MULTIPARAMETER SURVEY DATA FROM THE SCOTIAN MARGIN

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Multiparameter Survey Data From the Scotian Margin

The data in the Open File were collected during survey cruise 79-015 aboard the Canadian Scientific Ship BAFFIN in September-October 1979 (see Figure 1 for the cruise track plot). Participating agencies were the Atlantic Region of the Canadian Hydrographic Service (Dept. of Fisheries and Oceans); the Atlantic Geoscience Centre of the Geological Survey of Canada (Dept. of Energy, Mines,and Resources); and the Gravity and Geodynamics Division of the Earth Physics Branch (DEMR). Senior personnel representing these agencies during the survey were: G. W. Henderson (Hydrographer-in-charge), R. A. Folinsbee, and D. Halliday.

Navigation

Navigation was performed by BIONAV - the Bedford Institute of Oceanography integrated navigation system - which combines fix information from the U. S. Navy Navigation Satellite System, range-range LORAN-C, and ship's log and gyro to yield continuous positions (Wells et al, 1980). At the 1σ level positional accuracy on this survey was estimated to be within 100 meters (Grant, personal communication).

Instrumentation

Water depth was measured with a 12 KHZ transducer driven by a Raytheon PTR-105B transceiver and recorded on a Raytheon Line Scan Recorder. Total magnetic field was measured with a Varian model V-75 proton precession magnetometer connected to a Barringer sensor which was towed some 200 meters astern of the ship. Total gravity field was measured with La Coste and Romberg sea gravity meter number S-56.

Data Processing

All data in this Open File have had at least a preliminary editing to remove or correct values which were found to be wrong.

The magnetic anomaly field was derived relative to IGRF 1975 (IAGA Division 1 Study Group, 1976). No corrections were applied for diurnal variations or for magnetic storms.

Gravity data were subjected to a standard processing sequence: correction for Eotvos effect; derivation of the free-air anomaly, and calculation of the Bouguer anomaly using a simple slab correction (slab thickness equal to water depth at observation point, with an assumed density of 1.64 gm/cc). The 1967 gravity reference field was used for gravity calculations, with base values connected to the 1971 International Gravity Standardization Net. Linear drift corrections were applied to remove closure errors observed in port; and remaining crossover differences were reconciled by a least squares adjustment.

Accuracy

Some idea of the internal consistency of the data can be gained from an examination of the histograms of discrepancies in bathymetric, magnetic, and gravimetric values at track crossover points. (See Figures 2, 3, 4 and 5). Assuming a normal distribution, a statistical analysis shows that 100% and 86% of the discrepancies in the adjusted free-air and Bouguer gravity anomalies, respectively, fall within plus or minus one milligal. (The wider spread of the Bouguer discrepancies arises from errors in the bathymetry). 54% of the total magnetic field discrepancies fall within plus or minus 25 nanotesla, 23% lie within the plus or minus 10 nanotesla range.

Bathymetric data in the Open File are uncorrected for sound velocity (all soundings were based on an assumed sound velocity of 1463 m/s) and factors such as tides and transducer depth. In general, the sound velocity error is a function of depth and may be estimated by consulting a standard table of corrections such as Matthews (1939). For this survey, the sound velocity error ranges from -3 metres at a depth of 200 metres to -110 metres at 4500 metres. The tidal range throughout the survey area is estimated to be less than 2 metres (Dohler, 1964). Transducer depth was approximately 5 metres.

For most of the survey period, daily variations in the total magnetic field measured at the EPB observatory in St. John's, Newfoundland, ranged between 10 and 20 nanotesla. On two magnetically disturbed days, the variations were in the order of 40 and 60 nanotesla.

Gravity values are believed to be accurate to within 1 or 2 milligals, based on a preliminary comparison of data at near-coincident points on the Scotian Shelf where both sea surface and sea floor measurements were available.

Construction of Contour Maps

The computer-drawn contour maps in this Open File portray total magnetic field, free-air gravity anomaly, Bouguer gravity anomaly, and magnetic anomaly (see Figures 6, 7, 8, and 9). There were produced on a Lambert conformal projection at a scale of one to one million, using standard parallels of 43 and 49 degrees.

To produce the contour maps, the data points were first gridded over a matrix of two-minute (latitude) by four-minute (longitude) cells: for each cell, all points within the cell boundary were averaged, and the mean value was assigned to a position at the midpoint of the cell. These numbers were

then fed to the CalComp General-Purpose Contouring Package II (GPCP II). All processing was carried out on a Cyber 170 main frame at the Bedford Institute of Oceanography.

Magtape Formats

The data used to produce the contour maps described in the preceding section are also distributed in digital form on 9-track magnetic tape. Depending on user specifications, the tape is coded in ASCII or EBCDIC, with a density of 800, 1600, or 6250 bpi.

Data are written in card-image format, in blocks of 50 cards. Each magnetic tape record consists of 4000 characters, except for the last record, which may be shorter. A double end-of-file follows the final record.

Each card image represents one observation point. Information is arranged on the card as described in the following table.

Columns (inclusive)	Parameter
1-5	Cruise number: 79015
6-8	Day number
9-12	GMT (Hour and minute)
13-20	Latitude x 10^6 e.g. 46573265 = 46.573265^{o}N
21-29	Longitude x 10^6 e.g. 58321759 = 58.321759^{o}W
30-33	Uncorrected bathymetry (metres) - zero if missing
34-38	Total magnetic field (nanotesla) - zero if missing
39-42	Meaningless: 9999
43-47	Magnetic anomaly (nanotesla), computed with reference to IGRF 1975.

48-55	Total gravity field (mgal)
56-59	Adjusted free-air gravity anomaly (mgal)
60-63	Eotvos correction (mgal), already applied.*
64-66	Adjustment values (mgal), already applied to free air and Bouguer anomalies
67-70	Adjusted Bouguer gravity anomaly (mgal)
71-80	Blank

* On the magnetic tape prepared for this Open File, Eotvos corrections don't appear in those relatively few observation points where total magnetic field readings are missing. (This was caused by a program error prior to the preparation of the magnetic tape.) The missing corrections, however, have all been previously calculated and applied to the gravity readings to obtain values for the total gravity field.

Bibliography

Dohler, G. 1964. Tides in Canadian Waters. Canadian Hydrographic Service, Ottawa.

IAGA Division 1 Study Grcup 1976. International Geomagnetic Reference Field 1975. Transactions of the AGI, Vol. 57, No. 3, pages 120-121.

Matthews, D.J. 1939. Tables of the velocity of sound in pure water and sea water. (H.D. 282) Admiralty Hydrographic Department, London.

Wells, D.E., Grant, S.T. and McKeown, D.C. 1980. Accuracy of the Bedford Institute of Oceanography integrated navigation system (BIONAV). Proceedings of the 19th annual Canadian Hydrographic Conference, Halifax.

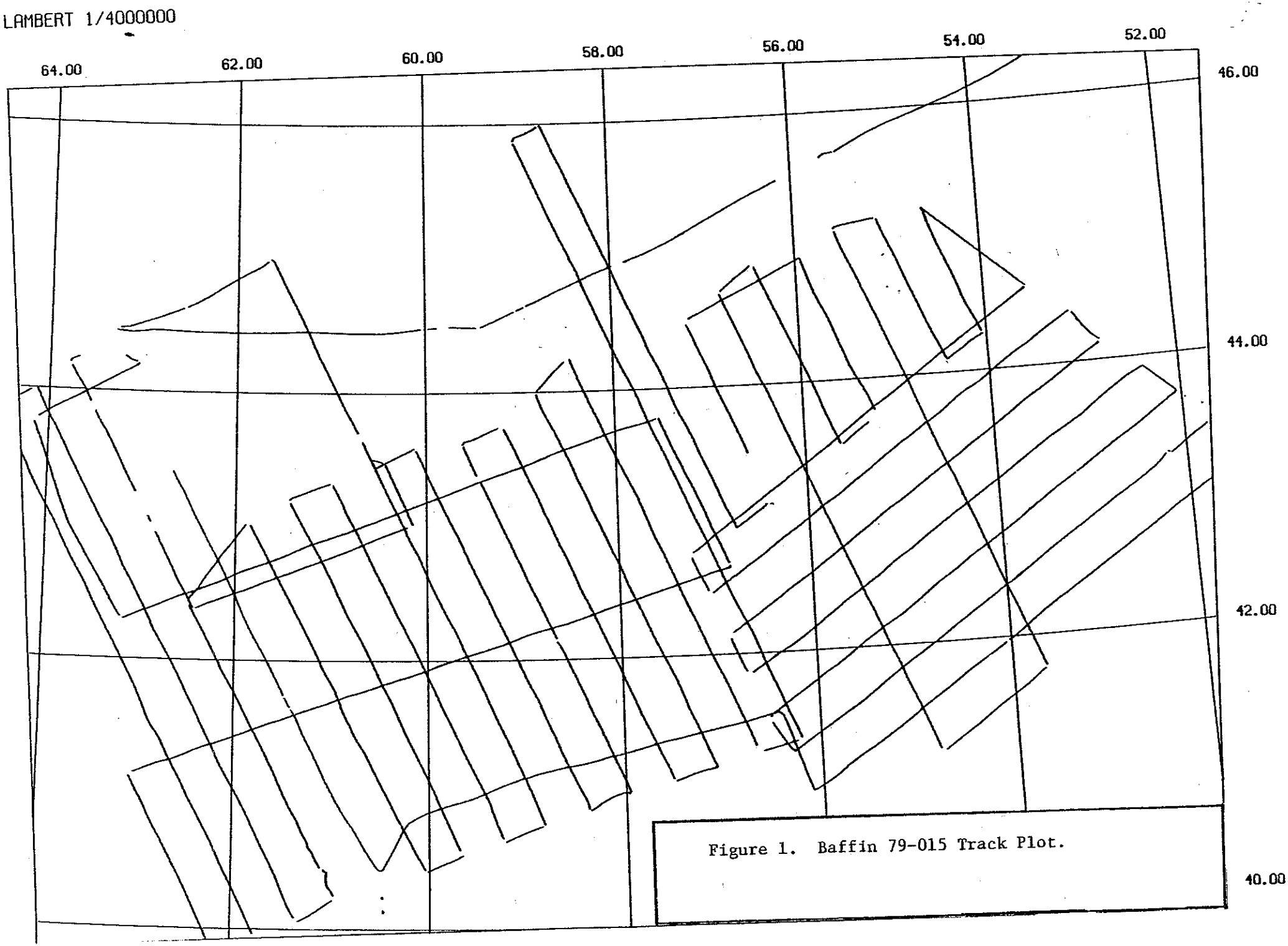
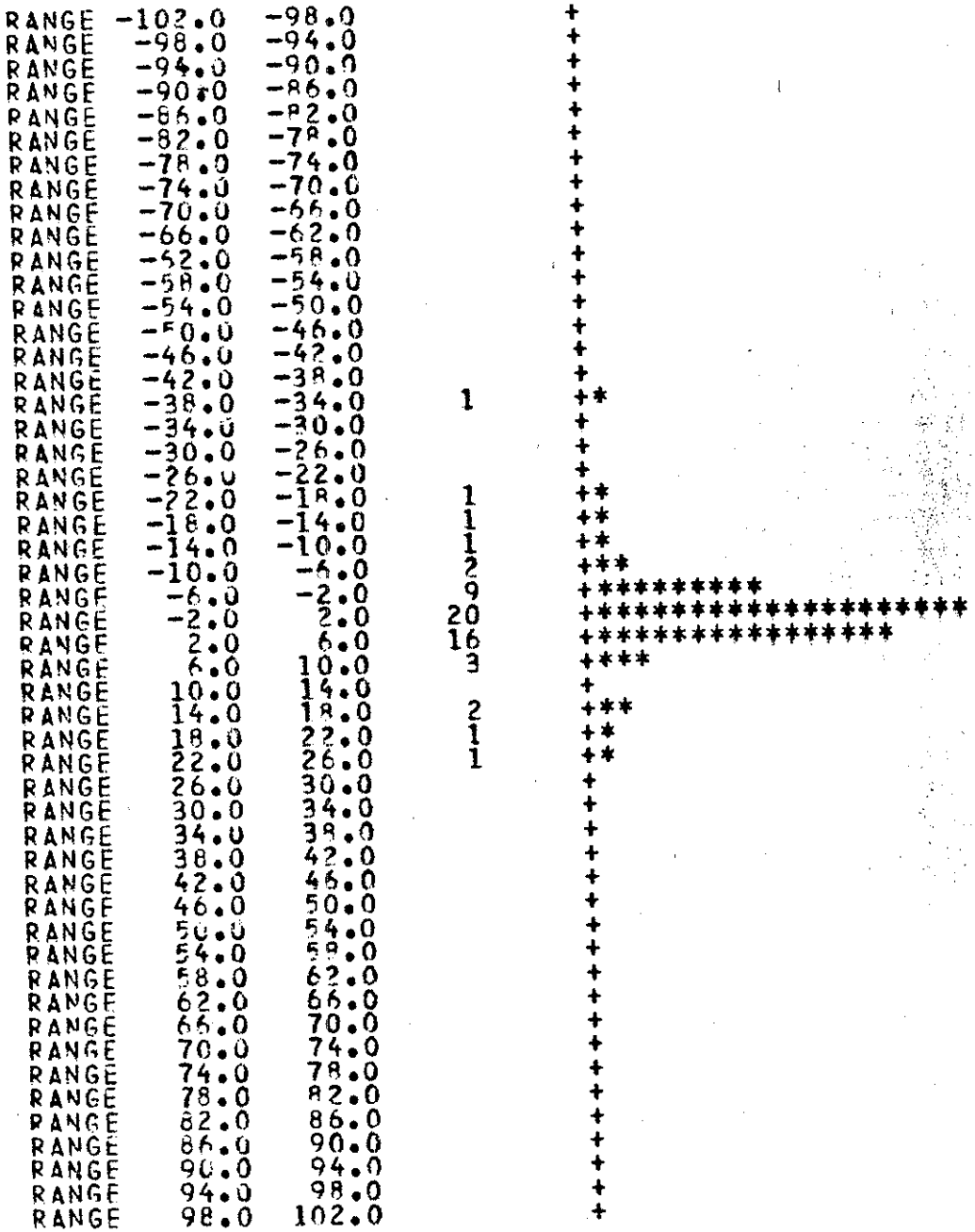


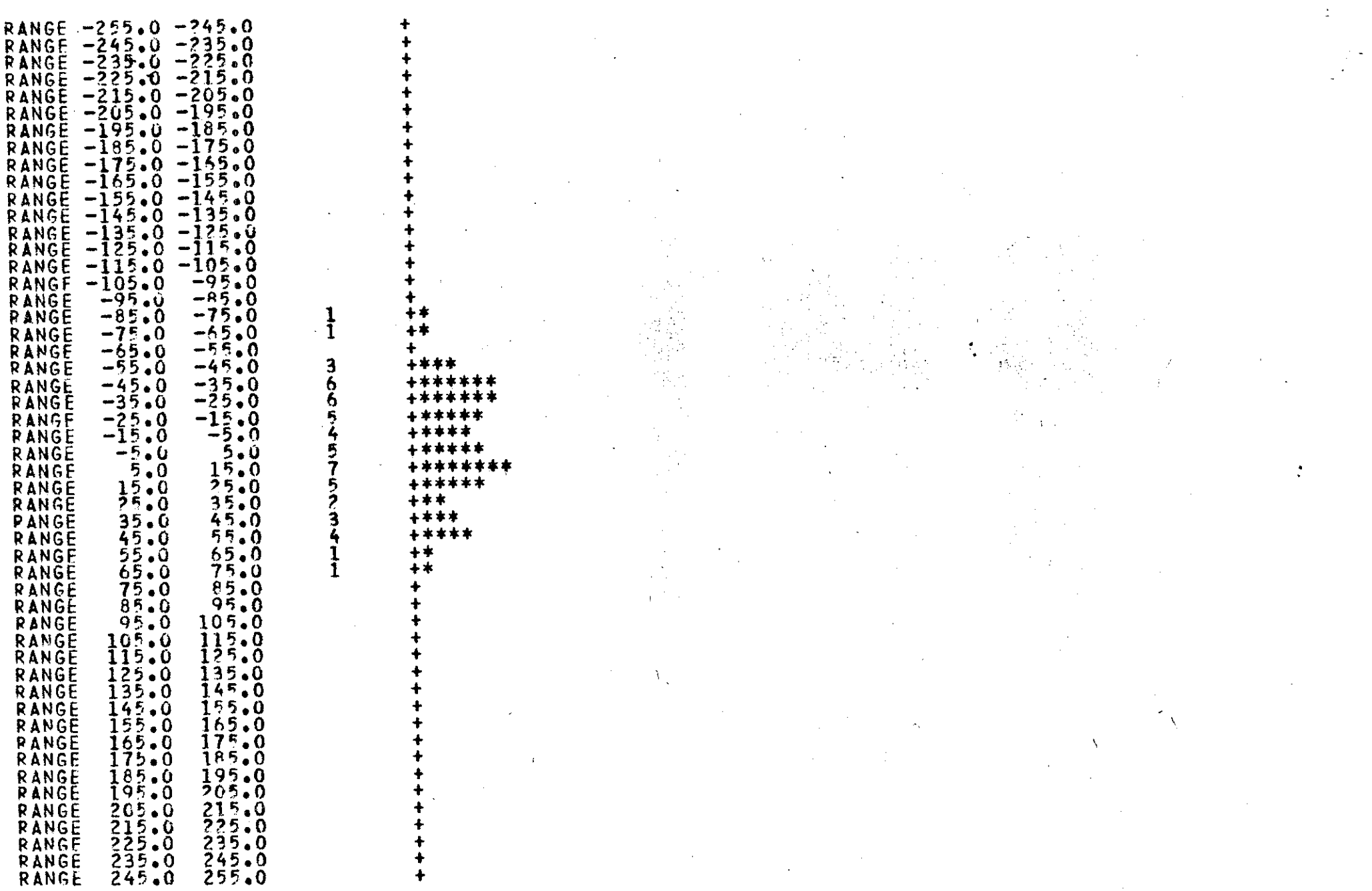
Figure 1. Baffin 79-015 Track Plot.



STATISTICS ON CROSSOVER BAFFIN 79-015 BATHYMETRY

NUMBER POINTS.....	58
MEAN DIFFERENCE.....	.45
STANDARD DEVIATION..	8.33
TOTAL REJECTIONS....	1

Figure 2, Histogram of Crossover Discrepancies In Bathymetry (Metres).

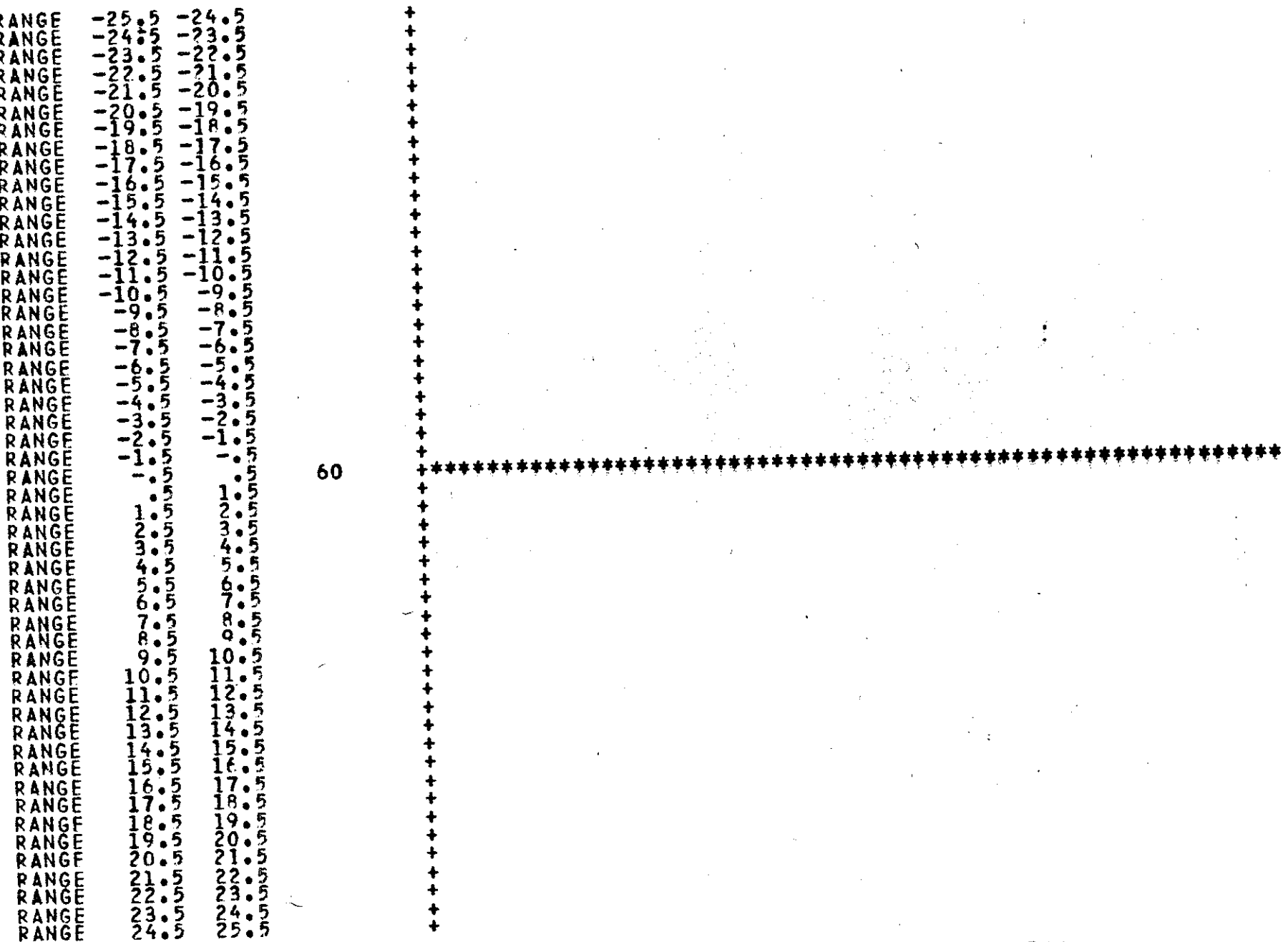


STATISTICS ON CROSSOVER BAFFIN 79-015 MAGNETICS

NUMBER POINTS.....	54
MEAN DIFFERENCE.....	-4.14
STANDARD DEVIATION..	33.89
TOTAL REJECTIONS....	0

Figure 3. Histogram of Crossover Discrepancies in Total Mag Field (Nanotesla).

HISTOGRAM OF CROSSOVER BAFFIN 79-015 ADJUSTED GRAVITY

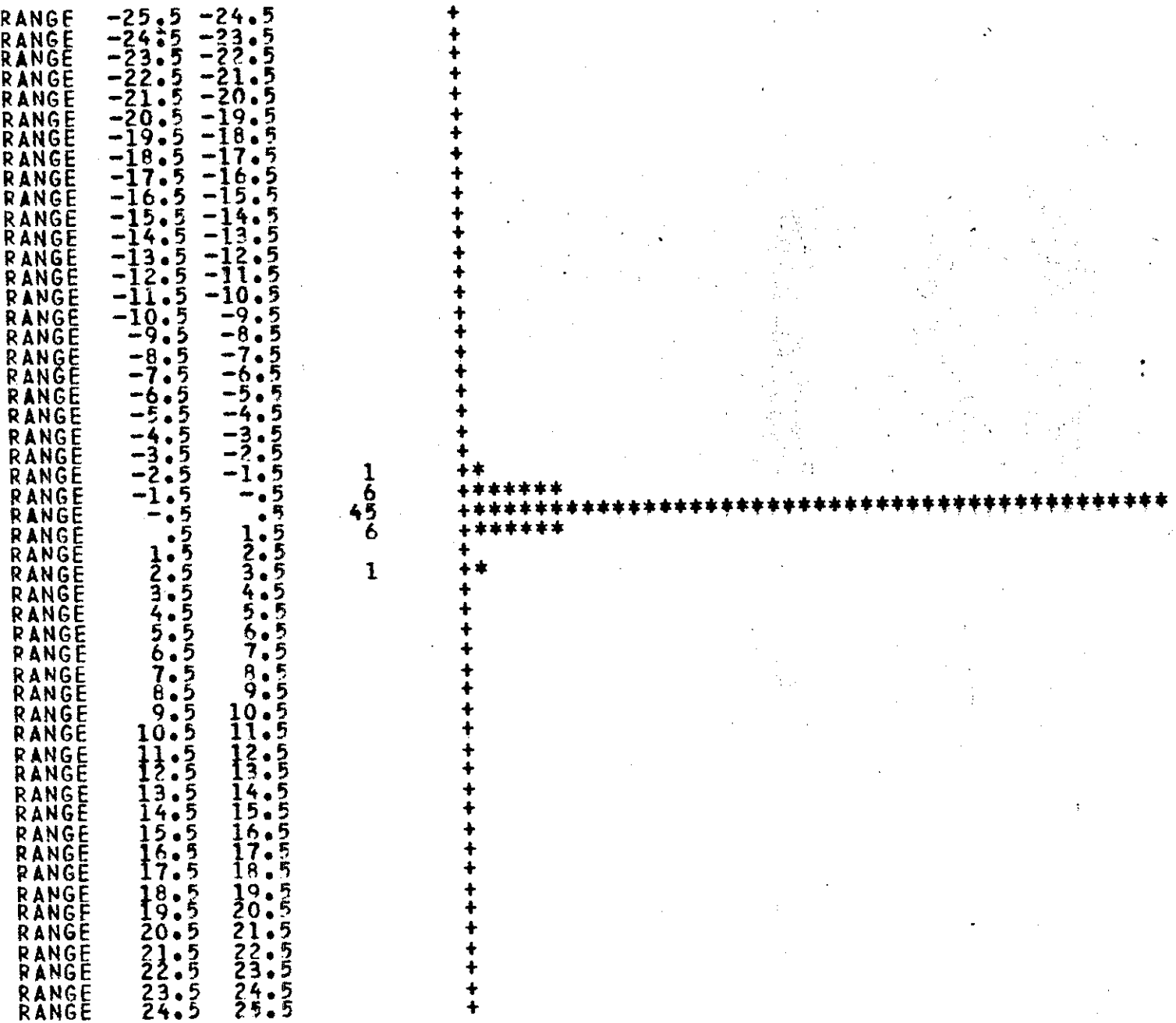


STATISTICS ON CROSSOVER BAFFIN 79-015 ADJUSTED GRAVITY

NUMBER POINTS.....	60
MEAN DIFFERENCE.....	.00
STANDARD DEVIATION..	.11
DRIFT(MGLS/DAY).....	.005
TOTAL REJECTIONS....	0
INSTRUMENT(S) USED..	A 2779

Figure 4. Histogram of Crossover Discrepancies In Free Air Gravity Anomaly (Milligals).

HISTOGRAM OF CROSSOVER BAFFIN 79-015 BOUGUER ANOMALIES



STATISTICS ON CROSSOVER BAFFIN 79-015 BOUGUER ANOMALIES

NUMBER POINTS.....	59
MEAN DIFFERENCE.....	.09
STANDARD DEVIATION..	.67
DRIFT(MGLS/DAY).....	.001
TOTAL REJECTIONS....	0
INSTRUMENT(S) USED..	A 2779

Figure 5. Histogram of Crossover Discrepancies in Bouguer Gravity Anomaly (Milligals).

T-F- 2X4 60X60 20X10

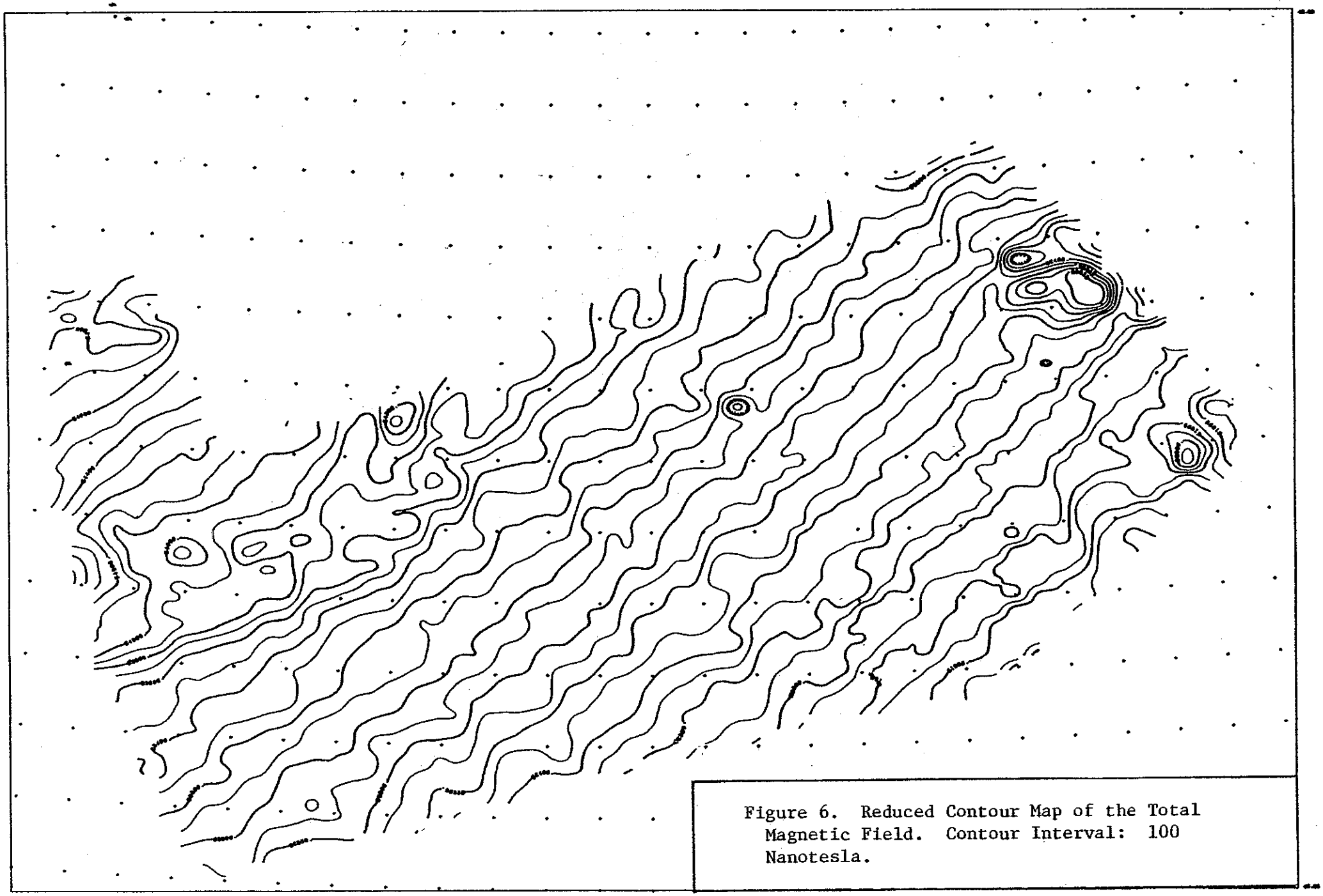


Figure 6. Reduced Contour Map of the Total Magnetic Field. Contour Interval: 100 Nanotesla.

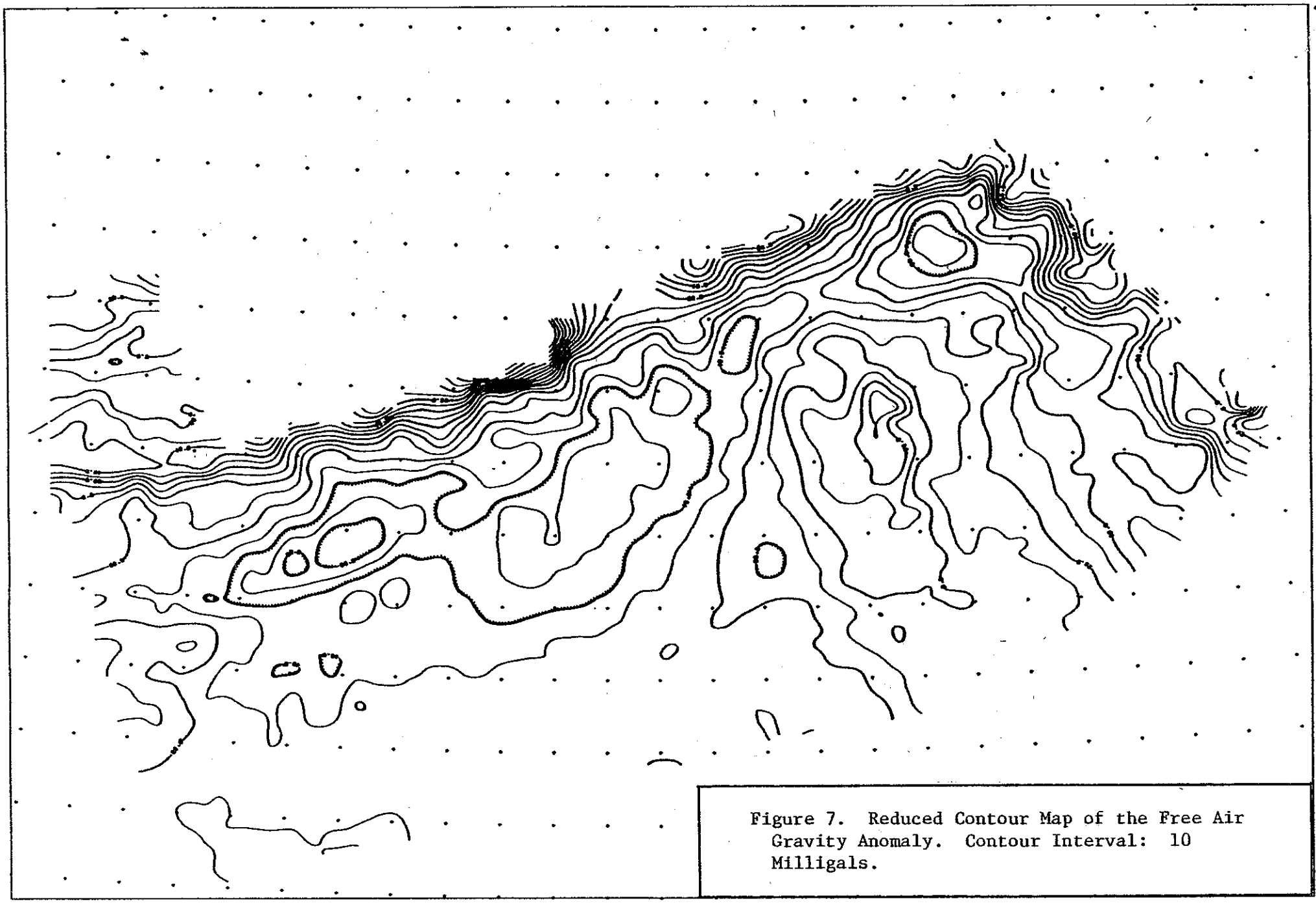


Figure 7. Reduced Contour Map of the Free Air Gravity Anomaly. Contour Interval: 10 Milligals.

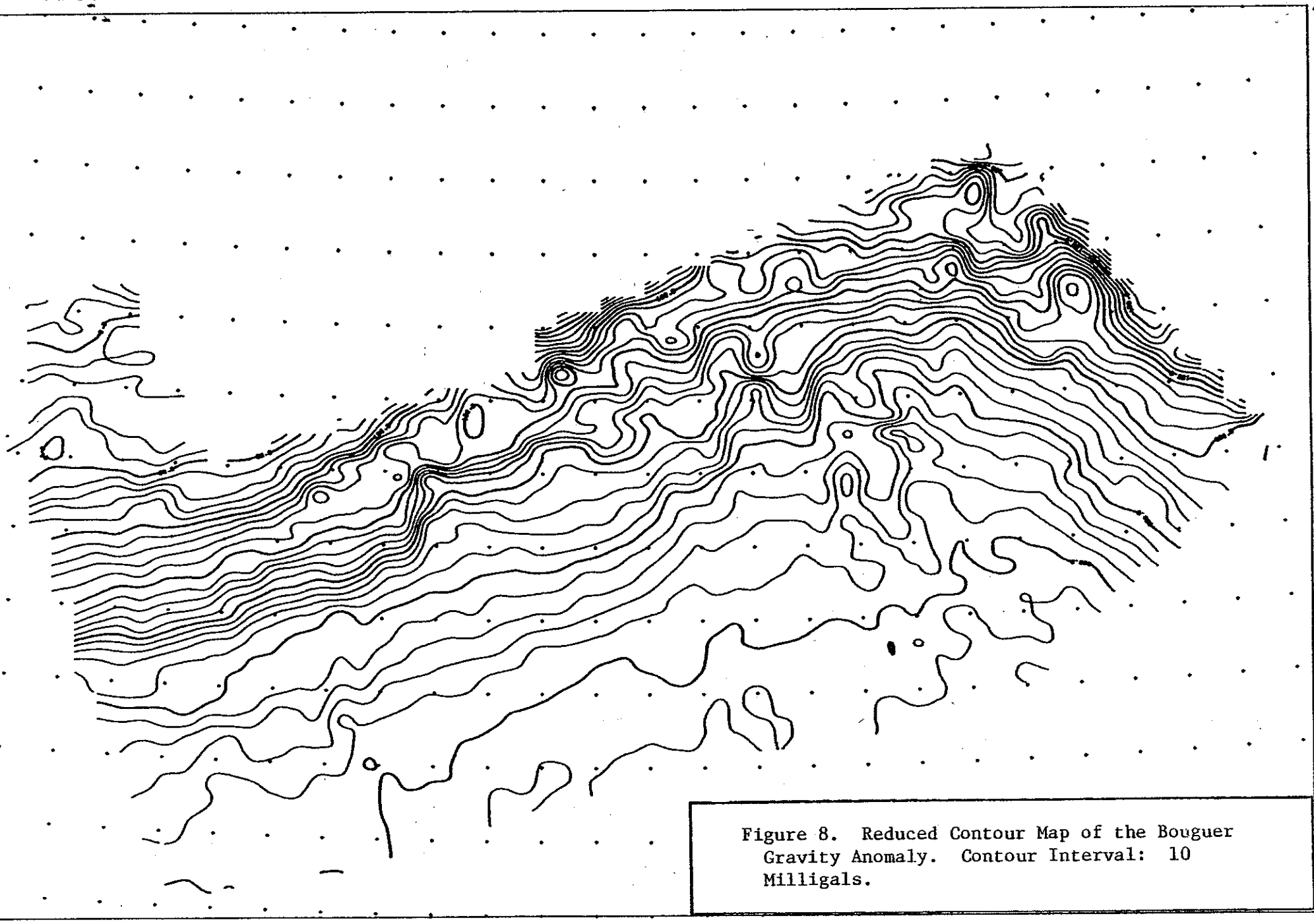


Figure 8. Reduced Contour Map of the Bouguer Gravity Anomaly. Contour Interval: 10 Milligals.

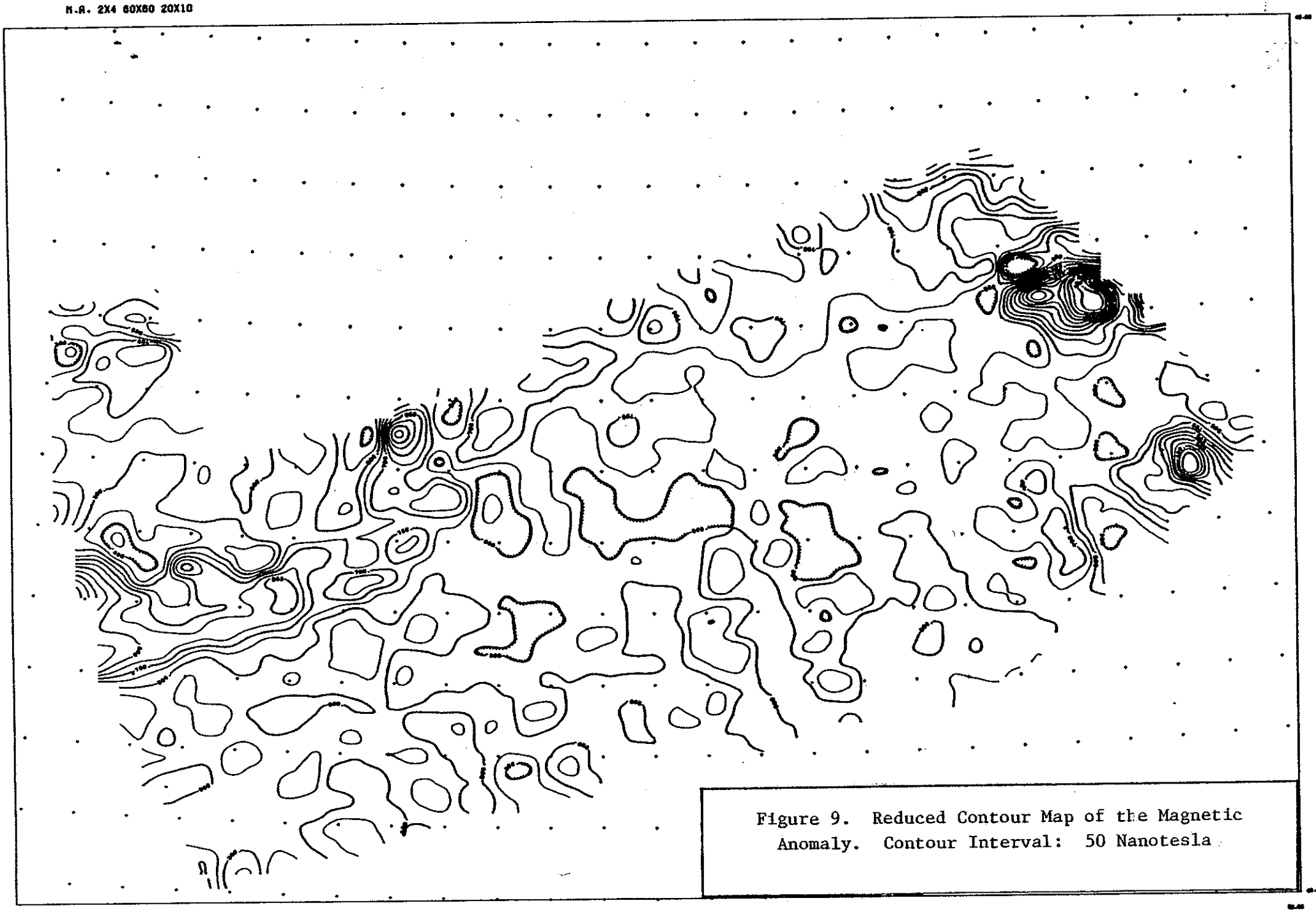


Figure 9. Reduced Contour Map of the Magnetic Anomaly. Contour Interval: 50 Nanotesla