# Alaska's Mineral Industry in 2018: Mines, Development, & Exploration

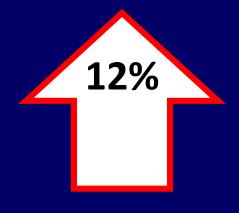








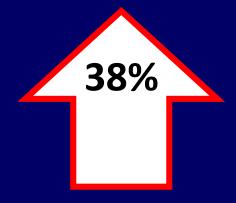
# Status of Alaska's Mineral Industry - 2017



Value of Alaska's
Mineral Industry in 2017
(US\$3.15 Billion)



**Exploration Expenditures**(US\$120.8 million)



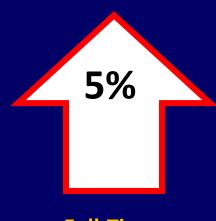
Development
Expenditures
(US\$299.5 Million)



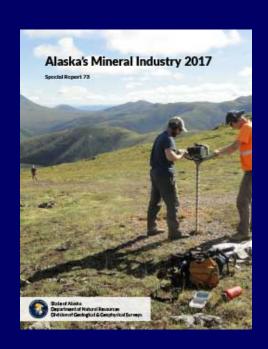
Estimated Revenue to Industry







Full-Time Employment







### 2018 Alaska Mineral Production

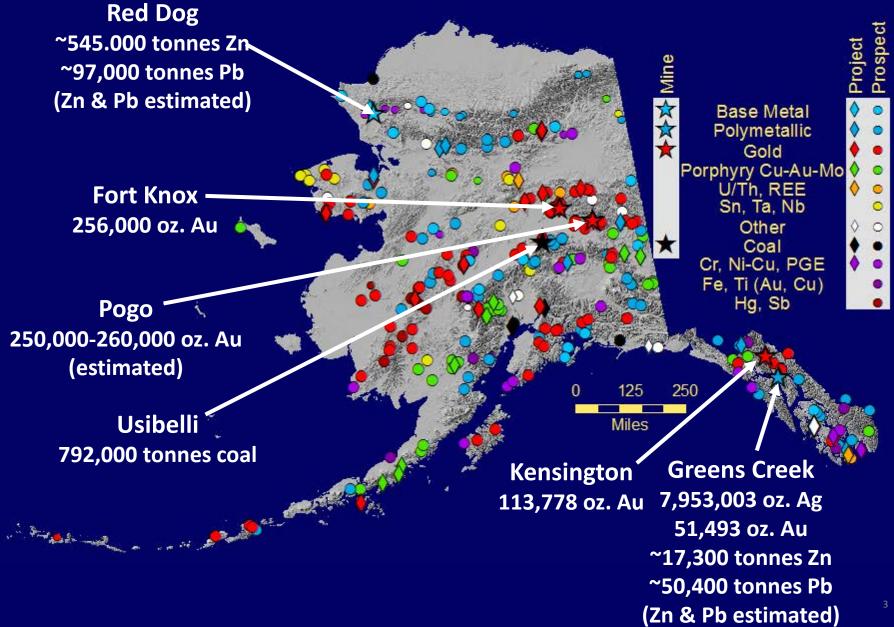
5 major lode mines

1 coal mine

~ 230 placer Au mines

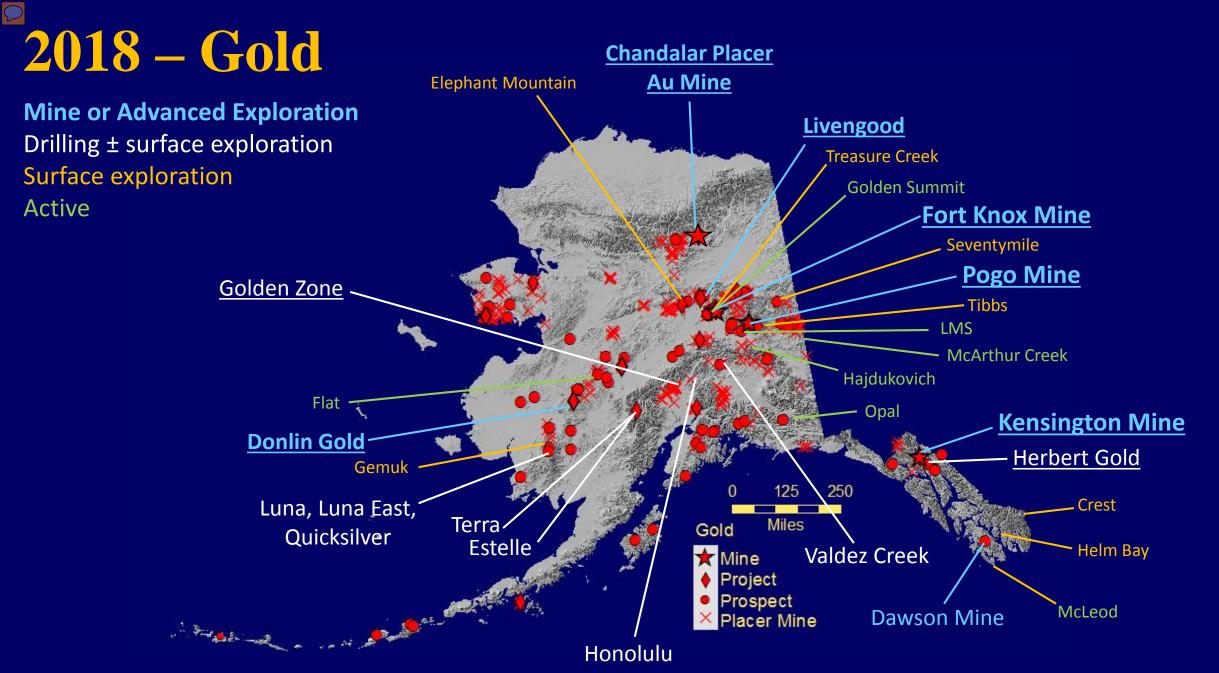
~ 52 exploration projects

|    | 2018 Production |
|----|-----------------|
| Zn | ~562,000 tonnes |
| Pb | ~147,000 tonnes |
| Au | ~625,000 oz.    |













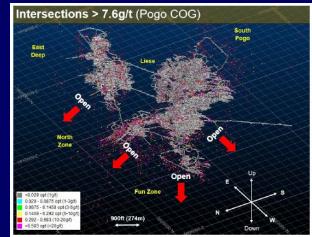
# Pogo Mine [Northern Star Resources Limited]

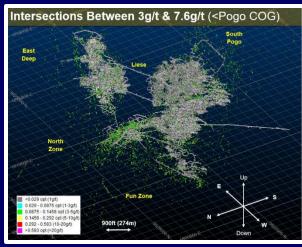
#### Northern Star acquired Pogo for US\$260 M

-Underground, shear zone/quartz vein-hosted gold mine

Estimated 2018 Production: 250,000-260,000 oz Au

|          | Million<br>Tonnes | Au g/T | Ounces<br>(million) |
|----------|-------------------|--------|---------------------|
| Reserve  | 1.98              | 11.9   | 0.76                |
| Resource | 6.8               | 15.5   | 3.39                |
| Total    | 8.78              | 14.7   | 4.15                |

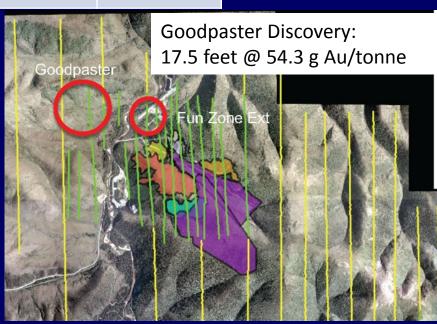


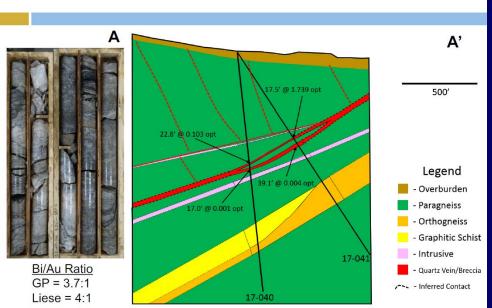


Intersections: Au >7 g/tonne (pink, left) and Au >3 g/tonne (green, right)

#### Plans through July 2019:

- -Invest AUS\$15-20 M in exploration/drilling
- -8 drill rigs
- -Switch from mining
- >7 g/T Au to >3 g/T Au
- -More ore through mill
- -Ramp up exploration





Goodpaster Generalized Geologic Section





### Fort Knox Mine [Kinross Gold corporation]

Open-pit gold mine; intrusion hosted

-Produced 256,000 oz. Au (2018)

#### **Gilmore expansion:**

- -Added 2.4 M oz. Au to resource; IRR 17%
- -Initial production in 2020
- -Extends mine life through 2027
- -2019-2027 annual production: 245,000 oz. Au

#### **Barnes Creek Heap Leach:**

- -New 172.4-M-tonne-capacity heap leach pad
- -Construction underway; leaching through 2030

|                      | Million<br>Tonnes | Au g/T | Ounces<br>(million) |
|----------------------|-------------------|--------|---------------------|
| Reserves             | 282.2             | 0.37   | 3.37                |
| Measured & Indicated | 146.9             | 0.38   | 1.8                 |
| Inferred             | 105.6             | 0.32   | 1.09                |
| Total                | 534.7             | 0.36   | 6.26                |

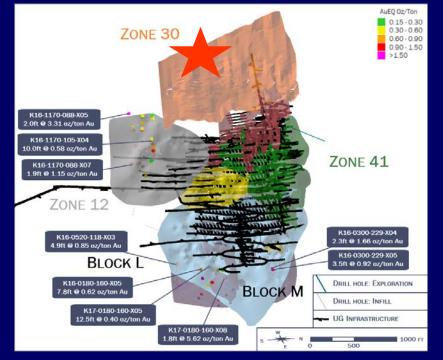






## Kensington Mine [Coeur Alaska, Inc.]

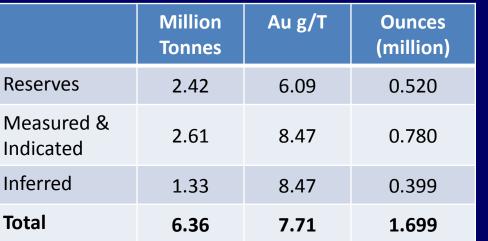
- -Underground mine: mesothermal-gold quartz-vein system
- -Produced: 113,778 oz. Au
- -Infill drilling Upper Kensington Zone 30 resource
- -Resource expansion on new Seward, Ophir, and Elmira veins
- -First Jualin production December 2018



Kensington Main: NW section with drill intercepts



Map of Kensington area deposits





Elmira vein



# Livengood [International Tower Hill Mines]

- -Metasediment-hosted, intrusion-related gold system
- -Easy access to road and power

| April 2017                        | Million<br>Tonnes | Au g/T | Ounces<br>(million) |
|-----------------------------------|-------------------|--------|---------------------|
| Proven &<br>Probable              | 392               | 0.71   | 8.9                 |
| Measured, Indicated & Inferred*** | 578               | 0.68   | 12.6                |

<sup>\*\*\*</sup>Inclusive of reserves



-6.8 M oz of Au

-23-year mine life

-52,600 tons/day

2018 program:

-US\$5.1 million work program

-Metallurgical studies

-4,000 kg of new metallurgical composites

-Ongoing environmental studies



Drilling atop the Money Knob area of the Livengood Project









# Donlin Gold (Development stage) [50% Barrick Gold Corp./50% NovaGold Resources Inc.]

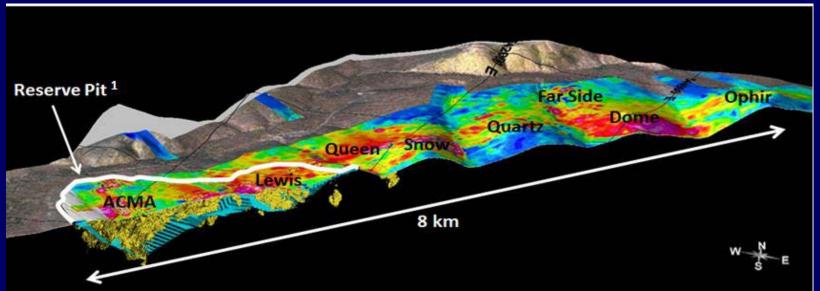
#### 2018 Milestones:

- -Received Final EIS ROD
- -Completed federal environmental process

#### 2018 Program (US\$28 M):

- -Incorporate 2017's drill data into geologic & resource models
- -Project optimization to improve capital efficiencies
- -Advance project towards construction/production decision
- -Update 2011 feasibility study





|                      | Million<br>Tonnes | Au g/T | Ounces<br>(million) |
|----------------------|-------------------|--------|---------------------|
| Proven &<br>Probable | 504.8             | 2.09   | 33.9                |
| Inferred             | 92.2              | 2.0    | 5.9                 |
| Total                | 541               | 2.24   | 39.0                |

#### **Projected production:**

1.1 M oz. of Au/year 27-year mine life





## Herbert Gold [Grand Portage Resources]

Mesothermal Au-quartz veins 25 miles SE of Kensington mine Disseminated Aspy, Py, Gal, Sphal, visible gold in quartz vein

| July 2018<br>2 g/T cut-off | Million<br>Tonnes | Au g/T | Ounces  |
|----------------------------|-------------------|--------|---------|
| Indicated                  | 1.107             | 7.25   | 257,950 |
| Inferred                   | 0.423             | 6.04   | 82,200  |
| Total                      | 1.53              | 6.92   | 360,000 |



-Gravity + flotation = >99% high grade; >97 % low grade

-Lidar survey for drill targeting

-Drilled 15 holes from 2 pads

New Discovery: 8.4 m of 1.65 g/T Au

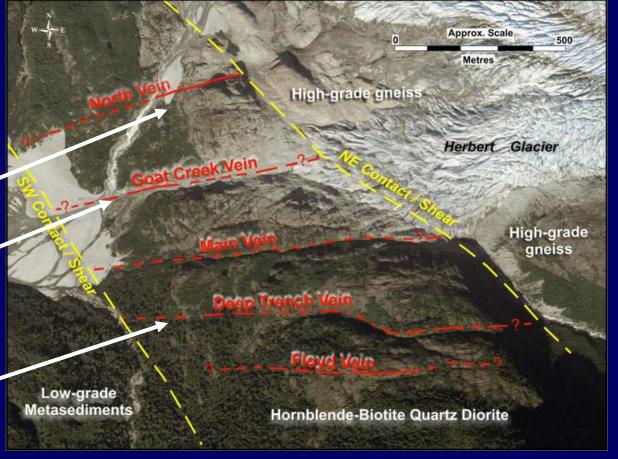
**Goat Vein:** 

DDH 18M-6: 6.3 m of 15.7 g/T Au

Deep Trench Vein:

DDH 18S-2: 9.1 m of 30.24 g/T Au, 40.52 g/T Ag









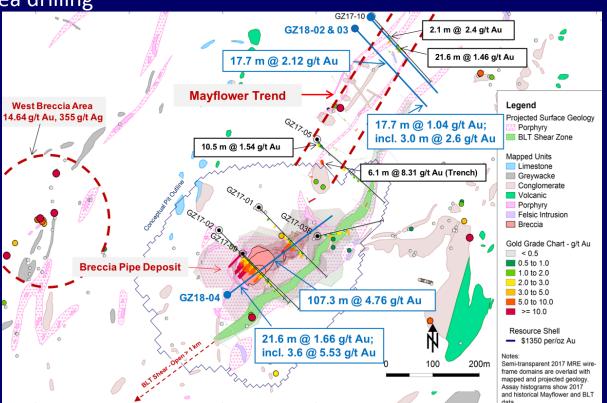
### Golden Zone [Avidian Gold]

Breccia pipe in Cretaceous porphyry stock, skarn, & sediment-hosted

Cu-Au mineralization

2016 Million Au g/T Ag g/T **Breccia Pipe Tonnes** Indicated 4.2 1.99 10.4 Inferred 1.4 0.83 2.6 5.6 1.7 8.5 Total

Breccia Pipe area drilling





#### Copper King area:

-DDH CK18-01: 9.1 m of 8.71 g/T Au, 80.8 g/T Ag, 3.57% Cu (semi-massive sulfides/skarn)

-Trench T18-09: 30.0 m of 2.24 g/T Au, 67.2 g/T Ag, 2.79% Cu (skarn)





### Golden Zone [Avidian Gold]

### **New exploration targets:**

#### **I. Gold in Conglomerate:**

- -Permian/Triassic Chulitna Terrane
- -Ave. clast size: 2 to 5 cm
- -Main inter-clast material: sand
- -Cement: carbonate
- -Ore minerals: arsenopyrite, chalcopyrite, pyrrhotite, pyrite
  - Golden Zone corridor = Au-dominant
  - Long Creek corridor = Cu-dominant
- -Found over 3 km in multiple horizons
- -Highest grade (Au-dominant): 1 m @ 8.86 g/t Au, 23 g/t Ag, 0.11% Cu
- -Highest grade (Cu-dominant): 1.51 g/t Au, 67 g/t Ag, 1.05% Cu

#### **II. Porphyry/Stockwork Veins:**

- -Granite plutons and dikes
- -Variable porphyritic
- -Stockwork veining
- -Molybdenum

















### DGGS Mapping -Richardson Gold District

#### **Multiple Gold Models:**

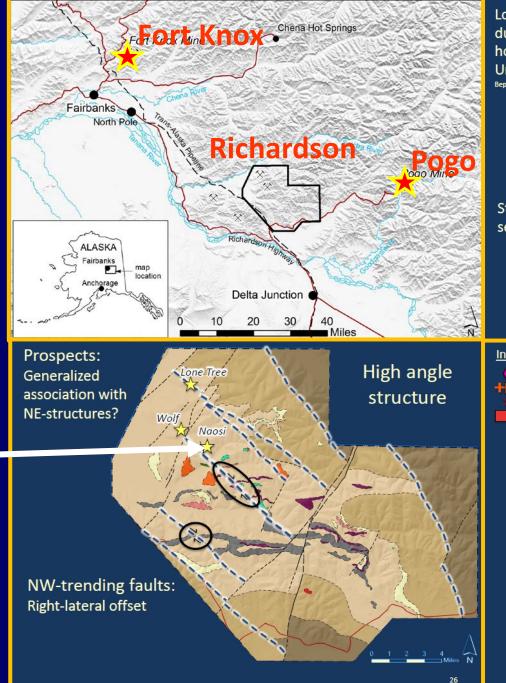
- 1) Low-angle structures (Pogo - Liese, LMS, Naosi)
- 2) High-angle structures (Pogo N. Zone, Fairbanks)
- 3) Quartz-Feldspar Porphyry Dikes (Democrat Lode)
- 4) Mineralized plutons (Fort Knox)

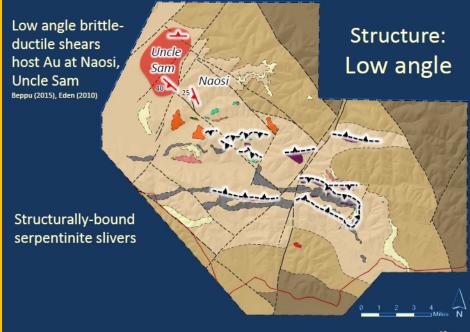
#### **Naosi Inferred Resource:**

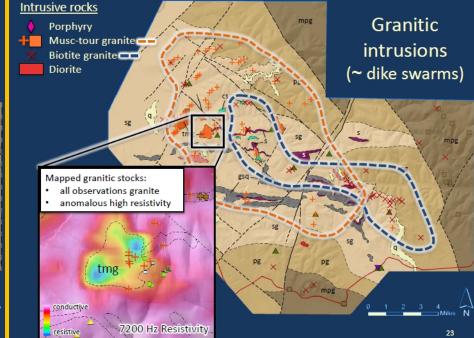
48.4 M tonnes @ 1.85 g Au/tonne (2.88 M oz. Au), 33 g Ag/tonne (51.4 M oz. Ag)

#### **DGGS Assays:**

Up to 43.3 g Au/tonne









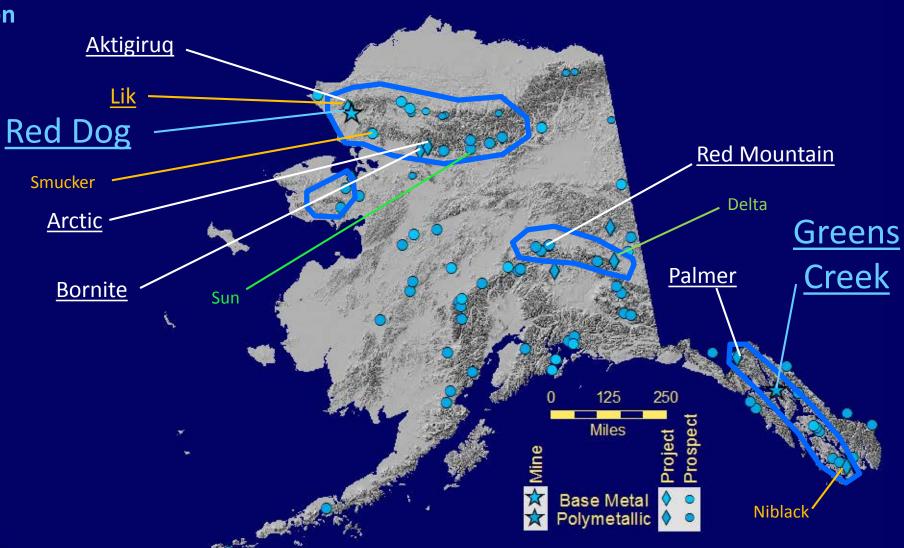
### 2018 – Base Metals & Polymetallic

Mine or Advanced Exploration

Drilling ± surface exploration

Surface exploration

Active



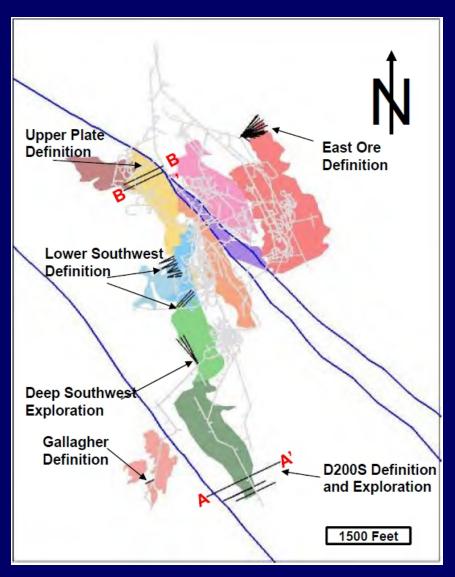


**Base Metal Belts** 





# Greens Creek VMS [Hecla Mining Co.]



Third quarter 2018 drilling activity

-2018 Production: 7.953 M oz. Ag; 51,493 oz. Au (2018); estimated 50,000 tonnes Zn, 17,000 tonnes lead

-Exploration drilling: East Ore, Upper Plate, Deep 200 South, Deep Southwest, Gallagher

-Expecting increased revenues in 2019 as Hecla accesses East Ore

|                      | Million<br>Tonnes | Zn % | Pb % | Au g/T | Ag g/T |
|----------------------|-------------------|------|------|--------|--------|
| Reserves             | 7.55              | 8.1  | 3.0  | 3.11   | 370.1  |
| Measured & Indicated | 2.81              | 7.7  | 2.9  | 2.80   | 348.4  |
| Inferred             | 2.71              | 6.9  | 2.7  | 2.49   | 376.4  |
| Total                | 13.07             | 7.8  | 2.9  | 2.91   | 366.7  |







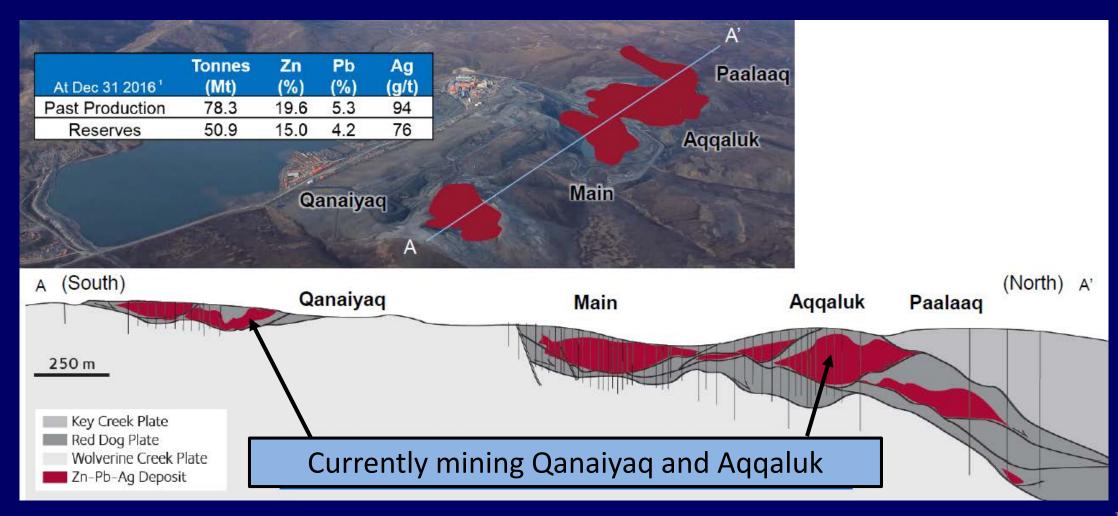


# Red Dog Mine [Teck]

Sediment-hosted Zn-Pb-Ag deposits; open-pit mine

- Projected 540,000 to 550,000 tonnes Zn (2018)
- Projected 95,000 to 100,000 tonnes Pb (2018)

-Reserves: 50.9 M tonnes @ 15.0% Zn, 4.2% Pb, 76.4 g/T Ag (Dec. 2017)







# Aktigiruq Zn-Pb-Ag [Teck]

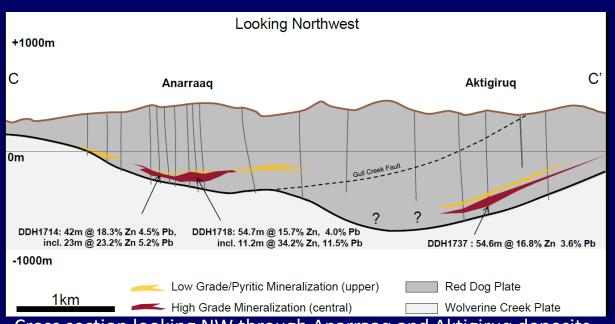
Sediment-hosted massive sulfide deposits

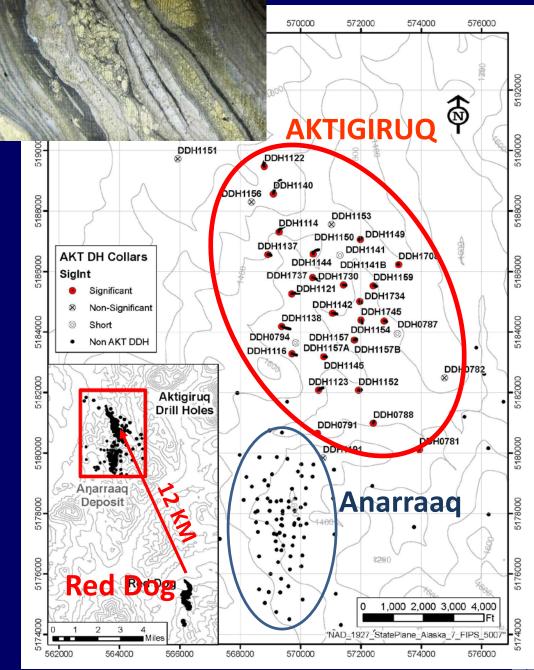
#### Anarraag resource:

-Inferred: 26 M tonnes @ 13.8% Zn, 4.3% Pb, 84.3 g/T Ag

#### 2018 Aktigiruq program:

- -Drilling program
- -Ore body is 400 to 1,000 m below surface
- -2016 drilling encountered 54.6 m @ 16.8% Zn, 3.63% Pb (DDH1737)









# Lik (Su) Zn-Pb-Ag [Solitario Exploration & Royalty Co. & Teck Resources Ltd.]

Sediment-hosted massive sulfide deposit

-New partnership; **Teck** taking exploration lead

#### 2014 PEA:

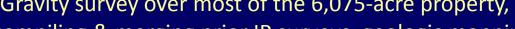
- -Open-pit mine, initial 9-year life
- -Produce 234,000 dry tonnes Zn & 55,800 dry tonnes lead concentrates/year
- -IRR = 9.7%; NPV(8%) of \$25.0 million
- -Assumed constructed as self-contained operation; no benefits from Red Dog infrastructure were considered

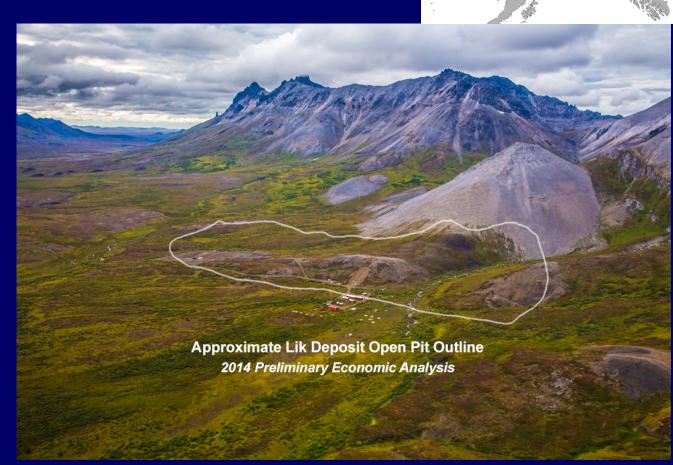
|           | Million<br>Tonnes | Zn % | Pb % | Ag g/T |
|-----------|-------------------|------|------|--------|
| Indicated | 17.3              | 8.0  | 2.7  | 51     |
| Inferred  | 2.9               | 8.6  | 2.6  | 37     |
| Total     | 20.2              | 8.1  | 2.7  | 49     |

Based on 229 drill holes

#### **2018 work:**

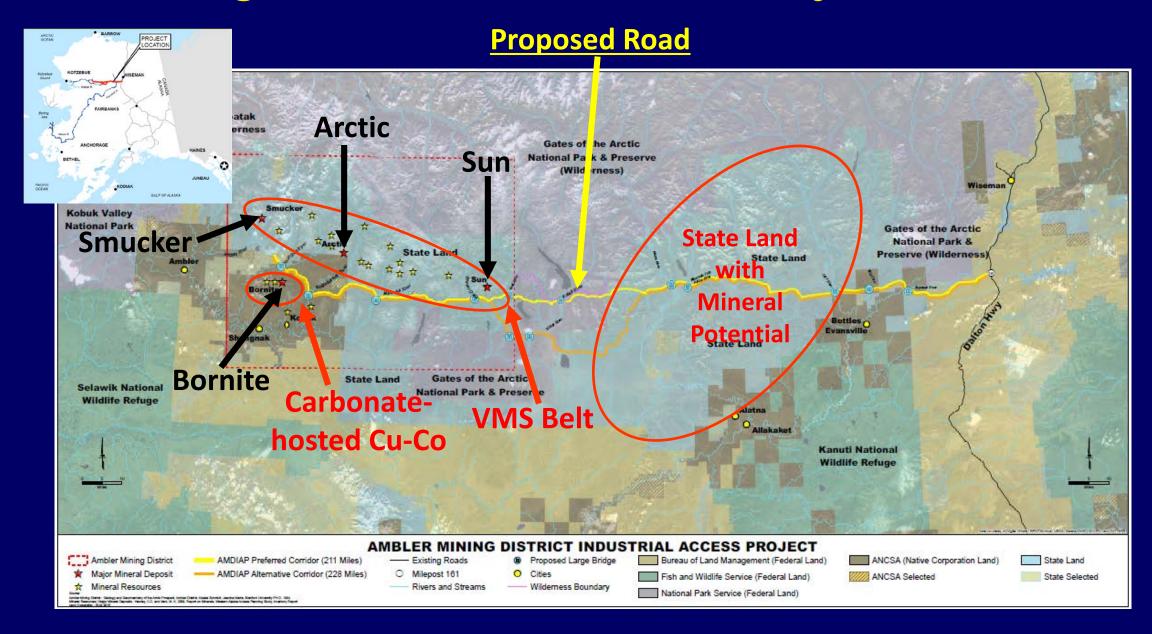
-Gravity survey over most of the 6,075-acre property,







### Ambler Mining District Industrial Access Project [AIDEA]







#### **?** ^ 1

### Arctic VMS [Trilogy Metals Inc./South32 Limited]

#### New PFS:

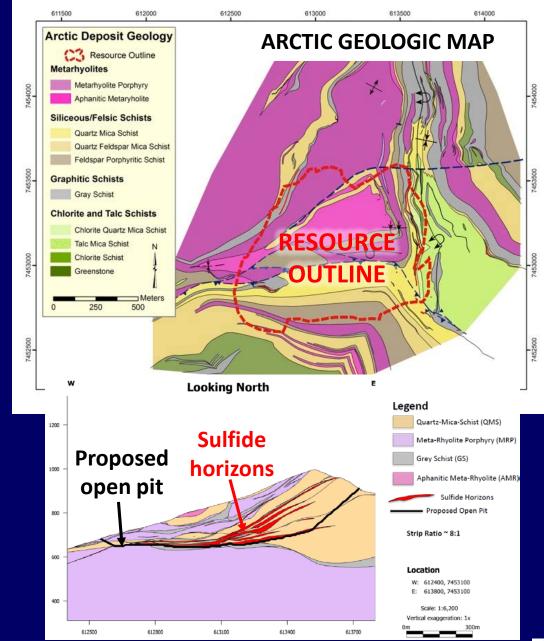
- -Ave. annual payable production: >159 M lbs. Cu, 199 M lbs. Zn, 33 M lbs. Pb, 30,600 oz. Au, 3.3 M oz. Ag
- -12-year mine life
- -Estimated pre-tax & after-tax payback within 2 years
- -Pre-tax 38.0% IRR; \$1,935.2 million NPV at 8%

**Resources:** (based on 152 DDH; inclusive of reserves)

| The second secon | Million<br>Tonnes |      | Zn % | Pb % | Au g/T | Ag g/T |
|--|-------------------|------|------|------|--------|--------|
| Probable   | 43                | 2.32 | 3.24 | 0.57 | 0.49   | 36.0   |

#### 2018 program (US\$6.7 million):

- -Completed ore-sorting program
- -Geotechnical & hydrological studies
- -Preparing for feasibility study & starting permitting in 2019
- -Working with AIEDA to advance the Ambler Mining District Industrial Access Road Project; BLM working on EIS.







### Bornite Carbonate-Hosted Cu-Co [Trilogy Metals Inc./South32 Limited]

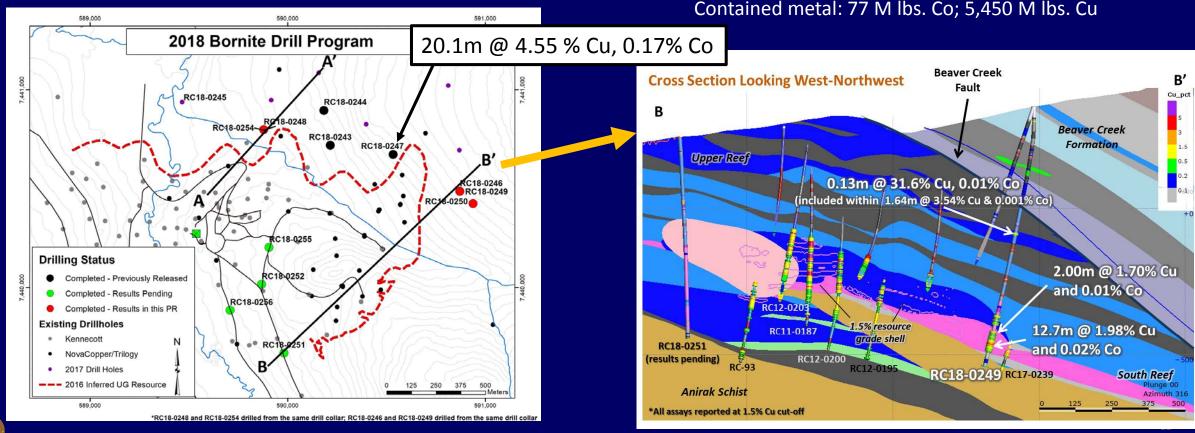
#### 2018 program (US\$10.8 M):

- 12 holes; total 10,123 m of infill & off-set drilling
- Seismic survey
- Metallurgical testing: produce Cu concentrates of 24% 33% Cu; & no deleterious metals

2019 program: Anticipated ~US\$9.2 million budget

|           | Million<br>Tonnes | Cu % | Co %  |
|-----------|-------------------|------|-------|
| Indicated | 40.5              | 1.02 | 0.017 |
| Inferred  | 141.9             | 1.74 | 0.025 |
| Total     | 182.4             | 1.24 | 0.019 |

Contained metal: 77 M lbs. Co; 5,450 M lbs. Cu







### Radi

### Red Mountain VMS District [White Rock Minerals Ltd./Sandfire Resources NL]

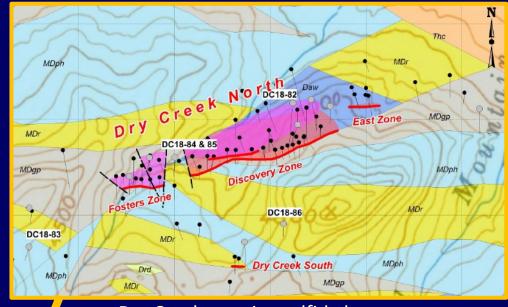
### **Resource** (3% Zn cut-off):

| April 2017        | Million<br>Tonnes | Cu % | Zn % | Pb % | Ag<br>g/T | Au<br>g/T | Zn Eq<br>% |
|-------------------|-------------------|------|------|------|-----------|-----------|------------|
| Dry Creek         | 2.4               | 0.2  | 4.7  | 1.9  | 69        | 0.4       | 8.7        |
| West Tundra Flats | 6.7               | 0.1  | 6.2  | 2.8  | 189       | 1.1       | 14.4       |
| Total Inferred    | 10.0              | 0.13 | 5.8  | 2.6  | 157       | 0.9       | 9.1        |

#### **2018 program:**

- -24 holes; total 4,111 m; down-hole EM surveying
- -CSAMT surveying, geologic mapping, stream-sediment sampling

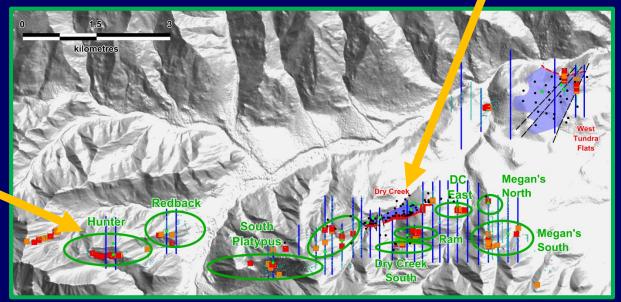
-Dry Creek: 4.7m @ 19.5% Zn, 7.8% Pb, 466 g/T Ag, 6.9 g/T Au, 1.5% Cu



Dry Creek massive sulfide lenses

#### **NEW DISCOVERY:**

Hunter: 1.4 m @ 17.4% Zn, 3.9% Pb, 90g/T Ag, 1.6% Cu





Red Mountain





# Palmer VMS District [Constantine Metal Resources Ltd. (51%) & Dowa Metals & Mining Alaska Ltd. (49%)]

#### 2018 Program:

- -Approval to extend access road to future portal
- -Evaluating exploration drift for drilling
- -29 DDH's, 10,000 m
- -Barite metallurgical program
- -Updated NI43-101 report
- -Launched PEA

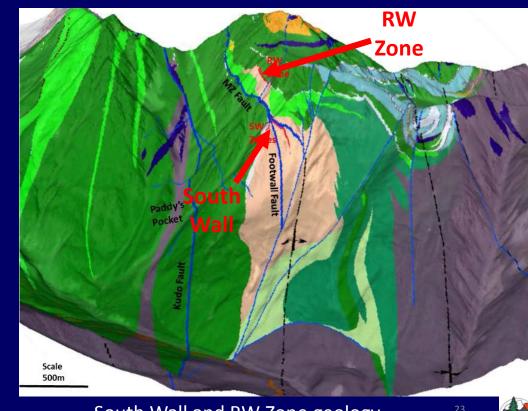
| Nov 2018  | Million<br>Tonnes | Cu % | Zn % | Ag g/T | Au g/T | Barite % | Zn Eq % |
|-----------|-------------------|------|------|--------|--------|----------|---------|
| Indicated | 4.7               | 1.49 | 5.23 | 30.8   | 0.30   | 23.9     | 11.67   |
| Inferred  | 5.3               | 0.96 | 5.2  | 29.2   | 0.28   | 22.0     | 9.9     |
| Total     | 10.1              | 1.21 | 5.21 | 29.9   | 0.29   | 22.9     | 10.72   |

Based on 108 DDH's totaling 44,900 m, \$75 NSR cutoff



Access Road

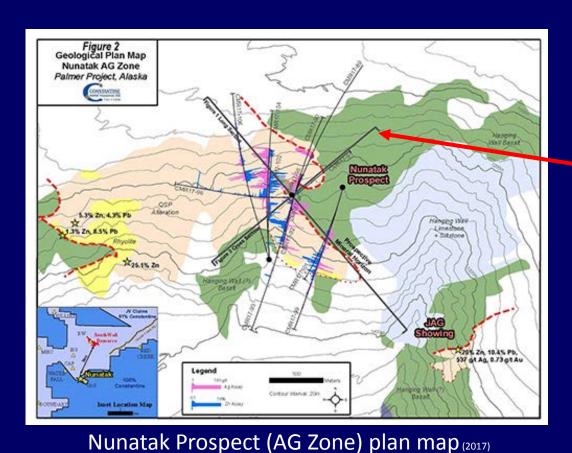
Property map: VMS horizon (red line) & prospects (stars)



# Nunatak — AG Zone [Constantine Metal Resources Ltd. (51%) & Dowa Metals & Mining Alaska Ltd. (49%)]

#### Maiden Resource (5% ZnEq cut-off grade):

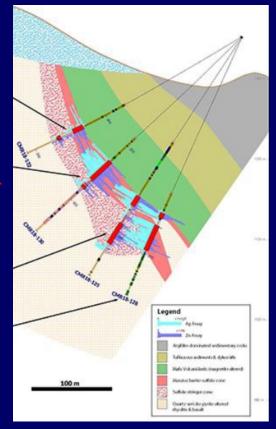
| Dec. 2018 | Million<br>Tonnes | Cu % | Zn % | Ag g/T | Au g/T | Barite % | Zn Eq % |
|-----------|-------------------|------|------|--------|--------|----------|---------|
| Inferred  | 4.256             | 0.12 | 4.64 | 119.5  | 0.53   | 34.8     | 9.04    |



X-section

#### DDH CMR18-130:

33.5 m @ 98 g/T Ag, 0.4 g/T Au, 5.0% Zn, 1.1% Pb, 0.2% Cu, 41.5% BaSO4



AG Zone x-section & drill holes

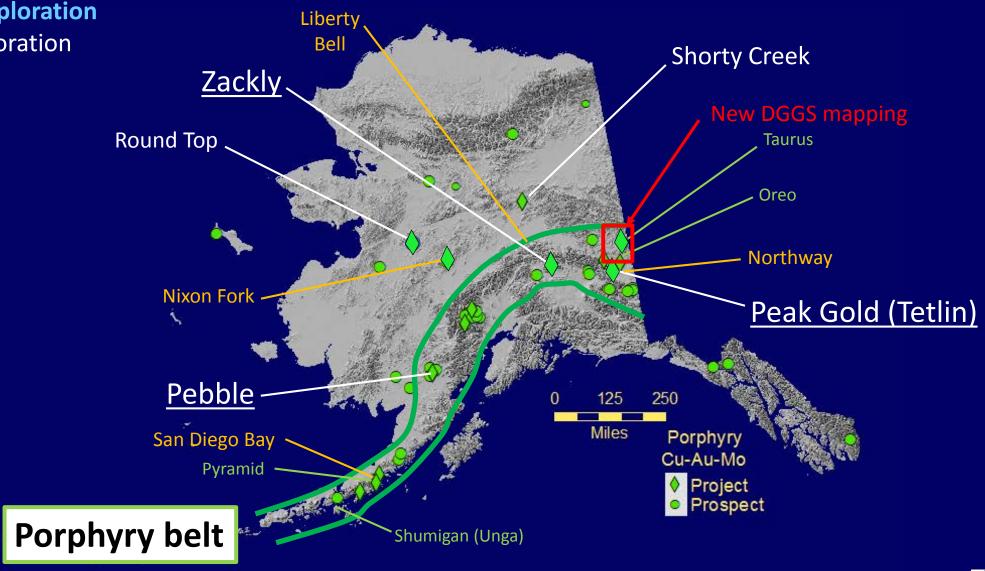






## 2018 – Porphyry + Skarn

Mine or Advanced Exploration
Drilling ± surface exploration
Surface exploration
Active







## Pebble Porphyry Cu-Mo-Au (Permitting phase) [The Pebble Partnership (PLP)]

#### 2018 Work:

- -Jan. 6, 2018: Corps of Engineers accepted PLP's permit application
- -Initiated NEPA review process
- -Geotechnical drilling

| Resource  | Million<br>Tonnes | Cu (%) | Au (g/t) | Mo<br>(ppm) | Ag<br>(g/t) |
|-----------|-------------------|--------|----------|-------------|-------------|
| Measured  | 527               | 0.33   | 0.35     | 178         | 1.66        |
| Indicated | 5,912             | 0.41   | 0.34     | 245         | 1.66        |
| Inferred  | 4,460             | 0.25   | 0.26     | 222         | 1.19        |



Photo credit: Jason Sear & PLP Oct. 5, 2017 presentation

#### **New proposed development plans:**

- -Footprint <1/2 of prior envisioned size
- -Single drainage for site infrastructure
- -Open-pit mine
- -Tailings storage facility designed for maximum safety
- -Separation of potentially acid generating tailings from nonacid generating; fully lined tailings storage facility
- -No permanent waste-rock piles or cyanide usage
- -Annual production: 287 M lbs. Cu, 321,000 oz Au, 1.6 M oz Ag,  $^{\sim}13$  M lbs. Mo



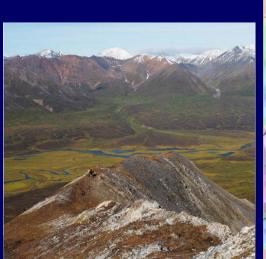


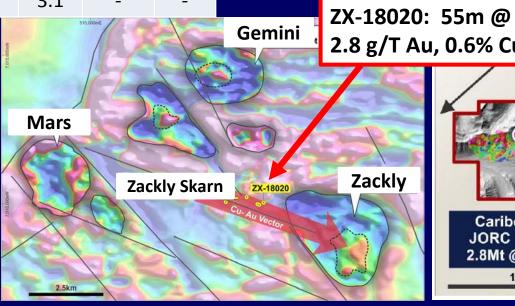
# Alaska Range Project [PolarX Ltd.]

#### 2018 program:

- -Airborne magnetic survey; 50-m line spacing
- -18 drill holes; 3,754 m
- -Surface exploration at Mars Porphyry Cu-Au, Gold Boulder Skarn,
- & Moonwalk reduced intrusion-related Au targets
- -New skarn zone: ZX-18024; 46.7 m @ 3.1 g/T Au, 0.6% Cu

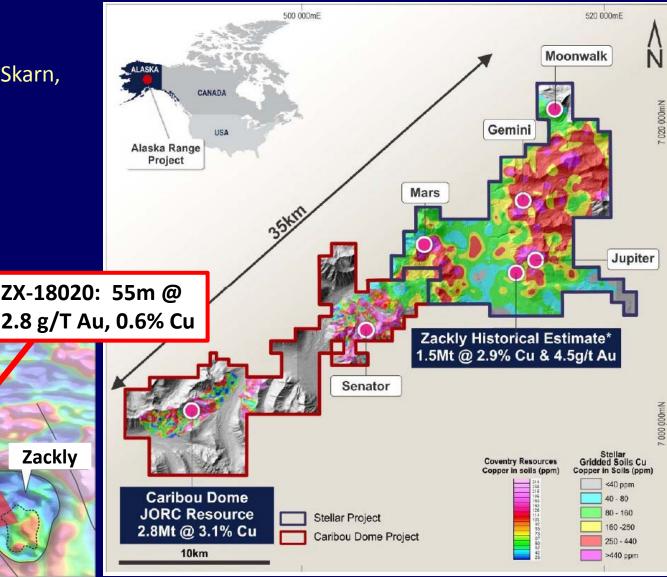
| JORC Inferred<br>Resources | Million<br>Tonnes | Cu % | Au<br>g/T | Aug<br>g/T |
|----------------------------|-------------------|------|-----------|------------|
| Zackly Skarn               | 3.4               | 1.2  | 2.0       | 14.0       |
| Caribou Dome               | 2.8               | 3.1  | -         | -          |





Zackly skarn + Mars, Zackly, Gemini Porphyry targets

### Cu-Au Skarn and Porphyry systems; Sediment hosted Cu



# Peak (Tetlin) Cu-Au Skarn [Peak Gold, LLC]

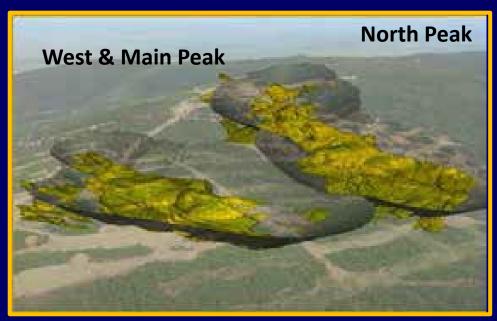
### PEA Highlights (Sept. 2018):

- -1.1 M oz. Au production
- -2 M oz. Ag production
- -8-year mine life
- -3,500 tonnes/day throughput
- -91.6% Au, 57.0% Ag recovery
- -3.9:1 strip ratio
- -US\$294 M initial capital
- -US\$428/oz. Au recovered, total cash cost
- -~2-year, after-tax payback for initial development capital
- -29% post-tax IRR

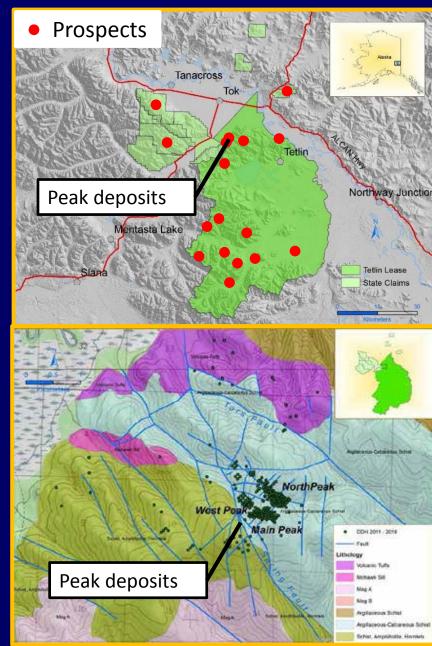
#### 2018 Program (~US\$9.1 million):

- -6,189 m of drilling
- -Geophysical surveys

|                      | Million<br>Tonnes | Cu %  | Au<br>g/T | Ag<br>g/T |
|----------------------|-------------------|-------|-----------|-----------|
| Measured & Indicated | 9.2               | 0.153 | 4.08      | 14.2      |
| Inferred             | 1.34              | 0.151 | 2.69      | 16.1      |
| Total                | 10.54             | 0.153 | 3.9       | 14.43     |

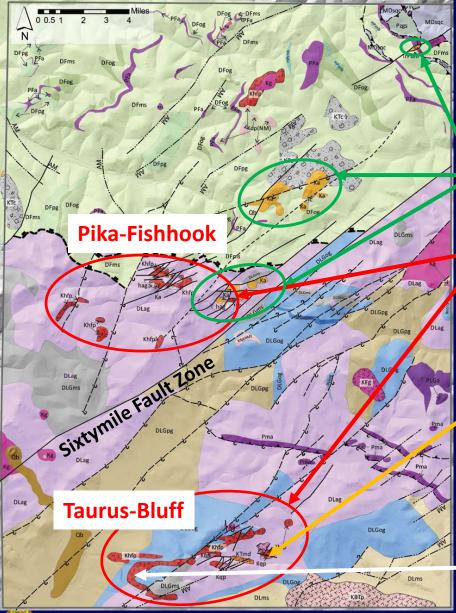


0.5 g/T Au shells (gold) within \$1,400-Au pit shells (gray)





## New DGGS Mapping – Tanacross Porphyry District



### **Taurus Porphyry Cu-Mo-Au-Re Deposit**

Unofficial resource: 68.2 M tonnes @ 0.275% Cu, 0.032 Mo, 0.166 g/T Au

#### **Notable intercepts (2008) East Taurus:**

-235 m of 0.309% Cu, 0.036% Mo, 0.245 g/T Au -54.6 m of 0.258% Cu, 0.026% Mo, 0.149 g/T Au

Andesite (66 Ma?)

Hbl porphyry (66.3 Ma)

### **Taurus**

Qtz-Feldspar Porphyry (70-72 Ma)

Qtz Monzonite
Hbl-Feldspar Porphyry
(68-70 Ma)



Potassic Alteration with Cu-Mo-Au



Quartz-sericite-pyrite





Sericite-tourmaline alteration; anomalous Ag



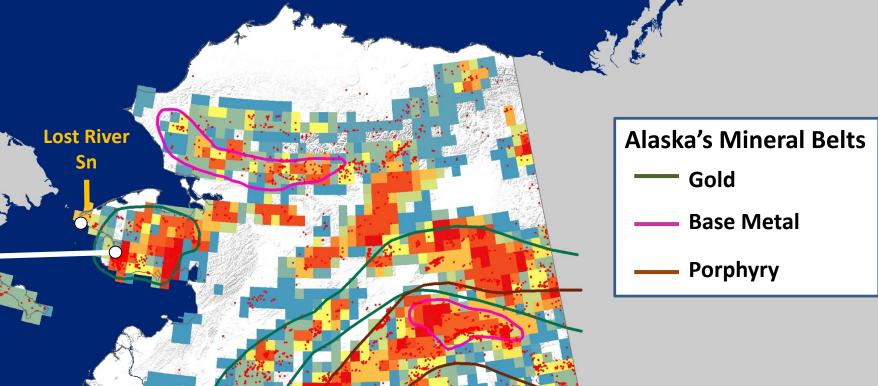


2018 – Graphite, REEs, PGEs, **Industrial Minerals** 

**Graphite Creek** 

Drilling ± surface exploration Surface exploration Active

> Alaska's **Criticality-Score-Weighted Critical Minerals Potential**



Genesis

PGE, Ni

**Icy Cape** (Tonsina) Au, industrial minerals

> **Bokan** Mountain **REEs**



## Graphite Creek [Graphite One Resources]

USA's largest, large-flake graphite deposit

#### 2018 Program:

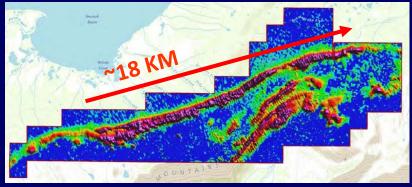
- -6 holes, 800 m of in-fill drilling
- -Additional metallurgical testing
- -Alternative access routes
- -Initiate environmental surveys
- -Collect data for future PFS



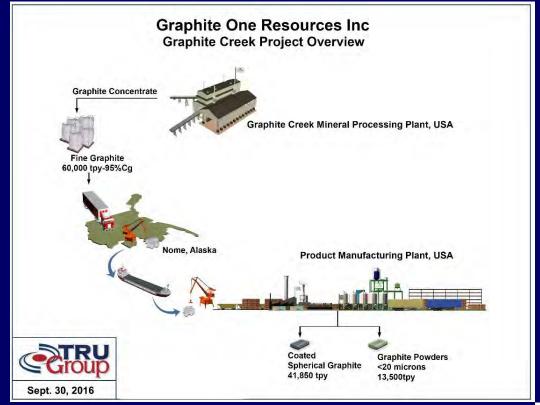
#### 2017 PEA:

- -Open-pit: 1.11 M tonnes graphite-bearing material/year
- -40-year mine life
- -41,850 tonnes of high-grade coated spherical graphite/year for lithium-ion battery applications
- -13,500 tonnes of refined, sub-20-micron graphite powder/year for various end-uses.

| 6% cutoff | Million Tonnes | Cg % |
|-----------|----------------|------|
| Indicated | 10.3           | 7.2  |
| Inferred  | 71.2           | 7.0  |
| Total     | 81.5           | 7.0  |



Time-Domain Electromagnetic Survey (red=conductive graphitic units)





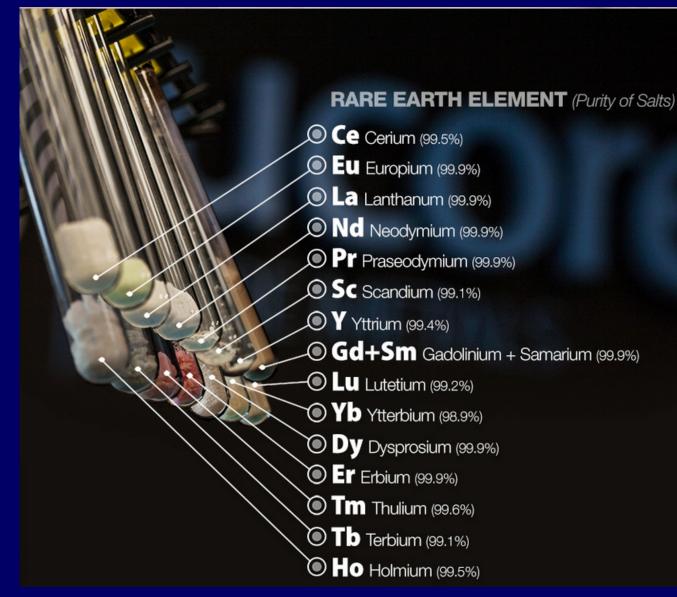


### Bokan REE [Ucore Rare Metals, Inc.]

Heavy REE-enriched Bokan Mountain intrusive suite

#### 2018 Milestones:

- -Ketchikan, Alaska → New Strategic Metals Complex (SMC)
- -Purchased REE-separation plant's development site
- -Process Bokan & REE ore from deposits worldwide
- -US\$145 million proposed AIDEA financing package for Bokan mine & processing facilities
- -Initiated engineering & design of SMC
- -FY2019 National Defense Authorization Act U.S. DoD banned from acquiring Rare Earth magnets from China
- -Ucore intends to exercise its option to purchase IBC Advanced Technologies (developer of Molecular-Recognition Technology [MRT]); Notice of Commencement due March 2019

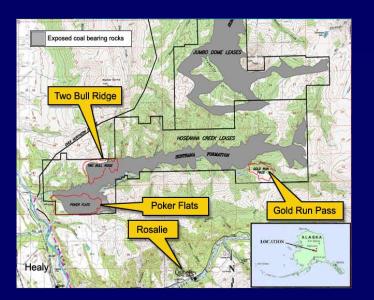


Separation purity for REEs using Molecular-Recognition Technology

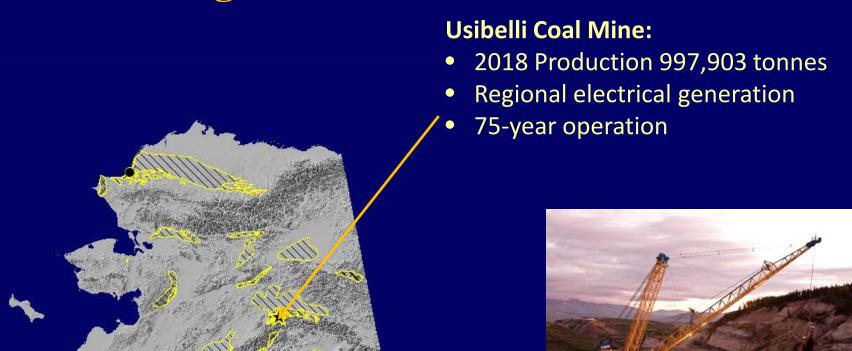




### **Usibelli Coal Mine – Celebrating 75 Years of Production**







Deposit Coal Field Coal Basin

Miles





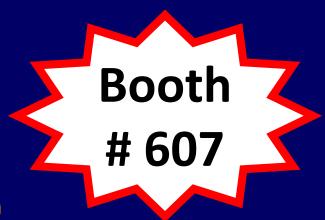


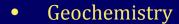
### Alaska's Mineral Resource Information

### **Division of Geological & Geophysical Surveys**

http://dggs.alaska.gov/



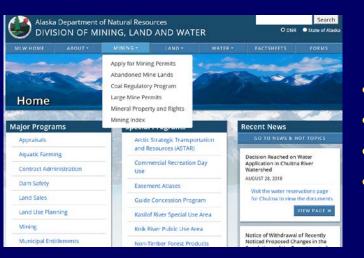




- Geophysics
- Geologic Maps
- Elevation Data
- Minerals Report
- Mineral Occurrences
- GMC

### Division of Mining, Land & Water

http://dnr.alaska.gov/mlw/



- Land status
- Mining claims
- Mine Permitting
- Mine Regulation

### **Geologic Materials Center**

http://dggs.alaska.gov/gmc/index.php

- Core Repository
- Indoor core viewing and storage
- Surface samples
- Geochemistry pulps
- Online Inventory
- Confidential storage and viewing



