HEADWATERS OF THE LITTLE CHENA RIVER ELECTROMAGNETIC AND MAGNETIC AIRBORNE GEOPHYSICAL SURVEY DATA COMPILATION

L.E. Burns, G.R.C. Graham, J.D. Barefoot, Rebecca-Ellen Woods, Dighem, D.L. McConnell, WGM, Inc., Stevens Exploration Management Corp., and Fugro Airborne Surveys Corp.

Geophysical Report 2020-4

2020
STATE OF ALASKA
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS

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L.E. Burns[1], G.R.C. Graham[1], J.D. Barefoot[1], Rebecca-Ellen Woods[1], Dighem, D.L. McConnell[2], WGM, Inc., Stevens Exploration Management Corp., and Fugro Airborne Surveys Corp.

ABSTRACT

This geophysical survey is located in interior Alaska in the Fairbanks mining district, about 60 kilometers northeast of Fairbanks, Alaska. Frequency domain electromagnetic and magnetic data were collected with the DIGHEM^{V} system in August 1994. A total of 135 line kilometers were collected covering 60.6 square kilometers. Line spacing was 400 meters (m). Data were collected 30 m above the ground surface from a helicopter towed sensor platform ("bird") on a 30 m long line.

PURPOSE

This airborne geophysical survey is part of a program to acquire data on Alaska's most promising mineral belts and districts. The information acquired is aimed at catalyzing new private-sector exploration, discovery, and ultimate development and production. The purpose of the survey was to map the magnetic and conductive properties of the survey area. Small placer gold prospects near the survey area include Flat Creek and Sorrels Creek. Other gold and base-metal anomalies, altered zones, favorable lithologies, and structural zones are known to exist throughout the survey area.

SURVEY OVERVIEW DESCRIPTION

This document provides an overview of the survey and includes text and figures of select primary and derivative products of this survey. A table of digital data packages available for download is provided to assist users in data selection. For reference, a catalog of the available maps is presented in reduced resolution. Please consult the metadata, project report, and digital data packages for more information and data.

ACKNOWLEDGMENTS

Funding was provided by the Alaska State Legislature as part of the DGGS Airborne Geophysical/Geological Mineral Inventory (AGGMI) program.

[1] Alaska Division of Geological & Geophysical Surveys, 3354 College Road, Fairbanks, Alaska 99709-3707
[2] WGM, Inc.

AVAILABLE DATA

Data Type	Provider	Description
ascii_data	contractor	ASCII format line data, other ASCII data
databases_geosoft	contractor	Geosoft format database of final line data, other Geosoft format databases
documents	DGGS and contractor	Project and field reports, survey background information, gridded data explanations, other documentation
grids_ermapper	DGGS and contractor	Geographically registered gridded data, ER Mapper ERS format
grids_geosoft	DGGS and contractor	Geosoft-format grids, these grids can be viewed in ESRI ArcMap using a free plugin from Geosoft or the free viewer available from Geosoft
images_registered	DGGS	GeoTiff format images of all gridded data
kmz	DGGS	keyhole markup language (kml) kmz archive files of project data. Viewable in Google Earth and other compatible programs
maps_pdf_format	DGGS and contractor	Printable maps in pdf format
maps_prn_format	contractor	Printable maps in HPGL/2 printer file format with extension .prn
profiles_stacked	contractor	Distance-based profiles of the digitally recorded geophysical data are generated and plotted at an appropriate scale. The profiles display electromagnetic anomalies with their respective interpretive symbols. Printable in pdf format
vector_data	contractor and DGGS	Line path, data contours, and survey boundary in ESRI shapefile (SHP) format, ESRI Geodatabase format, and/or AutoCAD dxf format

REFERENCES

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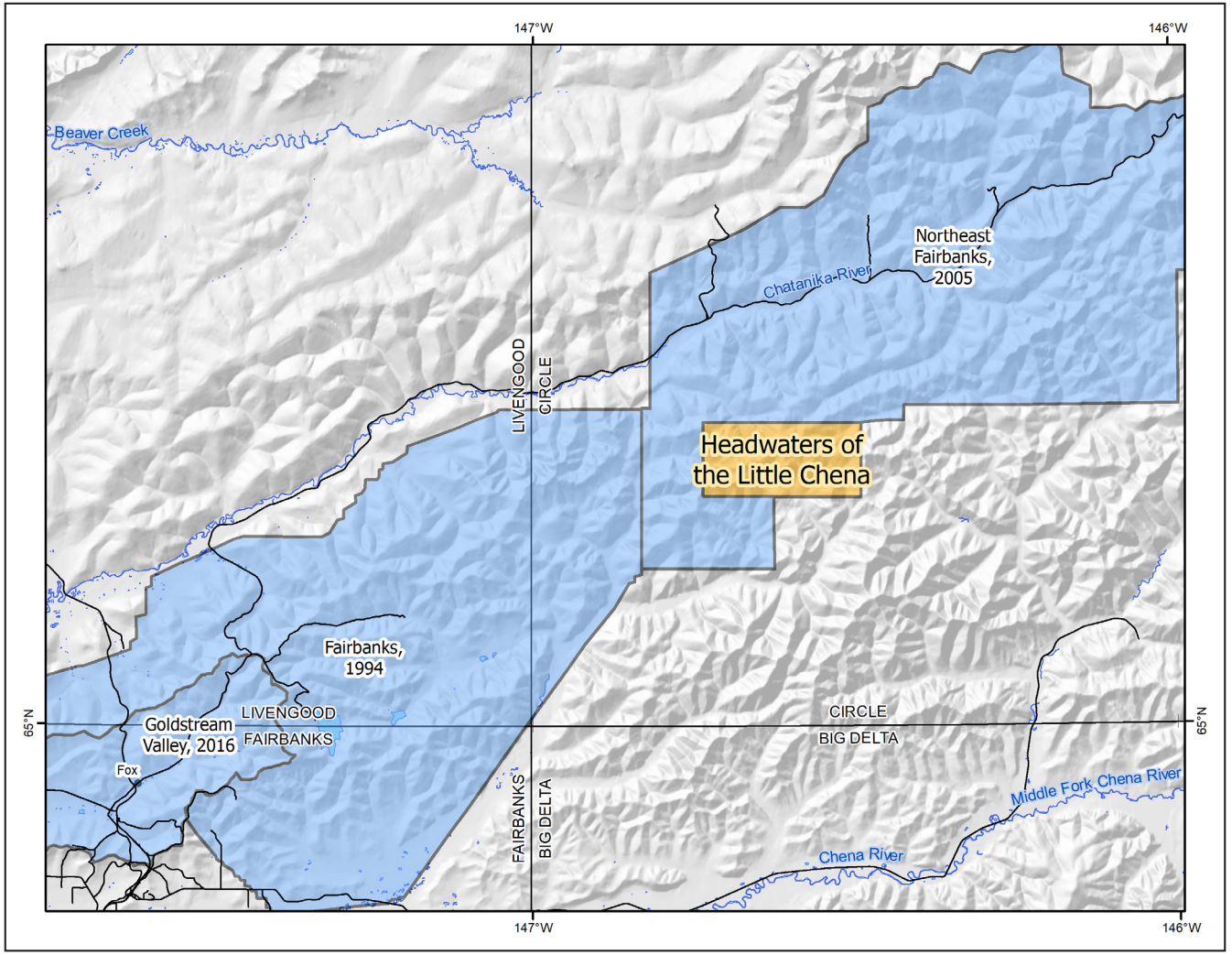
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McConnell, D.L., WGM, Inc., and Dighem, 1995, Project report of the Little Chena River headwaters: Alaska Division of Geological & Geophysical



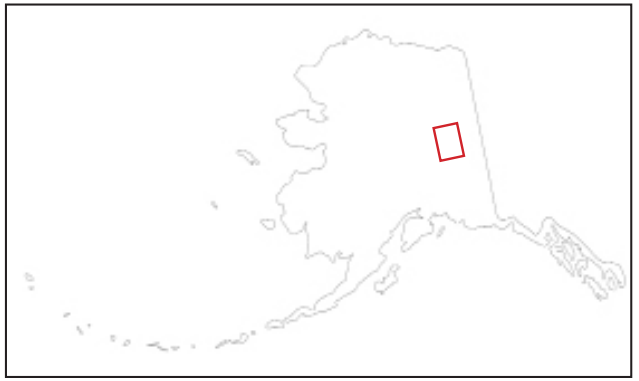


Figure 1. Headwaters of the Little Chena River electromagnetic and magnetic airborne geophysical survey location shown in interior Alaska (inset). Headwaters of the Little Chena River survey area shown with adjacent DGGS geophysical surveys, landmarks, relevant 1:250,000-scale quadrangle boundaries, mountain ranges, rivers, glaciers, and elevation hillshade.

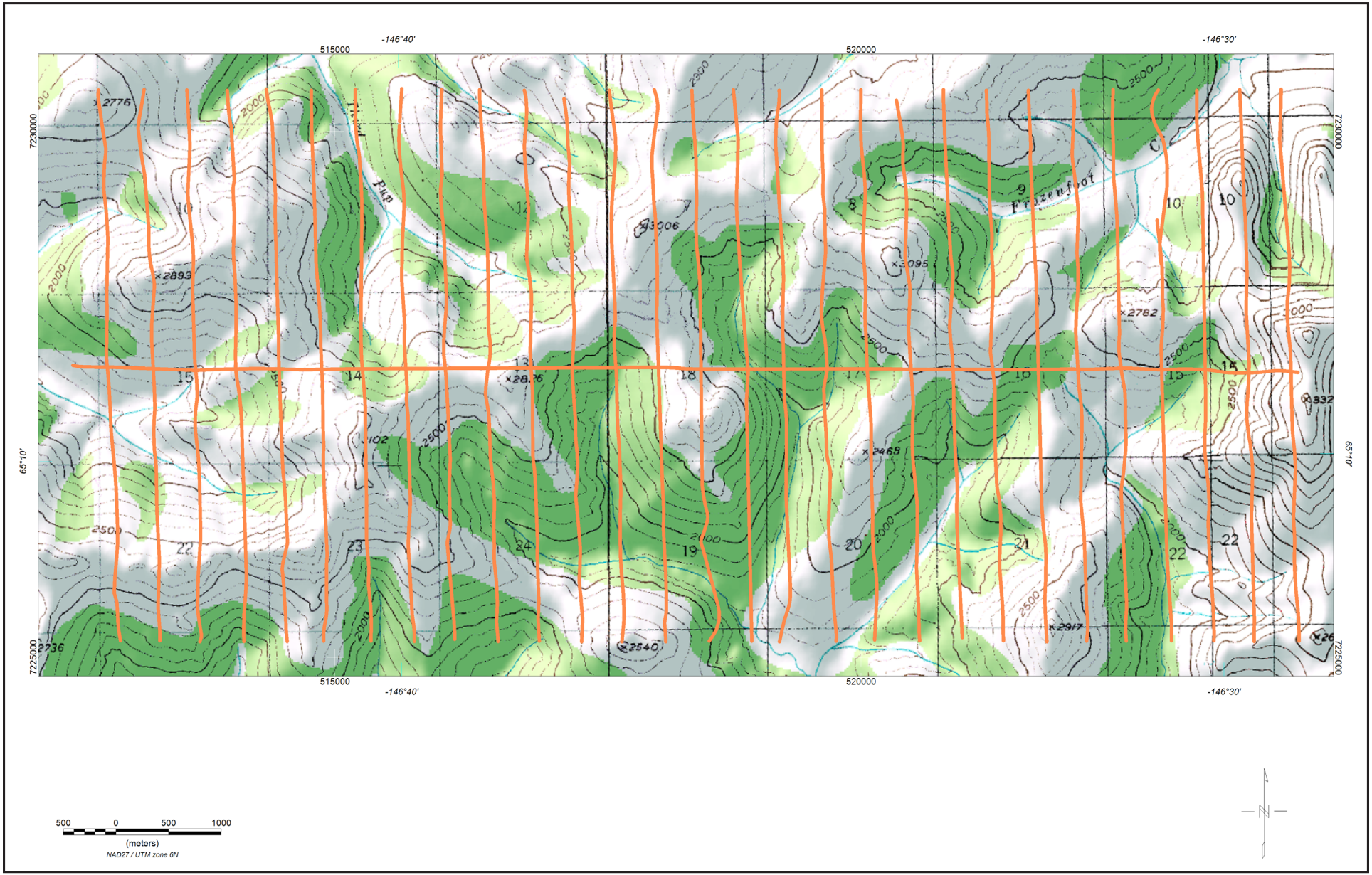


Figure 2. Flight path with topographic basemap.

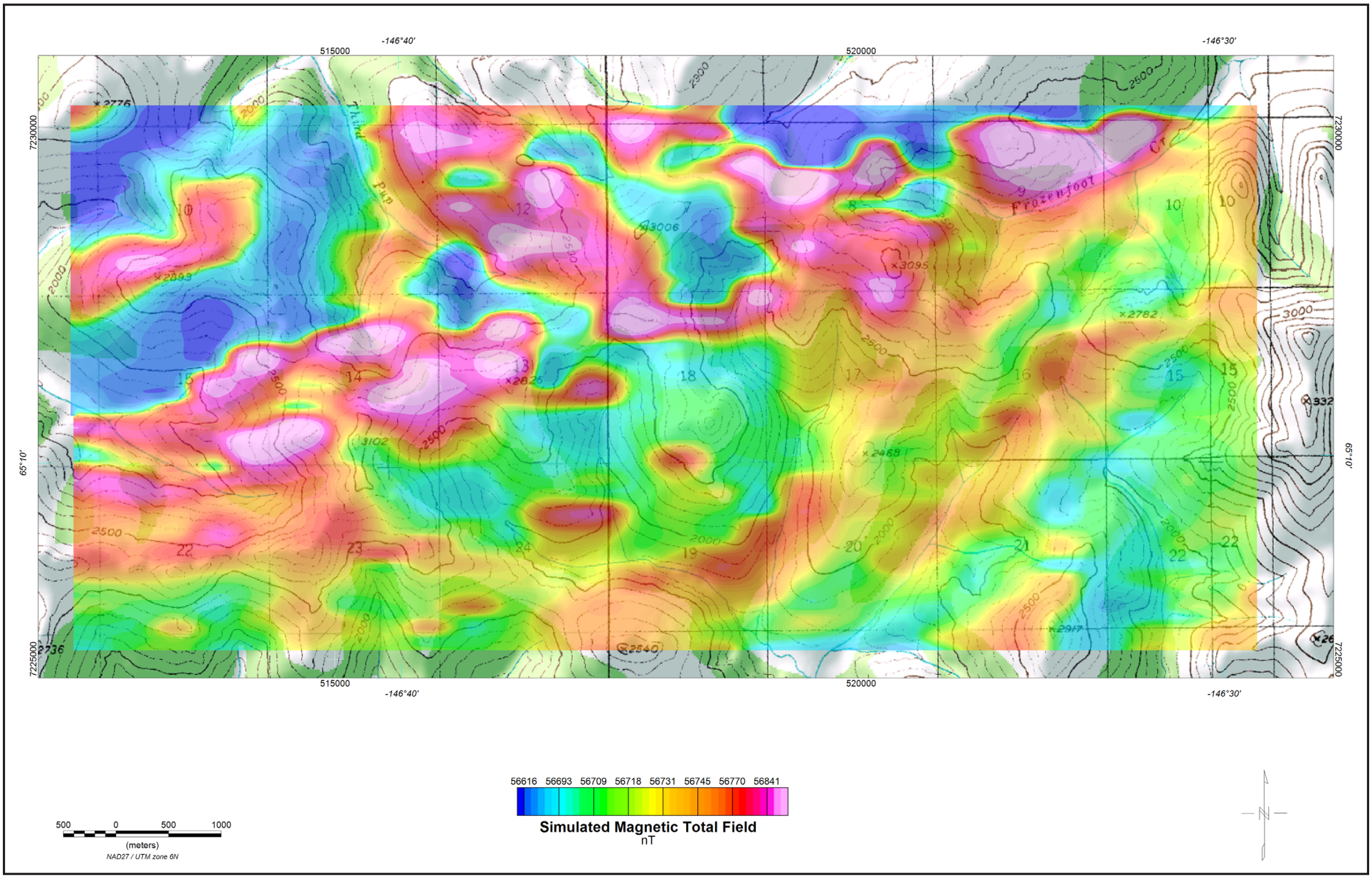


Figure 3. Simulated magnetic total field grid with topographic basemap. The magnetic total field data were processed using digitally recorded data from a Scintrex cesium CS3 magnetometer. Data were collected at a sampling interval of 0.1 seconds. The magnetic data were (1) corrected for diurnal variations by subtracting the digitally recorded base station magnetic data, (2) IGRF corrected (IGRF model 1985, updated to August 1994), (3) leveled to the tie line data, (4) a constant value of approximately 57,000 nT was added to all data, and (5) interpolated onto a regular 100 m grid using a modified Akima (1970) technique.

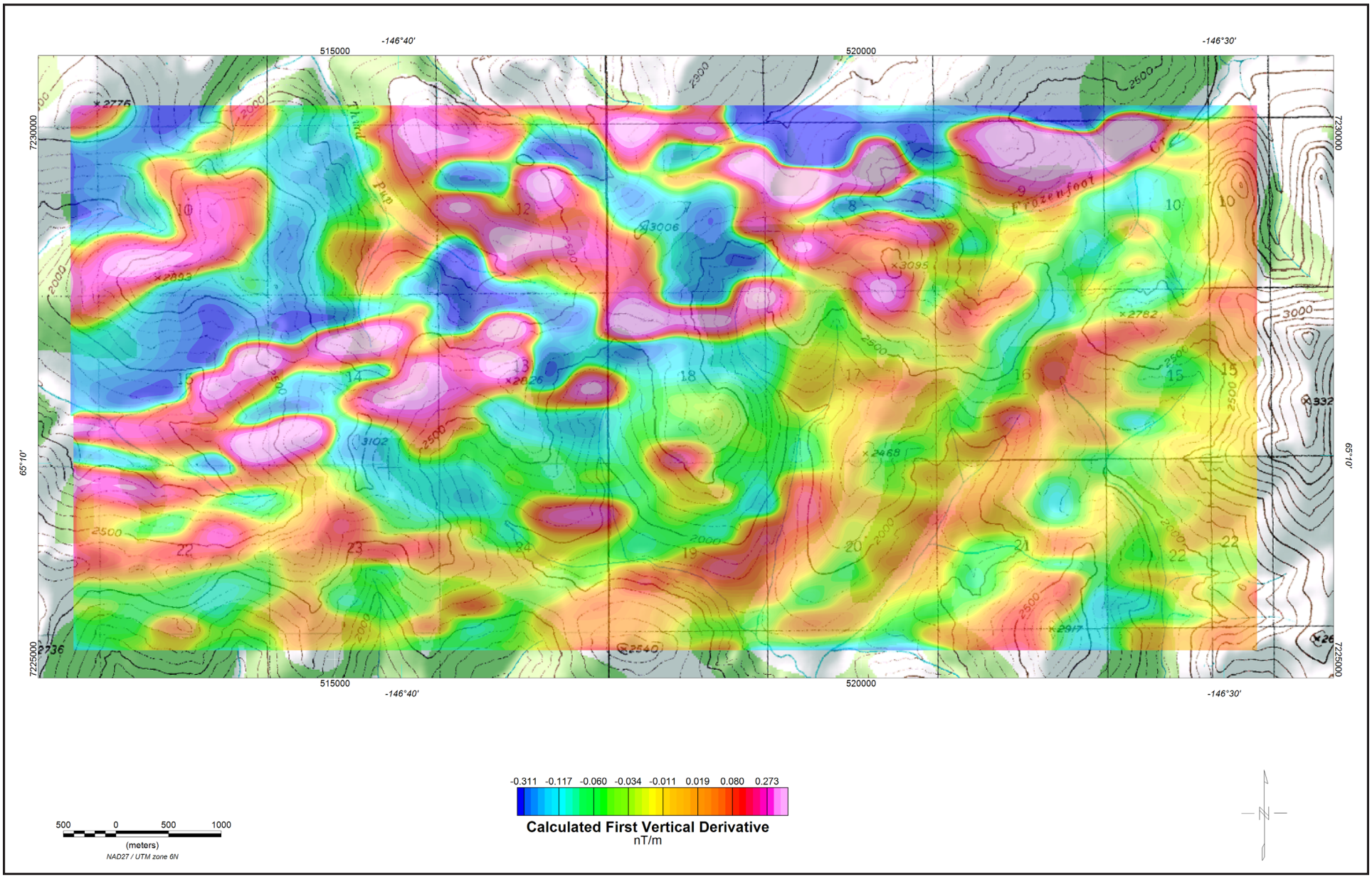


Figure 4. Calculated first vertical derivative grid with topographic basemap. The first vertical derivative grid was calculated from the diurnally-corrected, IGRF-corrected total magnetic field grid using a FFT base frequency domain filtering algorithm. The resulting first vertical derivative grid provides better definition and resolution of near- surface magnetic units and helps to identify weak magnetic features that may not be evident on the total field data.

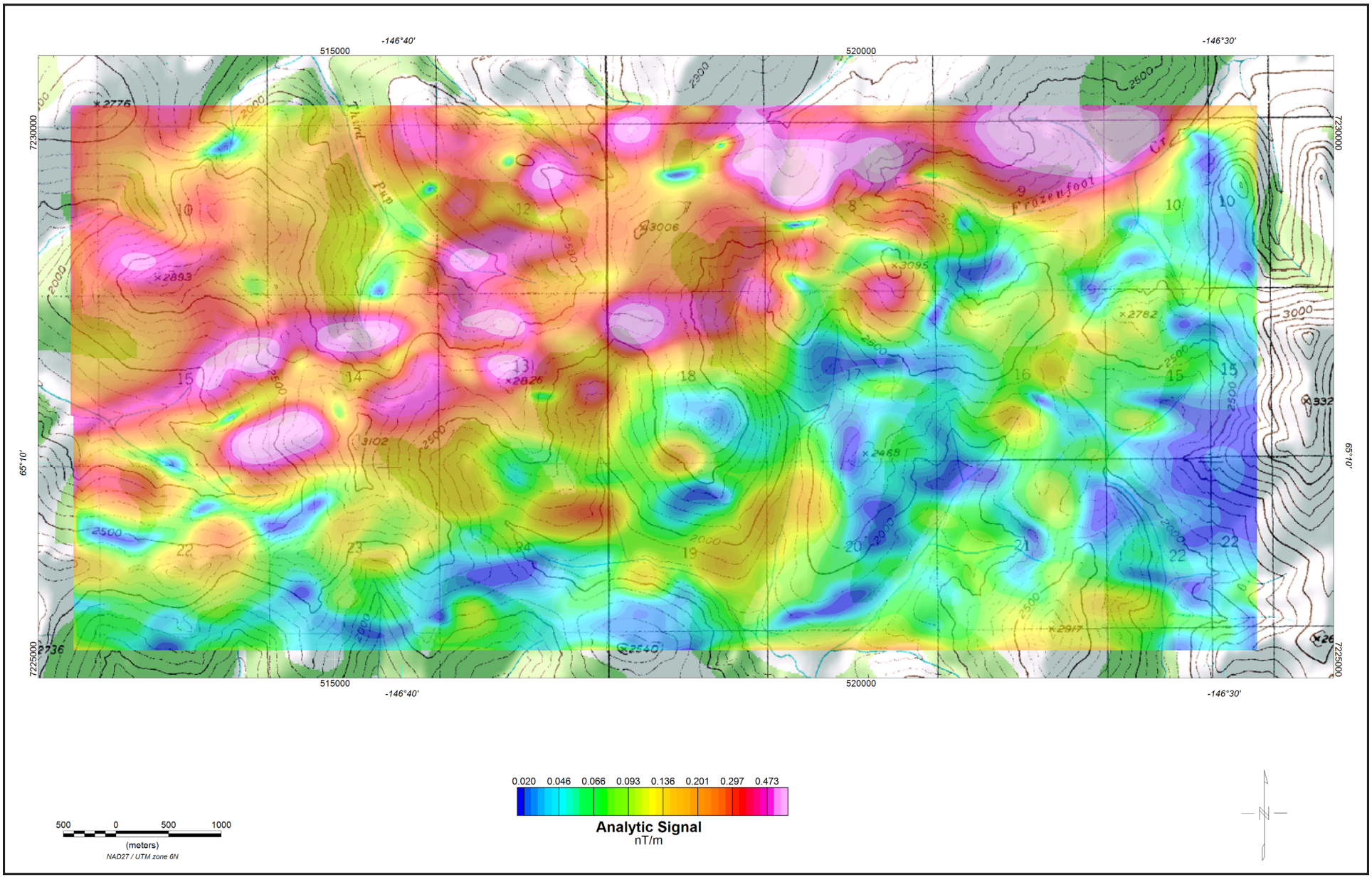


Figure 5. Analytic signal grid with topographic basemap. Analytic signal is the total amplitude of all directions of magnetic gradient calculated from the sum of the squares of the three orthogonal gradients. Mapped highs in the calculated analytic signal of magnetic parameter locate the anomalous source body edges and corners (such as contacts, fault/shear zones, etc.). Analytic signal maxima are located directly over faults and contacts, regardless of structural dip, and independent of the direction of the induced and/or remanent magnetizations.

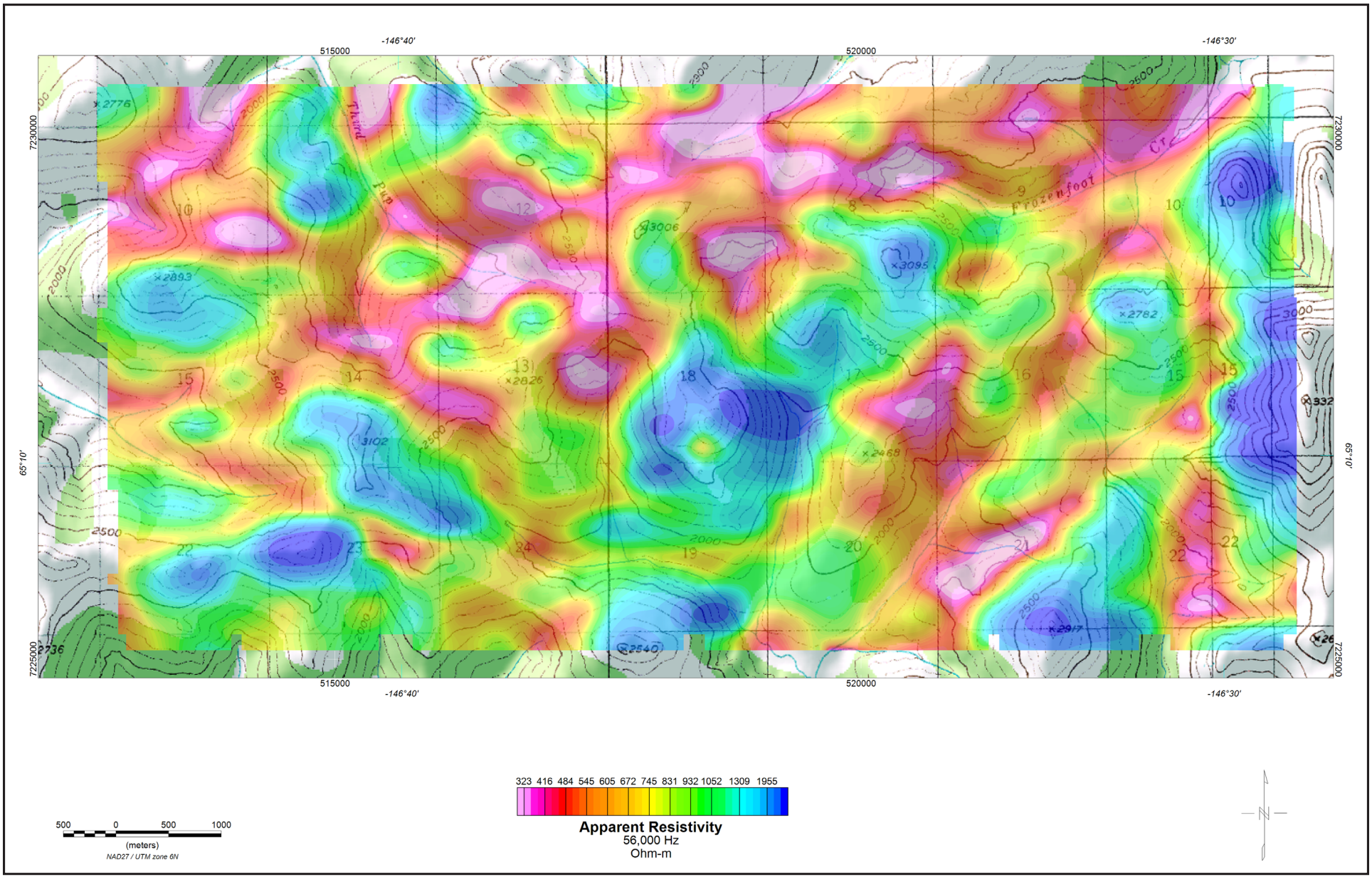


Figure 6. 56,000 Hz coplanar apparent resistivity grid with topographic basemap. The DIGHEM^{V} EM system measured inphase and quadrature components at five frequencies. Two vertical coaxial coil-pairs operated at 900 and 5,000 Hz while three horizontal coplanar coil-pairs operated at 900, 7,200, and 56,000 Hz. EM data were sampled at 0.1 second intervals. The EM system responds to bedrock conductors, conductive overburden, and cultural sources. Apparent resistivity is generated from the inphase and quadrature component of the coplanar 56,000 Hz using the pseudo-layer half space model. The data were interpolated onto a regular 100 m grid using a modified Akima (1970) technique.

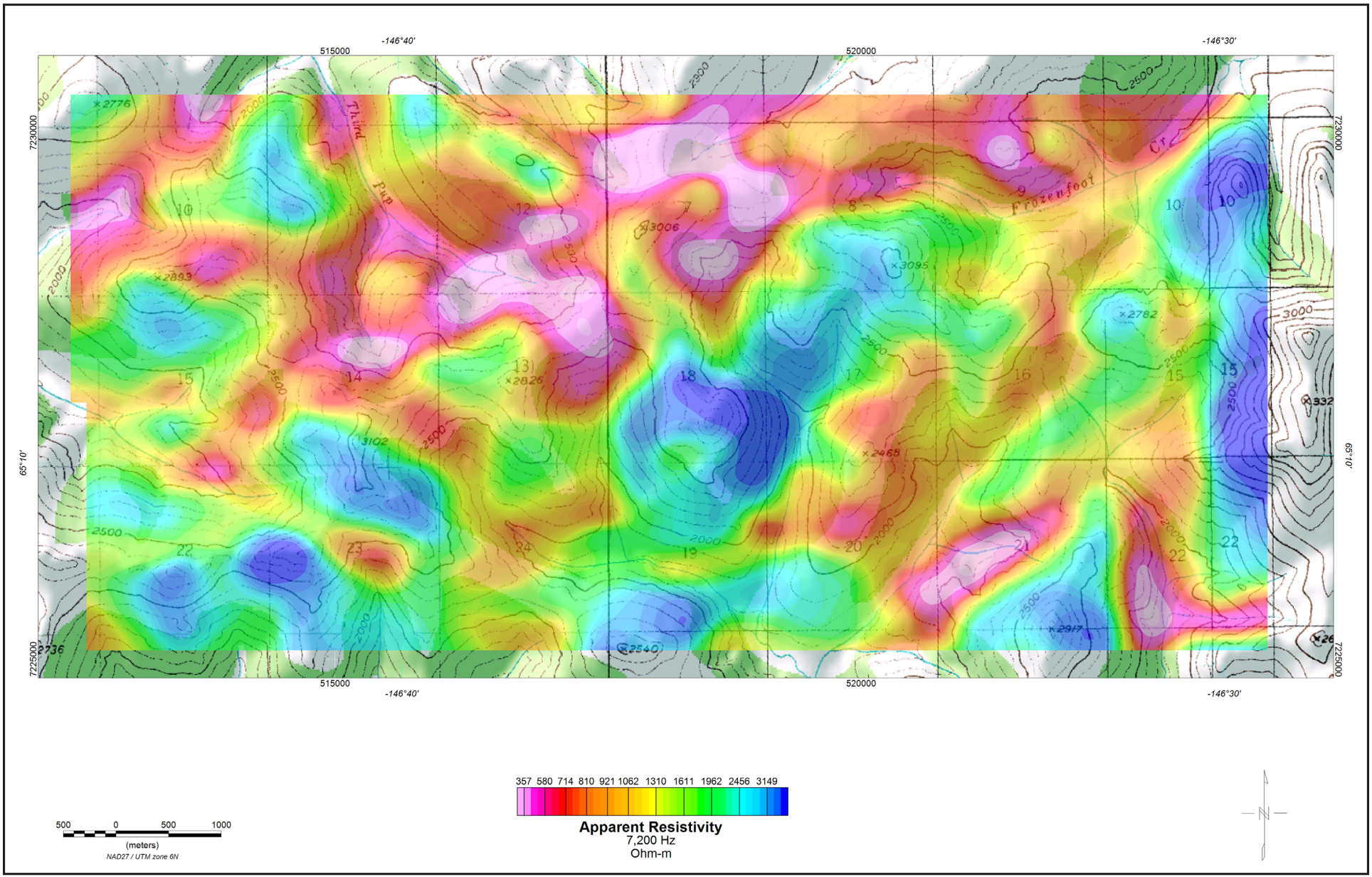


Figure 7. 7,200 Hz coplanar apparent resistivity grid with topographic basemap. The DIGHEM^{V} EM system measured inphase and quadrature components at five frequencies. Two vertical coaxial coil-pairs operated at 900 and 5,000 Hz while three horizontal coplanar coil-pairs operated at 900, 7,200, and 56,000 Hz. EM data were sampled at 0.1 second intervals. The EM system responds to bedrock conductors, conductive overburden, and cultural sources. Apparent resistivity is generated from the inphase and quadrature component of the coplanar 7,200 Hz using the pseudo-layer half space model. The data were interpolated onto a regular 100 m grid using a modified Akima (1970) technique.

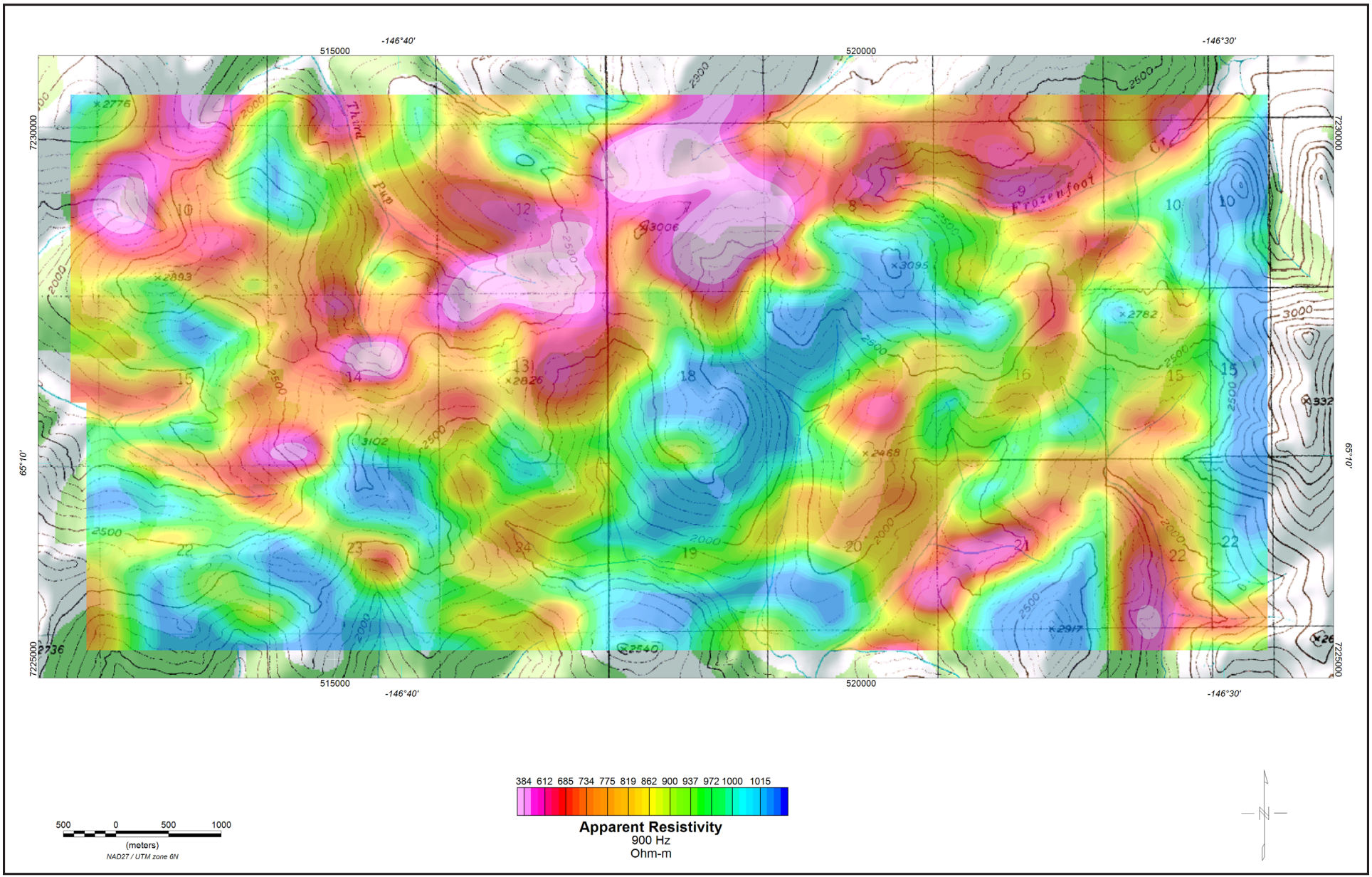


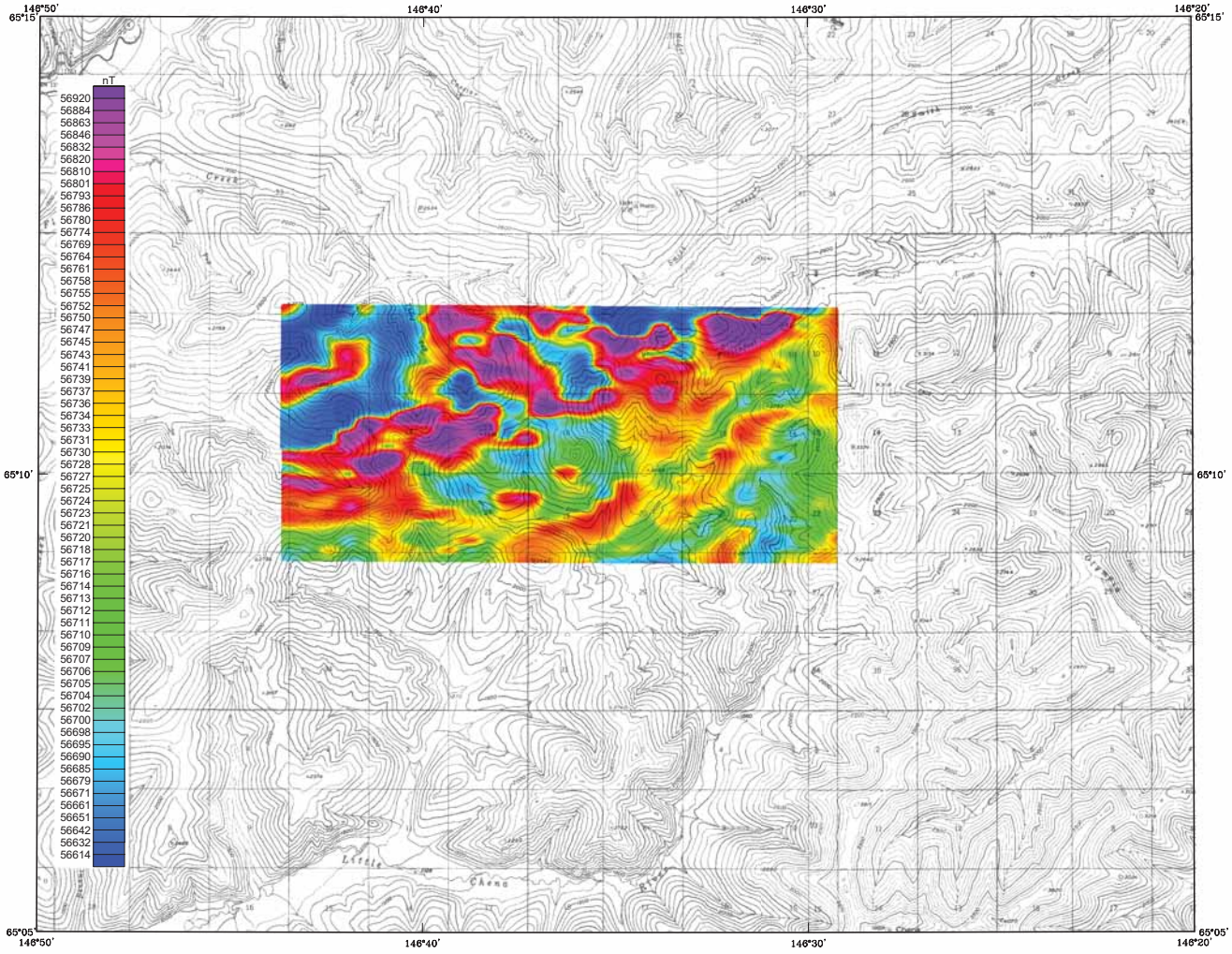
Figure 8. 900 Hz coplanar apparent resistivity grid with topographic basemap. The DIGHEM^{V} EM system measured inphase and quadrature components at five frequencies. Two vertical coaxial coil-pairs operated at 900 and 5,000 Hz while three horizontal coplanar coil-pairs operated at 900, 7,200, and 56,000 Hz. EM data were sampled at 0.1 second intervals. The EM system responds to bedrock conductors, conductive overburden, and cultural sources. Apparent resistivity is generated from the inphase and quadrature component of the coplanar 900 Hz using the pseudo-layer half space model. The data were interpolated onto a regular 100 m grid using a modified Akima (1970) technique.

Table 1. Copies of the following maps are included at the end of this booklet. The low-resolution, page-size maps included in this booklet are intended to be used as a search tool and are not the final product. Large-scale, full-resolution versions of each map are available to download on this publication's citation page: http://doi.org/10.14509/30418

Map Title	Description
headwaters_little_chena_sim_magtf_topo_map.pdf	simulated magnetic total field grid with topographic base map
headwaters_little_chena_res7200hz_topo_map.pdf	7,200 Hz apparent resistivity grid with topographic base map
headwaters_little_chena_res900hz_topo_map.pdf	900 Hz apparent resistivity grid with topographic base map
headwaters_little_chena_emanomalies_sim_magtf_contours_topo_map.pdf	electromagnetic anomalies with simulated total magnetic field data contours and topographic base map
headwaters_little_chena_interpretation_plss_map	interpretation based on geophysical data with public land survey system base layer

ALASKA DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS

GEOPHYSICAL REPORT 2004_7_1a



Base from U.S. Geological Survey Circle A-5; 1952, A-6; 1954, Quadrangles, Alaska



SCALE 1:63,360

1 0 1 2 3 4 MILES

1 0 1 2 3 4 5 KILOMETERS

CONTOUR INTERVAL 100 FEET
DATUM MEAN SEA LEVEL



APPROXIMATE MEAN DECLINATION, 1954

TOTAL MAGNETIC FIELD OF THE HEADWATERS LITTLE CHENA RIVER AREA, ALASKA

CIRCLE A-6 QUADRANGLE

by

Laurel E. Burns, Fugro Airborne Surveys Corp., and Stevens Exploration Management Corp.

2004

DESCRIPTIVE NOTES

The geophysical data were acquired with a DIGHEM^V Electromagnetic (EM) system, a Scintrex cesium CS2 magnetometer, and a Herz VLF system installed in an AS350B–1 Squirrel helicopter. In addition, the survey recorded data from a radar altimeter, GPS navigation system, 50/60 Hz monitors and video camera. Flights were performed at a mean terrain clearance of 200 feet along survey flight lines with a spacing of a quarter of a mile. Tie lines were flown perpendicular to the flight lines at intervals of approximately three miles.

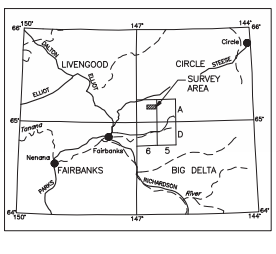
A Sercel Real–Time Differential Global Positioning System (RT–DGPS) was used for both navigation and flight path recovery. The helicopter position was derived every 0.5 seconds using real–time differential positioning to a relative accuracy of better than 10 m. Flight path positions were projected onto the Clark 1866 (UTM) spheroid, 1927 North American datum using a Central Meridian (CM) of 147, a north constant of 0 and an east constant of 500,000. Positional accuracy of the presented data is better than 10 m with respect to the UTM grid.

TOTAL MAGNETIC FIELD

The magnetic total field contours were produced using digitally recorded data from a Scintrex cesium CS2 magnetometer, with a sampling interval of 0.1 seconds. The magnetic data were (1) corrected for diurnal variations by subtraction of the digitally recorded base station magnetic data, (2) leveled to the tie line data, and (3) interpolated onto a regular 100 m grid using a modified Akima (1970) technique. The regional variation (or IGRF gradient, 1985, updated to August, 1994) was removed from the leveled magnetic data.

Akima, H., 1970, A new method of interpolation and smooth curve fitting based on local procedures: Journal of the Association of Computing Machinery, v. 17, no. 4, p. 589–602.

LOCATION INDEX

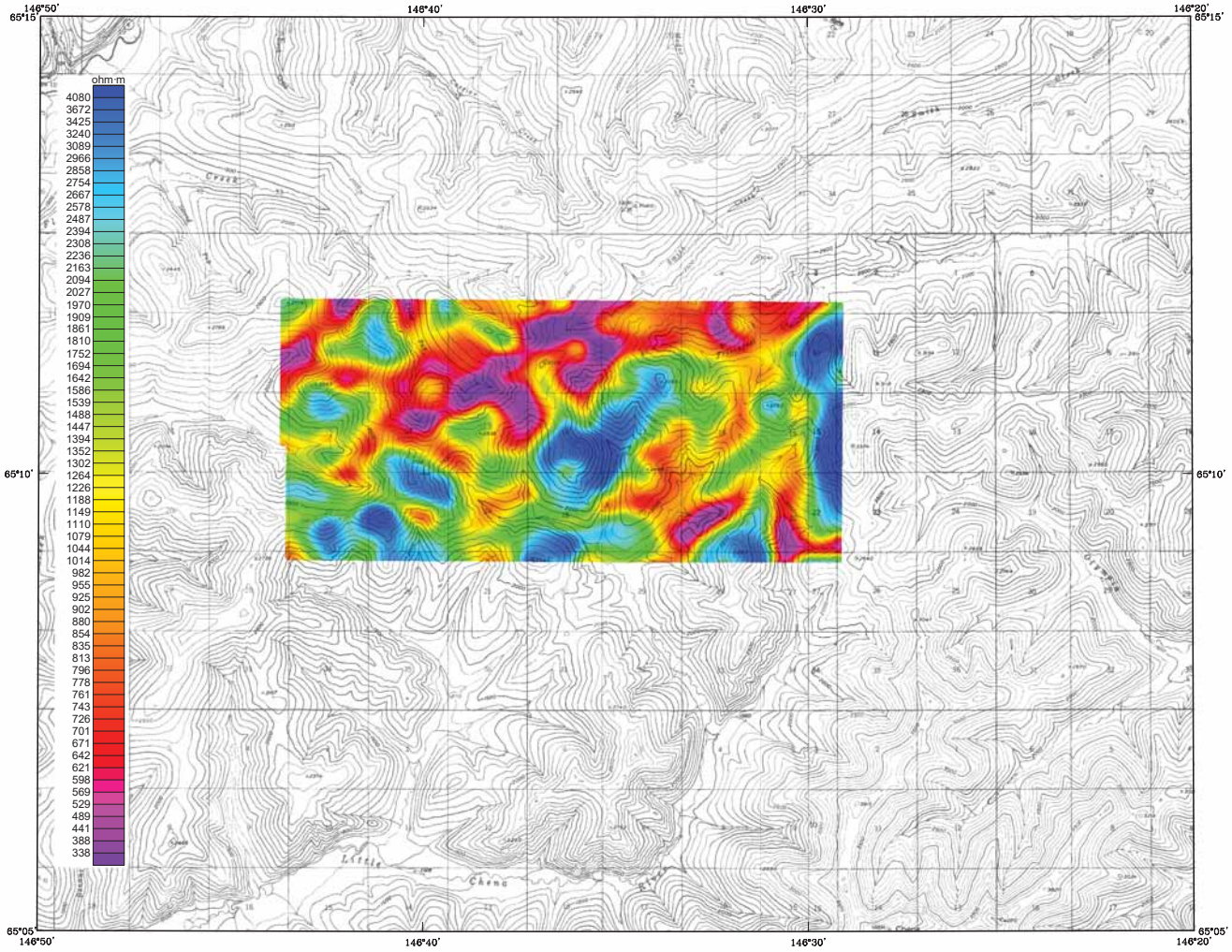


SURVEY HISTORY

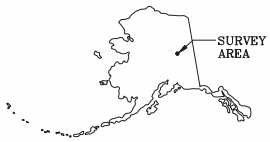
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ALASKA DIVISION OF GEOLOGICAL
& GEOPHYSICAL SURVEYS

GEOPHYSICAL REPORT 2004_7_2a



Base from U.S. Geological Survey Circle A-6; 1952, A-6; 1954, Quadrangles, Alaska



SCALE 1:63,360

1 0 1 2 3 4 MILES

1 0 1 2 3 4 5 KILOMETERS

CONTOUR INTERVAL 100 FEET
DATUM MEAN SEA LEVEL



APPROXIMATE MEAN DECLINATION, 1954

7200 Hz COPLANAR APPARENT RESISTIVITY OF THE HEADWATERS LITTLE CHENA RIVER AREA, ALASKA

CIRCLE A-6 QUADRANGLE

by
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2004

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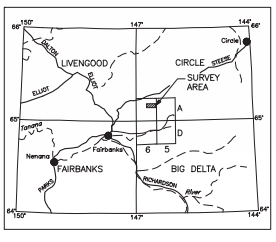
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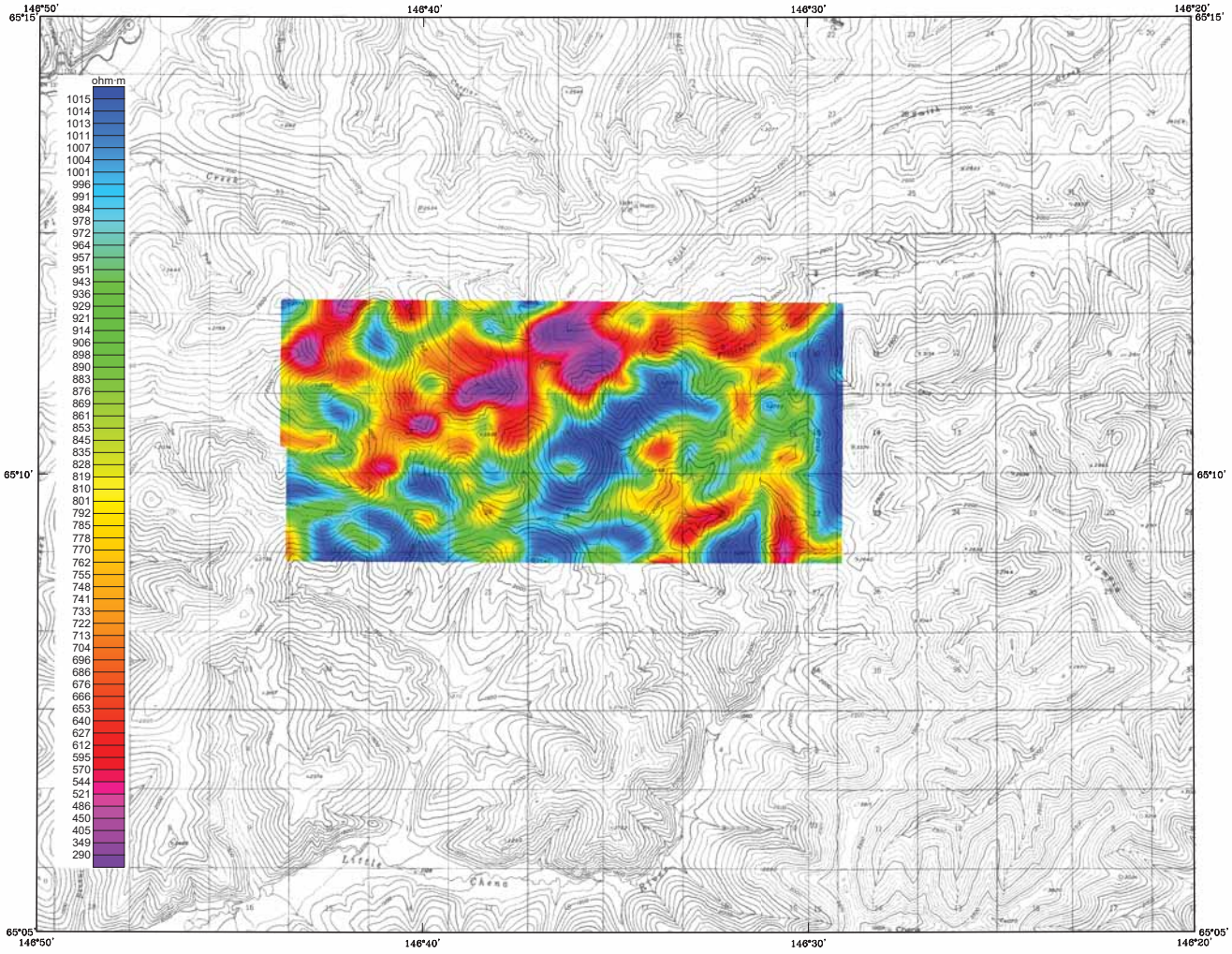


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ALASKA DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS

GEOPHYSICAL REPORT 2004_7_3a



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SCALE 1:63,360

1 0 1 2 3 4 MILES

1 0 1 2 3 4 5 KILOMETERS

CONTOUR INTERVAL 100 FEET
DATUM MEAN SEA LEVEL



APPROXIMATE MEAN DECLINATION, 1954

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CIRCLE A-6 QUADRANGLE

by

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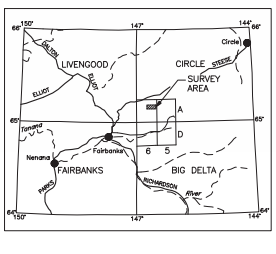
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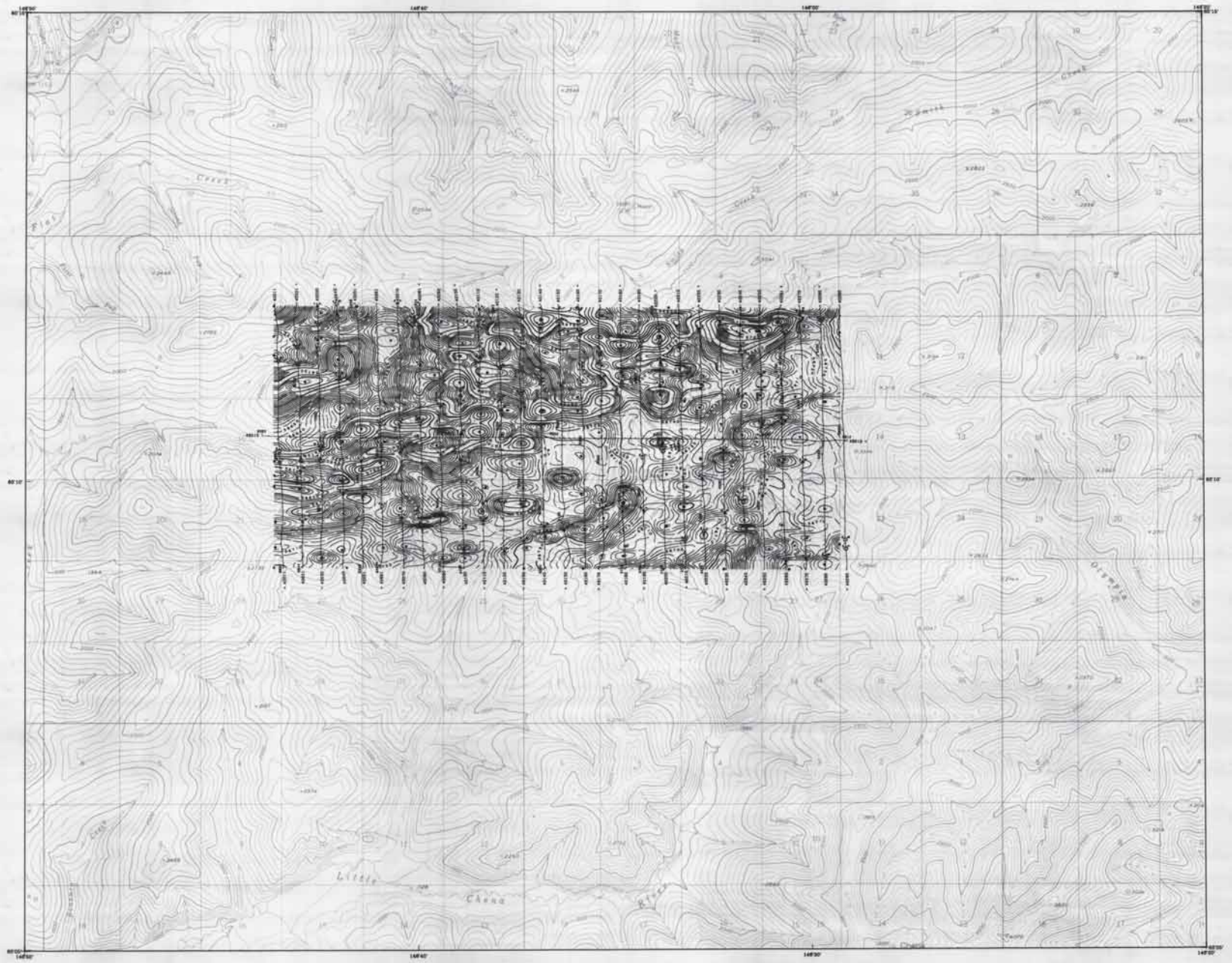
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SCALE 1:31,680

0.5 0 0.5 1 1.5 2 MILES

0.5 0 0.5 1 1.5 2 2.5 KILOMETERS

CONTOUR INTERVAL 100 FEET
DATUM MEAN SEA LEVEL

MAGNETIC NORTH
APPROXIMATE MEAN
DECLINATION, 1994

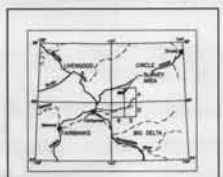
TOTAL FIELD MAGNETICS AND ELECTROMAGNETIC ANOMALIES OF THE HEADWATERS LITTLE CHENA RIVER AREA

CIRCLE A-6 QUADRANGLE, ALASKA

(IGRF GRADIENT REMOVED)

1995

LOCATION INDEX



DESCRIPTIVE NOTES

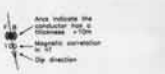
The geophysical data were acquired with a DIGHEM^V Electromagnetic (EM) system, a Scintrex cesium DS2 magnetometer, and a Herz VLF system installed in an AS.350B-1 Squirrel helicopter. In addition, the survey recorded data from a radar altimeter, GPS navigation system, 35/80 Hz monitors and video camera. Flights were performed at a mean terrain clearance of 200 feet along survey flight lines with a spacing of ¼ quarter of a mile. Tie lines were flown perpendicular to the flight lines at intervals of approximately three miles.

A Garcel Real-Time Differential Global Positioning System (RT-DGPS) was used for both navigation and flight path recovery. The helicopter position was derived every 0.5 seconds using real-time differential positioning to a relative accuracy of better than 10 m. Flight path positions were projected onto the Clark 1866 (UTM) spheroid, 1927 North American datum using a Central Meridian (CM) of 147°, a north positions of 0 and an east constant of 500,000. Positional accuracy of the presented data is better than 10 m with respect to the UTM grid.

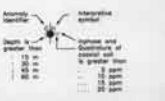
ELECTROMAGNETICS

To determine the location of EM anomalies or their boundaries, the DIGHEM^V EM system measured inphase and quadrature components at five frequencies. Two vertical coaxial coil-pairs operated at 900 and 5000 Hz while three horizontal coplanar coil-pairs operated at 900, 7200 and 56,000 Hz. EM data were sampled at 0.1 second intervals. The EM system responds to bedrock conductors, conductive overburden, and cultural sources. The type of conductor is indicated on the aeromagnetic map by the interpretive symbol attached to each EM anomaly. Determination of the type of conductor is based on EM anomaly shapes of the coaxial and coplanar coil responses, together with conductor and magnetic patterns and topography. The power line monitor and the flight track video were examined to locate cultural sources.

ELECTROMAGNETIC ANOMALIES



Anomaly	Conductance
●	>100 siemens
●	50–100 siemens
●	20–50 siemens
●	10–20 siemens
◎	5–10 siemens
○	1–5 siemens
○	< 1 siemens
✱	Questionable anomaly
Δ^{in}	EM magnetite response



Interpretive symbol	Conductor
0	Bedrock conductor ("model")
2	Narrow bedrock conductor ("thin sheet")
3	Conducting cover ("horizontal thin sheet")
w	Broad conductive rock unit, deep conductive weathering, thick conductive cover ("half space")
t	Edge of broad conductor ("edge of half space")
⊥	Culture, e.g. power line, metal building or fence

MAGNETIC CONTOUR INTERVAL

———	250 nT
———	50 nT
———	10 nT
— — — —	5 nT
⊕	magnetic low
⊖	magnetic high

SURVEY HISTORY

This map has been compiled and drawn under contract between the State of Alaska, Department of Natural Resources, Division of Geological & Geophysical Surveys, and WGM Inc., Mining and Geological Consultants. Airborne geophysical data for the area were acquired by DIGHEM, a division of CGG Canada Ltd., in 1994.

TOTAL FIELD MAGNETICS

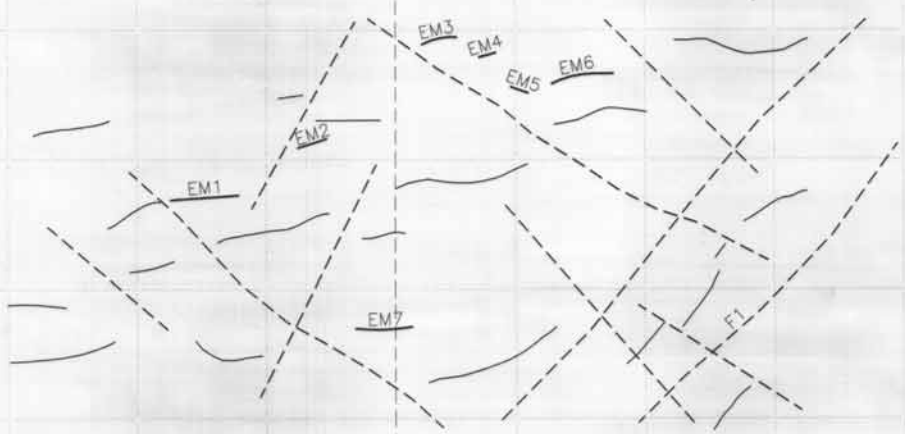
The total field magnetic data were acquired with a sampling interval of 0.1 seconds, and were (1) corrected for diurnal variations by subtraction of the digitally recorded base station magnetic data, (2) levelled to the tie line data, and (3) interpolated onto a regular 100 m grid using a modified Akima (1970) technique. The regional variation (or IGRF gradient, 1985, updated to August, 1994) was removed from the levelled magnetic data. Processed data without IGRF removal are also available.

Akima, H., 1970, A new method of interpolation and smooth curve fitting based on local procedures: Journal of the Association of Computing Machinery, v. 17, no.4, p.589-602.

PUBLIC-DATA FILE 95-18

INTERPRETATION-HEADWATERS LITTLE CHENA RIVER AREA

(figure 4-1)





LEGEND

F1 — Fault

D1 — Inferred Contact

EM1 — Conductor Axis

M1 — Magnetic Trend

A — Lithologic Unit with Distinct Geophysical Signature

INTERPRETATION MAP OF THE HEADWATERS LITTLE CHENA RIVER AREA

1995

The interpretation is based on the geophysical parameters with support from geological maps, which were supplied by the State of Alaska.

SCALE 1:31,680

0.5 0 0.5 1 1.5 2 MILES

0.5 0 0.5 1 1.5 2 2.5 KILOMETERS