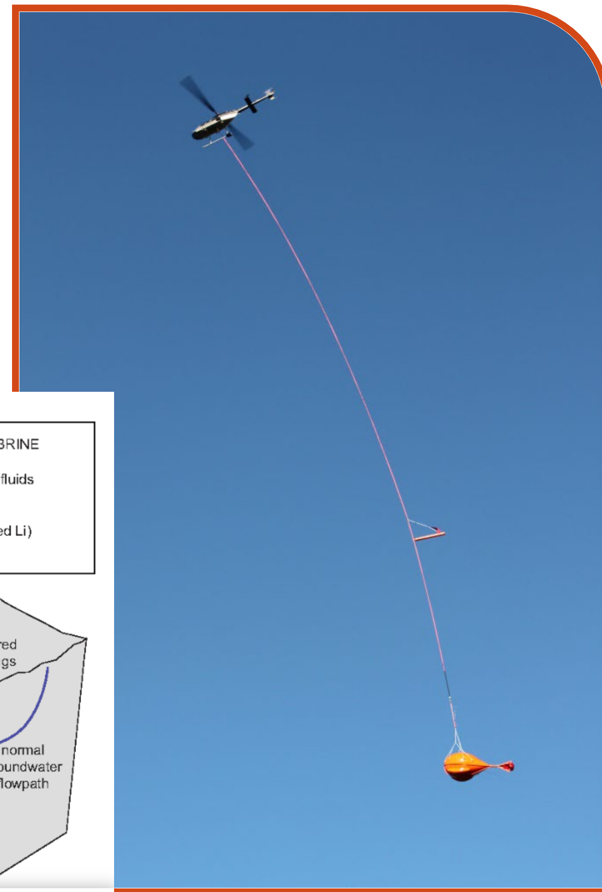
Airborne MobileMT forward modeling

Lithium brines



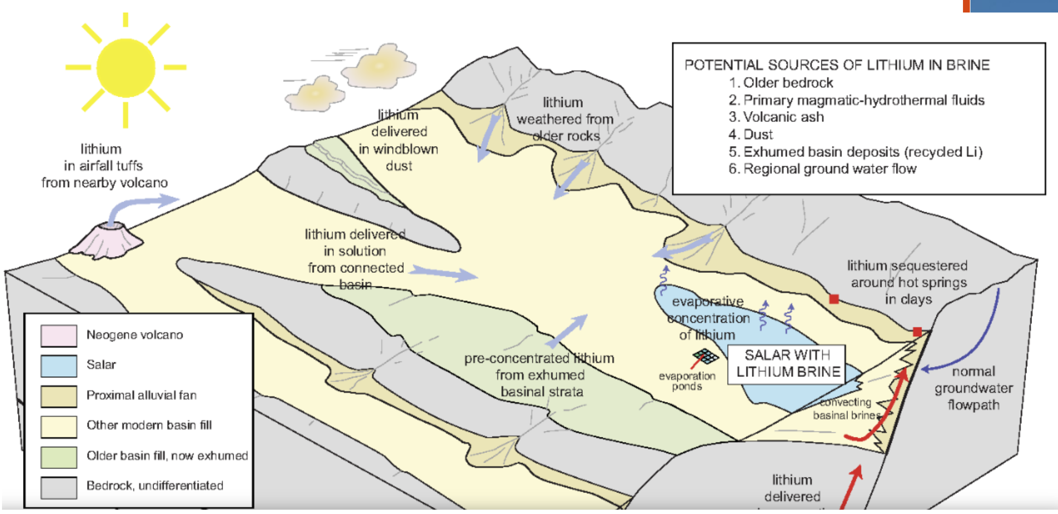


Fig. 2. Summary diagram of the geologic, geochemical, and hydrogeologic features of lithium brines emphasizing the sources, transport, and fate of lithium (adapted from Bradley et al., 2013).

info@expertgeophysics.com
www.expertgeophysics.com

EXPERT GEOPHYSICS

MobileMT is an airborne EM technology based on natural fields. The technique records magnetic (in the air) and electric (on the ground) fields generated by natural sources in the audio frequency range[11]. The technology is utilizing the natural electromagnetic fields with the frequencies ranging from 25 Hz to 21 kHz (ELF+VLF) what determines the depth range of investigation from surface up to >1 km depending on geoelectrical conditions.
MobileMT, has the following advanced features:

- 3+ orders of frequency measurement range reflecting near surface and deep geological structures;
- the broadband range is divided on up to 30 collected frequency windows what provides data selection capabilities and high in-depth resolution;
- Inferring geoelectrical structures in absolute conductivity units (utilizing the magnetic and electric components);
- Resolving resistivity contrasts between geological units in any direction including layered geology and subvertical structures (utilizing total field through three geometrical components);
- Sensitivity to 'superconductors' with no limits;
- Sensitivity to resistivity differentiations in thousands and tens of thousands ohm-m range.

Objective of the forward modeling is determining detectability of an exploration model or target using MobileMT airborne EM, based on a provided geoelectric model.

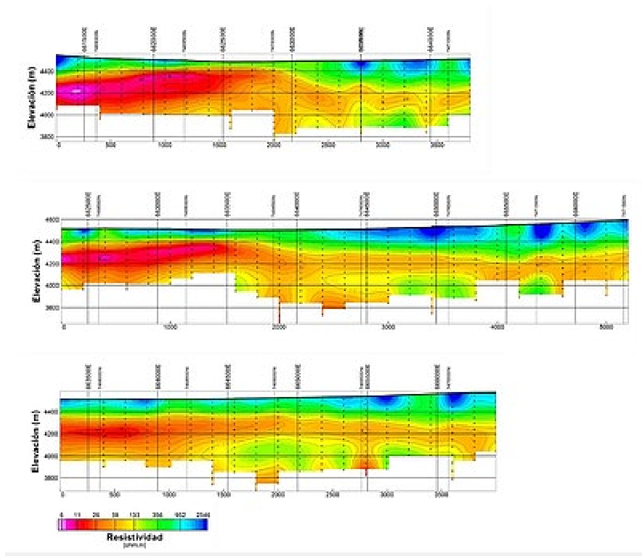
Method: use 2D adaptive finite elements and regularized non-linear MARE2DEM[1] forward and inversion code to obtain MobileMT synthetic forward apparent conductivity (or resistivity) data and then invert the calculated data with added noise into a resistivity section.

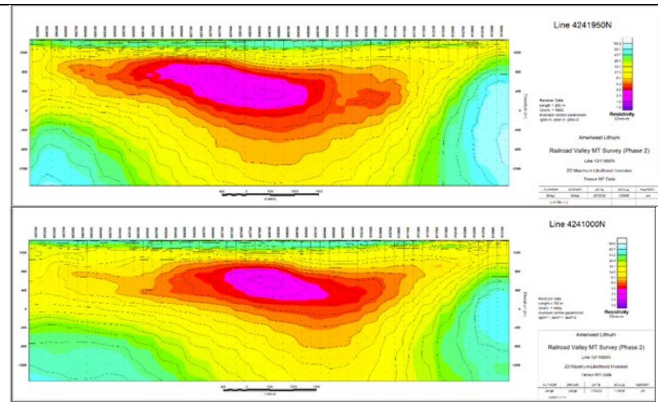
<u>The next steps are implemented into the forward modeling procedure:</u>

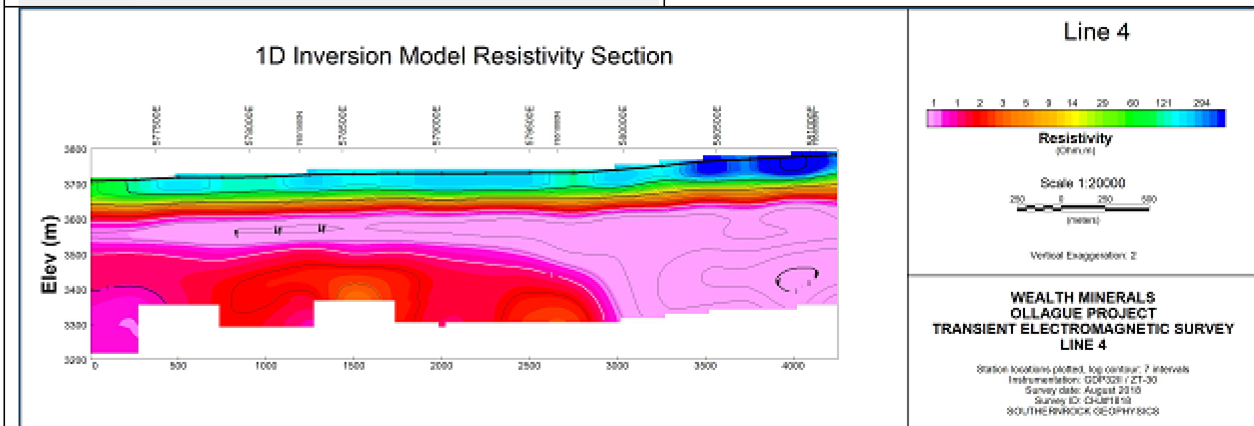
- Development a simplified or fully identical geoelectrical model-section.
- Calculation of MobileMT response (apparent conductivity or apparent resistivities values) for different frequencies along a model.
- Adding gaussian noise into the calculated data.
- Non-constraint, based on half-space initial model, inversion of the calculated+noise field.
- The MobileMT technology is recognized as potentially effective if the inverted data is recovering the initial model or a target.

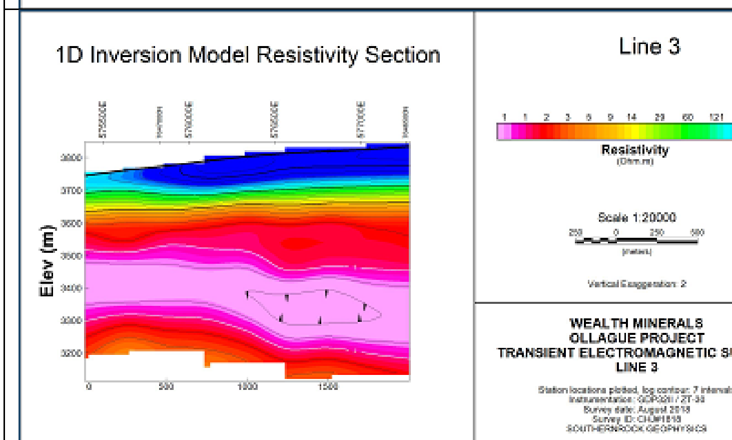
[1] Kerry Key, Jeffrey Ovall. A parallel goal-oriented adaptive finite element method for 2.5-D electromagnetic modelling. Geophysical Journal International. Vol.186, Issue 1. 2011

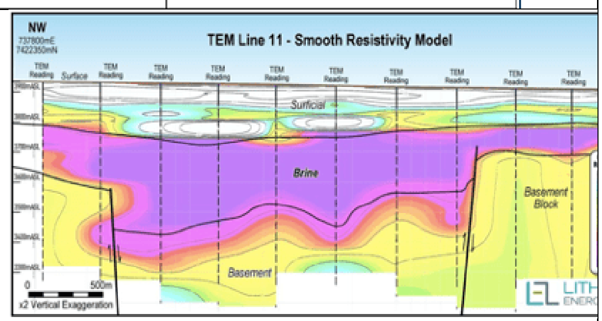
Initial geoelectrical models from open sources

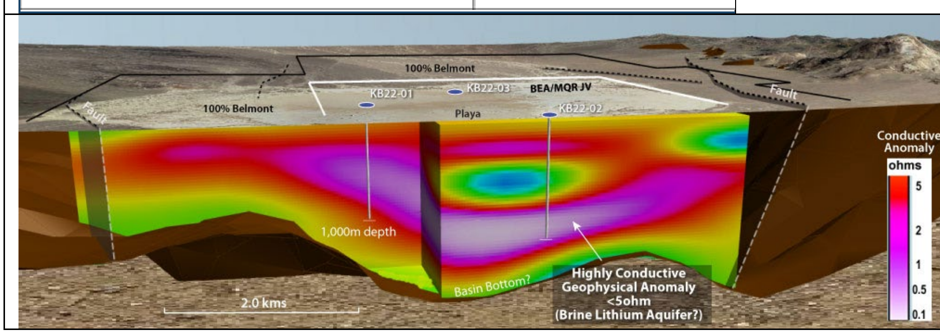






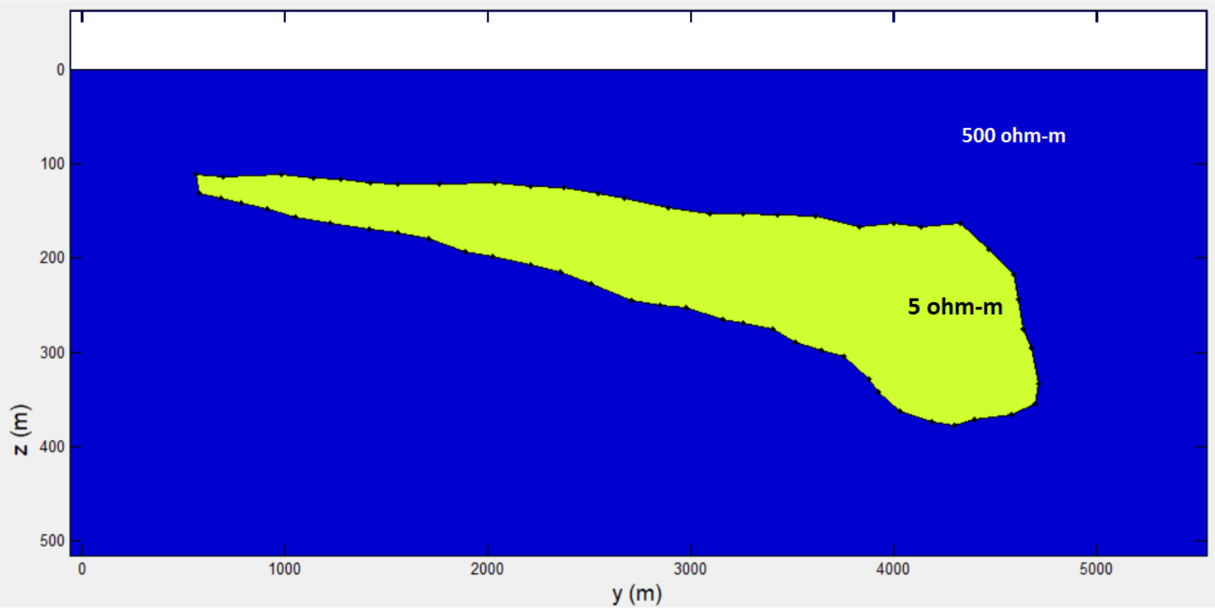




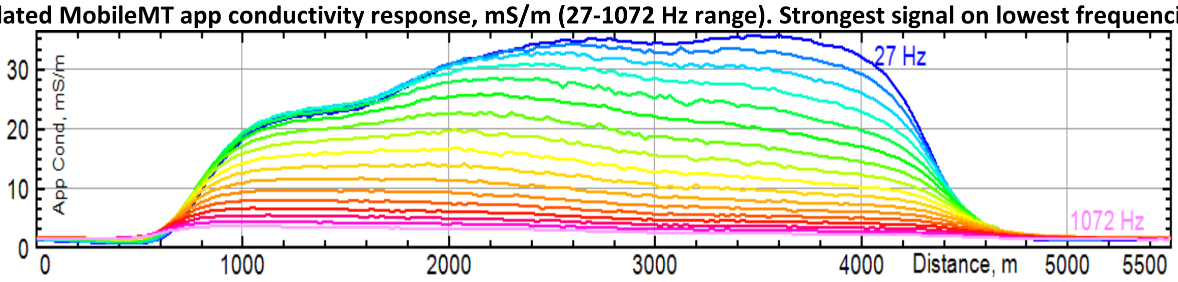


Model 1

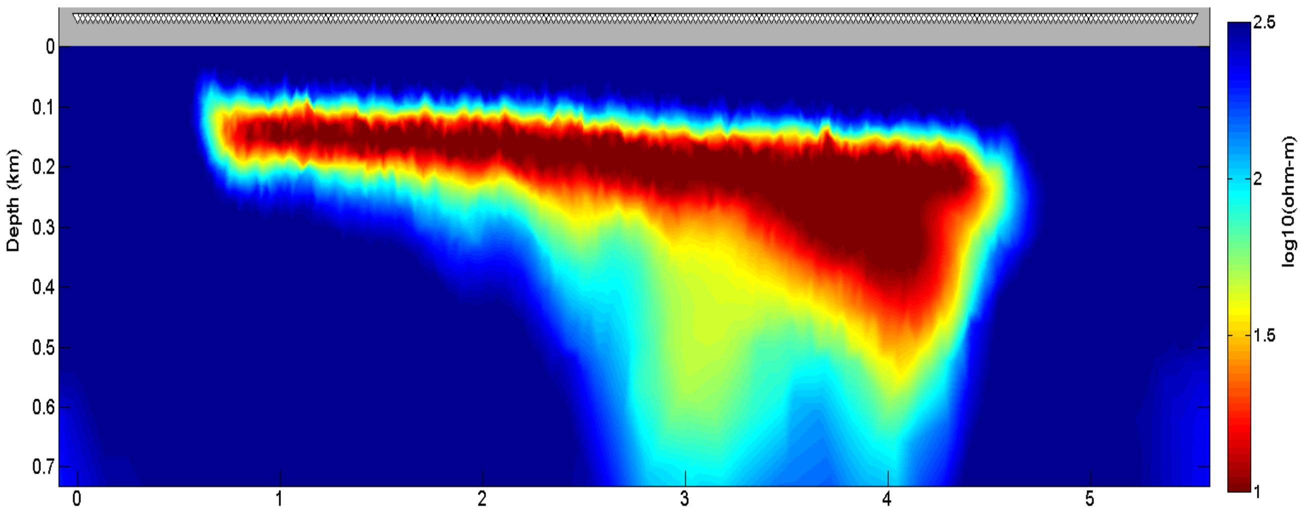
Simplified geoelectrical model



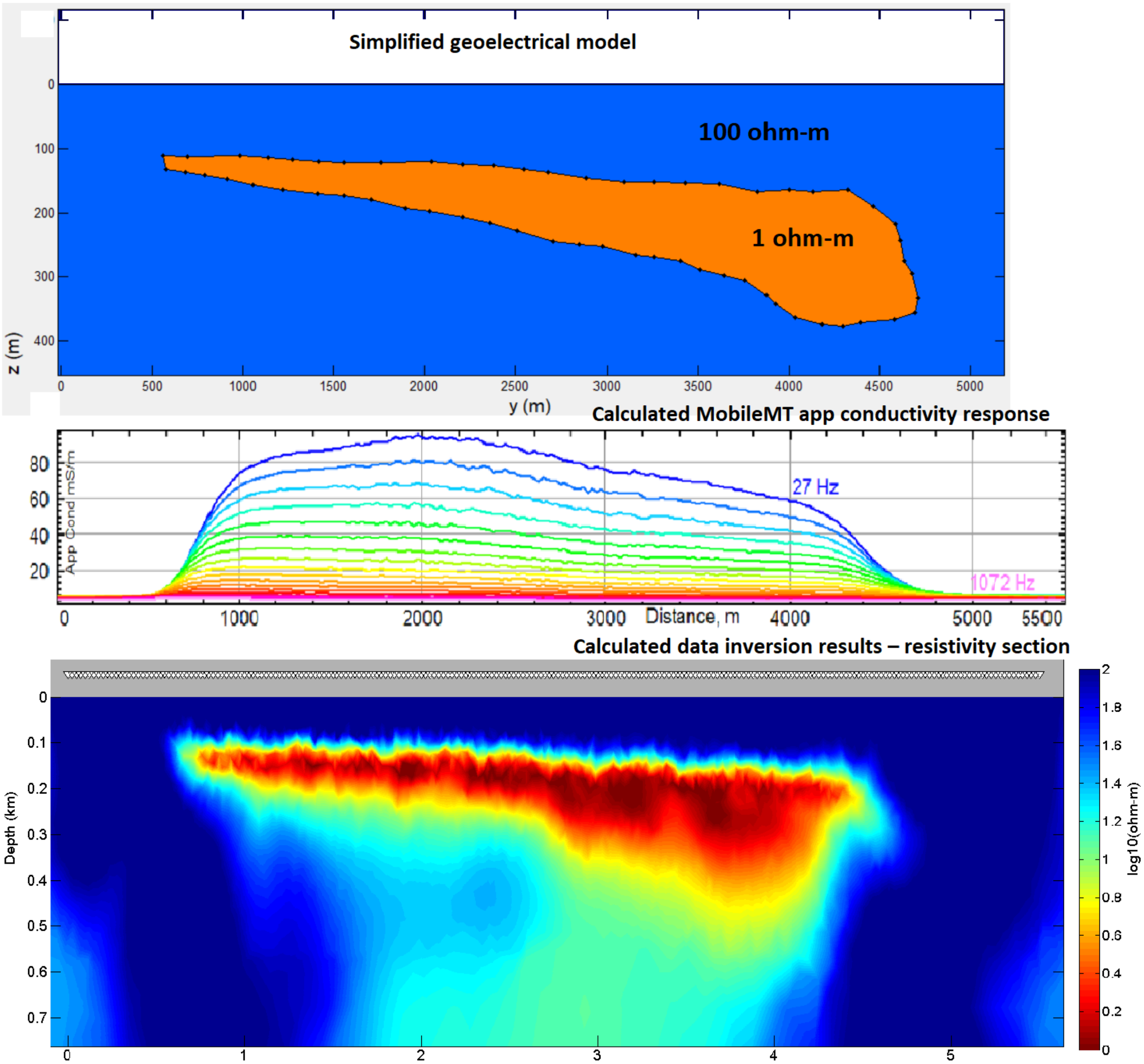
Calculated MobileMT app conductivity response, mS/m (27-1072 Hz range). Strongest signal on lowest frequencies.



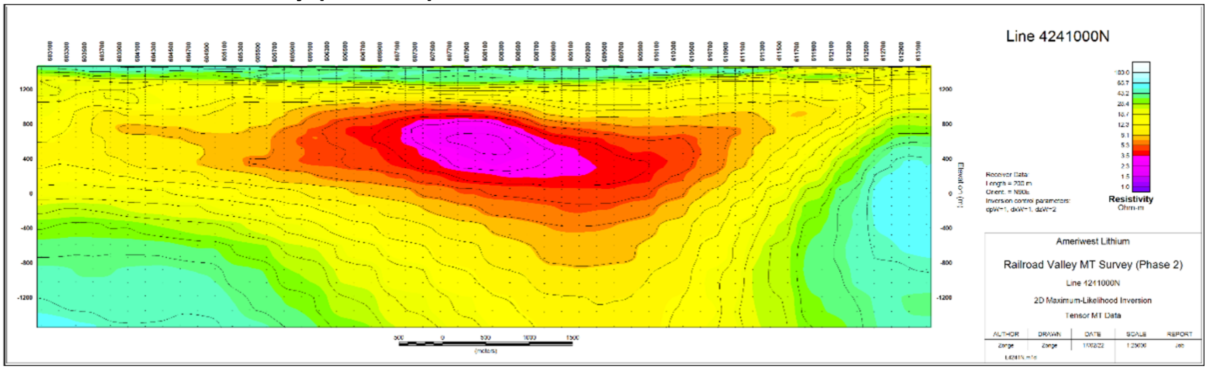
Calculated data inversion results – resistivity section.



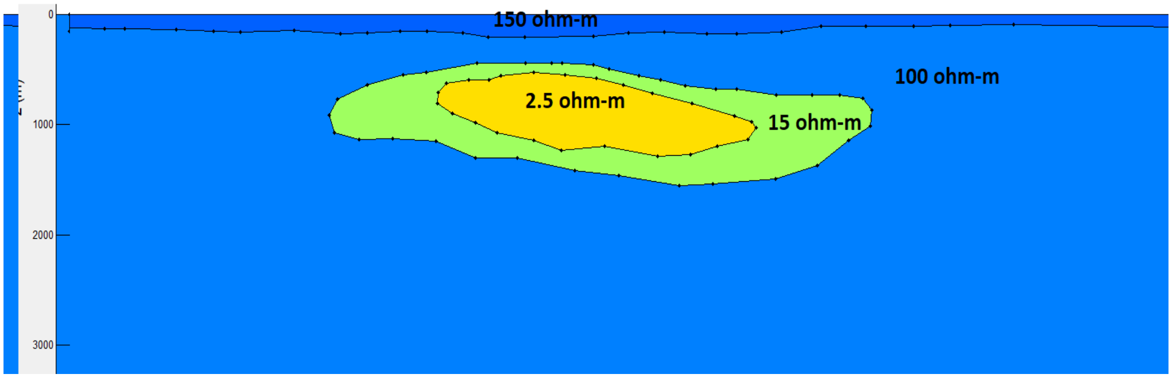
Model 2


Simplified geoelectrical model
100 ohm-m
1 ohm-m
z (m)
y (m)
Calculated MobileMT app conductivity response
App Cond mS/m
27 Hz
1072 Hz
Distance, m
Calculated data inversion results – resistivity section
Depth (km)
log10(ohm-m)

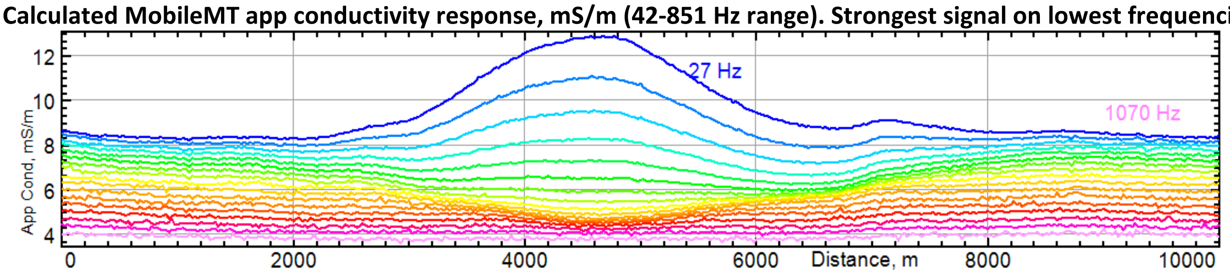
Model Rail Road Valley (Nevada)

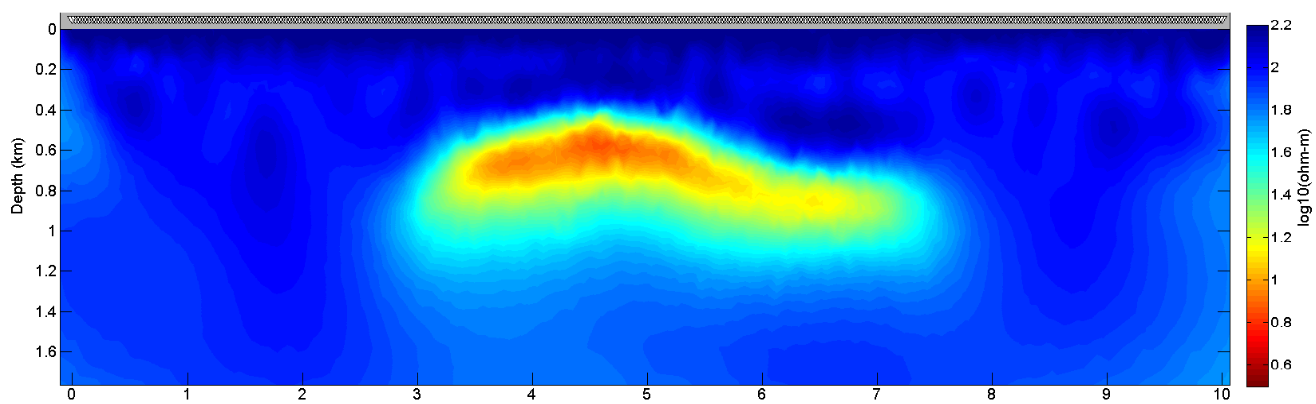


Simplified geoelectrical model. Values in Ohm-m.



Calculated MobileMT app conductivity response, mS/m (42-851 Hz range). Strongest signal on lowest frequencies.





Conclusion

Numerical methods have been used to simulate lithium brines models and to check potential models' reflection in the MobileMT data. The current forward modeling covers three scenarios - (Model 1), (Model 2) and Model Rail Road Valley. As the theoretical results show, MobileMT airborne EM system is able to recover subsurface conductors present in all three models effectively. In all cases, anomalies from the conductors significantly exceed expected MobileMT sensitivity and recovered well by the data inversions.