Intergovernmental Oceanographic Commission

Workshop Report No. 98

CoMSBlack '92A Physical and Chemical Intercalibration Workshop

Erdemli, Turkey
15-29 January 1993

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7	Report of the Scientific Workshop to Initiate Planning for a Co-operative Investigation in the North and Central Western Indian Ocean, organized within the IDOE under the sponsorship of IOC/FAO (IOFC)/UNESCO/EAC; Nairobi, Kenya, 25 March-2 April 1976.	E, F, S, R
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11	Report of the IOC/FAO/UNEP International Workshop on Marine Pollution in the Caribbean and Adjacent Regions; Port of Spain, Trinidad, 13-17 December 1976.	E, S (out of stock)
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12	Report of the IOCARIBE Interdisciplinary Workshop on Scientific Programmes in Support of Fisheries Projects; Fort-de-France, Martinique, 28 November-2 December 1977.	E, F, S
13	Report of the IOCARIBE Workshop on Environmental Geology of the Caribbean Coastal Area; Port of Spain, Trinidad, 16-18 January 1978.	E, S
14	IOC/FAO/WHO/UNEP International Workshop on Marine Pollution in the Gulf of Guinea and Adjacent Areas; Abidjan, Côte d'Ivoire, 2-9 May 1978.	E, F
15	CPPS/FAO/IOC/UNEP International Workshop on Marine Pollution in the South-East Pacific; Santiago de Chile, 6-10 November 1978.	E (out of stock)
16	Workshop on the Western Pacific, Tokyo, 19-20 February 1979.	E, F, R
17	Joint IOC/WMO Workshop on Oceanographic Products and the IGOSS Data Processing and Services System (IDPSS); Moscow, 9-11 April 1979.	E
17 Suppl.	Papers submitted to the Joint IOC/WMO Seminar on Oceanographic Products and the IGOSS Data Processing and Services System; Moscow, 2-6 April 1979.	E
18	IOC/UNESCO Workshop on Syllabus for Training Marine Technicians; Miami, 22-26 May 1978 (UNESCO reports in marine sciences, No. 4 published by the Division of Marine Sciences, UNESCO).	E (out of stock), F, S (out of stock), R
19	IOC Workshop on Marine Science Syllabus for Secondary Schools; Llantwit Major, Wales, U.K., 5-9 June 1978 (UNESCO reports in marine sciences, No. 5, published by the Division of Marine Sciences, UNESCO).	E (out of stock), E, S, R, Ar
20	Second CCOP-IOC Workshop on IDOE Studies of East Asia Tectonics and Resources; Bandung, Indonesia, 17-21 October 1978.	E
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28	FAO/IOC Workshop on the effects of environmental variation on the survival of larval pelagic fishes. Lima, 20 April-5 May 1980.	E
29	WESTPAC Workshop on Marine Biological Methodology; Tokyo, 9-14 February 1981.	E
30	International Workshop on Marine Pollution in the South-West Atlantic; Montevideo, 10-14 November 1980.	E (out of stock) S
31	Third International Workshop on Marine Geoscience; Heidelberg, 19-24 July 1982.	E, F, S
32	UNU/IOC/UNESCO Workshop on International Co-operation in the Development of Marine Science and the Transfer of Technology in the context of the New Ocean Regime; Paris, 27 September-1 October 1982.	E, F, S
32 Suppl.	Papers submitted to the UNU/IOC/UNESCO Workshop on International Co-operation in the Development of Marine Science and the Transfer of Technology in the Context of the New Ocean Regime; Paris, 27 September-1 October 1982.	E
33	Workshop on the IREP Component of the IOC Programme on Ocean Science in Relation to Living Resources (OSLR); Halifax, 26-30 September 1963.	E
34	IOC Workshop on Regional Co-operation in Marine Science in the Central Eastern Atlantic (Western Africa); Tenerife, 12-17 December 1963.	E, F, S
35	CCOP/SOPAC-IOC-UNU Workshop on Basic Geo-scientific Marine Research Required for Assessment of Minerals and Hydrocarbons in the South Pacific; Suva, Fiji, 3-7 October 1983.	E
36	IOC/FAO Workshop on the Improved Uses of Research Vessels; Lisbon, 28 May-2 June 1984.	E
36 Suppl.	Papers submitted to the IOC/FAO Workshop on the Improved Uses of Research Vessels; Lisbon, 28 May-2 June 1984.	E
37	IOC/UNESCO Workshop on Regional Co-operation in Marine Science in the Central Indian Ocean and Adjacent Seas and Gulfs; Colombo, 8-13 July 1985.	E
38	IOC/ROPME/UNEP Symposium on Fate and Fluxes of Oil Pollutants in the Kuwait Action Plan Region; Basrah, Iraq, 8-12 January 1984.	E
39	CCOP (SOPAC)-IOC-IFREMER-ORSTOM Workshop on the Uses of Submersibles and Remotely Operated Vehicles in the South Pacific; Suva, Fiji, 24-29 September 1985.	E
40	IOC Workshop on the Technical Aspects of Tsunami Analysis, Prediction and Communications; Sidney, B.C., Canada, 29-31 July 1985.	E
40 Suppl.	IOC Workshop on the Technical Aspects of Tsunami Analysis, Prediction and Communications, *Submitted Papers;* Sidney, B.C., Canada, 29-31 July 1985.	E
41	First Workshop of Participants in the Joint FAO/IOC/WHO/IAEA/UNEP Project on Monitoring of Pollution in the Marine Environment of the West and Central African Region (WACAF/2); Dakar, Senegal, 28 October-1 November 1985.	E
43	IOC Workshop on the Results of MEDALPEX and Future Oceanographic Programmes in the Western Mediterranean; Venice, Italy, 23-25 October 1985.	E
44	IOC-FAO Workshop on Recruitment in Tropical Coastal Demersal Communities; Ciudad del Carmen, Campeche, Mexico, 21-25 April 1986.	E (out of stock) S
44 Suppl.	IOC-FAO Workshop on Recruitment in Tropical Coastal Demersal Communities, *Submitted Papers;* Ciudad del Carmen, Campeche, Mexico, 21-25 April 1986.	E
45	IOCARIBE Workshop on Physical Oceanography and Climate; Cartagena, Colombia, 19-22 August 1986.	E
46	Reunión de Trabajo para Desarrollo del Programa "Ciencia Oceánica en Relación a los Recursos No Vivos en la Región del Atlántico Sud-occidental"; Porto Alegre, Brazil, 7-11 de abril de 1986.	S
47	IOC Symposium on Marine Science in the Western Pacific: The Indo-Pacific Convergence; Townsville, 1-6 December 1966.	E
48	IOCARIBE Mini-Symposium for the Regional Development of the IOC-UN (OETB) Programme on 'Ocean Science in Relation to Non-Living Resources (OSNLR)'; Havana, Cuba, 4-7 December 1986.	E, S
49	AGU-IOC-WMO-CPPS Chapman Conference: An International Symposium on 'El Niño'; Guayaquil, Ecuador, 27-31 October 1986.	E
50	CCALR-IOC Scientific Seminar on Antarctic Ocean Variability and its Influence on Marine Living Resources, particularly Krill (organized in collaboration with SCAR and SCOR); Paris, France, 2-6 June 1987.	E
51	CCOP/SOPAC-IOC Workshop on Coastal Processes in the South Pacific Island Nations; Lae, Papua-New Guinea, 1-8 October 1987.	E

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Intergovernmental Oceanographic Commission

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CoMSBlack '92A Physical and Chemical Intercalibration Workshop

Institute of Marine Sciences
Middle East Technical University
Erdemli, Turkey
15-29 January 1993

Edited and contributed by
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INTRODUCTION

The Executive Council of the Intergovernmental Oceanographic Commission, at its Twenty-fifth Session (Paris, UNESCO, March 1992), recognized the important initiatives taken by scientists from the Black Sea riparian countries, as well as from countries outside the region, that had resulted in the development of the Co-operative Marine Science Programme for the Black Sea (CoMSBLACK) initiated in 1991 (IOC Workshop Report No.86).

With the publication of these technical reports of intercalibration work carried out during several CoMSBLACK field studies in 1992 when different sampling methods, equipment and analytical techniques were applied, the Intergovernmental Oceanographic Commission, under the Global Investigation of Pollution in the Marine Environment (GIPME) programme promotes efforts aimed at the establishment of a scientific database in support of numerical modelling and the interpretation of systematic observations of the Black Sea ecosystem. Quality-controlled systematic observations are fundamental to obtaining environmental impact assessments and support towards integrated coastal area management in the unique Black Sea region.

The Institute of Marine Sciences, Middle East Technical University, Erdemli, Turkey, made arrangements for an intercalibration workshop.

1. ABSTRACT

An Intercalibration Workshop for physical and chemical data was held at the Institute of Marine Sciences (IMS) of the Middle East Technical University, Erdemli, Turkey, from 15-29 January 1993, for physical and chemical data acquired during CoMSBlack '92a. This intercalibration exercise was a follow-up to an intercalibration exercise for CoMSBlack '92a biological data held at this same site during December 1992.

CoMSBlack '92 acquired a complete hydrographic, biological, and chemical data set for the entire Black Sea with the participation of all Black Sea riparian countries (except Georgia) as well as the U.S. Nearly 400 hydrographic stations were occupied to the nominal water depth of 500 dbar; biological and chemical measurements were made at 100 of these stations. This quasi-synoptic survey was accomplished using five ships during an interval of approximately three weeks. The cruise coverage was essentially the same as for the companion cruise, HydroBlack '91 of September 1991.

Results show good agreement between CTD's from the different regions (an improvement over HydroBlack '91), and the intercalibrated results show a consistent and high resolution detail of the dynamic topography and other physical characteristics of the entire Black Sea basin. The intercalibrated data set is now available within each country and from the Woods Hole Oceanographic Institution (W.H.O.I.), and contributes to the basis for studies on oceanography as well as interdisciplinary issues such as oxygen depletion within the basin and hydrogen sulfide distribution. This effort provides an intercalibrated, spatially-dense baseline against which all future and past measurements can be compared, contributing to results from HydroBlack '91.

The chemical data showed considerably more disparity, because of sensitivity of results to sampling methods and equipment, analytical techniques, and various sources of contamination. In addition, some ships were not able to measure all parameters for a variety of reasons, and some chemical fields are therefore incomplete. However, the data show a considerable improvement over those from HydroBlack '91, and provide some exciting data for future scientific papers.

The Workshop resulted in exchange of all data, plans for a detailed, ship-board intercalibration cruise for sampling and analysis comparisons for biogeochemical purposes, and detailed outlines of scientific articles to be prepared during the following six months, to be submitted to scientific journals. For a period of three years after the data exchange, the data collected by each party is considered the property of that party. Use of the data must be approved by the party acquiring those data. More details can be gathered from any of the authors.

2. GOALS OF WORKSHOP

The goals of the Intercalibration Workshop include the following:

- Complete intercalibration of all chemical and physical data for CoMSBlack '92a.
- Complete this intercalibration workshop report for publication by IOC.
- Make final plans for CoMSBlack '93a, and begin discussions of CoMSBlack '93b.
- Complete scientific papers on HydroBlack '91 results.
- Make outline of scientific papers to come from CoMSBlack '92a.
- Plan intercalibration cruise for nutrient, oxygen, and hydrogen sulfide sampling and methods.

The steps used at the Intercalibration Workshop include:

- Assess quality of CoMSBlack '92a data.

- Intercalibrate the CoMSBlack data sets using intercalibration stations and other methods.
- Discuss scientific results of CoMSBlack '92a: compare with results of earlier cruises to Black Sea. Interdisciplinary discussions were encouraged.

The agenda for the intercalibration workshop is presented as Annex I.

3. CRUISE DESCRIPTION

Five ships participated in CoMSBlack '92a (Table 1). These ships all provided data from several different brands of CTD's, using to the extent possible similar procedures as outlined in the CoMSBlack '92a cruise plan (Annex II).

Table 1

Ship and CTD Inventory for CoMSBlack '92a

Vessel	Country	CTD	Dates	Number of Stations
R/V *Akademik*	Bulgaria	Istok V	07 Jul - 17 Jul	55
R/V *Bilim*	Turkey	Sea Bird SBE-9	04 Jul - 26 Jul	135
R/V *Prof. Kolesnikov*	Ukraine	Istok VII	07 Jul - 02 Aug	138
R/V *Vodyanitsky*	Ukraine	NBIS, Mk. 3		
R/V *Piri Reis*	Turkey	Sea Bird SBE-9	04 Jul - 18 Jul	66
			TOTAL	394

CoMSBlack '92a accomplished nearly 400 hydrographic stations (Figure 1; Table 2) using ships from three different Black Sea riparian countries. Two Ukrainian vessels (*Kolesnikov* and *Vodyanitsky*), two Turkish ships (*Bilim* and *Piri Reis*), and one Bulgarian vessel (*Akademik*) participated, occupying stations quasi-synoptically over the entire Black Sea within a period of three weeks (see Table 1). Station spacing was approximately 20 nm. At one-third of the stations, the CTD measurements were accompanied by biogeochemical measurements as outlined in the cruise plan (Annex II).

Vodyanitsky performed a fish egg and larvae (ichthyoplankton) study within the northern half of the Black Sea. She covered approximately the same area as R/V *Kolesnikov,* but on a coarser grid. R/V *Bilim* also performed similar work within the Turkish EEZ. Both data sets were intercalibrated and processed during the fish egg and larvae intercalibration meeting held in Erdemli, Turkey during 3-15 December 1992. The fish egg and larvae data and their intercalibration will be included in a separate report.

For intercalibration purposes of the physical and chemical data, eleven stations were occupied by two or more ships. One station (43° 30'N, 31° 45'E) was occupied by all four ships (see Figure 1). In these stations, the CTD casts were to full water depth, and chemical data were also collected.

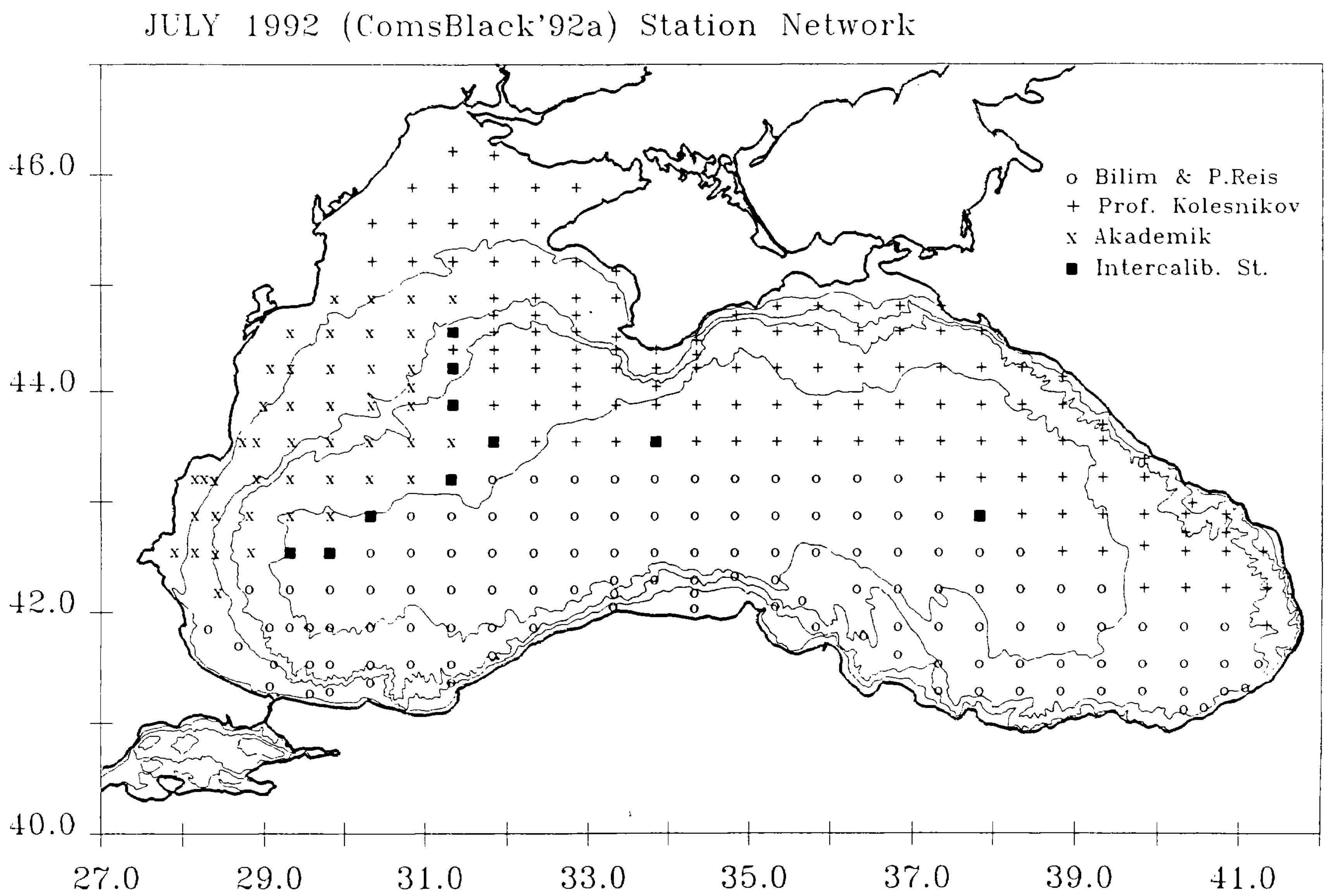

Figure 1a: Station locations for CoMSBlack'92a hydrographic casts (Sections used for the temperature, salinity and density transects are also shown).

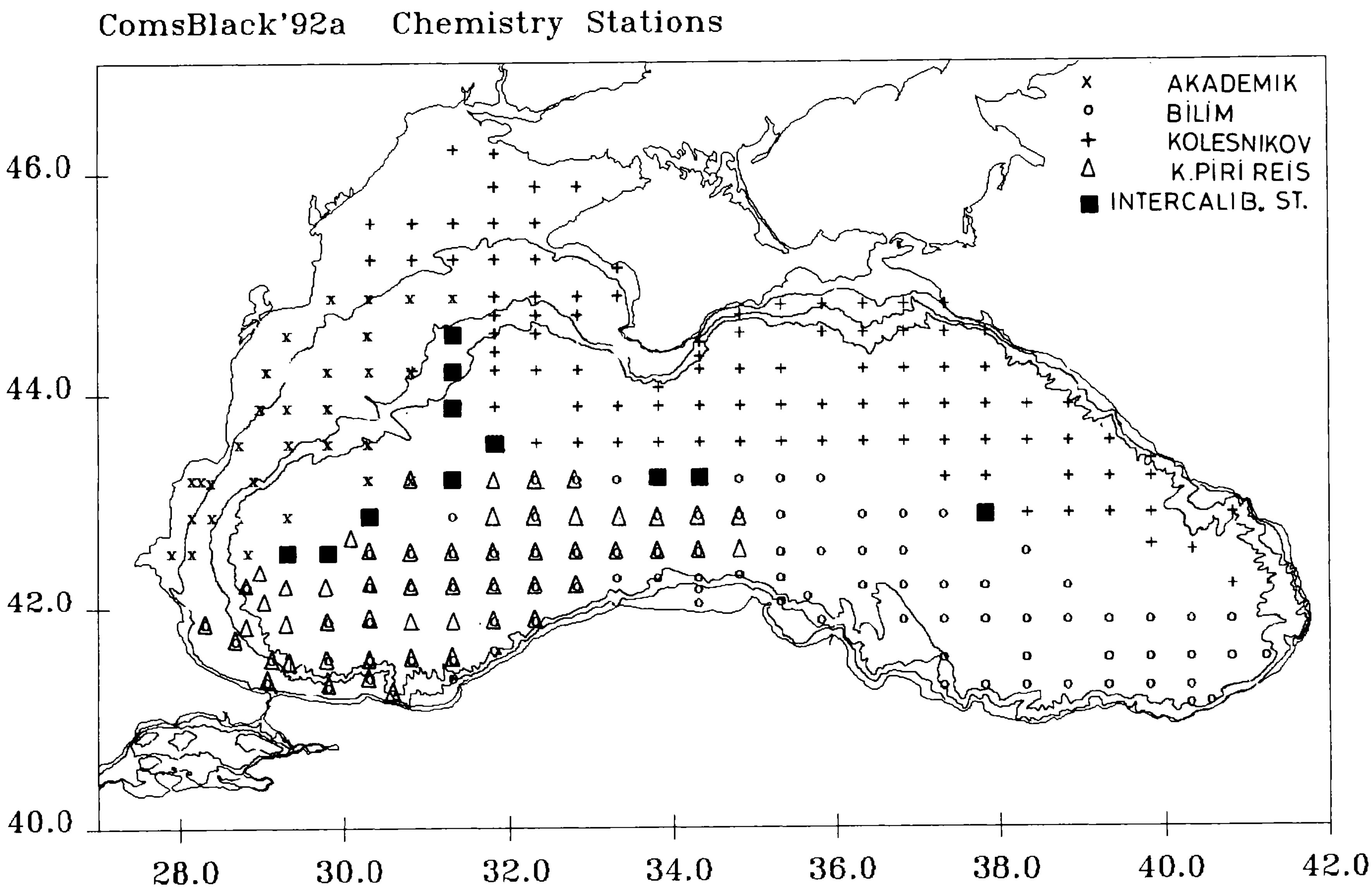

Figure 1b: Sampling locations for chemical measurements in CoMSBlack'92a survey.

TABLE 2

Station codes and locations

R/V BILIM STATIONS

B	41	18	00	29	00	00	07	03	92	18 25	0060	L18L00
B	41	14	00	29	30	00	07	03	92	22 15	0042	L14L30
B	41	15	00	29	45	00	07	04	92	00 10	0058	L15L45
B	41	30	00	29	45	00	07	04	92	03 00	1500	L30L45
B	41	30	00	29	30	00	07	04	92	05 25	0800	L30L30
B	41	30	00	29	03	00	07	04	92	09 30	0095	L30L03
B	41	40	00	28	37	00	07	04	92	13 05	0086	L40K37
B	41	49	00	28	15	00	07	04	92	15 55	0066	L49K15
B	41	50	00	29	00	00	07	04	92	23 10	1100	L50L00
B	42	10	00	28	45	00	07	05	92	03 30	0815	M10K45
B	42	30	00	29	15	00	07	05	92	07 15	2000	M30L15
B	42	10	00	29	15	00	07	05	92	12 10	2000	M10L15
B	41	50	00	29	15	00	07	05	92	15 35	1800	L50L15
B	41	50	00	29	30	00	07	05	92	16 00	2000	L50L30
B	41	50	00	29	45	00	07	05	92	19 35	2000	L50L45
B	42	10	00	29	45	00	07	05	92	23 00	2200	M10L45
B	42	30	00	29	45	00	07	06	92	02 00	2200	M30L45
B	42	30	00	30	15	00	07	06	92	05 30	2200	M30M15
B	42	50	00	30	15	00	07	06	92	09 00	2100	M50M15
B	42	50	00	30	45	00	07	06	92	13 15	2100	M50M45
B	42	50	00	31	15	00	07	06	92	16 30	2100	M50N15
B	43	10	00	31	15	00	07	06	92	19 55	1860	N10N15
B	43	30	00	31	45	00	07	07	92	02 00	1950	N30N45
B	43	10	00	31	45	00	07	07	92	07 15	2000	N10N45
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B	42	10	00	32	15	00	07	13	92	11 00	2200	M10P15
B	42	30	00	32	15	00	07	13	92	13 50	2200	M30P15
B	42	50	00	32	15	00	07	13	92	17 00	2200	M50P15
B	43	10	00	32	15	00	07	13	92	20 00	2000	N10P15

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B	42	08	00	33	15	00	07	15	92	09 40	0920	M08Q15
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B	41	50	00	40	15	00	07	23	92	08 20	1860	L50Y15
B	41	50	00	40	45	00	07	23	92	13 00	1600	L50Y45
B	41	30	00	40	45	00	07	23	92	15 50	1750	L30Y45
B	41	30	00	41	10	00	07	23	92	18 50	1300	L30Z10
B	41	17	00	41	00	00	07	23	92	21 30	1350	L17Z00
B	41	15	00	40	45	00	07	23	92	23 40	1390	L15Y45
B	41	06	00	40	30	00	07	24	92	02 00	1390	L06Y30
B	41	05	00	40	15	00	07	24	92	04 15	1060	L05Y15
B	41	15	00	40	15	00	07	24	92	06 05	1650	L15Y15
B	41	30	00	40	15	00	07	24	92	08 30	1800	L30Y15
B	41	30	00	39	45	00	07	24	92	11 40	2000	L30X45
B	41	15	00	39	45	00	07	24	92	14 00	1700	L15X45
B	41	15	00	39	15	00	07	24	92	19 05	1500	L15X15
B	41	30	00	39	15	00	07	24	92	21 25	1950	L30X15
B	41	30	00	38	45	00	07	25	92	00 35	1960	L30W45
B	41	15	00	38	45	00	07	25	92	03 35	1600	L15W45
B	41	15	00	38	15	00	07	25	92	09 25	1500	L15W15
B	41	30	00	38	15	00	07	25	92	11 45	2000	L30W15
B	41	30	00	37	45	00	07	25	92	15 15	1850	L30V45
B	41	15	00	37	45	00	07	25	92	18 35	1450	L15V45
B	41	15	00	37	15	00	07	25	92	20 45	0200	L15V15
B	41	30	00	37	15	00	07	25	92	23 00	0135	L30V15
B	41	35	00	36	45	00	07	26	92	02 10	0490	L35T45
B	41	50	00	36	45	00	07	26	92	04 30	0675	L50T45
B	41	45	00	36	20	00	07	26	92	07 30	0740	L45T20

R/V KOLESNIKOV STATIONS

K	43	30	00	31	45	00	07	07	92	23 14	2100	N30N45
K	43	50	00	31	45	00	08	07	92	07 37	1589	N50N45
K	43	50	00	31	15	00	08	07	92	13 53	1532	N50N15
K	43	50	00	30	45	00	08	07	92	17 44	1050	N50M45
K	44	00	00	30	45	00	08	07	92	20 55	0509	P00M45
K	44	10	00	30	45	00	08	07	92	23 40	0142	P10M45
K	44	30	00	31	15	00	09	07	92	05 10	0490	P30N15
K	44	20	00	31	15	00	09	07	92	08 33	0600	P20N15
K	44	10	00	31	15	00	09	07	92	10 28	0684	P10N15
K	44	10	00	31	45	00	09	07	92	15 03	0530	P10N45
K	44	20	00	31	45	00	09	07	92	16 46	1215	P20N45
K	44	30	00	31	45	00	09	07	92	19 48	1140	P30N45
K	44	40	00	31	45	00	09	07	92	23 29	1140	P40N45
K	44	50	00	31	45	00	10	07	92	01 30	0068	P50N45
K	44	50	00	32	15	00	10	07	92	05 27	0514	P50P15
K	44	40	00	32	15	00	10	07	92	08 21	1574	P40P15
K	44	30	00	32	15	00	10	07	92	09 58	1390	P30P15
K	44	20	00	32	15	00	10	07	92	14 36	1560	P20P15
K	44	10	00	32	15	00	10	07	92	16 48	1580	P10P15
K	43	50	00	32	15	00	10	07	92	20 01	1758	N50P15

K	43	30	00	32	15	00	10 07 92	23	01	2010	N30P15
K	43	30	00	32	45	00	11 07 92	04	04	2016	N30P45
K	43	50	00	32	45	00	11 07 92	07	26	1977	N50P45
K	44	00	00	32	45	00	11 07 92	10	20	1833	P00P45
K	44	10	00	32	45	00	11 07 92	11	42	1800	P10P45
K	44	20	00	32	45	00	11 07 92	13	58	1725	P20P45
K	44	30	00	32	45	00	11 07 92	15	53	0679	P30P45
K	44	40	00	32	45	00	11 07 92	18	57	0204	P40P45
K	44	50	00	32	45	00	11 07 92	20	49	0100	P50P45
K	44	50	00	33	15	00	11 07 92	23	58	0090	P50Q15
K	44	27	00	33	15	00	12 07 92	02	46	0300	P27Q15
K	44	20	00	33	15	00	12 07 92	04	23	1600	P20Q15
K	44	10	00	33	15	00	12 07 92	06	18	1914	P10Q15
K	44	10	00	33	45	00	12 07 92	14	19	0162	P10Q45
K	44	00	00	33	45	00	12 07 92	15	51	1677	P00Q45
K	43	50	00	33	45	00	12 07 92	17	29	2054	N50Q45
K	43	50	00	33	15	00	12 07 92	20	27	2030	N50Q15
K	43	30	00	33	15	00	13 07 92	01	07	2100	N30Q15
K	43	30	00	33	45	00	13 07 92	05	56	2198	N30Q45
K	43	10	00	33	45	00	13 07 92	08	51	2216	N10Q45
K	43	10	00	34	15	00	13 07 92	20	19	2212	N10Q15
K	43	30	00	34	15	00	14 07 92	00	22	2200	N30R15
K	43	50	00	34	15	00	14 07 92	05	04	2100	N50R15
K	44	10	00	34	15	00	14 07 92	08	03	1733	P10R15
K	44	17	00	34	15	00	14 07 92	13	16	0829	P17R15
K	44	25	00	34	15	00	14 07 92	15	05	0125	P25R15
K	44	20	00	33	45	00	14 07 92	18	11	0094	P20Q45
K	45	05	00	33	15	00	15 07 92	12	04	0039	Q05Q15
K	45	10	00	32	45	00	15 07 92	23	22	0072	Q10P45
K	45	10	00	32	15	00	16 07 92	08	51	0055	Q10P15
K	45	30	00	32	15	00	16 07 92	10	51	0040	Q30P15
K	45	50	00	32	45	00	16 07 92	13	48	0024	Q50P45
K	45	50	00	32	15	00	16 07 92	16	11	0029	Q50P15
K	45	50	00	31	45	00	16 07 92	20	27	0022	Q50N45
K	46	08	00	31	45	00	16 07 92	22	43	0010	R08N45
K	46	10	00	31	15	00	17 07 92	01	15	0021	R10N15
K	45	50	00	31	15	00	17 07 92	02	53	0025	Q50N15
K	45	50	00	30	45	00	17 07 92	05	00	0025	Q50M45
K	45	30	00	30	45	00	17 07 92	07	37	0032	Q30M45
K	45	30	00	30	15	00	17 07 92	09	38	0018	Q30M15
K	45	10	00	30	15	00	17 07 92	11	44	0029	Q10M15
K	45	10	00	30	45	00	17 07 92	14	07	0039	Q10M45
K	45	10	00	31	15	00	17 07 92	16	21	0050	Q10N15
K	45	30	00	31	15	00	17 07 92	18	38	0044	Q30N15
K	45	30	00	31	45	00	17 07 92	20	42	0046	Q30N45
K	45	10	00	31	45	00	17 07 92	23	03	0052	Q10N45
K	44	40	00	34	45	00	24 07 92	05	46	1161	P40R45
K	44	30	00	34	45	00	24 07 92	07	16	1824	P30R45
K	44	10	00	34	45	00	24 07 92	11	48	2170	P10R45
K	43	50	00	34	45	00	24 07 92	15	42	2194	N50R45
K	43	30	00	34	45	00	24 07 92	19	30	2200	N30R45
K	43	30	00	35	15	00	24 07 92	21	36	2200	N30S15
K	43	50	00	35	15	00	25 07 92	00	47	2180	N50S15

K	44	10	00	35	15	00	25 07 92			05 11	2099	P10S15
K	44	30	00	35	15	00	25 07 92			07 51	1516	P30S15
K	44	45	00	35	15	00	25 07 92			11 43	0089	P45S15
K	44	45	00	35	45	00	25 07 92			14 50	0510	P45S45
K	44	30	00	35	45	00	25 07 92			18 13	1376	P30S45
K	44	10	00	35	45	00	25 07 92			22 28	1800	P10S45
K	43	50	00	35	45	00	26 07 92			01 31	2090	N50S45
K	43	30	00	35	45	00	26 07 92			04 37	2196	N30S45
K.	43	30	00	36	15	00	26 07 92			07 27	2190	N30T15
K	43	50	00	36	15	00	26 07 92			10 38	2122	N50T15
K	44	10	00	36	15	00	26 07 92			13 24	1746	P10T15
K	44	30	00	36	15	00	26 07 92			16 41	0709	P30T15
K	44	45	00	36	15	00	26 07 92			18 50	0086	P45T15
K	44	45	00	36	45	00	26 07 92			21 44	0094	P45T45
K	44	30	00	36	45	00	26 07 92			23 38	1070	P30T45
K	44	10	00	36	45	00	27 07 92			02 48	1850	P10T45
K	43	50	00	36	45	00	27 07 92			05 36	2102	N50T45
K	43	30	00	36	45	00	27 07 92			08 33	2170	N30T45
K	43	30	00	37	15	00	27 07 92			11 29	2162	N30V15
K	43	50	00	37	15	00	27 07 92			13 58	2135	N50V15
K	44	10	00	37	15	00	27 07 92			17 08	2071	P10V15
K	44	30	00	37	15	00	27 07 92			20 28	1200	P30V15
K	44	45	00	37	15	00	27 07 92			22 43	0110	P45V15
K	44	30	00	37	45	00	28 07 92			02 11	1130	P30V45
K	44	10	00	37	45	00	28 07 92			04 51	1994	P10V45
K	43	50	00	37	45	00	28 07 92			07 46	2128	N50V45
K	43	30	00	37	45	00	28 07 92			10 20	2154	N30V45
K	43	10	00	37	45	00	28 07 92			13 06	2153	N10V45
K	42	50	00	37	45	00	28 07 92			20 02	2148	M50V45
K	42	50	00	38	15	00	28 07 92			23 30	2100	M50W15
K	43	10	00	38	15	00	29 07 92			02 07	2100	N10W15
K	43	30	00	38	15	00	29 07 92			04 57	2093	N30W15
K	43	50	00	38	15	00	29 07 92			08 18	1955	N50W15
K	44	10	00	38	15	00	29 07 92			10 39	1277	P10W15
K	44	05	00	38	45	00	29 07 92			13 07	1151	P05W45
K	43	50	00	38	45	00	29 07 92			15 15	1680	N50W45
K	43	30	00	38	45	00	29 07 92			18 10	2122	N30W45
K	43	10	00	38	45	00	29 07 92			20 57	2119	N10W45
K	42	50	00	38	45	00	29 07 92			23 45	2106	M50W45
K	42	50	00	39	15	00	30 07 92			02 22	2042	M50X15
K	43	10	00	39	15	00	30 07 92			05 00	1924	N10X15
K	43	30	00	39	15	00	30 07 92			08 13	1679	N30X15
K	43	39	00	39	15	00	30 07 92			10 09	1461	N39X15
K	43	20	00	39	45	00	30 07 92			13 56	1009	N20X45
K	43	10	00	39	45	00	30 07 92			15 40	1635	N10X45
K	42	50	00	39	45	00	30 07 92			18 16	1852	M50X45
K	42	33	00	39	45	00	30 07 92			21 02	1925	M33X45
K	42	30	00	40	15	00	31 07 92			00 14	1600	M30Y15
K	42	40	00	40	15	00	31 07 92			01 48	1200	M40Y15
K	42	56	00	40	20	00	31 07 92			04 22	0270	M56Y20
K	42	50	00	40	15	00	31 07 92			05 43	1114	M50Y15
K	42	50	00	40	45	00	31 07 92			08 48	0464	M50Y45
K	42	40	00	40	45	00	31 07 92			11 26	0907	M40Y45

K	42 30 00	40 45 00	31 07 92	13 06	1646	M30Y45
K	42 30 00	41 12 00	31 07 92	16 58	0495	M30Z12
K	42 10 00	41 15 00	31 07 92	19 51	1245	M10Z15
K	41 50 00	41 15 00	31 07 92	22 32	1045	L50Z15
K	42 10 00	40 45 00	01 08 92	10 27	1563	M10Y45
K	42 10 00	40 15 00	01 08 92	13 34	1874	M10Y15
K	42 10 00	39 45 00	01 08 92	16 53	1976	M10X45
K	42 30 00	39 15 00	01 08 92	20 50	2051	M30X15
K	42 30 00	38 45 00	01 08 92	23 54	2098	M30W45
K	43 10 00	37 15 00	02 08 92	08 46	2172	N10V15

(repeat stations)

K	44 50 00	33 15 00	11 7 92	23 58	90	P50Q15r
K	44 50 00	32 45 00	11 7 92	20 49	100	P50P45r

R/V AKADEMIK STATIONS

A	43 30 00	28 40 00	07 07 92	17 30	0063	N30K40
A	43 30 00	28 50 00	07 07 92	21 00	0069	N30K50
A	43 30 00	29 16 00	07 08 92	00 30	0100	N30L15
A	43 30 00	29 45 00	07 08 92	05 10	0830	N30145
A	43 30 00	30 14 00	07 08 92	12 50	1304	N30M15
A	43 30 00	30 45 00	07 08 92	18 30	1405	N30M45
A	43 30 00	31 15 00	07 08 92	23 10	1644	N30N15
A	43 30 00	31 45 00	07 09 92	07 30	1925	N30N45
A	43 36 00	31 12 00	07 09 92	15 46	1635	N36N12
A	43 50 00	31 15 00	07 09 92	20 30	1583	N50N15
A	43 50 00	30 45 00	07 10 92	01 30	1071	N50M45
A	43 50 00	30 15 00	07 10 92	05 00	0116	N50M15
A	43 50 00	29 45 00	07 10 92	09 30	0072	N50L45
A	43 50 00	29 15 00	07 10 92	12 10	0064	N50L15
A	43 50 00	28 55 00	07 10 92	15 15	0050	N50K55
A	44 10 00	29 00 00	07 10 92	18 10	0041	P10L00
A	44 10 00	29 15 00	07 10 92	20 50	0052	P10L15
A	44 30 00	29 15 00	07 11 92	00 15	0035	P30L15
A	44 50 00	29 48 00	07 11 92	04 40	0039	P50L48
A	44 50 00	30 15 00	07 11 92	08 15	0050	P50M15
A	44 50 00	30 45 00	07 11 92	12 00	0059	P50M45
A	44 50 00	31 16 00	07 11 92	16 10	0066	P50N15
A	44 30 00	31 15 00	07 11 92	20 20	0612	P30N15
A	44 30 00	30 45 00	07 12 92	00 30	0088	P30M45
A	44 30 00	30 14 00	07 12 92	04 50	0072	P30M15
A	44 30 00	29 45 00	07 12 92	08 40	0058	P30L45
A	44 10 00	29 45 00	07 12 92	12 50	0065	P10L45
A	44 10 00	30 15 00	07 12 92	16 50	0095	P10M15
A	44 10 00	30 45 00	07 12 92	21 45	0137	P10M45
A	44 10 00	31 15 00	07 13 92	01 30	0762	P10N15
A	43 10 00	31 15 00	07 13 92	13 00	1816	N10N15
A	43 10 00	30 45 00	07 13 92	20 30	1945	N10M45
A	43 10 00	30 14 00	07 14 92	00 00	1729	N10M15
A	43 10 00	29 45 00	07 14 92	03 30	1580	N10L45

A	43	10	00	29	15	00	07	14	92	07 00	1637	N10L15
A	43	10	00	28	50	00	07	14	92	11 00	0319	N10K50
A	43	09	00	28	19	00	07	14	92	14 20	0045	N10K20
A	43	10	00	28	12	00	07	14	92	15 30	0026	N10K12
A	43	10	00	28	05	00	07	14	92	17 50	0020	N10K05
A	42	50	00	28	05	00	07	14	92	20 10	0075	M50K05
A	42	30	00	27	50	00	07	14	92	23 30	0038	M30J50
A	42	30	00	28	05	00	07	15	92	01 40	0068	M30K05
A	42	08	00	28	22	00	07	15	92	06 30	0100	M10K20
A	42	29	00	28	20	00	07	15	92	12 00	0093	M30K20
A	42	50	00	28	20	00	07	16	92	06 10	0074	M50K20
A	42	50	00	28	45	00	07	16	92	10 30	1076	M50K45
A	42	30	00	28	46	00	07	16	92	14 40	1440	M30K45
A	42	30	00	29	15	00	07	16	92	19 00	2020	M30L15
A	42	50	00	29	15	00	07	17	92	01 50	2036	M50L15
A	42	50	00	29	45	00	07	17	92	06 30	2128	M50L45
A	42	30	00	29	45	00	07	17	92	10 40	2160	M30L45
A	42	50	00	30	15	00	07	17	92	17 00	2148	M50M15

(repeat stations)

A	43	50	00	31	15	00	07	13	92	06 30	1587	N50N15r
A	43	36	00	31	12	00	07	13	92	09 00	1623	N36N12r
A	43	30	00	31	15	00	07	13	92	10 20	1634	N30N15r

R/V K.PIRI REIS

P	41	18	00	29	15	00	07	04	92	10 43	0060	L18L15
P	41	30	00	29	15	00	07	04	92	14 39	0095	L30L15
P	41	30	00	28	45	00	07	04	92	16 58	0060	L30K45
P	41	50	00	28	45	00	07	04	92	19 57	1100	L50K45
P	41	50	00	28	20	00	07	04	92	21 27	110C	L50K20
P	42	10	00	28	20	00	07	05	92	00 20	0815	M10K20
P	42	10	00	28	45	00	07	05	92	04 57	0815	M10K45
P	42	30	00	29	15	00	07	05	92	18 13	2000	M30L15
P	42	30	00	29	45	00	07	05	92	23 11	2200	M30L45
P	42	50	00	30	15	00	07	05	92	09 21	2100	M50M15
P	42	50	00	30	45	00	07	06	92	10 55	2100	M50M45
P	43	10	00	31	15	00	07	06	92	17 00	1860	N10N15
P	43	30	00	31	45	00	07	06	92	21 21	1950	N30N45
P	43	10	00	31	45	00	07	06	92	07 15	2000	N10N45
P	43	10	00	32	15	00	07	07	92	01 00	2000	N10P15
P	43	10	00	32	45	00	07	07	92	05 03	2000	N10P45
P	43	10	00	33	15	00	07	07	92	08 58	2000	N10Q15
P	43	10	00	33	45	00	07	07	92	13 42	2200	N10Q45
P	43	10	00	34	15	00	07	07	92	18 30	2200	N10R15
P	43	10	00	34	45	00	07	07	92	22 16	2200	N10R45
P	42	50	00	34	45	00	07	08	92	01 12	2200	M50R45
P	42	30	00	34	45	00	07	08	92	04 20	2200	M30R45
P	42	15	00	34	45	00	07	08	92	06 57	0600	M15R45
P	42	15	00	34	15	00	07	08	92	10 34	0360	M15R15
P	42	15	00	33	45	00	07	08	92	21 20	0840	M15Q45

P	42	30	00	33	45	00	07	08	92	23 55	2200	M30Q45
P	42	30	00	34	15	00	07	09	92	03 24	2200	M30R15
P	42	50	00	34	15	00	07	09	92	07 25	2200	M50R15
P	42	50	00	33	45	00	07	10	92	19 23	2200	M50Q45
P	42	50	00	33	15	00	07	10	92	22 33	2200	M50Q15
P	42	30	00	33	15	00	07	11	92	02 29	2200	M30Q15
P	42	15	00	33	15	00	07	13	92	10 05	0840	M15Q15
P	42	10	00	32	45	00	07	13	92	13 24	2200	M10P45
P	42	30	00	32	45	00	07	13	92	16 40	2200	M30P45
P	42	50	00	32	45	00	07	13	92	20 10	2200	M50P45
P	42	50	00	32	15	00	07	13	92	23 15	2200	M50P15
P	42	30	00	32	15	00	07	14	92	02 45	2200	M30P15
P	42	10	00	32	15	00	07	14	92	06 18	2200	M10P15
P	41	50	00	32	15	00	07	14	92	09 46	1700	L50P15
P	41	35	00	31	45	00	07	14	92	14 21	0066	L35N45
P	41	50	00	31	45	00	07	14	92	17 07	1600	L50N45
P	42	10	00	31	45	00	07	14	92	20 27	2200	M10N45
P	42	30	00	31	45	00	07	14	92	23 53	2200	M30N45
P	42	50	00	31	45	00	07	15	92	23 06	2090	M50N45
P	42	50	00	31	15	00	07	15	92	06 38	2100	M50N15
P	42	30	00	31	15	00	07	15	92	08 46	2200	M30N15
P	42	10	00	31	15	00	07	15	92	13 00	2200	M10N15
P	41	50	00	31	15	00	07	15	92	16 11	2000	L50N15
P	41	30	00	31	15	00	07	15	92	19 24	1400	L30N15
P	41	11	00	31	15	00	07	15	92	22 40	0058	L11N15
P	41	11	00	30	45	00	07	16	92	02 08	0042	L11M45
P	41	30	00	30	45	00	07	16	92	05 40	1300	L30M45
P	41	50	00	30	45	00	07	16	92	09 32	1900	L50M45
P	42	10	00	30	45	00	07	16	92	13 10	2200	M10M45
P	42	30	00	30	45	00	07	16	92	17 04	2200	M30M45
P	42	30	00	30	15	00	07	16	92	23 28	2200	M30M15
P	42	10	00	30	15	00	07	17	92	02 50	2000	M10M15
P	41	50	00	30	15	00	07	17	92	06 01	1900	L50M15
P	41	30	00	30	15	00	07	17	92	09 11	0600	L30M15
P	41	15	00	30	15	00	07	17	92	12 05	0800	L15M15
P	41	15	00	29	45	00	07	17	92	15 26	1500	L15L45
P	41	30	00	29	45	00	07	17	92	17 49	0086	L30L45
P	41	50	00	29	45	00	07	17	92	21 48	2000	L50L45
P	42	10	00	29	45	00	07	18	92	01 56	2200	M10L45
P	42	10	00	29	15	00	07	18	92	06 35	2000	M10L15
P	41	50	00	29	15	00	07	18	92	09 28	1100	L50L15

The vertical profiles of temperature and salinity were measured using various types of CTD systems (Tables 1 and 3). Biogeochemical data were collected at stations along selected transects, and additional sampling for the fish egg and larvae survey took place.

Table 3

CTD Technical Specifications CoMSBlack '92a

MODEL	SBE-9	ISTOK V	ISTOK VII
Temperature:			
range (°C)	-5 + 35	-2 + 35	-2 + 35
resolution (°C)	0.0003	0.0025	0.0006
accuracy (°C)	±0.003	±0.025	±0.01
response time (s)	0.082 (V=0.5m/s)	0.050	0.050 - 0.070
Conductivity:			
range (S/m)	0 - 7	0.15 - 5.5	0.15 - 5.7
resolution (S/m)	0.00004	0.00025	0.00005
accuracy (S/m)	±0.0004	±0.00025	±0.0002
response time (s)	0.084 (V=0.5m/s)		
Pressure:			
range (dbar)	0 - 6000	0 - 6000	0 - 2000
resolution	0.004%	0.025*Pmax	0.025*Pmax
accuracy (%)	±0.02		
response time (s)	0.001		
Samp. Rate (Hz)24		4	10

4. CHEMICAL DATA

4.1 Chemical Data Assessment

Data collected by all ships were included in ASCII files containing depth, density, dissolved oxygen, hydrogen sulfide, phosphate, nitrate, nitrite, silicate and chlorophyll-a. Although it had been agreed at HydroBlack '91 that all chemical data should be reported in micromoles per liter (μM) and chlorophyll-a in micrograms per litre (mg/l or mg/m^3), some of the data obtained during CoMSBlack '92a still had to be converted into these units. Given in Table 4 are the lists of the chemical measurements attempted by each research group. Unfortunately, the chemical parameters (O_2, H_2S, PO_4, NO_3, NO_2, Si and Chlorophyll-α), accepted by all participants as the principal parameters to be monitored during the '92 joint cruise were not measured completely by all participants. Thus, (NO_3 + NO_2) measurements were not obtained by the R/V *Kolesnikov*, whereas the R/V *Akademik* was unable to obtain data at each of the defined surfaces or at every prescribed station. Obviously, this lack of sampling has impaired the success of the joint cruise.

Table 4

Chemical Parameters Analyzed During CoMSBlack '92a

Ship	1	2	3	4
Dissolved Oxygen	+	+	+	+
Hydrogen Sulfide	+	+	+	+
Phosphate	+	+	+	+
Nitrate	+	+		+
Nitrite		+		
Silicate	+	+	+	+
Chlorophyll-a	+	+		+
Secchi disk	+	+	+	

4.2 Chemical Data Interpretation

4.2.1 *Methodological unification:* It was agreed in HydroBlack '91 that the goals of the joint cruise program could be achieved only if each group was "using methods as similar in detail to each other as possible, with extensive testing of those methods, and intercalibration of results". Unfortunately, little further unification of methodology has been achieved and a planned cruise dedicated to the intercalibration of results and the unification of methodology has yet to occur. These problems remain urgent: there have now been two joint cruises which have produced significant discrepancies especially in the PO_4 data obtained by different groups at the same station. This discrepancy is considered to be due to the insufficiency of the amount of some chemicals used in the phosphate analysis. Groups will correct their methods for phosphate measurements in sulfidic waters in future cruises.

4.2.2 *Data intercomparison:* Plots of chemical parameters versus density surfaces, as a principle parameter, measured by each group at intercalibration stations are displayed in Figs. 2-4. Intercalibration station N30N45 (Figure 2) also includes the data of R/V *Knorr* (Cruise No. 4, Sta. 2, 25, July, 1988) for comparison. As is seen from the figures, it is difficult to correlate the PO_4 data due to the wide scatter. During the '93 cruise the source of this scatter will be investigated in detail. On the other hand, differences between silicate, nitrate and hydrogen sulfide data are small for all ships although there are some deviations in the data. However, hydrogen sulfide concentrations obtained by R/V *Akademik* below the 16.50 density surface were about two times higher than those from other ships. These high hydrogen sulfide levels measured by R/V *Akademik* are considered to be the result of using the spectrophotometric method instead of standard titrimetric method use by other groups.

Chlorophyll-a concentrations collected by R/V *Bilim*, R/V *K. Piri Reis* and R/V *Akademik* were not comparable with each other though there was good agreement on the depth of the maximum chlorophyll-a concentration (Figure 5). In recognition of this, a detailed plan for mutual education in methodology and sample analysis was agreed at the meeting.

The scientific evidence from joint investigations carried out since HydroBlack '91 suggests that a considerable simplification of Black Sea oceanography occurs if vertical profiles are plotted in terms of water density (sigma-t) rather than depths or pressure, irrespective of geographical locations in the basin. Therefore, since the intercalibration stations were visited by the participating research vessels at different dates during the joint July-92 cruise, the chemical data from each ship were plotted as a function of water density rather than depth and compared with each other in that way.

Displayed in Figures 6-8 are the composite plots of ratios of the Si/PO_4 and Si/H_2S with respect to density for four ships. The same ratios for the R/V *Knorr* data (1988 Cruise) are also plotted in Figure 9 for comparison. As can be seen from Figures 5 and 9, some of the R/V *Bilim*, R/V *K. Piri Reis* and R/V *Kolesnikov* data do not fit the expected curve. This deviation is caused by the ineffectiveness of the methods used in phosphate measurements.

During the cruise it was observed that the surface waters were unusually green and fertile in the central part of the western Black Sea; it appeared that a summer bloom occurred in these regions. All analyses showed that in these regions the euphotic zone was abnormally thin (<5 m) and was indeed unusually fertile. When the Black Sea is divided into different oceanographic regions such as the region where planktonic productivity is high or the regions where biochemical properties do not deviate from the levels measured during previous cruises, composite plots of the data show differences in scattering in vertical distributions. Displayed in Figure 9 are the plots of phosphate concentrations versus density, as an example, for two different regions (Region II and Region IV). As is seen from Figure 9 (Region II) where abnormal euphotic zones (with summer blooms) have been observed, analyses show considerable scattering in the water masses below 16.20 density surface. On the other hand, vertical distribution of the same parameter does not show any scattering in biochemically 'normal' regions below 16.20 density surface.

5. PHYSICAL DATA

5.1 Assessment of Physical Data

Data collected by all ships were included in ASCII files containing one decibar averaged values of pressure (dbar), temperature (°C), salinity, and density (kg/m^3). Data from the intercalibration stations were first examined. The comparison was done only for data recorded below 1000 db, since the spatial and temporal variability at these depths is small and the dynamic range is narrow. These data, as in HydroBlack '91, proved to be suitable for drift and noise analysis and removal.

In order to assess the quality of the data quantitatively, the first test was a drift check for the temperature and conductivity/salinity, for each instrument. The parameters recorded by each ship in all the deep stations were plotted versus pressure, for P>1000 dbar (Figure 10).

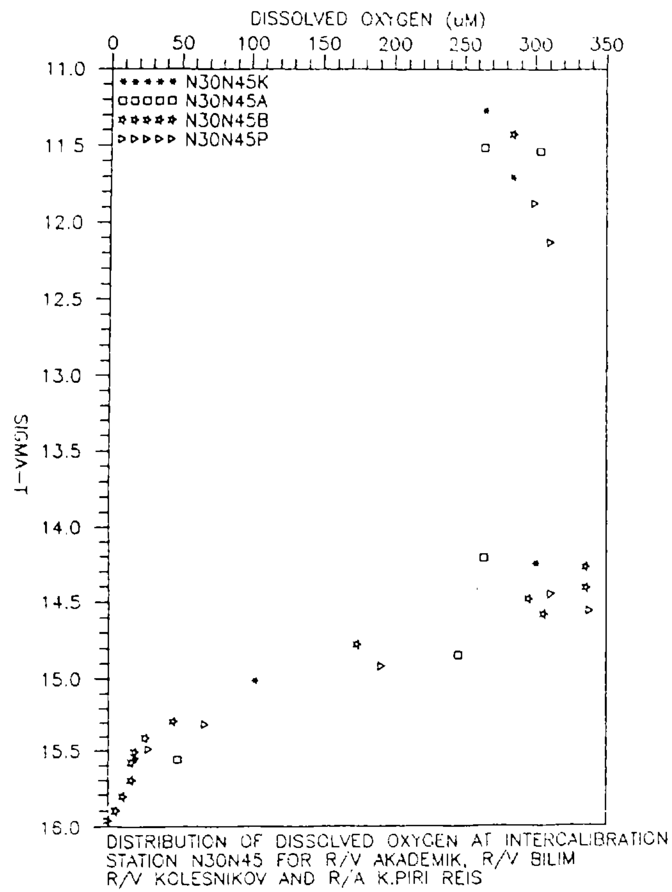
The results for *Bilim, Kolesnikov,* and *P. Reis* show that in the deep layers the profiles are remarkably smooth and their concordance meets the experiment requirements. For the *Akademik* data, the drift (with a range exceeding slightly 0.01 °C) and the 'step' in the temperature were obvious as for the ISTOK V data in HydroBlack '91. Conductivity profiles were smooth, without time or depth-dependent drift. A brief description of each data set is given below.

5.1.1 *Bilim:* The CTD data recorded with the SBE-9 instrument are of good quality. The data are practically noise-free and there is no evidence of sensor drift for temperature or conductivity, and, as a result, the salinity profiles are also smooth (Figure 10a).

5.1.2 *Kolesnikov*: The ISTOK VII CTD instrument recorded data which are of good quality, without noise or time drift, both in temperature and conductivity/salinity (Figure 10b).

5.1.3 *Piri Reis:* The ship used the same instrument as *Bilim* (SBE-9) and occupied the same stations as *Bilim* in the western part of the network. The data are of good quality, with no differences in the bottom mixed layer (Figure 10c).

5.1.4 *Akademik:* These data, collected with an ISTOK V CTD, are of good quality, but they show the same problems as the HydroBlack '91 data recorded by R/V *Kolesnikov* with the same instrument (Aubrey *et al.,* 1992). Both temperature and conductivity data were noisy due to coarse discretization, but this fact has little influence on the data quality, the noise level being below the instrument accuracy. The response of the temperature sensor experienced a drift during the cruise, but it was not linear in time, showing instead erratic deviation from station to station. However, in each intercalibration station, the difference due to the drift was not depth dependent. Also, the sensor "stuck" at a temperature of about 9.025 for a depth range of more than 25 m at every station (Figure 10d). There was practically no drift in the conductivity sensor, the shift in the recorded values being well below the desired accuracy (Figure 10d).



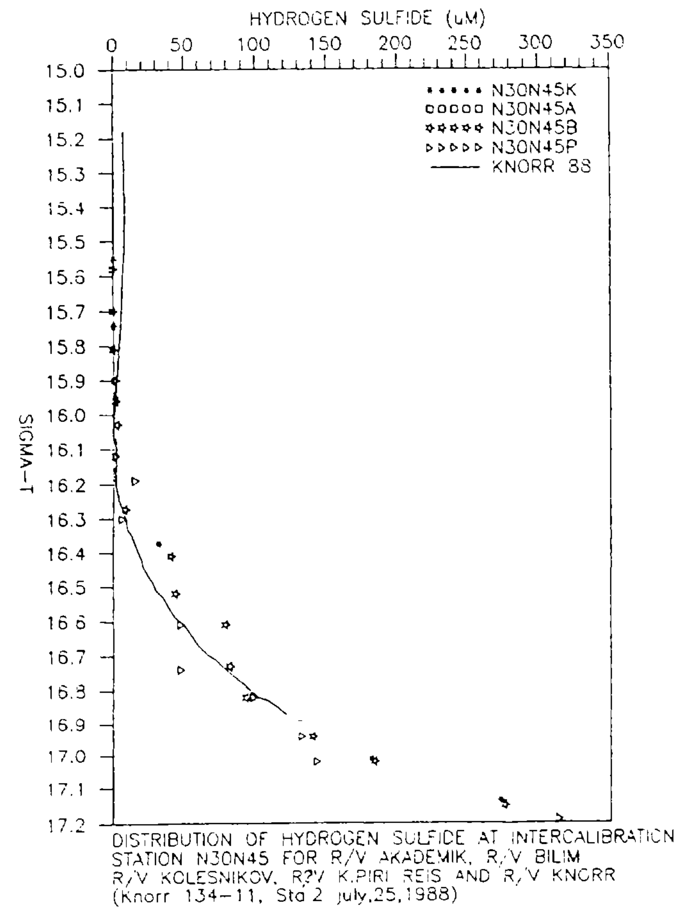
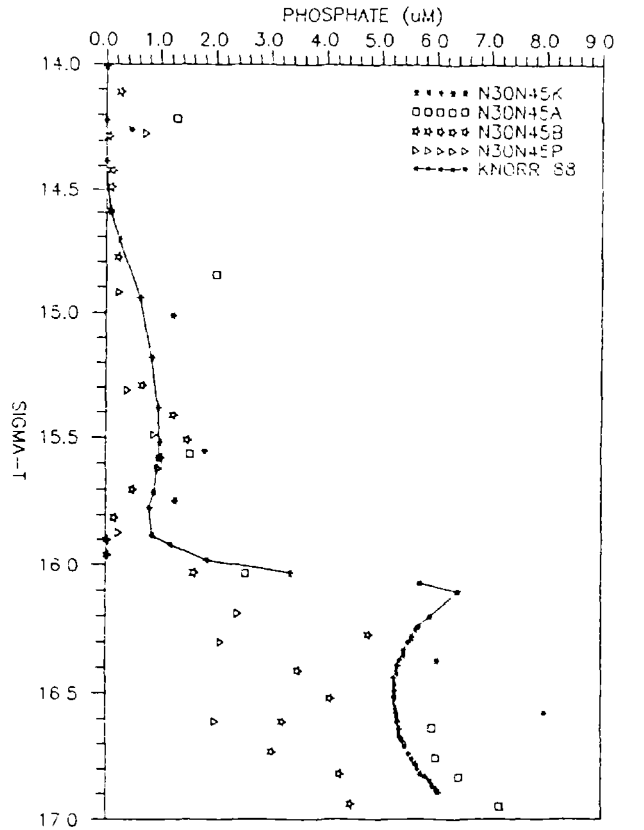
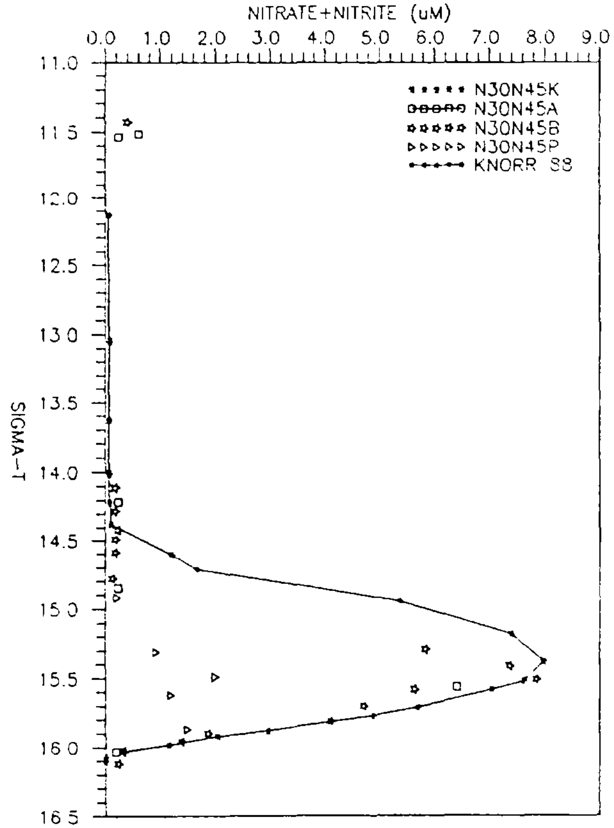


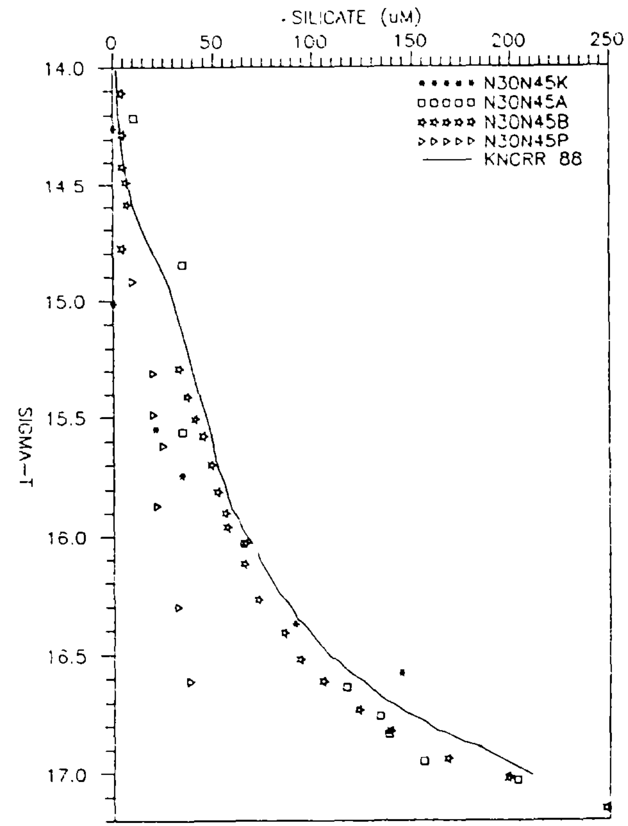
Figure 2: Distributions of chemical parameters measured by Akademik, Bilim, Kolesnikov and Piri Reis at intercalibration station N30N45. (Knorr Cruise-4, July 25, 1988, Sta.2 is also included for comparison)



DISTRIBUTION OF PHOSPHATE AT INTERCALIBRATION STATION N30N45 FOR R/V AKADEMIK, R/V BILIM R/V KOLESNIKOV, R/V K.PIRI REIS AND R/V KNORR 88 (R/V Knorr, 134-11, Sta.2, July,25,1988)



DISTRIBUTION OF NITRATE AT INTERCALIBRATION STATION N30N45 FOR R/V AKADEMIK, R/V BILIM R/V KOLESNIKO, R/V K.PIRI REIS AND R/V KNORR (R/V Knorr, 134-11 Sta.2 July,25,1988)



DISTRIBUTION OF SILICATE AT INTERCALIBRATION STATION N30N45 FOR R/V AKADEMIK, R/V BILIM R/V KOLESNIKOV, R/V K.PIRI REIS AND R/V KNORR (Knorr 134-11, Sta.2, 25,july,1992)

Figure 2: Continued.

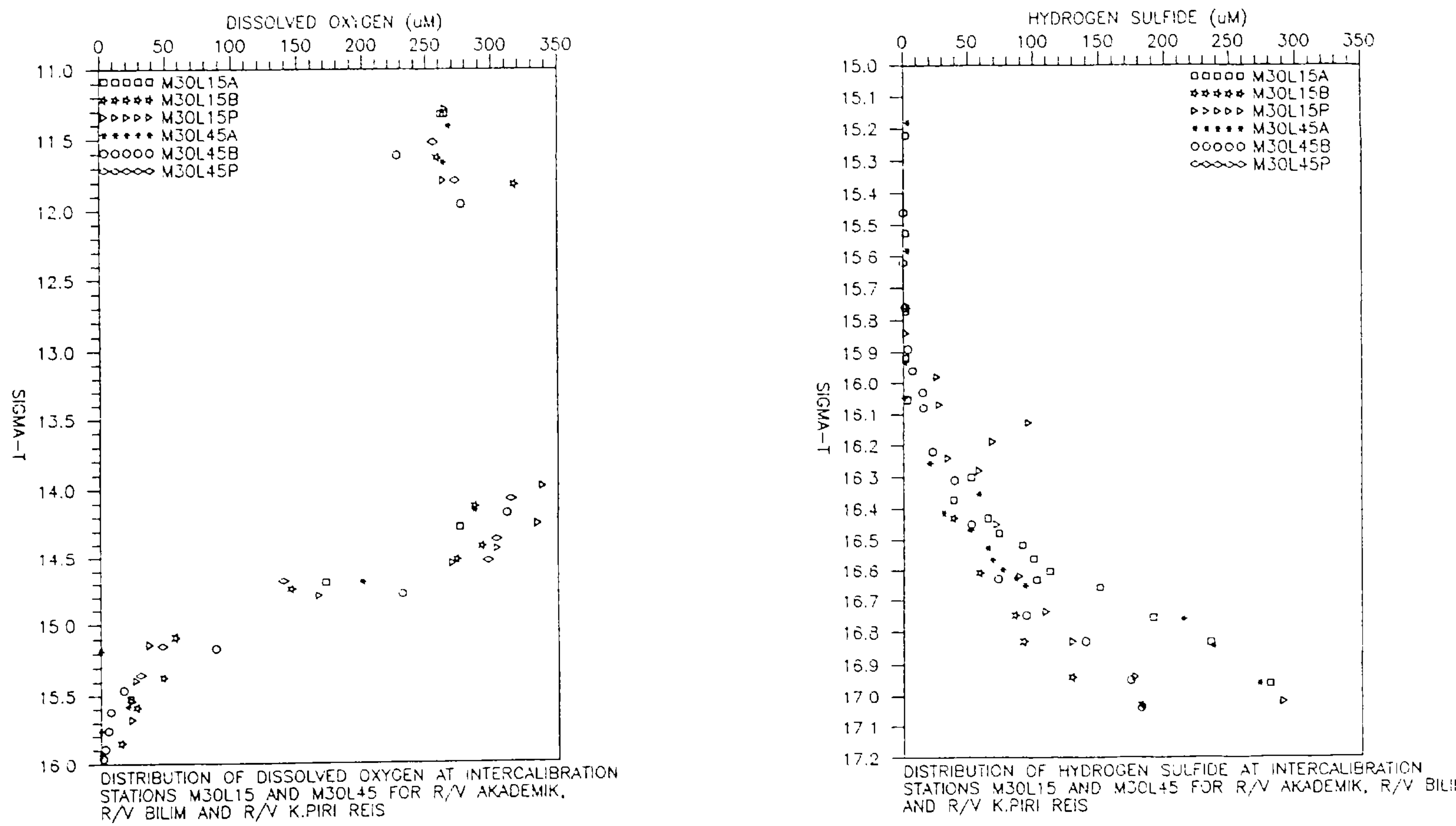


Figure 3: Distributions of chemical parameters measured by Akademik, Bilim and Piri Reis at intercalibration stations M30L15 and M30L45.

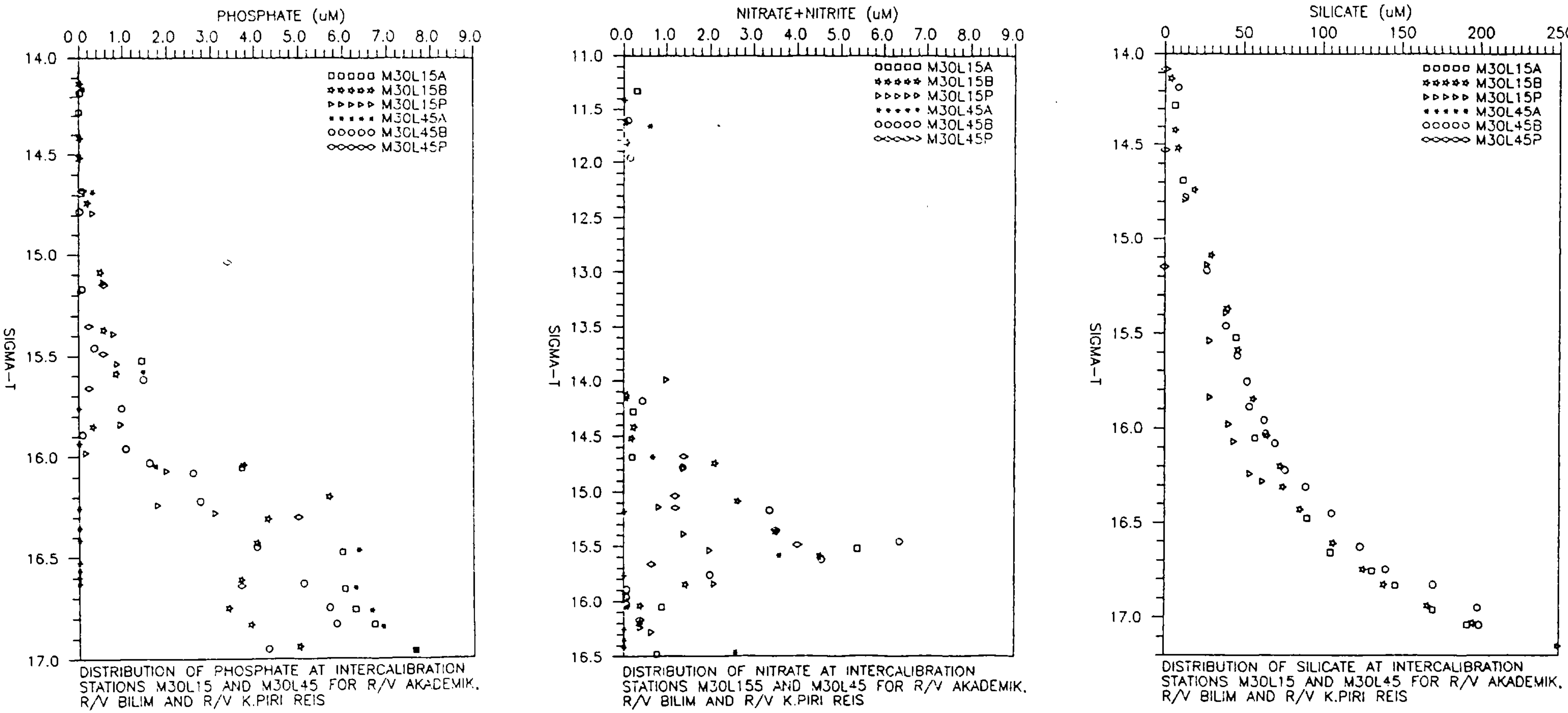
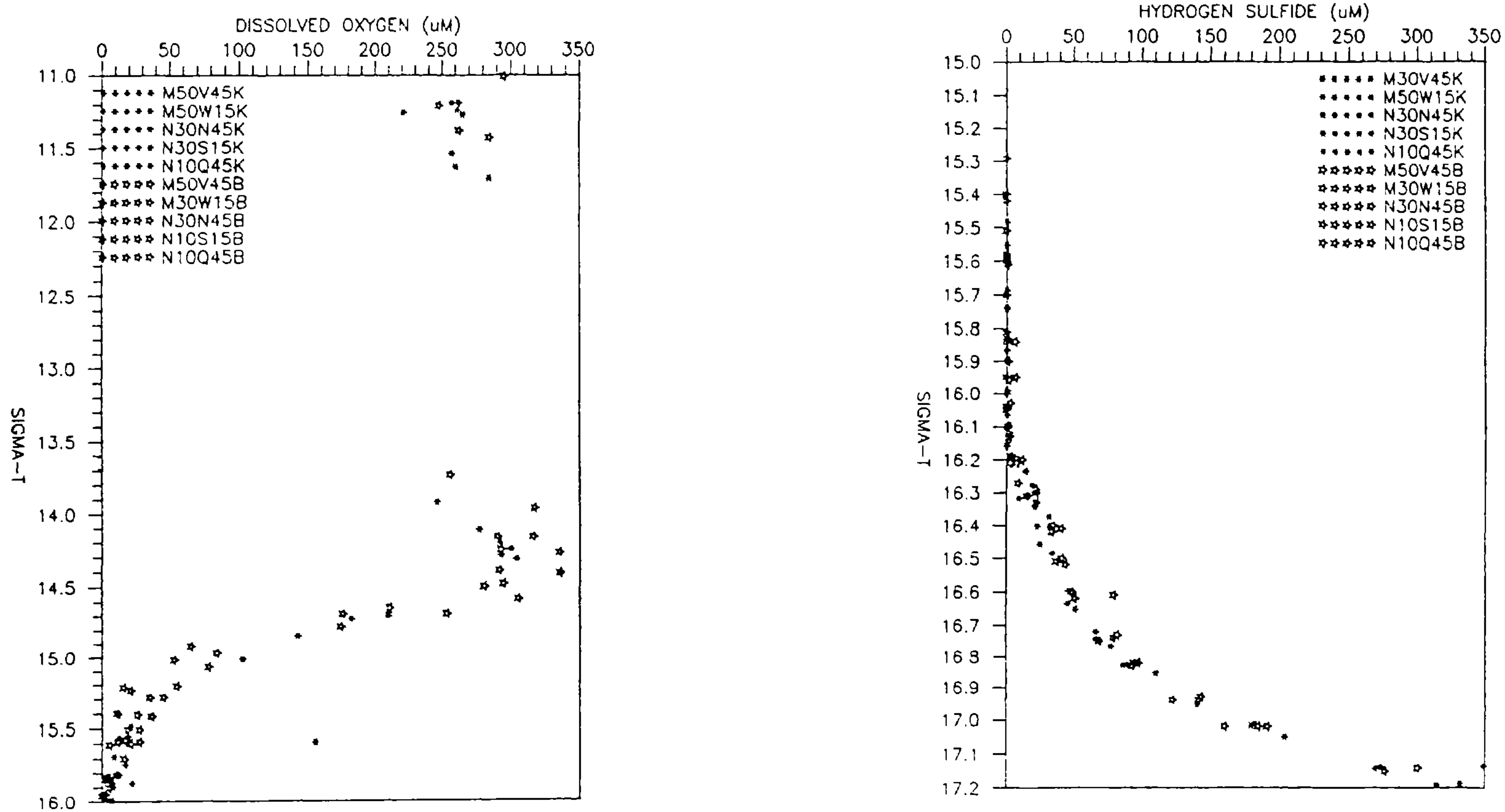


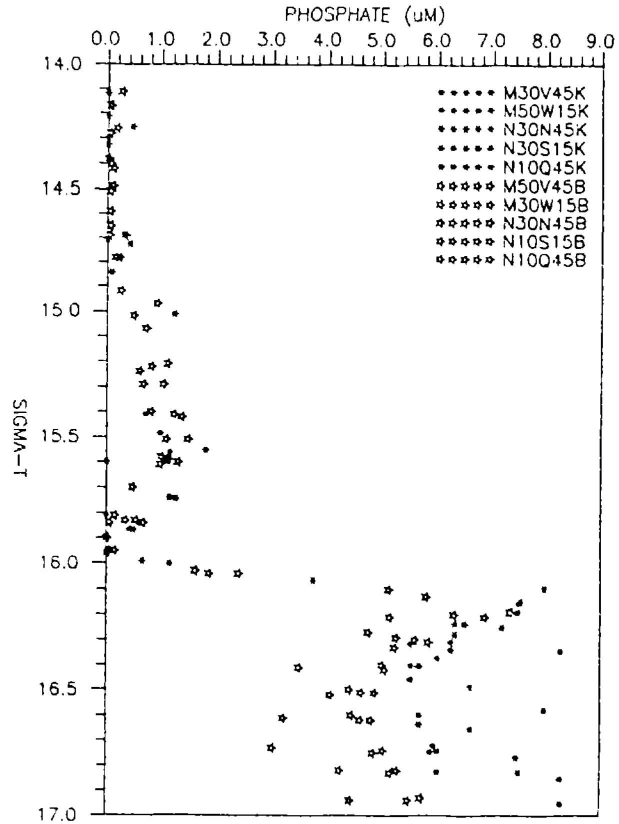
Figure 3: Continued.



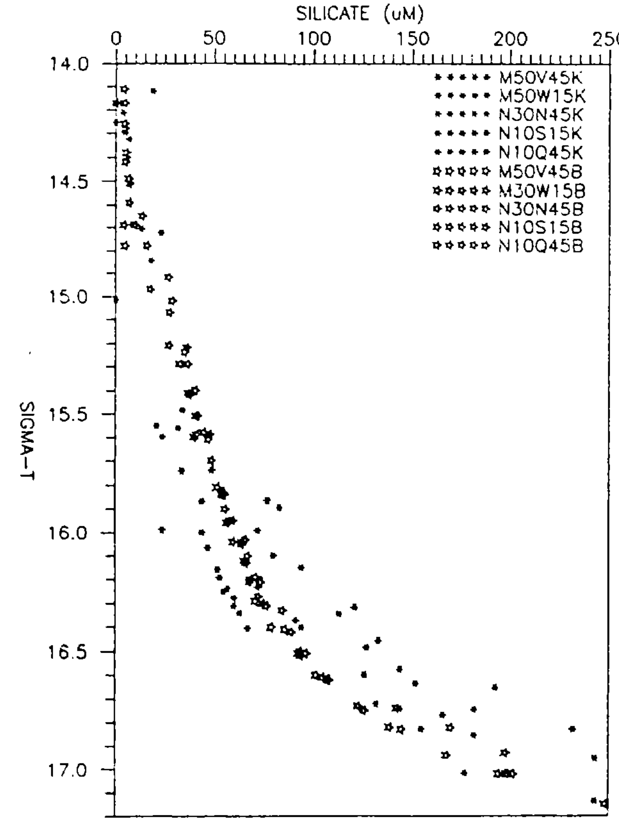
DISTRIBUTION OF DISSOLVED OXYGEN AT INTERCALIBRATION STATIONS FOR R/V BILIM AND R/V KOLESNIKOV

DISTRIBUTION OF HYDROGEN SULFIDE AT INTERCALIBRATION STATIONS FOR R/V BILIM AND R/V KOLESNIKOV

Figure 4: Distributions of chemical parameters measured by Bilim and Kolesnikov at stations M50V45, M50W15, N30N45, N10S15 and N10Q45.



DISTRIBUTION OF PHOSPHATE AT INTERCALIBRATION STATIONS FOR R/V BILIM AND R/V KOLESNIKOV



DISTRIBUTION OF SILICATE AT INTERCALIBRATION STATIONS FOR R/V BILIM AND R/V KOLESNIKOV

Figure 4: Continued.

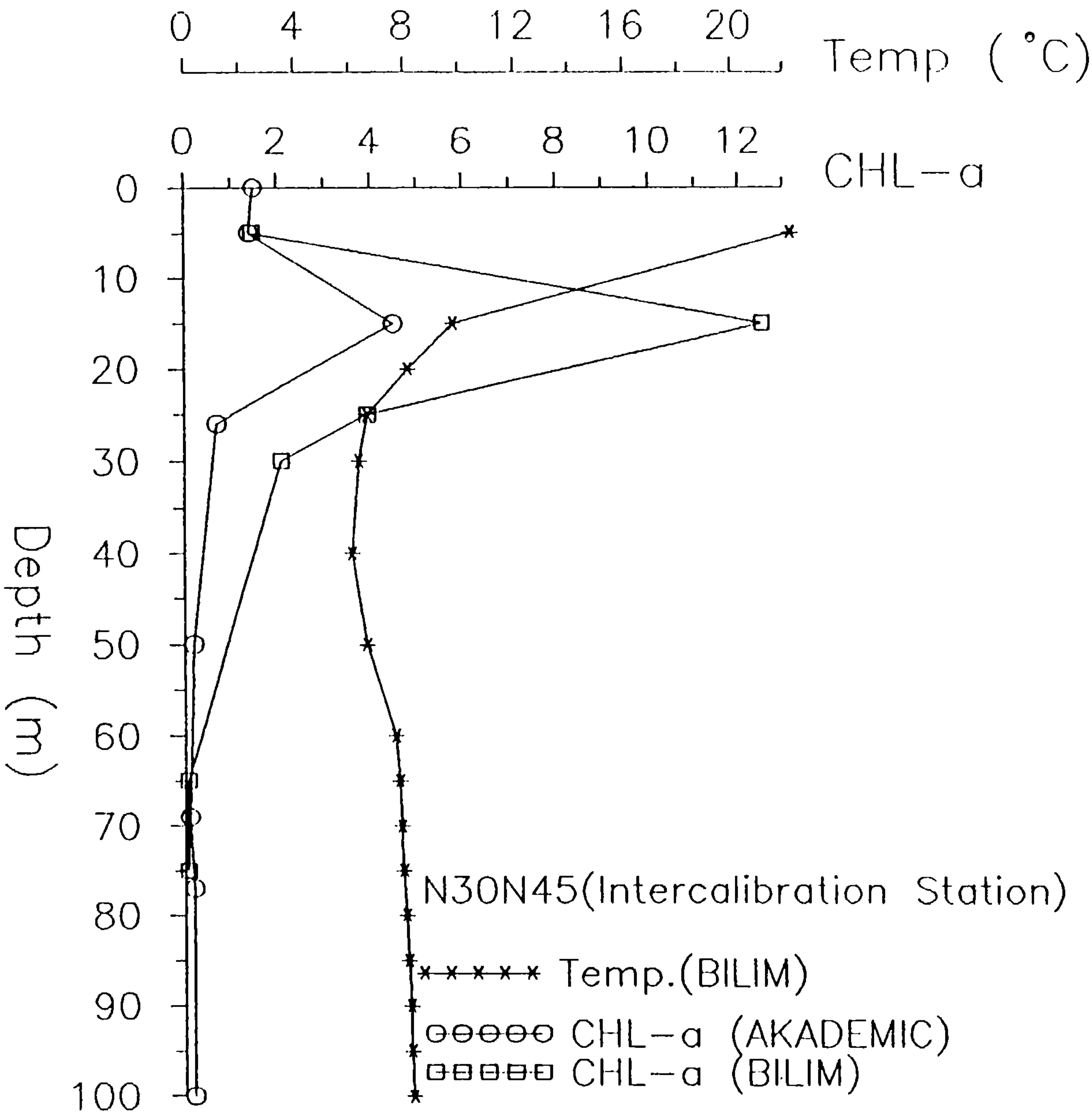


Figure 5: Plots of chlorophyll-a data collected by Akademik and Bilim at intercalibration station N30N45.

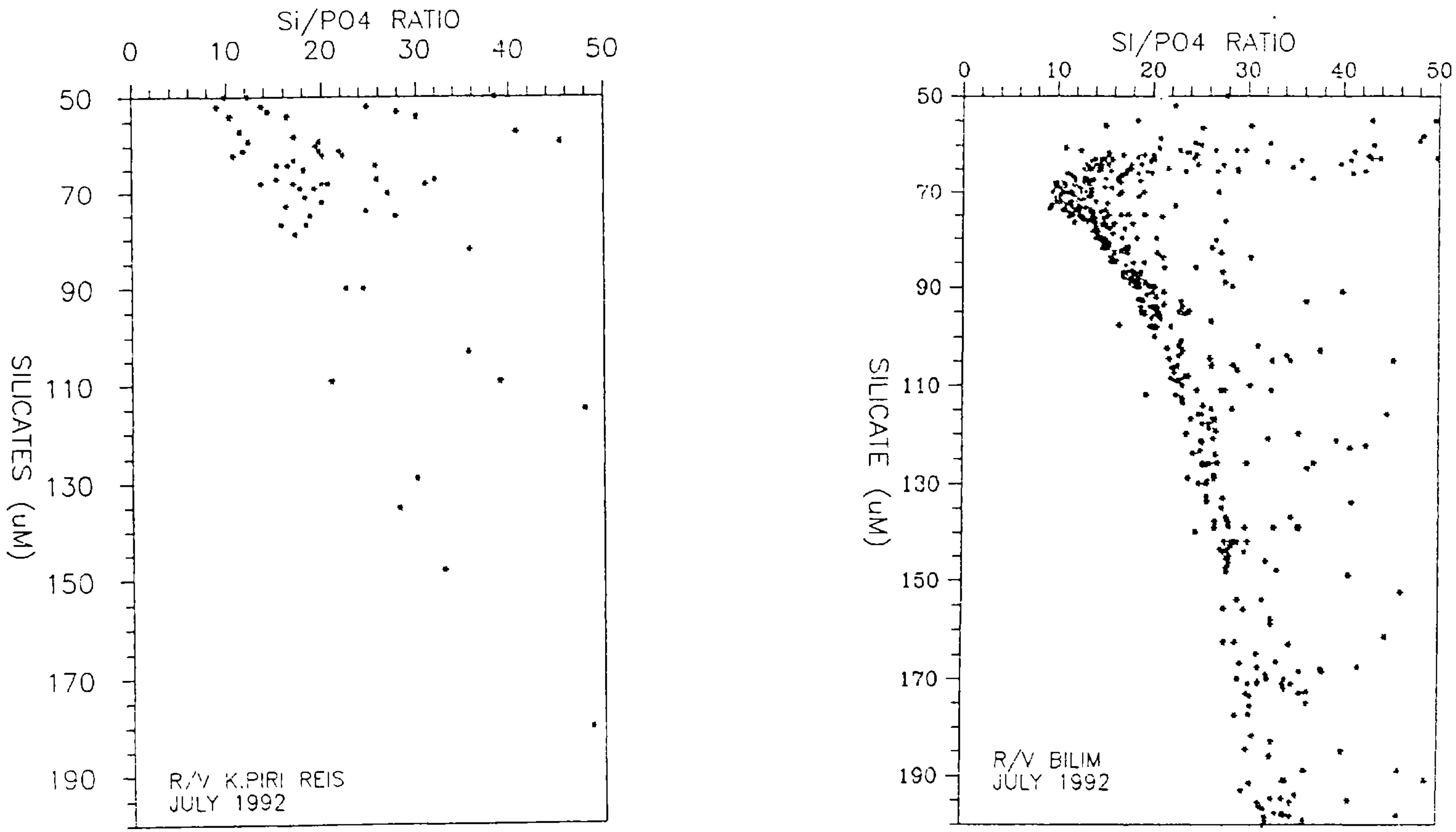


Figure 6: Composite plots of Si/PO_4 ratios versus silicate concentrations for Bilim, Piri Reis, Akademik and Kolesnikov.

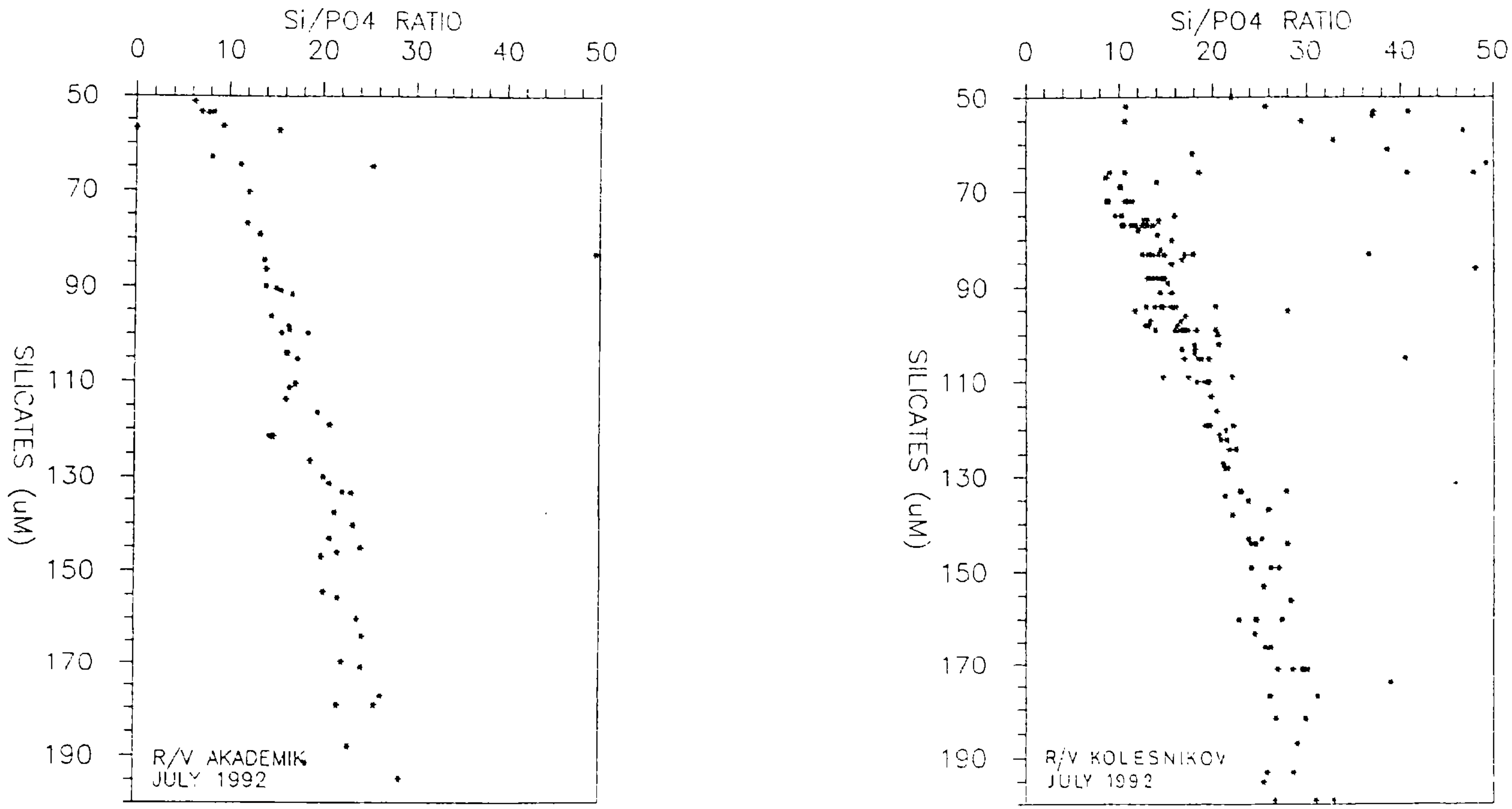


Figure 6: Continued.

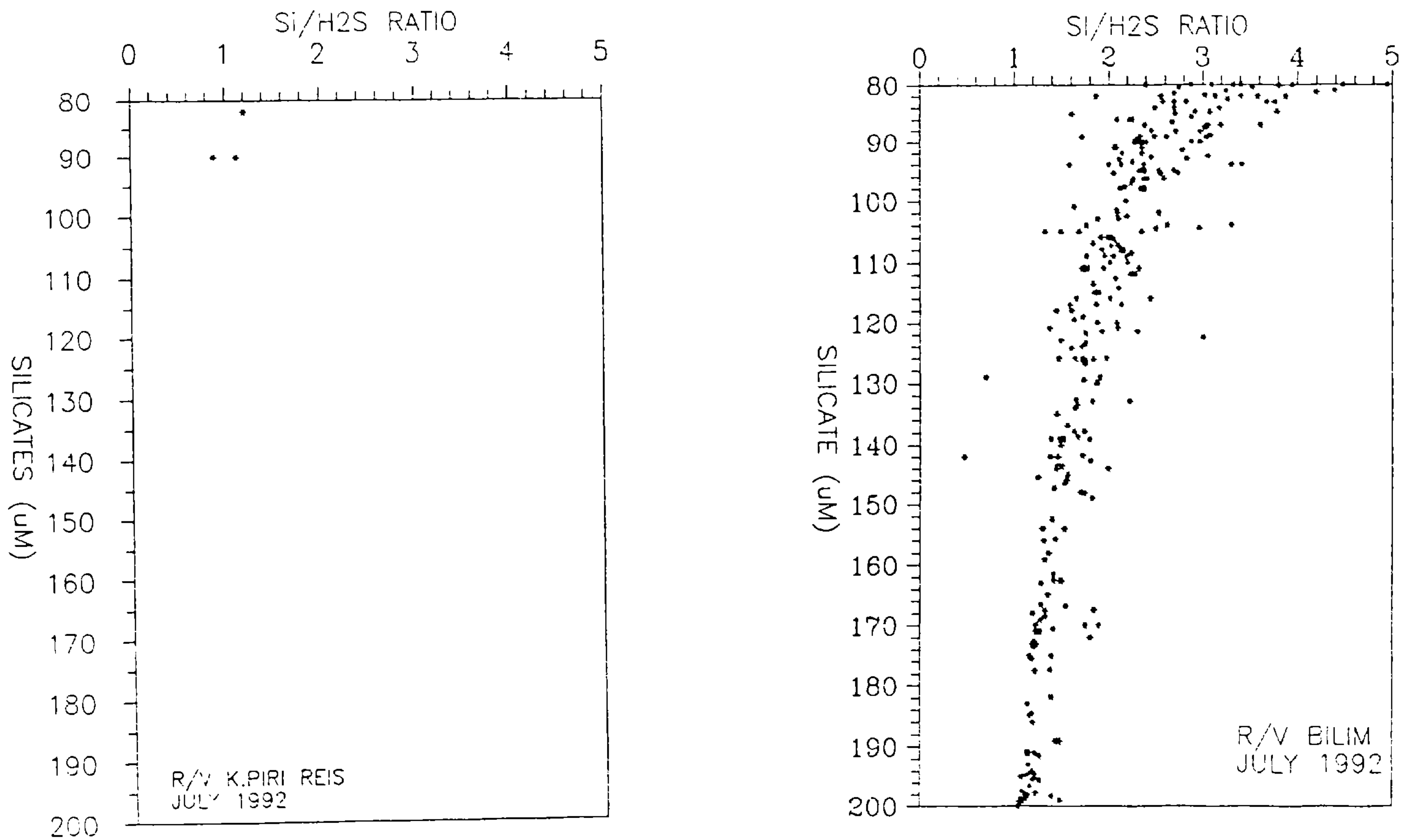
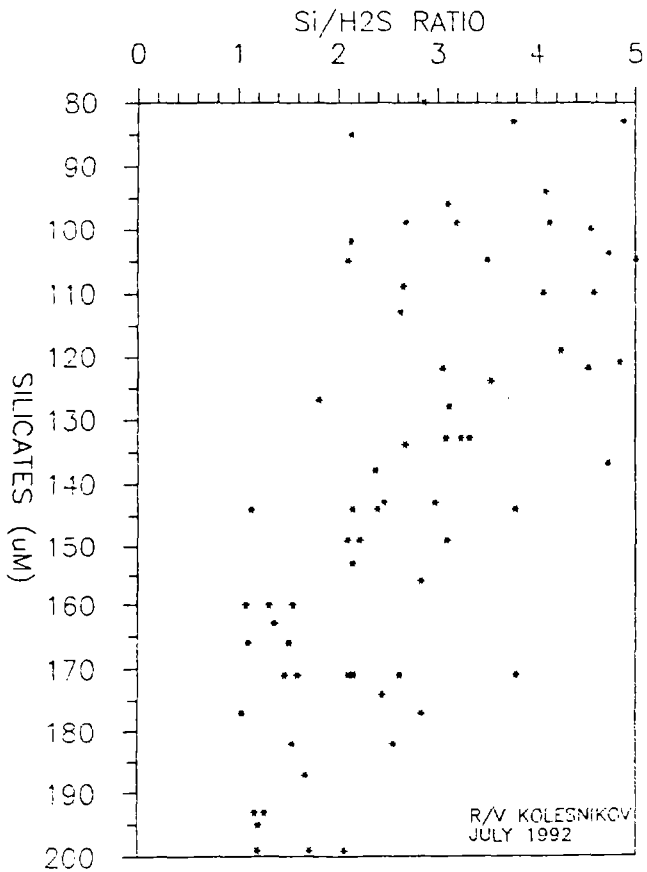


Figure 7: Composite plots of Si/H_2S ratios versus silicate concentrations for Bilim, Piri Reis, Akademik and Kolesnikov.



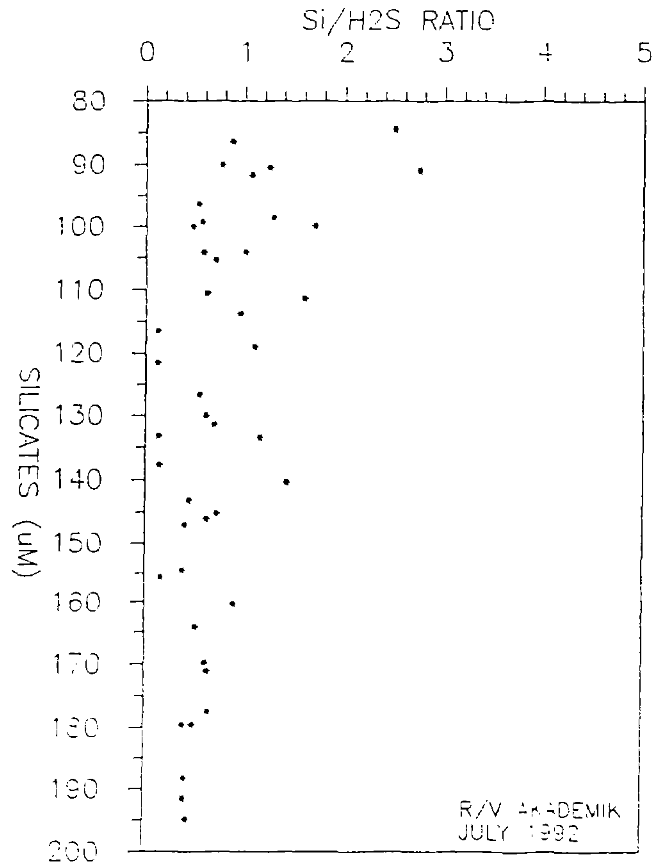
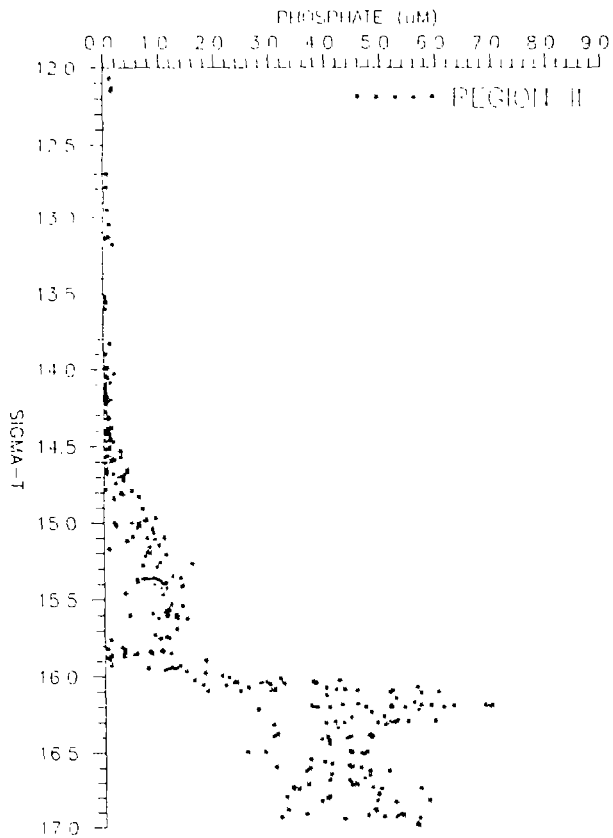


Figure 7: Continued.



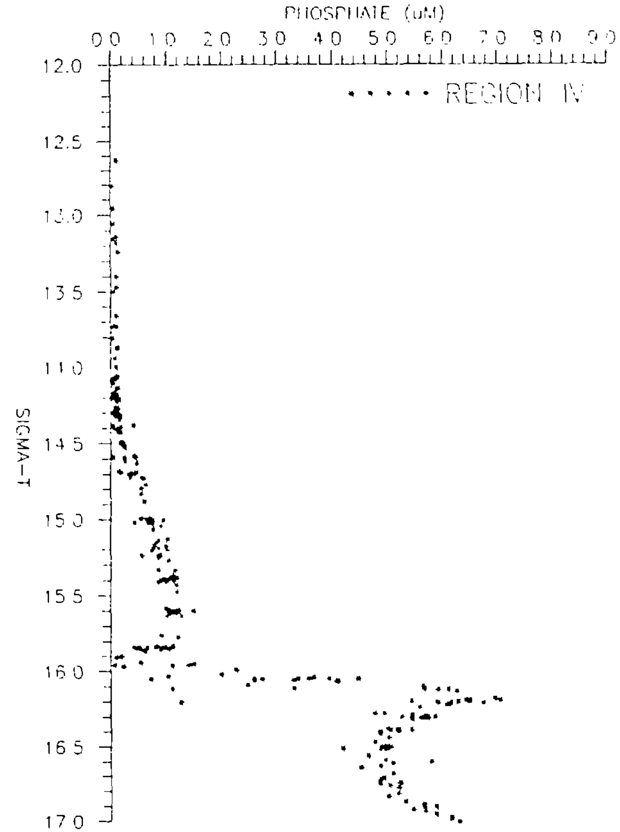


Figure 9: Composite plots of o-phosphate versus density measured by Bilim for regions of high planktonic production (Region II) and low production regions (Region IV).

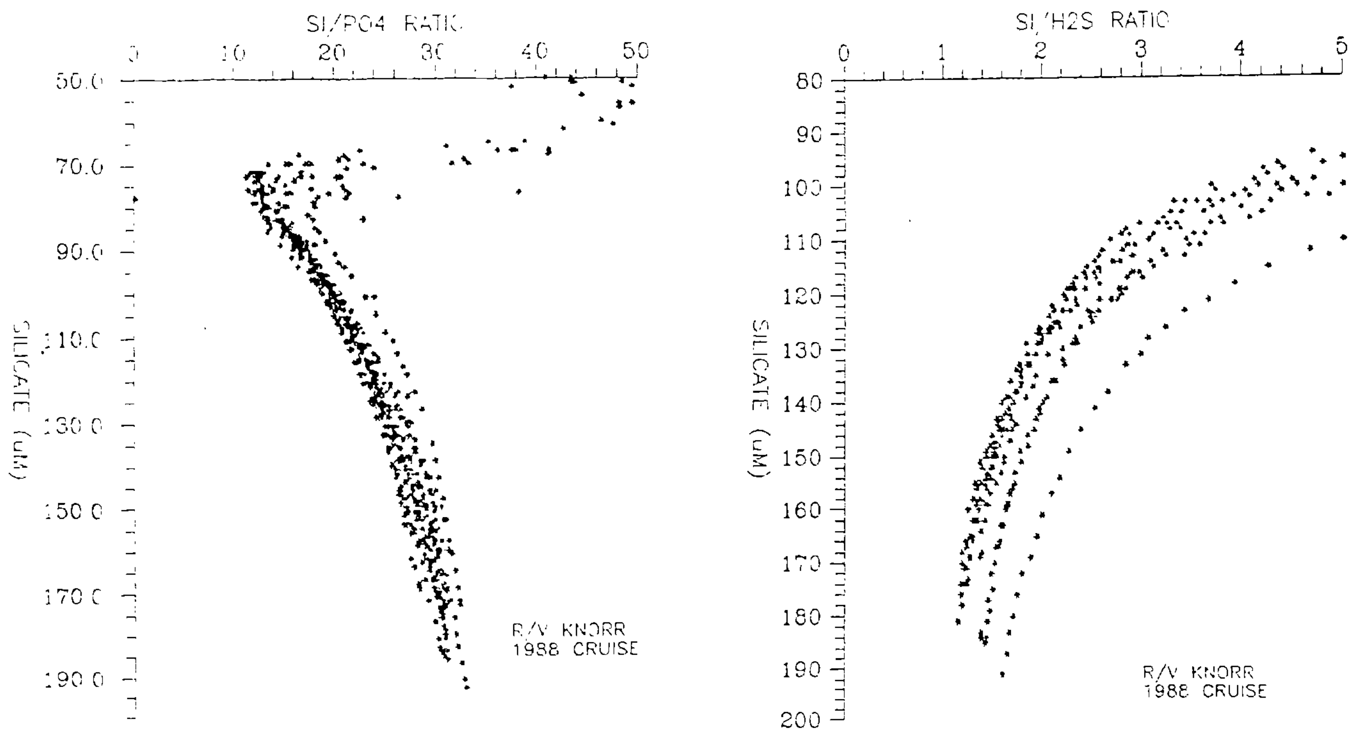


Figure 8: Composite plots of Si/PO_4 and Si/H_2S ratios versus silicate concentrations for Knorr (Cruise No.4, Sta.2)

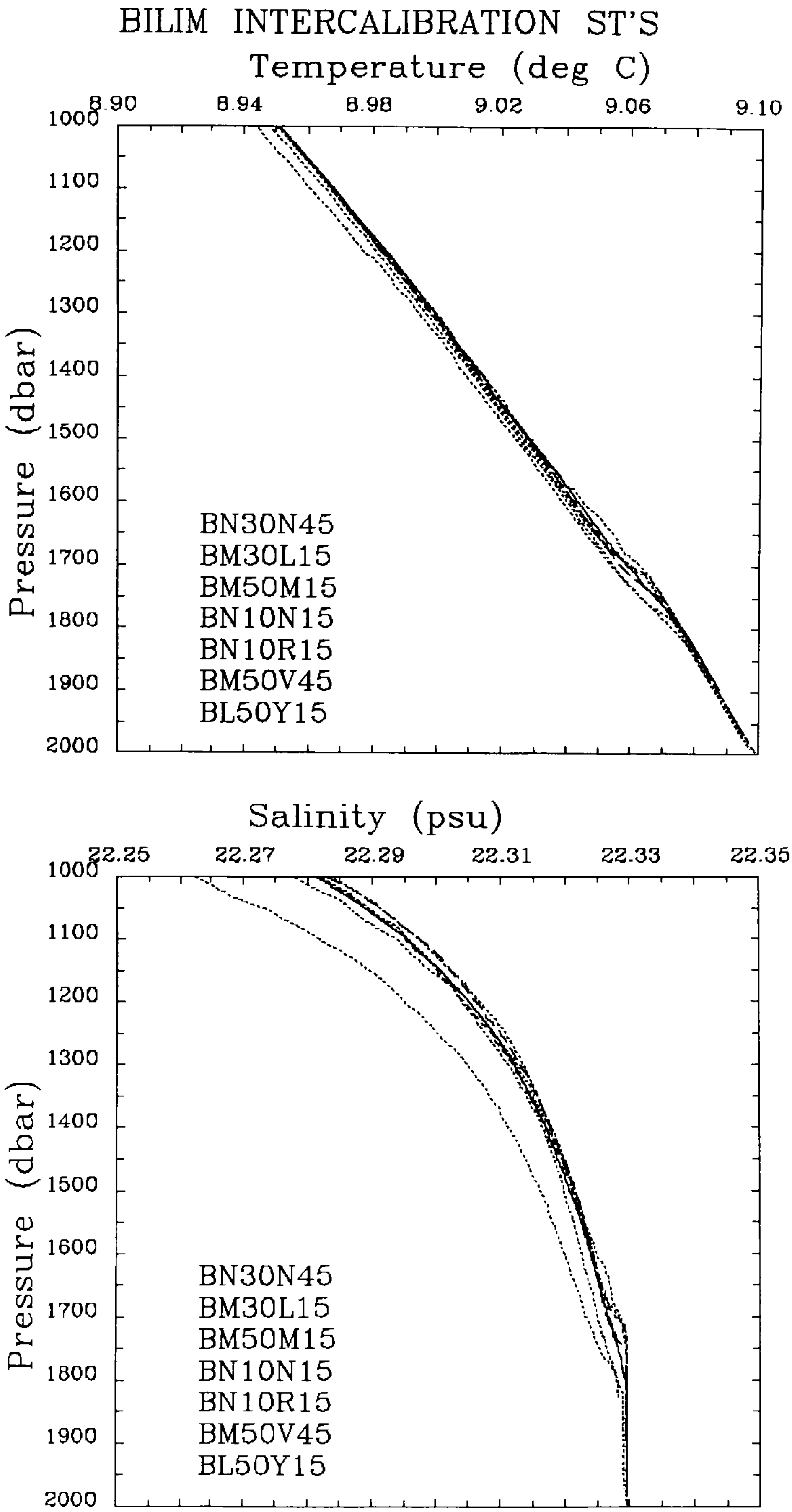


Figure 10a: Temperature and salinity profiles showing drift test for R/V Bilim measurements.

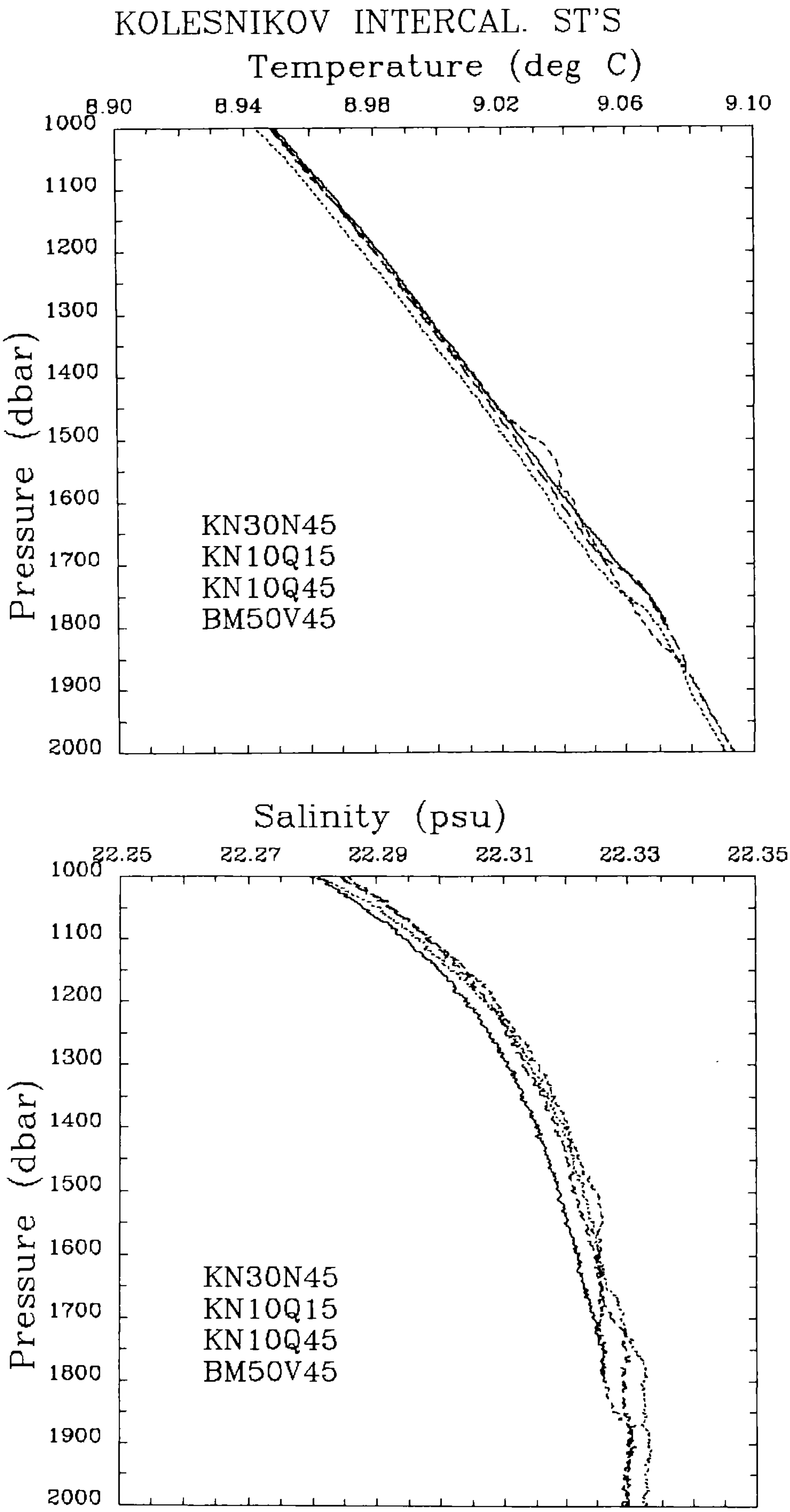


Figure 10b: Temperature and salinity profiles showing drift test for R/V Kolesnikov measurements.

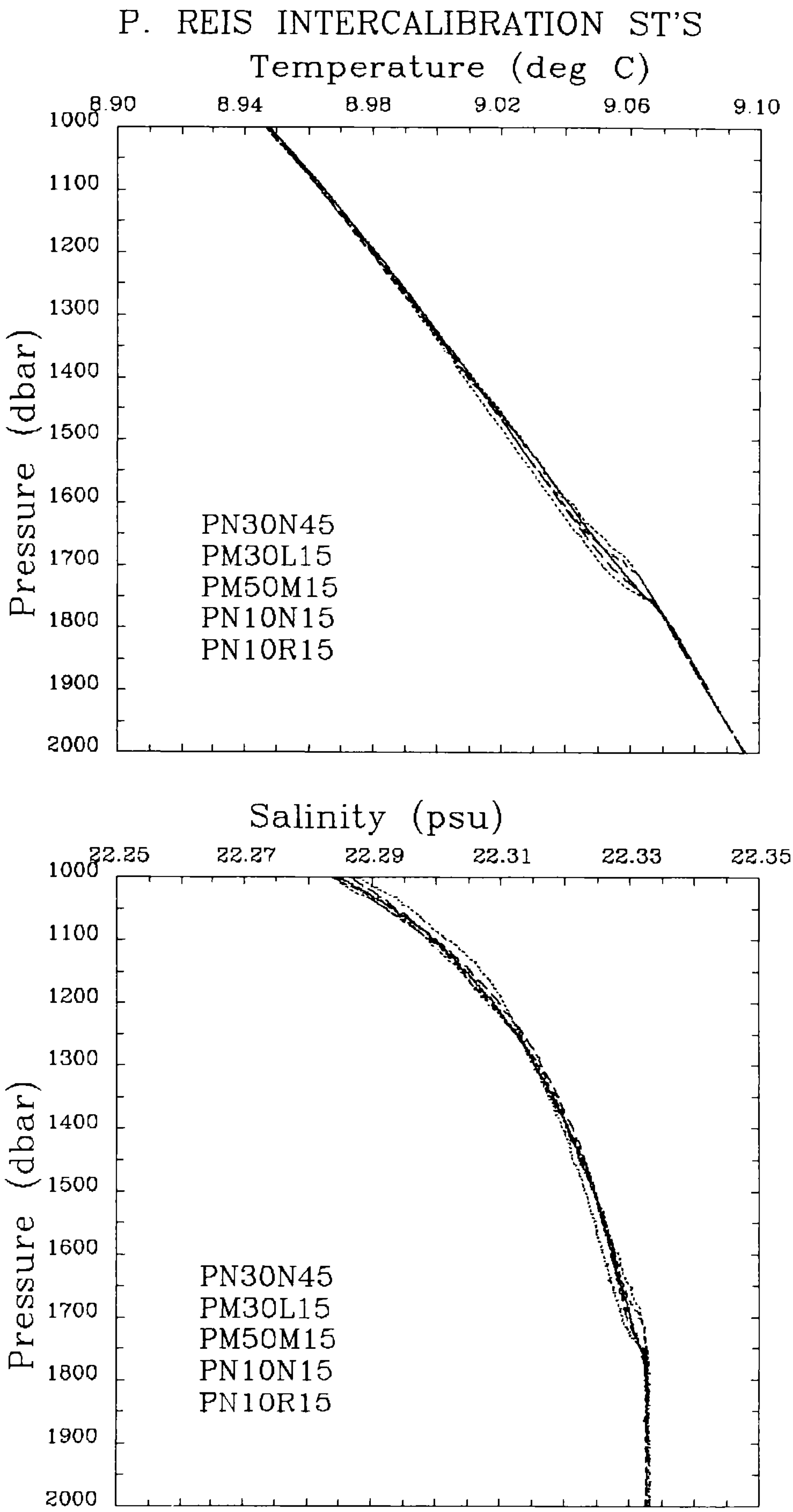


Figure 10c: Temperature and salinity profiles showing drift tests for R/V Piri Reis measurements.

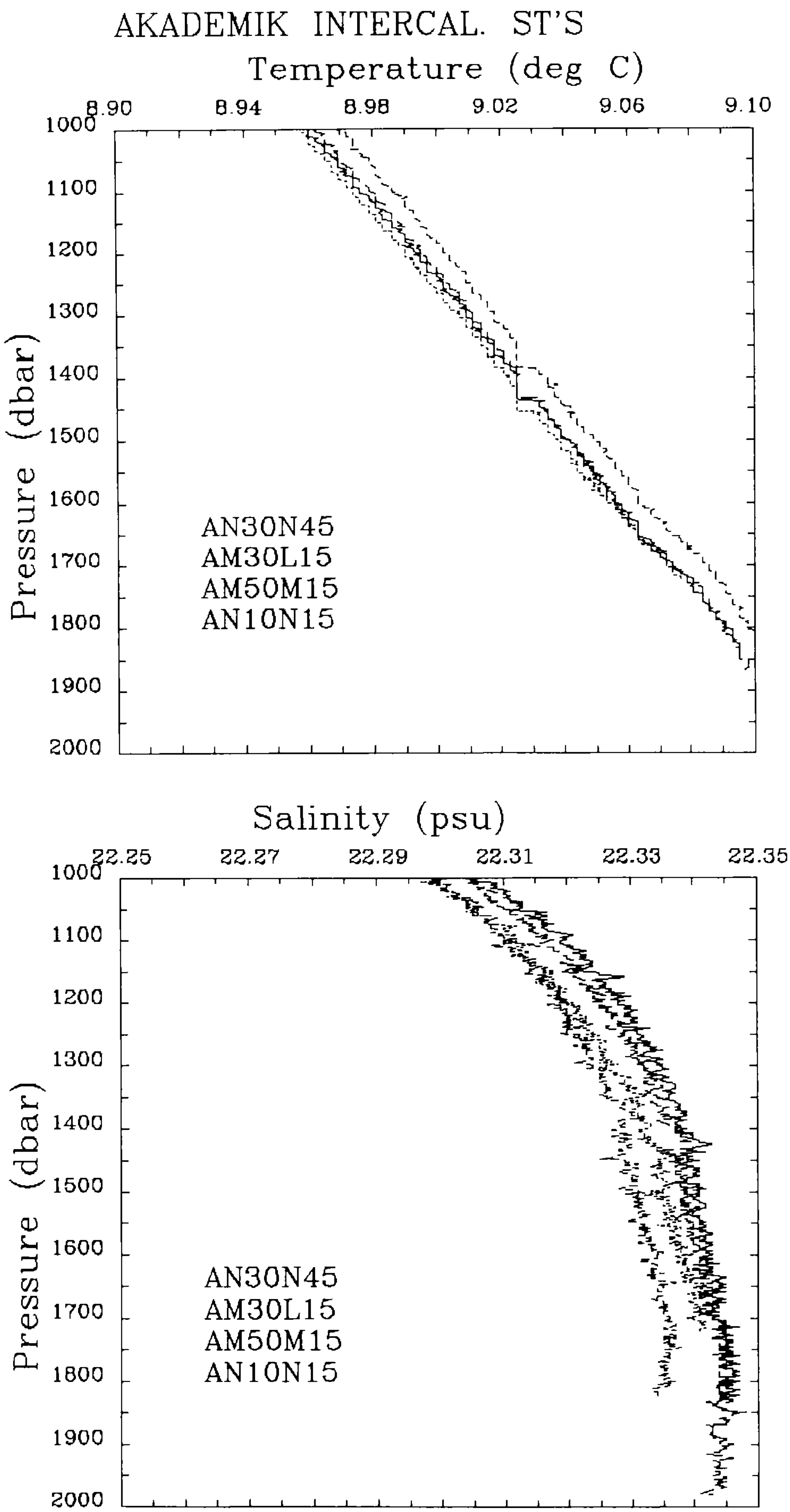


Figure 10d: Temperature,salinity and conductivity profiles showing drift tests for R/V Akademik measurements.

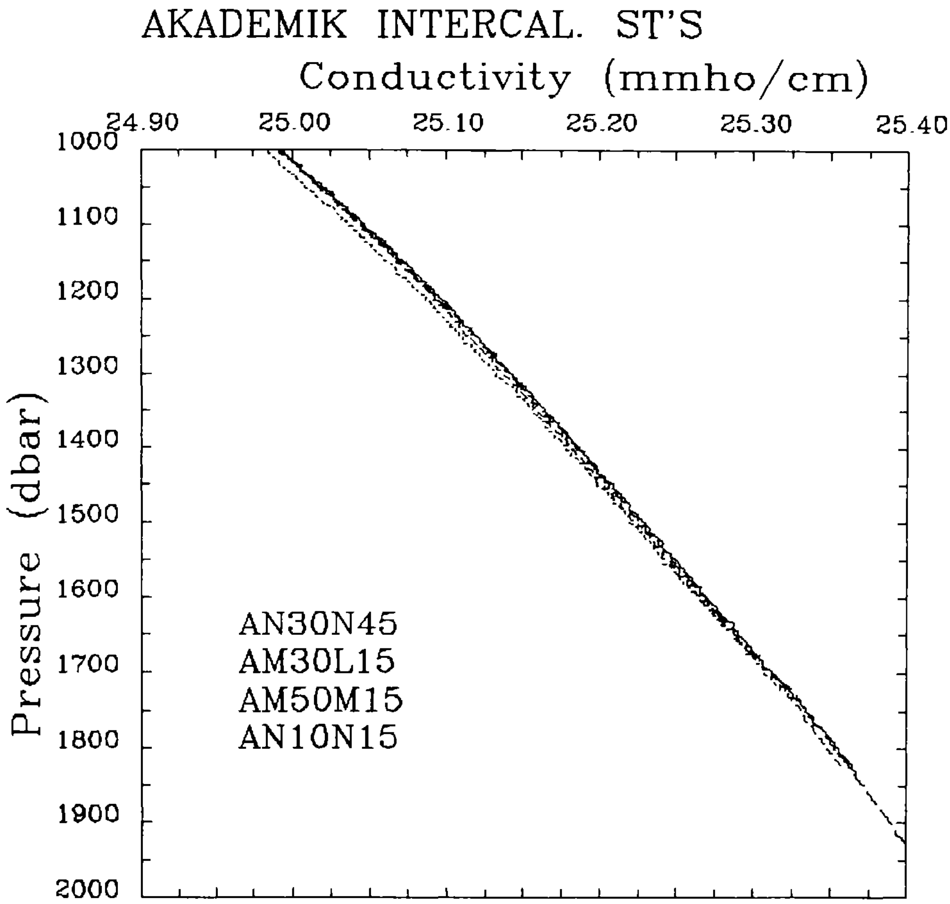


Figure 10d: Continued.

Water samples were obtained at intercalibration stations for intercalibration of the salinity values obtained from the CTD casts. The titration of the bottle samples was carried out on board the R/V *Kolesnikov* during the cruise and later at WHOI. The titration results made on board *Kolesnikov* were found to be consistent with the CTD values (Table 5). The results of the analyses made at WHOI after several months following the survey, however, differed by 0.005 - 0.01 psu from the corresponding CTD values. They indicate the necessity of immediate titration during the cruise.

Table 5

Comparison of the ISTOK-7 and the Salinometer Data

Date	Station	Depth (db)	S ISTOK-VII	S Salinometer	Δ S
07-07-92	N30N45	3	18.254	18.257	+0.003
		400	21.958	21.959	+0.001
		700	22.201	22.200	-0.001
		1000	22.294	22.291	-0.003
		1250	22.318	22.316	-0.002
		1500	22.327	22.325	-0.002
07-13-92	N10Q45	1000	22.291	22.290	-0.001
		1250	22.317	22.316	-0.001
		1500	22.328	22.326	-0.002
		1750	22.334	22.335	+0.001
		2000	22.334	22.335	+0.001
	N10Q15	1000	22.291	22.291	+0.000
		1250	22.316	22.316	+0.000
		1500	22.329	22.328	-0.001
		1750	22.334	22.330	-0.004
		2000	22.334	22.334	+0.000
07-28-92	M50V45	5	22.349	22.348	-0.001
		500	22.058	22.060	+0.002
		1000	22.286	22.286	+0.000
		1500	22.327	22.324	-0.003
		1750	22.334	22.331	-0.003
		2000	22.332	22.332	+0.000

5.2 Intercalibration of Physical Data

The intercalibration was accomplished using the deep data (below 1000 dbar) from the intercalibration stations occupied within a reasonable interval of time by two, three or four ships.

5.2.1 Processing of Physical Data: At the common intercalibration station (N30N45), the vertical profiles of the temperature and salinity from all the four ships (Figure 11) showed a good agreement for the first parameter (except of the *Akademik* data, which were higher), and a fairly good one for the second (again, the data from *Akademik* being higher and noisier). Comparison of *Bilim* and *Akademik* temperature and salinity profiles at three additional intercalibration stations are given in Figure 12.

Temperature and conductivity recorded by *Akademik* at the intercalibration stations were first smoothed using a centered three-point running mean filter, applied three times (Figure 13). It was not considered appropriate to use more sophisticated filters, because the final goal was to reduce the noise in the differences with respect to other data sets. Contrary to the HydroBlack '91

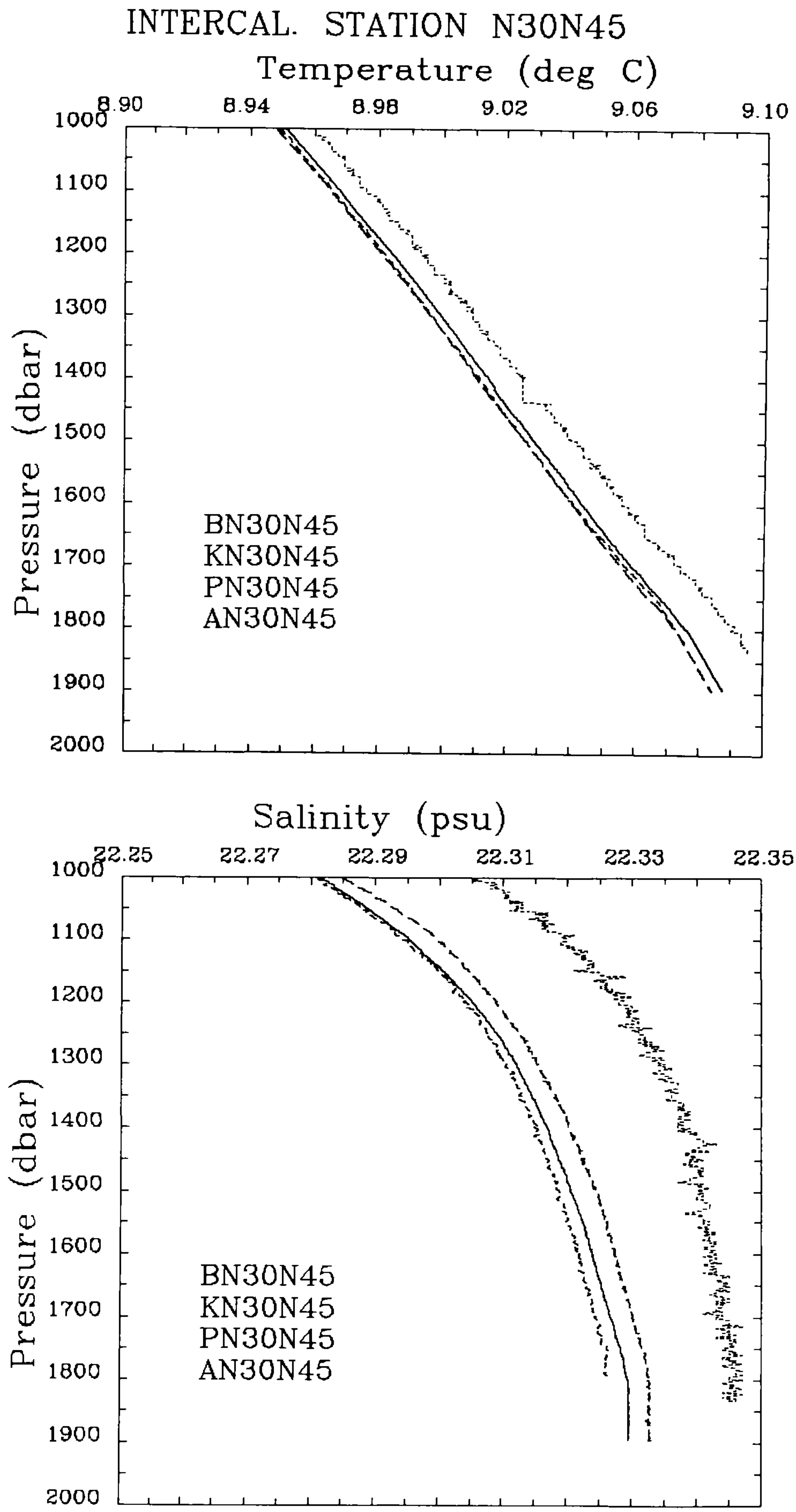


Figure 11: Comparision of non-intercalibrated temperature and salinity profiles measured by Bilim, Kolesnikov, Piri Reis and Akademik at the common station N30N45.

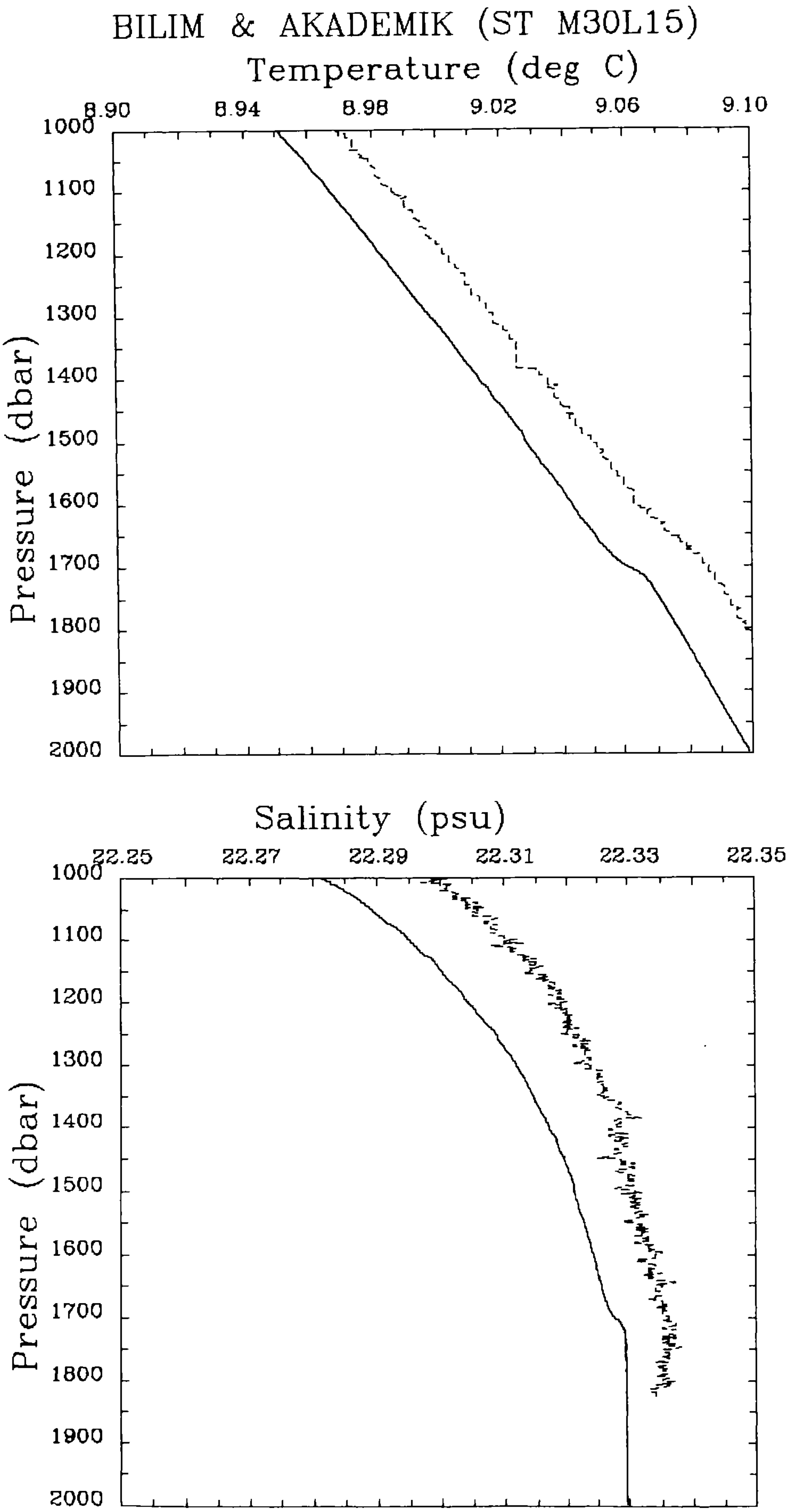


Figure 12a: Comparision of non-intercalibrated temperature and salinity profiles measured by Bilim and Akademik at station M30L15.

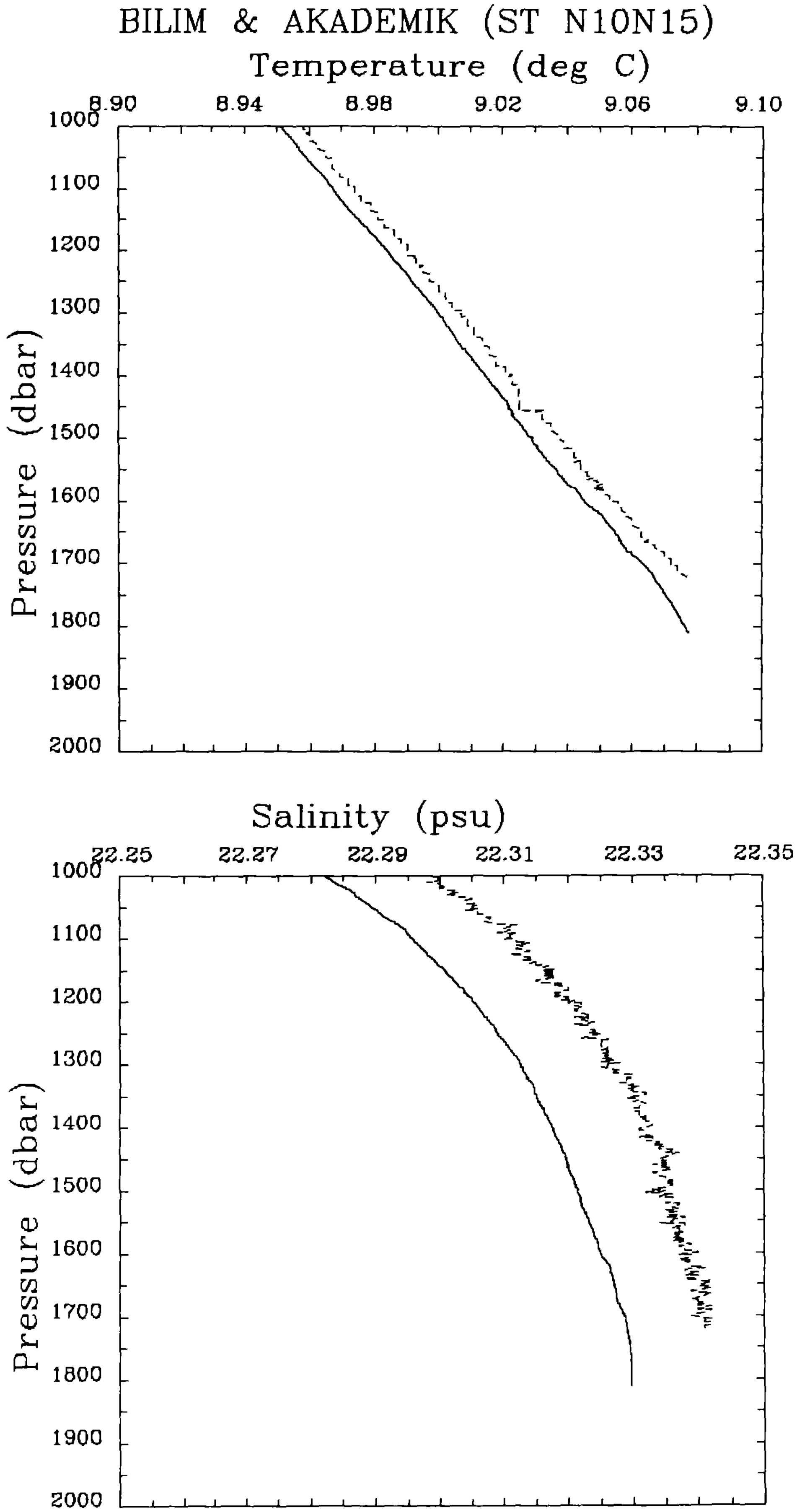


Figure 12b: Comparision of non-intercalibrated temperature and salinity profiles measured by Bilim and Akademik at station N10N15.

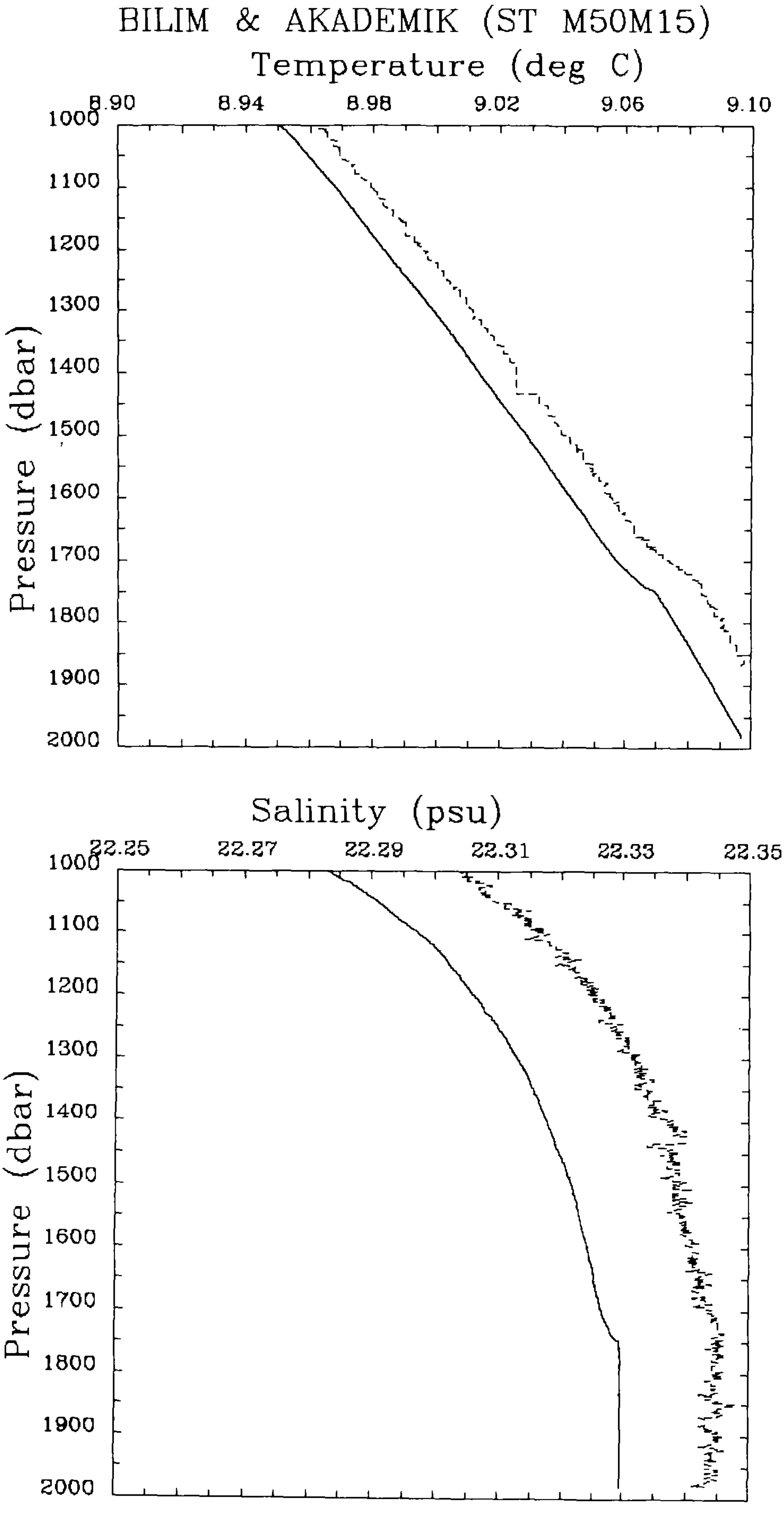


Figure 12c: Comparision of non-intercalibrated temperature and salinity profiles measured by Bilim and Akademik at station M50M15.

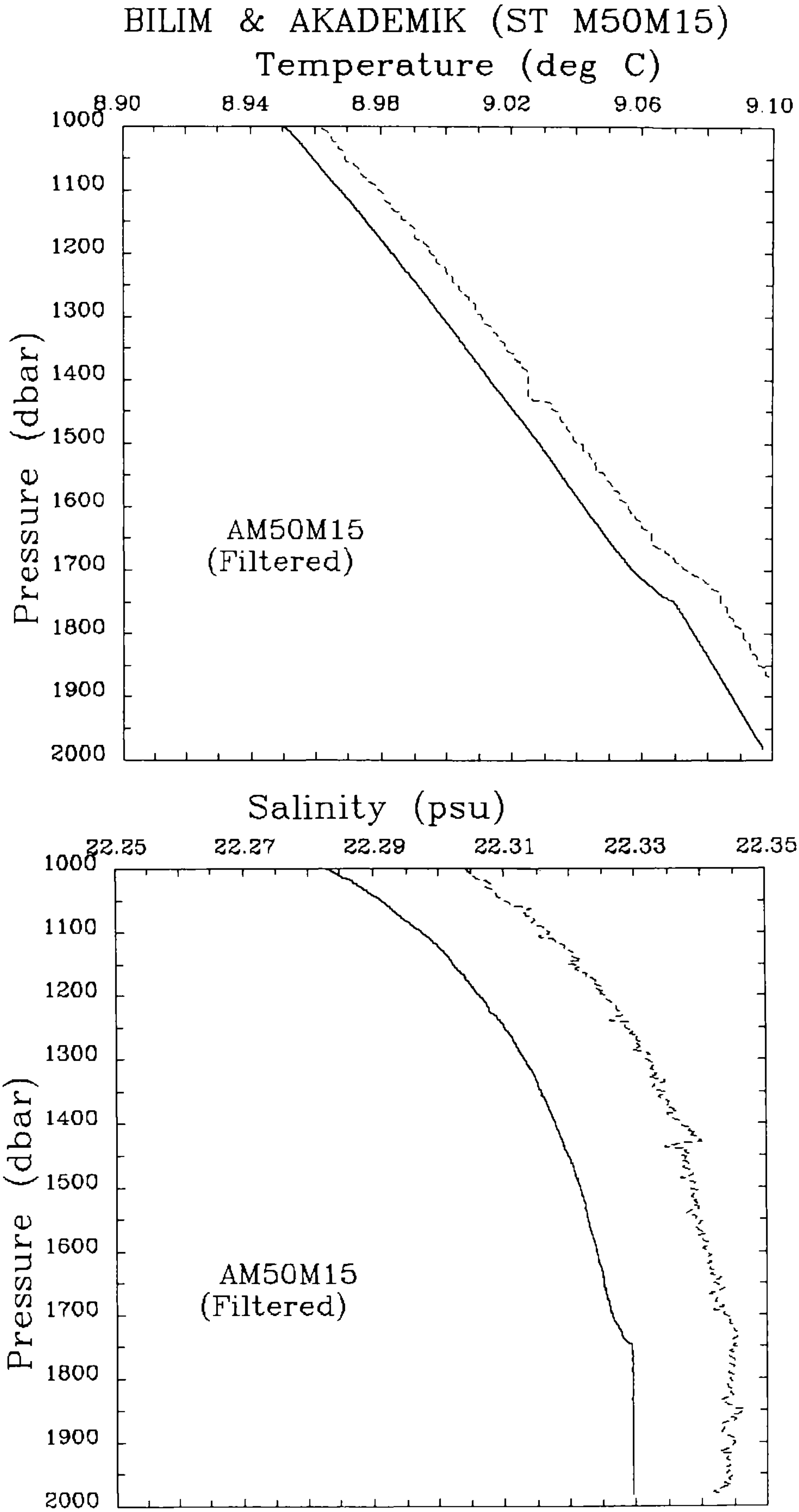


Figure 13a: Comparision of non-intercalibrated temperature and salinity profiles measured by Bilim and Akademik at station M50M15, after three point running-mean filter is applied three times to the Akademik data (compare this figure with Figure 12c).

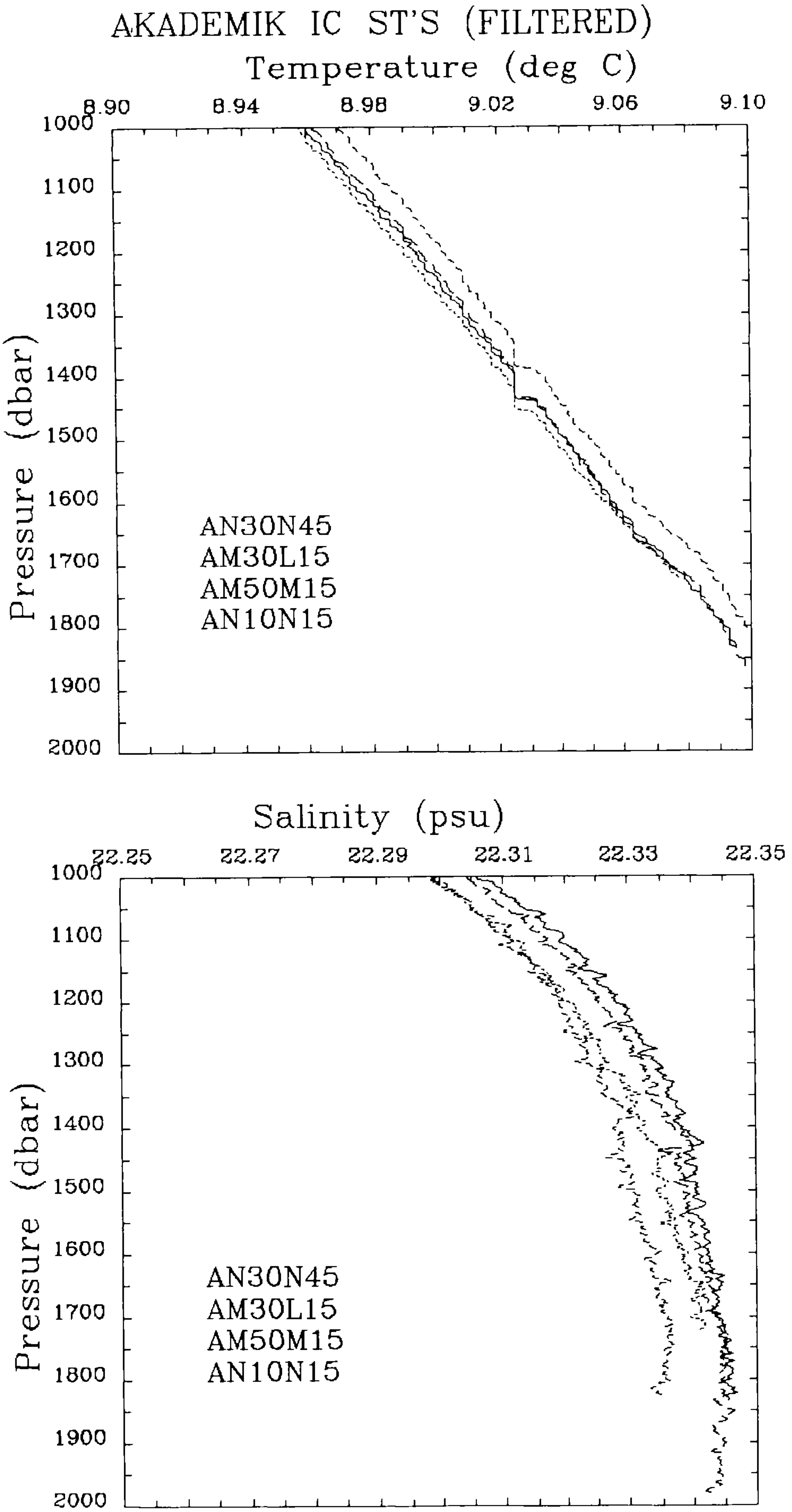


Figure 13b: Non-intercalibrated temperature, salinity and conductivity profiles measured by Akademik at stations N30N45, M30L15, M50M15 and N10N15 after three point running-mean filter is applied three times.

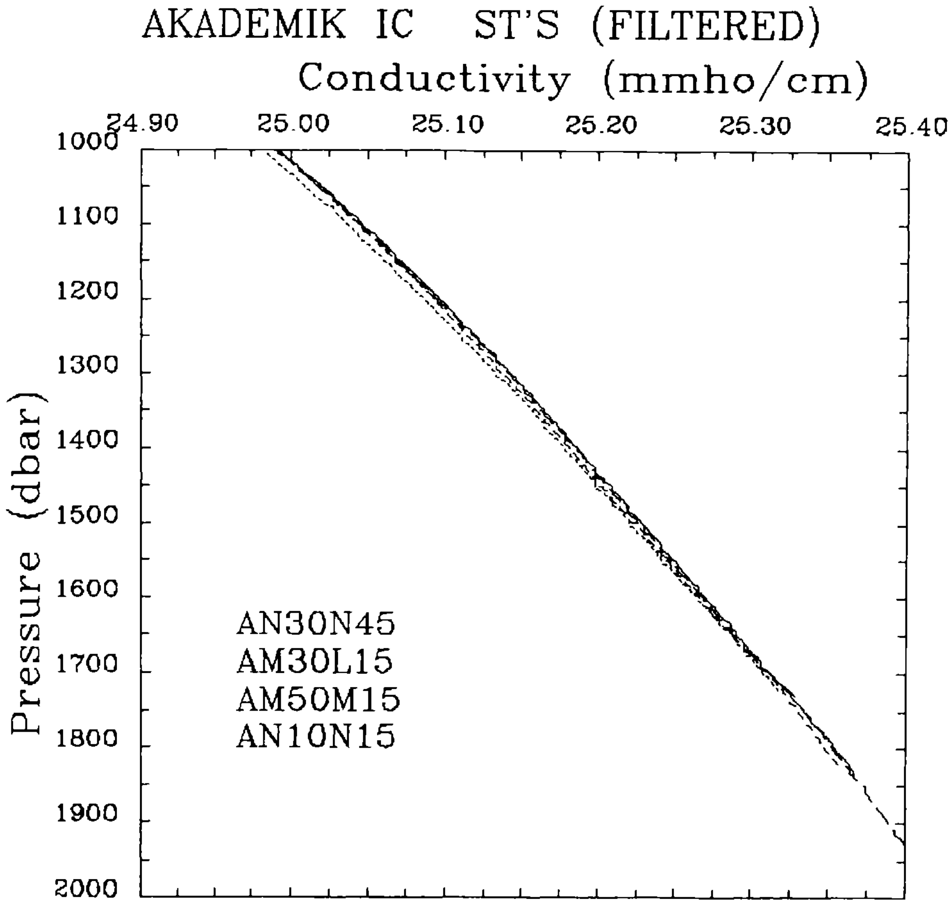


Figure 13b: Continued.

data set, the present observations were made within the upper 500 dbar layer, except few deep intercalibration stations. That is why the 'step' in the temperature response of the ISTOK V sensor (*Akademik*), which was removed in the HydroBlack '91 data and replaced by linearly interpolated values, was left unchanged in the CoMSBlack '92a data set.

The second test was to compute the statistical parameters (mean and standard deviation) of the differences between *Bilim* data and other data using the temperature and salinity/conductivity at all levels below 1000 dbar (Table 6). In order to get more information, four pairs of adjacent stations made by *Bilim* and *Akademik* have been included in the computations.

The results (Table 6, Figure 15) show that the *Akademik* temperature data are approximately 0.013°C higher than that of the *Bilim*, the mean differences ranging from −0.007 to −0.020°C. For *Kolesnikov* and *Piri Reis*, the temperature exceed those of *Bilim* by roughly 0.003°C, i.e., they are practically the same as the given precision.

For the *Bilim - Akademik* conductivity differences, the mean values at every station ranged from −0.017 to −0.033 mS/cm, with an average of −0.025 mS/cm. The differences between *Bilim* and *Kolesnikov* or *Piri Reis* data did not exceed an absolute value of 0.0036 mS/cm.

Table 6

Temperature and (Conductivity/Salinity) Ratio Differences (below 1000 dbar)

Station	*Bilim-Akademik* ΔT & (ΔC)	*Bilim-Piri Reis* ΔT & (ΔS)	*Bilim-Kolesnikov* ΔT & (ΔS)
N30N45	-0.011 (0.0029) -0.026 (0.0038)	+0.0031 (0.00032) -0.0036 (0.00038)	+0.0024 (0.0005) +0.0016 (0.0007)
M30L15	-0.020 (0.0035) -0.022 (0.0036)	+0.0034 (0.00051) -0.0035 (0.00047)	
M50M15	-0.013 (0.0030) -0.024 (0.0034)	+0.0037 (0.00031) -0.0031 (0.00033)	
N10N15	-0.007 (0.0018) -0.017 (0.0023)	+0.0036 (0.00077) -0.0031 (0.00042)	
N10Q45		+0.0036 (0.0019) -0.0027 (0.00127)	+0.0031 (0.0009) -0.0002 (0.0005)
M50V45			+0.0048 (0.0009) -0.0030 (0.0006)
N30N15	-0.018 (0.0024) -0.025 (0.0028)		
M30K45	-0.013 (0.0021) -0.033 (0.0036)		
M30L45	-0.007 (0.0016) -0.023 (0.0039)		
N50N15	-0.016 (0.0050) -0.031 (0.0056)		

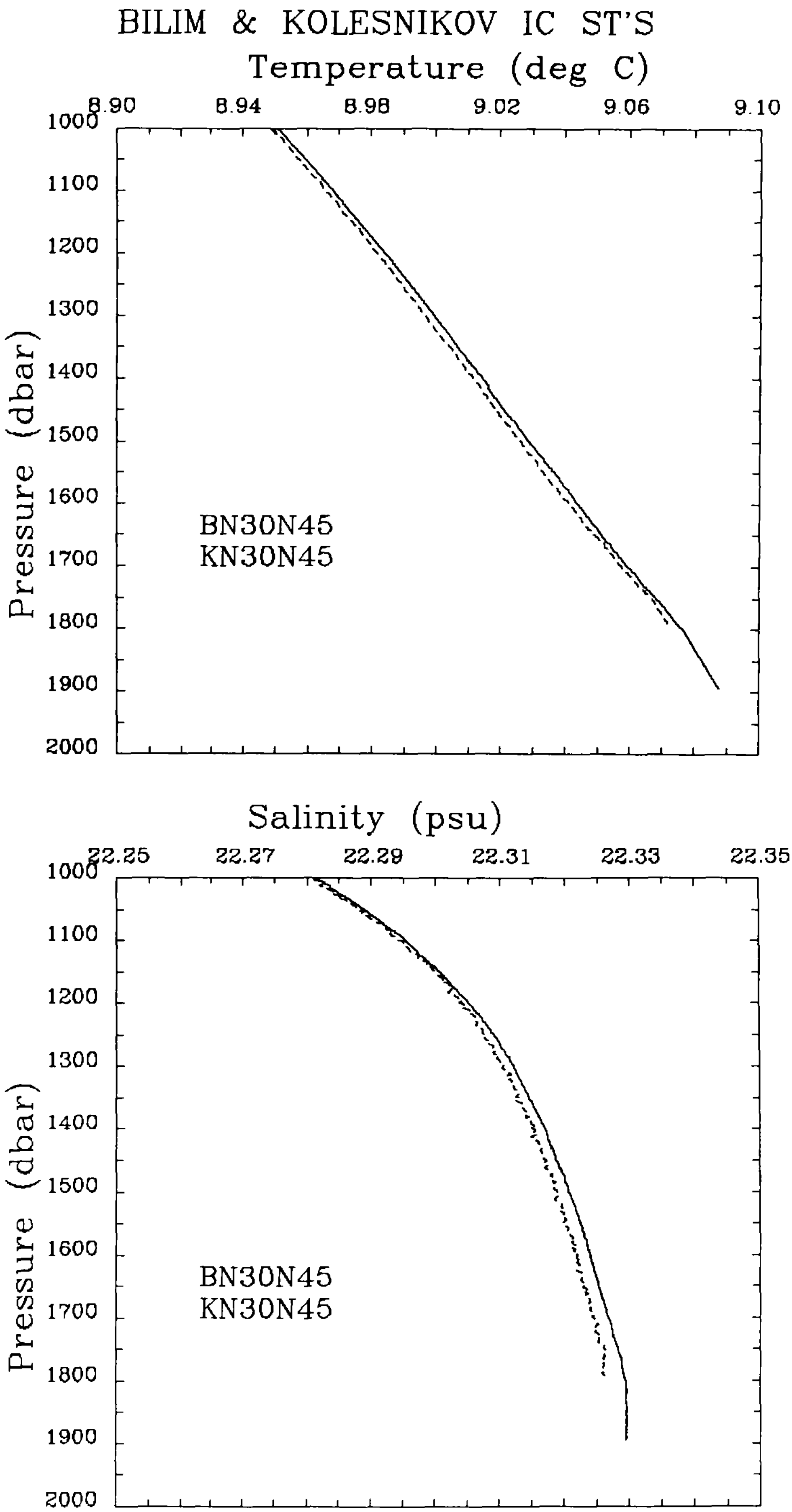
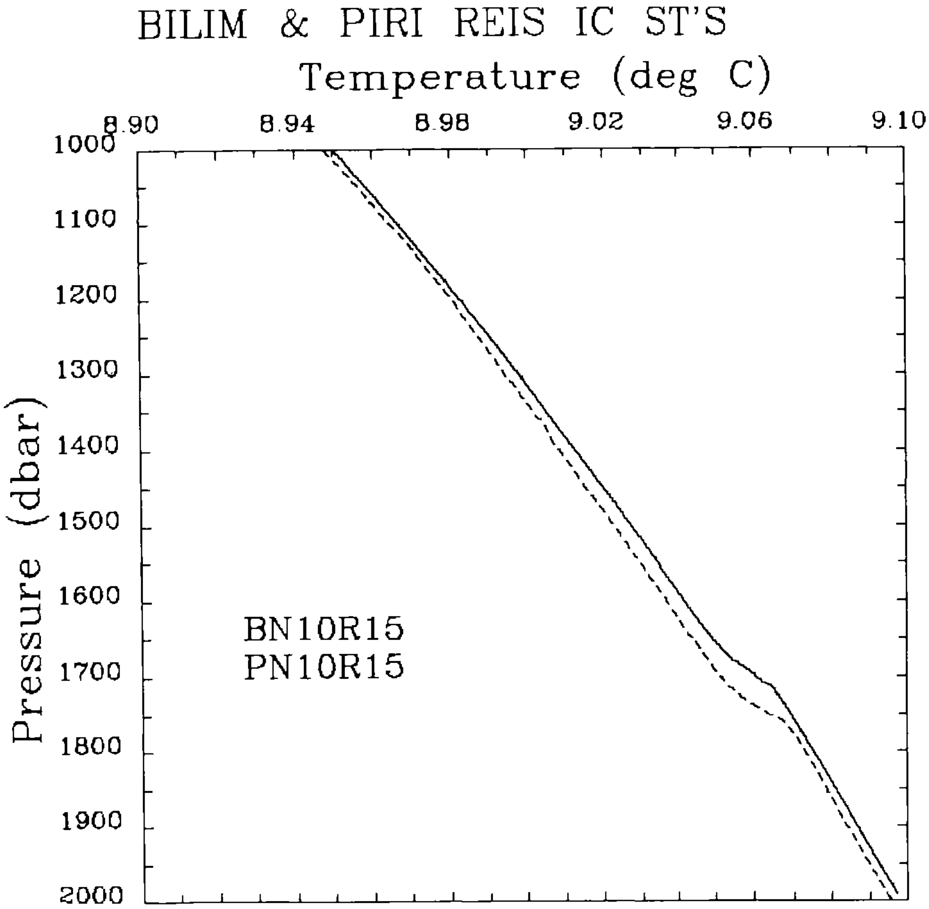


Figure 14 : Comparision of non-intercalibrated temperature and salinity profiles measured by Bilim and Kolesnikov at stations N30N45, N10Q45 and M50V45.



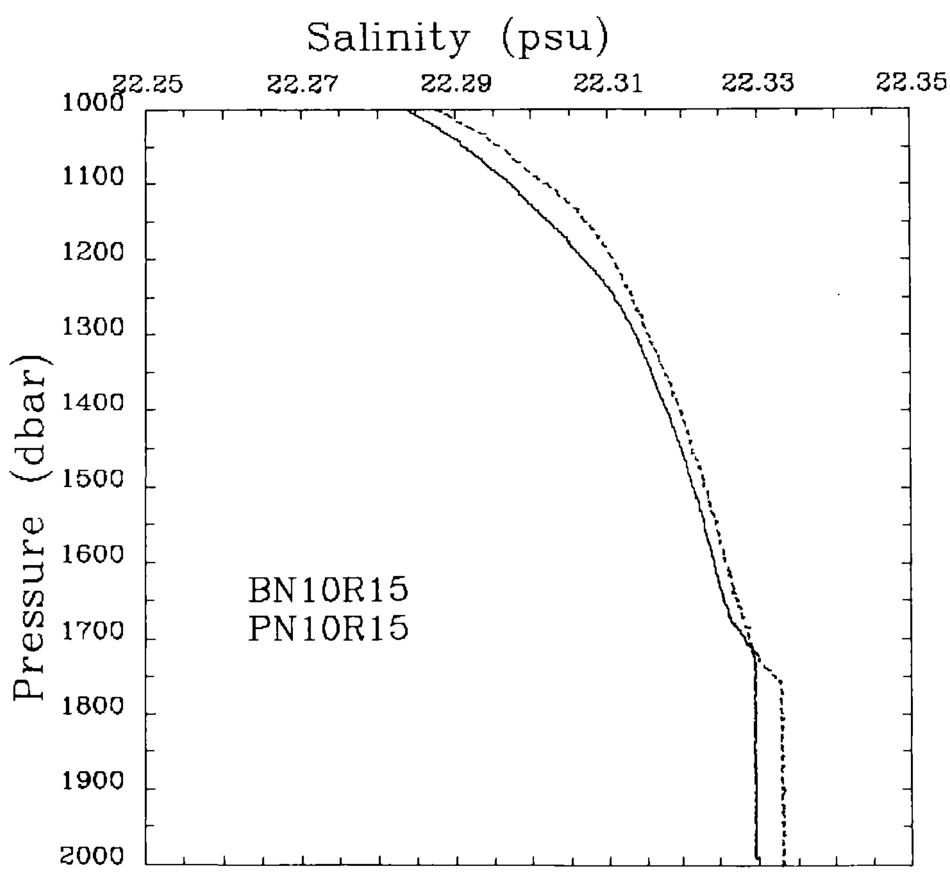


Figure 14 : continued

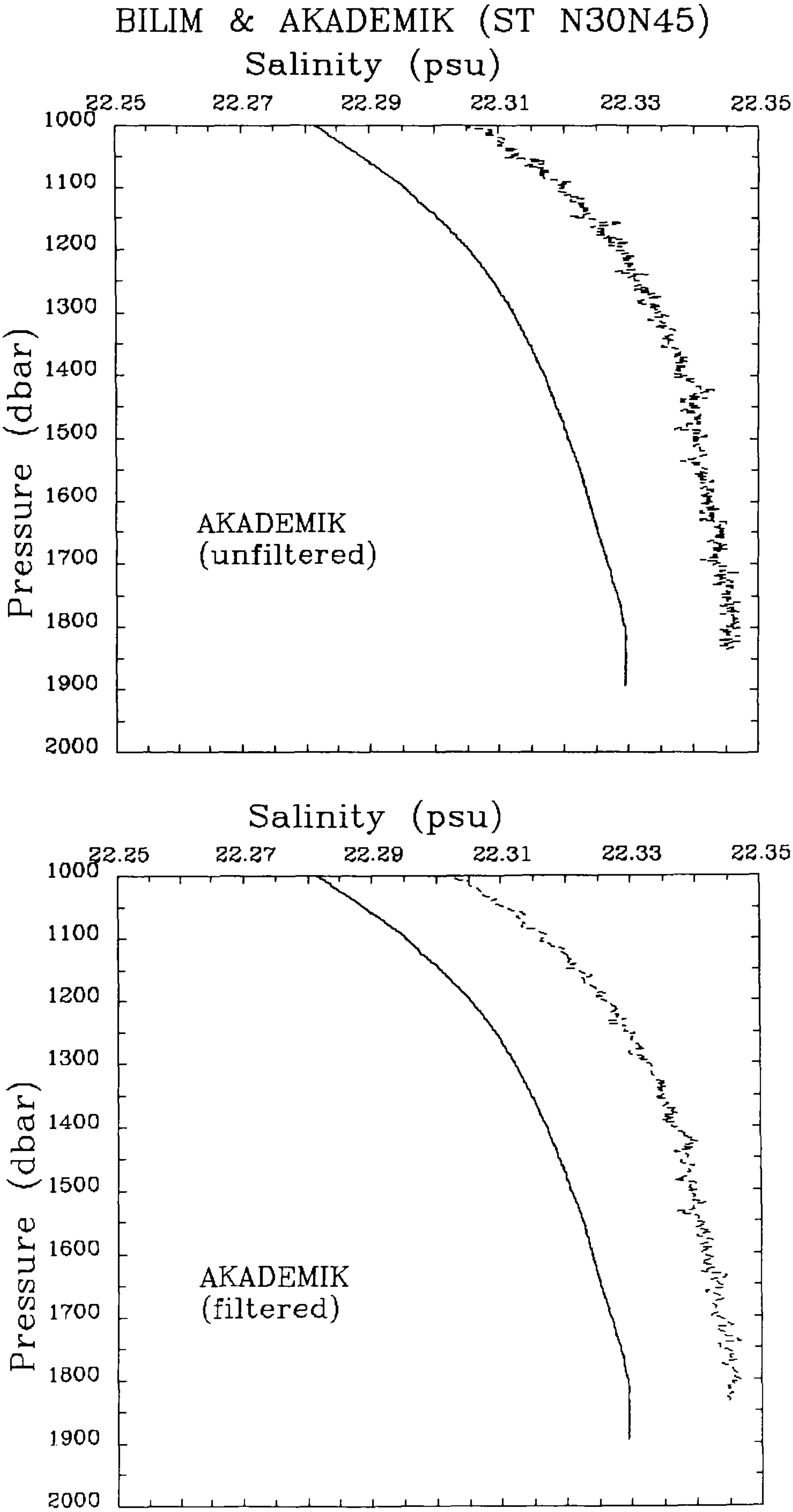


Figure 14 : continued

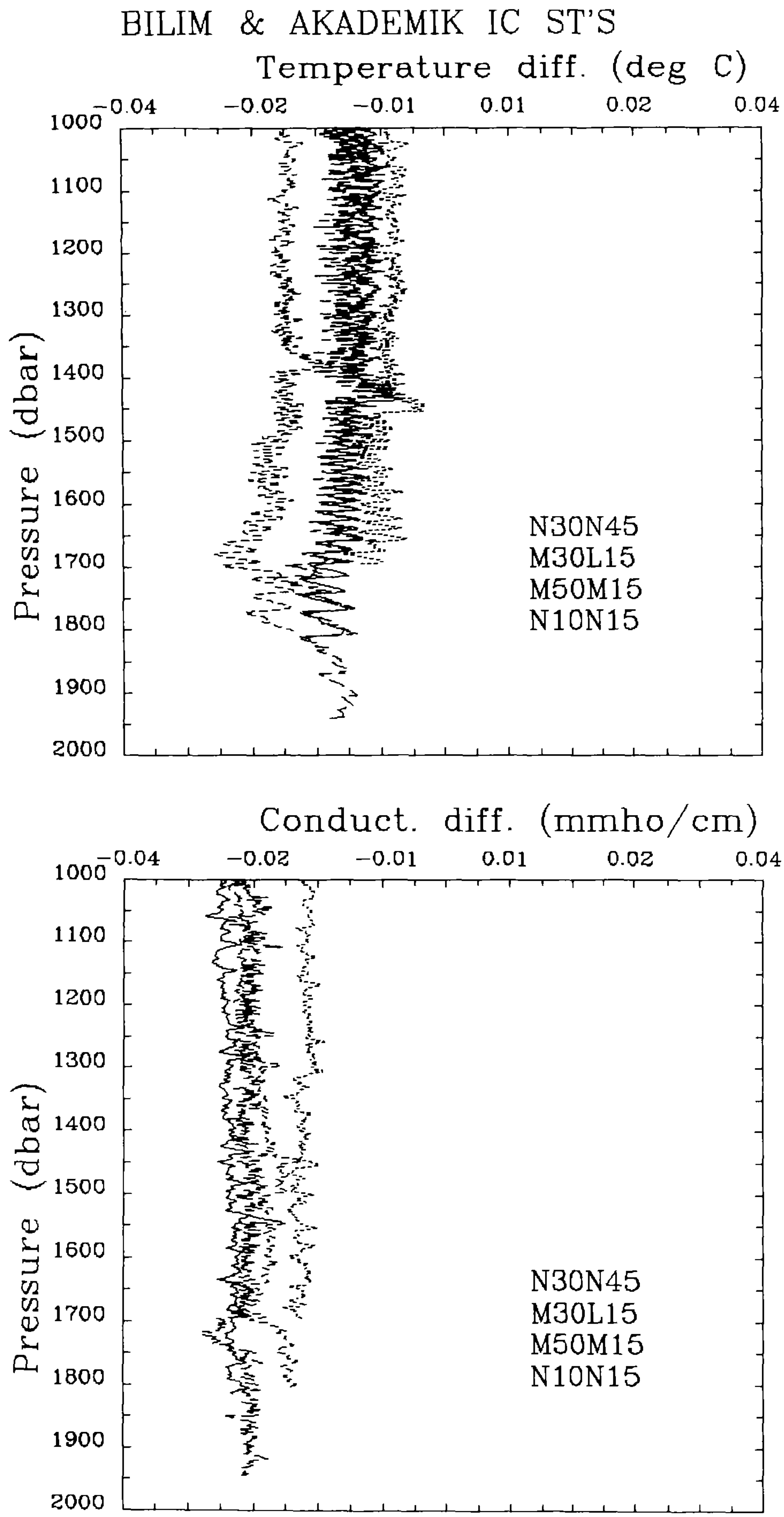


Figure 15a: Profiles of the temperature and conductivity differences of the non-calibrated data between Bilim and Akademik at four intercalibration stations.

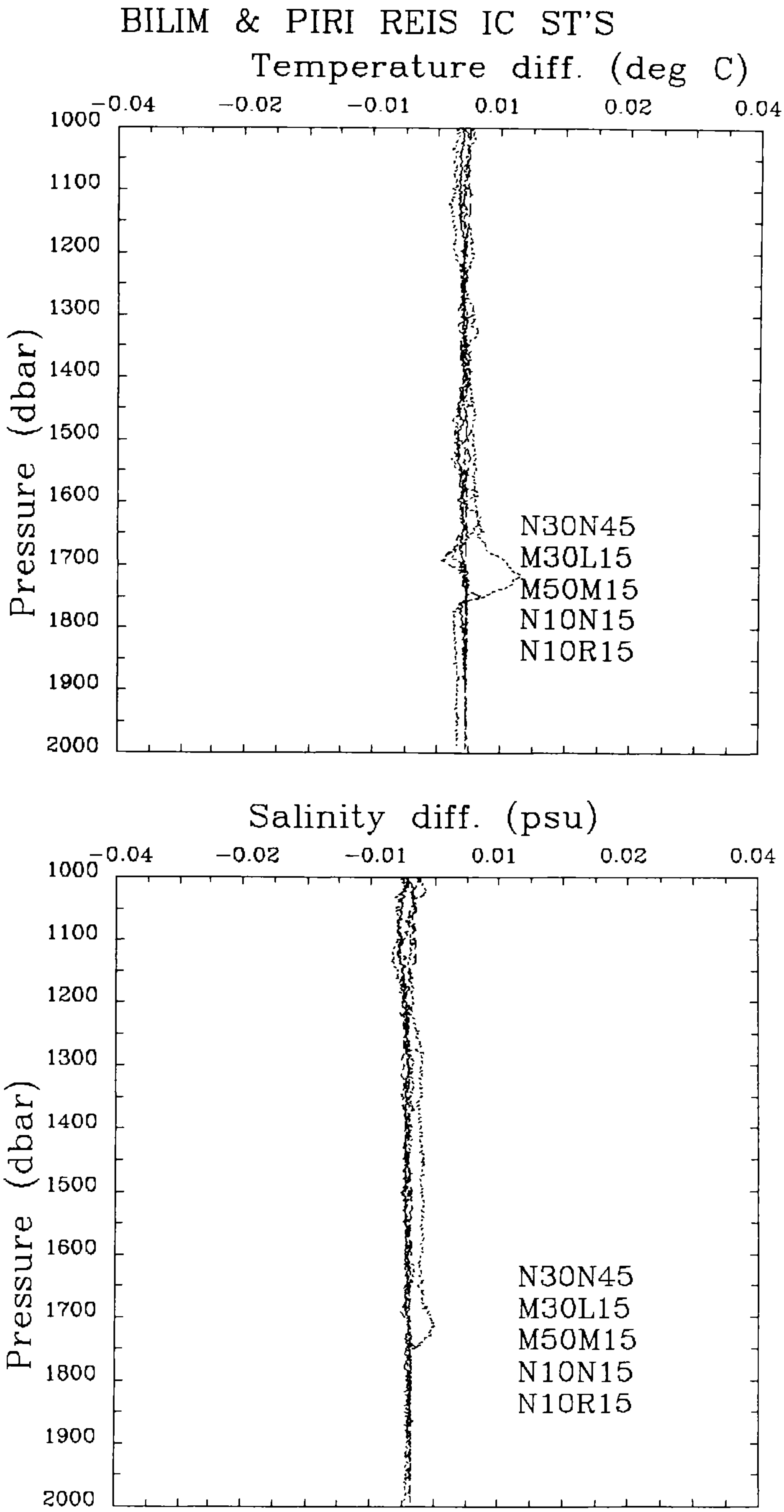


Figure 15b: Profiles of the temperature and salinity differences of the non-calibrated data between Bilim and Piri Reis at five intercalibration stations.

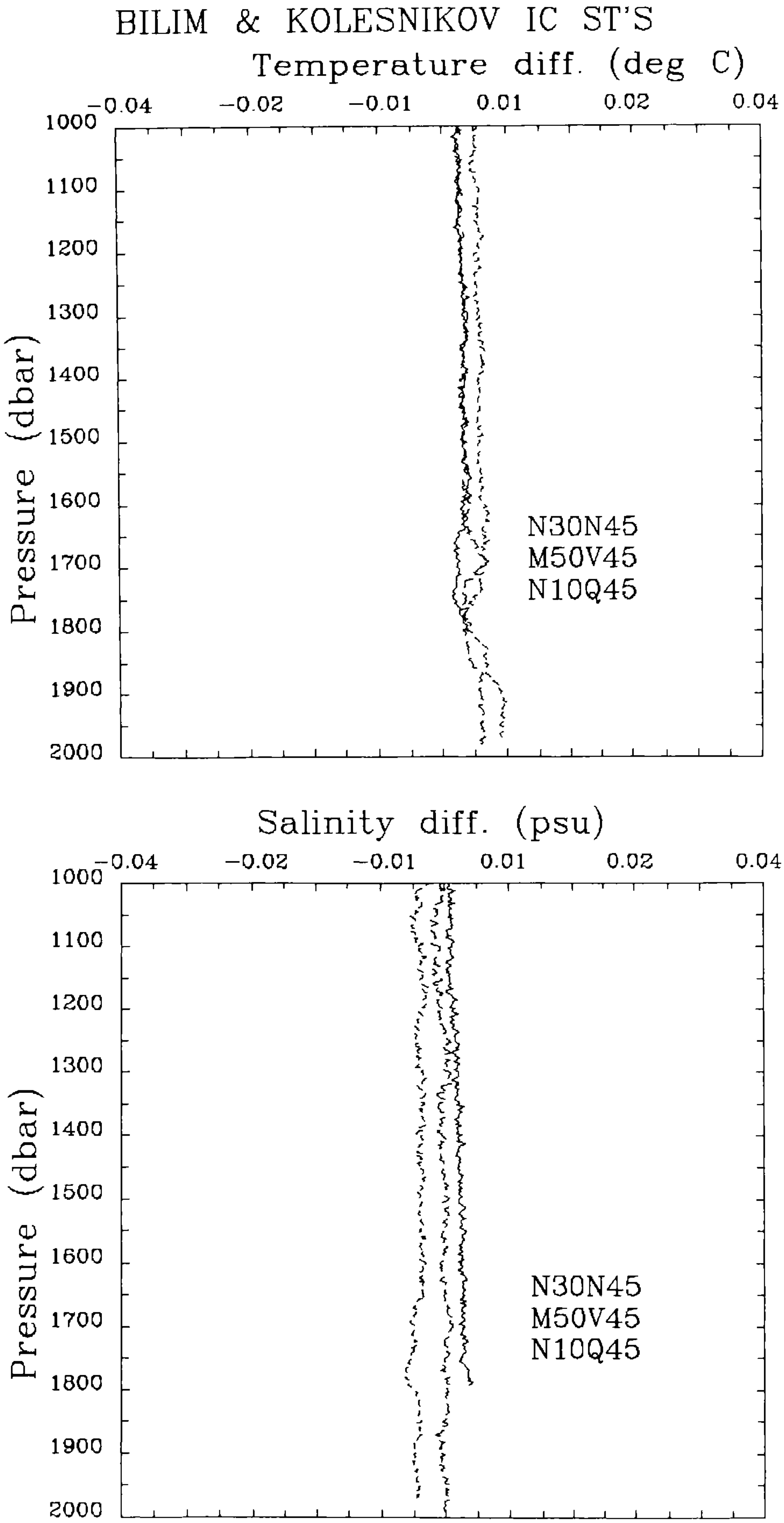


Figure 15c: Profiles of the temperature and salinity differences of the non-calibrated data between Bilim and Kolesnikov at three intercalibration stations.

5.2.2 Correction of Physical Data: After the comparison made using the data from the intercalibration stations, the agreed correction procedures were applied to all the data sets.

Temperature: Since the *Kolesnikov* and *Piri Reis* temperatures were practically identical, they were taken as a reference and left unchanged. The *Bilim* temperatures were reduced by 0.003°C (the mean difference relative to the previous two) for all the stations. An average value of 0.013°C was subtracted from all the *Akademik* temperature values, with no possible method to remove the erratic drift of the sensor.

Conductivity: Due to the good quality of the data, only the *Akademik* conductivity have been changed, by subtracting the value of the mean difference found in the intercalibration stations (0.025 mS/cm).

Salinity: After applying the corrections to temperature and/or conductivity data, the salinity were recomputed with the standard algorithm (UNESCO, 1983). All salinity are referenced to the Practical Salinity Scale.

The final profiles of temperature, conductivity and salinity for the *Akademik* data are shown in Figure 16. Figure 17 shows profiles for all the ships at the common intercalibration station N30N45. For comparison, the analogous profiles for HydroBlack '91 are given in Figure 18.

5.2.3 Final Physical Data Sets: According to the CoMSBlack '92A Cruise Plan, for each station and using the one dbar averaged values of pressure, temperature and salinity, the potential temperature and the corresponding potential density (sigma-theta) have been computed and included in the final data files. At the same time, header files containing information about the position, time, depth and Secchi disk depth have been compiled for all ships.

After the completion of the intercalibration exercise, attention was also paid to the salinity spikes observed within the seasonal thermocline. At some stations, 'positive' as well as 'negative' salinity spikes have been recorded leading sometimes to unrealistic density 'instability'. After discussions it was decided to leave the data unchanged, but the user should be aware of this thermocline artifact.

5.3 Analysis of Intercalibrated Physical Data

Using the intercalibrated and pooled data set, various plots were prepared to illustrate circulation and water mass characteristics of the Black Sea. Vertical sections of temperature, salinity and density were made along selected transects across the Black Sea (Figures 19-24). Horizontal distributions of temperature, salinity and density were plotted at pressure levels of 5, 50, 100, 200, 300 dbar (Figures 25-29). Calculations of dynamic topography, relative to 500 dbar level, were performed using standard analysis techniques. The dynamic topography maps at the same pressure levels are shown in Figures 30-34.

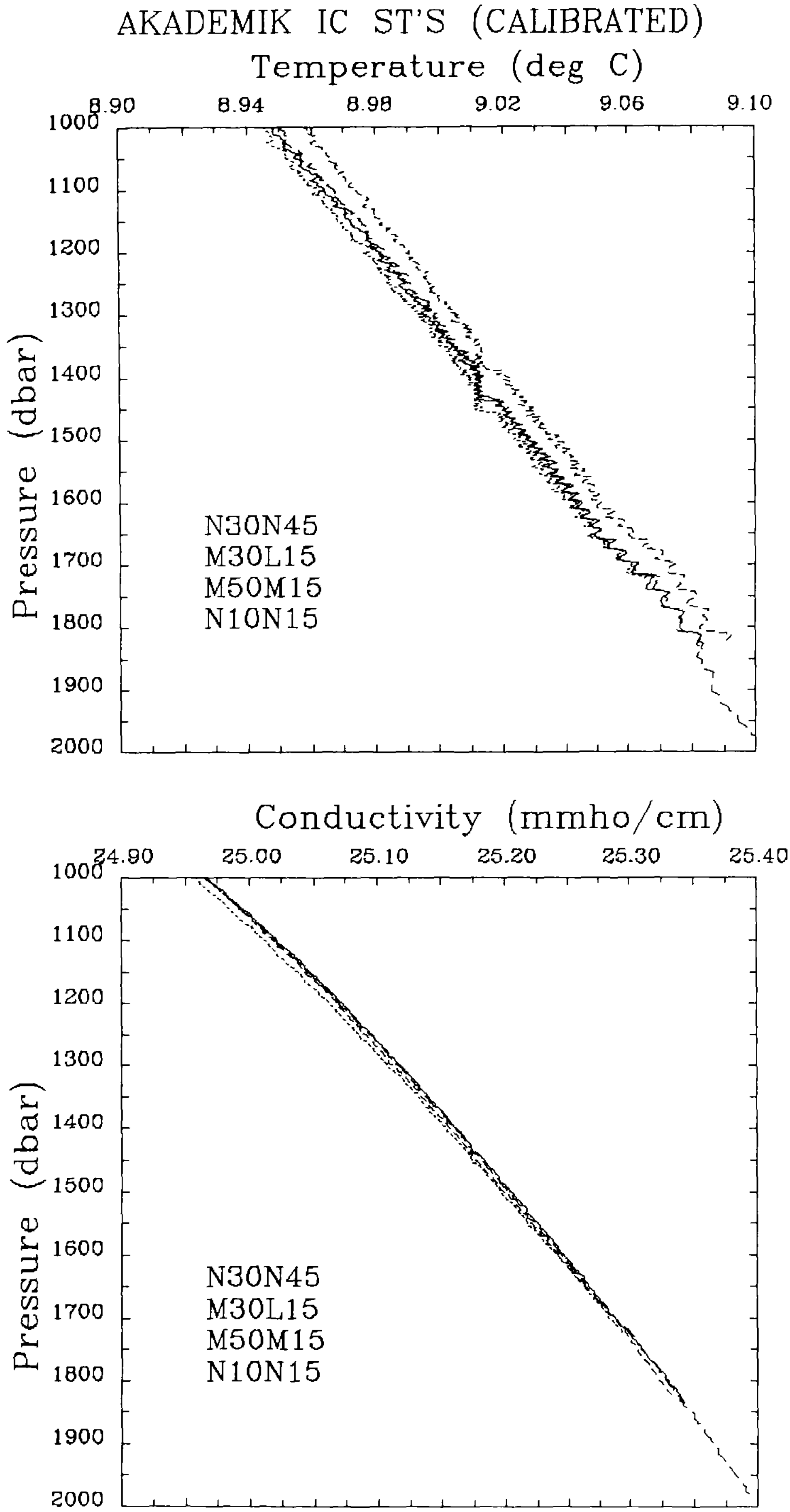


Figure 16: The temperature, conductivity and salinity profiles of Akademik at stations N30N45, M30L15, M50M15 and N10N15 after filtering and intercalibration are applied.

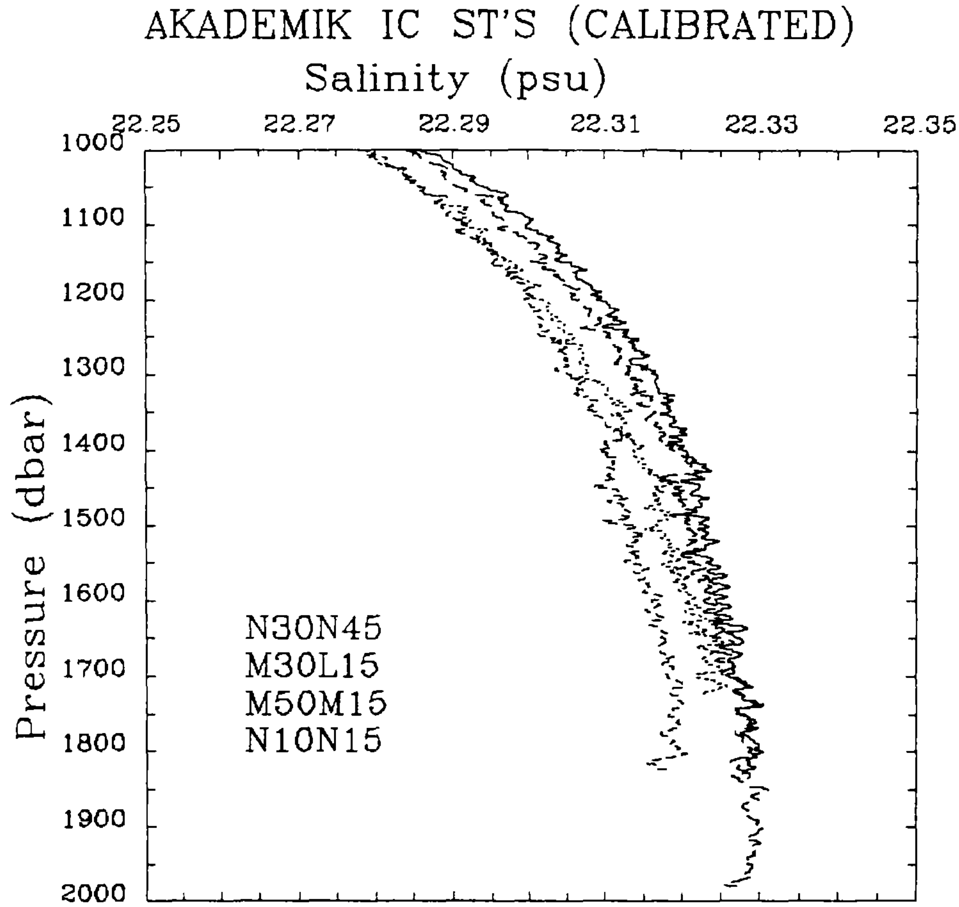


Figure 16: Continued.

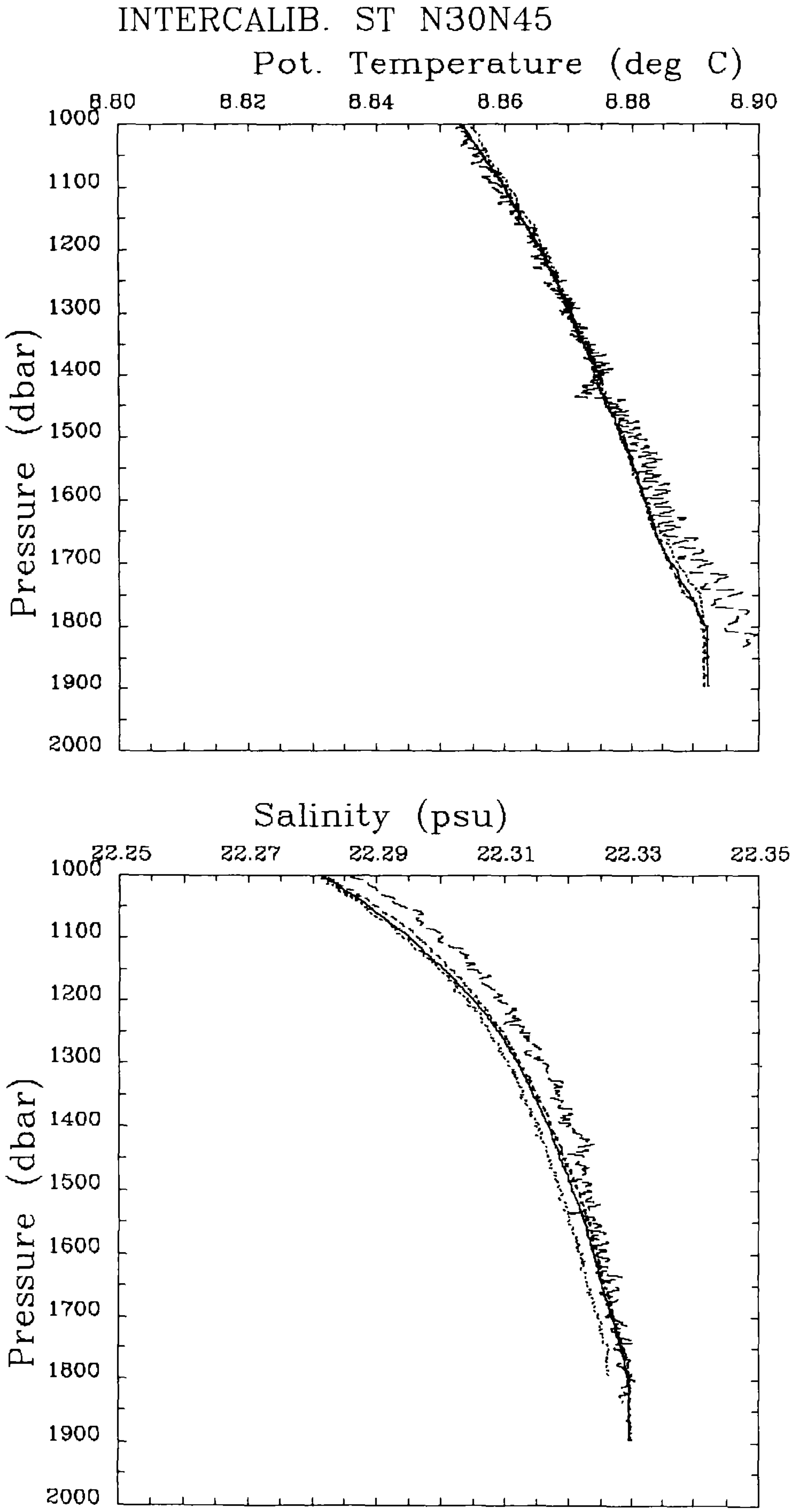


Figure 17: Comparision of intercalibrated potential temperature and salinity profiles measured by Bilim, Kolesnikov, Piri Reis and Akademik at the common station N30N45 (compare this figure with Figure 11).

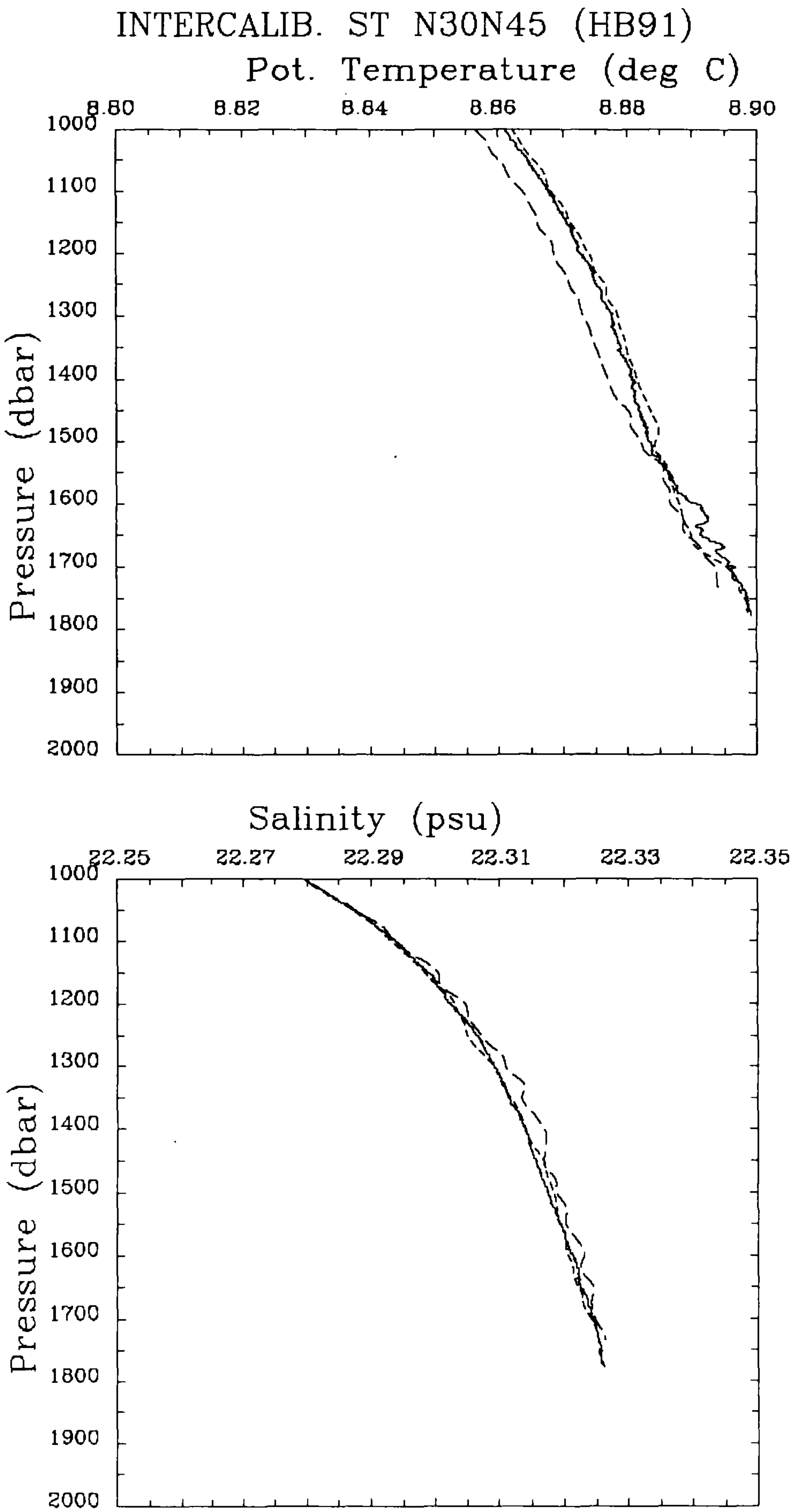


Figure 18: Comparision of intercalibrated temperature and salinity profiles measured by Bilim, Kolesnikov, Piri Reis and Akademik at the common station N30N45 during HydroBlack'91 survey.

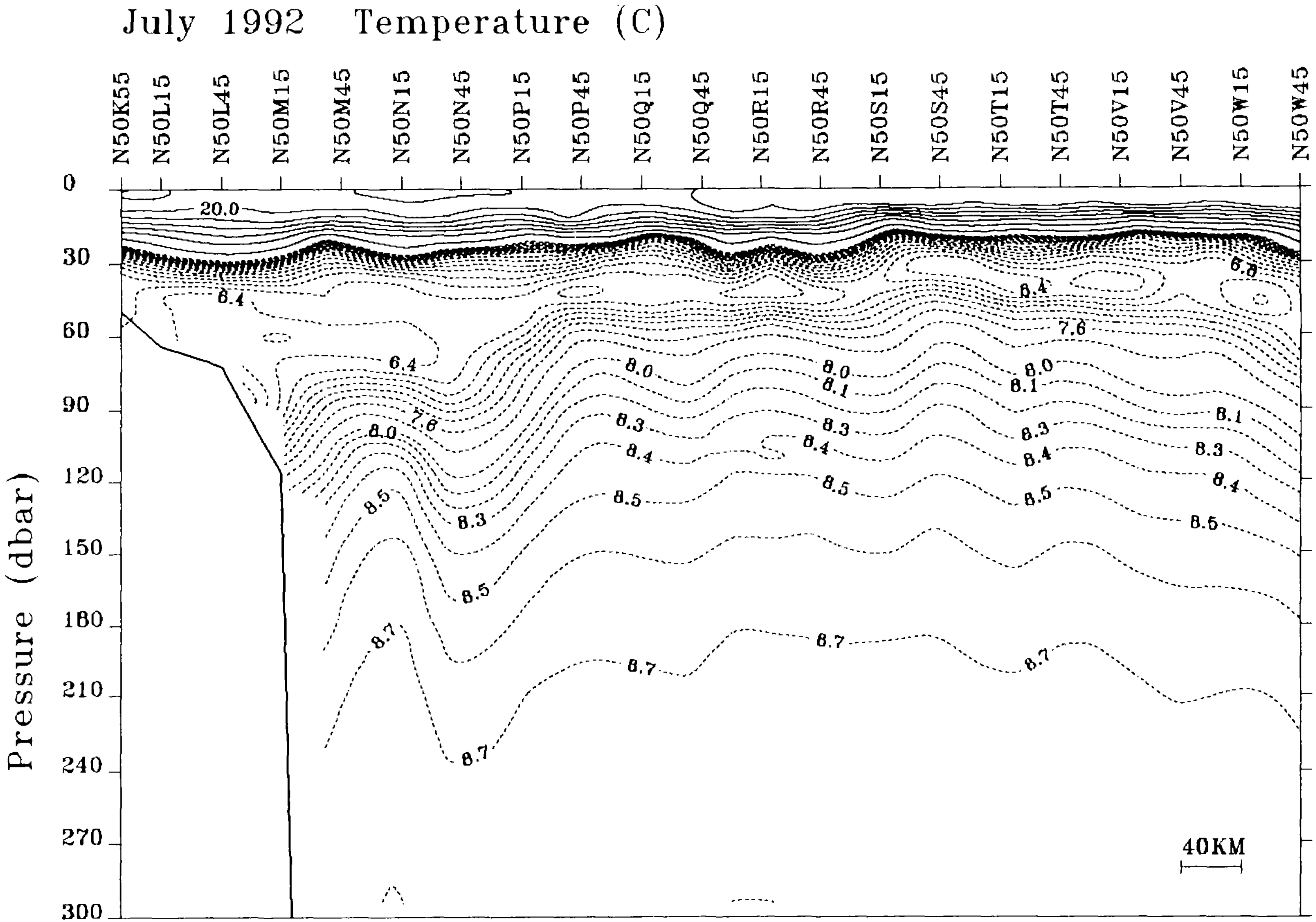


Figure 19a: Potential temperature (deg. C) transect along Section 1.

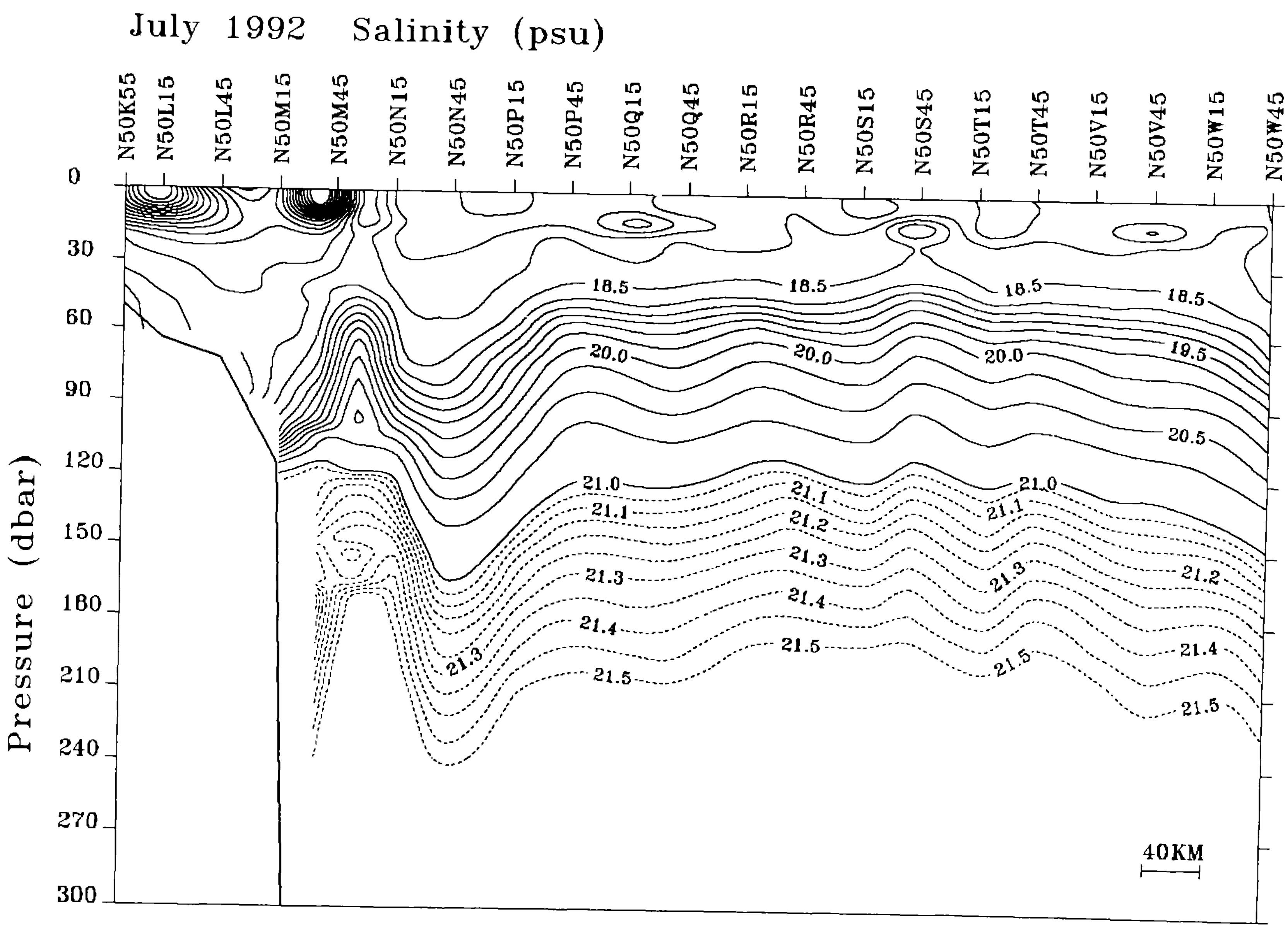


Figure 19b: Salinity (psu) transect along Section 1.

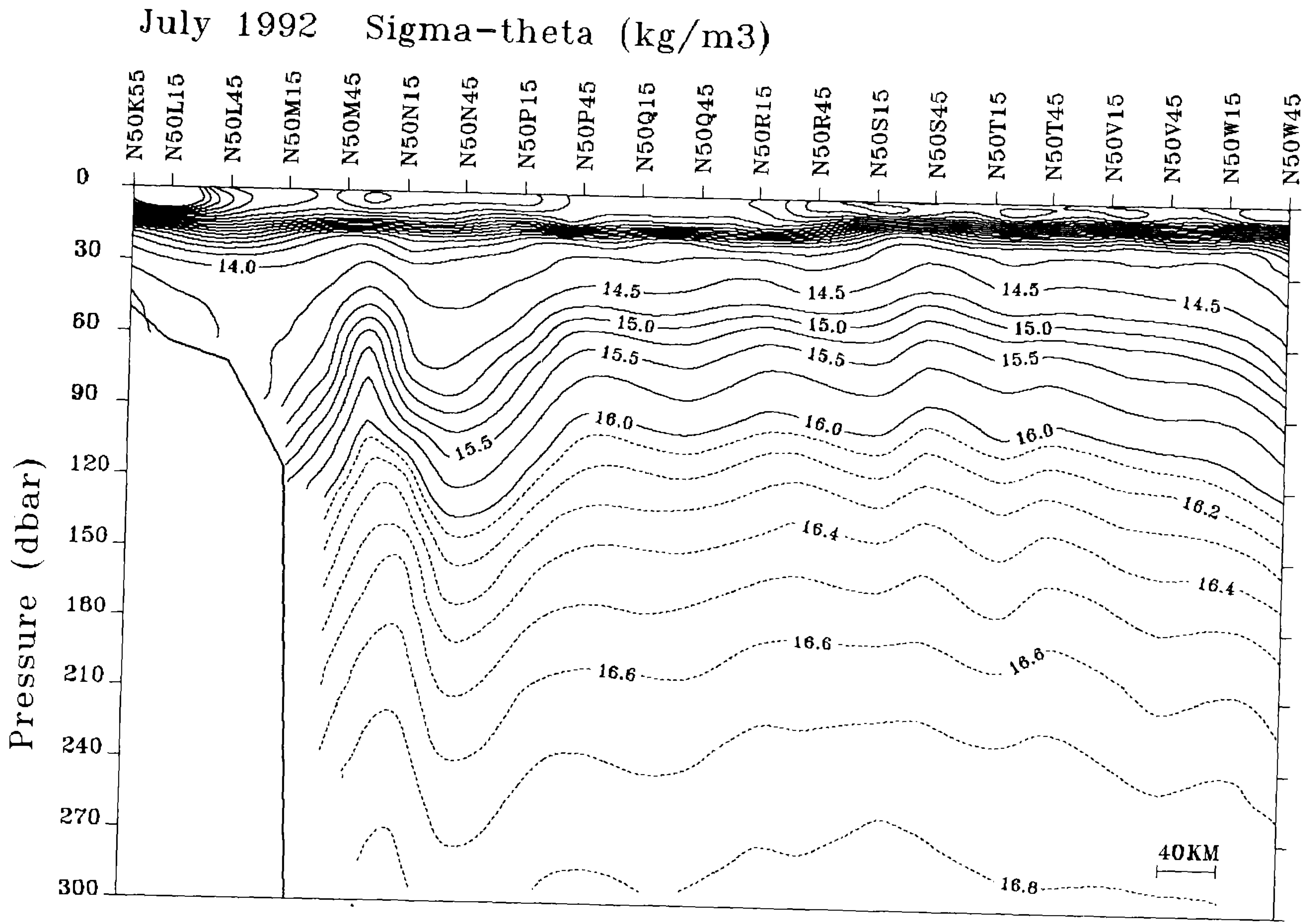


Figure 19c: Sigma-theta (kg/m^3) transect along Section 1.

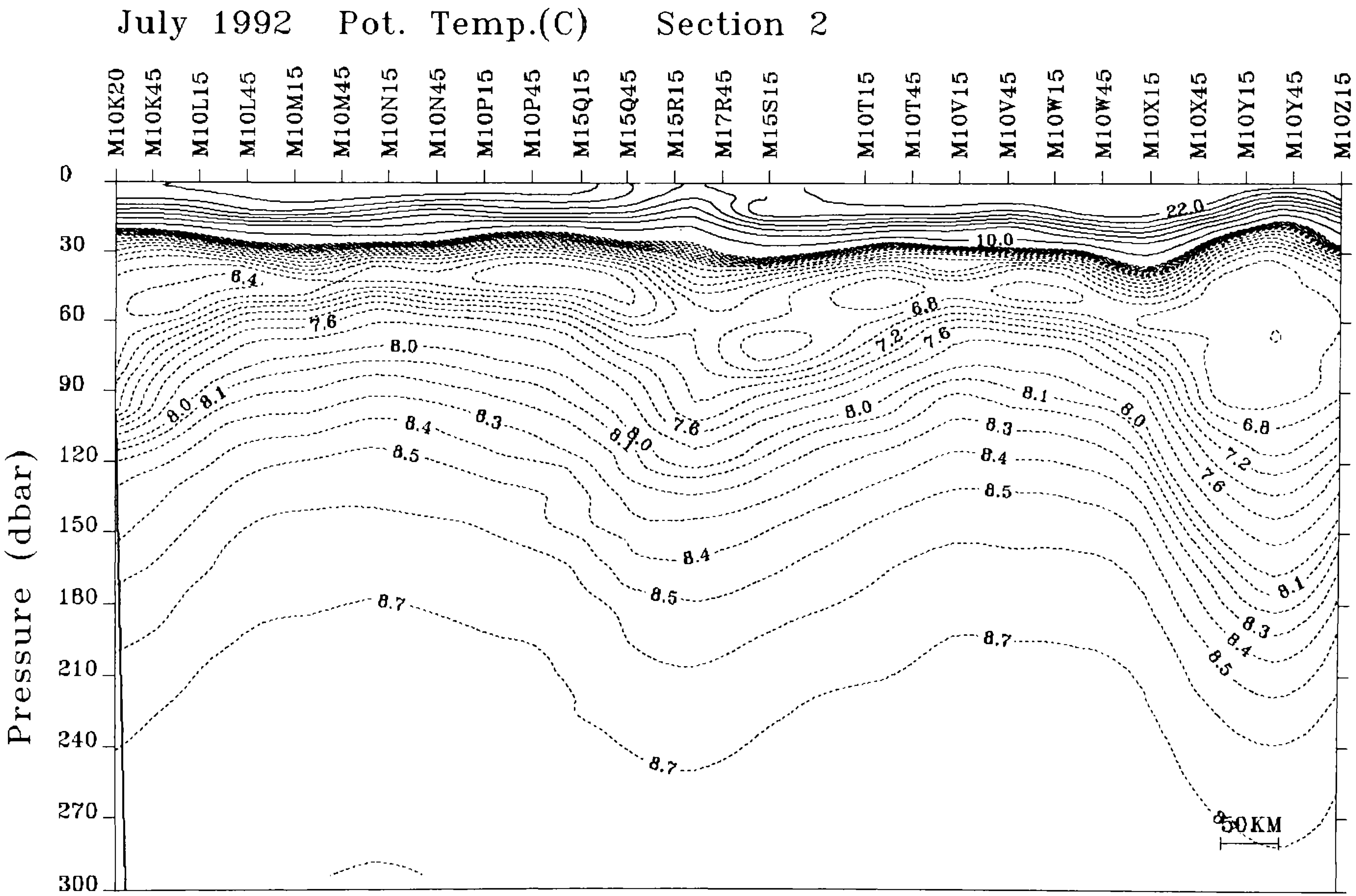


Figure 20a: Potential temperature (deg. C) transect along Section 2.

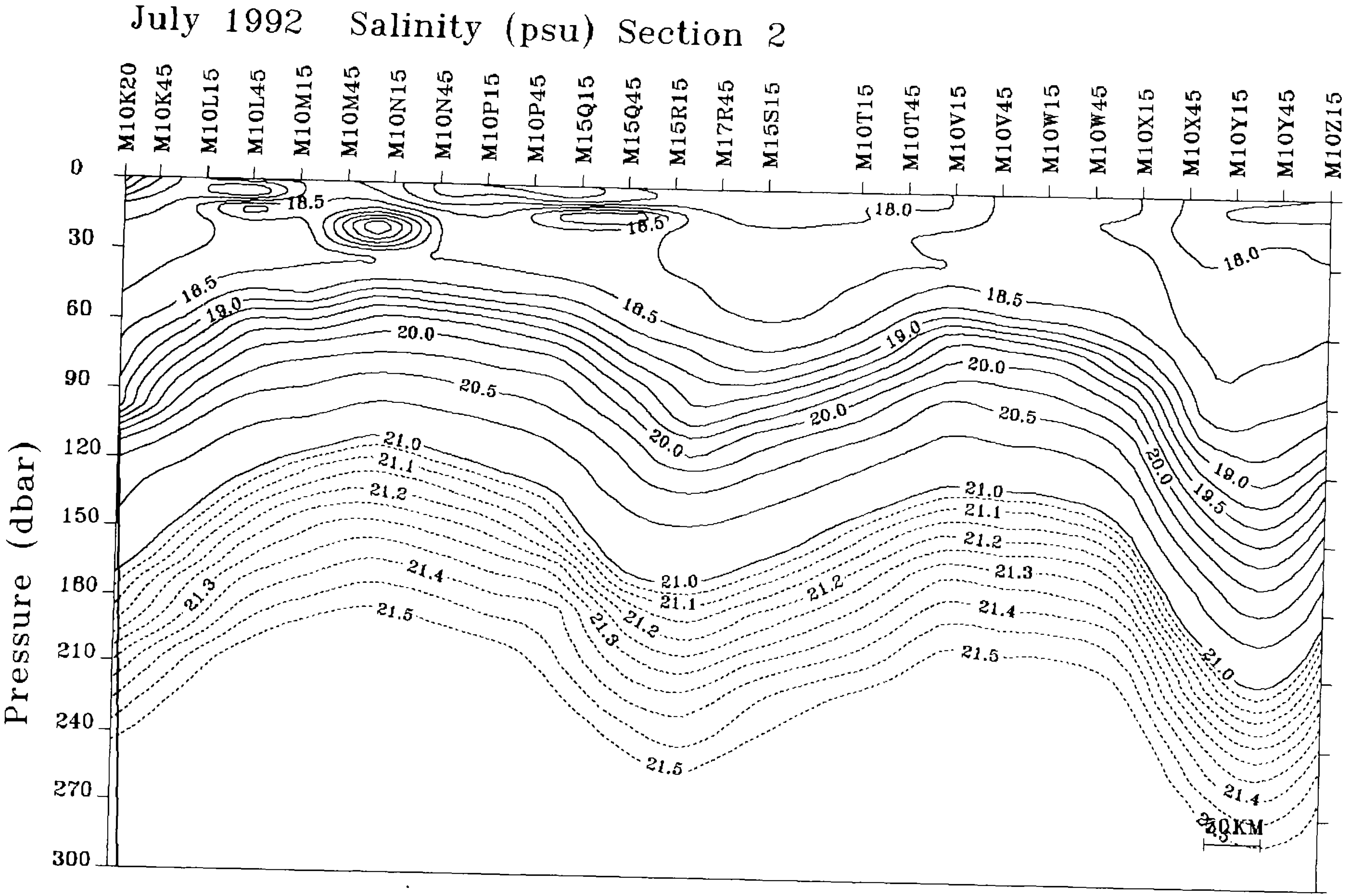


Figure 20b: Salinity (psu) transect along Section 2.

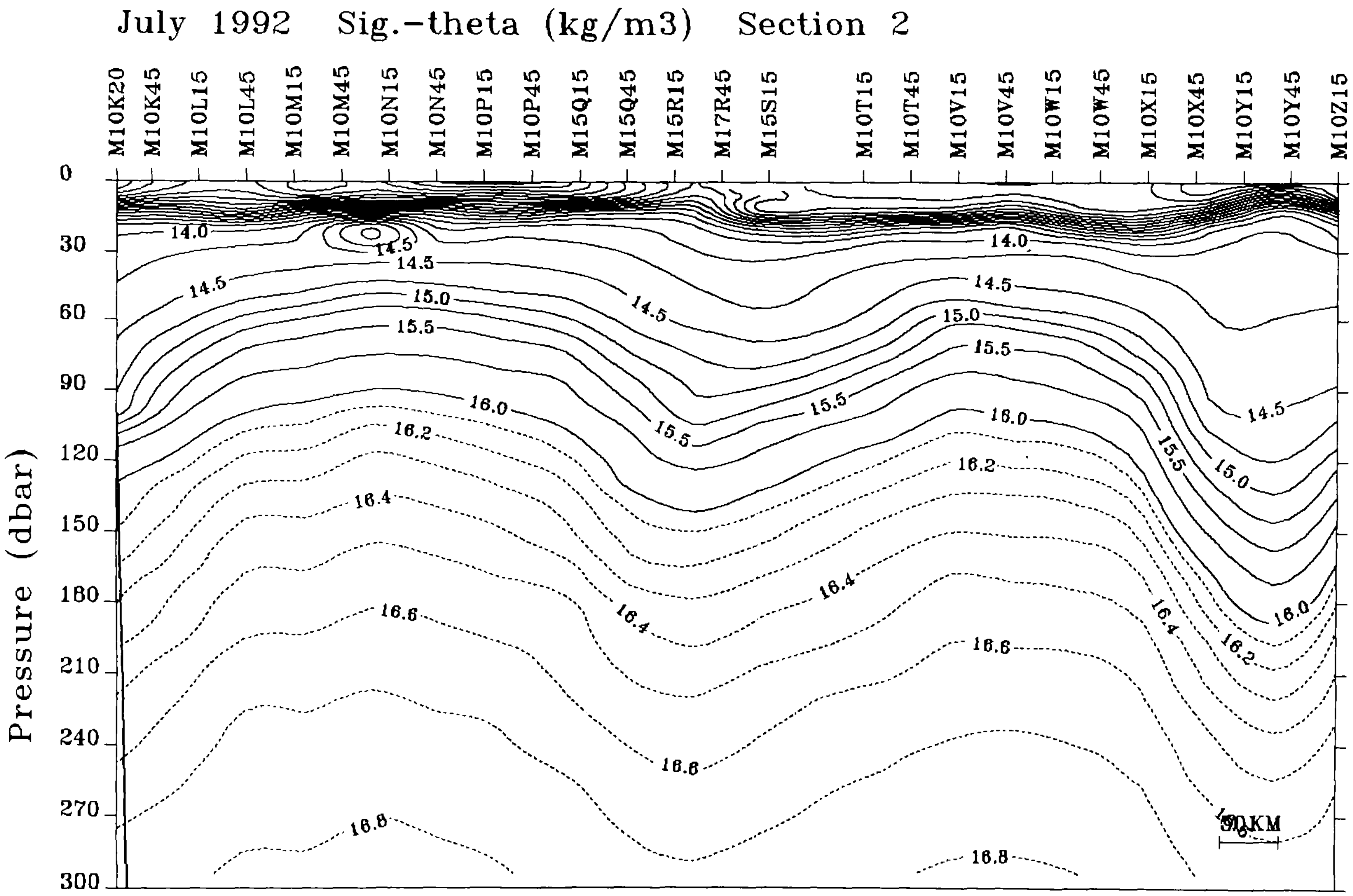


Figure 20c: Sigma-theta (kg/m^3) transect along Section 2.

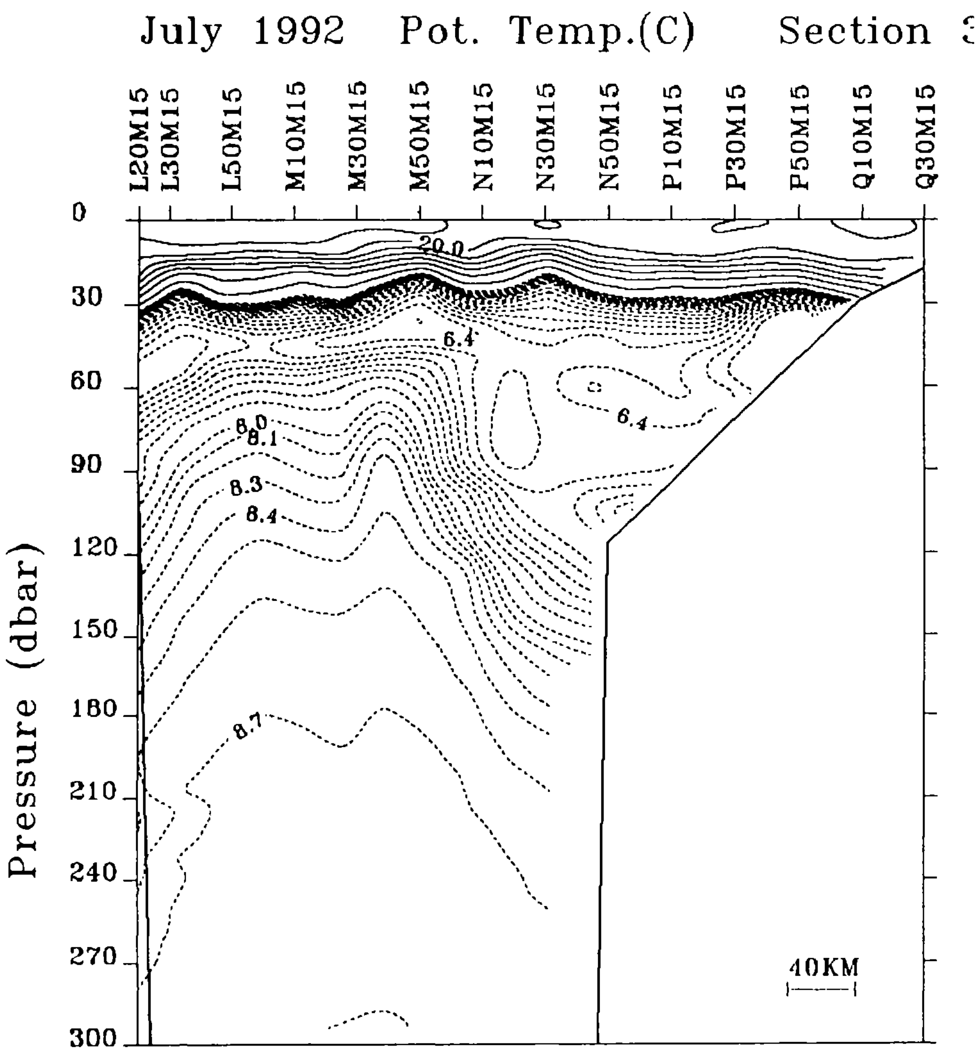


Figure 21a: Potential temperature (deg. C) transect along Section 3.

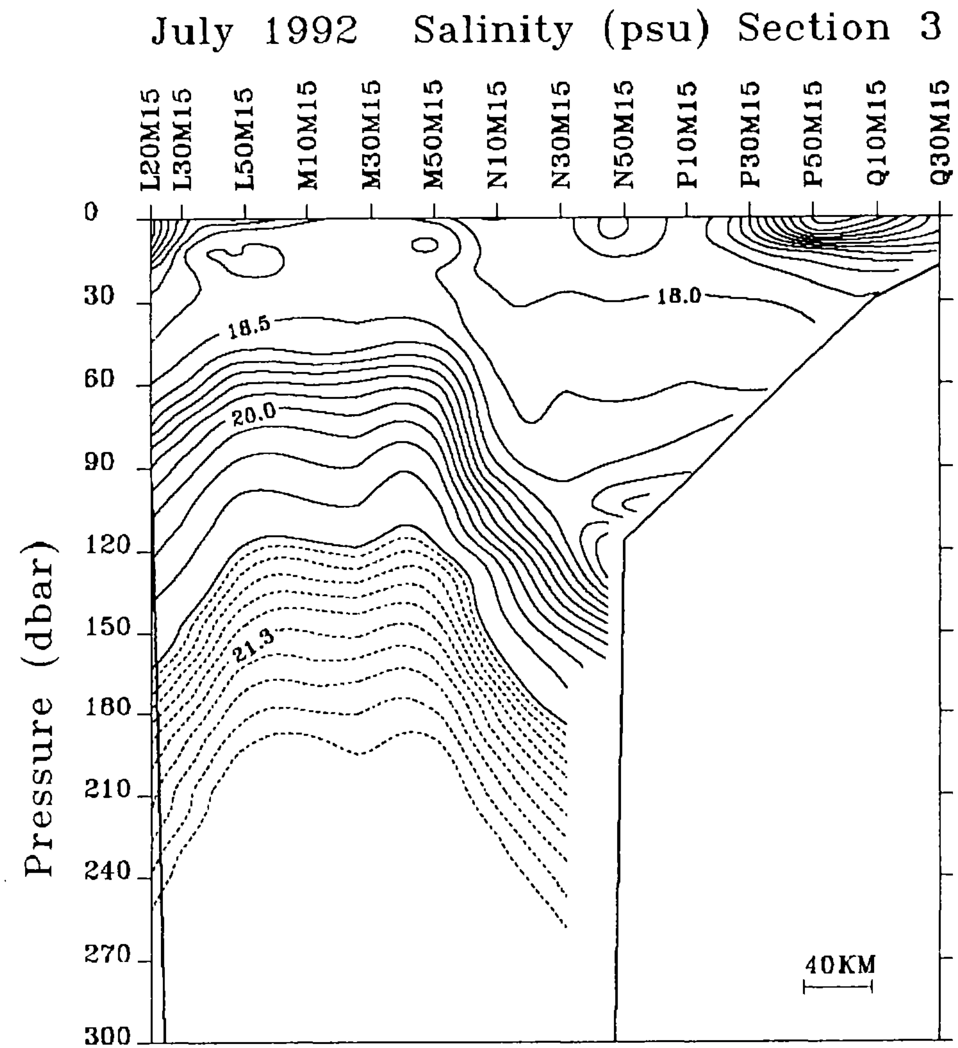


Figure 21b: Salinity (psu) transect along Section 3.

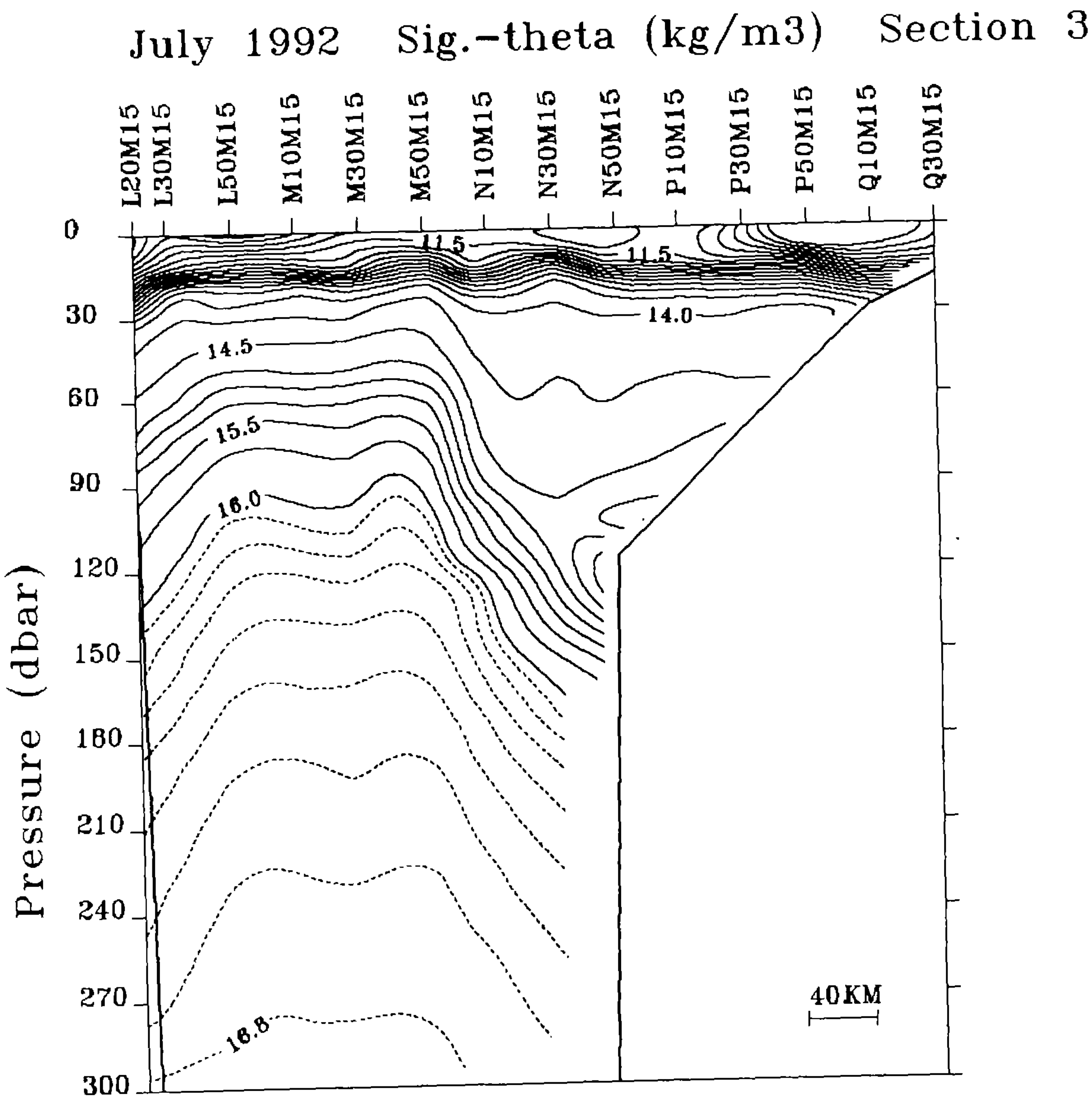


Figure 21c: Sigma-theta (kg/m^3) transect along Section 3.

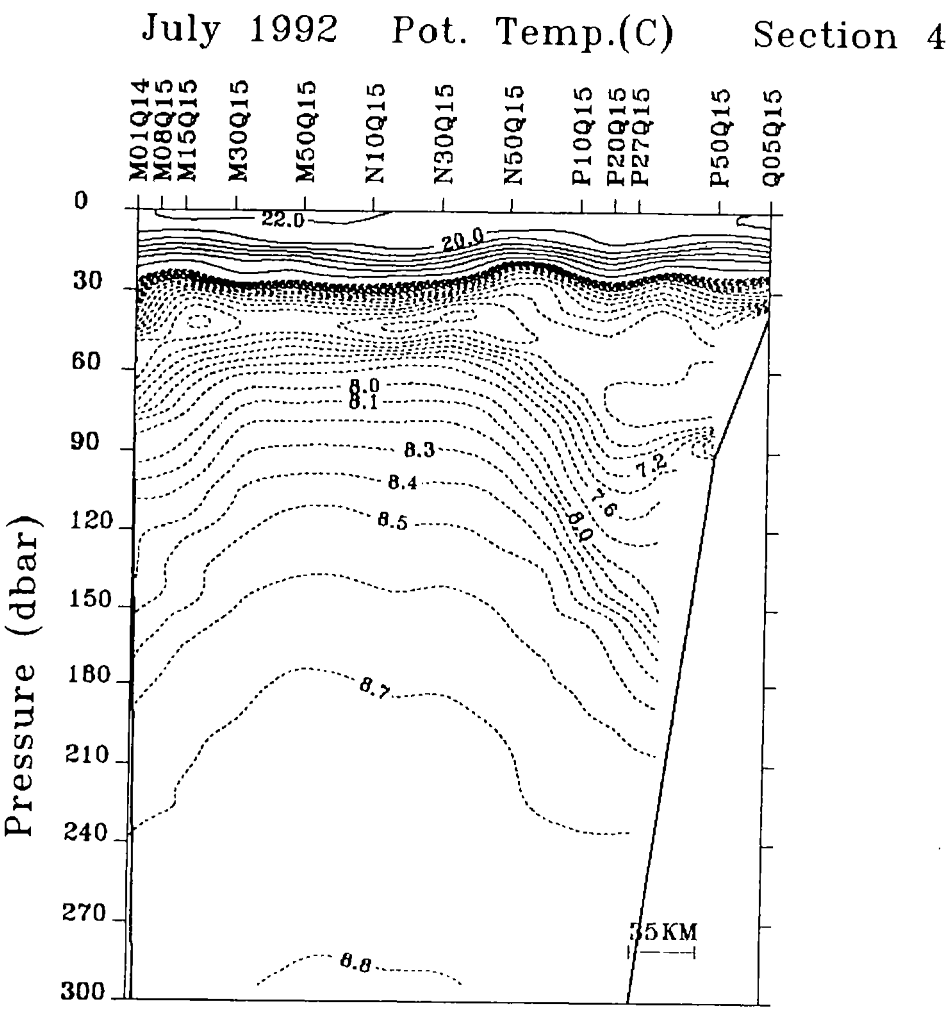


Figure 22a: Potential temperature (deg. C) transect along Section 4.

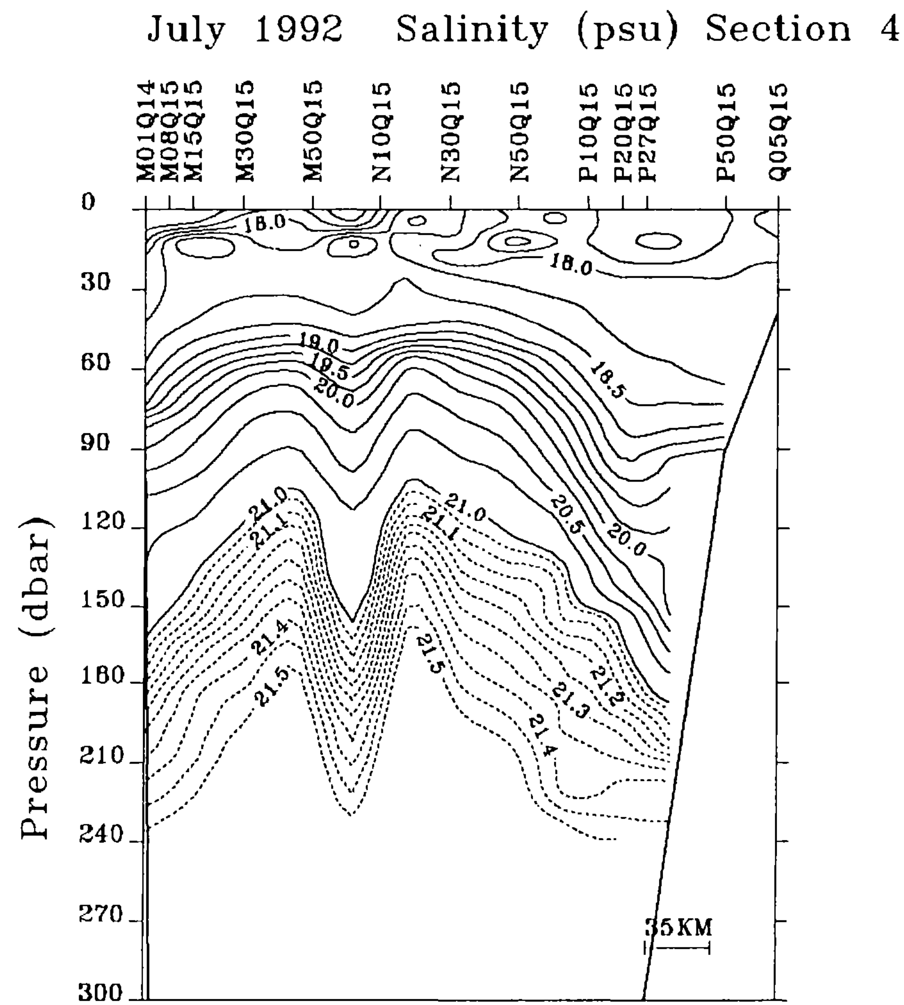


Figure 22b: Salinity (psu) transect along Section 4.

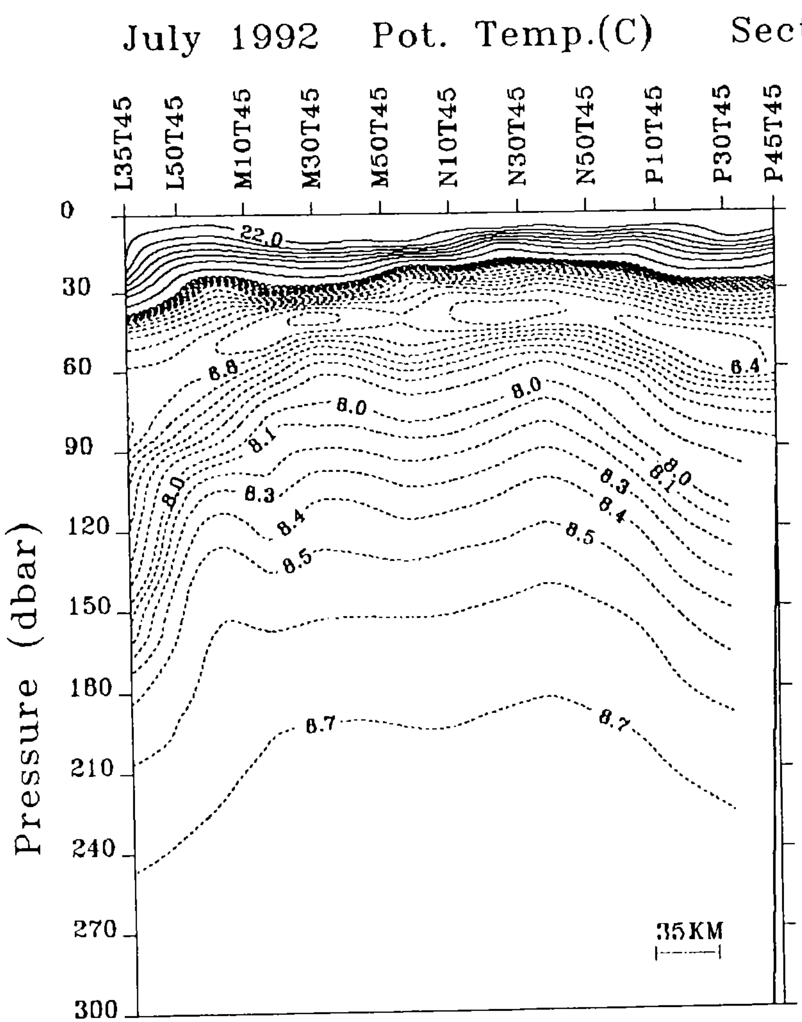


Figure 23a: Potential temperature (deg. C) transect along Section 5.

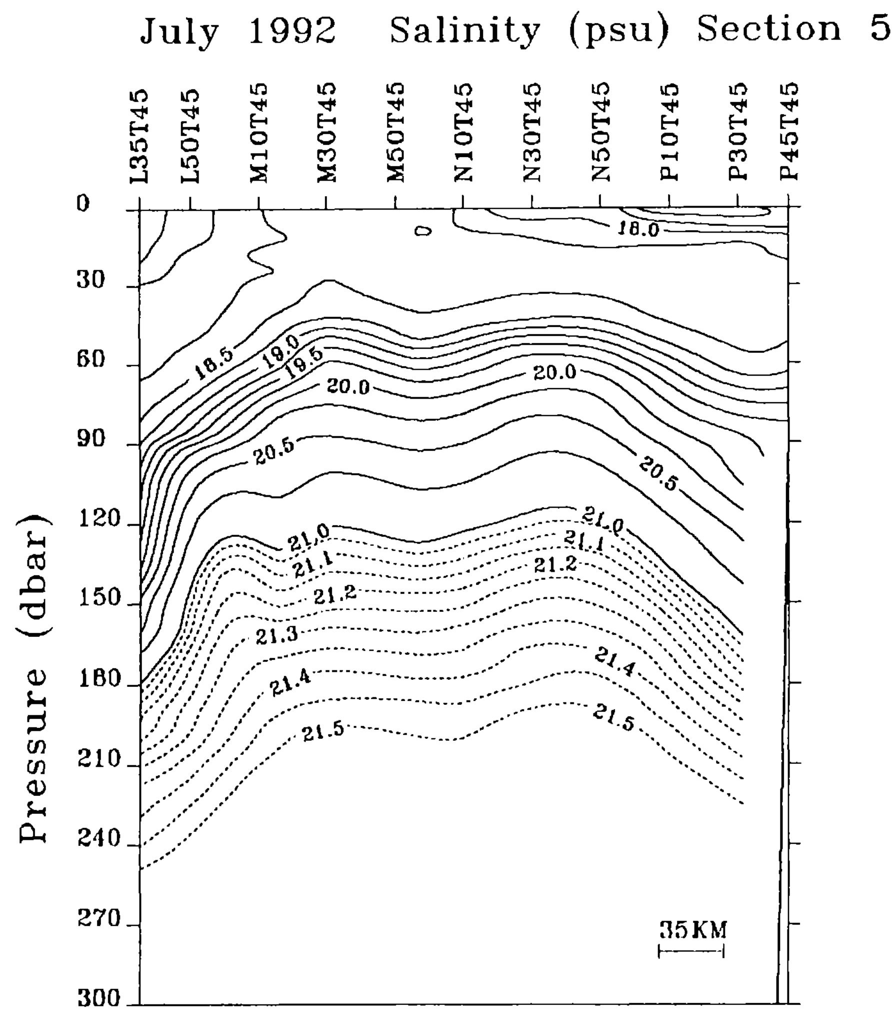


Figure 23b: Salinity (psu) transect along Section 5.

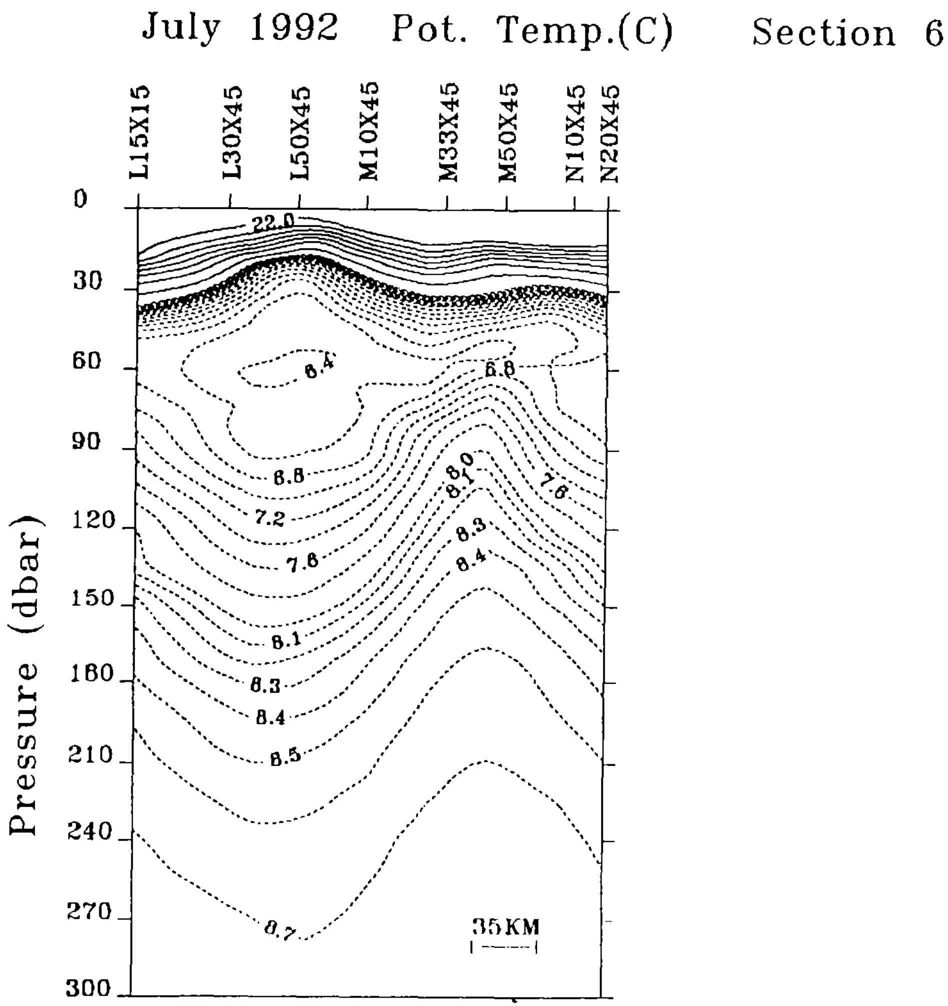


Figure 24a: Potential temperature (deg. C) transect along Section 6.

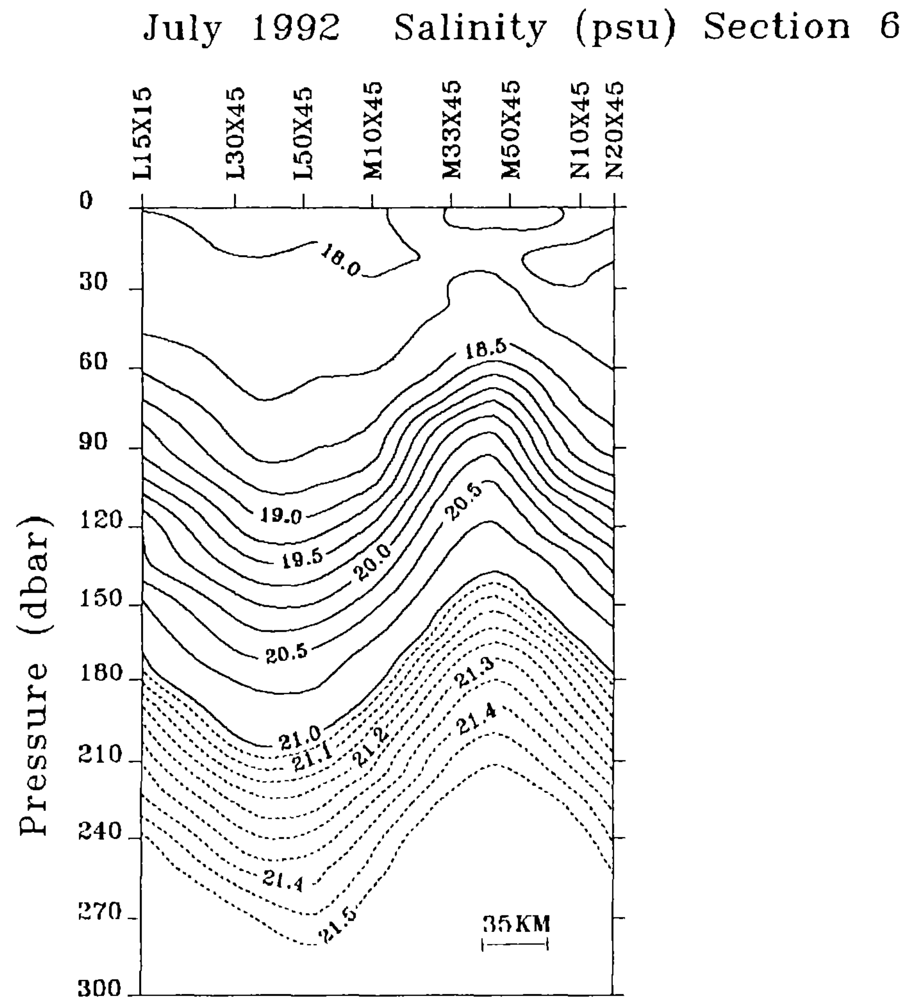


Figure 24b: Salinity (psu) transect along Section 6.

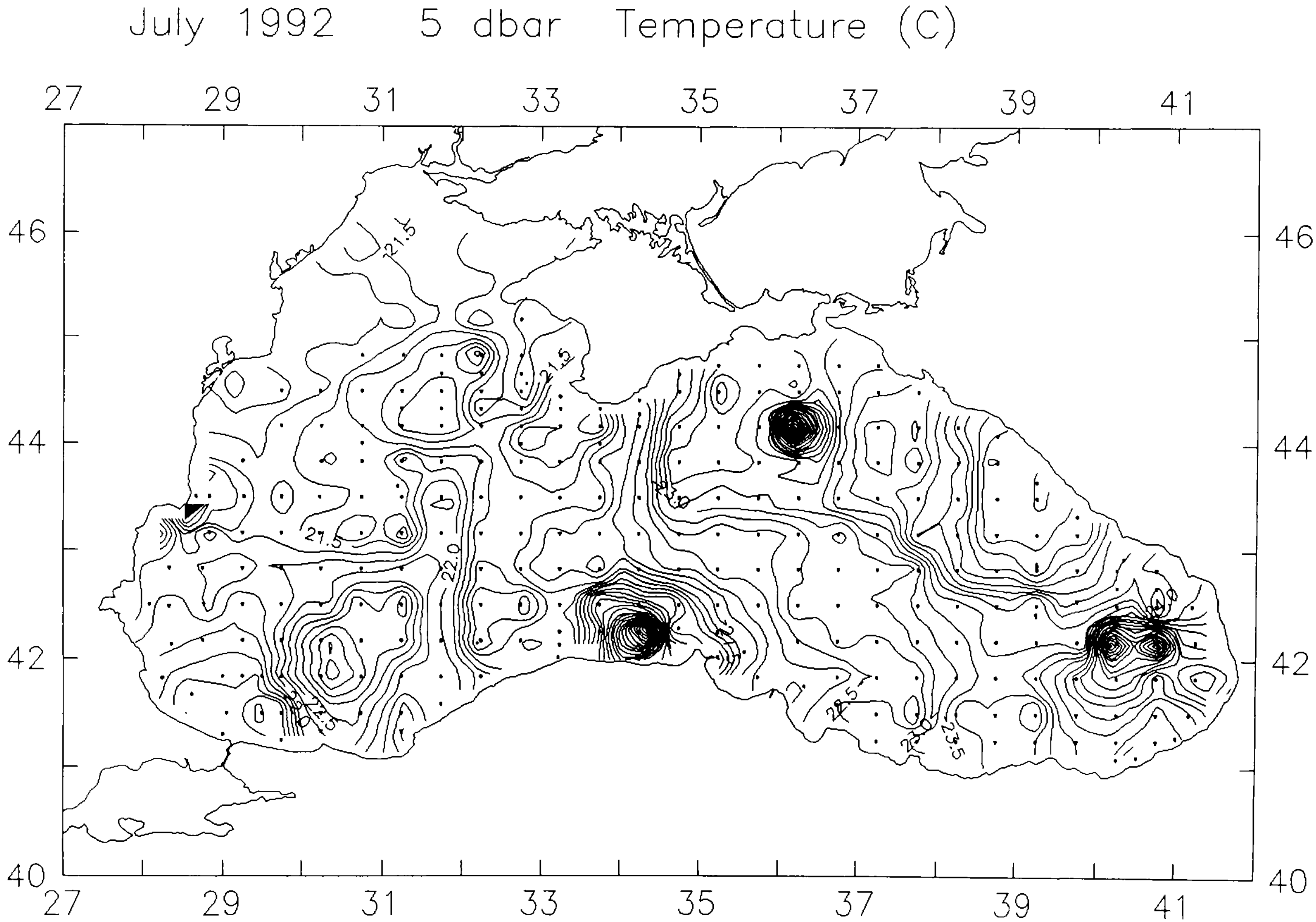


Figure 25a: Horizontal distribution of potential temperature at 5 dbar level.

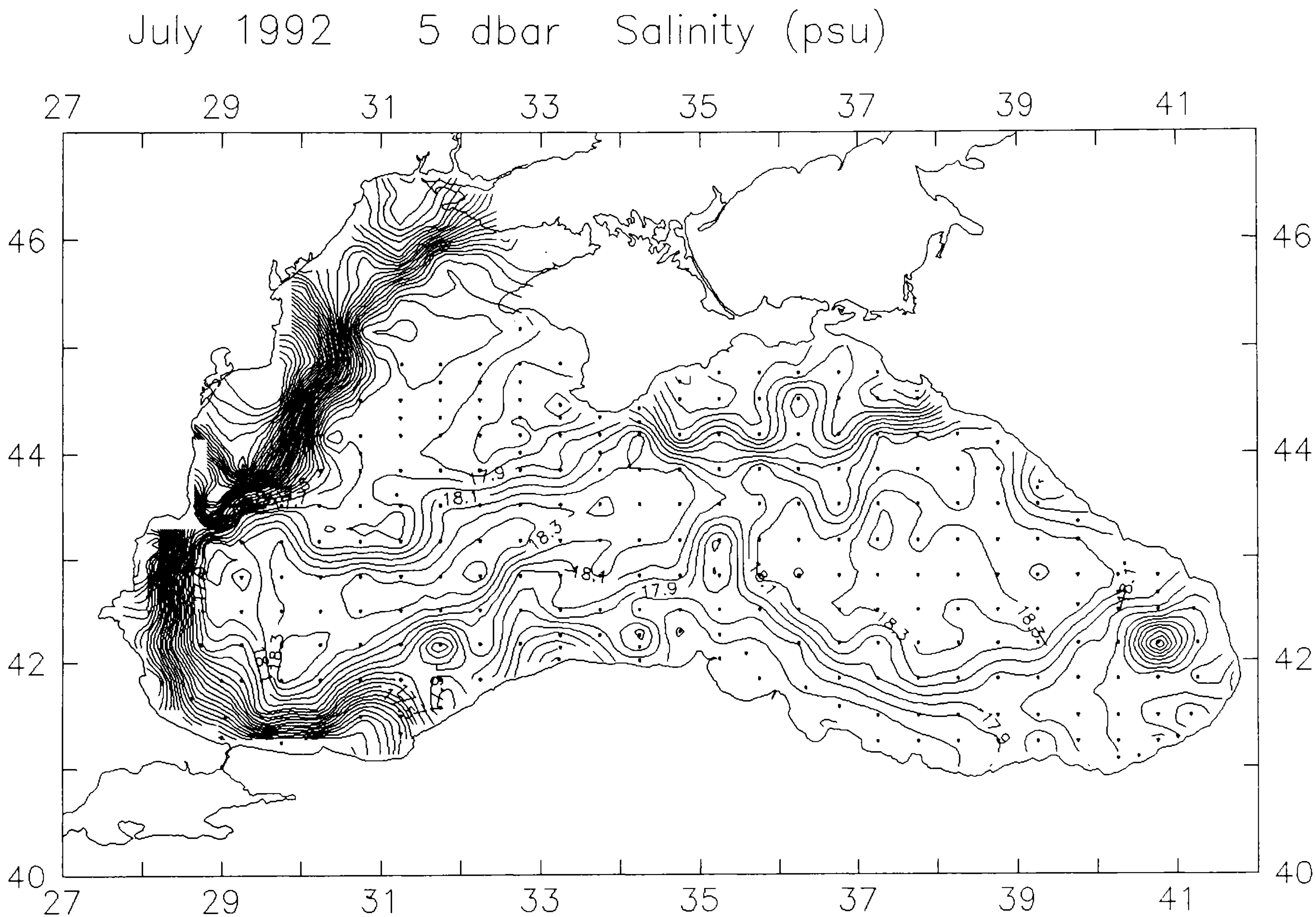


Figure 25b: Horizontal distribution of Salinity at 5 dbar level.

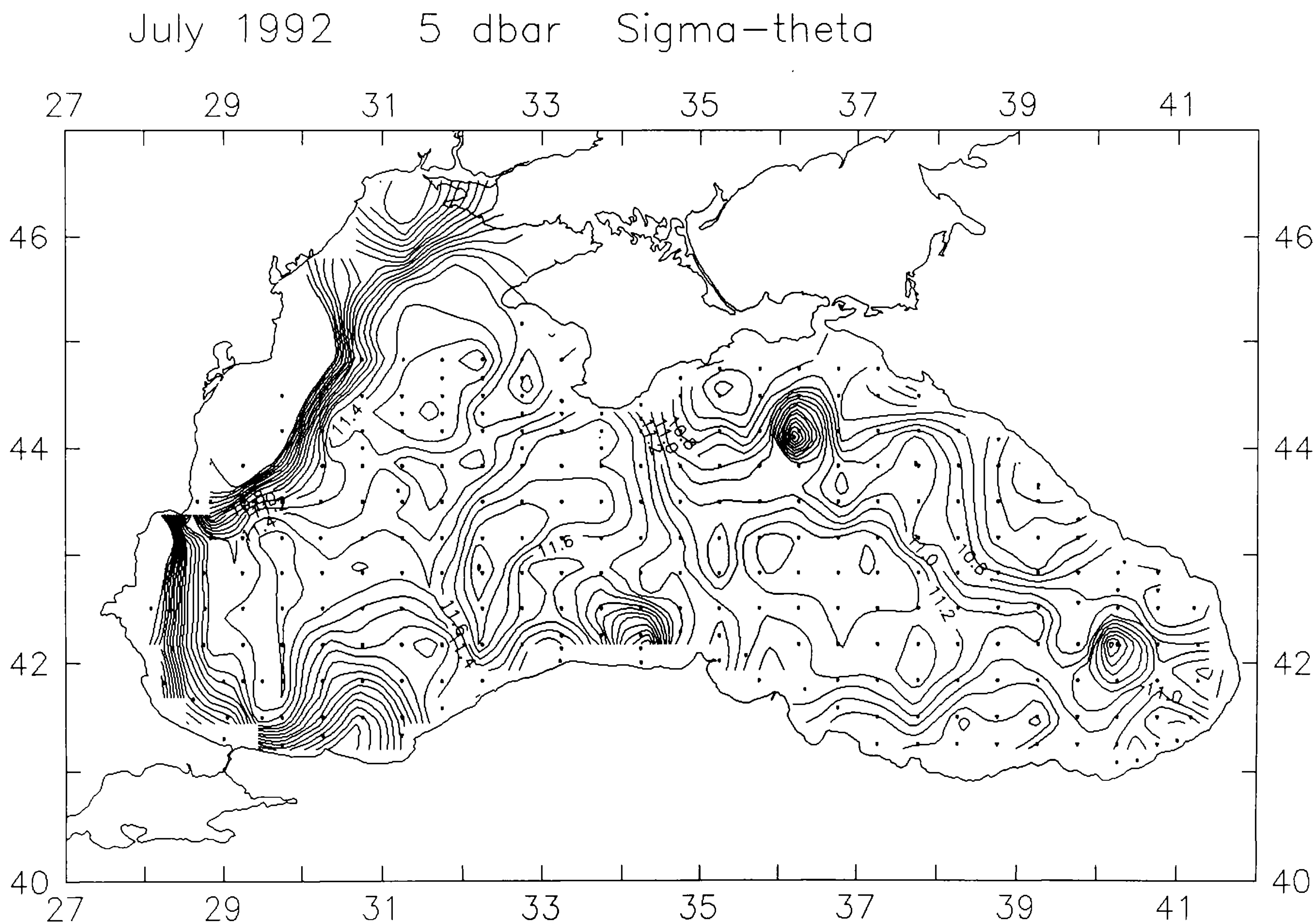


Figure 25c: Horizontal distribution of Sigma-theta at 5 dbar level.

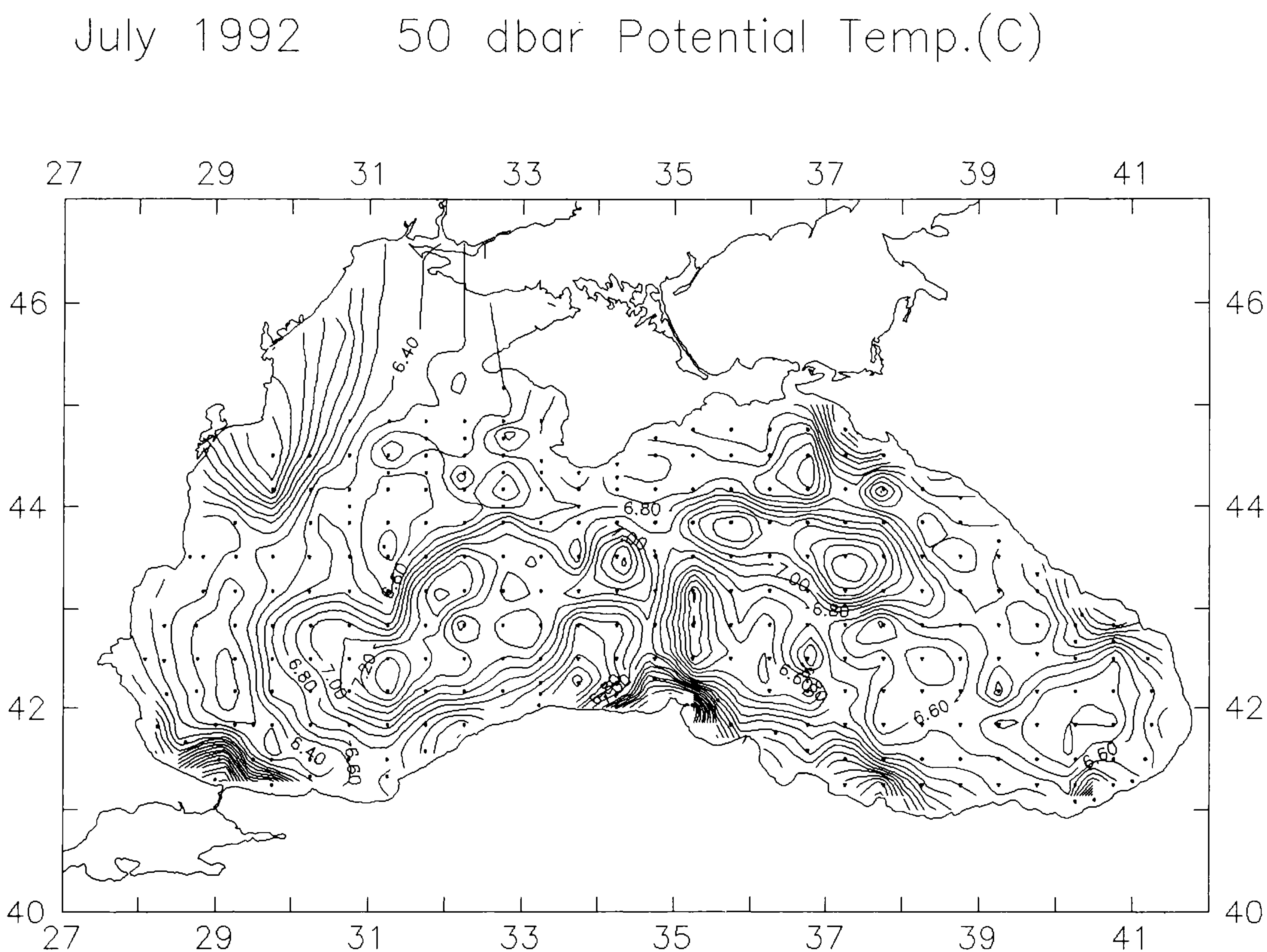


Figure 26a: Horizontal distribution of potential temperature at 50 dbar level.

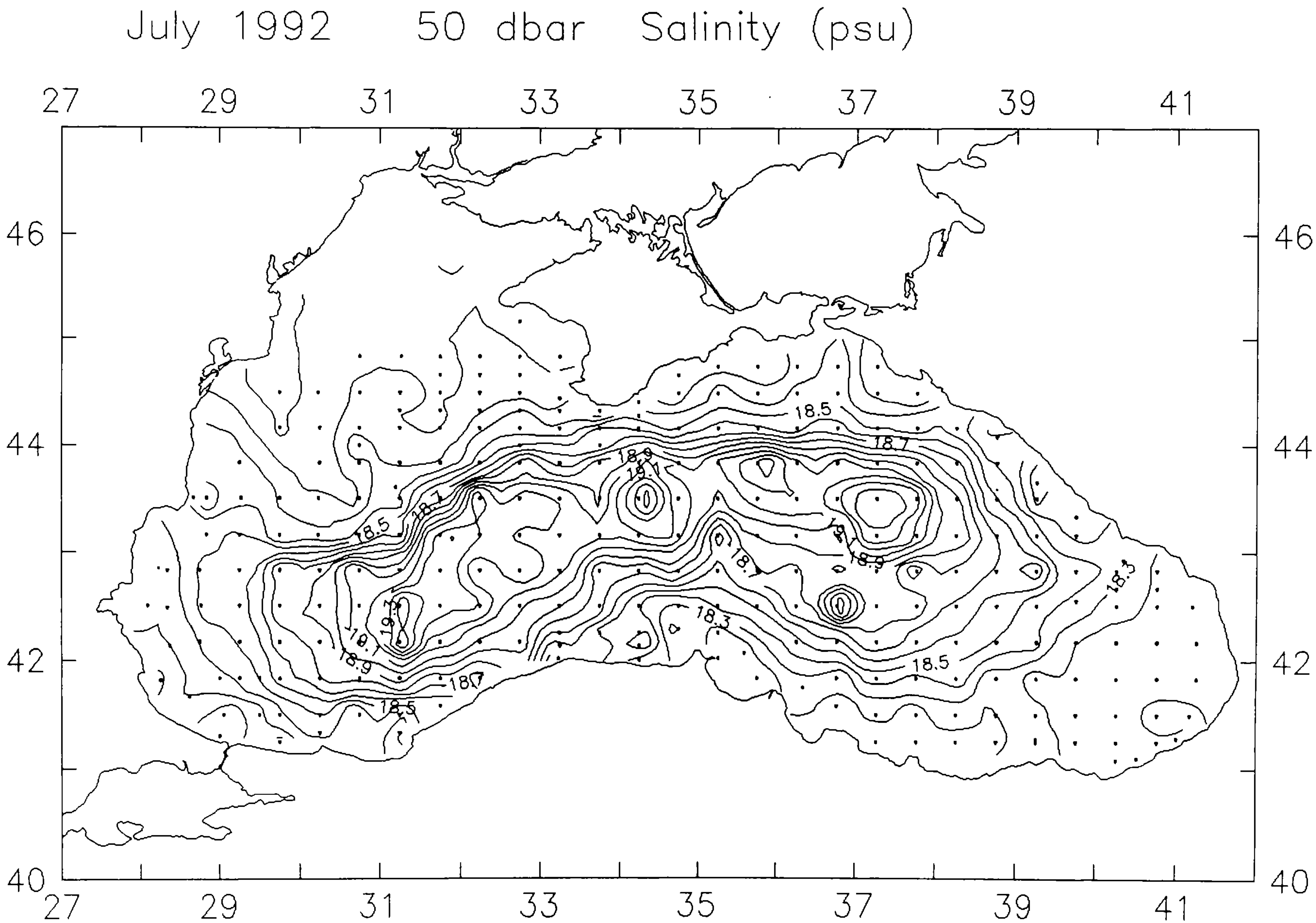


Figure 26b: Horizontal distribution of Salinity at 50 dbar level.

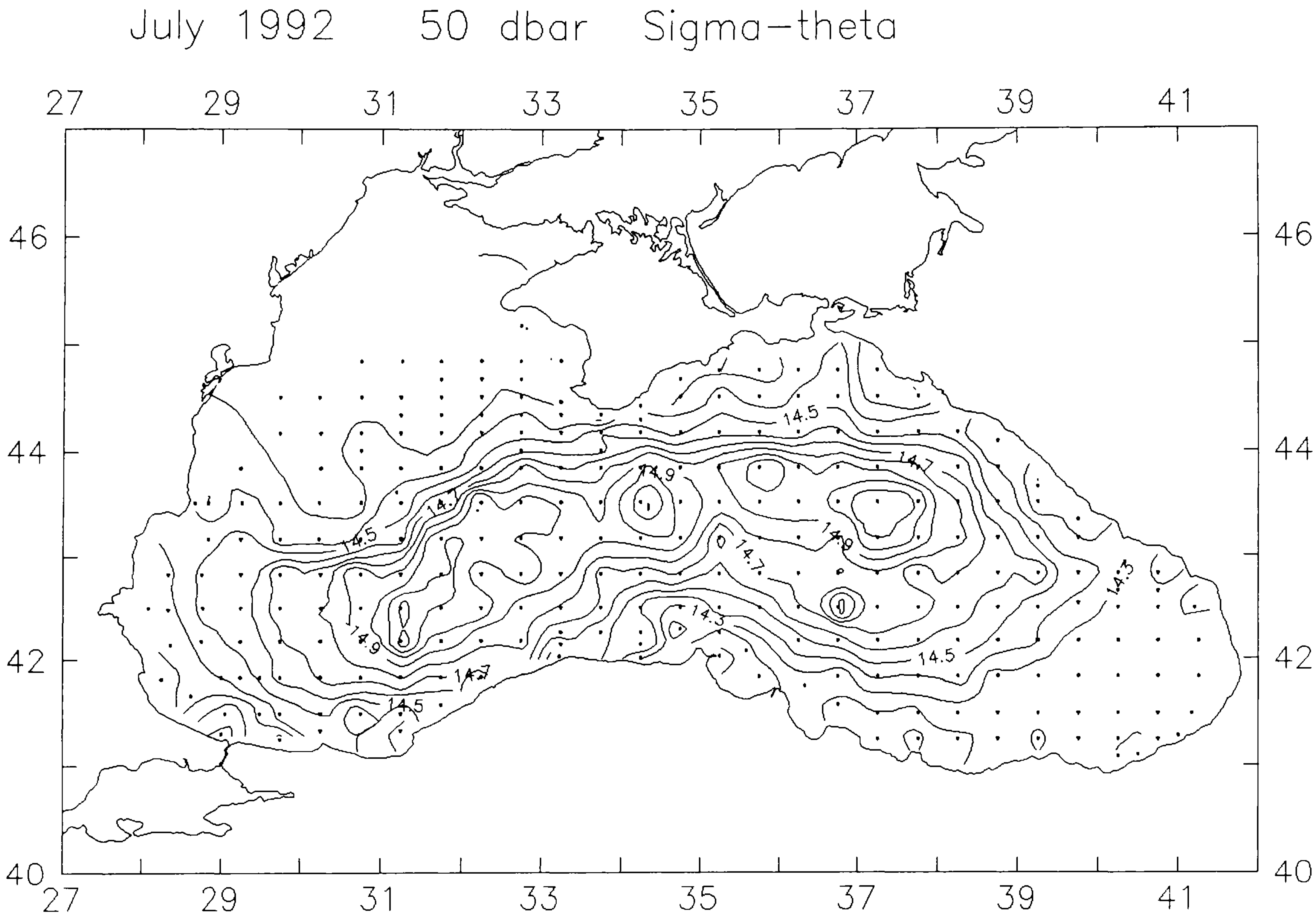


Figure 26c: Horizontal distribution of Sigma-theta at 50 dbar level.

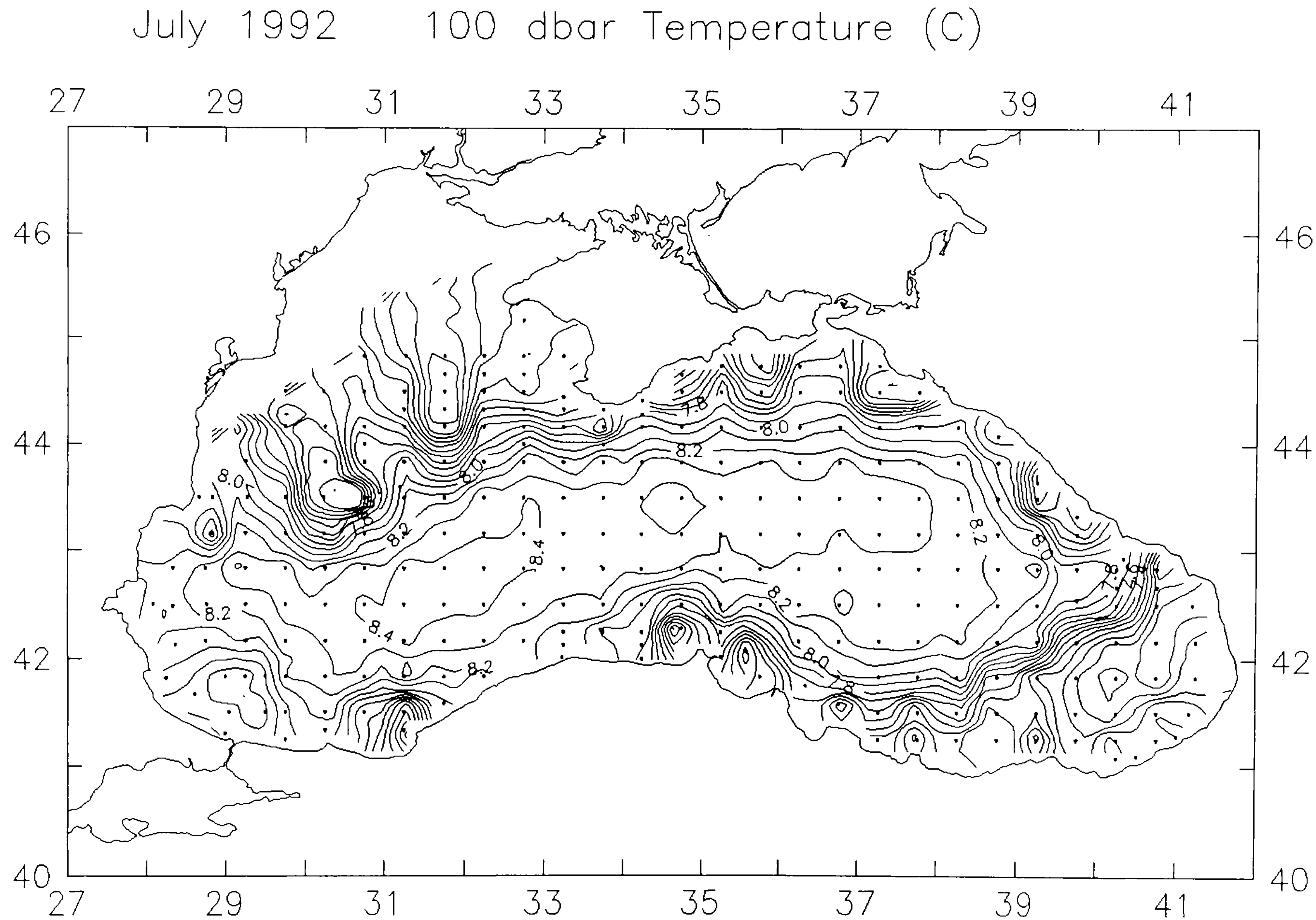


Figure 27a: Horizontal distribution of potential temperature at 100 dbar level.

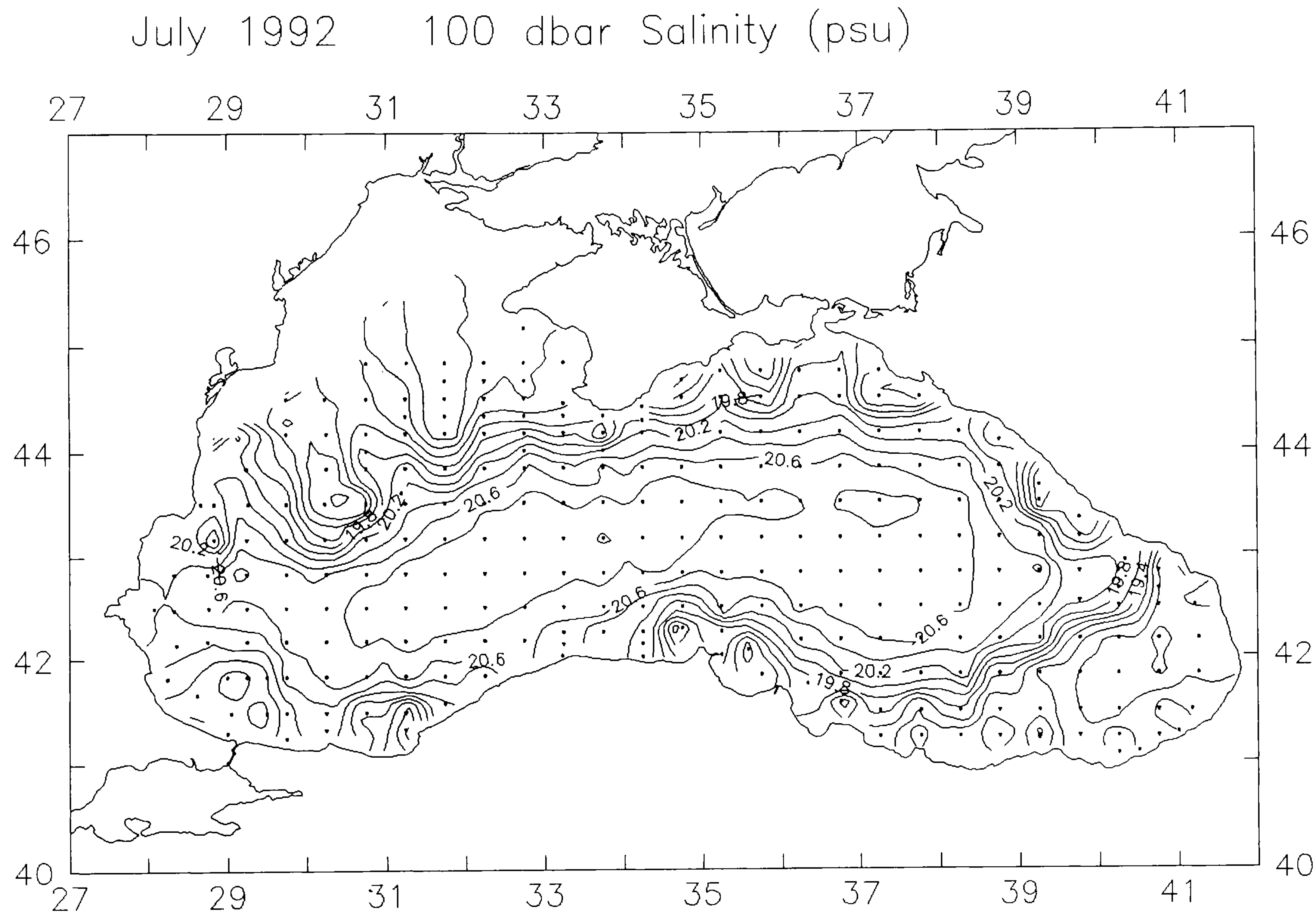


Figure 27b: Horizontal distribution of Salinity at 100 dbar level.

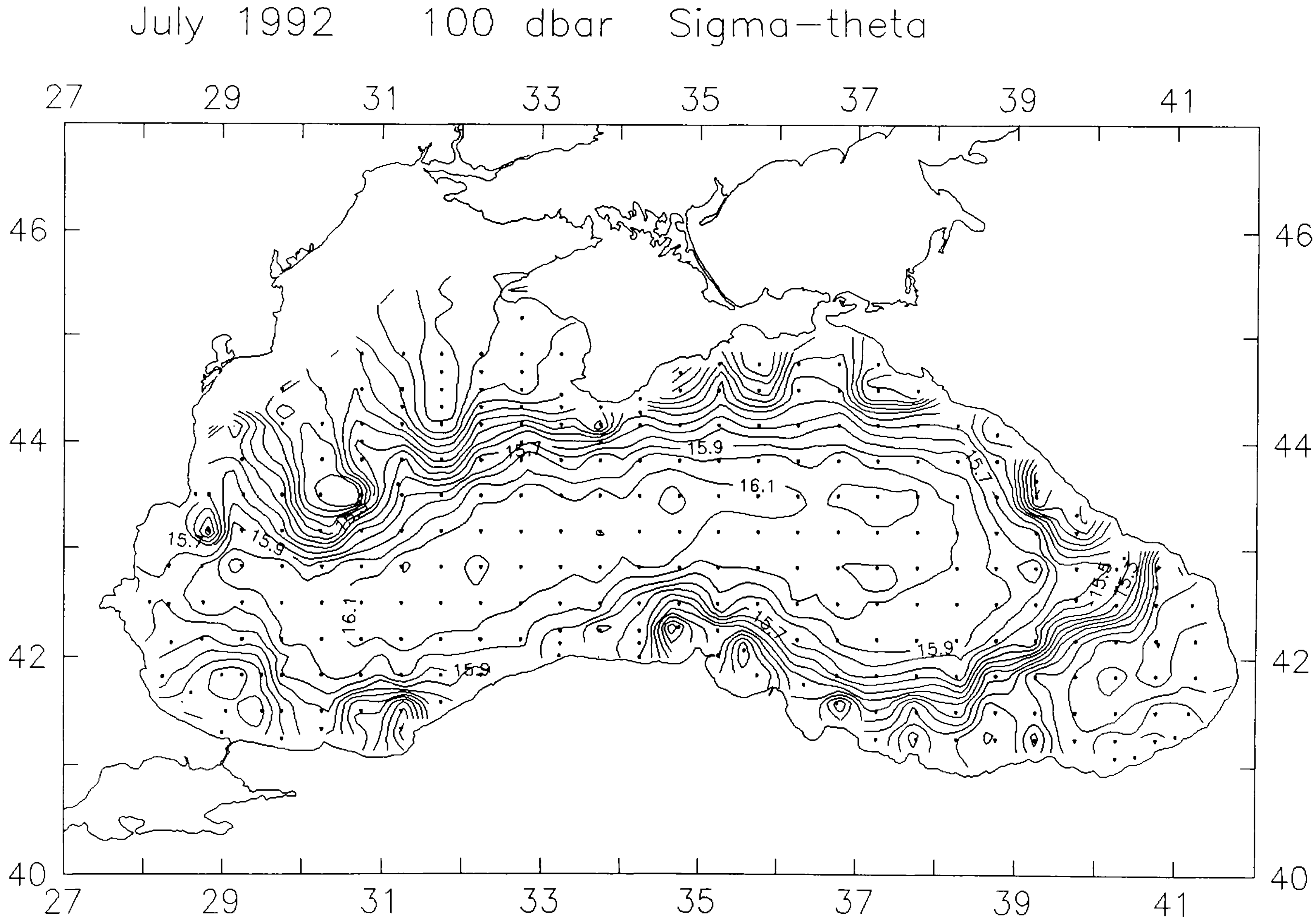


Figure 27c: Horizontal distribution of Sigma-theta at 100 dbar level.

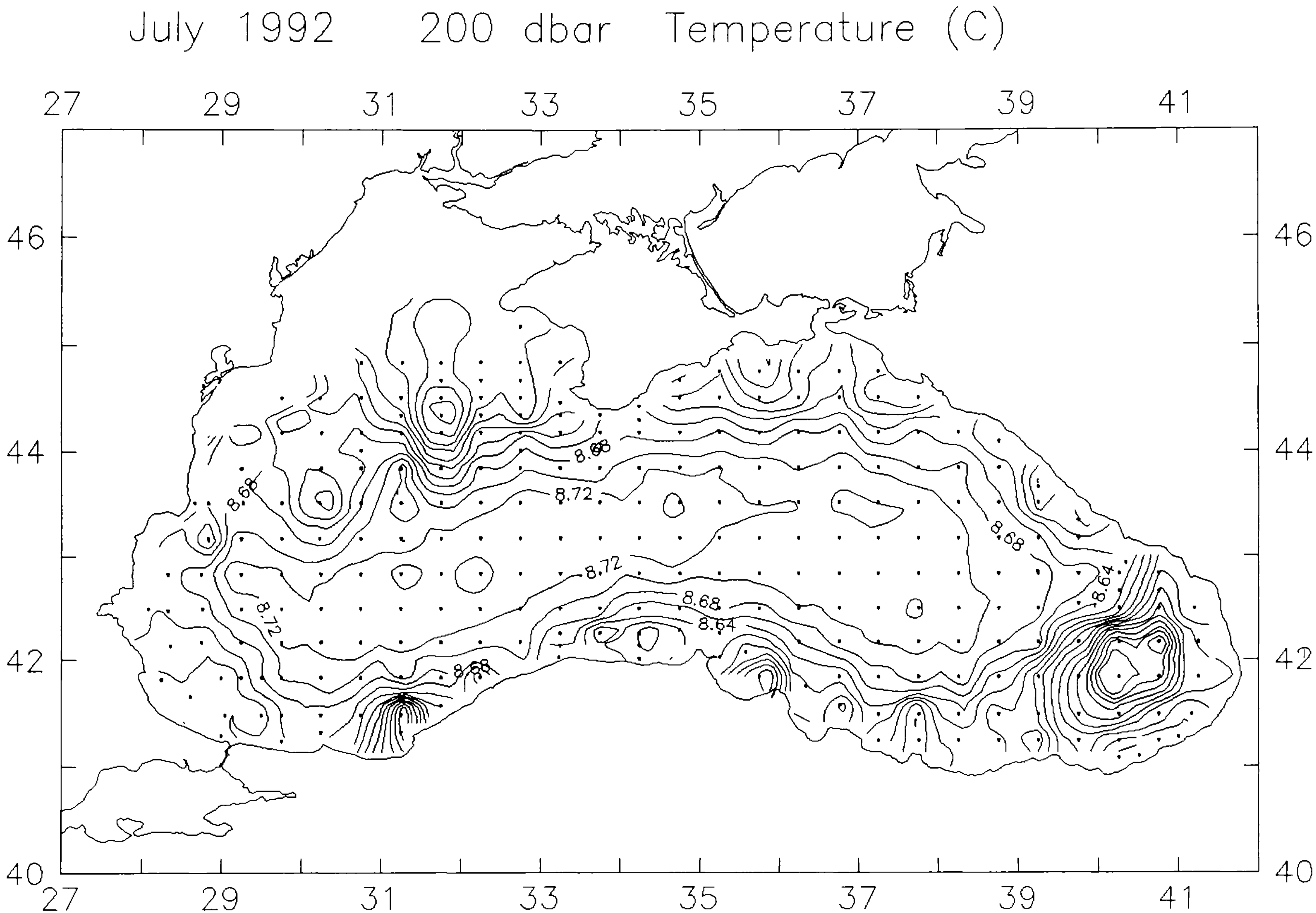


Figure 28a: Horizontal distribution of potential temperature at 200 dbar level.

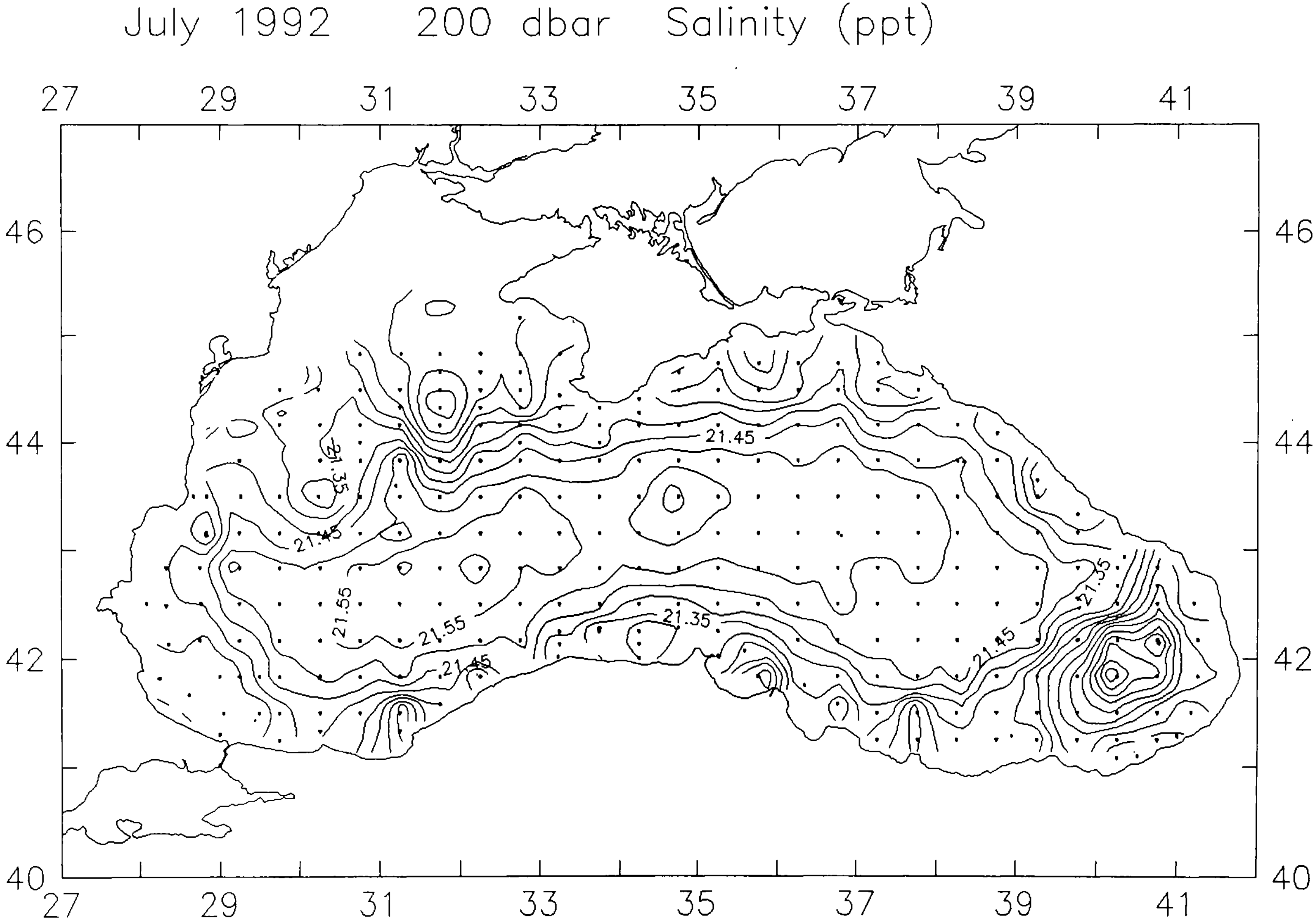


Figure 28b: Horizontal distribution of Salinity at 200 dbar level.

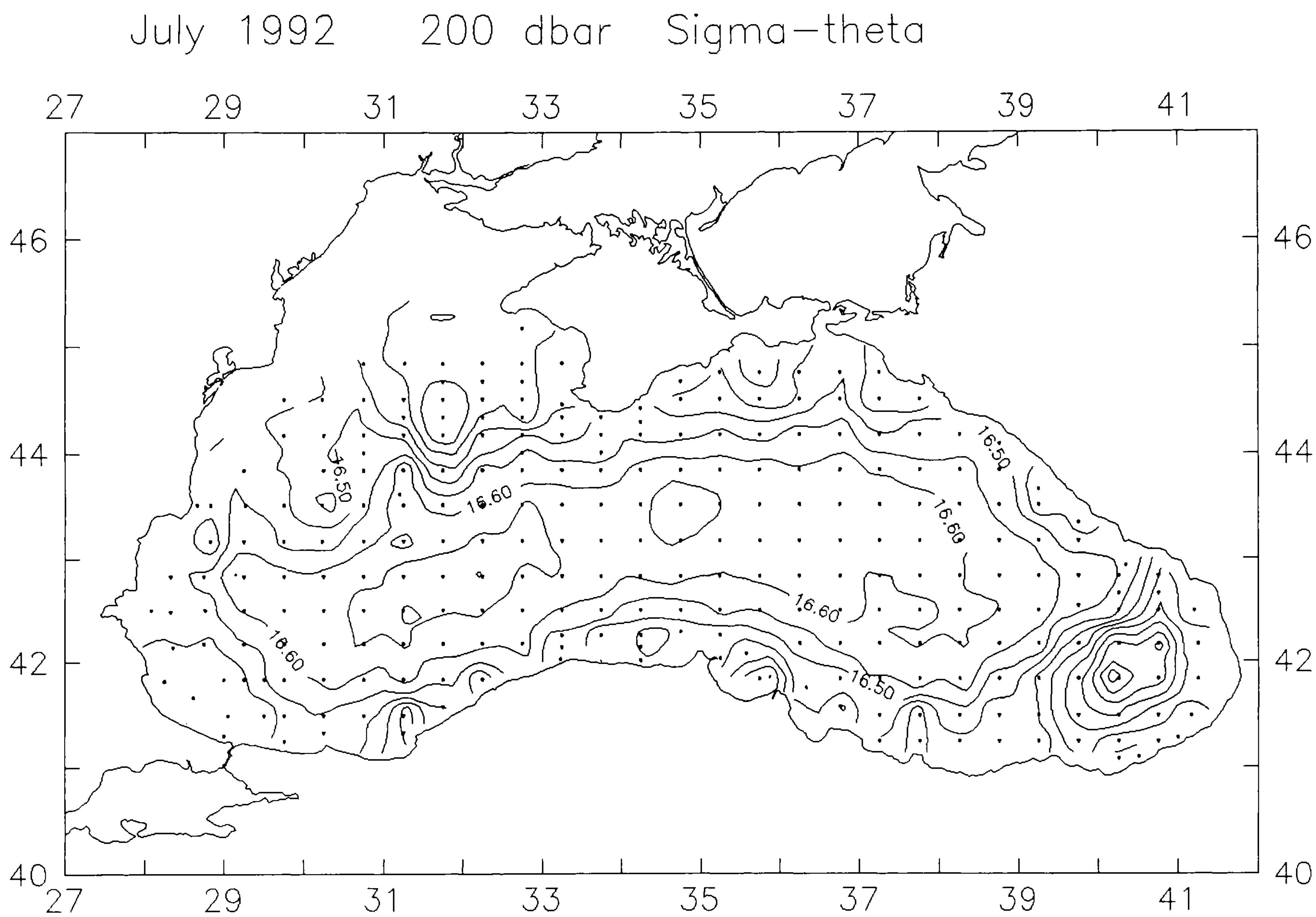


Figure 28c: Horizontal distribution of Sigma-theta at 200 dbar level.

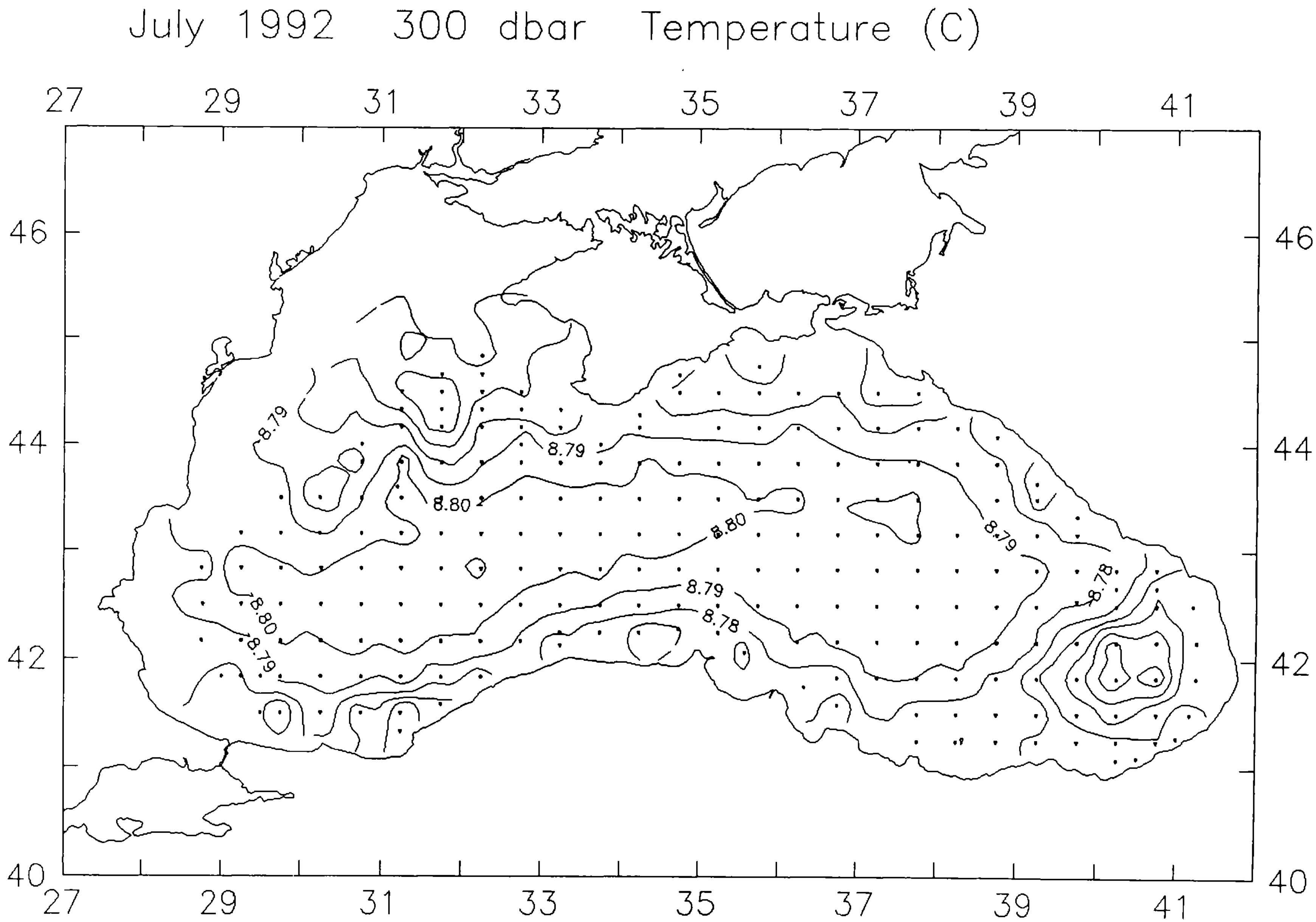


Figure 29a: Horizontal distribution of potential temperature at 300 dbar level.

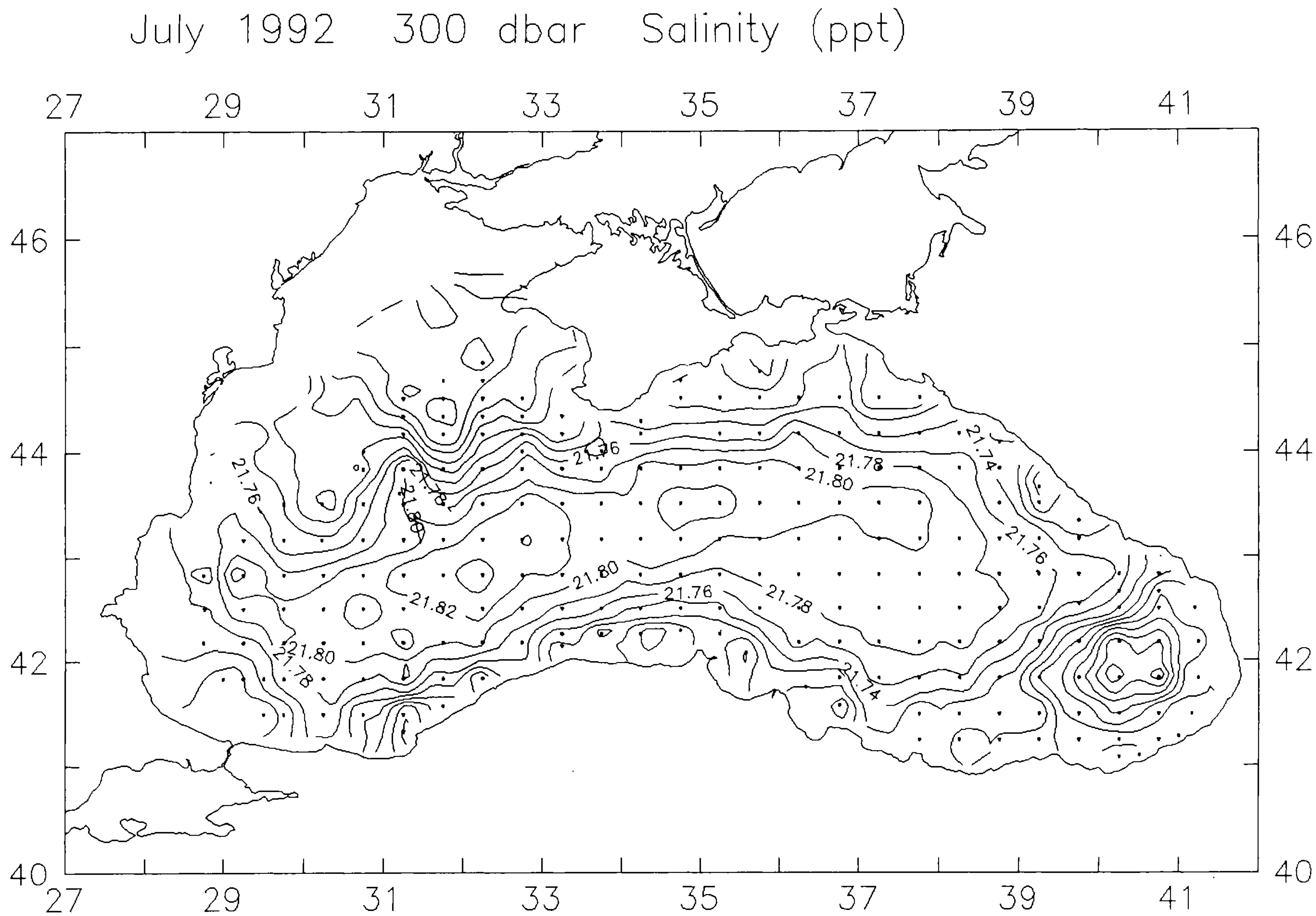


Figure 29b: Horizontal distribution of Salinity at 300 dbar level.

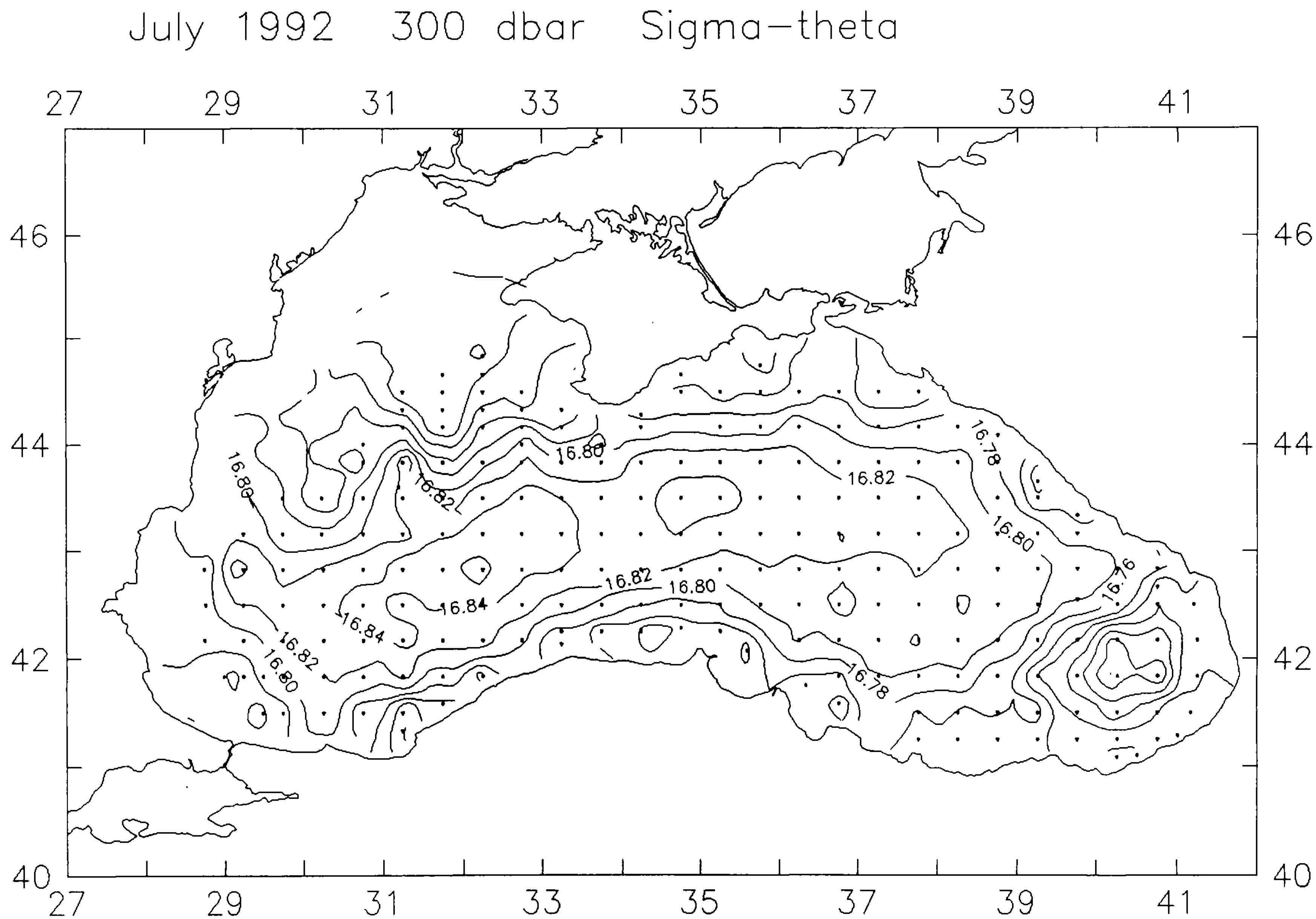


Figure 29c: Horizontal distribution of Sigma-theta at 300 dbar level.

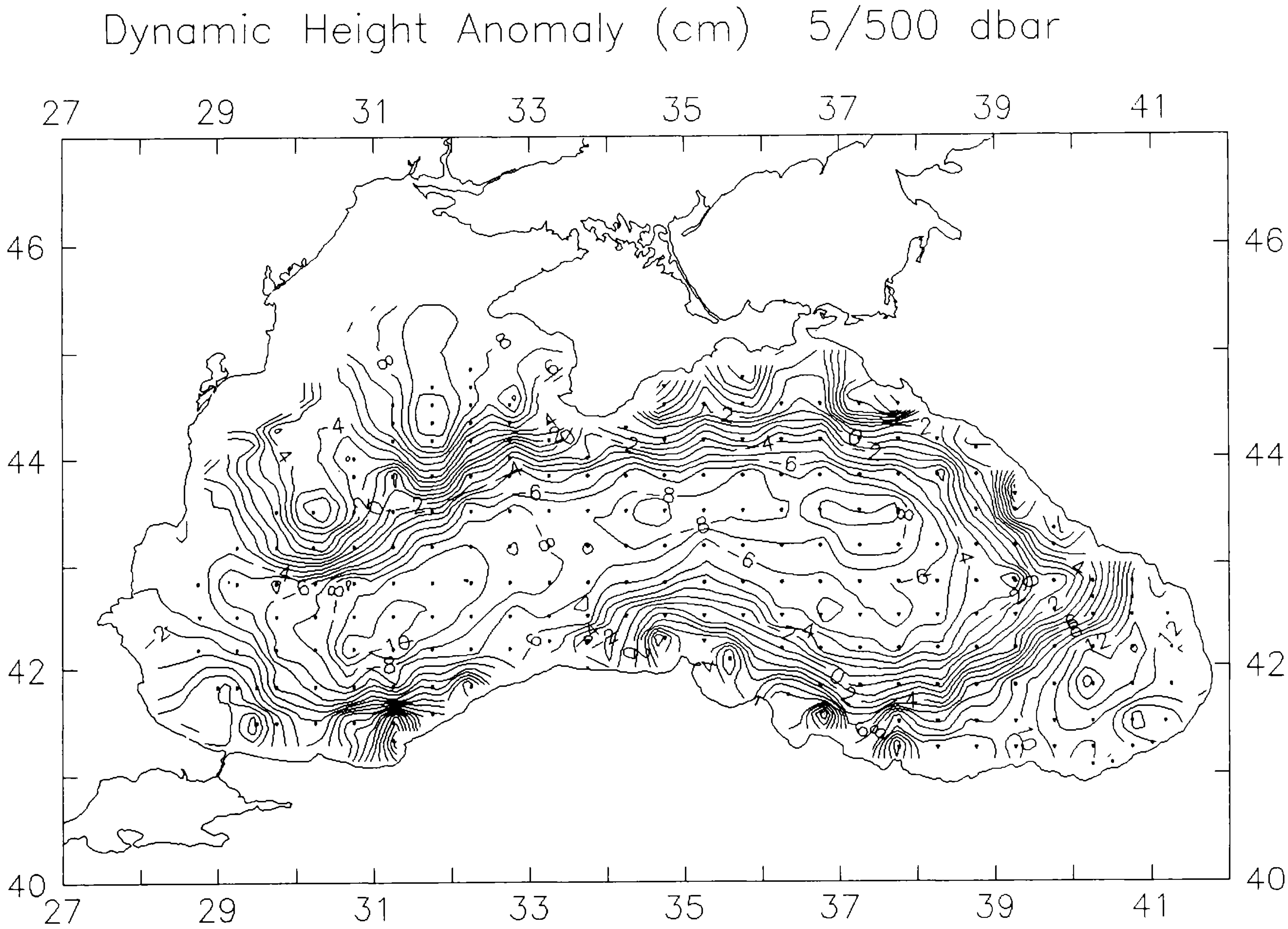


Figure 30: Dynamic topography map (relative to 500 dbar) at 5 dbar level.

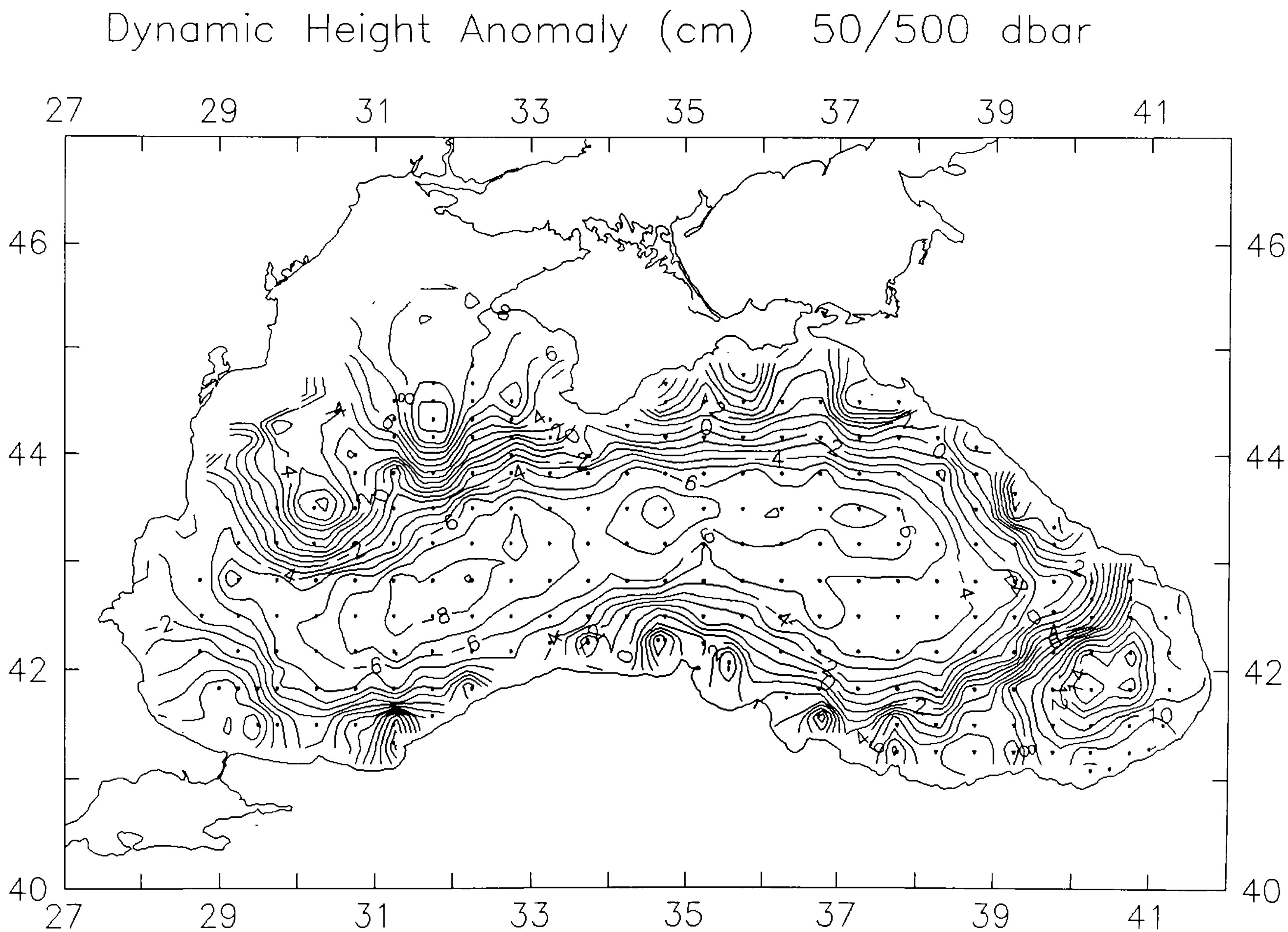


Figure 31: Dynamic topography map (relative to 500 dbar) at 50 dbar level.

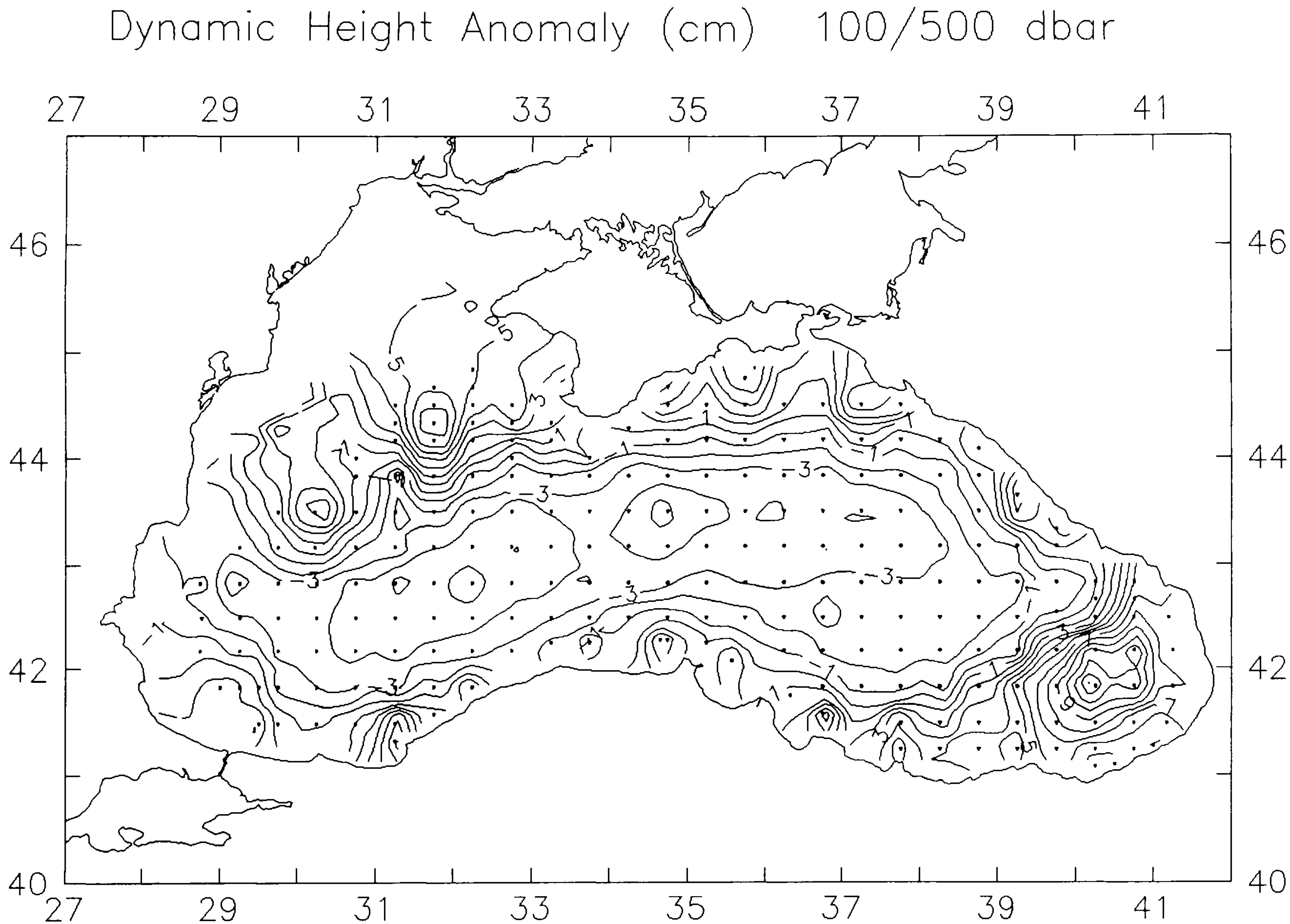


Figure 32: Dynamic topography map (relative to 500 dbar) at 100 dbar level.

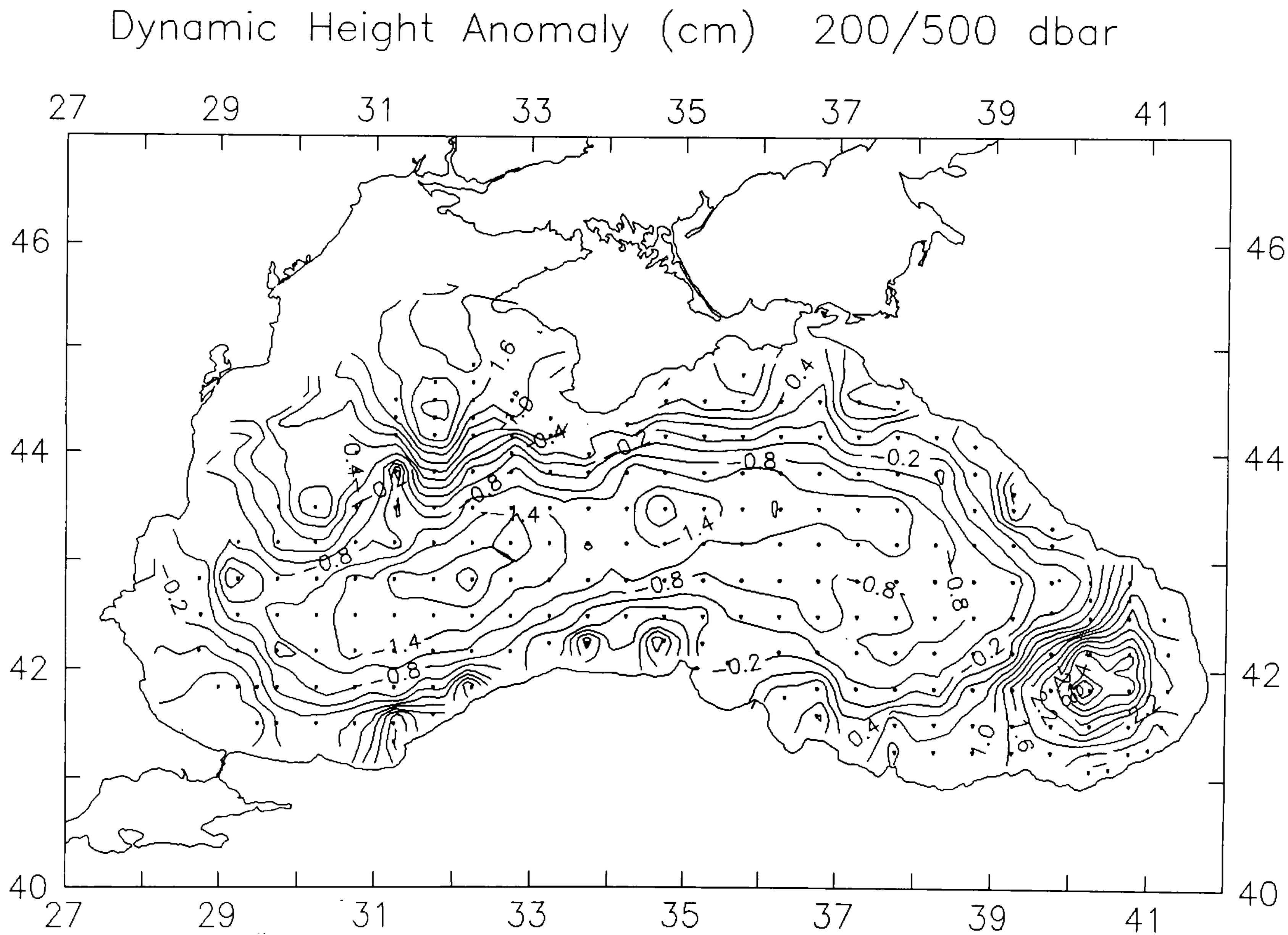


Figure 33: Dynamic topography map (relative to 500 dbar) at 200 dbar level.

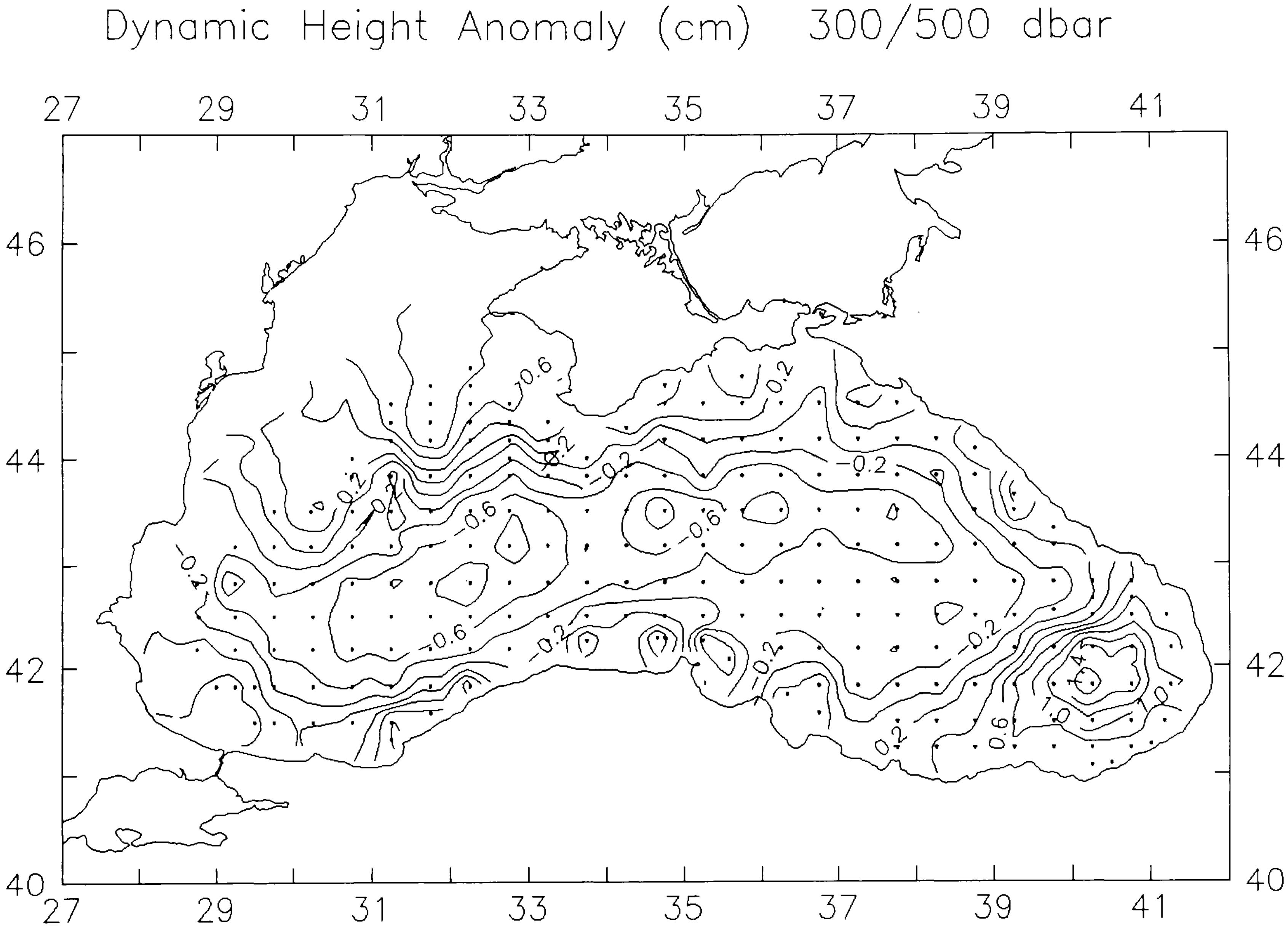


Figure 34: Dynamic topography map (relative to 500 dbar) at 300 dbar level.

6. PUBLICATIONS

At the Workshop, publications were discussed. The need to publish high quality papers in the international literature was stressed, since this will be the ultimate measure of our scientific success. Scientific thoughts were exchanged, comments made, and papers suggested. Some of these were outlined, and preliminary authors assigned. These are listed below. We emphasize that this is only a partial list of publications to come from HydroBlack '91 and CoMSBlack '92a data; the purpose of publishing these ideas is partly to encourage thoughts about other process-oriented papers, and to encourage possible collaborators to communicate more effectively.

For physics, the following papers and lead authors were identified:

- HydroBlack '91 and CoMSBlack '92a: Descriptive paper on seasonal variability of water masses on the northwest shelf of the Black Sea. Lead author: E. Demirov.

- Northwest shelf of the Black Sea: eutrophication observed during CoMSBlack '92a: Lead author: S. Moncheva.

- Diagnostic study comparing full nonlinear numerical model with quasi-geostrophic model using data from HydroBlack '91. Lead author: D. Trukhchev.

- Cold Intermediate Layer: Fine structure of the CIL. Lead author: L. Ivanov.

- CoMSBlack '92a general mesoscale circulation and thermohaline structure: CoMSBlack '92a. Lead author: T. Oguz.

- Light transparency in the Black Sea. Lead author: V. Vladimirov.

For chemistry, two papers were identified based on the joint evaluation of the biochemical data from the HydroBlack '92 cruise:

- Hydrochemistry of the oxic/anoxic transition zone.

- Regional distribution of biochemical parameters in the productive layer.

The first chemistry paper will include discussion on the differences between phosphate, silicate, dissolved oxygen, nitrate and hydrogen sulfide concentrations within different dynamical regions such as the centers of cyclones and anti-cyclones and the rim current regions.

In addition, nearly complete manuscripts exist on two general topics: general chemistry results from HydroBlack '91 results.

7. FUTURE CoMSBlack EXPEDITIONS

At this meeting, future CoMSBlack expeditions were discussed. CoMSBlack '93a, to be held in April, 1993, was discussed in detail, and a Cruise Report update was issued. This expedition will focus on the spring phytoplankton bloom on the northwest shelf of the Black Sea.

CoMSBlack '93b will focus on ichthyoplankton (fish eggs and larvae) and their relationship to *Mnemiopsis* and other predators.

CoMSBlack '94a was discussed. Early ideas were to hold this cruise in February, 1994, and focus on the winter bloom in the interior Black Sea, as well as Cold Intermediate Layer (CIL) formation in the interior cyclones.

8. REFERENCES

Aubrey, D.G., T. Oguz, E. Demirov, V. Ivanov, T. McSherry, V. Diaconu and E. Nikolaenko, 1992. HydroBlack '91 - Report of the CTD Intercalibration Workshop. Woods Hole Oceanographic Institution Technical Report, WHOI 92-10, CRC-92-01, CoMSBlack 92-005, 126 pp.

Fofonoff, N.P. and R.C. Millard, 1983. Algorithms for Computation of Fundamental Properties of Seawater. UNESCO Technical Papers in Marine Science no. 44, 53 pp.

ANNEX I

WORKSHOP AGENDA

CoMSBlack '92a DATA INTERCALIBRATION MEETING
INSTITUTE OF MARINE SCIENCES, M.E.T.U.

15-29 JANUARY 1993

SCHEDULE

Friday, 15 January 1993
- 0830: Breakfast
- 0900: Meeting begins: Plenary session
- 1000: Working groups: Data quality checks
- 1300: Lunch
- 1499: Working groups: Data quality checks
- 1930: Dinner

Saturday, 16 January 1993
- 0830: Breakfast
- 0900: Working groups: data quality checks/intercalibration
- 1300: Lunch
- 1499: Working groups: data quality checks/intercalibration
- 1930: Dinner

Sunday, 17 January 1993
- 0830: Breakfast
- 0900: Working groups: intercalibration
- 1300: Lunch
- 1400: Working groups: intercalibration
- 1930: Dinner

Monday, 18 January 1993
- 0830: Breakfast
- 0900: Free day
- 1300: Lunch
- 1400: Free day
- 1930: Dinner

Tuesday, 19 January 1993
- 0830: Breakfast
- 0900: Working groups: complete intercalibration stations
- 1300: Lunch
- 1400: Working groups: complete intercalibration stations
- 1930: Dinner

Wednesday, 20 January 1993
- 0830: Breakfast
- 0900: Plenary session: Working group reports
- 1300: Lunch
- 1400: Working groups: Pool data
- 1930: Banquet: Mersin

Thursday, 21 January 1993
- 0830: Breakfast
- 0900: Working groups: data interpretation/plotting
- 1300: Lunch
- 1400: Working groups: data interpretation/plotting
- 1900: Dinner

Friday, 22 January 1993
- 0830: Breakfast
- 0900: Working groups: Review/correct HydroBlack '91 science papers
- 1300: Lunch
- 1400: Working groups: data interpretation/plotting
- 1930: Dinner

Saturday, 23 January 1993
- 0830: Breakfast
- 0900: Plenary: Cruise planning: CoMSBlack '93a
- 1300: Lunch
- 1400: Plenary: Cruise planning: CoMSBlack '93a
- 1930: Dinner

Sunday, 24 January 1993
- 0830: Breakfast
- 0900: Working groups: data interpretation/plotting
- 1300: Lunch
- 1400: Working groups: data interpretation/plotting
- 1930: Dinner

Monday, 25 January 1993
- 0830: Breakfast
- 0900: Free day
- 1300: Lunch
- 1400: Free day
- 1930: Dinner

Tuesday, 26 January 1993
- 0830: Breakfast
- 0900: Plenary: Interdisciplinary discussions on CoMSBlack '92a
- 1300: Lunch
- 1400: Plenary: Interdisciplinary discussions on CoMSBlack '92a
- 1930: Dinner

Wednesday, 27 January 1993
- 0830: Breakfast
- 0900: Working groups: Complete Workshop Report
- 1300: Lunch
- 1400: Working groups: detailed outlines of science papers: writing assignments
- 1930: Dinner

Thursday, 28 January 1993
- 0830: Breakfast
- 0900: Working groups: detailed outlines of science papers: writing assignments
- 1300: Lunch
- 1400: Working groups: complete Workshop Reports, end session
- 1930: Final dinner

Friday, 29 January 1993
- 0830: Breakfast
- 0900 Departures as scheduled

Plenary Session: Classroom
Working Groups: Computer rooms
All Meals are in Dining Room, unless otherwise indicated
For detailed working group assignments and goals, see attached sheets.

OUTLINE OF THE WORKING GROUP
PHYSICAL OCEANOGRAPHY
INTERCALIBRATION WORKSHOP
ERDEMLI, TURKEY
15-29 JANUARY 1993

Physicists attending:

- Encho Demirov
- Vladimir Vladimirov
- Vasile Diaconu
- Leonid Ivanov
- Vitaly Ivanov
- Muhammed Duman
- David Aubrey
- Temel Oguz (Chair)
- Erdemli group

PHYSICS TASKS

- Data quality check: finish in a few days
  - spikes
  - stability
  - data gaps
- Intercalibration stations
  - look for drift in temperature sensors
  - choose "best" data/intercalibration parameters
  - compare with *Knorr*, HydroBlack '91, and previous data sets
- Application of intercalibration constants to data sets
  - check against previous work
  - use with remote sensing
  - pool data
- Plot data
  - examine spatial distributions (outliers, consistency)
  - science interpretation
- Discuss HydroBlack '91 paper
  - draft handed out on 15 January 1993
  - comments and discussion on 22 January 1993
- CoMSBlack '92a papers
  - outline and lead authors
  - assign writing assignments and time schedule

OUTLINE OF THE WORKING GROUP PHYSICAL OCEANOGRAPHY INTERCALIBRATION WORKSHOP ERDEMLI, TURKEY 15-29 JANUARY 1993

Chemists attending:

- Sergei Konovalov
- Lilian Dorogan
- Alexander Stoyanov
- Ahmet Balci
- Özden Bastürk
- Süleyman Tugrul
- Aysen Yilmaz

CHEMISTS TASKS

- Data quality checks: finish in one week
    - Discussion about the methodology used
    - Conversion of data into common units
    - Input of density values for each sampling depth
    - Data gaps
- Intercalibration
    - Plots of composite data versus σ_t for each group
    - Plots of ratios of Si to H_2S and PO_4
    - Comparison of the composite plots with *Knorr*, 1988
- Comparison of data at common intercalibration station with *Knorr*, 1988 data
- Discussion about HydroBlack '91 joint papers
    - Draft paper handed out on 20 January 1993
    - Comments and discussion on 22-23 January 1993
- CoMSBlack '92a papers
    - Topics of papers and leading authors
    - Writing assignments and time schedule

ANNEX II

CRUISE PLANNING DOCUMENT

CoMSBlack '92A

CRUISE START: 1 JULY 1992

Following the successful completion of HYDROBLACK '91, the Steering Committee of the Cooperative Marine Science Program for the Black Sea (CoMSBlack) has decided to conduct two additional CoMSBlack cruises in 1992. The first of these, CoMSBlack '92a, will be held beginning on 1 July 1992. A cruise planning meeting, held in Constantza on 22 May 1992, finalized the details of this cruise. This document emerged from the decisions made at the meeting in Constantza.

In keeping with the results of the Steering Committee meetings, as well as the other CoMSBlack meetings and workshops, the overall goals of CoMSBlack will be expanded to include other program elements in addition to the emphasis on ocean circulation and mixing. In particular, CoMSBlack '92a will focus on egg and larvae surveys, using plankton nets at selected stations, as well as biogeochemistry. Intercalibration is a key issue in this survey, as in past surveys. The name of the cruise series (formerly HYDROBLACK) has been changed (now CoMSBlack) to reflect this broader focus. The use of the prefix "hydro" inferred hydrography to many participants, to the exclusion of broader interdisciplinary interests.

With the signing of the Convention for the Protection of the Black Sea against Pollution in April 1992, and in light of the May 1992 GEF meeting in Constantza, Romania, these cruises are taking on an added importance in providing decision- and policy-makers with much needed scientific evidence of the condition of the Black Sea. These data must be acquired with as much precision as possible, and results disseminated to the community as rapidly as possible.

1. SCIENTIFIC OBJECTIVES OF CoMSBlack '92a

The existing scientific studies on the Black Sea oceanography indicate the major physical, chemical, and biological processes are inadequately understood and further studies are essential. Growing evidence of deteriorating environmental conditions of the sea make it timely to carry out multi-institutional interdisciplinary studies on the Black Sea oceanography because the problems have regional character, their solutions are of practical consequence, and they require coordinated research efforts between and among neighboring countries.

Fish egg and larval studies have taken on an added importance considering the decline in fisheries yields in past decades. The collapse of fisheries for larger fish, the preying on eggs and larvae by the abundant intruder *Mnemiopsis*, and the questionable health of the fisheries for smaller fish, all argue strongly for an effective, basin-wide egg and larval survey. This survey will be conducted using plankton nets of specific design, though the first survey is meant to serve also as intercalibration and cross-training. The station network is defined below.

Biogeochemical sampling will focus again on the dynamics of nutrients, the processes contributing to eutrophication, and the cycling of various biogeochemically active materials (carbon, silica, etc.). Sampling will be performed at standard depth intervals at every third hydrographic station, and will include oxygen, nitrate, ammonia, phosphate, silica, oxygen, hydrogen sulfide, and other parameters listed in the attached table.

Mixing and dispersion of passive particles and admixtures within the Black Sea are influenced by winds and density differences due to heating/cooling, evaporation, precipitation, inflow/outflow from straits and the river run-off. All these sources act on the Black Sea and contribute to its temporally and spatially complex patterns of circulation. The circulation is complicated by a field of eddies with intense jets, filaments, and meandering currents along the coasts. The circulation has permanently a cyclonic character and seems to have both transient and stationary components: the mesoscale variability appears to mask the traditionally defined general circulation field.

In the Black Sea, the so-called Cold Intermediate Layer (CIL) is formed in the northwestern shelf region as well as in the upwelled waters of the basin's interior. Neither the process of formation (e.g., intensity and patchiness of convection events) nor the subsequent spreading, mixing, and transformation characteristics of this water mass are clearly understood and deserve further scientific studies. The CIL is a critical mechanism for transport of pollutants basin-wide, serving as a conveyor belt for elements input at the surface or boundaries and vertically entrained to the slightly deeper waters above the main pycnocline.

The overall scientific objective for the Black Sea oceanographic studies is to establish a definitive phenomenology to understand, quantify, and model the fundamental biological, chemical, and physical mechanisms and their interactions, particularly with respect to pollution. This will form a basis for further studies on transport and dispersion of material, productivity, efficient utilization, exploration and exploitation of marine resources, management of the environment, and control of pollution, etc. The following are some specific problems that need to be addressed to achieve this objective:

- investigation of the primary biogeochemical processes of the euphotic and aphotic zones of the water column, and of the interactions between the shelf and deep sea,
- factors influencing biological productivity in coastal and offshore waters,
- determination of the dissolved oxygen and hydrogen sulfide levels at the oxic/anoxic interface, and its influence on rates of N and S transformation,
- determination of important sources and sinks of C, N, P and Si as well as nutrients, and the role of eddies in nutrient cycling and primary productivity,
- how the invasion of exotic species has altered Black Sea food webs,
- how the microbial loop partitions primary production into recycled and new production,
- impact of eddies and other features of circulation on fisheries through recruitment and/or production.
- determination of horizontal and vertical material fluxes within the sea and their variability,
- intercomparison of the main forcing mechanisms; the wind versus thermohaline forcing, source/sink flow through straits and their spatial as well as seasonal, annual, interannual variability's, and budgets,
- the roles played by the topography and the irregular coastline on mixing and dispersion,
- the process of convection associated with the Cold Intermediate Layer formation and its subsequent sinking, spreading and mixing characteristics, as well as its influence on the oxic/anoxic interface,
- identification of major features of circulation, its energetics, and basic space and time scales of its variability,
- analysis of available historical data sets and satellite imagery (both AVHRR and CZCS),
- implication of the circulation for the distribution of biological and chemical processes.

This program will contain not only hydrographic and biogeochemical measurements, but also remotely sensed data to place those measurements in context, as well as numerical modeling results to compare modeling techniques and assumptions. The new focus on fish egg and larval surveys will be implemented beginning with CoMSBlack '92a.

2. ELEMENTS OF THE CoMSBlack '92a RESEARCH PROGRAM

In order to achieve some of the scientific objectives specified in the previous section, a basin-wide multi-institutional survey was carried out during September 1991. The survey was aimed at quantifying the spatial distribution of important physical and biogeochemical parameters and their interrelations with the mesoscale features (eddies, jets, and filaments, etc.). CoMSBlack '92a will carry on many of the same objectives of HYDROBLACK '91. The objectives listed above can be accomplished by the determination and/or measurement of the following parameters:

Meteorological Measurements

At each hydrographic station, each ship observed and recorded the following meteorological parameters:

1. Time (Greenwich Mean Time),
2. Location (degrees latitude/longitude, using GPS if possible),
3. Air temperature (degrees Celsius),
4. Humidity (relative humidity, dew point, or wet bulb),
5. Wind speed and direction (m/sec, degrees from north),
6. Atmospheric pressure (millibars),
7. Sea surface temperature (degrees Celsius),
8. Rainfall (centimeters).

Parameters 3 through 5 should be measured as closely as possible to the 10 m height as required by bulk flux formulae. Additional measurements could be helpful but are not required.

Physical Measurements

The station network for the CoMSBlack '92a July survey is shown in Figures 1 and 2. The CTD stations at which the physical parameters (depth versus temperature and conductivity) are measured are, in general, located on a grid with spacing of 1/3° latitude and 1/2° longitude. CTD measurements will nominally be up to 500 m, except the intercalibration stations will be to the full 2000 m depth. Stations located at the continental slope should be at the full water depth. The *Kolesnikov* will collect CTD data for all stations in Georgian, Russian, and Ukrainian waters; the *Bilim* and *Piri Reis* will collect data in Turkish waters; and the *Akademik* will collect data in Bulgarian and Romanian waters. The *Vodyanitsky* will collect CTD data at the stations where it performs the fish and larvae measurements.

The raw CTD data obtained for all stations will be processed by each party to obtain bin-averaged data at 1 db depth intervals and converted to the pressure, potential temperature, salinity, sigma-theta by means of standard software packages (e.g., MatLab).

Experience with HYDROBLACK '91 showed some stations had spikes caused by slow lowering of the instrument through the thermocline. The instrument should be lowered quickly and smoothly through this rapid gradient, to prevent errors (spikes) due to wake shedding from an unsteady descent of the CTD.

Secchi disk depths are also to be measured at CTD stations.

Biogeochemical Measurements

Biogeochemical parameters which are to be measured in the Black Sea are shown in Table 1. Dissolved oxygen, hydrogen sulfide, phosphate, nitrate, ammonia, silica, and chlorophyll-α are the main parameters to be measured. The other parameters listed in Table 1 are optional.

Biogeochemical measurements are to be carried out at a smaller number of stations along selected transects. These transects are in the regions where important physical variability is anticipated. The water samples are to be taken with Rosette samplers where available at pre-specified depth levels depending on the biological and chemical quantities desired.

- For dissolved oxygen, the standard depth levels specified for this study are 5m, 10m, 20m, 30m, 40m, 50m, 60m, 70m, 80m, 90m, 100m, 110m, or until the 15.4 density level (sigma-theta) is reached. Every 5m will be sampled between 15.4 sigma-theta and 16.20 sigma-theta.

• For nutrients, above sigma-t of 15.4, the same depths will be sampled as for oxygen. Below sigma-theta of 15.4, samples will be taken at the following depths: 150m, 200m, 250m, 300m, 400m, 500m, 750m, 1000m, 1250m, 1500m, 1800m, and 2000m.

• For H_2S, samples will be taken every 5m between sigma-theta of 15.4 and 16.2 (same as oxygen); below sigma-theta of 16.20, samples will be taken at 12 depths (same as for nutrients).

• For chlorophyll, samples will be taken at the standard shallow depths, plus at the sigma-theta level of 15.4 and at the fluorometer maximum.

Other samples, such as for TOC, DOC, POC, PON, TSS, Eh and pH will be taken as possible according to the capabilities of each ship.

See table 1 for the details of the biogeochemical measurements.

Based on experience from HYDROBLACK '91, the chemical measurements must be taken carefully. Errors in depth measurement made intercomparison of measurements near the chemocline poor. A pressure sensor recording the exact depth at the sampling point should be used to verify the sampling pressure depth at each location. Otherwise, these intercalibration errors are sure to persist.

Biogeochemical parameters should be reported in the following units:

- O_2, H_2S, PO_4, NO_3+NO_2 and other chemical parameters to be reported in micromolar.
- Chlorophyll-α reported in micrograms per liter.

The cruise plan recognizes the need for proper cross-training and intercalibration of methods, as recommended at the Yalta meeting in February, 1992. However, we may still continue biogeochemical sampling with the Yalta meeting in mind, though this intercalibration exercise has not yet been held.

Fish Egg and Larval Measurements

Parameters to be measured are listed in Table 2. Fish will be measured at stations indicated in Table 2 (only the Vodyanitsky will be sampling for fish). All parameters shown in the table will be measured. Phytoplankton will be collected for processing as soon as possible after the cruise. The phytoplankton will be sampled using large volume bottles, and identified quantitatively at the species level. Bottle samples will be obtained by sieving through a 55 μ mesh. It will be concentrated in a nucleopore filter, and fixed with gluta-aldehyde. Biomass will be determined through the size and pattern of the cells. Primary production will be estimated, as in HYDROBLACK '91, by chlorophyll-α measurements. Zooplankton will be measured quantitatively to the species level; net samples will be taken using a 300 (or 500) μ mesh net.

Ichthyoplankton will be measured using nets as well. Measurements will be made by vertical tows and at specific depth intervals of interest (Table 2). IBSS will conduct acoustic monitoring for fish; IMS/METU will attempt this. Other ships may do this according to their capabilities. Finally, CHN-analysis will be conducted of anchovy eggs and larvae in areas of normal high concentration indicated by acoustic measurements (thought to be off Bosphorus and Sevastopol). These measurements will be made by IBSS and IMS/METU only.

The fish egg and larval measurements will be taken along transects shown in Figure 2. Within the Georgia, Russia, and Ukraine EEZ, the *Vodyanitsky* will take these measurements. Within the Turkish EEZ, the *Bilim* will take these measurements, and within Romanian and Bulgarian waters, the *Akademik* will take these measurements. In addition, the *Vodyanitsky* will take CTD profiles at all stations they occupy, for intercalibration and consistency purposes.

Remote Sensing

CoMSBlack '92a will also be supported by the remote sensing facilities of the participating institutions. The AVHRR imagery from the Black Sea will include a sequence of pictures that will describe the temporal evolution of the features in the sea. A period of about one month starting from one week before the survey and ending one week after the survey is accepted as the optimum period for the coverage of the AVHRR data.

The Institute of Marine Science--Middle East Technical University will attempt to provide the real time AVHRR infrared and visible satellite data through the Automatic Picture Transmission (APT) system in use at Erdemli campus. APT givens three AVHRR pictures in the Black Sea each day with a 4 km x 4 km resolution.

Intercalibration Requirements

Intercalibration/intercomparison constitutes an essential component of the CoMSBlack '92a program. All measurements are to be carried out with approved, calibrated instruments. Meteorological instruments are to be calibrated with the local meteorological service before the cruise. CTD sensors are to be calibrated before the cruise by the manufacturer (Seabird or other).

Four intercalibration stations for CTD are to be co-occupied simultaneously per joint research area. These stations should ideally be occupied simultaneously but a reasonable time lag between the measurements can be tolerated. Uniform properties of the Benthic Boundary Layer (about 400 m thick) near the bottom form an ideal environment for the intercalibration of the physical measurements, so all deep stations should penetrate to this depth.

Intercomparison/intercalibration is vital and will be accomplished generally by three means: (1) pre-cruise exchange of standard samples, (2) at-sea calibration at common stations, and (3) for some easily preserved quantities, post-cruise exchange of samples collected at sea. For at-sea calibration, there is a much greater time constraint on the measurement of biochemical variables than on the physical variables. In order to intercalibrate measurements for the upper layer above the pycnocline, the measurements will be simultaneous, where possible. The measurements must, however, be made within 24 hours of each other.

Integration of the CTD observations from different profilers requires an estimate of the error associated with each CTD profiler. Salinity values will be calibrated against the salinometer at the Woods Hole Oceanographic Institution. For this purpose, 100 ml water samples will be collected during the upcast at appropriate depths. These depths will be in the lower 1000 m of the water column, where the temperature and salinity are more vertically homogeneous. One such bottle will be collected during each cast. At every third station, three bottles will be collected in the vertical, to allow improved intercalibration. Standard water bottles made of suitable glass must be used for the sampling. The following information should be recorded at each station: Station name, Time & Date (GMT), CTD pressure, CTD temperature, CTD conductivity, CTD salinity (to 0.001 psu), and the sample bottle number. After the cruise, water bottles and a copy of the station log will be sent to Dave Aubrey at WHOI where the bottle salinity will be measured with the high quality salinometer. The *in situ* conductivity will then be calculated from the CTD pressure and temperature, and the bottle salinity. The difference between the in situ true conductivity and the CTD conductivity is the sensor error. Systematic errors can be used to correct the raw CTD conductivity.

Biogeochemical measurements are to be intercalibrated at the intercalibration stations according to the procedures set before the cruise. It is important that the parties agreed on the methodology to be followed in the analysis of the biogeochemical parameters. The methodology should be as discussed at the Yalta workshop of February 1992.

For egg and larval surveys, intercomparison will be made at two common stations as shown in Figure 2. The dates and times of the intercomparison stations will be decided by the chief scientists of the research vessels, and every effort will be made to meet at the intercomparison stations to make the casts simultaneously. At these egg and larval intercomparison stations, at least seven vertical tows (0-100 m) will be made and jelly fish and ctenophora samples will be processed on the ship. Data on other organisms will be collected and processed as soon as possible during or immediately after the cruise.

Equipment Available

The SeaBird Electronics CTD will be the standard CTD for the program. WHOI will attempt to place a SeaBird on the Akademik. If WHOI cannot place a CTD, MHI will bring an ISTOK VII on board the ship. Since this cruise is such a major undertaking, it is essential that the CTD's all provide the same accuracy and sampling capabilities. Experience with HYDROBLACK '91 showed the *Kolesnikov's* Istok V CTD was not of great enough precision or accuracy. Temperature must be measured to 0.0001 °C, with a precision of 0.003°C. Conductivity must have an accuracy of 0.002 siemans/m.

All ships have the equipment specified in Table 1 as required.

Plankton nets will be agreed to and standardized at the 10 June 1992 meeting in Varna, as indicated in Table 3.

Data Exchange

The processed CTD data sets (i.e., 1 db bin-averaged and converted to the form of pressure, temperature, salinity, and density) will be exchanged between all participating groups immediately after the cruise, in IBM-compatible ASCII files on 5.25 or 3.5 inch flexible diskettes. The precise format of the CTD data is given Table 5. The data exchange mechanism will be specified.

A workshop will be planned for August 1992 to pool all the CTD data, make a collective data set and carry out the cooperative and synthetic scientific analysis. For this purpose, the quality control of the CTD data sets will be first checked for instrument error. The data will then be intercalibrated with respect to bottle-calibrated CTD measurements and by other means which will be set during the workshop. The final form of the pooled data set will contain pressure, temperature, potential temperature, salinity, density, and sigma theta.

Because a major part of the biogeochemical samples requires laboratory analysis, exchange of the biogeochemical data will be done within three months following completion of the cruise. It is also to be exchanged in the form of ASCII files on the IBM compatible 5.25" and 3.5" diskettes. The data format will be as set out during the Yalta meeting. A brief description of format, analysis techniques, problems, and errors should accompany each data set in a "read-me" file.

For a period of three years after the data exchange, the data collected by each party will be considered the property of that party. The data cannot be published by another party without permission of the party collecting those data. Joint publications are encouraged. After three years, the complete data set will be considered common property of the participating institutions.

Publications

On the basis of the data gathered during CoMSBlack '92a, a series of joint publications will be produced within the first three years. These joint publications will bear the name of the scientists who were actively involved in the data collection/processing stages of the CoMSBlack '92a program. They will be prepared in English for their submittal to high standard oceanographic journals. Some articles also may be prepared in the native languages of each party.

Exchange of scientists between the parties is considered to be desirable in order to review jointly and evaluate the data and prepare drafts of the joint articles. The time and place of the meetings will be decided later by the organizing committee of CoMSBlack.

3. DETAILED CRUISE PROGRAM

The station network presented in figures 1 and 2 will be covered by the participating ships. To the extent possible, ships will operate within their national waters; those that cannot will obtain permission from the other countries. Scientific parties from all countries should be encouraged to participate in the cruises off their coast. The names of the ships, cruise coordinators, and chief scientists assigned for each ship are given in Table 5. The equipment available on board each ship is listed in Table 6. The cruise schedule is planned such that quasi-synoptic results are achieved. The survey period will start within the first week of July, 1992, and is expected to be completed within two weeks. Approximate starting dates for each ship are given in Table 7. The locations of stations which will be visited by each ship are given in Table 8.

Each ship will cover a specified region (Figure 1), but there are some overlapping stations which will be visited by more than one ship during the survey. These common stations are essential for intercalibration purposes. Figure 3 shows the selected transects for the biogeochemical stations; biogeochemical stations are listed in Table 9.

R/V *Bilim* and *Akademik* has been assigned as the mother ship responsible for ship-to-ship communications during the survey. The R/V *Bilim* will make contact with all other ships immediately when CoMSBlack begins, to establish the frequency of use and the specific times of the daily communication. R/V *Bilim* will be responsible for the communication with the Ukrainian ships. R/V *Akademik* will communicate with the *Bilim* and the *Piri Reis* and closest Ukrainian ship. A single-side-band channel will be assigned for this purpose, with frequency to be established by the Bilim. Ship-to-ship communications will be done twice a day at 0600 and 1400 GMT hours, unless changed by the *Bilim*.

Starting date and times of the ships for the survey must be informed to all other participating institutions the day of departure by the institutions, by telemail or telex. Institutions will be responsible to inform the others of the stations occupied by their ships every three days.

To finalize the details of the plankton sampling for eggs and larvae, a planning meeting will be held in Varna, Bulgaria, hosted by the Institute of Oceanology of the Bulgarian Academy of Sciences. In-country living expenses will be borne by the Institute of Oceanology. One biologist representing each plankton sampling ship and/or country should attend this meeting. At this meeting, the final specification will be made for equipment and methods to be used, including net sizes and operation, tow speeds, and tow strategies; timing and synchronization of plankton sampling within the hydrographic and biogeochemical sampling; sampling grid for plankton for the Romanian and Bulgarian sector; and completion of Table 3 of this report. The participants should assure that the methodology and number of stations chosen are the most suitable for quantification of the plankton, and interpretation of the basin-wide conditions.

Table 1

Biogeochemical Measurements
(Units to be reported in micromolar for O_2, H_2S, PO_4, NO_3+NO_2,SiO_4; Chlorophyll-α to be reported in μg/l)

Table 2 of Yalta report (February 1992) will be used, with measurements made as well as possible. Some items (POC, DOC) may be outside capabilities of ships.

List of Biochemical Parameters

Parameters	Depth levels	Sampling equipment	Volume required	Method & Instruments	Detection Limit	Stations	Notes
Dissolved O_2	Above σ_θ = 15.4 (density) at 9 standard depths + Between σ_θ = 15.4 and 16.20 every 5 meters	Niskin* (Rosette) Nansen	150 ml	Winkler (semi-automatic)*	1 μM	every 3rd CTD station or along specified trancests	
H_2S	Between σ_θ = 15.4 and 16.20 every 5 meters (same levels as O_2), then 12 depths	Niskin* (Rosette) Nansen	250 ml	Winkler (semi-automatic)* Colorimetric*	1 μM	every O_2 station	
Nutrients NO_3^- (+NO_2^-) PO_4^{-3} SiO_4 NH_4^-	Standard depths and at σ_θ = 15.4, + Below σ_θ = 15.4 at 12 standard depths	Niskin* (Rosette) Nansen	250 to 1000 ml+	Autoanalyser* Colorimetric	1 μM	every O_2 station	
chl. a	Standard depths, at the Fluor. max, and at σ_θ = 15.4,	Niskin* (Rosette) Nansen	250 to 2000 ml+	Spectro-photometer (Spectro-fluorometer)	0.1 mg/m^3 0.1 mg/m^3	every O_2 station	UNESCO (1966) optional
chl. a size fractionation	same as chl. a						
Phaeopigments	same as chl. a	-	-	-			
TOC	14 levels (0 - 1000 m and at the chl. a max - min	Niskin* (Rosette) Nansen	100 ml	Organic carbon analyser	To be discussed	selected	calculated as TOC minus POC
DOC	same as TOC	Niskin* (Rosette) Nansen	100 ml	Organic carbon analyser	To be discussed	selected	only IMS has the equipment at present

Parameters	Depth levels	Sampling equipment	Volume required	Method & Instruments	Detection Limit	Stations	Notes
POC	4 levels (0 - 500 m)	Niskin* (Rosette) Nansen	2.5 l	CHN Analyser	To be discussed	selected	
PON	4 levels (0 - 500 m)	Niskin* (Rosette) Nansen	2.5 l	CHN Analyser	To be discussed	selected	
TSS (Light transmission)	Continuous with depth	-	-	Transmisometry	To be discussed	all CTD	only IMS have the equipment at present
Fluorescence	Continuous with depth	-	-	In situ Fluorometer		all CTD	only IMS has the equipment at present
Eh and pH	Standard depths and at high resolution between σ_θ = 15.4 and 16.2	Niskin* (Rosette) Nansen	50 ml	pH meter		selected	only IMS and IBSS have the equipment at present
Primary production	6 Light levels (surface to 1% light transmission)	Niskin* (Rosette) Nansen	100 ml	β - counter		selected	only IMS and IBSS have the equipment at present
Phytoplankton	same levels as chl. a	Niskin* (Rosette) Nansen	1 l	Inverted* Microscope		all chl. a station	only IMS and IBSS have the equipment at present
Zooplankton	Oxic layers	Plankton Net		Microscope		all O_2 stations	

* Recommended

+ Depends on laboratory equipment available

(from CoMSBlack 92-006)

Table 2

Biological Measurements
R/V's *Vodyanitsky*, *Piri Reis*, *Bilim* and *Akademik*

Fish (at selected stations)

++ Population characteristics, growth and mortality
++ Age and length distribution
++ Maturity stages, sex ratio
++ Stomach content analysis
++ Fat content (lipids), albumin and glycogen

Phytoplankton (quantitatively at species level; bottle samples sieved through 55 μ mesh for Vodyanitsky and Bilim; sedimentation method for filtering to be used by the Akademik)

oo * + Homogeneous layer
oo * + Thermocline layer
oo * + Cold Intermediate Water
oo * + Continuous halocline
oo * + Sampling and Preservation

Zooplankton (Quantitatively at species level; 300 μ mesh; net samples)

* ++ Homogeneous layer (at stations indicated with a +)
* ++ Thermocline layer (at stations indicated with a +)
* ++ Cold Intermediate Water (at stations indicated with a +)
oo ** ++ 0-100 m vertical tows

Jelly fish - Aurelia

oo ** ++ 0-100 m vertical tows. Wet weight only

Comb jellies: Mnemiopsis and Pleurobrachia

oo ** ++ 0-100 m vertical tows. Wet weight only.
oo ++ Chemical composition of hydrobionts (Aurelia, Mnemiopsis); dry weight, ash weight, fat, protein, and carbohydrate contents.

Ichthyoplankton (up to 15 mm in length)

oo ** ++ 0-100 m vertical tows
* ++ Homogeneous layer. Horizontal tows at stations indicated by (*)
* ++ Thermocline layer. Horizontal tows at stations indicated by (*)
* ++ Cold intermediate water. Horizontal tows at stations indicated by (*)
* ++ Continuous halocline. Horizontal tows at stations indicated by (*)

Acoustical detection of fish larvae

* ++ 20 min. collection of data at stations given in Figure 2 for comparison with net samples

CTD casts:

oo ** ++ Continuous profile down to 500 m depth. Data reduced to one-meter bin averages

Primary production:

oo ** Chlorophyll-a

Table 2 (continued)

Nutrient salts

(At all stations at depths 0, 10, 20, 30, 40 m) and in polygons at stations indicated with (*) only

oo	** ++	PO_4, NO_3, SiO_4
oo	** ++	PO_4, NO_3, SiO_4 (D, E, F) indicated with asterisks (*) in Figure 2) at depths 0, 10, 20, 30, 40, 50, 75, 100, 125, 150 meters and down to anoxic layer (σt = 16.4).
oo	** ++	NO_3 (at depth of $\sigma t = 15.4$)
oo	** ++	PO_4 (at depth of $\sigma t = 16.1$)

CHN- Analysis of anchovy egg and larvae

** ++ (at high egg and larvae density sites off Sevastopol and off Bosphorus, to be collected before the start of each cruise)

**	IMS will complete task
*	IMS attempts will be made
++	IBSS will complete task
+	IBSS attempts will be made
oo	Akademik will complete task
o	Akademik will attempt work

Table 3

Net Specifications

For macroplankton, eggs, and larvae: (TO BE COMPLETED AT VARNA, 10 JUNE 1992)

Bilim		300 μ mesh
Vodyanitsky		300 μ mesh
Akademik	Double bongo net	500 μ mesh

Table 4
Physical Data Format
CTD file--CoMSBlack '92a

HEADER: A header file will accompany each data file. The header will have the following information:

First line:	Latitude in Degrees, Minutes, and Seconds
Second line:	Longitude in Degrees, Minutes and Seconds
Third line:	Date and starting time for measurements (in the form of MONTH DAY YEAR HOURS MINUTES) For example: 02 07 92 14 15
Fourth line:	Total water depth at station (in meters)
Fifth line:	The Secchi disk depth (in meters); use 999 if no depth was taken
Sixth line:	Blank

DATA FILE

First line:	First line of data set, in form: Pressure (db), Temp (Deg. C), Sal. (psu), Density (cgs)
Second line:	Second line of data set

.
.
.

Table 4 (continued)

FORMAT:

Header file:	
First line:	FORMAT (3I2)
Second line:	FORMAT (3I2)
Third line:	FORMAT (5(I2,2X))
Fourth line:	FORMAT (F5.0)
Fifth line:	FORMAT (F4.1)
Sixth line:	FORMAT (1X)
Data file:	
All Lines:	FORMAT (I4,3(1X,F7.4))

Table 5

CoMSBlack '92A
Ships, Cruise Coordinators, and Chief Scientists

Nationality	Ship	Chief Scientist	Cruise Coordinator
Bulgaria	R/V *Akademik*	Konsulov	Z. Belberov
Romania	None	Diaconu	
Turkey	R/V *Bilim* R/V *Piri Reis*	C. Saydam	Ü. Ünlüata Ü. Ünlüata
U.S.A.	None		D. Aubrey
Ukraine	R/V *Kolesnikov* R/V *Vodyanitsky*		

OVERALL CRUISE COORDINATOR: D. G. Aubrey (via OMNET)

Table 6
List of Equipment
CoMSBlack '92a

Ship	CTD PROBE	Water Sampler	Winkler Tit. System	Auto-Analyzer	Fluoro-meter
R/V Akademik	SeaBird SBE-9	Niskin Bottles	semi-automatic (Hydro-bios)	Colorimetric	Spectro-photometer
R/V Bilim	SeaBird SBE-9	General Oceanics	semi-automatic (Hydro-bios)	Technicon multichan	Navitronic Q-200
R/V Kolesnikov	ISTOK VII	ISTOK (Rosette)	Conventional lab technique	Colorimetric	Spectro-photometer
R/V Piri Reis	SeaBird SBE-9	General Oceanics	semi-automatic (Hydro-Bios)	Skalar multichan.	Spectro-photometer
R/V Vodyanitsky	IO Mark-III	Nansen Bottles	Conventional Lab Technique	Colorimetric	Spectro-photometer

Table 7
Starting Date for Ships
CoMSBlack '92a

R/V *Akademik*	**1 July 1992**
R/V *Bilim*	**1 July 1992**
R/V *Kolesnikov*	
R/V *Piri Reis*	**1 July 1992**
R/V *Vodyanitsky*	

Table 8
Stations Occupied by Each Ship

(see Table 2 of this Report)

ANNEX III

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No.	Title	Languages
52	SCOR-IOC-UNESCO Symposium on Vertical Motion in the Equatorial Upper Ocean and its Effects upon Living Resources and the Atmosphere; Paris, 6-10 May 1985.	E
53	IOC Workshop on the Biological Effects of Pollutants; Oslo, 11-29 August 1986.	E
54	Workshop on Sea-Level Measurements in Hostile Conditions; Bidston, UK, 28-31 March 1988	E
55	IBCCA Workshop on Data Sources and Compilation, Boulder, Colorado, 18-19 July 1988.	E
56	IOC-FAO Workshop on Recruitment of Penaeid Prawns in the Indo-West Pacific Region (PREP); Cleveland, Australia, 24-30 July 1988.	E
57	IOC Workshop on International Co-operation in the Study of Red Tides and Ocean Blooms; Takamatsu, Japan, 16-17 November 1987.	E
58	International Workshop on the Technical Aspects of the Tsunami Warning System; Novosibirsk, USSR, 4-5 August 1989.	E
58 Suppl.	Second International Workshop on the Technical Aspects of Tsunami Warning Systems, Tsunami Analysis, Preparedness, Observation and Instrumentation. *Submitted Papers*; Novosibirsk, USSR, 4-5 August 1989.	E
59	IOC-UNEP Regional Workshop to Review Priorities for Marine Pollution Monitoring Research, Control and Abatement in the Wider Caribbean; San José, Costa Rica, 24-30 August 1989.	E, F, S
60	IOC Workshop to Define IOCARIBE-TRODERP proposals; Caracas, Venezuela, 12-16 September 1989.	E
61	Second IOC Workshop on the Biological Effects of Pollutants; Bermuda, 10 September-2 October 1988.	E
62	Second Workshop of Participants in the Joint FAO-IOC-WHO-IAEA-UNEP Project on Monitoring of Pollution in the Marine Environment of the West and Central African Region; Accra, Ghana, 13-17 June 1988.	E
63	IOC/WESTPAC Workshop on Co-operative Study of the Continental Shelf Circulation in the Western Pacific; Bangkok, Thailand, 31 October-3 November 1989.	E
64	Second IOC-FAO Workshop on Recruitment of Penaeid Prawns in the Indo-West Pacific Region (PREP); Phuket, Thailand, 25-31 September 1989.	E
65	Second IOC Workshop on Sardine/Anchovy Recruitment Project (SARP) int he Southwest Atlantic; Montevideo, Uruguay, 21-23 August 1989.	E
66	IOC *ad hoc* Expert Consultation on Sardine/Anchovy Recruitment Programme; La Jolla, California, USA, 1989.	E
67	Interdisciplinary Seminar on Research Problems in the IOCARIBE Region; Caracas, Venezuela, 28 November-1 December 1989.	E (out of stock)
68	International Workshop on Marine Acoustics; Beijing, China, 26-30 March 1990.	E
69	IOC-SCAR Workshop on Sea-Level Measurements in the Antarctica; Leningrad, USSR, 28-31 May 1990.	E
69 Suppl.	IOC-SCAR Workshop on Sea-Level Measurements in the Antarctica; Leningrad, USSR, 28-31 May 1990.	E
70	IOC-SAREC-UNEP-FAO-IAEA-WHO Workshop on Regional Aspects of Marine Pollution; Mauritius, 29 October - 9 November 1990.	E
71	IOC-FAO Workshop on the Identification of Penaeid Prawn Larvae and Postlarvae; Cleveland, Australia, 23-28 September 1990.	E
72	IOC/WESTPAC Scientific Steering Group Meeting on Co-Operative Study of the Continental Shelf Circulation in the Western Pacific; Kuala Lumpur; Malaysia, 9-11 October 1990.	E
73	Expert Consultation for the IOC Programme on Coastal Ocean Advanced Science and Technology Study; Liège, Belgium, 11-13 May 1991.	E
74	IOC-UNEP Review Meeting on Oceanographic Processes of Transport and Distribution of Pollutants in the Sea; Zagreb, Yugoslavia, 15-18 May 1989.	E
75	IOC-SCOR Workshop on Global Ocean Ecosystem Dynamics; Solomons, Maryland, USA, 29 April-2 May 1991.	E
76	IOC/WESTPAC Scientific Symposium on Marine Science and Management of Marine Areas of the Western Pacific; Penang, Malaysia, 2-6 December 1991.	E
77	IOC-SAREC-KMFRI Regional Workshop on Causes and Consequences of Sea-Level Changes on the Western Indian Ocean Coasts and Islands; Mombasa, Kenya, 24-28 June 1991.	E
78	IOC-CEC-ICES-WMO-ICSU Ocean Climate Data Workshop Goddard Space Flight Center; Greenbelt, Maryland, USA, 18-21 February 1992.	E
79	IOC/WESTPAC Workshop on River Inputs of Nutrients to the Marine Environment in the WESTPAC Region; Penang, Malaysia, 26-29 November 1991.	E
80	IOC-SCOR Workshop on Programme Development for Harmful Algae Blooms; Newport, USA, 2-3 November 1991.	E
81	Joint IAPSO-IOC Workshop on Sea Level Measurements and Quality Control; Paris, 12-13 October 1992.	E
82	BORDOMER 92: International Convention on Rational Use of Coastal Zones. A Preparatory Meeting for the Organization of an International Conference on Coastal Change; Bordeaux, France, 30 September-2 October 1992.	E
83	IOC Workshop on Donor Collaboration in the Development of Marine Scientific Research Capabilities in the Western Indian Ocean Region; Brussels, Belgium, 12-13 October 1992.	E
84	Workshop on Atlantic Ocean Climate Variability; Moscow, Russian Federation, 13-17 July 1992.	E
85	IOC Workshop on Coastal Oceanography in Relation to Integrated Coastal Zone Management; Kona, Hawaii, 1-5 June 1992.	E
86	International Workshop on the Black Sea; Varna, Bulgaria 30 September - 4 October 1991.	E
87	Taller de trabajo sobre efectos biológicos del fenómeno «El Niño» en ecosistemas costeros del Pacífico Sudeste; Santa Cruz, Galápagos, Ecuador, 5-14 de octubre de 1989.	S only (Summary in E, F, S)
88	IOC-CEC-ICSU-ICES Regional Workshop for Member States of Eastern and Northern Europe (GODAR Project); Obninsk, Russia, 17-20 May 1993.	E
89	IOC-ICSEM Workshop on Ocean Sciences in Non-Living Resources; Perpignan, France, 15-20 October 1990.	E
90	IOC Seminar on Integrated Coastal Management; New Orleans, USA. 17-18 July 1993.	E
91	Hydroblack'91 CTD Intercalibration Workshop; Woods Hole, USA. 1-10 December 1991.	E
92	Réunion de travail IOCEA-OSNLR sur le Projet « Budgets sédimentaires le long de la côte occidentale d'Afrique » Abidjan, Côte d'Ivoire, 26-28 juin 1991.	F
93	IOC-UNEP Workshop on Impacts of Sea-Level Rise due to Global Warming. Dhaka, Bangladesh, 16-19 November 1992.	E
94	BMTC-IOC-POLARMAR International Workshop on Training Requirements in the Field of Eutrophication in Semi-Enclosed Seas and Harmful Algal Blooms, Bremerhaven, Germany, 29 September - 3 October 1992.	E
95	SAREC-IOC Workshop on Donor Collaboration in the Development of Marine Scientific Research Capabilities in the Western Indian Ocean Region. Brussels, Belgium, 23-25 November 1993.	E