PUBLIC-DATA FILE 99-16

PORTFOLIO OF AEROMAGNETIC AND RESISTIVITY MAPS OF PART OF THE LIVENGOOD MINING DISTRICT, ALASKA, CENTRAL LIVENGOOD QUADRANGLE

by

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PORTFOLIO OF AEROMAGNETIC AND RESISTIVITY MAPS OF PART OF THE LIVENGOOD MINING DISTRICT, ALASKA, CENTRAL LIVENGOOD QUADRANGLE

In the fall of 1998, the Alaska Division of Geologic and Geophysical Surveys acquired airborne geophysical data over about 230 square miles in the Livengood Quadrangle (figure 1). The data acquired were aeromagnetic and resistivity data at several frequencies. The data were released in January 1999. This Public-Data File (PDF) contains generalized information on data acquisition, data interpretation, and publications and data formats available for the survey area. Another report, PDF 99-17 gives a more detailed interpretation of the data and a more complete description of the processing.

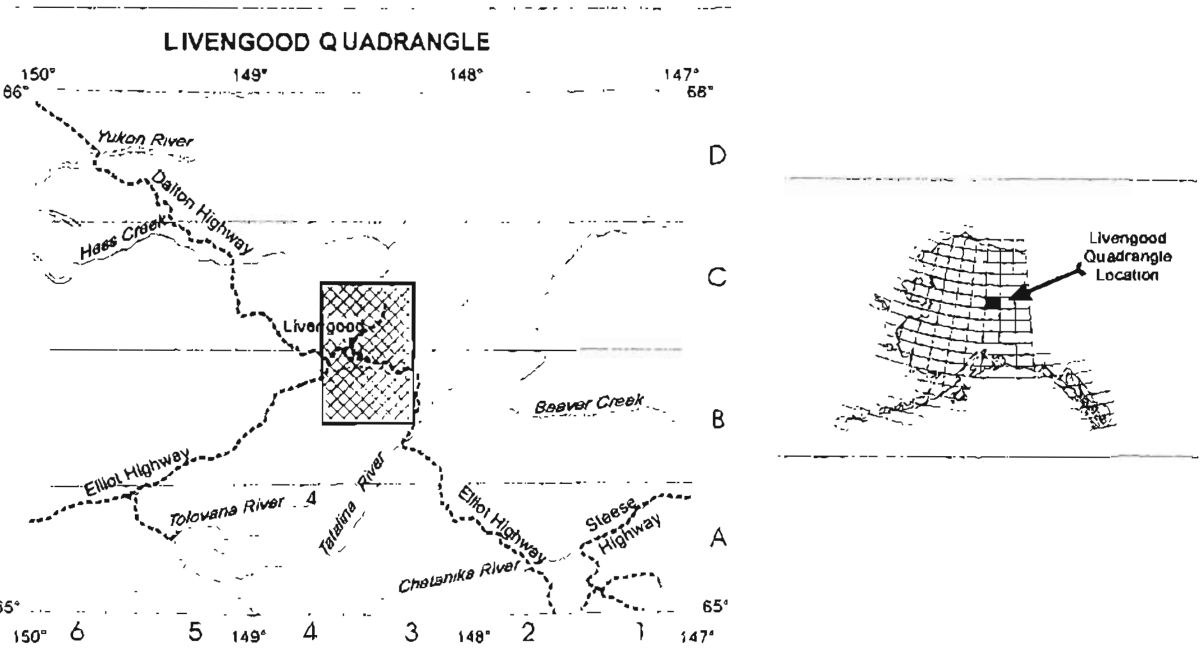

Figure 1. Index map for aeromagnetic and resistivity maps that are available at 1:63,360 scale.

This report also shows some of the data as page-size color maps and includes an acetate overlay of the topography. The acetate topography included as figure 8 in this portfolio should be used only for generalized locations. For accurate locations, the large-scale geophysical maps or the computer files should be used. Clients can request any color map from this portfolio at scale of 1:63,360 (1 inch = 1 mile) from the Alaska Division of Geological & Geophysical Surveys, 794 University Avenue, Suite 200, Fairbanks, Alaska, 99709-3645. Phone: (907) 451-5020. Fax: (907) 451-5050. Custom plots of variations of the data can be made at any scale at the DGGS office for a reasonable fee.

The area surveyed includes parts of the Livengood B-3, B-4, C-3, and C-4 quadrangles. Figures

1 and 2 show the layout of the maps at a scale of 1:63,360 (1 inch = 1 mile) and 1:31,680 (1 inch = ½ mile).

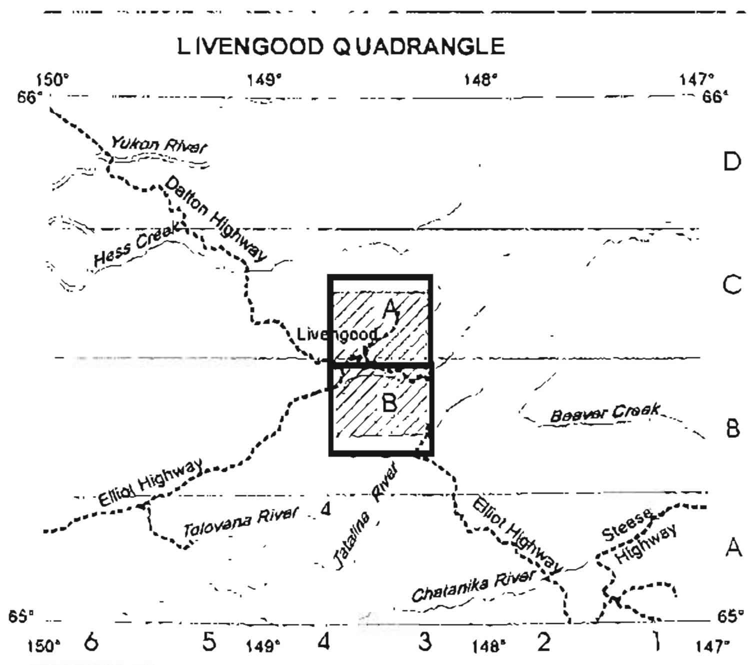

Figure 2. Index map for aeromagnetic maps available at 1:31,680 scale. Only aeromagnetic maps are available at this scale. These contain photographic topography, magnetic contours, and detailed EM anomalies. The Em anomaly is shown as a symbol that denotes signal strength and an interpretation as to the source of the EM anomaly.

Survey history, instrumentation, and data processing

The following indented section describing the instrumentation and processing is from the maps produced by Stevens Exploration Management Corporation and Geoterrex-Dighem, the contractor and subcontractor, in conjunction with DGGS.

> The airborne geophysical data were compiled and drawn under contract between the State of Alaska, Department of Natural Resources, Division of Geological & Geophysical Surveys, and Stevens Exploration Management Corporation. Airborne geophysical data for the area were acquired in 1998 by Geoterrex-Dighem, a division of CGG Canada Ltd.

> Geophysical data were acquired with a DIGHEM^V Electromagnetic (EM) system and a Scintrex cesium magnetometer. Both 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 a video camera. Flights were performed with a AS350B-2 Squirrel helicopter 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.

An Ashtech/Racal 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 both real-time differential positioning to a relative accuracy of better than 10 m. Flight path positions were projected onto the Clark 1866 (UTM zone 6) spheroid, 1927 North American datum using a central meridian (CM) of 147 degrees, 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 total field magnetic data were acquired with a sampling interval of 0.1 seconds, and were (1) corrected for diurnal variations by subtraction of the digitally recorded base station magnetic data, (2) 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, 1995 updated to September, 1998) was removed from the leveled magnetic data.

Resistivity:
The Dighem^{V} EM system measured inphase and quadrature components at five frequencies. Two vertical coaxial coil-pairs operated at 900 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 power line monitor and the flight track video were examined to locate cultural sources.

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.

Magnetic data

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 lowangle (thrust) fault has a different signature than one hosted by a high-angle fault.

Figure 3 shows the aeromagnetic data for the survey 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 the mountain tops 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). Shadow maps can enhance structures, such as faults, intrusions, and the trend of stratigraphic layers. Figures 4 and 5 have azimuths that were chosen to show particular features for the survey area.

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. powerlines). 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 they either 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 7200 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 generally as circular symbols along flight lines with 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. This information is also available on the CD-ROM. The project report, PDF 99-17 gives a more detailed discussion of these EM anomalies.

Description of selected products

Three maps are in full color, the aeromagnetic data, the 900 Hz coplanar resistivity data, and the 7200 Hz coplanar resistivity data. All three have scanned topography at a scale of 1:63,360 (inch to a mile). The data contours, electromagnetic anomaly symbols, and flight lines are not included in any of these maps. They are all DGGS Reports of Investigation (RI's) and the actual numbers for this survey area are listed at end of this portfolio.

The blueline format for the aeromagnetic data, the 900 Hz coplanar resistivity data, and the 7200 Hz coplanar resistivity data contain data contours and section lines, but do not show topography. An addition, the aeromagnetic maps show simplified electromagnetic anomaly symbols (discussed above) along the flight lines. This aeromagnetic map is also available on diazo.

The flight line maps contain photographically-produced topography, which is clearer than the scanned topography. These other maps are all DGGS Public-Data File reports (PDF's) and are also listed at the end of this portfolio.

The CD-ROM 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. The zip-disk 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. These computer products are also DGGS PDF's and listed at end of this portfolio.

DGGS PUBLICATIONS PRODUCED FOR THE LIVENGOOD AREA SURVEY

AEROMAGNETIC MAPS

RI 99-4. Total field magnetics of part of the Livengood mining district, Alaska, central Livengood quadrangle, 1 sheet, scale 1:63,360. Topography included. Full color plot from electronic file, 400 dpi. Made on request

PDF 99-13. Total field magnetics and electromagnetic anomalies of part of the Livengood mining district, Alaska, central Livengood quadrangle, 1 sheet, scale 1:63,360. Clear diazo film. Magnetic contours and section lines included. Made on request.

PDF 99-12. Total field magnetics and electromagnetic anomalies of part of the Livengood mining district, Alaska, central Livengood quadrangle, 1 sheet, scale 1:63,360. Blueline. Magnetic contours and section lines included.

PDF 99-20a. Total field magnetics and detailed electromagnetic anomalies of part of the Livengood mining district, Alaska, central Livengood Quadrangle, 1 sheet, scale 1:31,680 (southwestern C-3 and southeastern C-4 Livengood Quadrangle). Blueline.

PDF 99-20b. Total field magnetics and detailed electromagnetic anomalies of part of the Livengood mining district, Alaska, central Livengood Quadrangle, 1 sheet, scale 1:31,680 (northwestern B-3 and northeastern B-4 Livengood Quadrangle). Blueline.

RESISTIVITY MAPS

RI 99-5. 900 Hz coplanar resistivity of part of the Livengood mining district, Alaska, central Livengood quadrangle, 1 sheet, scale 1:63,360. Topography included. Full color plot from electronic file, 400 dpi. Made on request.

RI 99-6. 7200 Hz coplanar resistivity of part of the Livengood mining district, Alaska, central Livengood quadrangle, 1 sheet, scale 1:63,360. Topography included. Full color plot from electronic file, 400 dpi. Made on request.

PDF 99-14. 900 Hz coplanar resistivity of part of the Livengood mining district, Alaska, central Livengood quadrangle, 1 sheet, scale 1:63,360. Blueline. Resistivity contours and section lines included.

PDF 99-15. 7200 Hz coplanar resistivity of part of the Livengood mining district, Alaska, central Livengood quadrangle, 1 sheet, scale 1:63,360. Blueline. Resistivity contours and section lines included.

DIGITAL FILES, PROJECT REPORTS, PORTFOLIO, FLIGHT LINES AND OTHER

PDF 99-11. Flight lines of part of the Livengood mining district, Alaska, central Livengood quadrangle, 1 sheet, scale 1:63,360. Blueline. Topography included.

PDF 99-16. Portfolio of aeromagnetic and resistivity maps of part of the Livengood mining district, Alaska, central Livengood quadrangle. Includes color maps. Maps fit 8½" x 11" sheet.

PDF 99-17. Project report of the 1997 geophysical survey data of part of the Livengood mining district, Alaska, central Livengood quadrangle.

PDF 99-19. CD-ROM containing profile and gridded data and section lines of 1997 geophysical survey data for part of the Livengood mining district, Alaska, central Livengood quadrangle, 1 CD-ROMs.

SOME AVAILABLE REFERENCES LIVENGOOD QUADRANGLE

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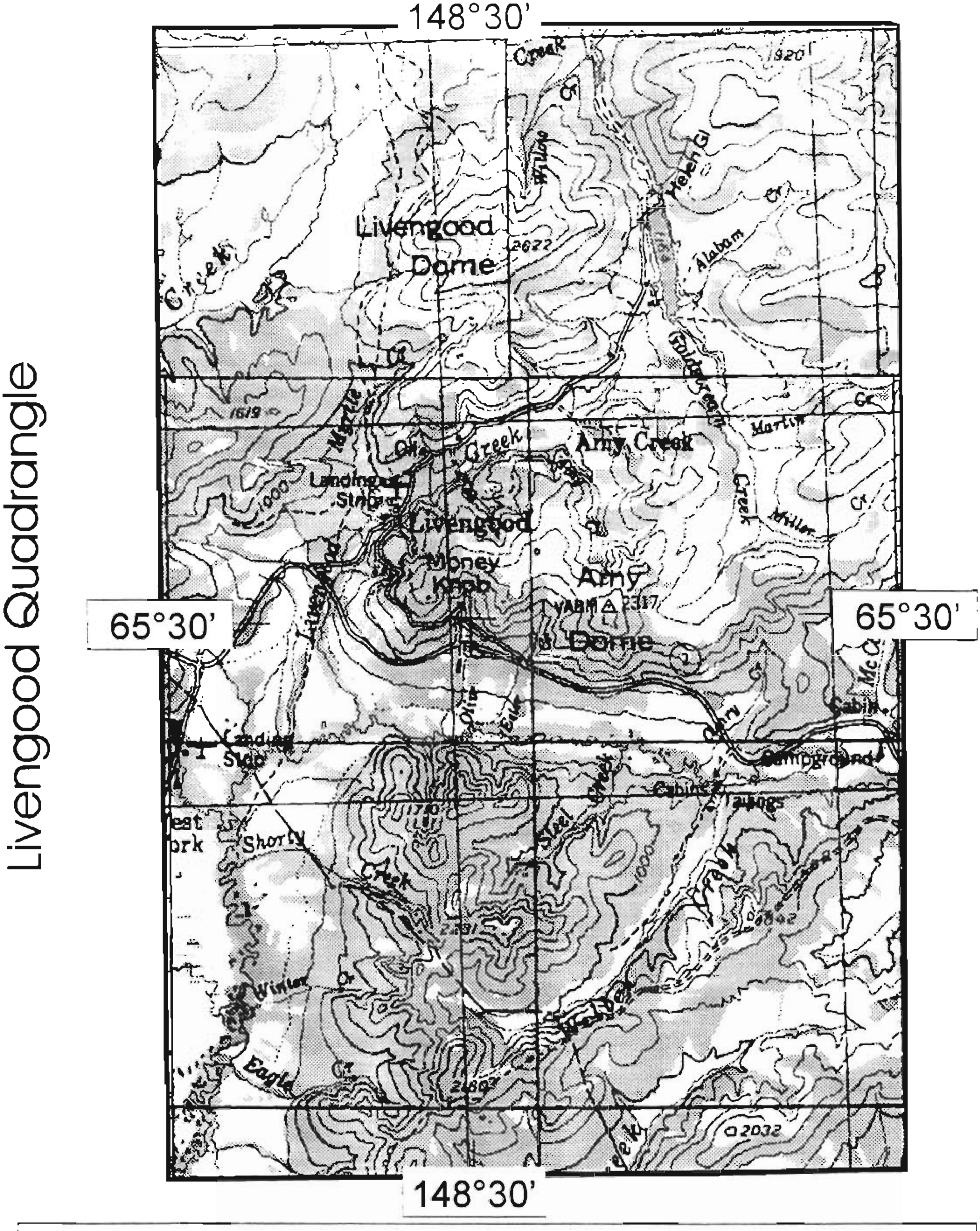

Livengood Quadrangle
148°30'
65°30'
65°30'
148°30'
Livengood Dome
Livengood
Money Knob
Amy Creek
Amy Dome
Landing Strip
Creek
5 0 5 10 Miles
5 0 5 10 Kilometers

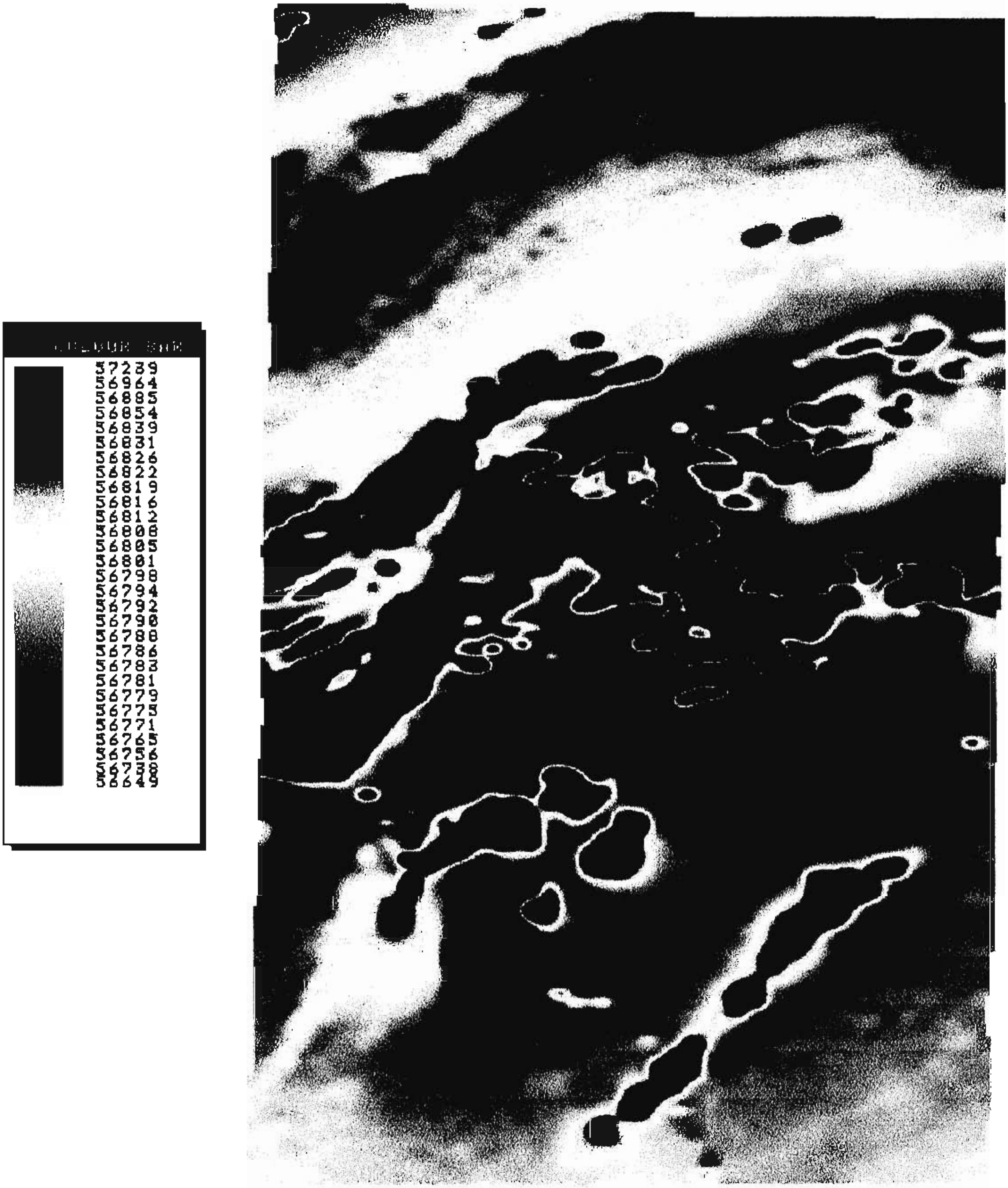

Figure 3: Total field magnetics of the Livengood area. Magnetic units are in nT.

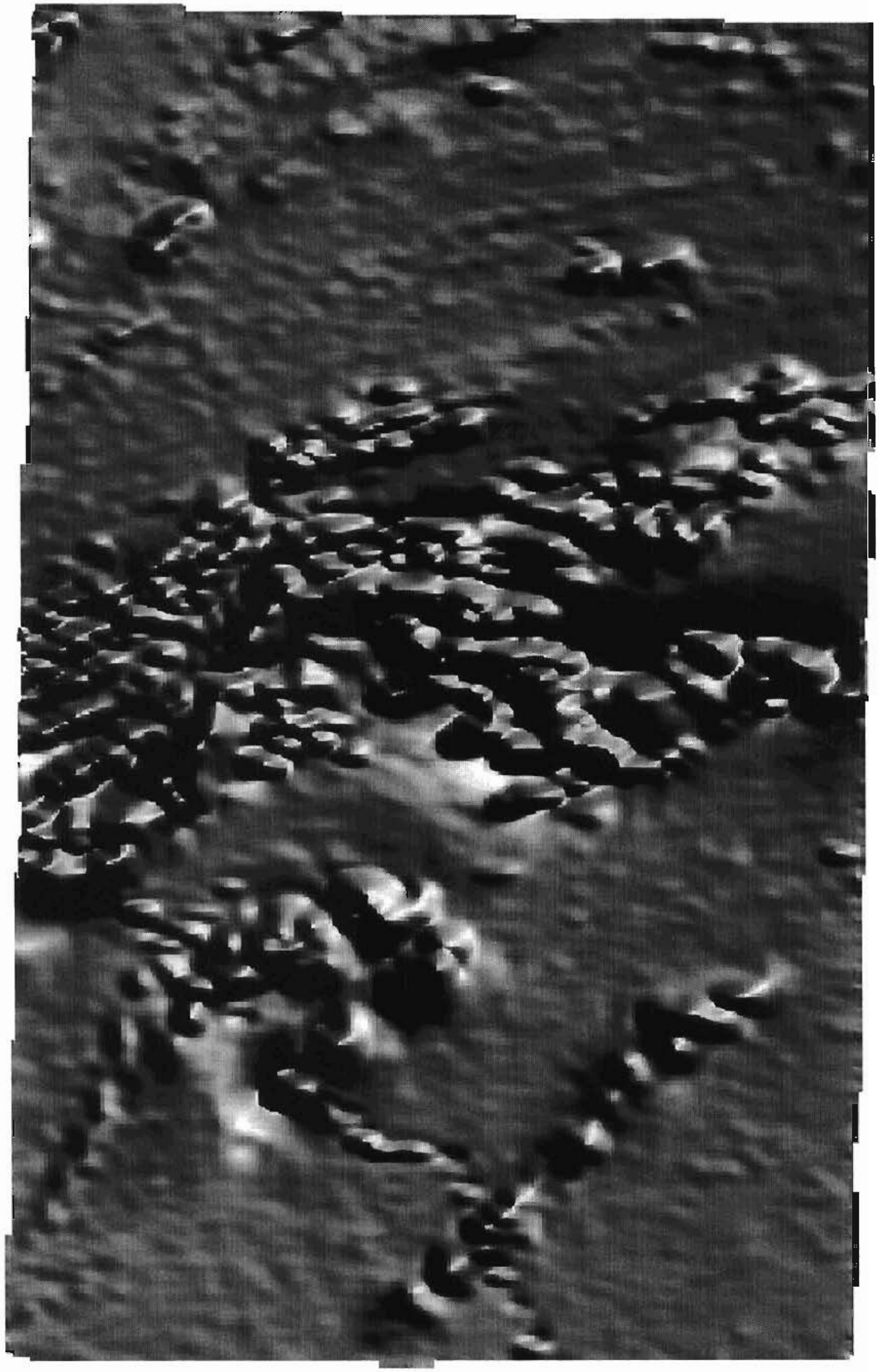

Figure 4: Shadow map of the aeromagnetic data from the Livengood area, Alaska. Illumination source is at N 51 E. High magnetic values appear like the tops of mountains that are hit by sunlight.

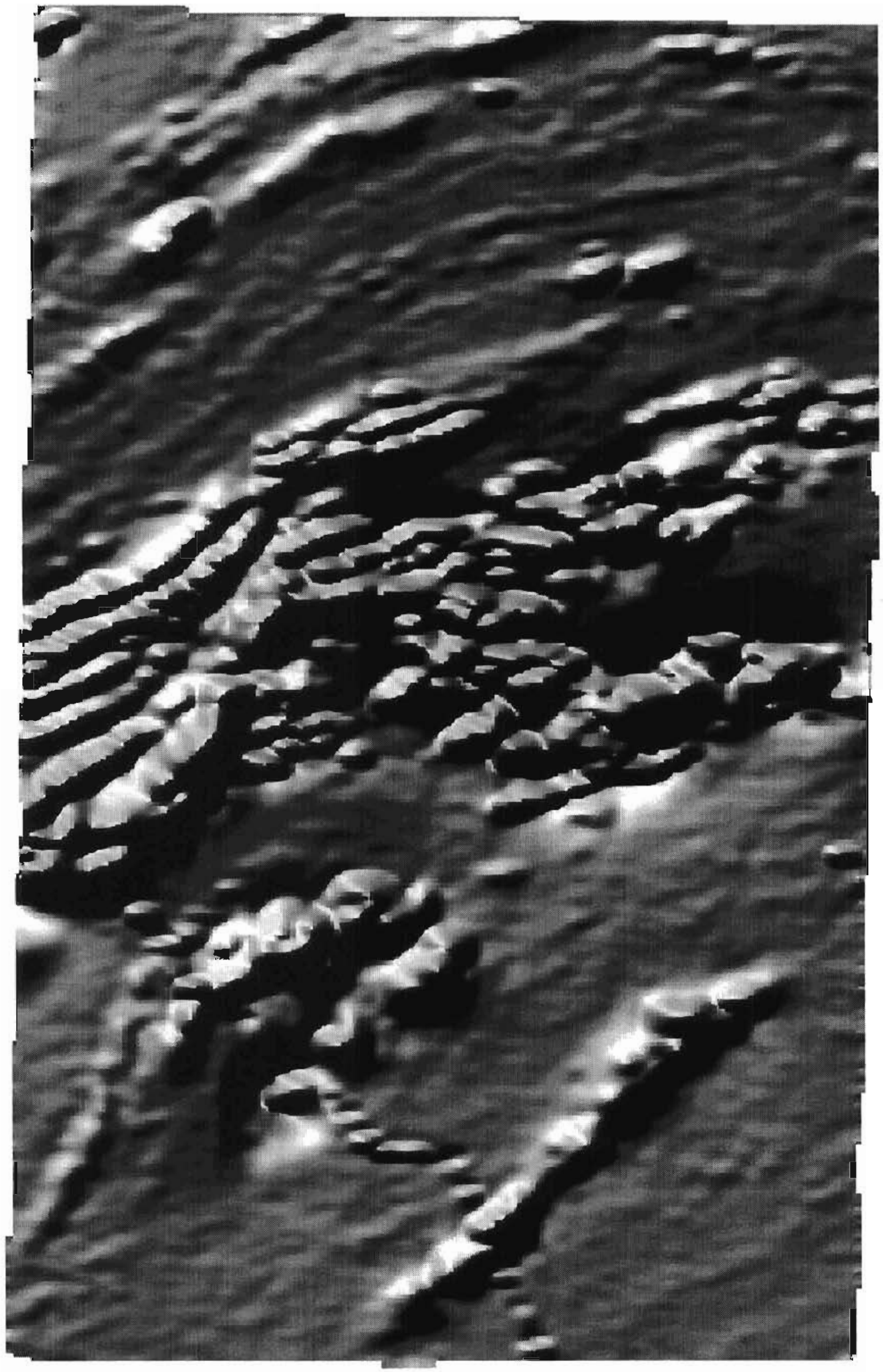

Figure 5: Shadow map of the aeromagnetic data from the Livengood area, Alaska. Illumination source is at N 327 E. High magnetic values appear like the tops of mountains that are hit by sunlight.

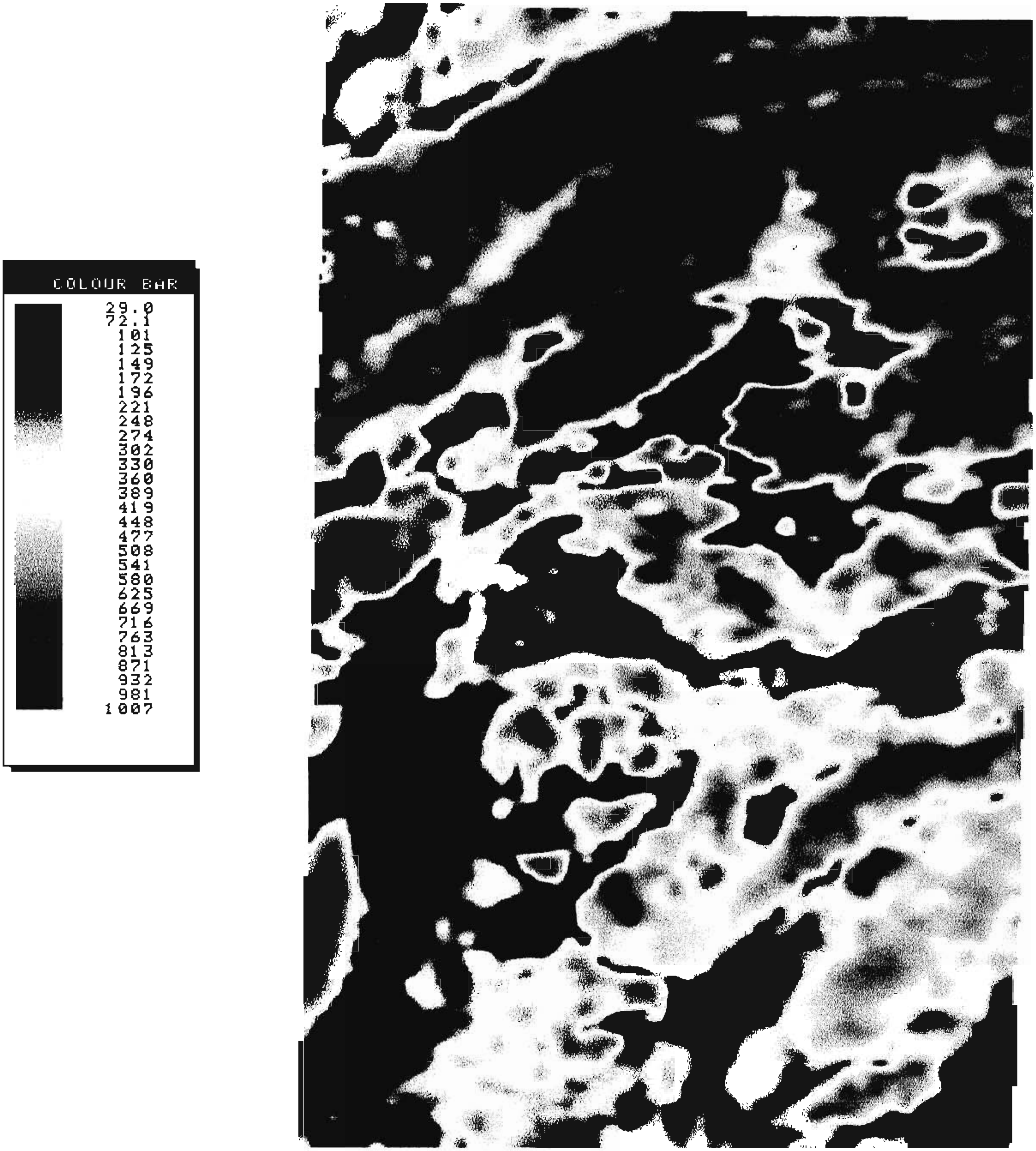

Figure 6: 900 Hz resistivity map of the Livengood area. Resistivity values in ohm-m. Conductive units have low numbers and are shown in purple and orange on this map.

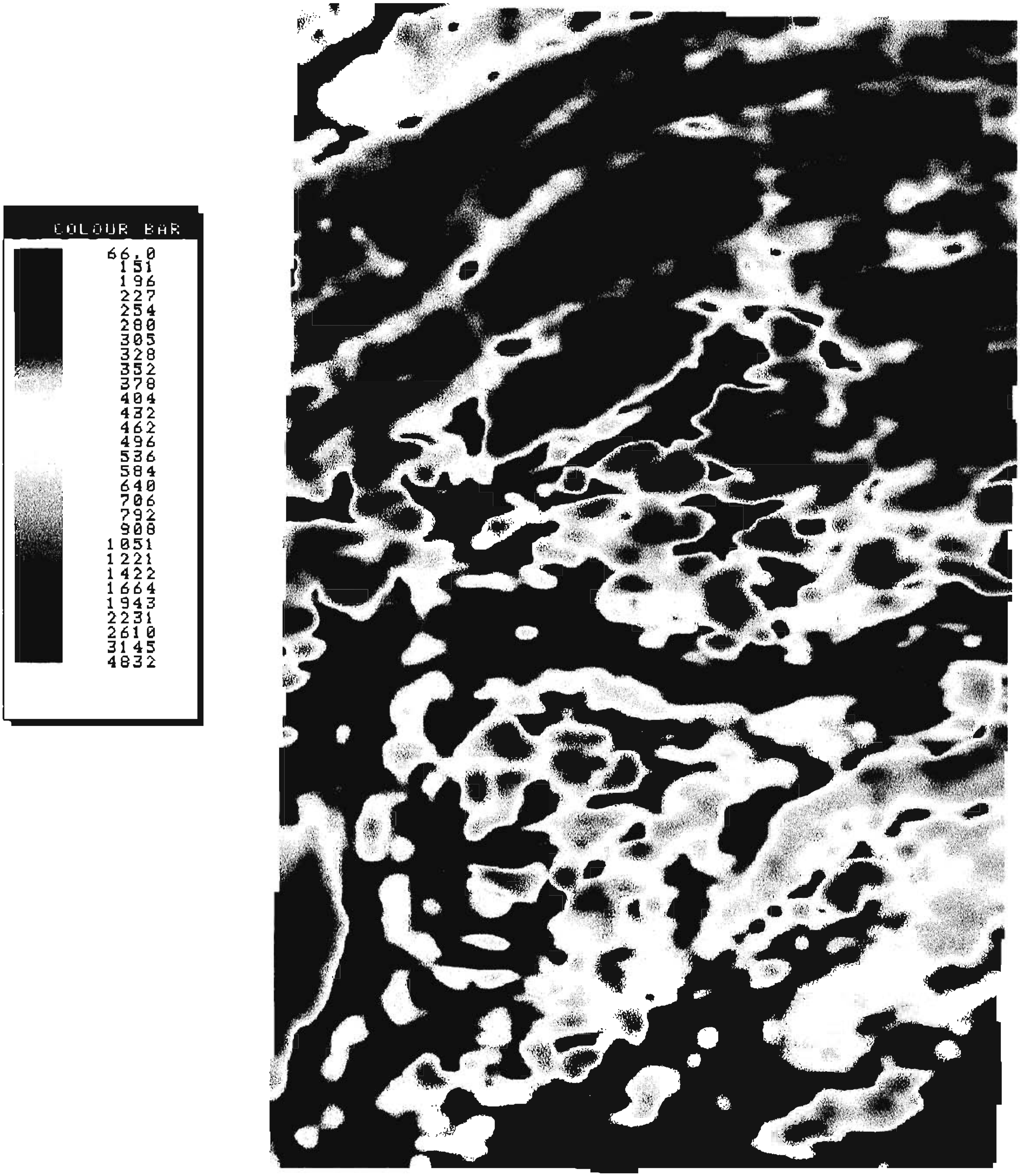

Figure 7: 7200 Hz resistivity map of the Livengood area. Resistivity values in ohm-m. Conductive units have low numbers and are shown in purple and orange on this map.