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Geodynamics Branch Data Base for Main Magnetic Field Analysis

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I. INTRODUCTION

The purpose of this catalog is to briefly describe the data sets used in geomagnetic field modeling at the Goddard Space Flight Center (GSFC). Data are measured and obtained from a variety of instrumentation and sources. In order to avoid confusion, data sets from different sources were categorized and processed separately. The data base is composed of magnetic observatory data, surface survey data (which contains land, some aeromagnetic, some total intensity marine, and three component marine data), high quality aeromagnetic, high quality, total intensity marine data, satellite data, and repeat data (Figure 1). These individual categories of data are described in detail in a series of notebooks in the Geodynamics Branch (Table 1.). This catalog reviews the original data sets, the processing history, and the final data sets available for each individual category of the data base and is to be used as a reference manual for the notebooks.

Table 1. Summary of Data Notebooks

Data Type	Data Span	Notebook Contents
Observatory	1820-1990	Plots of spline function fit, data formats, description of processing programs, first difference plots, world data distribution plots, and comments on observatory station operations.
Aeromagnetic	1950-1990	Data formats, description of processing, flight line time and location information, world data distribution plots, observed and processed data plots.
Marine	1953-1987	Data formats, description of processing, flight line time and location information, world data distribution plots, observed and processed data plots. See also Baldwin et al, 1990, Langel et al, 1990.
Land Survey	1900-1988	Description of processing programs, data formats, world data distribution plots, microfiche of processing runs and weighting histograms, accounting of land survey contents, statistics listing for source and bin numbers.
Satellite	1959-1990	(incomplete) see technical memorandum (Langel et al, 1990; Ridgway 1988; Ridgway et al, 1989).
Repeat	1900-1990	(incomplete)

Each data type used in geomagnetic field modeling has varying levels of complexity requiring specialized processing routines for satellite and observatory data and two general routines for processing aeromagnetic, marine, land survey and repeat data. Observatory and satellite processing routines will be briefly addressed with references to more detailed decriptions in technical memorandum and notebooks. The two general purpose processing routines AVSIG and EQBIN will be described in detail in section II. These routines are distinguished by the observed time information or sampling rate associated with the data. Data with high sample rates (> 1 per 3 hour interval) are better suited for AVSIG, while data with lower sample rates are best processed with EQBIN.

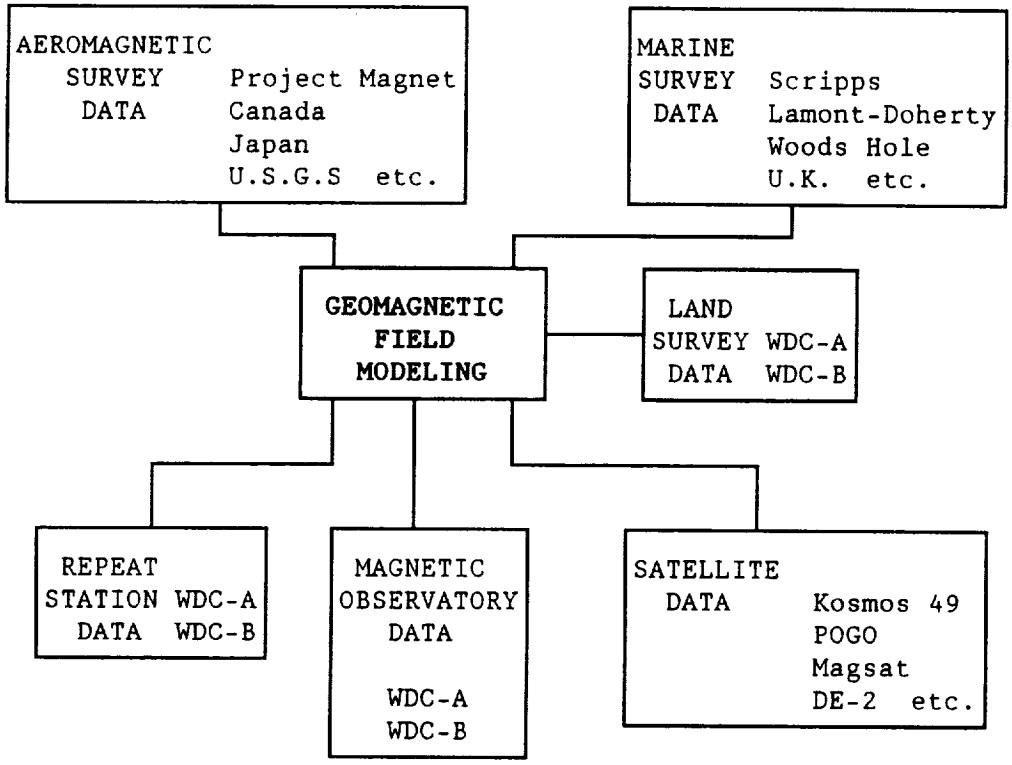

Figure 1.

Following the processing description in section II, each data type is decribed and its processing history explained in sections III - XIII. As noted, the data base is separated into several catagories. The mainstay of geomagnetic field modeling has been and will continue to be the magnetic observatory data (section III). Additional survey data supplements the observatory data by filling in areas of sparse geographic coverage. The basic surface survey data set, described in section IV, was furnished by the British Geological Survey (BGS) at Edinburgh, Scotland, and by the National Geophysical Data Center (NGDC) at Boulder, Colorado. A summary catalog of this data exists, and a printout of the catalog is listed in section X. The data referenced in the catalog are subdivided by source. Each source consists of one survey. The catalog is organized by source number and tells the dates and locations of the survey as well as who carried it out. A data source reference is also given when available. Also given in section X is a summary of data which has a source code but no reference in the catalog (this mainly stems from different forms of the data set sent from NGDC and BGS). Separate survey data sets exist for aeromagnetic, section V, and scalar marine surveys, section VI, which have more detailed information and require AVSIG processing. Satellite data sets are decribed briefly in section VII. Due to the complex processing history, a detailed description of satellite data can be found in technical memorandum or notebooks. Data from magnetic repeat stations have been separated from the surface survey data and are considered as a separate category, described in section VIII. In our case, repeat data have been

limited by uncertainty as to which sites have been exactly reoccupied. When exact re-occupation seems certain, the data are treated as a separate category, otherwise the repeat data are simply used as though they were surface survey data.

Section IX summarizes the various quality control data (ie. Dst and Kp) used for eliminating or weighting observations which have been measured during periods of magnetic disturbance. In order to properly associate quality control data with the magnetic data, magnetic data must have time information accurate to within 1 hour for Dst and 3 hours for Kp. These criterion are generally met when processing data with high sample rates (AVSIG). Occasionally these surveys fail to record sufficient time information for the inclusion of Dst or Kp. In these instances, a daily average Dst or Kp value is determined and applied after EQBIN processing. Data with lower sample rates, processed with EQBIN, rarely meet the Dst or Kp criterion and are weighted or excluded from the data sets after EQBIN processing using average daily Dst and Kp values.

The surface survey catalog (as mentioned) and the formats for all data types are given in sections X and XI. The numerous formats listed in section XI indicate the need for the scientific community, particularly the world data centers, to adopt a consistent format for all standard data products. Documentation and a listing of the main field data base library are given in section XII. The unprocessed and processed data permanently stored in the library are copied on magnetic cartridges with labels SU0000 to SU9999. The library was subdivided into contiguous sections for each data type and further divided into original data, final processed data, and working data sets. This organization makes the library manageable and readily expandable and provides reference for the data processsing history.

II. SURVEY DATA PROCESSING

A. Introduction

The survey data (aeromagnetic, marine, surface survey, and repeat) are processed by two methods dependent on sampling rate. These methods are described in detail here because they are applied to 75% of the data base. The first, described in section B, was designed to filter aeromagnetic or marine data along track reducing very large data sets (suitable for crustal studies) into a smaller set (suitable for main field analyses) without sacrificing the information needed for spherical harmonic modeling. The result is a data set with crustal features attenuated by the filtering process and with main field information retained. The second method, described in section C, was designed to eliminate outliers from survey data and to assign appropriate weights to that data. This procedure does not depend on data being measured along track, but treats the data in batches with either a common source or a common region of origin.

B. Along Track Filter Program

For surveys with a high sample rates and accurate time information along track, the averaging program, called AVSIG, stored on IBM disk XR1RB.MAGNET.PROGRAMS(AVSIG) and on cartridge SU9200 is used to reduce data volume and attenuate high frequency crustal noise, while maintaining sufficient information to sample the core-produced field. It averages the data along airplane or ship track, in track lengths of approximately 220 km, or 2 degrees.

The procedure is as follows: First, the data residuals are computed relative to a preliminary field model. These residuals are then averaged for a specified length of data along the track. For the marine shipborne and aeromagnetic data, the program computes the distance traversed from the survey starting point, and so the averaging interval is directly measured.

Gross outliers in the residuals (residual values greater than a specified cutoff, typically 1000 nT) are not included in the averaging process. Data intervals with interior gaps greater than 10% of the averaging length or exterior gaps greater than 20% of the averaging length are rejected.

K_p and Dst values are averaged along with the magnetic measurements. If an interval of data has an average K_p greater than a specified cutoff level 2^0, then it is rejected. If magnetic measurements are before 1957 or after 1985 (where digital Dst values are not yet available) a value of -10 nT is assigned to each interval. This will be changed to actual Dst values when possible.

The position, time, and altitude corresponding to each average field value are calculated also. Once the average residual value is obtained, total magnetic field values are reconstructed by adding in the preliminary field model at the average data position. This avoids the mistake of averaging the non-linear core field change over the data averaging interval.

Data are output in new FIT format, to be described in section XI.

The standard error was calculated for an estimate of the data variance. The variance, σ^2_j, is computed for each interval (where j is for the jth interval). If individual data points were then used in the fit, σ^2_j would be a suitable estimate of the variance of each of the points in the jth interval. However, we are compressing the data by computing the mean, μ_j, in the filtering program. In this case, the correct estimate of variance is $\sigma^2_{\mu j} = \sigma^2_j/n_j$, where n_j is the number of points in the jth interval. σ^2_μ is called the standard error of the mean. The μ_j then become the data input to the fitting program. Each μ_j "represents" n_j actual data points.

C. EQBIN Cleanup Process for Survey Data.

A three step process which is suitable for data with low sample rates is used for eliminating outlying points from survey data and for estimating an appropriate standard error for each data point. This three step process is culminated in a program residing in XR1RB.SURVEY.PROGRAMS(NEQBIN), herein referred to as EQBIN.

For each 5-year interval, residuals of the survey data from the IGRF were formed. For declination (D) and inclination (I) all data with residuals greater in absolute magnitude than 2^o were flagged as anomalous; for H the critical value of the residual was 300 nT; for X, Y, Z and B it was 600 nT.

In step one, the survey data are divided by source, each survey having an identifying source number. Under the assumption that each survey is relatively homogeneous, a statistical analysis was performed, by year (from mid year to mid year), on the residuals of each survey to the appropriate IGRF model. In each case the mean, standard deviation about the mean (σ), skewness ($\underline{s}$) and kurtosis ($\underline{k}$) were computed. Surveys with less than 12 data points were not included in this step. It was intended to use the resulting $1/\sigma^2$ as the weight in the fitting process. However it was found that often the distribution deviated considerably from normal and we wished to modify the weight in some appropriate, albeit somewhat subjective, fashion. To this end a modified "standard deviation", σ', was computed as follows:

$$(\sigma')^2 = \sigma^2[1 + \alpha\underline{s} - \beta(\underline{k}-3)].$$

The reasoning behind this equation is, first, that skewness is a measure of the departure from symmetry of a distribution: the difference between the mean and the mode, measured in units of σ. The term $\alpha\underline{s}$ then reflects our judgement that the mean of a skewed distribution should be viewed as proportionately less reliable than the σ indicates. Second, kurtosis measures the degree of peakedness of a distribution, relative to a normal distribution. Since $\underline{k} = 3$ for a normal distribution, we used an adjusting term proportional to $(\underline{k}-3)$. The result is that a highly peaked distribution, $\underline{k}>3$, will be treated as having less scatter than a normal distribution while a broadened distribution, $\underline{k}<3$, will be treated as having more scatter. The factors α and β were chosen to be 1 and .01, respectively, after trying several values. Admittedly this is subjective, but we consider it to give a more reliable weighting scheme than simply using the usual σ.

During this phase of the analysis, each data point whose individual residual differed by more than 2σ (not σ') from the mean residual for that survey was flagged as anomalous, except that for Project MAGNET and Vanguard data a cutoff of 1σ was used. The computation is then repeated (step two), using only the non-flagged data, after which each non-rejected data point was assigned the value of σ' appropriate to its year and source ($\sigma'_{\underline{s}}$).

The procedure is then repeated (step three) but now collecting together data for each year and for each element into approximately equal-area bins whose size was 10^{o} by 10^{o} at the equator. Surveys with less than 12 points are now included. Only data not previously flagged as unreliable were used. Each data point was also assigned the value of σ' appropriate to its equal-area bin ($\sigma'_{\underline{b}}$). In this step no data are rejected.

During the fitting procedure the weighting goes as follows: each survey data point is assigned a weight of $1/\sigma_m^2$, where $\sigma_m = \max(\sigma'_{\underline{s}}, \sigma'_{\underline{b}})$, see e.g. Langel et al. (1988).

III. MAGNETIC OBSERVATORY DATA BASE

World-wide observatory data are the mainstay of surface data used in main field modeling. The data used are the annual mean values for each observatory, computed on the half year and furnished to us by the NGDC. If data for less than a full year are available the average time of the data is computed instead. The processing performed on the observatory data before they are used in main field modeling is described in detail in a series of notebooks. All magnetic observatory processing programs can be found on the partitioned data set XR1RB.OBSERVO.PROGRAMS and are permanently stored on cartridge SU9000. The following series of programs are used to update the existing observatory files with new data. Observatory data sent from NGDC are reformated to a modified "old" FIT format (section XI) which contain the year in F8.3 format instead of F6.3, and any station name which differs from our standard station names are replaced by program (REFRMNEW). A complete list of station names are found in the observatory notebooks. Duplicate records are removed and station names alphabetically sorted using programs (DUPYRNEW) and (RUNSORT). Station breaks are determined by 1) fitting a spline function through the observatory values to determine outliers using program (SFIT) and 2) by computing the first differences of the remaining observatory values using (JCLFIRST) and (FIRSTDIF). By assessing first difference and spline fit plots, station breaks are assigned manually. Station breaks are located at times of data jumps within a station that are known to have physical causes, such as a new magnetometer, or a change in location, or they may be located at breaks in the first difference plots (eg. see notebooks). Station breaks are denoted with Roman numerals, for example ALIBAG I, ALIBAG II etc. Stations with the same name but with different numerals are treated as different stations by the new FIT program. Program (ADDEND) adds the station break designator (ie. I,II etc.) on to the station name. The observatory station names are sorted again alphabetically and then by year for each station with program (RUNSORT). Programs (MERGEA) and (MERGEB) merge the new data with the old observatory data, and program (NEWFIT) reformats the data into new FIT format. As of 6/90 the entire observatory data set was reprocessed (all data from 1820-1989). Several new programs are (OBSOUT) which flag the user specified outliers and (OBSSIG) which computes sigmas for each observation from a spline fit to each station and reformats the data into new FIT format. Another new program is (BIASGLB) which reads observatory biases from the new FIT global file. Observatory biases are linear adjustments made to each observatory. These are computed from the difference between the observations at each station and the computed field. They also allow for adjustments in the field models for stations with station breaks, thus giving spherical harmonic coefficients which are more representative of the secular variation. Figure 2. summarizes the processing necessary for the observatory data sets.

Original observatory data are stored on cartridge SU0000. Processed observatory values are stored on cartridge SU0500. This cartridge will also contain observatory bias values in the future.

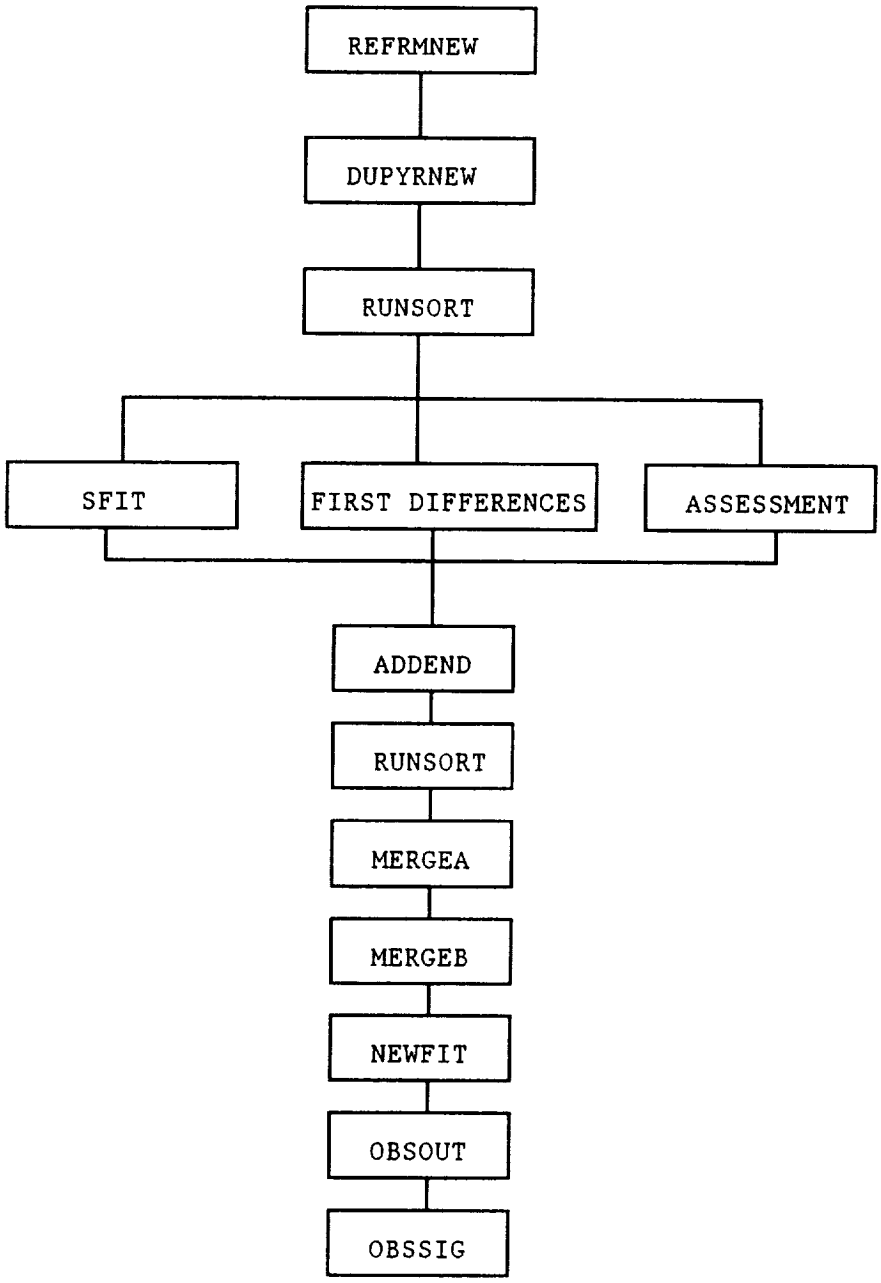
REFRMNEW
DUPYRNEW
RUNSORT
SFIT
FIRST DIFFERENCES
ASSESSMENT
ADDEND
RUNSORT
MERGEA
MERGEB
NEWFIT
OBSOUT
OBSSIG

Figure 2.

IV. SURFACE SURVEY DATA BASE

A. NGDC/BGS Survey Data Base.

World-wide survey data stored at the NGDC and BGS contain approximately 180,000 data points. The basic survey data bases maintained by NGDC and BGS should be the same, but are not. The data from the NGDC was cleaned up by David Barraclough at the British Geological Survey (BGS). The cleanup process consisted of deleting duplicate data and flagging outliers. These data were sent to GFSC on two tapes SURVEY and SURVY1 which are ASCII standard labeled and must be read on the VAX11/780. The format for these data sets are in NOAA survey format. The data base spans from 1900.0 to 1987.5 and is divided into files of 5-year intervals (ie. 1912.5-1917.5 => SDAT15). The blocking parameters on tape SURVEY were in error for the files containing SDAT55, SDAT60, SDAT65. Tape SURVY1 contains these files. Additional data were sent from BGS on a 3.5 in. diskette titled NEWSVY.DAT. This contained repeat data from 1977-1989 and Japanese aeromagnetic data for 1984-85.

B. GSFC Data Base

The surface survey files cleaned up by BGS and the file NEWSVY.DAT were combined and further cleaned up by removing duplicate records using programs XR1RB.SURVEY.PROGRAMS(DUPLIC). In addition, surveys duplicated in the marine data set were deleted from the survey data set. These have the following source numbers: 543, 552, 576, 605, 656, and 658 (see Marine Survey Data Base below). Project MAGNET (source 500), Canadian aeromagnetic (source 501), and Vanguard, Allouette, and Woomera satellite (source 502) data were also treated separately and were not included in the surface survey data base. These surveys are present with the surface data in the NGDC data base but are kept separate in the BGS data base. Japanese aeromagnetic data for 1975 (source 748) and 1984-85 (source 842) have been left in the survey data set until time information (accurate to < 3 hours) is obtained to allow for AVSIG processing. Source 900, the Soviet survey data, was on files SDAT50, SDAT55, and SDAT60 but not on SDAT45. This data was added from XRTJS.SRV.USSR.DATA which contains data from 1945, 1950, and 1955. The survey data files are located on disk under XR1RB.NEW.SDAT05.DATA (etc.) and on cartridge SU1000 (see section XII.). Repeat data have also been removed from the surface survey data set and are discussed in section XIII.

At this point all of the duplicate records and unwanted surveys have been removed from the data base, however there are duplicate data in time and location still present (ie. data with different observations but the same time and location). Each file was seperated into a file with no time and location duplications (SDAT05.DATA etc.; cleaned) and a file of duplicates (SDAT05Q.DATA etc; questionable). These files are stored on SU1002. The cleaned up files were processed with EQBIN as described in section II. The final cleaned up versions are GDAT05.G12#89 etc. and are on cartridge SU1500 (see Figure 3.). A detailed description of processing and output is documented in a notebook for the survey data set. World data distribution plots of the final data sets, output and histograms from EQBIN in microfiche form, and listings of the number of data observed for each data type and source number are also contained in the notebooks.

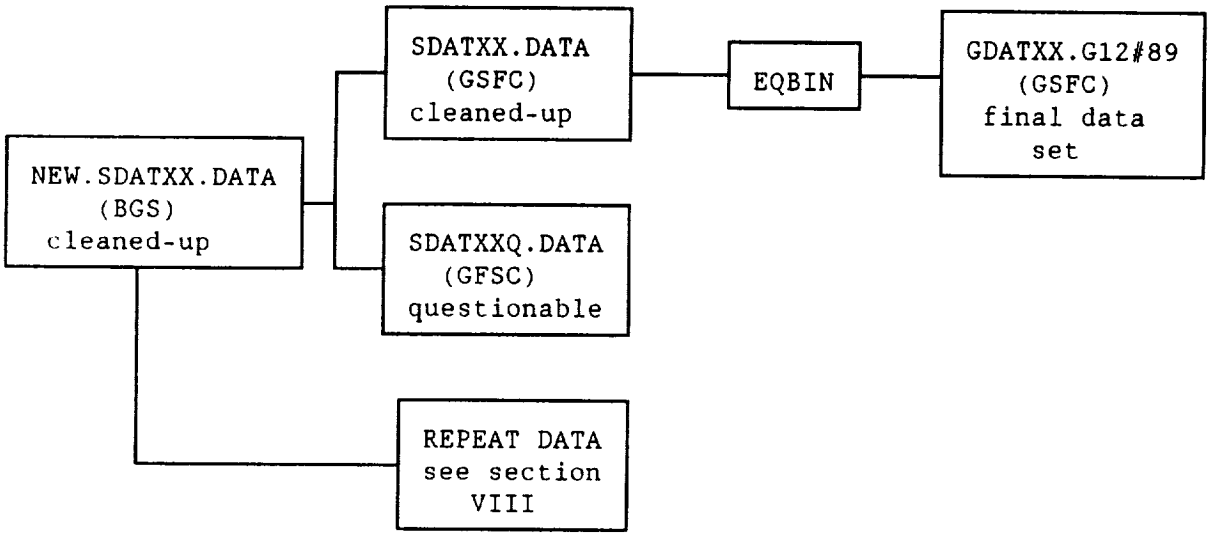
SDATXX.DATA
(GSFC)
cleaned-up
EQBIN
GDATXX.G12#89
(GSFC)
final data
set
NEW.SDATXX.DATA
(BGS)
cleaned-up
SDATXXQ.DATA
(GFSC)
questionable
REPEAT DATA
see section
VIII

Figure 3.

V. AEROMAGNETIC SURVEY DATA BASE

A. Project MAGNET Data

1. Background

The descriptive information regarding these data is taken from the NOO Reference Publication, RP-23 (Basset,C.H., 1982).

Project MAGNET was initated in 1953 to conduct airborne magnetic surveys on a global basis. "From 1953 to 1972, vector airborne geomagnetic measurements were made by a Naval Surface Weapons Center (formerly Naval Ordnance Laboratory) fluxgate Vector Airborne Magnetometer (VAM-2). Total magnetic intensity, inclination, and declination were determined to the following accuracies: ±15 nanoteslas (gammas), ±0.1 degrees, and ±0.2 degrees. To reduce the effects of aircraft motion, angular measurements were averaged over a 100 second time period centered on each 5 minute GMT. The observed data were recorded on continuous analog strip charts. Navigational accuracy was ±5 nm (nautical miles). Beginning in 1964, the survey aircraft was equipped with a digital magnetic tape recording system which sampled and recorded the data at a one sample per second rate; and in 1965, an optical pumping metastable helium magnetometer system was operated during special aeromagnetic surveys. This magnetometer system was towed approximately 100 feet behind and 100 feet below the survey aircraft and measured only the total magnetic intensity."

"Since 1973, navigational and geomagnetic data have been collected on board the Project MAGNET RP-3D aircraft using the Geomagnetic Airborne Survey System (GASS). Both vector geomagnetic measurements and scalar magnetic measurements have been made with a Honeywell Vector Fluxgate Magnetometer and the optical pumping metastable helium magnetometer system, respectively. The navigational sensors include a Loran C, Omega, Navigational Satellite, and an electrostatically suspended gyro inertial navigator. The vector magnetometer is located in the magnetically clean cabin of the aircraft, and the scalar magnetometer is located in the tail-boom section."

"Magnetic data accuracies obtained with the GASS system are inclination, ±7 arc minutes; variation, ±6 arc minutes; horizontal intensity, ±5 nanoteslas; vertical intensity ±5 nanoteslas; and total intensity, ±1 nanotesla."

"Navigational equipment used on the aircraft and their accuracies are Navigational Satellite (ARNNS) ±0.5 nm; Loran C (ARN-98) ±0.25 nm; inertial navigation, (ASN-84 and ASN-101) 1.0 nm/hour and 0.1 nm/hour respectively. The GASS system overall positional accuracy is ±1 nm for high-level worldwide vector geomagnetic surveys and ±0.25 nm for low- level magnetic surveys."

As a result of a phone conversation with John Quinn of the NOO (8-494-4250, 8/8/88) the following was determined:
a. Data from the '50's to early '70's were largely strip chart traces. These data were digitized at 5 minute intervals and are available through the NGDC at NOAA; these are called the SP66 data file.

b. During the 70's (Viet Nam) high level surveys were not flown, only low level total intensity surveys. These data are not generally available, except upon special request. (A catalog of the areas surveyed from the early 1950's through 1982 is located in the Geodynamics Branch (Code 921).)
c. In 1980 high level surveys suitable for field modeling data were restarted. The basic sampling rate is 4/sec.

The following sections describe the Project MAGNET data which we currently (2/91) have processed for the main field data base.

2. Selected Data for 1952.5 - 1967.5

As part of the derivation of the DGRF models for 1955 and 1960, the BGS sent us their cleaned up project MAGNET data files in NOAA format (section XI). Data for 1952.5 to 1957.5 was copied to reel DT0035 and cartridge SU2012. Data for 1957.5 to 1962.5 was copied to reel DT0087 and cartridge SU2012, and data for 1962.5 to 1967.5 was copied to reel DT0021 and cartridge SU2012.

Because of insufficient time information (time resolution no better than 3 hours, see introduction) , each of these data sets were processed through the cleanup process (Program EQBIN) described in section II. The resulting cleaned up files, with assigned weights for the fitting process, are: XR1RB.MDAT55.G12#89, XR1RB.MDAT60.G12#89, and XR1RB.MDAT65.G12#89. These files are in new FIT format and are on SU2600.
In the cleanup process the gross outlier limits were 2° for D and I, 300 nT for H, and 600 nT for X, Y, Z, and B. The statistical outlier test rejected data more than 1σ from the mean of the source. Plots of the data locations for the five year time spans and statistics generated are listed in the Aeromagnetic notebook.

3. Continental U.S., 1976-1977.

These data are from a special survey of the U.S. The original survey included both vector and scalar data, but there were severe problems with the vector data so only the scalar data are published. The data were copied onto reel OF0948 and cartridge SU2000. There are approximately 650,000 data points. The record format is listed in section XI. The survey was flown at altitudes between 0.9 and 1.6 km with a sampling interval of one per second.

The data were processed with the program XR1RB.MAGNET.PROGRAMS(AVS7677), a modified version of (AVSIG). The processed data are documented in the aeromagnetic data notebook and reside on disk XR1RB.MAGNET.AVDATA.G12#89 and on cartridge SU2600. The averaging interval was 220 km reducing the data set to 480 points.

4. Data for 1980 - 1990

Project MAGNET data for this time interval are composed of three groups; high density data, preliminary high density data, and decimated data. Our goal is to process all available high quality, high density Project MAGNET data. This will result in the eventual replacement of any preliminary or decimated data. There exists in the high density and decimated data sets

sent to us from NGDC and NOO duplicate flights. Of these, only the high density data were processed with AVSIG.

i) High Density

Selected Project Magnet flights covering altitudes of 1.5 to 8 km with sampling rate at 1 per 2 seconds have been obtained from NOO for the period 1981 - 1985. The format for these data are listed in section XI. The data for 1981 is on reel DT0045 with 11 files and on cartridge SU2002 with 11 files. Some of the 1982 data are located on reel DT0047 with 11 files and on cartridge SU2002 on files 11-22. The remaining 1982 data are on reel DT0048 and on cartridge SU2004. The data for 1983 are on reel DT0046 and cartridge SU2006. The data for 1984-85 are on reel DT0279 and cartridge SU2008 (files 1-15 are from 1984; files 16-18 are from 1985).

Additional data for the period 1987-1989 not present in the NOO decimated data set (see below) but included with NGDC current (2/91) data are found on cartridge SU2016 (42 files).

All these data were processed with program XR1RB.MAGNET.PROGRAMS(AVSIG). Dst values were added later with program XR1RB.FITFIL.PROGRAMS(DSTADD). Averaged measurements with Kp values > 2+ for 1986-1989 were excluded using program XR1RB.FITFIL.PROGRAMS(NEWKP). Output data for 1981-1985 are in new fit format on file XR1RB.MAGNET.AVDATA.G12#89 and on cartridge SU2600 (file 5). NGDC data 1987-1989 are in new fit format on file XR1RB.MAGNET.AVDATA.G08#90 and on cartridge SU2600 file 6.

Much of the Project MAGNET data for the 1980's are in a decimated data set processed by NOO. These same data in undecimated form are also available at NGDC and will be obtained and processed with AVSIG in the near future.

ii) Preliminary High Density

Preliminary data for 1988-1989 has been acquired from NOO and is stored on cartridge SU2018 (41 files). These data are in new FIT format on file XR1RB.MAGNET.AVDATA.YR8790C. After processing, this data contained large measurement errors due to incomplete processing at NOO. Flights with such errors were not used. Some flights scalar measurements were used in place of suspect vector data. The preliminary NOO data was not stored on cartridge owing to large fluctuations in scalar and vector measurements. These data will be reprocessed when the final data becomes available.

iii) Decimated

A special data set from the 1980's with world-wide coverage was assembled by NOO in 1989 with altitudes above 20,000 ft and a sample rate of 1 point/200 sec. These data are on reel DT0295 and on cartridge SU2014 and were processed with program XR1RB.MAGNET.PROGRAMS(AVHILE), a modified version of (AVSIG). The 1264 averaged points are on disk XR1RB.MAGNET.AVDATA.G01#90 and on cartridge SU2600. As mentioned, the undecimated data at NGDC for these flights will be prcessed with AVSIG to replace the decimated data set.

5. 1989 White Sands Survey

In March of 1989, a special Project MAGNET survey was flown over the White Sands Missile Base for the Strategic Defense Initiative field model (Langel, et al.,1990). There were approximately 60,000 measured observations each with X, Y, and Z components which are stored on reel DT0282 and on cartridge SU2010. The record format is N00 described in section XI. This data were processed with program XR1RB.MAGNET.PROGRAMS(AVSIG2) resulting in roughly 364 averaged data values for each component. For this case, (AVSIG2) calculated an averaged point every 1/2° with the constraint that each computed component must fall within one standard deviation of the observations for the entire flight line or be flagged as an outlier. These data are stored on disk XR1RB.MAGNET.AVDATA.WS89.

For general field modeling, one flight line of the White Sands survey was processed again with average points calculated every 2°. This was done to prevent overemphasizing the survey in standard models. These data are stored on disk XR1RB.MAGNET.AVDATA.G12#89 and on cartridge SU2600.

B. Canadian Aeromagnetic Data

1. Background

Aeromagnetic measurements over Canada, the Arctic, Greenland, Scandinavia etc., have been carried out by the Division of Geomagnetism of the Earth Physics Branch of the Department of Energy, Mines and Resources (formerly the Dominion Observatory) since 1953. A brief description of these surveys is given by G.V. Haines, 1982. Much of the following information comes from this report. Also useful are a series of Energy Mines and Resources reports by G.V. Haines and W. Hannaford (1972, 1974, 1976, 1978, 1980).

"The Earth Physics Branch, Ottawa, conducted fifteen 3-component aeromagnetic surveys between 1953 and 1976. Almost 500,000 km were flown in nine surveys from 1953 to 1963, nearly covering Canada twice. Digital data from these surveys comprise 11,500 5-minute vector averages. More than 600,000 km were flown in six surveys from 1965 to 1976, covering Canada, the Nordic countries, and the Greenland and Norwegian Seas. Digital data comprise 120,000 1/2 minute averages."

"Errors in aeromagnetic data come from incorrect instrumental calibrations, from incomplete aircraft field corrections, and from unknown time variations of the geomagnetic field. Instrumental calibrations and aircraft field corrections that are assumed to be constant with time are determined on the basis of calibration flights, although the corrections can be confidently applied only to field values similar to those of the calibration area. Aircraft-field corrections that change with time have been applied, in recent surveys, to the vertical intensity based on a comparison of total intensity from a fluxgate magnetometer inside the aircraft with that from a proton magnetometer outside the aircraft. Corrections to declination for improper sextant levelling must be made when the celestial body being observed is not near the horizon. Although no corrections are made for diurnal variations, minor disturbance fields, or ring current effects, data are accepted only when the field at nearby observatories lies within a 100-nT band over a time interval of 3 hours or more." (Haines, 1983)

2. Data for 1953-1976

The Canadian surveys are divided (Coles, personal communication) into Phase 1 and Phase 2. Phase 1 comprise the data prior to 1965; Phase 2 after 1965. In 1965 the aircraft platform was replaced along with the instrumentation. The 3- component fluxgate was updated and a proton precession magnetometer was installed in a 3.5 meter boom at the end of the aircraft. The addition of the proton magnetometer provided high accuracy total field measurements from outside the aircraft. These measurements were generally taken at an altitude of 3.5 km above sea level, or greater.

List of Phase 2 Surveys:

1965	9/13-11/16	Denmark, Norway, Sweden, Finland, Greenland,
1969	Feb-March	British Columbia and Northeastern Pacific
1970	late	Canadian Arctic
1972	10/24-12/22	Saskatchewan, n.e. Alberta, Yukon, Mackenzie
1974	late	Ontario, Manitoba, Keewatin, parts of Quebec
1976	late	central and eastern Quebec, Davis Strait

Our data files include:

1. Reel DT0153 and cartridge SU2202, File 1, which contains data from 1953.677 to 1969.216, i.e. probably through the British Columbia Survey. This file also contains Vanguard, Alouette and Woomera data. These data are in the standard NOAA format for survey data.

2. Reel DT0257 was received from the NGDC in mid Sept., 1988. The NOAA Master Tape number is W03688, Archive Tape number is W01707, and Customer Tape number is TG0-0100 for file 1 and TG0-0110 for file 2. This reel was copied on to cartridge SU2204. File 1 is the set of 5 minute averages from all the Canadian Surveys except for data from 1972, i.e. from the survey of Western Canada: Saskatchewan, n.e. Alberta, Yukon and Mackenzie in NOAA format. File 2 is the 1/2 minute averages from the Phase 2 surveys,[i.e. 1965-1976 (See format in section XI)].

3. Reel OF4287 and cartridge SU2206 from Richard Coles contain 6 files of Z data covering Scandanavia, 1965, Greenland/Norwegian Sea, 1965, Iceland, 1965, British Columbia, 1969, Arctic, 1970, and the Canadian Prairies, 1972. This data was upward continued and used with the POGO data set in Langel and Coles (1980) (See format in section XI).

Phase 1 data (1953-63) was processed with program EQBIN in three parts for D, H, and Z components. Outlier limits were 2^{o} for D, 300 nT for H, and 600 nT for Z. The final data sets are: XR1RB.CANADA55.G12#89 (1953-54), XR1RB.CANADA60.G12#89 (1959), and XR1RB.CANADA63.G12#89 (1963). These data sets are stored on cartridge SU2602 labels 2, 3, and 4.

The 1/2 minute (averaged) Phase 2 data (1965-76, file 2 from SU2204) was processed with program AVSIG for D, H, and Z components. The outlier limits were $^{+}$-90^{o} for D and $^{+}$-500 nT for H and Z. The large outlier limit for D results from flight lines passing over the magnetic pole. Although the total field was also measured, it was not used due to the small discrepancy between the measured and computed values. The final data sets are stored on files 5, 6, and 7 on cartridge SU2602. These files cover 1965 and 1969: XR1RB.CANADA.AV65.G12#89; 1970, 1972, and 1974: XR1RB.CANADA.AV70.G12#89; and 1976: XR1RB.CANADA.AV75.G12#89. The declination fluctuates for several flight lines in 1965, 1970, and 1974 where flights pass near the pole. All of the above final data sets are in new FIT format.

3. Data for 1980-1987

Aeromagnetic data for 1980-1985 from the National Research Council of Canada are stored on tapes UT2577, UT2936, UT761U, UT773U, UT2485 and on cartridge SU2208. These data were processed with program XR1RB.MAGNET PROGRAMS(AVSIGCAN) and stored on file XR1RB.CANADA.AV8085.G08#90. Due to the large Kp values observed during these flights many of the averaged points were deleted during program execution.

Additional Artic flights from 1983-1987 were obtained in March of 1990 from the National Research Council of Canada. The raw data are stored on SU2210 files 1-17 and on reel UT2491 files 1-17. The data was processed with program (AVSIGCAN) with Kp and Dst set to 0.0 and -10.0 respectively for years after 1985 (where Kp and Dst are not yet available). The processed data are stored on disk XR1RB.CANADA.AV87.G03#90 and on cartridge SU2602 file 9. The flight lines were flown at about 305 m.

4. Caribbean aeromagnetic survey

The Canadian Geological Survey conducted aeromagnetic surveys of the Caribbean in 1984 and in 1986. Reel DT0039 and cartridge SU2200 contain only the data flown in 1984 which comprise 14 flight lines of scalar data. No altitude information was specified, but Peter Hood indicated that the aircraft maintained an altitude of 305 m during the survey. Data from 1984.836 to 1984.871 was processed using the along track averaging program (AVSIGCAN) which condensed the entire data set into 13 points. The averaged data in new FIT format are on XR1RB.MAGNET.AVDATA.G12#89 and on SU2600.

The Caribbean data for 1986 are stored on cartridge SU2210 files 18-38 and on ASCII reel UT2844 file 1-21. The data were processed with program (AVSIGCAN) with Kp and Dst values of 0.0 and -10 respectively for data after 1985 and stored on disk XR1RB.CANADA.AV86.G03#90 and on cartridge SU2602. These flight lines were flown at 305 m and cover parts of the Caribbean Sea, Gulf of Mexico, and Atlantic ocean.

C. Other Aeromagnetic Data

1. The East Coast Aeromagnetic Survey flown from 1974 to 1976 is stored on reel OF8303. These data contain no time information and are not used.

2. The Japanese have conducted aeromagnetic surveys of the islands and their surrounding oceans for 1975, 1980, and 1985. The data for 1980 have

approximately 20 flight lines and are stored on reel DT0261 and cartridge SU2400. Data for 1975 and 1985 are found in the survey data sets in SDAT75 and SDAT85 with source numbers 748 and 842. The data for 1975 and 1985 have limited time information and were reduced using EQBIN, however data for 1980 were found to be suitable for AVSIG processing. The processed files in new FIT format are stored on XR1RB.JAPMAG.G12#89 and on cartridge SU2602. The aeromagnetic data for 1975 and 1985 will be processed through AVSIG when accurate time information becomes available.

3. Aeromagnetic data measured by the Naval Research Laboratory over the Chilean Ridge in 1/90 was stored on SU2018 files 42-51. After processing with AVSIG, records measured during times where Kp > 2+ were removed by hand (no digital Kp information available). The new fit formated file is XR1RB.NVLRES.AVDATA.G08#90 stored on SU2600 file 7.

VI. MARINE SURVEY DATA BASE

A. Data for 1953,1958, 1960-1987

The processing of the world data base of marine scalar magnetic data was a major task completed by personnel at GFSC and the NGDC. The data set covered the years 1953, 1958, and 1960 - 1987 and contained over 13 million observations. The data from the NGDC archive were processed with program (AVSIG). This involved averaging the data along track in 220 km segments into one value. The program also calculated an average K_p value; if the average K_p was greater than a specified cutoff (2+), then no average reading was output for that point. The averaging program also added an average Dst value to the data. The processed data files which includes an output file, an averaged output file, a non-averaged plot file, and an averaged plot file were sent from NGDC to GSFC for plotting and reformating. These data are stored on cartridges SU3000, SU3002, and SU3004. The reduced data set for main field modeling contains approximately 24,243 points and is stored on disk file XR1RB.MARINE.AVDATA.G12#89 and on cartridge SU3500. A complete description of this analysis can be found in the marine data notebooks at GSFC and a summary in Langel et al.,(1990a).

B. Other Marine Data

Other marine data processed with AVSIG include a survey conducted by the USGS in late 1985 south of Puerto Rico. The raw data are stored on cartridge SU3004 file 4 and on reel DT0200 and were reduced to a average point every 220 km. The reduced data are stored on disk XR1RB.MARINE.AV85.G02#90 and on cartridge SU3500 file 2.

VII. SATELLITE AND ROCKET DATA SETS

A. Vanguard 3

Vanguard 3 made absolute measurements of the magnetic field with a Proton Precession Magnetometer from September 18 to December 11, 1959. Data were acquired in real time only, i.e. when the satellite was in sight of a Minitrack station. These stations were located at Ft. Myers, Florida, Woomera, Australia, Quito, Equador, Lima, Peru, Antofagasta, Chile, Santiago, Chile, Antigua, British West Indies, Chula Vista, California, Blossom Point, Maryland, and Johannesburg, Union of South Africa. A description of the experiment and a catalog of data are given in Cain et al. (1962).

These data are located on disk XR1RB.VANGRD.DATA and on cartridge SU5000 file 1 and SU2202 (after the Canadian survey data) in standard NOAA survey data format.

For cleanup and assignment of fitting weights, these data were processed with (EQBIN). In this case the B gross outlier tolerance level was 100 nT and the tolerance level was 1σ. The final EQBIN cleaned up data set is XR1RB.VANGRD.G12#89 on cartridge SU5500 file 4 in new FIT format and contains 3872 measurements. The statistics from EQBIN are summarized in the satellite data notebooks.

B. Alouette

Among other things the Alouette satellite measured the electron gyro frequency from which the ambient magnetic field can be inferred. Gyro frequency values were furnished and converted to magnetic field values. The data epoch is 1962.874; the data are on cartridge SU5000 file 2 and SU2202, and on disk file XRTJS.ALOUETTE.CLEAN.DATA. These data are in the standard NOAA survey data format.

Data were processed through the EQBIN cleanup process resulting 184 points output to XR1RB.ALOUETTE.G12#89 and cartridge SU5500 file 5 in new FIT format. The gross outlier limit was set at 600 nT. The statistical outlier limit was set to reject data more than 2σ from the mean of the source. The mean and sigma shown in the satellite data notebook seem to indicate that this is not a particularly reliable data set.

C. Woomera

Magnetic data from a single rocket flight: epoch 1964.191: location about 120° colatitude, 136° longitude. 76 data points are on cartridge SU5000 file 3 and SU2202 and disk data set XRTJS.WOOMERA.CLEAN.DATA. These data are in the standard NOAA survey data format.

To check the data set validity, data were processed through the EQBIN cleanup process resulting in disk data XR1RB.WOOMERA.G12#89 found on cartridge SU5500 file 6 in new FIT format. The gross outlier limit was set at 600 nT. The statistical outlier limit was set to reject data more than 2σ from the mean of the source. The statistic for this data were contained in the notebooks.

D. Kosmos 49.

The following description is taken from "The Survey with Cosmos-49" by Benkova (1971).

"The satellite was launched into an orbit with inclination 49°, perigee 260 km, and apogee 490 km. The orbit precessed westward at a rate of 4.5° per day." "The measurements were made each 32.76 seconds during the interval October 24 to November 6 in 1964, a magnetically quiet period." The satellite had onboard memory so the coverage was global, equatorial of 49°. "Two proton precession magnetometers were orthogonally mounted in the satellite...the time of the measurement is uncertain to ±0.5 second. The magnetometers are mounted 3.3 meters from the center of the satellite, whose magnetic effects are compensated to an accuracy of 2 γ by an array of permanent magnets producing a homogeneous compensating field at the sensor locations.....In addition to the uncertainty of ±0.5 second earlier discussed, errors in satellite position existed that could reach 3 km in the direction of the flight path and 1 km in altitude as well as in the direction of the normal to the satellite orbit. Random errors due to unfavorable orientation of one of the magnetometer sensors were rejected." "The usable scalar intensity values totaled 18,000 and were published in catalogue form."

The basic Kosmos data set is contained on reel DT0246 and on cartridge SU5000. This tape file was converted to the standard NOAA survey data format and stored in the disk file XRTJS.KOSMOS49.DATA and on cartridge SU5000 file 4. To check the data set validity, they were processed through EQBIN cleanup process resulting a cleaned up data set, in new FIT format on XR1RB.KOSMOS49.G12#89 and on cartridge SU5500 file 7. The gross outlier limit was set at 600 nT. The statistical outlier limit was set to reject data more than 2σ from the mean of the bin. This data set is discussed in the satellite data notebook.

E. POGO

The SELECTED POGO data set is a collection of observations made by the OGO-2, -4, AND -6 satellites. Three subsets of data were selected.

1. DSN=POG246, (DSN - data set name for SL standard label tapes) with 54K measurements selected from quiet times between 1964 and 1971. The bulk of this data set is comprised of 47384 observations which were used to derive the POGO(2/72) field model (Langel et al., 1980). Added to this were OGO-6 magnetic field values taken from intervals from 1969-1971. Desired time intervals were selected from quiet (ΔB<10nT) and moderately quiet (10nT<ΔB<30 nT) periods of magnetic activity.

2. DSN=POGCQ, with 94K measurements selected from quiet OGO-6 data during 1970 and 1971.

3. DSN=POG6MQ, with 24K measurements selected from moderately quiet OGO-6 data during 1970 and 1971.

The "master tape" for these data is MAG001; file 1 is POG6CQ, file 2 is POG6MQ, and file 3 is POG246. These data are stored on cartridges SU5002 and SU5003. Each data point is tagged with time, latitude, longitude, a satellite identification number and the Dst value. The tape format can be found in secton XI. OF3104 is possibly the predecessor to MAG001. It seems to be a one file tape with all the above described data but with no Dst values. These data are stored on file 4 of SU5002 and SU5003 with DSN=OF3104. These data sets are not in the new FIT format and contain no weight values from processing. Weight information must be assigned in the field modeling routine or in seperate processing.

F. Magsat

1. Early Data Sets for Field Modeling

One of the first data subsets was a selection of scalar and vector data for 15 magnetically quiet days (November 5, 1979 - April 20, 1980). The data for each day was further culled from specified time intervals (see the Table) judged to be relatively undisturbed. These data are in the Binary Fit Format (unmodified) and are contained on on cartridge SU5004 and on tapes OF8029, OF8030 and OF7514; data for each day are written on a separate file: 9 track EBCDIC, standard labeled, DSN=TD5821, VBS, LRECL=11200, BLKSIZE=22404.

FILE	DATE	TIME INTERVALS (HHMMMSS)
1	Nov 5, 79	5000-10400; 105753-112920; 115300-121700; 232820-
2	Nov 6, 79	3000-92000; 102450-110350; 112000-114300; 115843-
3	Dec 13, 79	0-54000; 105200-120000
4	Dec 25,	0-4800; 13000-61000; 103600-110000; 121000-123300
5	Jan 9, 80	2500-55000; 114835-121140; 155000-165000; 173000-
6	Jan 10, 80	11500-34000; 72500-95500; 110000-112100; 115200-
7	Jan 18, 80	3000-6000; 13800-15300; 112800-115100
8	Jan 19, 80	22700-70000; 103600-110700; 112500-124000; 224000-
9	Feb 12, 80	0-64000; 101000-112100; 150000-190000; 231300-240000
10	Feb 13, 80	4600-11700; 20000-90000; 130000-152000
11	Mar 3, 80	3700-10800; 14600-71800; 111000-115600; 122000-
12	Mar 15, 80	3200-73000; 110500-121400; 160000-202000
13	April 18, 80	43000-90000; 171000-181000
14	April 19, 80	4600-10900; 15500-54500; 114400-115900
15	April 20, 80	53500-91500; 12000-130500; 180500-190500

The next data set was derived by adding three days of data to the above:

	Nov 28, 79	12500-24500; 30000-55000; 61000-72000; 74500-90000;
	Mar 2, 80	4200-10500; 30000-41500; 44000-64000; 65400-81600;
	Mar 12, 80	3100-90000; 94500-123700; 125800-170500; 171200-

The resulting data set consists of 30,700 scalar and vector component data for the 18 quiet days, globally selected for areal uniformity. The

resulting data was fit with individual models in which the attitude biases and external fields were solved for, as follows:

DATE	σ of Fit nT	External Field (e_1, e_2, e_3) nT			Attitude Correction (Roll, Pitch, Yaw) arc sec		
11/5/79	10	25.9	-1.5	-0.6	4.	-4.	-14.
11/6/79	5	20.9	-1.5	-0.6	4.	-4.	-14.
11/28/79	7	20.5	-1.5	-0.6	29.	-10.	-7.
12/13/79	10	13.	-1.7	-3.1	-11.	-9.	18.
12/25/79	10	8.5	-0.5	-0.3	4.	-22.	21.
12/9/79	15	22.5	2.4	-4.	7.	-9.	35.
1/10/80	15	22.5	2.4	-4.	7.	-9.	35.
1/18/80	15	23.2	2.7	0.2	5.	-20.	53.
1/19/80	15	23.2	2.7	0.2	5.	-20.	53.
2/12/80	10	17.	1.5	-2.9	-26.	-7.	94.
2/13/80	8	17.	1.5	-2.9	-26.	-7.	94.
3/2/80	8	16.	0.6	-3.1	-19.	-3.	77.
3/3/80	8	14.2	-0.7	-2.8	-22.	-8.	94.
3/12/80	8	11.9	0.9	-2.7	-37.	-5.	84.
3/15/80	5	9.3	-1.4	-1.5	-35.	-3.	79
4/18/80	20	22.2	0.3	-4.3	-67.	-14.	87
4/19/80	20	22.2	0.3	-4.3	-67.	-14.	87
4/20/80	20	22.2	0.3	-4.3	-67.	-14.	87

After correction for these external fields and attitude biases, the data were sorted within each 10° x 10° global area by time. The following algorithm was then used to obtain a more uniform areal and temporal coverage.

(1) Vector component data are cut-off at ±50° latitude.
(2) A relative precision measure (the standard deviation of a least-squared fit to each quiet day) is assigned to the data for each day, as given in the above table.
(3) A maximum number of points is established for each 10° x 10° area by specifying the number at the equator and applying the cosine of the latitude of the mid-point as a factor in each 10° x 10° area block
    (a) Vector-- for each individual component the equatorial number is set at 30 points per 10° x 10° block. The time sorted data for that component are then examined relative to the allowed number for that particular 10° x 10° block. If the total number of data are less than the desired number, then all data are taken. If the total data are greater than the points requested for the 10° x 10° block, data are selected by skipping through the total data set at a prescribed interval. If the resulting data set is still too large, they are sorted by the relative precision measure and truncated at the desired number of points. The data sets are biased in favor of November 6 and March 15 by not allowing the algorithm to skip through observations for these days.
    (b) Scalar -- the scalar data are processed similarly to the vector components except that 10° x 10° blocks within ±50° latitude

are selected with an equatorial number of 15 per 10° x 10° block, while outside of ±50° latitude an equatorial number of 90 per 10° x 10° block is used.

These data were written onto cartridge SU5012 from tape KJE11.

2. The Basic FIT Data Sets.

A new procedure for selecting data was next implemented resulting in a completely new data set for main field modeling. The Magsat data were initially screened on the three hourly Kp index by choosing only data for KP < 1- and for which the previous three hourly Kp index was less than or equal to 2°. Component data at latitudes poleward of 50° geomagnetic latitude were excluded to minimize the effects of field aligned and ionospheric currents in the auroral regions, while scalar data (either from the scalar instrument or from vector measurements) were retained. After the initial screening, the data were sorted into separate subsets for dawn and dusk by Dst value into 5 nT intervals from -22.5 to +22.5 nT and visually scanned both for quality and to assure minimization of the effects of short wavelength external fields. These data were kept on tapes and files as follows:

Dst, nT (±2.5)	TAPE	FILE
-20	TD5349	12
-15	TD6458	10
-10	TD6576	10
-5	TD5349	13
0	TD6458	11
5	TD6576	11
10	TD5349	14
15	TD6458	12
20	TD6576	12

At present only tape TD6576 can be located, so this data set is essentially lost.

Separate models were derived from data at dawn and dusk (see Langel and Estes, 1985). The difference between these models was significant, and it appeared to have the characteristics which would be expected if a significant effect were present in the dusk data due to the equatorial electrojet, the Sq current system, and the effects of meridional currents. These effects were particularly evident in the latitude ranges:

X data for |geomagnetic latitude| < 20°

Y data for |geomagnetic latitude| < 15°

Z data for |geomagnetic latitude| < 50°

B data for |geomagnetic latitude| < 20°

Accordingly a "corrected" data set was derived. The correction left the dawn data unchanged but affected the dusk data within the latitude limits specified above. i.e. a correction was applied to the dusk data within

these latitude limits. The correction was based on the spherical harmonic models derived from the DUSK and DAWN data sets separately. The correction added to the dusk data is

$$\Delta = B_{DAWN\ Model} - B_{DUSK\ Model} .$$

The corrected data sets, still sorted by Dst, are located on on files 1-9 on cartridge SU5006 and tape DT0245 tape, as follows:

	UNCORRECTED		CORRECTED	
Dst, nT (±2.5)	TAPE	FILE	CARTRIDGE	FILE
-20	TD5349	12	SU5006	1
-15	TD6458	10		2
-10	TD6576	10		3
-5	TD5349	13		4
0	TD6458	11		5
5	TD6576	11		6
10	TD5349	14		7
15	TD6458	12		8
20	TD6576	12		9

Files 10 of SU5006 and DT0245 contain all of the data.

To establish Magsat data sets for spherical modeling of the main field, an algorithm was then applied to the above described data sets for dawn and dusk selecting data from all Dst levels. The data selection algorithm was applied separately for the time intervals (1) November - December, 1979; (2) January - February, 1980; and, (3) March - April, 1980, in an attempt to obtain a uniform data distribution in both time and space. For each period, and for dawn and dusk separately, vector data in the range ±50° geomagnetic latitude and magnitude data poleward of ±50° latitude were collected into 5° x 5° equiangular bins over the globe. In regions where vector data were sparse within ±50°, available scalar data were retained. Within each bin the data were sorted by time and a mean and standard deviation calculated. All data with residual (relative to the GSFC(9/80) model) greater than 150 nT, and/or greater than 2σ from the mean, were rejected.

The desired number of points in each bin was selected so as to obtain roughly the same number of points for equal area at all latitudes. This was accomplished by specifying a maximum of nine values for each vector component in an equatorial 5° x 5° bin, and scaling the number of points in each bin at other latitudes by the cosine of the latitude. An equatorial bin value of 27 was used for scalar data retained poleward of ±50°, while 6 was used for scalar data retained within ±50°. Each of the nine Dst intervals was assigned an algorithm weighting factor (in nT) as follows:

Dst	-20	-15	-10	-5	0	5	10	15	20
Weight	8	8	8	8	8	10	12	14	16

If a bin has more data than is desired after applying the above criteria, data are rejected first by an interval skipping algorithm (to maintain good temporal distribution) and then by eliminating data with higher algorithm weight factors. The mean and σ of the residuals for each data type within each bin for the resulting global distribution were computed.

This "full" Magsat data set was written on MG0015. This tape has definitely been written over and its contents destroyed, so the data set is lost. The tape was in "Gridded" Format with the following files:

FILE	DESCRIPTION
13	November - December, Dusk data.
14	January - February, Dusk data.
15	March - April, Dusk data.
16	November - December, Dawn data.
17	January - February, Dawn data.
18	March - April, Dawn data.

To obtain managable data sets for least squares modeling while retaining good temporal and geographic coverage, the above global data sets were reduced to approximately one third size. Within each 5° x 5° bin, and for each data type, an interval skipping algorithm was used (with data sorted by time) to take every third point. Any further reduction required was accomplished by eliminating data with the largest absolute deviation from the mean.

To these November - December, January - February, and March - April reduced Dawn and Dusk data sets were added passes in sparse areas for purposes of improving the geographic coverage. These passes were of greater disturbance levels than the previously selected data and were assigned higher data noise sigmas in the data set. These sigmas were determined during special pre-processing and were stored in gridded format (see section XI). Typical sigmas for DAWN and DUSK data in sparse regions ranged from 40 to 100. These values of σ were taken into account when deriving the DAWN(6/83) and DUSK(6/83) models. The resulting data sets are referred to as the DAWN and DUSK data sets.

To obtain a combined Magsat data set with good spatial coverage, the DAWN and DUSK data were merged, with stronger emphasis given to the dawn data. This was accomplished by assigning a common algorithm weighting factor to all dawn data (exclusive of the special passes in sparse regions). The same algorithm weighting factor was assigned to dusk data (exclusive of the special passes in sparse regions) in the following regions which seem to be least affected by Sq and the equatorial ionospheric currents:

X data for |geomagnetic latitude| > 20°

Y data for |geomagnetic latitude| > 15°

Z data for |geomagnetic latitude| > 50°

B data for |geomagnetic latitude| > 20°

The special sparse region passes (about 100 points for both dawn and dusk) were correspondingly given a higher algorithm weighting factor during pre-processing. This resulted in higher sigmas for these sparse points with typical values ranging from 40 to 200. The specific algorithm weight factors used in this and the following cases can be determined from the final "Gridded" format data sets (see section XI).

The dusk data inside the above indicated geomagnetic latitude limits, i.e. equatorward of 20° for X and B, equatorward of 50° for Z, and equatorward of 15° for Y, were given an intermediate algorithm weighting factor during pre-processing.

Two separate combined data sets were derived based on the treatment of the dusk data within these latitude limits. A data set denoted the COMBINED DATA SET used the dusk data within these limits directly (with the intermediate weighting factor), while a set denoted COMBINED DATA (CORRECTED) applied the previously described correction to the dusk data within the appropriate latitude limits.

Pre-processing the merged dawn and dusk data sets involved sorting the data within each 5° x 5° bin by weighting factor. The data with the lowest algorithm weighting factors were used to determine the sigmas for each bin. This procedure effectively selects dawn and dusk data equally outside of the specified geomagnetic latitude limits, while within these limits dawn data are preferentially taken with dusk data used only to fill in 5° x 5° bins sparse in dawn data.

The sigmas for the final data sets were determined using subroutine SVDATA (from the old 'FIT' program; reading gridded format). Scalar and vector data were intially assigned a sigma of 8, while dusk vector sigmas were 16. If the absolute value of the dipole latitude exceeded 50°, the scalar sigmas were assigned a value of 12 (only scalar data were used at these latitudes). If the sigmas from the 5° x 5° binning pre-processing exceeded the initial dawn and dusk sigmas, the later sigmas were used in the weighting. If data were in sparse regions, the special sparse data sigmas were assigned for the vector and scalar data.

The basic uncorrected data sets are contained on cartridge SU5006 files 11-32 and on files (1-22) on tape MG0017, in "Gridded" format in the following files:

FILE		DESCRIPTION
11	(1)	November - December, Dawn data, after selection of every third point
12	(2)	January - February, Dawn data, after selection of every third

point

13	(3)	March - April, Dawn data, after selection of every third point
14	(4)	November - December, Dawn data, data added in sparse areas.
15	(5)	March - April, Dawn data, data added in sparse areas.
16-20	(6-10)	Same as 11-15, except for Dusk data.
21	(11)	November - December, Dusk data, Special selected vector data at polar latitudes.
22	(12)	March - April, Dusk data, Special selected vector data at polar latitudes.
23-24	(13-14)	Same as 21 - 22, except Dawn data.
25-29	(15-19)	Copy of Files 11-15

Note: Files 16-20 were used in the DUSK(6/83) Model
Files 25-29 were used in the DAWN(6/83) Model.

30	(20)	Jan - Feb DAWN special data set, vector at all latitudes, for J_r computation.
31	(21)	Jan - Feb DUSK special data set, vector at all latitudes, for J_r computation.

The "corrected" data sets and the combined data sets are contained on cartridge SU5006 files 33-44 and on tape OF0933 files (1-12), in "Gridded" Format, as follows:

FILE		DESCRIPTION
33-35	(1-3)	Erroneous data sets, ignore
36	(4)	Jan - Feb, Dawn Δ data set (Data-DAWN Model) for special J_r computation (vector at all latitudes).
37	(5)	Jan - Feb, Dusk Δ data set (Data-DAWN Model) for special J_r computation (vector at all latitudes).
38	(6)	Dusk data (files 16-22 of SU5006) corrected by Δ DAWN - DUSK models.
39	(7)	COMBINED DAWN AND DUSK (CORRECTED) Nov - Dec.
40	(8)	COMBINED DAWN AND DUSK (CORRECTED) Jan - Feb.
41	(9)	COMBINED DAWN AND DUSK (CORRECTED) March - April.
42	(10)	COMBINED DAWN AND DUSK, (UNCORRRECTED) Nov. - Dec.

43 (11) COMBINED DAWN AND DUSK, (UNCORRECTED) Jan - Feb.

44 (12) COMBINED DAWN AND DUSK, (UNCORRECTED) March - April.

Copies of OF0933 are contained on DT0005, DT0028, and DT0029.

The final MAGSAT data in the newfit format are on XR1RB.MAGSAT.G12#89 and on cartridge SU5500 file 1. These data (in COMBINED and CORRECTED form) are composed of files 39, 40, and 41 from SU5006. They were processed through XRTJS.LIB.CNTL(MAGSAT) where the data was reformated, and weights were assigned to the data based on location and magnetic activity as in SVDATA.

3. Small Subsets Selected for Equal Area Distribution.

When working with Loren Shure on Harmonic Spline Models (e.g. Shure, Parker and Langel, JGR, 90, 11505-11512, 1985), sets of decimated data were extracted from the basic data set. The original Harmonic Spline models required inversion of a data by data matrix so a relatively small data set was desirable. Later models were freed of this restriction. The data sets so selected acquired the name "LOREN" data sets.

These data sets are located in the PDS F8#GM.LOREN.DATA(...)

Member Name	Number of Pts.	Description
L05DHLAT	391	5° Equal Area Binned, Combined Dusk and Dawn, High Lat.
L05DLLAT	1263	5° Equal Area Binned, Combined Dusk and Dawn, Low Lat.
L5DNHLAT	392	5° Equal Area Binned, Dawn only, High latitude.
L5DNLLAT	1262	5° Equal Area Binned, Dawn only, Low latitude.
L5DKHLAT	398	5° Equal Area Binned, Dusk only, High latitude.
L5DKLLAT	1256	5° Equal Area Binned, Dusk only, Low latitude.
L06DHLAT	267	6° Equal Area Binned, Combined Dusk and Dawn, High Lat.
L06DLLAT	881	6° Equal Area Binned, Combined Dusk and Dawn, Low Lat.
L07DHLAT	201	7° Equal Area Binned, Combined Dusk and Dawn, High Lat.
L07DLLAT	643	7° Equal Area Binned, Combined Dusk and Dawn, Low Lat.
L7DNHLAT	203	7° Equal Area Binned, Dawn only, High latitude.
L7DNLLAT	641	7° Equal Area Binned, Dawn only, Low latitude.
L7DKHLAT	203	7° Equal Area Binned, Dusk only, High latitude.
L7DKLLAT	641	7° Equal Area Binned, Dusk only, Low latitude.
L5DN1313		Field Model
L92DHLAT	22	Z data only. 22 points. Alt. = 500km. High latitude
L92DLLAT	70	XYZB data, Alt. = 500 km., low latitude.

[All high latitude data are Z component only.]

These data sets are stored on cartridge SU5008.

G. DE-2

DE-2 Satellite Data. (For a more detailed discussion of this data, see Ridgway (1988), Langel et al. (1988).

1. Original Data

The original data set is stored on cartridge SU5010 file 1 and on tape DT0034. There are approximately 19600 3-component magnetic field readings from 9/30/81 through 1/6/83. The data are heavily concentrated at the poles and near January, 1982 (See section XI for formats).

The processed data as described by Ridgway (1988) are stored on cartridge SU5010 files 2-4 with each file containing roughly 10,577 data points.

2. Processing Procedure

The data were first sorted into 3 time zones. Time zone #1 spanned 9/30/81 - 3/7/82, time zone #2 spanned 5/23/82 - 8/15/82, and time zone #3 spanned 12/1/82 - 1/6/83. Within each zone, data were geographically sorted into equal-area bins of size 10 degrees square at the equator. Data were decimated in each bin utilizing various quality criteria until 10 vector points were obtained (below 30 degrees dip-latitude) or 30 scalar points were obtained (above 30 degrees). The DST index was appended to each data point. A further data set was created by calibrating the vector magnetic values with land observatories.

Data processing programs (all under XRJRR.DE2.PROGRAMS and stored on SU9500) are summarized in the satellite data notebook and in section XII.

The processed data are stored on disk and on files 2-4 on cartridge SU5010.
i) File#2 or disk file XRJRR.DE2.FITPRP2A is binned data in spacecraft coordinates. Format identical to original format except that there are 100 points per logical record instead of 1, with each point containing 22 real words instead of 21. Word #22 equals the DST index.

ii) File#3 or disk file XRJRR.DE2.FITPRP.XYZOLD is binned data in topocentric (XYZ) coordinates. The data are non-calibrated and have the same format as file#2 except that word #3 contains X(north) magnetic component, #4 contains Y(east) component, #5 contains Z. Position of satellite still in GCI coordinates.

iii) File#4 or disk file XRJRR.DE2.FITPRP.XYZCAL is binned data in topocentric coordinates, and the data have been calibrated with ground observatories and have the same format as file #3

Data from XRJRR.DE2.FITPRP.XYZCAL were decimated above +-50^{0} geomagnetic latitude where every third point was choosen. They were then converted to the new FIT format using program XRTJS.LIB.CNTL(DE2) and weights added. A non-weighted data set is stored on file 2 of SU5500 (XR1RB.DE2.G12#89), and the weighted data set is stored on file 3 of SU5500 (XR1RB.DE2.BWT.G12#89). This data set was used in the analysis by Langel et al. 1988 and contains 5100 points.

File XR1RB.DE2.G12#89 was copied on to a 3.5 inch diskette by J.R. Ridgway for general distribution. The fomat of the diskette file is not in newfit format (see section XII.).

H. DMSP F-7

1. Background

The DMSP F7 spacecraft was launched on 18 Nov, 1983 into a 98.74 degree inclination orbit, with apogee 844 km altitude and perigee 822 km. (Rich, 1984). The primary purpose of the spacecraft was to obtain tropospheric meteorological data. However, a triaxial fluxgate magnetometer was included on the spacecraft in order to monitor the geophysical environment. Analysis of the DMSP data revealed that the magnetometer data were too severely contaminated by onboard noise to be of use for main field modeling. The DMSP data are reported in detail in (Langel et.al, 1990) and (Ridgway et. al, 1989).

VIII. REPEAT STATION DATA.

Repeat stations are locations at which "permanent" markers are located so that measurements can be taken at widely separated times at the same location. Such stations are ideally occupied, i.e. measurements taken, at three to six year intervals. In many cases only one or two occupations have occurred. In some cases different names have been used at different occupation times. In this and in other cases, we cannot actually be sure that exactly the same location was occupied.

1. The NOAA World-wide repeat data on reel DT0049 and on file 1 of cartridge SU4000 span the time period 1900 to 1985 and contain approximately 13,000 data points with numerous observations having sign errors or duplicate records. These data also contained various source numbers which were not recorded in the Survey Catalog (see section X.).

2. A second file of repeat data was assembled as noted in Figure 3. by merging all of the NEW.SDATXX.DATA files with data types equal to 9 (ie. repeat data). This file contains all of the repeat data posessed by BGS and is stored on disk XR1RB.REPEAT.DATA and on file 2 of SU4000.

These two data sets were merged and duplicate records and duplicate records in time and location were removed using program XR1RB.SURVEY.PROGRAMS (DUPLIC). The cleaned-up and questionable files are stored on disk XR1RB.CL9.REPEAT and XR1RB.CL9Q.REPEAT (Figure 4). Further processing of these data are anticipated in the future.

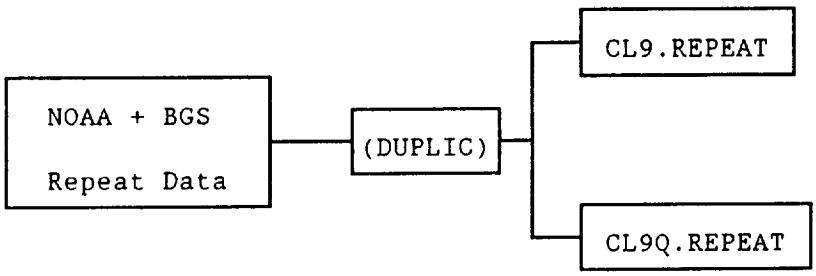

Figure 4.

IX. ANCILLARY DATA

This catagory of data includes secular variation model data and Kp and Dst data sets.

Secular variation data from 1975-1985 (centered at 1980.0) produced by Johnston (1985) in California are stored on disk data set XR1RB.CALSV.G02#90 and on cartridge SU6500

Kp data from January 1, 1932 through June 30, 1988 are stored on reel tape 802991 and cartridge SU7000. Also on SU7000 and tape TD5696 are Dst data from January 1, 1957 through December 31, 1985.

X. NGDC SURVEY CATALOG

A. The Catalog Format

The following is a catalog of surface surveys residing on the NGDC data set. The catalog format is relatively self explanitory except for a few items. The first number consists of the survey source code followed by a page number, e.g. 41 = source code 4, page 1; 42 = source code 4, page 2. This is followed by the year and country of publication. Still on the first line are the start and stop year of the survey and the elements measured.

The full format is as follows:

Card 1

Columns	Contents
1-4	Source Number - as filed at WDC-A
5	Card Number (1 for first card, 2 for second...)
6	Volume Number (A-Z)
7-10	Year of publication (or of receipt of document)
11-13	Country publishing (coded, left justified, FIPS)
14	Code for countries covered (C) or area description (D)
15-34	Country codes or area description
35-36	High latitude (deg.)
37	North/South designator (N or S)
38-39	Low latitude (deg.)
40	Hemisphere designator (N or S)
41-43	High longitude (deg.)
44	Hemisphere designator (E or W)
45-47	Low longitude (deg.)
48	Hemisphere designator (E or W)
49-56	Beginning year and end year of observations (i.e. 19481952)
57-63	Elements (observed, or calculated) D,I,H,X,Y,Z,F
64-66	Type(s) of observations (coded and left justified) 1=land survey,2=aeromagnetic,4=3-component marine,5=satellite 6=scalar marine,9=repeat,0=observatory
67-73	Beginning serial number
74-80	End Serial number

Cards 2-9

Columns	Contents
1-4	Source Number (as above)
5	Card Number (as above)
6	Volume Number (as above)
7-80	Title, author, agency bibliographical information separated

B. Data Given a Source Code but not Entered in Catalog.

Source Code	Data Description
720	Japanese repeat data, 1 observation.
755	Pacific Ocean repeat data, 161 observations
756	West African repeat data, 108 observations
757	Mexico, South or Central America, 303 repeat obsevations
758	Spanish repeat data, 345 observations
761	Italian repeat data, 112 observations
762	Japanese repeat data, 437 observations
764	Thialand, repeat data, 193 observations
765	Guatamala, repeat data, 286 observations
768	Peru, repeat data, 10 observations
769	Japanese repeat data, 24 observations
770	Eastern Africa, repeat data, 1 observation
771	Mexico, South or Central America, 519 repeat observations
772	South Africa, 12 repeat observations
776	New Zealand, 9 repeat observations
777	Canada, 1517 repeat observations
778	Canada, 2 repeat observations
780	Western Africa, 32 repeat observations
888	Kosmos-49 Data, As Described in Section VII.
900	Soviet Survey Data furnished by Golovkov of IZMIRAN.

C. Survey Catalog

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40*
41 1946GE Latvia                                  19391943DIH    9      339    68
42 Magnetic survey of Latvia, 1937-1943*Dr. L. Slaucitajs/
50*
51 1933PL Poland                                 19101930DIH    1      690    225
52 Leve magnetique de la Pologne*Stanislaw Kalinowski/
60*
61 1920SW Sweden                                 1919           1      2257   228
62 Magnetiska deklinationsbestamningar ar 1919 i Stockholms Norra Skargard*
63 G.S. Ljungdahl/
70*
71 1922SW Sweden                                 1919D          1      2287   234
72 Magnetiska deklinationsbestamningar ar 1919 pa Gottland*G.S. Ljungdahl/
80*
81 1934SW Sweden                                 19281930DIH    1      2348   260
82 Magnetic survey of Sweden* G.S. Ljungdahl*Hydrographic Service/
90*
91 1939SW Sweden                                 1937DIH        9      2605   270
92 The re-survey of the magnetic main repeat-stations in Sweden for the epoc
93 July 1, 1936*Gustaf S. Ljungdahl/
100*
101 1927SW Sweden, Finland                       1925D H  Z     14     2729   295
102 Magnetic measurements in the Baltic Sea, South Quarken and northern coast
103 of the Baltic Sea*J. Keranen & H. Odelsio/
110*
111 1936SW Sweden                                19281934D      1      2959   499
112 General Earth magnetic investigation of Sweden carried out during the
113 period 1928-1934*Kurt Molin*Geological Survey of Sweden/
120*
121 1940SW Sweden                                1938D H  Z     1      5010   515
122 Magnetic measurements on the "Kompass" in the Baltic Sea 1938*
123 G.S. Ljungdahl/
130*
131 1912US Worldwide                             19051910DIH    1      5159   742
132 Land magnetic observations 1905-1910*L.A. Bauer* Dept. of Terrestrial
133 Magnetism/
140*
141 1915US Worldwide                             19111913DIH    1      7430   956
142 Land magnetic observations 1911-1913 and reports on special researches*
143 L.A. Bauer & J.A. Fleming/
150*
151 1917US Worldwide                             19051916DIH    4      9571   1264
152 Ocean magnetic observations 1905-1916 and reports on special researches*
153 L.A. Bauer*Dept. of Terrestrial Magnetism/
160*
161 1921US Worldwide                             19141920DIH    1      12692  1613
162 Land magnetic observations 1914-1920-Researches of the Dept. of Terr. Mag
170*
171 1926US Worldwide                             19151921DIH    4      16139  1972
172 Ocean magnetic and electric observations 1915-1921*Dept. of Terr. Mag./
180*
181 1927US Worldwide                             19181926DIH    1      28070  3311
182 Land magnetic and electric observations 1918-1926*Dept. of Terr. Mag./
190*
191 1933UR USSR & vicinity                       19001930DIH    1      19742  2806
192 Catalogue of magnetic determinations in USSR and adjacent countries*
193 Weinberg/
200*
201 1947US Worldwide                             19271944DIH    14     33791  3462
202 Land and ocean magnetic observations 1927-1944*Dept. of Terr. Mag.*Also
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203 numbers 32024-33578 (incomplete)/
210*
211 1949CA Canada, north of 60 N.              19381947D      1    34630  3499
212 Declination results at Canadian stations north of latitude 60 degrees N*
213 R.G. Madill/
220*
221 1918JA Japan                                1913DIH      1    34993  3532
222 A magnetic survey of Japan for the epoch 1913.0*The Bulletin of the
223 Hydrographic Office, Imperial Japanese Navy, Vol. II/
230*
231 1926JA Japan                                1923DIH      1    35323  3553
232 A magnetic survey of Japan for the epoch 1923.0*The Bulletin of the
233 Hydrographic Dept., Imperial Japanese Navy, Vol. V/
240*
241 1936JA Japan                             19321933DIH      1    36144  3638
242 Magnetic survey of Japan 1932-1933*The Bulletin of the Hydrographic Dept.
243 Imperial Japanese Navy Vol. VIII/
250*
251     JA Japan                             19421944DIH      1    35532  3560
252 Preliminary values of magnetic elements from surveys made in 1942-1944 at
253 Japanese secular variation stations*Mr. Sano*Hydrographic Dept./
260*
261 1944NZ New Zealand                       19411943DIH      1    35602  3614
262 Tabulation of observations of 1941,42,43*Director of Observatory/
270
271     NZ New Zealand                       19441947DIH      1    36748  3700
272 Tabulation of magnetic survey of New Zealand 1944-1947/
280
281     NZ New Zealand                          1948DIH      1    37003  3710
282 Tabulation of magnetic observations at field stations in NZ Jan to May 48
290
291     IN India                             19011920DIH      1    40745  4786
292 The magnetic survey of India 1901-1920*Records Surv. India, Vol. XIX/
300
301     IN India                             19301931DIH      1    37103  3721
302 Survey of India, Geodetic Report Vol. VII for 1st Oct to 30th Sept 1931/
310*
311 1947US Tibet                                1947         1    37214  3726
312 Preliminary report on the magnetic results of a journey to Sikkim and
313 southern Tibet*Terr. Mag., Vol. 52, pp. 505-521/
320
321 1931CH China, Tibet                      19261928         1    37269  3741
322 Die erdmagnetischen Beobachtungen von Dr. Filchner auf seiner Reise in
323 China und Tibet in den Jahren 1926-1928*O. Venske*Veroff. Preuss. Met.
324 Inst., Abhand. Bd. IX, Nr. 7/
330
331     CH China                             19361947DIH      1    37419  3776
332 Results of magnetic observations in China by Natl Geological Survey of
333 China: SW China 1940-43. Academia Sinica: SE coast 1936; Kwangsi Prov
334 1939; Fukien Prov 1942-2; Pehpei 1945-6; observations in 1946-7/
340*
341     CH Tibet                             19351937DIH           37852  3813
342 Geophysikalisches Institut Potsdam Abhandlungen 7 Ergebnisse der erd-
343 magnetischen Beobachtungen Prof. Filchners auf seiner zweiten Tibetreise
344 1935-1937/
350*
351 1937CH China                                    D      1    38135  3849
352 Observatoire de Zikawei, Etudes sur le magnetisme terrestre, Etude 40,
353 Carte magnetique de Chine, Fasc X Tabulation/
360*
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361 1907ID East Indies (Indonesia)                19031907DIH    1    38503  3866
362 Magnetic survey of Dutch East Indies 1903-07*Dr. W. van Bemmelen*Obsns.
363 Roy. Magn. Met. Obs., Batavia, Vol. XXX, App. I/
370*
371 1916NZ New Zealand                                1903DIH    1    38661  3891
372 A magnetic survey of the Dominion of New Zealand*Lands and Survey Dept./
380*
381 1925ID Netherlands East Indies (Indonesia)    1925DIH    1    38936  3909
382 Isomagnetics for the Netherlands East Indian Archipelago epoch 1925*
383 Visser*Kon. Magn. Met. Obs., Batavia, Verhand. No. 13/
390*
391 1938CH China                                  19081937       10   39103  3917
392 Observatoire de Zi-ka-wei Observations magnetiques Tome XXII Annee 1937/
400*
401 1916AS Australia                                  1914DIH    1    39174  3921
402 Results of magnetic and astronomical observations between Oodnadatta,
403 Warrina and Musgrave Ranges Sept to Nov 1914*Adelaide Observatory/
410
411     CA Canada                                 19071920DIH    1    40121  4012
412 Publications of the Dominion Observatory Ottawa Vol. V No. 5/
420
421     CA Canada                                 19211923DIH         40123  4030
422 Publications of the Dominion Observatory Ottawa Vol. VIII No. 8/
430
431     CA Canada                                 19241926DIH    1    40121  4040
432 Publications of the Dominion Observatory Ottawa Vol. VIII No. 10/
440*
441 1940CA Canada                                 19271937DIH    1    40405  4074
442 Publications of the Dominion Observatory Ottawa Vol. XI No. 7/
450*
451 1924CA Canada                                        DIH    1    47868  6416
452 Magnetic results in Western Canada*Topographical Survey of Canada*Dept.
453 of the Interior, Canada/
460*
461 1909SF South Africa                           18981906DIH    1    64184  6785
462 Report of a magnetic survey of South Africa*J.C. Beattie/
470*
471 1930FR Angola, Rhodesia (Zimbabwe)        19121914DIH    1    67854  6790
472 Mission Rohan-Chabot, Tome II 1912-1914/
480*
481 1915EG Egypt, Sudan                               1910DIH    1    67903  6801
482 Magnetic survey of Egypt and the Sudan*H.E. Hurst*Ministry of Finance/
490*
491     GE Antarctica                             19011903D      1    68019  6825
492 German South Polar Expedition*Deutsche Sudpolar Expedition V,
493 Erdmagnetismus 1, Erdmagnetische See Beobachtungen by F. Bidlingmaier
494 II Teil, Deklination, pp. 327-329, 332-334/
500*
501 1948US Worldwide                                                   0
502 List of geomagnetic observatories and thesaurus of values - VIII*Fleming
503 & Scott*Terr. Magn., Vol. 53, No. 3, pp. 200-234/
510*
511 1944US Worldwide                                                   0
512 List of geomagnetic observatories and thesaurus of values - VI & VII*
513 Fleming & Scott*Terr. Magn., Vol. 49, Nos. 3 & 4, pp. 199-200, 267-269/
520*
521 1944US Worldwide                                                   0
522 List of geomagnetic observatories and thesaurus of values - I to V*
523 Fleming & Scott*Terr. Magn., Vols. 48 (1943) & 49 (1944)/
540*
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541 1909UK Antarctica                          19011904DIH     1    72515  7296
542 National Antarctic Expedition 1901-04 Physical Observations*Royal Society
543 London/
550
551     IN India                               19441947DIH     1    72969  7321
552 Survey of India Technical Report 1947, Part III-Geodetic Work/
560*
561 1942SF South Africa                        19381940D H  Z  1    73218  7329
562 Transactions of the Royal Society of South Africa Vol XXIX Part IV/
570
571     SF Rhodesia                            19051916DIH     1    73294  7337
572 Transactions of the Royal Society of South Africa Vol VIII Part IV/
580*
581 1921UK Antarctica                          19101913DI      4    73372  7378
582 British Antarctic Expedition 1910-13 in ship "Terra Nova"/
590*
591 1937SF South Africa                           1936D        1    73788  7398
592 Magnetic declination in South Africa*Dept of Irrigation/
600
601 1929TH Siam (Thailand)                     19261929DIH     1    74038  7417
602 Report on the operations of the Royal Survey Dept*Ministry of War 1926-27
603 1928-29 /
610
611     TH Siam (Thailand)                     19371938DIH     1    74177  7422
612 Report on the operations of the Royal Survey Dept*Ministry of Def 1937-38
620*
621 1923UK Arctic                                 1923D        1    74229  7425
622 The Geographical Journal Vol LXII, July to Dec. 1923*Royal Geographical
623 Society London/
640
641     AS Australia                           19461948DIH     1    74317  7437
642 Results of field observations of terrestrial magnetism*Bureau of Mineral
643 Resources/
660*
661 1924FR French Africa                          1924DIH     1    74420  7481
662 Annales de l'Institut de Physique du Globe 1924 Vol 2/
670*
671 1927UK Channel Islands, S England          19251926DIH     1    74824  7486
672 Magnetic survey of Channel Islands in 1925 and Southern England in 1926*
673 Ordnance Survey/
680*
681 1929UK England, Wales                      19271928DIH     1    74863  7489
682 Magnetic survey of England and Wales*Ordnance Survey/
690*
691 1930UK England, Wales, Scotland            19281929DIH     1    74899  7494
692 Results of the magnetic observations made by the Ordnance Survey in
693 England and Wales in 1928 and preliminary results (declination only)
694 of those made in Scotland in 1929/
700
701     GE Arctic                                 1931D H      2    74948  7502
702 Die Arktisfahrt des Luftschiffes "Graf Zeppelin"*Petermanns Mitteilungen/
710
711     UK East Africa                         19391942        1    75030  7519
712 Magnetic observations made in British East Africa 1939-1942
720
721     EG Egypt                               19361939D       1    75355  7537
722 Report on terrestrial magnetism at Helwan Observatory/
730*
731 1925FR French Africa                             DIH      1    75372  7552
732 Annales de l'Institut de Physique du Globe Vol 3/
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740*
741 1926FR French West Africa, Syria                1926DIH    1    75524  7567
742 Annales de l'Institut de Physique du Globe Vol IV/
750*
751 1916BR Brazil                                   19131915DIH    1    75674  7573
752 Terr. Magn. Atm. Electr., Vol 21, No 3, 1916/
760*
761 1912BR Brazil                                   19101911DIH    1    75734  7578
762 Terr. Magn. Atm. Electr., Vol 17, No 3, 1912/
770*
771 1928YO Yugoslavia                                  DIH    1    75783  7602
772 Razdioba Glavnih Elemenata Zemaljskoga Magnetizma*Travaux de l'Institut
773 de Physique du Globe de Zagreb/
780
781     BR Brazil                                   19381942       1    76029  7607
782 Anais Hidrograficos, Vols VI-IX (Vol VI for 1938 and previous
783 observations, Vol VII for 1939, Vol VIII for 1940, Vol IX for 1941-42) /
800
801 1940FR French West Africa                       1940DIH    1    76088  7614
802 Comptes Rendus des Seances de l'Academie des Sciences Tome 210 No 6/
810
811     AG North Africa                             19431945DIH    1    76149  7646
812 Resultats de mesures magnetiques faites au Sahara Algerien et en
813 Tripolitaine de Dec 1943 a Juin 1945*J. Dubief/
820
821 1948FR French Africa                            19461947DIH    1    76468  7693
822 Resultats de mesures magnetiques en Afrique Francaise*J. Dubief*Travaux
823 Inst. Met. Phys. Globe de l'Algerie, Fasc. 8/
830
831 1905BF Bahama Islands                              DI    F1    76932  7693
832 Magnetic observations in the Bahama Islands*Oliver L. Fassig, Ph.D./
840
841 1944FR Algeria, Tripolitania                    1943DIH    1    76941  7700
842 Resultats de mesures magnetiques au Sahara (Algerie et Tripolitaine)
843 en 1943*J. Dubief*Travaux Inst. Met. Phys. Globe d'Algerie, Fasc. 6/
850*
851 1937FR French North Africa, Morocco, Syria      1937DIH    1    77005  7731
852 Annales de l'Institut de Physique du Globe Vol XV (Morocco, Syria, French
853 North Africa) /
860
861     AR Argentina                                1948DIH    1    77313  7735
862 Relevamiento Geomagnetico de la Republica Argentina/
870
871 1934FR French Equatorial Africa                 1934D      1    77358  7737
872 Memoires de l'Academie des Sciences de l'Institut de France/
880
881 1944IT Albania, Ethiopia                        19391942DIH    1    77376  7746
882 Geofisica Pura e Applicata Vol VI Fasc 1-2/
890
891 1943FR North Africa                                DIH    1    77468  7758
892 Travaux de l'Institut de Meteorologie et de Physique du Globe de
893 l'Algerie, Fasc 1 /
900
901 1948UY Uruguay                                  19401943D      1    77584  7767
902 Relacion de las estaciones de magnetismo hechas hasta la fecha espresandc
903 las coordenadas geograficas, fechas de observacion y valores obtenidos*
904 Ejercito Nacional, Instituto Geografico Militar/
910
911 1940RO Romania                                  1940DIH    1    77681  7776
912 Mesures magnetiques en Roumanie de 1931 a 1940 et cartes magnetiques de
```

913 la Roumanie dressees pour le 1er Juillet 1940/
920
921 1947RO Romania 19311947DIH 1
922 Valeurs des elements magnetiques et des variations seculaires a Jassy,
923 pendant 16 ans, de 1931 a 1947*Stefan Procopiu
930*
931 1935RO Romania 1934 1 77807 7789
932 Determination des elements magnetiques en Roumanie et cartes magnetiques
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3112 Registry cards (USGS)*572001-572003*715001-715005/
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3122 Registry cards (USGS)*572201-572208*725006-715010*
3123 Destroyed 300380-300396/
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3131     US Arkansas                                                300455 30064
3132 Registry cards (USGS)*572401-572403*715011-715019*730883-730884/
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3141     US California                                              300641 30152
3142 Registry cards (USGS)*572602-572641*715020-715056*730885-730888/
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3151     US Colorado                                                301526 30177
3152 Registry cards (USGS)*315528-315529*715082/
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3161     US Connecticut                                             301775 30184
3162 Registry cards (USGS)* 315511-315521/
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3171     US Delaware                                                301848 30191
3172 Registry cards (USGS)*568400-568401/
3180
3181     US District of Colombia                                    301915 30193
3182 Registry cards (USGS)*315530-315531/
3190
3191     US Florida                                                 302000 30237
3192 Registry cards (USGS)*572815-572831*301933-301999*533487-533491*
3193 715095-715131*730889-730896*729635/
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3201     US Georgia                                                 302376 30270
3202 Registry cards (USGS)*573001-573008*715132-715142*730898-730899*/
3210
3211     US Idaho                                                   302701 30282
3212 Registry cards (USGS)*573201*533517*715143-715164/
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3221     US Illinois                                                302823 30311
3222 Registry cards (USGS)*573404*533483-573404*715165-715174/
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3231     US Indiana                                                 303114 30338
3232 Registry cards (USGS)*573601*533668-533669*533690*715175-715178/
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3241     US Iowa                                                    303386 30369
3242 Registry cards (USGS)*533482*715179-715180/
3250
3251     US Kansas                                                  303693 30400
3252 Registry cards (USGS)*574001-574016*715181-715197*533464-533465*315532*
3253 533691-533693/
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3261     US Kentucky                                                304010 30422
3262 Registry cards (USGS)*574201-533485*715198-715202/
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3271     US Louisiana                                               304230 30449
3272 Registry cards (USGS)*574401-574411*715203-715207/
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3281     US Maine                                                   304492 30460
3282 Registry cards (USGS)*304609-304737*568710-568715*533500-533783*
3283 715209-715245*730900-730904/
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3291     US Maryland                                                    304740 30507
3292 Registry cards (USGS)*533699-533700*715246-715254*730905/
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3301     US Massachusetts                                               305075 30532
3302 Registry cards (USGS)*568901-568905*715255-715258*533789/
3310
3311     US Michigan                                                    305330 30571
3312 Registry cards (USGS)*533471-533704*715259-715268*730906-730907/
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3321     US Minnesota                                                   305716 30600
3322 Registry cards (USGS)*304606*533615-533616*533705*730908/
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3331     US Mississippi                                                 306009 30623
3332 Registry cards (USGS)*574601*533475-533478*715269-725284/
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3341     US Missouri                                                    306240 30661
3342 Registry cards (USGS)*574803-574805*533480-533481*715285-715296*
3343 730909-730910/
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3351     US Montana                                                     306617 30688
3352 Registry cards (USGS)*575003-575006*533518-533709*715297-715304*
3353 730911-730917/
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3361     US Nebraska                                                    306883 30706
3362 Registry cards (USGS)*575201-575203*715305-715312/
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3371     US Nevada                                                      307070 30724
3372 Registry cards (USGS)*533510-533512*533710*715313-715326/
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3381     US New Hampshire                                               307247 30732
3382 Registry cards (USGS)*307330-307334*569101-569102*715327-715329*703916/
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3391     US New Jersey                                                  307335 30752
3392 Registry cards (USGS)*715330-715332/
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3401     US New Mexico                                                  307529 30774
3402 Registry cards (USGS)*575502*533461*533711*715333-715346/
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3411     US New York                                                    307747 30817
3412 Registry cards (USGS)*533504-533713*569203-569209*715347-715354*
3413 730918-730919/
3420
3421     US North Carolina                                              308179 30866
3422 Registry cards (USGS)*569301*533497*715355-715364/
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3431     US North Dakota                                                308668 30882
3432 Registry cards (USGS)*533470*533714-533715*715365-715370*730920-730923/
3440
3441     US Ohio                                                        308830 30906
3442 Registry cards (USGS)*569401-569405*533643-533647*715371*715374/
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3451     US Oklahoma                                                    309064 30922
3452 Registry cards (USGS)*575701-57512*533462-533463*715375*715386*
3453 730924-730927/
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3461     US Oregon                                                      309230 30953
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3471     US Pennsylvania                                                309538 30980
3472 Registry cards (USGS)*569502*533505*533648*533670-533671*715400*730928/
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3481     US Rhode Island                                                309813 30985
3482 Registry cards (USGS)*533499*533672*533781*715401*730929/
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3491     US South Carolina                                              309857 31002
3492 Registry cards (USGS)*569701-569705*533494-533495*715402-715410/
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3501     US South Dakota                                                310028 31019
3502 Registry cards (USGS)*575901-575902*533468-533469*533717-533718*
3503 715411-715415*730930-730932/
3510
3511     US Tennessee                                                   310201 31040
3512 Registry cards (USGS)*715416-715436/
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3521     US Texas                                                       310403 31109
3522 Registry cards (USGS)*576101-576116*533457-533460*533673*576101-576116*
3523 715437-715477/
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3531     US Utah                                                        311093 31130
3532 Registry cards (USGS)*576301 *533674-533675*715478-715492/
3540
3541     US Vermont                                                     311301 31155
3542 Registry cards (USGS)*533523*533679-533680*715493*715574*730933*730935/
3550
3551     US Virginia                                                    311555 31189
3552 Registry cards (USGS)*533486*533676-533678*533784-533788*569898-569900*
3553 715510-715520*730936/
3560
3561     US Washington                                                  311894 31254
3562 Registry cards (USGS)*576501-576587*576588*533515*533681-533682*
3563 533790-533804*715521-715559/
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3571     US West Virginia                                               312550 31266
3572 Registry cards (USGS)*715560-715561/
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3581     US Wisconsin                                                   312671 31298
3582 Registry cards (USGS)*576701*533618-533666*715562-715563*730937-730939/
3590
3591     US Wyoming                                                     312965 31312
3592 Registry cards (USGS)*533466-533467*533683-533685*715564-715573*730940/
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3601     US Alaska                                                      313145 31553
3602 Registry cards (USGS)*533807-534453*550213-550215*793500-793502*
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3611     US Hawaii, Saipan (Palau Islands)                              315122 31550
3612 Registry cards (USGS)*599503*715850-715865*315094-315121*315084-315093*
3613 594300.3/
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8090*
8091 1981GE Germany                                      1980D      1
8092 From computer listing received via DMS (DMS Ref Bm502A)/
8100*
8101 1985   Greece                                       1985D      1
8102 Chart of the Magnetic Declination (D) for Greece for the 1st of January
8103 1985*D values printed on chart, positions interpolated (DMS Ref Bo501B)/
8110*
8111 1981NO Norway                                       1980D      1
8112 Values interpolated at 1 degree intervals of latitude & longitude from
```

```
8113 contour chart received via DMS (DMS Ref Bt501C)/
8120*
8121 1981   Turkey                                    1980D      1
8122 Values interpolated at 1 degree intervals of latitude & longitude from
8123 contour chart received via DMS (DMS Ref Bac501A)/
8130*
8131 1986IT Italy                                     1985D H  Z 9
8132 From computer listing provided by Istituto Nazionale di Geofisica
8133 (DMS Ref Bq500c(3))/
8140*
8141 1986FI Baltic Sea                                1985D H   F4
8142 Observations in the Gulf of Finland made on board "Zarya". Data
8143 received on magnetic tape from C Sucksdorff, Finnish Meteorological
8144 Institute Oct. 1986/
8150*
8151 1986FI Finland                              19451986D H  Z 9
8152 Repeat station data received on magnetic tape from C Sucksdorff,
8153 Finnish meteorological Institute Oct. 1986*Values reduced to middle
8154 of year using quiet-day annual means/
8160*
8161 1986UK Great Britain                             1985D      9
8162 Preliminary values reduced to 1985.0/
8170*
8171 1982DA Faeroe Islands                            1980D H  Z 9
8172 Geomagnetiske malinger pa Faeroerne*H A Hansen*Det Danske Meteorologiske
8173 Institut Geofysik Afdeling, p. 9/
8180*
8181 1984   Iceland                                   1984D H   F9
8182 Leirvogur Magnetic Results, 1983/
8190*
8191 1986   Ireland                              19801985D H  Z 9
8192 The secular variation of magnetic declination in Ireland (1985)*K G
8193 Commins*And letter from Irish Meteorological Service/
8200*
8201 1986   Switzerland                               1978D H  Z 1
8202 Data received on magnetic tape from G Fischer, Neuchatel Observatory
8203 Nov. 1986. Slightly modified of data in A New Geomagnetic Survey of
8204 Switzerland*G Fischer, P A Schnegg & J Sesiano*Materiaux Geolog. Suisse,
8205 Geophys., No. 19 (1979), pp. 37-42/
8210*
8211 1986BR Brazil                                    1985DI    F9
8213 Campo geomagnetico normal e sua variacao secular no Brasil em 1985,0*
8214 C de Mello Motta & L M Barreto/
8220*
8221 1985   China                                     1980DIH    9
8222 Repeat station data received from Shi Mei-kung, Institute of Geophysics
8223 Academia Sinica, May 1985/
8230*
8231 1984RO Romania                                   1980  H  Z 9
8232 Valori normale ale elementelor geomagnetice H, Z si F in Romania, la
8233 epoca 1980,0*C Demetrescu & T Nestianu*St. Cerc. Geol., Geofiz., Geogr.,
8234 Geofizica, 22, 35-41/
8250*
8251 1983UK Saudi Arabia                         19801983D H   F1
8252 Observations by various surveying companies, provided by Clyde Surveys
8253 Reduced to epoch by BGS/
8260*
8261 1985UK Worldwide                            19821985D H   F1
8262 Observations made by Hydrographic Department, MOD/
8270*
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8271 1982SF South Africa, Botswana                    19771980D H  Z 9
8272 Geomagnetic secular variation observations in southern Africa 1980*
8273 G J Kuhn*CSIR Rep. MAG C7, pp.6-12/
8280*
8281 1983JA Japan                                     1980D H  Z 9
8282 Magnetic survey of Japan 1979-1980*Data Rep. Hydrogr. Obsns. Series
8283 Magn. Surv. No. 4, pp. 15-17/
8290*
8291 198?UK Canada                                    1982D H  Z 9
8292 Observations of the magnetic field at International Polar Year sites
8293 in Canada*L R Newitt*Nature/
8300*
8301 1986CA Canada                                    1984   XYZ 9
8302 Relocation of the north magnetic dip pole*L R Newitt & E R Niblett*
8303 Can. J. Earth Sci., 23, 1062-1067, Table 1/
8310*
8311 1985SF South Africa, Botswana                    19821984D H  Z 9
8312 Geomagnetic secular variation observations in southern Africa 1985*
8313 G J Kuhn*CSIR Rep. MAG C8, pp. 7-15/
8320*
8321 1987UK Antarctic                                 19851986D H   F9
8322 Hallpike, T. R., HMS "Endurance". Report of magnetic observations in
8323 South Georgia, South Shetlands, Antarctic Peninsula and Falkland Islands
8324 December 1985 - February 1986 (HI 275).
8330*
8331 1987UK South Atlantic                            19861987D H   F9
8332 Kelly, P. J. L., South Atlantic. Magnetic observations ashore.
8333 H. M. Surveying Ship "Herald". Surveyed by Commander P. J. L. Kelly,
8334 Royal Navy, 1st November 1986 - 14th February 1987. Report of Survey
8335 (HI 350).
8340*
8341 1987UK South Georgia                            19841987D H  Z 9
8342 Buckingham, J. P., Dowson, M. J. & Simmons, D. A., Notes on geomagnetic
8343 repeat measurements at Grytviken, April 1987. Bull. Brit. Antarct. Surv.
8350*
8351 1987UK Ascension Island                          1987D      9
8352 Kimber, S. M., Ascension Island. H. M. Surveying Ship "Herald". 11th -
8353 15th July 1987. Report of Survey. Hydrographic Dept. Ref. 266/11.
8360*
8361 1987JA West Africa                               19731986D H  Z 9
8362 Vassel, J., Secular change in the geomagnetic field in West Africa
8363 for thirty years: comparison with fourth generation IGRF models. J.
8364 Geomagn. Geoelectr., 39, 699-707/
8370*
8371 1988JA Japan                                     1985D H  Z 9
8372 Magnetic survey of Japan 1984-1985*Data Rep. Hydrogr. Obsns. Series
8373 Magn. Surv., no 5, pp. 21-22/
8380*
8381 1988FR France                                    19861987DI   F9
8382 Gilbert, J., Reseau magnetique de repetition de la France*Unpublished
8383 document from Institut de Physique du Globe de Paris/
8390*
8391 1988FR French Subantacrtic Islands               19811986DI XY F9
8392 Bitterly, J., Maisons, C., Bitterly, M., Folques, J. & Schlich, R.
8393 Absolute magnetic measurements at French Subantarctic island: repeat
8394 stations results for the period 1981-1987*Inst. Phys. Globe, Strasbourg/
8400*
8401 1988JA Japan                                     19791986DIH   F9
8402 Geomagnetic observations at Mizusawa and Kanozan 1987, first order
8403 geomagnetic stations 1979-1986, Geographical Survey Institute, Japan/
```

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 8410*
 8411 1989CA Canada                                  19871988DIH  ZF9
 8412 Canadian repeat station data received from Larry Newitt on IBM diskette/
 8420*
 8421 1989JA Japan                                    19841985   XYZ 2
 8422 Aeromagnetic observations received from Martime Safety Agency
 8423 on magnetic tape. Values reduced to 1985.0 have been publishedin
 8424 Magnetic survey of Japan 1984-1985*Data Rep. Hydrogr. Obsns. Series
 8425 Magn. Surv., No. 5 (see source 837)/
 8430*
 8431 1989NZ New Zealand                             19751988    XYZ 9
 8432 Values at 3 New Zealand repeat stations received in letter from DSIR
 8433 dated 1989 May 12.
 8440*
 8441 1989PO Portugal                                   1988DI    F9
 8442 Values at 19 Portuguese repeat stations, reduced to epoch 1988.0
 8443 Received in letter from Instituto Nacional de Meteorologia e Geofisica
 8444 dated May 29th 1989
 8450*
 8451 1987DA Denmark                                    1985D H  Z 9
 8452 Values at 9 repeat stations expressed as differences from Rude Skov*
 8453 Brorfelde Geomagnetic Observatory, Magnetic Results, 1985, Danish
 8454 Meteorological Institute, Copenhagen, 1987.
 9000*
 9001 1986UR USSR                                   19451960D H  Z 9
 9002 Values at Russian repeat stations interpolated graphically to epochs
 9003 1945, 1950, 1955 & 1960*Received from V P Golovkov via WDDC B/
85480*
85481 1948GE Worldwide                                1900DIH  Z 0   790000   141
85482 Katalog der Jahresmittel der magnetischen Elemente der Observatorien und
85483 der Stationen*In separate file/
```

XI. FORMATS

Most of the data sets to be described are in one of a series of "standard" formats, or a minor variation therof. This section describes the standard formats (see Table of Contents for a listing of formats).

A. The NOAA Survey Format

The NGDC of NOAA has adopted a standard format for their world-wide magnetic survey data. The format has 130 characters per record and has 10 records per block. The format description is as follows:

ITEM	NAME	LOCATION	FORMAT	DESCRIPTION
		1	A1	Blank
A	NM	2 - 16	A15	Station Name (Track)
B	T	17 - 22	F6.2	Time (Year and Fraction since 1900)
		23 - 24	A2	Blank
C	CLT	25 - 31	F7.3	Geodetic Colatitude (Deg.)
D	ELN	32 - 39	F8.3	East Longitude (Deg.)
E	EL(1)	40 - 49	F10.3	Declination, D (Deg.)
F	EL(2)	50 - 57	F8.3	Inclination, I (Deg.)
G	EL(3)	58 - 64	F7.0	Horizontal Intensity, H (nT)
H	EL(4)	65 - 72	F8.0	North Component, X (nT)
I	EL(5)	73 - 80	F8.0	East Component, Y (nT)
J	EL(6)	81 - 88	F8.0	Vertical Intensity, Z (nT)
K	EL(7)	89 - 95	F7.0	Total Intensity, B or F or T (nT)
L	ALT	96 -100	I5	Altitude (tens of meters, except for Satellite data which is km.)
M	CDE	101 -102	I2	Data Code
	CDE	101	A1	'*' if corrections have been made to this record. 'A' if all data on this record are anomalous blank otherwise
	IDC	102	I1	Data Type Code =1, Land Survey Data =2, Aeromagnetic Data =3, unused =4, 3-component Marine Data =5, Satellite data =6, Marine total intensity data =9, Repeat Station data =0, Observatory Annual Means
N	NSO	103 -106	I4	Source Number
O	NSL	107 -114	I8	Serial Number
P	IOC	115 - 121	7I1	Element Code: observed element code =0: no value for this element =1: this element has been calculated

For data from BGS and for our internal use, item M has been subdivided into two items. The first is new; the second is identical to the NOAA Data Code.

				=2: observed value - - - - - - - - - - - - - - - The following codes have been added =3: computed value rejected during =4: observed value rejected during =5: computed value rejected during =6: observed value computed value =7: gross outlier =8: not used =9: anomalous observed value (BGS) - - - - - - - - - - - - - - - - - - -
Q	IH	122 -125	I2	GMT: UT time in hours
	IM		I2	: UT time in minutes
R	CY	126 -130	A5	Country code: Abbreviated country or

For example, this record can be read with the statements:

```
WRITE (   ) NM, T, CLT, ELN, EL, ALT, CDE, IDC, NSO, NSL, IOC, IH, IM, CY
FORMAT (A16, F6.3, F9.3, F8.3, F10.3, F8.3, F7.0, 3F8.0, F7.0, F5.0,
        A1, I1, I4, I8, 7I1, 2I2, A5)
```

B. New FIT Format

The output from the programs which filters aeromagnetic and shipborne data along track, i.e. AVSIG and the statistical binning routine i.e. EQBIN described above, is the standard data base library format as of 3/91. A header record prefaces the data for surveys only. The format for each data record is as follows:

```
(A4,1x,A15,I1,I1,1X,I4,I8,1X,F8.3,I6,I8,1X,2F7.3,2(F8.3,1X),2F8.3,5F8.1,
            1X,7(2I1),1X,2F6.3,5F5.1,1X,I4,1X,3F10.5,21x)
```

Where:

Item	Location	Data type	Format	Description
A	1 - 5	Char*4	A4,1x	Four-letter code
B	6 - 20	Char*15	A15	Station Name
C	21	Integer	I1	Data Source code: 0-Observatory 1- Land 2- Aeromagnetic 4- 3-component marine 5- Satellite 6- Scalar marine 9- Repeat station
D	22 - 23	Integer	I1,1x	Reference frame code: 1 - Geodetic 2 - Geocentric 3 - Satellite coordinates
E	24 - 27	Integer	I4	Source #
F	28 - 36	Integer	I8,1x	Serial #

G	37 - 44	Real	F8.3	Time (decimal years)
H	45 - 50	Integer	I6	Modified Julian Date
I	51 - 59	Integer	I8,1x	Milliseconds of day.
J	60 - 66	Real	F7.3	Geodetic colatitude (DEG)
K	67 - 73	Real	F7.3	Geocentric colatitude (DEG)
L	74 - 82	Real	F8.3,1x	East longitude (DEG).
M	83 - 91	Real	F8.3,1x	Altitude (Km)
N	92 - 99	Real	F8.3	Declination[1] (DEG, DEG/YR)
O	100 - 107	Real	F8.3	Inclination[1] (DEG, DEG/YR)
P	108 - 115	Real	F8.1	Horiz. component[1] (nT,nT/yr)
Q	116 - 123	Real	F8.1	North component[1] (nT,nT/yr)
R	124 - 131	Real	F8.1	East component[1] (nT,nT/yr)
S	132 - 139	Real	F8.1	Vertical component[1] (nT,nT/yr)
T	140 - 148	Real	F8.1,1x	Total Intensity[1] (nT,nT/yr)
U	149 - 163	Integer	7(2I1),1X	Data type codes (for items N - T):

First digit
- 0 - No data
- 1 - Computed
- 2 - Observed
- 3 - Computed derivative
- 4 - Observed derivative
- 9 - Anomalous

Second digit:
- 0 - Data acceptable
- 1 - Gross outlier
- 2 - Padded time gap value
- 3 - B-spline outlier.
- 4 - Fourier function outlier
- 5 - B-spline/Fourier combination outlier.
- 6 - Geocentric latitude bound exceeded.
- 7 - Satellite direction indeterminable.

V	164 - 169	Real	F6.3	Dec. sigma (Deg,Deg/yr)
W	170 - 175	Real	F6.3	Incl. sigma (Deg,Deg/yr)
X	176 - 180	Real	F5.1	H. component sigma(nt,nt/yr)
Y	181 - 185	Real	F5.1	N. component sigma(nt,nt/yr)
Z	186 - 190	Real	F5.1	E. component sigma(nt,nt/yr)
AA	191 - 195	Real	F5.1	V. component sigma(nt,nt/yr)
BB	196 - 201	Real	F5.1,1X	T. intensity sigma(nt,nt/yr)
CC	202 - 205	Integer	I4	DST value
DD	206 - 215	Real	F10.5	Transformation angle #1.
EE	216 - 225	Real	F10.5	" " #2.
FF	226 - 235	Real	F10.5	" " #3.
GG	235 - 255	---	21X	Spare.

1(If the data type code for this value equals 4, units are replaced by a rate in units per year)

C. Survey Format for (old) FIT Program

The output of the old EQBIN program is listed here for historical purposes. A record in this format is written as follows:

```
WRITE (    ) NM, T, CLT, ELN, IALT, NEL, EL, SMEAN, SSTMOD, SSKEW, SKURT
             BMEAN, BSTMOD, BSKEW, BKURT
FORMAT (1X, A16, F6.3, F7.3, F8.3, I5, I1, 9F10.3)
```

where:

NM	Station Name
T	Date (Year - 1900.0), units years
CLT	Colatitude (Deg.)
ELN	East Longitude (Deg.)
IALT	Altitude: 10's of meters for survey: km for satellite
NEL	Component Code =1: Declination, D (Deg.) =2: Inclination, I (Deg.) =3: Horizontal Intensity, H (nT) =4: North Component, X (nT) =5: East Component, Y (nT) =6: Vertical Component, Z (nT) =7: Total Intensity, F, B or T (nT)
EL	Actual component measurement corresponding to NEL
SMEAN	Survey source mean
SSTMOD	Survey source modified standard deviation
SSKEW	Survey source skewness
SKURT	Survey source kurtosis
BMEAN	Equal area bin mean
BSTMOD	Equal area bin modified standard deviation
BSKEW	Equal area bin skewness
BKURT	Equal area bin kurtosis

D. Binary (old) FIT Format.

One of the common formats into the (old) field modeling program is listed here. Data from the POGO, Magsat and DMSP F-7 satellites are generally in this format, or a variation therof. These files are binary with 100 points per record and with each point having 28 REAL*4 words of data, as follows:

```
REAL*4 A(28,100)
INTEGER IA(28,100)
EQUIVALENCE (A(1,1), IA(1,1))
```

ARRAY LOCATION	DESCRIPTION

IA(1,I)	Modified Julian Day.
IA(2,I)	Milliseconds of Day.
A(3,I)	Not used.
A(4,I)	In some cases not used, in others fraction of day.
A(5,I)	Time in years from 1900.
A(6,I)	Geocentric latitude.
A(7,I)	Longitude.
A(8,I)	Not used.
A(9,I)	Not used.
A(10,I)	Not used.

- - - - - - - - - - - - - - - - - - -

If data are in geocentric coordinates:

A(11,I)	North component, $-B\theta$, or Satellite X-axis
A(12,I)	East component, $B\phi$, or Satellite Y-axis component.
A(13,I)	Satellite Z-axis component (along-track).

- - - - - - - - - - - - - - - - - - -

If data are in spacecraft coordinates:

A(11,I)	Cross track component
A(12,I)	Radially down component
A(13,I)	Along track component

- - - - - - - - - - - - - - - - - - -

A(14,I)	Scalar total intensity.
IA(15,I)	Geocentric altitude (meters) above earth radius,
A(16,I)	Not used.
A(17,I)	Not used.
IA(18,I)	Used only for DMSP = Data quality classification 0 = Data is adequate quality 1 = Residual from field model exceeds a 2 = Padded time gap value (data does not 3 = Outlier from B-spline function 4 = Outlier from Fourier function 5 6 = Latitude of data exceeds specified 7 = Direction of satellite indeterminable
IA(19,I)	=0
IA(20,I)	=0 except for DMSP where it indicates satellite
IA(21,I)	=0
IA(22,I)	Magnetic latitude outlier flag for sat. X axis.
IA(23,I)	" " " " " " Y "
IA(24,I)	" " " " " " Z "
IA(25,I)	" " " " " total intensity.
A(26,I)	Not used.
A(27,I)	Not used.
A(28,I)	Not used.

The above format was used for the early Magsat data. However, as the Magsat data selection became more sophisticated, format variations became necessary. These fall into several classes:

"Select" Format: same as the "standard" format, except:

A(4,I)	Fraction of day
11 - 14	X, Y, Z, and F (Geocentric so: $-B\theta$, $B\phi$, $-B_r$)
A(28,I)	Dst

"Correction" Format: same as the "standard" format, except:

A(4,I)	Fraction of day
A(8,I)	Computed X (=-Bθ), from GSFC(9/80)
A(9,I)	Computed Y (=Bϕ), from GSFC(9/80)
A(10,I)	Computed Z (=B$_r$), from GSFC(9/80)
A(11,I)	Corrected X
A(12,I)	Corrected Y
A(13,I)	Corrected Z
A(14,I)	Corrected F
A(16,I)	Uncorrected X
A(17,I)	Uncorrected Y
A(18,I)	Uncorrected Z
A(19,I)	Uncorrected F
IA((20,I)	Flag for uncorrected X
IA(21,I)	Flag for uncorrected Y
IA(22,I)	Flag for corrected X
IA(23,I)	Flag for corrected Y
IA(24,I)	Flag for corrected Z
IA(25,I)	Flag for corrected F
IA(26,I)	Flag for uncorrected Z
IA(27,I)	Flag for uncorrected F
A(28,I)	Dst

"Gridded" Format

A(3,I)	Weight (Used in selecting gridding criteria.)
A(4,I)	Dipole latitude
A(16,I)	Residual of X
A(17,I)	Residual of Y
A(18,I)	Residual of Z
A(19,I)	Residual of B
IA(20,I)	Number of data points for type X, Y, Z or B in 5° x 5° bin.
A(21,I)	σ of residuals about the mean for type X, Y, Z, 5° x 5° bin.
A(26,I)	Average of residuals for type X, Y, Z or B in 5° x 5° bin.
A(27,I)	Sparse data sigma
A(28,I)	Dst.

"Pseudo-Fit" Format: same as standard format (1 point per record, 28 real*4 words per point) except:

IA(16)	geographic equal-area bin number
IA(17)	Dst hourly index

E. Project MAGNET 1976-77

Characters	Code	Description
1-2	A2	Line Number

3-4	I2	Degrees of Latitude
5-7	F3.1	Minutes of Latitude, implicit decimal point
8	A1	Sign of Latitude - N/S
9-11	I3	Degrees of Longitude
12-14	F3.1	Minutes of Longitude, implicit decimal point.
15	A1	Sign of Longitude - E/W
16-21	I6	Date - month, day, year
22-27	I6	Time (GMT) - hours, minutes, seconds
28-32	I5	Total Magnetic Intensity - in nT.
33-37	I5	Altitude - above ground in meters.
38-40	A3	Navigation device - ESG for electrostatic gyro. - INS for mechanical gyro.
41-44	I4	Elevation of local terrain - in meters

F. Project MAGNET Data Format 1981-1989

- Header record

The first logical record of each file is a header consisting of 108 characters. The format is as follows:

Item	Location	Format	Description
A	1-15		Project identification
	16		Blank
B	17-27		Flight number
	28		Blank
C	29-35		Inclusive Julian days
	36		Blank
D	37-40		Year of survey
	all others		Not used

- Track identification record

A 4-digit integer in columns 1-4 denoting the survey track id is found only on 1989 data. The remaining columns are unused.

- Data records

Each other logical record includes the following information in this format: (3F10.4,5F8.0,2F10.4,2F9.0)

Item	Location	Format	Description
A	1-10	F10.4	Greenwich mean time in seconds from midnight of the survey date
B	11-20	F10.4	Latitude in degrees decimal
C	21-30	F10.4	Longitude in degrees decimal
D	31-38	F8.0	X-component in nT, observed
E	39-46	F8.0	Y-component in nT, observed
F	47-54	F8.0	H-component in nT, computed
G	55-62	F8.0	Z-component in nT, observed
H	63-70	F8.0	F total insensity in nT, computed
I	71-80	F10.4	D computed declination in degrees
J	81-90	F10.4	I computed inclination in degrees
K	91-99	F9.0	F total intensity in nT, observed

L	100-108	F9.0	Barometric altitude in feet

G. Canadian Aeromagnetic Survey 1965-1976 (1/2 minute)

Each logical record contains the following format information for the 1/2' data: (2I2,I4,2I2,I4,F4.0,2F8.3,F7.1,3F7.0)

Item	Location	Format	Description
A	1-2	I2	Flight line
B	3-4	I2	Hour
C	5-8	I4	Minute to 1/100 place
D	9-10	I2	Day of Month
E	11-12	I2	Month
F	13-16	I4	Year
G	17-20	F4.0	Altitude (X 100 ft)
H	21-28	F8.3	Latitude
I	29-36	F8.3	Longitude
J	37-43	F7.1	Declination
K	44-50	F7.0	Horizontal component
L	51-57	F7.0	Z component
M	58-64	F7.0	F component

H. Canadian Aeromagnetic Survey 1965-1972 (Z component).

Each logical record contains the following information for Z component data (SU2206): (I4,3I2,I4,F6.1,F8.3,F9.3,4F8.1,F7.1,4X)

Item	Location	Format	Description
A	1-4	I4	Year
B	5-6	I2	Month
C	7-8	I2	Day
D	9-10	I2	Hour
E	11-14	I4	Minute (eg. 12.00)
F	15-20	F6.1	Altitude (x 100 ft)
G	21-28	F8.3	Latitude
H	29-37	F9.3	Longitude
I	38-45	F8.1	F
J	46-53	F8.1	Z
K	54-61	F8.1	?
L	62-69	F8.1	?
M	70-76	F7.1	H
N	77-80	4X	

I. USGS Farnella (Puerto Rico)

Each logical record contains the following format information: (A14,3I2,1X,2I2,F8.4,F9.5,23X,2I5)

Item	Location	Format	Description
A	1-14	A14	Header record
B	15-16	I2	Year (1900-year)
C	17-18	I2	Month
D	19-21	I2,1X	Day
E	22-23	I2	Hour

F	24-25	I2	Minute
G	26-33	F8.4	Latitude
H	34-42	F9.5	Longitude
I	43-65	23X	blank
J	66-70	I5	Observed total intensity
K	71-75	I5	Residual (observed-main field)
L	76-80	5X	blank

J. C.G.S. Caribbean Survey 1984, 1986; Artic 1983-87, Canada 1980-85

Data records

Each logical record contains the following format information: (2I4,2A4,4X,I2,1X,I2,1X,I2,10(3F8.0))

Item	Location	Format	Description
A	1-4	I4	Year
B	5-8	I4	Day of year
C	9-12	A4	Flight indentifier
D	13-16	A4	Line number
	17-20		blank
E	21-22	I2	Hour of day
	23		blank
F	24-25	I2	Minute of hour
	26		blank
G	27-28	I2	Second of Minute
H	29-36	F8.0	Geodetic latitude
I	37-44	F8.0	Geodetic longitude
J	45-52	F8.0	Scalar magnetic field value
	53-528	9(3F8.0)	Repeat H,I,J (10 seconds of data are given per record)

K. Japanese Aeromagnetic Data 1980

The Japanese aeromagnetic data is in the following format:
(I5,5I3,I4,F6.1,I5,F6.1,3I6,2F6.1,3I6,3X)

Item	Location	Format	Description
A	1-5	I5	Year
B	6-8	I3	Month
C	9-11	I3	Day
D	12-14	I3	Hour
E	15-17	I3	Minute
F	18-20	I3	Second
G	21-24	I4	Latitude (degrees)
H	25-30	F6.1	Latitude (minutes)
I	31-35	I4	Longitude (degrees)
J	36-41	F6.1	Longitude (minutes)
K	42-47	I6	Altitude (meters)
L	48-53	I6	Total Field (x10 nT)
M	54-59	I6	Horizonal Component (x10 nT)
N	60-65	F6.1	Declination (degrees)
O	66-71	F6.1	Inclination (degrees)
P	72-77	I6	North Component (x10 nT)
Q	78-83	I6	East Component (x10 nT)

R	84-89	I6	Vertical Component (x10 nT)
S	89-92	3x	blank

L. NOAA Marine Survey Data Format

The following is a description of the format of the raw marine data stored at NGDC.

On-tape data format:

1. Header file: 16 records, 120 characters per record. Contains descriptions of data (see NOAA manual for discussion of data descriptions)
2. Data file: Data is input with the following FORTRAN statement:

```
READ(10,100,END=1000) SIGN1,TZONE,IYR,IMO,IDAY,IHR,XMIN,SIGN2,
                      XLAT,SIGN3,XLON,MAG1,MAG2,SIGN4,RESMAG,
                      ISENS,SIGN5,DI,SIGN6,ALT
100  FORMAT(9X,A1,F4.2,4I2,F5.3,A1,F7.5,A1.F8.5,16X,2F6.1,A1,F5.1,
           I1,A1,F4.1,A1,F5.0)
```

Variable description:

Name	Type	Description
SIGN1	C*1	+ or - sign for TZONE.
TZONE	REAL	Time zone correction. Equals zero when time is GMT.
IYR	INT	Year from 1900.
IMO	INT	Month.
IDAY	INT	Day of month.
IHR	INT	Hour of day.
XMIN	REAL	Minute. Precision to 0.001 minute.
SIGN2	C*1	+ or - sign for XLAT.
XLAT	REAL	Geodetic latitude.
SIGN3	C*1	+ or - sign for XLON.
XLON	REAL	Longitude.
MAG1	REAL	Scalar magnetic field, 1st sensor, to 0.1 nT. If unspecified, set to 999999
MAG2	REAL	Scalar magnetic field, 2nd sensor. If only one sensor is deployed or if field is unspecified, set equal to 999999
SIGN4	C*1	+ or - sign for RESMAG.
RESMAG	REAL	Residual magnetic field. Set to 99999 if unspecified.
ISENS	INT	Sensor used for residual field.
SIGN5	C*1	+ or - sign for DI.
DI	REAL	Magnetics diurnal correction. If =9999, then total and residual fields are uncorrected. If not equal 9999, then total and residuals are assumed to have been already corrected.
SIGN6	C*1	+ or - sign for altitude of sensor. If +, below sea level, if -, above sea level.
ALT	REAL	Altitude of lead magnetic sensor above or below sea level, in meters.

M. Processed Marine Data Formats

The processed marine data can be read off tape or disk using program XR1RB.MARINE.PROGRAMS(RW1). This program reads a particular file or year of data and separates the file into the 4 data sets mentioned above in the following order:

1. Output Data Set

- Header record

The first logical record contains a header consisting of 120 characters and is the title of the file.

- Data record

Each logical record contains the following information in this format: (A120)

2. Averaged Output Data

- Header record

The first logical record contains a header consisting of 75 characters and is the title of the file.

- Data record

Each logical record contains the following information in this format: (A10,F9.6,F7.3,F8.3,F10.1,F7.0,I5,I2,I11,F6.1)

Item	Location	Format	Description
A	1-10	A10	MGG ID #
B	11-19	F9.6	Date
C	20-26	F7.3	Latitude
D	27-34	F8.3	Longitude
E	35-44	F10.1	Standard error of the mean
F	45-51	F7.0	Mean total intensity
G	52-56	I5	Altitude
H	57-58	I2	Data source code
I	59-69	I11	Data type code
J	70-75	F6.1	Dst

This file is converted to the 'new' FIT format using program XR1RB.MARINE.PROGRAMS(NEWFIT).

3. Average Plot Data

- Header record

The first logical record of each file is a header record consisting of 38 characters and is the title of the file.

- Data record

Each logical record of the file contains the following information:

Record	Location	Format	Description
1	1-38	A38	Title - MGG ID # & Cruise ID
2	1-10	F10.3	Distance along shiptrack (Km)
2	11-20	F10.3	Residual scalar anomaly (nT)
3			"plot information continued
3			as in the 2nd record"
N	1-10	F10.3	0.0 marks the end of the shiptrack

Program XR1RB.MARINE.PROGRAMS(AVETIT2) must be run with this data set in order to add titles to shiptracks which were segmented.

4. Non-averaged Plot Data

- Header record

The first logical record of each file is a header record consisting of 38 characters and is the title of the file.

- Data record

Each logical record of the file contains the following information:

Record	Location	Format	Description
1	1-38	A38	Title - MGG ID # & Cruise ID
2	1-10	F10.3	Distance along shiptrack (Km)
2	11-20	F10.3	Residual scalar anomaly (nT)
3			"plot information continued
	3		as in 2nd record"
N	1-10	F10.3	0.0 marks the end of the shiptrack

Program XR1RB.MARINE.PROGRAMS(AVETIT2) must be run with this data set in order to add titles to shiptracks which were segmented.

N. World Data Center Format

The data are stored on tape with no header record. Stations are listed alphabetically, and data within each station are sorted chronologically from oldest to the most recent year. Data are in fixed blocks, 130 characters per block. Each record is read using a FORTRAN read statement with the format:

(19A1,1X,A3,1X,3F8.3,I6,2F8.3,3I6,I7,I6,1X,A1,I3,I5,I4,4A1,1X,A3,1X,I6)

A complete description is as follows:

Item	Location	Format	Description

A	1 - 19	19A1	Station name (IAGA standard)
	20	1X	Blank
B	21 - 23	A3	3 - letter code
	24	1X	Blank
C	25 - 32	F8.3	Date
D	33 - 40	F8.3	Geodetic Latitude
E	41 - 48	F8.3	East Longitude
F	49 - 54	I6	Elevation - meters
G	55 - 62	F8.3	Declination - degrees.
H	63 - 70	F8.3	Inclination - degrees.
I	71 - 76	I6	Horizontal intensity - nT
J	77 - 82	I6	North component (X) - nT
K	83 - 88	I6	East component (Y) - nT
L	89 - 95	I7	Vertical component (Z) - nT
M	96 -101	I6	Total Intensity - nT
	102	1X	Blank
N	103	A1	Record flag: A = all day, J = JUMP
O	104-106	I3	Foot note - retates to NOTE file.
P	107-111	I5	Data source - relates to SOURCE file.
Q	112-115	I4	Source code - 548 for annual means
R	116-119	4A1	Element code for elements measured (e.g. DHZ)
	120	1X	Blank
S	121-123	A3	2 - letter country code.
	124	1X	Blank
T	125-130	I6	Record number - sequence number within file.

O. Old FIT Format (NOAA format)

Data Organization - The data are stored on tape with no header record. Stations are listed alphabetically, and data within each station are sorted chronologically from oldest to the most recent year.

The data are in standard NOAA format. This is fixed block, 130 characters per record, 30 records per block. Each record is read using a FORTRAN read statement with the format:

(1x,A15,F6.3,2x,F7.3,F8.3,F10.3,F8.3,F7.0,3F8.0,F7.0,I5,I2,I4,I8,7I1,I4/A4*, A5)

* (A4 is used for observatory and land survey data, I4 for aeromagnetic and satellite data)

A complete description of NOAA world-wide magnetic survey data format is as follows:

Item	Location	Description
	1	Blank
A	2 - 16	Station Name
B	17 - 22	Date
	23 - 24	Blank
C	25 - 31	Geodetic Colatitude
D	32 - 39	Longitude

E	40 - 49	Declination[1]
F	50 - 57	Inclination
G	58 - 64	Horizontal intensity[1]
H	65 - 72	North component[1]
I	73 - 80	East component[1]
J	81 - 88	Vertical component[1]
K	89 - 95	Total Intensity[1]
L	96 - 100	Geodetic Altitude (Decameters)
M	101 - 102	Data Flag
N	103 - 106	Source number
O	107 - 114	Serial number
P	115 - 121	Element Code
Q	122 - 125	GMT
R	126 - 130	Country abbreviation

[1] (If the data flag for this type equals 4, data is derivative in units per year)

P. NOAA World-wide Repeat Data

Time period: 1900 - 1985.
description: World-wide survey and repeat data stations.
Approximately 11,000 data points.

Tape characteristics: Tape density = 1600, ASCII, fixed block, LRECL=130,Blksize=3900.

On-tape data format:

Columns	Type	Format	Description
1	--	1X	Blank
2 - 16	C*15	A15	Station name.
17 - 24	REAL	F8.0	Time (years)
25 - 32	REAL	F8.0	Latitude (deg)
33 - 40	REAL	F8.0	Longitude (deg)
41 - 48	REAL	F8.0	Declination (deg)
49 - 56	REAL	F8.0	Inclination (deg)
57 - 63	INT	I6,1X	H component (nT)
64 - 70	INT	I6,1X	X component (nT)
71 - 77	INT	I6,1X	Y component (nT)
78 - 83	INT	I6	Z component (nT)
84 - 89	INT	I6	B value (total intensity).
90 - 95	INT	I6	Altitude (meters).
96 - 100	--	5X	Blank
101 - 103	INT	I2,1x	Data identification code (=9)
104 - 108	INT	I4,1X	Source code.
109 - 116	INT	I7,1X	Serial number.
117 - 119	C*1	3A1	3 Data component codes (DIHXYZ or B combinations).
120 - 127	--	8X	Blank.
128 - 130	C*2	A2,1X	Country Code.

Q. Kosmos 49

The requisite JCL is

```
//      DD UNIT=9TRACK,LABEL=(1,nL,IN),DISP=(OLD,KEEP),
//    DCB=(RECFM=VBS,LRECL=4004,BLKSIZE=4000,DEN=3),
//    DSN=M2.XQWMD.K49H0RB,VOL=SER=DT0246
```

And the tape is read by the statements:

```
DIMENSION FIT(10,100),IFIT(10,100)
EQUIVALENCE (FIT(1,1),IFIT(1,1))

READ(    ) IOUT,((FIT(I,J),I=1,10),J=1,IOUT)
```

Where IOUT: I*4 = Number of points this profile (record).

FIT (,J)

1	I*4	Milliseconds of day.
2	R*4	Total field value in nT
3	R*4	ΔF with KOSMOS 8/73 model removed
4	R*4	Altitude, Km
5	I*4	Half-orbit number (1-641)
6	I*4	Instrument number (1 or 2)
7	R*4	Geodetic latitude, deg.
8	R*4	East longitude, deg.
9	R*4	=0, spare
10	I*4	Modified Julian Day.

R. POGO

POGO data on tape SU5002 is unformated (binary). Fortran statements to read the data are:

```
REAL*4 A(10,100)
INTEGER IA(10,100)
EQUIVALENCE (IA(1,1),A(1,1))

READ(  ) A
```

Where,

IA(1,*)	Modified Julian Day (MJD)	
IA(2,*)	Milliseconds of day	
A(3,*)	Geodetic latitude, deg.	
A(4,*)	Longitude	
A(5,*)	Altitude, km.	
IA(6,*)	Satellite flat	File 1 POGO-6: =5 File 2 POGO-6: =5 File 3 POGO 2,4,6 =1, 2, 3, resp.
IA(7,*)	Flag value: =1	
A(8,*)	Total field value, F, nT	
IA(9,*)	Not used	
A(10,*)	Dst value, nT.	

S. LOREN Data Set Format

The data set format is as follows:

FORMAT (1X, I5, 7G18.5)

IP	
ALAT	Geocentric latitude (deg.)
ALON	Longitude (deg.)
ALT	Altitude (above 6371.2 km)
X	$-B_\theta$, nT [99999. = pad]
Y	B_ϕ, nT
Z	$-B_r$, nT
B	Field magnitude, nT

T. DE-2 Data Formats

1. Original Data

a. Tape characteristics: SU5010 (file 1), RECFM=V, LRECL=X, BLKSIZE=19069.

b. On tape data format: 1 Logical record equals 21 real*4 words:

Word #	Type	Description
1	INT	Date (YYDDD)
2	INT	Time (milliseconds)
3	REAL	X magnetic component, GCI field vector.
4	REAL	Y " " " "
5	REAL	Z " " " "
6	REAL	X component, GCI satellite position (km).
7	REAL	Y component, GCI satellite position (km).
8	REAL	Z component, GCI satellite position (km).
9	REAL	Geographic longitude of satellite.
10-18	REAL	Transformation matrix from spacecraft to GCI coordinate systems.
19	REAL	X calculated field in GCI coordinates.
20	REAL	Y calculated field in GCI coordinates.
21	REAL	Z calculated field in GCI coordinates.

Sample FORTRAN read:

```
Dimension IA(21), RA(21)
Equivalence ( IA,RA )
Read(10)  RA
```

2. Processed Data

a. Tape characteristics: SU5010 (files 2-4), RECFM=VBS, LRECL=8804, Blksize=17612, Non-Labeled.

b. On tape data format: 1 logical record equals 22 real*4 words:

Sample FORTRAN read:

```
Dimension RA(22,100),IA(22,100)
```

```
Equivalence ( RA(1,1),IA(1,1) )
Read(10) RA
IDATE = IA(1,I)
ITIME = IA(2,I)
GCI = RA(3,I)
IDST = IA(22,I)  etc.
```

(See discussion of DE-2 for further details.)

DE-2 diskette data are formatted as follows: fixed-block, logical record length = 60, (1X,F8.3,1X,I6,1X,I8,1X,F7.3,2(1X,F8.3),1X,F8.1)

where:

Item	Location	Data type	Format	Description
A	1 - 9	Real	1X,F8.3	Time (decimal years)
B	10-16	Integer	1X,I6	Modified Julian Date
C	17-25	Integer	1X,I8	Milliseconds od day
D	26-33	Real	1X,F7.3	Geocentric colatitude
E	34-42	Real	1X,F8.3	East longitude (deg)
F	43-51	Real	1X,F8.3	Altitude (km)
G	52-60	Real	1X,F8.3	Total Intensity (nT)

XII. LIBRARY OF DATA FOR MAIN FIELD ANALYSIS

A. Background

The main field data base was designed to be readily expandable, cover all data types, allow for duplicate tapes (for back-up), and allow data sets to be fixed at a desired time. The following tables show 1) an outline of the library and its general contents and 2) a detailed listing of tapes and data sets with a description of formats, contents, and blocking parameters. The data library is stored on cartridge tapes with VOL=SER (volume=serial) numbers ranging from SU0000 TO SU9999. On all even numbered volumes, original, working or final version data are stored, and on all odd numbered volumes, duplicates of the preceeding cartridge are stored. There are notebooks describing data processing and formats for these data types at NASA/Goddard Space Flight Center in Code 921.

Data Type	Cartridge #	Description
Observatory	SU0000 - SU0449	Original data sets
	SU0500 - SU0989	Final processed data sets
	SU0990 - SU0999	Working data sets
Land Survey	SU1000 - SU1499	Original data sets
	SU1500 - SU1989	Final processed data sets
	SU1990 - SU1999	Working data sets
Aeromagnetic	SU2000 - SU2199	Original data - Project Magnet
	SU2200 - SU2299	Original data - Canadian
	SU2300 - SU2399	Original data - European/Scandinavian
	SU2400 - SU2499	Original data - Japanese/Asia
	SU2500 - SU2599	Original data - other
	SU2600 - SU2989	Final processed data sets
	SU2990 - SU2999	Working data sets
Scalar Marine	SU3000 - SU3499	Original data sets
	SU3500 - SU3989	Final processsed data sets
	SU3990 - SU3999	Working data sets
Repeat	SU4000 - SU4249	Original data sets
	SU4250 - SU4489	Final processed data sets
	SU4490 - SU4499	Working data sets
3-Component	SU4500 - SU4749	Original data sets
Marine	SU4750 - SU4989	Final processed data sets
	SU4990 - SU4999	Working data sets
Satellite	SU5000 - SU5499	Original data sets
	SU5500 - SU5989	Final processed data sets
	SU5990 - SU5999	Working data sets
Miscellaneous	SU6000 - SU6499	Original data sets
	SU6500 - SU6989	Final processed data sets
	SU6990 - SU6999	Working data
Ancillary	SU7000 - SU7989	Original data
Data	SU7900 - SU7999	Working data sets.
Distributed	SU8000 - SU8999	Original or final versions
Data Sets		
Programs	SU9000 - SU9099	Observatory
	SU9100 - SU9199	Land Survey
	SU9200 - SU9299	Aeromagnetic
	SU9300 - SU9399	Scalar Marine

SU9400	- SU9449	Repeat
SU9450	- SU9499	Three Component Marine
SU9500	- SU9599	Satellite
SU9600	- SU9699	Miscellaneous
SU9700	- SU9799	Ancillery Data

B. Library

Observatory (1)

Cartridge	file	Reel	file	Data Set Name	Description
SU0000	1	DT0064	1		5/88,pre-1900 to 1988,den=3,fb,rl=130,blk=1300,WDC
"	2			XR1RB.AM.MAY90	
SU0002	1	DT0220	1		8/88,comments,ASCII,fb,rl=130,blk=1300
SU0500	1			XRJRR.OBSERV.A1900.NEW89.DATA	4/89,old fit format,fb,rl=130,blk=1300
"	2			XRTJS.OBSERV.A1900.NEW89.DATA	4/89,new fit format,fb,rl=255,blk=7650
"	3			XR1RB.OBSERV.A1900.DST89.DATA	4/89,new fit format w/ Dst,fb,rl=255,blk=7650

Land Survey (1)

Cartridge	file	Reel	file	Data Set Name	Description
SU1000	1			XR1RB.NEW.SDAT05.DATA	12/89,BGS,NOAA format,fb,rl=130,blk=3900
"	2			XR1RB.NEW.SDAT10.DATA	12/89,BGS,NOAA format, "
"	3			XR1RB.NEW.SDAT15.DATA	12/89,BGS,NOAA format, "
"	4			XR1RB.NEW.SDAT20.DATA	12/89,BGS,NOAA format, "
"	5			XR1RB.NEW.SDAT25.DATA	12/89,BGS,NOAA format, "
"	6			XR1RB.NEW.SDAT30.DATA	12/89,BGS,NOAA format, "
"	7			XR1RB.NEW.SDAT35.DATA	12/89,BGS,NOAA format, "
"	8			XR1RB.NEW.SDAT40.DATA	12/89,BGS,NOAA format, "
"	9			XR1RB.NEW.SDAT45.DATA	12/89,BGS,NOAA format, "
"	10			XR1RB.NEW.SDAT50.DATA	12/89,BGS,NOAA format, "
"	11			XR1RB.NEW.SDAT55.DATA	12/89,BGS,NOAA format, "
"	12			XR1RB.NEW.SDAT60.DATA	12/89,BGS,NOAA format, "
"	13			XR1RB.NEW.SDAT65.DATA	12/89,BGS,NOAA format, "
"	14			XR1RB.NEW.SDAT70.DATA	12/89,BGS,NOAA format, "
"	15			XR1RB.NEW.SDAT75.DATA	12/89,BGS,NOAA format, "
"	16			XR1RB.NEW.SDAT80.DATA	12/89,BGS,NOAA format, "
"	17			XR1RB.NEW.SDAT85.DATA	12/89,BGS,NOAA format, "
"	18			XR1RB.NEW.SDAT90.DATA	12/89,BGS,NOAA format, "

Cartridge	file Reel	file Data Set Name	Description
SU1002	1	XR1RB.SDAT05.DATA	12/89,GSFC cleaned,NOAA format,fb,rl=130,blk=3900
"	2	XR1RB.SDAT05Q.DATA	12/89,questionable,NOAA format, "
"	3	XR1RB.SDAT10.DATA	12/89,GSFC cleaned,NOAA format, "
"	4	XR1RB.SDAT10Q.DATA	12/89,questionable,NOAA format, "
"	5	XR1RB.SDAT15.DATA	12/89,GSFC cleaned,NOAA format, "
"	6	XR1RB.SDAT15Q.DATA	12/89,questionable,NOAA format, "
"	7	XR1RB.SDAT20.DATA	12/89,GSFC cleaned,NOAA format, "
"	8	XR1RB.SDAT20Q.DATA	12/89,questionable,NOAA format, "
"	9	XR1RB.SDAT25.DATA	12/89,GSFC cleaned,NOAA format, "
"	10	XR1RB.SDAT25Q.DATA	12/89,questionable,NOAA format, "
"	11	XR1RB.SDAT30.DATA	12/89,GSFC cleaned,NOAA format, "
"	12	XR1RB.SDAT30Q.DATA	12/89,questionable,NOAA format, "
"	13	XR1RB.SDAT35.DATA	12/89,GSFC cleaned,NOAA format, "
"	14	XR1RB.SDAT35Q.DATA	12/89,questionable,NOAA format, "
"	15	XR1RB.SDAT40.DATA	12/89,GSFC cleaned,NOAA format, "
"	16	XR1RB.SDAT40Q.DATA	12/89,questionable,NOAA format, "
"	17	XR1RB.SDAT45.DATA	12/89,GSFC cleaned,NOAA format, "
"	18	XR1RB.SDAT45Q.DATA	12/89,questionable,NOAA format, "
"	19	XR1RB.SDAT50.DATA	12/89,GSFC cleaned,NOAA format, "
"	20	XR1RB.SDAT50Q.DATA	12/89,questionable,NOAA format, "
"	21	XR1RB.SDAT55.DATA	12/89,GSFC cleaned,NOAA format, "
"	22	XR1RB.SDAT55Q.DATA	12/89,questionable,NOAA format, "
"	23	XR1RB.SDAT60.DATA	12/89,GSFC cleaned,NOAA format, "
"	24	XR1RB.SDAT60Q.DATA	12/89,questionable,NOAA format, "
"	25	XR1RB.SDAT65.DATA	12/89,GSFC cleaned,NOAA format, "
"	26	XR1RB.SDAT65Q.DATA	12/89,questionable,NOAA format, "
"	27	XR1RB.SDAT70.DATA	12/89,GSFC cleaned,NOAA format, "
"	28	XR1RB.SDAT70Q.DATA	12/89,questionable,NOAA format, "
"	29	XR1RB.SDAT75.DATA	12/89,GSFC cleaned,NOAA format, "
"	30	XR1RB.SDAT75Q.DATA	12/89,questionable,NOAA format, "
"	31	XR1RB.SDAT80.DATA	12/89,GSFC cleaned,NOAA format, "
"	32	XR1RB.SDAT80Q.DATA	12/89,questionable,NOAA format, "
"	33	XR1RB.SDAT85.DATA	12/89,GSFC cleaned,NOAA format, "
"	34	XR1RB.SDAT85Q.DATA	12/89,questionable,NOAA format, "

Cartridge	file Reel	file Data Set Name	Description
SU1500	1	XR1RB.GDAT05.G12#89	12/89,new fit format,EQBIN,fb,rl=255,blk=7650
"	2	XR1RB.GDAT10.G12#89	12/89,new fit format,EQBIN, "
"	3	XR1RB.GDAT15.G12#89	12/89,new fit format,EQBIN, "
"	4	XR1RB.GDAT20.G12#89	12/89,new fit format,EQBIN, "
"	5	XR1RB.GDAT25.G12#89	12/89,new fit format,EQBIN, "
"	6	XR1RB.GDAT30.G12#89	12/89,new fit format,EQBIN, "
"	7	XR1RB.GDAT35.G12#89	12/89,new fit format,EQBIN, "
"	8	XR1RB.GDAT40.G12#89	12/89,new fit format,EQBIN, "
"	9	XR1RB.GDAT45.G12#89	12/89,new fit format,EQBIN, "
"	10	XR1RB.GDAT50.G12#89	12/89,new fit format,EQBIN, "
"	11	XR1RB.GDAT55.G12#89	12/89,new fit format,EQBIN, "
"	12	XR1RB.GDAT60.G12#89	12/89,new fit format,EQBIN, "
"	13	XR1RB.GDAT65.G12#89	12/89,new fit format,EQBIN, "
"	14	XR1RB.GDAT70.G12#89	12/89,new fit format,EQBIN, "
"	15	XR1RB.GDAT75.G12#89	12/89,new fit format,EQBIN, "
"	16	XR1RB.GDAT80.G12#89	12/89,new fit format,EQBIN, "
"	17	XR1RB.GDAT85.G12#89	12/89,new fit format,EQBIN, "

Aeromagnetic (1)

Cartrigde	file	Reel	file	Data Set Name	Description
SU2000	1	OF0948	1		1976-1977 Project Magnet U.S.,fb,rl=40,blk=3480
SU2002	11*	DT0045	11*		1981 Project Magnet,ASCII,fb,rl=108,blk=1080
"	22*	DT0047	11*		1982 Project Magnet,ASCII, "
SU2004	7*	DT0048	7*		1982 Project Magnet,ASCII, "
SU2006	12*	DT0046	12*		1983 Project Magnet,ASCII, "
SU2008	18*	DT0279	18*		1984-1985 Project Magnet,ASCII, "
SU2010	4*	DT0282	4*		1989 Project Magnet, "
SU2012	1	DT0035	1		1955 Project Magnet,NOAA format,fb,rl=130,blk=4030
"	2	DT0087	1		U.S. Antarctica,NOAA format,fb,rl=130,blk=4030
"	3	DT0087	2		1960 Project Magnet,NOAA format,fb,rl=130,blk=4030
"	4	DT0021	1	XR1RB.MBGS65.DATA	1965 Project Magnet,NOAA format,fb,rl=130,blk=2600
SU2014	1	DT0295	1		1981-89,Proj.Magnet,decimated,fb,rl=109,blk=1090
SU2016	42				1987-89,NGDC Project Magnet,fb,rl=109,blk=1090
SU2018	41				1987-89,NOO Prelim.Proj.Magnet,fb,rl=108,blk=1080
"	50				1990 Nav.Res.Lab. Chil.Ridge,fb,rl=80,blk=4000
SU2200	14*	DT0039	14*		1984 C.G.S.(Caribbean),fb,rl=528,blk=528
SU2202	1	DT0153	1		1953.6-1969.2,NOAA format,ASCII,fb,rl=130,blk=1300
SU2204	1	DT0257	1		5' ave. 1953.6-76 w/o '72,NOAA,fb,rl=130,blk=3900
"	2	DT0257	2		1/2' 1965-1976 Canadian,fb,rl=64,blk=2048
SU2206	1	OF4287	1		Scandanavia,1965,fb,rl=80,blk=3200
"	2	"	2		Greenland/Nor. Sea,1965,fb,rl=80,blk=3200
"	3	"	3		Iceland,1965,fb,rl=80,blk=3200
"	4	"	4		British Columbia,1965,fb,rl=80,blk=3200
"	5	"	5		Artic,1970,fb,rl=80,blk=3200
"	6	"	6		Prairies,1972,fb,rl=80,blk=3200
SU2208	9	UT2485	9		1980-85 Canadian Aero.,fb,rl=528,blk=528
"	30	UT2577	20		"
"	52	UT2936	22		"
"	110	UT761U	58		"
"	137	UT773U	27		"
SU2210	22*	UT2844	22*		Caribbean,1986,fb,rl=528,blk=528
"	38*	UT2491	17*		Artic,1983-87,fb,rl=528,blk=528
SU2400	1	DT0261	1		Japanese,1984,fb,rl=92,blk=920
"	2	"	2		Japanese,1980,fb,rl=92,blk=920

Cartrigde	file	Reel	file	Data Set Name	Description
SU2600	1			XR1RB.MAGNET.AVDATA.G12#89	Proj. Mag.,1976-77,81-85,89,C.G.S 84,AVSIG
"	2			XR1RB.MDAT55.G12#89	1952.5-57.5 Project Magnet,EQBIN
"	3			XR1RB.MDAT60.G12#89	1957.5-62.5 Project Magnet,EQBIN
"	4			XR1RB.MDAT65.G12#89	1962.5-67.5 Project Magnet,EQBIN
"	5			XR1RB.MAGNET.AVDATA.G01#90	Proj. Mag.,1981-89,(decimated),AVSIG
"	6			XR1RB.MAGNET.AVDATA.G08#90	1987-1989 NGDC Project Magnet, AVSIG
"	7			XR1RB.NVLRES.AVDATA.G08#90	1990 Nav. Res. Lab., AVSIG new fit format,fb,rl=255,blk=7650
SU2602	1			XR1RB.JAPMAG.AV80.G12#89	1980 Japanese,AVSIG,newfit,fb,rl=255,blk=7650
"	2			XR1RB.CANADA55.G12#89	1953-57 5' ave. Canadian,EQBIN,fb,rl=255,blk=7650
"	3			XR1RB.CANADA60.G12#89	1957.5-61.5 5' ave. CA,EQBIN,fb,rl=255,blk=7650
"	4			XR1RB.CANADA63.G12#89	1963 5' ave. Canadian,EQBIN,fb,rl=255,blk=7650
"	5			XR1RB.CANADA.AV65.G12#89	1965,69 1/2' ave Canadian,AVSIG,fb,rl=255,blk=7650
"	6			XR1RB.CANADA.AV70.G12#89	1970,72,74 1/2' ave. CA,AVSIG,fb,rl=255,blk=7650
"	7			XR1RB.CANADA.AV75.G12#89	1976 1/2' ave. Canadian,AVSIG,fb,rl=255,blk=7650
"	8			XR1RB.CANADA.AV86.G03#90	1986, C.G.S Caribbean,AVSIG,fb,rl=255,blk=7650
"	9			XR1RB.CANADA.AV87.G03#90	1983-87 C.G.S Artic fb,rl=255,blk=7650

Scalar Marine (1)

Cartridge	file	Reel	file	Data Set Name	Description
SU3000	15*				1953,58,1960-72,fb,rl=120,blk=12000
SU3002	12*				1973-84,fb,rl=120,blk=12000
SU3004	3*				1985-87,fb,rl=120,blk=12000
"	4	DT0200	1		1985,USGS,S.Puerto Rico,Farnella,fb,rl=80,blk=800
SU3500	1			XR1RB.MARINE.AVDATA.G12#89	1953,58,1960-87,AVSIG,new fit,fb,rl=255,blk=7650
"	2			XR1RB.MARINE.AV85.G02#90	1985,S. Puerto Rico,AVSIG,fb,rl=255,blk=7650

Repeat

Cartridge	file	Reel	file	Data Set Name	Description
SU4000	1	DT0049	1		NOAA,fb,rl=130,blk=3900
"	2			XR1RB.REPEAT.DATA	BGS (from SDAT files),fb,rl=130,blk=3900

Satellite

Cartridge	file	Reel	file	Data Set Name	Description
SU5000	1			XR1RB.VANGRD.G12#89	Vanguard,standard NOAA format,fb,rl=130,blk=3900
"	2			XR1RB.ALOUETTE.G12#89	Alouette,standard NOAA format,fb,rl=130,blk=3900
"	3			XR1RB.WOOMERA.G12#89	Woomera,standard NOAA format,fb,rl=130,blk=3900
"	4	DT0246		XR1RB.KOSMOS49.G12#89	Kosmos 49,standard NOAA format,fb,rl=130,blk=3900
SU5002	1	MAG001		DSN=POG246	POGO,unformated binary,SL,vbs,rl=11200,blk=22404
"	2	"		DSN=POGCQ	POGO,unformated binary,SL,vbs,rl=11200,blk=22404
"	3	"		DSN=POGMQ	POGO,unformated binary,SL,vbs,rl=11200,blk=22404
"	4	OF3104	1	DSN=OF3104	All POGO,unform. binary,SL,vbs.rl=11200,blk=22404
SU5004	15*	OF8030	15*	DSN=TD5821	MAGSAT,quiet,un. binary,SL,vbs.rl=11200,blk=22404
SU5006	10*	DT0245	10*		MAGSAT,corrected format,NL,vbs.rl=11200,blk=22404
"	32*	MG0017	22*		MAGSAT,gridded format,NL,vbs,rl=11200,blk=22404
"	44*	OF0933	44*		MAGSAT,gridded format,NL,vbs,rl=11200,blk=22404
SU5008	1			F8#GM.LOREN.DATA(member)	Loren Shure harmonic splines,fb,rl=132,blk=6072
SU5010	1	DT0034	1		DE-2,original data,un. binary,v,rl=x,blk=19069
"	2			XRJRR.DE2.FITPRP2A	DE-2,processed, un. binary, vbs,rl=8804,blk=17612
"	3			XRJRR.DE2.FITPRP.XYZOLD	DE-2,processed, un. binary, vbs,rl=8804,blk=17612
"	4			XRJRR.DE2.FITPRP.XYZCAL	DE-2,processed, un. binary, vbs,rl=8804,blk=17612
SU5012	1	KJE11	1		MAGSAT, vector/scalar ,SL,DSN=KJE11, EBCDIC, vbs,rl=11200,blk=22404
SU5500	1			XR1RB.MAGSAT.G12#89	MAGSAT,new fit format,fb,rl=255,blk=7650
"	2			XR1RB.DE2.G12#89	DE-2,new fit format,fb,rl=255,blk=7650
"	3			XR1RB.DE2.BWT.G12#89	DE-2,new fit format w/ weights,fb,rl=255,blk=7650
"	4			XR1RB.VANGRD.G12#89	Vanguard,1959,EQBIN,fb,rl=255,blk=7650
"	5			XR1RB.ALOUETTE.G12#89	Alouette,1962,EQBIN,fb,rl=255,blk=7650
"	6			XR1RB.WOOMERA.G12#89	Woomera,1964.EQBIN,fb,rl=255,blk=7650
"	7			XR1RB.KOSMOS49.G12#89	Kosmos49,1964,EQBIN.fb,rl=255,blk=7650

Miscellaneous Data

SU6500	1	XR1RB.CALSV.G02#90	1976-84,Secular Variation,fb,rl=255,blk=7650

Companion Data

Cartridge	file	Reel	file	Data Set Name	Description
SU7000	1	802991	1		Kp data 1/1/32-6/30/88,fb,rl=80,blk=7200
"	2	TD5696	1		Dst data 1/57-12/31/85,fb,rl=120,blk=7200

Programs (1)

Cartidge	file	Reel file	Data Set Name	Description
SU9000	1		XR1RB.OBSERVO.PROGRAMS(REFORM)	4/89,Reformats from WDC to NOAA,fb,rl=80,blk=9600
"	"		" (DUPYR)	Removes duplicates years
"	"		" (RUNSORT)	Sorts data alphabetically
"	"		" (ADDEND)	Adds station break information
"	"		" (MERGEA)	Prepares old and new observatory data for merge
"	"		" (MERGEB)	Merges old and new observatory data
"	"		" (COMB3)	Selects stations w/ 3 measured component values
SU9000	2		XRJRR.PAYNE.PROGRAMS(COMMENT)	6/88,Comments observatory data,fb.rl=80,blk=9600
"	"		" (COMWRITE)	Adds comments to observatory notebooks file
"	"		" (COMWRIT1)	"
"	"		" (COMWRIT2)	"
"	"		" (TAPEREAD)	Reads observatory comment file
"	"		" (SORTFILE)	Sorts observatory comment file
"	"		" (ADDDATE)	Adds the date to observatory comment files
"	"		" (SCWRITE)	Writes comments into SCRIPT for IBM output
SU9000	3		XR1RB.OBSERVO.PROGRAMS( )	4/89,fb,rl=80,blk=9600
"	"		" (JCLFIRST)	JCL for 1st difference program
"	"		" (FIRSTDIF)	Computes 1st differences
"	"		DIF EXEC (VM)	EXEC file for VM plotting routine
"	"		1STDIF FORTRAN	VM plotting routine for 1st differences
SU9000	4		XR1RB.OBSERVO.PROGRAMS(SFIT)	6/88,Spline fitting routine,fb,rl=80,blk=9600
"	"		SPLINER1 FORTRAN	Plots spline fit to observatory data (VM)
SU9000	5		XR1RB.OBSERVO.PROGRAMS(BIAS)	6/88,Generates synthetic biases,fb,rl=80,blk=9600
"	"		" (GAP)	Records stations w/ time gaps
"	"		" (INTERP)	Interpolates observatory data to certain date
"	"		" (NAME)	Finds alternate station name
"	"		" (STATION)	Determines time-span and # of observations
"	"		" (YRCOUNT)	Counts the number of stations/year
"	"		" (NEAROBS)	Calculates nearest neighbors to each station
"	"		" (WRITNST)	Writes out nearest neighbors to each station
SU9100	1		XR1RB.SURVEY.PROGRAMS(DUPLIC)	12/89,Removes duplicate data,fb,rl=80,blk=9600
"	"		" (NEQBIN)	Statisical processing routine
"	"		" (ACC)	Gives an account of data types and sources
"	"		DIFICH EXEC	EXEC file for microfich output from EQBIN
"	"		EQBHST FORTRAN	Plots EQBIN histograms (VM)

Cartidge	file	Reel file	Data Set Name	Description
SU9200	1		XR1RB.MAGNET.PROGRAMS(AVSIG)	9/89,Filtering routine,fb,rl=80,blk=9600
"	"		" (AVSIGJAP)	Processes Japanese aeromagnetic data
"	"		" (AVS7677)	Processes U.S. aeromagnetic data
"	"		" (AVSIG2)	Processes Project Magnet data
"	"		" (NOTES)	Produces comment notebook files
"	"		DIF1 EXEC	EXEC file for (VM) plotting
"	"		MAGPLOT FORTRAN	Plots AVSIG profiles
"	"		XR1RB.FITFIL.PROGRAMS(NEWPLOT)	World data distribution files
"	"		" (DSTADD)	Adds Dst values
"	"		PLTMGT FORTRAN	Plots world data distribution plots (VM)
SU9300	1		XR1RB.MARINE.PROGRAMS(AVETIT2)	9/89,Adds titles to marine data.fb,rl=80,blk=9600
"	"		" (AVSIG)	Filtering routine
"	"		" (NOTES)	Adds comments to notebook files
"	"		" (RW1)	Reads data output from AVSIG at NGDC
"	"		DIF1 EXEC	EXEC file for (VM) plotting
"	"		MARPLOT FORTRAN	Plots AVSIG profiles
"	"		XR1RB.FITFIL.PROGRAMS(NEWPLOT)	World data distribution files
"	"		" (DSTADD)	Adds Dst values
"	"		PLTMGT FORTRAN	Plots world data distribution plots (VM)
SU9500	"		XRJRR.DE2.PROGRAMS(RETIME)	Re-sorts DE-2 data for each date by time
"	"		" (DEVEC3)	Calculates field model, puts data into GCI coordinates, puts data on to array position 19-21
"	"		" (RETIME2)	Refines RETIME sorting of data
"	"		" (RETIME3)	Deletes reversed sections of data from RETIME 1&2
"	"		" (SEPDAT)	Seperates out specified time periods of data
"	"		" (DSTEU2)	Adds Dst, bin & orbit # to data. Corrects data w/ Euler angles. Deletes specified orbits; adds flags
"	"		" (BINSORT)	Sorts data by bin number
"	"		" (BINSIFT)	Reduces the # of data points in each bin to 10 below 30° dip-lat. & to 30 above 30° dip-lat.
"	"		" (FITPREP)	Concatenates files & puts them into FIT format (100 pts per logical record). Transforms to spacecraft coordinates before writing out
"	"		" (RDWRIT2)	Reverses sign on longitudes. Corrects data with calibration solution. Still in spacecraft coord.
"	"		" (XYZTRANS)	Transforms spacecraft data into topocentric coordinate system

Footnotes

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* indicates total number of files present
(1) see notebook for additional information

C. Work in Progress 2/91

This document was assembled to be "fluid" in that it is updated as new data is processed. Currently, the repeat data with frequent observations at valid locations requires processing. POGO, POGS, and DE-1 data will be processed upon data and software availability. Much of the data base requires cartridge back-ups, and all of the notebooks need to updated. The decimated Project Magnet data for 1980-1989 currently used should be replaced by undecimated data processed with AVSIG. NOO uncorrected Project Magnet data for 1989-1990 should be replaced with navigation corrected data. Observatory biases calculated with past and present models should be documented and stored in the data library. Additional effort is required for contacting various data centers (WDC-A, WDC-B, NOO, NRC) for updates to all data types.

D. Library Maintenance

Inorder for the main field data base to be maintained, the following is required:

1) For each addition to the data base, appropriate processing documentation and figures should be added to the notebooks and to the Geodynamic Branch Main Field Data Base Manual (this text)
2) The unprocessed and processed data should be recorded with the branch tape librarian and documented in section XII of the Main Field Data Base Manual.

Current MASS-11 documentation are held on the LTP/VAX under the GEOBALD account.

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16. Abstract

The purpose of this catalog is to briefly describe the data sets used in geomagnetic field modeling at GSFC. Data are measured and obtained from a variety of information and sources. For clarity, data sets from different sources are categorized and processed separately. The data base is composed of magnetic observatory data, surface survey data (which contains land, some aeromagnetic, some total intensity marine, and three component marine data),high-quality aeromagnetic, high-quality total intensity marine data, satellite data, and repeat data. These individual data categories are described in detail in a series of notebooks in the Geodynamics Branch, GSFC. This catalog reviews the original data sets, the processing history, and the final data sets available for each individual category of the data base and is to be used as a reference manual for the notebooks. Each data type used in geomagnetic field modeling has varying levels of complexity requiring specialized processing routines for satellite and observatory data and two general routines for processing aeromagnetic, marine, land survey and repeat data.

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