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Deep exploration: reasons and results

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Chris Wijns
Group Geophysicist, First Quantum Minerals

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What is “undercover”?

- Is not lack of outcrop
  - Deeply weathered in-situ regolith is usually amenable to soil geochemistry for geological and alteration mapping
- Is not leached regolith (leached of target metal)
  - still usually holds other geochemical indicators (Chile=Mo, Kamoa=Zn,Pb)
- Is transported overburden that masks or displaces surface geochemical expression of mineralisation
  - e.g., windblown sand, transported gravel, young surface volcanic flows

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Reasons for looking deep

- Junior purpose: get an intersection, doesn't matter if it will ever be economic
- Top end of town: have $$, will probably mine it (more concerned with tonnes than profit)
- "Research hole": geological understanding will let us explore better near the surface

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Do we really need to look deep?

- As an industry … maybe
- As individual companies … no
- Do we need to look under cover? … Yes

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First Quantum deep exploration examples

- NiS deep drilling on seismic + concept
- Sed Cu deep drilling on concept alone

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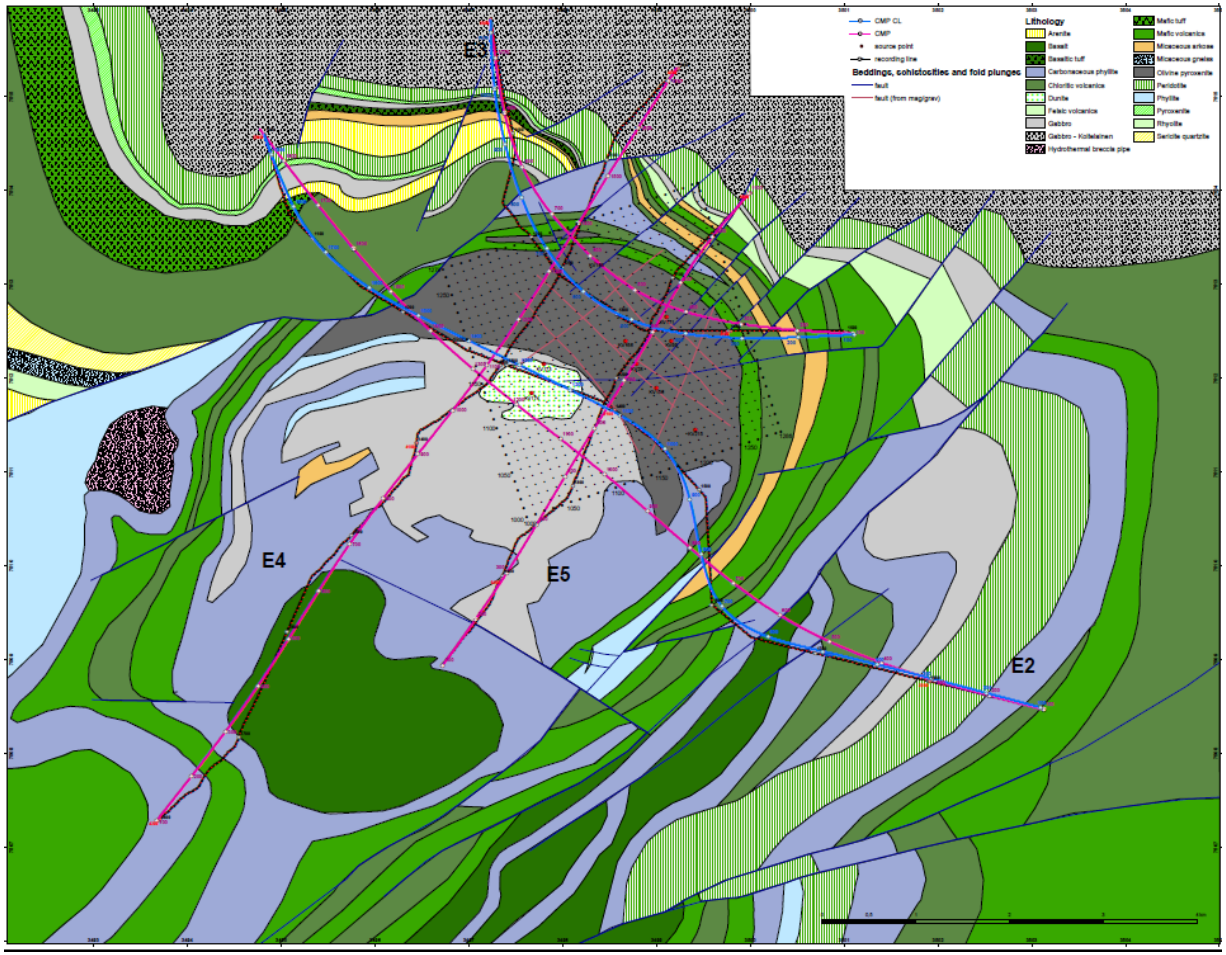
Kevitsa Ni-Cu

- Mafic/UM intrusion into interlayered metavolcanic/ metased country rock
- Grades 0.3% Ni, 0.4% Cu, 275 M tonnes



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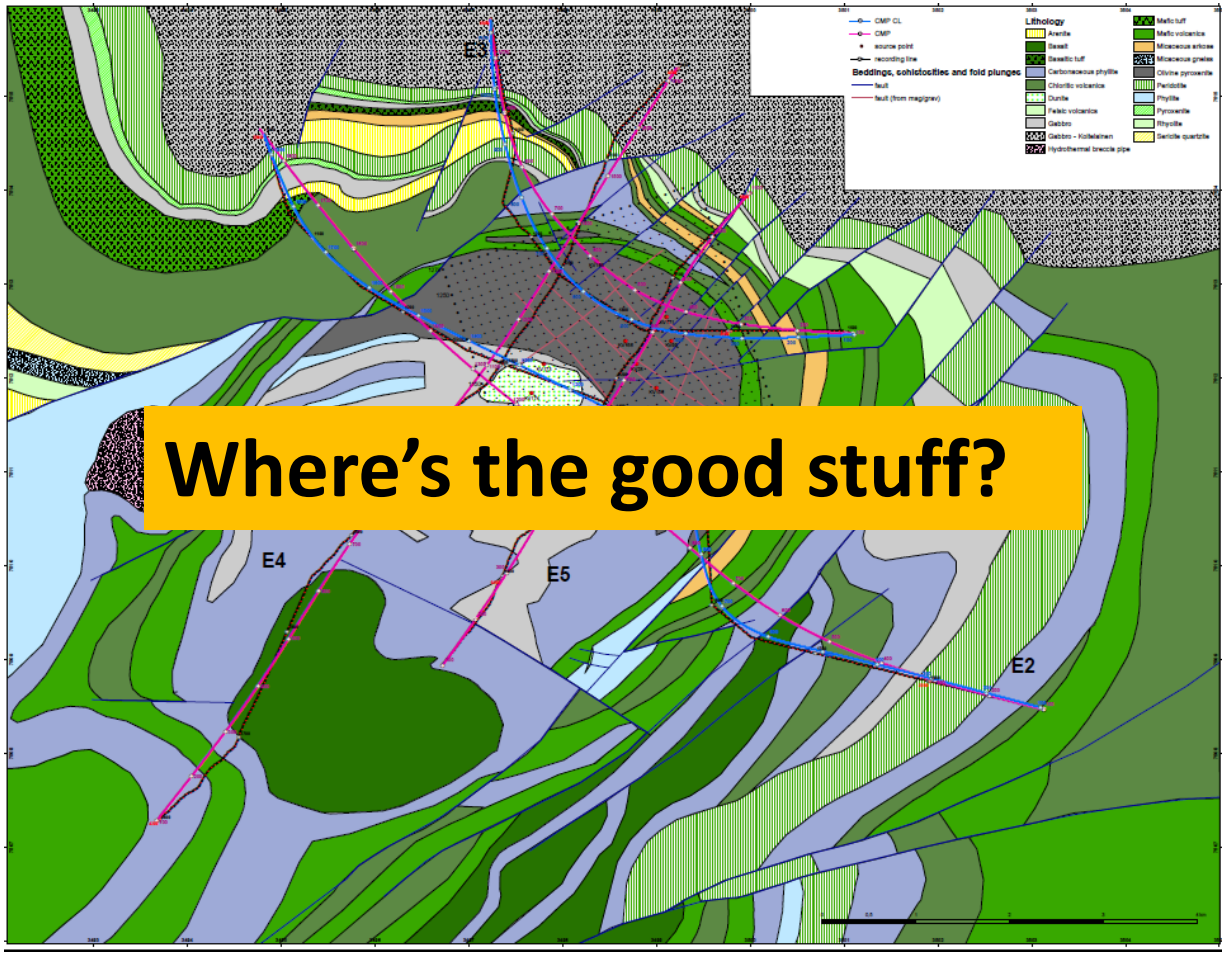

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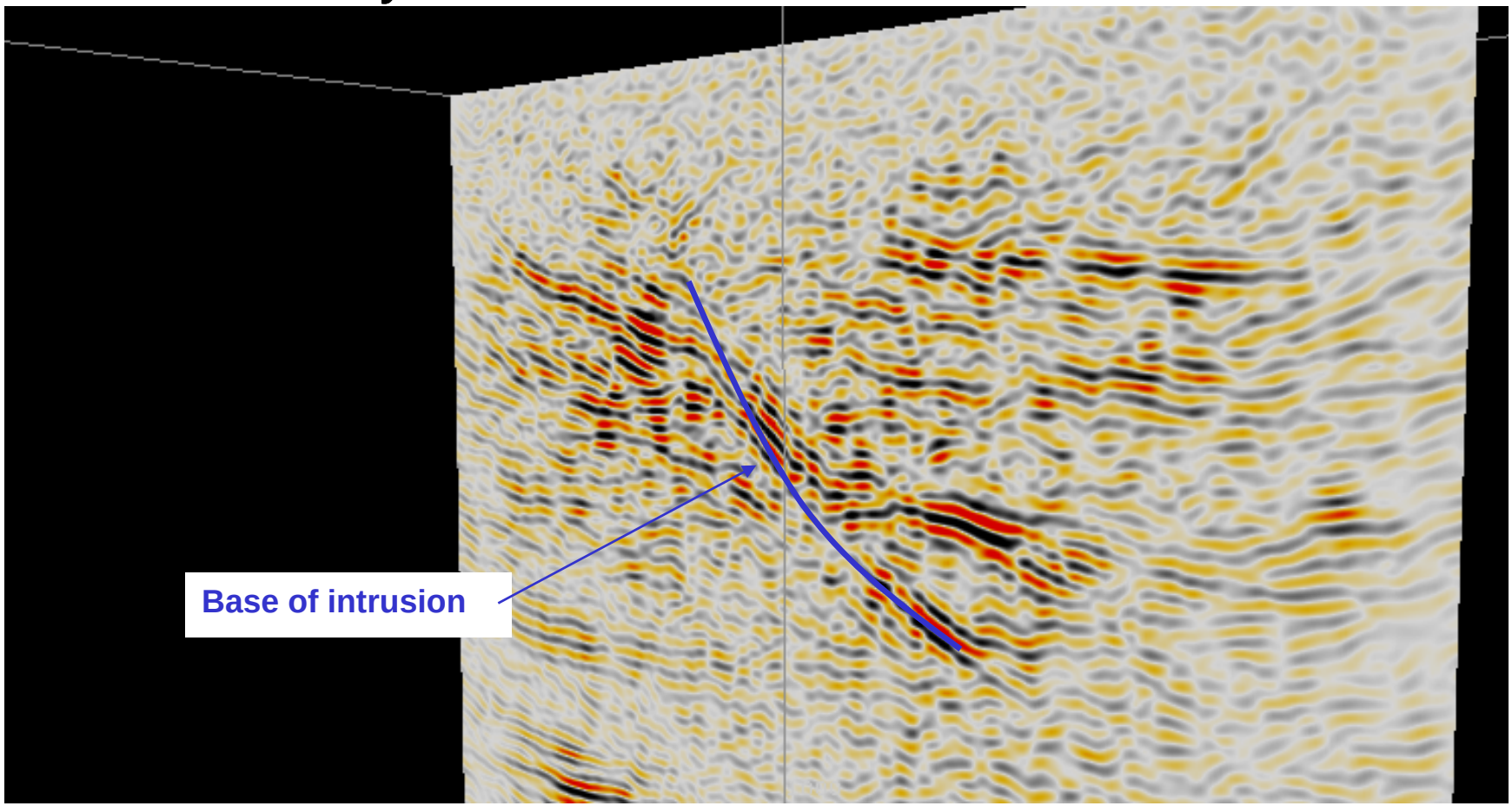
Defining base of intrusion

- Base of intrusion interpretation to constrain exploration for contact style ore



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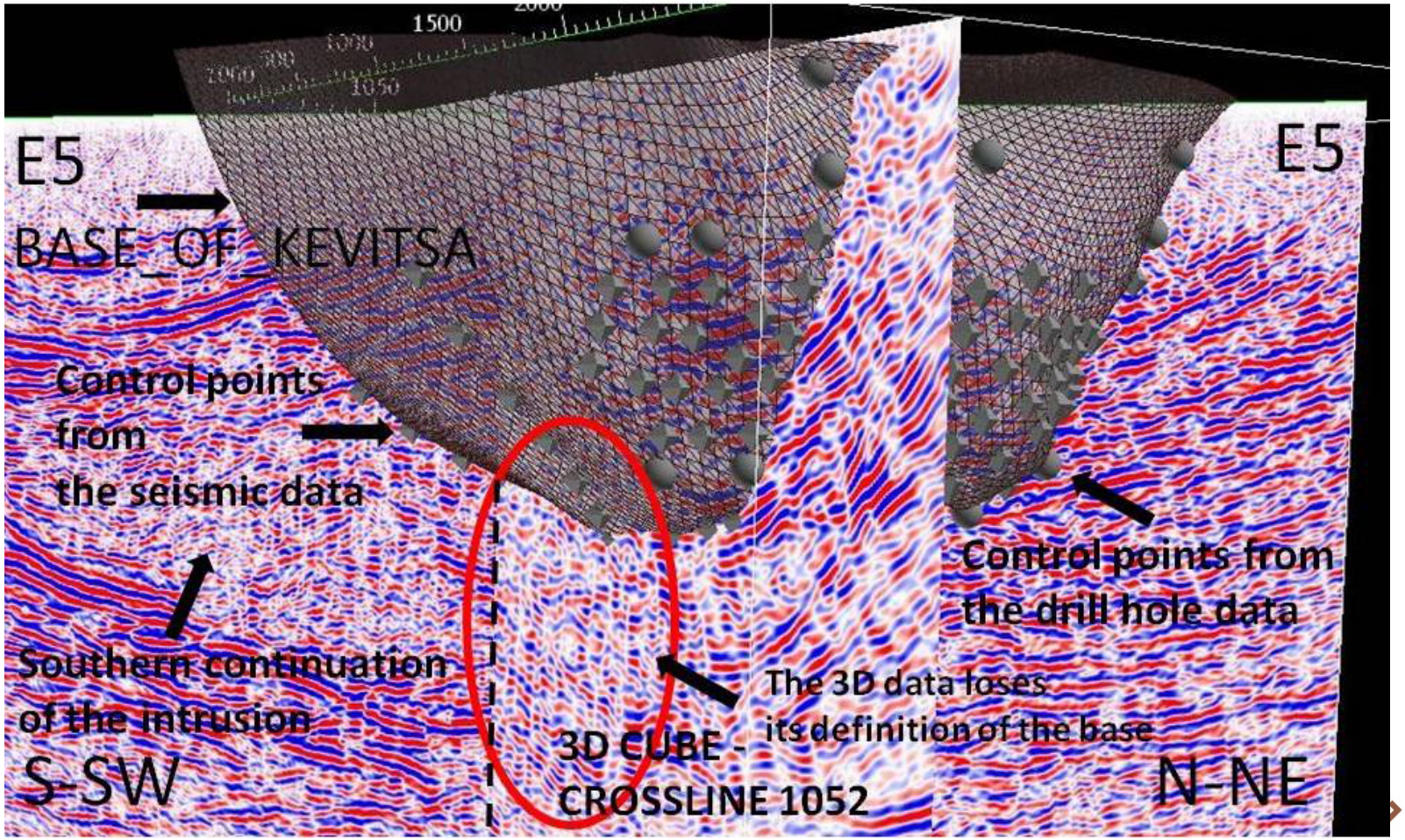
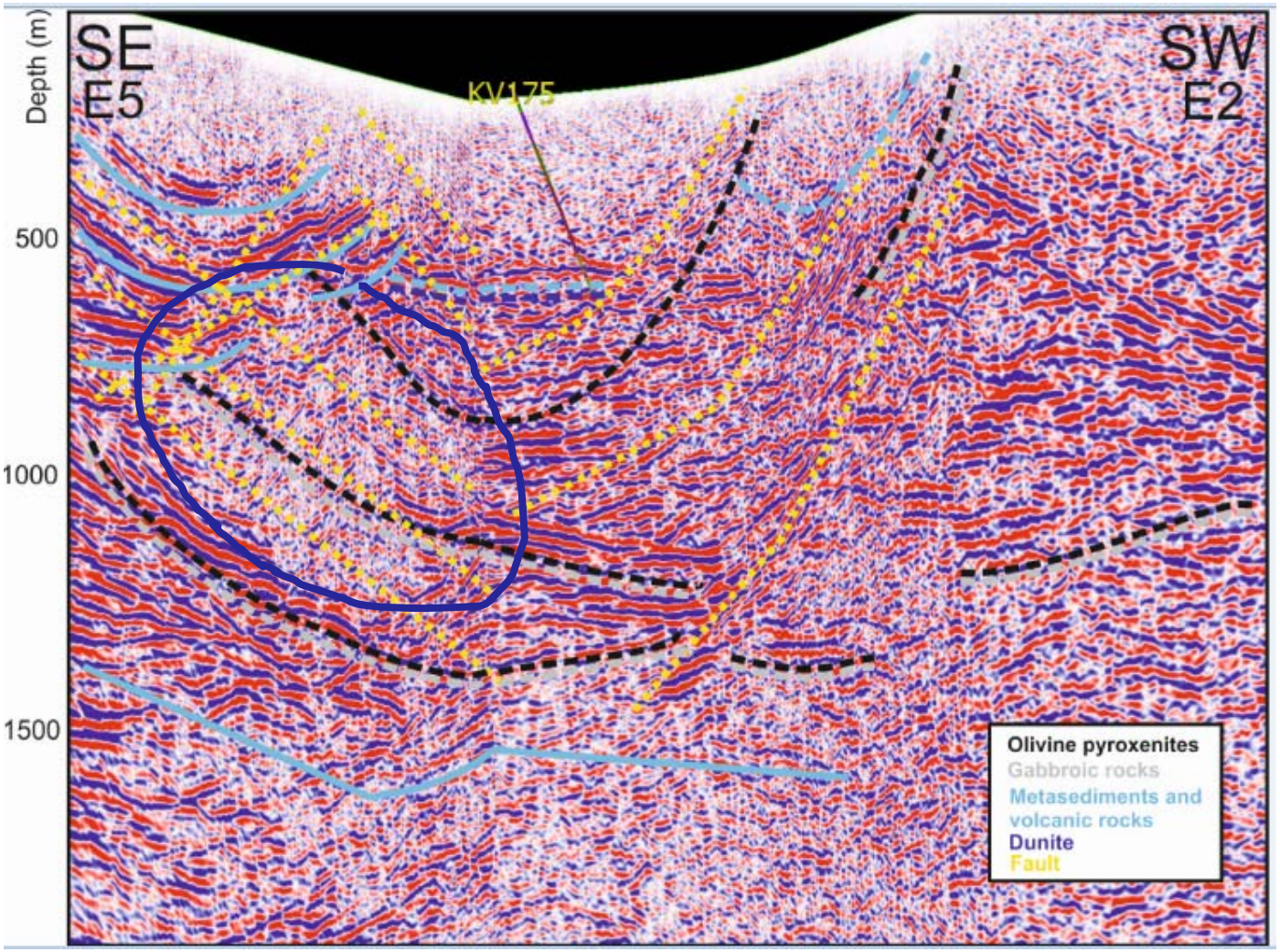
Base of intrusion

- Drill pierce points + 2D and 3D seismic



Extension of intrusion?



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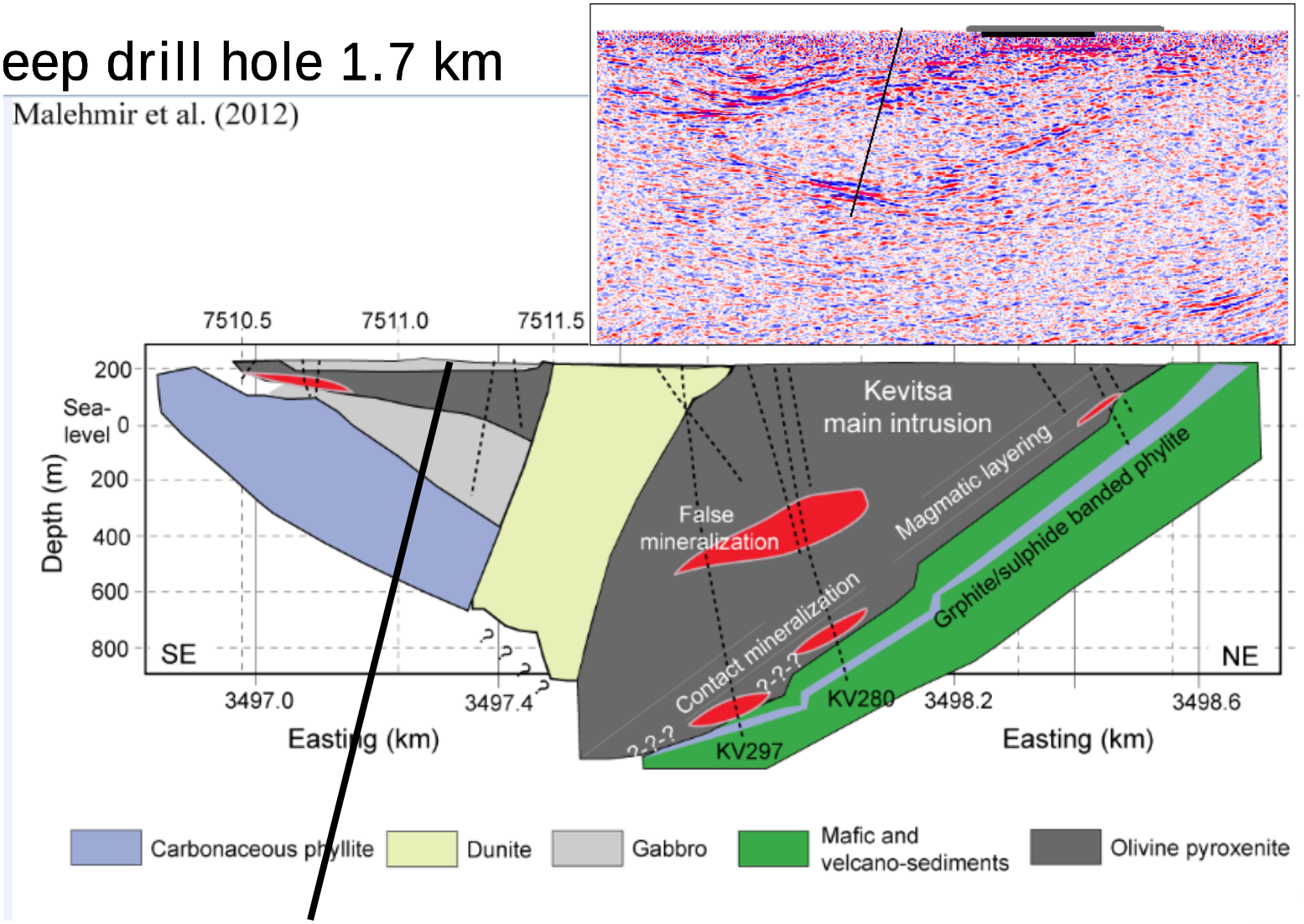
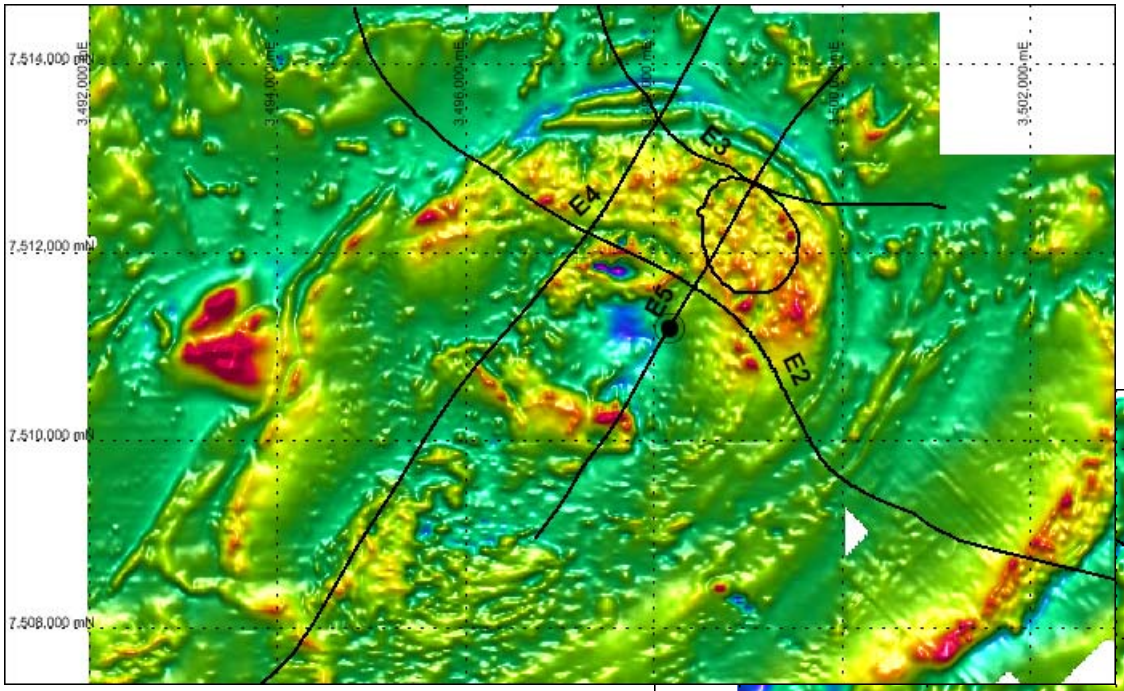
Extension of intrusion?

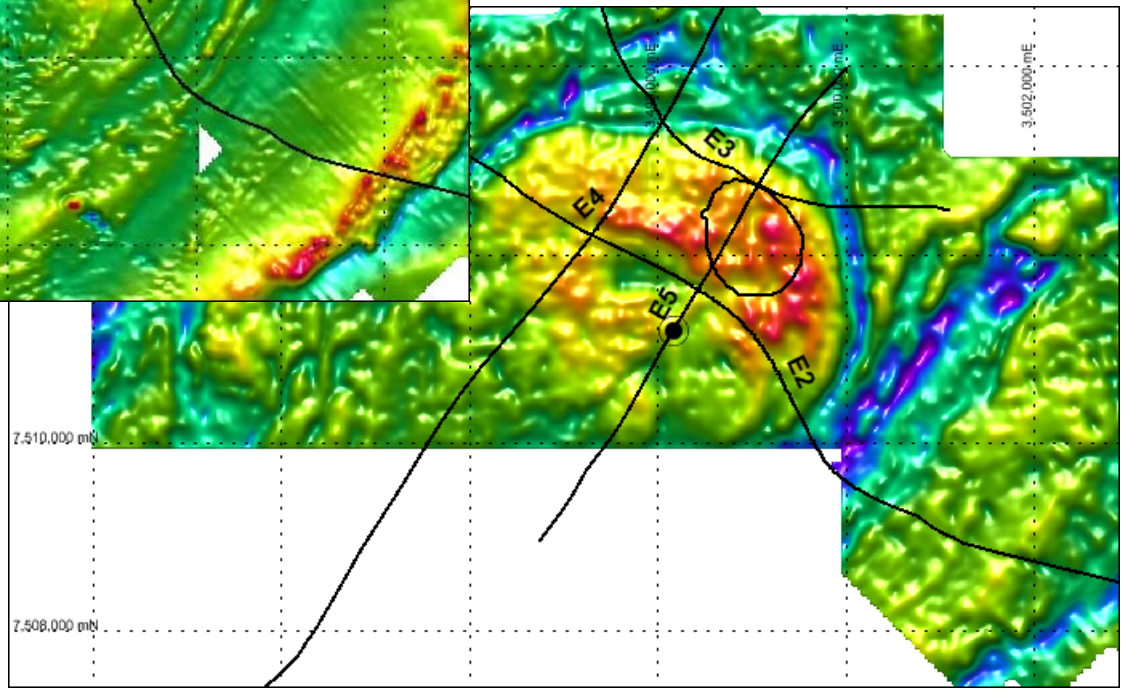
- Deep drill hole 1.7 km



Gravity and magnetics



Magnetics (RTP)



Gravity (Bouguer)

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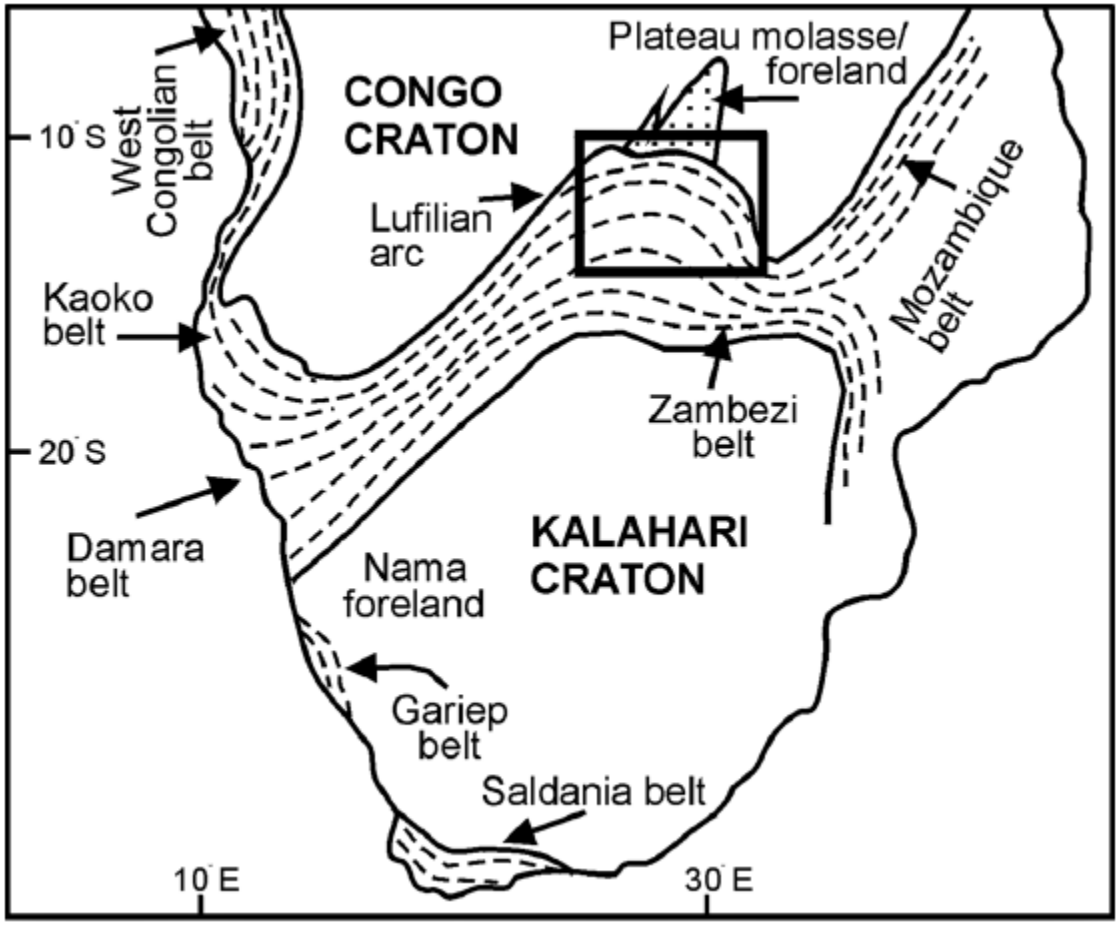
Sediment-hosted Cu

- African Copperbelt = Lufilian Arc



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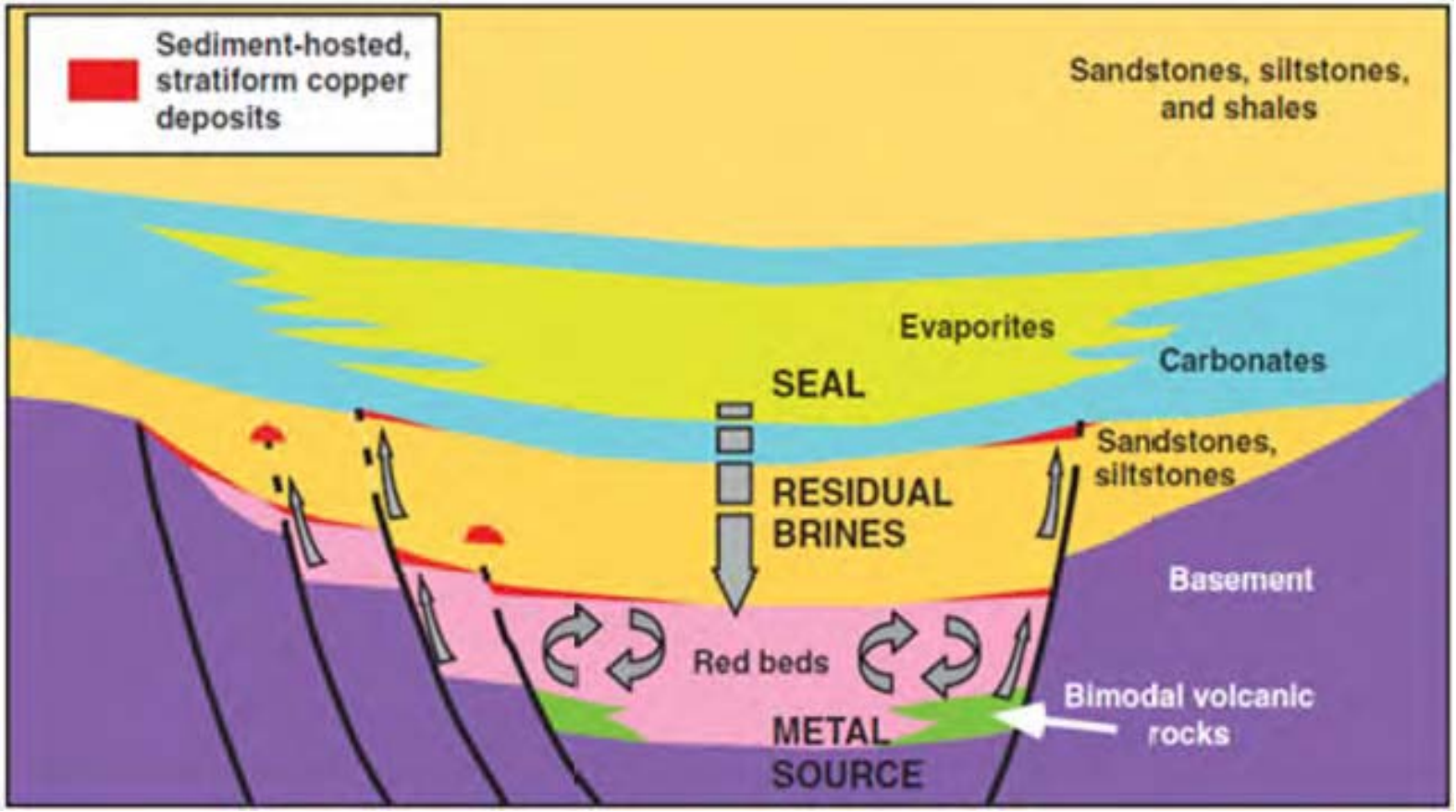
Copperbelt deposit settings

- Schematic stratigraphy, fluid/metal sources, and traps



Hitzman et al, 2010

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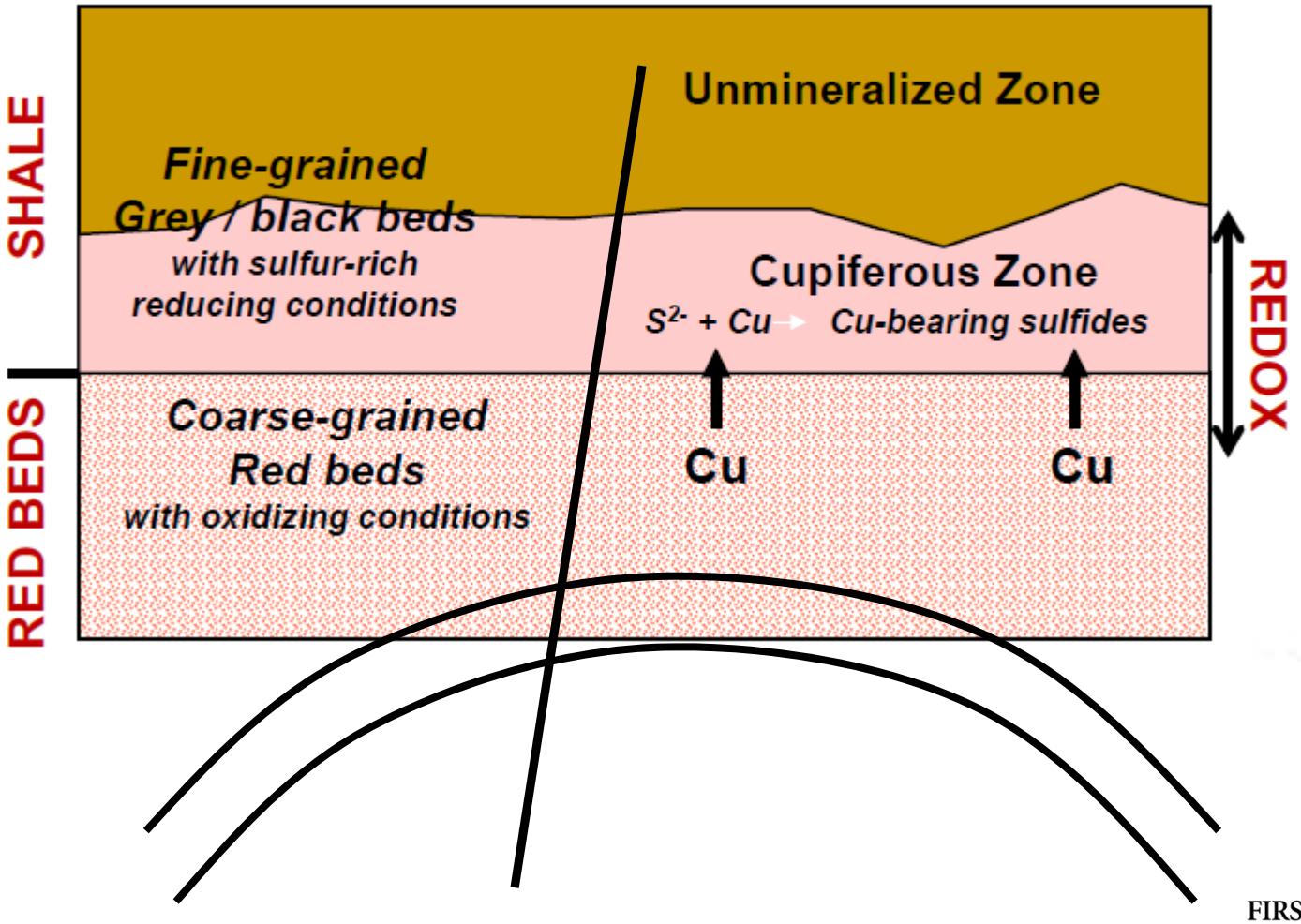
Copperbelt deposit settings

- Simple structural/chemical trap model



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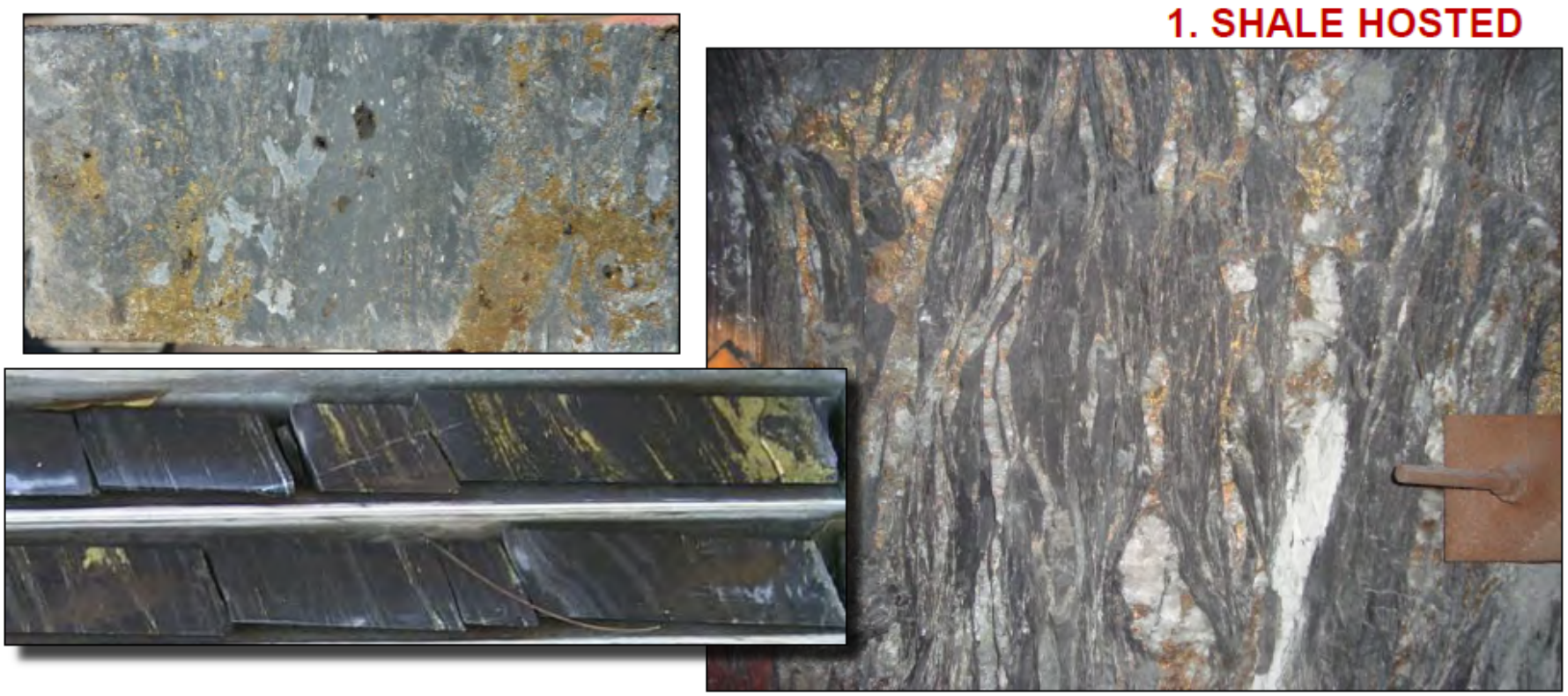
Copperbelt deposit settings - ores

- predominantly in clastic (less commonly carbonate) sediments; (1) large tonnage deposits in dark shales and carbonates above thick red bed sequence



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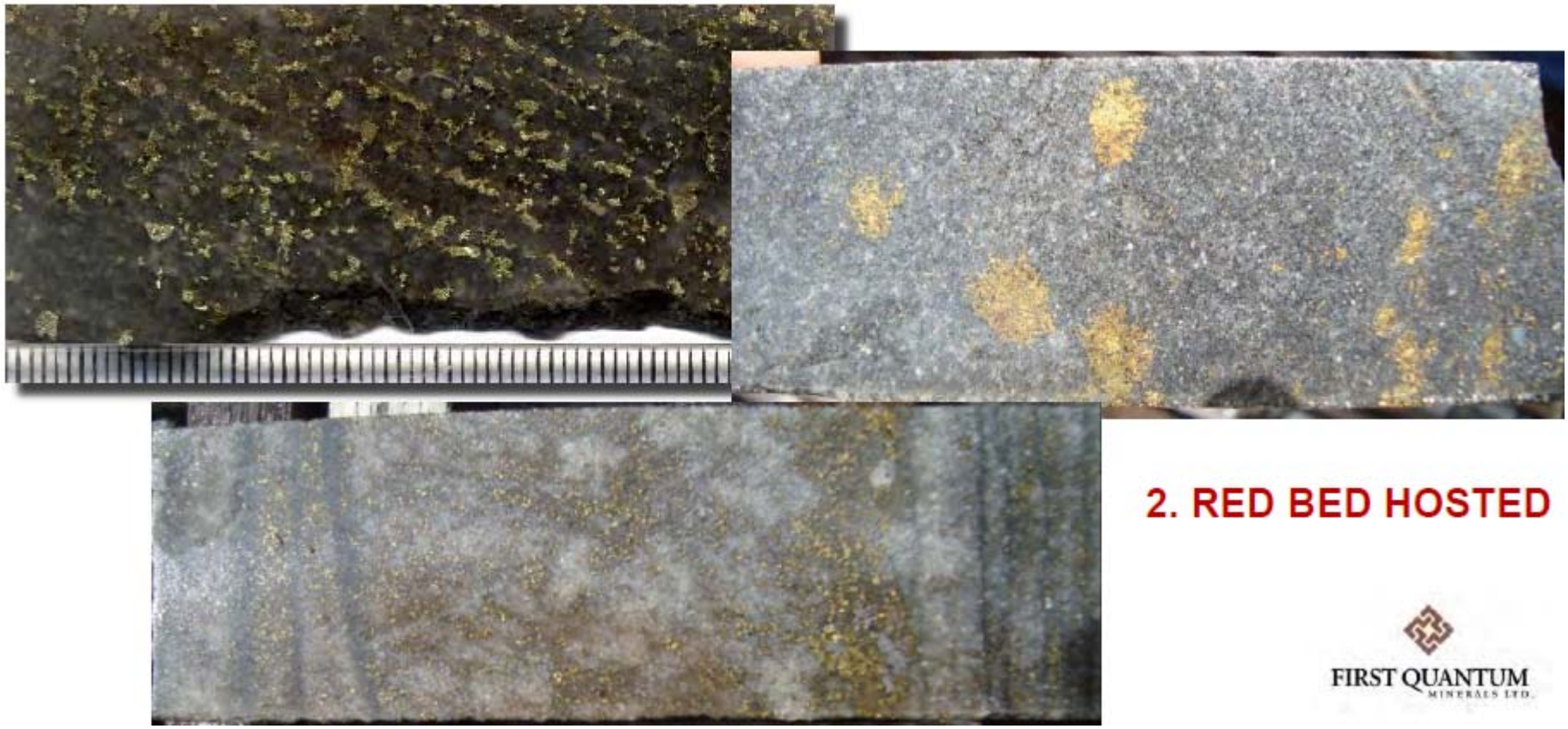
Copperbelt deposit settings - ores

- predominantly in clastic (less commonly carbonate) sediments; (2) small/large deposits in sandstone or arkose lenses within interbedded sandstone/shale redbed



2. RED BED HOSTED

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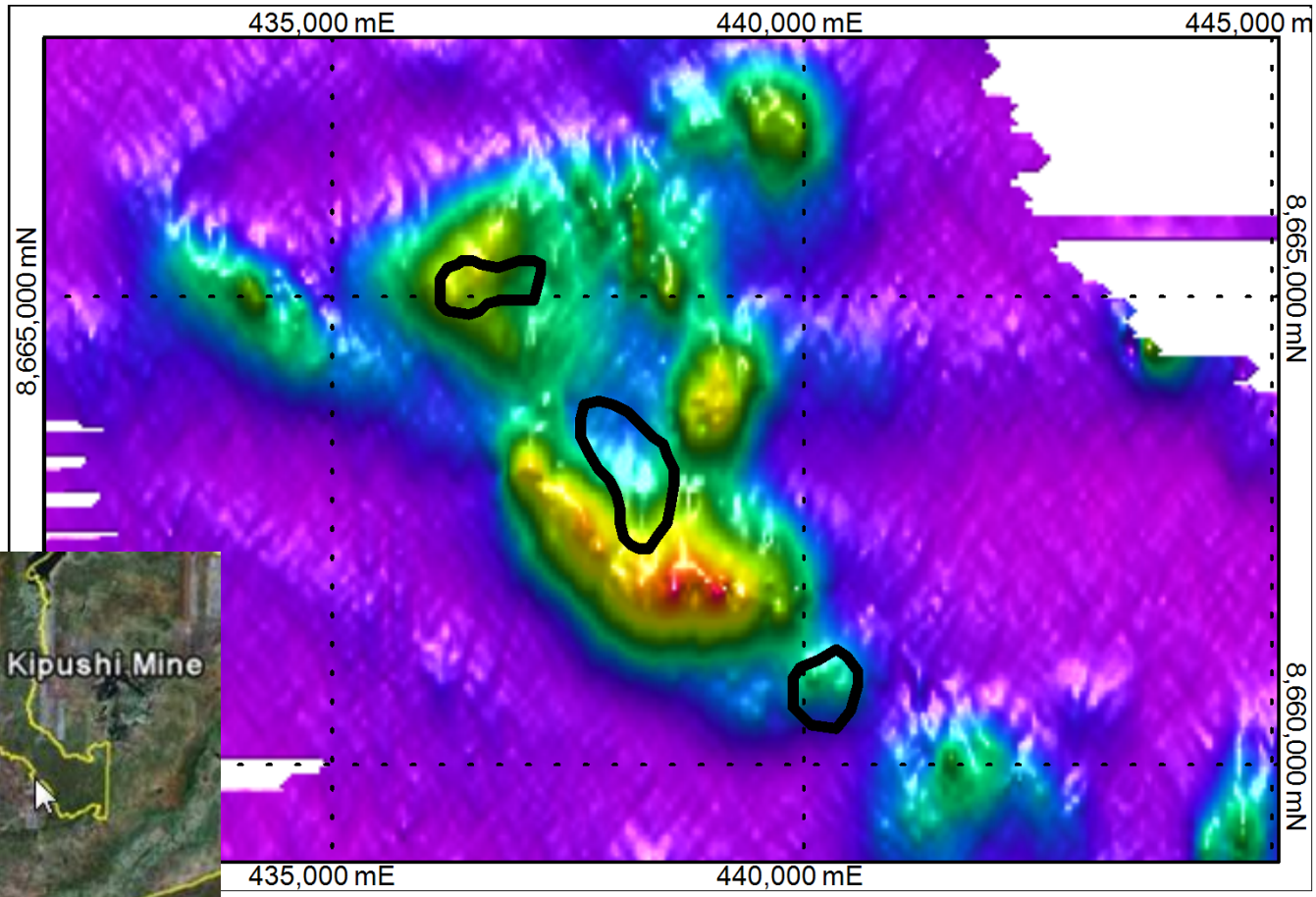
Kansanshi Cu(-Au)

- Kansanshi domes – mineralisation at each local apex



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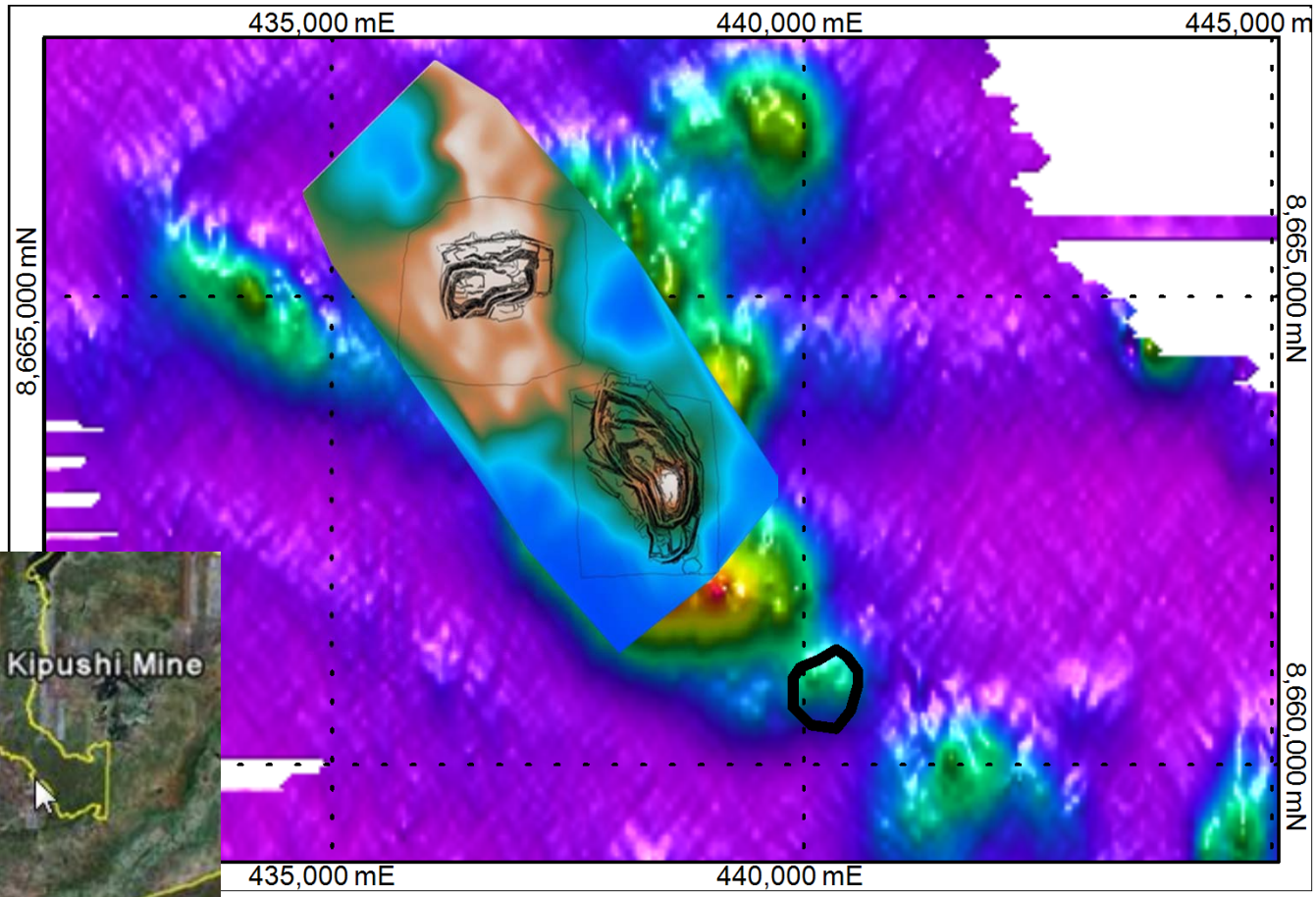

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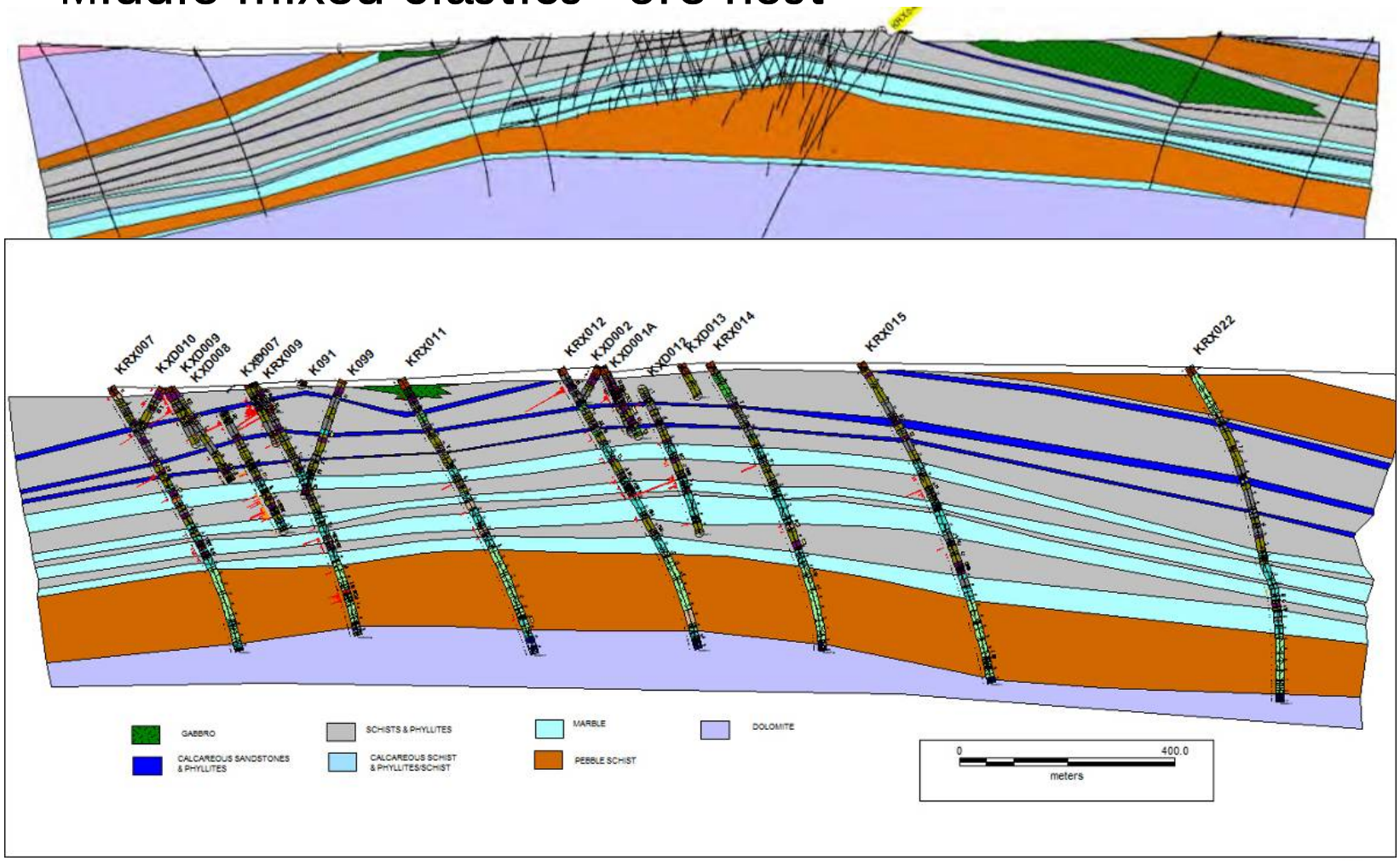
Reductant horizon control

- "Middle mixed clastics" ore host



Drilling result

- Nil

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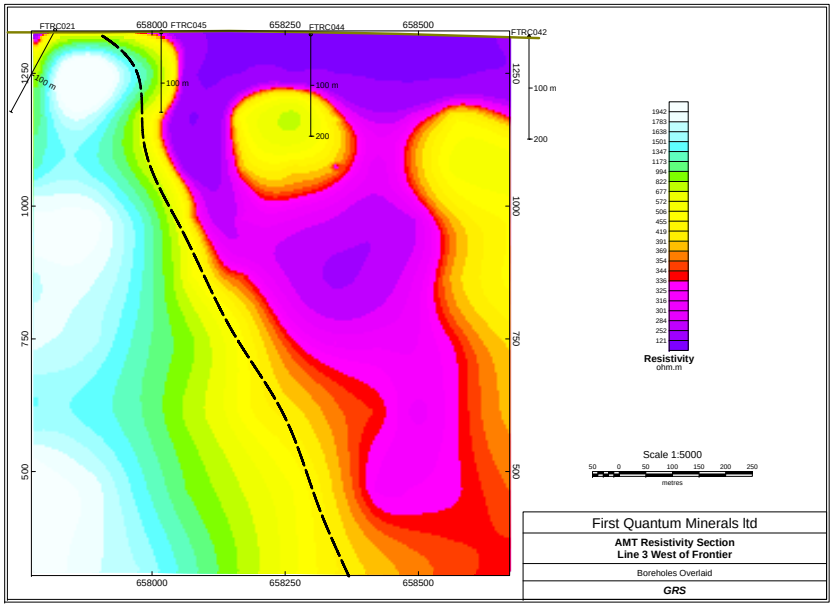
Mapping basement domes with AMT

- AMT conductivity, 16 – 8192 Hz, 1+ km depth resolution
- Control line mapping basement in the west, dominated by Mwashia shale to east



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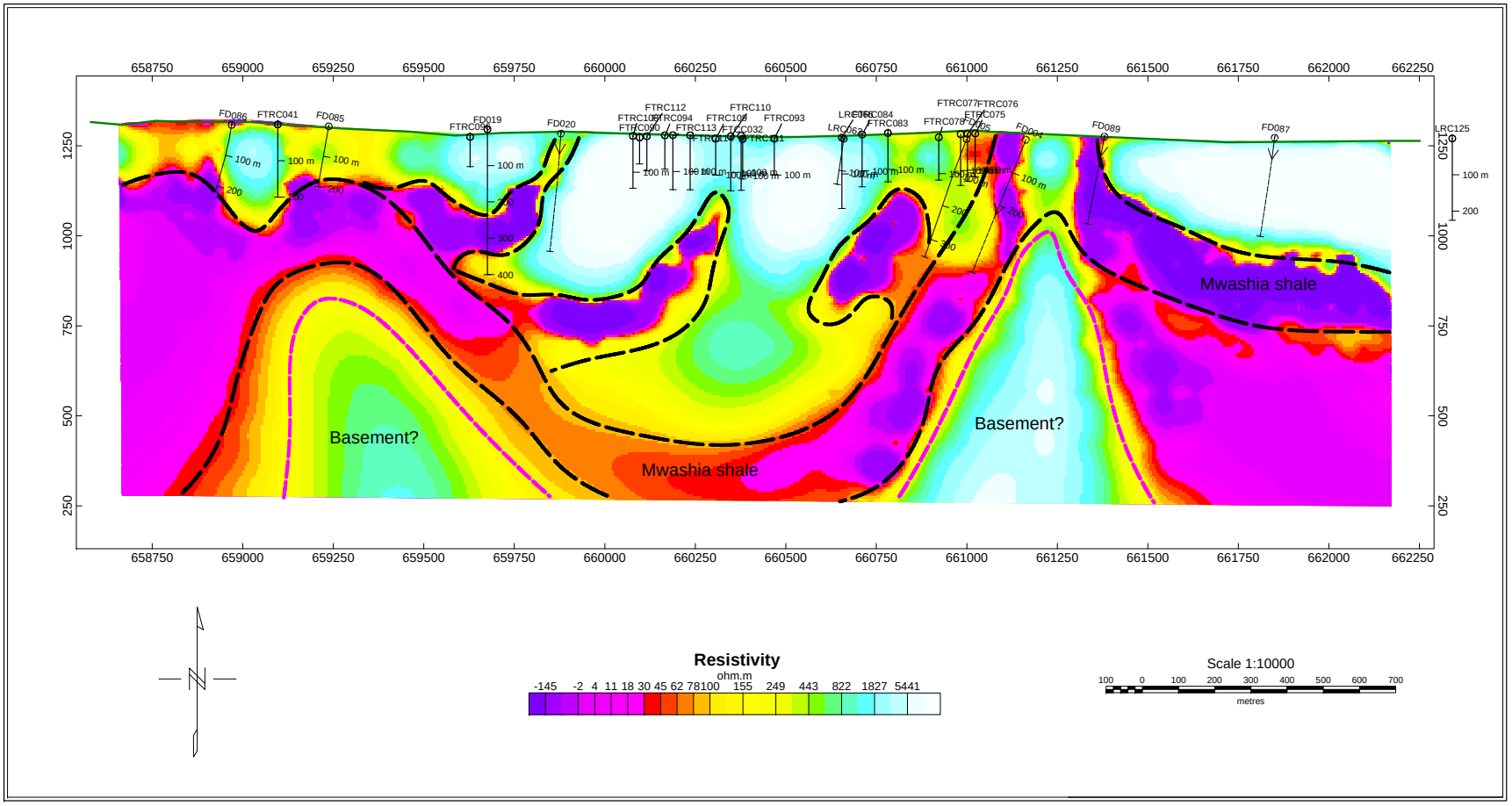

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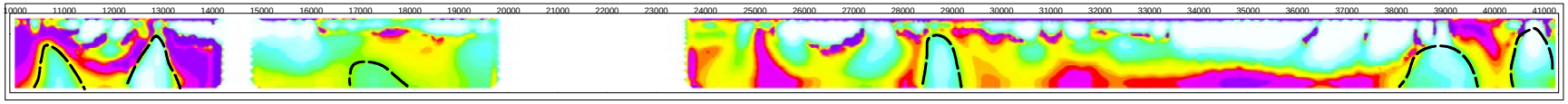
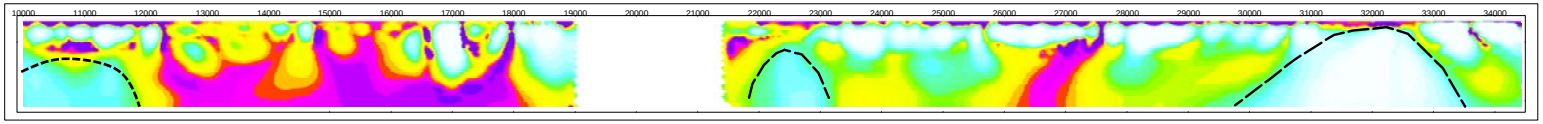
Mapping basement domes with AMT

- Long regional lines < 40 km for detection of hidden basement domes





Depth extent 1.4 km

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Conclusions

- For First Quantum, deep drilling is about geology and not metal
  - improving stratigraphic and structural understanding to help shallow targeting
- Seeing deep is a fight against physics
  - seismic = $$ vs objectives
  - geologically constrained inversions of various data sets
- Explorability depends on deposit style
  - Drill deep for hydrothermal systems with huge alteration footprints
  - NiS cannot afford exploration by deep drilling

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End

- What is “under cover”?
- Do we need to look deep?

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Pyhasalmi

- 2012 production: 12,600 t Cu, 25,600 t Zn, 891,700 Py
- home of the worlds deepest sauna at 1440 metres

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