RICHARDSON ELECTROMAGNETIC AND MAGNETIC AIRBORNE GEOPHYSICAL SURVEY DATA COMPILATION

Burns, L.E., Graham, G.R.C., Barefoot, J.D., Woods, Rebecca-Ellen, Dighem, and WGM Inc.

Geophysical Report 2019-22

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DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS

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RICHARDSON ELECTROMAGNETIC AND MAGNETIC AIRBORNE GEOPHYSICAL SURVEY DATA COMPILATION

Burns, L.E.[1], Graham, G.R.C.[1], Barefoot, J.D.[1], Woods, Rebecca-Ellen[1], Dighem, and WGM Inc.

ABSTRACT

The Richardson electromagnetic and magnetic airborne geophysical survey is located in interior Alaska in the Richardson mining district, about 65 kilometers southeast of Fairbanks, Alaska. Frequency domain electromagnetic and magnetic data were collected with the DIGHEM^{V} system in August 1994. A total of 1,094.0 line kilometers were collected covering 400.0 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. The survey area contains several past-producing placer gold mines, as well as the Democrat lode, Gold Run, and Shamrock intrusion-related gold prospects. Other gold and base-metal anomalies, altered zones, favorable lithologies, and structural zones are known to exist throughout the survey area.

SURVEY OVERVIEW DESCRIPTION

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

ACKNOWLEDGMENTS

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

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

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 and DGGS	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 and DGGS	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

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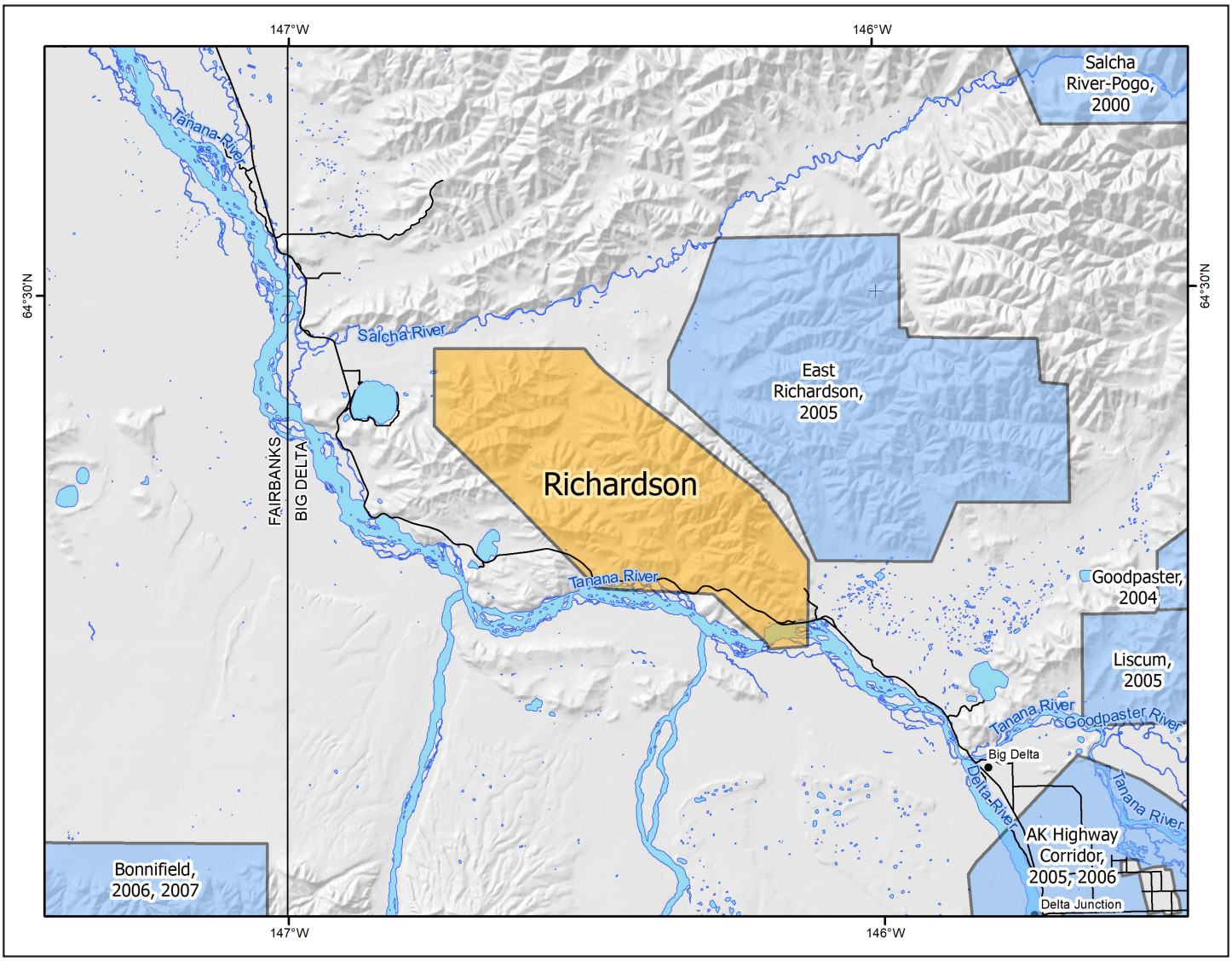
DGGS Staff, Dighem, and WGM, Inc., 1995, 900 Hz coplanar resistivity of the Richardson mining district: Alaska Division of Geological & Geophysical Surveys Report of Investigation 95-12, 1 sheet, scale 1:63,360. http://doi.org/10.14509/2526

DGGS Staff, Dighem, and WGM, Inc., 1995, CD-ROM digital archive files of 1994 survey data for Fairbanks and Richardson mining districts: Alaska Division of Geological & Geophysical Surveys Public Data File 95-11, 1 DVD. http://doi.org/10.14509/1690

DGGS Staff, Dighem, and WGM, Inc., 1995, Total field magnetics and electromagnetic anomalies of the Richardson mining district: Alaska Division of Geological & Geophysical Surveys Report of Investigation 95-9, 1 sheet, scale 1:63,360. http://doi.org/10.14509/2523

DGGS Staff, Dighem, and WGM, Inc., 1995, Total field magnetics of the Richardson mining district: Alaska Division of Geological & Geophysical Surveys Report of Investigation 95-10, 1 sheet, scale 1:63,360. http://doi.org/10.14509/2524

McConnell, D.L., WGM, Inc., and Dighem, 1995, Project report of the Fairbanks and Richardson mining districts: Alaska Division of Geological & Geophysical Surveys Public Data File 95-12, 178 p., 3 sheets, scale 1:63,360. http://doi.org/10.14509/1691



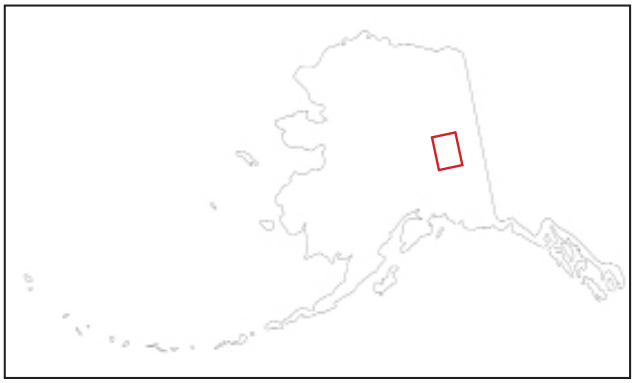


Figure 1. Richardson electromagnetic and magnetic airborne geophysical survey location shown in interior Alaska (inset). Richardson survey area shown with adjacent DGGS geophysical surveys, landmarks, relevant 1:250,000-scale quadrangle boundaries, mountain ranges, rivers, glaciers, and elevation hillshade.

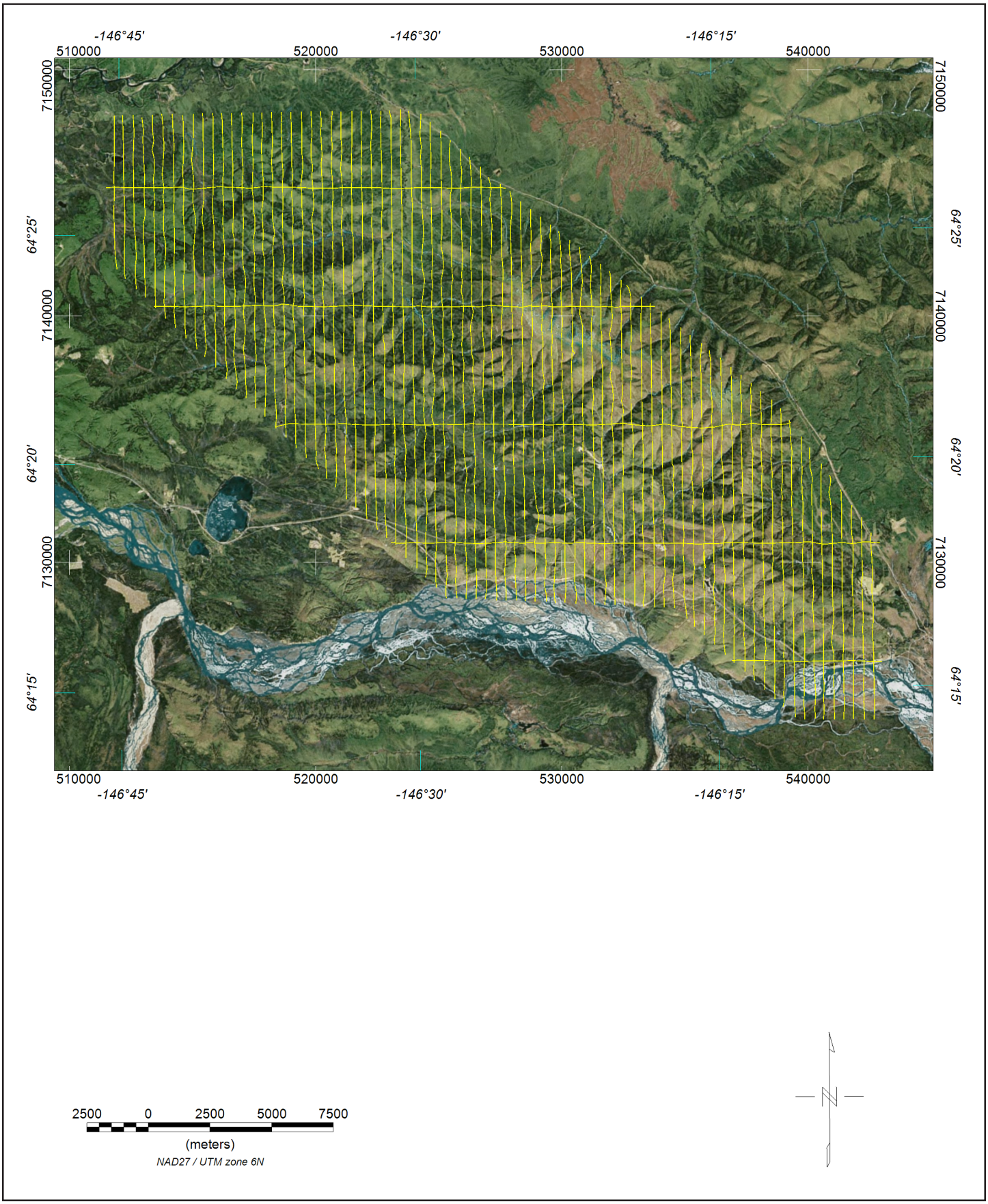


Figure 2. Flight path with orthometric image.

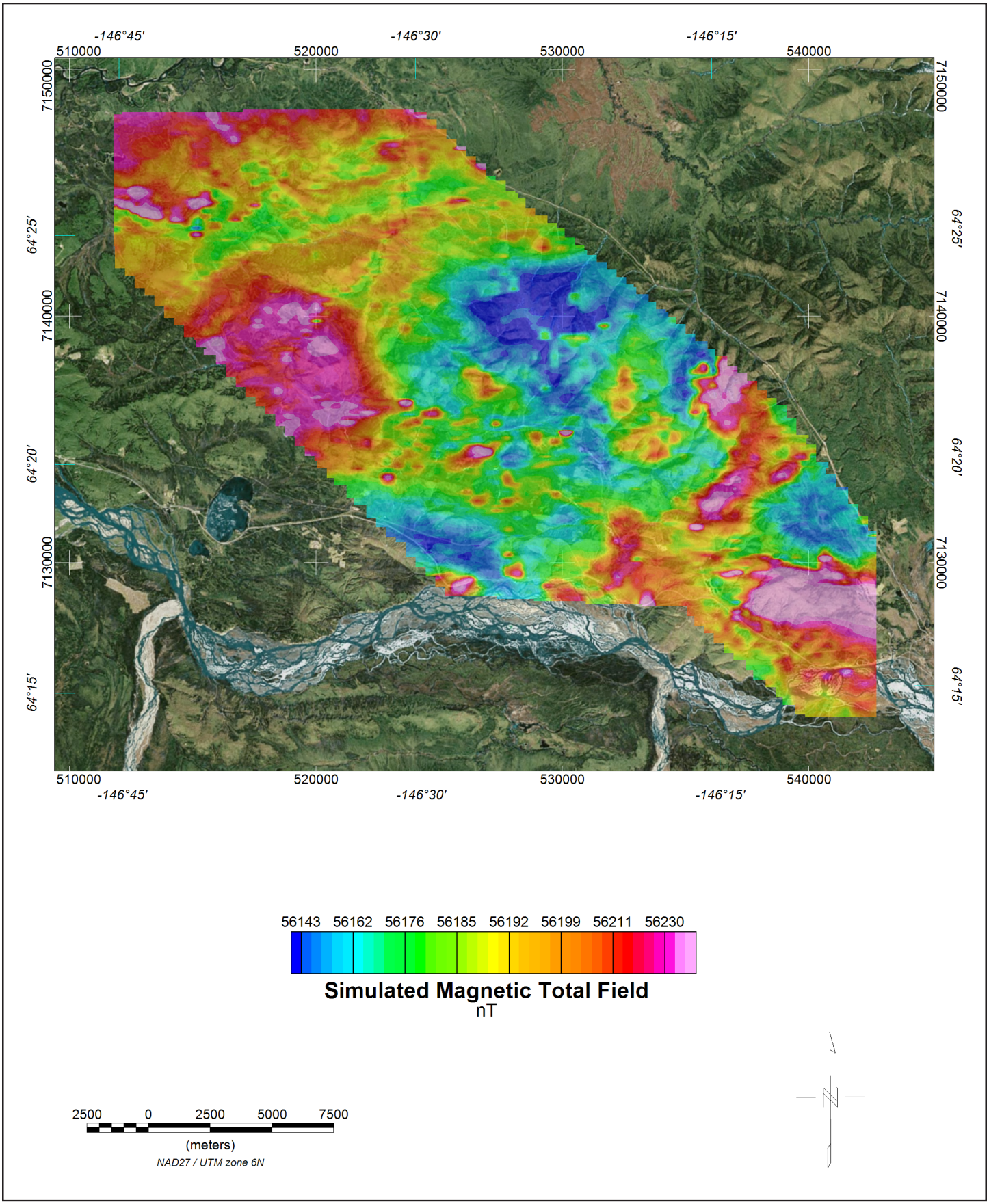


Figure 3. Simulated magnetic total field grid with orthometric image. The magnetic total field data were produced using digitally recorded data from a Scintrex cesium CS2 magnetometer. Data were collected at a sampling interval of 0.1 seconds. The magnetic data were (1) corrected for diurnal variations by subtracting the digitally recorded base station magnetic data, (2) leveled to the tie line data, (3) the regional variation (IGRF gradient, 1985, updated to August 1994) was removed from the leveled magnetic data, (4) a constant value of approximately 57,000 nT was added to all data, and (5) interpolated onto a regular 100 m grid using a modified Akima (1970) technique.

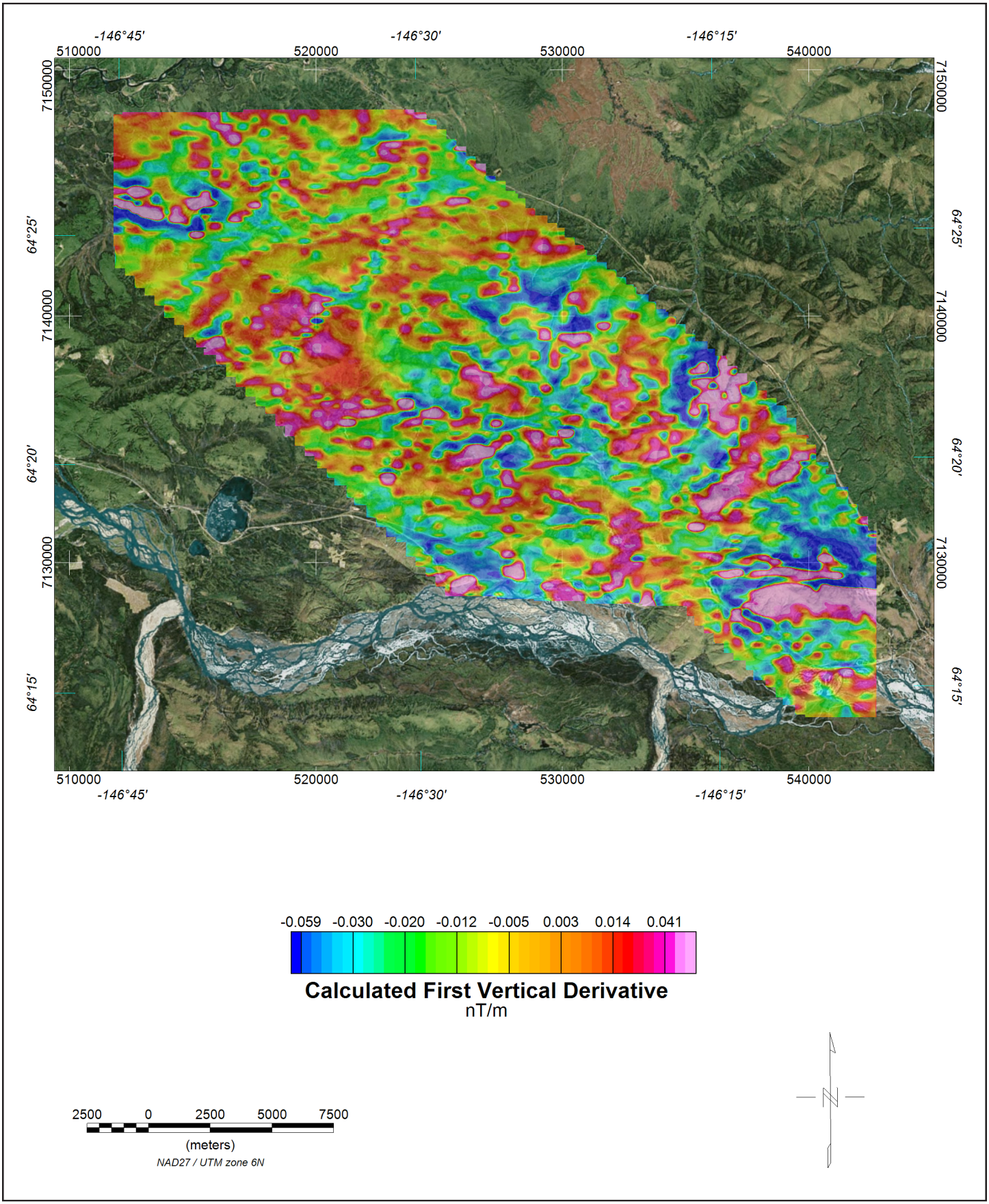


Figure 4. Calculated first vertical derivative grid with orthometric image. The first vertical derivative grid was calculated from the diurnally-corrected, IGRF-corrected total magnetic field grid using a FFT base frequency domain filtering algorithm. The resulting first vertical derivative grid provides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

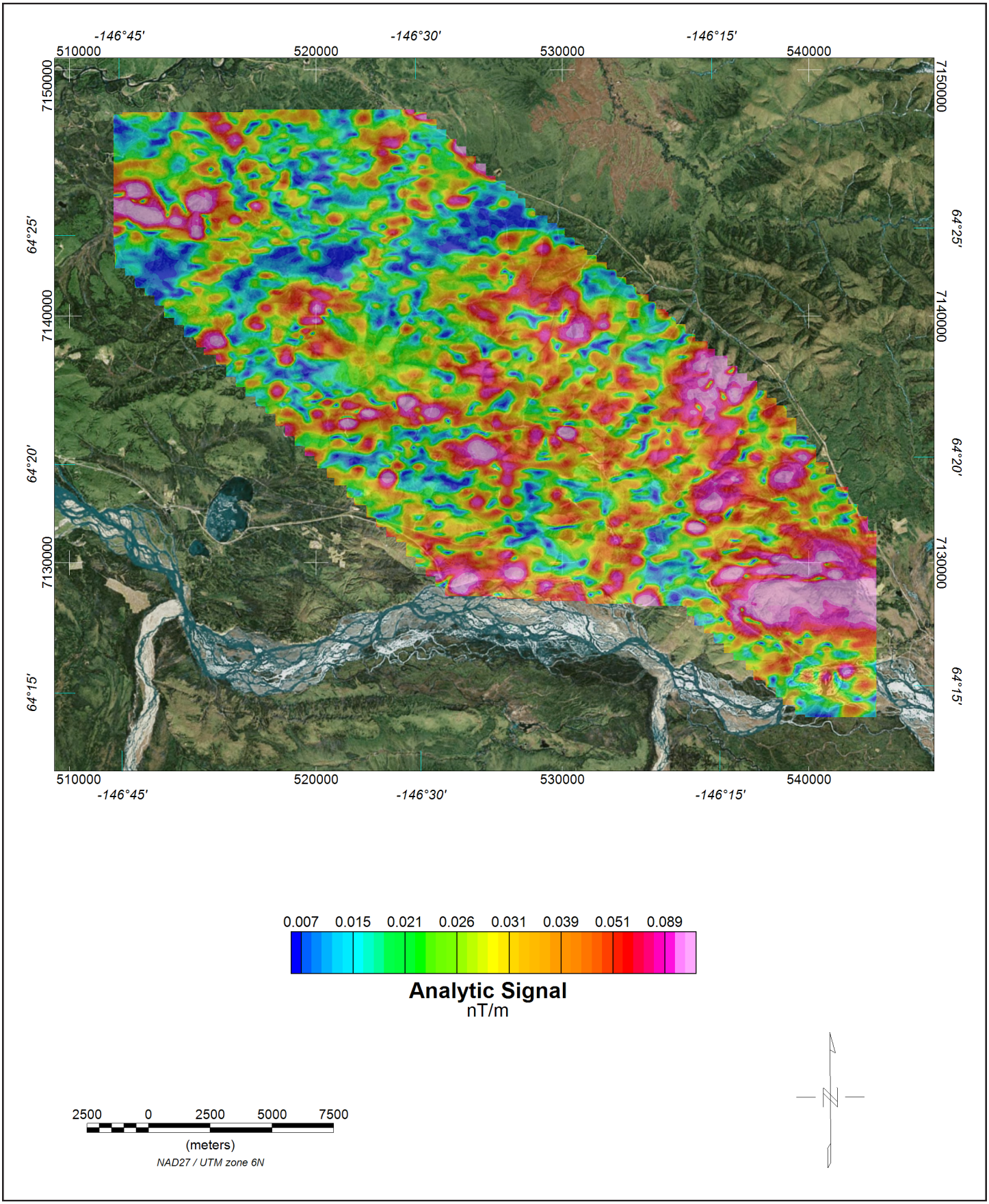


Figure 5. Analytic signal grid with orthometric image. Analytic signal is the total amplitude of all directions of magnetic gradient calculated from the sum of the squares of the three orthogonal gradients. Mapped highs in the calculated analytic signal of magnetic parameter locate the anomalous source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

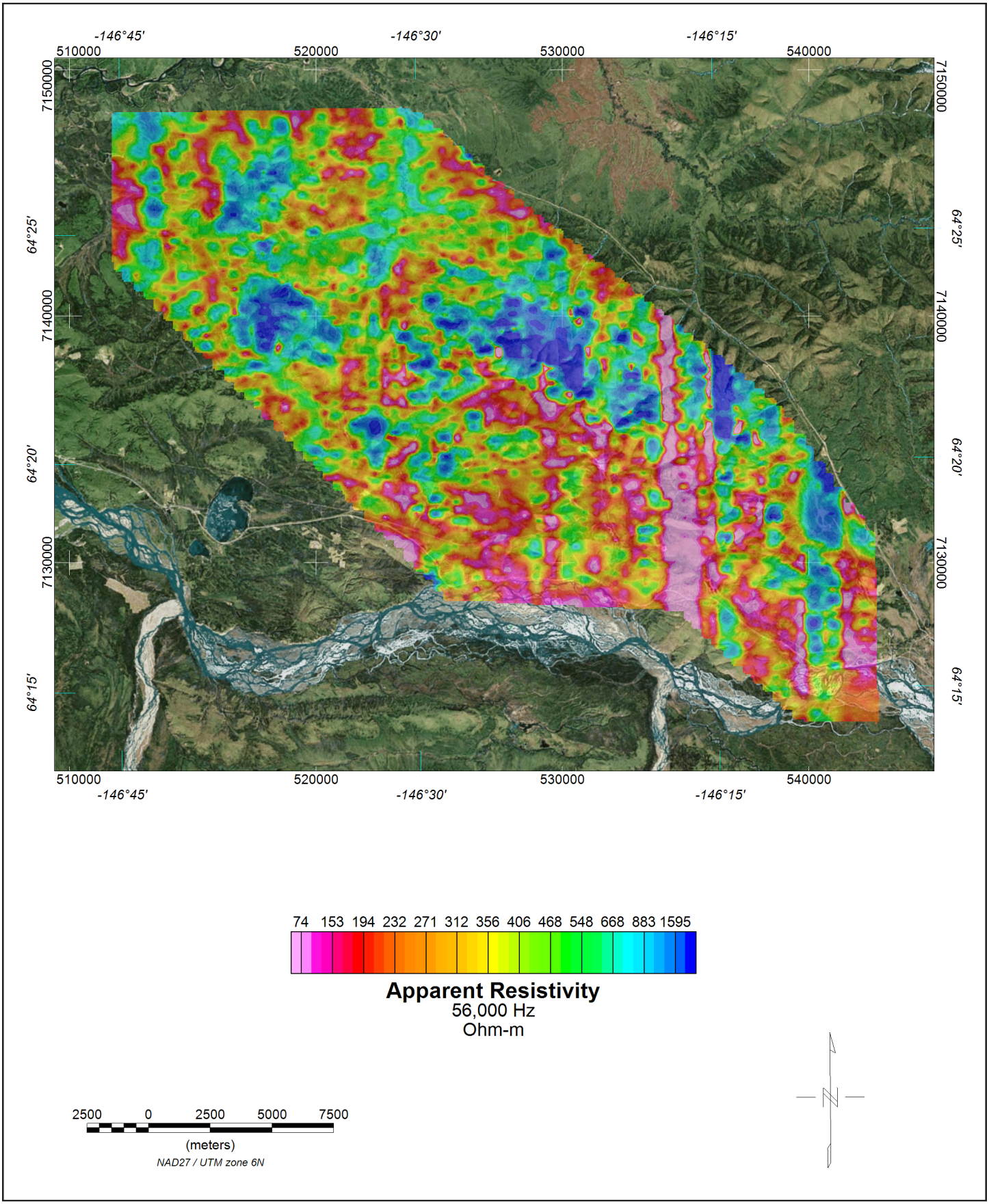


Figure 6. 56,000 Hz coplanar apparent resistivity grid with orthometric image. The DIGHEM^{V} EM system measured inphase and quadrature components at five frequencies. Two vertical coaxial coil-pairs operated at 900 and 5,000 Hz while three horizontal coplanar coil-pairs operated at 900, 7,200, and 56,000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

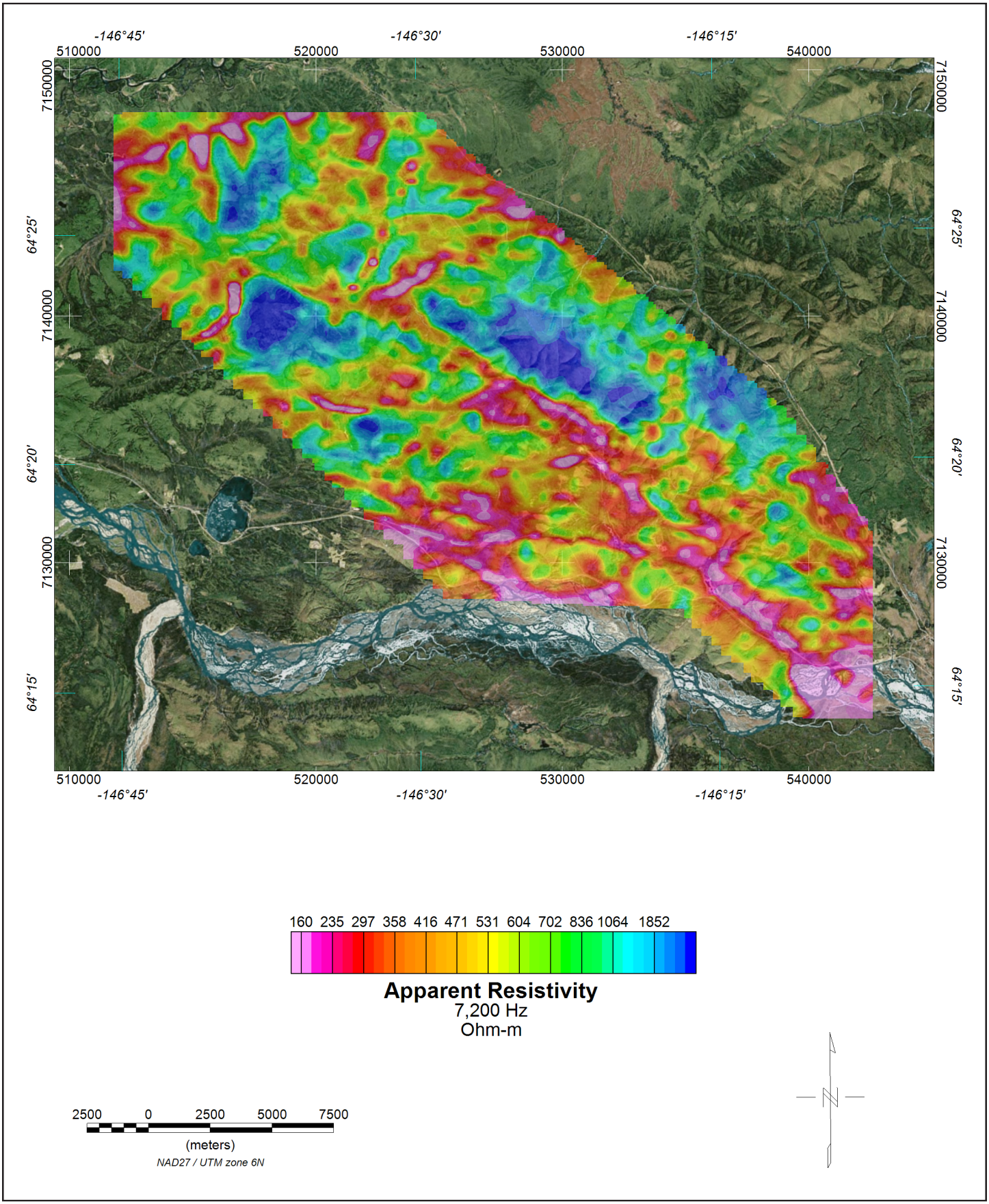


Figure 7. 7,200 Hz coplanar apparent resistivity grid with orthometric image. The DIGHEM^{V} EM system measured inphase and quadrature components at five frequencies. Two vertical coaxial coil-pairs operated at 900 and 5,000 Hz while three horizontal coplanar coil-pairs operated at 900, 7,200, and 56,000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

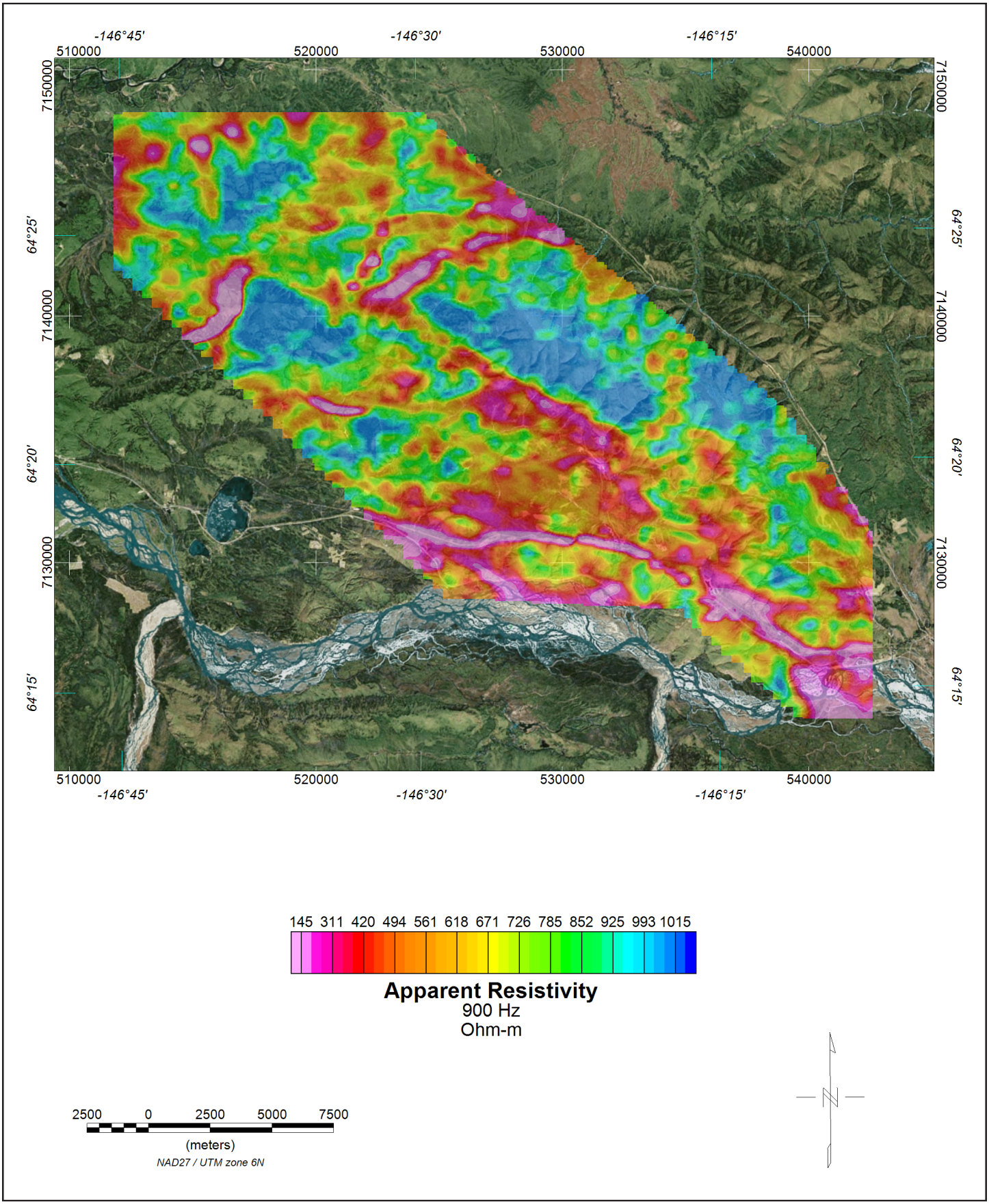
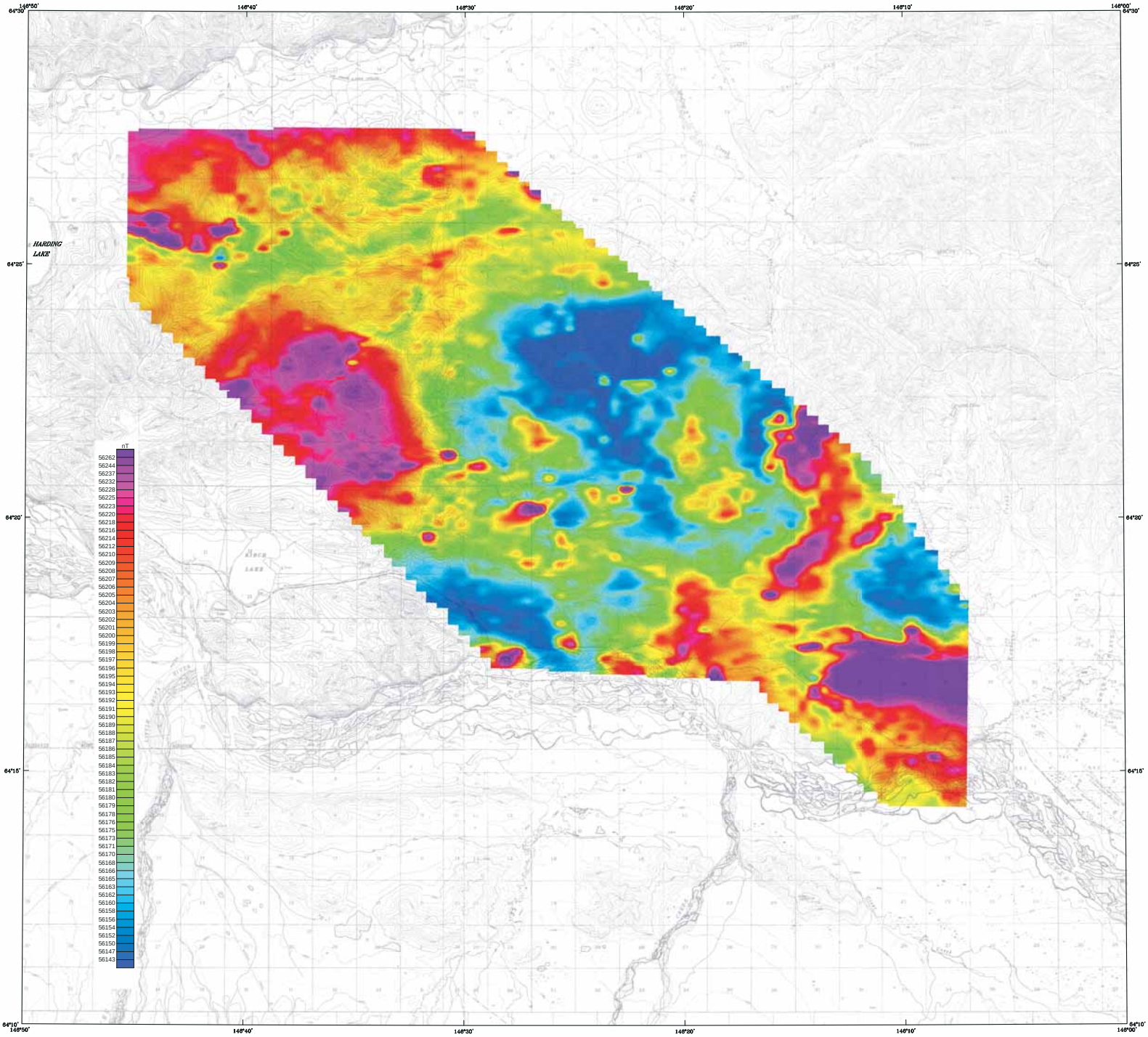


Figure 8. 900 Hz coplanar apparent resistivity grid with orthometric image. The DIGHEM^{V} EM system measured inphase and quadrature components at five frequencies. Two vertical coaxial coil-pairs operated at 900 and 5,000 Hz while three horizontal coplanar coil-pairs operated at 900, 7,200, and 56,000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

Table 1. Copies of the following maps are included at the end of this booklet. The low-resolution, page-size maps included in this booklet are intended to be used as a search tool and are not the final product. Large-scale, full-resolution versions of each map are available to download on this publication's citation page: http://doi.org/10.14509/30261

Map Title	Description
richardson_sim_magtf_topo_map.pdf	simulated magnetic total field grid with topographic base map
richardson_sim_magtf_contours_plss_map.pdf	simulated magnetic total field grid and contours with public land survey system base layer
richardson_res7200hz_topo_map.pdf	7,200 Hz apparent resistivity grid with topographic base map
richardson_res7200hz_contours_plss_map.pdf	7,200 Hz apparent resistivity grid with data contours and public land survey system base layer
richardson_res900hz_topo_map.pdf	900 Hz apparent resistivity grid with topographic base map
richardson_res900hz_contours_plss_map.pdf	900 Hz apparent resistivity grid with data contours and public land survey system base layer



Section outlines from U.S. Geological Survey Big Delta A-5; 1978, A-6; 1949, B-5; D-5; 1978, Quadrangles, Alaska



SCALE 1:63,360

1 0 1 2 3 4 MILES

1 0 1 2 3 4 5 KILOMETERS

CONTOUR INTERVAL 50 FEET
DATUM MEAN SEA LEVEL



APPROXIMATE MEAN DECLINATION, 1975

TOTAL MAGNETIC FIELD OF THE RICHARDSON MINING DISTRICT, INTERIOR ALASKA

PARTS OF BIG DELTA QUADRANGLE

by

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

2004

DESCRIPTIVE NOTES

The geophysical data were acquired with a DIGHEM^V Electromagnetic (EM) system, a Scintrex cesium CS2 magnetometer, and a Herz VLF system installed in an AS.350B-1 Squirrel helicopter. In addition, the survey recorded data from a radar altimeter, GPS navigation system, 50/60 Hz monitors and video camera. Flights were performed at a mean terrain clearance of 200 feet along survey flight lines with a spacing of a quarter of a mile. Tie lines were flown perpendicular to the flight lines at intervals of approximately three miles.

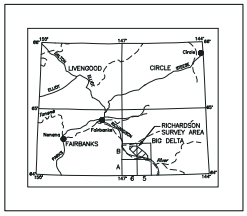
A Sercel Real-Time Differential Global Positioning System (RT-DGPS) was used for both navigation and flight path recovery. The helicopter position was derived every 0.5 seconds using real-time differential positioning to a relative accuracy of better than 10 m. Flight path positions were projected onto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

TOTAL MAGNETIC FIELD

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

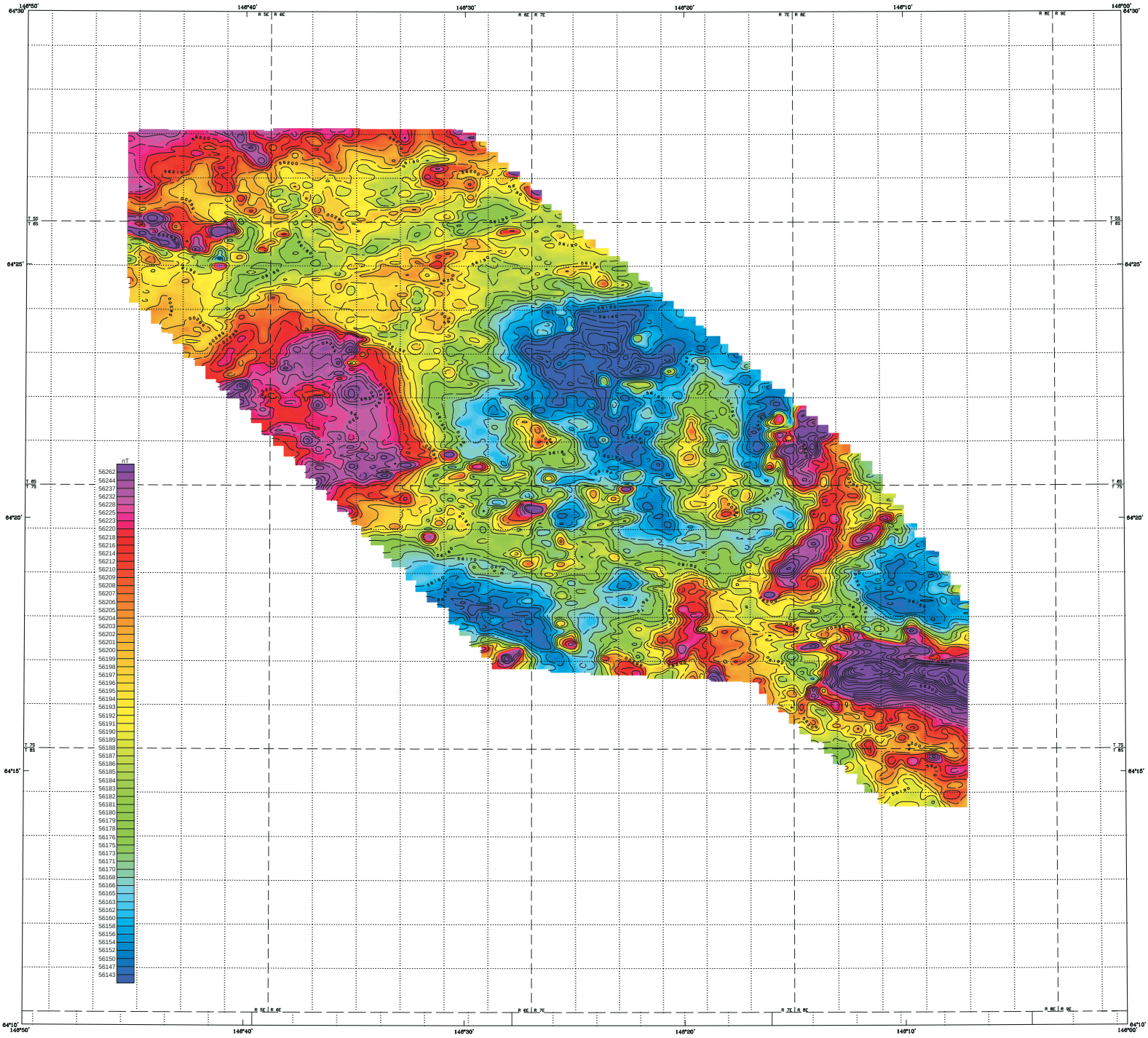
Akima, H., 1970, A new method of interpolation and smooth curve fitting based on local procedures: Journal of the Association of Computing Machinery, v. 17, no. 4, p. 589–602.

LOCATION INDEX



SURVEY HISTORY

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Section outlines from U.S. Geological Survey Big Delta A-5; 1978, A-6; 1948, B-5; B-6; 1978, 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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TOTAL MAGNETIC FIELD OF THE RICHARDSON MINING DISTRICT, INTERIOR ALASKA

PARTS OF BIG DELTA QUADRANGLE

by

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MAGNETIC CONTOUR INTERVAL

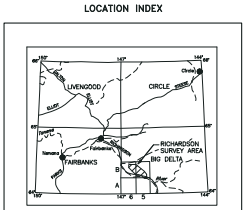
250 nT

50 nT

10 nT

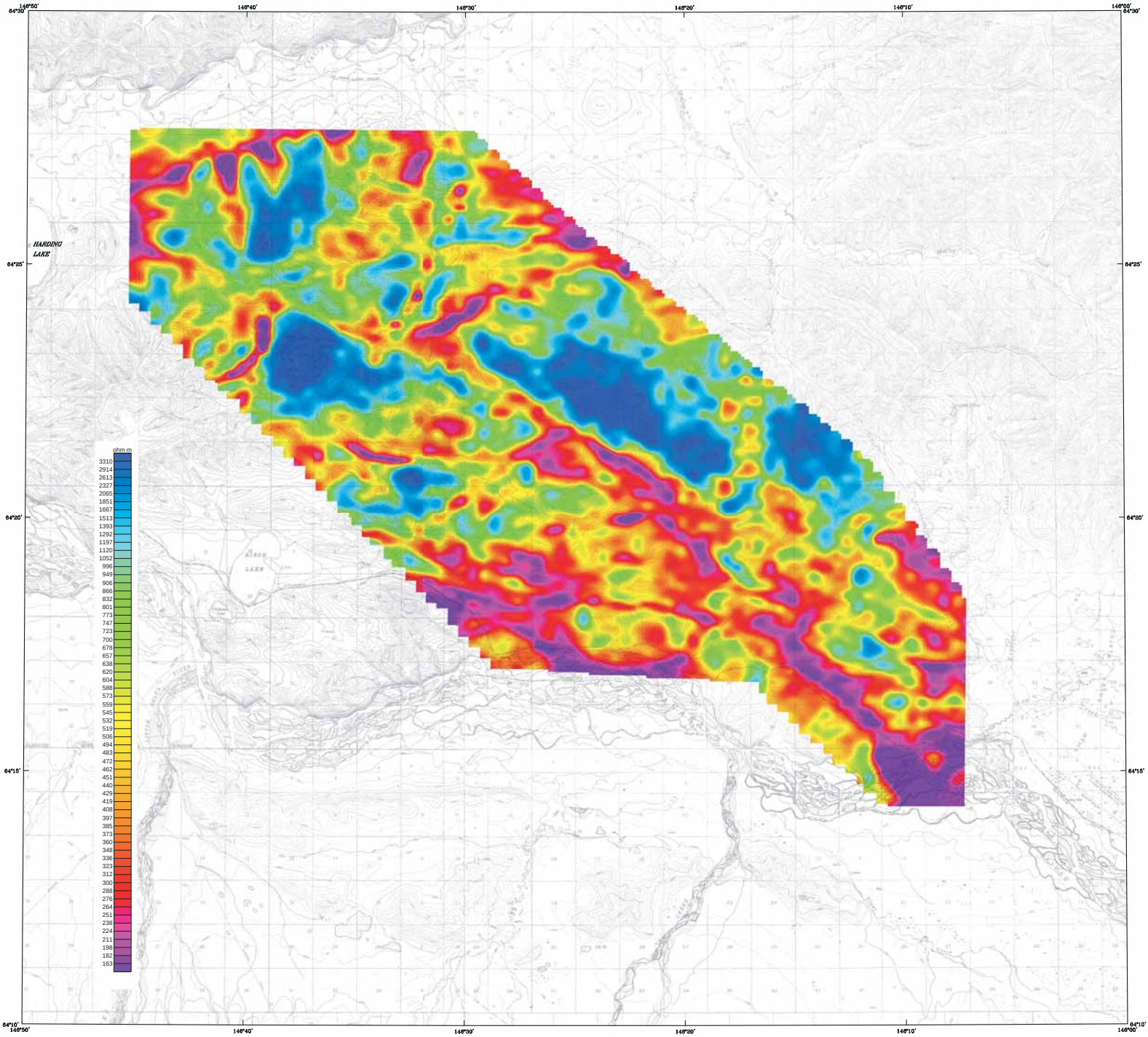
5 nT

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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 50 FEET
DATUM MEAN SEA LEVEL



7200 Hz COPLANAR APPARENT RESISTIVITY OF THE RICHARDSON MINING DISTRICT, INTERIOR ALASKA

PARTS OF BIG DELTA QUADRANGLE

by

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

2004

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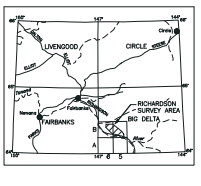
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RESISTIVITY

The DIGHEM^V EM system measured inphase and quadrature components at five frequencies. Two vertical coaxial coil-pairs operated at 900 and 5000 Hz while three horizontal coplanar coil-pairs operated at 900, 7200 and 56,000 Hz. EM data were sampled at 0.1 second intervals. The EM system responds to bedrock conductors, conductive overburden, and cultural sources. 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 100 m grid using a modified Akima (1970) technique.

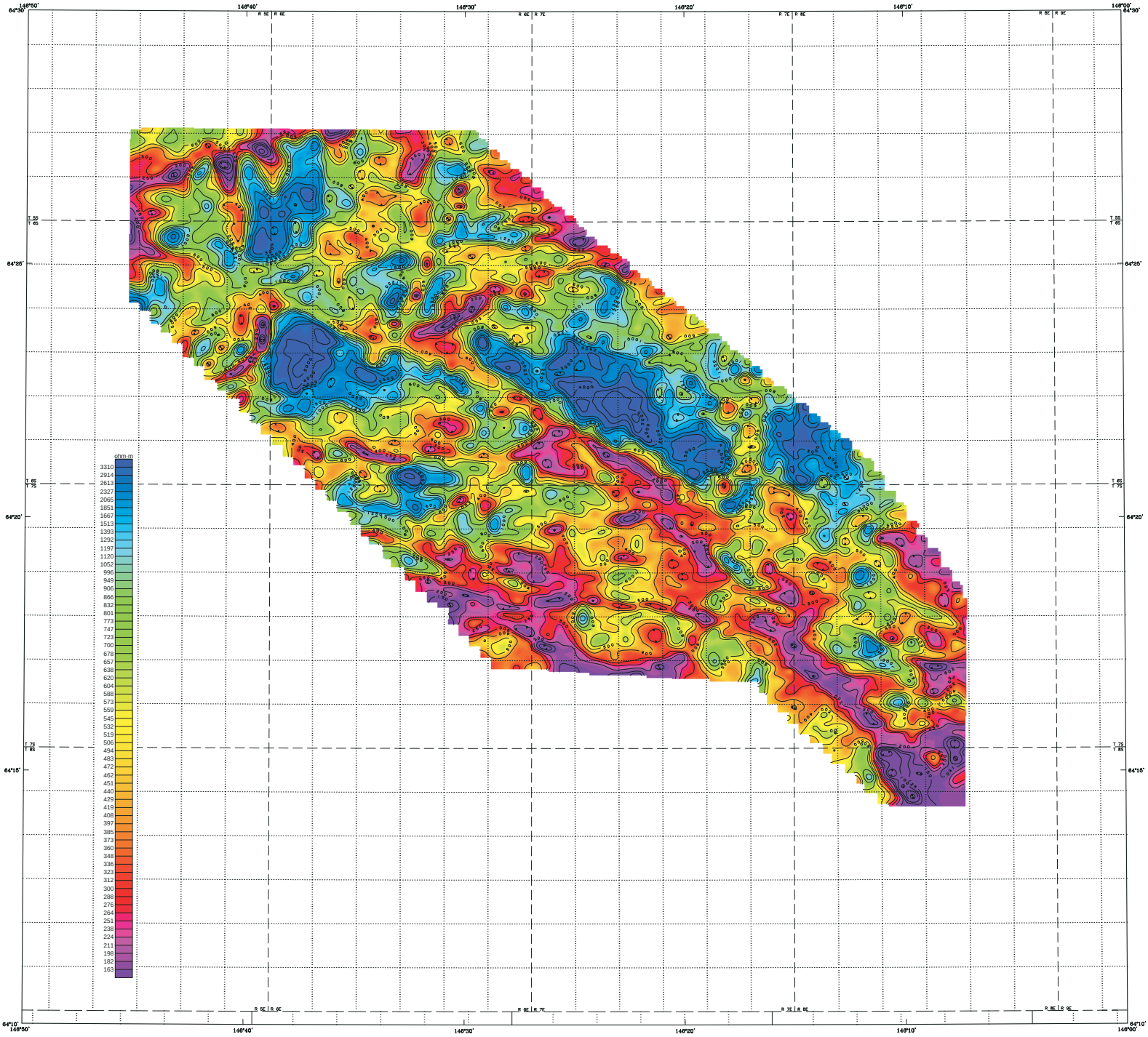
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SCALE 1:63,360

1 0 1 2 3 4 MILES

1 0 1 2 3 4 5 KILOMETERS

TRUE NORTH

MAGNETIC N

APPROXIMATE MEAN DECLINATION, 1975

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PARTS OF BIG DELTA QUADRANGLE

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2004

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

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

RESISTIVITY

The DIGHEM^V EM system measured inphase and quadrature components at five frequencies. Two vertical coaxial coil-pairs operated at 900 and 5000 Hz while three horizontal coplanar coil-pairs operated at 900, 7200 and 56,000 Hz. EM data were sampled at 0.1 second intervals. The EM system responds to bedrock conductors, conductive overburden, and cultural sources. 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 100 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.

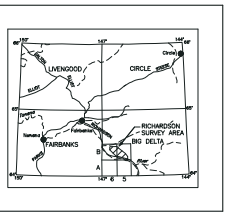
RESISTIVITY CONTOURS

1000
800
600
500
400
300
250
200
150
125
100

Contours in ohm-m at 10 Intervals per decade

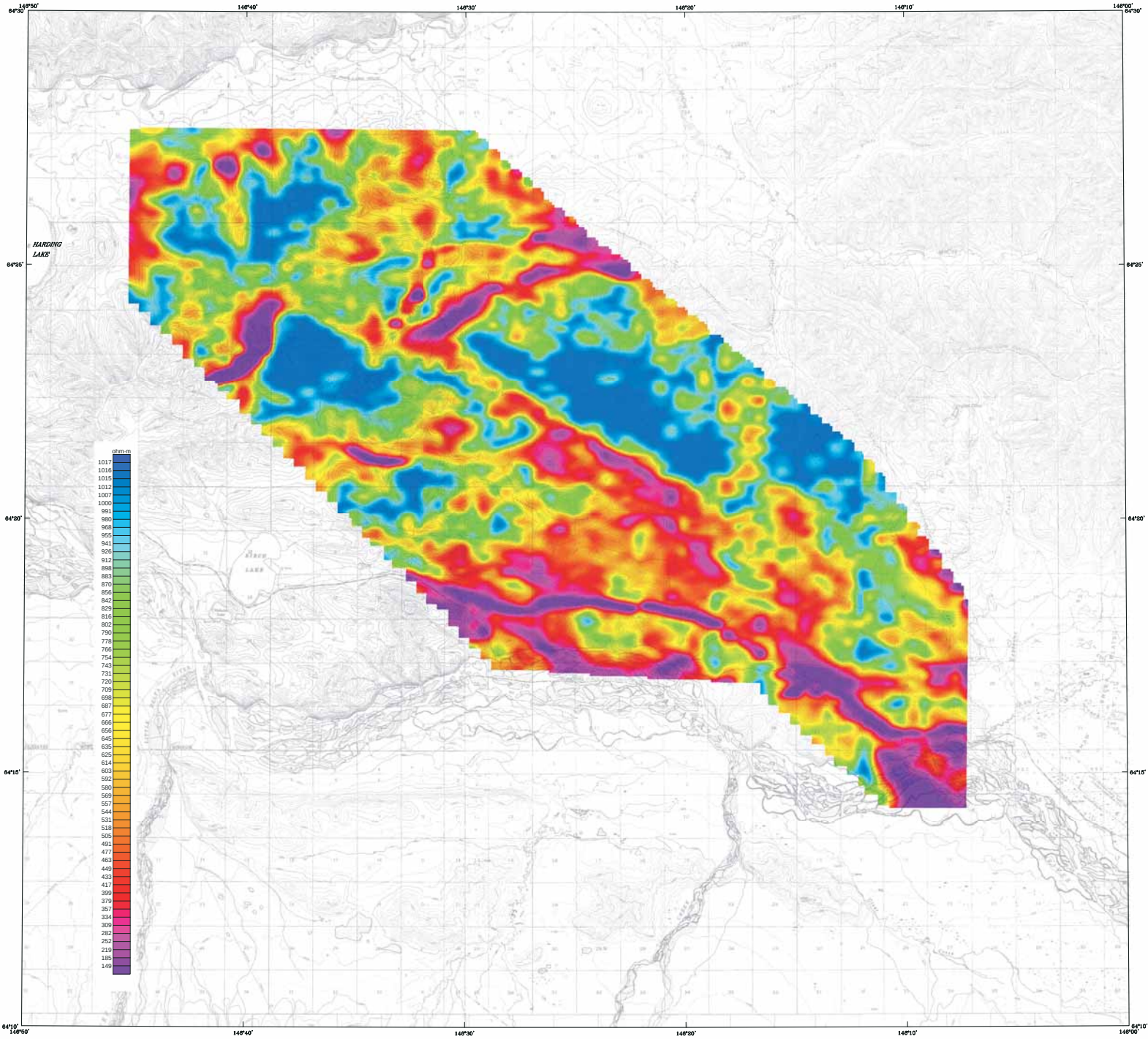
. . . . . resistivity low

LOCATION INDEX



SURVEY HISTORY

The map has been compiled and drawn under contract between the State of Alaska, Department of Natural Resources, Division of Geological & Geophysical Surveys, and Stevens Exploration Management Corp. The map was produced by Fugro Airborne Surveys and supercedes the earlier full color version released by DGGS in 1995. Airborne geophysical data for the area were acquired and processed in 1994 under contract between DGGS and WGM, Mining and Geological Consultants, Inc. The subcontractor acquiring and processing the data was DIGHEM, a division of CGG Canada Ltd. Other products from this survey are available from DGGS, 3354 College Road, Fairbanks, Alaska, 99709-3707.



Section outlines from U.S. Geological Survey Big Delta A-5; 1970, A-6; 1949, B-5; B-6; 1970, Quadrangles, Alaska



SCALE 1:63,360

1 0 1 2 3 4 MILES

1 0 1 2 3 4 5 KILOMETERS

CONTOUR INTERVAL 50 FEET
DATUM MEAN SEA LEVEL



900 Hz COPLANAR APPARENT RESISTIVITY OF THE RICHARDSON MINING DISTRICT, INTERIOR ALASKA

PARTS OF BIG DELTA QUADRANGLE

by

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

2004

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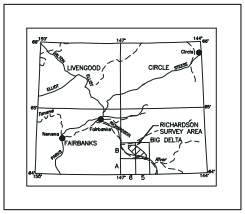
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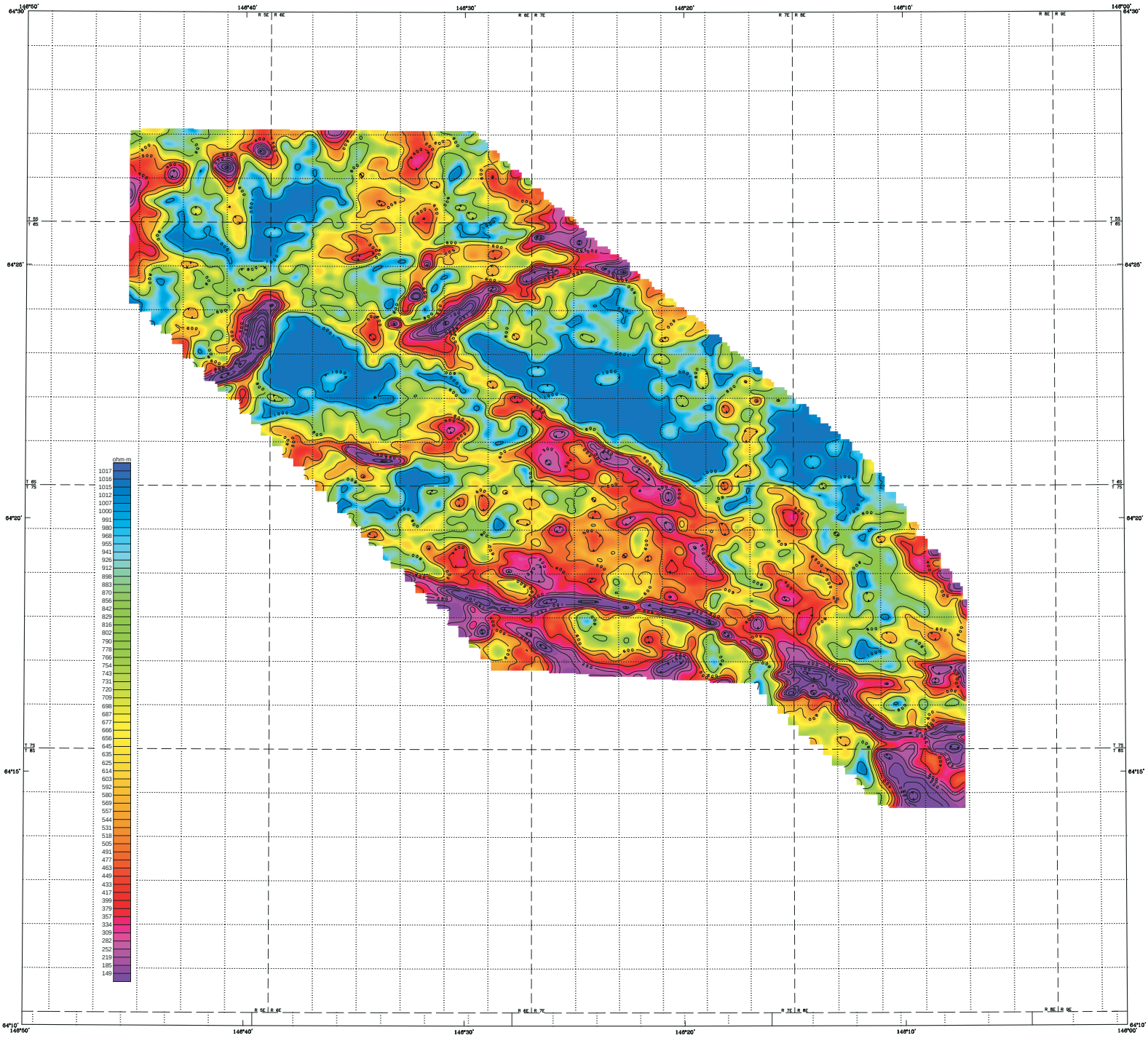
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Section outlines from U.S. Geological Survey Big Delta A-2; 1976, A-1; 1949, B-2; B-1; 1972, Cumberland, Alaska



SCALE 1:63,360

1 0 1 2 3 4 MILES

1 0 1 2 3 4 5 KILOMETERS



APPROXIMATE MEAN DECLINATION, 1975

900 Hz COPLANAR APPARENT RESISTIVITY OF THE RICHARDSON MINING DISTRICT, INTERIOR ALASKA

PARTS OF BIG DELTA QUADRANGLE

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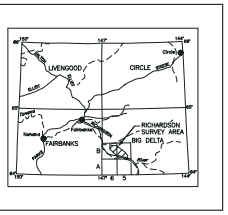
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