

# Alaska's Mineral Industry in 2017: Mines, Development, & *Exploration*



Photo courtesy: Teck [Red Dog Exploration 2017]

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AMEBC Mineral Exploration Roundup – Vancouver, BC Canada – January 22, 2018



# State of Alaska

## Commodity Reserves & Resources

### The State of Alaska hosts Important Reserves & Resources:

- **Coal:** 13% of world's coal resources; 2<sup>nd</sup> most in the world
- **Copper:** 5.8% of world's copper reserves; 2% of world resources
- **Lead:** 2.7% of world's lead reserves; 0.2% of world resources
- **Gold:** 2.5% of world's gold reserves; 40% of U.S. resources
- **Zinc:** 3.9% of world's zinc reserves; 1% of world resources
- **Silver:** 1.2% of world's silver reserves

*(USGS 2016 world estimates; DGGS Alaska 2016 data)*

**Diverse metallogenic provinces**

**Top area of the world for under-explored mineral-resource potential**

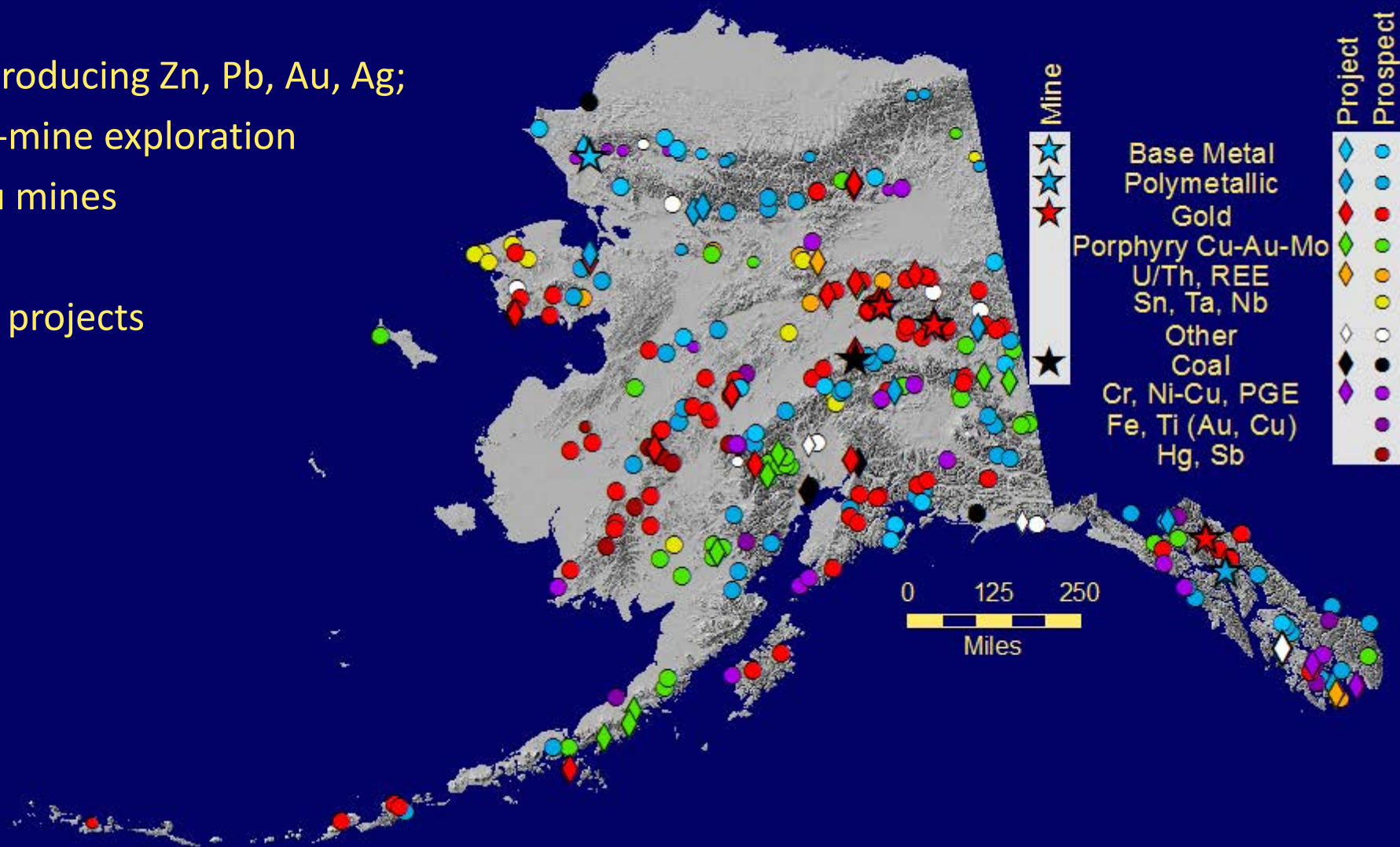
**Over 7,400 documented prospects**





# 2017 Alaska Mineral Industry Overview

- 5 major lode mines producing Zn, Pb, Au, Ag; all conducting near-mine exploration
- ~ 230 small placer Au mines
- 1 coal mine
- 48 active exploration projects



# Fort Knox Mine [Kinross]

Intrusion-hosted gold deposit

-Produced 285,933 oz Au (as of 3<sup>rd</sup> quarter 2017)

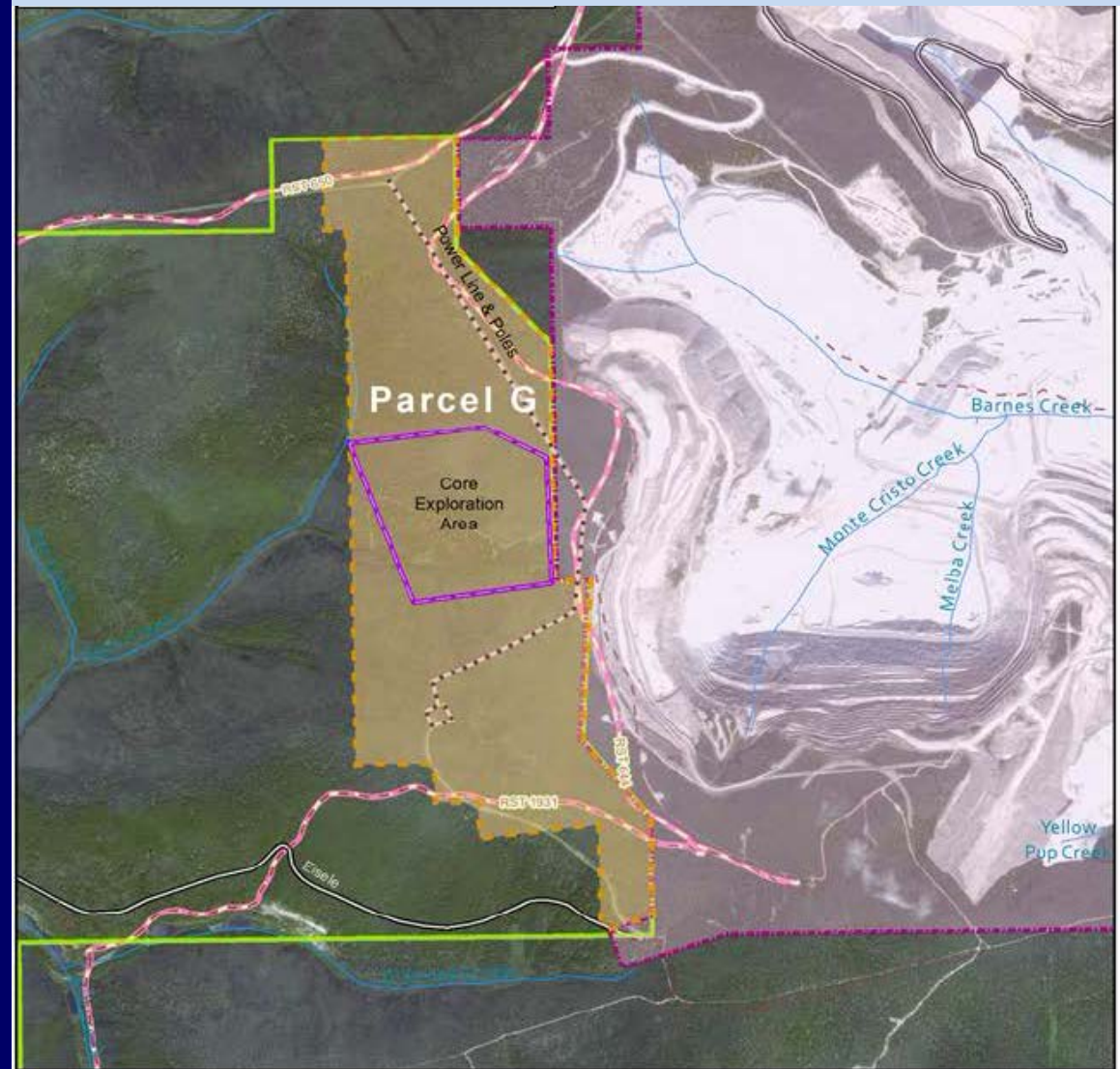
-1.315 M oz Reserve (Nov. 2017)

-3.919 M oz Resource (Nov. 2017)

-New mineral rights on Parcel G land adjacent to open pit



Kinross gained mineral rights to Parcel G land in 2017







# Pogo Mine [Sumitomo Metal Mining Pogo LLC]

Shear zone/quartz vein-hosted gold lodes

-Produced >271,000 oz Au (2017)

-1.2 M oz Au Reserve (Dec. 2017)

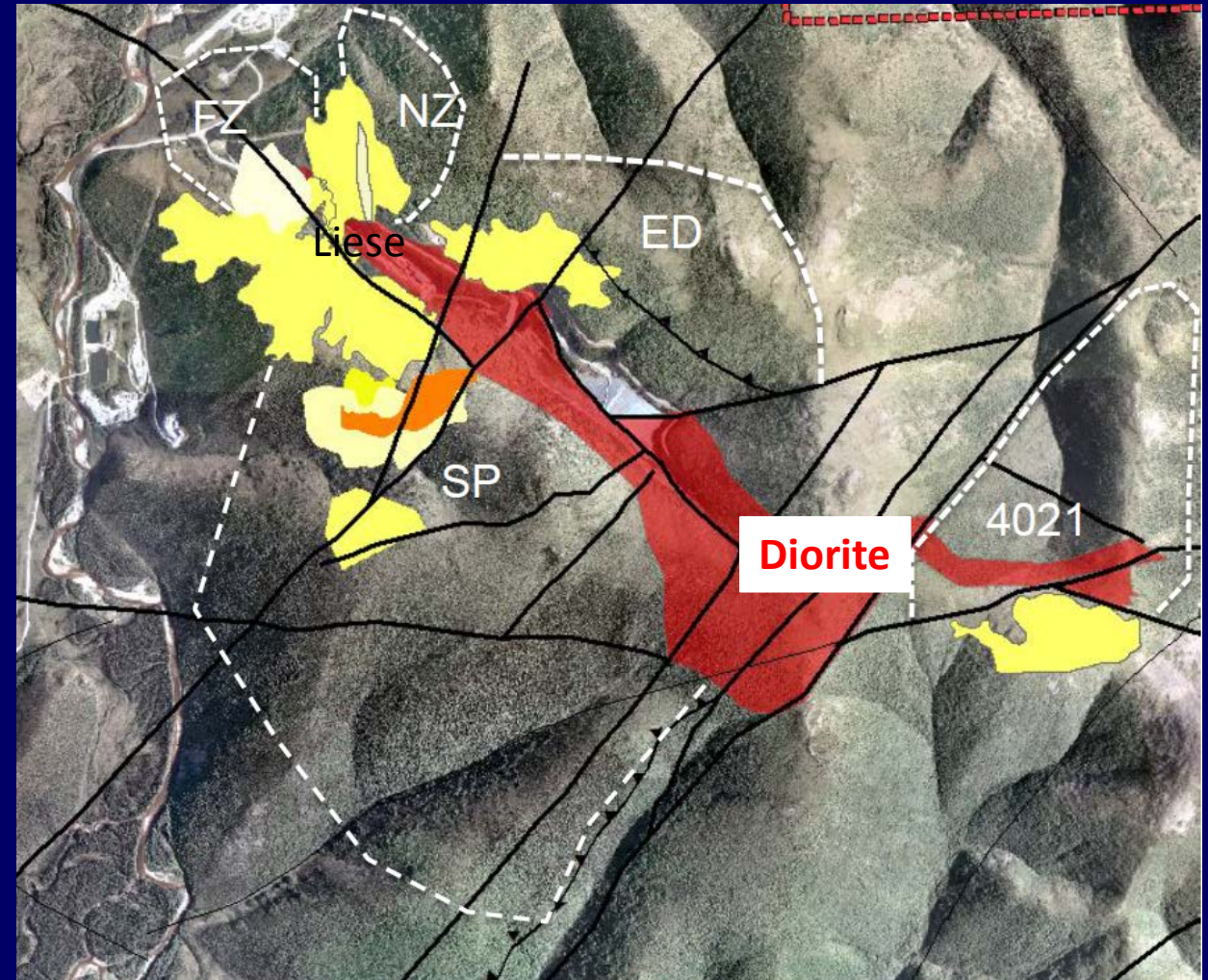
## Currently Mining:

-Liese

-East Deep

-North Zone

-Near-mine exploration = new discoveries



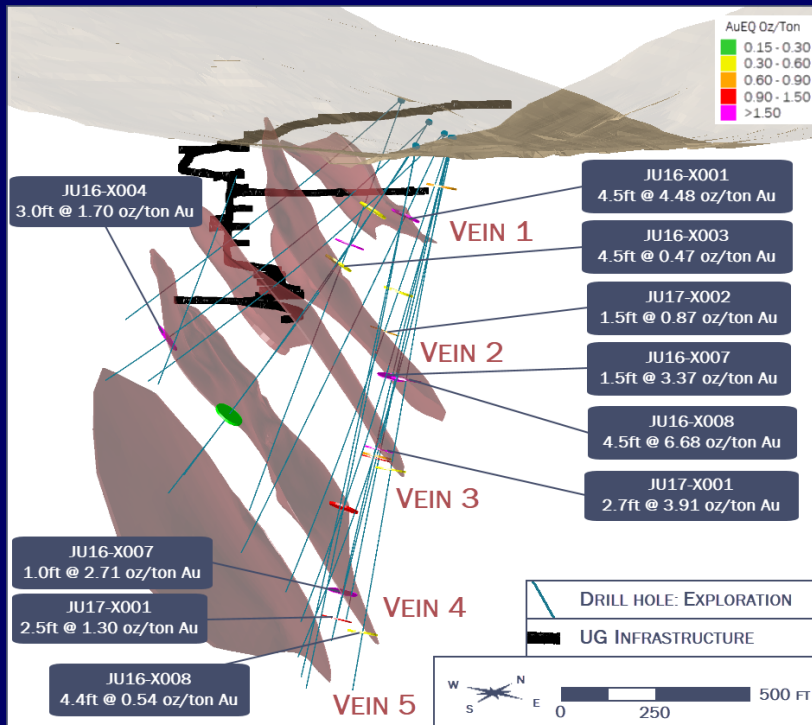
Near-mine exploration in the Fun Zone (FZ), North Zone (NZ), East Deep (ED), South Pogo (SP), and 4021 Zones



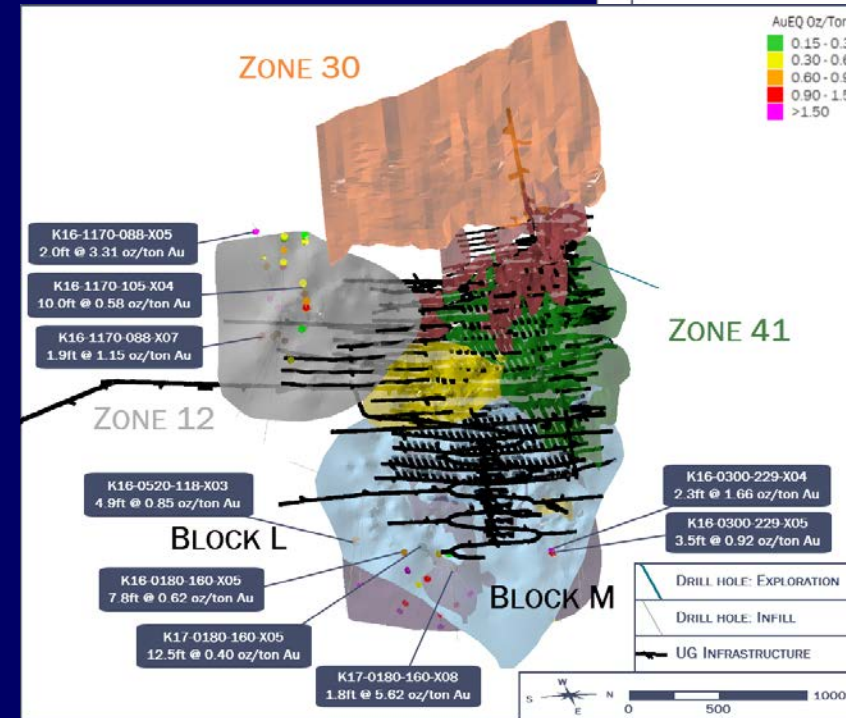


# Kensington Mine [Coeur Alaska, Inc.]

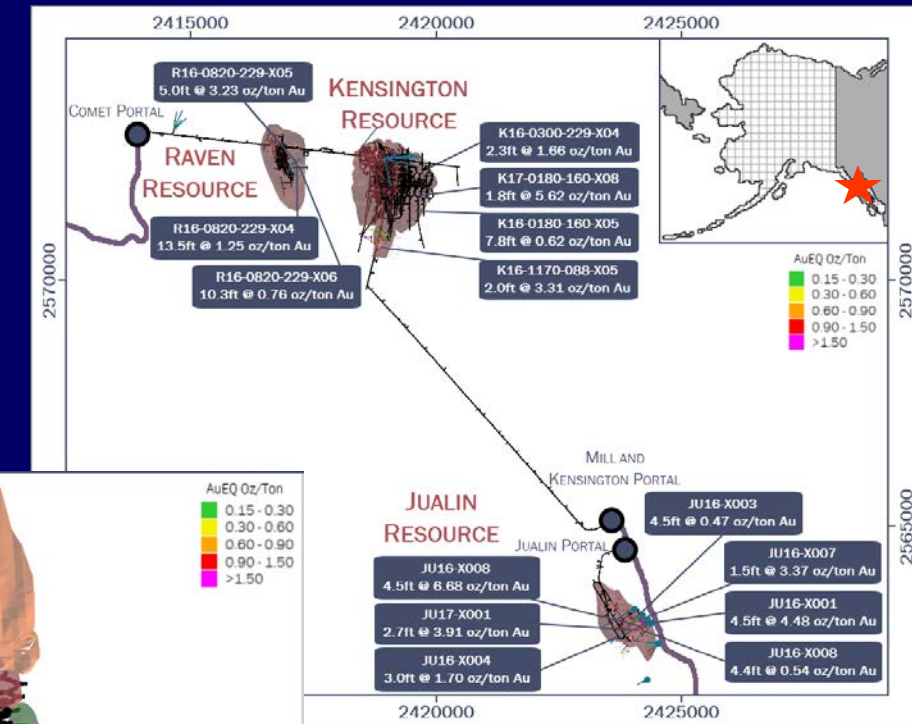
- Underground mine: structurally controlled, gold-bearing quartz veins
- Produced 80,162 oz of Au (as of 3rd quarter 2017)
- 497,000 oz Au Reserve; 1.3 M oz Au Resource (Dec. 2016)
- Exploration-investment levels at Kensington have nearly tripled



Jualin: NW section, veins 1-5 intercepts



Kensington Main: NW section view with drill intercepts



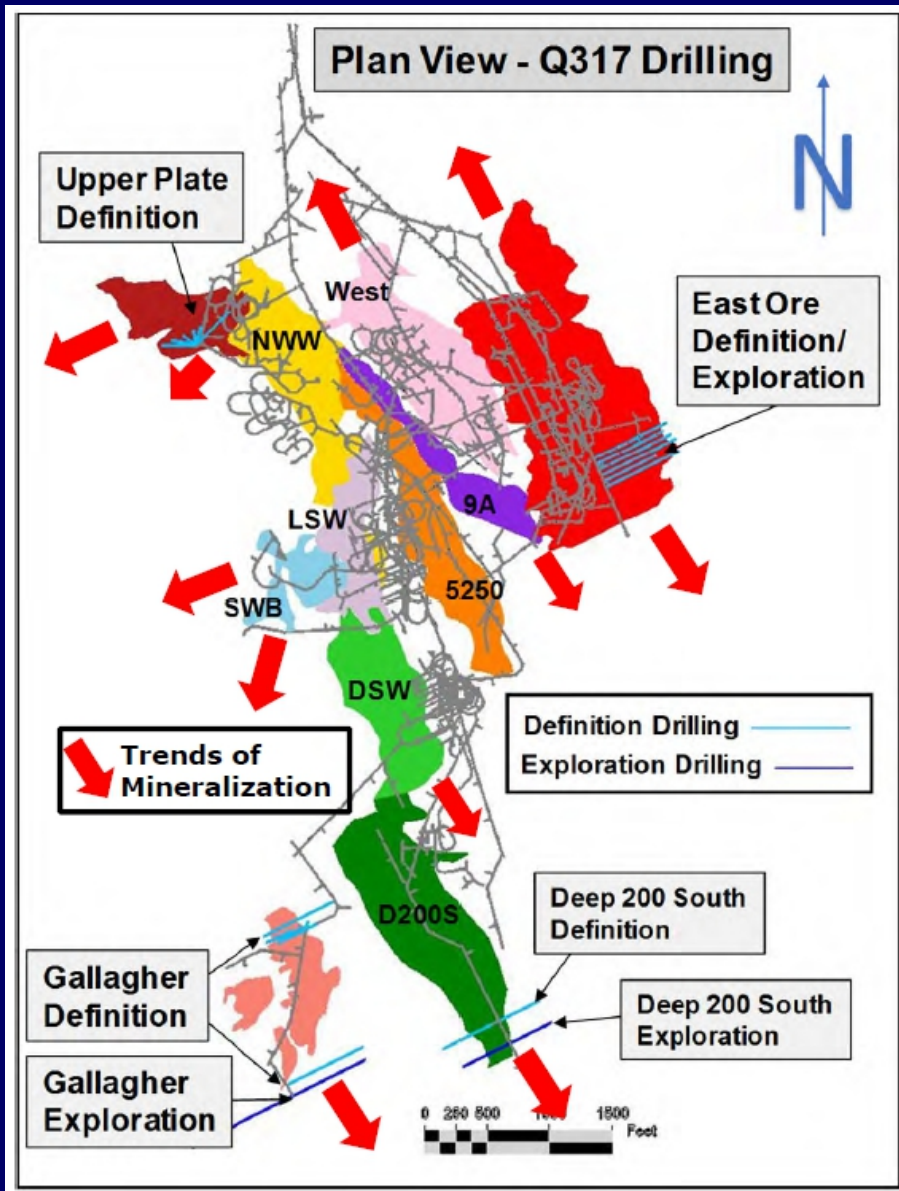
Map of Kensington deposits







# Greens Creek [Hecla Mining Co.]



Silver-rich VMS deposit; underground mine

- Produced 8.4 M oz Ag, 69,578 oz Au (2017)
- Mill averaged 2,086 tonnes/day (2017)
- Proven & Probable Reserves: 6.9 M tonnes @ 3.1 g Au/tonne, 401 g Ag/tonne, 8.1 % Zn, 3.0 % Pb (Jan. 2017)
- Exploration drilling: Deep 200 South, East Ore, Gallagher, and Upper Plate zones
- Woodgrove staged-flotation reactor improving Pb floatation circuit output

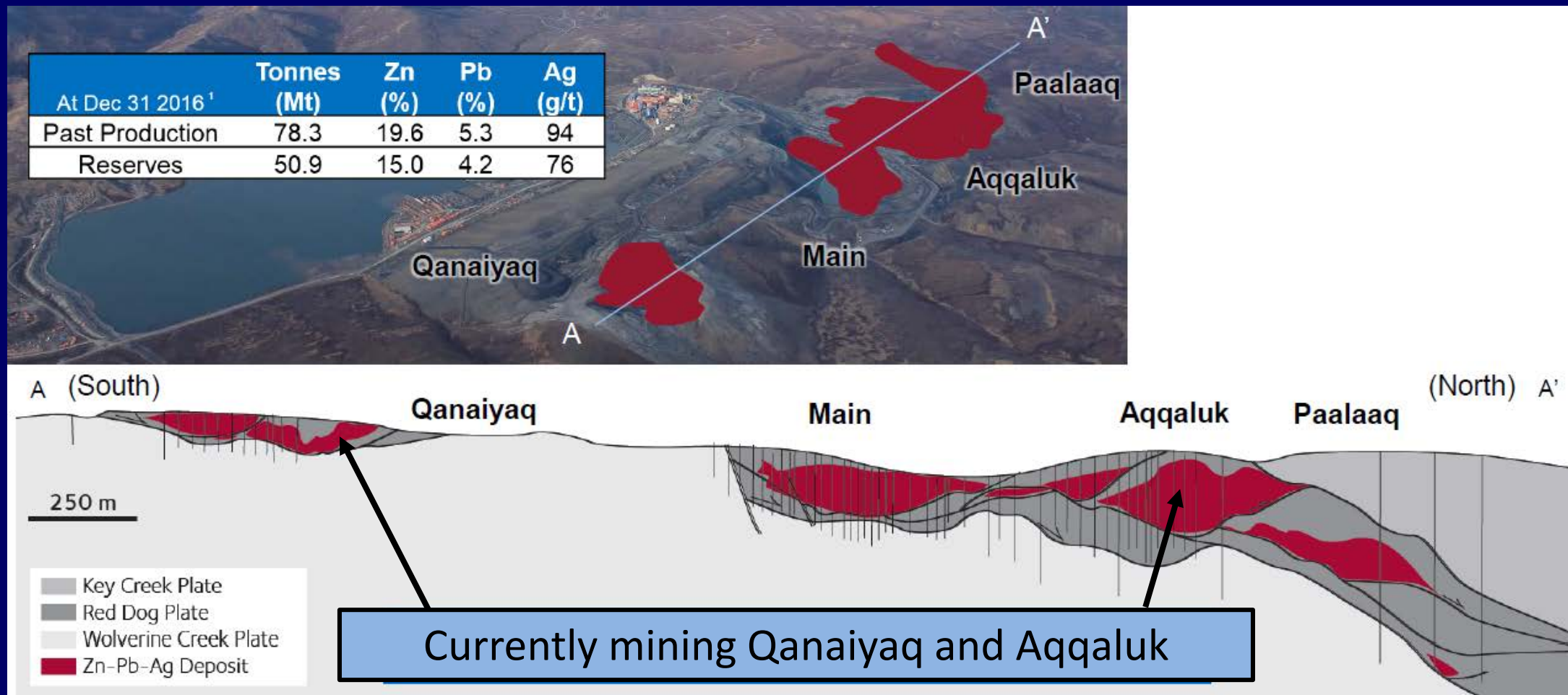


# Red Dog Mine [Teck]

Sediment-hosted Zn-Pb-Ag deposits

- Projected 525,000 to 550,000 tonnes Zn (2017)
- Projected ~115,000 tonnes Pb (2017)

-Total Reserves: 50.9 M tonnes @ 15.0% Zn, 4.2% Pb, 76 g of Ag/tonne (Dec. 2016)





# 2017 Drilling Activity & Exploration Expenditures

## 2017 Exploration Drilling:

- **Mines:** Minimum of 50,000 m (very incomplete data)
- **Development/Advanced Exploration:** ~16,769 m
- **Early to Mid-Stage Exploration:** ~52,871 m
- **Total:** Minimum of **102,924 m**

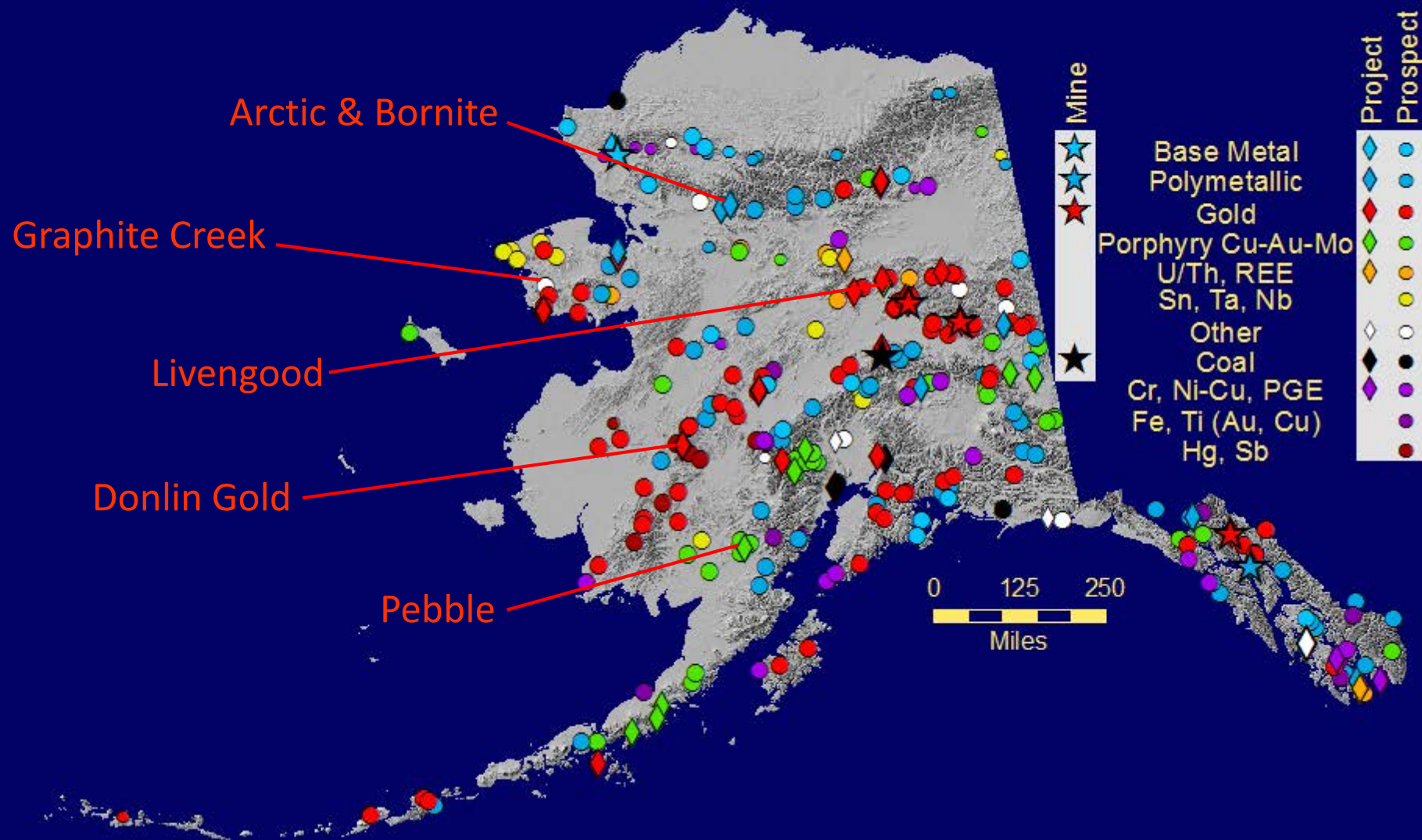
## 2017 Exploration Expenditures:

- **Mines:** Minimum of US\$18,000,000 (very incomplete data)
- **Development/Advanced Exploration:** ~US\$32,192,170
- **Early to Mid-Stage Exploration:** ~US\$38,966,002
- **Total:** Minimum **~US\$94.1 million** (2017)



Photo courtesy of Donlin Gold

# 2017 Development & Advanced Exploration Projects



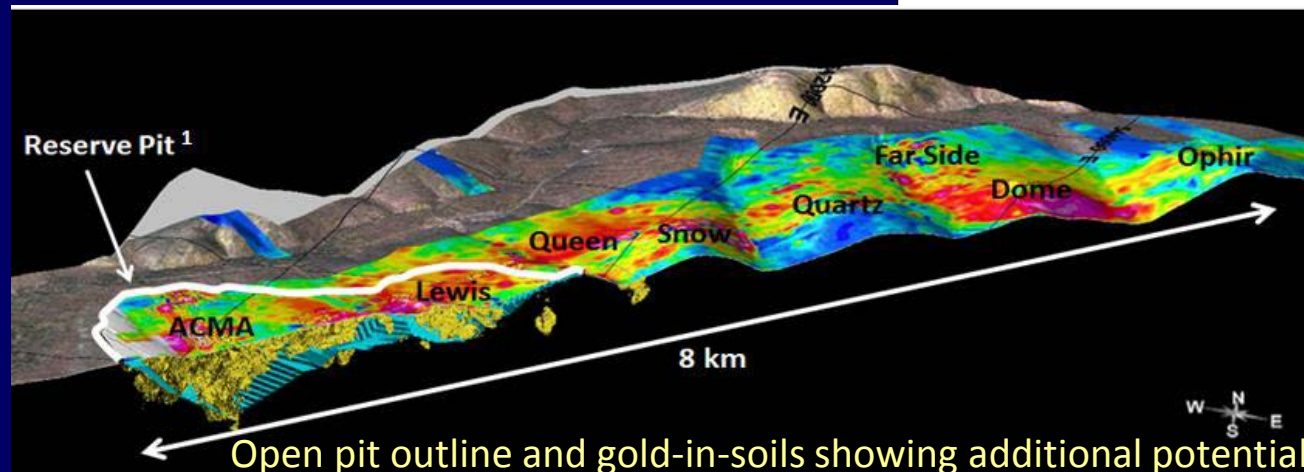
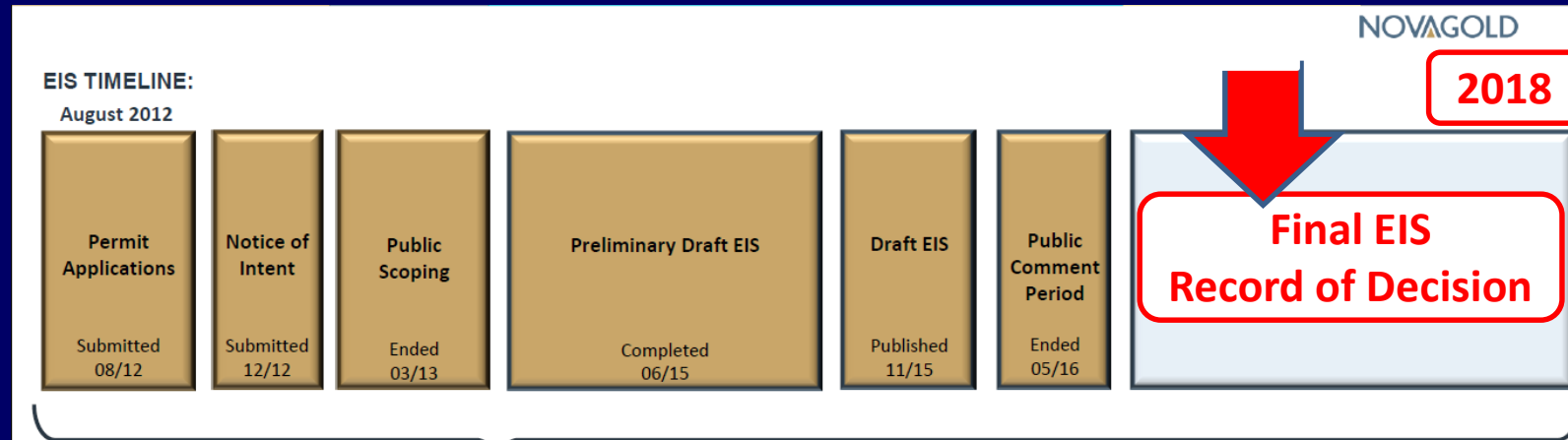


# Donlin Gold (Development project) [50% Barrick Gold Corp./50% NovaGold Resources Inc.]

- Proven and Probable reserves: 34 million oz. of gold
- Projected production of 1.1 M oz. of Au/year
- In 2017, US\$8 million drill program (24 holes; 7,620 m) for project-economics optimization

-Corps of Engineers completed preliminary final EIS internal review in Sept.; scheduled for filing in 2018; COE's Record of Decision soon after

-Most key State permits/approvals scheduled to be finalized concurrently with ROD



# Pebble Porphyry Cu-Mo-Au (Development project) [The Pebble Partnership]

- Jan. 6, 2018: Corps of Engineers accepted Pebble Limited Partnership's permit application
- Initiated NEPA review process

## New proposed development plans:

- Address stakeholder concerns
- Footprint <1/2 of prior envisioned size
- Single drainage for major site infrastructure
- Tailings storage facility designed for maximum safety
- Separation of potentially acid generating tailings from non-acid generating; fully lined tailings storage facility
- No permanent waste-rock piles or cyanide usage

## Proposed open-pit mine:

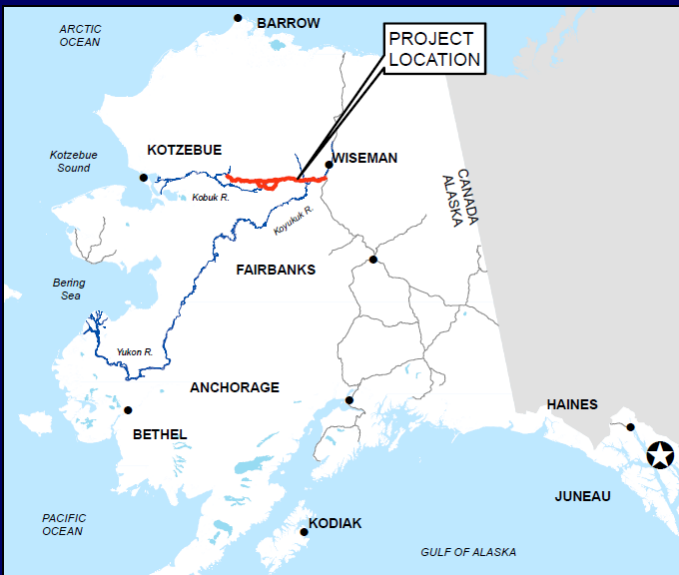
- ~600,000 tons of Cu-Au concentrate/year (~287 M lbs. Cu, ~321,000 oz Au, 1.6 M oz Ag)
- ~15,000 tons of Mo concentrate/year (~13 M lbs. Mo)



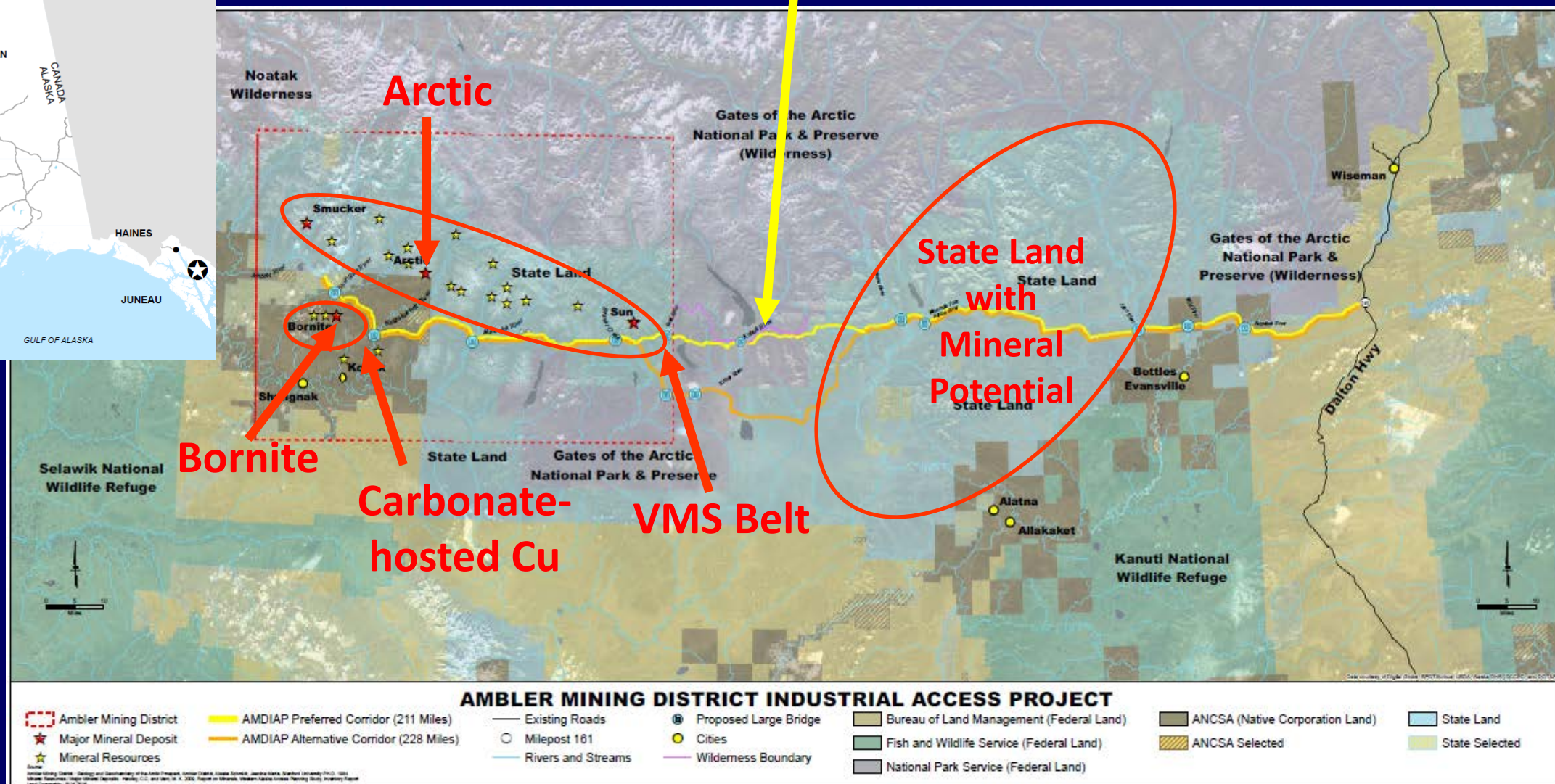
Photo credit: Jason Sear & PLP Oct. 5, 2017 presentation



# Ambler Mining District Industrial Access Project [AIDEA]



## Ambler Mining District Industrial Access Road





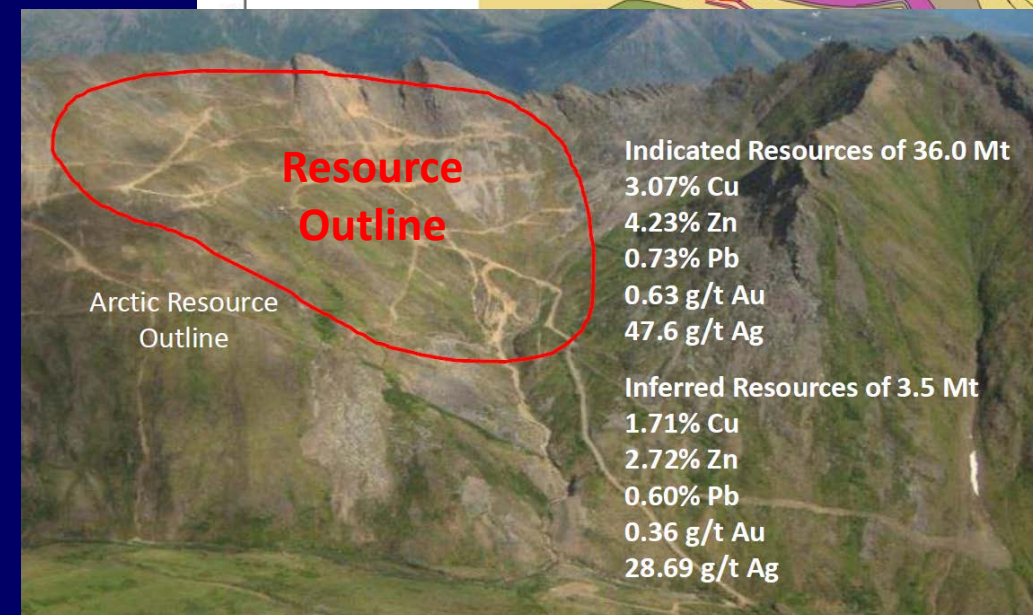
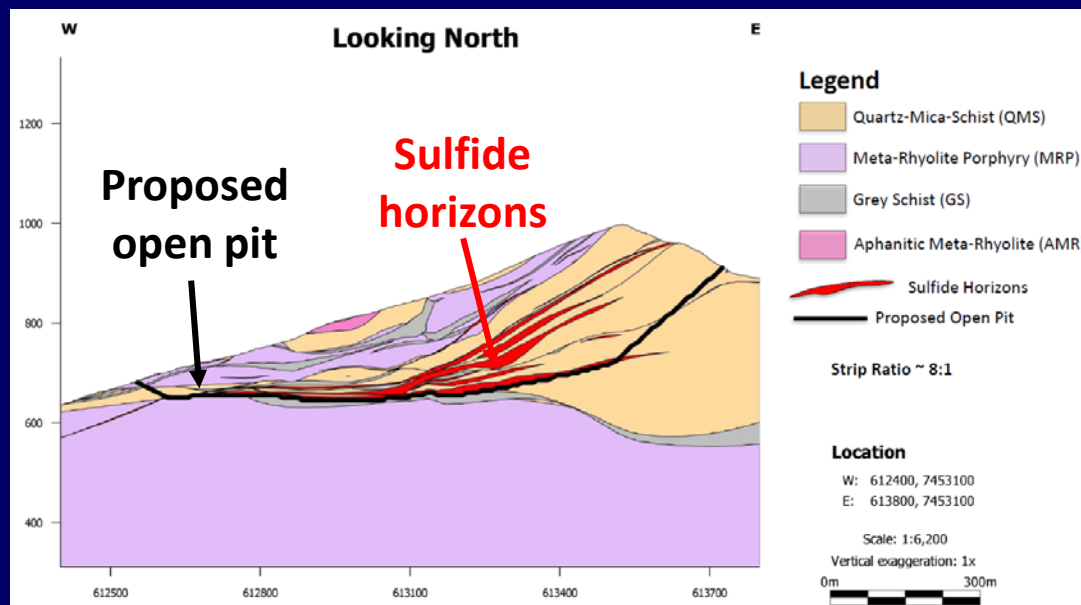
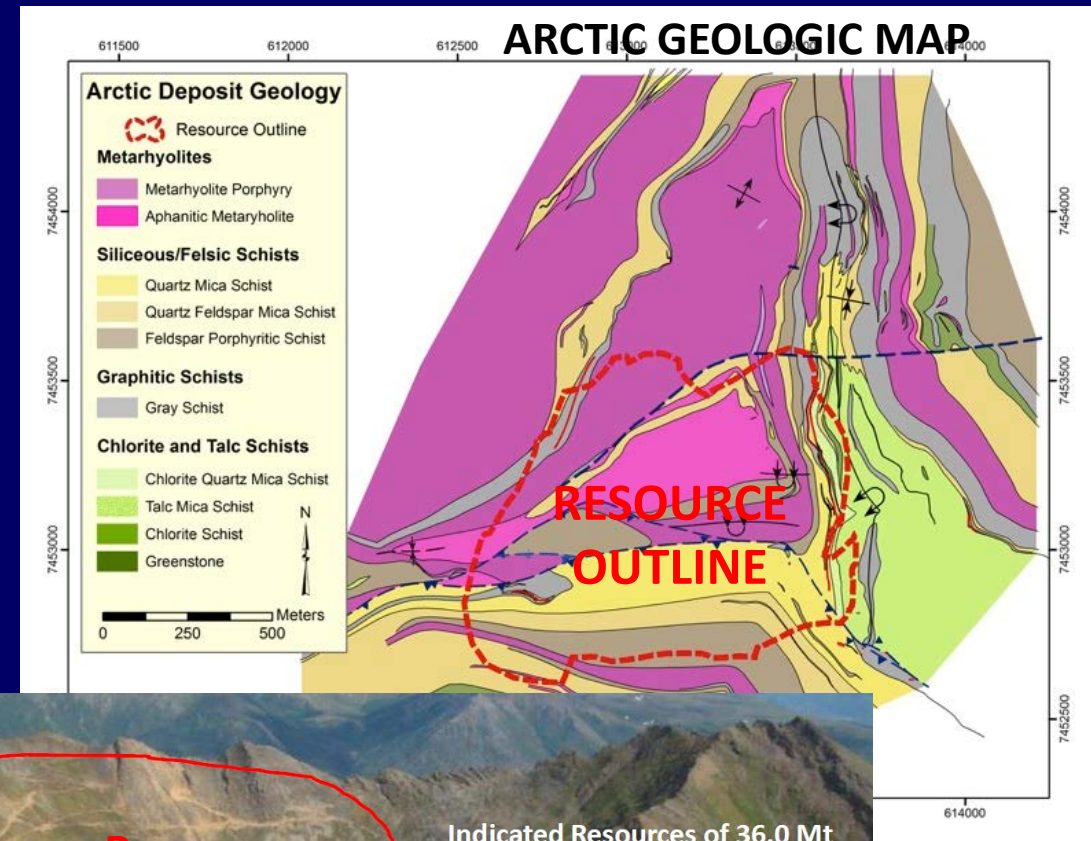
# Arctic VMS [Trilogy Metals Inc./South32 Limited]

-Trilogy Metals – South32 Limited agreement

-Resource update: in-pit indicated 36.0 M tonnes @ 3.07% Cu, 4.23% Zn, 0.73% Pb, 0.63 g of Au/tonne, 47.6 g of Ag/tonne  
-2.4 billion lbs. contained Cu, 3.4 billion lbs. contained Zn

2017 program (US\$7.1 million):

-Geotechnical and in-fill drilling  
-Metallurgy, infrastructure, environmental, geophysical studies  
-Initiated PFS; complete 2018; convert resources to reserves

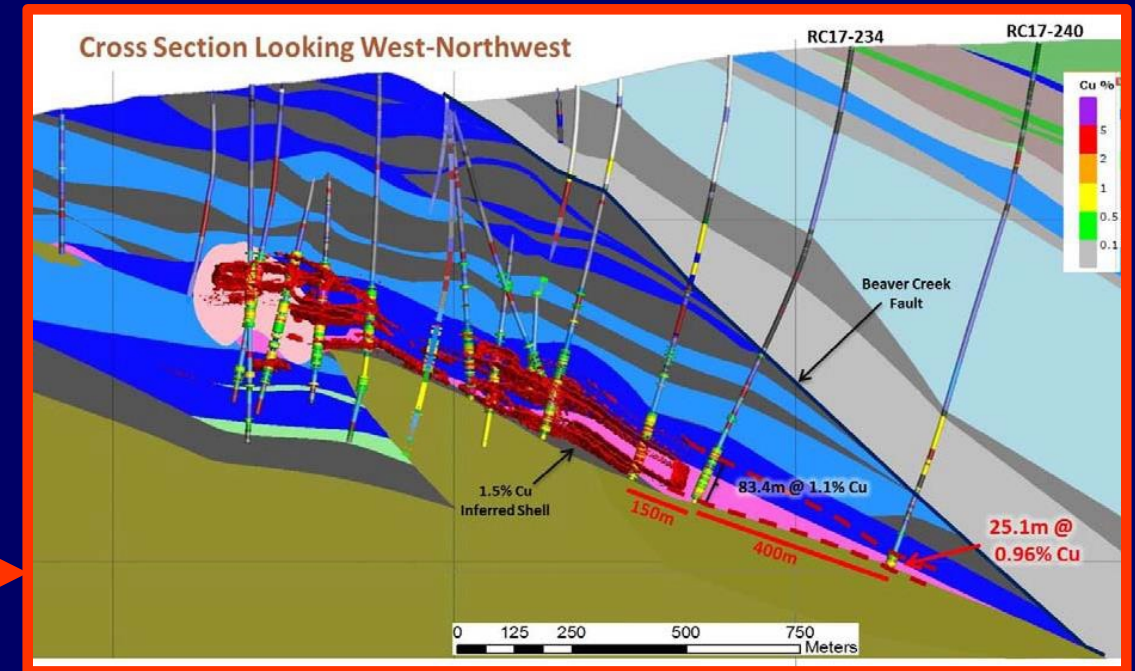
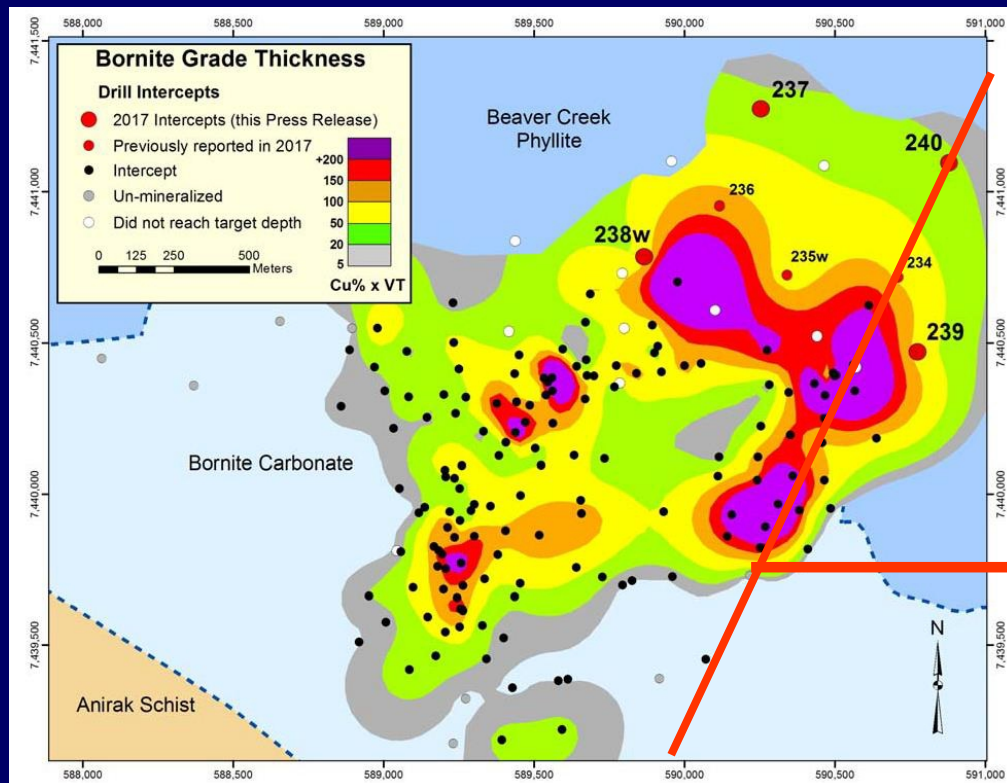




# Bornite [Trilogy Metals Inc./South32 Limited]

## 2017 program:

- US\$10 million budget; funded by South32 Limited
- 9 holes; total 8,437 m; and, soil sampling
- Targeted high-grade carbonate-hosted copper mineralization north and east of previously identified resources
- Gravity; 3D inversion
- Doubled Bornite's footprint to 1,500 m x 2,500 m



## 2018 program:

- ~US\$10 million budget; seismic; in-fill + expansion drilling



# Graphite Creek [Graphite One Resources]

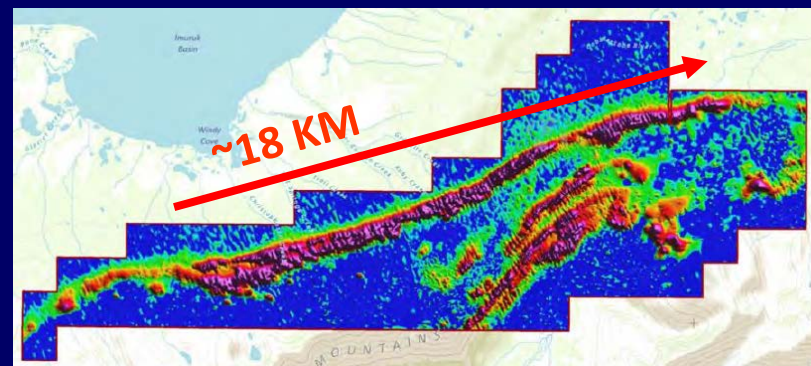
- USA's largest, large-flake graphite deposit
- 10.3 M tonnes indicated, 71.2 M tonnes inferred, both @ 6% Cg cut-off

## Inaugural PEA Overview:

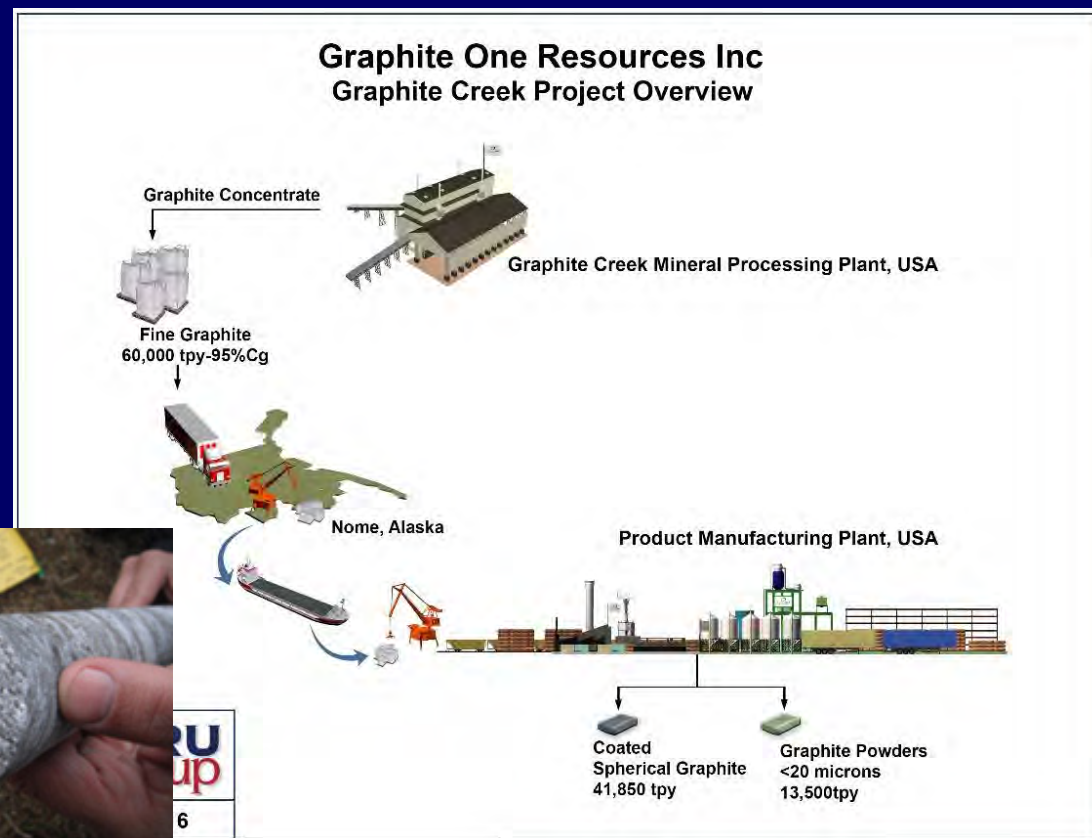
- Open-pit: 1.11 M tonnes graphite-bearing material/year
- Local mineral processing plant for extraction/recovery of graphite
- 60,000 tonnes of concentrate/year grading 95% carbon as graphite
- Transport concentrate to port of Nome
- Barge concentrate to product-manufacturing plant for:
  - 1) Thermal purification,
  - 2) mechanical-chemical processing (spheronization),
  - 3) classification,
  - 4) coating of spherical graphite, and
  - 5) heat treatment

## Produce:

- 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.



Time-domain EM image





# Livengood [International Tower Hill Mines]

Intrusion-related gold system

## 2017 Initial PFS:

-Proven and Probable reserves: 391.7 M tonnes @ average grade of 0.71 g of Au/tonne (8.97 M oz. Au)

## 2017 program:

- Finalized purchase of mining claims
- US\$6.3 million work program
- Implementing PFS's recommendations:
  - Metallurgical testing
  - Assay ~20,000 prior drilling pulps for multi-elements (Sb)
  - Improve mineralization + alteration models



Drilling atop the Money Knob area of the Livengood Project

CLOSE X



Livengood Drill Core

CLOSE X



Chris Puchner, Chief Geologist, looking over core

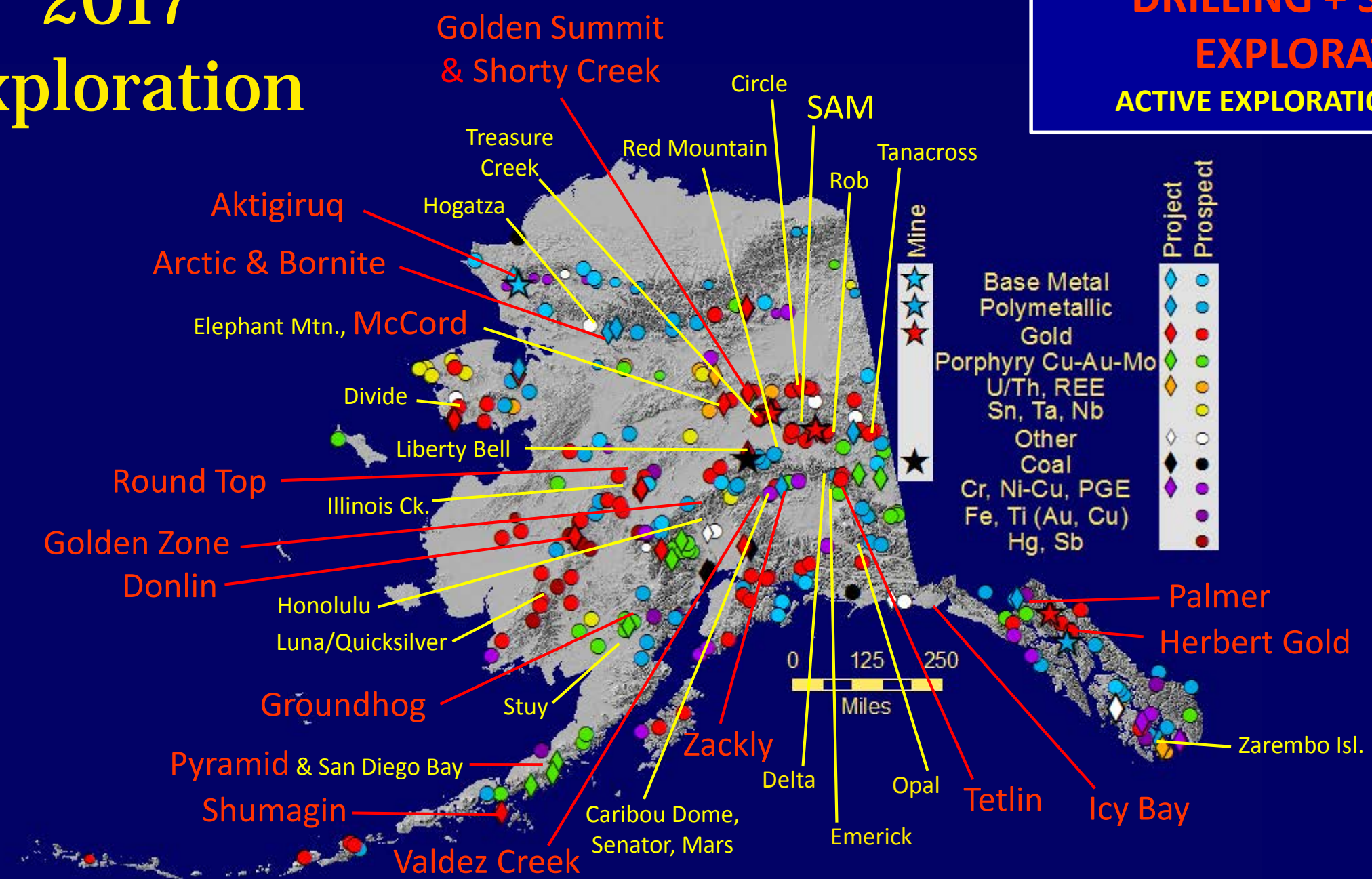
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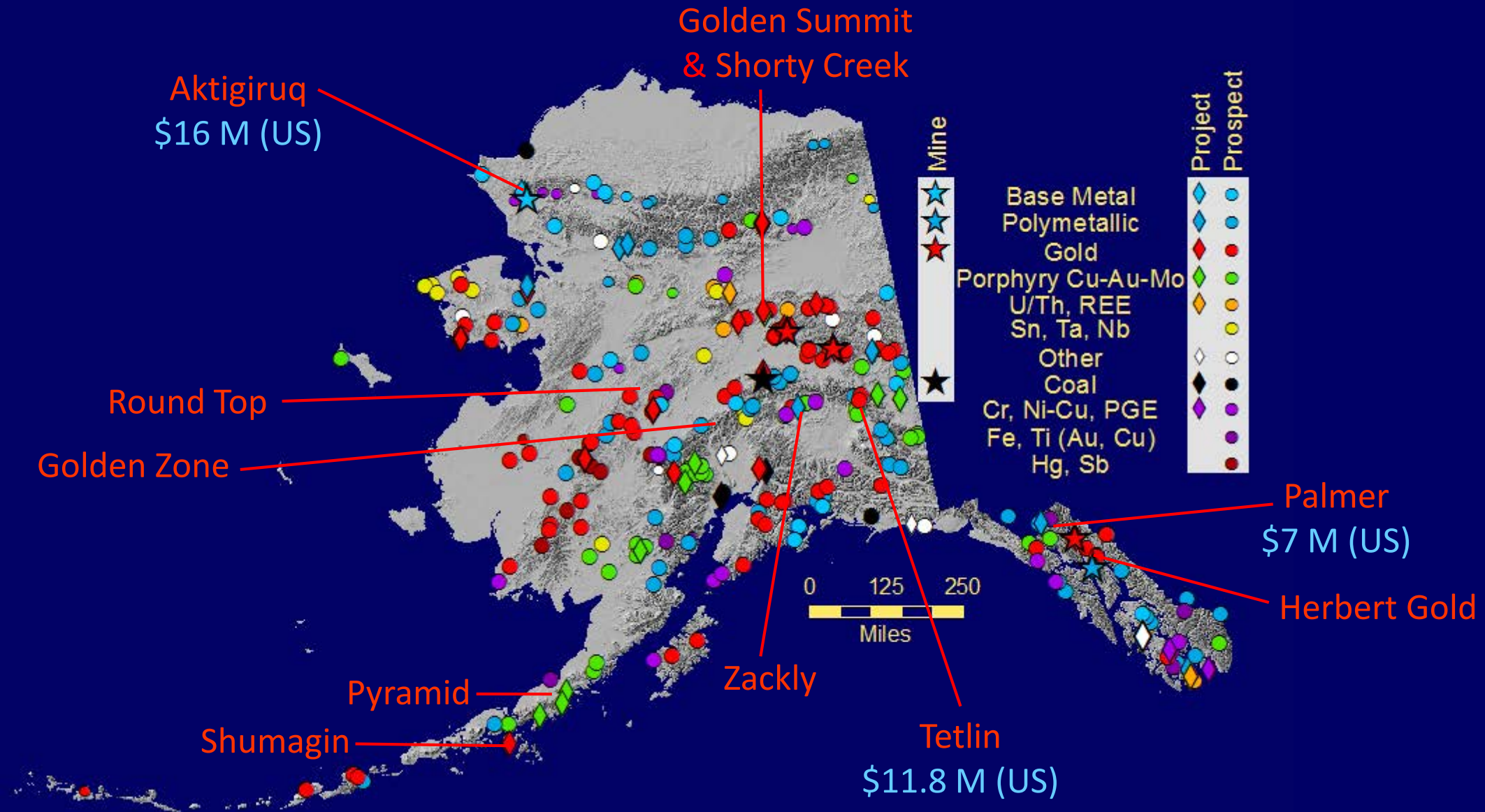
# 2017 Exploration

## DRILLING + SURFACE EXPLORATION ACTIVE EXPLORATION PROJECTS





# 2017 Exploration Drilling Highlights



# Aktigirua Zn-Pb-Ag [Teck]

Sediment-hosted massive sulfide deposit 12 km NW of Red Dog Mine

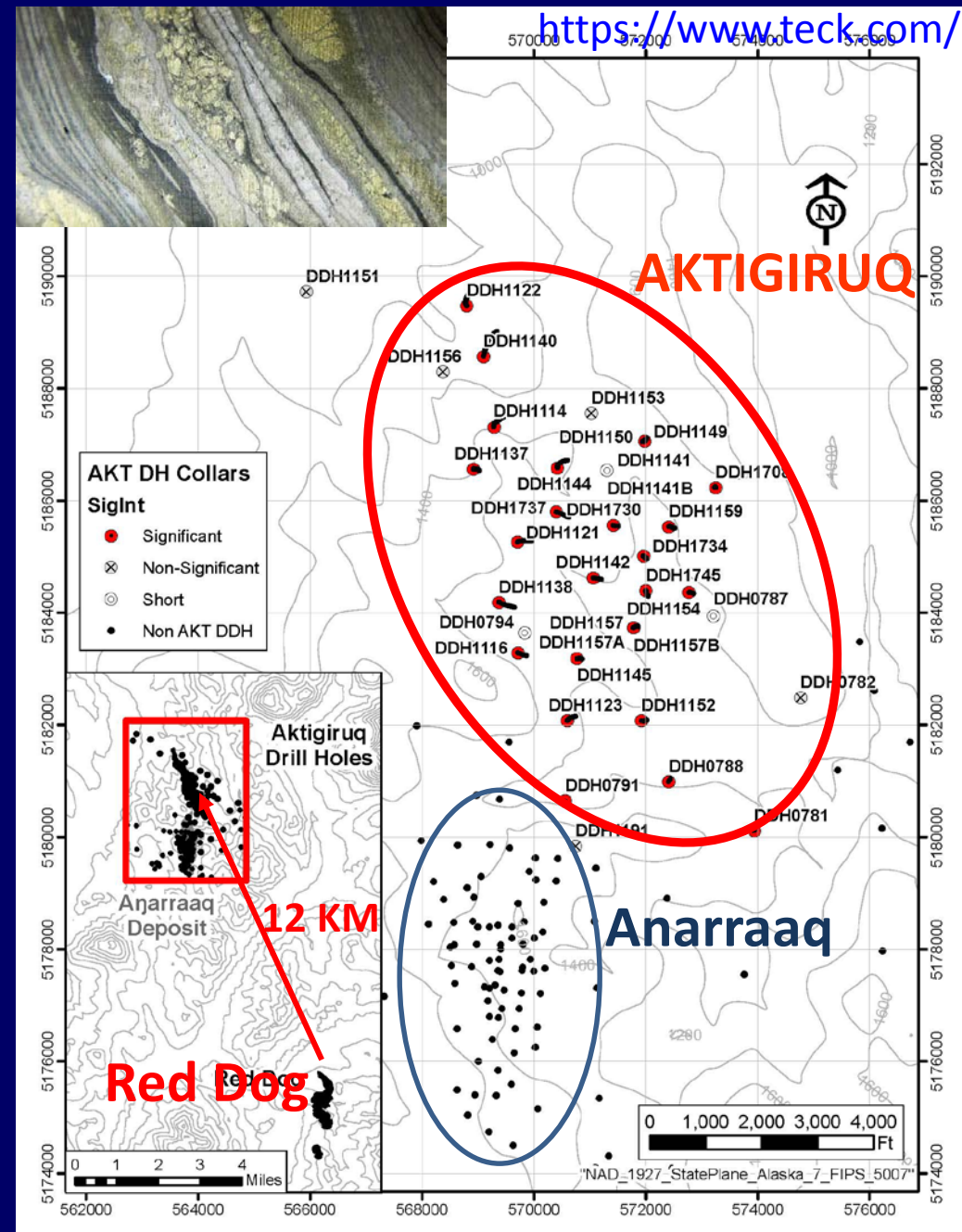
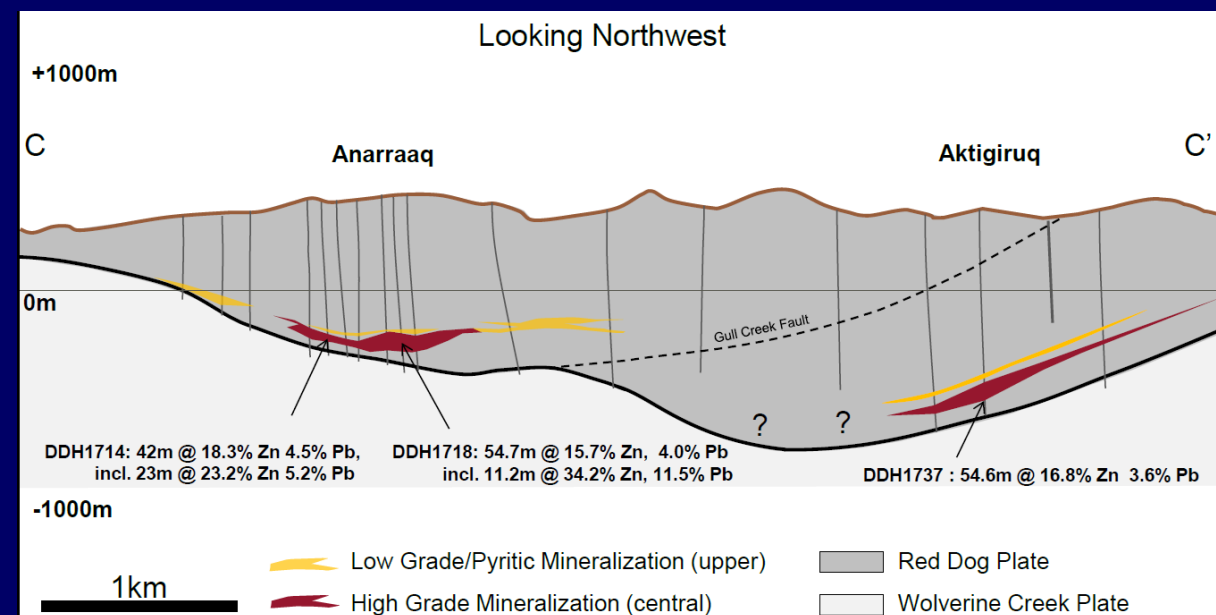
Anarraaq: inferred 26 M tonnes @ 13.8% Zn, 4.3% Pb, 84.3 g of Ag/tonne

## 2017 Aktigirua drilling program (US\$16 million):

-18,000 m in 16-20 planned holes

-Ore body is 400 to 1,000 m below surface

-2016 drilling encountered 54.6 m @ 16.8% Zn, 3.63% Pb (DDH1737)





# Tetlin Cu-Au Skarn [Peak Gold, LLC; JV between Contango Ore Inc./Royal Gold Inc.]

-Road-accessible, Au- and Cu-rich skarns (70 Ma)

## 2017 program (US\$11.8 million):

-Alaska's second-largest exploration program

-Drilling: total 15,000 m;

Phase 1 = 47 DDH's (N. Peak + True Blue Moon)

Phase 2 = 41 DDH's (N. & W. Peak + Main Peak)

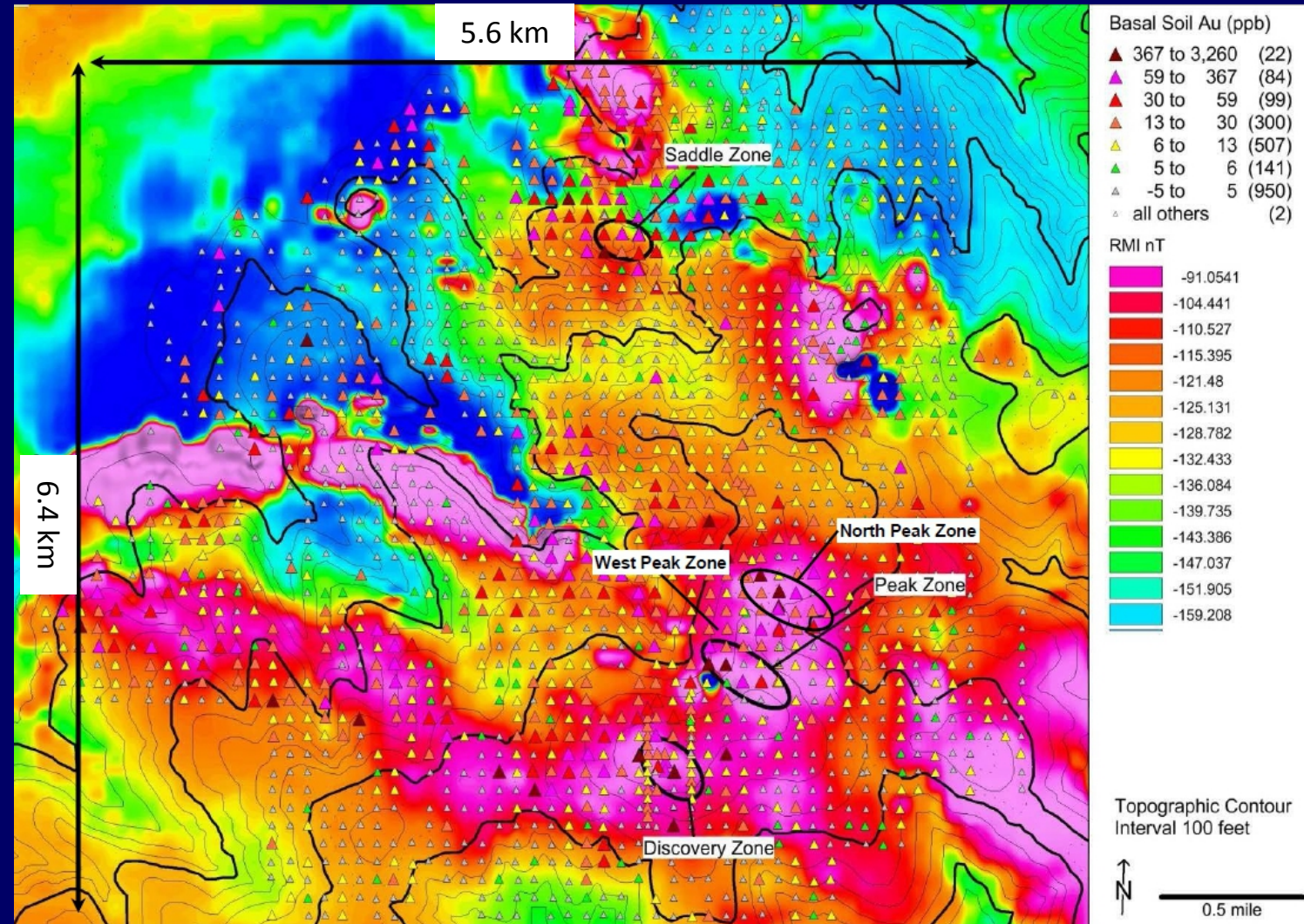
Phase 3 = 8 DDH's (W. Peak)

-Measured, Indicated, and Inferred resource:  
1.5 M oz. Au, 7.38 M oz. Ag, 55 M lbs. Cu (June 2017)

-Stream-sediment sampling at Noah prospect,  
west of Tetlin property.



Sulfides in skarn



Gold in soils over magnetic survey

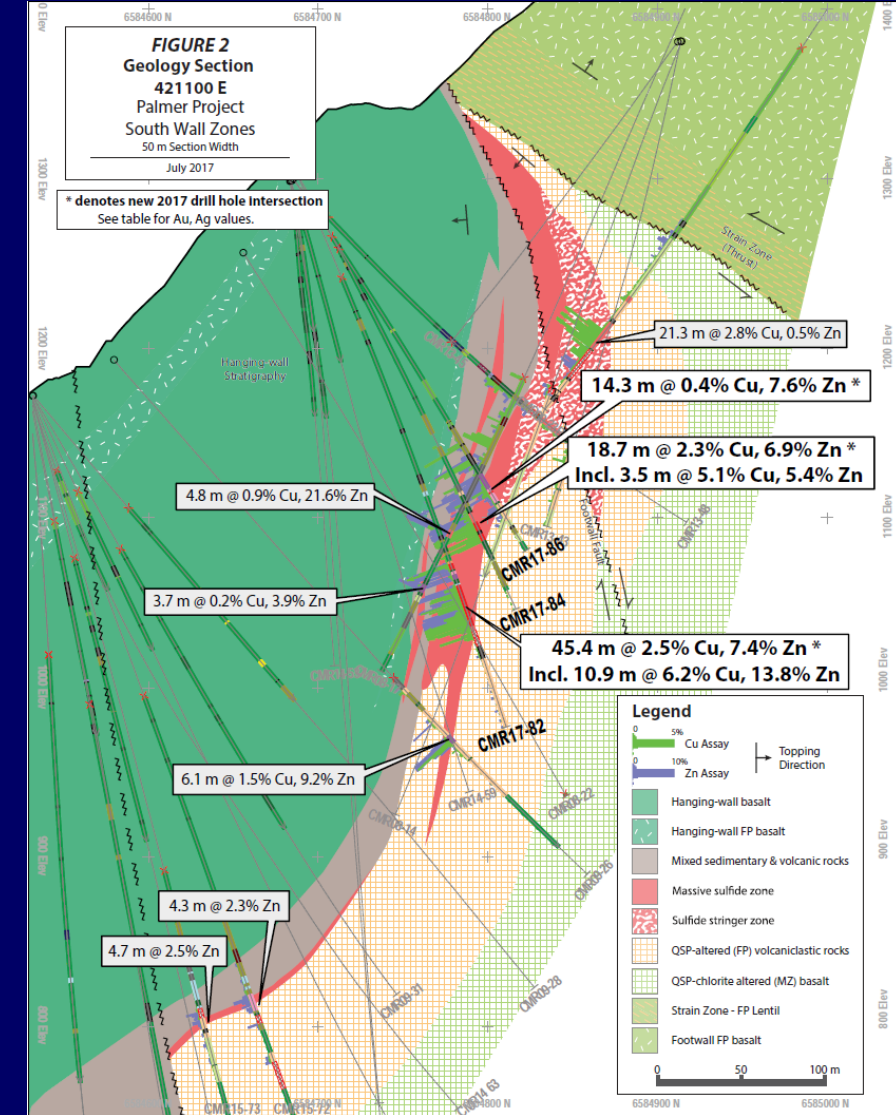
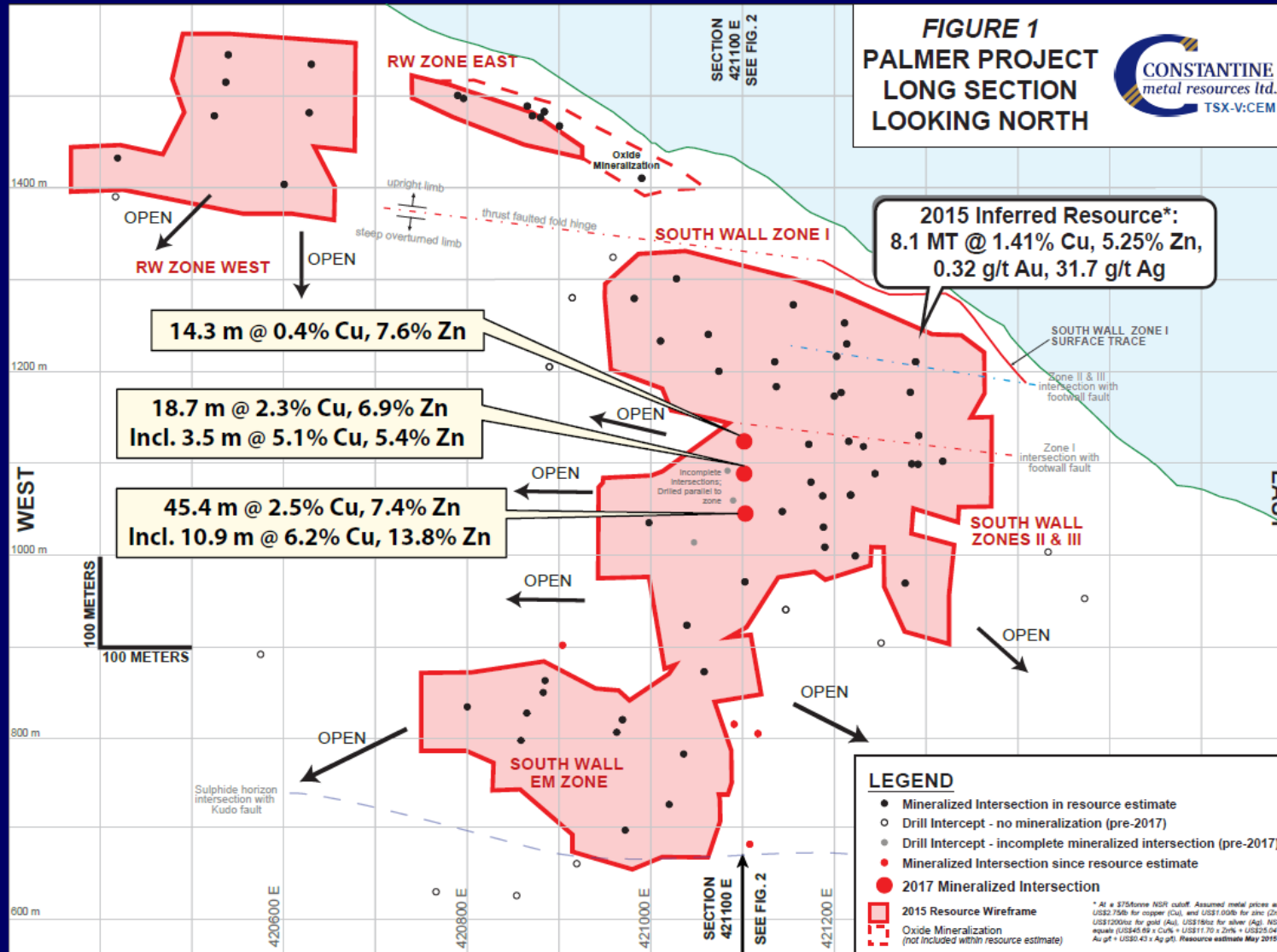
Figure courtesy of Peak Gold, LLC





# Palmer VMS District

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



Long-section map of South Wall and RW Zone resources, Palmer deposit

Cross-section of South Wall, Palmer deposit









# Alaska Range Project [PolarX Ltd.]

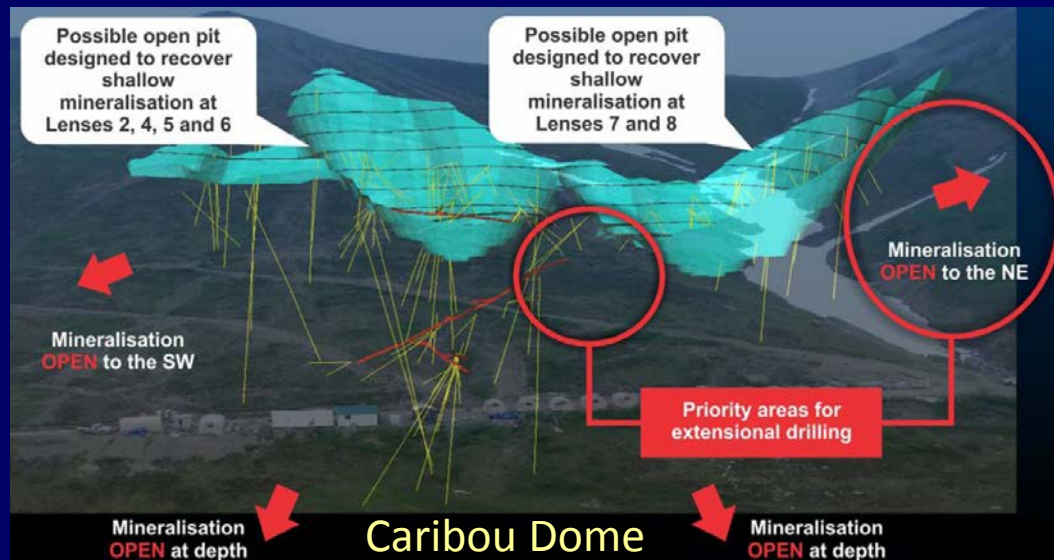
## Alaska Range Project:

- Sediment-hosted Caribou Dome deposit and Senator prospect
- Zackly Cu-Au skarn deposit; Moonwalk Au target
- Jupiter, Mars, and Gemini porphyry Cu-Au-Mo targets

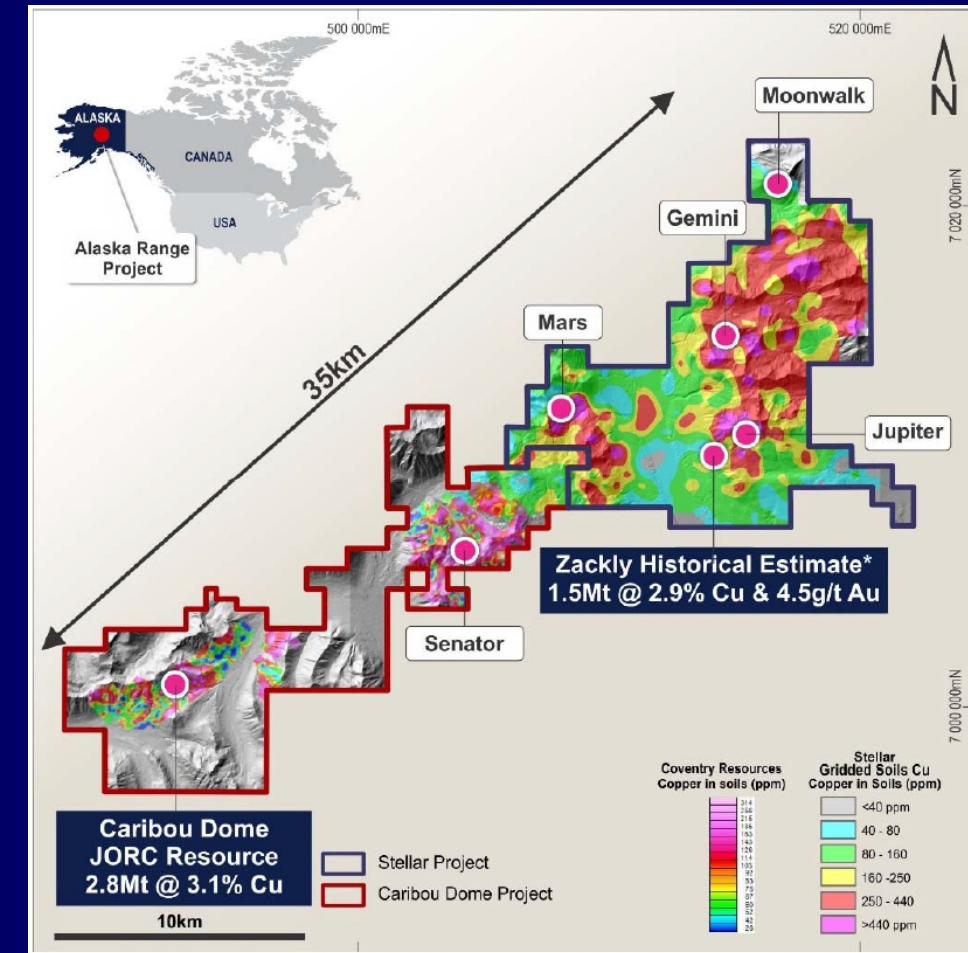
## 2017 Caribou Dome work:

- JORC-compliant, resource estimate: 2.8 M tonnes @ 3.1% Cu;
- ~86,000 tonnes Cu
- Geological & structural mapping of outcrops and core

- Senator: Geochemical sampling, IP survey, mapping
- Mars: IP surveying



Caribou Dome:  
CD15-14 L7/8  
>16% Cu



Alaska Range Project – Copper in soils





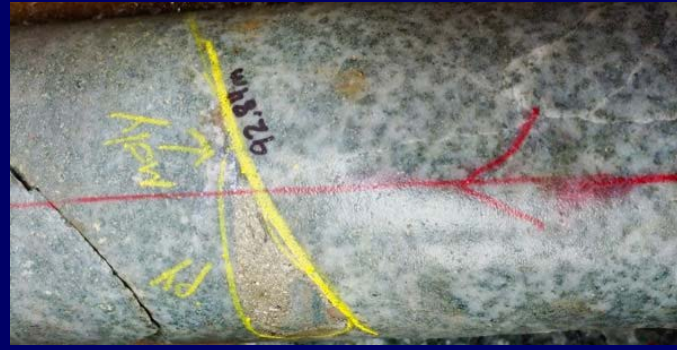
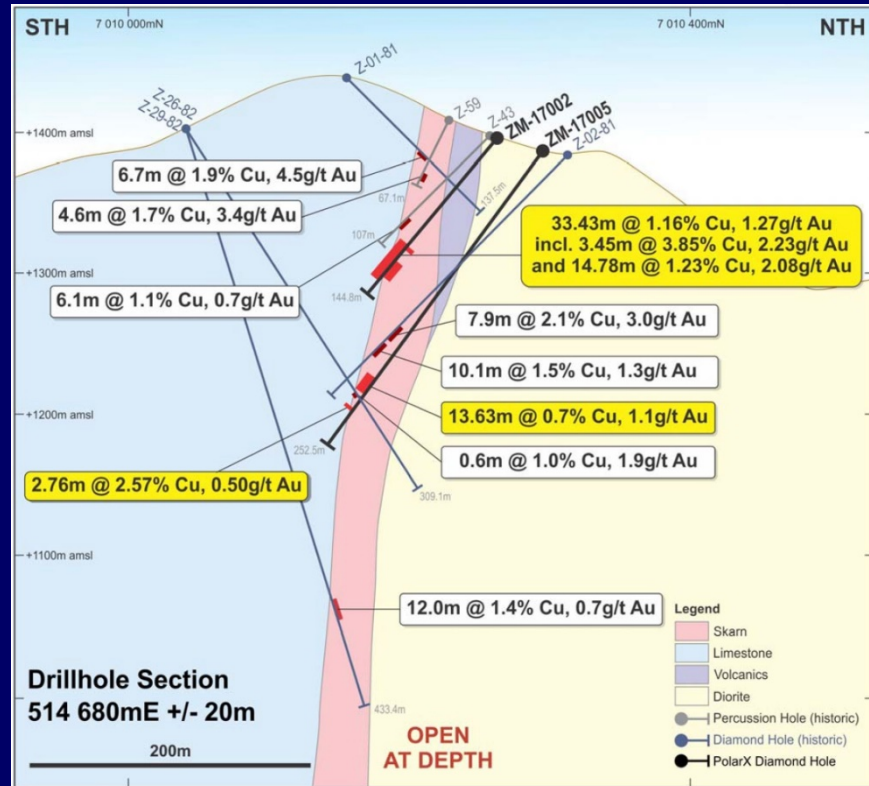
# Zackly Cu-Au skarn (+porphyry?) [PolarX Ltd.]

<http://www.polarx.com.au/>

-Historical, non-NI43-101-compliant resource of 1.54 M tonnes grading 4.5 g of Au/tonne (218,944 ounces); 2.9% Cu (66.9 M pounds)

## 2017 program:

-Upgrade to JORC-compliant resource  
-13 holes; 2,050 m



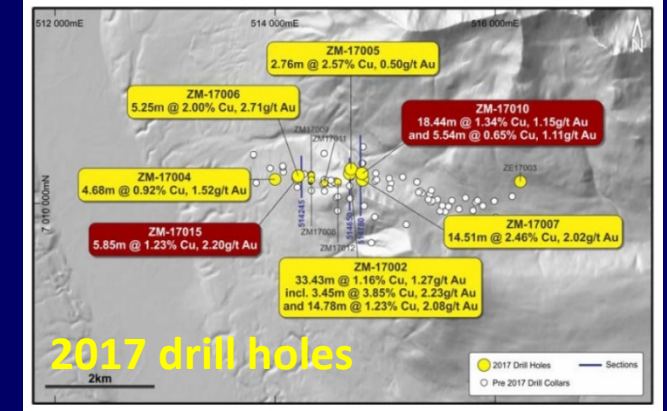
Pyrite & molybdenum in diorite endoskarn



Covellite- & bornite-bearing skarn



Bornite in garnet-bearing skarn



Disseminated native copper in garnet skarn



Potassic (K-feldspar & secondary biotite) alteration overprinting earlier diorite





# Round Top Porphyry Cu [Western Alaska Copper and Gold]

Porphyry Cu + skarn + Pb-Zn-Ag-Au carbonate-replacement

~1 km x 1 km area: supergene chalcocite grading down into primary Cu

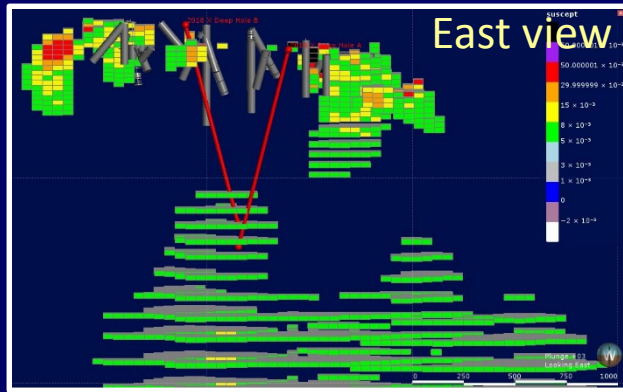
## 2017 program:

-9 holes, 2,170m

-Hole RT-18: 3 intervals for 64.7 m @ 0.49% Cu

-Hole RT-19: 7 intervals for 166 m @ 0.43% Cu

-Discovered new area with hypogene sulfides



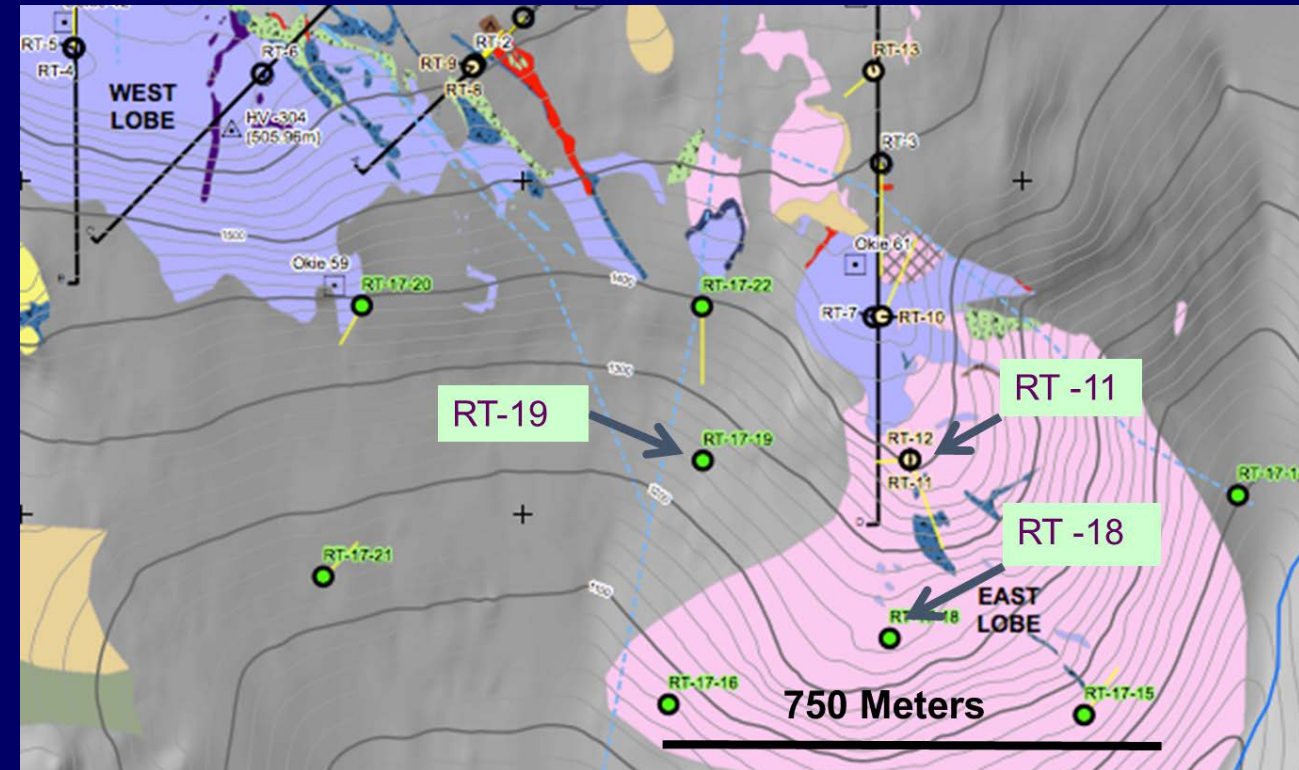
Magnetic susceptibility model: Existing (gray); planned 2018 DDH's (red)



Chalcocite & covellite in core



6-cm-wide quartz +  
chalcopyrite + pyrite vein  
offset by later-stage  
vertical pyrite vein



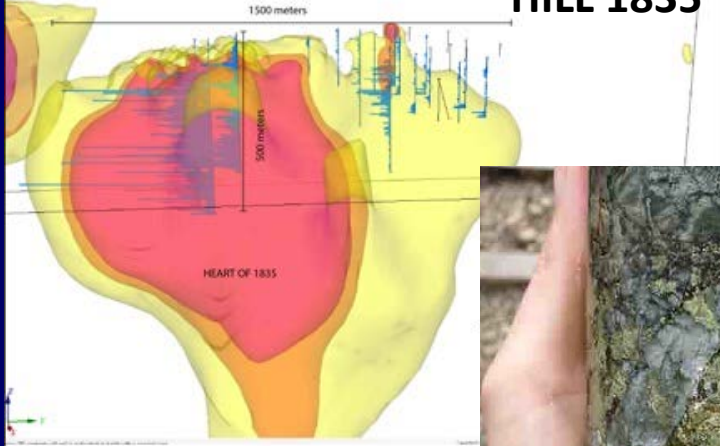
Geologic map showing location of 9 drill holes (green dots):  
Quartz monzonite porphyry (pink); fragmental quartz latite (purple)





# Shorty Creek Cu & Golden Summit [Freegold Ventures Limited]

3D Magnetic susceptibility model  
HILL 1835



**SHORTY CREEK:** Porphyritic intrusions associated with Cu-Au & Cu-Mo

## 2017 program:

-7 holes; 2,768 m

## Hill 1835:

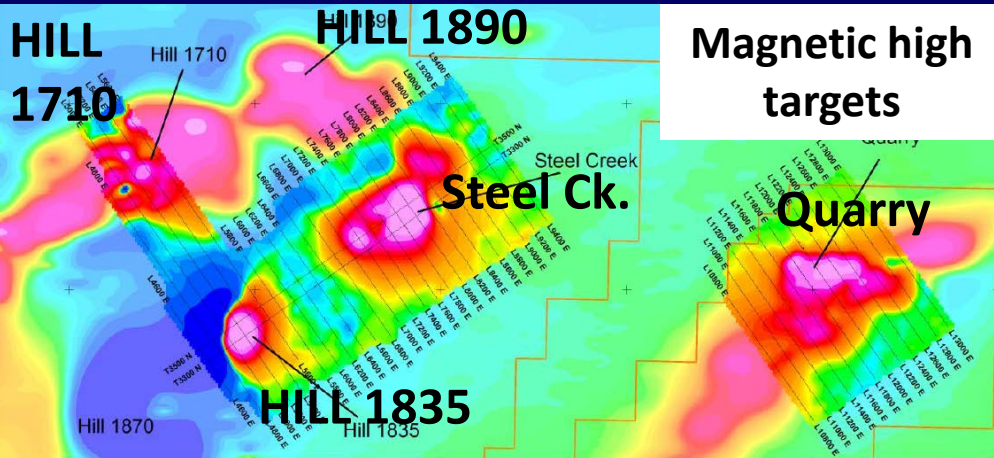
-Vertical step-out holes, 100 m and 200 m SW of 2016 drilling

-Hole SC17-01: 360 m, 0.24% Cu, 4.04 g Ag/tonne, 100 ppm Co, 0.03% WO<sub>3</sub>

## Steel Creek:

-Initial drilling of magnetic high

Chalcopyrite in core



## GOLDEN SUMMIT:

Intrusion-related gold

## Resources:

-Indicated 61.5 M tonnes

-Inferred 71.5 M tonnes

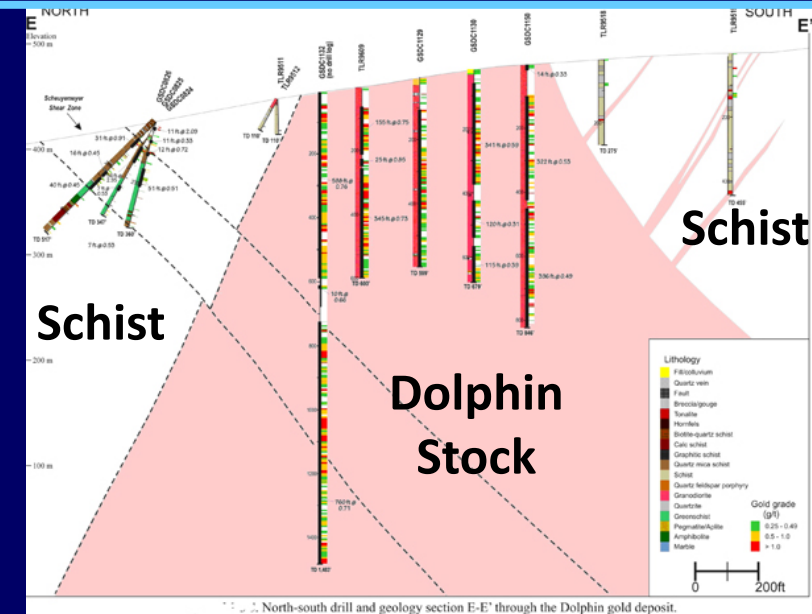
-Both @ 0.02 opt Au

## 2017 program:

-27 holes; 1,890 m

-IP survey

-Expanded resource



# Herbert Gold [Grand Portage Resources]

Mesothermal Au-quartz veins along trend and SE of Kensington Mine

## Resources:

- Indicated: 821,079 tonnes @ 6.91 g of Au/tonne (182,400 oz.)
- Inferred: 51,611 tonnes @ 7.73 g of Au/tonne (12,800 oz.)

## 2017 Work:

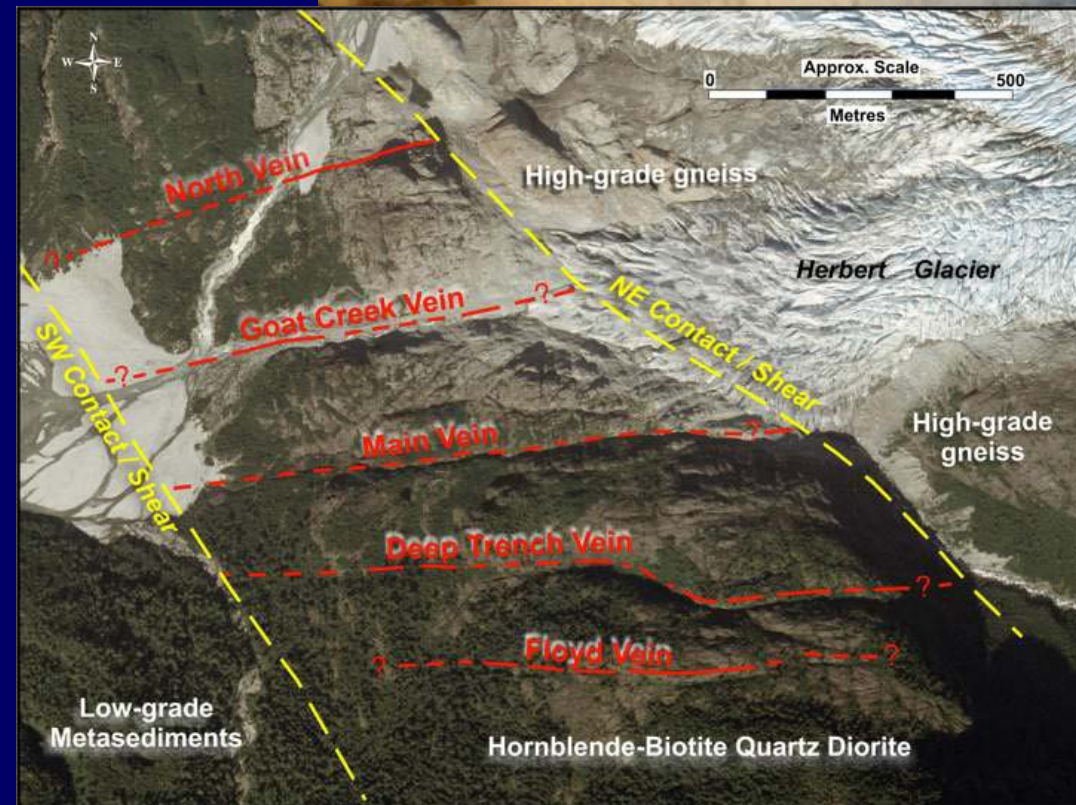
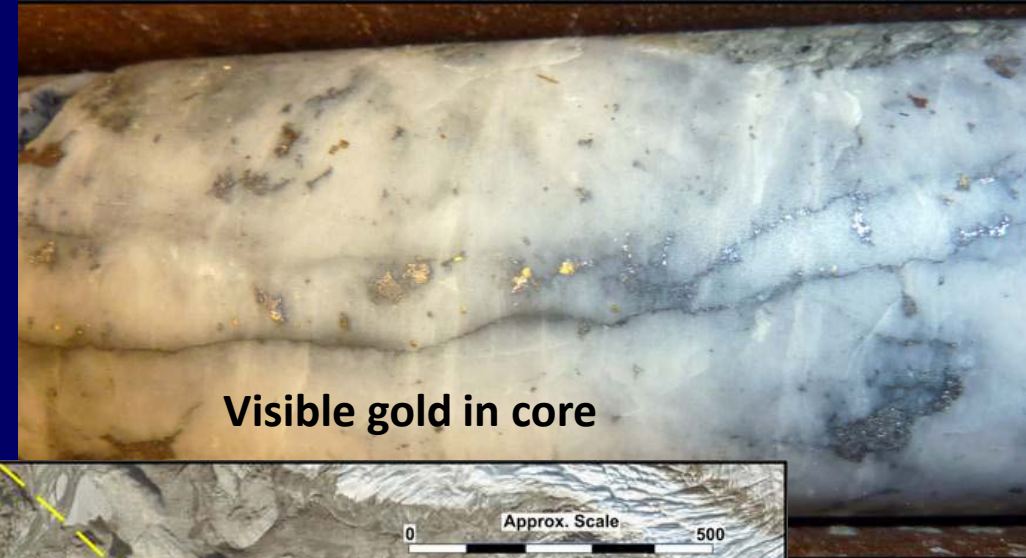
- 12 holes; 3,700 m
- Parallel sets of quartz veins with disseminated arsenopyrite, pyrite, galena, sphalerite, and visible gold

## Goat Vein:

- 8 DDH; 1,952 m; discovered subsidiary veins in hanging wall and foot wall
- 6.3 m w/weighted-average of 7.31 g of Au/tonne

## Main & Deep Trench Veins:

- 4DDH; 1,757 m; discovered subsidiary veins with Au
- 5.06 m w/weighted-average of 2.83 g of Au/tonne







# Unga Epithermal Au-Ag [Redstar Gold Corp.]

## Spring 2017:

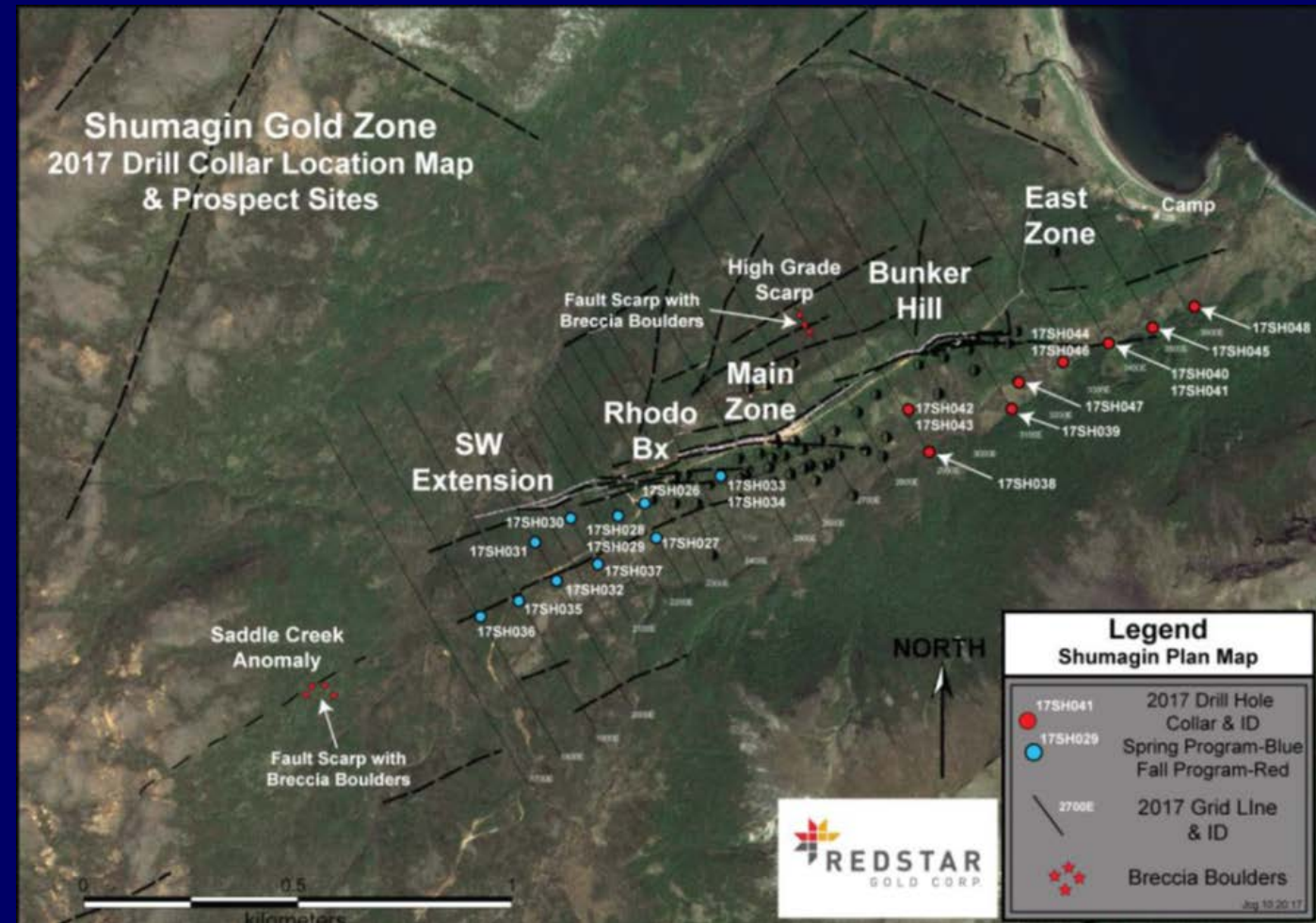
- Mapping, rock and soil geochemical sampling
- Ground IP & magnetic surveys defined multiple blind structures; extended Shumagin Fault 600 m to SW
- 12 holes; 2,288 m; SW Extension Zone
- Hole 17-SH-34 intersected 2.2 m of 9.9 g of Au/tonne; 29.3 g of Ag/tonne

## Fall 2017:

- 11 holes; 2,407 m; NE of Main Zone, Bunker Hill, & East Zone (Shumagin Zone)
- 2 holes; 233.9 m; Rising Sun (Apollo area)

## Outcome:

- ↑ known strike length of Shumagin structure by 84% to 1,750 m
- Colloform textures = active boiling and mineral deposition = indicate proximity to precious-metal deposition zones





# Pyramid Porphyry Cu-Mo-Au Deposit

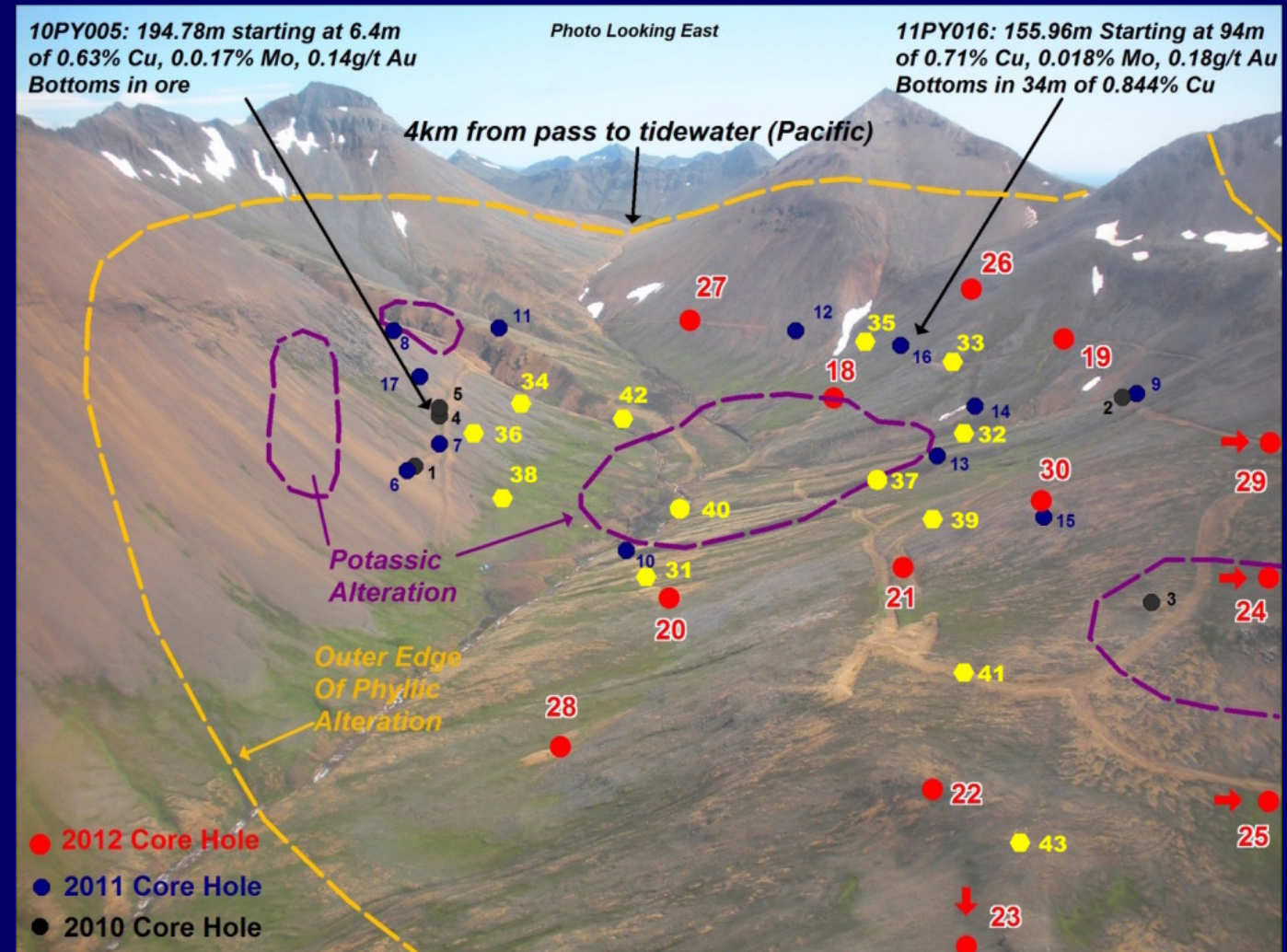
[Copperbank Resources Corp.]

**Historical inferred resource:** 122 M tonnes at 0.41% Cu (1.3 B lbs.), 0.02% Mo (74 M lbs.), & 0.10 g/tonne Au (0.5 M ounces)

## 2017 Work:

- 13 holes, 3,690 m; test lateral extents of known mineralization + step outs
- DDH 17PY035: total 251 m with weighted-average grade 0.41% Cu over two intervals (137 m of 0.45% Cu and 114 m of 0.37% Cu)
- DDH 17PY036: 179.5 m of 0.37% Cu

Hole No	From m	To m	Width m	Cu %	Mo %	Au g/t	CuEq
17PY031	24	30	6	0.24	0.05	0.04	0.39
17PY032	3.1	401.7	399.6	0.35	0.02	0.08	0.44
17PY033	64	364	300	0.53	0.02	0.12	0.65
17PY034	7	239.9	232.9	0.19	0.04	0.06	0.33
17PY035	42	179	137	0.45	0.02	0.15	0.60
and	205	319	114	0.37	0.01	0.08	0.45
17PY036	22.5	202.0	179.5	0.37	0.03	0.12	0.52
17PY037	7.3	331.6	324.3	0.31	0.02	0.12	0.43
17PY038	11	61	50.0	0.31	0.01	0.24	0.36
17PY039	60	116	56	0.34	0.00	0.08	0.34
17PY040	7	309	302	0.10	0.14	0.06	0.18
17PY041	74	154.2	80.2	0.33	0.01	0.02	0.36
17PY042	7.9	248.8	240.9	0.12	0.03	0.04	0.22
including	184	204	20	0.15	0.04	0.09	0.15
17PY043	171	203	32	0.15	0.01	0.01	0.20



2017 Drill Holes shown in yellow





# Golden Zone [Avidian Gold]

## Resource (2016):

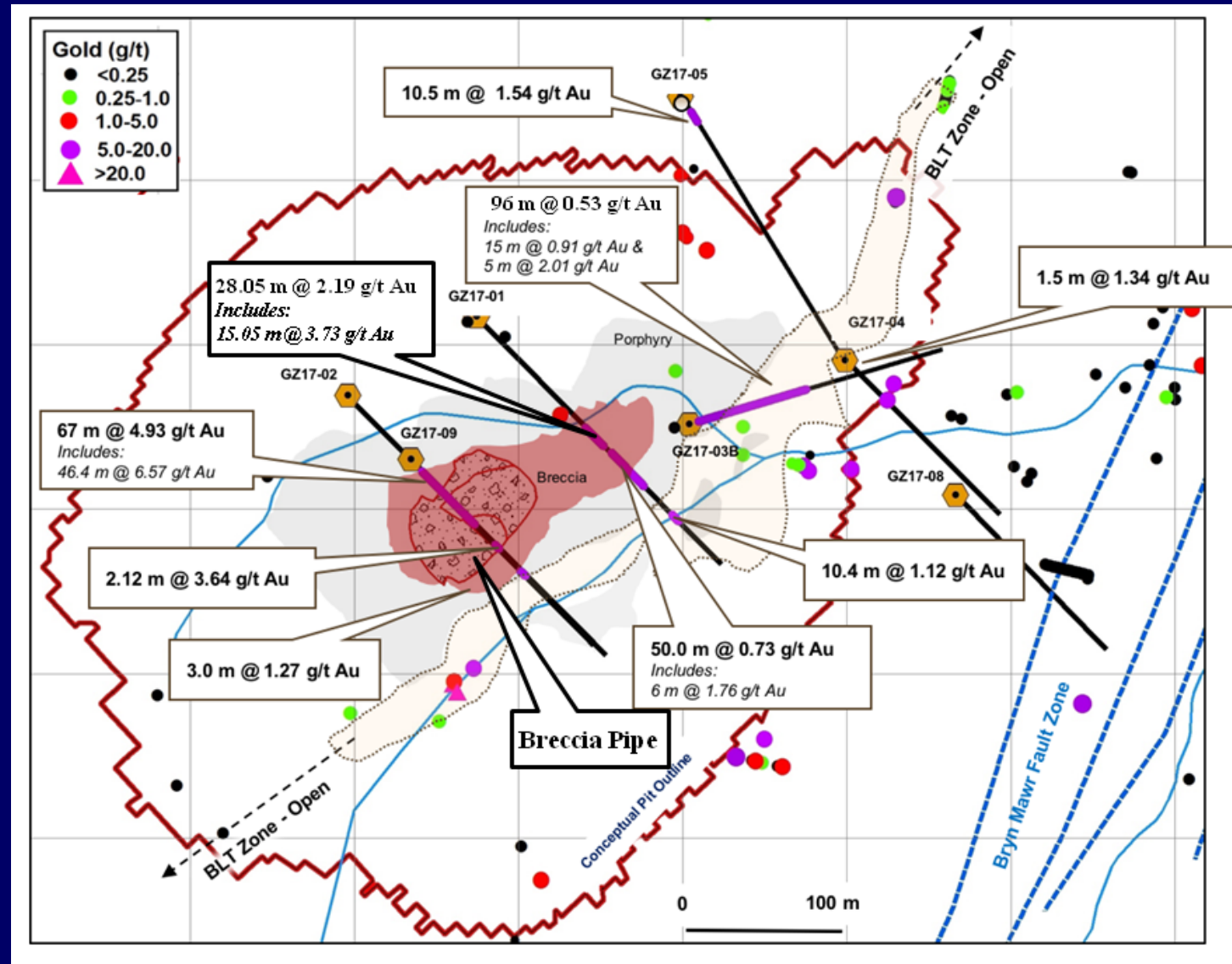
Indicated: 4.187 M tonnes @ 1.99 g of Au/tonne,  
10.38 g of Ag/tonne

Breccia pipe (150 m by 80 m) in core of Cretaceous  
porphyry stock with arsenopyrite-chalcopyrite-pyrite

## 2017 work:

- 11 holes, 2,579 m
- Intercepted 96 m @ 0.53 g of Au/tonne outside  
breccia pipe & current resource in BLT Zone
- 43 line km of IP surveying
- 970 grab & channel samples
- Trenching

-Sampling in Golden Zone and Long Creek Corridors  
defined an area with anomalous (>1 g of Au/tonne)  
over 8-km strike & >2 km width



Golden Zone: map showing 2017 drill-intercept results and  
conceptual pit outline (red outline)