Indexed 91B.

PD

RRS CHALLENGER

CRUISE 18

2 SEPTEMBER - 25 SEPTEMBER 1987

1. Personnel

		Leg 1	Leg 2
R Easton	MBA	✓	✓
K Goy	IOSDL	✓	✓
D Griffiths	MBA	✓	✓
A Hall	ISODL	✓	✓
R Harris	MBA	✗	✓
A New	IOSDL	✓	✓
D White	IOSDL	✓	✗
R Pingree PSO	IOSDL/MBA	✓	✓
K Potter	RVS	✓	✓
J Sleep	MBA	✓	✓
E Cooper	RVS	✓	✓
J Smithers	IOSDL	✓	✓
D Smythe Wright	IOSDL	✓	✓
I Waddington	IOSDL	✓	✗
A Pichon	EPSHOM	✓	✗
J Girardot	UBO	✗	✓
K Smith	RVS	✓	✗
M Davies	RVS	✗	✓

2. Aims

(i) To recover current meter moorings 108 and 109 deployed on Frederick Russell Cruise 2/87.

(ii) To deploy 2 short term current meter and thermistor chain rigs in the region of strong tidal flow on the continental slopes south of Chapel Bank to examine the production and generation of internal tides. These moorings (rigs 110 and 111 are to be deployed in depths of 2500 m and 1000 m and to be instrumented over most of the water column.

(iii) To deploy 4 long term current meter rigs in the Porcupine Sea Bight. These moorings (112, 113, 114, 115) are to be recovered on Challenger Cruise 31/88.

(iv) To make repeated runs with the Sea Soar, thermistor span and side-scan both at spring tides and neap tides to investigate internal wave propogation and near surface mixing.

(v) To make CTD yoyos over a tidal cycle in the upper slope region and at increasing distances from the slopes. These are to be made in conjunction with the ADCP and the transmissometer to investigate mixing within the water column and the production of turbid layers near the bottom. Samples are to be drawn for inorganic nutrients, freon, and Coulter Counter analyses.

(vi) To continuously measure the surface values of temperature, salinity, fluorescence, light transmissions, inorganic nitrate, reactive silicate and to obtain samples for particle size, phytoplankton and zooplankton analyses.

(vii) To deploy three satellite tracked drifting buoys in the Porcupine Sea Bight.

3. Procedure and Scientific Programme

1st Leg

The RV Challenger sailed from Barry at 1330 hrs (GMT) on 2.9.87 and steamed along the track shown in Fig. 1 towards the working area south of Chapel Bank. On Thursday 3.9.87 at 2000 hrs the catamaran and side scan sonar were deployed to obtain a section across the continental shelf and slopes. At 0200 hrs (Friday 4.9.87) the catamaran capsized and the Challenger slowed to recover the side scan sonar and right the thermistor spar. RV Challenger continued with the catamaran tow until 0709 hrs. After a water depth survey of the region, current meter and thermistor chain mooring 111 was deployed at 1624 hrs in a depth of 1047 m at position 47°25.3'N 06°38.3'W (All mooring positions and mooring details are given in Table 1).

After completion of mooring 111, the Sea Soar was deployed to obtain a 45 nm section from the upper slopes to a position in the Biscay at 46°45'N 07°02.4'W. Then with Sea Soar still deployed the Challenger turned to steam in a direction 015° to complete an on-shelf run at 1536 hrs on Saturday 5 September (Sea Soar runs are given in Table 2). The Sea Soar was recovered at 1949 hrs and the vessel took up a position for an ADCP survey on the 200 m contour which lasted through to Sunday morning (0300 hrs, 6.9.87).

After a wire test in 3000 m, mooring 110 was deployed in 2639 m on position 47°17.6'N 06°40.3'W at 1844 hrs on Sunday evening. The Sea Soar was then deployed and the RV Challenger steamed at 7 kts towards position A (48°N 6°27'W) for the second Sea Soar Run which was completed at 0800 hrs, Monday 7.9.87.

From Monday 7.9.87 to Thursday 10.9.87 a series of CTD stations (1-4) was undertaken in the vicinity of the upper slopes. Each station was occupied for a complete tidal cycle and the CTD was yoyoed from the surface to within 5 m of the bottom whilst the ship maintained a fixed position alongside a moored dahn buoy. Throughout this period current profiles using the ADCP were also obtained (The positions of the CTD stations are given in Table 3). On completion of the 4 CTD tidal yoyo stations, the catamaran was relaunched to obtain the thermal structure of the surface layers under spring tide conditions. This survey, together with an XBT run, was completed at 0330 hrs on Friday 11 September. The CTD was then redeployed for a further CTD yoyo (station 5) in a depth of 570 m on the upper slope. At 0805 hrs the CTD was winched into the block by an inexperienced crew member. Fortunately little damage occurred and only the safety stops broke. These were quickly replaced whilst the end termination was made. CTD station 5 was completed at 1000 hrs Saturday (12.5.87) and RV Challenger then steamed to the 1000 m depth contour for wire tests for all the moorings that were planned for the second leg of the cruise. On Saturday evening the weather deteriorated with winds increasing to 30 kts and it was not until 1000 Sunday morning that conditions improved sufficiently to deploy the Sea Soar for a final run from the ocean to the slopes. The Sea Soar and PES fish were recovered at 1800 hrs and RV Challenger steamed at full speed to make the port call, Concarneau, for midday Monday 14.9.87. Here the RV Challenger was met by Ives Camus of the French Navy who visited the ship and helped to arrange the change of both British and French scientific personnel.

Leg 2

Dr Roger Harris, Mr R Easton and M Girardot joined the ship on 15.9.87 and RV Challenger sailed from Concarneau at 2000 hrs heading for the position of mooring 109. RV Challenger arrived at mooring 109 at 0400 hrs Thursday 17.9.87 and although the mooring was located it failed to release. A dahn buoy was laid on the mooring position and a grapnelling exercise was started and continued without success for 12 hours after which RV Challenger steamed to the Porcupine Sea Bight in readiness to deploy moorings 112, 113, 114 and 115. Mooring 113 was deployed in a depth of 505 m and mooring 112 was deployed in a depth of 980 m at positions 50°49.1'N 11°18.4'W and 50°47.4'N 11°24.5'W respectively on Friday 18.9.87. CTD stations 6, 7, 8, 9, 10, 11 and 12 were also completed as part of a study aimed at examining the production of turbid layers and their subsequent spreading and mixing from the sea floor into the ocean interior. On Saturday 19.9.87 mooring 114 was deployed in a depth of 1000 m at a position 51°40.5'N 12°02.6'W followed by mooring 115, at midday, in a water depth of 480 m, at position 51°46.1'N 11°44.3'W. After the deployment of the moorings the CTD benthic boundary study was resumed with the completion of CTD stations 13, 14 and 15 by 1707 hrs. RV Challenger then steamed at 4 kts towards position P (located in the centre of the Porcupine Sea Bight) with the catamaran and side scan sonar deployed.

The spar and fish were recovered at 0330 hrs on Sunday 20.7.87 and RV Challenger proceeded at full speed, finally arriving at 46°10'N 07°20'W (station P) at 1019 hrs. Here three satellite tracked drifting buoys were deployed and a deep CTD station (station 46) was completed in conjunction with freon and Coulter water column sampling. RV Challenger then steamed back towards the internal wave working area recovering mooring 108 and completing a further CTD station (17) on route.

On Tuesday 22.7.87 the thermistor chain and current meter moorings (111 and 110) that were deployed on the first leg were recovered and a CTD tidal yoyo station followed at 1705 hrs in a water depth of 1000 m close to the position that mooring 111 had occupied. On completion of CTD 18 a deep CTD tidal yoyo station was started at a position about 40 km from the generating region of the internal tides on the upper slopes. Water samples were collected on the first station profile which was to a depth of 4000 m and commenced at 0911 hrs on Wednesday 23.9.87. There after repeated CTD yoyos were made to a depth of 3000 m and the station was completed at 2210 hrs. The final CTD tidal yoyo station (20) was made on the shelf in a water depth of 183 m and completed at 1300 hrs on Thursday 24.9.87. RV Challenger then steamed at full speed for Barry and arrived in Barry Docks on Friday evening, 25 September 1987.

4. Towed Thermistor Spar, Sidescan Sonar, and High-Frequency Echo-Sounder

Spar and Sidescan Sonar

In all three tows were made with the thermistor spar, two in the Bay of Biscay over La Chapelle Bank, and one in the Porcupine Sea-Bight area:-

Run	Area	Tides	Start	Lat	Long	Stop	Lat	Long
1	Biscay	Neaps	246/2000	47°51'	6°24'	247/0317	47°27'	6°35'
2	Biscay	Springs	253/1730	47°45'	6°32'	254/0245	47°07'	6°44'
3	Porcupine	Neaps	262/1900	51°33'	11°24'	263/0300	51°22'	12°02'

For all the runs, the spar was towed just ahead of the ship's bow wake, about 35 m from the side of the ship. The sidescan sonar was simultaneously deployed on Runs 1 and 3 via a block on the stern A-frame.

Run 1

The sidescan sonar was deployed with two transducers looking up at 20° from the horizontal on the port and starboard sides, but on this run it proved possible to display only one beam at a time. Surface swell waves impinging from the starboard beam were clearly visible, as well as modulations in the scatterers (bubble clouds) which had a much longer period. When the starboard sonar beam was selected a strong signal from the catamaran wake was observed.

The quality of the spar data seemed reasonably good (on the BBC display) although the standard deviation of the resistor was larger than hoped for. The recorded temperatures dropped markedly in a series of steps from 0030 to 0050(GMT) and then rose steadily from 0115 to 0200. At 0247 the catamaran capsized in 5-6 m swell, after completing about two-thirds of its planned track. The instrument was subsequently found to be undamaged apart from severance of the inclinometer cable, which was later repaired, and some damage to the towing cable at the towing point, so that 50 m had to be cut away.

Run 2

This tow was made over nearly the same track as Run 1, so that Spring-Neap differences could be investigated. In addition, XBTs were launched at 15 minute intervals and provided the 'background' temperature structure. Since the sidescan towing cable had been temporarily damaged in a winch accident, the 1 MHz forward-looking spar sonar was instead displayed on the EPC chart recorder, but failed to show much of interest, apart from a few dark streaks. At 0030 the sonar apparently began producing frequent noise spikes on the EPC and the BBC (possibly as a result of being triggered by spurious interferences from the ship which, for instance, also caused repeated crashes of the BBC system), and so was disconnected for the remainder of the tow. Apart from this interference, the quality of the spar data was again reasonably good. Internal waves were noted on the spar display at 2115, with a ramp at 2137, but of particular interest was a large and sudden temperature increase (about 1°C) at 0130.

Run 3

The opportunity of a tow in the Porcupine area was taken in the hope of providing an insight into the nature of the upper ocean over a different part of the shelf break. This time, XBTs were launched at hourly intervals and the sidescan sonar was operated with downward- and starboard-looking beams. The former beam often revealed distinct internal waves (of typically 3-4 minute periods), and corresponding modulations of the scatterers were seen in the latter. The quality of the spar data was this time not as good as the other tows, with noise spikes occurring quite frequently from 2130, but only in every other thermistor. This could have been caused by an open circuit in a Marsh and Marine underwater connector, which was discovered after recovery, and could have resulted from the capsize on Run 1. The data collected on the unaffected channels, however, should still be worth study.

High Frequency Echo-Sounder

The results from this instrument were generally disappointing, but the 50 kHz channel did reveal large and distinct internal waves on several occasions. The quality of the 123 kHz output was markedly inferior to that of the lower frequency, and the corresponding transducers quickly overloaded the pulse power amplifier, possibly due to flooding. Consequently, only the 50 kHz system was operational for a significant part of the cruise, and even on this channel there were sporadic failures of the power amplifiers.

As similar failures occurred on a previous cruise, it seems essential that this system is realistically tested before being deployed again. The problems associated with keeping an EPC graphic recorder displaying high quality data are such that tape recording the data or the use of a thermal line scan recorder might be considered, or preferably both.

5. Freon Analysis

The objectives of the work on this cruise were twofold:-

(a) To establish if new modifications to, and thorough cleaning of the extraction board had alleviated some of the problems encountered on Cruise 15.

(b) To progress with the chromatographic technique to a stage where freon-11 and freon-12 in air and seawater could be detected with confidence.

No quantitative data were expected since the system required extensive calibration once working satisfactorily.

During the first leg, further problems were encountered with leaking Valco valves and the CR34 computer/integrator pen head did not work. The former was solved by shortening the screws which held the valve body together thereby allowing the 'O' rings to seal correctly. (All seven valves on the extraction board had now shown faults; a situation which should be discussed with Valco.) The latter was overcome by rigging a chart recorder to the chromatograph as a temporary measure and using the software which was functioning correctly as normal. A spare PCB and pen head was sent to Concarneau, for the second leg of the cruise.

The new assemblies for the glass to stainless steel linkages in the drying tubes and the stripper proved satisfactory from a gas-tight aspect. However the nitrile 'O' rings and to a lesser extent the distributor seals did appear to be a source of contamination. Heating these components in the ship's oven at 250°C for 6 hrs did not help. A gas tight seal was made without the 'O' rings in the drying assembly between valves v_4 and v_6 and acceptable blanks were achieved. More than usual opening and closing of these new glass/stainless steel assemblies whilst establishing the source of contamination resulted in a problem of pick up in the threads. This did not cause any down-time, but is something which needs attention.

Contamination from laboratory air was a major problem and two isolation coils were fitted to stop air entering the system.

Acceptable chromatograms were eventually forthcoming and samples from two deep stations - one to 2685 m and the other to 3700 m were collected and measured.

6. The RDI Acoustic Doppler Current Profiler

On the whole the performance of the Doppler Profiler (software version 2.28, RVS deck unit) was completely satisfactory, both in shallow and deep water. Output was to a PDP/PSTAR system, which enabled physically reasonable contour plots to be obtained of nearly all the data, with only the vertical velocities sometimes appearing spurious.

In all, six configurations were set up, namely aln1 (50 x 2 m bins, for maximum depth 100 m), aln2 (50 x 4 m, 200 m limit), aln3 (75 x 4 m, 300 m), aln4 (50 x 8 m, 400 m), aln5 (62 x 8 m, 500 m) and aln6 (75 x 8 m, up to 600 m or deeper). The first five of these configurations employed bottom tracking and enabled velocities relative to the bottom to be obtained. The last did not use this facility so that velocities could only be plotted relative to some mean when in deep water.

Typically, the percentage of good pings per ensemble (% good data) was about 50% in depths of 25-50 m, 75% in depths of 75-125 m, and about 95% in depths greater than 200 m or so. However, for the deeper configurations, the % good data began to fall by about 125 m above the bottom. Typically, no data was recorded within 20-30 m of the bottom (% good data   25%, a pre-set cut-off level), and also the % good data fell noticeably in rougher weather i.e. 50% at 200 m in force 7-8 and deep water, whereas reliable data was usually obtainable down to about 400 m. Bottom tracking was generally effective down to a depth of about 500 m, but note that when attempting to bottom track in water deeper than this, although the data would be displayed on the screen relative to the mean, it would not be transferred to the PDP.

A synchro gyro (as opposed to a stepper gyro) was used for this cruise, so that regular checks on the ship's heading were unnecessary (although some were made). No navigation was able to be directly input to the Doppler programme for the duration of the cruise, but this was able to be remedied once the data had reached the PSTAR system. The most serious problem encountered concerned the clock in the Doppler programme, which was typically 5-8 minutes fast, and varying by up to 30 seconds a day. Although it was possible to reset the clock using the disk operating system, it would revert to its old, incorrect, time upon entering Doppler software. This problem should be rectified if at all possible.

7. Studies on suspended particles

During the second leg of the cruise samples were taken and analysed to determine the distribution of suspended particles, their size spectra, and their chemical characteristics. A total of 114 analyses were made by Coulter providing size distributions in the range 2-128 um. In addition, a directed sampling programme using the CTD/Transmissometer provided discrete samples for studies of particle characteristics of "turbid layers" for 14 deep CTD casts. The aim was to compare the intermediate nepheloid layers (INLS) with the clear water immediately above and below. In addition to Coulter Counter analyses, which were carried out on fresh material, samples were taken for pigment analysis, light microscopy (Lugol and Formalin), CHN analysis and SEM (0.1, and 5.0 um Nucleopore). Some of the data from these samples are already available, and the remaining analyses should be completed before the June 1988 Challenger cruise.

8. Conclusions

This was a tight but successful cruise, with the scientific work benefitting from the full cooperation of the ships' officers and crew. The main scientific objectives of the cruise were fully met.

9. Table 1 (mooring details)

Mooring Number depth position	Date deployed	 recovered	Equipment	Depth off bottom (m)
108 540 m 48°15.9'N 09°14.4'W	10.3.87	21.9.87	ACM 4817	462
			ACM 5318	234
			ACM 5228	~~562~~
110 2639 m 47°17.6'N 06°40.3'W	6.9.87	22.9.87	TL 602	2350
			TC 1290	
			ACM 3277	2304
			TL 926	2254
			TC 1537	
			TL 869	1728
			TC 1289	
			ACM 1139	1604
			TL 925	1576
			TC 1388	
			ACM 8011	1452
			TL 806	1424
			TC 1393	
			ACM 1260	1300
			TL 772	1248
			TC 1403	
			ACM 7943	997
			TL 740	945
			TC 1536	
			ACM 1259	444
111 1047 m 47°25.3'N 06°38.3'W	4.9.87	22.9.87	ACM 4387	457
			TL 561	
			TC 892	
			ACM 4388	345
			TL 876	
			TC 1271	
			ACM 2108	244
			TL 875	217
			TC 959	
			ACM 6225	142
			TL 871	
			TC 760	
			ACM 2406	40.5
			ACM 6372	19.5
112 960 m 50°47.4'N 11°24.5'W	18.9.87		ACM 740	499
			ACM 7643	8
113 505 m 50°49.1'N 11°18.4'W	18.9.87		ACM 7766	254
			ACM 6585	8

114 1000 m 51°40.5'N 12°02.6'W	19.9.87	ACM 7451 ACM 7765	499 8
115 480 m 51°46.1'N 11°44.3'W	19.9.87	ACM 7645 ACM 8039	254 8

10. Table 2

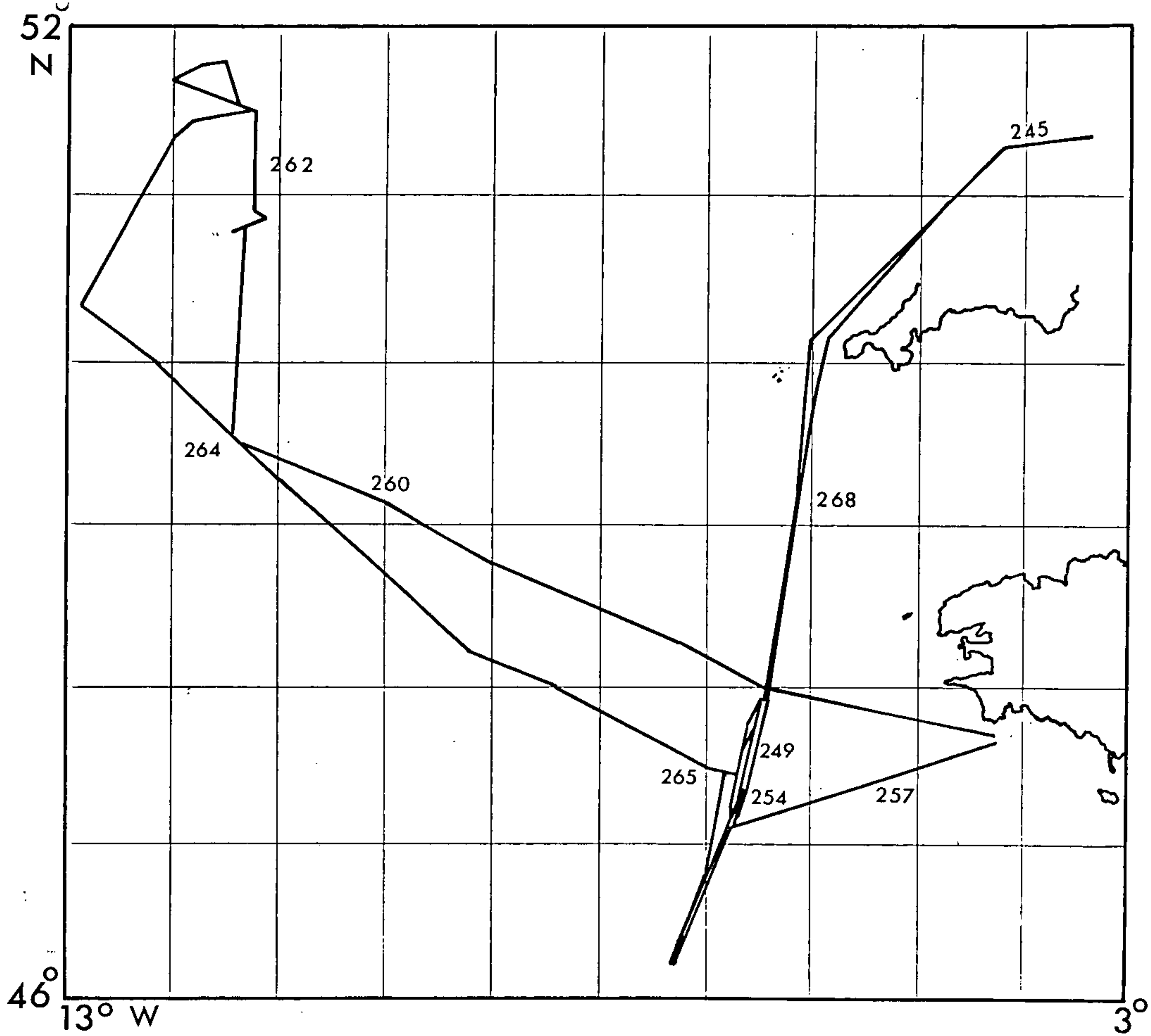
Season Runs

Run 1	247	2113
	248	1931
Run 2	249	2021
	250	0800
Run 3	256	1045
	256	1741

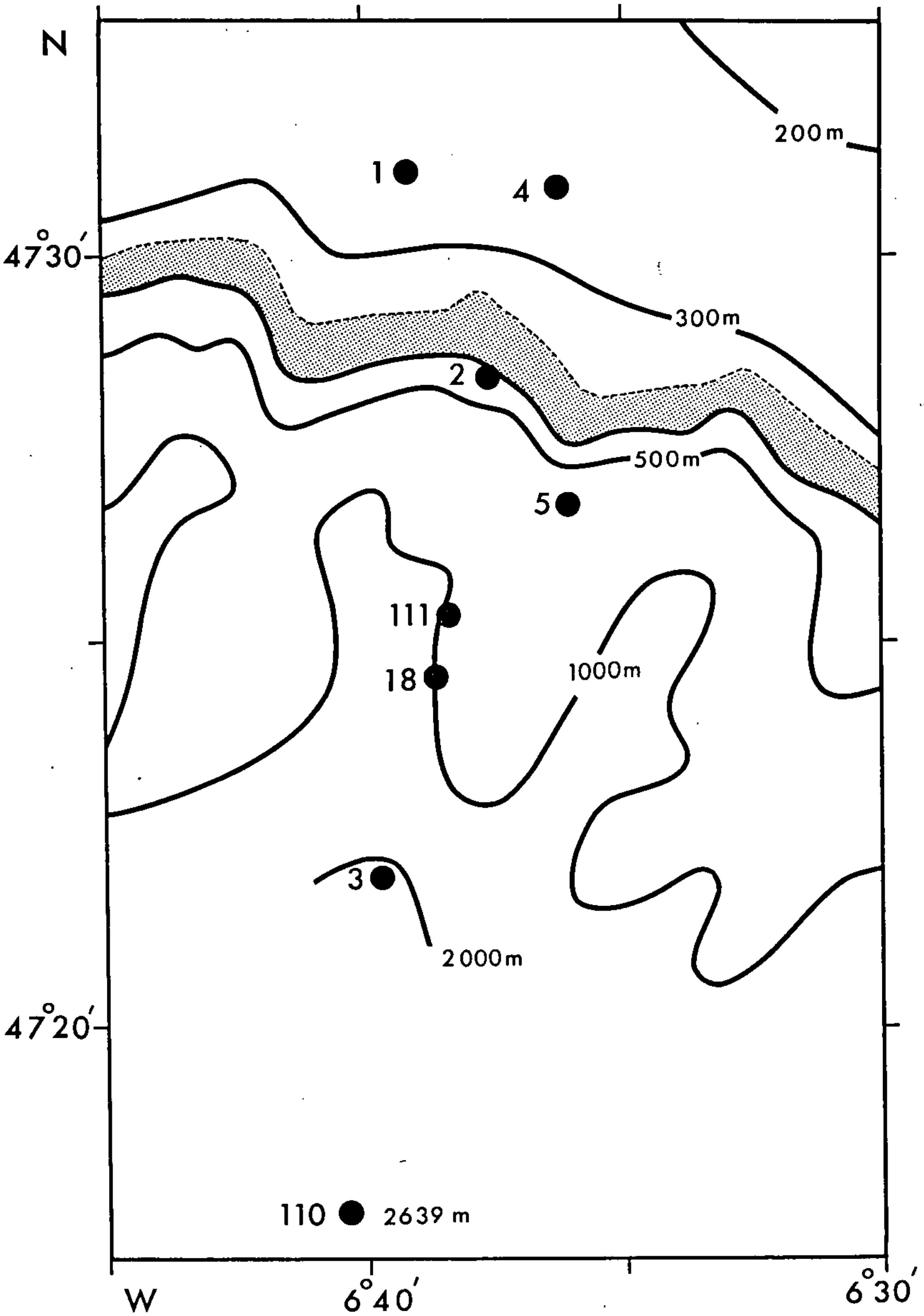
11. Table 3

CTD Stations

Date 1987		Position	CTD Station	dips	depth in CTD Station (m)	CTD depth (m)
250	1700	47°31.1'N	1	44	269	263.2
251	0700	06°39.1'W				
251	1130	47°28.4'N	2	51	415	409
252	0500	06°37.7'W				
252	0700	47°21.95'N	3	12	2108	2100
252	2200	06°39.75'W				
253	0700	47°30.85'N	4	37	259	253
253	1500	06°36.15'W				
254	1200	47°26.75'N	5	31	570	263
255	1000	06°36.05'W				
261	0830 0930	50°49.5'N 11°18.2'W	6	2	480	475
261	1100 1130	50°46.5'N 11°24.0'W	7	1	960	955
261	1612 1650	50°48.4'N 11°22.3'W	8	1	770	765
261	1820 1845	50°49.6'N 11°14.4'W	9	1	350	340
261	1930 1953	50°51.7'N 11°06.9'W	10	1	247	242
261	2041 2109	50°53.0'N 11°10.0'W	11	1	395	390
261	2138 2216	50°54.1'N 11°13.6'W	12	1	648	643
262	1336 1400	51°44.9'N 11°44.0'W	13	1	475	470
262	1446 1500	51°45.6'N 11°38.8'W	14	1	345	340
262	1648 1707	51°47.0'N 11°29.3'W	15	1	256	251
263	1300 1645	50°20.0'N 12°49.1'W	16	2	2630	2573
264	1246 1325	48°15.1'N 09°14.7'W	17	1	590	585
265	1730	47°24.6'N	18	18	992	984
266	0530	06°38.65'W				
266	0930 2200	47°08.65'N 06°41.35'W	19	7	3710	3000
267	0230	47°35.55'N	20	37	188	183
267	1300	06°34.4'W				



52°
N
262
245
264
260
268
249
265
254
257
46°
13° W
3°



N
200m
1
4
47°30′
300m
2
500m
5
111
18
1000m
3
2000m
47°20′
110
2639 m
W
6°40′
6°30′