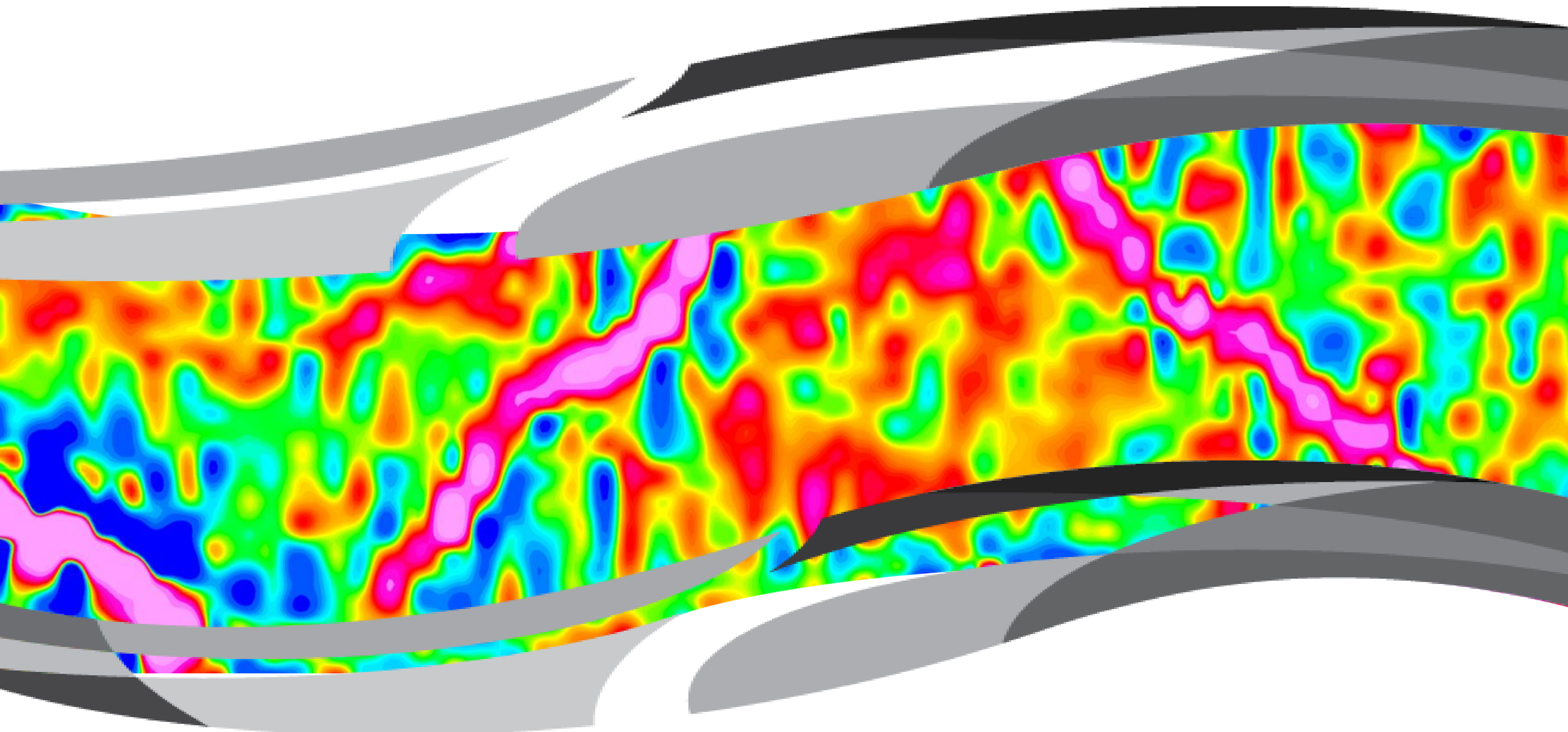
NWT Open Report 2015-018
Enhancements of airborne geophysical data from assessment report 084585, Matonabbee Point, Great Slave Lake, NWT

A.M. Mirza



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NORTHWEST TERRITORIES
GEOLOGICAL SURVEY

Government of
Northwest Territories

NWT Open Report 2015-018

Enhancements of airborne geophysical data from assessment report 084585, Matonabbee Point, Great Slave Lake, NWT

Asif Mirza

Northwest Territories Geological Survey
Department of Industry, Tourism and Investment
Government of the Northwest Territories
P.O. Box 1320, 4601-B 52nd Avenue
Yellowknife, NT, Canada
X1A 2L9
867-767-9211
www.nwtgeoscience.ca

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INTRODUCTION

This publication provides enhancements of the airborne geophysical data submitted as part of assessment report 084585, and **is intended to be used in conjunction with that assessment report.**

Assessment reports are submitted to the Government of the Northwest Territories by members of the mineral exploration industry pursuant to the NWT Mining Regulations (and prior to April 2014, to the federal government pursuant to the Canada Mining Regulations). These reports contain the results of exploration work as well as interpretations of those results. Released to the public after a period of confidentiality, they can be downloaded from the Northwest Territories Geological Survey (NTGS) website (www.nwtgeoscience.ca).

Older assessment reports were submitted as paper reports and maps (which are available online as scanned copies). However, starting in the 1980's, geophysical and geochemical surveys began to appear with assessment report submissions as manipulable digital data. These digital data are available online in their originally submitted form. In addition, NTGS is using those data to create useful products that were not provided in the original assessment report (for example, grids of calculated parameters like analytic signal; databases in GDB format if the originals were in ASCII format; merges of adjacent surveys from different assessment reports), and correcting any errors that are found.

These enhancements are being published as NWT Open Reports like this one. Some of these publications may contain the enhancements from a number of spatially related assessment reports.

SURVEY INFORMATION*

Name of Survey	HURCOMB-1 Claim
Contractor	Geotech Ltd.
NTS Sheets	85I-04
Line km reported	135 km
Dates flown	July 2002
Aircraft wing type	Rotary
Nominal bird terrain clearance	30 m
Nominal sample interval	0.1s
Nominal traverse-line spacing	75 m
Traverse-line direction	0-180 degrees
Nominal tie-line spacing	1300 m
Tie-line direction	90-270 degrees
Datum	NAD27
Projection	UTM ZONE 12N

*Information from assessment report 084585, Air_Mag_Survey.pdf

Figure 1 shows the location of the survey.

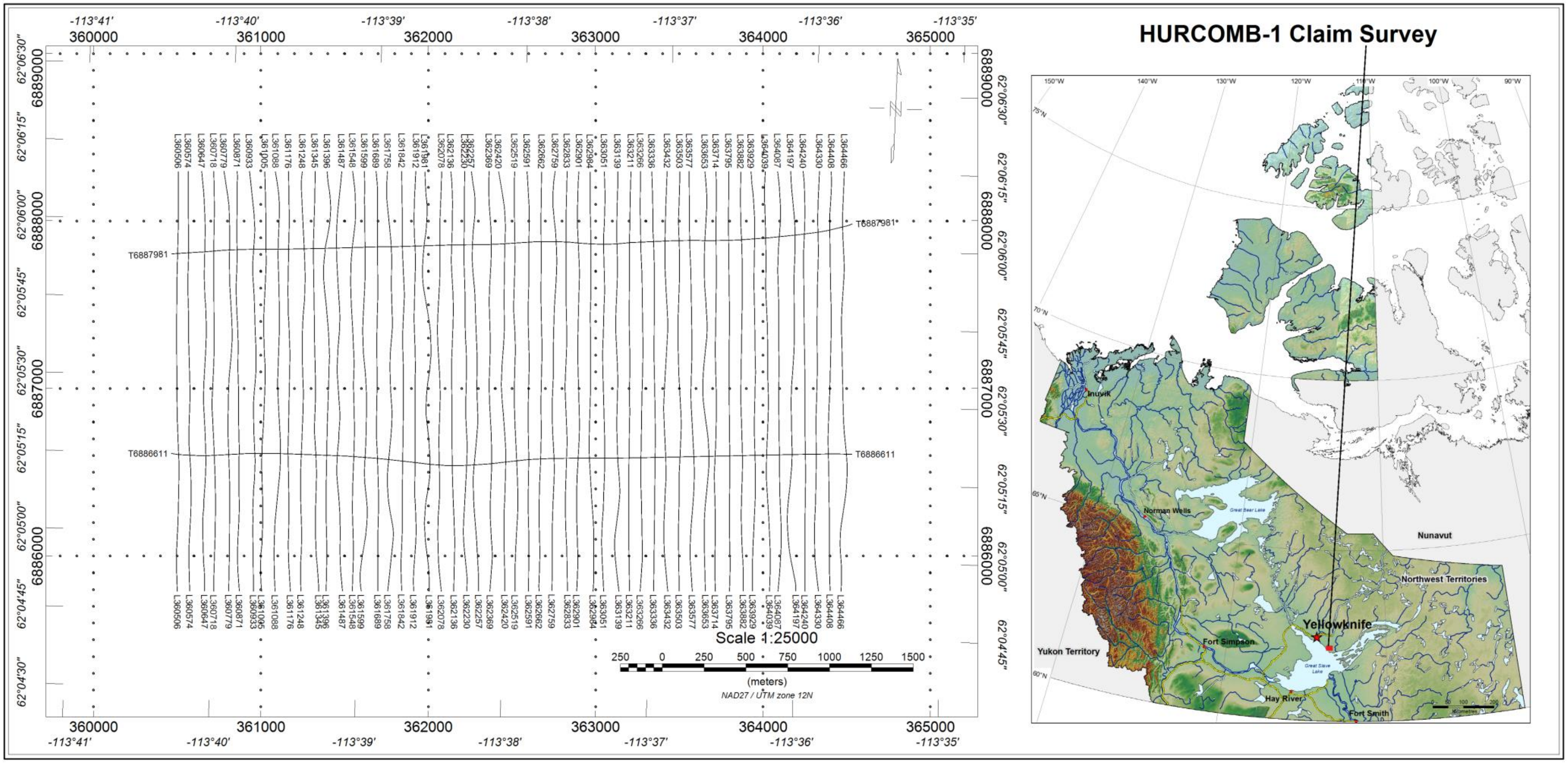

Figure 1. Location of the HURCOMB 1 claim survey.

DESCRIPTION OF ENHANCEMENTS

Original data submitted with the assessment report that have been used to generate this publication consist of one file of line data in Geosoft gdb format and six files of Geosoft maps. The magnetic grid was extracted from the magnetic map and used for enhancements.

The enhancements by NTGS provided herein consist of additional grids derived from the total magnetic field grid, georeferenced images of both the new grids and the original submitted grids, and a boundary polygon, as follows:

GRIDS\
Grid in geosoft binary (2-byte) format

084585_Hurcomb_1VD.GRD	-Calculated First Vertical Derivative from Total Magnetic Field grid
084585_Hurcomb_2VD.GRD	-Calculated Second Vertical Derivative from Total Magnetic Field grid
084585_Hurcomb_AS.GRD	-Calculated Analytic Signal from Total Magnetic Field grid
084585_Hurcomb_Susc.GRD	-Calculated Apparent Susceptibility from Total Magnetic Field grid

Additional files with filename extensions of *.gi contain projection information for each grid.

TIFF\
Georeferenced image in Tagged Image File Format

084585_Hurcomb_Mag.tif	-Calculated Total Magnetic Field
084585_Hurcomb_1VD.tif	-Calculated First Vertical Derivative from Total Magnetic Field
084585_Hurcomb_2VD.tif	-Calculated Second Vertical Derivative from Total Magnetic Field
084585_Hurcomb_AS.tif	-Calculated Analytic Signal from Total Magnetic Field
084585_Hurcomb_Susc.tif	-Calculated Apparent Susceptibility from Total Magnetic Field

Additional files with filename extensions of *.gi contain projection information for each TIFF image.

SHP\
Shapefile (a set of four binary files with extensions .shp, .dbf, .prj, and .shx, collectively called a shapefile, that contain spatial and attribute information for points, lines, or polygons; for use in ESRI ArcMap software)

084585_Hurcomb_AG_AGMag_AGFEM.shp	-Boundary of the area

CREATION OF GRIDS

Analytic Signal

The total magnetic field grid was used to calculate the analytic signal grid using a fast Fourier transform method.

The analytic signal does not depend on the direction of magnetization or the direction of the Earth's magnetic field. As a result, bodies of the same geometry will have the same analytic signal shape, even where their total-field shapes would differ. The analytic signal is also useful in locating the edges of magnetic source bodies, particularly where remanence and/or low magnetic latitude complicates interpretation. The analytic signal is the square root of the sum of the squares of the derivatives in the x, y, and z directions of the total magnetic field.

First Vertical Derivative

The total magnetic field grid was used to calculate the first vertical derivative grid by applying the following filters:

1. Derivative
   a. Direction = Z
   b. Order of differentiation = 1
2. Butterworth:
   a. Cutoff wavelength = 75
   b. Filter order = 8

The vertical derivative indicates the rate of change of the magnetic field with height. The first vertical derivative (1VD) has the effect of sharpening anomalies, allowing improved spatial location of source axes and contacts. It also provides better definition and resolution of near-surface magnetic units as well as defines weak features that may not be evident in the total magnetic field.

Second Vertical Derivative

The total magnetic field grid was used to calculate the second vertical derivative grid by applying the following filters:

1. Derivative
   a. Direction = Z
   b. Order of differentiation = 2
2. Butterworth:
   a. Cutoff wavelength = 75
   b. Filter order = 8

The second vertical derivative is the rate of change of the 1VD with height. It is used to enhance local anomalies and help outline the edges of anomalous bodies. A second vertical derivative map is a powerful interpretive tool that can be used to assist in the delineation of causative bodies and accurately locate changes in the magnetic field gradients. Better definition of discontinuities and their relation to geology can be gained from the use of this tool. A second vertical derivative map will show steep gradients over faults and positive closures over up-thrown blocks.

Apparent Magnetic Susceptibility

The total magnetic field grid was used to calculate the apparent susceptibility grid by applying the following filters:

1. Apparent Susceptibility
    a. Field strength = 59695 nT
    b. Inclination = 81.5^o
    c. Declination = 22.5^o
    d. Depth of source = 30m
2. Butterworth:
    a. Cutoff wavelength = 75
    b. Filter order = 8

The magnetic susceptibility is a dimensionless number that represents the degree to which a body can be magnetized in response to the presence of a magnetic field. (It is the ratio of magnetization within the material to the strength of the applied magnetic field.) It is the fundamental parameter in magnetic prospecting, since the magnetic response of the rocks is a combination of the strength of the earth's field at a given point and the amount and type of magnetic material in them.

In the absence of being able to directly measure magnetic susceptibility, apparent susceptibility values can be calculated by making certain assumptions. Typically, the geometry of the source is represented by a collection of vertical, square-ended prisms of infinite depth extent, the horizontal dimensions of which are taken to be equal to the cell size of the input grid. To calculate susceptibility, a compound filter is applied that performs: a reduction to the pole (see below), downward continuation to the chosen source depth, correction for the geometric effect of the prisms, and division by the total magnetic field. The first three operations estimate the magnetization of the rocks, and the last generates the susceptibility ratio. The resulting apparent susceptibility data is in SI units.

Reduction to the pole attempts to eliminate the effect of the direction of the Earth's magnetic field, which points more downward near the poles and closer to horizontal near the equator. The reduction to the pole operation recalculates total magnetic intensity data as if the inducing magnetic field was vertical, transforming some types of asymmetrical magnetic anomalies to symmetrical ones centered over their causative bodies. Reduction to the pole makes the simplifying assumption that the rocks in the survey area are all magnetized parallel to the earth's magnetic field, and performs best at middle to high latitudes.

Downward continuation is a method of estimating the magnetic field at a datum lower than that at which it was measured. A number of calculation methods are available, but all require the assumption that the field is continuous, which can be misleading if there are anomalies between the measured surface and the new datum. The method increases the horizontal resolution of anomalies but noise can be exaggerated.

ACKNOWLEDGEMENTS

The author gratefully acknowledges the contribution of Beth Fischer in her review of the enhanced geophysical data files.