STYX RIVER ELECTROMAGNETIC AND MAGNETIC AIRBORNE GEOPHYSICAL SURVEY DATA COMPILATION

Burns, L.E., Emond, A.M., Fugro Airborne Surveys Corp., and Stevens Exploration Management Corp

Geophysical Report 2019-2

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DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS

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STYX RIVER ELECTROMAGNETIC AND MAGNETIC AIRBORNE GEOPHYSICAL SURVEY DATA COMPILATION

Burns, L.E.,[1] Emond, A.M.[1], Fugro Airborne Surveys Corp., and Stevens Exploration Management Corp

ABSTRACT

This geophysical survey is located in the upper South Fork Kuskokwim River and Skwentna river drainages, southcentral Alaska. The Styx River survey is in the Yentna and McGrath mining districts, about 150 kilometers northwest of Anchorage, Alaska. Frequency domain electromagnetic and magnetic data were collected with the DIGHEM system from October 16th to November 12th, 2007 and from March 21st to April 22nd, 2008. A total of 5338.6 line-kilometers were collected covering 1859.3 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. Major lode-mineral prospects in the survey area include Estelle, Whistler, Terra, and Copper Joe. 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 and by a contribution from Anglo American Exploration (USA) Inc.

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

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 binary grids, these grids can be viewed in ESRI ArcMap using a free plugin from Geosoft or a free viewer available from Geosoft
images_registered	DGGS	GeoTiff format images of all gridded data
kmz	contractor	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/G 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

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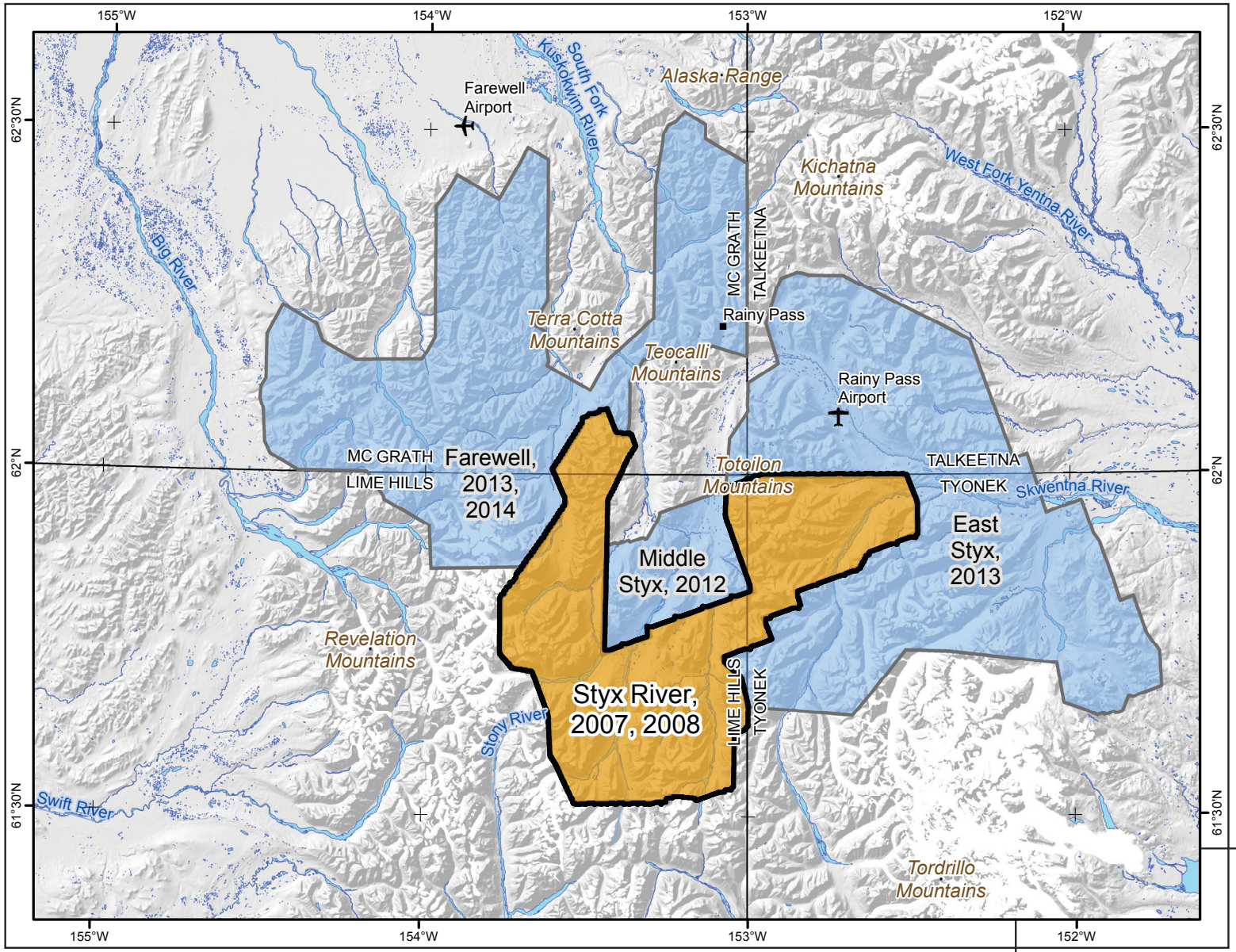
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CGG, and Fugro GeoServices, Inc., 2015, Farewell and Middle Styx survey areas: Project report, interpretation maps, EM anomalies, stacked multi-channel profiles, and other products of the airborne geophysical surveys, parts of the McGrath, Lime Hills, and Tyonek quadrangles, south-central Alaska: Alaska Division of Geological & Geophysical Surveys Geophysical Report 2014-4, 22 sheets. http://doi.org/10.14509/29349

Geoterrex-Dighem, Fugro Airborne Surveys, Stevens Exploration Management Corp., Pritchard, R.A., Burns, L.E., Emond, A.M., and DGGS Staff, 2016, Sub-regional, merged, gridded airborne geophysical data: Alaska Division of Geological & Geophysical Surveys Digital Data Series 12, 1 DVD. http://doi.org/10.14509/29555



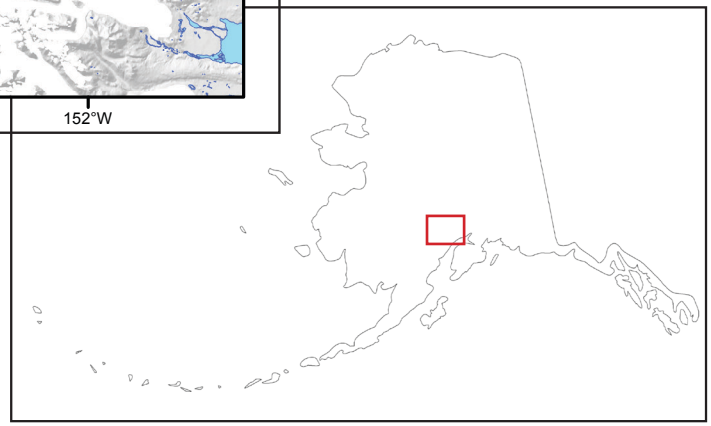


Figure 1. Location of Styx aeromagnetic geophysical survey area, southern Alaska (inset). Styx River survey area shown with adjacent DGGS geophysical surveys, landmarks, relevant 1:250,000-scale quadrangle boundaries, mountain ranges, rivers, glaciers, and elevation hillshade.

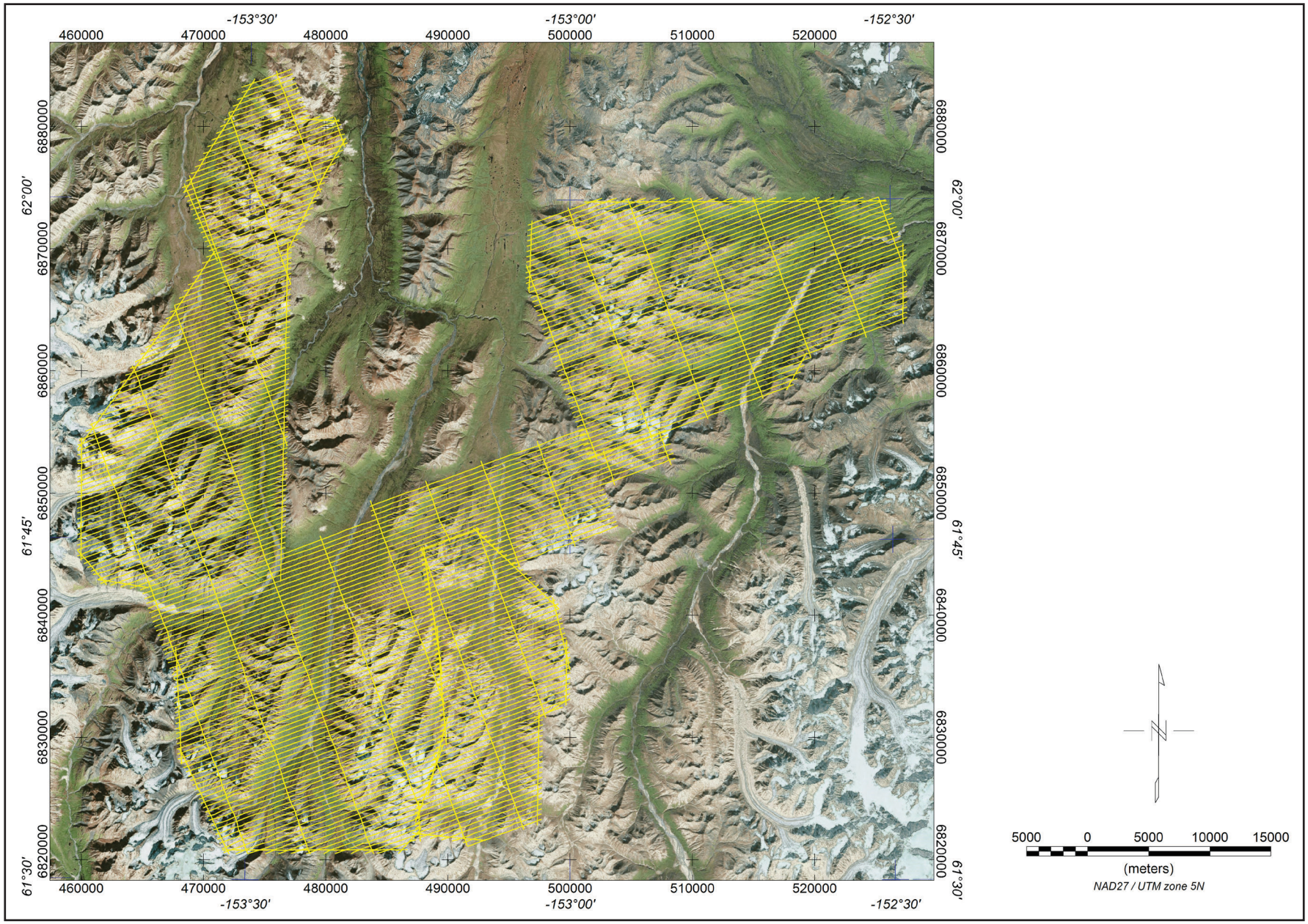


Figure 2. Flight path with orthometric image.

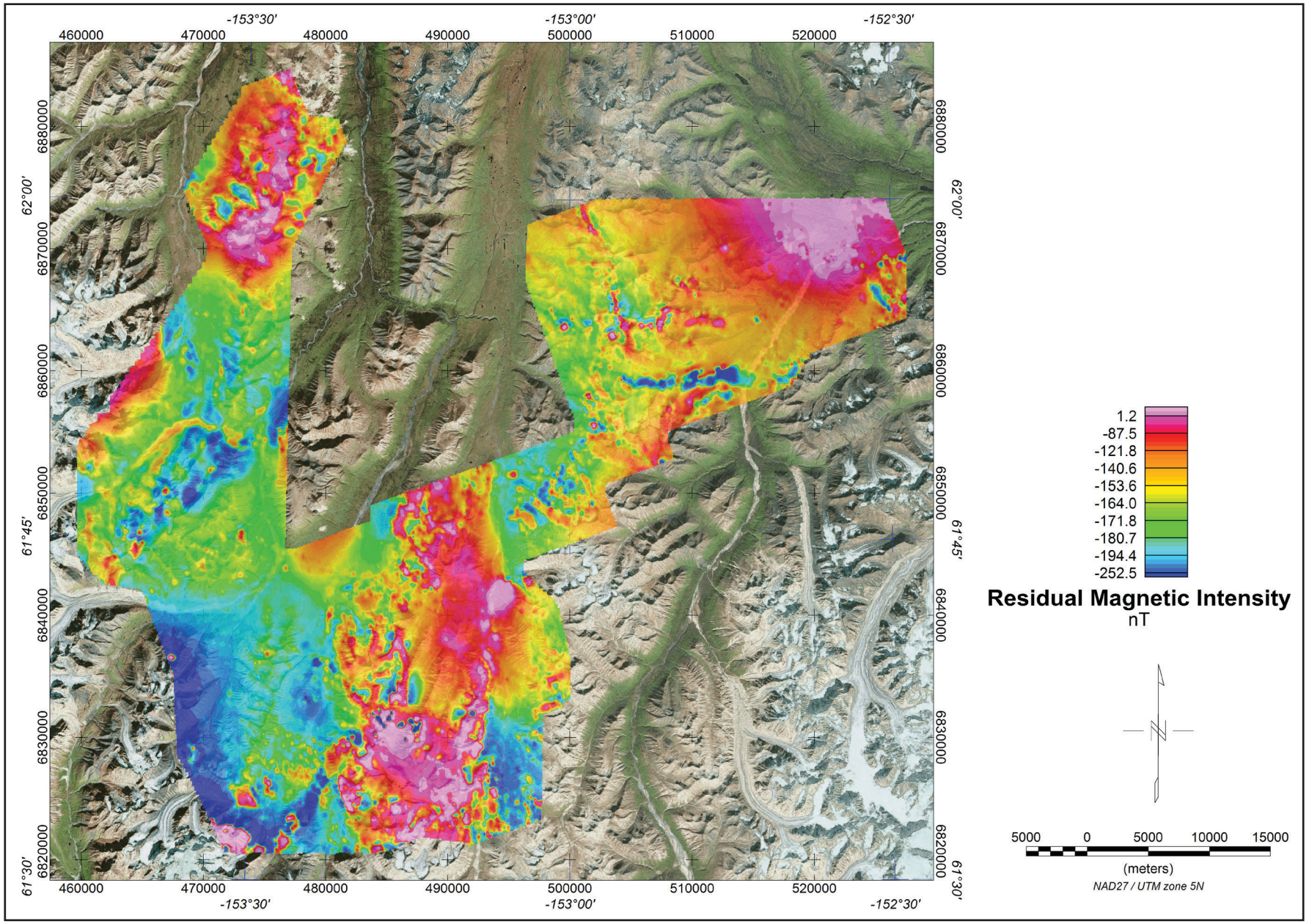


Figure 3. The residual magnetic intensity data were created using digitally recorded magnetic total field data from a Fugro D1344 magnetometer with a Scintrex CS3 cesium sensor. Data were collected at a sampling interval of 0.1 seconds. The magnetic data were (1) corrected for diurnal variations by subtracting the digitally recorded base station magnetic data, (2) IGRF corrected (IGRF model 2005), 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 minimum curvature.

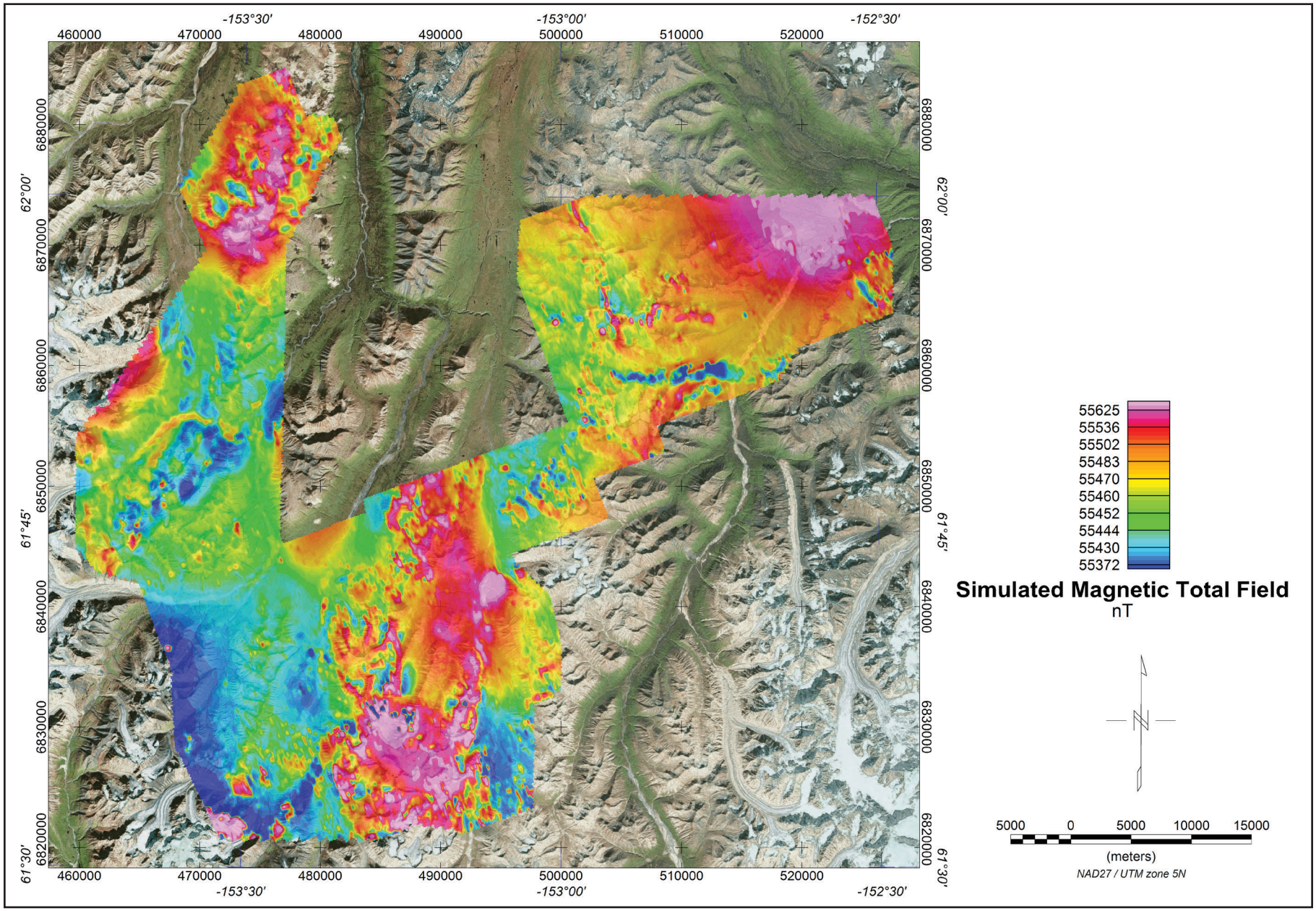


Figure 4. The simulated magnetic total field data were created using digitally recorded magnetic total field data from a Fugro D1344 magnetometer with a Scintrex CS3 cesium sensor. Data were collected at a sampling interval of 0.1 seconds. The magnetic data were (1) corrected for diurnal variations by subtracting the digitally recorded base station magnetic data, (2) IGRF corrected (IGRF model 2005), 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 (Akima 1970) technique.

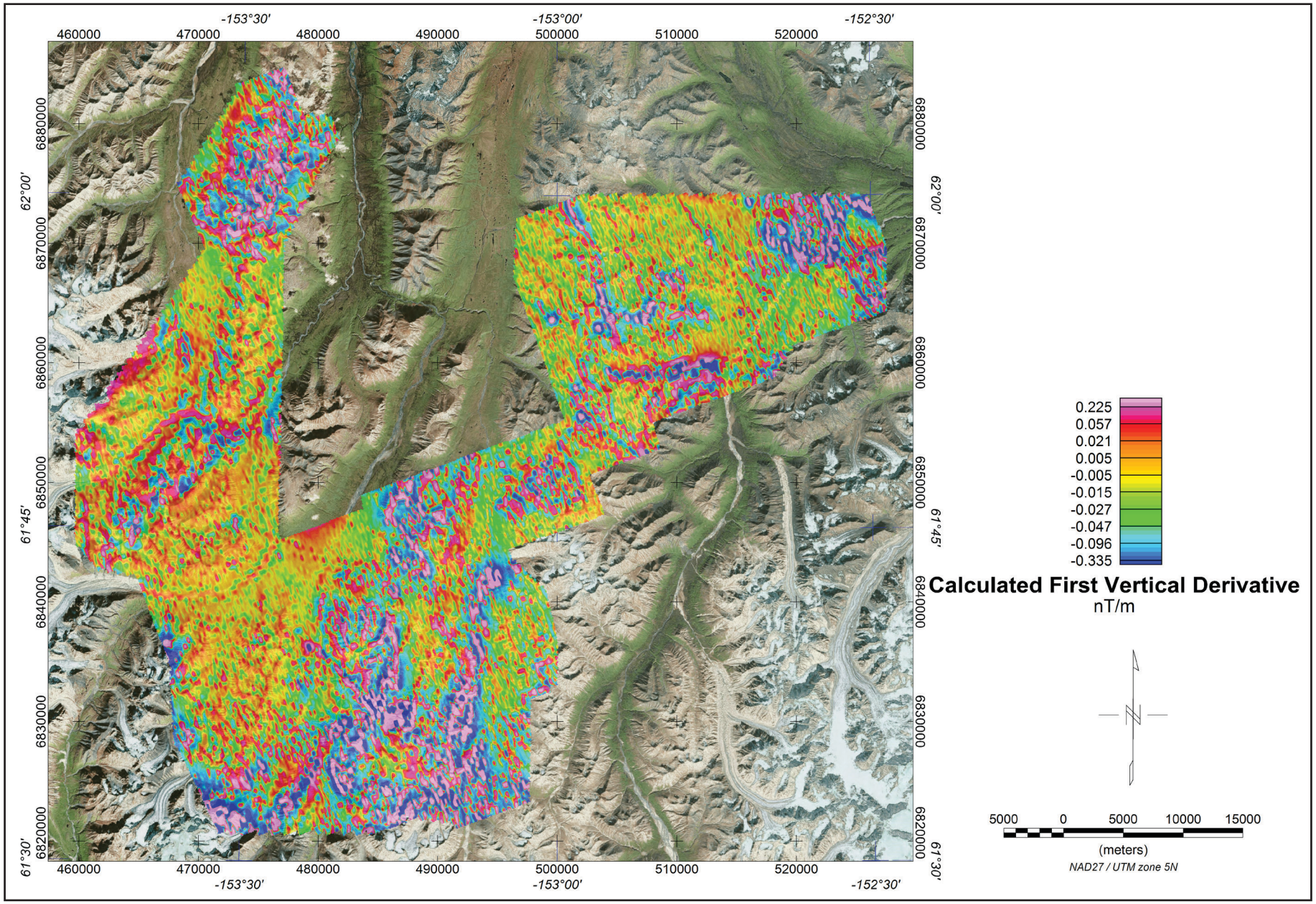


Figure 5. The calculated first vertical derivative data were created using digitally recorded data from a Fugro D1344 cesium magnetometer with a Scintrex CS3 sensor. Data were collected at a sampling interval of 0 .1 seconds. The magnetic data were (1) corrected for diurnal variations by subtraction of the digitally recorded base station magnetic data, (2) IGRF corrected (IGRF model 2005, 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. 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.

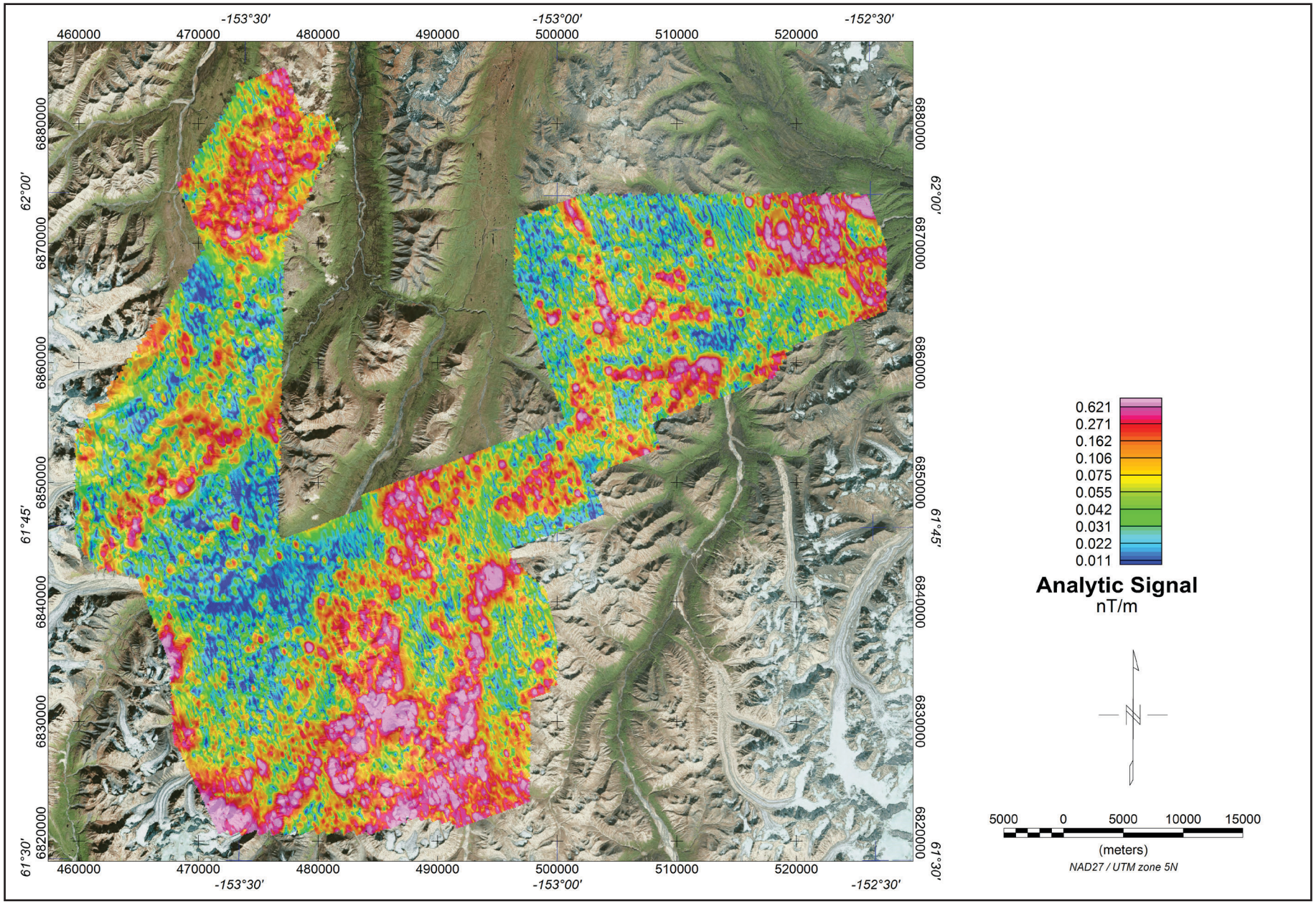


Figure 6. Analytic signal is the total amplitude of all directions of magnetic gradient calculated from the sum of the squares of the three orthogonal gradients. Mapped highs in the calculated analytic signal of magnetic parameter locate the anomalous source body edges and corners (such as contacts,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

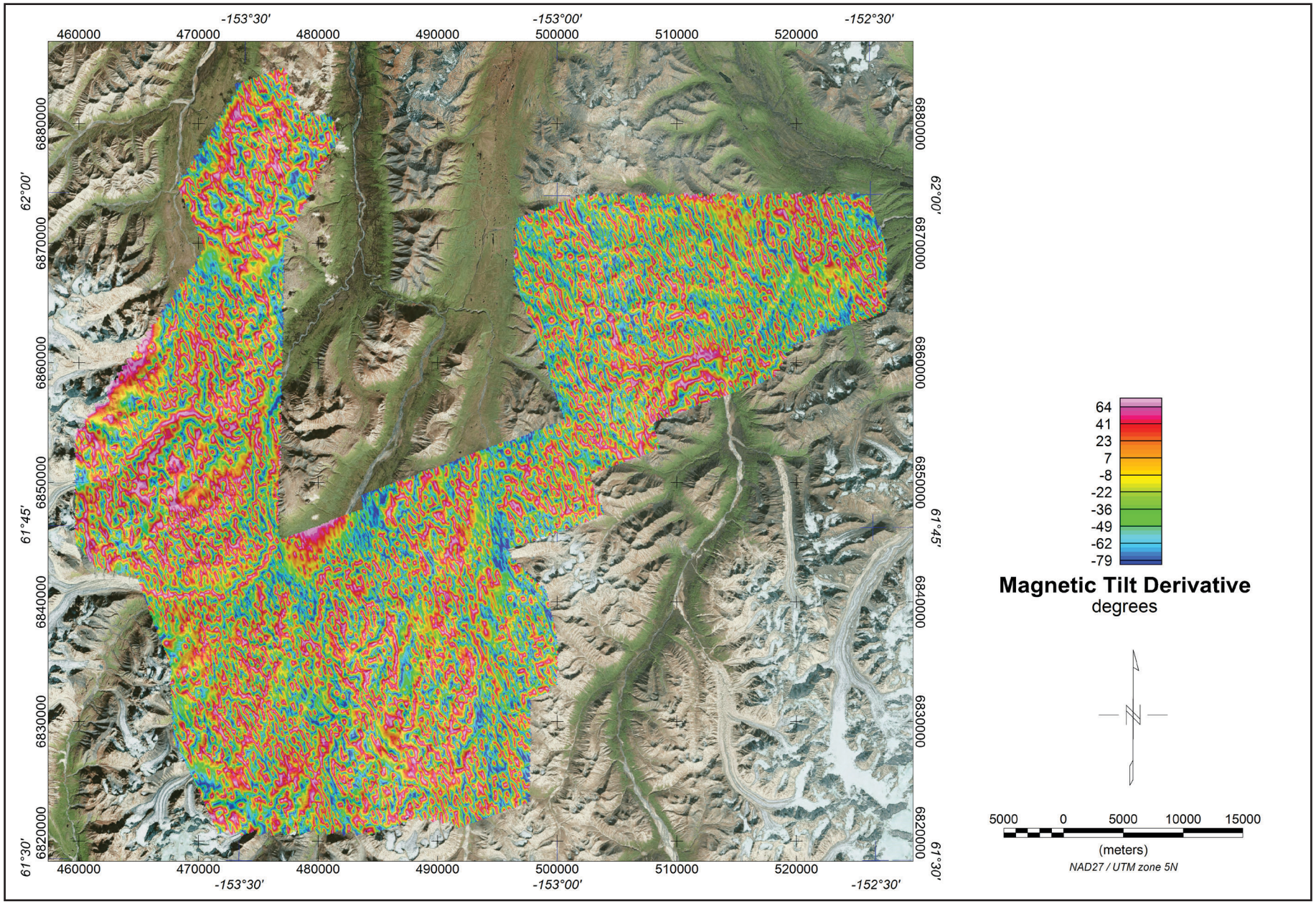


Figure 7. The tilt derivative is the angle between the horizontal gradient and the total gradient, which can be used to identify the depth and type of source. The tilt angle is positive over the source, crosses through zero at, or near, the edge of a vertical-sided source, and is negative outside the source region. The tilt derivative 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.

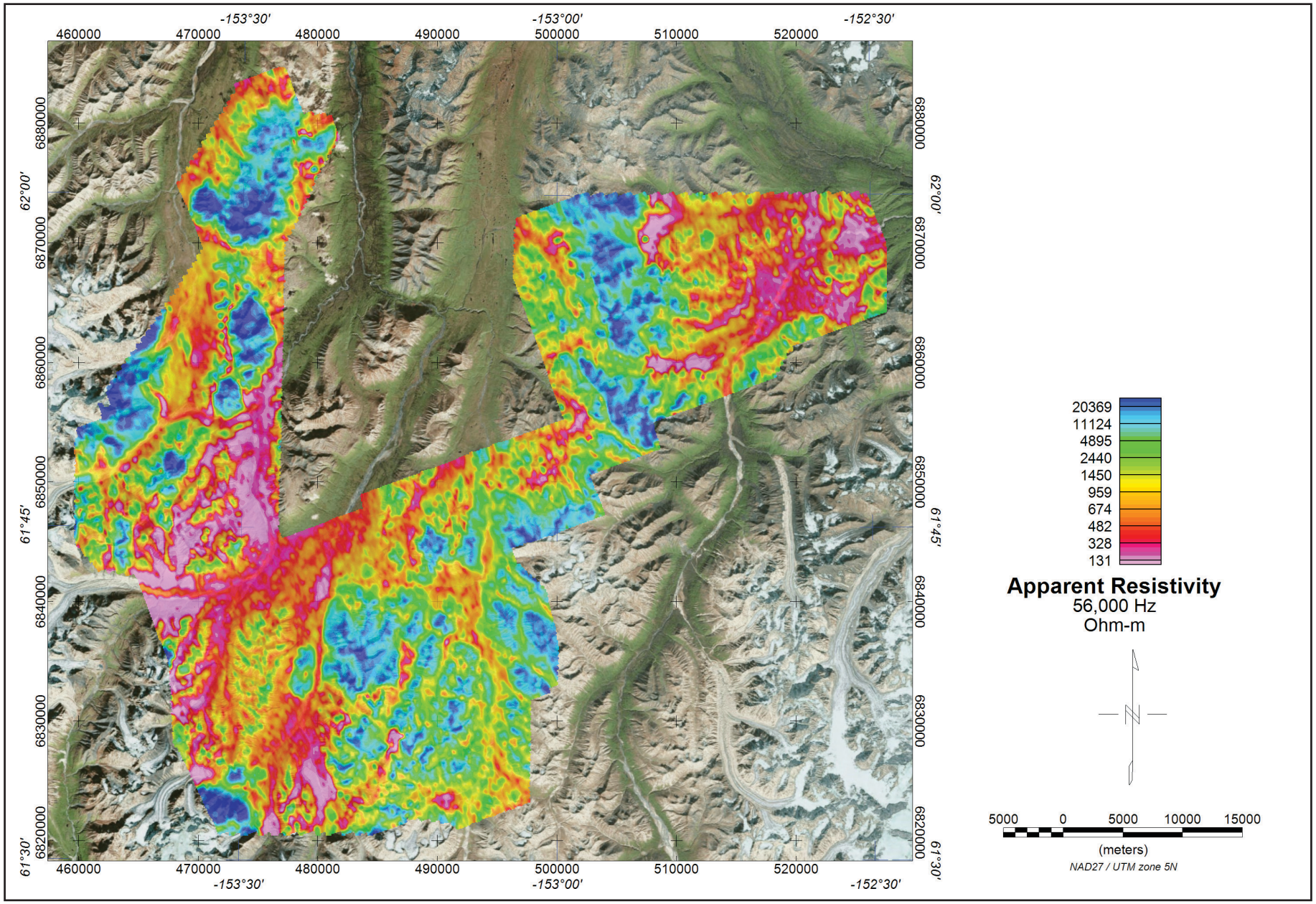


Figure 8. The DIGHEM^{V} EM system measured inphase and quadrature components at five frequencies. Two vertical coaxial coil-pairs operated at 1,000 and 5500 Hz while three horizontal coplanar coil-pairs operated at 900, 7,200 and 56,000 Hz. EM data were sampled at 0.1 second intervals. The EM system 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 (Akima 1970) technique.

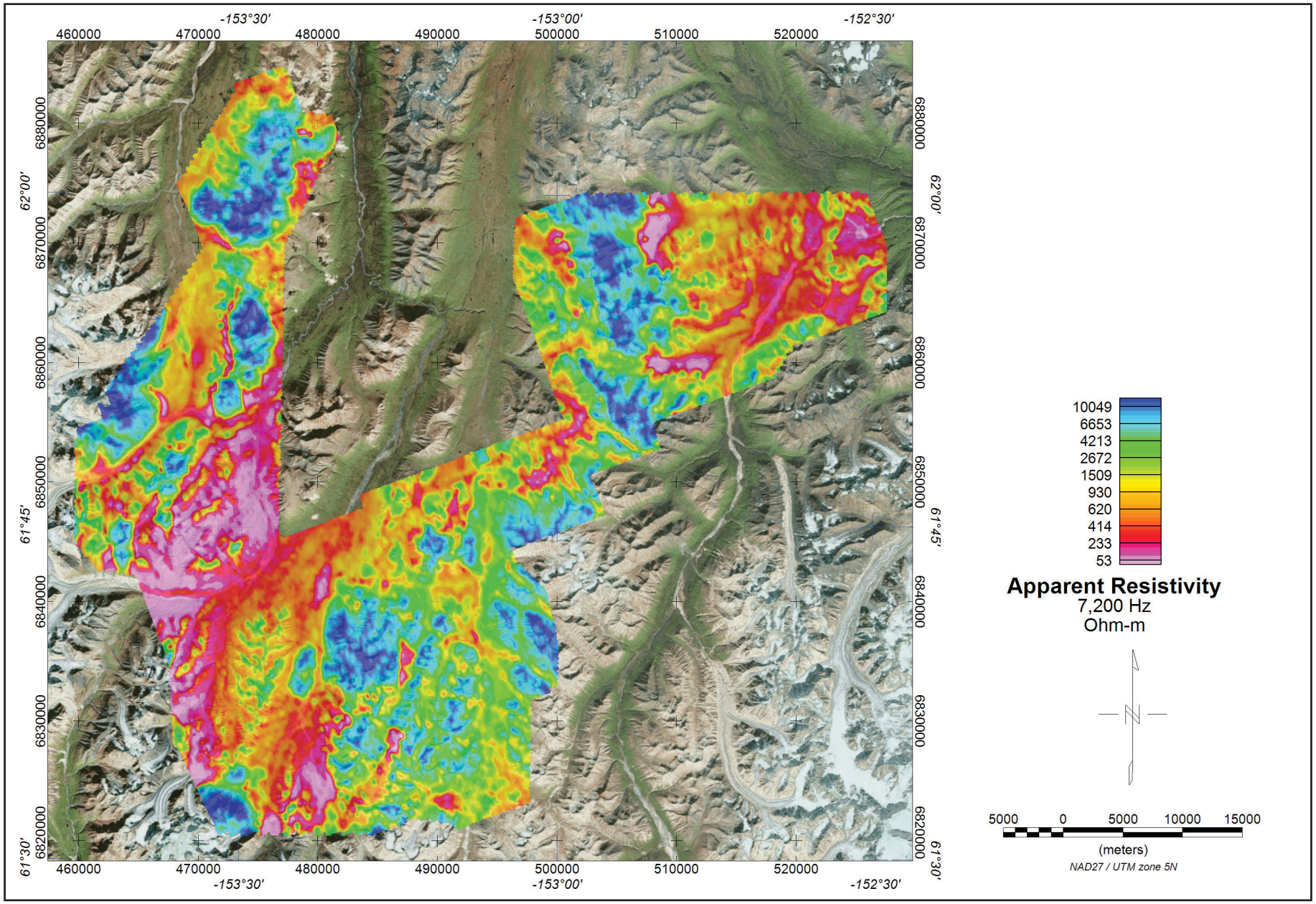


Figure 9. The DIGHEM^{V} EM system measured inphase and quadrature components at five frequencies. Two vertical coaxial coil-pairs operated at 1,000 and 5500 Hz while three horizontal coplanar coil-pairs operated at 900, 7,200 and 56,000 Hz. EM data were sampled at 0.1 second intervals. The EM system 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 (Akima 1970) technique.

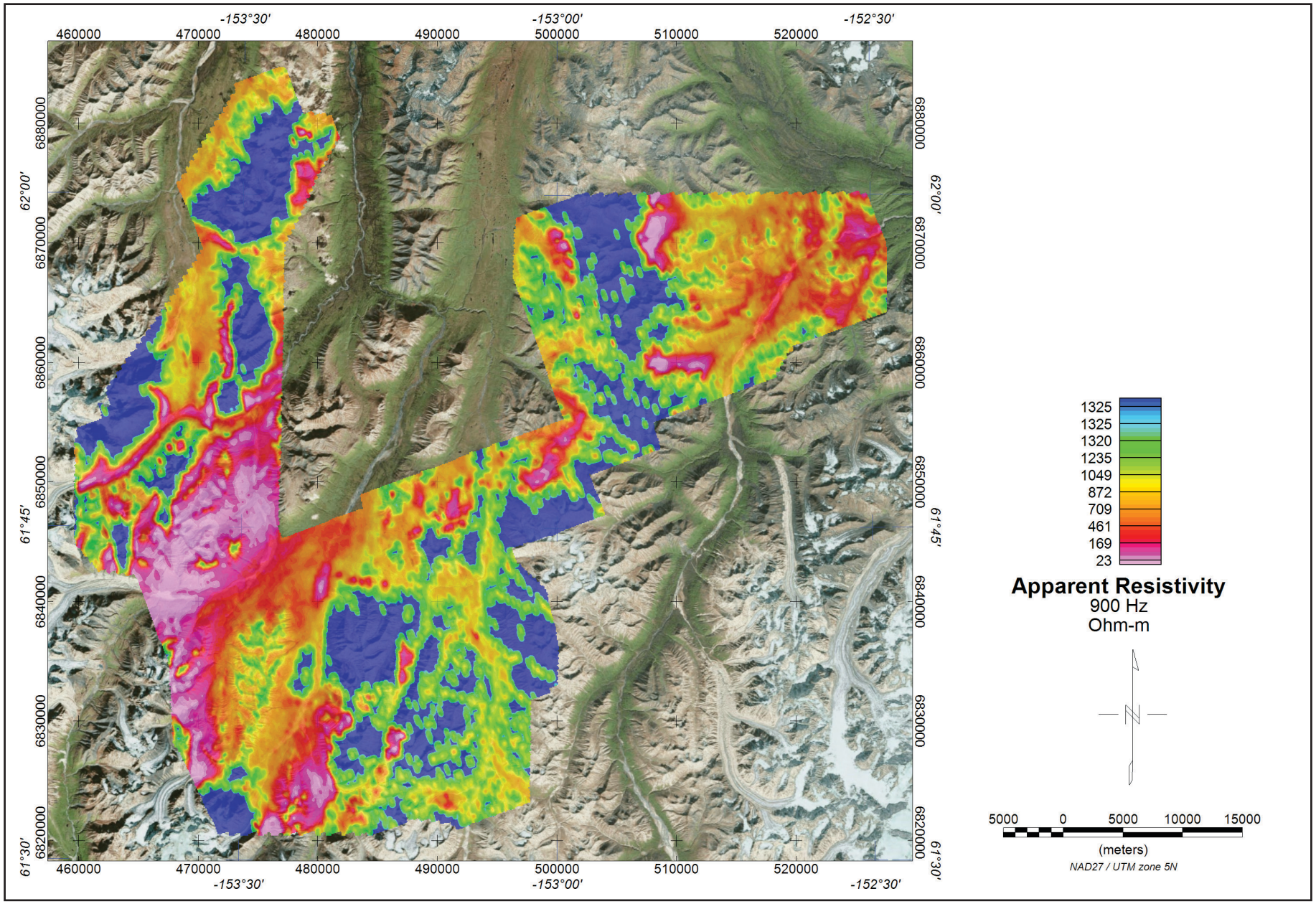


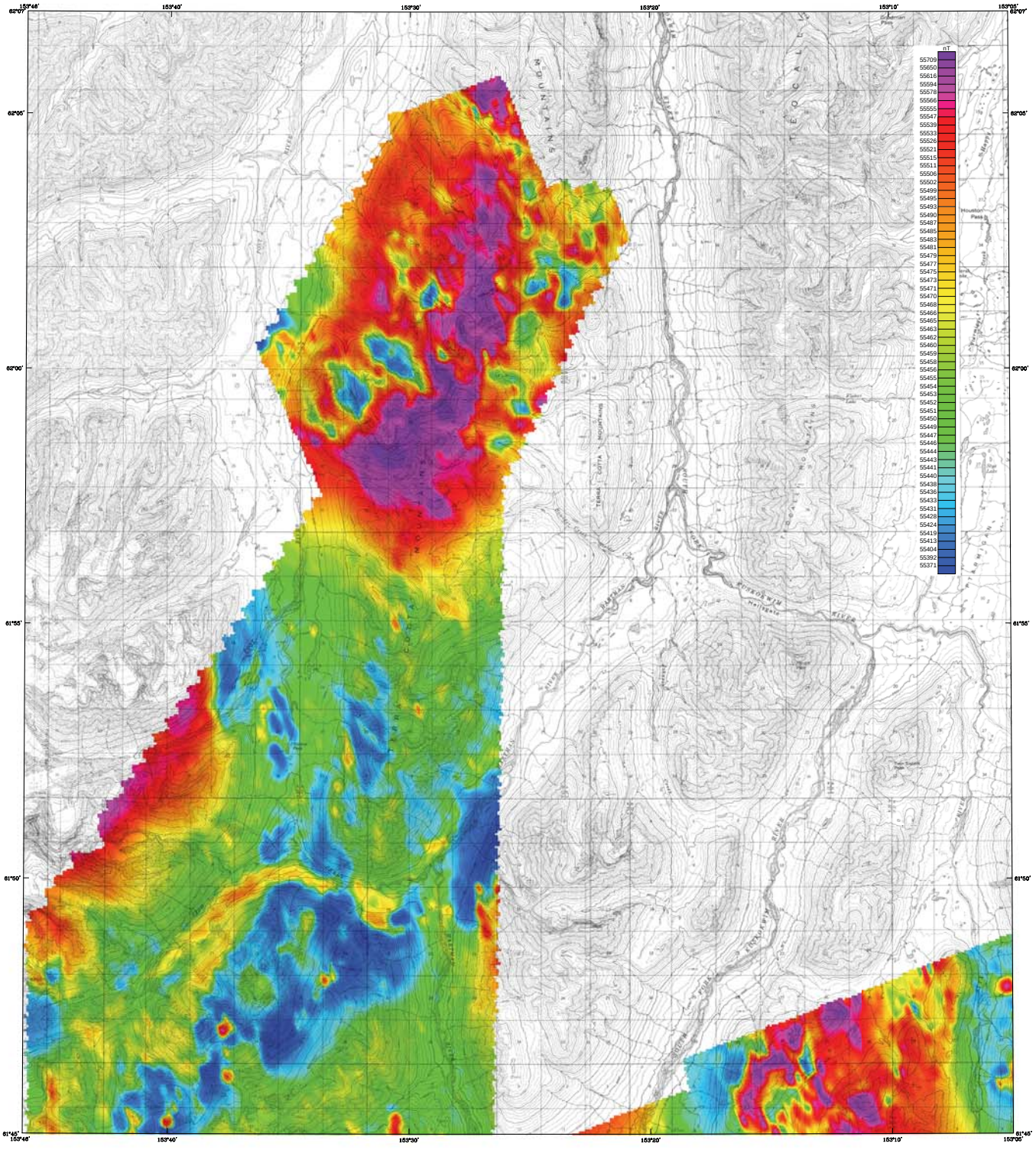
Figure 10. The DIGHEM^{V} EM system measured inphase and quadrature components at five frequencies. Two vertical coaxial coil-pairs operated at 1,000 and 5500 Hz while three horizontal coplanar coil-pairs operated at 900, 7,200 and 56,000 Hz. EM data were sampled at 0.1 second intervals. The EM system 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 (Akima 1970) technique.

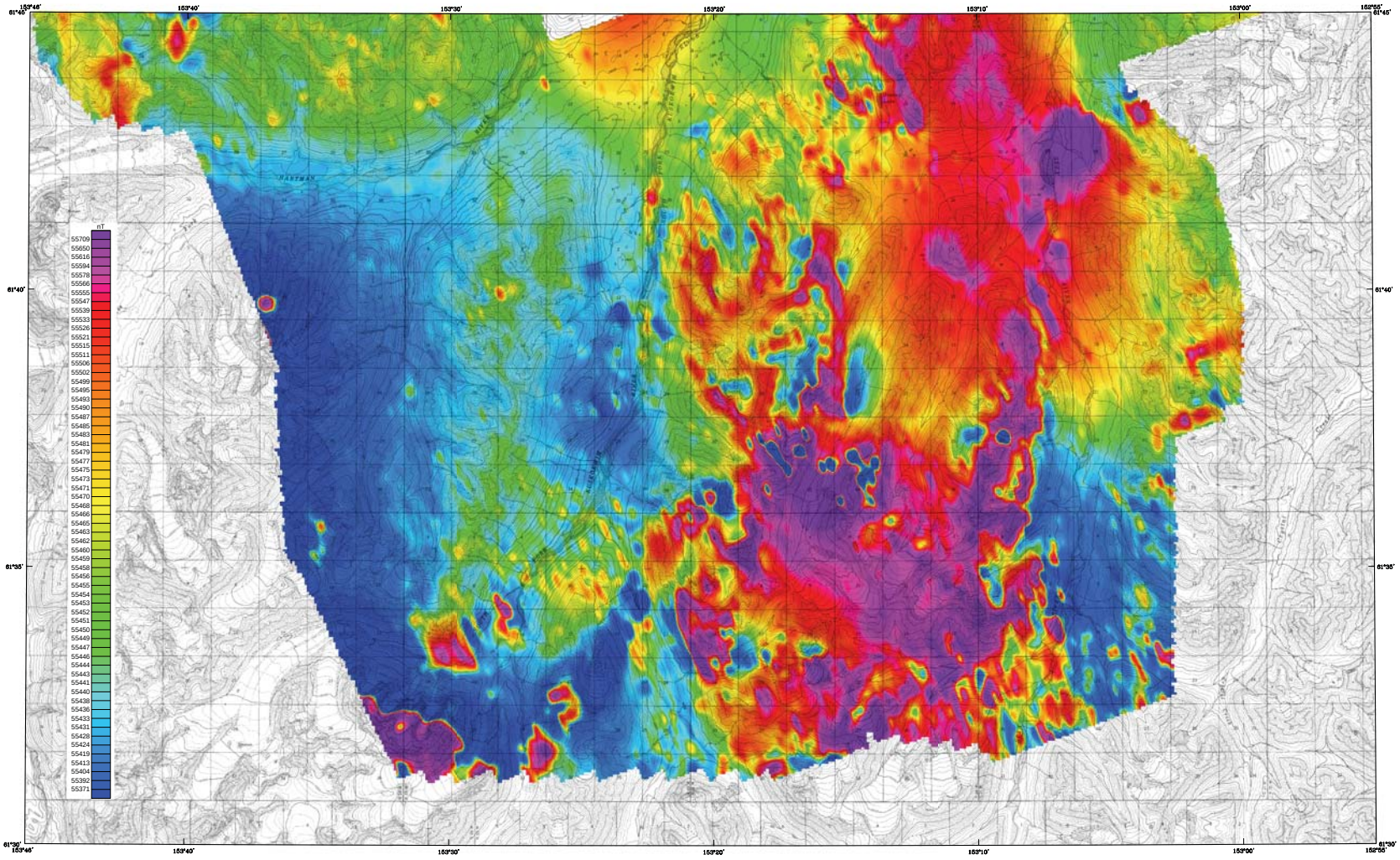
Table 1. Copies of the following maps are included at the end of this booklet. The low-resolution, page-size maps included in this booklet are intended to be used as a search tool and are not the final product. Large-scale, full-resolution versions of each map are available to download on this publication's citation page: http://doi.org/10.14509/30166.

Map Title	Original Publication Number	Description
styx_map_sim_magtf_topo_1_of_3	GPR2008-3-1a	Simulated magnetic total field grid with topography base layer
styx_map_sim_magtf_topo_2_of_3	GPR2008-3-1b	Simulated magnetic total field grid with topography base layer
styx_map_sim_magtf_topo_3_of_3	GPR2008-3-1c	Simulated magnetic total field grid with topography base layer
styx_map_sim_magtf_contours_trs_1_of_3	GPR2008-3-2a	Simulated magnetic total field grid and contours with Public Land Survey System base layer
styx_map_sim_magtf_contours_trs_2_of_3	GPR2008-3-2b	Simulated magnetic total field grid and contours with Public Land Survey System base layer
styx_map_sim_magtf_contours_trs_3_of_3	GPR2008-3-2c	Simulated magnetic total field grid and contours with Public Land Survey System base layer
styx_map_calculated1vd_topo_1_of_3	GPR2008-3-3a	Calculated magnetic field first vertical derivative grid with topography base layer
styx_map_calculated1vd_topo_2_of_3	GPR2008-3-3b	Calculated magnetic field first vertical derivative grid with topography base layer
styx_map_calculated1vd_topo_3_of_3	GPR2008-3-3c	Calculated magnetic field first vertical derivative grid with topography base layer
styx_map_res56khz_topo_1_of_3	GPR2008-3-4a	56,000 Hz coplanar apparent resistivity grid with topography base layer
styx_map_res56khz_topo_2_of_3	GPR2008-3-4b	56,000 Hz coplanar apparent resistivity grid with topography base layer
styx_map_res56khz_topo_3_of_3	GPR2008-3-4c	56,000 Hz coplanar apparent resistivity grid with topography base layer
styx_map_res56khz_contours_trs_1_of_3	GPR2008-3-5a	56,000 Hz coplanar apparent resistivity grid and contours with Public Land Survey System base layer
styx_map_res56khz_contours_trs_2_of_3	GPR2008-3-5b	56,000 Hz coplanar apparent resistivity grid and contours with Public Land Survey System base layer
styx_map_res56khz_contours_trs_3_of_3	GPR2008-3-5c	56,000 Hz coplanar apparent resistivity grid and contours with Public Land Survey System base layer
styx_map_res7200hz_topo_1_of_3	GPR2008-3-6a	7,200 Hz coplanar apparent resistivity grid with topography base layer
styx_map_res7200hz_topo_2_of_3	GPR2008-3-6b	7,200 Hz coplanar apparent resistivity grid with topography base layer
styx_map_res7200hz_topo_3_of_3	GPR2008-3-6c	7,200 Hz coplanar apparent resistivity grid with topography base layer
styx_map_res7200hz_contours_trs_1_of_3	GPR2008-3-7a	7,200 Hz coplanar apparent resistivity grid and contours with Public Land Survey System base layer
styx_map_res7200hz_contours_trs_2_of_3	GPR2008-3-7b	7,200 Hz coplanar apparent resistivity grid and contours with Public Land Survey System base layer

Table 1, continued. 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/10.14509/30166.

Map Title	Original Publication Number	Description
styx_map_res7200hz_contours_trs_3_of_3	GPR2008-3-7c	7,200 Hz coplanar apparent resistivity grid and contours with Public Land Survey System base layer
styx_map_res900hz_topo_1_of_3	GPR2008-3-8a	900 Hz coplanar apparent resistivity grid with topography base layer
styx_map_res900hz_topo_2_of_3	GPR2008-3-8b	900 Hz coplanar apparent resistivity grid with topography base layer
styx_map_res900hz_topo_3_of_3	GPR2008-3-8c	900 Hz coplanar apparent resistivity grid with topography base layer
styx_map_res900hz_contours_trs_1_of_3	GPR2008-3-9a	900 Hz coplanar apparent resistivity grid and contours with Public Land Survey System base layer
styx_map_res900hz_contours_trs_2_of_3	GPR2008-3-9b	900 Hz coplanar apparent resistivity grid and contours with Public Land Survey System base layer
styx_map_res900hz_contours_trs_3_of_3	GPR2008-3-9c	900 Hz coplanar apparent resistivity grid and contours with Public Land Survey System base layer
styx_map_em_anomalies_sim_magtf_topo_1_of_7	GPR2008-5-1a	electromagnetic anomalies identified by contractor, simulated magnetic total field grid, and topography
styx_map_em_anomalies_sim_magtf_topo_2_of_7	GPR2008-5-1b	electromagnetic anomalies identified by contractor, simulated magnetic total field grid, and topography
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styx_map_em_anomalies_sim_magtf_topo_4_of_7	GPR2008-5-1d	electromagnetic anomalies identified by contractor, simulated magnetic total field grid, and topography
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styx_map_em_anomalies_sim_magtf_topo_6_of_7	GPR2008-5-1f	electromagnetic anomalies identified by contractor, simulated magnetic total field grid, and topography
styx_map_em_anomalies_sim_magtf_topo_7_of_7	GPR2008-5-1g	electromagnetic anomalies identified by contractor, simulated magnetic total field grid, and topography
styx_map_interpretation_1_of_3	GPR2008-5-2a	magnetic and electromagnetic data interpretation performed by contractor
styx_map_interpretation_2_of_3	GPR2008-5-2b	magnetic and electromagnetic data interpretation performed by contractor
styx_map_interpretation_3_of_3	GPR2008-5-2c	magnetic and electromagnetic data interpretation performed by contractor


153°45'
153°40'
153°30'
153°20'
153°10'
153°05'
62°07'
62°05'
62°00'
61°55'
61°50'
61°45'
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55709
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55419
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55404
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55371
MOUNTAINS
TEOCALL
Mountain Pass
Houston Pass
TERRACE CUTTA MOUNTAINS
Mountain Pass
Mountain Pass
Mountain Pass



Base from U.S. Geological Survey Lime Hills C-1, 1952; C-2, 1952; C-3, 1952; Tyonek C-4, 1952; Kenai, 1952





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

TOTAL MAGNETIC FIELD OF THE SOUTHERN STYX RIVER SURVEY, SOUTHCENTRAL ALASKA

PARTS OF LIME HILLS and TYONEK QUADRANGLES

by

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

2008

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 a radar altimeter, GPS navigation system, 50/60 Hz monitors and video camera. Flights were performed with an AS350B-3 Squirrel helicopter at a mean terrain clearance of 200 feet along NE-SW (70°) 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.

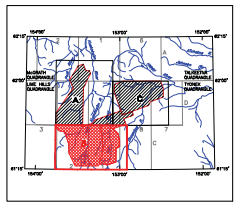
A Novatel OEM4-G2L Global Positioning System was used for navigation. The helicopter position was derived every 0.5 seconds using post-flight differential positioning to a relative accuracy of better than 5m. Flight path positions were projected onto the Clarke 1866 (UTM zone 5) spheroid, 1927 North American datum using a central meridian (CM) of 153°, 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.

TOTAL MAGNETIC FIELD

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LOCATION INDEX

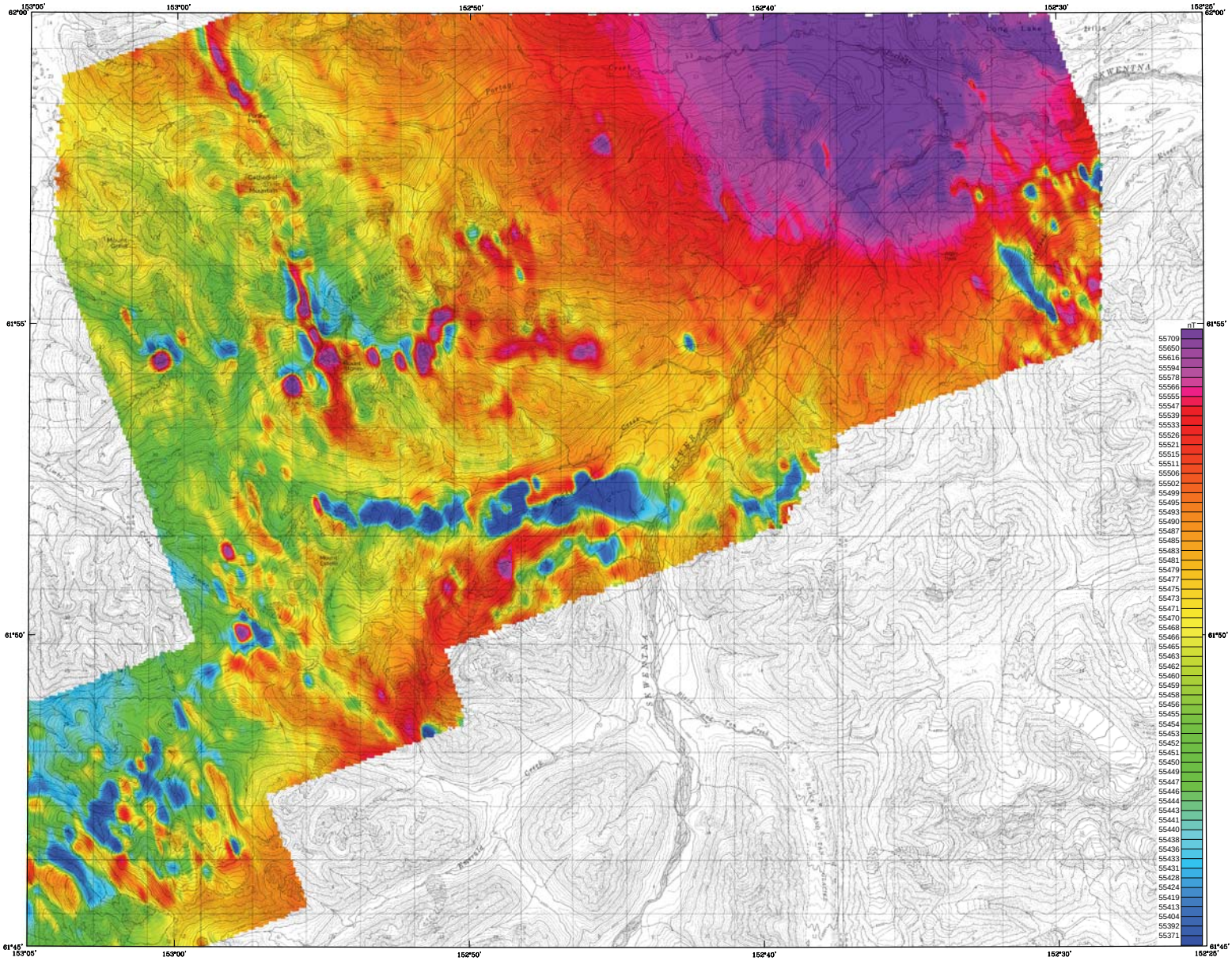


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Base from U.S. Geological Survey Lime Hills D-1, 1950; Tyonek D-7, 1975; D-8, 1952; Quadrangles, Alaska





APPROXIMATE MEAN DECLINATION, 2008

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

TOTAL MAGNETIC FIELD OF THE EASTERN STYX RIVER SURVEY, SOUTHCENTRAL ALASKA

PARTS OF LIME HILLS and TYONEK QUADRANGLES

by

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

2008

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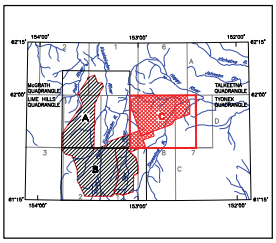
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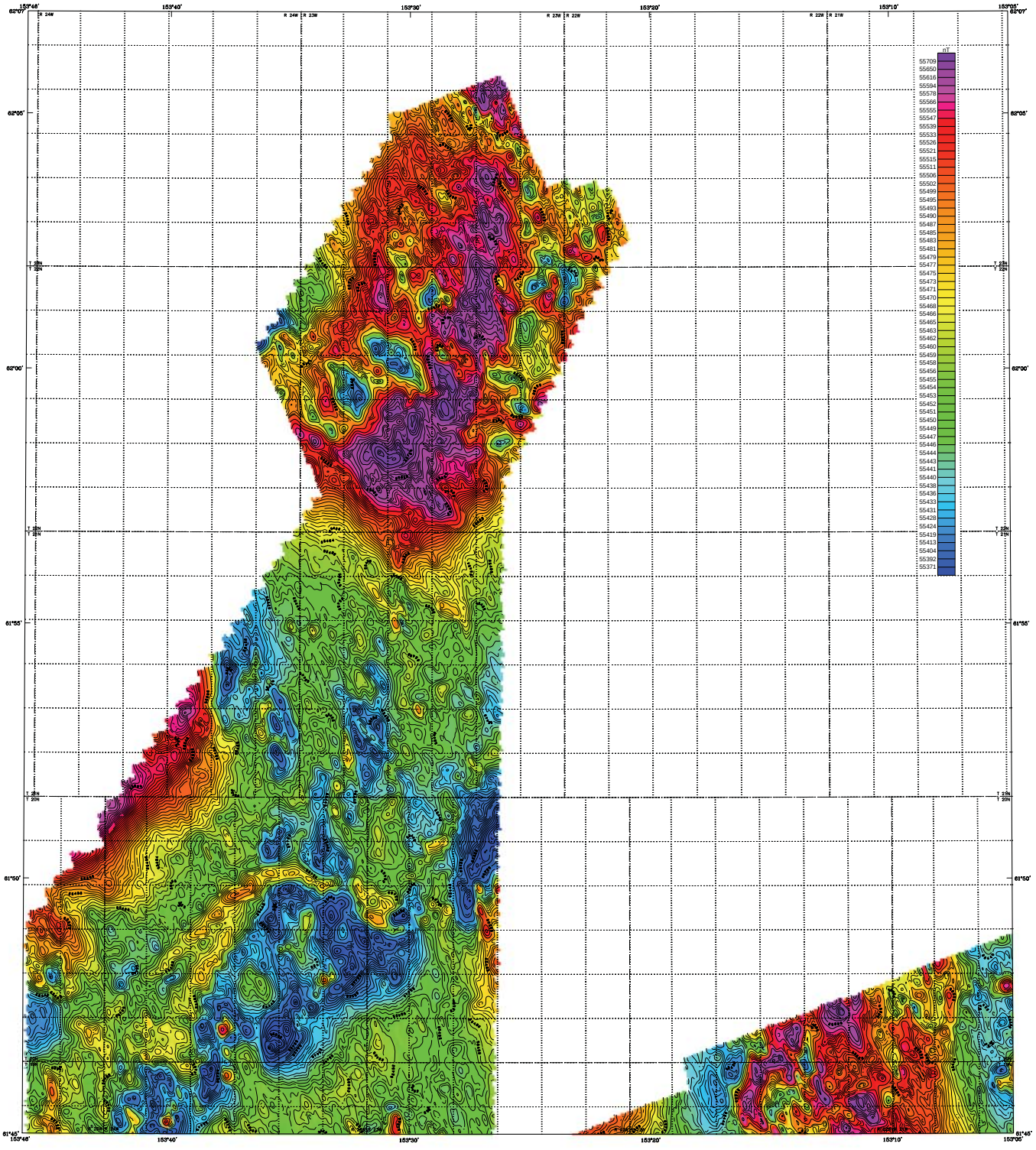


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Section outlines from U.S. Geological Survey Lime Hills D-1, 1952; D-2, 1977; D-3, 1978; McGrath A-1, 1952; A-2, 1952, Quadrangles, Alaska

SCALE 1:63,360

1 0 1 2 3 4 MILES

1 0 1 2 3 4 5 KILOMETERS



TOTAL MAGNETIC FIELD OF THE WESTERN STYX RIVER SURVEY, SOUTHCENTRAL ALASKA

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MAGNETIC CONTOUR INTERVAL

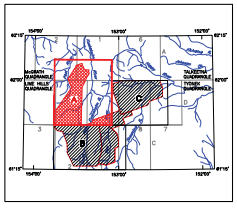
100 nT

20 nT

4 nT

2 nT

LOCATION INDEX

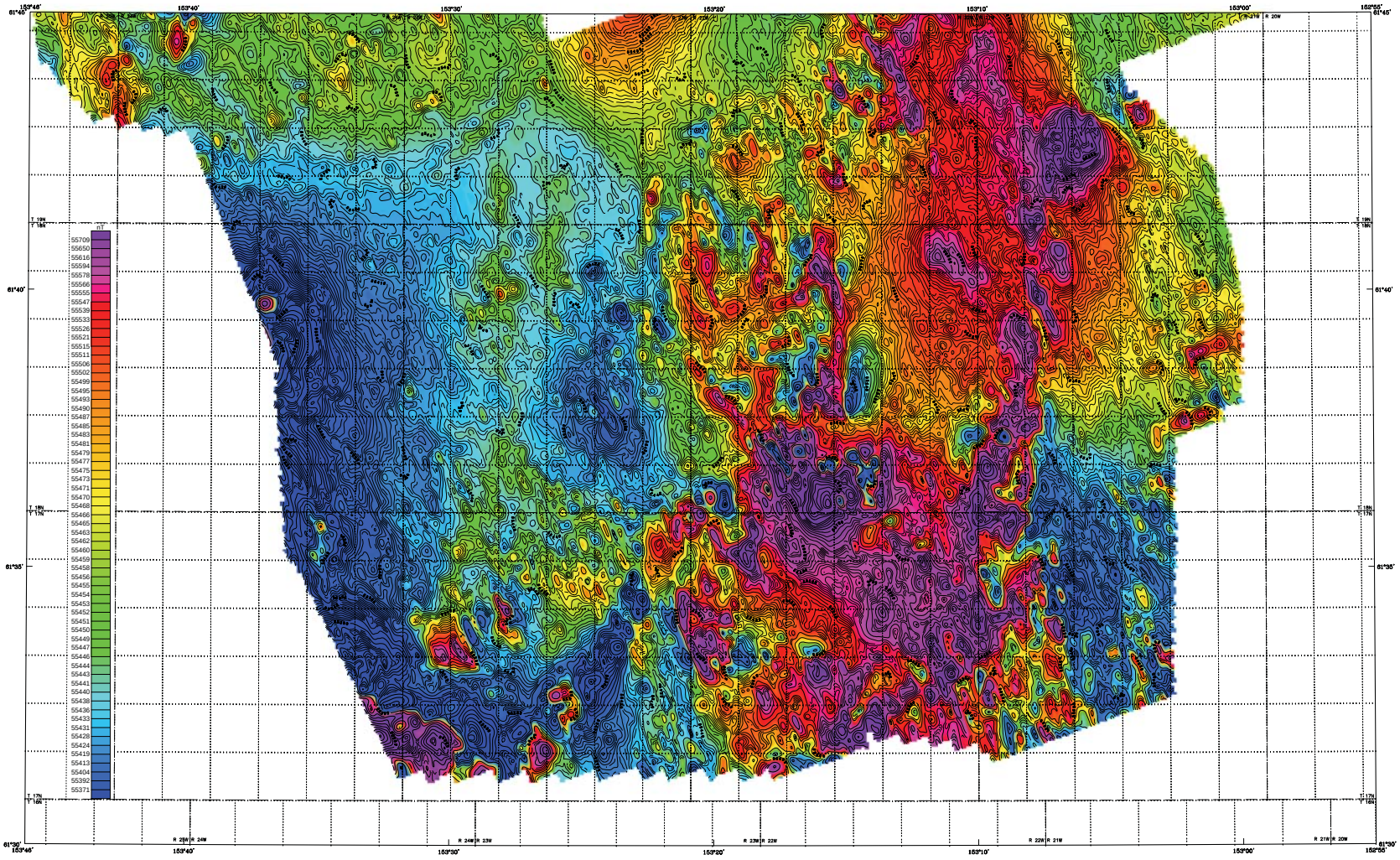


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SCALE 1:63,360

1 0 1 2 3 4 MILES

1 0 1 2 3 4 5 KILOMETERS

TOTAL MAGNETIC FIELD OF THE SOUTHERN STYX RIVER SURVEY, SOUTHCENTRAL ALASKA

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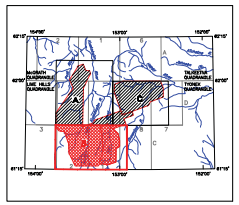
100 nT

20 nT

4 nT

2 nT

LOCATION INDEX

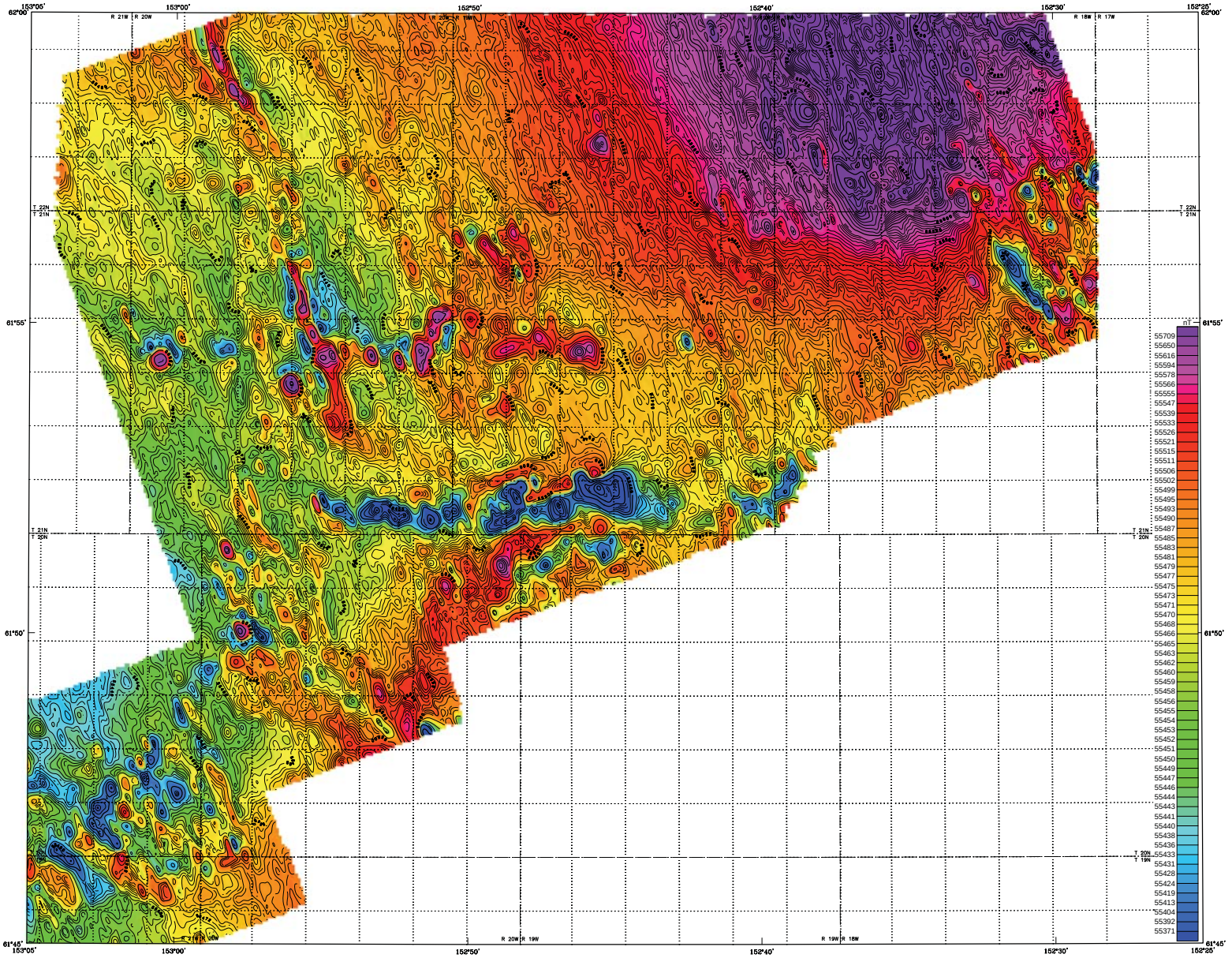


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APPROXIMATE MEAN DECLINATION, 2008

SCALE 1:63,360

1 0 1 2 3 4 MILES

1 0 1 2 3 4 5 KILOMETERS

TOTAL MAGNETIC FIELD OF THE EASTERN STYX RIVER SURVEY, SOUTHCENTRAL ALASKA

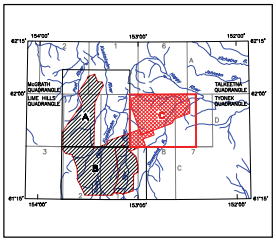
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MAGNETIC CONTOUR INTERVAL

100 nT

20 nT

4 nT

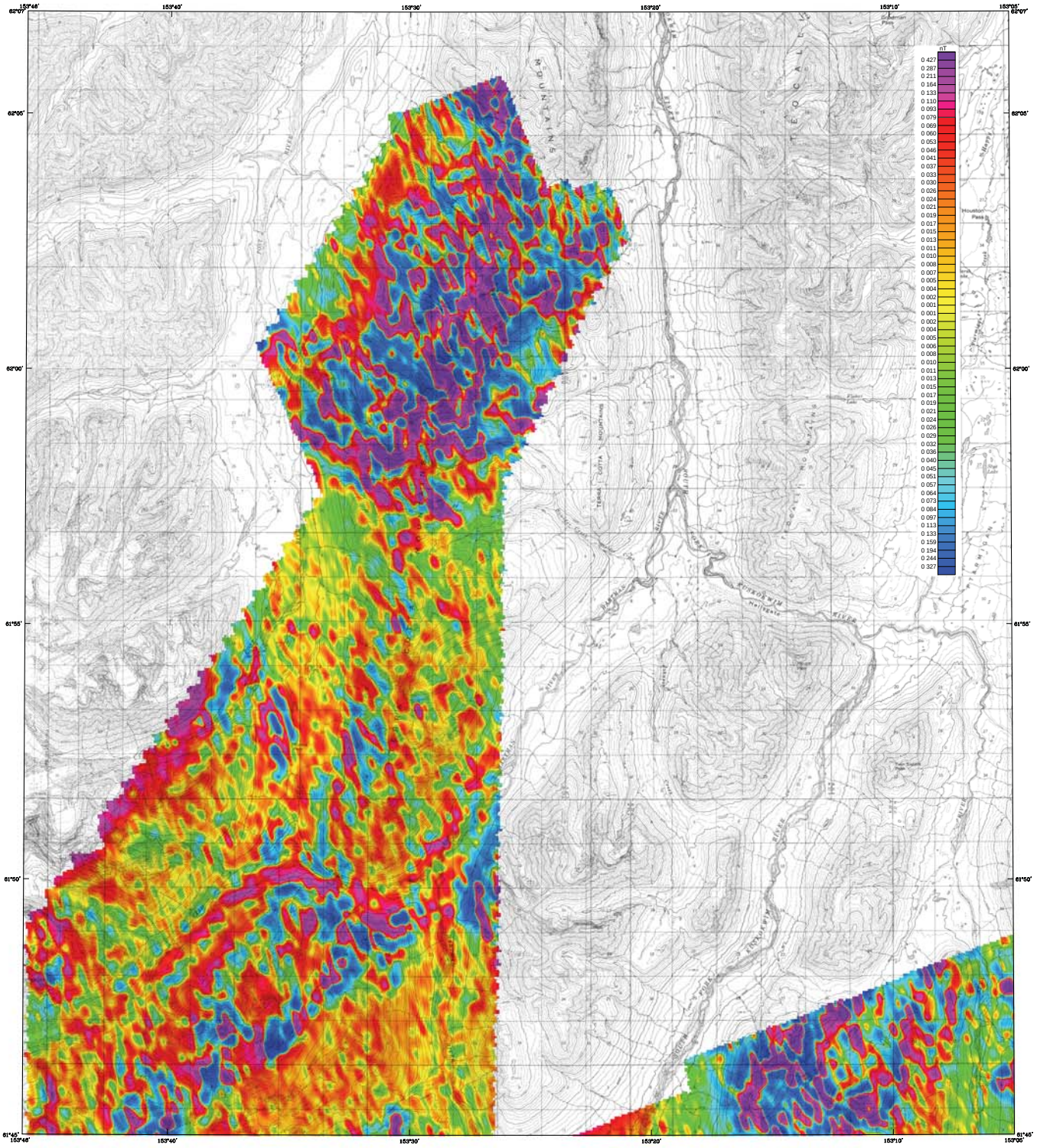
2 nT

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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 AND DATUM
DATUM MEAN SEA LEVEL

FIRST VERTICAL DERIVATIVE OF THE MAGNETIC FIELD OF THE WESTERN STYX RIVER SURVEY, SOUTHCENTRAL ALASKA

PARTS OF LIME HILLS and McGRATH QUADRANGLES

by

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COLOR BAR HISTOGRAM

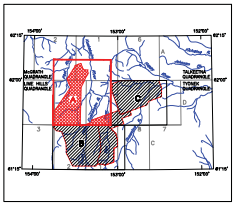
Approximately 98% of the first vertical derivative of the magnetic field for the Western Fortymile Mining District dataset lie within the range displayed on the color bar. Data values actually range from –7.857 nT/m (dark blue) to about 6.592 nT/m (magenta).

FIRST VERTICAL DERIVATIVE OF THE MAGNETIC FIELD

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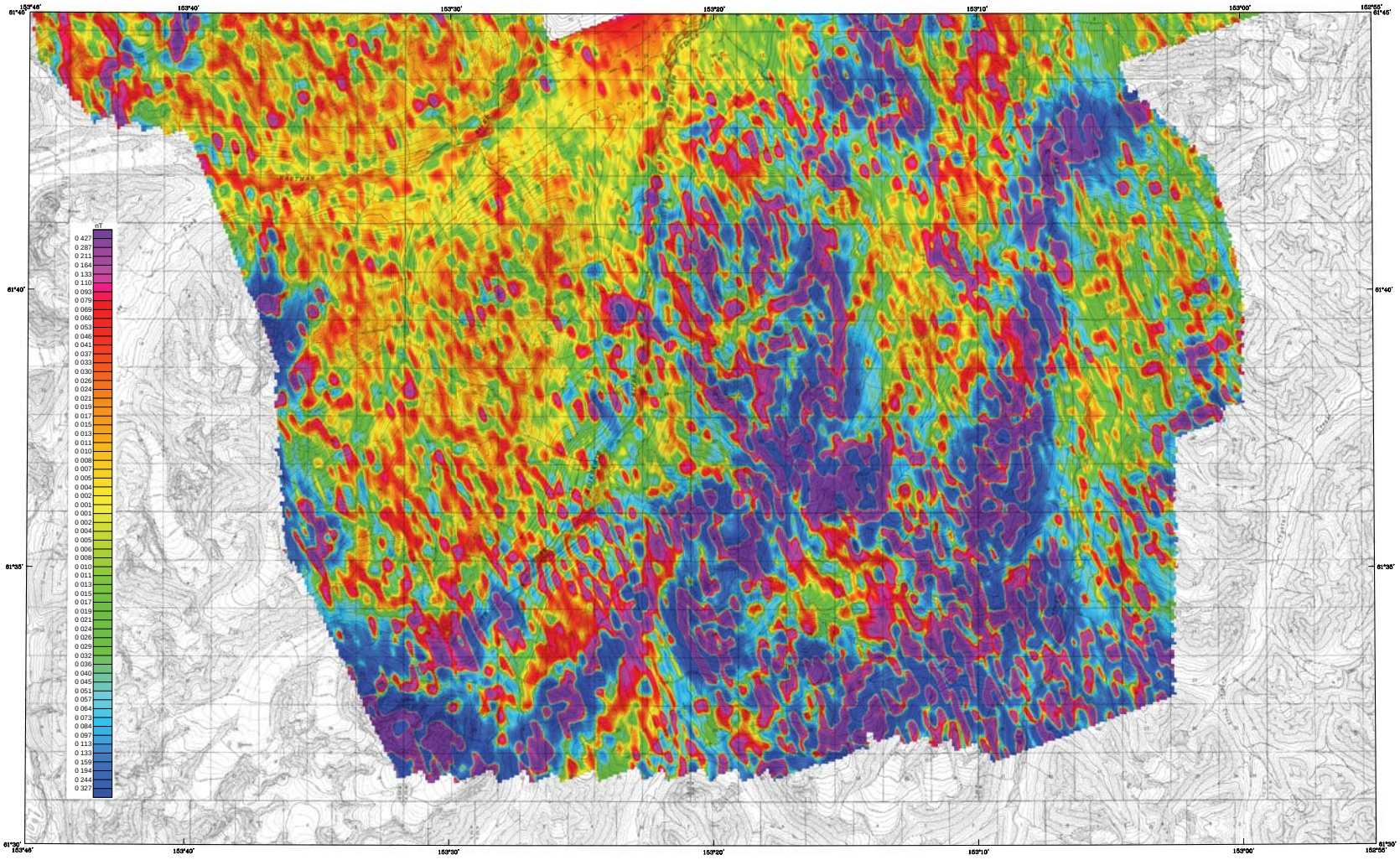


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SCALE 1:63,360

1 0 1 2 3 4 MILES

1 0 1 2 3 4 5 KILOMETERS

CONTOUR INTERVAL 100 FEET
DATUM: MEAN SEA LEVEL

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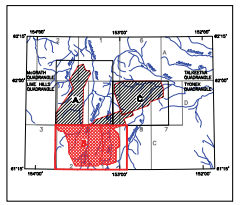
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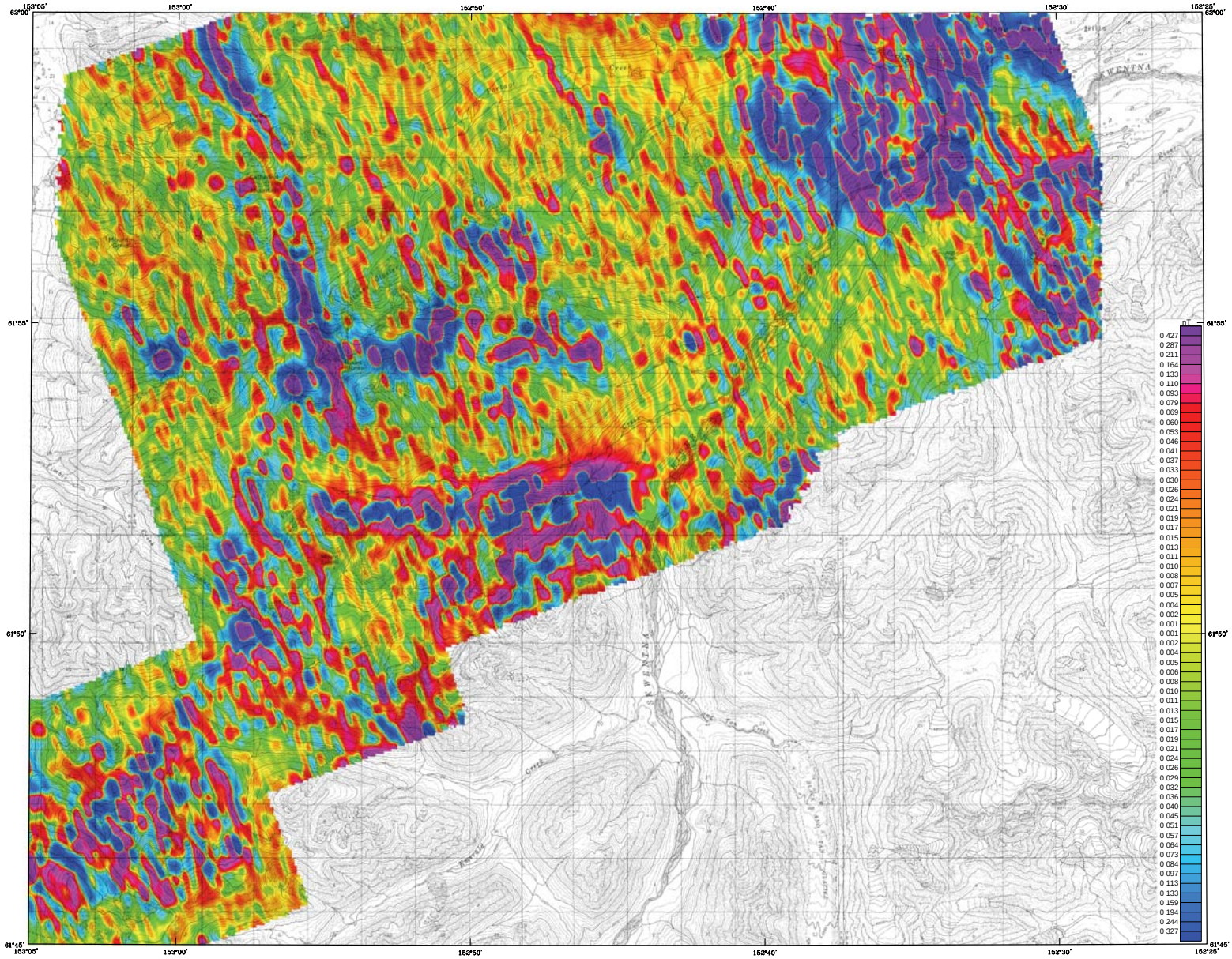


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Base from U.S. Geological Survey Lime Hills D-1, 1950; Tyonek D-7, 1975; D-8, 1952; Quadrangles, Alaska





APPROXIMATE MEAN DECLINATION, 2008

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 EASTERN STYX RIVER SURVEY, SOUTHCENTRAL ALASKA

PARTS OF LIME HILLS and TYONEK QUADRANGLES

by

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

2008

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 a radar altimeter, GPS navigation system, 50/60 Hz monitors and video camera. Flights were performed with an AS350B-3 Squirrel helicopter at a mean terrain clearance of 200 feet along NE–SW (70°) 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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COLOR BAR HISTOGRAM

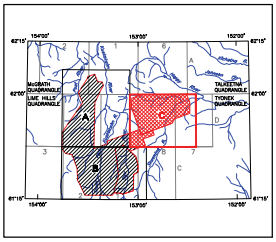
Approximately 98% of the first vertical derivative of the magnetic field for the Western Fortymile Mining District dataset lie within the range displayed on the color bar. Data values actually range from –7.857 nT/m (dark blue) to about 6.592 nT/m (magenta).

FIRST VERTICAL DERIVATIVE OF THE MAGNETIC FIELD

The magnetic total field data were processed using digitally recorded data from a Fugro D1344 cesium magnetometer with a Scintrex CS3 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 2005, 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. 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 veritical 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

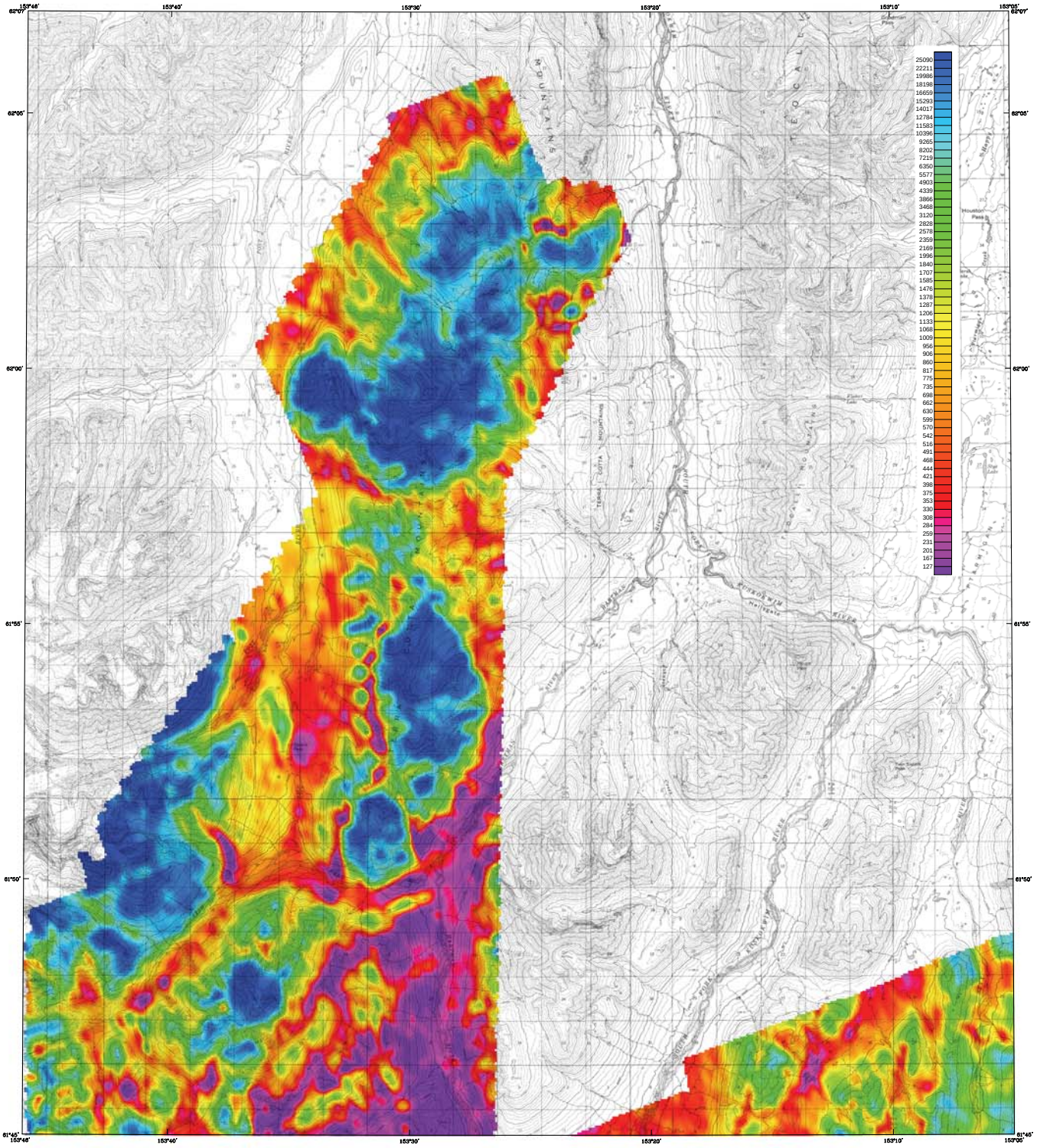


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Base from U.S. Geological Survey Lime Hills B-1, 1952; B-2, 1977; B-3, 1978; McGrath A-1, 1952; A-2, 1952, Quadrangles, Alaska



SCALE 1:63,360

1 0 1 2 3 4 MILES

1 0 1 2 3 4 5 KILOMETERS

CONTOUR INTERVAL AND DATUM
DATUM MEAN SEA LEVEL

56,000 Hz COPLANAR APPARENT RESISTIVITY OF THE WESTERN STYX RIVER SURVEY, SOUTHCENTRAL ALASKA

PARTS OF LIME HILLS and McGRATH QUADRANGLES

by

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

2008



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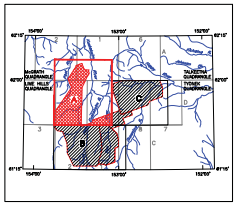
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RESISTIVITY

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.

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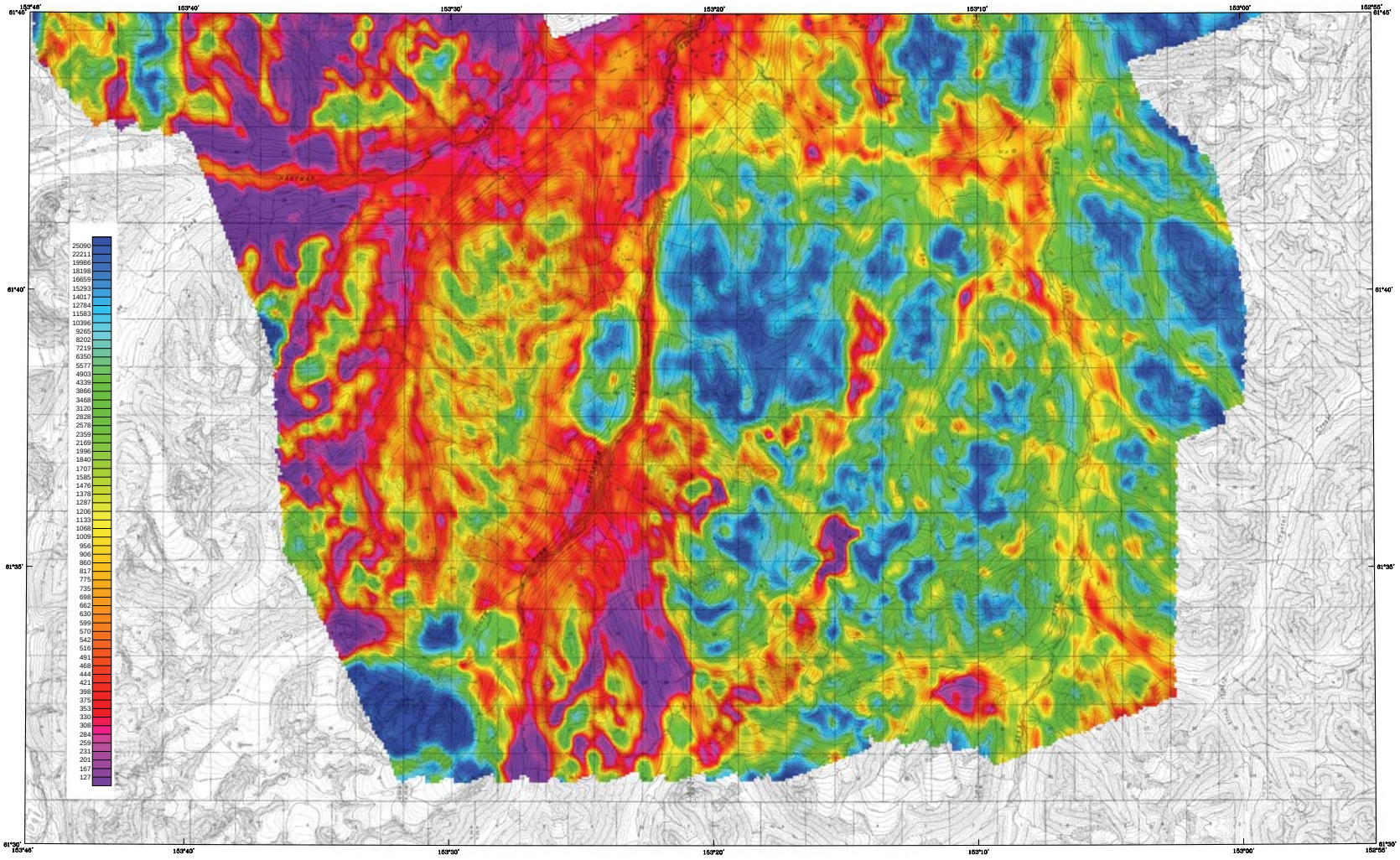


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Base from U.S. Geological Survey Lime Hills C-1, 1952; C-2, 1952; C-3, 1952; Tyonek C-4, 1951; Anchorage, Alaska



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

56,000 Hz COPLANAR APPARENT RESISTIVITY OF THE SOUTHERN STYX RIVER SURVEY, SOUTHCENTRAL ALASKA

PARTS OF LIME HILLS and TYONEK QUADRANGLES

by

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

2008

TRUE NORTH

APPROXIMATE MEAN DECLINATION, 2008

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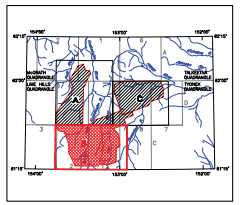
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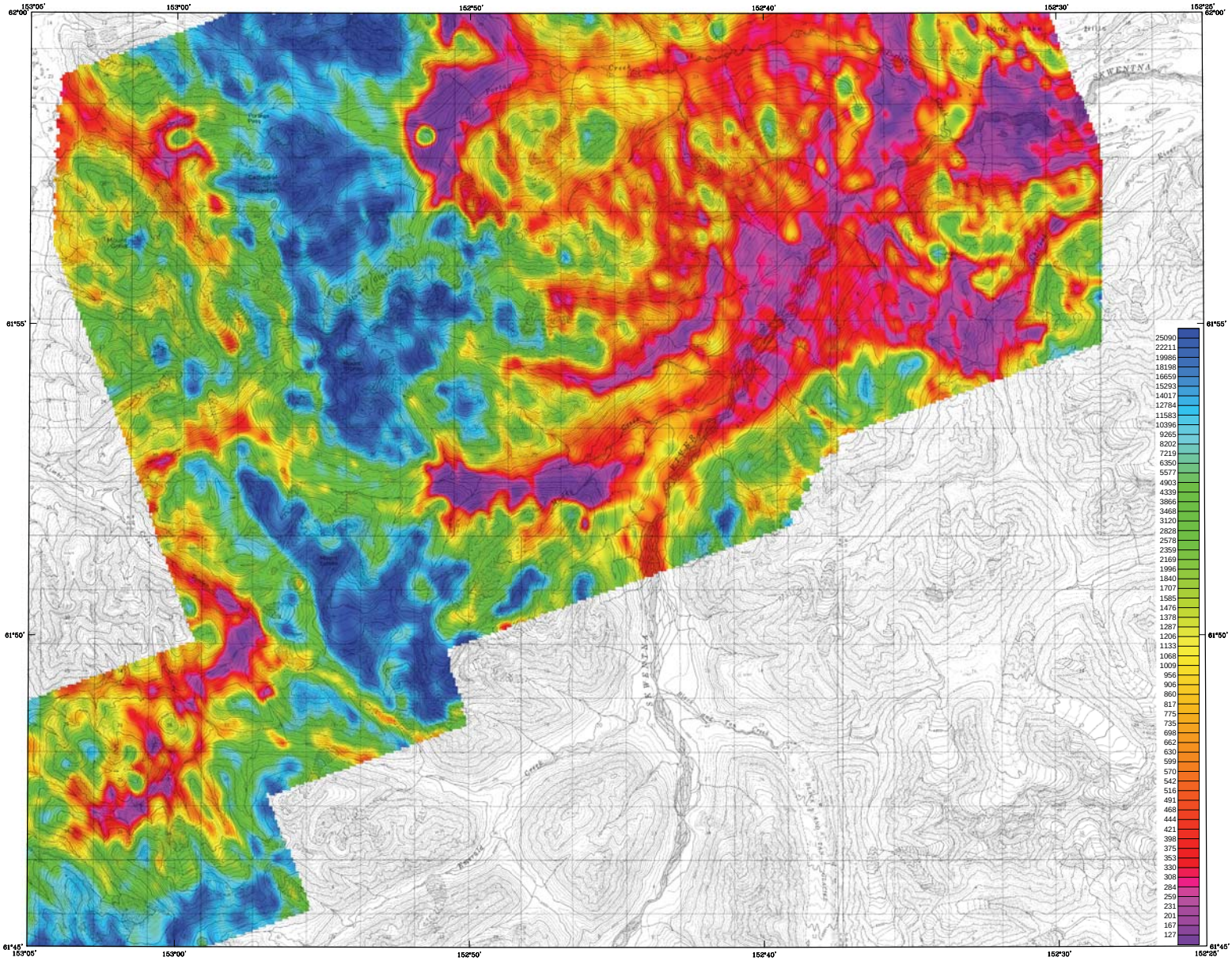


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SCALE 1:63,360

1 0 1 2 3 4 MILES

1 0 1 2 3 4 5 KILOMETERS

CONTOUR INTERVAL 100 FEET
DATUM MEAN SEA LEVEL

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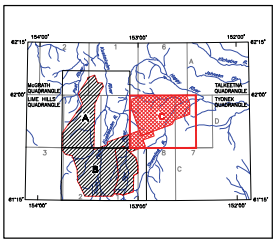
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2008

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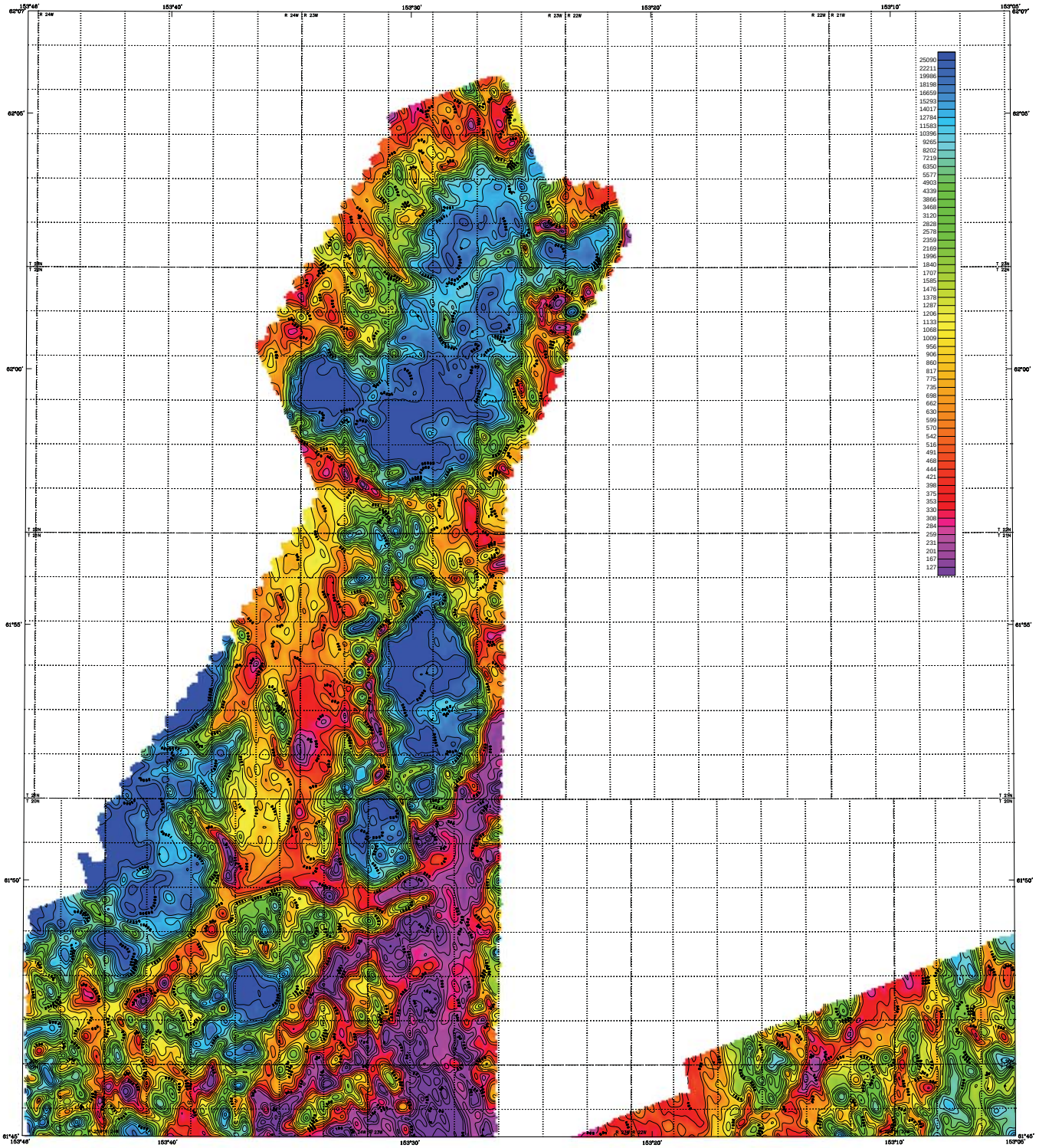
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SCALE 1:63,360

1 0 1 2 3 4 MILES

1 0 1 2 3 4 5 KILOMETERS

STYX RIVER SURVEY AREA

56,000 Hz COPLANAR APPARENT RESISTIVITY OF THE WESTERN STYX RIVER SURVEY, SOUTHCENTRAL ALASKA

PARTS OF LIME HILLS and McGRATH QUADRANGLES

by

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

2008

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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

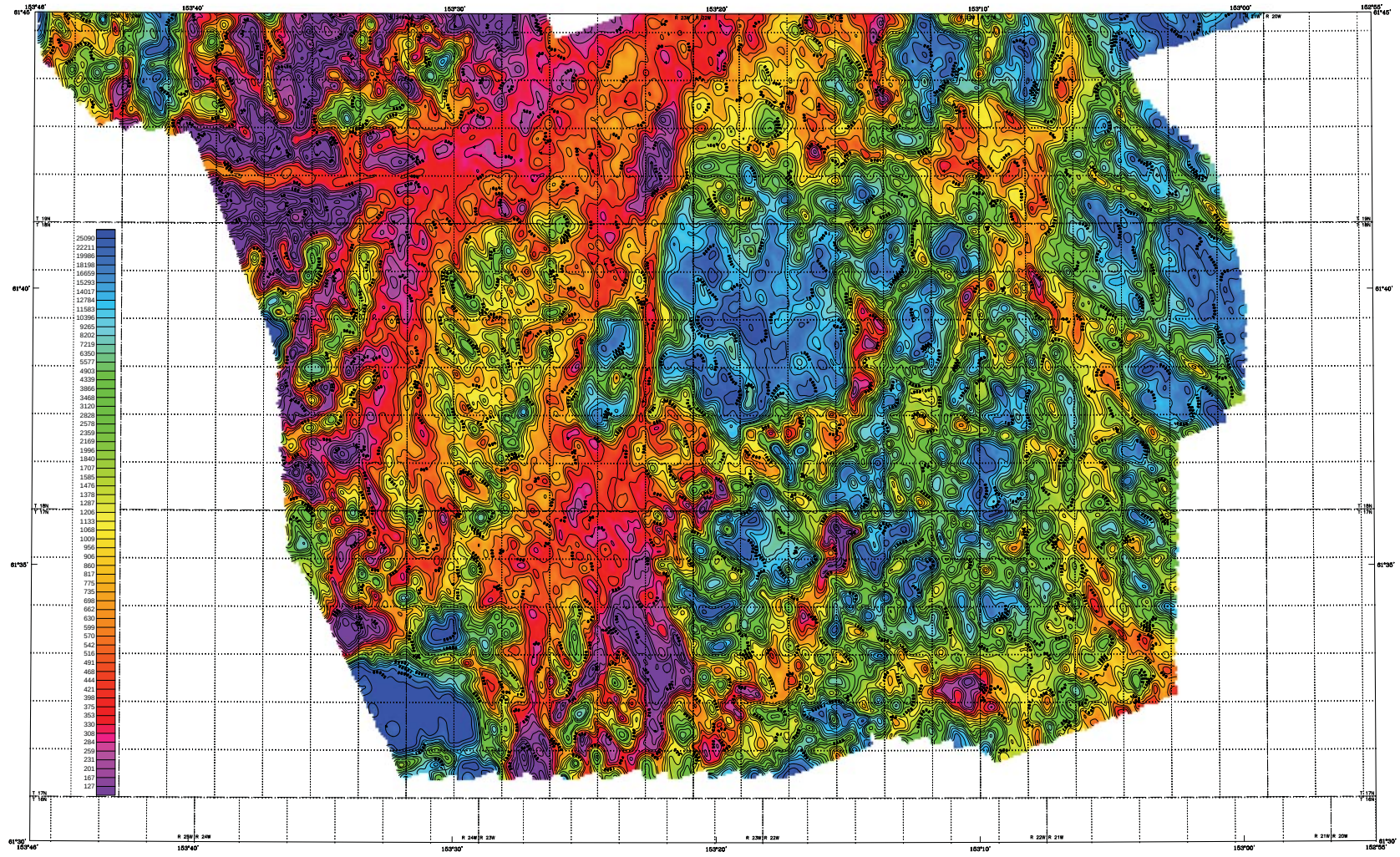
. . . . . resistivity low

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SCALE 1:63,360

1 0 1 2 3 4 MILES

1 0 1 2 3 4 5 KILOMETERS

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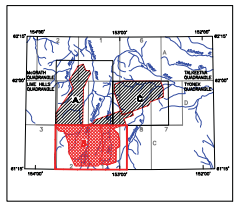
RESISTIVITY CONTOURS

1000
800
600
500
400
300
250
200
150
125
100

Contours in ohm–m at 10 intervals per decade

. . . . . resistivity low

LOCATION INDEX

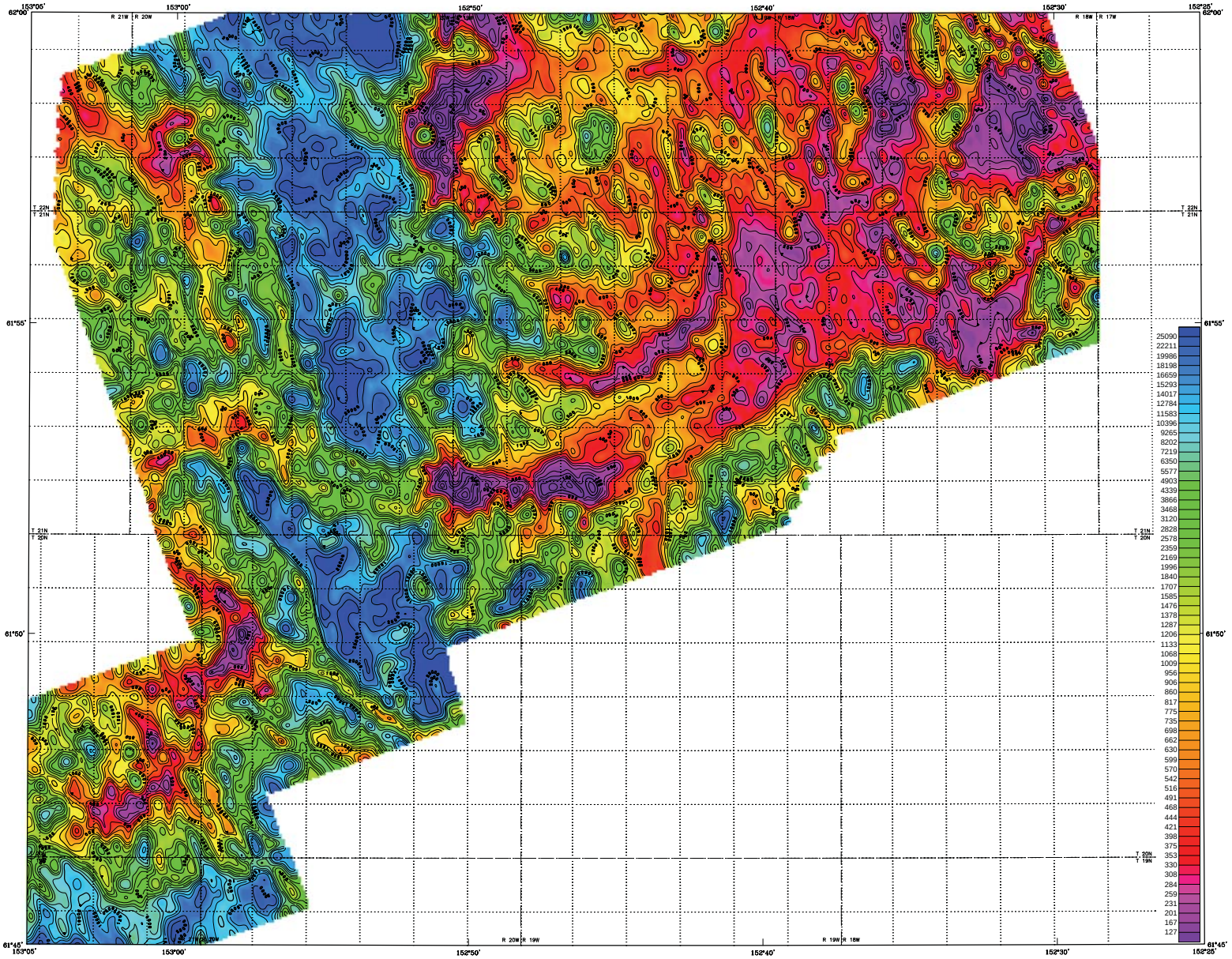


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SCALE 1:63,360

1 0 1 2 3 4 MILES

1 0 1 2 3 4 5 KILOMETERS

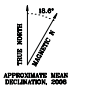
56,000 Hz COPLANAR APPARENT RESISTIVITY OF THE EASTERN STYX RIVER SURVEY, SOUTHCENTRAL ALASKA

PARTS OF LIME HILLS and TYONEK QUADRANGLES

by

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

2008



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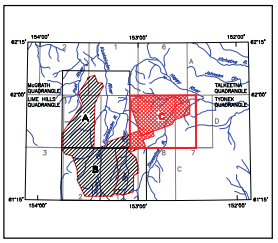
RESISTIVITY CONTOURS

1000
800
600
500
400
300
250
200
150
125
100

Contours in ohm-m at 10 intervals per decade

. . . . . resistivity low

LOCATION INDEX

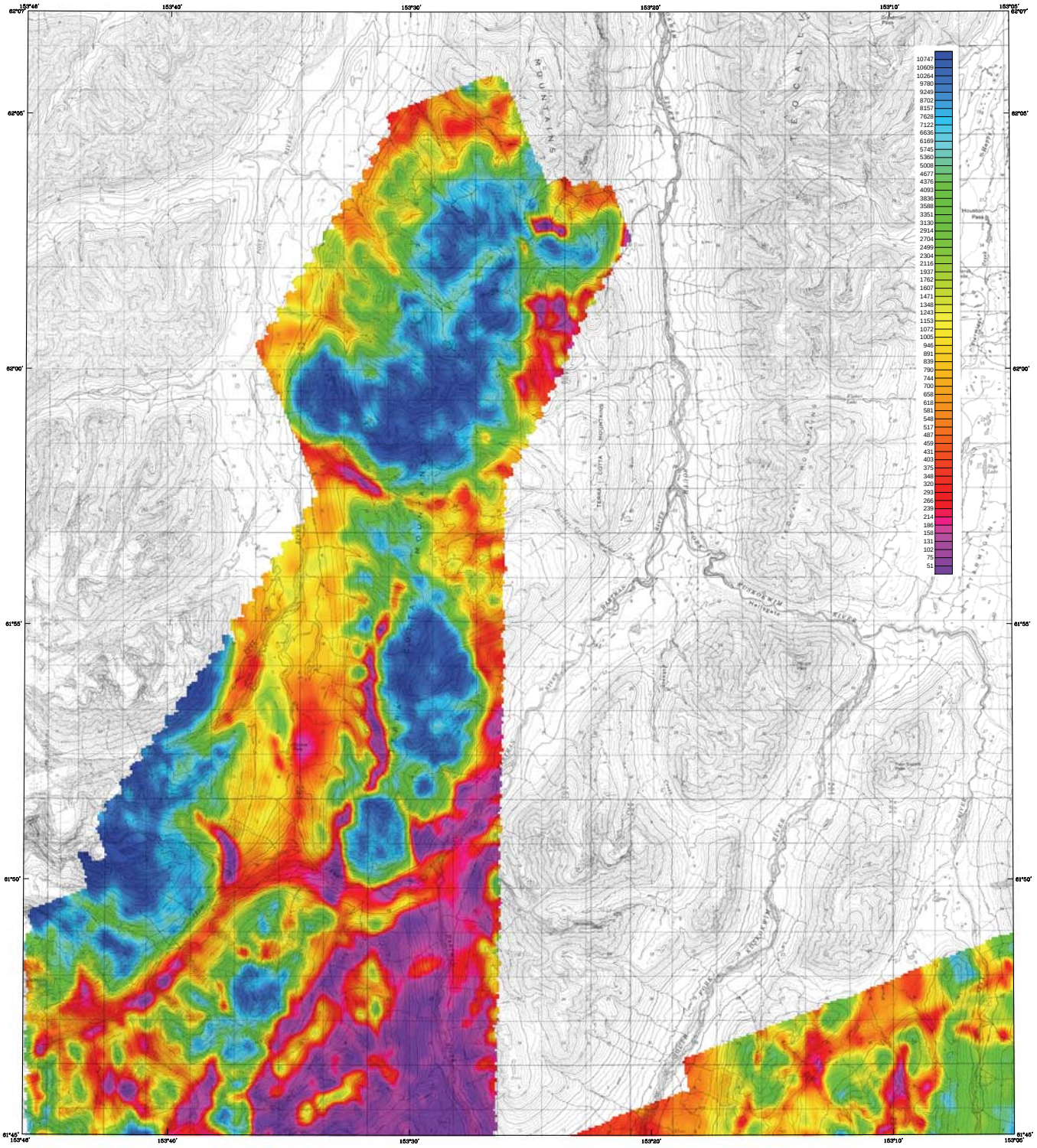


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Base from U.S. Geological Survey Lime Hills B-1, 1952; B-2, 1977; B-3, 1978; McGrath A-1, 1952; A-2, 1952, Quadrangles, Alaska





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

7200 Hz COPLANAR APPARENT RESISTIVITY OF THE WESTERN STYX RIVER SURVEY, SOUTHCENTRAL ALASKA

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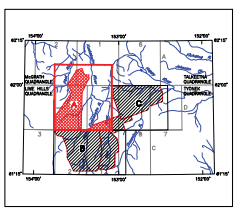
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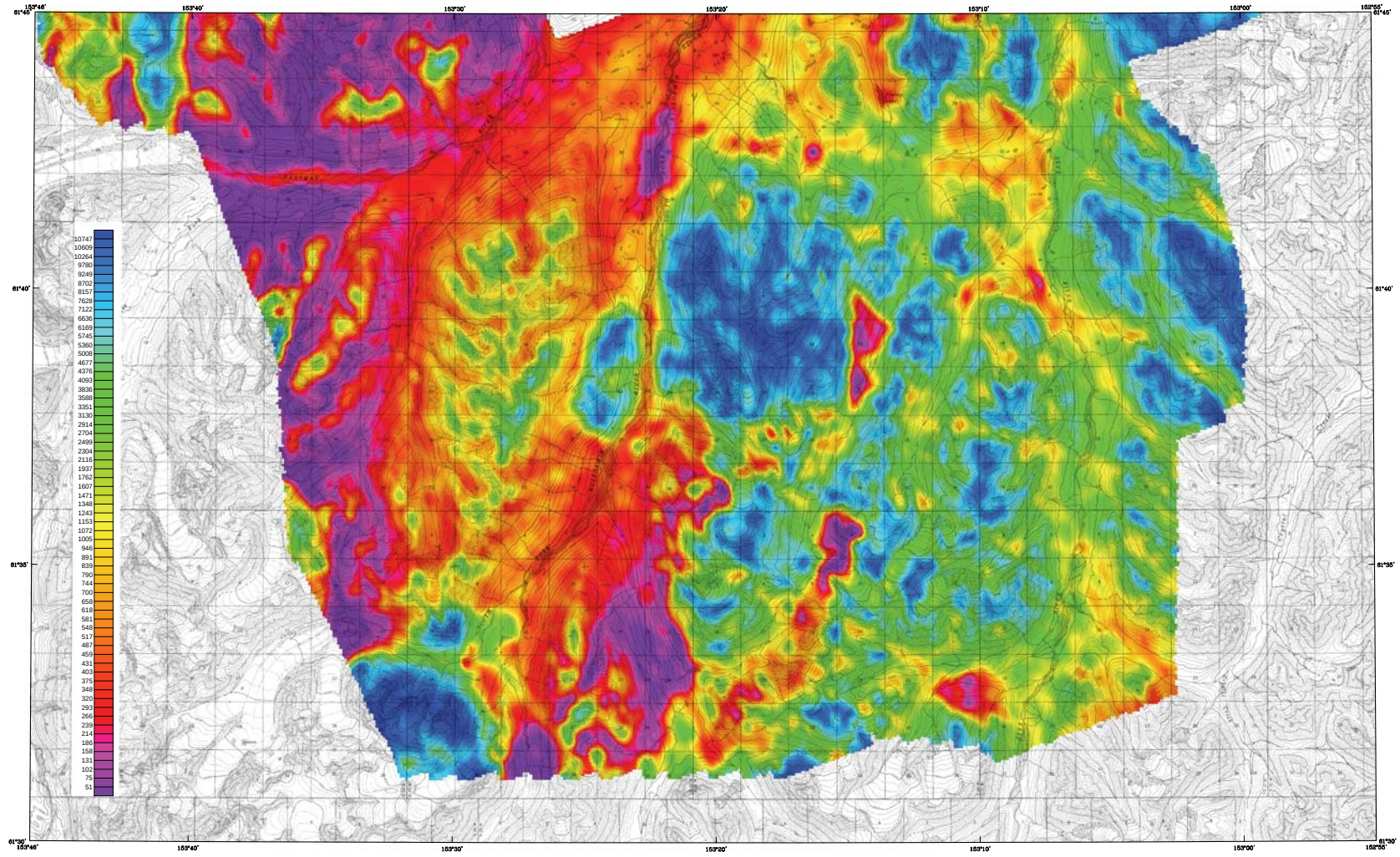


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SCALE 1:63,360

1 0 1 2 3 4 MILES

1 0 1 2 3 4 5 KILOMETERS

CONTOUR INTERVAL 100 FEET
DATUM: MEAN SEA LEVEL

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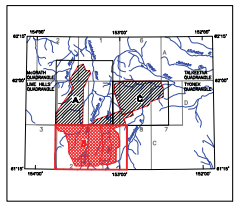
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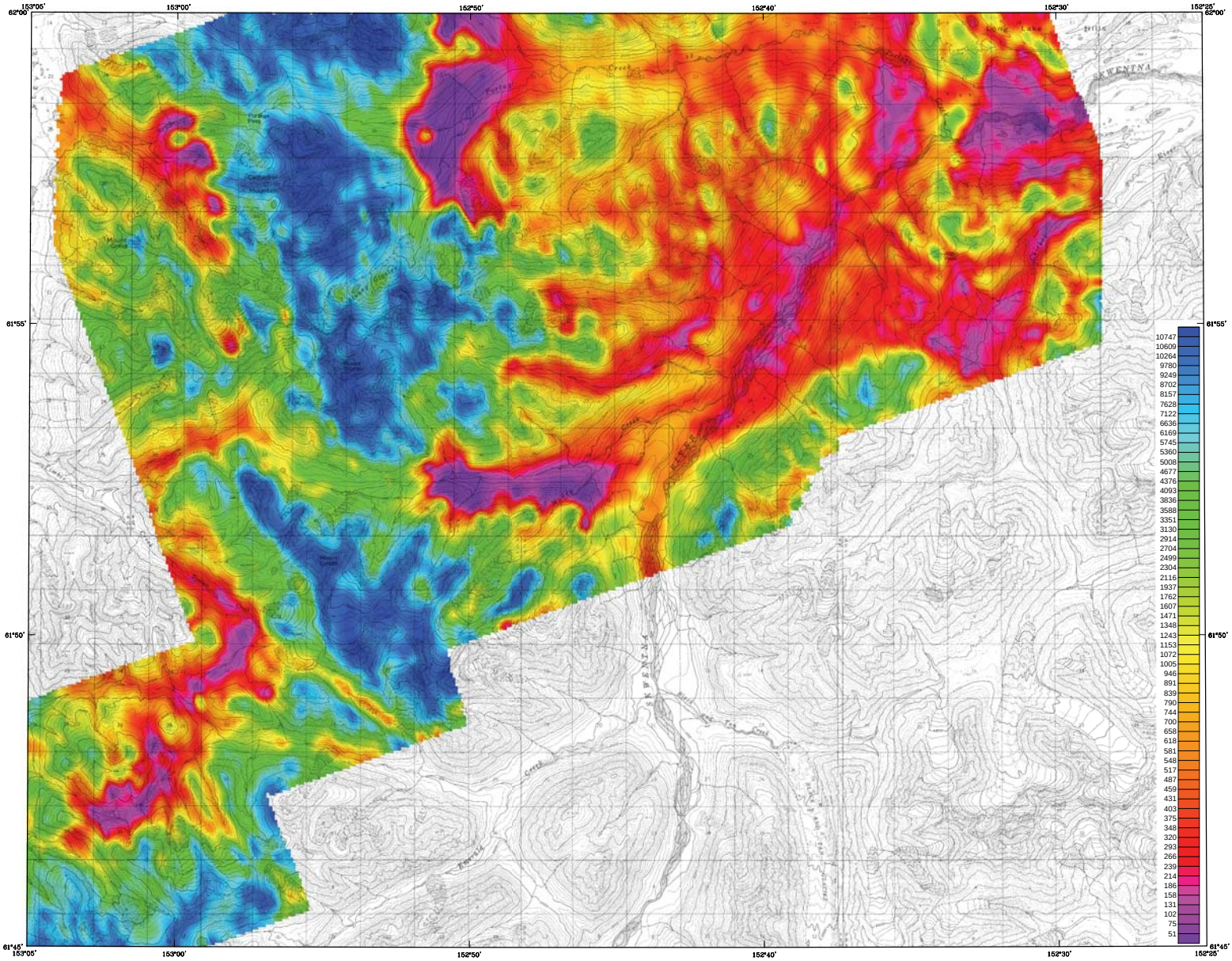


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APPROXIMATE MEAN DECLINATION, 2008

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

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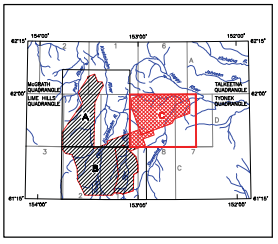
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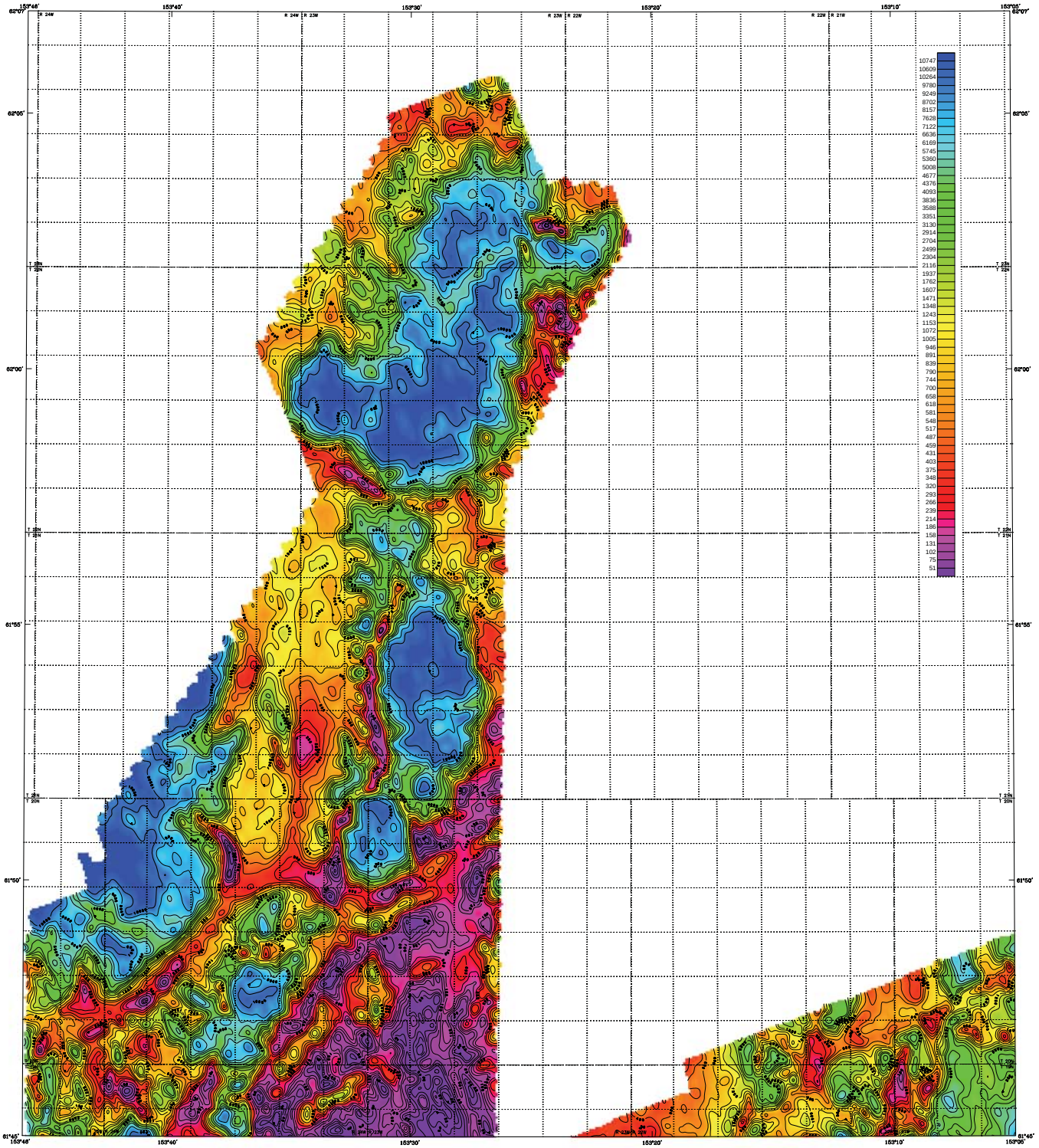


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SCALE 1:63,360

1 0 1 2 3 4 MILES

1 0 1 2 3 4 5 KILOMETERS

7200 Hz COPLANAR APPARENT RESISTIVITY OF THE WESTERN STYX RIVER SURVEY, SOUTHCENTRAL ALASKA

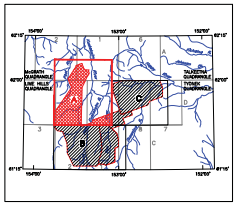
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RESISTIVITY CONTOURS

1000
800
600
500
400
300
250
200
150
125
100

Contours in ohm–m at 10 intervals per decade

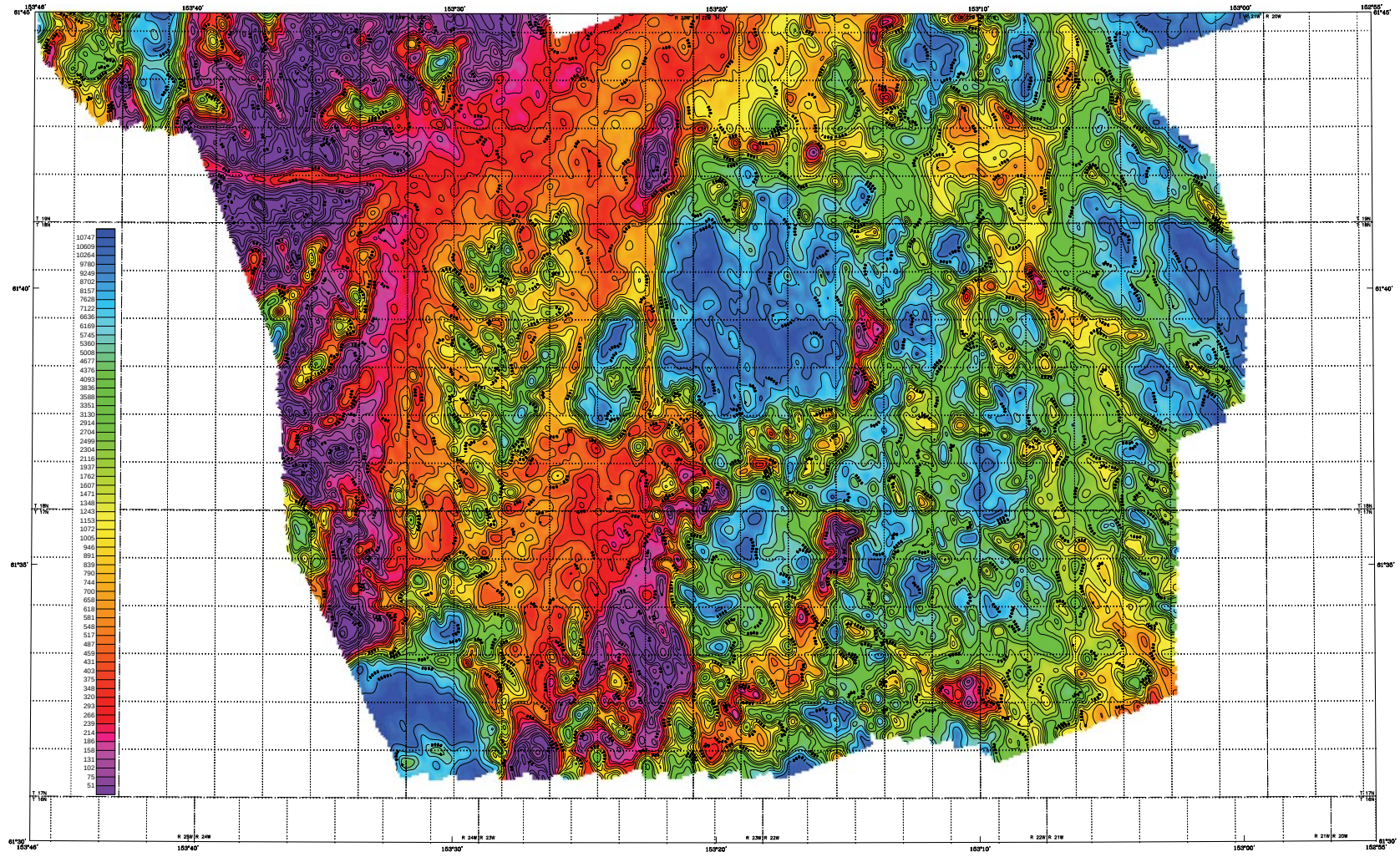
. . . . . resistivity low

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SCALE 1:63,360

1 0 1 2 3 4 MILES

1 0 1 2 3 4 5 KILOMETERS

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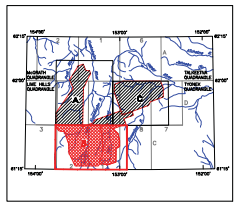
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1000
800
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Contours in ohm–m at 10 intervals per decade

. . . . . resistivity low

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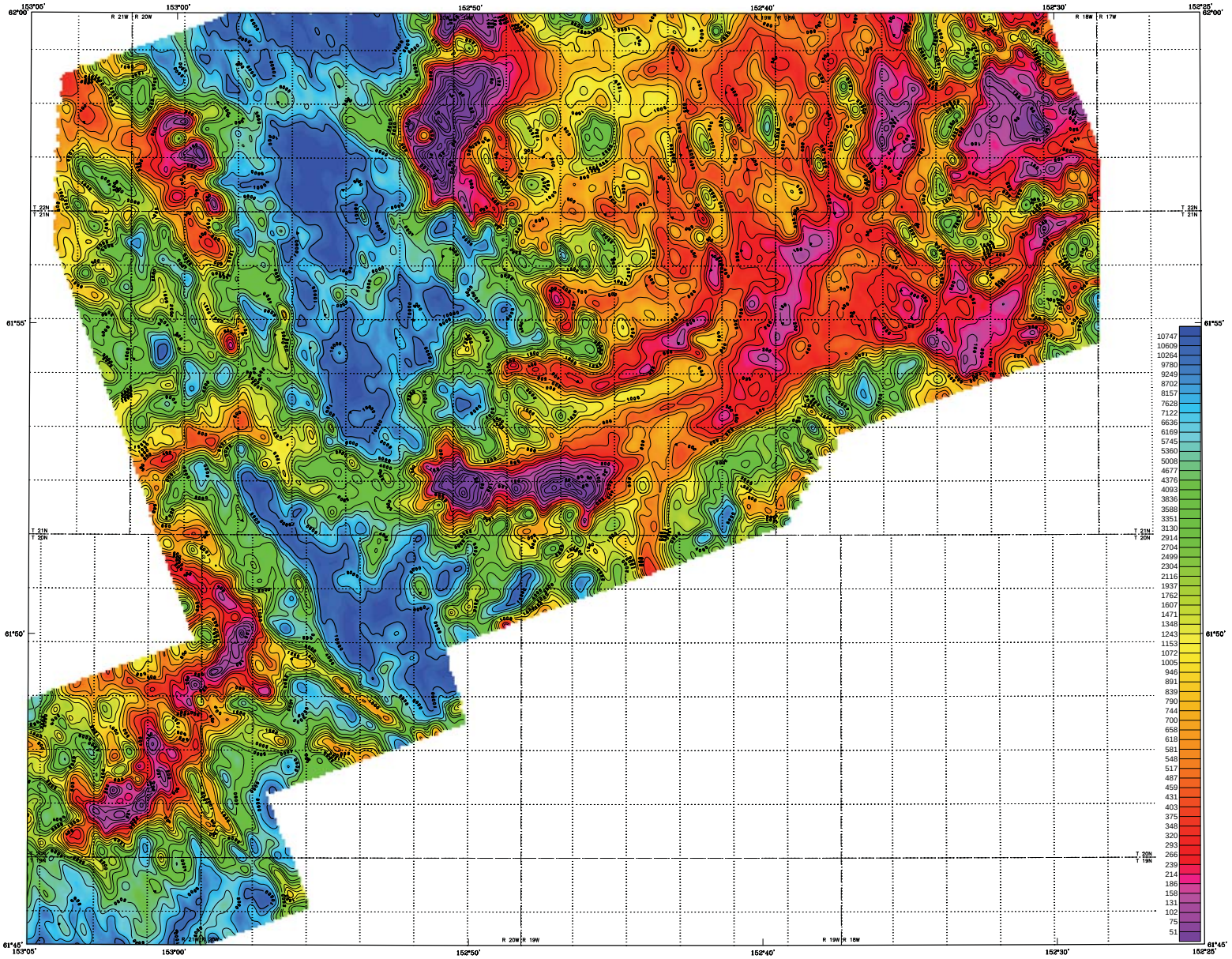


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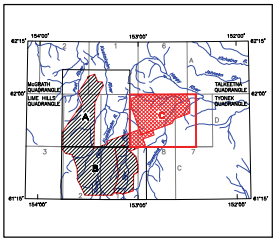
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Akima, H.,1970, A new method of interpolation and smooth curve fitting based on local procedures: Journal of the Association of Computing Machinery, v. 17, no.4, p.589–602.

RESISTIVITY CONTOURS

1000
800
600
500
400
300
250
200
150
125
100

Contours in ohm-m at 10 intervals per decade

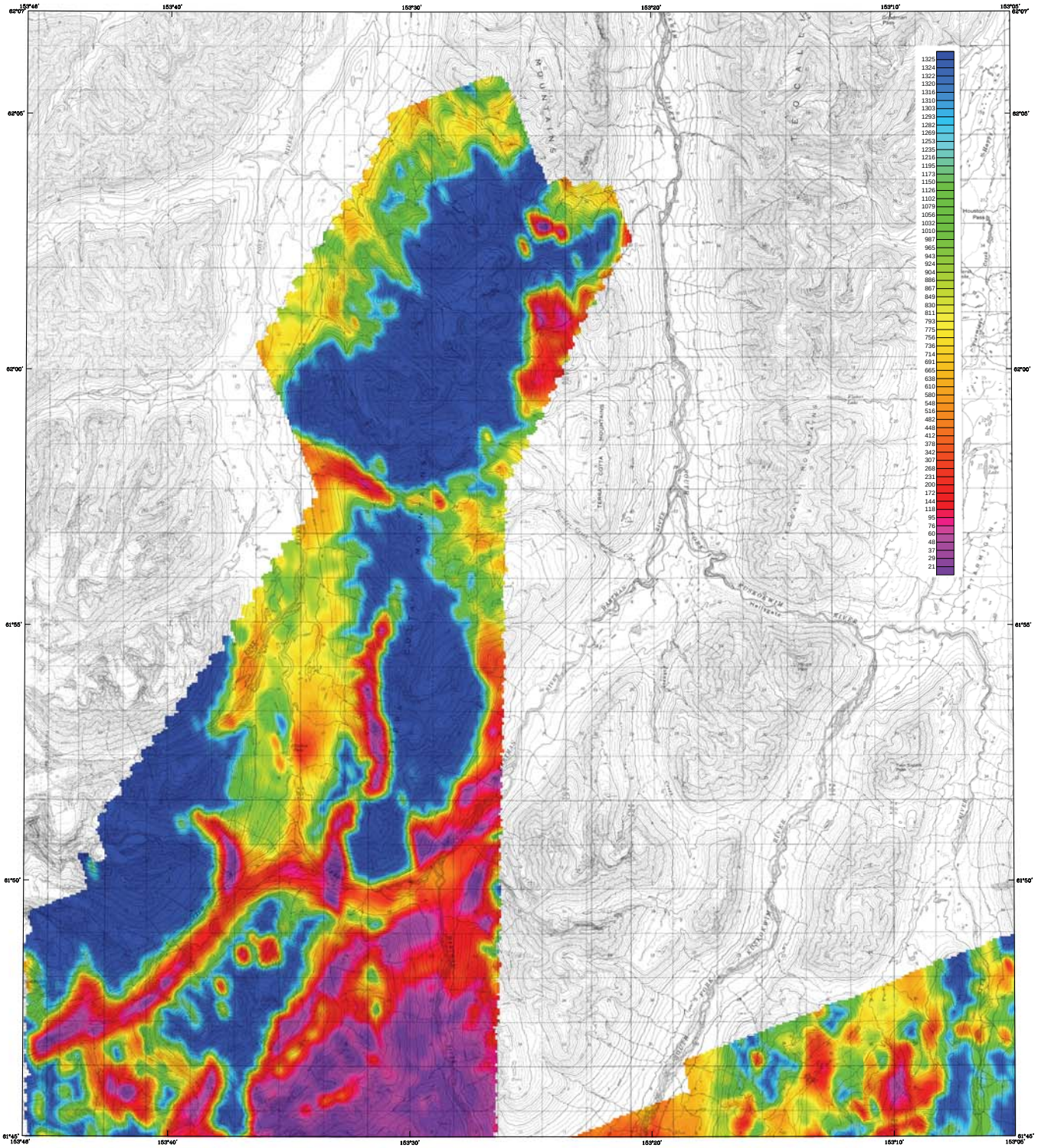
. . . . . resistivity low

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Base from U.S. Geological Survey Lime Hills D-1, 1952; D-2, 1977; D-3, 1978; McGrath A-1, 1952; A-2, 1952, 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

900 Hz COPLANAR APPARENT RESISTIVITY OF THE WESTERN STYX RIVER SURVEY, SOUTHCENTRAL ALASKA

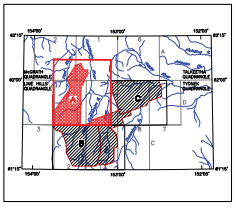
PARTS OF LIME HILLS and McGRATH QUADRANGLES

by

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

2008

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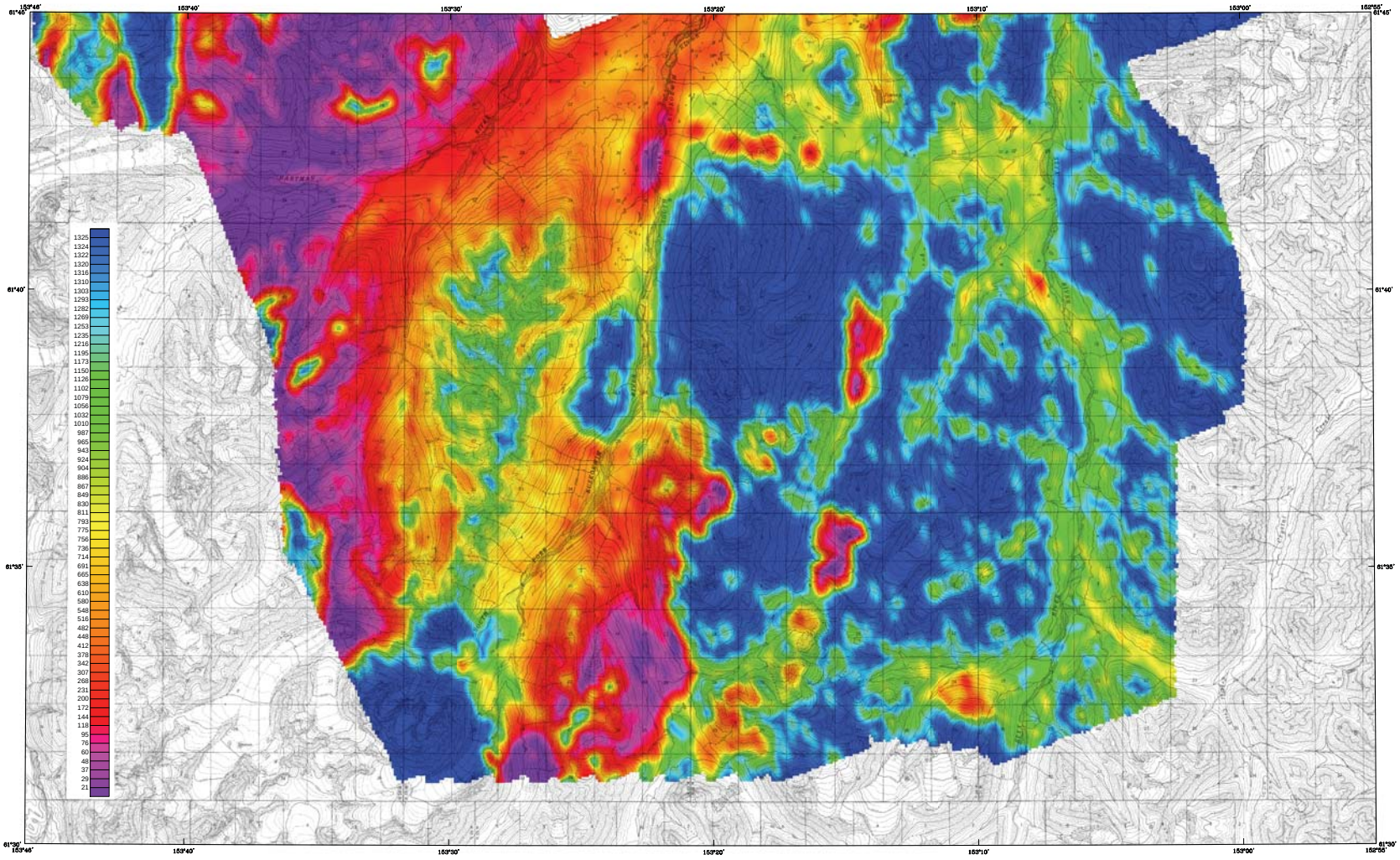
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1 0 1 2 3 4 MILES

1 0 1 2 3 4 5 KILOMETERS

CONTOUR INTERVAL 100 FEET
DATUM: MEAN SEA LEVEL

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2008

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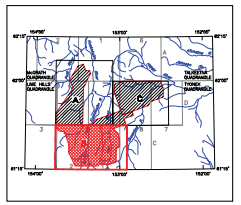
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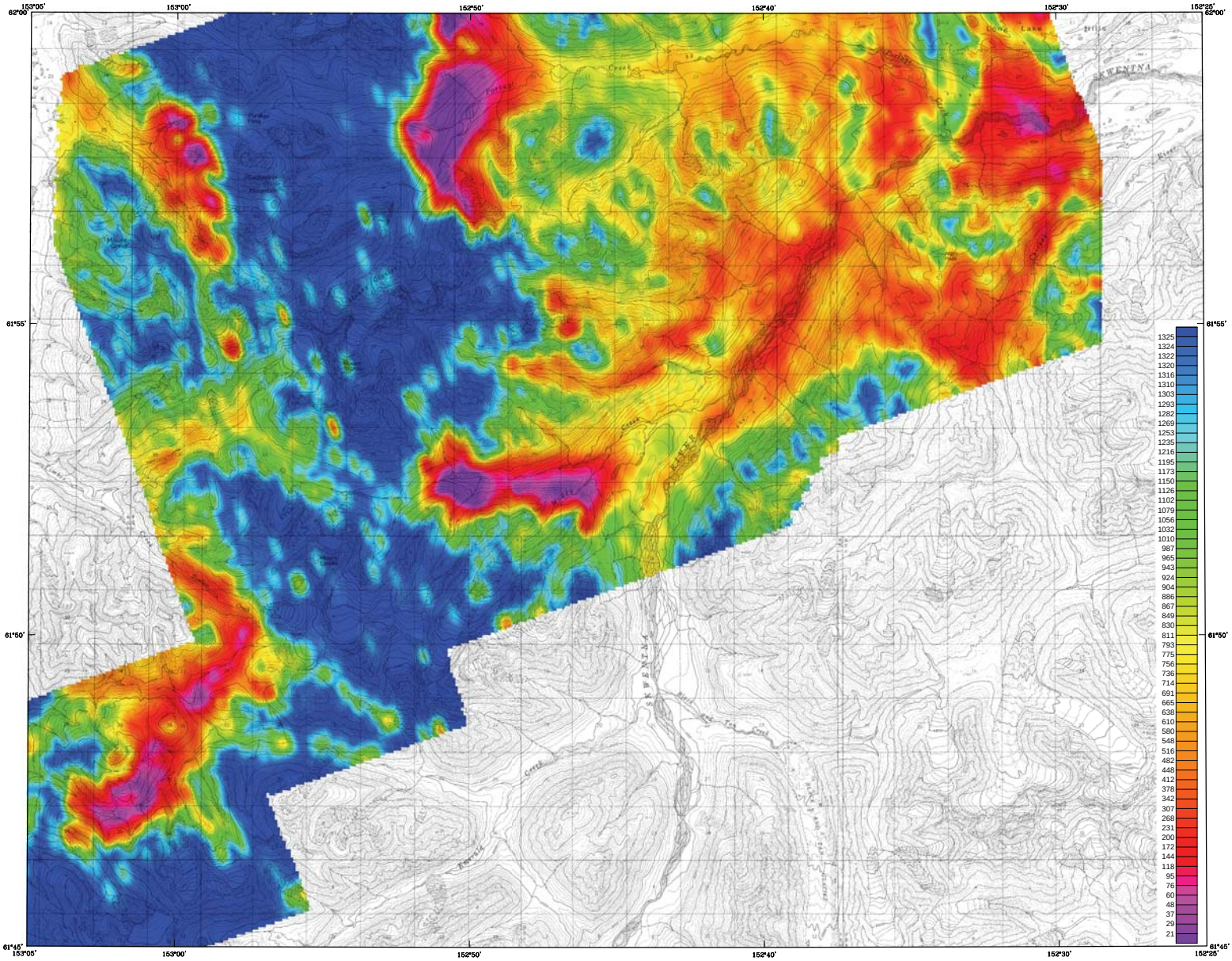


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APPROXIMATE MEAN DECLINATION, 2008

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

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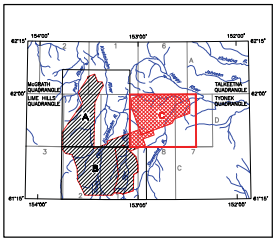
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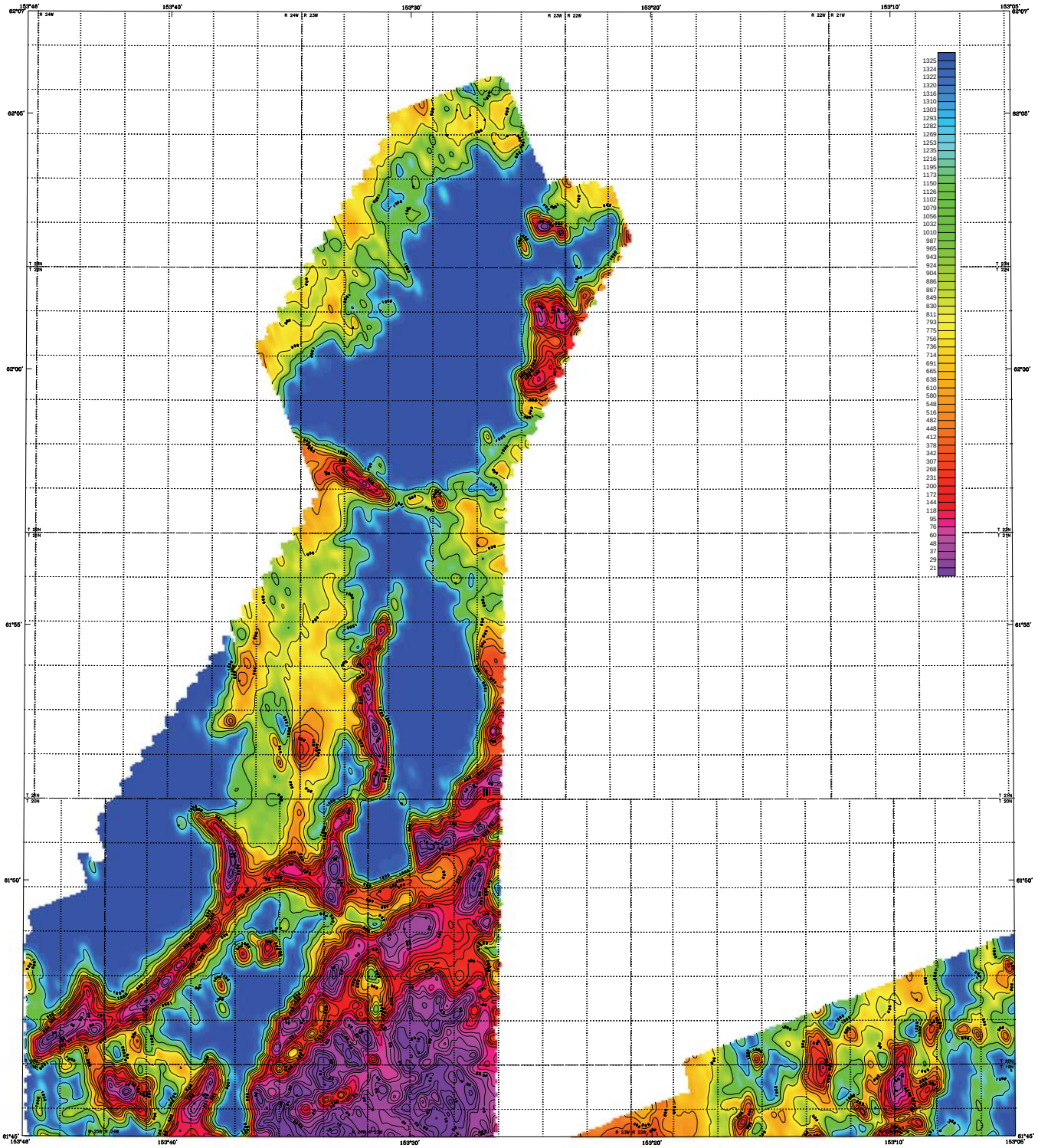


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SCALE 1:63,360

1 0 1 2 3 4 MILES

1 0 1 2 3 4 5 KILOMETERS

STYX RIVER SURVEY AREA

900 Hz COPLANAR APPARENT RESISTIVITY OF THE WESTERN STYX RIVER SURVEY, SOUTHCENTRAL ALASKA

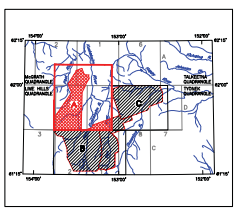
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2008

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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

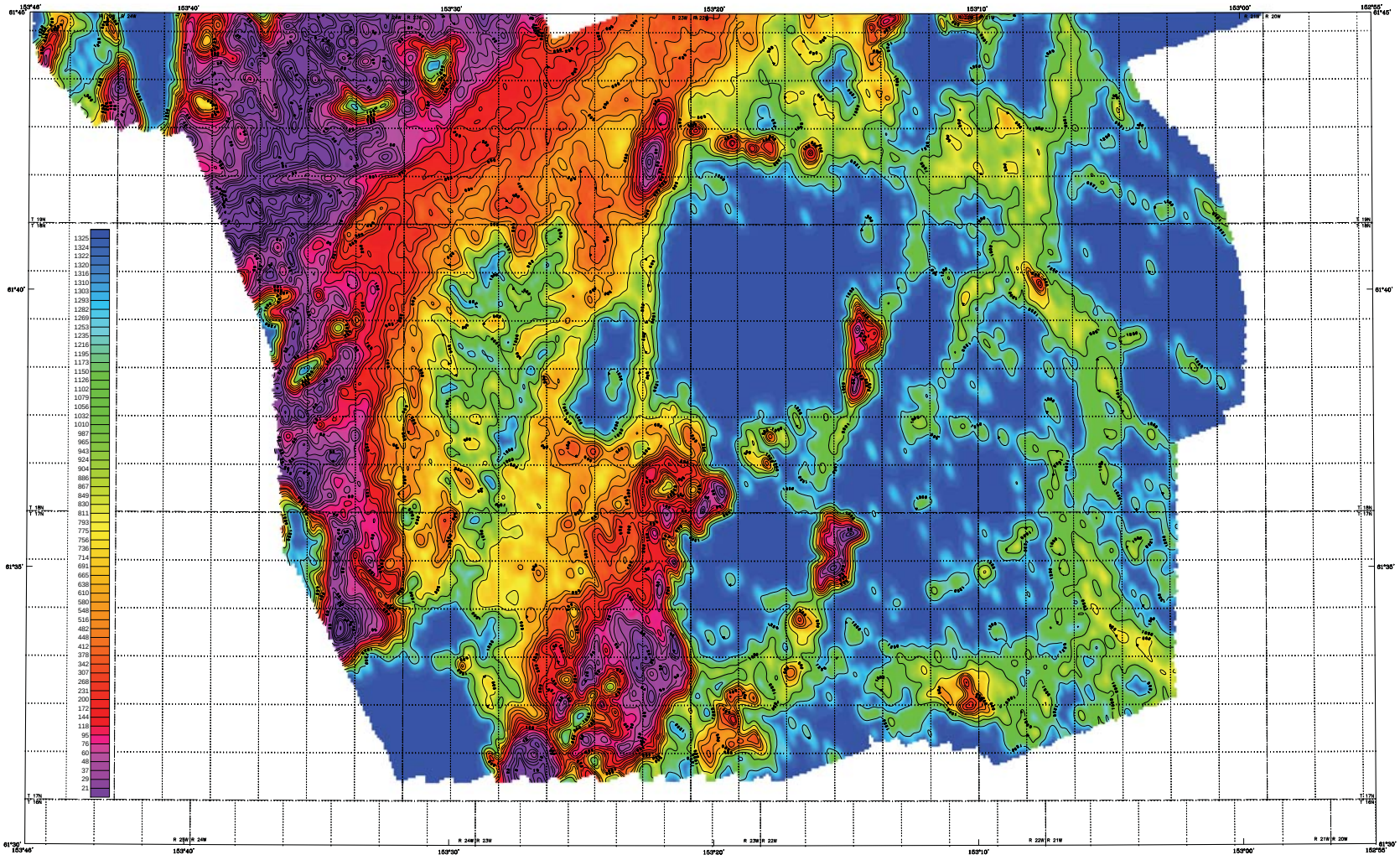
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SCALE 1:63,360

1 0 1 2 3 4 MILES

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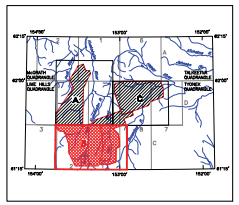
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1000
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Contours in ohm–m at 10 intervals per decade

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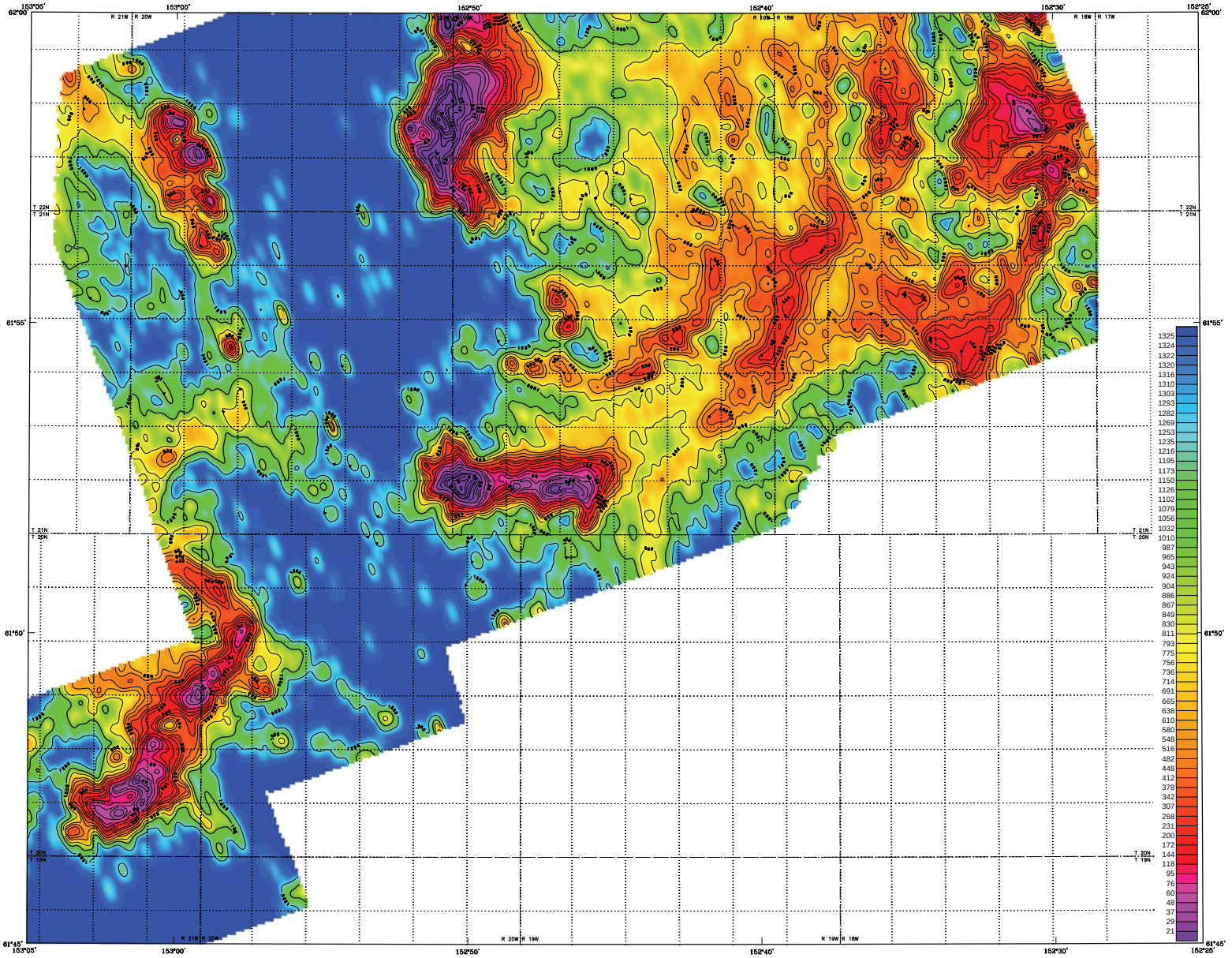


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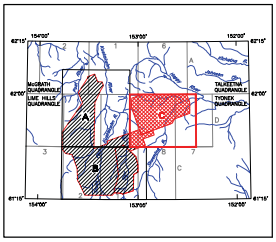
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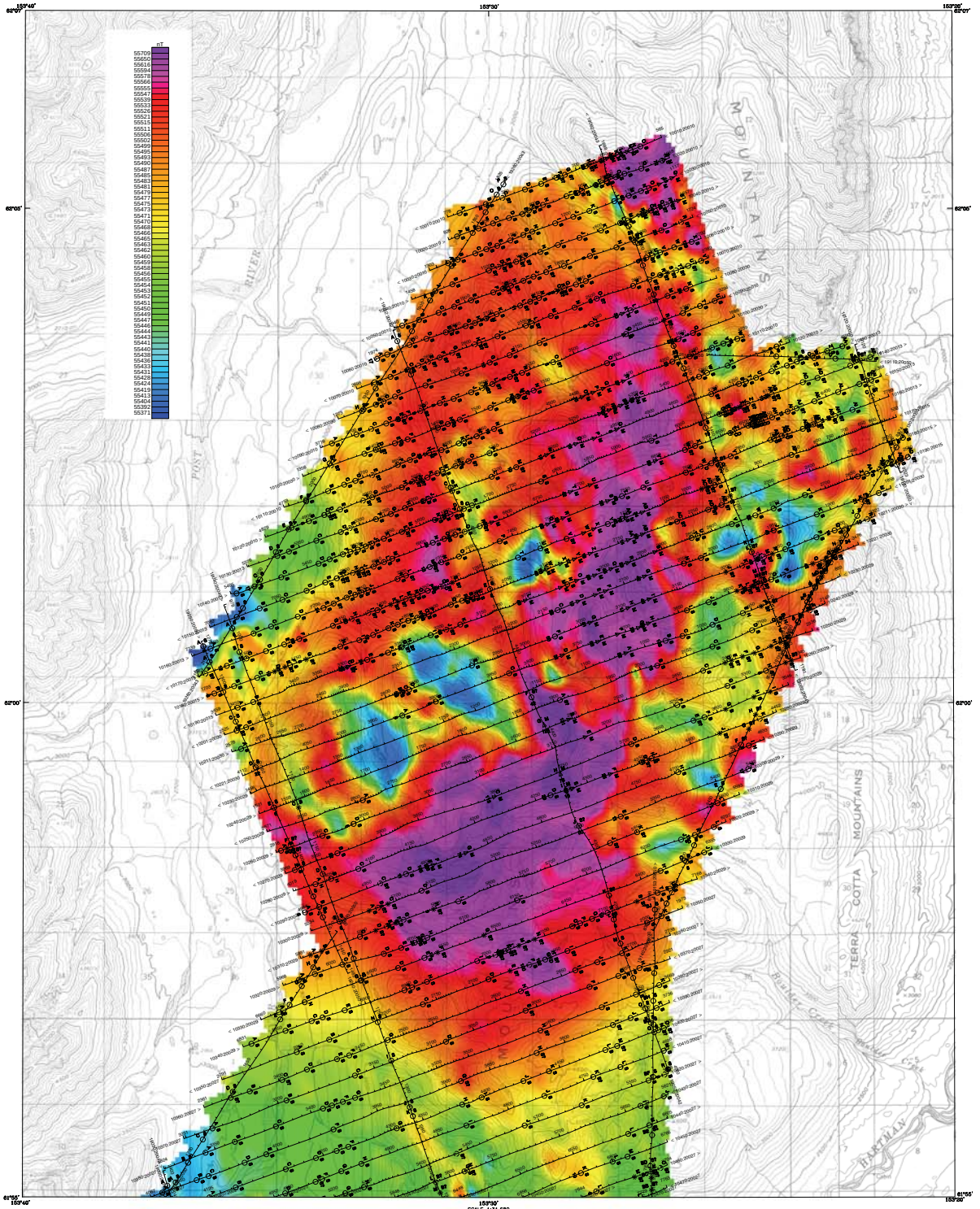
GPR 2008–4 supercedes GPR 2008–2, which contained the maps and data produced for most of the survey area in the Tyonek quadrangle. Data and maps in GPR 2008–2 were modified only slightly upon merging with the data to the south and west. All the final data and 1:63,360–scale maps are included in GPR 2008–4. A future release will include EM anomaly 1:31,680–scale maps and the Contractor's Project Report.

This map and other products from this survey are available by mail order, or in person, from DGGS, 3354 College Road, Fairbanks, Alaska, 99709–3707. Published maps are also available for viewing or downloading as Adobe Acrobat Files (*.pdf) on our Web site (http://www.dggs.dnr.state.ak.us/pubs/).

ALASKA DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS

GEOPHYSICAL REPORT 2008-5-1a

PARTS of LIME HILLS D-1, D-2 and McGRATH A-1, A-2 QUADRANGLES



Base from U.S. Geological Survey Lime Hills D-1, 1950; D-2, 1977; McGrath A-1, 1952; A-2, 1952; 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 100 FEET DATUM MEAN SEA LEVEL



TOTAL MAGNETIC FIELD AND DETAILED ELECTROMAGNETIC ANOMALIES OF THE STYX RIVER SURVEY, SOUTHCENTRAL ALASKA

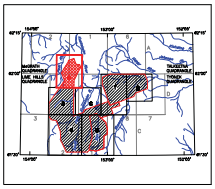
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by

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

2008

LOCATION INDEX FOR 1:31,680



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 150 feet. In addition the survey recorded data from a radar altimeter, GPS navigation system, 50/60 Hz monitors and video camera. Flights were performed with an AS350B-3 Squirrel helicopter at a mean terrain clearance of 200 feet along NE-SW (70°) 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.

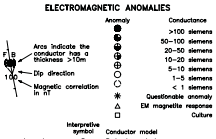
A Novatel OEM4-G2L Global Positioning System was used for navigation. The helicopter position was derived every 0.5 seconds using post-flight differential positioning to a relative accuracy of better than 5m. Flight path positions were projected onto the Clarke 1866 (UTM zone 5) spheroid, 1927 North American datum using a central meridian (CM) of 153°, 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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The magnetic total field data were processed using digitally recorded data from a Fugro D1344 cesium magnetometer with a Scintrex CS3 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 2005, 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.

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ELECTROMAGNETIC ANOMALIES



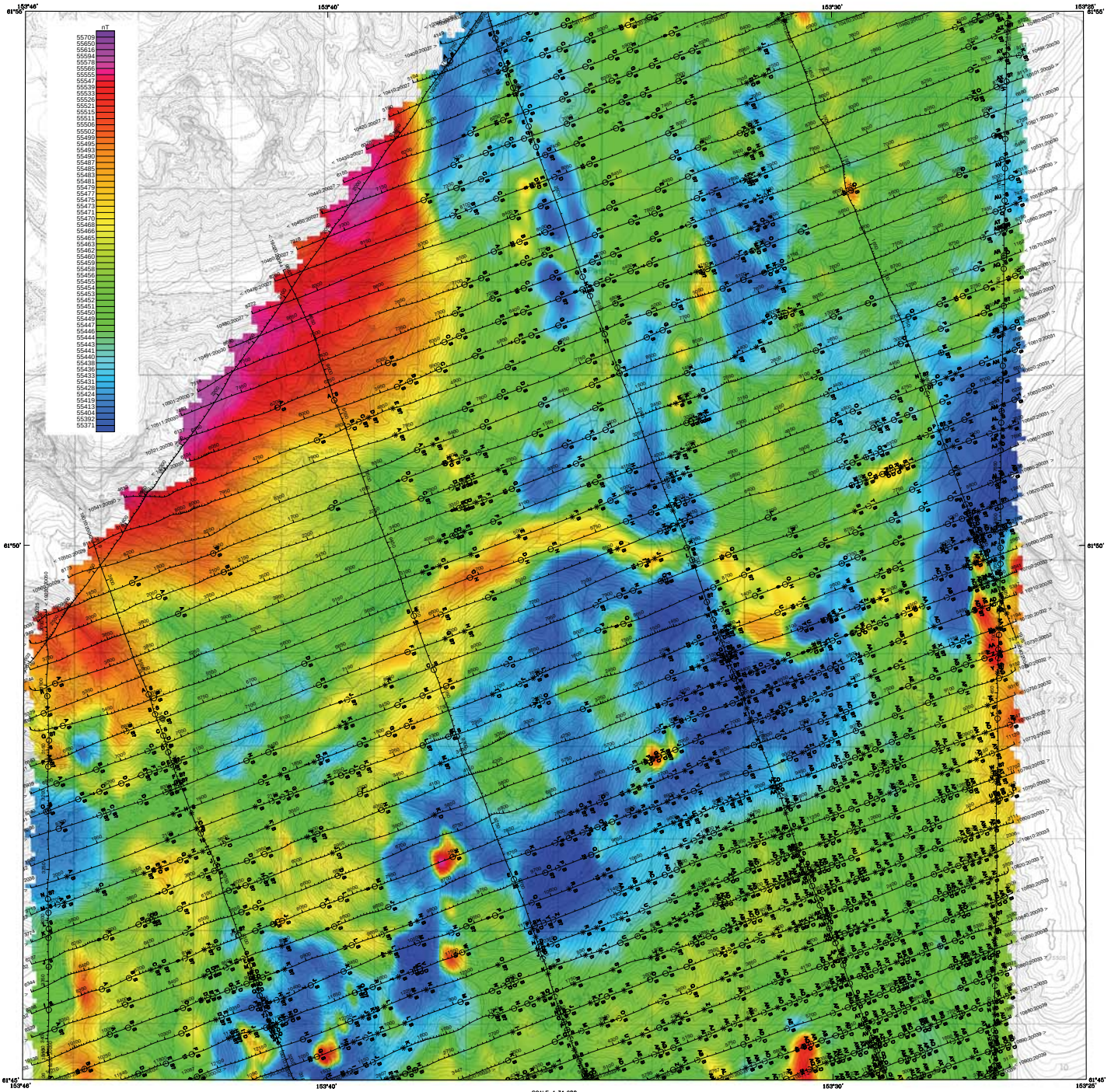
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To determine the location of EM anomalies or their boundaries, the DIGHEM^V EM system measured inphase and quadrature components at five frequencies, two vertical coaxial-coil pairs operated at 1000 and 5500 Hz while three horizontal coplanar-coil 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. 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.

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Base from U.S. Geological Survey Lime Hills D-2, 1977; D-3, 1976, Quadrangles, Alaska

SCALE 1:31,680

0.5 0 0.5 1 1.5 2 MILES

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CONTOUR INTERVAL 100 FEET
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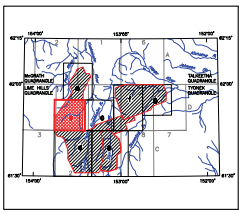


TOTAL MAGNETIC FIELD AND DETAILED ELECTROMAGNETIC ANOMALIES OF THE STYX RIVER SURVEY, SOUTHCENTRAL ALASKA

PARTS of LIME HILLS D-2 and D-3 QUADRANGLES

by
Laurel E. Burns, Fugro Airborne Surveys Corp., and Stevens Exploration Management Corp.
2008

LOCATION INDEX FOR 1:31,680



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 a radar altimeter, GPS navigation system, 50/60 Hz monitors and video camera. Flights were performed with an AS350B-3 Squirrel helicopter at a mean terrain clearance of 200 feet along NE–SW (70°) 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.

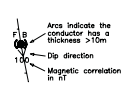
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ELECTROMAGNETIC ANOMALIES



Anomaly	Conductance
●	>100 siemens
◕	50–100 siemens
◑	20–50 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 dike")
S	Conductive cover ("horizontal thin sheet"). Broad conductive rock unit, deep conductive weathering, thick conductive cover ("half–space")
H	
E	Edge of broad conductor ("edge of half space")
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

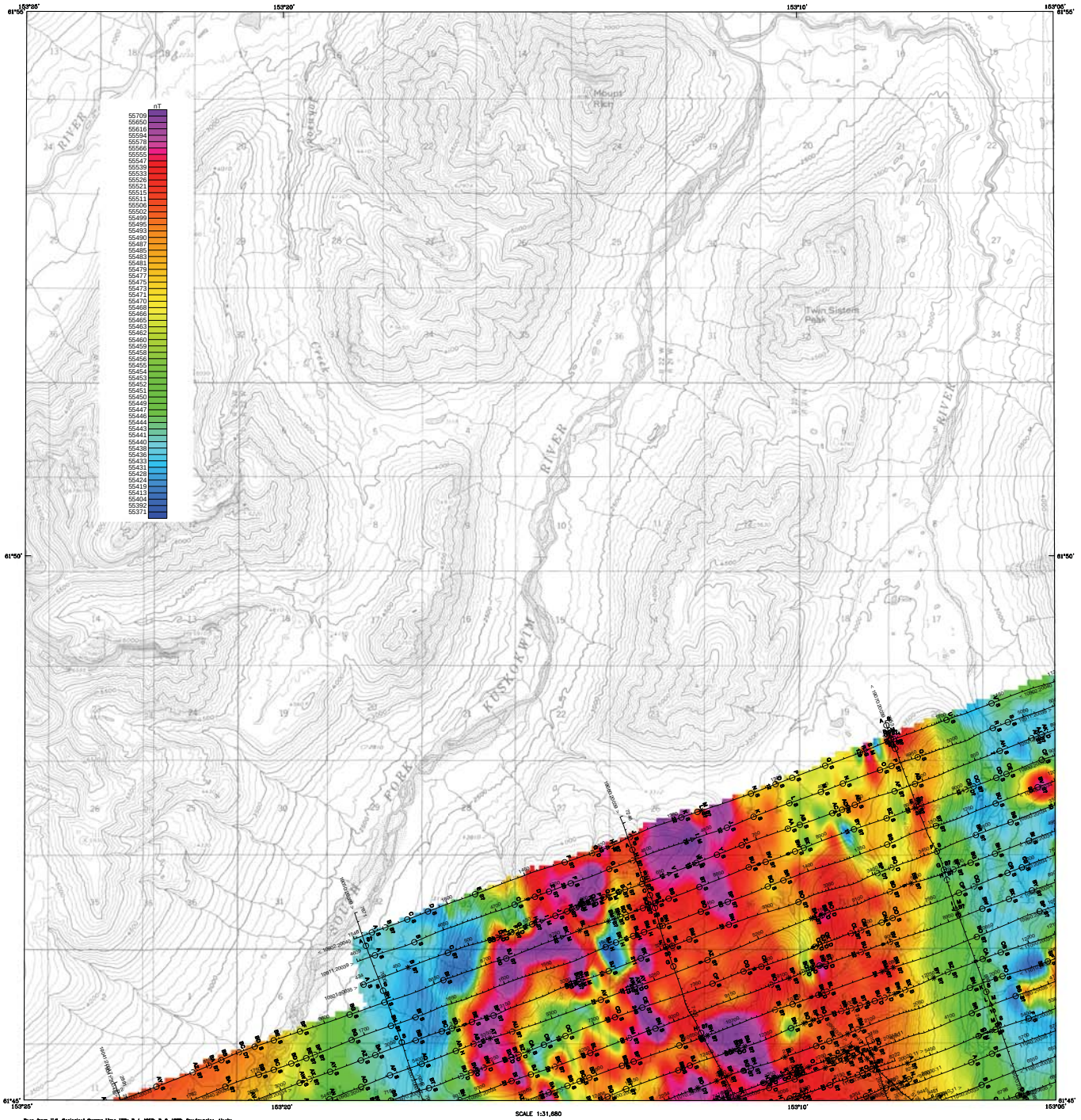
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TOTAL MAGNETIC FIELD AND DETAILED ELECTROMAGNETIC ANOMALIES OF THE STYX RIVER SURVEY, SOUTHCENTRAL ALASKA

PARTS of LIME HILLS D-1 and D-2 QUADRANGLES

by
Laurel E. Burns, Fugro Airborne Surveys Corp., and Stevens Exploration Management Corp.
2008

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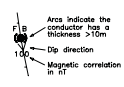
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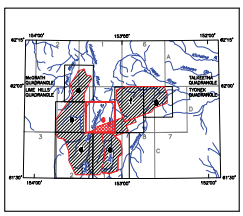


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LOCATION INDEX FOR 1:31,680

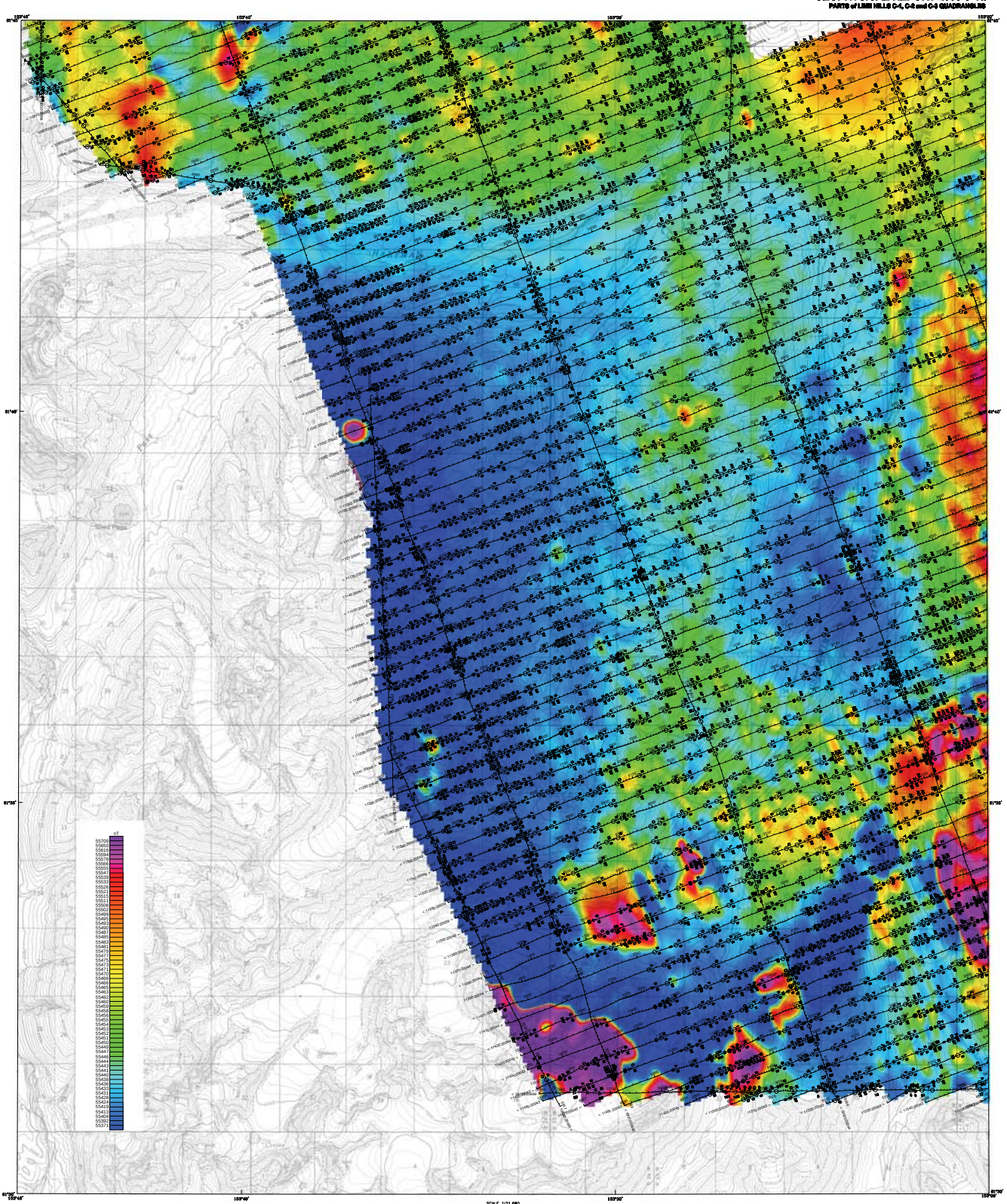




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Base from U.S. Geological Survey Lime Hills C-1, 1978; C-2, 1978; C-3, 1978; Southwest, Alaska

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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

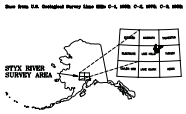
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PARTS of LIME HILLS C-1, C-2 and C-3 QUADRANGLES

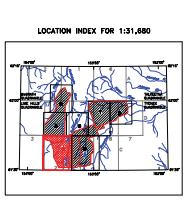
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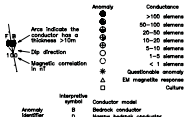
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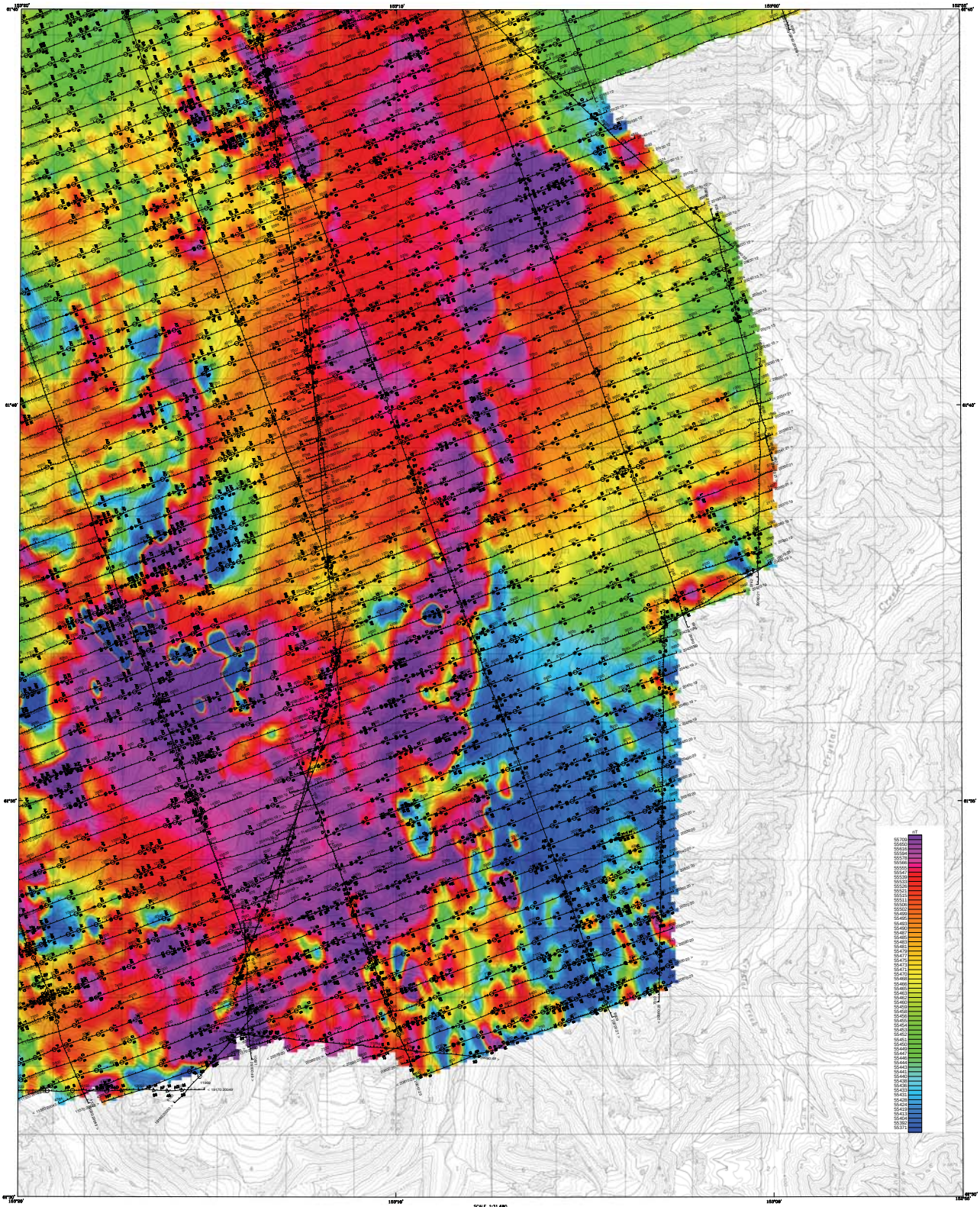
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ALASKA DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS

GEOPHYSICAL REPORT 2008-5-1e
PARTS of LIME HILLS C-1 and TYONEK C-6 QUADRANGLES



Base data U.S. Geological Survey Lime Hills C-1, 1955; Tyonek C-6, 1955; Quadrangles, Alaska

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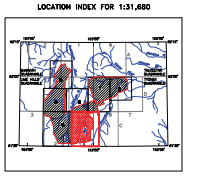
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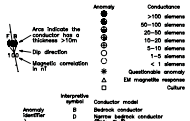
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M	Magnetite
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ELECTROMAGNETICS

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 coplanar coil pairs operated at 900, 7200, and 56,000 Hz, three horizontal coaxial 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.



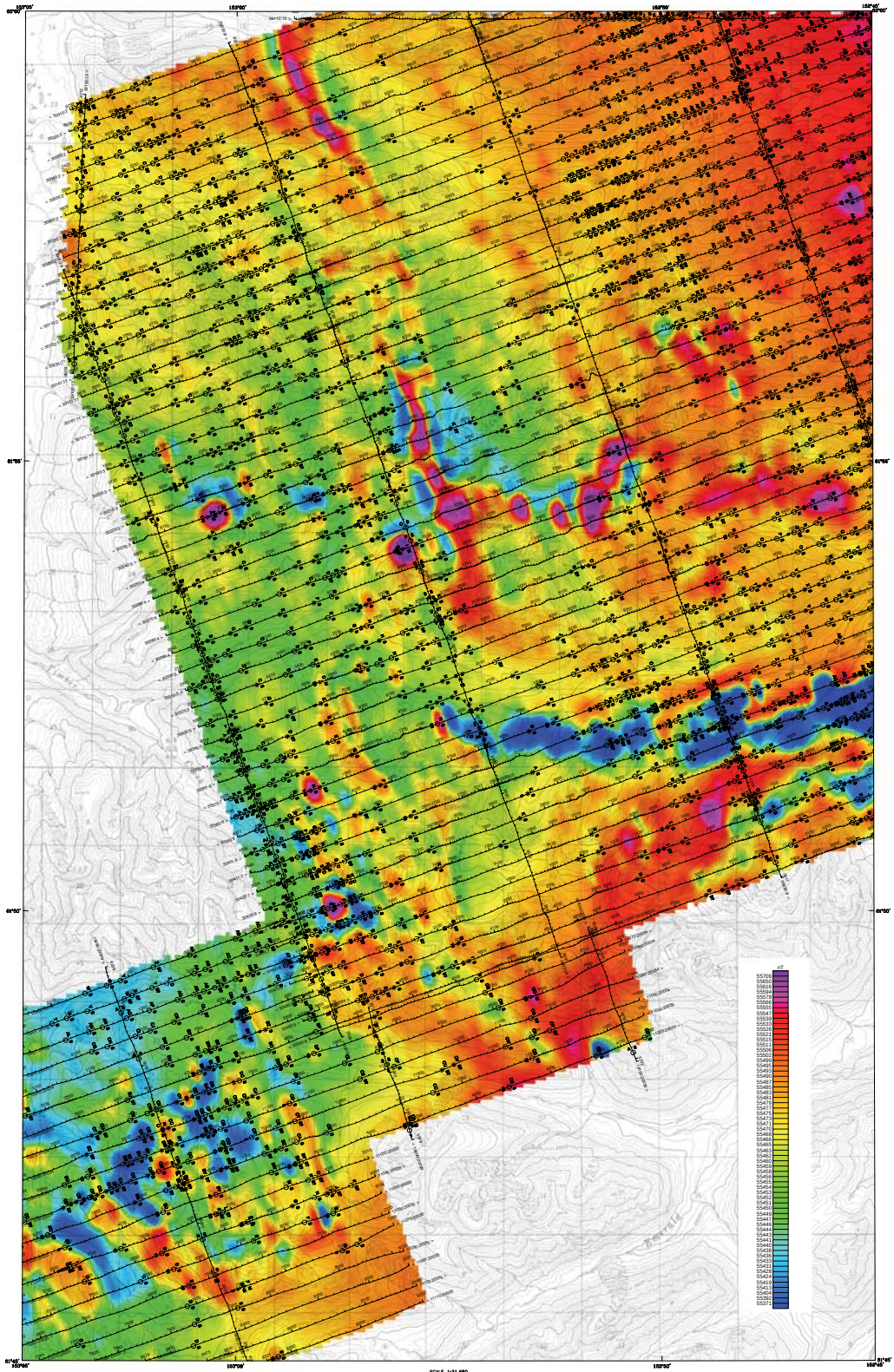
SURVEY HISTORY

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ALASKA DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS

GEOPHYSICAL REPORT 2008-5-1f
PARTS of LIME HILLS D-1 and TYONEK D-8 QUADRANGLES



Base from U.S. Geological Survey Lime Hills D-1, 1950; Tyonek D-8, 1952; 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

STYX RIVER SURVEY AREA

TOTAL MAGNETIC FIELD AND DETAILED ELECTROMAGNETIC ANOMALIES OF THE STYX RIVER SURVEY, SOUTHCENTRAL ALASKA

PARTS of LIME HILLS D-1 and TYONEK D-8 QUADRANGLES

by

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

2008

LOCATION INDEX FOR 1:31,680

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 a radar altimeter, GPS navigation, and a Sony high resolution digital video camera. Flights were performed with an AS350B-3 Squirrel helicopter at a mean terrain clearance of 200 feet along NE–SW (70°) 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 5) spheroid, 1927 North American datum using a central meridian (CM) of 153°, 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.

TOTAL MAGNETIC FIELD

The magnetic total field data were processed using digitally recorded data from a Fugro D1344 cesium magnetometer with a Scintrex CS3 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 2005, 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.

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.

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
△	EM magnetic response
□	Culture

P1 B — Area indicates the conductor has a thickness >10m

100 — Dip direction

Magnetic correlation in nT

Interpretive symbol	
Conductor model	
Anomaly identifier	B Bedrock conductor
	C Bedrock conductor (Thick sheet)
	S Surficial conductor (Thickness thin sheet)
	H Broad conductive rock unit, deep conductive weathering, thick conductive cover (Half–space)
Interpretive symbol	E Edge of broad conductor
	L Flight line
	C Culture, e.g. power line, metal building or fence
	M Magnetic
	? 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 measured in-phase and quadrature components from 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. 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.

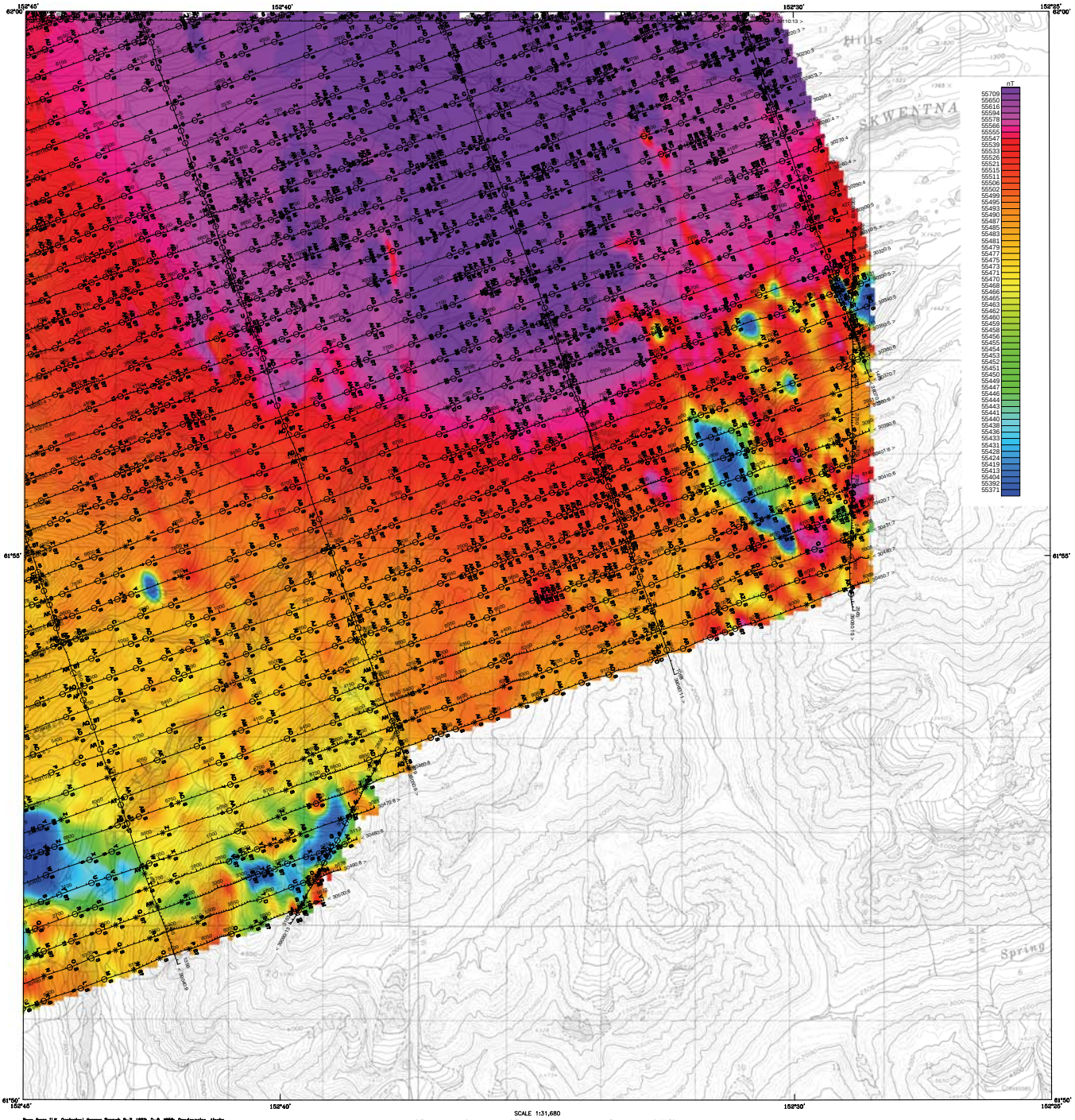
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ALASKA DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS

GEOPHYSICAL REPORT 2008-5-1g
PARTS of TYONEK D-7 and D-8 QUADRANGLES



Base from U.S. Geological Survey Tyonek D-7, 1972; D-8, 1952; 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 100 FEET
DATUM: MEAN SEA LEVEL

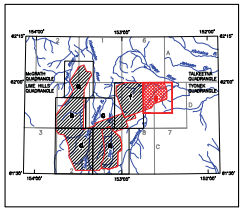


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PARTS of TYONEK D-7 and D-8 QUADRANGLES

by
Laurel E. Burns, Fugro Airborne Surveys Corp., and Stevens Exploration Management Corp.
2008

LOCATION INDEX FOR 1:31,680



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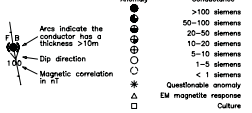
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ELECTROMAGNETIC ANOMALIES



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●	20–50 siemens
●	10–20 siemens
●	5–10 siemens
○	1–5 siemens
○	<1 siemens
✳	Questionable anomaly
△	EM magnetite response
□	Culture

Anomaly Identifier — Interpretive symbol

Interpretive symbol	Conductor model
B	Bedrock conductor
D	Narrow bedrock conductor ("thin dike")
S	Conductive cover ("horizontal thin sheet")
H	Broad conductive rock unit, deep conductive weathering, thick conductive cover ("half-space")
E	Edge of broad conductor ("edge of half space")
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.

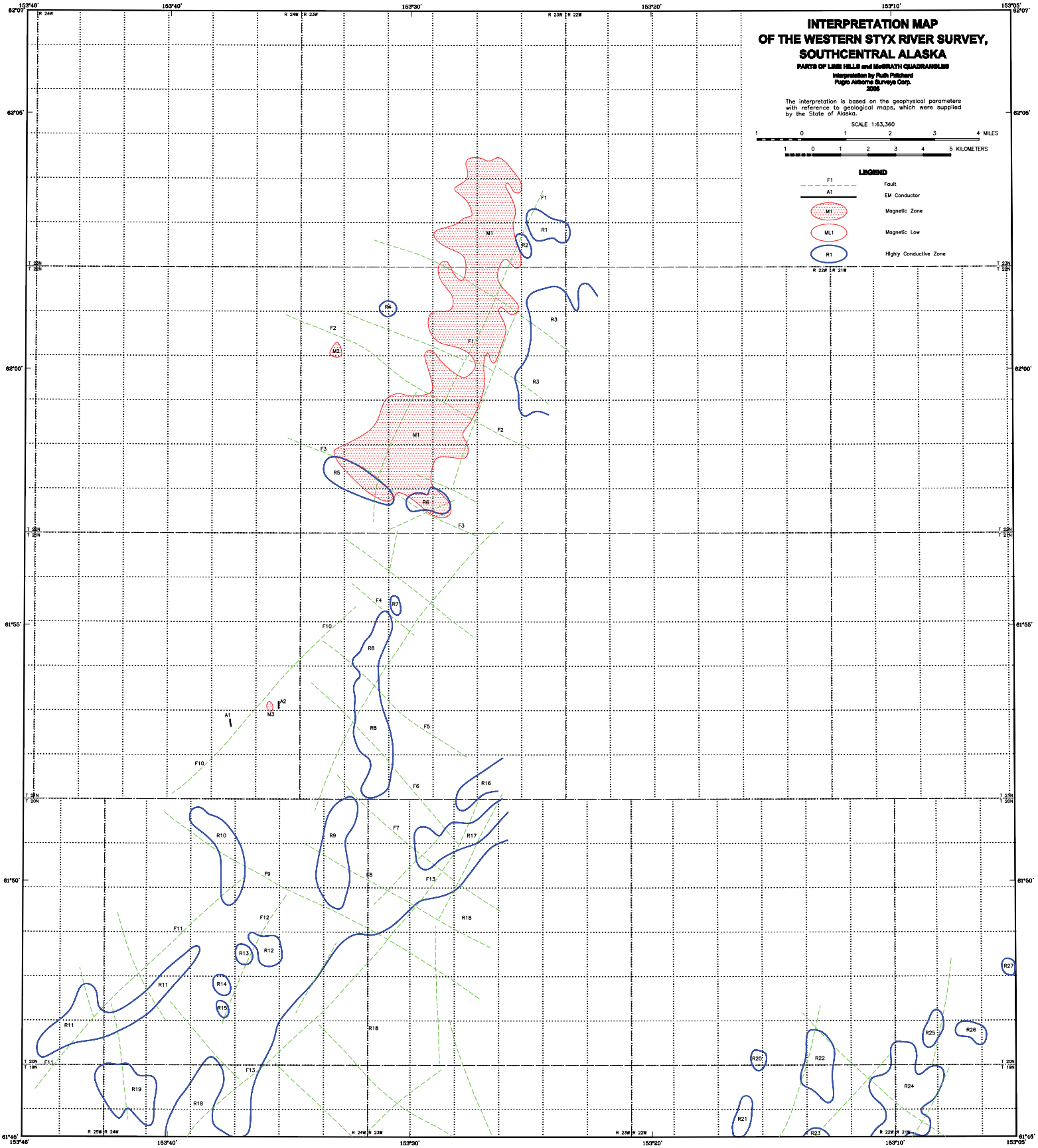
ELECTROMAGNETICS

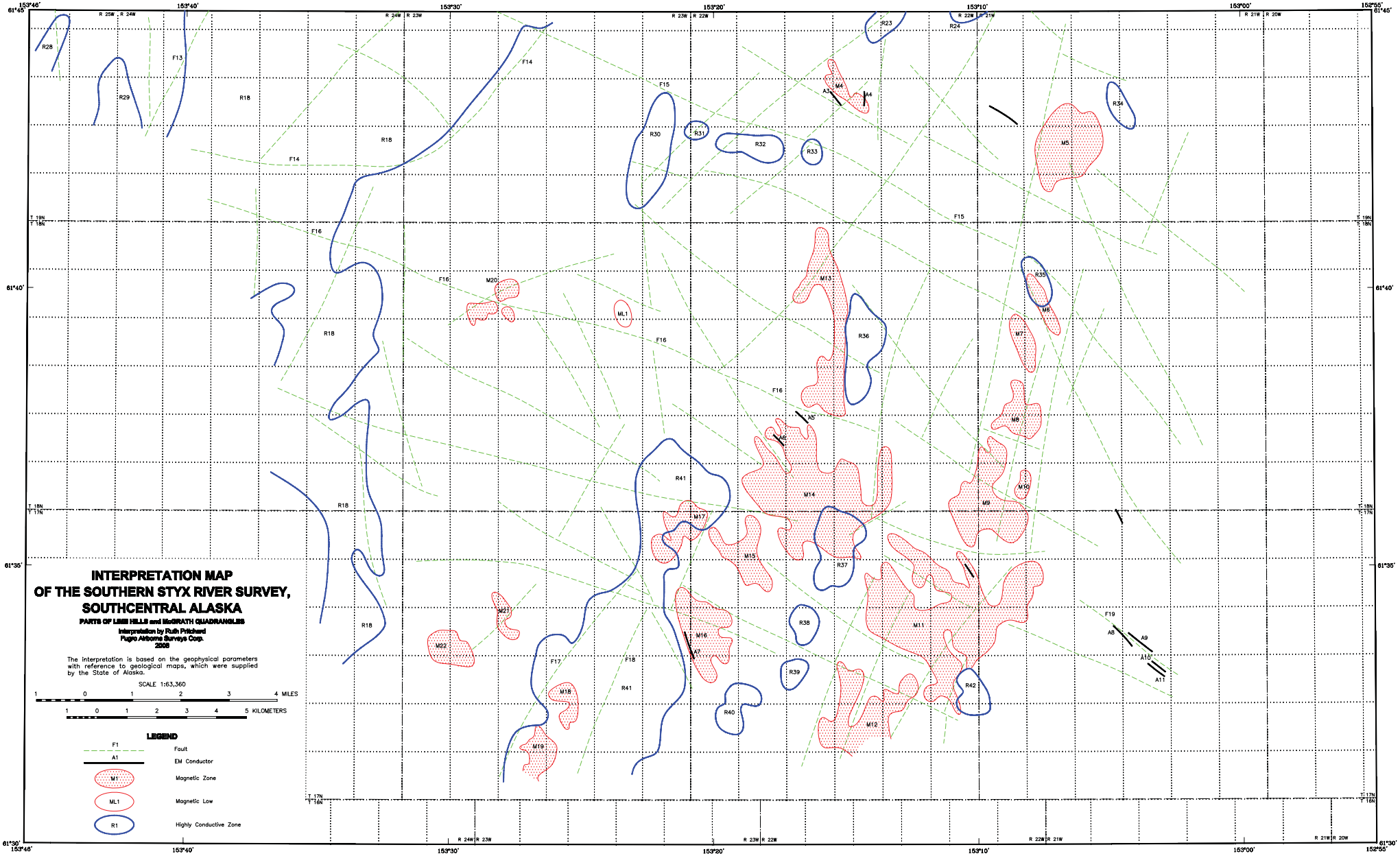
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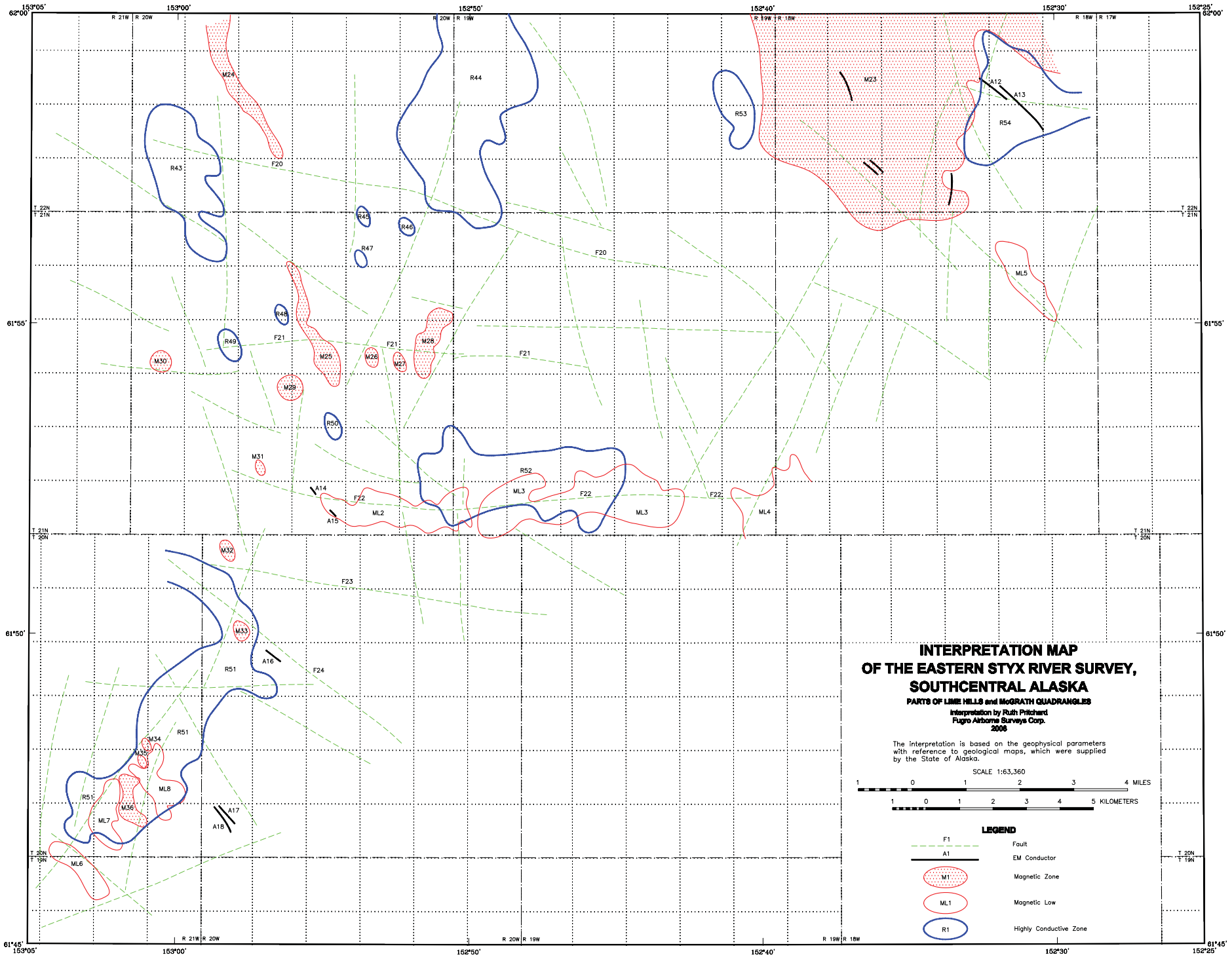
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INTERPRETATION MAP
OF THE WESTERN STYX RIVER SURVEY,
SOUTHCENTRAL ALASKA
PARTS OF LIME HILLS and McGRATH QUADRANGLES
Interpretation by Ruth Pritchard
Fugro Airborne Surveys Corp.
2008
The interpretation is based on the geophysical parameters with reference 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 Fault
A1 EM Conductor
M1 Magnetic Zone
ML1 Magnetic Low
R1 Highly Conductive Zone
153°46'
153°40'
153°30'
153°20'
153°10'
153°05'
62°07'
62°05'
62°00'
61°55'
61°50'
61°45'
R 24W
R 23W
R 22W
R 21W
T 20N
T 19N
M1
M2
M3
A1
A2
F1
F2
F3
F4
F5
F6
F7
F8
F9
F10
F11
F12
F13
R1
R2
R3
R4
R5
R6
R7
R8
R9
R10
R11
R12
R13
R14
R15
R16
R17
R18
R19
R20
R21
R22
R23
R24
R25
R26
R27


INTERPRETATION MAP
OF THE SOUTHERN STYX RIVER SURVEY,
SOUTHCENTRAL ALASKA
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Interpretation by Ruth Pritchard
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1 0 1 2 3 4 MILES
1 0 1 2 3 4 5 KILOMETERS
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F1 Fault
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153°46'
153°40'
153°30'
153°20'
153°10'
153°00'
152°55'
61°45'
61°40'
61°35'
61°30'
T. 19N
T. 18N
T. 17N
T. 16N
R 25W
R 24W
R 23W
R 22W
R 21W
R 20W



INTERPRETATION MAP OF THE EASTERN STYX RIVER SURVEY, SOUTHCENTRAL ALASKA

PARTS OF LIME HILLS and McGRATH QUADRANGLES

Interpretation by Ruth Pritchard
Fugro Airborne Surveys Corp.
2008

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	Fault
A1	EM Conductor
M1	Magnetic Zone
ML1	Magnetic Low
R1	Highly Conductive Zone