

MTNet EMinar - Quo Vadimus



QUANTEC
Geoscience

2023-05-03

5 minutes

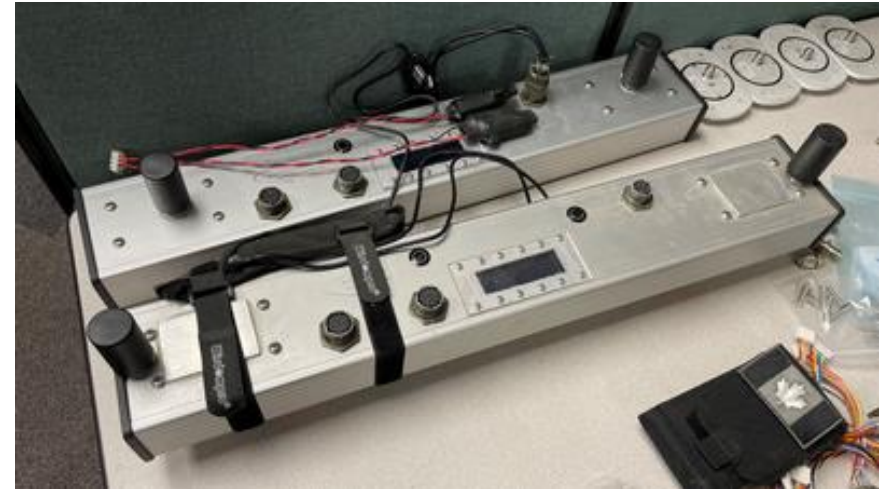
Reducing cost of equipment

- ❑ BB sensors cost less because there is only one (vs multi-band)
 - ❑ \$9 k vs (\$9 k + \$ 5 k)
 - ❑ BB sensors consume less power for the same reason (1 vs 2)
- ❑ **Plate electrodes** cost less, last longer and are lighter than pots or active electrodes
 - ❑ \$150 plate vs \$250 pot
 - ❑ Vs active: \$2500 + the Ti plate + power
- ❑ Battery technology – LiFePO_4 vs SLA; 40% - 60% lighter (smaller size for same energy density)
- ❑ Dedicated MT loggers cost less than universal loggers but are less flexible
 - ❑ Dedicated coils channels don't need a front end
 - ❑ Dedicated electrics channels don't need power
 - ❑ Single digitizers cost less than multiple digitizers per channel
 - ❑ Single digitizers consume less power
 - ❑ Power paradigms are easier to manage (e.g., for one known brand of coil)
 - ❑ **But no multi-physics capability (e.g., IP + DC resistivity + MT)**



Rapid, accurate deployment of MT sensors

- ❑ Mag sensors
 - ❑ Digital serial ID
 - ❑ Graphical configuration interface
 - ❑ Smaller sensors are easier to stabilize
 - ❑ **The dream: 3-component sensors are de facto orthogonal and easier to align**
- ❑ Dual antenna GPS (vs traditional handheld)
 - ❑ Alignment
 - ❑ Positional accuracy (1 m vs 3 - 8 m)
 - ❑ Navigation
 - ❑ But: bush (vegetation), topo, & size problems
- ❑ Are drones in our future?
 - ❑ Staging?
 - ❑ State of Health (SOH) Monitoring
 - ❑ Data transfer
- ❑ **Fewer coils per electrics (TITAN tensor electrics and e-map scalar)**
- ❑ **Is tipper always required?**
 - ❑ Maybe a good idea, but then do we always need dense horizontals?
 - ❑ Maybe airborne takes care of this and ground can walk away from it



MT market (from a contractor perspective)

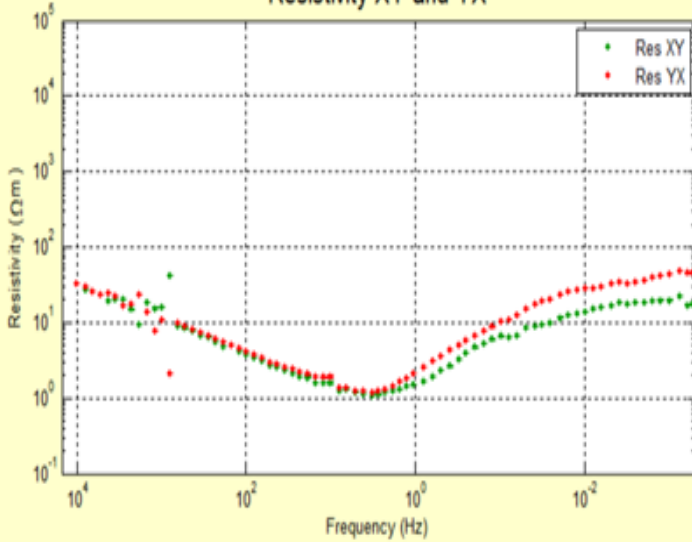
- ❑ MT popularity has exploded in the last decade
 - ❑ **Mineral exploration**: Huge uptake due to resolution, depth scale and array development
 - ❑ Geothermal mapping: Goes in waves
 - ❑ Energy industry (O&G): Grand-scale but requires specialized collaboration
 - ❑ Conventional academic studies (deep crust & mantle): less impact for contractors
- ❑ Next generation gear should focus on;
 - ❑ large & dense site numbers for near surface resolution
 - ❑ Therefore, fast production, low operation cost, high reliability (low repeats)
 - ❑ **The frequency range most relevant is 10+ kHz to 10 s**
 - ❑ Sensors and methodology should focus on this band
 - ❑ Stable plate electrodes
 - ❑ BB Magnetometers
 - ❑ **Overnight acquisition is always required**
 - ❑ Frequency band of interest generally includes one or both dead-bands



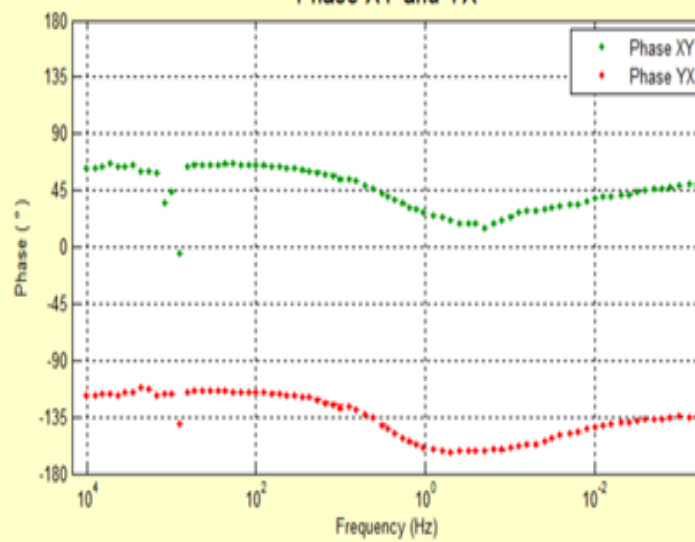
lead chloride Pots vs Stabilized plates

MT Site: Site27T_Pots

Resistivity XY and YX

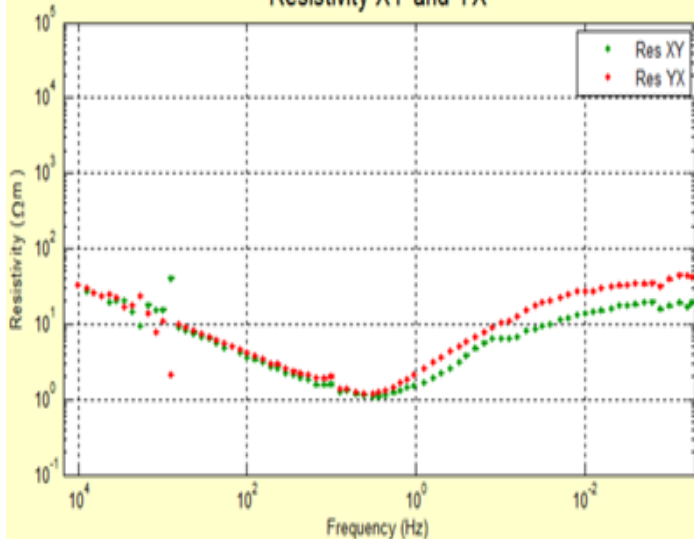


Phase XY and YX

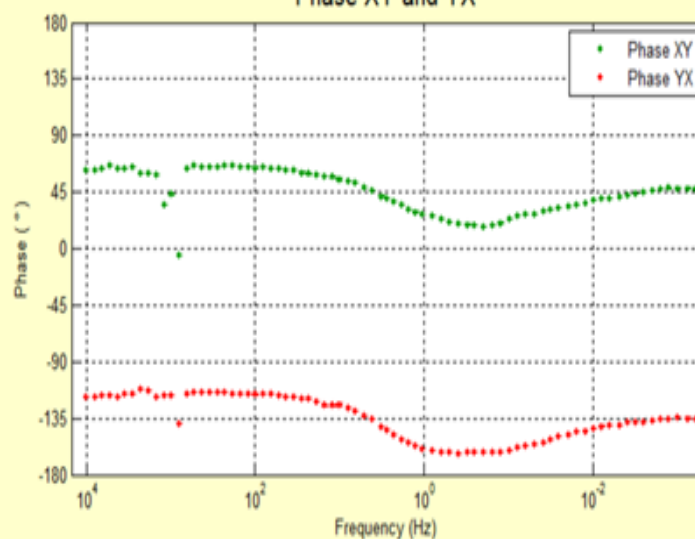


MT Site: Site27T_Plates

Resistivity XY and YX

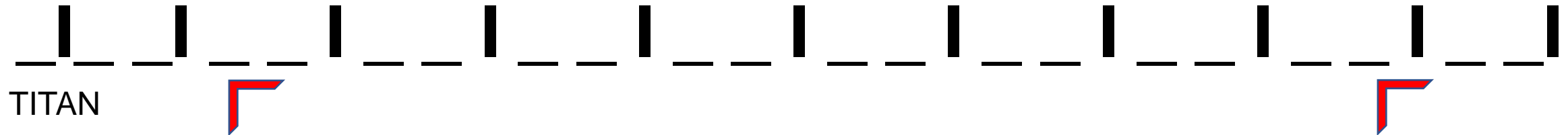
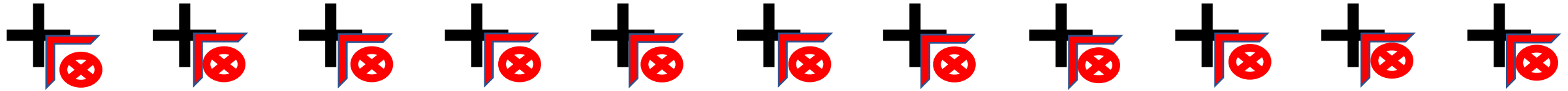


Phase XY and YX

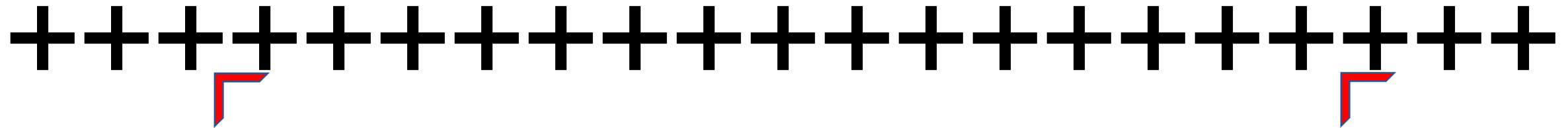


High density acquisition: (focus on electrics)

SPARTAN Sites



TITAN



TITAN +

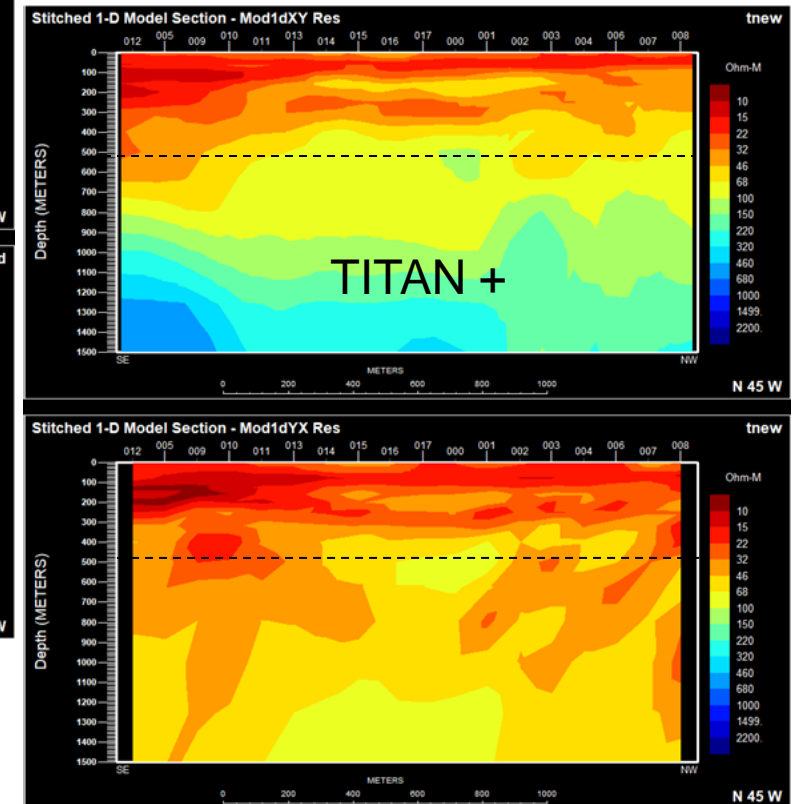
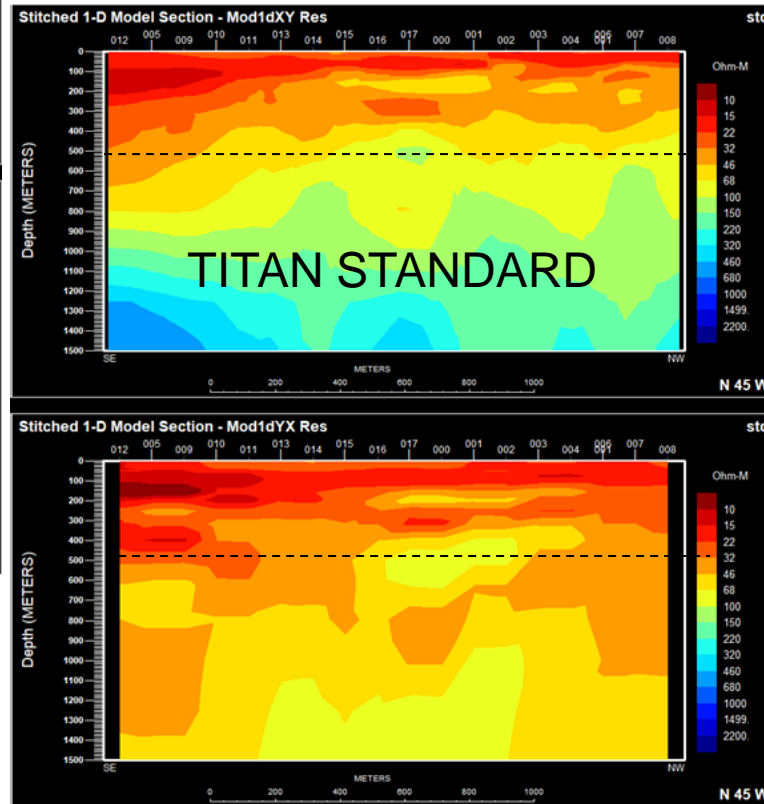
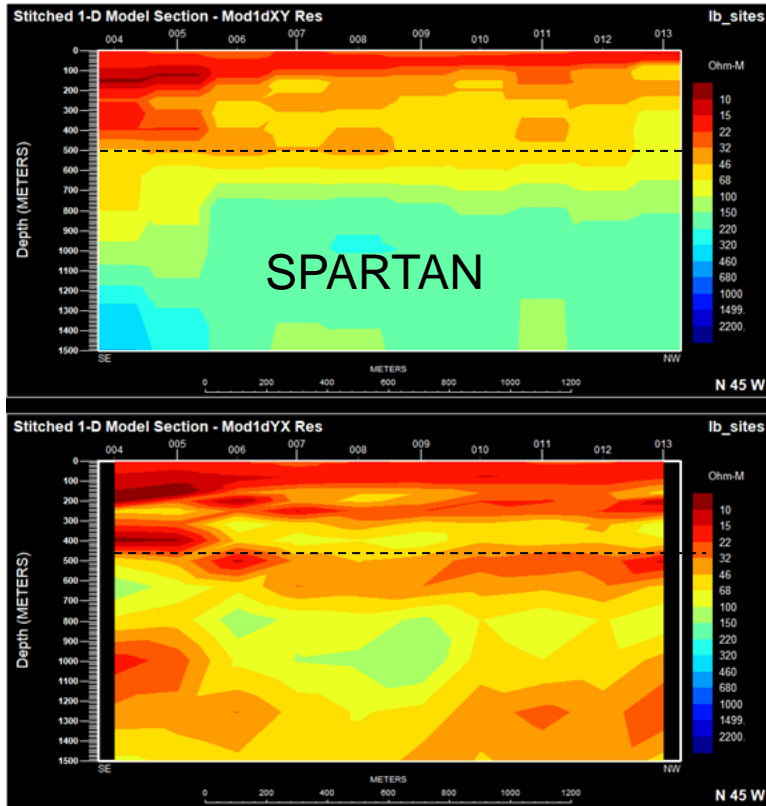


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Thank you to RTX for the collaboration

Stitched 1D – Rho XY (TM), Rho YX (TE)

Better resolving the upper 500 m → → → →



Thank you to RTX for the collaboration

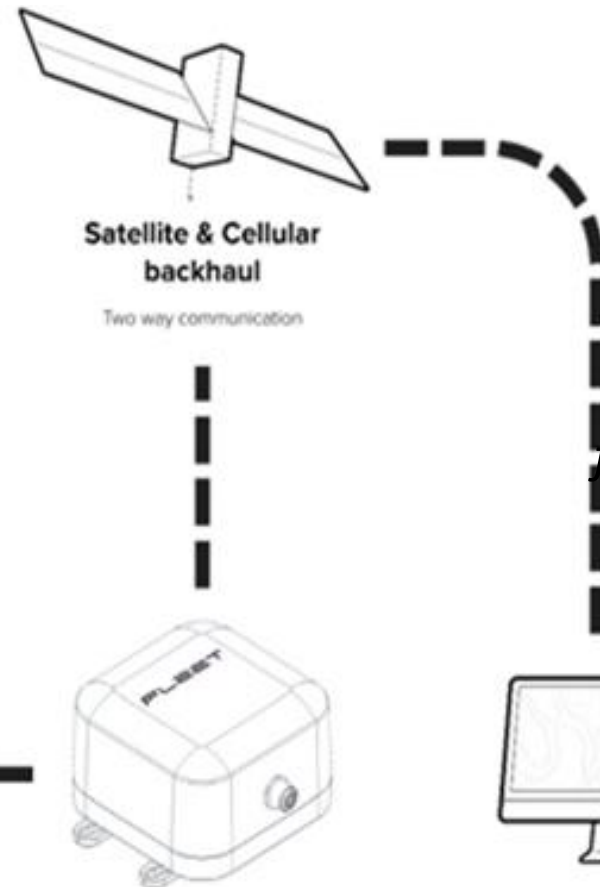


Thank you and initial stop

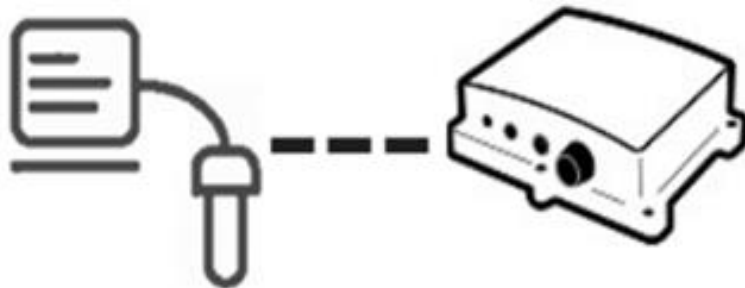
IoT tech for site monitoring (and data transfer)



- ❑ Noise tests show this sort of monitoring doesn't interfere and can be useful



Thanks to RTX and Fleet for collaborating on this project





Appropriate frequency range (and dead-bands)

Do you need to define your exploration depth?

- ❑ Deeper mapping helps the geological model, - defines the plumbing; even if you're not going to drill that deep
- ❑ Frequency band of interest generally includes one or both dead-bands
 - ❑ So, **overnight acquisitions are required**
 - ❑ Then you get broadband data anyway and your sensors may as well be capable
 - ❑ But, no typical need for perfect extreme lows (< 100 s)

- ❑ Skin-depth in high resistivity environments
 - ❑ We should do a good job all to 10 kHz
 - ❑ Conductive targets may remain resolvable at shallow depths
 - ❑ Tipper may help but is expensive
 - ❑ Higher frequencies (> 10 kHz) might be interesting
 - ❑ But we may have to transmit

Frequency			
Hz	Resistivity (ohm-m)	Resistivity (ohm-m)	Resistivity (ohm-m)
	100	1000	10000
10000	50	159	503
6813	61	193	609
4642	74	233	738
3162	89	283	895
2154	108	343	1084
1468	131	415	1313
1000	159	503	1591

- ❑ A little extra DOI is good for inversion (maybe 1 frequency decade?)

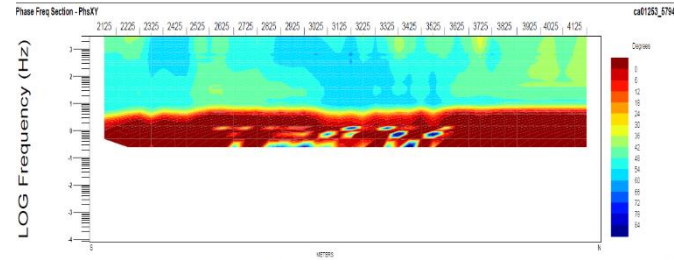
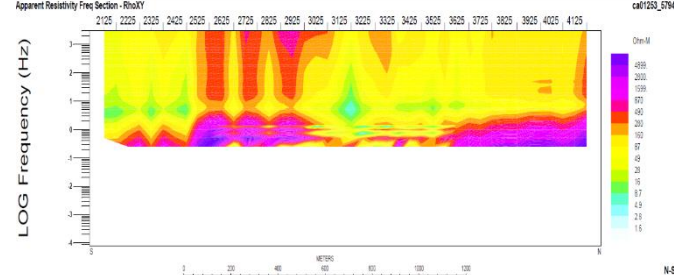
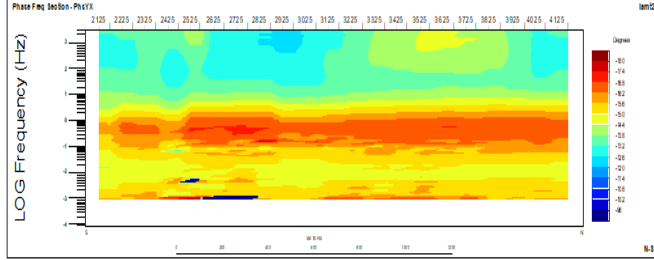
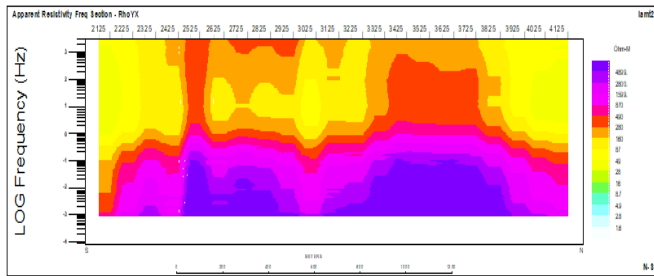
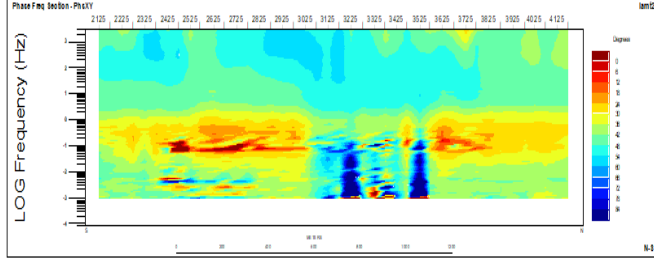
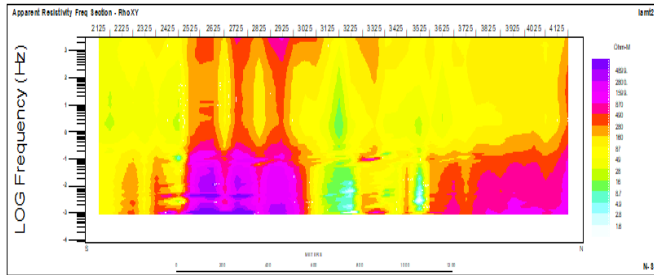


MT TE/TM overnight vs CSAMT and daytime

TM

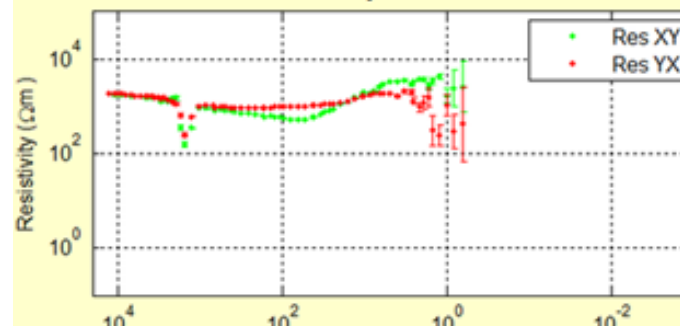
MT

CSAMT

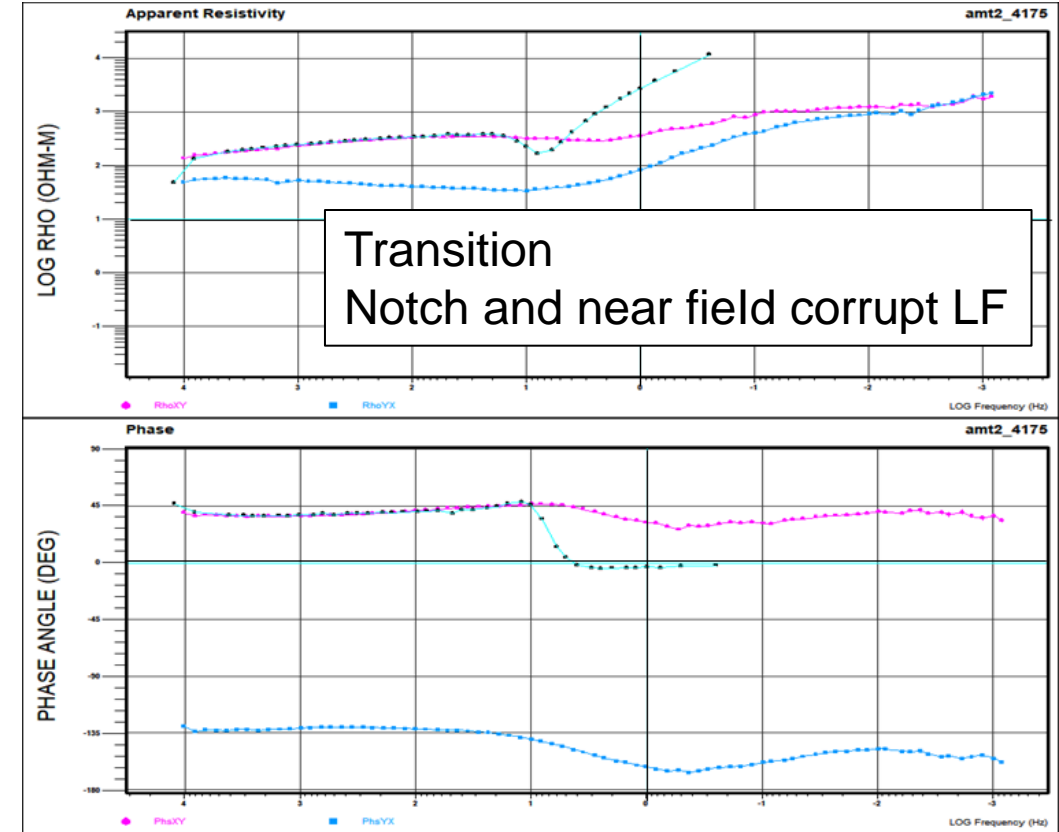
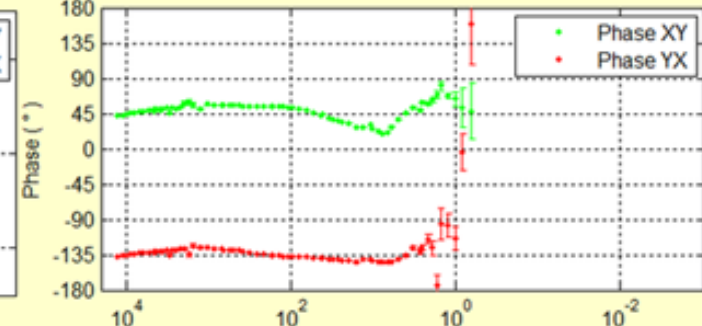


Daytime roll-along

Resistivity XY and YX



Phase XY and YX



Transition
Notch and near field corrupt LF

TE

Thanks to Newmont for the collaboration



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Human resource discussion items

- ❑ The people resource
 - ❑ Young geophysicists
 - ❑ Field staff
 - ❑ Processing
 - ❑ Inversion
 - ❑ Interp
 - ❑ Senior experienced geos
 - ❑ for dealing with the complexities of MT data – It is quite specialized
- ❑ The education resource
 - ❑ Ultimately it is geologists that are using this.
 - ❑ We have invested a lot in educating clients
 - ❑ Use
 - ❑ Applications
 - ❑ Limitations
 - ❑ It is arguably complex

