I.O.S.

OFF SHORE BOTTOM PRESSURE RECORDS CELTIC SEA 1980

BY

G A ALCOCK

DATA REPORT NO 28
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 Celtic Sea in 1980. 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 in graphical form and in tables of harmonic constants.

1. INTRODUCTION

An experiment was conducted by I.O.S. Bidston in the Celtic Sea during August to October 1980, in order to study sea level, vertical current structure and circulation patterns under stratified conditions. The experiment complemented one in March-May 1978 which studied the Celtic Sea under homogeneous conditions (ALCOCK, MACDONALD and VASSIE, 1980, and HOWARTH and EVANS, 1980).

19 rigs containing recording current meters, thermistor chains or pressure recorders were deployed for 50 days at 8 stations (Figure 1). The density field was measured during both the deployment and recovery legs by continuous monitoring of sea surface temperature and conductivity and by recording CTD profiles.

This report displays the sea bed pressure data from stations; current meter and thermistor chain data are given in HOWARTH and EVANS (1982); and a narrative of the cruise is given in HEAPS and HOWARTH (1981).

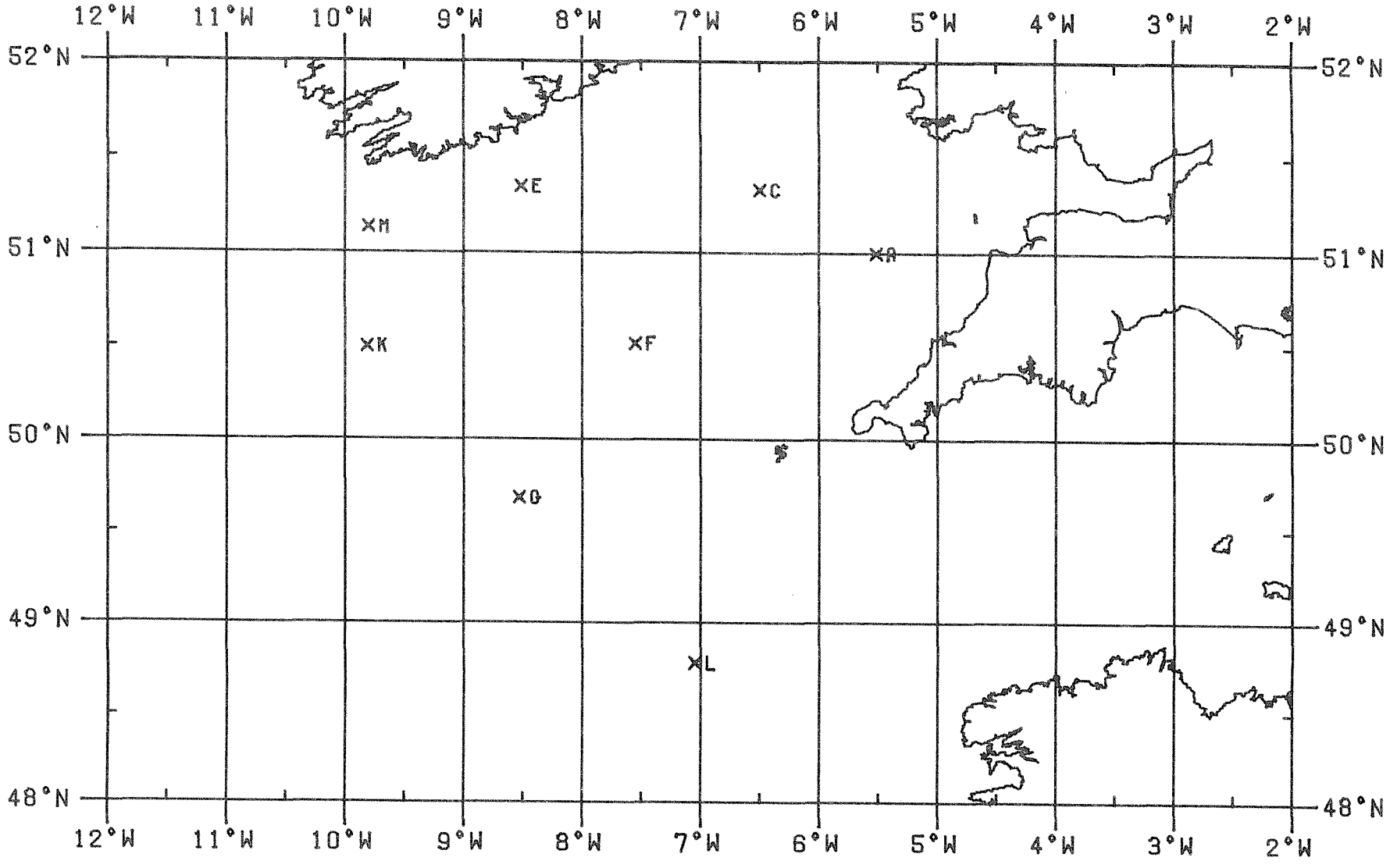


FIGURE 1. STATION POSITIONS AUG/OCT 1980.

2. INSTRUMENTATION and MOORING CONFIGURATIONS

(i) BOTTOM MOUNTED CURRENT METER/PRESSURE RECORDER

The bottom mounted recorders deployed at stations A, F, G and K each utilised a Digiquartz pressure sensor interfaced into a modified Aanderaa current meter (Alcock and Howarth 1978). CM/PR No. 1 was deployed at A but not recovered. CM/PR No. 5 was deployed at F and contained pressure transducer no. 4132, with a pressure sensitivity of 0.123 Hz mb^{-1}, and current meter no. 1750. CM/PR No. 3 was deployed at G with pressure transducer no. 4161, with a pressure sensitivity of 0.129 Hz mb^{-1}, and current meter no. 302. CM/PR No. 4 was deployed at K with pressure transducer no. 4143, with a pressure sensitivity of 0.134 Hz mb^{-1}, and current meter no. 1506.

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 0.70m. Each 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 line.

(ii) TELEOST PRESSURE RECORDERS

Teleost pressure recorders were deployed at stations E (PR 284), L(PR 281), and M (PR 287). Each recorder consisted of a pressure transducer (Bell and Howell strain gauge type 4-306 at E and L, and Digiquartz type at M), and a platinum resistance thermometer interfaced to an Aanderaa logger.

PR 281, 284 and 287 had pressure sensitivities of 0.038 Hz mb^{-1}, 0.057 Hz mb^{-1}, and 0.125 Hz mb^{-1}; and temperature coefficients of -6.7 mb $^{o}C^{-1}$, -22.0 mb $^{o}C^{-1}$, and 0.0 mb $^{o}C^{-1}$ respectively. At E, PR 284 was mounted in a low profile steel tripod frame of 0.76m height and 1.183m breadth with the sensor level about 0.48m above the frame base, and deployed using a W-shaped shallow water rig incorporating a current-meter string. At L and M, the pressure recorders were mounted in a protective frame with overall dimensions of 1.75m long by 1.14m wide by 0.66m high and attached to a 1.22m diameter tripod ballast frame. They were deployed as pop-up moorings and released from their ballast frames by firing a pyrotechnic release by acoustic command.

(iii) AANDERAA WATER LEVEL RECORDER

An Aanderaa water level recorder type 500 was also mounted in the frame deployed at L. It contained a Digiquartz type 2-300 A quartz crystal pressure transducer with a sensitivity of 14.346 Hz mb^{-1}.

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, FLPO3, of half length 18 and cut-off frequency (half-power point) of 0.35 cph (126° 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, $2N_2$, ν_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 6 years of data from St. Marys, Scilly Isles. 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). H can be readily converted to sea surface elevation using the hydrostatic relation:

$$H = P/\rho g ,$$

where H is elevation in metres, P is pressure in pascals (1 Pa = 10^{-2} mb), ρ is sea water density in kilograms per cubic metre and g is acceleration due to gravity in metres per second squared. Values of ρ, derived from CTD casts, and g for each station are given in the launch and recovery details.

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., MACDONALD, D.C.C. and VASSIE, J.M. 1980. Offshore bottom pressure records from the Celtic Sea and South West Approaches to the U.K. 1978. Institute of Oceanographic Sciences, Data Report No. 22. 40 pp, figs and tables. (Unpublished manuscript).

HEAPS, N.S., and HOWARTH, M.J. 1981. RRS 'JOHN MURRAY' cruise 9/80 and RRS 'CHALLENGER' cruise 16/80. Institute of Oceanographic Sciences, Cruise Report No. 114. 45 pp, figs and tables. (Unpublished manuscript).

HOWARTH, M.J., and EVANS, J.J. 1980. Moored current meter records, Celtic Sea 1978. Institute of Oceanographic Sciences, Data Report No. 18. 143 pp, figs and tables (Unpublished manuscript).

HOWARTH, M.J. and EVANS, J.J. 1982. Moored current meter records, Celtic Sea 1980. Institute of Oceanographic Sciences Data Report (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.

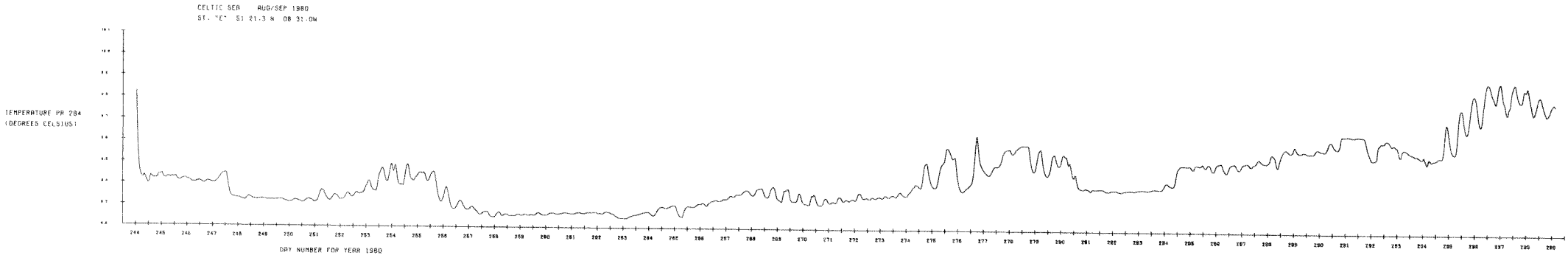
Analysis:

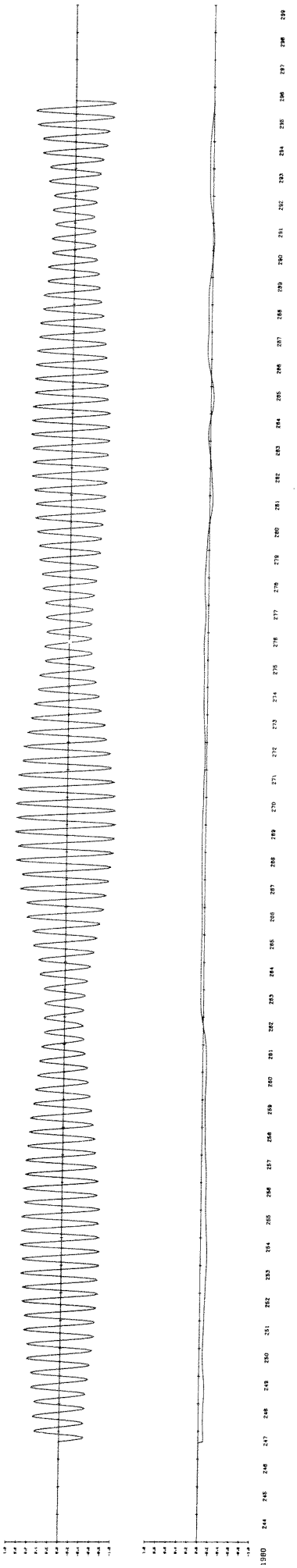
Tables of amplitude and phase (G - referred to lunar transit at Greenwich and time zone S = 0) of the major and related constituents of tidal record from each sensor, and the vector means if applicable.

Recorder position	Station A, Celtic Sea, 1980. Lat 51^{o} 00'N 05^{o} 30'W. $g = 9.812\ ms^{-2}$.
Water depth	77m.
Recorder details	Aanderaa CM/PR 1 with Digiquartz pressure sensor no. 280, current meter no. 1747 and Aanderaa logger 1747. 900s sampling and integration periods.
Time of launch	Deployed at 0615 -0640 GMT day 241 (28 August).
Time of recovery	Rig not located despite searches on days 293 and 304 (19 and 30 October).
CTD casts	Cast no. 1 at 0825 GMT day 241. Cast no. 36 at 1730 GMT day 252. Cast no. 40 at 0542 GMT day 293.
Comments	A separate rig with current meters nos. 4968 and 1139 at 55 and 30m above the sea bed was deployed nearby and successfully recovered.

Recorder position	Station E, Celtic Sea, 1980. Lat 51^{o} 21.3'N Long 08^{o} 31.0'W. $g = 9.812\ ms^{-2}$.
Water depth	92m.
Recorder details	Teleost PR 284. 900s sampling and integration periods.
Time of launch	Recorder in water at 0810 GMT day 244 (31 August). On sea bed at 0819 GMT.
Time of recovery	Recorder off sea bed at 1636 GMT day 299 (25 October). On deck at 1712 GMT.
CTD casts	Cast no. 10 at 0625 GMT day 244. Cast no. 62 at 1753 GMT day 299. Density, ρ = 1026.63 Kg m^{-3}.
Comments	Pressure recorder was mounted in 'Dunbar' frame and incorporated into a W shape rig with a string of three current meters nos. 2575, 3560 and 3559 at 70, 55 and 30m above sea bed. The rig was recovered by dragging.

Timing	Scan No. 2 at 0845, 00 GMT day 235.
	Scan no. 6275 at 1659, 39 GMT day 300.
	Clock fast, gained 21s in 65d and 8¼h.
Raw data	Start 1037,27 GMT day 244.
	End 1622,09 GMT day 299.
Temperature data	As above.
Drift free data	Start 1500 day 244.
	End 1100 day 299.
	FHP 53 filter used.
Tidal analysis	TIRA, days 264 to 292 1980, 29 days of filtered bottom pressure data. 27 major and 8 related constituents from analysis of St. Marys data from 1968/73.
	See comments.
Comments	Discontinuity of approx. 30 mb between 1645 and 1700 GMT day 262, therefore analysed period taken after this. PR moved approx. 30 cm down and evidence from cm rig showing decrease in pressure suggests sub surface buoy moved up, lifting anchor and dragging pressure recorder frame.


CELTIC SEA AUG/SEP 1980
ST. "E" 51 21.3 N 08 31.0W
TEMPERATURE PR 284
(DEGREES CELSIUS)
DAY NUMBER FOR YEAR 1980



FILTERED VALUES
SCALE Y=0.21484 E03
MEAN VALUE=0.10378 E05

RESIDUALS
SCALE Y=0.21484 E03
MEAN VALUE=0.10377 E05

CELTIC SEA E 284/4

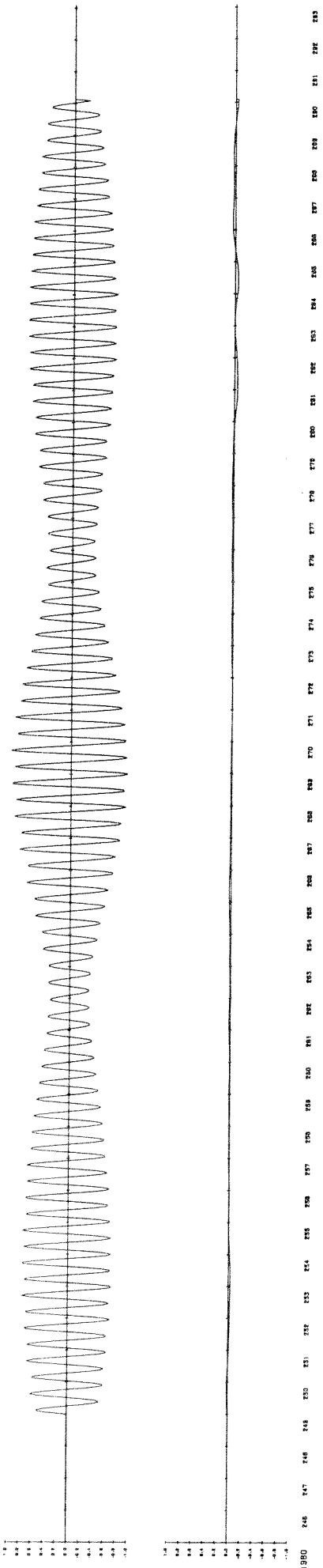
TABLE 1

Station E, Celtic Sea, Lat 51° 21.3'N Long 08° 31.0'W.
Teleost recorder PR 284.
Drift free bottom pressure (millibars), FHP53 filter.
0000 day 264 to 2300 day 299 1980, 29 days.
Total variance = =0836.8 mb^2. Residual variance = 4.8 mb^2.
*Related constituent using analysis from St. Marys 1968/73.

Constituent	related to	H(mb)	G(°)
Q1		1.6	4.1
O1		2.1	24.6
M1		0.4	173.6
*π1	K1	0.03	49.4
*P1	K1	0.6	123.6
K1		1.8	125.9
*ψ1	K1	0.03	311.8
*φ1	K1	0.03	121.3
J1		0.5	100.1
001		0.2	143.2
*2N2	N2	1.3	75.8
μ2		1.2	128.5
N2		26.4	120.7
*ν2	N2	5.0	115.7
M2		130.3	140.7
L2		8.6	146.8
*T2	S2	2.5	173.2
S2		41.8	180.9
*K2	S2	12.0	178.0
2SM2		1.2	36.9
MO3		0.5	138.2
M3		1.0	24.8
MK3		0.3	334.3
MN4		2.2	206.4
M4		4.4	234.5
SN4		0.4	74.2
MS4		2.7	292.5
2MN6		0.5	158.1
M6		0.9	178.5
MSN6		0.2	215.5
2MS6		1.1	221.9
2SM6		0.4	268.4

Recorder position	Station F, Celtic Sea, 1980. Lat 50^{o} 31.7'N Long 07^{o} 36.7'W. $g = 9.811\ ms^{-2}$.
Water depth	110m.
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	Recorder on sea bed at 1849 GMT day 246 (2 September).
Time of recovery	On deck at 0754 GMT day 294 (20 October),
CTD casts	No. 5 at 0547 GMT day 242. No. 25 at 1950 GMT day 246. No. 44 at 1840 GMT day 294. No. 64 at 0600 GMT day 300. Density, ρ = 1026.61 Kg m^{-3}.
Comments	The following rigs were also deployed nearby: (i) A rig with a meteorological buoy and 4 current meters. (ii) A surface current meter rig. (iii) A thermistor chain rig. Only iii) was recovered successfully.

Timing	Scan no. 1 at 1345,00 GMT day 234. Scan no. 5762 at 1359,57 GMT day 294. Clock fast, gained 3s in 60 days and ¼ hour.
Raw data	Start 1907,29 GMT day 246. End 0737,27 GMT day 294.
Temperature data	See comments.
Drift-free data	Start 0000 GMT day 250. End 0200 GMT day 291. FHP53 filter.
Tidal analysis	TIRA, days 260 to 288, 1980; 29 days of filtered bottom pressure data using analysis of St. Marys data from 1968/73.
Comments	As the pressure sensor had a negligible tamperature coefficient, no temperature record was used to correct the pressure frequency record.



FILTERED VALUES
SCALE Y=0.26671 E03
MEAN VALUE=0.12169 E05

RESIDUALS
SCALE Y=0.26671 E03
MEAN VALUE=0.12169 E05

CELTIC SEA F CM/PR 5

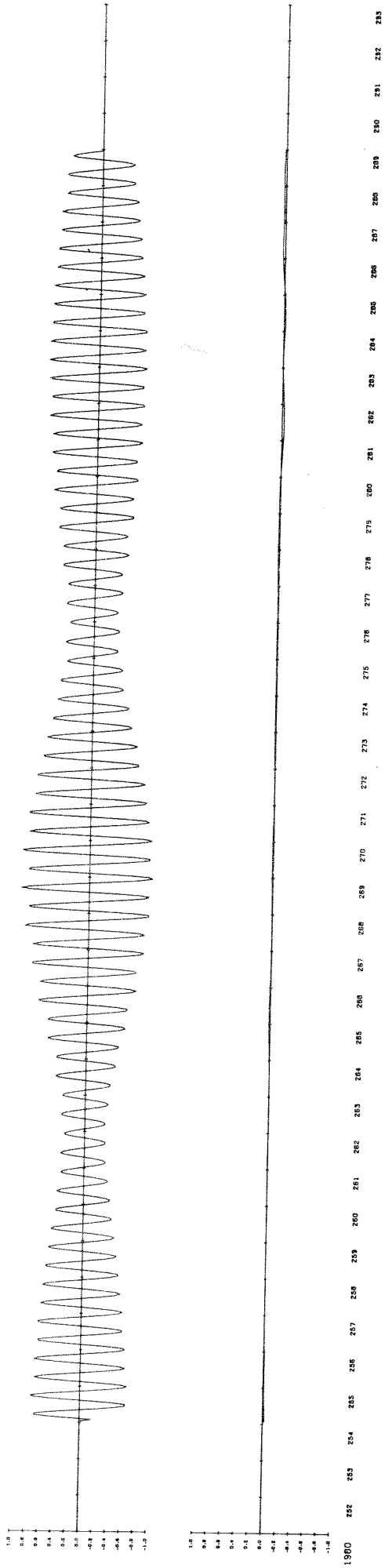
TABLE 2

Station F, Celtic Sea, Lat 50° 31.7'N Long 07° 36.7'W.
Aanderaa CM/PR 05, Digiquartz pressure sensor 4132.
Drift free bottom pressure (millibars), FHP53 filter.
0000 day 260 to 2300 day 288 1980, 29 days.
Total variance = 15030.8 mb^2. Residual variance = 3.8 mb^2.
*Related constituent using analysis from St.Marys 1968/73.

Constituent	related to	H(mb)	G(°)
Q1		2.1	322.8
O1		4.1	353.9
M1		0.3	153.7
*π_1	K1	0.1	39.9
*P_1	K1	1.5	114.1
K1		4.8	116.4
*ψ_1	K1	0.1	302.3
*ϕ_1	K1	0.1	111.8
J1		0.2	171.3
OO1		0.5	94.9
*2N2	N2	3.4	99.6
ν2		3.3	152.3
N2		31.2	116.8
*ν_2	N2	5.9	111.1
M2		152.9	136.1
L2		8.8	134.6
*T2	S2	3.1	169.1
S2		52.0	176.8
*K2	S2	15.0	173.9
2SM2		1.3	16.3
MO3		0.5	118.5
M3		1.1	28.8
MK3		0.3	329.8
MN4		2.1	198.4
M4		4.4	218.1
SN4		0.5	87.1
MS4		2.5	272.5
2MN6		0.3	3.5
M6		0.4	45.8
MSN6		0.1	105.5
2MS6		0.6	89.5
2SM6		0.2	172.6

Recorder position	Station G, Celtic Sea, 1980, Lat 49° 39.6'N Long 08° 31.7'W. $g = 9.810\ ms^{-2}$.
Water depth	140m.
Recorder details	Aanderaa CM/PR 3 with Digiquartz pressure sensor 4161, current meter no. 302 and Aanderaa logger 302. 900s sampling and integration periods.
Time of launch	Recorder in water at 2136 GMT day 251 (7 September). On sea bed at 2139 GMT.
Time of recovery	Off sea bed at 1021 GMT day 297 (23 October). On deck at 1024 GMT.
CTD casts	No. 31 at 2139 GMT day 251. No. 55 at 1805 GMT day 297. No. 66 at 1730 GMT day 302. Density, ρ = 1026.51 Kg m^{-3}.
Comments	A pop-up current meter rig with 5 current meters and a thermistor chain rig were deployed nearby.

Timing	Scan no. 1 at 1805,00 GMT day 247. Scan no. 4786 at 1420,14 GMT day 297. Clock slow, lost 14s in 49 days and 20¼ hours.
Raw data	Start 2157,31 GMT day 251 End 0957,34 GMT day 297. See comments.
Temperature data	See comments.
Drift free data	Start 0200 GMT day 255. End 2300 GMT day 289. FHP53 filter. See comments.
Tidal analysis	TIRA, days 260 to 288, 1980; 29 days of filtered bottom pressure data using analysis of St. Marys data from 1968/73.
Comments	As the pressure sensor had a negligible temperature coefficient, no temperature record was used to correct the pressure frequency record. There was a discontinuity of approx. 70 mb in the pressure record occurring between 0727 and 0743 GMT day 293. Therefore the unfiltered hourly record was truncated at 2300 GMT day 292.



FILTERED VALUES
SCALE Y=0.24945 E03
MEAN VALUE=0.15080 E05

RESIDUALS
SCALE Y=0.24945 E03
MEAN VALUE=0.15080 E05

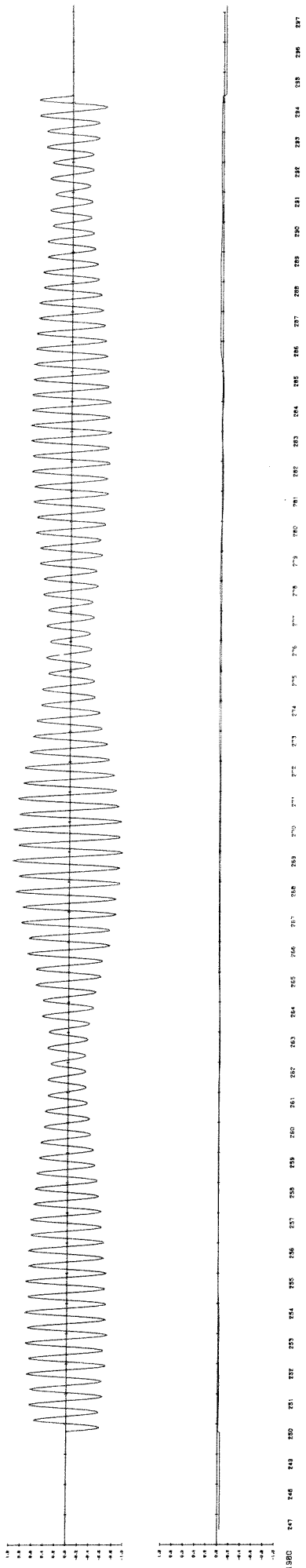
TABLE 3

Station G, Celtic Sea, Lat 49° 39.6'N Long 08° 31.7'W.
Aanderaa CM/PR 03 Digiquartz pressure sensor 4161.
Drift free bottom pressure (millibars), FHP53 filter.
0000 day 260 to 2300 day 288 1980, 29 days.
Total variance = 12100.0 mb^2. Residual variance = 2.2 mb^2
*Related constituent using analysis from St. Marys 1968/73.

Constituent	related to	H(mb)	G(°)
Q1		2.3	305.6
O1		5.3	339.1
M1		0.3	151.1
*π_1	K1	0.1	23.0
*P1	K1	2.0	97.2
K1		6.4	99.5
*ψ_1	K1	0.1	285.4
*ϕ_1	K1	0.1	94.9
J1		0.3	148.0
OO1		0.3	73.5
*2N2	N2	3.7	66.9
μ2		3.7	119.6
N2		28.5	104.2
*ν2	N2	5.3	98.0
M2		137.0	123.0
L2		6.4	128.2
*T2	S2	2.8	151.8
S2		46.5	159.5
*K2	S2	13.4	156.6
2SM2		0.5	7.3
MO3		0.4	90.7
M3		1.1	8.4
MK3		0.2	318.1
MN4		1.4	213.1
M4		2.9	231.7
SN4		0.2	70.0
MS4		1.9	285.4
2MN6		0.7	323.0
M6		1.0	353.7
MSN6		0.2	92.6
2MS6		1.3	50.5
2SM6		0.3	135.4

Recorder position	Station K, Celtic Sea, 1980. Lat 50^{o} 31.4'N Long 09^{o} 48.5'W. $g = 9.811\ ms^{-2}$.
Water depth	130m.
Recorder details	Aanderaa CM/PR 4 with Digiquartz pressure sensor 4143, current meter no. 1506 and Aanderaa logger 1506. 900s sampling and integration periods.
Time of launch	Recorder in water at 1316 GMT day 247 (03 September). On sea bed at 1318 GMT.
Time of recovery	Off sea bed at 1114 GMT day 298 (24 October). On deck at 1122 GMT. See comments.
CTD casts	No. 7 at 0724 GMT day 243. No. 26 at 1010 GMT day 247. No. 57 at 1757 GMT day 298. Density ρ = 1026.94 Kg m^{-3}.
Comments	The buoy wire parted during recovery and so the rig was recovered by dragging. A pop-up rig with 4 current meters and a thermistor chain rig were deployed nearby.

Timing	Scan no. 1 at 1115,00 GMT day 234. Scan no. 6171 at 1745,04 GMT day 298. Clock slow, lost 4s in 64 days and 6½ hours.
Raw data	Start 1337,31 GMT day 247. End 1007,34 GMT day 298.
Temperature data	See comments.
Drift-free data	Start 1800 GMT day 250. End 0400 GMT day 295. FHP53 filter.
Tidal analysis	TIRA, days 260 to 288, 1980; 29 days of filtered bottom pressure data using analysis of St. Marys data from 1968/73.
Comments	As the pressure sensor had a negligible temperature coefficient, no temperature record was used to correct the pressure frequency record.



FILTERED VALUES
SCALE Y=0.21728 E03
MEAN VALUE=0.14181 E05

RESIDUALS
SCALE Y=0.21728 E03
MEAN VALUE=0.14172 E05

CELTIC SEA K CH/PR 4

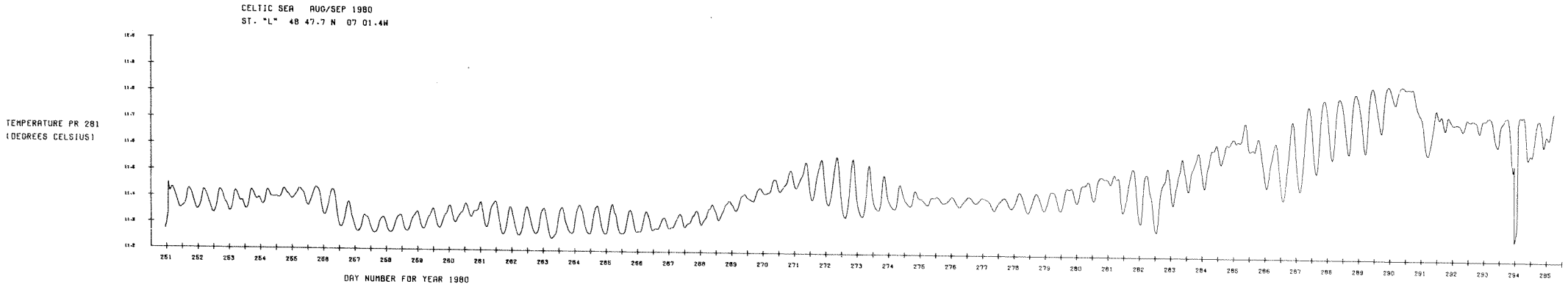
TABLE 4

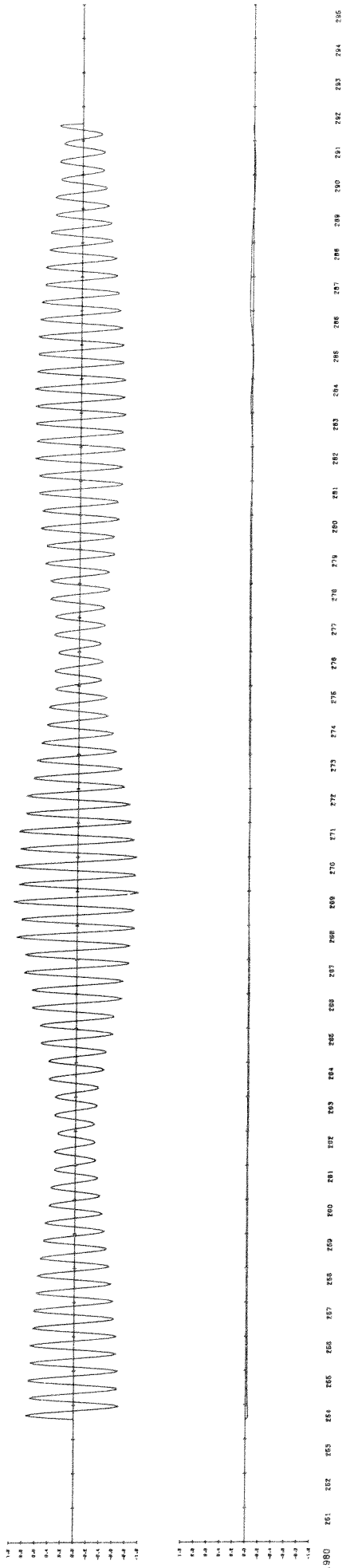
Station K, Celtic Sea, Lat 50° 31.4'N Long 09° 48.5'W.
Aanderaa CM/PR 04, Digiquartz pressure sensor 4143.
Drift free bottom pressure (millibars), FHP53 filter.
0000 day 260 to 2300 day 288 1980, 29 days.
Total variance = 9414.8 mb^2. Residual variance = 1.7 mb^2.
*Related constituent using analysis from St. Marys 1968/73

Constituent	related to	H(mb)	G(°)
Q1		2.0	306.9
O1		4.8	341.0
M1		0.3	159.1
*π1	K1	0.1	22.3
*P1	K1	2.1	96.5
K1		6.5	98.8
*ψ1	K1	0.1	284.7
*ϕ_1	K1	0.1	94.2
J1		0.4	133.8
OO1		0.3	40.6
*2N2	N2	3.4	56.2
μ2		3.3	108.9
N2		25.3	106.2
*ν2	N2	4.7	100.2
M2		120.9	125.2
L2		5.3	140.3
*T2	S2	2.4	151.9
S2		40.6	159.6
*K2	S2	11.7	156.7
2SM2		0.3	58.5
MO3		0.3	102.6
M3		1.0	9.4
MK3		0.2	345.4
MN4		1.1	237.0
M4		2.4	258.3
SN4		0.3	85.8
MS4		1.6	328.7
2MN6		0.3	297.3
M6		0.3	335.2
MSN6		0.1	107.2
2MS6		0.3	46.1
2SM6		0.1	199.8

Recorder position	Station L, Celtic Sea, 1980. Lat 48° 47.7'N Long 07° 01.4'W. g = 9.810 ms^{-2}.
Water depth	125m.
Recorder details	Teleost PR 281 and Aanderaa WLR 500 900s sampling period for both, 900s and 100s integration periods for PR 281 and WLR 500 respectively.
Time of launch	Recorders in water at 0734 GMT day 251 (7 September). One sea bed at 0735 GMT.
Time of recovery	Off sea bed at 1728 GMT day 295 (21 October). On deck at 1740 GMT.
CTD casts	No. 30 at 1030 GMT day 251. No. 49 at 2100 GMT day 295. Density ρ = 1026.69 Kg m^{-3}.
Comments	A moored rig with 4 current meters and a thermistor chain rig were deployed nearby.

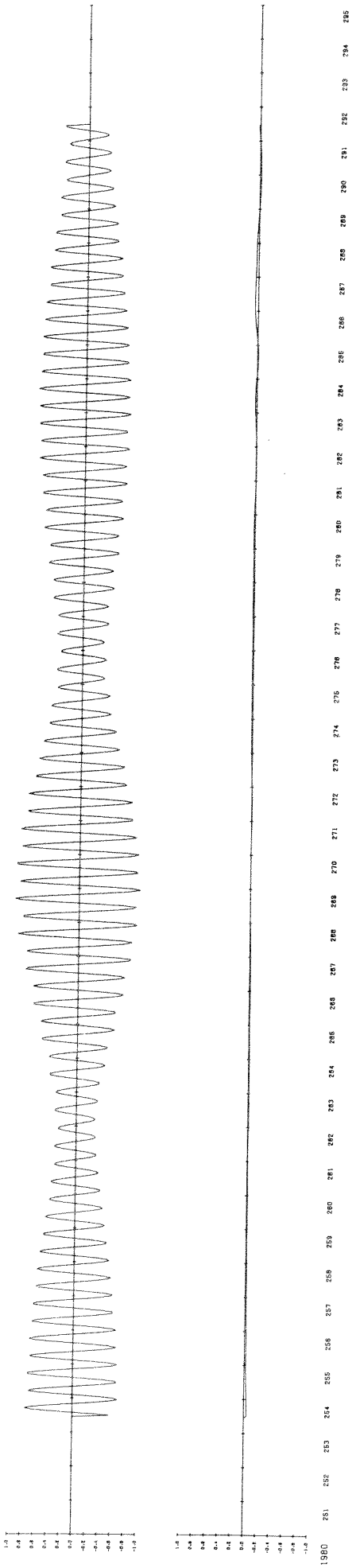
Timing	PR 281:	Scan no. 2 at 0815,00 GMT day 235.
		Scan No. 6149 at 0859,41 GMT day 299.
		Clock fast, gained 19s in 64 days and ¾ hour.
	WLR 500:	Scan no. 2 at 1545,00 GMT day 233.
		Scan no. 6314 at 0945,00 GMT day 299.
		No clock error.
Raw data	PR 281:	Start 1052,25 GMT day 251.
		End 1707,12 GMT day 295.
	WLR 500:	Start 0744,10 GMT day 251.
		End 1714,10 GMT day 295.
Temperature data		Complete record for PR 281.
Drift free data	PR 281:	Start 1500 GMT day 254.
		End 1000 GMT day 292.
	WLR 500:	Start 1200 GMT day 254.
		End 1100 GMT day 292.
		FHP 53 filter used for both.
Tidal analysis		TIRA days 260 to 298 1980, 29 days of filtered bottom pressure data, using analysis of St. Marys data from 1968/73. Vector mean of analyses from PR 281 and WLR 500.


CELTIC SEA AUG/SEP 1980
ST. "L" 48 47.7 N 07 01.4W
TEMPERATURE PR 281
(DEGREES CELSIUS)
251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275 276 277 278 279 280 281 282 283 284 285 286 287 288 289 290 291 292 293 294 295
DAY NUMBER FOR YEAR 1980



FILTERED VALUES
SCALE Y=0.27582 E03
MEAN VALUE=0.13720 E06

RESIDUALS
SCALE Y=0.27582 E03
MEAN VALUE=0.13721 E06



FILTERED VALUES
SCALE Y=0.27724 E03
MEAN VALUE=0.13758 E05

RESIDUALS
SCALE Y=0.27724 E03
MEAN VALUE=0.13758 E05

CELTIC SEA L 500/1

TABLE 5

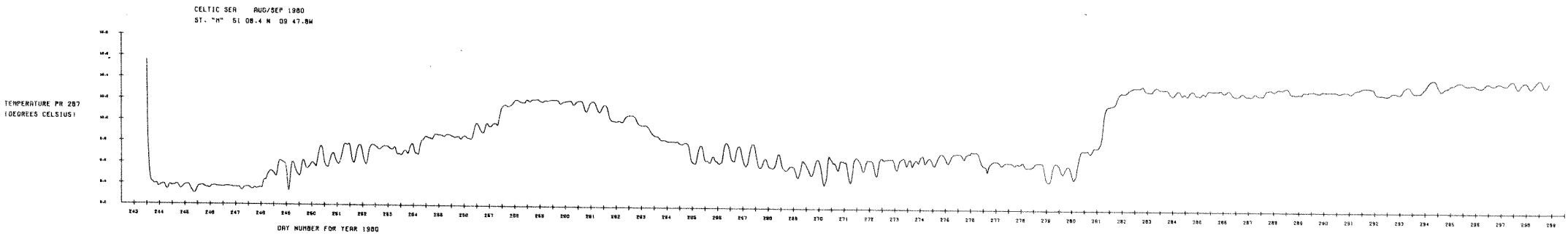
Station L, Celtic Sea, Lat 48° 47.7'N Long 07° 01.4'W.
Teleost recorder PR 281 and Aanderaa recorder WLR 500.
Drift free bottom pressure (millibars), FHP53 filter.
0000 day 260 to 2300 day 288 1980, 29 days.
Total variance = 14689.4 and 14884.0 mb^2. Residual variance = 2.7 mb^2 and 2.9 mb^2.
*Related constituent using analysis from St. Marys 1968/73.

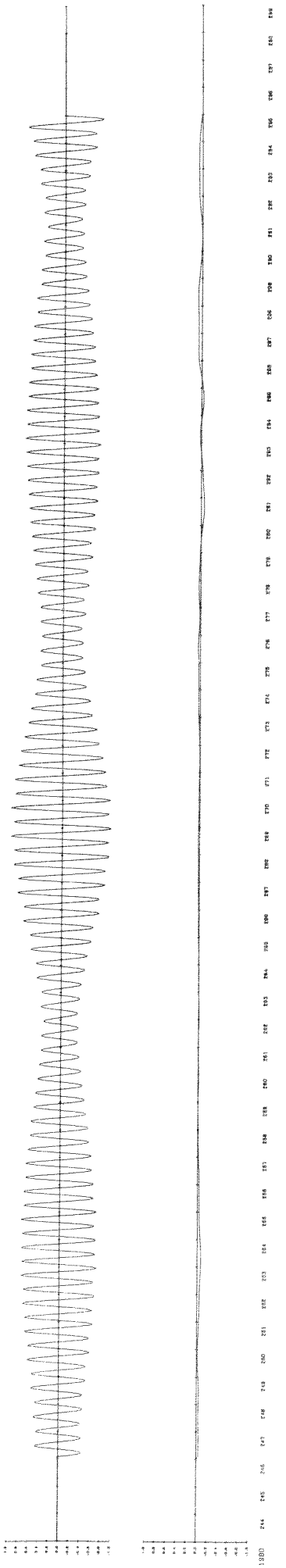
Constituent	related to	PR 281 H(mb)	PR 281 G(°)	WLR 500 H(mb)	WLR 500 G(°)	Vector Mean H(mb)	Vector Mean G(°)
Q1		2.3	299.6	2.3	298.7	2.3	299.1
O1		6.2	334.5	6.2	334.7	6.2	334.6
M1		0.2	157.9	0.2	162.5	0.2	160.2
*π_1	K1	0.1	17.8	0.1	18.0	0.1	17.9
*P_1	K1	2.1	92.0	2.1	92.2	2.1	92.1
K1		6.7	94.3	6.7	94.5	6.7	94.4
*ψ_1	K1	0.1	280.2	0.1	280.4	0.1	280.3
*ϕ_1	K1	0.1	89.7	0.1	89.9	0.1	89.8
J_1		0.3	151.0	0.3	150.6	0.3	150.8
OO1		0.2	59.4	0.2	61.0	0.2	60.2
*2N2	N2	4.7	67.7	4.7	68.0	4.7	67.9
μ_2		4.6	120.4	4.6	120.7	4.6	120.5
N2		31.4	98.6	31.6	98.5	31.5	98.5
*ν_2	N2	5.8	92.4	5.8	92.1	5.8	92.3
M2		150.6	117.4	151.5	117.1	151.1	117.3
L2		6.5	118.8	6.6	116.8	6.6	117.8
*T_2	S2	3.1	147.2	3.1	146.9	3.1	147.1
S2		52.0	154.9	52.4	154.6	52.2	154.8
*K2	S2	15.0	152.0	15.1	151.7	15.1	151.9
2SM2		0.8	342.7	0.8	341.0	0.8	341.8
MO3		0.5	85.5	0.5	87.2	0.5	86.4
M3		1.1	2.9	1.2	3.1	1.2	3.0
MK3		0.3	306.9	0.3	303.8	0.3	305.3
MN4		0.9	188.5	0.9	179.8	0.9	184.2
M4		2.3	199.9	2.3	192.1	2.3	196.0
SN4		0.1	331.7	0.1	351.5	0.1	341.6
MS4		2.0	245.2	2.0	238.8	2.0	242.0
2MN6		1.1	312.3	1.0	311.2	1.1	311.8
M6		1.4	342.1	1.4	342.2	1.4	342.2
MSN6		0.3	37.5	0.3	35.5	0.3	36.6
2MS6		1.6	36.4	1.7	35.5	1.7	35.9
2SM6		0.3	97.1	0.3	103.3	0.3	100.2

Recorder position	Station M, Celtic Sea, 1980. Lat 51^{o} 08.4'N Long 09^{o} 47.8'W. $g = 9.812\ ms^{-2}$.
Water depth	117m.
Recorder details	Teleost PR 287. 900s sampling and integration periods.
Time of launch	Recorder in water at 1850 GMT day 243 (30 August). On sea bed at 1851 GMT.
Time of recovery	Off seabed at 0719 GMT day 299 (25 October). On surface 0721 GMT and on deck at 0743 GMT.
CTD casts	No. 8 at 1740 GMT day 243. No. 61 at 0635 GMT day 299. Density, ρ = 1026.90 Kg m^{-3}.

Comments

Timing	Scan no. 2 at 1030,00 GMT day 235.
	Scan no. 6140 at 0859,44 GMT day 299.
	Clock fast, gained 16s in 63 days 22¼ hours.
Raw data	Start 2137,28 GMT day 243.
	End 0607,14 GMT day 299.
Temperature data	As above.
Drift free data	Start 0200 GMT day 247.
	End 0000 GMT day 296.
Tidal analysis	TIRA days 260 to 288, 1980 29 days of filtered bottom pressure data, using analysis of St. Marys data from 1968/73.
Comments	


CELTIC SEA AUG/SEP 1980
ST. "M" 51 08.4 N 09 47.8W
TEMPERATURE PR 287
(DEGREES CELSIUS)
DAY NUMBER FOR YEAR 1980



FILTERED VALUES
SCALE Y=0.20003 E03
MEAN VALUE=0.12895 E06

RESIDUALS
SCALE Y=0.20003 E03
MEAN VALUE=0.12895 E06

CELTIC SEA M 2871

TABLE 6

Station M, Celtic Sea, Lat 51° 08.4'N Long 09° 47.8'W.
Teleost recorder PR 287.
Drift free bottom pressure (millibars), FHP 53 filter.
0000 day 260 to 2300 day 288 1980, 29 days.
Total variance = 8425.4 mb^2. Residual variance = 2.2 mb^2.
*Related constituent using analysis from St. Marys 1968/73.

Constituent	related to	H(mb)	G(°)
Q1		1.1	318.4
O1		2.9	330.2
M1		0.3	167.6
*π_1	K1	0.1	5.3
*P1	K1	1.4	79.5
K1		4.4	81.8
*ψ_1	K1	0.1	267.7
*ϕ_1	K1	0.1	77.2
J1		0.8	115.3
OO1		0.3	1.0
*2N2	N2	3.1	48.4
μ_2		3.0	101.1
N2		24.0	109.6
*ν_2	N2	4.4	104.2
M2		114.7	129.2
L2		5.6	151.8
*T2	S2	2.2	155.2
S2		37.7	162.9
*K2	S2	10.9	160.0
2SM2		0.5	89.4
MO3		0.2	122.5
M3		1.0	11.6
MK3		0.3	5.3
MN4		1.3	241.2
M4		2.8	263.6
SN4		0.4	93.9
MS4		1.9	334.9
2MN6		0.2	253.6
M6		0.2	270.9
MSN6		0.1	203.6
2MS6		0.1	285.8
2SM6		0.1	248.6

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