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...

How does DGGS use Airborne Geophysics?

Topography

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

Analytical Data

Outcrop Samples

Photo by: A. Wypych

Geology

5 km
Updated Geologic Map
Magnetic and Electromagnetic Data - Intrusions

- Donlin
- Chicken Mountain, Golden Horn, Malemute
- Ganes Creek
- Red Devil
- Iditarod

Residual Magnetic Intensity 7200 Hz Coplanar Apparent Resistivity

Positive
Weak
Negative

High
Low
Magnetic and Electromagnetic Data - Faults

- Residual Magnetic Intensity
- 7200 Hz Coplanar Apparent Resistivity

Locations:
- Donlin
- Iditarod
- Ganes Creek

Key Locations:
- Chicken Mountain
- Golden Horn
- Malemute

Legend:
- Positive
- Weak
- Negative

Scale: 20 km
Magnetic and Electromagnetic Data – Volcanic Rocks

Residual Magnetic Intensity

Positive
Weak
Negative

20 km

Donlin
40M oz Au

Red Devil

Ganes Creek

Chicken Mountain, Golden Horn, Malemute

Iditarod

7200 Hz Coplanar Apparent Resistivity

High
Low
Imagery and Electromagnetic Data – Folds & Shears

SPOT5 Imagery

7200 Hz Coplanar Apparent Resistivity
Magnetic and Electromagnetic Data – **Folds & Shears**

- **Residual Magnetic Intensity**
  - Positive
  - Weak
  - Negative

- **7200 Hz Coplanar Apparent Resistivity**
  - High
  - Low

20 km
Distinguishing Intrusions

Farewell and Styx surveys

Electromagnetic Data

- Magnetic Data
- Positive
- Weak
- Negative

Radiometric Data

- Th / %K
- High
- Low

Roberts PGEs
Chip-Loy
Eudialyte REEs
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
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

DGGS Electromagnetic Data for Exploration

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 Ridnitşohkka 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

- pipeline
- area for re-opening mineral entry
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 Recommended Closure Area

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

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

Percent of Alaska
16%
Magnetic Data with ACCEPTABLE Ranking by USGS

Percent of Alaska
1.7%
Electromagnetic Data Coverage

Percent of Alaska
6%
Radiometric Data Coverage

Percent of Alaska
1%
Aircraft Type

Fixed-wing
- 5X cheaper
- faster
- terrain limited

Helicopter
- 5X more $$
- slower
- lower
- any terrain
Magnetic Data by Fixed-wing

resolution

- good
- fair
- poor
Electromagnetic Data by Fixed-wing
Challenging!
Thank You

contributors: Gina Graham, Alicja Wypych, Melanie Werdon, Steve Masterman, and DGGS staff
Modern Airborne Geophysical Data Coverage

DGGS Helicopter EM and Mag (400 m line spacing)
- State Funded
- Federally Funded

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

Percent of Alaska
- 6% EM
- 1% RAD
- 16% Mag
Magnetic Data with ACCEPTABLE Ranking by USGS

Percent of Alaska
1.7%
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

10 km

High
Low

residual magnetic intensity

7200 Hz apparent resistivity

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

Donlin

Chicken Mountain, Golden Horn, Malemute

A

B

Ganes Creek

Positive
Weak
Negative

7200 Hz apparent resistivity
Resistivity and Magnetic Data Composite Map:
S. Dishna, Iditarod, Beaver Creek, Sleetmute, Aniak, and Fox Hills surveys

Donlin

Chicken Mountain, Golden Horn, Malemute

Ganes Creek

10 km

Positive
Weak
Negative

residual magnetic intensity

7200 Hz apparent resistivity

High
Low
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

- Donlin
- Chicken Mountain, Golden Horn, Malemute
- Ganes Creek
- Red Devil

Legend:
- Positive
- Negative
- Weak
- High
- Low

Residual magnetic intensity
- 7200 Hz apparent resistivity

Scale: 10 km
Treasure Creek - Resistivity 109 Meters Depth