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NAVAL OCEAN RESEARCH AND DEVELOPMENT ACTIVITY NSTL S--ETC F/8 8/10
CHEMICAL, BIOLOGICAL AND PHYSICAL MEASUREMENTS FROM THE WESTERN--ETC(U)
FEB 82 D M LAVOIE, D F REID, I P DEPALMA
NORDA-TN-140

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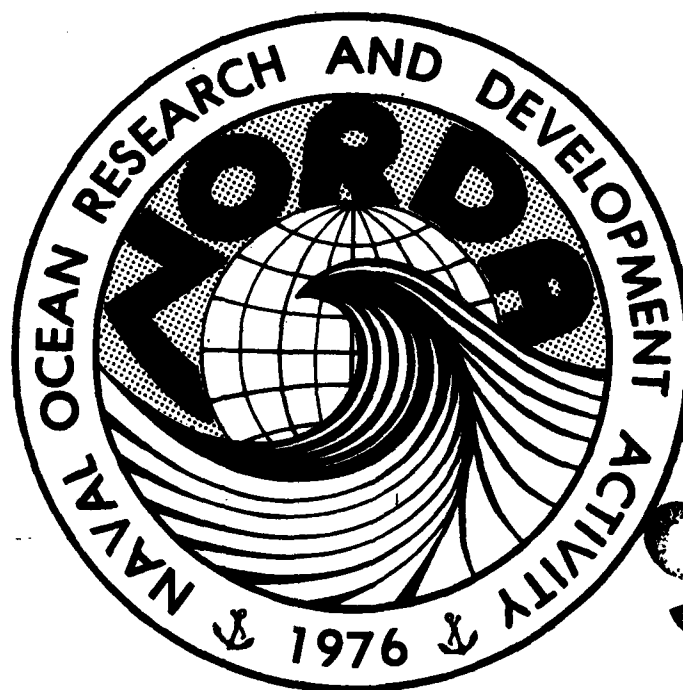


NORDA Technical Note 148

Naval Ocean Research
and Development Activity
NSTL Station, Mississippi 39529

✓ **Chemical, Biological and Physical Measurements
from the Western Caribbean and Gulf of Mexico,
Spring 1979, USNS DeSTEIGUER, Cruise 1207-79, Leg II**

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Ocean Science and Technology Laboratory
Oceanography Division

February 1982

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EXECUTIVE SUMMARY

This report is a summary of data collected in the Western Caribbean and Gulf of Mexico during the spring of 1979. Vertical profiles through most of the water column were obtained for the following parameters: conductivity, temperature, salinity, nephelometry, total suspended matter, dissolved and particulate organic carbon, adenosine triphosphate (ATP), chlorophyll and phaeopigments, nutrients (nitrate, ammonium, phosphate, silicate), dissolved oxygen and dissolved reduced gases (methane and nitrous oxide). Results are presented as: (1) tables of measured and derived parameters; (2) depth profiles of unnormalized values, normalized values, and normalized rates of change. Descriptions of the collection and analytical procedures are also given.

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Introduction

This technical note constitutes the final data set for the first cruise of a NORDA Code 334 (Biological and Chemical Oceanography Branch) program which was undertaken in conjunction with elements of Texas A&M University to study the relationship between near-surface nepheloid (suspended particle) layers and dissolved reduced gases in the open ocean. The cruise was conducted as part of the first phase of the field program, during which we sought to (1) examine several oceanic regions to determine the generality of the occurrence of concentration maxima for the reduced gases methane (CH_4) and nitrous oxide (N_2O) in the oxygenated, near-surface layers of the open ocean; and (2) examine a wide range of physical, chemical, and biological parameters in an effort to establish relationships with the gas distributions. The ultimate goal is to identify the in situ sources and sinks for these gases in oceanic near-surface waters.

The data are summarized in tables of the measured and derived parameters for each hydrostation. The tables are followed by depth profiles of three different treatments of the data for selected parameters. Collection and analytical procedures are detailed in Appendix B.

Cruise Description

The program was conducted aboard the USNS DESTEIGUER Cruise 1207-79, Leg II, which departed from Rodman Naval Base, Panama, on 10 May 1979 and terminated at Gulfport, Mississippi, on 24 May 1979. Ten stations were successfully completed (see Fig. 1). Program participants and their collection and/or analytical responsibilities are listed in Appendix A.

Station Protocol

In general, stations were taken during darkness since daylight interferes with the nephelometer sensor. The sampling package consisted of a CTD probe (Conductivity/Temperature/Depth, Neil Brown Instr., Cataumet, MA) co-mounted on a large frame with a Nephelometer (SeaMarTek, Seattle, WA) and with twelve 30 liter PVC Niskin bottles, which were tripped using an electronically controlled Rosette Sampler (frame, Niskin bottles, and rosette sampler by General Oceanics, Miami, FL). The package, standing about 2 m high and weighing almost 900 kg upon retrieval, was lowered on a single conductor, armored cable from the stern U-frame. During lowering, vertical profiles of conductivity, temperature, and nephelometry vs. depth were continuously plotted on X-Y plotters. Based on the profiles, sampling depths were chosen, the Niskin bottles raised to each desired sample depth, halted, and tripped. Once on deck, water samples were drawn from the Niskin bottles as appropriate to the lability of the parameters being measured, with gas samples being drawn first. To provide profile detail in the shallow zone, the most intense sampling was done in the upper 200 m or so; one entire cast of 12 bottles was generally tripped in this region. A second cast of 12 bottles covered the remainder of the water column.

The following parameters were measured or calculated on board: conductivity, in-situ temperature and pressure (all from the CTD), depth, Niskin sample salinity, nephelometry (light scattering at 90°), nutrients (NO_2^- , NO_3^- , NH_4^+ ,

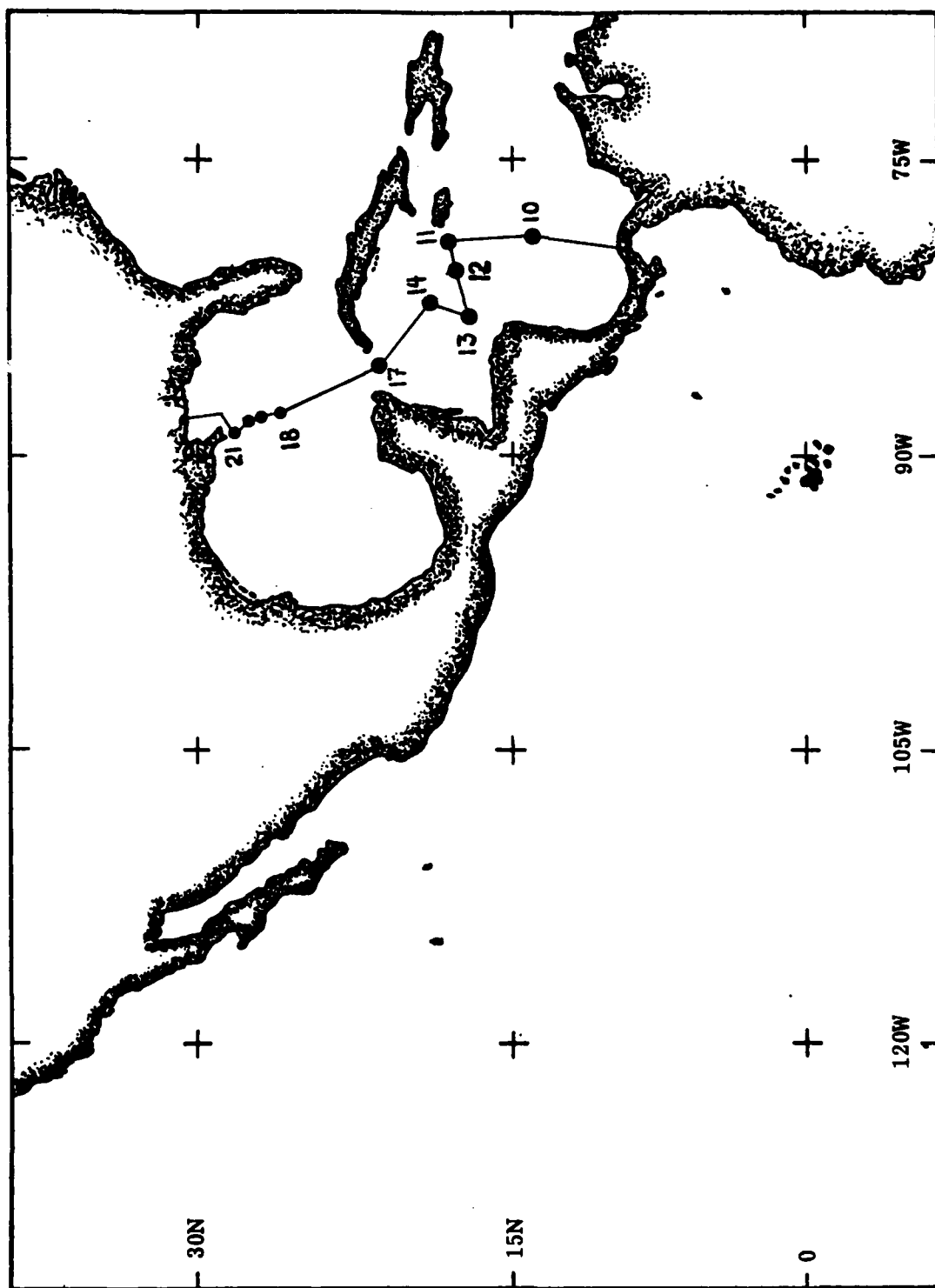


Figure 1. Cruise track, USNS DeSTEIGUER, 1207-79, Leg II

$\text{PO}_4^{=}$, $\text{Si}(\text{OH})_4$, and the dissolved gases O_2 , CH_4 and N_2O . The following parameters were measured or calculated from samples or data brought back to the laboratory: sigma t, total suspended matter (TSM), dissolved and particulate organic carbon (DOC AND POC), chlorophyll and phaeopigment (chlorophyll degradation product), and adenosine triphosphate (ATP, a measure of living biomass). Special collection procedures as well as the essential elements of the analytical methods may be found in Appendix B.

Data Tables

The data for the first 24 depths are tabulated for each station. The following comments apply:

1. Where a blank appears, no measurements were taken; where a zero appears, the parameter was below detectable limits.
2. Nutrient, CH_4 and N_2O data were supplied by Dr. James Brooks, Texas A&M University. His permission to include his data here is gratefully acknowledged.
3. TSM samples were collected in a separate cast from the chemical data at sampling depths chosen on the basis of the continuous nephelometry trace. Thus, the TSM sample depths did not always correspond to the chemistry sample depths. In the tables, TSM values have been placed at the closest chemistry sample depths, and in most cases, they are within a few meters of their actual depths.

5. Table Legend:

Depth: (meters) Calculated from CTD pressure reading (from Saunders, 1981);

In Situ Temp: (degrees Celsius) Temperature from CTD reading;

Bottle Salin: (parts per thousand) Salinity of Niskin sample;

Sigma T: ((density - 1) $\times 10^3$) Density anomaly using CTD salinity and temperature (Millero et al., 1980);

CH(4): (nl/L) Dissolved methane;

N(2)O: (nl/L) Dissolved nitrous oxide;

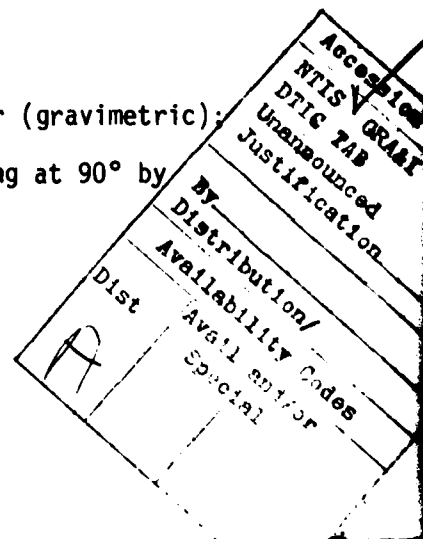
O(2): (ml/L) Dissolved oxygen;

TSM: ($\mu\text{g/liter}$ of sea water) Total Suspended Matter (gravimetric);

Nephels: Arbitrary units of nephelometry (scattering at 90° by suspended particles);

POC: ($\mu\text{g Carbon/L}$) Particulate organic carbon;

DOC: ($\mu\text{g Carbon/L}$) Dissolved organic carbon;



Total Chloro: ($\mu\text{g/L}$) Total chlorophyll "a" (chl "a");

>3 μm ATP: (ng/L) ATP of particles from 200 to 3 μm diameter;

Total ATP: (ng/L) ATP of particles 200 to 0.2 μm diameter;

NO(3): ($\mu\text{g-atoms/L} = \mu\text{M}$) Nitrate;

NO(2): ($\mu\text{g-atoms/L} = \mu\text{M}$) Nitrate;

PO(4): ($\mu\text{g-atoms/L} = \mu\text{M}$) Orthophosphate;

SiO(4): ($\mu\text{g-atoms/L} = \mu\text{M}$) Silicate;

NH(4): ($\mu\text{g-atoms/L} = \mu\text{M}$) Ammonium;

Depth Profiles

As an aid to perceiving relationships among the data, depth profiles are presented for the eleven most important parameters: temperature, salinity, sigma t, chlorophyll "a", >3 μm ATP, methane, nitrous oxide, nephelometry (or TSM), particulate and dissolved organic carbon, and dissolved oxygen. All the profiles have the same depth scale - 0 to 340 m - and the parameters are arranged to facilitate intercomparison at each depth. There are three types of profiles, each presenting a different aspect of the data:

- A. Straight Data. Useful for comparing magnitudes of the parameters from station to station. Parameters and their units are as in the table legend.
- B. Values as % of Maximum. Each parameter is normalized to its maximum value in the upper 340m for each station. These plots allow immediate identification of the depth of maximum value and facilitate comparisons among the parameters.
- C. Average Gradient, Normalized to Maximum. The change per meter was determined between two succeeding depths, was normalized to the maximum rate of change in the upper 340m, and the normalized value was plotted halfway between the depths. The gradient scale runs from -1 (maximum rate of decrease) through 0 (no change) to +1 (maximum rate of increase). (It should be noted that, since the data set consists of discrete values only, one cannot interpolate gradient values between points on this plot, only the gradient sign). These plots facilitate interparameter comparisons of gradient with depth.

DATA TABLES
USNS DESTIGUER 1207-79
LEG II
STATIONS 10 THROUGH 21

DATE: 5/12/79 POSITION: 14.03N; 78.95W

DATE	TIME	STATION	CH(4)	W(2)0	U(2)	TSA	DEPTH	POC	DOC	TOTAL CHLORO	33um APP	TOTAL APP	NO(3)	NO(2)	NO(1)	NO(4)	NO(5)
(0)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
0	27.510	30.223	23.403	46	154	4.71		24	1258	0.010	37.29	36.21					
00	27.527	30.220	23.549	52	144	4.70	190	27	1006	0.046	11.57	46.42	1.00			0.20	1.20
17	20.003	30.223	23.740	57		4.63	182	46	1005	0.072	20.23	43.11					
00	26.050	30.272	23.025	30	147	4.73	196	18	1130	0.116	10.15	21.26					
100	25.311	30.000	24.443	86	112	4.00	196	23	942	0.190	10.52	19.38	1.10			0.40	1.30
110	24.303	30.332	24.921	92	154	4.36	179	18	891	0.143	27.39	24.29					
131	23.000	30.944	25.237	80	216	4.27	111	14	793	0.063	3.68	19.16	1.90			0.20	0.60
142	22.903	30.940	25.446	80	245	4.17	94	25	804	0.047	6.33	11.27	1.70			0.20	0.50
100	21.243	30.312	25.833	80	316	3.78	77	10	696	0.012		6.18	5.20			0.50	1.00
200	17.237	30.367	26.510	49	411	3.09	74	14	649		2.10	6.06	14.80			0.60	1.30
300	12.477	30.504	26.930	52	460	3.03	65	7	1633		1.08	1.46	18.60			1.30	9.50
400	10.003	30.209	27.009	34	490	2.94	58	9	19251		0.75	1.35	19.00			1.30	11.00
500	7.019	30.313	27.212	23	534	2.90	81	34	531								
600	6.301				468		108										
775	6.210	34.006	27.373	17	227	3.33	106	19	441			1.20					
800	5.003	34.000	27.427	17	362	3.58	91	16	375		1.77	1.70					
910	5.474	34.052	27.502	14	311	3.63	88	11	406			1.16					
910	5.207						90										
970	4.773	34.003	27.597		292	4.29	80	12	413			0.53					
1000	4.029	34.014	27.627		294	4.46	75	7	432		0.31	1.42					
1102	4.710	34.123	27.649	11	314	4.71	82	19	535			2.16					
1110	4.431	34.130	27.684		307	4.84	35	13	430			1.00					
1203	4.370	34.140	27.702		266	4.91	81	9	496			1.25					
1300	4.240	34.119	27.720		237	4.99	87	9	441			1.36					

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2002-2003: 14,148, 70,152

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14-11-79

DATE: 5/15/79 POSITION: 17.76N; 80.52W

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5/10/73

5/10/73

DATE: 5/10/73 POSITION: 17.204; 82.87W

Depth	Temp	Salinity	Stem	Ch(4)	u(2)	TSM	Nephel	POC	DOC	Total Chloro	Sum APP	Total APP	PO(3)	PO(2)	PO(4)	SI(4)	SI(4)
(m)	°C	g/100	m/L	m/L	m/L	ug/L	arbit	ug/L	ug/L	ug/L	ng/L	ng/L	ug/L	ug/L	ug/L	ug/L	ug/L
0	23.245	36.202	23.226	60			405	40	1394	0.037	6.82	17.39	1.00		0.40	1.30	
15	23.167	36.197	23.242	63		110	303	25	1245	0.036	31.19	29.76	0.60		0.20	0.90	
34	20.922	36.302	23.732	67		135	345	28	1457	0.207	20.19	30.17	1.00		0.40	1.20	
63	24.552	36.542	24.559	66	167	150	410	90	1284	0.956	90.60	140.07	1.00		0.30	0.50	
77	22.022	36.096	23.273	93		97	336	31	1233	0.346	17.98	42.86	1.30		0.10	0.40	
90	22.941	36.719	23.519	89		49	268	19	1071	0.060	7.90	15.52	5.40		0.50	2.00	
104	21.035	36.066	23.760	82		27	244	20	1012	0.107	2.14	17.10	3.10		0.20	0.90	
127	19.999	36.633	26.119	75	290	17	197	9	1037	0.016		3.90	4.10		0.30	1.20	
139	16.999	36.521	26.301	63		15	174	9	397	0.005	1.39	2.77	5.60		0.40	1.70	
157	16.112	36.143	26.098	60			296	7	932	0.001	0.33	7.26	15.90		1.20	6.30	
203	14.535	35.368	26.767	52	401		285	6	994	0.001	1.62	1.05	16.40		1.30	6.70	
220	12.946	35.471	26.953	48	433		274	6	1055	0.002	0.87	1.51	23.10		1.50	10.70	
253	10.157	35.309	27.029	34			262	7	942			4.07	15.00		1.30	7.20	
300	9.079	35.100	27.099	30	454		270	5	850			2.30	16.80		1.20	1.20	
360	9.001	34.903	27.135	26			270	7	837			2.08	16.50		1.20	9.30	
377	7.175	34.840	27.209	19	689		265	4	303		0.21	1.28	25.30		1.90	10.10	
392	5.595	34.625	27.352	22			273	4	336			2.47	26.30		2.80	20.10	
404	6.013	34.696	27.421	19			261	8	361			1.38	23.90		2.20	22.00	
460	5.712	34.736	27.490	19	533		276	7	412			3.37	22.60		1.70	13.40	
470	5.473	34.572	27.513	15			269	7	431		0.70	3.73	21.20		1.70	13.40	
500	5.139	34.394	27.566	19	407		274	4	321			2.00	12.40		1.10	9.30	
500	5.074	34.399	27.564	19	395		262	0	267			0.57	7.00		1.10	5.30	
510	5.703	34.320	27.657	15	344		290	5	364			1.61	23.40		1.40	23.70	
1109	4.449	34.944	27.093	19			240	3	338		0.40	1.76	7.40		0.30	6.90	

DATE: 5/16/79 POSTED: 18.914; 82.16W

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USNS 1207-79 STN 17

DATE: 5/20/79 POSITION: 21.71N; 85.59W

DEPTH METER	TEMP C	SALINITY PPT	SIGMA T	CH(4) nm/L	N(2)O ml/L	O(2) ml/L	%S ug/L	Hephal. arbit	POC ugC/L	DOC ugC/L	Total Chloro ug/L	>3um ATP ng/L	Total ATP ng/L	NO(3) ugA/L	NO(2) ugA/L	PO(4) ugA/L	SiO(4) ugA/L	NH(4) ugA/L
0	27.735	36.201	23.393	51	147	4.63			33	1016	0.032	3.13	12.94	1.30		0.50	1.90	
53	27.017	36.103	23.611	55	133	4.79			33	916	0.050	19.93	16.86	1.00		0.40	1.70	
67	26.661	36.174	23.718	62	133	4.81			30	863	0.051	5.40	15.23	1.00		0.40	1.90	
83	26.410	36.182	23.804	62	133	4.79			26	1048	0.078	7.50	10.80	0.80		0.20	1.50	
96	25.957	36.198	23.958	58	162	4.78		141	23	851	0.143	9.68	18.62	1.00		0.30	1.90	
125	25.762	36.504	24.244	86	157	4.51		281	25	831	0.112	4.82	32.44	0.80		0.20	0.80	
149	24.370	36.755	24.666	89	181	4.00		203	20	677	0.051	3.31	23.18	3.60		0.50	1.70	
174	22.572	36.858	25.473	82	262	3.95		177	11	656	0.012	2.48	10.13	4.40		0.50	1.70	
196	21.503	36.830	25.754	79	218	3.94		150	13	759	0.002	1.73	20.18	4.90		0.50	1.90	
246	19.359	36.952	26.196	68	221	3.99		129	10	626		1.92	9.75	6.20		0.60	2.20	
294	16.176	36.513	26.391	58	294	3.97		123	12	862	0.001	0.45	19.78	8.20		0.70	3.60	
369	15.556	36.062	26.684	55	271	3.54		119	14	699		0.51	1.70	14.40		1.10	5.60	
436	14.359	35.876	26.790	48	358	3.33		137	35	806		0.67	11.10			0.90	4.50	
474	13.123	35.662	26.898	41	475	3.27		124	28	953		0.36	18.40			1.40	6.30	
539	11.606	35.426	26.997	38	504	3.00		120	18	679		0.41	22.10			1.60	10.80	
569	10.556	35.268	27.066	36	356	2.94		125	12	660		0.22	26.10			1.90	13.70	
639	9.631	35.142	27.127	31	522	2.90		136	18	837		0.75	28.10			1.90	14.80	
662	8.925	35.041	27.163	27	457	2.89		129	9	833		0.19	27.90			2.10	16.50	
732	6.064	34.940	27.215	21	485	2.93		128	12	656		0.18	30.50			2.20	19.90	
779	7.312	34.876	27.270	21	535	3.06		126	13	599		0.40	34.20			2.20	20.20	
876	6.172	34.840	27.405	17	434	3.40		134	12	683		0.32	31.30			2.40	24.60	
969	5.516	34.864	27.523		464	3.86		128	11	850				25.00		1.90	21.30	
1932	4.139	34.979	27.755		336	5.61		116	12	794		0.38	20.50			1.70	16.40	
1969	4.117	34.982	27.759		301	5.71		114	19	703		0.51	1.16	18.70		1.40	25.90	

USGS 1207-79 STW 18
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DATE: 5/22/79 POSTULON: 26.02N; 87.71W

LEPUS INSULIS	WGT (g)	STOMACH	CH (4)	N (2) O	G (2)	TSH	REPNET	POC	DOC	Total Chloro	>3um ATP	Total ATP	NO (3)	NO (2)	PO (4)	SI (4)	SI (4)
(M)	WGT	WGT	WGT	WGT	WGT	WGT	WGT	WGT	WGT	WGT	WGT	WGT	WGT	WGT	WGT	WGT	WGT
1	27.523	36.079	23.370	42	158		138			0.034							
20	27.540	36.001	23.351	47			208			0.039							
38	27.549	36.124	23.395	47	152		202			0.054							
70	26.983	36.252	23.674	49	134		196			0.070							
94	25.092	36.074	23.885	47	164		217			0.115							
104	25.030	36.160	23.909	52	166		201			0.134							
120	25.022	36.256	24.044	66	184		196			0.199							
147	25.398	36.400	24.345	71	171		130			0.079							
170	23.776	36.761	25.040	71			101			0.047							
245	20.044	36.768	25.943	71	249		80			0.019							
370	16.302	36.185	26.592	52	349		103			0.010							
400	15.760	36.117	26.663	47	354		71			0.006							

USNS 1207-79 SIM 19

DATE: 5/22/79 POSITION: 26.84N; 88.03W

DEPTH (m)	INSITU TEMP deg C	SAMPLE SALIN g/g	SIGMA t	Cu(4) nm/L	N(2)O ml/L	O(2) ml/L	TSM ug/L	nephel arbit	POC ugC/L	DOC ugC/L	Total Chloro ug/L	>3um ATP ng/L	Total ATP ng/L	NO(3) ugA/L	NO(2) ugA/L	PO(4) ugA/L	SiO(4) ugA/L	NH(4) ugA/L
1	27.599	36.232	23.460	47	212		46	129		0.026	16.14	29.49	1.00	0.30	1.70			
16	27.509	36.226	23.461	57	184			165		0.028	2.66	8.35	1.00	0.20	1.30			
41	27.590	36.234	23.465	61	178		37	164		0.028	7.20	14.75	1.00	0.30	1.50			
62	26.899	36.254	23.703	57	203			189		0.055	7.91	10.42	1.20	0.30	1.70			
84	26.116	36.143	23.867	55	192			182		0.071	8.98	10.30	0.70	0.10	1.00			
107	25.635	36.421	24.211	63	163		35	211		0.230	12.43	33.82	1.00	0.30	1.50			
124	24.716	36.716	24.732	80	205			142		0.108	9.17	15.31	2.60	0.40	1.50			
146	23.640	36.826	25.126	86	234		19	109		0.064	0.75	13.92	1.40	0.10	0.60			
180	21.771	36.054	25.697	74	218			88		0.013	0.60	5.52	4.30	0.40	1.70			
200	20.537	36.770	25.973	70	231		19	89		0.008	1.77	10.57	3.80	0.30	1.20			
306	16.884	36.303	26.549	59	351			72		0.001	0.74	12.28	6.70	0.40	2.10			
416	13.367	35.706	26.667	43	432		17	70		0.001	0.49	3.64	16.20	0.10	7.30			

USGS 1207-79

STW 20

DATE: 5/23/79 POSITION: 27.55N; 83.30W

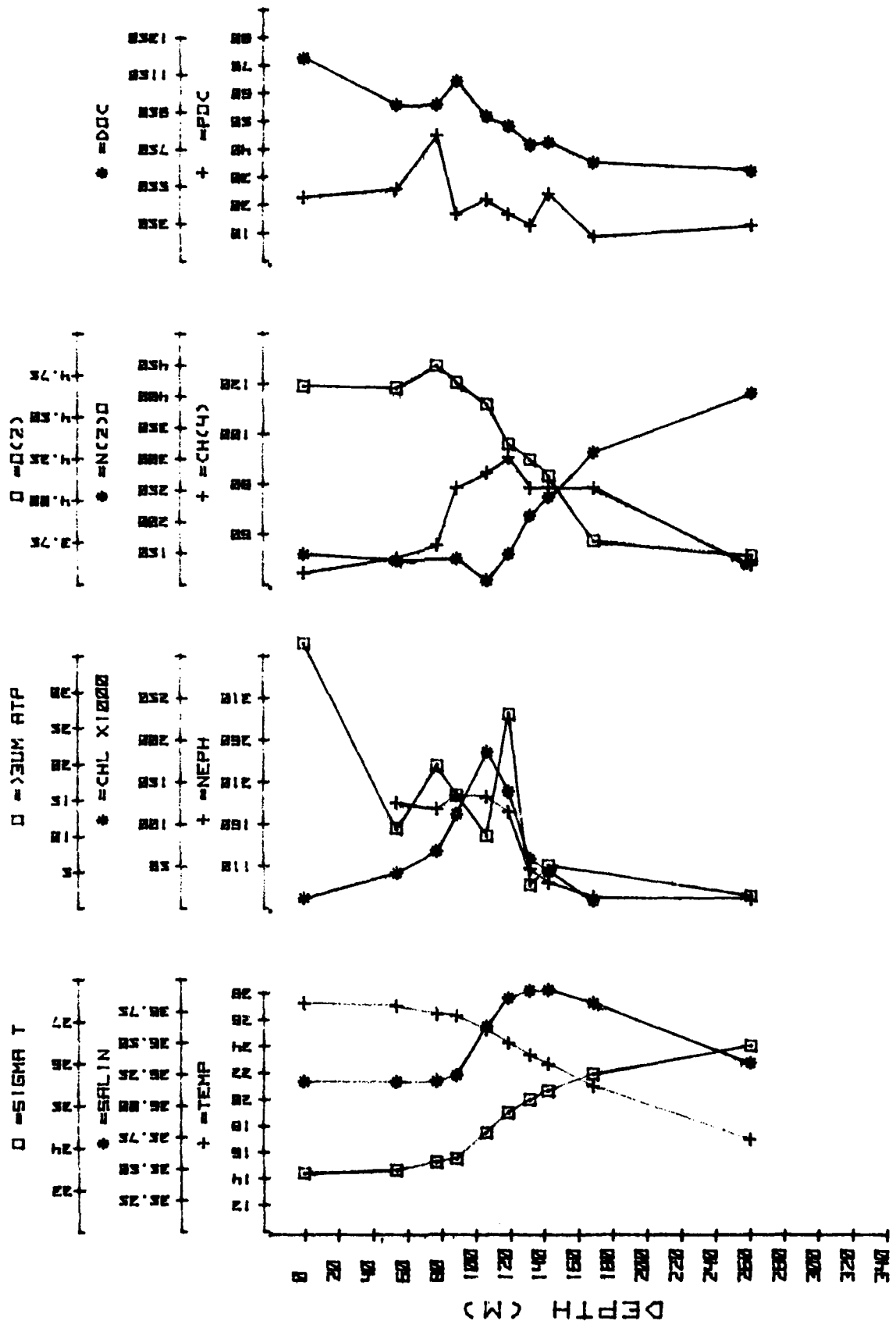
DEPTH (m)	TEMP °C	SALINITY	SIGMA t	CHL(4) nm/L	N(2)O nm/L	O(2) mL/L	TSM ug/L	NEPHEL arbit	POC ugC/L	DOC ugC/L	TOTAL Chloro ug/L	ΣUM Air ng/L	TOTAL AIP ng/L	NO(3) ugA/L	NO(2) ugA/L	PO(4) ugA/L	SI(4) ugA/L
1	24.794	36.116	24.254	80	173			200			0.067			1.40		0.40	1.20
21	24.667	36.320	24.447	80	205			206			0.089			1.00		0.30	0.60
42	21.161	36.424	25.534	80	220			238			0.123			1.20		0.40	1.50
68	19.725	36.411	25.915	82	241			327			0.642			2.40		0.30	1.50
76	19.294	36.449	26.057	82	242			269			0.421			10.70		0.70	3.20
102	17.930	36.372	26.344	74	389			143			0.068			12.10		0.90	4.40
116	17.205	36.305	26.470	55	527			139			0.046			10.00		0.70	3.70
142	16.215	36.157	26.591	55	398			134			0.012			10.00		0.70	3.60
174	15.185	36.012	26.714	40	386			112			0.005			12.10		0.90	5.00
184	14.866	35.950	26.732	45	382			97			0.003			13.30		1.00	5.00
192	14.515	35.889	26.766					103									
230	12.960	35.656	26.911	45				88			0.002			20.20		1.50	16.00

USNS 1207-79
===== SFN 21
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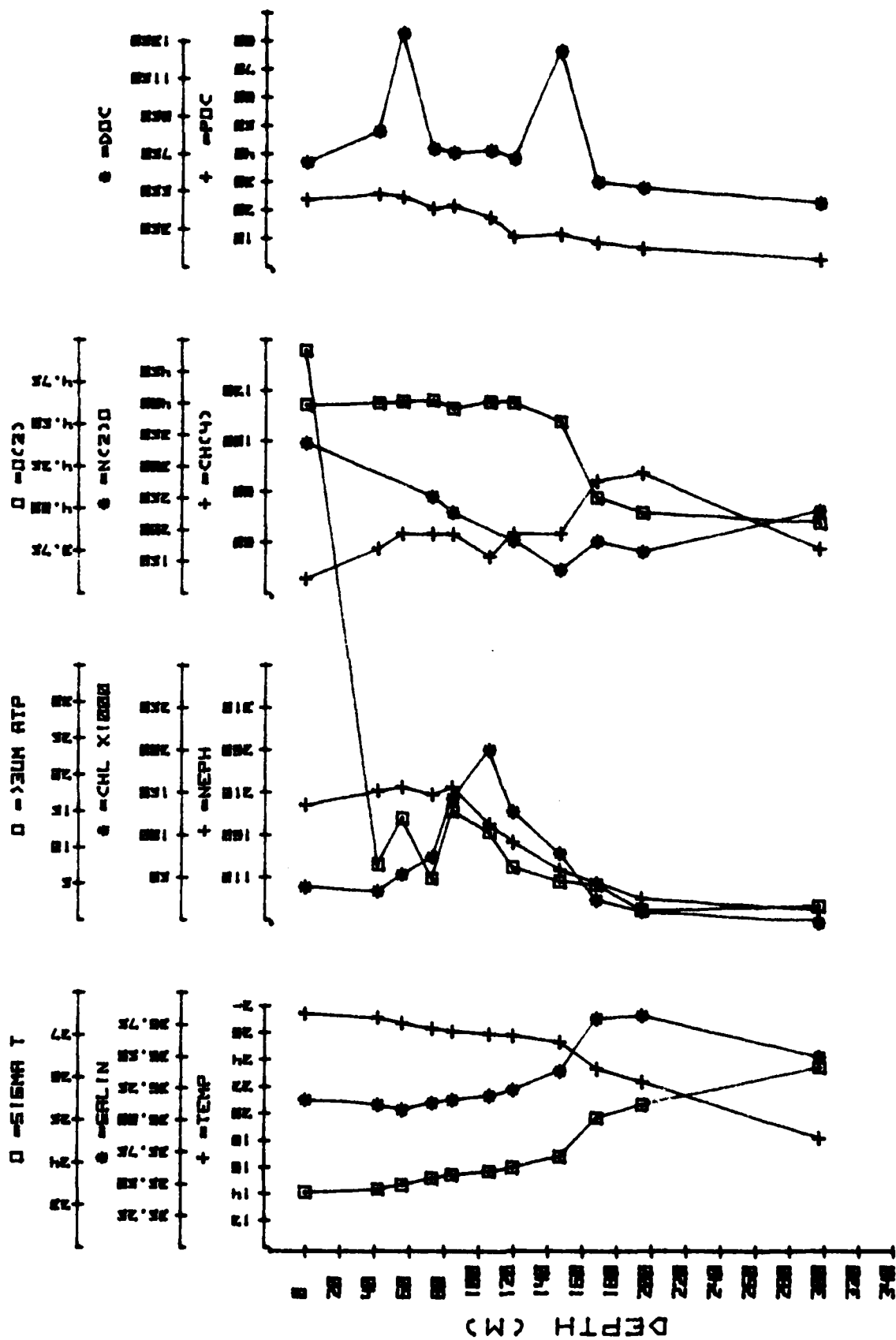
DATE: 5/23/79 POSITION: 28.24N; 88.77W

DEPTH (m)	INSTR TYPE	NOFLE SALIN	SIGMA T	CH(4) ml/L	N(210) ml/L	O(2) ml/L	TSM ug/L	Nephel arbit	POC ugC/L	DOC ugC/L	Total Chloro ug/L	>3um ATP ng/L	Total ATP ng/L	NO(3) ugA/L	NO(2) ugA/L	PO(4) ugA/L	SI(4) ugA/L	MI(4) ugA/L
1	24.793	36.314	24.404	52	185		21	180		0.073		32.83		1.20		0.50	1.00	
18	24.444	36.367	24.550	80	168			182		0.075		47.69		1.20		0.40	1.00	
40	22.952	36.393	25.010	113	131		39	205		0.100		26.10		1.00		0.30	0.50	
61	20.316	36.352	25.713	86	205			229		0.215		15.54		1.20		0.30	1.20	
62	19.331	36.270	25.911	149	189		45	262		0.332		19.43		2.60		0.40	1.70	
103	18.271	36.261	26.022	154	214			228		0.123		22.85		4.20		0.50	1.50	
116	18.618	36.262	26.007	96	183			182		0.053		0.24		4.20		0.40	1.70	
131	18.407	36.309	26.177	76	253		19	172		0.022		0.82		7.90		0.60	3.50	
167	17.476	36.335	26.427	59	349			95		0.004		2.37		10.20		0.50	3.80	
214	16.244	36.153	26.581	47	356			78		0.003		0.23		13.60		1.00	5.00	
250	14.940	35.958	26.727	45	390		12	86		0.001		0.36		13.60		0.30	5.00	
285	13.335	35.766	26.816	35	436			86		0.002		2.87		10.20		0.00	4.00	

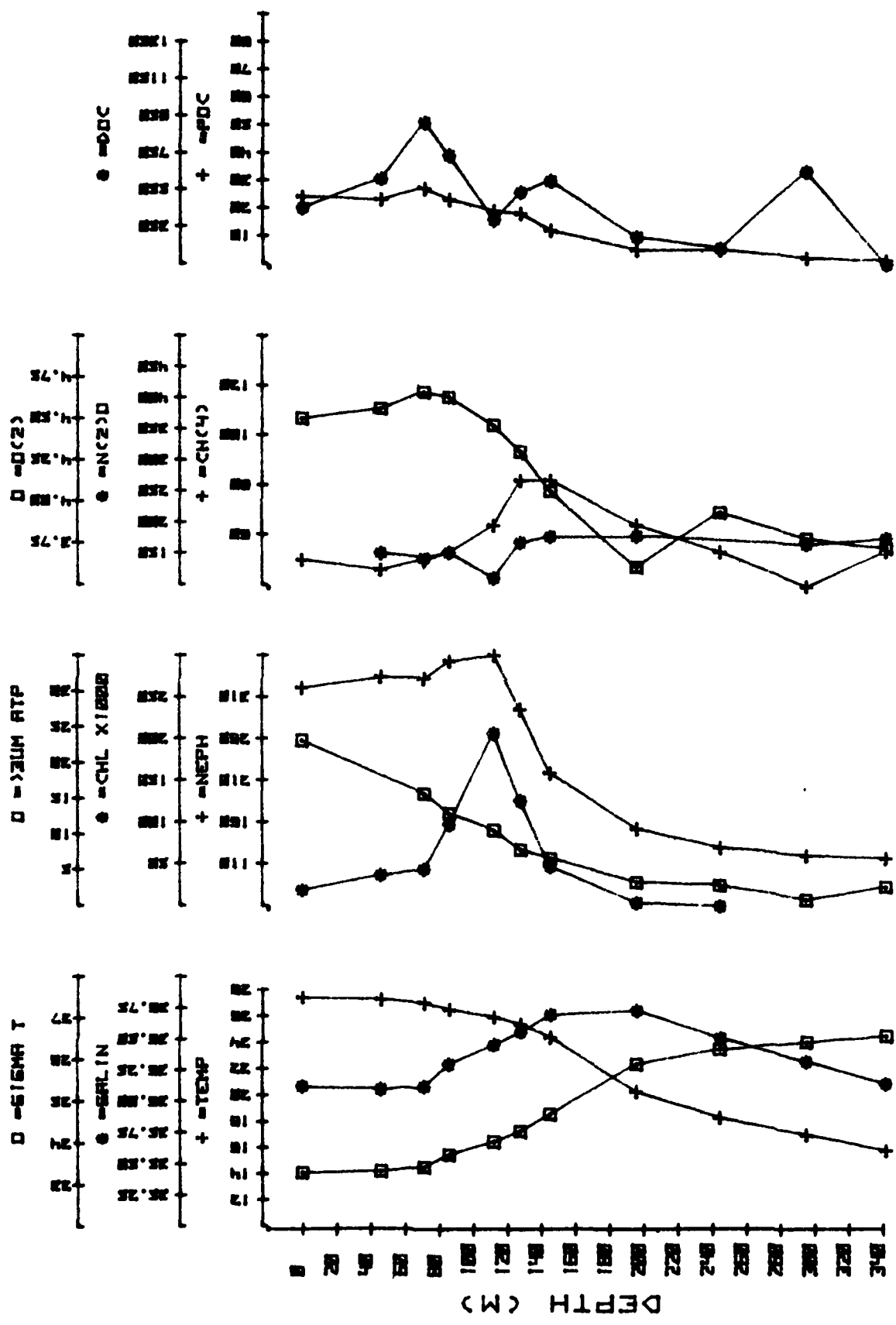
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USNS DESTIEGUER 1207-79
LEG II
STATIONS 10 THROUGH 21



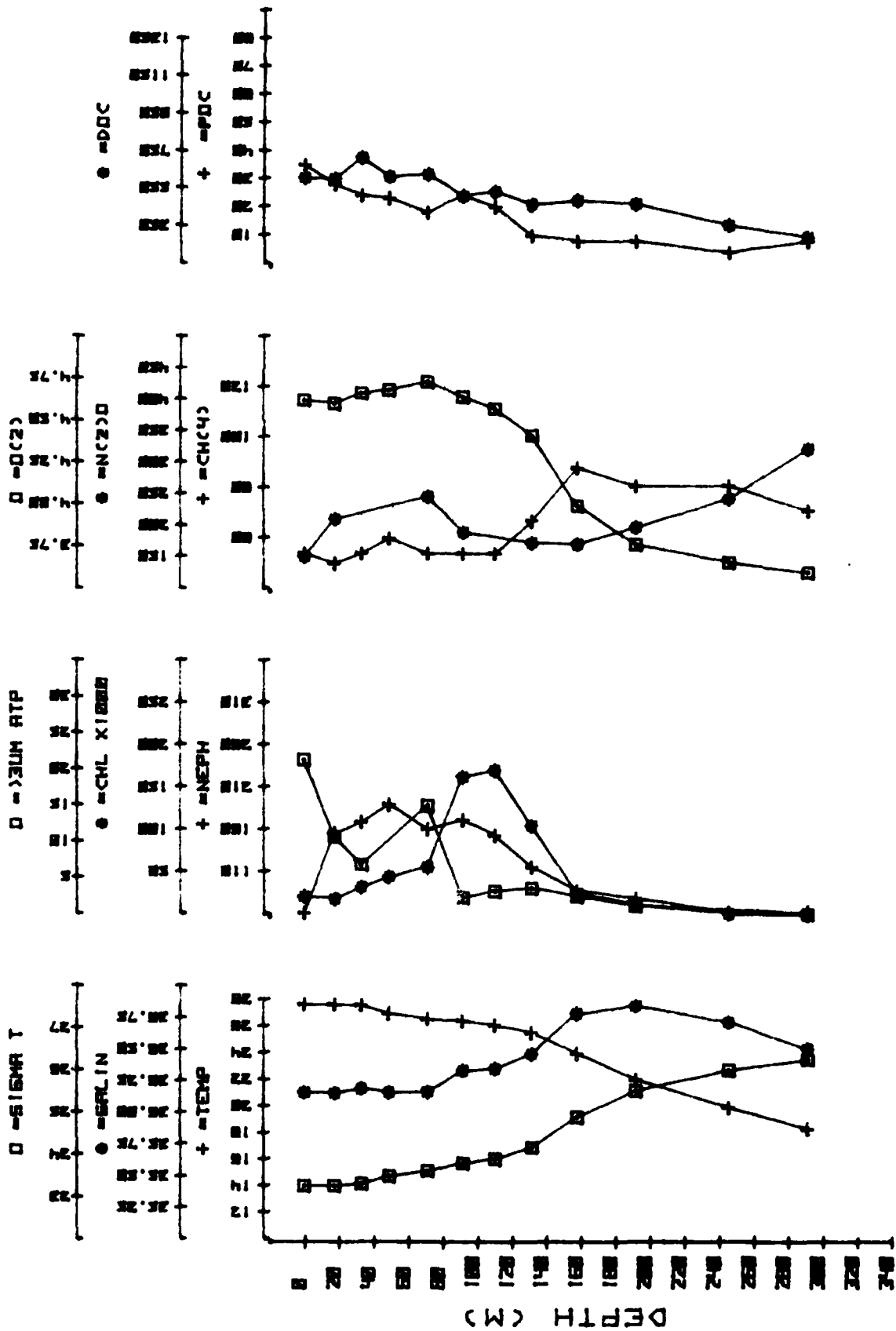
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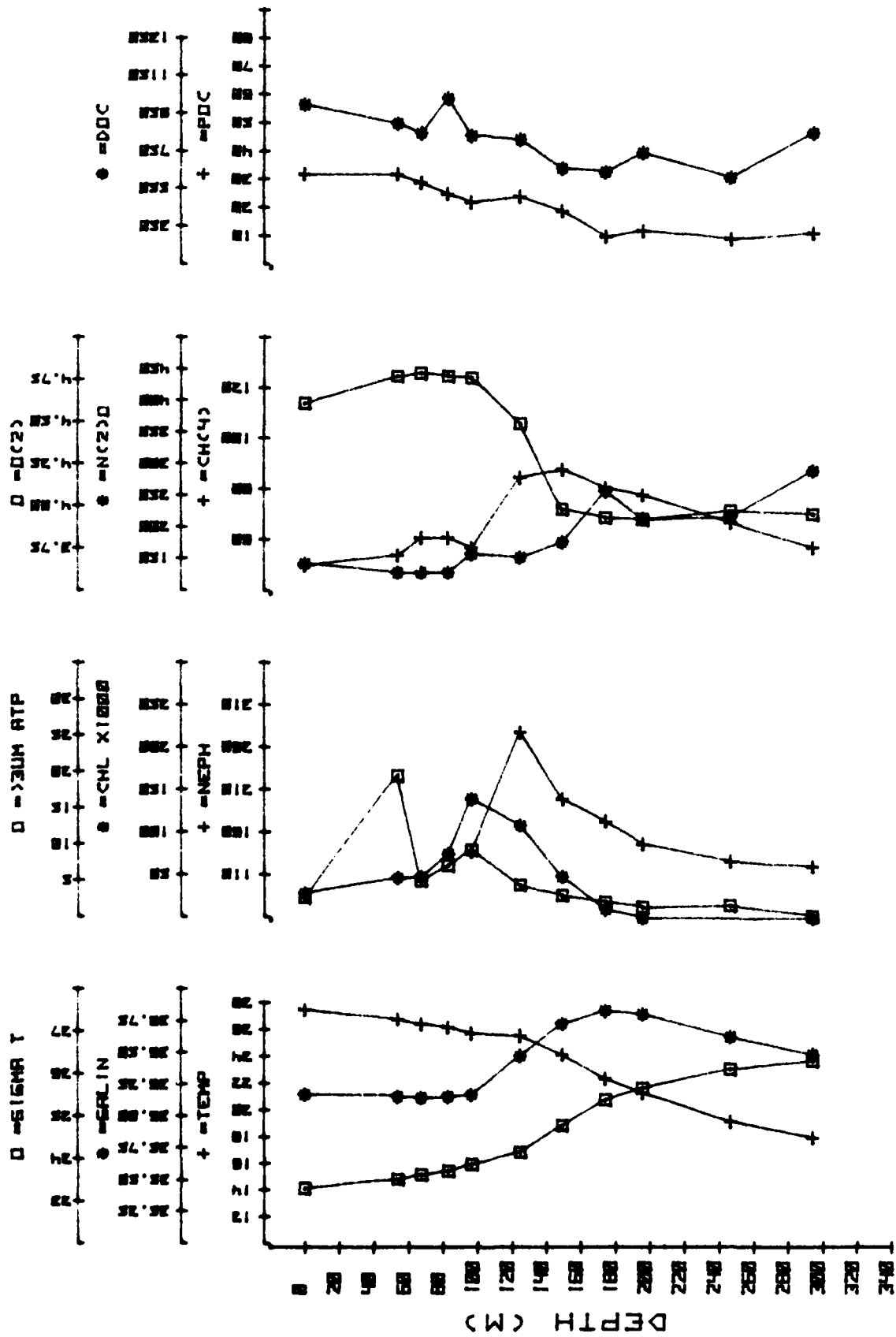


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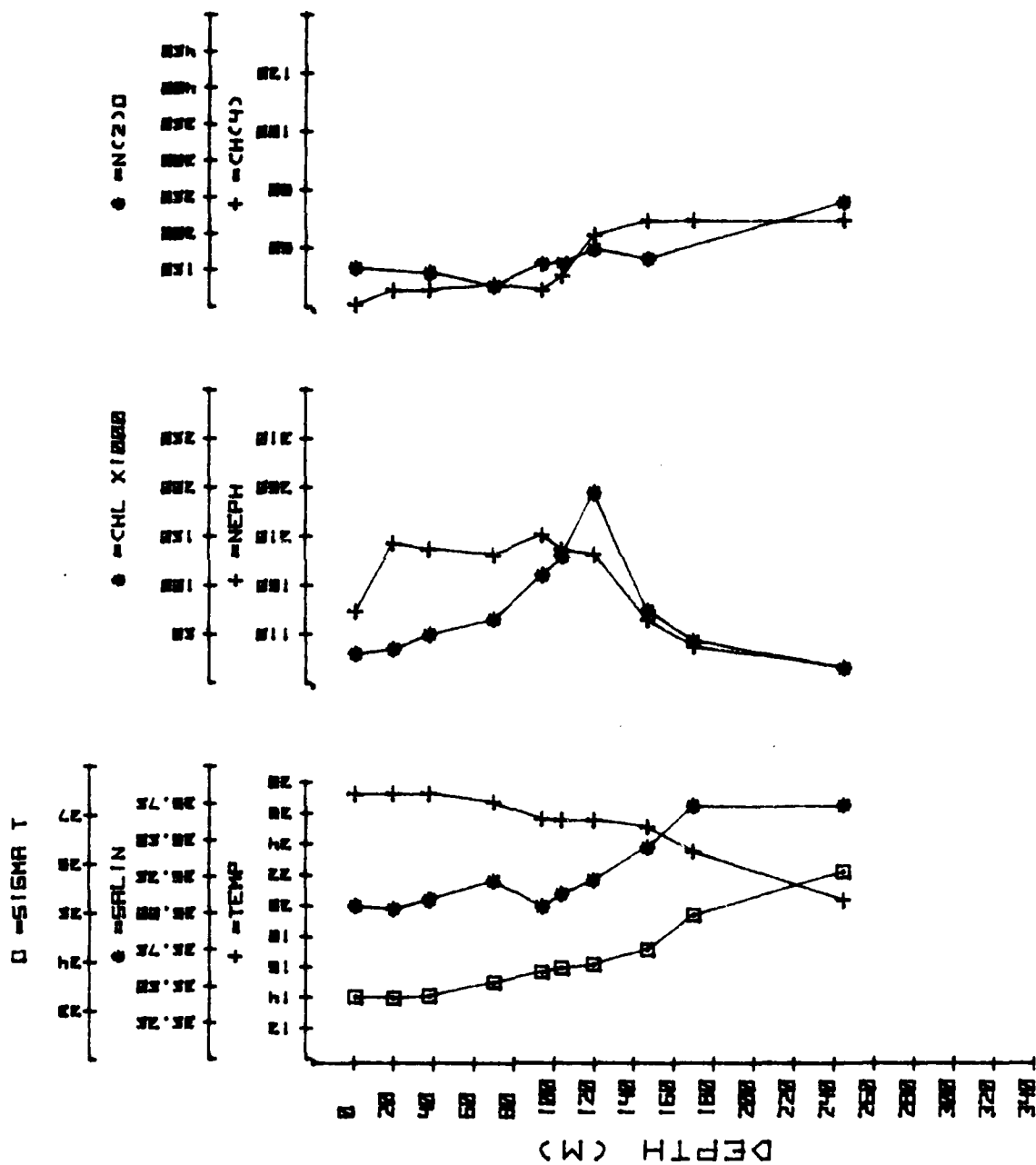


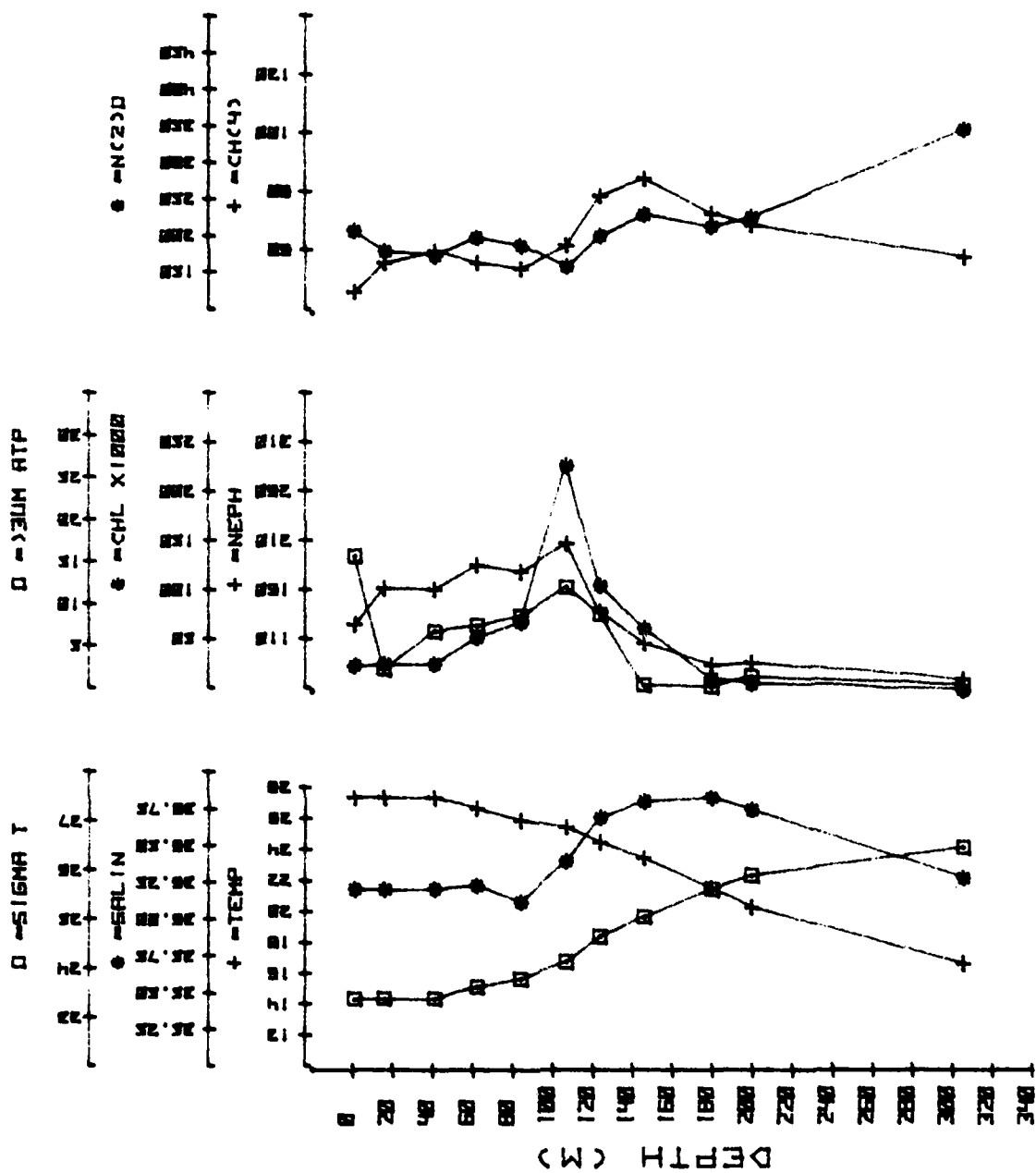
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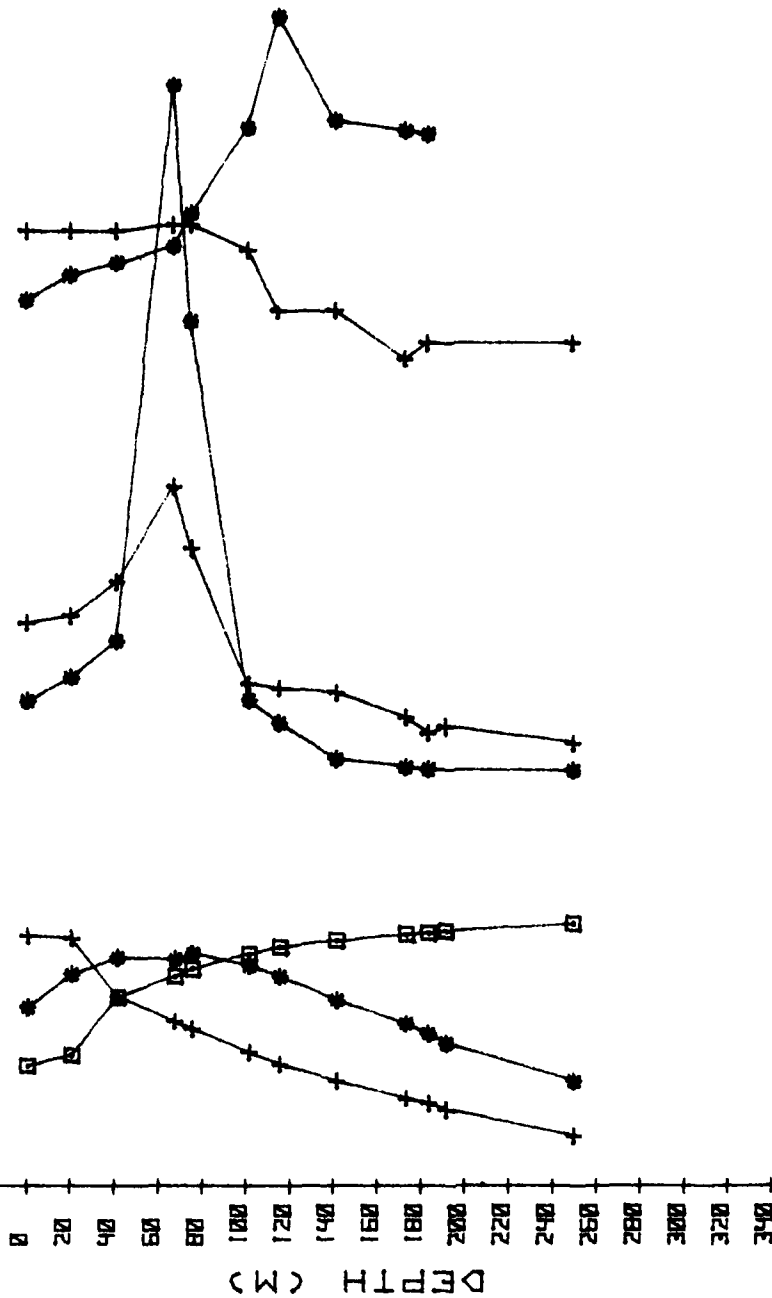
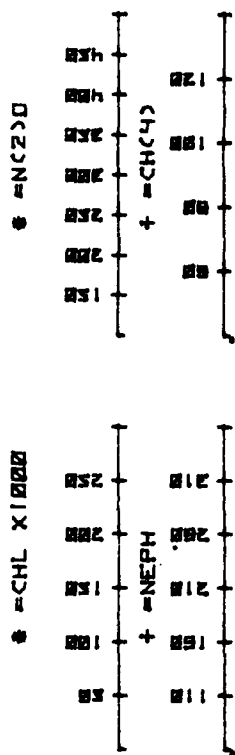


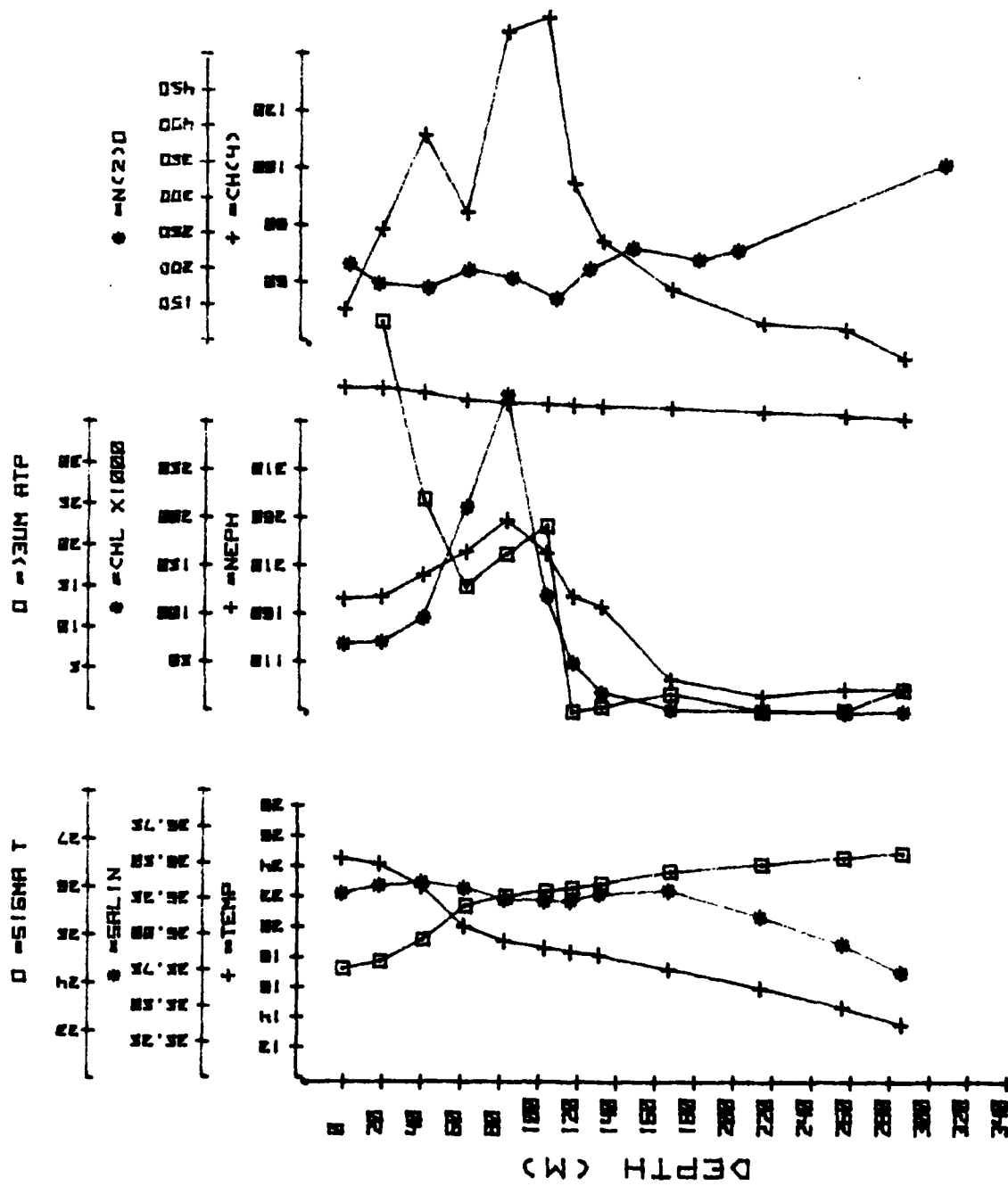
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STN 19 USNS 1207-79





STN 21 USNS 1207-78

DATA PROFILES OF NORMALIZED DATA

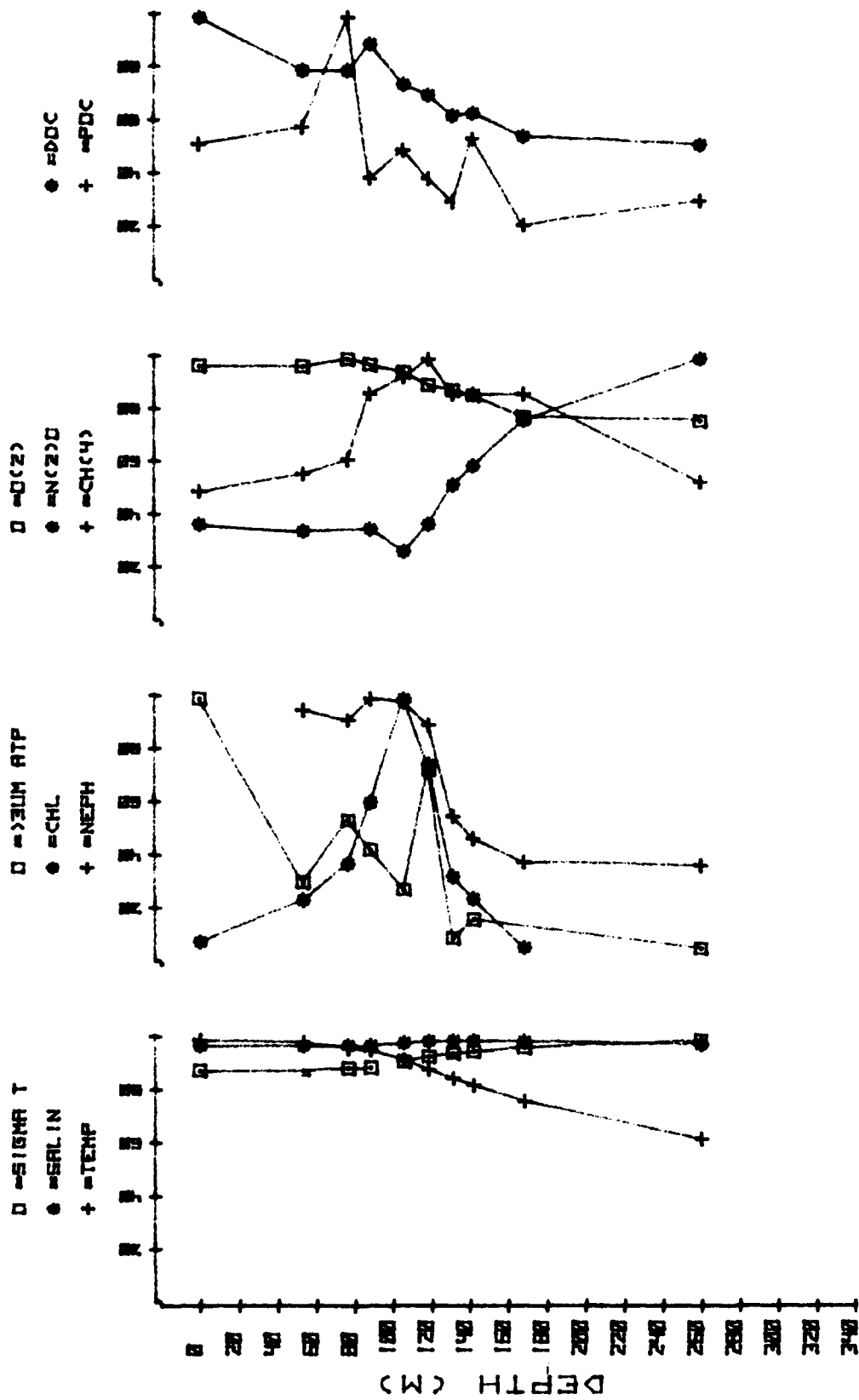
USNS DESTIGUER 1207-79

LEG II

STATIONS 10 THROUGH 21

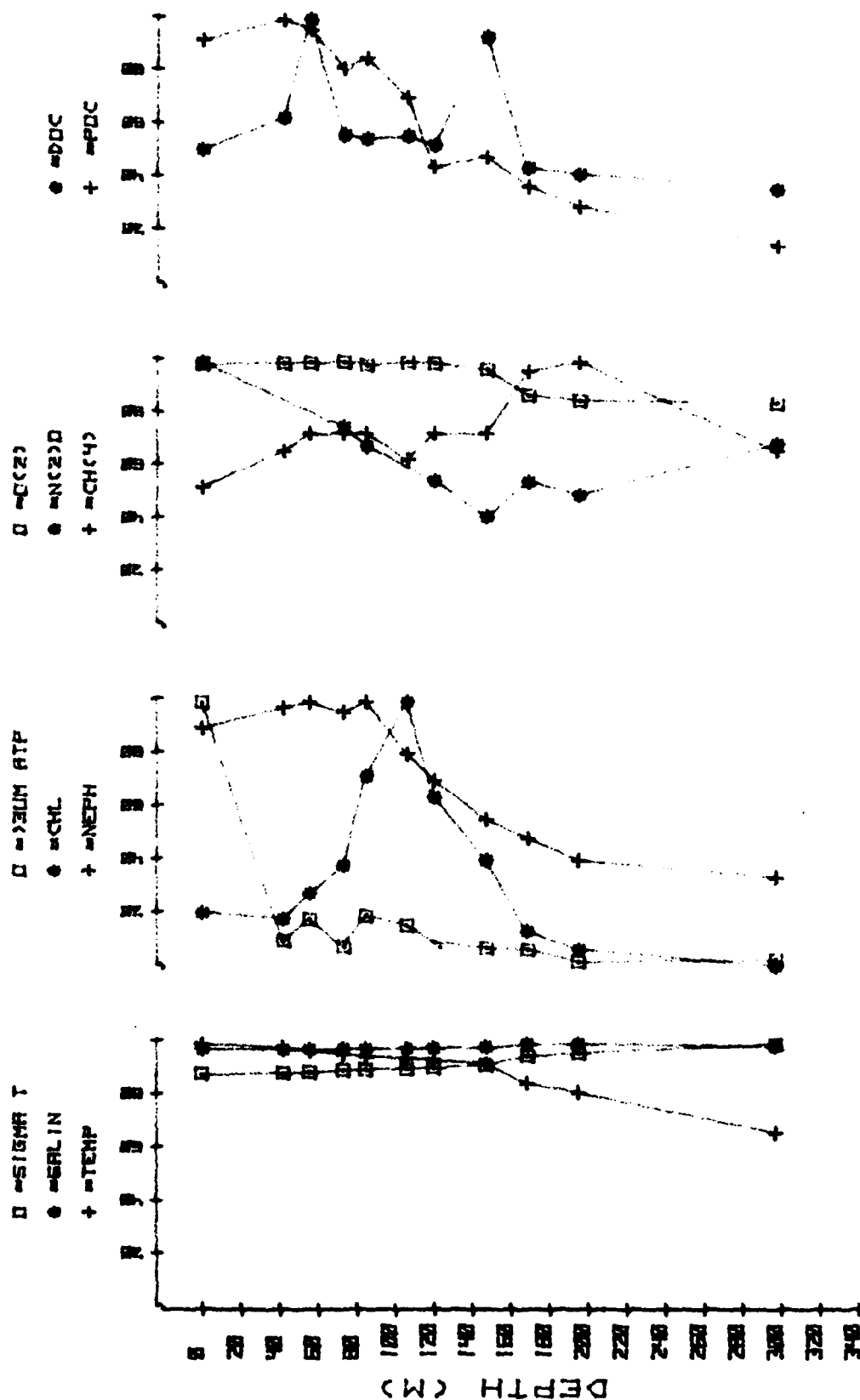
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VALUES AS % OF MAXIMUM



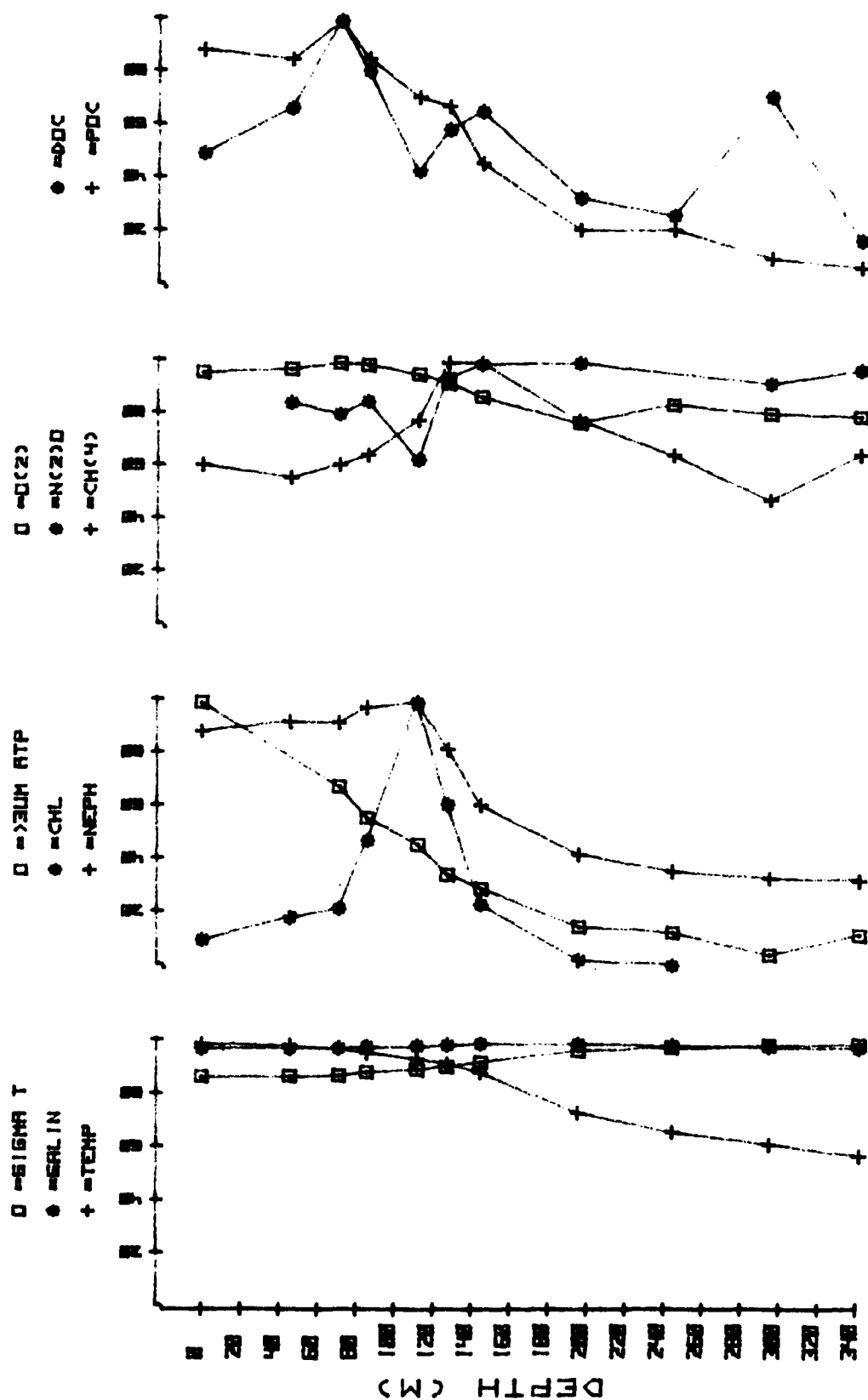
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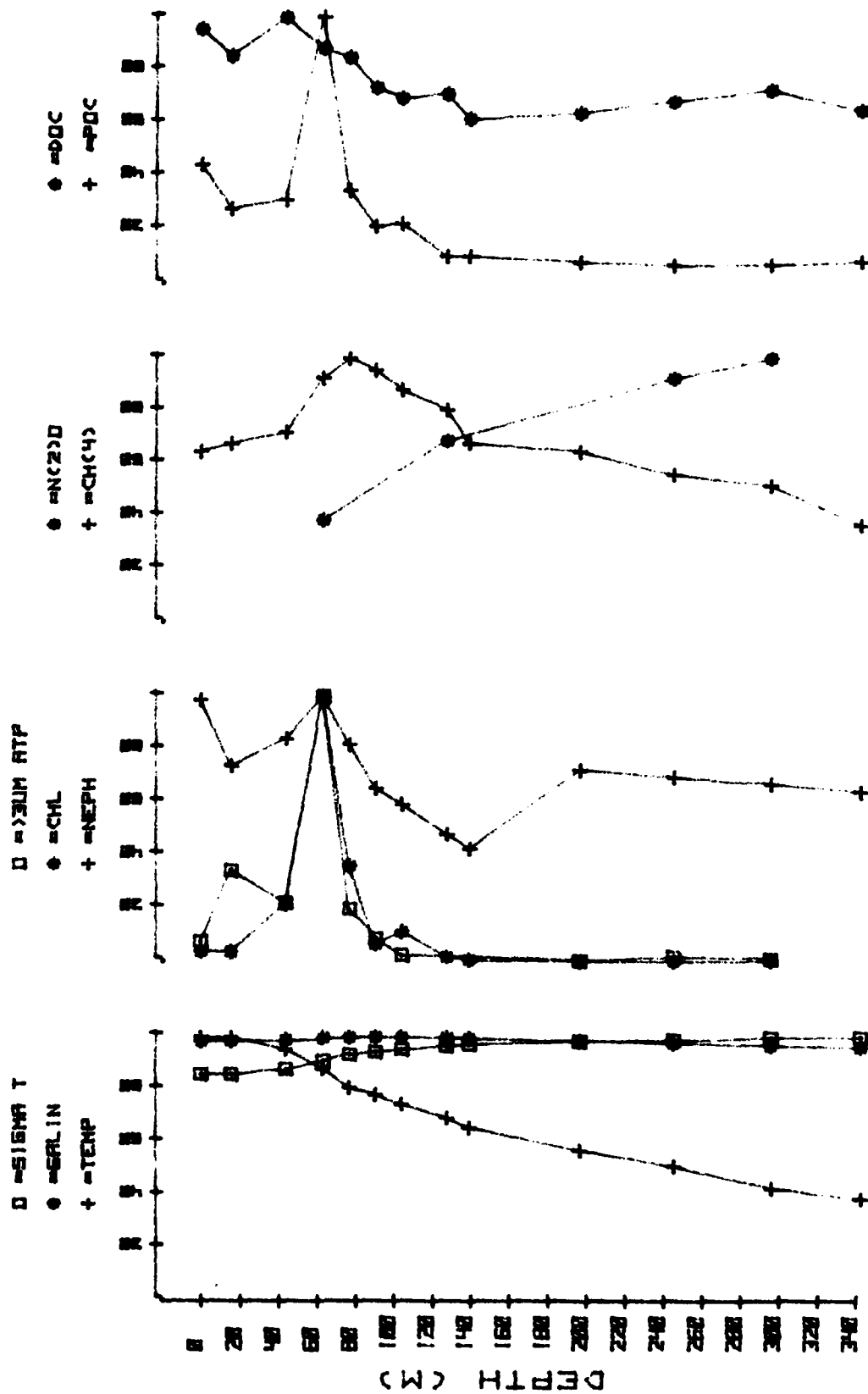


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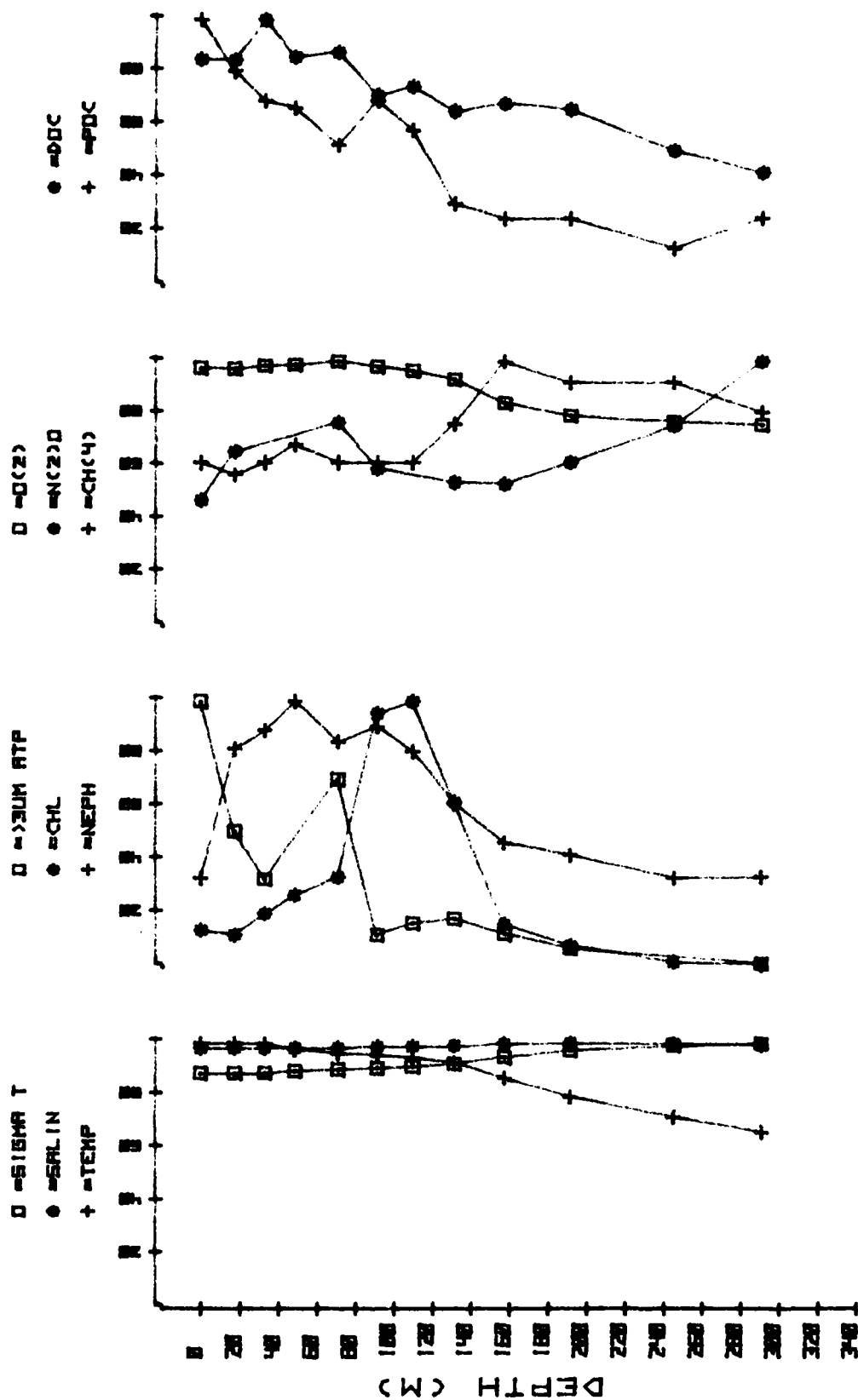


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VALUES AS % OF MAXIMUM



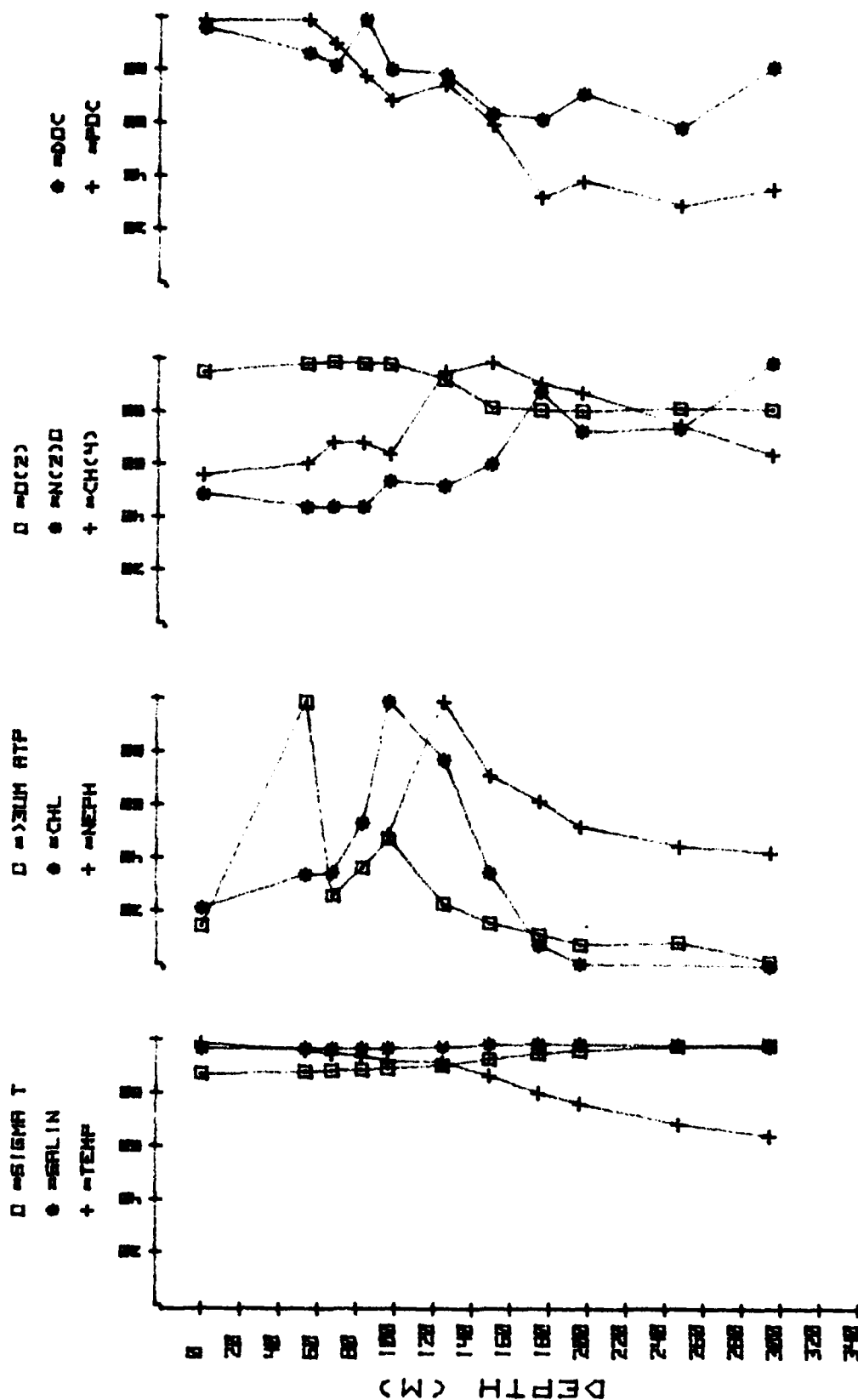
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VALUES AS % OF MAXIMUM



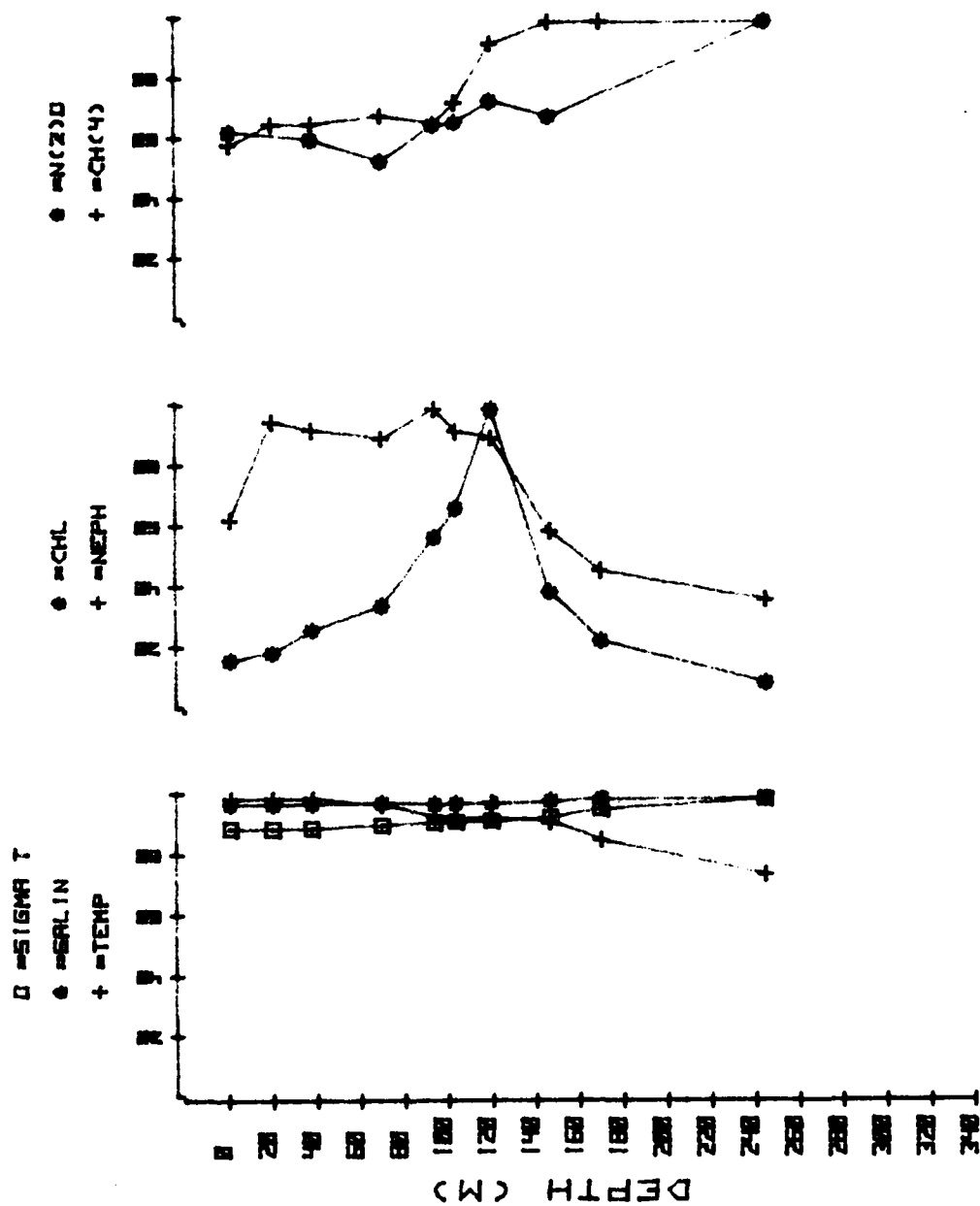
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VALUES AS % OF MAXIMUM

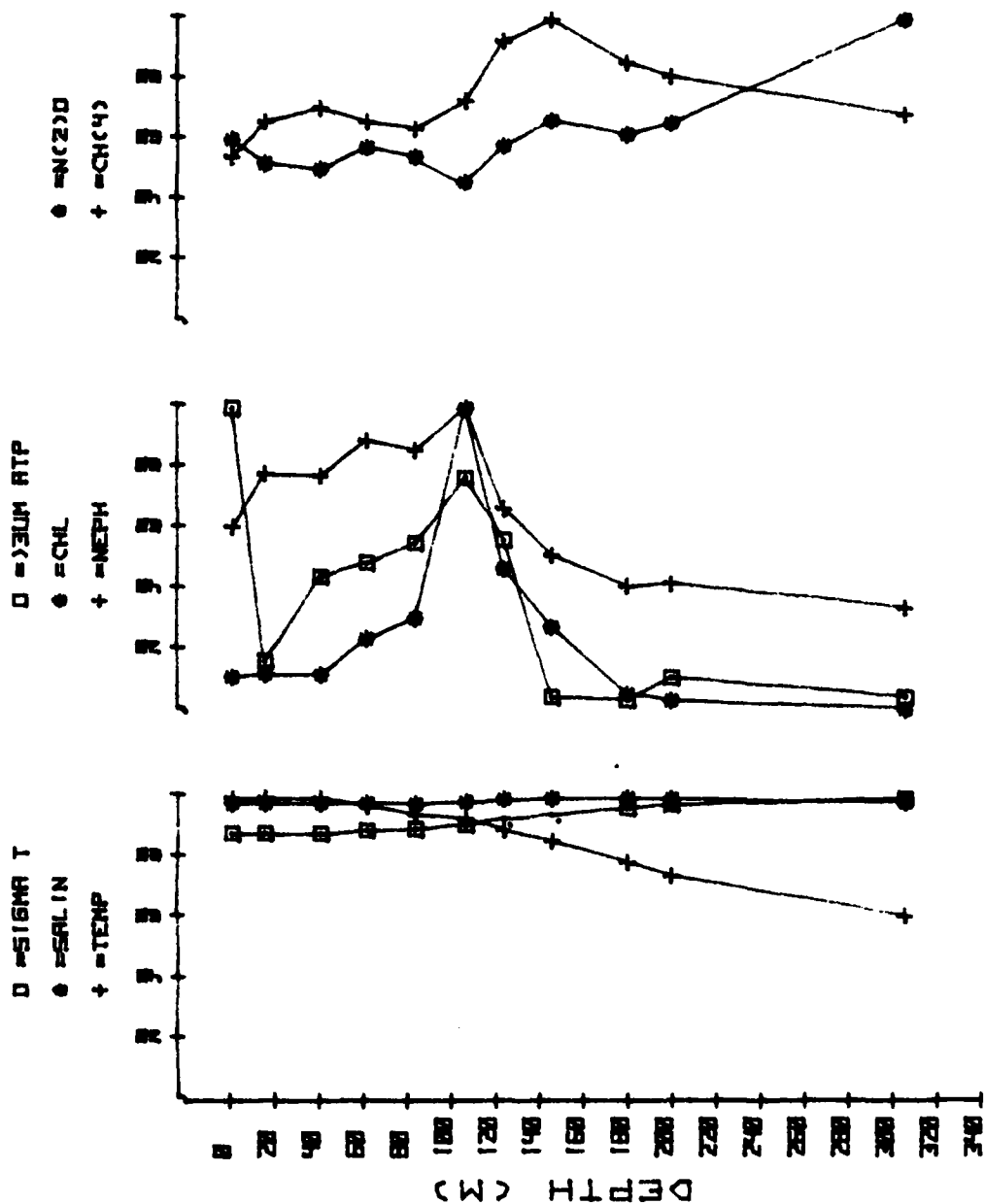


STN 18 USNS 1207-79

VALUES AS % OF MAXIMUM

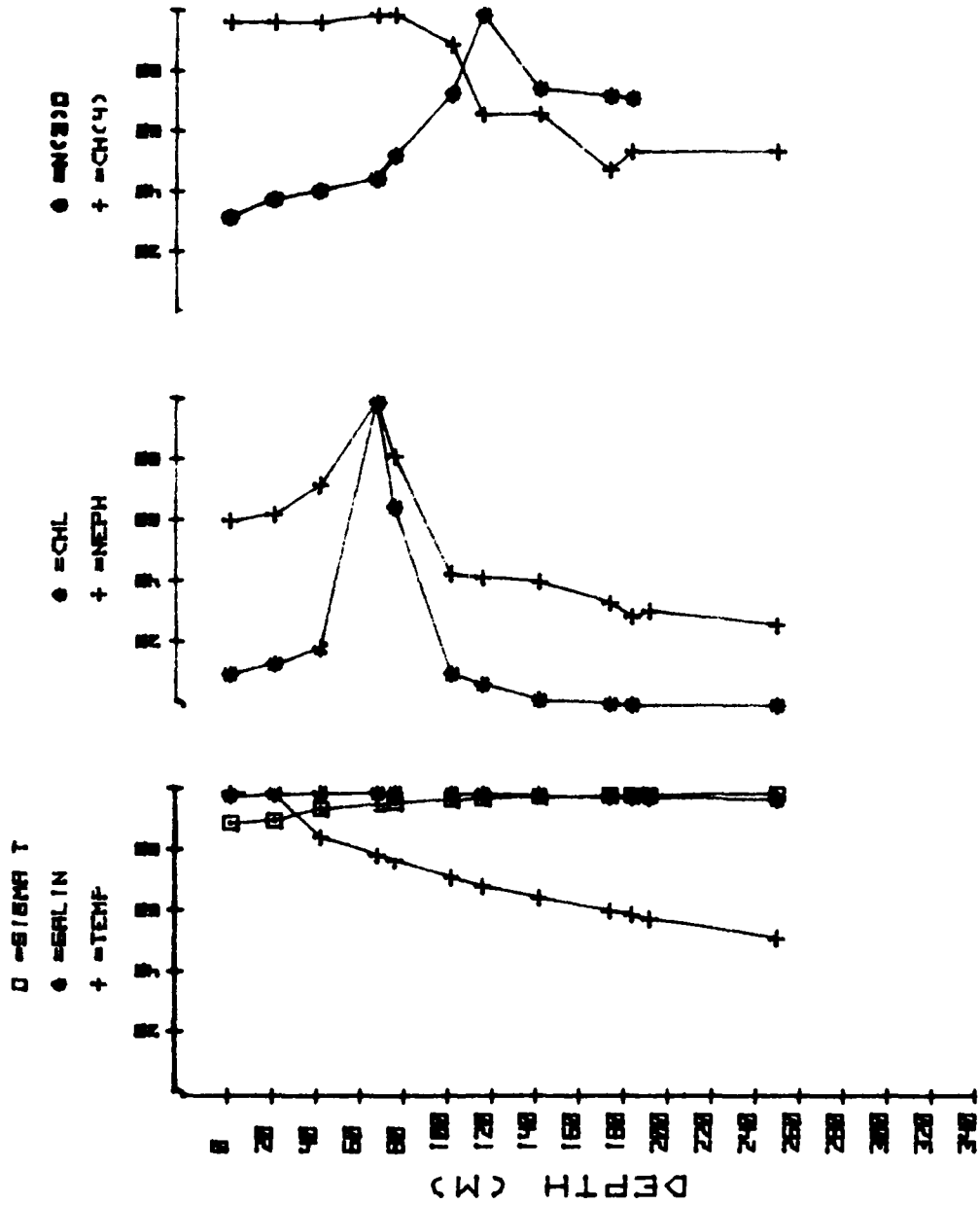


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VALUES AS % OF MAXIMUM



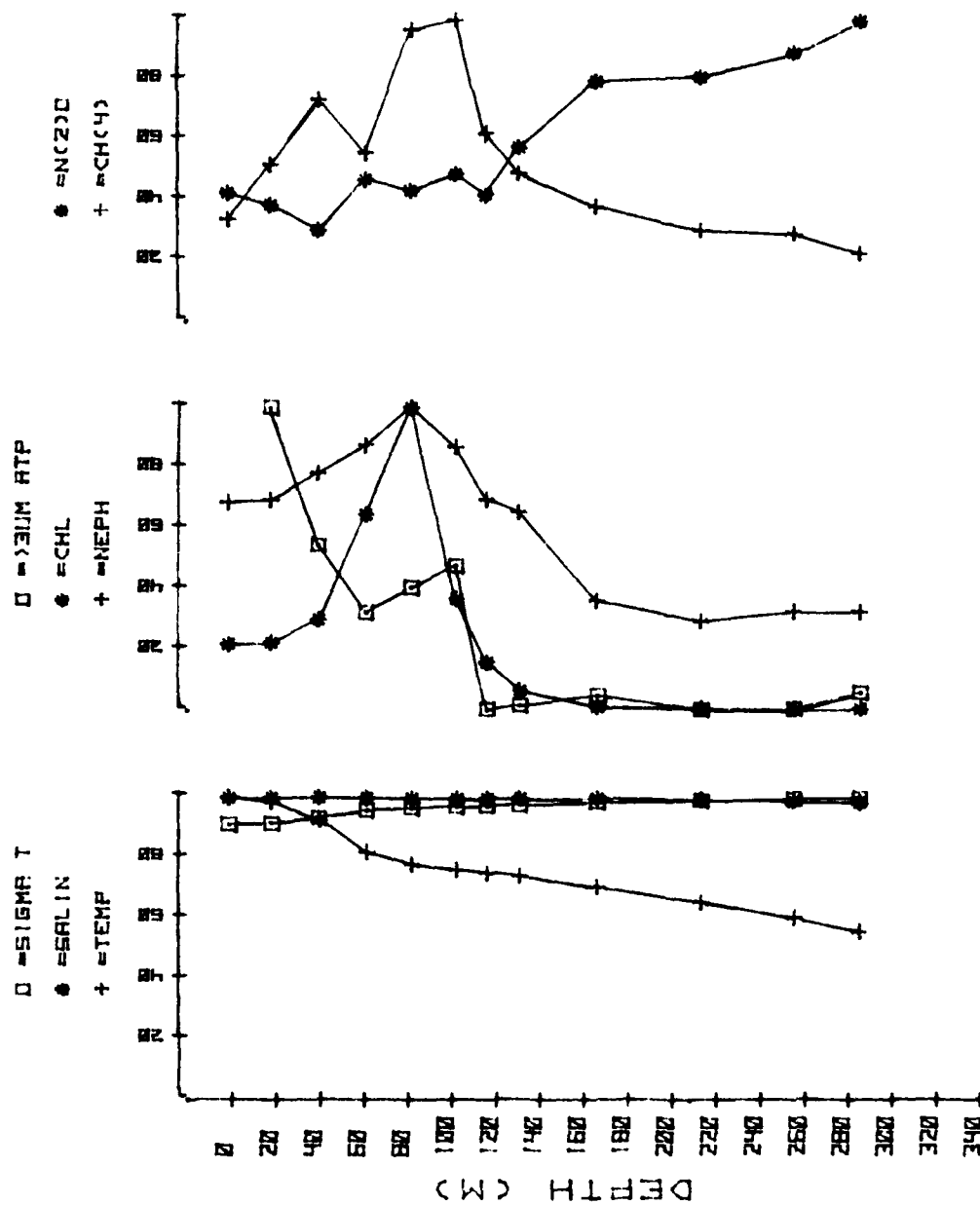
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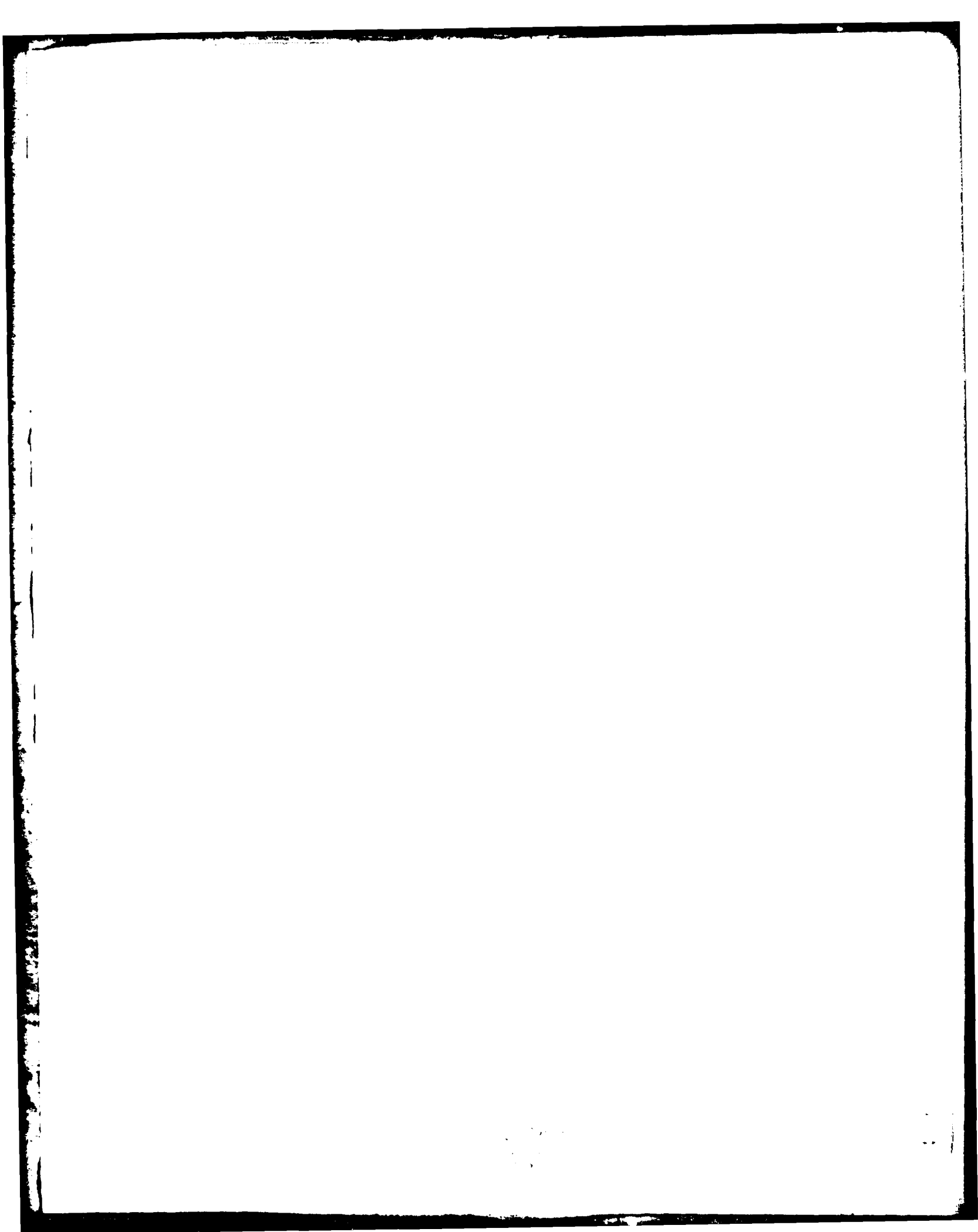
VALUES AS % OF MAXIMUM



STN 21 USNS 1227-73

VALUES AS % OF MAXIMUM





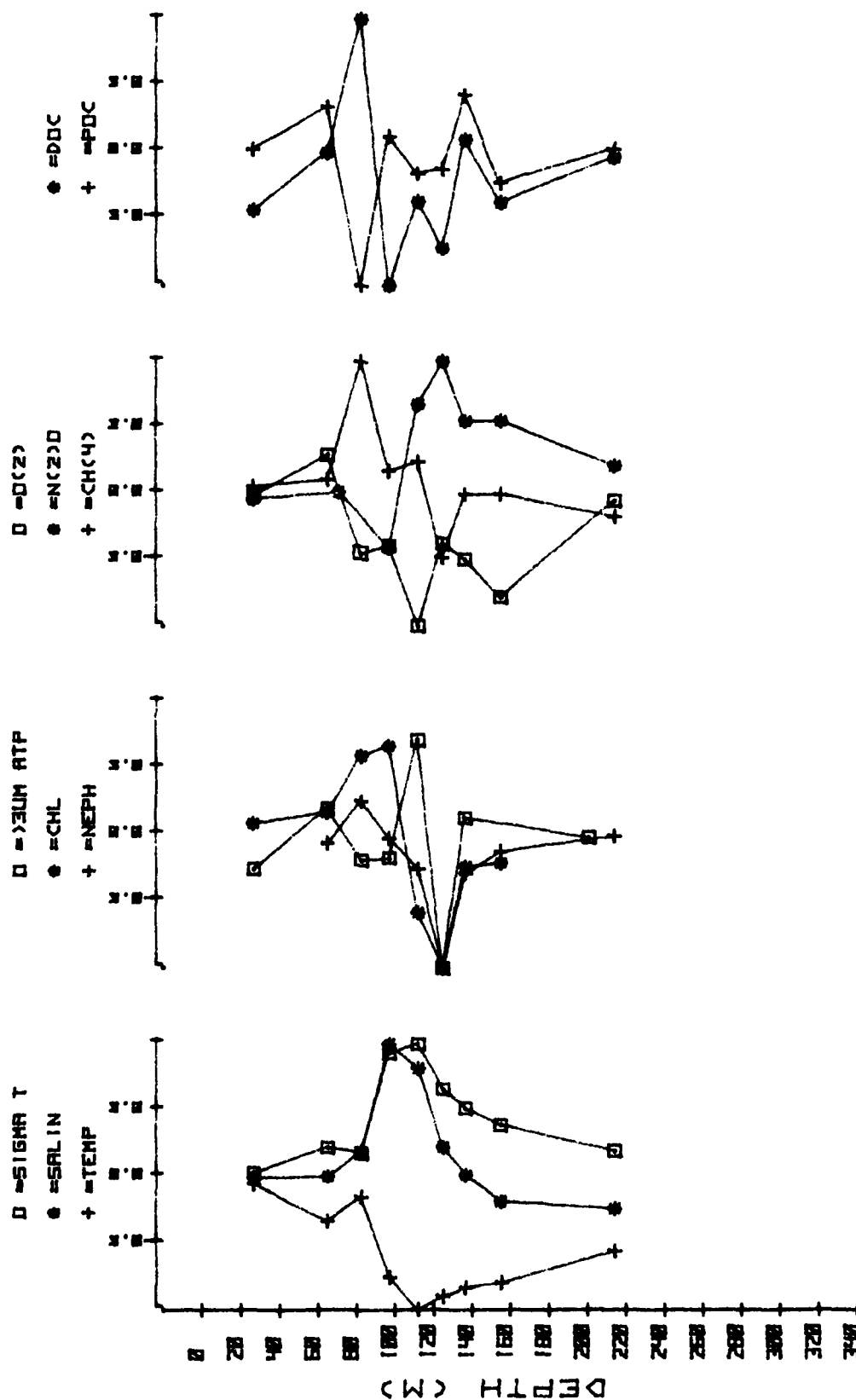
DEPTH PROFILES OF NORMALIZED GRADIENTS

USNS DESTIEGUER 1207-79

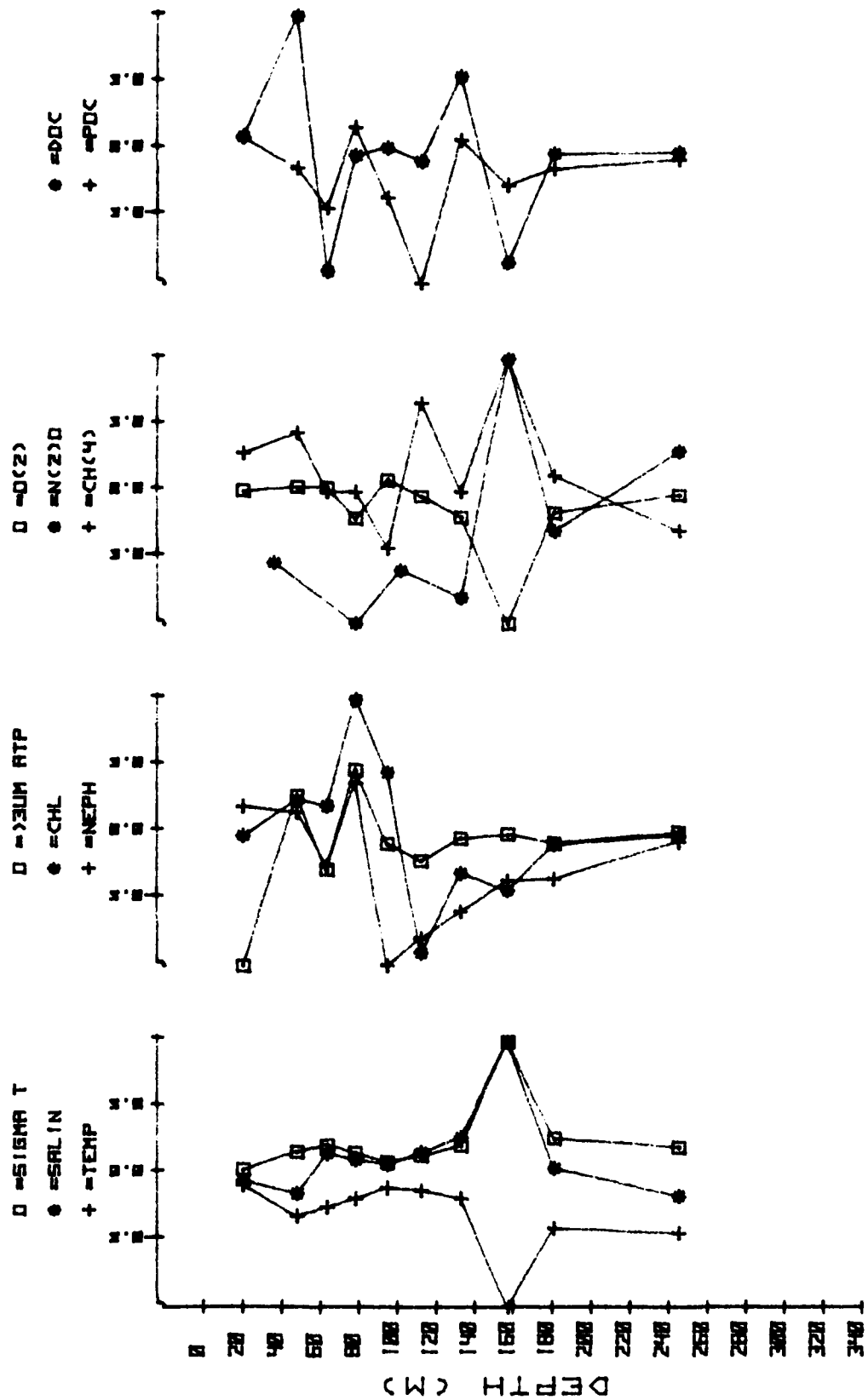
LEG II

STATIONS 10 THROUGH 21

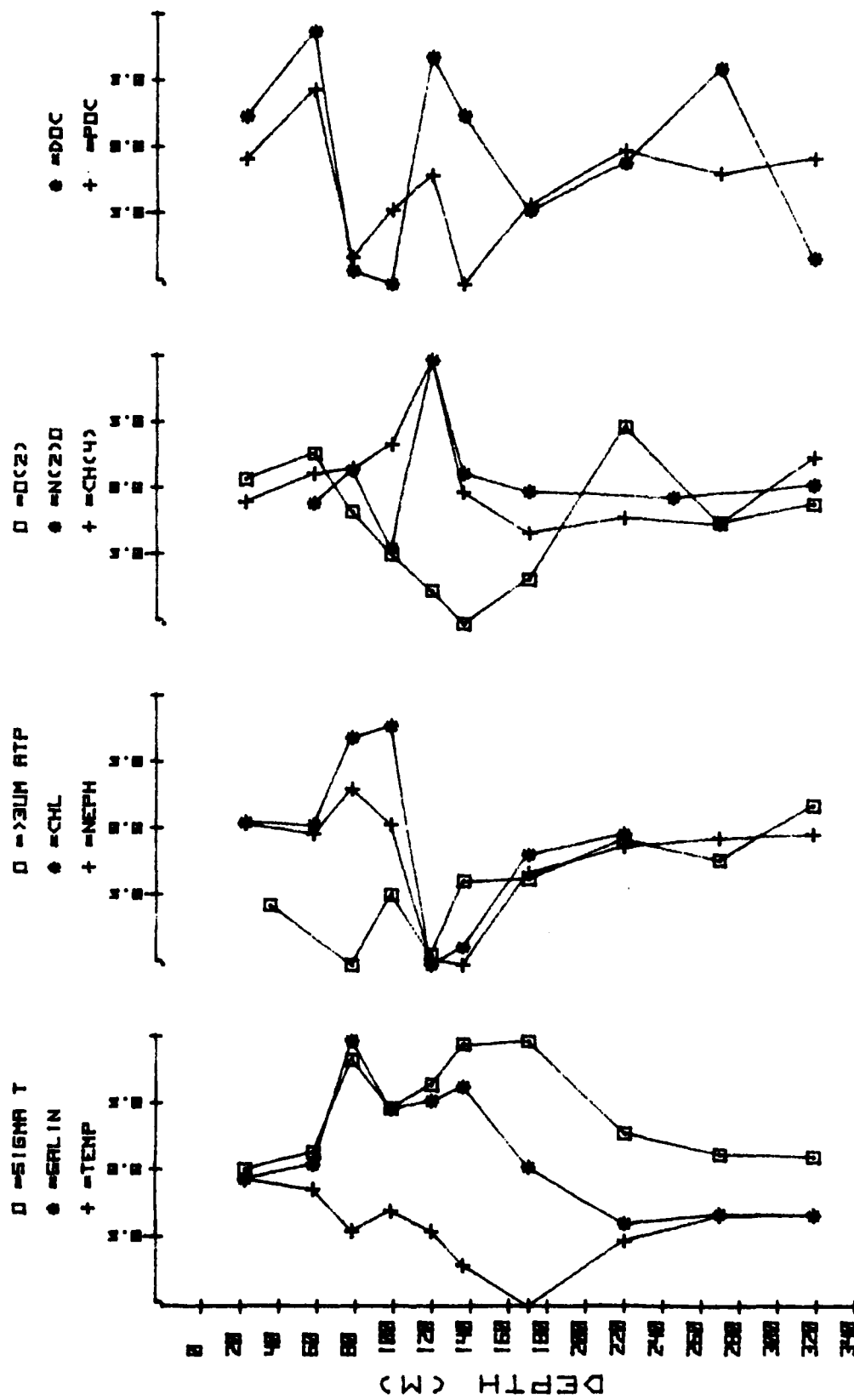
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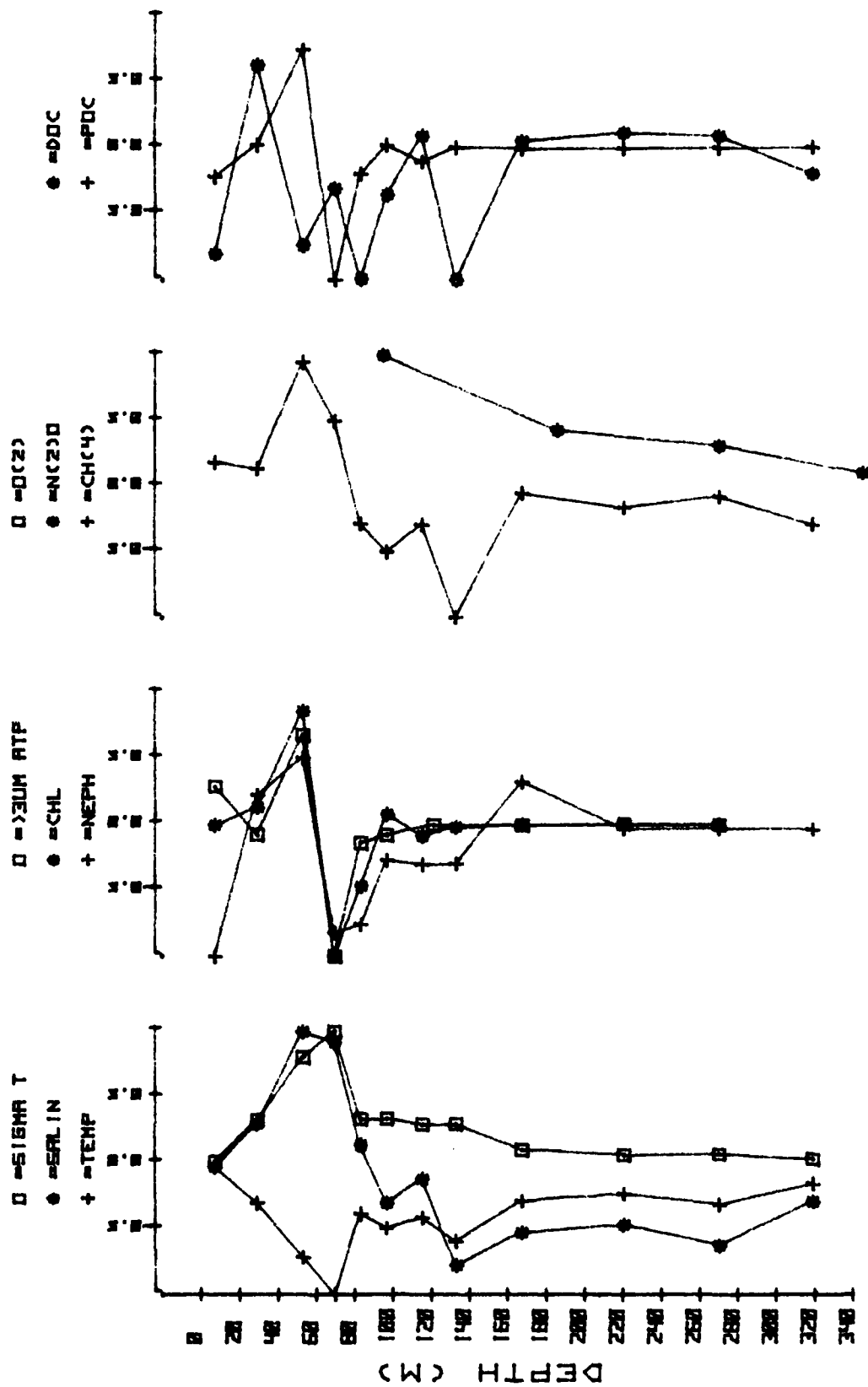
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 AVG GRADIENT, NORMALIZED TO MAXIMUM



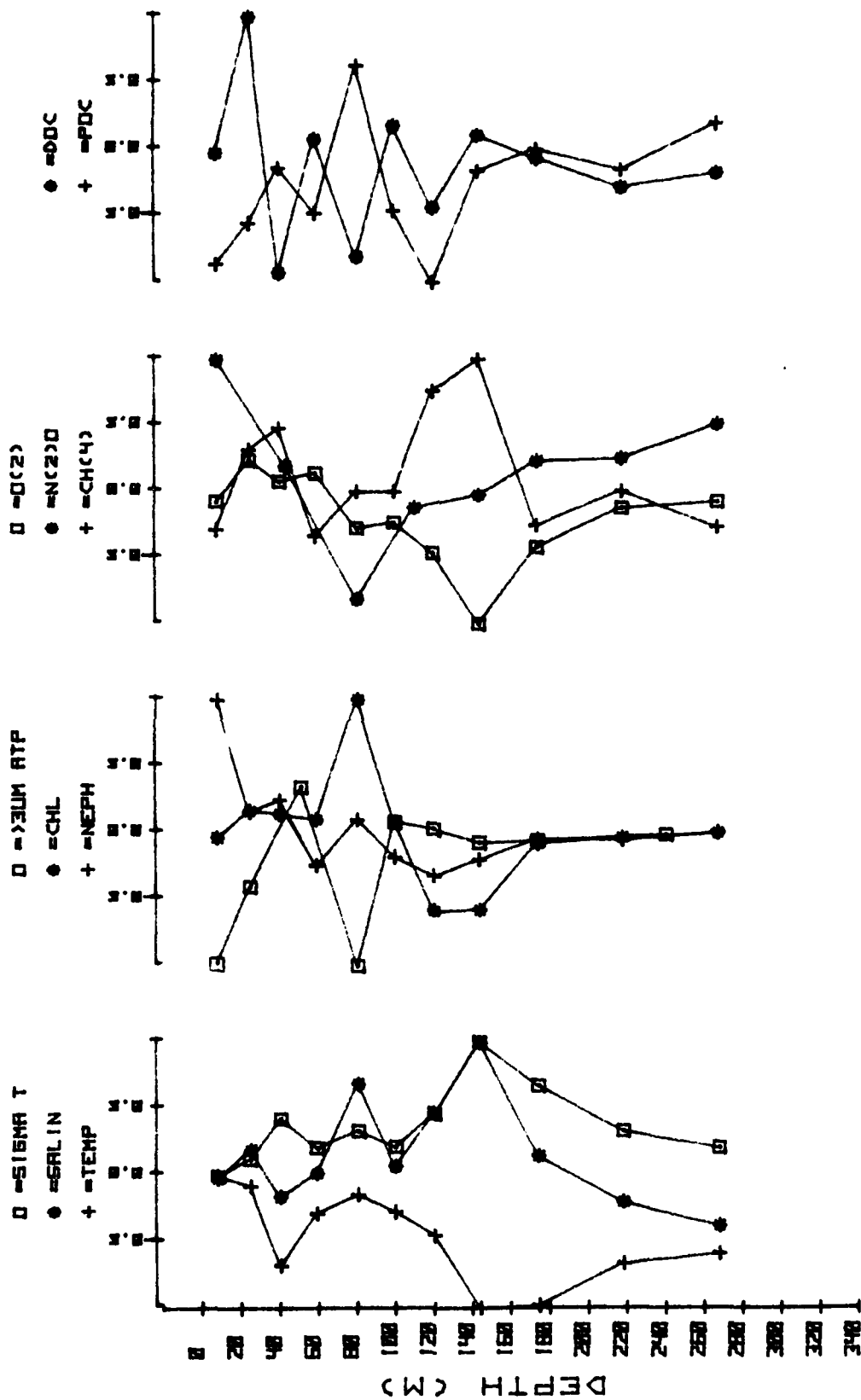
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 AVG GRADIENT, NORMALIZED TO MAXIMUM



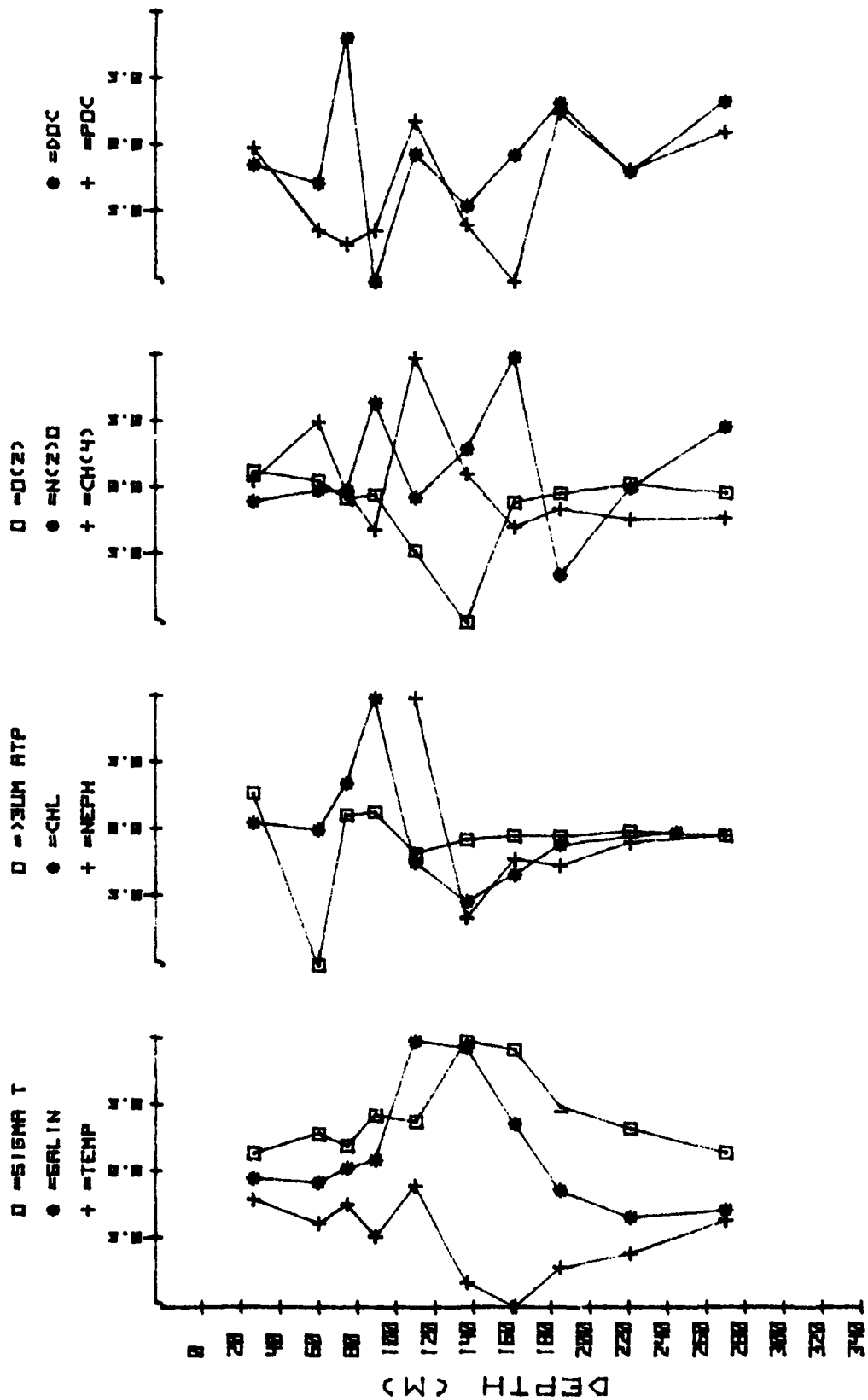
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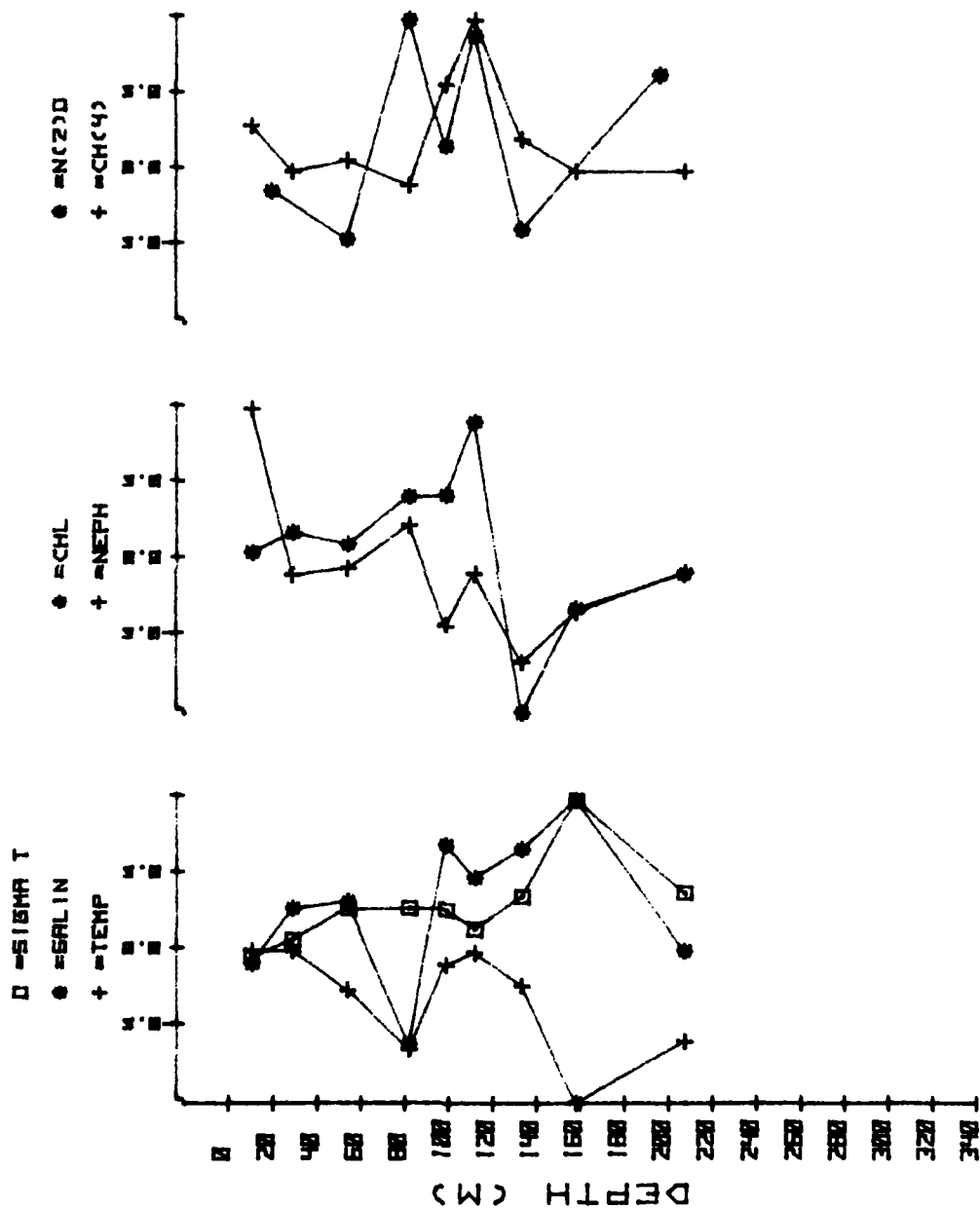
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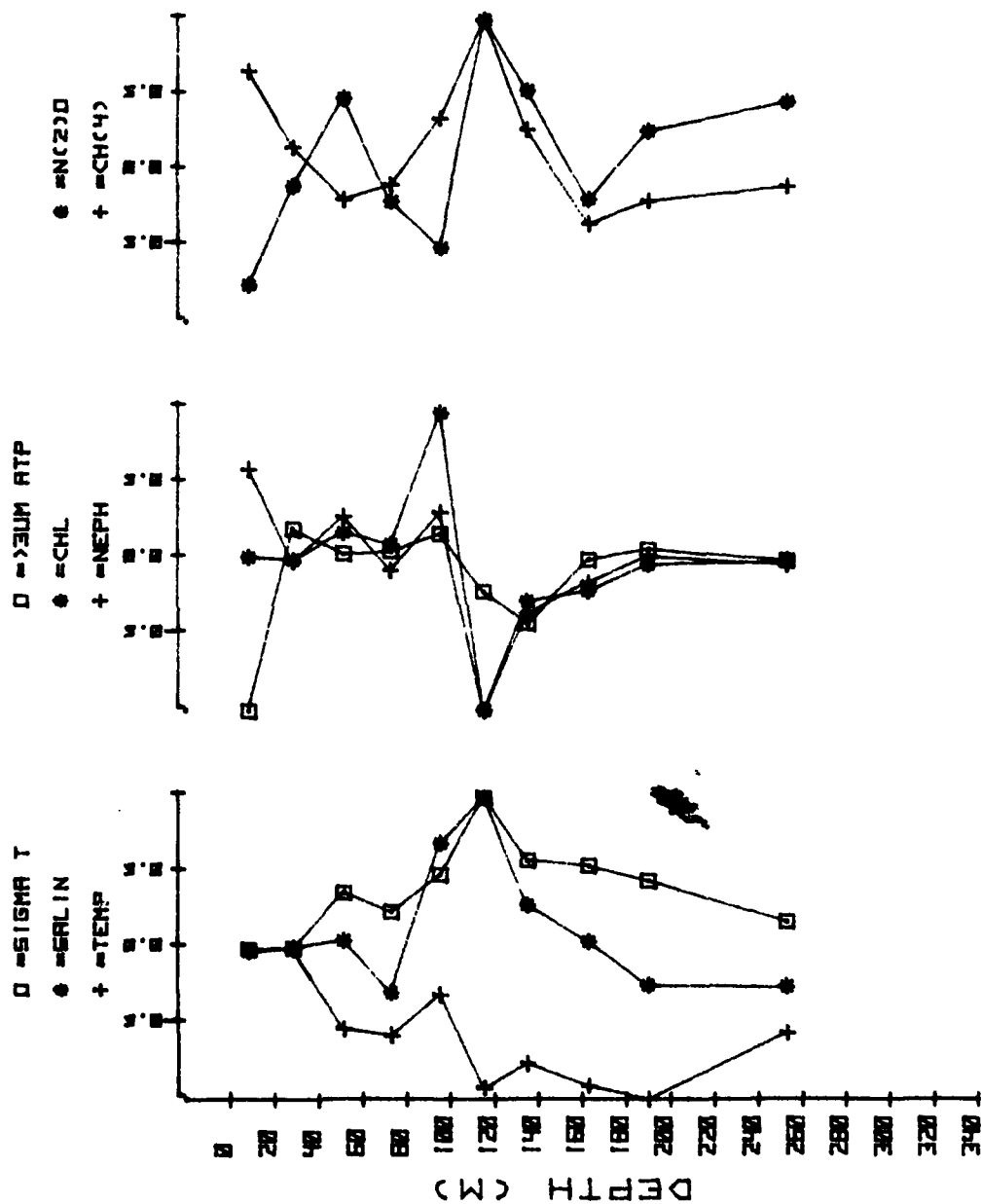
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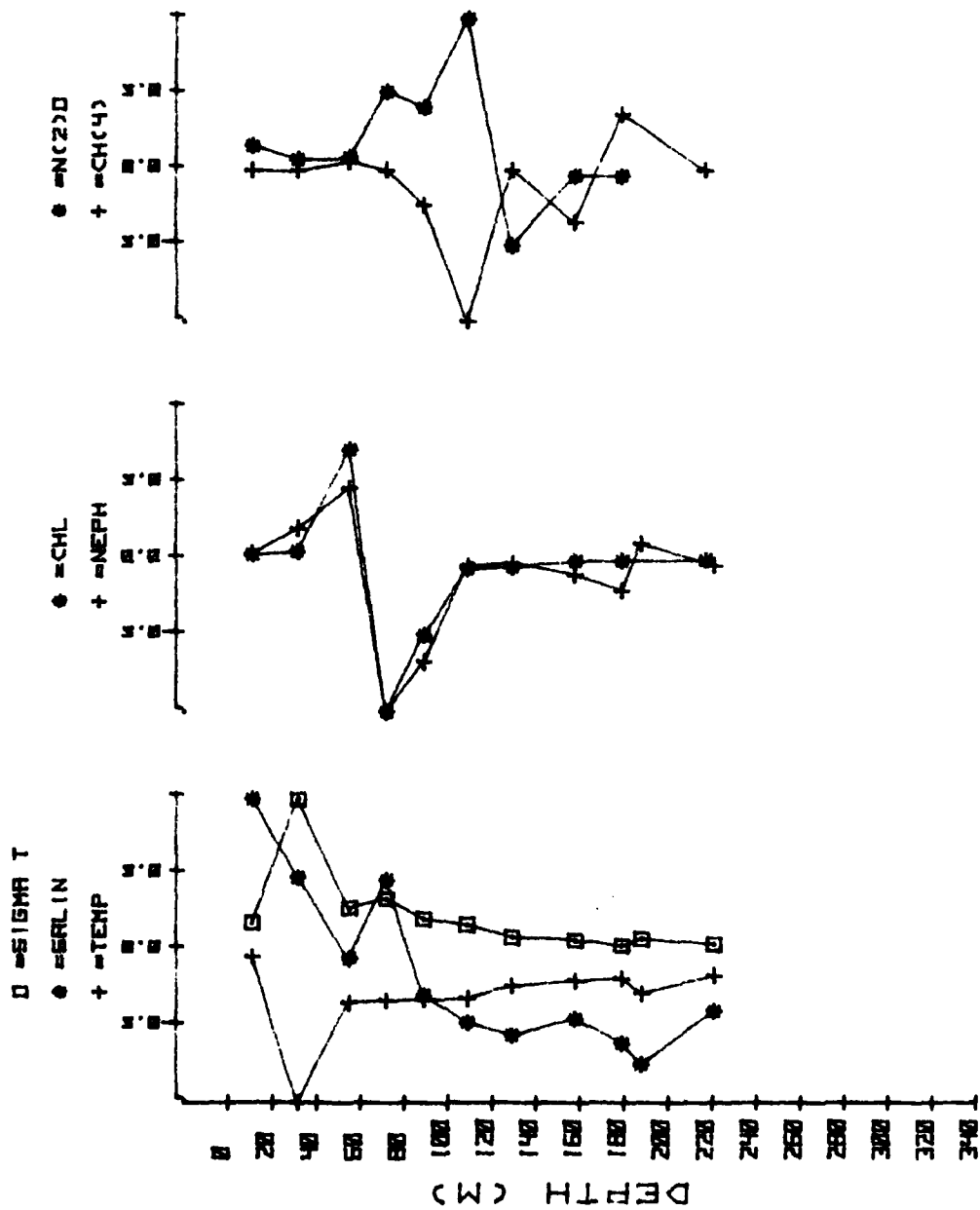


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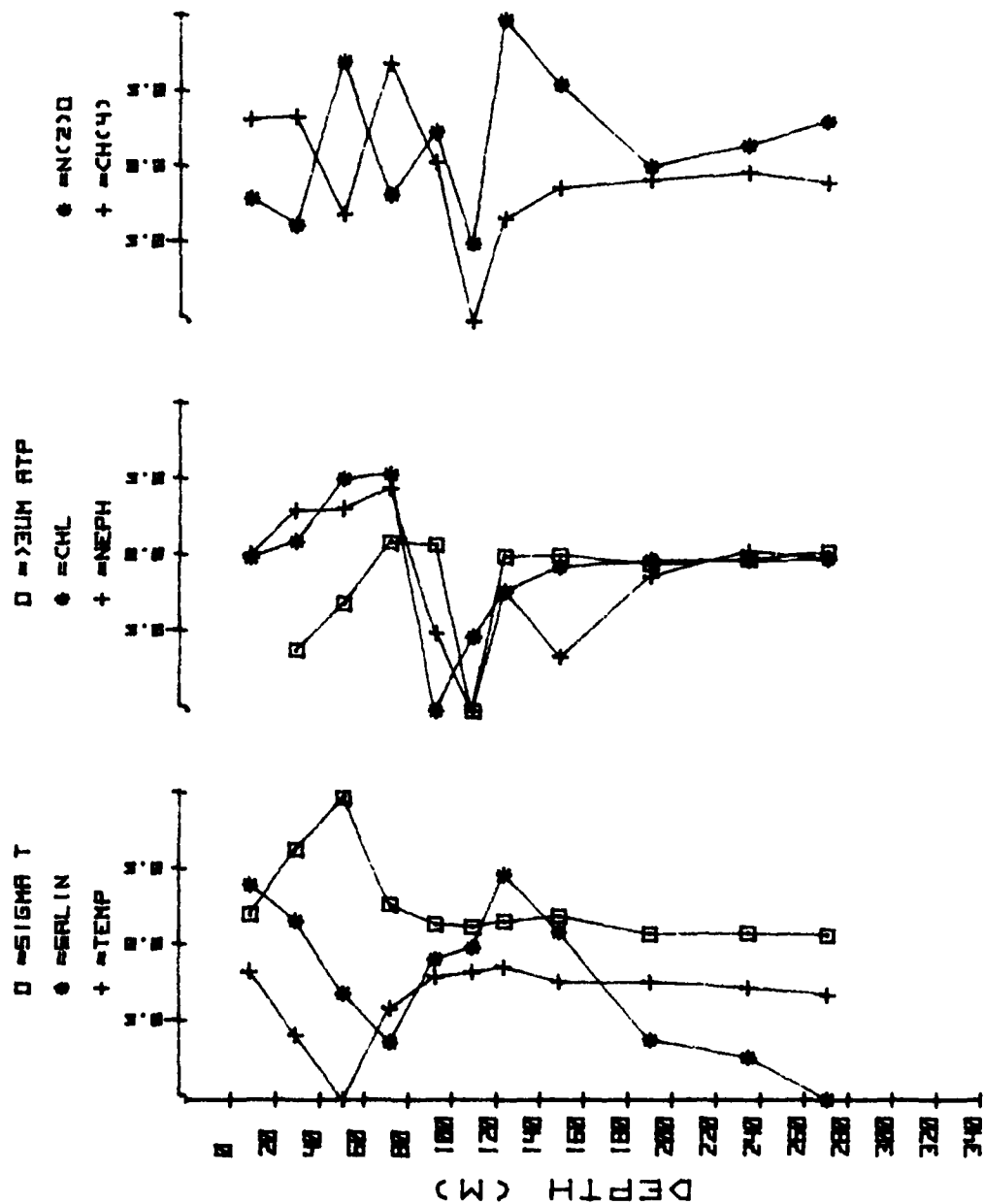


STN 20 USNS 1207-79

AVG GRADIENT, NORMALIZED TO MAXIMUM



STN 21 USNS 1207-79
 AVG GRADIENT, NORMALIZED TO MAXIMUM



Blank
50

APPENDIX A: CRUISE AND LABORATORY PARTICIPANTS

<u>Name</u>	<u>Affiliation</u>	<u>Principal Responsibility</u>
Reid, David F.	NORDA	CTD/Chief Scientist
Brooks, James M.	TAMU	N ₂ O, CH ₄ /TAMU Project Leader
Sackett, W. M.	TAMU	N ₂ O, CH ₄ /TAMU Project Leader
ABD El-Reheim, H.	TAMU	Nutrients
Bodennec, G.	Centre' Oceano- logique de Bretagne (FRANCE)	N ₂ O, CH ₄
Burke, R. A.	TAMU	N ₂ O, CH ₄
DePalma, Irene P.	NORDA	Salinity, O ₂ , TSM, ATP analysis
Hayes, Joe D.	NORDA	DOC, POC Laboratory Analysis
Kennicutt, M. C.	TAMU	DOC, POC Sample preparation
Lavoie, Dennis M.	NORDA	ATP Sample preparation
Turner, C. A.	NORDA	Chlorophyll sample preparation

Blank
52

APPENDIX B: COLLECTION AND ANALYTICAL METHODS

1. CH₄ and N₂O

Care was taken to prevent the introduction or trapping of air in the collection bottle by filling the bottle from the bottom using a piece of plastic tubing fitted to the Niskin bottle drain cock, by allowing the filled bottle to overflow, and by capping the collection bottle carefully. Analysis was begun immediately using the method of Brooks, Reid and Bernard (1981).

In its essentials, the method consists of first separating and concentrating the dissolved gases by bubbling pure helium through the sample in a closed purging loop. The purged gases are trapped in a tube containing a hydrocarbon adsorbant cooled by liquid nitrogen. Subsequently, the gases are released from the trap by heating and are flushed with helium through a gas chromatograph fitted with a flame ionization detector (for CH₄) or an electron capture detector (for N₂O). Calibration is accomplished using standard gas mixtures; precision of the method is approximately 5.5% and the detection limit 0.2 nl/l. Single analyses were done for each gas at each depth.

2. O₂

Calibrated 125 ml glass flasks were rinsed twice with the seawater sample, then gently filled from the bottom using a short length of plastic tubing attached to the Niskin drain cock. After allowing the flask to overflow copiously, a glass stopper having a conical end to displace contaminating air bubbles was inserted.

A modified ("Micro") version of the standard Winkler titration was used to analyze for dissolved oxygen (Carpenter, 1965; U. S. Naval Oceanographic Office, 1970). The tabulated values are the average of duplicate determinations.

3. TSM

A separate hydrocast, consisting of twelve 30 liter Niskin bottles, was used to collect water for total suspended matter. These bottles were fitted with new rubber springs (to minimize the occurrence of rubber particles in the sample water) and with special taps threaded into the bottom edge to enable all the water to be drained. A short piece of plastic tubing connected each tap to a 47 mm diameter in-line filter holder (Nuclepore Corp., Pleasanton, CA); this in turn was connected to a "catch" jug which was maintained under continuous vacuum. Each filter holder contained a tared 0.4 μ m pore size Nuclepore filter.

Vacuum filtration of the seawater proceeded until either all the water was drained from the Niskin bottle or the filter clogged. Salt was removed from the filter by injecting 30 ml of filtered, distilled water into the filter holder and applying suction until the filter was dry. The filter was then placed in a 47 mm plastic culture dish (Millepore Corp., Bedford, MA), desiccated overnight, and sealed with tape. "Blank" filters were loaded, rinsed, unloaded and stored along with the test filters, but no seawater was passed through them. The volume of seawater passed through each filter was measured in the catch jugs using a calibrated dipstick. Loading and unloading

of the filter membranes from the holders was done in a down-draft, laminar-air-flow hood.

At the laboratory, the filter membranes were weighed to the nearest microgram on a digital Cahn Electrobalance (Cahn Instrument Co., Cerritos, CA). Although they load up more quickly, Nuclepore filters are readily washed of salts and are not subject to the hydration problems associated with membrane filters or the fraying problems of glass fiber filters. The polycarbonate filters do tend to be prone to electrostatic effects, but this problem can be controlled by maintaining moderate humidity (approx. 70%) and using an ionization source in the weighing chamber. Single measurements were made at each depth.

4. Organic Carbon

Preparation of materials and analytical procedures generally followed those of Strickland and Parsons (1972) with some modifications. Calibrated, 1 liter glass reagent bottles were rinsed and filled with the sample. Particulate and dissolved organic carbon fractions were obtained simultaneously with an in-line system: the sea water was drawn up a glass siphon tube placed in the sample bottle and through a precombusted 25 mm diameter glass-fiber filter (GF/C, Whatman Inc., Clifton, NJ) mounted in a polycarbonate in-line holder (Nuclepore Corp.) attached to the top of the tube. The filtrate was then drawn into a 250 ml side arm flask from which it overflowed into the vacuum reservoir/waste receptacle. The filter was analyzed for particulate organic carbon (POC), and the filtrate remaining in the 250 ml flask was analyzed for dissolved organic carbon (DOC). Duplicate sample bottles were taken so that duplicate POC determinations could be made, and three replicate samples for DOC determinations were drawn by glass syringe from one of the 250 ml flasks. Reagents were added to the DOC ampules as per Strickland and Parsons (1972), but for the POC ampules, the glass-distilled water, persulfate and acid were premixed 8 hours before use for convenience and to minimize the reagent blank. This reagent solution was dispensed using an all-glass and Teflon Repipettor (Oxford Instruments Inc., Columbia, MD). The ampules were sealed using an Oceanography International Corporation (OIC, College Station, TX) Sealing/Purging Unit and were packed for transport.

At the laboratory, the ampules were cooked at 100°C overnight to complete digestion of the organic material to CO₂ and analyzed by infrared adsorption on an OIC Carbon Analyzer. Standards were run at the beginning and end of each sample set using oxalic acid dilutions prepared in ampules. The standard curve was best fitted by a quadratic equation to account for nonlinearity at the low end of the range of concentrations encountered. Blanks on standards and samples were run according to Strickland and Parsons (1972).

5. Chlorophyll and Phaeopigment

Pigment samples were drawn into rinsed, calibrated 1 liter, brown plastic bottles, and filtered and stored according to Strickland and Parsons (1972). Duplicate samples of the total phytoplankton pigment were filtered at each depth.

The filters, stored at -20°C in a desiccator, were transported to the laboratory at the end of the cruise, and the pigments extracted by grinding and steeping in neutral 90% acetone approximately 4 to 6 hours. Chlorophyll

"a" and phaeopigment "a" were measured after Strickland and Parsons (1972) using a Turner Designs Model 000-10 Fluorometer (Turner Designs, Mountain View, CA).

6. ATP

Seawater was drained into rinsed, brown plastic, 250 ml and 500 ml bottles. Duplicate aliquots were drawn through 3 μm pore size Nuclepore filters to recover particles larger than 3 μm . In a separate filtration, duplicate 250 ml aliquots were drawn through 0.2 μm pore Nuclepore filters to recover particles larger than 0.2 μm . After extraction, the latter filters yielded a "Total" ATP estimate for all microorganisms in the water down to bacteria. The results from the first fraction were then subtracted from this value to derive a "<3 μm " fraction. The ">3 μm " fraction represents ATP contributions from microzooplankton, net phytoplankton, micro flagellates (also known as nanoplankton or ultraplankton), and bacteria on detrital or fecal particles. The "Total ATP" fraction includes all of these contributions + that of the bacterioplankton and the smaller microflagellates.

ATP was extracted from the particles on the filters by the standard method (Holm-Hansen and Booth, 1966): as soon as the last of the seawater passed through it, the filter was removed from the filter holder and plunged into 5 ml of boiling Tris buffer (tris hydroxyaminomethane at pH 7.8, 0.05 M) contained in a 20 ml scintillation vial and boiled for at least 3 minutes. Procedural blanks were obtained by extracting filters taken straight from the box.

The extracts and filters were cooled and frozen in the vials and maintained at -20°C until analysis at the laboratory, where they were gently thawed and brought to the original 5 ml volume with "low response" water (i.e., water purified by ion exchange and reverse osmosis, neutralized with NaOH, and tested for ATP activity). Analysis was accomplished by injecting 200 μl of sample into 100 μl of purified luciferin-luciferase system (DuPont Inc., Wilmington, DL). The resulting light emission was measured in a sensitive photometer (SAI Inc., San Diego, CA), after a 10 second delay, by integrating the area under the reaction decay curve for 30 seconds. From two to four injections were made of each extract, so that each data point represents a minimum of duplicate determinations on each of two replicate filtration/ extractions. Standards were made with "low response" water and pure Na-ATP salt (Sigma Chem. Corp., St. Louis, MO). Both blank and unknown concentrations were normalized to 5 ml before correcting for the blank and extrapolating back to the seawater concentration.

7. Nutrients

Samples were drawn into sterile Whirl Pak plastic bags (NASCO, Inc.) and kept at 4°C until processing, which was completed within six hours. Sample preparation followed Strickland and Parsons (1972) and analysis was performed using a Technicon Auto Analyzer (Technicon Instruments Corp., Tarrytown, NY).

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7. AUTHOR(s) D.M. Lavoie D.F. Reid I.P. DePalma J.D. Hayes		6. PERFORMING ORG. REPORT NUMBER
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report is a summary of data collected in the Western Caribbean and Gulf of Mexico during the spring of 1979. Vertical profiles through most of the water column were obtained for the following parameters: conductivity, temperature, salinity, nephelometry, total suspended matter, dissolved and particulate organic carbon, adenosine triphosphate (ATP), chlorophyll and phaeopigments, nutrients (nitrate, ammonium, phosphate, silicate), dissolved oxygen and dissolved reduced gases (methane and nitrous oxide). Results are presented as:		

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(1) tables of measured and derived parameters; (2) depth profiles of unnormalized values, normalized values, and normalized rates of change. Descriptions of the collection and analytical procedures are also given.

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