FOX HILLS ELECTROMAGNETIC AND MAGNETIC AIRBORNE GEOPHYSICAL SURVEY DATA COMPILATION

L.E. Burns, G.R.C. Graham, J.D. Barefoot, T.J. Naibert, CGG, and Fugro Airborne Surveys Corp.

Geophysical Report 2018-6

2019
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DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS

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ABSTRACT

The Fox Hills survey is one of several geophysical surveys, collectively known as the Five Spot project (Southern Dishna River, Beaver Creek, and Fox Hills surveys), located in the Iditarod-Innoko and Aniak mining districts, which is about 575 km southwest from Fairbanks, Alaska. Frequency domain electromagnetic and magnetic data were collected with the DIGHEM^{V} system from September to November 2012. A total of 1538.2 line kilometers were collected covering 529.5 square kilometers for the Fox Hills survey. 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. The Iditarod-Innoko and Aniak mining districts have a history of placer mining, and the discovery of the Donlin Gold lode deposit, 40 kilometers (25 miles) to the southwest, has kept mining activity in the region high. 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.

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	contractor and DGGS	Project and field reports, survey background information, gridded data explanations, other documentation
grids_ermapper	contractor	Geographically registered gridded data, ER Mapper ERS format
grids_geosoft	contractor and DGGS	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	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
video_flightpath	contractor	Survey flight path downward facing video

REFERENCES

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, n. 4, p. 589–602.

Burns, L.E., CGG, and Fugro GeoServices, Inc., 2015, Project report, interpretation maps, EM anomalies, stacked multi-channel profiles, and other products of the airborne geophysical survey for the southern Dishna River, Fox Hills, and Beaver Creek survey areas, Iditarod, Ophir, and Holy Cross quadrangles, western Alaska: Alaska Division of Geological & Geophysical Surveys Geophysical Report 2014-3, 126 sheets, 1 DVD. http://doi.org/10.14509/27326

Burns, L.E., Fugro Airborne Surveys Corp., and Fugro GeoServices, Inc., 2013, Southern Dishna River, Fox Hills, and Beaver Creek survey areas: Airborne Magnetic and electromagnetic data in line (point), grid, vector, and map formats, Iditarod, Ophir, and Holy Cross quadrangles, western Alaska: Alaska Division of Geological & Geophysical Surveys Geophysical Report 2013-1, scale 1:63,360, 1 DVD. http://doi.org/10.14509/26701

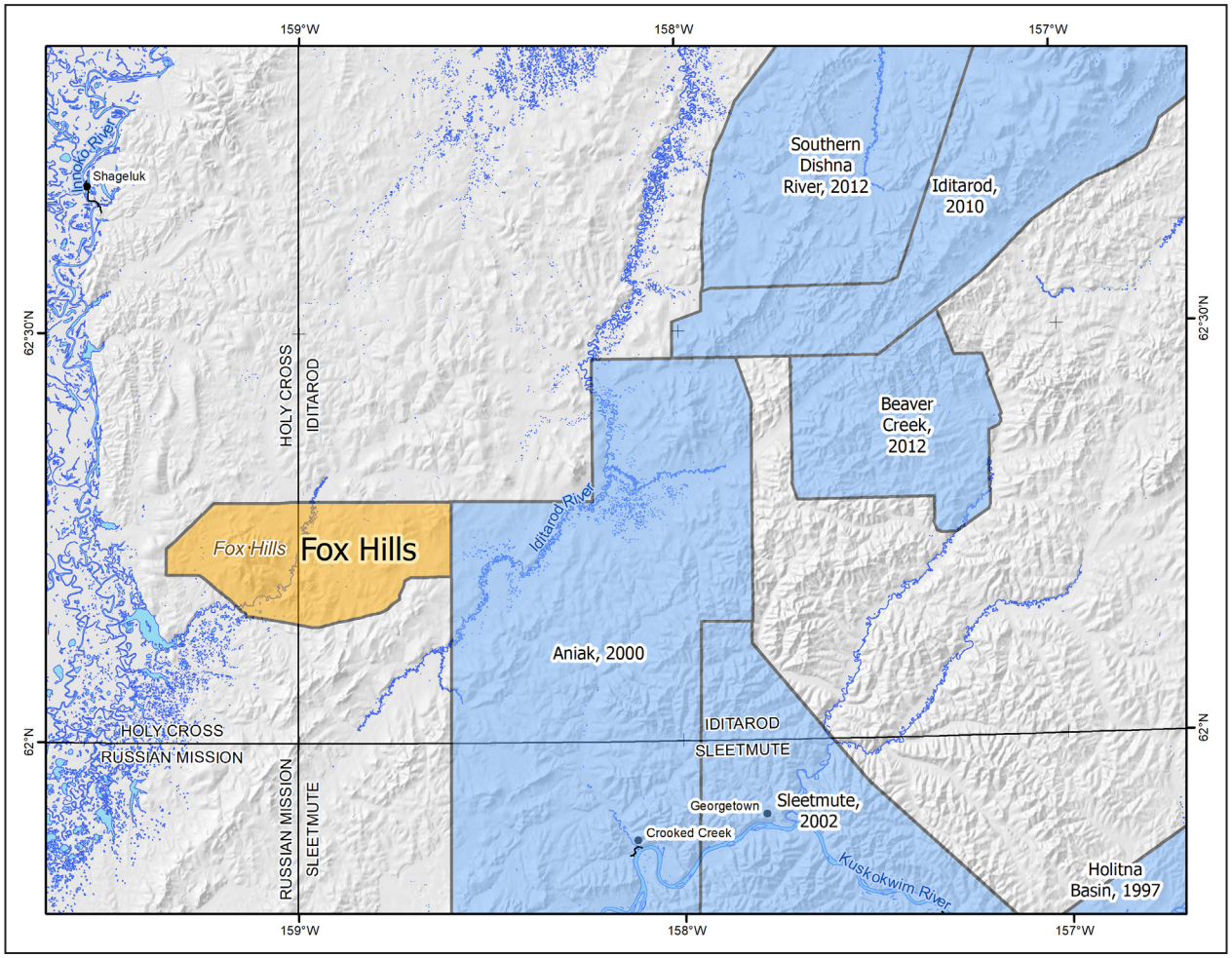


Figure 1. Fox Hills electromagnetic and magnetic airborne geophysical survey location shown in western Alaska (inset). Fox Hills survey area shown with adjacent DGGS geophysical surveys, landmarks, relevant 1:250,000-scale quadrangle boundaries, mountain ranges, rivers, glaciers, and elevation hillshade.

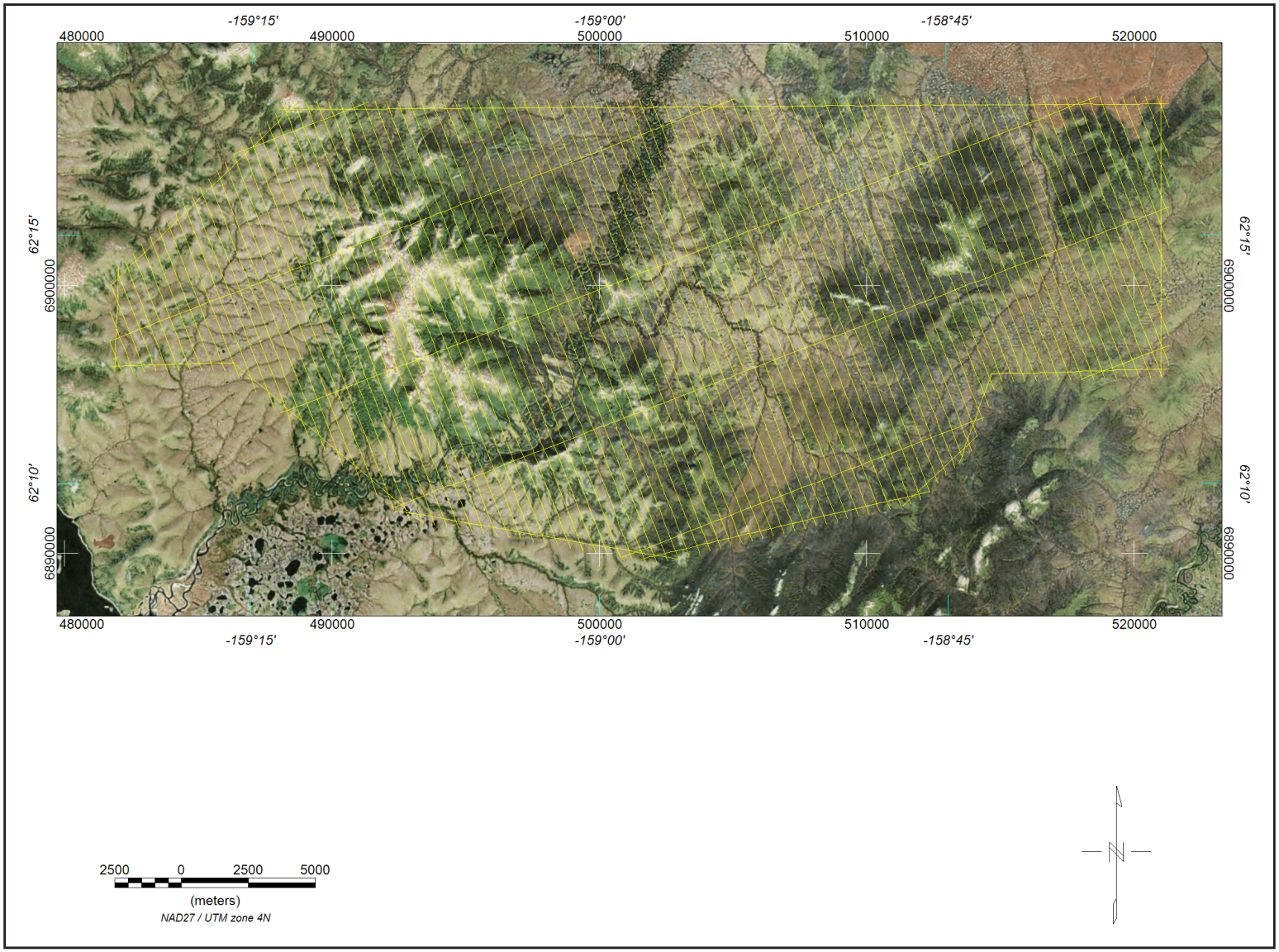


Figure 2. Flight path with orthometric image.

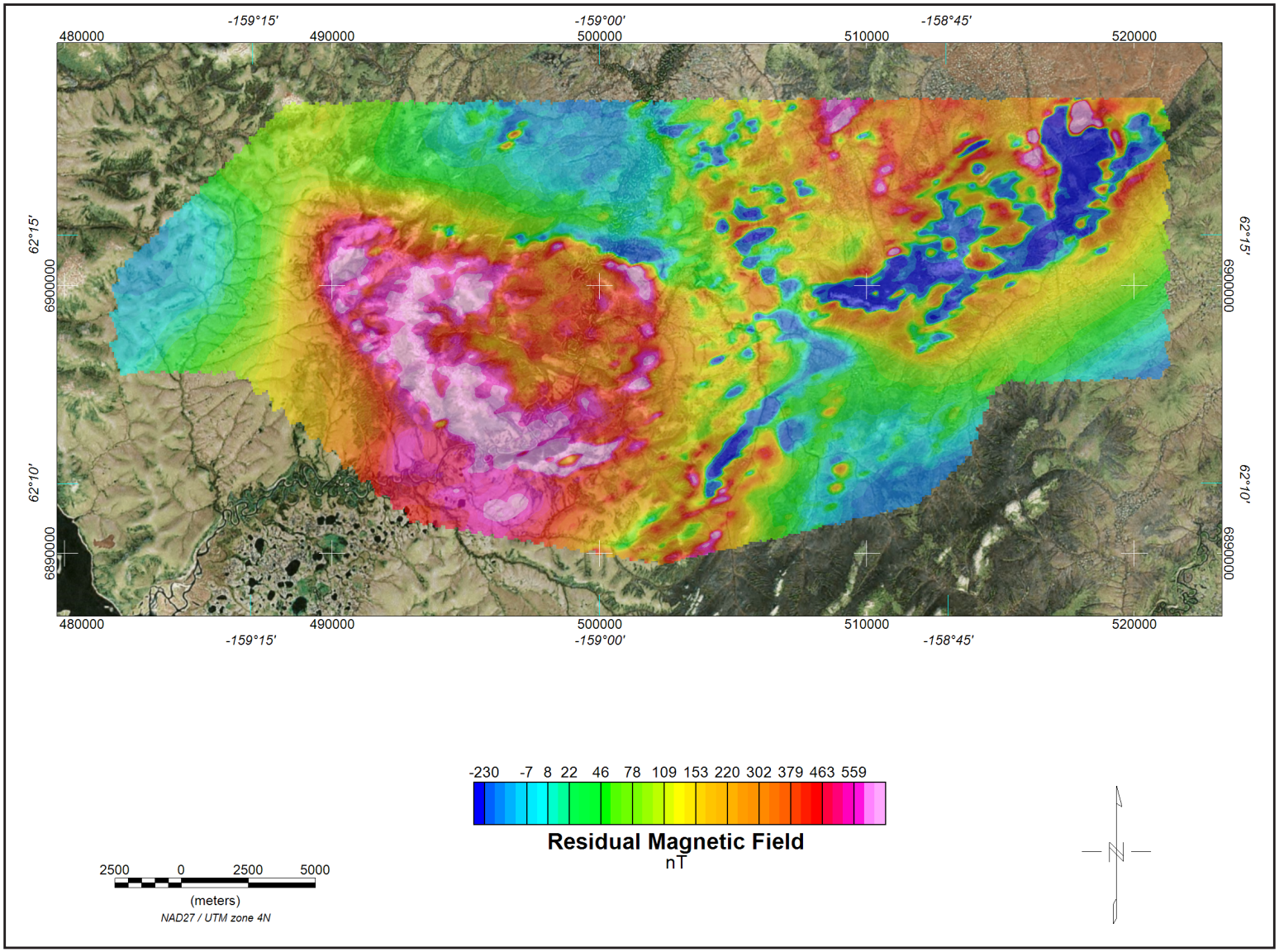


Figure 3. The magnetic total field data were processed using digitally recorded data from a Fugro D1344 magnetometer with a Scintrex CS3 cesium sensor. Data were collected at a sampling interval of 0.1 seconds. The magnetic data were (1) corrected for diurnal variations by subtracting the digitally recorded base station magnetic data, (2) IGRF corrected (IGRF model 2010, updated for date of flight and altimeter variations), (3) leveled to the tie line data, and (4) interpolated onto a regular 80 m grid using a modified Akima (1970) technique.

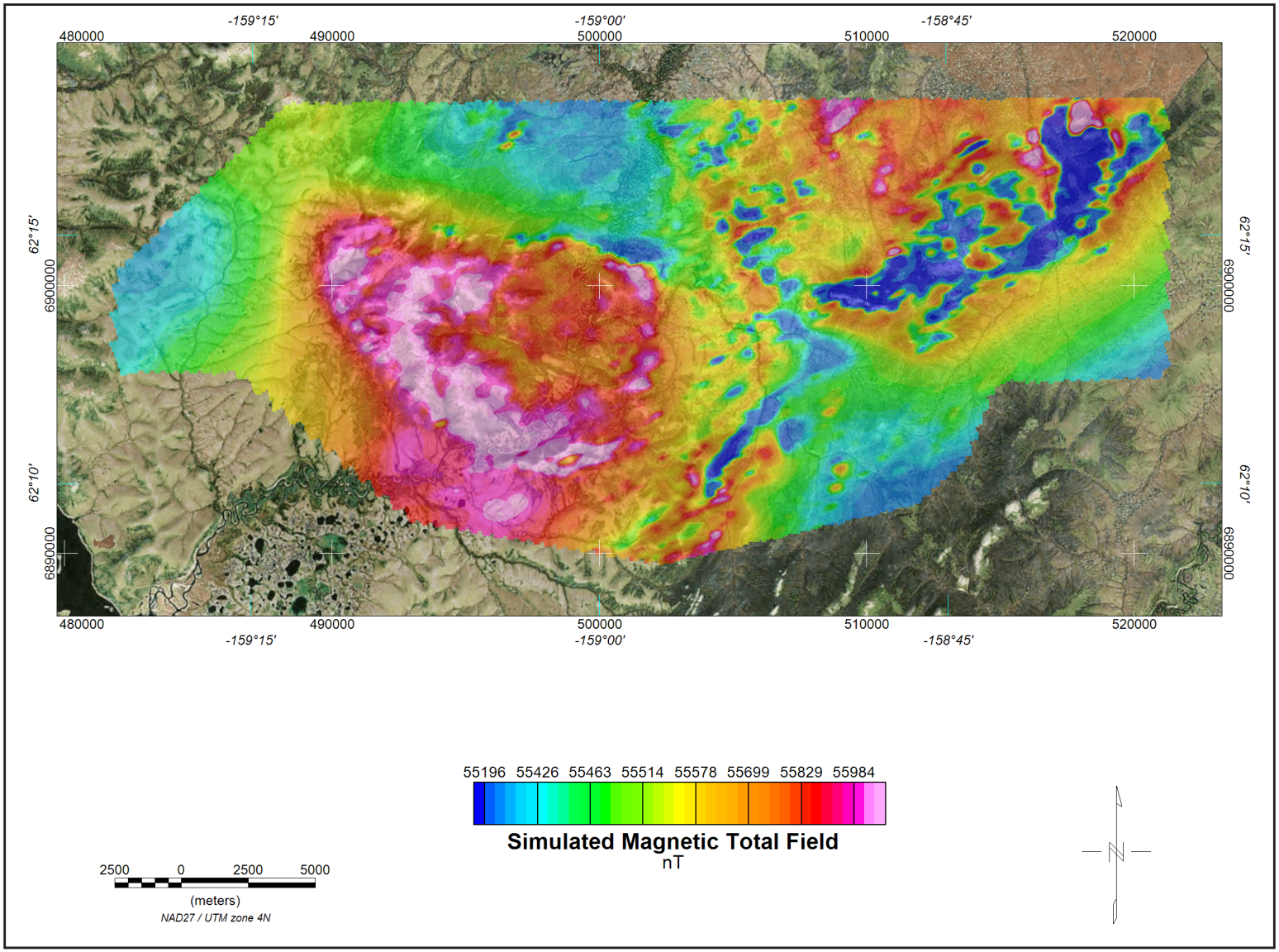


Figure 4. The magnetic total field data were processed using digitally recorded data from a Fugro D1344 magnetometer with a Scintrex CS3 cesium sensor. Data were collected at a sampling interval of 0.1 seconds. The magnetic data were (1) corrected for diurnal variations by subtracting the digitally recorded base station magnetic data, (2) IGRF corrected (IGRF model 2010, updated for date of flight and altimeter variations), (3) leveled to the tie line data, (4) a constant value of approximately 55,000 nT was added to all data, and (5) interpolated onto a regular 80 m grid using a modified Akima (1970) technique.

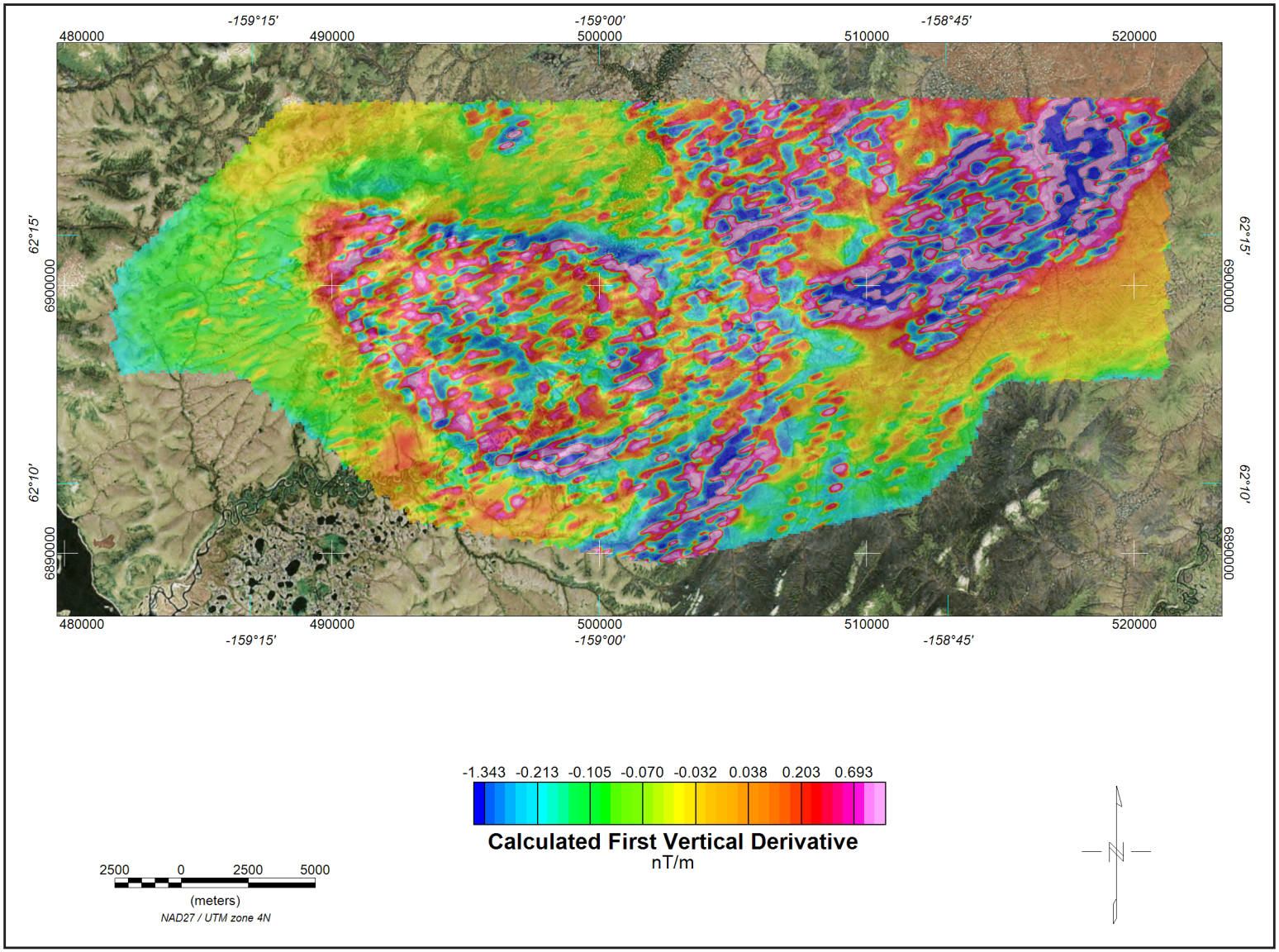


Figure 5. The first vertical derivative grid was calculated from the diurnally-corrected, IGRF-corrected total magnetic field grid using a FFT base frequency domain filtering algorithm. The resulting first vertical derivative grid provides better definition and resolution of near-surface magnetic units and helps to identify weak magnetic features that may not be evident on the total field data.

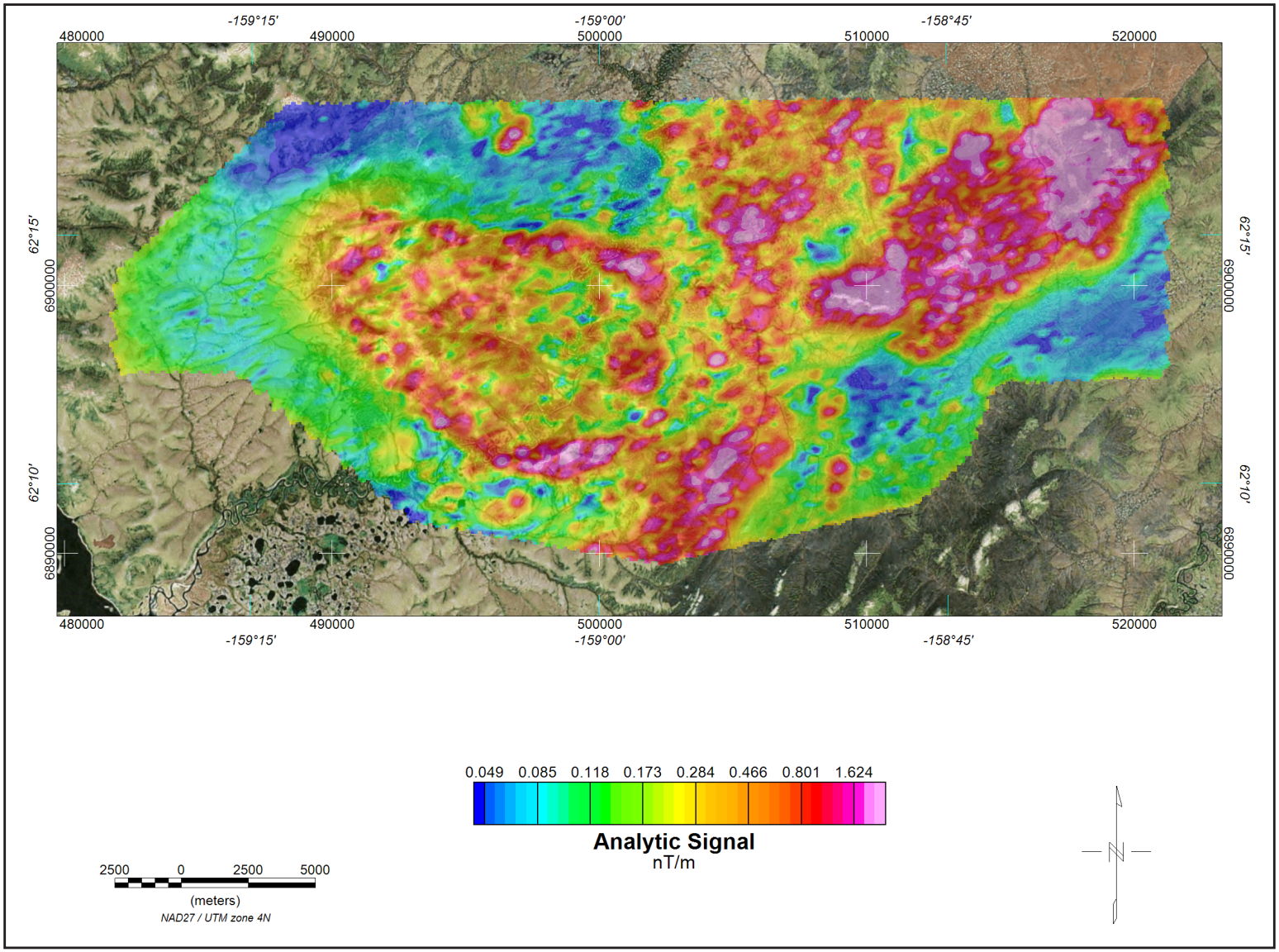


Figure 6. Analytic signal is the total amplitude of all directions of magnetic gradient calculated from the sum of the squares of the three orthogonal gradients. Mapped highs in the calculated analytic signal of magnetic parameter locate the anomalous source body edges and corners (such as contacts, 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.

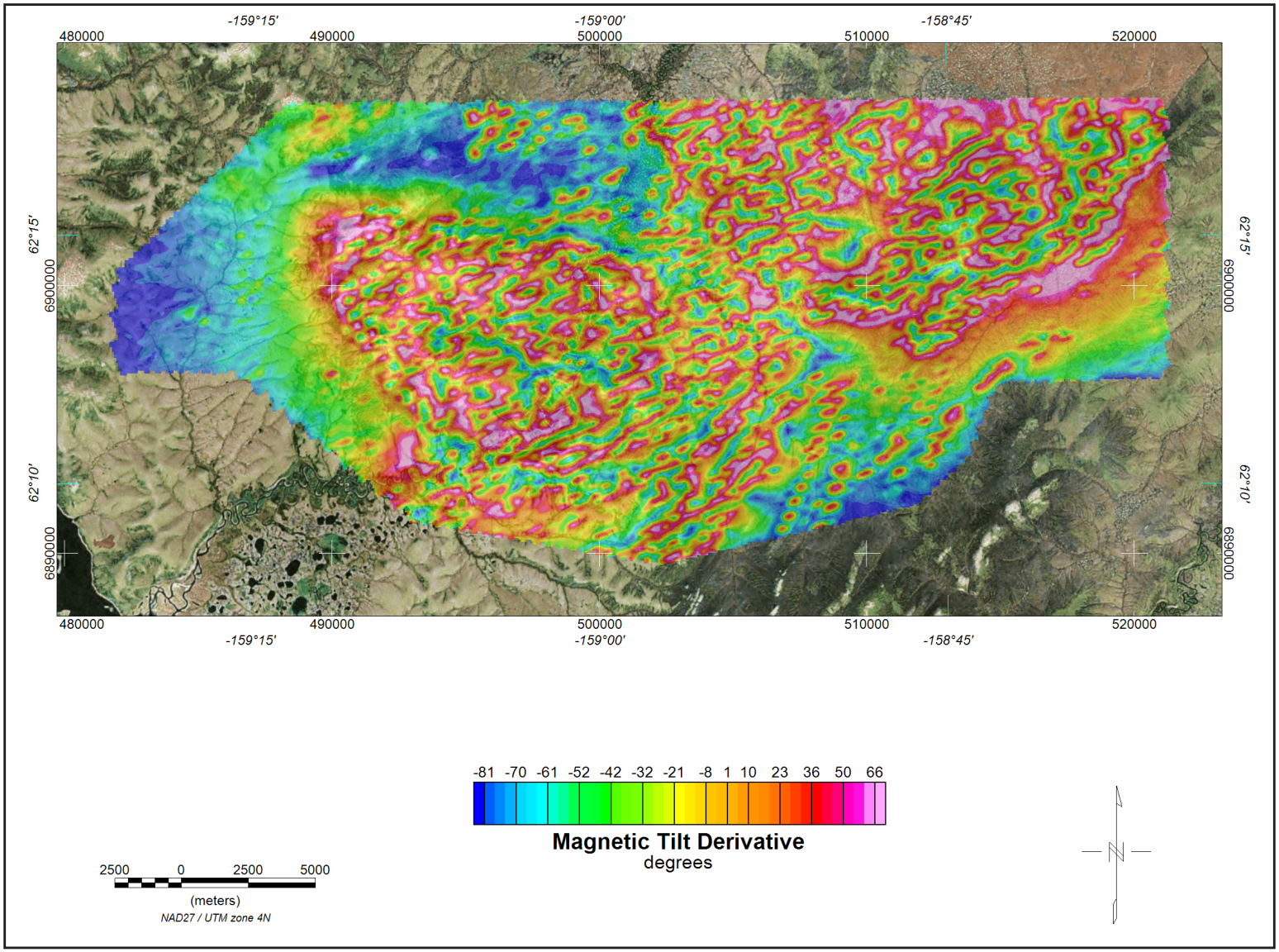


Figure 7. The tilt derivative is the angle between the horizontal gradient and the total gradient, which is useful for identifying the depth and type of source. The tilt angle is positive over the source, crosses through zero at, or near, the edge of a vertical sided source, and is negative outside the source region. It has the added advantage of responding equally well to shallow and deep sources and is able to resolve deeper sources that may be masked by larger responses from shallower sources.

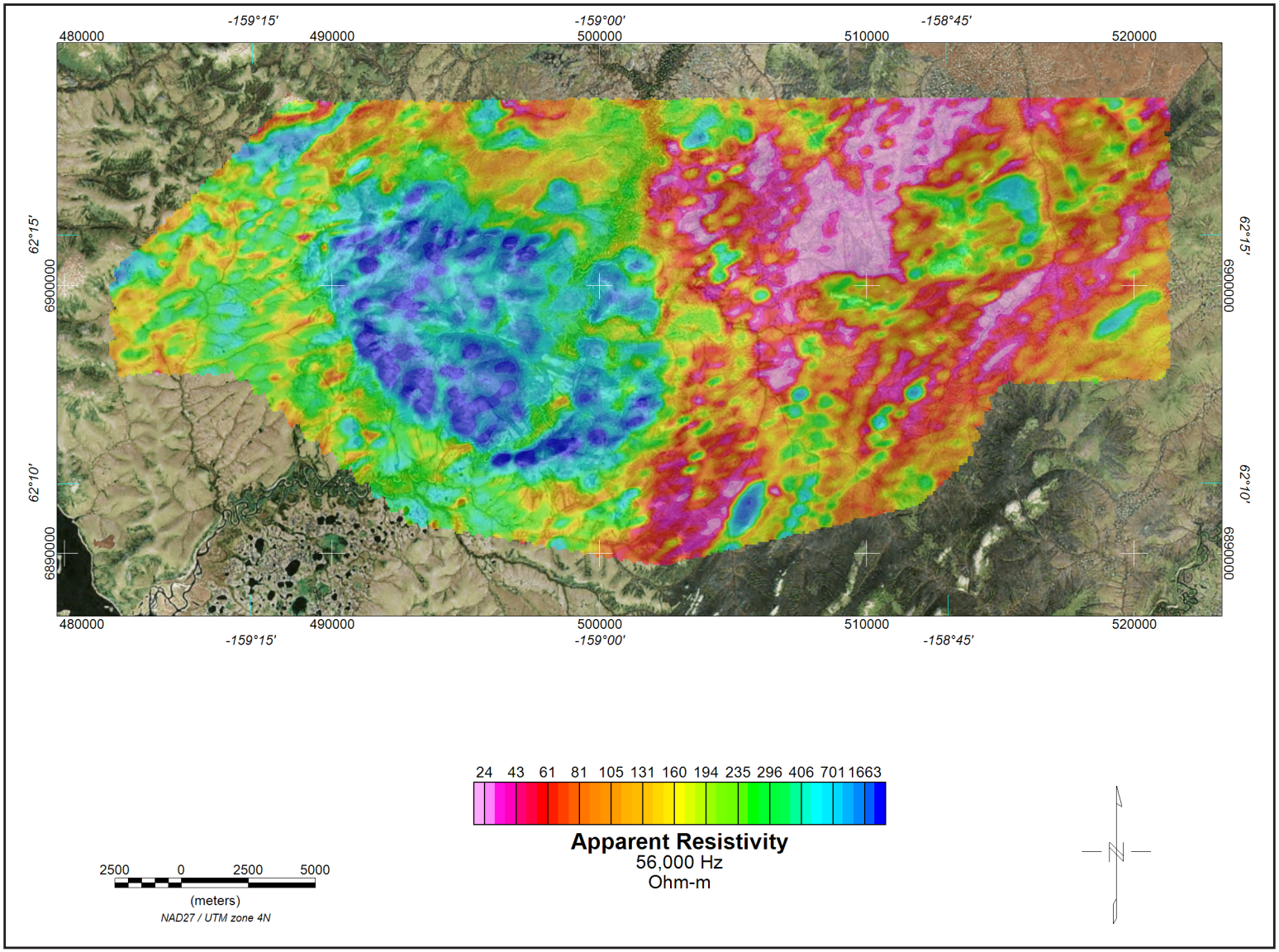


Figure 8. The DIGHEM^{V} EM system measured inphase and quadrature components at five frequencies. Two vertical coaxial coil-pairs operated at 1000 and 5500 Hz while three horizontal coplanar coil-pairs operated at 900, 7,200, and 56,000 Hz. EM data were sampled at 0.1 second intervals. The EM system 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 80 m grid using a modified Akima (1970) technique.

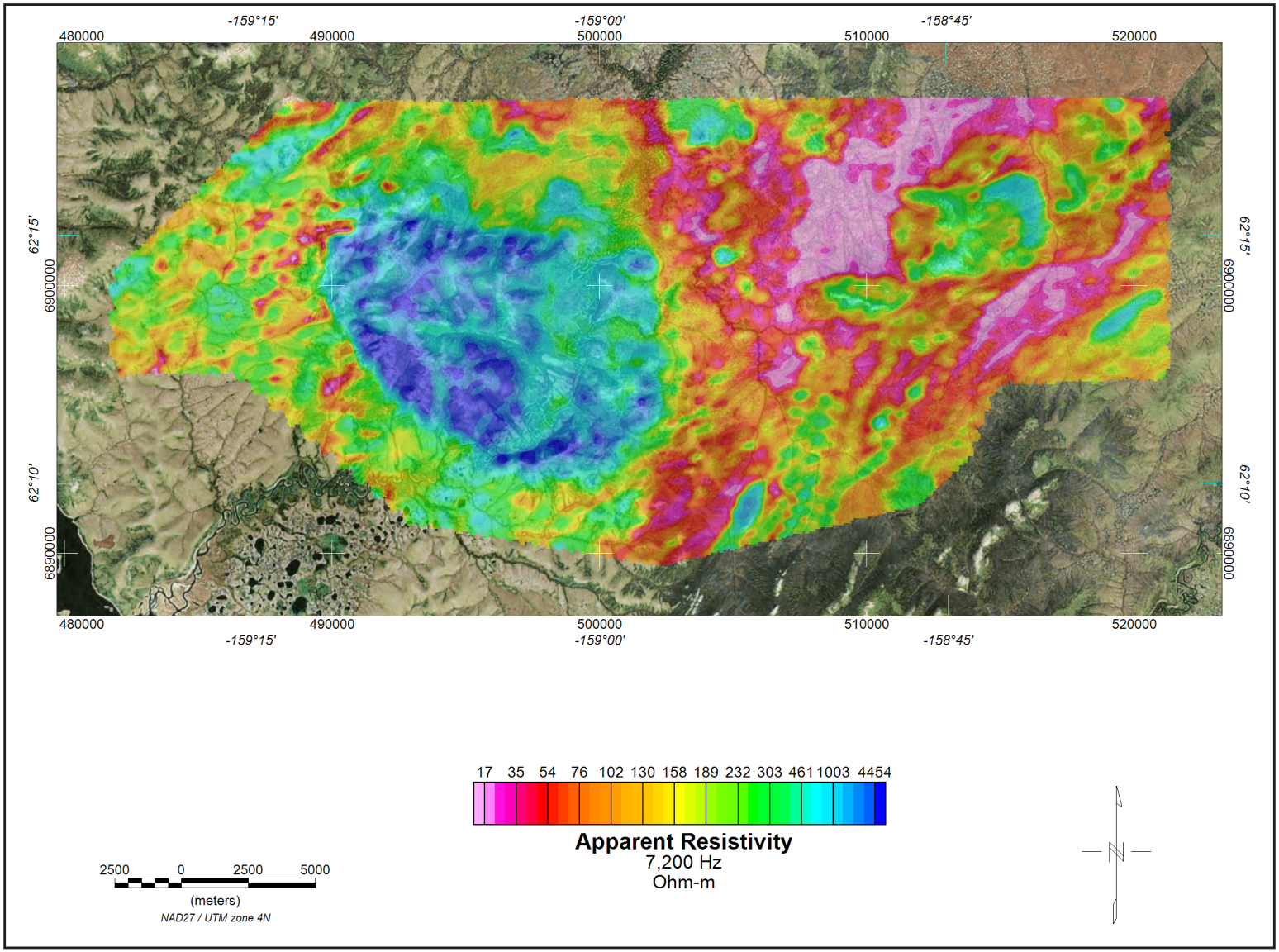


Figure 9. The DIGHEM^{V} EM system measured inphase and quadrature components at five frequencies. Two vertical coaxial coil-pairs operated at 1000 and 5500 Hz while three horizontal coplanar coil-pairs operated at 900, 7,200, and 56,000 Hz. EM data were sampled at 0.1 second intervals. The EM system 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 80 m grid using a modified Akima (1970) technique.

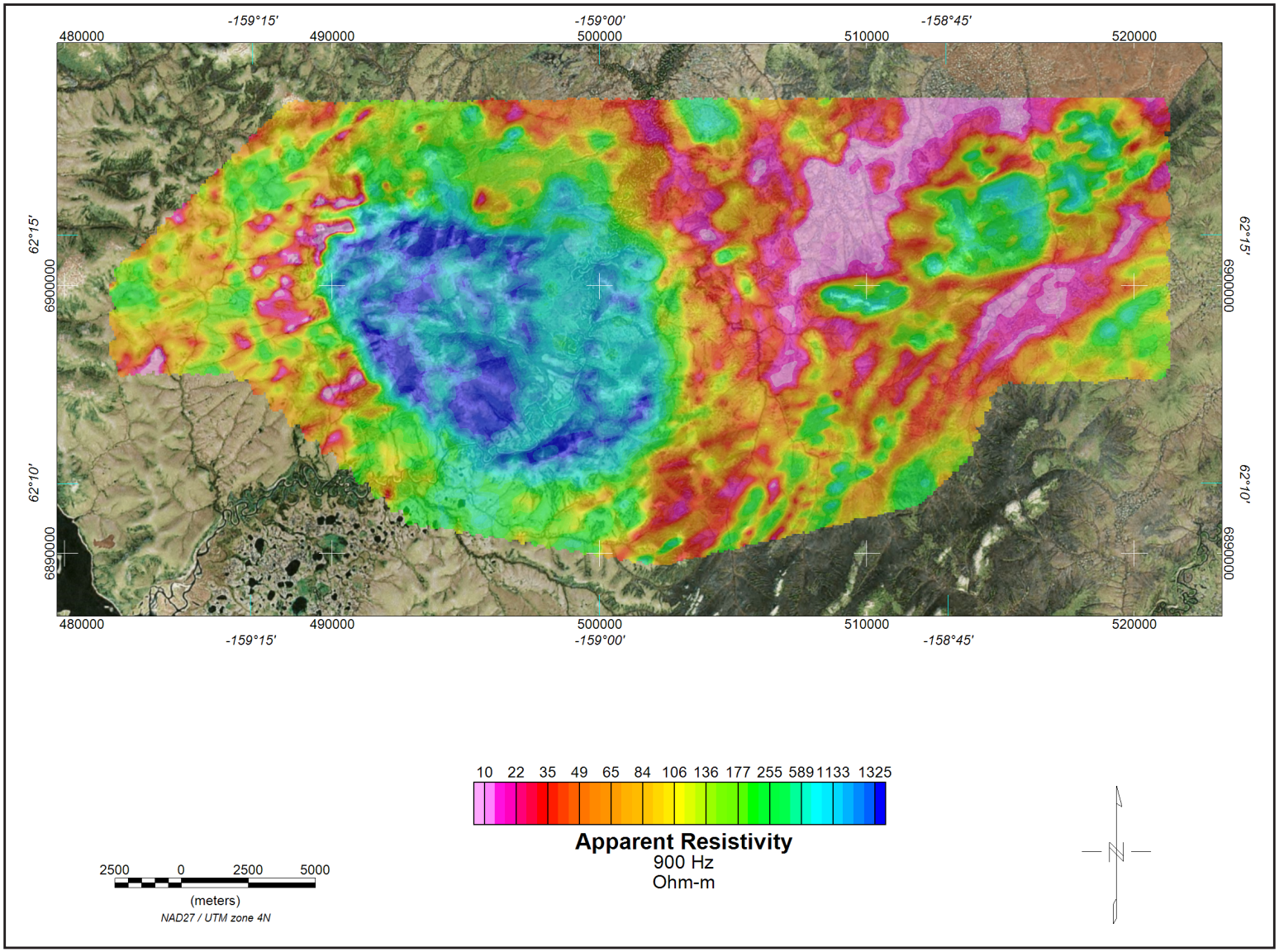
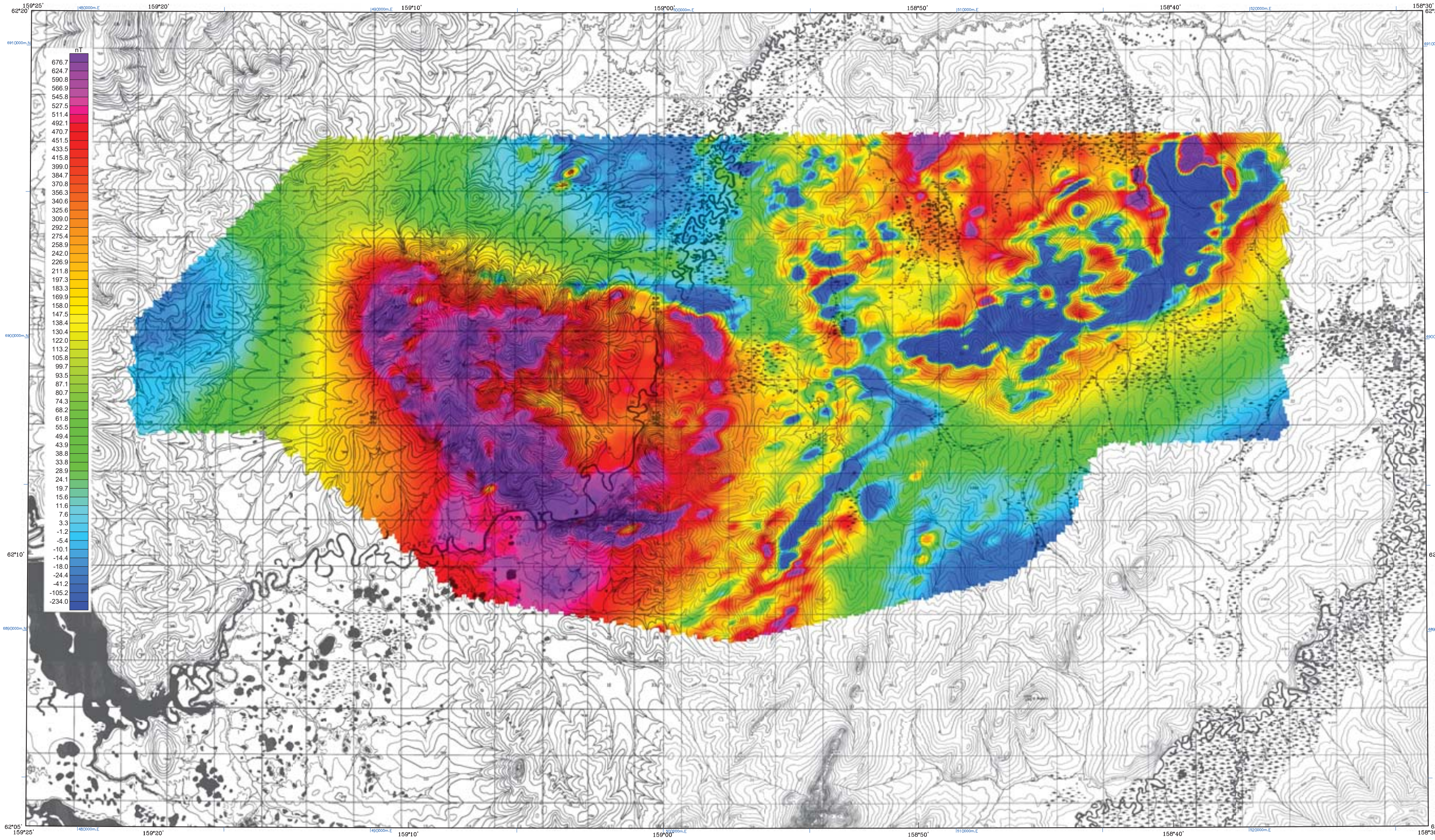


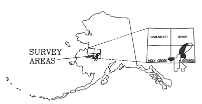
Figure 10. The DIGHEM^{V} EM system measured inphase and quadrature components at five frequencies. Two vertical coaxial coil-pairs operated at 1000 and 5500 Hz while three horizontal coplanar coil-pairs operated at 900, 7,200, and 56,000 Hz. EM data were sampled at 0.1 second intervals. The EM system 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 80 m grid using a modified Akima (1970) technique.

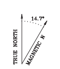
Table 1. Copies of the following maps are included at the end of this booklet. The low-resolution, page-size maps included in this booklet are intended to be used as a search tool and are not the final product. Large-scale, full-resolution versions of each map are available to download on this publication's citation page: http://doi.org/10.14509/29820.

Map Title	Description
foxhills_residualmag_topo_map.pdf	residual magnetic intensity grid with topographic base map
foxhills_residualmag_contours_plss_map.pdf	residual magnetic intensity grid with data contours and public land survey system base layer
foxhills_calculated1vd_topo_map.pdf	calculated first vertical derivative of the residual magnetic intensity grid with topographic base map
foxhills_analyticalsignal_topo_map.pdf	analytic signal grid with topographic base map
foxhills_analyticalsignal_contours_plss_map.pdf	analytic signal grid with data contours and public land survey system base layer
foxhills_tiltderivative_contours_topo_map.pdf	magnetic tilt derivative grid with data contours and topographic base map
foxhills_residualmag_shaded_tiltderivative_contours_topo_map.pdf	shaded residual magnetic intensity grid with tilt derivative data contours and topographic base map
foxhills_res56k_topo_map.pdf	56,000 Hz apparent resistivity grid with topographic base map
foxhills_res56k_contours_plss_map.pdf	56,000 Hz apparent resistivity grid with data contours and public land survey system base layer
foxhills_res7200_topo_map.pdf	7,200 Hz apparent resistivity grid with topographic base map
foxhills_res7200_contours_plss_map.pdf	7,200 Hz apparent resistivity grid with data contours and public land survey system base layer
foxhills_res900_topo_map.pdf	900 Hz apparent resistivity grid with topographic base map
foxhills_res900_contours_plss_map.pdf	900 Hz apparent resistivity grid with data contours and public land survey system base layer
foxhills_interpretation_plss_map.pdf	interpretation based on the geophysical data with public land survey system base layer
foxhills_interpretation_residualmag_plss_map.pdf	interpretation based on the geophysical data with residualmagnetic intensity grid and public land survey system base layer
foxhills_emanomalies_residualmag_detailed_topo_map_1of2.pdf	detailed electromagnetic anomalies with residual magnetic intensity grid and topographic base map
foxhills_emanomalies_residualmag_detailed_topo_map_2of2.pdf	detailed electromagnetic anomalies with residual magnetic intensity grid and topographic base map



Base from U.S. Geological Survey Iditarod A-6, 1982; B-6, 1954; Holy Cross A-1, 1975; B-1, 1967; Quadrangles, Alaska





APPROXIMATE MEAN DECLINATION, 2010

SCALE 1:63,360

1 0 1 2 3 4 MILES

1 0 1 2 3 4 5 KILOMETERS

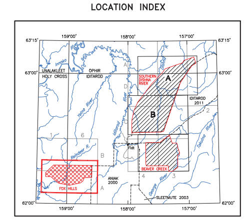
CONTOUR INTERVAL 100 FEET
DATUM MEAN SEA LEVEL

RESIDUAL MAGNETIC FIELD WITH TOPOGRAPHY OF THE FOX HILLS SURVEY AREA, WESTERN ALASKA

PARTS OF THE HOLY CROSS AND IDITAROD QUADRANGLES

by
Laurel E. Burns, Fugro Airborne Surveys Corp., and Fugro GeoServices, Inc.
2013

LOCATION INDEX



DESCRIPTIVE NOTES

The geophysical data were acquired with a DIGHEM^V Electromagnetic (EM) system and a Fugro D1344 cesium magnetometer with a Scintrex CS3 cesium sensor. The EM and magnetic sensors were flown at a height of 100 feet. In addition the survey recorded data from radar and laser altimeters, GPS navigation system, 50/60 Hz monitors and video camera. Flights were performed with an AS-350-B3 Squirrel helicopter at a mean terrain clearance of 200 feet along NW-SE (340°) 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 3 miles.

A Novatel OEM4-G2L Global Positioning System was used for navigation. The helicopter position was derived every 0.5 seconds using post-flight differential positioning to a relative accuracy of better than 5m. Flight path positions were projected onto the Clarke 1866 (UTM zone 4) spheroid, 1927 North American datum using a central meridian (CM) of 159°, a north constant of 0 and an east constant of 500,000. Positional accuracy of the presented data is better than 10m with respect to the UTM grid.

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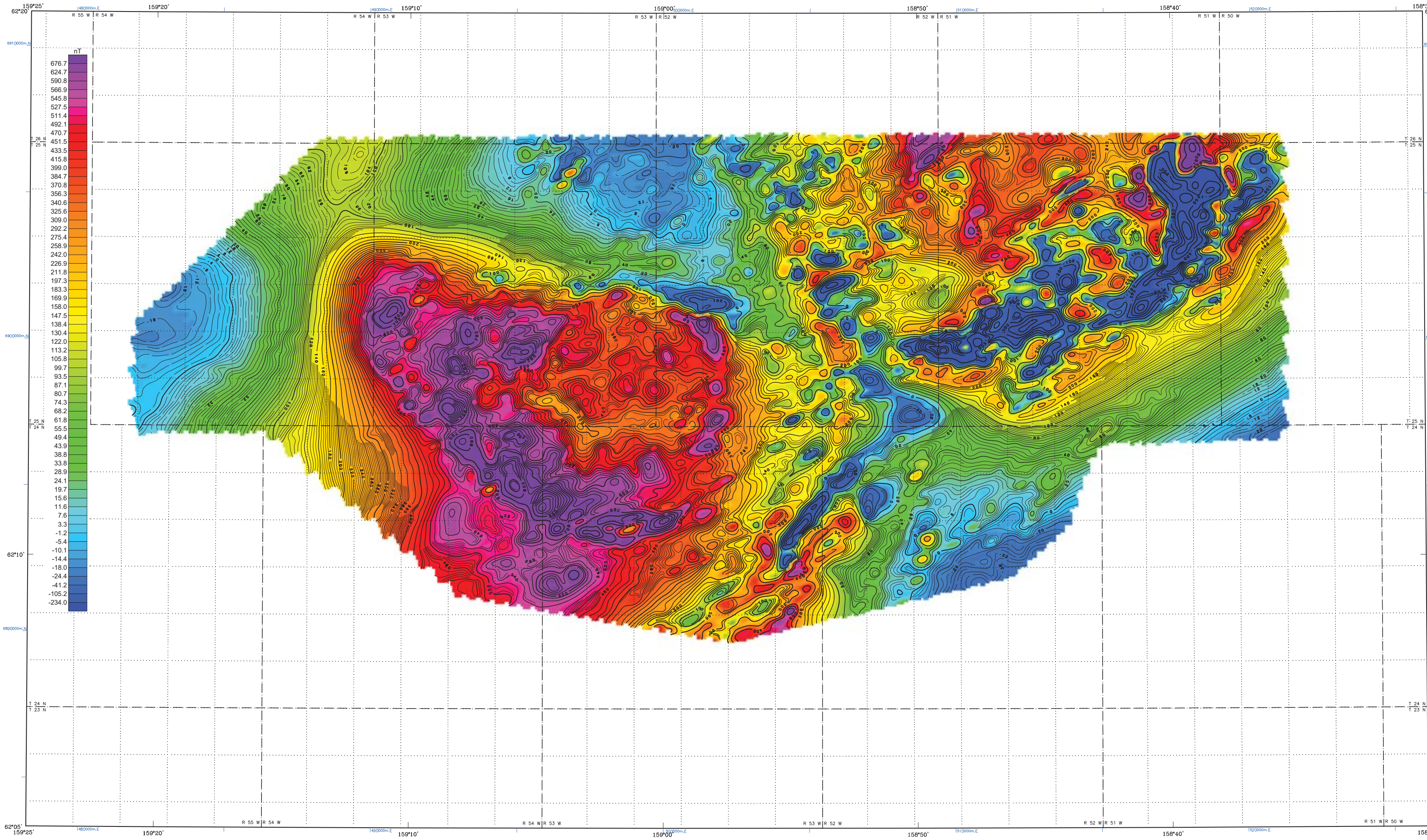
Akima, H., 1970, A new method of interpolation and smooth curve fitting based on local procedures: Journal of the Association of Computing Machinery, v. 17, no. 4, p. 589-602.

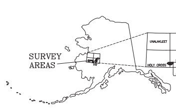
SURVEY HISTORY

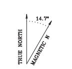
This map has been compiled and drawn under contract between the State of Alaska, Department of Natural Resources, Division of Geological & Geophysical Surveys (DGGS), and Fugro GeoServices, Inc. Airborne geophysical data for the area were acquired and processed by Fugro Airborne Surveys Corp. in 2012 and 2013. Previously flown DGGS surveys adjacent to the current survey are shown in the location map by dashed lines, survey name, and date of publication. The project was funded by the Alaska State Legislature as part of the Alaska Airborne Geophysical and Geological Mineral Inventory Program.

All data and maps produced to date from this survey are available in digital format on DVD for a nominal fee through DGGS, 3354 College Road, Fairbanks, Alaska, 99709-3707, and are downloadable for free from the DGGS website (www.dggs.alaska.gov/pubs). Maps are also available on paper through the DGGS office, and are viewable online at the website in Adobe Acrobat .PDF file format.



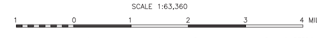
Section outlines from U.S. Geological Survey Iditarod A–6, 1982; B–6, 1954; Holy Cross A–1, 1975; B–1, 1967; Quadrangles, Alaska





APPROXIMATE MEAN DECLINATION, 2010

SCALE 1:63,360



RESIDUAL MAGNETIC FIELD AND DATA CONTOURS OF THE FOX HILLS SURVEY AREA, WESTERN ALASKA

PARTS OF THE HOLY CROSS AND IDITAROD QUADRANGLES

by
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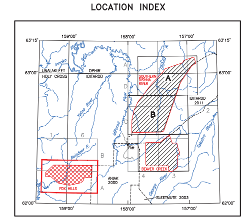
2013

LOCATION INDEX



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MAGNETIC CONTOURS

——— (heavy)	100 nT
———	20 nT
——— (thin)	4 nT
— — —	2 nT

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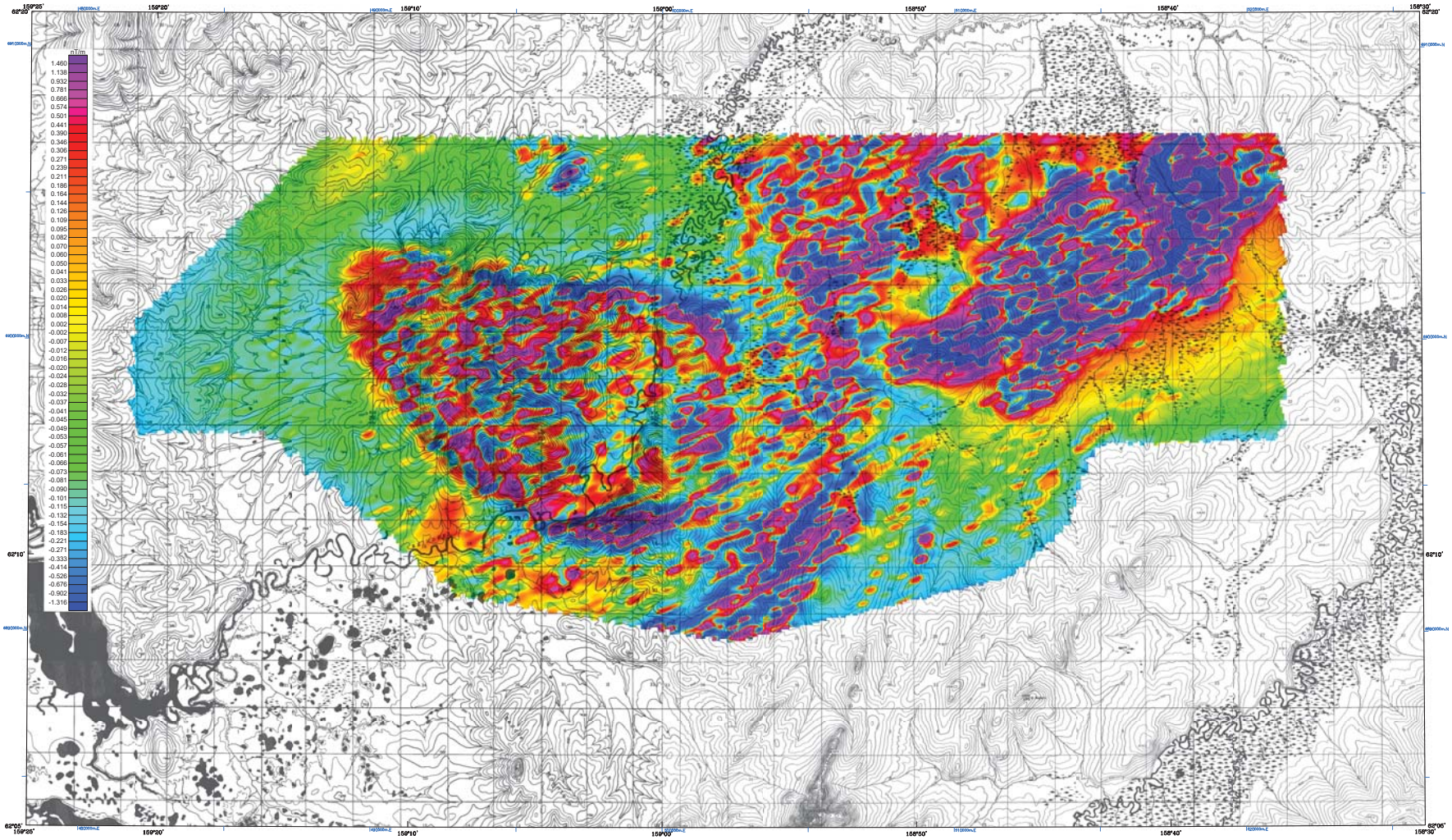

Base from U.S. Geological Survey Bethel A-5, 1951; B-6, 1954; Holy Cross A-1, 1975; B-1, 1972; Goodnews, Alaska

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

FIRST VERTICAL DERIVATIVE OF THE MAGNETIC FIELD OF THE FOX HILLS SURVEY AREA, WESTERN ALASKA

PARTS OF THE HOLY CROSS AND IDITAROD QUADRANGLES

by

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COLOR BAR HISTOGRAM

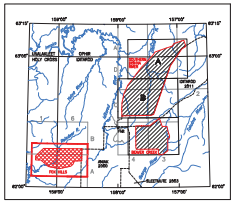
Approximately 98% of the first vertical derivative of the magnetic field for the Fox Hills Survey Area dataset lie within the range displayed on the color bar. Data values actually range from −13.931 nT/m (dark blue) to about 11.319 nT/m (magenta).

FIRST VERTICAL DERIVATIVE OF THE MAGNETIC FIELD

The magnetic total field data were processed using digitally recorded data from a Fugro D1344 magnetometer with a Scintrex CS3 cesium sensor. Data were collected at 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) IGRF corrected (IGRF model 2010, updated for date of flight and altimeter variations), (3) leveled to the tie line data, and (4) interpolated onto a regular 80 m grid using a modified Akima (1970) technique. All grids were then resampled from the 80 m cell size down to a 25 m cell size to produce the maps and final grids contained in this publication. The first vertical derivative grid was calculated from the processed 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.

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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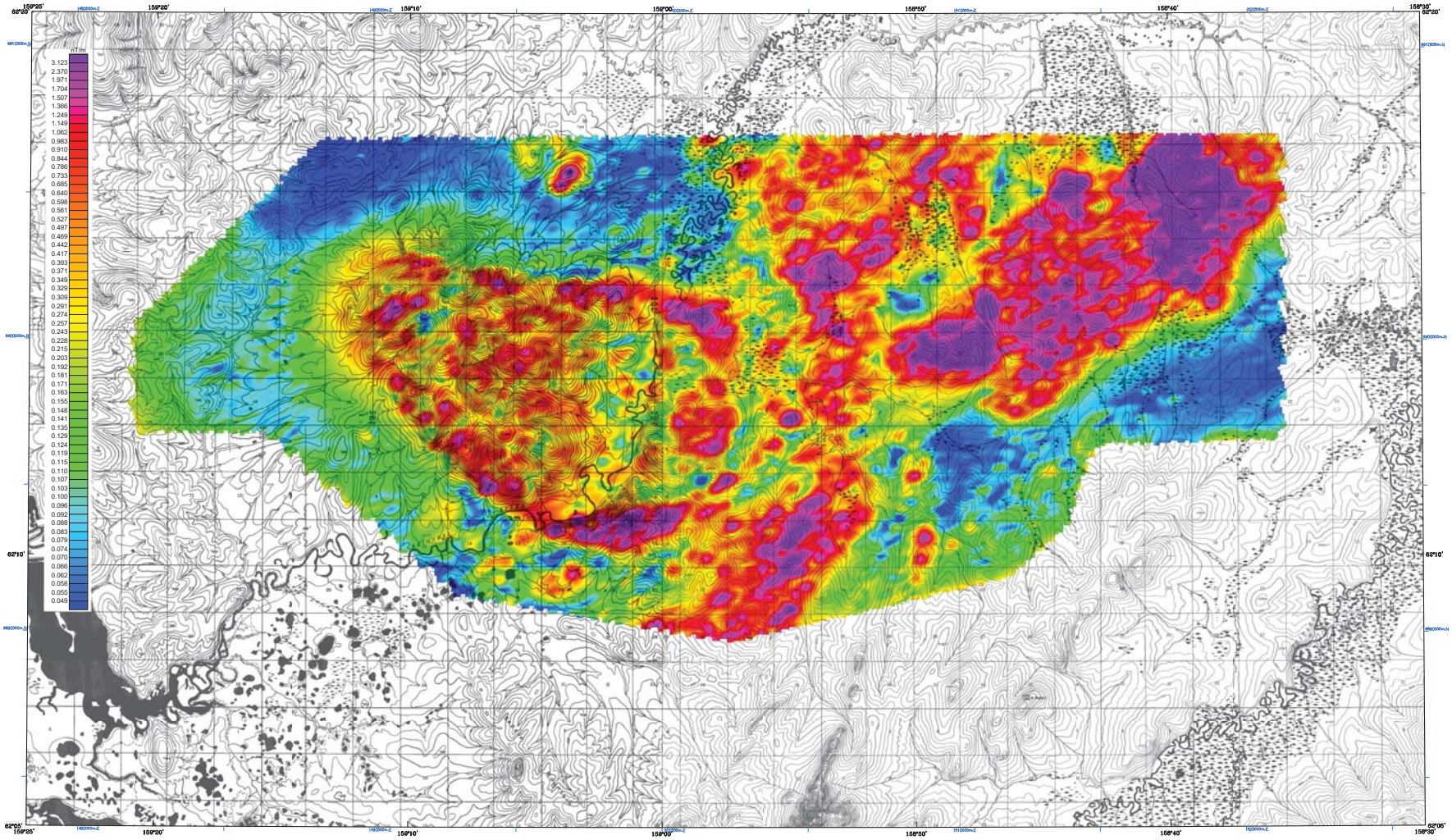


Base from U.S. Geological Survey Bethel A-5, 1951; B-6, 1954; Holy Cross A-1, 1975; B-1, 1977; Queingnaghak, Alaska

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

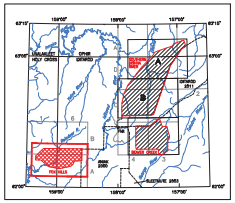
ANALYTIC SIGNAL WITH TOPOGRAPHY OF THE FOX HILLS SURVEY AREA, WESTERN ALASKA

PARTS OF THE HOLY CROSS AND IDITAROD QUADRANGLES

by

Laurel E. Burns, Fugro Airborne Surveys Corp., and Fugro GeoServices, Inc.
2013

LOCATION INDEX



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ANALYTIC SIGNAL

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 (e.g., contacts, fault/shear zones, etc.). Analytic signal maxima are located directly over faults and contacts, regardless of structural dip, and independently of the direction of the induced and/or remanent magnetizations.

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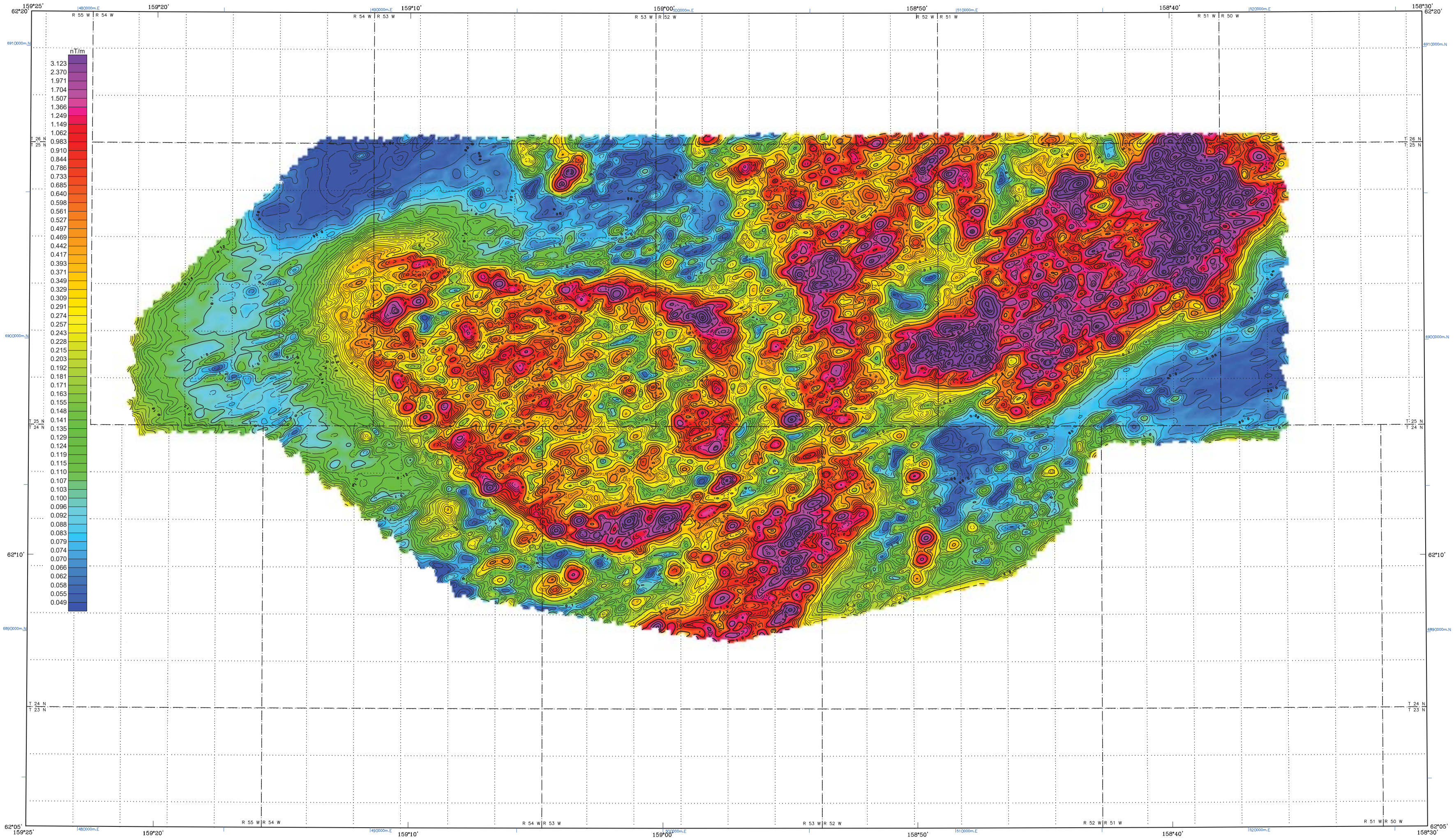
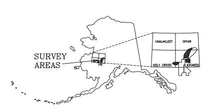


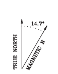
Section outlines from U.S. Geological Survey Iditarod A–6, 1982; B–6, 1954; Holy Cross A–1, 1975; B–1, 1967; Quadrangles, Alaska

SCALE 1:63,360

1 0 1 2 3 4 MILES

1 0 1 2 3 4 5 KILOMETERS





APPROXIMATE MEAN DECLINATION, 2010

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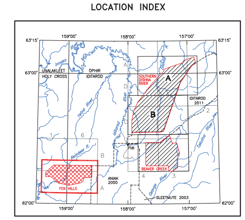

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ANALYTIC SIGNAL CONTOURS

________	0.50 nT/metre
________	0.10 nT/metre
________	0.02 nT/metre
__ __ __ __	0.01 nT/metre

SURVEY HISTORY

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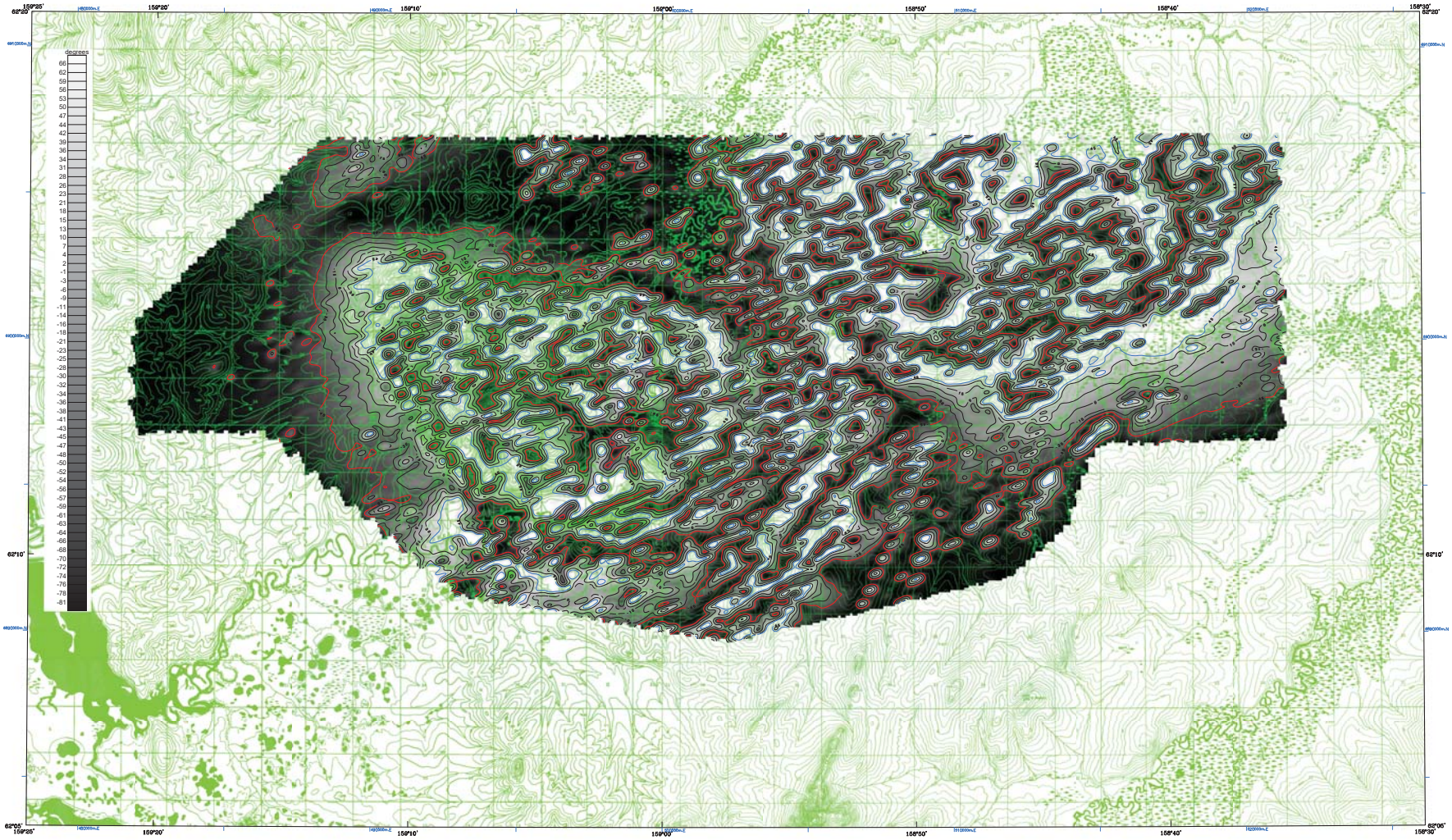


Base from U.S. Geological Survey Bethel A-5, 1951; B-6, 1954; Holy Cross A-1, 1975; B-1, 1975; Queinagbee, Alaska

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

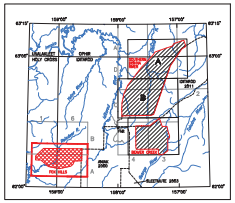
MAGNETIC TILT DERIVATIVE WITH TOPOGRAPHY AND DATA CONTOURS OF THE FOX HILLS SURVEY AREA, WESTERN ALASKA

PARTS OF THE HOLY CROSS AND IDITAROD QUADRANGLES

by

Laurel E. Burns, Fugro Airborne Surveys Corp., and Fugro GeoServices, Inc.
2013

LOCATION INDEX



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MAGNETIC TILT DERIVATIVE

The tilt derivative is the angle between the horizontal gradient & the total gradient, which is useful for identifying the depth & type of source. The tilt angle is positive over the source, crosses through zero at, or near, the edge of a vertical sided source, and is negative outside the source region. It has the added advantage of responding equally well to shallow and deep sources and is able to resolve deeper sources that may be masked by larger responses from shallower sources.

MAGNETIC TILT DERIVATIVE CONTOURS

- +45 degrees
- +30 degrees
- +15 degrees
- 0 degrees
- -15 degrees
- -30 degrees
- -45 degrees

SURVEY HISTORY

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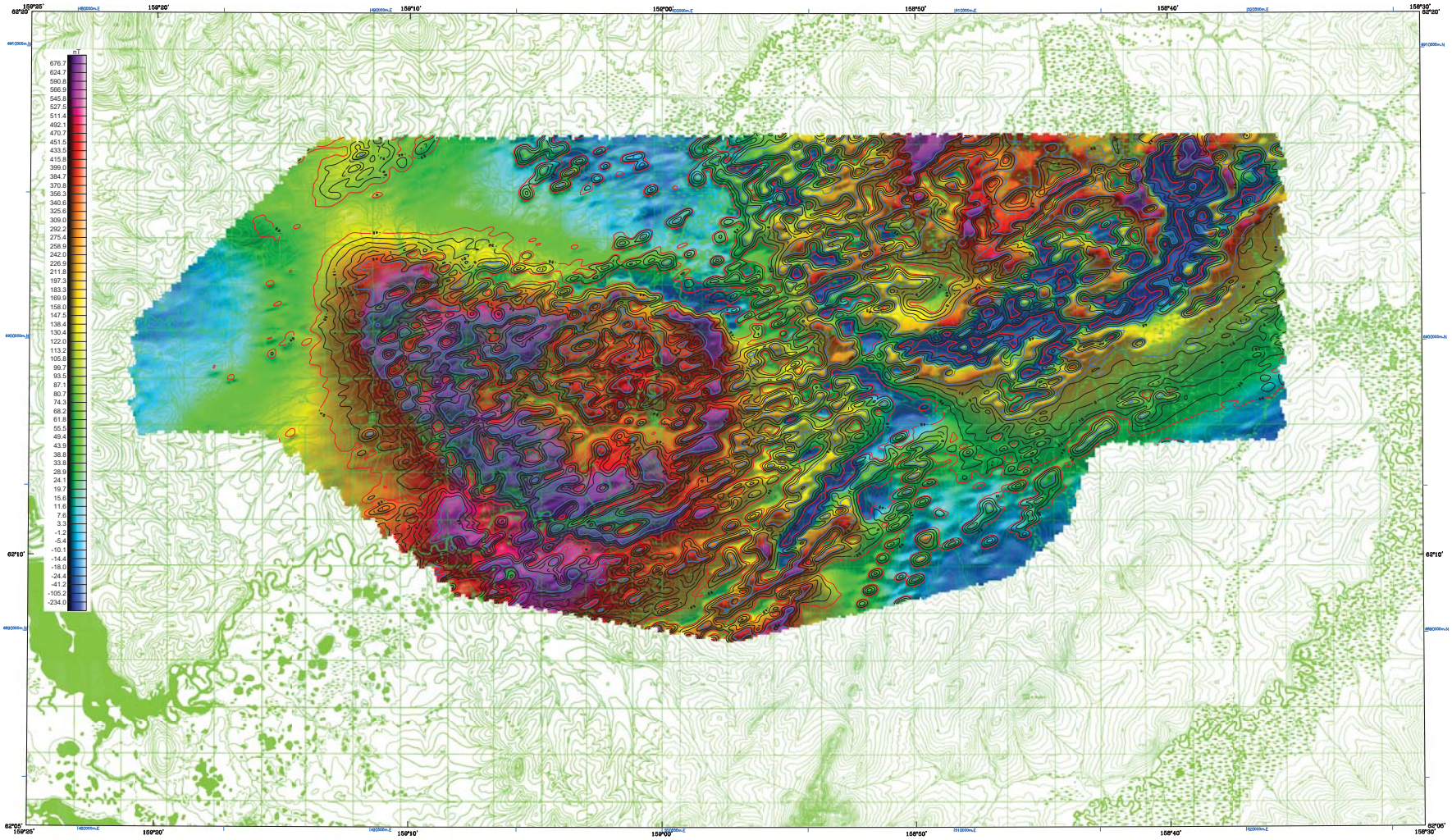


Roadbed outlines from U.S. Geological Survey Mineral A-8, 1953; D-8, 1954; Holy Cross A-1, 1975; D-1, 1975; Quadrangles, Alaska

SCALE 1:63,360

1 0 1 2 3 4 MILES

1 0 1 2 3 4 5 KILOMETERS

COLOR SHADOW RESIDUAL MAGNETIC FIELD WITH MAGNETIC TILT DERIVATIVE DATA CONTOURS OF THE FOX HILLS SURVEY AREA, WESTERN ALASKA

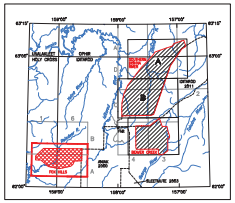
PARTS OF THE HOLY CROSS AND IDITAROD QUADRANGLES

by

Laurel E. Burns, Fugro Airborne Surveys Corp., and Fugro GeoServices, Inc.
2013

Sun Azimuth: 0 degrees
Sun Inclination: 45 degrees

LOCATION INDEX



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- +30 degrees
- +15 degrees
- 0 degrees
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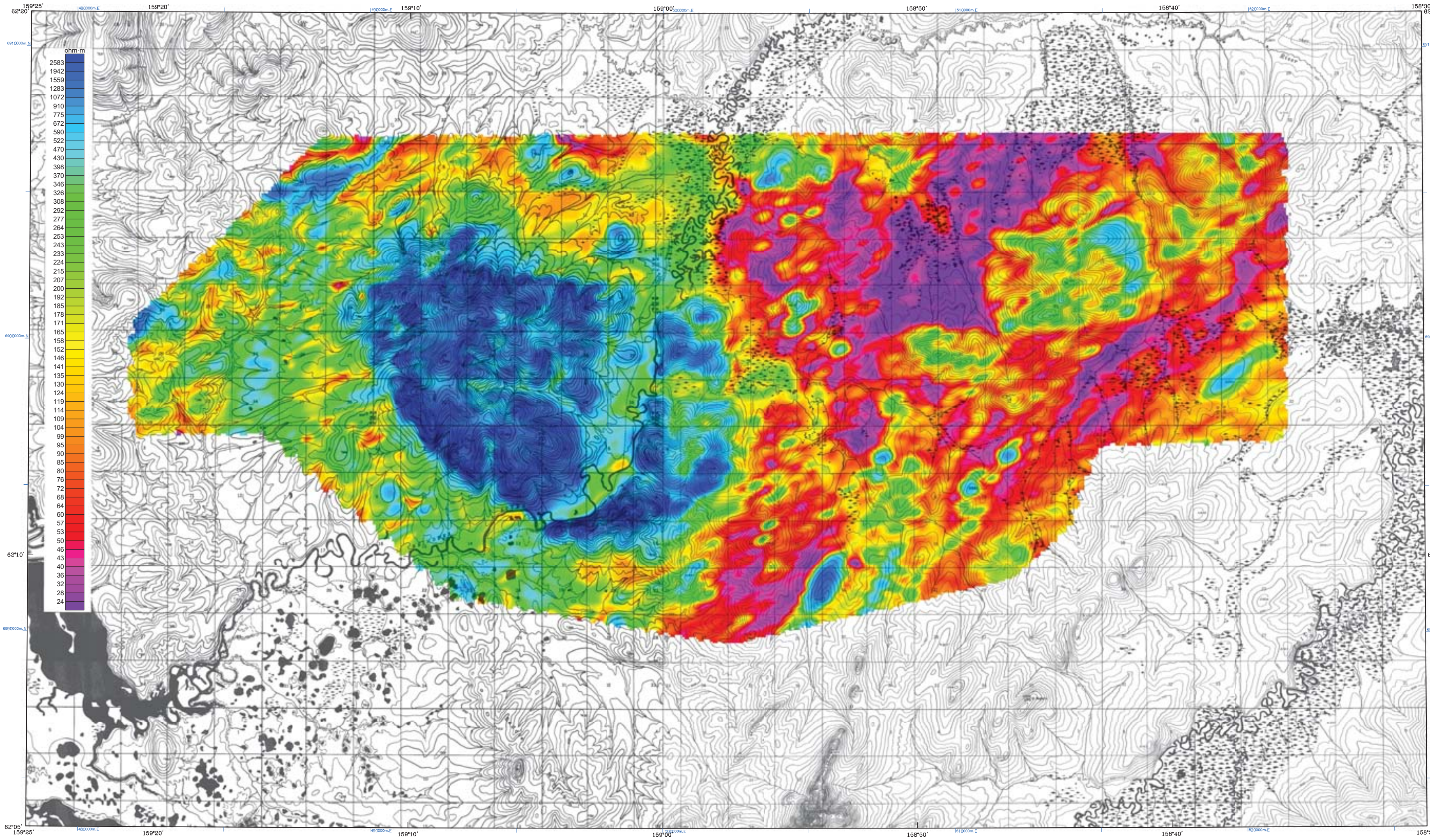
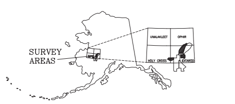
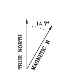


Base from U.S. Geological Survey Iditarod A-6, 1982; B-6, 1954; Holy Cross A-1, 1975; B-1, 1967; Quadrangles, Alaska





APPROXIMATE MEAN DECLINATION, 2010

SCALE 1:63,360

1 0 1 2 3 4 MILES

1 0 1 2 3 4 5 KILOMETERS

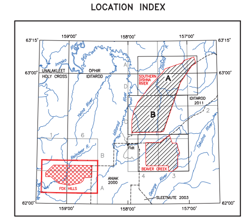
CONTOUR INTERVAL 100 FEET
DATUM MEAN SEA LEVEL

56,000 Hz COPLANAR APPARENT RESISTIVITY WITH TOPOGRAPHY OF THE FOX HILLS SURVEY AREA, WESTERN ALASKA

PARTS OF THE HOLY CROSS AND IDITAROD QUADRANGLES

by
Laurel E. Burns, Fugro Airborne Surveys Corp., and Fugro GeoServices, Inc.
2013

LOCATION INDEX



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RESISTIVITY

The DIGHEM^V EM system measured inphase and quadrature components at five frequencies. Two vertical coaxial coil–pairs operated at 1000 and 5500 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. 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 80 m grid using a modified Akima (1970) technique. All grids were then resampled from the 80 m cell size down to a 25 m cell size to produce the maps and final grids contained in this publication.

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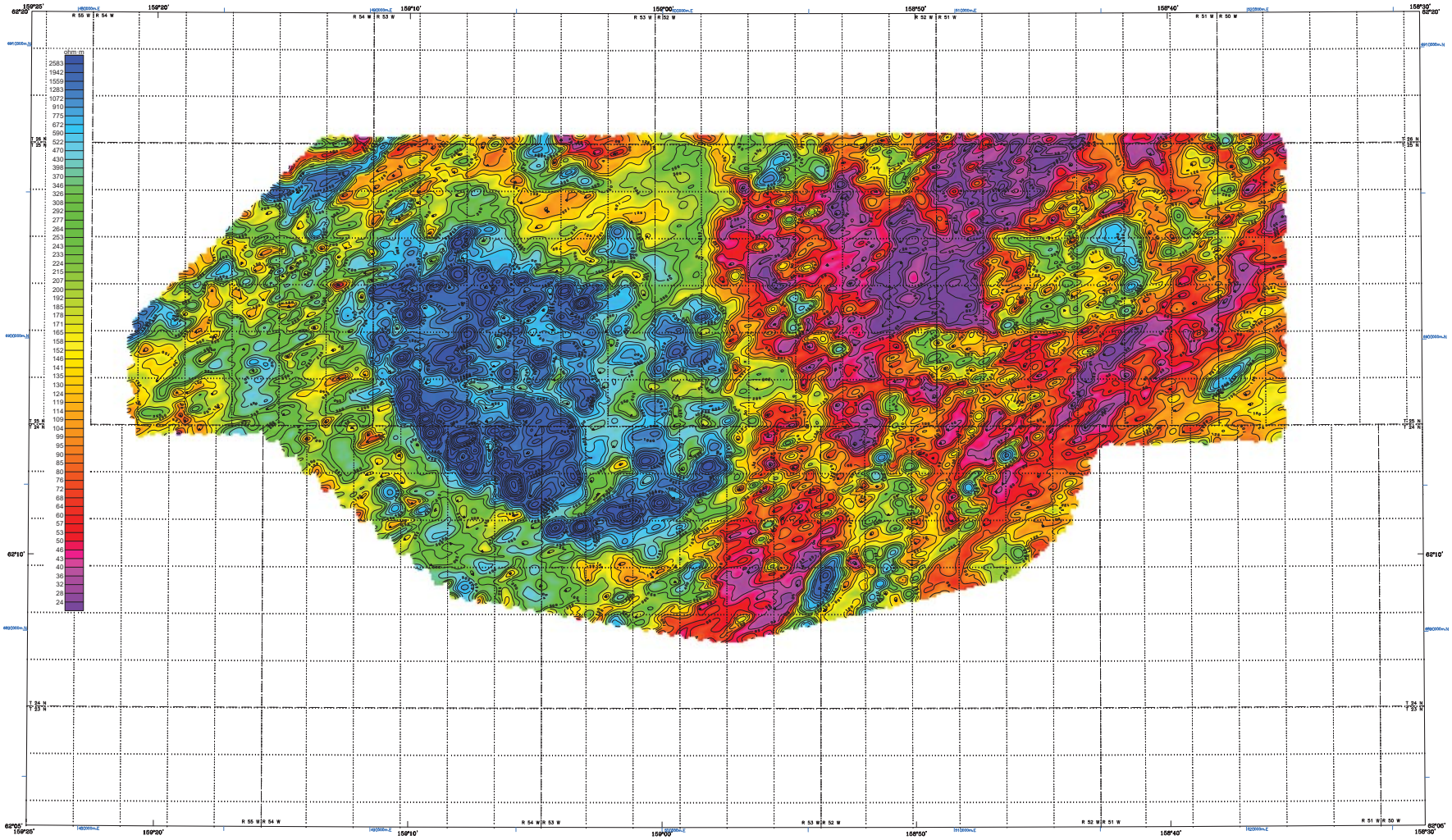

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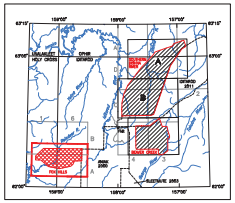

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RESISTIVITY CONTOURS

1000
800
600
500
400
300
250
200
150
125
100

Contours in ohm-m at 10 intervals per decade

. . . . . resistivity low

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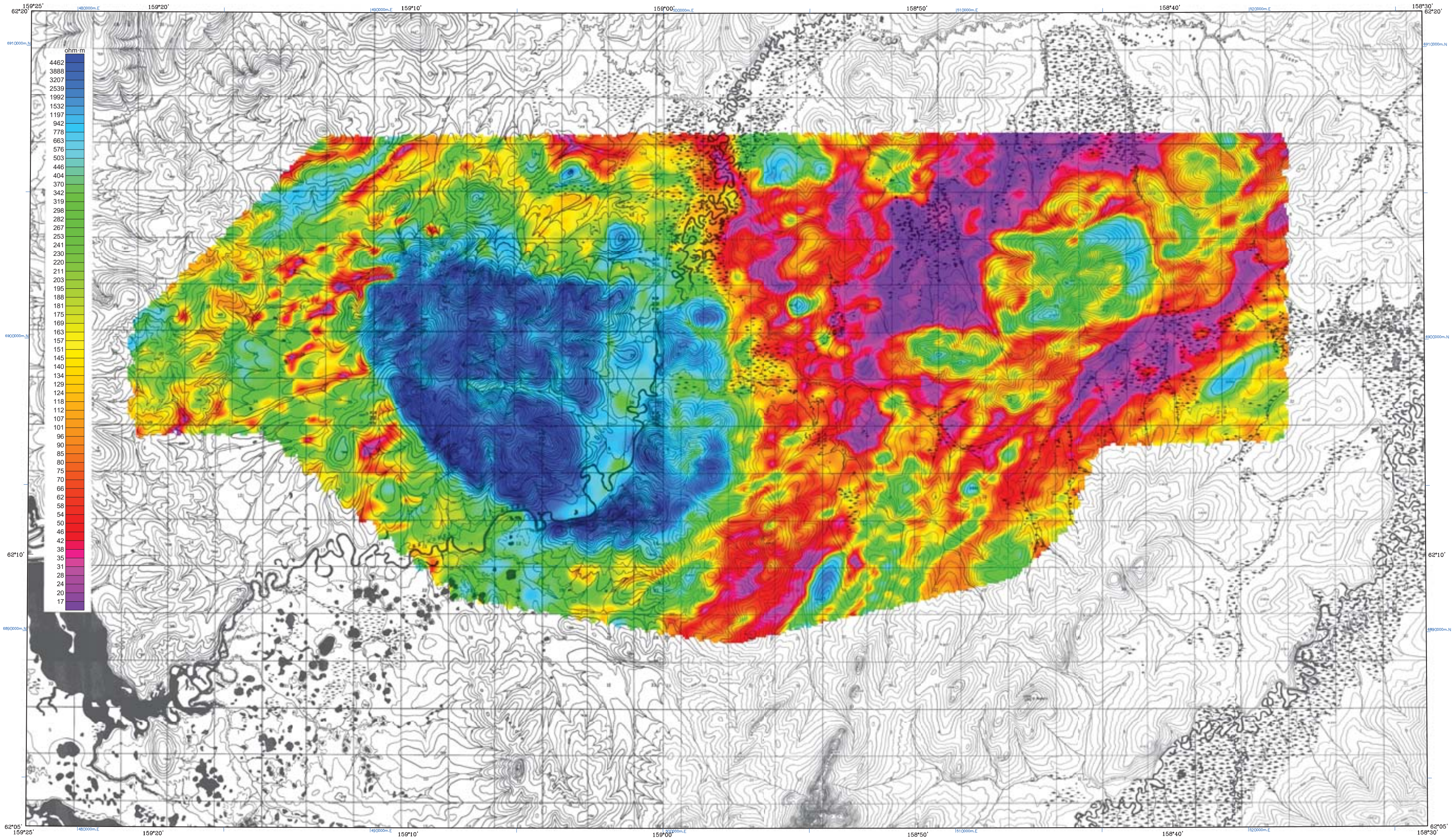
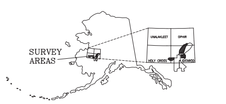
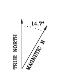


Base from U.S. Geological Survey Iditarod A–6, 1982; B–6, 1954; Holy Cross A–1, 1975; B–1, 1967; Quadrangles, Alaska





APPROXIMATE MEAN DECLINATION, 2010

SCALE 1:63,360

1 0 1 2 3 4 MILES

1 0 1 2 3 4 5 KILOMETERS

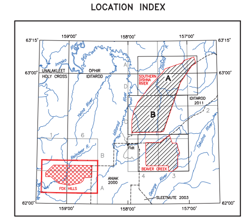
CONTOUR INTERVAL 100 FEET
DATUM MEAN SEA LEVEL

7200 Hz COPLANAR APPARENT RESISTIVITY WITH TOPOGRAPHY OF THE FOX HILLS SURVEY AREA, WESTERN ALASKA

PARTS OF THE HOLY CROSS AND IDITAROD QUADRANGLES

by
Laurel E. Burns, Fugro Airborne Surveys Corp., and Fugro GeoServices, Inc.
2013

LOCATION INDEX



DESCRIPTIVE NOTES

The geophysical data were acquired with a DIGHEM^{V} Electromagnetic (EM) system and a Fugro D1344 cesium magnetometer with a Scintrex CS3 cesium sensor. The EM and magnetic sensors were flown at a height of 100 feet. In addition the survey recorded data from radar and laser altimeters, GPS navigation system, 50/60 Hz monitors and video camera. Flights were performed with an AS–350–B3 Squirrel helicopter at a mean terrain clearance of 200 feet along NW–SE (340°) 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 3 miles.

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RESISTIVITY

The DIGHEM^{V} EM system measured inphase and quadrature components at five frequencies. Two vertical coaxial coil–pairs operated at 1000 and 5500 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. Apparent resistivity is generated from the inphase and quadrature component of the coplanar 7200 Hz using the pseudo–layer half space model. The data were interpolated onto a regular 80 m grid using a modified Akima (1970) technique. All grids were then resampled from the 80 m cell size down to a 25 m cell size to produce the maps and final grids contained in this publication.

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.

SURVEY HISTORY

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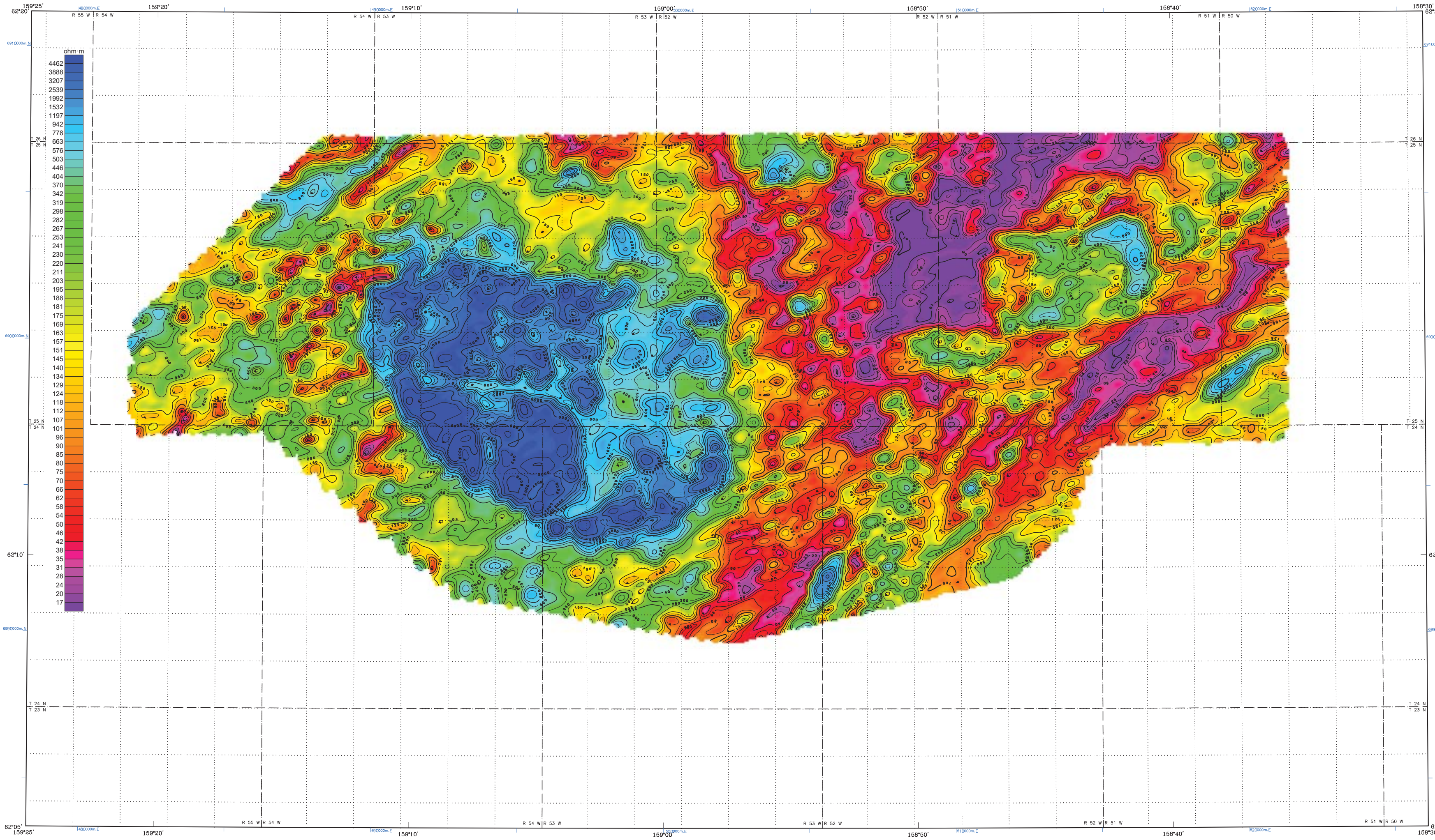
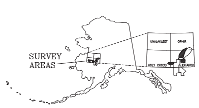


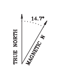
Section outlines from U.S. Geological Survey Iditarod A-6, 1952; B-6, 1954; Holy Cross A-1, 1975; B-1, 1967; Quadrangles, Alaska

SCALE 1:63,360

1 0 1 2 3 4 MILES

1 0 1 2 3 4 5 KILOMETERS





APPROXIMATE MEAN DECLINATION, 2010

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2013

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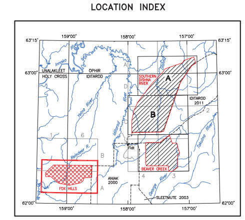

DESCRIPTIVE NOTES

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RESISTIVITY CONTOURS

1000
800
600
500
400
300
250
200
150
125
100

Contours in ohm–m at 10 intervals per decade

. . . . resistivity low

SURVEY HISTORY

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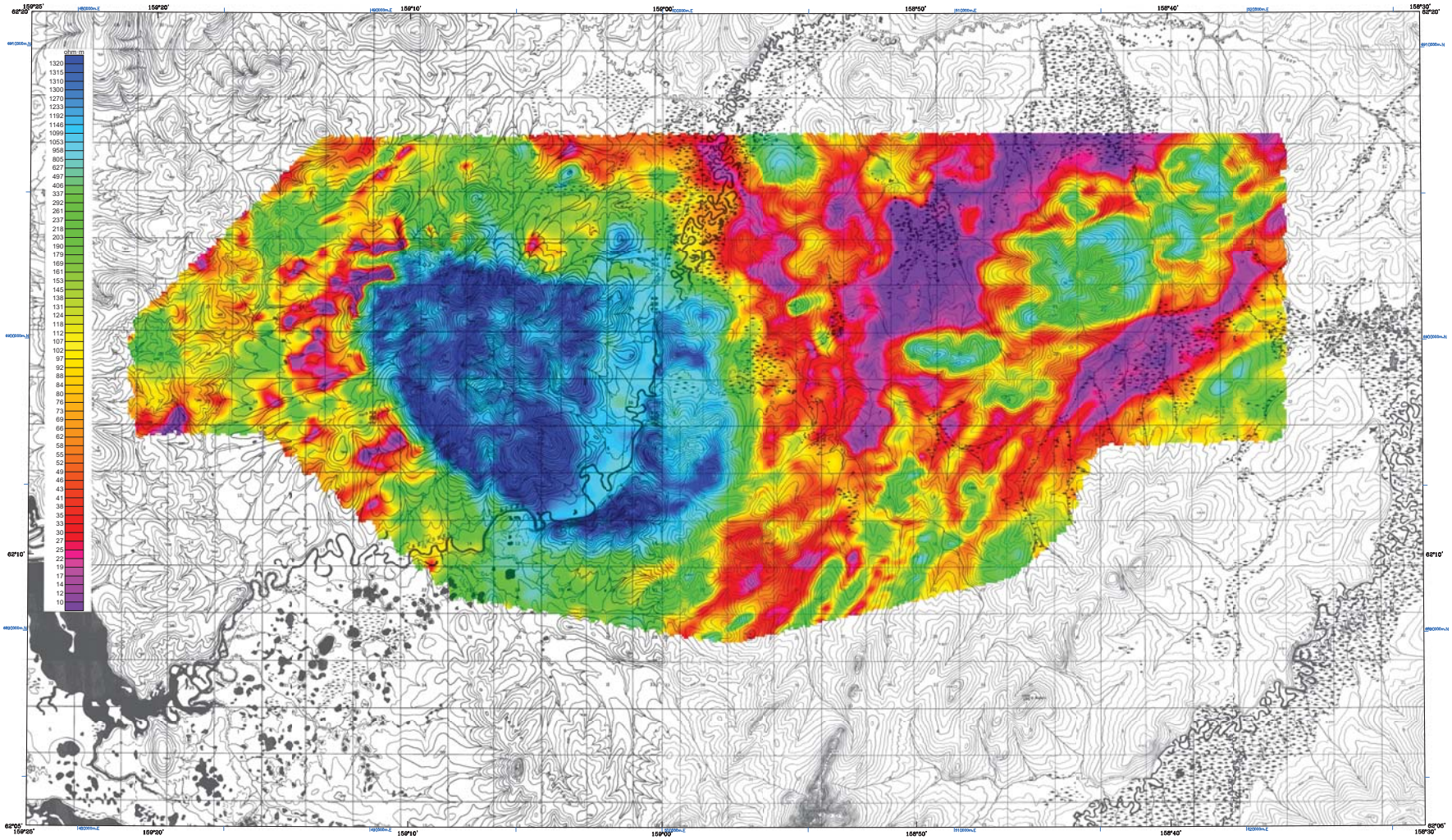


Base from U.S. Geological Survey Bethel A-5, 1951; B-6, 1954; Holy Cross A-1, 1975; B-1, 1972; Queingnagbak, Alaska

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

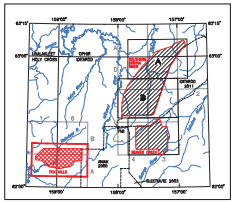
900 Hz COPLANAR APPARENT RESISTIVITY WITH TOPOGRAPHY OF THE FOX HILLS SURVEY AREA, WESTERN ALASKA

PARTS OF THE HOLY CROSS AND IDITAROD QUADRANGLES

by

Laurel E. Burns, Fugro Airborne Surveys Corp., and Fugro GeoServices, Inc.
2013

LOCATION INDEX



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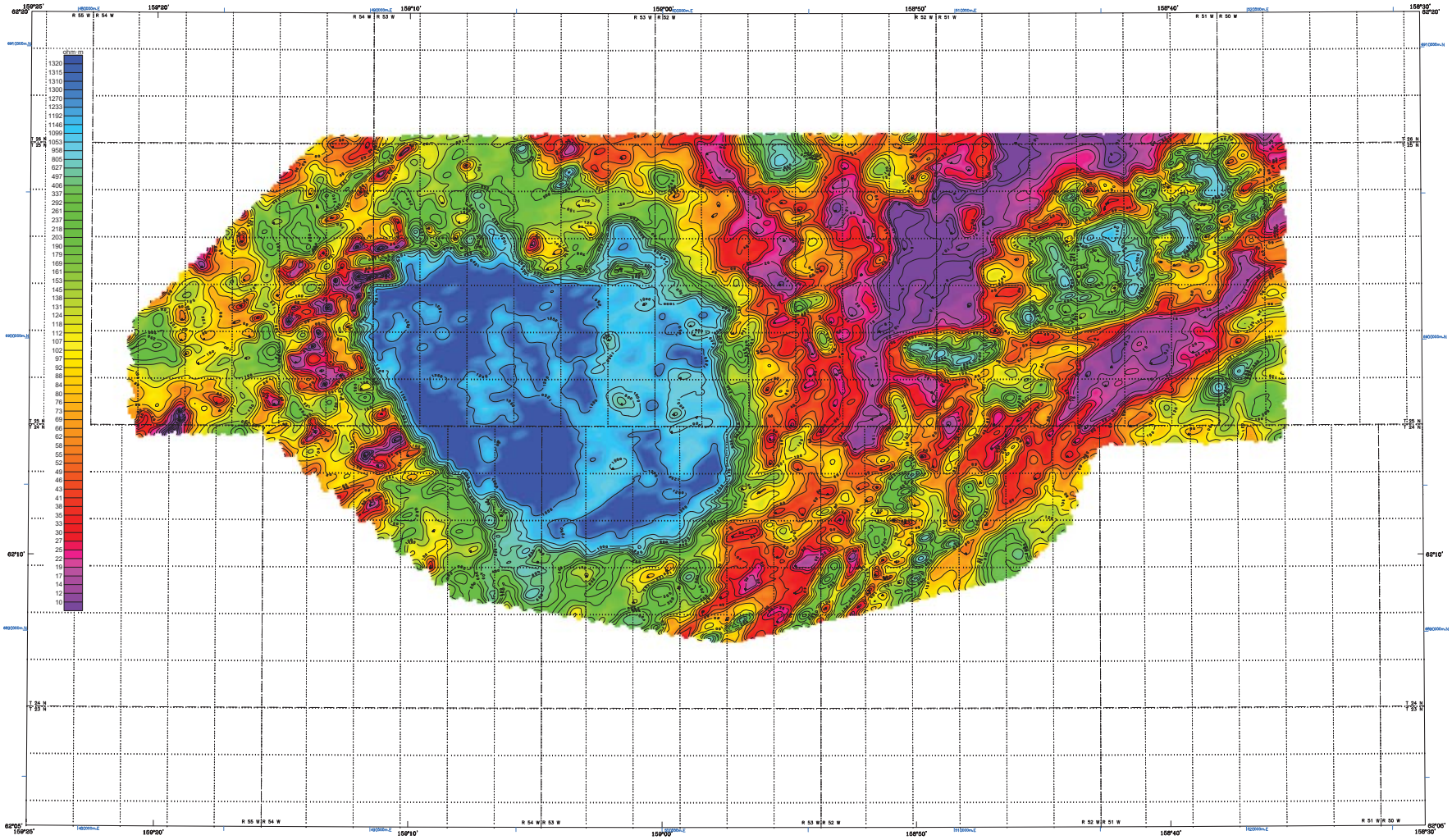

Base outline from U.S. Geological Survey Miscellaneous Investigations Series Maps I-1, 1958; I-2, 1964; Holy Cross A-1, 1975; D-1, 1975; Quadrangles, Alaska

SCALE 1:63,360

1 0 1 2 3 4 MILES

1 0 1 2 3 4 5 KILOMETERS

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2013

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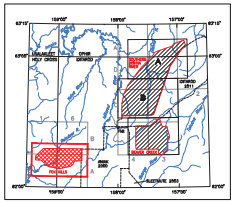

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RESISTIVITY CONTOURS

1000
800
600
500
400
300
250
200
150
125
100

Contours in ohm-m at 10 intervals per decade

. . . . . resistivity low

SURVEY HISTORY

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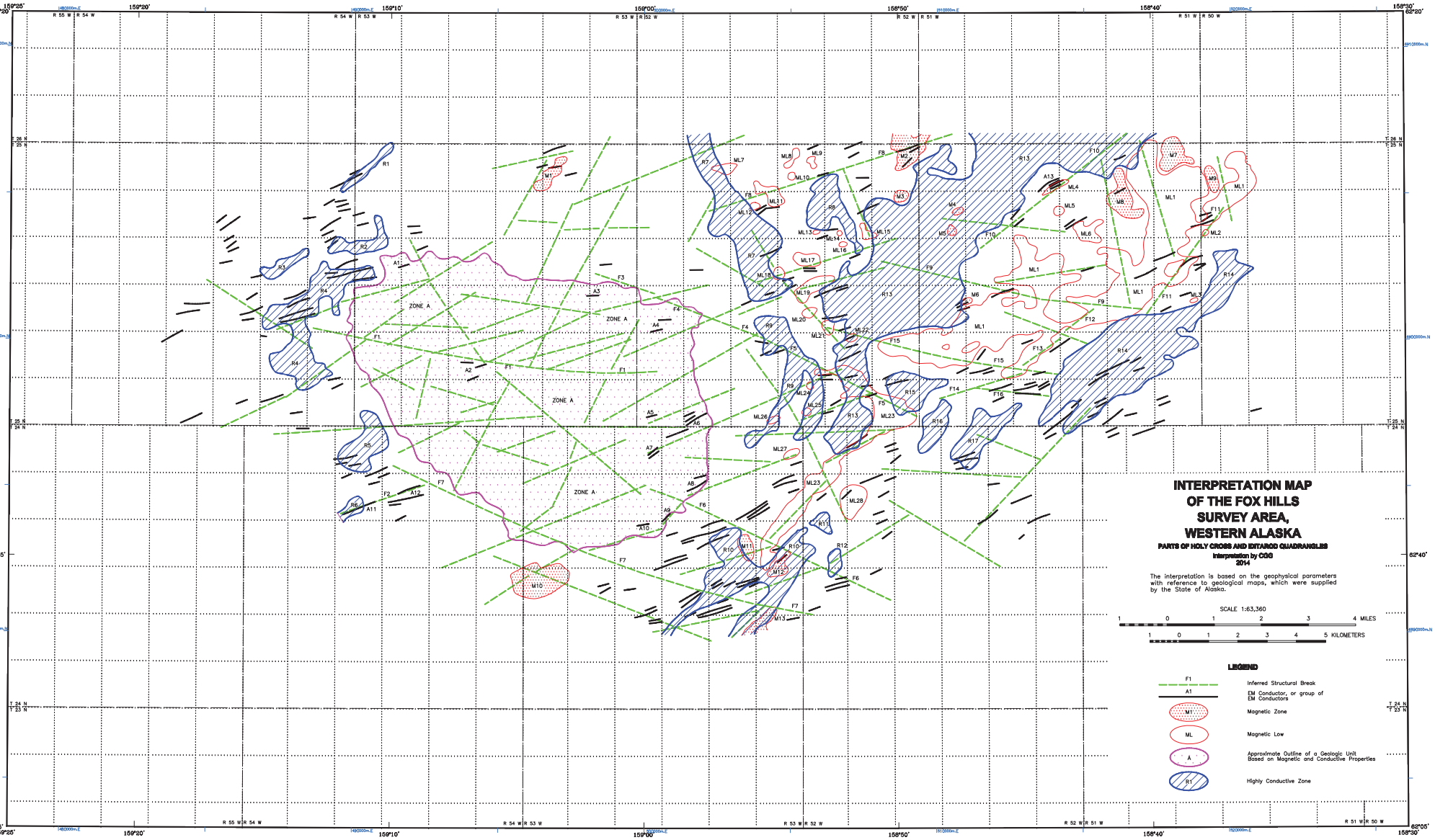
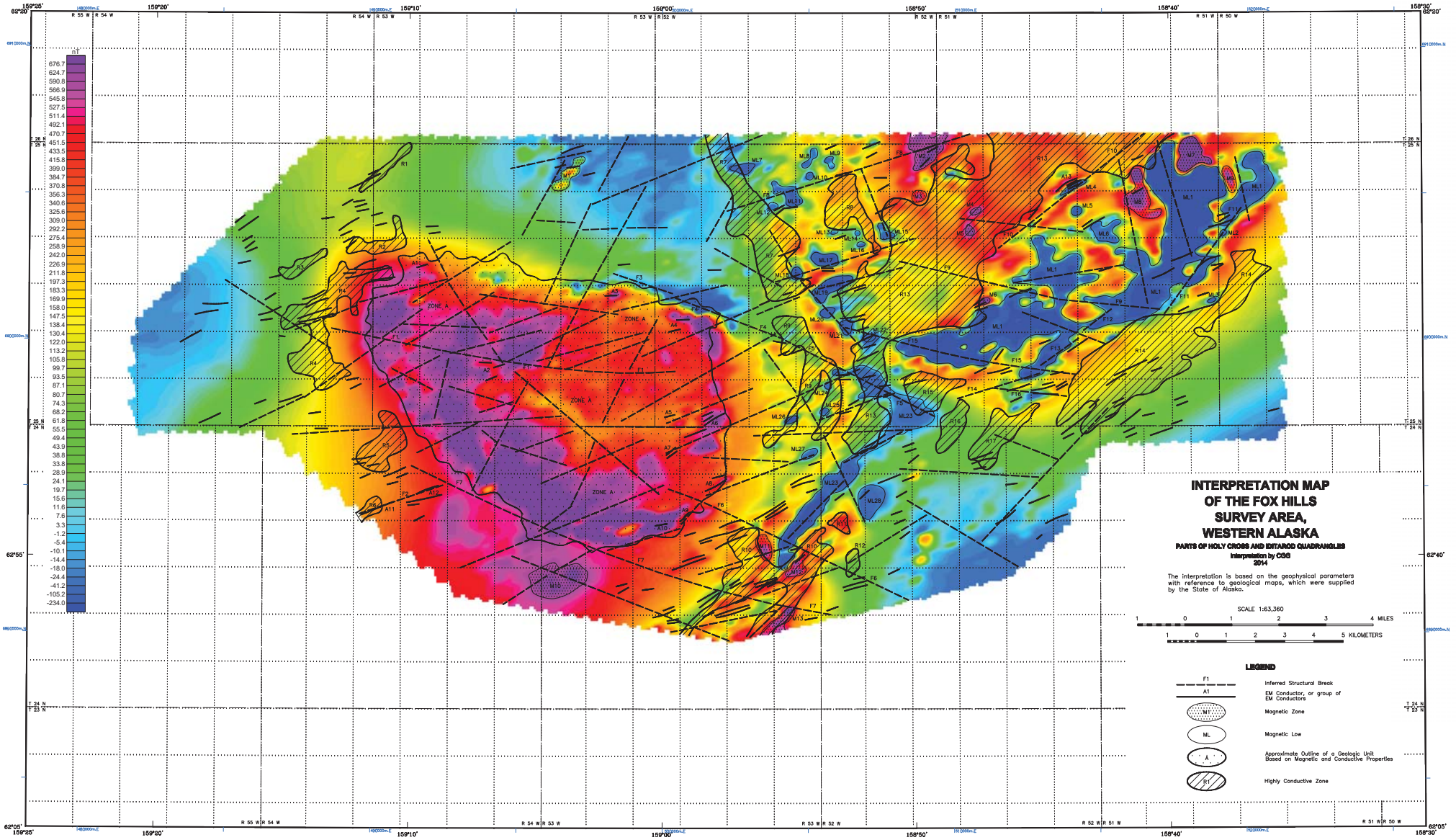

INTERPRETATION MAP
OF THE FOX HILLS
SURVEY AREA,
WESTERN ALASKA
PARTS OF HOLY CROSS AND ISTAROD QUADRANGLES
Interpretation by CGG
2014
The interpretation is based on the geophysical parameters with reference to geological maps, which were supplied by the State of Alaska.
SCALE 1:63,360
1 0 1 2 3 4 MILES
1 0 1 2 3 4 5 KILOMETERS
LEGEND
F1 Inferred Structural Break
A1 EM Conductor, or group of EM Conductors
M1 Magnetic Zone
ML Magnetic Low
A Approximate Outline of a Geologic Unit Based on Magnetic and Conductive Properties
R1 Highly Conductive Zone
ZONE A
159°25'
159°20'
159°10'
159°00'
158°50'
158°40'
158°30'
62°20'
62°55'
62°40'
62°05'
R 55 W R 54 W
R 54 W R 53 W
R 53 W R 52 W
R 52 W R 51 W
R 51 W R 50 W
T 26 N
T 25 N
T 24 N
T 23 N


INTERPRETATION MAP
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PARTS OF HOLY CROSS AND ECHAROO QUADRANGLES
Interpretation by CGG
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1 0 1 2 3 4 MILES
1 0 1 2 3 4 5 KILOMETERS
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62°40'
62°05'
R 55 W R 54 W
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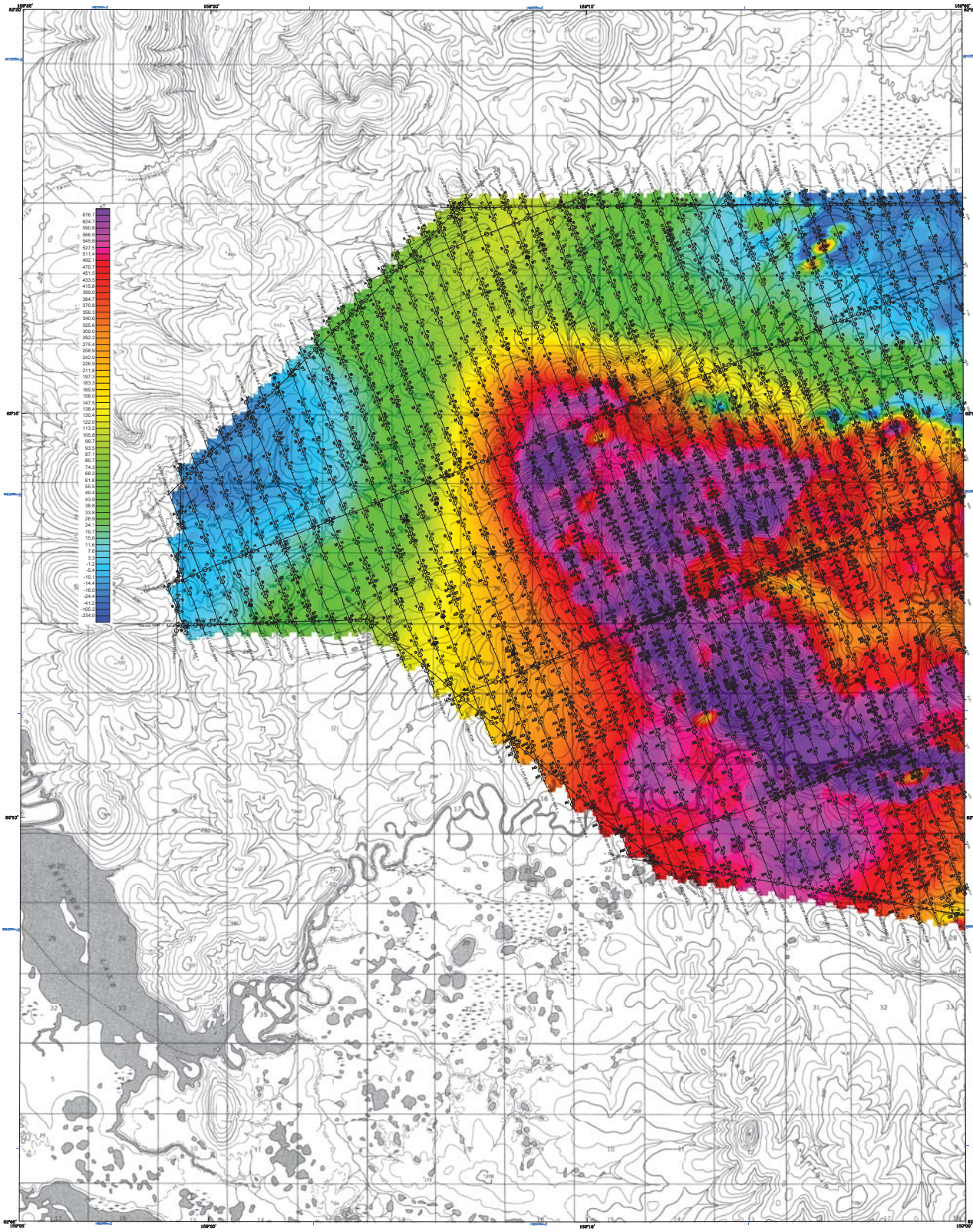
T 26 N
T 25 N
T 24 N
T 23 N



Base Data U.S. Geological Survey Holy Cross A-1, 1970; B-1, 1971 Quadrangles, 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

PROJECTION: UNIVERSAL TRANSVERSE MERCATOR
DATUM: NORTH AMERICAN 1927

RESIDUAL MAGNETIC FIELD AND DETAILED ELECTROMAGNETIC ANOMALIES WITH TOPOGRAPHY, FOX HILLS SURVEY AREA, WESTERN ALASKA

PARTS of HOLY CROSS A-1 and B-1 QUADRANGLES

by
Laurel E. Burns, CGG, and Fugro GeoServices, Inc.
2014

DESCRIPTIVE NOTES

The geophysical data were acquired with a DIGHEM^{V} Electromagnetic (EM) system and a Fugro D1344 cesium magnetometer with a Scintrex CS3 cesium sensor. The EM and magnetic sensors were flown at a height of 100 feet. In addition the system measured data from a radar altimeter, GPS navigation system, 50/60 Hz monitors and video camera. Flights were performed with an AS-350-B2 Squirrel helicopter at a mean terrain clearance of 200 feet along NW-SE (340°) 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 3 miles.

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ELECTROMAGNETIC ANOMALIES

Anomaly identifier: Area indicate the conductor has a thickness >10m; Dip direction; Magnetic correlation in nT

Interpretive symbol: Anomaly identifier

Interpretive symbol

Anomaly	Conductance
●	>100 siemens
●	50–100 siemens
●	20–30 siemens
●	10–20 siemens
○	5–10 siemens
○	1–5 siemens
○	< 1 siemens
❋	Questionable anomaly
△	EM magnetite response
□	Culture

Interpretive symbol	Conductor model
B	Bedrock conductor
D	Narrow bedrock conductor ("thin sheet")
S	Conductive cover ("horizontal thin sheet")
H	Broad conductive rock unit, deep conductive weathering, thick conductive cover ("half-space")
E	Edge of broad conductor (half-space model)
L	Culture, e.g., power line, metal building or fence
M	Magnetite

Indicates some uncertainty as to the most appropriate EM source model, but does not question the validity of the EM anomaly.

ELECTROMAGNETICS

To determine the location of EM anomalies or their boundaries, the DIGHEM^{V} EM system measures inphase and quadrature components at five frequencies. Two vertical coaxial coil pairs operated at 1000 and 56,000 Hz, a slide 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.

RESIDUAL MAGNETIC FIELD

The magnetic total field data were processed using digitally recorded data from a Fugro D1344 magnetometer with a Scintrex CS3 cesium sensor. Data were collected at 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) IGRF corrected (IGRF model 2010, updated for date of flight and altimeter variations), (3) leveled to the tie line data, and (4) interpolated onto a regular 80 m grid using a modified Akima (1970) technique. All grids were then resampled from the 80 m cell size down to a 25 m cell size to produce the maps and final grids contained in this publication.

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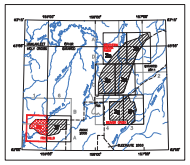
LOCATION INDEX OF 1:31,680-SCALE MAPS



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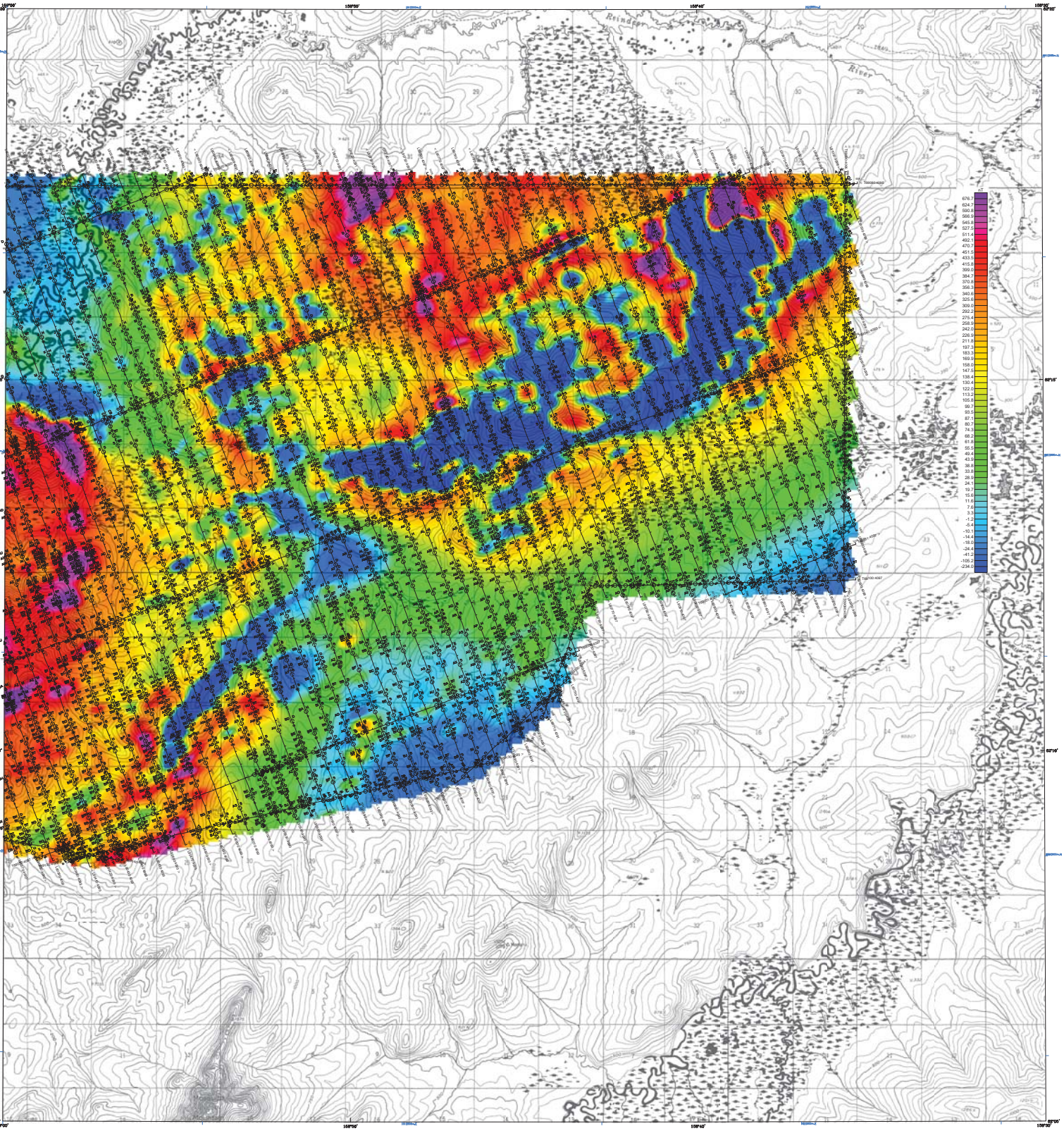

Base from U.S. Geological Survey Iditarod A-5, 1953; B-5, 1954; Quadrangles, Alaska

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

CONTOUR INTERVAL 40 FEET
DATUM IS MEAN SEA LEVEL

RESIDUAL MAGNETIC FIELD AND DETAILED ELECTROMAGNETIC ANOMALIES WITH TOPOGRAPHY, FOX HILLS SURVEY AREA, WESTERN ALASKA

PARTS of IDITAROD A-5 and B-5 QUADRANGLES

by
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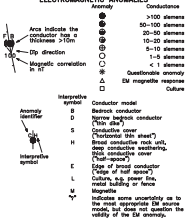
DESCRIPTIVE NOTES

The geophysical data were acquired with a DIGHEM Electromagnetic (EM) system and a Fugro D1344 cesium magnetometer with a Scintrex CS3 cesium sensor. The EM and magnetic sensors were flown at a height of 100 feet. In addition the system measures the height above terrain with altimeters, GPS navigation system, 50/60 Hz monitors and video cameras. Flights were performed with an AS-350-B2 Squirrel helicopter at a mean terrain clearance of 200 feet along NW-SE (340°) 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 3 miles.

A Novatel OEM4-G2L Global Positioning System was used for navigation. The helicopter position was derived every 0.5 seconds using post-flight differential positioning to a relative accuracy of better than 5 m. Flight path positions were projected onto the Clarke 1866 (UTM zone 4) spheroid, 1927 North American datum using a central meridian (CM) of 159°, 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.

ELECTROMAGNETIC ANOMALIES



ELECTROMAGNETICS

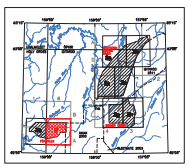
To determine the location of EM anomalies or their boundaries, the DIGHEM EM system measures inphase and quadrature components at five frequencies (coaxial-coplanar coils operated at 1000 and 5000 Hz while three horizontal coplanar-coil pairs operated at 900, 7200, and 56,000 Hz. EM data were sampled 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.

RESIDUAL MAGNETIC FIELD

The magnetic total field data were processed using digitally recorded data from a Fugro D1344 magnetometer with a Scintrex CS3 cesium sensor. Data were collected at 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) IGRF corrected (IGRF model 2010, updated for date of flight and altimeter variations), (3) leveled to the tie line data, and (4) interpolated onto a regular 80 m grid using a modified Akima (1970) technique. All grids were then resampled from the 80 m cell size down to a 25 m cell size to produce the maps and final grids contained in this publication.

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 OF 1:31,680-SCALE MAPS



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 (DGGS), and Fugro GeoServices, Inc. Airborne geophysical data for the area were acquired and processed by CGG in 2012, 2013, and 2014. Previously flown DGGS surveys adjacent to the current survey are shown in the location map by dashed lines, survey name, and date of publication. The project was funded by the Alaska State Legislature as part of the Alaska Airborne Geological & Geophysical Mineral Inventory Program.

All data and maps produced to date from this survey are available in digital format on DVD for a nominal fee through DGGS, 3354 College Road, Fairbanks, Alaska, 99709-3707, and are downloadable for free from the DGGS website (www.dggs.alaska.gov/pubs). Maps are also available on paper through the DGGS office, and are viewable online at the website in Adobe Acrobat .PDF file format.