Aeromagnetics
Project Magnet Data (1953–1994)

CD-ROM User's Manual

by

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INTRODUCTION

The purpose of this compilation is to provide, in one complete collection, Project Magnet, developed by the U.S. Department of Defense's, Naval Oceanographic Office. This set consists of aircraft derived aeromagnetic data which were collected world wide to aid the geomagnetic field modeling efforts of the U.S. Navy. This manual provides data documentation and explains how to use GeoVu (access software developed by the National Geophysical Data Center).

The compact disc contains approximately 600 megabytes (4.1 million statute miles) of trackline data in binary form, dating from 1953 to 1994. The majority of the data consists of flight surveys in binary (.bin) files. Many other documentation (.txt, .doc, .wp), and meta-data (.lst,.cst,.hdr,.hlp) support files are also included.

The National Oceanic and Atmospheric Administration (NOAA) appreciates the value of integrated data management, and has assembled data for this compact disc in order to simplify the work of scientists performing regional and global geophysical studies. The primary application for this disc is research into the nature of the Earth's magnetic field.

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CHAPTER 1
The Project Magnet Program
A Brief History

From 1951 through 1994, the U.S. Navy, under its Project MAGNET program, continuously collected vector aeromagnetic survey data to support the U.S. Defense Mapping Agency's world magnetic modeling and charting program. The high-level survey coverage during this period is presented in Figure 1. Early test flights began in 1951. Full operational capability was established in 1953. Since that time five separate aircraft have been employed as the survey platform. Each succeeding aircraft represented a significant improvement in range, speed, or altitude. The flight capabilities and deployment dates of these aircraft are summarized in Table 1.

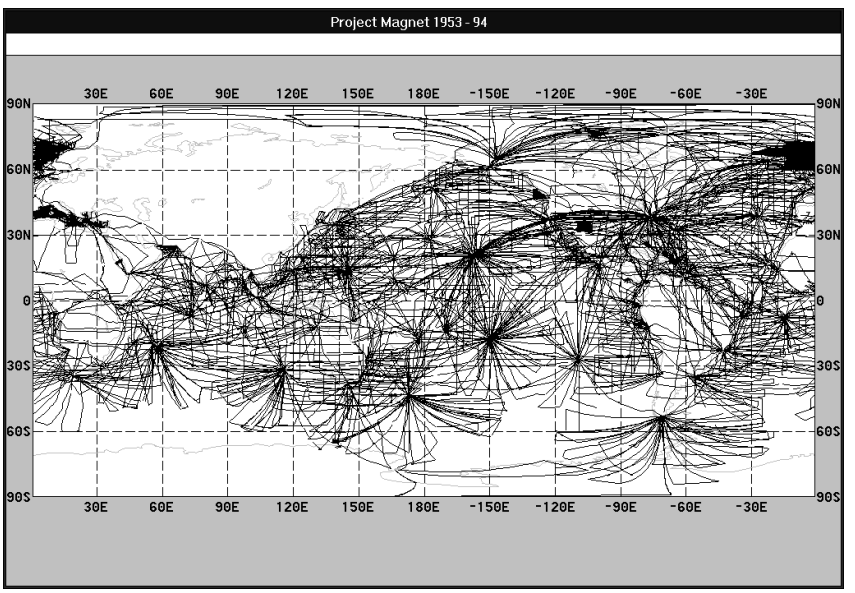

Figure 1. Survey coverage of Project Magnet

Table I. Project MAGNET Aircraft History.

- 1953 - P-2V Neptune
  Range: 2200 nm
  Survey Altitude: 9,000 - 13,000 ft
  Speed: N/A

- 1955 - NC-54 Skymaster
  Range: Greater than 2350 nm
  Survey Altitude: 9,000 - 13,000 ft
  Speed: 175 kts

- 1958/1962 - NC-121 Super Constellation
  Range: Greater than 4000 nm
  Survey Altitude: 25,000 ft
  Speed: 210 kts

- 1970/Present - RP-3D Orion (modified P-3C)
  Range: 5,000 nm high-level
  2,800 nm low-level
  Survey Altitudes: 25,000 ft high-level
  500 ft low-level
  Speed: 340 kts high-level
  240 kts low-level
  Wing Span: 99 ft 8 in
  Length: 107 ft 10 in

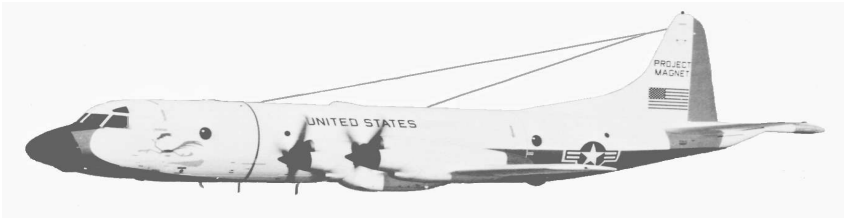

Figure 2. Last Project MAGNET Aircraft.

The primary purpose of the high-level Project MAGNET aeromagnetic surveys is to supply data in support of the World Magnetic Modeling (WMM) program, which in turn supports civilian and military global navigation needs. Most Global Positioning System (GPS) receivers made in the United States incorporate the WMM either as a piece of hardware in the form of a computer chip, or as a piece of software. The model also is used to control drift rates in inertial navigation systems. Other applications of the WMM include its use as a control measurement for the Earth's core-mantle boundary, and as an aid for geophysical prospecting and resource evaluation.

The Aircraft and Instrumentation

Between 1953 and 1970, the survey did not fly much higher than 15,000 feet and, since most surveys were conducted in remote ocean areas, navigation was limited to periodic celestial fixes, some Loran and dead reckoning. By today's standards, therefore, navigation during this period was rather poor, with accuracies no better than about five nautical miles (±5 nm). Table 2 summarizes the capabilities of the early magnetic survey system. The data acquisition system consisted primarily of strip chart recorders and navigation logs. Consequently, the majority of these data were hand digitized. All vector magnetic data collected during this early period is now summarized in the U.S. Naval Oceanographic Office (NAVOCEANO) Special Publication #66 (SP-66) and is also digitized on this CD-ROM at five minute intervals. The analog magnetograms (strip charts as mentioned above), were transferred to micro film and are available from the National Geophysical Data Center.

During the last twenty years, after the introduction of the Orion aircraft, the high-level vector aeromagnetic surveys were conducted above 15,000 feet, usually between 20,000 feet and 25,000 feet. Navigational accuracy during this period was generally within ±1 nm, although some flights since the introduction of GPS receivers in 1987 have positioning accuracies on the order of 30 to 100 meters whenever there was a good GPS window.

Table 2. Project MAGNET Survey System 1953-1970.

MAGNETOMETERS

Vector Airborne Magnetometer (VAM-2A)
Type - Self-Orienting Fluxgate
Measures - D, I, F
Accurcy - +/- 15 nT (for F)

Optically Pumped Metastable Helium Magnetometer
Type - Towed
Measures - F
Accuracy - +/- 4 nT

NAVIGATION

Type - Dead Reckoning
- Celestial Fixes
- LORAN (where available)
- Radar
Accuracy - +/- 5 nm (at best)

ALTITUDE

Type - Aneroid Barometic Altimeter (Standard Pressure Used)
Accuracy - +/- 30 m

TIME

Type - 24 hr Chronometer
Accuracy - 0.8 sec/24 hrs

RECORDING

Magnetics
Punched Paper Tape, Strip Chart Recorders, and Magnetic Tape (late 1960's)
Navigation
Paper Charts, Navigation Log

The fluxgate vector magnetometer and the electrically suspended gyro (ESG) are shockmounted on a rigid aluminum beam in a magnetically clean area at the rear of the aircraft. The ESG has been the primary inertial navigation and attitude determination instrument during most of the past twenty years. It has been augmented, first with two ASN-84 inertial systems and later by two Litton inertial systems which were located on shock mounts toward the middle of the aircraft.

The two Litton inertial systems are referred to as INS-1 and INS-2. These inertial systems were not mounted on the rigid beam with the magnetometer or the ESG. Therefore, due to the flexure of the fuselage of the aircraft, attitude as specified by these instruments did not as accurately represent the orientation of the magnetometer in space as did the ESG. Nevertheless, they provided a sufficiently accurate redundant attitude capability to be used in data reduction in the event of ESG failure.

The scalar magnetometer used during the past twenty years has been the ASQ-81 optically pumped metastable helium magnetometer. Its purpose is to calibrate the vector magnetic data collected from the fluxgate magnetometer, which has a tendency to drift. The ASQ-81 magnetometer is located in the stinger at the rear of the aircraft, which can be seen in figure 2. Table 3 summarizes the Project MAGNET survey capabilities for the period 1971-1990.

Since mid-1990, the Project MAGNET aircraft has undergone extensive maintenance and reconfiguration which was completed in early 1992. The old fluxgate magnetometer was replaced with a NAROD, ring-core fluxgate vector magnetometer, while the ASG-81 scalar magnetometer was retained. The ESG and the two Litton inertial systems was replaced with one ring-laser gyro (RLG) inertial system which was shockmounted on a rigid beam along with the ring-core fluxgate vector magnetometer in the magnetically clean area in the rear of the aircraft. A spare RLG was carried aboard the aircraft for use in case of failure of the other RLG. The RLG was used primarily for attitude, while GPS, which is now becoming globally available, is the primary navigational system.

Due to the inclusion of aerogravimetric surveying capability on the aircraft, more accurate and redundant altitude instrumentation has been included. These instruments and their accuracies, along with other details of the Replacement Geophysical Airborne Survey System (RGASS) are given in table 4.

Table 3. Project MAGNET Geomagnetic Airborne Survey System (GASS) 1971-1990.

MAGNETOMETERS

Fluxgate Vector Magnetometer
Measures: X, Y, Z Acc\Res: +/- 40 nT \ +/- 5 nT

Optically Pumped Metastable Helium Magnetometer
Measures: F Acc\Res: +/- 1 nT \ +/- .01 nT

INERTIAL NAVIGATION SYSTEMS

Electrically Suspended Gyro (ESG)

Measures:		Accuracy:
	position	0.1 nm/hr
	roll/pitch	3 arc min
	heading	3 arc min

Two ASN-84's (1971-1982)

Measures:		Accuracy:
	position	2 nm/hr
	roll/pitch	+/- 12 arc min
	heading	+/- 6 arc min

Two Litton 72's (1982-1990)

Measures:		Accuracy:
	position	2 nm/hr
	roll/pitch	+/- 10 arc min
	heading	+/- 6 arc min

ALTITUDE

Type: Barometric Altimeter Accuracy: +/- 30 m

TIME

Type: Cesium Standard Accuracy: 1 millisec

DATA COMPUTERS/LOGGERS

Two 16K Computers
Two Tape Drives

Table 4. Project MAGNET Replacement Geophysical Airborne Survey System (Geomagnetic Equipment) 1991.

MAGNETOMETERS

Ring-Core Fluxgate Vector Magnetometer
Measures: X,Y,Z Acc\Res: +/- 40 nT \ +/- 6 nT

Optically Pumped Metastable Helium Magnetometer
Measures: F Acc\Res: +/- 1 nT \ +/- .01 nT

NAVIGATION SYSTEMS

Ring-Laser Gyro Inertial System (RLG)

Measures:		Accuracy:	
	position		0.8 nm/hr cep*
	roll/pitch		0.05 deg
	heading		0.10 deg

Global Positioning Satellite System (GPS)

Measures:		Accuracy:	
	position		15 mcep

ALTITUDE

GPS Altimeter	Accuracy:	20-25 m
Radar Altimeter	Accuracy:	+/-(5ft +0.5% alt)
Precision Baro Altimeter	Accuracy:	1 ft

Time

GPS	Accuracy:	0.2 millisec

SURVEY CONTROL/DATA ACQUISITION SYSTEMS

Four 386 Microcomputers
2 - Sensor Control
1 - Survey Control
1 - Survey Analysis
Two 9 - Track Tape Drives @ 6250 BPI each
Two 330 Mbyte Hard Drives

* 10 hr flight or less

cep - circular error probability
mcep - meter circular error probability
msep - meter spherical error probability

The Surveys

A full survey lasts approximately two and a half months during which twenty to twenty-five, ten to twelve hour flights are scheduled. This group of flights is referred to as a "project" and is assigned a project designation such as C32-452. The "C32" is an accounting designation which changes about once a decade. The "452" indicates the project was conducted in FY84 using the fifth Project MAGNET aircraft during the second quarter of the fiscal year.

Each flight of a project is also tagged with an identifying number. For example, flight 4061 indicates that this flight took off from an airport in area 4 of a world divided into seven areas. This would be the sixty-first flight to have taken off in this area during the existence of the Project MAGNET program. Flights in the 9000 series are low-level flights below 15,000 feet and are usually constrained to a small geographical area.

A typical project begins with a low-level (approximately 1,000 feet) calibration flight, called an airswing, over a geomagnetic observatory. Usually the observatory in Fredericksburg, Virginia, which is nearest to the Patuxent River Naval Air Station where the Project MAGNET aircraft was based, was used for airswing purposes at the beginning and at the end of a project. Other airswings are flown during the course of a project, as observatory proximities permit. Usually, three to four airswings are performed during each project. It is particularly important to fly airswings in both the North and South geomagnetic hemispheres if surveying covers both hemispheres.

A calibration flight consists of a roll maneuver in each of the four cardinal directions, and a yaw maneuver in all four cardinal directions. Additionally, the aircraft performs straight and level passes over the observatory in all four cardinal and intercardinal directions. The straight and level passes are sometimes flown at a somewhat higher altitude than the maneuvers. The yaw, pitch, and roll maneuvers are automatically controlled at ±5. The purpose of these maneuvers is to provide data to compute the coefficients of a phenomenological magnetic compensation model. This model characterizes the contaminating magnetic fields associated with:

1. The permanently magnetized portion of the aircraft.
2. The magnetic fields induced in the aircraft's metal parts by the Earth's main (core-generated) field.
3. The magnetic fields generated by eddy-currents that are driven by the changes in the Earth's main and crustal field as the aircraft travels through them.

Of course, there is also a certain amount of feedback and coupling among these fields which also interfere with the magnetic field as seen in the absence of the aircraft. The aircraft is primarily made of aluminum. However, many other metals such as copper and iron may be found in and around the aircraft.

Details of the airswing data flow and the compensation model used by the Project Magnet aircraft program can be found in the PCX images called N_CP_215.PCX through N_CP_248.PCX which are located in the \document\images directory on this CD-ROM.

CHAPTER 2
Technical Specifications

The Compact Disc Format

The data on the CD-ROM are in the International Organization for Standardization (ISO) 9660 format. Mastering of the CD-ROM disc and replication of the copies were done by Disc Manufacturing, Inc., Anaheim, California, under contract to NGDC.

Handle the CD-ROM carefully to avoid damage. Dust, scratches, ink, paint, and fingerprints may obscure some of the data. With careful handling, one can expect at least a 10-year lifetime for the data disc.

Directory Structure of the CD-ROM

The compact disc contains approximately 600 megabytes of data. The majority of the data consists of 528 flight surveys.

GeoVu has standard file extensions used when writing and reading files and these may also appear on CD-ROM products:

.BIN	binary data files
.FMT	format descriptions
.HDR	header files documenting grid data
.MEN	menu file
.TXT	documentation in ASCII
.CST	character histogram file
.LST	integer histogram file
.GIF	graphics file
.PCX	graphics file
.PS	postscript file

GENERALIZED DIRECTORY

DOCUMENT	Documentation Directory
3153_NAS.A	NASA Conference Publication #3153 Excerpt from “Project Magnet High Level Vector Survey Data Reduction”
HELP	Metadata (documenting survey characteristics)
GRAPHICS	Graphics Directory
GIF	GIF images of flight coverage
PCX	PCX images of flight coverage
POSTSCRP	Postscript images of flight coverage
GRIDS	
VIETNAM	Gridded data for Southern Vietnam
JOHN_ATL	Gridded data for Johnston’s Atoll
HI_ALT	High altitude aeromagnetic vector survey data
0NNN-NNN	479 flight surveys (NGDC assigned numbers)
LISTS	Histograms of survey parameters
LO_ALT	Low altitude aeromagnetic survey data
95_SURV	5 Seamount surveys (1995)
ICELAND	Iceland survey data (1978)
JOHN_ALT	Johnstons Atoll survey data(1989)
JUAN_DE	12 Juan De Fuca surveys (1991)
PM_53_70	29 global flight surveys (1953 - 1970)
PM_76_77	U.S. flight survey data (1976 - 1977)
SOFTWARE	
GEODAS	Trackline Inventory Software & Database
GEOVU	GeoVu Access and Browse Software
PC	MS Windows Software
UNIX_SGI	UNIX Software for SGI
UNIX_SUN	UNIX Software for SUN
MAC	Macintosh Software

Chapter 3

Trackline Inventory System

Aeromagnetic Survey Inventory

NGDCs Aeromagnetic Survey Trackline Inventory Database, found in the software directory, is searchable with the GEODAS (GEOphysical DAta System) software. The aeromagnetic data records are not available directly using the GEODAS. Each header file contains 24 80-character ASCII records, each containing survey documentation in specific fields. The survey Headers are described in file ARO88.TXT.

GEODAS is an interactive database management system developed by NGDC for use in the assimilation, storage and retrieval of geophysical data. The GEODAS software is presently being used with three types of data: Marine Trackline Geophysical Data, Hydrographic (bathymetric) Survey Data, and Aeromagnetic Survey Data. Searches by geographic area, year of survey, source, platform/project, survey identifier, or data type are available.

You can perform On-Line Searches on the World Wide Web (WWW), and a new UNIX XWINDOWS version of GEODAS which is now available.

- WWW http://www.ngdc.noaa.gov/mgg/mggd.html
- ftp ftp.ngdc.noaa.gov
- gopher gopher.ngdc.noaa.gov

The purpose of the Header Record is to document the content and structure of the aeromagnetic data contained within the data records. In general, documentation that is constant throughout the cruise will be in the Header Record, while documentation that is variable will be in the Data Records. The data records are not in a common format, rather we have retained the format in which they were submitted to NGDC.

Format Conventions for the Header Record:

1. All decimal points are explicit.

2. Leading zeros and blanks are equivalent.

3. Unknown or unused fields are to be blank filled.

The following is a detailed description of the Header Record. Fields can be of type integer, real (or floating point) or character. Fields that represent whole numbers are integers Fields that contain a decimal component are real, and fields that are alphanumeric are character.

Character Nos.	Length of Field	Type	Description
Sequence No. 1			
1	1	integer	RECORD TYPE - ("1")
2-9	8	char	SURVEY IDENTIFIER identifier supplied by the contributing organization, else given by NGDC in a manner which represents the data.
10-14	5	char	FORMAT ACRONYM ("ARO88")
15-22	8	integer	DATA CENTER FILE NUMBER survey identifier bestowed by the data center. First 4 chars indicate the project as defined by NGDC.
27-31	5	char	PARAMETERS SURVEYED CODE if code is present, parameter is contained in file.

	COL	CODE	PARAMETER SURVEYED
	1	F	Total Field
	2	X	xyz Components
	3	D	dhz Components
	4	R	Residual Field
	5	O	Other (radiometrics)
32-37	6	integer	FILE CREATION DATE (YYMMDD) date data records were last altered.
38-78	41	char	SOURCE INSTITUTION organization which collected the data. Include contributor if different from collector.
79-80	2	integer	SEQUENCE NUMBER - ("01")

Sequence No. 2

1-18	18	char	COUNTRY
19-39	21	char	PLATFORM NAME
40	1	integer	PLATFORM TYPE CODE 0 - Unspecified Platform 1 - Surface ship 2 - Submersible ship 3 - Aircraft 4 - Buoy 5 - Mobile land 6 - Fixed land 7 - Deep tow 8 - Anchored seafloor 9 - Other, specify
41-46	6	char	PLATFORM TYPE (e.g. "SHIP","PLANE","SUB", etc.)

47-78	32	char	CHIEF SCIENTIST(S)
79-80	2	integer	SEQUENCE NUMBER - ("02")

Sequence No. 3

1-78	78	char	PROJECT (e.g. "China Sea, high density, 1 min")
79-80	2	integer	SEQUENCE NUMBER - ("03")

Sequence No. 4

1-6	6	char	SURVEY DEPARTURE DATE (YYMMDD)
7-40	34	char	AIRPORT OF DEPARTURE city, country
41-46	6	char	SURVEY ARRIVAL DATE (YYMMDD)
47-78	32	char	AIRPORT OF ARRIVAL city, country
79-80	2	integer	SEQUENCE NUMBER - ("04")

Sequence No. 5

1-40	40	char	FLIGHT LINE SPACINGS (e.g. NW-SE 37 km.)
41-78	38	char	MAGNETOMETER(S) USED (e.g. Geometrics G801/3 Proton Precession)
79-80	2	integer	SEQUENCE NUMBER - ("05")

Sequence No. 6

1-20	20	char	AIRCRAFT ALTITUDE (e.g. 11000 Feet BAR)
21-34	14	char	AIRCRAFT VELOCITY (e.g. 120 Knots)
35-37	3	integer	SAMPLING RATE in seconds
38-44	7	char	SENSOR TOW DISTANCE
45-57	13	char	REFERENCE FIELD field used to calculate Residual Magnetics. (e.g. IGRF-85)
58-67	10	integer	TOTAL OBSERVATIONS
68-78	11	char	MAGNETIC SENSITIVITY (e.g. 0.001)
79-80	2	integer	SEQUENCE NUMBER - ("06")

Sequence No. 7-11

1-78	78	char	DATA PARAMETER FORMAT AND UNITS DESCRIPTION defines format of the data file; uses Fortran edit descriptors. (e.g. "TOTAL-MAG-FIELD- nT(F6.1),")
79-80	2	integer	SEQUENCE NUMBER ("07" thru "11")

Sequence No. 12

1-2	2	integer	NUMBER OF 10-DEGREE IDENTIFIERS number of 4-digit 10-degree identifiers, (excluding "9999"), which will follow this field (see table A below)
4-78	75	integer	15 10-DEGREE IDENTIFIERS a series of 4-digit codes, separated by commas or space, which identify the 10-degree squares through which the survey collected data. Last ID is "9999". (see table A)
79-80	2	integer	SEQUENCE NUMBER - ("12")

Sequence No. 13-15

1-75	75	integers	15 10-DEGREE IDENTIFIERS continued
79-80	2	integer	SEQUENCE NUMBER ("13" thru "15")

Sequence No. 16

1-49	49	integers	10 10-DEGREE IDENTIFIERS continued
65-67	3	integer	TOPMOST LATITUDE OF SURVEY expand to next whole degree
68-70	3	integer	BOTTOMMOST LATITUDE
71-74	4	integer	LEFTMOST LONGITUDE
75-78	4	integer	RIGHTMOST LONGITUDE
79-80	2	integer	SEQUENCE NUMBER - ("16")

Sequence No. 17

1	1	integer	ARCHIVE NGDC TAPE LETTER
2-78	77	char	ARCHIVE NGDC TAPE NUMBERS
79-80	2	integer	SEQUENCE NUMBER - ("17") Sequence Nos. 18-24
1-78	78	char	ADDITIONAL DOCUMENTATION information concerning this survey not contained in header fields.
79-80	2	integer	SEQUENCE NUMBER ("18" thru "24")

TABLE A 10-DEGREE-SQUARE IDENTIFIER CODE

A 10-degree-square area can be easily identified by constructing a four-digit number. The components of this number, in order of their construction are described as follows: Quadrant - A one-digit number identifies the quadrant of the world with the following significance to each digit:

1st digit = Quadrant number

Qc Code	Latitude	Longitude
1	North	East
3	South	East
5	South	West
7	North	West

10-Degree Square - The next three digits identify a unique 10-degree square; thus the significant digits consist of:

2nd digit = Tens digit of degrees latitude

3rd digit = Hundreds digit of degrees longitude

4th digit = Tens digit of degrees longitude

	10-DEGREE SQ IDENT. CODE			
Examples:	Quad	Lat	Long	Long
37 deg 48'S, 4 deg 13'E	3	3	0	0
21.6 deg S, 14.3 deg W	5	2	0	1
34 deg 28'N, 143 deg 27'W	7	3	1	4
75 deg N, 43 deg E	1	7	0	4

Setting Up the Trackline Inventory

1. In WINDOWS click on FILE RUN. Enter the name of your CD-ROM drive and path name for the setup file. (e.g., L:\SOFTWARE\GEODAS\WIN31\setup.exe)

2. For a minimal run, install the GEODAS\ARODAS SOFTWARE, COASTLINES files and the Project Magnet Inventory File.

The trackline inventory will automatically setup a directory on your hard drive and a window with icons for you.

Sample Search

1. Open the GEODAS/ARODAS window.

2. Click on the GEODAS icon.

3. Click on FILE, NEW SEARCH.

4. Enter a search key (8 characters or less).

5. Enter a title. This can say anything that you want (40 character maximum).

6. The database line should already have the Project Magnet Aeromagnetics line highlighted.

There are many parameters to choose from now. For example purposes, we will choose SEARCH AREA(S).

7. Click on AREA.

8. Once the map displays, several options are available. Click on SELECT-AREA(S)

9. Click on LAT/LON BOX(S)

10. Click on DIALOG LAT/LON ENTRY

11. Enter the following area: 44 North, -120 West, -60 West and 20 North.

NOTE: Use the tab key to go on to the next option or click on it. DO NOT hit the return key. Western and Southern Hemispheres are denoted as negative values.

12. Click OK. A box covering the southern half of the North American continent should be displayed on the terminal.

13. Click on FILE, ACCEPT. This enters the values into memory. The SEARCH CRITERIA screen should now be displayed with a check mark next to the Select Area button.

14. Click on RUN, SEARCH.

15. Choose a location to put your metadata. (default is C:\GDAS)

16. When the search is complete click OK.

17. A summary listing window should appear and there should be 100 files listed at the bottom.

18. Click on PROGRAM, PLOT SEARCH. This will bring up a plotting window and the options are self explanatory. Choose COLORS and then COLOR CODE BY PROJECT.

19. Click on SCREEN PLOT. A summary plot of the area with quite a few flight lines should appear on the screen. One of the options on this level is the ability to zoom in or out of an area.

From here the user can create a PostScript file of the map if they so desire.

NOTE: All of the search material is written to the hard drive and can eventually take up quite a bit of space. When exiting the program either save the files or delete them.

Chapter 4

Accessing Data with GeoVu

Hardware and Software Requirements

The access software provided with this package will operate on any IBM-PC/AT or compatible personal computer, with MS Windows (3.1) and a compatible CD-ROM reader. The software is not fully tested to operate on other types of computers; however, prototype UNIX-Motif versions (SUN & SGI) and a Macintosh version are included in the "Software/GeoVu" directory. As available, updated releases of these and other system-ports can be found in the "Access_Tools" directory of our on-line system:

- http://www.ngdc.noaa.gov/ngdc.html
- gopher.ngdc.noaa.gov
- ftp.ngdc.noaa.gov

Three (3) megabytes of hard disk space are required to load and execute the software. A high capacity hard disk is needed if large files are to be copied from the CD, or if many screen images are to be saved. We recommend using a computer with a minimum of eight (8) megabytes of RAM. A math coprocessor should significantly speed up the application.

GeoVu Loading Instructions

The GeoVu software is provided on the CD-ROM in the Software/GeoVu directory.

1. Insert the CD-ROM into the reader.

2. With Windows operating, choose the Program Manager FILE menu and select RUN. BROWSE the CD-ROM to locate within the software directory the appropriate setup file and launch in standard manner (e.g. L:\SOFTWARE\GEOVU\PC\setup.exe).

3. Follow the installation instructions on the screen. The contents of the GeoVu directory will be copied to your hard drive in the directory of your choice. The install default will create a directory, GEOVU, in the same drive as your Windows directory (e.g., C:\GEOVU). The install will also create a file, FREEFORM.INI, in your Windows directory, and create a GeoVu Program Manager Group and icon.

Overview of GeoVu Access Software

There are several ways to run GeoVu:

To start GeoVu as a Windows desktop application, double-click on the GeoVu icon. Remember that GeoVu help is available through either a HELP key or F1.

Pull-down menus are a familiar part of any Windows application. They appear at the top of the application window, and each one displays a family of commands when you click on it. The GeoVu menus are File, Edit, Search, GeoRef, Utilities, Windows and Help.

There are three major components of GeoVu: (1) the data description layer, known as FREEFORM, (2) the data navigation layer, known as the "Menu Guide", and (3) the data browse and retrieval layer, referenced as GeoVu.

When a user requests data, GeoVu searches for a format description using the FREEFORM layer (descriptions exist within the data compilation in the form of format files, .FMT). For data not previously defined, the user is prompted for format information.

Data are often described in CD-ROMs in obscure ways, leaving users to guess the exact meaning of a cryptic file name. GeoVu's Menu Guide removes this obstacle by providing understandable navigation throughout the data compilation. The actual menu guide is written in an ASCII text, which GeoVu translates into screen dialogues with companion help panels. Using the Menu Guide, data producers are provided with a mechanism of integrating data documentation with the data itself; data users are provided with context-sensitive help and information.

The browse and retrieval capabilities of GeoVu were designed to provide users with a quick-look and data extraction capabilities. GeoVu was not designed to provide GIS-level or sophisticated analysis level features, since numerous commercial products serve this function well. Rather, GeoVu was conceived of as a link between data compilations and the researcher's analytic application of choice. The following descriptions highlight GeoVu's major capabilities:

1. Display grids and images—with pan, zoom, profile, value look-up, color manipulation and histogram support

2. Display tabular data sets—with two-dimensional plots of any combination of parameters

3. Display correlative documentation—in the form of scrollable text boxes

4. Extract data—in multi-platform representations, with choices of data content and structure.

Caution: Sometimes users open too many files, resulting in unfriendly computer memory messages. To help manage this situation, a STATUS display window is always available while running GeoVu. This helps you keep track of your open data and search definitions. The WINDOWS menu also helps by providing a list of all top-level display windows.

Hints on Using GeoVu to Display Aeromagnetic Data

The data are accessible through a menu system that allows the user to:

- select a specific data set
- browse data set documentation
- browse field-value distributions as histograms
- identify a geographic area-of-interest
- define the desired output (screen display, data to disk or floppy)
- view the selected data (using standard or user defined palettes)

To familiarize yourself with GeoVu capabilities, the following exercises are suggested:

1. Explore the help facility. (Note: This can be reviewed by selecting HELP from the menu bar. Also, a "GeoVu Users Guide" exists in the form of a PostScript file, GVHELP.PS. You may wish to print out this file.

2. Review metadata by exploring the VIEW HISTOGRAM and FACTS. (Hint: After opening a data file, view histograms and examine "Terms". "Terms" in a histogram window provides definitions of terms.)

3. Examine a graphic overview of the CD data collection by using the SLIDE SHOW option.

4. Output a 1-degree region from a data set. (Hint: Define a SEARCH and select the WRITE TO FILE option.)

CHAPTER 5
Acknowledgments

Program Support

The National Geophysical Data Center (NGDC), Boulder, Colorado, USA is now the custodian of the Project Magnet digital Data. These data have a very long history and were used as the primary input to the US/UK World Magnetic Model (several epochs). The below acknowledgments section is excerpted from DOD Technical Report 314 and identifies many of the individuals responsible for both the Project Magnet and Polar Orbiting Geomagnetic Satellite data collections. The significant efforts of this group are evident in the data collections and the resultant WMM-95 model.

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Of course, this model could not have been produced without the tireless efforts of those many unnamed individuals around the world who collect and process magnetic field data on a day-to-day basis at the geomagnetic observatories. The Dst indices which were provided by M. Sugiura of the University of Kyoto, Japan, and the Kp indices which were provided by Helen Coffey of NGDC, are both based on observatory data. These indices were key factors in selecting subsets of POGS data for input to this model.

A special effort has been made to preserve the several million Project MAGNET and POGS magnetic field measurements collected for use in the 1995 Epoch World Magnetic Model at NOAA/NGDC. This effort has been coordinated by Bob Jones and John Weaver of NAVOCEANO and Ronald Buhmann, Stewart Racey and Susan McLean of NGDC. The entire high-level data set from Project MAGNET, going back to its origins in 1951, will be placed on its own CD-ROM by NGDC, as will the entire POGS data set. Both CD-ROM's will then be made available to the general public in this convenient form through NGDC.

Many government agencies were responsible for placing the POGS satellite in space. Among these were the Office of Naval Research, the Navy Space Systems Activity, the Space Test Program, and the U.S. Air Force. The satellite itself was built by Defense Systems Incorporated, of McLean, Virginia.

Staff Credits

Many workers in the National Oceanic and Atmospheric Administration (NOAA) were involved in the preparation of the Project Magnet CD-ROM and the related access software:

Project Authorization:	Herb Meyers and Allen M. Hittelman
Project Management:	Ronald W. Buhmann and Stewart D. Racey
Data Preparation:	Stewart D. Racey
Access Software:	Ray E. Habermann, Deborah Sinay, Dan R. Metzger, and Allen M. Hittelman
Documentation:	Allen M. Hittelman, Stewart D. Racey, Ronald W. Buhmann, and Joy Ikelman

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