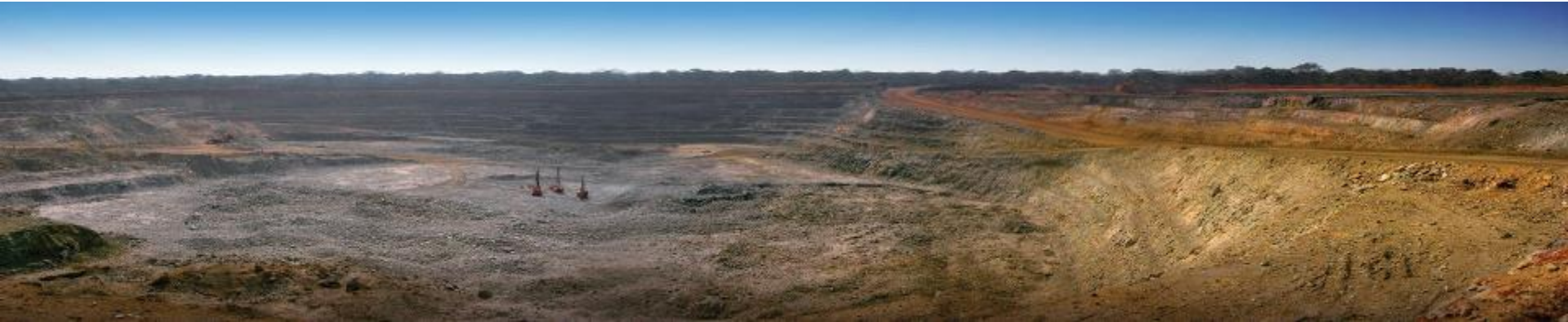




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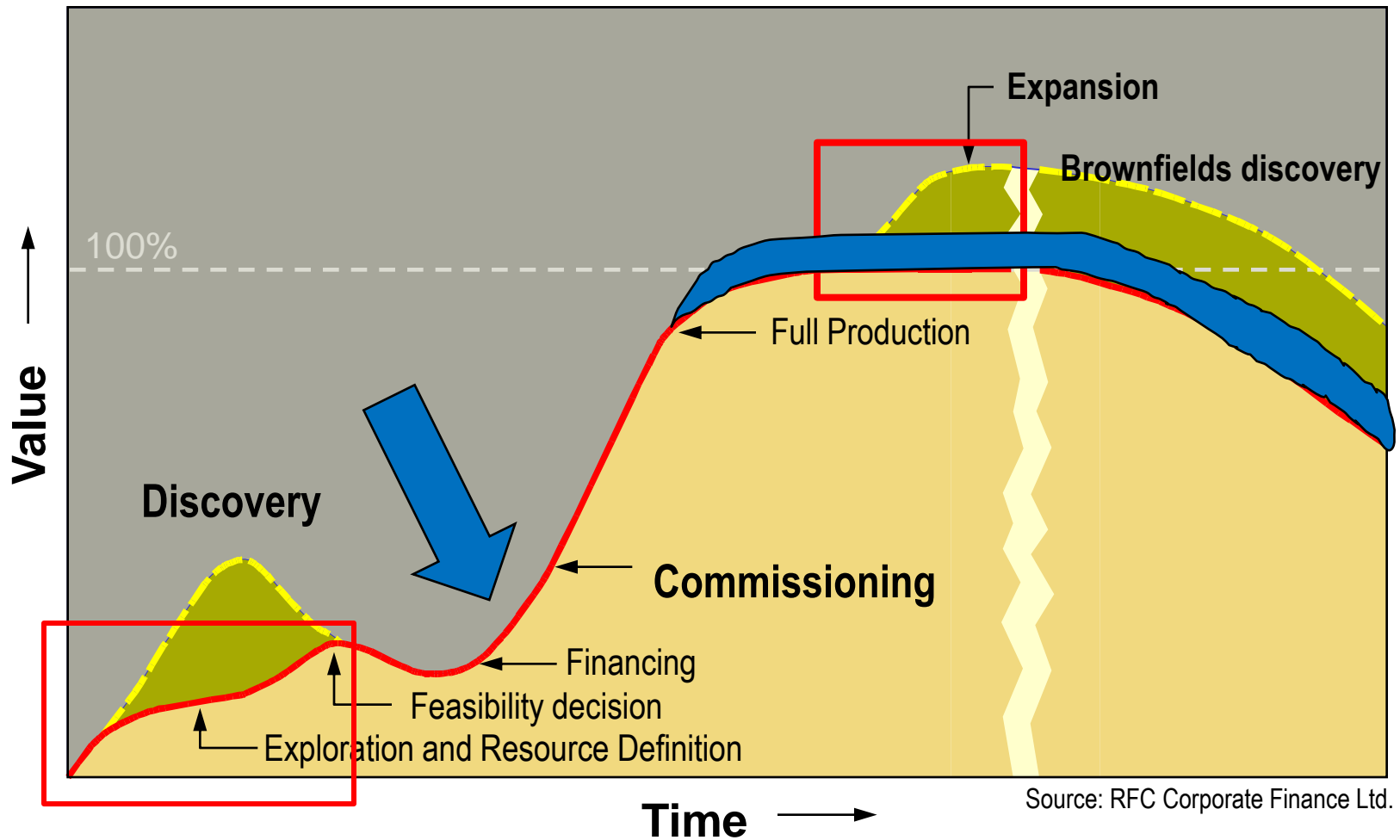
Pit-scale geological modelling with magnetic and EM inversions

Chris Wijns

Group Geophysicist, First Quantum Minerals Ltd

Perth, 2 September 2014

Where is geophysics adding value?

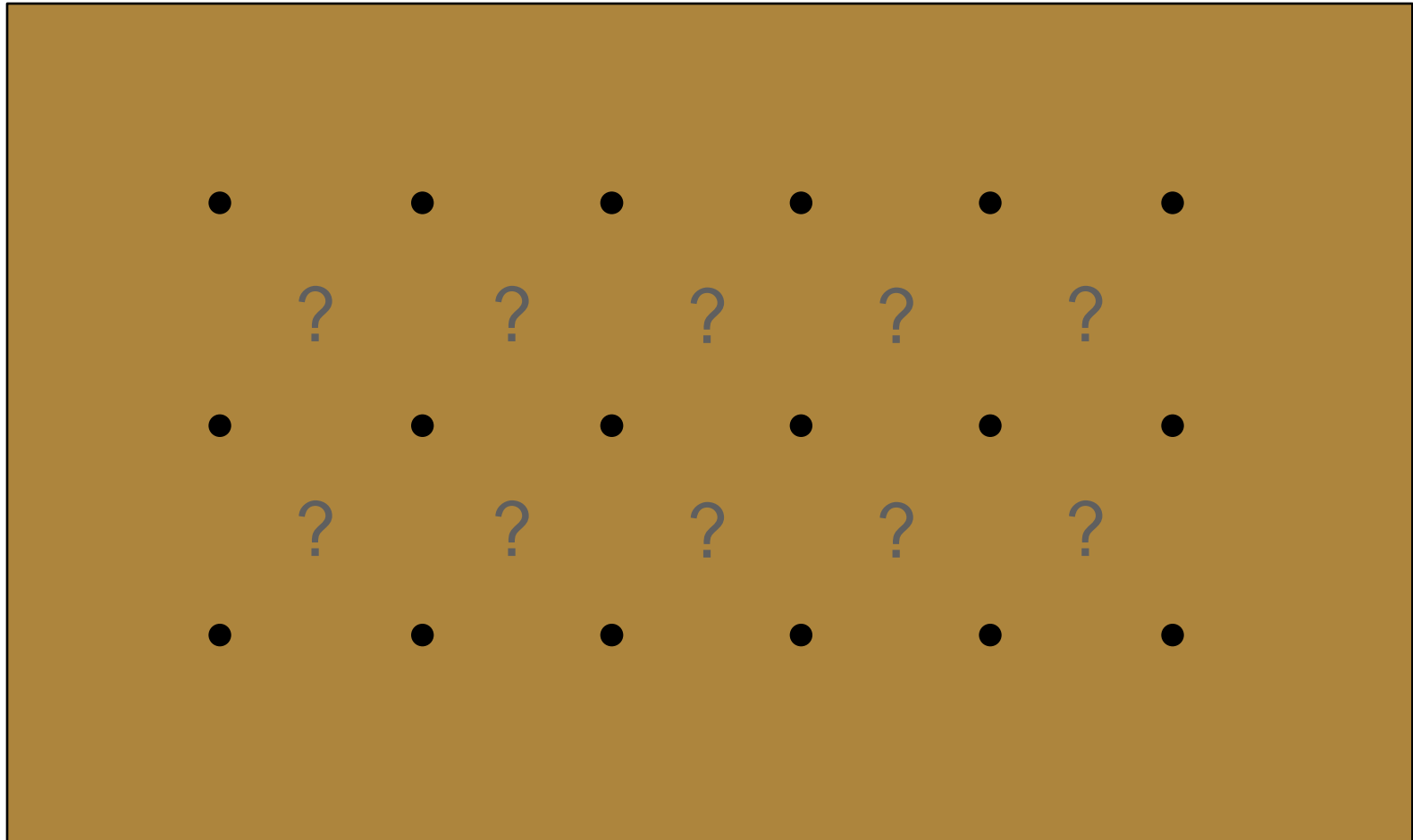


Outline

- How to use geophysics
- Magnetics and AEM at Cobre Panama
 - saprolite depth mapping
 - alteration mapping
- Conclusions



How to use geophysics to reduce uncertainty?



How to use geophysics to reduce uncertainty?

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Geophysics is never wrong

• • • • • •



How to use geophysics to reduce uncertainty?

- Interpolation tool to reduce uncertainty between drillholes
- Provides information (from surface, from downhole) that can be used to do a better job of connecting the dots (assays, lithology, density, RQD)
- Caveat: the geophysical data need to represent the rock volume of interest
 - Careful filtering may be required to remove unwanted signal



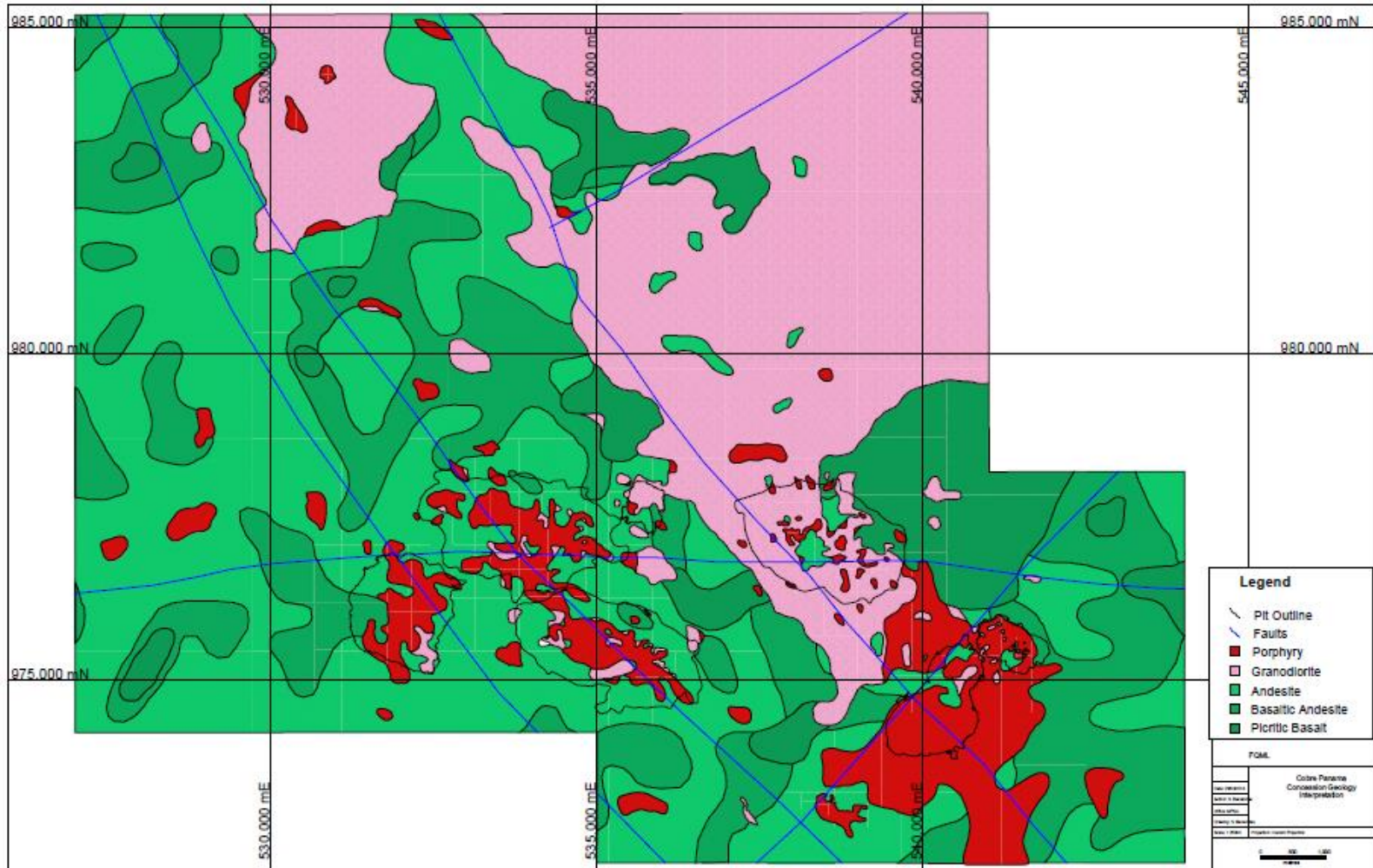
Project location - Panama



Project location - Panama

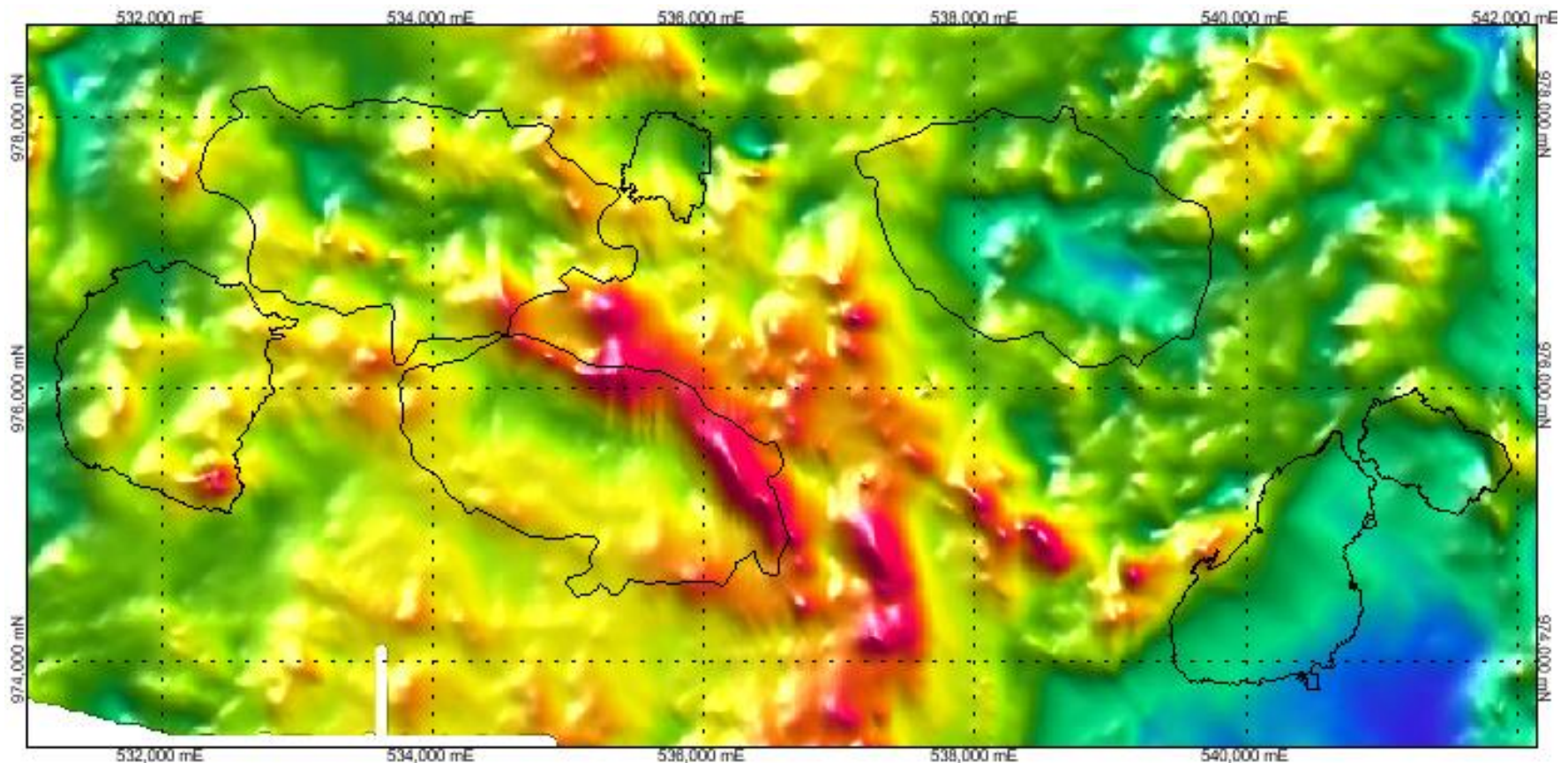


Tenement geology



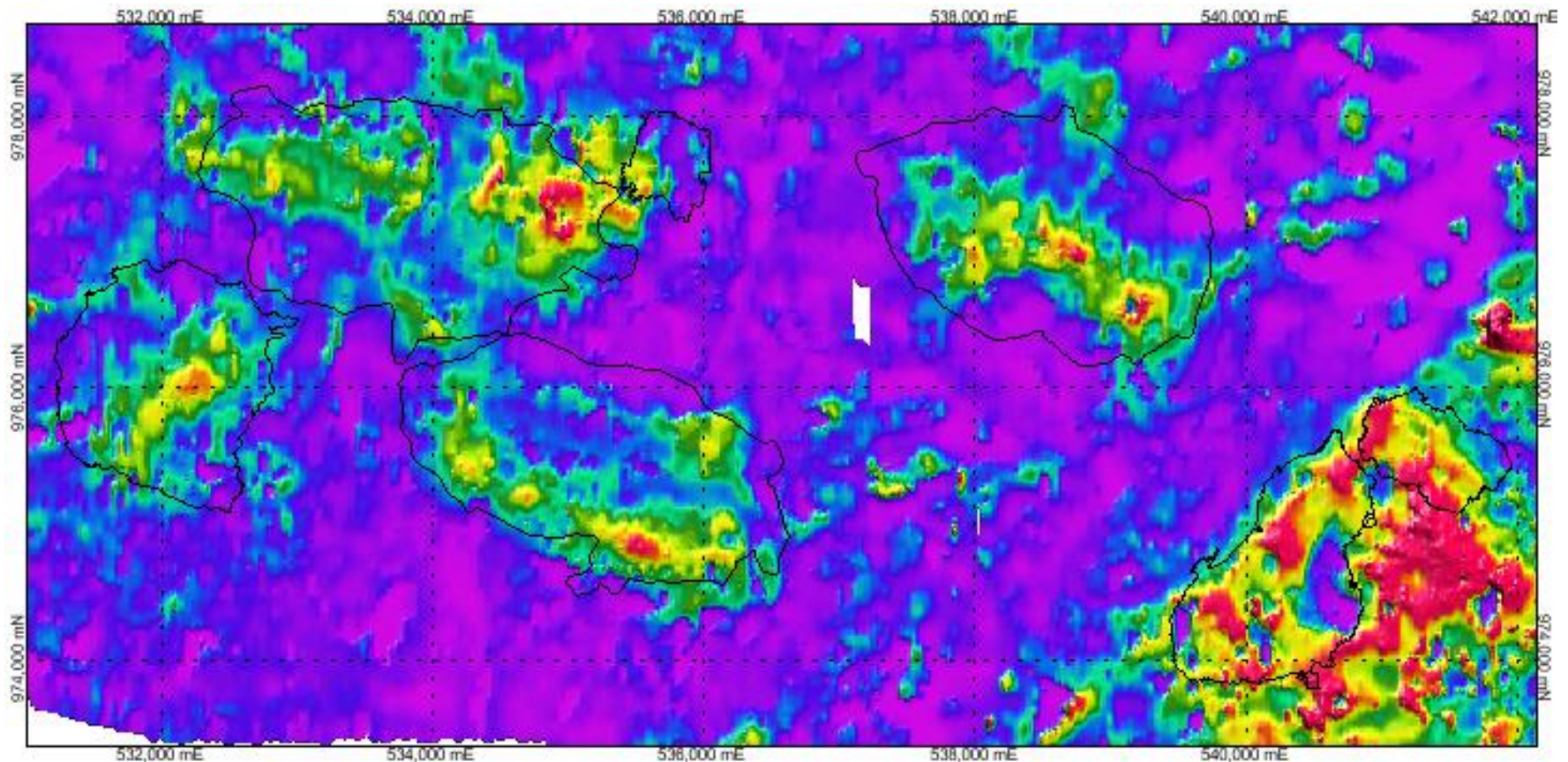
Alteration effects

- RTP magnetics illustrates demagnetised clay alteration zone over each deposit



Alteration effects

- Conductivity depth slice at -50 m illustrates clay (sericite) alteration over each deposit

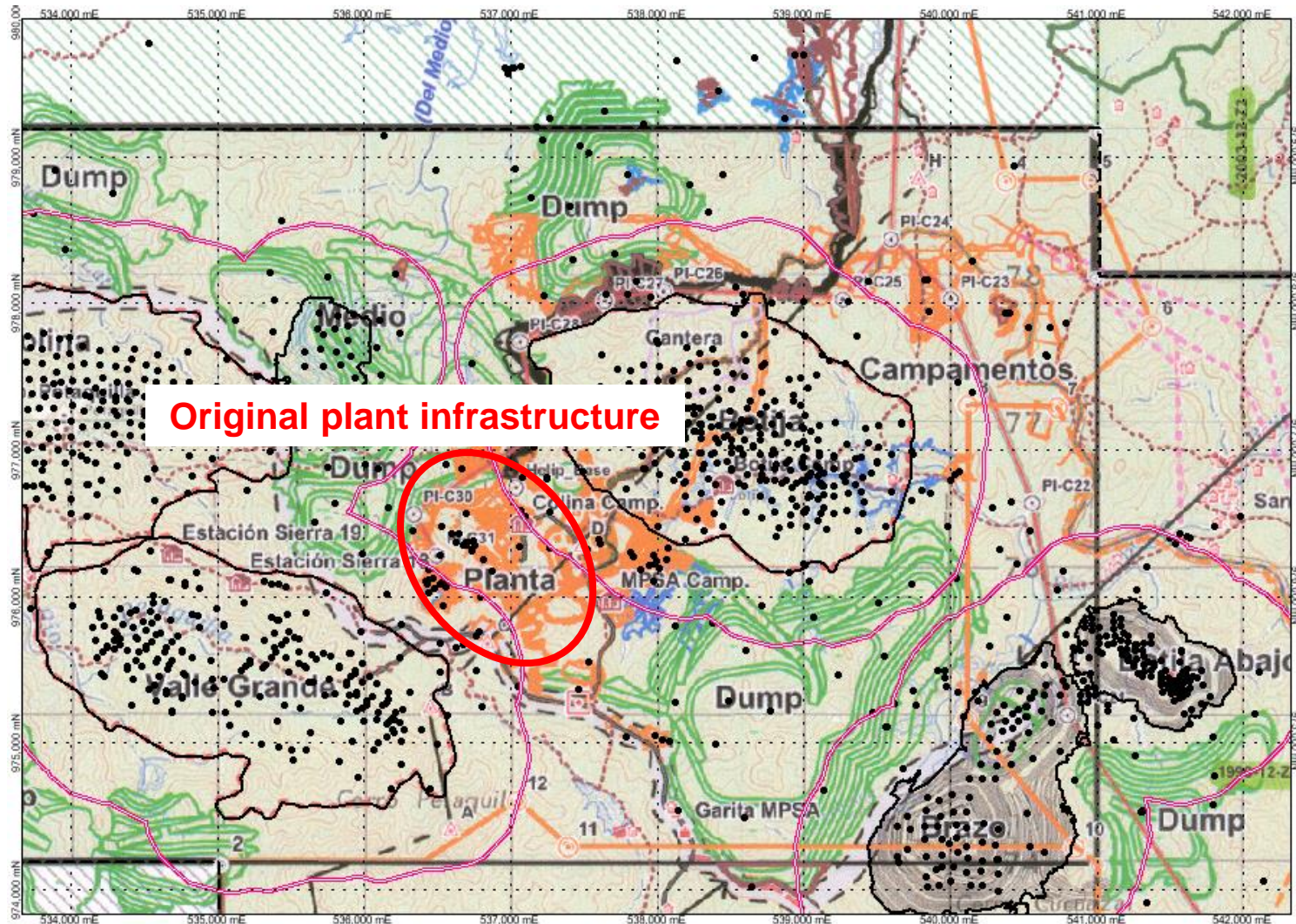


Saprolite depth

- Two issues
 - Siting mine infrastructure on shallow bedrock
 - Modelling pre-strip mining volumes
- Drill hole coverage is insufficient over entire pit area for complete saprolite model

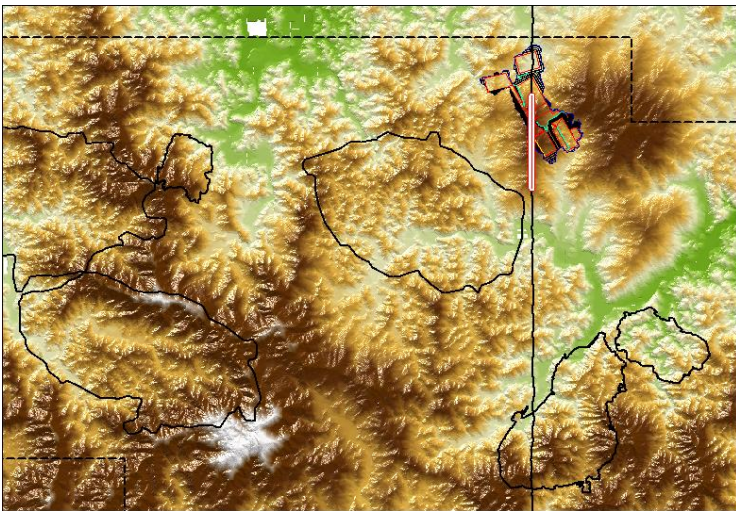
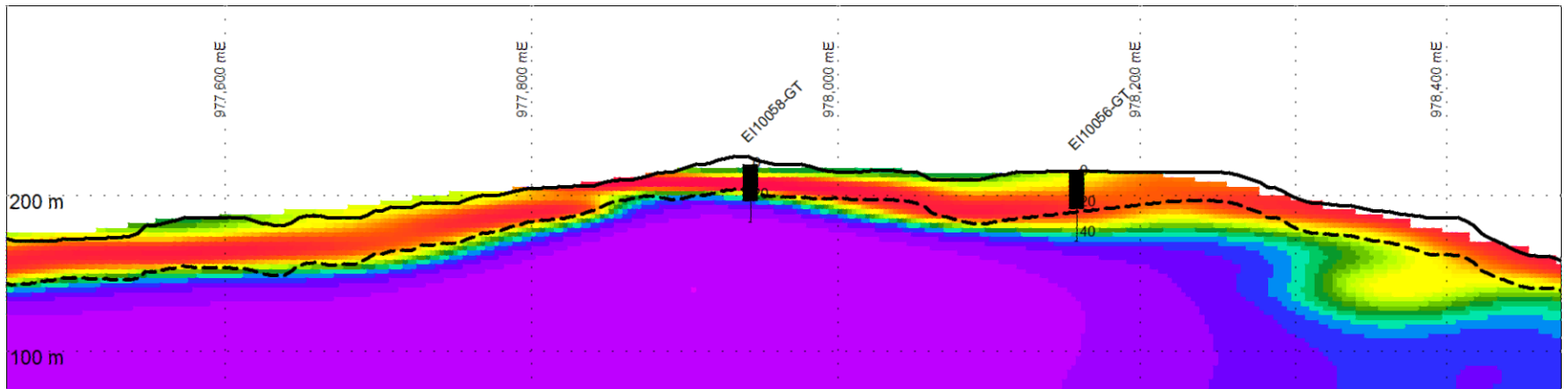


Cobre Panama mine infrastructure

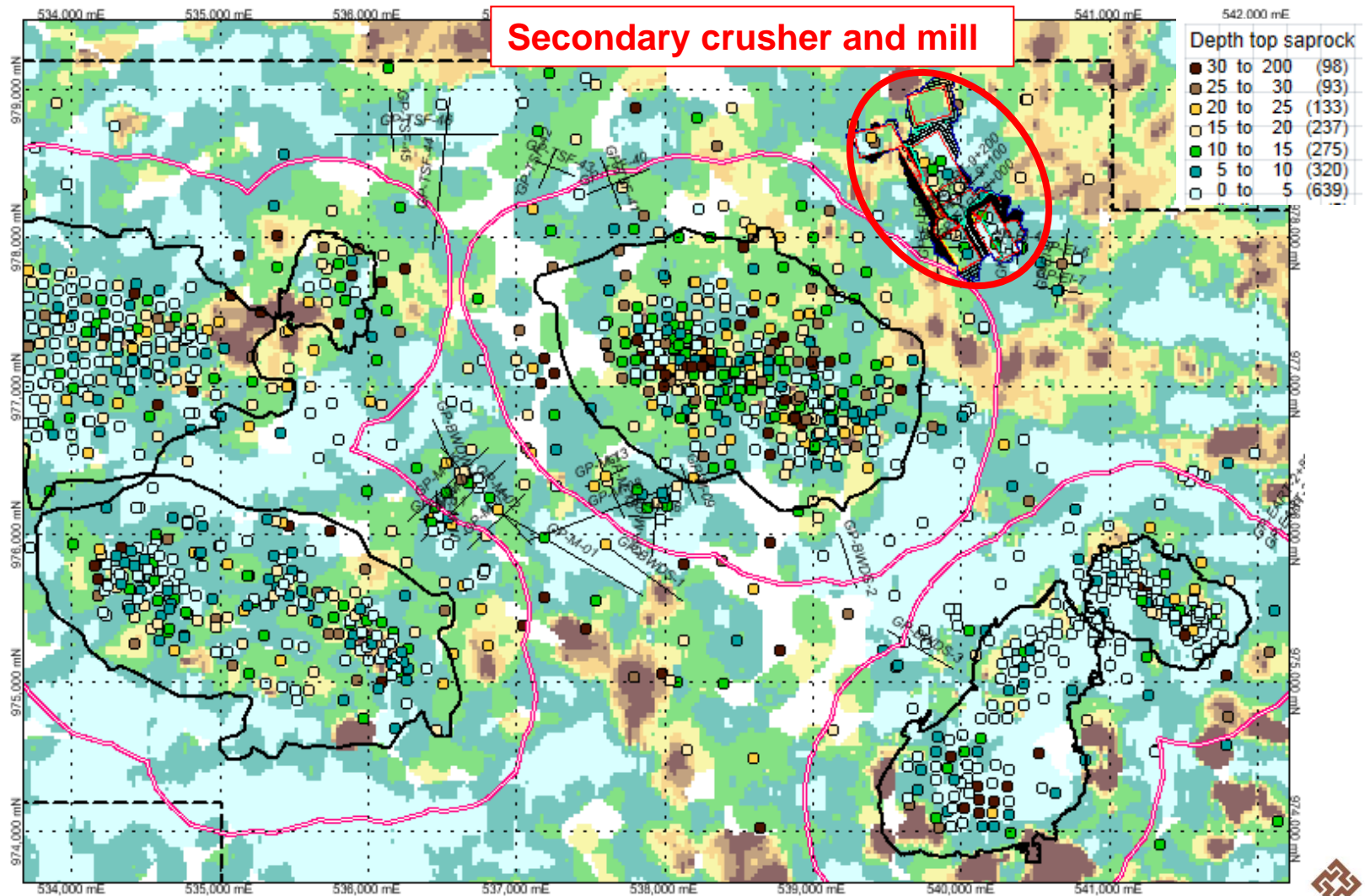


EM-derived depth of saprolite

- Calibrated against drill holes

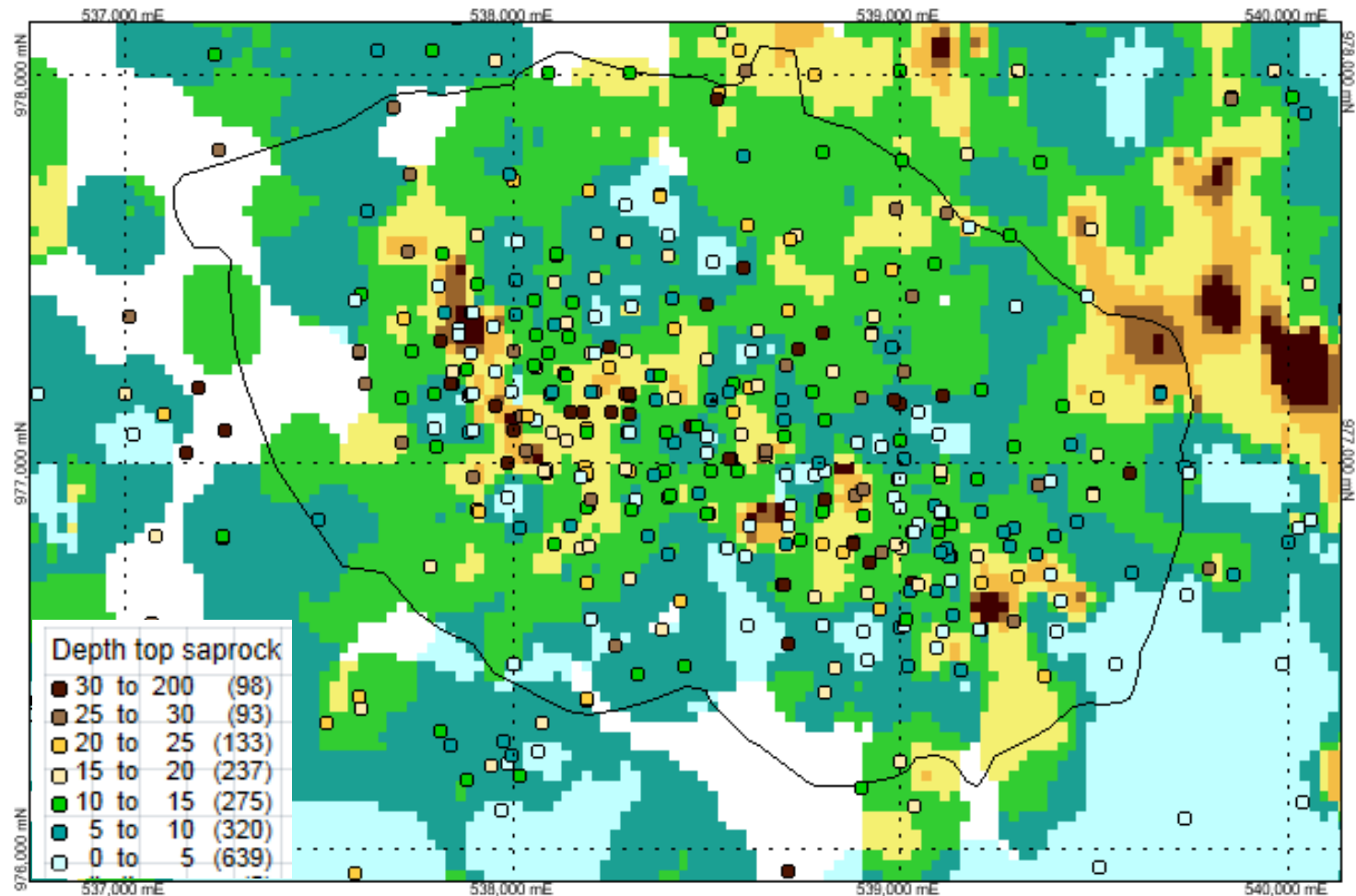


EM-derived depth of saprolite



Saprolite depth

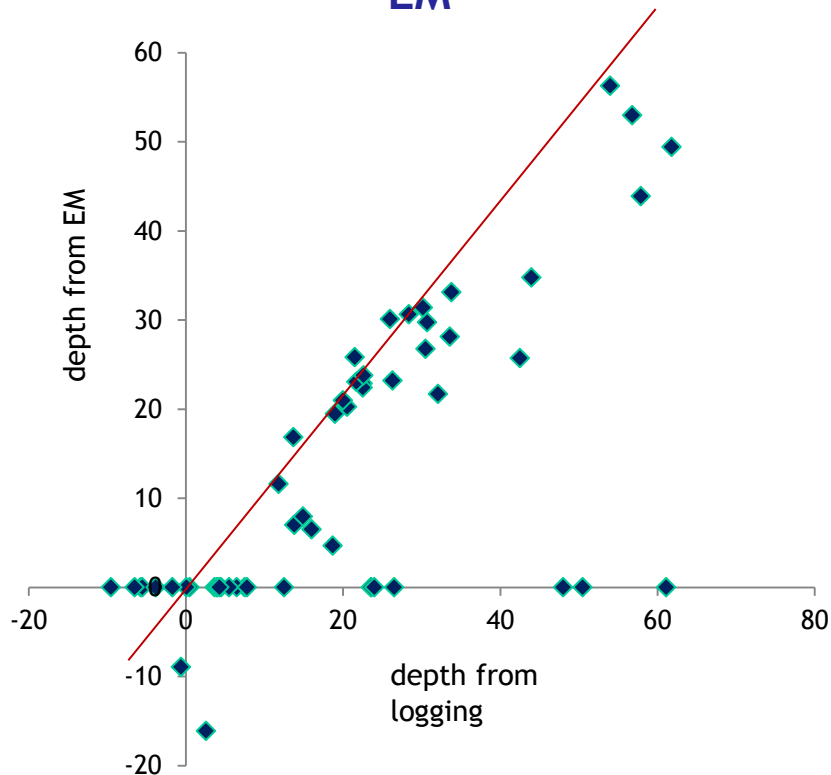
- Variable depth of pre-strip



“Truth” test

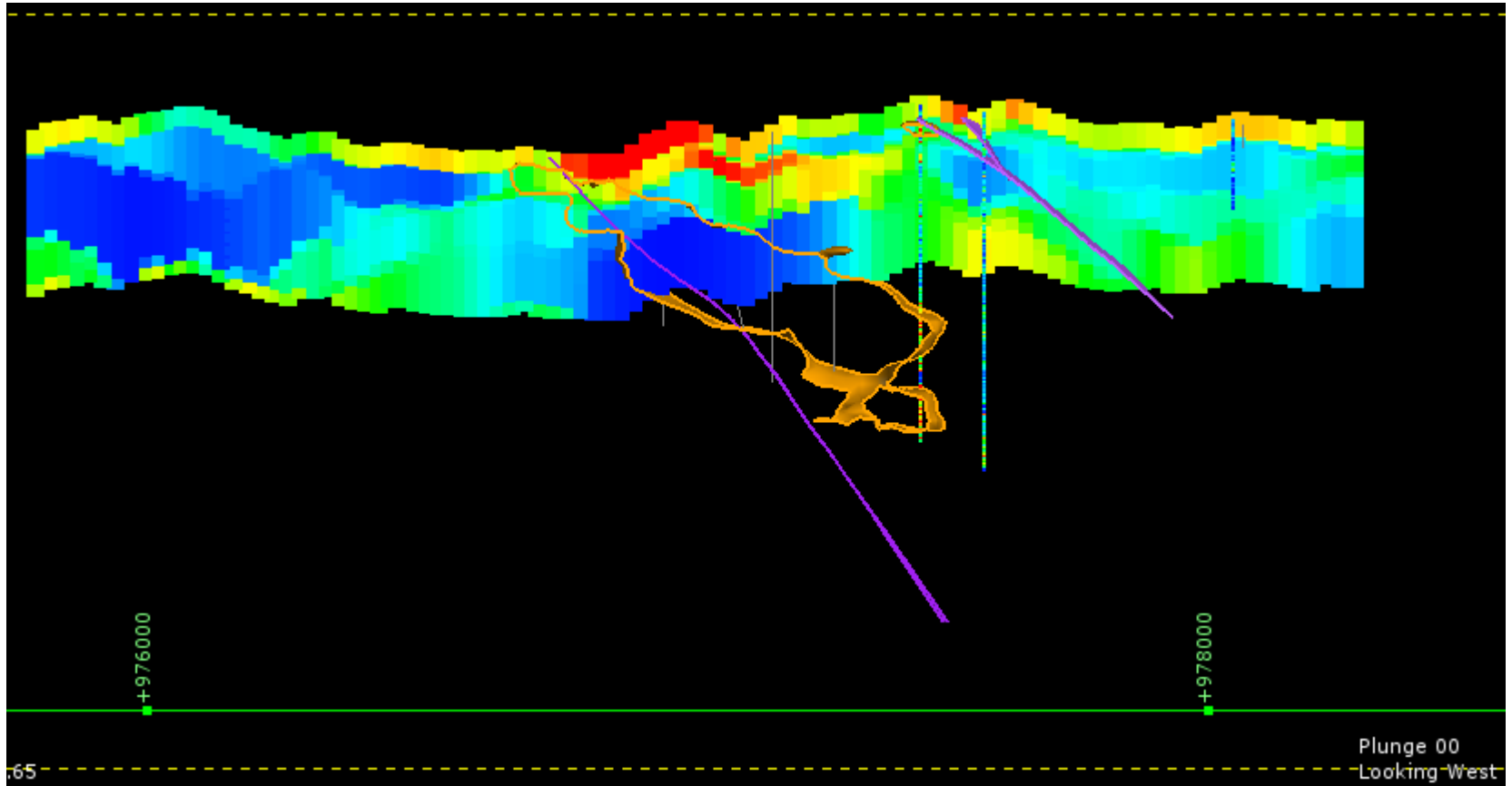
- Comparison of visual logging to EM depth
 - think about volume of mining blocks

Saprock depth from logging vs
EM



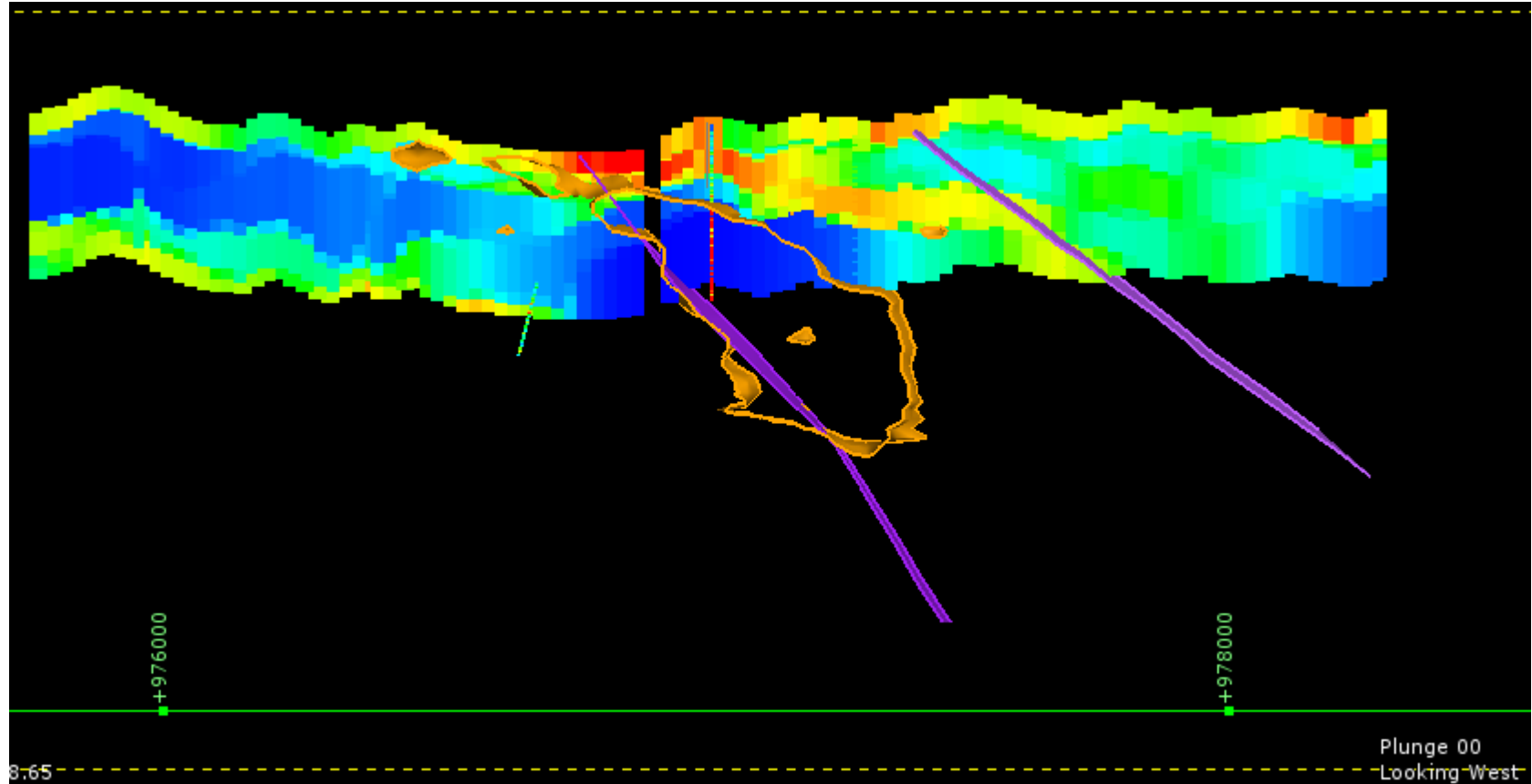
EM maps sericite alteration above ore

- Higher conductivity alteration domain



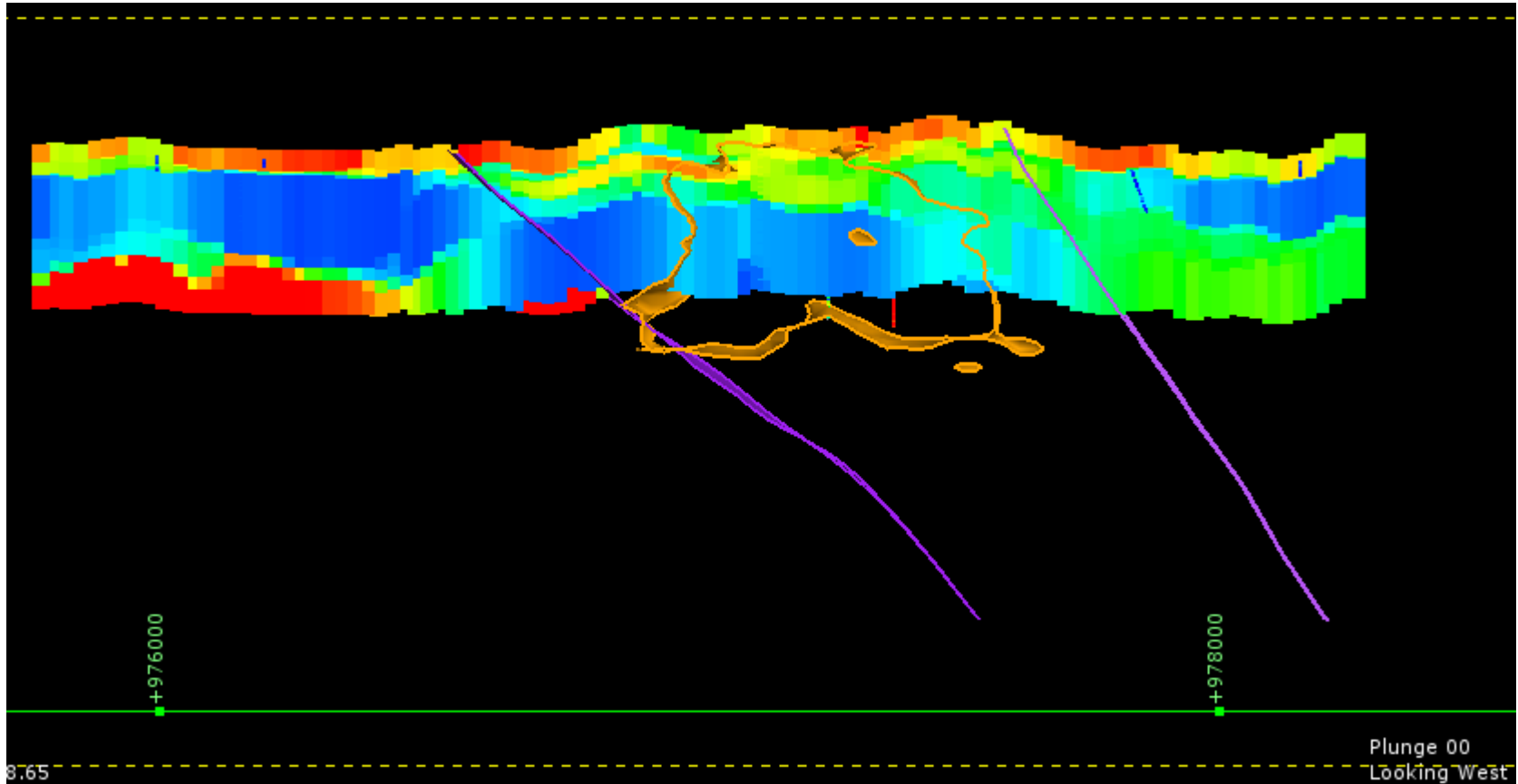
EM maps sericite alteration above ore

- Higher conductivity does not represent sulphides

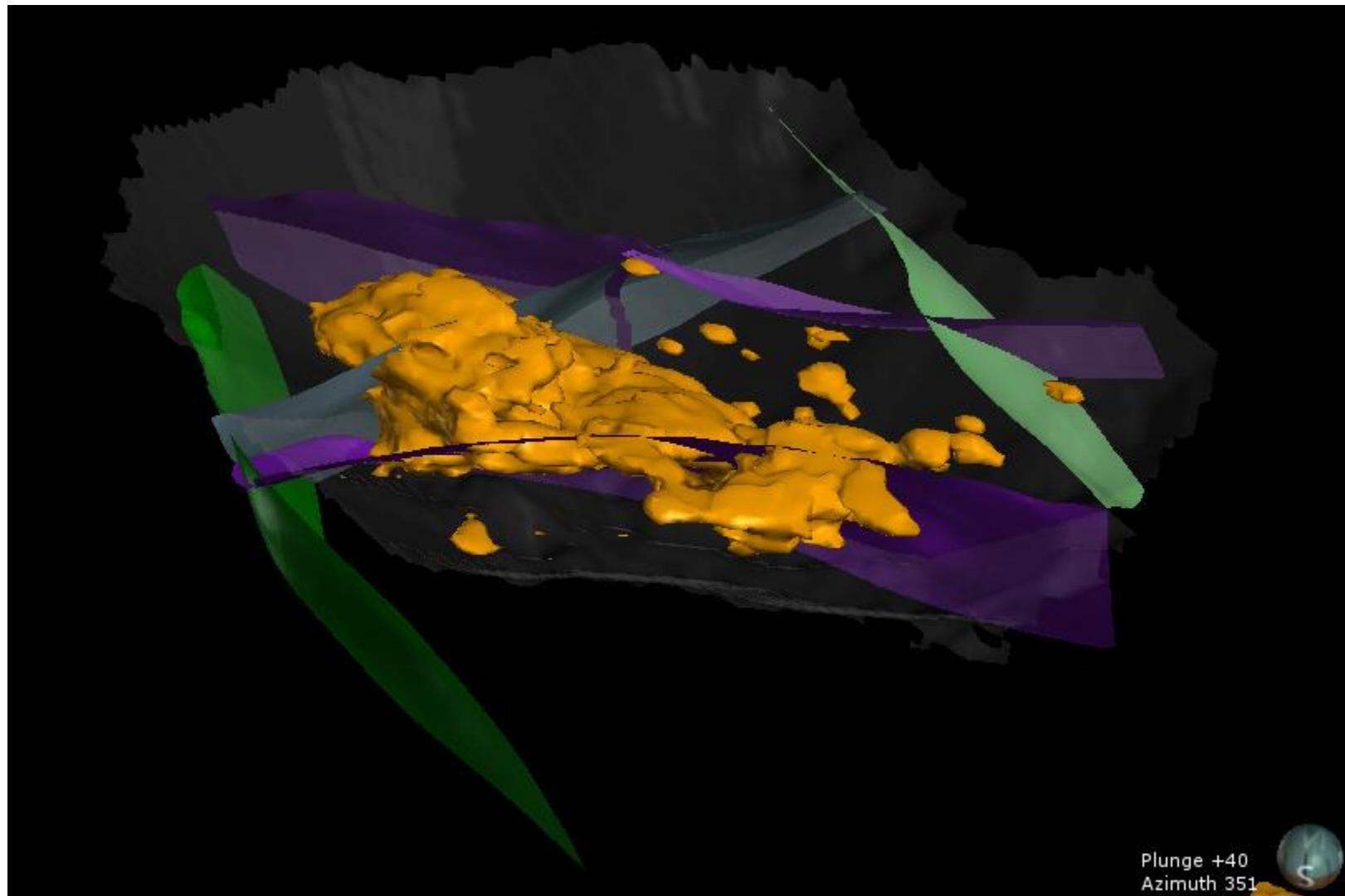


EM maps sericite alteration above ore

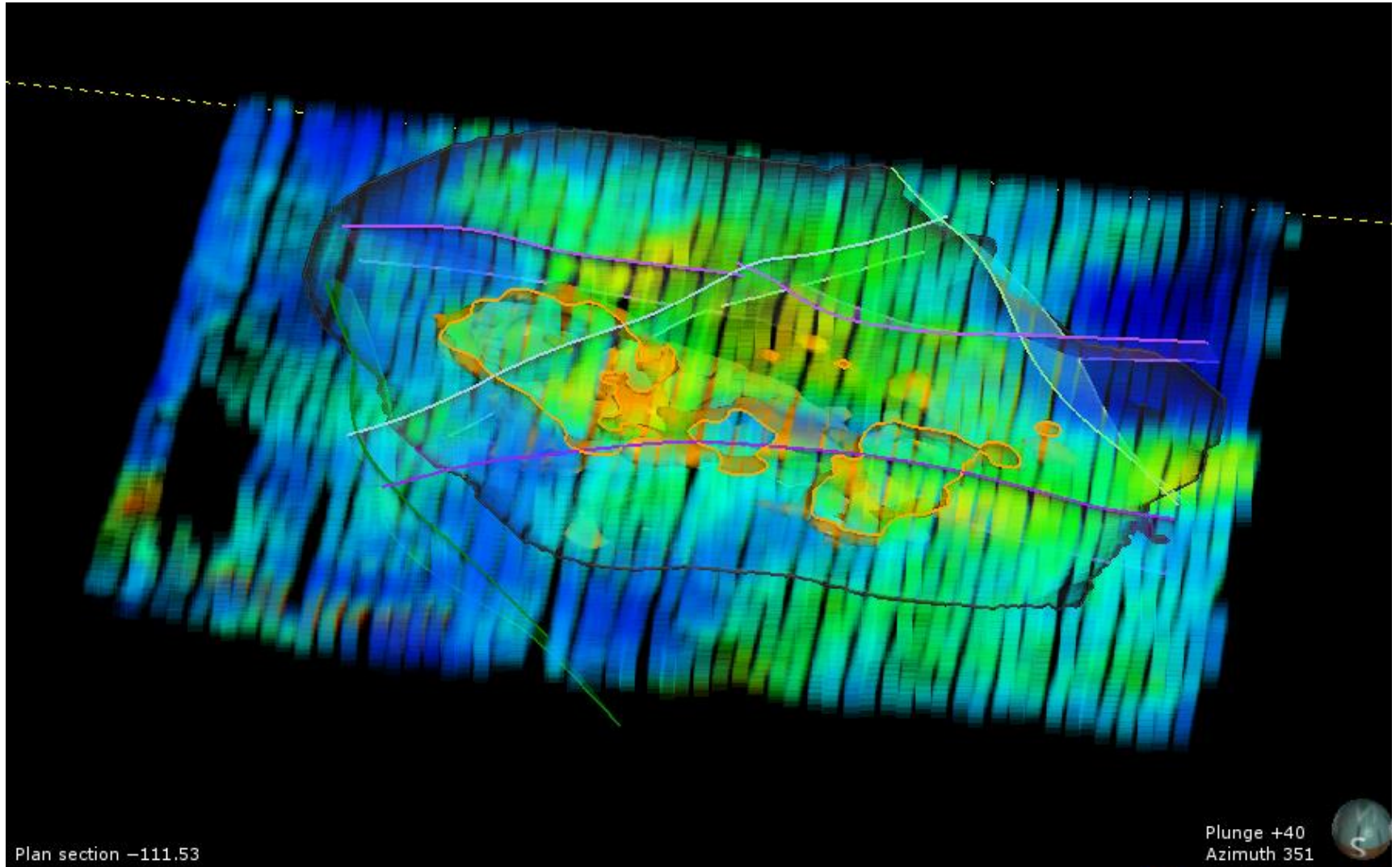
- Higher conductivity between minz-bounding faults



Fault network with 0.4% Cu

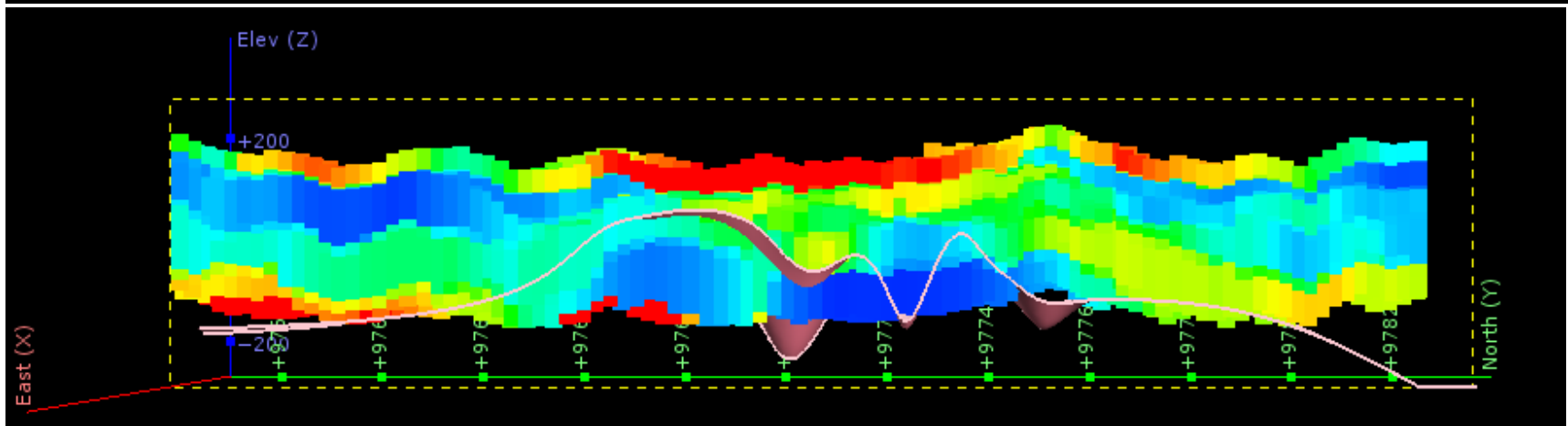
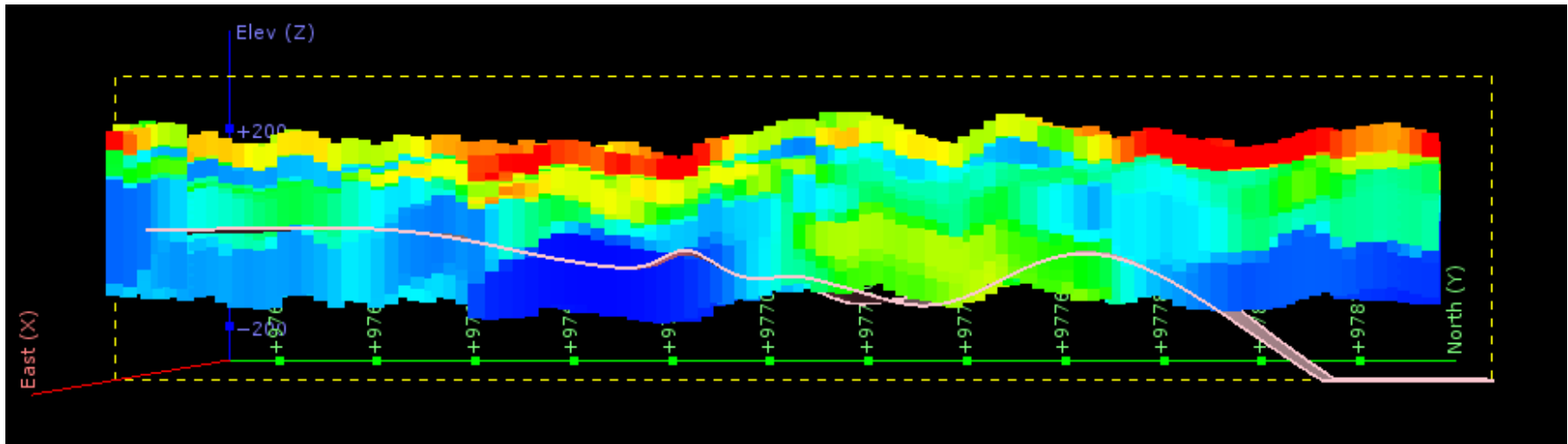


Fault network with EM conductivity



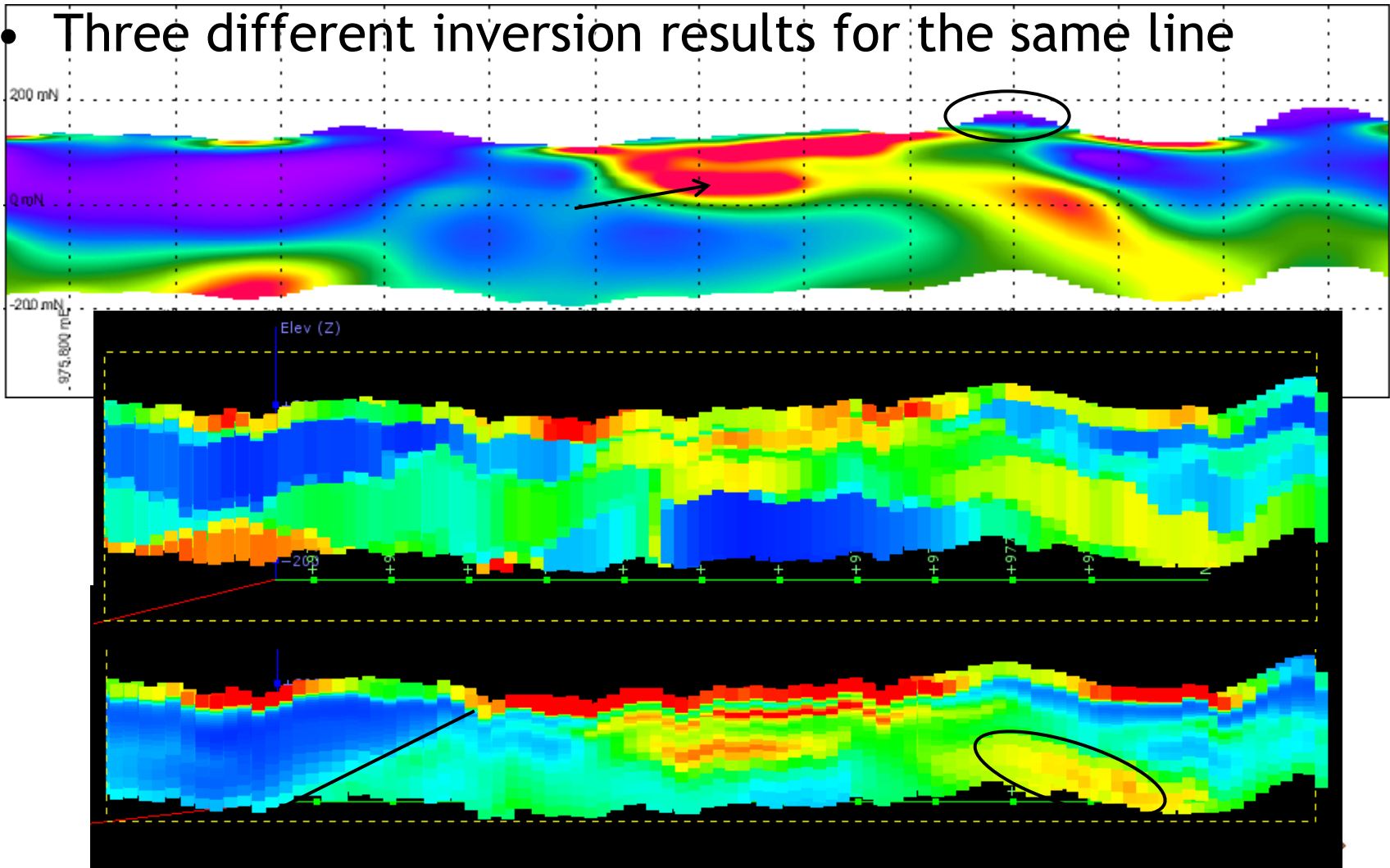
EM and anhydrite front

- Gypsum dissolves to create high porosity above front



Inversions: what is robust?

- Three different inversion results for the same line



Conclusions

- Geophysics can often find a role in reducing uncertainty inside resource and mining work
 - interpolator between drill holes
 - domain definition
- Geophysics sometimes directly delineates the orebody, but usually associated geology/alteration/structure
- At Cobre Panama, EM
 - defines broad clay (sericite) alteration zone
 - may relate to anhydrite front
 - physical property implications
- Cost is most often minimal vs denser drilling

