

**Aeromagnetic Surveying in Wisconsin 1996:
Digital Data Files**

By

[Stephen L. Snyder](#)¹

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¹USGS, MS 954, 12201 Sunrise Valley Drive, Reston, VA 20192
Email: ssnyder@usgs.gov

Introduction

Over the past 12 years the U.S. Geological Survey has conducted a series of aeromagnetic surveys in Wisconsin aimed at completing the coverage of high-quality, moderate-resolution aeromagnetic surveying in the State. The data from these surveys have proven to be an effective tool for delineating structures in the Precambrian basement in Wisconsin and have been useful in the study of the mineral resources in the region. Precambrian basement rocks rarely crop out in this region because of glacial deposits and Paleozoic sedimentary cover rocks. Surveys by the U.S. Geological Survey (USGS) in 1988 (Hittleman and others, 1992), 1996 (Snyder, 1998), 1997-1998 (Daniels and others, 1998, 1999) and 1998-1999 (Bracken and Nicholson, 2000) have closed gaps in the aeromagnetic coverage of the state of Wisconsin.

The survey flown in 1996 is the focus of this report. Aeromagnetic contour maps (scale 1:125,000) were previously released as open-file paper maps (Snyder, 1998). This report releases the digital data for the same survey. Both digital flight-line and gridded data are included as well as images of the aeromagnetic data for the three areas. Facts about this survey and parameters for the digital files are listed below.

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Survey Facts

The 1996 Wisconsin aeromagnetic survey was flown between August 1996 and September 1996 in three separate areas. These blocks are outlined on the index map of Wisconsin and are named: A, B, and C (to see these images go to the end of this report). The index map shows the location of this survey and the three areas where these data were collected. The color-shaded-relief images of the aeromagnetic maps for the three areas show the magnetic field as if illuminated from the north. This south-directed illumination is parallel to the flightline direction, and minimizes enhancement of “herringbone,” or flightline noise.

The survey was flown using a U.S. Geological Survey owned Fairchild Helio-Porter Short Take-Off and Landing (STOL) aircraft at an average elevation of 500 feet (152 m) above terrain along 215 flight lines spaced ½-mile (805m) apart in a North-South direction. No tie lines were flown. See the “Data Processing” section below for more detail. The total flight line distance for the three areas was about 6,700 miles (10,780 km). Navigational information was gathered in real time using an on-board Global Positioning System (GPS) with an estimated accuracy of ± 50 meters. The airborne magnetometer used was a Geometrics G-813 proton-precession type with 0.5 NanoTeslas (nT) sensitivity. Magnetic values were recorded every 0.5 seconds.

Due to a navigational error in Area B, there is no flight line #12 included in the data in this report. Instead, flight line #13 was shifted by ½ mile due west, resulting in an overlap between flight lines #12 and #13. Therefore, flight line #12 was dropped because flight line 13 covers a longer distance. This navigational error accounts for the one-mile gap in the coverage between flight lines 13 and 14 along longitude 92° 45' west.

Two ground-based Geometrics G-856 proton-precession magnetometers were used to monitor the daily variations of the Earth's magnetic field. One base magnetometer was located at the Hayward Municipal Airport near Hayward, Sawyer County, WI, and was used to process the airborne data collected for area A (see Index map). The second base magnetometer was located at the Osceola Municipal Airfield near Osceola, Polk County, WI, and was used to process the airborne data collected for areas B and C (see Index map). The aircraft operated out of the Hayward, WI airport for the duration of the entire survey.

Data Processing

Intermittent problems with the Osceola Airfield base magnetometer while data for area B were collected left gaps in the diurnal corrections for about 20 percent of the area B records. Data from the Hayward Airport base magnetometer were used in place of the missing data from the Osceola Airfield base magnetometer. For the few times when neither base magnetometer was collecting data, alternate magnetic base data were obtained from the Glenlea Geomagnetic Observatory, located near Winnipeg, Manitoba, Canada, about 360 miles (580 km) northwest of the Osceola Airfield. These other base

data integrated easily into the airborne data; however, some minor mismatches have inevitably occurred. See Snyder, 1998.

Because no tie lines were flown, it was impossible to perform any flight line leveling of the data at the time the data were first processed, using various USGS-authored UNIX programs. As a result, visible striping occurs parallel to some flight lines in the data.

The USGS has since obtained PC-based software from Geosoft, Inc., Toronto, Ontario, Canada. Additional processing and noise removal was carried out using Geosoft's Oasis Montaj software. The results were improved leveling of the flight line data.

The first 13 fields of each ASCII point data file (.dat file - see below) were imported into a Geosoft database. Lambert conformal conic X and Y coordinates were calculated from the geographic coordinates using a central meridian of 90° West and a base latitude of 0°. A minimum curvature grid was interpolated from the profile coordinates using a 0.25 km node interval. Color shaded-relief magnetic maps were produced, using a sun azimuth of 90 degrees, as if illuminated from the east. This westward illumination is perpendicular to the flight line direction, which enhances any flight line noise. This enhancement showed that several flight lines in Areas B and C needed manual adjustment before proceeding with Geosoft's decorrugation and microleveling routines. The table below lists the values (in nanoTeslas) of flight lines that were adjusted for Areas B and C. Area A required no adjustments to any flight lines.

Area B		Area C	
Line #	nT added	Line #	nT added
-----	-----	-----	-----
57 S	-4.0	22 N	4.0
59 S	-4.0		
65 S	-1.0		
66 N	1.0		
67 S	-7.0		
69 S	-5.0		

The values given above were added to the "Residual Magnetic Intensity" (field #13), which was used to create the "Adjusted Magnetic Intensity" (field #14). This field is then used as the input channel to Geosoft's decorrugation routine, which applies a sixth-order high-pass Butterworth filter combined with a directional filter to produce a noise channel, called "Decorrugated Noise Value" (field #15). This field will appear as long stripes along the flight lines when gridded and displayed. This channel is then used as the input channel to Geosoft's microleveling routine, which applies amplitude limiting low-pass filtering to the noise channel (field #15), which is intended to remove any

remaining geological signal, leaving only the component of line level drift. The line level drift is then subtracted from the “Adjusted Magnetic Intensity” channel (field #14) to produce a leveled output channel named “Final Corrected Residual Magnetic Value” (field #16). The grid files and images in this report are produced from this last channel.

Disc Organization

This CD-ROM disc is structured with 5 directories/folders as follows:

\DATA The basic survey measurements are in three ASCII files (file extension .dat) derived from the Geosoft Oasis Montaj databases. Each record of each file contains 16 fields of data per measurement, at a sampling interval of 0.5 second. USGS style DOS binary point files (.pos) with 9 fields are also given.

\GRIDS The point data have been interpolated into binary raster USGS style grids (file extension .grd) by using a minimum curvature gridding algorithm using Geosoft Oasis Montaj software. These grids were produced from the “Final Corrected Residual Magnetic Value” channel of the databases. See below for description of the data file format. ASCII versions of the USGS grids are also given (.agd). USGS grids and binary point files can be manipulated using USGS (DOS) software for the PC (Phillips, 1997). This is freeware that is included in a separate directory on this disc, called \USGS_PF or may be downloaded from <ftp://greenwood.cr.usgs.gov/pub/open-file-reports/ofr-97-0725/pfofr.htm>. Two alternate ASCII file formats are also included. These ASCII grids permit importation into other software packages. Files with extension .arc can be imported into Arcview 3 - Spatial Analyst, and files with extension .gxf (“Grid Exchange File,” Geosoft, Inc. 1998) can be imported into several programs including ER Mapper and Geosoft Oasis Montaj. The X origin (Xo), the Y origin (Yo), the number of columns and rows of each grid are given in the description of the Grid Files below. The origin of the grids is in kilometers from the Central Meridian and Base Latitude used to project the data. These are also given below.

\IMAGES Images of the aeromagnetic data for each of the three areas covered by the survey are included in this directory and are given in 5 graphic formats (file extensions .bmp, .eps, .jpg, .pdf and .tif), derived from Geosoft Oasis Montaj maps. The index map was created as a Postscript file using GCLR (unpublished USGS Fortran program), and associated UNIX programs written by Robert W. Simpson, Jr. of the USGS, and was later converted into the other graphics formats. This folder contains 3 sub-folders (\250k, \IndexMap, and \PageSize) containing the images. See the file Readme.txt in this folder for details.

\ACROBAT Adobe Acrobat software can be used for viewing PDF files. The latest version can also be downloaded from the web at this URL:
<http://www.adobe.com/products/acrobat/readermain.html>.

\USGS_PF The USGS potential field software package (Phillips, 1997). Installation is described in the readme files.

File Facts

Point Files

File Name	Bytes	Records
Wisc96_A.dat	17,784,984	105,863
Wisc96_A.pos	4,446,248	105,863
Wisc96_B.dat	36,809,976	219,107
Wisc96_B.pos	9,202,496	219,107
Wisc96_C.dat	12,677,784	75,463
Wisc96_C.pos	3,169,448	75,463

ASCII Point Data File (.DAT) Format:

Each record represents one measurement recorded at one-half second flight intervals. The record length is 165 bytes. The “Final Corrected Residual Magnetic Value” field is the residual total magnetic intensity data with the Definitive Geomagnetic Reference Field (DGRF) removed and corrected for flight line errors. The grid files are constructed from this field.

Field No.	Format	Field Name	Units
-----	-----	-----	-----
1	A8	Flight-Line number, Direction	
2	F9.5	Longitude	Decimal Degrees
3	F11.5	Latitude	Decimal Degrees
4	I9	Fiducial	
5	F10.3	Date (Year.Julian Day)	YYDDD
6	F10.1	Time	Seconds of the day
7	F11.2	Radar Altimeter	Feet
8	F11.2	Barometric Altimeter	Feet
9	F11.2	Raw Magnetic Field Intensity	NanoTeslas
10	F9.2	DGRF Base Magnetic Correction	NanoTeslas
11	F11.2	Total Field Magnetic Intensity	NanoTeslas
12	F11.2	DGRF Correction	NanoTeslas
13	F11.2	Residual Magnetic Intensity (DGRF removed)	NanoTeslas
14	F11.2	Adjusted Magnetic Intensity	NanoTeslas
15	F11.2	Decorrugated Noise Value	NanoTeslas
16	F11.2	Final Corrected Residual Magnetic Value	NanoTeslas

USGS Binary Post File (.POS) Data Fields:

Field	Description	Units
-----	-----	-----
1	Flight-line number, Direction	
2	Longitude	Degrees
3	Latitude	Degrees
4	Final Corrected Residual Magnetic Value	Nanoteslas
5	Total Field Magnetic Intensity	Nanoteslas
6	Radar Altimeter	Feet
7	Barometric Altimeter	Feet
8	Fiducial	
9	Year.Julian Day	YYYY.DDD

Grid Files

Residual Total Magnetic Intensity Binary Grid Files, USGS Grid Format

Grid File	Rows	Columns	Xo (km)	Yo (km)
Wisc96_A.grd	190	353	-123.75	5395.75
Wisc96_B.grd	280	402	-224.75	5310.25
Wisc96_C.grd	241	165	-197.50	5282.75

Grid Parameters (.grd, .agd, .gxf, .arc)

X, Y units:	Kilometers
Grid node interval:	0.25 kilometers
No-Data Value (.grd, .agd):	10E+38
No-Data Value (.gxf):	-99999.99
No-Data Value (.arc):	-99999.99
Ellipsoid:	Clark 1866
Horizontal Datum:	1927 North American Datum
Projection:	Lambert Conformal Conic
Standard Parallels:	33 degrees North and 45 degrees North
Central Meridian:	90 degrees West
Base Latitude:	0 degrees

References Cited

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Daniels, D.L., Snyder, S.L., Nicholson, S.W., and Cannon, W.F., 1998, New aeromagnetic surveys in Wisconsin by the U.S. Geological Survey: Institute on Lake Superior Geology, 44th Annual Meeting, May 6-10, 1998, Minneapolis, Minnesota, pp. 62-63.

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Hittleman, A.M., Buhmann, R.W., Racey, S.D., Chandler, V.W., 1992, Aeromagnetics Earth System Data, Minnesota Region: National Geophysical Data Center, CD-ROM, diskettes, and User's Manual.

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Index Map of 1996 Wisconsin Aeromagnetic Data







