MAGNETIC CHARACTER OF THE KEMESS PORPHYRY SYSTEM, BC

R.J. Irvine, Ken Witherly*

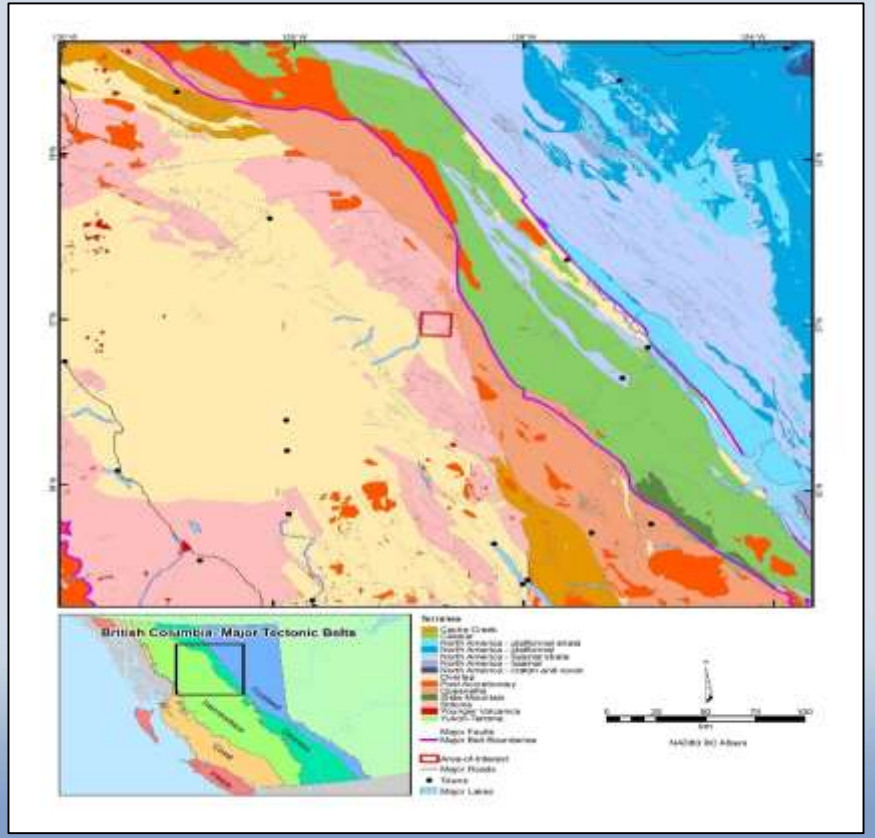
Workshop 8: "Improving Exploration with Petrophysics: The Application of Magnetic Remanence and Other Rock Physical Properties to Geophysical Targeting"

Regional setting

Located in north-central British Colombia

Regional geology

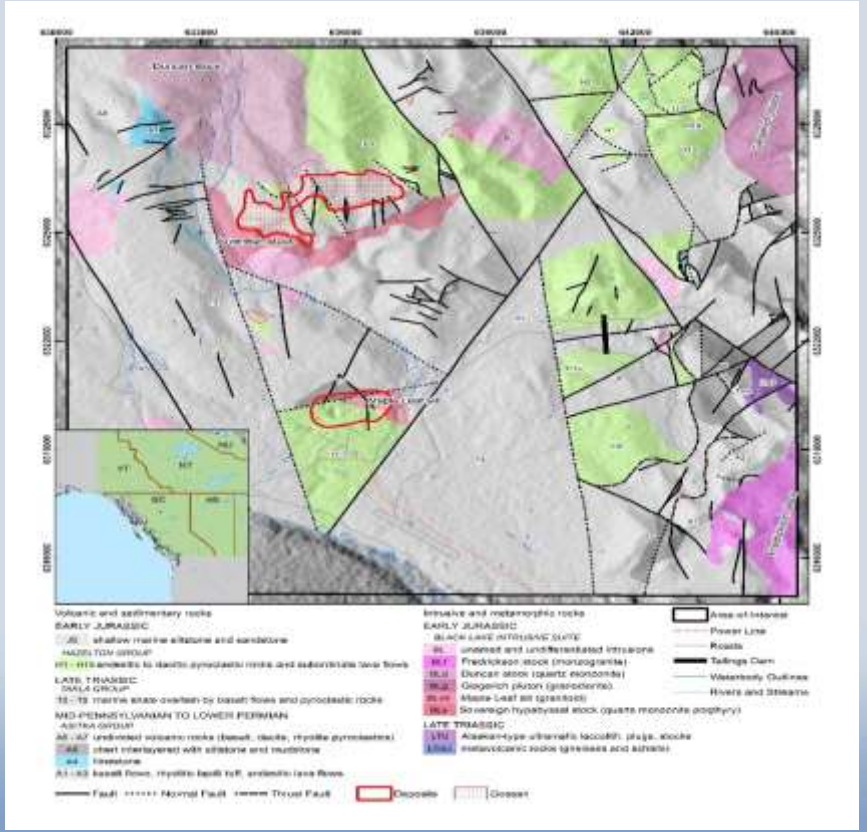
- The project area lies in the western margin Intermontane Belt of the Canadian Cordillera- a succession of volcanic arcs and accretionary complexes formed by subduction of oceanic plates under the North American plate and subsequent collisional tectonics.
- The Intermontane Belt hosts porphyry-type deposits, and includes the volcanic, sedimentary and plutonic Stikinia Terrane.
- The Mesozoic Toodoggone District of the Stikinia Terrane hosts Au-Cu-Mo porphyry deposits and Au-Ag epithermal systems.
- Mineralization dates from approximately 200 Ma in the Kemess project area.
- The main directions of the structures are northwest to N-S and are offset by northeast structures. Most faults are steeply-dipping normal faults, strike-slip and thrust faults are less common.



Project and deposit setting

Deposit Geology

- The Toodoggone District is comprised of 4 Groups:
  - Early Permian Asitka marine sedimentary and volcanic rocks
  - Mid Triassic Takla basalt
  - Late Triassic to Early Jurassic Hazelton volcanic and volcaniclastic rocks
  - Cretaceous Sustut conglomerates and interlayered mudstones, sandstones and ash-tuff
- Upper Triassic to Lower Jurassic mineralization associated with plutonism
- Black Lake calc-alkaline plutons and dykes intrude the Asitka, Takla, and Hazelton Groups
- North Kemess and South Kemess Au-Cu porphyry deposits intrude into the Takla basalt

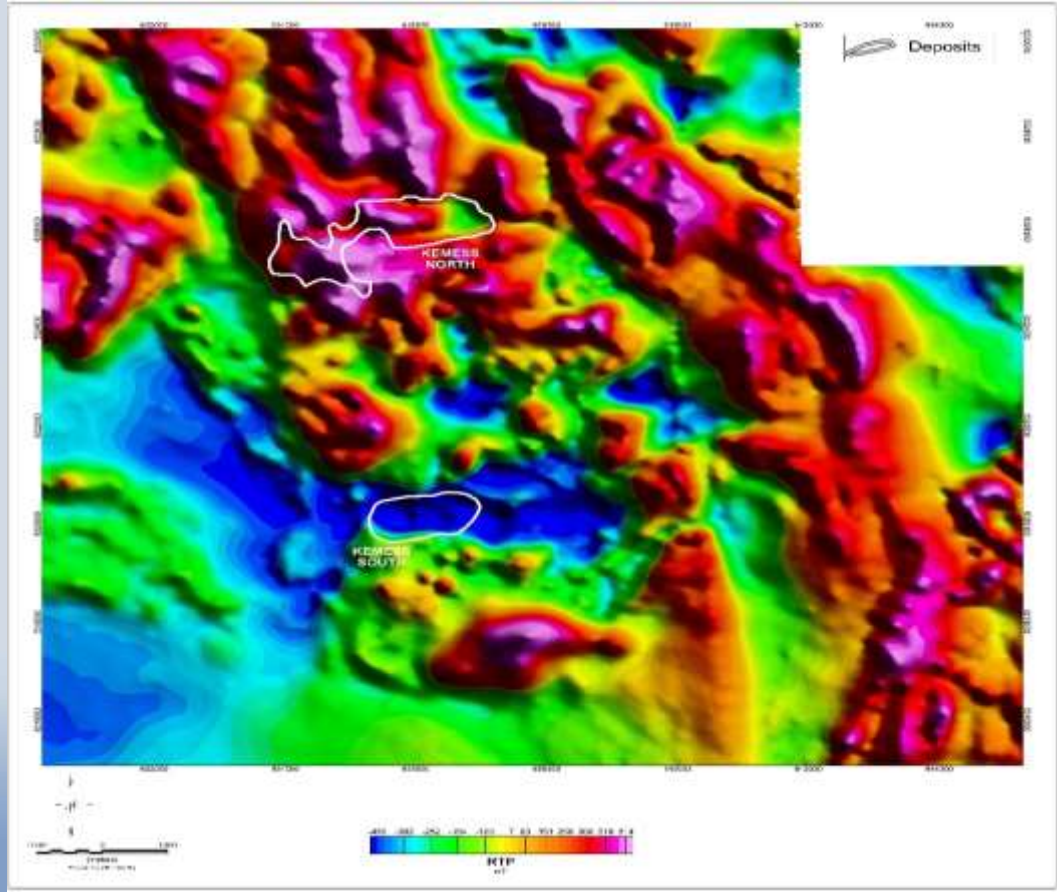


Primary geophysical datasets

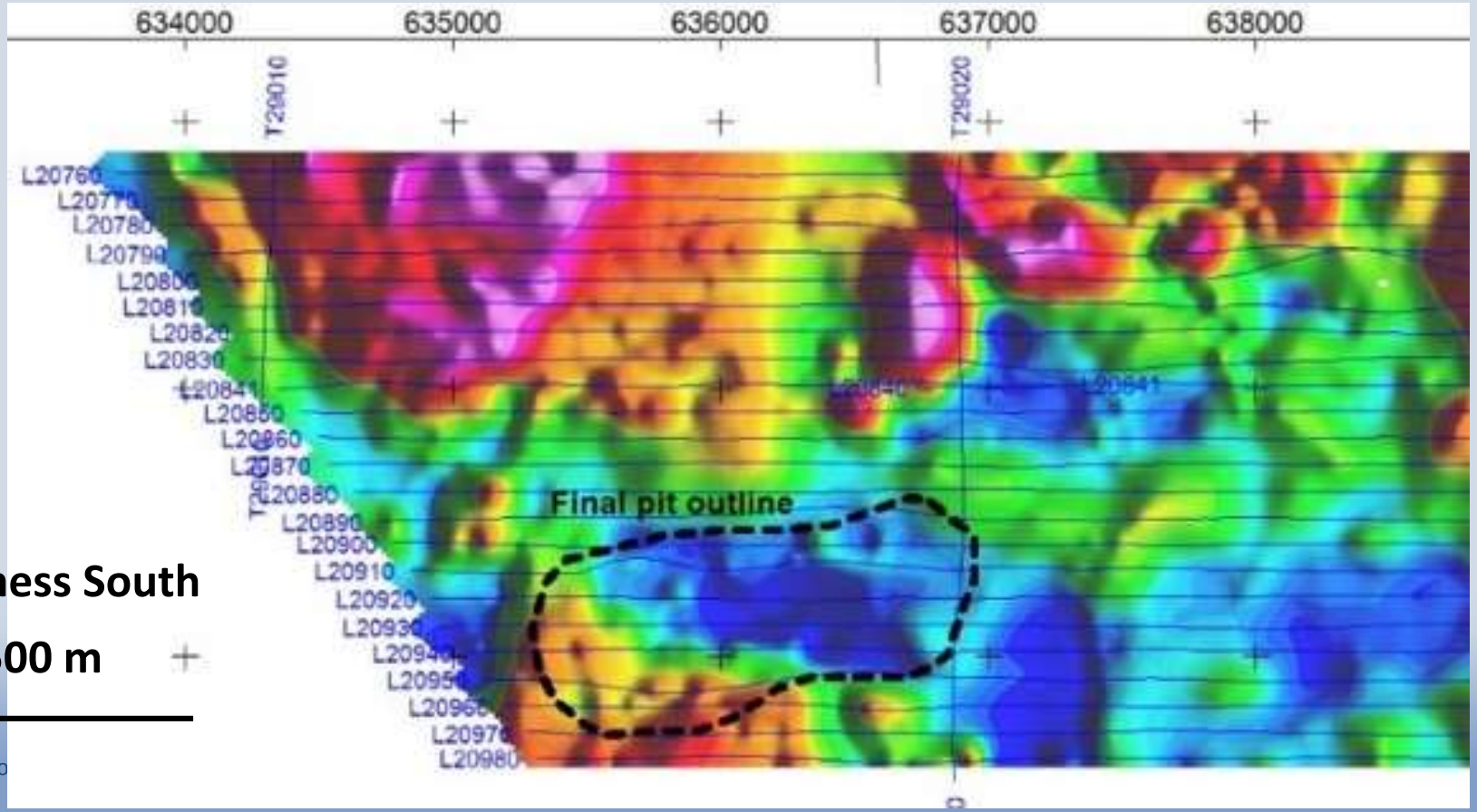
Magnetics

Condor undertook the assessment of the several magnetic data sets over the deposit area. While there were four surveys in the area, two were of primary focus-

- 2002 DIGHEM
- 2014 ZTEM



DIGHEM-TMI-RTP



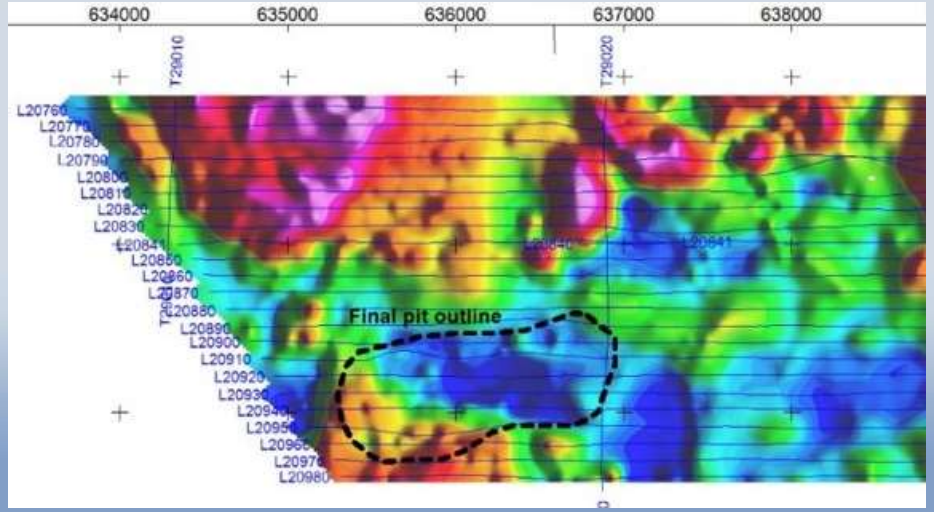
DIGHEM-TMI-RTP

At issue is whether the negative anomaly correlating with the mine is due to

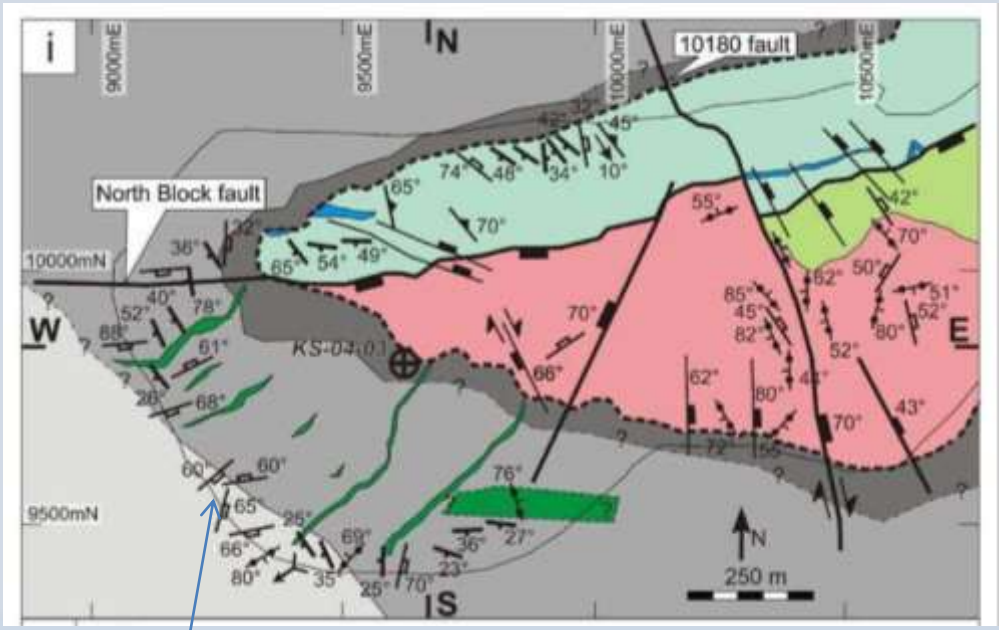
(1) negative remanent magnetization

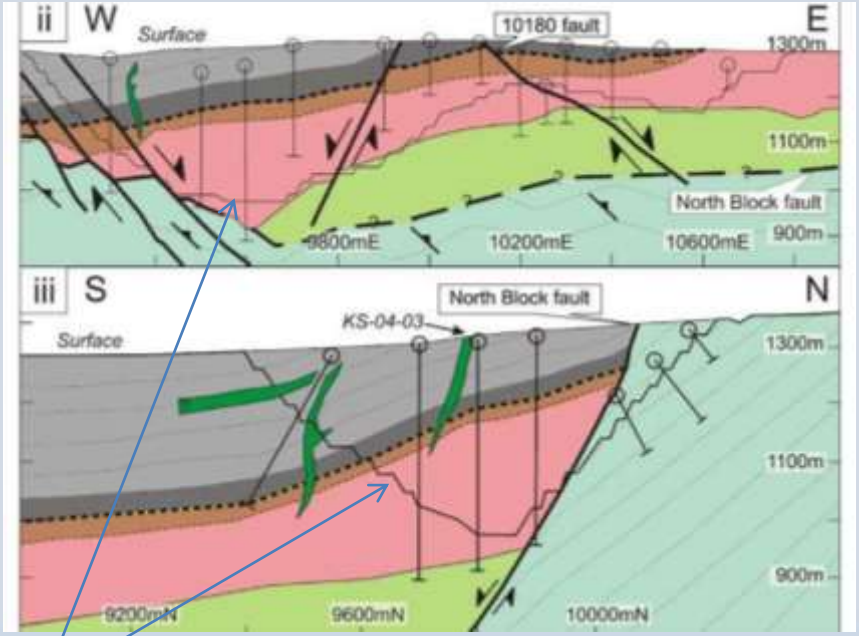
(2) destruction of magnetite and magnetic pyrrhotite by hydrothermal alteration

(3) some other explanation



Geology-Kemess South





Pit outline

Plan

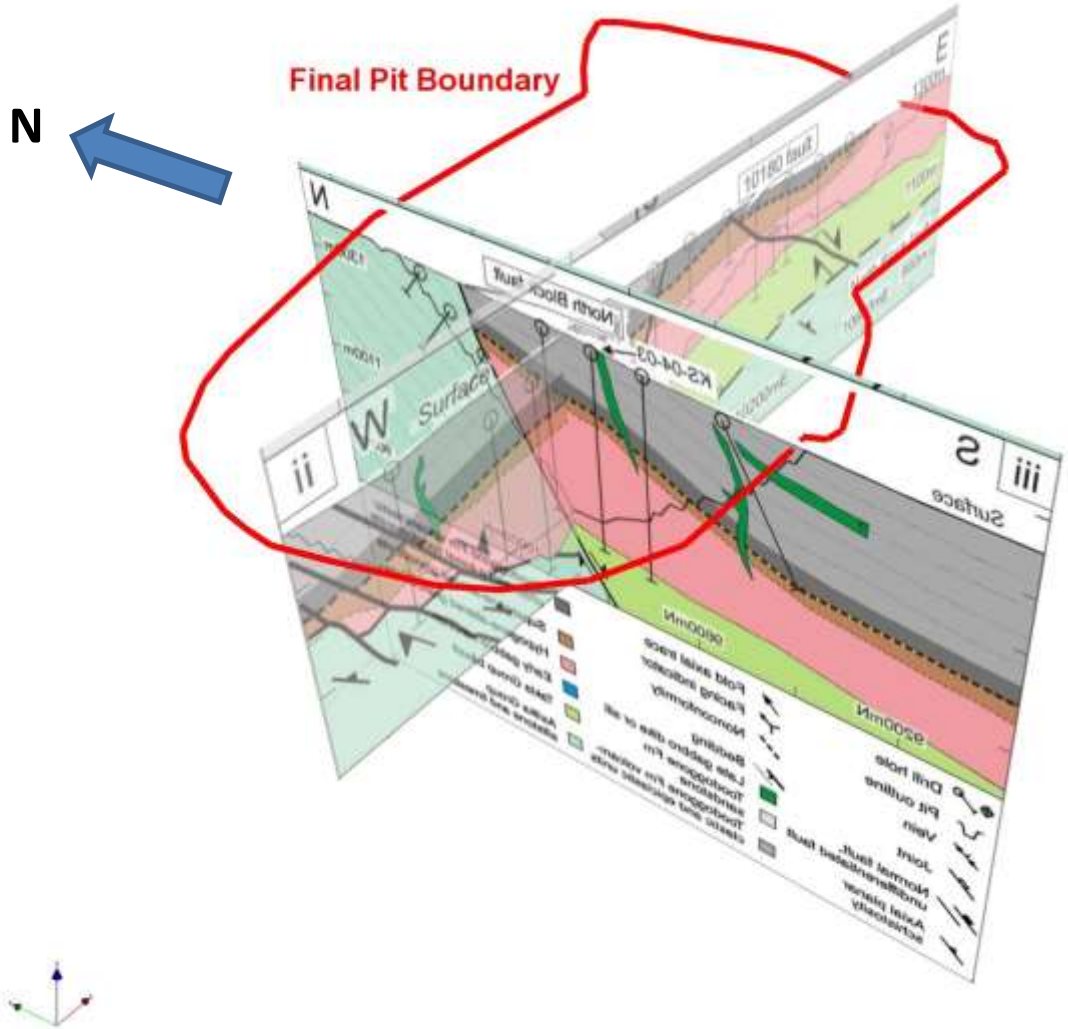
Pit outline

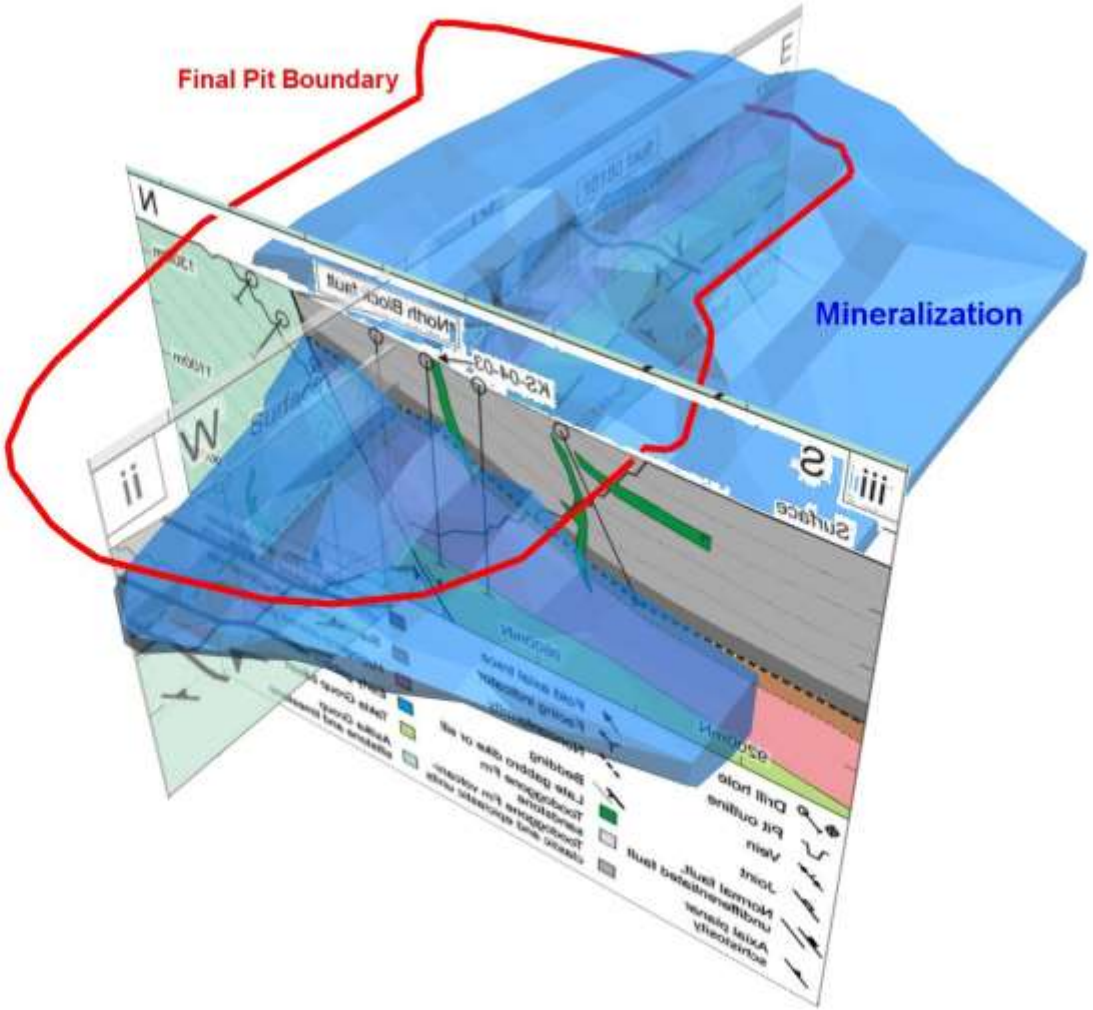
Sections

Recent (2010) structural and stratigraphic work has postulated the deposit was-

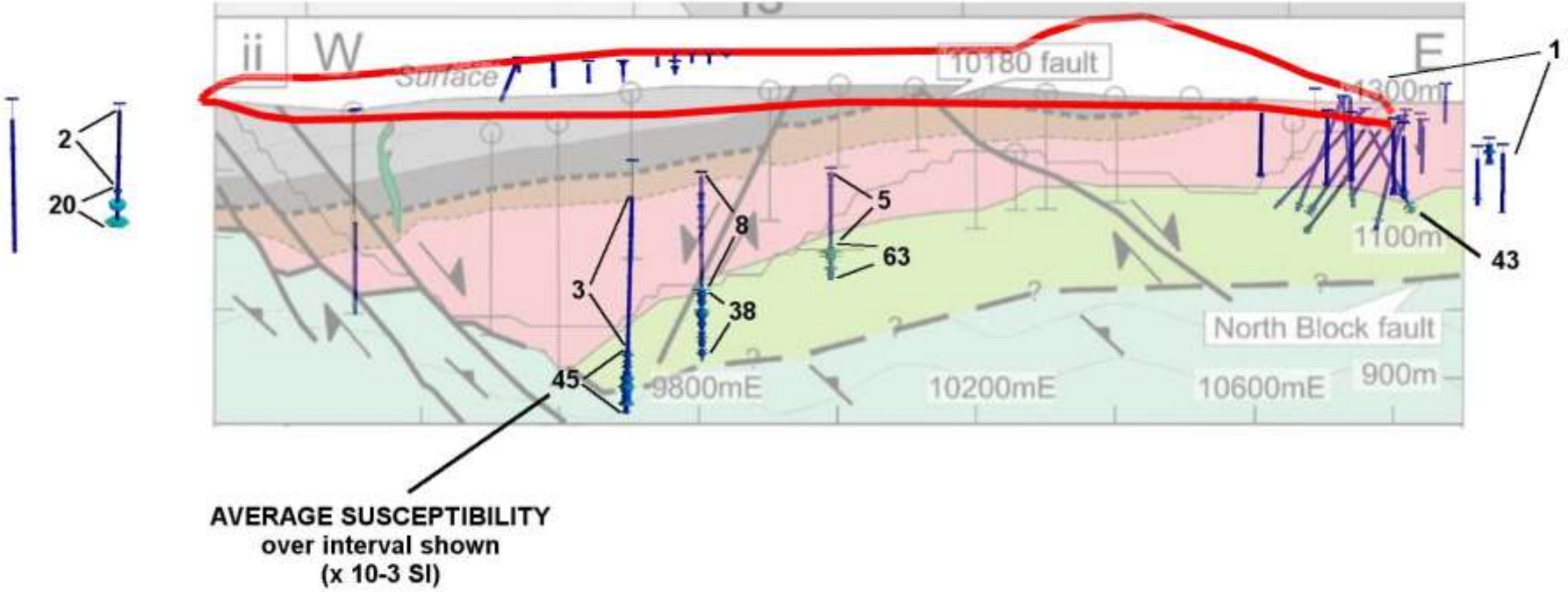
- originally vertical
- rotated horizontally
- up-lifted
- exhumed
- supergene Cu mineralization as it…
- simultaneously being eroded and…
- buried by younger sediments that contain clasts of supergene mineralization
- E-W ‘North Block’ fault cut off the northern part of the deposit
- development in west of a deep paleo-valley filled with the younger sediment.
- entire western extension eroded away at a depth of about 500 m or less from the current surface.

Geo-history of Kemess South-Mark Rebagliati

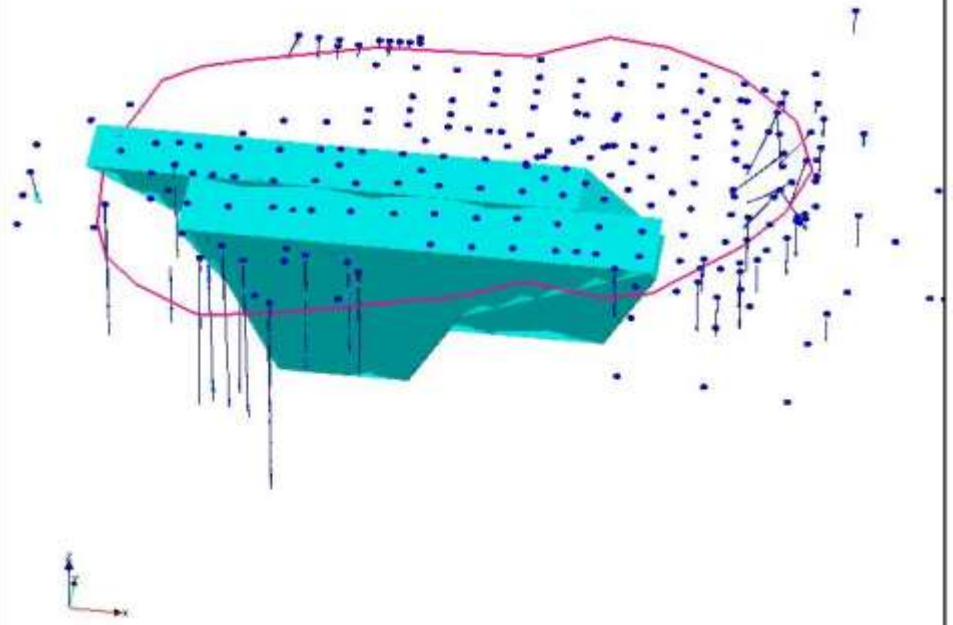


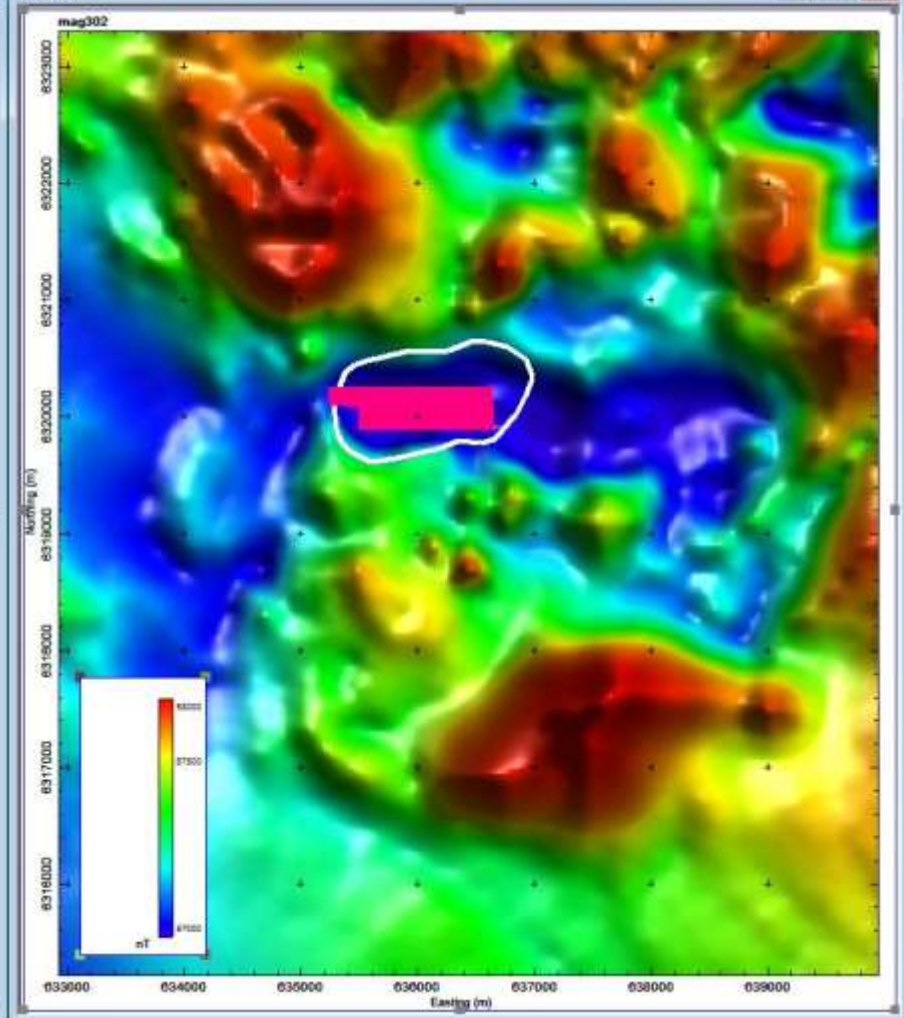


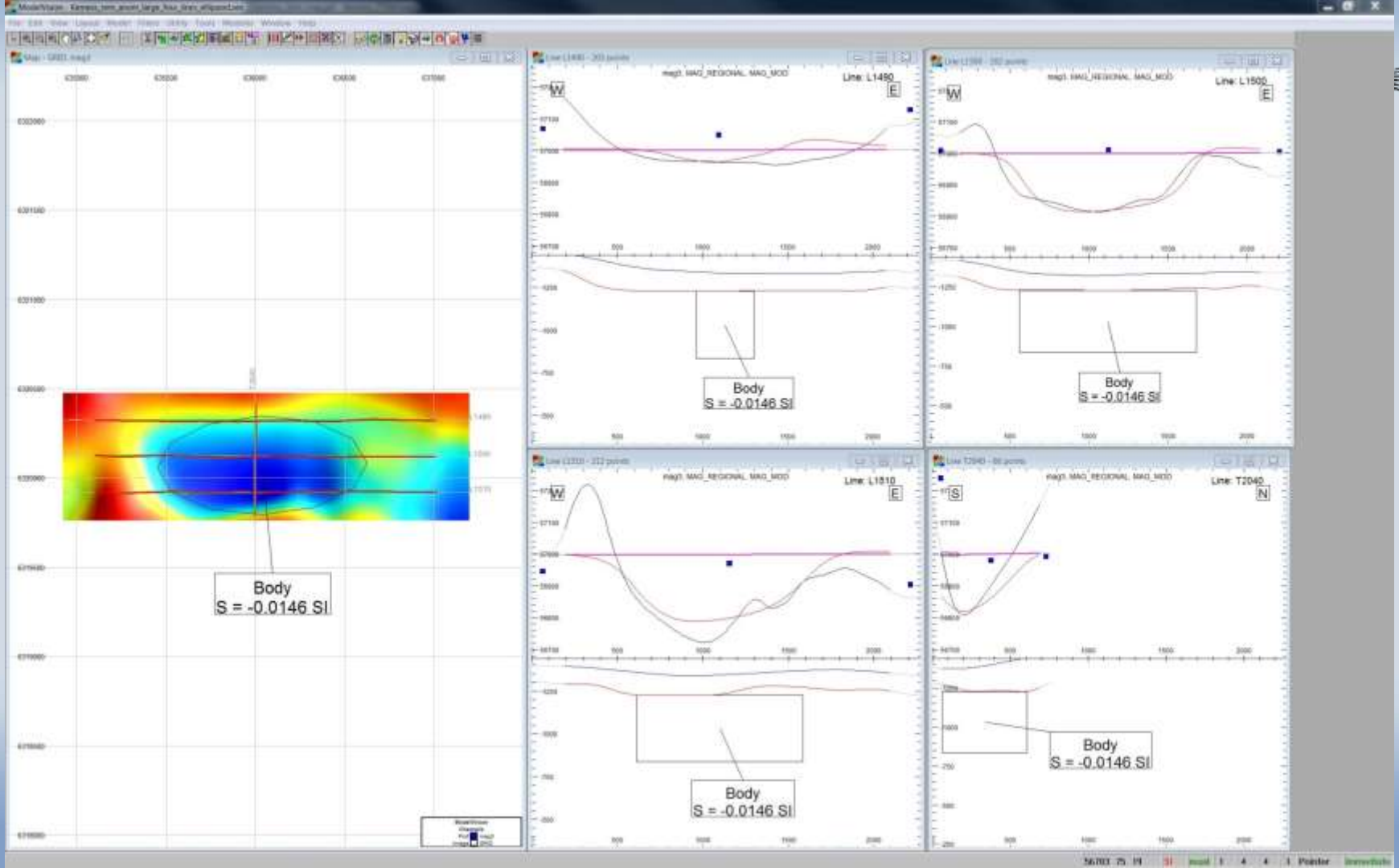
Kemess South-mag sus in core



First modeling suggests sub-vertical remanently magnetized bodies






Body
S = -0.0146 SI
Line: L1480
W
E
Body
S = -0.0146 SI
Line: L1500
W
E
Body
S = -0.0146 SI
Line: L1510
W
E
Body
S = -0.0146 SI
Line: T2040
S
N
Body
S = -0.0146 SI

Next, we examined the fwd responses for the geology using the mag sus data we had obtained. Fits were not that good.

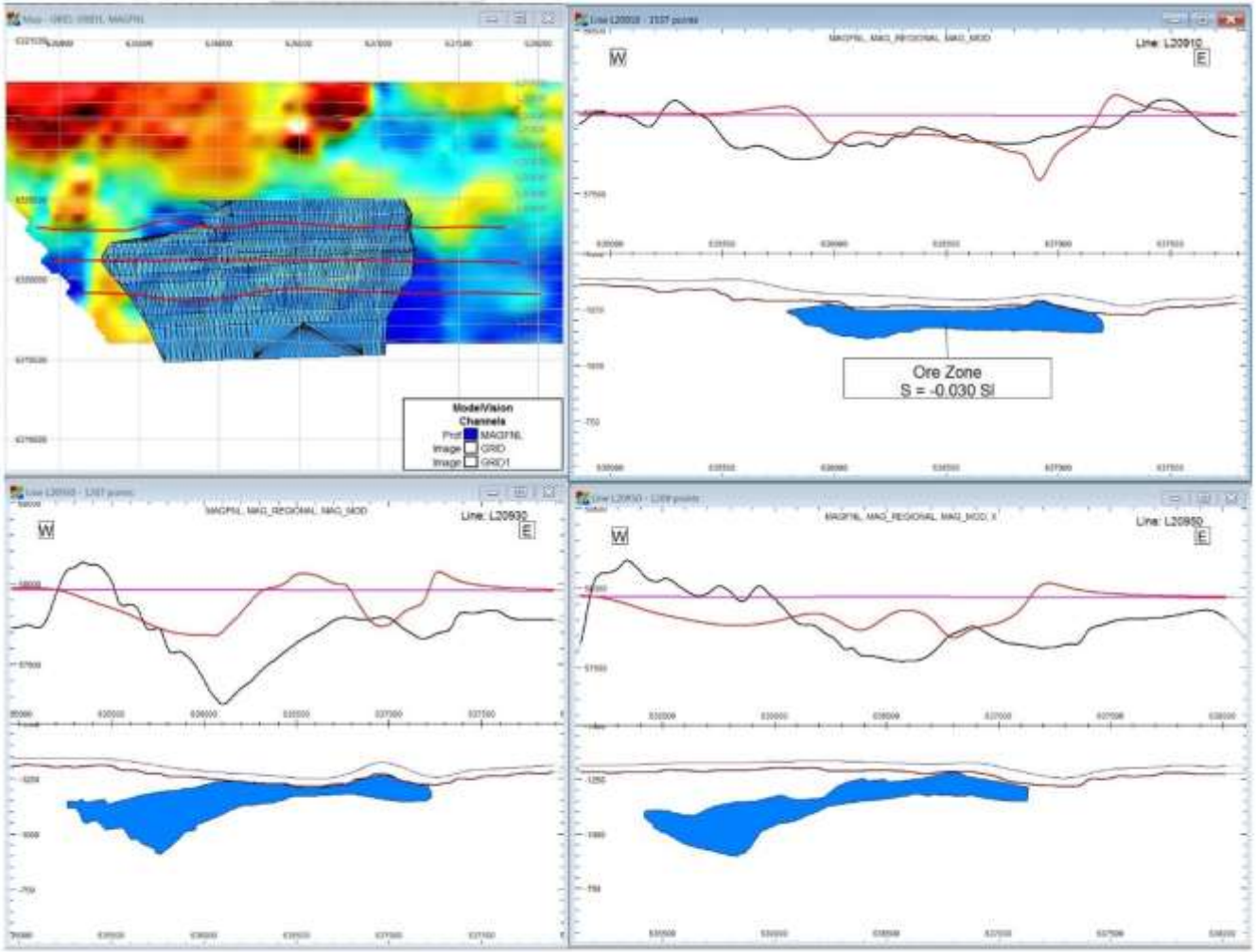


Figure 5: DIGHEM. Forward model of ore zone with sus -0.03 SI.

Then we allowed the deposit to take on a remanence; again fits were not that good.

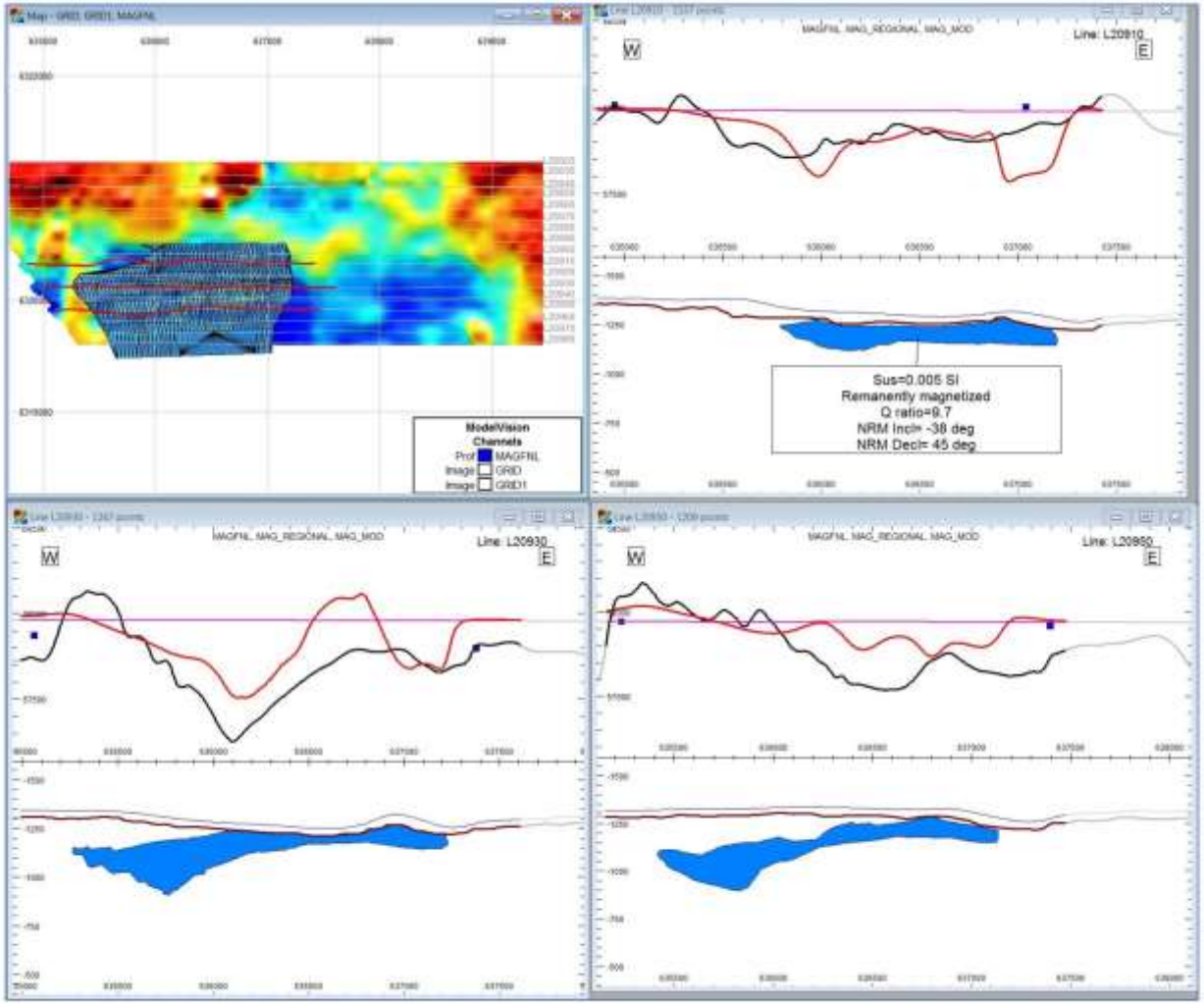


Figure 6: DIGHEM. Remanently magnetized inversion model.

Kemess South response of topo-only

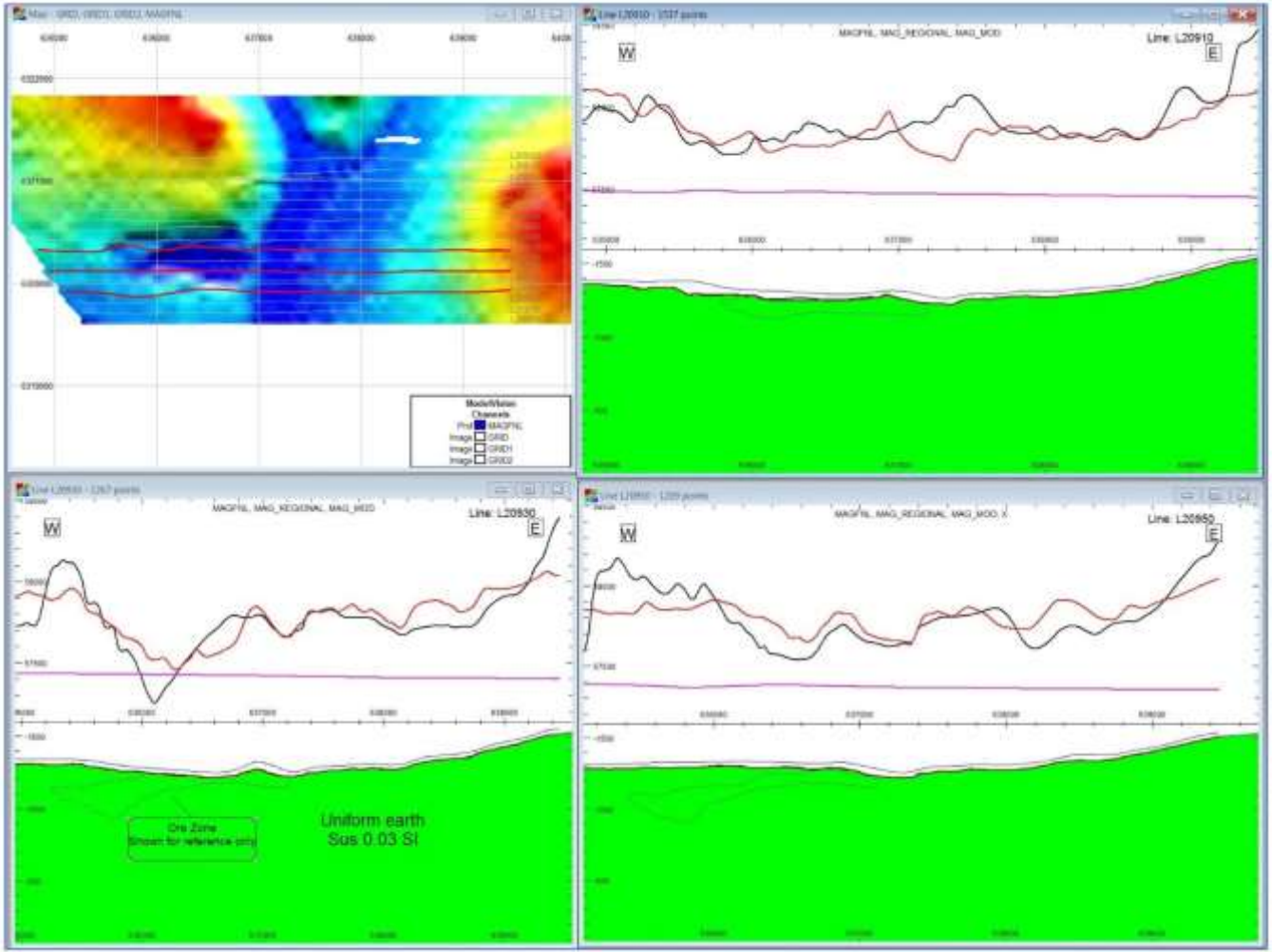
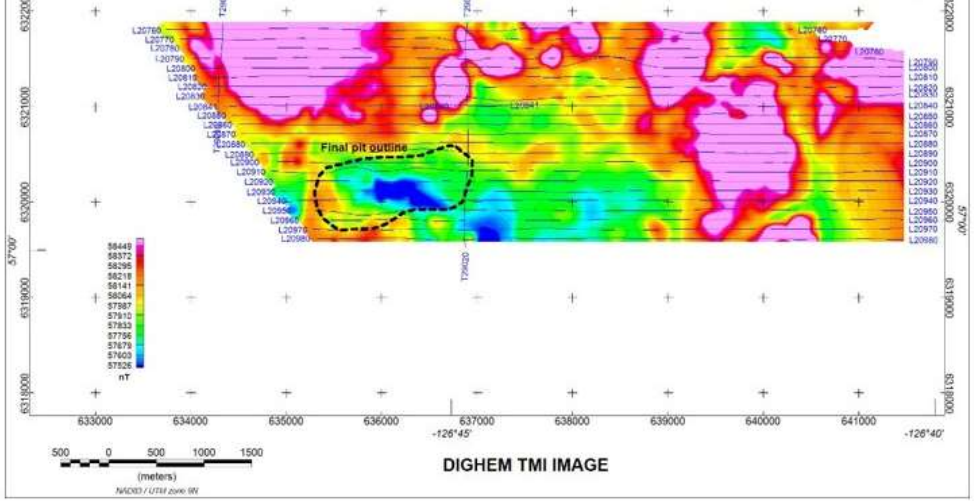
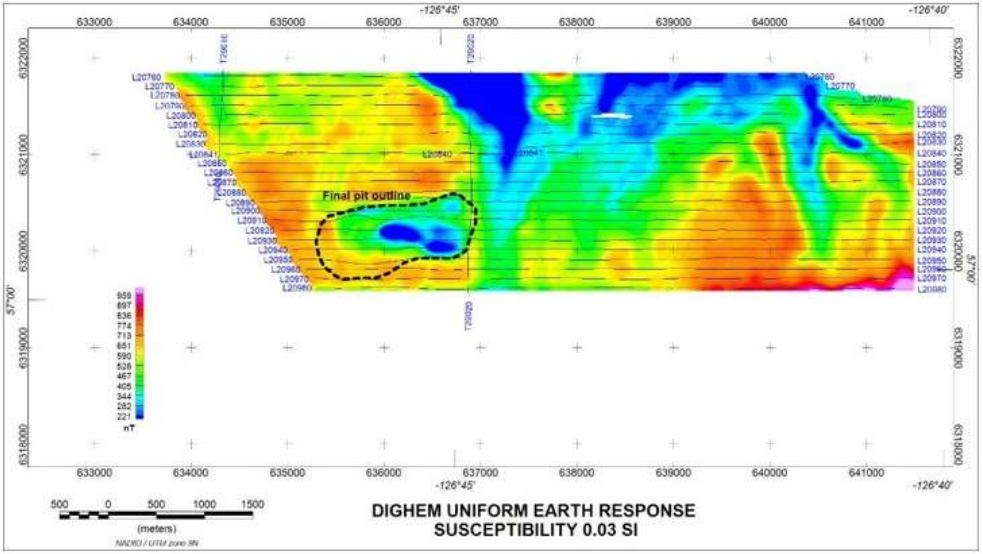


Figure 7: DIGHEM. Response of a uniform earth with sus 0.03 SI.



Kemess South
response of topo-only



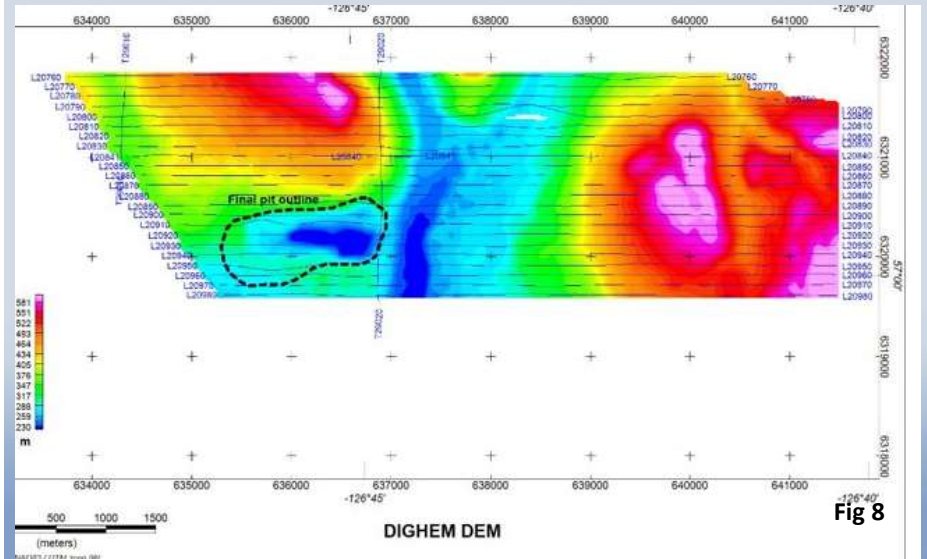
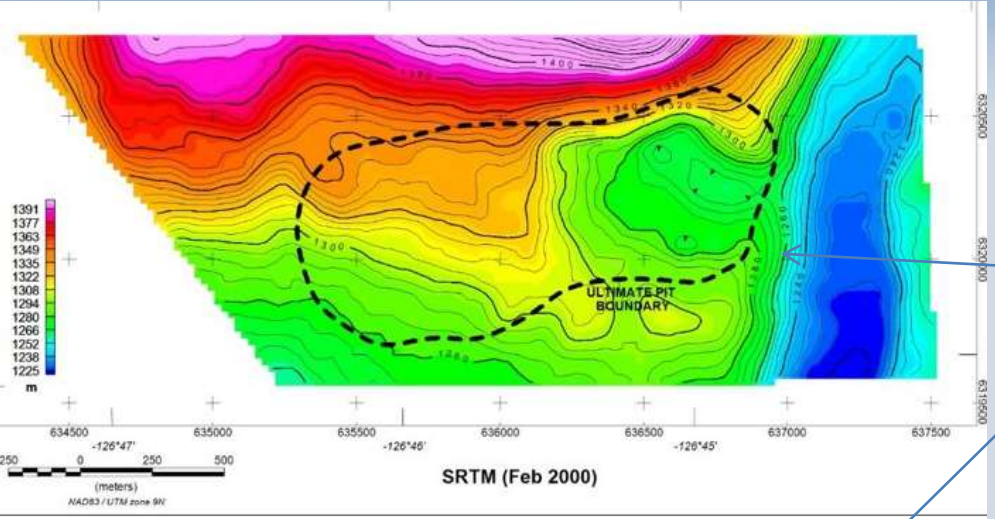


Fig 8



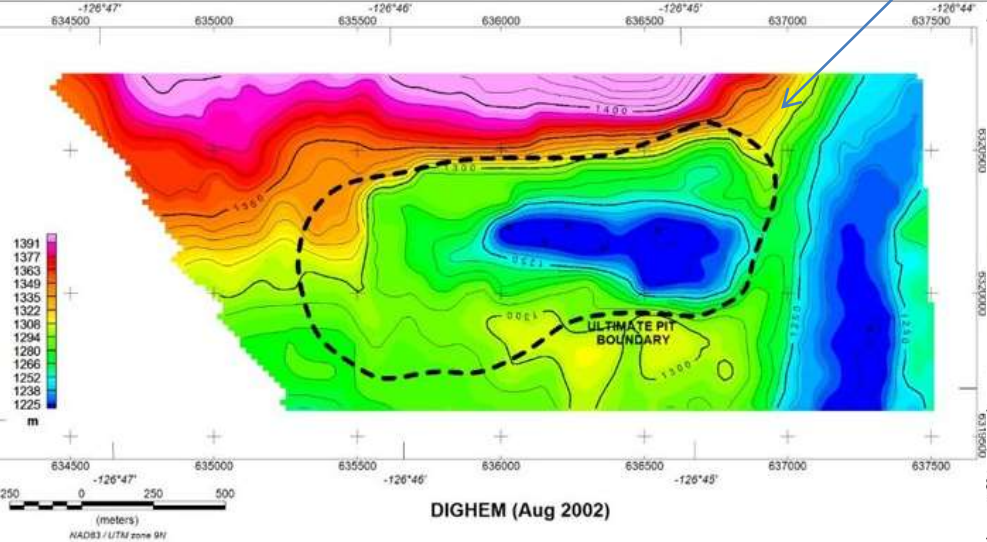
Kemess South

topo changing in time

SRTM-2000

DIGHEM-2002

ZTEM-2014



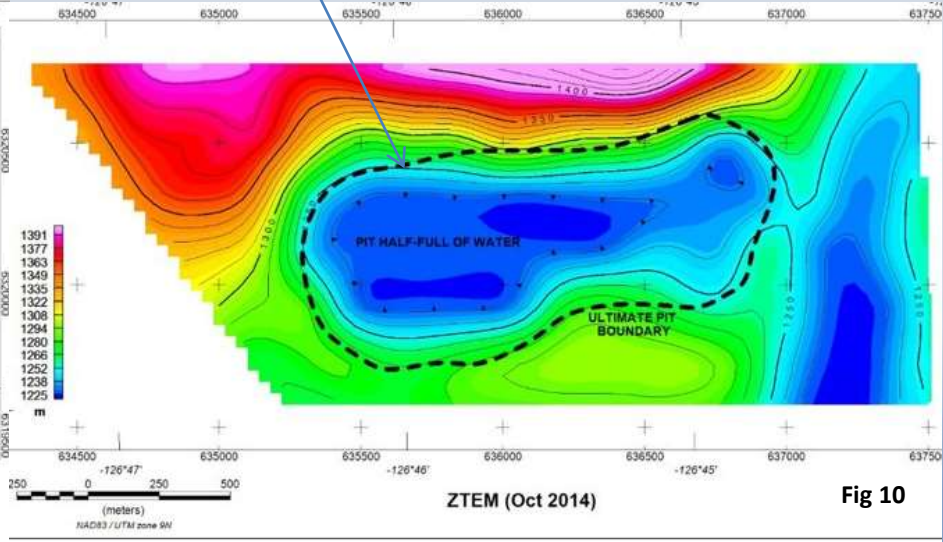


Fig 10

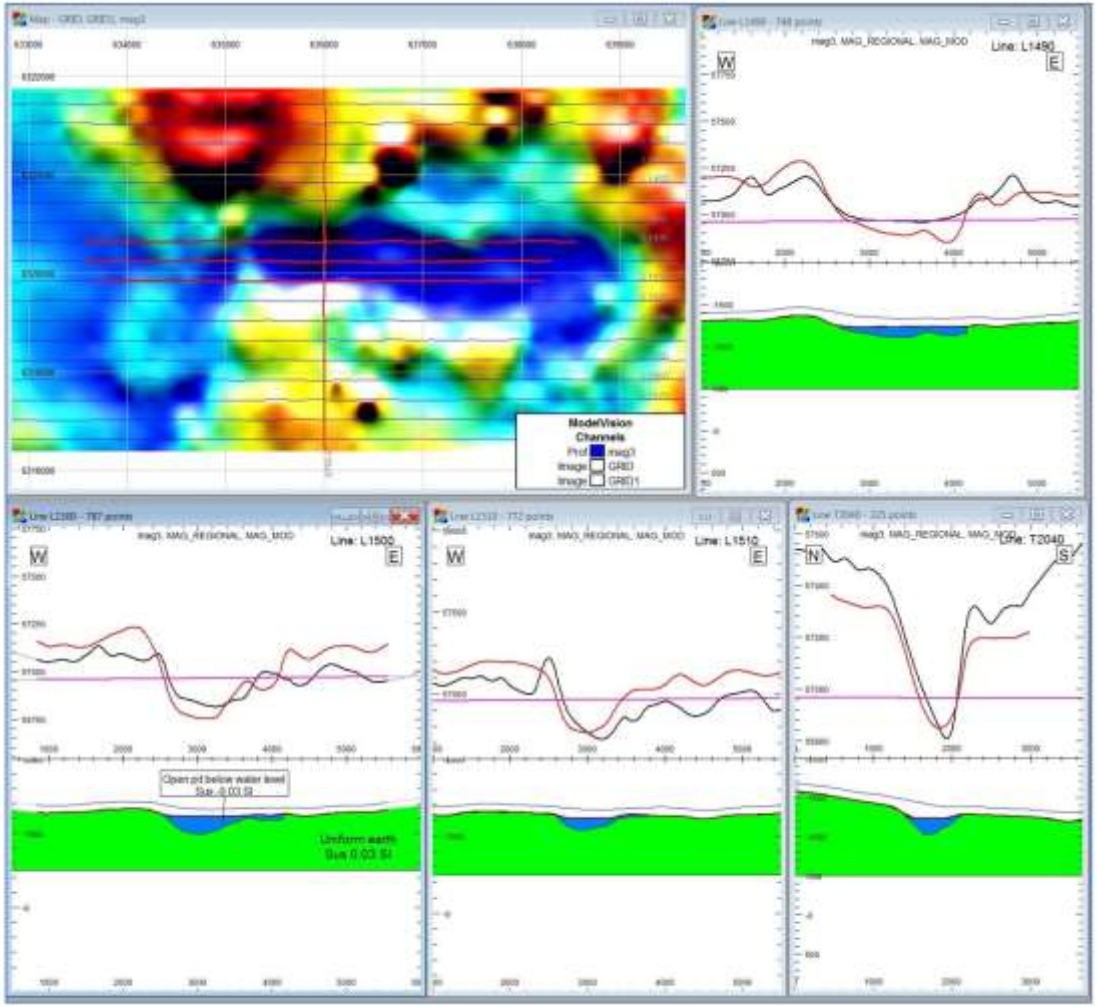


Figure 11: ZTEM response of uniform earth (sus 0.03 SI), including open pit below water level.

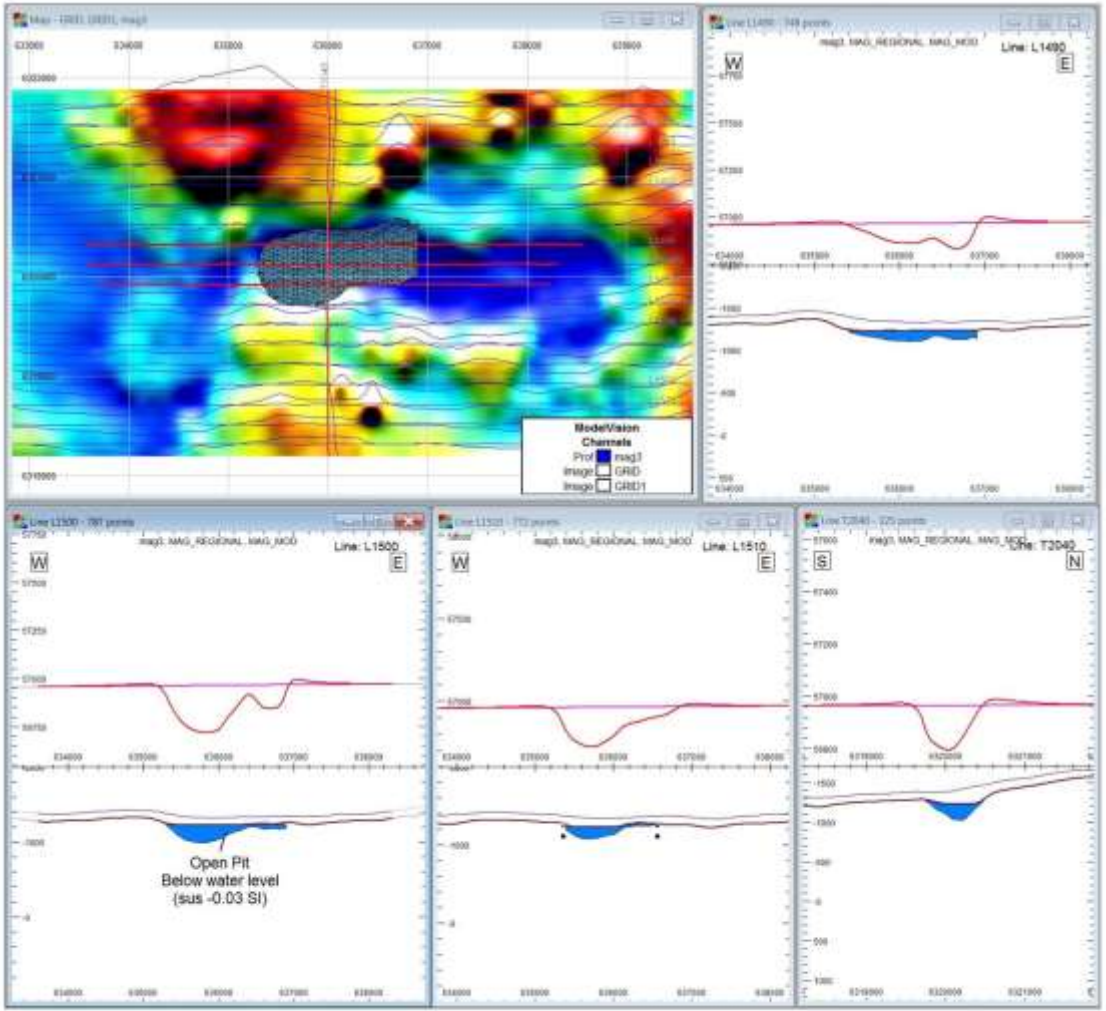


Figure 12: ZTEM response of open pit below water level.

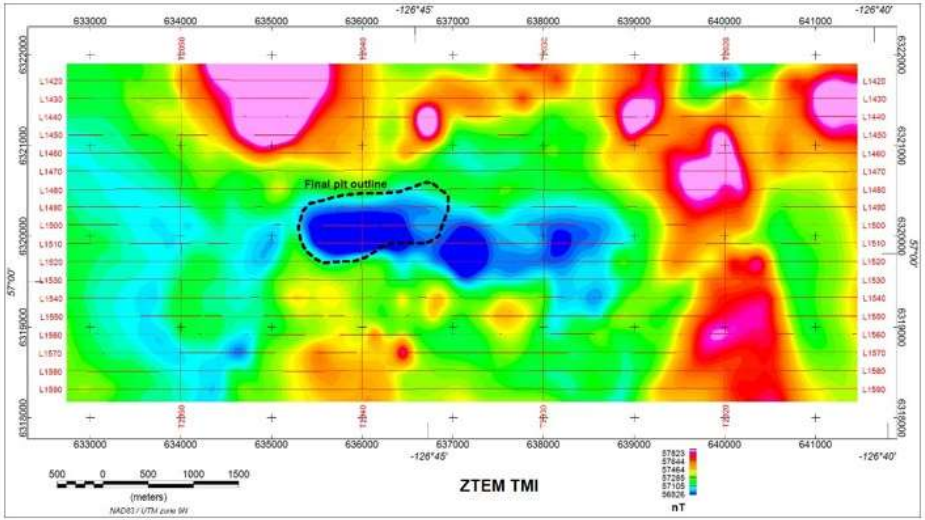
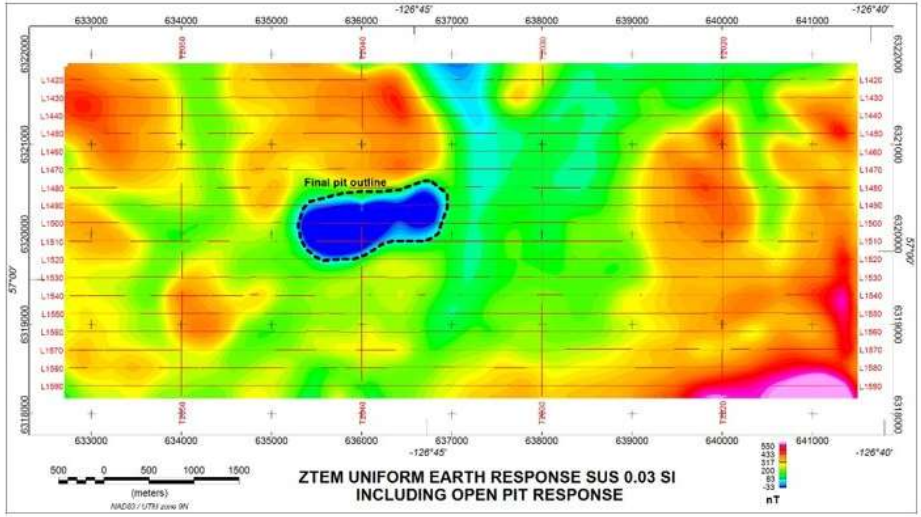


Figure shows only the responses of the open pit below water level. The amplitude of these negative anomalies is greater than 200 nT.



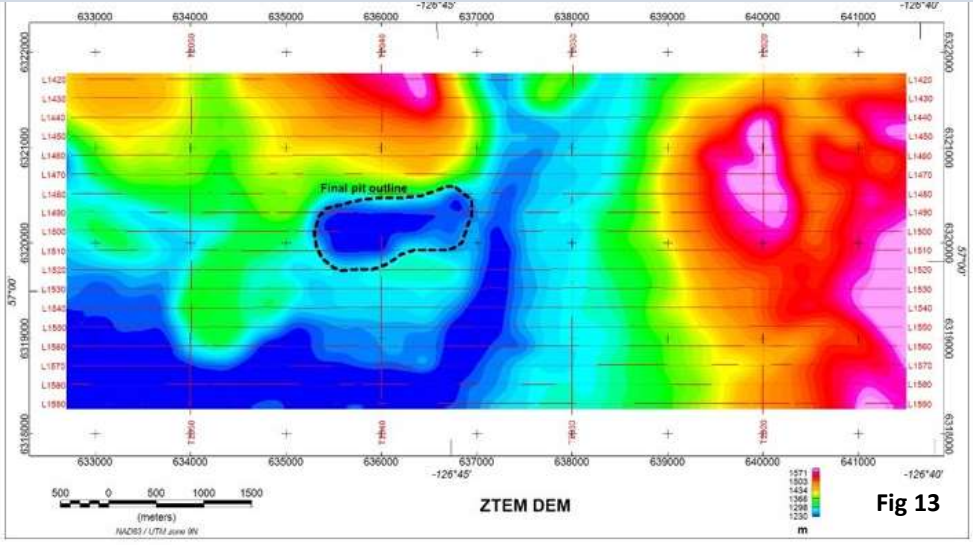


Fig 13

Conclusions

- Porphyry copper deposits often show significant magnetic character but styles/patterns can vary considerably even within a district
- Simplistic assessment of geophysical results without an appreciation of the geology can lead to erroneous interpretation
- Even limited petrophysical data can be helpful to guide modeling (i.e. does not need to be used as hard constraint)