Project Overview and Critical Minerals in Alaska

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KEY MINERALS IN ELECTRIC & HYBRID CARS

Batteries
Body
Catalytic converter
Electrical system
Frame
Motor
Safety system
and more...

2016 IMPORT RELIANCE

Canada
Ni
Nickel

Al
Zn
Aluminum
Zinc

Tb
La
Dy
Pr
Nd
Terbium
Lanthanum
Dysprosium
Praseodymium
Neodymium

V
Vanadium

Y
C
W
Yttrium
Graphite
Tungsten

Li
Lithium

Co
Cobalt

Cr
Mn
Chromium
Manganese

China

D. R. Congo
Czechia
Chile
South Africa

Hybrid and electric cars contain minerals for which the USA is >50% IMPORT RELIANT

Information from USGS Professional Paper 1802

AASG
Association of American State Geologists
Energy Transition Impact

Metals Demand From Energy Transition May Top Current Global Supply
Projected Demand

**Metals in a net-zero scenario**
Current production rates of some important metals, including copper, are likely to be inadequate to satisfy future demand. (supply/demand ratio, energy and non-energy demand coverage)
Revised Critical Minerals

<table>
<thead>
<tr>
<th>Objective from the FOA</th>
<th>UAF/DGGS Task Equivalent</th>
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</thead>
<tbody>
<tr>
<td>Basinal Assessment of CORE-CM Resources</td>
<td>Task 2: Basinal Assessments</td>
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<tr>
<td>Basinal Strategies for Reuse of Waste Streams</td>
<td>Task 3: Waste Stream Reuse</td>
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<td>Task 6: AK-TIC</td>
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<td>Task 7: Stakeholder Outreach &amp; Education</td>
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**Proposed Removals**:
- HAFNIUM
- RHELIUM
- TANTALUM
- URANIUM
- GERMANIUM
- INDIUM
- GALLIUM
- RARE EARTHS
- BERYLLIUM
- ZIRCONIUM
- TUNGSTEN
- ALUMINUM
- PGMs
- BARITE
- FLUORSPAR
- ARSENIC
- STRONTIUM
- TITANIUM
- ZINC
- NICKEL
- MANGANESE
- VANADIUM
- NIOMBIUM
- MAGNESIUM
- CHROMIUM
- TIN
- TELLURIUM
- LITHIUM
- COBALT
- ANTIMONY
- GRAPHITE
- RUBIDIUM
- CESIUM
- BISMUTH

**Proposed Additions**: Solar/Wind/Batteries/EV

**Solar/Wind**, **Batteries/EV’s**, **Solar/Wind/Batteries/EV**

USGS OFR 2018-1021 describes uses and methods
Meeting Increased Demand

1) Reduce Demand
2) Recycling
3) Substitution
4) Trading partners and supply chain stability
5) Stockpiling
6) Increase production:
   1) Brownfields production
      1) Recovery from waste streams
      2) Increase recovery from current production
   2) New mines
2019 U.S. Critical Minerals Import Reliance

NOTE:
Does not include beryllium, selenium, zirconium, and hafnium, as these commodity data are not available.

SOURCE:
USGS, 2020, Mineral Commodity Summaries
CORE-CM

- Phase 1
  - Basin Assessment
- Phase 2
  - Planning and Initial Implementation
- Phase 3
  - Strategic Plan Implementation

Developing solutions for commercializing REE-CM mineral recovery from carbon ores and associated materials and waste streams
Phase 1

Basin Resources Assessment

- Carbon ore REE and critical mineral basin-focused critical mineral resource assessments
- Assessment of technology needs and initial testing
- Understand industrial and energy needs for development
- Develop strategy for integrating regions resources, infrastructure, needs and opportunities
Phase 2

Planning and Initial Implementation

- Build on Phase 1 CORE-CM basin-focused critical mineral resource assessments
- Technology development and field validation for production of REE’s, CM’s and high-value carbon-ore based resources
Phase 3

Strategic Plan Implementation

- Recovery technology development and field testing
- Execution of technical solutions and commercialization plans
- Programs for outreach, education and training
## Phase 1 Overview

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Critical Mineral Occurrences

Legend
- State land
- REE + Yttrium
- Platinum-Group Elements
- Chromium
- Cobalt
- Tantalum
- Niobium
- Graphite
- Tungsten
- Antimony
Select Significant Critical Mineral Occurrences
Mines and Advanced Projects - Brownfield Opportunities

Red Dog
Zn, Pb, Ag (Ge, Ga, In, Ba)

Arctic & Bornite
Cu, Zn, Pb, Au, Ag Co (As, Ge, Ga, PGE)

Graphite Creek

Donlin
Au (As, Hg, Sn, Be, W)

Pebble
Cu, Au, Mo (Re, Pd, Te, Bi)

Livengood
Au (As, Sb?)

Fort Knox
Au (W, Sn, Te, Bi, As, Sb)

Pogo
Au, (W, Te, As, Sb)

Palmer
Cu, Zn, Pb, (Co, Bi, Te, In, Sn, Ge, Ga, Sb, Ba)

Kensington
Au (As, Bi, W, Sb)

Greens Creek
Ag, Au, Zn, Pb (Sn, Bi, In, Ge, Ga, Sb, As, Ba)

Bokan Mountain
(HREE, U, Hf, Zr, Nb)
CM’s in Alaska

Karl et al., 2016, USGS OFR 2016-1191
REE-Th-Y-Nb(-U-Zr)
PGE (-Co-Cr-Ni-Ti-V)
Placer/paleoplacer Au
Sn-W-Mo (-Ta-In-fluorspar)
Sandstone U (-V-Cu)
Cu (-Co-Ag-Ge-Ga) in carbonate

Au(-W-Sb-As-Hg-Bi)
REE-Th-Y_Nb
PGE-(Co-Cr-Ni-Ti-V)
CRITICAL MINERAL BELTS

Partial Evaluation of Alaska’s Critical Mineral Potential

USGS Studies of Alaska’s Critical Minerals
- Covered
- Not covered

Carbon Ores in Alaska

- Estimated to contain more than 5 trillion short tons of coal—over half the coal in North America
- 50+ coal fields deposited in a variety of tectonic settings
- Coarse graphite on the Seward Peninsula
REE & Coal Basins
Ray Mountains

- Eocene Lignite - Subbituminous coal seams up to 18’ thick in fault bounded grabens
- Ge to 1%
- Ga to 0.08%
- W to 2%
- REE’s to 0.16% in ash

Barker, 2006
Dickinson et al., 1987
Clough et al., 1995
Boulder Creek

- Paleocene coals up to 175 feet thick occur in graben bounded by Kugruk fault and overlain by Associated sandstone has epigenetic and supergene U-mineralization averaging 0.27% and a calculated resource of 1,000,000 pounds of $U_3O_8$. 

Graphite One

- North America’s largest large-flake graphite deposit, located on Alaska’s Seward Peninsula
- Minimum total resource of 10.95 million tonnes at 7.8% carbon as graphite.
- Small amounts of REEs were identified in residue from thermally processed graphite concentrate.
Carbon-rich rocks

- Mudstones with very high total organic carbon
- Isolated occurrences of tasmanite yield anomalous vanadium concentrations
- North Slope Triassic mudstone intervals host high phosphorous, fluorite, REE, V
- Many highly condensed shales are interbedded with abundant airfall volcanic material, potentially influencing their REE/CM content
Airborne Geophysics

### Coverage Needs at End of FY2022

<table>
<thead>
<tr>
<th>Area</th>
<th>Sq. Km Done</th>
<th>% Done</th>
<th>Sq. Km Not Done</th>
<th>% Not Done</th>
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</thead>
<tbody>
<tr>
<td>INT</td>
<td>92,072</td>
<td>63.5%</td>
<td>52,907</td>
<td>36.5%</td>
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<tr>
<td>SP</td>
<td>3,175</td>
<td>4.2%</td>
<td>72,687</td>
<td>95.8%</td>
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<tr>
<td>SE</td>
<td>4,976</td>
<td>6.3%</td>
<td>74,605</td>
<td>93.7%</td>
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<tr>
<td>Ruby</td>
<td>1,329</td>
<td>4.3%</td>
<td>38,474</td>
<td>95.7%</td>
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<tr>
<td>AR</td>
<td>7,628</td>
<td>20.4%</td>
<td>29,767</td>
<td>79.6%</td>
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<tr>
<td>SBR</td>
<td>1,329</td>
<td>2.2%</td>
<td>58,764</td>
<td>97.8%</td>
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<tr>
<td>SW</td>
<td>10,082</td>
<td>12.2%</td>
<td>72,436</td>
<td>87.8%</td>
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<tr>
<td>TOTAL</td>
<td>120,591</td>
<td>23.2%</td>
<td>399,640</td>
<td>76.8%</td>
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</table>

- Critical Mineral Belts
- Road System
THANK YOU

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