NEW GEOCHEMICAL AND GEOPHYSICAL DATA FROM THE WESTERN WRANGELLIA MINERALS ASSESSMENT AREA

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Why are we interested in PGEs?

(PGEs = Platinum-group elements: Pt, Pd, Rh, Ir, Os, Ru)

Strategic & Critical Minerals

PGEs essential as catalysts
- Automotive
- Chemical industry
- Your new EPA woodstove

Heavy dependence on foreign sources:
- US Net import reliance: 91% of Pt, 56% of Pd
- Mine production:
  - South Africa + Russia = 92% of Pt, 77% of Pd

1USGS 2013 Commodity summary for Platinum-Group Metals
Where are we going to find PGEs in Alaska?

- **Fairbanks**
- **Anchorage**
- **Project Area**

**Terrane map modified from Colpron and Nelson, 2011**

**Wellgreen**
- 2B lbs Cu
- 2B lbs Ni
- 133m lbs Co
- 2.4M oz Pt
- 3.3M oz Pd*

**MAN Project**

**Caribou Dome**

**Farewell Geophysical Survey**

**Farewell Project**

**Kennecott**

*Life-of-mine production under 2012 PEA (Tetra Tech Wardrop, 2012)
1. New airborne magnetic and electromagnetic data
2. Geologic/geochemical evaluation of Ni-Cu-PGE potential
3. Reanalysis of existing pulps with modern techniques
   ~1600 USGS stream sediment re-analyses by June 30
Geological/Geochemical Program

- Rock samples for multi-element and PGE analysis, lithogeochemistry
- 137 stream sediment samples for multielement geochemistry indicator mineralogy
- Magnetic susceptibility
- Gravity profiles (39km)
- Petrologic and stratigraphic studies
Copper:
Basaltic Cu
Skarn
Ni-Cu-PGE

Log transformed
\[ z = \frac{\text{value} - \text{mean}}{\text{std dev}} \]
“anomaly map”
(no economic threshold implied)

3.82 % Cu
24 g/t Ag
(Skarn)

4.19 % Cu
21 g/t Ag
(Basalt)

9.8 % Cu
22.6 g/t Au
104 g/t Ag
(Skarn)

1.94 % Cu
2.5 % Ni
0.06 % Co
395 ppb Pt
706 ppb Pd
(Magmatic sulfide)

Data released on April 9th as RDF 2014-3:
http://www.dggs.alaska.gov/pubs/id/27181
Copper:
Basaltic Cu
Skarn
Ni-Cu-PGE

$z = \frac{\text{value} - \text{mean}}{\text{std dev}}$

“anomaly map”
(no economic threshold implied)

Legend
- Rock
- Stream Sed
- Pan Con

Z-Score
- < -3
- -3 to -2
- -2 to -1
- -1 to 1
- 1 to 2
- 2 to 3
- 3 to 4
Intrusion-related systems

- 1.29 g/t Au
- 3.84 g/t Au
- 15.35 g/t Au
- 22.6 g/t Au

Legend:
- Rock
- Stream Sed
- Pan Con
- Z-Score
  - < -3
  - -3 to -2
  - -2 to -1
  - -1 to 1
  - 1 to 2
  - 2 to 3
  - 3 to 4

Scales:
- 0 to 30 Miles
- North (N)

Map shows various locations with different gold concentration levels.
Intrusion-related systems
Magmatic System: Ni-Cu-Co-PGE
Mafic-Ultramafic intrusions
Normative mineralogy; DGGS & USGS data

- Gabbroic: troctolite, olivine gabbro
- Ultramafics: harzburgite, dunite
- Olivine gabbro
- Gabbro, gabbronorite, olivine gabbro

Plagioclase
Pyroxene
Olivine
Peak 5532 Gabbroic Complex

- Gabbronorite
- Olivine gabbro
- Olivine-rich troctolite
- Olivine gabbro
- Hornfels
Peak 5532: Cross Section

Based on measured dips, approximately 700 m (2300 feet) thick
Peak 5532: Modal Zonation

General pattern of more mafic, more olivine towards center of the most mafic phase of the complex
Ni-Cu-PGE deposit-forming processes

Diagram modified from Arndt et al, 2005

Two Challenges:
1) Extract magma from the mantle without losing the Ni-Cu-PGE
2) Concentrate the Ni-Cu-PGE as high grade ores
Ni-Cu-PGE deposit-forming processes

Scenarios:

A. **Sulfide** saturation at a deep level: PGE, Cu, Ni not extracted with melt

B. **Olivine** saturation at a deep level: Ni not extracted

C. Sulfide, olivine are undersaturated until high level emplacement: Sulfide melt can separate, interact, and accumulate in economic quantities

Diagram modified from Arndt et al, 2005
Peak 5532: Olivine Compositions

Microprobe data (WDS) collected at UAF’s Advanced Instrumentation Laboratory

Yukon data from Hulbert, 1997
Peak 5532: Magmatic Fe-Ni Sulfides

- Olivine
- Plagioclase
- Pyrrhotite/
Pentlandite
- Magnetite

BSE images
**PGE content of sulfide**

Disregards variable sulfide concentrations, focuses on magmatic system processes (no relation to economics)

High values imply a high degree of sulfide-silicate melt interaction

Comparable values to Wellgreen deposit, YT, Norilsk, Russia

Much less than Stillwater J-M

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Concentrations in 100% sulfide*

- < 0.1 ppm
- 0.1 to 1 ppm
- 1 to 3 ppm
- 3 to 10 ppm
- > 10 ppm

DGGS sample

BLM sample

*sulfide calculated using 35.7% S

Wellgreen data: Hulbert (1997); BLM data are from Bittenbender et al (2007)
Stay Tuned: 2014 STATEMAP Project: Talkeetna Mountains C-4

• 1:50,000
• Bedrock & surficial maps
• Structural history
• Ni-Cu-PGE potential
• USGS STATEMAP matching grant

Geology after Wilson and others, 1998
Four Mag & EM Surveys

Wrangellia survey released January 2014 as GPR 2014-1
Online at: http://www.dggs.alaska.gov/pubs/id/27022
“Major” Mapped Faults

DENALI

“TALKEETNA THRUST”

“A FAULT”
NE area Magnetics

High values

Low values
Analytic Signal

High values

Low values
Color Shadow Magnetics

Residual Magnetic field in 3-D

High values

Low values

nT
Color Shadow Magnetics

High values

Low values

nT
Color Shadow Magnetics

High values

Low values
Detailed and Regional Magnetics

Valdez Creek not shown

Iron Creek not merged
References Cited


