

Investigation of the Garzweiler Coal Deposit using Central and Fixed Loop Transient Electromagnetics



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Introduction

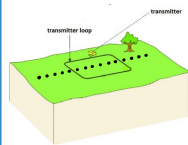
The study area, Garzweiler, is located in the Rheinland Lignite deposit where three open-pit coal mines exist. The key objectives of the geophysical study are:

- Detecting the thickness and depth of coal bearing layers
- Providing information about faults, and water bearing layers
- Comparing different TEM configurations:
 - Large Fixed Loop using two receiver components
 - Conventional Central Loop
- 2D/3D Inversion of the field data for multiple Fixed Loop sources and all receiver components
- Interpretation of the geophysical results using geological and borehole data from the survey area

Methods

Transient Electromagnetics (TEM)

- Electrical conductivity σ
- Penetration depth: ~ 200 - 300 m
- 1D inversion using EMU+



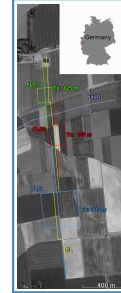
Fixed Loop

- One Tx loop and several Rx
- Multicomp. Hz and Hx

Central Loop

- One loop for Tx and one central Rx
- Only Hz

Field Survey



TEM Measurements

Two configurations:

Central Loop:

- 1 Central Loop Profile ~ 1800 m

Fixed Loop

- 3 Fixed Loop Profiles
- Fixed Loop 01 (FL-01) ~ 1200 m
- Fixed Loop 02 (FL-02) ~ 700 m
- Fixed Loop 03 (FL-03) ~ 600 m

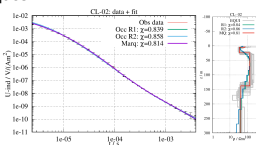
Devices

- Transmitter: Zonge NT-20 & ZT-30
- Receivers: GDP - 32 & KMS 820 logger system, Zonge TEM-3 coil

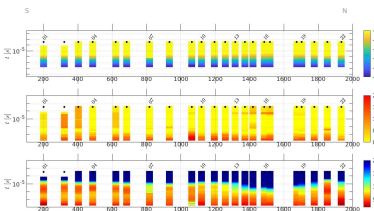
Geophysical Results – Central and Fixed Loop TEM

Central Loop

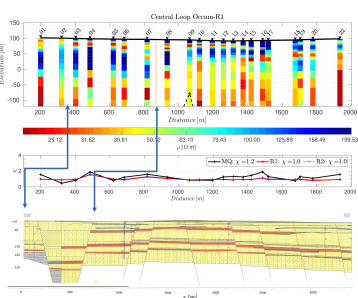
- 1D resistivity depth models are derived using conventional Occam and Marquardt-Levenberg techniques.



Observed Data



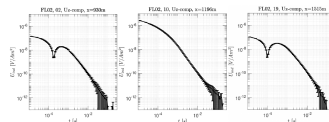
1D Inversion



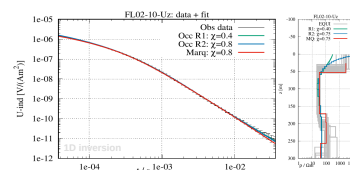
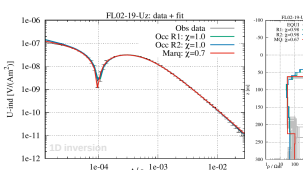
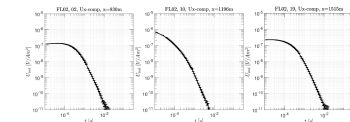
- A clear correlation with the coal bearing layers is difficult.
- The depth of the shallow coal layer is ~50 m and compares partly well with the shallow conductor.
- The 2nd and 3rd coal bearing layers are not visible.
- Comparison with a borehole is required.

Fixed Loop

Fixed Loop Z component examples



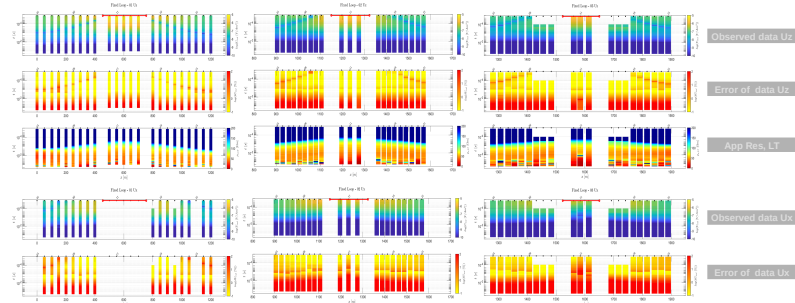
Fixed Loop X component examples



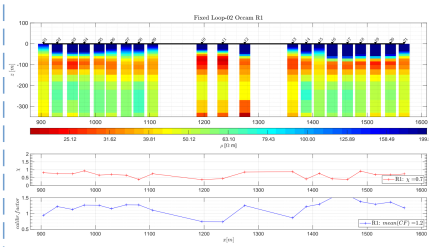
Fixed Loop 01

Fixed Loop 02

Fixed Loop 03



1D Inversion – FL02



- Systematic and symmetric sign reversals are observed.
- Good data quality with increasing errors at late time.
- Conventional Occam and Marquardt Levenberg technique used for the Fixed Loop TEM data. The resistivity distribution of FL02 differs from the CL results.
- Fixed loop indicates deeper structures better.
- Good data fit for all 1D results with $x=0.7$.
- A free calibration factor is required and ranges between 0.5 and 1.5.

Conclusion & Outlook

- A direct comparison of the CL results with the geological cross-section is only partly possible. Borehole information will be helpful.
- The shallow coal bearing layer seems to be resolved at a depth of approx. 50 m.
- The deep coal transitions are not resolved.

Future steps are:

- Joint inversion of CL and FL data
- 2D/3D inversion of field data
- Integration with ERT results and comparison with geology.

Acknowledgments and References

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