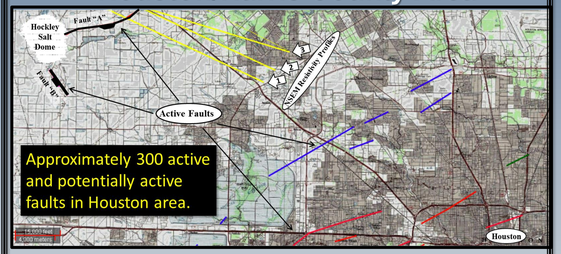
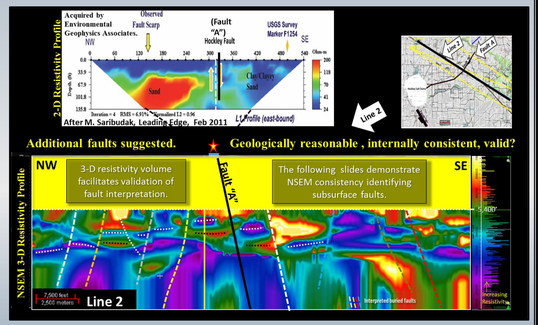
Lightning Sparks Interest in the Unconventional Mapping of Active Subsurface Faults

- Can lightning energy be harnessed for mapping structure, stratigraphy and rock properties?
- Is Natural-Sourced Electromagnetics (NSEM) an effective exploration tool for petroleum and mineral resource exploration?

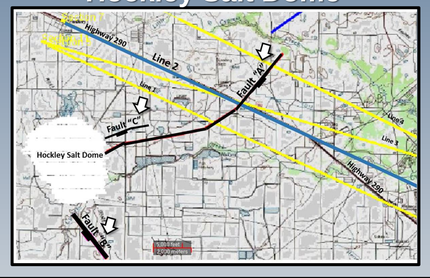
Active Faults Houston/Harris County Area

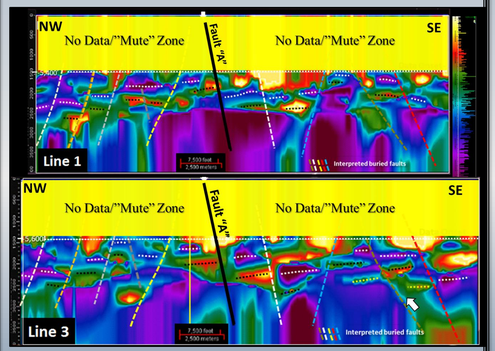




Subsurface fault interpretation of Fault "A" on NSEM apparent resistivity (lower image) is validated by tie to surface fault trace on 2-D resistivity imaging (white arrow, upper image). Resistivity profile provided by Mustafa Saribudak of EGA.

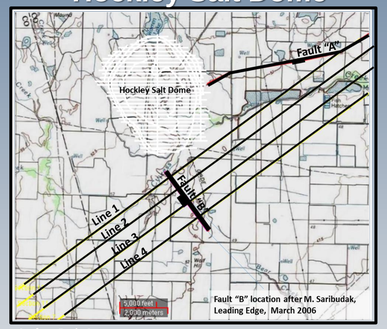
Radial Fault "A" Hockley Salt Dome

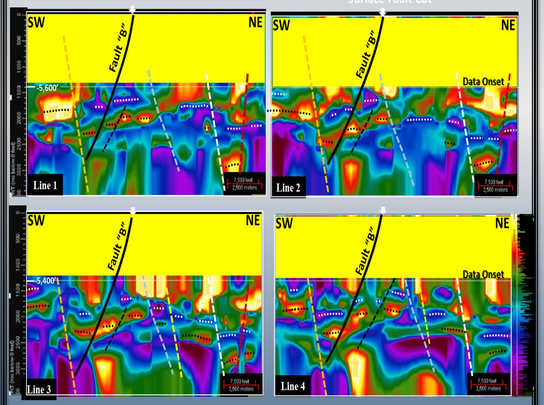




Hockley Fault "A" identified in subsurface on two arbitrary NSEM apparent resistivity profiles. Both fault interpretations validated via tie to surface fault trace.

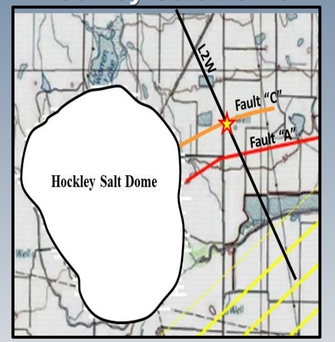
Radial Fault "B" Hockley Salt Dome

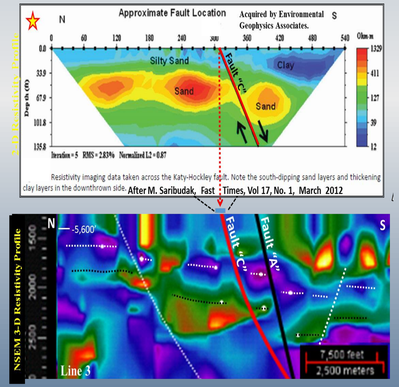




All four NSEM profiles reveal presence of active Fault "B" validated at surface.

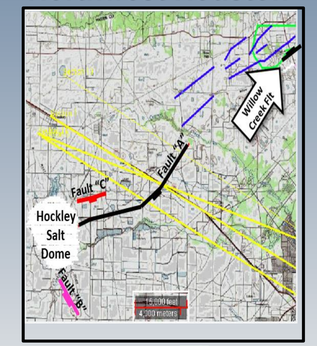
Radial Fault "C" Hockley Salt Dome

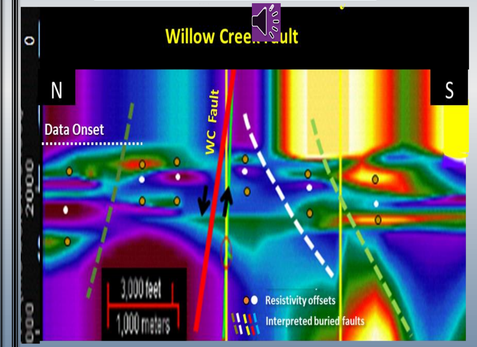




This NSEM profile shows both Faults "A" & "B".

Willow Creek Fault Northwest Houston





Another active fault in Northwest Houston has been identified on an NSEM apparent resistivity profile.

Conclusions

- 3-D NSEM resistivity can be interpreted similar to 3-D seismic data to build structural frameworks.
- It can be integrated with and calibrated to other near-surface and potential field geophysical data to expand depth and aerial extent of investigated areas.
- It is scalable, providing reconnaissance data for detailed follow-up geophysical evaluation or can focus on specific faults and previously identified anomalies.

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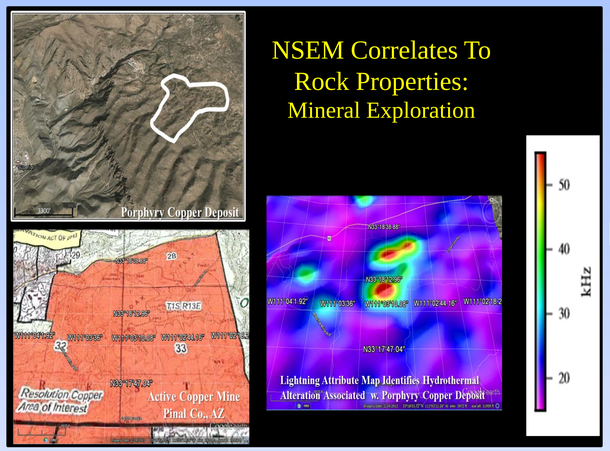
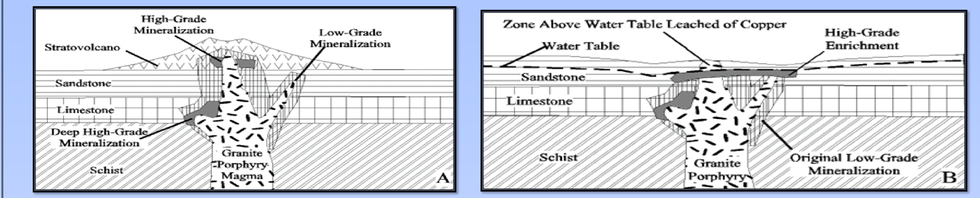


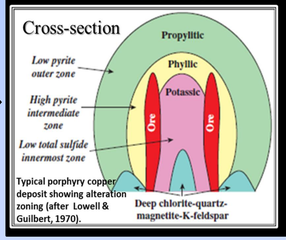
Formation of Porphyry Copper Deposits

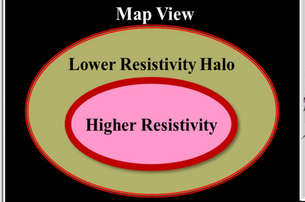


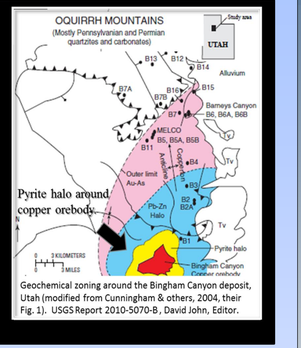
1. Igneous intrusion of shallow sedimentary rocks.
2. Magma and associated hot mineral-rich fluids come in contact with host rocks and generate chemical/mineral changes creating low-grade copper mineralization.
3. Erosion strips away overburden subjecting low-grade mineralized areas to weathering.
4. Rainwater leaches Copper and redeposits it below at the water table, creating concentrations of high-grade Cu deposits.

Porphyry Copper Exploration Signature

- Multiple igneous intrusions present.
- Contact metamorphism/alteration halos.
- Inner high resistivity zone partially or completely enclosed by outer conductive zone.



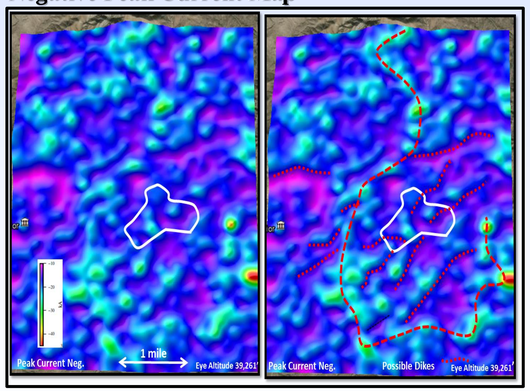




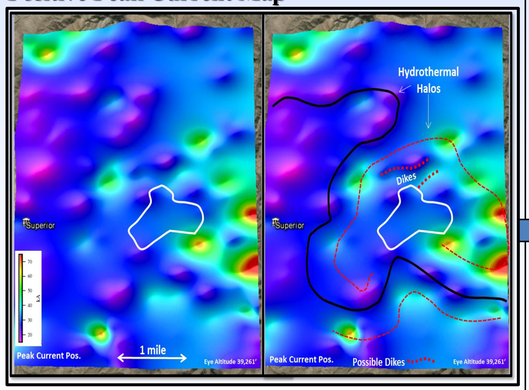
Geochemical zoning around the Bingham Canyon deposit, Utah (modified from Cunningham & others, 2004, their Fig. 1). USGS Report 2010-5070-B, David John, Editor.

Exploration Signature Duplicated Across Porphyry Copper Deposit

Negative Peak Current Map

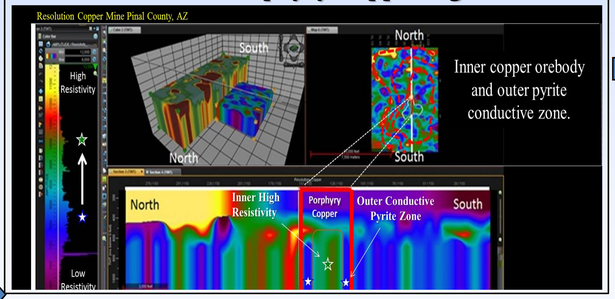


Positive Peak Current Map

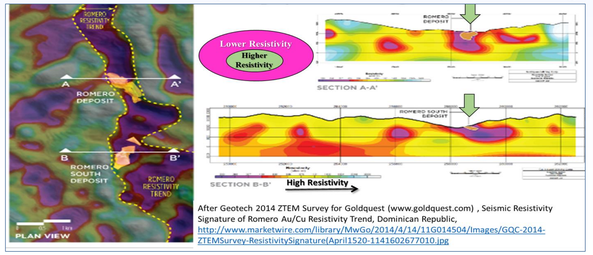


Note positive and negative lightning peak current contour-like anomalies partially enclosing copper orebody at Resolution Copper Mine. Patterns consistent with hydrothermal alteration zones associated with pyrite halos. Linear features correspond to igneous intrusions, typically associated with porphyry copper deposits.

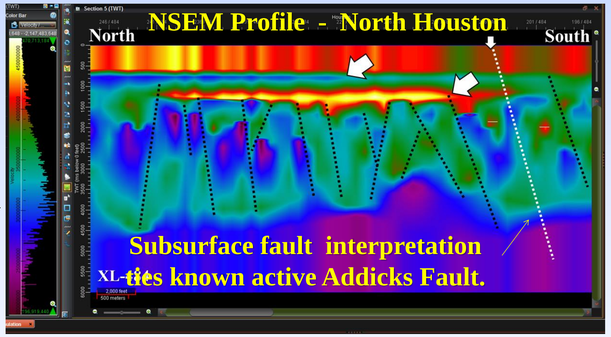
3-D Apparent Resistivity Profile Through Mine Also Reveals Porphyry Copper Signature



Resistivity Profile Signature, Dominican Republic Analog



After Geotech 2014 ZTEM Survey for Goldquest (www.goldquest.com) , Seismic Resistivity Signature of Romero Au/Cu Resistivity Trend, Dominican Republic, http://www.marketwire.com/library/MwGo/2014/4/14/11G014504/Images/GQC-2014-ZTEMSurvey-ResistivitySignature(April1520-1141602677010.jpg



Mapping faults, fractures, stratigraphy, lateral variation in fluid content, and potential hydrocarbon accumulations.

Mineral Exploration Conclusions

NSEM has the potential to explore for any mineral commonly found by conventional electrical geophysical prospecting techniques.

NSEM can map subsurface electrical rock properties, structure & stratigraphy, also applicable to unconventional resource exploration.