I.O.S.

OFFSHORE BOTTOM PRESSURE RECORDS FROM THE CELTIC SEA AND SOUTH-WEST APPROACHES TO THE U.K., 1978.

G A ALCOCK, D C C MACDONALD
and J M VASSIE

DATA REPORT NO 22

1980

NATURAL ENVIRONMENT RESEARCH COUNCIL

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ABSTRACT

This report describes the bottom pressure data gathered by IOS Bidston in an exercise in 1978 in the Celtic Sea and South-West Approaches to the U.K. A brief description of the instruments, mooring configurations and data processing is followed by a section presenting the pressure data in graphical form and in tables of harmonic constants.

1. INTRODUCTION

An experiment was conducted by I.O.S. Bidston in the Celtic Sea and South West Approaches to the U.K. during the period March to May 1978. Currents and sea bed pressures were measured at each of 8 stations, A to H, in the Celtic Sea and one station, I, in 4000m of water at the shelf edge (Figure 1). Aanderaa thermistor chains were deployed at four of the stations, C, F, G and H. 67 profiles of sea water conductivity and temperature with depth were taken during the cruises and sea surface temperatures and conductivity were continuously monitored. This report displays the bottom pressure data; current meter and thermistor chain data are contained in HOWARTH and EVANS (1980) and a summary of the scientific objectives of the experiment is given in the cruise report (PUGH and HARRISON, 1978).

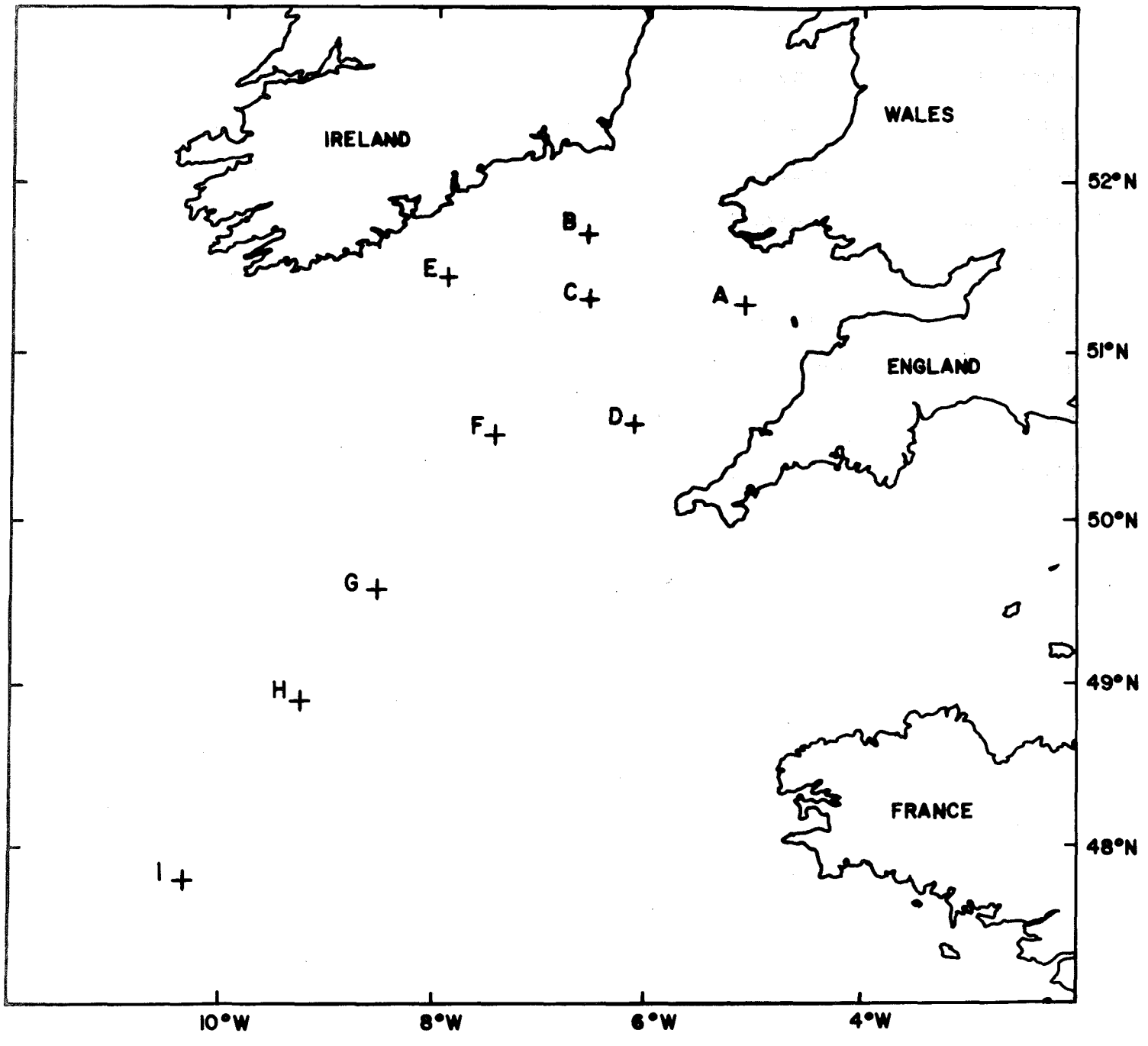

FIGURE 1 : STATION POSITIONS, MARCH - MAY 1978

2. INSTRUMENTATION

(i) Type II Pressure recorder

This type of Off shore bottom pressure recorder has previously been deployed by I.O.S. (Bidston) at 14 sites in the shelf seas around the United Kingdom (ALCOCK and VASSIE 1975 and 1977, ALCOCK and HOWARTH 1978.) These references contain details of the data logger used in this type of recorder, together with details of the vibrating wire sensors VIB 1/4 and VIB 1/5, strain gauge sensors SG 2/6 and SG 2/7, quartz crystal sensors DS 6/1 and DS 6/2, and platinum resistance thermometer temperature sensors. Strain gauge sensors SG 2/11 and SG 2/12 were developed using a Bell and Howell type 4-306 pressure transducer and type 4-800 thin film pressure transducer respectively (mode of operation for both types are described in ALCOCK and HOWARTH 1978).

All the calibrations of the pressure and temperature sensor packs were carried out by members of the Research Technology Group using equipment and facilities at Bidston. For Station D, the sensors VIB 1/5, SG2/6, DS6/2, SG2/11 and SG2/12 had pressure sensitivities of 0.037 H_z mb^{-1}, 0.083 H_z mb^{-1}, 0.155 H_z mb^{-1}, 0.045 H_z mb^{-1}, and 0.058 H_z mb^{-1} respectively; and temperature coefficients of 0.0 mb $^{o}C^{-1}$, 0.0 mb $^{o}C^{-1}$, -52.0 mb $^{o}C^{-1}$, and 5.7 mb $^{o}C^{-1}$ respectively. For station E, the sensors VIB1/4, SG2/7 and DS6/1 had pressure sensitivities of 0.038 H_z mb^{-1}, 0.072 H_z mb^{-1}, and 0.163 H_z mb^{-1} respectively; and temperature coefficients

of 3.9 mb $^{o}C^{-1}$, -10.1 mb $^{o}C^{-1}$, and 0.8 mb $^{o}C^{-1}$ respectively.

The data logger and its batteries were housed in a 0.56m diameter aluminium sphere. Sensor batteries for the Digiquartz pressure sensor were also housed within this sphere.

Water tight connectors mounted on the parts of the sphere enable sensors external to the sphere to be powered and their output signals fed into the sphere. The sphere and the sensor packs were mounted in an aluminium sub-frame which in turn was protected by a heavy steel outer frame.

(ii) AANDERAA RECORDER TYPE 2A

The recorder deployed at Station C was an Aanderaa type 2A, serial number 64, which was a Digiquartz type 2-300 A quartz crystal pressure transducer (ALCOCK and HOWARTH 1978). with a pressure sensitivity of 0.175 H_z mb^{-1}. The sensor pack 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. Integration period for this sensor was 105 seconds.

(iii) BOTTOM MOUNTED CURRENT METER/PRESSURE RECORDER

The bottom mounted recorder deployed at stations A and B utilised a Digiquartz pressure sensor interfaced into a modified Aanderaa current meter (see ALCOCK and HOWARTH 1978 for further technical details). At station B, CM/PR No. 1 was deployed and contained Digiquartz pressure transducer SN 280 with a pressure sensitivity of 0.153 H_z mb^{-1}.

At station A, CM/PR No. 2 was deployed but not recovered.

The recorder deployed at F consisted of a modified current meter and Teleost pressure recorder, PR 282, consisting of a Bell and Howell type 4-800 thin film strain gauge (rated to 300 bar) and a platinum resistance thermometer interfaced to an Aanderaa logger. The pressure and temperature sensors and electronics were all mounted in the same aluminium heat sink. Pressure sensor PR 282 had a pressure sensitivity of 0.009 H_z mb^{-1} and a temperature coefficient of 43.2 mb $^{\circ}C^{-1}$.

The pressure sensor pack and current meter pack were mounted approximately 1m and 0.7m above the rig base respectively, the rig had an overall height of 1.5m and its base was formed by a tripod with legs of length 0.7m.

(iv) POP-UP CURRENT METER AND PRESSURE RECORDER

A pop-up rig consisting of two Aanderaa current meters and two Teleost pressure recorders was deployed at station F. The pressure recorders were mounted on the ballast cruciform frame of the rig and each consisted of an Aanderaa logger accepting inputs from a pressure sensor containing a Bell and Howell type 4-306 strain gauge pressure transducer and a platinum resistance thermometer. The pressure and temperature transducers and electronics were all mounted in the same aluminium heat sink. Pressure sensitivities for PR 280 and PR 281 were 0.091 H_z mb^{-1} and 0.043 H_z mb^{-1} respectively; with temperature coefficients of -3.0 mb $^{o}C^{-1}$ and -5.7 mb $^{o}C^{-1}$ respectively.

(v) POP-UP PRESSURE RECORDER

Type I pop-up pressure recorders were deployed at stations G and H. This recorder has been developed for use on the continental shelf at depths up to 200 metres (COLLAR and SPENCER 1970); some previous deployments of the type I recorder are described in COLLAR and CARTWRIGHT (1972). At station G, recorder No. 9 was used with strain gauge pressure sensors No. 1/19 and 1/21 and platinum resistance temperature sensor No. 1/T9. Pressure sensitivities were 0.0029 H_z mb^{-1} and 0.0031 H_z mb^{-1} respectively; and temperature coefficients of -48.5 mb $^oC^{-1}$ and 14.4 mb $^oC^{-1}$ respectively. At station H, recorder No. 14 was used with strain gauge pressure sensors No. 1/13 and 1/22 and platinum resistance temperature sensor No. 1/T8. Pressure sensitivities were 0.0029 H_z mb^{-1} and 0.0029 H_z mb^{-1} respectively; and temperature coefficients were -28.7 mb $^oC^{-1}$ and 60.3 mb $^oC^{-1}$ respectively.

A TYPE III pop-up pressure recorder was deployed at station I. This recorder has been developed for use in the deep ocean (SPENCER and GWILLIAM 1974); results from a series of deployments in the N.E. Atlantic are described in CARTWRIGHT, EDDEN, SPENCER and VASSIE (1980). Recorder No. 17 was deployed at I with strain gauge pressure sensors No. D1/78, D2/78 and D3/78 and Digiquartz pressure sensor No. 2262; these had pressure sensitivities of 41.9 cm H_z^{-1}, 36.0 cm H_z^{-1}, 40.6 cm H_z^{-1}, and 108.2 cm H_z^{-1} respectively and temperature coefficients of 30.0 cm $^oC^{-1}$, 35.7 cm $^oC^{-1}$,

-35.0 cm $^{o}C^{-1}$, and 11.35 cm $^{o}C^{-1}$ respectively. A platinum resistance temperature sensor (No. 2/T10) was also deployed.

3. MOORING CONFIGURATIONS

Schematic diagrams of the various mooring arrangements are shown in Figures 5 (Stations A, B and F), 6 (D, E), 7 (C) and 9 (F) of PUGH and HARRISON (1978). Stations A to E and the bottom mounted current meter rig at F were deployed using standard U-shaped shallow water rigs designed to give surface warning of the rig, to provide a back-up recovery method by dragging for the ground-line and, for current meter rigs, to reduce the effect of surface waves on the meters.

Stations F to I were pop-up rigs in which the pressure recorder (and current meters for F) was attached to a ballast frame on the sea bed and released by firing a pyrotechnic release by acoustic command, the pressure gauges rising to the surface under their own positive buoyancy, the current meters rising under the positive buoyance of a sub-surface buoy.

4. DATA PROCESSING

The magnetic tape from each of the MK II and MK III recorders was copied onto a 9 track magnetic tape and the channel counts read into disk storage on the IBM 370/165 computer at Daresbury Nuclear Physics Laboratory. The magnetic tapes from the other recorders were translated into paper tapes and the channel counts read into disk storage on the IBM 370/165 computer. Due to logger malfunction on the MK I recorder deployed at station H, the magnetic tape had to be repeatedly read and listed out and the data punched onto cards

and then read into disk.

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. The MK III recorder sampled every 1/16 h and this set of pressure data was reduced to ¼ h values using a low pass filter, FLP15. (Fig. 2).

For the recorders deployed at A to F, 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 (Fig. 2), of half length 18 and a cut-off frequency (half-power point) of 0.35 cph (126° per hour) - thus the amplitude response of the sixth channel 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 is taken as the mid-time of the integration period. Root mean square errors due to the interpolation method are of the order of 0.02 mb .

5. ANALYSIS OF TIDAL DATA

The series of hourly or ¼ hourly values of the sea bed pressure

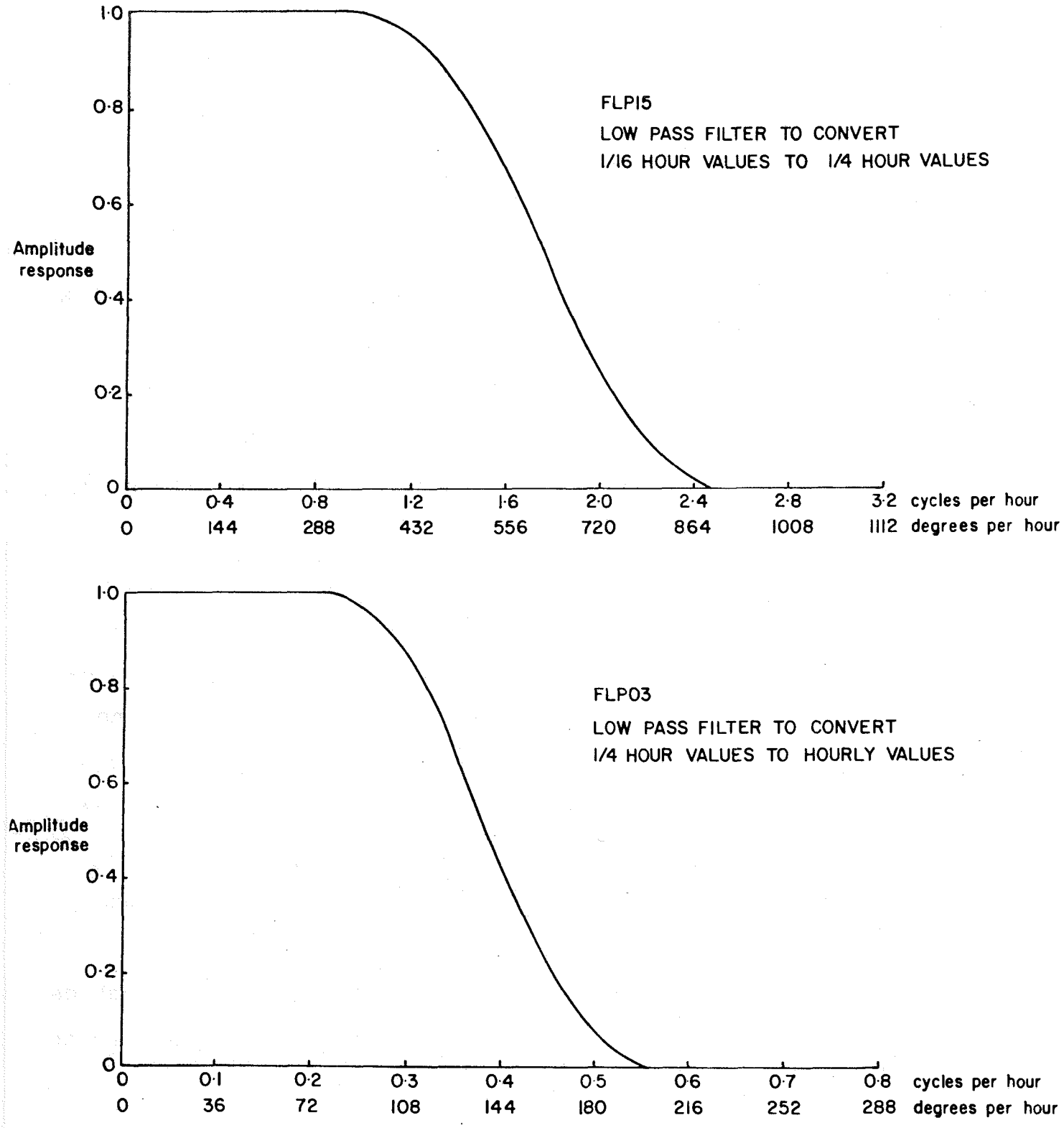

FIG. 2 FILTER CHARACTERISTICS

contain components of sensor drift and external surges as well as the desired tidal signal. For the recorders deployed at A to F, the hourly data were filtered with a high power high pass filter, FHP53, (Fig. 3) which removed jointly sensor drift, long period tides and surge activity, and isolated the tidal signal. For the deployments at stations G to I, the ¼ hourly data were filtered using the Doodson Xo filter (Fig. 3) and the resulting drift curve fitted with a low order polynomial which was then removed from the original record to leave the tidal record.

Tidal analysis of a 29 day period of each hourly series was carried out using the T.I.R.A. (Tidal Institute Recursive Analysis) 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, ρ_1, ψ_1, ϕ_1, 2N2, $\vartheta 2$, T2 and K2 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. Mary's,Scilly Isles. When there were analyses from more then 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:

$H = P/\rho g,$

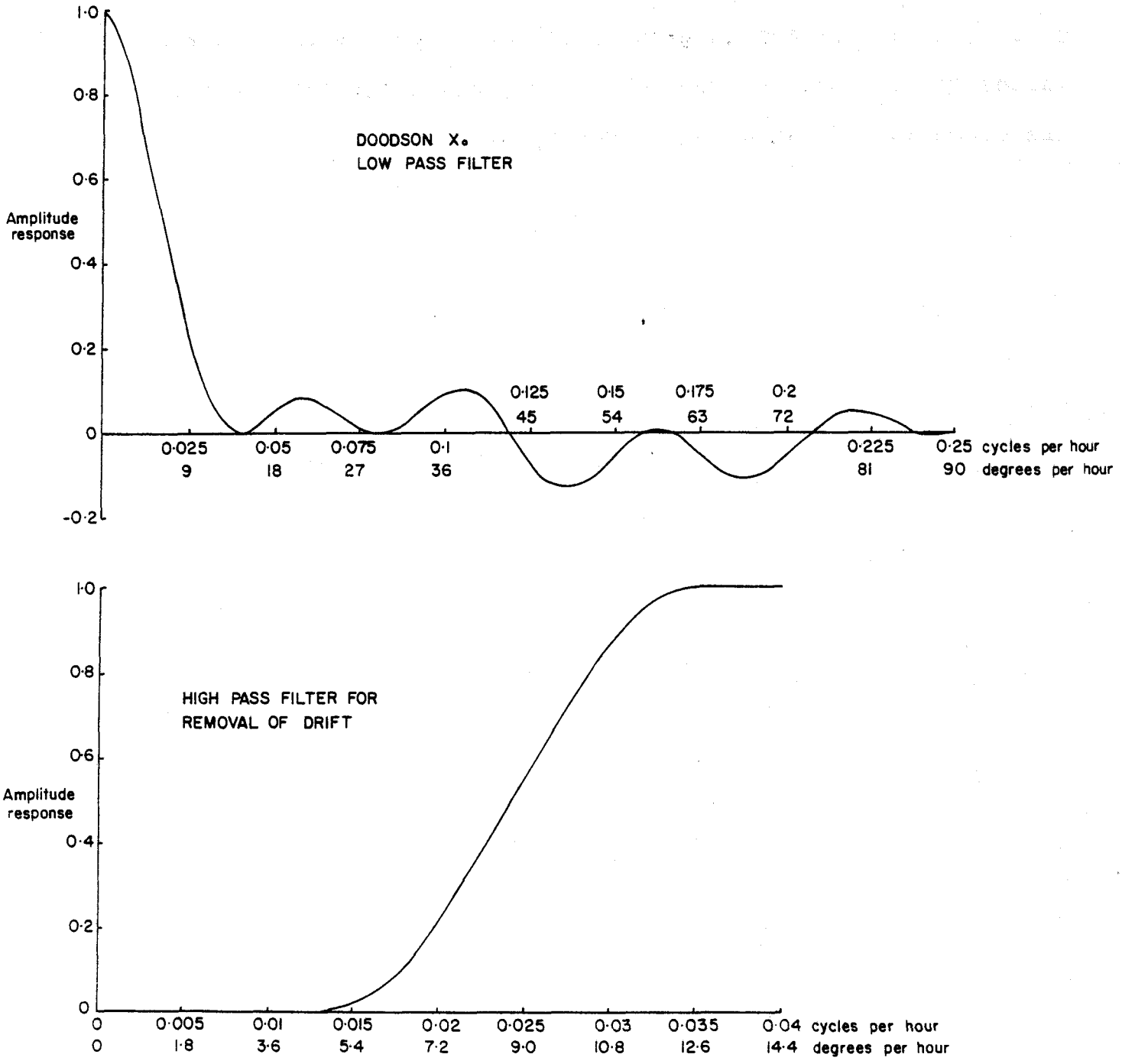

FIG. 3 FILTER CHARACTERISTICS

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.

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7. 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 was on sea bed and/or launch start and finish times.
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.

Computer plots

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

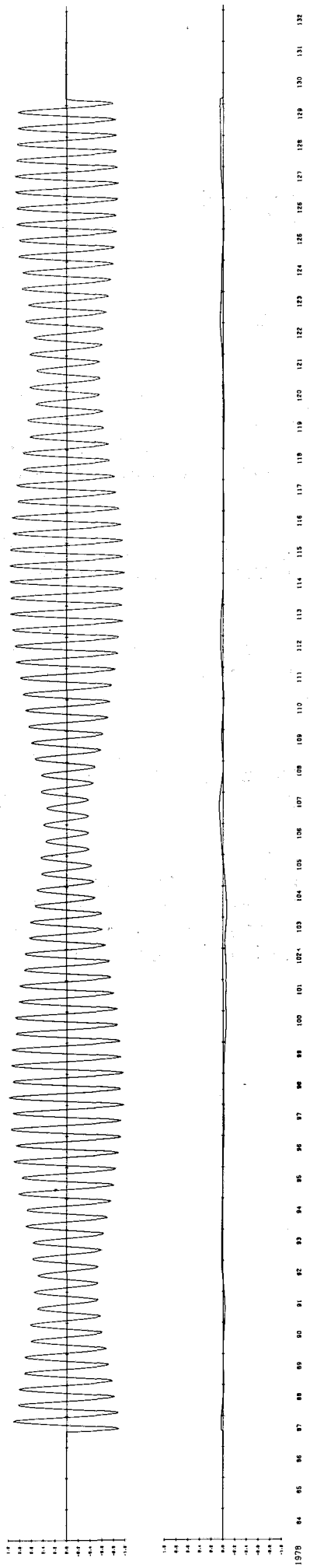
(2) Plot of tidal and non tidal components of the hourly record of bottom pressure data.

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, 1978. Lat 51° 17'N, Long 05° 17'W. $g = 9.812 \ ms^{-2}$
Water depth	74m.
Recorder details	Aanderaa CM/PR 2, with Digiquartz pressure sensor (S/N 275), current meter No. 1507 and Aanderaa logger 1507. 900s sampling and integration periods.
Time of launch	CM/PR in water at 1540 GMT day 083 (24 March). On sea bed at 1542 GMT.
Time of recovery	See Comments.
CTD casts	Cast No. 1 at 1930 GMT day 083. Cast No. 21 at 2057 GMT day 132. Cast No. 62 at 1620 GMT day 140. Density, ρ = 1027.0 kg m^{-3} .
Comments	A separate current meter rig with current meter No. 2573 35m above seabed was deployed at this station and subsequently recovered. Only the surface buoy of the CM/PR rig was recovered on day 132 (12 May), and so no pressure data were obtained.

Recorder position	Station B, Celtic Sea, 1978. Lat 51° 45.2'N, Long 06° 35.7'W. $g = 9.812 m\ s^{-2}$
Water depth	70m.
Recorder details	Aanderaa CM/PR 1, with Digiquartz pressure sensor (Serial No. 280), current meter No. 1747 and Aanderaa Logger 1747. 900s sampling and integration periods.
Time of launch	CM/PR in water at 0759 GMT day 084 (25 March). On sea bed at 0800 GMT.
Time of recovery	Recovery started at 0826 GMT day 133 (13 May). On deck at 0900 GMT.
CTD casts	Cast No. 5 at 0914 GMT day 084. Cast No. 22 at 1110 GMT day 133. Density, ρ = 1027.0 kg m^{-3}.
Comments	A separate current meter rig with current meters No. 1139 and 1508 at 20m and 40m above the seabed respectively was deployed and recovered at this station.



FILTERED VALUES
SCALE Y=0.21425 E03
MEAN VALUE=0.81353 E04

RESIDUALS
SCALE Y=0.21425 E03
MEAN VALUE=0.81361 E04

CELTIC SEA "B" DIG280 TOTAL PRESSURE

Timing	Scan No. 2 at 1715, 00 GMT day 073 (14 March). On recovery, instrument had stopped due to a flat battery so no timings at end of the record were available, and so no time corrections were made.
Raw data	Start 0822,30 GMT day 084. End 0837,30 GMT day 133.
Temperature data	See comments.
Drift-free data	Start 1300 GMT day 087. End 0400 GMT day 130. FHP 53 filter used.
Tidal analysis	TIRA, 0000 GMT day 098 to 2300 GMT day 126, 29 days, using 27 major and 8 related constituents from analysis of St. Mary's 1968/1973.
Comments	As the pressure sensor has a negligible temperature coefficient, no temperature record was used to correct the pressure frequency record.

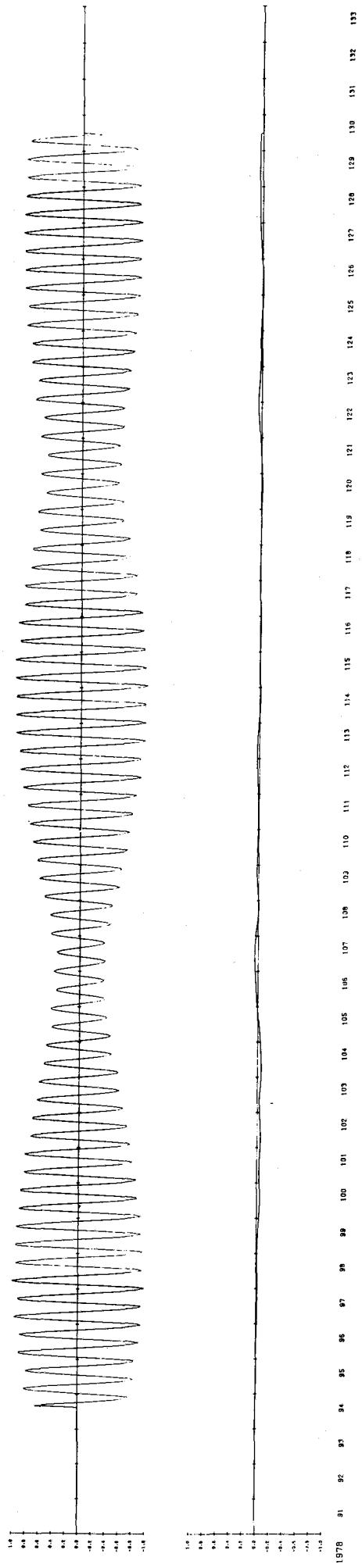
TABLE 1

Station B, Celtic Sea, Lat 51° 45.2'N Long 06° 35.7'W.
Aanderaa CM/PR rig, Digiquartz pressure sensor SN 280.
Drift free bottom pressure (millibars), FHP53 filter.
0000 GMT day 098 to 2300 GMT day 126, 1978, 29 days.
27 constituents + 8 related (*) using analysis of St. Mary's 1968/1973.

Constituent	related to	H (mb)	G (o)
Q1		2.2	332.7
O1		5.5	21.1
M1		1.1	157.9
π1	K1	0.1	50.5
* P1	K1	1.3	124.7
K1		4.1	127.0
* ψ1	K1	0.1	312.9
* φ1	K1	0.1	122.4
J1		0.7	186.9
001		0.9	132.1
*2N2	μ2	22.8	103.9
μ2		22.4	156.6
N2		26.7	132.0
* ν2	M2	5.6	129.1
M2		144.6	154.1
L2		4.5	133.1
* T2	S2	2.9	193.9
S2		49.3	201.6
* K2	S2	14.2	198.7
2SM2		2.1	42.2
MO3		0.2	278.2
M3		0.6	81.3
MK3		0.1	108.9
MN4		0.7	185.6
M4		2.5	209.6
SN4		0.3	213.0
MS4		1.0	259.3
2MN6		1.0	158.2
M6		1.9	168.4
MSN6		0.6	178.9
2MS6		2.2	227.7
2SM6		0.6	317.5

Recorder position	Station C, Celtic Sea, 1978. Lat 51° 20'N Long 06° 30'W. $g = 9.812 m S^{-2}$.
Water depth	95m.
Recorder details	Aanderaa recorder type 2A/64. 900s sampling and sampling and 104s integrating periods.
Time of launch	Recorder in water at 1410 GMT day 084 (25 March), and on sea bed at 1413 GMT.
Time of recovery	Recorder on deck at 1538 GMT day 133 (13 May).
CTD casts	Cast No. 24 at 1655 GMT day 133. Cast No. 58 at 2022 GMT day 139. Density, ρ = 1026.9 kg m^{-3} .
Comments	Thermistor chain No. 212 with logger No.178 was incorporated on this rig. A separate current meter rig with meters 1506, 3277, and 567 at 15m, 40m and 60m above the sea bed respectively was deployed and recovered at this station.

Timing	Scan No. 1 at 1045,00 GMT day 076 (17 March) Scan No. 7306 at 1259,57 GMT day 152 (01 June). Clock fast, gained 3s in 76 days and 2.25 hours.
Raw data	Start 1114,08 GMT day 091 (01 April). End 1444,06 GMT day 133. See Comments.
Temperature data	No temperature sensor.
Drift free data	Start 1600 GMT day 094. End 1000 GMT day 130. FHP 53 filter used.
Tidal analysis	TIRA, 0000 GMT day 098 to 2300 GMT day 126, 29 days of filtered total pressure data. 27 major and 8 related constituents from analysis of St. Mary's 1968/73.
Comments	Discontinuity of ~ 235 mb in record at 1000 GMT day 091. Therefore, record was truncated at beginning, and first usable scan taken at 1114,07 GMT day 091.



FILTERED VALUES
SCALE Y=0.24483 E01
MEAN VALUE=0.10473 E05

RESIDUALS
SCALE Y=0.24483 E03
MEAN VALUE=0.10473 E05

CELTIC SEA "C" 2A/64 TOTAL PRESSURE

TABLE 2

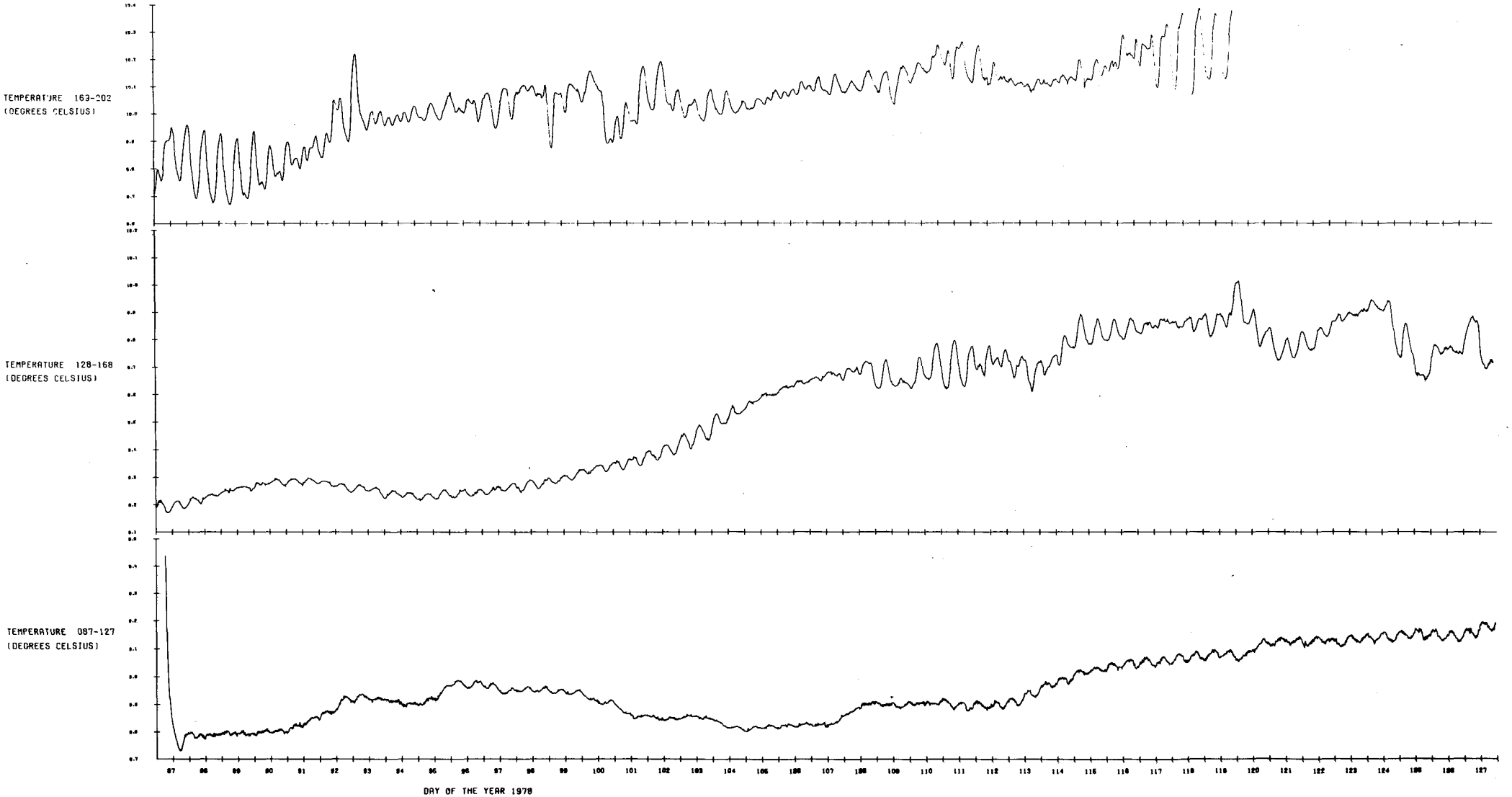
Station C, Celtic Sea, Lat 51° 20'N Long 06° 30'W.
Aanderaa Recorder 2A/64.
Drift free bottom pressure (millibars) FHP 53 filter.
0000 GMT day 098 to 2300 GMT day 126 1978, 29 days.
27 constituents + 8 related (*) using analysis of St. Mary's 1968/1973.

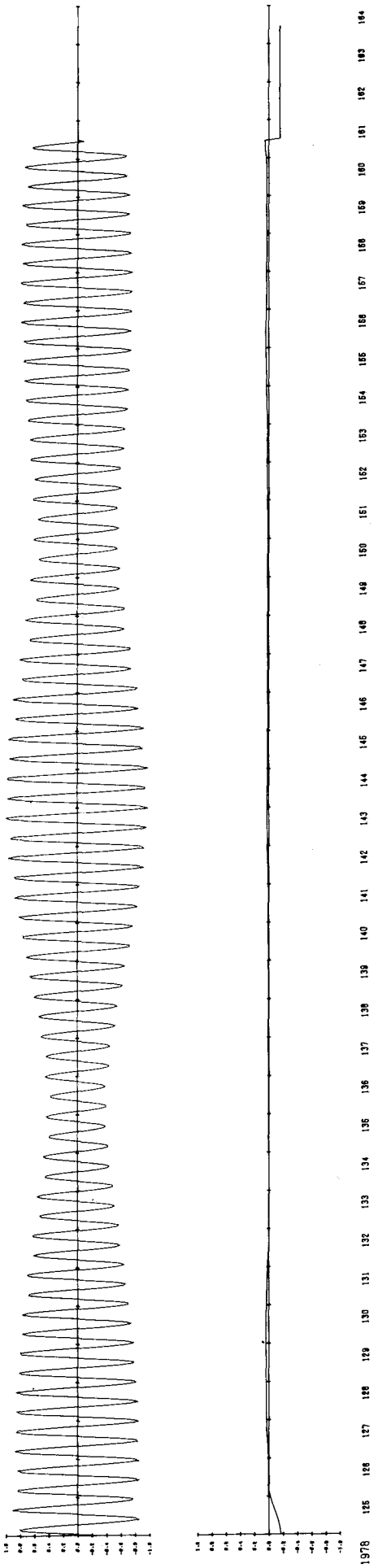
	related to	H(mb)	G(°)
Q1		2.1	318.1
O1		5.4	7.8
M1		1.2	145.0
π1	K1	0.1	36.0
*P1	K1	1.4	110.2
K1		4.6	112.5
*ψ1	K1	0.1	298.4
*φ1	K1	0.1	107.9
J1		0.6	181.7
001		0.8	126.1
*2N2	μ2	18.7	107.7
μ2		18.4	160.4
N2		31.5	129.7
*ν2	M2	6.4	126.5
M2		165.7	151.5
L2		4.7	136.8
*T2	S2	3.4	189.2
S2		56.7	196.9
*K2	S2	16.3	194.0
2SM2		2.1	39.0
MO3		0.3	247.5
M3		1.0	75.0
MK3		0.1	78.3
MN4		1.0	199.0
M4		3.5	223.4
SN4		0.5	217.5
MS4		1.5	268.8
2MN6		0.7	145.8
M6		1.5	157.7
MSN6		0.4	162.0
2MS6		1.5	214.5
2SM6		0.3	314.2

Recorder position	Station D, Celtic Sea, 1978. Lat 50° 35'N Long 06° 10'W. g = 9.811 ms^{-2}
Water depth	91m.
Recorder details	Mk II, logger No. 002, sensors VIB 1/5, SG 2/6, DIG DS 6/2, SG 2/11, SG 2/12. 900s sampling and 899.994s integration periods.
Time of launch	Recorder in water at 0628 GMT day 087 (28 March). On sea bed at 0631 GMT. See Comments.
Time of recovery	Pinger was located at 2342 GMT day 140 (20 May) but no instruments were recovered during the cruise. The recorder was recovered at 0225 GMT day 256 (13 Septemver) by Naval divers from the M.V. Seaforth Clansman on charter to the Royal Navy.
CTD casts	Cast No. 12 at 0720 GMT day 087. Cast No. 66 at 2137 GMT day 141. Density, ρ = 1027.0 Kg m^{-3}.
Comments	Recorder was known to have dragged along the bottom whilst the Selco buoy was laid. This rig also incorporated current meters No. 2969, 568, and 1750 at 15m, 40m, and 65m above sea bed respectively. Current meters No. 568 and 1750 were subsequently recovered by a fisherman during April 1978.

Timing	Scan No. 1132 at 0545,02 GMT day 087 (28 March). No timing scans on recovery. Previous deployments of logger 002 in 1976 and 1977 gave identical time gains of 0.01 seconds per hour; therefore it was assumed that clock was fast with this time gain.
Raw data	Start 0637,32 GMT day 087. End 1537,14 GMT day 161 for SG 2/6. 1522,13 GMT day 164 for VIB 1/5. 1837,10 GMT day 180 for SG 2/12. 1437,08 GMT day 186 for SG 2/11. 0237,04 GMT day 202 for DS 6/2. See Comments.
Temperature data	Complete temperature records for all sensors. See Comments.
Drift free data	Start 1100 GMT day 090 (31 March). End 1100 GMT day 158 for SG 2/6. 1100 GMT day 161 for VIB 1/5. 1400 GMT day 177 for SG 2/12. 1000 GMT day 183 for SG 2/11. 2200 GMT day 198 for DS 6/2. FHP53 filter used.
Tidal analysis	TIRA, 0000 GMT day 129 to 2300 day 157, 29 days of filtered total pressure data. 27 major and 8 related constituents using analysis of St. Mary's 1968/73.
Comments	Discontinuities in records at 2230 GMT day 109 and 1445 GMT day 125. Tidal analysis taken on data after these times. Only the longest temperature record, from DS 6/2 is presented in graphical form. Only the pressure records from day 125 onwards are presented, and that from DS 6/2 is plotted only up to day 186.

CELTIC SEA "D" LAT 50 35N LONG 06 10W
OSTG MKII 02 MARCH/JUNE 1978

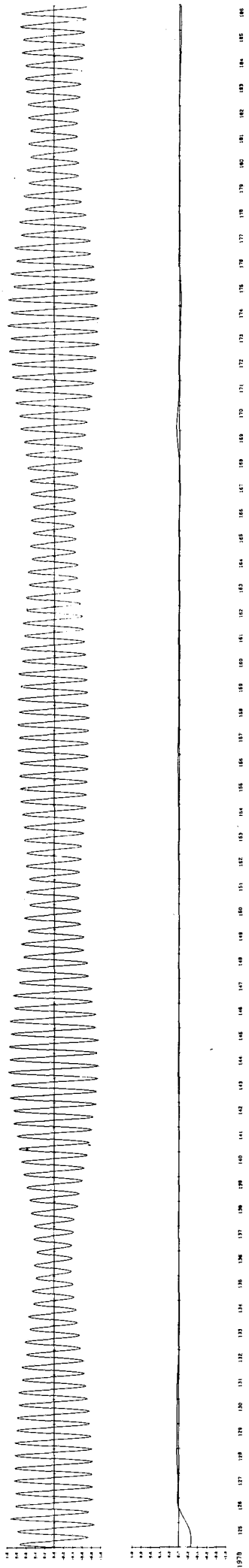




FILTERED VALUES
SCALE Y=0.29138 E03
MEAN VALUE=0.10218 E05

RESIDUALS
SCALE Y=0.29138 E03
MEAN VALUE=0.10284 E05

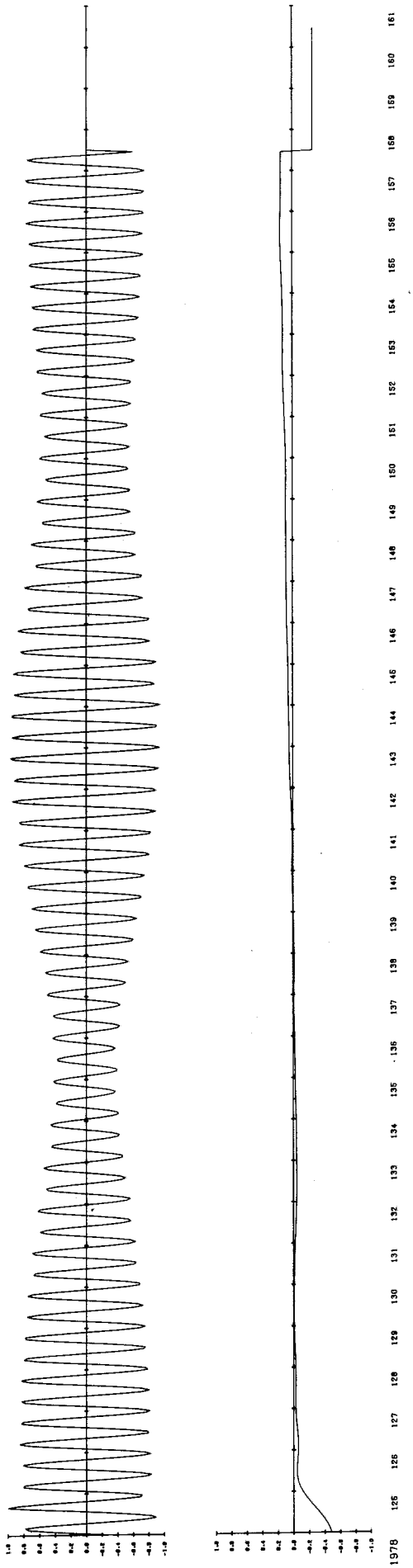
CELTIC SEA "D" VIB1/5 TOTAL PRESSURE



FILTERED VALUES
SCALE Y=0.29854 E03
MEAN VALUE=0.10167 E05

RESIDUALS
SCALE Y=0.29854 E03
MEAN VALUE=0.10188 E05

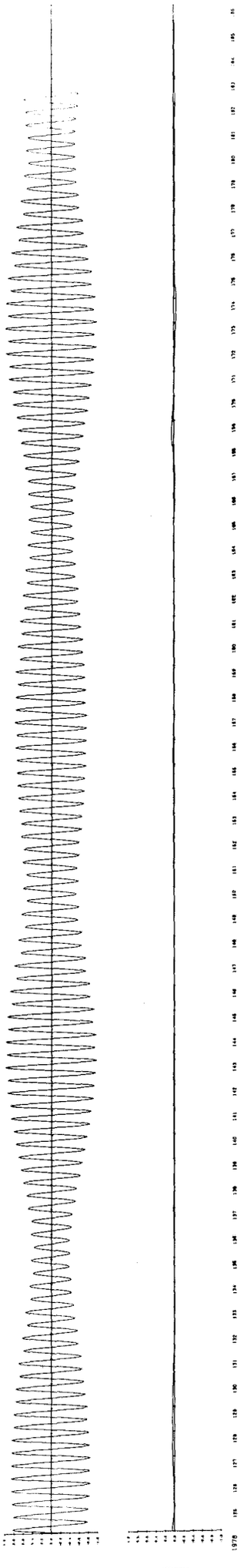
DS 6/2



FILTERED VALUES
SCALE Y=0.29949 E03
MEAN VALUE=0.99488 E04

RESIDUALS
SCALE Y=0.29949 E03
MEAN VALUE=0.10027 E05

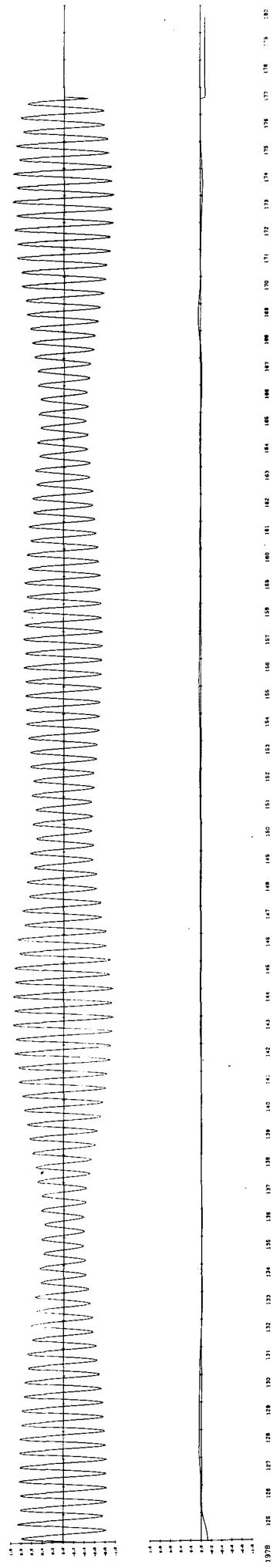
CELTIC SEA "D" SG2/6 TOTAL PRESSURE



FILTERED VALUES
SCALE 1=0.20000 E03
MEAN VALUE=0.10748 E04

RESIDUALS
SCALE 1=0.10000 E01
MEAN VALUE=0.10851 E04

CELTIC SEA "D" 802/11 TOTAL PRESSURE



FILTERED VALUES
SCALE Y=0.29834 E03
MEAN VALUE=0.10188 E05

RESIDUALS
SCALE Y=0.29834 E03
MEAN VALUE=0.10217 E06

CELTIC SEA "D" SG2/12 TOTAL PRESSURE

TABLE 3

Station D, Celtic Sea, 1978. Lat 50° 35'N, Long 06° 10'W
0000 GMT Day 129 to 2300 GMT 157 1978 29 days.
*Related constituent using analysis of St. Mary's 1968/1973.
Drift free bottom pressure (millibars). FHP53 filter.

Constituent	related to	VIB 1/5 H (mb)	VIB 1/5 G (°)	DIG 6/2 H (Mb)	DIG 6/2 G (°)	SG 2/6 H (mb)	SG 2/6 G (°)	SG 2/11 H (mb)	SG 2/11 G (°)	SG 2/12 H (mb)	SG 2/12 G (°)
Q1		1.7	297.5	1.8	295.6	1.6	297.0	1.6	302.1	1.7	295.2
O1		5.9	353.8	5.9	352.7	5.8	354.4	5.8	333.9	5.7	353.6
M1		0.7	160.4	0.8	152.8	0.7	156.1	0.6	159.9	0.6	159.9
* π1	K1	0.1	29.4	0.1	26.8	0.1	29.2	0.1	30.2	0.1	29.3
* P1	K1	1.6	103.6	1.6	101.0	1.6	103.4	1.6	104.4	1.7	103.5
K1		5.2	105.9	5.0	103.3	5.2	105.7	5.2	106.7	5.3	105.8
* ψ1	K1	0.1	291.8	0.1	289.2	0.1	291.6	0.1	292.6	0.1	291.7
* ϕ1	K1	0.1	101.3	0.1	98.7	0.1	101.1	0.1	102.1	0.1	101.2
J1		0.3	288.4	0.6	296.4	0.3	299.1	0.5	292.1	0.3	288.8
OO1		0.5	215.5	0.6	260.3	0.5	212.8	0.4	244.8	0.5	218.9
* 2N2	μ_2	5.2	111.2	5.6	116.4	5.2	112.1	4.2	104.1	5.2	113.5
μ_2		5.1	163.9	5.5	169.1	5.1	164.8	4.1	156.8	5.1	166.2
N2		37.8	123.1	37.8	122.8	37.8	123.1	39.3	125.8	37.8	122.9
* ν_2	M2	7.3	117.2	7.3	117.1	7.3	117.2	7.3	118.2	7.3	117.1
M2		190.7	142.2	190.3	142.1	190.5	142.2	189.8	143.2	190.5	142.1
L2		6.9	129.7	6.9	131.2	6.9	129.9	8.1	133.2	6.8	129.8
* T2	S2	3.9	178.6	3.9	178.9	3.9	178.6	4.0	179.8	3.9	178.7
S2		65.9	186.3	65.9	186.6	65.8	186.3	66.8	187.5	65.8	186.4
* K2	S2	19.0	183.4	19.0	183.7	19.0	183.4	19.3	184.6	19.0	183.5
2SM2		1.5	39.2	1.2	49.2	1.5	39.7	0.9	40.3	1.4	38.5
MO3		0.7	207.2	0.7	197.7	0.7	207.5	0.7	215.6	0.7	209.5
M3		1.4	62.5	1.4	58.0	1.4	61.7	1.4	62.9	1.4	62.6
MK3		0.1	341.6	0.1	331.4	0.1	341.6	0.2	338.8	0.2	345.9

TABLE 3 CONT'D.

MN4	2.0	198.7	1.9	206.4	2.0	199.7	2.1	202.6	2.0	198.8
M4	5.5	219.5	5.5	220.3	5.5	220.6	5.4	221.4	5.5	219.7
SN4	0.7	157.9	0.7	171.5	0.7	159.9	0.8	156.1	0.7	161.0
MS4	2.0	258.5	2.1	263.0	2.1	259.9	2.1	260.6	2.0	258.2
2MN6	0.4	77.0	0.4	71.1	0.4	76.3	0.5	80.8	0.4	76.2
M6	0.7	87.6	0.7	84.2	0.7	87.4	0.8	91.5	0.7	85.9
MSN6	0.2	48.6	0.2	54.5	0.2	47.5	0.2	43.8	0.2	46.5
2MS6	0.5	116.3	0.5	120.9	0.5	116.9	0.5	119.0	0.5	119.4
2SM6	0.1	131.3	0.1	109.8	0.1	130.1	0.2	135.3	0.1	130.7

TABLE 4

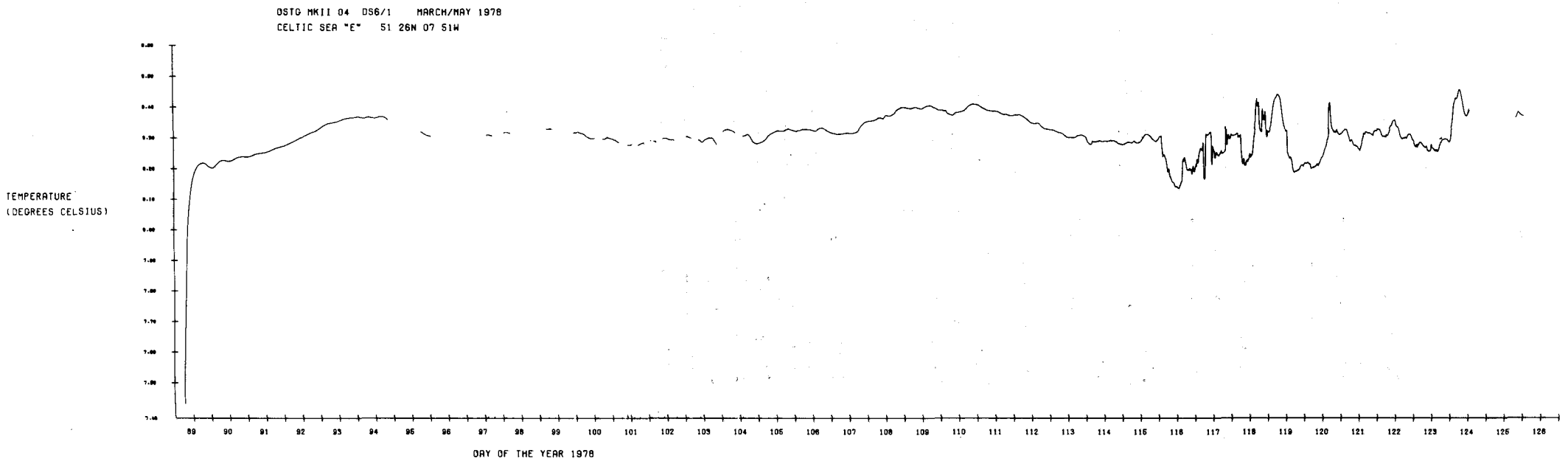
Station D, Celtic Sea, 1978. Lat 50° 35'N Long 06° 10'W.
Drift free bottom pressure (millibars) FHP53 filter.
0000 GMT day 129 to 2300 GMT 157 1978, 29 days.
*Related constituent using analysis of St. Mary's 1968/1973.

Vector mean of 5 analyses.

Constituent	Related to	H (MB)	G (°)
Q1		1.7	297.5
O1		5.9	353.7
M1		0.7	157.6
*π1	K1	0.1	29.0
*P1	K1	1.7	103.2
K1		5.2	105.5
*ψ1	K1	0.1	291.4
*φ1	K1	0.1	100.9
J1		0.4	293.4
001		0.5	230.9
*2N2	μ2	5.1	111.9
ν2		5.0	164.6
N2		38.1	123.6
*λ2	M2	7.3	117.4
M2		190.4	142.4
L2		7.2	130.9
* T2	S2	4.0	179.0
S2		66.1	186.7
* K2	S2	19.1	183.8
2SM2		1.3	41.2
MO3		0.7	207.5
M3		1.4	61.6
MK3		0.2	340.6
MN4		2.0	201.3
M4		5.5	220.4
SN4		0.8	161.2
MS4		2.1	260.1
2MN6		0.5	76.6
M6		0.8	87.5
MSN6		0.2	48.2
2MS6		0.5	118.5
2SM6		0.2	128.8

Recorder position	Station E, Celtic Sea, 1978. Lat 51° 27'N, Long 07° 51'W. g = 9.812 ms^{-2}.
Water depth	84m.
Recorder details	Mk II, logger No. 004, sensors VIB 1/4, SG 2/7, DIG DS 6/1. 900s sampling and 899.994s integration periods.
Time of launch	Recorder in water at 0617 GMT day 089 (30 March). On sea bed at 0619 GMT.
Time of recovery	Recorder on deck at 0643 GMT day 134 (14 May).
CTD casts	Cast No. 13 at 0640 GMT day 089. Cast No. 28 at 0655 GMT day 134. Density, ρ = 1027.1 kg m^{-3}.
Comments	This rig incorporated current meters No. 2971, 1002, and 1867 at 15m, 40m, and 60m above sea bed respectively.

Timing	Scan No. 1344 at 0544,04 GMT day 089 (30 March). Scan No. 6185 at 1559,14 GMT day 139 (19 May). Clock slow, lost 10s in 50 days and 10.25 hours.
Raw data	Start 0636,34 GMT day 089. End 0052,37 GMT day 126. See Comments.
Temperature data	Complete record for all sensors except VIB 1/4 which truncated at 2145 GMT day 094. See Comments.
Drift free data	See Comments.
Tidal analysis	TIRA, 0000 GMT day 105 to 2300 GMT day 119, 15 days of unfiltered total pressure data. 16 major and 15 related constituents using analysis of St. Mary's, 1968/73.
Comments	Many blocks of data on the tape were in error. Hourly unfiltered record from 1100 GMT day 089 to 1000 GMT day 104 contains many gaps. Best 15 days of unfiltered data analysed. Only the pressure records starting from day 104 are presented. Temperature records contain gaps, only that from DS 6/1 is presented.

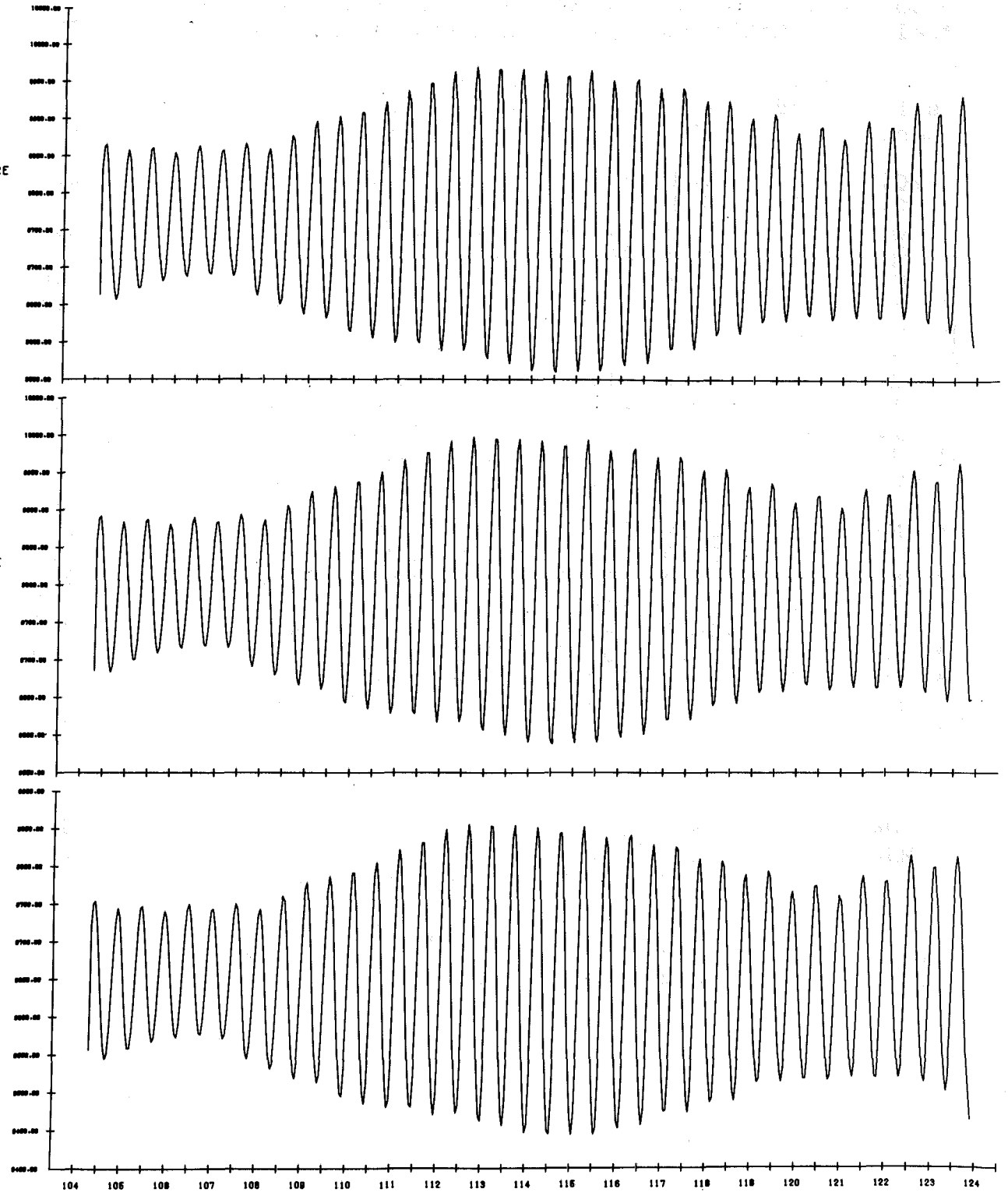

OSTG MKII 04 DS6/1 MARCH/MAY 1978
CELTIC SEA "E" 51 26N 07 51W
TEMPERATURE
(DEGREES CELSIUS)
89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126
DAY OF THE YEAR 1978

OSTG MKII 04 MARCH/MAY 1978
CELTIC SEA "E" 51 27N 07 51W

DS6/1 TOT. PRESSURE (MILLIBARS)

SG2/7 TOT. PRESSURE (MILLIBARS)

I81/4 TOT. PRESSURE MILLIBARS)



DAY OF THE YEAR 1978

TABLE 5

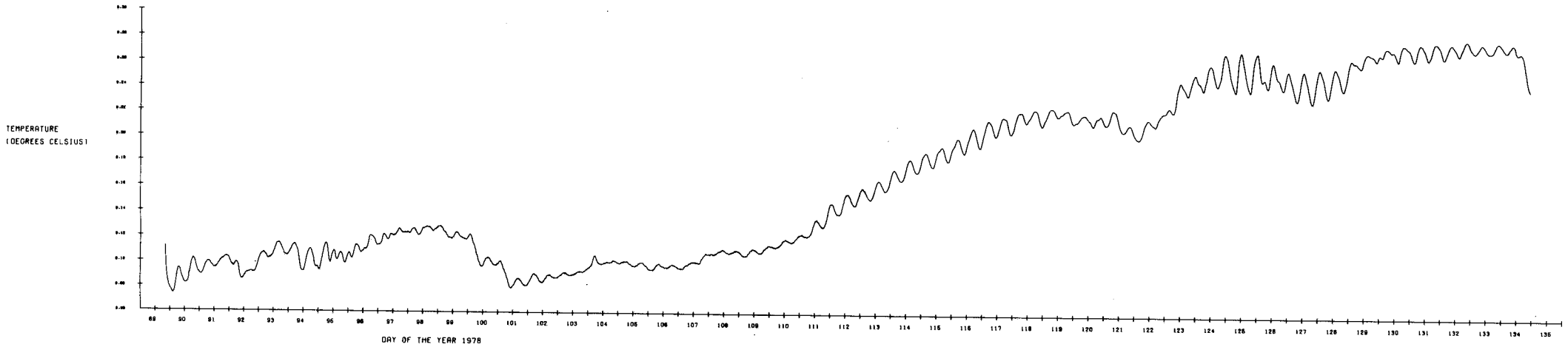
Station E, Celtic Sea, 1978. Lat 51° 27'N, Long 07° 51'W.
Unfiltered bottom pressure data (millibars).
0000 GMT day 105 to 2300 GMT day 119 1978, 15 days.
*Related constituents using analysis of St. Mary's 1968/1973.

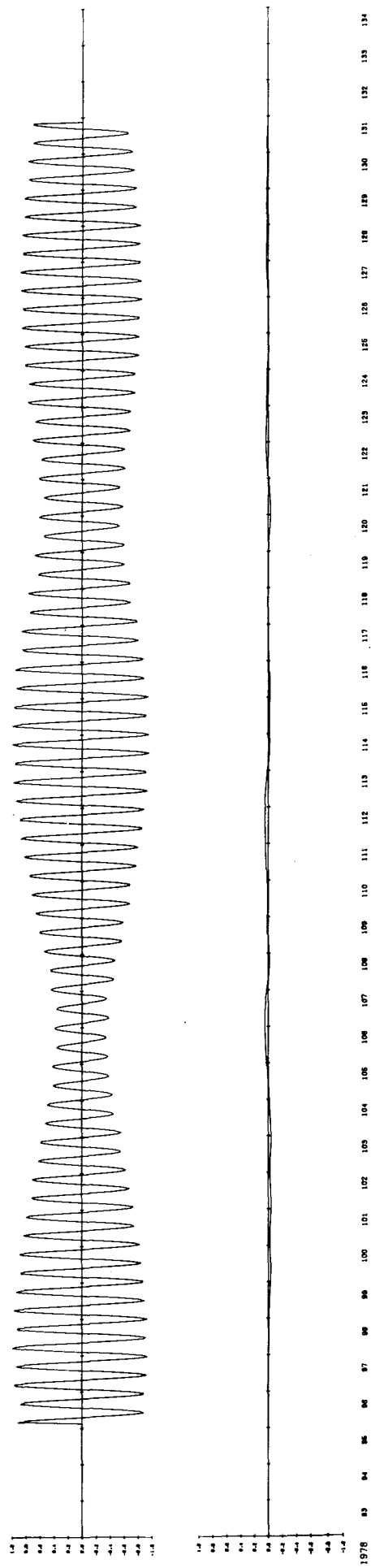
Constituent	related to	VIB 1/4 H (mb)	VIB 1/4 G (°)	SG 2/7 H (mb)	SG 2/7 G (°)	DIG 6/1 H (mb)	DIG 6/1 G (°)	Vector Mean H (mb)	Vector Mean G (°)
2Q1		2.1	336.1	2.2	341.7	2.3	340.6	2.2	339.6
* σ1	2Q1	1.1	5.0	1.1	10.6	1.2	9.5	1.2	8.5
* Q1	O1	1.0	334.4	1.0	328.5	1.0	328.8	1.0	330.6
* ρ1	O1	0.2	342.3	0.2	336.4	0.2	336.7	0.2	338.5
O1		2.9	26.2	3.0	20.3	3.1	20.6	3.0	22.4
* π1	K1	0.1	37.0	0.1	33.2	0.1	34.0	0.1	34.8
* P1	K1	1.7	111.2	1.8	107.4	1.7	108.2	1.8	109.0
* S1	K1	1.5	335.1	1.6	331.3	1.5	332.1	1.6	332.9
K1		5.4	113.5	5.6	109.7	5.5	110.5	5.5	111.3
* ψ1	K1	0.1	299.4	0.1	295.6	0.1	296.4	0.1	297.2
* φ1	K1	0.1	108.9	0.1	105.1	0.1	105.9	0.1	106.7
* J1	OO1	0.7	218.8	0.6	210.2	0.6	215.4	0.7	215.1
OO1		0.3	283.6	0.3	275.0	0.3	280.2	0.3	279.7
* 2N2	μ2	21.4	129.7	22.3	127.2	22.2	127.3	22.0	128.1
μ2		21.0	182.4	21.9	179.9	21.7	180.0	21.6	180.8
* N2	M2	28.0	124.5	27.8	124.3	27.9	124.4	27.9	124.4
* ν2	M2	5.5	119.6	5.5	119.4	5.5	119.5	5.5	119.5
M2		143.0	144.6	141.7	144.4	142.2	144.5	142.3	144.5
* L2	M2	5.0	153.7	5.0	153.5	5.0	153.6	5.0	153.6
* T2	S2	2.8	180.3	2.8	180.3	2.8	180.3	2.8	180.3
S2		46.5	188.0	46.5	188.0	46.6	188.0	46.6	188.0
* K2	S2	13.4	185.1	13.4	185.1	13.4	185.1	13.4	185.1
M3		0.8	35.8	0.8	30.2	0.8	29.0	0.8	31.7
M4		5.6	208.4	5.6	208.7	5.7	208.7	5.7	208.7
MS4		2.4	266.7	2.4	267.6	2.4	267.8	2.4	267.7
S4		0.3	204.5	0.3	194.9	0.3	193.2	0.3	197.6
M6		2.0	143.8	1.9	144.4	1.9	144.6	2.0	144.3
2MS6		1.9	209.2	1.9	210.7	1.9	210.9	1.9	210.3
2SM6		0.4	277.1	0.3	276.6	0.3	278.3	0.4	277.4

Recorder position	Station F, Celtic Sea, 1978. Lat 50° 33'N, Long 07° 32'W. $g = 9.811\ ms^{-2}$.
Water depth	108m.
Recorder details	Teleost PR 280 and 281. 900s sampling and integration periods.
Time of launch	Recorder in water at 1324 GMT day 089 (03 March). On seabed at 1340 GMT.
Time of recovery	Recorder on deck at 0628 GMT day 135 (15 May).
CTD casts	Cast No. 15 at 1500 GMT day 089. Cast No. 32 at 1417 GMT day 134. Cast No. 33 at 1604 GMT day 134. Cast No. 53 at 1045 GMT day 139. Density, ρ = 1027.1 kg m^{-3}.
Comments	Current meters No. 2575 and 2576, at 25m and 65m above sea bed respectively, were incorporated in this rig. A separate rig with thermistor chain No. 260 was deployed and recovered at this station. A separate rig with an experimental 300 bar sensor, PR 282, was deployed at this station at 1648 GMT day 134 and recovered at 1230 GMT day 139.

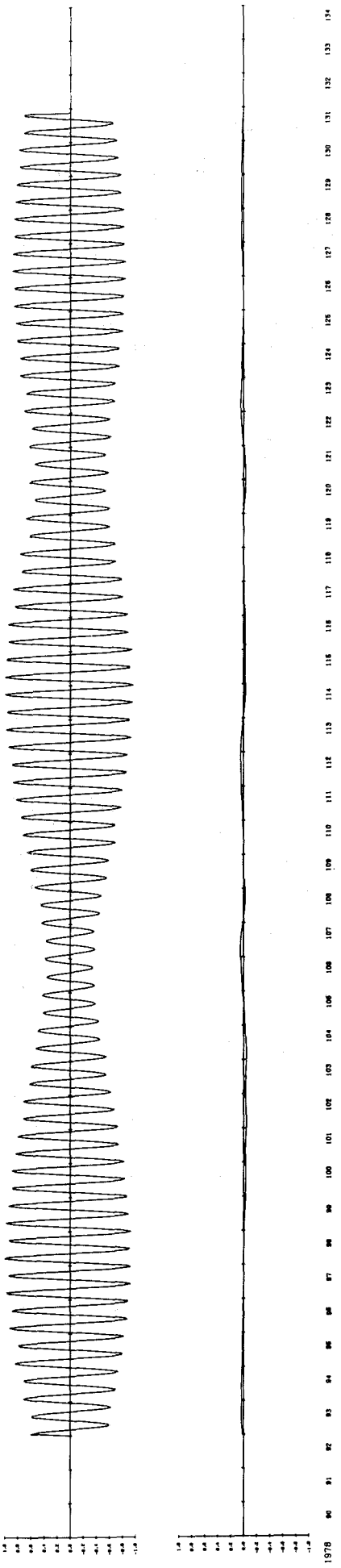
Timing	PR 280: Scan No. 1 at 1600,00 GMT day 076 (17 March). Scan No. 7193 at 1359,57 GMT day 151 (31 May). Clock fast, gained 3 seconds in 74 days and 22 hours. PR 281: Scan No. 1 at 2315,00 GMT day 080 (21 March). Scan No. 6788 at 1559,03 GMT day 151 (31 May). Clock fast, gained 57 seconds in 70 days and 16.75 hours.
Raw data	Start 2337,29 GMT day 092 for PR 280. End 0022,28 GMT day 135. Start 2022,23 GMT day 089 for PR 281. End 0021,46 GMT day 135.
Temperature data	Complete record for both sensors.
Drift free data	Start 0400 GMT day 096 for PR 280. End 2000 GMT day 131. Start 0100 GMT day 093 for PR 281. End 2000 GMT day 131. FHP 53 filter used.
Tidal analysis	TIRA, 0000 GMT day 098 to 2300 GMT day 126, 29 days of filtered total pressure data. 27 major and 8 related constituents using analysis of St. Mary's 1968/73.
Comments	Only the temperature record from PR 281 is presented.

AANDERAA TG/SG 281 MARCH/MAY 1978
CELTIC SEA "F" LAT 50 33N LONG 07 32W





CELTIC SEA "F" TO280 TOTAL PRESSURE



FILTERED VALUES
SCALE Y=0.23641 E03
MEAN VALUE=0.12012 E06

RESIDUALS
SCALE Y=0.23641 E03
MEAN VALUE=0.12013 E06

CELTIC SEA "F" T3281 TOTAL PRESSURE

TABLE 6

Station F, Celtic Sea, Lat 50° 33'N, Long 07° 32'W.
Drift free bottom pressure (millibars) FHP53 filter.
0000 GMT day 098 to 2300 GMT day 126 1978, 29 days.
*Related constituent using analysis of St. Mary's 1968/1973.

Constituent	related to	PR 280 H(mb)	PR 280 G(°)	PR 281 H(mb)	PR 281 G(°)	Vector mean H(mb)	Vector mean G(°)
Q1		1.9	298.3	1.9	296.3	1.9	297.3
O1		5.0	351.1	4.8	352.8	4.9	352.0
M1		1.2	132.9	1.1	127.0	1.1	130.1
* π1	K1	0.1	14.4	0.1	15.5	0.1	15.0
* P1	K1	1.4	88.6	1.5	89.7	1.5	89.2
K1		4.6	90.9	4.7	92.0	4.6	91.5
* ψ1	K1	0.1	276.8	0.1	277.9	0.1	277.4
* φ1	K1	0.1	86.3	0.1	87.4	0.1	86.9
J1		0.5	209.8	0.4	177.3	0.4	195.2
OO1		0.4	103.8	0.5	125.6	0.4	115.5
* 2N2	μ2	11.1	135.6	11.1	137.3	11.1	136.5
μ2		10.9	188.3	10.9	189.9	10.9	189.1
N2		31.5	114.6	31.3	114.6	31.4	114.6
* ν2	M2	6.1	111.2	6.1	111.2	6.1	111.2
M2		157.8	136.2	157.0	136.2	157.4	136.2
L2		4.3	135.4	4.3	136.2	4.3	135.8
* T2	S2	3.1	169.8	3.1	169.8	3.1	169.8
S2		52.3	177.5	52.1	177.5	52.2	177.5
* K2	S2	15.1	174.5	15.0	174.5	15.1	174.5
2SM2		1.2	34.6	1.2	33.5	1.2	34.1
MO3		0.6	204.4	0.6	206.8	0.6	205.6
M3		1.1	34.2	1.1	35.3	1.1	34.8
MK3		0.2	351.4	0.3	357.6	0.2	354.7
MN4		1.4	195.6	1.4	195.5	1.4	195.6
M4		5.2	218.8	5.2	219.3	5.2	219.1
SN4		0.7	209.9	0.7	209.0	0.7	209.5
MS4		2.4	264.8	2.4	265.3	2.4	265.1
2MN6		0.2	38.2	0.3	36.5	0.2	37.3
M6		0.4	50.6	0.4	49.0	0.4	49.8
MSN6		0.2	65.2	0.2	54.8	0.2	60.5
2MS6		0.5	96.0	0.5	99.4	0.5	97.7
2SM6		0.2	180.1	0.2	181.1	0.2	180.6

Recorder position	Station G, Celtic Sea, 1978. Lat 49° 36.7'N Long 08° 36.9'W. $g = 9.810\ ms^{-2}$.
Water depth	144m.
Recorder details	Mk I, No. 9, with SG sensors 1/19 and 1/21 and temperature sensor No. 1/T9. 900s integration and sampling times.
Time of launch	Started 0540 GMT day 090 (31 March). Finished 0551 GMT.
Time of recovery	Started 0830 GMT day 136 (16 May). Finished 0850 GMT.
CTD casts	No. 17 at 0628 GMT day 090. No. 34 at 0800 GMT day 136. No. 49 at 0205 GMT day 139. Density, ρ = 1027.3 kg m^{-3}.
Comments	A pop-up rig with current meters No. 1865 and 2970 30m and 104m above sea bed and thermistor chain No. 220 was deployed at this station and subsequently recovered.

Timing	Scan 0 at 0830 GMT day 089 (30 March). Scan No. 4810 at 1100,41 GMT day 139 (19 May). Clock slow, lost 41 seconds in 50 days 2½ hours.
Raw data	Start 0607,36 GMT day 090. End 0423,13 GMT day 136.
Temperature data	As above.
Drift free data	See Comments.
Tidal analysis	TIRA, 0606 GMT day 090 to 0254 GMT day 136, 1978. 2 x 29 days of overlapping unfiltered total pressure data. 27 major and related constituents using analysis of St. Mary's 1968/1973.
Comments	As the record was found to have negligible drift, the unfiltered data were analysed.

SG 1/19 PRESSURE MBAR
SG 1/19 PRESSURE MBAR
SG 1/21 PRESSURE MBAR
SG 1/21 PRESSURE MBAR

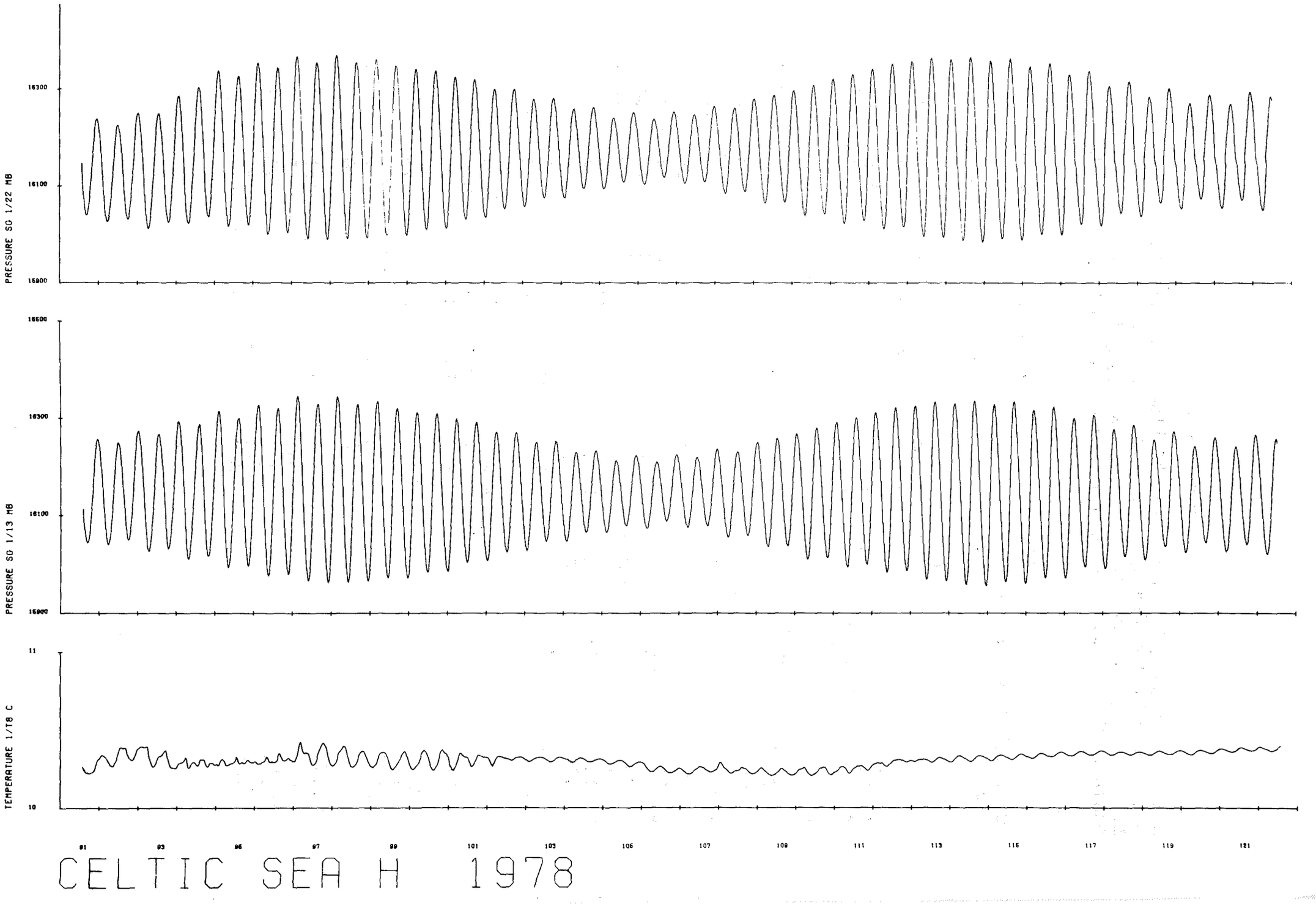
TABLE 7

Station G, Celtic Sea, Lat 49° 36.7'N, Long 08° 36.9'W.
Unfiltered bottom pressure data (millibars).
0606 GMT day 090 to 0254 GMT day 136 1978, 2 x 29 days overlapping analyses.
*Related constituent using analysis of St. Mary's 1968/1973.

	Con-stituent	related to	SG 1/19 H (mb)	SG 1/19 G (°)	SG 1/21 H (mb)	SG 1/21 G (°)	Vector Mean H (mb)	Vector Mean G (°)
	Q1		2.1	278.8	2.1	278.4	2.1	278.6
	O1		5.4	344.0	5.6	339.7	5.5	341.9
	M1		1.0	92.6	1.1	109.2	1.1	101.3
*	π1	K1	0.1	3.3	0.1	2.6	0.1	3.0
*	P1	K1	1.9	77.5	1.9	76.8	1.9	77.2
	K1		6.0	79.8	6.0	79.1	6.0	79.5
*	ψ1	K1	0.1	265.7	0.1	265.0	0.1	265.4
*	φ1	K1	0.1	75.2	0.1	74.5	0.1	74.9
	J1		0.3	80.6	0.1	126.3	0.2	91.6
	OO1		0.6	189.4	0.3	172.1	0.5	183.7
*	2N2	μ2	10.5	228.3	8.6	208.8	9.5	219.6
	μ2		10.3	281.0	8.4	261.5	9.3	272.3
	N2		27.5	98.8	27.4	98.7	27.5	98.8
*	ν2	N2	5.5	93.9	5.4	93.8	5.5	93.9
	M2		138.9	121.6	139.3	121.6	139.2	121.6
	L2		2.7	142.9	3.1	138.7	2.9	140.7
*	T2	S2	2.7	149.9	2.7	151.3	2.7	150.7
	S2		45.6	157.6	45.6	159.0	45.6	158.3
*	K2	S2	13.1	154.7	13.2	156.1	13.2	155.5
	2SM2		1.1	7.2	0.6	28.1	0.9	14.6
	MO3		0.3	165.1	0.5	189.6	0.4	180.5
	M3		1.1	4.6	1.1	7.9	1.1	6.3
	MK3		0.3	19.9	0.3	336.4	0.3	358.2
	MN4		0.4	235.7	0.8	215.1	0.6	222.0
	M4		2.7	231.0	3.0	230.1	2.9	230.6
	SN4		0.1	230.6	0.4	243.3	0.3	240.9
	MS4		1.3	292.6	1.7	283.7	1.5	287.6
	2MN6		0.7	356.0	0.5	342.8	0.6	350.6
	M6		1.1	348.3	1.1	350.2	1.1	349.3
	MSN6		0.4	11.7	0.4	8.4	0.4	10.1
	2MS6		1.2	54.5	1.3	53.1	1.3	53.8
	2SM6		0.3	159.8	0.3	144.8	0.3	152.4

Recorder position	Station H, Celtic Sea, 1978. Lat 48° 54.6'N, Long 09° 21.0'W. $g = 9.810 m\ s^{-2}$.
Water depth	164m.
Recorder details	Mk I No. 14, SG pressure sensors 1/13 and 1/22 and temperature sensor 1/T8. 900s sampling and integration periods.
Time of launch	Started 1313 GMT day 091 (01 April). Finished 1323 GMT.
Time of recovery	Started 1623 GMT day 136 (16 May). Finished 1645 GMT.
CTD casts	No. 18 at 1335 GMT day 091. No. 35 at 1650 GMT day 136. No. 45 at 1825 GMT day 138. Density, ρ = 1027.3 kg m^{-3}.
Comments	A pop-up rig with current meters No. 2574 and 1746 29m and 119m above sea bed and thermistor chain No. 334 was deployed at this station but not recovered during the cruise. The top current meter was recovered later by a French fishing vessel.

Timing	Scan 0 at 0800 GMT day 091 (01 April). Scan No. 4620 at 1101,44 GMT day 139 (19 May). Clock slow, lost 104 seconds in 48 days and 3 hours.
Raw data	Start 1337,30 GMT day 091. End 1323,37 GMT day 122.
Temperature data	As above.
Drift free data	See Comments.
Tidal Analysis	TIRA, 1336 GMT day 093 to 1324 GMT day 122, 1978. 29 days of unfiltered total pressure data. 27 major and 8 related constituents using analysis of St. Mary's 1968/1973.
Comments	As the record was found to have negligible drift, the unfiltered data were analysed.


PRESSURE SG 1/22 MB
16300
16100
15900
PRESSURE SG 1/13 MB
16500
16300
16100
15900
TEMPERATURE 1/T8 C
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121
CELTIC SEA H 1978

TABLE 8

Station H, Celtic Sea, Lat 48° 54.6'N, Long 09° 21.0'W.
Unfiltered bottom pressure data (millibars).
1336 GMT day 093 to 1324 GMT day 122 1978, 29 days.
*Related constituent using analysis of St. Mary's 1968/1973.

Constituent	related to	SG 1/13 H (mb)	SG 1/13 G (°)	SG 1/22 H (mb)	SG 1/22 G (°)	Vector Mean H (mb)	Vector Mean G (°)
Q1		2 2	271.6	1.9	271.8	2.1	271.7
O1		6.7	333.9	6.4	333.8	6.6	333.9
M1		1.2	105.6	1.1	116.4	1.2	110.8
* π1	K1	0.1	358.8	0.1	357.7	0.1	358.3
* P1	K1	2.2	73.0	2.2	71.9	2.2	72.5
K1		7.1	75.3	7.0	74.2	7.1	74.8
* ψ1	K1	0.1	261.2	0.1	260.1	0.1	260.7
* φ1	K1	0.1	70.7	0.1	69.6	0.1	70.2
J1		0.1	185.7	0.1	293.6	0.1	239.7
OO1		0.4	154.4	0.7	173.1	0.6	166.3
* 2N2	μ2	5.3	222.9	5.7	226.6	5.5	224.9
μ2		5.2	275.6	5.5	279.3	5.4	277.5
N2		26.3	89.0	26.3	89.1	26.3	89.1
* ν2	N2	5.2	84.1	5.2	84.2	5.2	84.2
M2		124.1	112.4	124.3	112.0	124.2	112.2
L2		3.3	114.6	2.8	112.7	3.1	113.8
* T2	S2	2.4	137.8	2.4	137.6	2.4	137.7
S2		40.8	145.5	40.9	145.3	40.9	145.4
* K2	S2	11.8	142.6	11.8	142.4	11.8	142.5
2SM2		0.5	317.3	0.4	300.2	0.5	309.7
MO3		0.3	162.9	0.3	171.6	0.3	167.3
M3		0.9	343.8	0.9	345.1	0.9	344.5
MK3		0.2	314.5	0.3	315.5	0.3	315.1
MN4		0.5	277.9	0.6	282.6	0.6	280.5
M4		1.5	267.1	1.4	271.1	1.5	269.1
SN4		0.2	314.6	0.2	333.1	0.2	323.9
MS4		1.1	308.8	0.9	317.6	1.0	312.8
2MN6		0.2	340.0	0.2	335.1	0.2	337.6
M6		0.5	12.1	0.5	4.2	0.5	8.2
MSN6		0.2	3.9	0.2	352.0	0.2	358.0
2MS6		0.5	57.8	0.4	59.2	0.5	58.5
2SM6		0.1	162.8	0.2	160.2	0.2	161.1

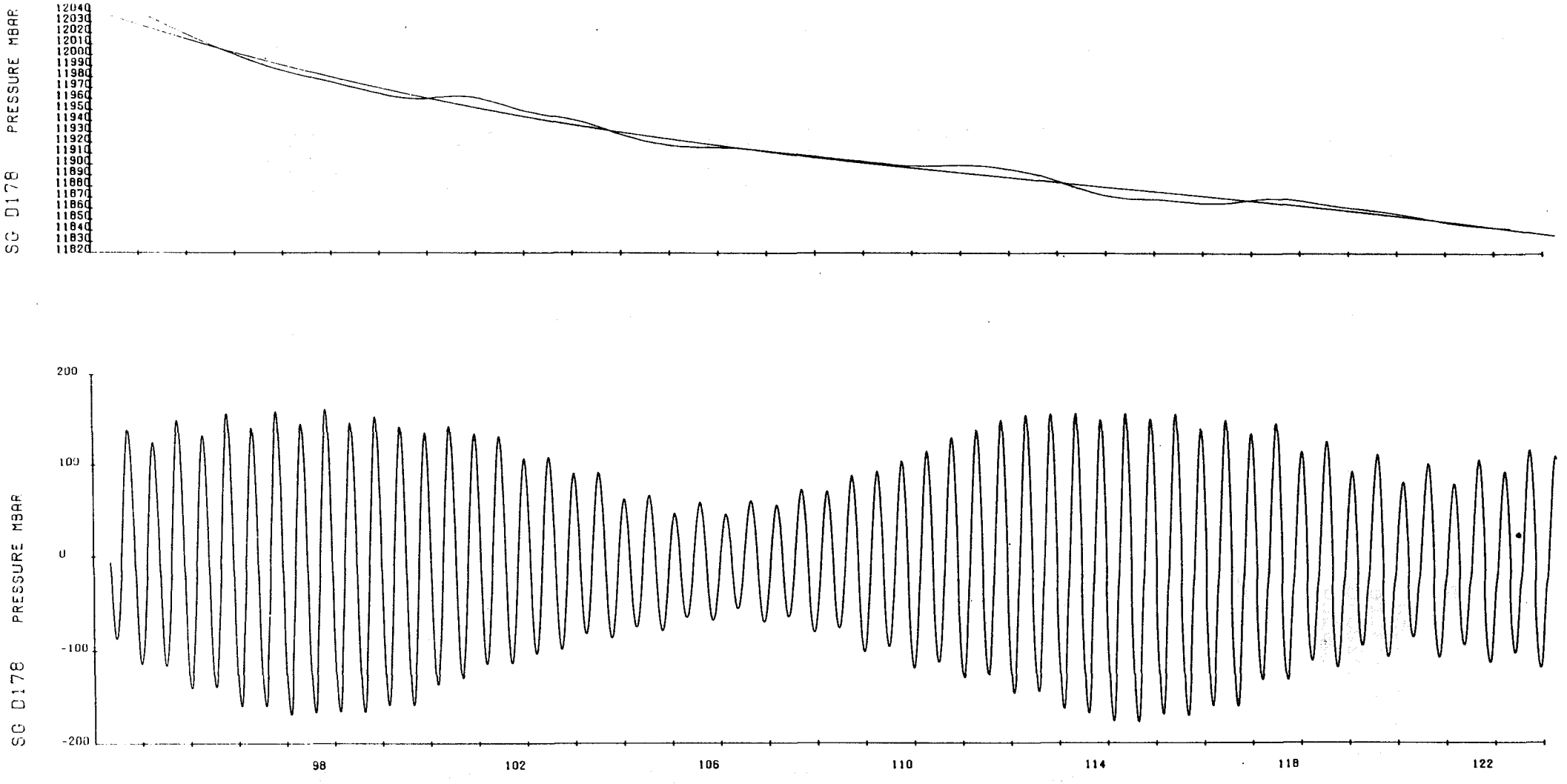
Recorder position	Station I, South-west Approaches, 1978. Lat 47° 51.0'N, 10° 22.6'W. $g = 9.809 m\ s^{-2}$.
Water depth	3850m.
Recorder details	Mk III No. 17, with SG pressure sensors No. D1/78, D2/78, and D3/78, and DIG pressure sensor No. 2262. 450s sampling and integration times.
Time of launch	Started 1058 GMT day 092 (02 April). Finished 1110 GMT.
Time of recovery	Started 0946 GMT day 137 (17 May). Finished 1104 GMT.
CTD casts	No. 19 at 0850 GMT day 092. No. 37 at 0655 GMT day 137. No. 38 at 1016 GMT day 137. Density, ρ = 1027.6 kg m^{-3}.
Comments	

Timing	Scan 0 at 0745 GMT day 092 (02 April). Scan No. 22368 at 1346,00 GMT day 150 (30 May). Clock slow, lost 60 seconds in 58 days and 6 hours.
Raw data	Start 1413,07 GMT day 092. End 0843,54 GMT day 137.
Temperature data	As above.
Drift free data	See Comments.
Tidal analysis	TIRA, 0212 GMT day 093 to 0200 GMT day 122, 1978. 29 days of unfiltered total pressure data. 27 major and 8 related constituents using analysis of St. Mary's 1968/1973.
Comments	Due to the malfunction of sensor D2/78, D3/78, and DIG 2262, only the analysis from the unfiltered pressure record of SG D1/78 is presented.

TABLE 9

Station I, S.W. Approaches, Lat 47° 51.0'N, Long 10° 22.6'W.
Unfiltered bottom pressure (millibars) from SG D1/78.
0212 GMT day 093 to 0200 GMT 122 1978, 29 days.
*Related constituent using analysis of St. Mary's 1968/1973.

	Constituent	related to	H (mb)	G (°)
	Q1		2.0	279.8
	O1		6.5	337.4
	M1		1.0	128.9
*	π1	K1	0.1	359.9
*	P1	K1	2.3	74.1
	K1		7.2	76.4
*	ψ1	K1	0.1	262.3
*	φ1	K1	0.1	71.8
	J1		0.3	232.2
	OO1		0.8	123.8
*	2N2	μ2	5.8	224.9
	μ2		5.7	277.6
	N2		24.1	83.7
*	ν2	N2	4.8	78.8
	M2		109.5	106.7
	L2		1.9	106.5
*	T2	S2	2.2	129.3
	S2		36.6	137.0
*	K2	S2	10.5	134.1
	2SM2		0.1	307.6
	MO3		0.2	222.8
	M3		0.8	337.6
	MK3		0.4	330.2
	MN4		0.3	302.5
	M4		0.8	304.8
	SN4		0.2	321.2
	MS4		0.4	0.2
	2MN6		0.1	129.2
	M6		0.04	213.8
	MSN6		0.1	128.3
	2MS6		0.2	164.6
	2SM6		0.1	11.4


SG D178 PRESSURE MBAR
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12030
12020
12010
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11980
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11910
11900
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11820
SG D178 PRESSURE MBAR
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-100
-200
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102
106
110
114
118
122

C I

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