

Physical Properties of Core Samples

Collected on Cruise 88024

K. Moran and P. Potter

Atlantic Geoscience Centre

Geological Survey of Canada

Open File Report #

2302

Introduction

13 cores were collected on cruise 88024 to the Labrador Sea region. Of those, three piston cores (PC) and one trigger weight core (TWC) were tested for physical properties. The locations of the measured cores are listed in Table 1. Onboard measurements of undrained shear strength were made by Ann Miller and Mark Fay using a Soiltest Inc. Torvane. In addition, subsamples for determination of bulk density, water content and salinity were collected onboard and later analyzed at the Atlantic Geoscience Centre Geomechanics Laboratory. Density was determined using a gas comparator pycnometer for volume measurement and an electronic balance for measurement of sediment mass. Water content was measured following the procedures of ASTM standard D2216-80 (ASTM, 1988) and correcting the measurement for pore water salinity as recommended by Noorany (1984). Salinity was measured following ASTM procedures

Results

PC-04 (Fig. 1) was taken from the western levee of the North Atlantic Mid-Ocean Channel (NAMOC). Water content, bulk density, and salinity were measured on this core. The results show little variation in water content down core, suggesting a homogeneous deposit that is not normally consolidated. Only the very bottom test is inconsistent, showing a low density and high water content which may represent a lithologic change. The salinity shows variation down core, but it is not significant and represents a normal marine distribution. In general, the density is high and the water content low for surficial marine sediment.

Shear strength, water content, bulk density, and salinity were measured on core PC-05 (Fig 2), which was taken from the eastern levee of NAMOC. The properties show normal changes in water content and density in the upper metre (i.e. decreasing water content and increasing density with depth). The shear strength profile in the upper metre, however, is anomalous as it decreases with depth. This behaviour has been seen in other slope environments on the Scotian slope (Mosher, 1987) and may be related to surface sediment failure, bioturbation, biostratigraphy or sediment physicochemical changes. Between 1 and 3 metres down core, the shear strength increases, the density fluctuates, but generally increases and the water content decreases with variations similar to the density. A change in all properties occurs below

3 metres, where the strength drops significantly, and the density and water content become almost constant with depth, similar to PC-04. However, the strength increases with depth, although the magnitude is low (< 15 kPa). Throughout the core, the salinity shows no significant change, with median values of about 34 ppt.

TWC-05 (Fig. 3) was collected with PC-05. The trigger weight core samples the very surface sediment which is displaced by the piston corer and by comparing the properties of both core samples, the amount of sediment displaced by the piston corer can be determined. The properties overlap at 80 cm below the TWC surface; therefore, the piston corer most likely missed the upper 80 cm of sediment. At the seabed surface, the TWC shows that the sediment properties decrease in strength with depth, have lower density and very high water content (close to 100% of dry weight), and low salinity which increases consistently with depth.

PC-12, taken from the Labrador Slope, shows the largest variations in sediment physical properties. Within the upper half metre, the properties are similar to the upper sediment of PC-05 where the strength decreases, density increases, and water content decreases. Below this depth, between 0.5 and 4 metres, the properties are variable. The density varies from less than 1.5 to 2.1 g/cm³ with similar changes in water content. These variations are most likely attributed to major changes in grain size (from clays in low density layers to sandy sediment in high density zones). The shear

strength within this depth range significantly increases with depth. Below 4 metres, the physical properties show two distinct zones: from 4 to 5 metres and from 5 metres to the bottom of the core. Between 4 and 5 metres, the sediment has the highest strength of all material tested (15-20 kPa), low density and relatively high water content. Below 5 metres, the strength decreases with depth except for the very base of the core, the density is high ($> 1.8 \text{ g/cm}^3$) and the water content is low. The salinity of this core varies from a median of 34 ppt in the upper 4 metres to a median of 33 ppt below 4 metres. In general, the sediment physical properties in this core represent a highly variable lithology which is most likely influenced by grain size changes. Based on these results and the sedimentological description (Fay, in prep.), these physical property variations are attributed to a series of turbidite deposits.

Table 1.
Core Locations

	Latitude	Longitude
PC-04	59° 12.12'	54° 05.69'
PC-05/TWC-05	59° 23.93'	53° 42.07'
PC-12	58° 02.78'	56° 22.05'

References

American Society for Testing Materials, 1988. Annual Book of ASTM Standards, Vol. 04.08, Soil and Rock, Building Stones; Geotextiles, Pub. ASTM, Philadelphia PA, 1988, 953 pp.

Mosher, D.C., 1987. Late Quaternary Sedimentology and Sediment Instability of a Small Area on the Scotian Slope, Master's Thesis, Department of Earth Sciences, Memorial University of Newfoundland, St. John's, Newfoundland, 249 pp.

Noorany, I., 1984. Phase Relations in Marine Soils, Journal of Geotechnical Engineering, Vol. 110, No. 4, April 1984, p. 539-543.

Hudson 88024
PC-04
Physical Properties

Depth (cm)	Bulk Density (g/cm ³)	Water Content (% dry wt.)	Salinity (ppt)
358	1.897111	42.03777	34
404	1.910863	40.35103	34
417	1.839626	49.04531	33
440	1.82761	48.31715	33
458	1.889871	41.6236	35
460	1.8034	47.84988	34
482	1.931012	36.76355	35
502	1.854859	44.47615	34
520	1.84402	43.89505	34
588	1.885083	39.84069	35
610	1.899165	40.38993	34
820	1.879975	41.22207	33
900	1.858885	44.85766	35
940	1.891753	42.06823	34
958	1.859365	44.87184	36
982	1.625964	76.79752	33

Hudson 88024
TWC-05
Physical Properties

Depth (cm)	Bulk Density (g/cm ³)	Water Content (% dry wt.)	Salinity (ppt)
21	1.536492	96.86749	30
40	1.538814	92.42017	32
60	1.559461	95.49238	33
80	1.562457	91.34017	34
84	1.575587	88.40979	34
121	1.783589	49.57216	34

Hudson 88024
PC-05
Physical Properties

Depth (cm)	Bulk Density (g/cm ³)	Water Content (% dry wt.)	Salinity (ppt)
10	1.564487	95.87341	34
42	1.741066	55.37929	34
62	1.765734	56.39795	34
80	1.749342	55.12717	34
100	1.792212	53.15043	35
120	1.874294	45.96931	33
140	1.828752	48.04515	33
160	1.784487	52.42497	33
180	1.756249	56.15571	34
200	1.861768	43.27783	34
200	1.852922	44.21041	33
240	1.831329	45.78612	33
262	1.871592	44.86942	35
280	1.809794	50.51972	34
300	1.931023	38.34905	34
340	1.841902	45.82078	35
380	1.830796	45.10664	34
542	1.858429	44.64856	34
561	1.87333	42.09268	34
618	1.884686	33.74267	35
642	1.889791	39.70431	36
660	1.860654	43.58943	34
680	1.842302	45.74911	34
713	1.858753	44.03097	36
716	1.88087	39.71744	35
854	1.879044	42.52328	35
874	1.816939	46.09411	34
920	1.86463	43.68346	35

Hudson 88024
TWC-12
Physical Properties

Depth (cm)	Bulk Density (g/cm ³)	Water Content (% dry wt.)	Salinity (ppt)
45	1.755	55.76	32
85	1.780	51.669	34

Hudson 88024
PC-12
Physical Properties

Depth (cm)	Bulk Density (g/cm ³)	Water Content (% dry wt.)	Salinity (ppt)
12	1.513197	103.9982	33
20	1.571285	97.09779	34
40	1.865144	44.02985	34
55	1.661282	72.17201	33
85	1.535709	101.4728	34
110	1.54825	93.63882	34
140	1.444407	124.1058	34
160	1.489681	104.9532	33
180	1.55177	100.5495	34
205	2.079927	25.60197	34
221	2.098049	25.23923	33
251	1.510444	101.8538	34
287	1.535615	99.40864	35
323	1.746673	53.38019	33
355	2.115917	24.71636	34
380	1.555394	92.1116	33
400	1.570694	86.98563	35
420	1.562688	92.19749	33
440	1.599326	84.26297	33
460	1.62365	82.75235	34
465	1.608622	80.14581	33
480	1.61393	78.69726	33
500	1.843681	47.59469	33
520	1.881854	40.16006	33
540	1.900702	39.50333	34
560	1.871157	42.86782	29
580	1.879007	42.66451	33
600	1.872103	40.77997	34
620	1.835199	45.86761	33
640	1.662543	77.71085	32
660	1.811525	30.57172	34
673	1.696487	64.66593	33
684	1.712579	62.52788	33
698	1.812123	49.58245	32
712	1.893898	25.20412	36

Fig. 1

CRUISE: 88024 CORE: PC-04

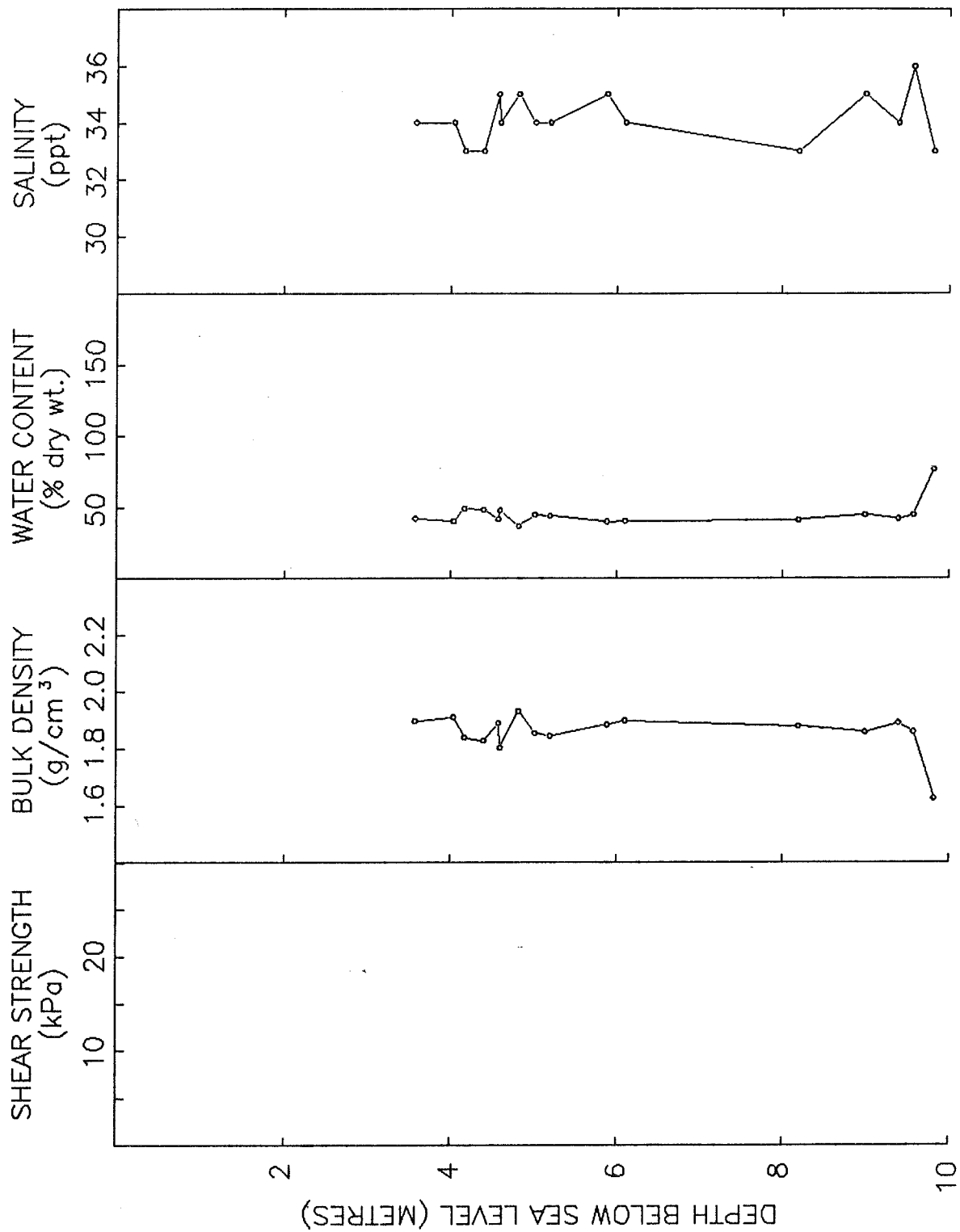
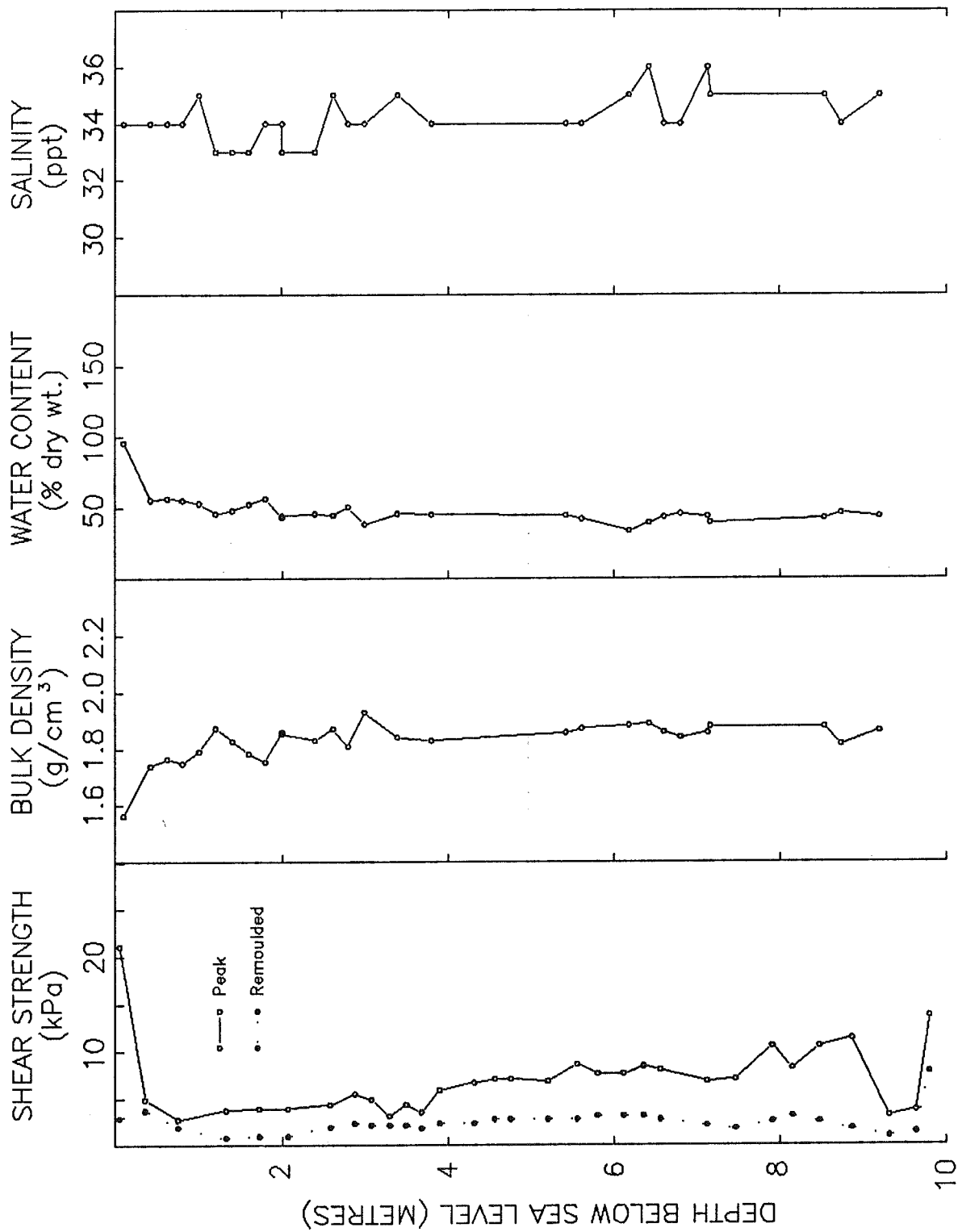


Fig. 2

CRUISE: 88024 CORE: PC-05



CRUISE: 88024 CORE: TWC-05

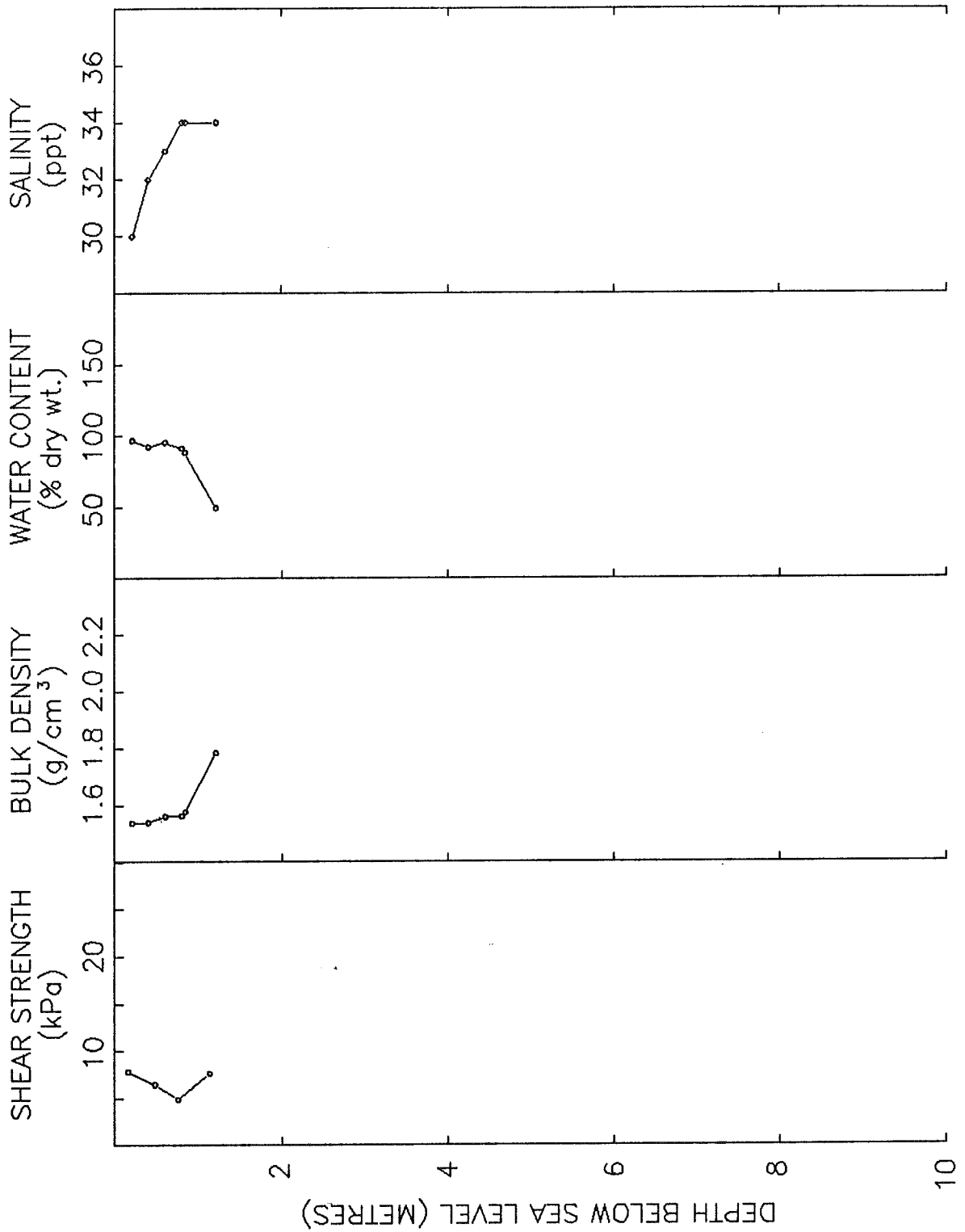


Fig. 3

Fig. 4

CRUISE: 88024 CORE: PC-12

