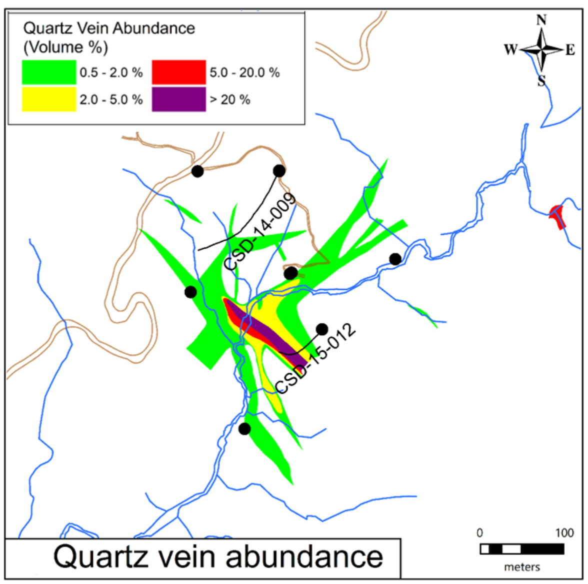
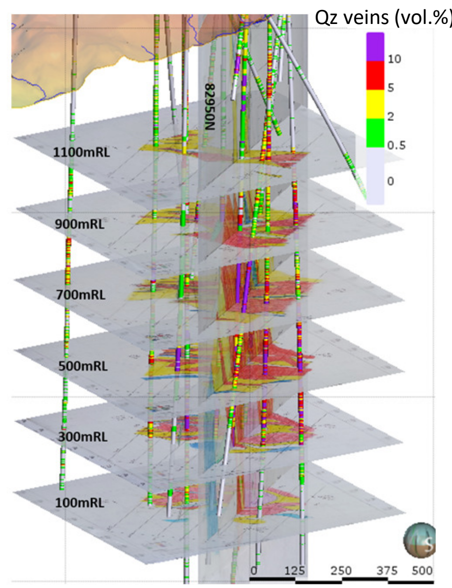
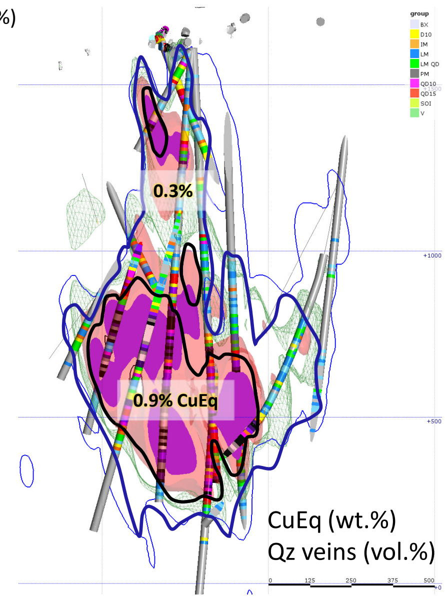
The importance of geological mapping, drill-hole logging and 3D geoscientific data integration in the exploration of porphyry copper-(gold) deposits







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SMEDG Golden Jubilee Conference

25th August 2022

Centre for EXPLORATION TARGETING

Geological mapping, core-logging and 3D geoscientific data integration in the exploration of porphyry copper-(gold) deposits

1. Anaconda Method

Observation as a basis for successful exploration that leads to discovery
Effective visualization of multi-variant data in geological mapping and core logging

2. Example from the Alpala porphyry copper-gold-silver deposit, Ecuador

Creek mapping through drill-core logging to 3D modelling and resource estimation

3. Conclusions

Basic geology provides a strong foundation for exploration ………..
in conjunction with 3D interpretation to enhance understanding of controls to mineralization and location of ore zones

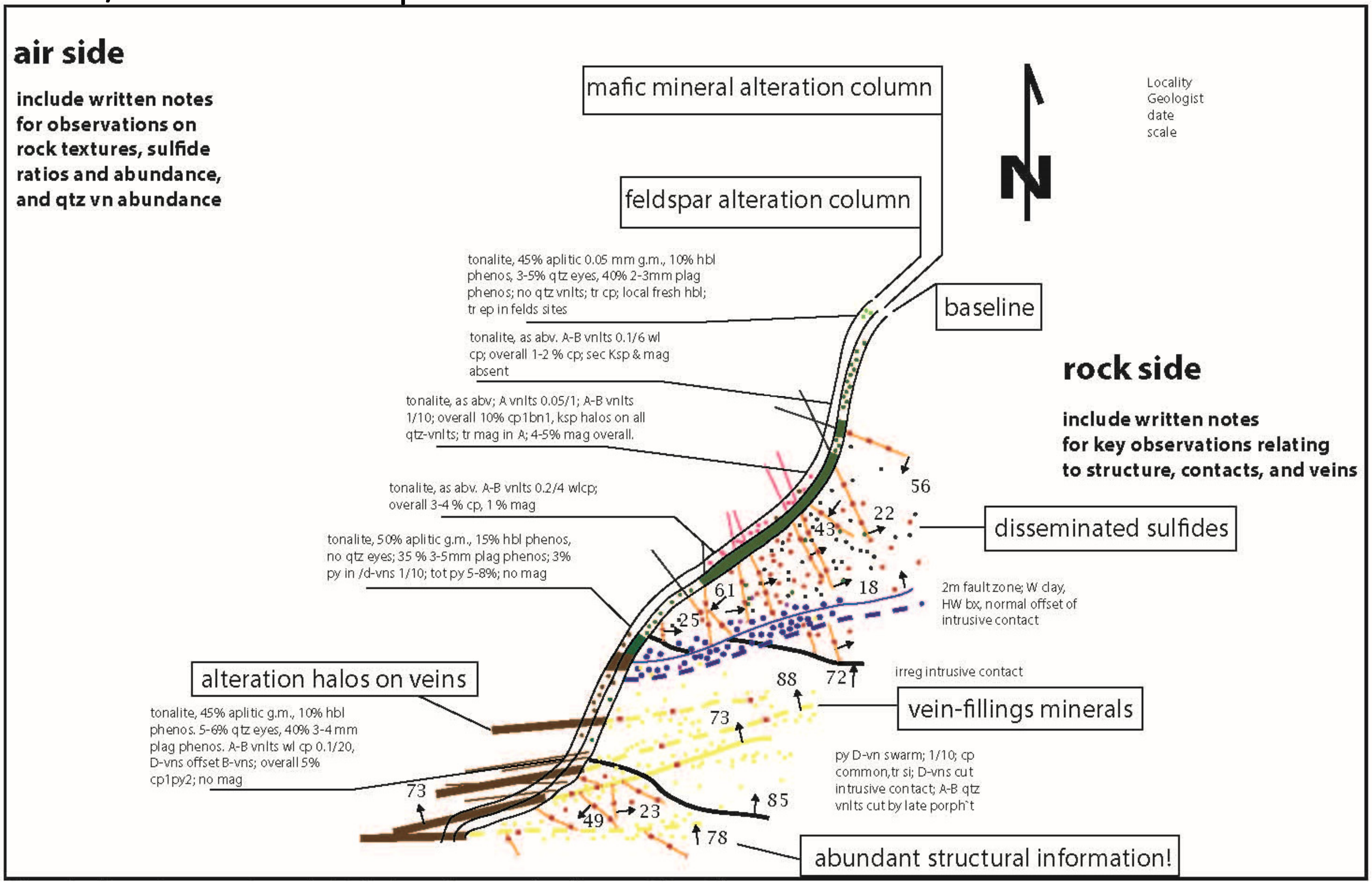
The Anaconda Method –

Manual Available on Request

An effective tool to record observations critical to discovery

- Color-coded mapping of key features of alteration/mineralization
- Quantitative estimates of mineral, vein and fracture abundances
- Measurement of attitudes and relative age between features (vein-types or intrusions)
- Mapping to complement numerical mapping designed for computer databases
- A geologist who draws what he sees in the rocks has greater flexibility and freedom of thought than one who is forced to pigeon-hole everything into a numerical category
- Detailed, geological and mineralogical notes compiled on posting sheets (“fact maps”), whose color and textural distinctions allow quick visual correlation of common features between outcrops, mine benches, or drill holes
- The use of standardized colours allows a given exploration team or research group to read and understand each other’s maps
- This approach presented is a direct evolution of mapping schemes devised by Anaconda geologists at El Salvador, Chile, and Yerington, Nevada in the 1960’s, based on Butte, Montana
- The ‘Anaconda method’ is drawn from ideas generated from field work and discussions between Marco Einaudi, John Proffett, John Hunt, Bill Atkinson and John Dilles (R. Sales / C. Meyer)

Face / Trench Example




Batu Hijau Open-Pit (2007), looking south towards the Indian Ocean

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ALPALA

(85% OWNED)

SOLGOLD'S MAIDEN PROJECT. THE FIRST OF MANY POTENTIAL WORLD CLASS PROJECTS ACROSS ECUADOR.

SolGold Discovery of Alpala Cu-Au Porphyry Deposit, Northern Ecuador

- **Alpala discovery outcrop found – May 2012**
- **World-class intersection achieved in Hole 5 – Jan 2014**

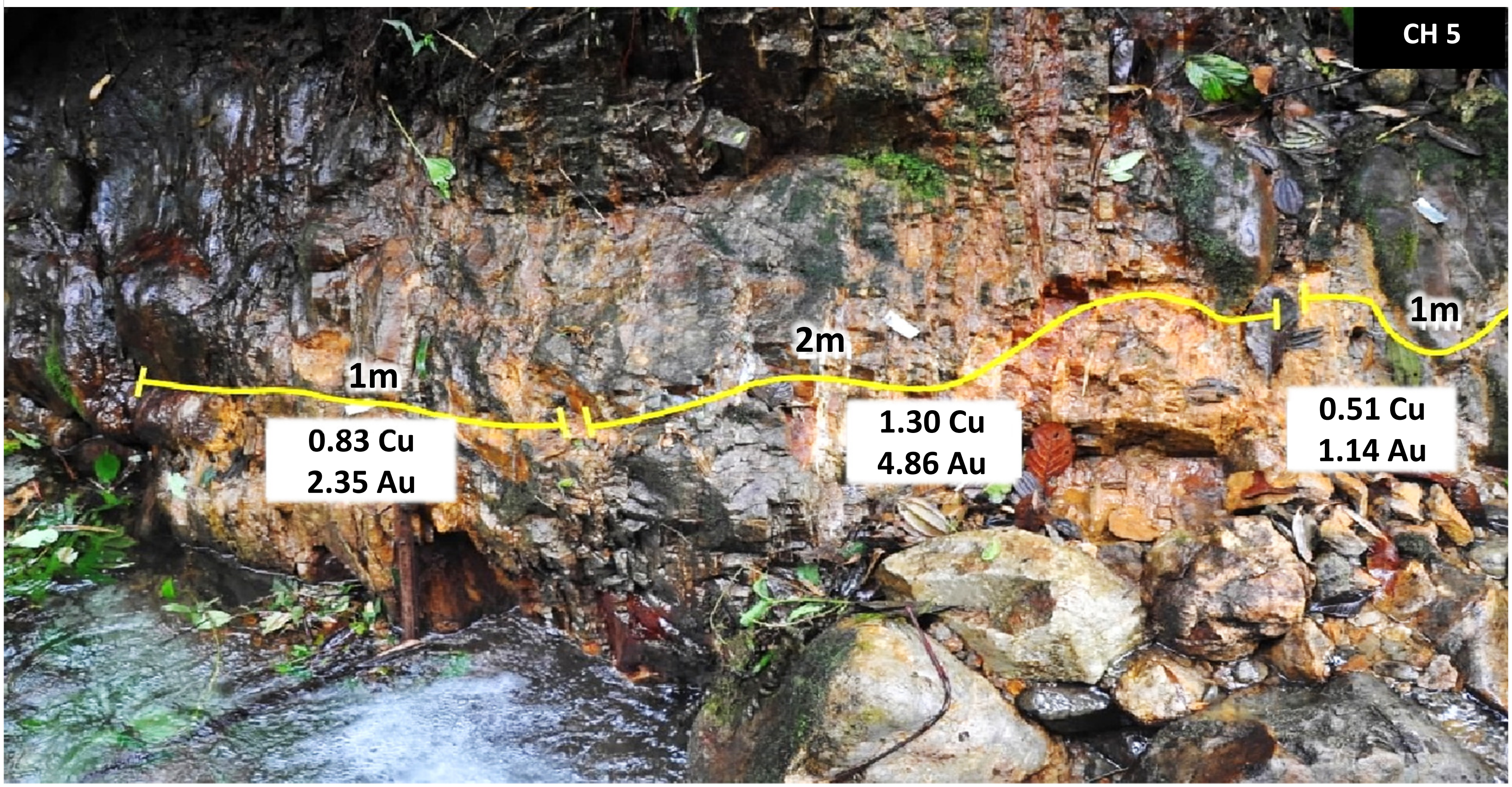
Reconnaissance mapping located ~80 m wide zone of Cu- and Au-bearing, sheeted, porphyry-style quartz veins in Alpala Creek

Alpala Deposit Stream Exposure

Rock-saw channel sampling in Alpala Creek

Channel 5: 33.3m @ 0.65 Cu, 1.02 Au

Channel 56A: 53.9m @ 0.32 Cu, 1.38 Au



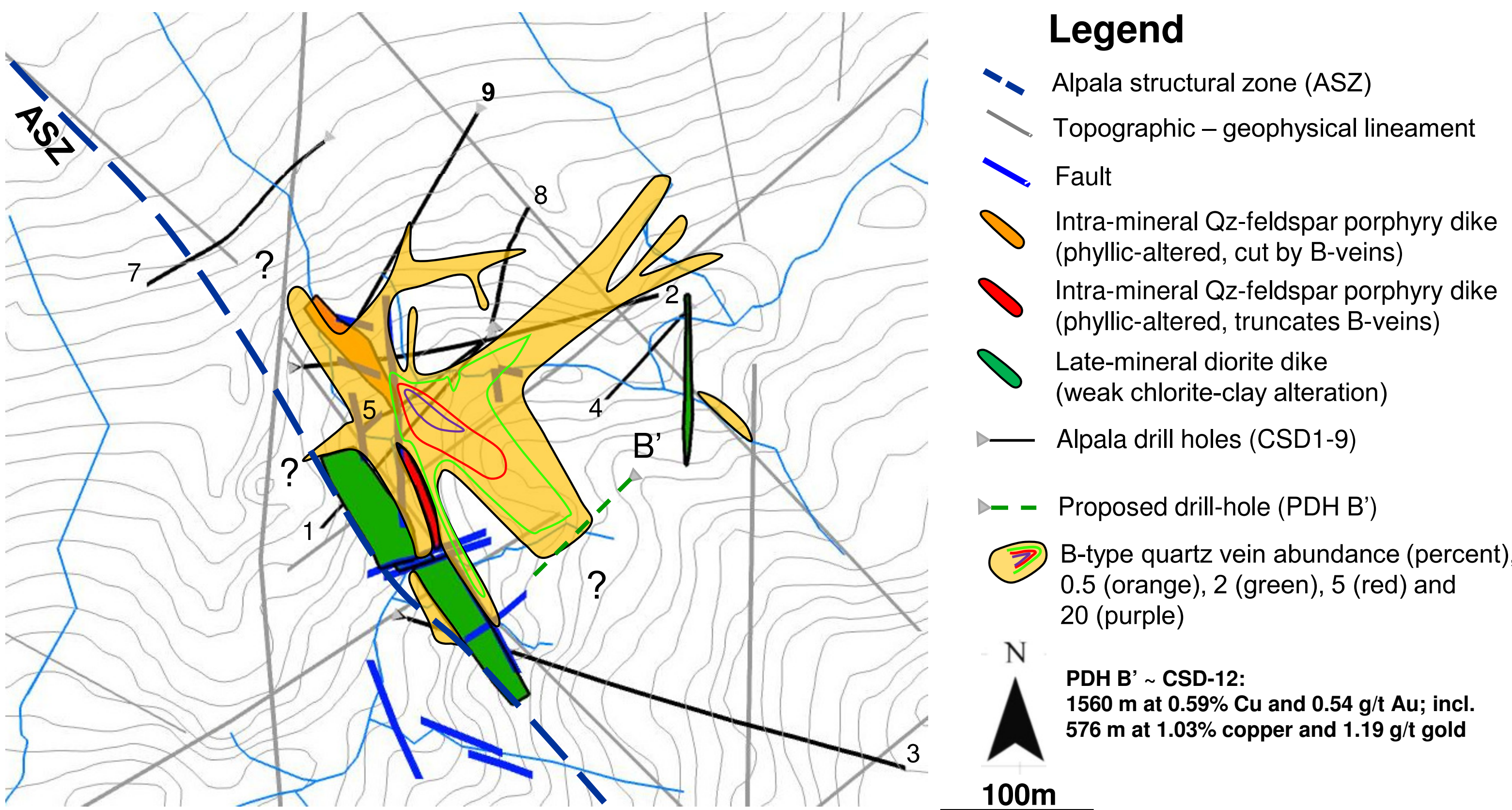
Long and High-Grade Porphyry Drill Intersections

Rank	Operator	Property	Location	*Interval (m)*	Cu (%)	Au (g/t)	Cu.Eq (%)	m% CuEq
1	Anglo American	Los Sulphatos	Central Chile	*717.0*	**3.60**	**0.00**	**3.60**	2581
2	Codelco	Chilean Giants	Northern Chile	unknown	unknown	unknown	unknown	2500
3	Kennecott	Bingham Canyon	Utah, USA	unknown	unknown	unknown	unknown	2500
4	Newcrest Mining	Wafi-Golpu	Papua New Guinea	*1421.5*	**1.14**	**0.64**	**1.54**	2195
5	Newcrest Mining	Wafi-Golpu	Papua New Guinea	*943.5*	**1.44**	**1.28**	**2.25**	2122
6	Imperial Metals	Red Chris	BC, Canada	*1024.0*	**1.01**	**1.26**	**1.81**	1850
7	Anglo Gold Ashanti	Nuevo Chaquiri	Colombia	*810.0*	**1.65**	**0.78**	**2.14**	1736
8	Freeport McMoran	Grasberg	Irian Jaya	*591.0*	**1.70**	**1.80**	**2.84**	1677
9	Ivanhoe Mines	Oyu Tolgoi	Southern Mongolia	*326.0*	**3.77**	**1.23**	**4.55**	1482
* **10**	**SolGold Plc**	**Cascabel - Hole 12**	**Ecuador**	***1560.0***	**0.59**	**0.54**	**0.93**	**1455**
11	**SolGold Plc**	**Cascabel - Hole 9**	**Ecuador**	***1197.4***	**0.63**	**0.83**	**1.16**	**1385**
12	Exeter Resources	Caspiche	Northern Chile	*1214.0*	**0.90**	**0.33**	**1.11**	1346
13	**SolGold Plc**	**Cascabel - Hole 5**	**Ecuador**	***1358.0***	**0.61**	**0.53**	**0.94**	**1279**
14	Metallica	El Morro, La Fortuna	Chile	*780.0*	**0.84**	**1.24**	**1.62**	1266
15	**SolGold Plc**	**Cascabel - Hole 16**	**Ecuador**	***936.0***	**0.75**	**0.95**	**1.35**	**1266**
16	Anglo American	Los Sulphatos	Central Chile	*990.0*	**1.26**	**0.00**	**1.26**	1247
17	Ivanhoe Mines	Oyu Tolgoi	Southern Mongolia	*476.0*	**2.16**	**0.67**	**2.58**	1230
18	**SolGold Plc**	**Cascabel - Hole 23R**	**Ecuador**	***1030.0***	**0.59**	**0.90**	**1.16**	**1195**
19	Metallica	El Morro, La Fortuna	Chile	*758.0*	**0.93**	**0.99**	**1.56**	1179
20	Newcrest	Cadia Ridgeway	NSW, Australia	*341.0*	**0.93**	**3.86**	**3.37**	1149
21	Ivanhoe Mines	Hugo Dummet	Southern Mongolia	*302.0*	**3.11**	**0.98**	**3.73**	1126
22	Ivanhoe Mines	Oyu Tolgoi	Southern Mongolia	*422.0*	**2.48**	**0.21**	**2.61**	1103
23	Imperial Metals	Red Chris	Canada	*1135.0*	**0.50**	**0.59**	**0.87**	991
24	Exeter Resources	Caspiche	Northern Chile	*1058.0*	**0.70**	**0.35**	**0.92**	975
25	**SolGold Plc**	**Cascabel - Hole 15R2**	**Ecuador**	***1402.0***	**0.48**	**0.34**	**0.69**	**974**
26	Exeter Resources	Caspiche	Northern Chile	*792.5*	**0.96**	**0.40**	**1.21**	961
27	Imperial Metals	Red Chris	BC, Canada	*716.3*	**0.79**	**0.74**	**1.26**	901
28	Nevsun	Timok	Serbia	*798.0*	**0.80**	**0.22**	**1.11**	886
29	**SolGold Plc**	**Cascabel - Hole 17**	**Ecuador**	***954.0***	**0.60**	**0.52**	**0.93**	**884**
30	**SolGold Plc**	**Cascabel - Hole 21**	**Ecuador**	***946.0***	**0.67**	**0.39**	**0.92**	**872**
31	Metallica	El Morro, La Fortuna	Chile	*820.0*	**0.59**	**0.73**	**1.05**	862
32	**SolGold Plc**	**Cascabel - Hole 19**	**Ecuador**	***1344.0***	**0.44**	**0.28**	**0.62**	**829**
33	**SolGold Plc**	**Cascabel - Hole 18**	**Ecuador**	***864.0***	**0.57**	**0.61**	**0.96**	**825**
34	Seabridge Gold Inc.	KSM	Canada	*1023.4*	**0.24**	**0.77**	**0.73**	744

NOTES: *Gold Conversion Factor of 0.63 calculated from a copper price of US$3.00/lb and a gold price US$1300/oz. True widths of downhole interval lengths are estimated to be approximately 25% to 50%. **Sources:** peer review, snl.com, various company releases & broker reports, intierra.com,

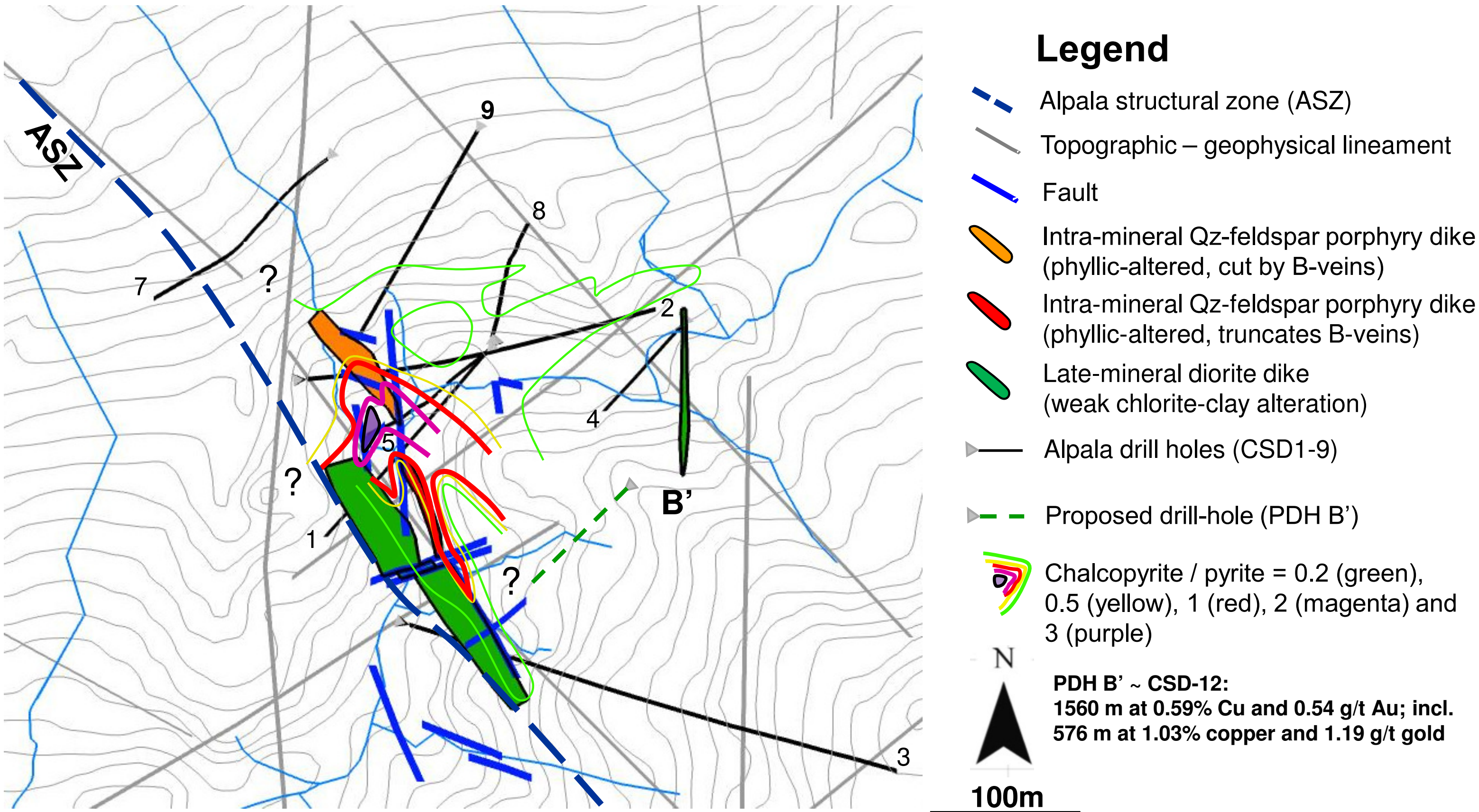
Alpala Central Geology and B-Vein Abundance (2014)

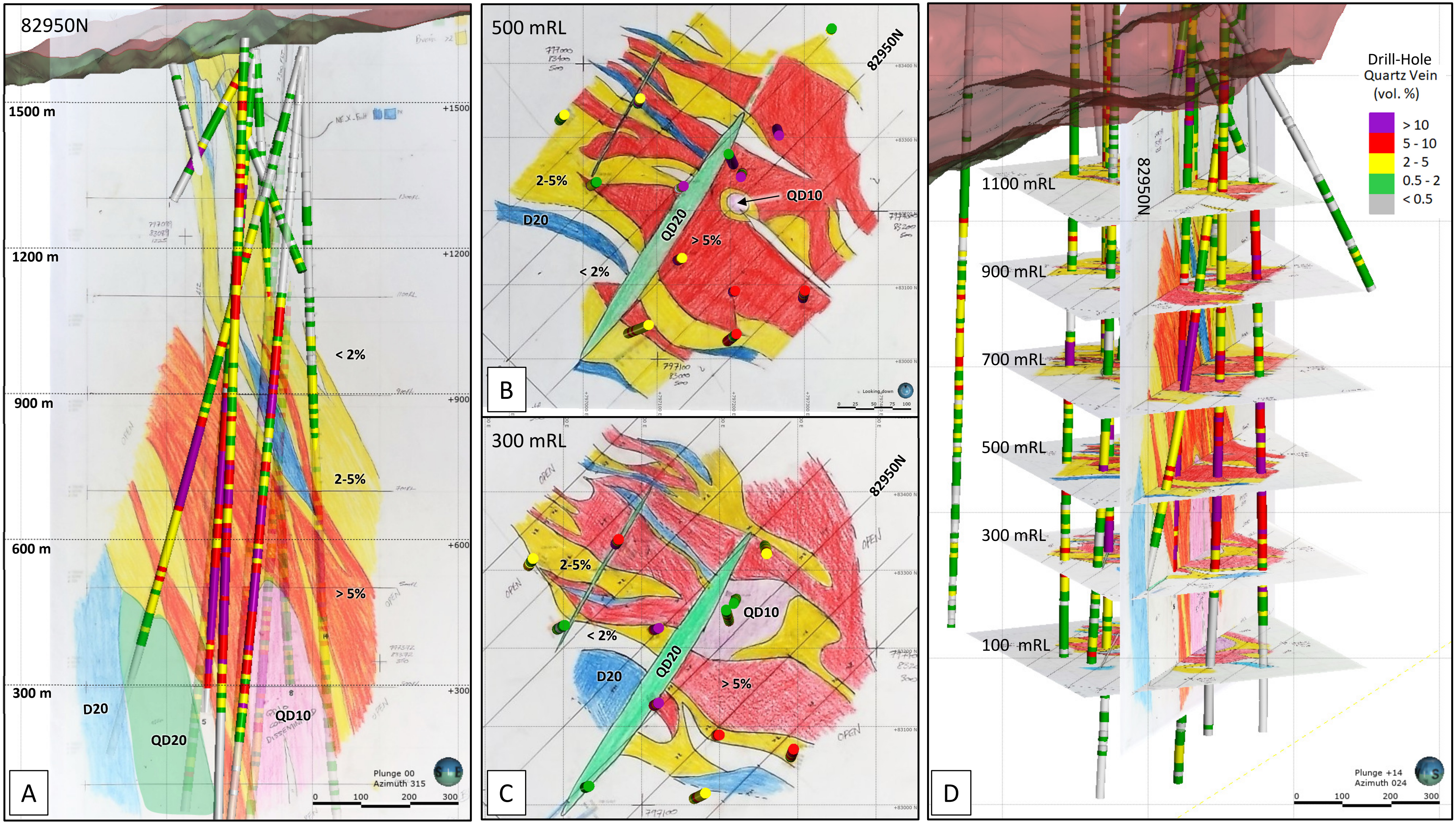
The geometry of the vein zones indicate northwesterly, northeasterly and subordinate northerly-trends, which are consistent with the strike-directions of the "B"-type quartz veins measured in the field. These three vein sets typically dip steeply towards the northeast, northwest and east, respectively.



Alpala Central Chalcopyrite-Pyrite Ratio (2014)

The mapped zone of chalcopyrite / pyrite > 1 trends north-northwest, parallel to the Alpala structural zone, and coincides with an increased abundance of "B"-type quartz veins.

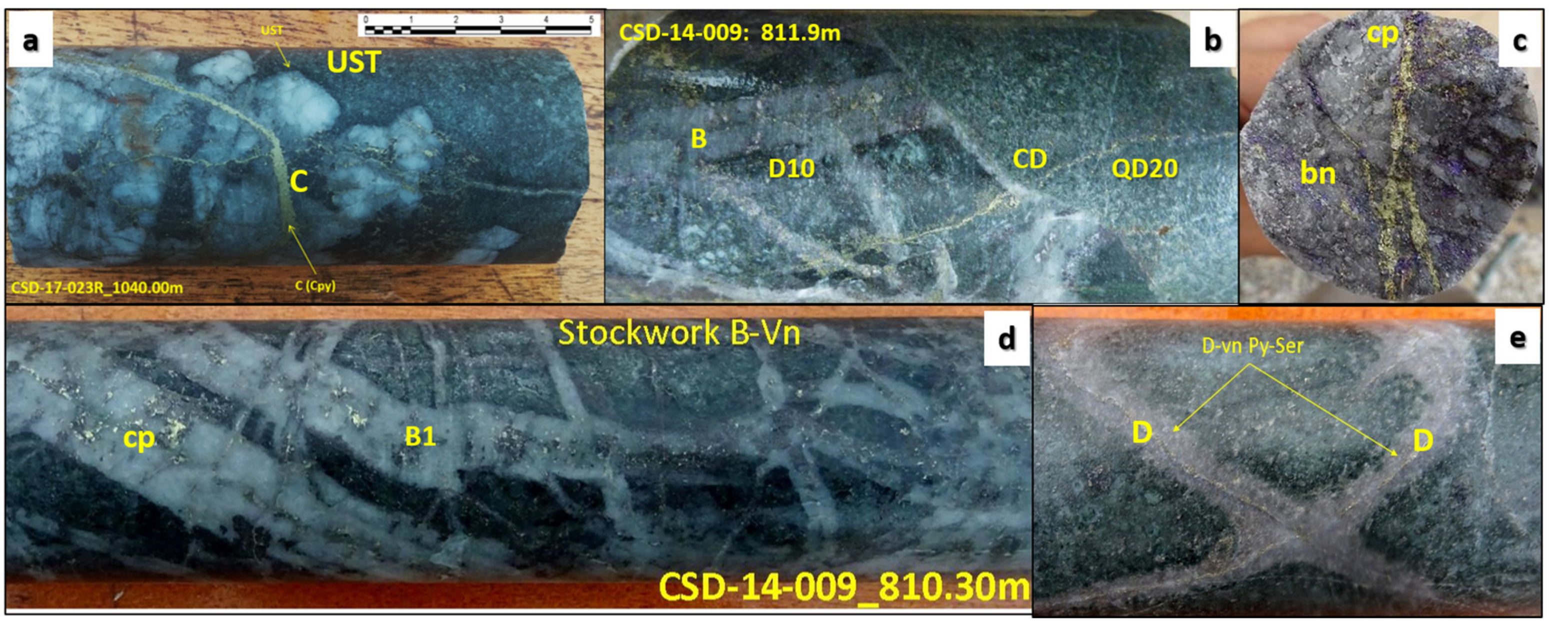




82950N
1500 m
1200 m
900 m
600 m
300 m
< 2%
2-5%
> 5%
D20
QD20
QD10
Plunge 00
Azimuth 315
A
500 mRL
82950N
2-5%
D20
QD20
QD10
> 5%
< 2%
B
300 mRL
82950N
2-5%
QD10
< 2%
D20
QD20
> 5%
C
Drill-Hole
Quartz Vein
(vol. %)
> 10
5 - 10
2 - 5
0.5 - 2
< 0.5
1100 mRL
900 mRL
700 mRL
500 mRL
300 mRL
100 mRL
82950N
Plunge +14
Azimuth 024
D

Alpala - Cascabel Vein Types

Photographs of drill-core from the Alpala deposit. **a)** Prismatic quartz showing unidirectional solidification texture (UST), cut by a chalcopyrite-rich C-vein; **b)** intrusive contact between late quartz diorite dike (QD20) and early diorite intrusion (D10), showing truncation of early porphyry-style quartz-veins (B) and a late CD-vein that cross-cuts the contact; **c)** Chalcopyrite vein and late-stage bornite along fracture surface; **d)** Magnetite-bearing B1 quartz vein stockwork with clots of chalcopyrite (cp); **e)** late-stage pyritic D-vein with selvedge of quartz-sericite.



Garwin et al., 2017

Alpala Vein Paragenesis

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- Classified on descriptive criteria: morphology, mineralogy, texture and orientation
- Grouped by interpreted age and from higher to lower temperatures

Early / Hotter

	UST:	Uni-directional Solidification Texture: late-magmatic quartz-(magnetite)
	A, AB:	early quartz veins (minor to rare)
	M:	magnetite veinlets
Main Mineralisation Stage	EDM:	early dark micaceous veins (and selvages)
Main Mineralisation Stage	B1:	quartz-coarse grained magnetite-chalcopyrite veins
Main Mineralisation Stage	B2:	quartz-chalcopyrite-magnetite-(pyrite) veins
Main Mineralisation Stage	MCA:	magnetite-chalcopyrite-pyrite-anhydrite veins
Main Mineralisation Stage	C:	chalcopyrite-(rare bornite) veins
Main Mineralisation Stage	CD:	chalcopyrite-pyrite-(bornite) veins with minor envelopes
	D:	pyrite-(chalcopyrite-bornite) veins with major envelopes
	ANH:	anhydrite veins
	CAL:	calcite veins
	BMV:	base metal veins (+ quartz, calcite and / or anhydrite)

Late / Cooler

NOTES:

- Anhydrite occurs over wide temperature range
- EDM veins are re-opened by later chalcopyrite
- Later vein-stages re-open earlier vein stages

Alpala Geological Units and Intrusive Phases

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HOST ROCKS	OLDER	Pre-Mineral Volcanic Rocks	Variable Grade 0.1 – 2.0 % Cu
		Pre-Mineral Diorite "D10"	Mod - High Grade 0.4 – 2.0 % Cu
UST + A-veins B-veins C-Veins		Early-Mineral Quartz Diorite "QD10" (Causal intrusions)	Very High Grade > 1.0 % Cu
Lesser B-veins C-Veins		Intra-Mineral Intrusions QD15/D15 T15	Moderate Grade 0.2 – 0.7 % Cu
CD, D-veins		Late-Mineral Dykes D20/QD20	Low Grade 0.1 – 0.3 % Cu
Post Mineral	YOUNGER	Post-Mineral Dykes30/40	Barren

Geological Model

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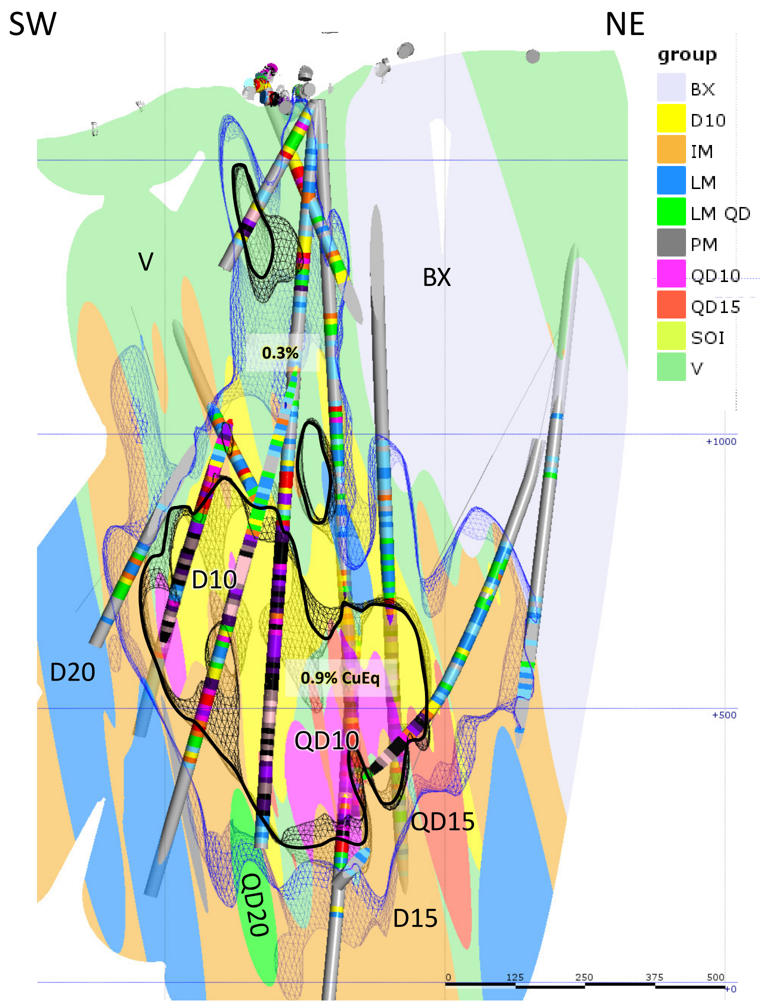
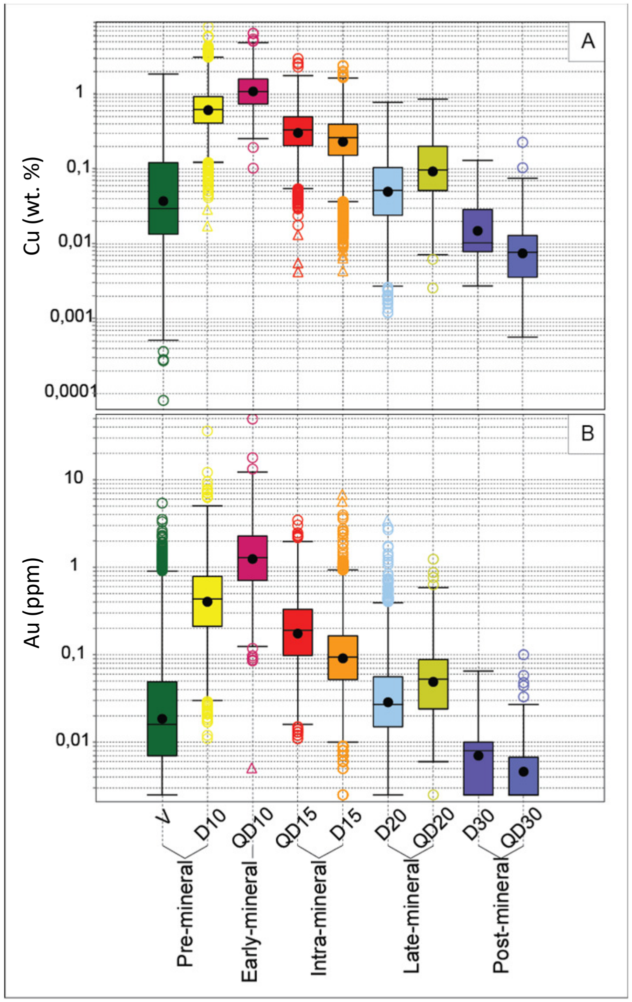
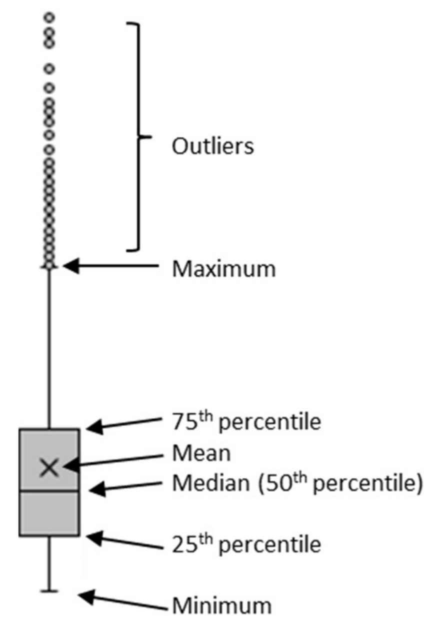
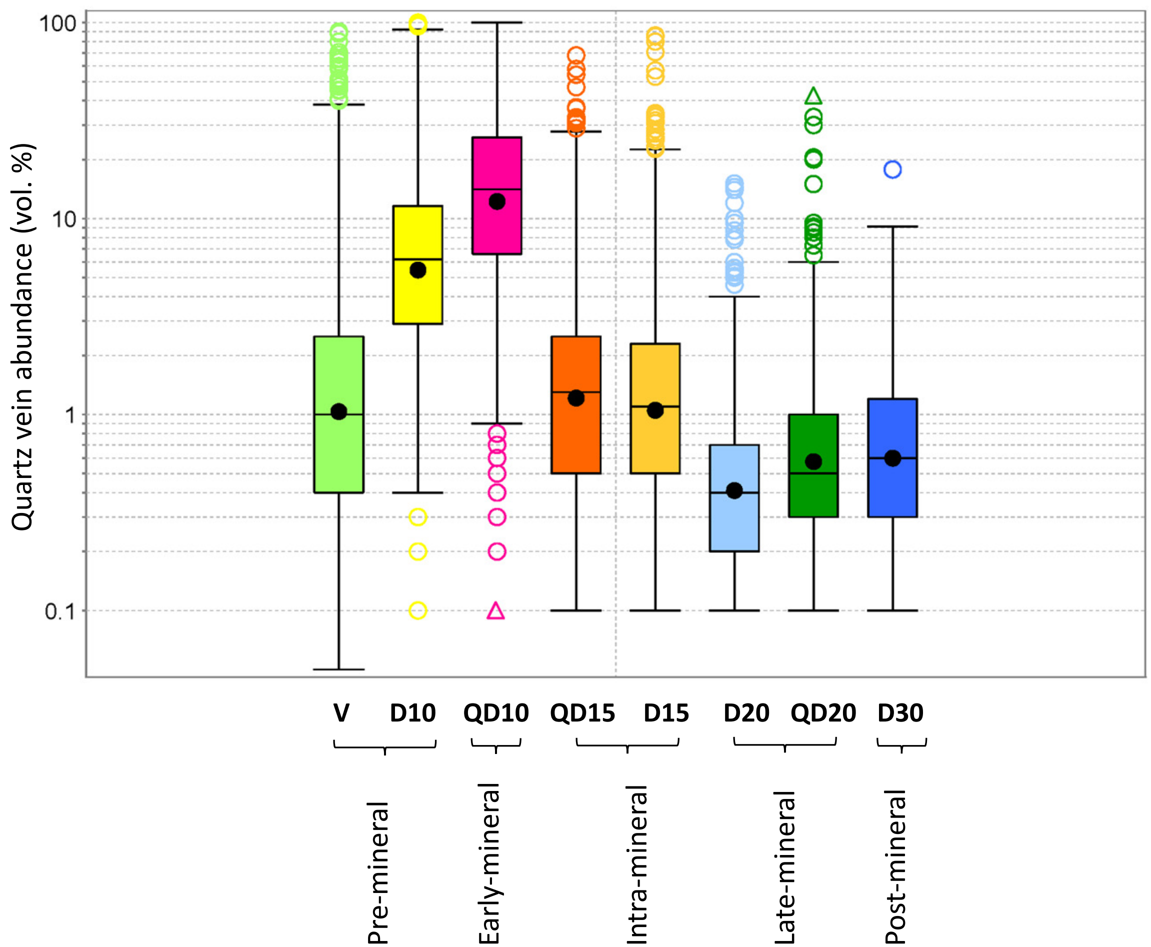


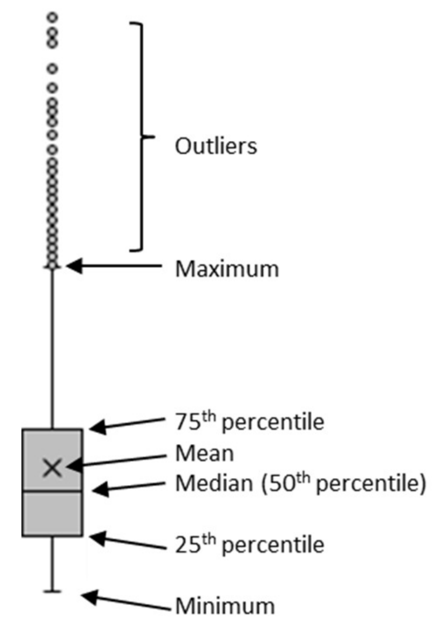




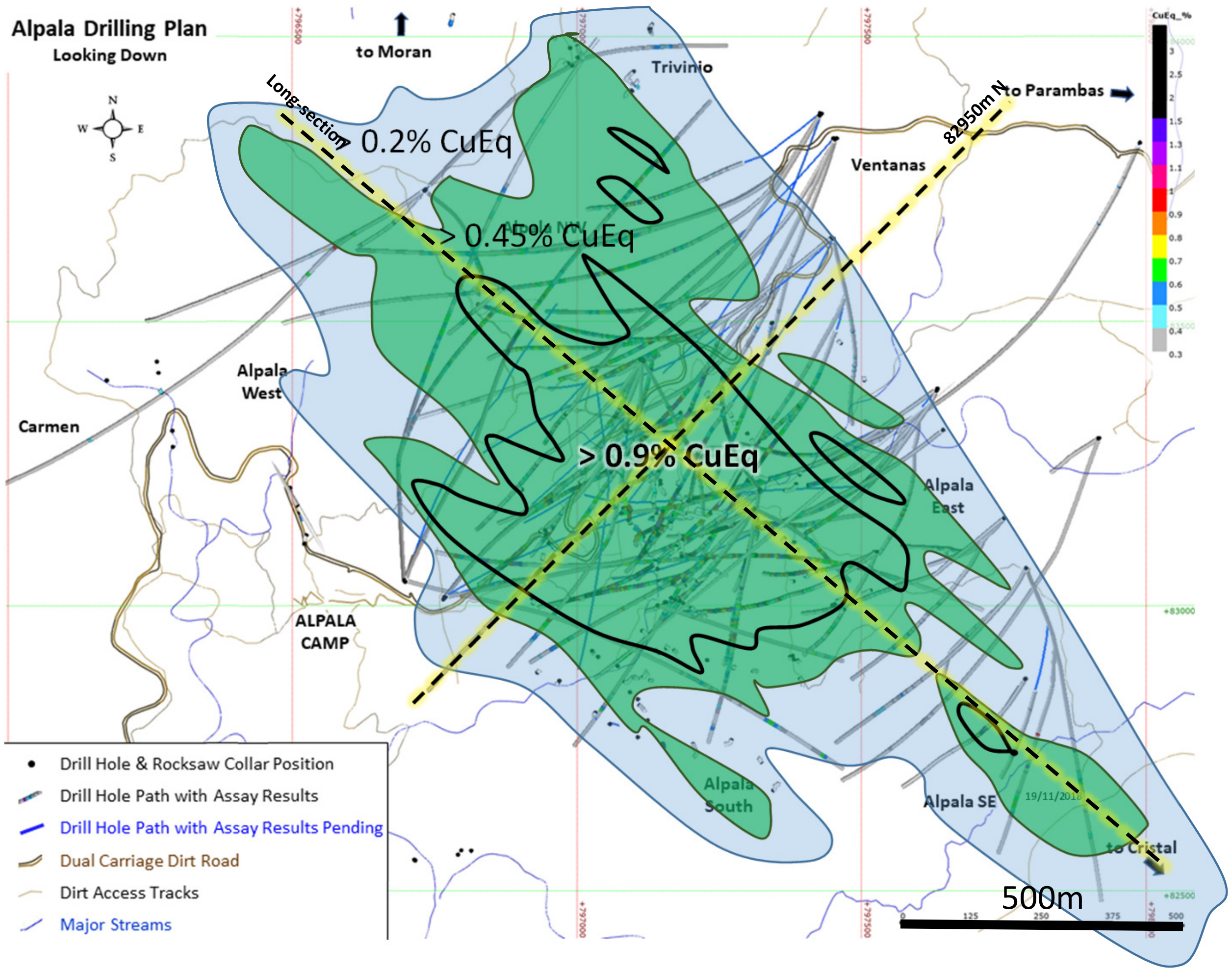
Cu-equivalent grade (wt.%) = Cu (wt.%) + 0.63 x Au (g/t), assuming US$ 3.00 per pound Cu and US$ 1300 per troy ounce Au.

Quartz Vein Abundance by Geological Unit





Alpala Diamond Drilling



Alpala drill plan

(January 2019), showing key grade shell outlines and the location of sections in the following figures, which also include the 500 m level-plan.

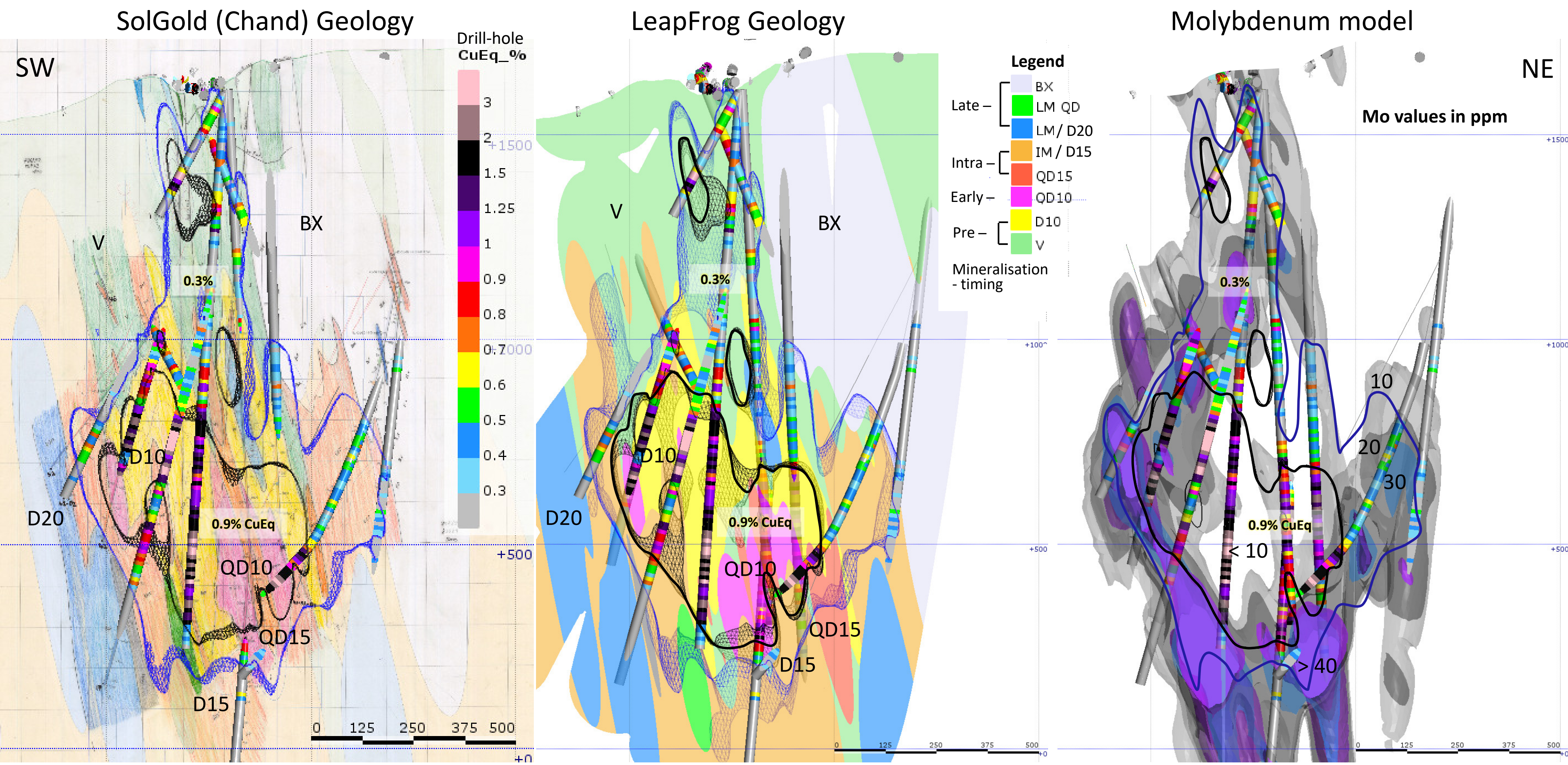
As of June 2022 (PFS), > 250,000 m of drilling.

At 0.2% Cu eq. cut-off:

- > 2,000 m strike-extent
- Steeply NE-dipping
- > 1,900 m vertical interval from surface to below -250 m asl
- > 1000 m wide
- Open in several directions

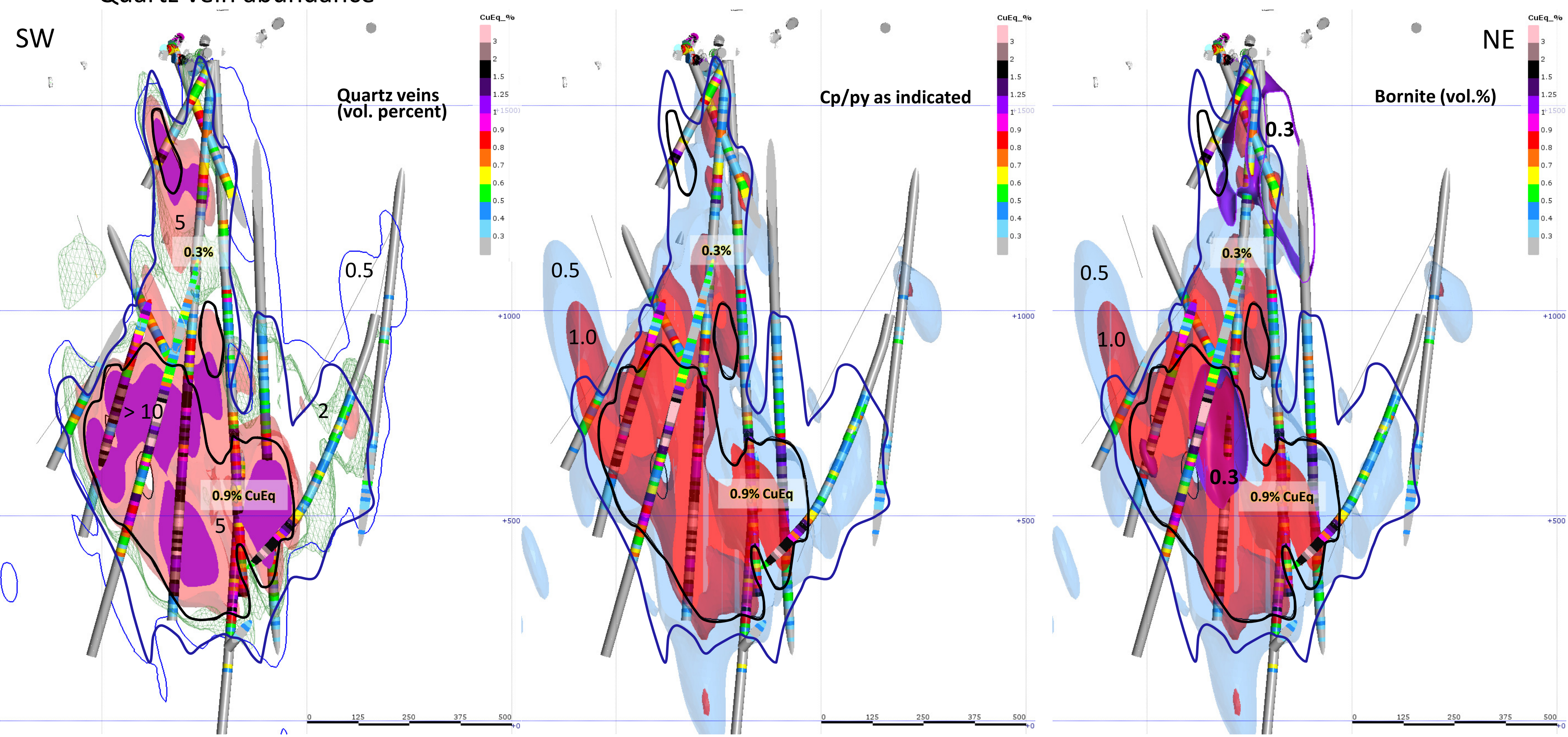
Cu-equivalent grade (wt.%) = Cu (wt.%) + 0.63 x Au (g/t), assuming US$ 3.00 per pound Cu and US$ 1300 per troy ounce Au.

Cross-section 82950 m N, showing geological interpretations, copper-equivalent shells of 0.9 wt.% and 0.3 wt.% and molybdenum in drill-core (window ± 50 m) **June 2018**

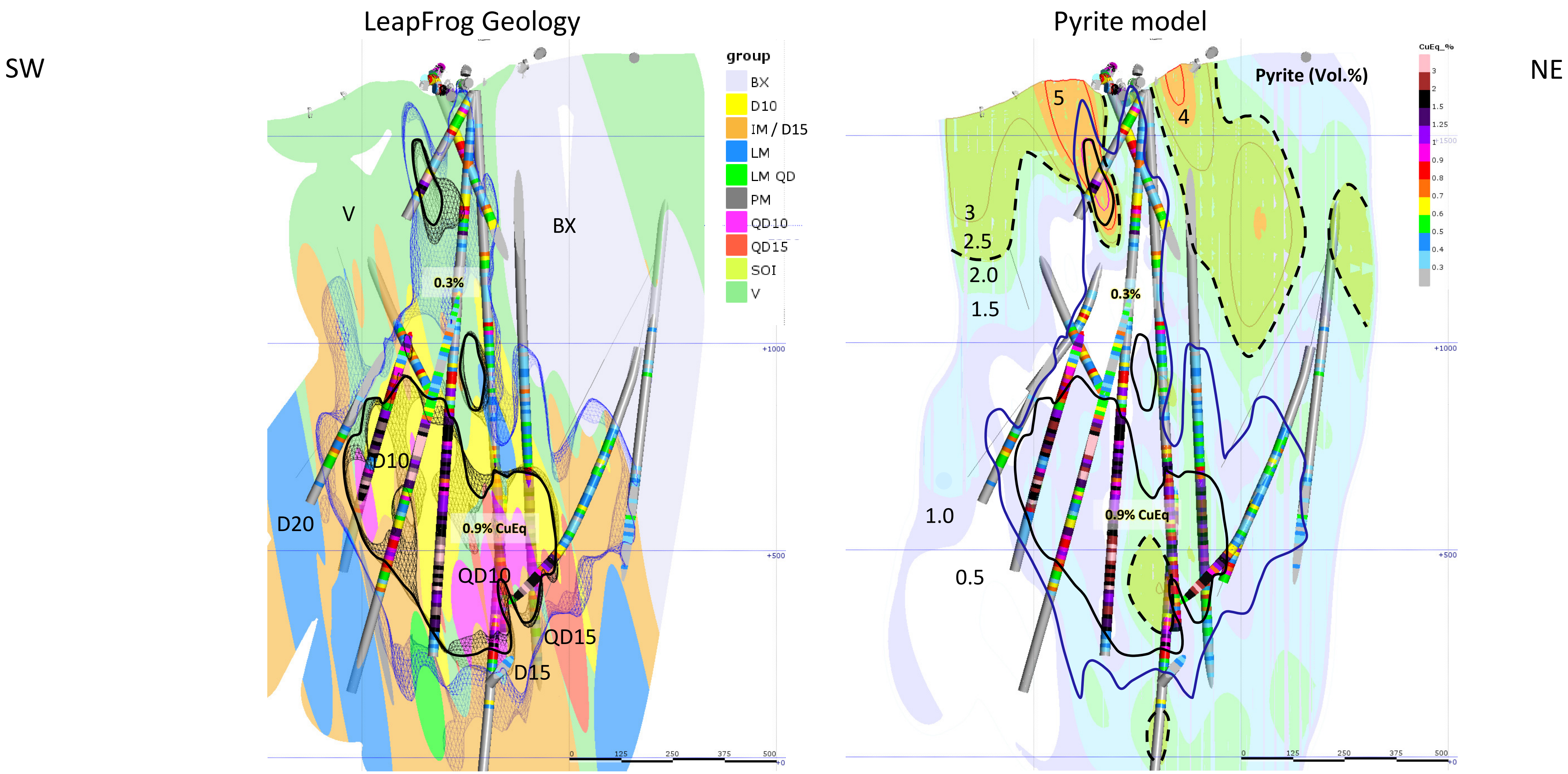


Cross-section 82950 m N, showing abundance of Cu-Au-bearing porphyry-type quartz veins, chalcopyrite-pyrite ratio and bornite concentration in drill-core

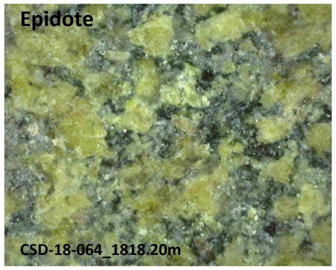
Quartz vein abundance | Chalcopyrite-pyrite (cp-py) ratios | Bornite abundance and cp-py ratios

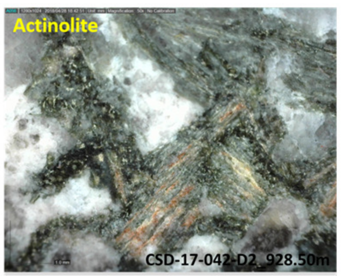


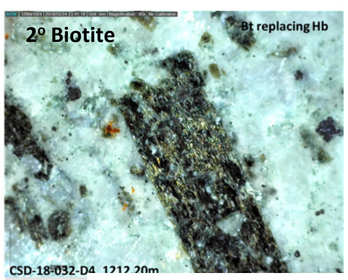
Cross-section 82950 m N, showing geological interpretation and visually estimated abundance of pyrite

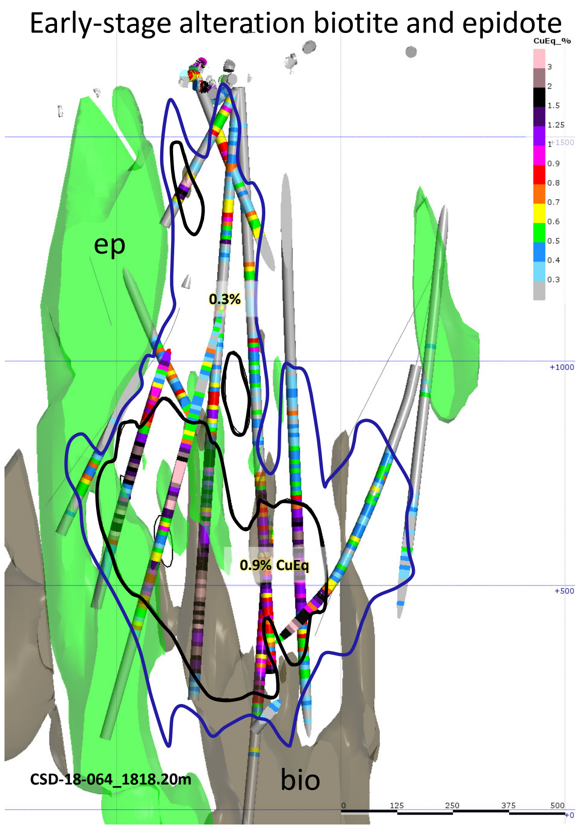


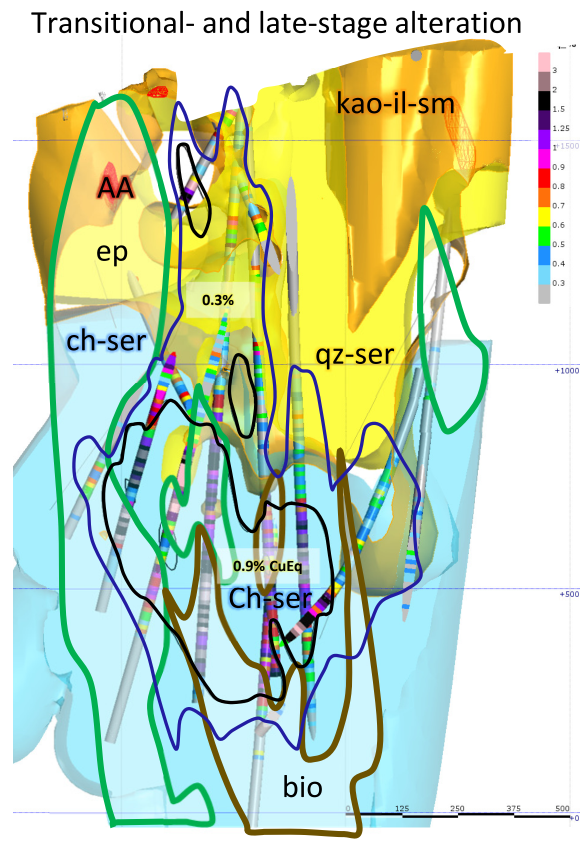
Cross-section 82950 m N, showing early- and late-stage hydrothermal alteration (based on visual logging and SWIR analyses of coarse rejects for drill-core)

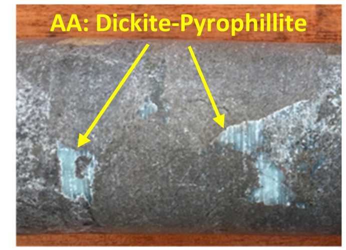


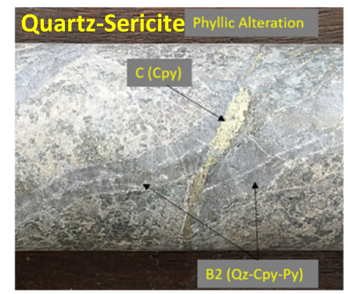






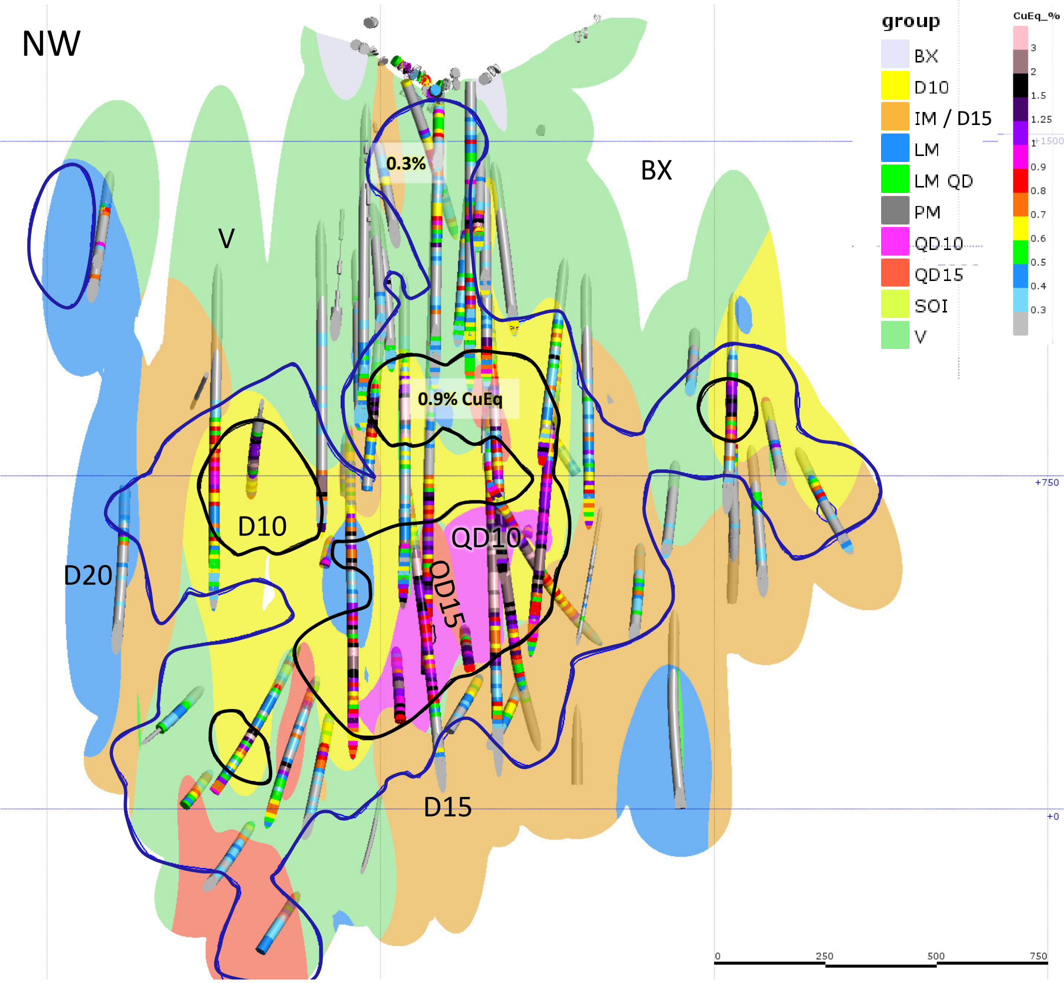




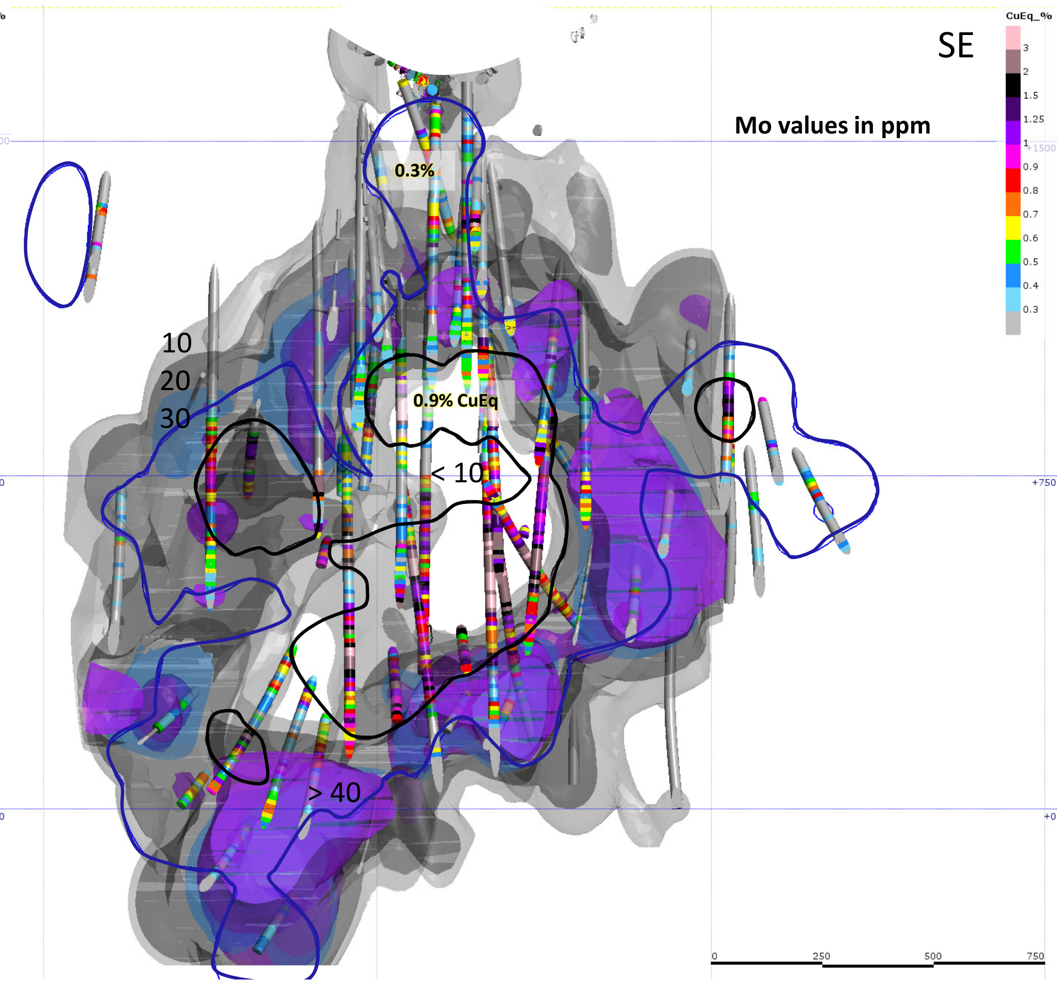


Longitudinal cross-section, showing geological interpretation, copper-equivalent shells of 0.9 and 0.3 wt.% and molybdenum in drill-core (dip-direction of -85 degrees towards N39E – window ± 50m),

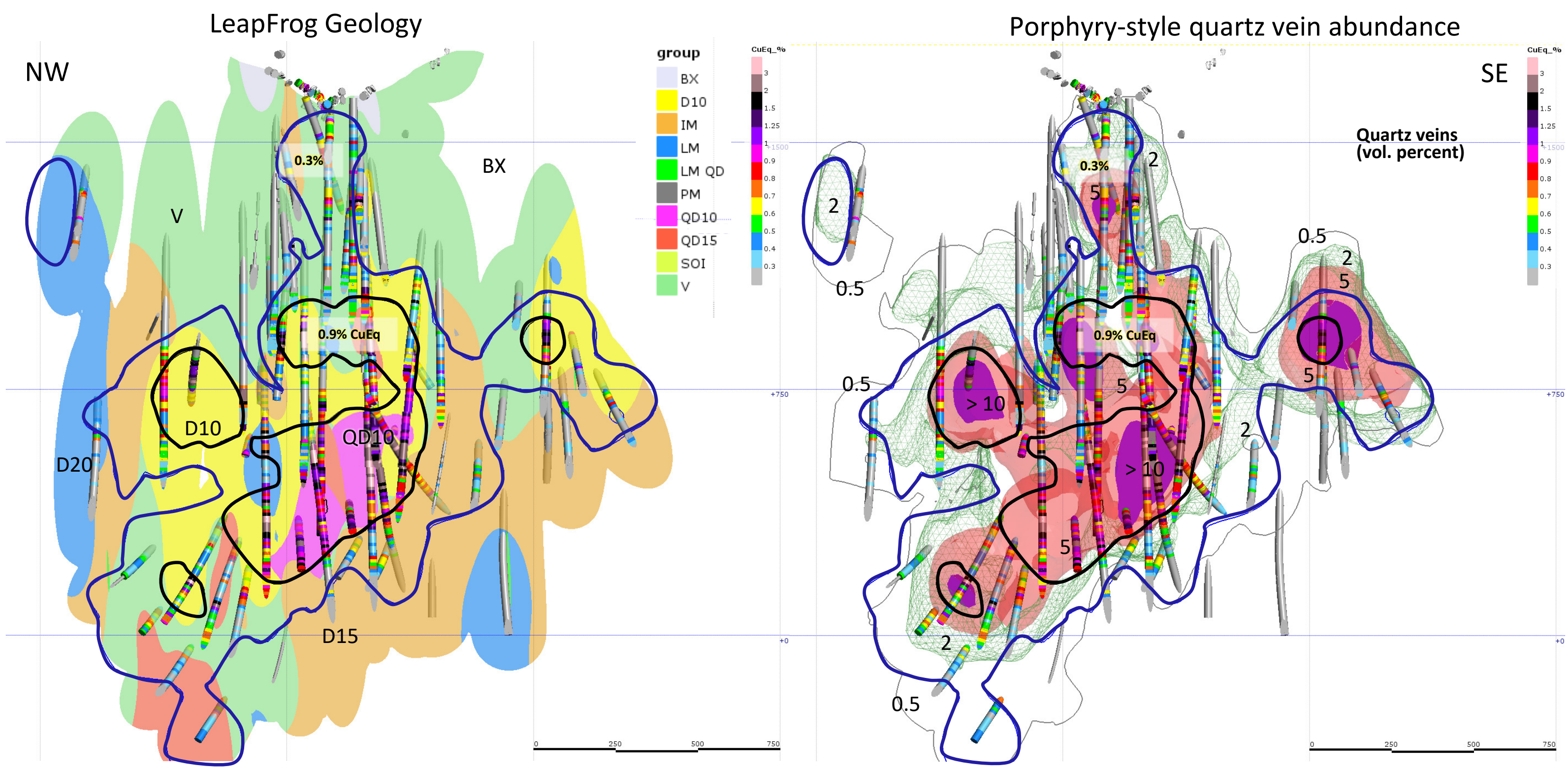
LeapFrog Geology



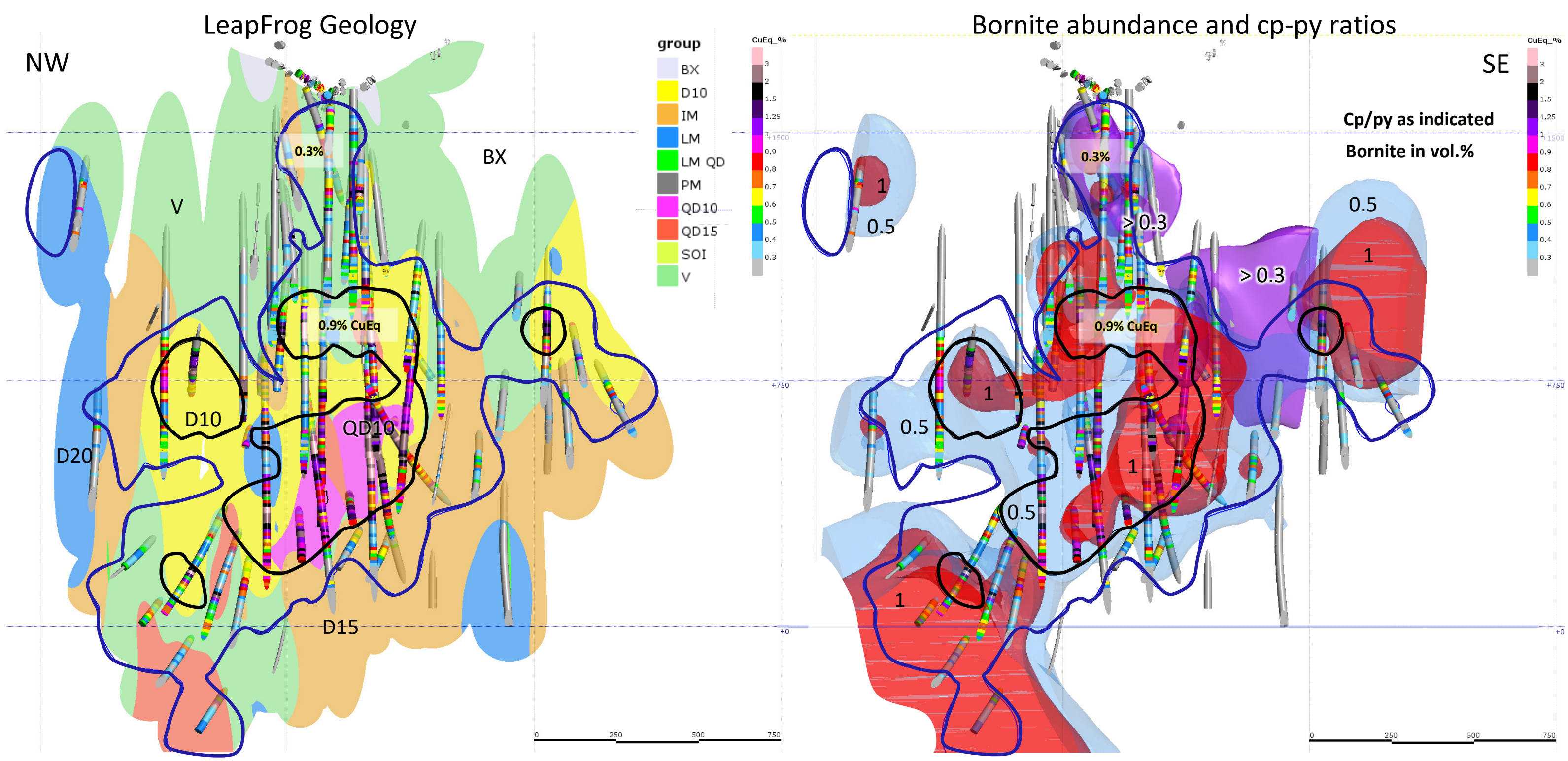
Molybdenum model



Longitudinal cross-section, showing the geological interpretation, copper-equivalent shells of 0.9% and 0.3% and the abundance of Cu-Au-bearing, porphyry-style quartz veins

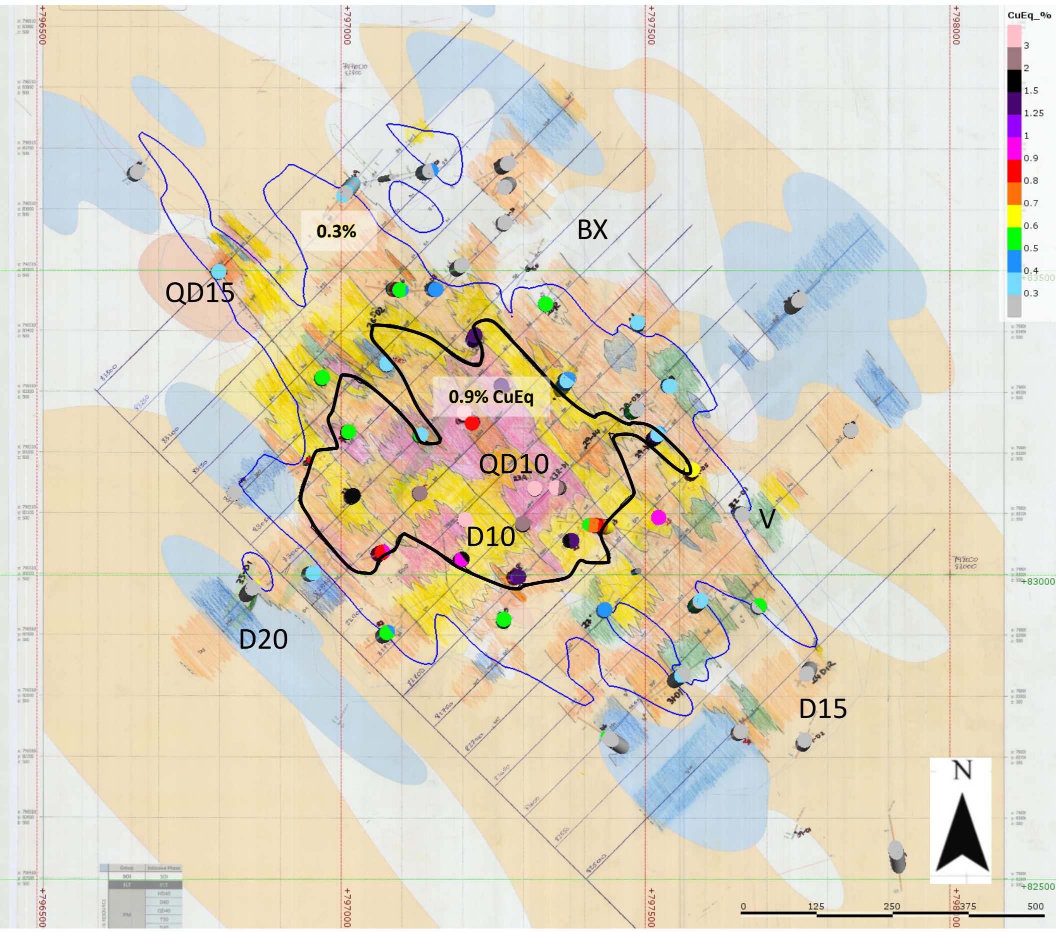


Longitudinal cross-section, showing the geological interpretation, copper-equivalent shells of 0.9% and 0.3%, chalcopyrite-pyrite ratio and bornite abundance

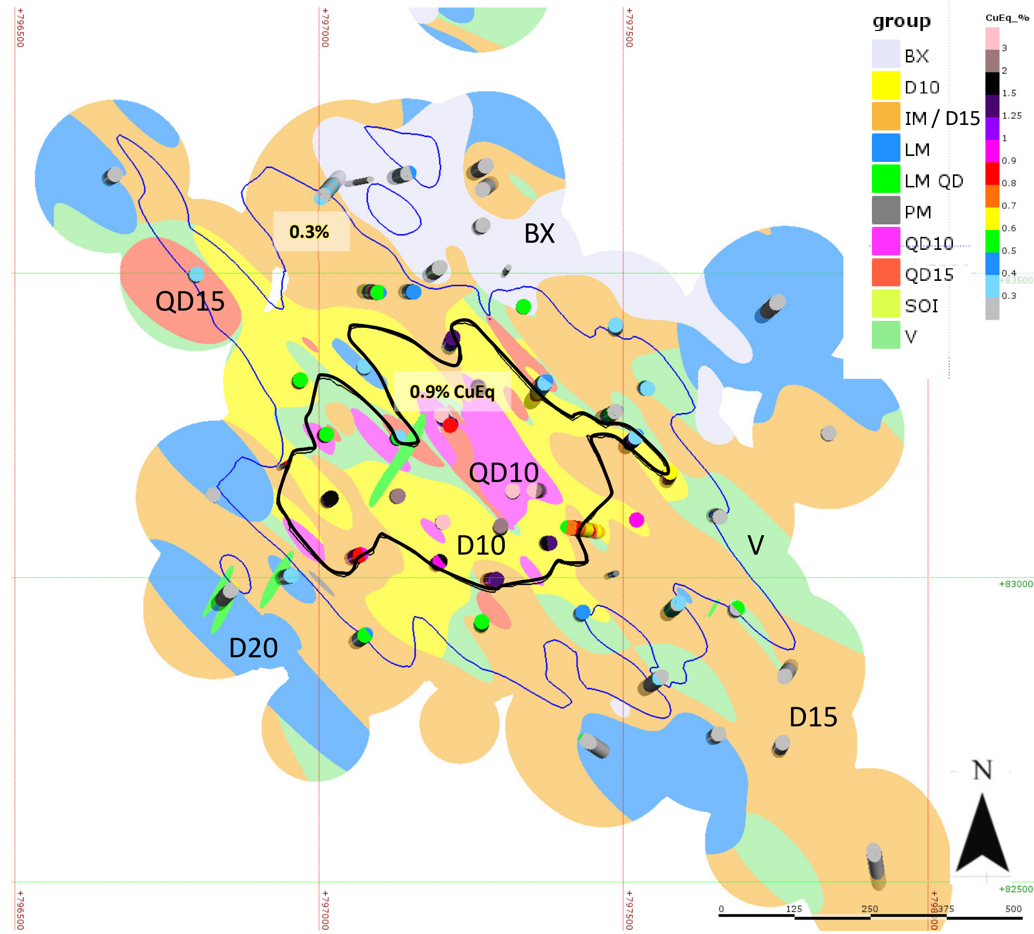


500m level-plan for the Alpala deposit, showing geology interpretations and Cu-equiv. shells of 0.9 and 0.3 wt.% (window $\pm$ 25m)

SolGold (Chand) Geology

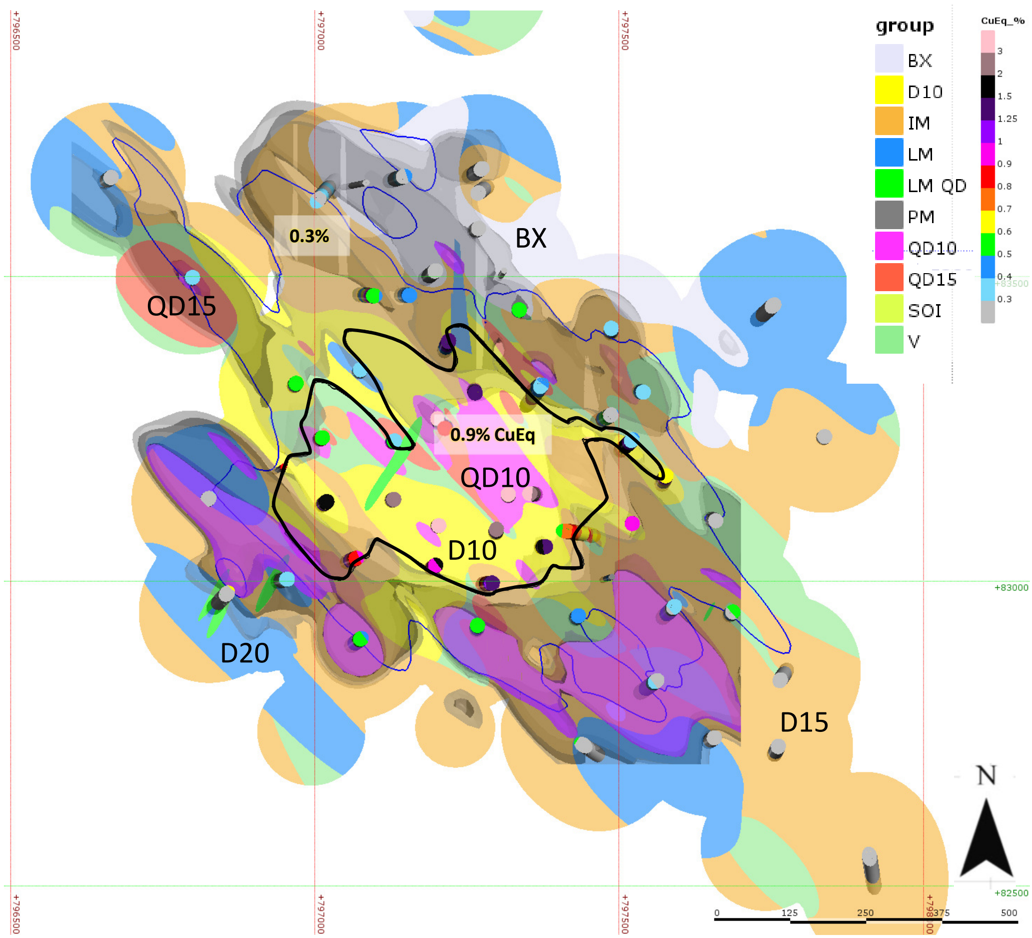


LeapFrog Geology

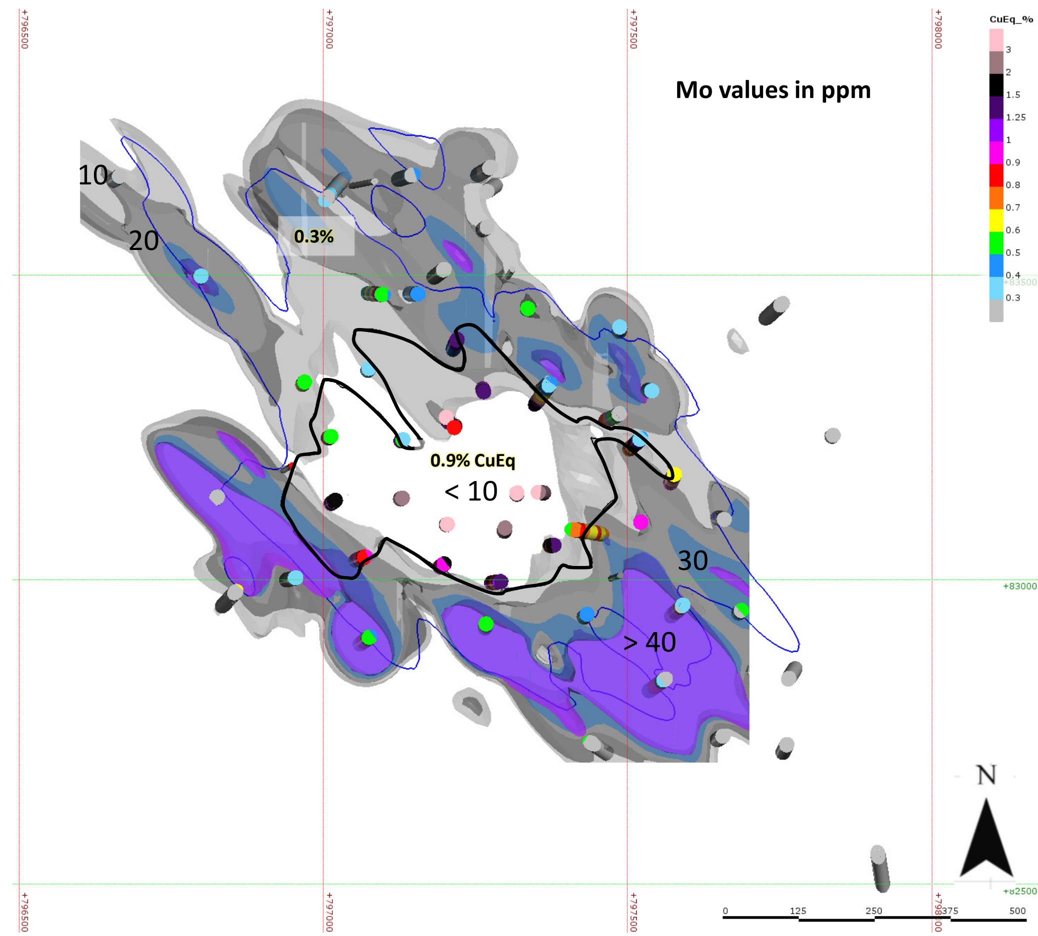


500m level-plan for the Alpala deposit, showing geological interpretation, Cu-equiv. shells of 0.9% and 0.3 wt.% and molybdenum

LeapFrog geology and molybdenum model

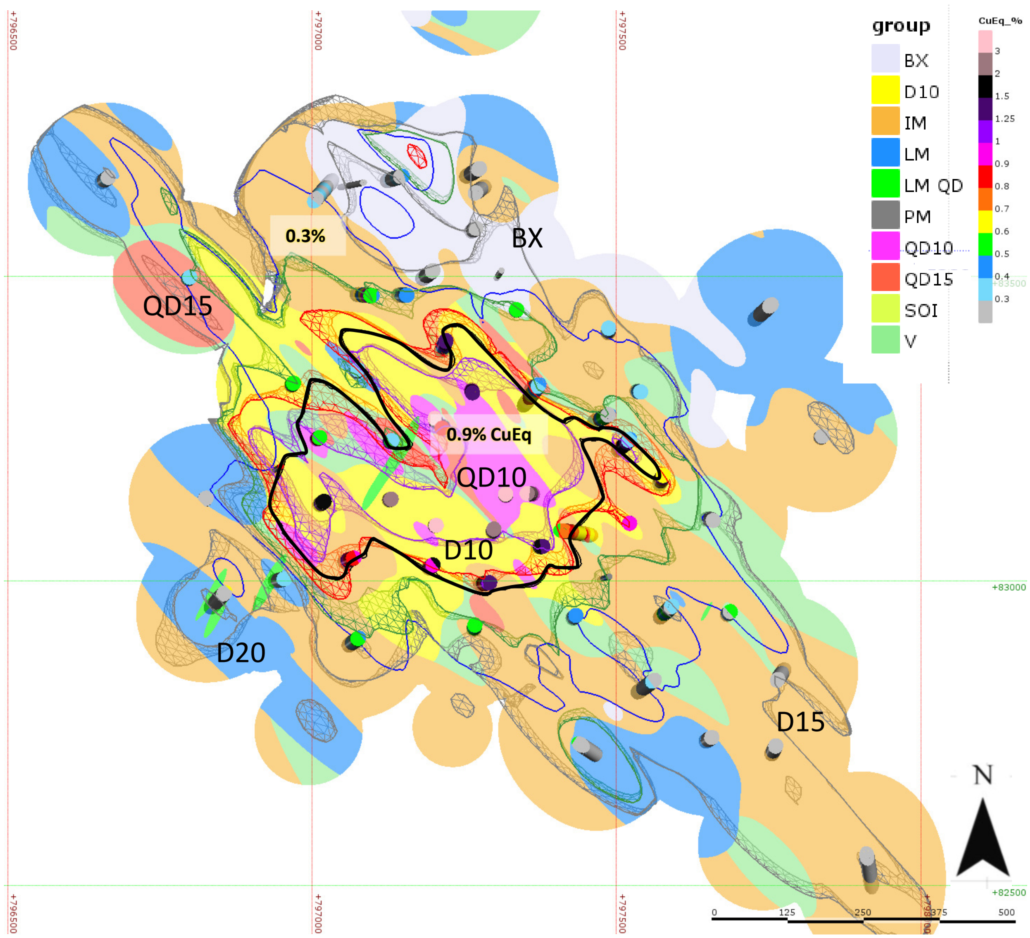


Molybdenum model

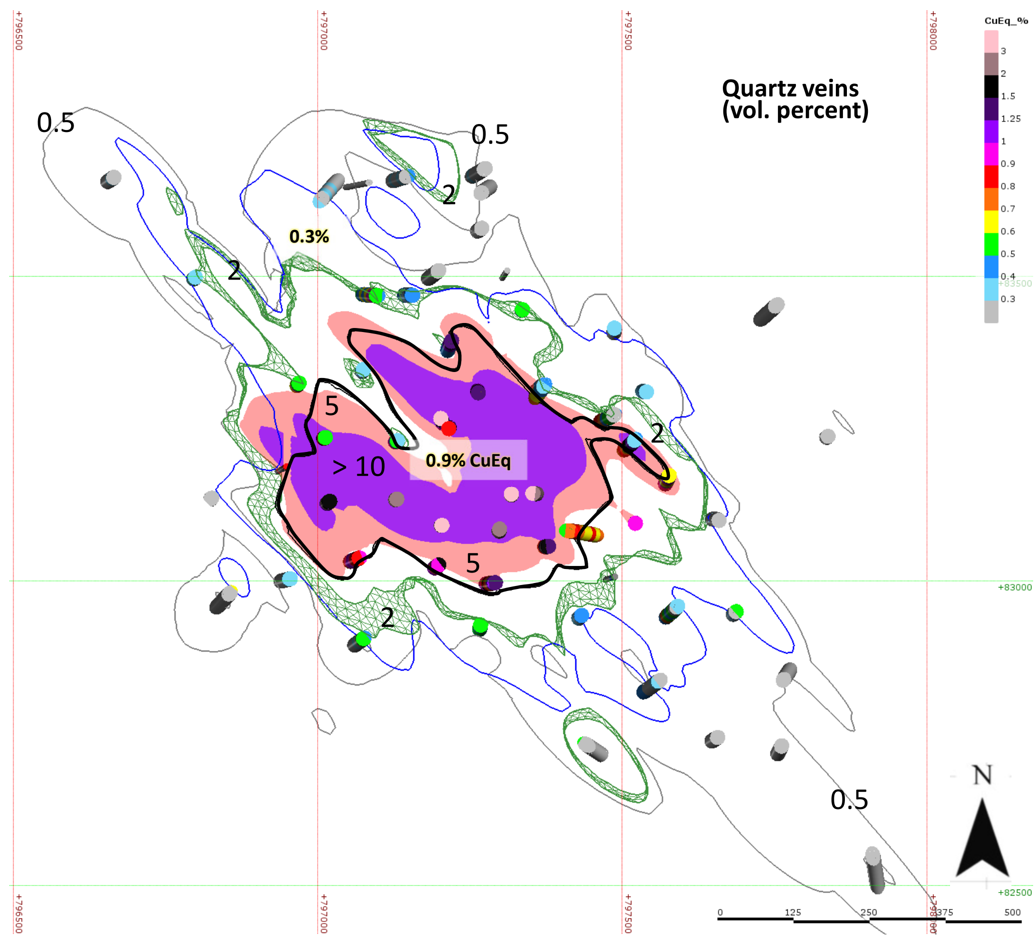


500m level-plan for the Alpala deposit, showing geological interpretation, Cu-equiv. shells of 0.9 and 0.3 wt.% and porphyry-style quartz vein abundance

LeapFrog geology and quartz vein abundance

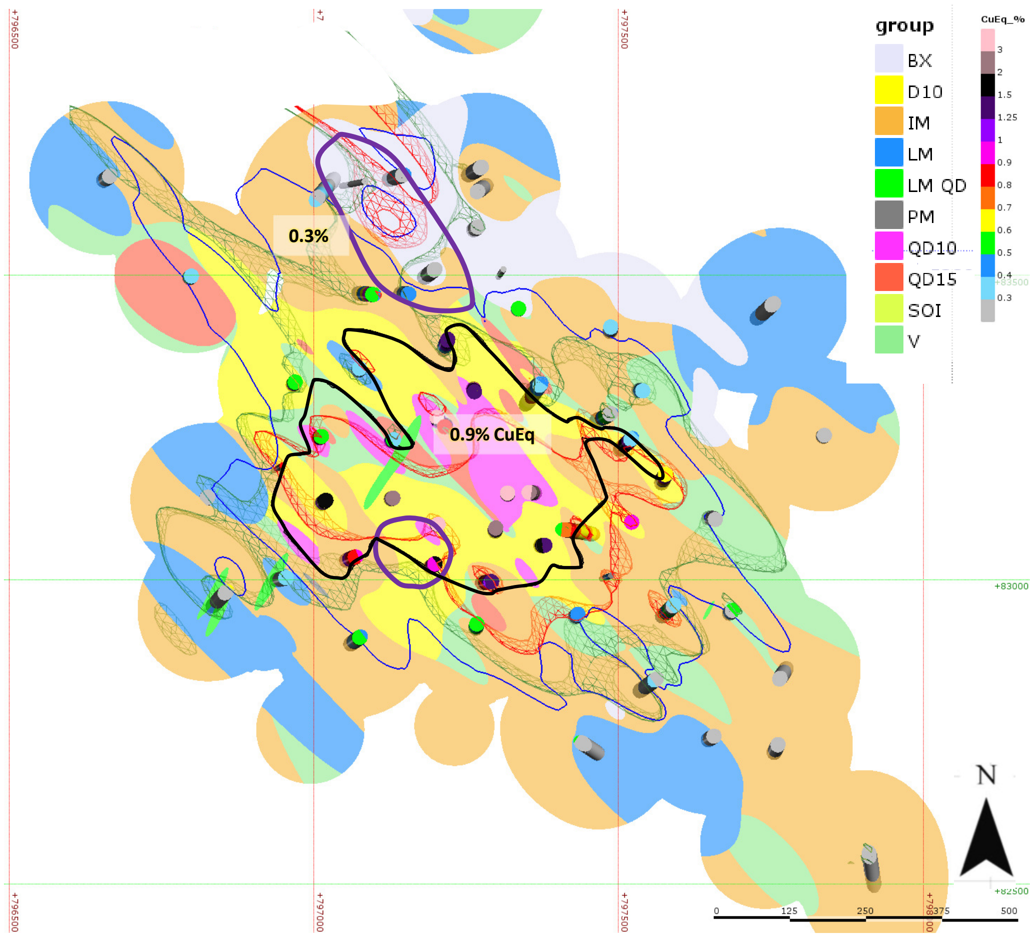


Quartz vein abundance model

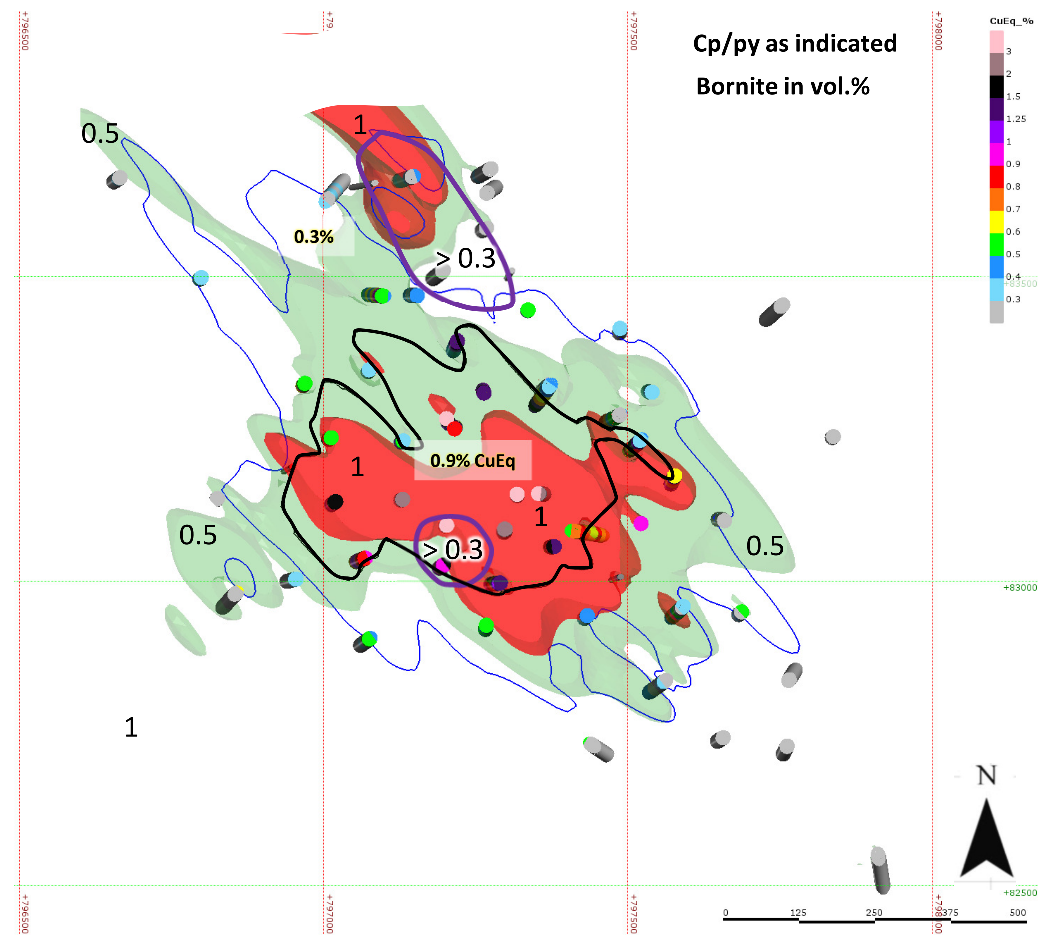


500m level-plan for the Alpala deposit, showing geological interpretation, Cu-equiv. shells of 0.9 and 0.3 wt.%, chalcopyrite-pyrite ratio and bornite abundance

LeapFrog geology and sulfide mineral abundance



Chalcopyrite-pyrite ratio and bornite abundance



Alpala Deposit Geometry

- Hand-drawn and LF-assisted models show relationships between CuEq grades, geology, mineralization and alteration
  - Examples include 0.9 wt.% and 0.3 wt.% CuEq grade shells, molybdenum, quartz vein abundance, chalcopyrite-pyrite ratio, bornite abundance and early- and late-stage hydrothermal alteration
- High-grade (> 0.9 wt.% CuEq) associated with pre-mineralization D10 and early-mineralization QD10 intrusions
  - Intra-mineralization D15 contributes lower grades to the deposit (e.g., 0.3 to 0.9 wt.% CuEq); late-mineralization intrusions and hydrothermal breccia are low-grade (< 0.3 wt.% CuEq)
  - Gentle northwesterly plunge to the base of the deposit generally follows the plunging apex of the D15 intrusions
- Molybdenum (in molybdenite) forms a halo to the high-grade core of the deposit
  - Mo < 10 ppm in high-grade core; Mo ranges from 10 to > 40 ppm in lower grade periphery
- Porphyry-type quartz vein abundance shows a strong positive spatial correlation to CuEq grades and intrusive stages
  - Quartz veins > 5 vol.% characterize > 0.9 wt.% CuEq; Vein abundance of about one-percent coincides with 0.3 wt.% CuEq shell
- Sulfide mineral distribution provides vectors towards high-grade ore zones
  - Chalcopyrite-pyrite ratios exceed one (cp/py > 1) in high-grade core and approximate 0.5 (cp/py = ½) for 0.3 wt.% CuEq periphery
  - Cpy is transitional-stage and occurs with mt, py and locally hm; early-stage metal deposition is characterized by mt ± (bn)
  - Bn > 0.3% occurs locally in the upper parts of the deposit – majority of bornite is late-stage and occurs with pyrite±chalcopyrite
  - Pyrite in high-grade core ~1.0 to 2.5 vol.%; In the lower-grade, upper portion of deposit, pyrite ranges from about 2.5 to 5 vol.%
- Spatial and temporal relationships between hydrothermal alteration and copper-gold mineralization
  - Transition zone between early-stage potassic- and propylitic-alteration, which contains actinolite, coincides with high-grade core
  - Cu+Au and cpy deposition are related to transitional-stage chlorite-sericite overprint of potassic- and propylitic-alteration
  - Late-stage quartz-sericite, pyrophyllite-dickite and kaolinitic alteration types characterize the upper portions of the deposit

MRE3
Jan 2021

ALPALA MINERAL RESOURCE ESTIMATE (*21.7 Moz Au, 9.9Mt Cu, 92.2Moz Ag*)

Cut-off Grade	Resource Category	Mt	Grade				Contained Metal			
			CuEq (%)	Cu (%)	Au (g/t)	Ag (ppm)	CuEq (Mt)	Cu (Mt)	Au (Moz)	Ag (Moz)
0.21	Measured	1,192	0.72	0.48	0.39	1.87	8.6	5.7	15	52.4
	Indicated	1,470	0.37	0.28	0.14	0.84	5.5	4.2	6.6	39.8
	Measured + Indicated	**2,663**	**0.53**	**0.37**	**0.25**	**1.08**	**14.0**	**9.9**	**21.7**	**92.2**
	Inferred	544	0.31	0.24	0.11	0.61	1.7	1.3	1.9	10.6
	Planned dilution	*5*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*

High Grade Core: Measured plus Indicated Categories									
Cut-off grade	Mt	Grade				Contained metal			
		CuEq (%)	Cu (%)	Au (g/t)	Ag (ppm)	CuEq (Mt)	Cu (Mt)	Au (Moz)	Ag (Moz)
0.80%	442	1.40	0.87	0.86	2.34	6.2	3.8	12.3	33.3

1. Mrs. Cecilia Artica, SME Registered Member, Principal Geology Consultant of Mining Plus, is responsible for this Mineral Resource statement and is an "independent Qualified Person" as such term is defined in NI 43-101.
2. The Mineral Resource is reported using a cut-off grade of 0.21% copper equivalent calculated using [copper grade (%)] + [gold grade (g/t) x 0.613] as discussed above. Metal prices used were US$3.40/lb for copper and US$1,400/oz for gold.
3. The Mineral Resource is considered to have reasonable prospects for eventual economic extraction by underground mass mining such as block caving.
4. Mineral Resources are not Mineral Reserves and do not have demonstrated economic viability.
5. The statement uses the terminology, definitions and guidelines given in the CIM Standards on Mineral Resources and Mineral Reserves (May 2014) as required by NI 43-101.
6. MRE is reported on 100 percent basis within an optimised shape as described below.
7. Figures may not compute due to rounding.

Cu-equivalent grade (wt.%) = Cu (wt.%) + 0.613 x Au (g/t), assuming US$ 3.40 per pound Cu and US$ 1400 per troy ounce Au.

SolGold

Geological mapping, core-logging and 3D geoscientific data integration in the exploration of porphyry copper-(gold) deposits

Conclusions

- The collection of accurate geological data is critical in minerals exploration, or any scientific endeavour
- The successful visualization, integration and interpretation of relevant data facilitates the path to discovery
- The field-based methods presented here have proven useful in exploration and mining programs for decades
- These approaches have become less main-stream recently
- Geologists who have yet to apply the Anaconda method will benefit from this old-school form of technology transfer

Acknowledgements

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THANK YOU