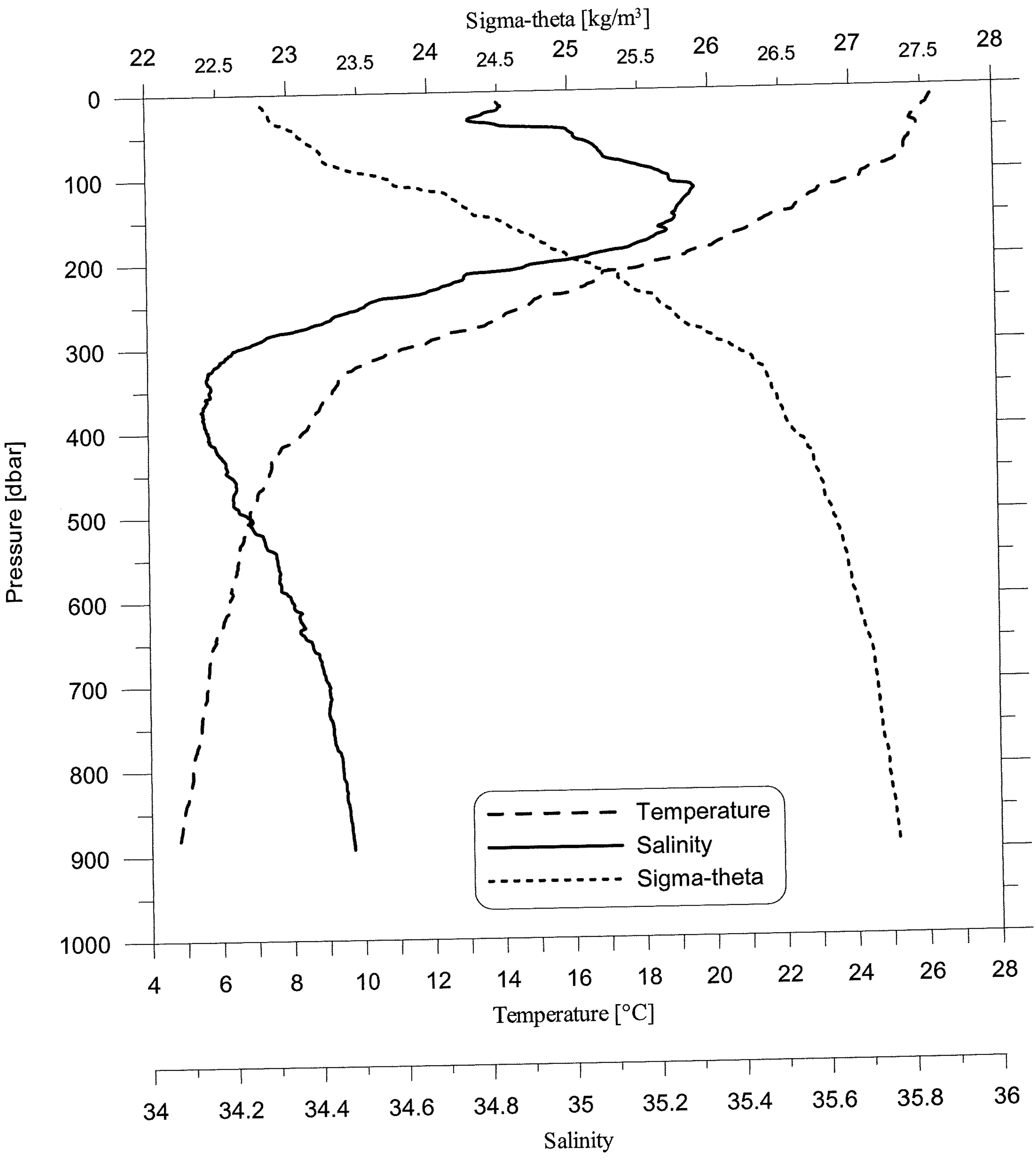


Sigma-theta [kg/m³]
22
22.5
23
23.5
24
24.5
25
25.5
26
26.5
27
27.5
28
0
100
200
300
400
500
600
700
800
900
1000
Pressure [dbar]
Temperature
Salinity
Sigma-theta
4
6
8
10
12
14
16
18
20
22
24
26
28
Temperature [°C]
34
34.2
34.4
34.6
34.8
35
35.2
35.4
35.6
35.8
36
Salinity

KOK 0515

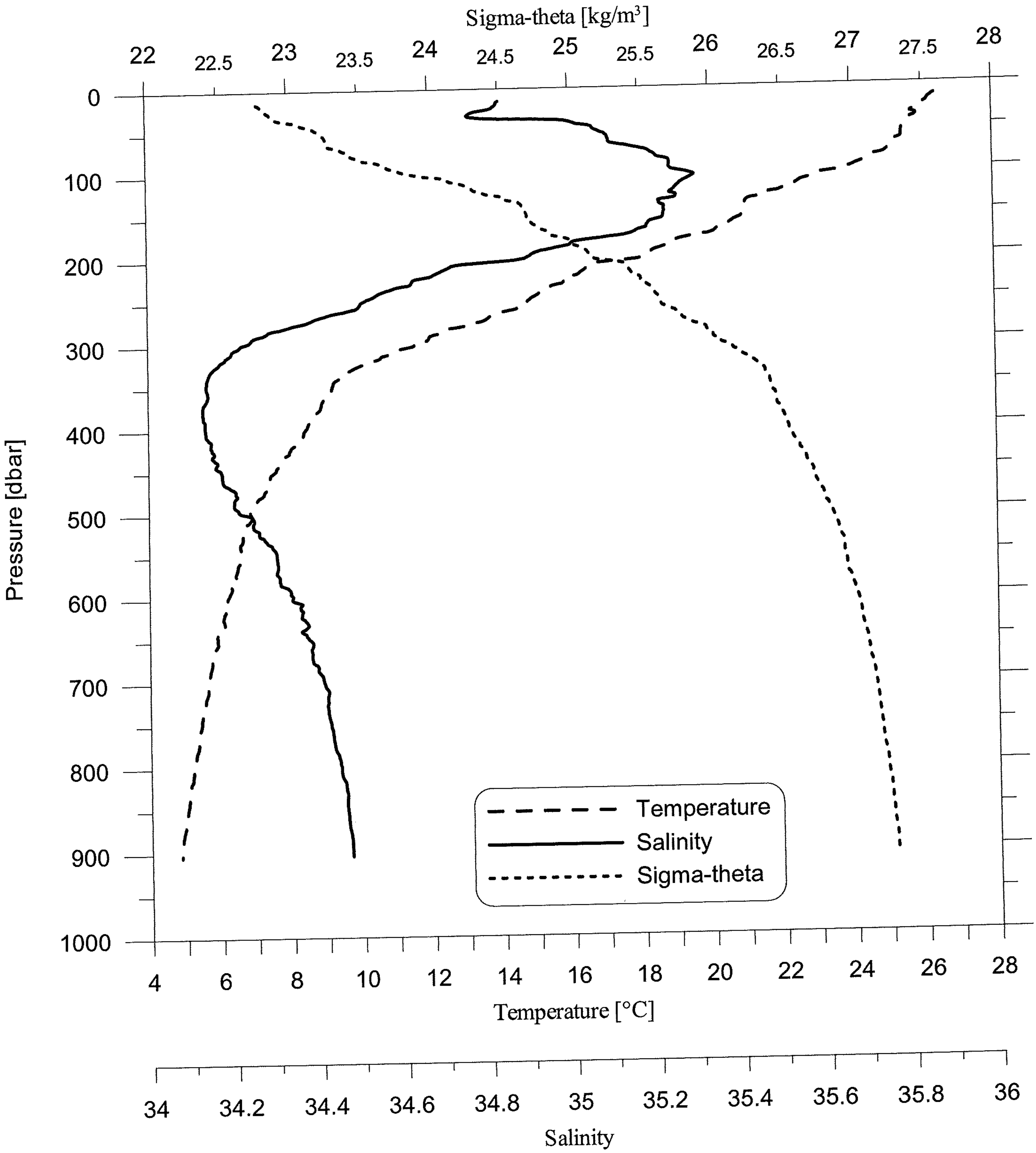

Sigma-theta [kg/m³]
22
22.5
23
23.5
24
24.5
25
25.5
26
26.5
27
27.5
28
Pressure [dbar]
0
100
200
300
400
500
600
700
800
900
1000
Temperature
Salinity
Sigma-theta
4
6
8
10
12
14
16
18
20
22
24
26
28
Temperature [°C]
34
34.2
34.4
34.6
34.8
35
35.2
35.4
35.6
35.8
36
Salinity

KOK 0516

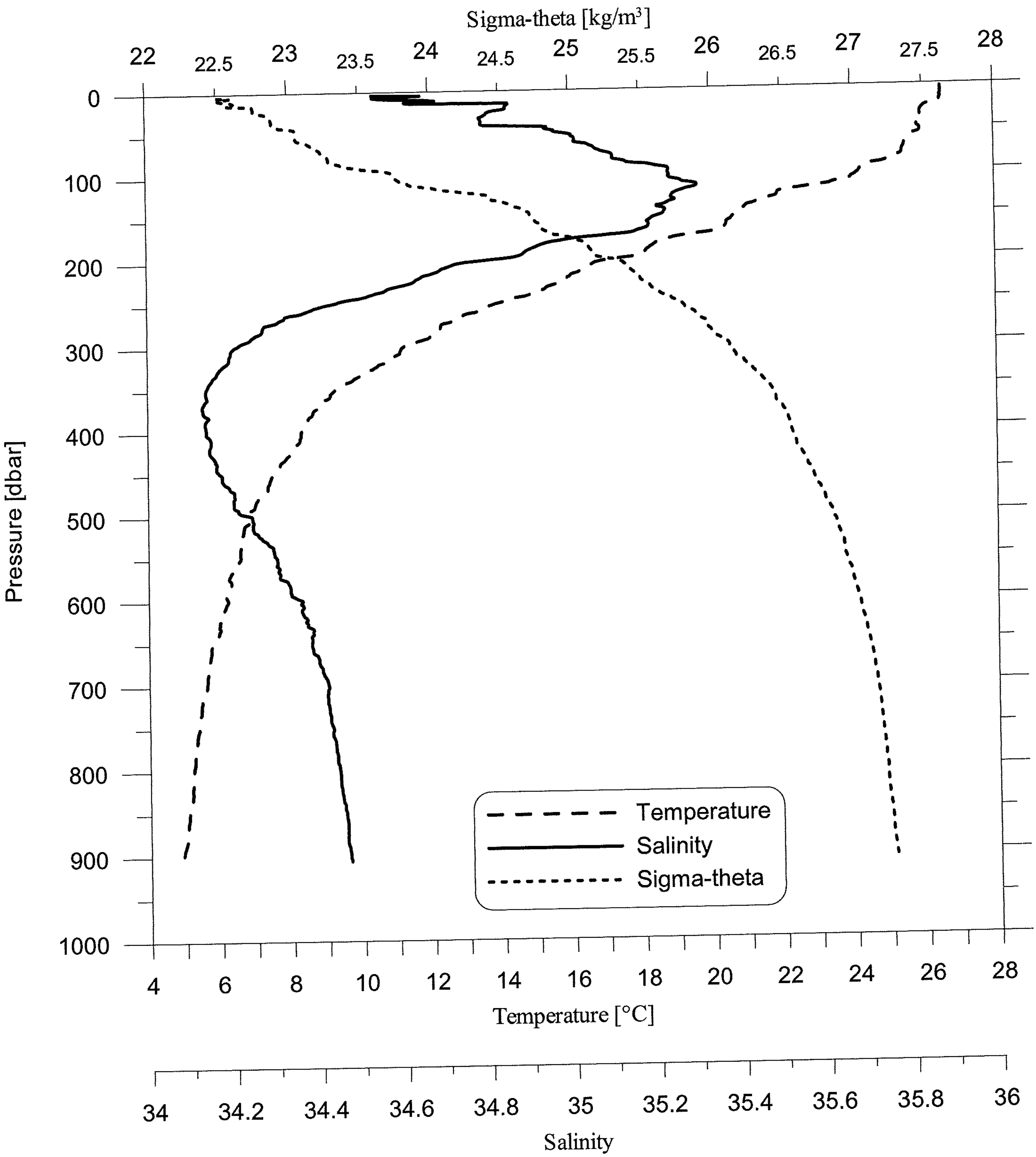


Sigma-theta [kg/m³]
22
22.5
23
23.5
24
24.5
25
25.5
26
26.5
27
27.5
28
Pressure [dbar]
0
100
200
300
400
500
600
700
800
900
1000
Temperature
Salinity
Sigma-theta
4
6
8
10
12
14
16
18
20
22
24
26
28
Temperature [°C]
34
34.2
34.4
34.6
34.8
35
35.2
35.4
35.6
35.8
36
Salinity

KOK 0517

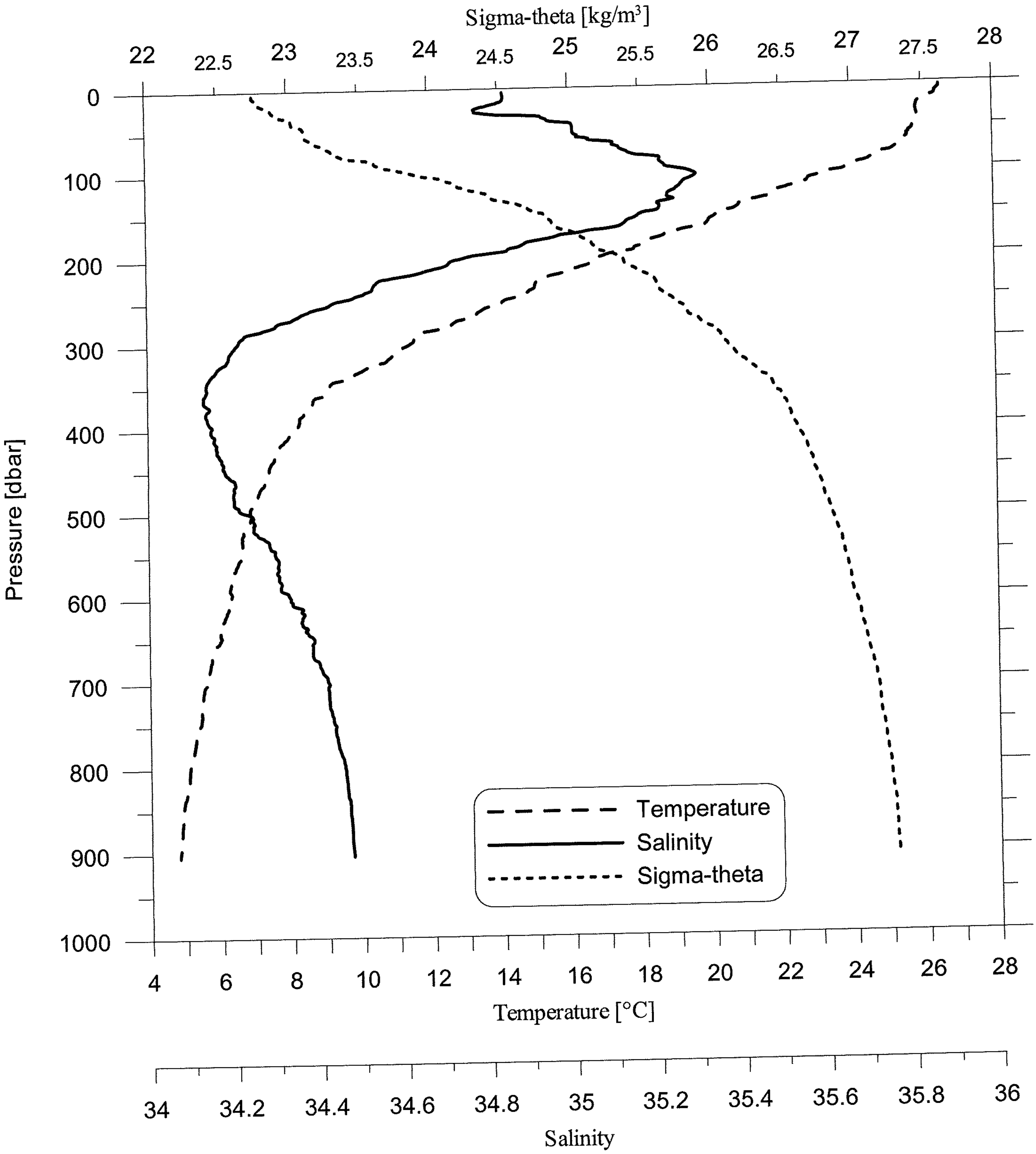

Sigma-theta [kg/m³]
22
22.5
23
23.5
24
24.5
25
25.5
26
26.5
27
27.5
28
Pressure [dbar]
0
100
200
300
400
500
600
700
800
900
1000
Temperature
Salinity
Sigma-theta
4
6
8
10
12
14
16
18
20
22
24
26
28
Temperature [°C]
34
34.2
34.4
34.6
34.8
35
35.2
35.4
35.6
35.8
36
Salinity

KOK 0518



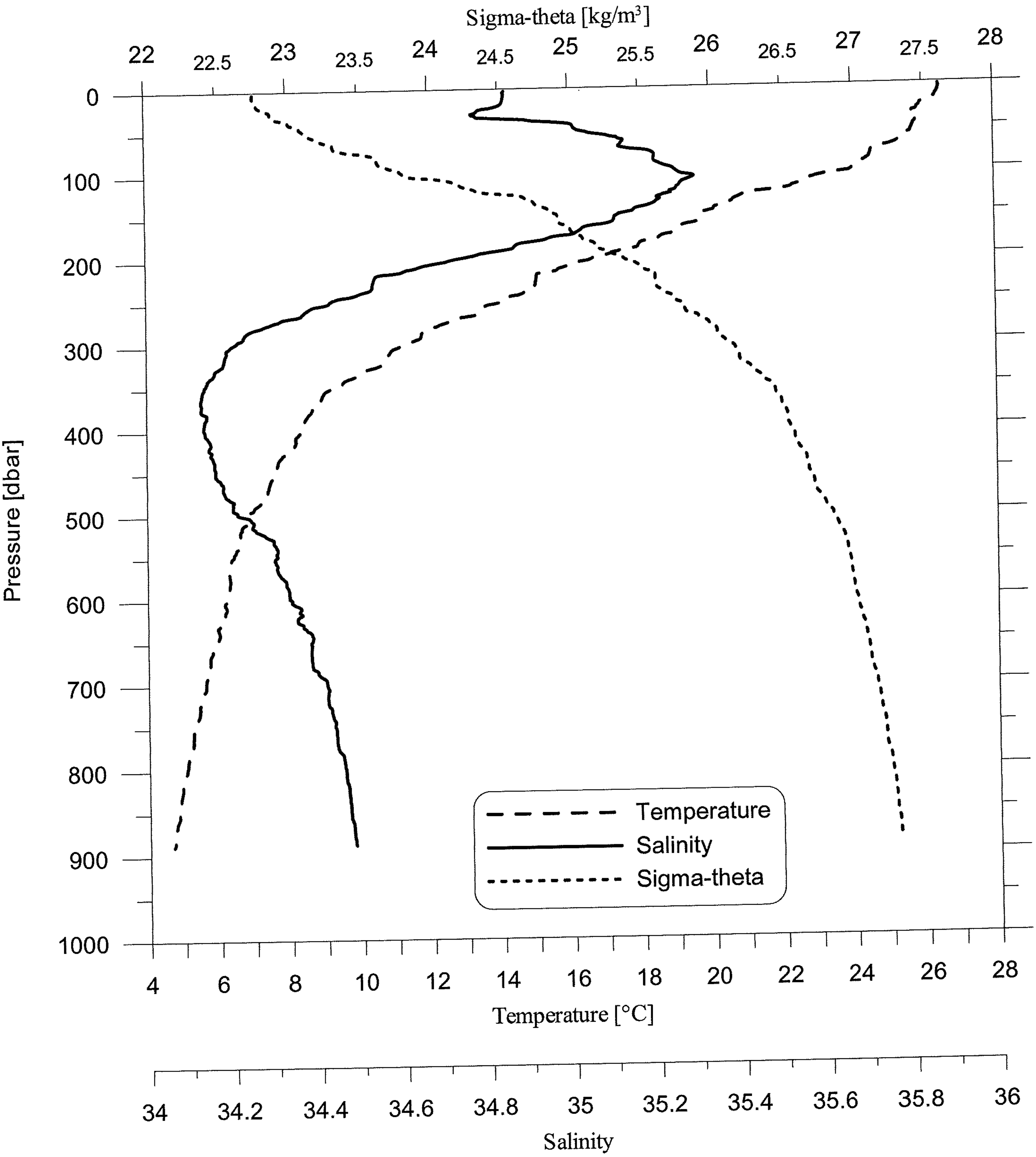
Sigma-theta [kg/m³]
22
22.5
23
23.5
24
24.5
25
25.5
26
26.5
27
27.5
28
Pressure [dbar]
0
100
200
300
400
500
600
700
800
900
1000
Temperature
Salinity
Sigma-theta
4
6
8
10
12
14
16
18
20
22
24
26
28
Temperature [°C]
34
34.2
34.4
34.6
34.8
35
35.2
35.4
35.6
35.8
36
Salinity

KOK 0519



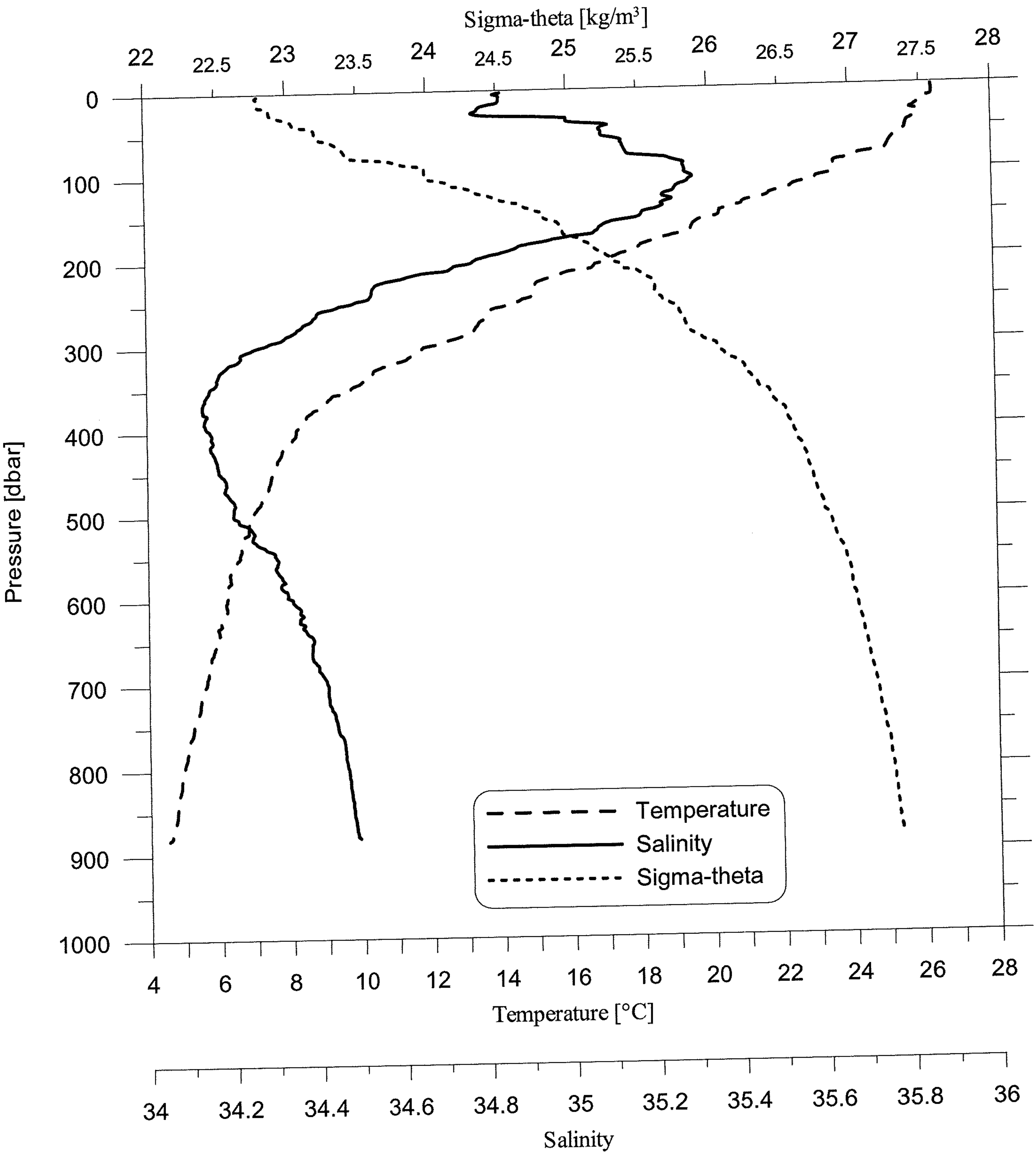
Sigma-theta [kg/m³]
22
22.5
23
23.5
24
24.5
25
25.5
26
26.5
27
27.5
28
Pressure [dbar]
0
100
200
300
400
500
600
700
800
900
1000
Temperature
Salinity
Sigma-theta
4
6
8
10
12
14
16
18
20
22
24
26
28
Temperature [°C]
34
34.2
34.4
34.6
34.8
35
35.2
35.4
35.6
35.8
36
Salinity

KOK 0520



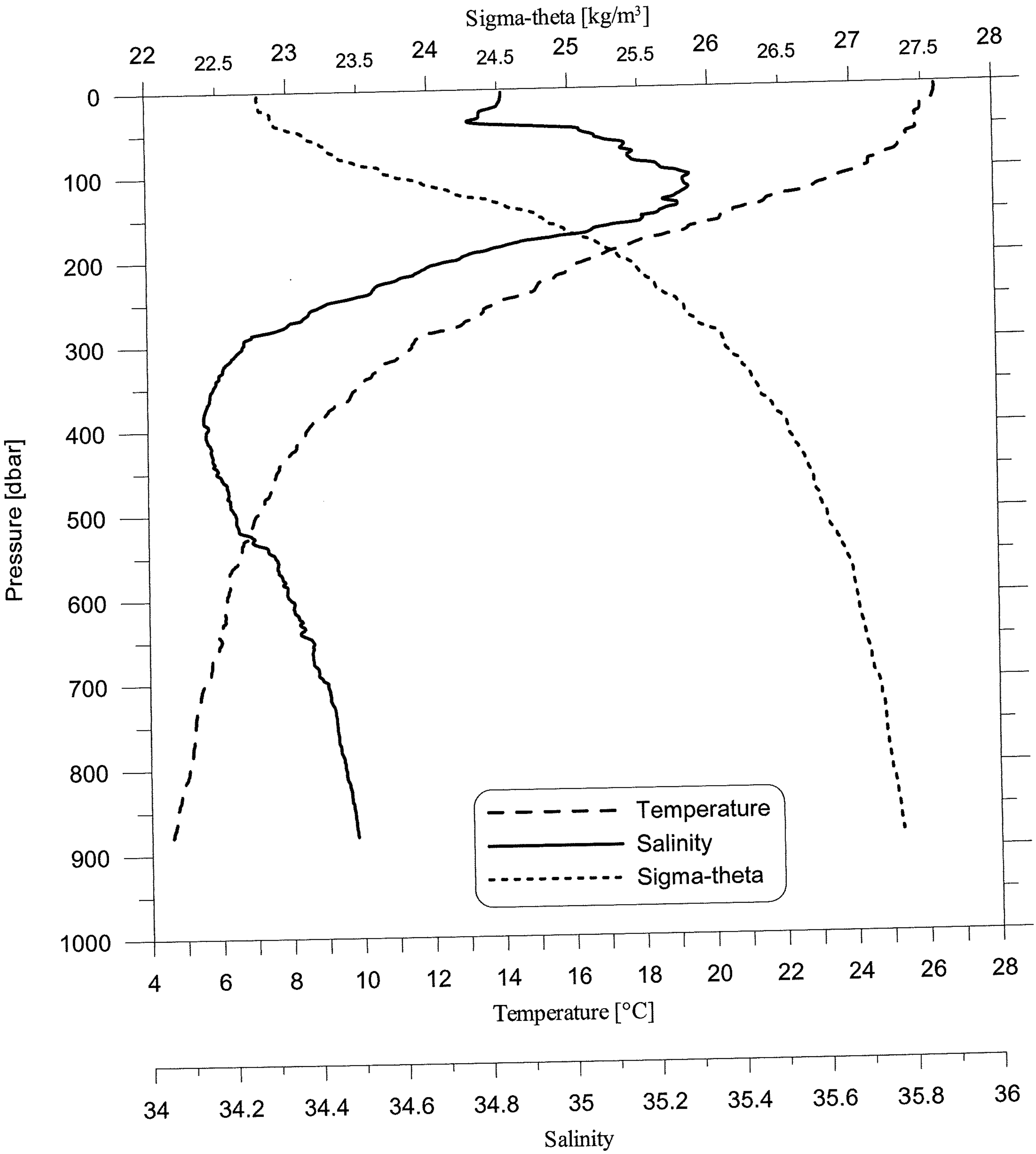
Sigma-theta [kg/m³]
22
22.5
23
23.5
24
24.5
25
25.5
26
26.5
27
27.5
28
0
100
200
300
400
500
600
700
800
900
1000
Pressure [dbar]
Temperature
Salinity
Sigma-theta
4
6
8
10
12
14
16
18
20
22
24
26
28
Temperature [°C]
34
34.2
34.4
34.6
34.8
35
35.2
35.4
35.6
35.8
36
Salinity

KOK 0521



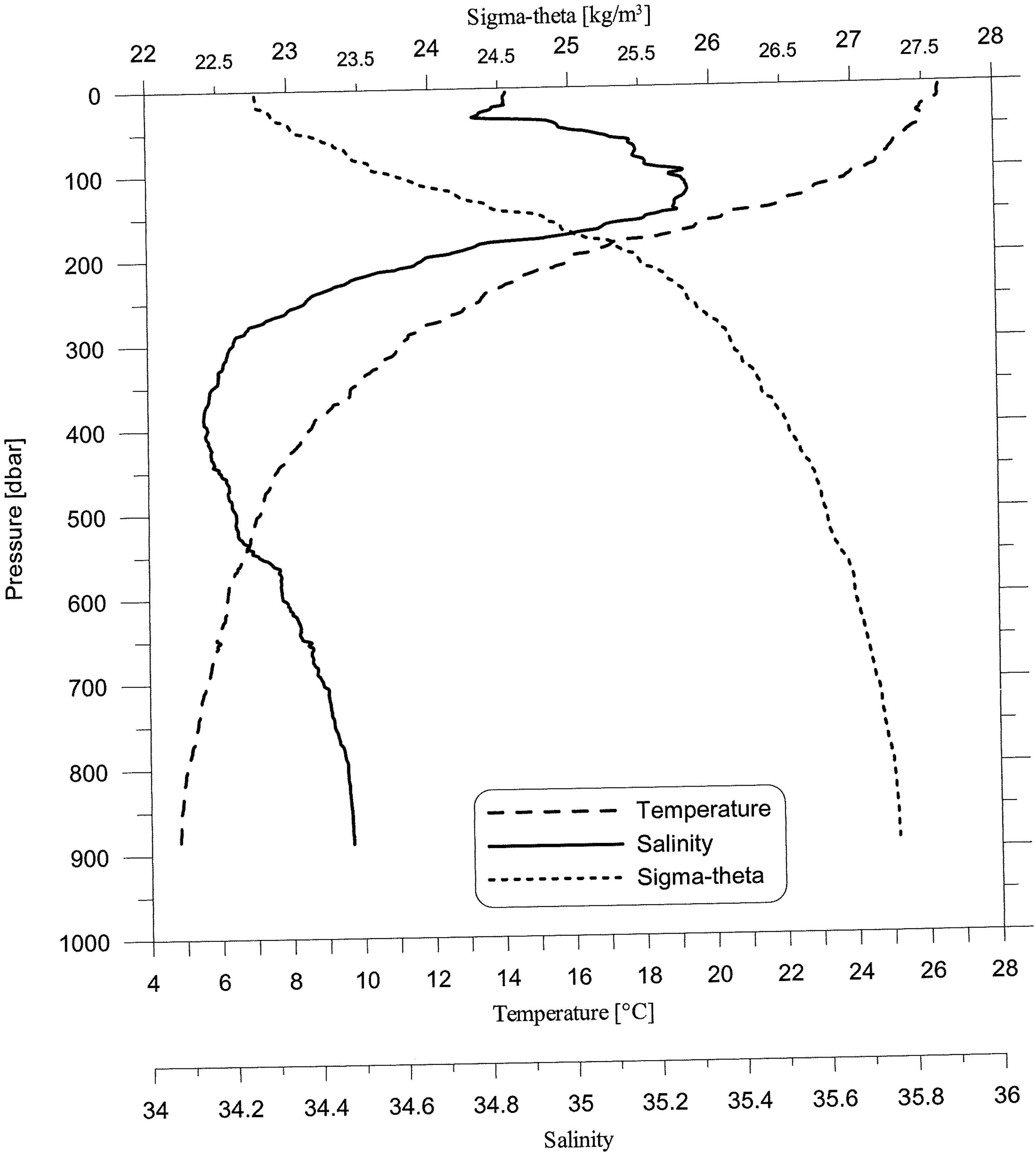
Sigma-theta [kg/m³]
22
22.5
23
23.5
24
24.5
25
25.5
26
26.5
27
27.5
28
Pressure [dbar]
0
100
200
300
400
500
600
700
800
900
1000
Temperature
Salinity
Sigma-theta
4
6
8
10
12
14
16
18
20
22
24
26
28
Temperature [°C]
34
34.2
34.4
34.6
34.8
35
35.2
35.4
35.6
35.8
36
Salinity

KOK 0522



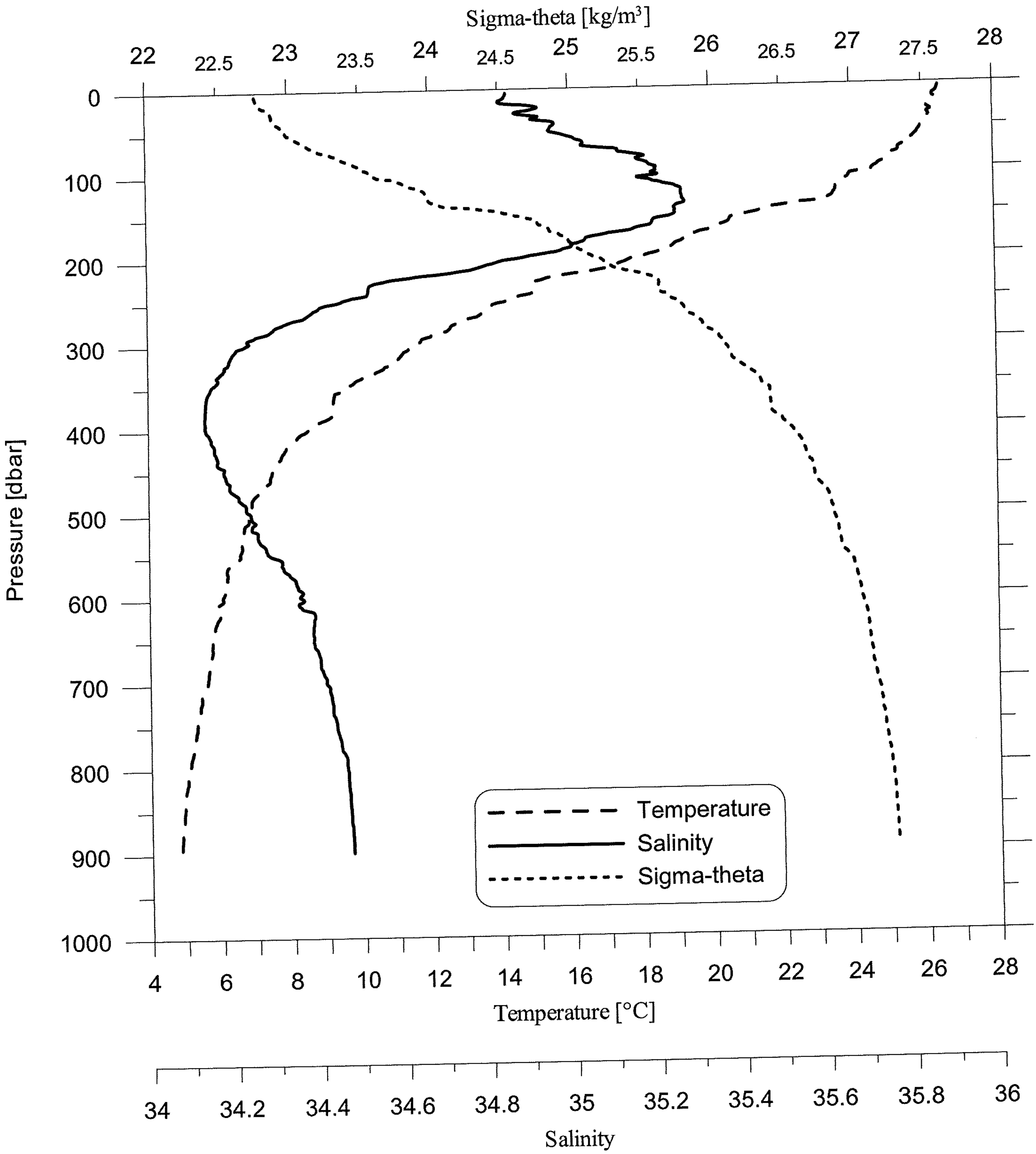
Sigma-theta [kg/m³]
22
22.5
23
23.5
24
24.5
25
25.5
26
26.5
27
27.5
28
Pressure [dbar]
0
100
200
300
400
500
600
700
800
900
1000
Temperature
Salinity
Sigma-theta
4
6
8
10
12
14
16
18
20
22
24
26
28
Temperature [°C]
34
34.2
34.4
34.6
34.8
35
35.2
35.4
35.6
35.8
36
Salinity

KOK 0523



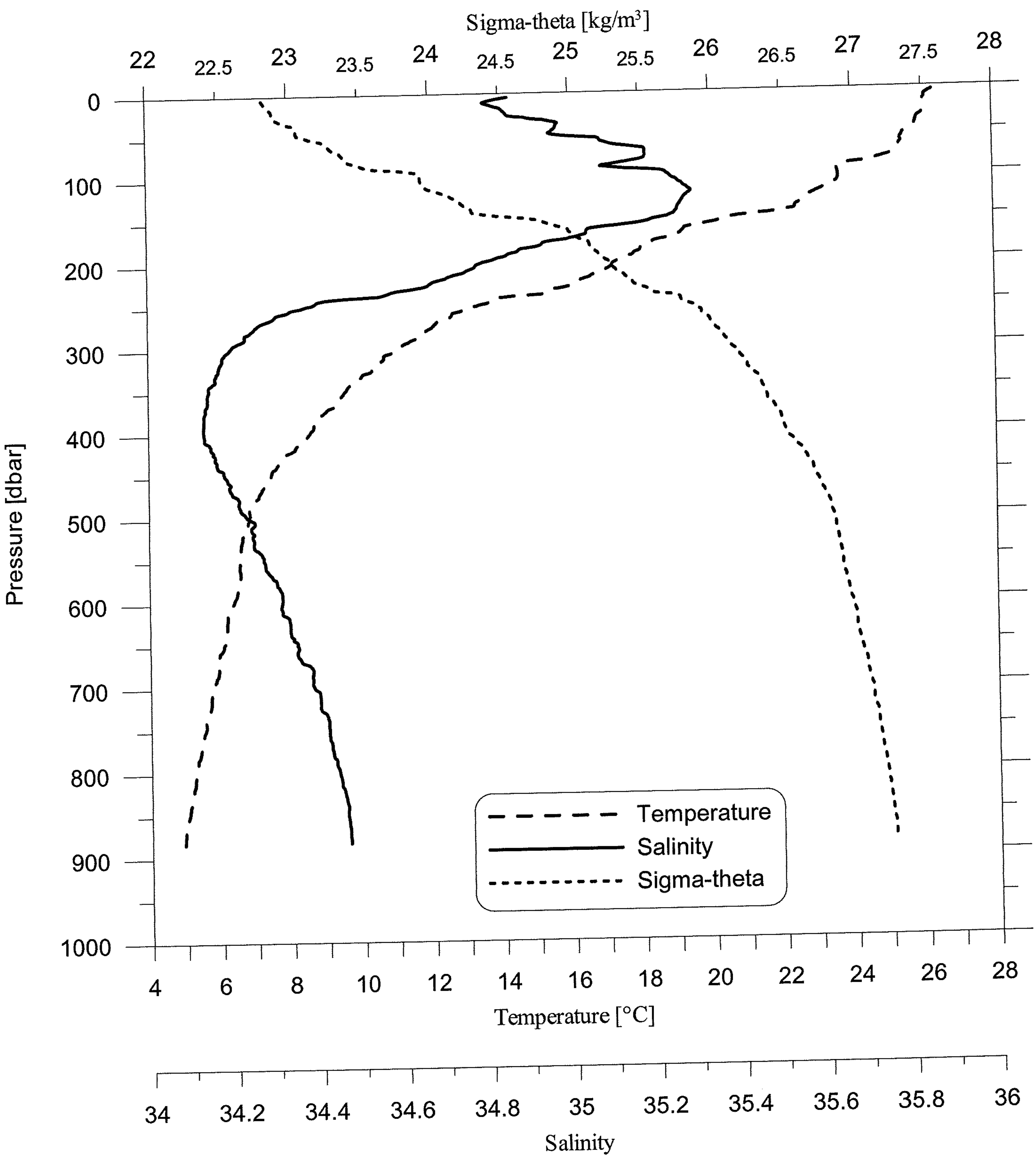
Sigma-theta [kg/m³]
22
22.5
23
23.5
24
24.5
25
25.5
26
26.5
27
27.5
28
0
100
200
300
400
500
600
700
800
900
1000
Pressure [dbar]
Temperature
Salinity
Sigma-theta
4
6
8
10
12
14
16
18
20
22
24
26
28
Temperature [°C]
34
34.2
34.4
34.6
34.8
35
35.2
35.4
35.6
35.8
36
Salinity

KOK 0524



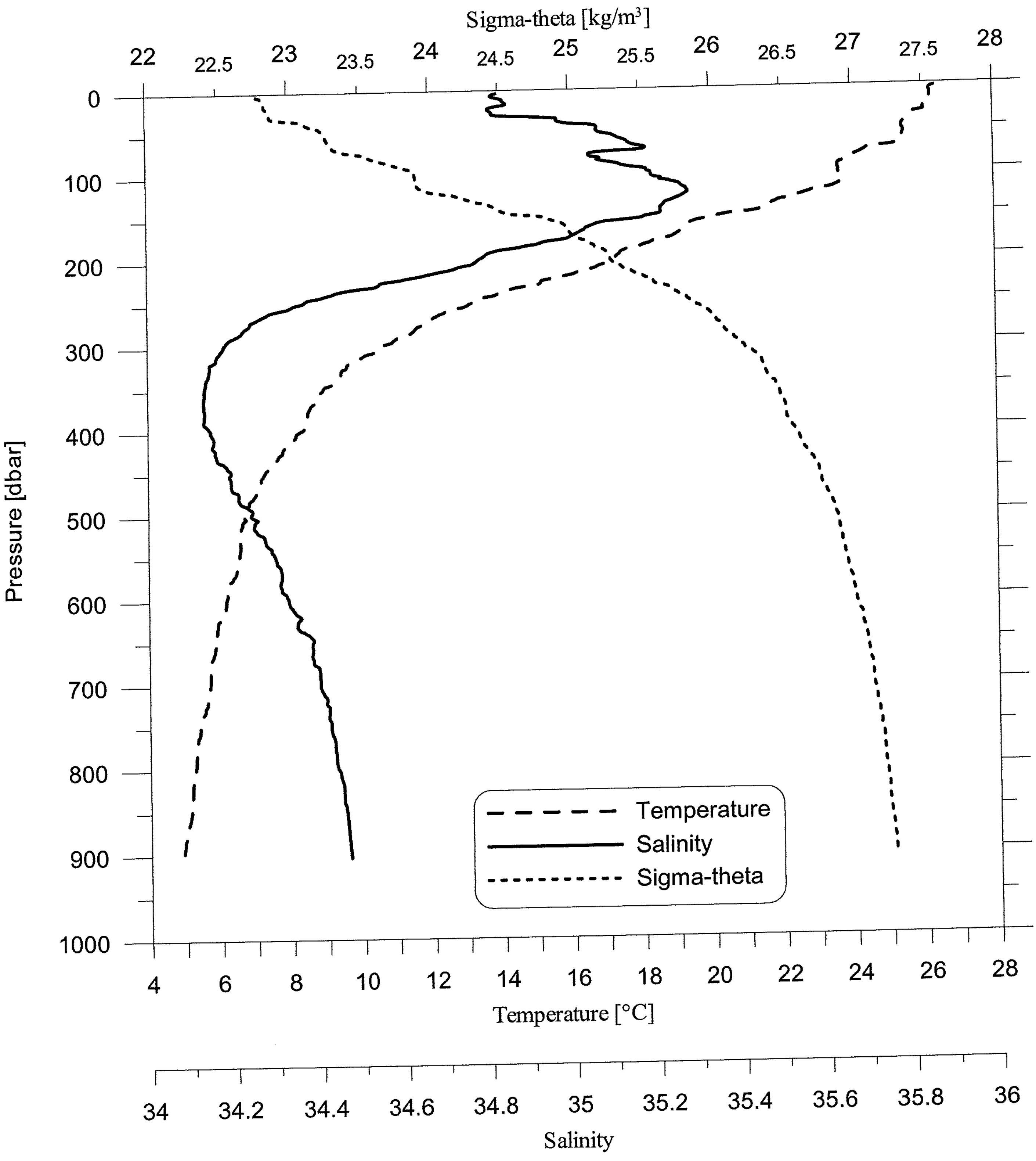
Sigma-theta [kg/m³]
22
22.5
23
23.5
24
24.5
25
25.5
26
26.5
27
27.5
28
Pressure [dbar]
0
100
200
300
400
500
600
700
800
900
1000
Temperature
Salinity
Sigma-theta
4
6
8
10
12
14
16
18
20
22
24
26
28
Temperature [°C]
34
34.2
34.4
34.6
34.8
35
35.2
35.4
35.6
35.8
36
Salinity

KOK 0525

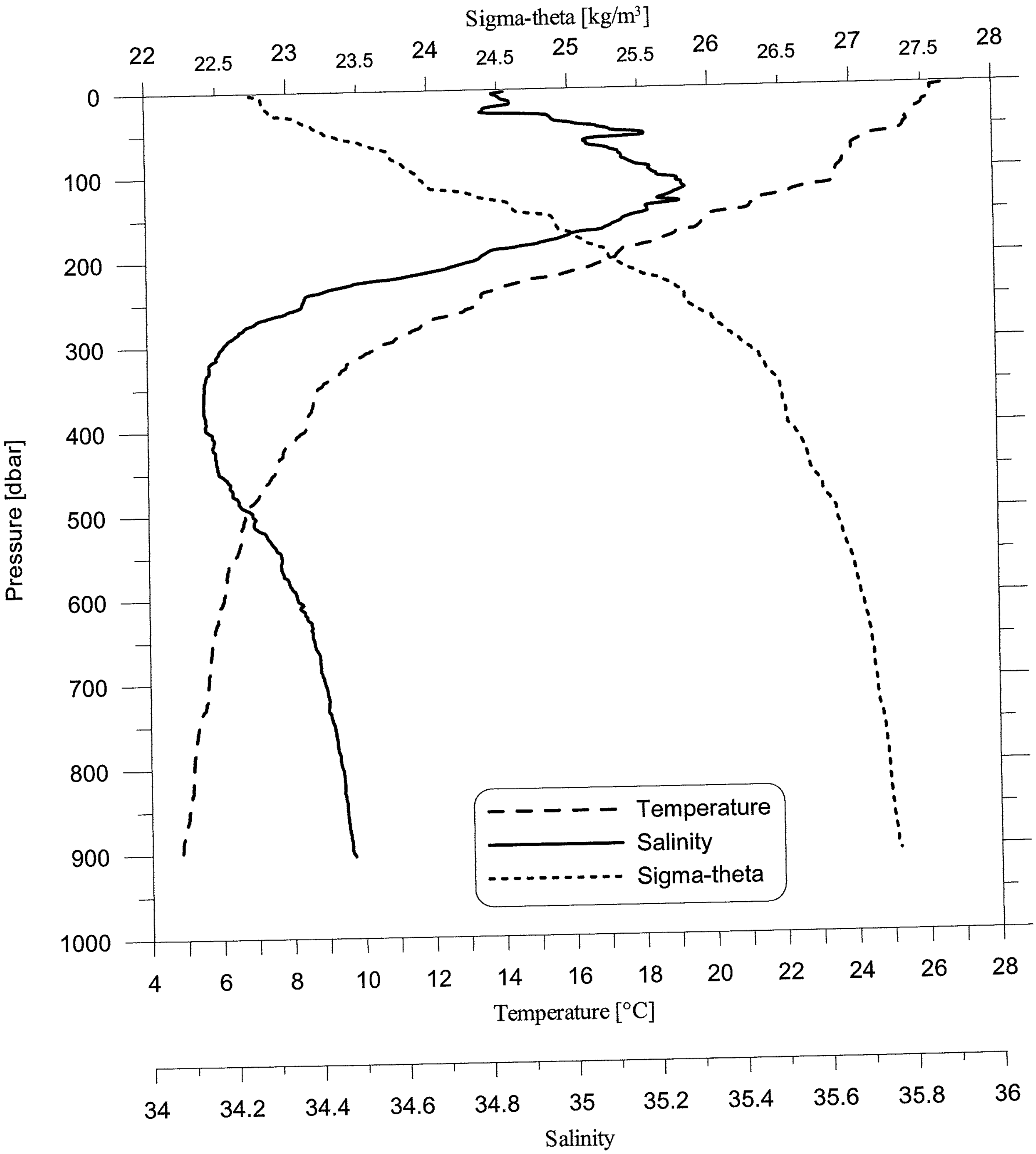


Sigma-theta [kg/m³]
22
22.5
23
23.5
24
24.5
25
25.5
26
26.5
27
27.5
28
Pressure [dbar]
0
100
200
300
400
500
600
700
800
900
1000
Temperature
Salinity
Sigma-theta
4
6
8
10
12
14
16
18
20
22
24
26
28
Temperature [°C]
34
34.2
34.4
34.6
34.8
35
35.2
35.4
35.6
35.8
36
Salinity

KOK 0526

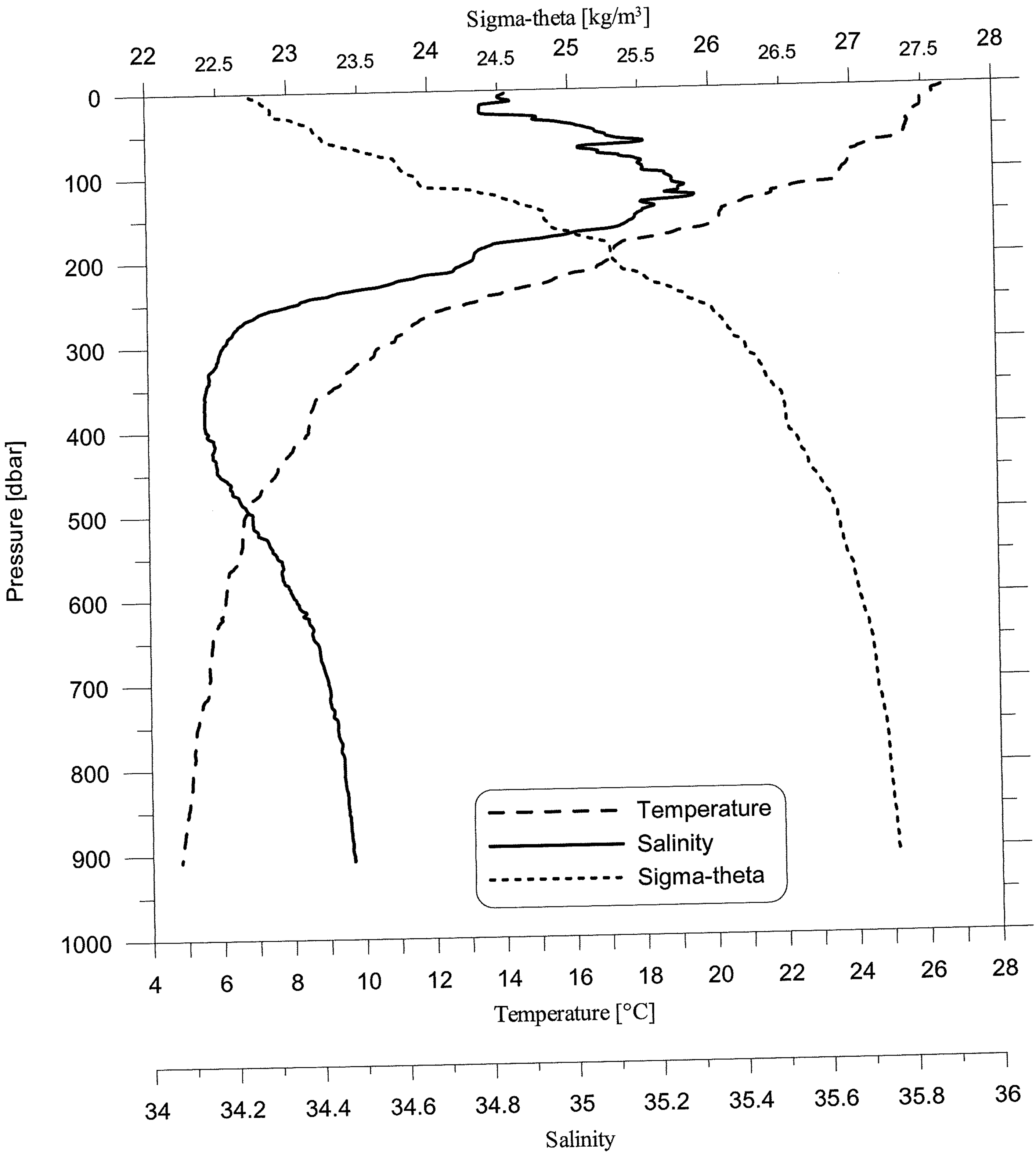

Sigma-theta [kg/m³]
22
22.5
23
23.5
24
24.5
25
25.5
26
26.5
27
27.5
28
Pressure [dbar]
0
100
200
300
400
500
600
700
800
900
1000
Temperature
Salinity
Sigma-theta
4
6
8
10
12
14
16
18
20
22
24
26
28
Temperature [°C]
34
34.2
34.4
34.6
34.8
35
35.2
35.4
35.6
35.8
36
Salinity

KOK 0527



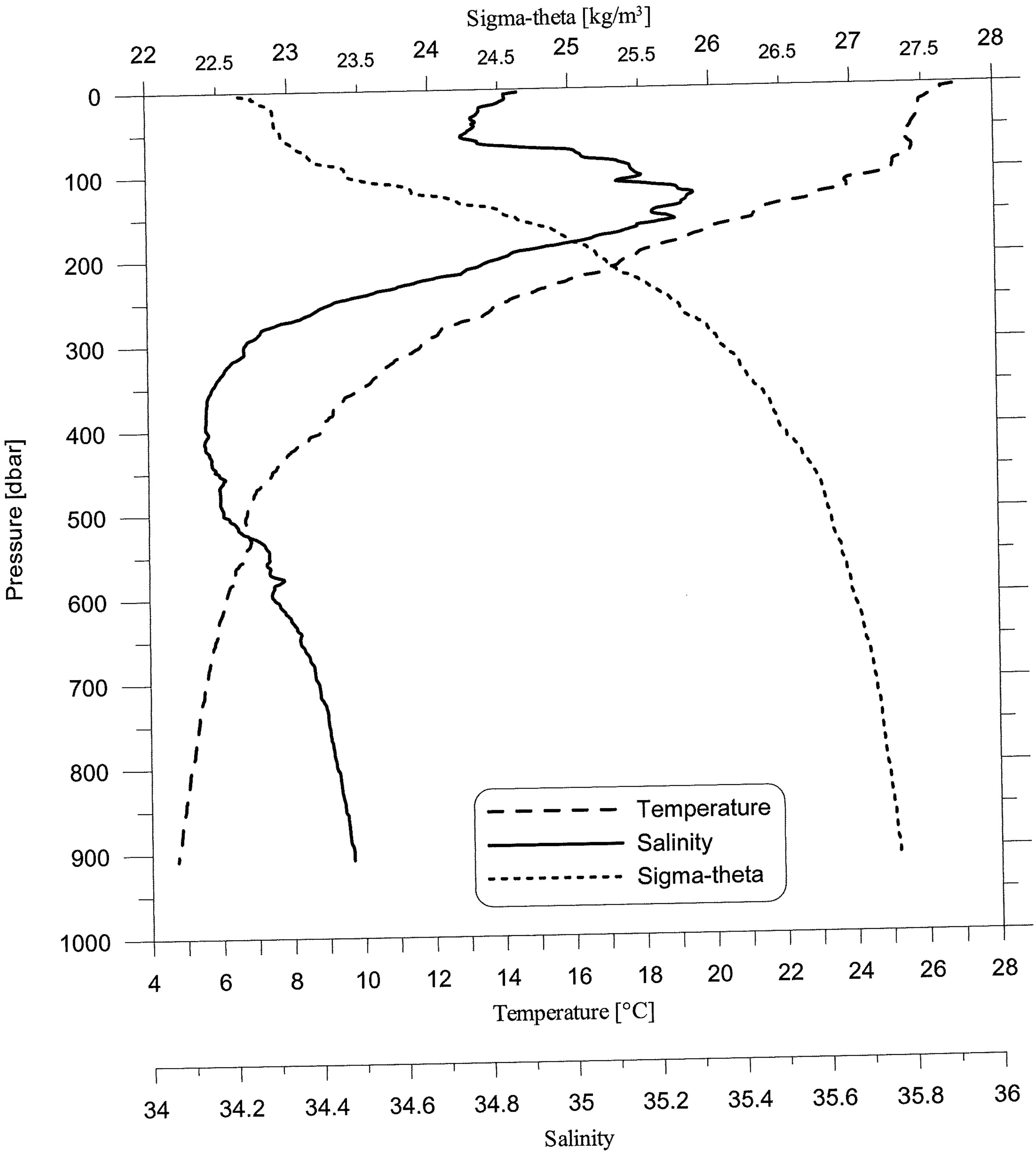
Sigma-theta [kg/m³]
22
22.5
23
23.5
24
24.5
25
25.5
26
26.5
27
27.5
28
Pressure [dbar]
0
100
200
300
400
500
600
700
800
900
1000
Temperature
Salinity
Sigma-theta
4
6
8
10
12
14
16
18
20
22
24
26
28
Temperature [°C]
34
34.2
34.4
34.6
34.8
35
35.2
35.4
35.6
35.8
36
Salinity

KOK 0528



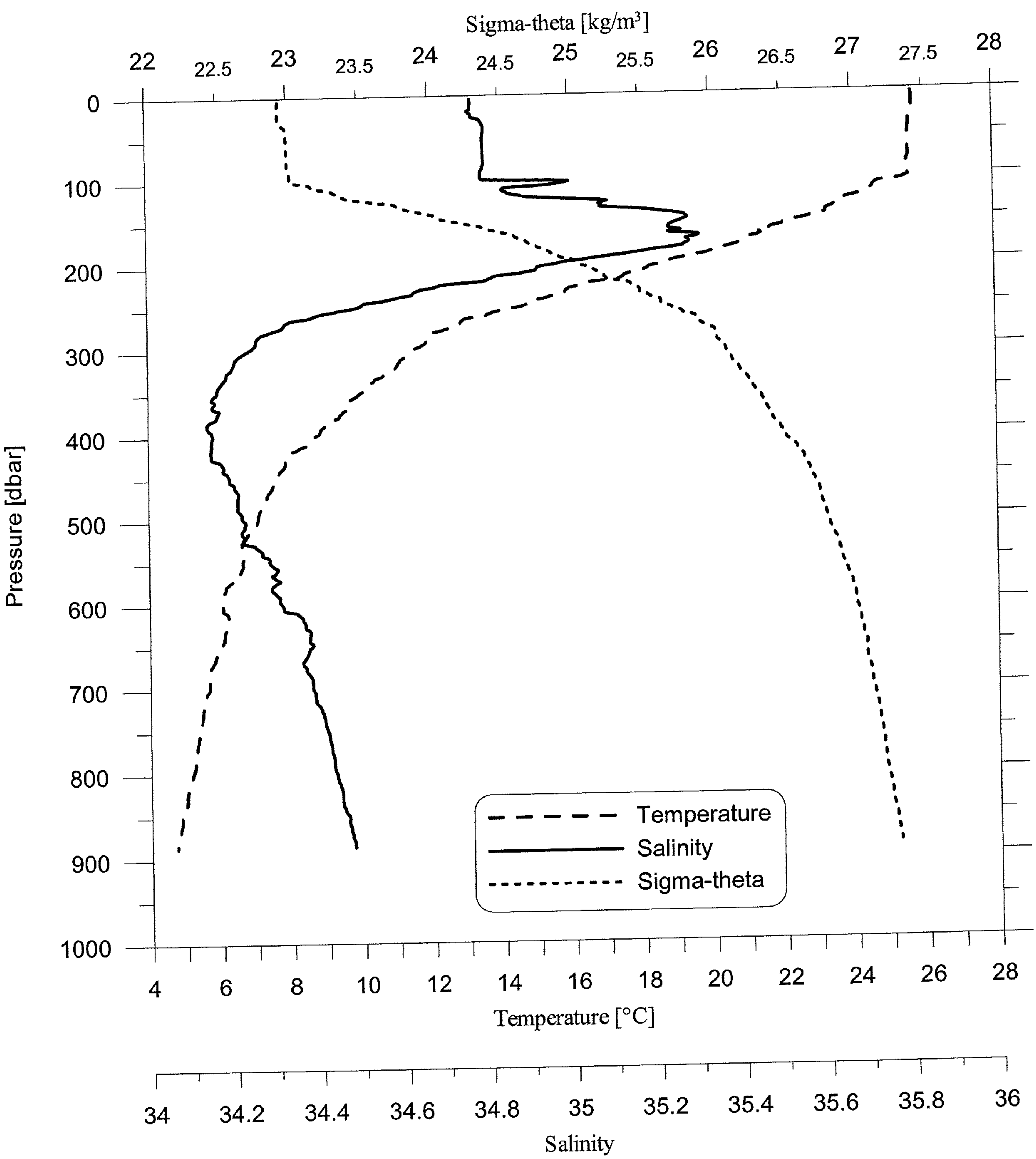
Sigma-theta [kg/m³]
22
22.5
23
23.5
24
24.5
25
25.5
26
26.5
27
27.5
28
Pressure [dbar]
0
100
200
300
400
500
600
700
800
900
1000
Temperature
Salinity
Sigma-theta
4
6
8
10
12
14
16
18
20
22
24
26
28
Temperature [°C]
34
34.2
34.4
34.6
34.8
35
35.2
35.4
35.6
35.8
36
Salinity

KOK 0529



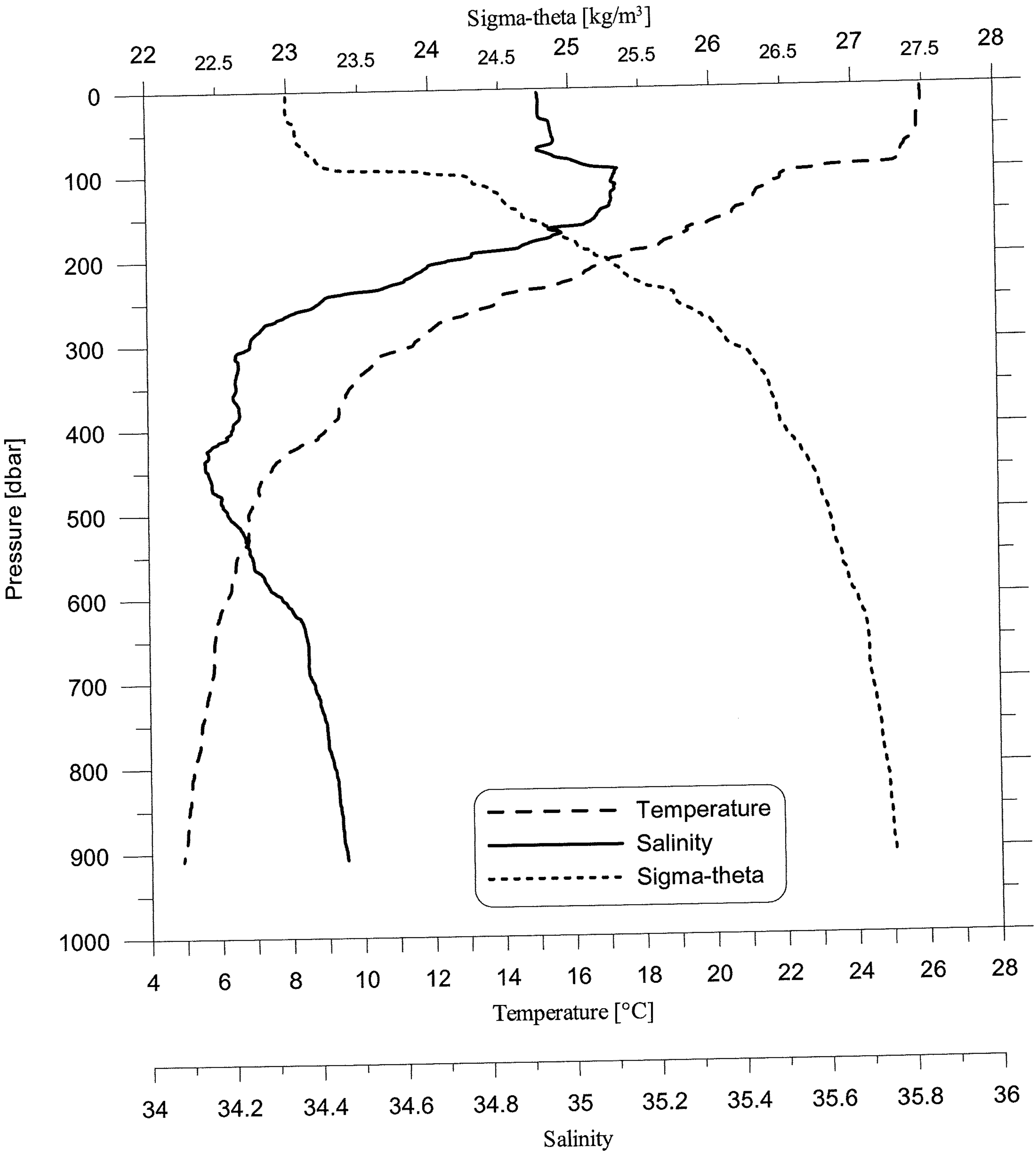
Sigma-theta [kg/m³]
22
22.5
23
23.5
24
24.5
25
25.5
26
26.5
27
27.5
28
Pressure [dbar]
0
100
200
300
400
500
600
700
800
900
1000
Temperature
Salinity
Sigma-theta
4
6
8
10
12
14
16
18
20
22
24
26
28
Temperature [°C]
34
34.2
34.4
34.6
34.8
35
35.2
35.4
35.6
35.8
36
Salinity

KOK 0530



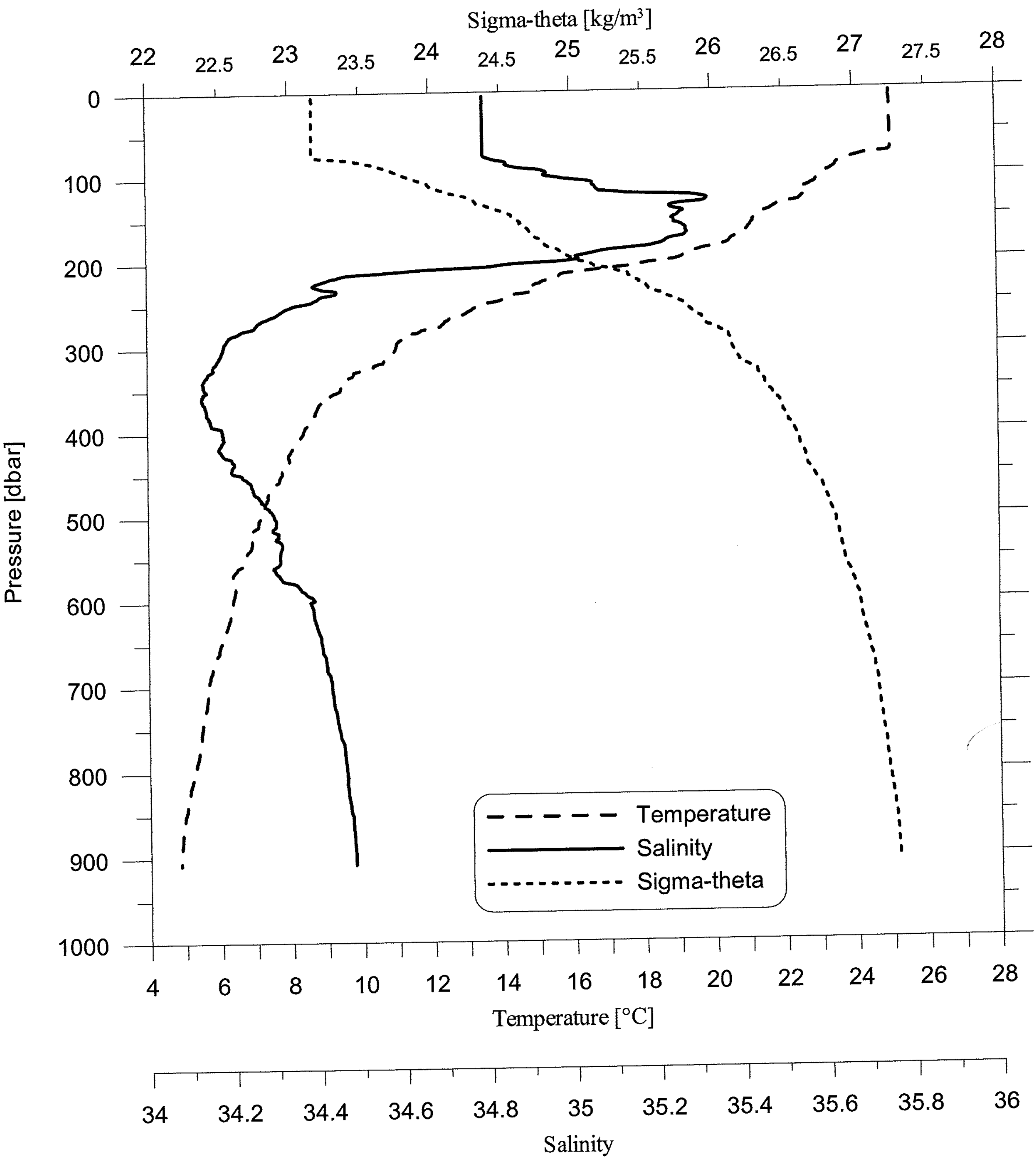
Sigma-theta [kg/m³]
22
22.5
23
23.5
24
24.5
25
25.5
26
26.5
27
27.5
28
Pressure [dbar]
0
100
200
300
400
500
600
700
800
900
1000
Temperature
Salinity
Sigma-theta
4
6
8
10
12
14
16
18
20
22
24
26
28
Temperature [°C]
34
34.2
34.4
34.6
34.8
35
35.2
35.4
35.6
35.8
36
Salinity

KOK 0531



Sigma-theta [kg/m³]
22
22.5
23
23.5
24
24.5
25
25.5
26
26.5
27
27.5
28
Pressure [dbar]
0
100
200
300
400
500
600
700
800
900
1000
Temperature
Salinity
Sigma-theta
4
6
8
10
12
14
16
18
20
22
24
26
28
Temperature [°C]
34
34.2
34.4
34.6
34.8
35
35.2
35.4
35.6
35.8
36
Salinity

KOK 0532



Sigma-theta [kg/m³]
22
22.5
23
23.5
24
24.5
25
25.5
26
26.5
27
27.5
28
Pressure [dbar]
0
100
200
300
400
500
600
700
800
900
1000
Temperature
Salinity
Sigma-theta
4
6
8
10
12
14
16
18
20
22
24
26
28
Temperature [°C]
34
34.2
34.4
34.6
34.8
35
35.2
35.4
35.6
35.8
36
Salinity