I.O.S.

OFF SHORE BOTTOM PRESSURE RECORDS

G A ALCOCK

North Channel of Irish Sea 1979
Malin Shelf 1979
Rockall Trough 1979

Data Report No 27

1982

NATURAL ENVIRONMENT RESEARCH COUNCIL
INSTITUTE OF OCEANOGRAPHIC SCIENCES

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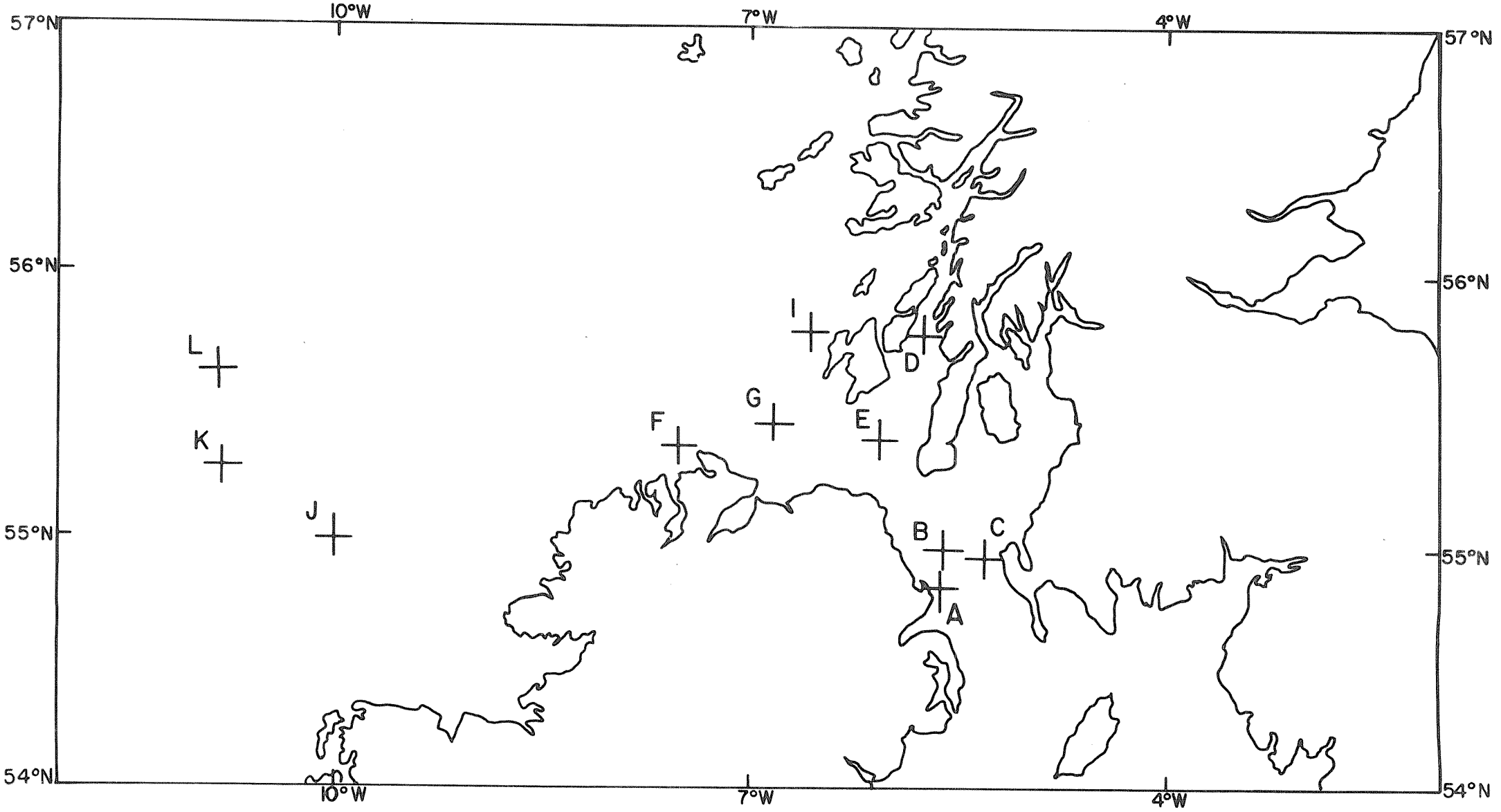
Abstract

This report describes the pressure data gathered by IOS Bidston in the North Channel of the Irish Sea and on the Malin Shelf in 1979. A brief description of the instruments, mooring configurations and data processing is followed by a section on the pressure data. Details of the deployment and recovery of each gauge are given, and the pressure measurements are presented both in graphical form and in tables of harmonic constants.

1. INTRODUCTION

An experiment was conducted by I.O.S. Bidston in the North Channel of the Irish Sea, during August to September 1979, in order to study the tidal and non-tidal dynamics of the region. Currents were measured at 8 stations, A to G and I (Fig 1), and sea bed pressures were measured at B, D and E. A density survey of the area was carried out by continuously monitoring sea surface temperature and sea water conductivity, and by taking profiles of temperature and conductivity with depth.

This report displays the sea bed pressure data from the North Channel and from three stations, J, K and L, deployed on the Malin Shelf and in Rockall Trough, to measure the tidal regime at the shelf edge. Current meter and thermistor chain data are given in HOWARTH and EVANS (1982), and a narrative of the cruises is given in HOWARTH and HARRISON (1980).


57°N
10°W
7°W
4°W
56°N
55°N
54°N
L
K
J
I
D
G
F
E
B
C
A

2. INSTRUMENTATION and MOORING CONFIGURATIONS

(i) AANDERAA RECORDER TYPE 2A

The recorder deployed at Station B was an Aanderaa type 2A, serial number 64, with a Digiquartz type 2-300A quartz crystal pressure transducer (ALCOCK and HOWARTH 1978) with a pressure sensitivity of 5.20 Hz mb^{-1}. The sensor pack was mounted in a low profile steel tripod frame of 760mm height and 1.183m breadth with the sensor level about 480mm above the frame base. Integration period for this sensor was 100 seconds. This rig was deployed using a W-shaped shallow water rig (HOWARTH and HARRISON 1980).

(ii) BOTTOM MOUNTED CURRENT METER/PRESSURE RECORDER

The bottom mounted recorder deployed at station D utilised a Digiquartz pressure sensor interfaced into a modified Aanderaa current meter (ALCOCK and HOWARTH 1978). CM/PR No. 5 was depoloyed and contained a Digiquartz pressure transducer, serial number 4132, with a pressure sensitivity of 0.123 Hz mb^{-1}, and current meter number 1750. The pressure sensor pack was mounted approximately 1 m above the rig base, the rig had an overall height of 1.5m and its base was formed by a tripod with legs of length 700mm. The rig was deployed using a standard U-shaped shallow water rig designed to give surface warning of the rig and a back-up recovery method by dragging for the ground-wire.

(iii) TELEOST PRESSURE RECORDERS

Teleost pressure recorders were deployed at stations E (PR 280 and PR 281), J (PR 294), and K (PR 282, 283, 285). Each recorder consisted of a Bell and Howell strain gauge

pressure transducer, (type 4-306 at E and J, type 4-800 thin film at K), and a platinum resistance thermometer interfaced to an Aanderaa logger.

At E, the two pressure sensors were mounted in a protective frame, with overall dimensions of 1.75m long by 1.14m wide by 660mm high, attached to a flat ballast plate 1.22m square. Current meter No.3359 was mounted 6m above the frame. At stations J and K, the pressure recorders were mounted in similar frames attached to a 1.22m diameter tripod ballast frame.

All Teleost recorders were deployed as pop-up moorings and released from their ballast frames by firing a pyrotechnic release by acoustic command.

At E, PR 280 and PR 281 had pressure sensitivities of 0.183 Hz mb^{-1} and 0.215 Hz mb^{-1} and temperature coefficients of -5.1mb $^{o}C^{-1}$ and -1.6 mb $^{o}C^{-1}$ respectively. At J, PR 284 had a pressure sensitivity of 0.040 Hz mb^{-1} and temperature coefficient of -22.5 mb $^{o}C^{-1}$. At K, PR 282, PR 283 and PR 285 had pressure sensitivities of 0.011 Hz mb^{-1}, 0.033 Hz mb^{-1} and 0.006 Hz mb^{-1} and temperature coefficients of -109.9 mb $^{o}C^{-1}$, -1.2 mb $^{o}C^{-1}$ and -16.5 mb $^{o}C^{-1}$ respectively.

(iv) MARK IV PRESSURE RECORDER

A Mark IV pressure recorder was deployed at Station L and consisted of a Digiquartz pressure sensor, two Bell and Howell strain gauge pressure sensors (one a thin film type), a Schaevitz strain gauge pressure sensor, and two platinum resistance temperature sensors, all interfaced into a Seadata cassette recorder housed in a 1m long aluminium alloy

of 150mm internal diameter and 15mm wall thickness. A pop-up rig was used with main buoyancy provided by glass spheres mounted in the tubular framework.

3. DATA PROCESSING

The magnetic tape from each pressure recorder was copied onto a 9 track magnetic tape and the channel counts listed using the CAMAC work station at Bidston. The data were then read into disk storage on the Honeywell 66/20 computer at Bidston and edited for any minor gaps or errors.

Pressure and temperature frequencies were calculated from the channel counts, plotted, checked and edited for any minor gaps or errors. Temperatures were calculated, plotted and stored on disk. A further program used the appropriate temperature values and the pressure frequency temperature coefficient to convert each pressure frequency to the frequency at the reference temperature, and calculated the pressures using the pressure/frequency calibration. The ¼ h values of pressure were plotted, stored on disk and punched on cards.

An interpolation program was used to produce an output of hourly values on the hour (GMT), of the pressure record. This program smoothed the data using a low pass filter, FLP03, of half length 18 and cut-off frequency (half-power point) of 0.35 cph (126^{o} per hour) - thus the amplitude response of the sixth diurnal band was -0.08 dB (1%). The resulting series was then interpolated using a cubic spline to obtain the hourly values, applying time corrections if the clock was fast or slow. (Exact times of scans at the beginning and end of the record were noted prior to launch and after recovery). The time associated with each pressure and

temperature value was taken as the mid-time of the integration period. Root mean square errors due to the interpolation method were of the order of 0.02 mb.

4. ANALYSIS

The series of hourly values of the bottom pressure contain components of sensor drift and external surges as well as the desired tidal signal. The hourly data were filtered with a high power high pass filter, FHP53, which removed jointly sensor drift, long period tides and surge activity, and isolated the tidal signal.

Tidal analysis of a 29 day period of each hourly series of bottom pressure was carried out using the IOS TIRA program which utilises the harmonic method of analysis. The amplitude and phase lag relative to Greenwich epoch of 27 major and 8 related constituents were computed, the time zone being Greenwich Mean Time (S=0). The constituents π_1, P_1, ψ_1, ϕ_1, $2N_2$, ϑ_2, T_2 and K_2 are not separable from the major harmonic constants with only one month of data, and so they were related to the major constituents using values derived from the harmonic analysis of 8 years of data from Malin Head. When there were analyses from more than one pressure sensor, a vector mean of each harmonic constant was computed.

The amplitude of each harmonic constant in the following tables is in units of pressure (millibars). It can be readily converted to sea surface elevation using the hydrostatic relation:

$$H = P/\varsigma g$$

where H is elevation in metres, P is pressure in pascals (1 Pa = 10^{-2} mb), ς is sea water density in kilograms per cubic metre and g is acceleration due to gravity in metres per second squared.

Values of ζ , derived from CTD casts, and g for each station are given in the launch and recovery details.

The amplitudes and phases of O_1, K_1, M_2 and S_2 at stations B, D, and E have been adjusted for seasonal variability using the empirical method (ALCOCK and PUGH 1980) of comparing a simultaneous analysis at a nearby reference port (Port Ellen or Tor Head) with a longer term analysis at the same port. The seasonal variations of these constituents can be significantly large (e.g. an amplitude range for O_1, K_1, M_2 and S_2 of 30, 40, 5 and 10% respectively and a phase range of 25, 15, 2 and 4^o respectively during 1969 at Port Patrick). The mechanisms causing these variations are poorly understood but are thought to include non linear shallow water interactions and variations in the atmospheric tide. (BAKER and ALCOCK 1981).

5. REFERENCES

ALCOCK, G.A. and HOWARTH, M.J. 1978. Offshore tide gauge and moored current meter records from the Irish Sea, 1977. Institute of Oceanographic Sciences, Data Report No. 15, 199 pp, figs and tables. (Unpublished manuscript).

ALCOCK, G.A. and PUGH, D.T. 1980. Observations of tides in the Severn Estuary and Bristol Channel. Institute of Oceanographic Sciences, Report No. 112. (Unpublished manuscript).

BAKER, T.F. and ALCOCK, G.A. 1981. On the time variation of ocean tides. Proceedings of the 9th International Symposium on Earth Tides, New York. (In Press).

HOWARTH, M.J. and HARRISON, A.J. 1980. RRS 'SHACKLETON' cruise 7/79 and RRS 'CHALLENGER' cruise 14/79 Institute of Oceanographic Sciences, Cruise Report No. 97, 45 pp, and figs. (Unpublished manuscript).

HOWARTH, M.J. and EVANS, J.J. 1982. Current meter data from North Channel, 1979. (In preparation).

6. REPORT FORMAT

The report is split into sections, one for each deployment, each section comprising a page of launch and recovery details, a page of data reduction details, and the record from each sensor displayed in computer plots and tables of the tidal constituents obtained by analysis of the tidal record.

Launch and recovery details:

Recorder position	Station identification, General Area, Year. Latitude and Longitude.
Water depth	Measured at Launch by PDR (Precision Depth Recorder) and/or taken from Admiralty Chart.
Recorder details	Type, Logger number, Sensor type(s) and number(s). Sampling and integration periods.
Time of launch	Time of launch of recorder from ship, time that recorder entered water and/or on sea bed.
Time of recovery	Time that recorder surfaced or was brought on board ship.
CTD casts	Times of any CTD casts on station. Value of density computed from casts.
Comments	Comments on the launch and/or recovery.

Data reduction details:

Timing	Times of specific scans and timing error.

Raw data	Times of start and end of raw bottom pressure data.
Temperature data	Details of temperature record(s) available.
Drift-free data	Times of start and end of drift-free hourly bottom pressure record. Method used to produce drift free data.
Tidal analysis	Method used, period analysed. Station used for related constituents.
Comments	Comments on data reduction and analysis.

Computer Plots:

(1) Plot of temperature record(s) if available.

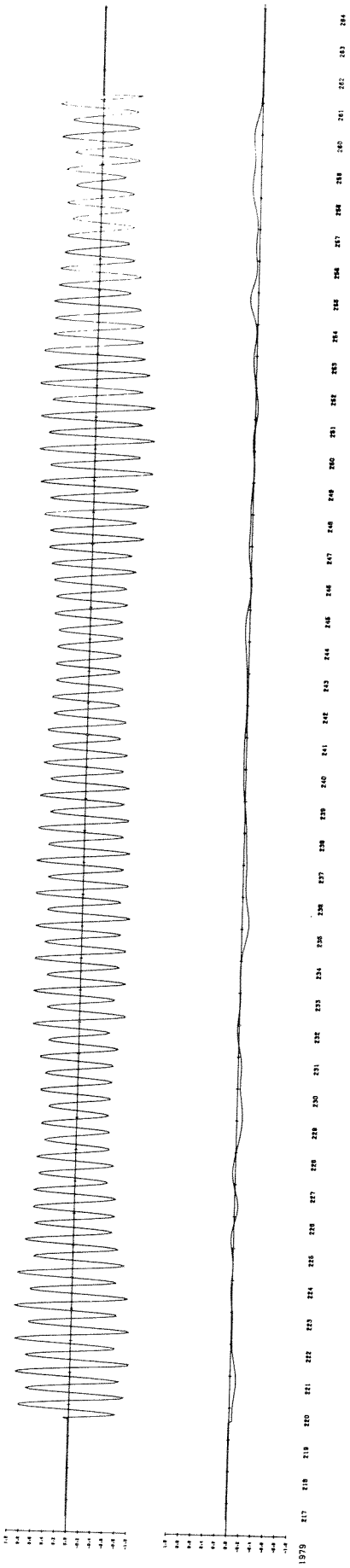
(2) Plot of tidal and non tidal components of bottom pressure record.

Analysis:

Tables of amplitude and phase (G - referred to lunar transit at Greenwich and time zone S=0) of the major and related constituents of tidal record from each sensor, and the vector means if applicable.

Recorder position	Station B, North Channel, 1979. Lat 54° 57.7'N, Long 05° 35.7'W. g = 9.815 ms^{-2}.
Water depth	157 m.
Recorder details	Aanderaa Recorder 2A/64 in Dunbar frame. 900s sampling and 100s integrating periods.
Time of Launch	Recorder in water from RRS "Shackleton" at 0901 GMT day 217 (05 August), and on sea bed at 0906 GMT.
Time of recovery	Recorder on deck of RRS "CHALLENGER" at 1000 GMT day 265 (22 September).
CTD casts	Cast No. 14 at 1023 GMT day 217. Cast No. 319 at 1025 GMT day 265 Density, σ = 1026.1 Kg m^{-3}.
Comments	Sub surface buoy recovered and redeployed when line snapped on deployment. On recovery, frame showed signs of having been on its side (score marks and corrosion). A separate current meter rig with current meters No. 3362, 2576 and 2970 at 20m, 60m, and 110m above the sea bed respectively was deployed and recovered at this station.

Timing	Scan No. 1 at 1400,01 GMT day 211. Scan No. 5205 at 1859,57 GMT day 265. Clock fast, gained 4s in 54 days and 5 hours.
Raw data	Start 0914,11 GMT day 217 End 0944,07 GMT day 265.
Temperature data	No temperature sensor.
Drift free data	Start 1400 GMT day 220 End 0400 GMT day 262 FHP 53 filter.
Tidal analysis	TIRA, days 229 to 257, 29 days of filtered bottom pressure data. 27 major and 8 related constituents from analysis of Malin Head, 8 years from 1960/70.
Comments	Tor Head used as reference station for seasonal adjustment of constituents.



FILTERED VALUES
SCALE Y=0.15111 E03
MEAN VALUE=0.16357 E05

RESIDUALS
SCALE Y=0.15111 E03
MEAN VALUE=0.16367 E05

NORTH CHANNEL "B" 2A/64 TOTAL PRESSURE

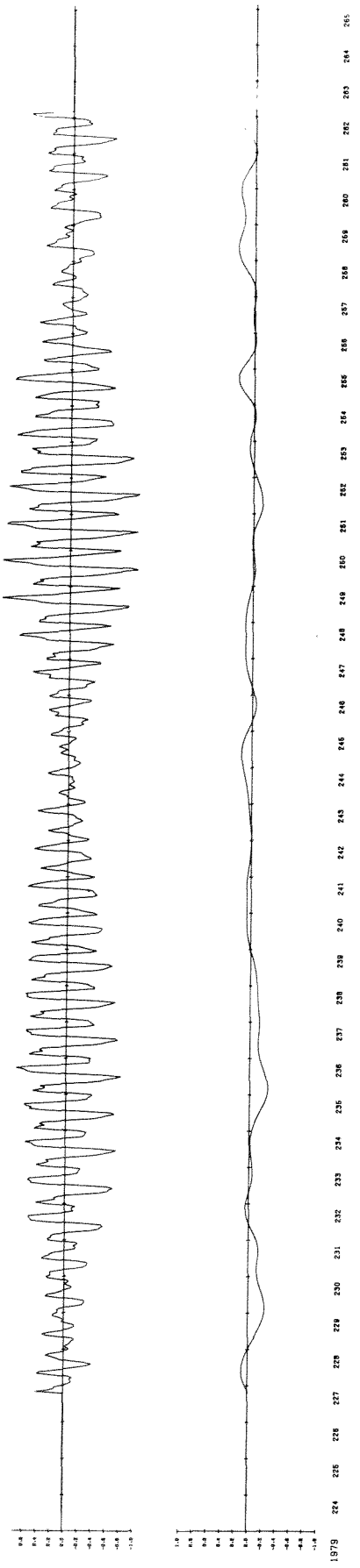
TABLE 1

Station B, North Channel of Irish Sea, Lat 54°57.7'N Long 05°35.7'W.
Aanderaa Recorder 2A/64.
Drift free bottom pressure (millibars), FHP 53 filter.
0000 GMT day 229 to 2300 GMT day 257 1979, 29 days.
27 constituents + 8 related (*) using analysis from Malin Head 1960/1970.

Constituent	related to	H(mb)	G(°)	Period Adjustment factor α	β	H(mb)	G(°)
Q1		3.8	334.1				
O1		9.1	43.4	1.019	+2.6	9.3	46.0
M1		0.4	190.4				
*π_1	K1	0.1	156.7				
*P1	K1	3.5	179.7				
K1		11.6	182.3	0.934	+5.6	10.8	187.9
*ψ_1	K1	0.7	108.1				
*ϕ_1	K1	0.1	207.6				
J1		1.5	288.5				
001		2.6	346.6				
*2N2	N2	2.8	276.3				
μ_2		4.8	115.1				
N2		19.3	296.7				
*ν_2	N2	3.6	307.1				
M2		94.9	324.4	1.028	+0.9	97.6	325.3
L2		9.7	1.2				
*T2	S2	1.3	1.8				
S2		22.7	9.6	1.169	-1.0	26.5	8.6
*K2	S2	6.3	8.4				
2SM2		2.4	275.6				
MO3		0.7	179.2				
M3		2.8	111.5				
MK3		1.8	235.6				
MN4		0.8	93.7				
M4		1.6	73.9				
SN4		0.4	49.2				
MS4		2.3	108.4				
2MN6		0.4	157.4				
M6		0.6	169.1				
MSN6		0.1	110.2				
2MS6		0.8	213.6				
2SM6		0.2	263.5				

Recorder position	Station D, North Channel, 1979. Lat. 55° 51.6'N, Long 05° 44.5'W. g = 9.816 ms^{-2}.
Water depth	104m.
Recorder details	Aanderaa CM/PR 5 with Digiquartz pressure sensor 4132, current meter No. 1750 and Aanderaa Logger 1750. 900s sampling and integration periods.
Time of Launch	Initially deployed on day 218 (06 August). (See Comments). Subsequently in water at 1456,50 GMT day 224 and on sea bed at 1504 GMT.
Time of recovery	Initially recovered on day 224. (See Comments). Subsequently on deck at 0842 GMT day 266.
CTD casts	Cast No. 23 at 1545 GMT day 218. Cast No. 79 at 1154 GMT day 224. Cast No. 334 at 0450 GMT day 266. Cast No. 380 at 1326 GMT day 274. Density, ρ = 1025.9 Kg m^{-3}.
Comments	Original rig position of 55° 40'N, 05°55'W was moved north under M.O.D. instructions to avoid torpedo-testing range. Rig was redeployed on day 224 in shallow water owing to submergence of surface buoy. A separate current meter rig with current meter No. 3561 and 3982 at 41m and 81m above the seabed was deployed and recovered at this station.

Timing	Scan No. 1 at 1642,25 GMT day 211. Scan No. 6427 at 1312,20 GMT day 279. Clock fast, gained 5s in 67 days and 20½ hours.
Raw data	Start 1534,54 GMT day 224. End 0819,51 GMT day 266.
Temperature data	See Comments.
Drift-free data	Start 2000 GMT day 227 End 0300 GMT day 268 FHP 53 filter used.
Tidal analysis	TIRA, days 229 to 257, 29 days of filtered bottom pressure data using Malin Head analysis of 8 years from 1960/70.
Comments	As the pressure sensor has a negligible temperature coefficient, no temperature record was used to correct the pressure frequency record. Port Ellen used as reference station for seasonal adjustment of constituents.



FILTERED VALUES
SCALE Y=0.72445 E02
MEAN VALUE=0.11722 E06

RESIDUALS
SCALE Y=0.72445 E02
MEAN VALUE=0.11723 E06

NORTH CHANNEL "D" CM/TGOS TOTAL PRESSURE

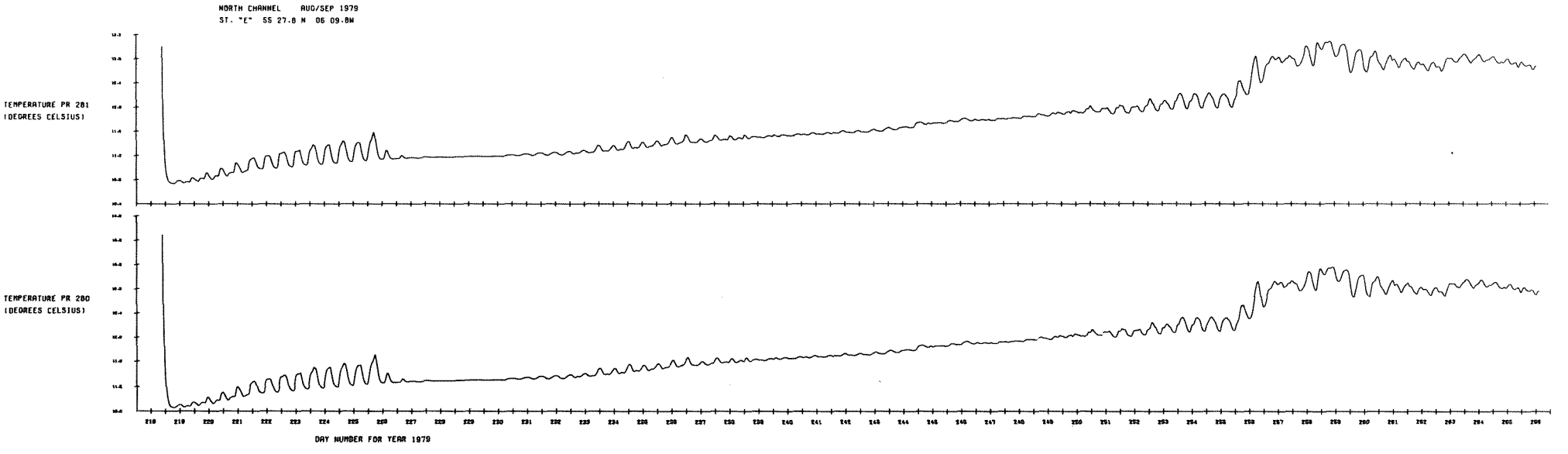
TABLE 2

Station D, North Channel of Irish Sea, Lat 55° 51.6'N Long 05°44.5'W.
Aanderaa CM/PR 05, Digiquartz pressure sensor SN4132.
Drift free bottom pressure (millibars), FHP53 filter.
0000 GMT day 229 to 2300 GMT day 257 1979, 29 days.
27 constituents +8 related (*) using analysis from Malin Head 1960/70.

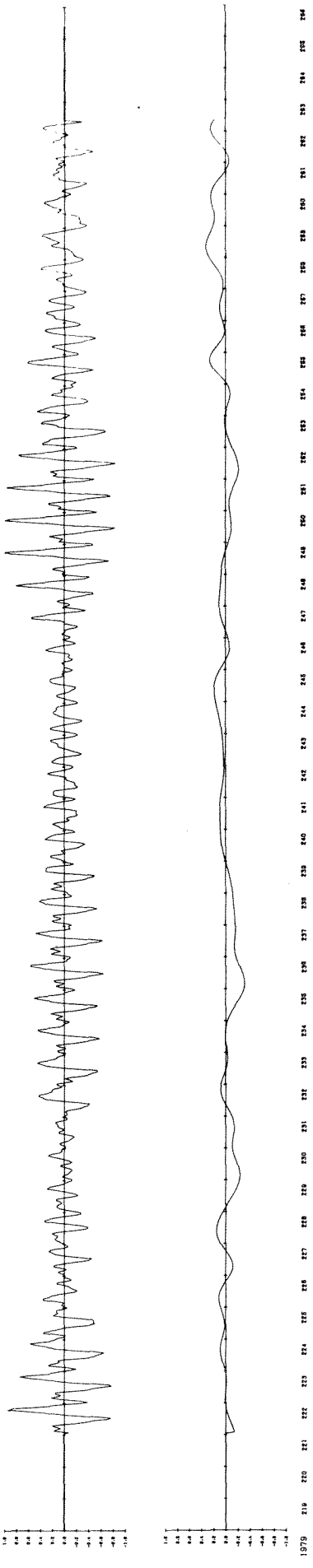
Constituent	related to	H(mb)	G(°)	Period Adjustment factor α	factor β	H(mb)	G(°)
Q1		3.4	328.8				
O1		7.9	41.0	1.005	+5.6	7.9	46.6
M1		0.6	170.6				
*π_1	K1	0.1	156.0				
*P1	K1	3.1	179.0				
K1		10.5	181.6	0.922	+6.2	9.7	187.8
*ψ_1	K1	0.6	107.4				
*ϕ_1	K1	0.1	206.9				
J1		1.3	274.1				
001		1.9	343.6				
*2N2	N2	0.5	44.6				
μ_2		3.4	124.3				
N2		3.8	65.0				
*ν_2	N2	0.7	75.4				
M2		26.9	90.4	0.986	-3.4	26.5	87.0
L2		3.4	40.5				
*T2	S2	1.0	142.4				
S2		18.4	150.2	0.958	+0.3	17.6	150.5
*K2	S2	5.1	149.0				
2SM2		2.0	300.7				
MO3		1.2	169.4				
M3		3.9	107.9				
MK3		2.6	235.2				
MN4		1.9	68.1				
M4		2.8	89.6				
SN4		0.3	27.9				
MS4		0.9	97.8				
2MN6		2.6	71.7				
M6		4.0	88.3				
MSN6		0.8	61.2				
2MS6		4.7	142.0				
2SM6		1.2	188.0				

Recorder position	Station E, North Channel, 1979. Lat 55^{o} 27.8'N Long 06^{o} 9.8'W $g = 9.815\ ms^{-2}$.
Water depth	108m.
Recorder details	Teleost 280 and 281. 900s sampling and integration periods.
Time of Launch	In water from RRS "SHACKLETON" at 2058 GMT day 218 (06 August). On seabed at 2101 GMT.
Time of recovery	On deck of RRS "CHALLENGER" at 1540 GMT day 266 (23 September).
CTD casts	Cast No. 24 at 2136 GMT day 218. Cast No. 337 at 1555 GMT day 266. Density, ρ 1026.05 Kg m^{-3}.
Comments	Initially deployed at 1912 GMT but heavy base plate lost at 1919 when release broke, therefore launched at 2058 after fitting spare base plate. Current meter No. 3559 was incorporated in this rig 6m above pressure recorder frame.

Timing	PR280: Scan No. 1 at 1045,00 GMT day 211. Scan No. 5986 at 1859,57 GMT day 273. Clock fast, gained 3s in 62 days and 8¼ hours. PR281: Scan No. 1 at 1429,29 GMT day 207. Scan No. 6363 at 2059,42 day 273. Clock slow, lost 13s in 66d and 6½ hours.
Raw data	PR280: Start 2122,30 GMT day 218. End 1507,27 GMT day 266. PR281: Start 2122,01 GMT day 218. End 1507,11 GMT day 266.
Temperature data	Complete record for both sensors.
Drift free data	Start 0200 day 222. } for both End 0900 day 263. } sensors. FHP53 filter used.
Tidal analysis	TIRA days 229 to 257 1979, 29 days of filtered bottom pressure data. 27 major and 8 related constituents from analysis of Malin Head, 8 years from 1960/70. Vector mean of 2 x 29 days.
Comments	Port Ellen used as reference port for seasonal adjustment of constituents.


NORTH CHANNEL AUG/SEP 1979
ST. "E" 55 27.8 N 06 09.8W
TEMPERATURE PR 281
(DEGREES CELSIUS)
TEMPERATURE PR 280
(DEGREES CELSIUS)
DAY NUMBER FOR YEAR 1979

NORTH CHANNEL "E" 280-4 TOTAL PRESSURE



FILTERED VALUES
SCALE Y=0.67088 E02
MEAN VALUE=0.11847 E05

RESIDUALS
SCALE Y=0.67088 E02
MEAN VALUE=0.11847 E05

NORTH CHANNEL "E" 281-4 TOTAL PRESSURE

TABLE 3

Station E, North Channel of Irish Sea, Lat 55° 27.8'N Long 06° 09.8'W.
Teleost recorders PR 280 and PR 281.
Drift free bottom pressure (millibars) FHP 53 filter.
0000 day 229 to 2300 day 257 1979, 29 days.
*Related constituent using analysis from Malin Head 1960/70.

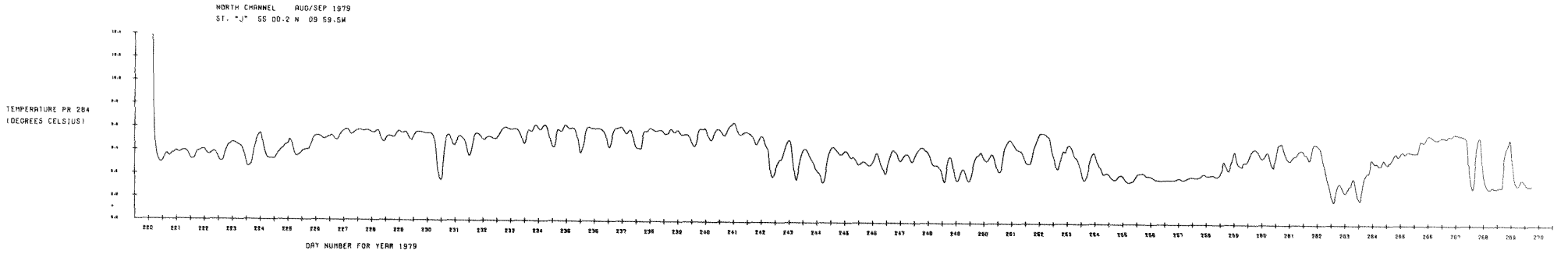
Constituent	related to	PR 280 H(mb)	PR 280 G(°)	PR 281 H(mb)	PR 281 G(°)	Vector mean H(mb)	Vector mean G(°)	Adjustment factor α	Adjustment factor β	H(mb)	G(°)
Q1		3.7	325.4	3.6	326.5	3.7	326.0				
O1		8.0	38.4	8.0	37.7	8.0	38.1	1.005	+5.6	8.0	43.7
M1		0.7	165.6	0.6	171.9	0.7	168.5				
*π_1	K1	0.1	152.1	0.1	151.8	0.1	152.0				
*P1	K1	3.1	175.1	3.1	174.8	3.1	175.0				
K1		10.6	177.1	10.4	177.4	10.5	177.6	0.922	+6.2	9.7	183.8
*ψ_1	K1	0.6	103.5	0.6	103.2	0.6	103.4				
*ϕ_1	K1	0.1	203.0	0.1	202.7	0.1	202.9				
J1		1.1	270.1	1.3	272.2	1.2	271.3				
OO1		1.9	337.1	1.8	343.2	1.9	340.1				
*2N2	N2	0.1	155.0	0.2	160.8	0.2	158.9				
μ_2		4.2	120.7	4.2	120.7	4.2	120.7				
N2		1.0	175.4	1.1	181.2	1.1	178.5				
*ν_2	N2	0.2	185.8	0.2	191.6	0.2	188.7				
M2		7.0	130.0	7.0	127.4	7.0	128.7	0.986	-3.4	6.9	125.3
L2		3.6	9.2	3.5	11.2	3.6	10.2				
*T2	S2	0.7	160.9	0.7	160.1	0.7	160.5				
S2		12.6	168.7	12.6	167.9	12.6	168.3	0.958	+0.3	12.1	168.6
*K2	S2	3.5	167.5	3.5	166.7	3.5	167.1				
2SM2		1.9	294.4	1.8	292.6	1.9	293.6				
MO3		1.1	167.1	1.0	169.3	1.1	168.1				
M3		3.5	107.6	3.5	106.9	3.5	107.3				
MK3		2.3	236.9	2.3	233.6	2.3	235.3				

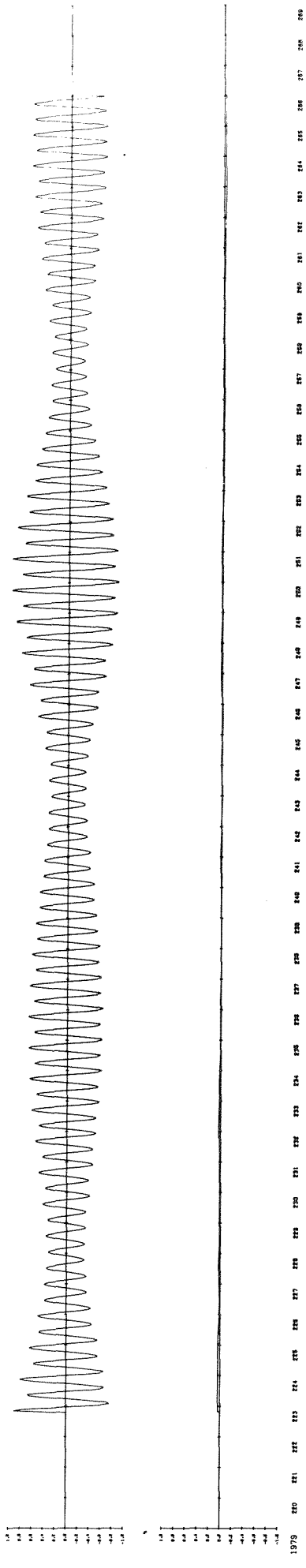
contd...

Constituent	related to	PR 280 H(mb)	PR 280 G(°)	PR 281 H(mb)	PR 281 G(°)	Vector mean H(mb)	Vector mean G(°)
MN4		1.2	62.8	1.1	63.1	1.1	63.0
M4		1.6	68.8	1.6	71.1	1.6	70.0
SN4		0.4	19.8	0.4	18.8	0.4	19.3
MS4		1.2	72.9	1.2	75.5	1.2	74.2
2MN6		1.2	100.8	1.2	102.1	1.2	101.5
M6		1.9	112.9	1.9	111.9	1.8	112.4
MSN6		0.4	91.4	0.4	82.5	0.4	86.9
2MS6		2.3	162.4	2.4	162.6	2.3	162.5
2SM6		0.7	211.8	0.6	210.7	0.7	211.3

Recorder position	Station J, Malin Shelf, 1979. Lat 55^{o} 00.2'N Long 09^{o} 59.5'W. g = 9.815 ms^{-2}.
Water depth	115m.
Recorder details	Teleost PR 284. 900s sampling and integration periods.
Time of launch	Initial launch at 1050 GMT day 220(08 August). Final launch at 1226 GMT. See comments.
Time of recovery	On deck at 0637 GMT day 270 (27 September).
CTD casts	Cast No. 43 at 1700 GMT day 221. Cast No.349 at 0645 GMT day 270. Density, ρ = 1027.0 kg m^{-3}.
Comments	Frame hit ship's side during initial deployment triggering pyro release and releasing ballast frame. A new frame was attached and rig re-launched.

Timing	Scan No. 1 at 1600,00 GMT day 207. Scan No. 6365 at 2259,39 GMT day 273. Clock fast, gained 21s in 66 days and 7 hours.
Raw data	Start 1507,26 day 220. End 0607,10 day 270.
Temperature data	Complete record.
Drift free data	Start 2000 day 223 End 0000 day 267 FHP53 filter.
Tidal analysis	TIRA, days 225 to 253, 29 days of filtered bottom pressure data. 27 major and 8 years from 1960/70.
Comments	


NORTH CHANNEL AUG/SEP 1979
ST. "J" 55 00.2 N 09 59.5W
TEMPERATURE PR 284
(DEGREES CELSIUS)
DAY NUMBER FOR YEAR 1979



FILTERED VALUES
SCALE Y=0.23780 E03
MEAN VALUE=0.12845 E05

RESIDUALS
SCALE Y=0.23780 E03
MEAN VALUE=0.12845 E05

NORTH CHANNEL "J" 284-1 TOTAL PRESSURE

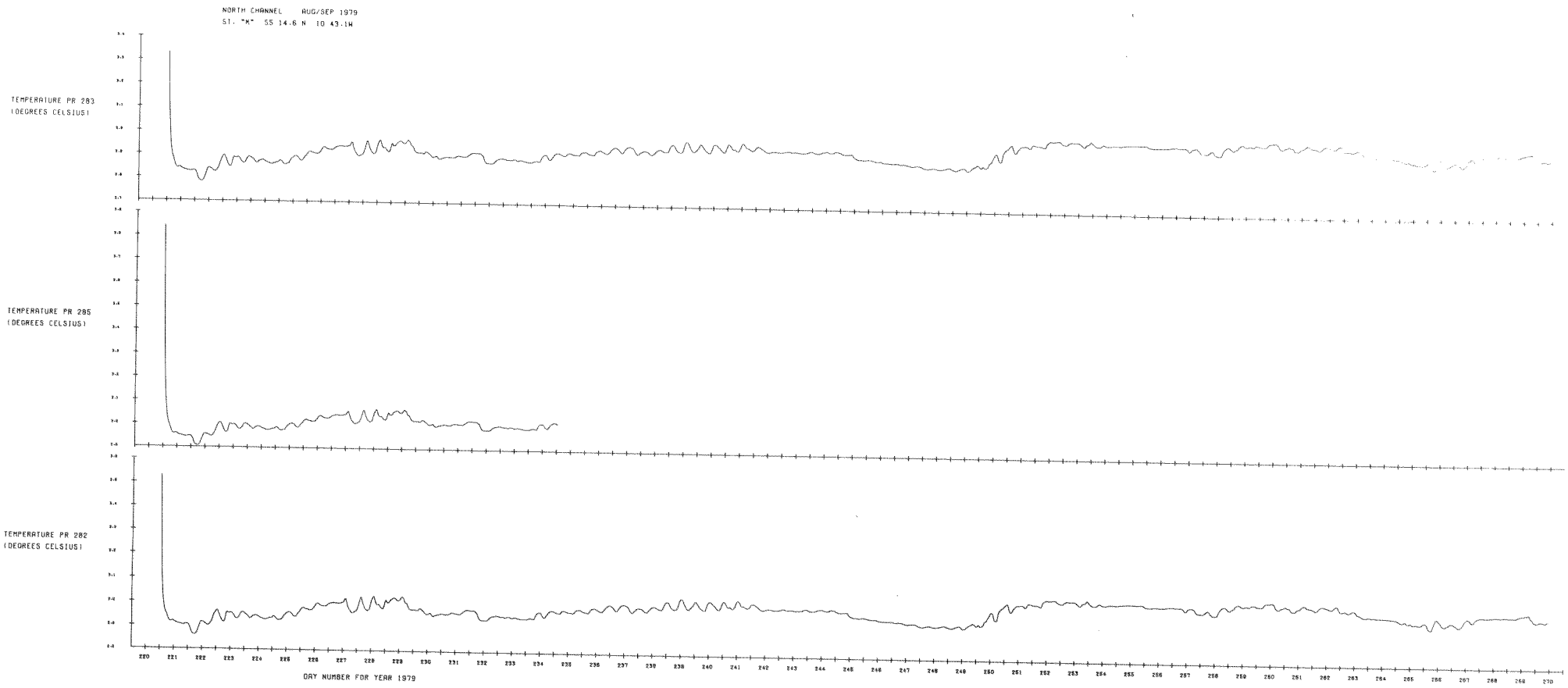
TABLE 4

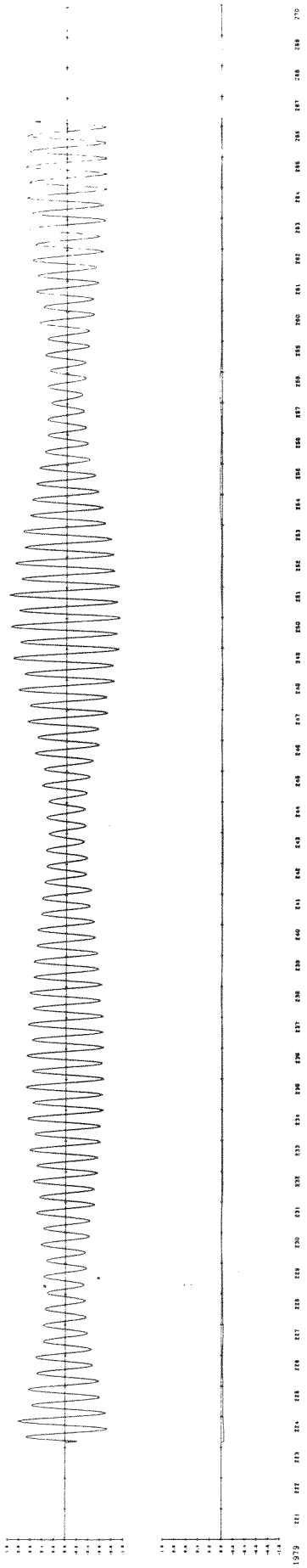
Station J, Malin Shelf, Lat 55° 00.2'N Long 09° 59.5'W.
Teleost Recorder PR 284,
Drift free bottom pressure (millibars) FHP53 filter.
0000 GMT day 225 to 2300 GMT day 253, 1979, 29 days.
27 constituents + 8 related using analysis from Malin Head 1960/70.

Constituent	related to	H(mb)	G(°)
Q1		3.4	297.0
O1		8.1	349.4
M1		0.8	147.9
*π_1	K1	0.1	84.8
*P1	K1	3.4	107.8
K1		11.4	110.4
*ψ_1	K1	0.7	36.2
*ϕ_1	K1	0.1	135.7
J1		1.0	189.4
001		0.8	189.5
*2N2	N2	3.5	115.4
ν_2		4.1	107.1
N2		24.3	135.8
*ν_2	N2	4.5	146.2
M2		117.0	157.5
L2		3.2	191.9
*T2	S2	2.5	183.1
S2		43.9	190.9
*K2	S2	12.2	189.7
2SM2		0.4	197.4
MO3		0.9	155.9
M3		1.1	59.5
MK3		0.4	262.4
MN4		1.7	309.2
M4		3.1	333.8
SN4		0.4	338.8
MS4		1.8	20.7
2MN6		0.4	141.8
M6		0.5	171.0
MSN6		0.2	151.1
2MS6		0.3	236.1
2SM6		0.1	233.2

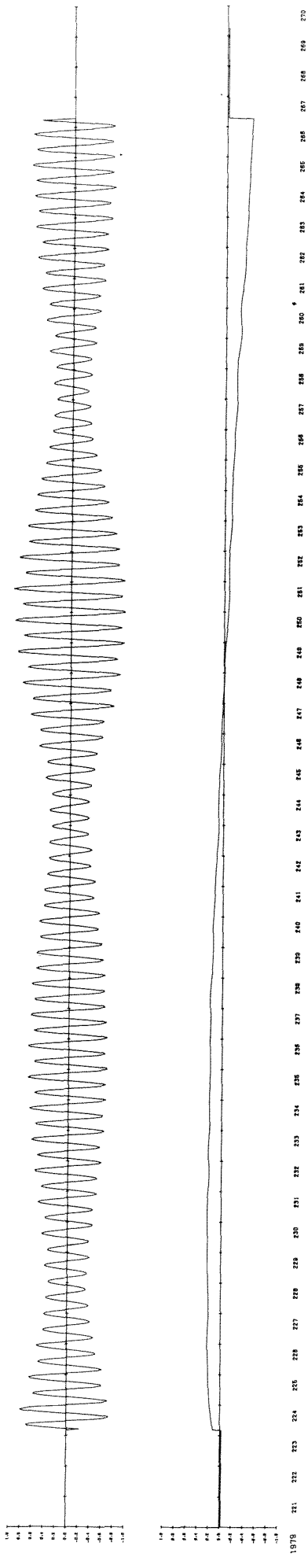
Recorder position	Station K, Malin Shelf, 1979. Lat 55^{o} 14.6'N Long 10^{o}43'W. $g = 9.815\ ms^{-2}$.
Water depth	2510m.
Recorder details	Teleost PR 282, 283 and 285. 900s sampling and integration periods for PR 282 and 283. 900s sampling and 884s integration periods for PR 285.
Time of Launch	On seabed at 2040 GMT day 220 (08 August).
Time of recovery	Off sea bed at 1143 GMT day 270 (27 September). On deck of RRS "CHALLENGER" at 1300 GMT.
CTD casts	Cast No. 41 at 2018 GMT day 220, only taken to 250m depth. Density not computed, estimated as 1027 kg m^{-3}.
Comments	

Timing	PR 282:	Scan No. 4 at 1459,59 day 211. Scan No. 6036 at 1059,45 day 274. Clock fast, gained 14s in 62 days and 20 hours.
	PR 283:	Scan No. 2 at 1629,59 day 211. Scan No. 6040 at 1359,46 day 274. Clock fast, gained 13s in 62 days and 21¼ hours.
	PR 285:	Scan No. 4 at 1945,00 day 213. Scan No. 5849 at 1700,28 day 274. Clock slow, lost 28s in 60 days and 21¼ hours.
Raw data	PR 282:	Start 0007,27 day 221. End 1122, 16 day 270.
	PR 283:	Start 0052,27 day 221. End 1137,17 day 270.
	PR 285:	Start 2352,27 day 220 End 0122,20 day 235.
Temperature data		As above.
Drift-free data	PR 282: and PR 283	Start 0500 day 224. End 0600 day 267.
	PR 285:	Start 0400 day 224. End 2000 day 231.
Tidal analysis		TIRA, days 225 to 253, 1979. 29 days of filtered bottom pressure data. 27 major and 8 related constituents using analysis of Malin Head 8 years from 1960/70. Vector mean of 2 * 29 days.
Comments		


NORTH CHANNEL AUG/SEP 1979
ST. "M" 55 14.6 N 10 43.1W
TEMPERATURE PR 283
(DEGREES CELSIUS)
TEMPERATURE PR 285
(DEGREES CELSIUS)
TEMPERATURE PR 282
(DEGREES CELSIUS)
DAY NUMBER FOR YEAR 1979



NORTH CHANNEL "K" 282-S TOTAL PRESSURE

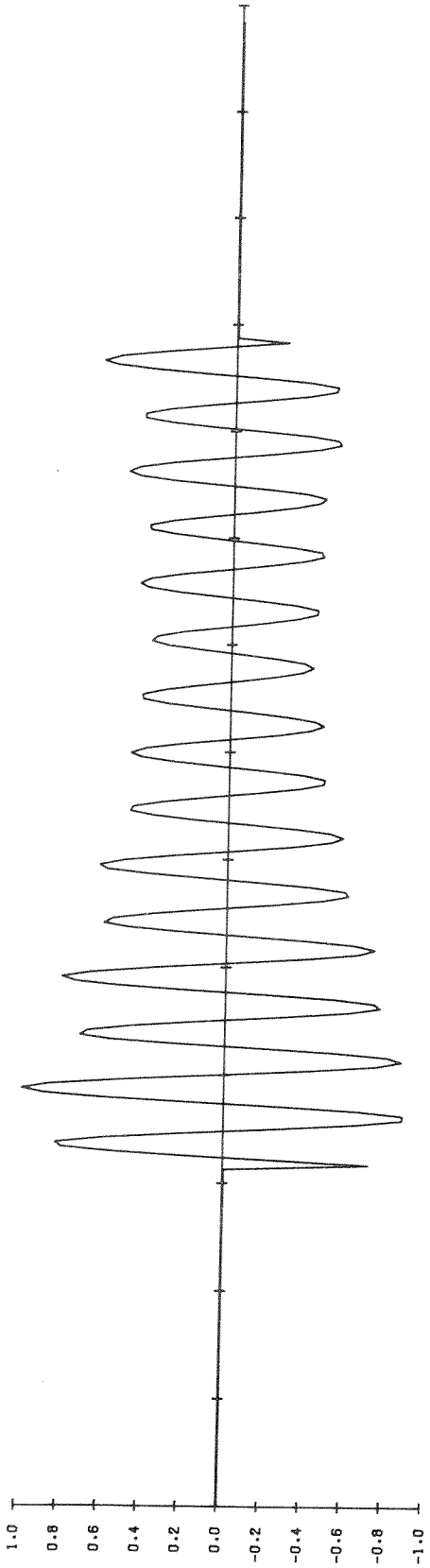


FILTERED VALUES
SCALE Y=0.20632 E03
MEAN VALUE=0.92838 E03

RESIDUALS
SCALE Y=0.20632 E03
MEAN VALUE=0.83310 E03

1979

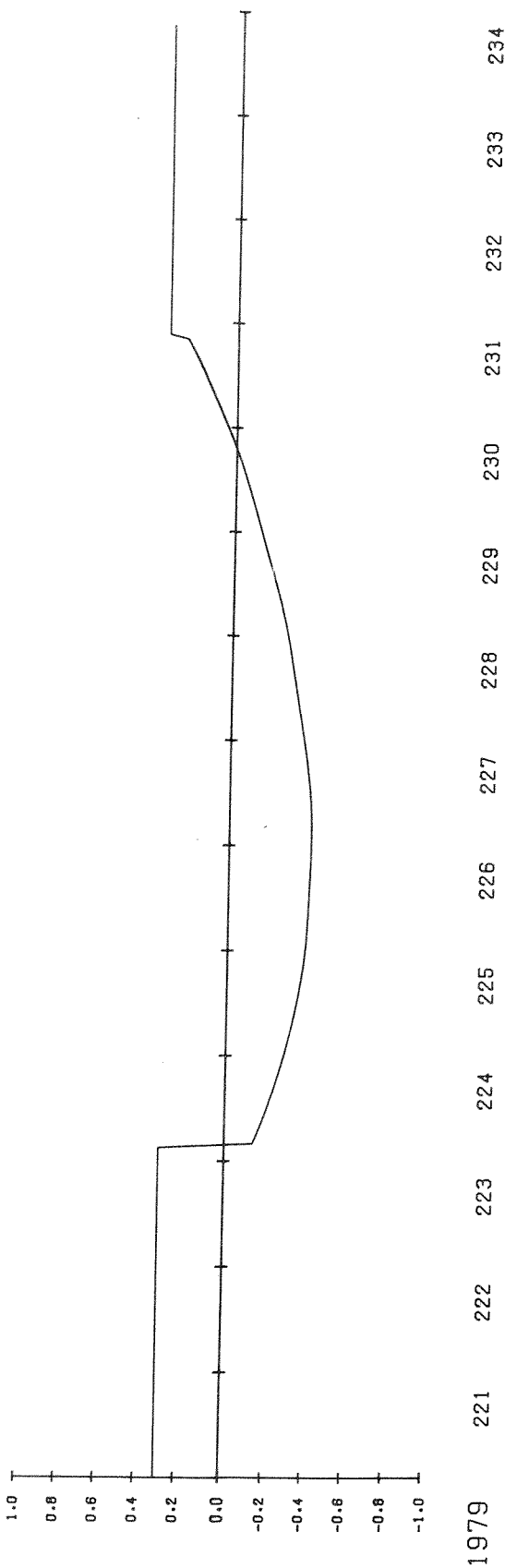
NORTH CHANNEL "K" 283-2 TOTAL PRESSURE



FILTERED VALUES

SCALE Y=0.16541 E03

MEAN VALUE=0.24659 E03



RESIDUALS

SCALE Y=0.16541 E03

MEAN VALUE=0.19656 E03

NORTH CHANNEL "K" 285-1 TOTAL PRESSURE

TABLE 5

Station K, Malin Shelf, Lat 55° 14.6'N Long 10° 43'W.
Teleost recorders PR 282 and PR 283.
Drift free bottom pressure (millibars), FHP 53 filter.
0000 GMT day 225 to 2300 day 253, 1979, 29 days.
*Related constituents using analysis from Malin Head 1960/70.

Constituent	related to	PR 282 H(mb)	PR 282 G(°)	PR 283 H(mb)	PR 283 G(°)	Vector Mean H(mb)	Vector Mean G(°)
Q1		3.3	297.5	3.4	297.6	3.4	297.6
O1		7.2	356.7	6.7	352.0	7.0	354.4
M1		0.8	151.1	0.6	146.6	0.7	149.2
*π_1	K1	0.1	84.3	0.1	85.2	0.1	84.7
*P1	K1	2.8	107.3	2.8	108.2	2.8	107.7
K1		9.5	109.9	9.5	110.8	9.5	110.3
*ψ_1	K1	0.6	35.7	0.6	36.6	0.6	36.1
*ϕ_1	K1	0.1	135.2	0.1	136.1	0.1	135.6
J1		0.7	144.9	0.6	103.0	0.7	125.6
OO1		0.3	224.2	0.6	273.2	0.5	257.4
*2N2	N2	3.2	114.4	3.2	114.3	3.2	114.4
μ_2		3.4	111.6	3.3	107.4	3.4	109.5
N2		22.2	134.8	22.5	134.7	22.4	134.8
*ν_2	N2	4.1	145.2	4.1	145.1	4.1	145.2
M2		108.0	157.0	107.8	157.1	107.9	157.0
L2		3.2	181.5	3.4	184.8	3.3	183.2
*T2	S2	2.3	182.9	2.3	182.8	2.3	182.8
S2		40.5	190.7	40.4	190.6	40.5	190.6
*K2	S2	11.3	189.5	11.2	189.4	11.3	189.5
2SM2		0.2	207.5	0.1	136.9	0.2	185.5
MO3		0.6	135.5	0.2	178.1	0.4	145.8
M3		0.8	56.6	1.0	56.4	0.9	56.5
MK3		0.1	211.9	0.3	187.0	0.2	193.1
MN4		0.5	326.4	0.2	345.9	0.4	331.9
M4		1.1	35.5	0.9	47.4	1.0	40.9
SN4		0.1	4.8	0.1	39.4	0.1	22.1
MS4		1.0	111.0	1.0	120.2	1.0	115.6
2MN6		0.1	240.2	0.3	123.1	0.2	142.4
M6		0.2	229.7	0.2	223.8	0.2	226.8
MSN6		0.1	126.7	0.1	211.1	0.1	168.9
2MS6		0.1	250.3	0.4	245.1	0.3	246.1
2SM6		0.1	359.3	0.2	356.0	0.2	357.1

Recorder position	Station L, Rockall Trough, 1979. Lat 55^{o} 40.3'N Long 10^{o} 49.1'W. $g = 9.816\ ms^{-2}$.
Water depth	2504 m.
Recorder details	Mk. IV logger no. 4 with Digiquartz pressure sensor no. 3845, Strain gauge sensor no. 2/D2, Bell and Howell thin film strain gauge no. 1, and Schaevitz Strain gauge sensor No. 1. 225s sampling and integration times.
Time of Launch	Recorder into water at 1033 GMT day 221 (09 August). On sea bed at 1120 GMT.
Time of recovery	Recorder released at 1617 GMT day 270 (27 September).
CTD casts	Cast no. 42 at 1045 GMT day 252, only taken to 250m depth. Density not computed, estimated as 1027.0 kg m^{-3}.
Comments	

Timing	Scan 0 at 1200 GMT day 206 (25 July). Scan 27689 at 1432,02 GMT day 278 (05 October). Clock slow, lost 17 seconds in 72 days 2 hours and 33¾ minutes.
Raw data	Start 1133,45 GMT day 221. End 0645,00 GMT day 241 for Bell and Howell sensor. End 1615,00 GMT day 270 for other sensors.
Temperature data	As above.
Drift free data	The raw data were filtered to 15 minute samples and the low frequency drift removed using a low order polynomial fit.
Tidal analysis	TIRA, Vector mean of 2 * 29 days overlapping analyses from 1242 GMT day 221 to 1512 GMT day 270, using 27 major and 8 related constituents using analysis of Malin Head 1960/70.
Comments	Only the analysis from the Digiquartz sensor is presented as this had the lowest noise residuals. Data reduction and analysis by D.C.C. MacDonald and J.M. Vassie.

TEMPERATURE 2/T6

PRESSURE 0022 3845

PRESSURE SG 2/027B

PRESSURE SCHAEVITZ

NCL

TABLE 6

Station L, Rockall Trough, Lat 55° 40.3'N Long 10° 49.1'W.
Mk.IV Recorder No. 4 with Digiquartz 3845.
Drift free bottom pressure (millibars), polynomial fit.
1242 GMT day 221 to 1512 GMT day 270 1979, 2 * 29 days overlapping analyses.
27 constituents + 8 related (*) using analysis from Malin Head 1960/70.

Constituent	related to	H(mb)	G(°)
Q1		2.9	301.0
O1		6.9	354.7
M1		0.5	141.8
*π_1	K1	0.1	87.2
*P1	K1	3.0	110.2
K1		10.0	112.8
*ψ_1	K1	0.6	38.6
*ϕ_1	K1	0.1	138.1
J1		0.5	133.9
OO1		0.2	314.6
*2N2	N2	3.1	116.7
μ_2		3.6	105.2
N2		21.6	137.1
*ν_2	N2	4.0	147.5
M2		104.6	159.0
L2		2.9	192.5
*T2	S2	2.2	185.5
S2		39.2	193.3
*K2	S2	10.9	192.1
2SM2		0.2	238.1
MO3		0.3	148.8
M3		0.8	66.3
MK3		0.2	169.7
MN4		0.4	348.5
M4		0.9	34.1
SN4		0.1	134.6
MS4		0.9	116.0
2MN6		0.2	171.8
M6		0.3	205.9
MSN6		0.04	236.5
2MS6		0.3	277.5
2SM6		0.03	304.5

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