



Click this icon in corner to read speaker notes, at date of publication Mozilla Firefox (presentation mode) provides the best note and slide viewing

Exploration, Mapping, Environmental Monitoring, Infrastructure Planning

Alaska Division of Geological & Geophysical Surveys' Geophysics Program
Abraham Emond



contributors: Gina Graham, Alicja Wypych, Melanie Werdon, Steve Masterman, and DGGS staff

Why airborne geophysics?

- Mapping by DGGS
- Regional questions
- Mineral exploration targeting
- Infrastructure and environment
- “Modern” data coverage
- Survey planning/challenges



Alaska Division of Geological & Geophysical Surveys Mission

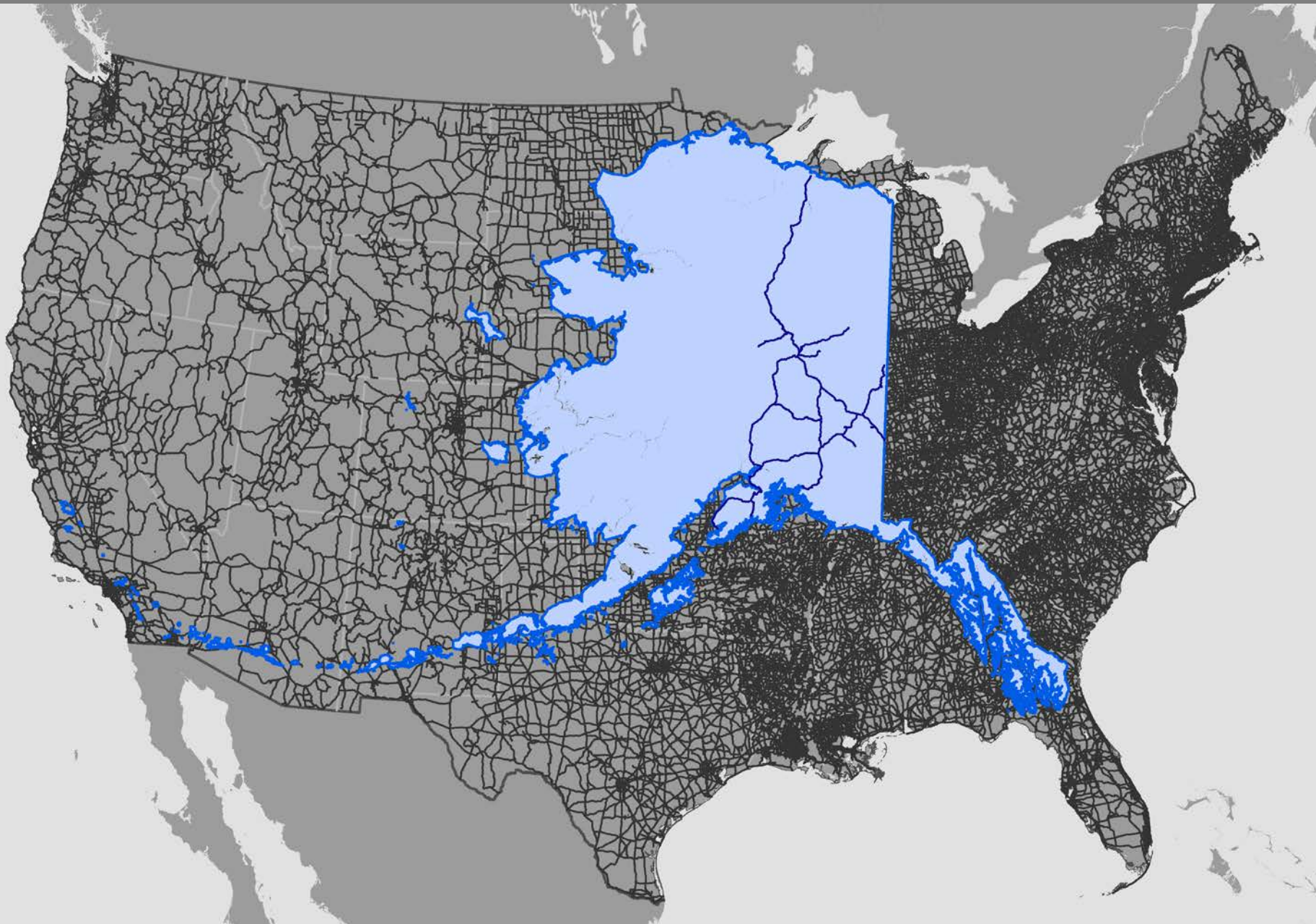


Powers and duties.

...the state geologist may acquire, by gift or purchase, geological and geophysical reports, surveys, and similar information...

More information at: <http://dggs.alaska.gov/about-us/alaska-statutes.php>

Large and Roadless





Excellent Exposure



Photo by: L. Lande



Beautiful Outcrop??

Photo by: A. Willingham



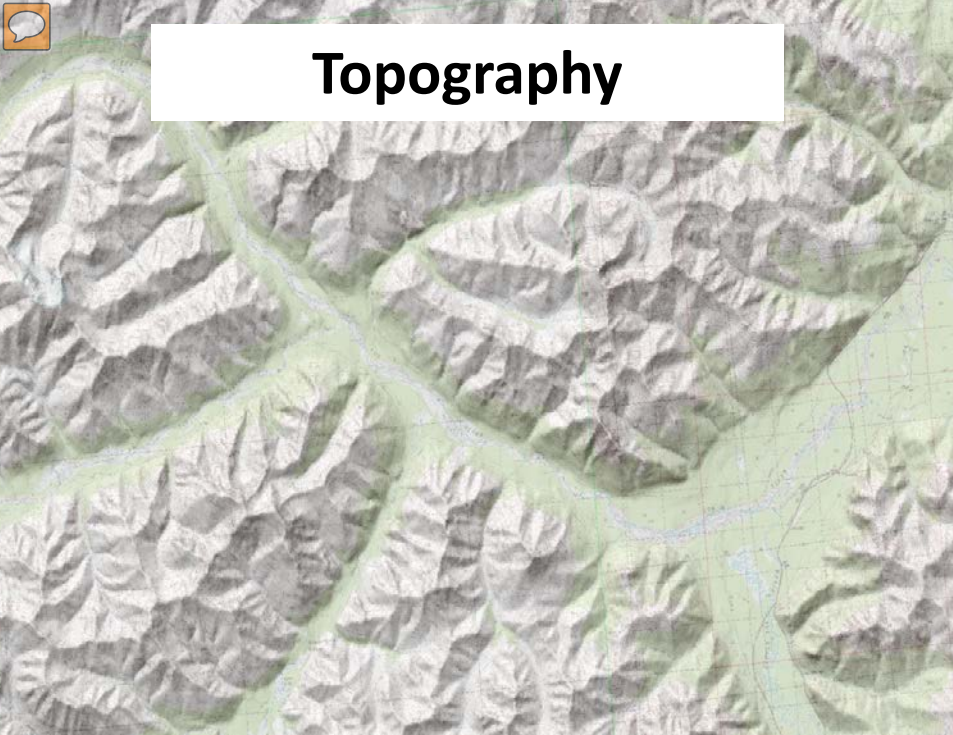
Photo by: A. Wypych



Photo by: K. Sicard

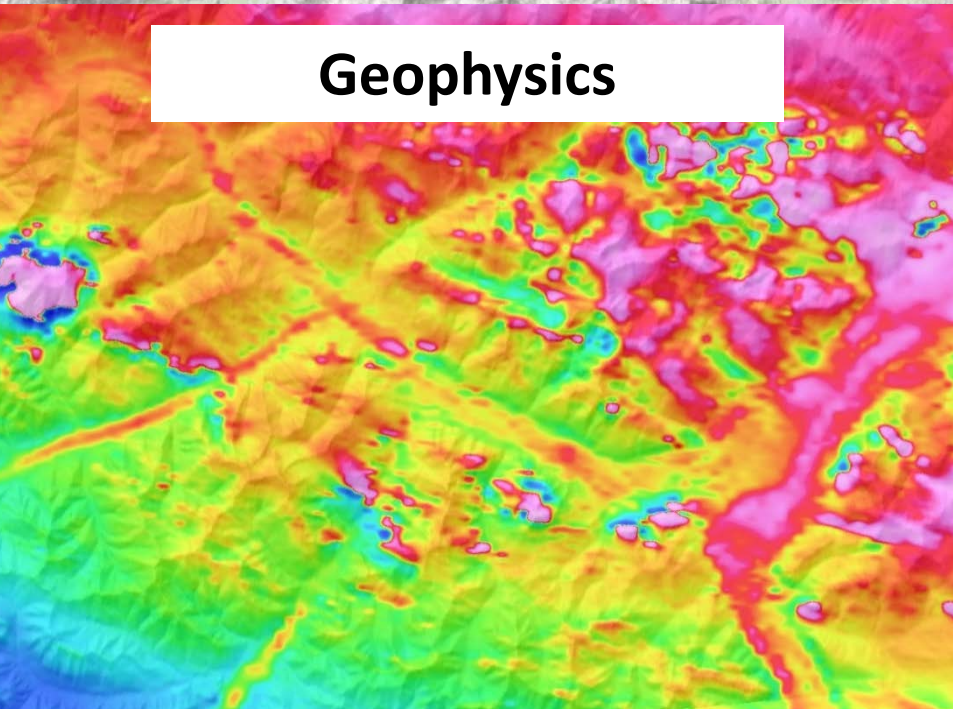


Topography

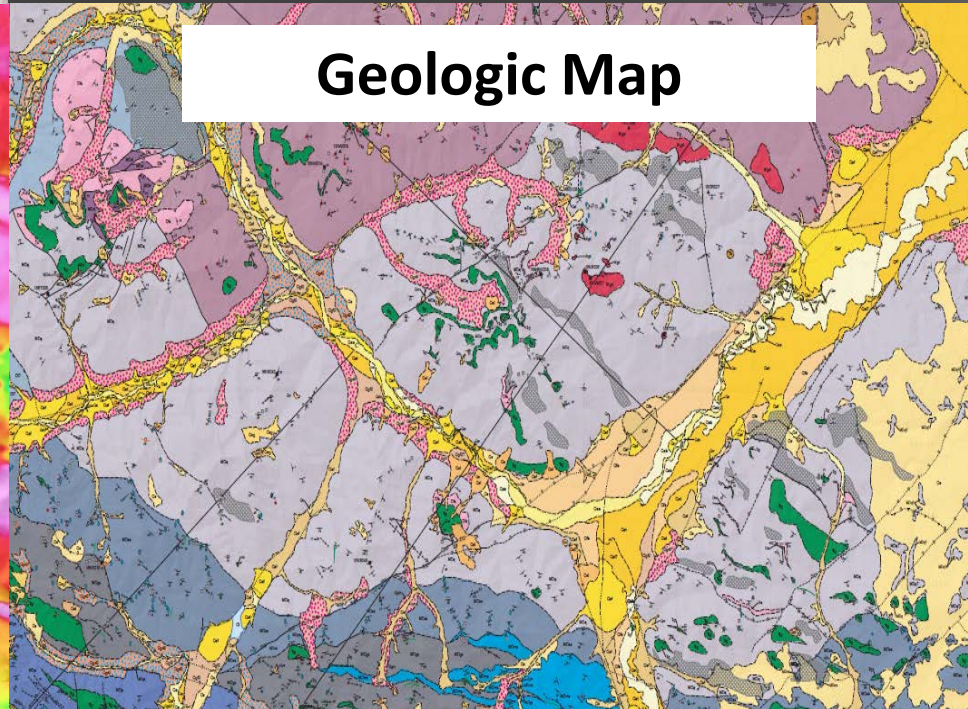


How does DGGS use
Airborne Geophysics?

Geophysics



Geologic Map





Field Stations

Station Planning and Field Observations

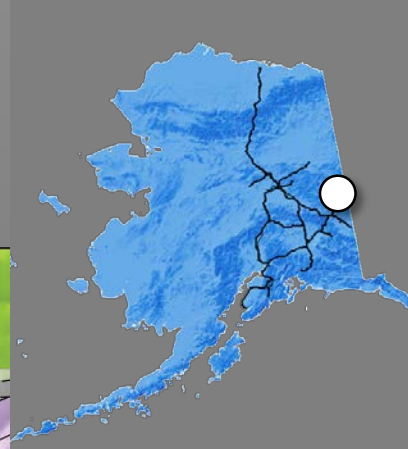
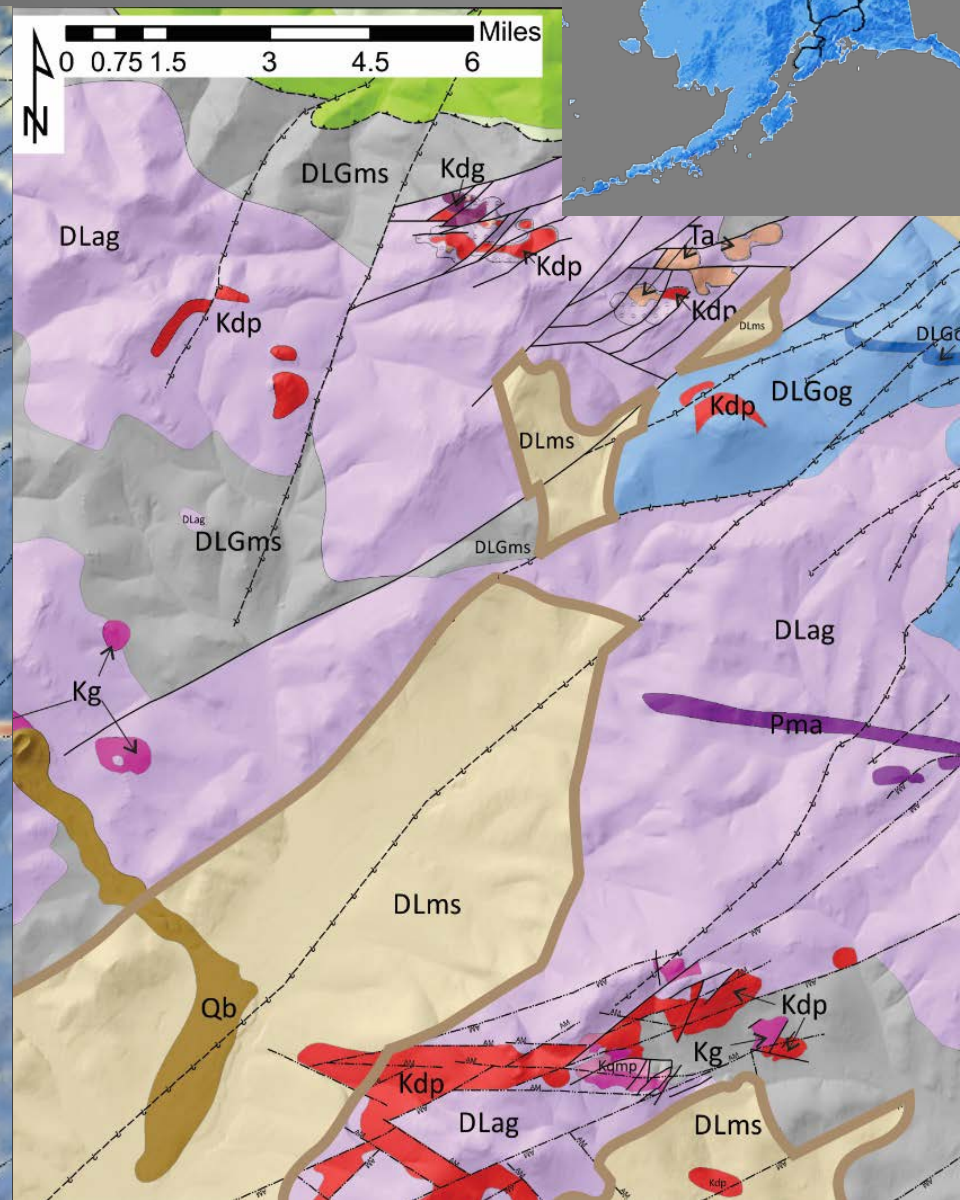
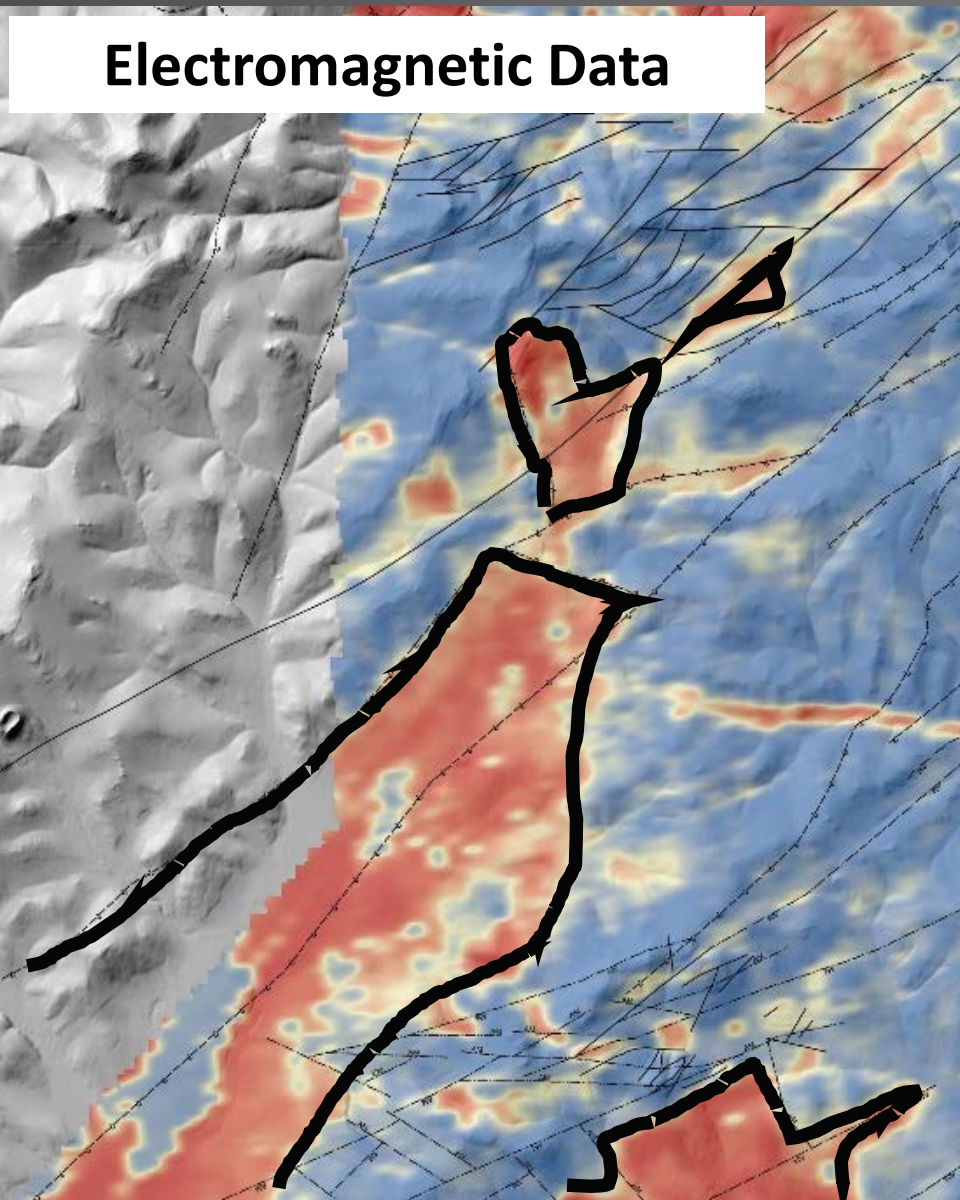


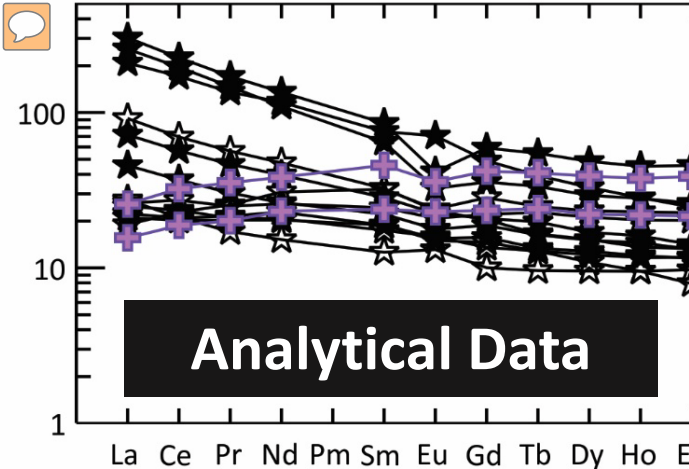
**GPS enabled
tablet**

**Magnetic
susceptibility
meter**

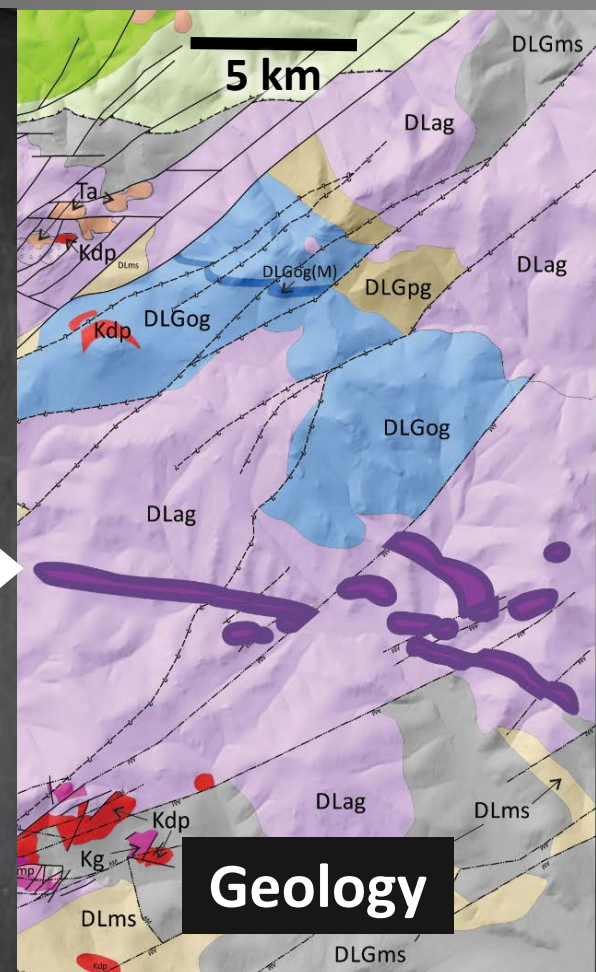
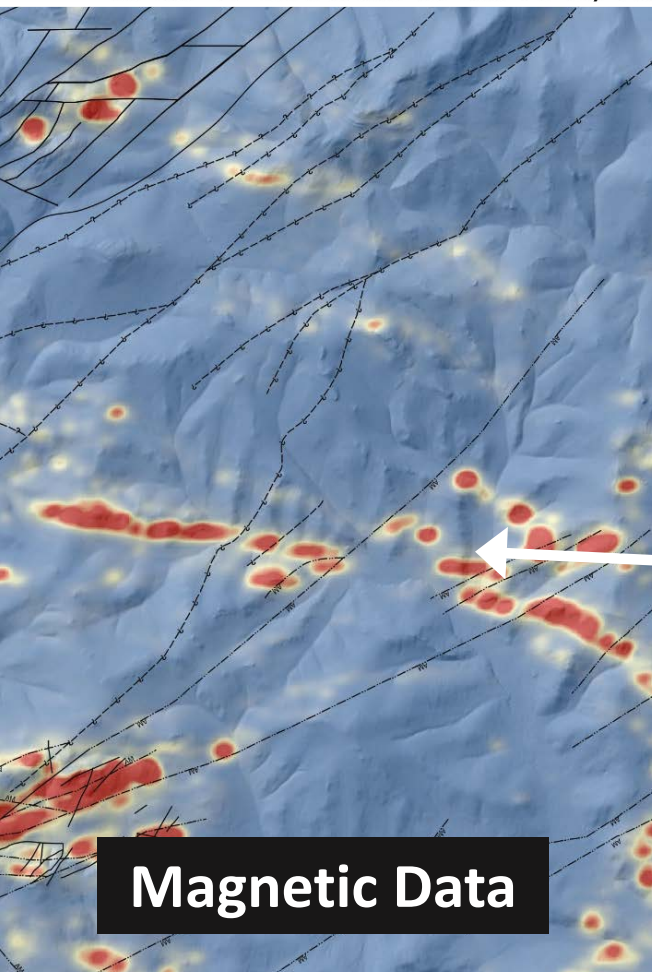
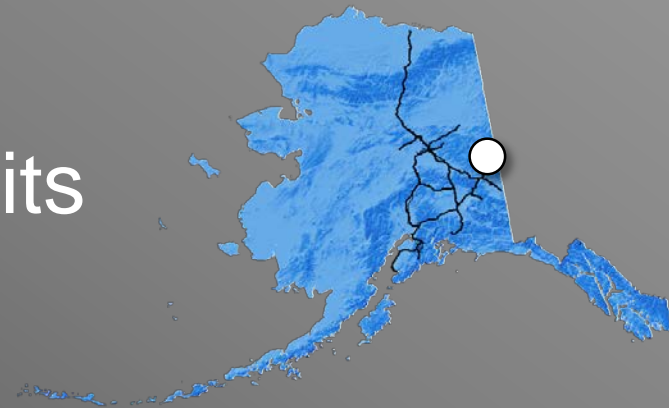
Mapping Conductive Metasediments

Electromagnetic Data



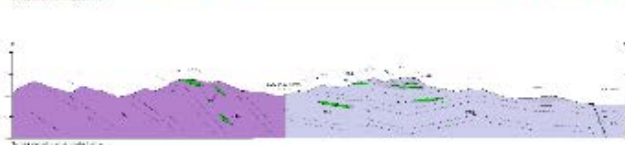
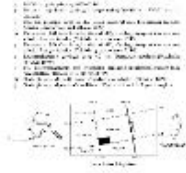
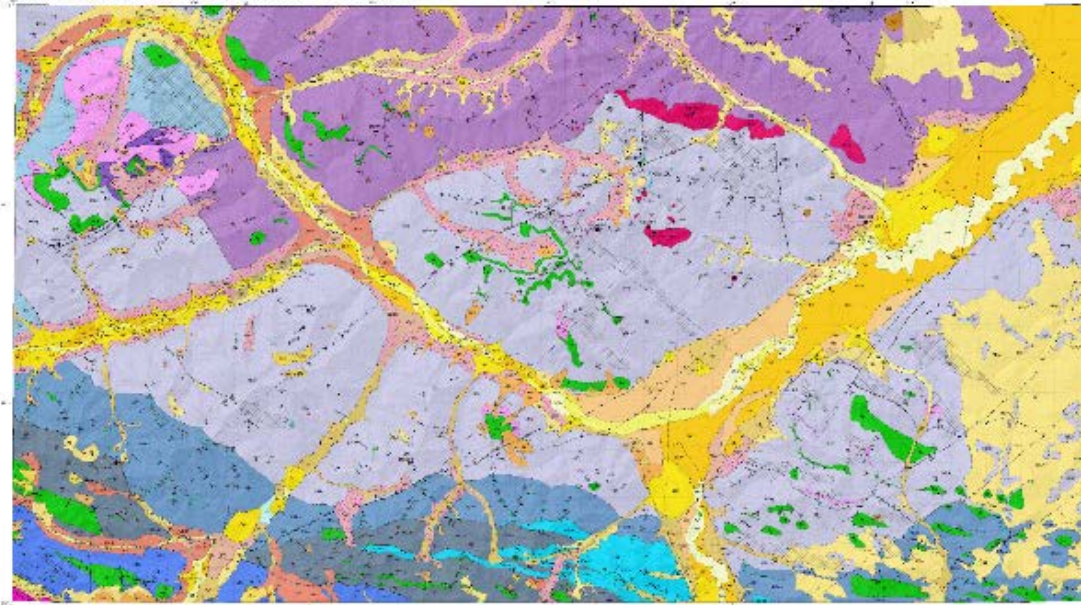


Mapping Magnetic Units serpentinite and amphibolite

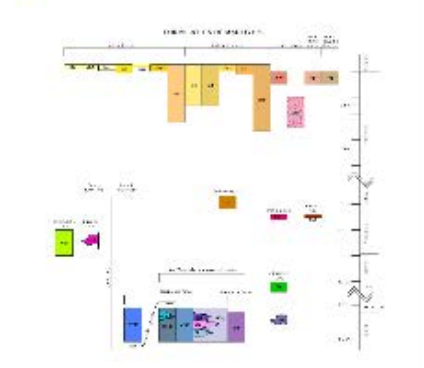


Updated Geologic Map

U.S. GEOLOGICAL SURVEY
BULLETIN 1462-A
1997



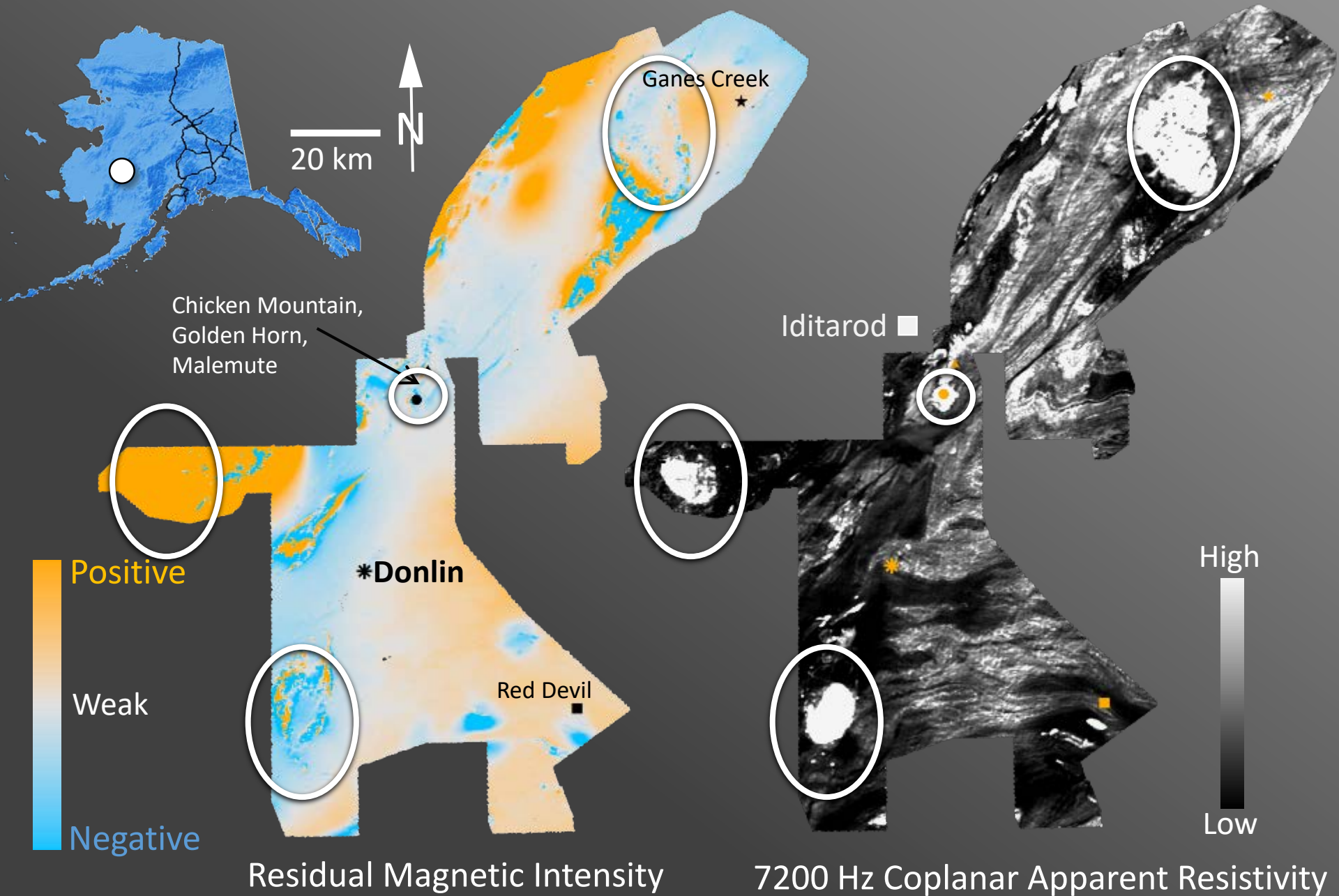
Unit	Color	Symbol	Description
1	Yellow		Quaternary alluvium
2	Orange		Quaternary sand and gravel
3	Red		Quaternary clay
4	Purple		Quaternary silt and clay
5	Blue		Quaternary sand
6	Green		Quaternary gravel
7	Light blue		Quaternary sand and gravel
8	Dark blue		Quaternary sand and gravel
9	Light green		Quaternary sand and gravel
10	Dark green		Quaternary sand and gravel
11	Light purple		Quaternary sand and gravel
12	Dark purple		Quaternary sand and gravel
13	Light orange		Quaternary sand and gravel
14	Dark orange		Quaternary sand and gravel
15	Light red		Quaternary sand and gravel
16	Dark red		Quaternary sand and gravel
17	Light purple		Quaternary sand and gravel
18	Dark purple		Quaternary sand and gravel
19	Light blue		Quaternary sand and gravel
20	Dark blue		Quaternary sand and gravel
21	Light green		Quaternary sand and gravel
22	Dark green		Quaternary sand and gravel
23	Light orange		Quaternary sand and gravel
24	Dark orange		Quaternary sand and gravel
25	Light red		Quaternary sand and gravel
26	Dark red		Quaternary sand and gravel
27	Light purple		Quaternary sand and gravel
28	Dark purple		Quaternary sand and gravel
29	Light blue		Quaternary sand and gravel
30	Dark blue		Quaternary sand and gravel
31	Light green		Quaternary sand and gravel
32	Dark green		Quaternary sand and gravel
33	Light orange		Quaternary sand and gravel
34	Dark orange		Quaternary sand and gravel
35	Light red		Quaternary sand and gravel
36	Dark red		Quaternary sand and gravel
37	Light purple		Quaternary sand and gravel
38	Dark purple		Quaternary sand and gravel
39	Light blue		Quaternary sand and gravel
40	Dark blue		Quaternary sand and gravel
41	Light green		Quaternary sand and gravel
42	Dark green		Quaternary sand and gravel
43	Light orange		Quaternary sand and gravel
44	Dark orange		Quaternary sand and gravel
45	Light red		Quaternary sand and gravel
46	Dark red		Quaternary sand and gravel
47	Light purple		Quaternary sand and gravel
48	Dark purple		Quaternary sand and gravel
49	Light blue		Quaternary sand and gravel
50	Dark blue		Quaternary sand and gravel
51	Light green		Quaternary sand and gravel
52	Dark green		Quaternary sand and gravel
53	Light orange		Quaternary sand and gravel
54	Dark orange		Quaternary sand and gravel
55	Light red		Quaternary sand and gravel
56	Dark red		Quaternary sand and gravel
57	Light purple		Quaternary sand and gravel
58	Dark purple		Quaternary sand and gravel
59	Light blue		Quaternary sand and gravel
60	Dark blue		Quaternary sand and gravel
61	Light green		Quaternary sand and gravel
62	Dark green		Quaternary sand and gravel
63	Light orange		Quaternary sand and gravel
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65	Light red		Quaternary sand and gravel
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67	Light purple		Quaternary sand and gravel
68	Dark purple		Quaternary sand and gravel
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70	Dark blue		Quaternary sand and gravel
71	Light green		Quaternary sand and gravel
72	Dark green		Quaternary sand and gravel
73	Light orange		Quaternary sand and gravel
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75	Light red		Quaternary sand and gravel
76	Dark red		Quaternary sand and gravel
77	Light purple		Quaternary sand and gravel
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81	Light green		Quaternary sand and gravel
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83	Light orange		Quaternary sand and gravel
84	Dark orange		Quaternary sand and gravel
85	Light red		Quaternary sand and gravel
86	Dark red		Quaternary sand and gravel
87	Light purple		Quaternary sand and gravel
88	Dark purple		Quaternary sand and gravel
89	Light blue		Quaternary sand and gravel
90	Dark blue		Quaternary sand and gravel
91	Light green		Quaternary sand and gravel
92	Dark green		Quaternary sand and gravel
93	Light orange		Quaternary sand and gravel
94	Dark orange		Quaternary sand and gravel
95	Light red		Quaternary sand and gravel
96	Dark red		Quaternary sand and gravel
97	Light purple		Quaternary sand and gravel
98	Dark purple		Quaternary sand and gravel
99	Light blue		Quaternary sand and gravel
100	Dark blue		Quaternary sand and gravel



Geological map of the Tok River area, Tanana River basin, Alaska. The map shows the distribution of various geological units and structural features. The legend lists the units and their corresponding colors and symbols. The map is oriented with North at the top. The scale bar indicates distances in miles and kilometers. The map is titled 'Geological map of the Tok River area, Tanana River basin, Alaska'.

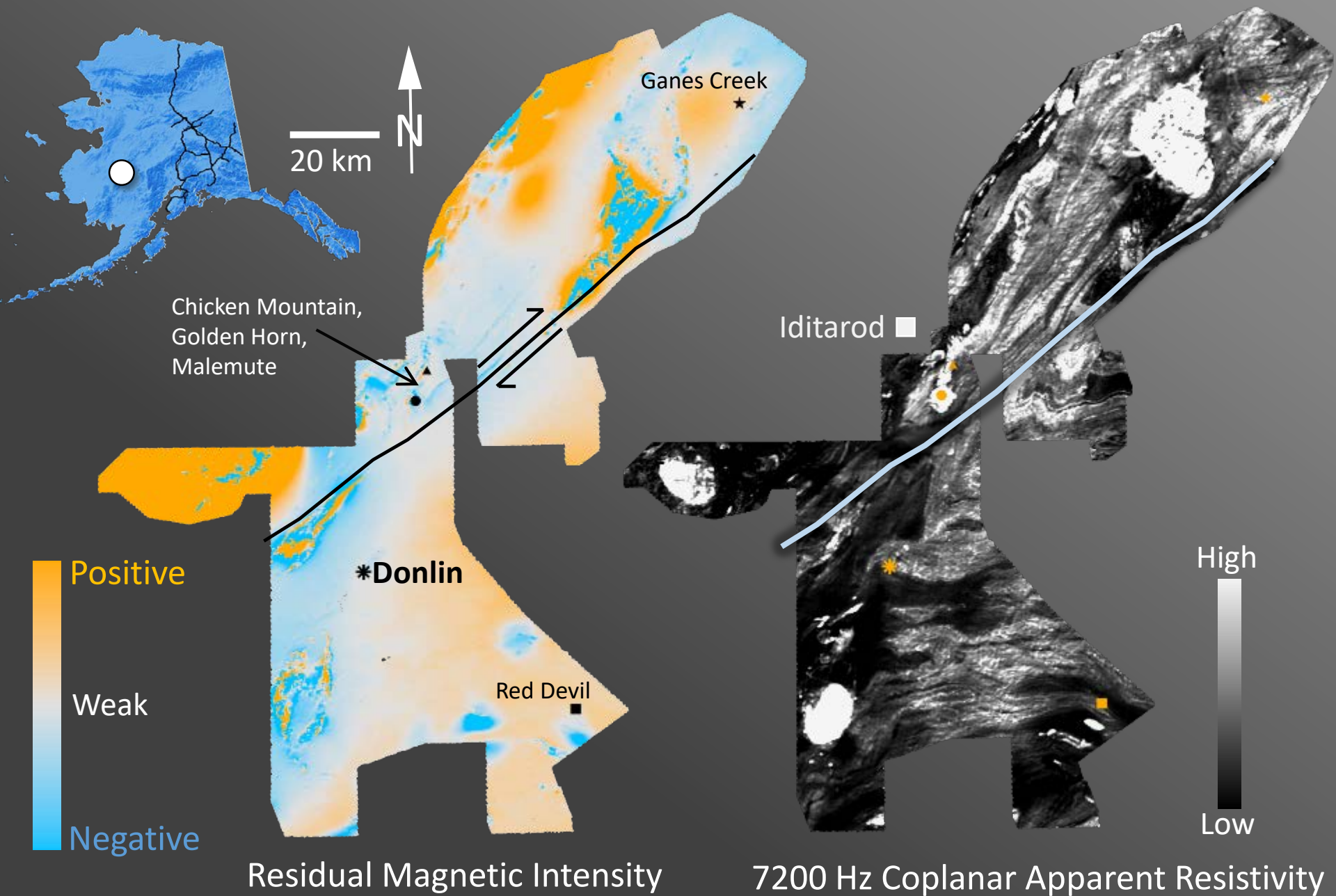


Magnetic and Electromagnetic Data - **Intrusions**



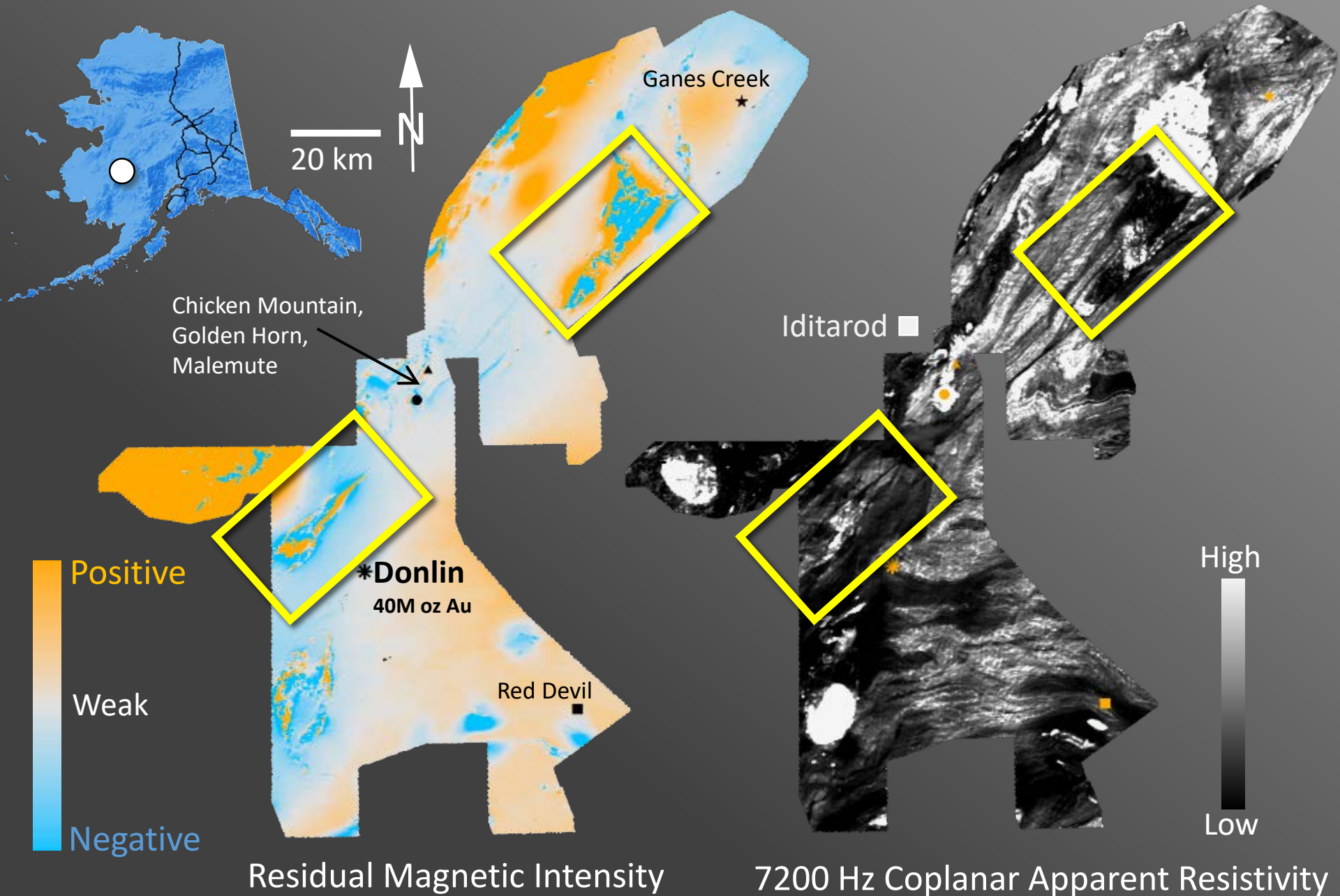


Magnetic and Electromagnetic Data - Faults



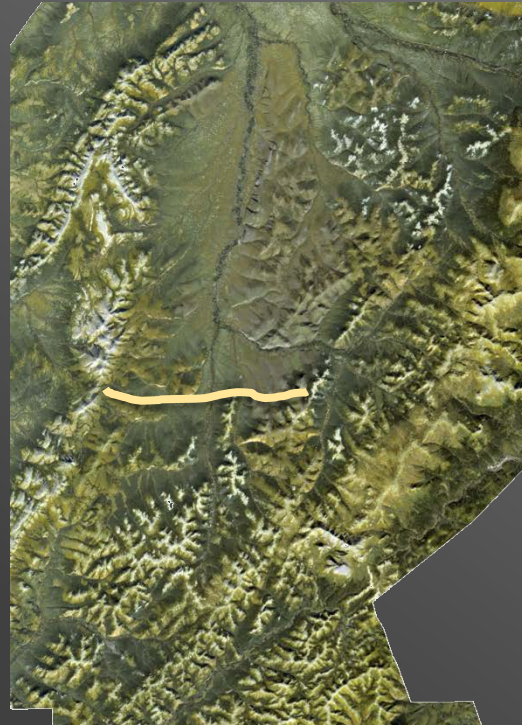


Magnetic and Electromagnetic Data – **Volcanic Rocks**

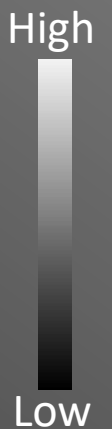
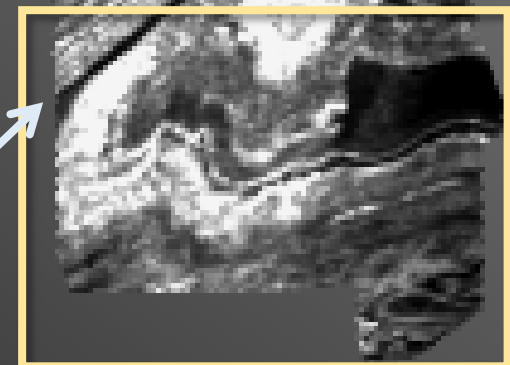
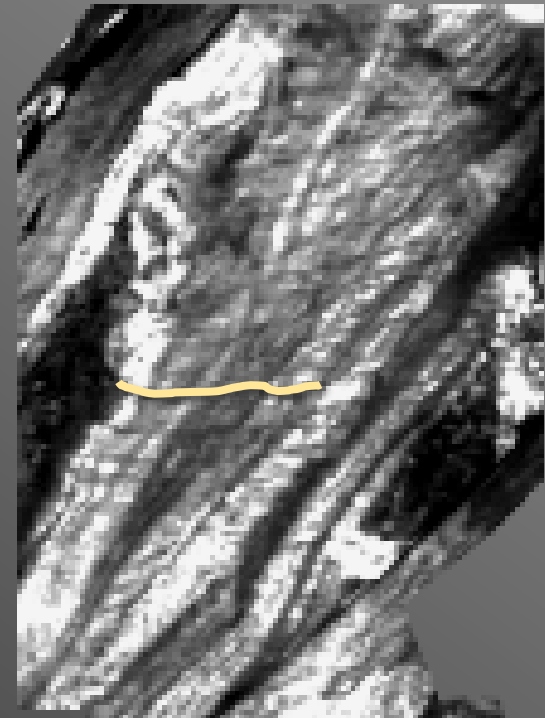




Imagery and Electromagnetic Data – **Folds & Shears**



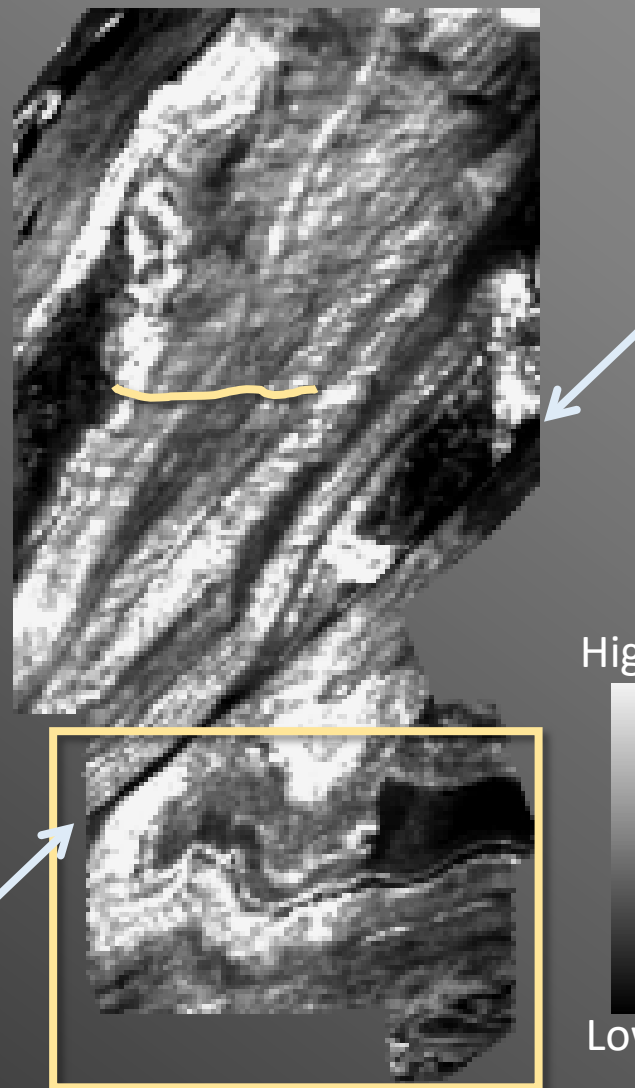
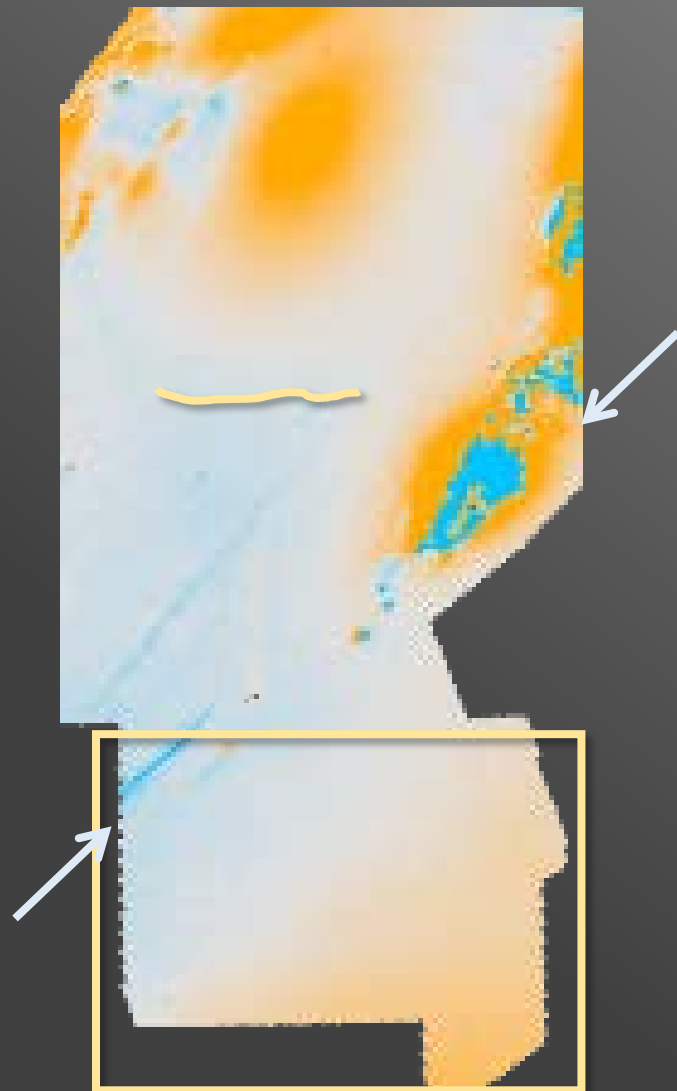
SPOT5 Imagery



7200 Hz Coplanar Apparent Resistivity



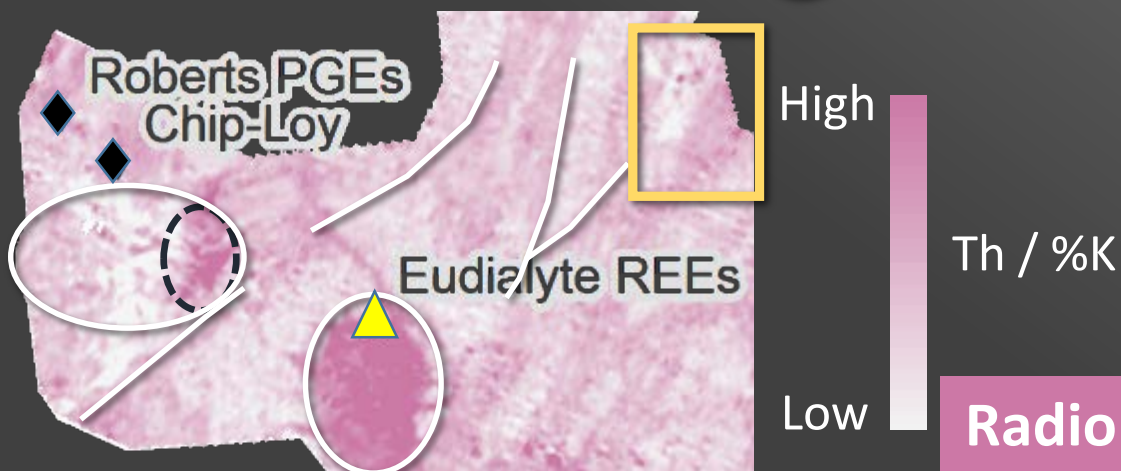
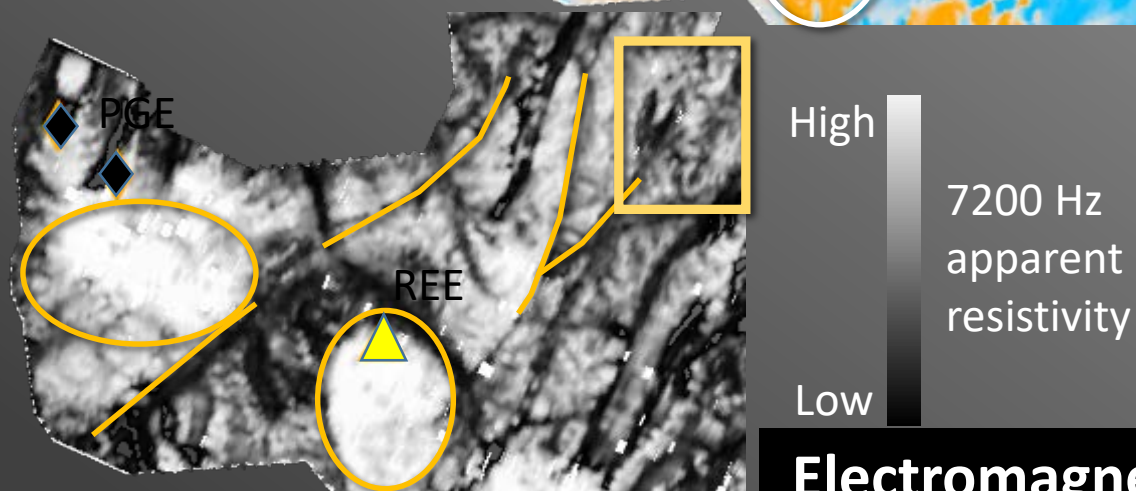
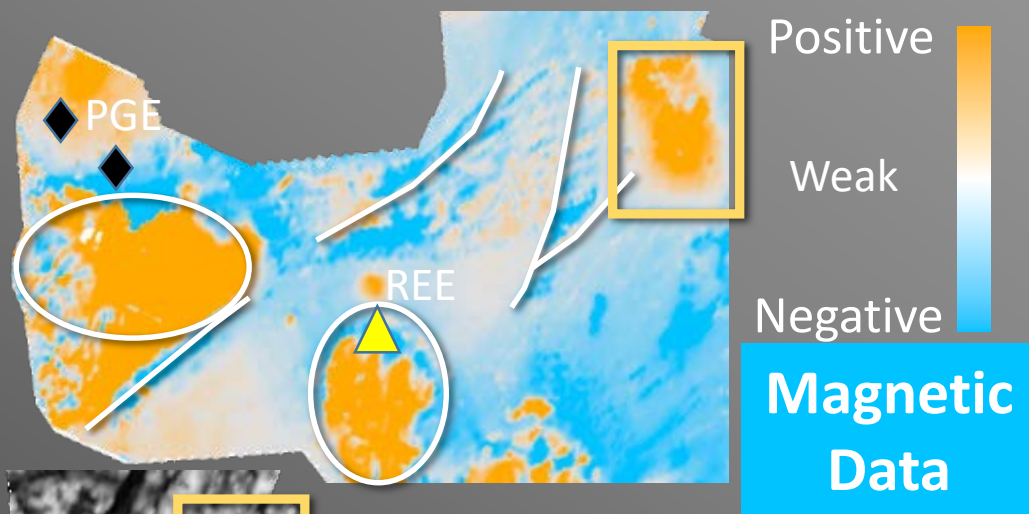
Magnetic and Electromagnetic Data – **Folds & Shears**



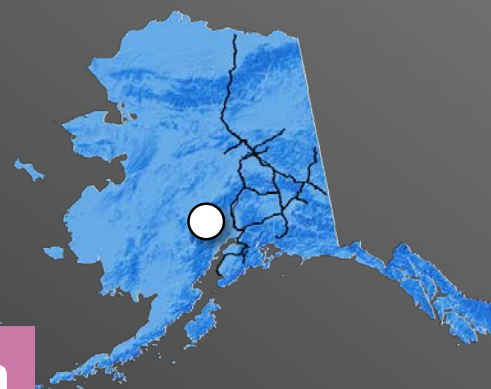


Distinguishing Intrusions

Farewell and Styx surveys

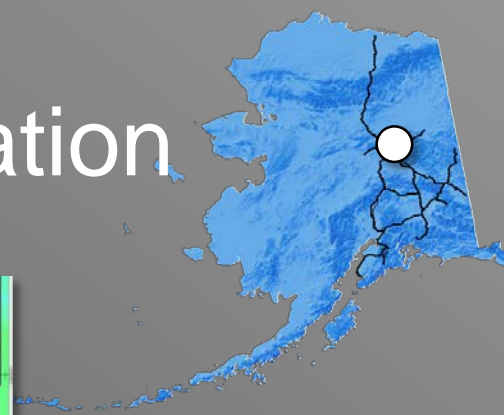


Radiometric Data

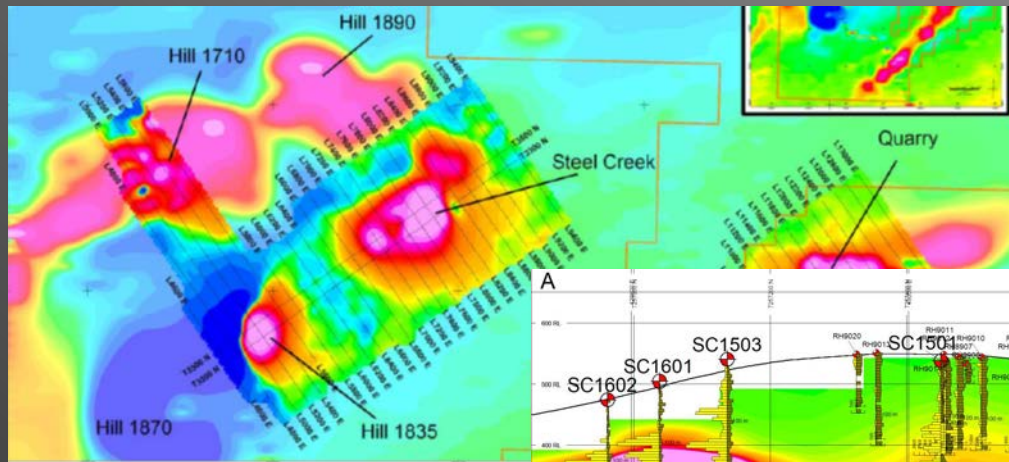




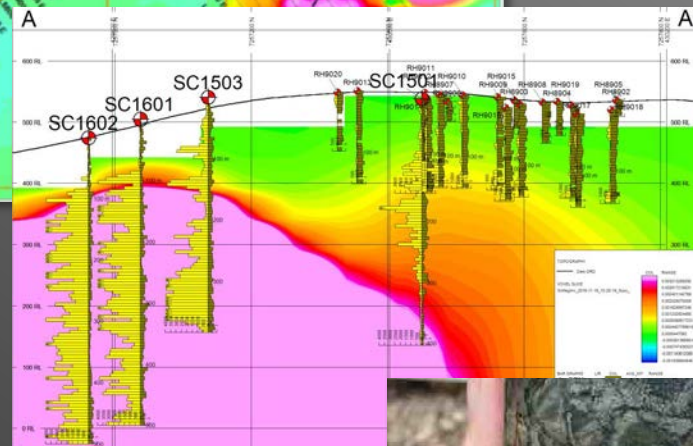
DGGS Magnetic Data for Exploration



1) State-funded magnetic and EM surveys



2) Industry modeling and inversions



3) Drilling

Shorty Creek Cu-Au
Porphyry Discovery
Freegold Ventures Limited

4) Cu-Au
Mineralization



DGGS Electromagnetic Data for Exploration

1) DGGS geophysics
and geology data

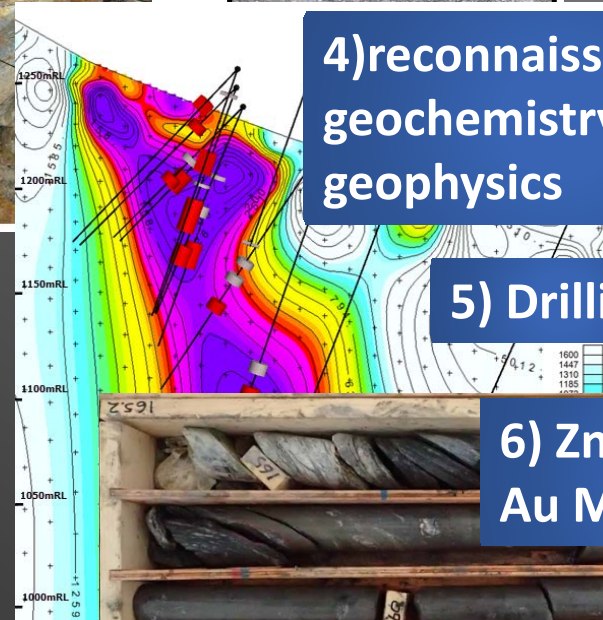
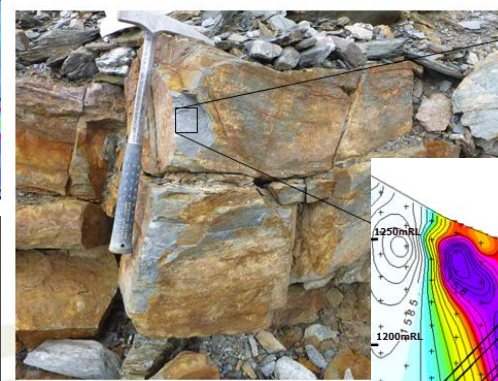
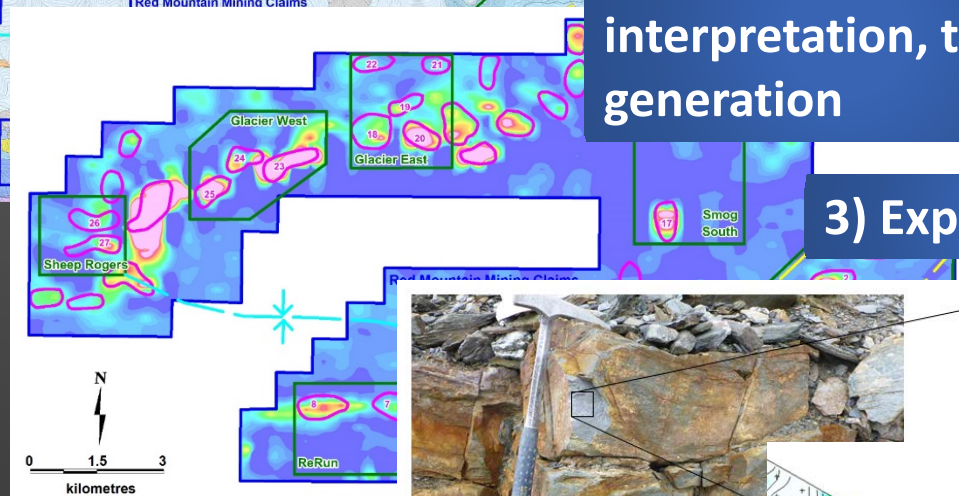
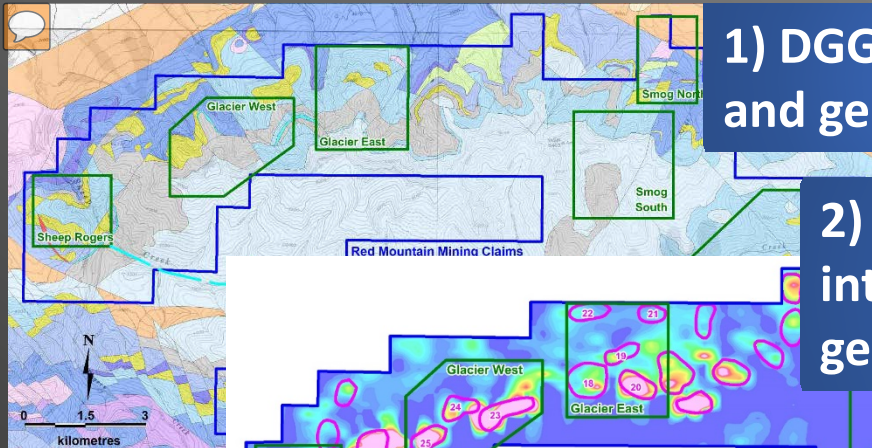
2) Industry modeling,
interpretation, target
generation

3) Expanded claims

4) reconnaissance,
geochemistry, CSAMT
geophysics

5) Drilling

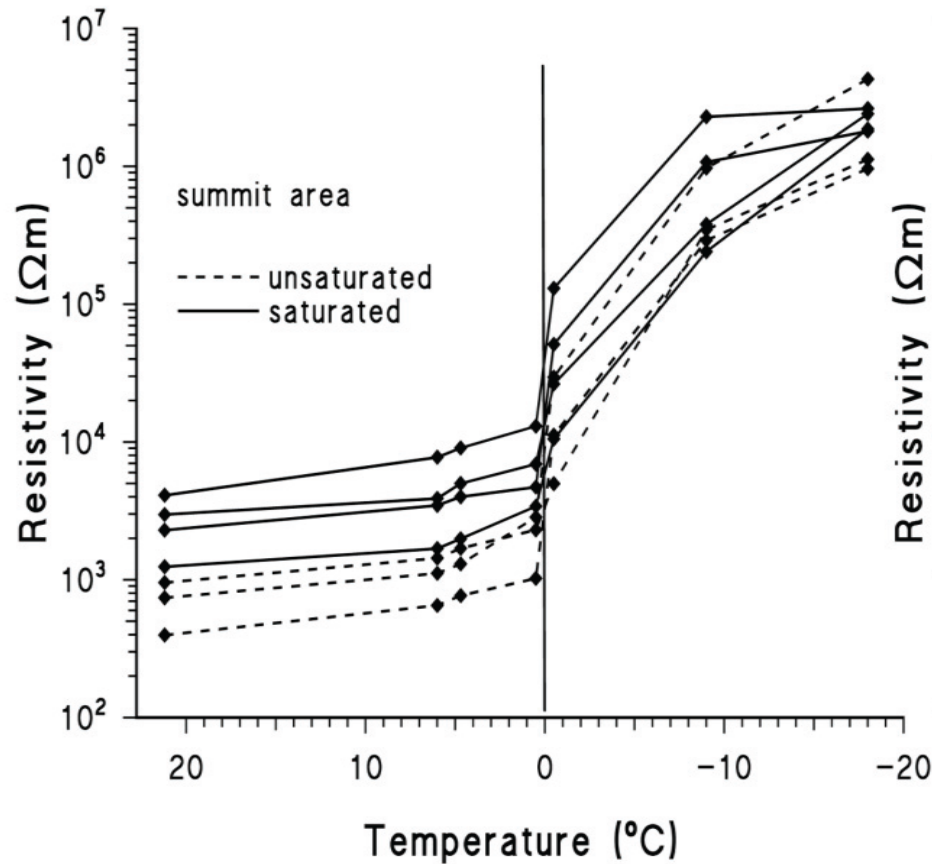
6) Zn, Pb, Cu, Ag,
Au Mineralization



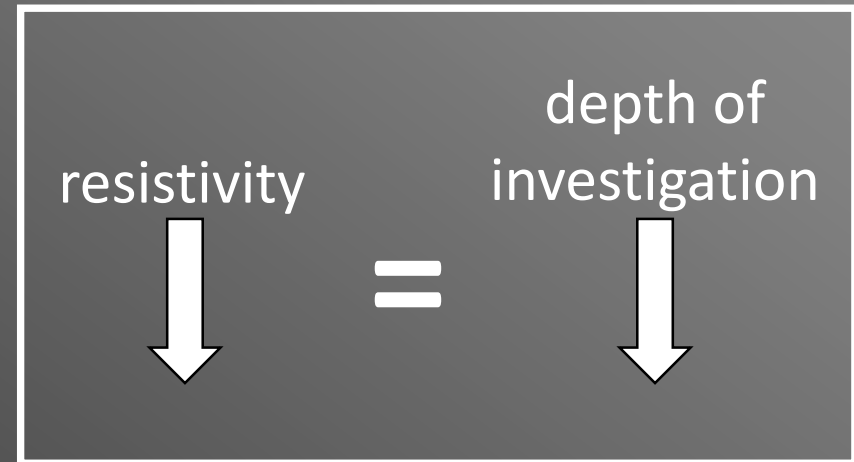
Volcanogenic Massive Sulfide
Discovery
Red Mountain
White Rock Minerals Ltd



Resistivity, Temperature, Depth of Investigation Electromagnetic Data



Till resistivity values from Finland

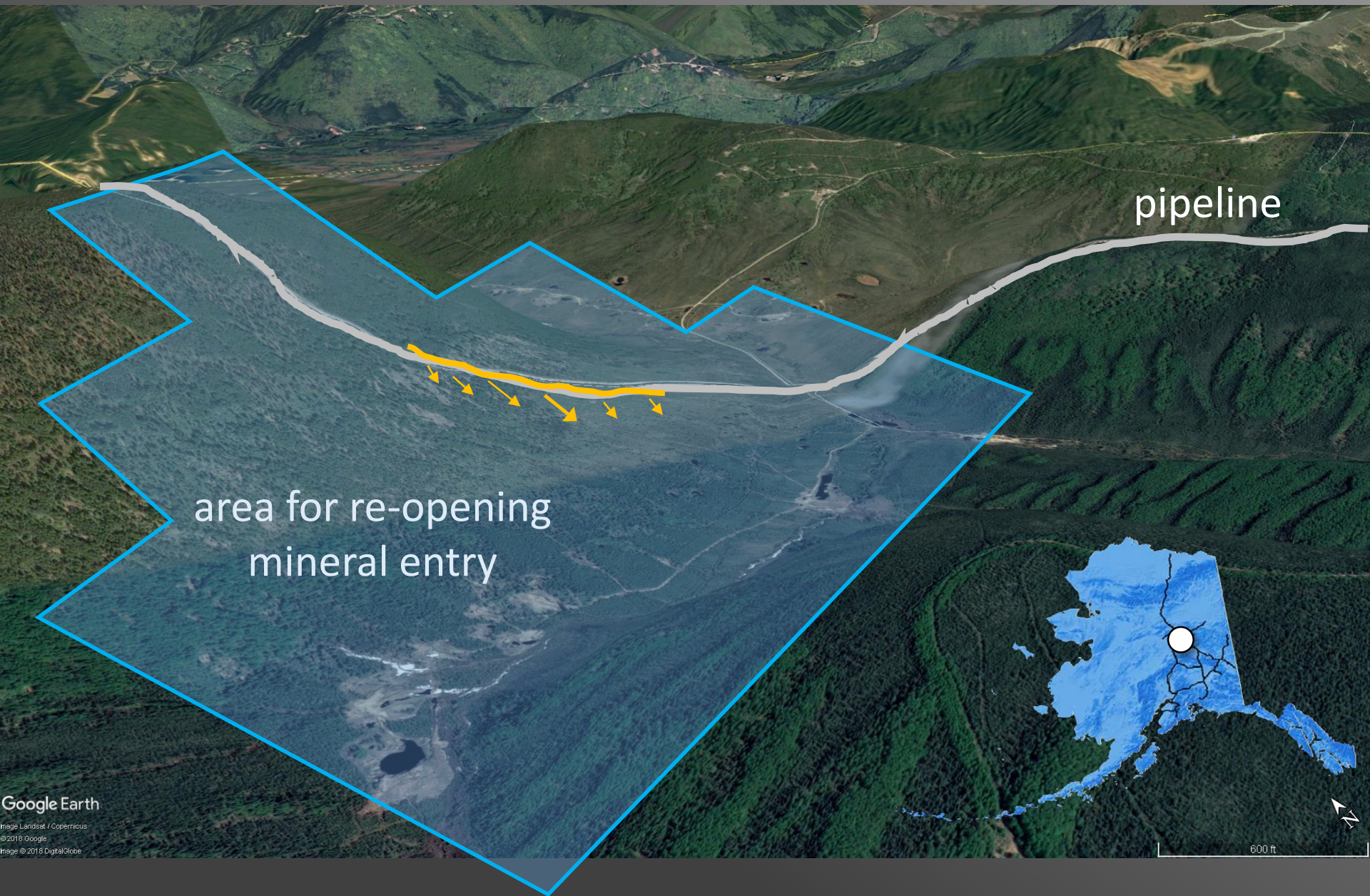


From:

Electrical Resistivity Study of Permafrost on Ridnitšohkka Fell in, Northwest Lapland, Finland, Heikki Vanhala, Petri Lintinen and Antti Ojala
Geological Survey of Finland, Betonimiehenkuja 4, FIN-02150 Espoo, Finland

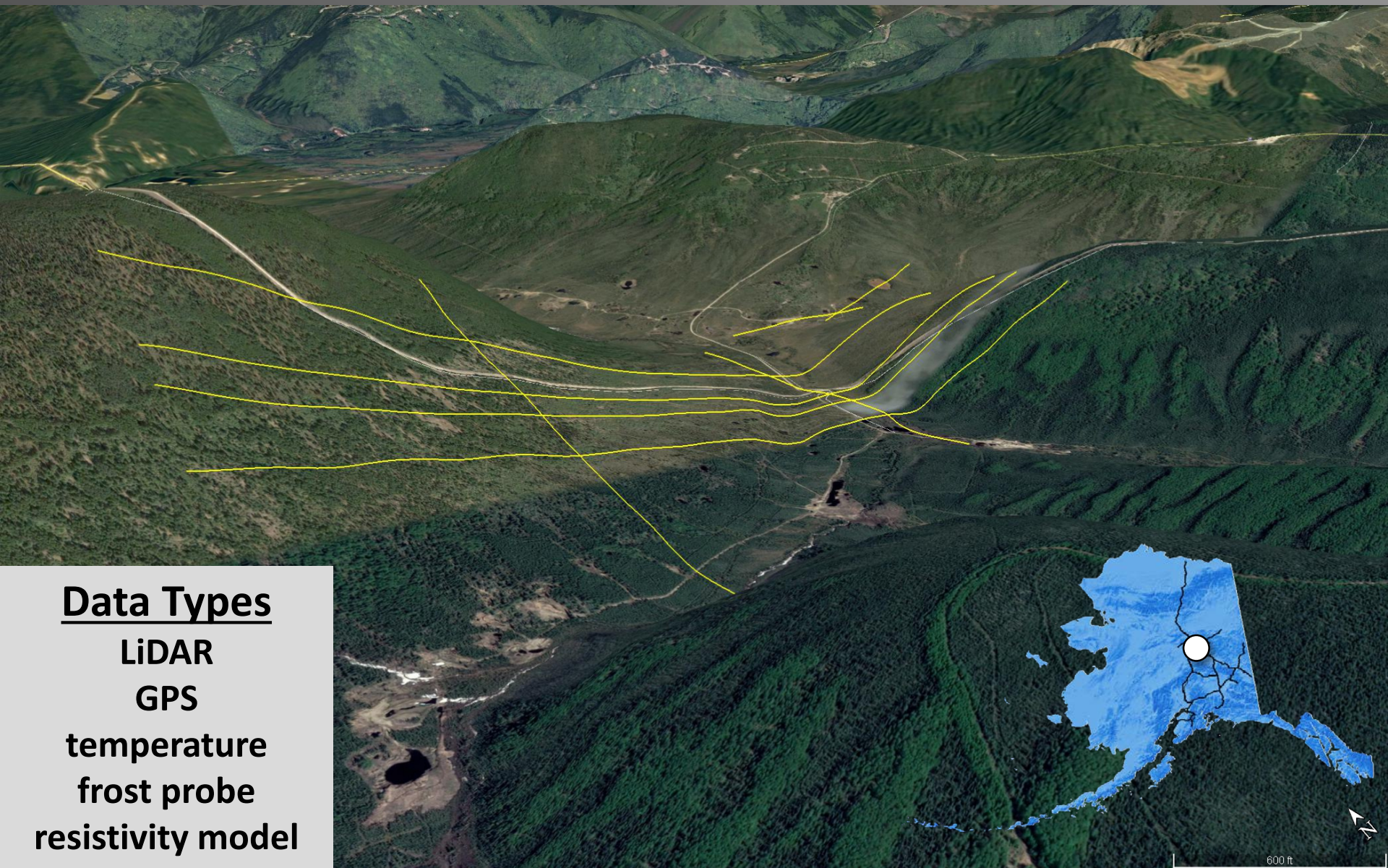


Treasure Creek - Engineering Geology





Treasure Creek – EM Flightpath



Data Types

LiDAR

GPS

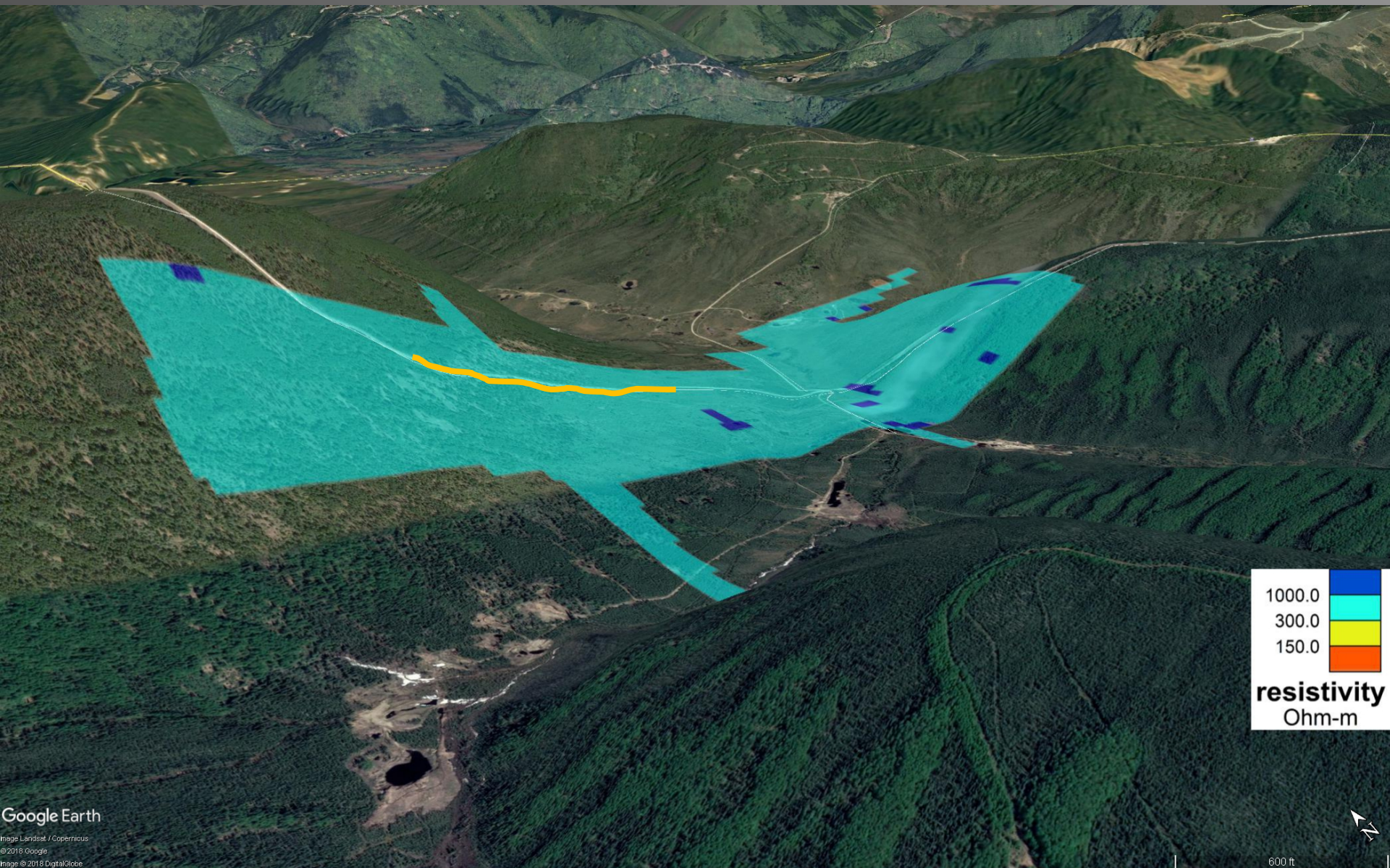
temperature

frost probe

resistivity model

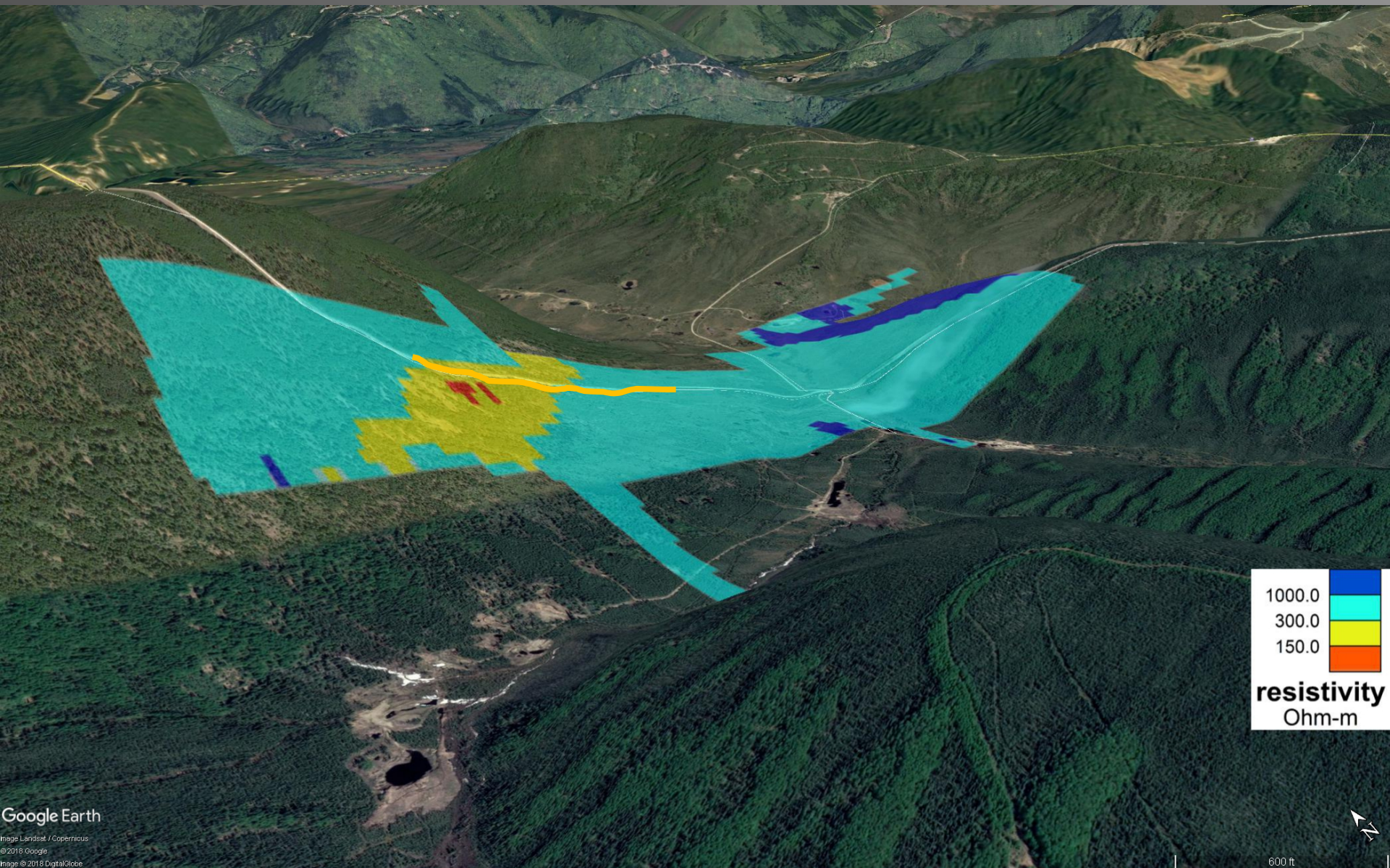


Treasure Creek – Surface Resistivity



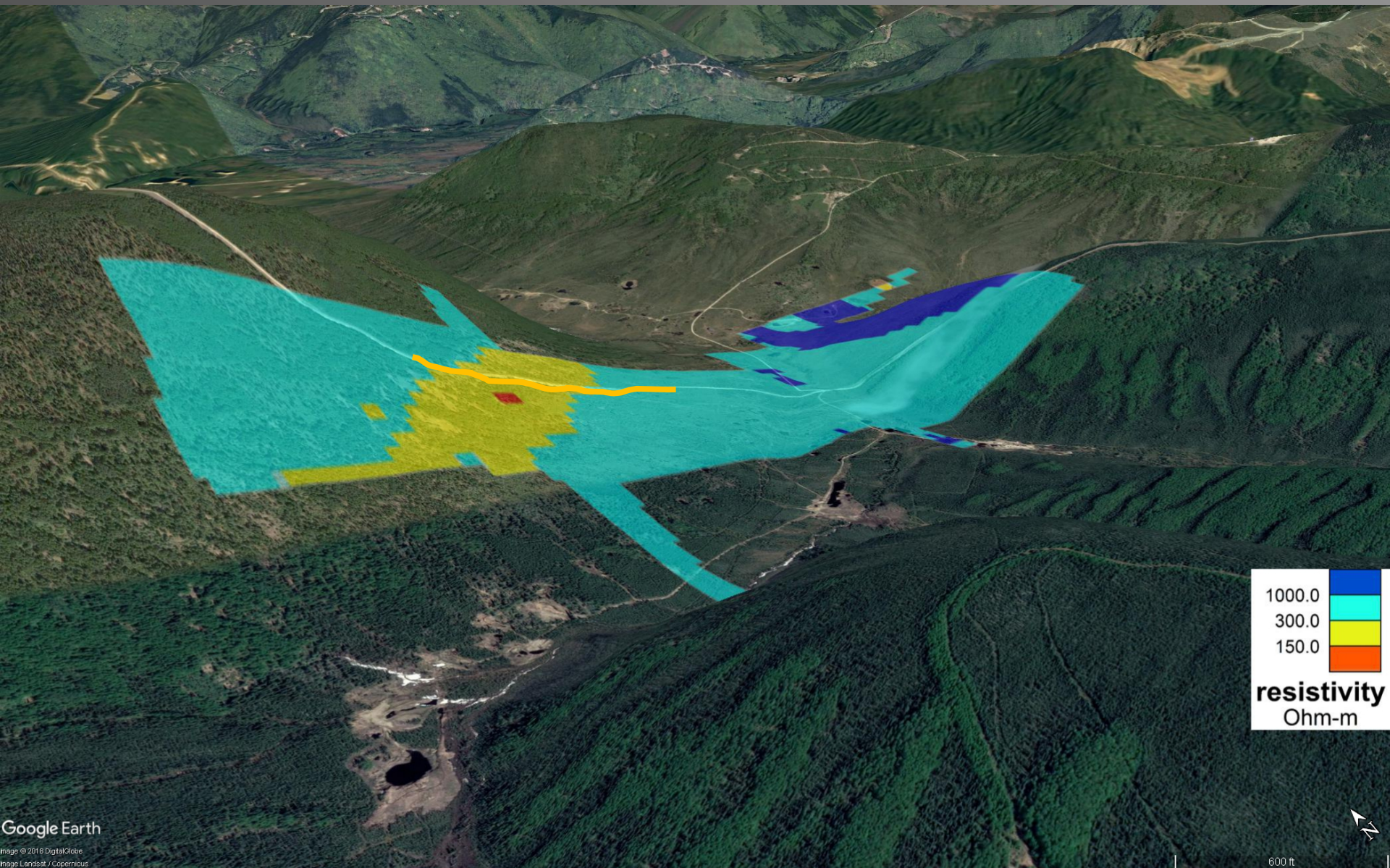


Treasure Creek – Resistivity 11 meters Depth



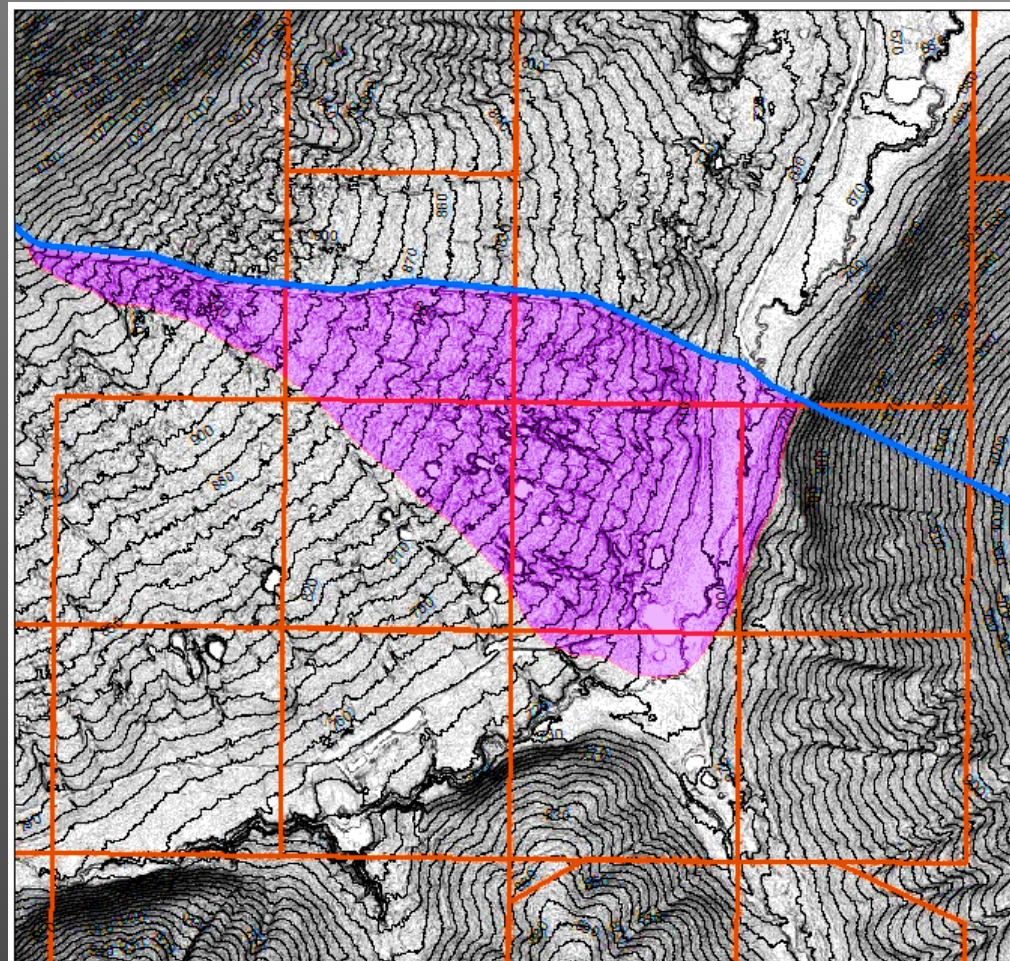


Treasure Creek – Resistivity 19 Meters Depth



Treasure Creek Recommended Closure Area

- instability due to degrading permafrost
- surface and subsurface disturbance accelerates degradation



0 0.05 0.1 0.2 0.3 0.4 Miles



Legend

- Trans-Alaska Pipeline
- Area of potential instability
- Mining claim blocks
- Contour lines (interval 10 ft.)

Online Publication

- 2017 downloads
 - 11,296 data package
 - 96,677 PDFs
- “all” data requests
- interactive map

Bonnifield Mining District Geophysical Survey

The Bonnifield electromagnetic and magnetic airborne geophysical survey data were acquired in 2006 and 2007 with a DIGHEM-V Electromagnetic (EM) system and a cesium magnetometer. Aeromagnetic and electromagnetic data were acquired for 613 sq miles during the helicopter-based survey. These new data were combined with a geophysical survey of the Liberty Bell area released in 2002 by DGGs. The merged grids and maps are included in this dataset.

Adjacent Surveys or Merged Data

- [Liberty Bell, Western Bonnifield Mining District](#)
- [Bonnifield Mining District](#)

[Overview](#) [Metadata](#)

Available Data

File Name	Data File Format	Download	File Size
bonnifield-geophys-video-flightpath	Video	Download	20.5 G
bonnifield-geophys-vector-data	Vector data	Download	569.7 M
bonnifield-geophys-maps-prn-format	Plot files	Download	152.5 M
bonnifield-geophys-db-geosoft	Line data Geosoft format database	Download	276.3 M
bonnifield-geophys-grids-geosoft	Gridded data Geosoft format	Download	56.5 M
bonnifield-geophys-grids-ermapper	Grid ERS files	Download	92.5 M
bonnifield-geophys-kmz	Google Earth files	Download	701.0 K
bonnifield-geophysics-images	Georeferenced raster files	Download	53.3 M
bonnifield-geophys-documents	Adobe PDF files	Download	22.0 M
		Download	138.8 M
		Download	148.6 M
		Download	601.8 M

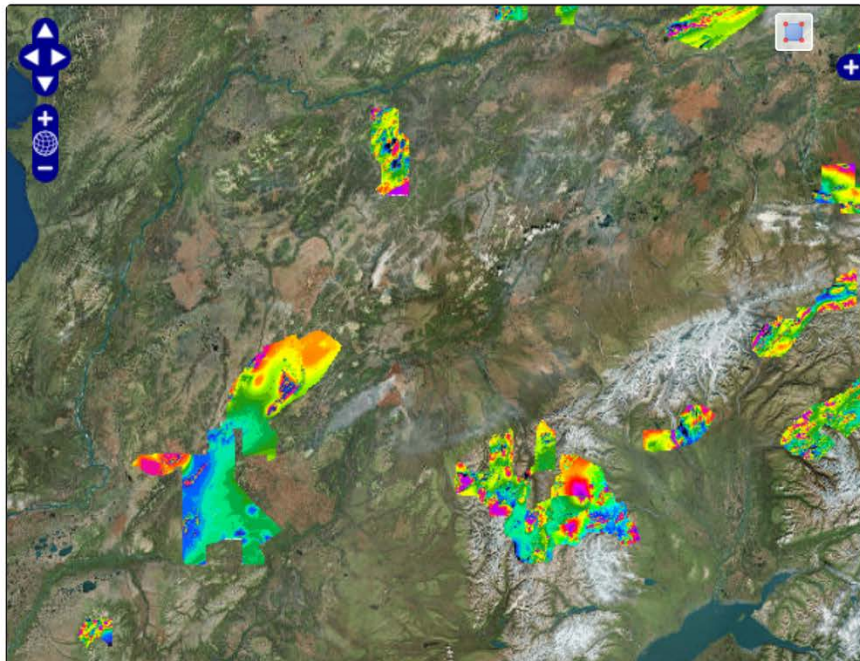
Airborne GeophysWeb

Enter survey name, type, or other

[\[Download CSV \]](#) [\[Help \]](#)

Search

Info



Border Image Layer

- | | | |
|-------------------------------------|----------------------------------|--|
| <input checked="" type="checkbox"/> | <input type="radio"/> | Current Surveys |
| <input checked="" type="checkbox"/> | <input checked="" type="radio"/> | H-Mag (Helicopter Magnetics) |
| <input checked="" type="checkbox"/> | <input type="radio"/> | FW-Mag (since 1993) (Fixed-Wing Magnetics) |
| <input checked="" type="checkbox"/> | <input type="radio"/> | H-FDEM Apparent Resistivity (Helicopter Frequency-Domain Electromagnetics) |
| <input checked="" type="checkbox"/> | <input type="radio"/> | H-Rad (Helicopter Radiometrics) |

Survey Name:

Year(s) Flown:

From: To:

Nominal AGL (feet):

From: To:

Line spacing (feet):

Any

Agency:

Any

DGGs

USGS

Quadrangle(s):

Any

Adak

Afognak

Ambler River

Amukta

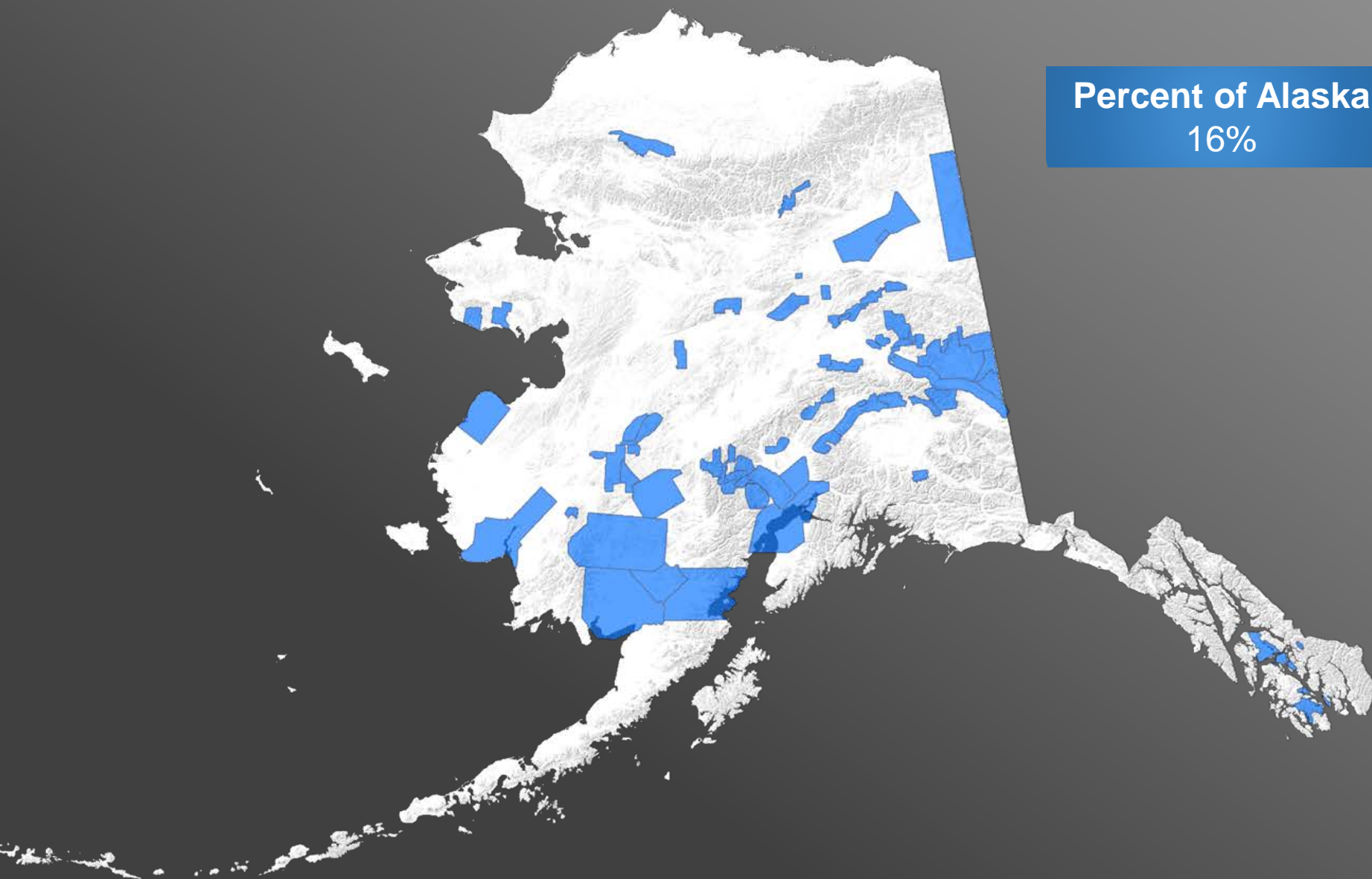
Sort by: Best Match

Reset





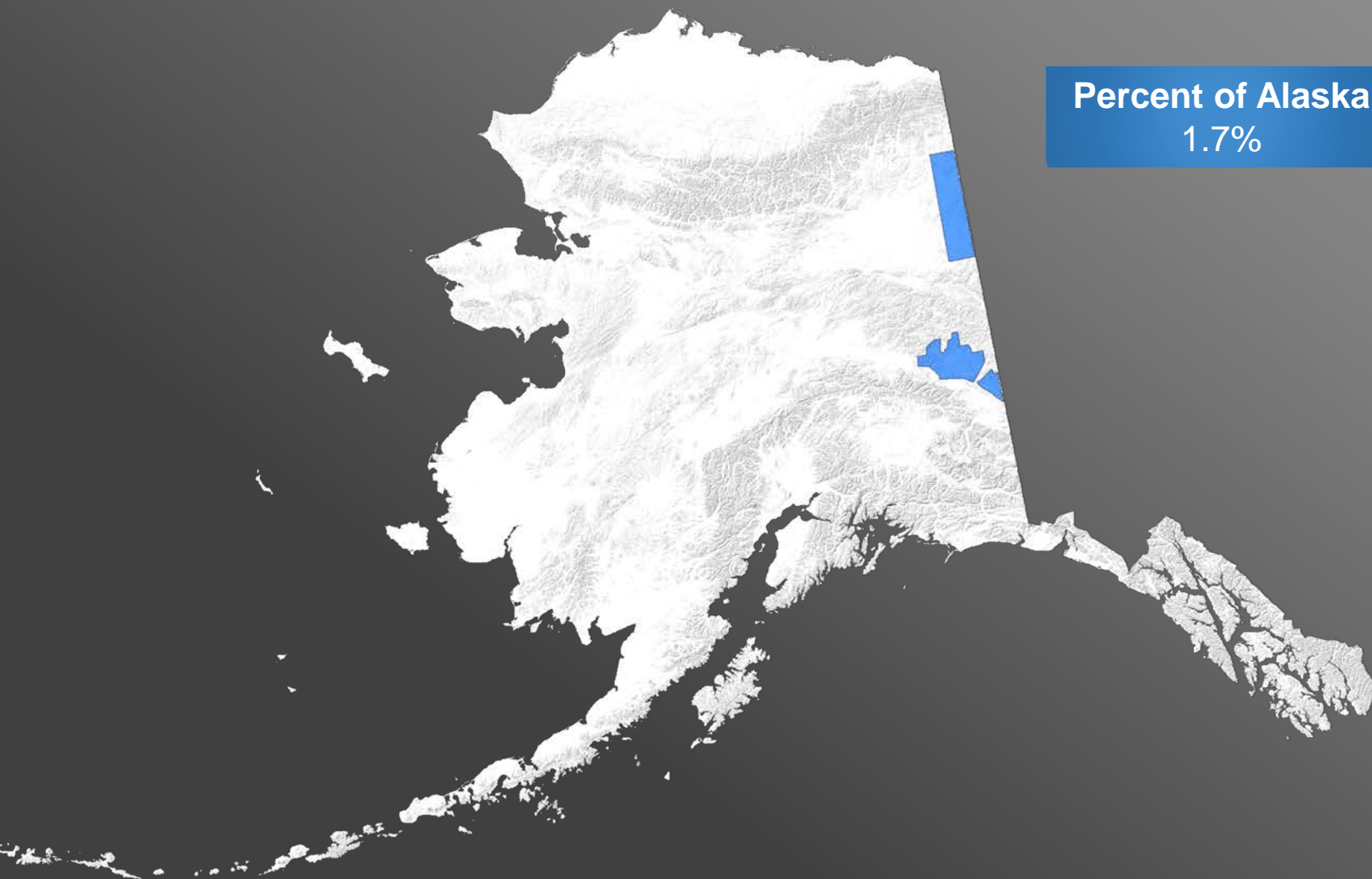
Modern Magnetic Data Coverage



Percent of Alaska
16%

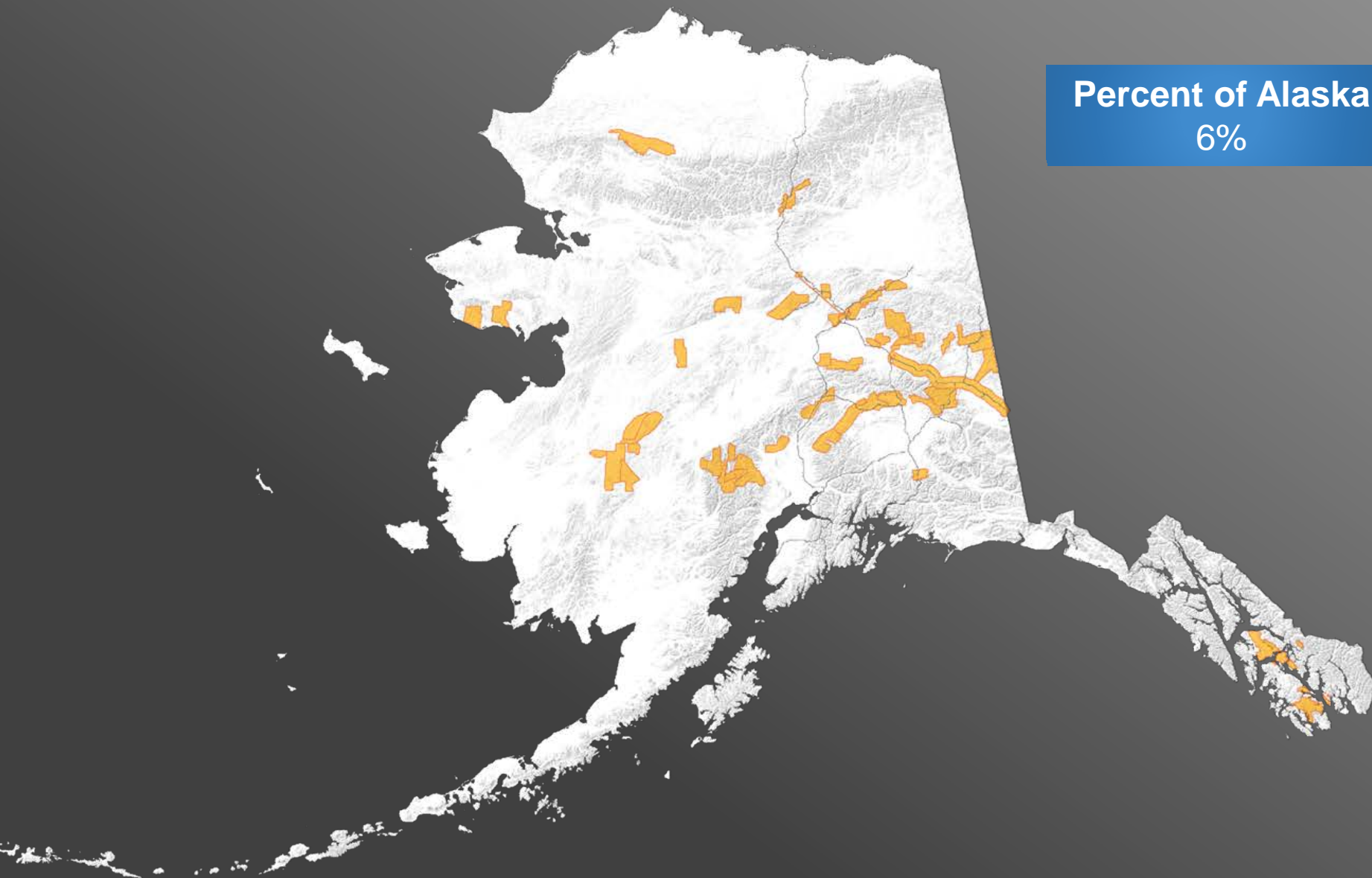


Magnetic Data with **ACCEPTABLE** Ranking by USGS



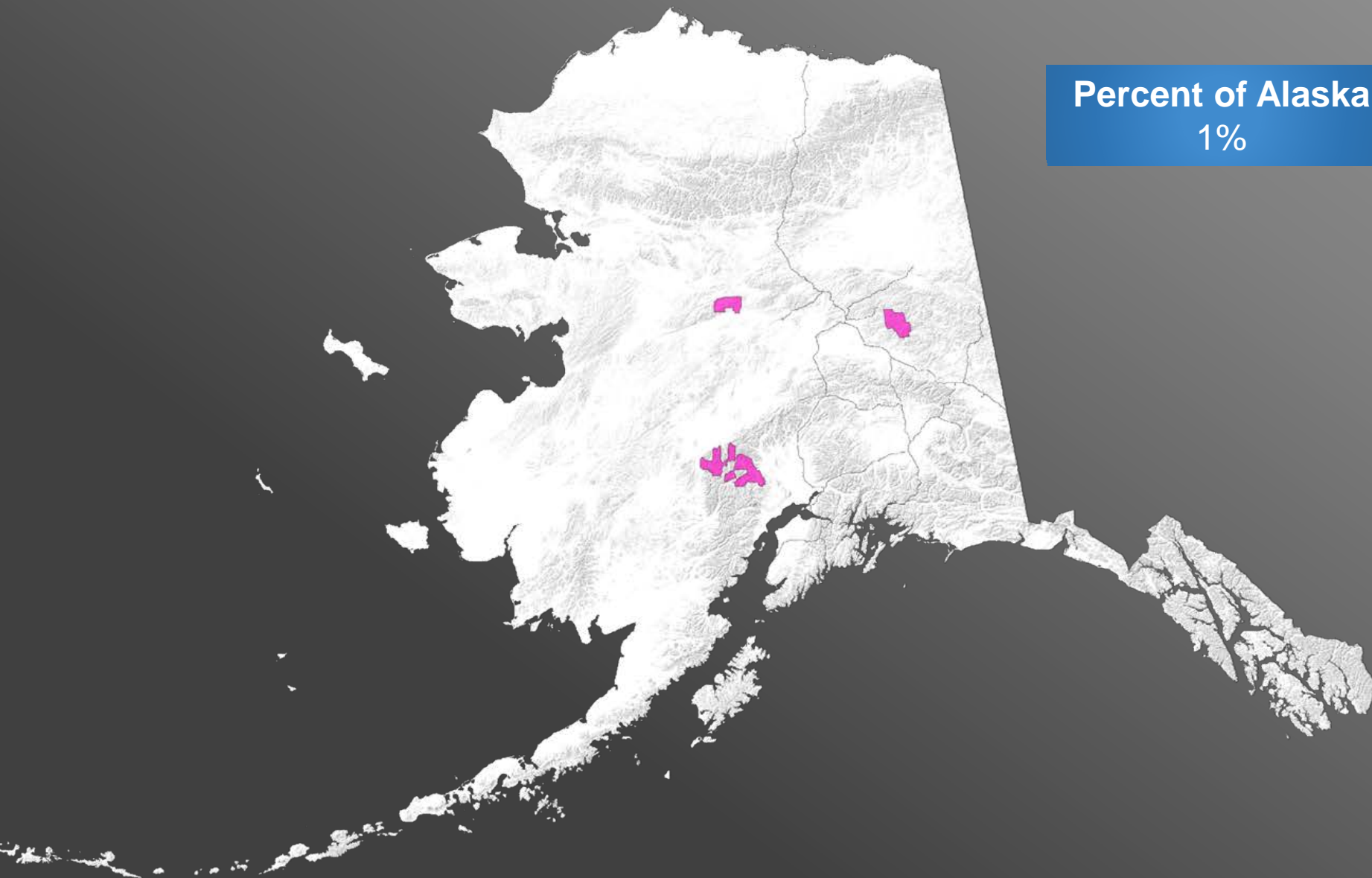


Electromagnetic Data Coverage





Radiometric Data Coverage





Aircraft Type



Fixed-wing

- 5X cheaper
- faster
- terrain limited

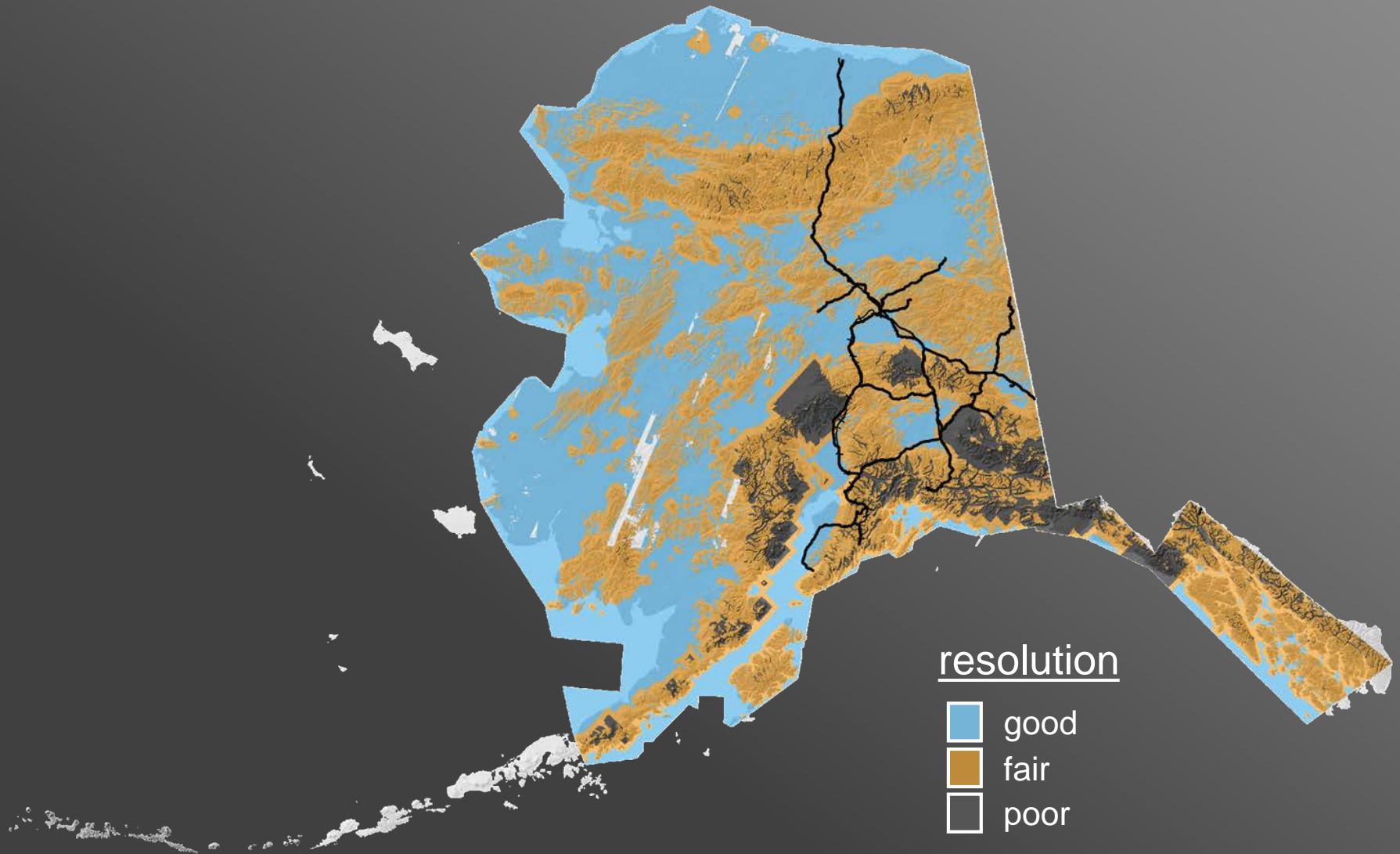


Helicopter

- 5X more \$\$
- slower
- lower
- any terrain

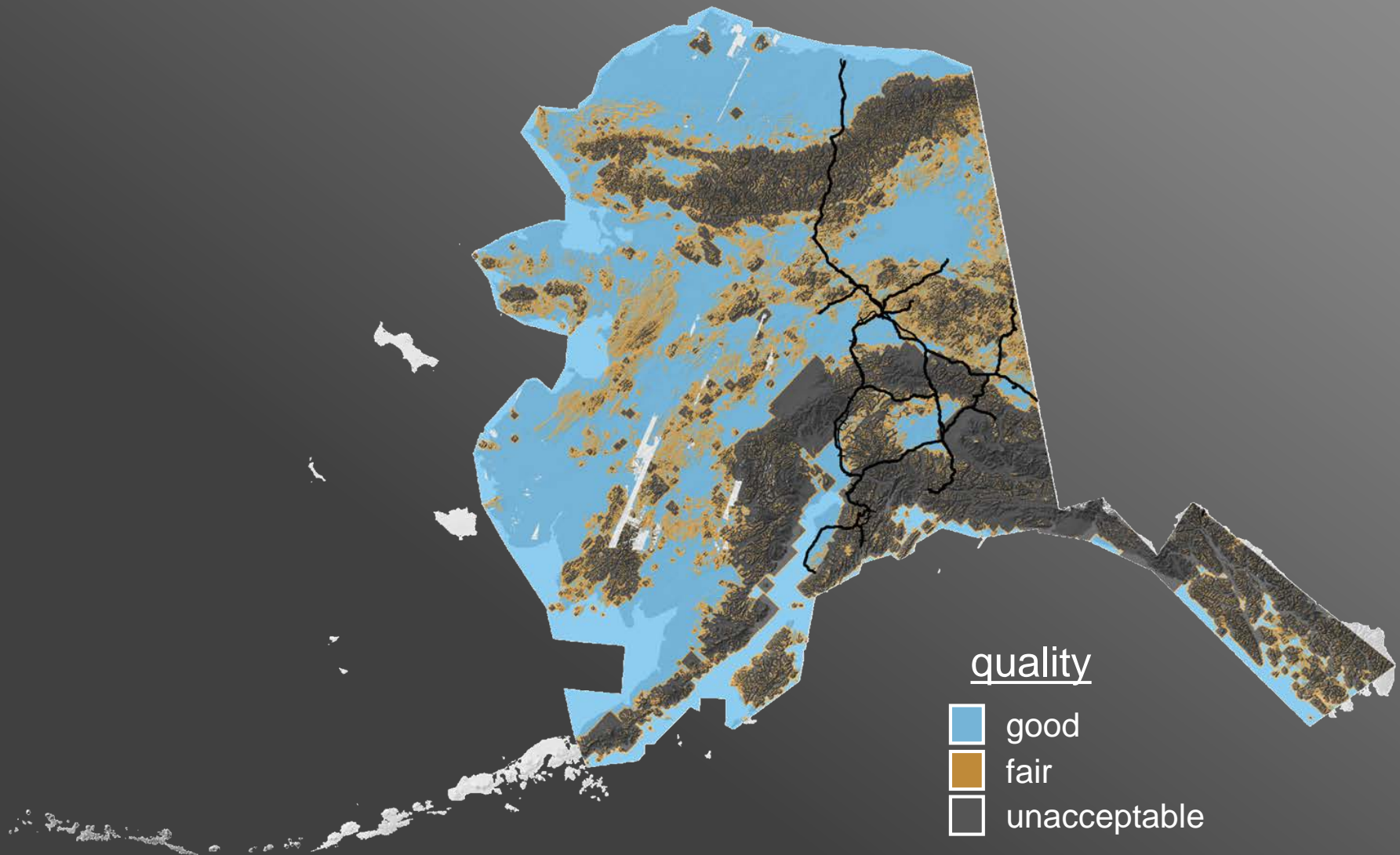


Magnetic Data by Fixed-wing



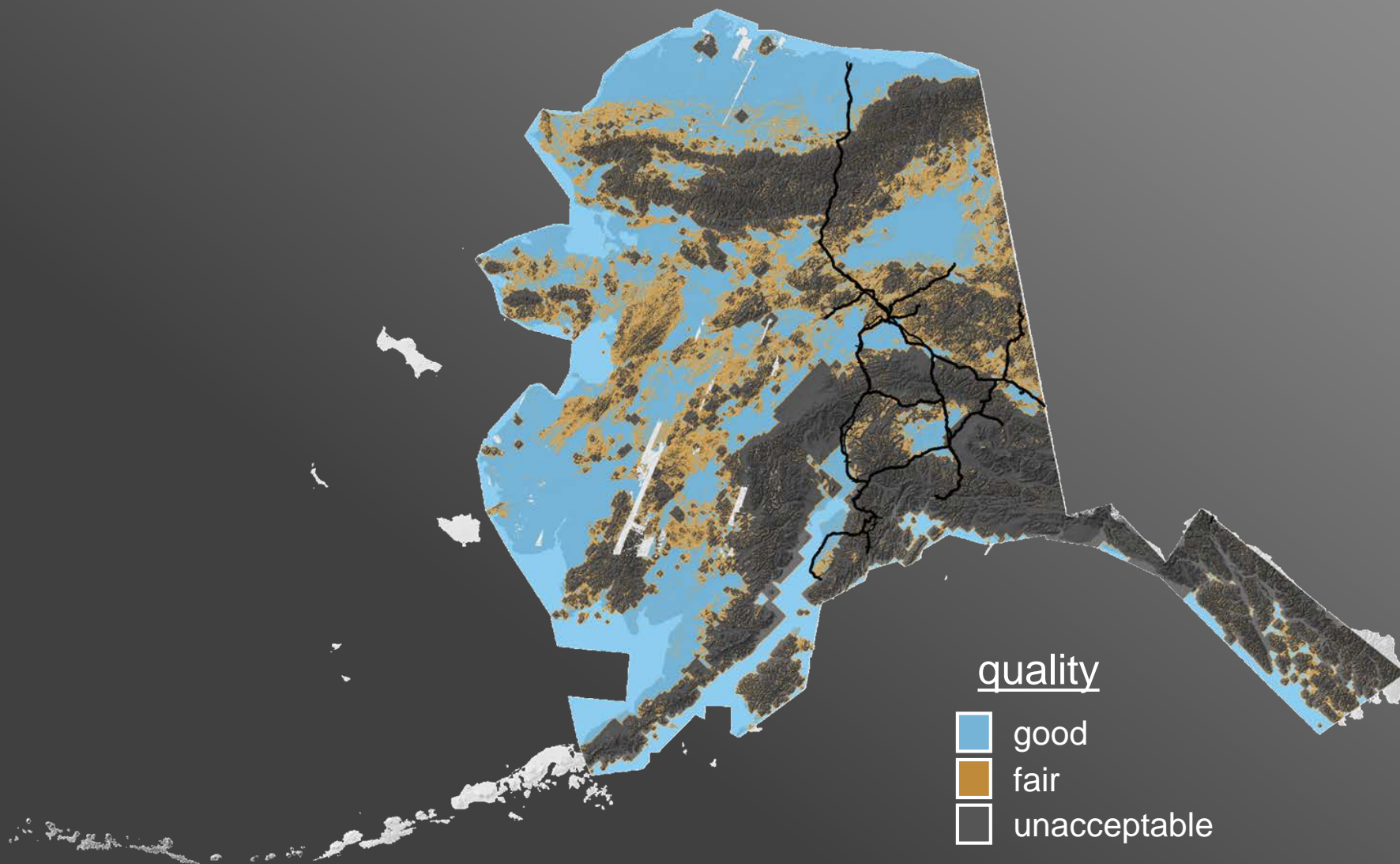


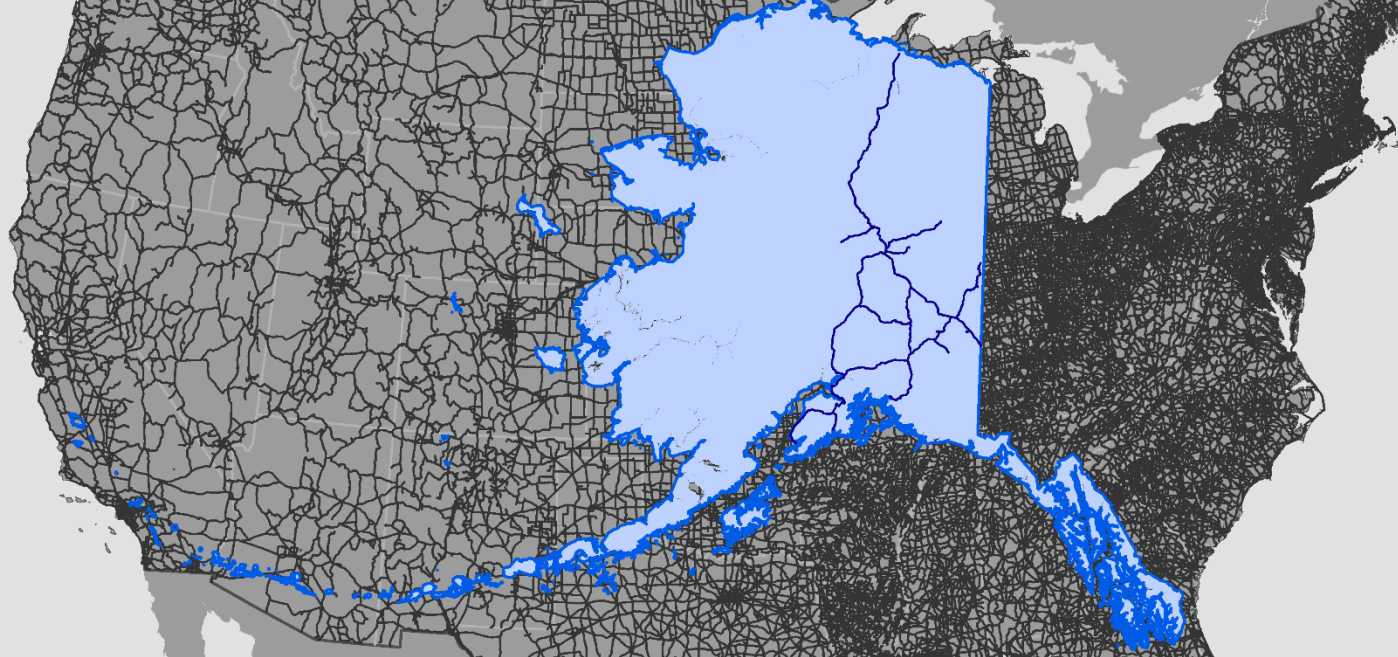
Electromagnetic Data by Fixed-wing





Radiometric Data by Fixed-wing





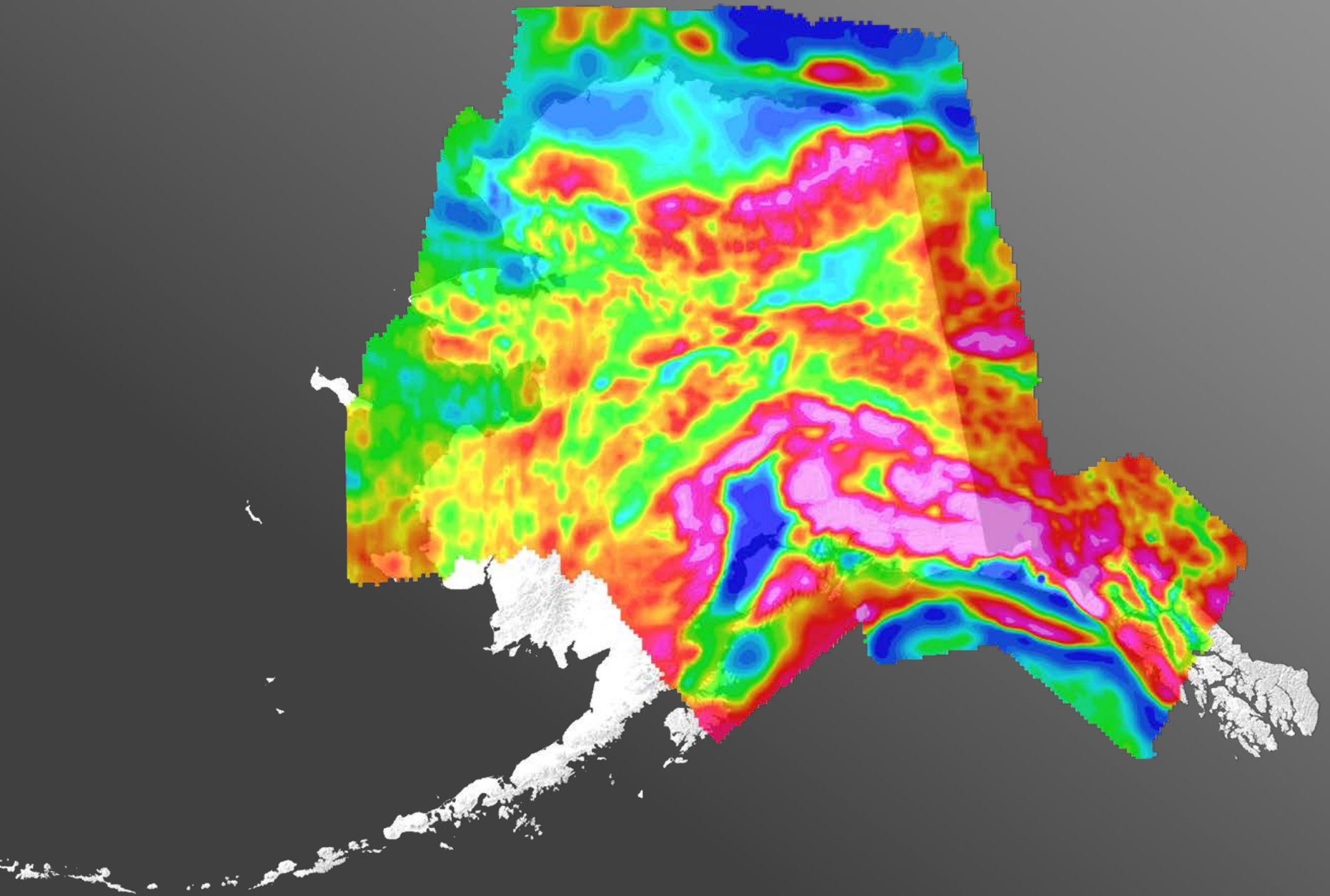
Challenging!



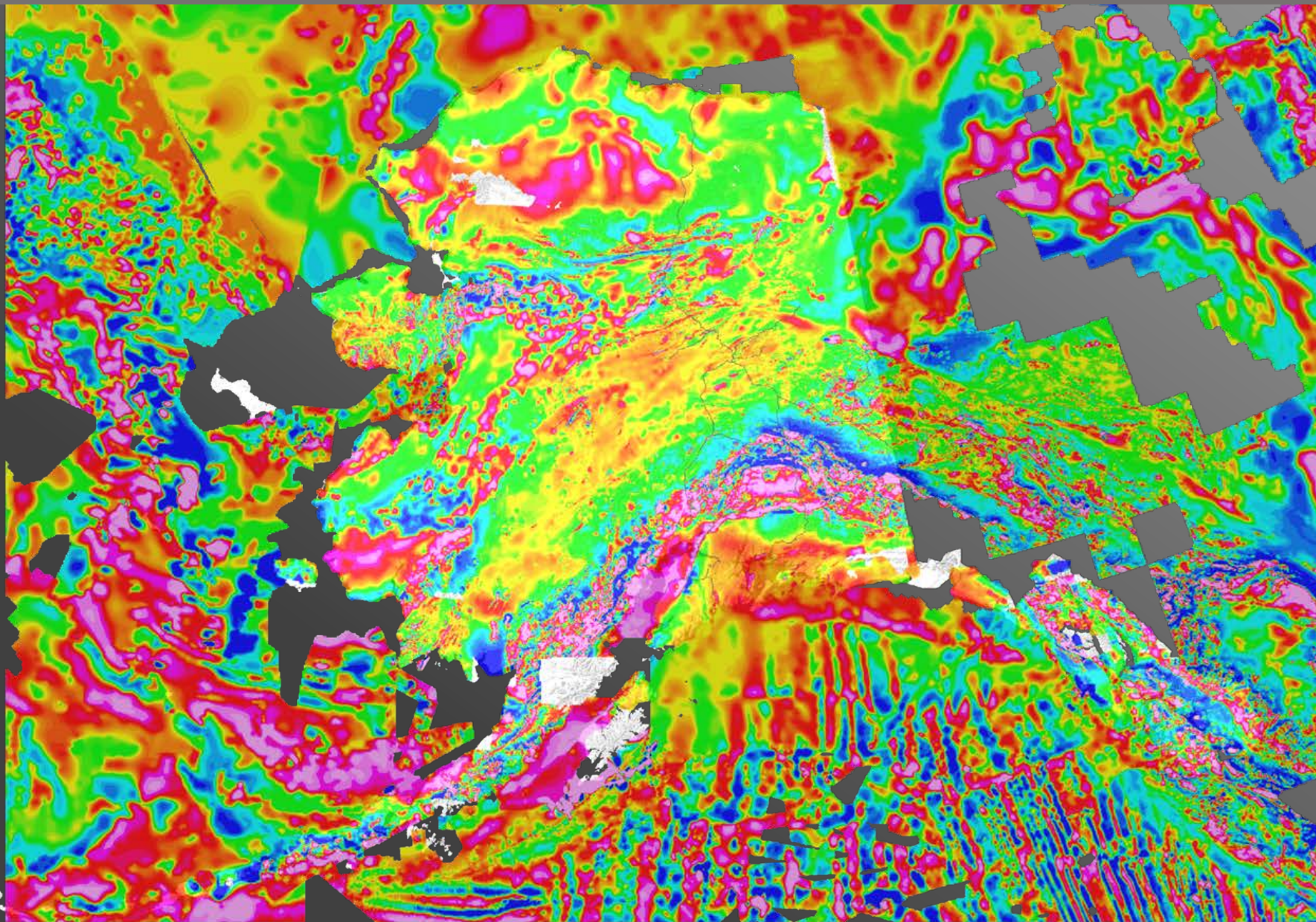
Thank You

contributors: Gina Graham, Alicja Wypych, Melanie Werdon, Steve Masterman, and DGGS staff

NOAA GRAV-D Data for Geology - Free Air Disturbance Map



AK15 Statewide Magnetic Grid





Modern Airborne Geophysical Data Coverage

DGGS Helicopter EM and Mag (400 m line spacing)

- State Funded
- Federally Funded

Percent of Alaska

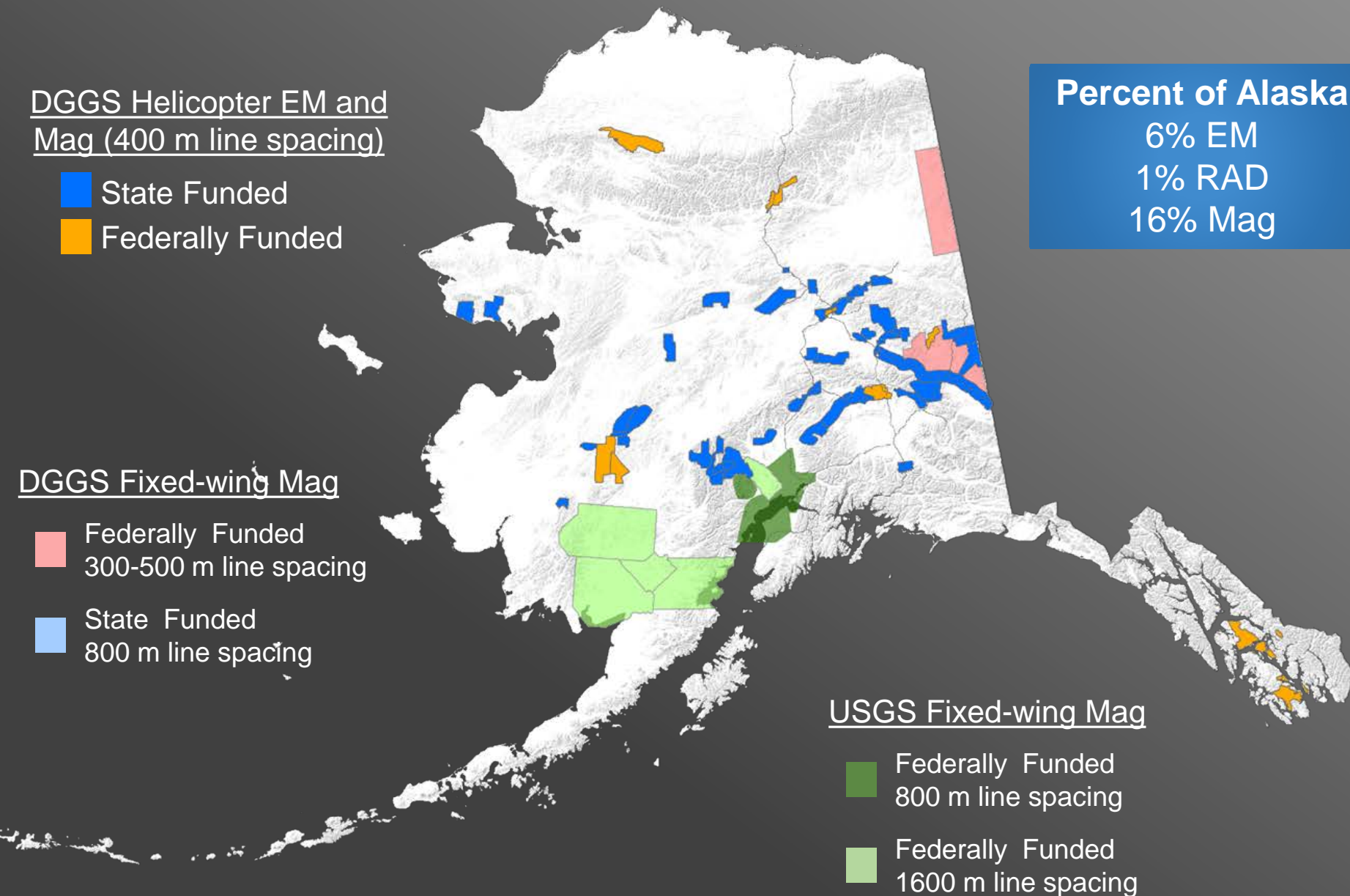
6% EM
1% RAD
16% Mag

DGGS Fixed-wing Mag

- Federally Funded
300-500 m line spacing
- State Funded
800 m line spacing

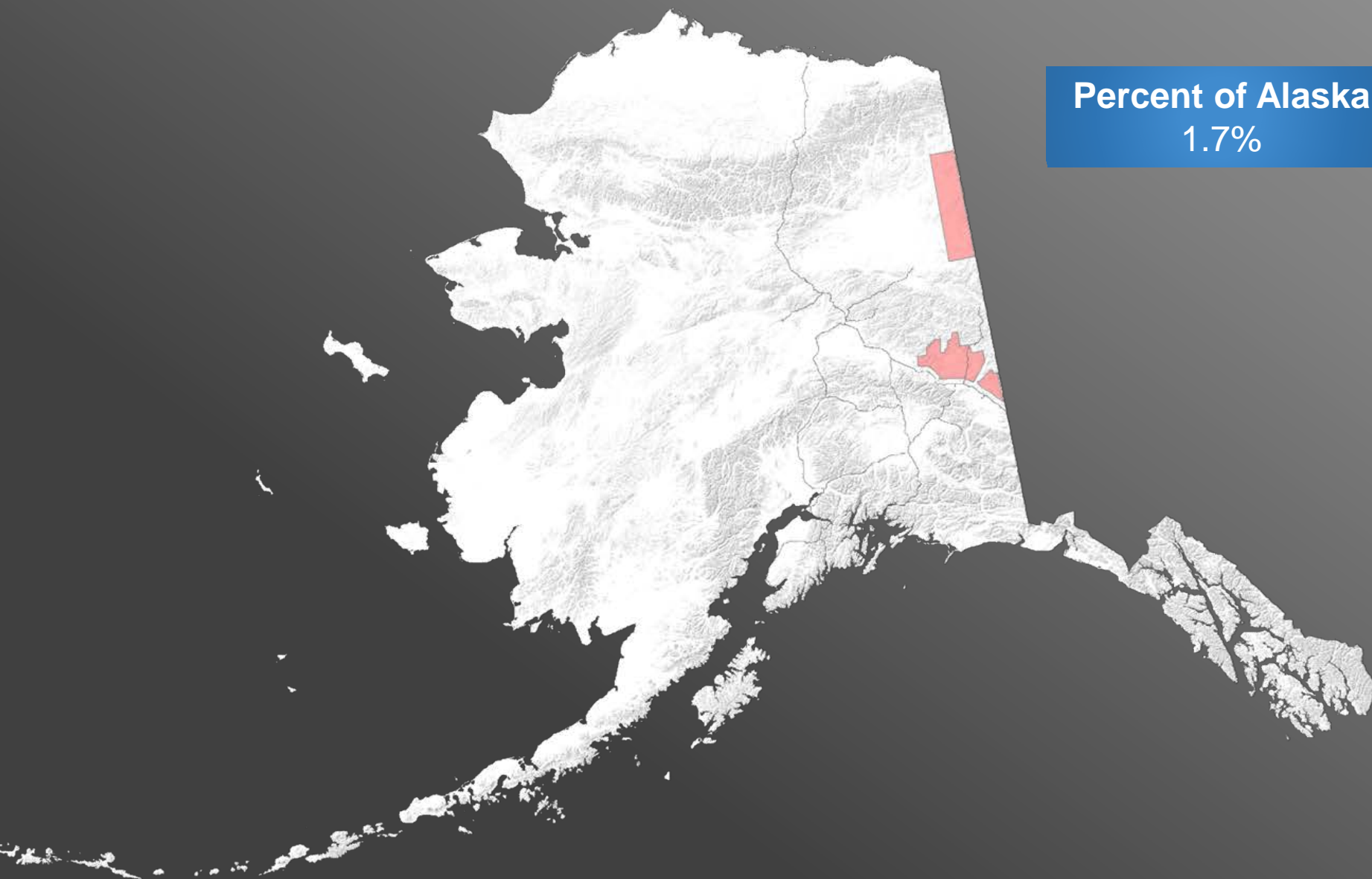
USGS Fixed-wing Mag

- Federally Funded
800 m line spacing
- Federally Funded
1600 m line spacing



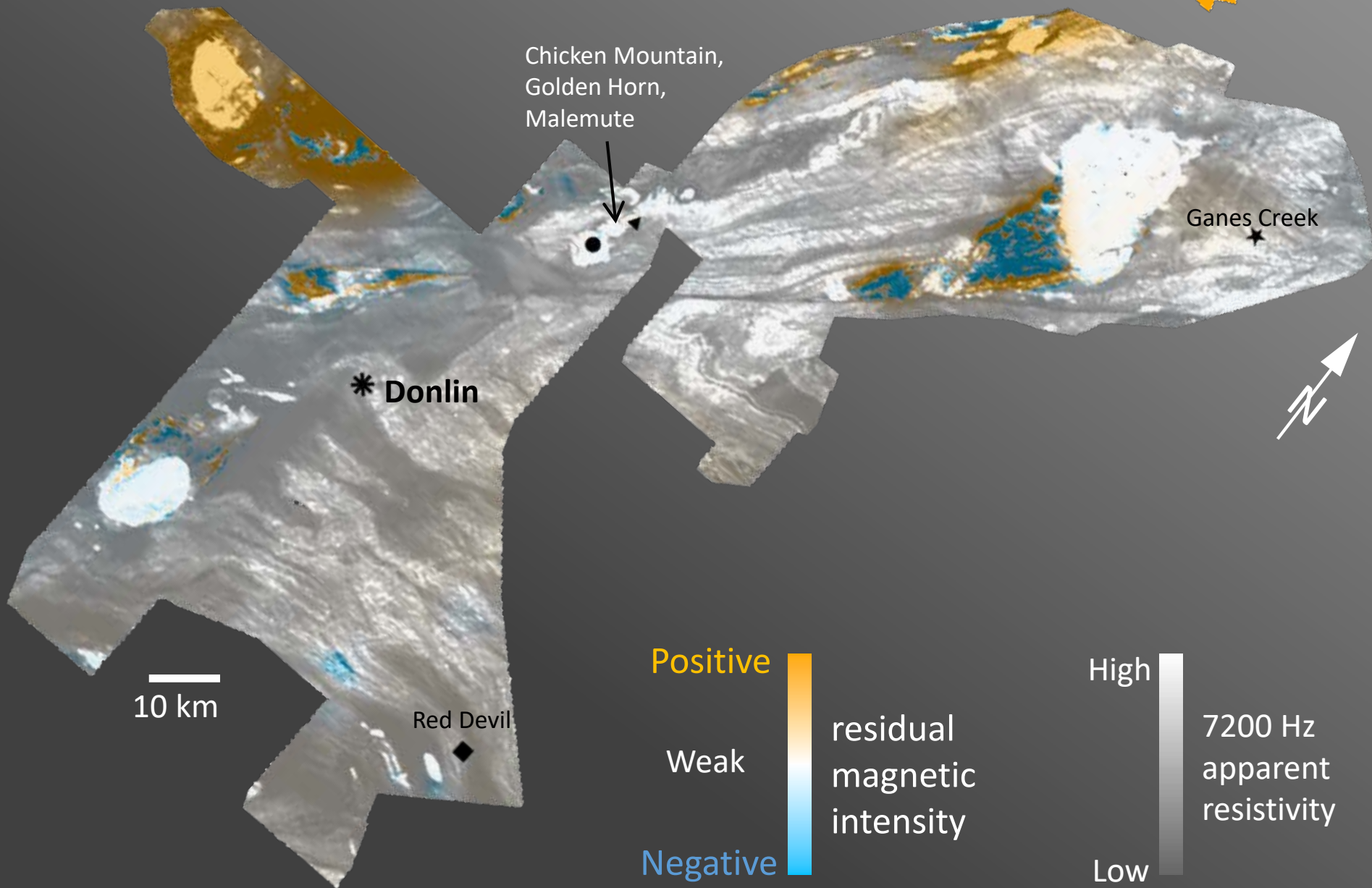


Magnetic Data with **ACCEPTABLE** Ranking by USGS



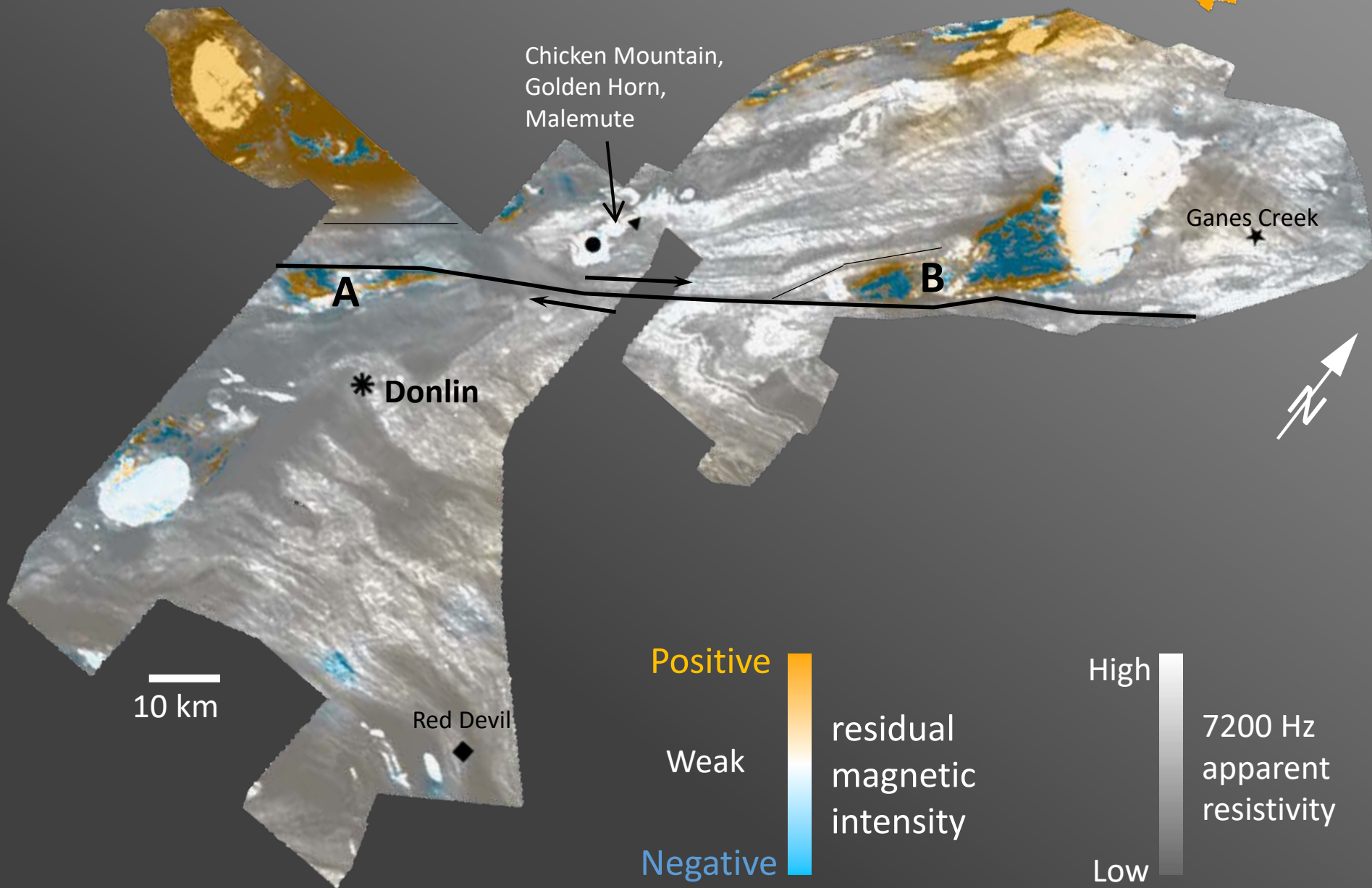


Resistivity and Magnetic Data Composite Map: S. Dishna, Iditarod, Beaver Creek, Sleetmute, Aniak, and Fox Hills surveys



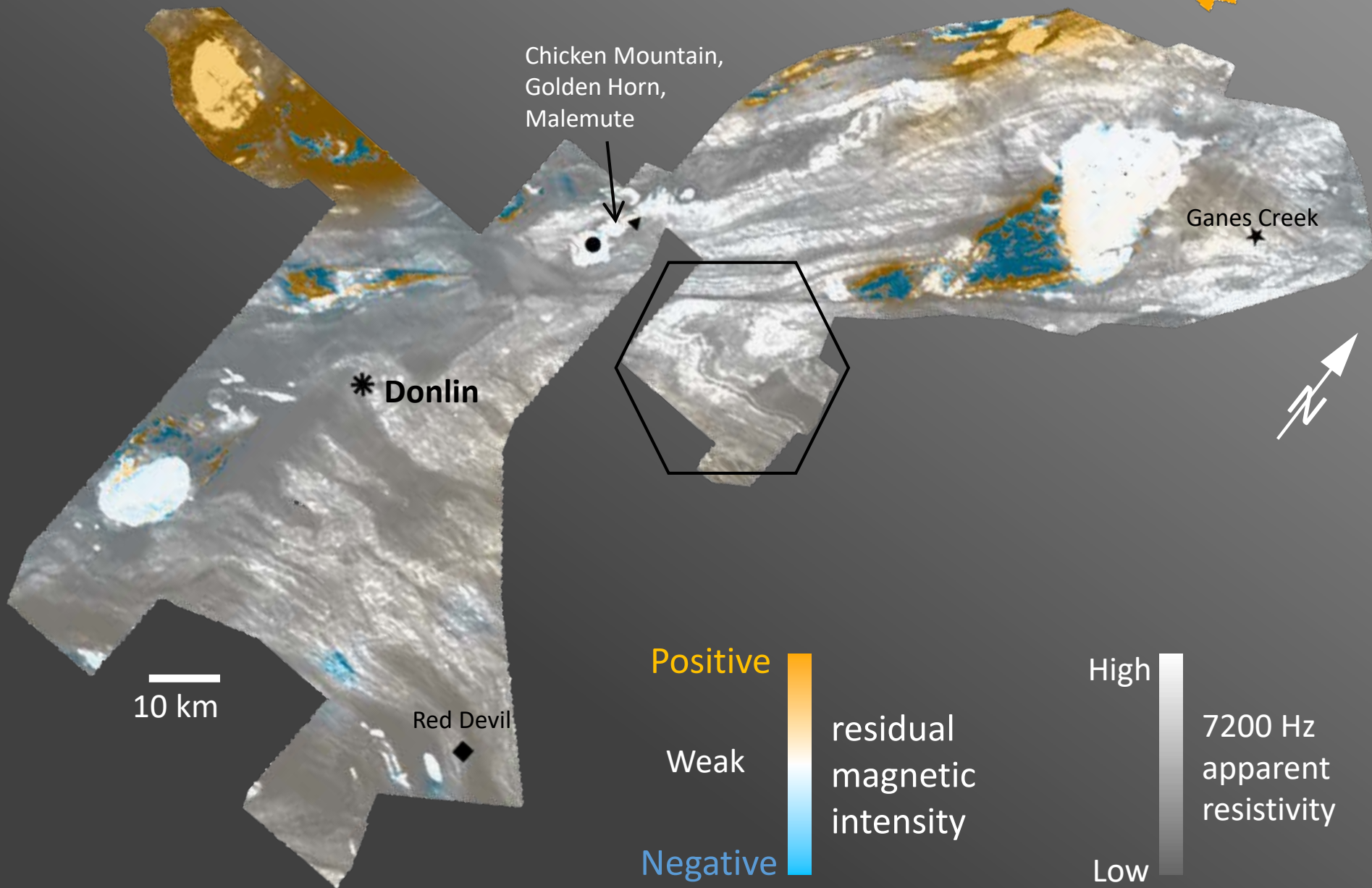


Resistivity and Magnetic Data Composite Map: S. Dishna, Iditarod, Beaver Creek, Sleetmute, Aniak, and Fox Hills surveys



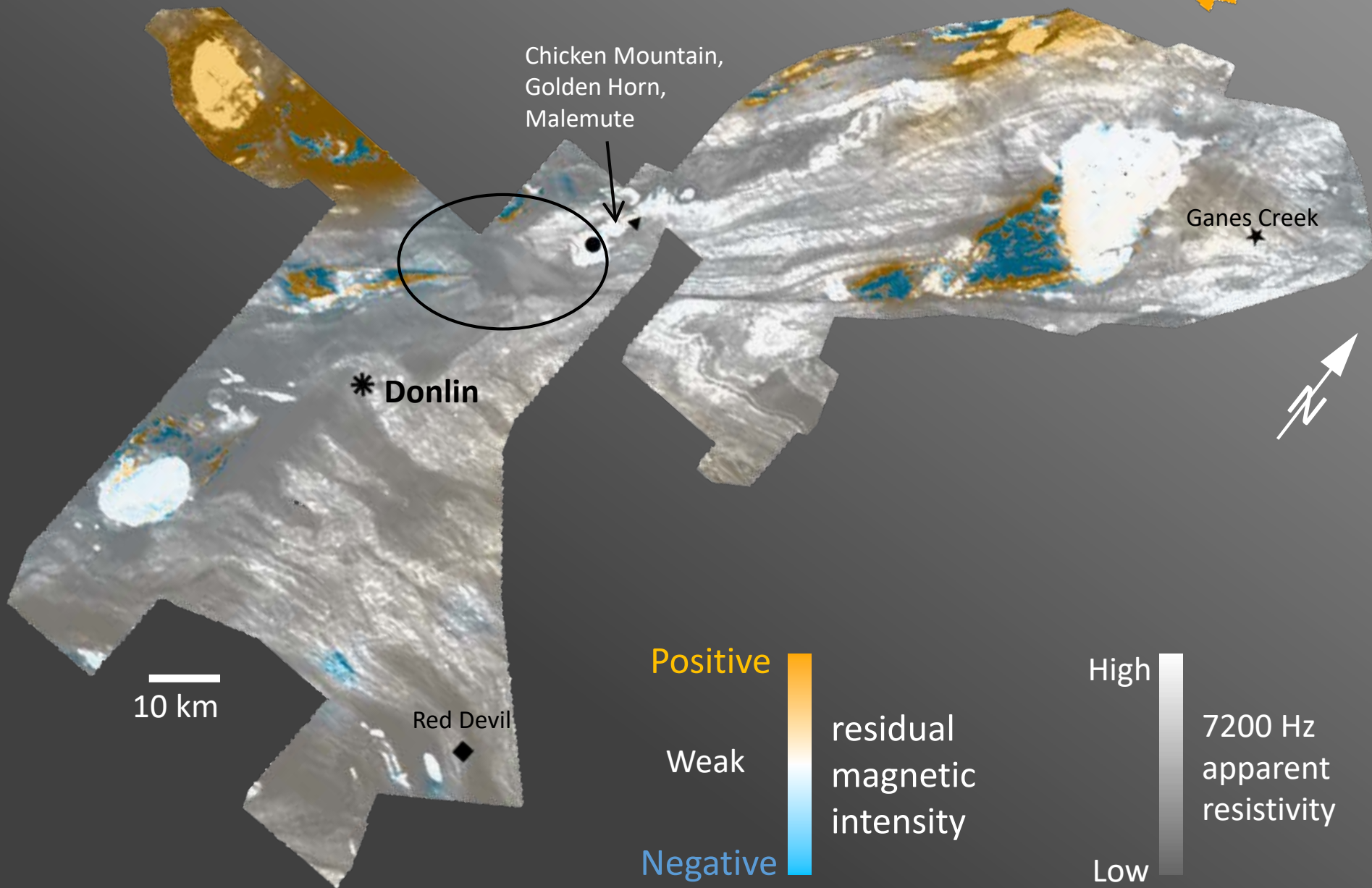


Resistivity and Magnetic Data Composite Map: S. Dishna, Iditarod, Beaver Creek, Sleetmute, Aniak, and Fox Hills surveys



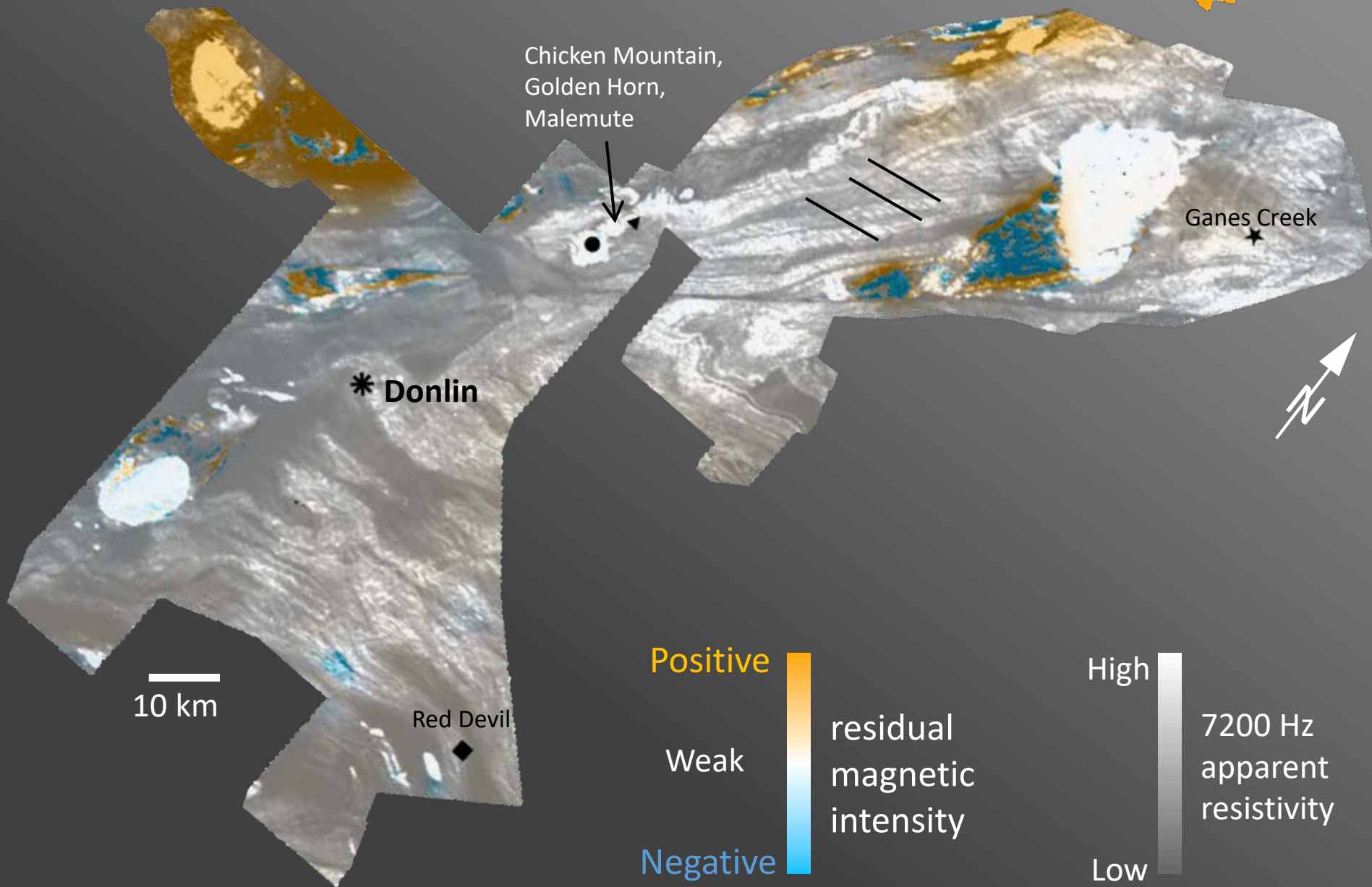


Resistivity and Magnetic Data Composite Map: S. Dishna, Iditarod, Beaver Creek, Sleetmute, Aniak, and Fox Hills surveys



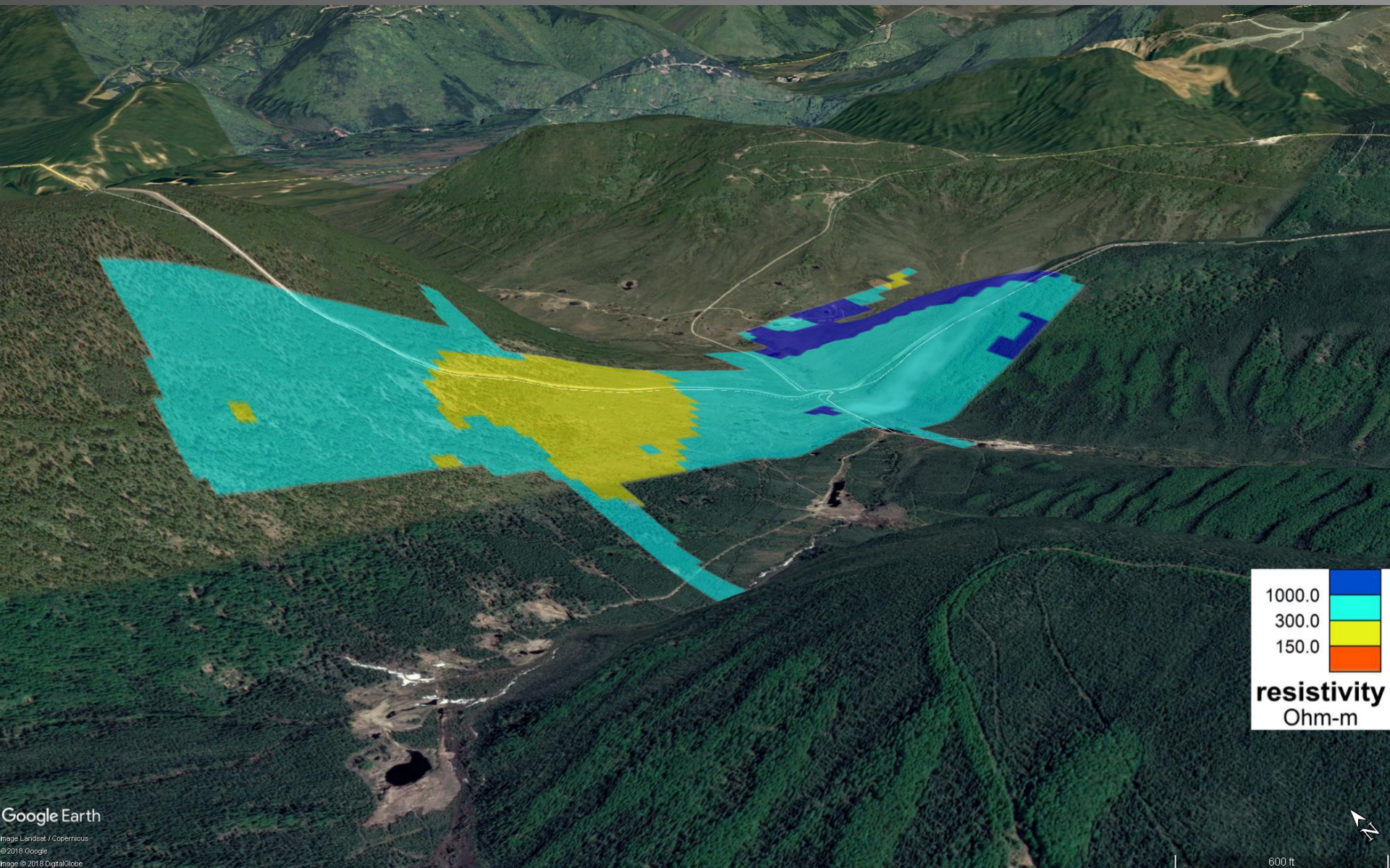


Resistivity and Magnetic Data Composite Map: S. Dishna, Iditarod, Beaver Creek, Sleetmute, Aniak, and Fox Hills surveys



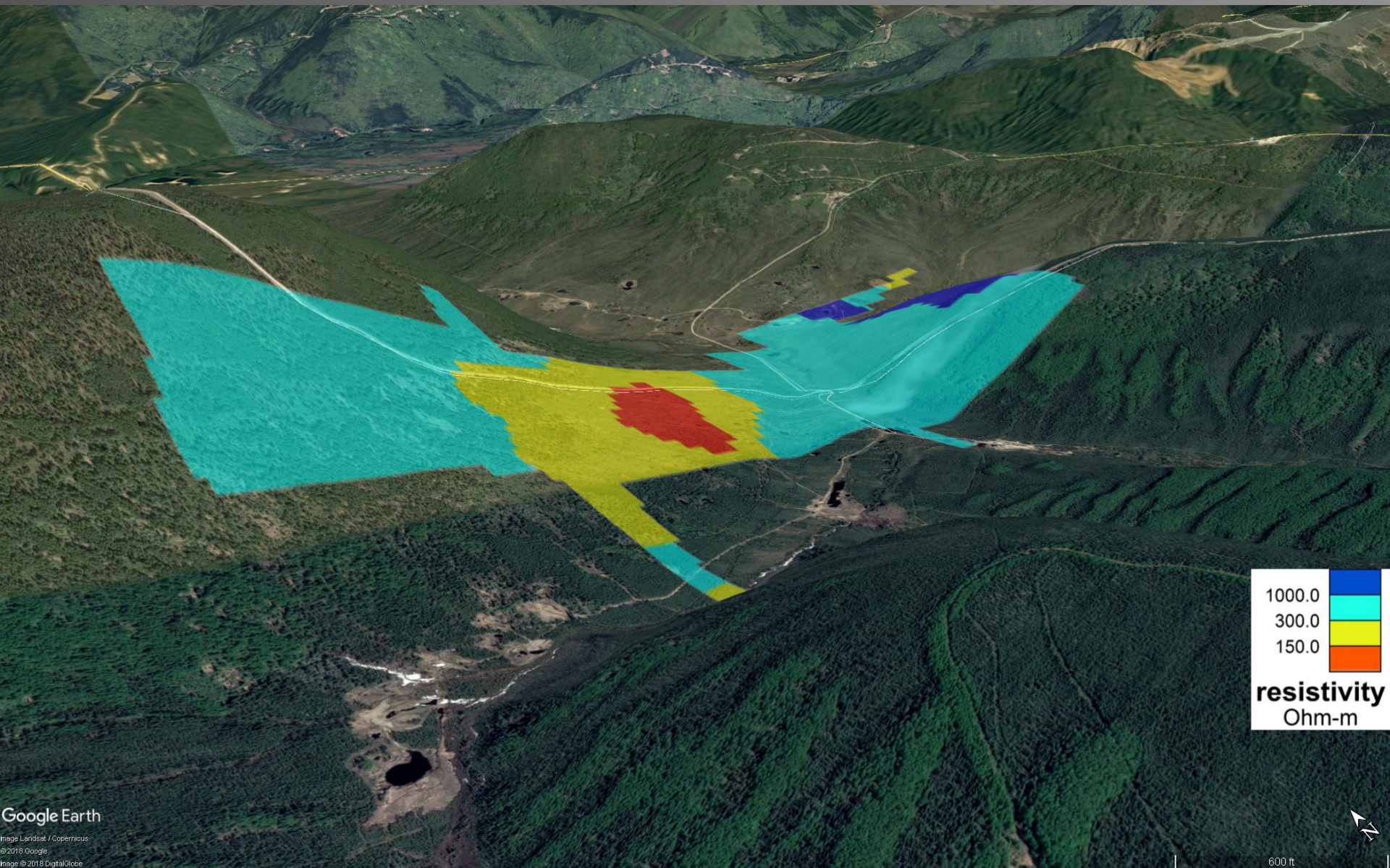


Treasure Creek - Resistivity 39 Meters Depth



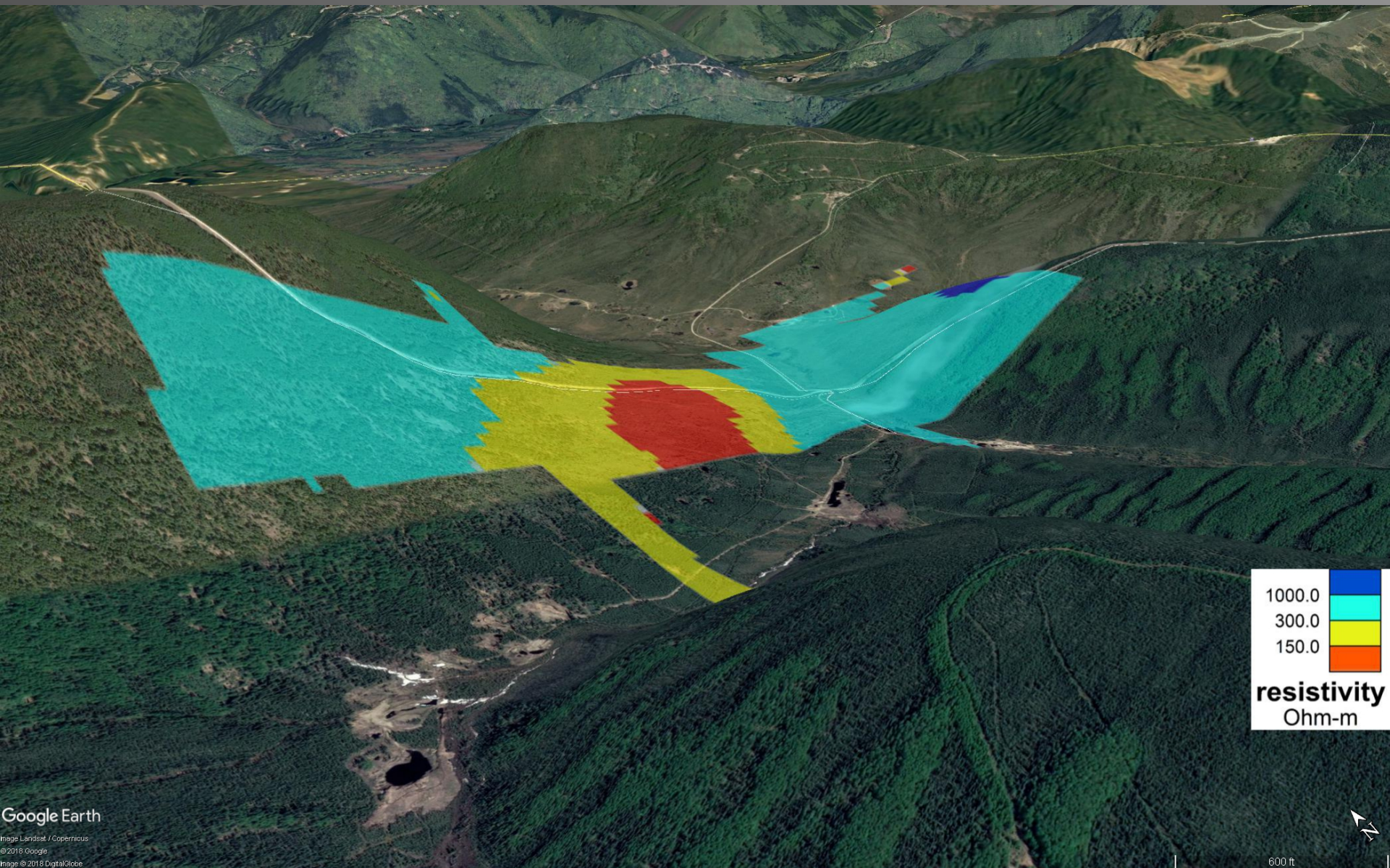


Treasure Creek - Resistivity 55 Meters Depth





Treasure Creek - Resistivity 82 Meters Depth



Google Earth

Image Landsat / Copernicus
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Treasure Creek - Resistivity 109 Meters Depth

