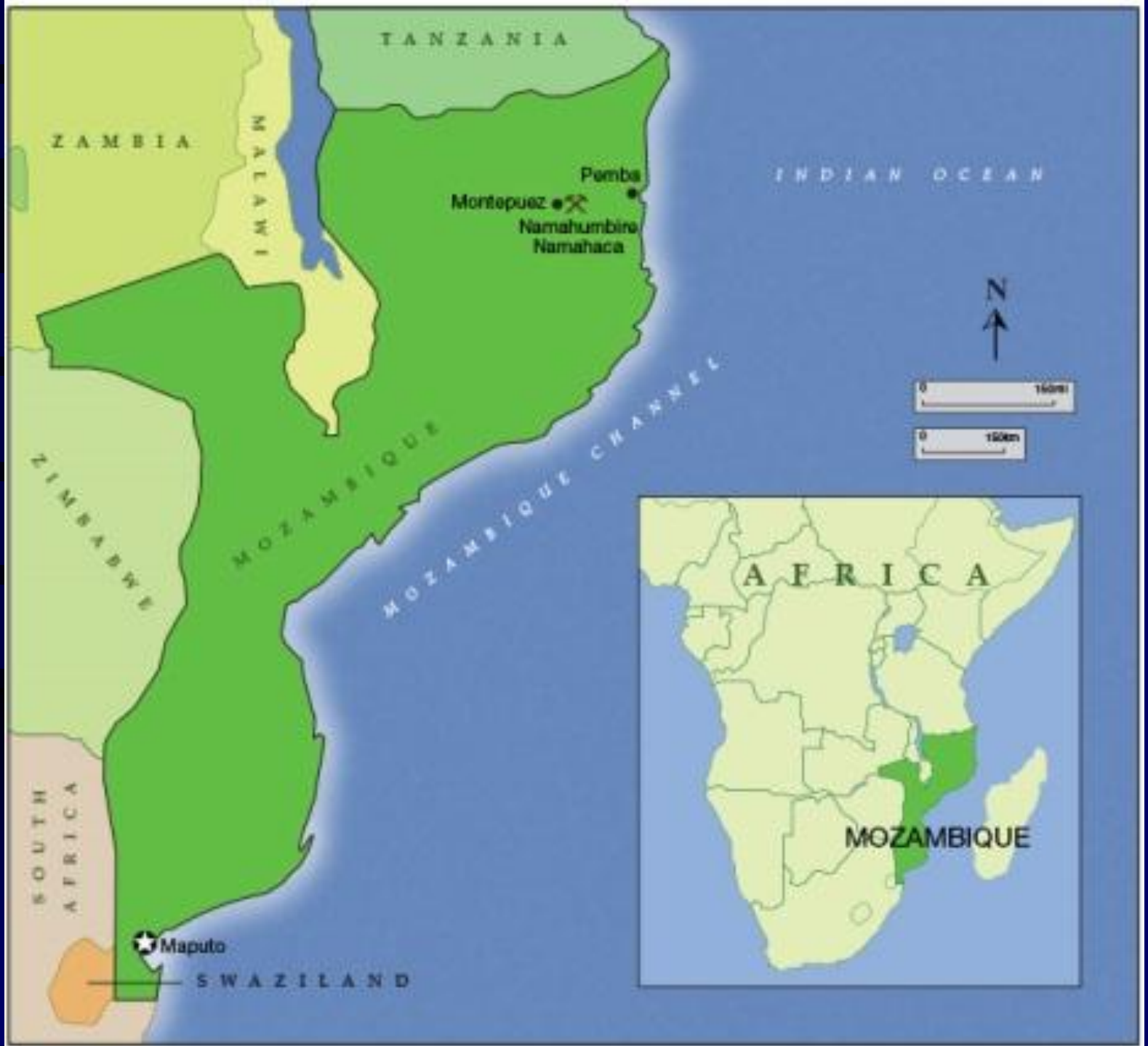
Geophysics of the ruby bearing Amphibolitic Gneisses – Montepuez Complex, Mozambique

Tenyears Gumede

Preamble

- **Montepuez is Mozambique's principal** ruby producing district.
- **Little systematic work appears to have** been undertaken/published in relation to the correlation between presence of rubies within the area and associated geology or geophysics
- To better understand the specific associations of garnets, corundum and ruby with their host formations, **it was deemed worthwhile to survey existing workings**
- **A team from Zimbabwe and Mozambique** conducted ground magnetic and very low frequency (VLF) electromagnetic surveys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ZAMBIA
MALAWI
Pemba
Montepuez
Namahumbire
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INDIAN OCEAN
N
MOZAMBIQUE CHANNEL
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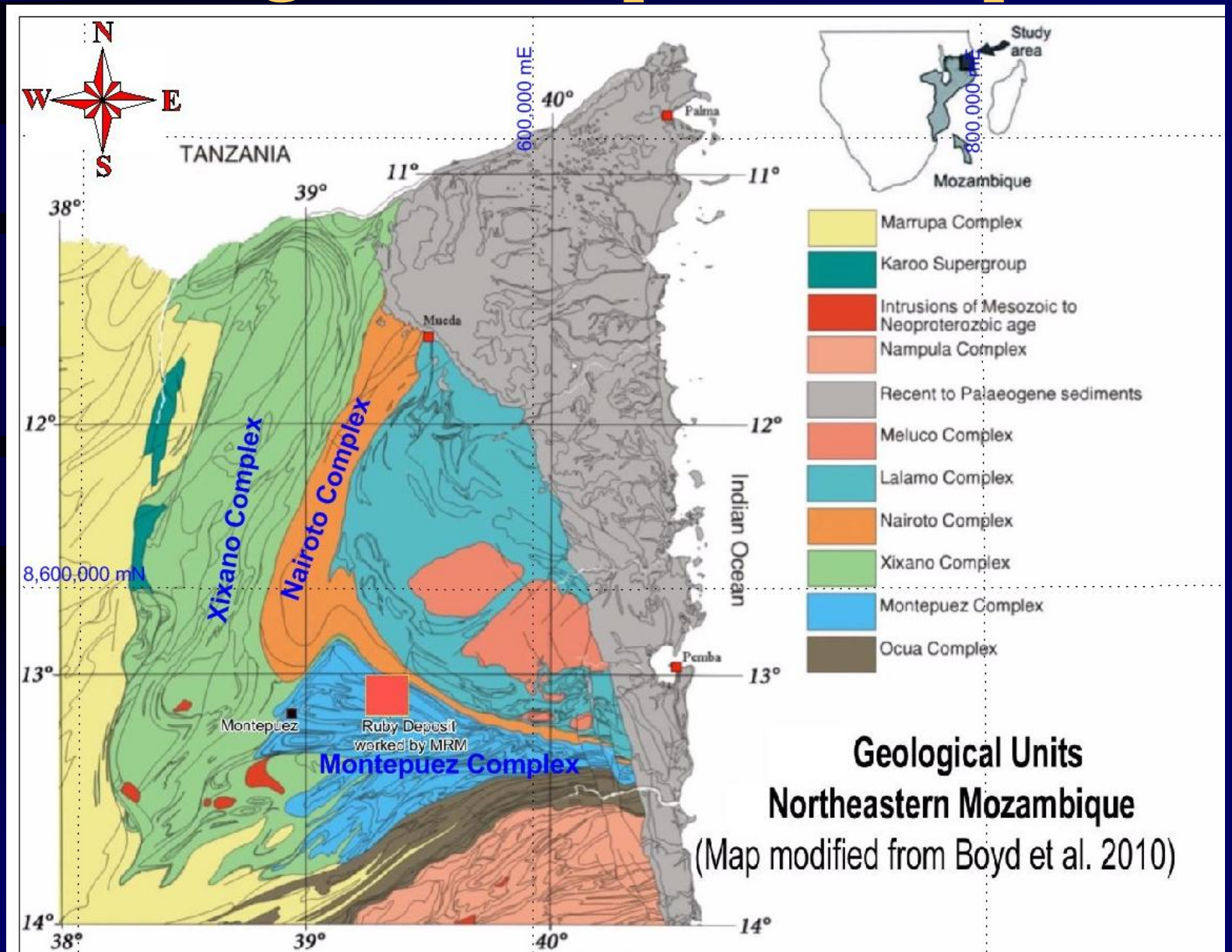
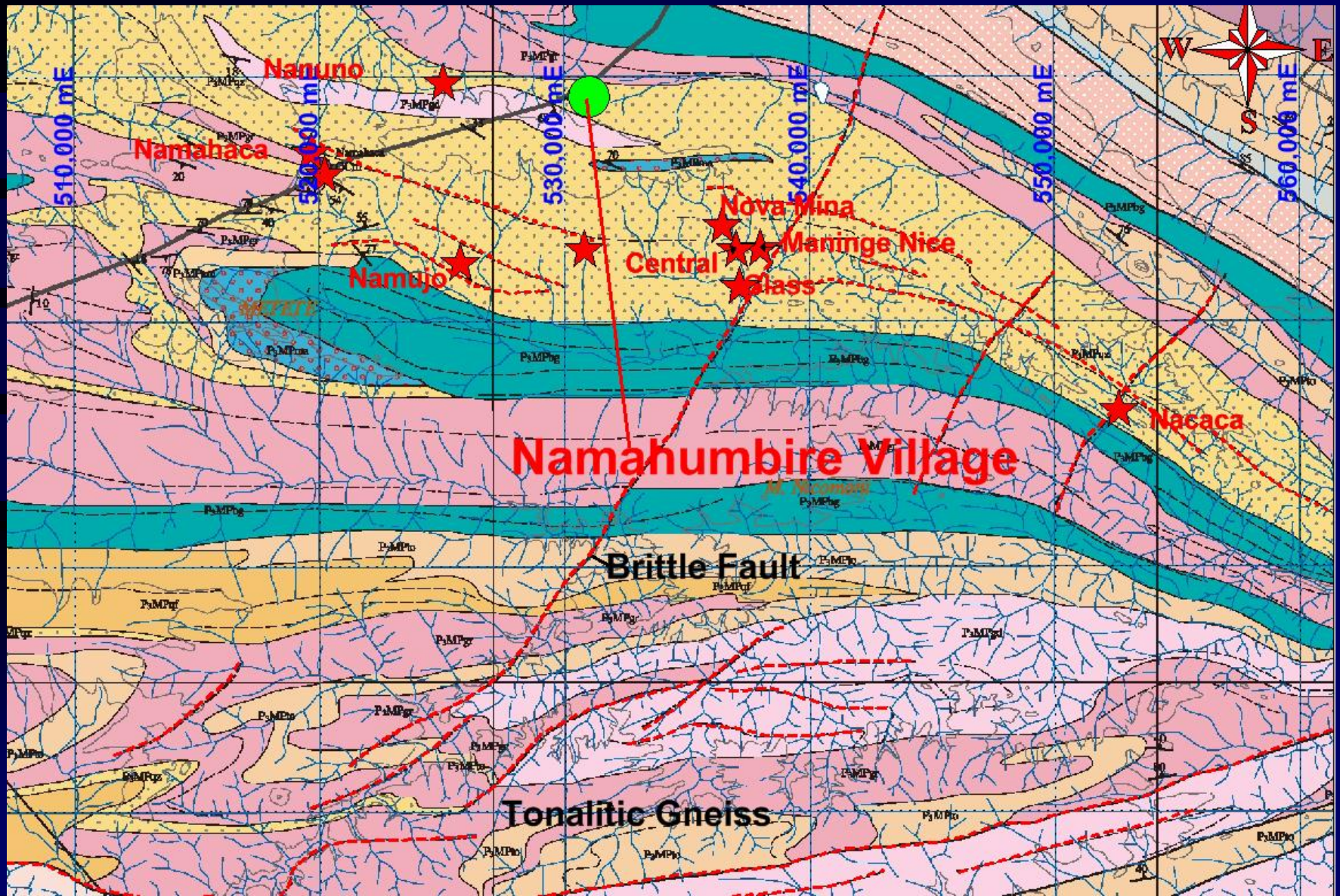
SOUTH AFRICA
Maputo
SWAZILAND
AFRICA
MOZAMBIQUE

Geological Setup - Montepuez

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Namahaca
Namujo
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Central
Glass
Nacaca
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W
E
S

Entrance to the areas

- Most production of Ruby consists of tabular hexagonal crystals.
- Material showing abraded features comes from alluvial/detritic deposit
- Material obtained from primary deposits is associated with some feldspar, mica or amphibole minerals.

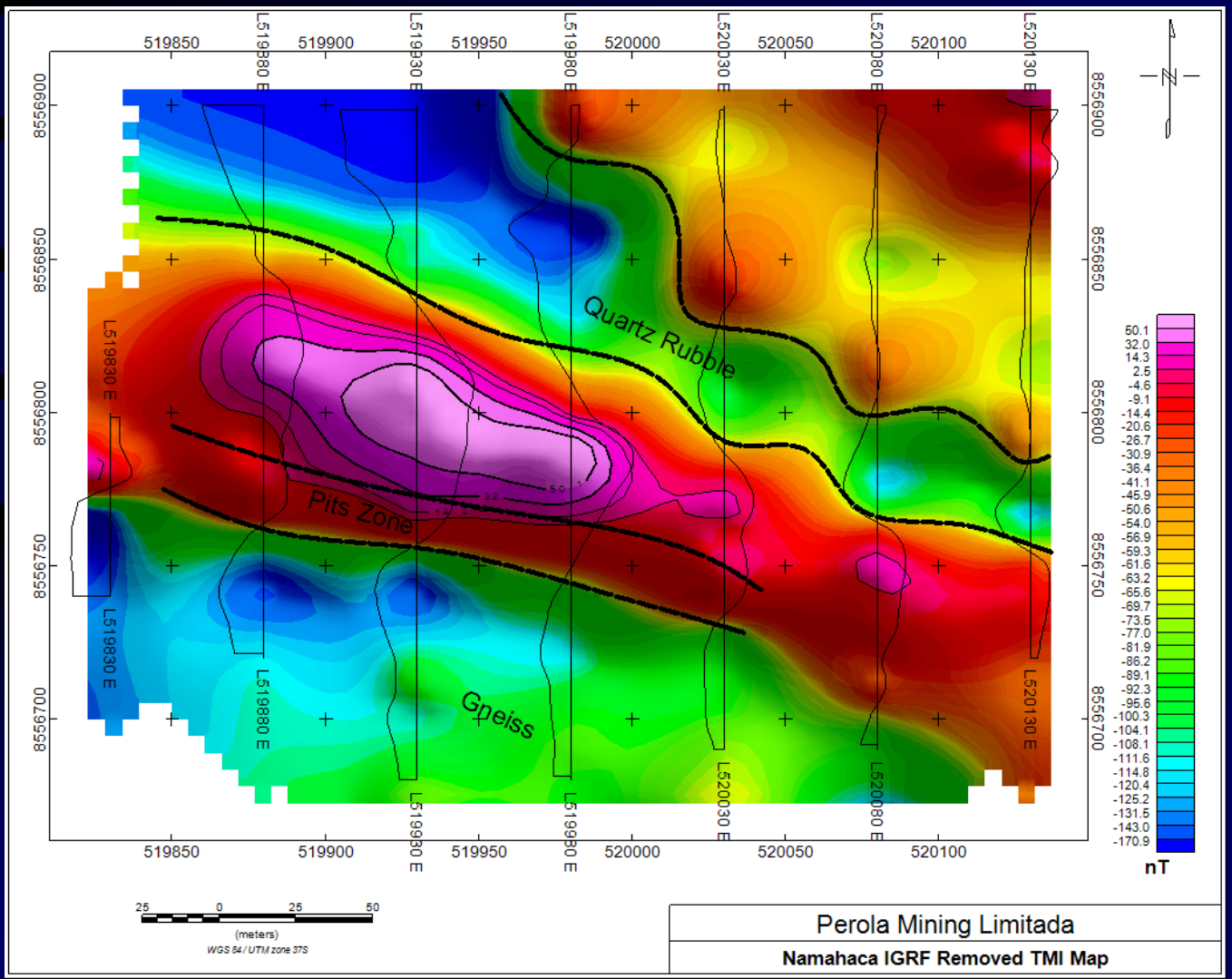
- Generally highly fractured

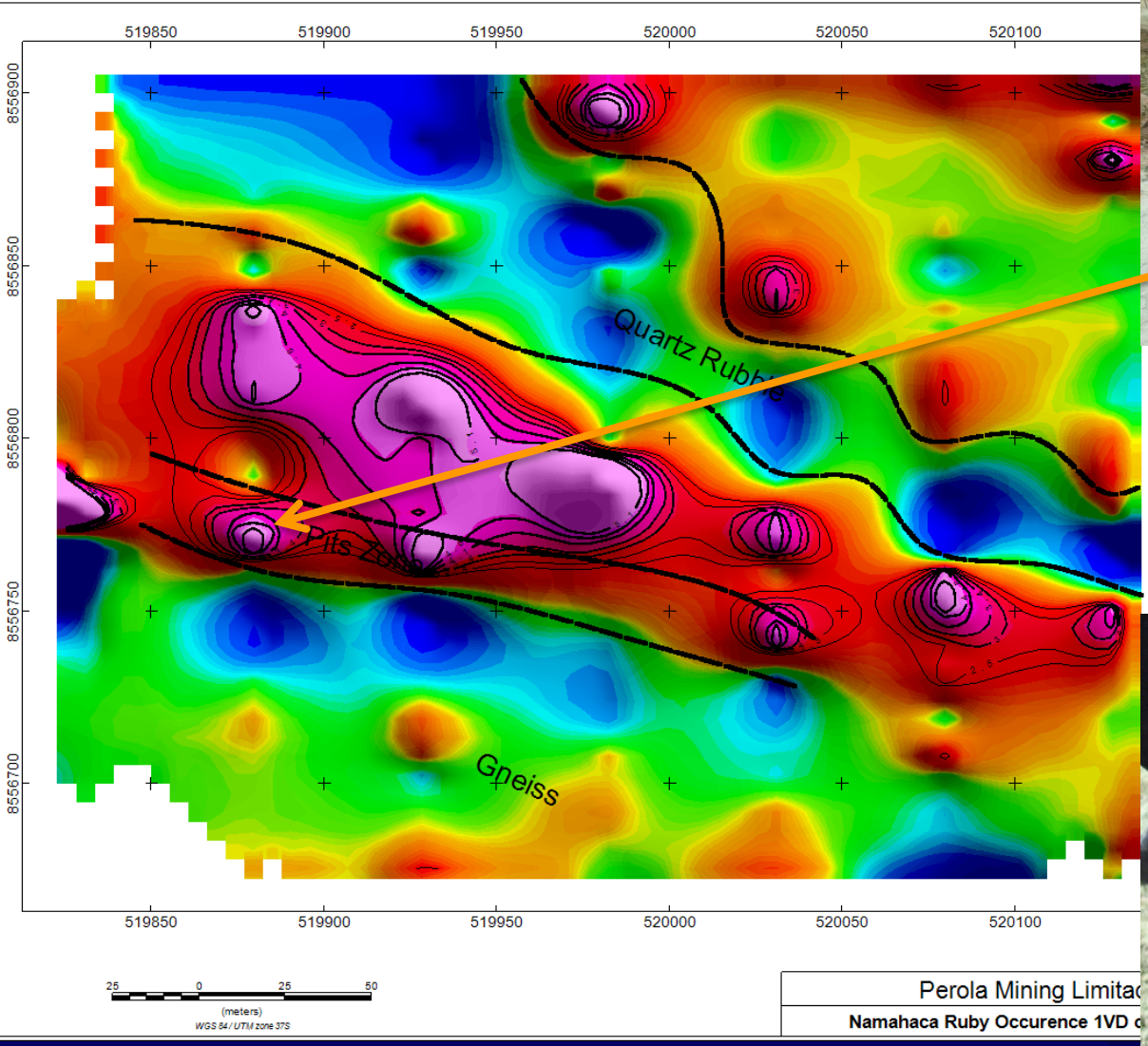
Alluvial panning by team to ascertain occurrence

Alluvial workings by Garimperos – targeting rhodolite, spessartite and rubies

Known Corundum/Ruby occurrences

Corundum / Ruby Target

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Quartz Rubble
Pits Zone
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3.4
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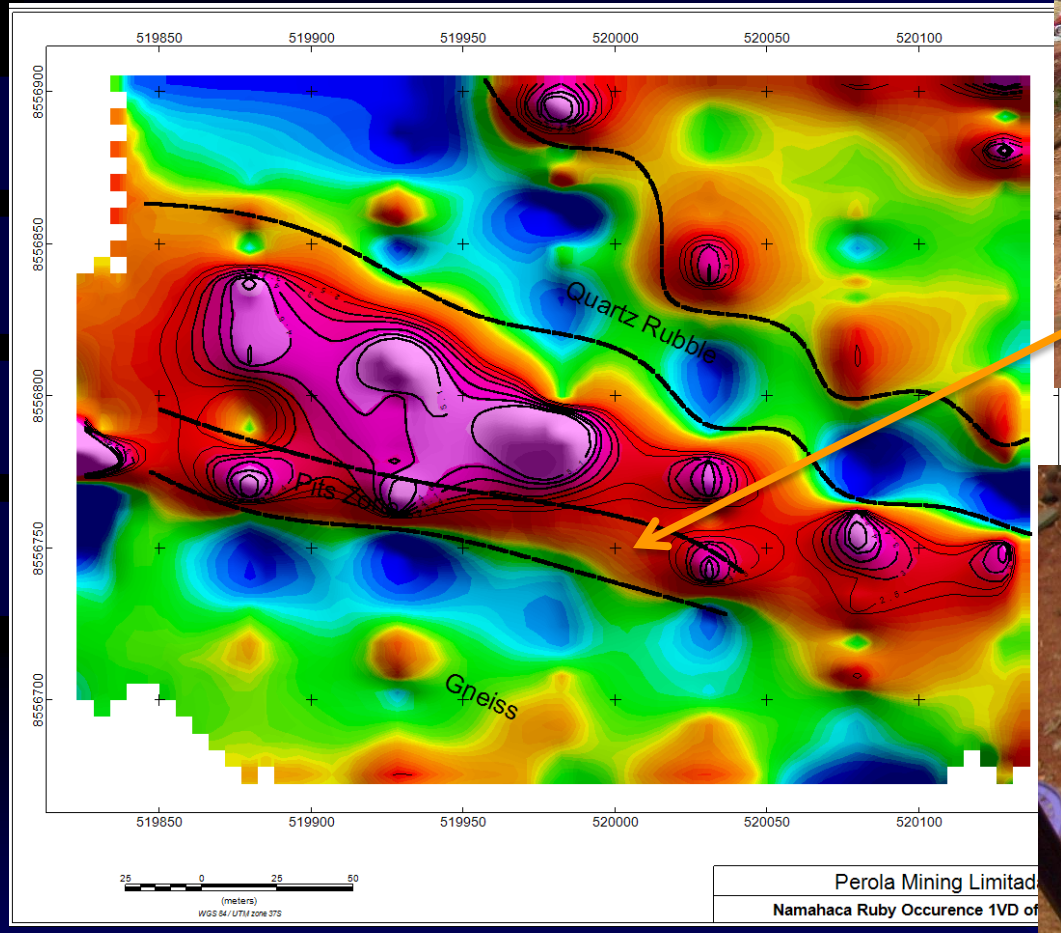
(meters)
WGS 84 / UTM zone 37S
Perola Mining Limited
Namahaca Ruby Occurence 1VD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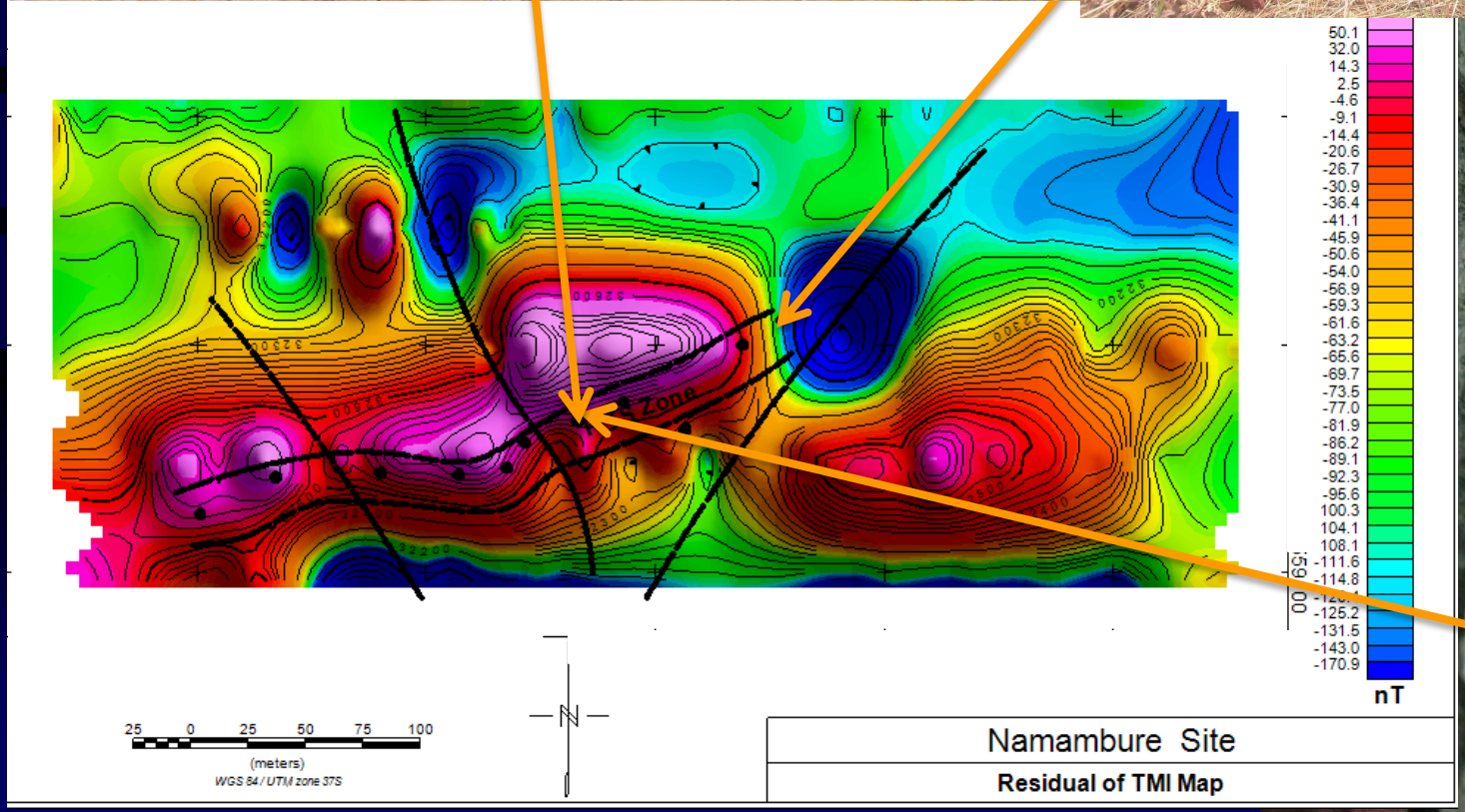
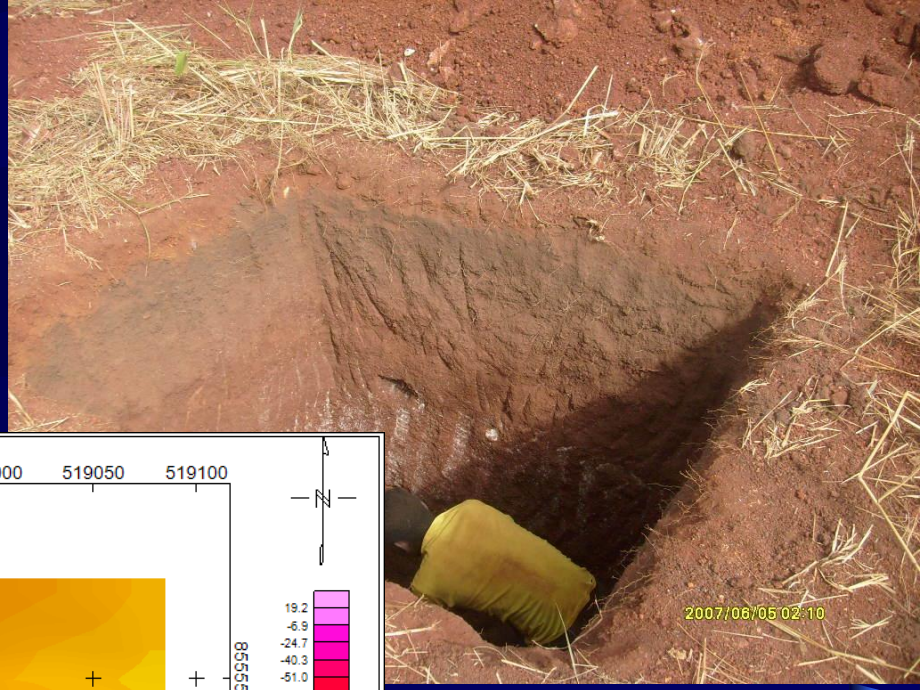
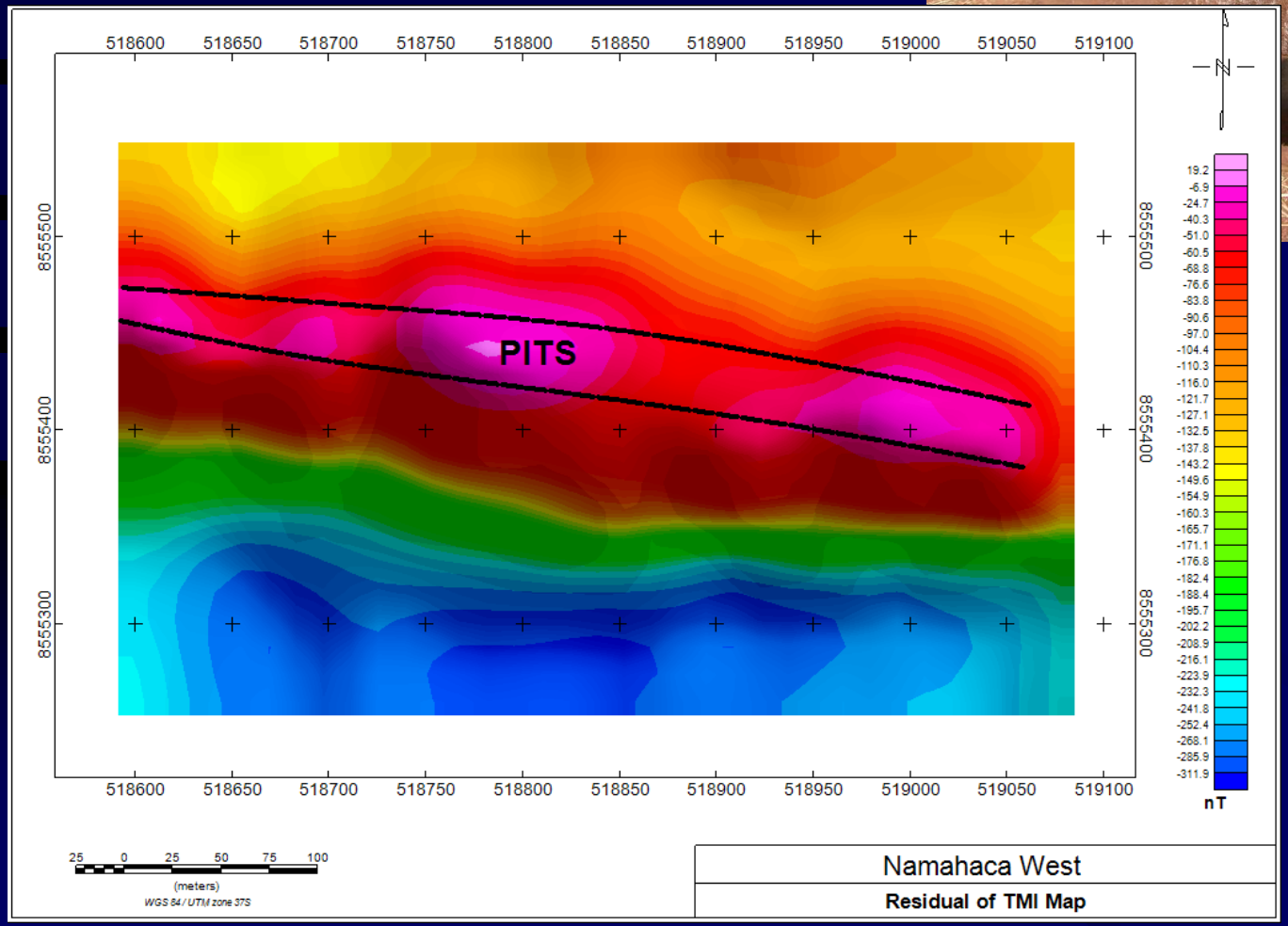
Producing Ruby Target



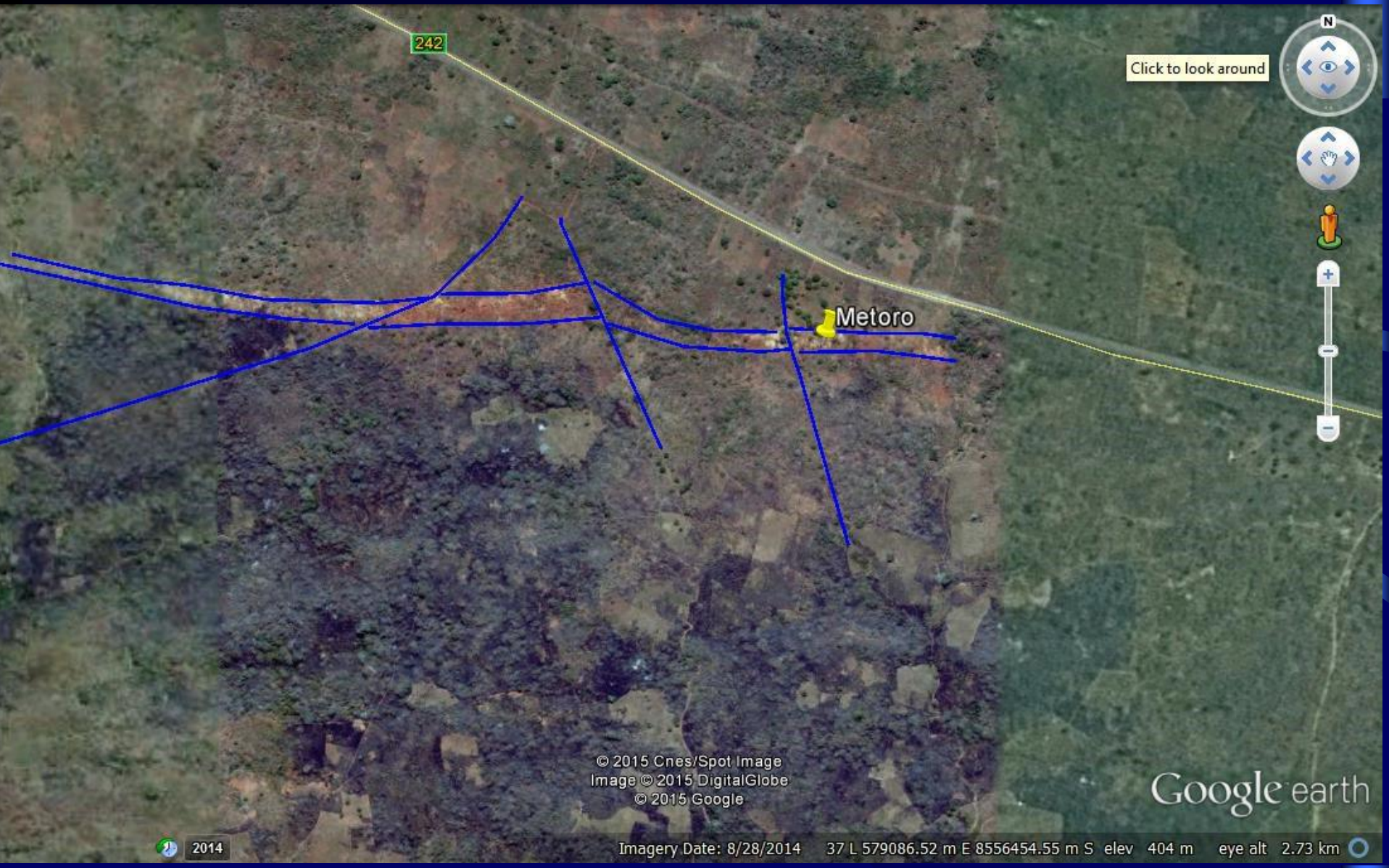

N
Namahaca West
Image © 2015 CNES / Astrium
© 2015 Google
Google earth
2013
Imagery Date: 7/15/2013 37 L 517738.52 m E 8555743.10 m S elev 564 m eye alt 2.53 km



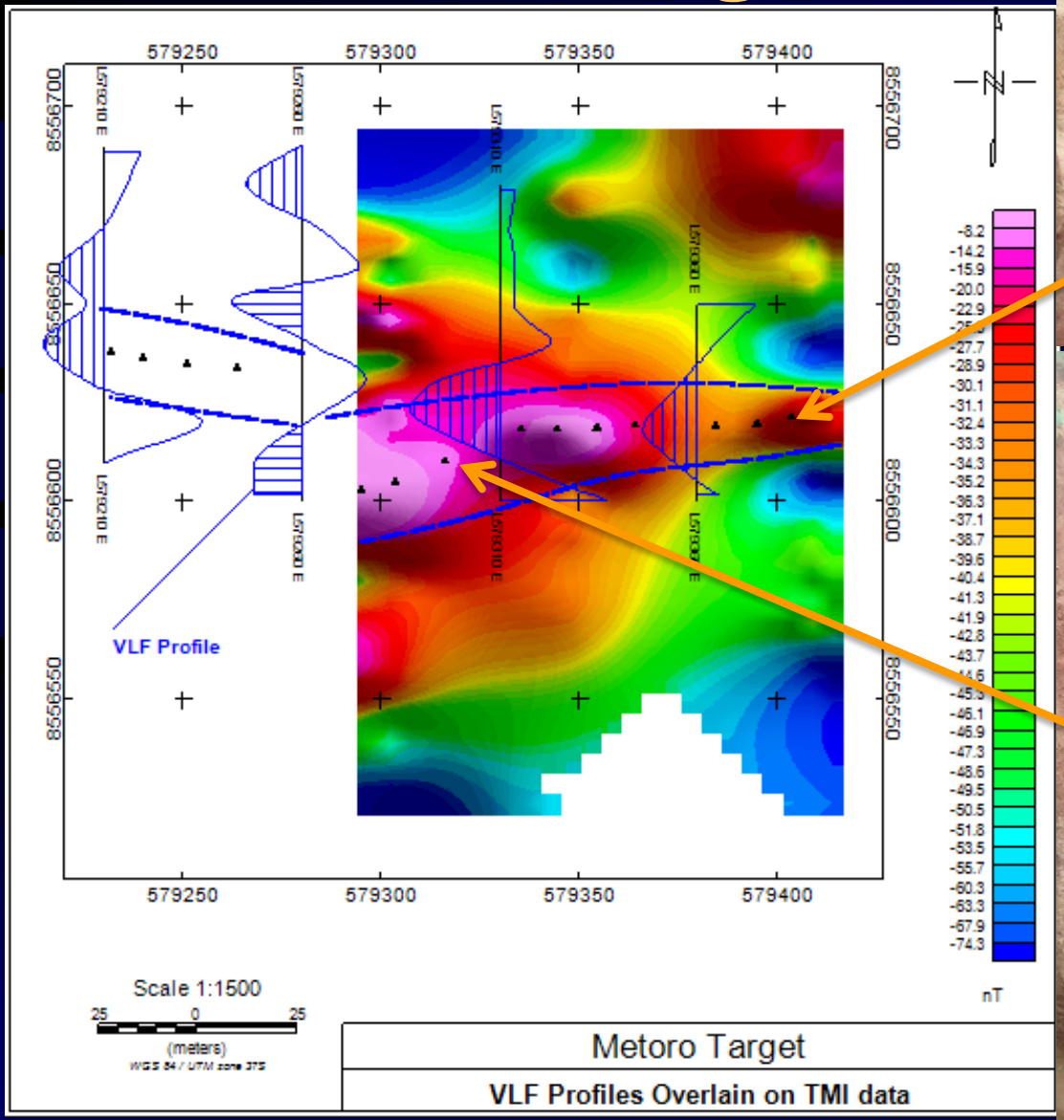


- Pits lie directly above the magnetic anomaly.
- Means the primary deposit is steeply dipping
- Pits as dip as 15m before evidence of the primary rock
- Peak magnetic anomaly of 19.2nT (IGRF removed)

Garnet Occurence



Rhodolite Target



Summary – Known Occurrences

Ruby/Corundum Targets

- Highly magnetic with peak anomalies of 50nT
- The Garimperos target the southerly boundaries of the anomalies – Modelling shows the anomalies dip steeply to the north, hence the more magnetic mass lies concealed at depth, unreachable by artisanal methods.
- Primary host mass is amphibolitic, hence magnetic, relative to gneisses

Summary Cont

Garnet Targets

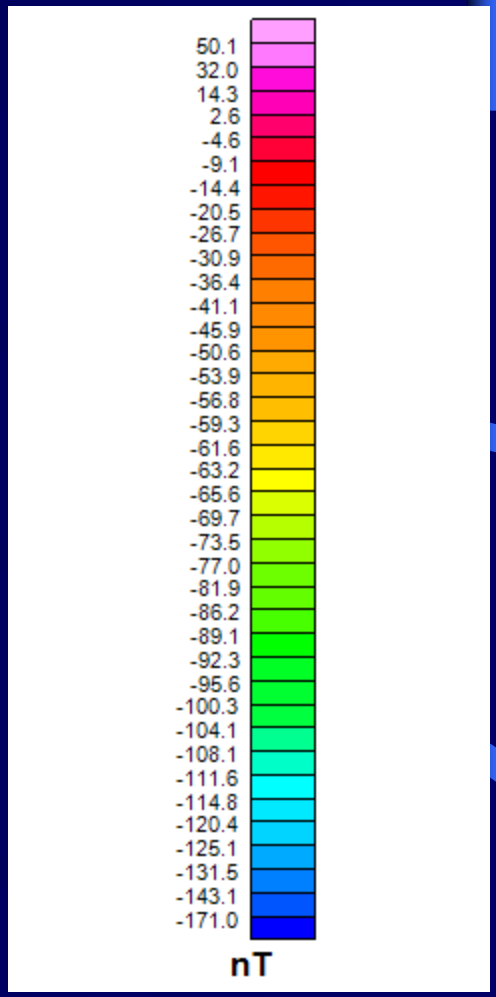
- The targets are fairly magnetic but with a peak anomaly of 8nT (compare with 50nT Ruby Corundum Targets)
- Steeply dipping, hence pits are above the magnetic anomalies
- Host rock is a schist – rhodolite is brought to surface by artisanal engulfed in a schist

Development/Application of Framework on Virgin Ground

- Discernible points of commonality between corundum/ruby hosting formation on one hand and garnet hosting formations on the other
- The corundum/ruby control sites were used to develop magnetic signature for corundum/ruby hosting formations
- Garnet control sites were used to develop magnetic signature for rhodolite/spessartine

Application

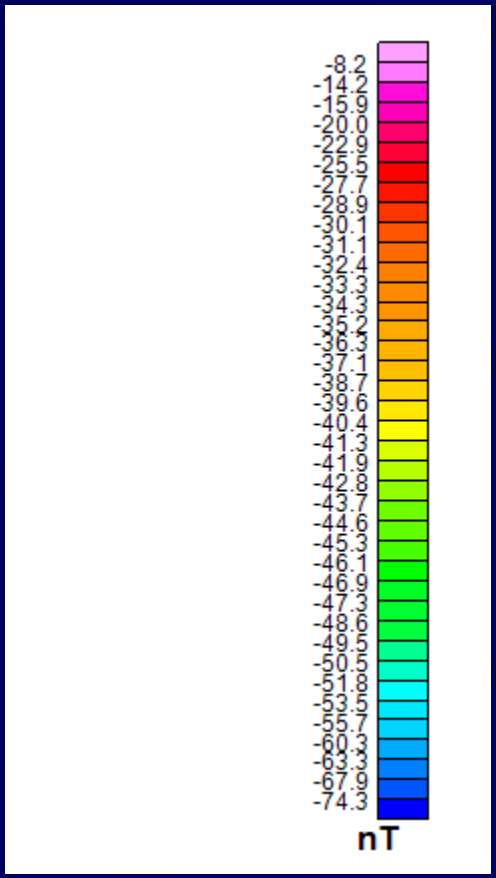
- Based on the two control sites for corundum/ruby, a lookup colour table (LUT) was developed to subsequently apply to other magnetic data in the area for defining corundum/ruby.
- The LUT was applied across the magnetic data to map out potential corundum/ruby targets



Corundum/Ruby Zone File (LUT)

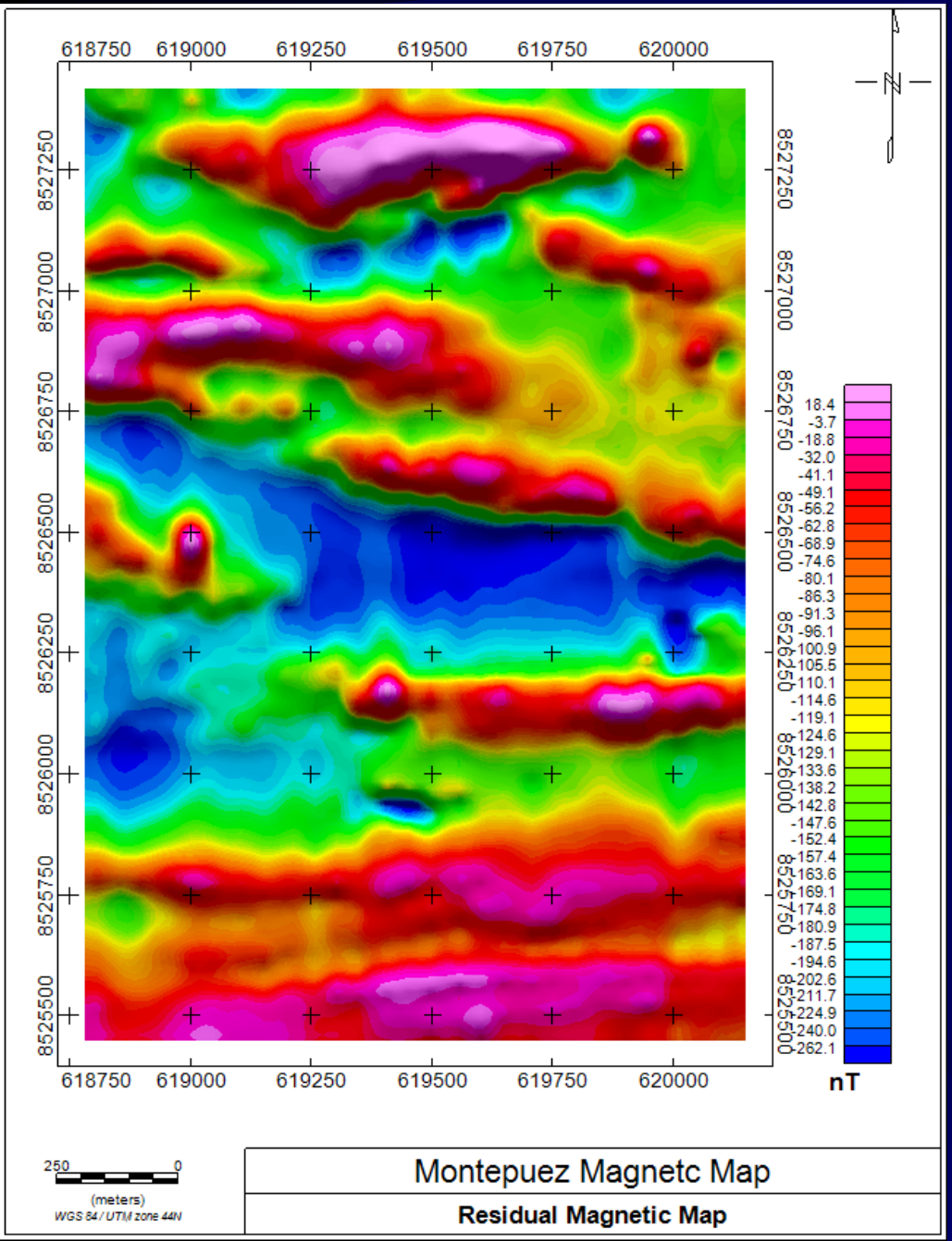
Application cont

- An equivalent exercise done from garnet control sites (here 4 sites were used)
- The peak values from the sites were -8.0nT,
- -8.2nT, -5.5nT and -7.0nT
- Generally, pinches and swell along strike
- Peak value from LUT is -8.2nT



Garnet Zone File (LUT)

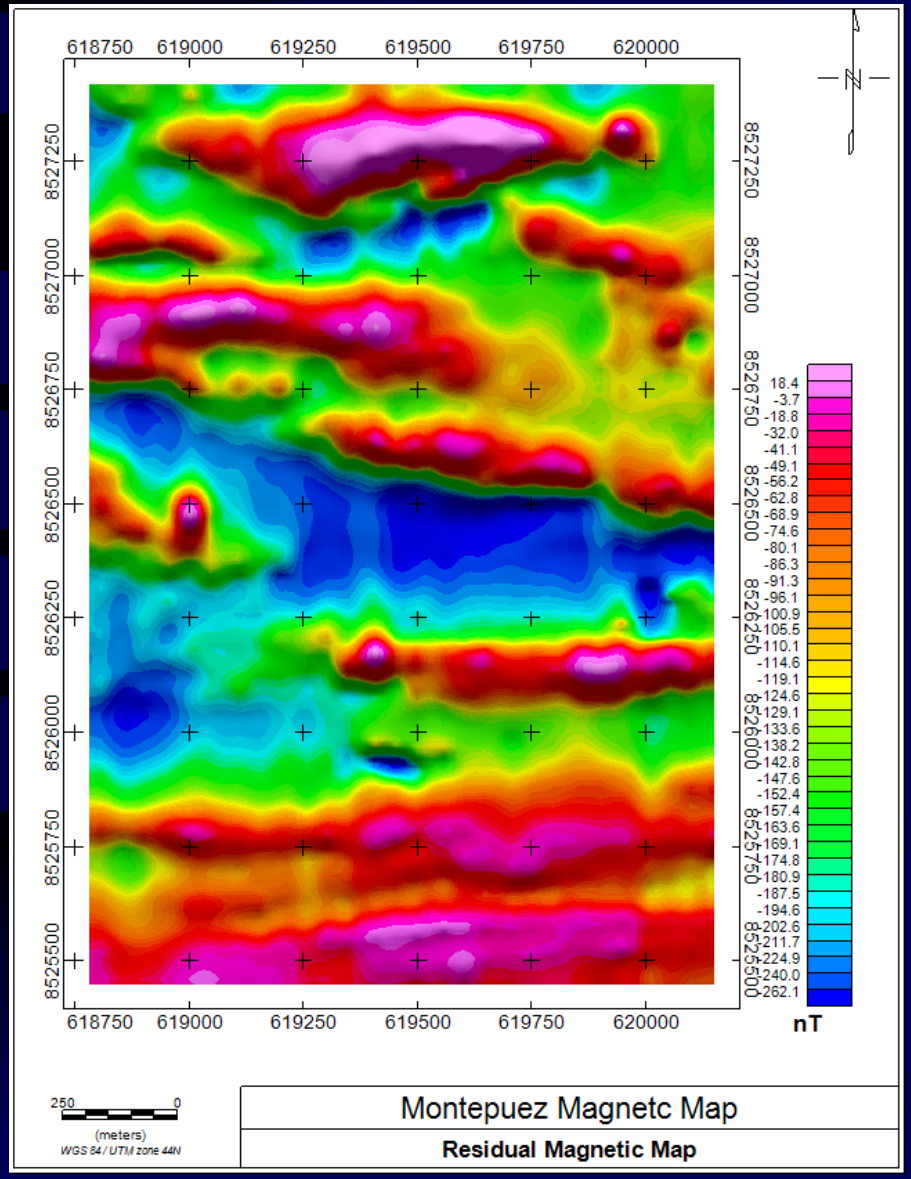
Application



- Magnetic Survey Results – applying histogram equalisation for colour distribution
- Peak Magnetic anomaly is 18.4nT

➢ Remember, for corundum/ruby targets, the peak anomaly was 50nT and for garnet targets, the peak was -8nT

- Need to apply the corundum/ruby and garnet LUT files to the data to generate refined targets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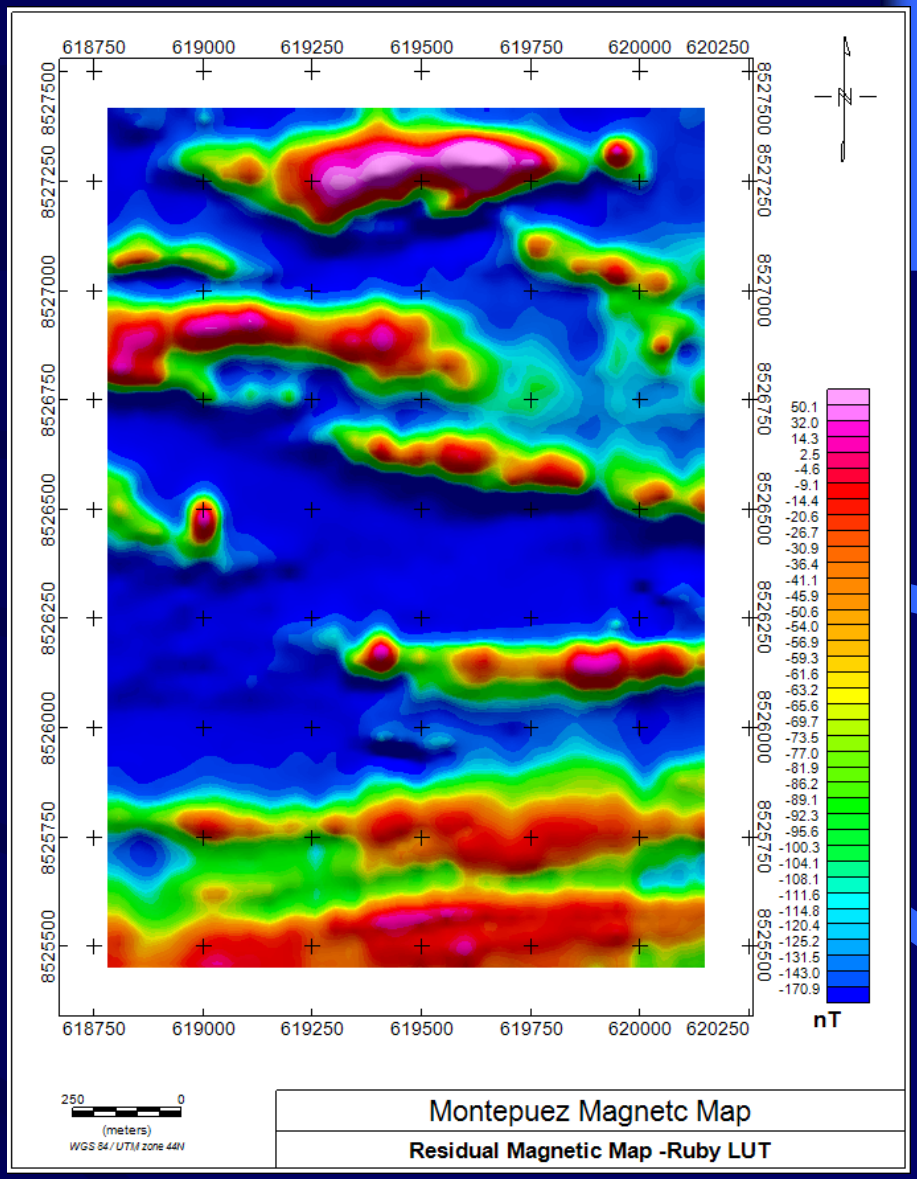
WGS 84 / UTM zone 44N
Montepuez Magnetc Map
Residual Magnetic Map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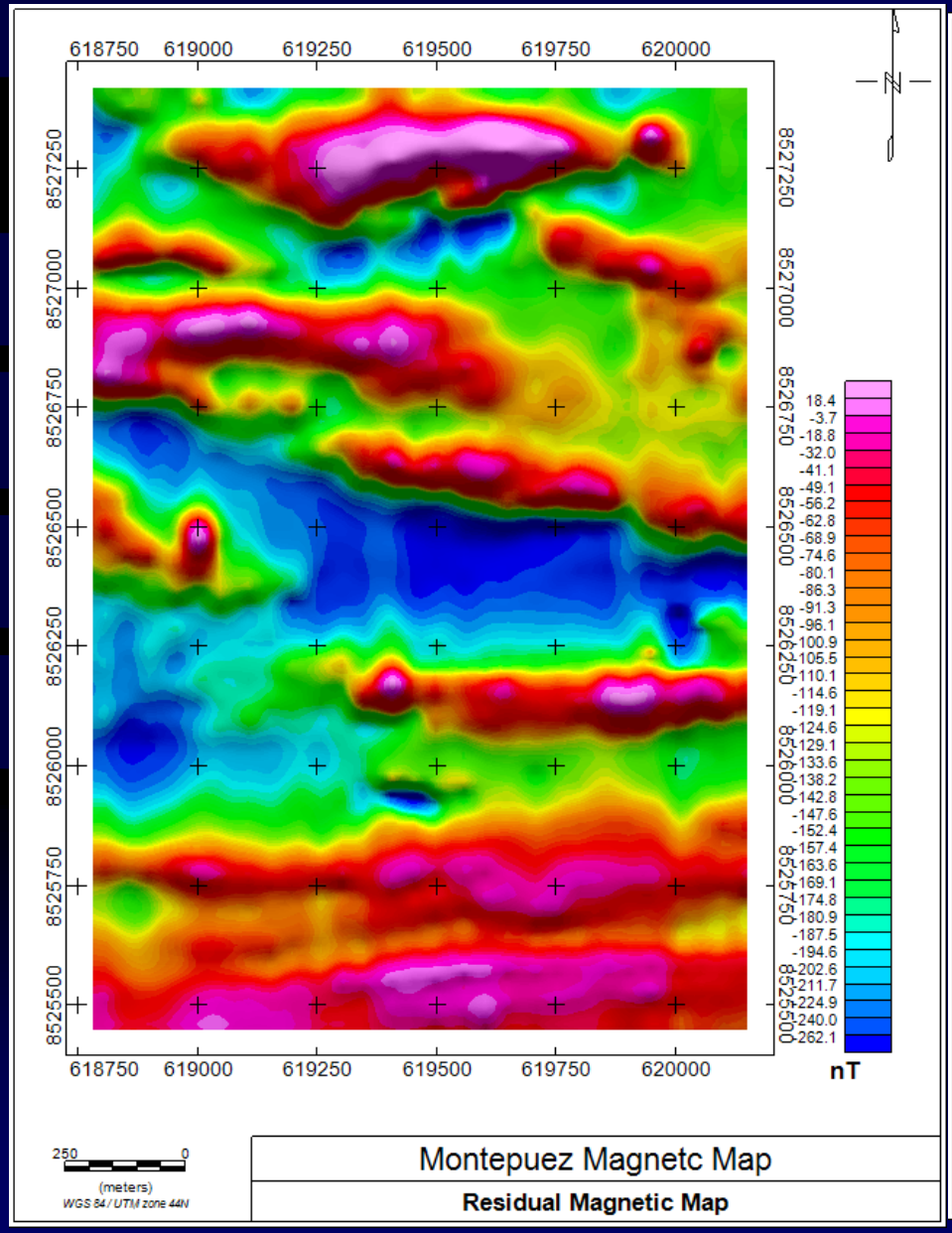
(meters)
WGS 84 / UTM zone 44N
Montepuez Magnetc Map
Residual Magnetic Map -Ruby LUT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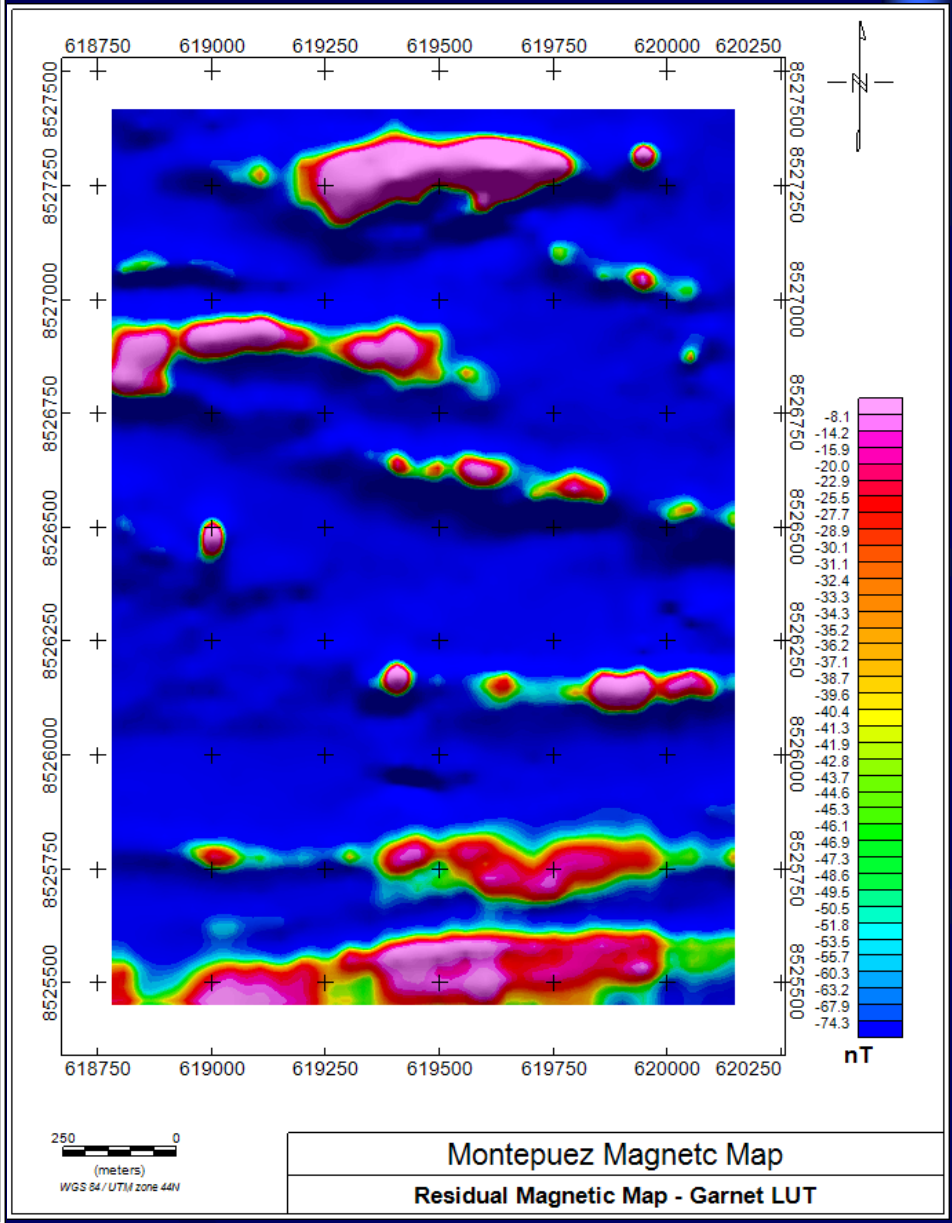
(meters)
WGS 84 / UTM zone 44N
Montepuez Magnetc Map
Residual Magnetic Map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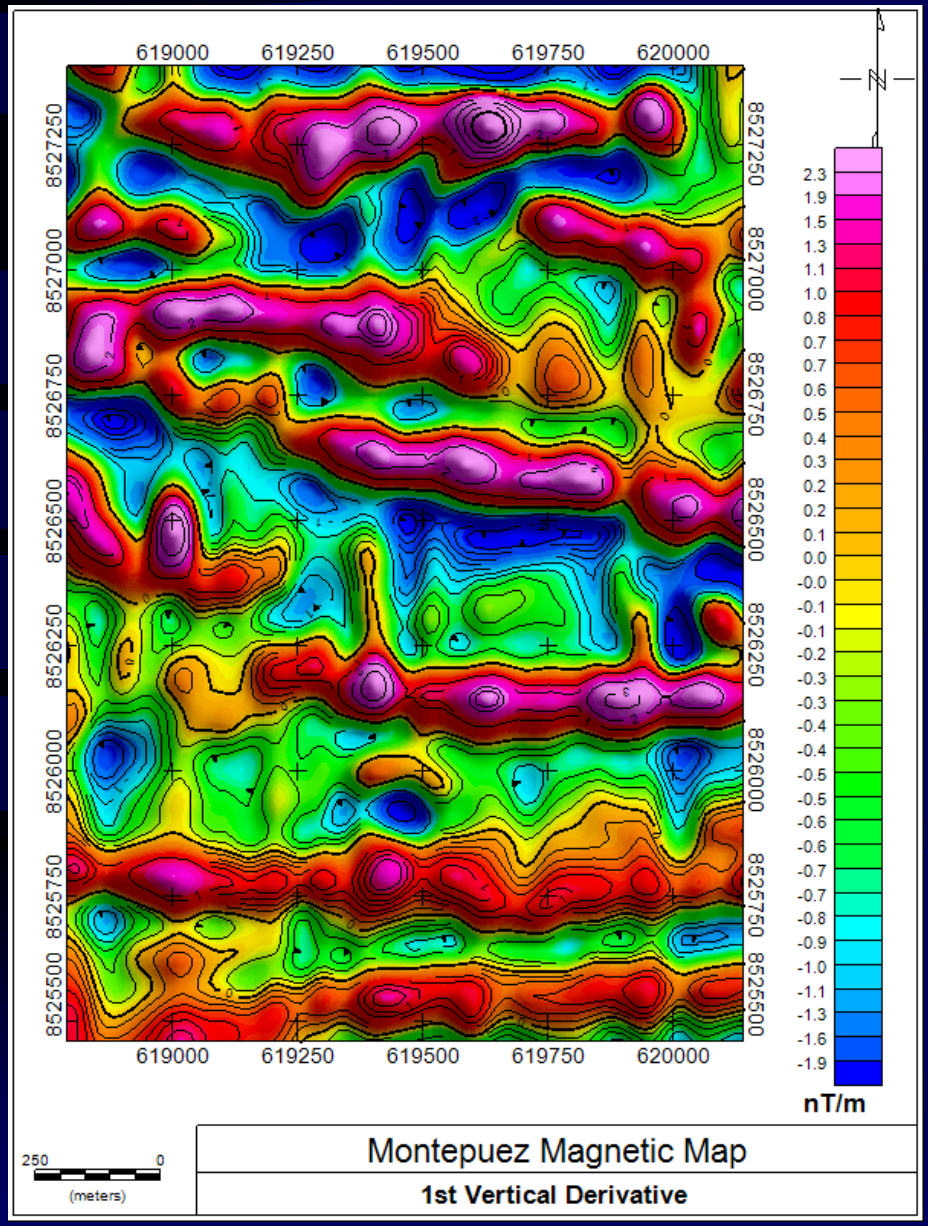
WGS 84 / UTM zone 44N
Montepuez Magnetc Map
Residual Magnetic Map - Garnet LUT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nT/m
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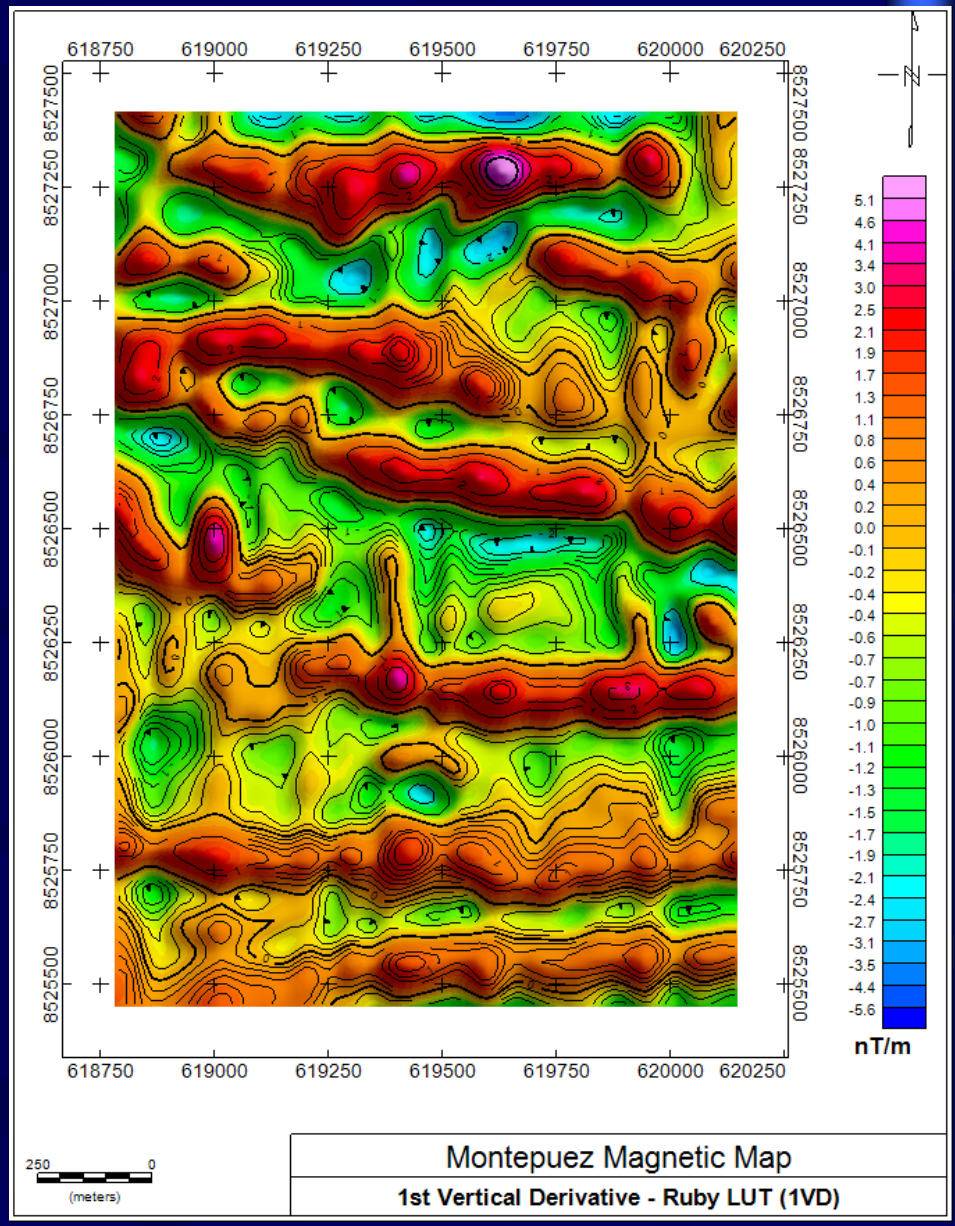
(meters)
Montepuez Magnetic Map
1st Vertical Derivative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nT/m
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(meters)
Montepuez Magnetic Map
1st Vertical Derivative - Ruby LUT (1VD)

Conclusion

- Magnetic Surveys have been useful mapping potential host rock
- Pitting/drilling can only prove the presence of the host rock and its mineralogy
- Pits will have to be some 20m