Division of Geological & Geophysical Surveys

PUBLIC-DATA FILE 98-26

PORTFOLIO OF AEROMAGNETIC AND RESISTIVITY MAPS OF THE NORTHEASTERN PORTION OF THE KOYUKUK MINING DISTRICT, EASTERN BROOKS RANGE ALASKA

by

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A cooperative agreement between the Alaska Division of Geological & Geophysical Surveys (DGGS) and the U.S. Department of the Interior Bureau of Land Management (BLM) resulted in acquiring and releasing geophysical data of the Koyukuk mining district, Brooks Range, Alaska. Funding was provided by BLM. The contract was monitored and the data published by DGGS in 1998.

This Public-data file (PDF) briefly describes the aeromagnetic and electromagnetic data and contains page-size illustrations of the data. The airborne geophysical information consists of aeromagnetic data and resistivity data at 900, 4200, and 33,000 Hz. This portfolio includes color maps of the aeromagnetic data, color maps of the coplanar resistivity data at 900 and 4200 Hz, three black and white shadow maps of the aeromagnetic maps, and an acetate overlay of the topography. PDF 98-25 gives a more detailed interpretation of the data and a more complete description of the processing. Clients can request any color map from this portfolio at a scale of 1:63,360 (1 inch = 1 mile) from the Alaska Division of Geological and Geophysical Surveys, 794 University Ave., Suite 200, Fairbanks, Alaska, 99709. Telephone: (907) 451-5020. FAX: (907) 451-5050. These maps are listed at the end of this sheet. Custom plots of variations of the data can be made at any scale at the DGGS office for a reasonable fee.

The acetate topography included with this portfolio should be used only for generalized locations. For accurate locations, the large scale geophysical maps or the computer files should be used. The area surveyed includes parts of Chandalar A-6, B-6, C-4, C-5, C-6, D-4, D-5 and Wiseman A-1, A-2, B-1, C-1 quadrangles. The maps produced at a scale of 1:63,360 (1 inch = 1 mile) cover the entire survey area shown in Figure 1. Maps at a scale of 1:31,680 (1 inch = ½ mile) are labeled as in Figure 2 and sold individually.

Location Index for Scale 1:63,360

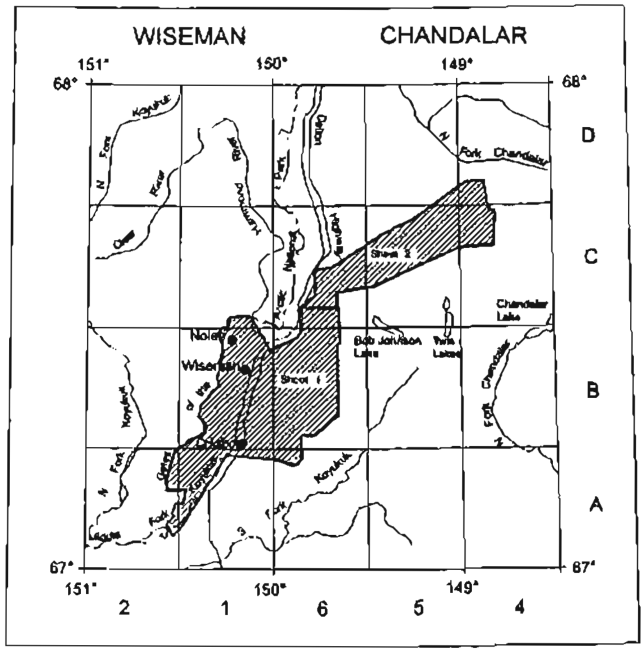

Figure 1. Index map for aeromagnetic and resistivity maps that are available at 1:63,360 scale.

Location Index for Scale 1:31,680

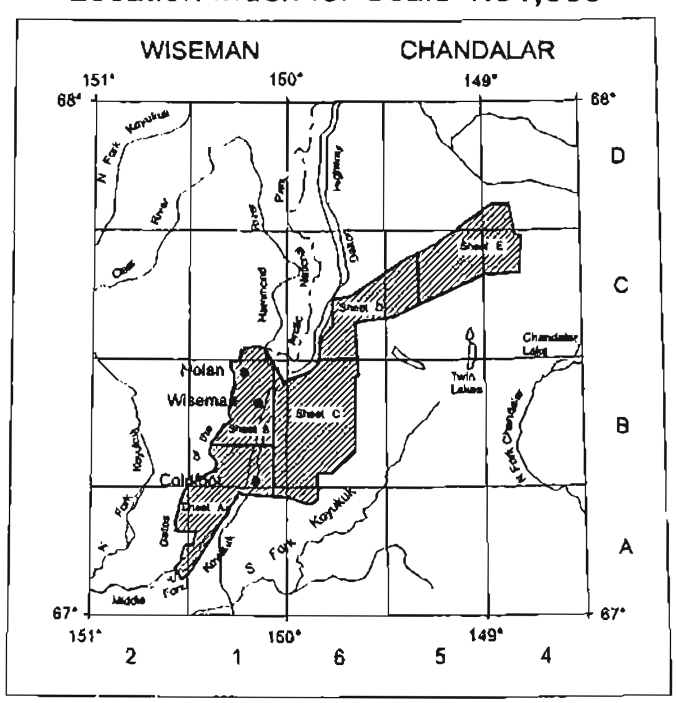

Figure 2. Index map for aeromagnetic maps available at 1:31,680 scale. The aeromagnetic maps at this scale are blue line with good topography. They show magnetic contours and detailed EM anomalies with a symbol denoting signal strength AND an interpretation as to what is causing the EM anomaly.

Survey history, instrumentation, and data processing

The following indented section describing the instrumentation and processing is from the maps produced by On-Line Exploration Services, Inc. and Sial Geosciences, Inc., the contractor and subcontractor, in conjunction with DGGS.

> The airborne geophysical data for the Koyukuk area were compiled and drawn under contract between the State of Alaska, Department of Natural Resources, Division of Geological & Geophysical Surveys, and On-Line Exploration Services, Inc. Airborne geophysical data for the area were acquired by Sial Geosciences, Inc. in 1997. The U.S. Department of Interior Bureau of Land Management (BLM) provided funding for the project.
>
> Geophysical data were acquired with a SIGHEM-5 Electromagnetic (EM) system, a Scintrex cesium CS2 magnetometer, and a Herz VLF system installed in a LAMA-N48087 Squirrel helicopter. In addition, the survey recorded data from a radar altimeter (TERRA), a GPS navigation system, 50/60 Hz monitors, and a 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.
>
> Two Trimble-4000 SE Differential Post-processing Global Positioning Systems were used for both navigation and flight path recovery. The helicopter position was derived every one second 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 degrees W, 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 Field Magnetics:
> The magnetic total field contours were produced using digitally recorded data from a Scintrex cesium magnetometer, with a sampling interval of 0.1 seconds. The magnetic data were (1) corrected for diurnal variations by subtraction of the digitally recorded base station magnetic data, (2) leveled to the tie line data, and (3) interpolated onto a regular 100 m grid using a modified Akima (1970) technique. The regional variation (or IGRF gradient, 1985 updated to August 1997) was removed from the leveled magnetic data.
>
> Resistivity:
> To determine the location of EM anomalies or their boundaries, the SIGHEM-5 EM system measured inphase and quadrature components at five frequencies. Two vertical coaxial coil-pairs operated at 870 and 4785 Hz while three horizontal coplanar coil-pairs operated at 945, 4212, and 36360 Hz. EM data were sampled at 0.1-second intervals. The EM system responds to bedrock conductors, conductive overburden, and cultural sources. The power line monitor and the flight track video were examined

to locate the cultural sources. The EM anomalies that are indicated are classified by conductance.

Apparent resistivity, calculated with leveled inphase and quadrature components, was (1) gridded with bi-directional method using a grid of 100m, and (2)filtered with a low pass directional filter (decorrugation)*.

* Keating, Pierre, 1994, Frequency Domain Filtering: Geological Survey of Canada, Unpublished Fortran program.

<u>Magnetic data</u>

The magnetometer is a passive instrument that measures the earth's magnetic field in nanoteslas (nT). Rocks with high magnetic susceptibilities (measured in SI units) locally attenuate or dampen these magnetic signals producing the relative highs and lows. Iron-rich magnetic minerals such as magnetite, ilmenite, and pyrrhotite have the highest magnetic susceptibility. These minerals commonly occur in mafic volcanic rocks (such as basalt), mafic and ultramafic plutonic rocks (such as serpentinite, clinopyroxenite, and gabbro), some skarns, and in some other geologic units. Rocks with low to no iron tend to produce little variation in the magnetic signal. These include silicic volcanic rocks (rhyolites), silicic plutonic rocks (granites), and most sedimentary rocks (for example, limestone, sandstone, and shale). Some iron-rich minerals—such as pyrite—are not magnetic and do not produce a magnetic signal.

Different types of ore deposits have different magnetic signatures. A bedrock gold deposit associated with the top of a granitic pluton would likely be an aeromagnetic low whereas a magnetite-bearing gold skarn would be an aeromagnetic high. A gold deposit hosted by a low-angle (thrust) fault has a different signature than one hosted by a high-angle fault.

Figure 3 shows the aeromagnetic data for the Wiseman area. The high values (in nanoteslas) are purple and orange and indicate appreciably magnetic rocks. The low values are the blues and greens. A gradual change in color indicates a gradual change in the magnetic field strength. This can be caused by either a gradual change in magnetic susceptibility of rocks near the surface, the gradual burial of a rock unit of relatively constant magnetic susceptibility, or the introduction of a new unit at depth. Conversely, an abrupt change in color indicates an abrupt change in the magnetic susceptibility. This is caused by juxtaposing two rock units with very different magnetic susceptibilities such as is the case with faults, volcanic dikes, or some mineralized zones. Faults can be inferred on aeromagnetic maps from linear or curvilinear features composed of discontinuous aeromagnetic highs or lows.

Figures 4 and 5 show the aeromagnetic data presented as "shadow" maps. These three-dimensional maps simulate a light source shining on the data. The higher values appear bright, like mountaintops struck by sunlight. The light source can be rotated in a complete circle with 0° (north) clockwise to 180° (south) and back to 360° (north). Figure 4 shows azimuth 40° (apparent light source in the northeast), and Figure 5 shows azimuth 320° (apparent light source in the northwest). Shadow maps can enhance structures, such as faults, intrusions, and the trend of stratigraphic layers.

Resistivity data

The electromagnetic (EM) system is an active instrument that measures the resistivity of the rocks below it by sending out electromagnetic signals at different frequencies and recording the signals that are returned from the earth. The high values (measured in ohm-m) are indicative of resistive (low conductivity) rocks, such as quartzite. Low resistivity (high conductivity) values are present for bedrock conductors (water-saturated clays, graphite, concentrations of certain sulfides, some alteration halos), conductive overburden (water-saturated zones), and cultural sources (e.g. power lines). The main conductive minerals are graphite, most sulfides, (but not sphalerite), and water-saturated clays. Rocks hydrothermally altered to clay minerals also are conductive. Some faults will show up very well on the resistivity maps, because either they offer a conduit for ground water or they separate rocks with markedly different resistivities.

The EM instrument (bird) contains 5 or more transmitting coils in front and 5 matching (paired) receiver coils in the rear. Three of these pairs are coplanar—the axes of the coils are perpendicular to the long axis of the bird. Two of these pairs are coaxial—the axes of the coils are parallel to the long axis of the bird. These two major geometric configurations, coplanar and coaxial, record different information about the conductivity of the rocks below. Coplanar coils emphasize horizontal and flat lying conductive units. Coaxial coils emphasize vertical to near vertical conductive units.

The EM coplanar coil pairs are processed to produce resistivity maps, shown in Figures 6 and 7. Since ground penetration correlates inversely with frequency, the 4200 Hz reflects near surface rocks and the 900 Hz adds the influence of deeper rocks in general. However, the depth of penetration is variable depending on the resistivity of the rocks the signal is passing through. Although the color bars in these figures differ, each figure has the most conductive rocks shown as purple and orange.

The information derived from the coaxial electromagnetic pairs emphasizes vertically- or near-vertically-dipping "discrete" bedrock conductors. These anomalies are shown as circular symbols along flight lines on some of the aeromagnetic maps. The 1 inch = 1 mile scale maps show anomaly symbols denoting strength of the signal, those caused by a concentration of magnetite, and those interpreted to have formed from cultural sources. More detailed interpretations for the electromagnetic anomalies are shown on the aeromagnetic maps produced at the 1:31,680 scale. PDF 98-25 gives a more detailed discussion of these EM anomalies.

Description of selected products

The aeromagnetic maps labeled Report of Investigation 98-7 (RI98-7) contains flight lines, simplified electromagnetic anomalies, and topography at a scale of 1:63,360. These maps are offset printed and may not be available on the date the data is released. They will be available for order in either blue line or diazo form. Topography is available on the flight lines map also (PDF98-19).

The following maps are in full color: the aeromagnetic data (RI 98-8), the 900 Hz coplanar resistivity data (RI 98-9), and the 4200 Hz coplanar resistivity data (RI 98-10). Each is at a scale of 1:63,360 and includes the data contours.

The blueline format for the 900 Hz coplanar resistivity data (PDF 98-21), and the 4200 Hz coplanar resistivity data (PDF 98-22) contain data contours and section lines. They do not show topography.

Aeromagnetic maps (PDF 98-40A through E), produced at a scale of 1:31680, contain detailed electromagnetic anomalies and topography. These maps will not be available on the release date.

The flight line maps (PDF 98-19) contain photographically produced topography, which is clearer than the scanned topography.

The zip-disk (PDF 98-23) contains gridded files in Geosoft format. A computer program capable of viewing these files in Geosoft format or converting files to another format is necessary to view the files. If you need assistance, please contact our office.

The CD-ROM (PDF 98-24) contains profile data, gridded data, and location information. The CD-ROM is useful for someone who would like to view the original processed data or take out different mathematical trends.

DGGS PUBLICATIONS PRODUCED FOR THE KOYUKUK MINING DISTRICT SURVEY

AEROMAGNETIC MAPS

RI 98-7. Total field magnetics and electromagnetic anomalies of the northeastern portion of the Koyukuk mining district, eastern Brooks Range, Alaska, 2 sheets, scale 1:63,360. Topography included. 3 colors.

RI 98-8. Total field magnetics of the northeastern portion of the Koyukuk mining district, eastern Brooks Range, Alaska, 2 sheets, scale 1:63,360. Full color plot from electronic file, 400 dpi. Made on request.

PDF 98-20. Total field magnetics and electromagnetic anomalies of the northeastern portion of the Koyukuk mining district, eastern Brooks Range, Alaska, 2 sheets, scale 1:63,360. Clear diazo film. Magnetic contours and section lines included. Made on request.

PDF 98-40a. Total field magnetics and detailed electromagnetic anomalies of the northeastern portion of the Koyukuk mining district, eastern Brooks Range, Alaska, 1 sheet, scale 1:31,680 (parts of the Wiseman A-1, A-2, and B-1 quadrangles). Blue line.

PDF 98-40b. Total field magnetics and detailed electromagnetic anomalies of the northeastern portion of the Koyukuk mining district, eastern Brooks Range, Alaska, 1 sheet, scale 1:31,680 (parts of the Wiseman B-1 and C-1 quadrangles). Blue line.

PDF 98-40c. Total field magnetics and detailed electromagnetic anomalies of the northeastern portion of the Koyukuk mining district, eastern Brooks Range, Alaska, 1 sheet, scale 1:31,680 (parts of the Wiseman A-1, B-1, Chandalar A-6 and B-6 quadrangles). Blue line.

PDF 98-40d. Total field magnetics and detailed electromagnetic anomalies of the northeastern portion of the Koyukuk mining district, eastern Brooks Range, Alaska, 1 sheet, scale 1:31,680 (parts of the Chandalar C-5 and C-6 quadrangles). Blue line.

PDF 98-40e. Total field magnetics and detailed electromagnetic anomalies of the northeastern portion of the Koyukuk mining district, eastern Brooks Range, Alaska, 1 sheet, scale 1:31,680 (parts of the Chandalar C-4, C-5, D-4, and D-5 quadrangles). Blue line.

RESISTIVITY MAPS

RI 98-9. 900 Hz coplanar resistivity of the northeastern portion Koyukuk mining district, eastern Brooks Range, Alaska, 2 sheets, scale 1:63,360. Resistivity contour lines included. Full color plot from electronic file, 400 dpi. Made on request.

RI 98-10. 4200 Hz coplanar resistivity of the northeastern portion Koyukuk mining district, eastern Brooks Range, Alaska, 2 sheets, scale 1:63,360. Resistivity contour lines included. Full color plot from electronic file, 400 dpi. Made on request.

PDF 98-21. 900 Hz coplanar resistivity contours of the northeastern portion Koyukuk mining district, eastern Brooks Range, Alaska, 2 sheets, scale 1:63,360. Blueline. Resistivity contours and section lines included.

PDF 98-22. 4200 Hz coplanar resistivity contours of the northeastern portion Koyukuk mining district, eastern Brooks Range, Alaska, 2 sheets, scale 1:63,360. Blueline. Resistivity contours and section lines included.

DIGITAL FILES, PROJECT REPORT, PORTFOLIO, AND FLIGHT LINES

PDF 98-19. Flight lines for the northeastern portion Koyukuk mining district, eastern Brooks Range, Alaska, 2 sheets, scale 1:63,360. Blueline. Topography included.

PDF 98-23. Zip disk containing gridded files, EM anomolies as vector file, and section lines of the 1997 geophysical survey data for the northeastern portion Koyukuk mining district, eastern Brooks Range, Alaska, 1 disk.

PDF 98-24. CD-ROM digital archive files of 1997 survey data for the northeastern portion Koyukuk mining district, eastern Brooks Range, Alaska, 1 CD-ROM.

PDF 98-25. Project report of the airborne geophysical survey for the northeastern portion Koyukuk mining district, eastern Brooks Range, Alaska.

PDF 98-26. Portfolio of aeromagnetic and resistivity maps of the northeastern portion Koyukuk mining district, eastern Brooks Range, Alaska. Includes color and shadow maps. Maps fit on 8 ½" x 11" sheet.

SOME AVAILABLE REFERENCES FOR THE KOYUKUK MINING DISTRICT, EASTERN BROOKS RANGE, ALASKA

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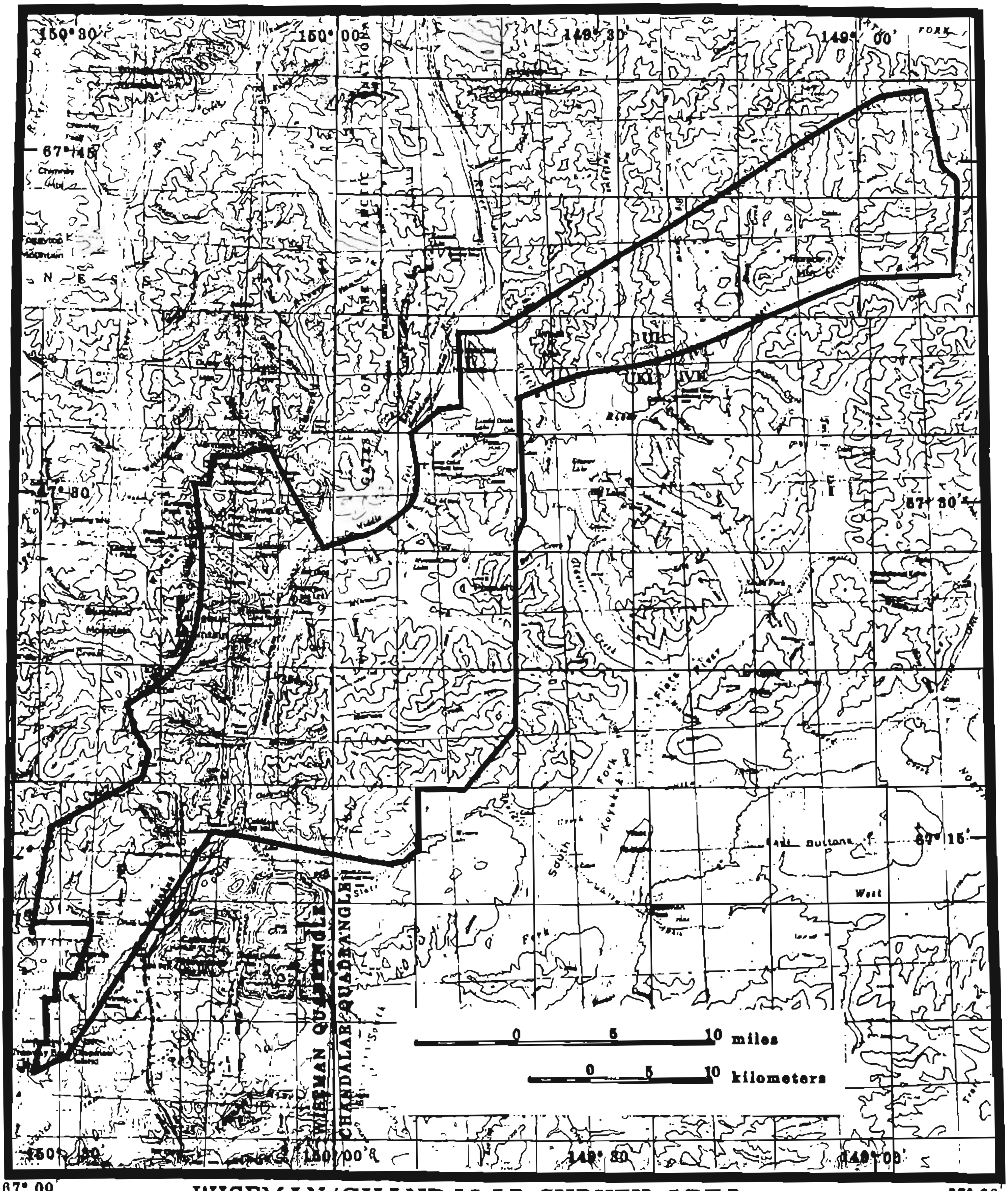

WISEMAN/CHANDALAR SURVEY AREA

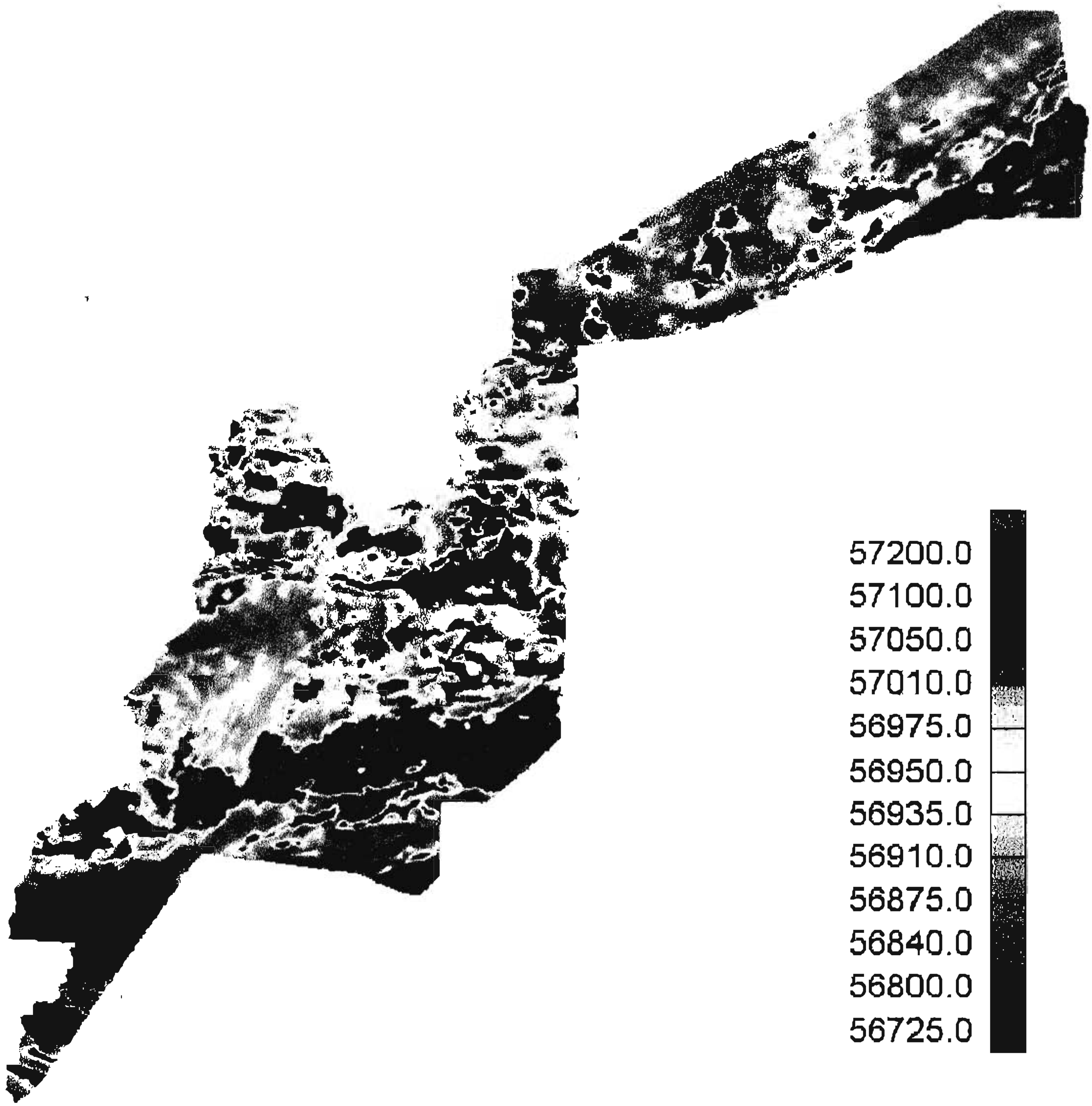

Figure 3: Total field magnetics of the Koyukuk (Wiseman) area, northern Alaska. Magnetic units are in nT.

Figure 4: Shadow map of the aeromagnetic data from the Koyukuk (Wiseman) area, northern Alaska.

Illumination source is at 40 degrees. High magnetic values appear like the tops of mountains that are hit by sunlight.

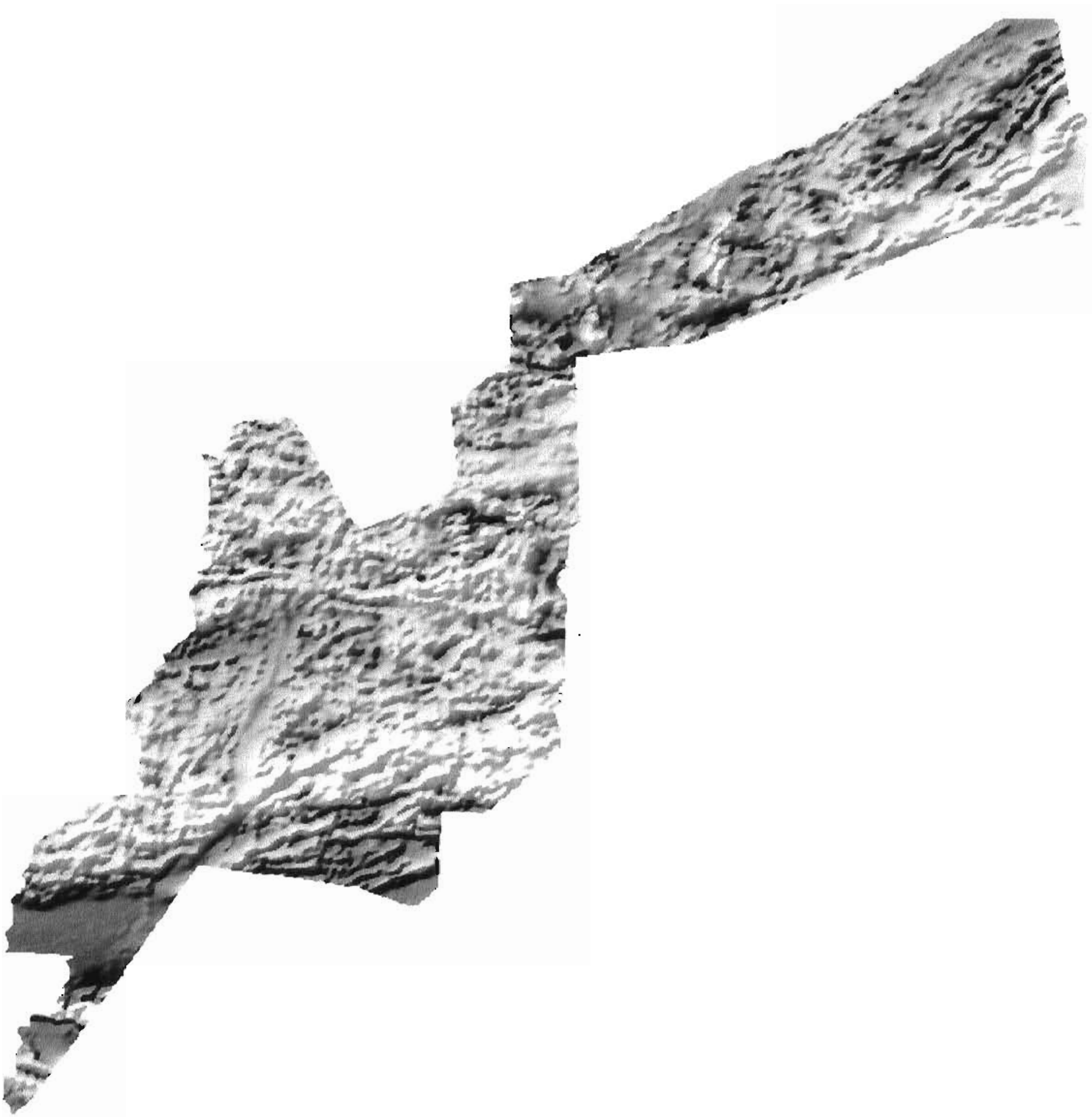

Figure 5: Shadow map of the aeromagnetic data from the Koyukuk (Wiseman) area, northern Alaska. Illumination source is at 320 degrees (northwest). High magnetic values appear like the tops of mountains that are hit by sunlight.

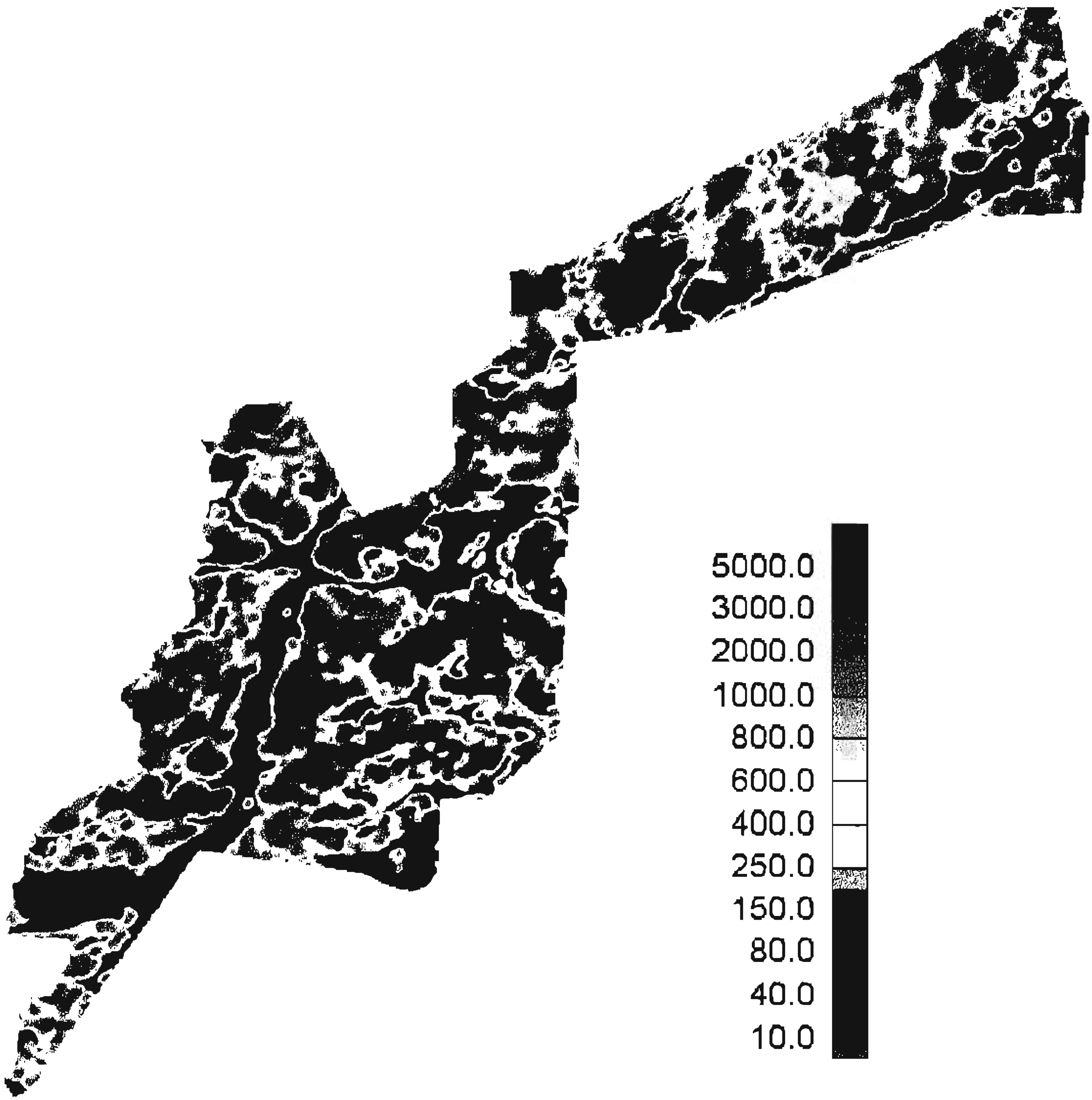

Figure 6: 4200 Hz coplanar resistivity map of the Koyukuk (Wiseman) area, northern Alaska. Resistivity values in ohm-m. Conductive units have low values and are shown in purple and orange on this map. The areas that are most resistive are shown in blue.

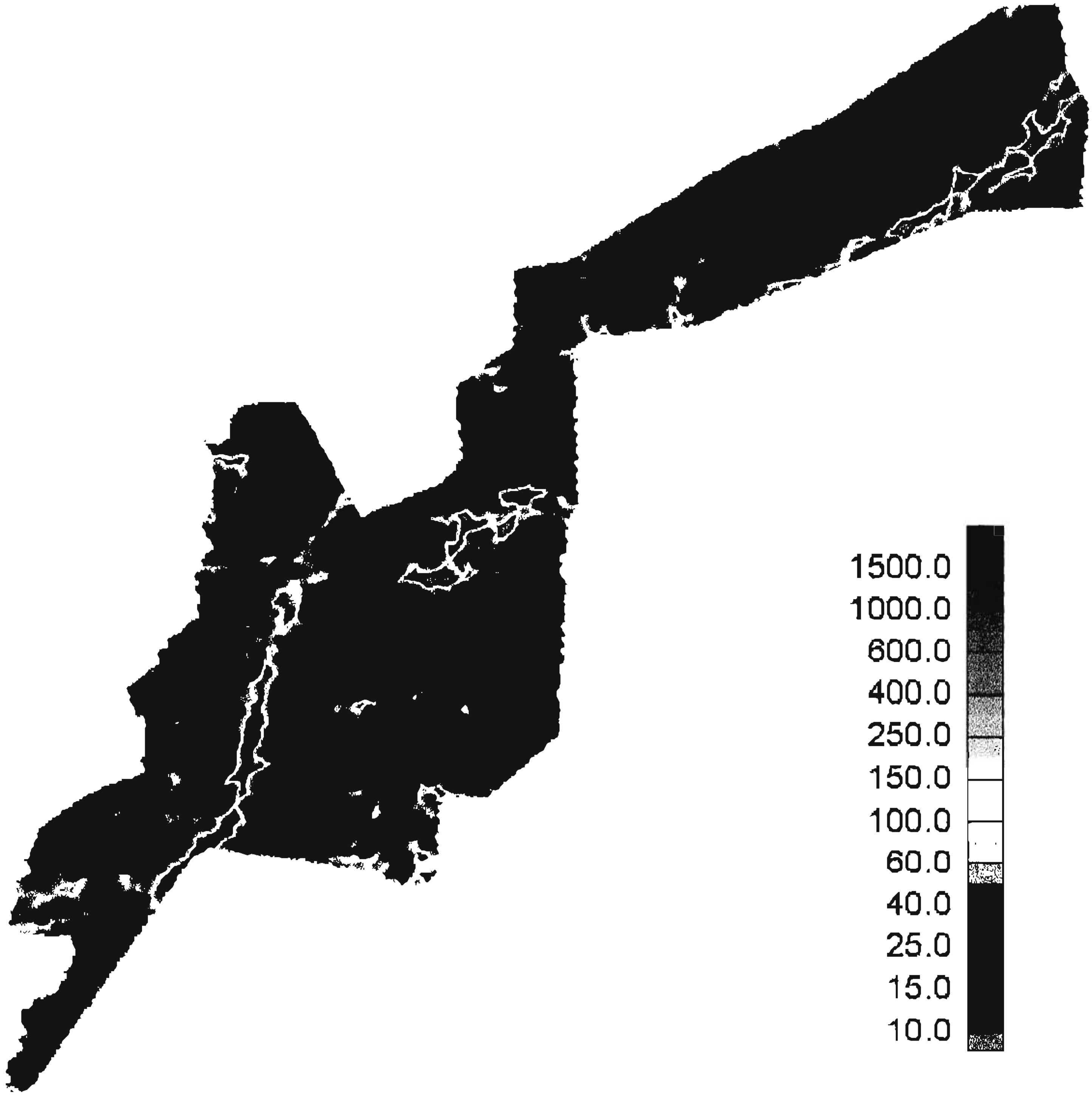

Figure 7: 900 Hz coplanar resistivity map of the Koyukuk (Wiseman) area, northern Alaska. Resistivity values in ohm-m. Conductive units have low values and are shown in purple and orange on this map. The areas that are most resistive are shown in blue.