Division of Geological & Geophysical Surveys

GEOPHYSICAL REPORT 2003_8

PORTFOLIO OF AEROMAGNETIC AND RESISTIVITY MAPS OF THE SOUTHERN DELTA RIVER AREA, EAST-CENTRAL ALASKA

by

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PORTFOLIO OF AEROMAGNETIC AND RESISTIVITY MAPS
OF THE SOUTHERN DELTA RIVER AREA
EAST-CENTRAL ALASKA

Data from airborne geophysical surveys covering approximately 603 square miles of land in the Mt. Hayes Quadrangle (fig. 1) were released to the public in 2003 by the U.S. Bureau of Land Management (BLM) and the Alaska Division of Geological & Geophysical Surveys (DGGS). The project was initiated and funded by the U.S. Department of the Interior, Bureau of Land Management (BLM). DGGS monitored the geophysical contract and released the data to the public.

The released data is the merged product of two different airborne surveys (fig. 2). The early survey, flown by Aerodat in 1995, was purchased by BLM from Fort Knox, Inc. BLM provided the early survey to DGGS for incorporation with the new data. In 2002, Fugro Airborne Surveys acquired geophysical data for the remaining survey area under a contract between DGGS and Stevens Exploration Management Corporation. Fugro merged the previously-acquired data with the new data for the current data release.

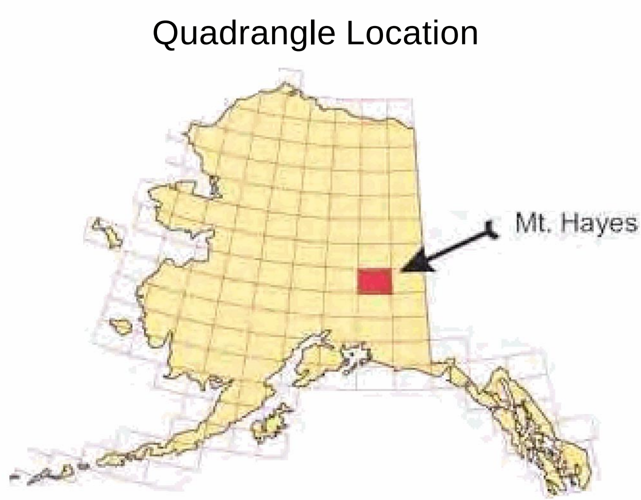

Figure 1. Location of Mt. Hayes Quadrangles.

This Geophysical Report (GPR) contains generalized information on data acquisition, data interpretation, publications, and data formats available for the southern Delta River geophysical survey. Page-size color maps of most of the data are also included. The contractor's report, GPR 2003–7, gives a more detailed interpretation of the data and a more complete description of the processing.

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 merged survey area includes parts of the Mt. Hayes A-3, A-4, A-5, A-6 and B-3, B-4, B- 5, and B-6 Quadrangles.

Clients can request maps from this geophysical survey from the Alaska Division of Geological & Geophysical Surveys. Ordering information and available maps are listed at the end of this portfolio. Some of the products are available at DNR's Public Information Center in Anchorage. Most of the maps in this portfolio are available from DGGS. Custom plots of variations of the data can be made at any scale at the DGGS office for a reasonable fee.

PRODUCTS AVAILABLE FROM THIS SURVEY

Maps are available of the aeromagnetic, 7200 Hz coplanar resistivity data, and 900 Hz coplanar resistivity data. Most of the maps for the southern Delta River area were produced at 1:63,360 scale (1 inch = 1 mile, fig. 2).

Aeromagnetic maps with electromagnetic (EM) anomalies were produced at **1:63,360-scale** with simplified EM symbols and 1:31,680-scale (1 inch = ½ mile; fig. 3) **with** detailed EM symbols (1 inch = ½ mile; fig. 3).

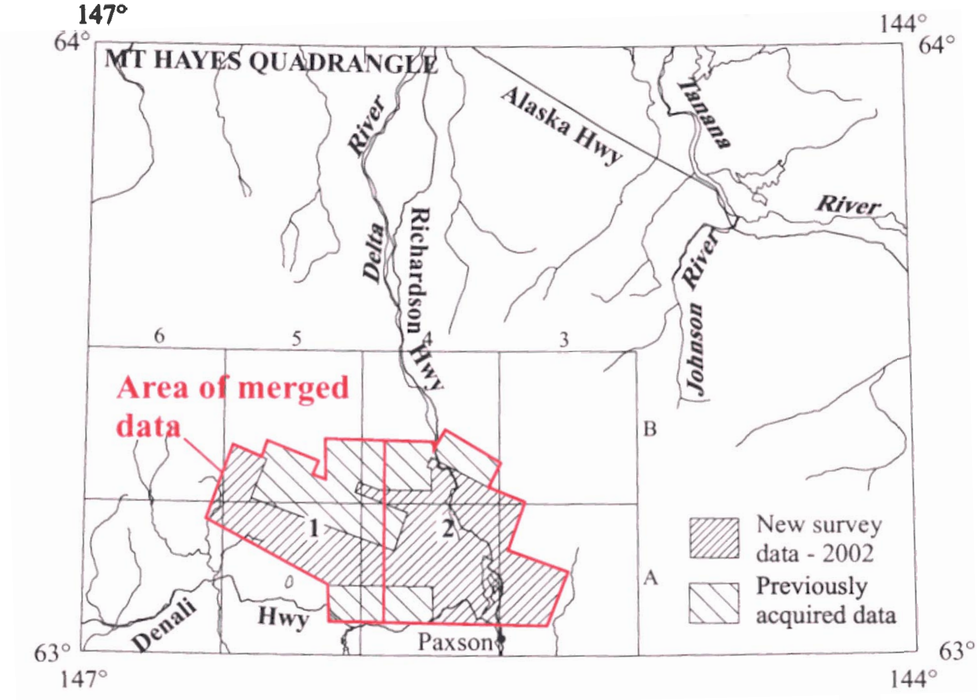

Figure 2. **Index** *map* showing **area** of data acquisition (red outline) **superimposed** on parts of the Mt. Hayes Quadrangle. All 63,360-scale **maps** fit on two sheets.

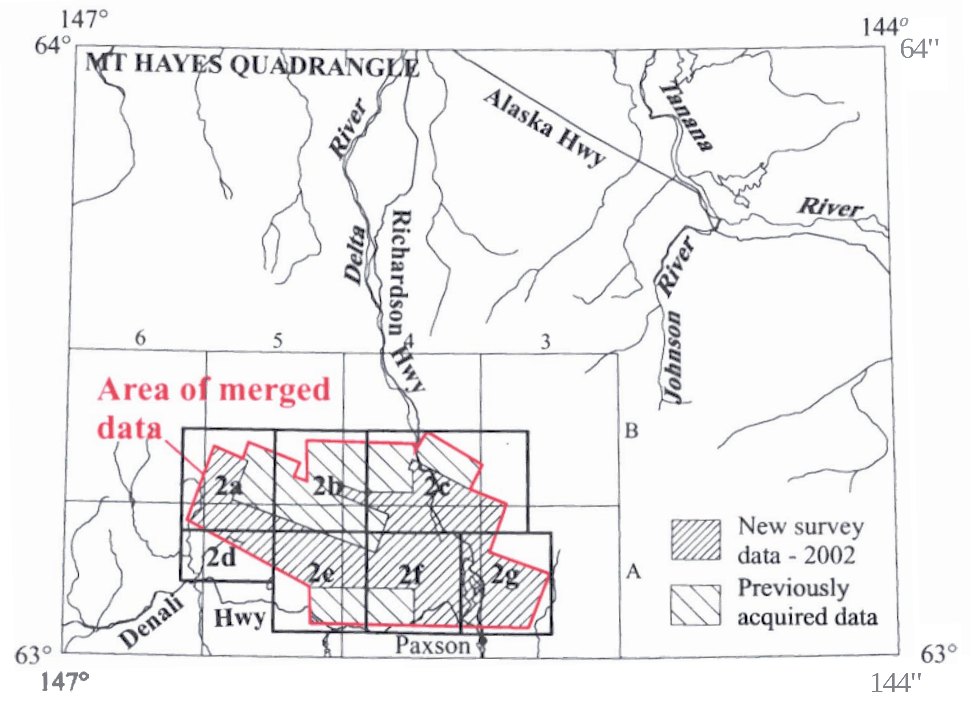

Figure 3. **Index** *map* for **aeromagnetic** maps available at **1:31,680** (1 inch = ½ mile) scale. **Only aeromagnetic** maps with detailed EM anomalies are available at this ***scale.*** **Seven** map sheets (marked 2a **through 2g**) are **used to** cover the area at 31,680-scale.

Data from this survey **are** available in two **CD-ROMS** and in **paper** maps (listed **near** the ***end*** of this publication). **The** CD-ROM GPR **2003_5** contains the 19 maps produced **from** this survey in both HPGL/2 format and postscript printer format. The HPGL2 plot files (prn printer file format) were made with an HP Designjet 2500 HPGL/2 printer driver v4.61 and must be plotted on an HP Designjet 2500. The postscript plot files (ps printer file format) were made with an Hewlett Packard Designjet 2500 Postscript 3 printer driver v5.0 and should plot on all Hewlett Packard plotters that can interpret postscript 3 files. GPR 2003–6 contains the processed line data, gridded data (magnetic data, 900 Hz, 7200 Hz, and 56,000 Hz coplanar apparent resistivity data, and a digital terrain model), data contour files, and detailed electromagnetic anomalies. The processed line data is in Geosoft Ascii format, the gridded data are in both Geosoft binary and ER Mapper format, and the vector files are in Autocad version 14 dxf files.

Survey history, instrumentation, & data processing

The following indented section describing the instrumentation and processing is modified from the metadata included on the CD-ROMS.

1995 survey:
The 1995 airborne geophysical data were acquired with an Aerodat five frequency configuration electromagnetic (EM) system and a Scintrex cesium magnetometer. The electromagnetic equipment recorded data slightly above 100 feet above ground level (AGL) and the magnetometer recorded data slightly above 150 feet AGL due to safety considerations. In addition, the survey recorded data from a radar altimeter, GPS navigation system, and video camera. Flights were performed with an AS350B-2 Squirrel helicopter at a mean terrain clearance slightly above 200 feet along survey flight lines with a spacing of one-eighth mile. The flight line direction varies among the blocks from 0° to N 30° E.

2002 survey:
The airborne 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 video camera. Flights were performed with an AS350B-2 Squirrel helicopter at a mean terrain clearance of 200 feet along NW-SE (340 degrees) survey flight lines with a spacing of one quarter mile. Tie lines were flown perpendicular to the flight lines at intervals of approximately 3 miles.

An Ashtech GG24 NAVSTAR/GLONASS Global Positioning System was used for navigation. The helicopter position was derived every 0.5 seconds using post-flight differential positioning to a relative accuracy of better than 5 m. Flight path positions were projected onto the Clarke 1866 (UTM zone 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.

The total magnetic field 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, 2000, updated to August 2002) was removed from the leveled magnetic data. The aeromagnetic data are interpolated onto a regular 100 m grid using a modified Akima (1970 technique.

The EM inphase and quadrature data are drift corrected using base level data collected at high altitude (areas of no signal). Along-line filters are applied to the data to remove spheric spikes. The data are inspected for variations in phase, and a phase correction is applied to the data if necessary. Resistivities are then calculated from the inphase and quadrature data for all frequencies based on a pseudo-layer half-space model. Manual leveling of the inphase and quadrature of each coil pair, based on the resistivity data and comparisons to the data from the other frequencies, is performed. Automated micro-leveling is carried out in areas of low signal. The resistivity data are then interpolated onto a regular 100 m grid using a modified Akima (1970) technique. The resulting grids are subjected to a 3x3 hanning filter before contouring and map production.

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.

Fraser, D.C., 1978, Resistivity mapping with an airborne multicoil electromagnetic system: Geophysics, v. 43, p.144-172.

Generalized information about aeromagnetic. electromagnetic, and radiometric data

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

Figures 4a and 4b show the aeromagnetic data for the survey area. The high values (in nT) 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.

Figure 4b shows the aeromagnetic data presented as "color shadow" maps where a simulated light source is shown on the three-dimensional 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). 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. 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 coplanar resistivity data are shown in Figures 5-7. The resistivity maps are produced from the EM coplanar coil pairs, and emphasize horizontal or near horizontal units and structures. Since ground penetration correlates inversely with frequency, the 56,000 Hz reflects very near surface rocks and the 900 Hz adds the influence of deeper rocks in general. The 7200 Hz in general reflects rocks between the two extremes. However, the depth of penetration is variable depending on the resistivity of the rocks the signal is passing through.

EM anomalies are shown with both the 1:63,360 and 1:31,680 scale magnetic maps. EM anomalies are derived from the coaxial coil pairs, which emphasize vertically- or near-vertically-dipping "discrete" bedrock conductors. These EM anomalies are shown as circular symbols along flight lines with the aeromagnetic contours. On the 1:63,360 scale maps, anomalies are subdivided into those with 1) a signal strength greater than 50 siemens, 2) a signal strength less than 50 siemens, and 3) weak conductivity associated with an EM magnetite response. Questionable (or possible) anomalies are also noted.

More detailed interpretations for the electromagnetic anomalies are shown on the **1:3**1,680 scale aeromagnetic maps. In these maps, the EM anomaly is shown as a symbol that denotes more information about signal strength and the anomaly source than on the **1:63,360** maps. Instead of two signal strengths (greater than or less than 50 siemens) shown on the **1:63,360** maps, signal strength on the **1:31,680** maps is broken into seven subdivisions **(e.g.** 5-10 siemens, 1-5 siemens, etc). In addition, potential sources shown for each symbol include **1)** bedrock conductors, 2) narrow bedrock conductors ("thin dike"), 3) conductive covers ("horizontal thin sheet"), 4) combination including broad conductive rock units, deep conductive weathering, and thick conductive cover, 5) edge of broad conductor, and 6) culture. This information is also available on the CD-ROMS. The project report, GPR 2003-7, gives a more detailed discussion of these EM anomalies.

DGGS PUBLICATIONS PRODUCED FOR THE SOUTHERN DELTA RIVER AREA

Bold font is used below to highlight the differences between the maps.

CD-ROMS

GPR 2003–5. Plot files of the airborne geophysical survey data of the southern Delta River area, east-central Alaska. 1 CD-ROM set. Contains the 19 maps listed below as **GPR2003_5_1** through **GPR2003_5_6** in both **HPGL/2** format and postscript printer format. The **HPGL2** plot files (prn printer file format) were made with an HP Designjet 2500 **HPGL/2** printer driver **v4.61** and must be plotted on an HP Designjet 2500. The postscript plot files (ps printer file format) were made with an Hewlett Packard Designjet 2500 Postscript 3 printer driver **v5.0** and should plot on all Hewlett Packmrd plotters that can interpret postscript 3 files.

GPR 2003–6. Line, gridded, and vector data of airborne geophysical survey data for the southern Delta River area, east-central Alaska. 1 CD-ROM set. Line data in ASCII format; gridded data in Geosoft and ER Mapper format; vector files in **Autocad** 14 dxf files.

AEROMAGNETIC MAPS

GPR 2003–5–la. Total magnetic field of the southern Delta River area, east-central Alaska, 2 sheets, scale **1:63,360.** Topography included. Full-color plot **from** electronic file, 600 dpi.

GPR **2003_5_1b.** Total magnetic field of the southern Delta River area, east-central, Alaska, 2 sheets, scale **1:63,360.** Magnetic contours and section lines included. Pull-color plot from electronic file, 600 dpi.

GPR **2003_5_1c.** Color shadow magnetic map of the southern Delta River area, east-central Alaska, 2 sheets, scale **1:63,360.** Full-color plot from electronic file, 600 dpi.

GPR 2003–5–Id. Total magnetic field and electromagnetic anomalies of the southern Delta River area, **east-**central Alaska, 2 sheets, scale **1:63,360.** Magnetic contours, simplified electromagnetic anomalies, and section lines included. Black and white plot from electronic file, 600 dpi.

GPR **2003_5_2a.** Total magnetic field and detailed electromagnetic anomalies of the southern Delta River area, east-central Alaska, 1 sheet, scale **1:31,680** (parts of Mt. Hayes A-5, A-6, B-5, and B-6 Quadrangles). Magnetic contours, detailed electromagnetic anomalies, and topography included. Black and white plot from electronic file, 600 dpi.

GPR **2003_5_2b.** Total magnetic field and detailed electromagnetic anomalies of the southern Delta River area, east-central Alaska, 1 sheet, scale **1:31,680** (parts of Mt. Hayes A-4, A-5, B-4, and B-5 Quadrangles).

Magnetic contours, detailed electromagnetic anomalies, and topography included. Black and white plot from electronic file, **600** dpi.

GPR **2003_5_2c.** Total magnetic field and detailed electromagnetic anomalies of the southern Delta River area, east-central Alaska, 1 sheet, scale **1:31,680** (parts of Mt. Hayes A-3, A-4, B-3, and B-4 Quadrangles). Magnetic contours, detailed electromagnetic anomalies, and topography included. Black and white plot from electronic file, **600** dpi.

GPR **2003_5_2d.** Total magnetic field and detailed electromagnetic anomalies of the southern Delta River area, east-central Alaska, 1 sheet, scale **1:31,680** (parts of Mt. Hayes A-5 and A-6 Quadrangles). Magnetic contours, detailed electromagnetic anomalies, and topography included. Black and white plot from electronic file, **600** dpi.

GPR **2003_5_2e.** Total magnetic field and detailed electromagnetic anomalies of the southern Delta River area, east-central Alaska, 1 sheet, scale **1:31,680** (parts of Mt. Hayes A-4 and A-5 Quadrangles). Magnetic contours, detailed electromagnetic anomalies, and topography included. Black and white plot from electronic file, **600** dpi.

GPR **2003_5_2f.** Total magnetic field and detailed electromagnetic anomalies of the southern Delta River area, east-central Alaska, 1 sheet, scale **1:31,680** (parts of Mt. Hayes A-4 Quadrangle). Magnetic contours, detailed electromagnetic anomalies, and topography included. Black and white plot from electronic file, **600** dpi.

GPR **2003_5_2g.** Total magnetic field and detailed electromagnetic anomalies of the southern Delta River area, east-central Alaska, 1 sheet, scale **1:31,680** (parts of Mt. Hayes A-3 and A-4 Quadrangles). Magnetic contours, detailed electromagnetic anomalies, and topography included. Black and white plot from electronic file, **600** dpi.

RESISTIVITY MAPS

GPR **2003_5_3a.** 7200 Hz coplanar resistivity of the southern Delta River area, east-central Alaska, 2 sheets, scale **1:63,360.** Topography included. Full-color plot from electronic file, **600** dpi.

GPR **2003_5_3b.** 7200 Hz coplanar resistivity of the southern Delta River area, east-central Alaska, 2 sheets, scale **1:63,360.** Resistivity contours and section lines included. Full-color plot from electronic file, **600** dpi.

GPR **2003_5_3c.** 7200 Hz coplanar resistivity of the southern Delta River area, east-central Alaska, 2 sheets, scale **1:63,360.** Resistivity contours and section lines included. Black and white plot **from** electronic file, **600** dpi

GPR **2003_5_4a.** 900 Hz coplanar resistivity of the southern Delta River area, east-central Alaska, 2 sheets, scale **1:63,360.** Topography included. Full-color plot from electronic file, **600** dpi.

GPR **2003_5_4b.** 900 Hz coplanar resistivity of the southern Delta River area, east-central Alaska, 2 sheets, scale **1:63,360.** Resistivity contours and section lines included. Full-color plot from electronic file, **600** dpi.

GPR **2003_5_4c.** 900 Hz coplanar resistivity of the southern Delta River area, east-central Alaska, 2 sheets, scale **1:63,360.** Resistivity contours and section lines included. Black and white plot from electronic file, **600** dpi.

PROJECT REPORT, PORTFOLIO, FLIGHT LINES, AND DEM

GPR **2003_5_5a.** Flight lines of the southern Delta River area, east-central Alaska, 2 sheets, scale **1:63,360.** Topography included. Black and white plot from electronic file, **600** dpi.

GPR **2003_5_6a.** Digital elevation model of the southern Delta River area, east-central Alaska, 2 sheets, scale

1:63,360. Produced from survey altimetry. Color plot from electronic file, 600 dpi.

GPR 2003–7. Project report of the airborne geophysical survey of the southern Delta River area, east-central Alaska, by Ruth Pritchard, Fugro Airborne Surveys, 2003, scale 1:63,360.

GPR 2003_8. Portfolio of aeromagnetic and resistivity maps of the southern Delta River area, east-central Alaska. **Includes color and shadow maps. Maps fit 8½" x 11" sheet.**

SELECTED REFERENCES FOR THE SOUTHERN DELTA RIVER AREA

Online links current at the time of this publication are provided when known. DGGS data on the web is either in PDF format (reports) or Mr. SID format (maps).

GEOPHYSICAL DATA

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http://wwwdggs.dnr.state.ak.us/scan1/aof/text/AOF010.PDF 130 KB
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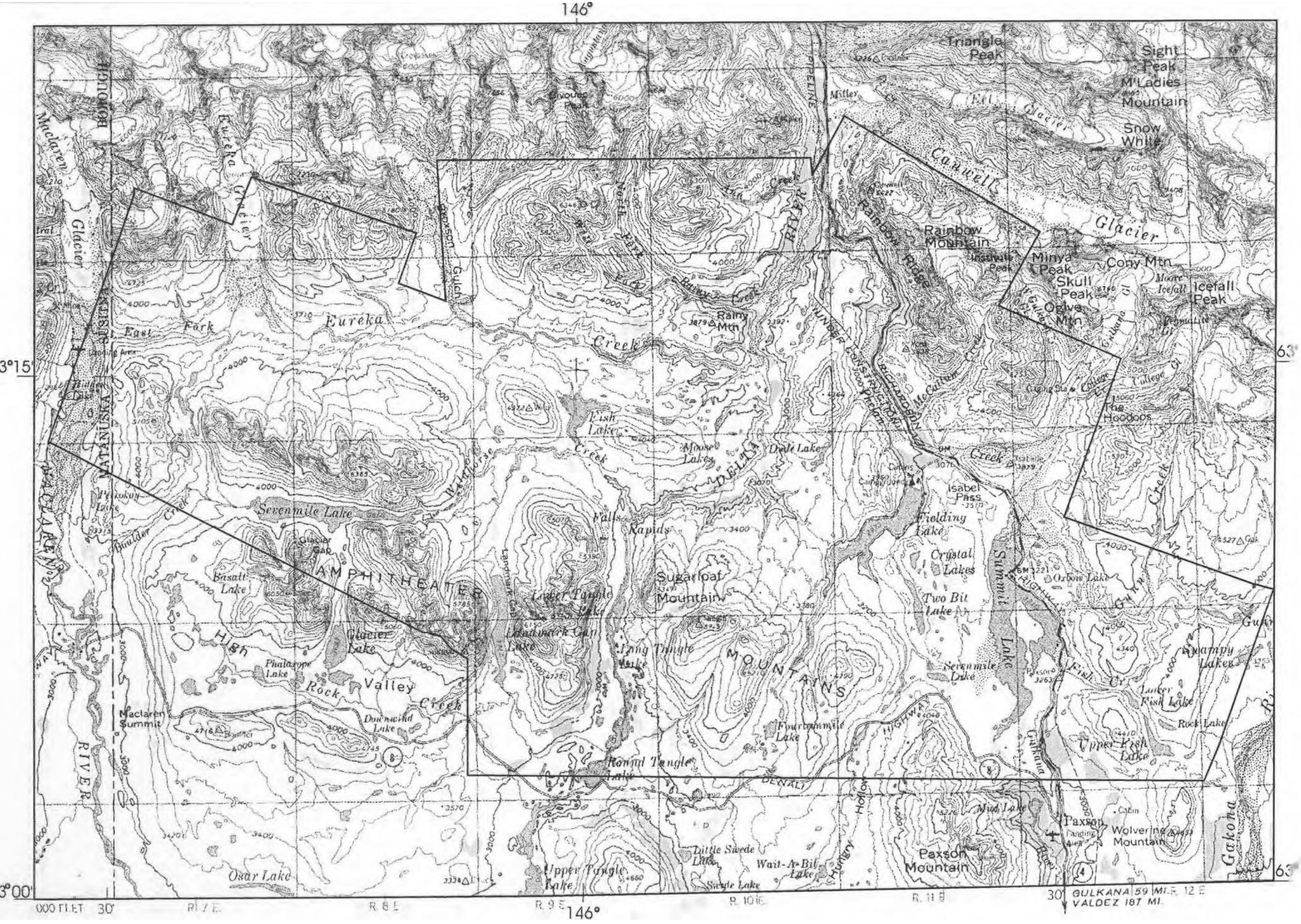
146°
146°
63°15'
63°00'
30'
30'
Triangle Peak
Sight Peak
M'Ladies Mountain
Snow White
Eel Glacier
Canwell Glacier
Rainbow Mountain
Rainbow Ridge
Institute Peak
Minya Peak
Skull Peak
Ogive Mtn
Cony Mtn
Icefall Peak
The Hoodoos
College Gl
Bivouac Peak
Eureka Glacier
Maclaren Glacier
PIPELINE
RIVER
Miller
Ann Creek
North Fork
Rainy Creek
Rainy Mtn
Eureka Creek
East Fork
Dickey Gulch
BOROUGH
MATANUSKA SUSITNA
MACLAREN
Fish Lake
Moose Lakes
Dale Lake
DELTA
Whistle Creek
Sevenmile Lake
Boulder Creek
Glacier Gap
Basalt Lake
AMPHITHEATER
Falls
Rapids
Sugarloaf Mountain
Lower Tangle Lake
Landmark Gap Lake
Long Tangle Lake
MOUNTAINS
High Rock Valley Creek
Glacier Lake
Phalarope Lake
Maclaren Summit
Downwind Lake
Round Tangle Lake
DENALI
HIGHWAY
Fourmile Lake
McCallum Creek
RICHARDSON
Isabel Pass
Fielding Lake
Crystal Lakes
Two Bit Lake
Summit Lake
Sevenmile Lake
Gulkana
Fish Cr
Swampy Lakes
Lower Fish Lake
Rock Lake
Upper Fish Lake
Mud Lake
Paxson
Paxson Mountain
Wolverine Mountain
Gakona
Little Swede Lake
Wait-A-Bit Lake
Swede Lake
Hungry Hollow
Upper Tangle Lake
Osar Lake
RIVER
R. 7 E.
R. 8 E.
R. 9 E.
R. 10 E.
R. 11 E.
R. 12 E.
GULKANA 59 MI.
VALDEZ 187 MI.

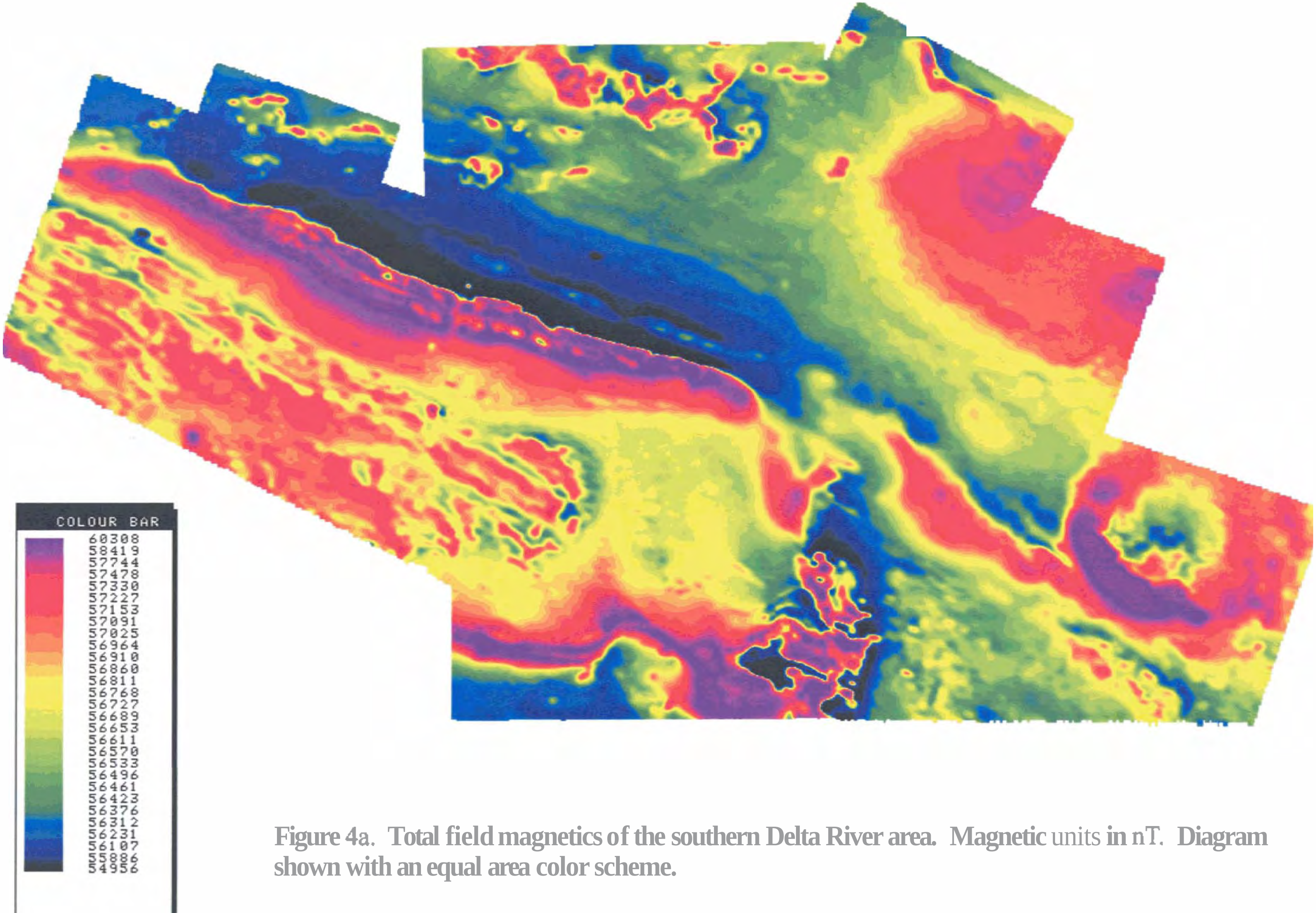

Figure 4a. Total field magnetics of the southern Delta River area. Magnetic units **in** nT. **Diagram shown with an equal area color scheme.**

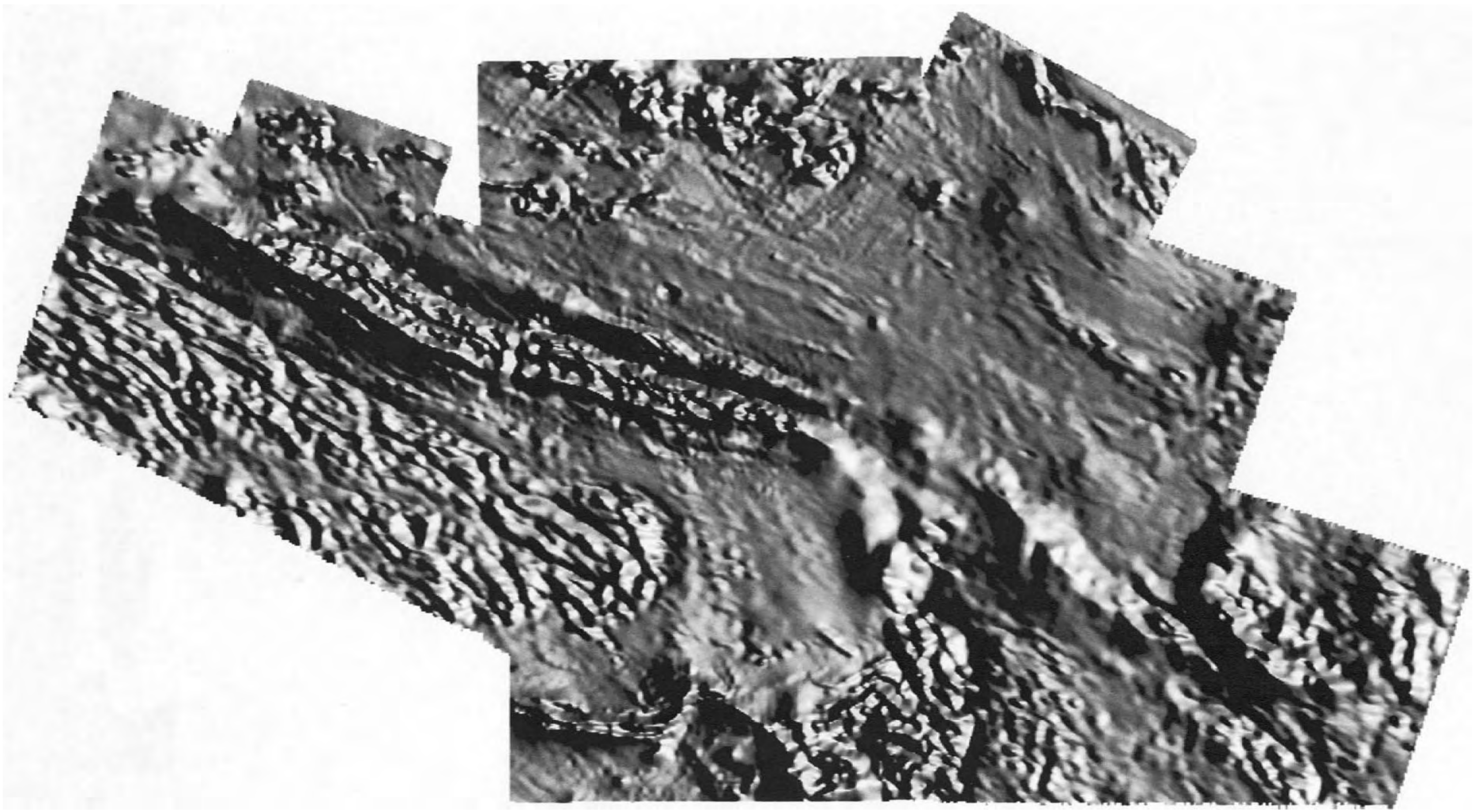

Figure 4b. Shadow map of the total field magnetics of the southern Delta River area. Illumination from N80E.

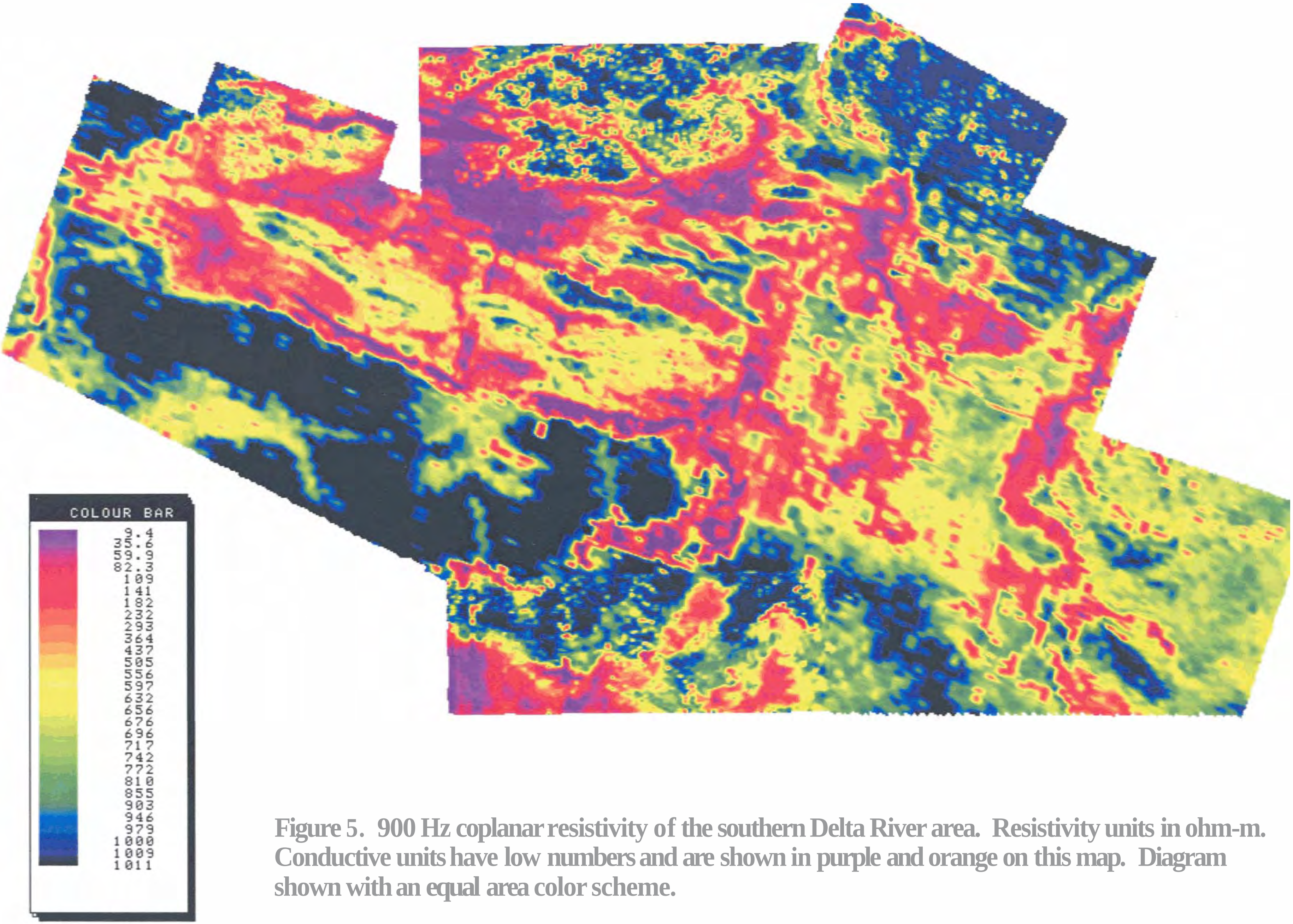

Figure 5. 900 Hz coplanar resistivity of the southern Delta River area. Resistivity units in ohm-m. Conductive units have low numbers and are shown in purple and orange on this map. Diagram shown with an equal area color scheme.

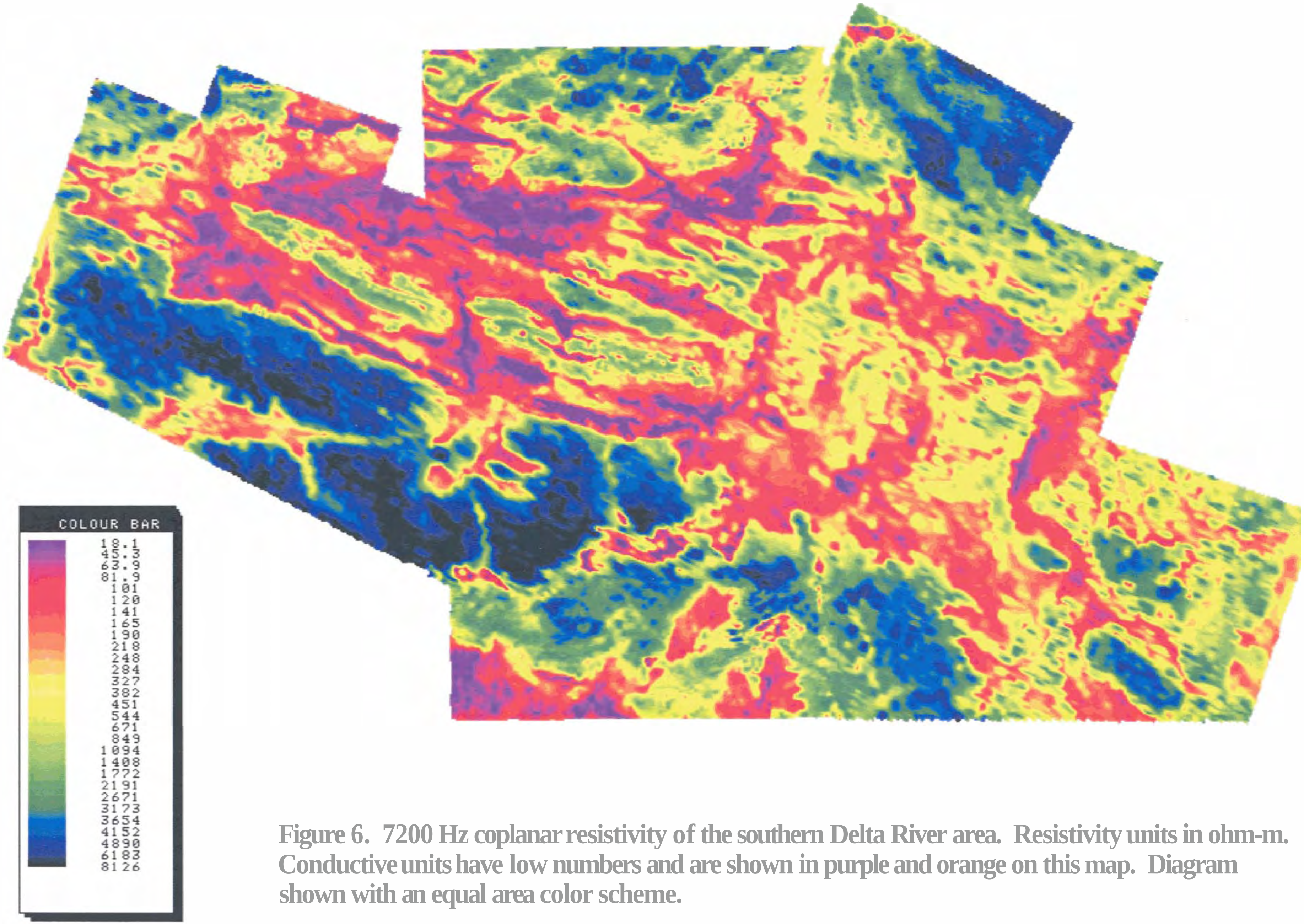

Figure 6. 7200 Hz coplanar resistivity of the southern Delta River area. Resistivity units in ohm-m. Conductive units have low numbers and are shown in purple and orange on this map. Diagram shown with an equal area color scheme.

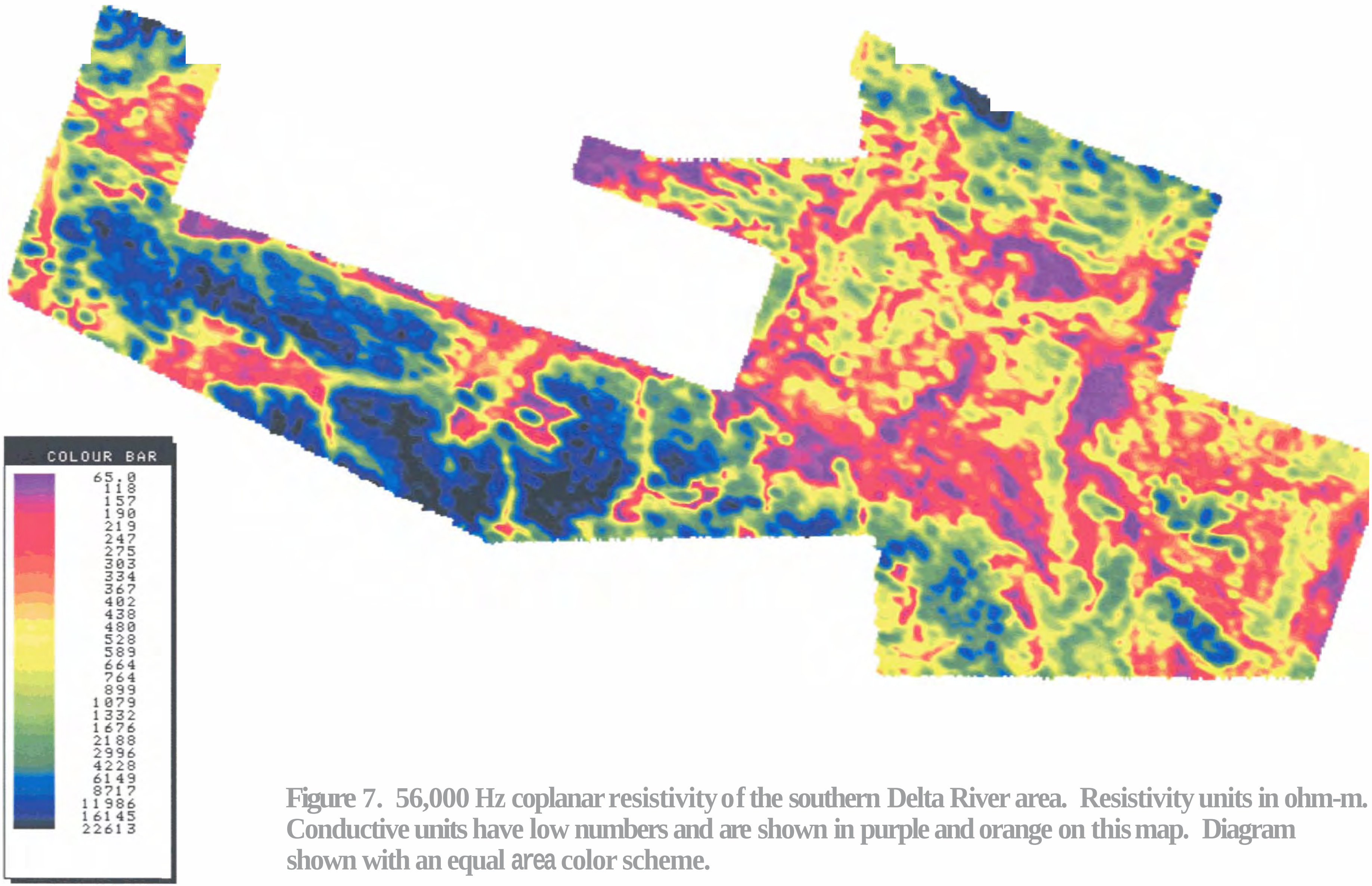

Figure 7. 56,000 Hz coplanar resistivity of the southern Delta River area. Resistivity units in ohm-m. Conductive units have low numbers and are shown in purple and orange on this map. Diagram shown with an equal area color scheme.