A brief analysis of MobileMT data

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MobileMT – acquisition

- natural-field EM system designed by Petr Kuzmin and operated by Expert Geophysics Limited (EGL)
- wide frequency range 25 Hz – 20 kHz, sampling rate 98 kHz
- records three-component airborne dB/dt data (1.4 m diameter coils)
- base station records horizontal E-field data with 2 pairs of orthogonal sensors (signal & reference), separated by ~30 m
- cesium magnetometer (Geometrics G-822A)
MobileMT – acquisition
MobileMT – acquisition
MobileMT - processing

\[
\begin{pmatrix}
H_x \\
H_y
\end{pmatrix} = \begin{pmatrix}
Y_{xx} & Y_{xy} \\
Y_{yx} & Y_{yy}
\end{pmatrix} \begin{pmatrix}
E_x \\
E_y
\end{pmatrix}
\]

\[Y = \text{admittance}\]

\[Y_{DET} = \sqrt{Y_{xx}Y_{yy} - Y_{yx}Y_{xy}}\]

\[\sigma_{app} = \mu\omega \left|Y_{DET}^2\right| \quad \varphi = \arg\left(Y_{DET}^2\right) \text{ not (yet) provided}\]

\[H_z\text{ data currently not used, but roving tipper could be derived from } H_x, H_y \& H_z\text{ data}\]

Petr Kuzmin’s comment: Hz data is used in the processing to derive Total Field from \(H_xH_yHz\). The expression above is a simplified expression.
MobileMT – processing, 2D case:

\[ Y_{DET} = \sqrt{-Y_{yx}Y_{xy}} = \sqrt{-Y_{TM}Y_{TE}} \]

\[ \sigma^{app} = \frac{1}{\sqrt{\rho_{TE}^{app} \rho_{TM}^{app}}} \quad \phi = \frac{1}{2}(\phi_{TE} + \phi_{TM}) \]

Parameters independent of strike direction – see also:

MobileMT - Products

- Apparent conductivity grids
- 2D inversions (Occam2D, Wannamaker & Constable)
- 3D forward modeling (UBC-GIF $MT3Dfwd$)
- 3D inversions
2D synthetic data modeling (Wannamaker & Constable)
3D synthetic data modeling (UBC-GIF) – 10 km strike
2D synthetic MobileMT data inversion of appcon
2D synthetic MobileMT data inversion of appcon & phase
2D synthetic MobileMT data modeling

Non-zero response over layered-earth!
2D synthetic MobileMT data inversion
2D synthetic MobileMT data inversion
2D synthetic MobileMT data modeling - appcon
Target without/with IP - $\tau=0.001\text{s}$, $m=1.0$, $f_c=0.5$
2D synthetic MobileMT data modeling – phase
Target without/with IP - \( \tau=0.001 \text{s} \ m=1.0 \ fc=0.5 \)
2D synthetic MobileMT data inversion, ignoring IP
MobileMT survey – VMS exploration, N Ontario

Apparent conductivities
MobileMT

VTEM
Con at 150 m depth
(Kaminski et al., 2016)
VTEM data modeling (Kaminski et al., 2016):
Occam2D inversion results
Occam2D inversion results
Occam2D inversion results
Occam2D inversion results
Occam2D inversion results
Holdsworth Gold project, N Ontario
Structural mapping - shear-zones, quartz veins
Holdsworth project
MobileMT appcon vs ZTEM tipper data

Pros:
- Extending frequency nice, though not critical
- dBx/dt & dBy/dt stronger signal than dBz/dt, requiring smaller Rx coils (1.4 m) than ZTEM (7.4 m)
- combination of H/E-fields makes data sensitive to resistivity values (eg LE), rather than resistivity contrasts

Cons:
- being more sensitive to local resistivities makes modeling harder (start model!)
- harder to collect good E-field data in rocky/sandy/frozen terrain?
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