MobileMT epithermal gold systems forward modeling

from innovations to discoveries

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Definition: for the case of MobileMT technology, forward modeling is the mathematical simulation of a geoelectrical model which is used to compute natural EM field data in the range of 26-20,000 Hz that would be observed given that model.

Objective of the forward modeling, based on a geologic model and petrophysical parameters of the model, is investigation a target detectability or the model recovering capabilities of the MobileMT technology in different geoelectrical conditions and scenarios.

The next steps are implemented into the forward modeling procedure:

- Approximation of the geoelectrical model-section.

- Calculation of MobileMT response (apparent conductivity or apparent resistivities values) for different frequencies along a model.

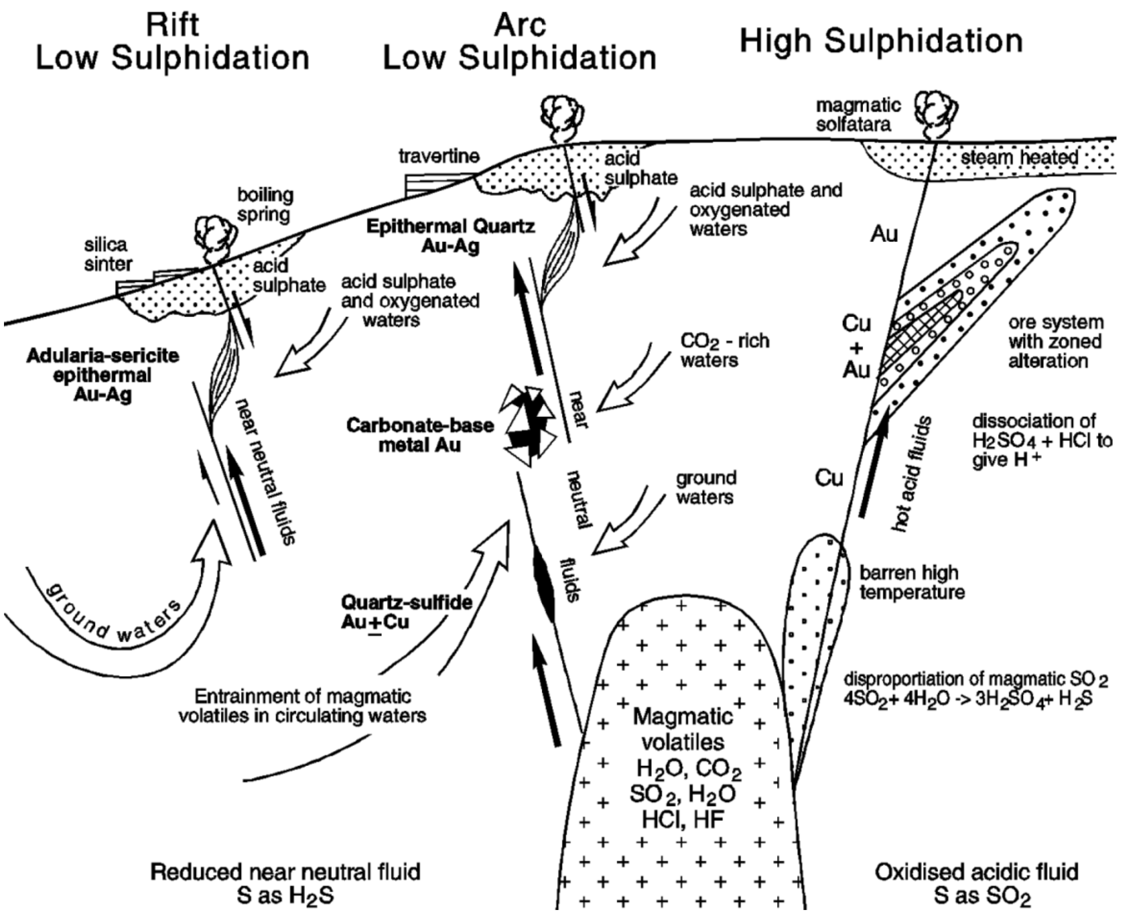
- Adding gaussian noise into the calculated data (~3%).

- Non-constraint 2D inversion of the calculated+noise field based on the half-space initial model.

- The MobileMT technology is recognized as potentially effective if the inverted data is recovering the initial model or detect a given target.

Genetic types of epithermal gold deposits

Epithermal gold deposits (defined by Lindgren in 1922&1933) usually are considered as those formed at higher crustal levels than porphyry environments, although many are telescoped upon deeper porphyry systems. The Au ± Ag ± Cu deposits formed in magmatic arc environments (including rifts) at elevated crustal settings, most typically above the level of formation of porphyry Cu-Au deposits (typically < 1 km), although in many instances associated with subvolcanic intrusions (Corbet, 2002).



Derivation of low and high sulphidation fluids including arc and rift low sulphidation. (after Corbet, 2002)

Presented models

- Case 1 – generalized low sulphidation epithermal gold deposit (similar to the Stockwork form McLaughlin deposit in USA, Golden Cross in New Zealand and the vein type Hishikari deposit in Japan)
- .Case 2 – buried generalized low sulphidation epithermal gold deposit
- Case 3 - Epithermal Tuoniuhe gold deposit, Northeast China, with a resistive target.
- Case 4 - Hishikari epithermal gold-silver deposit, Kagoshima, Japan

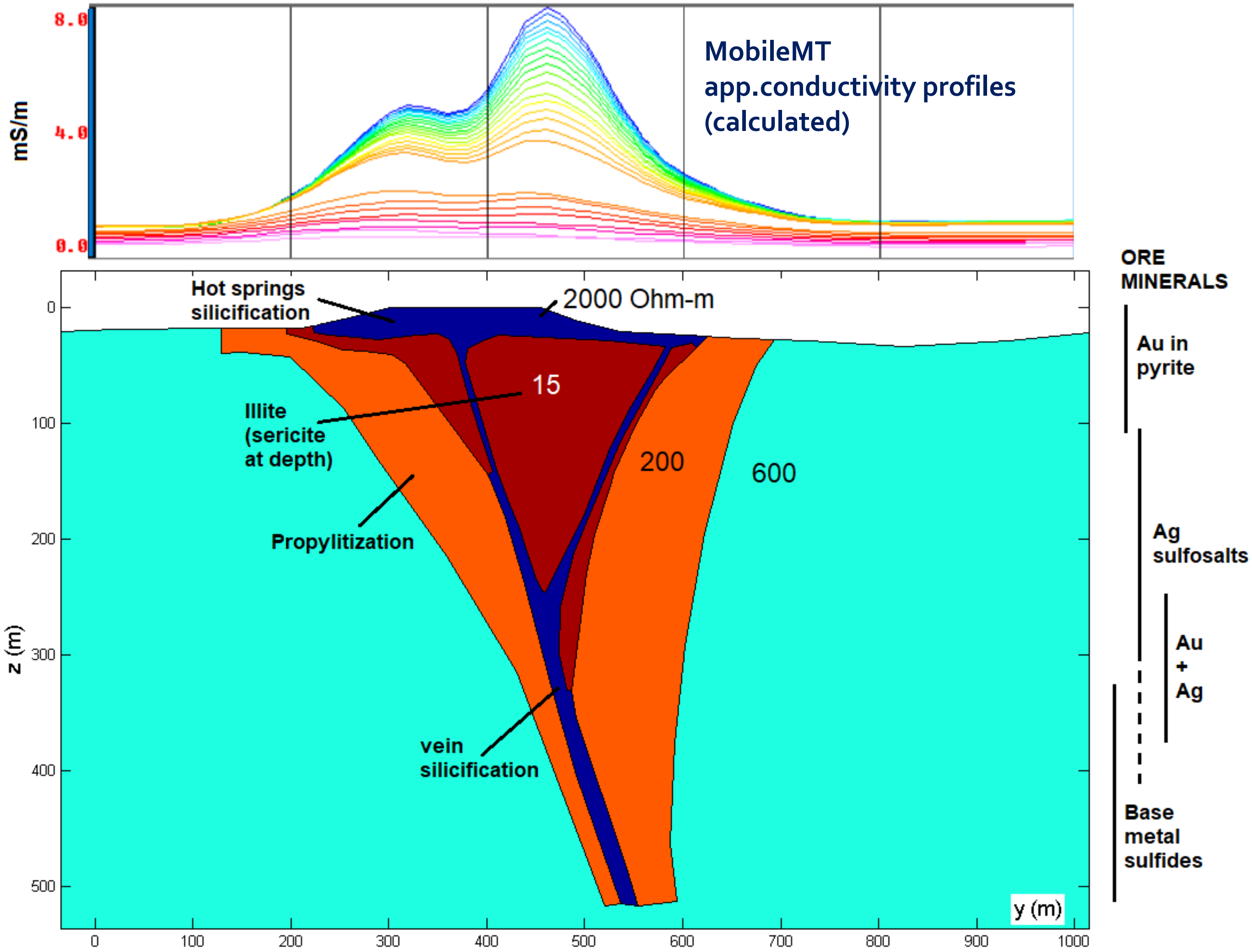
low sulphidation epithermal gold deposit (after Williams, 1997)

Factors increasing rocks conductivity:

- Kaolinitic and bentonitic clays derived from felsic rocks;
- serpentine and montmorillonite clays derived from basic rocks;
- Increased porosity and permeability;
- Saline fluids.

Factor increasing rocks resistivity:

- the formation of silica which decreases the permeability and porosity of the rocks.

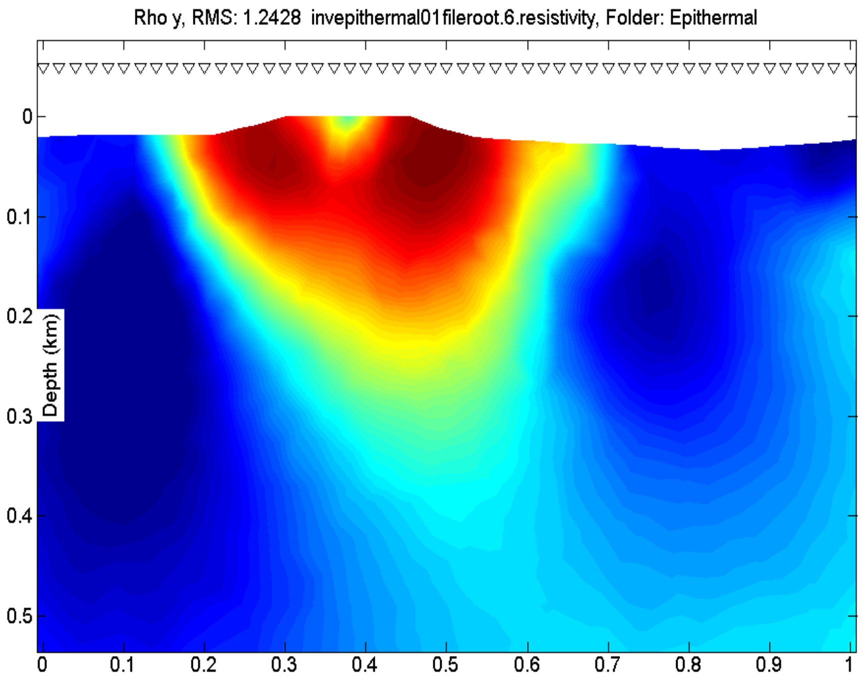


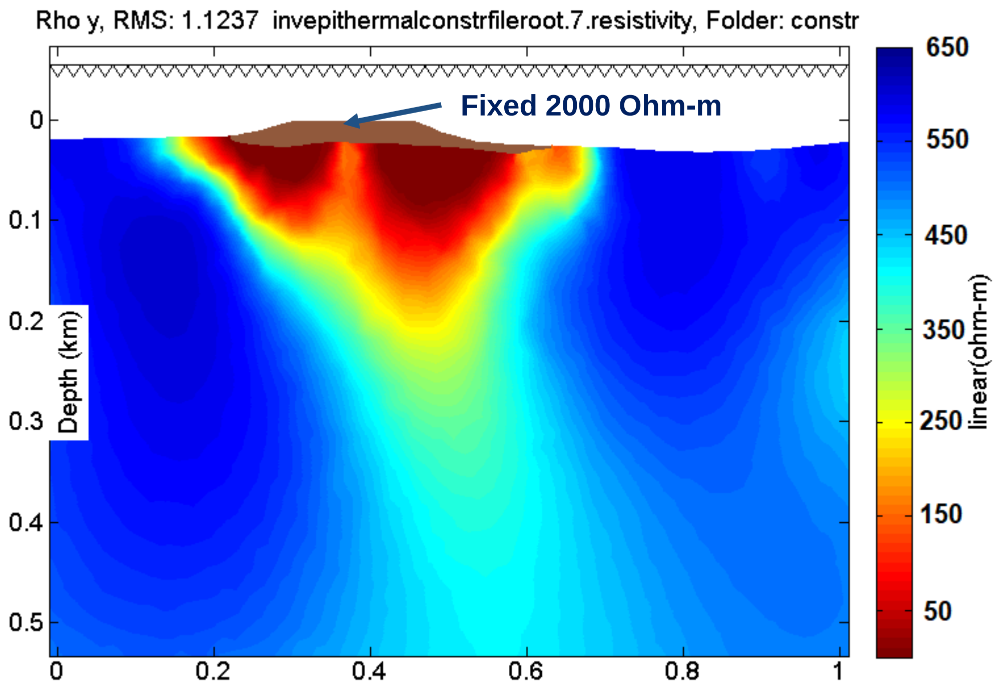
Examples of LS deposits: the Stockwork form McLaughlin deposit in USA, Golden Cross in New Zealand and the vein type Hishikari deposit in Japan.

low sulphidation epithermal gold deposit

unconstrained inversion based on a half-space initial model.

Constraining the silica cap (2000 Ohm-m) during the inversion makes the rest part of the section closer to the original model.

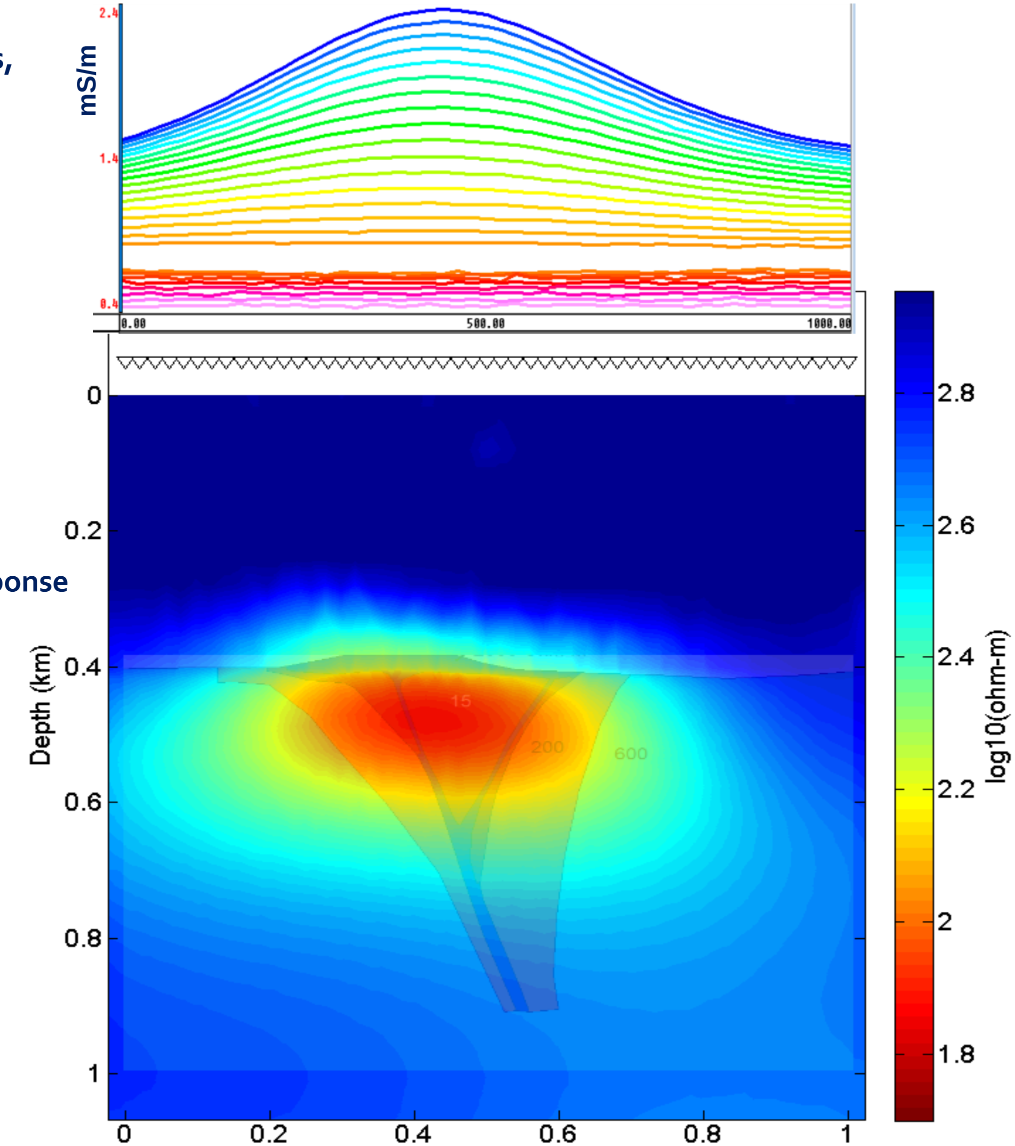




Buried low sulphidation epithermal gold deposit
(modified after Williams, 1997)

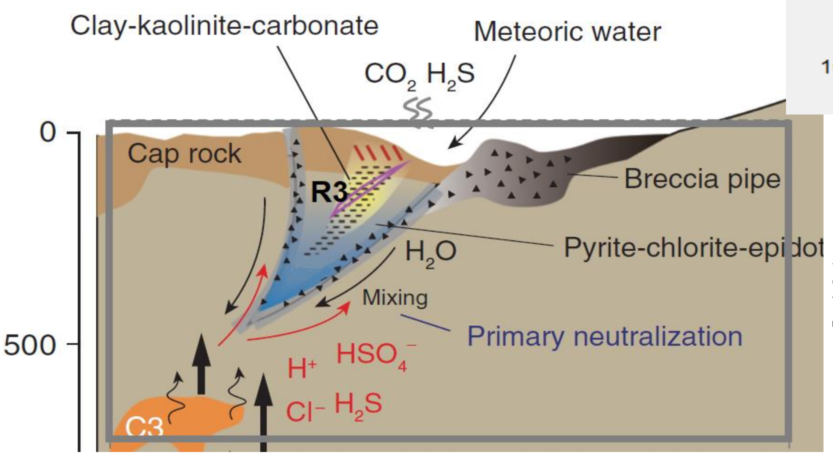
MobileMT app.conductivity profiles, calculated from the buried model

Unconstrained inversion of the calculated response with the transparent projection of the model

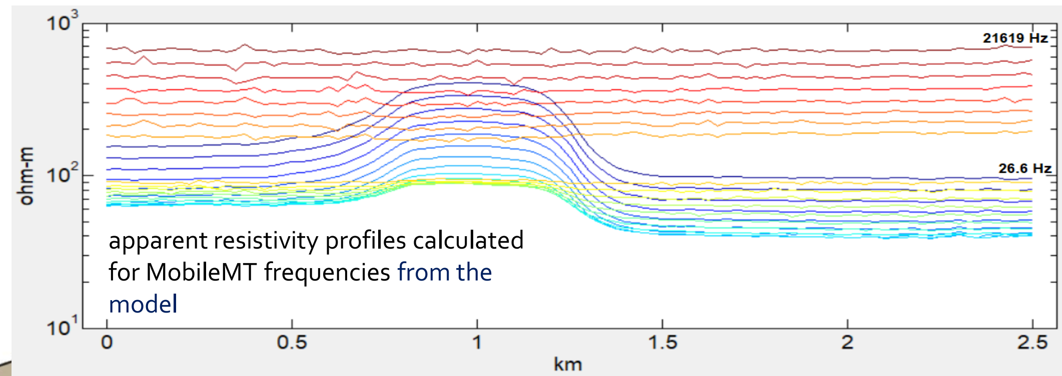


Epithermal Tuoniuhe gold deposit, Northeast China (Xu et al., 2020)

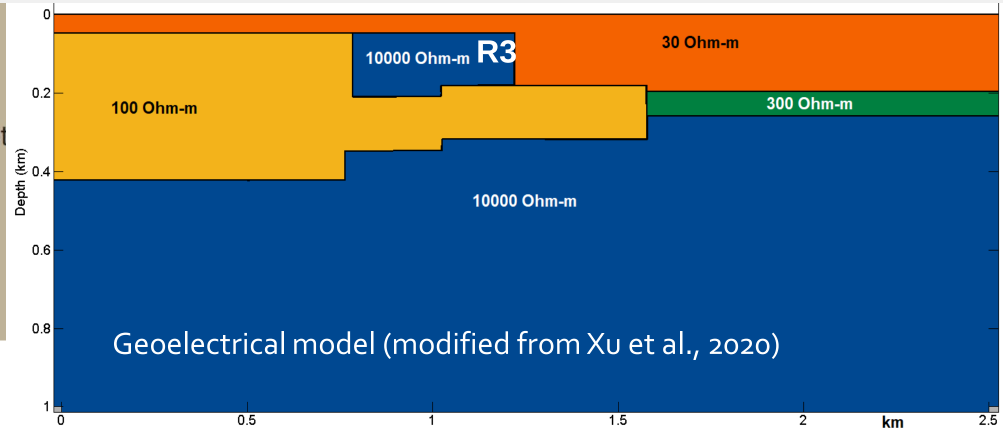
The deposit is hosted in the Early Cretaceous volcanic and volcano-sedimentary complex, which is composed of andesite, rhyolite, and tuff breccia. Kaolinite and disseminated pyrite are abundant in the andesitic pyroclastics. The replacement of feldspar and pyroxene minerals by clay minerals and sulfides cause a significant decrease of resistivity (30 Ohm-m top layer). The deposit is characterized by silicic-pyrite-sericitecarbonate-kaolinite-chlorite alteration assemblage. The zone R3 is associated with mineralization in the epithermal environment, in vuggy and massive quartz as well as in quartz veins.



Simplified genetic model



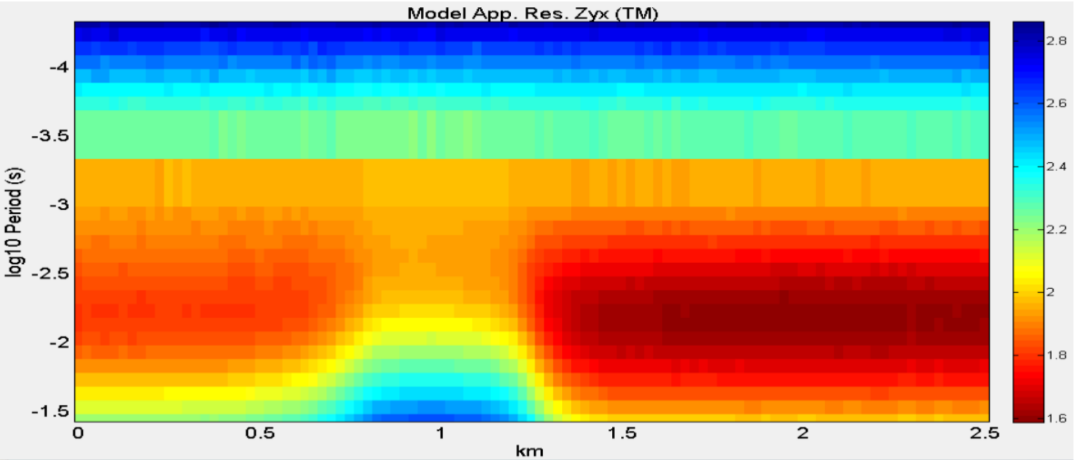
apparent resistivity profiles calculated for MobileMT frequencies from the model

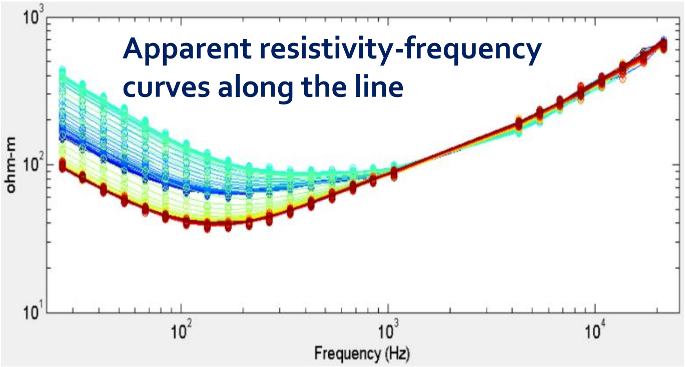


Geoelectrical model (modified from Xu et al., 2020)

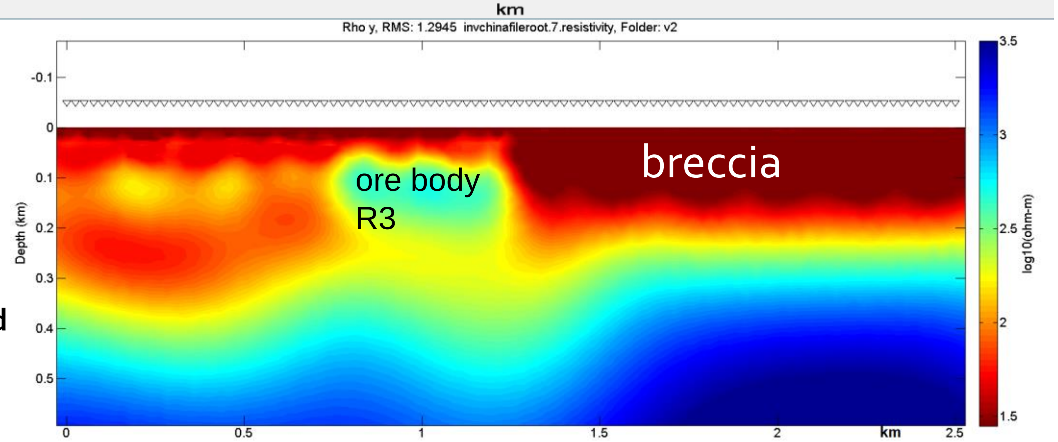
Epithermal Tuoniuhe gold deposit, Northeast China

Apparent resistivity pseudosection





Apparent resistivity-frequency curves along the line

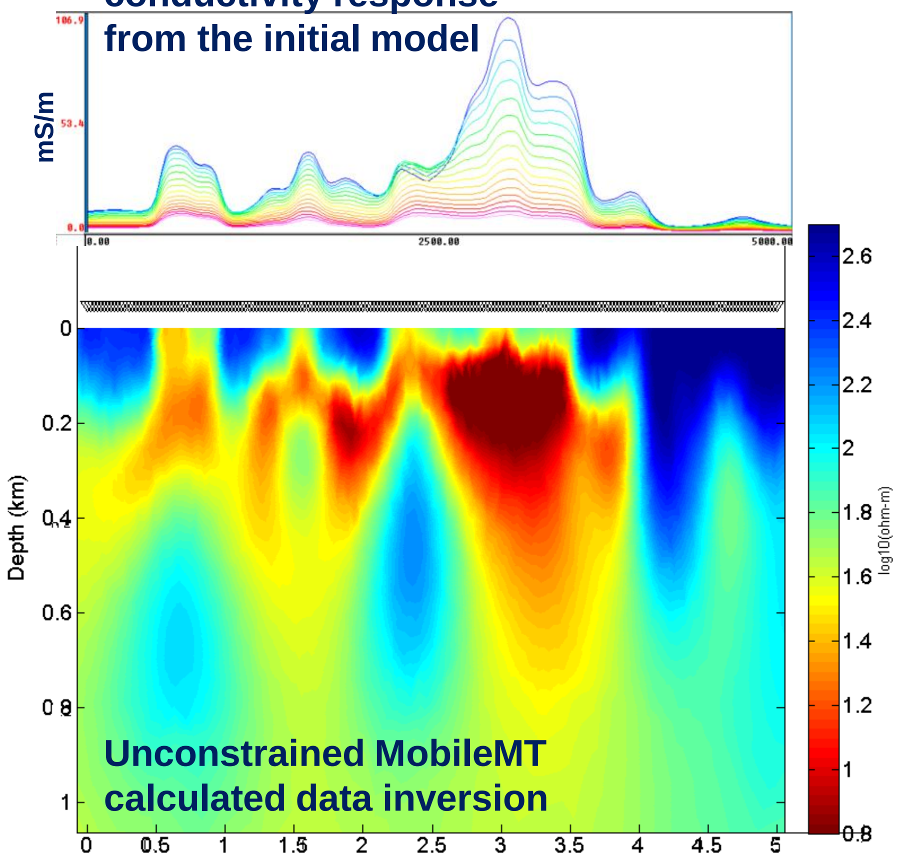


Unconstrained inversion of the calculated response from the model

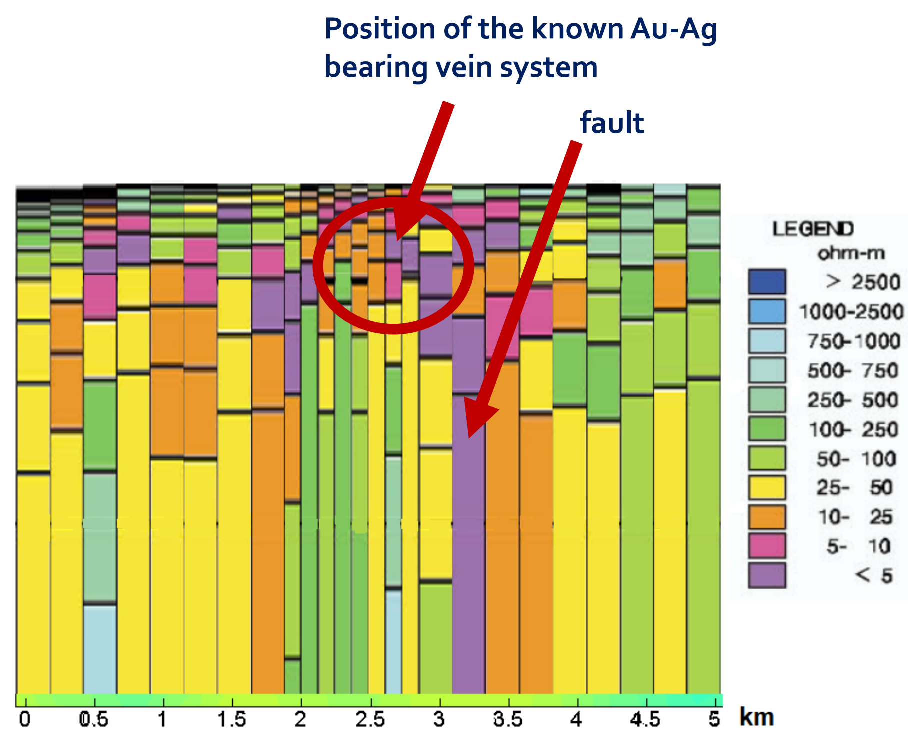
Hishikari epithermal gold-silver deposit, Kagoshima, Japan
(Okada, 2000)

One of the world's richest gold mines, is in northeastern Kagoshima on Kyushu Island, southwest of Japan. The Hishikari deposit is an epithermal, fissure-filling, gold- and silver-bearing quartz-adularia vein system, occurring in both shale and andesites, still bathed in hot solutions.

MobileMT calculated apparent conductivity response from the initial model



Interpreted resistivity section from ground VES (initial model)



Conclusion

Numerical methods have been used to simulate epithermal gold bearing ore-systems models and their reflection in the MobileMT data. The current forward modeling covers 3+ typical and generalized epithermal systems models in a wide spectrum of geoelectrical conditions, from resistive to conductive.

As the theoretical results and practice show, the MobileMT airborne EM system is able to recover subsurface geology effectively in the broad range of resistivities and depths.

Mobile-MT technology is highly potential in mineral exploration, including deeply located targets or masked by challenging post-mineral cover.

References:

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Please send us your models or sections and we will check MobileMT capabilities in solving your exploration problems.

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