Division of Geological & Geophysical Surveys

GEOPHYSICAL REPORT 1999-13

PORTFOLIO OF AEROMAGNETIC AND RESISTIVITY MAPS OF THE KETCHIKAN AREA, SOUTHEAST ALASKA

by

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PORTFOLIO OF AEROMAGNETIC AND RESISTIVITY MAPS OF THE KETCHIKAN AREA, SOUTHEAST ALASKA

Data from airborne geophysical surveys covering approximately 785 square miles of Prince of Wales and Gravina islands near Ketchikan (fig. 1) were released in 1999 by the Alaska Division of Geological & Geophysical Surveys (DGGS). The project was initiated by the U.S. Department of the Interior, Bureau of Land Management (BLM), and funded mainly by BLM and the Ketchikan Gateway Borough. Other contributors included Sealaska Corporation, Alaska State Mental Health Land Office, and the Cities of Coffman Cove and Helm Bay. DGGS monitored the geophysical contract and released the data to the public.

Geoterrex-Dighem acquired the data for all portions of the survey area. Data for most of the area were acquired in 1999 under contract between DGGS and WGM, Inc. Data for portions of the area were acquired in 1991 and 1992 by Sealaska Corporation, who contributed this previously unpublished data to the project.

Figure 1. Location of Ketchikan survey area.

The airborne geophysical information consists of aeromagnetic data and resistivity data at 900, 7200, and 56,000 Hz. Maps were made of the aeromagnetic data and the 7200 and 56,000 Hz coplanar resistivity data. The 900 Hz coplanar resistivity data is included on the CD-ROM (GPR 1999-15). This portfolio briefly describes and contains generalized page-size color maps of the data. Two black & white shadow maps of the aeromagnetic maps and an acetate overlay of the topography are also included. GPR 1999-17, the project report by Geoterrex-Dighem, 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 area surveyed includes parts of the Craig A-1, A-2, A-3, B-1, B-2, B-3, B-4, C-1, C-2, the Dixon Entrance C-3, D-2, D-3, and D-4, and the Ketchikan A-5, A-6, 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 the Bureau of Land Management Offices in Juneau and at DNR's Public Information Center in Anchorage. Custom plots of variations of the data can be made at any scale at the DGGS office for a reasonable fee.

Most of the maps for the Ketchikan survey were produced at 1:63,360 scale (1 inch = 1 mile; fig. 2). Aeromagnetic maps with electromagnetic (EM) anomalies are released at both the 1:63,360 and the 1:31,680 scale (1 inch = ½ mile; fig. 3). The difference between these maps is that more information about the EM anomalies is given on the 1:31,680 scale maps than on the 1:63,360 scale maps. The EM anomalies are discussed below in the section "Generalized information about aeromagnetic and electromagnetic data," under the subtitle "Resistivity Data."

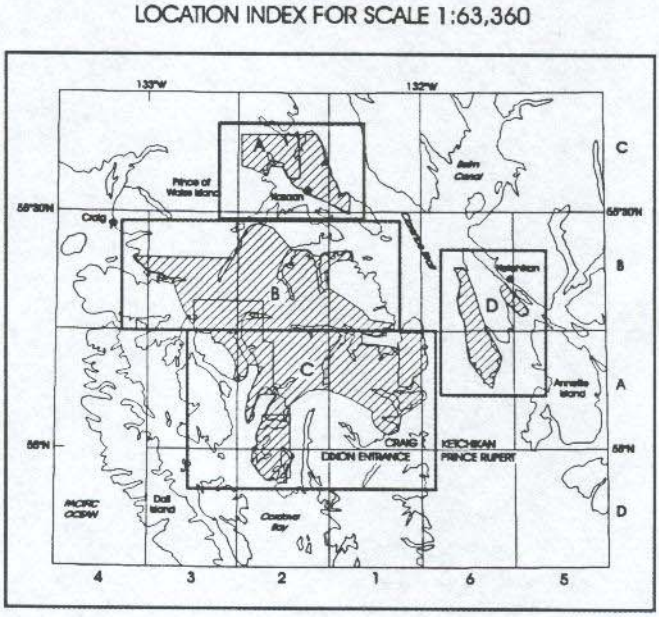

Figure 2. Index map for aeromagnetic and resistivity maps that are available at 1:63,360 (1 inch = 1 mile) scale.

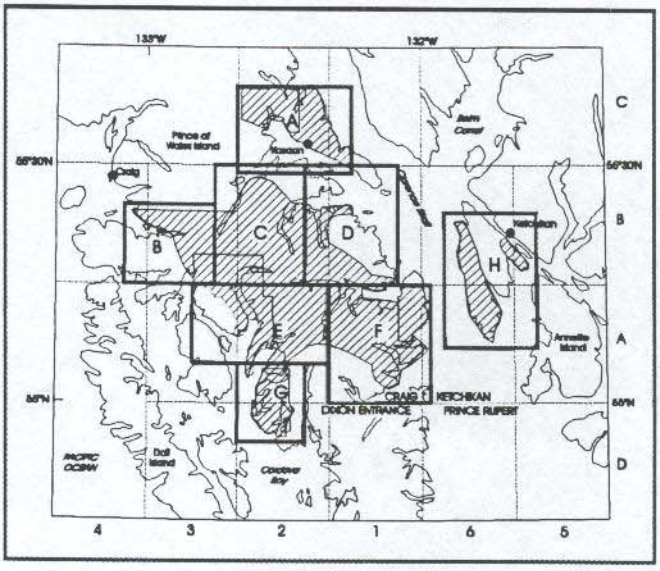

Figure 3. Index map for aeromagnetic maps available at 1:31,680 (1 inch = ½ mile) scale. Only aeromagnetic maps with detailed EM anomalies are available at this scale.

Survey history, instrumentation, & data processing

The following indented section describing the instrumentation and processing is modified from the maps produced by Burns and others (1999).

> The airborne geophysical data for the Ketchikan area were compiled and processed under contract between the State of Alaska, Department of Natural Resources, Division of Geological & Geophysical Surveys, and WGM, Mining and Geological Consultants, Inc. Airborne geophysical data for most of the area were acquired by Geoterrex-Dighem, a division of CGG Canada Ltd., in 1999 (fig. 4). Geophysical data for areas 1-3 in Figure 4 were provided by Sealaska Corporation and were merged with the new geophysical data. These three older surveys were flown by Geoterrex-Dighem in 1991 and 1992.

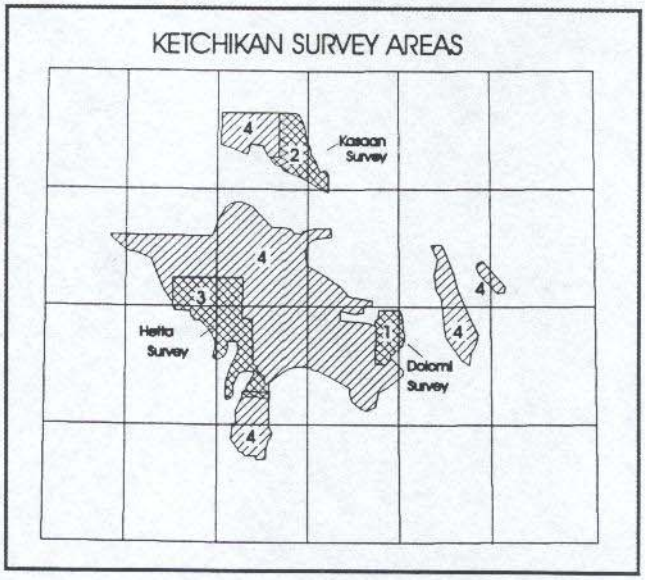

Figure 4. Index map showing older survey areas (1-3) and survey area flown in 1999 (4).

> A GPS navigation system was used for location with the data acquired in 1999. Navigation in the earlier surveys (areas 1-3) was accomplished with a Del Norte UHF electronic positioning system. Because this system is not as accurate as GPS data, the positional accuracy of the data in areas 1-3 must be considered of low reliability. An additional problem, caused by an error on the U.S. Geological Survey Craig C-2 topographic map, caused distortion of the positioning of the original data in area 2.
>
> The data for areas 2 and 4 (fig. 4) were acquired with a DIGHEM^{V} Electromagnetic (EM) system, while data for areas 1 and 3 were acquired with a DIGHEM^{IV} EM System. The DIGHEM^{V} EM system contains one more frequency (5500 Hz coaxial) than the DIGHEM^{IV} EM System. The DIGHEM^{V} EM system is also able to record more sensitive readings.
>
> The equipment was installed in AS350B-2 (area 4) and AS350B-1 (areas 1-3) Squirrel helicopters. In addition, the survey recorded data from a radar altimeter, 50/60 Hz monitors, and a video camera.

For area 4, flights were performed at a mean terrain clearance of 200 feet along survey flight lines with a spacing of a quarter of a mile. Flight direction was north-south in the northern portion and east-west for the southern portion. Tie lines were flown perpendicular to the flight lines at intervals of approximately three miles.

For areas 1-3, mean terrain clearance for the magnetometer and EM system was approximately 213 and 164 feet, respectively. The flight lines were flown with one-eight mile line spacing. Further details about the surveys are included in GPR 1999-17.

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 March 1999) 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 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. For the 900 and 7200 Hz resistivity maps, the resistivity is generated from the inphase and quadrature component of the coplanar 900 and 7200 Hz respectively using the pseudo-layer half space model. The data were interpolated onto a regular 25 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.

Generalized information about aeromagnetic and electromagnetic 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.

Figure 5 shows 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.

Figures 6 and 7 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). Shadow maps can enhance structures, such as faults, intrusions, and the trend of stratigraphic layers. Figures 6 and 7 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 8 and 9. Since ground penetration correlates inversely with frequency, the 56,000 Hz reflects very near surface rocks and the 7200 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 ranges in the color bars of these figures differ, each figure has the most conductive rocks shown as purple and orange.

EM anomalies are shown in both the 1:63,360 and 1:31,680 scale 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 1:31,680 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-ROM. The project report, GPR 99-17, gives a more detailed discussion of these EM anomalies.

Notes about aeromagnetic and electromagnetic data of the Ketchikan area

The color schemes used in the 1:63,360 scale full color aeromagnetic maps show more detail for each area than is shown in Figure 5. Three different color schemes, based on 1) Map A, 2) Maps B and C, and 3) Map D, are used for the full size maps. The primary reason for the different color scales is the tremendous range of data values (over 8000 nT) represented in the western portions of the area. Using the different color schemes allows important information about each area to be shown.

In contrast, to show detail in the areas with lower magnetism in Figure 5, all values over about 57,000 nT are shown as magenta. The three magenta-colored areas contain a wide range of values. The Salt Chuck ultramafic body causes the northernmost positive anomaly, on Map A. Magnetic values generally range between 61,000 and 63,500 nT for this area. The other two large magenta-colored areas, southern part of Map B and northern part of Map C, generally range in values from 59,000 to 61,000 nT, with the northern area being more magnetic. Magnetic plutons probably cause these anomalies.

The 7200 and 56,000 Hz coplanar resistivity maps (figs. 8 and 9) show little difference using these color schemes at page size. As with the aeromagnetic maps, different color scales are used for full sized maps of Map A, Maps B and C, and Map D. Differences, more subtle than those in the aeromagnetic maps, are apparent at full scale between the 7200 and 56,000 Hz resistivities. Regardless of the color schemes used, the saltwater and the saltwater-saturated areas dominate the conductive colors in both the 7200 and 56,000 Hz resistivity maps.

DGGS publications produced for the Ketchikan area survey

Bold font is used below to highlight the differences between the maps. Scanned topography used for these maps is not as clearly defined as the photographic topography.

AEROMAGNETIC MAPS

GPR 1999-1A. Total field **magnetics** of selected areas near Ketchikan, southeastern Alaska—**Map A** (Salt Chuck and Kasaan Peninsula, Prince of Wales Island), 1 sheet, **scale 1:63,360. Scanned topography included. Full-color** plot from electronic file, 600 dpi. Made on request.

GPR 1999-1B. Total field **magnetics** of selected areas near Ketchikan, southeastern Alaska—**Map B** (Surveyed area immediately north of 55° 15', Prince of Wales Island), 1 sheet, **scale 1:63,360. Scanned topography included. Full-color** plot from electronic file, 600 dpi. Made on request.

GPR 1999-1C. Total field **magnetics** of selected areas near Ketchikan, southeastern Alaska—**Map C** (Surveyed area south of 55° 15', Prince of Wales Island), 1 sheet, **scale 1:63,360. Scanned topography included. Full-color** plot from electronic file, 600 dpi. Made on request.

GPR 1999-1D. Total field **magnetics** of selected areas near Ketchikan, southeastern Alaska—**Map D** (Western and eastern parts, Gravina Island), 1 sheet, **scale 1:63,360. Scanned topography included. Full-color** plot from electronic file, 600 dpi. Made on request.

GPR 1999-5A. Total field **magnetics and electromagnetic anomalies** of selected areas near Ketchikan, southeastern Alaska—**Map A** (Salt Chuck and Kasaan Peninsula, Prince of Wales Island), 1 sheet, **scale 1:63,360. Clear diazo film. Magnetic contours and section lines included**. Made on request.

GPR 1999-5B. Total field **magnetics and electromagnetic anomalies** of selected areas near Ketchikan, southeastern Alaska—**Map B** (Surveyed area immediately north of 55° 15', Prince of Wales Island), 1 sheet, **scale 1:63,360. Clear diazo film. Magnetic contours and section lines included**. Made on request.

GPR 1999-5C. Total field **magnetics and electromagnetic anomalies** of selected areas near Ketchikan, southeastern Alaska—**Map C** (Surveyed area south of 55° 15', Prince of Wales Island), 1 sheet, **scale 1:63,360. Clear diazo film. Magnetic contours and section lines included**. Made on request.

GPR 1999-5D. Total field **magnetics and electromagnetic anomalies** of selected areas near Ketchikan, southeastern Alaska—**Map D** (Western and eastern parts, Gravina Island), 1 sheet, **scale 1:63,360. Clear diazo film. Magnetic contours and section lines included**. Made on request.

GPR 1999-6A. Total field **magnetics and electromagnetic anomalies** of selected areas near Ketchikan, southeastern Alaska—**Map A** (Salt Chuck and Kasaan Peninsula, Prince of Wales Island), 1 sheet, **scale 1:63,360. Blueline. Magnetic contours and section lines included**.

GPR 1999-6B. Total field **magnetics and electromagnetic anomalies** of selected areas near Ketchikan, southeastern Alaska—**Map B** (Surveyed area immediately north of 55° 15', Prince of Wales Island), 1 sheet, **scale 1:63,360. Blueline. Magnetic contours and section lines included**.

GPR 1999-6C. Total field **magnetics and electromagnetic anomalies** of selected areas near Ketchikan, southeastern Alaska—**Map C** (Surveyed area south of 55° 15', Prince of Wales Island), 1 sheet, **scale 1:63,360. Blueline. Magnetic contours and section lines included**.

GPR 1999-6D. Total field **magnetics and electromagnetic anomalies** of selected areas near Ketchikan, southeastern Alaska—**Map D** (Western and eastern parts, Gravina Island), 1 sheet, **scale 1:63,360. Blueline. Magnetic contours and section lines included.**

GPR 1999-9A. Total field **magnetics** of selected areas near Ketchikan, southeastern Alaska—**Map A** (Salt Chuck and Kasaan Peninsula, Prince of Wales Island), 1 sheet, **scale 1:63,360. Magnetic contours and section lines included. Full-color** plot from electronic file, 600 dpi. Made on request.

GPR 1999-9B. Total field **magnetics** of selected areas near Ketchikan, southeastern Alaska—**Map B** (Surveyed area immediately north of 55° 15', Prince of Wales Island), 1 sheet, **scale 1:63,360. Magnetic contours and section lines included. Full-color** plot from electronic file, 600 dpi. Made on request.

GPR 1999-9C. Total field **magnetics** of selected areas near Ketchikan, southeastern Alaska—**Map C** (Surveyed area south of 55° 15', Prince of Wales Island), 1 sheet, **scale 1:63,360. Magnetic contours and section lines included. Full-color** plot from electronic file, 600 dpi. Made on request.

GPR 1999-9D. Total field **magnetics** of selected areas near Ketchikan, southeastern Alaska—**Map D** (Western and eastern parts, Gravina Island), 1 sheet, **scale 1:63,360. Magnetic contours and section lines included. Full-color** plot from electronic file, 600 dpi. Made on request.

GPR 1999-10A. Color shadow magnetic map of selected areas near Ketchikan, southeastern Alaska—**Map A** (Salt Chuck and Kasaan Peninsula, Prince of Wales Island), 1 sheet, **scale 1:63,360. Section lines included.**

GPR 1999-10B. Color shadow magnetic map of selected areas near Ketchikan, southeastern Alaska—**Map B** (Surveyed area immediately north of 55° 15', Prince of Wales Island), 1 sheet, **scale 1:63,360. Section lines included.**

GPR 1999-10C. Color shadow magnetic map of selected areas near Ketchikan, southeastern Alaska—**Map C** (Surveyed area south of 55° 15', Prince of Wales Island), 1 sheet, **scale 1:63,360. Section lines included.**

GPR 1999-10D. Color shadow magnetic map of selected areas near Ketchikan, southeastern Alaska—**Map D** (Western and eastern parts, Gravina Island), 1 sheet, **scale 1:63,360. Section lines included.**

GPR 1999-16A. Total field **magnetics and detailed electromagnetic anomalies** of selected areas near Ketchikan, southeastern Alaska, 1 sheet, **scale 1:31,680 (parts of Craig C-1 and C-2 quadrangles). Blueline. Magnetic contours and section lines included.**

GPR 1999-16B. Total field **magnetics and detailed electromagnetic anomalies** of selected areas near Ketchikan, southeastern Alaska, 1 sheet, **scale 1:31,680 (parts of Craig B-3 and B-4 quadrangles). Blueline. Magnetic contours and section lines included.**

GPR 1999-16C. Total field **magnetics and detailed electromagnetic anomalies** of selected areas near Ketchikan, southeastern Alaska, 1 sheet, **scale 1:31,680 (parts of Craig B-2 and B-3 quadrangles). Blueline. Magnetic contours and section lines included.**

GPR 1999-16D. Total field **magnetics and detailed electromagnetic anomalies** of selected areas near Ketchikan, southeastern Alaska, 1 sheet, **scale 1:31,680 (parts of Craig B-1 and B-2 quadrangles). Blueline. Magnetic contours and section lines included.**

GPR 1999-16E. Total field **magnetics and detailed electromagnetic anomalies** of selected areas near Ketchikan, southeastern Alaska, 1 sheet, **scale 1:31,680 (parts of Craig A-2 and A-3 quadrangles). Blueline. Magnetic contours and section lines included.**

GPR 1999-16F. Total field **magnetics and detailed electromagnetic anomalies** of selected areas near Ketchikan, southeastern Alaska, 1 sheet, **scale 1:31,680 (parts of Craig A-1 and Ketchikan A-6 quadrangles). Blueline. Magnetic contours and section lines included.**

GPR 1999-16G. Total field **magnetics and detailed electromagnetic anomalies** of selected areas near Ketchikan, southeastern Alaska, 1 sheet, **scale 1:31,680 (parts of Craig A-2 and Dixon Entrance D-2 quadrangles). Blueline. Magnetic contours and section lines included.**

GPR 1999-16H. Total field **magnetics and detailed electromagnetic anomalies** of selected areas near Ketchikan, southeastern Alaska, 1 sheet, **scale 1:31,680 (parts of Ketchikan A-6, B-5, and B-6 quadrangles). Blueline. Magnetic contours and section lines included.**

RESISTIVITY MAPS

GPR 1999-2A. 56,000 Hz coplanar resistivity of selected areas near Ketchikan, southeastern Alaska—**Map A** (Salt Chuck and Kasaan Peninsula, Prince of Wales Island), 1 sheet, **scale 1:63,360. Scanned topography included. Full-color** plot from electronic file, 600 dpi. Made on request.

GPR 1999-2B. 56,000 Hz coplanar resistivity of selected areas near Ketchikan, southeastern Alaska—**Map B** (Surveyed area immediately north of 55° 15', Prince of Wales Island), 1 sheet, **scale 1:63,360. Scanned topography included. Full-color** plot from electronic file, 600 dpi. Made on request.

GPR 1999-2C. 56,000 Hz coplanar resistivity of selected areas near Ketchikan, southeastern Alaska—**Map C** (Surveyed area south of 55° 15', Prince of Wales Island), 1 sheet, **scale 1:63,360. Scanned topography included. Full-color** plot from electronic file, 600 dpi. Made on request.

GPR 1999-2D. 56,000 Hz coplanar resistivity of selected areas near Ketchikan, southeastern Alaska—**Map D** (Western and eastern parts, Gravina Island), 1 sheet, **scale 1:63,360. Scanned topography included. Full-color** plot from electronic file, 600 dpi. Made on request.

GPR 1999-3A. 7200 Hz coplanar resistivity of selected areas near Ketchikan, southeastern Alaska—**Map A** (Salt Chuck and Kasaan Peninsula, Prince of Wales Island), 1 sheet, **scale 1:63,360. Scanned topography included. Full-color** plot from electronic file, 600 dpi. Made on request.

GPR 1999-3B. 7200 Hz coplanar resistivity of selected areas near Ketchikan, southeastern Alaska—**Map B** (Surveyed area immediately north of 55° 15', Prince of Wales Island), 1 sheet, **scale 1:63,360. Scanned topography included. Full-color** plot from electronic file, 600 dpi. Made on request.

GPR 1999-3C. 7200 Hz coplanar resistivity of selected areas near Ketchikan, southeastern Alaska—**Map C** (Surveyed area south of 55° 15', Prince of Wales Island), 1 sheet, **scale 1:63,360. Scanned topography included. Full-color** plot from electronic file, 600 dpi. Made on request.

GPR 1999-3D. 7200 Hz coplanar resistivity of selected areas near Ketchikan, southeastern Alaska—**Map D** (Western and eastern parts, Gravina Island), 1 sheet, **scale 1:63,360. Scanned topography included. Full-color** plot from electronic file, 600 dpi. Made on request.

GPR 1999-7A. 56,000 Hz coplanar resistivity of selected areas near Ketchikan, southeastern Alaska—**Map A** (Salt Chuck and Kasaan Peninsula, Prince of Wales Island), 1 sheet, **scale 1:63,360. Blueline. Resistivity contours and section lines included**.

GPR 1999-7B. 56,000 Hz coplanar resistivity of selected areas near Ketchikan, southeastern Alaska—**Map B** (Surveyed area immediately north of 55° 15', Prince of Wales Island), 1 sheet, **scale 1:63,360. Blueline. Resistivity contours and section lines included**.

GPR 1999-7C. 56,000 Hz coplanar resistivity of selected areas near Ketchikan, southeastern Alaska, **Map C** (Surveyed area south of 55° 15', Prince of Wales Island), 1 sheet, **scale 1:63,360. Blueline. Resistivity contours and section lines included**.

GPR 1999-7D. 56,000 Hz coplanar resistivity of selected areas near Ketchikan, southeastern Alaska—**Map D** (Western and eastern parts, Gravina Island), 1 sheet, **scale 1:63,360. Blueline. Resistivity contours and section lines included**.

GPR 1999-8A. 7200 Hz coplanar resistivity of selected areas near Ketchikan, southeastern Alaska—**Map A** (Salt Chuck and Kasaan Peninsula, Prince of Wales Island), 1 sheet, **scale 1:63,360. Blueline. Resistivity contours and section lines included**.

GPR 1999-8B. 7200 Hz coplanar resistivity of selected areas near Ketchikan, southeastern Alaska—**Map B** (Surveyed area immediately north of 55° 15', Prince of Wales Island), 1 sheet, **scale 1:63,360. Blueline. Resistivity contours and section lines included**.

GPR 1999-8C. 7200 Hz coplanar resistivity of selected areas near Ketchikan, southeastern Alaska—**Map C** (Surveyed area south of 55° 15', Prince of Wales Island), 1 sheet, **scale 1:63,360. Blueline. Resistivity contours and section lines included**.

GPR 1999-8D. 7200 Hz coplanar resistivity of selected areas near Ketchikan, southeastern Alaska—**Map D** (Western and eastern parts, Gravina Island), 1 sheet, **scale 1:63,360. Blueline. Resistivity contours and section lines included**.

GPR 1999-11A. 56,000 Hz coplanar resistivity of selected areas near Ketchikan, southeastern Alaska—**Map A** (Salt Chuck and Kasaan Peninsula, Prince of Wales Island), 1 sheet, **scale 1:63,360. Resistivity contours and section lines included. Full-color plot** from electronic file, 600 dpi. Made on request.

GPR 1999-11B. 56,000 Hz coplanar resistivity of selected areas near Ketchikan, southeastern Alaska—**Map B** (Surveyed area immediately north of 55° 15', Prince of Wales Island), 1 sheet, **scale 1:63,360. Resistivity contours and section lines included. Full-color plot** from electronic file, 600 dpi. Made on request.

GPR 1999-11C. 56,000 Hz coplanar resistivity of selected areas near Ketchikan, southeastern Alaska—**Map C** (Surveyed area south of 55° 15', Prince of Wales Island), 1 sheet, **scale 1:63,360. Resistivity contours and section lines included. Full-color plot** from electronic file, 600 dpi. Made on request.

GPR 1999-11D. 56,000 Hz coplanar resistivity of selected areas near Ketchikan, southeastern Alaska—**Map D** (Western and eastern parts, Gravina Island), 1 sheet, **scale 1:63,360. Resistivity contours and section lines included. Full-color plot** from electronic file, 600 dpi. Made on request.

GPR 1999-12A. 7200 Hz coplanar resistivity of selected areas near Ketchikan, southeastern Alaska—**Map A** (Salt Chuck and Kasaan Peninsula, Prince of Wales Island), 1 sheet, **scale 1:63,360. Resistivity contours and section lines included. Full-color plot** from electronic file, 600 dpi. Made on request.

GPR 1999-12B. 7200 Hz coplanar resistivity of selected areas near Ketchikan, southeastern Alaska—**Map B** (Surveyed area immediately north of 55° 15', Prince of Wales Island), 1 sheet, **scale 1:63,360. Resistivity contours and section lines included. Full-color plot** from electronic file, 600 dpi. Made on request.

GPR 1999-12C. 7200 Hz coplanar resistivity of selected areas near Ketchikan, southeastern Alaska—**Map C** (Surveyed area south of 55° 15', Prince of Wales Island), 1 sheet, **scale 1:63,360. Resistivity contours and section lines included. Full-color plot** from electronic file, 600 dpi. Made on request.

GPR 1999-12D. 7200 Hz coplanar resistivity of selected areas near Ketchikan, southeastern Alaska—**Map D** (Western and eastern parts, Gravina Island), 1 sheet, **scale 1:63,360. Resistivity contours and section lines included. Full-color plot** from electronic file, 600 dpi. Made on request.

DIGITAL FILES, PROJECT REPORT, PORTFOLIO, AND FLIGHT LINES

GPR 1999-4A. Flight lines of selected areas near Ketchikan, southeastern Alaska—**Map A** (Salt Chuck and Kasaan Peninsula, Prince of Wales Island), 1 sheet, **scale 1:63,360. Blueline. Photographic topography** included.

GPR 1999-4B. Flight lines of selected areas near Ketchikan, southeastern Alaska—**Map B** (Surveyed area immediately north of 55° 15', Prince of Wales Island), 1 sheet, **scale 1:63,360. Blueline. Photographic topography** included.

GPR 1999-4C. Flight lines of selected areas near Ketchikan, southeastern Alaska—**Map C** (Surveyed area south of 55° 15', Prince of Wales Island), 1 sheet **scale 1:63,360. Blueline. Photographic topography** included.

GPR 1999-4D. Flight lines of selected areas near Ketchikan, southeastern Alaska—**Map D** (Western and eastern parts, Gravina Island), 1 sheet, **scale 1:63,360. Blueline. Photographic topography** included.

GPR 1999-13. Portfolio of aeromagnetic and resistivity maps of selected areas near Ketchikan, southeastern Alaska. Includes **color and shadow maps**. Maps fit **8½" x 11" sheets**.

GPR 1999-14. Zip disk containing **gridded files and section lines** of **geophysical survey data** for Ketchikan area, parts of the Craig, Dixon Entrance, and Ketchikan quadrangles, southeastern Alaska.

GPR 1999-15. CD-ROM containing **profiledata, gridded data, and section lines** of **geophysical survey data** for Ketchikan area, parts of the Craig, Dixon Entrance, and Ketchikan quadrangles, southeastern Alaska.

GPR 1999-17. Project report of the **airborne geophysical survey** for the **Ketchikan area**, southeastern Alaska.

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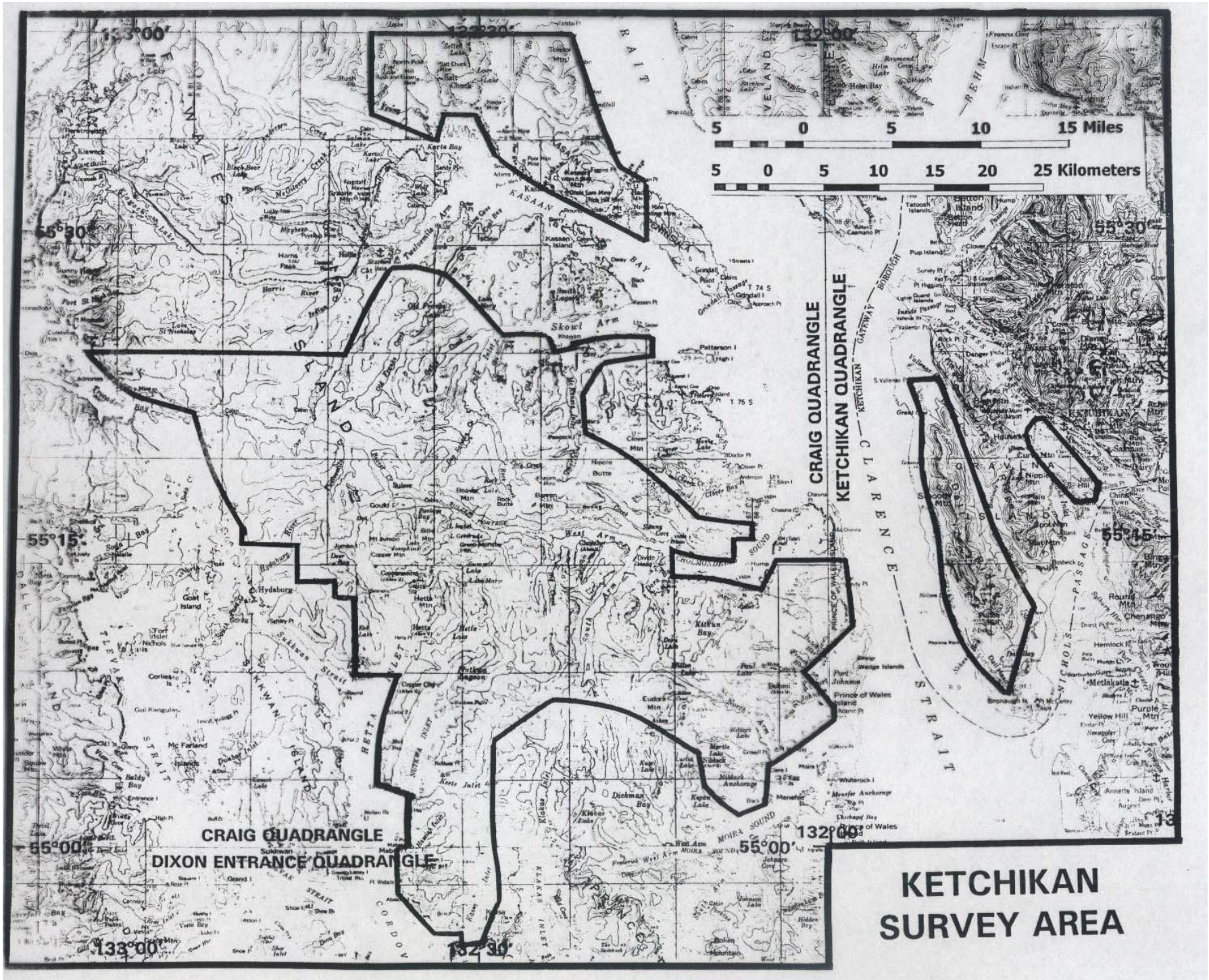

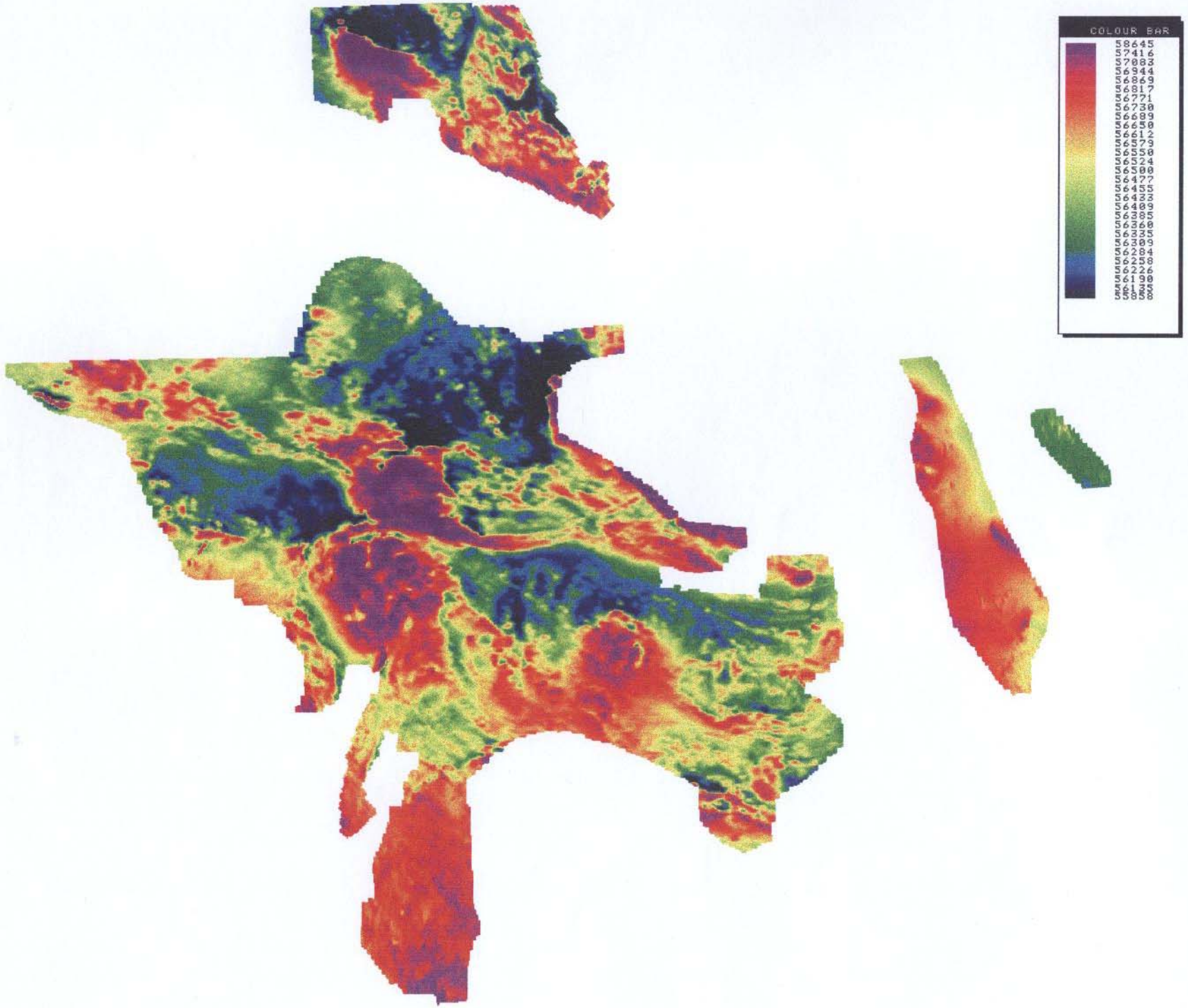

Figure 5: Total field magnetics of the Ketchikan area, southeast Alaska. Magnetic units are in nT.

Figure 6: Shadow map of the aeromagnetic data from the Ketchikan area, Southeast Alaska. Illumination source is at 45 degrees. High magnetic values appear like the tops of mountains that are hit by sunlight.

Figure 7: Shadow map of the aeromagnetic data from the Ketchikan area, Southeast Alaska. Illumination source is at 315 degrees. High magnetic values appear like the tops of mountains that are hit by sunlight.

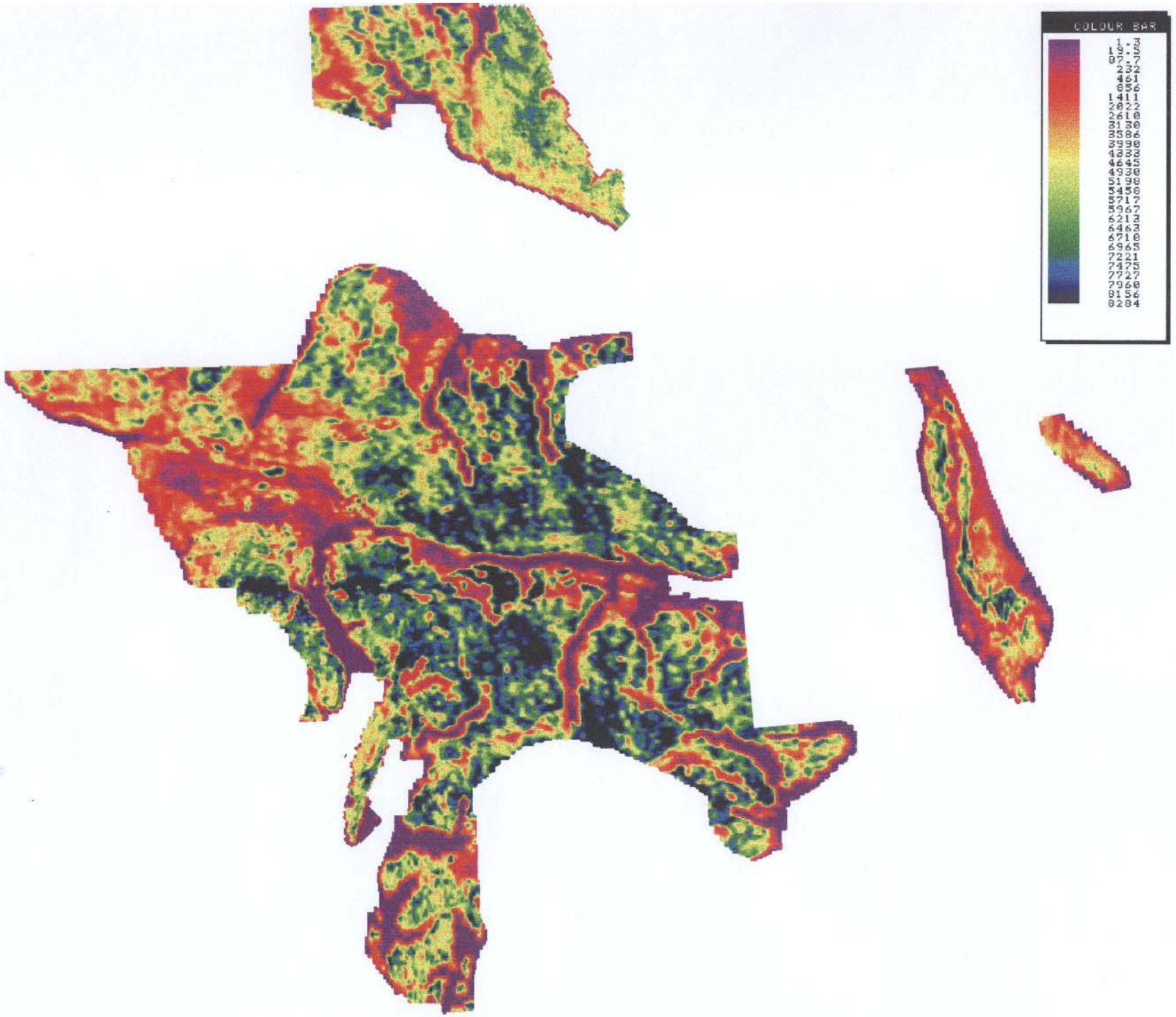

Figure 8: 7200 Hz coplanar resistivity of the Ketchikan area, southeast Alaska. Resistivity values in ohm-m. Conductive units have low numbers and are shown in purple and orange on this map.

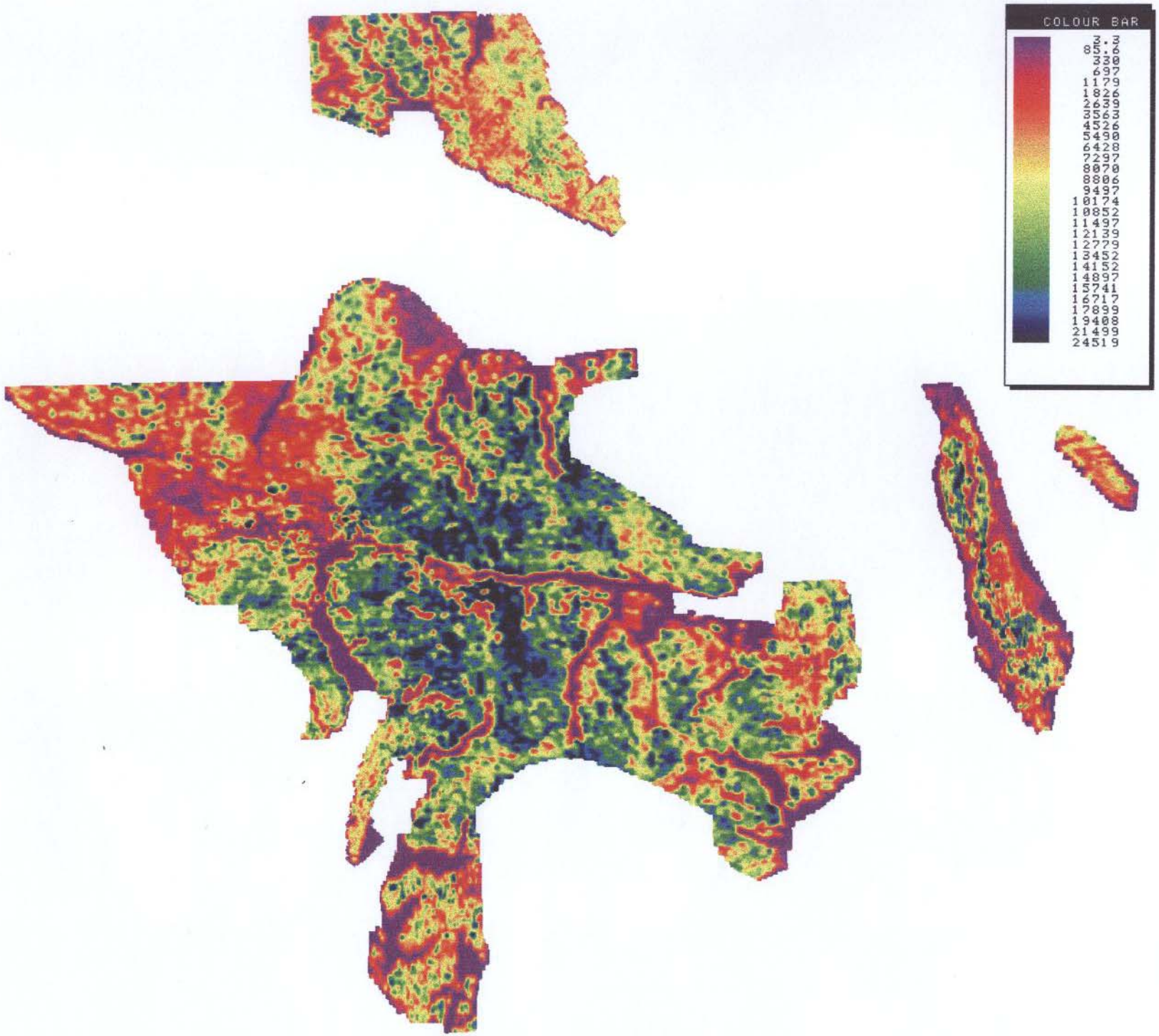

Figure 9: 56,000 Hz coplanar resistivity of the Ketchikan area, southeast Alaska. Resistivity values in ohm-m. Conductive units have low numbers and are shown in purple and orange on this map.