



QUANTEC
Geoscience



Mine site Imaging

**Innovative Technology Solutions
for Planning & Risk Mitigation**

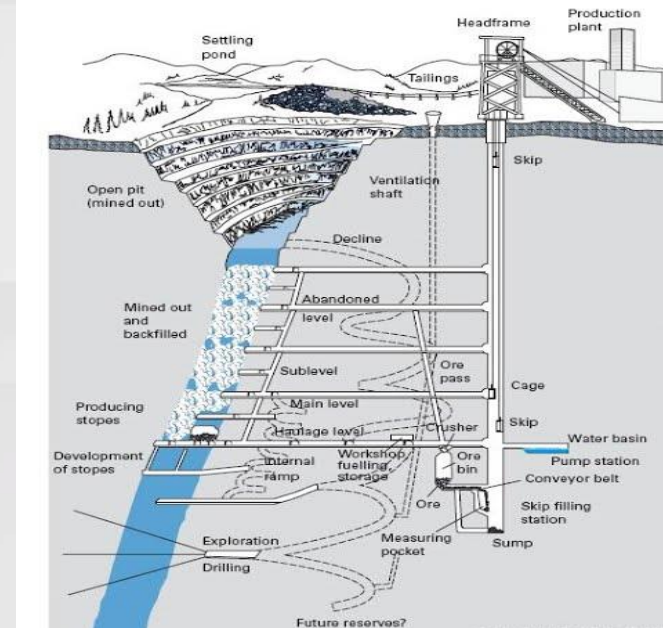
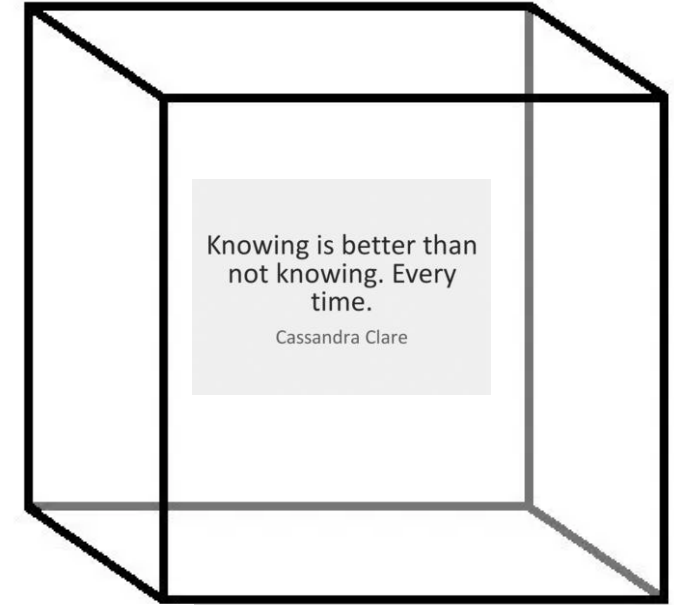


TITAN



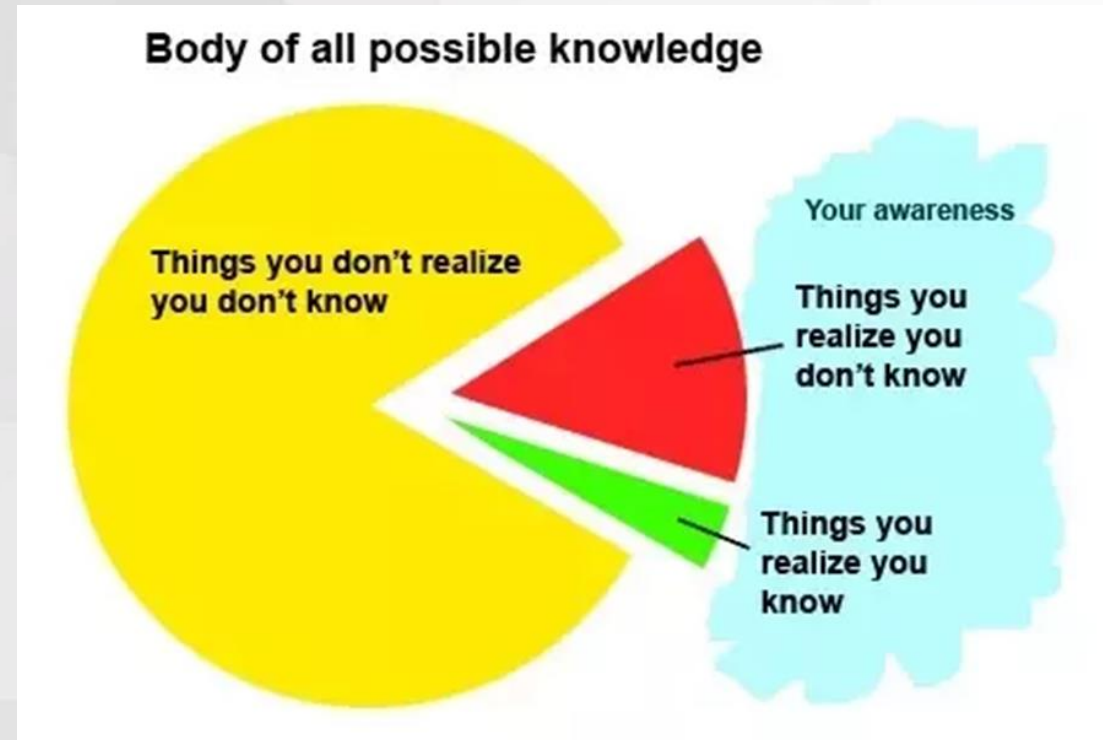
Design and Planning

- Design and Planning are the key first steps recognized as a primary line of defense for risk mitigation at mine sites
- By obtaining information early in the process and knowing about the 3D volume of space that will support your mine infrastructure for 10, 20 or 100 years ..you help to set the foundation for best practice mine planning



Site Assessment and Characterization

- Consideration of all pertinent information should happen at feasibility
- Pre - Plan Site Assessment
 - 3D data
 - Obtain accurate and reliable data within your mine plan volume (not area)



Critical information for Mine planning

- More subsurface information earlier in the process to improve overall planning

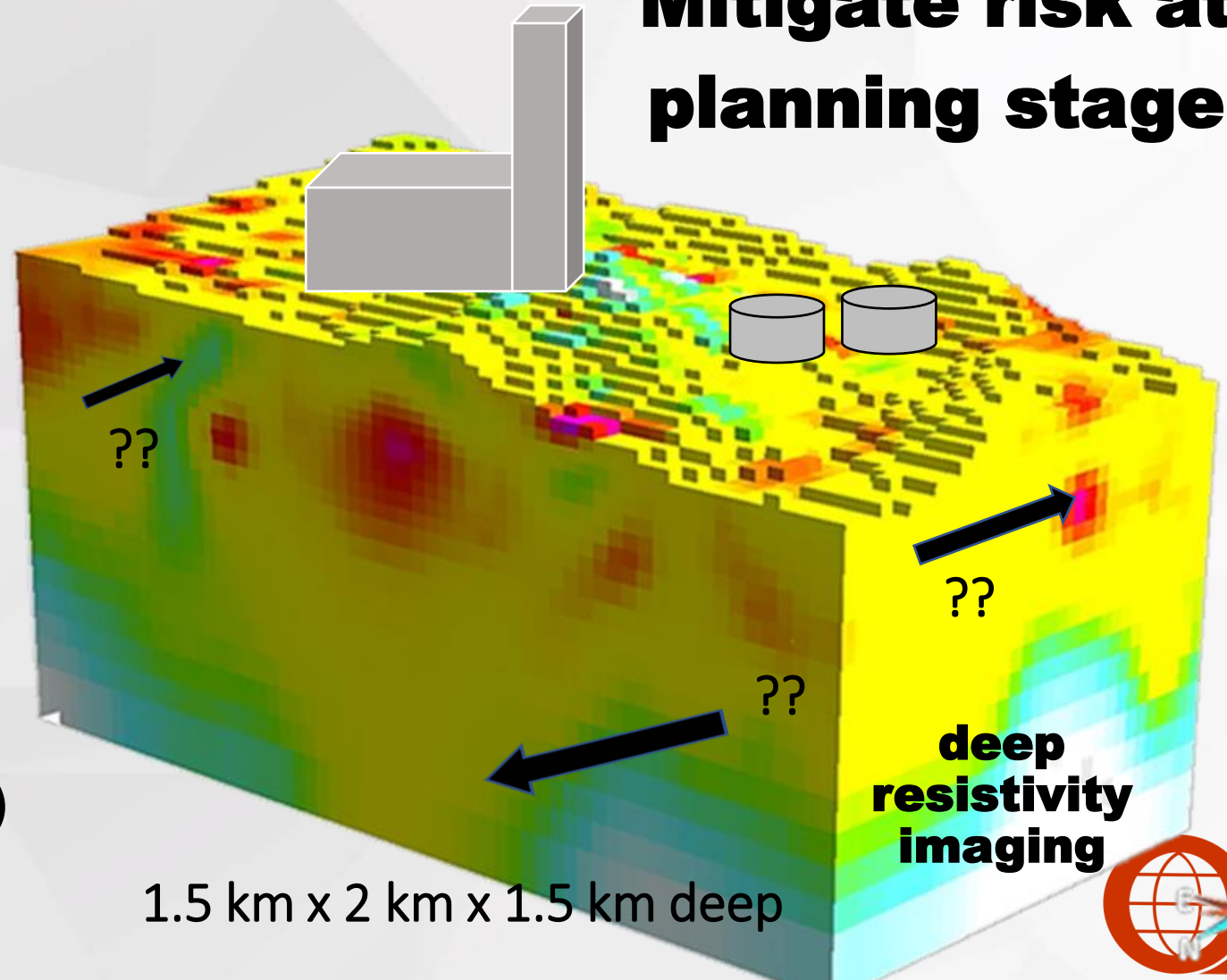


- Site assessment
 - Map deep structures and potential risks
 - Map potential water sources for use/or encroachment
- Improve drill planning for condemnation
 - Data asset for life of mine



- Additional discovery and mapping
 - Save money over life of mine
- Monitor fluid movement over time (tailings)

Mitigate risk at planning stage



1.5 km x 2 km x 1.5 km deep

deep resistivity imaging

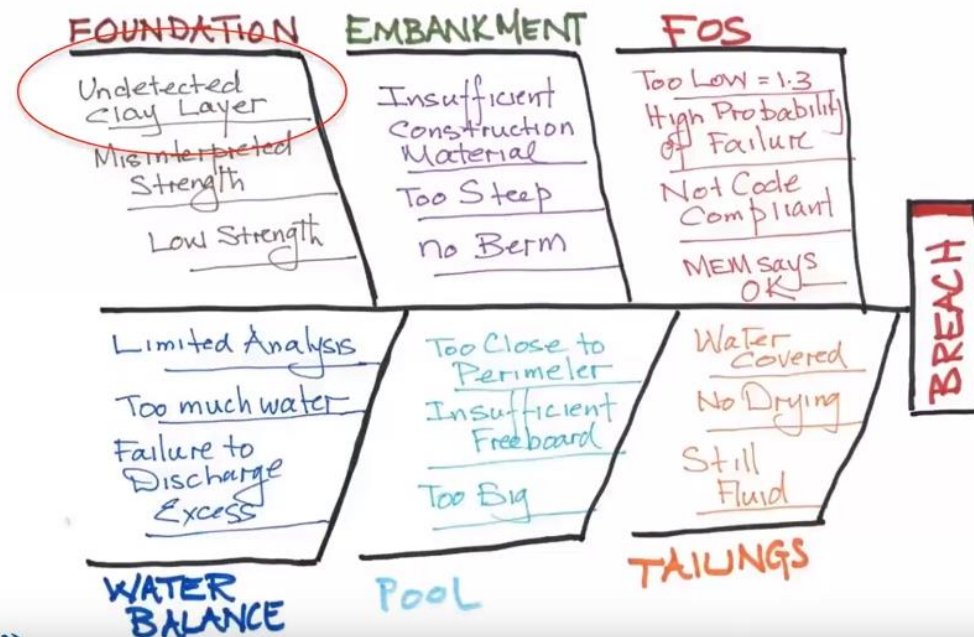


the absence of evidence .. is not evidence of absence



Source: NASA Earth Observatory Images by Jesse Allen

Recent Examples of Tailings Failures Mount Polley, BC, Canada



- From SNC Lavelin presentation, 2018 Chad Lepoudre

<https://www.youtube.com/watch?v=Lb-2w2NI6CM>

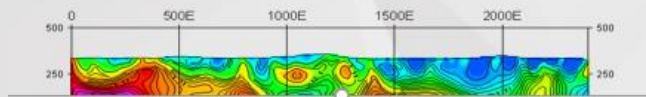


Deposit Characterization

4sq km package imaged from surface to depth

Traditional Information

- ❑ Geology
- ❑ Geochemistry
- ❑ Drilling
- ❑ Shallow geophysics

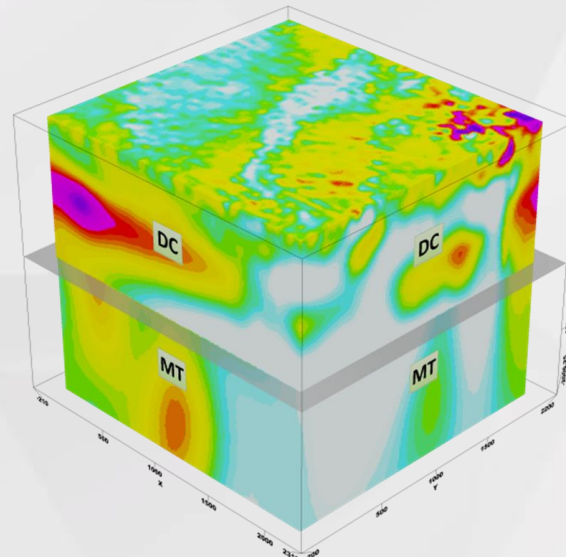


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Deposit Characterization

- ❑ Geology
- ❑ Geochemistry
- ❑ Drilling
- ❑ Deep Mine site imaging



E.g. 2 x 2 x 2 km

- ❑ Structure (faults)
- ❑ Condemnation
- ❑ Tailings planning/monitoring
- ❑ Alteration, mineralisation (delineation)
- ❑ Life of mine data asset
- ❑ Cost \$500k, time 5 weeks



ORION 3D

Mine site imaging applications

APPLICATIONS INCLUDE MINE PLANNING TO EXPLORATION:

- Pre - tailings pond planning for risk mitigation
- Condemnation surveys for mine planning
- Additional Hydrogeology information
- Delineation surveys at the discovery stage – to focus drilling and obtain resource and subsurface information sooner – applications – before feasibility
- Near mine exploration surveys to identify new resources earlier and extend mine life
- Data asset for life of mine - monitor changes over time (**4D**)



Mine sites are challenging environments

- Haul Roads
- Cultural Noise
- Power Lines
- Active Pits

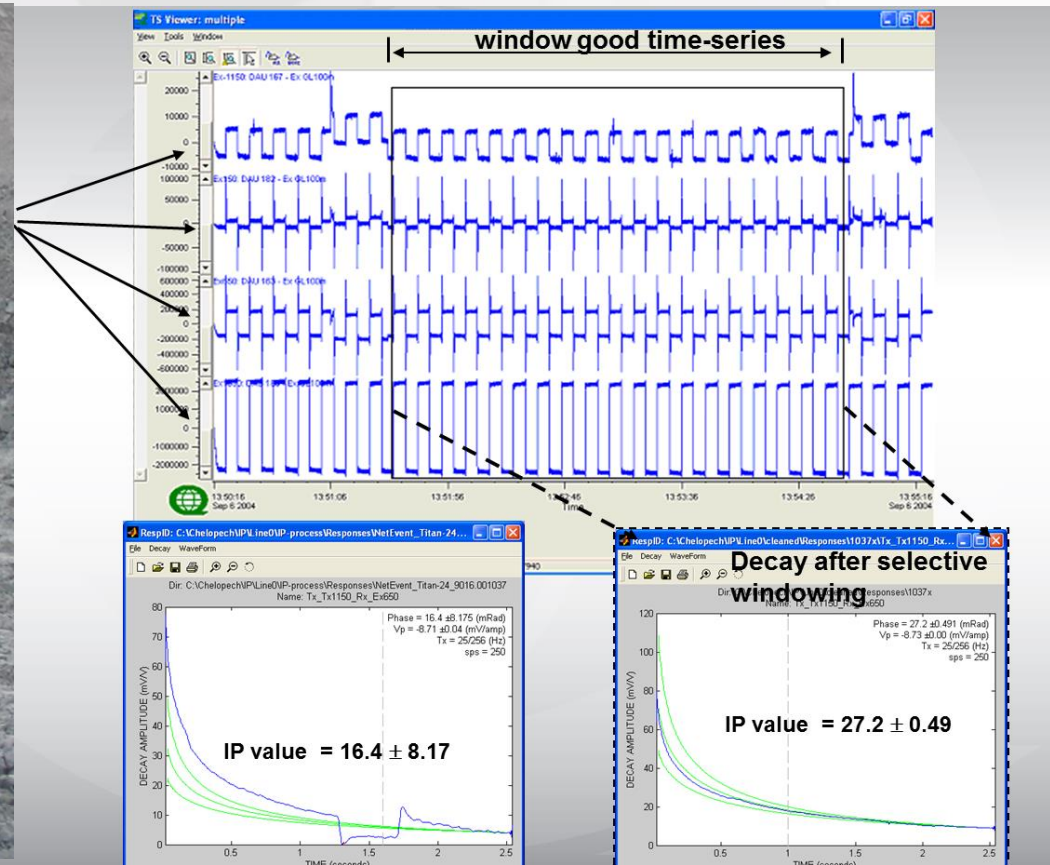


Quantec has experience (20 years) with mine site surveying and is experienced working with mine operators and issues such as; scheduling, access, Health and Safety



TITAN

High volume time series distributed data



- E.g. active mine deployment of temporary data receiver network
- (4-10 hrs)
- Allows windowing: needed to minimize cultural noise to obtain accurate responses
- Small signal monitoring and noise rejection

Experience at over 60 minesites

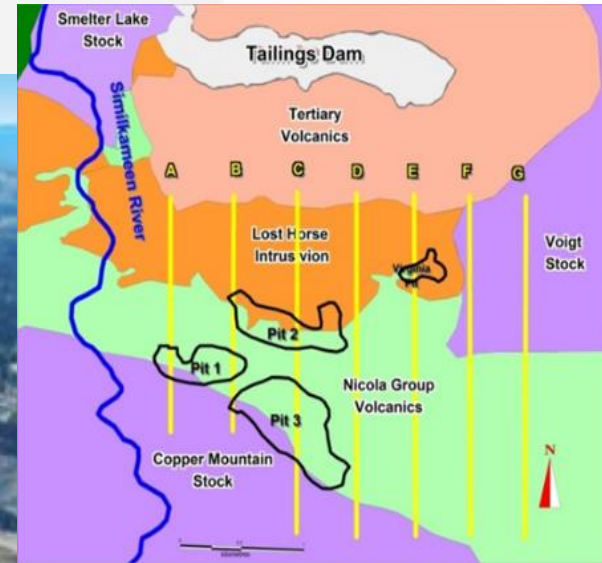
Some of our mine site exploration clients...

- Bolivar, Yauricocha – Sierra Metals
- Cerro Lindo – Nexa (Milpo)
- Charcas, El Pilar – Campo Medio Grupo Mexico
- Copper Mountain – Copper Mountain
- Gold Strike, Pueblo Viejo – Barrick
- Black Fox – Apollo (McEwen)
- Lac de Isles – North American Palladium
- Red Chris – Imperial Metals
- Chelopech – Dundee Precious Metals
- Venetia Pit – De Beers
- Kidd Creek – Falconbridge
- Kemess – Northgate (Alamos)
- Cerro Corona, Goldfields
- Inmaculada, Arcata y Pallancata, Hochschild Mining
- Raglan
- Ren
- Red Lake Gold Mine
- Geikle
- Voisey's Bay
- Levack
- San Nicolas
- Black Fox Gold Mine
- Fortitude
- Chelopech
- Borroo
- Red Chris
- Tenke Fungurume
- Tati Nickel

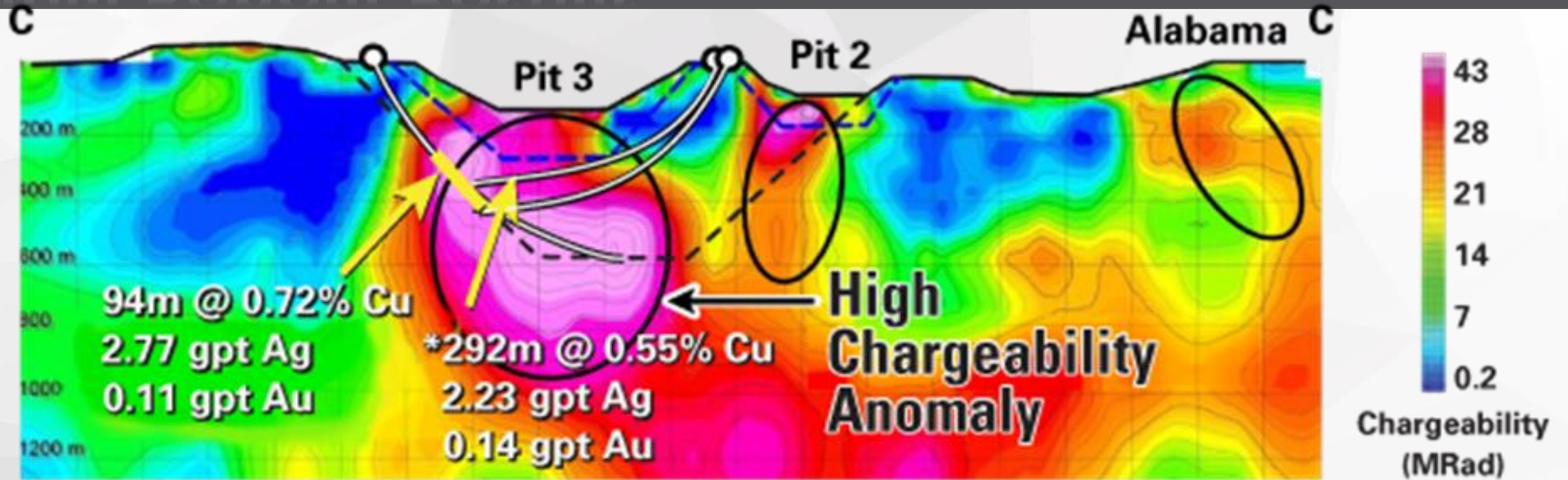


Case Study - Copper Mountain, Canada – minesite investigations

- To confirm continuity of mineralization between the pits.
- To identify the potential for large, deep-seated porphyry deposits through a comprehensive mine site exploration program.



Multi Benefit Results



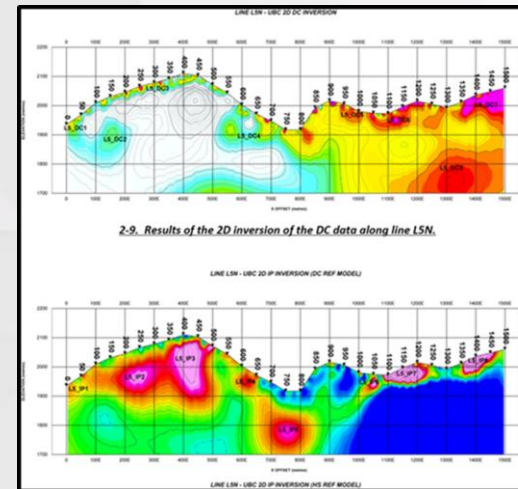
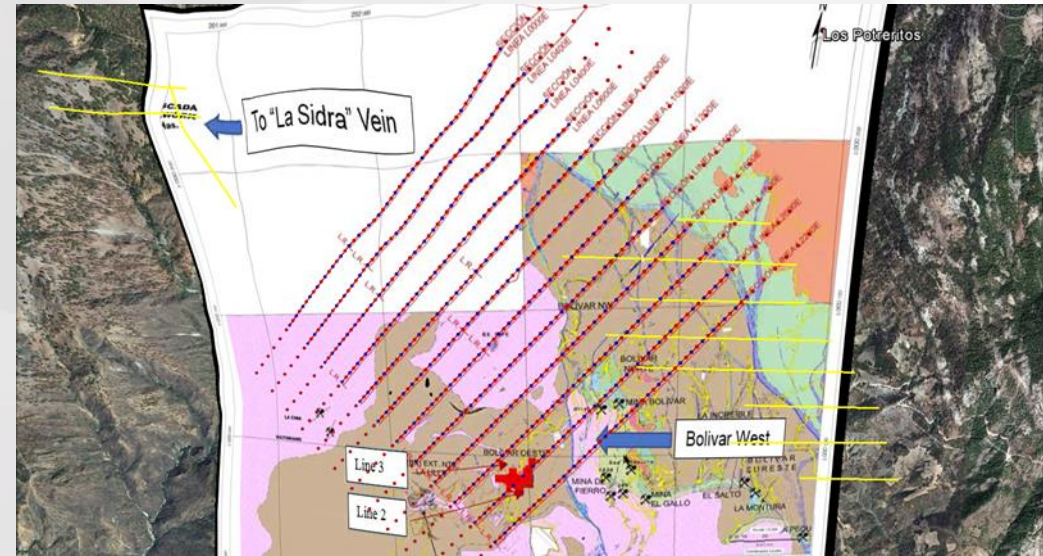
- Savings on condemnation drilling 140k
- Savings on ABA drilling 100k
- Savings on permitting time – 2 months
- Discovery of New mineralization
- Pit design changed
- Mine life extension – 25 years
- (cost of survey 300k)



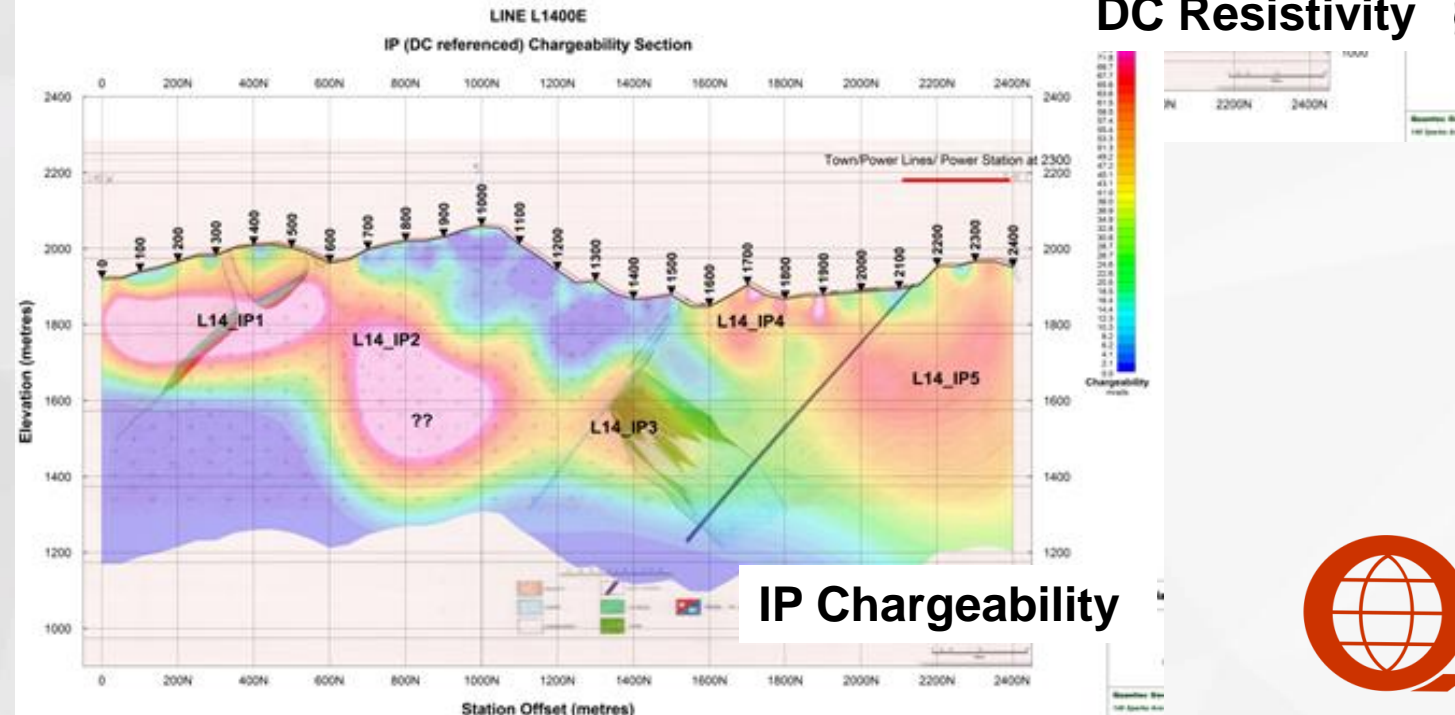
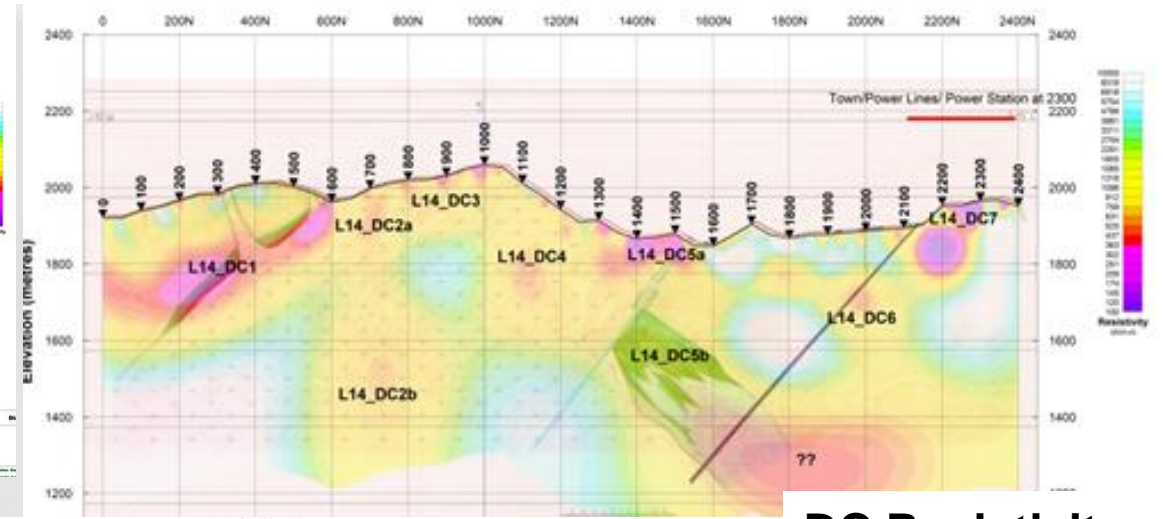
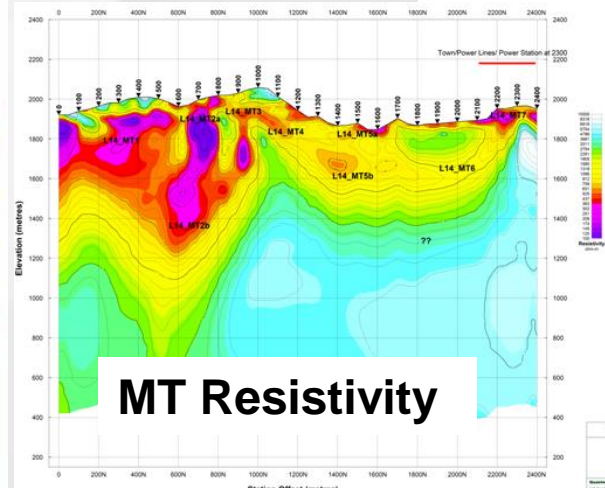
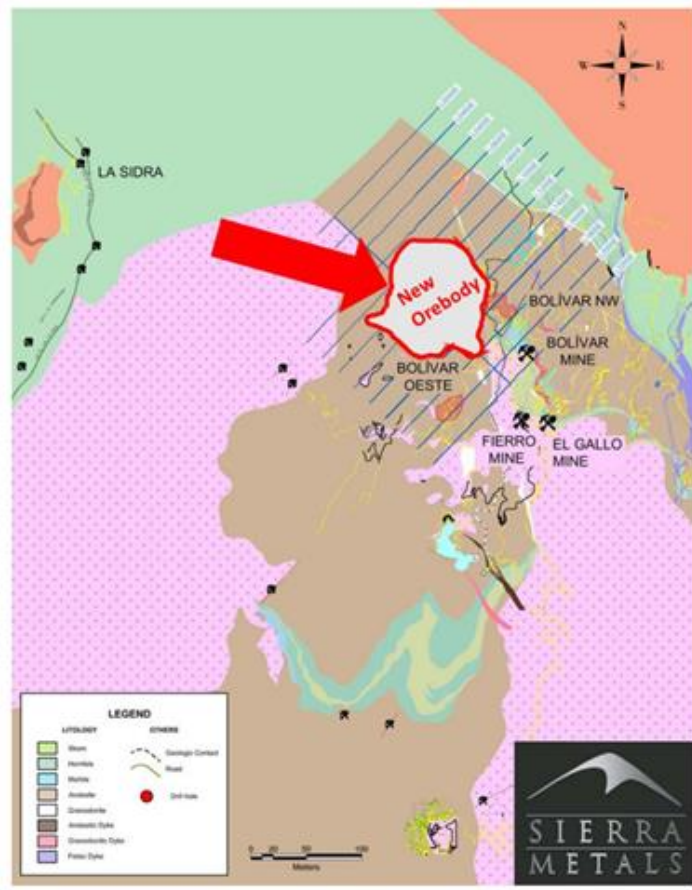
Case Study Bolivar Mine Project , Mexico

Survey planned for..

- Use TITAN 24 DC/IP & MT to help delineate the Bolivar deposit for drill targeting.
- Map and delineate near-surface zones associated with skarn mineralization.
- Map and delineate deep-seated alteration zones that could control or host mineralization.
- Focus drilling.
- Mine planning.



2017 Bolivar North-west . Lines 1400



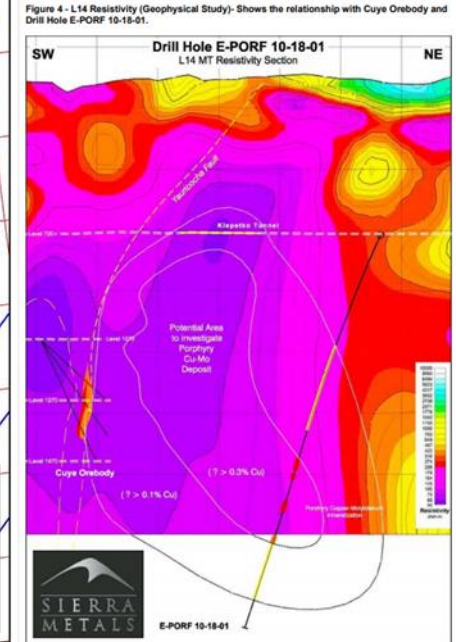
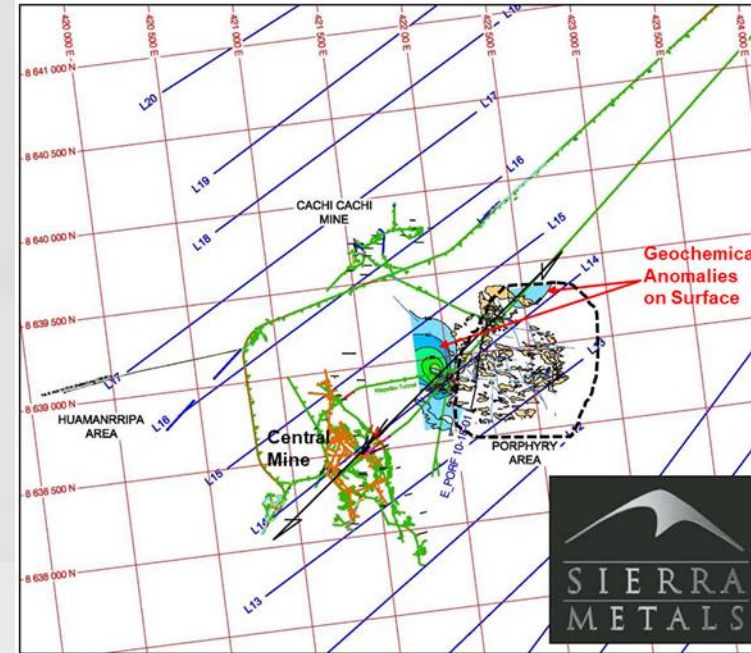
New Orebody Discovered .. SIERRA METALS CONFIRMS NORTHERN EXTENSION OF THE BOLIVAR NORTHWEST OREBODY CONTAINING AN AVERAGE GRADE OF 1.37% COPPER AND AN AVERAGE TRUE WIDTH OF 8.1 METERS AT THE BOLIVAR MINE, MEXICO (Press from 2018).



Case Study 2018 – Yauricocha Mine, Peru – near mine exploration

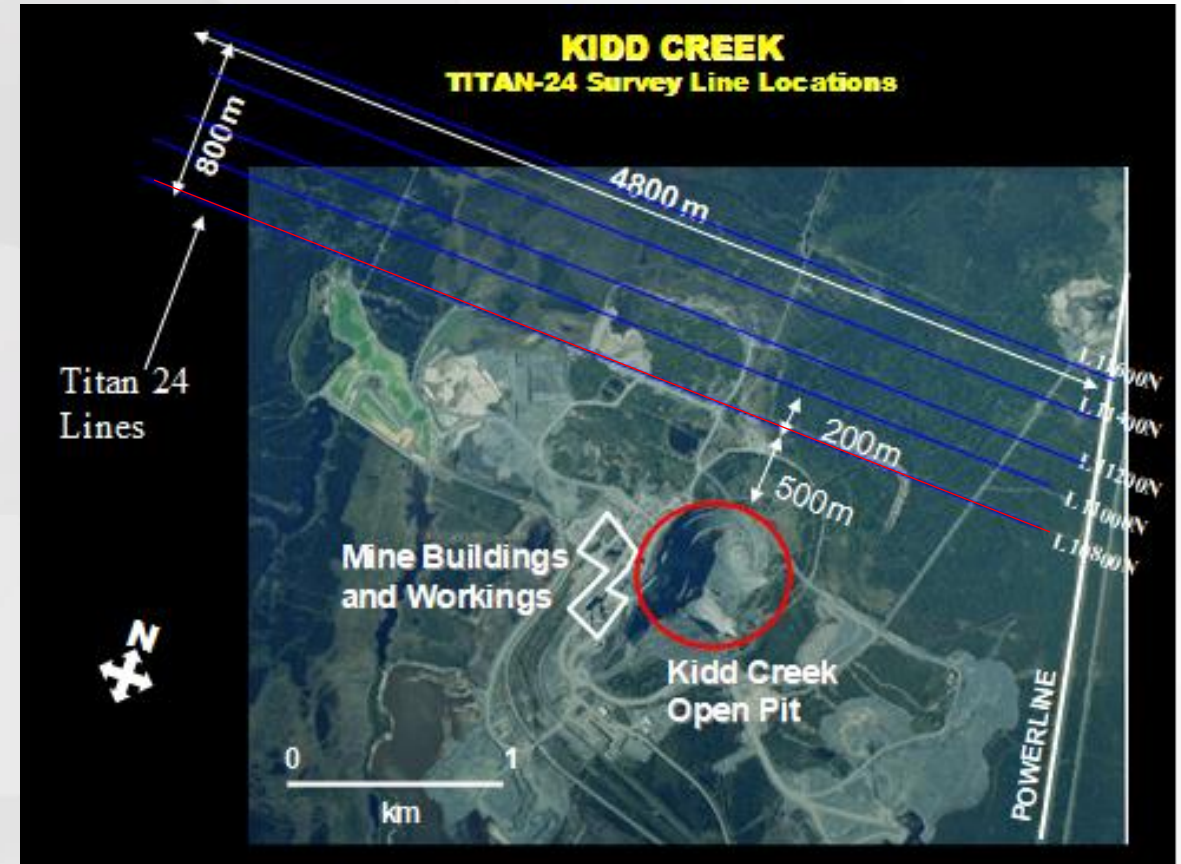
- MT resistivity was used to target areas 700m below the current workings at depths greater than 1000m. A new porphyry was discovered, associated with large deep conductive zones identified by the survey.

The discovery comes as part of an ongoing drilling program to test priority geophysical anomalies at the Yauricocha Mine.



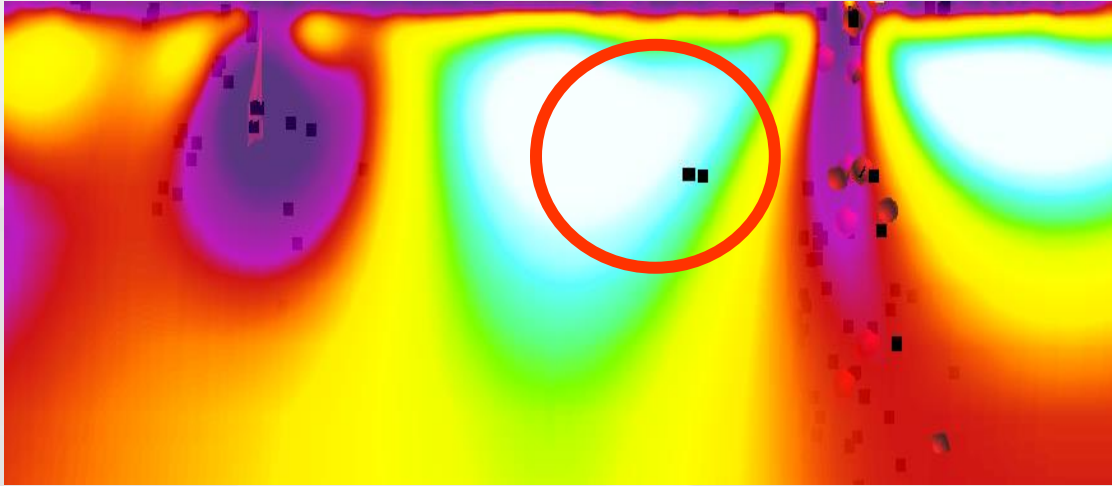
Case Study - KIDD Creek Mine - investigations

- The TITAN 24 deep imaging system was deployed over an area of 5 km by 1 km only 500m from the pit at the top of the mine. The approach and system were successfully demonstrated as a significant exploration tool for near mine application.
- Significant savings could have been realized if the images were available over the life of mine

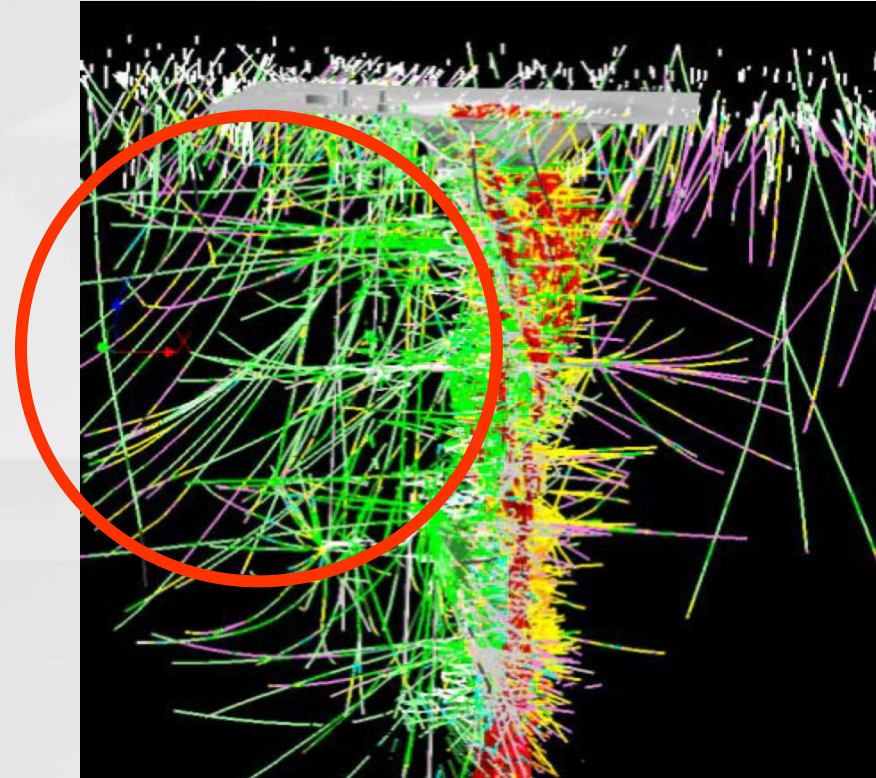


Life of mine data asset

- Resistivity image near mine indicates no conductive material in circle (i.e. minor drill testing required in this area)



- 15 years of drilling shown in model
- Potential drill savings over life of mine estimated to be > 15 Million dollars



Cost Savings and benefits over the life of mine

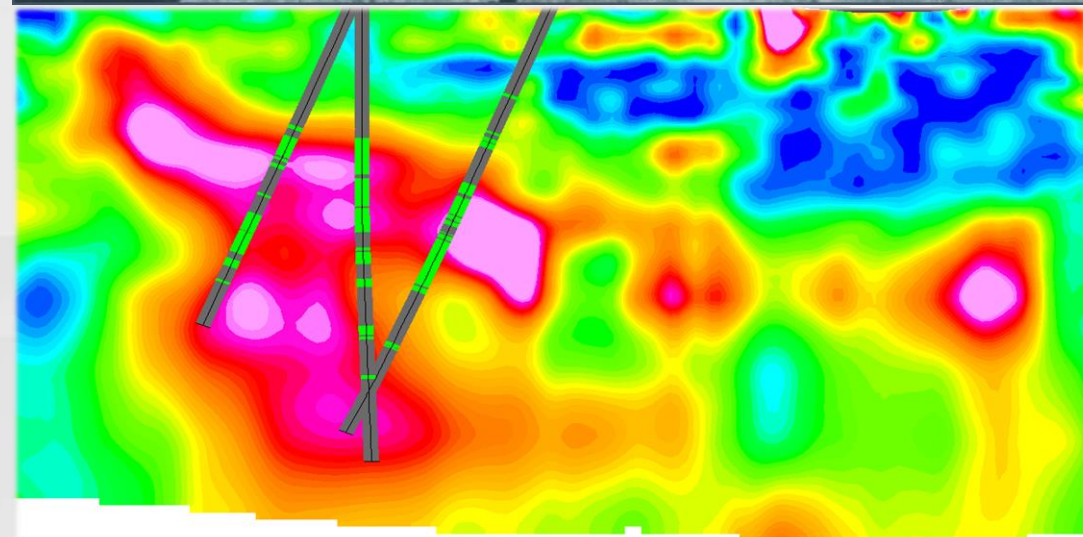
- More subsurface information earlier in the process

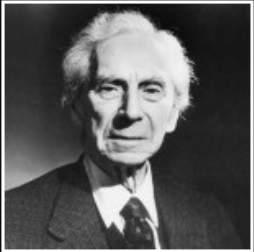


- Improve overall design and planning process



- Help mitigate risk

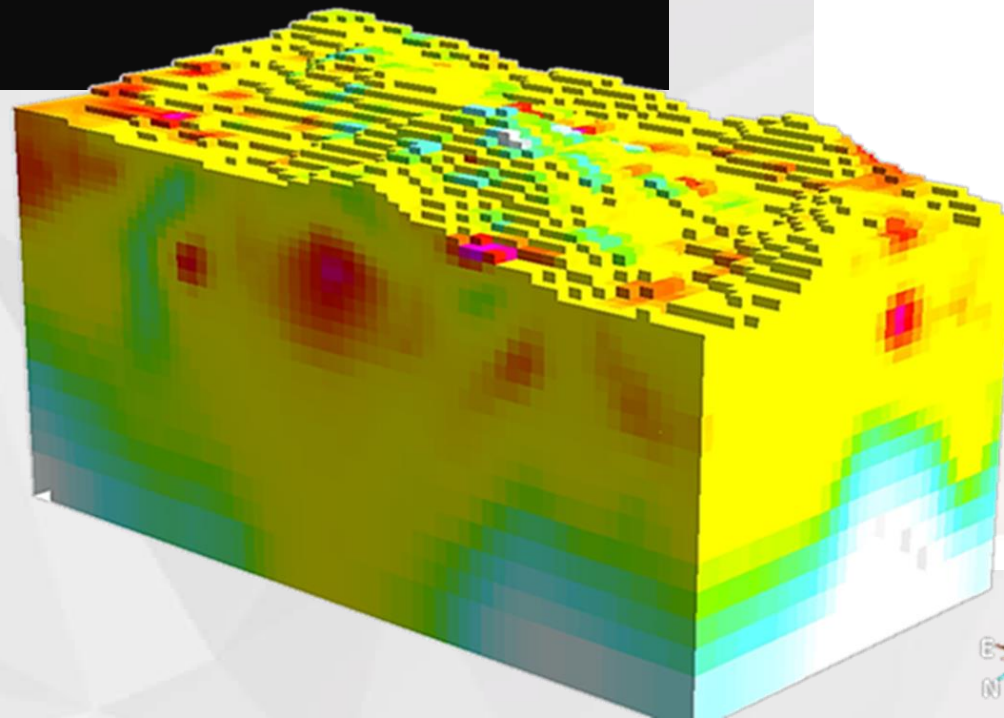




author

Science is what you know, philosophy
is what you don't know.

-Bertrand Russell



**TRUE WISDOM IS
KNOWING WHAT YOU
DON'T KNOW**

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