BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

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RIG SEISMIC RESEARCH CRUISES 4 & 5
NORTH EAST AUSTRALIA, QUEENSLAND PLATEAU:
EXPLANATORY NOTES TO ACCOMPANY RELEASE OF
NON-SEISMIC DATA

by

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DIVISION OF MARINE GEOSCIENCES & PETROLEUM GEOLOGY

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INTRODUCTION

The purpose of this report is to summarise the processing techniques applied to the non-seismic geophysical data on *Rig Seismic* Research Cruises 4 & 5 (Surveys 50 & 51), Queensland plateau, north east Australia). Cruise 4 was conducted between 20th September and 17th October 1985; Cruise 5 was conducted between 12th November and 8th December 1985. Both cruises formed part of project ID02 (1985/86), IC04 (1986/87) and 9131.04 (1987/88).

GEOPHYSICAL SYSTEMS & PERFORMANCE

The following non-seismic geophysical systems were employed during Surveys 50 & 51:

Navigation

Prime System: Magnavox MX1107RS dual-channel short-count TRANSIT satellite navigator; ship speed from Magnavox 610D dual-axis sonar doppler and heading from Arma-Brown SGB 1000 gyro-compass.
Secondary System: Magnavox MX1142 single-channel short-count TRANSIT satellite navigator; ship speed from Raytheon DSN-450 dual-axis sonar doppler and heading from a Robertson gyro-compass.
Tertiary System: Magnavox T-Set Global Positioning System (GPS).
Radio Navigation: Decca Hifix radio navigator using a set of three Hifix ranges (channels) in hyperbolic mode transmitted from stations located on the coast.

Performance Comments: Both satellite navigators generally performed reliably. They were interfaced to the Data Acquisition System (DAS) and latitude, longitude, course, speed (every 10 seconds) and all satellite fix details were transferred and recorded. T-Set data was good for the majority of times it was avialable. The Radio navigation performance was poor over distances greater than 200 kms from the transmitting stations, however over distances of 100-200 kms the Hifix system provided acceptable accuracy compared with Satnav and t-set navigation.

Both gyro-compasses performed satisfactorily for both the entire surveys.

Bathymetric Systems

Raytheon Deep-sea Bathymetric System, with a maximum power output of 2 kW at 12 kHz. This system, purchased in the early 1970's, was of very sophisticated design for its day, providing in addition to digital depths and various alarm flags, an automatic tracking facility that should theoretically provide usable bathymetric data even in marginal recording conditions.

Performance Comments: The general quality of the data varied from poor to fair and the extensive processing required to retrieve acceptable bathymetric data is described fully later in this report.

Magnetics

Approximately 10 days of magnetic data were recorded during survey 50 and 6 days during survey 51, the system worked reliably during those days. reliably during those days.

Gravity

A Bodenseewerk KSS-31 marine gravity meter has been installed on the *Rig Seismic*, and data were recorded for the entire two surveys. Gravity ties were conducted in Brisbane before survey 50, and in Townsville at the end of survey 50. Gravity ties were done again in Townsville at the start and finish of survey 51. Gravity tie information is provided in Table 1.

Performance Comments: The KSS-31 is a highly sophisticated single-axis marine gravity meter with extensive microprocessor control. The KSS-31 is designed to be interfaced to an external navigation system that can provide speed and heading input at a rate of as fast as 1 second; the speed and heading are then used by the processor to provide gyro corrections to the gravity meter to improve performance in heavy seas or during turns. For Surveys 50 and 51, satisfactory gravity data have been achieved with appropriate post-survey filtering. Though due to the nature of survey 51, data quality at sample sites was poor due to constant turns and erratic ship speeds. Trouble was experienced with the meter 'crashing' numerous times through the survey, particularly during the final week. This problem is believed to have been caused by a power supply problem but efforts to trace the problem have been unsuccessful. The problem has not been evident in subsequent surveys.

TABLE 1: Gravity tie information For surveys 50 & 51

Survey 50

Place	Date	Time (GMT)	KSS-31 value	Corrected
Brisbane	19.07.85	0400	-1261.935	979167.66
Townsville	19.10.85	0400	-1803.246	978631.48

Gravity meter drift - Brisbane to Townsville = 5.13(mgal)

Survey 51

Townsville	11.11.85	1400	-1803.246	978614.81
Townsville	10.01.86	1400	-1799.860	978614.01

Gravity meter drift - Townsville to Townsville = 2.58(mgal)

DATA ACQUISITION SYSTEM (DAS)

The shipboard DAS is based on a Hewlett-Packard (HP) 1000 E-Series 16-bit minicomputer. The DAS programs run under the HP Real Time Executive (RTE-6/VM) disc-based operating system, which allows a multiprogramming environment and a large number of interactive users. Data are acquired either directly from the appropriate device through

an RS-232C interface (gravity, Magnavox MX1107RS), or through a BMR-designed 16-bit digital multiplexer (magnetics, bathymetry) and attached gyro-log interface (for both sonar dopplers and gyro-compasses). After preliminary processing, plotting on strip-chart recorders, and listing on a variety of printers, the data were recorded on 9-track, 1600 bpi, phase-encoded magnetic tape in HP's 32-bit floating-point format.

Data were acquired and saved at a 10-second rate, regardless of ship speed and independently of the seismic acquisition system. The data were written to tape in 2.5 minute (15 record) blocks with 80 channels of data being recorded. The channels that were recorded are listed in Table 2.

DATA PROCESSING

The data were processed on an in-house Hewlett-Packard 1000 F-Series minicomputer utilising similar hardware and the same operating system as the DAS. The processing was applied in two phases, as follows:

Phase 1: transcription of field tapes; correction of time errors; production of raw data plots; bulk editing (principally deletion of bad data segments); retrieval of water depth data; EDATA minor editing; computation of incremental latitudes and longitudes; production of final check plots; final editing.

Phase 2: tying of the dead-reckoned (DR) track to the satellite fixes using a cubic spline fitting technique to model ocean currents; assessment and deletion of poor quality satellite fixes; computation of final positions for each DR system; computation of final ship position from an appropriate mix of the available DR systems, the GPS system and the Hifix system; computation of final Eotvos-corrected gravity, including a correction for gravity meter drift; final data editing (particularly gravity data during turns).

A brief summary of the processing steps follows, with some detail of the techniques applied.

PHASE 1

FCOPY: All field tapes were transcribed to processing tapes with several field tapes being combined into a single processing tape. Processing tapes were separated at obvious breaks (such as recording system crashes), or after about seven days recording. Time jumps (positive or negative) were reported for processing in the next phase.

FIXTM: Time jumps reported in *FCOPY* were corrected, either automatically, or with a file of manual time corrections. Data channels were re-ordered (Table 3) to simplify further processing.

VARPL: All raw data channels requiring processing were plotted as strip records on a drum plotter. These plots were used to determine where editing was required and as a first guide for the setting of filter parameters.

FTAPE: This program was used for a variety of tasks as follows -

(1) Removal of hardware/software flags in the bathymetric data. The Raytheon echo-sounder system provides, in addition to digital bathymetry, 'flags' indicating that the echo-sounder has lost track or that the digitiser gate is searching for an echo. These flags were removed, as appropriate, and such values were replaced by the number 1.0E10 (10 raised to the power 10), to indicate absent data.

(2) 'Bulk' deletions were done of any large blocks of irretrievable data in particular channels.

(3) Automatic interpolations were done across data gaps of up to 120 seconds for selected data channels.

GMUL2: All raw gravity data were divided by 100 to reduce them to milligals. All three speed logs (each of which outputs a fixed number of 'clicks' per nautical mile) were reduced to give speeds in knots.

EDATA: This is a utility program used for the manual editing of problem areas that are not amenable to filtering or automatic editing.

SALVG (Water depth recovery): Briefly stated, the problem of bathymetry recovery is to fill in all the gaps left after the Raytheon hardware/software flags were removed and to discriminate against the bad bathymetric values that still remain.

To accomplish this, a file was first created of manually digitised water depths at selected points; this file was then read in conjunction with the processing data file. SALVG then performs a straight line interpolation between adjacent tie points and compares the interpolated depth with the 10-second digital depth. If the difference is less than a user-specified threshold, then the digital depth is accepted and is used to replace the previous first tie point. If the difference is greater than the threshold, then the 10-second digital depth is replaced by the interpolated depth. In this way, the program tracks along the acceptable water depths, providing the threshold is small enough to reject bad data and large enough to accept the good data. In the case of the digital data being totally unacceptable, as during poor sea conditions, the threshold was set to a very small number (0.01 m) and the process became one of simple linear interpolation between adjacent tie points. In practice, the interval between manually digitised tie points varied from several hours in the case of good digital 10-second data, to several minutes in the case of poor 10-second data or a very rugged seabed.

The success of this process, which is routinely applied to all *Rig Seismic* bathymetric data, can be seen in the following 'before and 'after' plots of Figure 1.

Figure 1: Bathymetry traces before (upper) and after processing by program SALVG. Vertical scale is 1000m/inch; horizontal scale is 3 inches/hour.

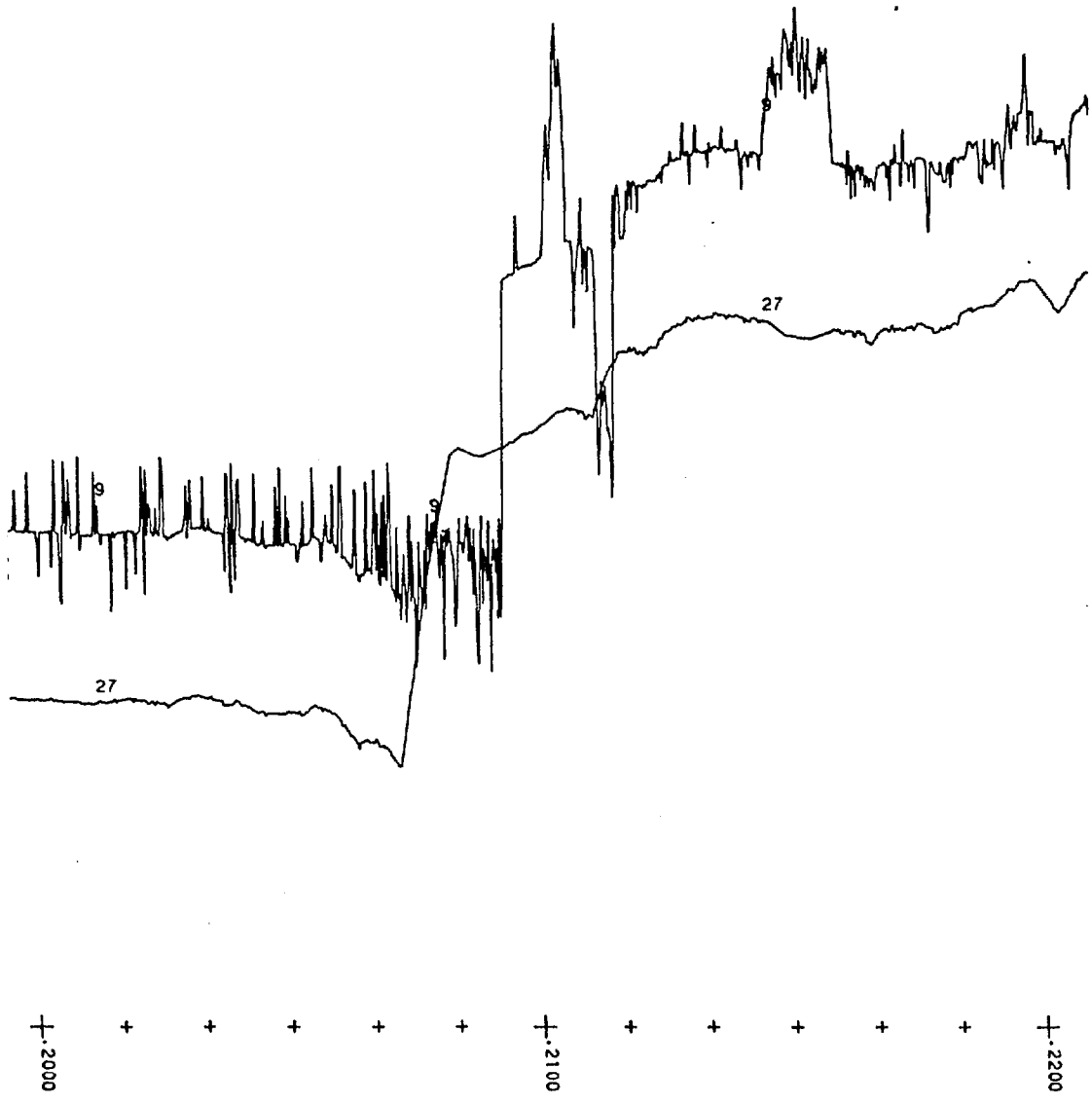

TABLE 2: Acquisition channel allocations
surveys 50 & 51

The following is a list of the channel allocations for the non-seismic data for the N.E Australia Qld Plateau cruises.

1 - Clock (survey & day number)
2 - GMT acquisition time from computer clock (hours,mins,secs)
3 - Master clock time at acquisition (hours,mins,secs)
4 - Latitude (radians)
5 - Longitude (radians)
6 - Speed (knots) - best estimate
7 - Heading (degrees) - best estimate
8 - Magnetometer No 1 (nT)
9 - Magnetometer No 2 (nT)
10 - Bathymetry No 1 (metres)
11 - Bathymetry No 2 (metres)
12 - Magnavox sonar doppler - fore/aft
13 - Magnavox sonar doppler - port/starboard
14 - Raytheon sonar doppler - fore/aft
15 - Raytheon sonar doppler - port/starboard
16 - Not used
17 - Not used
18 - Heading No 1 Arma Brown gyro-compass
19 - Heading No 2 Robertson gyro-compass
20 - Not used
21 - Not used
22 - Not Used
23 - Not used
24 - Not used
25 - Hifix fine A
26 - Hifix fine B
27 - Hifix fine C
28 - Not used
29 - Not used
30 - Not used
31 - Not used
32 - T-Set time (GMT secs)*2
33 - T-Set (Dop)
34 - T-Set latitude (radians)
35 - T-Set longitude (radians)
36 - T-Set height (above Geoid)
37 - T-Set speed (knots) * 10
38 - T-Set course (degrees) * 10
39 - T-Set frecuency bias No 1
40 - T-Set GMT (hours,mins,secs)
41 - Not used
42 - Not used
43 - Not used
44 - Not used
45 - Not used
46 - Not used
47 - Not used
48 - Not used
49 - Not used
50 - GMT time from MX1107 satnav
51 - Dead-reckoning time from MX1107

52 - Latitude (radians) from MX1107
53 - Longitude (radians) from MX1107
54 - Speed (knots) from MX1107
55 - Heading (degrees) from MX1107
56 - Set (degrees) from MX1107
57 - Drift (knots) from MX1107
58 - Set/drift flag, 0 = No 1 , 1 = auto from MX1107
59 - GMT from MX1142 satnav
60 - Dead-reckoning time from MX1142
61 - Latitude (radians) from MX1142
62 - Longitude (radians) from MX1142
63 - Speed (knots) from MX1142
64 - Heading (degrees) from MX1142
65 - Set (degrees) from Mx1142
66 - Drift (knots) from MX1142
67 - Set/drift flag, 0 = No 1 , 1 = auto from MX1142
68 - Vector speed Magnavox sonar dopplar
69 - Vector speed Raytheon sonar doppler
70 - Not used
71 - Not used
72 - Not used
73 - Not used
74 - Gravity (μms**-2 * 100)
75 - ACX (ms**-2 *1000) roll
76 - ACY (ms**-2 *1000) pitch
77 - Sea state
78 - Not used
79 - Not used
80 - Not used

TABLE 3: Processing channel allocations
surveys 50 & 51

The following is a list of the channel allocations used for processing the non-seismic data for the N.E.Australia Qld Plateau cruises.

1 - Clock (survey & day number)
2 - GMT acquisition time from computer clock (hours,mins,secs)
3 - Master clock time at acquisition (hours, minutes,secs)
4 - Latitude (radians)
5 - Longitude (radians)
6 - Heading (degrees) - best estimate
7 - Speed (knots) - best estimate
8 - Bathymetry No 1 (metres)
9 - Bathymetry No 2 (metres)
10 - Magnetometer No 1 (nT)
11 - Magnetometer No 2 (nT)
12 - Magnetic gradient
13 - Gravity (mgal x 100)
14 - Pitch acceleration (m/s**2)
15 - Roll acceleration (m/s**2)
16 - Sea state filter number
17 - Magnavox sonar doppler - fore/aft
18 - Magnavox sonar doppler - port/starboard
19 - Raytheon sonar doppler - fore/aft
20 - Raytheon sonar doppler - port/starboard
21 - T Set Latitude
22 - T Set Longitude
23 - Arma-Brown gyro-compass (degrees)
24 - Robertson gyro-compass (degrees)
25 - Not used
26 - Miniranger 1 not used
27 - Miniranger 2 not used
28 - Miniranger 3 not used
29 - Miniranger 4 not used
30 - Hifix (fine) A
31 - Hifix (fine) B
32 - Hifix (fine) C
33 - Hifix (course) not used
34 - Hifix (course) not used
35 - Hifix (course) not used
36 - 10-sec delta latitude - Magnavox S/D + Arma-Brown
37 - 10-sec delta longitude - Magnavox S/D + Arma-Brown
38 - 10-sec delta latitude - Magnavox S/D + Robertson
39 - 10-sec delta longitude - Magnavox S/D + Robertson
40 - 10-sec delta latitude - Raytheon S/D + Arma-Brown
41 - 10-sec delta longitude - Raytheon S/D + Arma-Brown
42 - 60-sec delta latitude - Magnavox S/D + Arma-Brown
43 - 60-sec delta longitude - Magnavox S/D + Arma-brown
44 - 60-sec delta latitude - Magnavox S/D + Robertson
45 - 60-sec delta longitude - Magnavox S/D + Robertson
46 - 60-sec delta latitude - Raytheon S/D + Arma-Brown
47 - 60-sec delta longitude - Raytheon S/D + Arma-Brown
48-56 -Not used
57 - Final Bathymetry (metres)

58 - Final Magnetometer No 1 (nT)
59 - Final Magnetometer No 2 (nT)
60 - Not used
61 - Not used
62 - Final Gravity (mGal)
63 - Final Latitude (radians)
64 - Final Longitude (radians)

FDATA: The magnetic, gravity and velocity data were filtered using a sophisticated form of the median filter, a highly successful spike deletion tool. Such a filter is essential for magnetic data, which is susceptible to spikes arising from either poor tuning of the magnetometer or from electrical interference. A filter threshhold of 7.0 nt was used with a filter window length of 13 samples for magnetic data. A threshold of 1 knot with a window length of 13 samples was used for the velocity data.

EDATA: This is a utility program used for the manual editing of problem areas that are not amenable to filtering or automatic editing.

TENAV: This program was used in the processing of Hifix radio navigation, it provides a listing of Hifix offsets calculated from the computed positions during acquisition of the data. After averaging the offsets a parameter file was created to be used in the next stage of processing.

NAVRO: This program used the offsets calculated in Tenav to compute at a specified frecquency the time and recomputed latitudes and longitudes. Also the differences between the positions calculated on board during acquisition and the recomputed positions were calculated during Navro.

MUFF: This program was used to anti-alias filter certain data channels prior to resampling to 60-seconds for Phase 2 processing. The channels filtered were magnetics, gravity, incremental latitude/longitudes and velocities. For the magnetic and gravity data the filter used was a SINC function with a filter period of 180 seconds extended to the third zero crossing of the abscissa each side of the filtered point. For the velocities, latitude and longitudes a filter of 60 seconds was used.

DELTA: Incremental (delta) latitude/longitudes were produced every 10 seconds by combining the ship speed with the headings from the Arma-Brown and Robertson gyro-compasses. This effectively gave two distinct dead-reckoning (DR) systems.

INTEG: The filtered incremental latitude/longitudes were re-integrated over running 60-second intervals. These 60-second incremental distances were then used in the Phase 2 processing to compute the DR vector over each satellite fix interval.

VARPL/EDATA: As the final stage of the Phase 1 processing, all processed channels were plotted again as 'strip' plots with program VARPL. Program EDATA was then used to correct any minor residual data problems.

PHASE 2

Phase 2 processing encompasses the following tasks -

1. Re-formatting and production of assessment listings of satellite fixes;

2. Resampling Phase 1 data;

3. Assessment of satellite fixes and deletion of those considered dubious or unacceptable;

4. Constrainment of DR track to remaining satellite fixes and computation of 1-minute positions for each DR system;

5. Selection of a suitable mix of navigation systems to produce final positions;

6. Application of Eotvos and drift corrections to gravity data and conversion to absolute values;

7. Final plots and editing as necessary.

In rather more detail, the programs applied were as follows -

RESAF: Re-format the ASCII parameter file of satellite fixes and adjust each fix to the nearest whole minute of survey time using the ship speed and heading applying at that time in the Phase 1 data file.

FIXES: Produce a listing of the satellite fixes for assessment purposes (Table 4).

RESAM: Concatenate the Phase 1 data files, as appropriate, and resample to produce 1-minute data.

SAT12: Two passes of this program are required for each round of satellite fix assessment. During each pass, a number of options are called, as follows:

Pass 1

a. SATEL - reads in the file of satellite fixes and stores them in memory. Any fix intervals with dubious speeds (too low or too high) or any intervals that are very short (<15 minutes) or very long (>120 minutes) are flagged in the output listing.

b. DRNAV - uses the incremental latitude/longitudes stored on the Phase 1 file and the satellite fix information to compute the DR path (or DR vector) for each satellite fix interval. This is saved as an ASCII parameter file.

c. CALNV - reads the DR file created by DRNAV and computes the ratio of the average DR velocity to the velocity computed from successive satellite fixes. This is done for each DR system used, and the results are listed.

d. CALPL - produces a line printer plot of the velocity ratios for each satellite fix interval.

Pass 2

a. CFACT - uses the DR file and a user-created file of calibration factor intervals to compute velocity calibration factors for each DR system.

b. APROX - uses the calibration factors computed in CFACT and the DR file to produce an approximately calibrated DR file.

c. ASSES - uses the approximately calibrated DR file created by APROX to produce a line printer plot of the current and summed error vectors at and between satellite fixes. The plot is produced at a 10-minute sample interval.

The basis of the processing is that option 'ASSES' takes the summed latitude and longitude error vectors at each fix (*ie* a running sum of the DR position to satellite fix position vectors at the time of each fix) and uses a piece-wise cubic polynomial curve-fitting function (the Akima spline) to compute error vectors at all times between satellite fixes. It is assumed that the ensuing smooth variation of the error vector is due to ocean currents, winds, etc. Poor quality fixes will produce unrealistic or large and variable ocean currents. At each round of assessment (and usually at least three rounds are required for each file), the satellite fixes are checked wherever the summed error and current vectors suggest a problem, and those fixes of poor quality are deleted for the next program run. The effect of this process can be seen in the example in Figures 2 and 3.

SAT3: uses the final file of satellite fixes and the DR data to produce final positions for each DR system. This program again uses the Akima spline to compute the assumed currents acting at all times between satellite fixes and applies those currents to the DR data to compute positions.

FINAV: performs the following functions -

a. Computes final 1-minute positions based on a 'mix' of DR systems and the Global Positioning System according to a file specified by the user.

b. The gravity data (which was in mgals relative to an arbitrary datum) was converted to absolute values corrected for meter drift and with Eotvos corrections applied.

VARPL/EDATA/FIXTM/MUFF: As a final check, the Phase 2 positions, water depths, magnetic, and gravity data were plotted and editing applied as necessary. The data was then re-blocked using program FIXTM to 8 channels x 60 records per block (1-hour blocks), and the final channel allocations are shown in Table 5. Final editing involved the editing of gravity spikes at turns using EDATA and further filtering of sea noise in the gravity using MUFF with a filter of 15-minute period.

Figures 2 & 3 (following pages). Satellite fix assessment plots for a part of Survey 50 & 51. 10-minute time (DD.HHMM) along bottom of plot; satellite fixes indicated by vertical row of dashes (eg at 78.1520); traces on plot are as follows:- N & E - north and east currents for DR system 1; 1 & 2 - north and east summed error vectors for DR system 1; Y & X - north and east currents for DR system 2; 3 & 4 - north & east summed error vectors for DR system 2.

Figure 2
Satellite fix assessment plot.

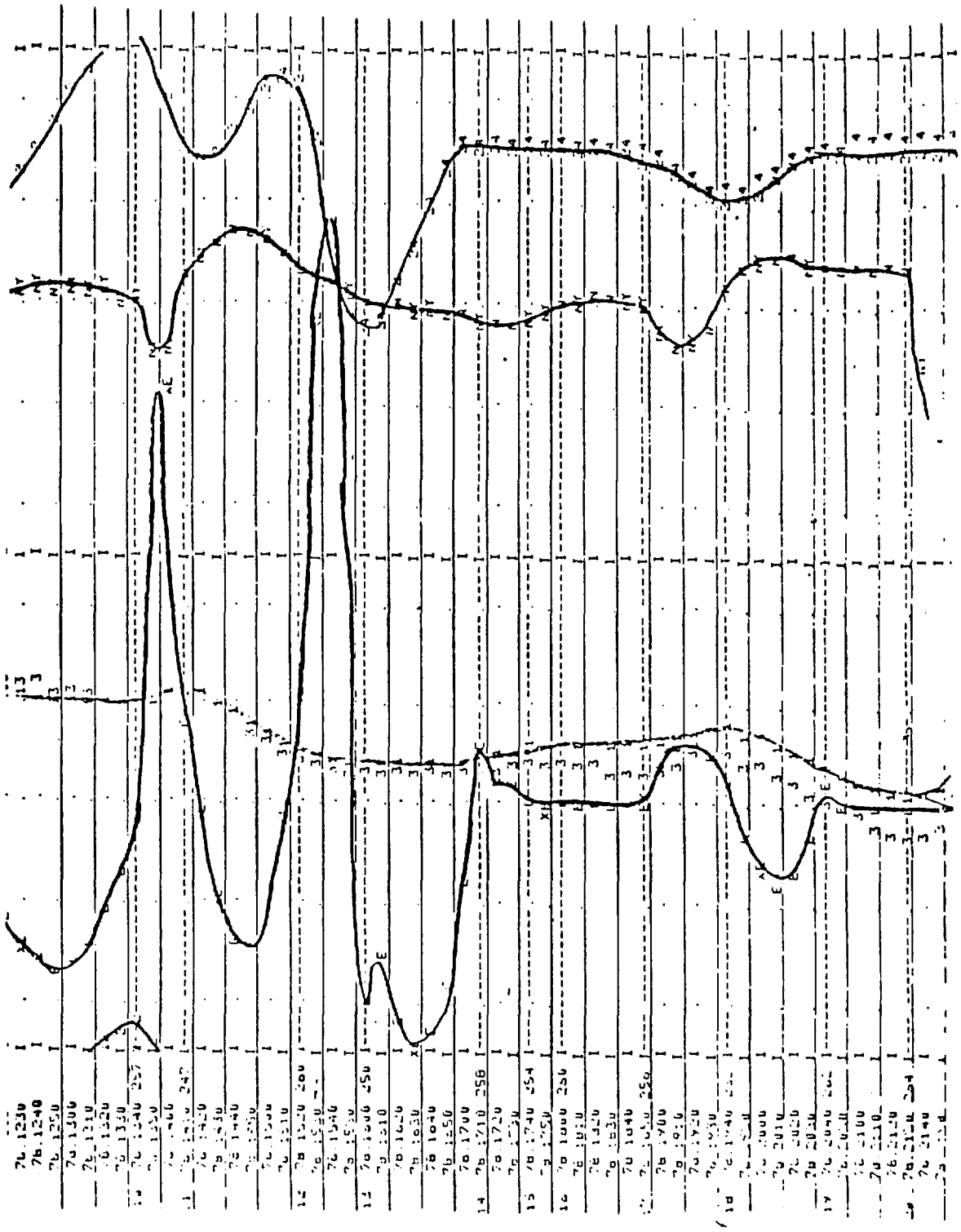

Figure 3
Satellite fix assessment plot after removal of bad satellite fixes at 78.1340 and 78.1600.

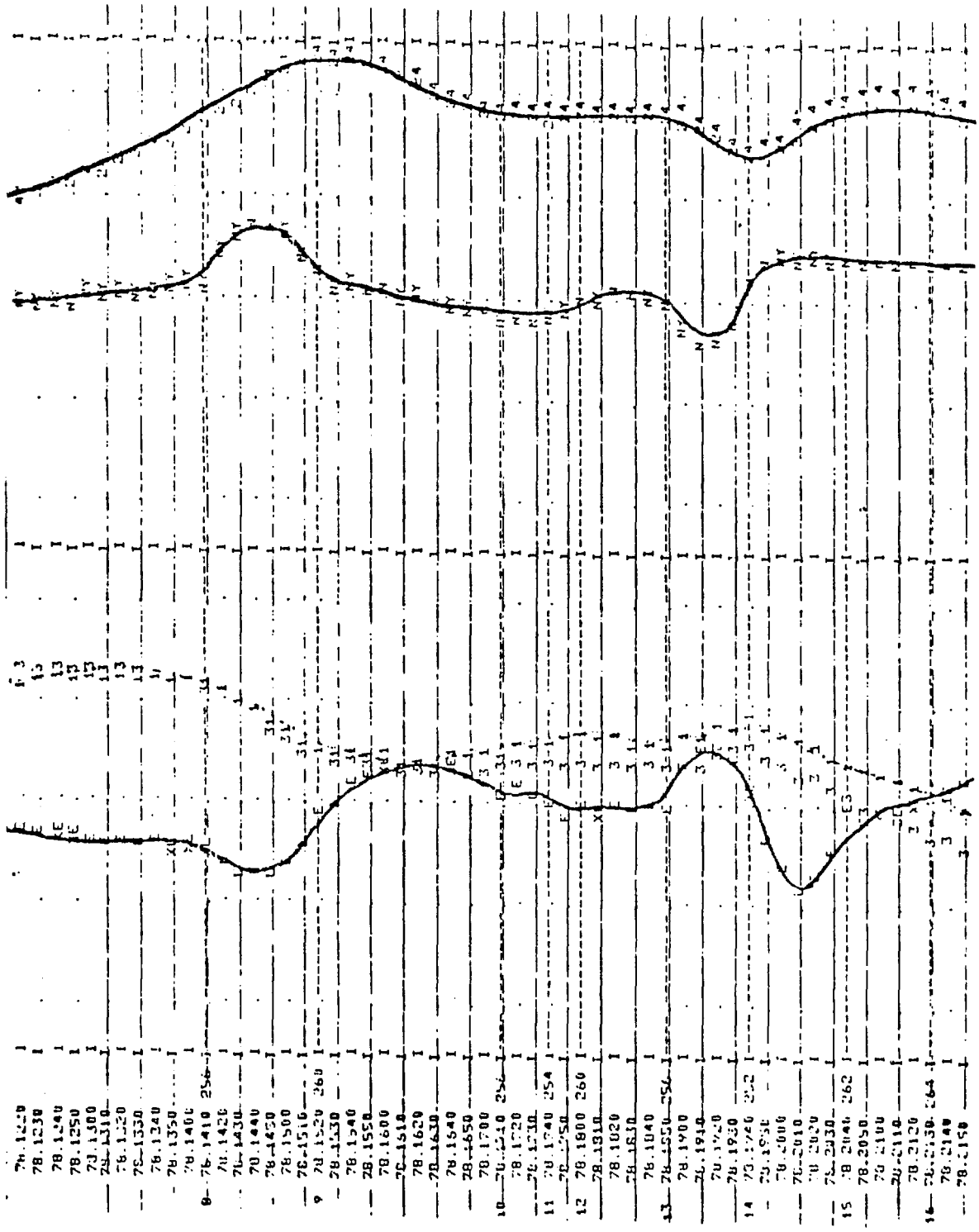

TABLE 4:

Sample listing of satellite fix parameters produced by program FIXES.

Column headings as follows:

FIX - satellite fix number within file;
FIX TIME - computed time of fix in format SS.DDD.HHMMSS,where SS is the survey number (50 or 51), DDD is the Julian day number in 1985, and HHMMSS is the GMT time;
LAT,LONG - Latitude & Longitude of fix in degrees & decimal minutes;
SYSTEM - Magnavox 1107 or 1142, or dummy fix (DFIX);
SAT - satellite number; OK - accepted (Y) or rejected (N) on-board;
ELEV - maximum elevation of satellite (degrees);
COUNT - number of doppler counts recieved;
ITER - number of iterations required to compute fix;
GEOM - geometry of pass; ERROR - amount of shipboard update (n.miles);
DIR - direction of shipboard update (degrees);
SLT,SLN - standard deviation of Latitude & Longitude (metres);
CODE - error code if fix not accepted by sat nav;
COURSE,SPEED - vessel's course and speed at time of fix.

FIX	FIX TIME	LAT	LONG	SYSTEM	SAT	OK	ELEV	COUNT	ITER	GEOM	ERROR	DIR	SLT	SLN	CODE	COURSE	SPEED
201	50.272.080500	17 41.181	151 28.201	1107	500	Y	48	36	3	SE	1.88	265	0	0		158.7	3.3
202	50.272.092900	17 47.221	151 32.240	1107	110	Y	24	28	4	SE	1.81	191	0	0		150.0	5.3
203	50.272.101100	17 50.668	151 34.609	1107	200	Y	26	30	3	SE	.68	261	0	0		136.5	5.6
204	50.272.111600	17 55.843	151 38.844	1107	110	Y	36	33	3	SW	.92	188	0	0		141.2	5.7
205	50.272.115600	17 59.213	151 40.477	1107	200	Y	35	32	3	SW	.80	236	0	0		146.0	4.9
206	50.272.130400	18 3.919	151 42.805	1107	130	Y	36	32	3	SE	1.57	279	0	0		146.5	5.0
207	50.272.145000	18 12.583	151 47.834	1107	130	Y	23	28	3	SW	1.12	229	0	0		147.5	5.4
208	50.272.155700	18 18.492	151 50.840	1107	300	Y	9	22	3	NE	.97	221	0	0		144.5	5.4
209	50.272.174500	18 27.756	151 56.240	1107	300	N	73	35	4	NW	1.18	357	0	0	1	146.7	6.2
210	50.272.194200	18 37.741	152 2.063	1107	500	Y	33	34	3	NE	1.49	262	0	0		145.5	6.4
211	50.272.205300	18 32.756	152 3.320	1107	110	Y	10	23	5	NE	.70	292	0	0		3.5	5.9
212	50.272.212600	18 29.197	152 3.197	1107	200	N	6	13	4	NE	.83	303	0	0	1	13.5	6.0
213	50.272.224000	18 20.918	152 3.563	1107	110	Y	70	35	3	NW	.70	355	0	0		1.5	5.9
214	50.272.241200	18 17.426	152 4.111	1107	200	Y	81	31	3	NW	.71	54	0	0	1	359.5	5.3
215	50.273.002800	18 9.990	152 1.088	1107	130	Y	17	22	4	NE	2.32	320	0	0		241.5	5.6
216	50.273.005600	18 10.341	151 59.889	1142	200	N	4	14	3		2.00	31	0	0	1	238.2	5.4
217	50.273.012100	18 11.141	151 57.213	1107	480	Y	14	26	3	SE	1.52	15	0	0		236.2	5.8
218	50.273.021500	18 12.556	151 52.486	1107	130	Y	47	34	3	NW	1.30	345	0	0		241.5	6.2
219	50.273.030900	18 12.855	151 46.293	1107	480	Y	62	37	3	SW	1.42	305	0	0		242.8	5.7
220	50.273.035000	18 13.044	151 42.514	1107	300	Y	10	24	6	SE	.70	4	0	0		254.0	5.9
221	50.273.053700	18 15.268	151 30.273	1107	300	N	86	40	7	SW	2.85	298	0	0	2	248.5	5.6
222	50.273.072500	18 18.546	151 20.158	1107	300	N	8	20	4	SW	.33	297	0	0	1	247.8	5.4
223	50.273.074200	18 18.647	151 18.428	1107	500	Y	32	33	3	SE	.61	317	0	0		256.5	5.4
224	50.273.084100	18 18.386	151 13.166	1142	110	N	6	21	2		.80	226	0	0	1	279.8	5.7
225	50.273.093000	18 18.622	151 7.324	1107	500	Y	30	33	3	SW	.62	328	0	0		250.8	5.0
226	50.273.102700	18 19.670	151 1.598	1107	110	N	83	36	3	SE	.67	287	0	0	1	254.8	5.1

TABLE 5:

TABLE 5: Final channel allocations.

Channel number	Contents
1	Time (SS.DDD)
2	Time (.HHMMSS)
3	Latitude (radians)
4	Longitude (radians)
5	Water depth (meters)
6	Gravity (mgals)
7	Total magnetic field (nT)
8	Not used

DATA AVAILABILITY

The Queensland Plateau non-seismic data are available in two forms:

a. Magnetic Tape - 9-track, 1600 bpi, phase-encoded, as either
- ASCII records, 80 characters per record, 10x1-minute records per block; or
- Hewlett-Packard 32-bit floating point, 8 channels, 60x1-minute records per block.

Enquiries concerning the digital data should be addressed to -

Chief Scientist,
Division of Marine Geosciences &
Petroleum Geology,
Bureau of Mineral Resources,
GPO Box 378
Canberra, ACT 2601, Australia

b. Analogue Displays - in film or paper form
- Cruise track charts at 1:1000000 scale
- Profile water depths, gravity and magnetic maps at 1:1000000
- Posted water depths, gravity and magnetic maps at 1:1000000

Enquiries concerning the analogue data should be addressed to

Copy Service
Bureau of Mineral Resources
PO Box 378,
Canberra, ACT 2601, Australia

Figure 4: Tracks of BMR Research Cruise 4 (survey 50).

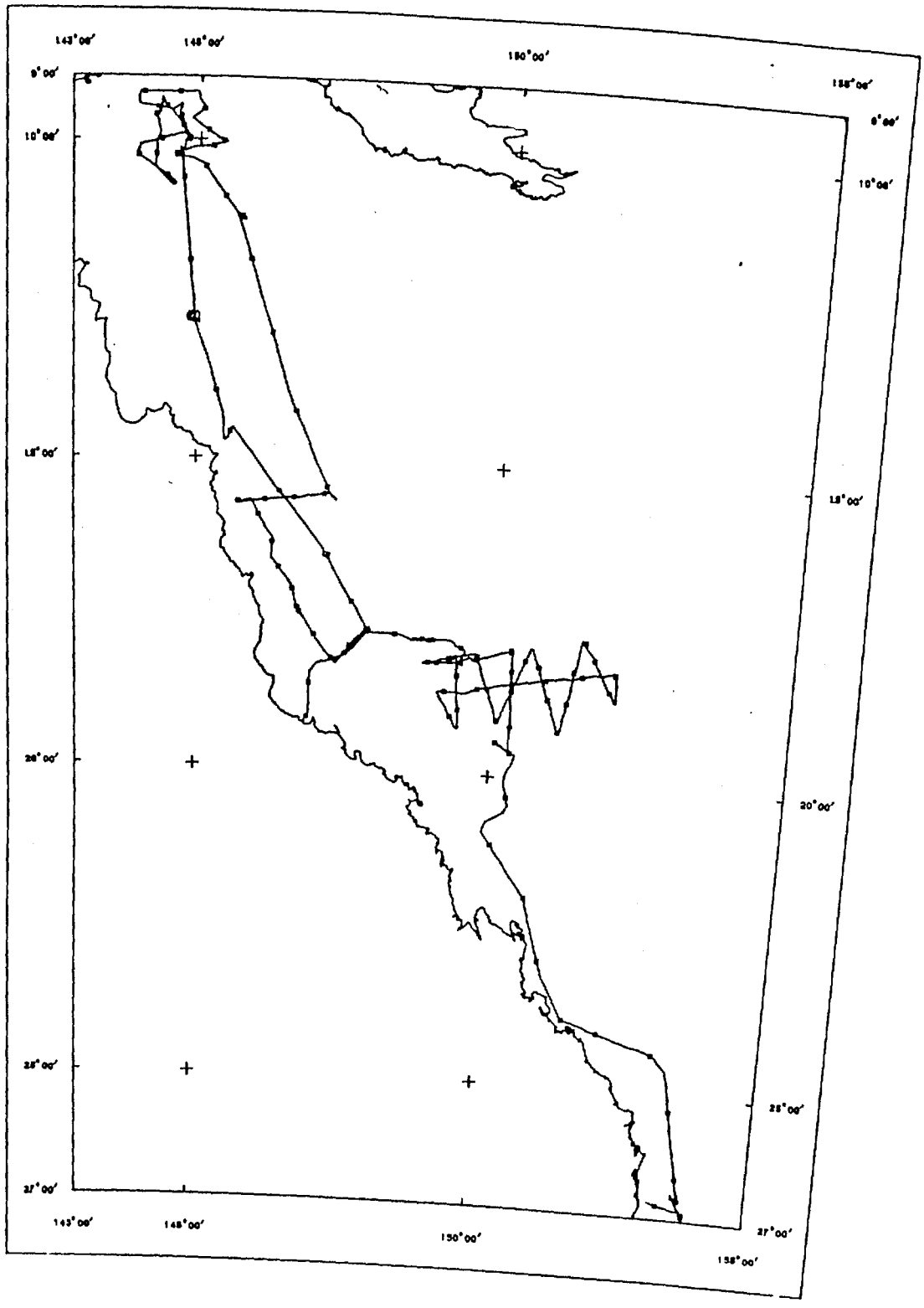

Figure 5: Tracks of BMR Research Cruise 5 (survey 51)

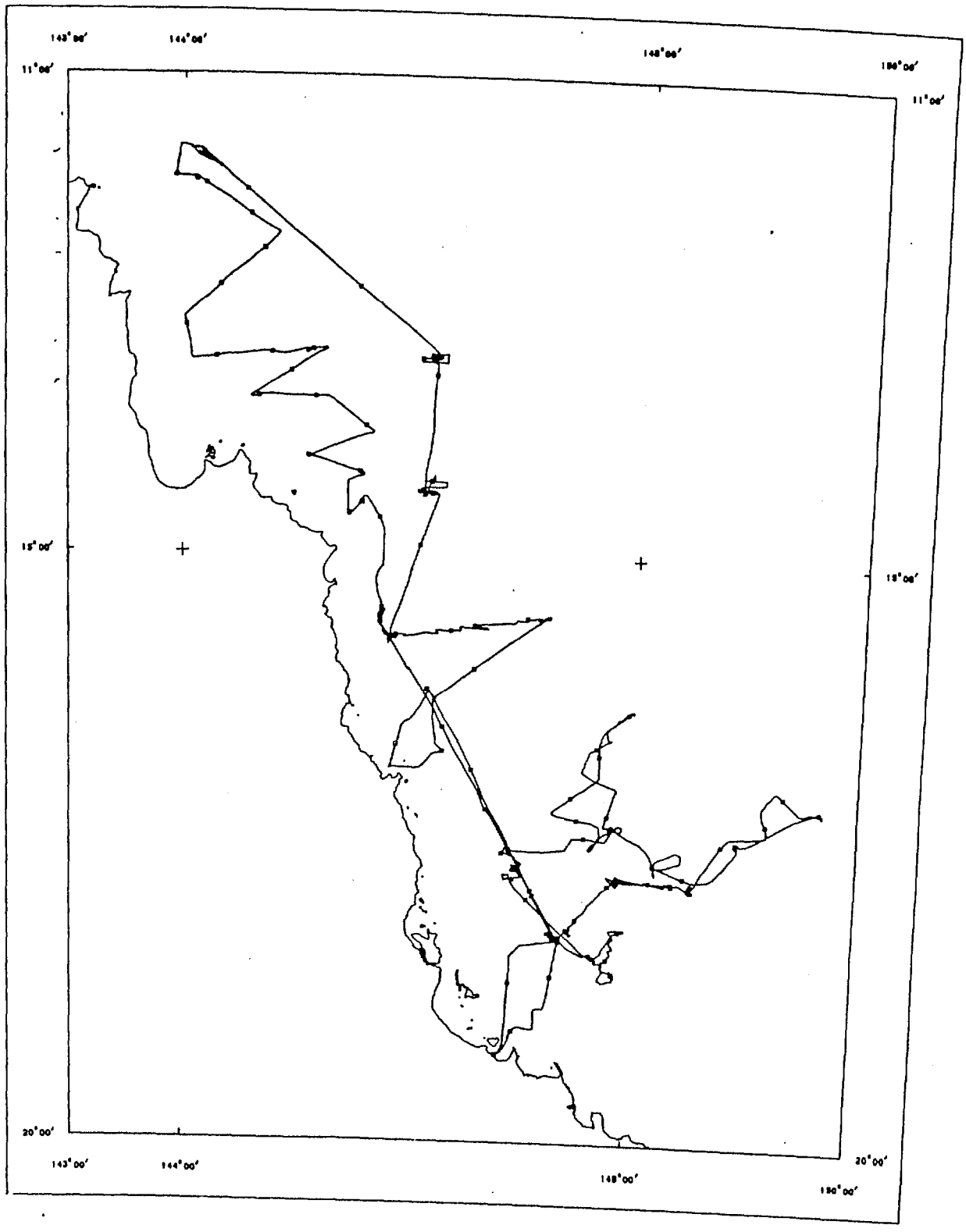

Figure 6: Tracks of BMR Research Cruises 4 & 5 combined.