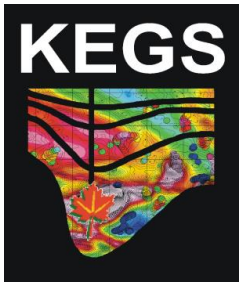


Correlations in geological mapping and Titan 24 DCIP/MT at the Bolivar skarn mineralization, Chihuahua, Mexico

L. Ramayo*, R. Sharpe,

M. Gharibi, A. Lujan

Lessons Learned: Exploration Advances Driven by Experience

QUANTEC Technology and Services

QUANTEC Geoscience | Since 1986

World Leading Deep Exploration Technology

TITAN 24

2D Deep earth imaging – distributed data acquisition of multi-parameter geophysics: Resistivity, IP and broad band magnetotellurics (MT resistivity)

ORION 3D

3D Imaging – complete 3D data acquisition for complex environments providing accurate surface to depth imaging of Resistivity, IP and MT

SPARTAN MT

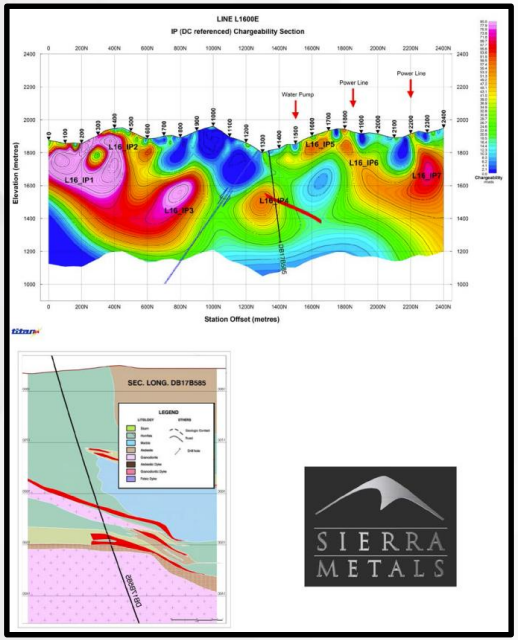
Flexible 2D and 3D deep resistivity imaging utilizing high resolution 24-bit MT

Broad Range of Expertise and Services

- Survey design, planning, acquisition, QA/QC, interpretation, data integration and consulting services
- Complete suite of conventional ground geophysical surveys including; gravity, magnetic, radiometric, IP (surface and borehole), TEM (surface and borehole), Max-Min, CSAMT and VLF

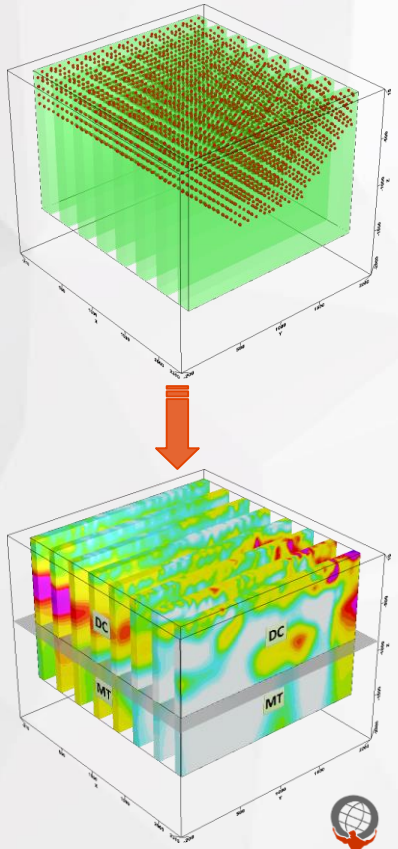
Structure

- The Titan system
- Sierra Metals Bolivar property description
- Correlation, integration and refinement with the geophysics. TITAN 24 Results
- Lessons learned:
- Conclusions



What is TITAN 24 DCIP & MT?

- **A “real-time” distributed array system**
  - Multiple source-receiver combinations sampled simultaneously
  - Multiple redundancy resulting in high density data sets
  - Higher data density
  - Current monitor, real time quality control
  - Easily configured into standard DCIP source-receiver arrays (i.e. Pole- Dipole, Dipole-Dipole, Centre Pole, etc.)
- **Time-series data acquisition:**
  - Application of digital signal processing software
  - Full time series recorded, not discrete windows, therefore more complete data acquisition
- **24-bit sigma-delta filtering**
  - Accurately measure very small voltages



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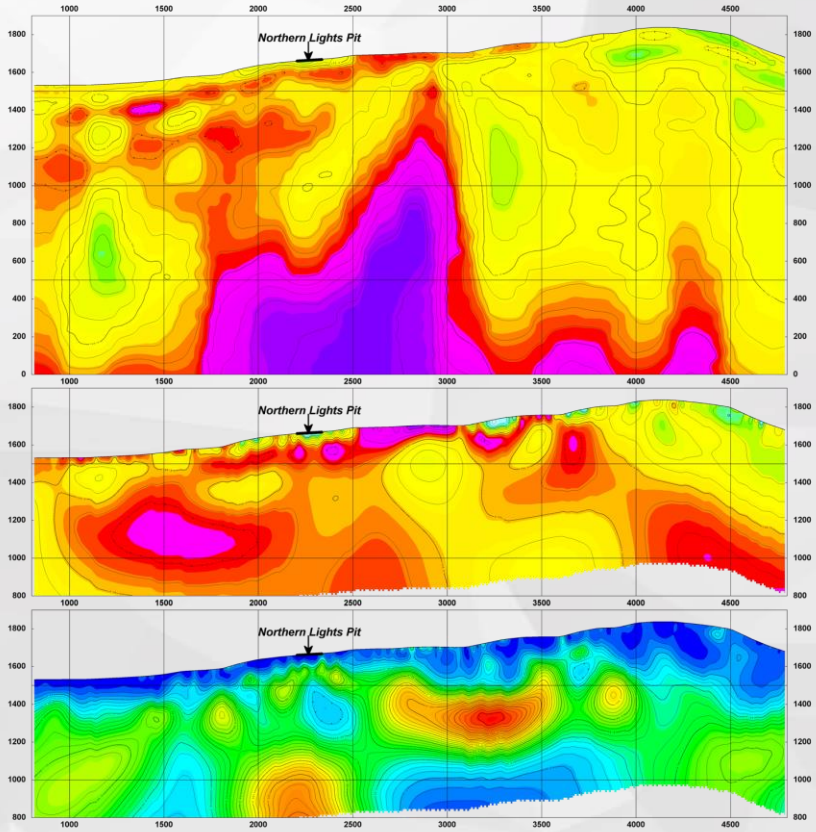
Deep multi-parameter information



Top panel: MT Resistivity

PW 2D inversion;

Typically 1500 metres

Middle panel: DC Resistivity

UBC smooth inversion;

Typically 500-750 metres

Bottom panel: Chargeability

UBC smooth inversion.

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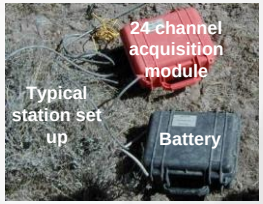
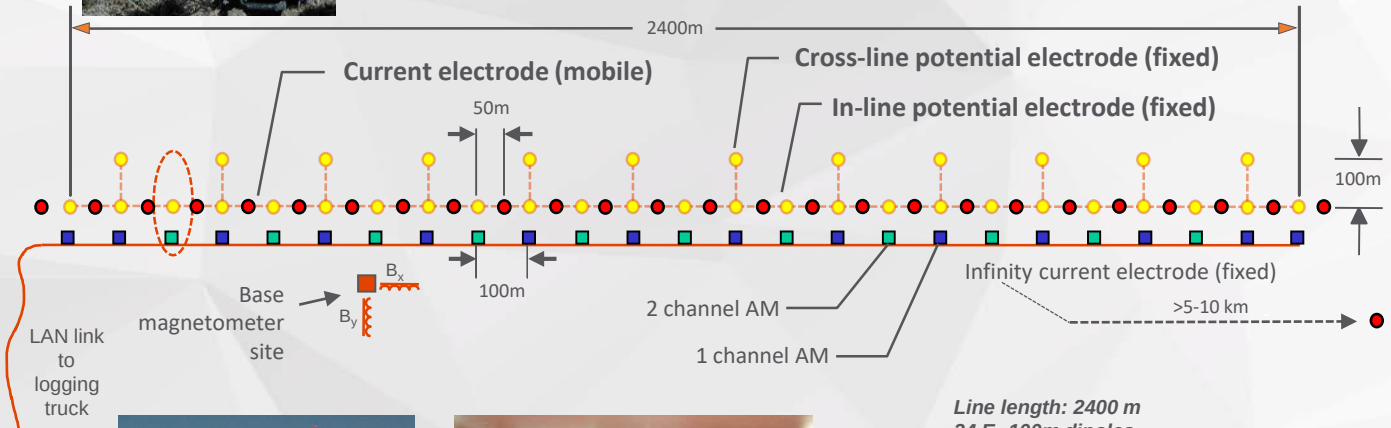
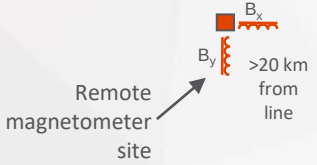
TITAN 24 distributed acquisition system





Line length: 2400 m
24 E_x 100m dipoles
12 E_y 100m dipoles
25 current stations
2 B_x/B_y magnetometer sites



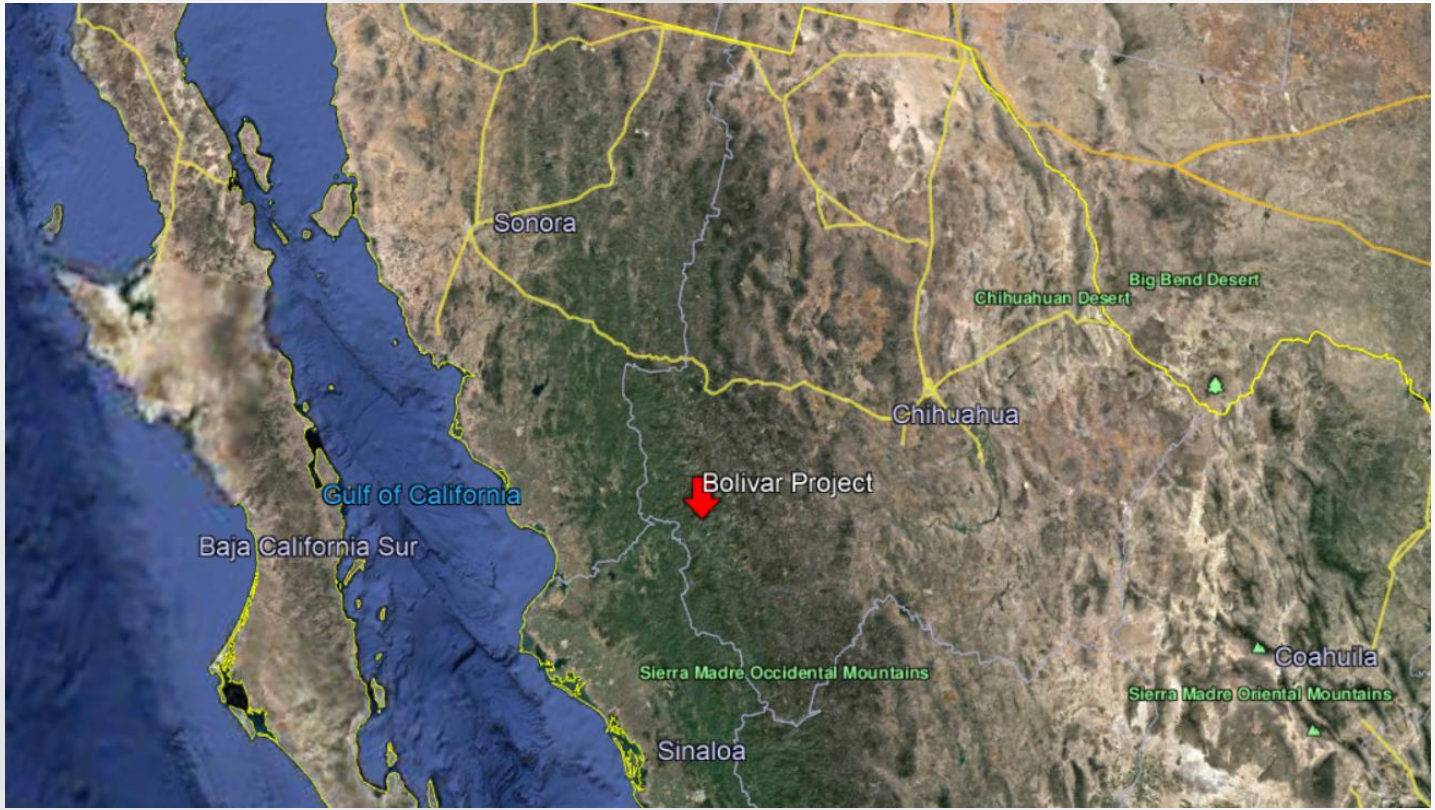
BOLIVAR PROJECT. Exploration Objectives

- Use TITAN 24 DC/IP & MT to help delineate the Bolivar deposit for drill targeting.
- Map and delineate near-surface zones associated with Skarn mineralization.
- Map and delineate deep-seated alteration zones that could control or host mineralization.
- Focus drilling thereby reducing overall drilling costs.
- Mine Planning

Exploration History

- Small-scale mining was conducted during the Spanish Colonial days
- An estimated 300,000 tonnes of mineralized material was reportedly mined from 1998 to 2000, while the Bolívar Mine was under the control of Bencomo Family
- Minera Frisco conducted a mapping and exploratory drilling program from 1968 to 1970
- Between 2003 and 2012, Dia Bras carried out an exploration program and the results have shown presence a polymetallic skarn mineralization within the Bolívar
- **In 2010 was conducted the first Titan24 DC-IP Survey**
- In 2014, underground drilling expanded the copper-gold-silver mineralization
- **In 2017 was conducted the second Titan24 Survey , but this time include MT (Titan24 DC-IP/MT)**
- In 2017 – 2018 drilling expanded the copper-gold-silver mineralization. New discovery

Location



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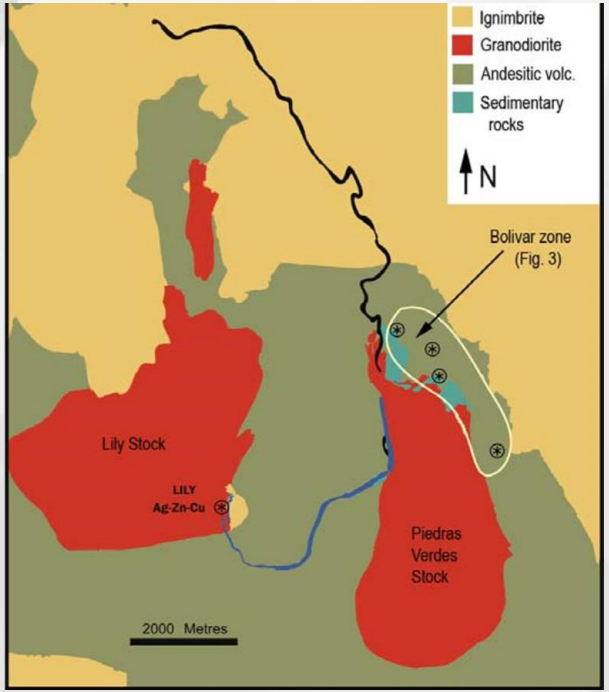
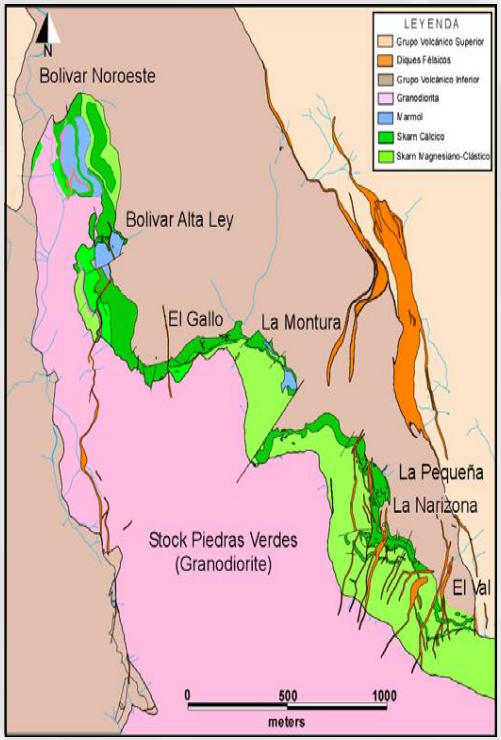
Geologic Setting



Regional Geologic setting of the Bolivar district



Local Geologic setting of the Bolivar district

- Guerrero composite terrane, western Mexico
- Consists of submarine and lesser subaerial volcanic and sedimentary sequences ranging from Upper Jurassic to middle Upper Cretaceous in age. Urique Group
- The Bolivar deposit is one of many precious and base metal occurrences in the Sierra Madre precious metals belt.

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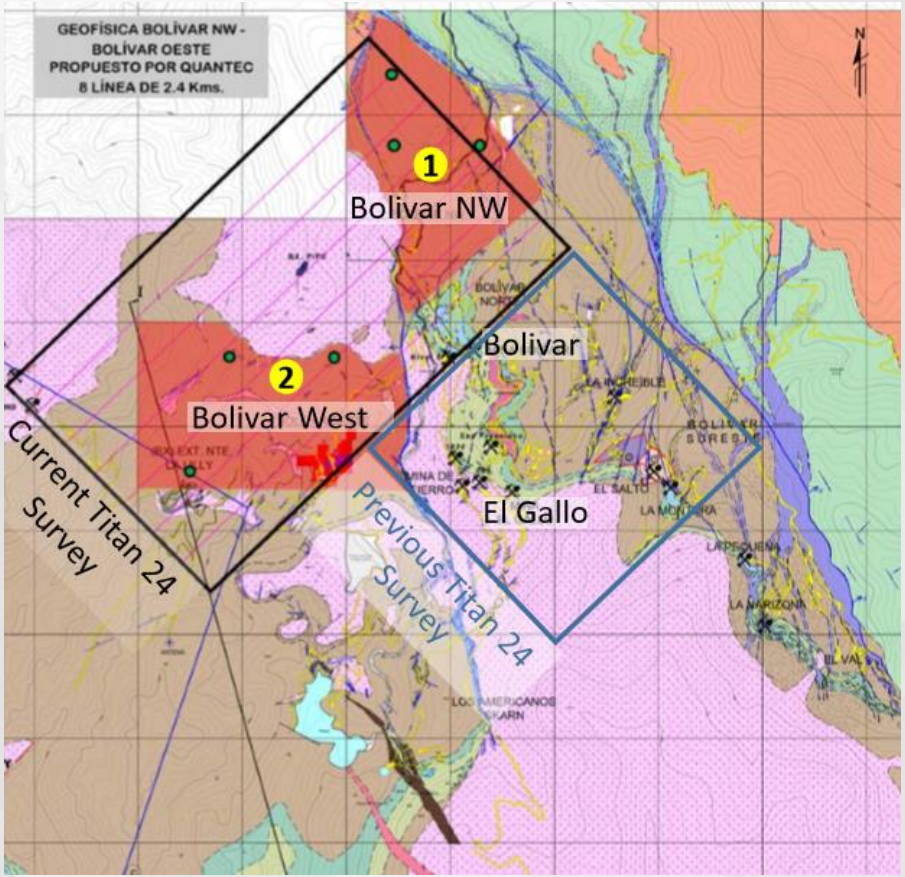
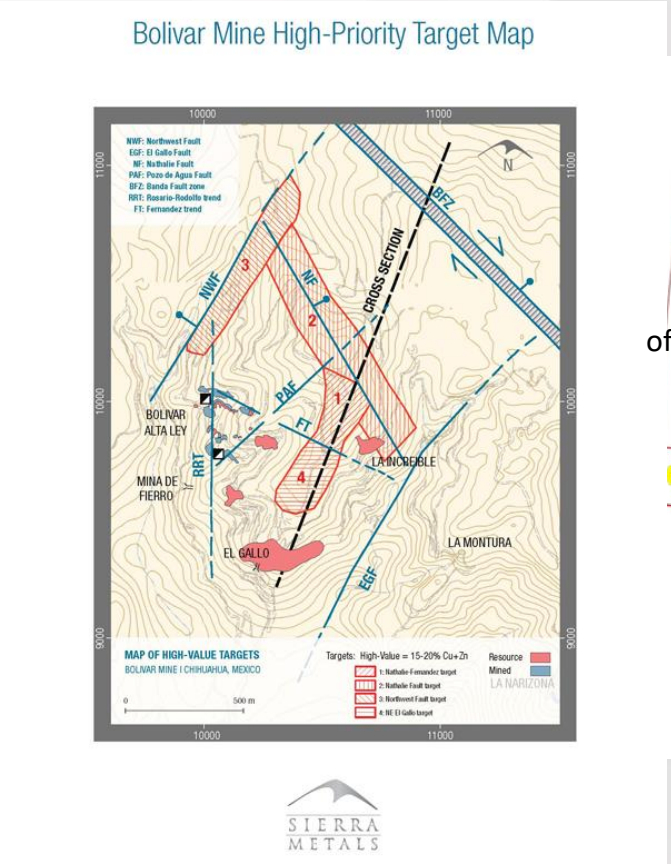
Bolivar mineralization



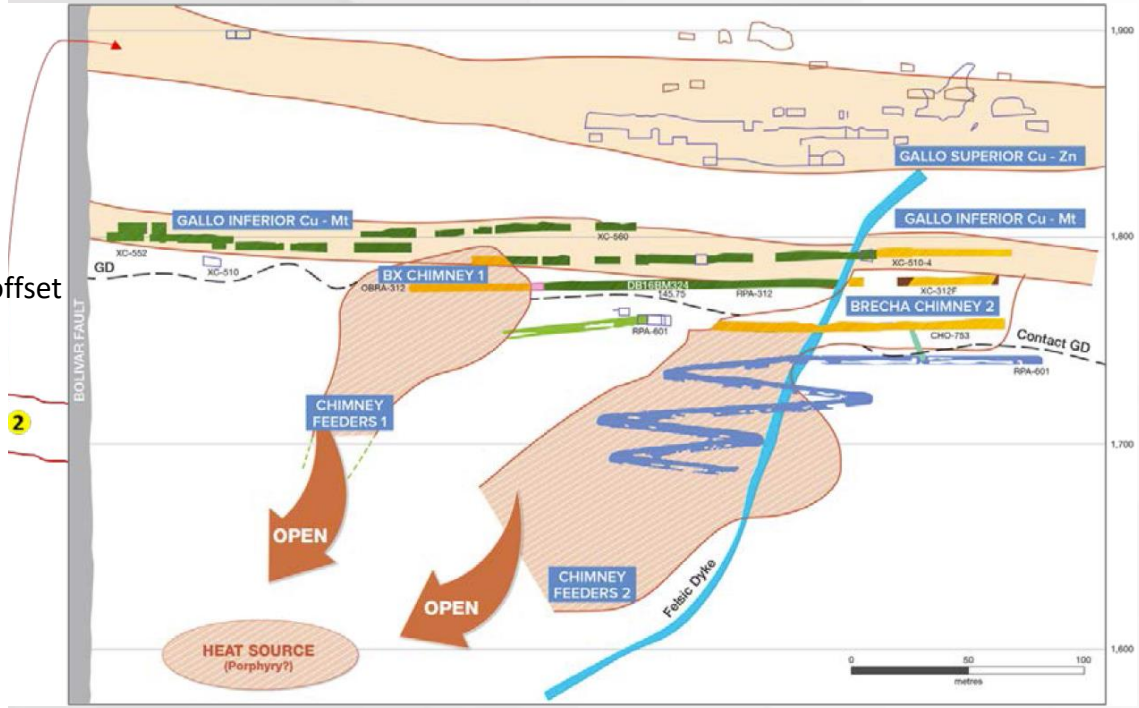
- Skarn alteration and mineralization
- hosted primarily in Late Cretaceous – Early Cenozoic sedimentary and volcanic rocks
- Skarn-type Cu-Zn-Ag-Au mineralization in the Bolivar area is structurally controlled and forms mineralized zones that are close to structures
- The mineralization is generally flat-lying mantos replacement or skarn with a high sulphide component.
- Chimneys and feeders are the exception and have a steeper dip

TITAN 24

Target Map

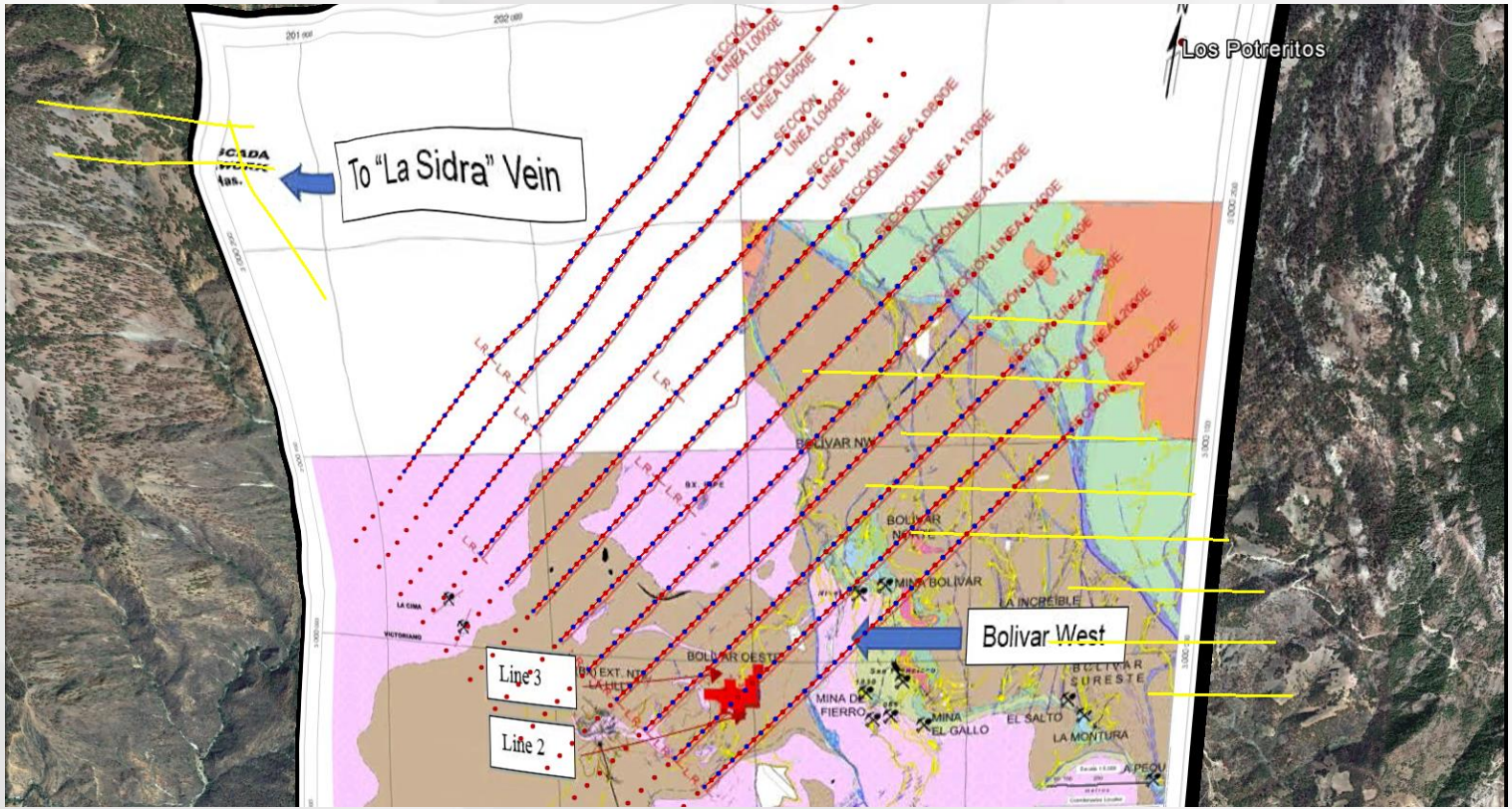


offset



TITAN 24

Titan 24 surveys



2010 DCIP-only shown in yellow

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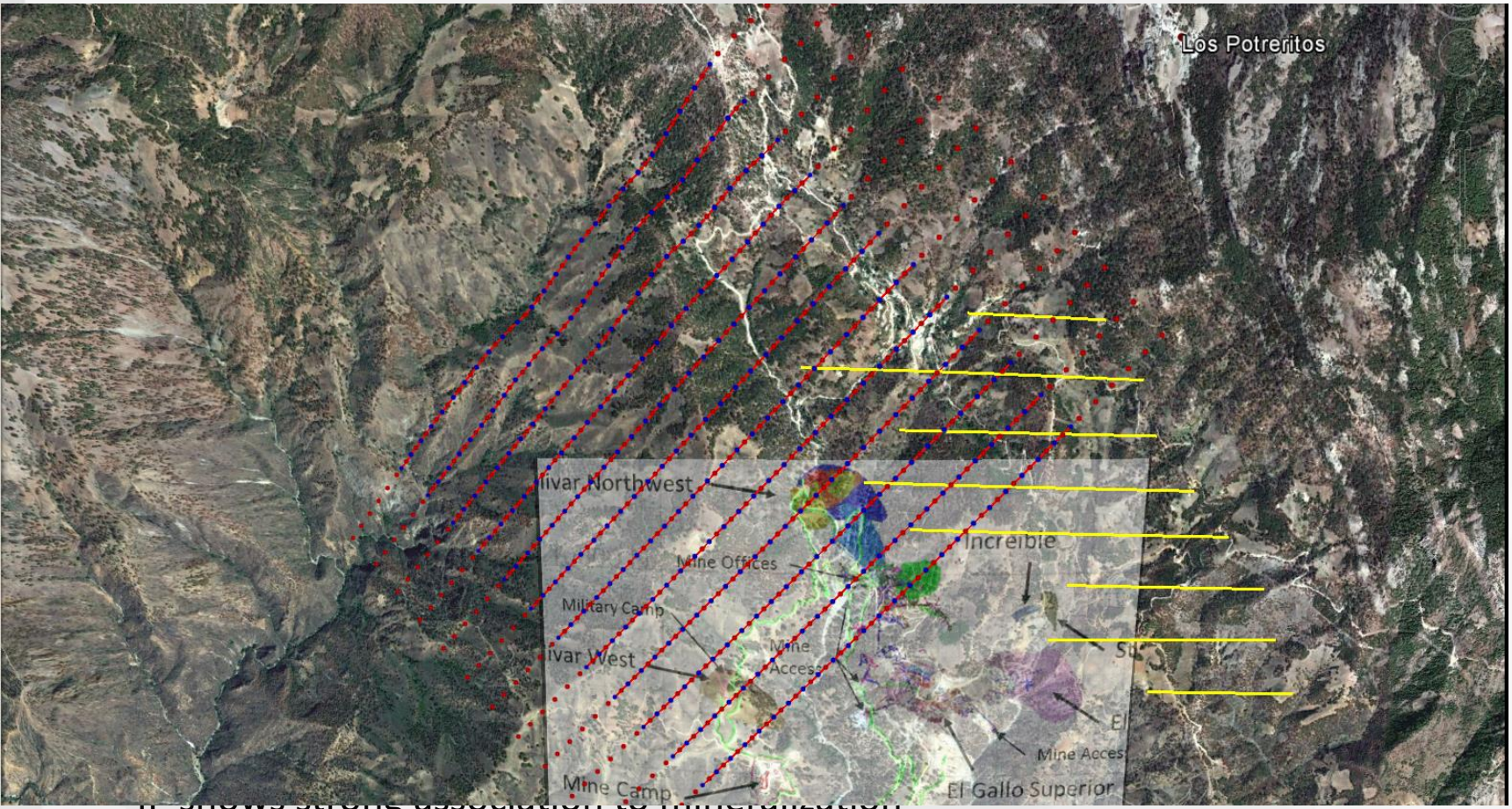
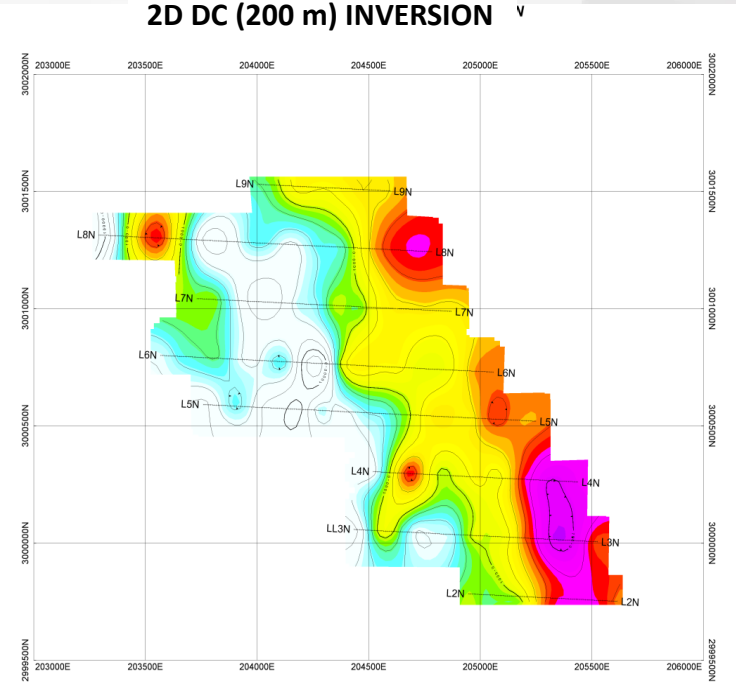
2017 re-orient the survey grid and add the MT



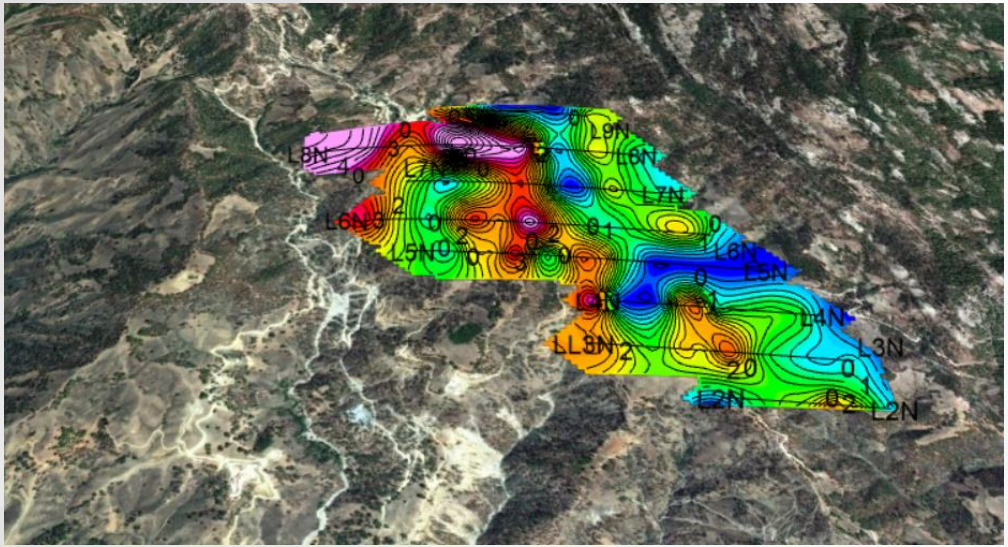
TITAN 24

2010 Titan24 DC-IP Survey Results

2D DC (200 m) INVERSION



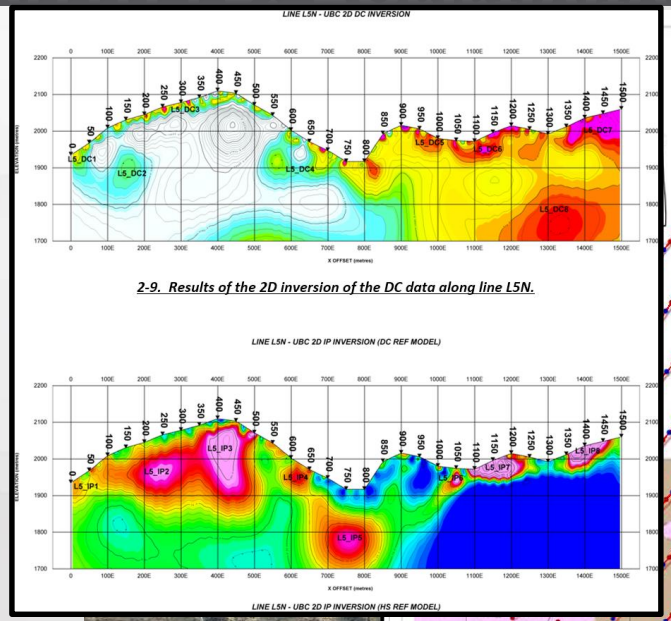
2D IP (200 m) INVERSION



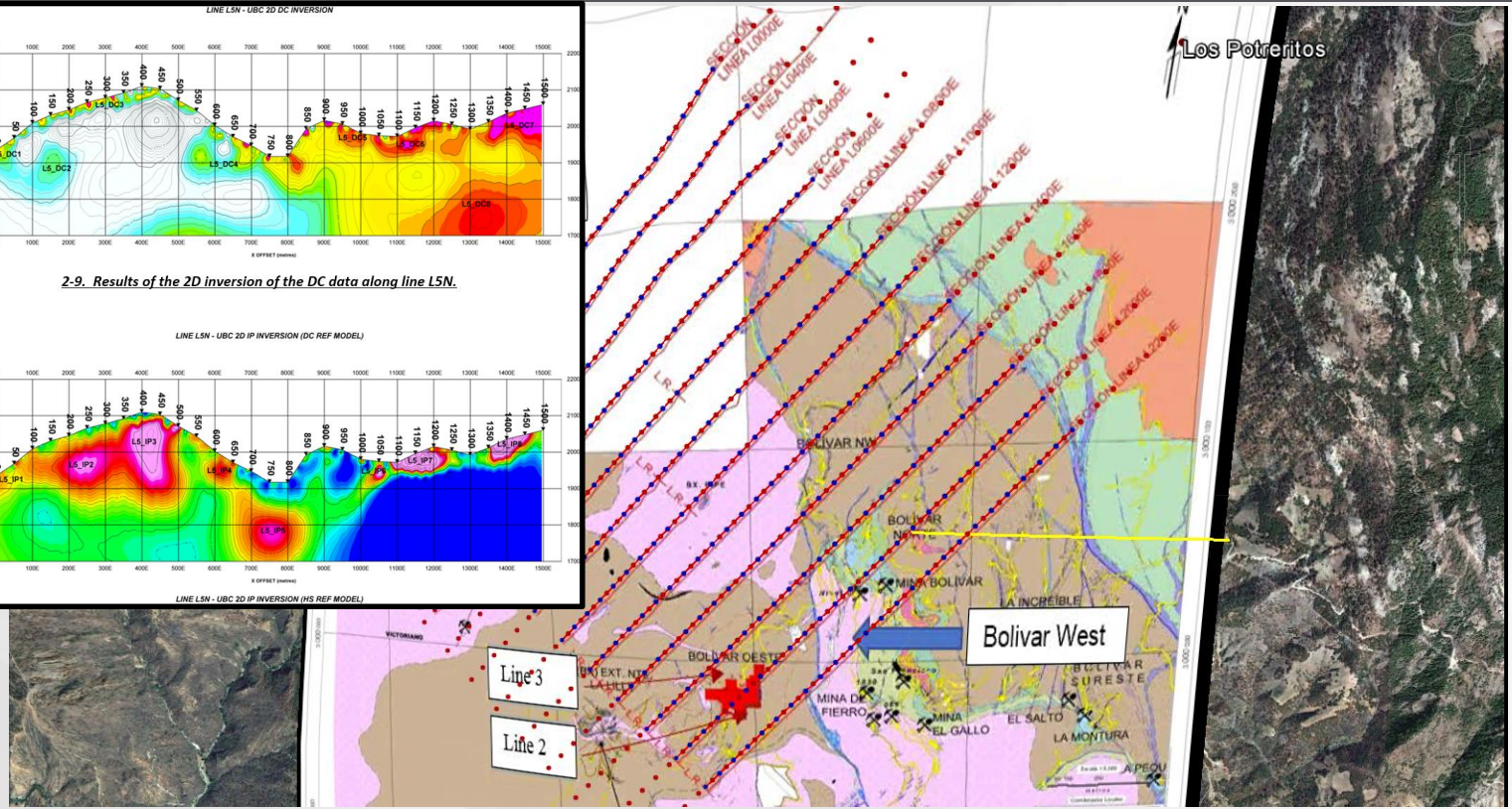
A total of 39 potential targets with different priority levels have been identified by the Titan 24 2D DCIP survey conducted in 2010

TITAN 24

2010 L5; Resistivity maps the Geology



2-9. Results of the 2D inversion of the DC data along line L5N.

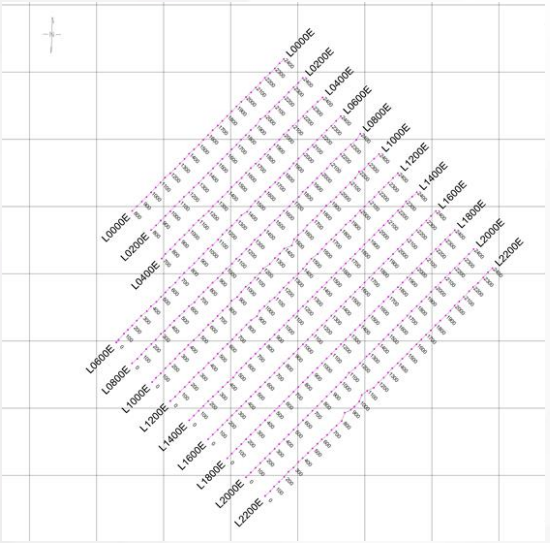


IP shows strong association to mineralization

TITAN 24

2017 Titan 24 deployment

- A Titan 24 geophysical survey was carried out to assist in mapping the extent of mantos replacement and structures containing copper and copper / zinc skarn mineralization
- In 2017, the survey was re-oriented and MT was added for drill targeting in the immediate vicinity of the Bolivar mine.
- The Bolivar survey grid consisted of a total of 12 lines which were 26.5 km in length.
- Each line had a 100 m dipole spacing and was located 200 m from the line adjacent.
- The survey covers an area of approximately 2.4 km by 2.2 km.
- The Titan 24 geophysical survey was planned and integrated with several phases and scales of geological mapping including



  - 25,000 scale regional geology and stream sediment sampling,
  - 1,000 scale geological mapping chip sampling and
  - 250 scale geological mapping and panel sampling.

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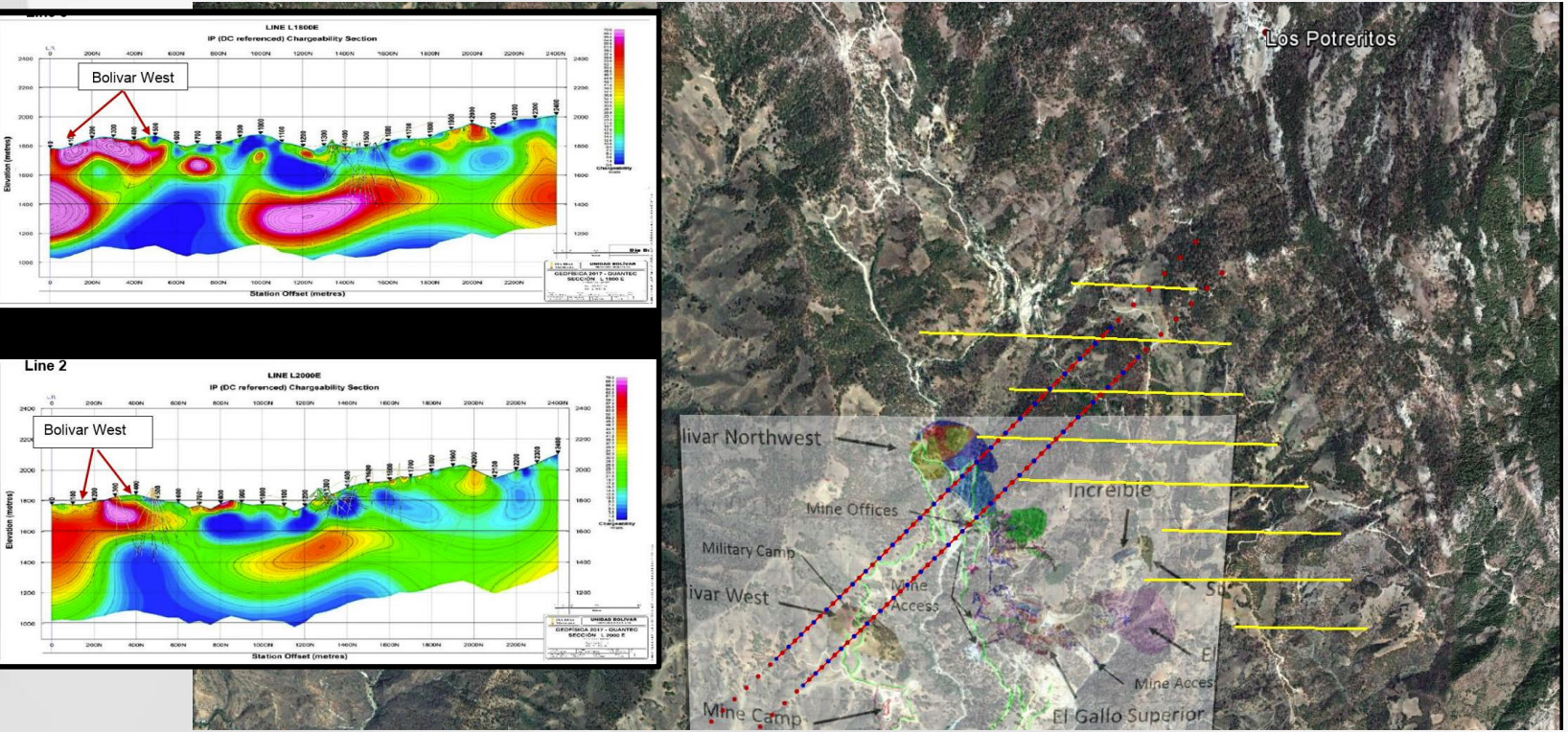
2017 Survey Results. Bolivar West Lines 1800 and 2000



Chargeability signature of Bolivar West Lines 1800 and 2000;
Note also signature of deep bolivar Mine mineralization

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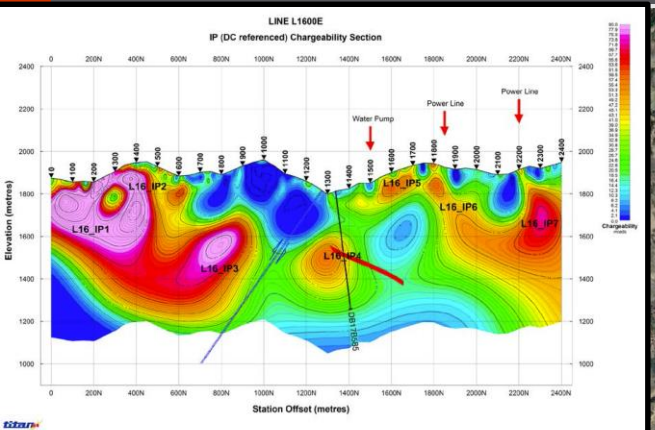
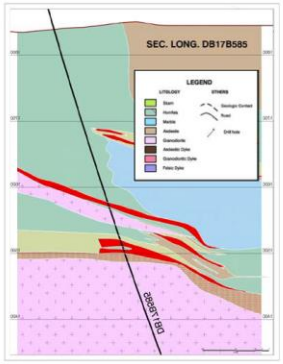
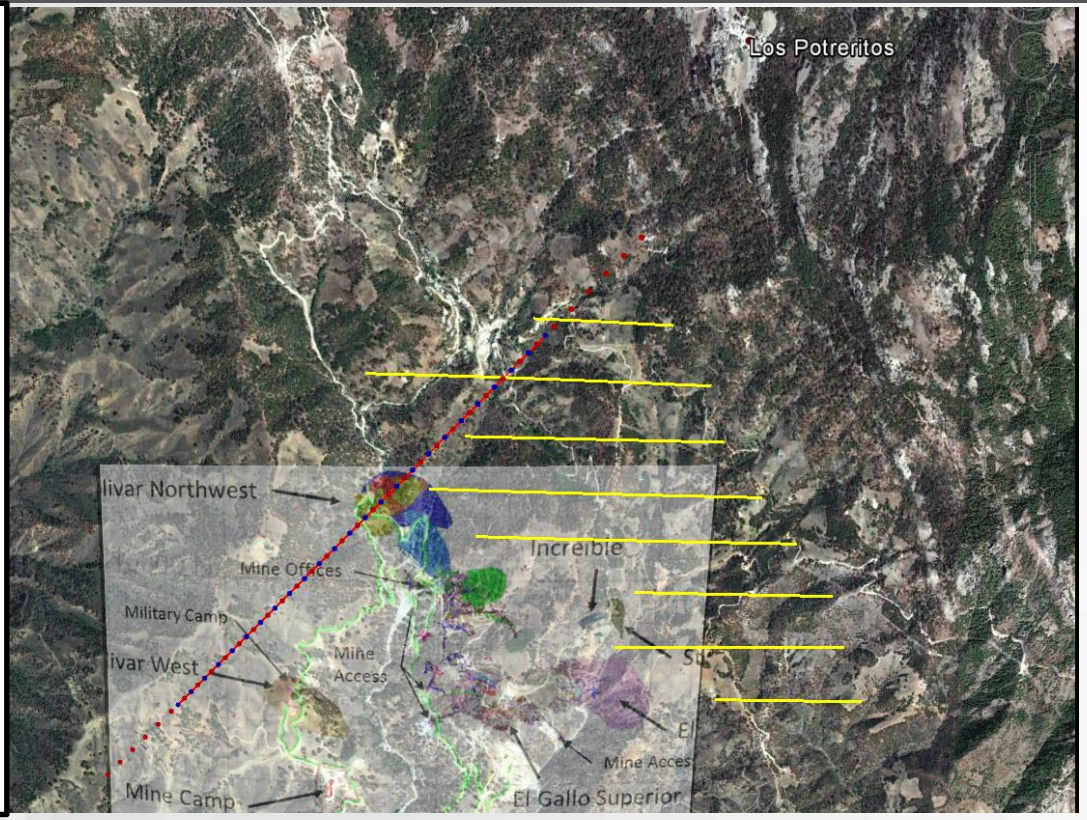
IP result from the 2017. Bolivar North-west





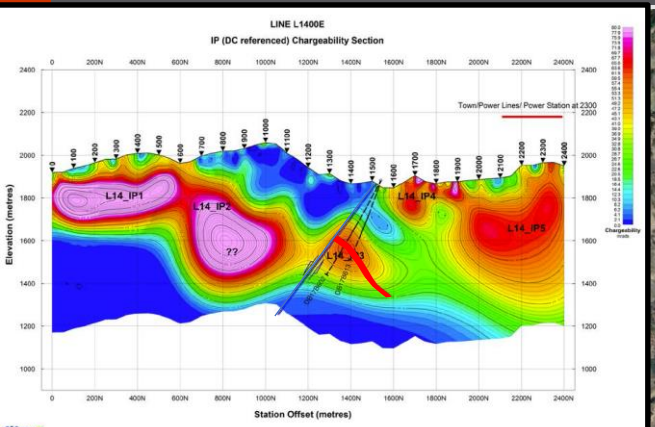
SIERRA METALS

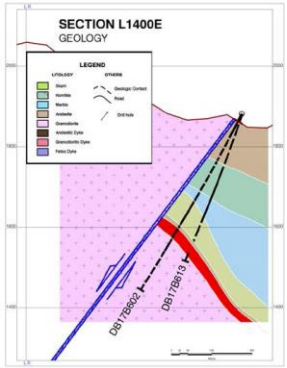


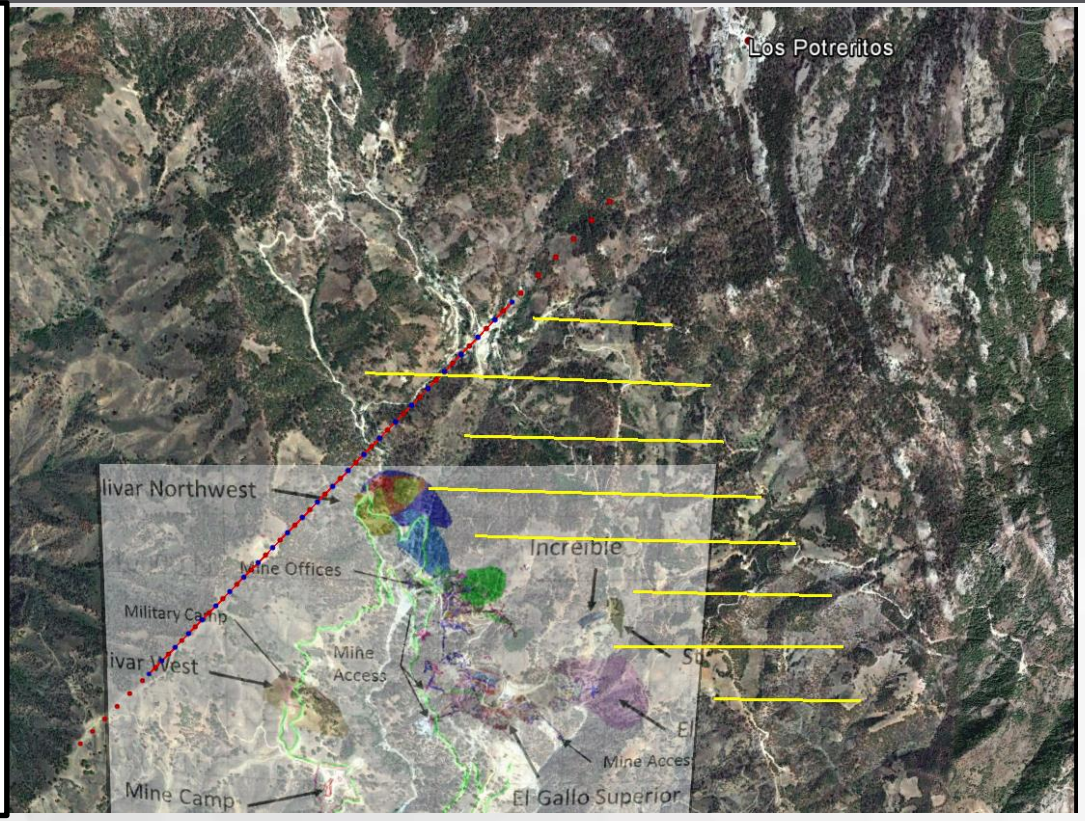
Line 1600

TITAN 24

IP result from the 2017. Bolivar North-west



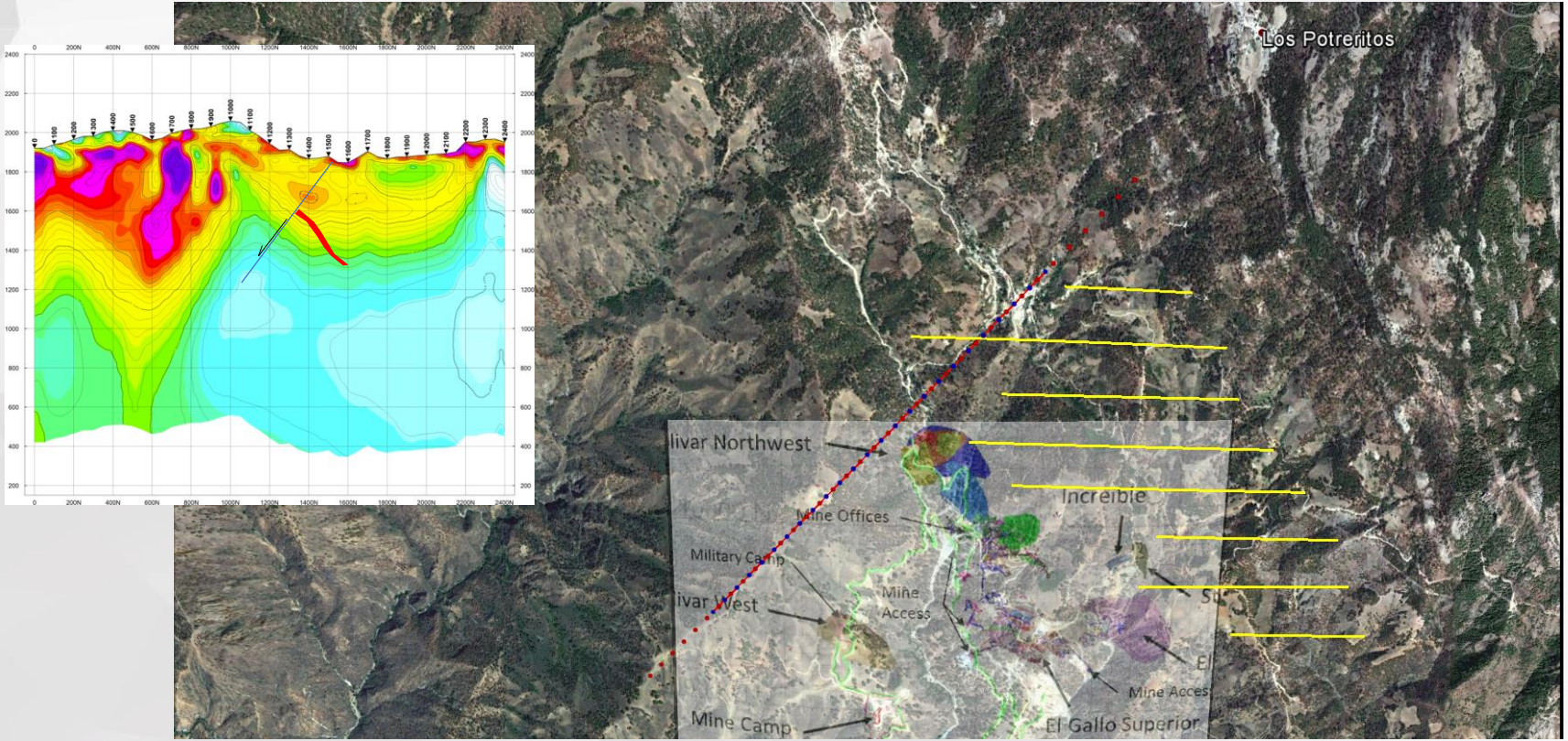




Lines 1400. Note structural changes (dip and faults)

TITAN 24

2017 Bolivar North-west MT resistivity



Lines 1400. Note deep correlation with the structure and dip of mineralization

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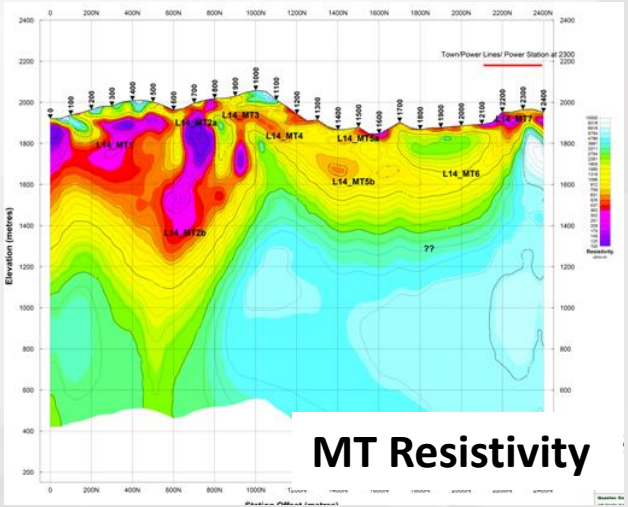
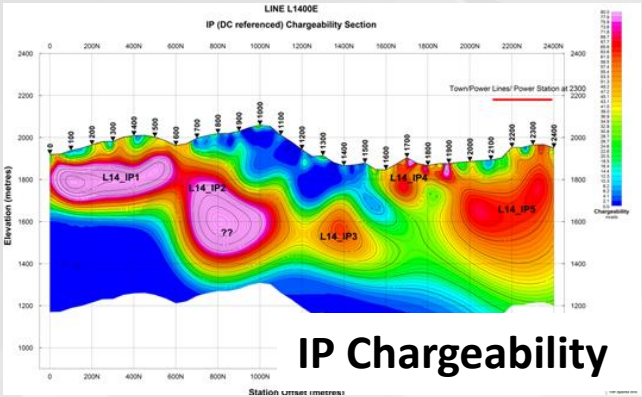
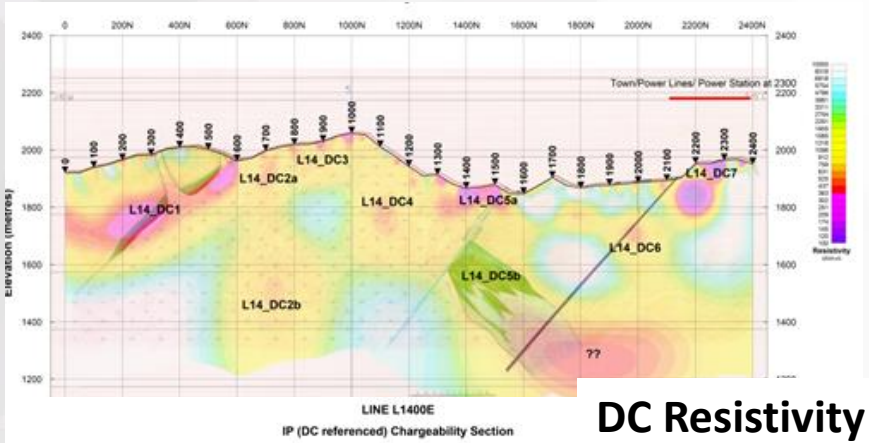
2017 Bolivar North-west . Lines 1400



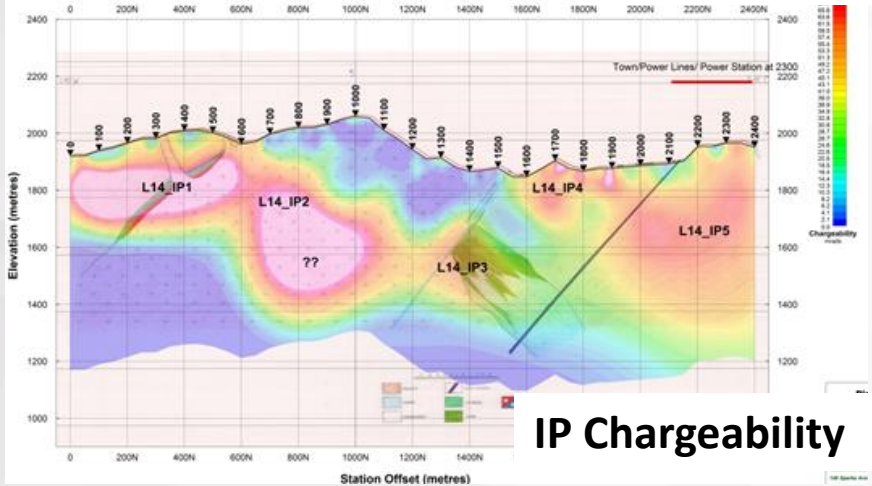
MT Resistivity



IP Chargeability



DC Resistivity



IP Chargeability

Conclusions

- Accurate delineation of alteration and mineralization (up to 400) with the TITAN 24 DCIP/MT
- Accurate Surveying in high noise environments (Bolivar Mine, active mining operations)
- 48 potential targets were detected
- 17,000 Meters of drilling program completed in 2017 with the majority occurring at Bolivar West where high grade copper intercepts have occurred.
- 28 holes (12,300 meters), recently completed which provided the Company with higher Copper, Zinc and Silver grades.

TITAN 24

Lessons Learned

- Make sure to add the current extensions so the section-ends plot to depth
- Annotate all your culture (section 1600)
- Don’t discount those ‘floating basketballs’ in the center of the section (sections 1400 and 1600)
- Even blobby ‘unconstrained’ anomalies can have shape characteristics that reflect dip (section 1400)
- Sometimes you have to drill through the anomaly (section 2000).
- Measure the MT.

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TITAN 24

Thank you

SIERRA METALS

KEGS