Pit-scale geological modelling with magnetic and EM inversions

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Where is geophysics adding value?

- Commissioning
- Full Production
- Brownfields discovery
- Expansion
- Financing
- Feasibility decision
- Exploration and Resource Definition
- Discovery

Source: RFC Corporate Finance Ltd.
Outline

• How to use geophysics

• Magnetics and AEM at Cobre Panama
  - saprolite depth mapping
  - alteration mapping

• Conclusions
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
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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

Original plant infrastructure
EM-derived depth of saprolite

- Calibrated against drill holes
EM-derived depth of saprolite

Secondary crusher and mill
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

depth from EM

depth from logging

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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