3D time-domain AEM modeling

Xiuyan Ren

RMIT University
Jilin University

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Field-separation method

- Footprint
- Local mesh
- Direct solver

$$\nabla \times \nabla \times \mathbf{E}_s + \mu\sigma \frac{\partial \mathbf{E}_s}{\partial t} = -\mu(\sigma - \sigma_p) \frac{\partial \mathbf{E}_p}{\partial t}$$

$$\iiint_V \mu\sigma \frac{\partial \mathbf{E}_s}{\partial t} \mathrm{d}V + \iint_{\partial V} \mathbf{n} \times (\nabla \times \mathbf{E}_s) \mathrm{d}S = -\iiint_V \mu(\sigma - \sigma_p) \frac{\partial \mathbf{E}_p}{\partial t} \mathrm{d}V$$

$$(3G^V C + 2\Delta t G^{\partial V} \mathbf{D}) \mathbf{E}_s^{i+1} = G^V C(4\mathbf{E}_s^i - \mathbf{E}_s^{i-1}) - G^V J_r (3\mathbf{E}_p^{i+1} - 4\mathbf{E}_p^i + \mathbf{E}_p^{i-1})$$

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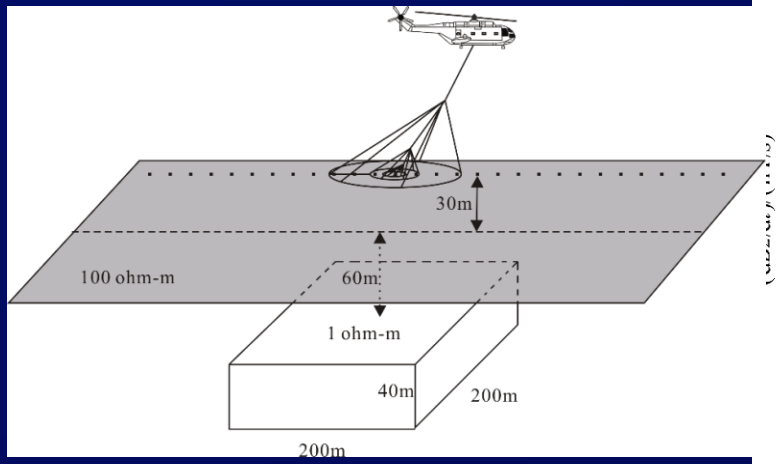

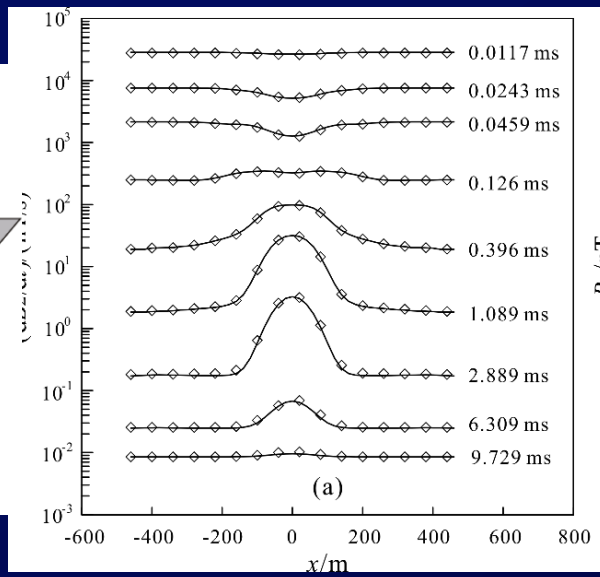

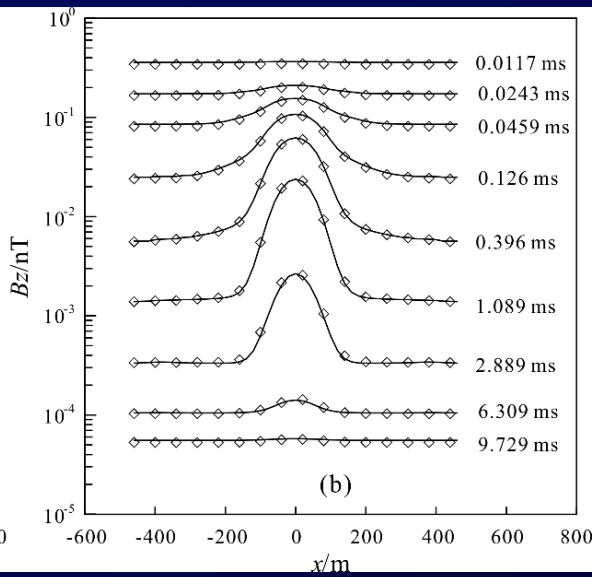

Method	t_f (s)	t_s (s)	n_f	n_s	N_{tx}	Running time (min)
Total-field method	4.2	0.07	5	500	47	43.87
Separation method	0.7	0.02	5	500	47	10.58

Speed up

Factorization： 83.33%

Solving： 71.43%

Total time： 75.9%

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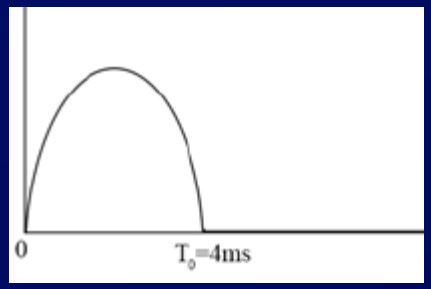
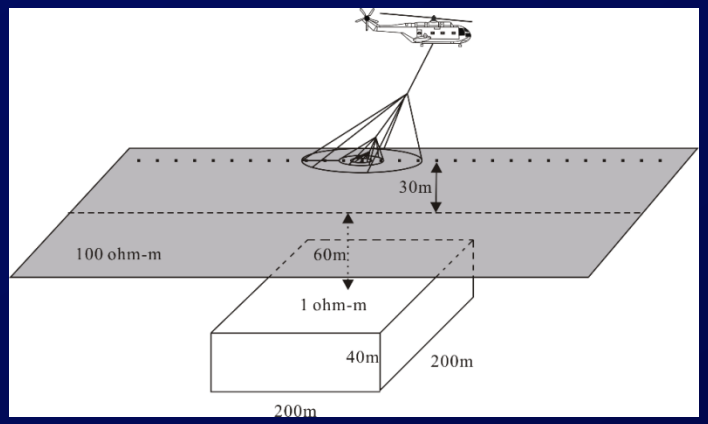
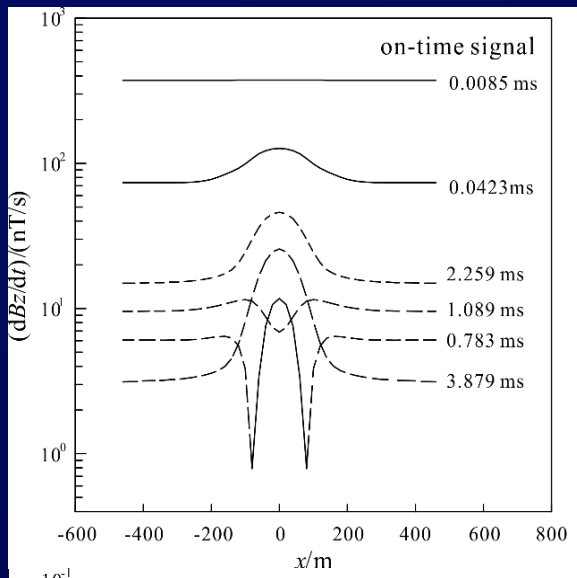
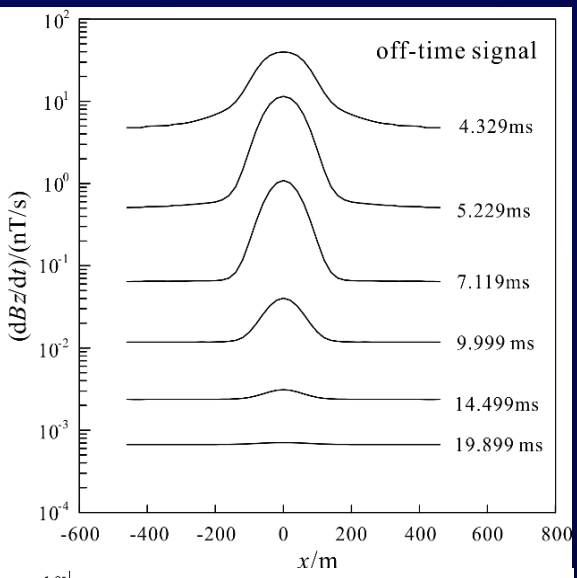
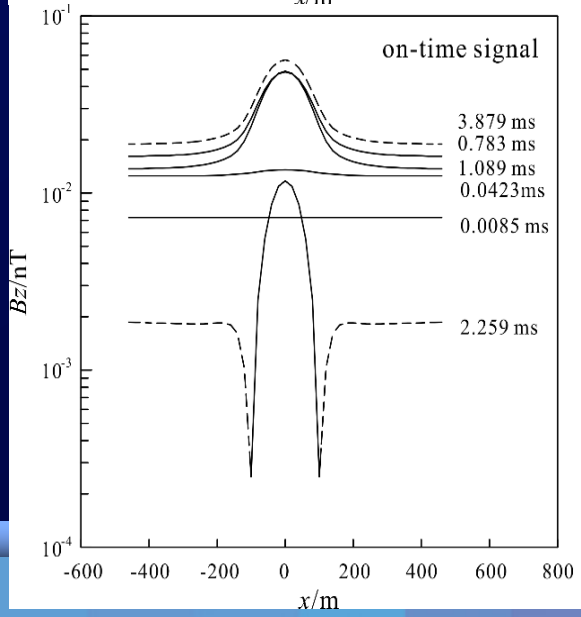
Arbitrary waveform

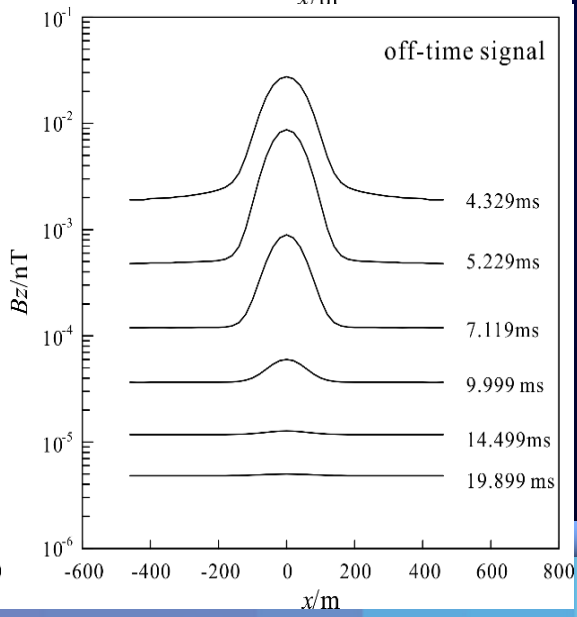


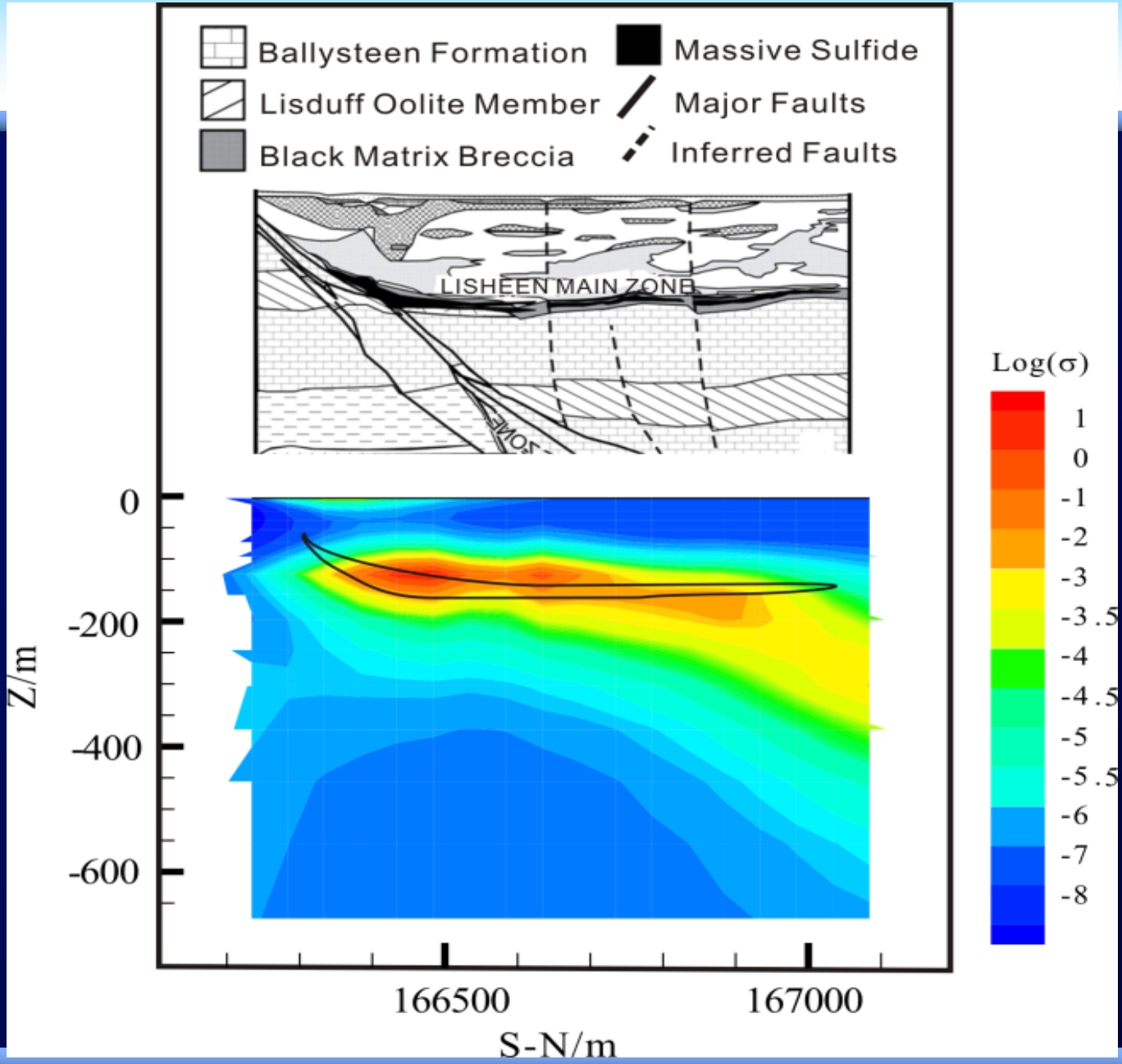











Ballysteen Formation
Lisduff Oolite Member
Black Matrix Breccia
Massive Sulfide
Major Faults
Inferred Faults
LISHEEN MAIN ZONE
0
-200
-400
-600
Z/m
166500
167000
S-N/m
Log(σ)
1
0
-1
-2
-3
-3.5
-4
-4.5
-5
-5.5
-6
-7
-8

References

1) Oldenburg, D. W., E. Haber, and R. Shekhtman, 2008, Forward modelling and inversion of multi-source TEM data: 78th Annual International Meeting, SEG Expanded Abstracts, 559-563.
2) Cox, L. H., and M. S. Zhdanov, 2007, Large scale 3D inversion of HEM data using a moving footprint: 77th Annual International Meeting, SEG, Expanded Abstracts, 467-471.
3) Yin, C. C., X. Y. Ren, and Y. H. Liu, 2015, Exploration capability of airborne TEM systems for typical targets in the subsurface: Chinese Journal of Geophysics, 58, 3370-3379.

Thank you