CANADA

DEPARTMENT OF ENERGY, MINES AND RESOURCES

Geological Survey of Canada

MARINE GRAVITY AND MAGNETIC MAPS, NORTHEAST OF NEWFOUNDLAND

by

R.A. FOLINSBEE, R.T. HAWORTH
and J.B. MACINTYRE

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INTRODUCTION

Data were collected and processed under the supervision of the Atlantic Geoscience Centre during surveys conducted by the Canadian Hydrographic Service (Atlantic Region). Data contouring was carried out under contract by Digitech Systems Ltd., Calgary under the supervision of R.A. Folinsbee of Atlantic Geoscience Centre.

Digital Data for this map may be obtained at user's expense from the Computer Science Centre, 588 Booth St., Ottawa, K1A 0E4. (Request open file #391).

NAVIGATION

The primary navigation systems employed during collecting of the data shown on this map were Decca 12F and Loran-C, both operating in a range-range mode. (Decca 12F was not used during much of the cruise Hudson 75-009.) Ranges to the shore stations were measured by comparing the signals from the shore stations against a time signal from a precise cesium beam clock carried onboard the survey vessel. Satellite navigation was used to calculate clock drift and synchronization errors. Speed and heading information from the Loran-C and Decca was used to improve the accuracy of the satellite positioning. The navigation is usually accurate to within 200 meters.

MAGNETICS

A towed proton precession magnetometer was used to measure the absolute magnitude of the earth's total field at the indicated positions along ship's track.

The magnetic anomaly values were calculated by subtracting the International Geomagnetic Reference field (IGRF 75) from each total field value.

Instrumental error, diurnal and secular variations, magnetic storms and navigation error lead to discrepancies at line intersections (Crossovers). Where errors could be identified, they have been corrected. The root mean square crossover discrepancy provides an estimate of the internal consistency of the survey.

GRAVITY

Data were measured by a shipborne gravimeter at indicated positions along ship's track.

The gravity values on which this map is based have been calculated using the new Gravity Reference Field (I.G.F. 1967) and base values adjusted to the new "International Gravity Standardization Net" (I.G.S.N. 1971).

There will be a difference between these maps and previous editions based in the old gravity system of about 6.5 mgal.(subtract 6.5 mgal from old maps to convert to the new system).

The descriptions and gravity values of all gravity base reference stations may be obtained from the Earth Physics Branch (Gravity Division) Department of Energy, Mines and Resources, Ottawa.

The simple Bouguer correction was obtained by calculating the gravitational effect of an infinite plate of thickness equal to water depth at the observation:

$$C_B = 0.0419277 \times D \times (\rho_c - \rho_w) \qquad [1]$$

where D = water depth (metres) uncorrected for Mathew's tables (assuming a velocity of sound in water of 1463 m/sec)

ρ_c = assumed crustal density of 2.67 g/cc.

ρ_w = density of sea water = 1.03 g/cc

Survey accuracy is affected by:

Instrumental error (a) meter drift (b) noise due to imperfectly compensated acceleration applied to the meter by a ship at sea and (c) navigational error giving inaccurate Eötvös corrections.

Together the errors lead to discrepancies at line intersections (crossovers). Where errors could be identified, they were corrected. The root mean square discrepancy provides an estimate of the internal consistency of the survey.

Data from many different cruises has been used in the preparation of these maps. Each phase of a cruise has been assigned a unique number (1 through 14) and the gravity equipment, base stations and meter drift applicable to that phase are given in table 1.

The "Equipment-Meter/Gyro" column is interpreted as follows:

Meter No.	Meter type Graf-Askania	Calibration Constant (mgal/measuring spring div.)
1	GSS-2-17	0.5043
2	GSS-2-26	0.4986
3	GSS-2-27	0.4742

Stabilization: Anschutz gyro stabilized platform with:

(A) Oil erected gyro

(B) Electrically erected gyro

Table 2 shows the gravity ties between the Harbour stations and the Earth Physics Branch base stations.

In table 3, the individual statistics for each map are shown. The phase number refers to the phases as given in table 1.

Table 4 shows the number of track intersections and the root mean square difference for each parameter. In general there are significantly more intersections for magnetics than for gravity because more gravity data has been rejected.

TABLE #1

Phase	Station* (See Table 2)	Date	BIO Cruise No.	Equipment Meter/Gyro	Closure Error (mgal)	Drift (mgal/day)
1	Bedford Inst. of Oceanography	27-6-73	73-019	2/A	-42.73	-2.5
2	St. John's Berth #10	14-7-73	73-019	2/A	-21.19	-1.01
3	St. John's Berth #8	4-8-73	73-019	2/A	-47.17	-1.68
4	St. John's Berth #8	1-9-73	73-019	2/A	- 3.06	-0.2
5	St. John's Berth #8	15-9-73	73-019	2/A	-13.72	-1.06
6	St. John's Berth #8	29-9-73	73-019	2/A	- 1.39	-0.87
	Bedford Inst. of Oceanography	15-10-73				
7	Bedford Inst. of Oceanography	2-7-75	75-018	1/B	0.6	0.02
	St. John's Berth #26	1-8-75		2/B	0.5	0.02
8	St. John's Berth #9	4-8-75	75-018	1/B	1.8	0.07
	St. John's Berth #26	29-8-75		2/B	1.2	0.05
9	St. John's Berth #26	29-8-75	75-018	1/B	0.7	0.03
	St. John's Berth #26	19-9-75		2/A,B	-0.1	-0.00
10	St. John's Berth #9	19-9-75	75-018	1/B	-3.3	-0.13
	Bedford Inst. of Oceanography	14-10-75		2/A	-8.5	-0.34
11	Bedford Inst. of Oceanography	18-7-75	75-009	3/B	3.45	0.1
	St. John's Berth #4	21-8-75				
12	St. John's Berth #4	22-8-75	75-009	3/B	-1.2	-0.04
	Skibshavnen Dock (east)	22-9-75				
13	Bedford Inst. of Oceanography	18-6-74	74-023		***	
	Skibshavnen Dock (west)	13-8-74				

Table 1 (cont'd)

Phase	Station*	Date	BIO Cruise No.	Equipment meter/gyro	Closure Error mgal	Drift mgal/day
14	St. John's Berth #8 St. John's Berth #10	4-8-72 25-8-72	72-015	2/A	1.08	0.05

* Berth Numbers shown for St. John's, Nfld. Refer to CHS Chart #4588 - St. John's Harbour.

*** Three meters were used (Graf-Askania Gss-2-17, Gss-3-1 and a Lacoste & Romberg S-54). These data were compared and adjusted for optimum consistency.

TABLE #2

HARBOUR STATION			BASE REFERENCE		
Location	Connection (g_b-g_h)	g_h (mgal)	Location	EPB Station No.	g_b (mgal)
Bedford Institute of Oceanography	---	980562.8	Bedford Institute of Oceanography	9861-62	980562.8
St. John's Berth #8	-20.5	980828.4	St. John's, Nfld. Airport	9513-63	980807.88
St. John's Berth #9	- 1.23	980828.29	St. John's, Nfld. M.O.T. Wharf	9402-72	980827.06
St. John's Berth #10	-20.6	980828.5	St. John's Nfld. Airport	9513-63	980807.88
St. John's Berth #4	- 0.20	980827.79	Nfld. Steam Ship Lines Jetty, St. John's	9401-72	980827.59
St. John's Berth #26	1.14	980826.45	Nfld. Steam Ships Lines Jetty, St. John's	9401-72	980827.59
Skibshavnen Dock (east) Godthaab, Greenland	1.38	982190.63	Godthaab, Greenland	9801-72	982192.01
Skibshavnen Dock (west) Godthaab, Greenland	---	982191.54	Godthaab, Greenland	9331-74	982191.54

TABLE #3

		MAGNETICS			GRAVITY			
					FREE AIR		BOUGUER	
PHASE	Cruise No.	No. of Observations	No. of Diurnal Corrections	No. of Manual Corrections	No. of Observations	Manual Corrections	No. of Observations	Manual Corrections
					MAP 15092			
1					417	417	414	414
					1982	1982	1982	1982
3	73-019	3829	3800	21				
4					195	195	194	194
5					183	183	183	183
9	75-018	89	(A)	0	359	0	358	0
11	75-009	1562	(A)	269	1083	1083	1083	1083
13	74-023	375	(A)	0	19	19	19	19
14	72-015	7	7	0	2	0	2	2
	TOTAL	5862			4240		4235	
					MAP 18518			
					317	317	317	317
1	73-019	589	589	0				
4					118	118	118	118
7					2356	292	2348	292
8	75-018	5144	(A)	0	2241	198	2240	197
9					363	0	363	0
12	75-009	15	(A)	0	9	9	9	9
	TOTAL	5748			5404		5395	

		MAGNETICS			GRAVITY			
					FREE AIR		BOUGUER	
PHASE	Cruise No.	No. of Observations	No. of Diurnal Corrections	No. of Manual Corrections	No. of Observations	Manual Corrections	No. of Observations	Manual Corrections
					MAP 18528			
7					1196	0	1196	0
8	75-018	3686	(A)	0	1476	0	1476	0
10					185	172	185	172
12	75-009	297	(A)	0	292	292	292	292
	TOTAL	3983			3149		3149	
					MAP 18538			
7					2553	386	2553	386
8	75-018	3319	(A)	0	631	0	631	0
12	75-009	309	(A)	0	283	283	283	283
	TOTAL	3628			3467		3467	
					MAP 18604 (B)			
4	73-019	244	244	0	176	176	176	176
7					280	0	260	0
8	75-018	3177	(A)	0	63	0	63	0
9					2720	0	2717	0
11	75-009	10793	(A)	3511	10304	10081	10236	10227

		MAGNETICS			GRAVITY			
					FREE AIR		BOUGUER	
PHASE	Cruise No.	No. of Observations	No. of Diurnal Corrections	No. of Manual Corrections	No. of Observations	Manual Corrections	No. of Observations	Manual Corrections
13	74-023	232	(A)	0	45	45	45	45
	TOTAL	14426			13588		13497	
					MAP 18610			
1					124	124	124	124
	73-019	693	693	0				
4					348	348	348	348
7					3304	352	3221	287
8	75-018	9691	(A)	0	2045	581	2045	581
9					4421	243	4421	243
12	75-009	143	(A)	0	98	98	98	98
13	74-023	96	(A)	0	67	67	67	67
	TOTAL	10623			10407		10324	
					MAP 18612			
3					207	207	207	207
	73-019	758	758	133				
4					384	384	384	384
7					3454	0	3454	0
8	75-018	10507	(A)	0	3084	361	3083	361
9					4284	0	4284	0

		MAGNETICS			GRAVITY			
					FREE AIR		BOUGUER	
PHASE	Cruise No.	No. of Observations	No. of Diurnal Corrections	No. of Manual Corrections	No. of Observations	Manual Corrections	No. of Observations	Manual Corrections
11	75-009	318	(A)	189	192	192	192	192
13	74-023	--	--	--	65	65	65	65
	TOTAL	11583			11670		11669	
					MAP 18614			
4	73-019	185	185	25	122	122	122	122
7					2157	0	2129	0
8					2435	201	2432	201
	75-018	8928	(A)	0				
9					3911	0	3907	0
10					276	0	275	0
11	75-009	6878	(A)	4601	6253	6253	6207	6207
13	74-023	138	(A)	0	31	31	31	31
	TOTAL	16129			15185		15103	
					MAP 18620			
7					1233	0	1233	0
8	75-018	8246	(A)	0	1860	0	1860	0
10					5050	658	5049	2657
13	74-023	164	(A)	0	63	63	63	63
	TOTAL	8410			8206		8205	

		MAGNETICS			GRAVITY			
					FREE AIR		BOUGUER	
PHASE	Cruise No.	No. of Observations	No. of Diurnal Corrections	No. of Manual Corrections	No. of Observations	Manual Corrections	No. of Observations	Manual Corrections
					MAP 18508			
1					302	302	302	302
2					423	423	423	423
3	73-019	2763	2732	247	68	68	67	67
4					200	200	199	199
5					315	315	315	315
7					311	311	311	311
	75-018	1690	(A)	1690				
8					688	0	653	0
11	75-009	364	(A)	364	126	126	126	126
	TOTAL	4817			2433		2396	
					MAP 18600			
1					192	192	192	192
2					197	197	187	187
3	73-019	5234	4968	718	1279	1279	1278	1278
4					646	646	646	646
5					502	502	502	502
					116	116	116	116
7	75-018	1822	(A)	1822				
9					1591	0	1591	0
12	75-009	115	(A)	115	83	83	83	83
13	74-023	315	(A)	315	38	38	38	38

		MAGNETICS			GRAVITY			
					FREE AIR		BOUGUER	
PHASE	Cruise No.	No. of Observations	No. of Diurnal Corrections	No. of Manual Corrections	No. of Observations	Manual Corrections	No. of Observations	Manual Corrections
	TOTAL	7486			4644		4633	
					MAP 18602			
1					102	102	101	101
2					186	186	186	186
3	73-019	5542	5192	530	1281	1281	1280	1280
4					824	824	824	824
5					714	714	713	713
8					352	0	352	0
	75-018	2900	(A)	2900				
9					2473	0	2473	0
11	75-009	1928	(A)	1928	1571	1571	1571	1571
13	74-023	99	(A)	0	27	27	27	27
	TOTAL	10469			7530		7527	

(A) No corrections for diurnal variations have been applied. Values considered to be erroneous have been deleted.

(B) Map area 18604 includes data from adjacent areas; 18606, 15096 and 15094.

TABLE #4

CROSSOVER STATISTICS

EDITION MAP	NO.	B (FREE AIR ANOMALY) RMS (MGAL)	NO.	C (MAG TOTAL FIELD) RMS (nT)	NO.	D (BOUGUER ANON) RMS (mgal)	NO.	E (MAG ANON) RMS (nT)
15092	76	2.8	134	24	73	3.0	134	24
18508	15	2.9	54	16	16	2.5	54	20
18518	25	3.0	33	28	29	3.4	33	22
18528	13	1.9	16	23	12	2.6	16	22
18538	10	1.0	10	40	9	1.6	10	40
18600	33	3.7	120	19	30	3.7	121	16
18602	139	3.2	297	26	139	3.3	298	26
18604	132	2.7	168	29	131	2.6	167	31
18610	19	2.2	59	26	19	2.0	59	27
18612	57	2.7	63	31	55	2.6	63	30
18614	131	2.8	158	36	125	2.8	158	37
18620	6	2.6	21	44	6	2.4	21	44