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A Program for Storing Oceanographic Data on Magnetic Tape

MARILYN L. BLODGETT

Research Computation Center
Office of Director of Research

and

JAMES V. MASSINGILL

Propagation Branch
Acoustics Division

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20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

A program has been written for the storage of navigation, bathymetry, and magnetics data on magnetic tape in BCD form. This eliminates the problem of storing vast amounts of data collected on computer cards by oceanographic and geophysical cruises. This program uses a slightly modified format recommended by the National Research Council of the National Academy of Sciences. The program was written in Fortran IV for use on the CDC 3800; however the program can be converted to run on other systems with little difficulty.

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A PROGRAM FOR STORING OCEANOGRAPHIC DATA ON MAGNETIC TAPE

1.0 IDENTIFICATION

1.1 Title

Storage Program for Navigation, Bathymetric, and Magnetics Data on Magnetic Tape.

1.2 Identification Name

GEODATA.

1.3 Classification Code

None.

1.4 NRL Research Computation Center Identification Number

None.

1.5 Entry Points

GEODATA.

1.6 Programming Language

Language: CDC 3600/3800 Fortran.
Routine Type: Program.
Operating System: Drum Scope 2.1.

1.7 Computer and Configuration

CDC 3800.

1.8 Contributor or Programmer

Marilyn L. Blodgett, Code 4223MB, Research Computation Center, written for Environmental Sciences Section, Acoustics Division.

1.9 NRL — Naval Research Laboratory, Washington, D.C. 20375.

NOTE: Manuscript submitted January 9, 1975.

1.10 Program Availability

If supplied with a magnetic tape, a copy of this program will be made available by the Environmental Sciences Section, Acoustics Division.

1.11 Verification

This program has been used and tested by the Environmental Sciences Section, Acoustics Division, for the past year.

1.12 Date

July 1974.

2.0 PURPOSE

2.1 Description of the Routine

This program transfers the data collected by an oceanographic or geophysical experiment to magnetic tape. The program will take up to 3000 navigational data points and an unlimited number of bathymetric and magnetic data points. The program is set up so that if one tape is filled, any number of continuation tapes can be used. The data tape will have one logical record (of 80 characters) for each data point. The different types of data (navigational, bathymetric, and magnetics) will be separated by an end-of-file mark, with a double end-of-file mark at the end of all the data.

2.1.1 Navigation Data

This program is presently set up to read the navigation data from cards. The data are in degrees, minutes, and hundredths of a minute; each navigation fix has an associated Julian date and time (24-hour clock). The southern latitudes and the western longitudes are preceded by a minus sign. This program changes the Julian date to month and day and changes the minutes and hundredths of minutes of latitude and longitude to ten thousandths of a degree.

2.1.2 Bathymetry Data

The bathymetry data are read in with the Julian date followed by five time-depth groups to a card. Time is read to tenths of a minute. The depth can be either uncorrected fathoms or uncorrected meters, but not both in the same run. This program converts the Julian date to month and prints out uncorrected fathoms, uncorrected meters, corrected meters, and Matthews zone. The uncorrected meters are not written on the data tape.

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2.1.3 Magnetics Data

The magnetics data are read in with the Julian date, then the hour, followed by 12 magnetic data points (one every five minutes). The program converts the Julian date to month and day and converts the total magnetic intensity in gammas (the data read in) to residual magnetic intensity using the International Geomagnetic Reference Field formula.

2.1.4 Gravity Data

This program is not set up to take gravity data, but a gravity subroutine could easily be inserted.

2.2 Problem Background

The rapid accumulation of many boxes of oceanographic data on computer cards necessitated the transfer of the data from cards to magnetic tape. It was decided that the format recommended by the National Research Council of the National Academy of Sciences would be used with one slight modification, the addition of a fix number with the navigation.

3.0 USAGE

3.1 Calling Sequence or Operational Procedure

Not applicable.

3.2 Arguments, Parameters, and/or Initial Conditions

Not applicable.

3.3 Space Required (Decimal and Octal)

3.3.1 Unique Storage

36533 Octal (15707 decimal) locations exclusive of system library functions.

3.3.2 Common Blocks

None.

3.3.3 Temporary Storage

None.

3.4 Messages and Instructions to the Operator

None.

3.5 Error Returns, Messages, and Codes

Deck set up incorrectly.
More than 3000 navigation data cards.
Unable to interpolate latitude and longitude.

3.6 Informative Messages to the User

None.

3.7 Input

Input parameters and data are read in via punched cards. The format statements can easily be changed to meet requirements of the user. See Appendix A for samples of our data formats. Each data type (navigation, bathymetry, magnetics) are bracketed by a control card with a negative number in columns 1 and 2. The control card preceding the data sets up the different options available. Appendix B is a complete description of the input setup.

3.8 Output

The program prints out on the standard printer (logical unit 61) the ship and cruise identification, number of cards read, number of logical records written for navigation, bathymetry, and magnetic data. There is an option for listing all the records written on the output tape and for punching out cards. Appendix C shows samples of the output.

3.9 Formats

Appendix B shows the program deck structure.

3.10 External Routines and Symbols

SKIPFILE, BACKFILE, XMØDF, SQRTF, SINF, CØSF.

3.11 Timing

This program will process approximately 1300 data points a minute. If a listing of all processed data is required, each data point will generate one line. Consequently, this program can process a great deal of data in little time but also produce large printouts.

3.12 Accuracy

Not applicable.

3.13 Cautions to Users

None.

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3.14 Program Deck Structure

See Appendix B.

3.15 References — Literature

"Formats for Marine Geophysical Data Exchange," National Academy of Sciences, June, 1972.

4.0 METHOD OR ALGORITHM

Not applicable.

5.0 FLOW CHART AND/OR SOURCE LANGUAGE LISTING

Flow chart and listing are given in Appendix D.

6.0 COMPARISON

There are no other known programs available for comparison.

7.0 TEST METHOD AND RESULTS

A sample of the three types of records written on the output tape are included in Appendix C.

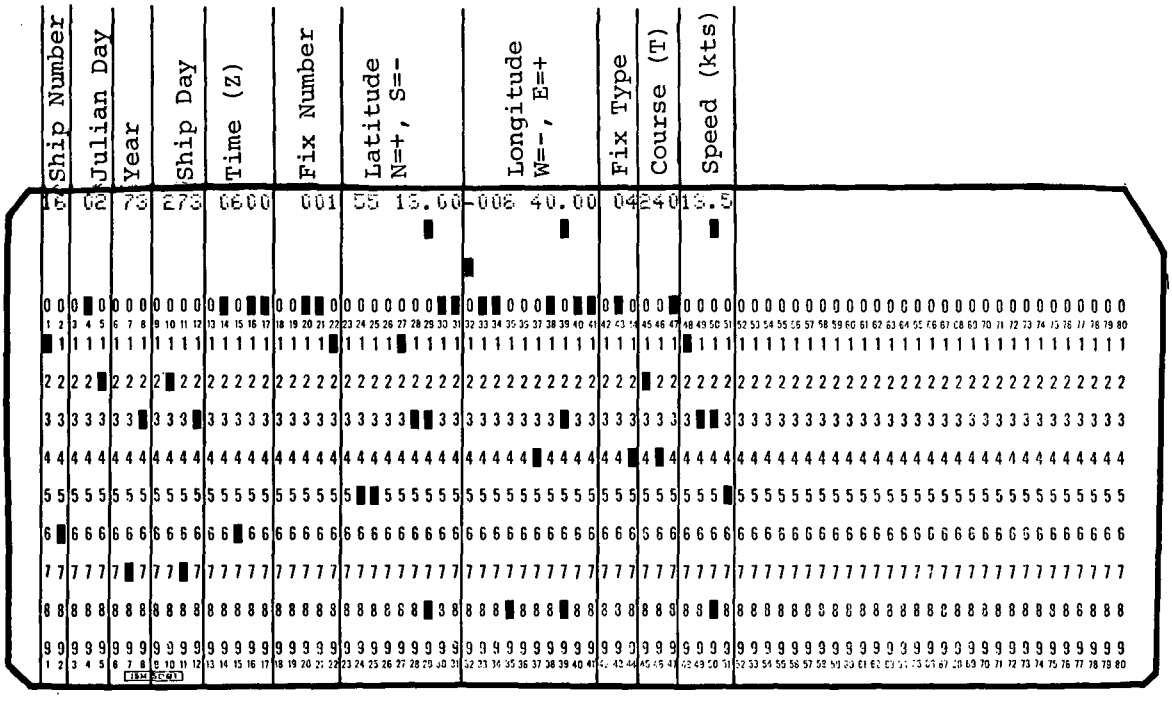
8.0 REMARKS

The authors thank Gary Flenner for his review of this report and Wayne Worsley for preparing the illustrations in the appendixes. The authors also thank Leon LaLumiere for providing some of the subroutines used by this program.

Appendix A

SAMPLE INPUT DATA CARDS

NAVIGATION INPUT FORMAT




```
108 READ (60,101)ISN,IY,JUDY,RNHR,RNMIN,IFN,XLAD,XLAM,XLOD,XLOM,IFIXTY
101 FORMAT (I2,4XI2,1X,1X13,1XF2,F2,I5,F3,F6.2,F4,F6.2,1XI2)
```

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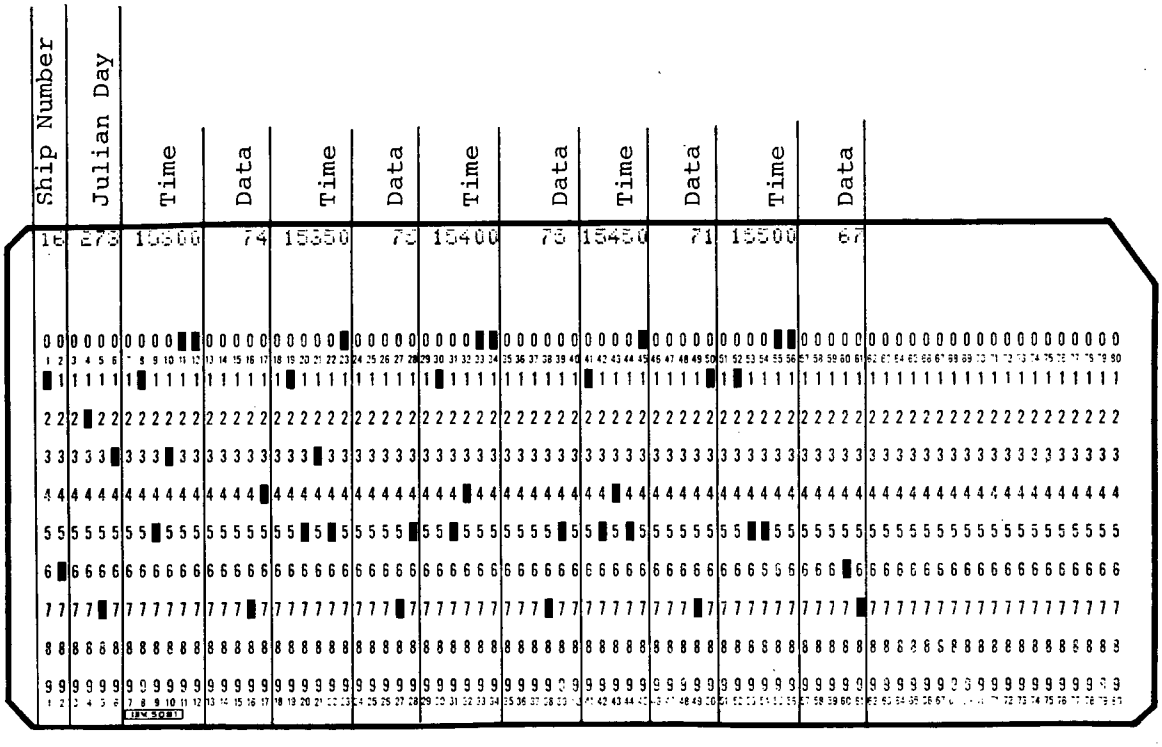
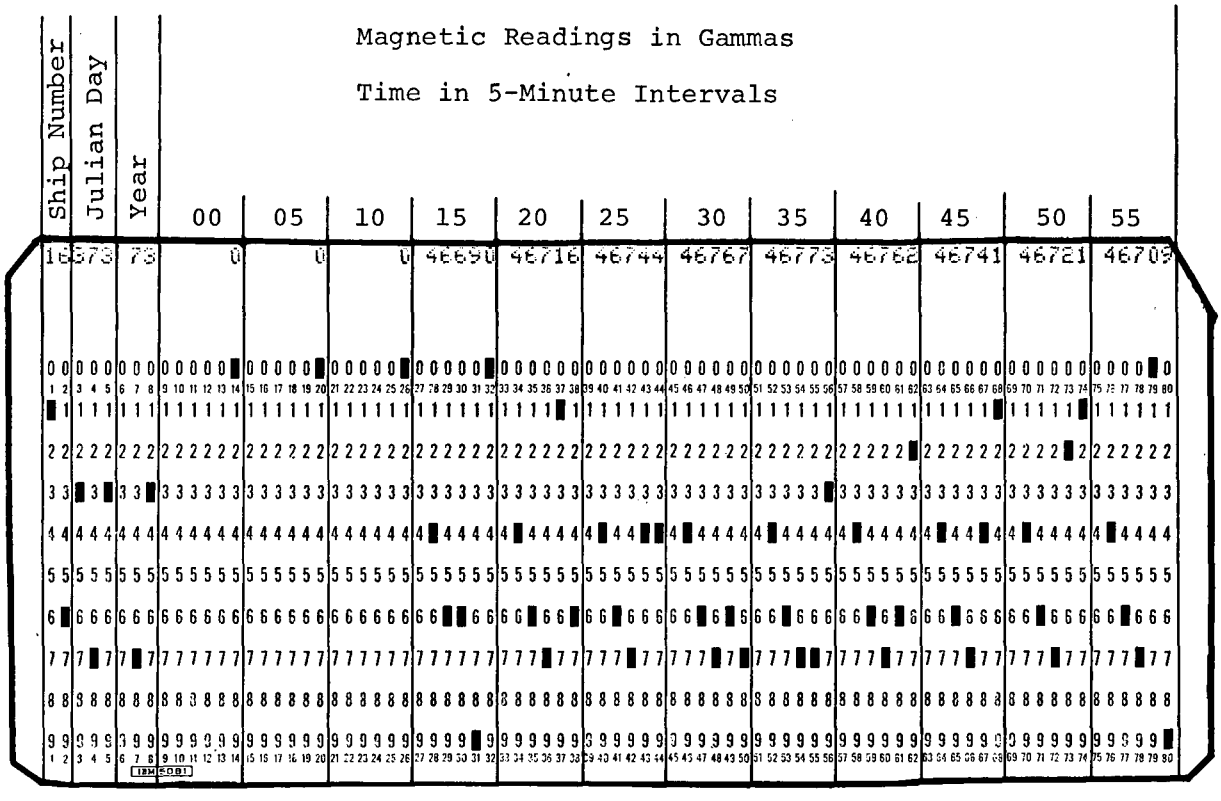
BATHYMETRY INPUT FORMAT




```
205 READ (60,204) ISN,JUDY,(BHR(I),BMIN(I),IDP(I),I=1,5)
204 FORMAT (I2,1XI3,5(1XF2,F3.1,1X14))
```

MAGNETICS INPUT FORMAT




```
302 READ (60,304) ISN,JUDY,RMHR,(IMG(I),I=1,12)
304 FORMAT (I2,I3,1XF2,12(1XI5))
```

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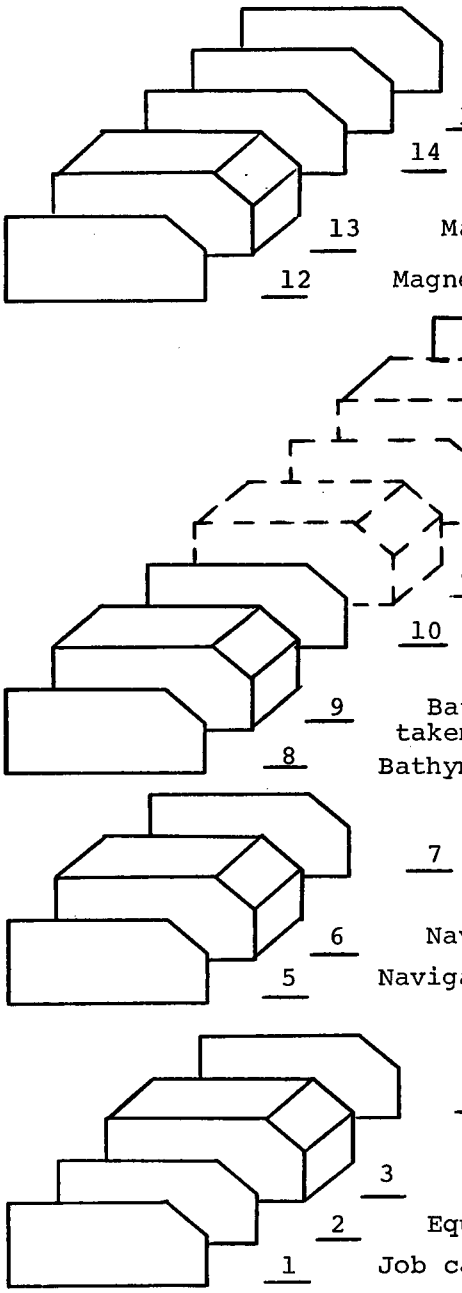
Appendix B

DECK ASSEMBLY



16 End of file card

15 Finish card

14 Magnetics end card

13 Magnetics data deck

12 Magnetics parameter card

11 Bathymetry end card

9B Bathymetry data deck

10A Zone change card

9A Bathymetry data deck (portion of data taken at new Matthews Zone)

10 Zone change card (needed only if change in Matthews Zone)

9 Bathymetry data deck (portion of data deck taken at Matthews Zone specified on bathymetry parameter card)

8 Bathymetry parameter card

7 Navigation end card

6 Navigation data deck

5 Navigation parameter card

4 Run card

3 Program geodata (binary deck)*

2 Equip card

1 Job card

*If the FORTRAN source deck is used instead of the binary deck, a FORTRAN card is required after the Equip card. The FORTRAN card reads--7/9 FTN, L, R, X. In addition a SCOPE card with SCOPE starting in column 10 and a LOAD card which reads 7/9 LOAD must follow the source deck.

Number	Card Title	Column Number	Description
1	Job	1-21	7/9 JOB, charge No., ID No., time. The charge number consists of alphanumeric characters of any length. The ID number is the programmer identification; it may be any length and appears as given in the control card listing. The time is the maximum time limit in minutes for the entire job. See page 2-2 of the 3600/3800 Computer Systems Drum Scope Manual.
2	Equip	1-18	7/9 EQUIP, 10 = **, WO, HI 10 = logical unit number. WO = write only. HI = high density.
3	Program GEODATA	Deck of cards	This is the main program with associated subroutines. If the Fortran source deck is used instead of the binary deck, a Fortran card is required after the Equip card. The Fortran card reads 7/9 FTN, L, R, X. In addition a Scope card with SCOPE starting in column 10 and a LOAD must follow the source deck.
4	Run	1-13	7/9 RUN, T, P, R, M, D T = time limit in minutes. P = maximum number of print or write operations. R, M, D may be left blank. See page 2-15 of the 3600/3800 Computer Systems Drum Scope Manual.
5	Navigation Parameter	1-2	—1 This number designates the Navigation Parameter card.
		5	0, 1, 2 0 = write the navigation data on a new tape. 1 = read the navigation data cards and store the information necessary for interpolation. The program will not write the navigation data on the tape. It will only write the bathymetry data on a tape that already contains the navigation and magnetic data.

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Number	Card Title	Column Number	Description
			2 = Read the navigation data cards and store the information necessary for interpolation. The program will not write the navigation data on the tape. It will only write the magnetics data on a tape that already contains the navigation and bathymetry data.
		19-20	0, 1, 2, 3 0 = just write the navigation data on tape in the required format. 1 = write the navigation data on tape and print out a listing of the data. 2 = write the navigation data on tape and punch out a card for each logical record written on the tape. 3 = write the navigation data on tape and print out a listing. In addition, punch out a card for each logical record written on the tape. If card columns 4-5 are 1 or 2, more of the options in card columns 19-20 are available.
		23-30	Columns 23-30 are for cruise identification. Any eight-digit alphanumeric number may be used.
6	Navigation Data Deck		Place the Navigation Data Deck after the Navigation Parameter card.
7	Navigation End	1-2	—5 This number designates the end of the Navigation Data Deck.
8	Bathymetry Parameter	1-2	—2 This number designates the Bathymetry Parameter card.
		4-5	Columns 4-5 are for the Matthews zone.
		14-15	1 or 2 1 = Depth data in uncorrected fathoms. 2 = Depth data in uncorrected meters.

Number	Card Title	Column Number	Description
		19-20	0, 1, 2, or 3 0 = just write the bathymetry data on tape in the required format. 1 = write the bathymetry data on tape and print out a listing of the data. 2 = write the bathymetry data on tape and punch out a card for each logical record written on the tape. 3 = write the bathymetry data on tape and print out a listing. In addition punch out a card for each logical record written on the tape.
9	Bathymetry Data Deck		Place that portion of the Bathymetry Data Deck which was taken at the Matthews zone specified on the Bathymetry Parameter card after the Bathymetry Parameter card.
10	Zone Change	1-2	—6 This number designates a change in the Matthews zone. A Zone Change card must precede the first data card taken at the new Matthews zone. These Zone Change cards can be scattered throughout the Bathymetry Data Deck.
		4-6	Value of the new Matthews zone.
11	Bathymetry End	1-2	—7 This number designates the end of the Bathymetry Data Deck.
12	Magnetics Parameter	1-2	—3 This number designates the Magnetics Parameter card.
		6-10	Height in feet above or below mean sea level.
		19-20	0, 1, 2, or 3 0 = just write the magnetics data on tape in the required format. 1 = write the magnetics data on tape and print out a listing of the data.

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Number	Card Title	Column Number	Description
			2 = write the magnetics data on tape and punch out a card for each logical record. 3 = write the magnetics data on tape and print out a listing. In addition, punch out a card for each logical record written on the tape.
13	Magnetics Data Deck		Place the magnetics data deck after the magnetics parameter card.
14	Magnetics End	1-2	—8 This number designates the end of the Magnetics Data Deck.
15	Finish	1-2	—4 This number designates the end of all data.
16	End-of-File		

SAMPLE NAVIGATION PRINTOUT

SHIP AND CRUISE IDENTIFICATION	TIME ZONE	YEAR	MONTH	DAY	HOUR	MINUTE	LATITUDE	LONGITUDE	FIX DESCRIPTION	FIX NUMBER
73-16-02	0	73	8	22	10	6.0	72.7297	-10.3975	50	200
73-16-02	0	73	8	22	10	40.0	72.7710	-10.3330	50	201
73-16-02	0	73	8	22	10	50.0	72.7850	-10.3167	49	202
73-16-02	0	73	8	22	11	0.0	72.7953	-10.2895	50	203
73-16-02	0	73	8	22	11	30.0	72.8333	-10.2253	50	204
73-16-02	0	73	8	22	11	54.0	72.8647	-10.1642	50	205
73-16-02	0	73	8	22	12	28.0	72.9088	-10.0868	50	206
73-16-02	0	73	8	22	12	48.0	72.9333	-10.0395	50	207
73-16-02	0	73	8	22	13	14.0	72.9685	-9.9792	50	208
73-16-02	0	73	8	22	13	37.0	72.9983	-9.9100	49	209
73-16-02	0	73	8	22	14	14.0	73.0460	-9.8135	50	211
73-16-02	0	73	8	22	14	34.0	73.0708	-9.7570	50	212
73-16-02	0	73	8	22	15	0.0	73.1072	-9.6877	49	213
73-16-02	0	73	8	22	15	28.0	73.1255	-9.6198	50	214
73-16-02	0	73	8	22	15	47.0	73.1375	-9.5817	49	215
73-16-02	0	73	8	22	16	2.0	73.1718	-9.5027	50	216
73-16-02	0	73	8	22	16	46.0	73.2778	-9.2473	50	218
73-16-02	0	73	8	22	17	14.0	73.3527	-9.0855	50	219
73-16-02	0	73	8	22	17	48.0	73.4387	-8.8817	50	220
73-16-02	0	73	8	22	18	5.0	73.4817	-8.7667	49	221
73-16-02	0	73	8	22	18	8.0	73.4865	-8.7435	50	222
73-16-02	0	73	8	22	18	28.0	73.5247	-8.6728	50	223
73-16-02	0	73	8	22	19	8.0	73.5942	-8.4753	50	225
73-16-02	0	73	8	22	19	32.0	73.6428	-8.3643	50	226
73-16-02	0	73	8	22	19	52.0	73.6785	-8.2742	50	227
73-16-02	0	73	8	22	20	14.0	73.7192	-8.1853	50	229
73-16-02	0	73	8	22	20	34.0	73.7575	-8.0848	50	230
73-16-02	0	73	8	22	21	16.0	73.8378	-7.9065	50	231
73-16-02	0	73	8	22	21	38.0	73.8803	-7.8202	50	232
73-16-02	0	73	8	22	22	4.0	73.9320	-7.7025	50	233
73-16-02	0	73	8	22	22	28.0	73.9790	-7.6172	50	234
73-16-02	0	73	8	22	23	0.0	74.0432	-7.4810	50	235
73-16-02	0	73	8	22	23	22.0	74.0893	-7.3897	50	236
73-16-02	0	73	8	22	23	50.0	74.1465	-7.2443	50	237
73-16-02	0	73	8	23	0	10.0	74.1880	-7.1523	50	238
73-16-02	0	73	8	23	0	44.0	74.2580	-6.9860	50	239
73-16-02	0	73	8	23	1	4.0	74.3000	-6.8735	50	240
73-16-02	0	73	8	23	2	6.0	74.4165	-6.5770	50	241
73-16-02	0	0	0	0	0	0.0	0.0000	0.0000	0	0
73-16-02	0	0	0	0	0	0.0	0.0000	0.0000	0	0

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SAMPLE BATHYMETRY PRINTOUT

SHIP AND CRUISE IDENTIFICATION	TIME ZONE	YEAR	MONTH	DAY	HOUR	MINUTE	LATITUDE	LONGITUDE	UNCORRECTED FATHOMS	UNCORRECTED METERS	CORRECTED METERS	MATTHI ZONI
73-16-02	0	73	8	22	10	30.0	72.7588	-10.3520	1440.8	2635.0	2642	1
73-16-02	0	73	8	22	10	35.0	72.7649	-10.3425	1448.4	2649.0	2657	1
73-16-02	0	73	8	22	10	40.0	72.7710	-10.3330	1453.4	2658.0	2666	1
73-16-02	0	73	8	22	10	45.0	72.7780	-10.3248	1459.9	2670.0	2678	1
73-16-02	0	73	8	22	10	50.0	72.7850	-10.3167	1467.6	2684.0	2692	1
73-16-02	0	73	8	22	10	55.0	72.7902	-10.3031	1473.0	2694.0	2703	1
73-16-02	0	73	8	22	11	0.0	72.7953	-10.2895	1479.1	2705.0	2714	1
73-16-02	0	73	8	22	11	5.0	72.8017	-10.2788	1482.9	2712.0	2721	1
73-16-02	0	73	8	22	11	10.0	72.8080	-10.2681	1487.3	2720.0	2729	1
73-16-02	0	73	8	22	11	15.0	72.8143	-10.2574	1492.7	2730.0	2739	1
73-16-02	0	73	8	22	11	20.0	72.8207	-10.2467	1497.7	2739.0	2748	1
73-16-02	0	73	8	22	11	25.0	72.8270	-10.2360	1501.5	2746.0	2756	1
73-16-02	0	73	8	22	11	28.0	72.8308	-10.2296	1503.7	2750.0	2760	1
73-16-02	0	73	8	22	11	35.0	72.8399	-10.2126	1509.1	2760.0	2770	1
73-16-02	0	73	8	22	11	40.0	72.8464	-10.1998	1513.5	2768.0	2778	1
73-16-02	0	73	8	22	11	45.0	72.8529	-10.1871	1516.2	2773.0	2783	1
73-16-02	0	73	8	22	11	50.0	72.8594	-10.1744	1520.1	2780.0	2790	1
73-16-02	0	73	8	22	11	55.0	72.8660	-10.1619	1525.5	2790.0	2800	1
73-16-02	0	73	8	22	12	0.0	72.8725	-10.1505	1528.3	2795.0	2805	1
73-16-02	0	73	8	22	12	5.0	72.8790	-10.1391	1529.9	2798.0	2809	1
73-16-02	0	73	8	22	12	8.0	72.8829	-10.1323	1531.0	2800.0	2811	1
73-16-02	0	73	8	22	12	10.0	72.8855	-10.1278	1532.1	2802.0	2813	1
73-16-02	0	73	8	22	12	15.0	72.8919	-10.1164	1536.5	2810.0	2821	1
73-16-02	0	73	8	22	12	20.0	72.8984	-10.1050	1539.8	2816.0	2827	1
73-16-02	0	73	8	22	12	25.0	72.9049	-10.0937	1544.1	2824.0	2835	1
73-16-02	0	73	8	22	12	30.0	72.9113	-10.0821	1549.1	2833.0	2844	1
73-16-02	0	73	8	22	12	35.0	72.9174	-10.0703	1552.9	2840.0	2851	1
73-16-02	0	73	8	22	12	40.0	72.9235	-10.0584	1558.3	2850.0	2862	1
73-16-02	0	73	8	22	12	45.0	72.9297	-10.0466	1563.8	2860.0	2872	1
73-16-02	0	73	8	22	12	50.0	72.9360	-10.0349	1579.1	2888.0	2900	1
73-16-02	0	73	8	22	12	55.0	72.9428	-10.0233	1585.7	2900.0	2913	1
73-16-02	0	73	8	22	12	59.0	72.9482	-10.0140	1594.4	2916.0	2929	1
73-16-02	0	73	8	22	13	5.0	72.9563	-10.0001	1591.7	2911.0	2924	1
73-16-02	0	73	8	22	13	10.0	72.9631	-9.9884	1597.2	2921.0	2934	1
73-16-02	0	73	8	22	13	15.0	72.9698	-9.9762	1603.7	2933.0	2946	1
73-16-02	0	73	8	22	13	20.0	72.9763	-9.9611	1607.6	2940.0	2953	1
73-16-02	0	73	8	22	13	25.0	72.9828	-9.9461	1605.4	2936.0	2949	1
73-16-02	0	73	8	22	13	30.0	72.9893	-9.9311	1605.4	2936.0	2949	1
73-16-02	0	73	8	22	13	35.0	72.9957	-9.9160	1604.8	2935.0	2948	1
73-16-02	0	73	8	22	13	40.0	73.0022	-9.9022	1604.8	2935.0	2948	1
73-16-02	0	73	8	22	13	45.0	73.0086	-9.8891	1603.7	2933.0	2946	1
73-16-02	0	73	8	22	13	50.0	73.0151	-9.8761	1603.2	2932.0	2945	1
73-16-02	0	73	8	22	13	55.0	73.0215	-9.8631	1602.6	2931.0	2944	1
73-16-02	0	73	8	22	14	0.0	73.0280	-9.8500	1604.8	2935.0	2948	1
73-16-02	0	73	8	22	14	5.0	73.0344	-9.8370	1605.4	2936.0	2949	1
73-16-02	0	73	8	22	14	10.0	73.0408	-9.8239	1610.3	2945.0	2959	1
73-16-02	0	73	8	22	14	12.5	73.0441	-9.8174	1613.0	2950.0	2964	1
73-16-02	0	73	8	22	14	20.0	73.0534	-9.7965	1626.7	2975.0	2989	1
73-16-02	0	73	8	22	14	25.0	73.0597	-9.7824	1639.3	2998.0	3013	1
73-16-02	0	73	8	22	14	30.0	73.0659	-9.7683	1634.4	2989.0	3004	1
73-16-02	0	73	8	22	14	35.0	73.0722	-9.7543	1632.2	2985.0	2999	1
73-16-02	0	73	8	22	14	40.0	73.0792	-9.7410	1632.2	2985.0	2999	1
73-16-02	0	73	8	22	14	45.0	73.0862	-9.7277	1632.2	2985.0	2999	1
73-16-02	0	73	8	22	14	50.0	73.0932	-9.7143	1630.0	2981.0	2995	1
73-16-02	0	73	8	22	14	55.0	73.1002	-9.7010	1629.4	2980.0	2994	1
73-16-02	0	73	8	22	15	0.0	73.1072	-9.6877	1629.4	2980.0	2995	2
73-16-02	0	73	8	22	15	5.0	73.1104	-9.6756	1628.3	2978.0	2993	2
73-16-02	0	73	8	22	15	10.0	73.1137	-9.6634	1627.2	2976.0	2991	2
73-16-02	0	73	8	22	15	15.0	73.1170	-9.6513	1626.7	2975.0	2990	2

SAMPLE MAGNETICS PRINTOUT

SHIP AND CRUISE IDENTIFICATION	TIME ZONE	YEAR	MONTH	DAY	HOUR	MINUTE	LATITUDE	LONGITUDE	TOTAL MAGNETIC INTENSITY	RESIDUAL MAGNETIC INTENSITY
73-16-02	0	73	8	22	11	10.0	72.8080	-10.2681	52969	155
73-16-02	0	73	8	22	11	15.0	72.8143	-10.2574	52964	149
73-16-02	0	73	8	22	11	20.0	72.8207	-10.2467	52962	146
73-16-02	0	73	8	22	11	25.0	72.8270	-10.2360	52962	145
73-16-02	0	73	8	22	11	30.0	72.8333	-10.2253	52965	147
73-16-02	0	73	8	22	11	35.0	72.8399	-10.2126	52964	144
73-16-02	0	73	8	22	11	40.0	72.8464	-10.1998	52957	136
73-16-02	0	73	8	22	11	45.0	72.8529	-10.1871	52965	143
73-16-02	0	73	8	22	11	50.0	72.8594	-10.1744	52955	132
73-16-02	0	73	8	22	11	55.0	72.8660	-10.1619	52948	124
73-16-02	0	73	8	22	12	0.0	72.8725	-10.1505	52935	110
73-16-02	0	73	8	22	12	5.0	72.8790	-10.1391	52934	108
73-16-02	0	73	8	22	12	10.0	72.8855	-10.1278	52938	110
73-16-02	0	73	8	22	12	15.0	72.8919	-10.1164	52947	118
73-16-02	0	73	8	22	12	20.0	72.8984	-10.1050	52982	152
73-16-02	0	73	8	22	12	25.0	72.9049	-10.0937	52995	164
73-16-02	0	73	8	22	12	30.0	72.9113	-10.0821	53035	203
73-16-02	0	73	8	22	12	35.0	72.9174	-10.0703	53075	242
73-16-02	0	73	8	22	12	40.0	72.9235	-10.0584	53124	290
73-16-02	0	73	8	22	12	45.0	72.9297	-10.0466	53162	327
73-16-02	0	73	8	22	12	50.0	72.9360	-10.0349	53197	361
73-16-02	0	73	8	22	12	55.0	72.9428	-10.0233	53224	386
73-16-02	0	73	8	22	13	0.0	72.9496	-10.0117	53235	396
73-16-02	0	73	8	22	13	5.0	72.9563	-10.0001	53230	390
73-16-02	0	73	8	22	13	10.0	72.9631	-9.9884	53206	365
73-16-02	0	73	8	22	13	15.0	72.9698	-9.9762	53165	323
73-16-02	0	73	8	22	13	20.0	72.9763	-9.9611	53111	267
73-16-02	0	73	8	22	13	25.0	72.9828	-9.9461	53043	198
73-16-02	0	73	8	22	13	30.0	72.9893	-9.9311	52996	150
73-16-02	0	73	8	22	13	35.0	72.9957	-9.9160	52931	84
73-16-02	0	73	8	22	13	40.0	73.0022	-9.9022	52865	17
73-16-02	0	73	8	22	13	45.0	73.0086	-9.8891	52820	-29
73-16-02	0	73	8	22	13	50.0	73.0151	-9.8761	52791	-59
73-16-02	0	73	8	22	13	55.0	73.0215	-9.8631	52769	-82
73-16-02	0	73	8	22	14	0.0	73.0280	-9.8500	52756	-96
73-16-02	0	73	8	22	14	5.0	73.0344	-9.8370	52764	-89
73-16-02	0	73	8	22	14	10.0	73.0408	-9.8239	52784	-71
73-16-02	0	73	8	22	14	15.0	73.0472	-9.8107	52809	-47
73-16-02	0	73	8	22	14	20.0	73.0534	-9.7965	52826	-31
73-16-02	0	73	8	22	14	25.0	73.0597	-9.7824	52828	-30
73-16-02	0	73	8	22	14	30.0	73.0659	-9.7683	52833	-26
73-16-02	0	73	8	22	14	35.0	73.0722	-9.7543	52835	-25
73-16-02	0	73	8	22	14	40.0	73.0792	-9.7410	52849	-12
73-16-02	0	73	8	22	14	45.0	73.0862	-9.7277	52862	0
73-16-02	0	73	8	22	14	50.0	73.0932	-9.7143	52874	10
73-16-02	0	73	8	22	14	55.0	73.1002	-9.7010	52893	28
73-16-02	0	73	8	22	15	0.0	73.1072	-9.6877	52917	51
73-16-02	0	73	8	22	15	5.0	73.1104	-9.6756	52936	69
73-16-02	0	73	8	22	15	10.0	73.1137	-9.6634	52946	79
73-16-02	0	73	8	22	15	15.0	73.1170	-9.6513	52954	86
73-16-02	0	73	8	22	15	20.0	73.1203	-9.6392	52956	88
73-16-02	0	73	8	22	15	25.0	73.1235	-9.6271	52957	89
73-16-02	0	73	8	22	15	30.0	73.1268	-9.6158	52959	90
73-16-02	0	73	8	22	15	35.0	73.1299	-9.6058	52961	92
73-16-02	0	73	8	22	15	40.0	73.1331	-9.5957	52961	91
73-16-02	0	73	8	22	15	45.0	73.1362	-9.5857	52985	115
73-16-02	0	73	8	22	15	50.0	73.1444	-9.5659	52987	115
73-16-02	0	73	8	22	15	55.0	73.1558	-9.5395	53005	131
73-16-02	0	73	8	22	16	0.0	73.1673	-9.5132	53014	138

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SAMPLE PRINTOUT OF DATA PROCESSED

```
SHIP AND CRUISE IDENTIFICATION        731602
NAVIGATION DATA
NUMBER OF NAVIGATION CARDS READ =    60
NUMBER OF LOGICAL RECORDS WRITTEN ON TAPE =    60

BATHYMETRY DATA
DEPTH DATA GIVEN IN UNCORRECTED METERS
MATTHEWS ZONES PASSED THROUGH WERE    1    2    3
NUMBER OF BATHYMETRY CARDS READ =    72
NUMBER OF LOGICAL RECORDS WRITTEN =    357

MAGNETICS DATA
HEIGHT IN FEET ABOVE OR BELOW SEA LEVEL IS    -20
NUMBER OF MAGNETICS CARDS READ =          23
NUMBER OF LOGICAL RECORDS WRITTEN =          258
```

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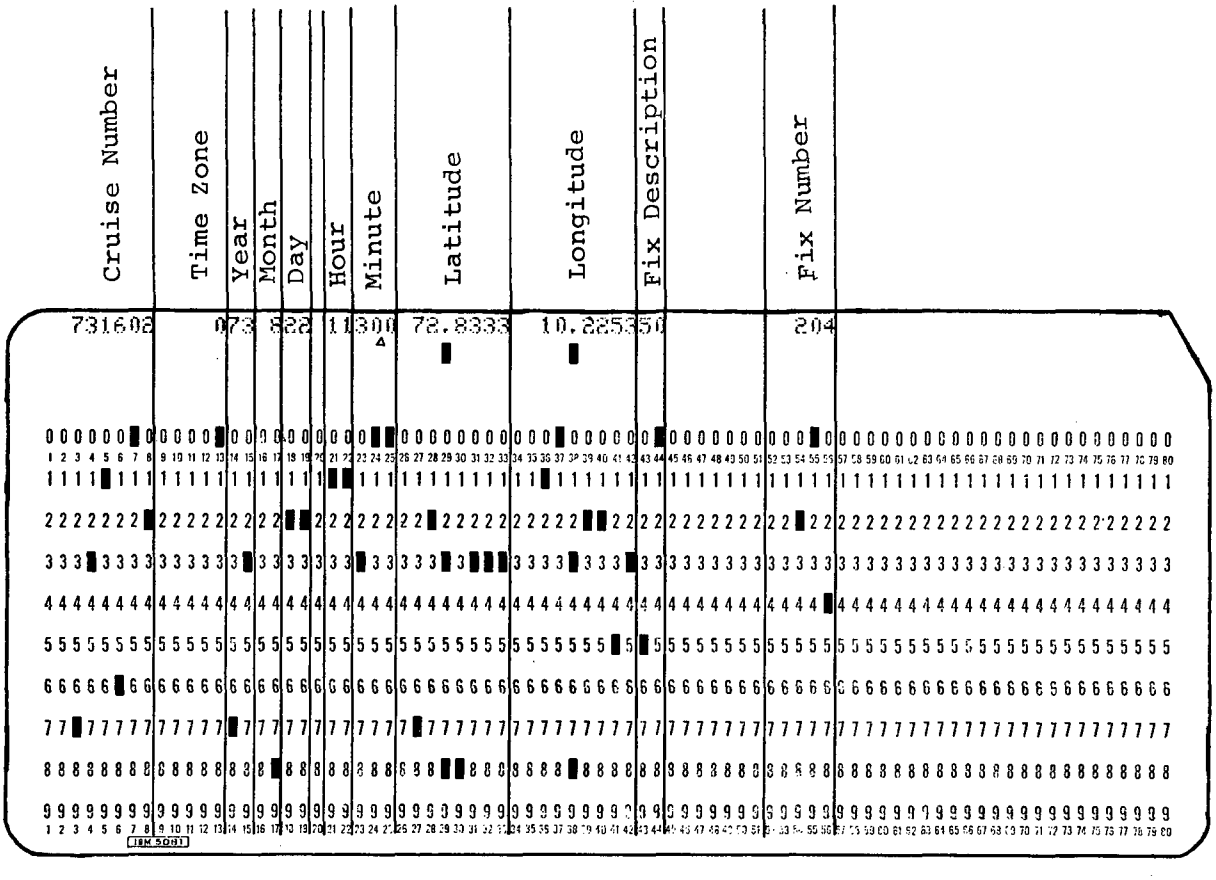
Appendix C2

SAMPLE OUTPUT CARDS

NAVIGATION OUTPUT CARD

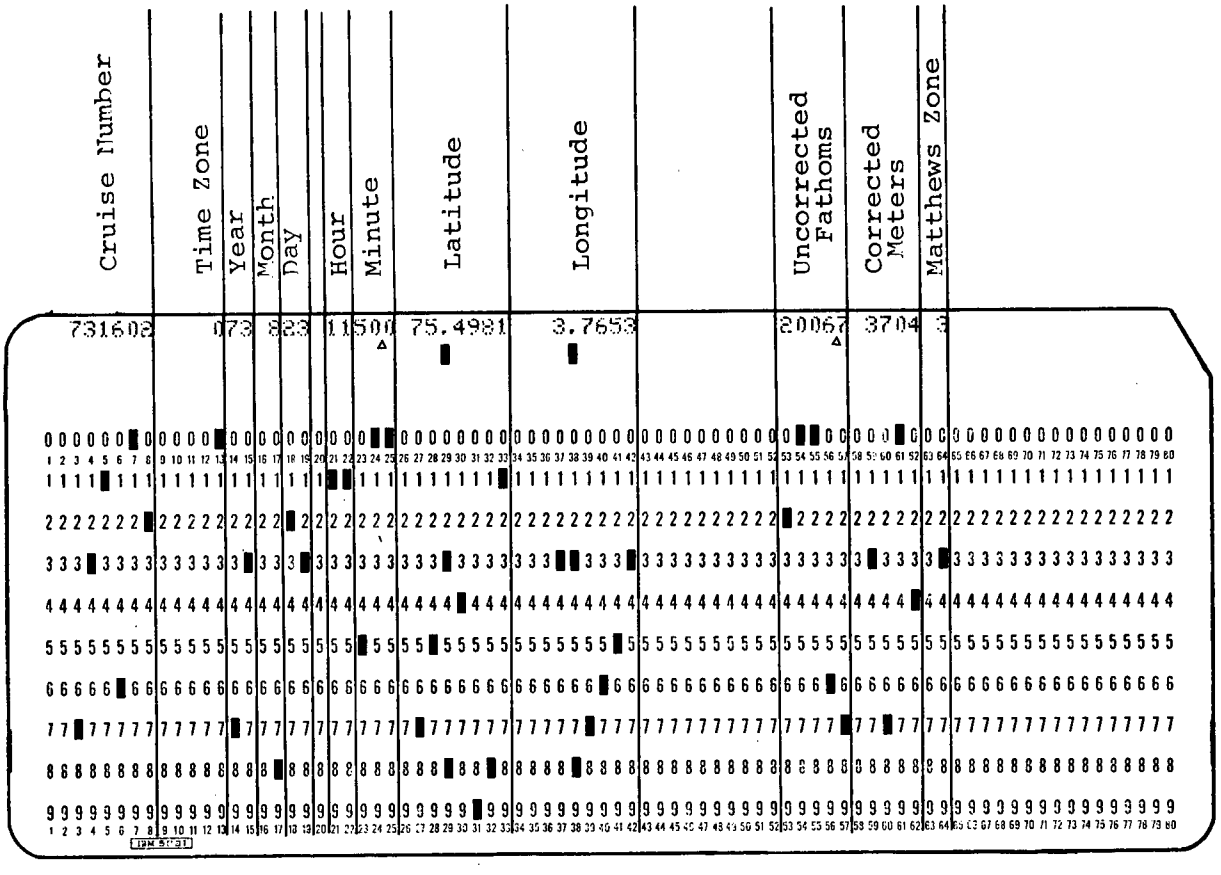



```
115 WRITE (62,110) (CRUISE,ITMZNE,IYEAR(I),MONTH(I),IDAY(I),HR(I),XMIN(I
    1),XLAT(I),XLONG(I),IFIX(I),NAVFIX(I),I=1,IWRITE)

110 FORMAT (A8,I5,I2,I2,I2,1XF2,F3,F8.4,F9.4,I2,7XI5,24X)
```

Δ Implies a decimal point

BATHYMETRY OUTPUT CARD




```
229 WRITE (62,224)(CRUISE,ITMZNE,IYEAR(I),MONTH(I),IDAY(I),HR(I),XMIN(I
    1),XLAT(I),XLONG(I),NAVFIX(I),ICRMET(I),IFIX(I),I=1,IWRITE)

224 FORMAT (A8,I5,I2,I2,I2,1XF2,F3,F8.4,F9.4,10XI5,I5,I2,16X)
```

Δ Implies a decimal point

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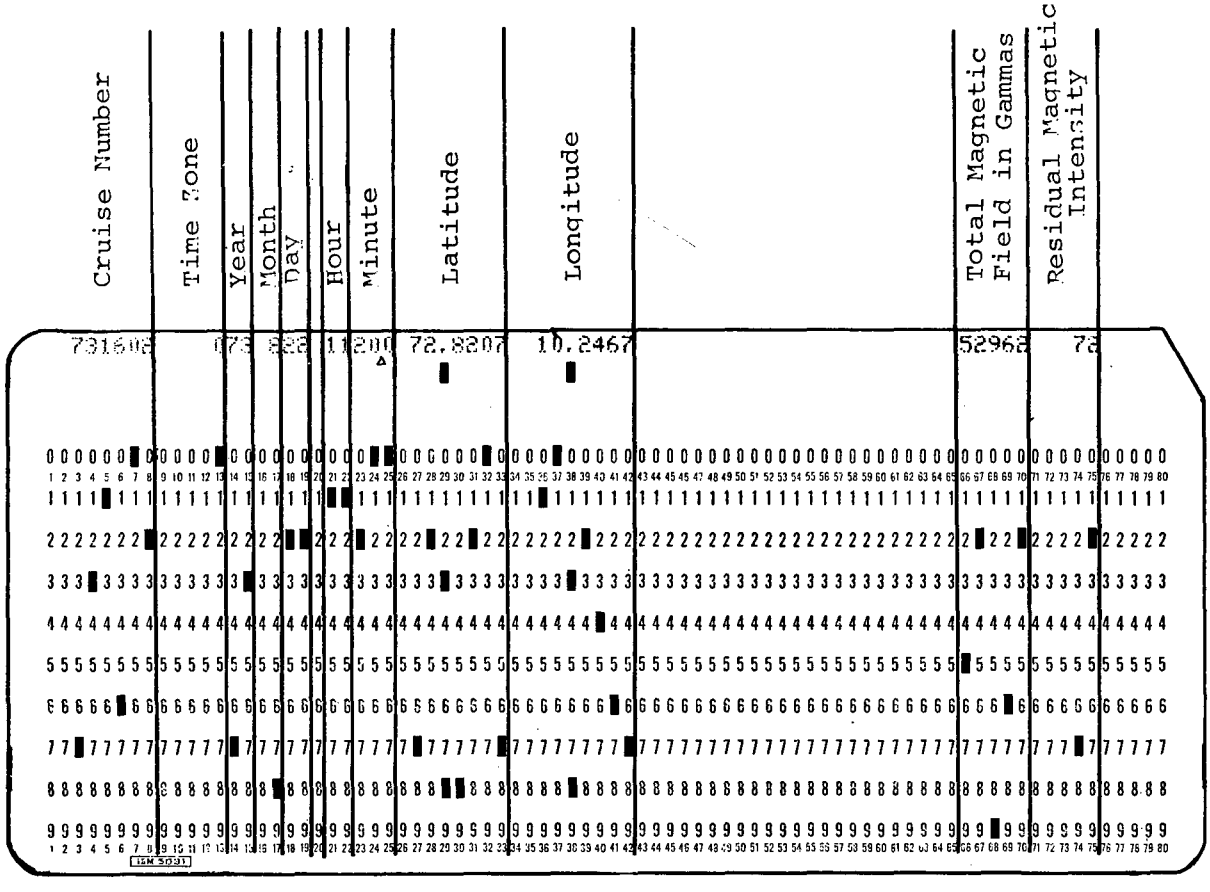
MAGNETICS OUTPUT CARD




```
323 WRITE(62,318) (CURISE,ITMZNE,IYEAR(I),MONTH(I),IDAY(I),HR(I),XMIN(I
    1),XLAT(I),XLONG(I),NAVFIX(I),ICRMET(I),I=1,IWRITE)

318 FORMAT (A8,I5,I2,I2,I2,1XF2,F3,F8.4,F9.4,23X,I5,I5,5X)
```

△ Implies a decimal point

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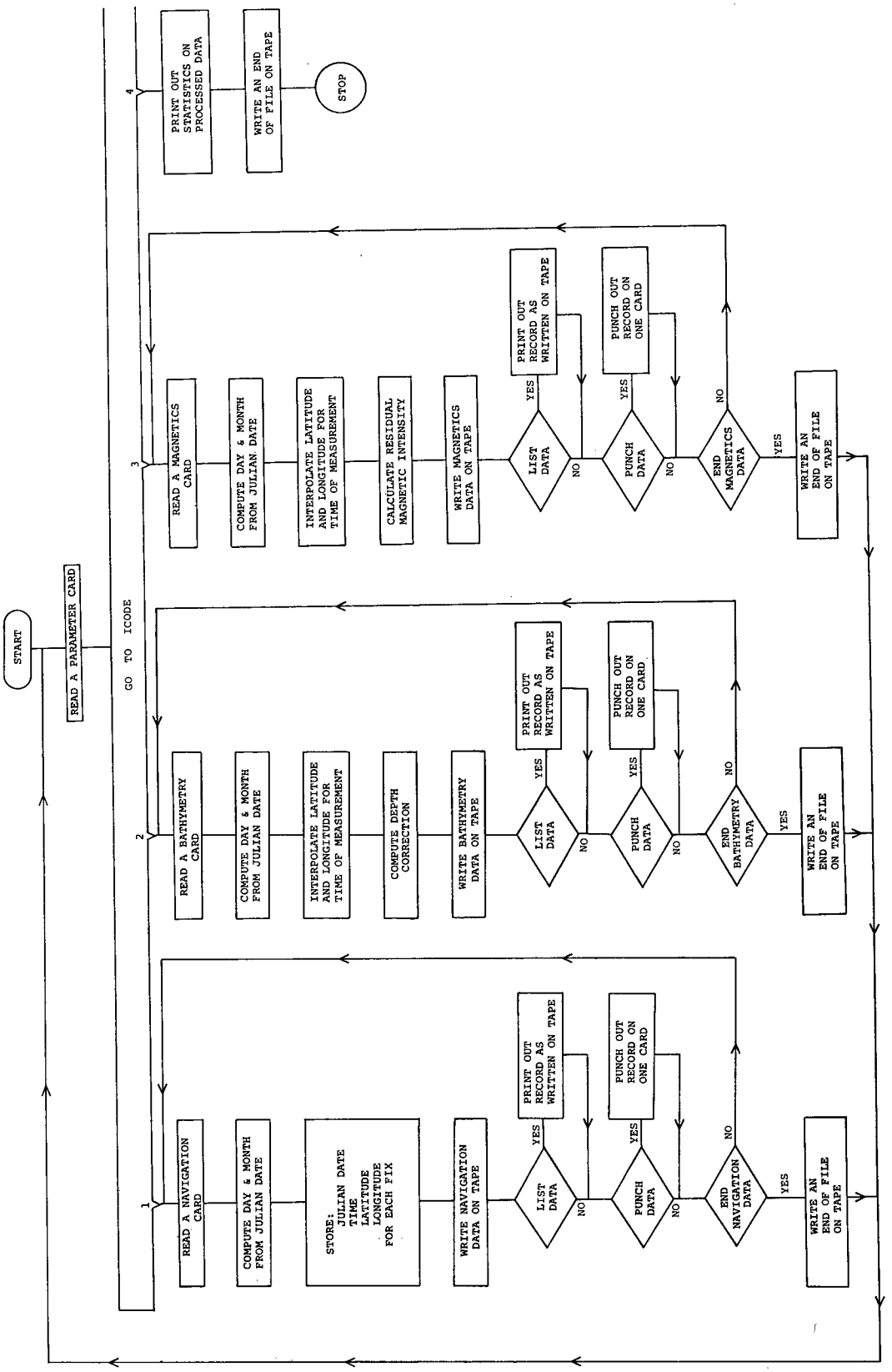

Appendix D2

SOURCE LANGUAGE LISTING

```
      PROGRAM GEODATA
C
C  PROGRAMMER  MARILYN L. BLODGETT    CODE 7817MLB
C              NAVAL RESEARCH LABORATORY
C              WASHINGTON, D.C.   20375
C
      DIMENSION IYEAR(20),MONTH(20),IDAY(20),HR(20),XMIN(20),XLAT(20),
     1XLONG(20),IFIX(20),NAVFIX(20),IDATE(3000),STIME(3000),STLAT(3000),
     2STLONG(3000),KEEPMT(24),BHR(5),BMIN(5),IDP(5),ICRMET(20),ZAVFIX(20
     3),ITM(12),IMG(12),ZMIN(20),SIDP(20)
      DATA((ITM(I),I=1,12)=0,5,10,15,20,25,30,35,40,45,50,55)
      REAL IDEPTH
C     REWIND 06
      REWIND 10
C     IFLIGHT=1
      ITMZNE=0
      ICNTB=0
      ICNTN=0
      ICTMAG=0
C
C  READ A PARAMETER CARD
C
 160  READ(60,10)ICODE,MT,ALT,INPUT,IOUT,SHIPID
 10   FORMAT(I2,1XI2,F5,3XI2,3XI2,2XA8)
      IF(ICODE)12,11,11
 11   WRITE(61,13)
 13   FORMAT(1H0,23HDECK SET UP INCORRECTLY)
      STOP
 12   IF(4*ICODE)11,14,14
 14   ICODE=-ICODE
      GO TO (100,200,300,400), ICODE
C
C  PROCESS THE NAVIGATION DATA CARDS
C
 100  CRUISE=SHIPID
      IOPT=IOUT
      NOWRIT=MT
      IF(NOWRIT  )166,165,166
 166  CALL SKIPFILE(10)
      READ(10,110)CRUISE
      IF(EOF,10)167,166
 167  CALL BACKFILE(10)
      GO TO 120
 165  IF(IOPT)121,120,121
 121  IF(IOPT-2)122,120,122
 122  WRITE(61,501)
 501  FORMAT(1H1,123HSHIP AND CRUISE     TIME     YEAR     MONTH     DAY
     1     HOUR     MINUTE     LATITUDE     LONGITUDE          FIX
     2   FIX)
      WRITE(61,502)
 502  FORMAT(1H ,24HIDENTIFICATION      ZONE,79X,22HDESCRIPTION     NUMB
     1ER)
 120  IENDFL=0
      IWRITE=0
      NLREC=0
      NPREC=0
```

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```
      ISTORE=1
C
C  READ A NAVIGATION CARD
C
 108  READ(60,101)ISN,IY,JUDY,RNHR,RNMIN,IFN,XLAD,XLAM,XLOD,XLOM,IFIXTY
C101  FORMAT(I2,4XI2,1XI3,1XF2,F2,2XI3,1XF2,F6.2,F4,F6.2,1XI2,36X)
 101  FORMAT(I2,4XI2,1XI3,1XF2,F2,I5,F3,F6.2,F4,F6.2,1XI2)
      IF(5+ISN)11,102,104
 102  IF(NOWRIT)160,170,160
 170  IENDFL=1
      IF(IWRITE)150,150,103
 103  NLREC=NLREC+IWRITE
      NPREC=NPREC+1
      IBEG=IWRITE+1
      DO 117 K=IBEG,20
      IYEAR(K)=0
      MONTH(K)=0
      IDAY(K)=0
      HR(K)=0
      XMIN(K)=0.0
      ZMIN(K)=0
      XLAT(K)=0.0
      XLONG(K)=0.0
      IFIX(K)=0
 117  NAVFIX(K)=0
      IWRITE=20
      GO TO 140
 104  IYR=IY
      ICNTN=ICNTN+1
      IF(3001-ICNTN)105,105,106
 105  WRITE(61,107)
 107  FORMAT(1H0,36HMORE THAN 3000 NAVIGATION DATA CARDS)
      STOP
C
C  COMPUTE DAY AND MONTH FROM JULIAN DATE
C
 106  CALL JULIAN(IYR,JUDY,ID,IM,LPYR)
C     XLOD=-XLOD
      XLOD=-XLOD
      MINUS=4000000000000000B
      XLAM=ABSF(XLAM)
      XLOM=ABSF(XLOM)
      KOY=XLAD.AND.MINUS
      IF(KOY.EQ.MINUS)27,28
 27   COMLAT=XLAD-XLAM/60.0
      GO TO 29
 28   COMLAT=XLAD + XLAM/60.0
 29   KEY=XLOD.AND.MINUS
      IF(KEY.EQ.MINUS)30,31
 30   COMLON=XLOD-XLOM/60.0
      GO TO 164
 31   COMLON=XLOD+XLOM/60.0
 164  TIME=RNHR+RNMIN/60.0
C
C  STORE JULIAN DAY, TIME, LATITUDE AND LONGITUDE FOR EACH FIX
C
```

```
      IDATE(ISTORE)=JUDY
      STIME(ISTORE)=TIME
      STLAT(ISTORE)=COMLAT
      STLONG(ISTORE)=COMLON
      ISTORE=ISTORE+1
      IF(NOWRIT)108,171,108
C
C  STORE INFORMATION FOR WRITING ON TAPE
C
 171  IWRITE=IWRITE+1
      IYEAR(IWRITE)=IYR
      MONTH(IWRITE)=IM
      IDAY(IWRITE)=ID
      HR(IWRITE)=RNHR
      XMIN(IWRITE)=RNMIN*10.0
      ZMIN(IWRITE)=XMIN(IWRITE)/10.0
      XLAT(IWRITE)=COMLAT
      XLONG(IWRITE)=COMLON
      IFIX(IWRITE)=IFIXTY
      NAVFIX(IWRITE)=IFN
      IF(20-IWRITE)109,109,108
 109  NLREC=NLREC+20
      NPREC=NPREC+1
C
C  WRITE LOGICAL RECORDS ON TAPE
C
 140  WRITE(10,110)(CRUISE,ITMZNE,IYEAR(I),MONTH(I),IDAY(I),HR(I),XMIN(I
     1),XLAT(I),XLONG(I),IFIX(I),NAVFIX(I),I=1,IWRITE)
 110  FORMAT(A8,I5,I2,I2,I2,1XF2,F3,F8.4,F9.4,  I2,7XI5,24X)
      IF(IOPT)111,112,111
 111  IF(IOPT-2)113,115,114
 116  FORMAT(1H ,2XA8,7XI5,7XI2,7XI2,7XI2,7XF2,7XF4.1,6XF8.4,5XF9.4,9XI2
     1,10XI5)
 113  IF(NPREC-1)601,600,601
 600  WRITE(61,116)(CRUISE,ITMZNE,IYEAR(I),MONTH(I),IDAY(I),HR(I),ZMIN(I
     1),XLAT(I),XLONG(I),IFIX(I),NAVFIX(I),I=1,IWRITE)
      GO TO 112
 601  IF(MOD(NPREC,3).NE.1) GO TO 600
      WRITE(61,501)
      WRITE(61,502)
      GO TO 600
 114  IF(NPREC-1)604,603,604
 603  WRITE(61,116)(CRUISE,ITMZNE,IYEAR(I),MONTH(I),IDAY(I),HR(I),ZMIN(I
     1),XLAT(I),XLONG(I),IFIX(I),NAVFIX(I),I=1,IWRITE)
      GO TO 115
 604  IF(MOD(NPREC,3).NE.1) GO TO 603
      WRITE(61,501)
      WRITE(61,502)
      GO TO 603
 115  WRITE(62,110)(CRUISE,ITMZNE,IYEAR(I),MONTH(I),IDAY(I),HR(I),XMIN(I
     1),XLAT(I),XLONG(I),IFIX(I),NAVFIX(I),I=1,IWRITE)
 112  IWRITE=0
      IF(IENDFL)150,108,150
 150  ENDFILE 10
      GO TO 160
```

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```
C  PROCESS THE BATHYMETRY DATA CARDS
C
 200  DO 201 L=1,24
 201  KEEPMT(L)=0
      KKMT=1
      KEEPMT(1)=MT
      IENDFL=0
      IWRITE=0
      IFIELD=0
      IBLREC=0
      IBPREC=0
      IOPT=IOUT
      KNPUT=INPUT
      IF(IOPT)241,240,241
 241  IF(IOPT-2)242,240,242
 242  WRITE(61,504)
 504  FORMAT(1H1,133HSHIP AND CRUISE   TIME   YEAR   MONTH   DAY   HOUR
     1  MINUTE   LATITUDE   LONGITUDE   UNCORRECTED   UNCORRECTED   CORR
     2ECTED   MATTHEWS)
      WRITE(61,505)
 505  FORMAT(1H ,22HIDENTIFICATION    ZONE,65X,44HFATHOMS        METERS
     1      METERS        ZONE)
 240  DO 202 J=1,ICNTN
      IF(IFIELD)203,205,203
C
C  READ A BATHYMETRY CARD
C
 205  READ(60,204)ISN,JUDY,(BHR(I),BMIN(I),IDP(I),I=1,5)
C204  FORMAT(I2,I1,1X,5(F2,F4.1,1XI4))
 204  FORMAT(I2,1XI3,5(1XF2,F3.1,1XI4))
      IF(ISN)206,207,207
 206  IF(ISN+6)209,208,209
 209  IF(ISN+7)11,234,11
 234  IENDFL=1
      IF(IWRITE)232,232,235
 235  IBLREC=IBLREC+IWRITE
      IBPREC=IBPREC+1
      IBEG=IWRITE+1
      DO 236 K=IBEG,20
      IYEAR(K)=0
      MONTH(K)=0
      IDAY(K)=0
      HR(K)=0
      XMIN(K)=0
      XLAT(K)=0
      XLONG(K)=0
      NAVFIX(K)=0
      ICRMET(K)=0
      SIDP(K)=0
 236  IFIX(K)=0
      IWRITE=20
      GO TO 223
 208  MT=JUDY
C208  MT=BHR(1)
      DO 210 L=1,24
      IF(KEEPMT(L))211,211,212
```

```
 212  IF(KEEPMT(L)-MT)210,205,210
 210  CONTINUE
 211  KEEPMT(L)=MT
      KKMT=L
      GO TO 205
 207  ICNTB=ICNTB+1
C     JUDY=ISN*10 + JUDY
      IFIELD=1
C
C  COMPUTE DAY AND MONTH FROM JULIAN DATE
C
      CALL JULIAN(IYR,JUDY,ID,IM,LPYR)
C
C  INTERPOLATE LATITUDE AND LONGITUDE AT THE TIME OF MEASUREMENT
C
 203  TIME=BHR(IFIELD)+BMIN(IFIELD)/60.0
      IF(BHR(IFIELD))273,270,273
 270  IF(BMIN(IFIELD))273,271,273
 271  IF(IDP(IFIELD))273,205,273
 273  IF(IDATE(J)-JUDY)202,213,217
 213  IF(TIME.LE.STIME(J))215,202
 215  IF(TIME-STIME(J))217,216,217
 216  XD=STLONG(J)
      YD=STLAT(J)
      GO TO 237
 217  TNB=STIME(J)
      TNA=STIME(J-1)
      TDX=TIME
      XNA=STLONG(J-1)
      YNA=STLAT(J-1)
      XNB=STLONG(J)
      YNB=STLAT(J)
      CALL PROPOR(TNA,TNB,TDX,XNA,YNA,XNB,YNB,XD,YD)
C
C  COMPUTE DEPTH CORRECTION ACCORDING TO THE MATTHEWS ZONE NUMBER
C
 237  IF(INPUT-1)219,219,218
 218  IDEPTH=IDP(IFIELD)/1.8288
      GO TO 220
 219  IDEPTH=IDP(IFIELD)
 220  CALL MTCOR(IDEPTH,MT,KORFAT,KORMET,METUNC,MTDC)
      IWRITE=IWRITE+1
C
C  STORE INFORMATION FOR WRITING ON TAPE
C
      IYEAR(IWRITE)=IYR
      MONTH(IWRITE)=IM
      IDAY(IWRITE)=ID
      HR(IWRITE)=BHR(IFIELD)
      XMIN(IWRITE)=BMIN(IFIELD)*10.0
      XLAT(IWRITE)=YD
      XLONG(IWRITE)=XD
      NAVFIX(IWRITE)=IDEPTH*10.
      ICRMET(IWRITE)=KORMET
      IFIX(IWRITE)=MT
      IF(INPUT-1)274,274,275
```

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```
275   SIDP(IWRITE)=IDP(IFIELD)
      GO TO 276
274   SIDP(IWRITE)=IDP(IFIELD)*1.8288
276   IF(20*IWRITE)222,222,221
222   IBLREC=IBLREC+20
      IBPREC=IBPREC+1
C
C  WRITE LOGICAL RECORDS ON TAPE
C
223   WRITE(10,224)(CRUISE,ITMZNE,IYEAR(I),MONTH(I),IDAY(I),HR(I),XMIN(I
     1),XLAT(I),XLONG(I),NAVFIX(I),ICRMET(I),IFIX(I),I=1,IWRITE)
224   FORMAT(A8,I5,I2,I2,I2,1XF2,F3,F8.4,F9.4,10XI5,I5,I2,16X)
      IF(IOPT)225,226,225
607   WRITE(61,228)(CRUISE,ITMZNE,IYEAR(I),MONTH(I),IDAY(I),HR(I),ZMIN(I
     1),XLAT(I),XLONG(I),ZAVFIX(I),SIDP(I),ICRMET(I),IFIX(I),I=1,IWRITE)
228   FORMAT(1H ,2XA8,5XI5,5XI2,5XI2,5XI2,5XF2.5XF4.1,4XF8.4,3XF9.4,5XF6
     1.1,8XF6.1,7XI5,9XI2)
      GO TO 226
225   DO 230 I=1,20
      ZMIN(I)=XMIN(I)/10.0
230   ZAVFIX(I)=NAVFIX(I)/10.
      IF(IOPT-2)227,229,231
227   IF(IBPREC*1)605,607,605
605   IF(MOD(IBPREC,3).NE.1) GO TO 607
      WRITE(61,504)
      WRITE(61,505)
      GO TO 607
231   IF(IBPREC*1)609,608,609
609   IF(MOD(IBPREC,3).NE.1) GO TO 608
      WRITE(61,504)
      WRITE(61,505)
      GO TO 608
608   WRITE(61,228)(CRUISE,ITMZNE,IYEAR(I),MONTH(I),IDAY(I),HR(I),ZMIN(I
     1),XLAT(I),XLONG(I),ZAVFIX(I),SIDP(I),ICRMET(I),IFIX(I),I=1,IWRITE)
229   WRITE(62,224)(CRUISE,ITMZNE,IYEAR(I),MONTH(I),IDAY(I),HR(I),XMIN(I
     1),XLAT(I),XLONG(I),NAVFIX(I),ICRMET(I),IFIX(I),I=1,IWRITE)
226   IWRITE=0
      IF(IENDFL)232,221,232
232   ENDFILE 10
      GO TO 160
221   IFIELD=IFIELD+1
      IF(IFIELD*6)203,205,205
202   CONTINUE
      WRITE(61,233)
233   FORMAT(1H0,44HUNABLE TO INTERPOLATE LATITUDE AND LONGITUDE)
      STOP
C
C  PROCESS THE MAGNETICS DATA CARDS
C
300   M=1
      IOPT=IOUT
      IENDFL=0
      IWRITE=0
      MLREC=0
      MPREC=0
      IFIELD=0
```

```
      IF(IOPT)341,340,341
 341  IF(IOPT-2)342,340,342
 342  WRITE(61,507)
 507  FORMAT(1H1,129HSHIP AND CRUISE     TIME     YEAR     MONTH     DAY
     1HOUR     MINUTE     LATITUDE     LONGITUDE     TOTAL MAGNETIC     RESID
     2UAL MAGNETIC)
      WRITE(61,508)
 508  FORMAT(1H ,23HIDENTIFICATION      ZONE,73X,29HINTENSITY            I
     1NTENSITY)
 340  DO 301 J=1,ICNTN
      IF(IFIELD)303,302,303
C
C  READ A MAGNETICS CARD
C
C302  READ(06,304)JUDY,(RMHR(I),RMMIN(I),RMSEC(I),IALT(I),IMG(I),
C    1I=1,12)
C304  FORMAT(I3,6(3F2,I4,I5)/6(3F2,I4,I5))
C     IF(EOF,06)305,306
C305  IFLIGHT=IFLIGHT +1
C     IF(IFLIGHT-13)302,302,325
 302  READ(60,304)ISN,JUDY,RMHR,(IMG(I),I=1,12)
 304  FORMAT(I2,I3,1XF2,12(1XI5))
      IF(ISN)305,306,306
 305  IF(ISN+8)11,325,11
 325  IENDFL=1
      IF(IWRITE)324,324,326
 326  MLREC=MLREC+IWRITE
      MPREC=MPREC+1
      IBEG=IWRITE+1
      DO 327 K=IBEG,20
      IYEAR(K)=0
      MONTH(K)=0
      IDAY(K)=0
      XLAT(K)=0
      XLONG(K)=0
      HR(K)=0
      XMIN(K)=0
      ZMIN(K)=0
      NAVFIX(K)=0
 327  ICRMET(K)=0
      IWRITE=20
      GO TO 317
 306  ICTMAG=ICTMAG+1
      IFIELD=1
C
C  COMPUTE DAY AND MONTH FROM JULIAN DATE
C
      CALL JULIAN(IYR,JUDY,ID,IM,LPYR)
C
C  INTERPOLATE LATITUDE AND LONGITUDE AT THE TIME OF MEASUREMENT
C
 303  TM=ITM(IFIELD)
      TIME=RMHR+TM/60.0
C303  TM=RMMIN(IFIELD) + RMSEC(IFIELD)/60.0
C     TIME=RMHR(IFIELD) + TM/60.0
C     IF(IFLIGHT-2)700,700,701
```

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```
C700  ALT=1200,
C     GO TO 702
C701  ALT=IALT(IFIELD)*100
      IF(IMG(IFIELD))350,315,350
 350  IF(IDATE(J)-JUDY)301,307,308
 307  IF(TIME.LE.STIME(J))309,301
 309  IF(TIME-STIME(J))308,310,308
 310  XD=STLONG(J)
      YD=STLAT(J)
      GO TO 330
 308  TNB=STIME(J)
      TNA=STIME(J-1)
      TDX=TIME
      XNA=STLONG(J-1)
      YNA=STLAT(J-1)
      XNB=STLONG(J)
      YNB=STLAT(J)
      CALL PROPOR(TNA,TNB,TDX,XNA,YNA,XNB,YNB,XD,YD)
C
C   CALCULATE RESIDUAL MAGNETIC INTENSITY
C
 330  CALL SPHERE(XD,YD,GLON,GLAT)
      ZYR=IYR
      IF(LPYR-2)311,329,311
 329  LEAP=366
      GO TO 312
 311  LEAP=365
 312  DATE=1900. + ZYR + (FLOATF(JUDY)/FLOATF(LEAP))
      ITYPE=1
      IF(ALT)314,313,314
 313  ALT=1.0
 314  BLT=.3048 * ALT/1000.
      CALL IGRF(DATE,ITYPE,BLT,GLAT,GLON,XV,YV,ZV,TV)
      ITV=TV
      NDP=IMG(IFIELD)-ITV
      STALT=ALT
C
C  STORE INFORMATION FOR WRITING ON TAPE
C
      IWRITE=IWRITE+1
      IYEAR(IWRITE)=IYR
      MONTH(IWRITE)=IM
      IDAY(IWRITE)=ID
      XLAT(IWRITE)=YD
      XLONG(IWRITE)=XD
      HR(IWRITE)=RMHR
      XMIN(IWRITE)=ITM(IFIELD)*10
      ZMIN(IWRITE)=ITM(IFIELD)
      NAVFIX(IWRITE)=IMG(IFIELD)
      ICRMET(IWRITE)=NDP
      IF(20-IWRITE)316,316,315
 316  MLREC=MLREC+20
      MPREC=MPREC+1
C
C  WRITE LOGICAL RECORDS ON TAPE
C
```

```
 317  WRITE(10,318)(CRUISE,ITMZNE,IYEAR(I),MONTH(I),IDAY(I), HR(I),XMIN(
     1I),XLAT(I),XLONG(I),NAVFIX(I),ICRMET(I),I=1,IWRITE)
 318  FORMAT(A8,I5,I2,I2,I2,1XF2,F3,F8.4,F9.4,23X,I5,I5,5X)
      IF(IOPT)319,320,319
 319  IF(IOPT-2)321,323,322
 321  IF(MPREC-1)611,610,611
 611  IF(MOD(MPREC,3).NE.1) GO TO 610
      WRITE(61,507)
      WRITE(61,508)
      GO TO 610
 322  IF(MPREC-1) 613,612,613
 613  IF(MOD(MPREC,3).NE.1) GO TO 612
      WRITE(61,507)
      WRITE(61,508)
      GO TO 612
 610  WRITE(61,328)(CRUISE,ITMZNE,IYEAR(I),MONTH(I),IDAY(I), HR(I),ZMIN(
     1I),XLAT(I),XLONG(I),NAVFIX(I),ICRMET(I),I=1,IWRITE)
      GO TO 320
 612  WRITE(61,328)(CRUISE,ITMZNE,IYEAR(I),MONTH(I),IDAY(I), HR(I),ZMIN(
     1I),XLAT(I),XLONG(I),NAVFIX(I),ICRMET(I),I=1,IWRITE)
 328  FORMAT(1H ,2XA8,6XI5,3(6XI2),6XF2,6XF4.1,5XF8.4,4XF9.4,8XI5,15XI5)
 323  WRITE(62,318)(CRUISE,ITMZNE,IYEAR(I),MONTH(I),IDAY(I), HR(I),XMIN(
     1I),XLAT(I),XLONG(I),NAVFIX(I),ICRMET(I),I=1,IWRITE)
 320  IWRITE=0
      IF(IENDFL)324,315,324
 324  ENDFILE 10
      GO TO 160
 315  IFIELD=IFIELD + 1
C315  IFIELD=IFIELD+1
      IF(IFIELD-13)303,302,303
 301  CONTINUE
      WRITE(61,233)
      STOP
C
C  WRITE OUT ACCUMULATED DATA
C
 400  WRITE(61,510)
 510  FORMAT(1HB)
      WRITE(61,401)CRUISE
 401  FORMAT(1H1,35HSHIP AND CRUISE IDENTIFICATION      ,A8)
      IF(NOWRIT)173,172,173
 172  WRITE(61,403)
 403  FORMAT(1H0,15HNAVIGATION DATA)
      WRITE(61,404)ICNTN
 404  FORMAT(1H0,34HNUMBER OF NAVIGATION CARDS READ = ,I4)
      WRITE(61,405)NLREC
 405  FORMAT(1H0,44HNUMBER OF LOGICAL RECORDS WRITTEN ON TAPE = ,I4///)
 173  IF(NOWRIT-1)174,174,175
 174  WRITE(61,407)
 407  FORMAT(1H0,15HBATHYMETRY DATA)
      IF(KNPUT-1)408,408,409
 408  WRITE(61,410)
 410  FORMAT(1H0,39HDEPTH DATA GIVEN IN UNCORRECTED FATHOMS)
      GO TO 411
 409  WRITE(61,412)
 412  FORMAT(1H0,38HDEPTH DATA GIVEN IN UNCORRECTED METERS)
```

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```
411   WRITE(61,413)(KEEPMT(K),K=1,KKMT)
413   FORMAT(1H0,35HMATTHEWS ZONES PASSED THROUGH WERE ,24I4)
      WRITE(61,414)ICNTB
414   FORMAT(1H0,34HNUMBER OF BATHYMETRY CARDS READ = ,I5)
      WRITE(61,415)IBLREC
415   FORMAT(1H0,36HNUMBER OF LOGICAL RECORDS WRITTEN = ,I6///)
175   IF(NOWRIT-1)176,177,176
176   WRITE(61,417)
417   FORMAT(1H0,14HMAGNETICS DATA)
      WRITE(61,418)STALT
418   FORMAT(1H0,43HHEIGHT IN FEET ABOVE OR BELOW SEA LEVEL IS ,F5)
      WRITE(61,419)ICTMAG
419   FORMAT(1H0,33HNUMBER OF MAGNETICS CARDS READ = ,I12)
      WRITE(61,420)MLREC
420   FORMAT(1H0,36HNUMBER OF LOGICAL RECORDS WRITTEN = ,I12)
177   ENDFILE 10
      REWIND 10
      STOP
      END
```

```
5,4DS   GEODATA

                                        IDENT     GEODATA
PROGRAM LENGTH                  33405
ENTRY POINTS     GEODATA        30767
EXTERNAL SYMBOLS
                 Q8QENTRY
                 THEND.
                 Q8QSTOPS
                 Q1010100
                 Q8ODICT.
                 SKIPFILE
                 BACKFILE
                 JULIAN
                 PROPOR
                 MTCOR
                 SPHERE
                 IGRF
                 XMODF
                 Q8QIFEOF
                 EFT.
                 REW.
                 TSH.
                 STH.
                 QNSINGL.
  00625 SYMBOLS
```

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```
      SUBROUTINE JULIAN (IY,JUDY,ID,IM,LPYR)
C     CNVERTS JULIAN DATE INTO DAY, MONTH, YEAR FOR ANNOTATION IN OCEANO
C     IY = YEAR, JUDY = JULIAN DAY, ID = CALENDER DAY, IM = CALENDER MON
C     OMPLIMENTS OF BOB FEDEN - CODE 8174 - 17 NOV 1971
C     MODIFIED BY LEON LA LUMIERE - CODE 8178 - 17 NOV 1971
C
      DIMENSION JJ(13), AA(12)
      TYPE INTEGER AA
      DATA ((JJ(I), I = 1, 13) = 0, 31, 59, 90, 120, 151, 181, 212, 243,
     1273, 304, 334, 365)
      DATA ((AA(I), I = 1, 12) = 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12)
      LL=IY
      MM=JUDY
      IF (LL.LT.0) GO TO 10
      IF (LL.EQ.0) GO TO 1
      IF (MOD(LL,4).EQ.0) GO TO 4
    1 IF (MM.LE.0.OR.MM.GT.365) GO TO 4
    2 DO 3 K=2,13
      IF (MM.LE.JJ(K)) GO TO 6
    3 CONTINUE
    4 LPYR=2
      IF (MM.LE.0.OR.MM.GT.366) GO TO 10
      IF (MM.LE.59) GO TO 2
      IF (MM.EQ.60) GO TO 5
      MM=MM+1
      GO TO 2
    5 II=29
      K=3
      GO TO 7
    6 II=MM-JJ(K-1)
      IF (LL.EQ.0) GO TO 8
      IF (MOD(LL,4).NE.0) GO TO 8
      IF (MOD(LL,4).EQ.0.AND.MM.LE.59) GO TO 8
      MM=MM+1
    7 IF (LL.GE.10) GO TO 8
    8 ID=II
      IM=AA(K-1)
    9 RETURN
   10 PRINT 11, LL,MM
      GO TO 9
C
   11 FORMAT (1X,*YEAR = *,I2,1X,*JULIAN DAY = *,I3,1X,*ARE BAD DATES*)
      END
```

```
5,4DS    JULIAN

                                          IDENT     JULIAN
      PROGRAM LENGTH                 00301
      ENTRY POINTS     JULIAN        00053
      EXTERNAL SYMBOLS
                       THEND,
                       QBODICT,
                       XMODF
                       STH,
                       QNSINGL,
         00116 SYMBOLS
```

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```
      SUBROUTINE PROPOR (TNA,TNB,TDX,XNA,YNA,XNB,YNB,XD,YD)
C     OMPUTES THE X-Y COORDINATES FOR PLOTTING BATHYMETRY
C     PROGRAMMER - LEON LA LUMIERE - CODE 8174 - 15 DEC 1971
C
      PERIOD=TNB-TNA
      DELT=TDX-TNA
      RATIO=DELT/PERIOD
      DELX=XNB-XNA
      DELY=YNB-YNA
      XD=DELX*RATIO+XNA
      YD=DELY*RATIO+YNA
      RETURN
      END
```

```
5,4DS    PROPOR

                                        IDENT     PROPOR
PROGRAM LENGTH                 00140
ENTRY POINTS     PROPOR        00003
EXTERNAL SYMBOLS
                 QBQDICT,
   00054 SYMBOLS
```

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FTN5.4A

```
      SUBROUTINE SPHERE(DLON,DLAT,GLON,GLAT)
      IF(DLON)10,20,20
10    GLON=DLON
      GO TO 30
20    GLON=360. + DLON
30    GLAT=90. -DLAT
      RETURN
      END
```

```
5,4DS    SPHERE

                                        IDENT      SPHERE
      PROGRAM LENGTH                 00102
      ENTRY POINTS     SPHERE        00003
      EXTERNAL SYMBOLS
                       C8QDICT,
         00033 SYMBOLS
```

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```
      SUBROUTINE MTCOR (IDEP,MT,KCDF,KCDM,METUNC,MTDC)
C
C     JAN 10, 1972
C
C     MODIFIED FOR CDC 3800 BY LEON LA LUMIERE - CODE 8174 - 20 MAR 1972
C
C     SUBROUTINE MTCOR(ARG)  MATTHEWS TABLE CORRECTION
C          VERSION WHERE COEFFICIENTS ENTERED AT RUN TIME
C     ALCULATES CORRECTED DEPTH IN METERS WHEN GIVEN
C          MATTHEWS TABLE COEFFICIENTS AND UNCORRECTED
C          DEPTH IN FATHOMS
C     COPIED FROM WHOI PROGRAM FOR IBM 1130
C
C     INPUT,
C          IDEP = UNCORRECTED DEPTH IN FATHOMS
C          MT = MATTHEWS TABLE COEFFICIENT(1 - 52)
C
C     OUTPUT,
C          KCDF = CORRECTED DEPTH IN FATHOMS
C          KCDM = CORRECTED DEPTH IN METERS
C          MTDC = MATHEWS TABLE DEPTH CORRECTION (METERS)
C
C     INTERNAL
C          NUDF  WATER DEPTH UNCORRECTED FATHOMS
C          WUDF  WATER DEPTH UNCORRECTED FATHOMS
C          WUDM  WATER DEPTH UNCORRECTED METERS
C          WCOR  CORRECTION IN METERS
C
C     SETTING MATTHEWS TABLE COEFFICIENTS SUPPLIED BY C. GANTAR
      DIMENSION MTN(52),AMT(52),BMT(52),CMT(52),DMT(52),EMT(52),FMT(52)
C
      REAL IDEP
      DATA (MTN=1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22
     1,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44
     2,45,46,47,48,49,50,51,52)
      DATA (AMT=-.05,.21,.19,.25,.35,.43,.12,-.21,.76,-.19,-.07,1.29,.34
     1,-.04,.12,.39,1.18,1.25,-.11,.64,-.31,.43,-.29,-.06,-.110,-.08,-.2
     23,.06,1.14,-.38,.2,-.56,.34,.58,1.15,.58,.01,.59,2.49,.97,3.93,1.9
     36,-.15,.09,.06,.42,-.05,.03,-.41,-.19,-.01,.07)
      DATA (BMT=-.01683,-.00247,.006885,.000632,.015719,.004269,.013881,
     1.025565,.030789,.023035,.031673,.036491,.031972,.049788,.032253,.0
     240042,.037533,.043541,.046531,.034097,.019659,.025093,.012063,.005
     3833,-.000139,-.006374,-.00994,-.012026,-.019317,-.011231,.034103,.
     4037121,.037874,.03524,.031429,.037872,.043038,.0398,.025775,.03583
     58,.021001,.0186,.021906,.013118,.001109,.044699,.02651,.028006,.03
     65524,.03841,.049807,.000832)
      DATA (CMT=.130695,-.028055,-.033416,.030785,-.169795,.049419,-.059
     1931,-.156579,-.141286,.00879,-.101806,-.121871,-.040565,-.233986,.
     2011268,-.363995,-.227838,-.239633,-.383832,-.24561,-.044804,-.2165
     309,-.014753,-.009209,.021746,.082109,.101101,.11843,.193882,.06327
     48,-.255508,-.174712,-.196492,-.149662,-.141422,-.17812,-.210477,-.
     5103453,-.092957,-.142494,-.04741,-.02271,-.117873,-.039335,.023648
     6,-.271705,-.041812,.048156,-.059269,-.097981,.001276,.161859)
      DATA (DMT=-.040587,.017161,-.00471,.012525,.115271,-.015992,.04609
     14,.083656,.05727,-.01941,.036137,.039775,.004688,.083487,-.030352,
     2.207727,.102774,.095135,.187189,.123539,.02245,.119429,.008118,.02
```

```
     34232,.01811,-.013313,-.020412,-.030545,-.061797,-.001826,.121471,.
     4064336,.081801,.056314,.055151,.067,.083684,.020131,.037683,.09235
     59,.018848,.00924,.06013,.023795,.007413,.103092,.167905,.004016,.0
     670316,.097868,-.000464,-.162078)
      DATA (EMT=.092394,.048995,.127138,-.02266,-.249166,.06975,-.087349
     1,-.154994,-.075775,.081004,-.035675,-.040077,.023167,-.115908,.107
     256,-.470139,-.166568,-.137278,-.366057,-.235691,-.029841,-.232583,
     3.015918,-.046104,-.045777,.024588,.037058,.062662,.110085,.001486,
     4-.214992,-.08885,-.138137,-.079156,-.07518,-.09377,-.136212,.01265
     52,-.041351,-.186534,-.014159,.001108,-.09774,-.025662,-.004717,-.1
     642748,-.983392,.000155,-.170839,-.2527,.24145,.983392)
      DATA (FMT=-.072171,-.158148,-.23102,.012058,.190978,-.076755,.0646
     179,.109779,.038823,-.075341,.011294,.015287,-.027333,.062495,-.096
     2216,.403122,.10073,.074903,.267798,.169277,.021495,.16502,-.028903
     3,.035913,.040884,-.014177,-.022102,-.045831,-.06729,.001066,.14100
     47,.04968,.094743,.048085,.039534,.050998,.089176,-.032552,.017001,
     5.140729,.003867,-.004373,.058355,.010515,.000162,.067775,2.003205,
     6-.00155,.149654,.235294,-.623288,-2.003205)
C
      NZERO=0
C
      NUDF=IDEP
      IF (NUDF) 3,5,1
    1 IF (52-MT) 4,2,2
C
    2 WUDF=IDEP
      WUDM=WUDF*1.8288
      WCOR=AMT(MT)+BMT(MT)*WUDM*CMT(MT)*1.E-04*(WUDM**2)+DMT(MT)*1.E-07*
     1(WUDM**3)+EMT(MT)*1.E-11*(WUDM**4)+FMT(MT)*1.E-15*(WUDM**5)
      WCDM=WUDM*WCOR
      KCDM=WCDM*0.5
      MTDC=WCOR*0.5
      KCDF=(WCDM*0.54681)*0.5
      METUNC=WUDM
      RETURN
C
    3 PRINT 6
      GO TO 5
C
    4 PRINT 7
C     ERROR EXIT
    5 KCDM=NZERO
      MTDC=NZERO
      KCDF=NZERO
      RETURN
C
    6 FORMAT (1X,*DEPTH READ IS NEGATIVE*)
    7 FORMAT (1X,*MATTHEWS ZONE NUMBER IS GREATER THAN 52*)
      END
```

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```
5,4DS     MTC@R

                                        IDENT     MTC@R
      PRCGRAM LENGTH              01015
      ENTRY P@INTS     MTC@R      00577
      EXTERNAL SYMB@LS
                       Q1Q10100
                       THEND,
                       Q8QDICT,
                       STH,
         00074 SYMB@LS
```

```
      SUBROUTINE IGRF(DATE,ITYPE,ALT,COLAT,ELONG,X,Y,Z,T)                JS170700
CGENP   IGRF
C
C                                                                        JS170800
C  THIS SUBROUTINE COMPUTES VALUES OF X,Y,Z AND T FOR A GIVEN EPOCH      JS170900
C  AND POSITION FROM THE SPHERICAL HARMONIC COEFFICIENTS OF THE          JS171000
C  INTERNATIONAL GEOMAGNETIC REFERENCE FIELD                             JS171100
C  DATA  DATE = REQUIRED EPOCH IN YEARS AND DECIMALS OF A YEAR, A.D.     JS171200
C        ITYPE = 1 IF GEODETIC COORDINATES ARE BEING USED                JS171300
C       ITYPE = 2 IF GEOCENTRIC COORDINATES ARE BEING USED               JS171400
C         ALT = HEIGHT ABOVE MEAN SEA LEVEL IN KILOMETERS                JS171500
C         ALT = RADIAL DISTANCE FROM CENTRE OF EARTH IN KILOMETERS       JS171600
C       COLAT = COLATITUDE IN DEGREES (0.0 TO 180.0)                     JS171700
C       ELONG = EAST LONGITUDE IN DEGREES (0.0 TO 360.0)                 JS171800
C  OUTPUT  X = NORTH COMPONENT OF MAGNETIC FORCE IN GAMMAS               JS171900
C          Y = EAST COMPONENT OF MAGNETIC FORCE IN GAMMAS                JS172000
C          Z = VERTICAL COMPONENT OF MAGNETIC FORCE IN GAMMAS            JS172100
C                                        (POSITIVE DOWNWARDS)            JS172200
C          T = TOTAL MAGNETIC FORCE IN GAMMAS                            JS172300
C  N.B. THE COORDINATE SYSTEM FOR X,Y AND Z IS THE SAME AS THAT          JS172400
C       SPECIFIED BY ITYPE                                               JS172500
      DIMENSION   P(44),Q(44),CL(8),SL(8),AGH(80),DGH(80)                JS172600
C  THE S.H.COEFFIEIENTS ARE SUPPLIED BY THE FOLLOWING DATA STATEMENTS    JS172700
C  ALTERNATIVELY, THE COEFICIENTS MAY BE SUPPLIED BY STATEMENTS OF       JS172800
C  THE FORM - AGH(1) = -30339, AGH(2) = -2123, ETC                       JS172900
C  OR THE COEFFICIENTS MAY BE READ IN THE MASTER PROGRAM AND MADE        JS173000
C  AVAILABLE TO THE SUBROUTINE BY A COMMON STATEMENT                     JS173100
C                                                                        JS173200
C  SET INITIAL VALUES                                                    JS173300
C                                                                        JS173400
      DATA (AGH = -30339.,-2123.,5758.,-1654.,2994.,-2006.,1567.,130.,   JS173600
     A1297.,-2036.,-403.,1289.,242.,843.,-176.,958.,805.,149.,492.,      JS173700
     B-280.,-392.,8.,256.,-265.,-223.,357.,16.,246.,125.,-26.,-123.,     JS173800
     C-161.,-107.,-51.,77.,47.,60.,-14.,4.,106.,-229.,68.,3.,-32.,-4.,   JS173900
     D-10.,-112.,-13.,71.,-54.,-57.,0.,-27.,12.,-8.,-25.,9.,-9.,23.,     JS174000
     E13.,-19.,-2.,-17.,10.,9.,3.,-3.,-13.,-12.,5.,-4.,-17.,7.,4.,-5.,   JS174100
     F22.,12.,-3.,6.,-16.)
      DATA (DGH = 15.3,8.7,-2.3,-24.4,0.3,-11.8,-1.6,-16.7,0.2,-10.8,    JS174200
     A4.2,0.7,0.7,-3.8,-7.7,-0.7,0.2,-0.1,-3.0,1.6,-0.1,2.9,-2.1,-4.2,   JS174300
     B1.9,1.1,2.3,2.9,1.7,0.6,-2.4,0.0,0.8,1.3,-0.3,-0.1,-0.3,-0.9,1.1,  JS174400
     C-0.4,1.9,2.0,-0.4,-1.1,-0.4,0.1,-0.2,0.9,-0.5,-0.3,-1.1,-0.7,0.3,  JS174500
     D-0.5,0.4,0.3,0.2,0.0,0.4,-0.2,0.2,-0.6,0.3,0.1,0.4,0.1,0.6,-0.2,   JS174600
     E0.0,-0.3,0.0,-0.2,-0.1,-0.3,0.3,-0.4,-0.3,-0.3,-0.5,-0.3)          JS174700
      T=DATE-1965.0                                                      JS177900
      R=ALT                                                              JS178000
      ONE=COLAT*0.0174533                                                JS178100
      SLAT=COS(ONE)                                                      JS178200
      CLAT=SIN(ONE)                                                      JS178300
      ONE=ELONG*0.0174533                                                JS178400
      CL(1)=COS(ONE)                                                     JS178500
      SL(1)=SIN(ONE)                                                     JS178600
      X=0.0                                                              JS178700
      Y=0.0                                                              JS178800
      Z=0.0                                                              JS178900
      CD=1.0                                                             JS179000
      SD=0.0                                                             JS179100
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      L=1                                                               JS179200
      M=1                                                               JS179300
      N=0                                                               JS179400
      GO TO (1,2), ITYPE                                                JS179500
C                                                                       JS179600
C  CONVERSION FROM GEODETIC TO GEOCENTRIC COORDINATES                   JS179700
C                                                                       JS179800
    1 A2=40680925.                                                      JS179900
      B2=40408585.                                                      JS180000
      ONE=A2*CLAT*CLAT                                                  JS180100
      TWO=B2*SLAT*SLAT                                                  JS180200
      THREE=ONE+TWO                                                     JS180300
      FOUR=SQRT(THREE)                                                  JS180400
      R=SQRT(ALT*(ALT+2.0*FOUR)+(A2*ONE+B2*TWO)/THREE)                  JS180500
      CD=(ALT+FOUR)/R                                                   JS180600
      SD=(A2-B2)/FOUR*SLAT*CLAT/R                                       JS180700
      ONE=SLAT                                                          JS180800
      SLAT=SLAT*CD-CLAT*SD                                              JS180900
      CLAT=CLAT*CD+ONE*SD                                               JS181000
C                                                                       JS181100
    2 RATIO=6371.2/R                                                    JS181200
C                                                                       JS181300
C  COMPUTATION OF SCHMIDT QUASI-NORMAL COEFFICIENTS P AND X(=Q)         JS181400
C                                                                       JS181500
      P(1)=2.0*SLAT                                                     JS181600
      P(2)=2.0*CLAT                                                     JS181700
      P(3)=4.5*SLAT*SLAT-1.5                                            JS181800
      P(4)=5.1961524*CLAT*SLAT                                          JS181900
      Q(1)=-CLAT                                                        JS182000
      Q(2)=SLAT                                                         JS182100
      Q(3)=-3.0*CLAT*SLAT                                               JS182200
      Q(4)=1.7320508*(SLAT*SLAT-CLAT*CLAT)                              JS182300
      DO 15 K=1,44                                                      JS182400
      IF(N-M) 3,4,4                                                     JS182500
    3 M=0                                                               JS182600
      N=N+1                                                             JS182700
      RR=RATIO**(N+2)                                                   JS182800
      FN=N                                                              JS182900
    4 FM=M                                                              JS183000
      IF(K-5) 8,5,5                                                     JS183100
    5 IF(M-N) 7,6,7                                                     JS183200
    6 ONE=SQRT(1.0-0.5/FM)                                              JS183300
      J=K-N-1                                                           JS183400
      P(K)=(1.0+1.0/FM)*ONE*CLAT*P(J)                                   JS183500
      Q(K)=ONE*(CLAT*Q(J)+SLAT/FM*P(J))                                 JS183600
      SL(M)=SL(M-1)*CL(1)+CL(M-1)*SL(1)                                 JS183700
      CL(M)=CL(M-1)*CL(1)-SL(M-1)*SL(1)                                 JS183800
      GO TO 8                                                           JS183900
    7 ONE=SQRT(FN*FN-FM*FM)                                             JS184000
      TWO=SQRT((FN-1.0)**2-FM*FM)/ONE                                   JS184100
      THREE=(2.0*FN-1.0)/ONE                                            JS184200
      I=K-N                                                             JS184300
      J=K-2*N+1                                                         JS184400
      P(K)=(FN+1.0)*(THREE*SLAT/FN*P(I)-TWO/(FN-1.0)*P(J))              JS184500
      Q(K)=THREE*(SLAT*Q(I)-CLAT/FN*P(I))-TWO*Q(J)                      JS184600
C                                                                       JS184700
```

```
C  SYNTHESIS OF X,Y AND Z IN GEOCENTRIC COORDINATES                    JS184800
C                                                                      JS184900
    8 ONE=(AGH(L)+DGH(L)*T)*RR                                         JS185000
      IF(M) 10,9,10                                                    JS185100
    9 X=X+ONE*Q(K)                                                     JS185200
      Z=Z-ONE*P(K)                                                     JS185300
      L=L+1                                                            JS185400
      GO TO 14                                                         JS185500
   10 TWO=(AGH(L+1)+DGH(L+1)*T)*RR                                     JS185600
      THREE=ONE*CL(M)+TWO*SL(M)                                        JS185700
      X=X+THREE*Q(K)                                                   JS185800
      Z=Z-THREE*P(K)                                                   JS185900
      IF(CLAT) 12,12,11                                                JS186000
   11 Y=Y+(ONE*SL(M)-TWO*CL(M))*FM*P(K)/((FN+1.0)*CLAT)                JS186100
      GO TO 13                                                         JS186200
   12 Y=Y+(ONE*SL(M)-TWO*CL(M))*Q(K)*SLAT                              JS186300
   13 L=L+2                                                            JS186400
   14 M=M+1                                                            JS186500
   15 CONTINUE                                                         JS186600
C                                                                      JS186700
C  CONVERSION TO COORDINATE SYSTEM SPECIFIED BY ITYPE                  JS186800
C                                                                      JS186900
      ONE=X                                                            JS187000
      X=X*CD+Z*SD                                                      JS187100
      Z=Z*CD-ONE*SD                                                    JS187200
      T=SQRT(X*X+Y*Y+Z*Z)                                              JS187300
C                                                                      JS187400
      RETURN                                                           JS187500
C                                                                      JS187600
C  LIBRARY FUNCTIONS USED BY THIS SUBROUTINE ARE SIN,COS,SQRT          JS187700
C                                                                      JS187800
C  SAMPLE RESULTS                                                      JS187900
C  IGRF(1965,0,1,0.0,0.0,30.0,2541.,-240.,56349.,56407.)               JS188000
C  IGRF(1965,0,1,0.0,180.0,295.0,12923.,9661.,-56900.,59144.)          JS188100
C  IGRF(1969,3,1,0.0,57.0,195.0,25092.,5729.,30145.,39638.)            JS188200
C  IGRF(1965,0,2,6371.2,45.0,10.0,21848.,-1052.,40417.,45956.)         JS188300
C  IGRF(1967,5,2,9000.0,31.0,359.0,5750.,-1226.,17853.,18796.)         JS188400
C                                                                      JS188500
      END                                                              JS188600
```

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5,4DS      IGRF
                                                IDENT      IGRF
      PROGRAM LENGTH                  01266
      ENTRY POINTS     IGRF           00413
      EXTERNAL SYMBOLS
                       Q2Q07110
                       Q8QDICT,
                       SQRTF
                       SINF
                       COSF
         00163 SYMBOLS
LOAD
RUN,60,9500
```