Bureau of Mineral Resources, Geology & Geophysics

R E C O R D

Record 1989/27

BMR MARINE SURVEY 77
TASMAN SEA:
EXPLANATORY NOTES TO ACCOMPANY RELEASE OF NON-SEISMIC DATA

by

A.Marks.

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DIVISION OF MARINE GEOSCIENCES & PETROLEUM GEOLOGY

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CONTENTS

FIGURES

TABLES

INTRODUCTION

The purpose of this report is to summarise the processing techniques applied to the non-seismic geophysical data collected on BMR Marine Survey 77, in the Tasman Sea. Survey 77 was conducted between 10th February and 15th March 1988 as part of project 9131.10.

GEOPHYSICAL SYSTEMS & PERFORMANCE

The following non-seismic geophysical systems were employed during Survey 77 :

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 psuedo-range 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 were good when available, which was generally from 2200 to 0730 GMT.

Radio navigation data were received at distances up to 900 km from the transmitting stations, however the data were very susceptible to noise at such distances. In addition atmospheric noise levels were high at night and they were also high at dusk and dawn. Problems were experienced with the drift levels of the atomic standards.

As processing of the long-range HIFIX navigation data was still at an experimental stage, it has not been used to compute final positions.

Table 1: Percentage use of Navigation Systems in processing of Final Positions.

System	Survey 77
Dead Reckoning	60%
T-Set	40%

Both gyro-compasses performed satisfactorily for the entire survey, except for a short period when they were inadvertently switched off.

Bathymetric Systems

Two Raytheon Deep-sea Bathymetric Systems, with a maximum power output of 2 kW at 12 kHz and 2 kW at 3.5 kHz. These systems, designed in the early 1970's, were of very sophisticated design for their 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 good to excellent. The processing required to retrieve acceptable bathymetric data is described fully later in this report. Overall the data could be described as very good. On this survey only the 12 kHz system was used.

Magnetics

Approximately 202 hours of magnetic data were recorded during Survey 77.

Performance Comments: After initial tuning, the Magnetometer system performed well until it was seriously damaged during deployment.

Gravity

Data were recorded from a Bodenseewerk KSS-31 marine gravity meter for the entire survey. Gravity ties were conducted in Sydney before Survey 77, and in Eden after the survey. Gravity tie information is provided in Table 2.

Performance Comments: The KSS-31 is a highly sophisticated single-axis marine gravity meter with extensive microprocessor control. Gravity data were recorded for the entire survey with no problems.

TABLE 2: Gravity tie information for Survey 77

Place	Date	Time (GMT)	KSS-31 value (mgal)	Corrected (mgal)
Sydney	10.02.88	0333	-717.21	980389.99
Eden	05.03.88	2326	-441.22	980387.03

Gravity meter drift - Sydney to Eden = 29.6 ums^{-2}

DATA ACQUISITION SYSTEM (DAS)

The shipboard DAS is based on a Hewlett-Packard (HP) 1000 F-Series 16-bit minicomputer. Using the HP Real Time Executive operating system, data were recorded 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 1-minute (6 record) blocks with 80 channels of data being recorded. The channels that were recorded are listed in Table 3.

TABLE 3: Field tape channel allocations Survey 77.

The following is a list of the channel allocations for the non-seismic data for the Otway Basin 2 cruise.

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) - not used
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 - not used
26 - Hifix fine B - not used
27 - Hifix fine C - not used
28 - Hifix coarse A - not used
29 - Hifix coarse B - not used
30 - Hifix coarse C - 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 MX1107RS satnav
51 - Dead-reckoning time from MX1107RS
52 - Latitude (radians) from MX1107RS
53 - Longitude (radians) from MX1107RS
54 - Speed (knots) from MX1107RS

55 - Heading (degrees) from MX1107RS
56 - Set (degrees) from MX1107RS
57 - Drift (knots) from MX1107RS
58 - Set/drift flag, 0 = No. 1 , 1 = auto from MX1107RS
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 ($um.s^{-2}$)*10
75 - ACX (ms^{-2})*1000 roll
76 - ACY (ms^{-2})*1000 pitch
77 - Sea state
78 - Not used
79 - Not used
80 - Not used

DATA PROCESSING

The data were processed on a 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; minor editing; anti-alias filtering; computation of incremental latitudes and longitudes; production of final check plots; final editing.

Phase 2: Resample 10-second data to 1-minute data; 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 and the GPS 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 :

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 4) 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.

SALVG (Water depth recovery): Briefly stated, the problem of bathymetry recovery is to fill in all the gaps left after the Raytheon hardware-

TABLE 4: Processing channel allocations Survey 77

The following is a list of the channel allocations used for processing the non-seismic data for the Otway Basin 2 cruise :

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 - 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 ($um.s^{-2}$)*0.1
14 - Pitch acceleration (ms^{-2})
15 - Roll acceleration (ms^{-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 - not used
31 - Hifix (fine) B - not used
32 - Hifix (fine) C - not used
33 - Hifix (coarse) A not used
34 - Hifix (coarse) B not used
35 - Hifix (coarse) C 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
48-55 - Not used
56 - Not used
57 - Final Bathymetry (metres)
58 - Final Magnetometer No. 1 (nT)
59 - Final Magnetometer No. 2 (nT) - not used
60 - Not used
61 - Not used

62 - Final Gravity ($um.s^{-2}$)*0.1
63 - Final Latitude (radians)
64 - Final Longitude (radians)

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.

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 threshold 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.

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 and velocities. For the magnetic and gravity data the filter used was a SINC function with a filter period of 180 seconds. For the velocities a SINC function with a period of 60 seconds was used.The filter coefficients and the approximate responses to a sine wave are given in Table 5.

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.

Figure 1: Bathymetry traces before (lower) and after processing by program SALVG. Vertical scale is 100m/inch; horizontal scale is 2 inches/hour.

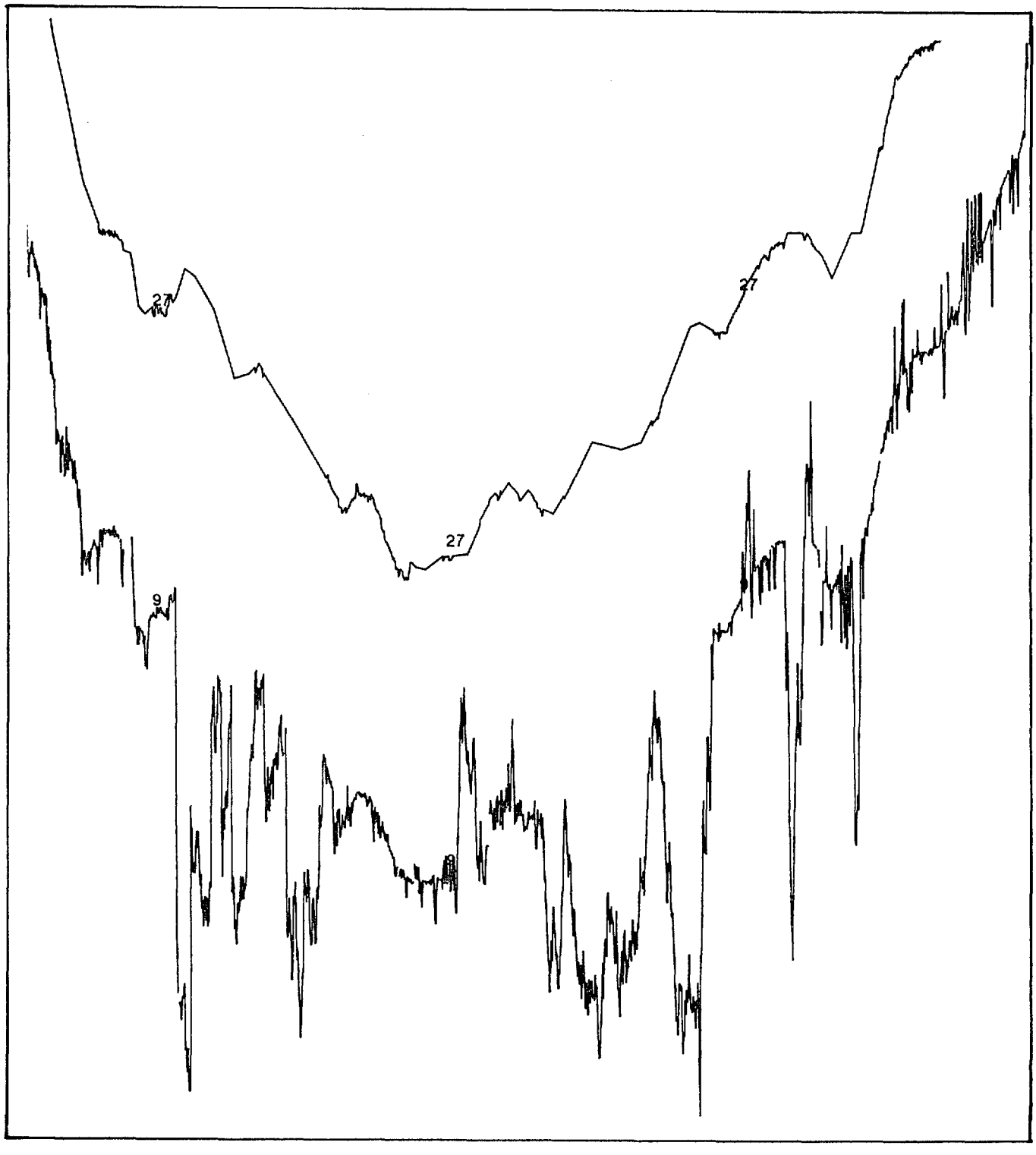

TABLE 5:

Filter coefficients and approximate response of filter to sine wave for magnetics smoothing filter.

SMOOTH FILTER 1 PUTS CHANNEL 11 INTO 11

FILTER CUT-OFF AT 3.RD ZERO

SAMPLING INTERVAL IN SECONDS 10.0

PERIOD OF FILTER IN SECONDS 180.0

APPROXIMATE RESPONSE OF FILTER TO SINE WAVE

NUMBER OF POINTS IN FILTER 53

FILTER COEFFICIENTS AS FOLLOWS

.000	.001	.002	.003	.004	.004	.004	.003	-.000	-.004
-.008	-.012	-.015	-.018	-.018	-.015	-.009	.000	.012	.027
.043	.060	.076	.091	.102	.109	.111	.109	.102	.091
.076	.060	.043	.027	.012	.000	-.009	-.015	-.018	-.018
-.015	-.012	-.008	-.004	-.000	.003	.004	.004	.004	.003
.002	.001	.000							

FRACTION	PERIOD	RESPONSE	db
.500	90.0	.00108	-59.3
.518	93.2	.00442	-47.1
.536	96.5	.00672	-43.5
.555	99.9	.00672	-43.5
.574	103.4	.00380	-48.4
.595	107.0	-.00178	-55.0
.616	110.8	-.00884	-41.1
.637	114.7	-.01548	-36.2
.660	118.8	-.01934	-34.3
.683	122.9	-.01804	-34.9
.707	127.3	-.00946	-10.5
.732	131.8	.00793	-42.0
.758	136.4	.03500	-29.1
.785	141.2	.07183	-22.9
.812	146.2	.11784	-18.6
.841	151.4	.17184	-15.3
.871	156.7	.23226	-12.7
.901	162.2	.29728	-10.5
.933	167.9	.36499	-8.8
.966	173.9	.43355	-7.3
1.000	180.0	.50127	-6.0
1.035	186.3	.56672	-4.9
1.072	192.9	.62872	-4.0
1.110	199.7	.68641	-3.3
1.149	206.8	.73918	-2.6
1.189	214.1	.78669	-2.1
1.231	221.6	.82882	-1.6
1.275	229.4	.86564	-1.3
1.320	237.5	.89735	-.9
1.366	245.9	.92426	-.7
1.414	254.6	.94676	-.5
1.464	263.5	.96527	-.3
1.516	272.8	.98024	-.2
1.569	282.5	.99210	-.1
1.625	292.4	1.00129	.0
1.682	302.7	1.00821	.1
1.741	313.4	1.01322	.1
1.803	324.5	1.01665	.1
1.866	335.9	1.01881	.2
1.932	347.7	1.01994	.2
2.000	360.0	1.02028	.2

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 6).

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.

TABLE 6:

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 (67), DDD is the Julian day number in 1987, 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
51	77.049.000800	33 26.830	159 13.332	1107	200	Y	28	28	3	SE	3.94	303	0	0		66.7	3.8
52	77.049.003400	33 25.438	159 14.432	1107	130	Y	14	19	5	SE	.77	315	0	0		71.8	3.7
53	77.049.005200	33 24.939	159 14.600	1107	500	Y	12	25	5	SW	.89	267	0	0		70.7	3.8
54	77.049.011000	33 24.041	159 15.352	1107	110	Y	14	25	3	SW	.53	313	0	0		70.8	3.9
55	77.049.013000	33 22.903	159 16.277	1107	290	Y	21	29	3	NE	.70	318	0	0		75.8	4.0
56	77.049.015300	33 21.746	159 17.361	1107	200	Y	37	32	3	SW	.79	305	0	0		76.7	4.6
57	77.049.022000	33 20.193	159 17.938	1107	130	N	80	31	3	SW	1.60	297	0	0	1	75.8	4.1
58	77.049.031800	33 17.087	159 22.600	1107	290	Y	58	37	3	NW	2.26	331	0	0		76.5	3.9
59	77.049.041000	33 14.777	159 24.422	1107	480	Y	31	33	3	NE	2.07	292	0	0		71.3	4.5
60	77.049.051400	33 11.217	159 27.545	1107	240	Y	16	28	3	NE	1.07	307	0	0		39.7	4.2
61	77.049.055900	33 8.459	159 29.602	1107	480	Y	38	35	3	NW	.67	337	0	0		55.5	4.0
62	77.049.070300	33 5.033	159 32.521	1107	240	N	77	39	3	NW	.86	300	0	0	1	44.0	4.1
63	77.049.084900	32 59.556	159 36.715	1107	240	Y	11	25	3	NW	2.45	274	0	0		48.8	4.2
64	77.049.103100	32 55.040	159 41.871	1107	500	Y	56	38	2	NE	.86	231	0	0		48.6	3.9
65	77.049.111200	32 53.159	159 43.775	1107	200	N	7	18	*	NE	.39	235	0	0	2	39.3	4.2
66	77.049.121900	32 49.791	159 46.453	1107	500	Y	22	29	3	NW	.90	235	0	0		29.8	4.0
67	77.049.125800	32 47.732	159 48.484	1107	200	N	83	26	6	NE	.57	125	0	0	1	29.0	4.1
68	77.049.132800	32 46.187	159 49.936	1142	290	Y	21	30	2		.20	112	0	0		24.5	4.1
69	77.049.133600	32 45.763	159 49.371	1107	130	Y	50	29	3	NE	.54	221	0	0		24.3	4.0
70	77.049.144200	32 42.050	159 51.084	1107	200	N	9	20	5	NW	.62	217	0	0	1	23.0	3.8
71	77.049.151400	32 40.219	159 52.086	1107	290	Y	55	35	3	SW	.14	187	0	0		23.5	3.8
72	77.049.161800	32 36.316	159 53.740	1107	480	Y	40	35	3	SE	.36	263	0	0		23.5	3.9
73	77.049.171600	32 32.932	159 55.594	1107	240	Y	16	25	3	SE	.61	269	0	0		37.2	4.2
74	77.049.180700	32 30.092	159 57.480	1107	480	Y	30	34	2	SW	.68	263	0	0		38.8	4.2
75	77.049.190400	32 26.896	159 59.477	1107	240	N	71	37	2	SW	.85	275	0	0	1	38.7	4.1
76	77.049.205200	32 20.782	160 4.133	1107	500	N	7	20	3	SE	2.40	290	0	0	1	46.5	4.1
77	77.049.223300	32 15.640	160 8.484	1107	110	Y	35	29	3	SE	4.38	293	0	0		61.8	3.9
78	77.049.225900	32 14.537	160 9.689	1107	200	N	6	17	4	SE	.62	295	0	0	1	61.8	4.0
79	77.050.002000	32 11.201	160 13.637	1107	110	Y	32	30	3	SW	1.56	272	0	0		42.2	3.9
80	77.050.004400	32 10.022	160 14.320	1107	200	Y	66	29	3	SE	.55	267	0	0		42.0	4.1
81	77.050.013600	32 7.815	160 16.371	1107	130	Y	47	34	3	SE	.54	209	0	0		28.6	4.7
82	77.050.022900	32 5.451	160 18.375	1142	200	Y	14	28	2		1.20	189	0	0		24.3	4.5
83	77.050.031600	32 1.622	160 20.631	1107	130	Y	23	28	3	SW	1.00	187	0	0		24.8	4.8
84	77.050.034700	31 59.753	160 21.596	1107	480	Y	23	31	3	NE	.29	224	0	0		24.5	4.3
85	77.050.042600	31 57.722	160 21.975	1107	290	Y	15	26	4	NW	.39	252	0	0		331.3	3.6
86	77.050.043900	31 56.826	160 21.400	1107	240	N	7	23	4	NE	.24	72	0	0	1	304.5	3.4
87	77.050.053600	31 55.818	160 19.641	1107	480	Y	50	36	3	NW	.21	80	0	0		312.3	.8
88	77.050.062800	31 55.167	160 19.232	1107	240	Y	67	34	2	NE	.24	288	0	0		344.5	.4
89	77.050.081400	31 54.185	160 18.619	1107	240	Y	19	25	3	NW	.29	337	0	0		325.5	.8
90	77.050.084900	31 53.844	160 17.428	1107	110	Y	15	25	3	NE	.65	266	0	0		326.7	.1
91	77.050.100800	31 53.875	160 17.303	1107	500	Y	41	36	3	NE	.10	294	0	0		325.2	-.4
92	77.050.114900	31 54.272	160 16.836	1107	200	Y	21	19	3	NE	.67	243	0	0		295.8	-.2

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 acording to a file specified by the user.

b. The gravity data (which were in mgals relative to an arbitrary datum) were converted to absolute values relative to ISOGAL 84, corrected for meter drift and had Eotvos corrections applied; no tidal corrections have been 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); the final channel allocations are shown in Table 7. Final editing involved the removal 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 77. 10-minute time (DD.HHMM) along bottom of plot. The satellite fixes indicated by vertical row of dashes (eg at 058.1050). 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.

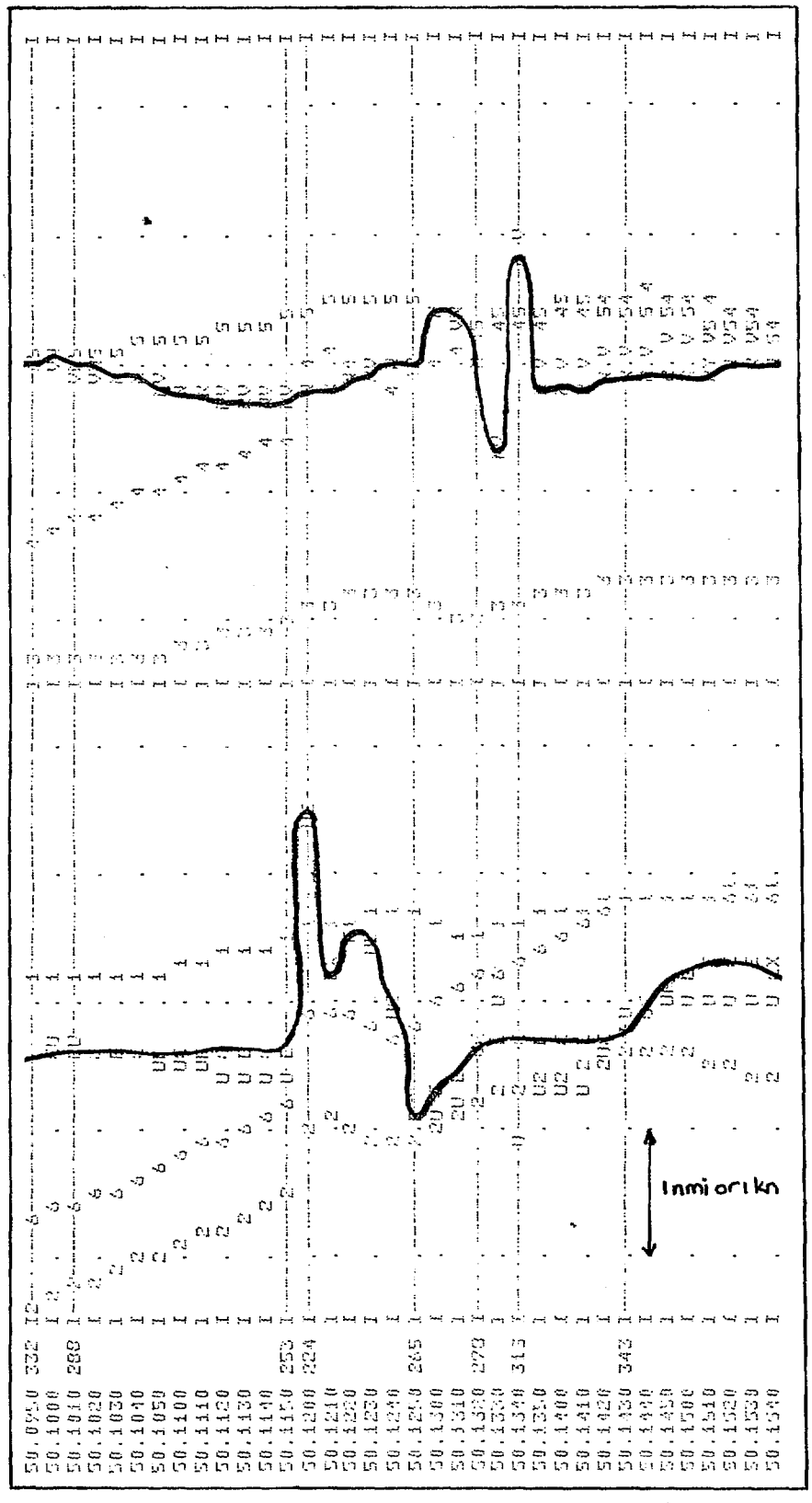

Figure 3:
Satellite fix assessment plot after removal of bad satellite fixes at 050.1150 and 050.1320

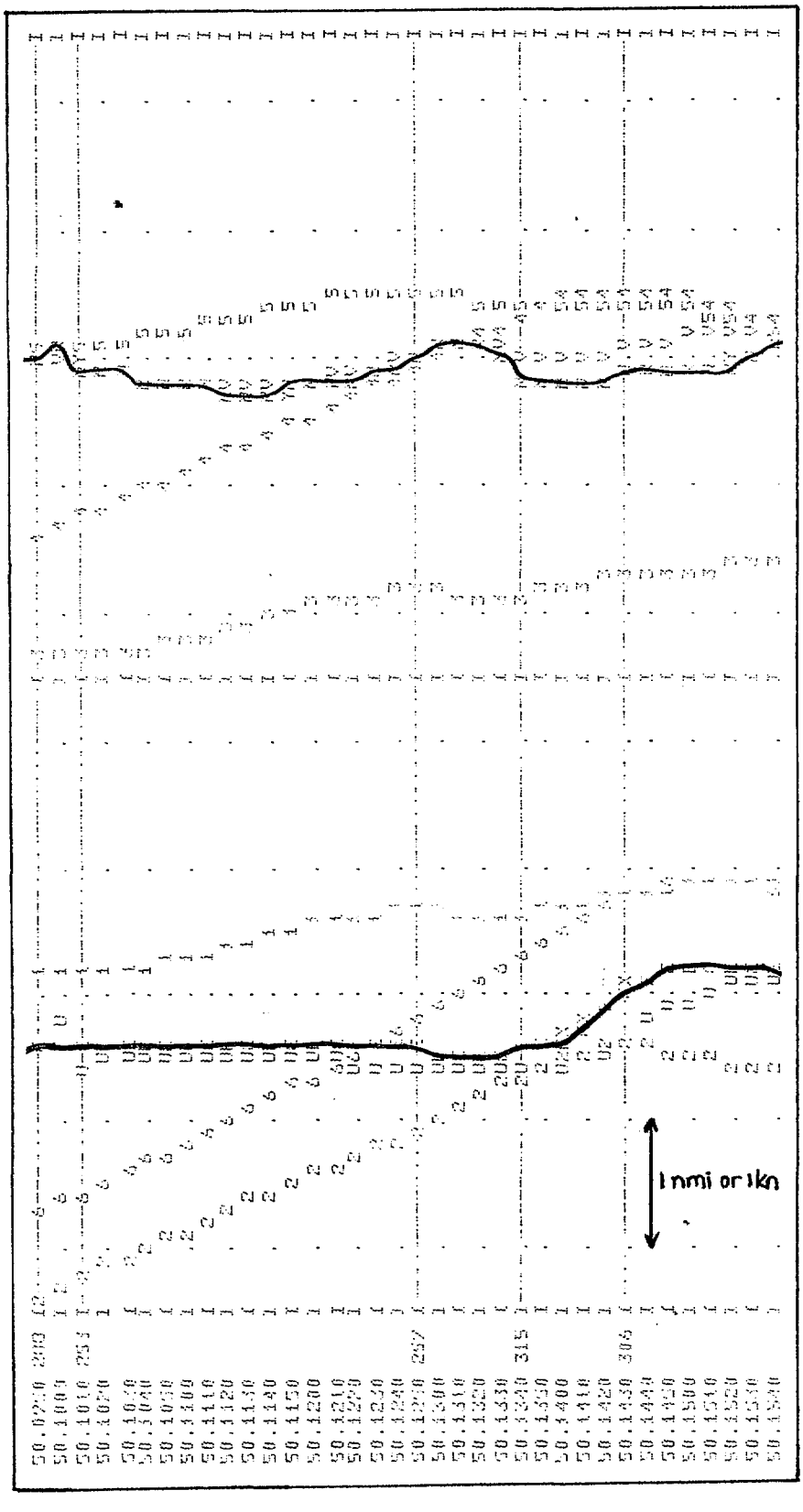

TABLE 7:

Final channel allocations.

Channel number	Contents
1	Time (SS.DDD)
2	Time (.HHMMSS)
3	Latitude (radians)
4	Longitude (radians), relative to 100° E
5	Water depth (meters)
6	Gravity ($um.s^{-2}$)*0.1
7	Total magnetic field (nT)
8	Not used

DATA AVAILABILITY

The Tasman Sea non-seismic data is 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.

b. Analogue Displays - on paper and film.

Lambert's Conformal projection maps at a scale of 1:1000000:
- Cruise track charts
- Profile maps of bathymetry, free-air anomaly and magnetic anomalies
- Posted value maps of bathymetry, observed gravity, total magnetic field and magnetic anomalies

Enquiries concerning the data should be addressed to:

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

SURVEY 77, TASMAN SEA, MAPS PRODUCED

Track Maps	Sheet Nos.	Product No.
1:1000000 Sheet Name		
SH57	1-5	M-77M0001P
SYDNEY (SI56)	2-5	M-77M0002P
SI57	3-5	M-77M0003P
MELBOURNE (SJ55)	4-5	M-77M0004P
BODALLA (SJ56)	5-5	M-77M0005P
Profile Maps		
Bathymetric Profiles	1-2 / 2-2	M-77M0006P
Free-Air Anomaly Profiles	1-2 / 2-2	M-77M0007P
Magnetic Anomaly Profiles	1-2 / 2-2	M-77M0008P
Post Maps		
Bathymetric values	1-2 / 2-2	M-77M0009P
Observed Gravity Values	1-2 / 2-2	M-77M0010P
Total Magnetic Field Values	1-2 / 2-2	M-77M0011P
Magnetic Anomaly Values	1-2 / 2-2	M-77M0012P

Figure 4: Track of BMR Survey 77.

SCALE 1:10000000