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Comparison of Observed Data and GDEM/Standard Ocean Data

Part I: Vertical Temperature, Salinity and Sound Speed Profiles at Six Selected Site Locations in the Mediterranean Sea

Final Technical Report Contract N00014-79-C-310

May 1982

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Naval Ocean Research and Development Activity

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COMPARISON OF OBSERVED DATA AND GDEM/STANDARD OCEAN DATA

Part I: Vertical Temperature, Salinity and Sound Speed Profiles at Six Selected Site Locations in the Mediterranean Sea

December 1981

Sponsored By:
Naval Ocean Research and Development Activity
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ABSTRACT

This report compares the results of the Generalized Digital Environmental Model (GDEM), developed by Dr. T. Davis of the Naval Oceanographic Office, with observed data from 169 vertical profiles of seasonally averaged temperature, salinity, and sound speed at six locations. The six sites, all located in the Mediterranean Sea, are the Alboran Sea, the Balearic Sea, the Tyrrhenian Sea, the Strait of Sicily, the Ionian Sea, and the Levantine Sea.

Evaluations of GDEM-derived temperature, salinity, and sound speed profiles were performed, considering location, season, and individual parameters.

CONTENTS

CONTENTS (continued)

CONTENTS (continued)

FIGURES

FIGURES (continued)

FIGURES (continued)

FIGURES (continued)

FIGURES (continued)

TABLES

PREFACE

This technical report has been written in support of the Generalized Digital Environmental Model (GDEM)/Standard Ocean Evaluation Project sponsored by the Surveillance Environmental Acoustic Support (SEAS) Program at the Naval Ocean Research and Development Activity (NORDA). It evaluates GDEM MOD Ø3 for the Mediterranean Sea. Comparisons and evaluations have been conducted for three physical parameters for four seasons at six different selected site locations in the Mediterranean Sea. Part I of the comparison consists of the evaluations performed on vertical profiles.

Later in FY-82, evaluations of contoured horizontal cross-sections along selected tracks will be contained in a separate technical report titled: "Comparison of Observed Survey/Analyzed Data and GDEM/Standard Ocean Data, Part II: Monthly Sea Surface Temperature (SST) Plots and Temperature/Salinity Vertical Cross-Sections Along Great Circle Tracks in the Mediterranean Sea."

The basic data set used in this analysis is a subset of the NODC Nansen cast data base acquired by NODC through NAVOCEANO containing approximately 549,000 stations worldwide. The final six locations used in this evaluation were selected from the major ocean regions of the Mediterranean. The attempt was made in each instance to choose a location that would be geographically representative of the region and would also provide an adequate observed data sample for comparison in the immediate vicinity. The objectives were necessarily compromised in some instances, as adequate observed data were not available near each location for all seasons.

The seasonal data subsets of sound-speed profiles (computed using Wilson's (1960) equation as were the GDEM sound speeds) were processed to provide a representative or "typical" sound speed profile for each location and season. The techniques and procedures used for selection of the typical profiles are described by Colborn and Pugh (1973). The observed temperature and salinity for the typical profile were used in the comparisons for these parameters. Plots of the typical profile and the observed minimum and maximum envelopes of values at standard depths are used to provide visual comparisons for GDEM evaluation.

It should be emphasized that the quality of the typical profile as a measure of the adequacy of GDEM depends not only on the amount of data available but also on the variability in the area. If the sample is small, biases can result in the typical selection. In these instances, an evaluation of the model and typical differences is restricted to general features and trends, and may be supplemented with comments regarding expected oceanographic conditions for the particular region.

The GDEM vertical profiles for comparison have been provided by Mr. Kenneth Countryman (NOO) and Dr. Michael Carron (NOO). The "typical" vertical profiles for comparison have been provided by Mr. J. Colborn (Naval Ocean Systems Center).

In memory of the fine work and friendship of

Scott C. Daubin, Jr.

July 1946 - August 1981

1.0 SUMMARY

This report evaluates the Generalized Digital Environmental Model (GDEM), developed by Dr. T. Davis of the Naval Oceanographic Office (NOO), and compares its results with observed data. Sixty-nine vertical profiles of seasonally representative temperature, salinity, and sound speed at six different select locations were compared. The six Mediterranean Sea comparison sites (Figure 1-1) were located in the Alboran Sea, the Balearic Sea, the Tyrrhenian Sea, the Strait of Sicily, the Ionian Sea, and the Levantine Sea.

The comparisons and evaluations were performed on the three major physical parameters: temperature, salinity, and sound speed. The temporal resolution was seasonal (four three-month seasons) and identified as winter, (January, February, March), spring (April, May, June), summer (July, August, September), and fall (October, November, December). The evaluation of each parameter was conducted in the above-listed order. Brief descriptions are provided below.

- Temperature Evaluations:

  Temperature appeared to be the primary factor in influencing the sound of speed. At most locations, temperature differences between the typical and GDEM Mod Ø3 profiles are small and within observational limits. In general, GDEM Mod Ø3 temperatures are about 0.1°C greater than the typical values.

  Occasionally, GDEM profiles made small excursions beyond the observation envelopes. However, because of a lack of observations or because most of those observations were obtained during one or two years, the excursions are often difficult to evaluate.

  The largest temperature differences are generally noted in the upper 200 m of the profiles during the spring and autumn seasons ($\Delta T \leq 2.5^{\circ}C$). Below the thermocline, GDEM temperatures were well inside the observational envelope and approached $\pm 0.2^{\circ}C$ of typical profile values. Deep GDEM temperatures agree closely with the typical values.

- Salinity Evaluations:

  Overall, Mod Ø3 salinities are about 0.01 ppt greater than the typical salinities.

Most GDEM Mod Ø3 salinities lie within or close to the observational envelopes. In the upper 300 m, where most changes in the salinity are observed, the model profiles duplicate the mean gradients of the typical profiles. The model frequently has difficulty duplicating the sharp features of the low salinity surface layers seen in the typical data. Rather than duplicating this layer exactly, GDEM indicates a shallower layer with similar salinities or a halocline with no layer at all.

Below 500 m, one frequently observes that the GDEM salinity profiles are about 0.05 ppt less than the minimum observed salinity. Then, below 2500 m, a slight increase is noted in all data.

- Sound-Speed Evaluations:

  At most locations and seasons, GDEM Mod Ø3 sound speeds correctly duplicate most of the significant acoustic features seen in the typical profiles.

  In instances where there are adequate observations to compare with, and when those observations are uniformly distributed in time, GDEM was found to lie within or close to the min/max envelopes of those observations. GDEM correctly indicates seasonal trends in the sound-speed profiles.

  In most cases, GDEM profiles show surface layers and sound-channel axes near their correct depths and sound speeds. Half-channel characteristics are correctly indicated in the GDEM profiles during the winter season.

  Overall, GDEM Mod Ø3 sound speeds are found to be slightly greater than the corresponding typical values.

In addition to seasonal comparisons and evaluations performed on vertical temperature, salinity, and sound-speed profiles, general quality assurances and checks of GDEM were conducted using T/S (Temperature/Salinity) Diagrams.

- T/S Diagrams:

  GDEM T/S diagrams typically duplicate the gradients seen in the observational data. In most cases, GDEM correctly duplicates the T/S characteristics of the surface water, Levantine Intermediate Water ($T \geq 13^{\circ}C$, $S \geq 38.3$ ppt), and the transition water beneath. However, the model incorrectly represents the Mediterranean Bottom Water, showing a slight salinity increase below 2500 m (≤ 0.05 ppt) rather than the observed slight decrease.

The difference results in a spurious hook in the T/S diagrams. This increase and the generally lower salinities above might be due to a salinity adjustment applied to ensure stability of the model's water column. Apparently this correction is applied so that values of σ_{STO}, the potential density at the surface, monotonically increase with depth. Considering the adiabatic temperature increase with depth below 2500 m, the more realistic approach to the stability adjustment might be to adjust salinity (if necessary) so that the in situ density, σ_{STD}, increases or remains constant with depth. Alternatively, the potential temperature θ might be used in the density calculation rather than the higher in situ temperature, T. Either solution might reduce the slight salinity differences. These salinity differences as well as those noted above are not expected to significantly alter the GDEM sound-speed values; sound-speed differences due to those anomalies should all be less than 0.2 m/sec.

In summary, GDEM adequately reproduces most mesoscale sound-speed, temperature, and salinity features at the locations analyzed. However, occasional differences in detail do exist.

Seasonal changes (changes which occur from one season to the next) in the upper 500 m of the model data are similar, in general, to the observed values. GDEM T/S relationships are similar to the observational data above 2500 m; below this depth, there is an anomalous (but slight) 0.05 ppt salinity increase. Apparently, this salinity anomaly results from an adjustment of the GDEM salinities so that σ_{STO} remains constant or increases with depth. A more realistic deep salinity field might result if the in situ density, σ_{STD}, or the potential temperature θ in the σ_{STO} calculation were used.

GDEM Mod Ø3 matches the typicals most closely in winter and summer. In the region of the Strait of Sicily, we observed large variability in sound speed, temperature and salinity. The largest sound-speed differences occasionally occur during the transition seasons of spring and autumn. Those large differences are found predominantly in the upper 200 m of the profiles and are directly related to large temperature or salinity (in some cases) differences at these depths. It is not always possible to determine their significance because there are few real observations with which to compare and/or most observations were taken during one or two years. For example, at location Med 4 - autumn, we compared GDEM with only six observations, all taken in 1949.

During seasons when there is a sound-channel axis present, GDEM Mod Ø3 values of the axis depth are usually within ≃50 m of the typical values. However, at locations Med 5 - summer and autumn, and Med 6 - spring, larger axis-depth differences are noted. At Med 5 - autumn, the typical axis depth is 75 m while GDEM Mod Ø3 indicates a broad minima near 300 m. It should be noted, though, that there is only one observation for Med 5 - autumn. At Med 6 - spring, there are 15 observations indicating an axis between 85 m and 420 m with a typical depth of 300 m. GDEM Mod Ø3 shows this minimum between 400 and 500 m near the maximum observed axis depth.

In an effort to summarize the seasonal temperature, salinity, and sound-speed evaluations for each selected site location, brief evaluations and comments are presented in Tables 1-1 through 1-4 by location, parameter, and season.

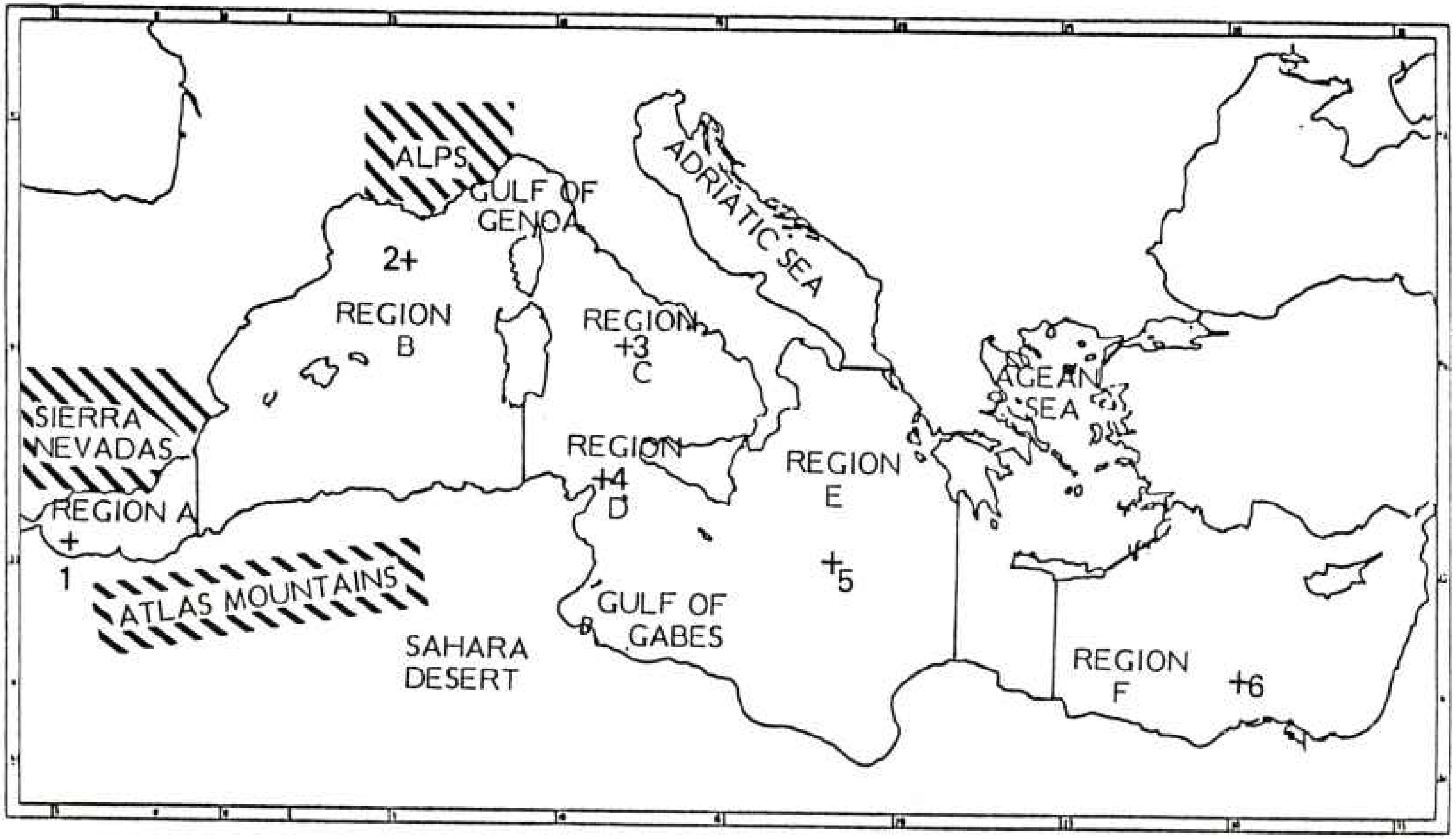

FIG. 1-1. GEOGRAPHIC LOCATIONS OF VERTICAL COMPARISON SITES AND PHYSICAL FEATURES FOR MEDITERRANEAN SEA

TABLE 1-1: SUMMARY OF GDEM/STANDARD OCEAN
WINTER SITE EVALUATION

SITE	WINTER			COMMENTS
	Temperature	Salinity	Sound Speed	
Med Location #1 (Alboran Sea)	Reasonable** and Seasonally Averaged	Acceptable** and Seasonally Averaged	Reasonable and Seasonally Averaged	•Possibly increase* salinity (0.10 - 0.15 ppt)
Med Location #2 (Balearic Sea)	Reasonable and Seasonally Averaged	Acceptable and Seasonally Averaged	Reasonable and Seasonally Averaged	•Possibly increase* salinity (0.08 - 0.12 ppt)
Med Location #3 (Tyrrhenian Sea)	Reasonable and Seasonally Averaged	Reasonable and Seasonally Averaged	Reasonable and Seasonally Averaged	
Med Location #4 (Strait of Sicily)	Reasonable and Seasonally Averaged	Acceptable and Seasonally Averaged	Reasonable and Seasonally Averaged	•Possibly increase* salinity (0.08 - 0.15 ppt)
Med Location #5 (Ionian Sea)	Reasonable and Seasonally Averaged	Acceptable and Seasonally Averaged	Reasonable and Seasonally Averaged	•Possibly increase* salinity (0.11 ppt)
Med Location #6 (Levantine Sea)	Reasonable and Seasonally Averaged	Reasonable and Seasonally Averaged	Reasonable and Seasonally Averaged	

*The differences noted have been brought to the attention of Dr. T. Davis (NOO). Undergoing constructive improvements and modifications, GDEM Mod Ø4 (currently under development) will contain several revisions that will address those differences and improve the temporal resolution of GDEM Mod Ø3. At this time, a documentation of the revisions along with their results is anticipated to follow.

**"Reasonable" is better quality than "Acceptable."

TABLE 1-2: SUMMARY OF GDEM/STANDARD OCEAN SPRING SITE EVALUATION

SITE	SPRING			COMMENTS
	Temperature	Salinity	Sound Speed	
Med Location #1 (Alboran Sea)	Reasonable** and Seasonally Averaged	Acceptable** and Seasonally Averaged	Reasonable and Seasonally Averaged	•Possibly increase* salinity (0.25 - 0.30 ppt)
Med Location #2 (Balearic Sea)	Reasonable and Seasonally Averaged	Acceptable and Seasonally Averaged	Reasonable and Seasonally Averaged	•Possibly increase* salinity (0.11 ppt)
Med Location #3 (Tyrrhenian Sea)	Reasonable and Seasonally Averaged	Acceptable and Seasonally Averaged	Reasonable and Seasonally Averaged	•Possibly increase* salinity (0.08 - 0.13 ppt)
Med Location #4 (Strait of Sicily)	Reconsider	Acceptable and Seasonally Averaged	Modify	•GDEM temperature* too high (75-200 m) •Possibly increase* salinity (0.14 ppt) •GDEM sound speed* consistently high
Med Location #5 (Ionian Sea)	Reasonable and Seasonally Averaged	Acceptable and Seasonally Averaged	Reasonable and Seasonally Averaged	•Possibly increase* salinity (0.11 ppt)
Med Location #6 (Levantine Sea)	Reasonable and Seasonally Averaged	Reasonable and Seasonally Averaged	Reasonable and Seasonally Averaged	

*The differences noted have been brought to the attention of Dr. T. Davis (NOO). Undergoing constructive improvements and modifications, GDEM Mod Ø4 (currently under development) will contain several revisions that will address those differences and improve the temporal resolution of GDEM Mod Ø3. At this time, a documentation of the revisions along with their results is anticipated to follow.

**"Reasonable" is better quality than "Acceptable."

TABLE 1-3: SUMMARY OF GDEM/STANDARD OCEAN SUMMER SITE EVALUATION

SITE	SUMMER			COMMENTS
	Temperature	Salinity	Sound Speed	
Med Location #1 (Alboran Sea)	Reasonable** and Seasonally Averaged	Reasonable and Seasonally Averaged	Acceptable** and Seasonally Averaged	•Over suppression* on sound speed profile at 200 m.
Med Location #2 (Balearic Sea)	Reasonable and Seasonally Averaged	Acceptable and Seasonally Averaged	Reasonable and Seasonally Averaged	•Possibly increase* salinity (0.08 - 0.12 ppt)
Med Location #3 (Tyrrhenian Sea)	Reasonable and Seasonally Averaged	Acceptable and Seasonally Averaged	Reasonable and Seasonally Averaged	•Possibly increase* salinity (0.08 - 0.10 ppt)
Med Location #4 (Strait of Sicily)	Reasonable and Seasonally Averaged	Acceptable and Seasonally Averaged	Reasonable and Seasonally Averaged	•Possibly increase* salinity (0.06 ppt)
Med Location #5 (Ionian Sea)	Reasonable and Seasonally Averaged	Acceptable and Seasonally Averaged	Reasonable and Seasonally Averaged	•Possibly increase* salinity (0.07 ppt)
Med Location #6 (Levantine Sea)	Reasonable and Seasonally Averaged	Reasonable and Seasonally Averaged	Reasonable and Seasonally Averaged	•Salinity gradient* reversals remarkably reproduced.

*The differences noted have been brought to the attention of Dr. T. Davis (NOO). Undergoing constructive improvements and modifications, GDEM Mod Ø4 (currently under development) will contain several revisions that will address those differences and improve the temporal resolution of GDEM Mod Ø3. At this time, a documentation of the revisions along with their results is anticipated to follow.

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TABLE 1-4: SUMMARY OF GDEM/STANDARD OCEAN FALL SITE EVALUATION

SITE	FALL			COMMENTS
	Temperature	Salinity	Sound Speed	
Med Location #1 (Alboran Sea)	No evaluation	No evaluation	No evaluation	
Med Location #2 (Balearic Sea)	Reasonable** and Seasonally Averaged	Acceptable** and Seasonally Averaged	Reasonable and Seasonally Averaged	•Possibly increase* salinity (0.12 ppt)
Med Location #3 (Tyrrhenian Sea)	Reasonable and Seasonally Averaged	Acceptable and Seasonally Averaged	Reasonable and Seasonally Averaged	•Possibly increase* salinity (0.05 - 0.13 ppt)
Med Location #4 (Strait of Sicily)	Reasonable and Seasonally Averaged	Acceptable and Seasonally Averaged	Reasonable and Seasonally Averaged	•Consider a* surface salinity minimum layer
Med Location #5 (Ionian Sea)	Reasonable and Seasonally Averaged	Reconsider	Modify	•Possibly increase* salinity (0.15 ppt) •Difference in* salinity maximums •Secondary sound* channel axis not seasonally persistent feature
Med Location #6 (Levantine Sea)	Reasonable and Seasonally Averaged	Reasonable and Seasonally Averaged	Reasonable and Seasonally Averaged	

*The differences noted have been brought to the attention of Dr. T. Davis (NOO). Undergoing constructive improvements and modifications, GDEM Mod Ø4 (currently under development) will contain several revisions that will address those differences and improve the temporal resolution of GDEM Mod Ø3. At this time, a documentation of the revisions along with their results is anticipated to follow.

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2.0 VERTICAL TEMPERATURE, SALINITY, AND SOUND-SPEED PROFILE COMPARISONS FOR MEDITERRANEAN (MED) LOCATION #1

Nine Vertical comparisons of temperature (T), salinity (S), and sound-speed (SS) for the winter, spring, and summer seasons* are presented in this section. Comparisons for the fall season* are not presented because of insufficient data for the selection of typical profiles.

2.1 Description

Med Location #1 is taken from the Alboran Sea region of the Mediterranean Sea. The geographical location selected for this comparison is at 35°30' north latitude and 004°30' west longitude. Vertical temperature, salinity, and sound-speed profiles of seasonal comparisons for three seasons are shown in Figures 2-1 through 2-9.

The Alboran Sea region of the western Mediterranean Sea, depicted as Region A on Figure 1-1, is defined for this report as the body of water that is bounded to the north by the southern coastline of Spain; to the south by the northern coastline of Morocco and Algeria; to the west by the Strait of Gibraltar, and to the east by 1° west longitude.

Meteorologically, this region is considered highly variable and seasonally influenced to a great degree by the movement of the semi-permanent Azores anticyclone. In most cases, the local to semilocal surface wind conditions are not produced by the distinct wind patterns associated with either the Sierra Nevada of Spain or the Atlas Mountains of Morocco and Algeria. Channeling and corner effects dominate the local wind patterns in this region. An area of cyclogenesis for the western portion has been identified as being in the center of the Alboran Sea.

Oceanographically, this region is considered to be highly active, extremely variable, and sufficiently influenced by a number of surface and subsurface physical features, e.g. ocean fronts, ocean eddies, current boundaries, and zones of convergence/divergence.

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*Seasons: Winter=January to March; Spring=April to June; Summer=July to September; Fall=October to December.

Proper environmental numerical modeling of this region is problematic. Substantial dynamic activity and variability make proper representation of typical conditions extremely difficult. Past studies of this region indicated the development and presence of a noticeable summer oceanic front. More recent studies have shown that the Alboran Sea front is not a summer feature, but a persistent feature that can be identified throughout the year (Cheney, 1977). The frontal system extends in a general eastward pattern establishing cyclonic and anticyclonic gyres. Large amounts of North Atlantic water flow through the Strait of Gibraltar, providing a source for warm water as well as exerting some influence on the meanderings of the front.

2.2 Comparisons for Location #1

The vertical site comparisons of seasonal temperature, salinity, and sound-speed profiles, respectively, are presented for Med Location #1.

- Temperature:

  The January-to-March temperature envelope was based on a data sample size of 14 observations (Figure 2-1). The GDEM value at the surface fell within the envelope of observed values and differed from the typical by 0.05°C. Differences in values between the surface and the 100 m level were less than 0.08°C. Differences at the 125, 150, and 200 m levels were 0.33°C, 0.47°C, and 0.33°C, respectively.

  The April-to-June temperature envelope was based on a data sample size of eight observations (Figure 2-2). The GDEM value at the surface fell within the envelope of observed values and differed from the typical by 0.19°C. Differences in values between the surface and 30 m did not exceed 0.06°C. Differences at the 50, 75, and 100 m levels were 0.44°C, 0.76°C, and 0.61°C, respectively. Differences at 150 and 200 m were 0.32°C and 0.51°C, respectively. Below 200 m, differences did not exceed 0.07°C.

  The July-to-September temperature envelope was based on a data sample size of 50 observations (Figure 2-3). The GDEM value at the surface fell within the envelope of observed values and differed from the typical by 1.31°C. Differences in values between the surface and 50 m varied up to 1.70°C. Below 75 m, the differences were less than 0.44°C to 125 m. Below 150 m, differences did not exceed 0.22°C.

  The October-to-December temperature comparison was not available because of insufficient data.

- Salinity:

  The January-to-March salinity envelope was based on a data sample size of 14 observations (Figure 2-4). The GDEM value at the surface fell within the envelope of observed values and differed from the typical by 0.05 ppt. Differences between the 10 and 150 m levels did not exceed 0.06 ppt. A difference of 0.31 ppt existed at 200 m. Below 200 m, there existed differences of 0.18 ppt.

  The April-to-June salinity envelope was based on a data sample size of eight observations (Figure 2-5). The GDEM value at the surface fell within the envelope of observed values and differed from the typical by 0.01 ppt. Various differences were found between the profiles with depth. Between 20 to 50 m, differences did not exceed 0.19 ppt. Between 75 to 100 m, differences were nearly 0.34 ppt. At 125 m the difference was 0.01 ppt. With the exception of the 200 m level, which had a difference of 0.38 ppt, differences between the 150 to 400 m levels ranged near 0.30 ppt.

  The July-to-September salinity envelope was based on a data sample size of 50 observations (Figure 2-6). The GDEM value at the surface fell within the envelope of observed values and differed from the typical by 0.12 ppt. Differences less than 0.33 ppt existed between 10 and 50 m. Between the 75 and 150 m levels, differences ranged from 0.41 ppt to 0.84 ppt. Below 200 m, differences did not exceed 0.23 ppt.

  The October-to-December salinity comparison was not available because of insufficient data.

- Sound Speed:

  The January-to-March sound-speed envelope was based on a data sample size of 14 observations (Figure 2-7). The GDEM value at the surface fell within the envelope of observed values and differed from the typical by 0.1 m/s. Differences in GDEM between the 10 to 100 m levels did not exceed 0.2 m/s. A difference of 1.4 m/s was found at the 150 m level. Below 200 m, differences did not exceed 0.5 m/s.

  The April-to-June sound-speed envelope was based on a data sample size of eight observations (Figure 2-8). The GDEM value at the surface fell within the envelope of observed values and differed from the typical by 0.5 m/s. Various differences existed between 10 and 400 m. With the exception of the 50, 75, 100 and 200 m levels, which had differences of 1.1 m/s, 2.4 m/s, 1.4 m/s and 1.3 m/s, respectively, other differences did not exceed 0.8 m/s.

The July-to-September sound-speed envelope was based on a data sample size of 50 observations (Figure 2-9). The GDEM value at the surface fell within the envelope of observed values and differed from the typical by 3.1 m/s. Various differences existed between 10 and 400 m. Between 10 and 50 m, differences ranged from 2.6 m/s to 4.5 m/s. Between 100 to 150 m, differences ranged from 1.2 m/s to 2.4 m/s. The 75, 200, 250, 300 and 400 m level differences did not exceed 0.7 m/s.

The October-to-December sound speed comparison was not available because of insufficient data.

2.3 Evaluation - Alboran Sea (Location #1)

- January to March:

  Comparison between GDEM and the typical temperature profiles revealed similar thermal structures. The absolute values defining the thermocline region differed (by 0.3 to 0.4°C). The general gradients of the thermocline were similar. This ocean region was known for its very high variability. The envelope of observed values was substantially wide for winter structuring and reflected a zone of noticeable thermal variability. The GDEM profile reflected a predominant and reasonable seasonally averaged winter thermal structure for this extremely variable ocean region when compared with the 14 usable observations.

  Comparison between GDEM and the typical salinity profiles revealed similar haline structures. Within the halocline, absolute values of salinity differed by 0.05 ppt to 0.3 ppt; however, the general gradients of the halocline were similar. The portion of the envelope showing the widest divergence was deep and was indicative of this region of persistent and strong haline variability. The GDEM profile reflected a seasonally averaged winter haline structure for this extremely variable ocean region when compared with the 14 usable observations. The numerical values of GDEM salinities below 300 m could be increased by approximately 0.10 to 0.15 ppt.

  Comparison between GDEM and the typical sound-speed profiles revealed similar near-surface and below-axis sound speed structure. Differences occurred in the depths of the subsurface maxima (of approximately 25 m) and in the numerical values between the maxima of 0.6 m/s. The difference in the depths of the subsurface maxima was reasonable within the envelope of observed values. There was a difference of 1.4 m/s at 150 m. This difference occurred within an envelope of variability of approximately 5.1 m/s. The difference in the GDEM and typical sonoclines between 100 to 200 m appeared to be caused by temperature. The GDEM profile reflected a seasonally averaged winter sound-speed structure for this extremely variable ocean region when compared with the particular 14 usable observations.

- April to June:

  Comparison between GDEM and the typical temperature profiles revealed similar thermal structures. Temperature values within the thermocline region differed (by less than 0.76°C). The general thermocline gradients were similar. This ocean region is known for its very high variability. The envelope of observed values was substantially wide for spring structuring and reflected a zone of noticeable thermal variability. The GDEM profile reflected a seasonally averaged spring thermal structure for this extremely variable ocean region when compared with the eight usable observations.

  Comparison between GDEM and the typical salinity profiles revealed similar haline structure. The GDEM subsurface haline minima differed by nearly 0.3 ppt from the typical; however, the envelope of observed values was substantially wide throughout the halocline region and reflected an ample zone for spring haline structuring. The GDEM profile reflected a seasonally averaged spring haline structure for this extremely variable ocean region when compared with the eight usable observations. In addition, GDEM salinity values below 200 m could be increased by approximately 0.25 ppt to 0.30 ppt.

  Comparison between GDEM and the typical sound-speed profiles revealed similar sound speed structure. There were differences in the depth and numerical values of the undulating sonoclines. Those differences were 1.1 m/s to 2.1 m/s. These differences occurred within an envelope of variability having a magnitude (width) of approximately 6.0 m/s. The undulations within the sonocline were directly related to the undulations reflected in the GDEM thermocline structure. There were vertical displacements in the depths of the sound channel axes of approximately 50 m. The GDEM profile reflected a seasonally averaged spring sound-speed structure for this extremely variable ocean region when compared with the particular eight usable observations.

- July to September:

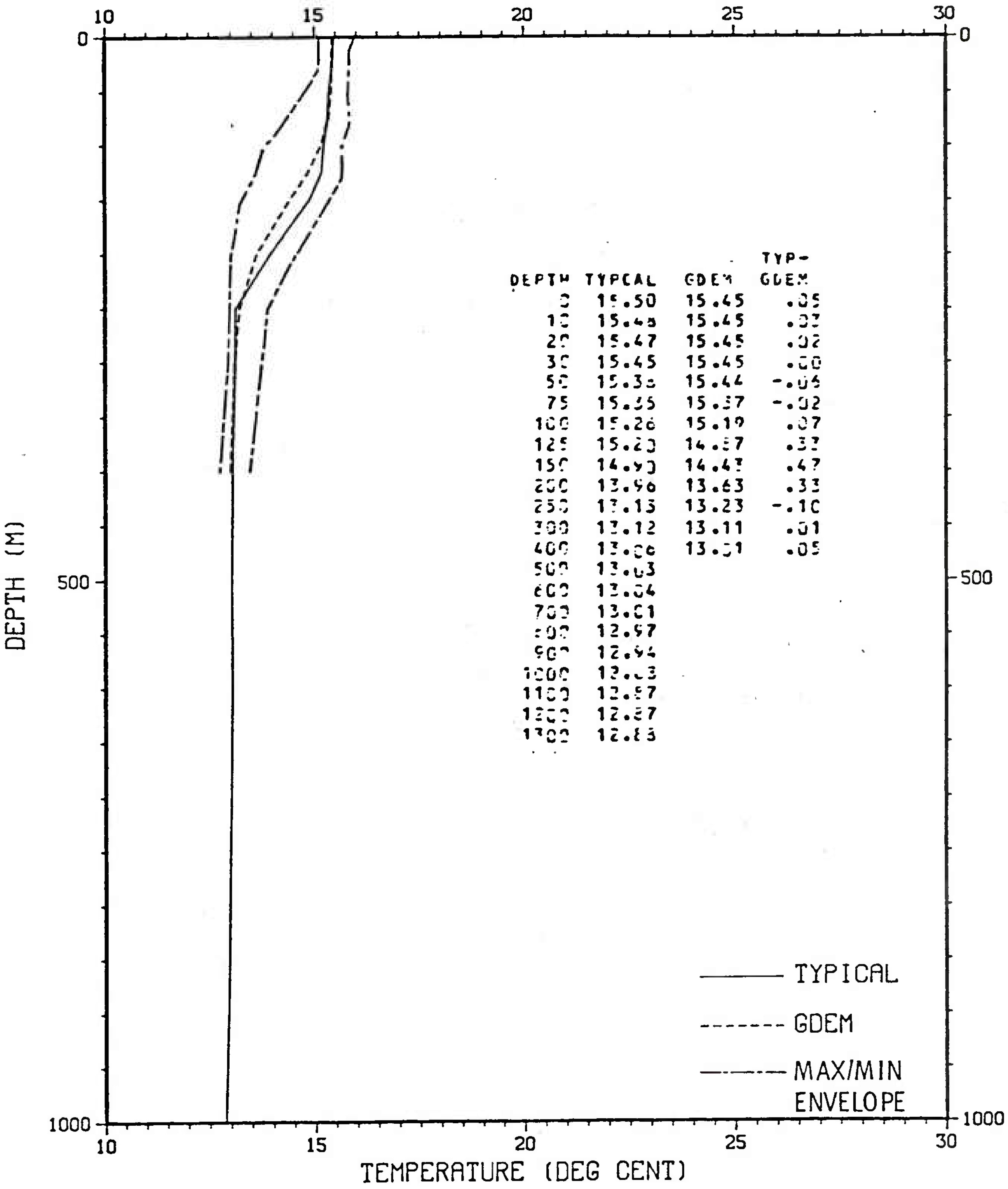
  Comparison between GDEM and the typical temperature profiles revealed similar thermal structures. The absolute values defining the thermocline region differed (by less than 1.7°C). However, the envelope of thermal variability near this region had a magnitude of approximately 5.8°C. This ocean region is known for its very high variability. The envelope of observed values was substantially wide for summer structuring and reflected a zone of noticeable thermal variability. The GDEM profile reflected a seasonally averaged summer thermal structure for this extremely variable ocean region when compared with the 50 usable observations.

Comparison between GDEM and the typical salinity profiles revealed similar haline structure. A noticeable difference occurred at 125 m. The typical reflected a definite halocline layer whereas the GDEM profile did not. Both the GDEM and the typical at 125 m remained within a very wide envelope of variability. The halocline layer of the typical at 125 m reflected an observation that was defining the minimum portion of the envelope, whereas the GDEM profile through the halocline region reflected an average or mean gradient within the very wide envelope. This ocean region is known for its very high variability. The envelope of observed values was substantially wide throughout the halocline region and reflected an ample zone for summer haline structuring. The GDEM profile reflected a seasonally averaged summer haline structure for this extremely variable ocean region when compared with the 50 usable observations.

Comparison between GDEM and the typical sound-speed profiles revealed similar sound speed structure. There were differences in the structure of the sonocline region, as well as in the strength of the upper portion of the apex of the sound-channel axis. The envelope of variability through the undulating portion of the GDEM sonocline was very wide (approximately 9.5 m/s to 15.2 m/s between 50 and 125 m). Undulating features could realistically occur within a region of high variability, physical processes, and broad max/min ranges. The curvature in the GDEM sound-channel axis was noticeably suppressed downward. This suppression could be directly attributed to a similar feature found on the GDEM temperature profile. This suppression was not considered historically representative. The depths of the sound-channel axes were similar. With the exception of the suppression in the sound-speed profile, the GDEM profile reflected an acceptable seasonally averaged summer sound-speed structure for this extremely variable ocean region when compared with the 50 usable observations.

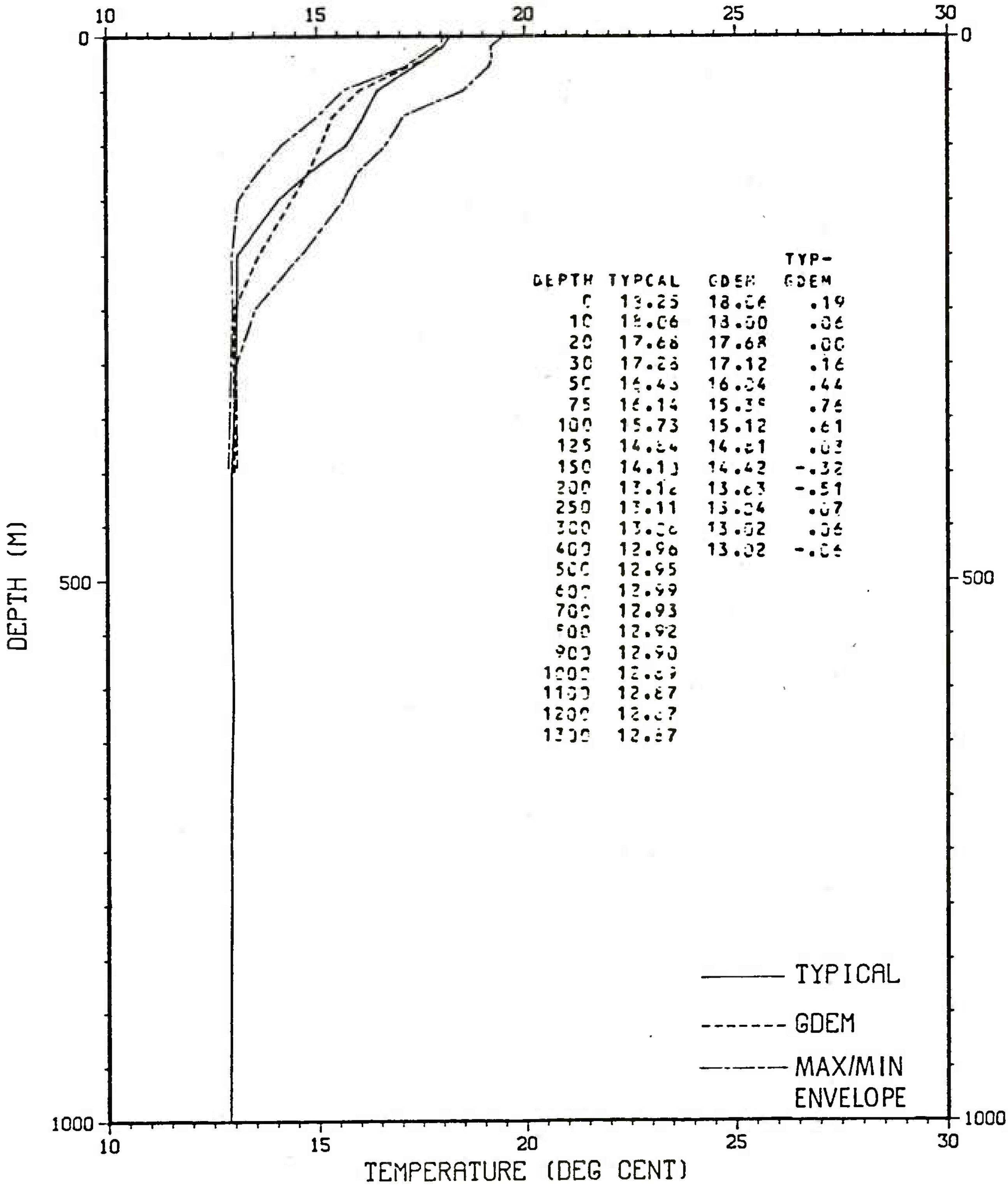
- October to December:

  Evaluation for this time period was not available because of the lack of usable data.



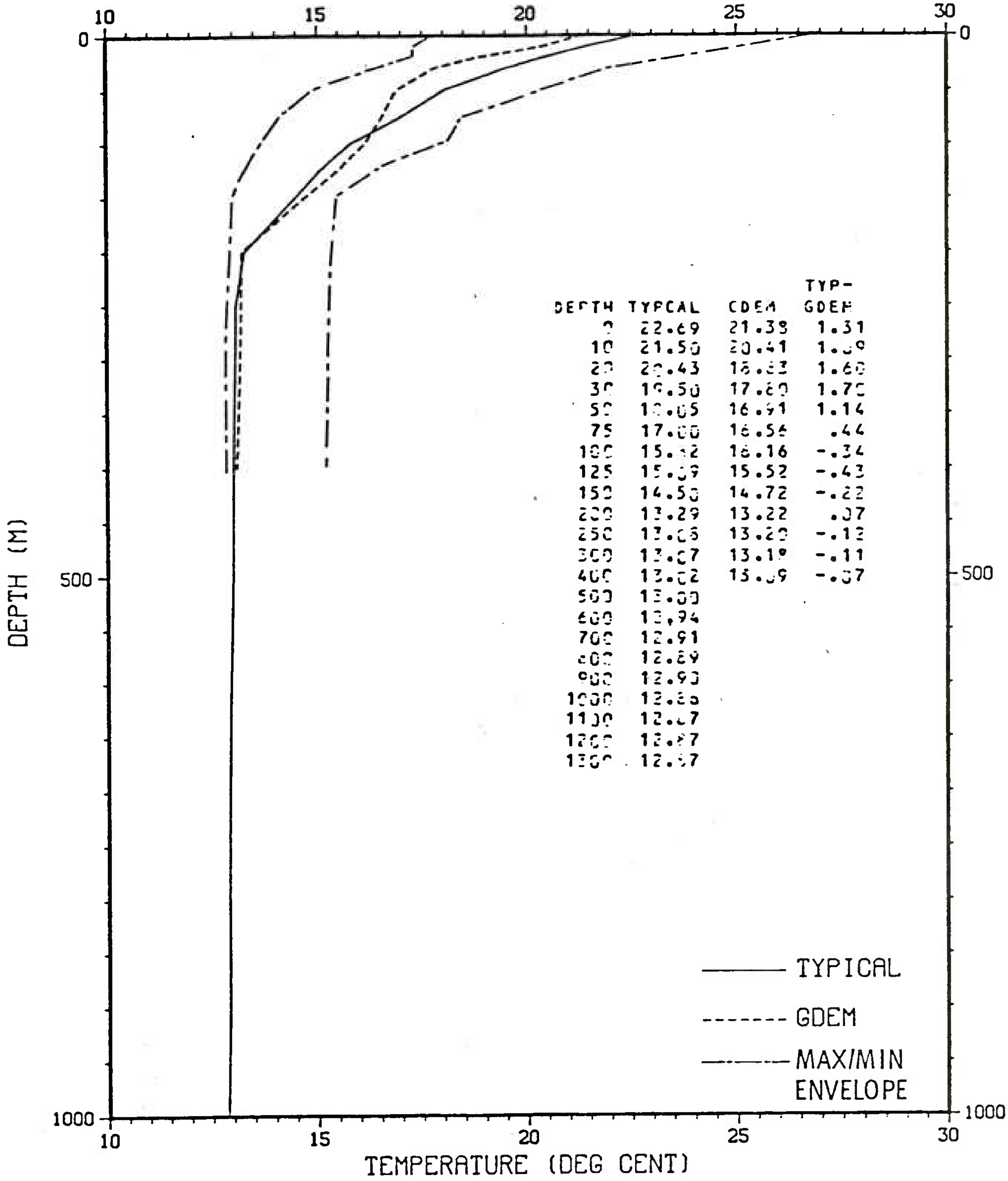
DEPTH	TYPCAL	GDEM	TYP-GDEM
0	15.50	15.45	.05
10	15.48	15.45	.03
20	15.47	15.45	.02
30	15.45	15.45	.00
50	15.38	15.44	-.06
75	15.35	15.37	-.02
100	15.26	15.19	.07
125	15.20	14.87	.33
150	14.90	14.43	.47
200	13.96	13.63	.33
250	13.13	13.23	-.10
300	13.12	13.11	.01
400	13.06	13.01	.05
500	13.03		
600	13.04		
700	13.01		
800	12.97		
900	12.94		
1000	12.93		
1100	12.87		
1200	12.87		
1300	12.83		

FIG. 2-1. VERTICAL TEMPERATURE PROFILE FOR ALBORAN SEA (JAN - MAR)



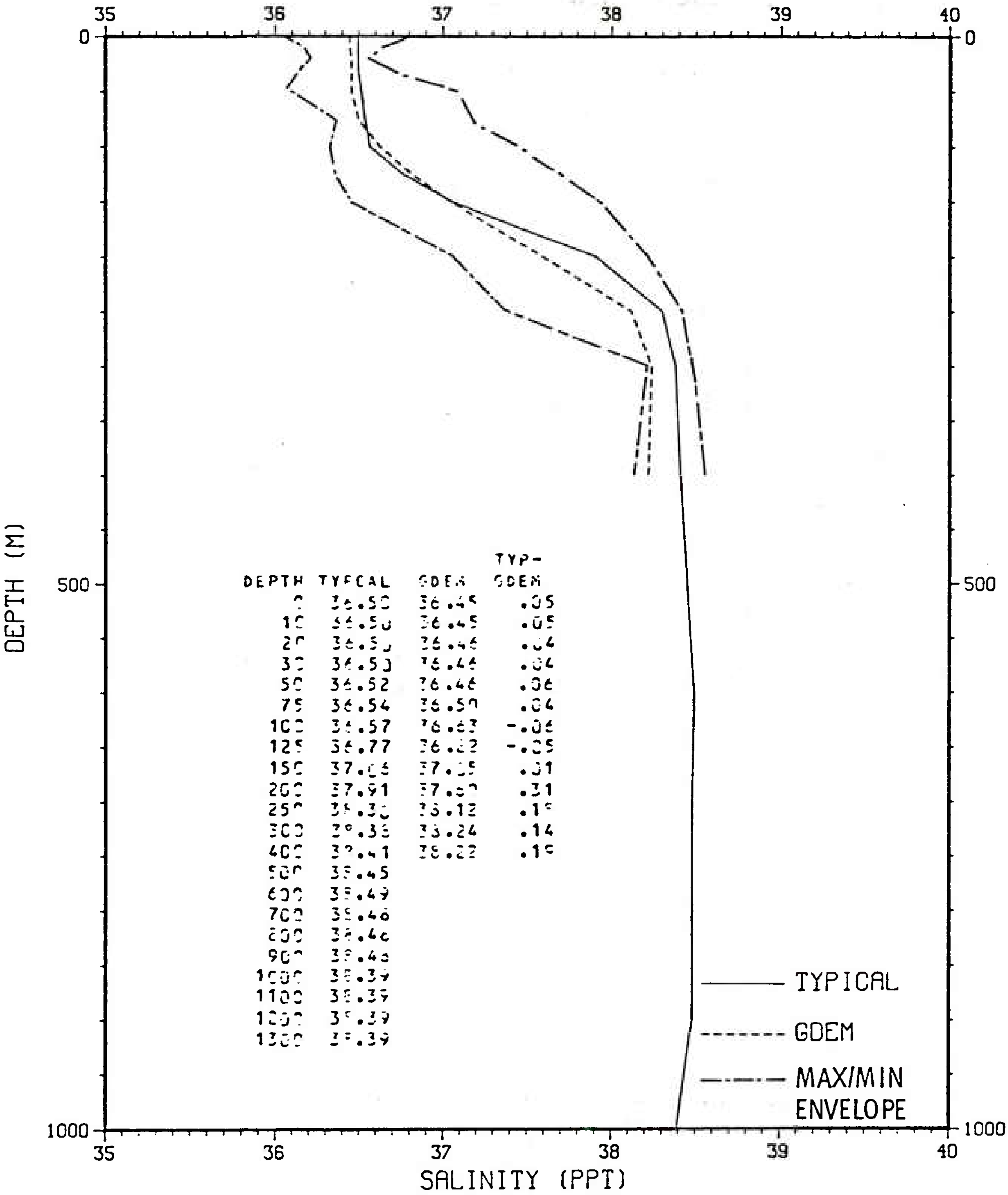
DEPTH	TYPCAL	GDEM	TYP-GDEM
0	18.25	18.06	.19
10	18.06	18.00	.06
20	17.66	17.68	.00
30	17.28	17.12	.16
50	16.48	16.04	.44
75	16.14	15.38	.76
100	15.73	15.12	.61
125	14.84	14.81	.03
150	14.10	14.42	-.32
200	13.12	13.63	-.51
250	13.11	13.04	.07
300	13.08	13.02	.06
400	12.96	13.02	-.06
500	12.95		
600	12.99		
700	12.93		
800	12.92		
900	12.90		
1000	12.89		
1100	12.87		
1200	12.87		
1300	12.87		

FIG. 2-2. VERTICAL TEMPERATURE PROFILE FOR ALBORAN SEA (APR - JUN)



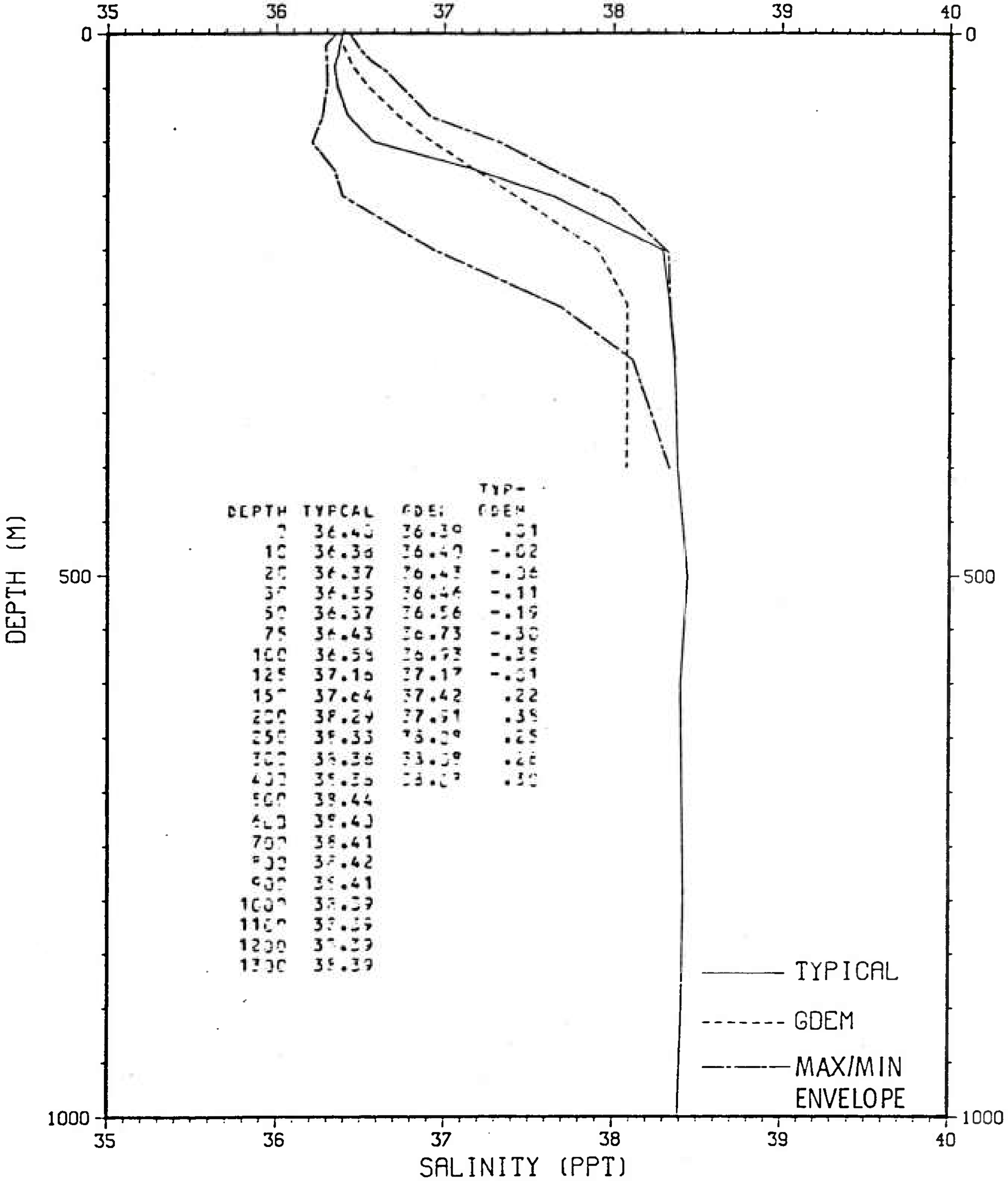
DEPTH	TYPCAL	GDEM	TYP-GDEM
0	22.69	21.38	1.31
10	21.50	20.41	1.09
20	20.43	18.83	1.60
30	19.50	17.80	1.70
50	18.05	16.91	1.14
75	17.00	16.56	.44
100	15.82	16.16	-.34
125	15.09	15.52	-.43
150	14.50	14.72	-.22
200	13.29	13.22	.07
250	13.08	13.20	-.12
300	13.07	13.18	-.11
400	13.02	13.09	-.07
500	13.00		
600	12.94		
700	12.91		
800	12.89		
900	12.90		
1000	12.88		
1100	12.87		
1200	12.87		
1300	12.87		

FIG. 2-3. VERTICAL TEMPERATURE PROFILE FOR ALBORAN SEA (JUL - SEP)



DEPTH	TYPICAL	GDEM	TYP-GDEM
0	36.50	36.45	.05
10	36.50	36.45	.05
20	36.50	36.46	.04
30	36.50	36.44	.04
50	36.52	36.46	.06
75	36.54	36.50	.04
100	36.57	36.63	-.06
125	36.77	36.82	-.05
150	37.06	37.05	.01
200	37.91	37.60	.31
250	38.30	38.12	.18
300	38.38	38.24	.14
400	38.41	38.22	.19
500	38.45		
600	38.49		
700	38.46		
800	38.46		
900	38.43		
1000	38.39		
1100	38.39		
1200	38.39		
1300	38.39		

FIG. 2-4. VERTICAL SALINITY PROFILE FOR ALBORAN SEA (JAN - MAR)



DEPTH	TYPCAL	GDEM	TYP-GDEM
0	36.40	36.39	.01
10	36.38	36.40	-.02
20	36.37	36.43	-.06
30	36.35	36.46	-.11
50	36.37	36.56	-.19
75	36.43	36.73	-.30
100	36.59	36.93	-.35
125	37.15	37.17	-.01
150	37.64	37.42	.22
200	38.29	37.91	.38
250	38.33	38.09	.25
300	38.36	38.09	.28
400	38.35	38.07	.30
500	38.44		
600	38.43		
700	38.41		
800	38.42		
900	38.41		
1000	38.39		
1100	38.39		
1200	38.39		
1300	38.39		

FIG. 2-5. VERTICAL SALINITY PROFILE FOR ALBORAN SEA (APR - JUN)

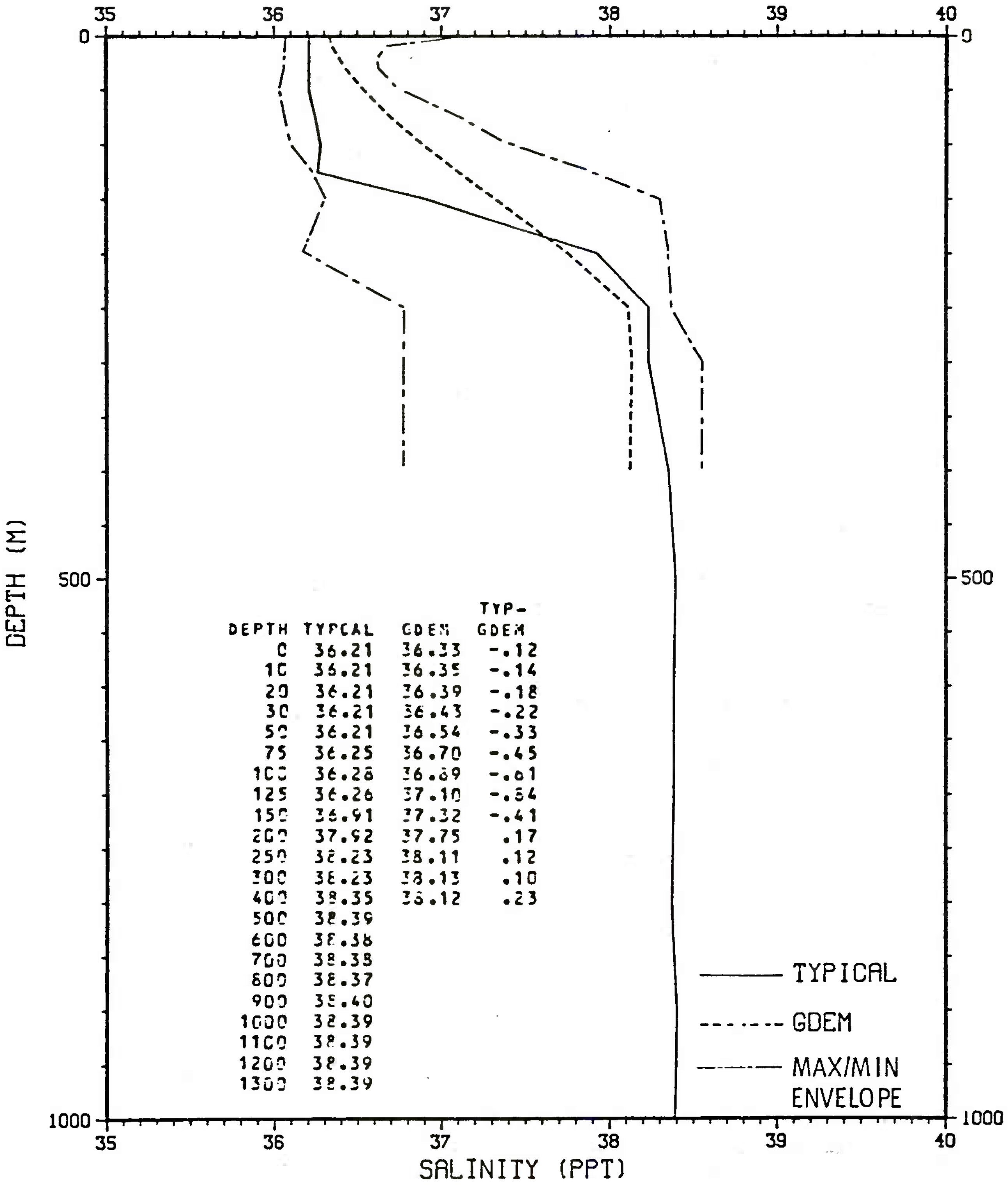
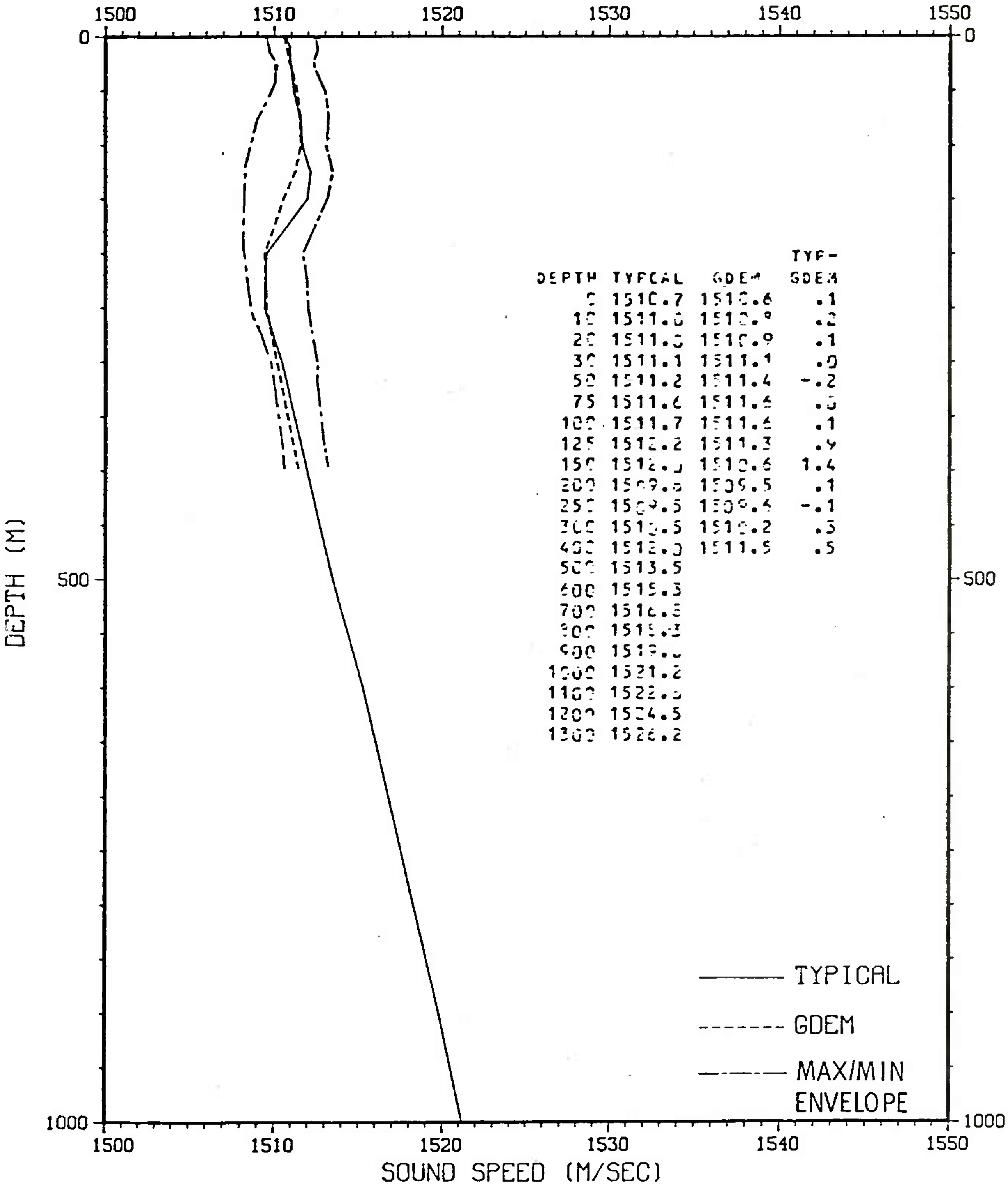


FIG. 2-6. VERTICAL SALINITY PROFILE FOR ALBORAN SEA (JUL - SEP)



DEPTH	TYPCAL	GDEM	TYP-GDEM
0	1510.7	1510.6	.1
10	1511.0	1510.8	.2
20	1511.0	1510.9	.1
30	1511.1	1511.1	.0
50	1511.2	1511.4	-.2
75	1511.6	1511.6	.0
100	1511.7	1511.6	.1
125	1512.2	1511.3	.9
150	1512.0	1510.6	1.4
200	1509.6	1509.5	.1
250	1509.5	1509.6	-.1
300	1510.5	1510.2	.3
400	1512.0	1511.5	.5
500	1513.5		
600	1515.3		
700	1516.8		
800	1518.3		
900	1519.8		
1000	1521.2		
1100	1522.8		
1200	1524.5		
1300	1526.2		

FIG. 2-7. VERTICAL SOUND-SPEED PROFILE FOR ALBORAN SEA (JAN - MAR)

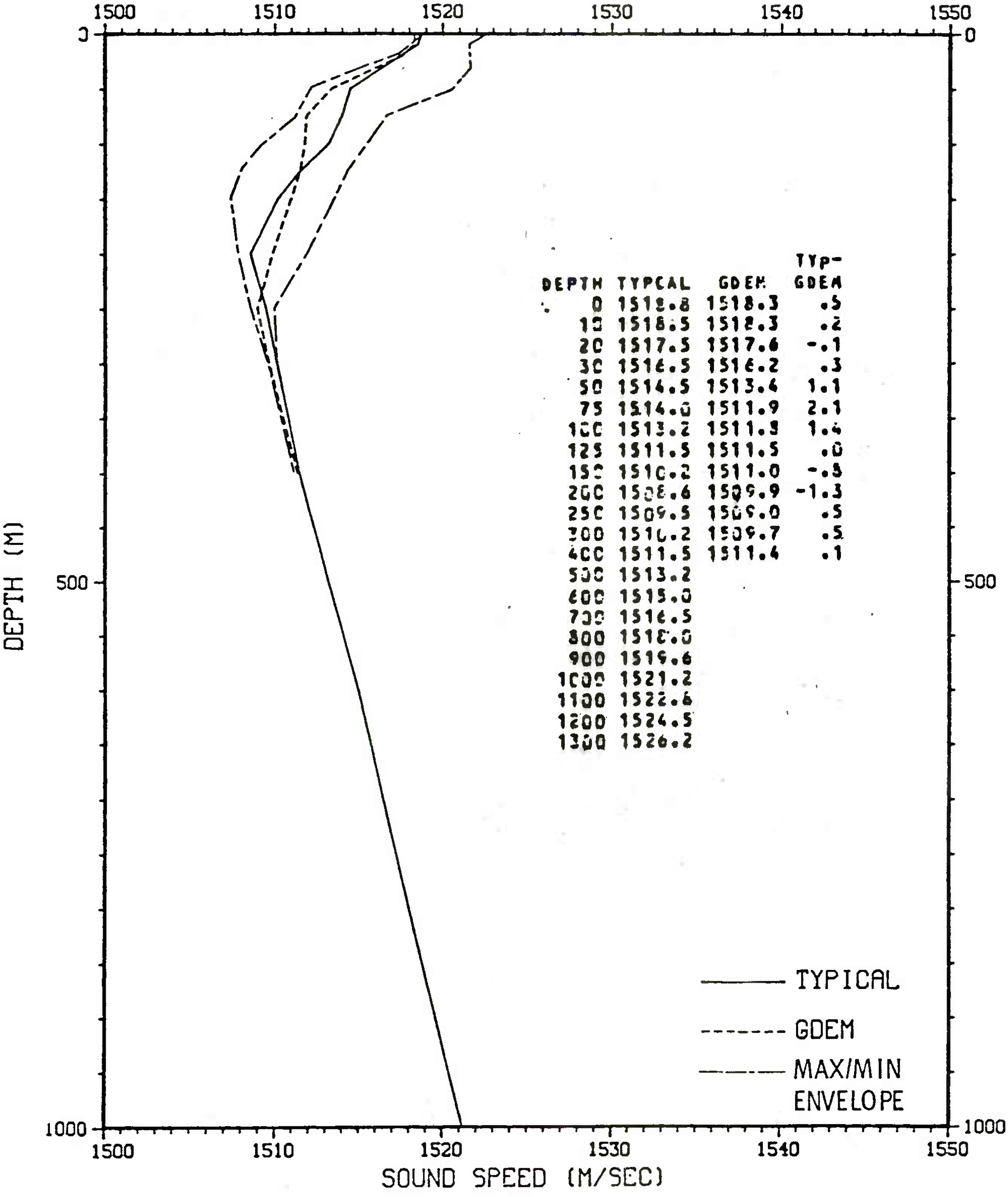


FIG. 2-8. VERTICAL SOUND-SPEED PROFILE FOR ALBORAN SEA (APR - JUN)

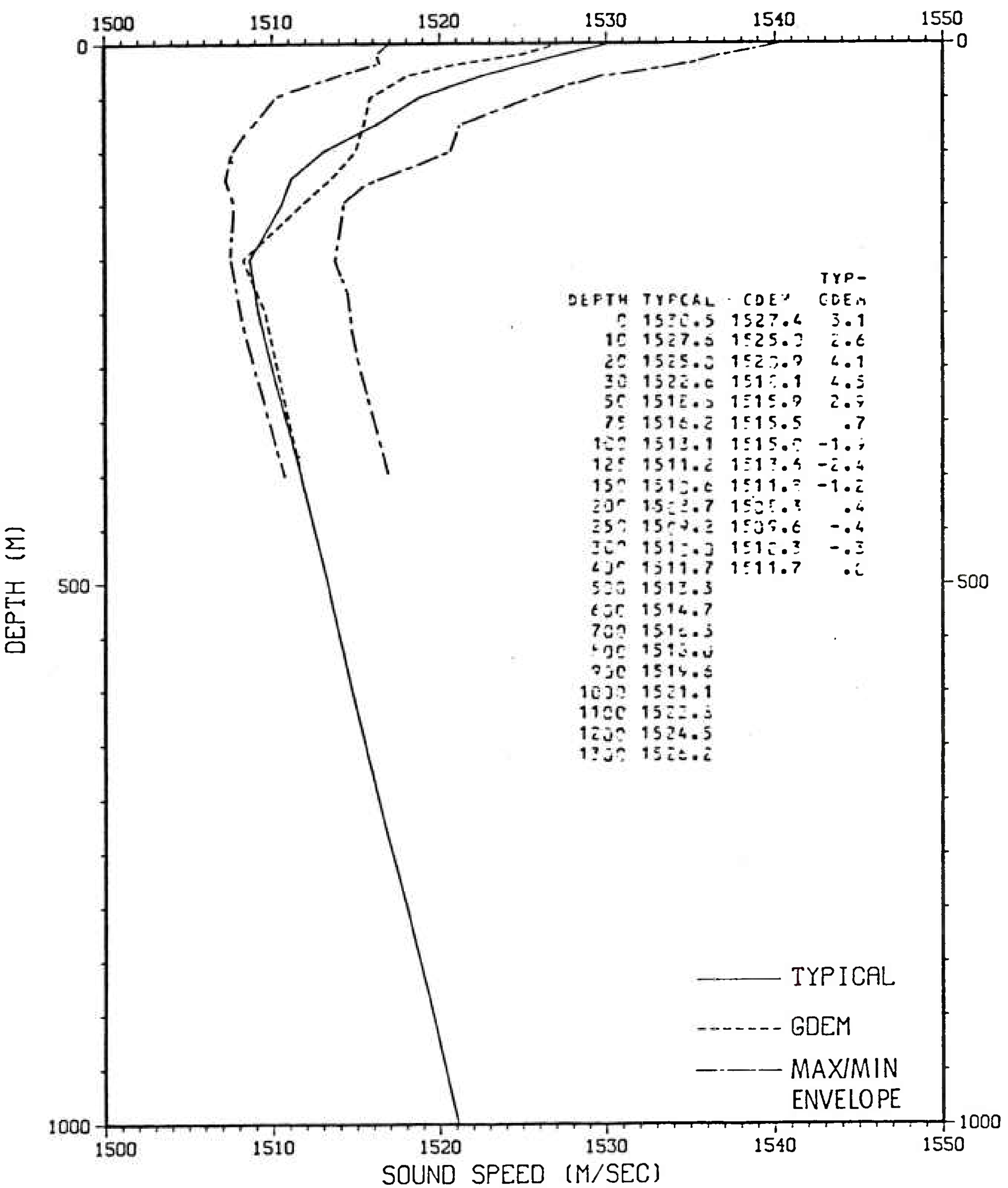


FIG. 2-9. VERTICAL SOUND-SPEED PROFILE FOR ALBORAN SEA (JUL - SEP)

3.0 VERTICAL TEMPERATURE, SALINITY, AND SOUND-SPEED PROFILE COMPARISONS FOR MEDITERRANEAN (MED) LOCATION #2

Twelve vertical comparisons of temperature (T), salinity (S), and sound-speed (SS) for winter, spring, summer, and fall seasons are presented in this section.

3.1 Description

Med Location #2 is taken from the Balearic Sea region of the Mediterranean Sea. The geographical location selected for this comparison is at 42°00' north latitude and 006°00' east longitude. Vertical temperature, salinity, and sound-speed profiles of seasonal comparisons are shown in Figures 3-1 through 3-12.

The Balearic Sea region of the western central Mediterranean Sea, depicted as Region B on Figure 1-1, is defined for this report as the body of water that is bounded to the west by 1° west longitude and the east coastline of Spain; to the north by the southern coastline of France; to the east by the islands of Corsica and Sardinia; and to the south by the coastline of Algeria.

Meteorologically, this region is considered active, variable, and seasonally influenced by an area that is known for cyclogenesis. This area is located off the eastern coast of Spain in the Balearic Sea and encompasses the Balearic Islands. Cyclogenesis over the Balearic Sea is frequently found in the winter, with common occurrences in the spring and fall.

Oceanographically, this region is considered highly variable. The ocean variability and changes in the vertical and horizontal structuring are directly related to the seasonal impulses received from the nearby zone of cyclogenesis. Seasonal effects of mechanical mixing are generally confined to the near-surface structure.

3.2 Comparisons For Location #2

The vertical site comparisons of seasonal temperature, salinity, and sound-speed profiles, respectively, are presented for Med Location #2.

- Temperature:

  The January-to-March temperature envelope was based on a sample size of 85 observations (Figure 3-1). The GDEM value at the surface fell within the envelope of observed values and differed from the typical by 0.12°C. Differences between GDEM and the typical from the surface to 2000 m did not exceed 0.19°C.

  The April-to-June temperature envelope was based on a data sample size of nine observations (Figure 3-2). The GDEM value at the surface fell within the envelope of observed values and differed from the typical by 1.33°C. Differences at 10 m and 75 m were 0.73°C, and 0.37°C, respectively. Between 75 and 600 m, numerical differences were less than 0.29°C. Below 600 m, down to 2000 m, differences did not exceed 0.06°C.

  The July-to-September temperature envelope was based on a sample size of 21 observations (Figure 3-3). The GDEM value at the surface fell within the envelope of observed values and differed from the typical by 1.14°C. Differences at the 10, 20, and 30 m levels were 1.47°C, 1.53°C, and 1.19°C, respectively. Between the 50 and 100 m levels, differences did not exceed 0.57°C. Below 125 m, to 2000 m, differences did not exceed 0.07°C.

  The October-to-December temperature envelope was based on a sample size of six observations (Figure 3-4). The GDEM value at the surface did not fall within the envelope of observed values and differed from the typical by 0.74°C. Differences of 0.70°C occurred from the surface down to 30 m. With the exception of 0.47°C at 75 m, differences between 100 and 600 m did not exceed 0.28°C. Below 600 m, differences did not exceed 0.15°C.

- Salinity:

  The January-to-March salinity envelope was based on a sample size of 86 observations (Figure 3-5). The GDEM value at the surface fell within the envelope of observed values and differed from the typical by 0.12 ppt. Differences from 10 m down to 1000 m were less than 0.16 ppt. Below 1000 m, differences did not exceed 0.09 ppt.

  The April-to-June salinity envelope was based on a data sample size of nine observations (Figure 3-6). The GDEM value at the surface fell within the envelope of observed values and differed from the typical by 0.9 ppt. Differences between 10 and 75 m did not exceed 0.12 ppt. Below 125 m, differences did not exceed 0.09 ppt.

  The July-to-September salinity envelope was based on a data sample size of 21 observations (Figure 3-7). The GDEM value at the surface fell within the envelope of observed values and differed from the typical by 0.18 ppt. Differences between 10 and 30 m and 200 to 1000 m range from 0.11 to 0.15 ppt. Below 1000 m, differences did not exceed 0.09 ppt.

The October-to-December salinity envelope was based on a data sample size of six observations (Figure 3-8). The GDEM value at the surface fell within the envelope of observed values and differed from the typical by 0.07 ppt. Differences between 10 to 2000 m did not exceed 0.08 ppt.

- Sound Speed:

  The January-to-March sound-speed envelope was based on a sample size of 86 observations (Figure 3-9). The GDEM value at the surface fell within the envelope of observed values and differed from the typical by 0.3 m/s. With the exception of a difference of 0.6 m/s at 100 m, all differences from the surface to 2000 m did not exceed 0.4 m/s.

  The April-to-June sound-speed envelope was based on a sample size of nine observations (Figure 3-10). The GDEM value at the surface fell within the envelope of observed values and differed from the typical by 3.3 m/s. With the exception of 1.6 m/s, 1.4 m/s, 1.1 m/s, 1.0 m/s, and 0.8 m/s at the 10 m, 50 m, 75 m, 100 m, and 125 m levels, respectively, all differences from the surface to 2000 m did not exceed 0.5 m/s.

  The July-to-September sound-speed envelope was based on a sample size of 21 observations (Figure 3-11). The GDEM value at the surface fell within the envelope of observed values and differed from the typical by 3.0 m/s. Differences in value from the surface to 100 m ranged between 0.8 m/s and 4.0 m/s. Differences below 125 m to 2000 m did not exceed 0.3 m/s.

  The October-to-December sound-speed envelope was based on a data sample of six observations (Figure 3-12). The GDEM value at the surface fell outside of the envelope of observed values and differed from the typical by 2.3 m/s. Differences below the surface to 75 m ranged between 1.2 and 2.3 m/s. Differences below 150 m to 2000 m did not exceed 0.8 m/s.

3.3 Evaluation - Balearic Sea (Location #2)

- January to March:

  Comparison between GDEM and the typical temperature profiles revealed similar thermal structure. Differences in values were quite small from the surface down to 2000 m. The GDEM profile was nearly identical to the typical. The GDEM profile remained within the entire envelope of observed values. The GDEM profile reflected a seasonally averaged winter thermal structure for this highly variable ocean region when compared with the 86 usable observations.

Comparison between GDEM and the typical salinity profiles revealed similar haline structure. Above 200 m, the envelope of variability was quite wide (nearly 0.70 ppt). Below 200 m the envelope narrowed progressively with depth. The GDEM profile remained within the envelope and closely resembled the typical above 400 m. Below 400 m, the GDEM profile fell outside the envelope of observed values, being slightly lower by nearly 0.08 ppt. The GDEM salinity below 400 m can be increased by 0.08 to 1.20 ppt. With the exception of the lower numerical values of salinity below 400 m, the GDEM salinity profile reflected a seasonally averaged winter haline structure for this highly variable ocean region when compared with the 86 usable observations.

Comparison between GDEM and the typical sound-speed profiles revealed similar sound speed structure. The numerical differences were very small. The proper half-channel mode was firmly represented. The GDEM sound-speed profile remained within the envelope of observed values. The GDEM profile reflected a seasonally averaged winter sound-speed structure for this highly variable ocean region when compared with the 86 usable observations.

- April to June:

  Comparison between GDEM and the typical temperature profiles revealed similar thermal structure. Differences in values were quite small from the surface down to 2000 m. GDEM surface value differed slightly from the typical. With the exception of the 150 m level, the GDEM temperature profile remained within the entire envelope of observed values. Below 200 m, this region was quite stable during this time period and was adequately represented by the tightness of fit of the envelope and profiles. The GDEM profile reflected a seasonally averaged spring thermal structure for this highly variable region when compared with the nine usable observations.

  Comparison between GDEM and the typical salinity profiles revealed similar haline structure from the surface down to 100 m. The gradients between 100 to 200 m indicated that GDEM had a stronger salinity gradient. Above 500 m, the salinity profile of GDEM was representative. Below 500, GDEM fell outside of the narrow envelope by a small amount (0.04 ppt). The GDEM profile between 150 - 2000 m could be increased by 0.11 ppt. The GDEM profile reflected a seasonally averaged spring salinity structure for this highly variable region when compared with the nine usable observations.

Comparison between GDEM and the typical sound-speed profiles revealed similar sound speed structure. The GDEM profile remained within a very tight spring envelope. The primary sound-channel axis was located at a reasonable depth for this region and was similar to the typical. The curvature above the apex of the sound-channel axis was slightly less in GDEM than in the typical. This difference can also be seen in the temperature and salinity profiles. This difference was realistic as indicated by the sudden broadening of the envelope at those depths. The GDEM profile reflected an acceptable seasonally averaged spring sound-speed structure for this highly variable region when compared with the nine usable observations.

- July to September:

  Comparison between GDEM and the typical temperature profiles revealed similar thermal structures. The thermocline gradients and absolute numerical values of the profiles were very similar. The GDEM profile remained within the very narrow envelope below 150 m. The envelope of observed values was substantially wide for GDEM spring structuring and reflected a zone of sufficient thermal variability. The GDEM profile reflected a seasonally averaged summer thermal structure for this highly variable ocean region when compared with the 21 usable observations.

  Comparison between GDEM and the typical salinity profiles revealed similar haline structure. Although GDEM remained within the envelope of observed values, there was a noticeable difference in the gradient of the halocline between 125 to 200 m. This difference strongly influenced the remaining portion of the GDEM salinity profile to remain outside of the envelope. Difference between GDEM and envelope values below 400 m were slight and remained at approximately 0.6 ppt. The spread in the width of the envelope above 150 m was slight. An increase of between 0.08 and 0.12 ppt can be made to GDEM levels below 150 m. The GDEM profile reflected a seasonally averaged summer haline structure for this highly variable ocean region when compared with the 21 usable observations.

  Comparison between the GDEM and the typical sound-speed profiles revealed similar sound speed structure. The sonocline gradients were very similar but differed in numerical value. There was a difference in the depths of the subsurface minima of approximately 25 m and a difference in numerical value between the minima of 0.6 m/s. The depth of the GDEM minimum appeared reasonable and remained within the envelope of observed values. The difference in depths of subsurface minima appeared to be caused by differences in temperature structure at those depths. The GDEM profile reflected a seasonally averaged summer sound-speed structure for this highly variable ocean region when compared with the 21 usable observations.

- October to December:

  Comparison between GDEM and the typical temperature profiles revealed similar thermal structure with some difference in numerical value. The differences were maximum near the surface (less than 0.7°C) and decrease to less than 0.05°C below 1000 m. The GDEM profile persistently remained outside the envelope of observed values (only six observations). The displacement of the GDEM profile outside the narrow envelope was not considered significant. Data sampling appeared to be a direct causal factor in the GDEM profile existing outside the envelope. The GDEM profile reflected the gradients of the typical and remained within the envelope of observed data for this highly variable ocean region when compared with the six usable observations.

  Comparison between GDEM and the typical salinity profiles revealed similar haline structure. An increase in salinity of between 0.08 and 0.12 ppt could be made to GDEM salinity values below 150 m. The GDEM profile reflected the overall gradients as well as a smooth seasonally averaged historical profile for fall for this highly variable region when compared with the six usable observations.

  Comparison between GDEM and the typical sound-speed profiles revealed similar sound speed structure, with some differences in numerical values. The GDEM profile persistently remained outside the envelope of observed values (only six observations). The displacement of the GDEM profile outside the envelope was directly related to the temperature profile. As stated in the temperature evaluation, this displacement was not necessarily incorrect, but may be caused by biased data sampling. The general GDEM gradient was similar to the typical and the GDEM sound-channel axis was not as abrupt at 75 m as in the typical. The gradients found on the smooth seasonally averaged historical profile of GDEM for the fall was considered representative.

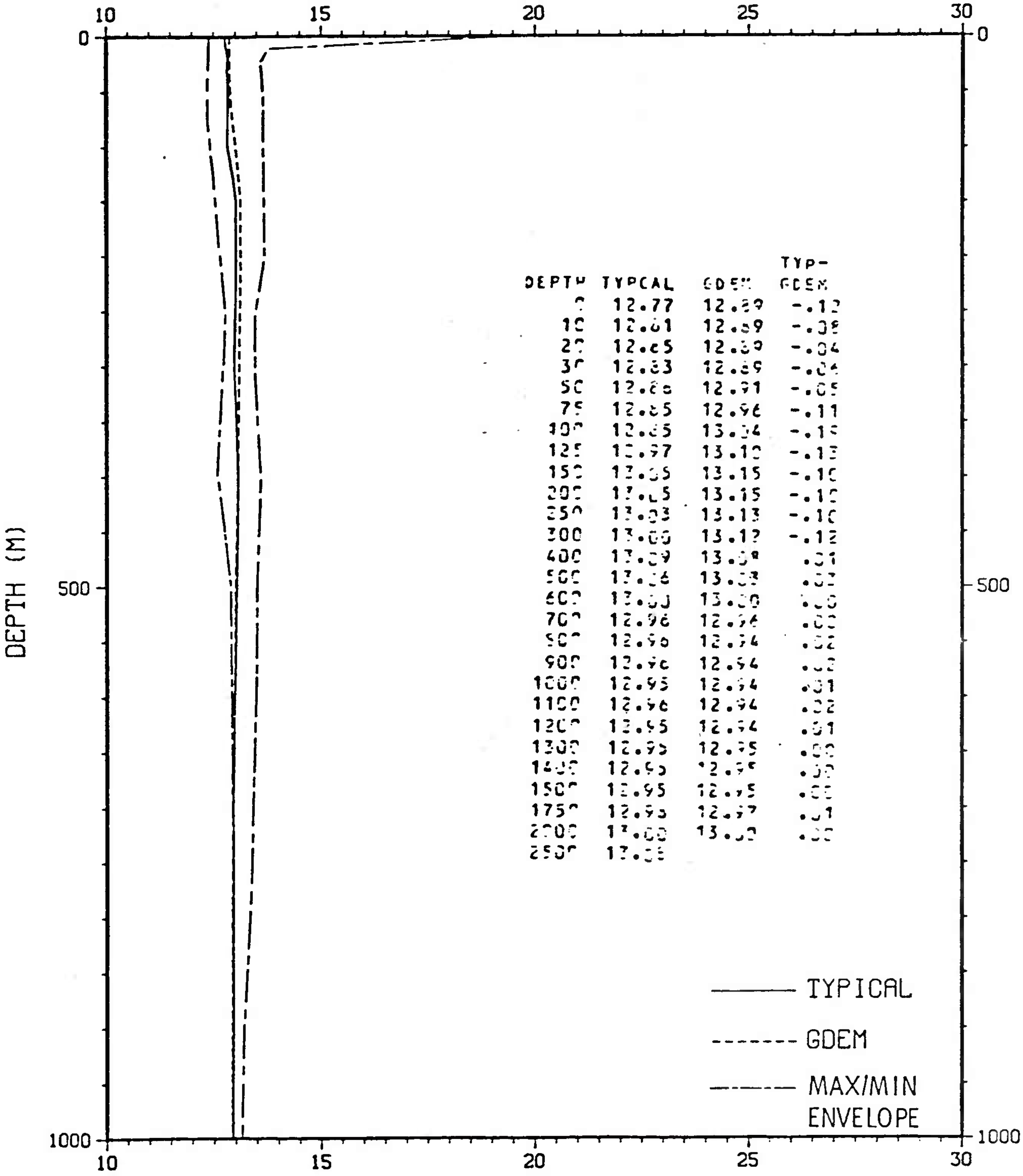
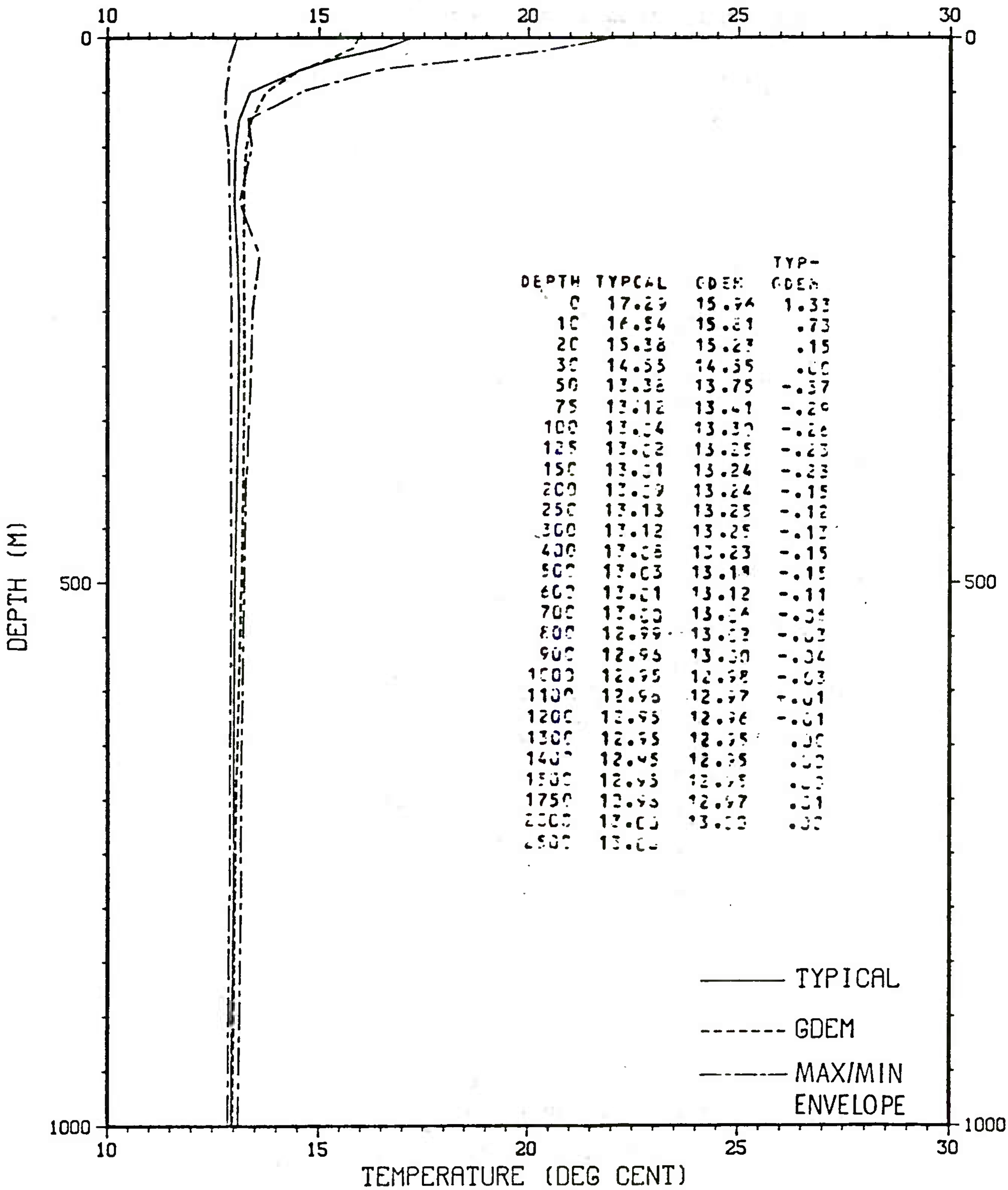
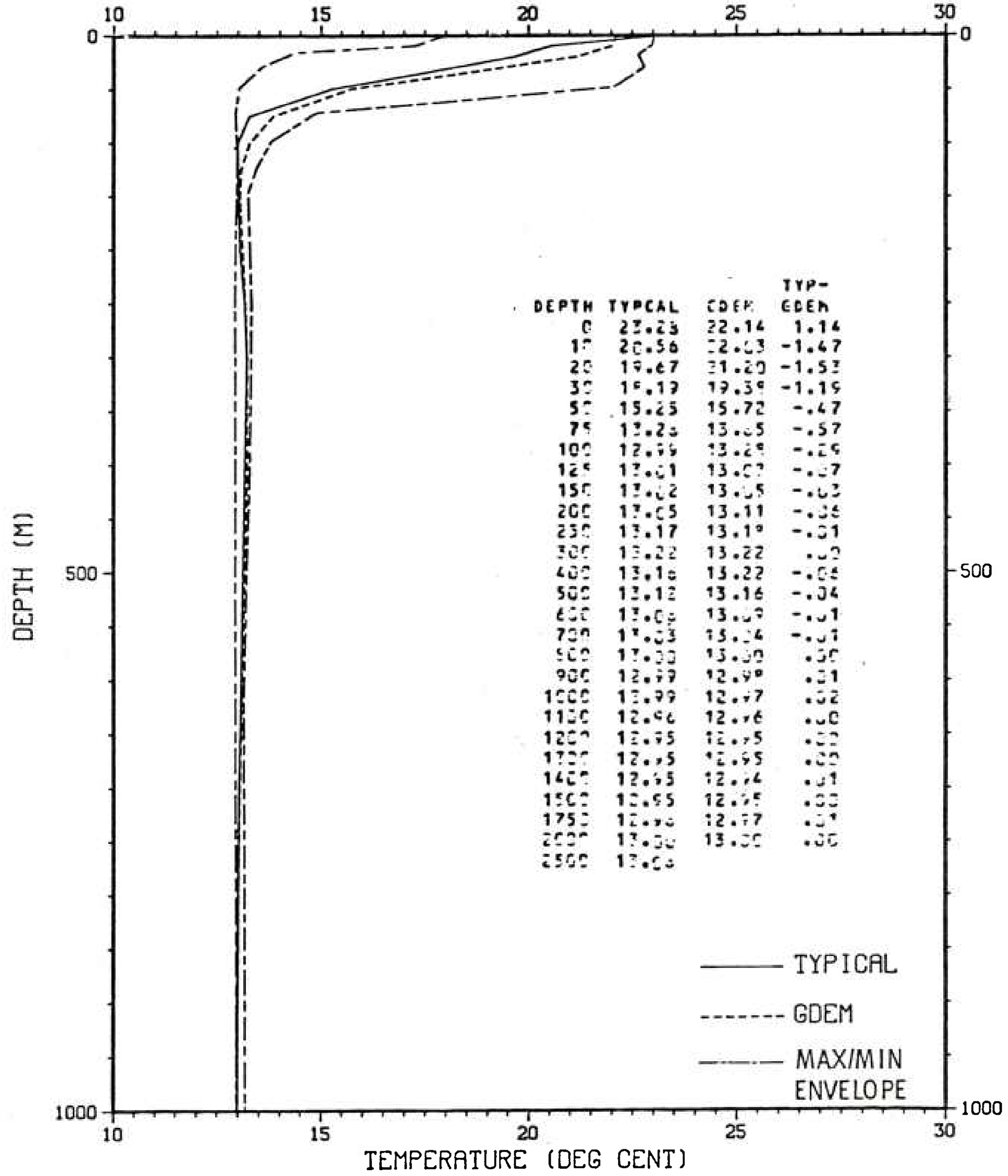


FIG. 3-1. VERTICAL TEMPERATURE PROFILE FOR BALEAREC SEA (JAN - MAR)



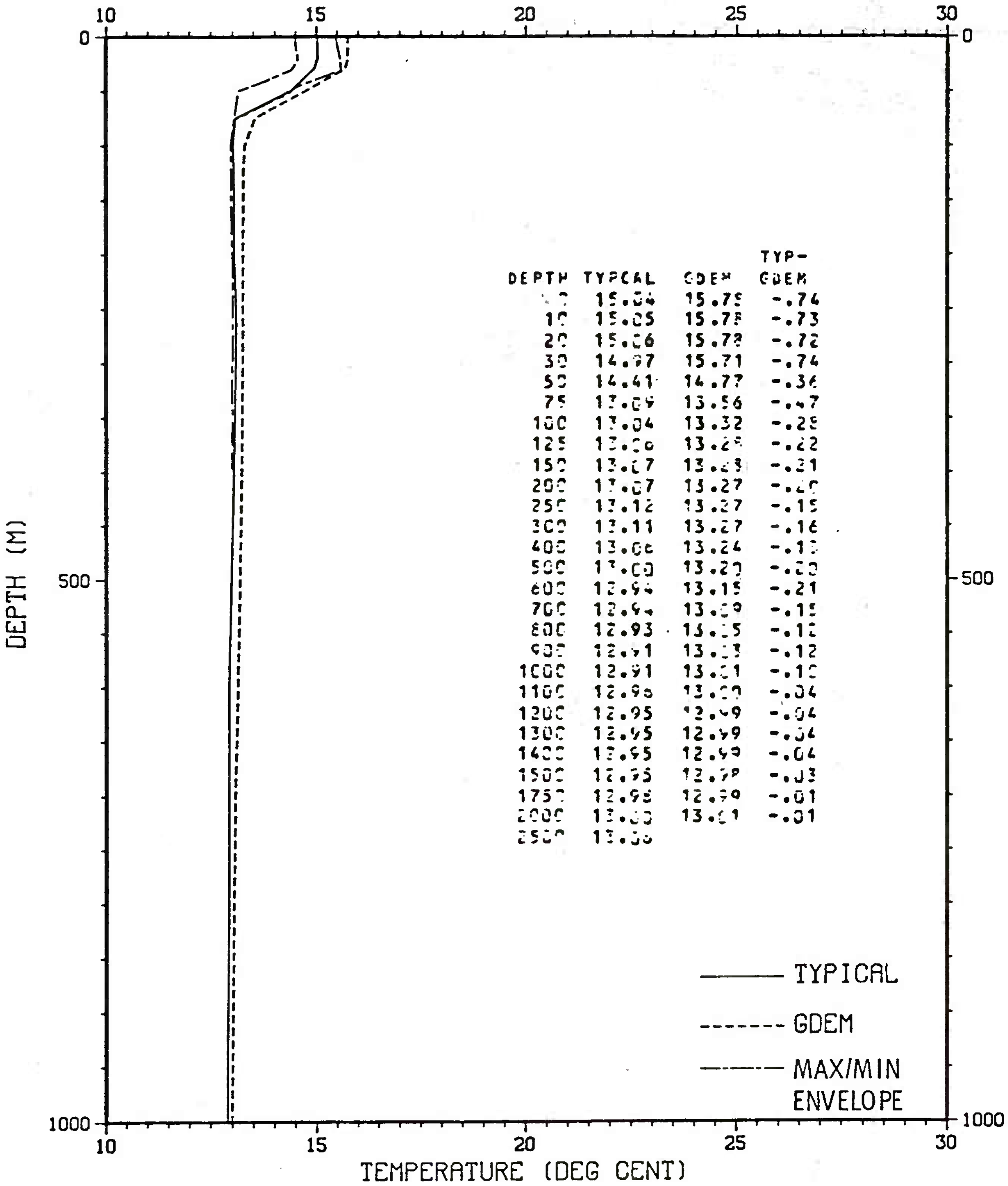
DEPTH	TYPCAL	GDEM	TYP-GDEM
0	17.29	15.96	1.33
10	16.54	15.81	.73
20	15.38	15.23	.15
30	14.55	14.55	.00
50	13.38	13.75	-.37
75	13.12	13.41	-.29
100	13.04	13.30	-.26
125	13.02	13.25	-.23
150	13.01	13.24	-.23
200	13.09	13.24	-.15
250	13.13	13.25	-.12
300	13.12	13.25	-.13
400	13.08	13.23	-.15
500	13.03	13.19	-.15
600	13.01	13.12	-.11
700	13.00	13.04	-.04
800	12.99	13.02	-.03
900	12.96	13.00	-.04
1000	12.95	12.98	-.03
1100	12.96	12.97	-.01
1200	12.95	12.96	-.01
1300	12.95	12.95	.00
1400	12.95	12.95	.00
1500	12.95	12.95	.00
1750	12.96	12.97	.01
2000	13.00	13.00	.00
2500	13.0[illegible]		

FIG. 3-2. VERTICAL TEMPERATURE PROFILE FOR BALEARIC SEA (APR - JUN)



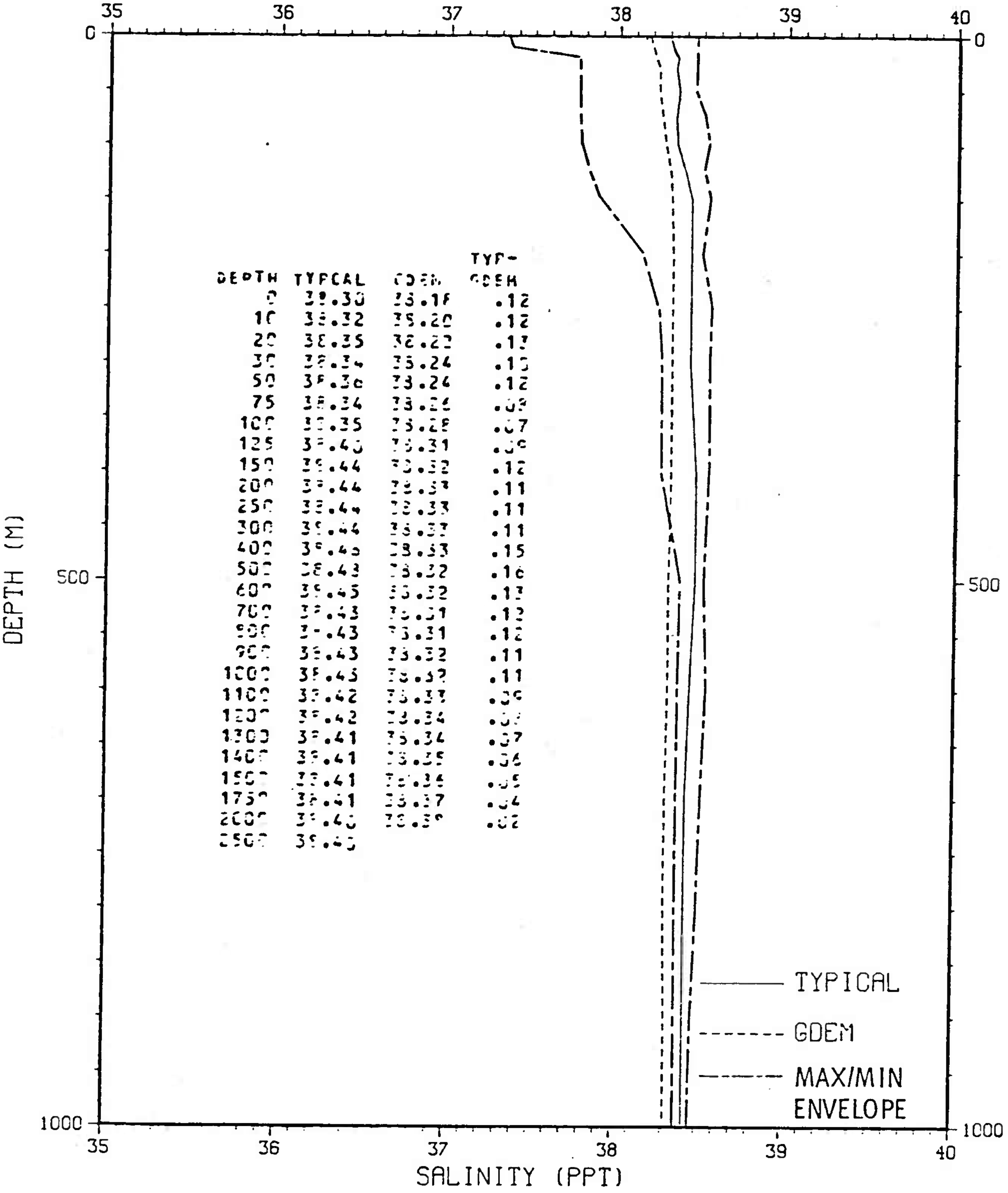
DEPTH	TYPCAL	GDEM	TYP-GDEM
0	23.28	22.14	1.14
10	20.56	22.03	-1.47
20	19.67	21.20	-1.53
30	18.19	19.39	-1.19
50	15.25	15.72	-.47
75	13.28	13.85	-.57
100	12.99	13.29	-.29
125	13.01	13.08	-.07
150	13.02	13.05	-.03
200	13.05	13.11	-.06
250	13.17	13.19	-.01
300	13.22	13.22	.00
400	13.16	13.22	-.06
500	13.12	13.16	-.04
600	13.08	13.09	-.01
700	13.03	13.04	-.01
800	13.00	13.00	.00
900	12.99	12.98	.01
1000	12.99	12.97	.02
1100	12.96	12.96	.00
1200	12.95	12.95	.00
1300	12.95	12.95	.00
1400	12.95	12.94	.01
1500	12.95	12.95	.00
1750	12.98	12.97	.01
2000	13.00	13.00	.00
2500	13.04		

FIG. 3-3. VERTICAL TEMPERATURE PROFILE FOR BALEARIC SEA (JUL - SEP)



DEPTH	TYPCAL	GDEM	TYP-GDEM
0	15.04	15.78	-.74
10	15.05	15.78	-.73
20	15.06	15.78	-.72
30	14.97	15.71	-.74
50	14.41	14.77	-.36
75	13.09	13.56	-.47
100	13.04	13.32	-.28
125	13.06	13.28	-.22
150	13.07	13.28	-.21
200	13.07	13.27	-.20
250	13.12	13.27	-.15
300	13.11	13.27	-.16
400	13.06	13.24	-.18
500	13.00	13.20	-.20
600	12.94	13.15	-.21
700	12.94	13.09	-.15
800	12.93	13.05	-.12
900	12.91	13.03	-.12
1000	12.91	13.01	-.10
1100	12.96	13.00	-.04
1200	12.95	12.99	-.04
1300	12.95	12.99	-.04
1400	12.95	12.99	-.04
1500	12.95	12.98	-.03
1750	12.98	12.99	-.01
2000	13.00	13.01	-.01
2500	13.00		

FIG. 3-4. VERTICAL TEMPERATURE PROFILE FOR BALEARIC SEA (OCT - DEC)



DEPTH	TYPICAL	GDEM	TYP-GDEM
0	38.30	38.18	.12
10	38.32	38.20	.12
20	38.35	38.22	.13
30	38.34	38.24	.13
50	38.36	38.24	.12
75	38.34	38.26	.08
100	38.35	38.28	.07
125	38.40	38.31	.09
150	38.44	38.32	.12
200	38.44	38.33	.11
250	38.44	38.33	.11
300	38.44	38.33	.11
400	38.45	38.33	.15
500	38.43	38.32	.16
600	38.45	38.32	.13
700	38.43	38.31	.12
800	38.43	38.31	.12
900	38.43	38.32	.11
1000	38.43	38.32	.11
1100	38.42	38.33	.09
1200	38.42	38.34	.08
1300	38.41	38.34	.07
1400	38.41	38.35	.06
1500	38.41	38.36	.05
1750	38.41	38.37	.04
2000	38.40	38.38	.02
2500	38.40		

FIG. 3-5. VERTICAL SALINITY PROFILE FOR BALEARIC SEA (JAN - MAR)

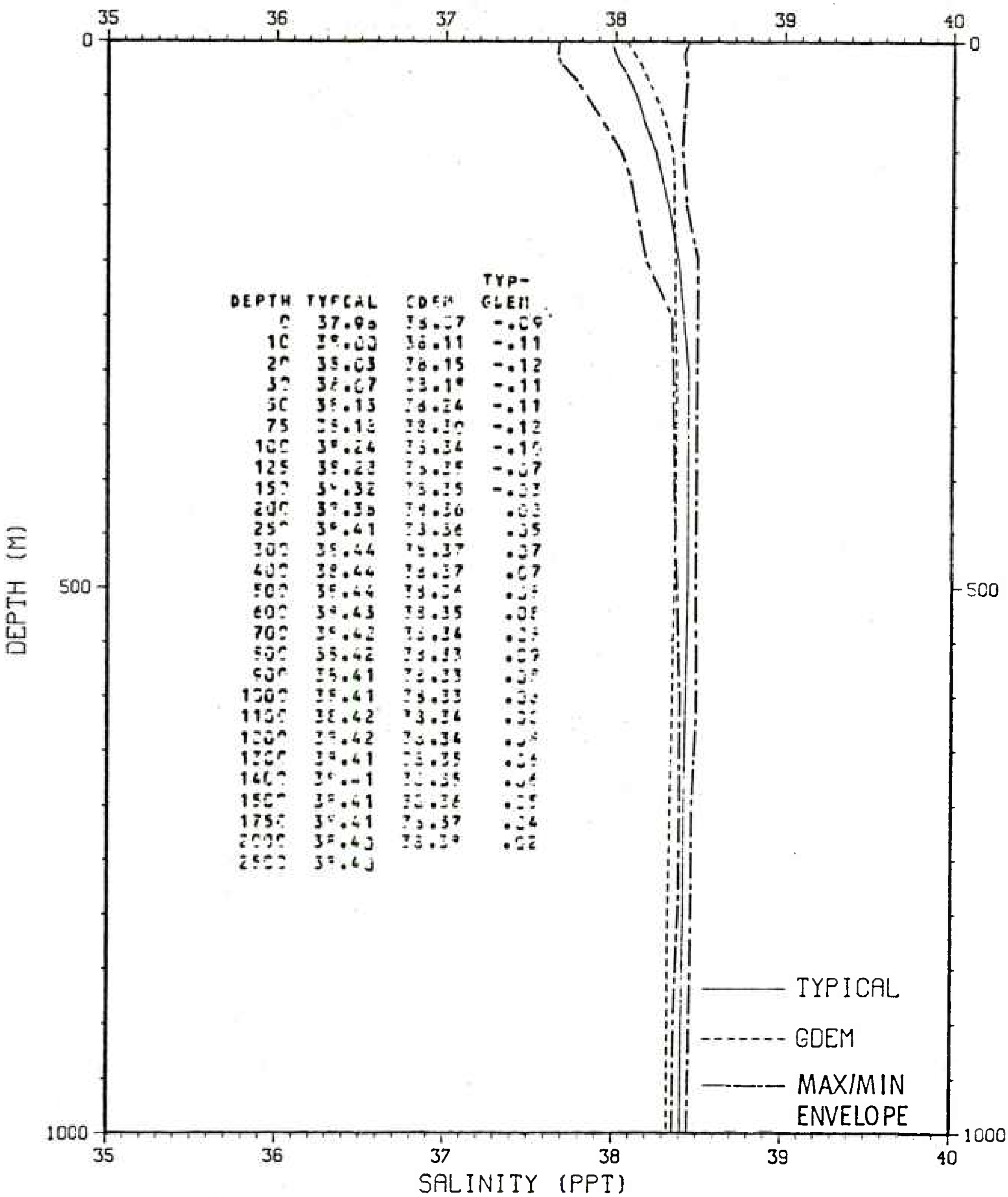
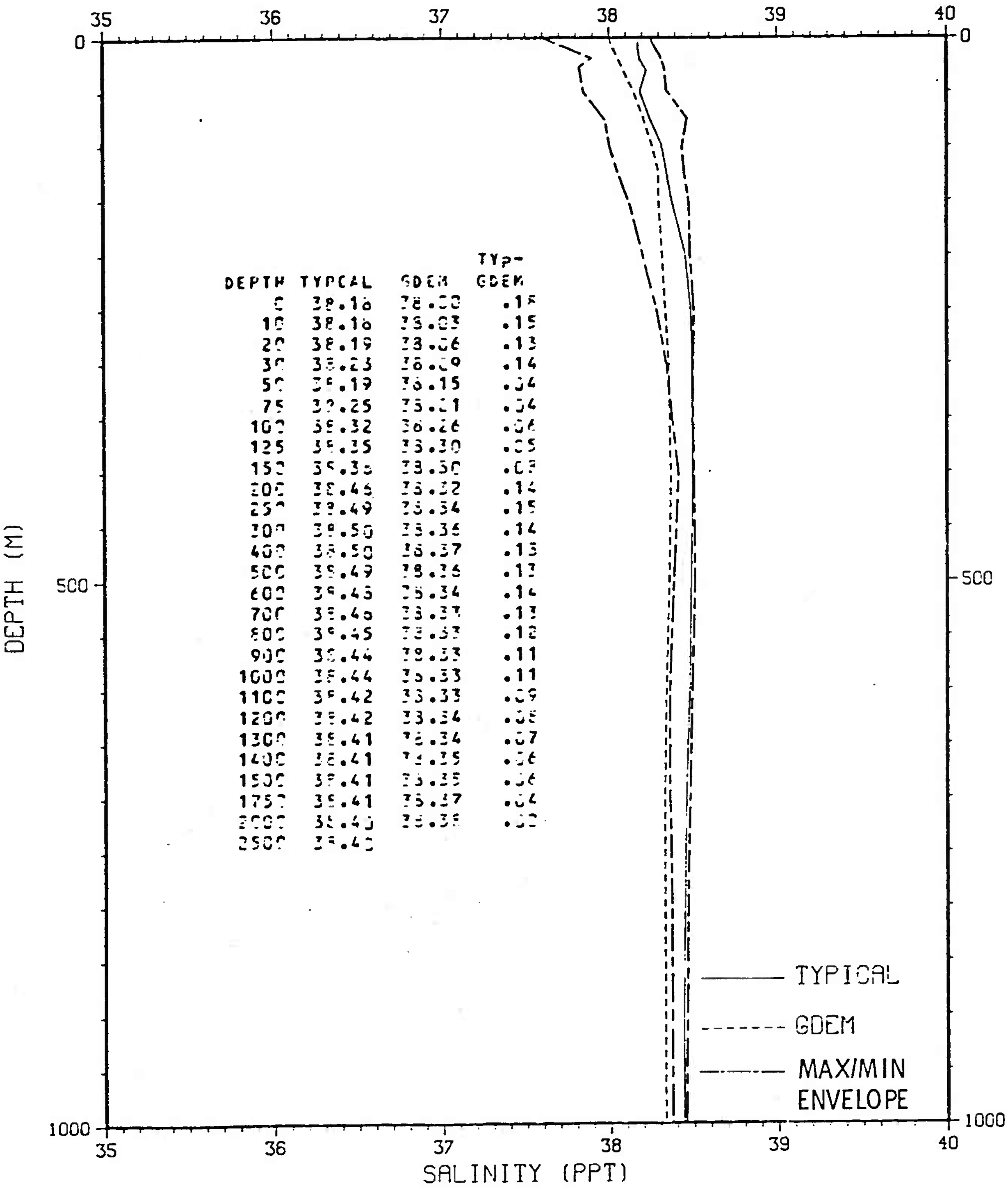
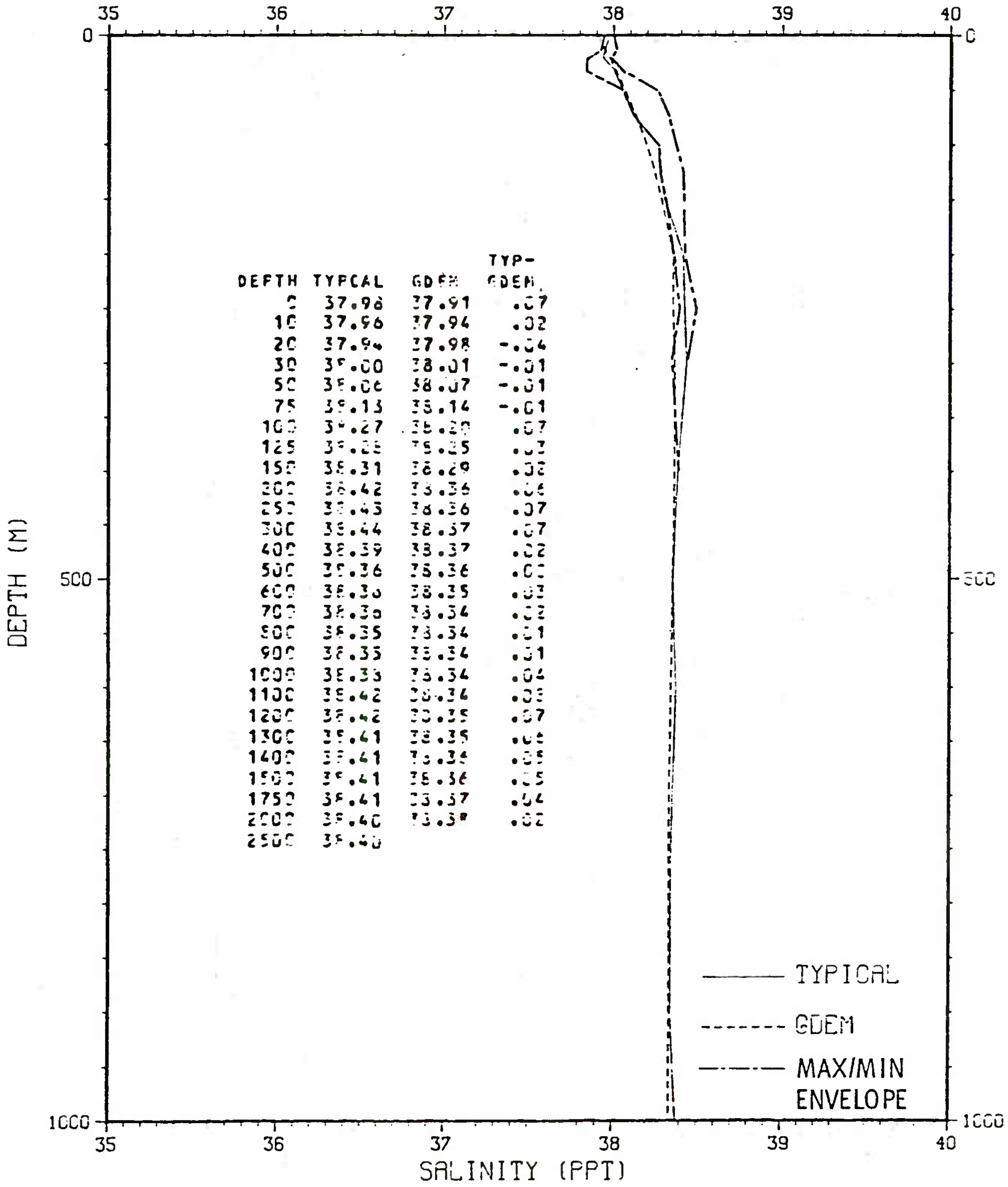


FIG. 3-6. VERTICAL SALINITY PROFILE FOR BALEARIC SEA (APR - JUN)



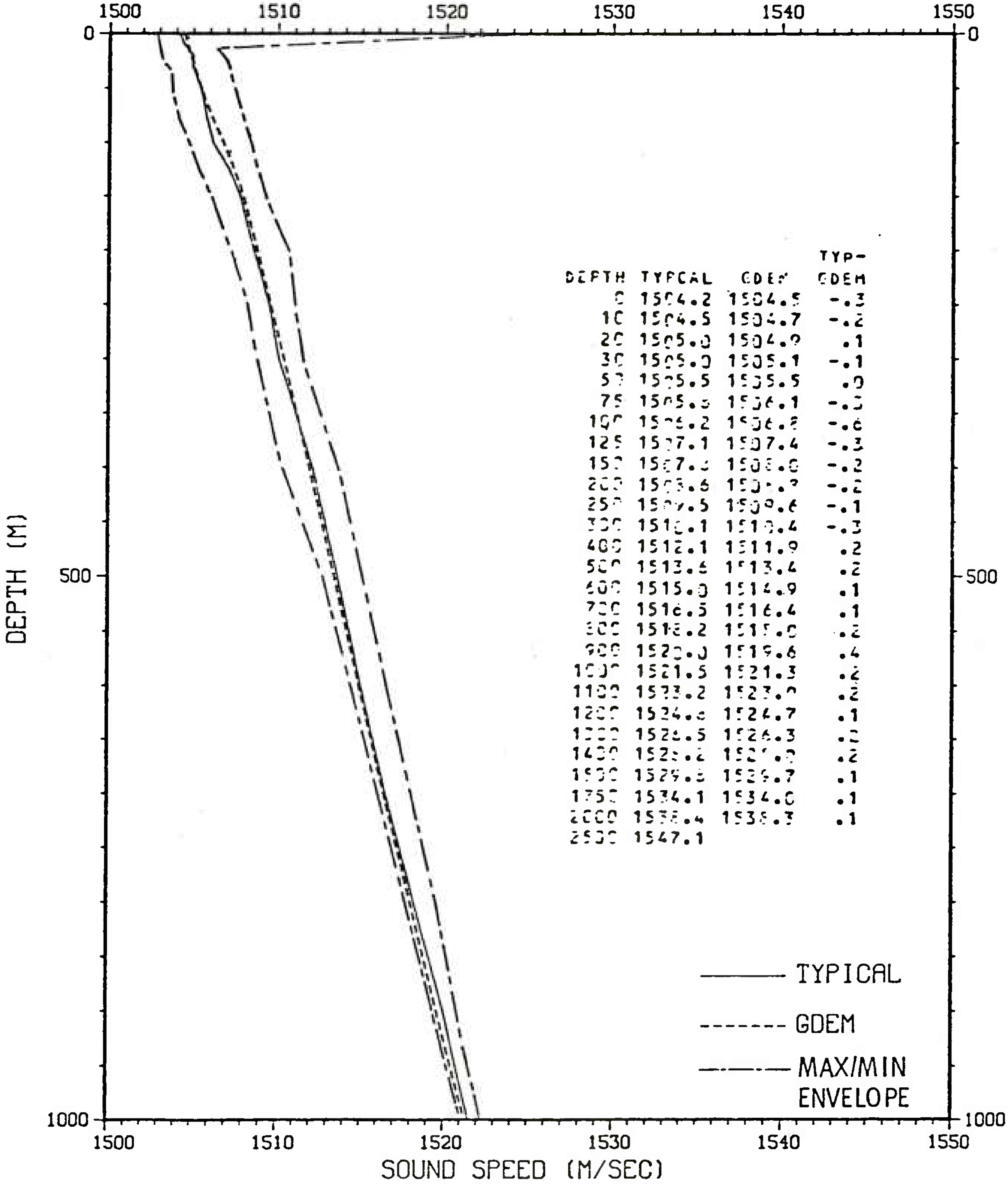
DEPTH	TYPCAL	GDEM	TYP-GDEM
0	38.16	38.00	.16
10	38.16	38.03	.15
20	38.19	38.06	.13
30	38.23	38.09	.14
50	38.19	38.15	.04
75	38.25	38.21	.04
100	38.32	38.26	.06
125	38.35	38.30	.05
150	38.33	38.30	.03
200	38.46	38.32	.14
250	38.49	38.34	.15
300	38.50	38.36	.14
400	38.50	38.37	.13
500	38.49	38.36	.13
600	38.48	38.34	.14
700	38.46	38.33	.13
800	38.45	38.33	.12
900	38.44	38.33	.11
1000	38.44	38.33	.11
1100	38.42	38.33	.09
1200	38.42	38.34	.08
1300	38.41	38.34	.07
1400	38.41	38.35	.06
1500	38.41	38.35	.06
1750	38.41	38.37	.04
2000	38.40	38.38	.02
2500	38.40		

FIG. 3-7. VERTICAL SALINITY PROFILE FOR BALEARIC SEA (JUL - SEP)



DEPTH	TYPCAL	GDEM	TYP-GDEM
0	37.98	37.91	.07
10	37.96	37.94	.02
20	37.94	37.98	-.04
30	38.00	38.01	-.01
50	38.06	38.07	-.01
75	38.13	38.14	-.01
100	38.27	38.20	.07
125	38.28	38.25	.03
150	38.31	38.29	.02
200	38.42	38.36	.06
250	38.43	38.36	.07
300	38.44	38.37	.07
400	38.39	38.37	.02
500	38.36	38.36	.00
600	38.38	38.35	.03
700	38.36	38.34	.02
800	38.35	38.34	.01
900	38.35	38.34	.01
1000	38.38	38.34	.04
1100	38.42	38.34	.08
1200	38.42	38.35	.07
1300	38.41	38.35	.06
1400	38.41	38.36	.05
1500	38.41	38.36	.05
1750	38.41	38.37	.04
2000	38.40	38.38	.02
2500	38.40		

FIG. 3-8. VERTICAL SALINITY PROFILE FOR BALEARIC SEA (OCT - DEC)



DEPTH	TYPCAL	GDEM	TYP-GDEM
0	1504.2	1504.5	-.3
10	1504.5	1504.7	-.2
20	1505.0	1504.9	.1
30	1505.0	1505.1	-.1
50	1505.5	1505.5	.0
75	1505.8	1506.1	-.3
100	1506.2	1506.8	-.6
125	1507.1	1507.4	-.3
150	1507.8	1508.0	-.2
200	1508.6	1508.8	-.2
250	1509.5	1509.6	-.1
300	1510.1	1510.4	-.3
400	1512.1	1511.9	.2
500	1513.6	1513.4	.2
600	1515.0	1514.9	.1
700	1516.5	1516.4	.1
800	1518.2	1518.0	.2
900	1520.0	1519.6	.4
1000	1521.5	1521.3	.2
1100	1523.2	1523.0	.2
1200	1524.8	1524.7	.1
1300	1526.5	1526.3	.2
1400	1528.2	1528.0	.2
1500	1529.8	1529.7	.1
1750	1534.1	1534.0	.1
2000	1538.4	1538.3	.1
2500	1547.1		

FIG. 3-9. VERTICAL SOUND-SPEED PROFILE FOR BALEARIC SEA (JAN - MAR)

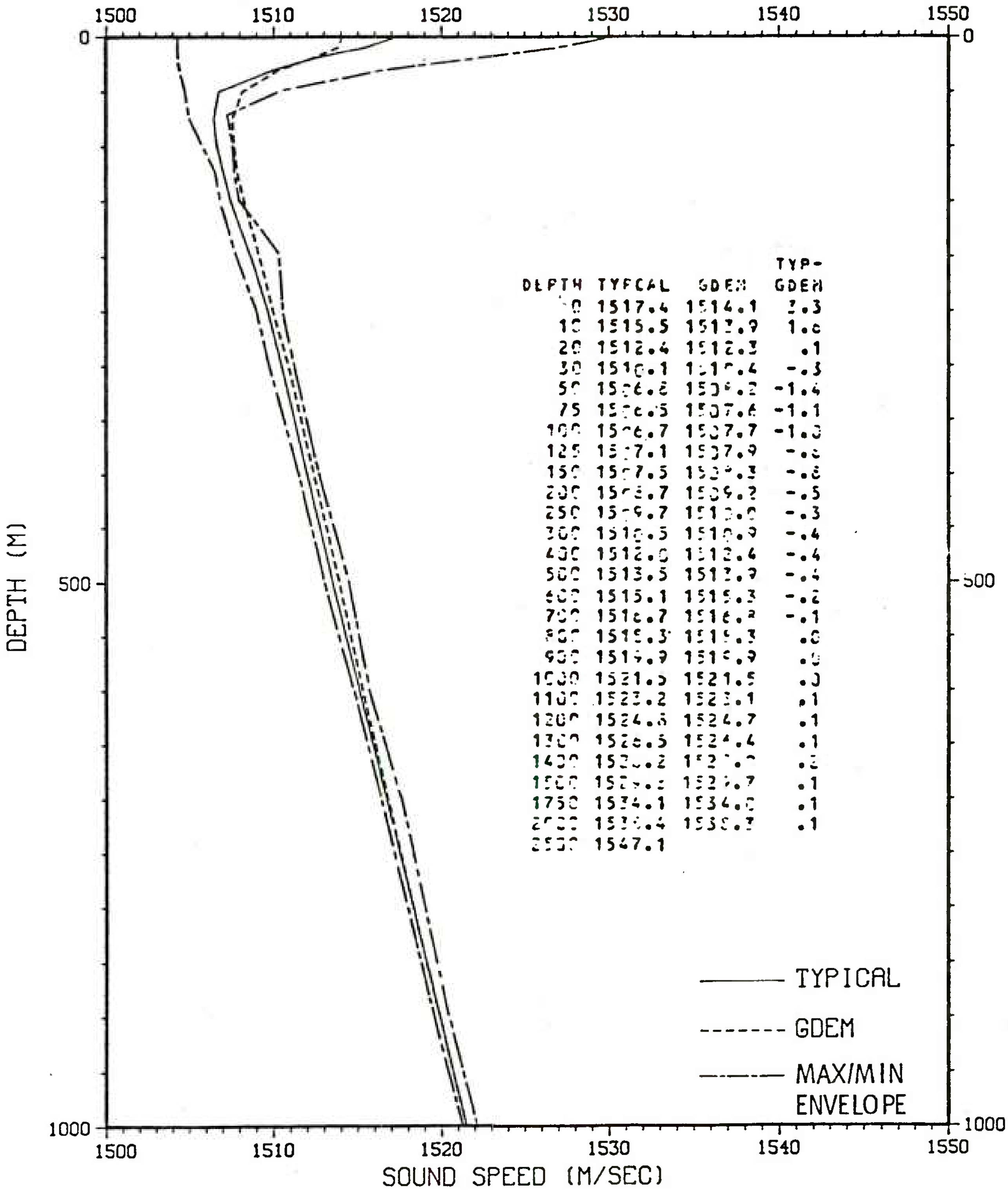
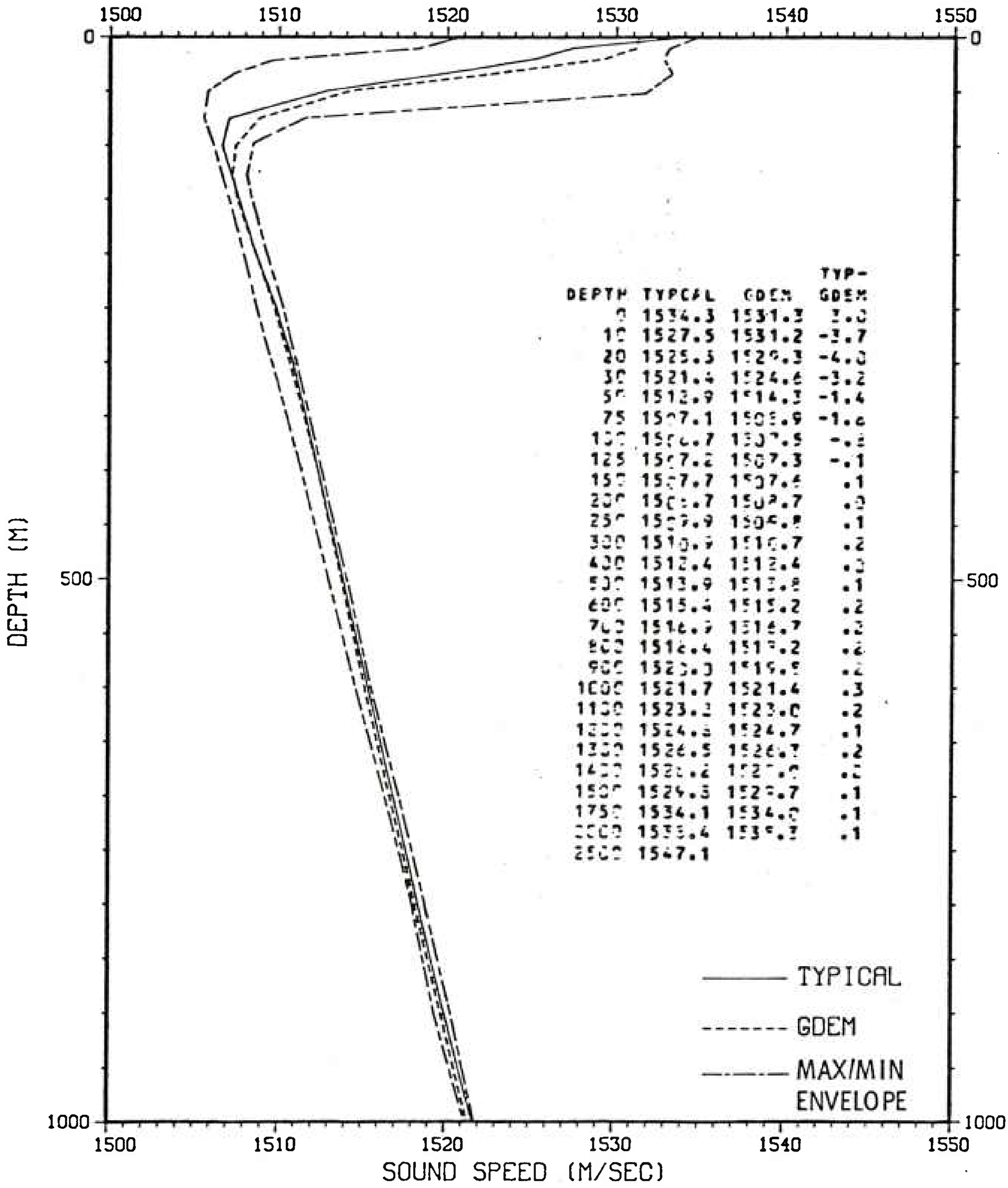
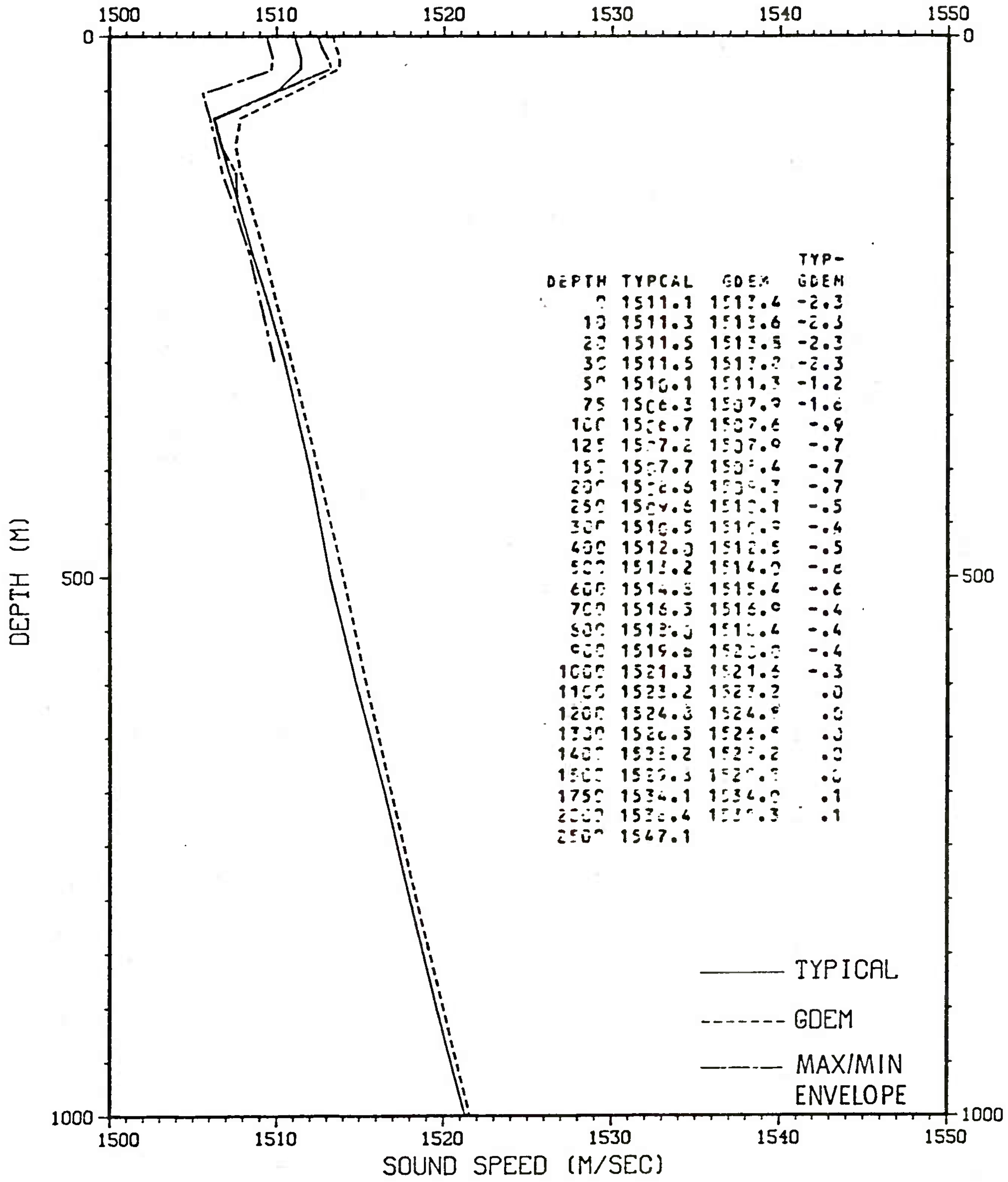


FIG. 3-10. VERTICAL SOUND-SPEED PROFILE FOR BALEARIC SEA (APR - JUN)



DEPTH	TYPICAL	GDEM	TYP-GDEM
0	1534.3	1531.3	3.0
10	1527.5	1531.2	-3.7
20	1525.3	1529.3	-4.0
30	1521.4	1524.6	-3.2
50	1512.9	1514.3	-1.4
75	1507.1	1508.9	-1.8
100	1506.7	1507.5	-.8
125	1507.2	1507.3	-.1
150	1507.7	1507.6	.1
200	1508.7	1508.7	.0
250	1509.9	1509.8	.1
300	1510.9	1510.7	.2
400	1512.4	1512.4	.0
500	1513.9	1513.8	.1
600	1515.4	1515.2	.2
700	1516.9	1516.7	.2
800	1518.4	1518.2	.2
900	1520.0	1519.8	.2
1000	1521.7	1521.4	.3
1100	1523.2	1523.0	.2
1200	1524.8	1524.7	.1
1300	1526.5	1526.3	.2
1400	1528.2	1528.0	.2
1500	1529.8	1529.7	.1
1750	1534.1	1534.0	.1
2000	1538.4	1538.3	.1
2500	1547.1		

FIG. 3-11. VERTICAL SOUND-SPEED PROFILE FOR BALEARIC SEA (JUL - SEP)



DEPTH	TYPCAL	GDEM	TYP-GDEM
0	1511.1	1513.4	-2.3
10	1511.3	1513.6	-2.3
20	1511.5	1513.5	-2.3
30	1511.5	1513.8	-2.3
50	1510.1	1511.3	-1.2
75	1506.3	1507.9	-1.6
100	1506.7	1507.6	-.9
125	1507.2	1507.9	-.7
150	1507.7	1508.4	-.7
200	1508.6	1509.3	-.7
250	1509.6	1510.1	-.5
300	1510.5	1510.9	-.4
400	1512.0	1512.5	-.5
500	1513.2	1514.0	-.8
600	1514.8	1515.4	-.6
700	1516.5	1516.9	-.4
800	1518.0	1518.4	-.4
900	1519.6	1520.0	-.4
1000	1521.3	1521.6	-.3
1100	1523.2	1523.2	.0
1200	1524.8	1524.9	.0
1300	1526.5	1526.5	.0
1400	1528.2	1528.2	.0
1500	1529.9	1529.9	.0
1750	1534.1	1534.0	.1
2000	1538.4	1538.3	.1
2500	1547.1		

FIG. 3-12. VERTICAL SOUND-SPEED PROFILE FOR BALEAREC SEA (OCT - DEC)

4.0 VERTICAL TEMPERATURE, SALINITY, AND SOUND-SPEED PROFILE COMPARISONS FOR MEDITERRANEAN (MED) LOCATION #3

Twelve vertical comparisons of temperature (T), salinity (S), and sound-speed (SS) for winter, spring, summer, and fall seasons are presented in this section.

4.1 Description

Med Location #3 is taken from the Tyrrhenian Sea region of the Mediterranean Sea. The geographical location selected for this comparison was at 40°00' north latitude and 012°00' east longitude. Vertical temperature, salinity, and sound-speed profiles of seasonal comparisons are shown in Figures 4-1 through 4-12.

The Tyrrhenian Sea region of the central Mediterranean Sea, depicted as Region C in Figure 1-1, is defined for this report as the body of water bounded to the west by the islands of Corsica and Sardinia; to the north and east by the southern coastline of Italy, and to the south by the island of Sicily.

Meteorologically, this region is considered variable and influenced in part by a region of cyclogenesis located over the Gulf of Genoa. The major geographical feature influencing the role of cyclogenesis in the Gulf of Genoa is the Alps, which are north of Italy. The Alps have been known to play a key role in determining the weather over the Gulf of Genoa, the northern Adriatic Sea, and the Ligurian Sea in terms of fronts, planetary waves, and degree of cyclogenesis. The Gulf of Genoa is perhaps one of the most significant regions of the world for cyclogenesis.

Oceanographically, this region is considered variable. The ocean variability and changes in the vertical water column (more so than in the horizontal) are directly influenced by the impulses received from the path of cyclogenesis which begin in the Gulf of Genoa toward the eastern part of Sicily. The vertical variability throughout the track region can be expected to provide broad and relatively deep seasonal ocean variability.

4.2 Comparisons for Location #3

The vertical site comparisons of seasonal temperature, salinity, and sound-speed profiles, respectively, were presented for Med Location #3.

- Temperature:

  The January-to-March temperature envelope was based on a sample size of 15 observations (Figure 4-1). The GDEM value at the surface fell within the envelope of observed values. There was no difference between the numerical values at the surface. Between the 10 and 300 m levels, differences were less than 0.09°C. Between the 400 and 900 m levels, differences did not exceed 0.21°C. Below 900 m, the differences did not exceed 0.06°C.

  The April-to-June temperature envelope was based on a sample size of 11 observations (Figure 4-2). The GDEM value at the surface fell within the envelope of observed values and differed from the typical by 1.46°C. Differences at the 10 m, 20 m, and 30 m levels were 1.77°C, 1.46°C, and 1.08°C, respectively. Between 75 m and 1000 m, the differences did not exceed 0.33°C. Below 1000 m, the differences did not exceed 0.07°C.

  The July-to-September temperature envelope was based on a sample size of 40 observations (Figure 4-3). The GDEM value at the surface fell within the envelope of observed values and differed from the typical by 0.30°C. Differences at the 30 m and 50 m levels were 2.69°C and 1.12°C, respectively. Between the 75 m and 1000 m levels, the differences did not exceed 0.32°C. Below 1000 m, the differences did not exceed 0.06°C.

  The October-to-December temperature envelope could not be developed because of an insufficient number of adequate data samples (Figure 4-4). There were two usable observations for this location. The GDEM value at the surface differed from the available typical by 2.92°C. This magnitude of difference continued at the 10 m, 20 m, and 30 m levels. Between the 75 m and 400 m levels, the differences did not exceed 0.38°C. Below 400 m, the differences did not exceed 0.16°C.

- Salinity:

  The January-to-March salinity envelope was based on a data sample size of 15 observations (Figure 4-5). The GDEM value at the surface fell within the envelope of observed values and differed from the typical by 0.11 ppt. Differences in numerical value were found between the profiles with depth. Between the 10 and 30 m levels, the differences were less than 0.05 ppt. Between 50 and 100 m, the differences ranged from 0.12 to 0.18 ppt. Between 125 and 2000 m, the differences did not exceed 0.12 ppt.

The April-to-June salinity envelope was based on a data sample size of 11 observations (Figure 4-6). The GDEM value at the surface fell within the envelope of observed values and differed from the typical by 0.02 ppt. Between the 10 and 1300 m levels, the differences did not exceed 0.12 ppt. Below 1750 m, the differences did not exceed 0.06 ppt.

The July-to-September salinity envelope was based on a data sample size of 40 observations (Figure 4-7). The GDEM value at the surface fell within the envelope of observed values and differed from the typical by 0.06 ppt. Differences of 0.26 and 0.21 ppt existed at the 50 and 75 m levels, respectively. Below 200 m down to 1400 m, the differences were between 0.08 and 0.13 ppt. Below 1750 m, the differences did not exceed 0.06 ppt.

The October-to-December salinity envelope could not be developed because of an insufficient number of adequate data samples (Figure 4-8). There were two usable observations for this location. The GDEM value at the surface differed from the nonrepresentative typical by 0.27 ppt. A maximum difference of 0.33 ppt existed at 50 m. Between 100 and 1400 m, the differences did not exceed 0.13 ppt. Below 1750 m, the differences did not exceed 0.06 ppt.

- Sound Speed:

The January-to-March sound-speed envelope was based on a data sample size of 15 observations (Figure 4-9). The GDEM value at the surface fell within the envelope of observed values and differed from the typical by 0.1 m/s. With the exception of the differences at the 400 m, 500 m, and 600 m levels (which have differences of 0.4 m/s, 0.6 m/s, and 0.4 m/s, respectively), all differences below the surface and down to 3000 m did not exceed 0.3 m/s.

The April-to-June sound-speed envelope was based on a data sample size of 11 observations (Figure 4-10). The GDEM value at the surface fell within the envelope of observed values and differed from the typical by 4.6 m/s. Differences of 5.5 m/s, 4.6 m/s, 3.5 m/s, 1.9 m/s, 1.2 m/s, and 1.0 m/s existed at the 10 m, 20 m, 30 m, 50 m, 75 m, and 100 m levels, respectively. Between 100 to 3000 m, all differences did not exceed 0.7 m/s.

The July-to-September sound-speed envelope was based on a sample size of 40 observations (Figure 4-11). The GDEM value at the surface fell within the envelope of observed values and differed from the typical by 0.7 m/s. With the exception of these differences at the 20 m, 30 m, 50 m, 250 m, 300 m levels (of 2.2 m/s, 6.9 m/s, 3.2 m/s, 0.8 m/s, and 1.1 m/s, respectively) all differences below the surface down to 3000 m did not exceed 0.7 m/s.

The October-to-December sound-speed envelope was not developed because of an insufficient number of adequate data samples (Figure 4-12). There were two usable observations for this location. The GDEM value at the surface differed from the nonrepresentative typical by 7.4 m/s. Differences below the surface to 100 m did exist. These differences for the 10 m, 20 m, 30 m, 50 m, 75 m, and 100 m levels were 8.3 m/s, 7.6 m/s, 8.0 m/s, 3.0 m/s, 1.5 m/s, and 1.3 m/s, respectively. With the exception of the 125 and 250 m levels, all differences below 125 m down to 3000 m did not exceed 0.5 m/s.

4.3 Evaluation - Tyrrhenian Sea (Location #3)

- January to March:

  Comparison between GDEM and the typical temperature profiles revealed similar thermal structures. The differences in the absolute numerical values were small from the surface to 3000 m. The GDEM profile was nearly identical to the typical. The GDEM profile remained within the envelope of observed values. A relatively isothermal characteristic is known for this region. GDEM reflected a seasonally averaged winter thermal structure for this variable region when compared with the 15 usable observations.

  Comparison between GDEM and the typical salinity profiles revealed similar numerical values and gradients. The GDEM historical profile reflected a late seasonally averaged winter profile. Both GDEM and the typical remained within the broad envelope (approximately 0.4 ppt) between 100 and 200 m. GDEM reflected a winter haline structure for this variable region when compared with the 15 usable observations.

  Comparison between GDEM and the typical sound-speed profiles revealed similar sound speed structures. Differences in numerical values were very small and the envelope of observed values was narrow and well defined. The proper half-channel mode was firmly represented. GDEM reflected a seasonally averaged winter sound-speed structure for this variable ocean region when compared with the 15 usable observations.

- April to June:

  Comparison between GDEM and the typical temperature profiles revealed similar thermal structure below 150 m. Between the surface and 150 m, the GDEM profile exhibited higher values and stronger thermal gradients within the thermocline region. Such temperatures and gradients were associated with biases caused by data sampling. The envelope was wide, and suited for both types of thermal structures. Both GDEM and the typical remained within the envelope. GDEM reflected a seasonally averaged spring thermal structure for this variable ocean region when compared with the 11 usable observations.

Comparison between GDEM and the typical salinity profiles revealed similar gradients above 200 m. The decreasing salinity gradient of the GDEM halocline between 200 to 500 m caused the profile to depart outside the envelope. The GDEM salinity values appeared to be low for this region below 500 m and could be increased by 0.08 to 0.13 ppt. Below 500 m, GDEM reflected a seasonally averaged spring haline structure for this variable ocean region when compared with the 11 usable observations.

Comparison between GDEM and the typical sound-speed profiles revealed similar sound speed structures below 150 m. Between the surface and 150 m, the GDEM was consistently higher in value. The sonocline gradient was also greater in GDEM; nevertheless, the GDEM profile remained within the envelope of observed values. Higher values in the GDEM sonocline resulted from higher values in temperature and salinity. The difference in gradient was influenced more by the temperature profile. The envelope was substantially wide from the surface down to the sound-channel axis. The depths of the sound-channel axes were similar. Both GDEM and the typical remained within the envelope. GDEM reflected a seasonally averaged spring sound-speed structure for this variable ocean region when compared with the 11 usable observations.

- July to September:

  Comparison between GDEM and the typical temperature profiles between the surface to 200 m and below 400 m to 3000 m revealed similar thermal structure. Between 200 and 400 m there was a difference between GDEM and the typical. Between these levels GDEM indicated an isothermal structure; the typical indicated a secondary subsurface minimum at 300 m. Between 300 to 600 m, the GDEM profile fell outside the envelope. The near surface, the thermal structure was very strong and well defined by realistic thermocline gradients for this region of the ocean. GDEM represented a seasonally averaged thermal structure for this variable ocean region when compared with the 40 usable observations.

  Comparison between GDEM and the typical salinity profiles exhibited a difference in profile gradients as well as in numerical values. The envelope was broad near the surface, and remained wide with increasing depth. Both GDEM and the typical remained within the envelope. The haline structures of GDEM and the typical for the near-surface layers was an example of a comparison between an average profile and an observed salinity profile in a high-salinity, varying ocean environment. Both remained within the envelope of observations. The GDEM structure exhibited gradients which were representative of a seasonally averaged salinity profile for this region of the ocean. The GDEM profile reflected a seasonally averaged haline structure for this variable ocean region when compared with the 40 usable observations.

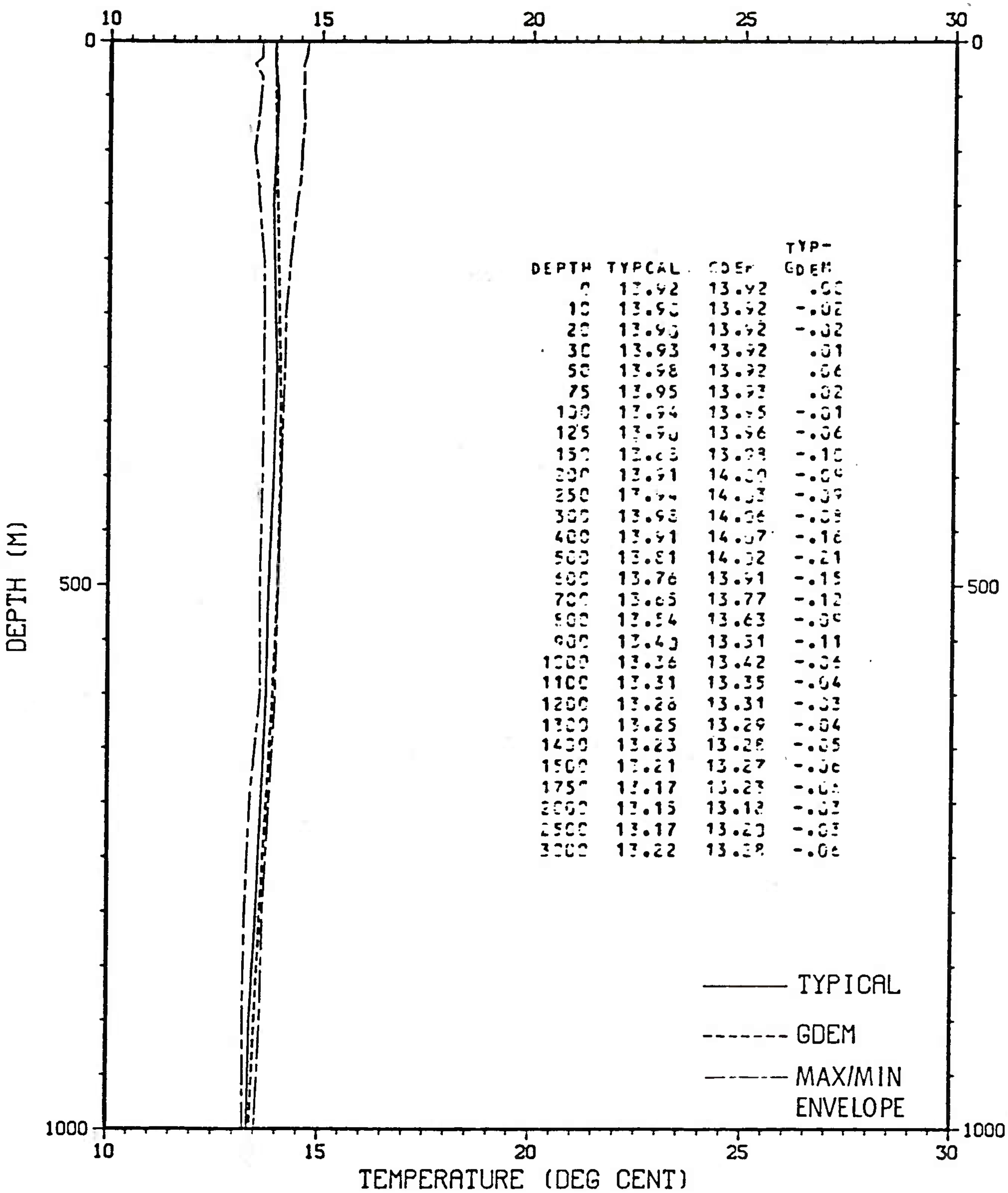
Comparison between GDEM and the typical sound-speed profiles between the surface to 200 m and 400 m to 3000 m revealed similar sound-speed structure. The depths of the sound-channel axes were similar. The GDEM structure reflected a seasonally averaged summer sound-speed structure for this variable ocean region when compared with the 40 usable observations.

- October to December:

  Comparison between GDEM and the typical temperature profiles revealed similar thermal structures. The surface values were different, but the magnitudes of these differences were realistic. The depths of the mixed layers were similar, as well as the gradients within the thermoclines. The profiles below the bottom of the thermoclines were identical. Due to an insufficient number of adequate data samples (two usable observations), an envelope was not developed. The GDEM reflected a seasonally averaged fall temperature structure for this variable ocean region.

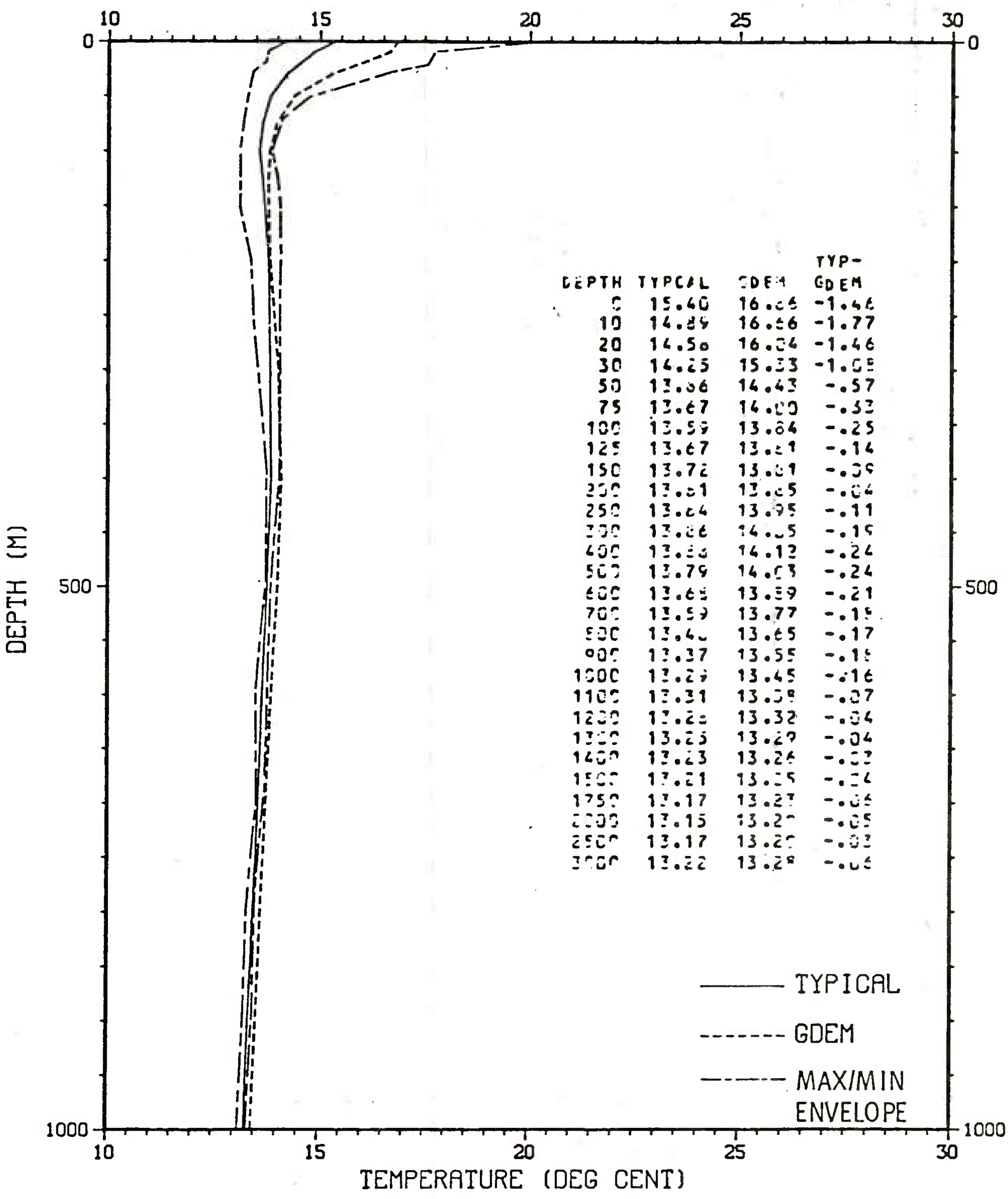
  Comparison between GDEM and the typical salinity profiles revealed a seasonally averaged fall haline structure for this variable ocean region. Below 600 m, the gradient appeared conservative with depth. The values below 500 m can be increased by 0.05 ppt to 0.16 ppt. GDEM reflected a seasonally averaged fall haline structure for this ocean region.

  Comparison between GDEM and the typical sound-speed profiles revealed similar sound-speed structures. The surface layers were different in value; however, the depth of the sonic layer and the gradients of the sonocline were similar. Values and gradients below the sound-channel axis and the depths of the sound-channel axis were similar. GDEM represented a seasonally averaged fall sound-speed structure for this variable ocean region.



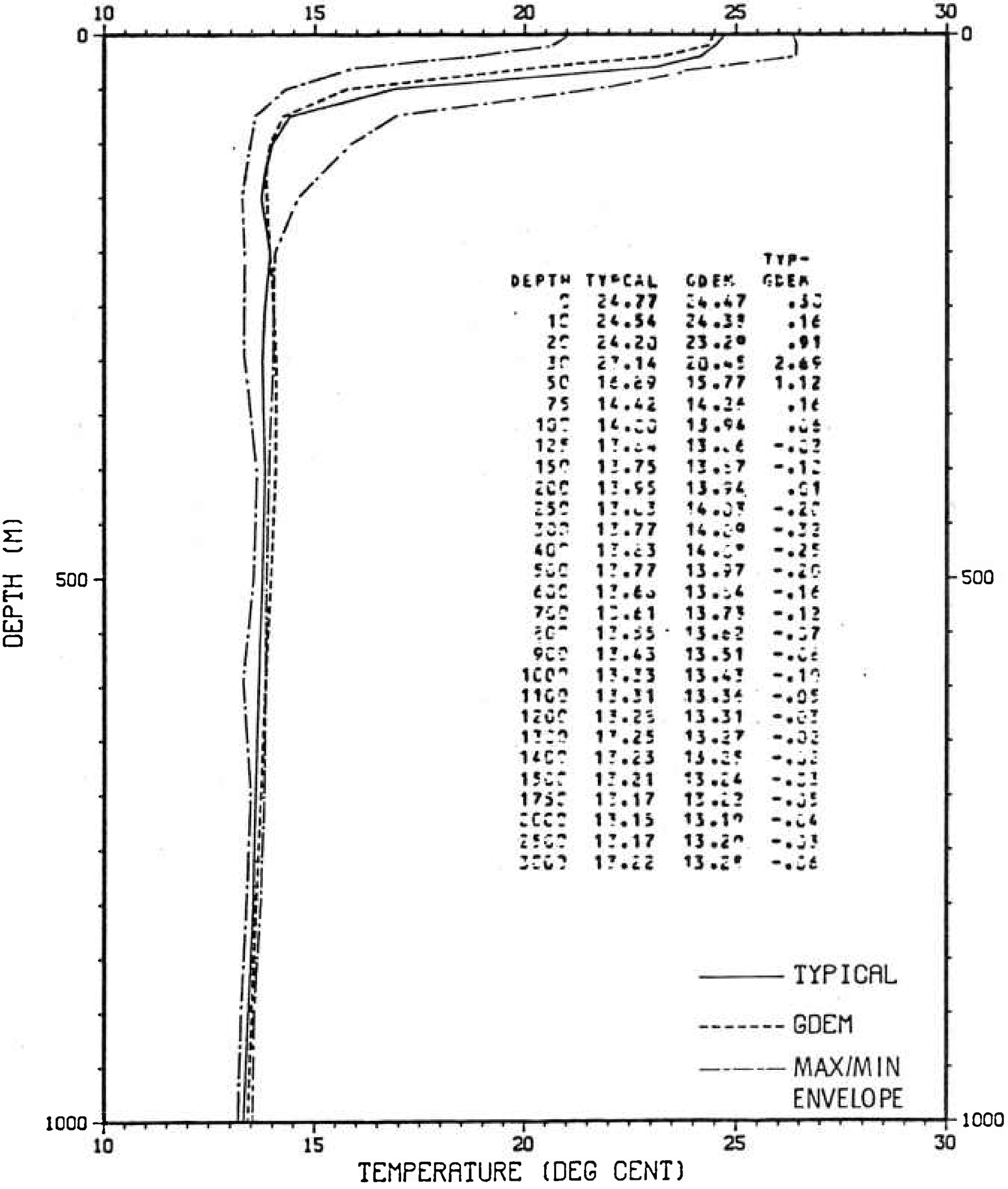
DEPTH	TYPCAL	GDEM	TYP-GDEM
0	13.92	13.92	.00
10	13.90	13.92	-.02
20	13.90	13.92	-.02
30	13.93	13.92	.01
50	13.98	13.92	.06
75	13.95	13.93	.02
100	13.94	13.95	-.01
125	13.90	13.96	-.06
150	13.83	13.98	-.15
200	13.91	14.00	-.09
250	13.94	14.03	-.09
300	13.98	14.06	-.08
400	13.91	14.07	-.16
500	13.81	14.02	-.21
600	13.76	13.91	-.15
700	13.65	13.77	-.12
800	13.54	13.63	-.09
900	13.40	13.51	-.11
1000	13.36	13.42	-.06
1100	13.31	13.35	-.04
1200	13.28	13.31	-.03
1300	13.25	13.29	-.04
1400	13.23	13.28	-.05
1500	13.21	13.27	-.06
1750	13.17	13.23	-.06
2000	13.15	13.18	-.03
2500	13.17	13.20	-.03
3000	13.22	13.28	-.06

FIG. 4-1. VERTICAL TEMPERATURE PROFILE FOR TYRRHENIAN SEA (JAN - MAR)



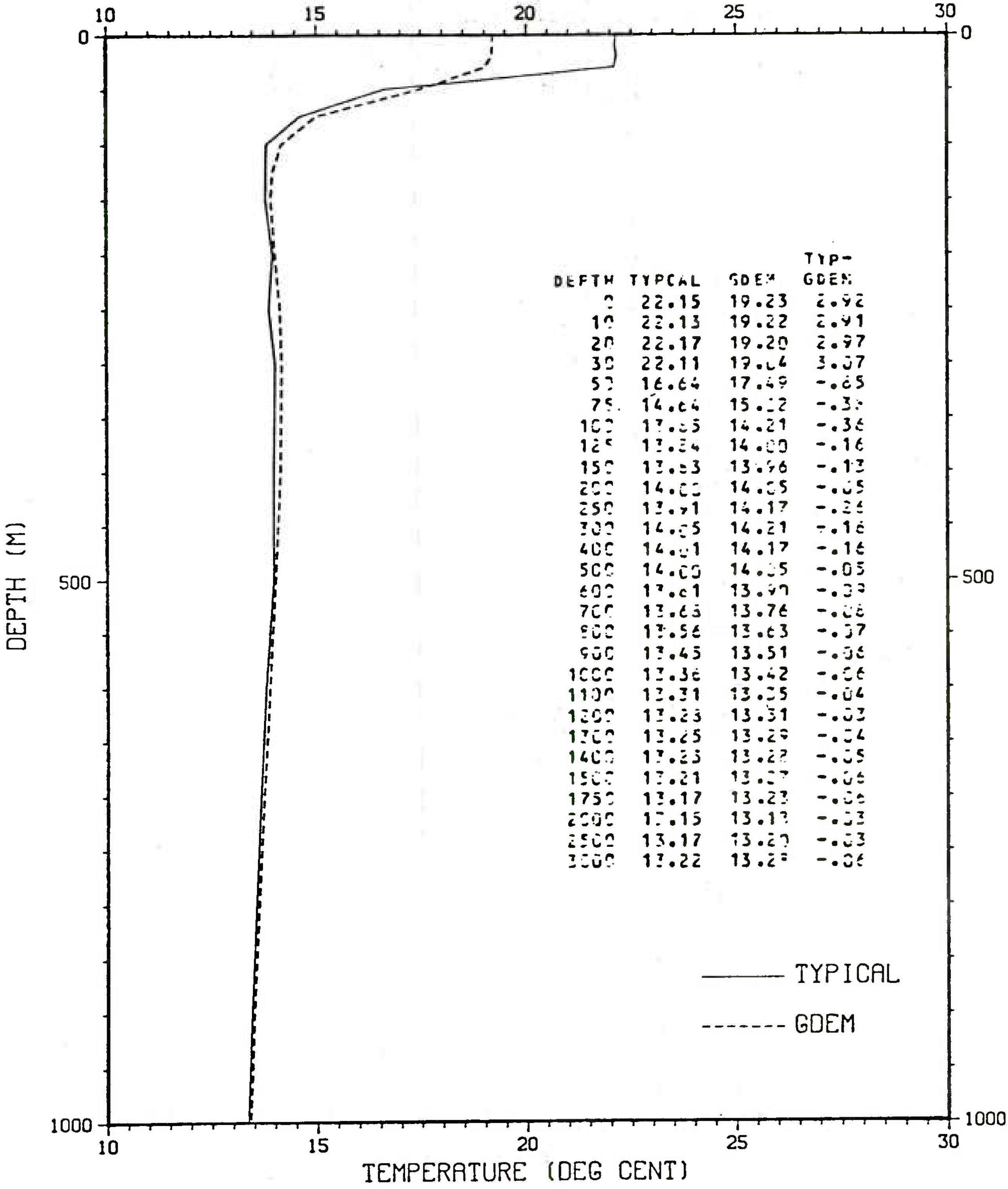
DEPTH	TYPCAL	GDEM	TYP-GDEM
0	15.40	16.86	-1.46
10	14.89	16.66	-1.77
20	14.58	16.04	-1.46
30	14.25	15.33	-1.08
50	13.86	14.43	-.57
75	13.67	14.00	-.33
100	13.59	13.84	-.25
125	13.67	13.81	-.14
150	13.72	13.81	-.09
200	13.81	13.85	-.04
250	13.84	13.95	-.11
300	13.86	14.05	-.19
400	13.88	14.12	-.24
500	13.79	14.03	-.24
600	13.68	13.89	-.21
700	13.59	13.77	-.18
800	13.48	13.65	-.17
900	13.37	13.55	-.18
1000	13.29	13.45	-.16
1100	13.31	13.38	-.07
1200	13.28	13.32	-.04
1300	13.25	13.29	-.04
1400	13.23	13.26	-.03
1500	13.21	13.25	-.04
1750	13.17	13.23	-.06
2000	13.15	13.20	-.05
2500	13.17	13.20	-.03
3000	13.22	13.28	-.06

FIG. 4-2. VERTICAL TEMPERATURE PROFILE FOR TYRRHENIAN SEA (APR - JUN)



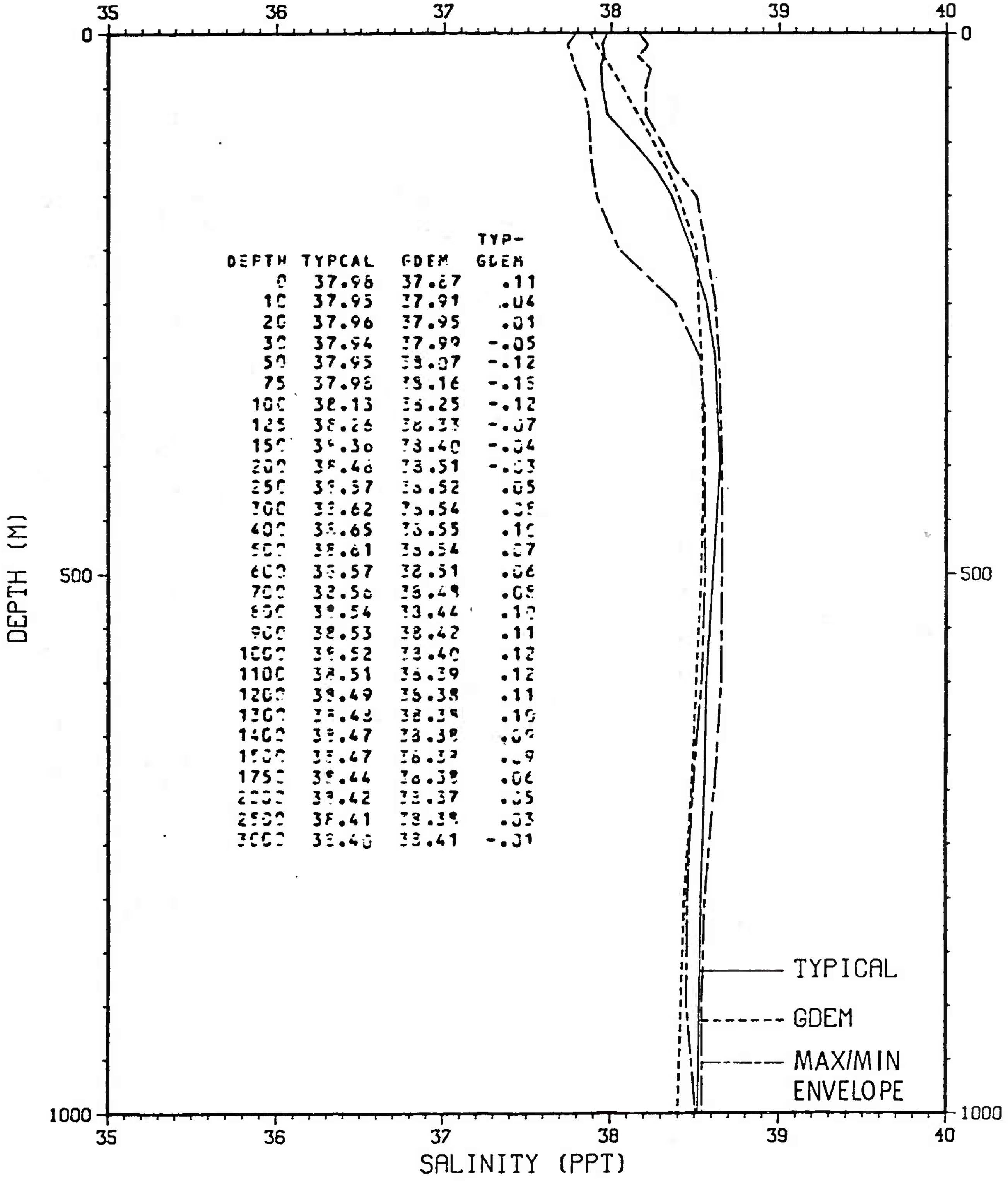
DEPTH	TYPICAL	GDEM	TYP-GDEM
0	24.77	24.47	.30
10	24.54	24.38	.16
20	24.20	23.29	.91
30	23.14	20.45	2.69
50	16.89	15.77	1.12
75	14.42	14.26	.16
100	14.00	13.94	.06
125	13.84	13.86	-.02
150	13.75	13.87	-.12
200	13.95	13.94	.01
250	13.83	14.03	-.20
300	13.77	14.09	-.32
400	13.83	14.08	-.25
500	13.77	13.97	-.20
600	13.60	13.74	-.16
750	13.61	13.73	-.12
800	13.55	13.62	-.07
900	13.43	13.51	-.08
1000	13.33	13.43	-.10
1100	13.31	13.36	-.05
1200	13.25	13.31	-.06
1300	13.25	13.27	-.02
1400	13.23	13.25	-.02
1500	13.21	13.24	-.03
1750	13.17	13.22	-.05
2000	13.15	13.19	-.04
2500	13.17	13.20	-.03
3000	13.22	13.28	-.06

FIG. 4-3. VERTICAL TEMPERATURE PROFILE FOR TYRRHENIAN SEA (JUL - SEP)



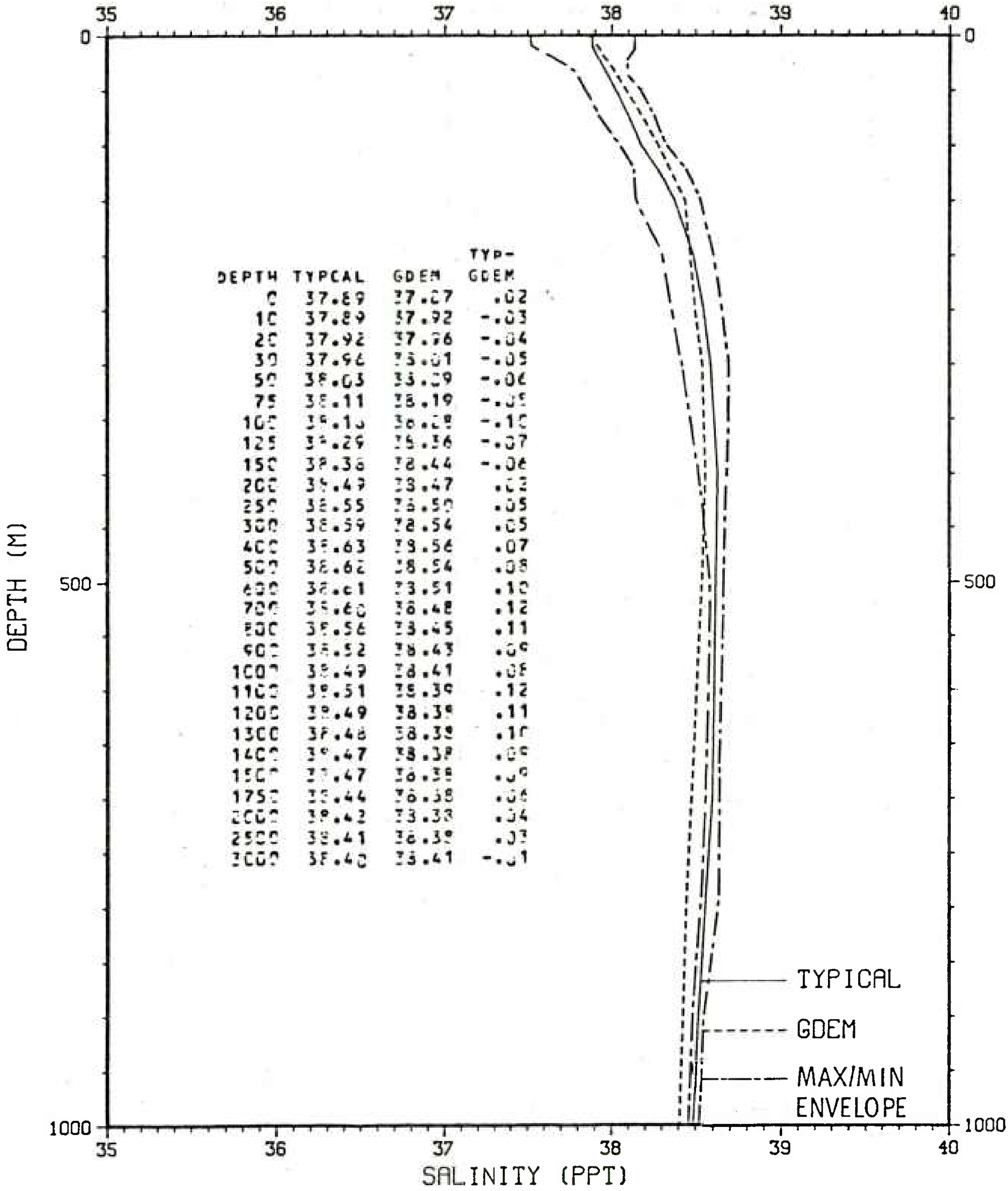
DEPTH	TYPCAL	GDEM	TYP-GDEM
0	22.15	19.23	2.92
10	22.13	19.22	2.91
20	22.17	19.20	2.97
30	22.11	19.04	3.07
50	16.64	17.49	-.85
75	14.64	15.02	-.38
100	13.85	14.21	-.36
125	13.84	14.00	-.16
150	13.83	13.96	-.13
200	14.00	14.05	-.05
250	13.91	14.17	-.26
300	14.05	14.21	-.16
400	14.01	14.17	-.16
500	14.00	14.05	-.05
600	13.61	13.99	-.38
700	13.68	13.76	-.08
800	13.56	13.63	-.07
900	13.45	13.51	-.06
1000	13.36	13.42	-.06
1100	13.31	13.35	-.04
1200	13.28	13.31	-.03
1300	13.25	13.29	-.04
1400	13.23	13.28	-.05
1500	13.21	13.27	-.06
1750	13.17	13.23	-.06
2000	13.15	13.18	-.03
2500	13.17	13.20	-.03
3000	13.22	13.28	-.06

FIG. 4-4. VERTICAL TEMPERATURE PROFILE FOR TYRRHENIAN SEA (OCT - DEC)



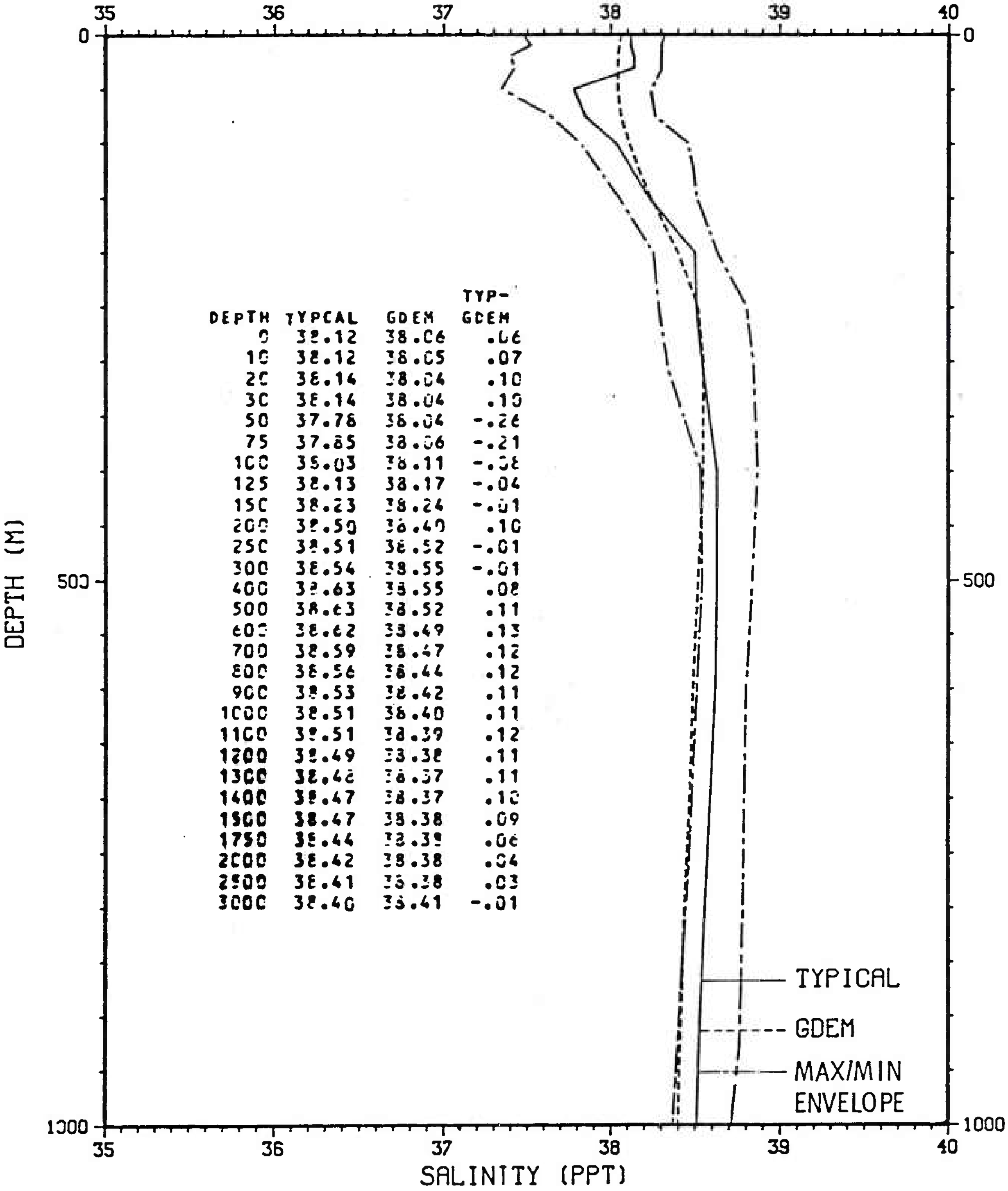
DEPTH	TYPCAL	GDEM	TYP-GDEM
0	37.98	37.87	.11
10	37.95	37.91	.04
20	37.96	37.95	.01
30	37.94	37.99	-.05
50	37.95	38.07	-.12
75	37.98	38.16	-.18
100	38.13	38.25	-.12
125	38.26	38.33	-.07
150	38.36	38.40	-.04
200	38.46	38.51	-.03
250	38.57	38.52	.05
300	38.62	38.54	.08
400	38.65	38.55	.10
500	38.61	38.54	.07
600	38.57	38.51	.06
700	38.56	38.49	.09
800	38.54	38.44	.10
900	38.53	38.42	.11
1000	38.52	38.40	.12
1100	38.51	38.39	.12
1200	38.49	38.38	.11
1300	38.48	38.38	.10
1400	38.47	38.38	.09
1500	38.47	38.38	.09
1750	38.44	38.38	.06
2000	38.42	38.37	.05
2500	38.41	38.38	.03
3000	38.40	38.41	-.01

FIG. 4-5. VERTICAL SALINITY PROFILE FOR TYRRHENIAN SEA (JAN - MAR)



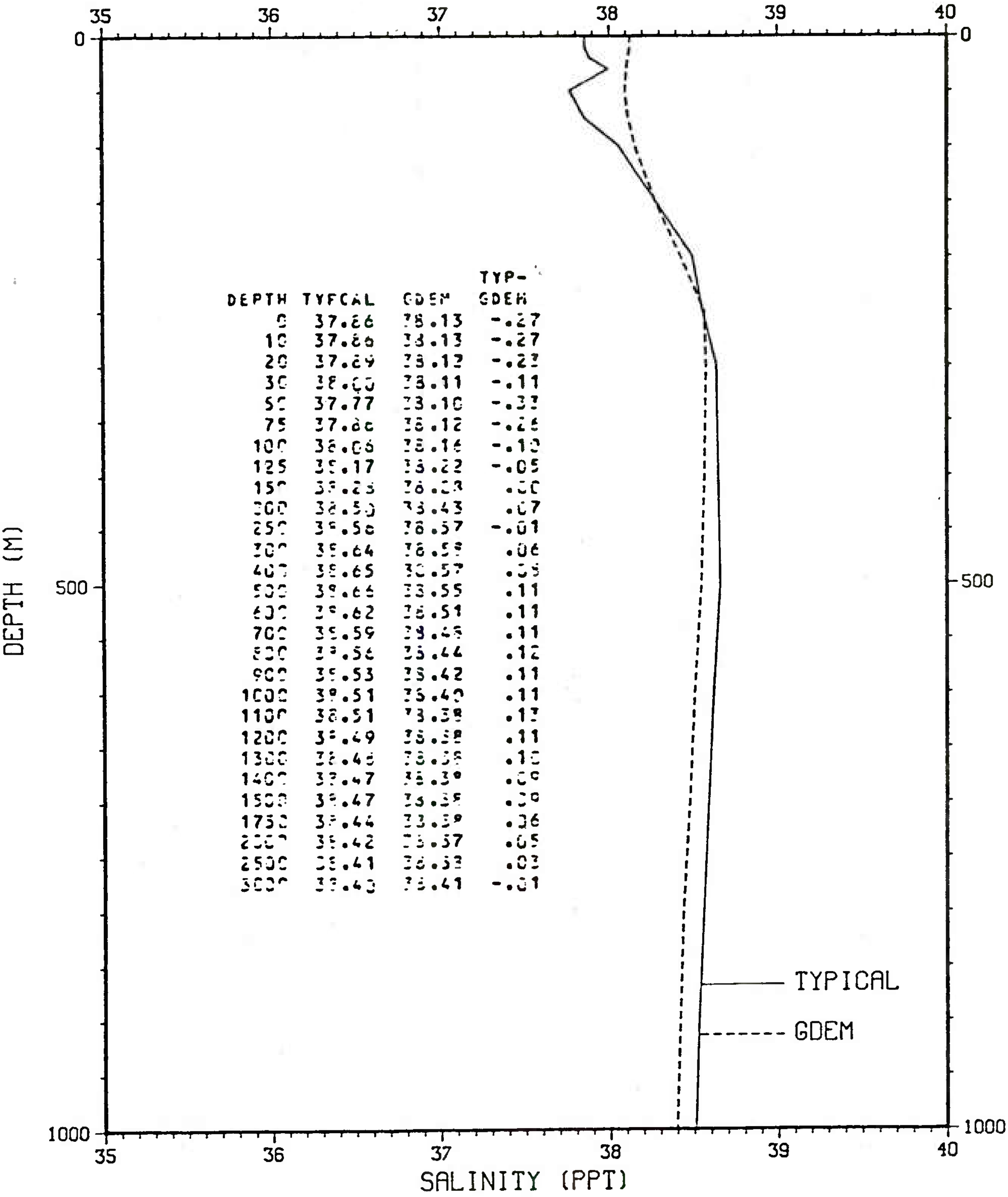
DEPTH	TYPCAL	GDEM	TYP-GDEM
0	37.89	37.87	.02
10	37.89	37.92	-.03
20	37.92	37.96	-.04
30	37.96	38.01	-.05
50	38.03	38.09	-.06
75	38.11	38.19	-.08
100	38.18	38.28	-.10
125	38.29	38.36	-.07
150	38.38	38.44	-.06
200	38.49	38.47	.02
250	38.55	38.50	.05
300	38.59	38.54	.05
400	38.63	38.56	.07
500	38.62	38.54	.08
600	38.61	38.51	.10
700	38.60	38.48	.12
800	38.56	38.45	.11
900	38.52	38.43	.09
1000	38.49	38.41	.08
1100	38.51	38.39	.12
1200	38.49	38.38	.11
1300	38.48	38.38	.10
1400	38.47	38.38	.09
1500	38.47	38.38	.09
1750	38.44	38.38	.06
2000	38.42	38.38	.04
2500	38.41	38.38	.03
3000	38.40	38.41	-.01

FIG. 4-6. VERTICAL SALINITY PROFILE FOR TYRRHENIAN SEA (APR - JUN)



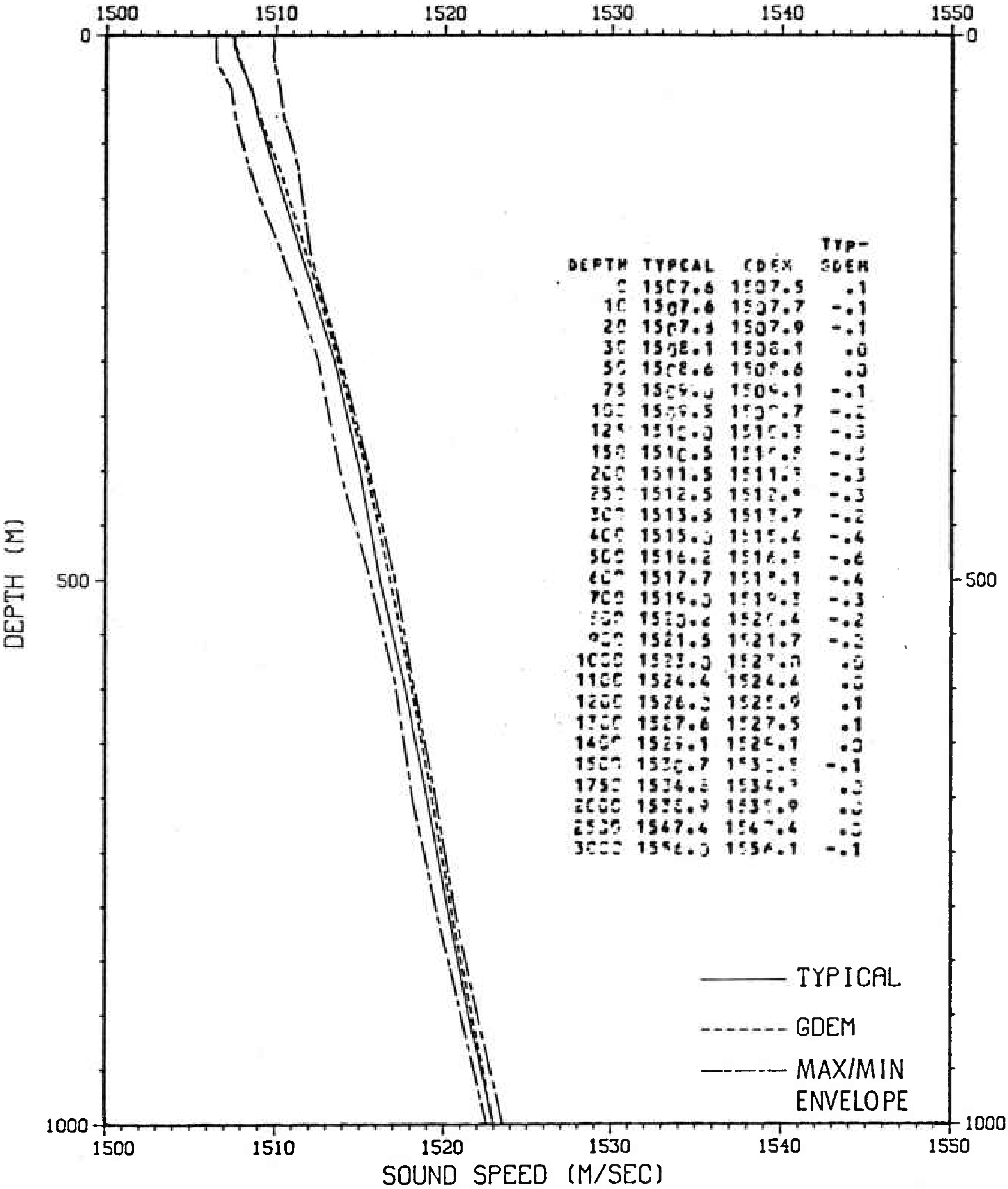
DEPTH	TYPCAL	GDEM	TYP- GDEM
0	38.12	38.06	.06
10	38.12	38.05	.07
20	38.14	38.04	.10
30	38.14	38.04	.10
50	37.78	38.04	-.26
75	37.85	38.06	-.21
100	38.03	38.11	-.08
125	38.13	38.17	-.04
150	38.23	38.24	-.01
200	38.50	38.40	.10
250	38.51	38.52	-.01
300	38.54	38.55	-.01
400	38.63	38.55	.08
500	38.63	38.52	.11
600	38.62	38.49	.13
700	38.59	38.47	.12
800	38.56	38.44	.12
900	38.53	38.42	.11
1000	38.51	38.40	.11
1100	38.51	38.39	.12
1200	38.49	38.38	.11
1300	38.48	38.37	.11
1400	38.47	38.37	.10
1500	38.47	38.38	.09
1750	38.44	38.39	.06
2000	38.42	38.38	.04
2500	38.41	38.38	.03
3000	38.40	38.41	-.01

FIG. 4-7. VERTICAL SALINITY PROFILE FOR TYRRHENIAN SEA (JUL - SEP)



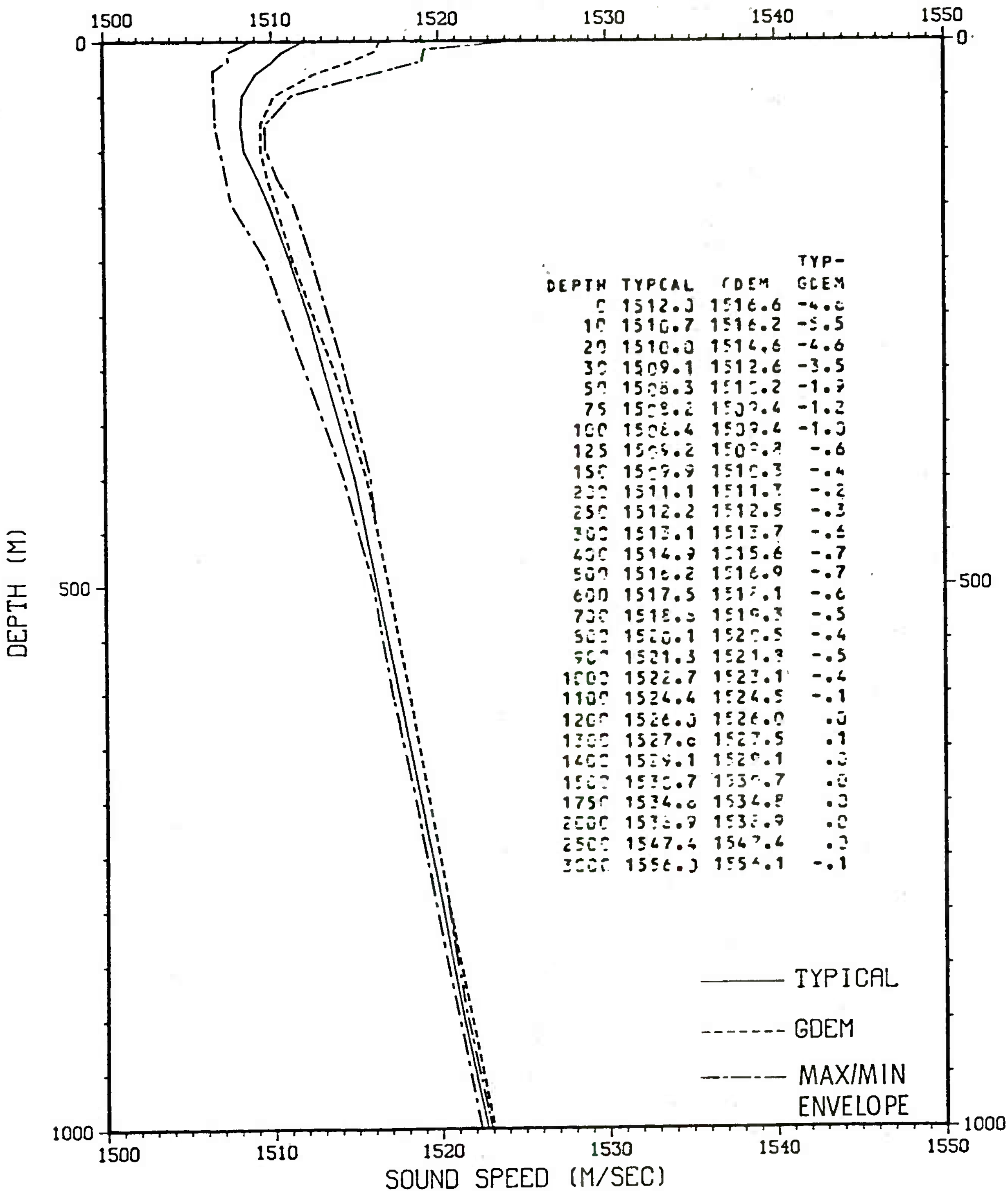
DEPTH	TYPICAL	GDEM	TYP-GDEM
0	37.86	38.13	-.27
10	37.86	38.13	-.27
20	37.89	38.12	-.23
30	38.00	38.11	-.11
50	37.77	38.10	-.33
75	37.86	38.12	-.26
100	38.06	38.16	-.10
125	38.17	38.22	-.05
150	38.23	38.23	.00
200	38.50	38.43	.07
250	38.56	38.57	-.01
300	38.64	38.58	.06
400	38.65	38.57	.08
500	38.66	38.55	.11
600	38.62	38.51	.11
700	38.59	38.48	.11
800	38.56	38.44	.12
900	38.53	38.42	.11
1000	38.51	38.40	.11
1100	38.51	38.38	.13
1200	38.49	38.38	.11
1300	38.48	38.38	.10
1400	38.47	38.38	.09
1500	38.47	38.38	.09
1750	38.44	38.38	.06
2000	38.42	38.37	.05
2500	38.41	38.38	.03
3000	38.40	38.41	-.01

FIG. 4-8. VERTICAL SALINITY PROFILE FOR TYRRHENIAN SEA (OCT - DEC)



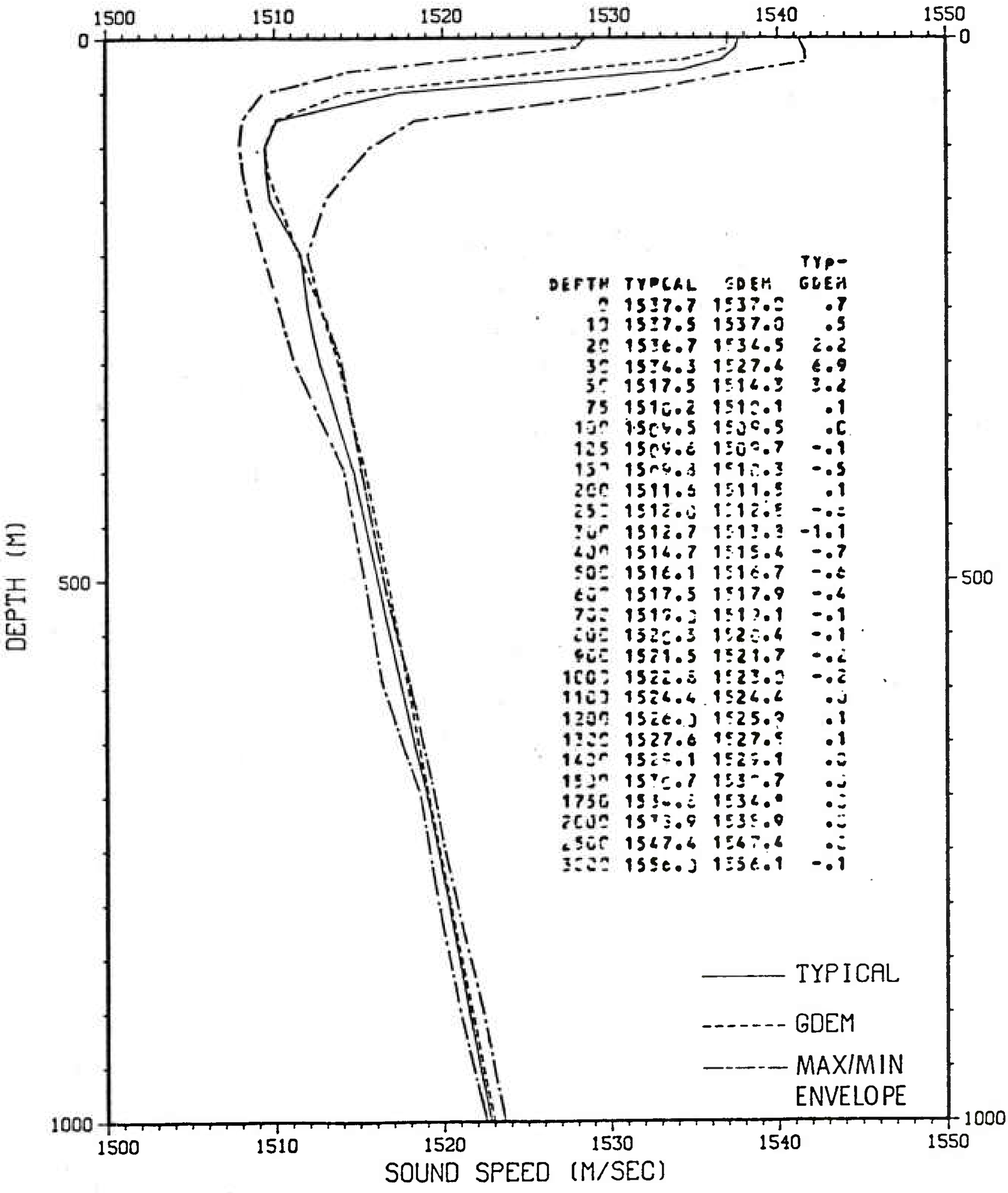
DEPTH	TYPCAL	GDEM	TYP-GDEM
0	1507.6	1507.5	.1
10	1507.6	1507.7	-.1
20	1507.8	1507.9	-.1
30	1508.1	1508.1	.0
50	1508.6	1508.6	.0
75	1509.0	1509.1	-.1
100	1509.5	1509.7	-.2
125	1510.0	1510.3	-.3
150	1510.5	1510.8	-.3
200	1511.5	1511.8	-.3
250	1512.5	1512.8	-.3
300	1513.5	1513.7	-.2
400	1515.0	1515.4	-.4
500	1516.2	1516.8	-.6
600	1517.7	1518.1	-.4
700	1519.0	1519.3	-.3
800	1520.2	1520.4	-.2
900	1521.5	1521.7	-.2
1000	1523.0	1523.0	.0
1100	1524.4	1524.4	.0
1200	1526.0	1525.9	.1
1300	1527.6	1527.5	.1
1400	1529.1	1529.1	.0
1500	1530.7	1530.8	-.1
1750	1534.8	1534.8	.0
2000	1539.9	1539.9	.0
2500	1547.4	1547.4	.0
3000	1556.0	1556.1	-.1

FIG. 4-9. VERTICAL SOUND-SPEED PROFILE FOR TYRRHENIAN SEA (JAN - MAR)



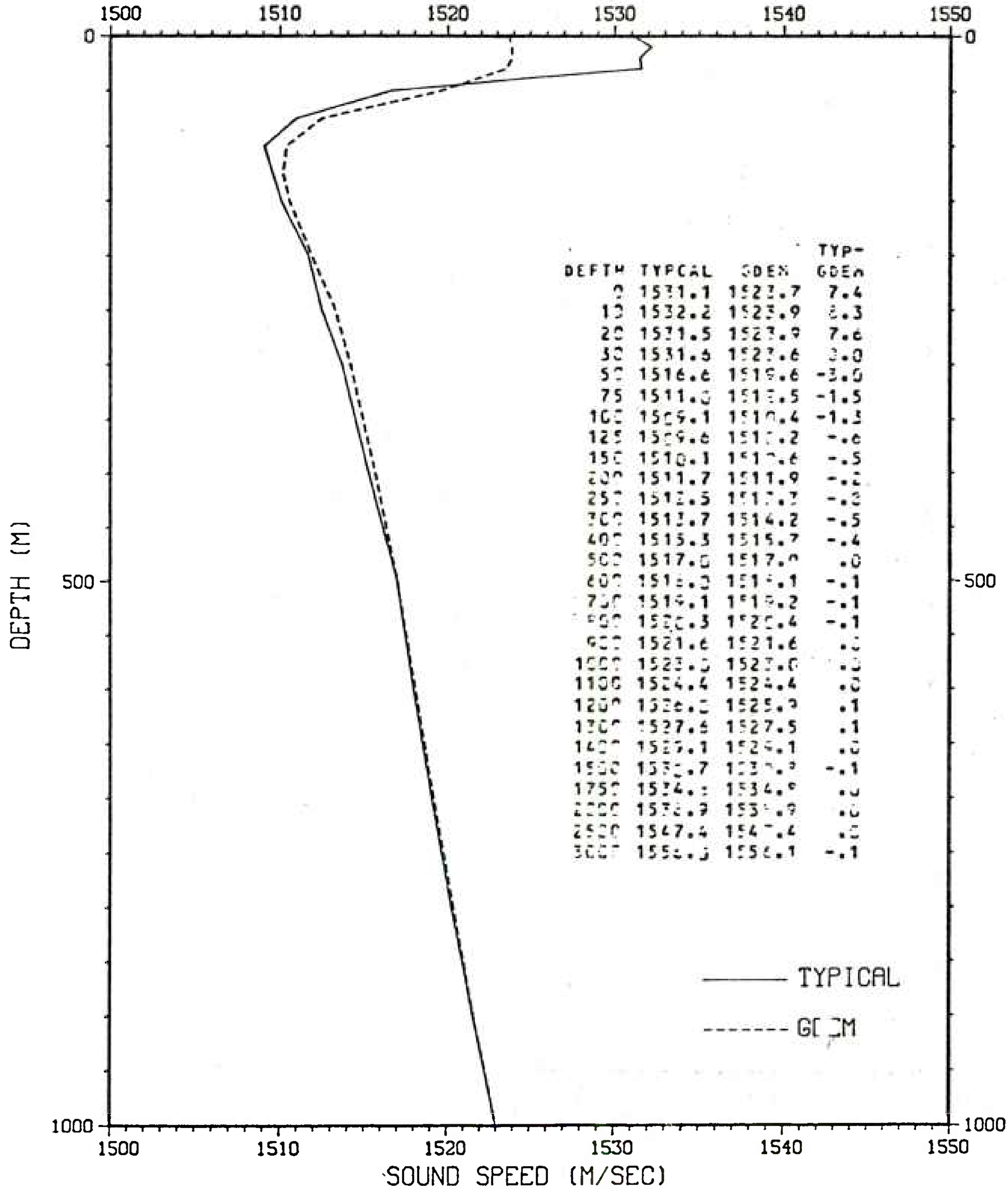
DEPTH	TYPCAL	GDEM	TYP-GDEM
0	1512.0	1516.6	-4.6
10	1510.7	1516.2	-5.5
20	1510.0	1514.6	-4.6
30	1509.1	1512.6	-3.5
50	1508.3	1510.2	-1.9
75	1508.2	1509.4	-1.2
100	1508.4	1509.4	-1.0
125	1509.2	1509.8	-.6
150	1509.9	1510.3	-.4
200	1511.1	1511.3	-.2
250	1512.2	1512.5	-.3
300	1513.1	1513.7	-.6
400	1514.9	1515.6	-.7
500	1516.2	1516.9	-.7
600	1517.5	1518.1	-.6
700	1518.8	1519.3	-.5
800	1520.1	1520.5	-.4
900	1521.3	1521.8	-.5
1000	1522.7	1523.1	-.4
1100	1524.4	1524.5	-.1
1200	1526.0	1526.0	.0
1300	1527.6	1527.5	.1
1400	1529.1	1529.1	.0
1500	1530.7	1530.7	.0
1750	1534.8	1534.8	.0
2000	1538.9	1538.9	.0
2500	1547.4	1547.4	.0
3000	1556.0	1556.1	-.1

FIG. 4-10. VERTICAL SOUND-SPEED PROFILE FOR TYRRHENIAN SEA (APR - JUN)



DEPTH	TYPICAL	GDEM	TYP-GDEM
0	1537.7	1537.0	.7
10	1537.5	1537.0	.5
20	1536.7	1534.5	2.2
30	1534.3	1527.4	6.9
50	1517.5	1514.3	3.2
75	1510.2	1510.1	.1
100	1509.5	1509.5	.0
125	1509.6	1509.7	-.1
150	1509.8	1510.3	-.5
200	1511.6	1511.5	.1
250	1512.0	1512.5	-.5
300	1512.7	1513.8	-1.1
400	1514.7	1515.4	-.7
500	1516.1	1516.7	-.6
600	1517.5	1517.9	-.4
700	1519.0	1519.1	-.1
800	1520.3	1520.4	-.1
900	1521.5	1521.7	-.2
1000	1522.8	1523.0	-.2
1100	1524.4	1524.4	.0
1200	1526.0	1525.9	.1
1300	1527.6	1527.5	.1
1400	1529.1	1529.1	.0
1500	1530.7	1530.7	.0
1750	1534.8	1534.8	.0
2000	1539.9	1539.9	.0
2500	1547.4	1547.4	.0
3000	1556.0	1556.1	-.1

FIG. 4-11. VERTICAL SOUND-SPEED PROFILE FOR TYRRHENIAN SEA (JUL - SEP)



DEPTH	TYPCAL	GDEM	TYP-GDEM
0	1531.1	1523.7	7.4
10	1532.2	1523.9	8.3
20	1531.5	1523.9	7.6
30	1531.6	1523.6	8.0
50	1516.6	1519.6	-3.0
75	1511.0	1512.5	-1.5
100	1509.1	1510.4	-1.3
125	1509.6	1510.2	-.6
150	1510.1	1510.6	-.5
200	1511.7	1511.9	-.2
250	1512.5	1512.7	-.2
300	1513.7	1514.2	-.5
400	1515.3	1515.7	-.4
500	1517.0	1517.0	.0
600	1518.0	1518.1	-.1
700	1519.1	1519.2	-.1
800	1520.3	1520.4	-.1
900	1521.6	1521.6	.0
1000	1523.0	1523.0	.0
1100	1524.4	1524.4	.0
1200	1526.0	1525.9	.1
1300	1527.6	1527.5	.1
1400	1529.1	1529.1	.0
1500	1530.7	1530.8	-.1
1750	1534.8	1534.8	.0
2000	1538.9	1538.9	.0
2500	1547.4	1547.4	.0
3000	1556.0	1556.1	-.1

FIG. 4-12. VERTICAL SOUND-SPEED PROFILE FOR TYRRHENIAN SEA (OCT - DEC)

5.0 VERTICAL TEMPERATURE, SALINITY, AND SOUND-SPEED PROFILE COMPARISONS FOR MEDITERRANEAN (MED) LOCATION #4

Twelve vertical comparisons of temperature (T), salinity (S), and sound-speed (SS) for winter, spring, summer, and fall seasons are presented in this section.

5.1 Description

Med Location #4 is taken from the Strait of Sicily region of the Mediterranean Sea. The geographical location selected for this comparison is at $37^{\circ}30'$ north latitude and $011^{\circ}30'$ east longitude. Vertical temperature, salinity, and sound-speed profiles of seasonal comparisons are shown in Figures 5-1 through 5-12.

The Strait of Sicily region of the central Mediterranean Sea, depicted as Region D on Figure 1-1, is defined for this report as the body of water located at the passageway that separates the southern Tyrrhenian Sea from the extreme western portion of the eastern Mediterranean basin. The immediate and major land masses present in this region are the coastline of Tunisia and the island of Sicily.

Meteorologically, this region is considered somewhat variable to highly variable and influenced heavily by the Atlas Mountains. Although known as a zone for cyclogenesis, the Atlas Mountains appear to function as a barrier for the Strait of Sicily region. The net results of this barrier effect are delays in the rapid formation of North African cyclones and in the directing of North African cyclones away from the Strait of Sicily and toward the Gulf of Gabes.

Oceanographically, this region is considered highly variable and significant to the exchange of flow between the major eastern and western Mediterranean basins. Bathymetric features in this region play a dominant role in the oceanographic activity. A long channel-shaped basin, with a northwest-to-southeast orientation, cuts deep into the shelf that lies between Tunisia and Sicily. Also, what is often referred to as a "system of sills" separates the major basins of the Mediterranean Sea. Unlike the exchange of North Atlantic water over the sill (not a system of sills) at the Strait of Gibraltar, the exchange of water and flow patterns that occur at the Strait of Sicily are between several secondary basins in this region. The main oceanographic process in this region occurs at subsurface levels. The well-known Levantine Water from the eastern Mediterranean flows westerly at varying depths, and fills the various secondary basins that precede the shallower shelf of the Strait of Sicily. The flow of the Levantine Water (characterized by a salinity maximum) was channeled through the Strait into the Tyrrhenian Basin, and assumes (based on the so-called "core method") a counterclockwise flow pattern. This channeling at the shelf was the primary factor that allows and provides for the exchange of subsurface flow between the two major basins. This flow of Levantine Water at the Strait of Sicily is often referred to as the Levantine Intermediate Current (reaching high velocities at approximately 250 m in depth of around 100 cm/sec or 2 kts). The strength of the Levantine Intermediate Current was perceptively stronger in the winter than in the summer.

5.2 Comparisons for Location #4

The vertical site comparisons of seasonal temperature, salinity, and sound-speed profiles, respectively, are presented for Med Location #4.

- Temperature:

  The January-to-March temperature envelope was based on a data sample size of five observations (Figure 5-1). The GDEM value at the surface fell within the envelope of observed values. No numerical difference was found at the surface between the typical and GDEM. The GDEM vertical profile remained within the envelope to 300 m. The 300 to 400 m levels reflected higher (but not exceeding 0.3°C) values than the typical. The GDEM values below 400 m cannot be properly evaluated due to the lack of sufficient observations.

  The April-to-June temperature envelope was based on a data sample size of 28 observations (Figure 5-2). The GDEM value at the surface fell within the envelope of observed values and differed from the typical by 1.82°C. The GDEM profile remained within the envelope down to 100 m. Below 100 m, the GDEM profile (between 100 to 400 m) fell outside the envelope resulting in higher GDEM values of 1.0°C to 1.3°C. Below 500 m, the GDEM profile migrated back towards the typical.

The July-to-September temperature envelope was based on a data sample size of 14 observations (Figure 5-3). The GDEM value at the surface fell within the envelope of observed values and differed from the typical by 0.74°C. Between the 20 and 30 m levels, there were differences of 1.3°C to 2.5°C. Below 50 m down to 700 m, differences did not exceed 0.8°C (at 75 m).

The October-to-December temperature envelope was based on a data sample size of six observations (Figure 5-4). The GDEM value at the surface did not fall within the envelope of observed values and differed from the typical by 1.84°C. This difference (nearly 1.8°C to 1.9°C) continued to occur from the surface down to 50 m. Below 50 m, the GDEM values fell within the envelope. Differences between the GDEM and typical below 100 m were less than 0.3°C.

- Salinity:

The January-to-March salinity envelope was based on a data sample size of five observations (Figure 5-5). The GDEM value at the surface did not fall within the envelope of observed values. A numerical difference of 0.50 ppt existed at the surface between the typical and the GDEM. Differences of 0.50 ppt remained to 30 m. Between the 50 to 150 m levels, differences were less than 0.43 ppt. Below 200 m, differences did not exceed 0.15 ppt and reflected GDEM as lower in value.

The April-to-June salinity envelope was based on a data sample size of 28 observations (Figure 5-6). The GDEM value at the surface fell within the envelope of observed values and differed from the typical by 0.26 ppt. Differences on the order of 0.33 ppt remained down to 100 m. Below 150 m, differences were less than 0.16 ppt, and reflected closer agreement.

The July-to-September salinity envelope was based on a data sample size of 14 observations (Figure 5-7). The GDEM value at the surface fell within the envelope of observed values and differed from the typical by 0.09 ppt. Between 50 to 150 m levels, differences were 0.27 ppt. Below 200 m, differences are less than 0.17 ppt and reflected GDEM as lower in value.

The October-to-December salinity envelope was based on a data sample size of six observations (Figure 5-8). The GDEM value at the surface fell outside the envelope of observed values and differed from the typical by 0.32 ppt. A consistent difference of 0.30 ppt to 0.40 ppt existed between 20 and 100 m. Below 150 m, differences were less than 0.17 ppt and reflected GDEM as lower in value.

- o Sound Speed:

  The January-to-March sound-speed envelope was based on a data sample size of five observations (Figure 5-9). The GDEM value at the surface did not fall within the envelope of observed values and differed from the typical by 0.7 m/s. Differences below the surface to 75 m did not exceed 0.9 m/s. Differences of 1.3 m/s, 1.1 m/s, and 1.0 m/s existed at 100 m, 125 m, and 150 m, respectively. Below 150 m to 700 m, all differences were less than 0.9 m/s.

  The April-to-June sound-speed envelope was based on a data sample size of 28 observations (Figure 5-10). The GDEM value at the surface fell within the envelope of observed values and differed from the typical by 5.6 m/s. Below the surface, differences ranged between 2.0 m/s to 5.3 m/s.

  The July-to-September sound-speed envelope was based on a data sample size of 14 observations (Figure 5-11). The GDEM value at the surface fell within the envelope of observed values and differed from the typical by 1.7 m/s. Differences below the surface to 150 m ranged between 0.7 to 6.7 m/s. Below 150 m, differences did not exceed 0.5 m/s.

  The October-to-December sound-speed envelope was based on a data sample size of six observations (Figure 5-12). The GDEM value at the surface did not fall within the envelope of observed values and differed from the typical by 5.8 m/s. Differences below the surface to 75 m ranged between 4.6 m/s to 6.2 m/s. Below 125 m, differences did not exceed 0.9 m/s.

5.3 Evaluation - Strait of Sicily (Location #4)

- January to March:

  Comparison between GDEM and the typical temperature profiles revealed similar thermal structures. Differences in values were small from the surface to 700 m. The GDEM profile was similar to the typical. The envelope was narrow and may not be a proper representation of the expected range of values. This region is shallow and known for a wide range of variabilities in the temporal and spatial domains. The GDEM profile reflected a seasonally averaged winter thermal structure for this highly variable ocean region when compared with the five usable observations.

Comparison between GDEM and the typical salinity profiles revealed differences in the haline structures. Salinity differences occurred at the surface (0.50 ppt), near-surface halocline and in below-halocline gradients. The envelope was viewed too narrow near the surface layers and was considered as being biased towards the minimum range of values. The surface salinities for this location and time period can range up to 37.55 ppt. The envelope did not reflect a proper range of variability. The GDEM surface value is reasonable and representative. The GDEM salinity profile below 300 m was low by 0.08 ppt to 0.15 ppt.

Comparison between GDEM and the typical sound-speed profiles revealed similar sound-speed structures. Differences in the numerical values were small. The envelope below the surface to 100 m was too narrow for this highly variable ocean region. The seasonally averaged half-channel mode sound-speed profile was appropriate. The GDEM profile reflected a seasonally averaged winter sound-speed structure for this highly variable region when compared with the five usable observations.

- April to June:

  Comparison between GDEM and the typical temperature profiles revealed differences in the thermal structures. Differences from the surfaces to 300 m were 1.0°C. The thermal gradients between 75 m down to 250 m were similar. The envelope indicated a high surface variability and a wide variability to 300 m. Although the region is highly variable and shallow for this area, the GDEM numerical values for temperature between 75 to 700 m were high. The typical values were reasonable and representative for spring thermal structure when compared with the 28 usable observations.

  Comparison between GDEM and the typical salinity profiles revealed differnces in the haline structure. The GDEM halocline was steeper (greater in gradient), revealed a well-defined subsurface salinity maxima at 300 m, and differed in value below 500 m by 0.14 ppt. The GDEM surface value was reasonable for this location. The envelope of observations did not reflect the variability for this region.

Comparison between GDEM and the typical sound-speed profiles revealed differences in the sound-speed structure. Differences of greater than 3.0 m/s were found from the surface to 300 m. Gradients below the sound channel axis, 75 m to 200 m, were similar. The GDEM profile revealed a secondary subsurface minimum between 300 to 400 m. Differences in sound speed above 300 m were related to the temperature values. The GDEM secondary subsurface minimum was caused by the GDEM salinity profile. The GDEM sound-speed profile was reasonable and representative for this highly variable ocean region when compared with the 28 usable observations.

- July to September:

  Comparison between GDEM and the typical temperature profiles revealed similar thermal structures. The near-surface thermal gradients above 50 m were similar. The thermal gradients below 150 m to 700 m were similar. Difference of 25 m in the depths of the bottom of the thermoclines were found. The bottom of the GDEM thermocline was shallower in depth. The GDEM profile reflected a seasonally averaged summer thermal structure for this highly variable ocean region when compared with the 14 usable observations.

  Comparison between GDEM and the typical salinity profiles revealed differences in haline structure. The near-surface GDEM halocline gradient was steeper (greater in gradient) and consistently lower in value below 100 m. The GDEM near-surface gradient was too linear for a representation of a seasonal salinity profile for this location. The numerical values below 150 m are too low and can be increased by 0.06 ppt from 150 m to 700 m. A thicker GDEM salinity minimum layer would be more reasonable. The GDEM surface value was reasonable for this highly variable ocean region when compared with the 14 usable observations.

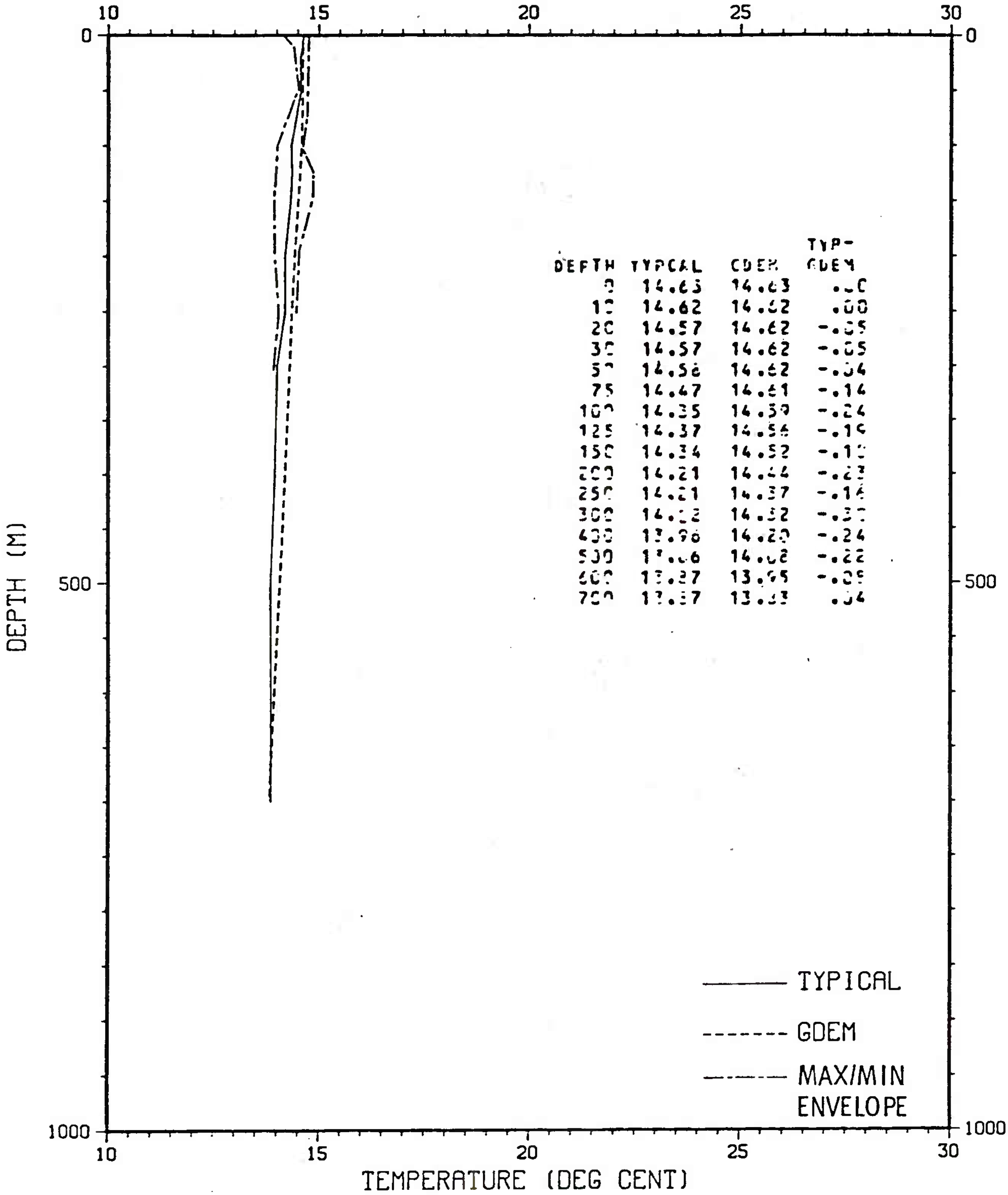
  Comparison between GDEM and the typical sound-speed profiles revealed similar sound-speed structures. The near-surface sonocline gradients above 50 m were similar. The sonocline gradients below 150 m to 700 m were similar. There were slight differences in the depths of the sound-channel axes by 25 m. The GDEM profile was shallower. Due to the shallower GDEM sound-channel axis, the GDEM gradient immediately above the apex of the axis was steeper. The GDEM profile reflected a seasonally averaged summer sound-speed structure for this highly variable ocean region when compared with the 14 usable observations.

- October to December:

  Comparison between GDEM and the typical temperature profile revealed similar thermal structures. The GDEM surface value was higher than the typical and was outside the envelope. In the near-surface layer (above 100 m), the thermal structures were similar. The envelope of observations did not reflect the variability for this region. The area is known for a noticeable fall variability. The GDEM surface value, thickness of the layer, and thermocline gradient were considered realistic, representative, and reasonable for this highly variable ocean region when compared with the four usable observations.

  Comparison between GDEM and the typical salinity profiles revealed differences in haline structure. The GDEM profile lacked a surface-salinity minimum layer. The GDEM values from 350 m to 700 m were lower. The surface envelope was considered narrow for this location. The GDEM surface value appeared reasonable. A surface salinity minimum layer would represent a more realistic seasonal salinity profile for this highly variable ocean region.

  Comparison between GDEM and the typical sound-speed profiles revealed similar sound-speed structure. The GDEM surface value was higher but realistic for this region. A well-defined shallow surface duct was reasonable. The depth of the sound-channel axis of GDEM and the typical were the same. The GDEM profile represented a seasonally averaged winter sound-speed structure for this highly variable ocean region when compared with the four usable observations.



DEPTH	TYPCAL	GDEM	TYP-GDEM
0	14.63	14.63	.00
10	14.62	14.62	.00
20	14.57	14.62	-.05
30	14.57	14.62	-.05
50	14.58	14.62	-.04
75	14.47	14.61	-.14
100	14.35	14.59	-.24
125	14.37	14.56	-.19
150	14.34	14.52	-.18
200	14.21	14.44	-.23
250	14.21	14.37	-.16
300	14.02	14.32	-.30
400	13.96	14.20	-.24
500	13.86	14.08	-.22
600	13.87	13.95	-.08
700	13.37	13.33	.04

FIG. 5-1. VERTICAL TEMPERATURE PROFILE FOR STRAIT OF SICILY (JAN - MAR)

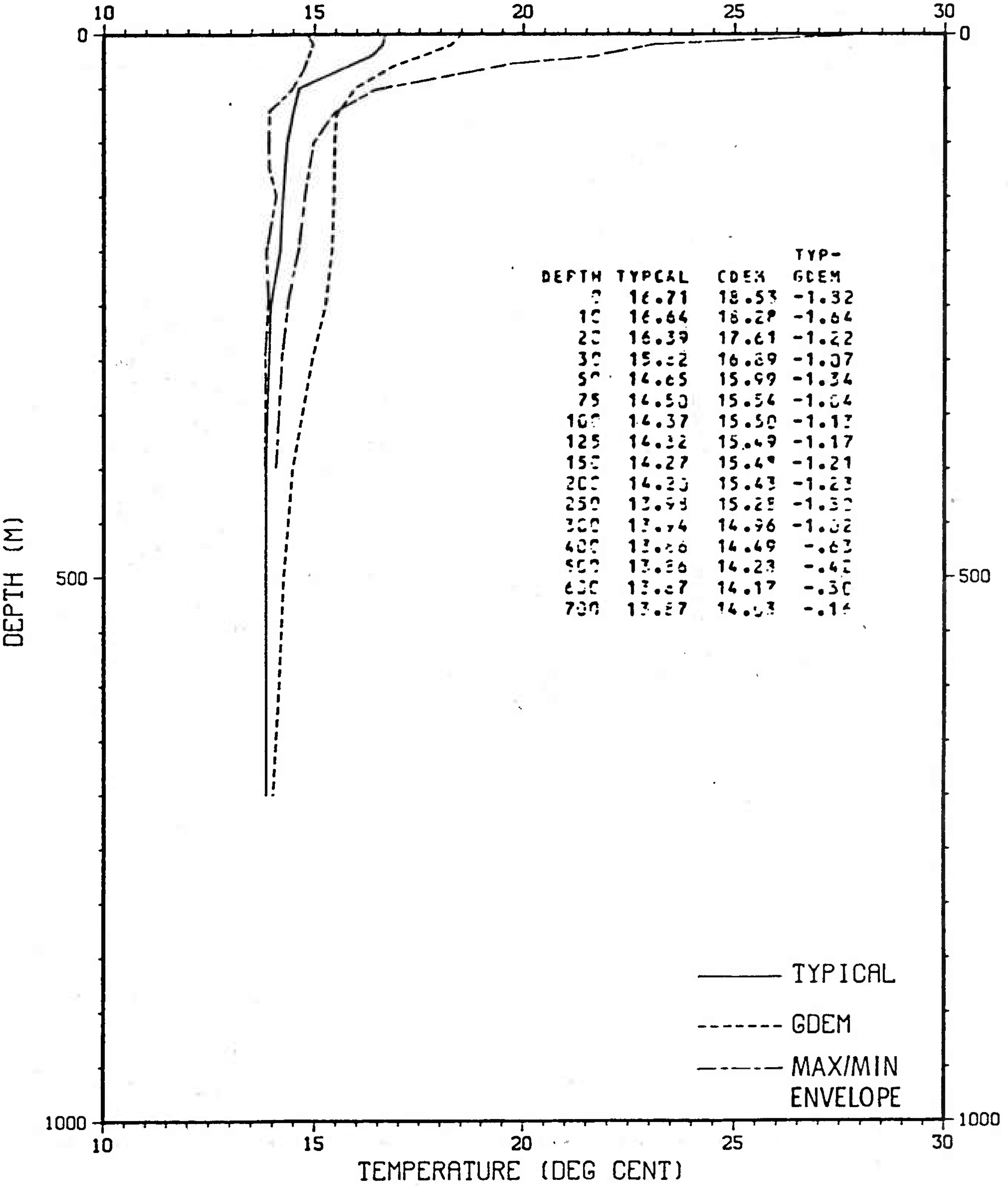


FIG. 5-2. VERTICAL TEMPERATURE PROFILE FOR STRAIT OF SICILY (APR - JUN)

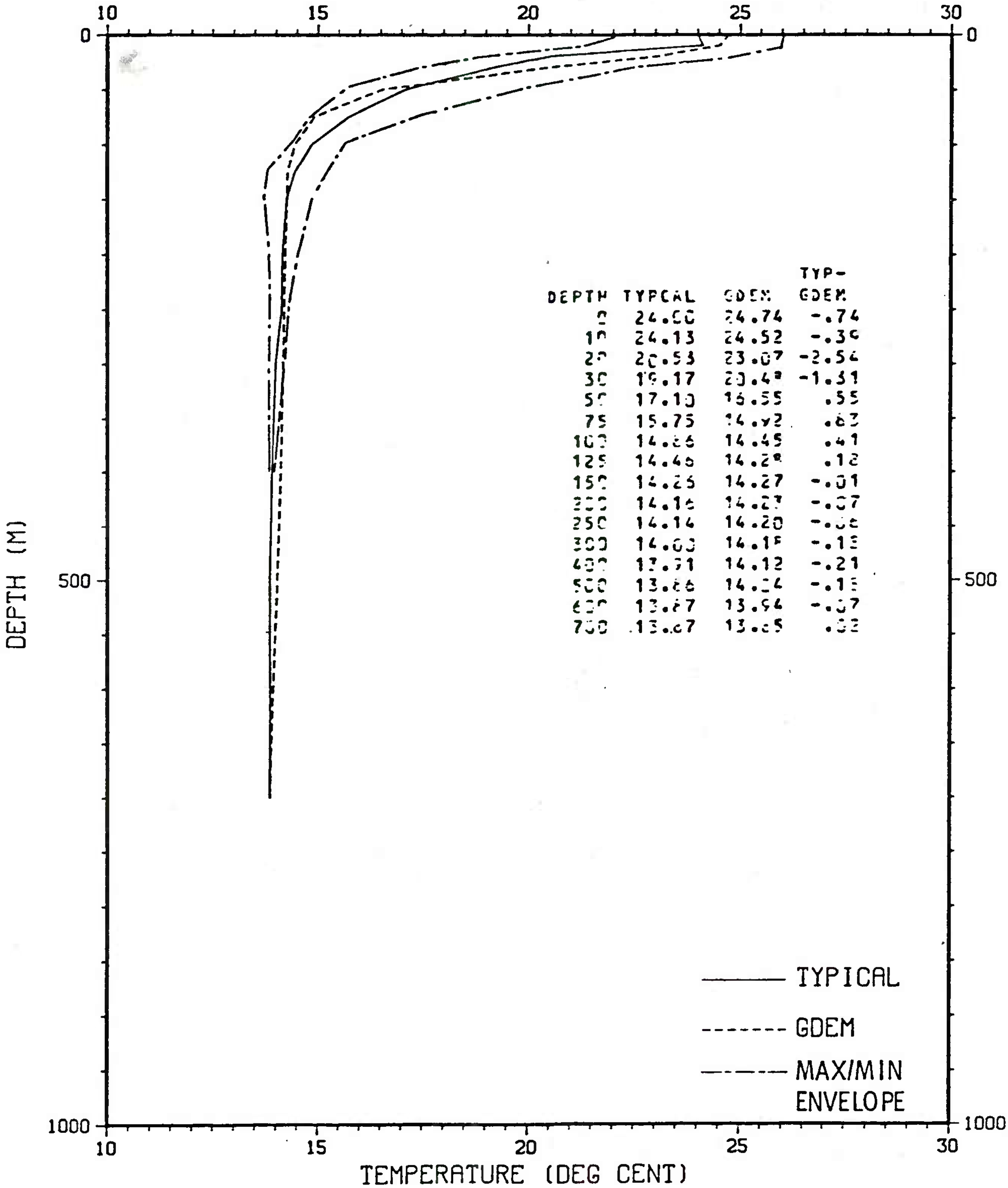
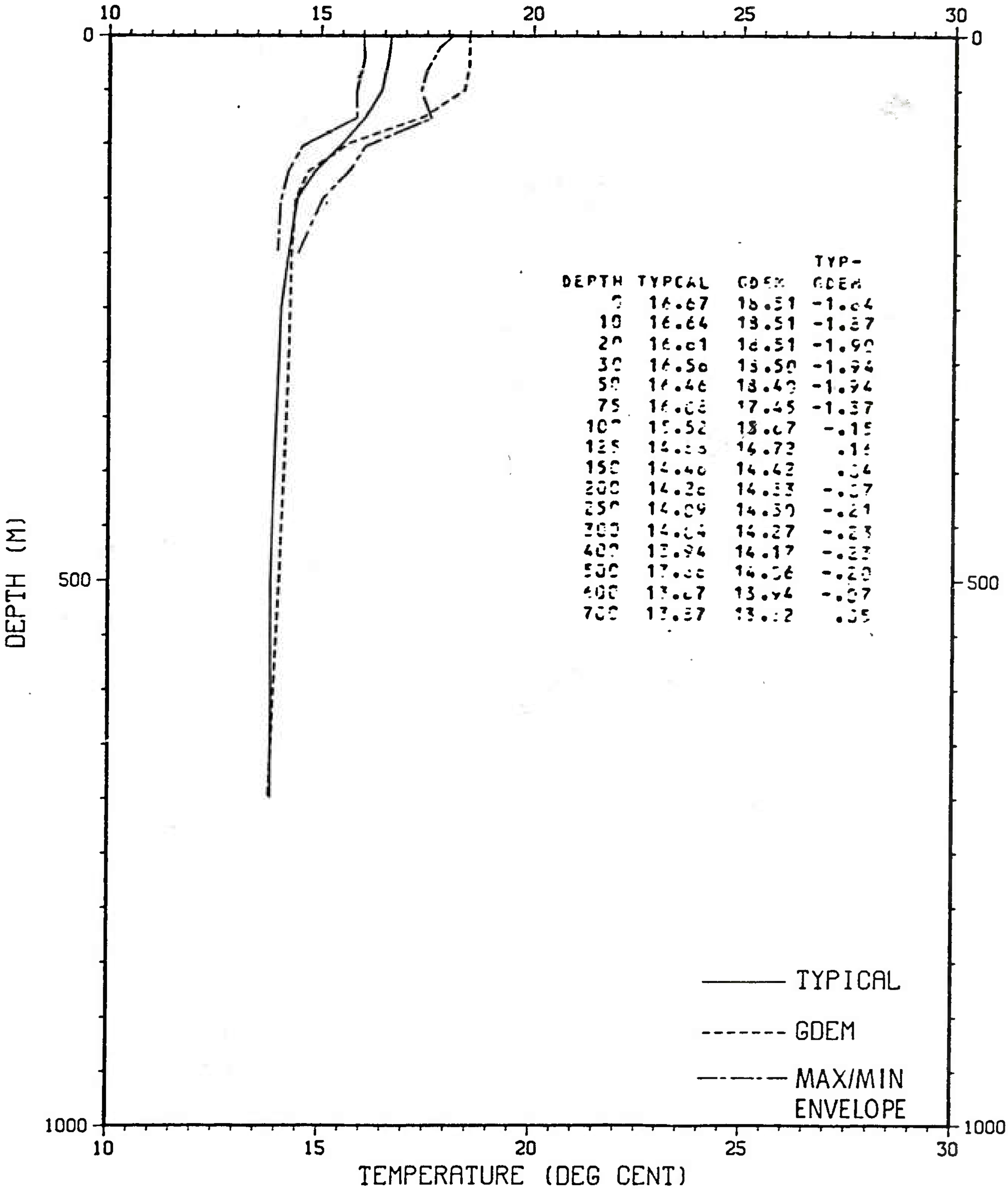
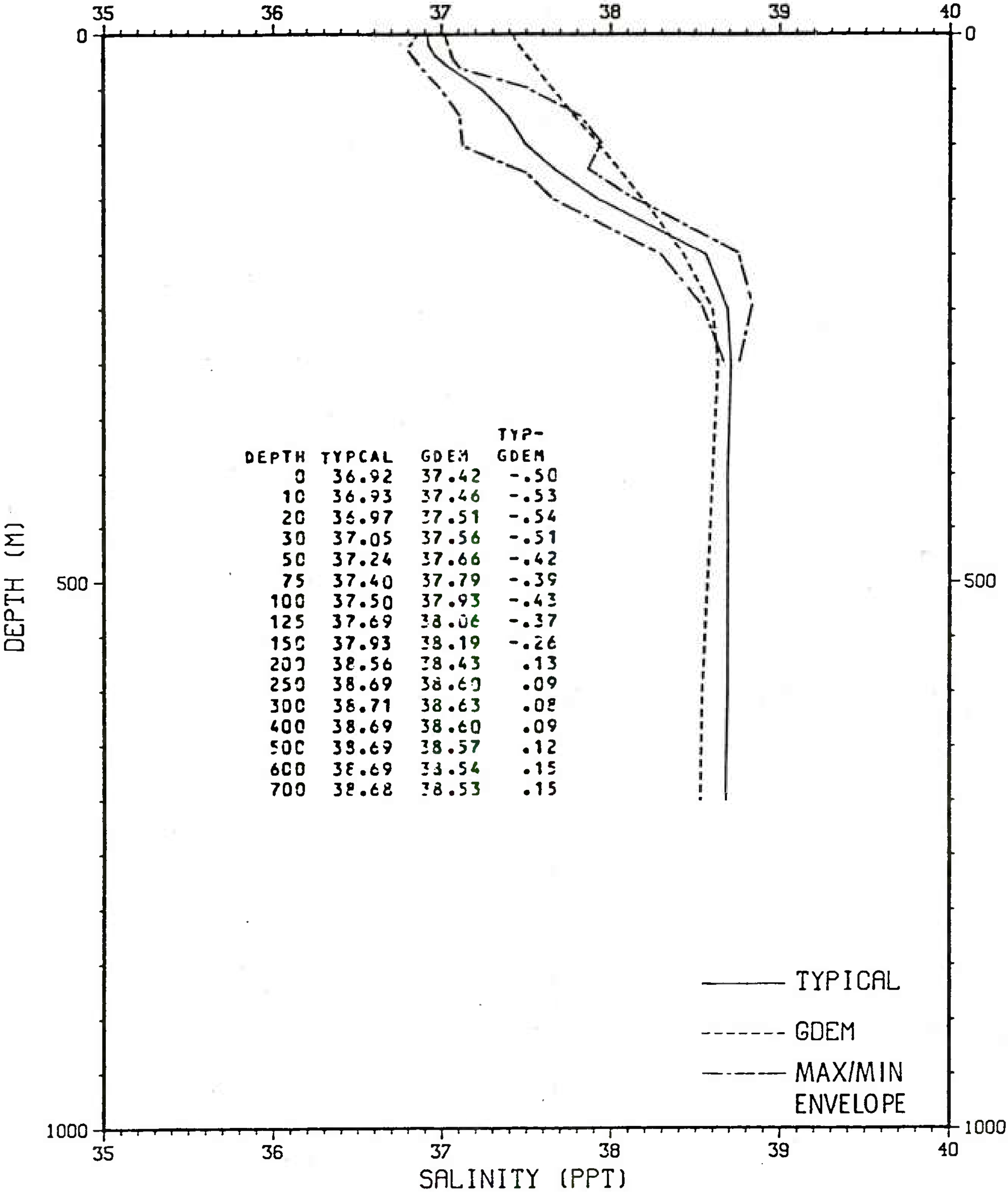


FIG. 5-3. VERTICAL TEMPERATURE PROFILE FOR STRAIT OF SICILY (JUL - SEP)



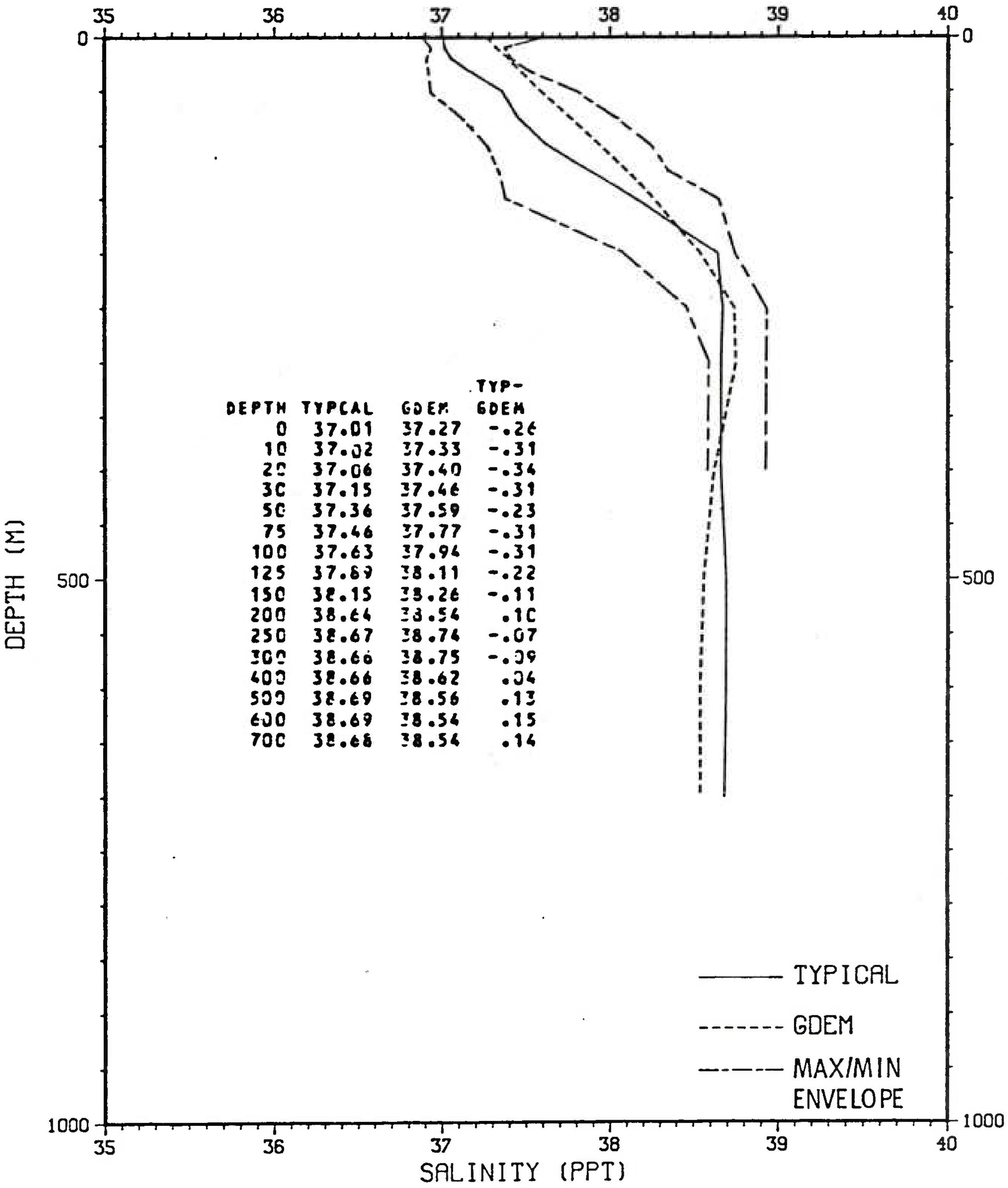
DEPTH	TYPCAL	GDEM	TYP-GDEM
0	16.67	18.51	-1.84
10	16.64	18.51	-1.87
20	16.61	18.51	-1.90
30	16.56	18.50	-1.94
50	16.46	18.40	-1.94
75	16.08	17.45	-1.37
100	15.52	15.67	-.15
125	14.86	14.72	.14
150	14.46	14.42	.04
200	14.26	14.33	-.07
250	14.09	14.30	-.21
300	14.04	14.27	-.23
400	13.94	14.17	-.23
500	13.86	14.06	-.20
600	13.67	13.94	-.27
700	13.37	13.32	.05

FIG. 5-4. VERTICAL TEMPERATURE PROFILE FOR STRAIT OF SICILY (OCT - DEC)



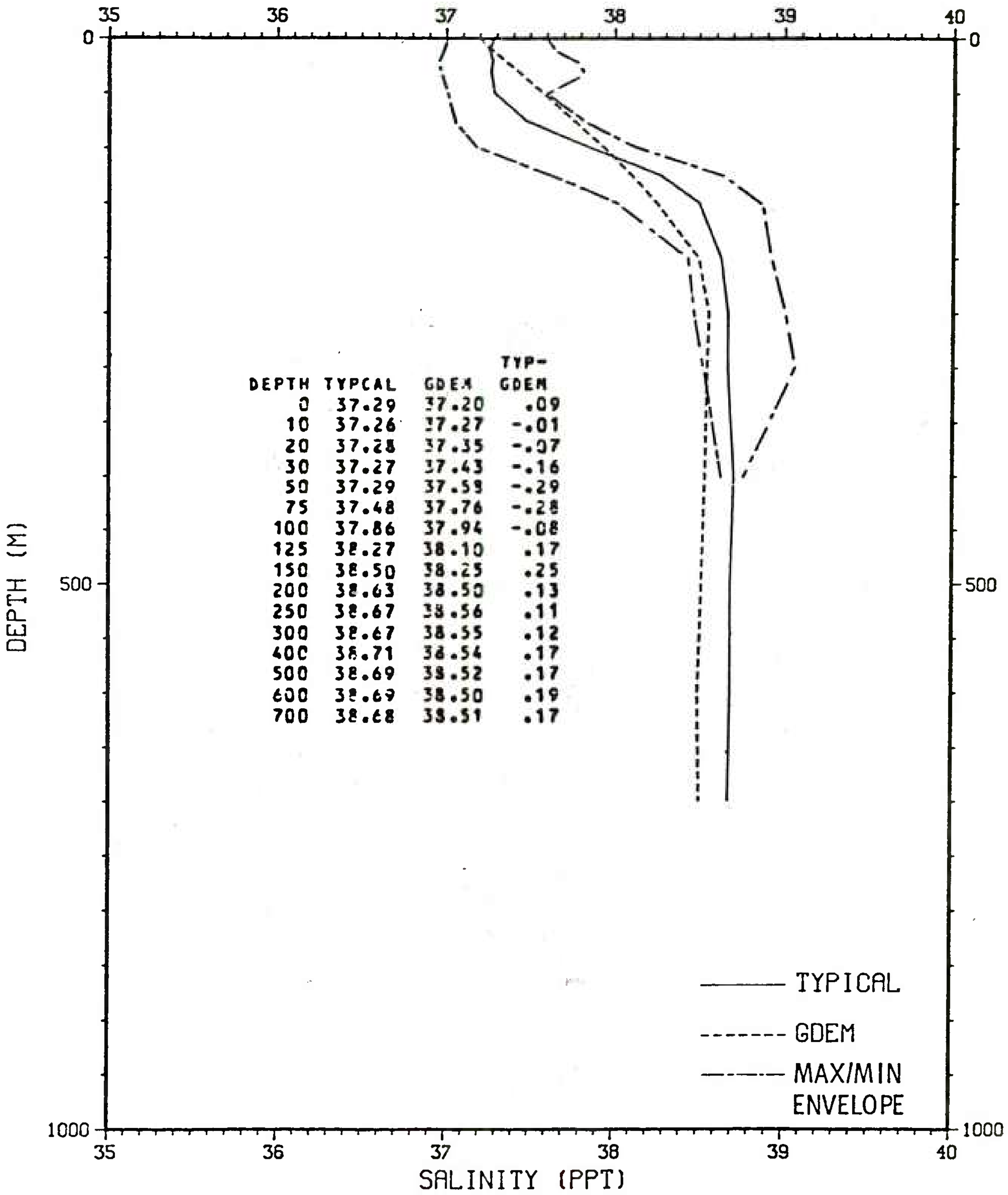
DEPTH	TYPCAL	GDEM	TYP-GDEM
0	36.92	37.42	-.50
10	36.93	37.46	-.53
20	36.97	37.51	-.54
30	37.05	37.56	-.51
50	37.24	37.66	-.42
75	37.40	37.79	-.39
100	37.50	37.93	-.43
125	37.69	38.06	-.37
150	37.93	38.19	-.26
200	38.56	38.43	.13
250	38.69	38.60	.09
300	38.71	38.63	.08
400	38.69	38.60	.09
500	38.69	38.57	.12
600	38.69	38.54	.15
700	38.68	38.53	.15

FIG. 5-5. VERTICAL SALINITY PROFILE FOR STRAIT OF SICILY (JAN - MAR)



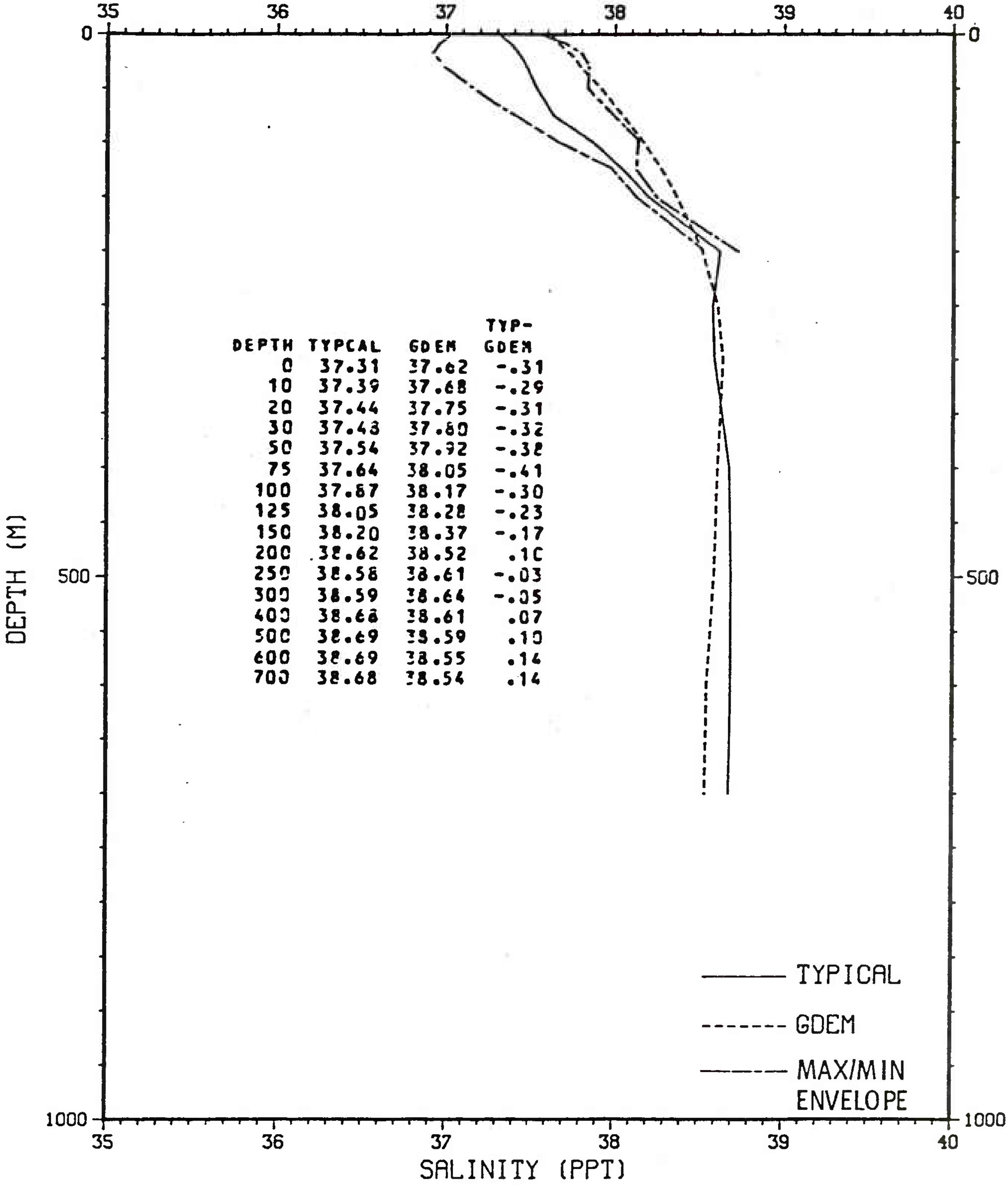
DEPTH	TYPCAL	GDEM	TYP-GDEM
0	37.01	37.27	-.26
10	37.02	37.33	-.31
20	37.06	37.40	-.34
30	37.15	37.46	-.31
50	37.36	37.59	-.23
75	37.46	37.77	-.31
100	37.63	37.94	-.31
125	37.69	38.11	-.22
150	38.15	38.26	-.11
200	38.64	38.54	.10
250	38.67	38.74	-.07
300	38.66	38.75	-.09
400	38.66	38.62	.04
500	38.69	38.56	.13
600	38.69	38.54	.15
700	38.68	38.54	.14

FIG. 5-6. VERTICAL SALINITY PROFILE FOR STRAIT OF SICILY (APR - JUN)



DEPTH	TYPCAL	GDEM	TYP-GDEM
0	37.29	37.20	.09
10	37.26	37.27	-.01
20	37.28	37.35	-.07
30	37.27	37.43	-.16
50	37.29	37.58	-.29
75	37.48	37.76	-.28
100	37.86	37.94	-.08
125	38.27	38.10	.17
150	38.50	38.25	.25
200	38.63	38.50	.13
250	38.67	38.56	.11
300	38.67	38.55	.12
400	38.71	38.54	.17
500	38.69	38.52	.17
600	38.69	38.50	.19
700	38.68	38.51	.17

FIG. 5-7. VERTICAL SALINITY PROFILE FOR STRAIT OF SICILY (JUL - SEP)



DEPTH	TYPCAL	GDEM	TYP-GDEM
0	37.31	37.62	-.31
10	37.39	37.68	-.29
20	37.44	37.75	-.31
30	37.48	37.80	-.32
50	37.54	37.92	-.38
75	37.64	38.05	-.41
100	37.87	38.17	-.30
125	38.05	38.28	-.23
150	38.20	38.37	-.17
200	38.62	38.52	.10
250	38.58	38.61	-.03
300	38.59	38.64	-.05
400	38.68	38.61	.07
500	38.69	38.59	.10
600	38.69	38.55	.14
700	38.68	38.54	.14

FIG. 5-8. VERTICAL SALINITY PROFILE FOR STRAIT OF SICILY (OCT - DEC)

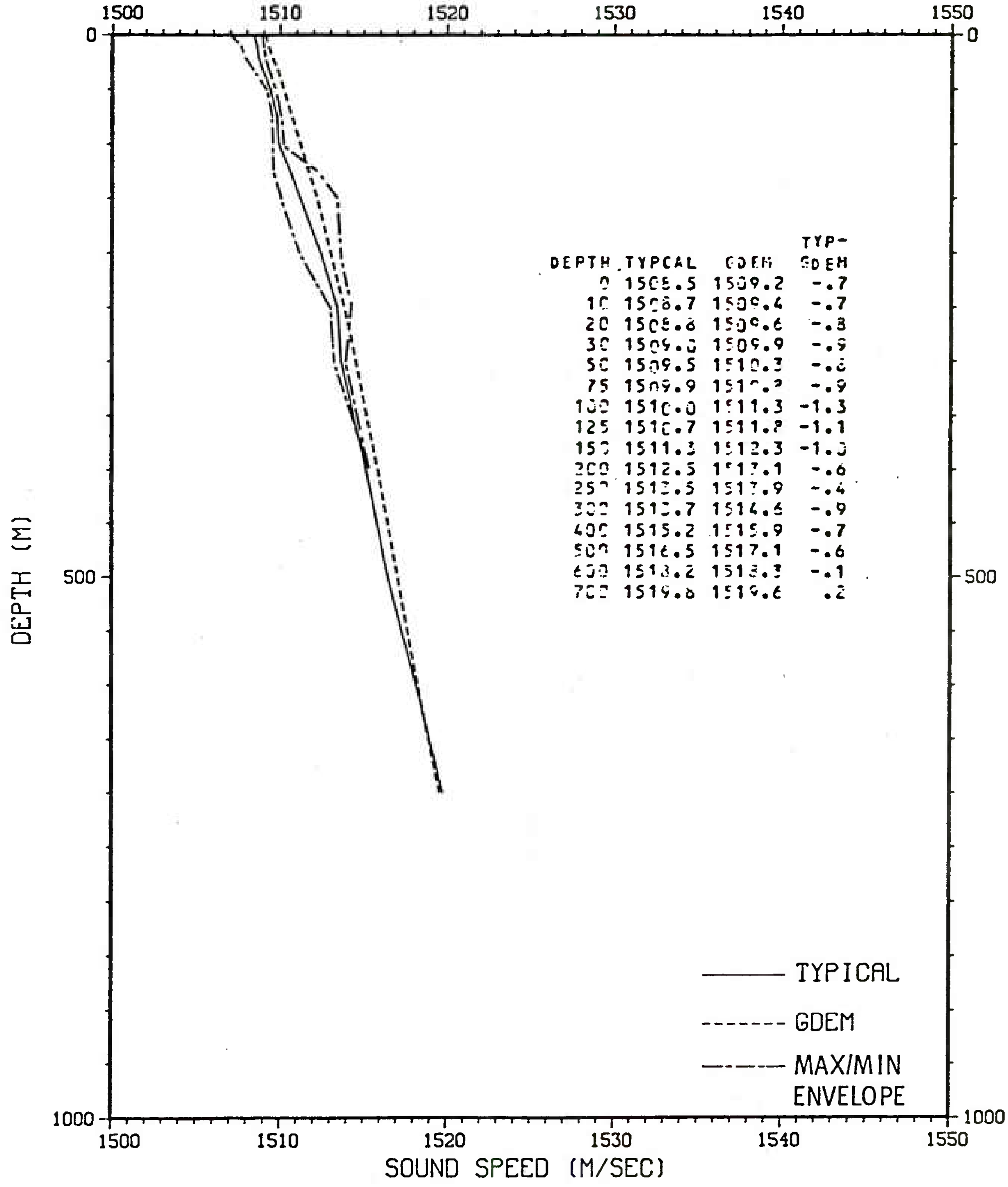
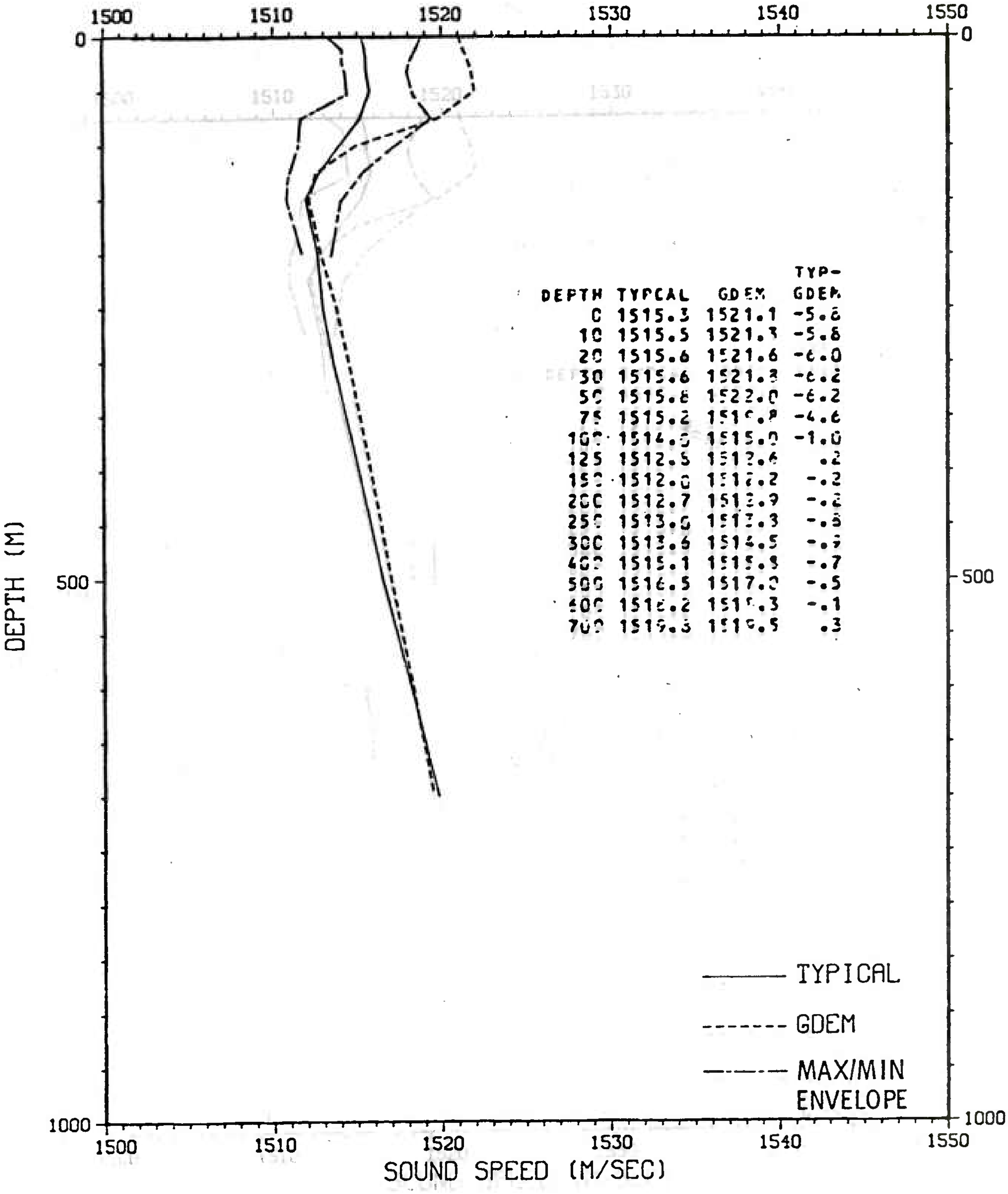


FIG. 5-9. VERTICAL SOUND-SPEED PROFILE FOR STRAIT OF SICILY (JAN - MAR)



DEPTH	TYPCAL	GDEM	TYP-GDEM
0	1515.3	1521.1	-5.8
10	1515.5	1521.3	-5.8
20	1515.6	1521.6	-6.0
30	1515.6	1521.8	-6.2
50	1515.8	1522.0	-6.2
75	1515.2	1519.8	-4.6
100	1514.0	1515.0	-1.0
125	1512.8	1512.6	.2
150	1512.0	1512.2	-.2
200	1512.7	1512.9	-.2
250	1513.0	1513.3	-.3
300	1513.6	1514.5	-.9
400	1515.1	1515.8	-.7
500	1516.5	1517.0	-.5
600	1518.2	1518.3	-.1
700	1519.8	1519.5	.3

FIG. 5-12. VERTICAL SOUND-SPEED PROFILE FOR STRAIT OF SICILY (OCT - DEC)

6.0 VERTICAL TEMPERATURE, SALINITY, AND SOUND-SPEED PROFILE COMPARISONS FOR MEDITERRANEAN (MED) LOCATION #5

Twelve vertical comparisons of temperature (T), salinity (S), and sound-speed (SS) for winter, spring, summer, and fall seasons are presented in this section.

6.1 Description

Med Location #5 is taken from the Ionian Sea region of the Mediterranean Sea. The geographic location selected for this comparison is at $35^{\circ}00'$ north latitude and $018^{\circ}00'$ east longitude. Vertical temperature, salinity, and sound-speed profiles of seasonal comparisons are shown in Figures 6-1 through 6-12.

The Ionian Sea region of the Mediterranean Sea, depicted as Region E in Figure 1-1, is defined for this report as the body of water that is bounded to the west by 15° east longitude; to the north by the land masses of Sicily, Italy, 40° north latitude and Greece; to the east by 22° east longitude; and to the south by 33° north latitude.

Meteorologically, this region is considered variable and seasonally active. The seasonal patterns are controlled primarily by the monsoonal characteristics of the Sahara Desert to the south and the Eurasian land mass to the north. The winters are characterized by a dominant high pressure with associated unsettled, windy conditions. The summers are characterized by a relatively weak high pressure with associated warm, dry settled conditions and light winds. Cyclogenesis does occur over the Ionian Sea. With their origin in the Atlas Mountains of Algeria and Tunisia, the primary path for the North African cyclones is north-eastward across the Ionian Sea. A secondary zone for Ionian cyclogenesis is located over the northern portion of the Ionian Sea. This region is known to generate southeastward cyclones that are associated with the southerly invasion of cold-air-mass movements from the Adriatic Sea.

Oceanographically, this region is considered variable. The ocean variability and changes in the near-surface vertical water column are directly influenced by the impulses received from the paths of cyclogenesis through mechanical mixing (especially in the winter and early spring). Because of the seasonal influence of surface air masses from the Sahara Desert, this area will reflect wide variability in vertical surface and near-surface stratification, especially in salinity.

6.2 Comparisons for Location #5

The vertical site comparisons of seasonal temperature, salinity, and sound-speed profiles, respectively, are presented for Med Location #5.

- Temperature:

  The January-to-March temperature envelope could not be developed from the statistical summaries because of an insufficient number of adequate data samples (Figure 6-1). There was one usable observation for this location. The GDEM value at the surface differed from the single observation by 0.76°C. Below 150 m, the GDEM and the single observation were in close agreement.

  The April-to-June temperature envelope taken from the statistical summaries was based on a data sample size of 42 observations (Figure 6-2). The GDEM value at the surface fell within the envelope of observed values and differed from the typical by 0.14°C. The numerical values within the thermocline region of GDEM w8re as high as 1.73°C. There was a slight negative inflection at 250 m by the typical which was not reflected by GDEM. Below 250 m, GDEM and the typical were similar.

  The July-to-September temperature envelope was based on a data sample size of 12 observations (Figure 6-3). The GDEM value at the surface fell within the envelope of observed values and differed from the typical by 0.34°C. Between 50 to 400 m, differences between GDEM and the typical were between 1.09°C and 0.18°C. Below 400 m GDEM and the typical were similar.

  The October-to-December temperature envelope could not be developed from the statistical summaries because of an insufficient number of adequate data samples (Figure 6-4). There was one usable observation for this location. The GDEM value at the surface differed from the typical by 0.03°C. Differences of 3.56°C and 1.60°C occurred at 50 m and 75 m, respectively. Below 75 m, GDEM and the typical were similar.

- Salinity:

  The January-to-March salinity envelope could not be developed from the statistical summaries because of an insufficient number of adequate data samples (Figure 6-5). There was one usable observation for this location. The GDEM value at the surface differed from the single observation by 0.12 ppt. Below the surface to 3000 m, the GDEM values did not differ by more than 0.16 ppt.

  The April-to-June salinity envelope was based on 42 observations (Figure 6-6). The GDEM value at the surface fell within the envelope of observed values and differed from the typical by 0.54 ppt. Below the surface to 125 m, differences were between 0.39 ppt and 0.63 ppt. Below 250 m, differences were slight reflecting a slightly lower GDEM value.

  The July-to-September salinity envelope was based on a data sample size of 12 observations (Figure 6-7). The GDEM value at the surface fell within the envelope of observed values and differed from the typical by 0.34 ppt. Below the surface to 3000 m, GDEM values did not differ from the typical by more than 0.13 ppt.

  The October-to-December salinity envelope could not be developed from the statistical summaries because of an insufficient number of adequate data samples (Figure 6-8). There was one usable observation for this location. The GDEM value at the surface differed from the typical by 0.08 ppt. This narrow difference continued to 30 m. At 50 and 75 m differences were 0.41 ppt and 0.20 ppt, respectively. Below 100 m to 3000 m, the numerical differences did not exceed 0.18 ppt reflecting a slightly lower GDEM value.

- Sound Speed:

  The January-to-March sound-speed envelope could not be developed from the statistical summaries because of an insufficient number of adequate data samples (Figure 6-9). There was one usable observation for this location. The GDEM value at the surface differed from the single observation by 2.3 m/s. Below the surface to 100 m, differences were between 1.1 m/s and 2.2 m/s. Below 200 m to 3000 m, the maximum difference was 0.4 m/s.

  The April-to-June sound-speed envelope was based on a data sample size of 42 observations (Figure 6-10). The GDEM value at the surface fell within the envelope of observed values and differed from the typical by 0.2 m/s. With the exception of the 20 m, 30 m, and 50 m, levels (with differences of 4.3 m/s, 2.0 m/s, and 1.1 m/s, respectively), the maximum difference below 300 m did not exceed 0.3 m/s.

The July-to-September sound-speed envelope was based on a data sample size of 12 observations (Figure 6-11). The GDEM value at the surface fell within the envelope of observed values and differed from the typical by 1.0 m/s. Differences of 1.2 m/s to 3.6 m/s existed between 20 m and 75 m. Differences of 1.1 m/s to 2.5 m/s existed between 150 m and 500 m. Below 600 m, the maximum difference was 0.5 m/s.

The October-to-December sound-speed envelope could not be developed from the statistical summaries because of an insufficient number of adequate data samples (Figure 6-12). There was one usable observation for this location. The GDEM value at the surface did not differ from the single observation. Differences of 10.8 m/s and 5.1 m/s existed at 50 m and at 75 m, respectively. Below the surface to 30 m, and from 200 m to 3000 m, the maximum difference was 0.9 m/s.

6.3 Evaluation - Ionian Sea (Location #5)

- January to March:

  Comparison between GDEM and the typical temperature profiles revealed similar thermal structure. The surface values differed by less than a degree (0.76°C). The mixed-layer depths differ by approximately 170 m. Differences in sea surface temperatures and layer depths fell within acceptable ranges for this season and area. Below 125 m, the profiles were identical. The primary difference between the two profiles were in the numerical depths of the mixed layer. Due to an insufficient number of adequate data samples (one usable observation), an appropriate envelope could not be developed. The GDEM appeared to adequately reflect a seasonally averaged winter temperature structure for this variable ocean region.

  Comparison between GDEM and the typical salinity profiles revealed similar salinity structures. The major difference was that the typical profile had a distinct isohaline layer at the near-surface whereas the GDEM reflected a nonlayer profile. GDEM had a definite positive gradient. Because of an insufficient number of adequate data samples (one usable observation), an appropriate envelope could not be developed. The GDEM values for salinity below 600 m can be increased by 0.11 ppt. GDEM appeared to reflect a seasonally averaged winter salinity structure for this variable ocean region.

  Comparison between GDEM and the typical sound-speed profiles revealed similar sound-speed structures below 200 m. Above 200 m, GDEM did not reflect as strong and well defined a surface duct as the typical; however, GDEM did reflect the general gradient for winter half channel. Due to an insufficient number of adequate data samples (one usable observation) an appropriate envelope could not be developed. Despite the differences in the depth of the surface ducts, GDEM did represent a known winter half channel sound-speed structure for this variable ocean region.

- April to June:

  Comparison between GDEM and the typical the temperature profiles revealed similar thermal structure. The envelope in the near-surface was adequately wide indicating a variable spring structuring, and reflecting a zone of sufficient thermal variability. GDEM reflected a seasonally averaged spring thermal structure for this variable ocean region when compared with the 42 usable observations.

  Comparison between GDEM and the typical salinity profiles were not similar. The surface and near-surface characteristics had differences. These differences were in surface value and in halocline gradient. Both, however, remained within the envelope. GDEM values for salinity below 700 m can be increased by 0.11 ppt. GDEM reflected a seasonally averaged spring haline stucture for this variable ocean region when compared with the 42 usable observations.

  Comparison between GDEM and the typical sound-speed profiles revealed similar sound speed structure. The sound-channel axes were similar. The gradients of the sonoclines were similar. The GDEM sound-speed profile reflected a seasonally averaged spring sound-speed structure for this variable ocean region when compared with the 42 usable observations.

- July to September:

  Comparison between GDEM and the typical temperature profiles revealed similar thermal structure. The near-surface thermocline gradients (above 50 m) were identical. Differences in thermal structure appeared between 50 m and 400 m. The GDEM profile indicated a sharp gradient change at approximately 75 m, then isothermal to 200 m, whereas the typical profile gradually decreased. In reviewing the data set, the typical was taken in July (early in the season) and therefore reflected the minimum end of the envelope. Both were reasonable for this time period. GDEM reflected more of a mean profile within the envelope of observed values. The envelope was wide below 200 m to 700 m, which indicated a high degree of variability within this season over the observational time period. Several of the observations revealed isothermal structure between 100 to 200 m. GDEM reflected a reasonable seasonally averaged summer thermal structure for this variable ocean region when compared with the 12 usable observations.

Comparison between GDEM and the typical salinity profiles revealed similar haline structures. The GDEM near surface did not reflect a negative structuring as indicated by either the typical or the envelope. Instead, GDEM revealed a positive gradient. This can result from the near-surface averaging process of GDEM. Below 500 m, GDEM values were lower than the envelope minimum. The positive gradient in the near surface and the slightly lower values below 500 m found in GDEM were not considered significant. GDEM reflected a seasonally averaged summer haline structure for this variable ocean region when compared with the 12 usable observations.

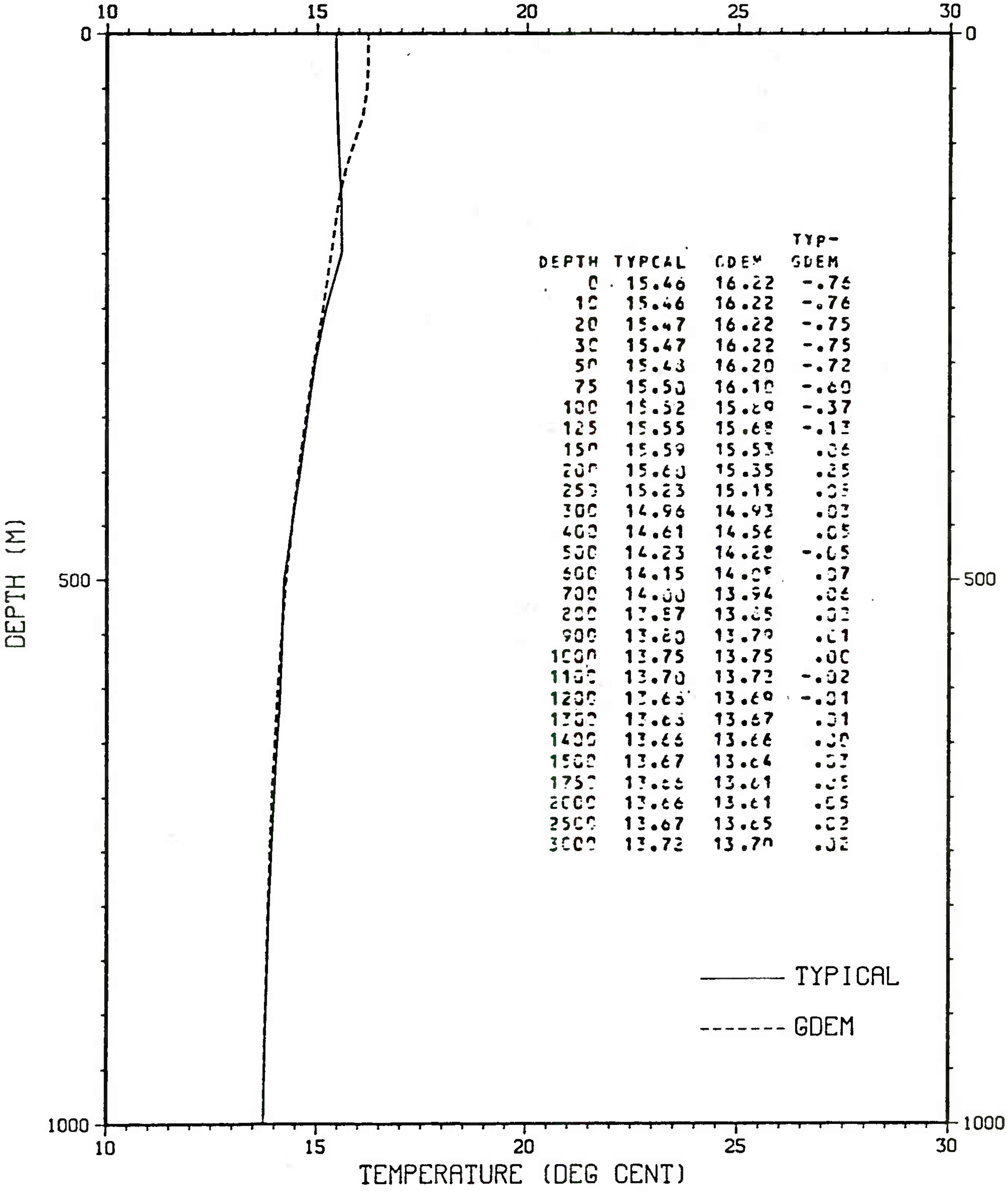
Comparison between GDEM and the typical sound-speed profiles were similar. The gradient of the sonoclines were similar above 50 m. The profiles were similar below 700 m. Differences between GDEM and the typical profile sound channel axes (of nearly 75m) occurred. Gradients below the primary axis (between 150 and 250 m) were also different. The GDEM summer sound-speed profile was considered seasonally representative for this variable ocean region when compared with the 12 usable observations.

- October to December:

  Comparison between GDEM and the typical temperature profiles revealed similar thermal structure. Below 200 m, both were similar. Differences existed in the upper gradient of the thermoclines. The primary difference was in the depth of the thermoclines. This difference was a 20 m separation. A 20 m thermocline separation for this region is not considered a substantial difference. Due to an insufficient number of adequate data samples (one usable observation) an appropriate envelope could not be developed. GDEM reflected a seasonally averaged fall thermal structure for this variable ocean region.

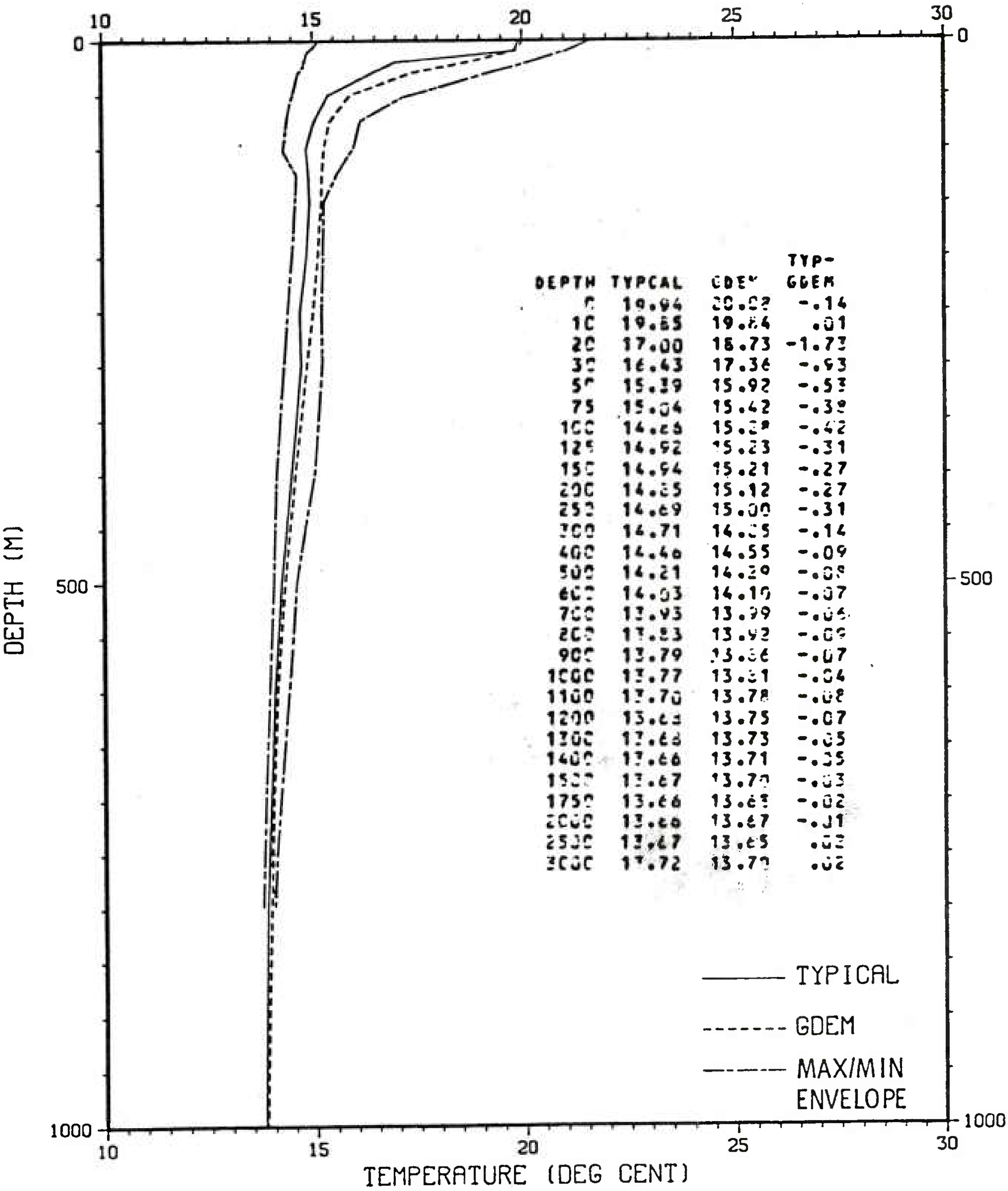
  Comparison between GDEM and the typical salinity profiles revealed differences in haline structure. The near-surface structure was different. GDEM revealed a zero layer structure. The typical revealed an isohaline layer of approximately 30 m. Differences also existed in the depths of the salinity maxima. GDEM had a salinity maximum at approximately 250 m. The salinity maximum of the typical was at approximately 350 m. Below the primary salinity maximum, GDEM revealed a stronger negative gradient of 0.11 ppt and 0.17 ppt down to 2000 m. GDEM values for salinity can be increased by 0.15 ppt below 400 m to 3000 m. Due to an insufficient number of adequate data samples (one usable observation) an appropriate envelope could not be developed. Modification of the GDEM fall salinity profile was viewed appropriate.

Comparison between GDEM and the typical sound-speed profiles revealed similar sound speed structure. These similarities were in the gradient of the sonoclines above the primary sound-channel axis and in the gradients below 500 m to 3000 m. Differences in sound speed were found at the primary sound channel axis (GDEM - 1515.7 m/s; typical -1513.2 m/s), in the gradients of the sound-speed profiles immediately below the primary sound channel axis, and in the presence of a weak secondary sound channel axis at approximately 300 m (in GDEM only). Because of an insufficient number of adequate data samples (one usable observation), an appropriate envel6pe could not be developed. Differences in the values for sound speed at and near the primary sound channel axis were due to features found in both the temperature and salinity profiles. The weak secondary sound channel of GDEM appeared to be influenced by the reversal in the salinity gradient. In reviewing other supplemental data sets for this time period and location, the weak secondary sound channel occurred approximately 10 to 15 percent of the time. Therefore, although a real intermittent feature, it is considered neither a seasonally nor historically persistent representative feature for this evaluation and location.



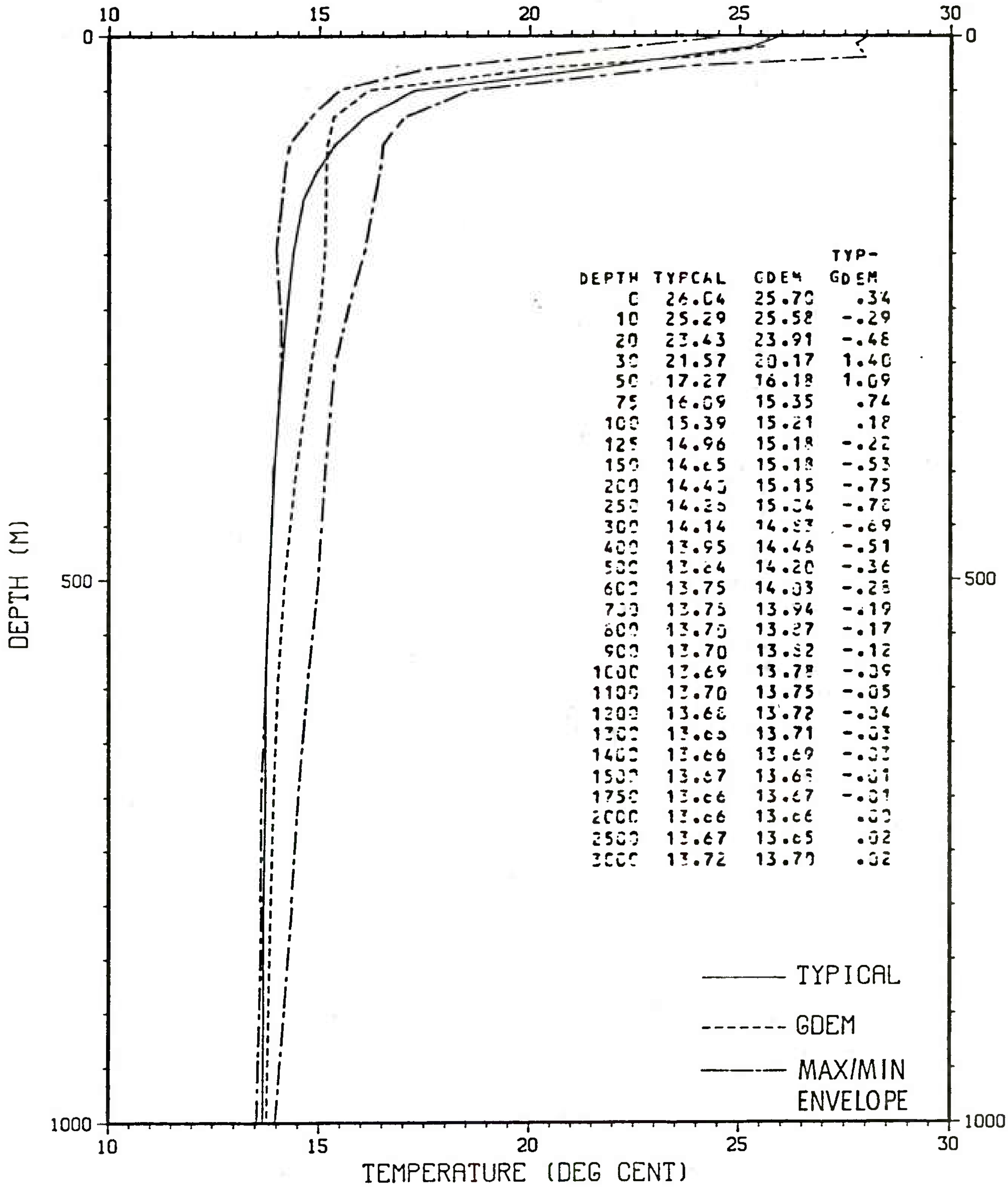
DEPTH	TYPCAL	GDEM	TYP-GDEM
0	15.46	16.22	-.76
10	15.46	16.22	-.76
20	15.47	16.22	-.75
30	15.47	16.22	-.75
50	15.48	16.20	-.72
75	15.50	16.10	-.60
100	15.52	15.89	-.37
125	15.55	15.68	-.13
150	15.59	15.53	.06
200	15.60	15.35	.25
250	15.23	15.15	.08
300	14.96	14.93	.03
400	14.61	14.56	.05
500	14.23	14.28	-.05
600	14.15	14.08	.07
700	14.00	13.94	.06
800	13.87	13.85	.02
900	13.80	13.79	.01
1000	13.75	13.75	.00
1100	13.70	13.72	-.02
1200	13.68	13.69	-.01
1300	13.68	13.67	.01
1400	13.66	13.66	.00
1500	13.67	13.64	.03
1750	13.66	13.61	.05
2000	13.66	13.61	.05
2500	13.67	13.65	.02
3000	13.72	13.70	.02

FIG. 6-1. VERTICAL TEMPERATURE PROFILE FOR IONIAN SEA (JAN - MAR)



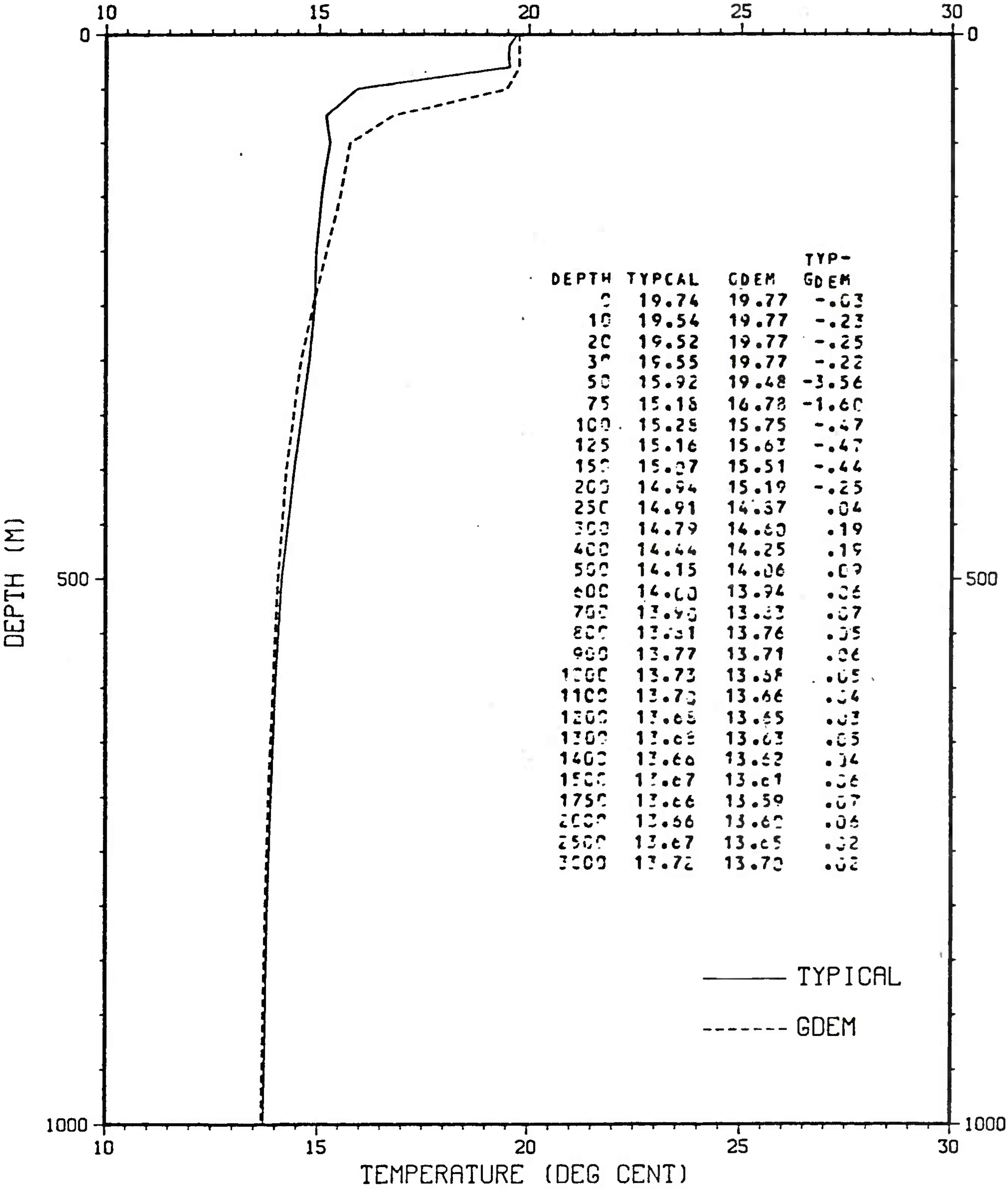
DEPTH	TYPCAL	GDEM	TYP-GDEM
0	19.94	20.08	-.14
10	19.65	19.64	.01
20	17.00	18.73	-1.73
30	16.43	17.36	-.93
50	15.39	15.92	-.53
75	15.04	15.42	-.38
100	14.86	15.28	-.42
125	14.92	15.23	-.31
150	14.94	15.21	-.27
200	14.85	15.12	-.27
250	14.69	15.00	-.31
300	14.71	14.85	-.14
400	14.46	14.55	-.09
500	14.21	14.29	-.08
600	14.03	14.10	-.07
700	13.93	13.99	-.06
800	13.83	13.92	-.09
900	13.79	13.86	-.07
1000	13.77	13.81	-.04
1100	13.70	13.78	-.08
1200	13.68	13.75	-.07
1300	13.68	13.73	-.05
1400	13.66	13.71	-.05
1500	13.67	13.70	-.03
1750	13.66	13.68	-.02
2000	13.66	13.67	-.01
2500	13.67	13.65	.02
3000	13.72	13.70	.02

FIG. 6-2. VERTICAL TEMPERATURE PROFILE FOR IONIAN SEA (APR - JUN)



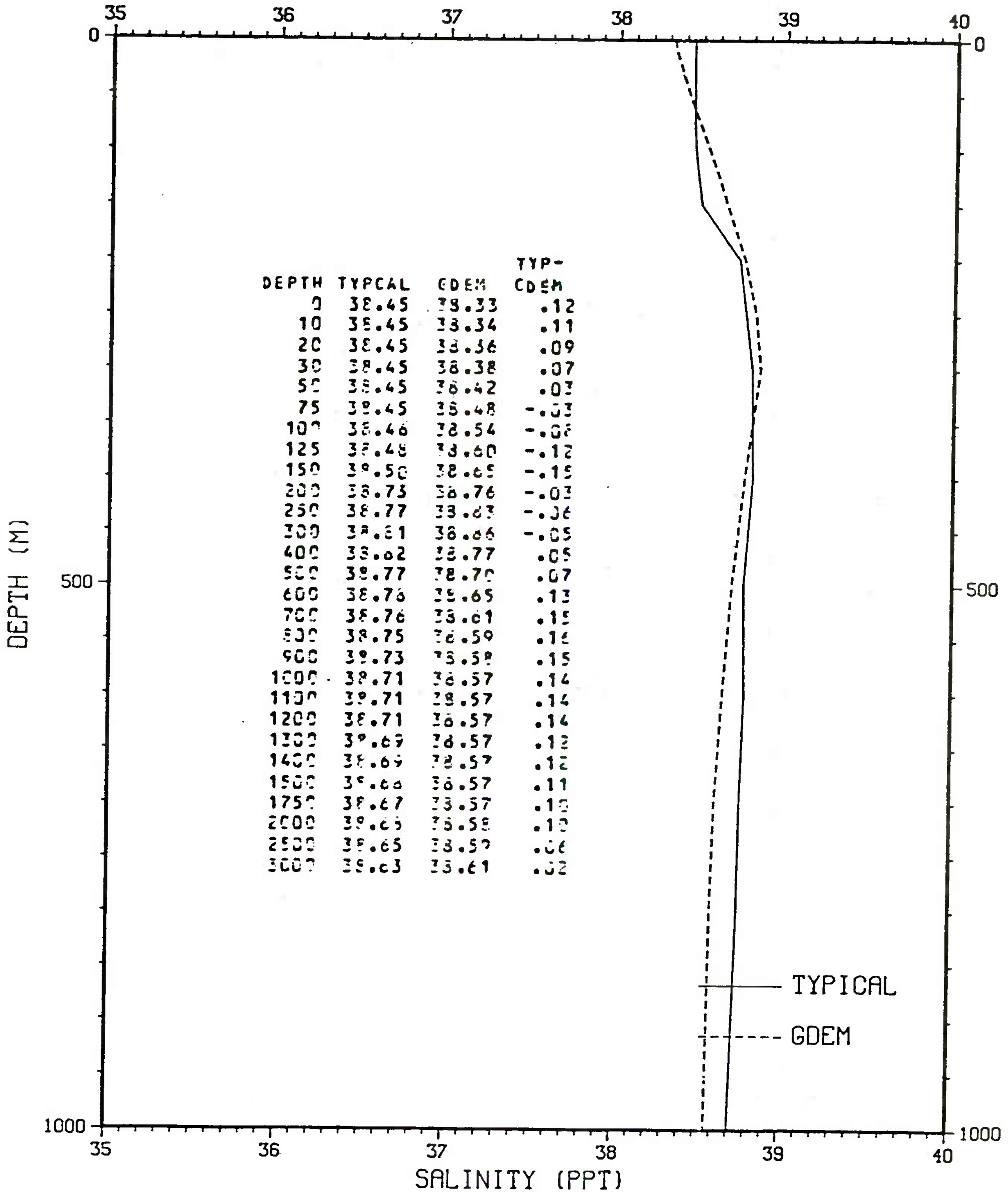
DEPTH	TYPCAL	GDEM	TYP-GDEM
0	26.04	25.70	.34
10	25.29	25.58	-.29
20	23.43	23.91	-.48
30	21.57	20.17	1.40
50	17.27	16.18	1.09
75	16.09	15.35	.74
100	15.39	15.21	.18
125	14.96	15.18	-.22
150	14.65	15.18	-.53
200	14.40	15.15	-.75
250	14.26	15.04	-.78
300	14.14	14.83	-.69
400	13.95	14.46	-.51
500	13.84	14.20	-.36
600	13.75	14.03	-.28
700	13.75	13.94	-.19
800	13.70	13.87	-.17
900	13.70	13.82	-.12
1000	13.69	13.78	-.09
1100	13.70	13.75	-.05
1200	13.68	13.72	-.04
1300	13.68	13.71	-.03
1400	13.66	13.69	-.03
1500	13.67	13.68	-.01
1750	13.66	13.67	-.01
2000	13.66	13.66	.00
2500	13.67	13.65	.02
3000	13.72	13.70	.02

FIG. 6-3. VERTICAL TEMPERATURE PROFILE FOR IONIAN SEA (JUL - SEP)



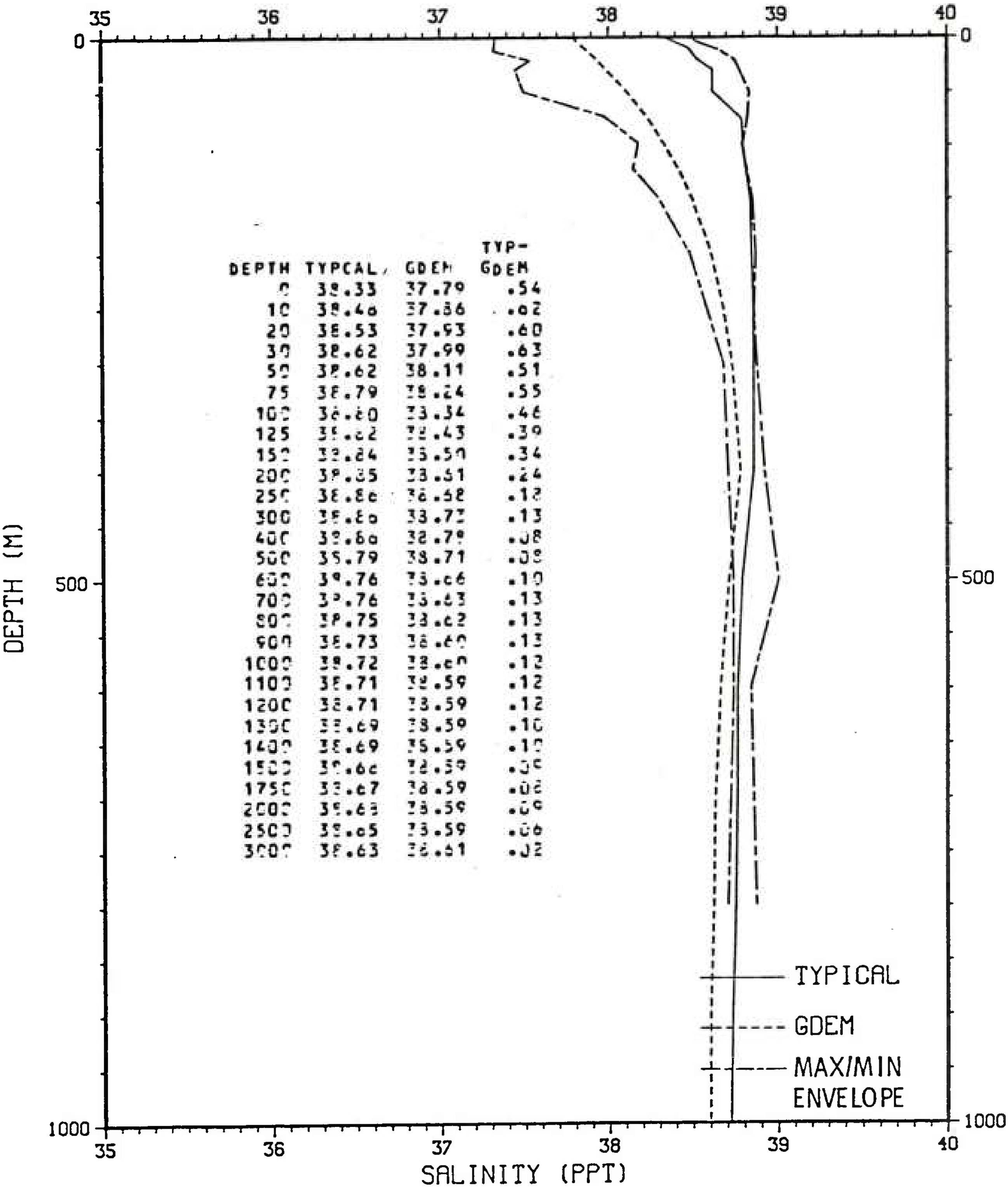
DEPTH	TYPCAL	GDEM	TYP-GDEM
0	19.74	19.77	-.03
10	19.54	19.77	-.23
20	19.52	19.77	-.25
30	19.55	19.77	-.22
50	15.92	19.48	-3.56
75	15.18	16.78	-1.60
100	15.28	15.75	-.47
125	15.16	15.63	-.47
150	15.07	15.51	-.44
200	14.94	15.19	-.25
250	14.91	14.87	.04
300	14.79	14.60	.19
400	14.44	14.25	.19
500	14.15	14.06	.09
600	14.00	13.94	.06
700	13.90	13.83	.07
800	13.81	13.76	.05
900	13.77	13.71	.06
1000	13.73	13.68	.05
1100	13.70	13.66	.04
1200	13.68	13.65	.03
1300	13.68	13.63	.05
1400	13.66	13.62	.04
1500	13.67	13.61	.06
1750	13.66	13.59	.07
2000	13.66	13.60	.06
2500	13.67	13.65	.02
3000	13.72	13.70	.02

FIG. 6-4. VERTICAL TEMPERATURE PROFILE FOR IONIAN SEA (OCT - DEC)



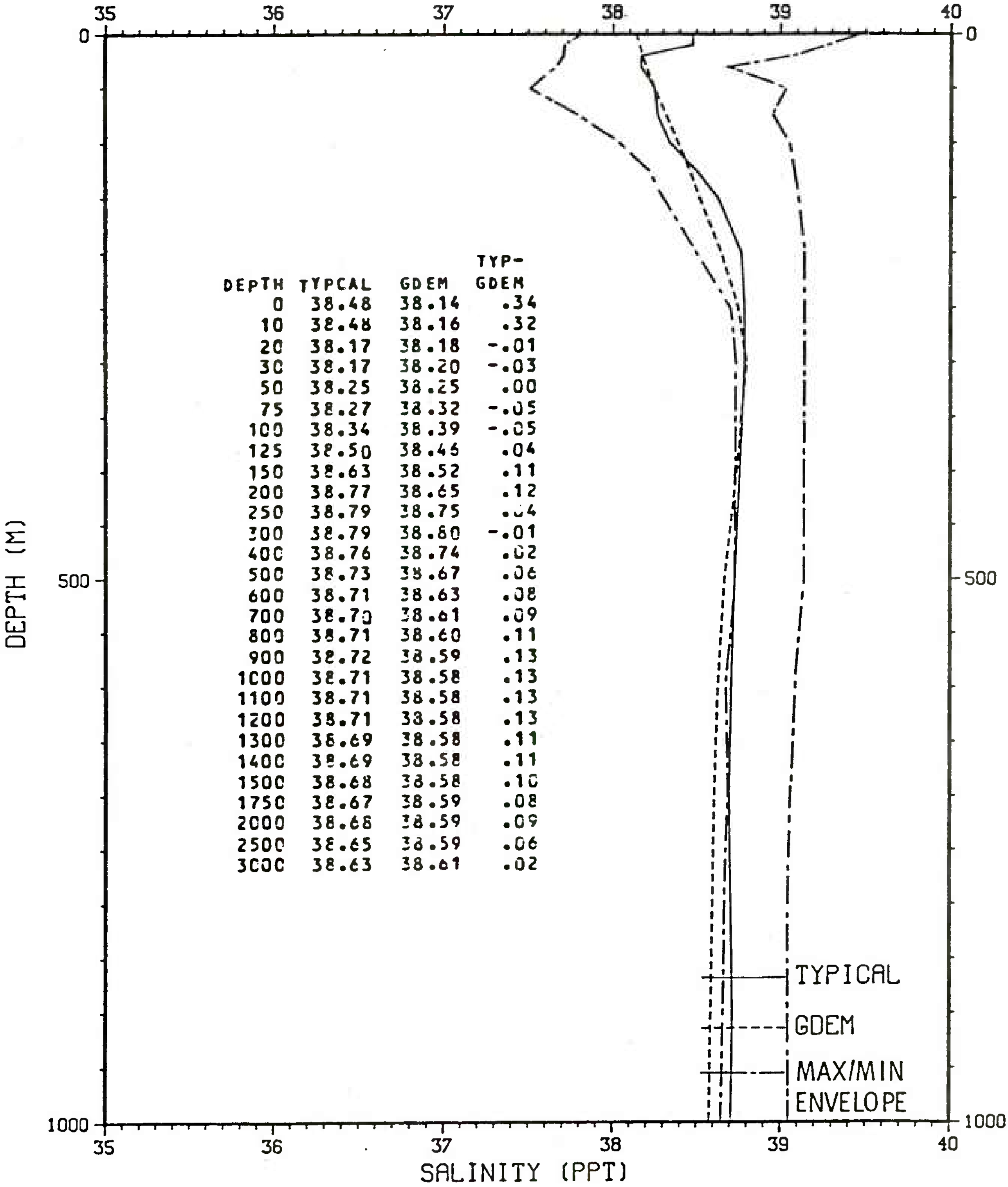
DEPTH	TYPCAL	GDEM	TYP-GDEM
0	38.45	38.33	.12
10	38.45	38.34	.11
20	38.45	38.36	.09
30	38.45	38.38	.07
50	38.45	38.42	.03
75	38.45	38.48	-.03
100	38.46	38.54	-.08
125	38.48	38.60	-.12
150	38.50	38.65	-.15
200	38.73	38.76	-.03
250	38.77	38.83	-.06
300	38.81	38.86	-.05
400	38.82	38.77	.05
500	38.77	38.70	.07
600	38.76	38.65	.13
700	38.76	38.61	.15
800	38.75	38.59	.16
900	38.73	38.58	.15
1000	38.71	38.57	.14
1100	38.71	38.57	.14
1200	38.71	38.57	.14
1300	38.69	38.57	.12
1400	38.69	38.57	.12
1500	38.68	38.57	.11
1750	38.67	38.57	.10
2000	38.65	38.55	.10
2500	38.65	38.59	.06
3000	38.63	38.61	.02

FIG. 6-5. VERTICAL SALINITY PROFILE FOR IONIAN SEA (JAN - MAR)



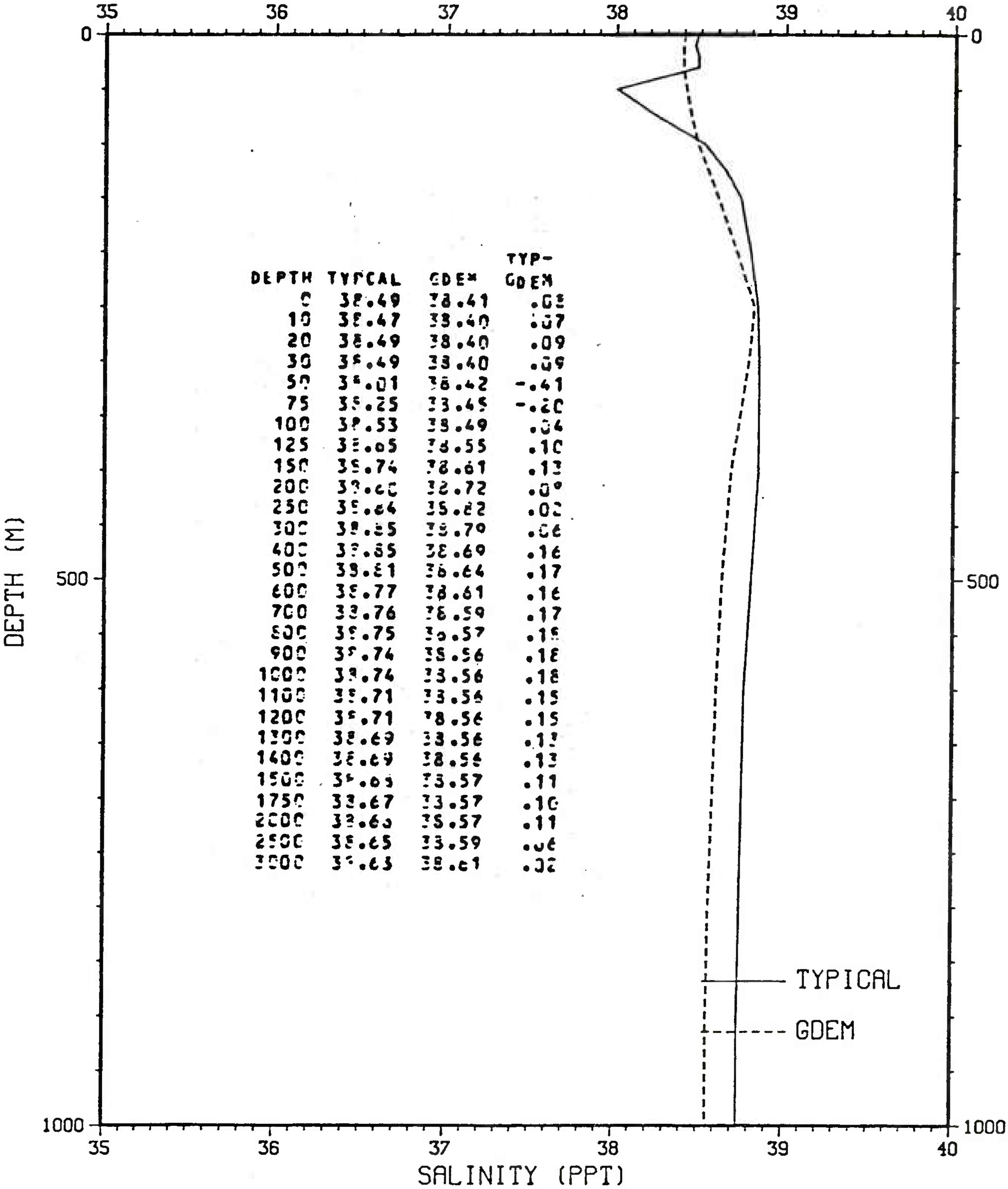
DEPTH	TYPCAL	GDEM	TYP-GDEM
0	38.33	37.79	.54
10	38.46	37.86	.62
20	38.53	37.93	.60
30	38.62	37.99	.63
50	38.62	38.11	.51
75	38.79	38.24	.55
100	38.80	38.34	.46
125	38.82	38.43	.39
150	38.84	38.50	.34
200	38.85	38.61	.24
250	38.86	38.68	.18
300	38.86	38.73	.13
400	38.86	38.78	.08
500	38.79	38.71	.08
600	38.76	38.66	.10
700	38.76	38.63	.13
800	38.75	38.62	.13
900	38.73	38.60	.13
1000	38.72	38.60	.12
1100	38.71	38.59	.12
1200	38.71	38.59	.12
1300	38.69	38.59	.10
1400	38.69	38.59	.10
1500	38.68	38.59	.09
1750	38.67	38.59	.08
2000	38.68	38.59	.09
2500	38.65	38.59	.06
3000	38.63	38.61	.02

FIG. 6-6. VERTICAL SALINITY PROFILE FOR IONIAN SEA (APR - JUN)



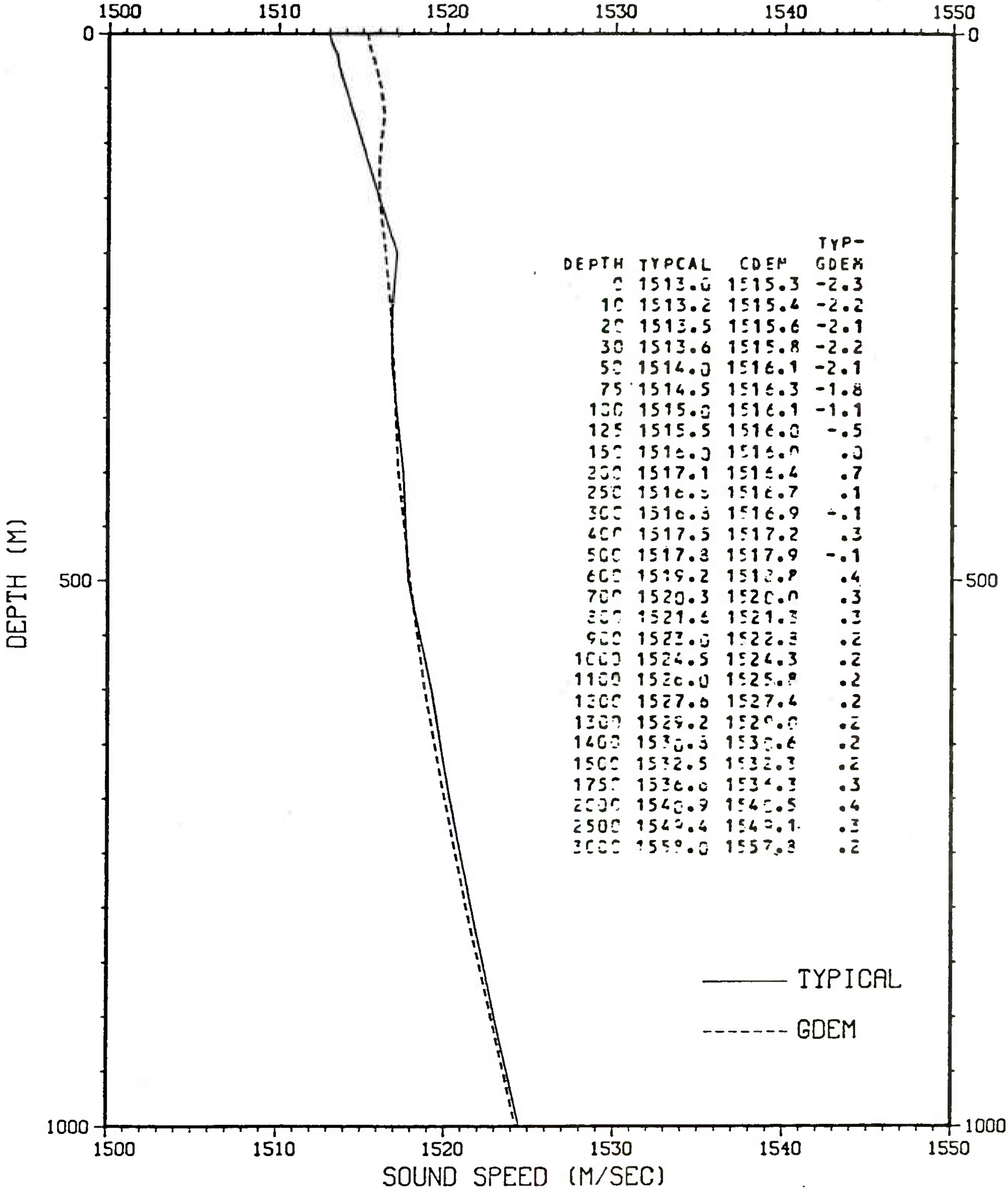
DEPTH	TYPCAL	GDEM	TYP-GDEM
0	38.48	38.14	.34
10	38.48	38.16	.32
20	38.17	38.18	-.01
30	38.17	38.20	-.03
50	38.25	38.25	.00
75	38.27	38.32	-.05
100	38.34	38.39	-.05
125	38.50	38.46	.04
150	38.63	38.52	.11
200	38.77	38.65	.12
250	38.79	38.75	.04
300	38.79	38.80	-.01
400	38.76	38.74	.02
500	38.73	38.67	.06
600	38.71	38.63	.08
700	38.70	38.61	.09
800	38.71	38.60	.11
900	38.72	38.59	.13
1000	38.71	38.58	.13
1100	38.71	38.58	.13
1200	38.71	38.58	.13
1300	38.69	38.58	.11
1400	38.69	38.58	.11
1500	38.68	38.58	.10
1750	38.67	38.59	.08
2000	38.68	38.59	.09
2500	38.65	38.59	.06
3000	38.63	38.61	.02

FIG. 6-7. VERTICAL SALINITY PROFILE FOR IONIAN SEA (JUL - SEP)



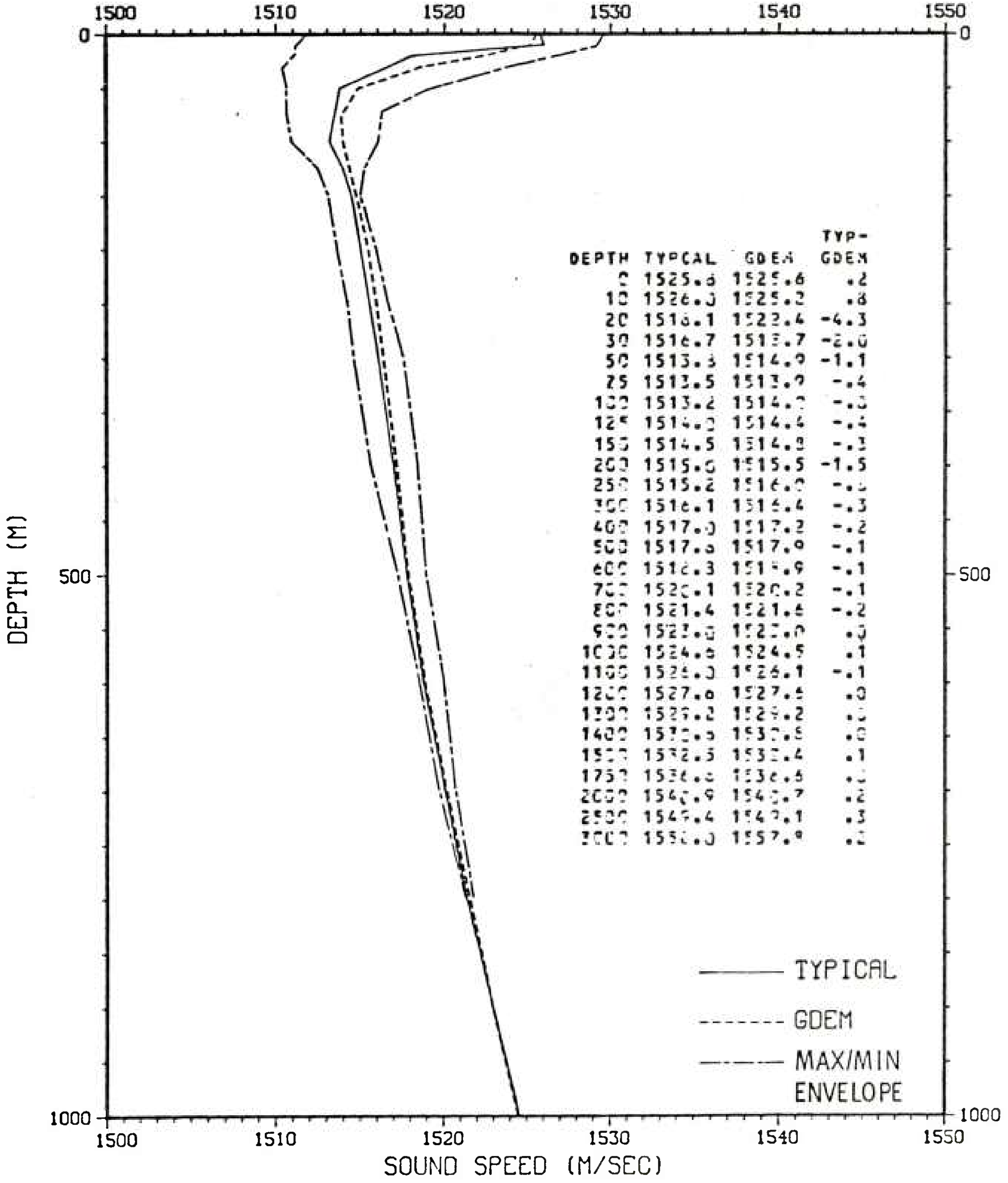
DEPTH	TYPCAL	GDEM	TYP-GDEM
0	38.49	38.41	.08
10	38.47	38.40	.07
20	38.49	38.40	.09
30	38.49	38.40	.09
50	38.01	38.42	-.41
75	38.25	38.45	-.20
100	38.53	38.49	.04
125	38.65	38.55	.10
150	38.74	38.61	.13
200	38.80	38.72	.09
250	38.84	38.82	.02
300	38.85	38.79	.06
400	38.85	38.69	.16
500	38.81	38.64	.17
600	38.77	38.61	.16
700	38.76	38.59	.17
800	38.75	38.57	.18
900	38.74	38.56	.18
1000	38.74	38.56	.18
1100	38.71	38.56	.15
1200	38.71	38.56	.15
1300	38.69	38.56	.13
1400	38.69	38.56	.13
1500	38.68	38.57	.11
1750	38.67	38.57	.10
2000	38.68	38.57	.11
2500	38.65	38.59	.06
3000	38.63	38.61	.02

FIG. 6-8. VERTICAL SALINITY PROFILE FOR IONIAN SEA (OCT - DEC)



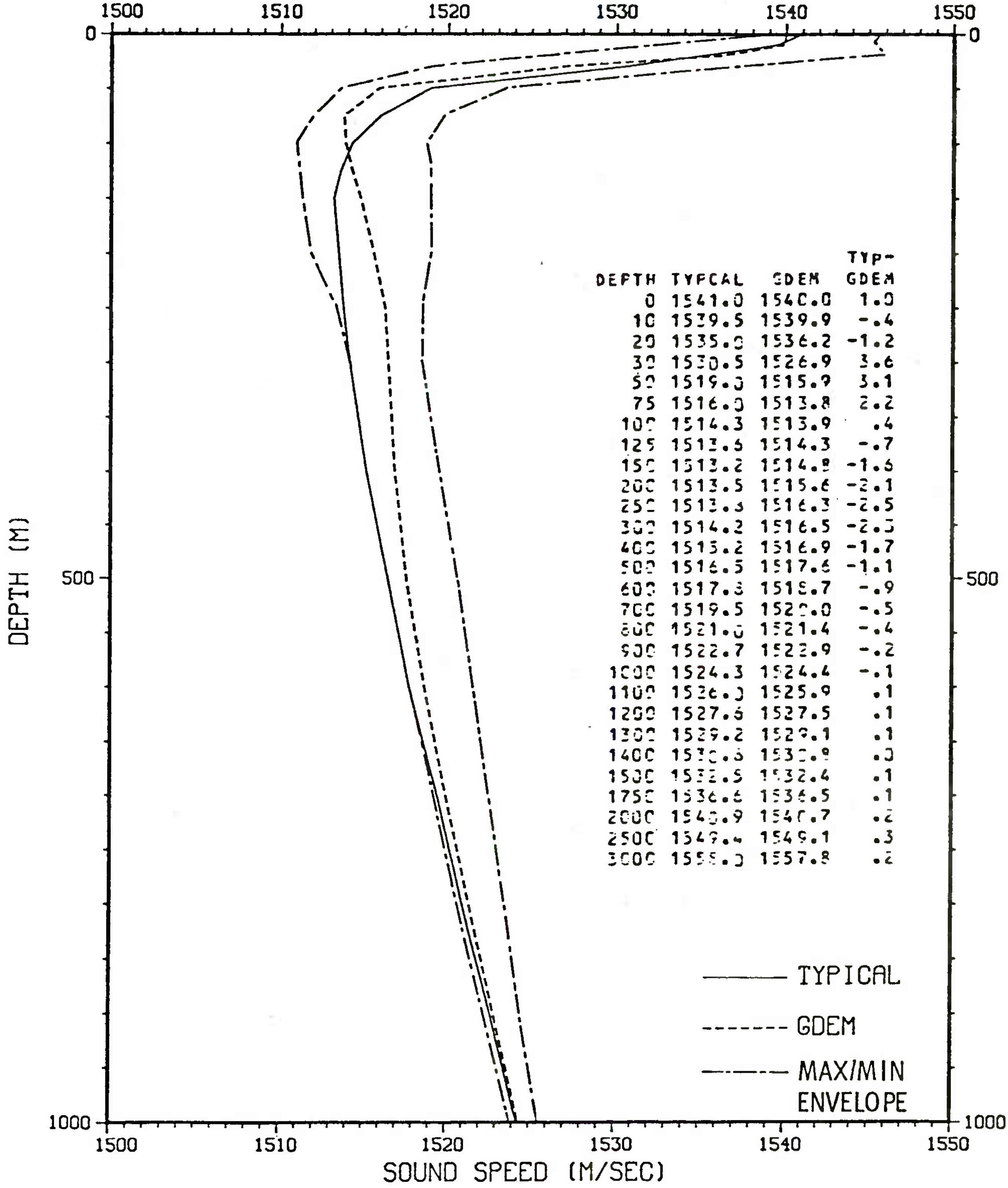
DEPTH	TYPCAL	GDEM	TYP-GDEM
0	1513.0	1515.3	-2.3
10	1513.2	1515.4	-2.2
20	1513.5	1515.6	-2.1
30	1513.6	1515.8	-2.2
50	1514.0	1516.1	-2.1
75	1514.5	1516.3	-1.8
100	1515.0	1516.1	-1.1
125	1515.5	1516.0	-.5
150	1516.0	1516.0	.0
200	1517.1	1516.4	.7
250	1516.8	1516.7	.1
300	1516.8	1516.9	-.1
400	1517.5	1517.2	.3
500	1517.8	1517.9	-.1
600	1519.2	1518.8	.4
700	1520.3	1520.0	.3
800	1521.6	1521.3	.3
900	1523.0	1522.8	.2
1000	1524.5	1524.3	.2
1100	1526.0	1525.8	.2
1200	1527.6	1527.4	.2
1300	1529.2	1529.0	.2
1400	1530.8	1530.6	.2
1500	1532.5	1532.3	.2
1750	1536.6	1536.3	.3
2000	1540.9	1540.5	.4
2500	1549.4	1549.1	.3
3000	1558.0	1557.8	.2

FIG. 6-9. VERTICAL SOUND-SPEED PROFILE FOR IONIAN SEA (JAN - MAR)



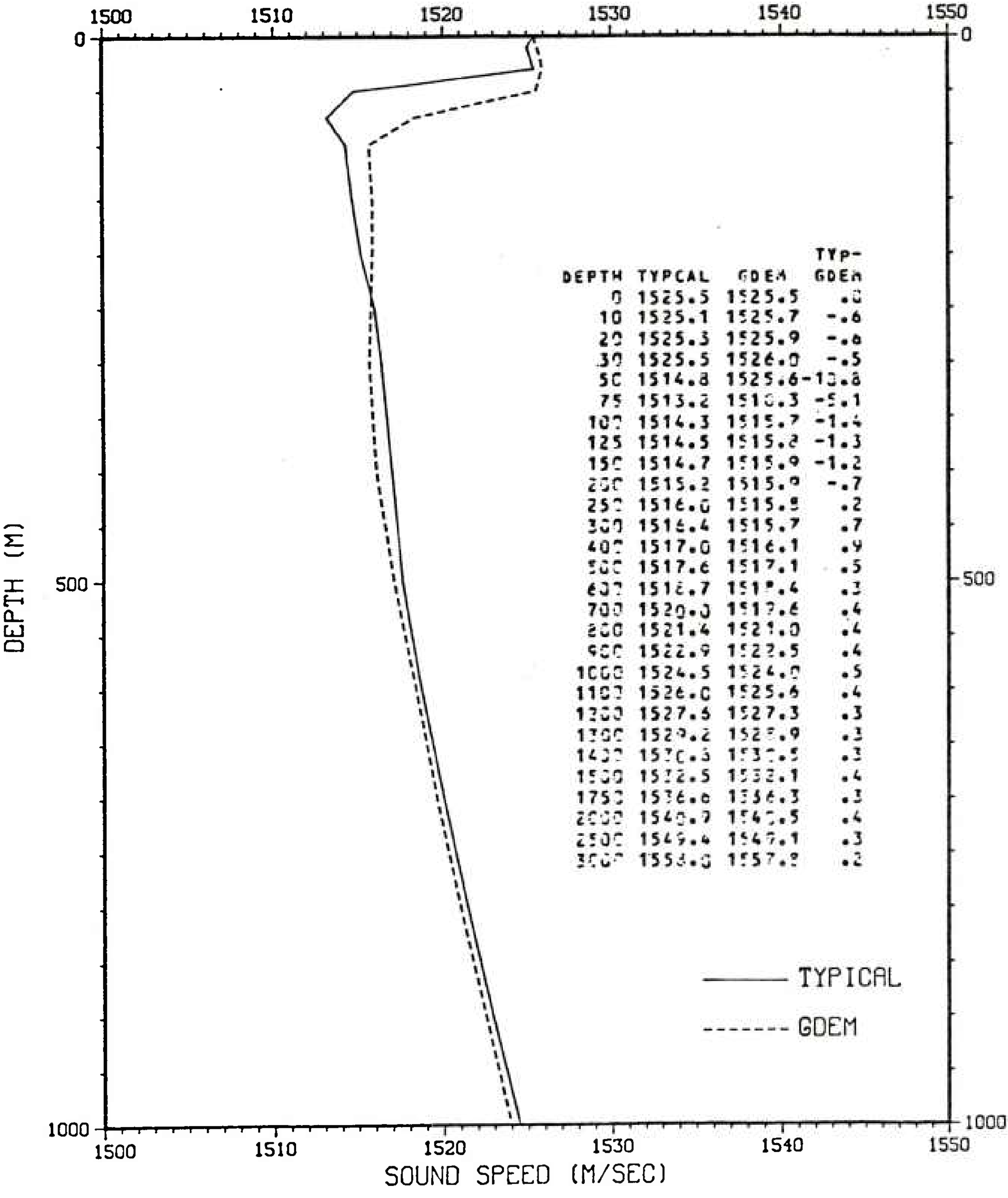
DEPTH	TYPCAL	GDEM	TYP-GDEM
0	1525.8	1525.6	.2
10	1526.0	1525.2	.8
20	1518.1	1522.4	-4.3
30	1516.7	1518.7	-2.0
50	1513.8	1514.9	-1.1
75	1513.5	1513.9	-.4
100	1513.2	1514.0	-.8
125	1514.0	1514.4	-.4
150	1514.5	1514.8	-.3
200	1515.0	1515.5	-1.5
250	1515.2	1516.0	-.8
300	1516.1	1516.4	-.3
400	1517.0	1517.2	-.2
500	1517.8	1517.9	-.1
600	1518.3	1518.9	-.1
700	1520.1	1520.2	-.1
800	1521.4	1521.6	-.2
900	1523.0	1523.0	.0
1000	1524.6	1524.5	.1
1100	1526.0	1526.1	-.1
1200	1527.6	1527.6	.0
1300	1529.2	1529.2	.0
1400	1530.5	1530.5	.0
1500	1532.5	1532.4	.1
1750	1536.6	1536.6	.0
2000	1540.9	1540.7	.2
2500	1549.4	1549.1	.3
3000	1558.0	1557.9	.2

FIG. 6-10. VERTICAL SOUND-SPEED PROFILE FOR IONIAN SEA (APR - JUN)



DEPTH	TYPCAL	GDEM	TYP-GDEM
0	1541.0	1540.0	1.0
10	1539.5	1539.9	-.4
20	1535.0	1536.2	-1.2
30	1530.5	1526.9	3.6
50	1519.0	1515.9	3.1
75	1516.0	1513.8	2.2
100	1514.3	1513.9	.4
125	1513.6	1514.3	-.7
150	1513.2	1514.8	-1.6
200	1513.5	1515.6	-2.1
250	1513.8	1516.3	-2.5
300	1514.2	1516.5	-2.3
400	1515.2	1516.9	-1.7
500	1516.5	1517.6	-1.1
600	1517.8	1518.7	-.9
700	1519.5	1520.0	-.5
800	1521.0	1521.4	-.4
900	1522.7	1522.9	-.2
1000	1524.3	1524.4	-.1
1100	1526.0	1525.9	.1
1200	1527.6	1527.5	.1
1300	1529.2	1529.1	.1
1400	1530.9	1530.9	.0
1500	1532.5	1532.4	.1
1750	1536.6	1536.5	.1
2000	1540.9	1540.7	.2
2500	1549.4	1549.1	.3
3000	1558.0	1557.8	.2

FIG. 6-11. VERTICAL SOUND-SPEED PROFILE FOR IONIAN SEA (JUL - SEP)



DEPTH	TYPCAL	GDEM	TYP-GDEM
0	1525.5	1525.5	.0
10	1525.1	1525.7	-.6
20	1525.3	1525.9	-.6
30	1525.5	1526.0	-.5
50	1514.8	1525.6	-10.8
75	1513.2	1518.3	-5.1
100	1514.3	1515.7	-1.4
125	1514.5	1515.8	-1.3
150	1514.7	1515.9	-1.2
200	1515.2	1515.9	-.7
250	1516.0	1515.8	.2
300	1516.4	1515.7	.7
400	1517.0	1516.1	.9
500	1517.6	1517.1	.5
600	1518.7	1518.4	.3
700	1520.0	1519.6	.4
800	1521.4	1521.0	.4
900	1522.9	1522.5	.4
1000	1524.5	1524.0	.5
1100	1526.0	1525.6	.4
1200	1527.6	1527.3	.3
1300	1529.2	1528.9	.3
1400	1530.8	1530.5	.3
1500	1532.5	1532.1	.4
1750	1536.6	1536.3	.3
2000	1540.9	1540.5	.4
2500	1549.4	1549.1	.3
3000	1558.0	1557.8	.2

FIG. 6-12. VERTICAL SOUND-SPEED PROFILE FOR IONIAN SEA (OCT - DEC)

7.0 VERTICAL TEMPERATURE, SALINITY, AND SOUND-SPEED PROFILE COMPARISONS FOR MEDITERRANEAN (MED) LOCATION #6

Twelve vertical comparisons of temperature (T), salinity (S), and sound-speed (SS) for winter, spring, summer, and fall seasons are presented in this section.

7.1 Description

Med Location #6 is taken from the Levantine Sea region of the Mediterrancean Sea. The geographical location selected for this comparison is at $33^{o}00'$ north latitude and $030^{o}00'$ east longitude. Vertical temperature, salinity, and sound-speed profiles of seasonal comparisons are shown in Figures 7-1 through 7-12.

The Levantine Sea region of the Mediterranean Sea, depicted as Region F on Figure 1-1, is located on the most easterly portion of the major eastern basin and is defined for this report as the body of water bounded to the west by 25^{o} east longitude; to the north by the coastline of Turkey; to the east by the coastlines of Syria, Lebanon, and Israel; and to the south by the coastline of the United Arab Republic.

Meteorologically, this region is considered variable. Seasonal weather patterns are largely influenced by patterns that develop over the adjacent land masses. Cyclogenesis development, in general, is limited and originates at other distant regions (i.e. Ionian Sea and the Aegean Sea regions). A minor region is located over Cyprus. The winter patterns are very cold (relative to the sea surface temperatures), unsettled, and have associated strong winds. The summer patterns are dry and with heated air masses having persistent surface winds.

Oceanographically, this region is considered to be active, variable and important to overall surface distribution of salt and heat fluxes of the eastern Mediterranean basin. Within this region, processes leading to the development of Levantine Intermediate Water, positive salt fluxes, selective near-surface stratifications from the Nile, and large-scale subsurface flow patterns (currents) are known to take place.

7.2 Comparisons for Location #6

The vertical site comparisons of seasonal temperature, salinity, and sound-speed profiles, respectively, were presented for Med Location #6.

- Temperature:

  The January-to-March temperature envelope was based on a data sample size of 15 observations (Figure 7-1). The GDEM value at the surface fell within the envelope of observed values and differed from the typical by 0.45°C. Differences between GDEM and the typical between the surface and 150 m were less than 0.76°C. Below 200 m, the differences were less than 0.12°C. Both profiles were similar below 200 m.

  The April-to-June temperature envelope was based on a data sample size of 17 observations (Figure 7-2). The GDEM value at the surface fell within the envelope of observed values and differed from the typical by 0.77°C. Differences between GDEM and the typical between the surface and 30 m were 1.14°C. Between 30 to 500 m, the maximum difference was 0.79°C at 300 m. Below 500 m, the differences were less than 0.18°C. Both profiles were similar below 300 m.

  The July-to-September temperature envelope was based on a data sample size of 29 observations (Figure 7-3). The GDEM value at the surface fell within the envelope of observed values and differed from the typical by 1.29°C. Differences below the surface to 50 m did not exceed 0.80°C. Below 75 m, the differences were 0.37°C.

  The October-to-December temperature envelope was based on a data sample size of 14 observations (Figure 7-4). The GDEM value at the surface fell within the envelope of observed values and differed from the typical by 0.29°C. Differences between GDEM and the typical between the surface and 50 m did not exceed 0.33°C. At 50 m there was a difference of 1.98°C. Below 75 m, the differences were less than 0.34°C). Both profiles were similar below 75 m.

- Salinity:

  The January-to-March salinity envelope was based on a data sample size of 15 observations (Figure 7-5). The GDEM value at the surface fell within the envelope of observed values and differed from the typical by 0.13 ppt. With the exception of the 10 m and 20 m levels (which have less than 0.19 ppt differences), differences below 30 m were slight and did not exceed 0.10 ppt.

  The April-to-June salinity envelope was based on a data sample size of 17 observations (Figure 7-6). The GDEM value at the surface fell within the envelope of observed values and differed from the typical by 0.09 ppt. Differences below 150 m were slight and did not exceed 0.07 ppt.

The July-to-September salinity envelope was based on a data sample size of 29 observations (Figure 7-7). The GDEM value at the surface fell within the envelope of observed values and differed from the typical by 0.09 ppt. Between the 10 m and 125 m levels (with the exception of the 0.31 ppt difference at 75 m), GDEM differed from the typical by less than 0.17 ppt. Below 100 m, the differences were slight and did not exceed 0.13 ppt.

The October-to-December salinity envelope was based on a sample size of 14 observations (Figure 7-8). The GDEM value at the surface fell within the envelope of observations and differed from the typical by 0.07 ppt. Differences of 0.11 ppt, 0.20 ppt, and 0.16 ppt occurred at the 30 m, 50 m, and 75 m levels, respectively. Differences below 75 m between GDEM and the typical did not exceed 0.08 ppt.

- Sound Speed:

The January-to-March sound-speed envelope was based on a data sample size of 15 observations (Figure 7-9). The GDEM value at the surface fell within the envelope of observed values and differed from the typical by 1.2 m/s. Differences of 1.1 m/s to 2.1 m/s were found between the 30 m and 150 m levels, respectively. Below 150 m to 2000 m, differences did not exceed 0.4 m/s.

The April-to-June sound-speed envelope was based on a data sample size of 17 observations (Figure 7-10). The GDEM value at the surface fell within the envelope of observed values and differed from the typical by 2.0 m/s. Differences in value of 2.1 m/s to 3.4 m/s were found between the 10 m and 30 m levels, respectively. Differences of 1.0 m/s and 2.4 m/s were found between the 150 m and 500 m levels, respectively. Below 500 m to 2000 m the differences did not exceed 0.6 m/s.

The July-to-September sound-speed envelope was based on a data sample size of 29 observations (Figure 7-11). The GDEM value at the surface fell within the envelope of observed values and differed from the typical by 3.0 m/s. With the exception of the 75 m (0.7 m/s) and the 100 m (0.9 m/s) levels, differences below the surface to 250 m ranged between 1.0 m/s and 2.0 m/s. Below 250 m to 2000 m the differences did not exceed 0.6 m/s.

The October-to-December sound-speed envelope was based on a data sample size of 14 observations (Figure 7-12). The GDEM value at the surface fell within the envelope of observed values and differed from the typical by 0.8 m/s. With the exception of the 50 m and 75 m levels (which have differences of 5.4 m/s and 1.4 m/s, respectively), differences below the surface to 500 m ranged between 0.5 m/s and 0.9 m/s. Below 500 m, differences did not exceed 0.1 m/s.

7.3 Evaluation - Levantine Sea (Location #6)

- January to March:

  Comparison between GDEM and the typical temperature profiles revealed similar thermal structure. Slight differences in value (less than 0.75^{o}C) in the near surface were considered acceptable as reflected by the relatively wide envelope of winter variability. The thermal variability for this area extends substantially in depth to nearly 350 m. The GDEM and typical profiles were identical in gradient and in value below 200 m to 2000 m. The GDEM temperature profile reflected a seasonally averaged winter thermal structure for this variable ocean region when compared with the 15 usable observations.

  Comparison between GDEM and the typical salinity profiles revealed similar haline structure. Most of the differences were small. The general gradient of a positive winter haline structure within a narrow salinity envelope of variability was most appropriate for this region in winter. The GDEM salinity profile reflected a seasonally averaged winter haline structure for this variable ocean region when compared with the 15 usable observations.

  Comparison between GDEM and the typical sound-speed profiles revealed similar sound-speed structure. The differences at the near-surface levels were caused by the thermal structure. The variability of sound speed within this near-surface layer was realistic for this area. The profiles below 200 m were identical to each other to 2000 m. The GDEM sound-speed profile reflected a seasonally averaged winter sound-speed structure for this variable ocean region when compared with the 15 usable observations.

- April to June:

  Comparison between GDEM and the typical temperature profiles revealed similar thermal structure. With the exception at 20 m, the general gradients of the profiles were similar and the values were within an acceptable range (less than 1.0^{o}C). The envelope reflected a variability in the near surface. The maximum width of the envelope above 200 m was relatively modest and could be wider for this period and region. GDEM reflected a seasonally averaged spring thermal structure for this variable ocean region when compared with the 17 usable observations.

Comparison between GDEM and the typical salinity profiles revealed similar haline structure. The width of the envelope in the near surface was narrow and remained relatively well-defined for this region in spring. The GDEM reflected a seasonally averaged spring haline structure for this variable ocean region when compared with the 17 usable observations.

Comparison between GDEM and the typical sound-speed profiles revealed similar sound speed structure. The typical reflected a profile "in transition" when compared with the more seasonally averaged "late transition" GDEM profile. Both were reasonable. GDEM sound speeds were higher between the 200 and 500 m levels when compared with other GDEM profiles from other seasons for the same location. GDEM reflected a late spring, mature transition sound-speed profile. GDEM reflected a seasonally averaged spring sound-speed structure for this variable ocean region when compared with the 17 usable observations.

- July to September:

  Comparison between GDEM and the typical temperature profiles revealed similar thermal structure. Near-surface and lower-structure characteristics were nearly identical. The values, as well as the gradients in the thermocline, were similar. Profile gradients and characteristics below 300 m were similar. Both the typical and the GDEM possessed a linear zone between 100 and 200 m. They were different numerically but were relatively parallel in orientation. With the exception of the flat linear region between 100 and 200 m, the general profile of GDEM reflected a seasonally averaged summer thermal structure for this variable ocean region when compared with the 29 usable observations.

  Comparison between GDEM and the typical salinity profiles revealed similar haline structure below 200 m. GDEM revealed a reversal in direction from negative to positive, then back to negative in its near-surface salinity profile. This substantial reversal in direction in salinity for a seasonally averaged salinity profile for summer was considered to be remarkably reproduced by GDEM. Although there was generally an isohaline layer at the surface to about 20 m, there were near-surface seasonal summer haline reversals in gradient near this location of the basin. It was not an intermittent feature but one of frequent occurrence in the summer period. GDEM reflected a seasonally averaged summer haline structure for this variable ocean region when compared with the 29 usable observations.

  Comparison between GDEM and the typical sound-speed profiles revealed similar sound-speed structure. Near surface and below 300 m were identical. The linear appearance near the apex of the

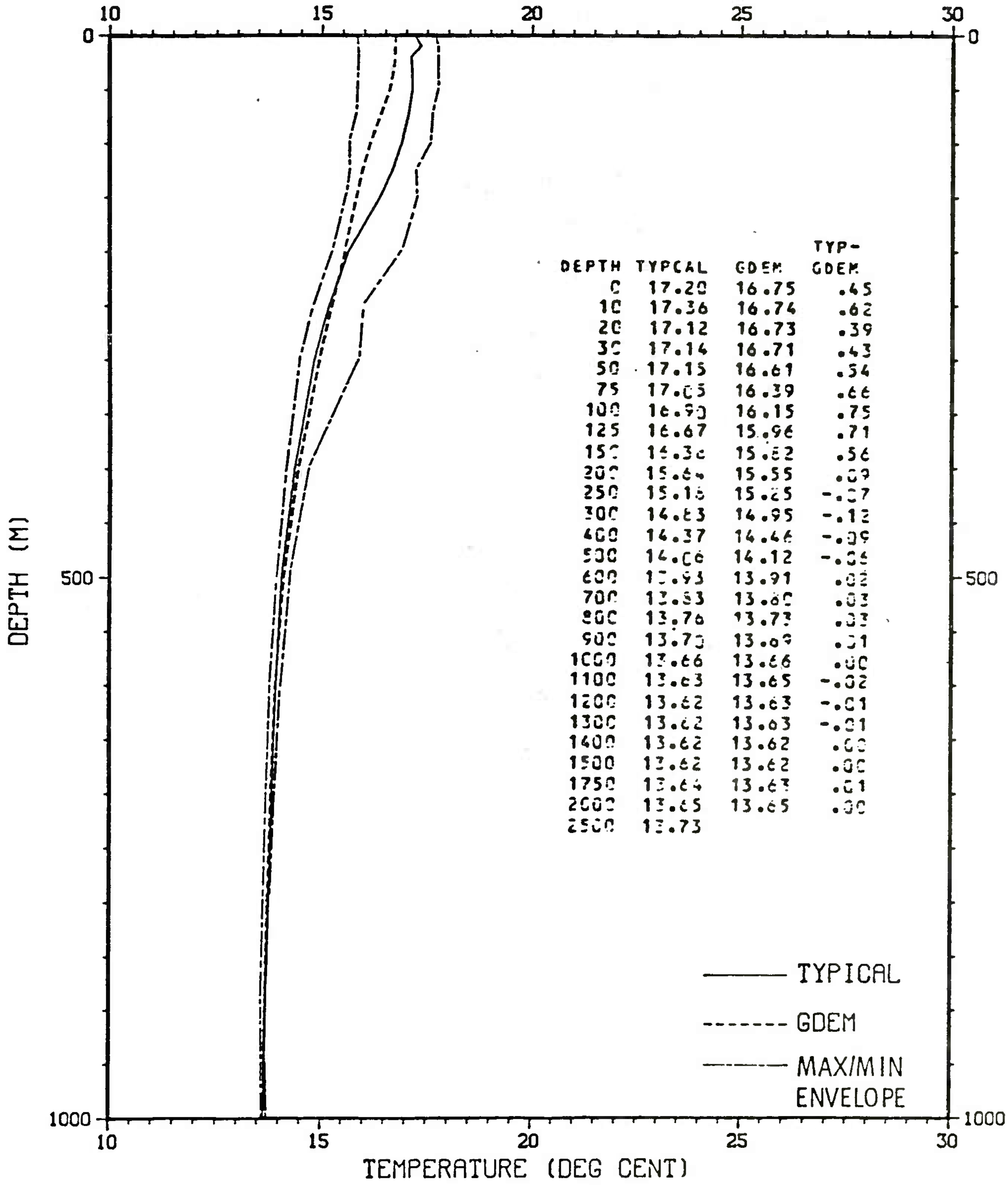
GDEM broad sound-channel axis was like that commonly observed in this region, as were sound-speed profiles having greater curvature in the sonocline gradient as depicted by the typical. GDEM reflected a seasonally averaged summer sound-speed structure for this variable ocean region when compared with the 29 usable observations.

- October to December:

  Comparison between GDEM and the typical temperature profiles revealed similar thermal structures. Both general gradients and values were similar with the exception at 50 m. GDEM revealed a linear flattening between the 100 to 250 m region of the thermocline. The typical revealed a curvature. The GDEM representatation of the fall structure was considered appropriate for this area. This was not to say that curvatures as depicted by the typical did not occur. GDEM reflected a seasonally averaged fall thermal structure for this variable ocean region when compared with the 14 usable observations.

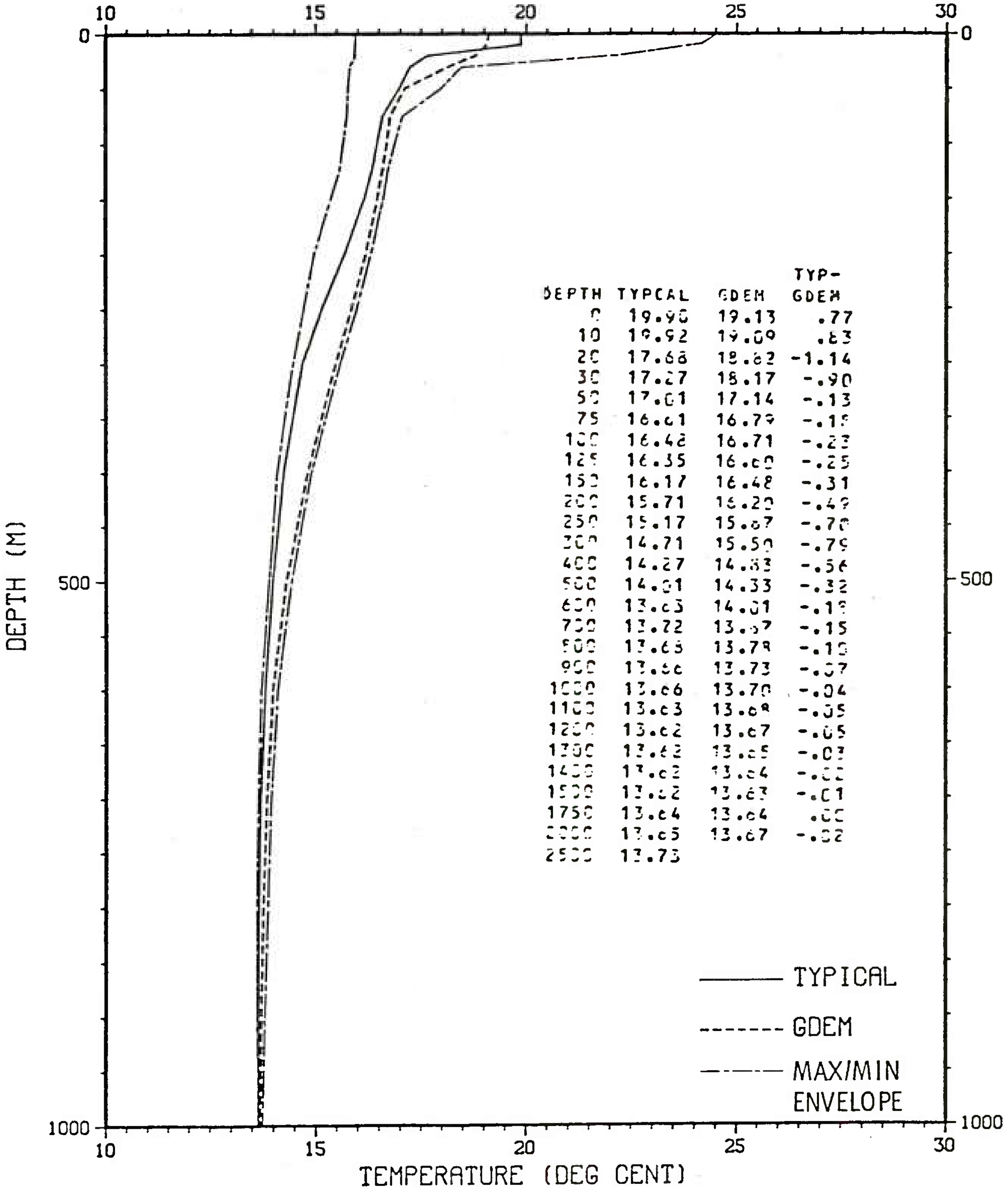
  Comparison between GDEM and the typical salinity profiles revealed similar haline structures. The smooth curvature of gradient in GDEM around 100 m, as opposed to the abrupt inflection of the typical, was a characteristic of averaging. GDEM reflected a seasonally averaged fall haline structure for this variable ocean region when compared with the 14 usable observations.

  Comparison between GDEM and the typical sound-speed profiles revealed similar sound-speed structures. The linear flattening in the GDEM sonocline between 100 to 150 m was realistic and commonly observed in fall for this region. This feature was present and appeared on 10 out of 14 usable ocean station hydrocasts as well as in independent historical references. This area characteristically had deeper axes down to 300 to 350 m. GDEM reflected a seasonally averaged fall sound-speed structure for this variable ocean region when compared with the 14 usable observations.



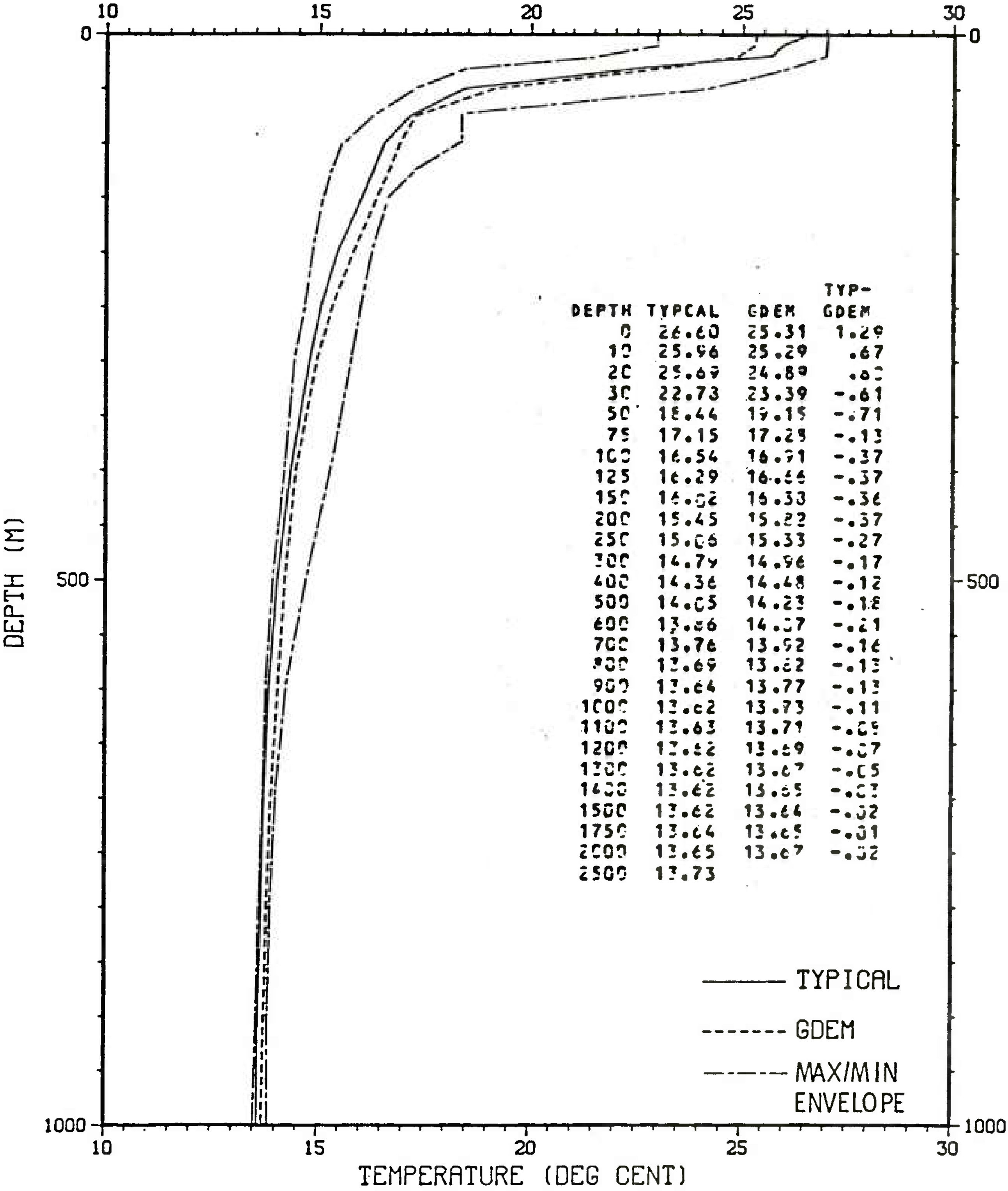
DEPTH	TYPCAL	GDEM	TYP-GDEM
0	17.20	16.75	.45
10	17.36	16.74	.62
20	17.12	16.73	.39
30	17.14	16.71	.43
50	17.15	16.61	.54
75	17.05	16.39	.66
100	16.90	16.15	.75
125	16.67	15.96	.71
150	16.38	15.82	.56
200	15.64	15.55	.09
250	15.18	15.25	-.07
300	14.83	14.95	-.12
400	14.37	14.46	-.09
500	14.06	14.12	-.06
600	13.93	13.91	.02
700	13.83	13.80	.03
800	13.76	13.73	.03
900	13.70	13.69	.01
1000	13.66	13.66	.00
1100	13.63	13.65	-.02
1200	13.62	13.63	-.01
1300	13.62	13.63	-.01
1400	13.62	13.62	.00
1500	13.62	13.62	.00
1750	13.64	13.63	.01
2000	13.65	13.65	.00
2500	13.73		

FIG. 7-1. VERTICAL TEMPERATURE PROFILE FOR LEVANTINE SEA (JAN - MAR)



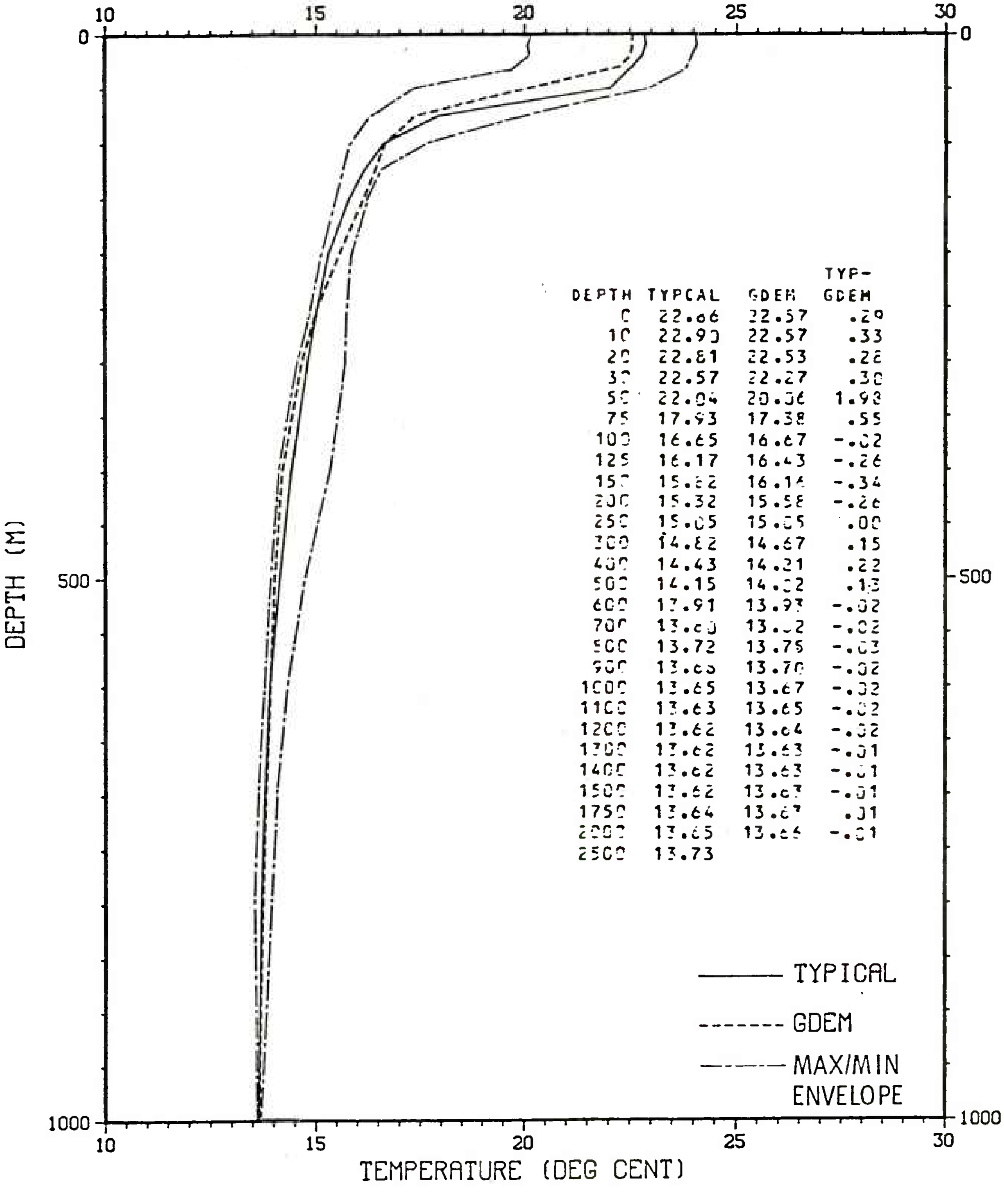
DEPTH	TYPCAL	GDEM	TYP-GDEM
0	19.90	19.13	.77
10	19.92	19.09	.83
20	17.68	18.82	-1.14
30	17.27	18.17	-.90
50	17.01	17.14	-.13
75	16.61	16.79	-.18
100	16.48	16.71	-.23
125	16.35	16.60	-.25
150	16.17	16.48	-.31
200	15.71	16.20	-.49
250	15.17	15.87	-.70
300	14.71	15.50	-.79
400	14.27	14.83	-.56
500	14.01	14.33	-.32
600	13.83	14.01	-.18
700	13.72	13.87	-.15
800	13.65	13.78	-.13
900	13.66	13.73	-.07
1000	13.66	13.70	-.04
1100	13.63	13.68	-.05
1200	13.62	13.67	-.05
1300	13.62	13.65	-.03
1400	13.62	13.64	-.02
1500	13.62	13.63	-.01
1750	13.64	13.64	.00
2000	13.65	13.67	-.02
2500	13.73		

FIG. 7-2. VERTICAL TEMPERATURE PROFILE FOR LEVANTINE SEA (APR - JUN)



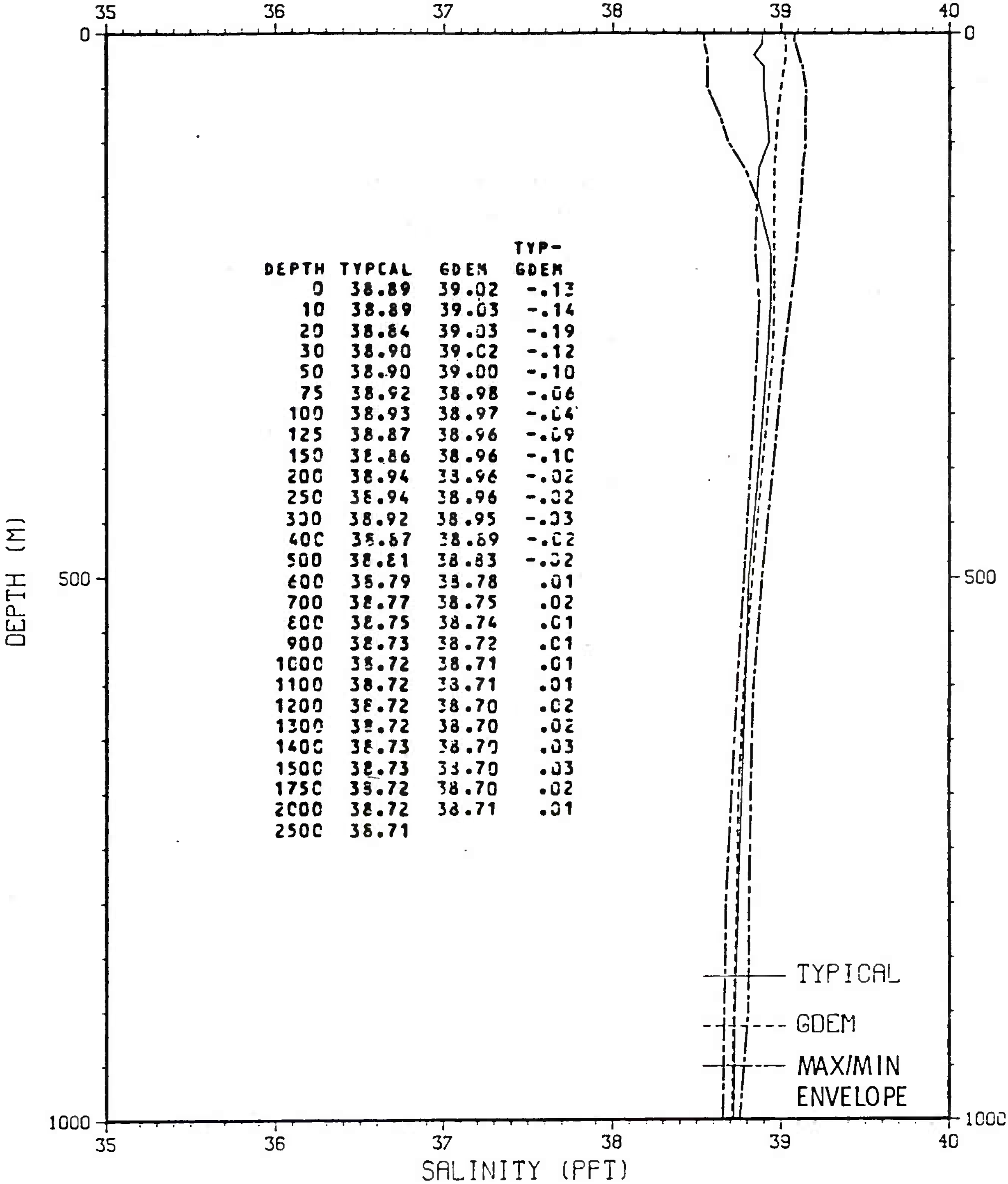
DEPTH	TYPCAL	GDEM	TYP-GDEM
0	26.60	25.31	1.29
10	25.96	25.29	.67
20	25.69	24.89	.80
30	22.73	23.39	-.61
50	18.44	19.15	-.71
75	17.15	17.28	-.13
100	16.54	16.91	-.37
125	16.29	16.66	-.37
150	16.02	16.33	-.36
200	15.45	15.82	-.37
250	15.06	15.33	-.27
300	14.79	14.96	-.17
400	14.36	14.48	-.12
500	14.05	14.23	-.18
600	13.86	14.07	-.21
700	13.76	13.92	-.16
800	13.69	13.82	-.13
900	13.64	13.77	-.13
1000	13.62	13.73	-.11
1100	13.63	13.71	-.08
1200	13.62	13.69	-.07
1300	13.62	13.67	-.05
1400	13.62	13.65	-.03
1500	13.62	13.64	-.02
1750	13.64	13.65	-.01
2000	13.65	13.67	-.02
2500	13.73		

FIG. 7-3. VERTICAL TEMPERATURE PROFILE FOR LEVANTINE SEA (JUL - SEP)



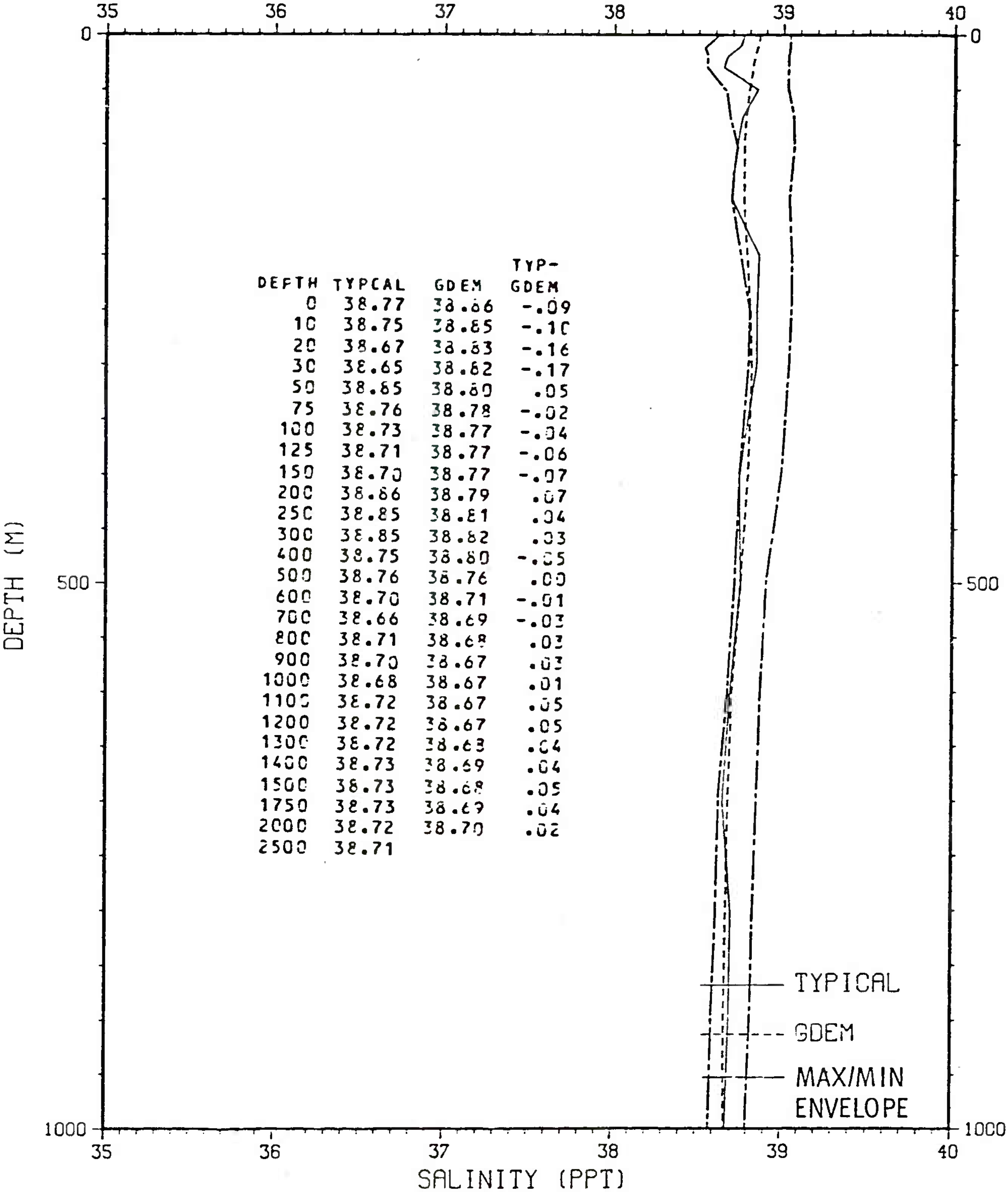
DEPTH	TYPCAL	GDEM	TYP-GDEM
0	22.86	22.57	.29
10	22.90	22.57	.33
20	22.81	22.53	.28
30	22.57	22.27	.30
50	22.04	20.06	1.98
75	17.93	17.38	.55
100	16.65	16.67	-.02
125	16.17	16.43	-.26
150	15.82	16.14	-.34
200	15.32	15.58	-.26
250	15.05	15.05	.00
300	14.82	14.67	.15
400	14.43	14.21	.22
500	14.15	14.02	.13
600	13.91	13.93	-.02
700	13.60	13.62	-.02
800	13.72	13.75	-.03
900	13.68	13.70	-.02
1000	13.65	13.67	-.02
1100	13.63	13.65	-.02
1200	13.62	13.64	-.02
1300	13.62	13.63	-.01
1400	13.62	13.63	-.01
1500	13.62	13.63	-.01
1750	13.64	13.63	.01
2000	13.65	13.66	-.01
2500	13.73		

FIG. 7-4. VERTICAL TEMPERATURE PROFILE FOR LEVANTINE SEA (OCT - DEC)



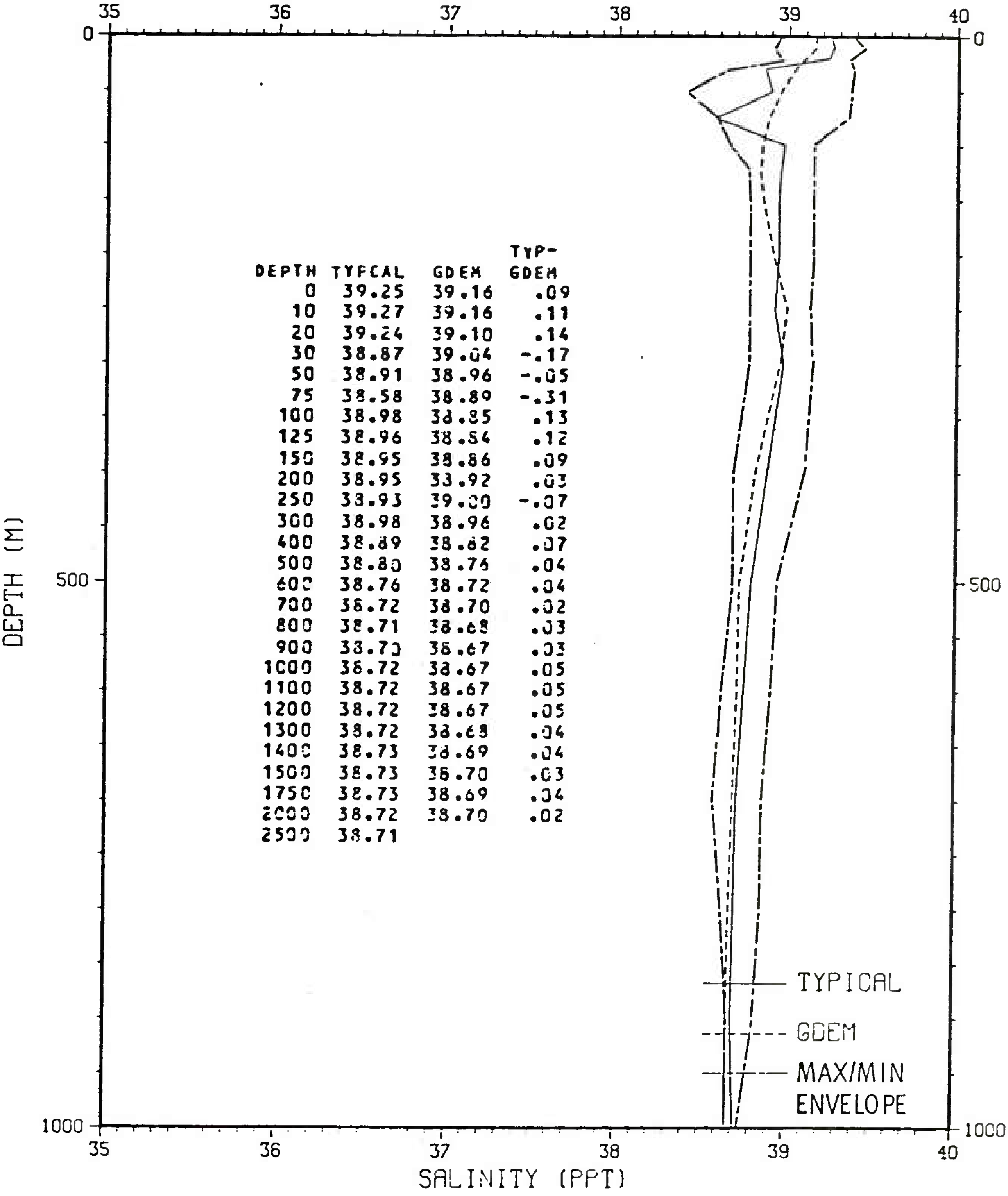
DEPTH	TYPCAL	GDEM	TYP-GDEM
0	38.89	39.02	-.13
10	38.89	39.03	-.14
20	38.84	39.03	-.19
30	38.90	39.02	-.12
50	38.90	39.00	-.10
75	38.92	38.98	-.06
100	38.93	38.97	-.04
125	38.87	38.96	-.09
150	38.86	38.96	-.10
200	38.94	38.96	-.02
250	38.94	38.96	-.02
300	38.92	38.95	-.03
400	38.87	38.89	-.02
500	38.81	38.83	-.02
600	38.79	38.78	.01
700	38.77	38.75	.02
800	38.75	38.74	.01
900	38.73	38.72	.01
1000	38.72	38.71	.01
1100	38.72	38.71	.01
1200	38.72	38.70	.02
1300	38.72	38.70	.02
1400	38.73	38.70	.03
1500	38.73	38.70	.03
1750	38.72	38.70	.02
2000	38.72	38.71	.01
2500	38.71		

FIG. 7-5. VERTICAL SALINITY PROFILE FOR LEVANTINE SEA (JAN - MAR)



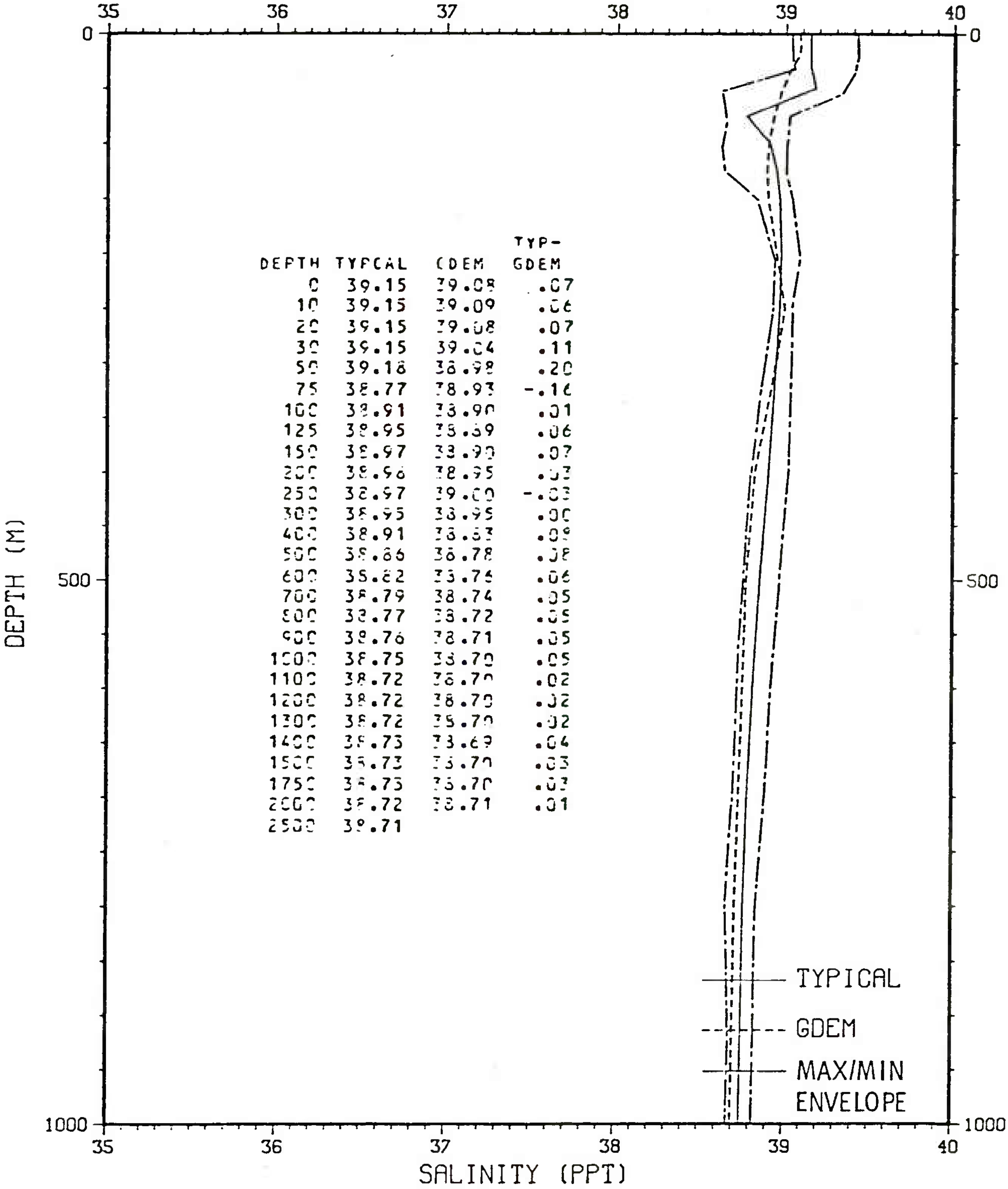
DEPTH	TYPCAL	GDEM	TYP-GDEM
0	38.77	38.86	-.09
10	38.75	38.85	-.10
20	38.67	38.83	-.16
30	38.65	38.82	-.17
50	38.85	38.80	.05
75	38.76	38.78	-.02
100	38.73	38.77	-.04
125	38.71	38.77	-.06
150	38.70	38.77	-.07
200	38.86	38.79	.07
250	38.85	38.81	.04
300	38.85	38.82	.03
400	38.75	38.80	-.05
500	38.76	38.76	.00
600	38.70	38.71	-.01
700	38.66	38.69	-.03
800	38.71	38.68	.03
900	38.70	38.67	.03
1000	38.68	38.67	.01
1100	38.72	38.67	.05
1200	38.72	38.67	.05
1300	38.72	38.68	.04
1400	38.73	38.69	.04
1500	38.73	38.68	.05
1750	38.73	38.69	.04
2000	38.72	38.70	.02
2500	38.71		

FIG. 7-6. VERTICAL SALINITY PROFILE FOR LEVANTINE SEA (APR - JUN)



DEPTH	TYPCAL	GDEM	TYP-GDEM
0	39.25	39.16	.09
10	39.27	39.16	.11
20	39.24	39.10	.14
30	38.87	39.04	-.17
50	38.91	38.96	-.05
75	38.58	38.89	-.31
100	38.98	38.85	.13
125	38.96	38.84	.12
150	38.95	38.86	.09
200	38.95	38.92	.03
250	38.93	39.00	-.07
300	38.98	38.96	.02
400	38.89	38.82	.07
500	38.80	38.76	.04
600	38.76	38.72	.04
700	38.72	38.70	.02
800	38.71	38.68	.03
900	38.70	38.67	.03
1000	38.72	38.67	.05
1100	38.72	38.67	.05
1200	38.72	38.67	.05
1300	38.72	38.68	.04
1400	38.73	38.69	.04
1500	38.73	38.70	.03
1750	38.73	38.69	.04
2000	38.72	38.70	.02
2500	38.71		

FIG. 7-7. VERTICAL SALINITY PROFILE FOR LEVANTINE SEA (JUL - SEP)



DEPTH	TYPICAL	GDEM	TYP-GDEM
0	39.15	39.08	.07
10	39.15	39.09	.06
20	39.15	39.08	.07
30	39.15	39.04	.11
50	39.18	38.98	.20
75	38.77	38.93	-.16
100	38.91	38.90	.01
125	38.95	38.89	.06
150	38.97	38.90	.07
200	38.96	38.95	.03
250	38.97	39.00	-.03
300	38.95	38.95	.00
400	38.91	38.83	.08
500	38.86	38.78	.08
600	38.82	38.76	.06
700	38.79	38.74	.05
800	38.77	38.72	.05
900	38.76	38.71	.05
1000	38.75	38.70	.05
1100	38.72	38.70	.02
1200	38.72	38.70	.02
1300	38.72	38.70	.02
1400	38.73	38.69	.04
1500	38.73	38.70	.03
1750	38.73	38.70	.03
2000	38.72	38.71	.01
2500	38.71		

FIG. 7-8. VERTICAL SALINITY PROFILE FOR LEVANTINE SEA (OCT - DEC)

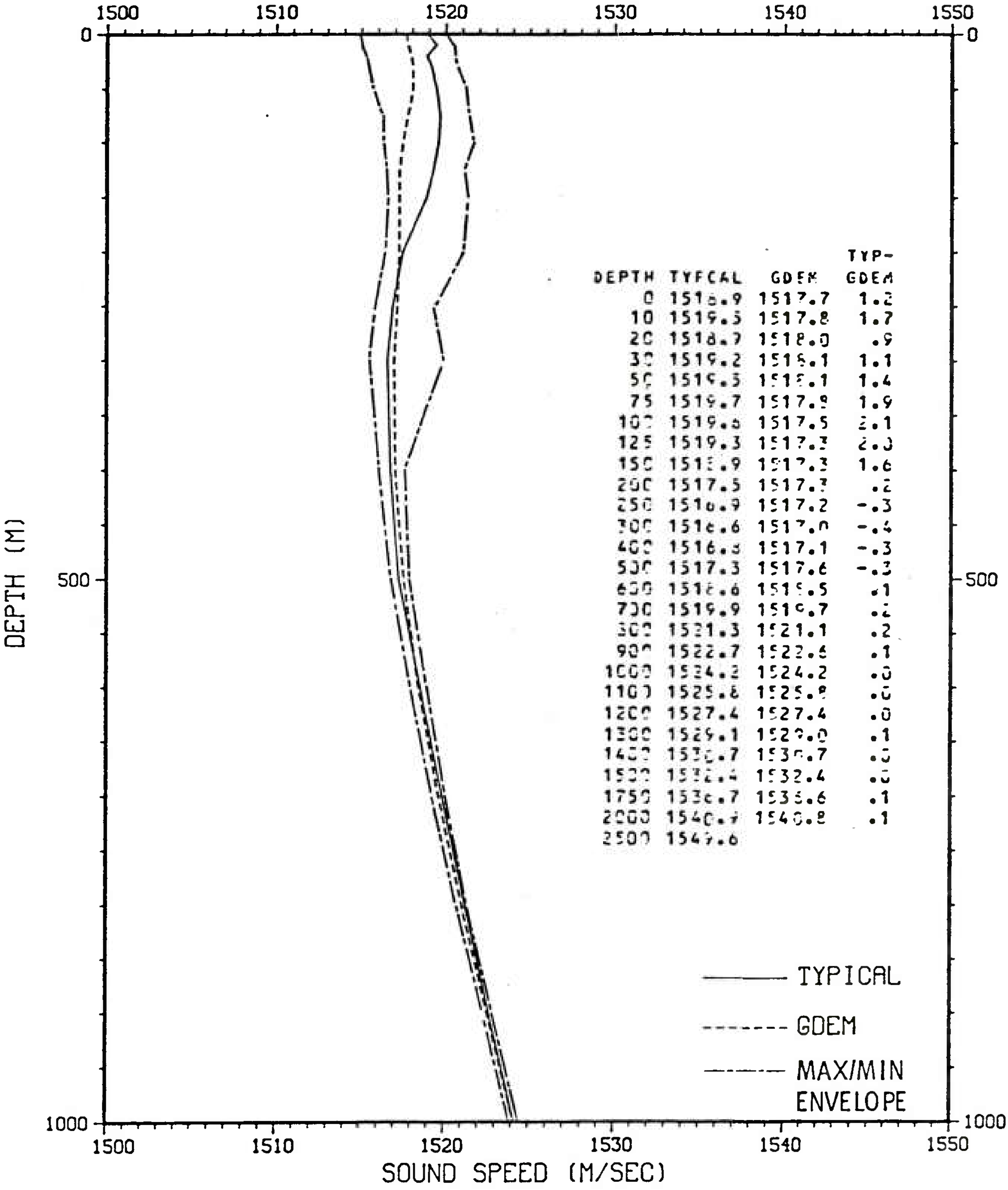


FIG. 7-9. VERTICAL SOUND-SPEED PROFILE FOR LEVANTINE SEA (JAN - MAR)

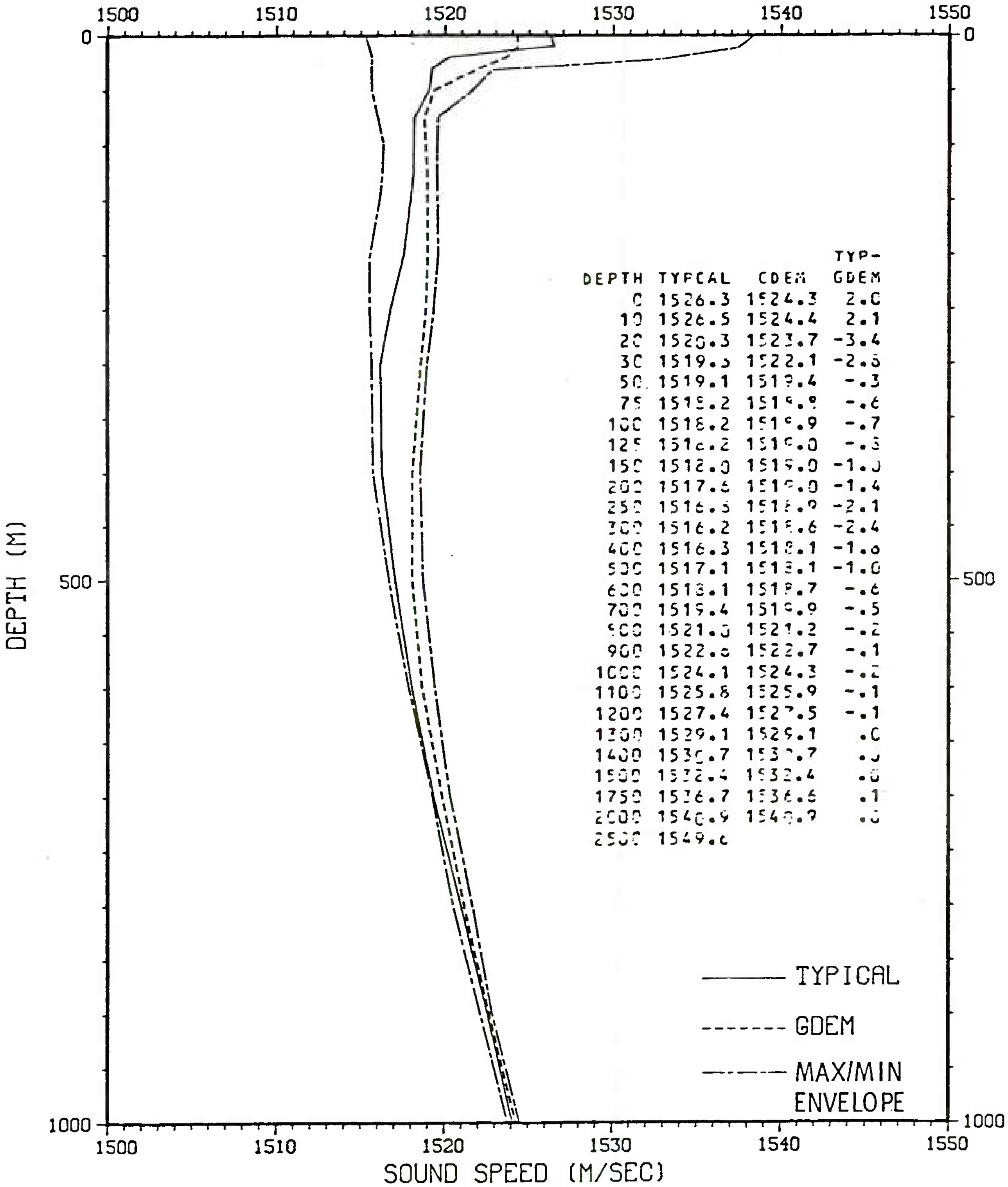
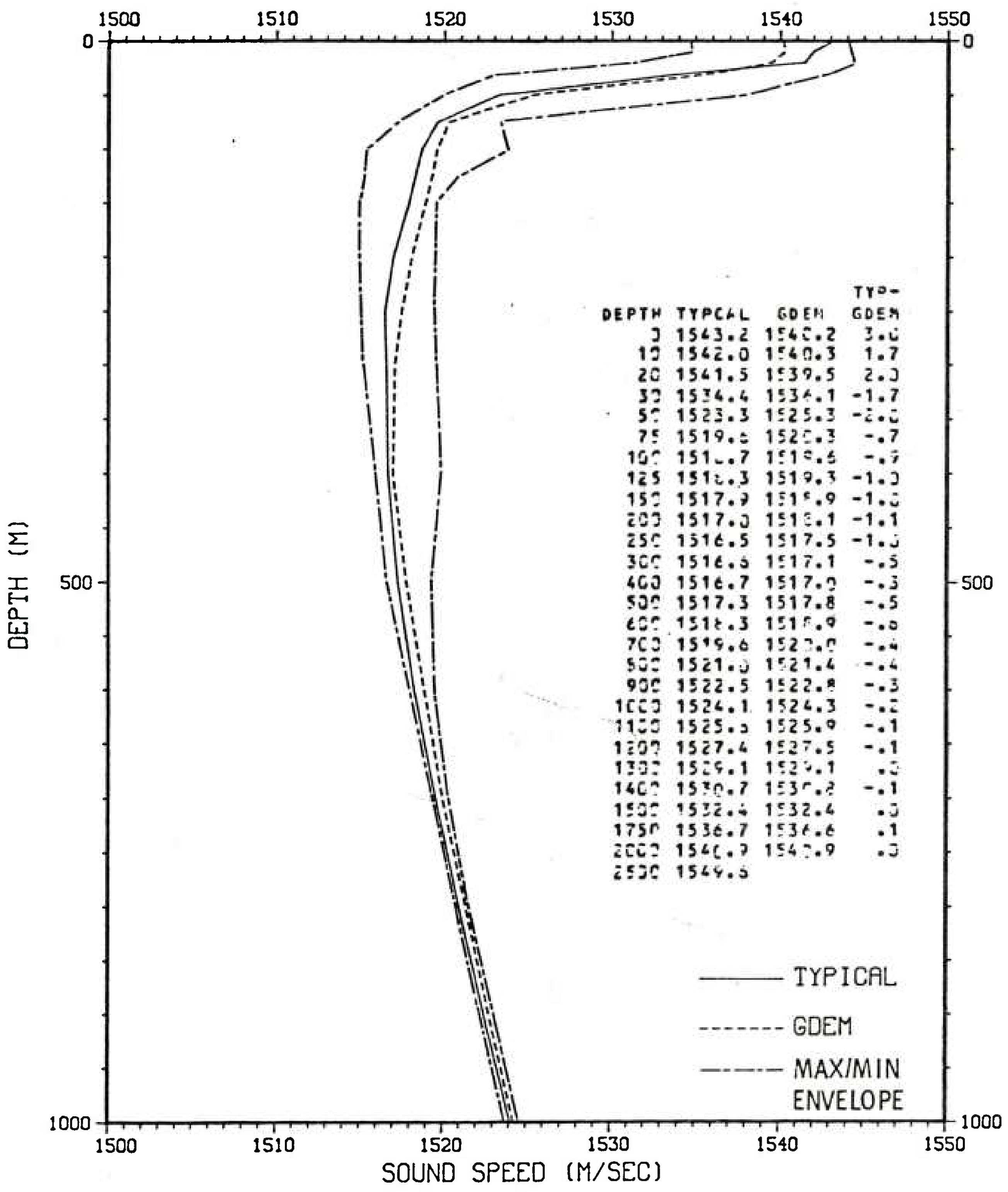
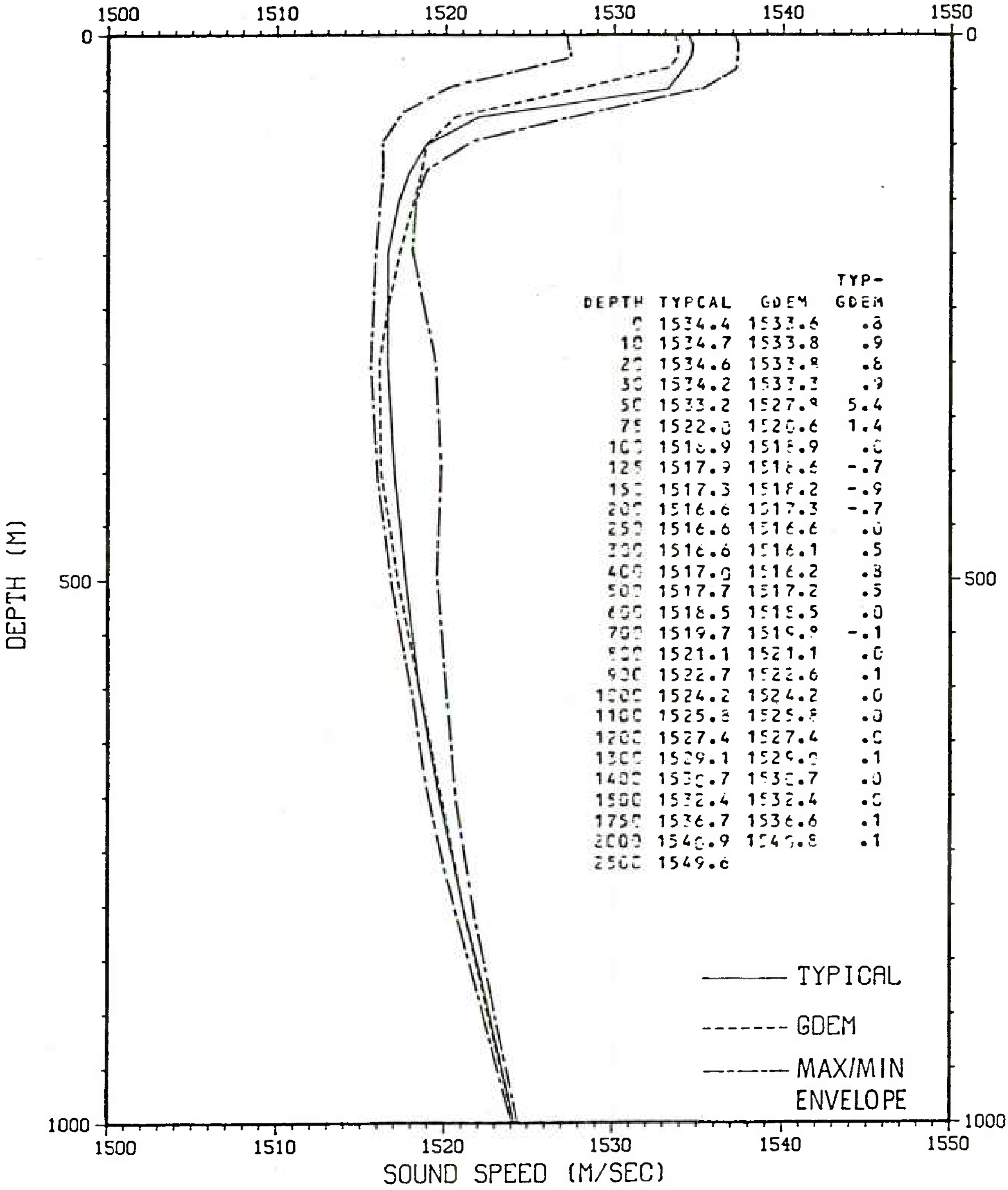


FIG. 7-10. VERTICAL SOUND-SPEED PROFILE FOR LEVANTINE SEA (APR - JUN)



DEPTH	TYPCAL	GDEM	TYP-GDEM
0	1543.2	1540.2	3.0
10	1542.0	1540.3	1.7
20	1541.5	1539.5	2.0
30	1534.4	1536.1	-1.7
50	1523.3	1525.3	-2.0
75	1519.6	1520.3	-.7
100	1518.7	1519.6	-.9
125	1518.3	1519.3	-1.0
150	1517.9	1518.9	-1.0
200	1517.0	1518.1	-1.1
250	1516.5	1517.5	-1.0
300	1516.6	1517.1	-.5
400	1516.7	1517.0	-.3
500	1517.3	1517.8	-.5
600	1518.3	1518.9	-.6
700	1519.6	1520.0	-.4
800	1521.0	1521.4	-.4
900	1522.5	1522.8	-.3
1000	1524.1	1524.3	-.2
1100	1525.8	1525.9	-.1
1200	1527.4	1527.5	-.1
1300	1529.1	1529.1	.0
1400	1530.7	1530.8	-.1
1500	1532.4	1532.4	.0
1750	1536.7	1536.6	.1
2000	1540.9	1540.9	.0
2500	1549.5		

FIG. 7-11. VERTICAL SOUND-SPEED PROFILE FOR LEVANTINE SEA (JUL - SEP)



DEPTH	TYPCAL	GDEM	TYP-GDEM
0	1534.4	1533.6	.8
10	1534.7	1533.8	.9
20	1534.6	1533.8	.8
30	1534.2	1533.3	.9
50	1533.2	1527.9	5.4
75	1522.0	1520.6	1.4
100	1518.9	1518.9	.0
125	1517.9	1518.6	-.7
150	1517.3	1518.2	-.9
200	1516.6	1517.3	-.7
250	1516.6	1516.6	.0
300	1516.6	1516.1	.5
400	1517.0	1516.2	.8
500	1517.7	1517.2	.5
600	1518.5	1518.5	.0
700	1519.7	1519.8	-.1
800	1521.1	1521.1	.0
900	1522.7	1522.6	.1
1000	1524.2	1524.2	.0
1100	1525.8	1525.8	.0
1200	1527.4	1527.4	.0
1300	1529.1	1529.0	.1
1400	1530.7	1530.7	.0
1500	1532.4	1532.4	.0
1750	1536.7	1536.6	.1
2000	1540.9	1540.8	.1
2500	1549.6		

FIG. 7-12. VERTICAL SOUND-SPEED PROFILE FOR LEVANTINE SEA (OCT - DEC)

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

This report compares the results of the Generalized Digital Environmental Model (GDEM), developed by Dr. T. Davis of the Naval Oceanographic Office (NOO), with observed data from 69 vertical profiles of seasonally averaged temperature, salinity, and sound speed at six locations. The six sites, all located in the Mediterranean Sea, are the Alboran Sea, the Tyrrhenian Sea, the Balearic Sea, the Strait of Sicily, the Ionian Sea, and the Levantine Sea.

Evaluations of GDEM-derived temperature, salinity, and sound speed profiles were performed, considering location, season, and individual parameters.

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