INSTITUTO DE INGENIEROS DE MINAS DEL PERÚ

REGULUS RESOURCES INC | Antakori

proEXPLO 2019

"The Exploration and Business Case for Doing Hyperspectral Core Imaging as Part of an Advanced-stage Exploration Program: Antakori Case Study"

Dr. Kevin B. Heather

21 de mayo, 2019

XI CONGRESO INTERNACIONAL DE PROSPECTORES Y EXPLORADORES

EXPLORACIÓN MINERA: CIENCIA, INNOVACIÓN E INVERSIÓN ESTRATÉGICA

DISCLAIMER

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NEW TECHNOLOGICAL FRONTIER

Unlocking Hidden Project Value

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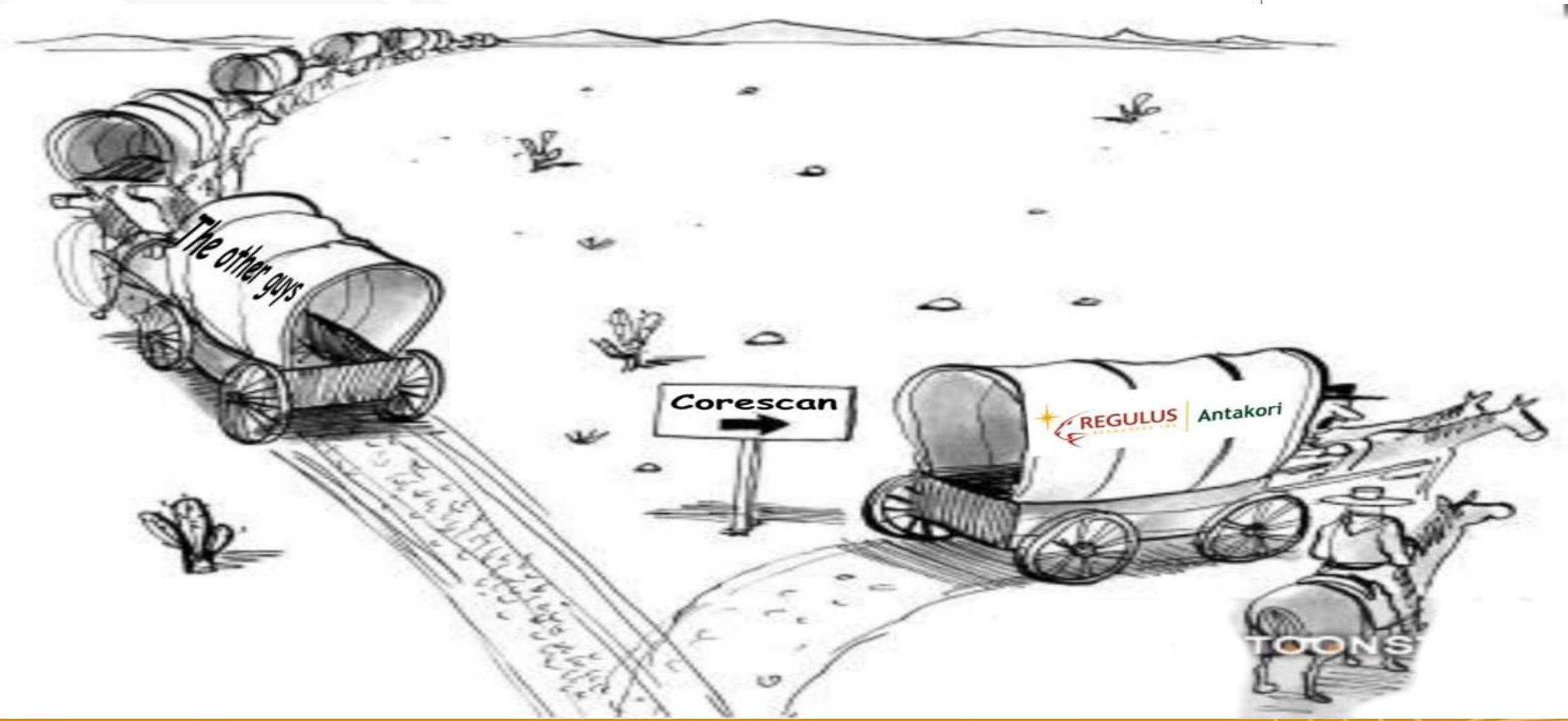
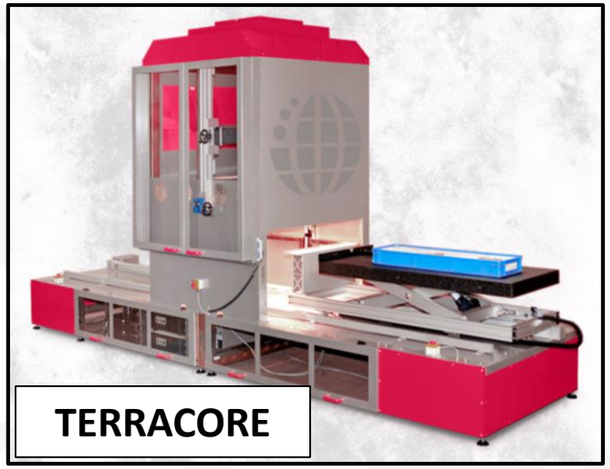
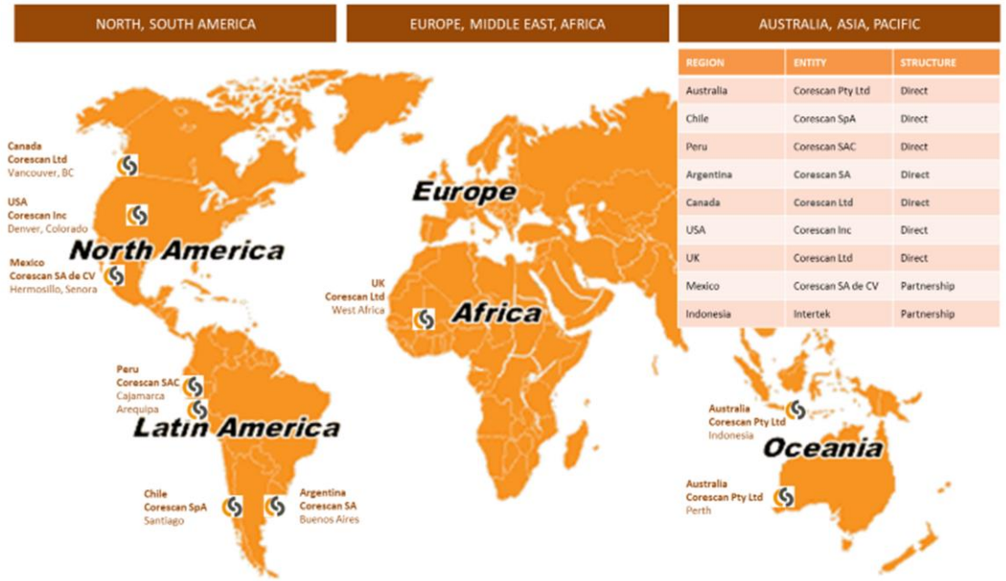


HYPERSPECTRAL IMAGING

Point vs Continuous Systems





REGION	ENTITY	STRUCTURE
Australia	Corescan Pty Ltd	Direct
Chile	Corescan SpA	Direct
Peru	Corescan SAC	Direct
Argentina	Corescan SA	Direct
Canada	Corescan Ltd	Direct
USA	Corescan Inc	Direct
UK	Corescan Ltd	Direct
Mexico	Corescan SA de CV	Partnership
Indonesia	Intertek	Partnership

- 10 labs located worldwide (14 by year end 2019)
- Regulus was the 1st junior company in the world with a dedicated onsite lab
- 1st Corescan lab in Peru (2nd lab recently located in Arequipa)

REGULUS CORE WAREHOUSE

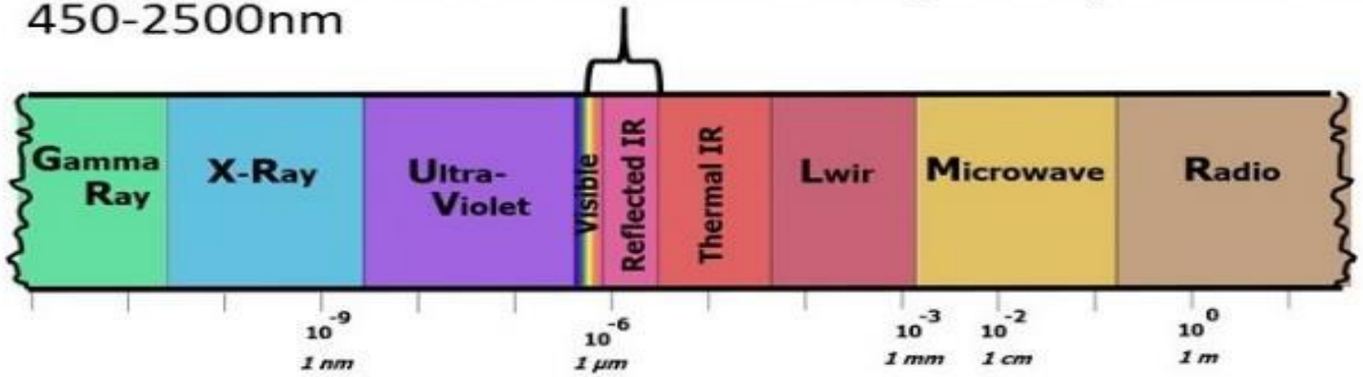
Cajamarca, Peru

- All historic and new drill holes are being scanned
- ~40,000 m (80 drill holes) scanned as of May 20th, 2019
- One of only a very few projects where all drill holes are being scanned

HYPERSPECTRAL IMAGING

The Basics

The imaging of earth materials in hundreds of contiguous, narrow bands across the electromagnetic spectrum from 450-2500nm

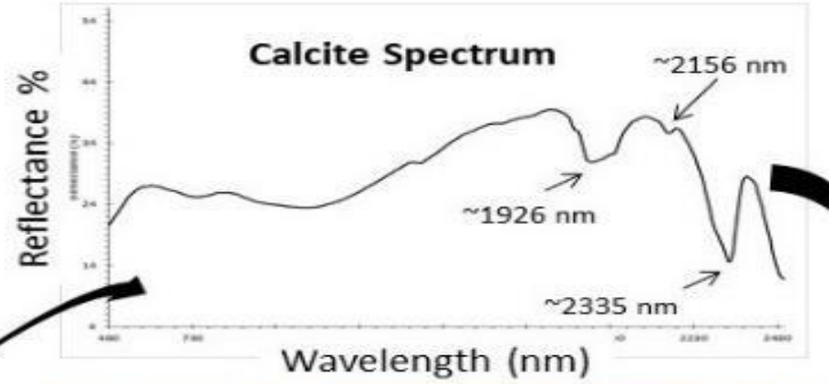


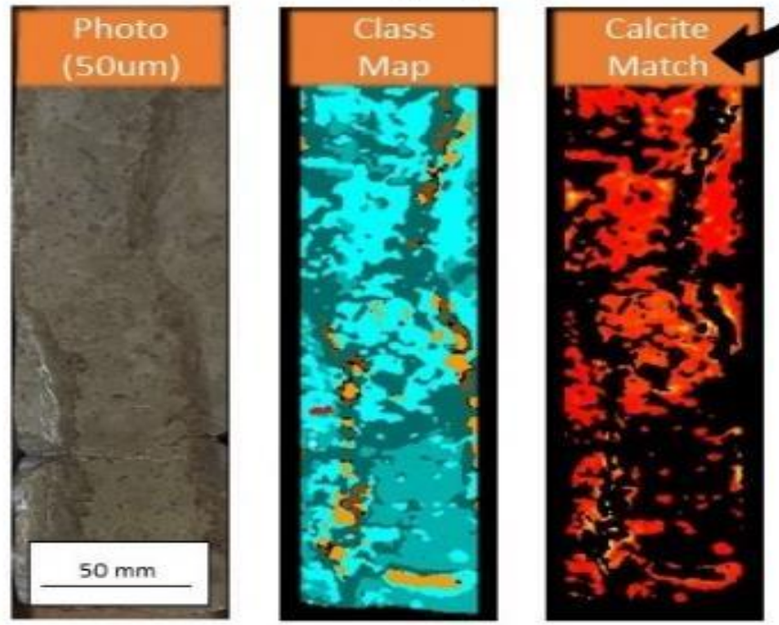
The surface of the core is imaged in ~200,000 pixels per meter; each 500 µm x 500 µm pixel has a single extracted spectral signature

500µm

500µm

Each single spectral signature contains 'absorption features', 'shoulders' and 'slopes' that quantifiably and uniquely identify specific minerals

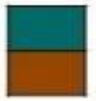




Calcite

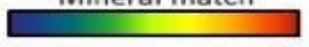
Calcite-Iron Oxide

Dolomite



Fe-rich Dolomite

Dolomite-Iron Oxide



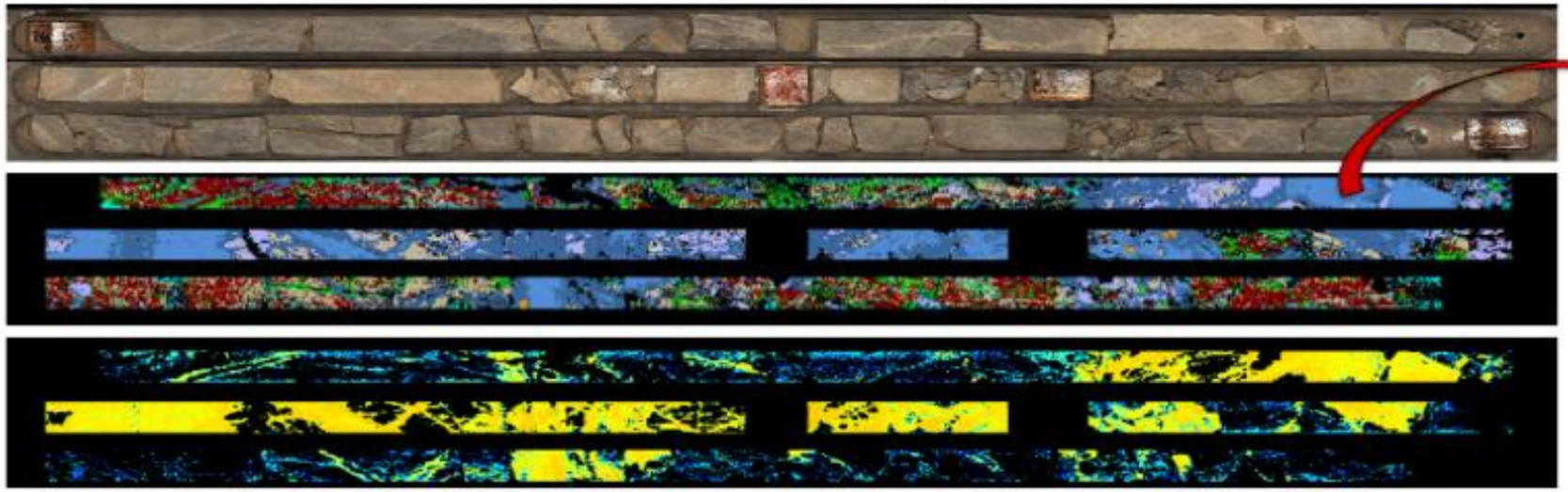
HYPERSPECTRAL IMAGING

Continuous vs Single Point Systems

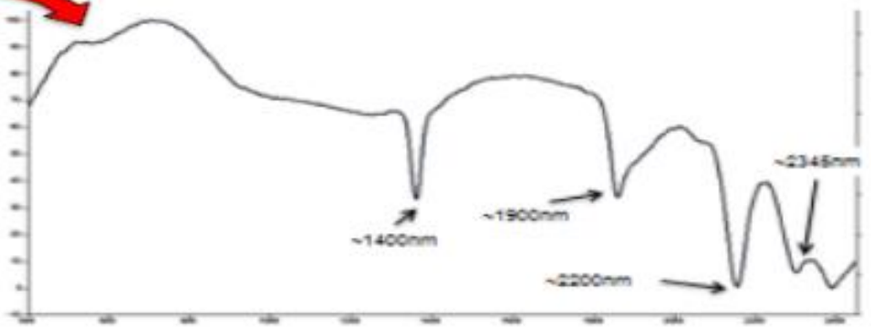
- Point systems (e.g. Terraspec, Spectral Evolution) produce a single spectral signature that is extracted from a core surface area of approximately 2cm
  - Size of measurement area depends on operator; can be inconsistent
- Typical point surveys in the coreshed range from a single measurement per core box to perhaps ~1-5 measurements per row of core; thus ~25 points per core box compared to ~1,000,000 points from Corescan

Corescan® Imaging System

HALO ™- Panlytical



Cu-Porphyry; Top: Photo Middle: Class Map Bottom: White Mica Abundance



White Mica spectral signature from a single Corescan pixel (500 um resolution)

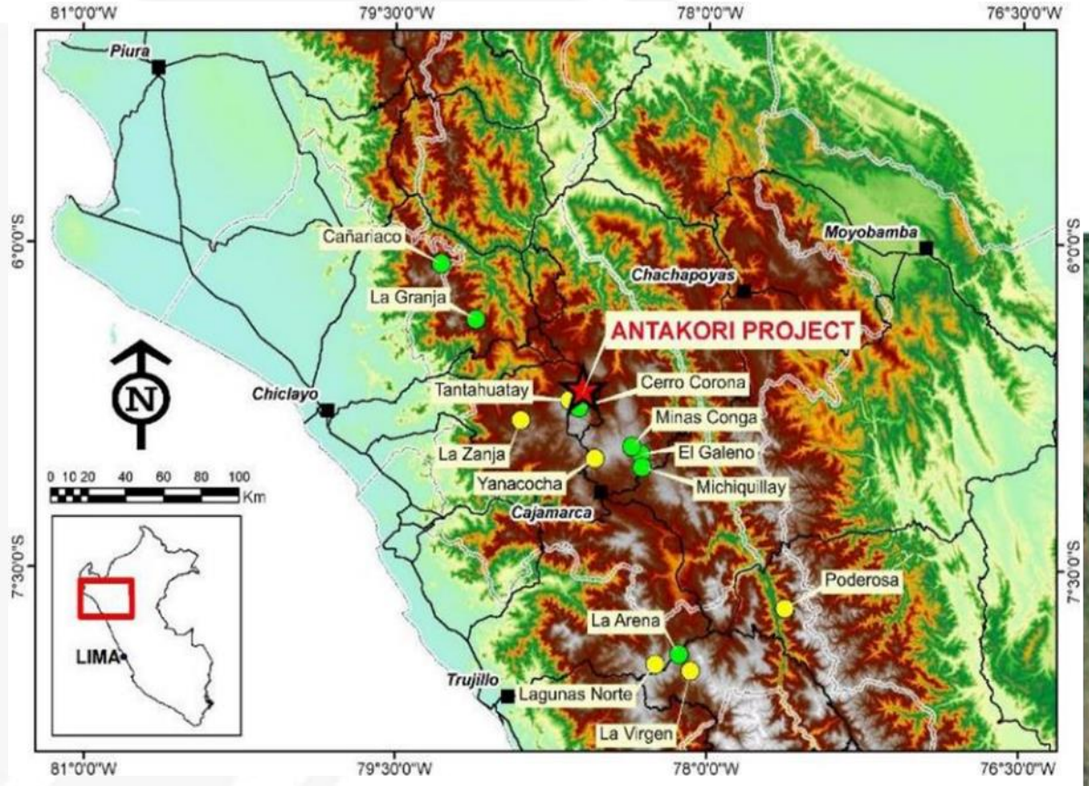
WHY ARE WE DOING CORESCAN?

Exploration to Mining Value Chain

- Consistent identification of complexly mixed alteration minerals (Geologists are inconsistent).
- Identification of some minerals not obvious to the naked eye, even to an experienced geologist's eye!
- Able to systematically define textural and temporal relationship of complex mineral assemblages.
- Able to determine the detailed chemistry and crystallinity of various clay and mica species.
- Valuable in determining vectors to mineralization for exploration.
- Consistent collection of geotechnical info.
- Systematic mineralogical data (especially clays and micas) which may have important repercussions in "down-stream" activities:
  - Mining (blasting & slope stability),
  - Crushing & grinding,
  - Metallurgical processing,
  - Tailings & waste disposal (acid drainage).

LOCATION

Land of the Peruvian Giants



2019 Resource on AntaKori by Regulus Resources – 0.3% Cu Eq cut-off

Resource Category	*Tonnes (millions)*	*Cu (%)*	*Au (g/t)*	*Ag (g/t)*	*Cu Eq (%)*	*Cu (B lbs)*	*Au (M oz)*	*Ag (M oz)*	*Cu Eq (B lbs)*	*Au Eq (M oz)*
Indicated	**250**	**0.48**	**0.29**	**7.5**	**0.74**	**2.6**	**2.3**	**61**	**4.1**	**8.8**
Inferred	**267**	**0.41**	**0.26**	**7.8**	**0.66**	**2.4**	**2.2**	**67**	**3.9**	**8.2**

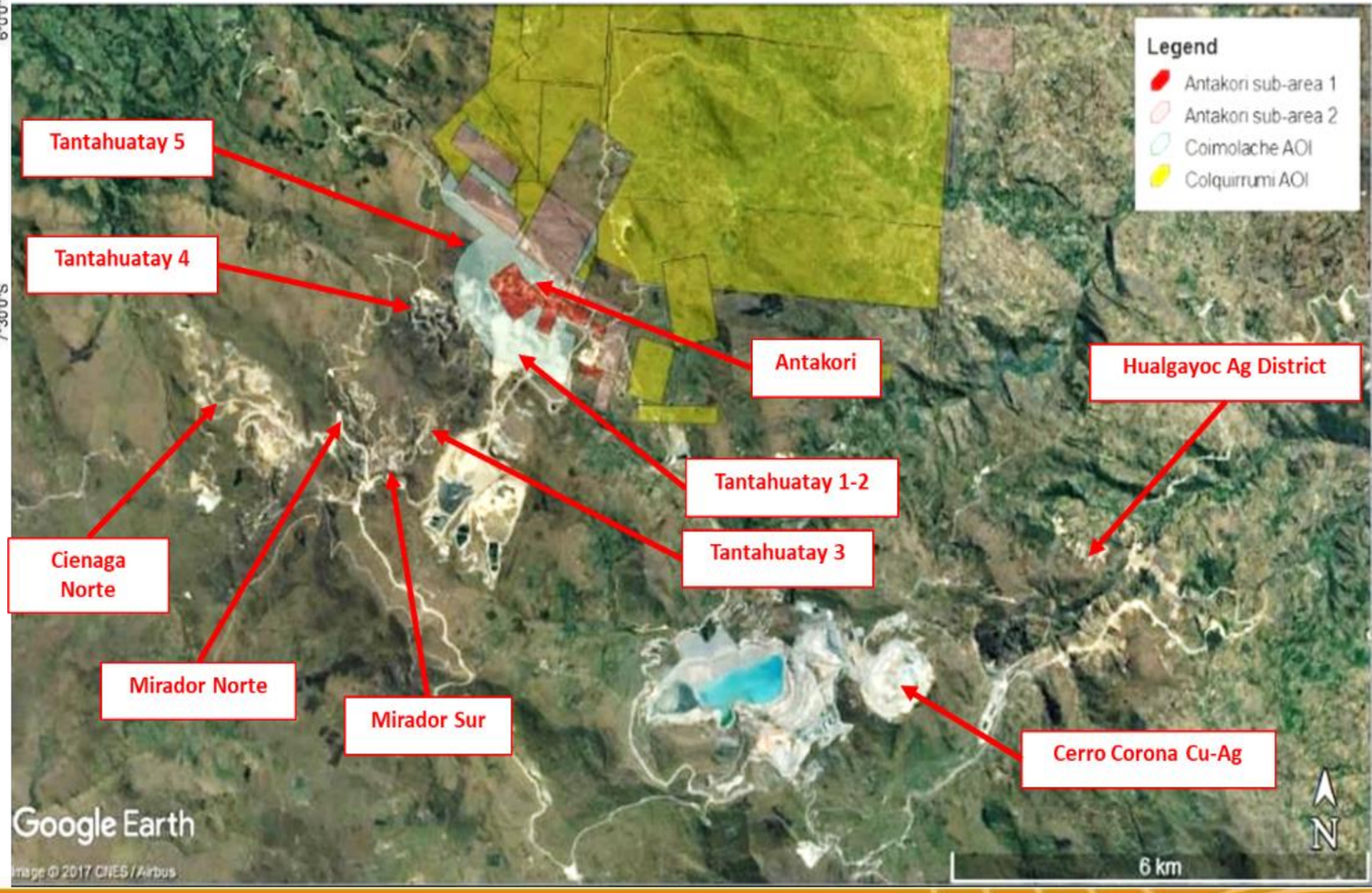
Resource estimate used metal prices: Au =US$1,400/oz, Cu = US$3.00/lb, Ag = US$18/oz
Au Eq and Cu Eq were calculated using the following metal prices: Au = US$1,400/oz, Cu = US$3.00/lb, Ag = US$18/oz

Average arsenic grade: Indicated Mineral Resource = 857ppm, Inferred Mineral Resource = 518ppm

54% of total mineralization is skarn (240ppm As)
39% of total mineralization is high-sulphidation epithermal in Miocene volcanic rocks (1,360ppm As)

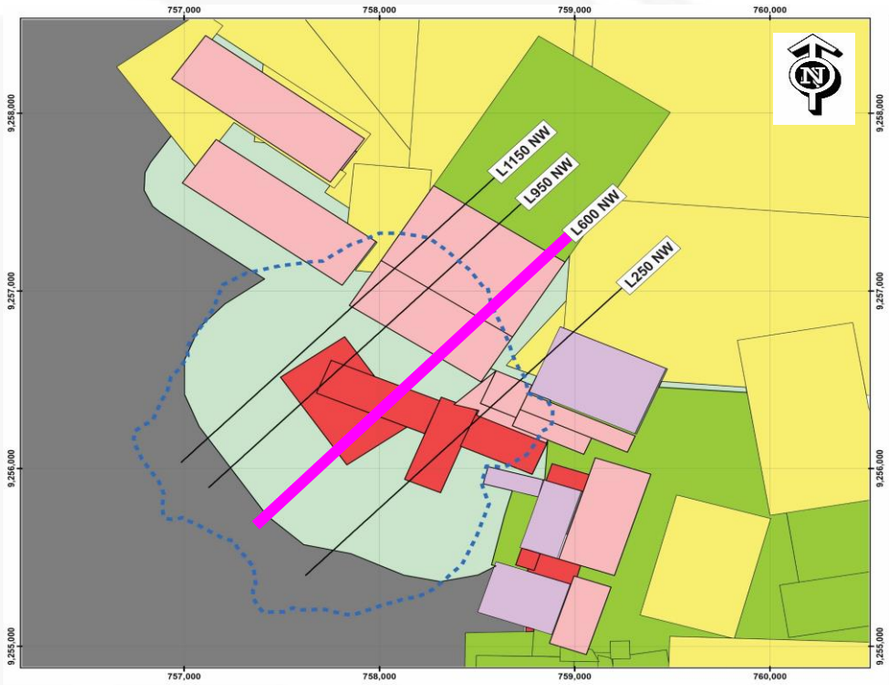
HUALGAYOC DISTRICT

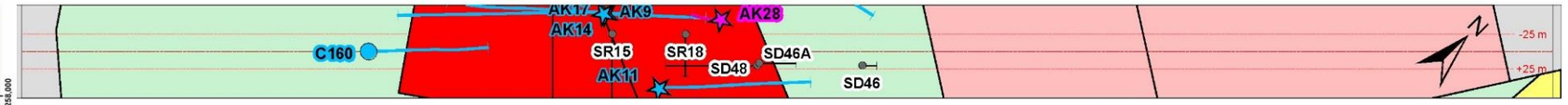
Tantahuatay & Cerro Corona

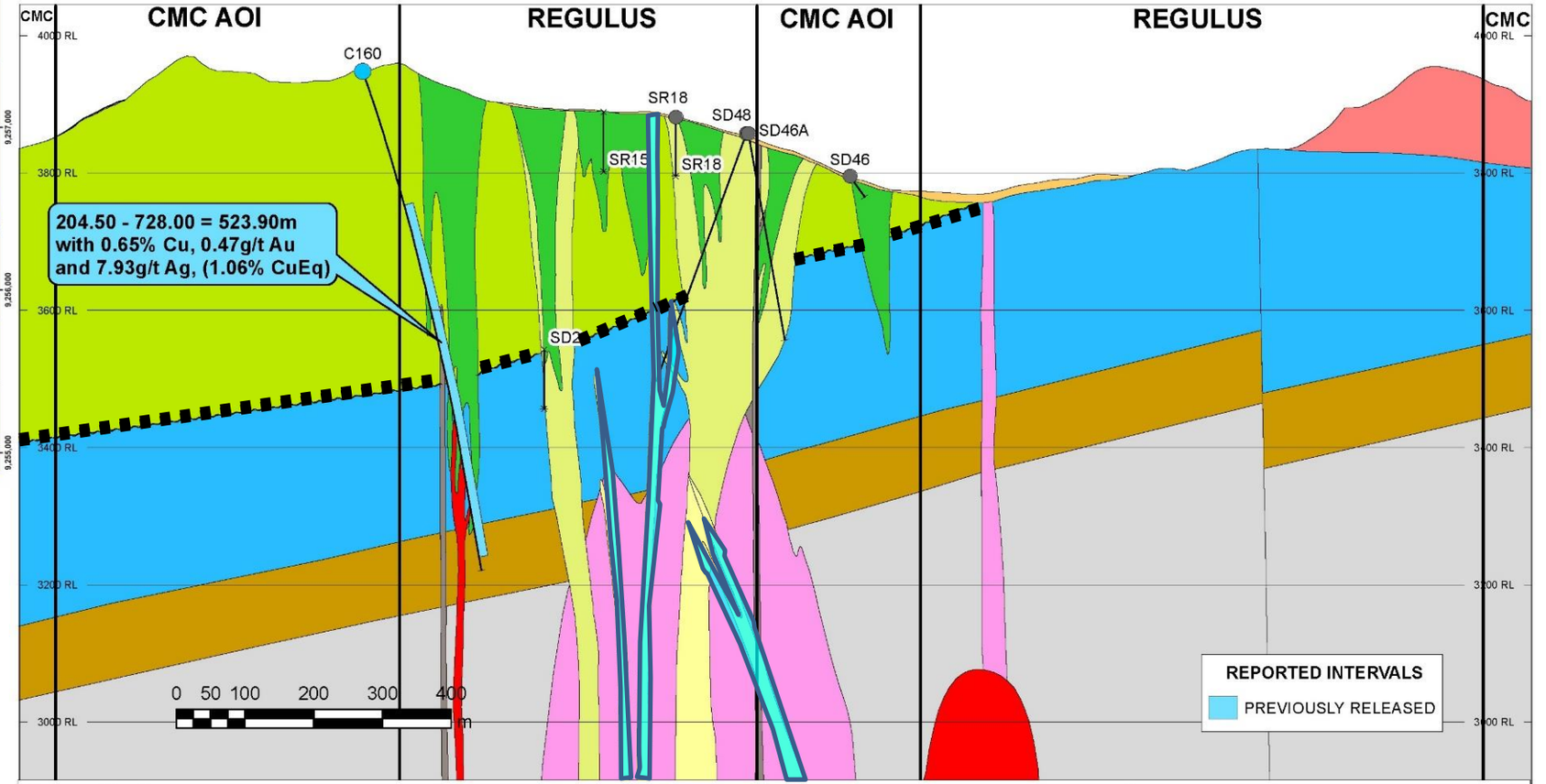


DEPOSIT GEOLOGY

Lithology, Alteration & Mineralization







LEGEND

Conceptual Pit Outline

CONCESSIONS

- REGULUS SUB-AREA 1
- REGULUS SUB-AREA 2
- COIMOLACHE_AOI
- COIMOLACHE
- COLQUIRRUMI JV REGULUS
- GOLDFIELDS
- OTHER

SYMBOL

- SECTION LINE

CRETACEOUS

- Limestone+skarn (Chulec Fm.)
- Fine-grained Sediments+skarn (Inca Fm.)
- Quarzite and Arkoses (Farrat Fm.)

MIOCENE (early)

- Porphyry Intrusion
- San Miguel Diorite
- Old Breccia

MIOCENE (late)

- Massive Sulphide Vein
- Subvolcanic Intrusive
- Intermediate Volcanic
- Young Felsic Intrusion
- Post Volcanic Breccia
- Unconformity

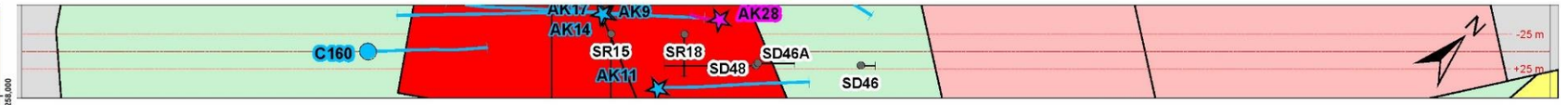
RECENT

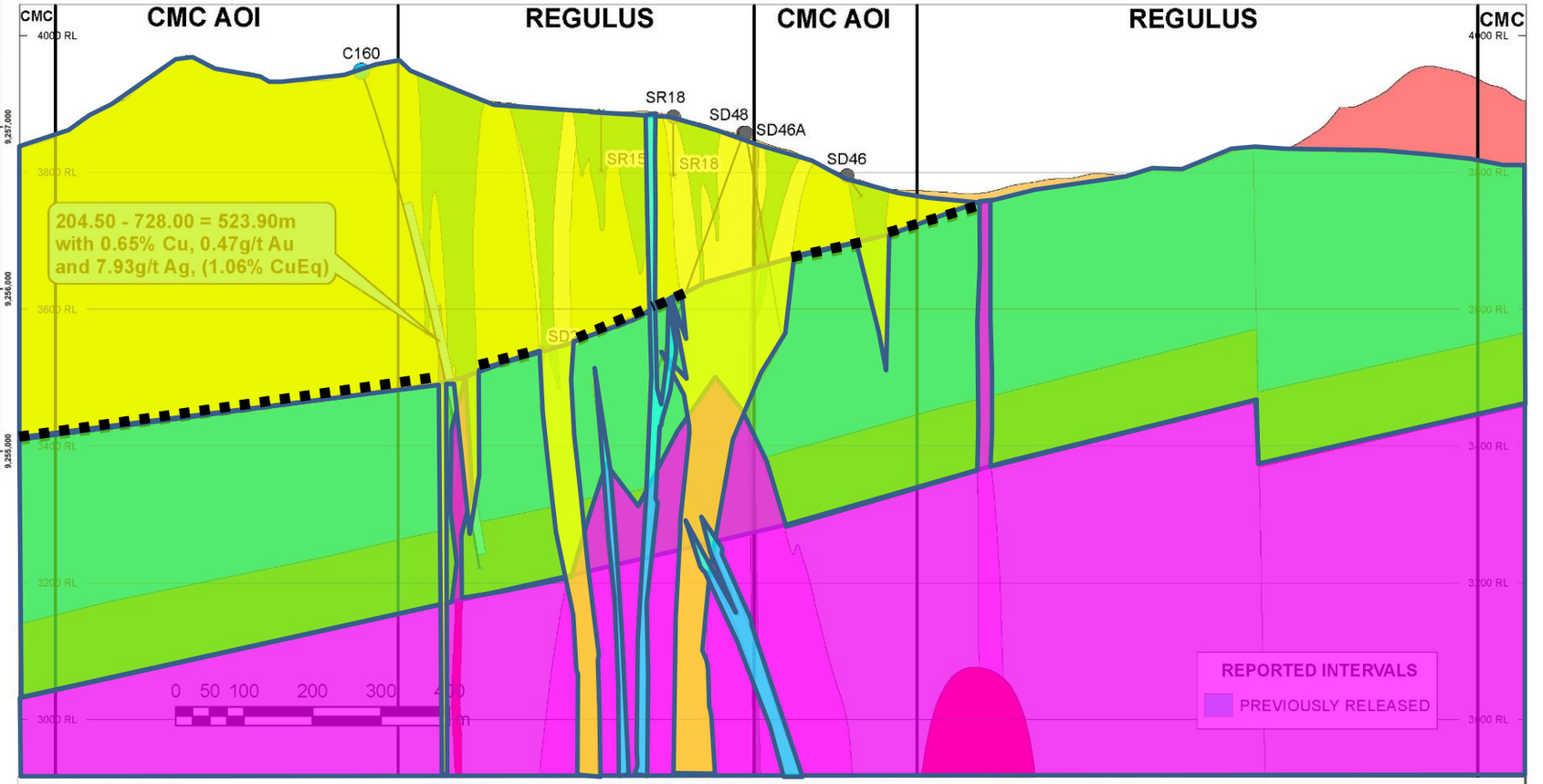
- Overburden

SECTION L600NW

DEPOSIT GEOLOGY

Lithology, Alteration & Mineralization





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- JV REGULUS
- GOLDFIELDS
- OTHER

SYMBOL

SECTION LINE

- **Base-Metal Carbonate (Zn-Pb-Ag-Au-Cu)** — Sericite-Chlorite (SCC)
- **High-sulphidation (Au-Cu-Ag)** — Advanced Argillic (AA)
- **Skarn-Hornfels (Cu-Au-Ag-Zn)** — Prograde-Retrograde
- **Porphyry-Skarn-Breccia (Cu-Au-Mo)** — Sericite-Pyrophyllite-Chlorite

CRETACEOUS

- Limestone+skarn (Chulec Fm.)
- Fine-grained Sediments+skarn (Inca Fm.)
- Quarzite and Arkoses (Farrat Fm.)

MIOCENE (early)

- Porphyry Intrusion
- San Miguel Diorite
- Old Breccia

MIOCENE (late)

- Massive Sulphide Vein
- Subvolcanic Intrusive
- Intermediate Volcanic
- Young Felsic Intrusion
- Post Volcanic Breccia
- Unconformity

RECENT

- Overburden

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SECTION L600NW

COMPLEX DEPOSIT GEOLOGY

Superposition of Multiple Hydrothermal Systems

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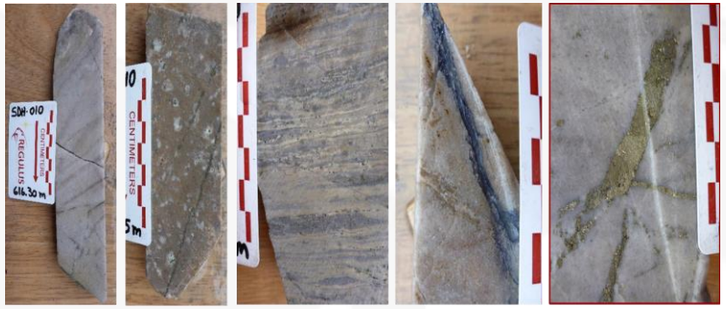
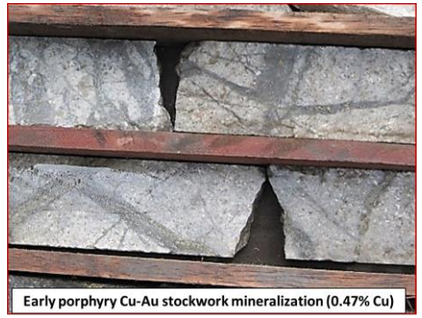




Red garnet prograde skarn

Green garnet prograde skarn

Massive sulphide skarn

Epidote retrograde skarn

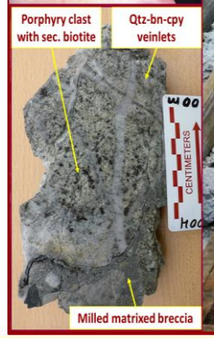
Mag-chl retrograde skarn

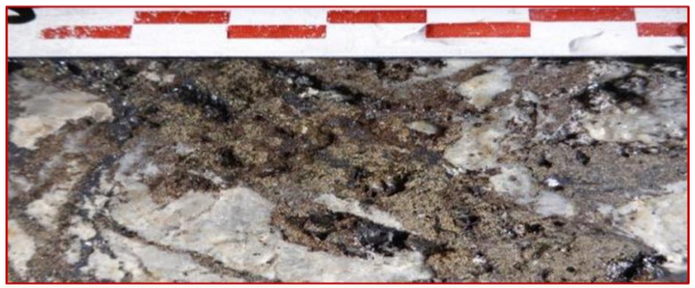
Skarn front

Marble

Calcite "escape" veinlets

Finely bedded limestone





CORESCAN

Antakori Mineral Library & Textural Resolution

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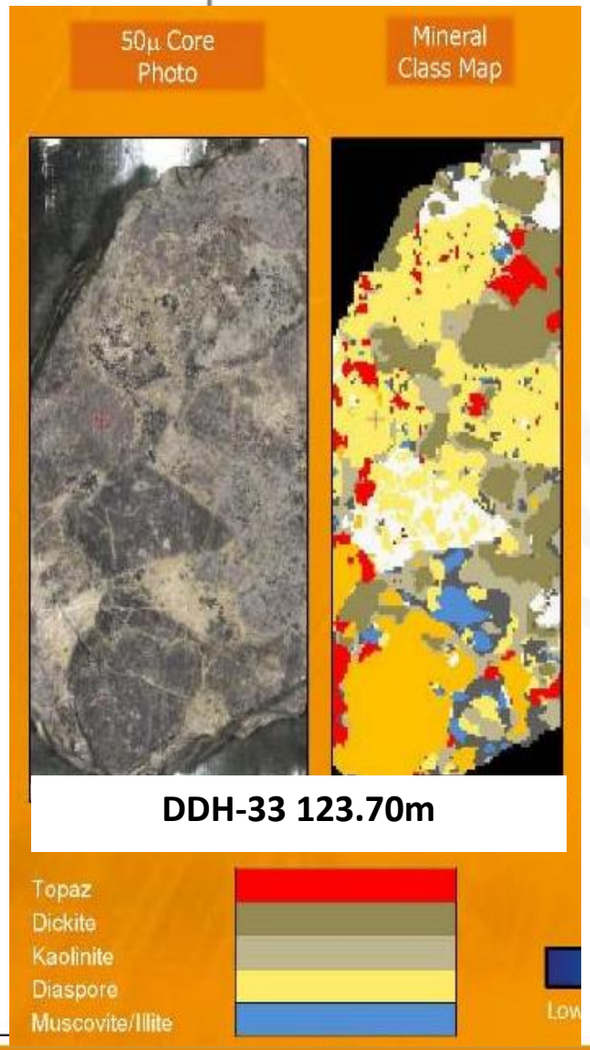
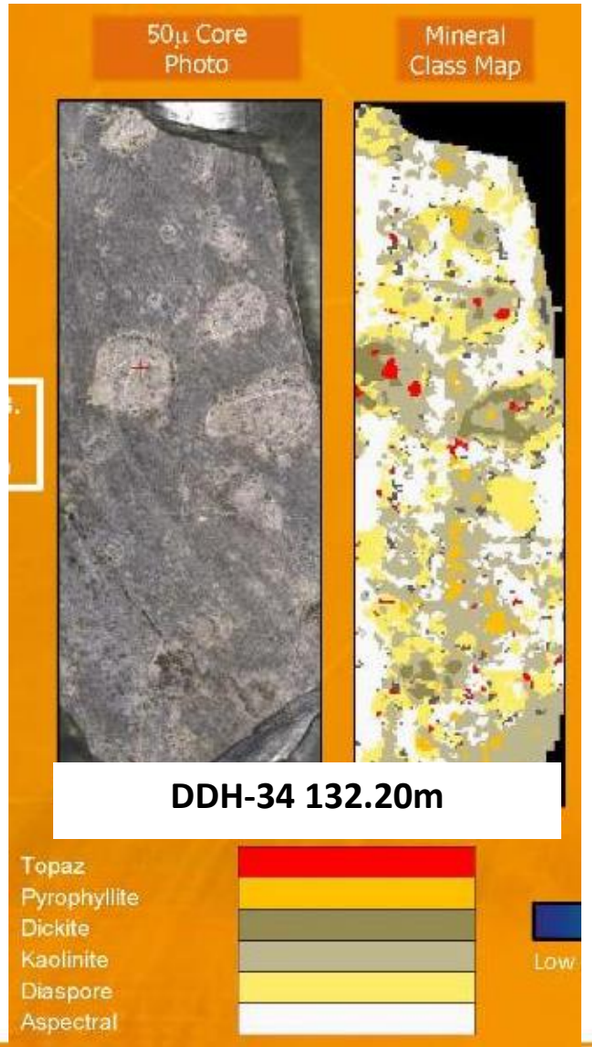
Class Map Priority Ranking	Colour	Mineral Name
Highest Priority		Zunyite
		Tourmaline
		Topaz
		Dumortierite
		Zeolite
		Alunite
		Dickite
		Kaolinite (High Xtallinity)
		Kaolinite (Low Xtallinity)
		Diapsore
		Mix: Pyrophyllite + Aspectral
		Pyrophyllite
		Garnet
		Vesuvianite
		Pyroxene
		Amphibole
		Biotite
		Epidote
		Clinochlore
		Chlorite
		Calcite
		Fe-carbonate
		White Mica (High Xtallinity)
		White Mica (Low Xtallinity)
		Scapolite
		Saponite
		Montmorillonite
		Jarosite
		Hydrous Silica
		Opaline Silica
		Gypsum
		Magnetite
		Fe Oxides (General)
		Specular Hematite
Lowest Priority		Aspectral

- **~40 minerals currently being systematically scanned at Antakori**





DRILL HOLE AK-18-013

Advanced Argillic Alteration Mineralogy

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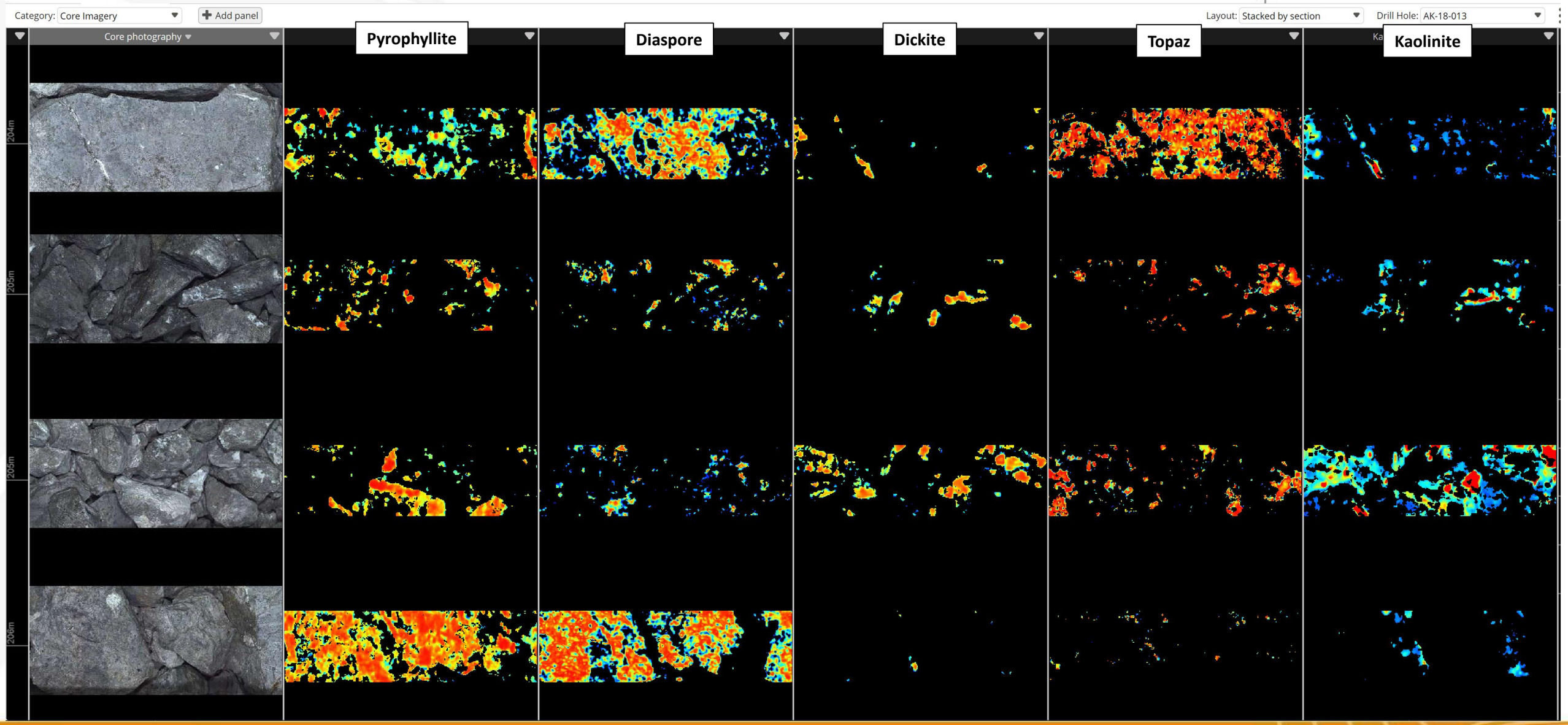

DRILL HOLE AK-18-010

Paleo-regolith Weathering & Gypsum Front

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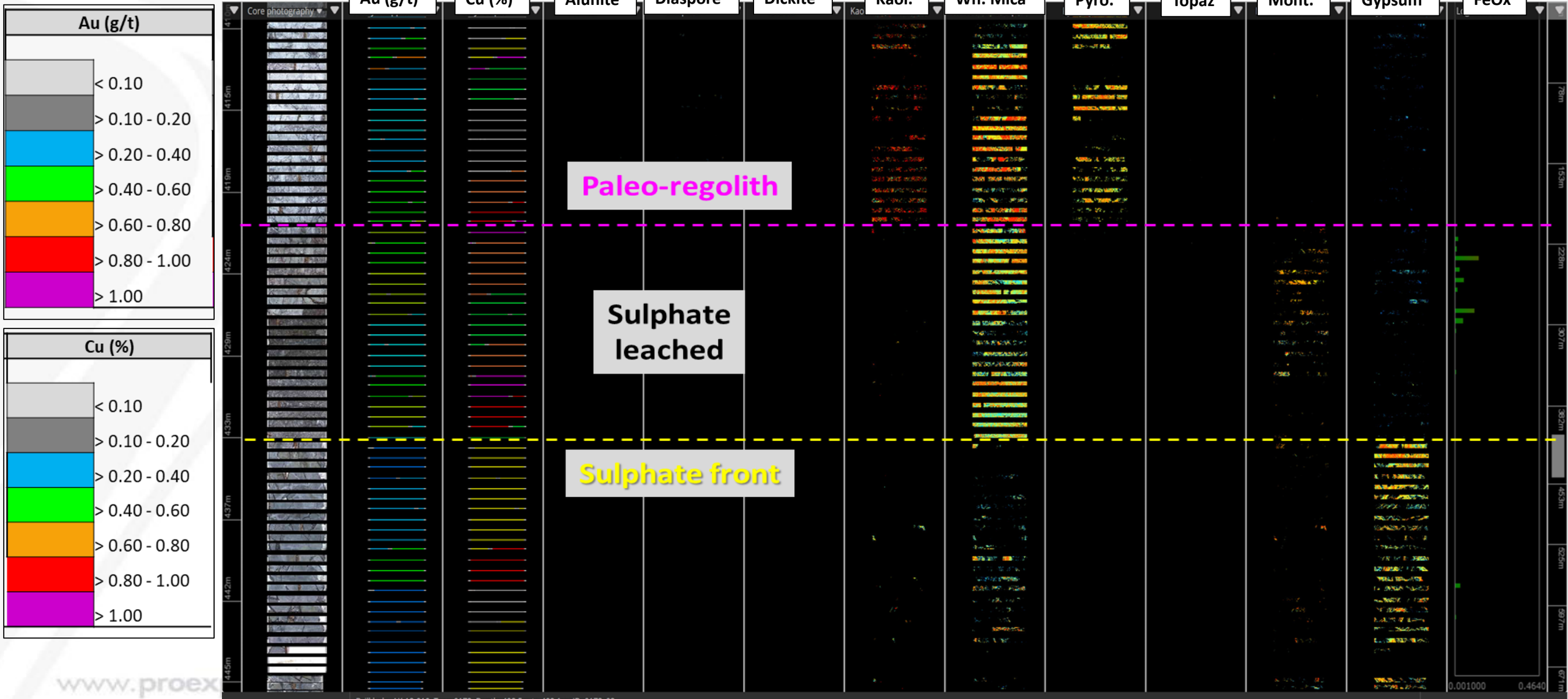
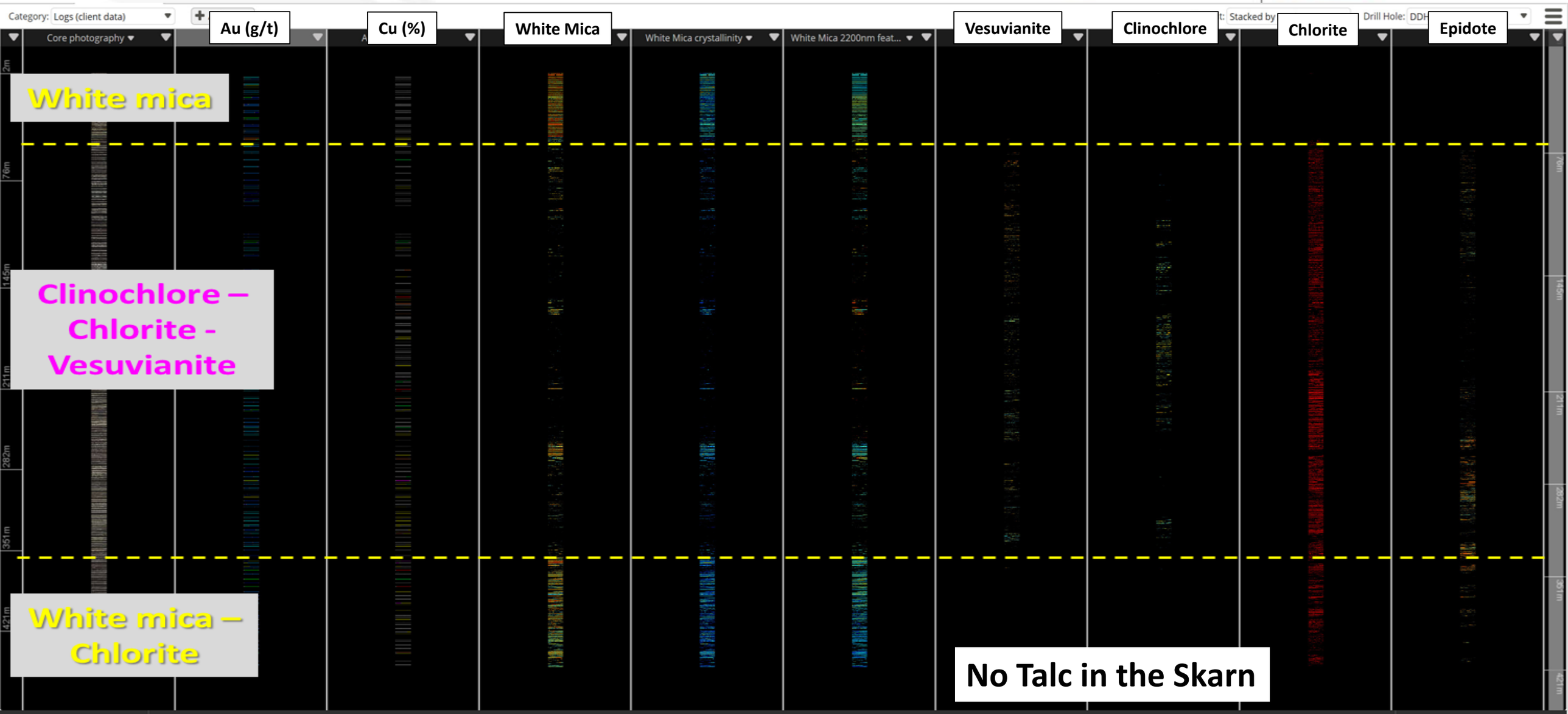


DRILL HOLE DDH-042

Skarn Zonation & Sericite-Chlorite Overprint



DRILL HOLE AK-18-010

High-grade Cu-Au with White Mica-Anhydrite

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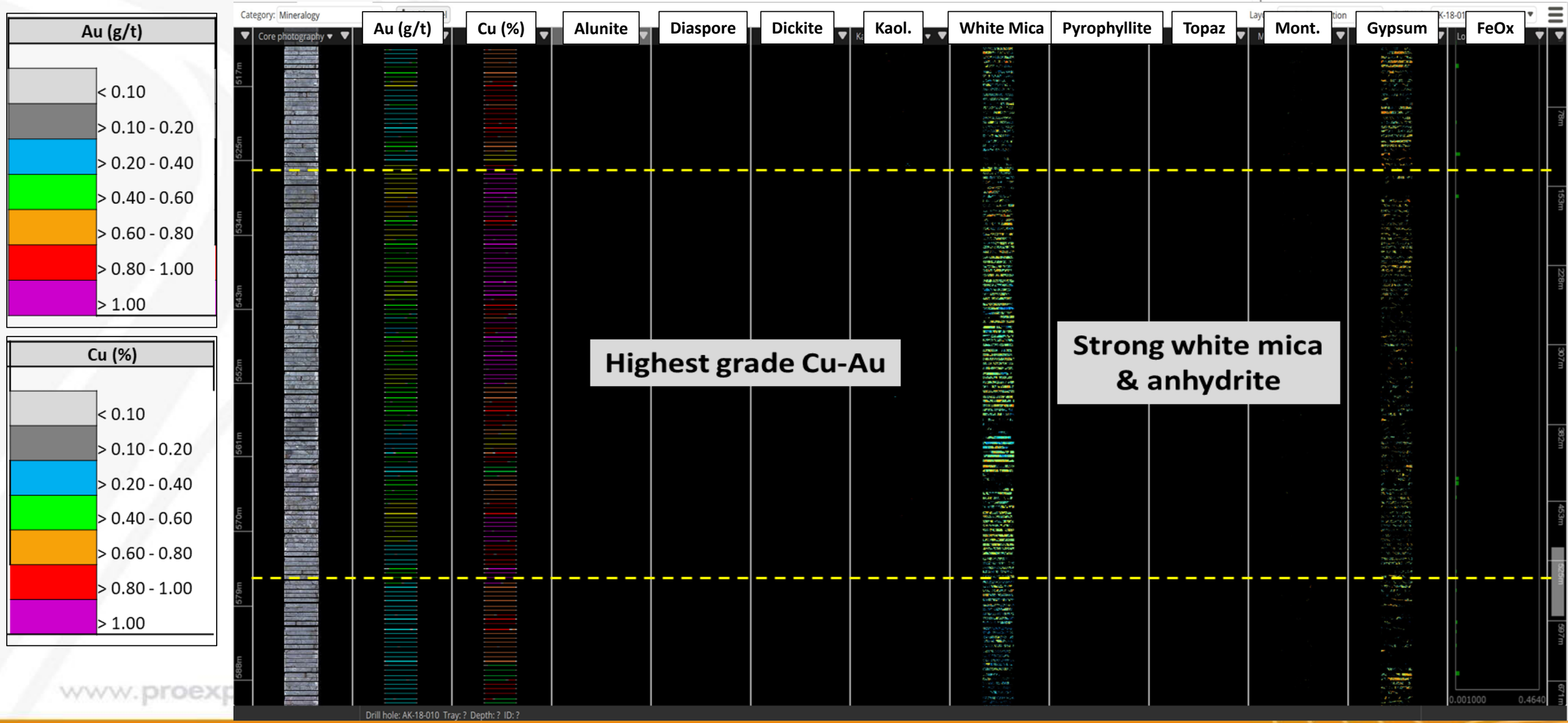

DRILL HOLE AK-17-001

High-grade Cu-Au with Pyrophyllite-Diaspore

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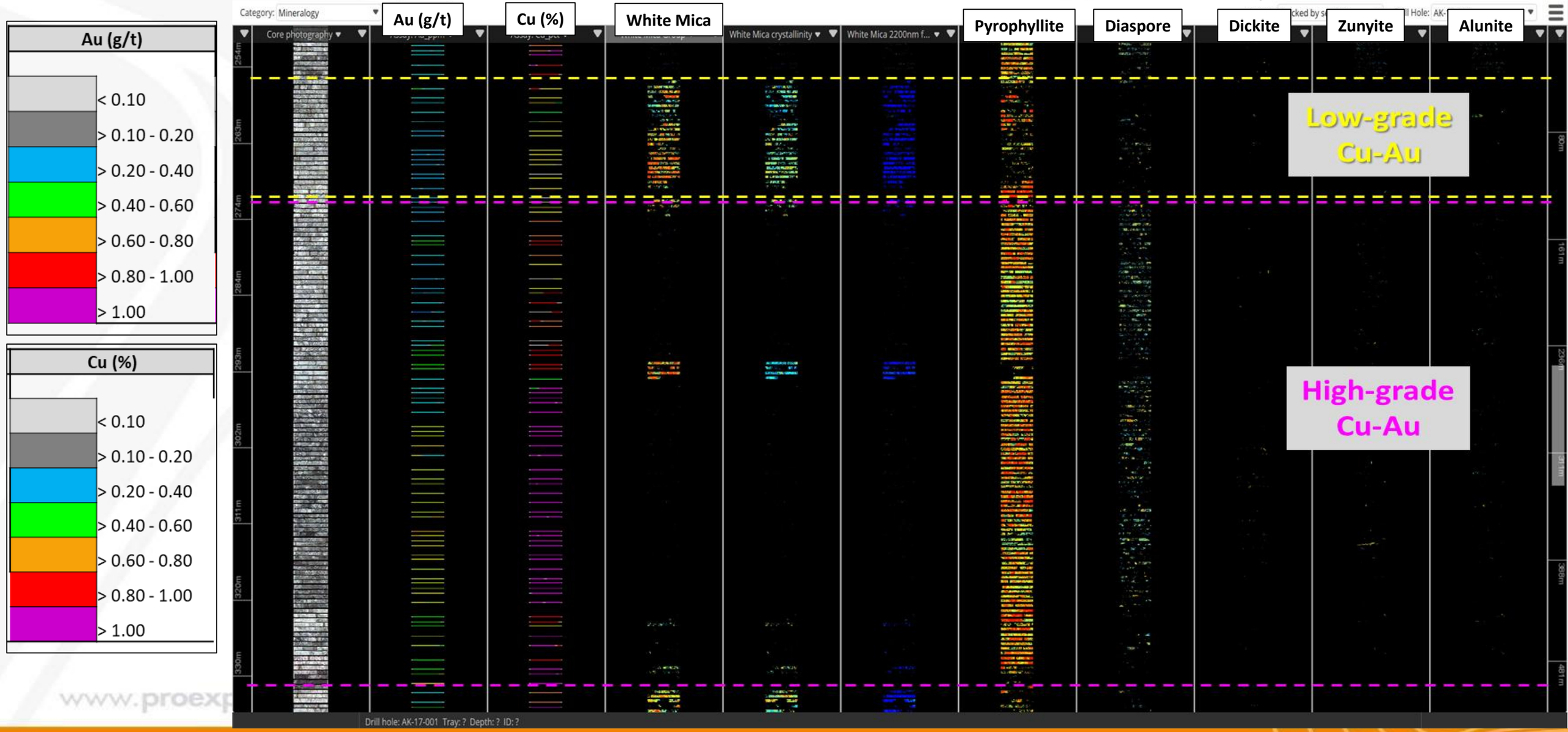

DRILL HOLE AK-18-010

Advanced Argillic Alteration Zonation

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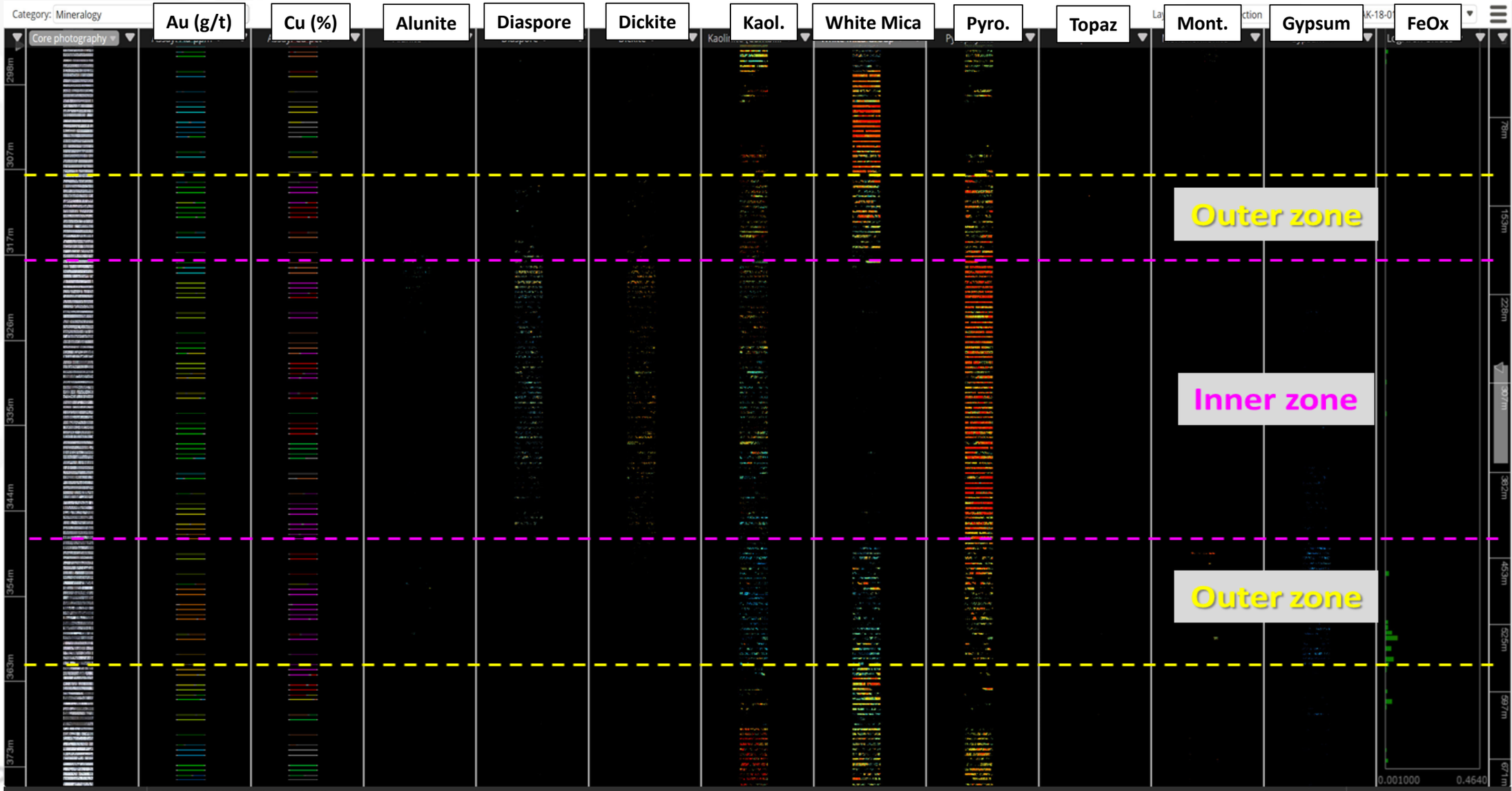
Au (g/t)

- < 0.10
- > 0.10 - 0.20
- > 0.20 - 0.40
- > 0.40 - 0.60
- > 0.60 - 0.80
- > 0.80 - 1.00
- > 1.00

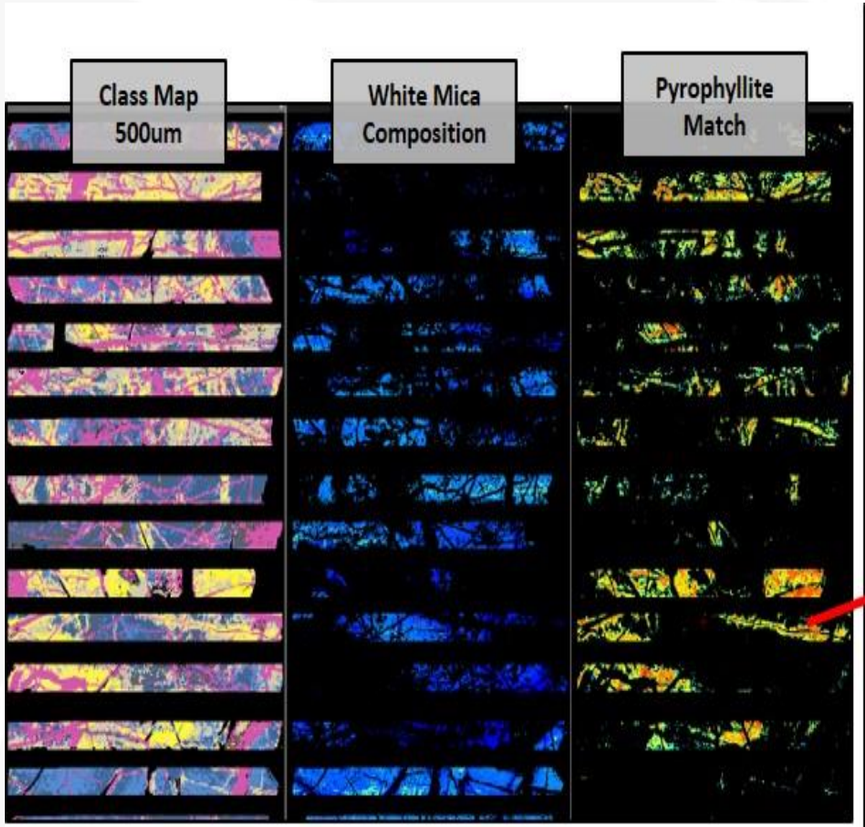
Cu (%)

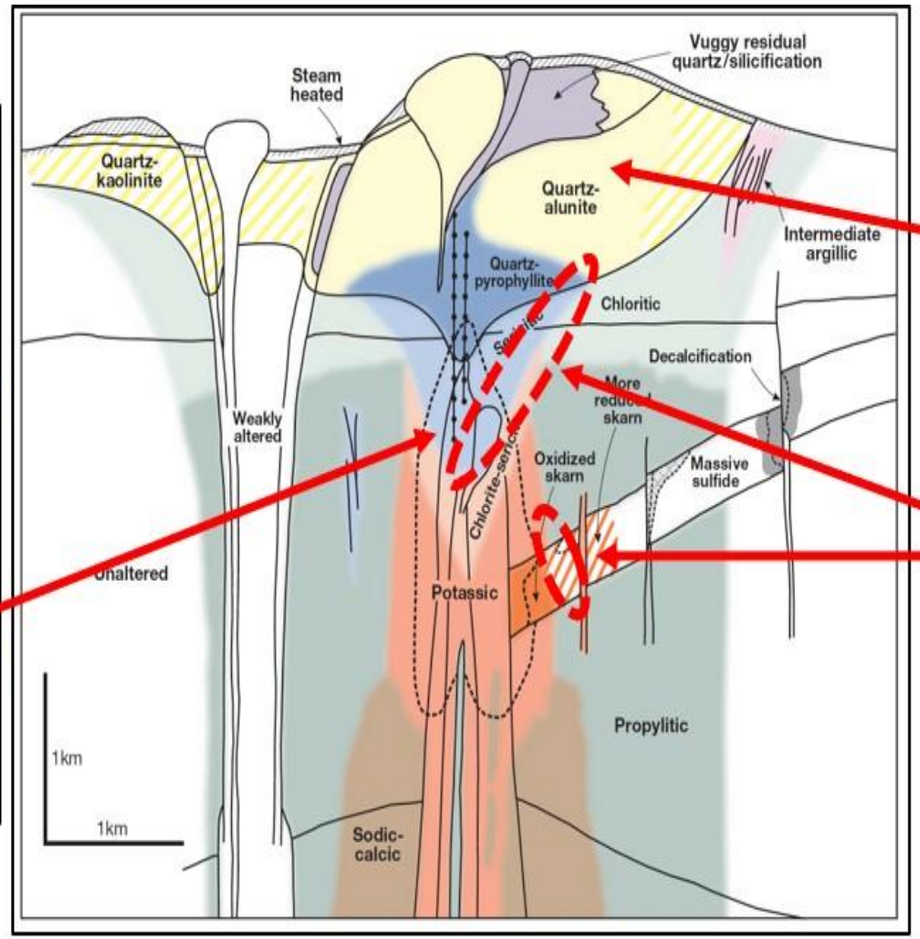
- < 0.10
- > 0.10 - 0.20
- > 0.20 - 0.40
- > 0.40 - 0.60
- > 0.60 - 0.80
- > 0.80 - 1.00
- > 1.00

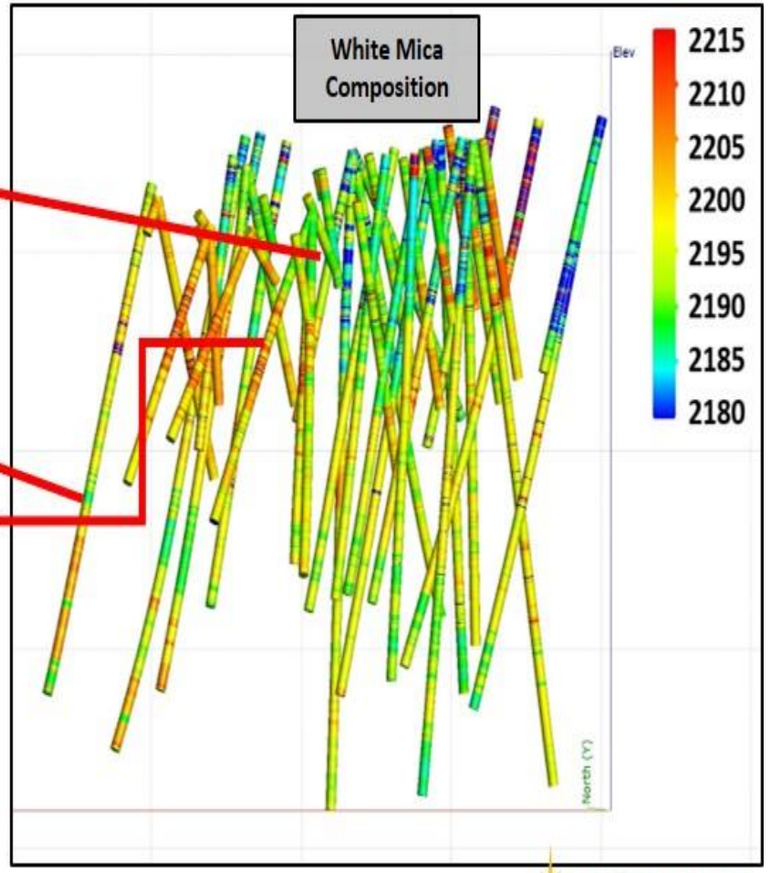


CORESCAN DATA

3D Domaining of Key Minerals and Overprints







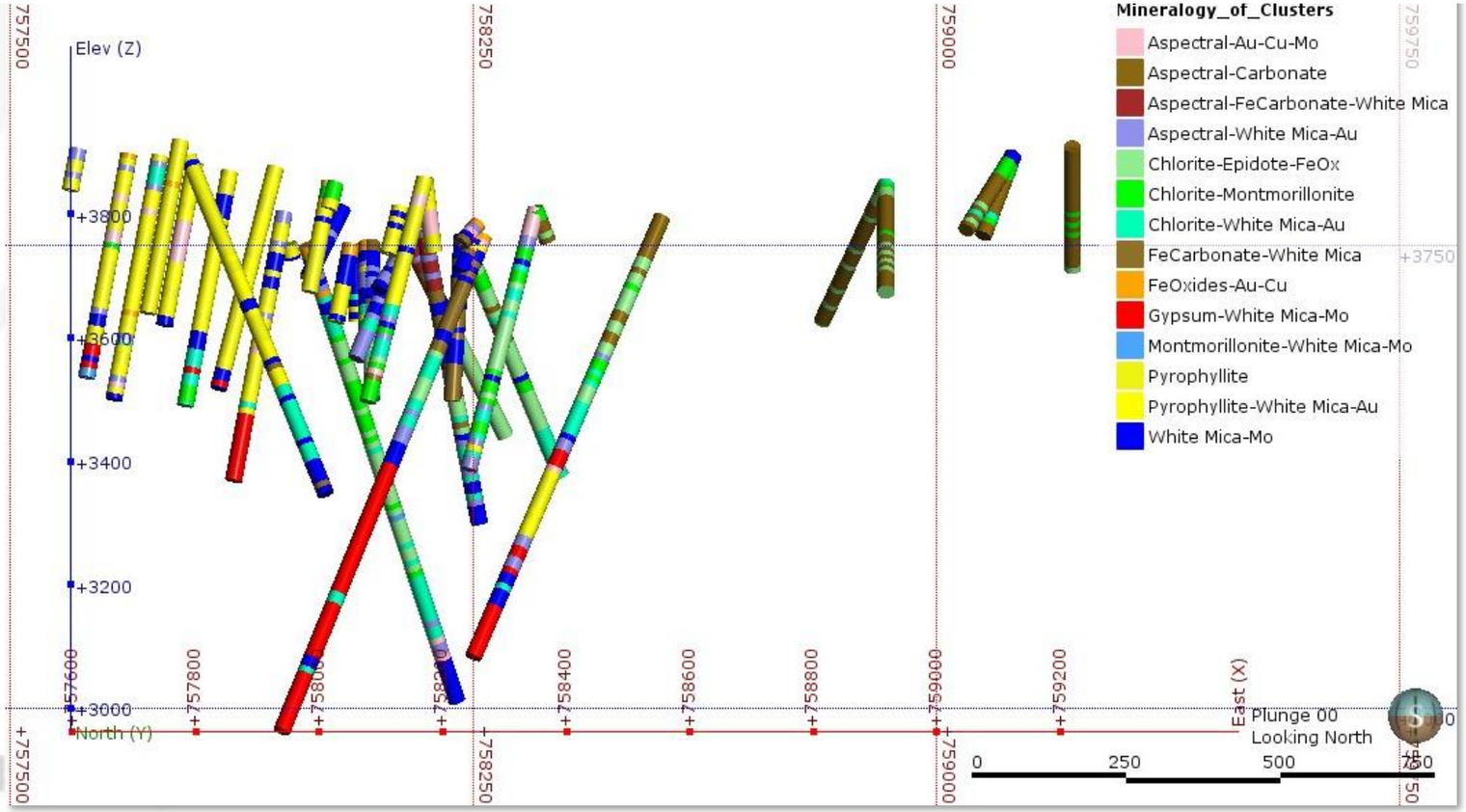
Compliments Scher 2019

3D MODELLING

Exploratory Data Analysis

- Domaining the Corescan results with clustering helps to understand natural groupings of the data in exploration projects and deposits.

- These domains can help with alteration logging code revision and promote discussion amongst geologists on projects to promote new ideas or reinforce existing ideas on paragenesis and alteration assemblages.



SOLVE GEOSOLUTIONS

corescan

3D MODELLING

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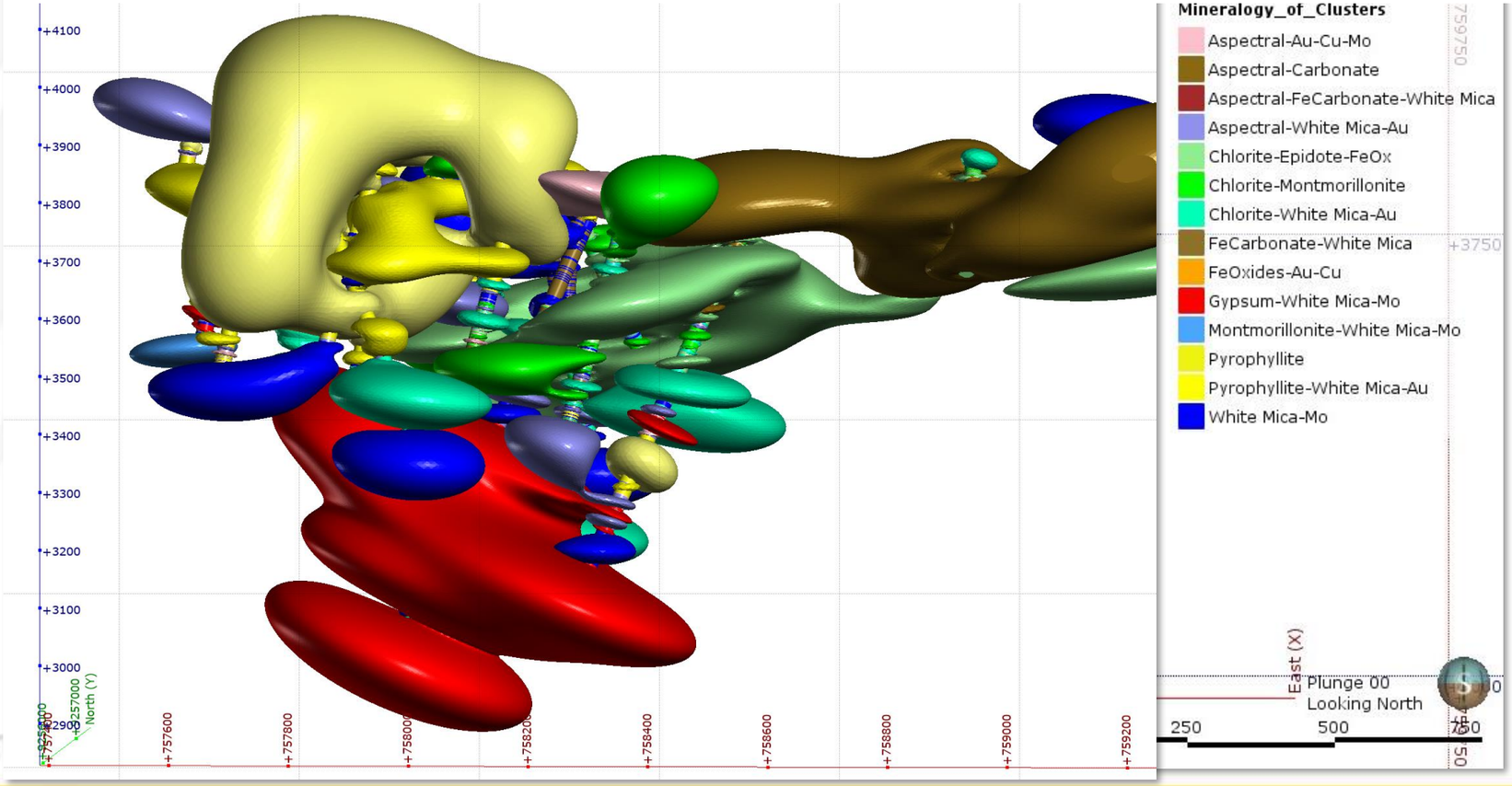

THE MINING VALUE CHAIN

Accurate Ore Body Characterization is Critical

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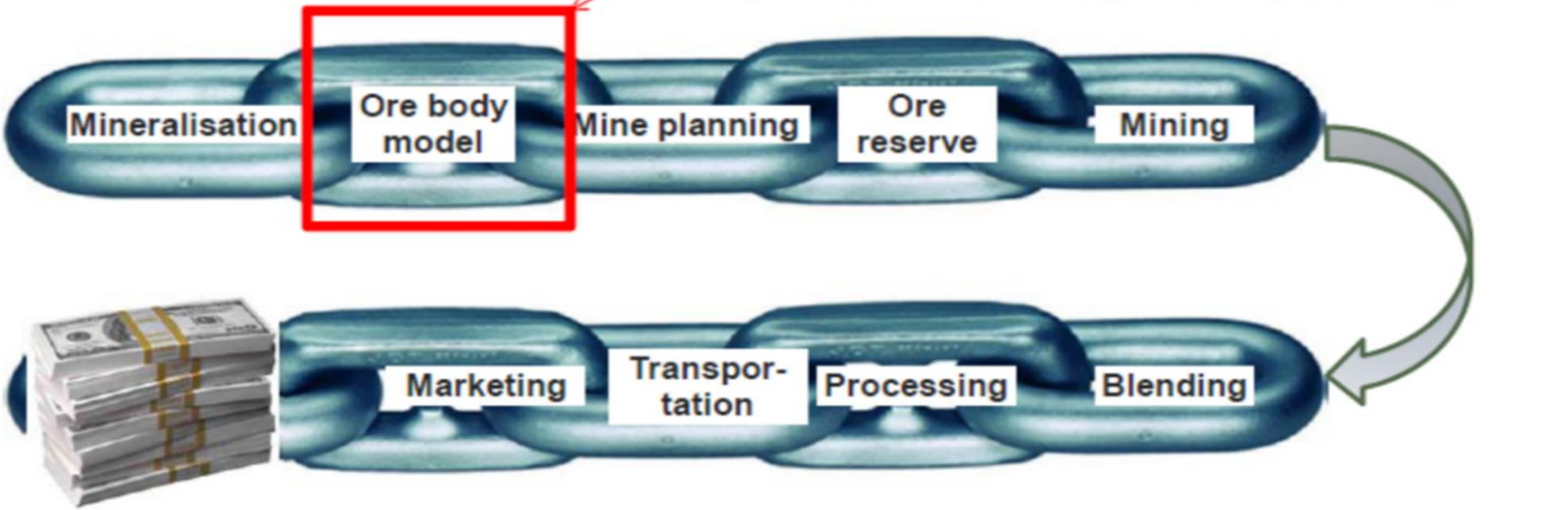
Value destruction if not properly understood the model

If biased or inadequate, it is impossible to optimise the subsequent steps of the chain



ANTAKORI WORK FLOW DIAGRAM

Corescan is an Integral Component

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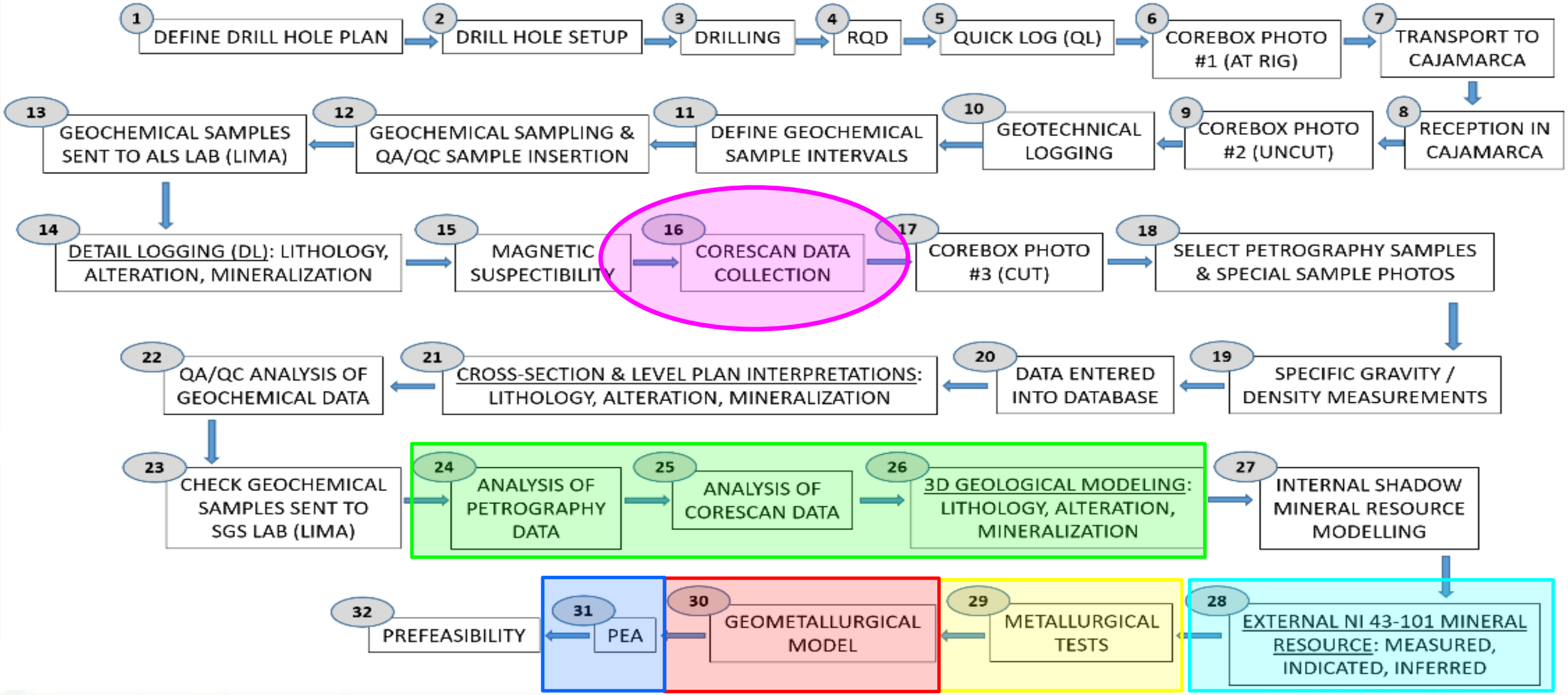
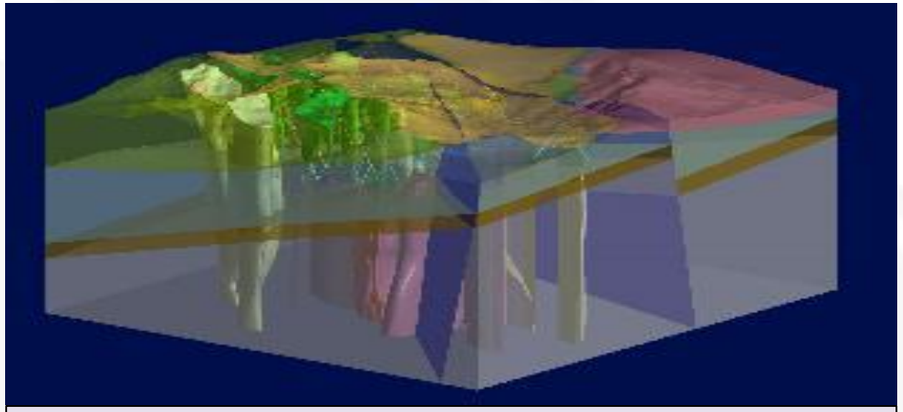


DATA INTEGRATION

Hyperspectral Data is One Component



Geological Models
(Lithology, Alteration, Mineralization, Structure)

Visual Logging Data

Multi-element Geochem Data

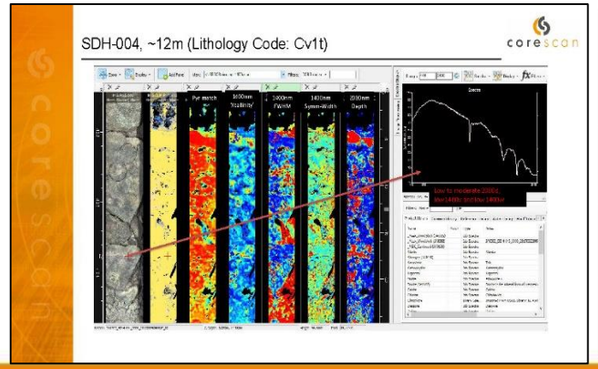
Petrographic Data

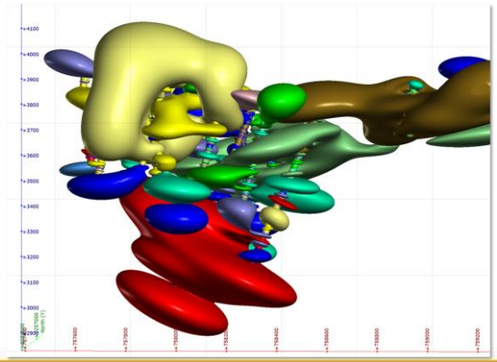
Geometallurgical Model

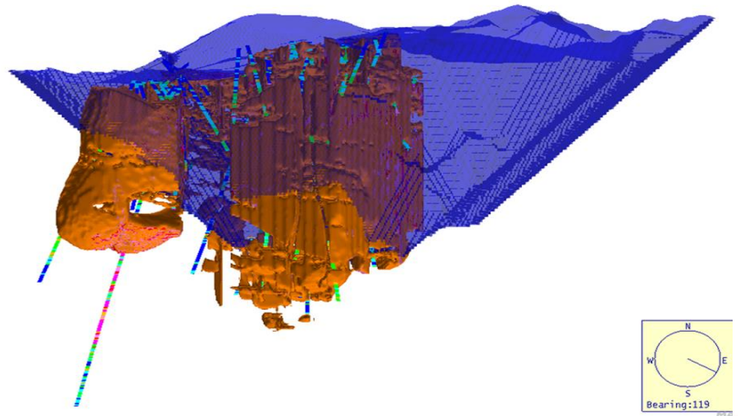
Metallurgical Test Data

Resource Block Model

CoreScan Data & Models







THE BUSINESS CASE

Hollistic Geometallurgical Model

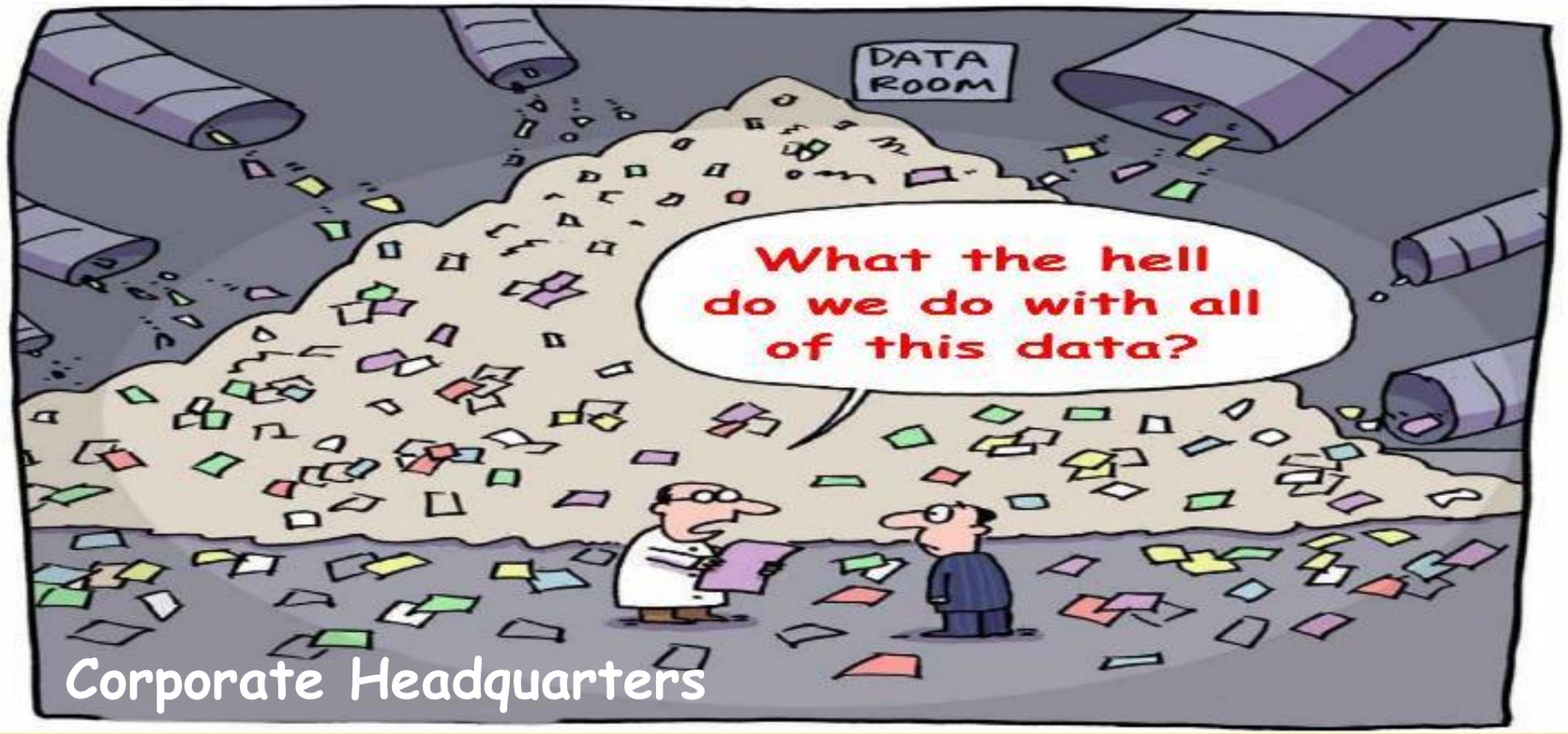
Consider the ways in which a model like this can benefit a mining operation:

- What is the relative hardness, BWi and mill throughput rates of ore with a feldspathic matrix versus ore in a phyllosilicate matrix? (Potential Proxies)
- If the sulphides were pre-concentrated in a flotation circuit, we need to know how clays and micas behave in this part of the processing.
- If the ore goes to a heap leach, we need to know how clays and micas behave on the leach pads.
- The model will show where zones of intense clay alteration will be located. If that is near the proposed pit walls, what are the implications for pit wall stability, and how will pit wall angles have to be designed to allow for those clay-rich domains?
- Corescan although initially an exploration targeting/vectoring tool; its true power may lay in its downstream applications
- Having a model like this will allow us to:
  - predict possible mining, processing and geotechnical problems,
  - design tests to quantify the risks,
  - spatially map problematic zones in orebodies.

CORESCAN

Too Much Data ??

- **Yes there is a lot of data, however most of the "heavy" data is processed on Corescan computers, stored on Corescan servers and backed-up on a regular basis**
- **Data can be composited to whatever intervals the user wants to use**
  - **At Antakori we composite to our assay intervals (1 to 3 m) and to our resource model block size (10m x 10m x 10m), but more detailed data is also being used for specific geological tasks**
- **Visual (pretty colored images) and hard numerical data (non-sexy backbone) both available for analysis**



CORESCAN

Is it Too Expensive ??

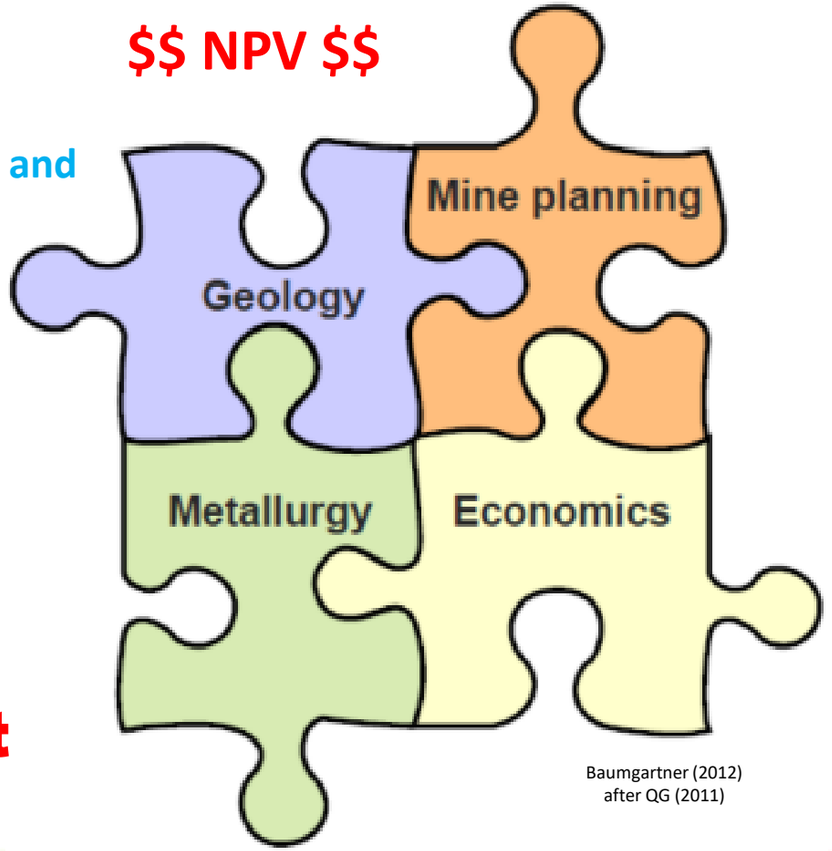
INTEGRATION OF CORESCAN

Future Value Add to the Project

1) Geometallurgy can be defined as the integration of geological, mine planning, extractive metallurgy and economic information to maximise the Net Present Value (NPV) of the mining project, while concurrently minimising technical and operational risks.

2) Early-stage adoption of spatial quantitative geometallurgical models:
   - Is underpinned by an investment in full multi-element geochemical analysis of all exploration to infill resource definition drilling
   - Systematic petrographic work of sulphides & gangue minerals
   - Collection of high-resolution hyperspectral data by CoreScan
   - Can provide positive economic outcomes, by minimizing the cost of metallurgical drilling and sampling needed

3) Create one model that is used by everyone:
   - Exploration geologists for targeting
   - Mining engineers for drilling & blasting
   - Geotech engineers for pit wall angles or underground development
   - Process engineers for crushing & grinding
   - Metallurgists for floatation
   - Enviros for AMD & waste management
   - Scheduling, blending, smelting, etc.



Baumgartner (2012) after QG (2011)

Overall value-add to any future buyer of the project

HYPERSPECTRAL CORE SCANNING

Should it be Considered ??

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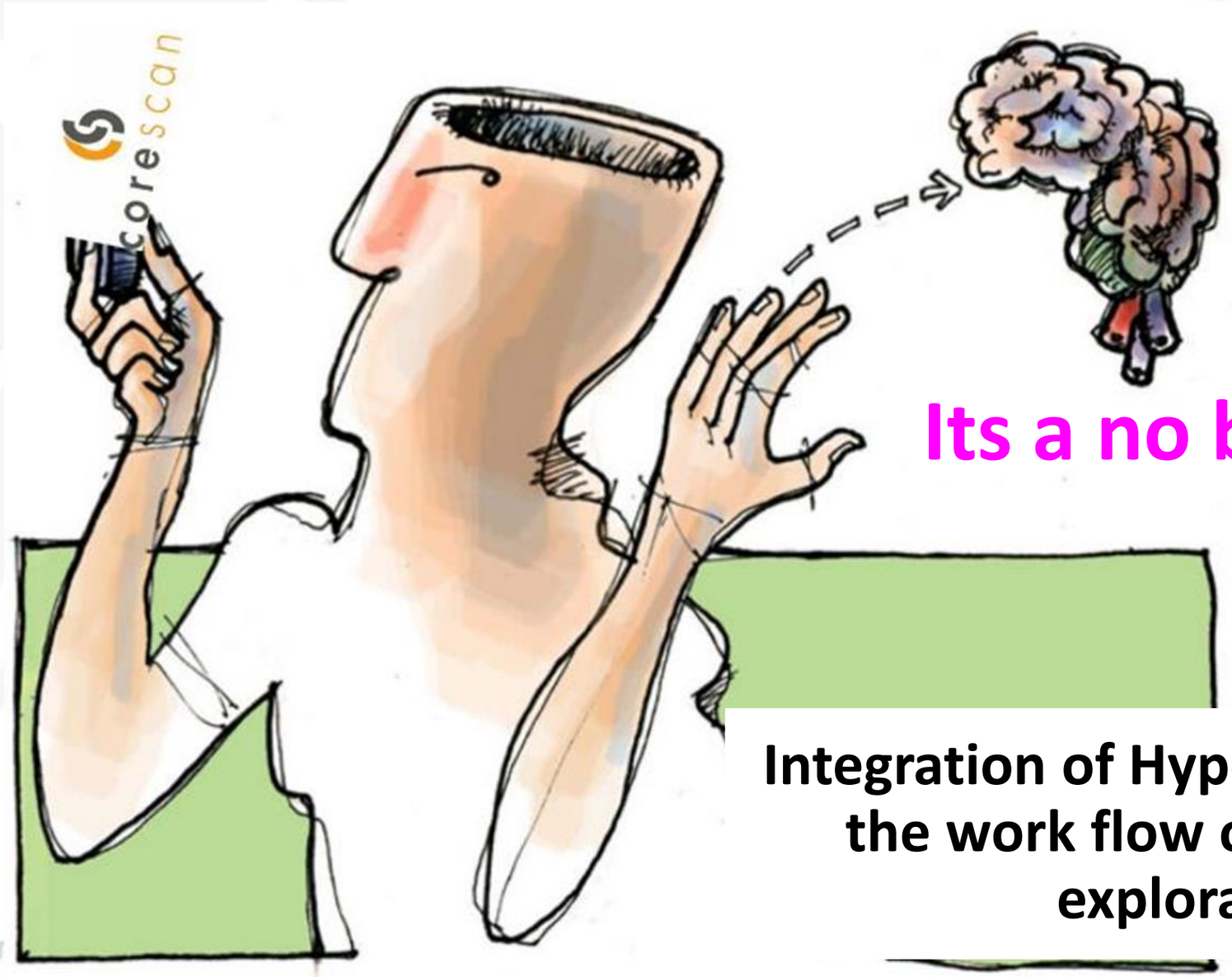

Its a no brainer !!

Integration of Hyperspectral scanning into the work flow of an advanced stage exploration project

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- Regulus Peru Exploration Team

XI CONGRESO INTERNACIONAL DE
PROSPECTORES Y EXPLORADORES

EXPLORACIÓN MINERA:
CIENCIA, INNOVACIÓN E
INVERSIÓN ESTRATÉGICA

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