Underground Geophysical Practical Course

Borehole electrical resistivity

Mathias Scheunert
mathias.scheunert@geophysik.tu-freiberg.de

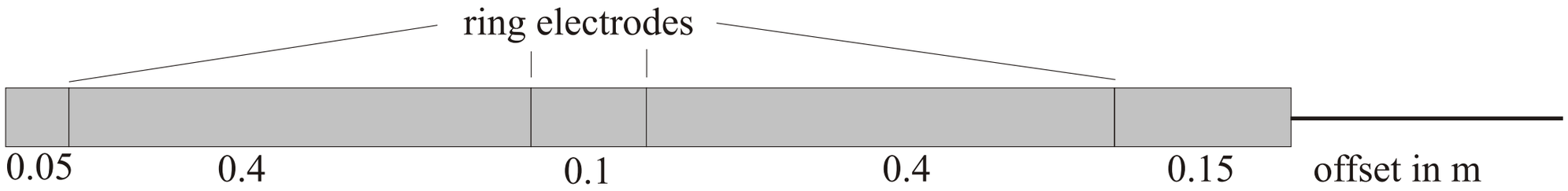
Thomas Günther
thomas.guenther@geophysik.tu-freiberg.de

TU BERGAKADEMIE FREIBERG

TUBAF
Die Ressourcenuniversität.
Seit 1765.

Experiment

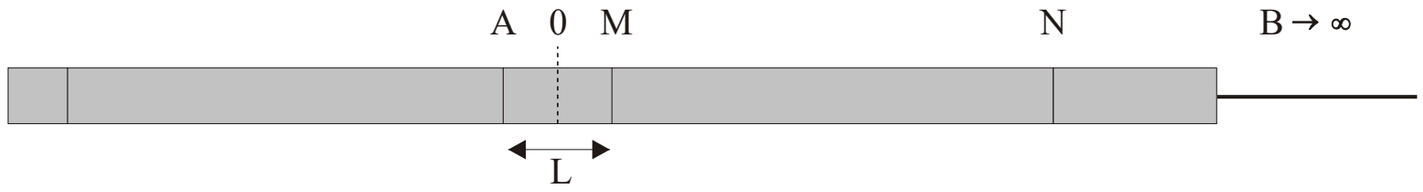
- Waterfilled horizontal borehole (approx. 9.5 m length)
- Borehole probe with four ring electrodes



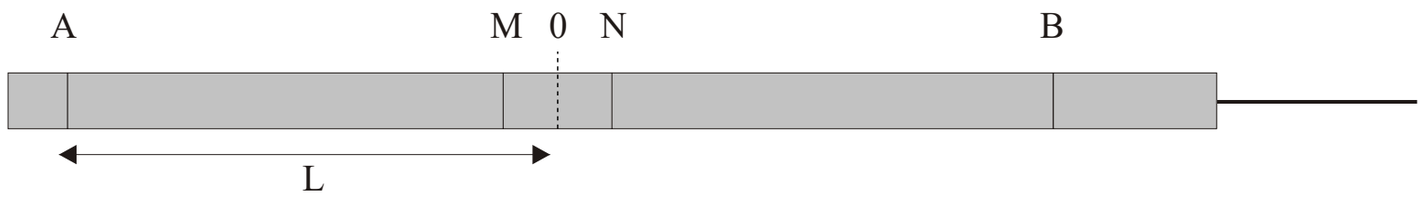
Construction of borehole probe

- Measurement of resistances R for different depths & different arrays (combinations of current & potential electrodes) $\rightarrow \rho_s = Rk$

Available electrode arrays

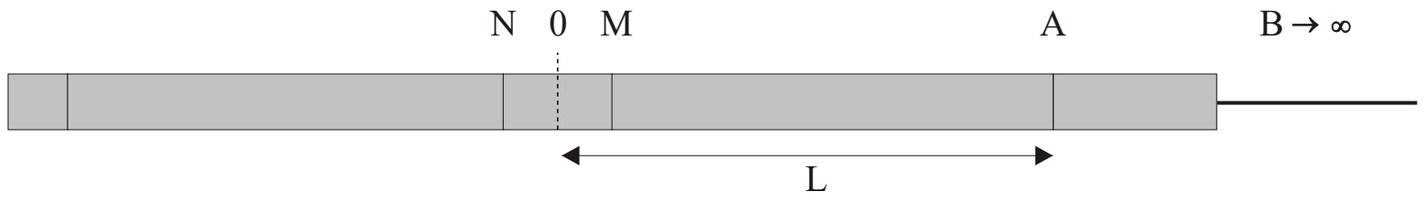


I Potential probe (Normal device, pole-pole): $\overline{AM} << \overline{MN}$



II Schlumberger (dipole-dipole): $AB/3 > \overline{MN}$

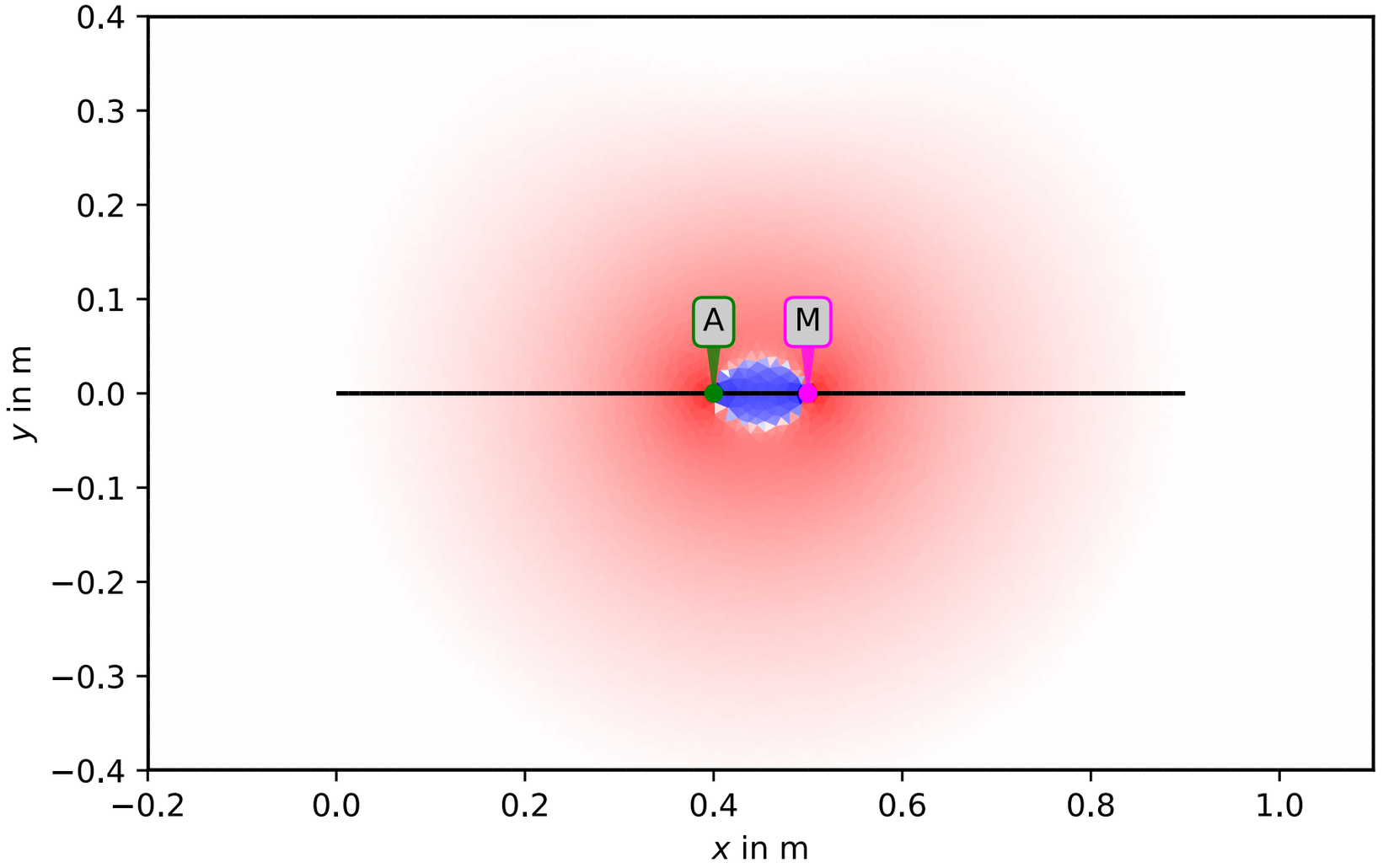
III Lateral probe (top-mounted, pole-dipole): $\overline{AM} >> \overline{MN}$



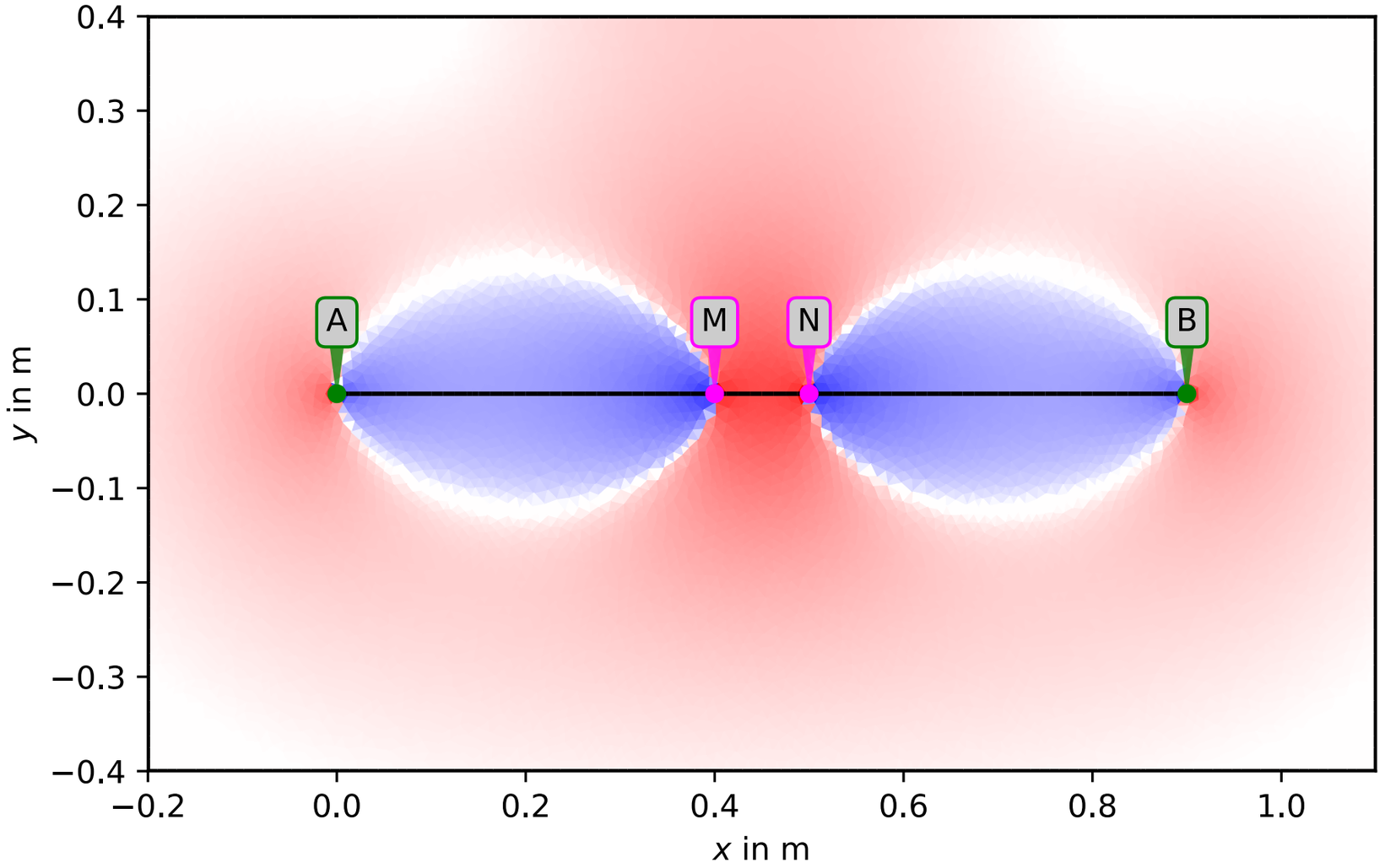
IV Lateral probe (bottom-mounted, pole-dipole): $\overline{AM} >> \overline{MN}$

- little normal (KN): AM=0.1m
- Schlumberger: AM=BN=0.4m, MN=0.1m
- Upper edge (OK): AM=0.4m,MN=0.1m
- Lower edge (UK): AM=0.4m,MN=0.1m

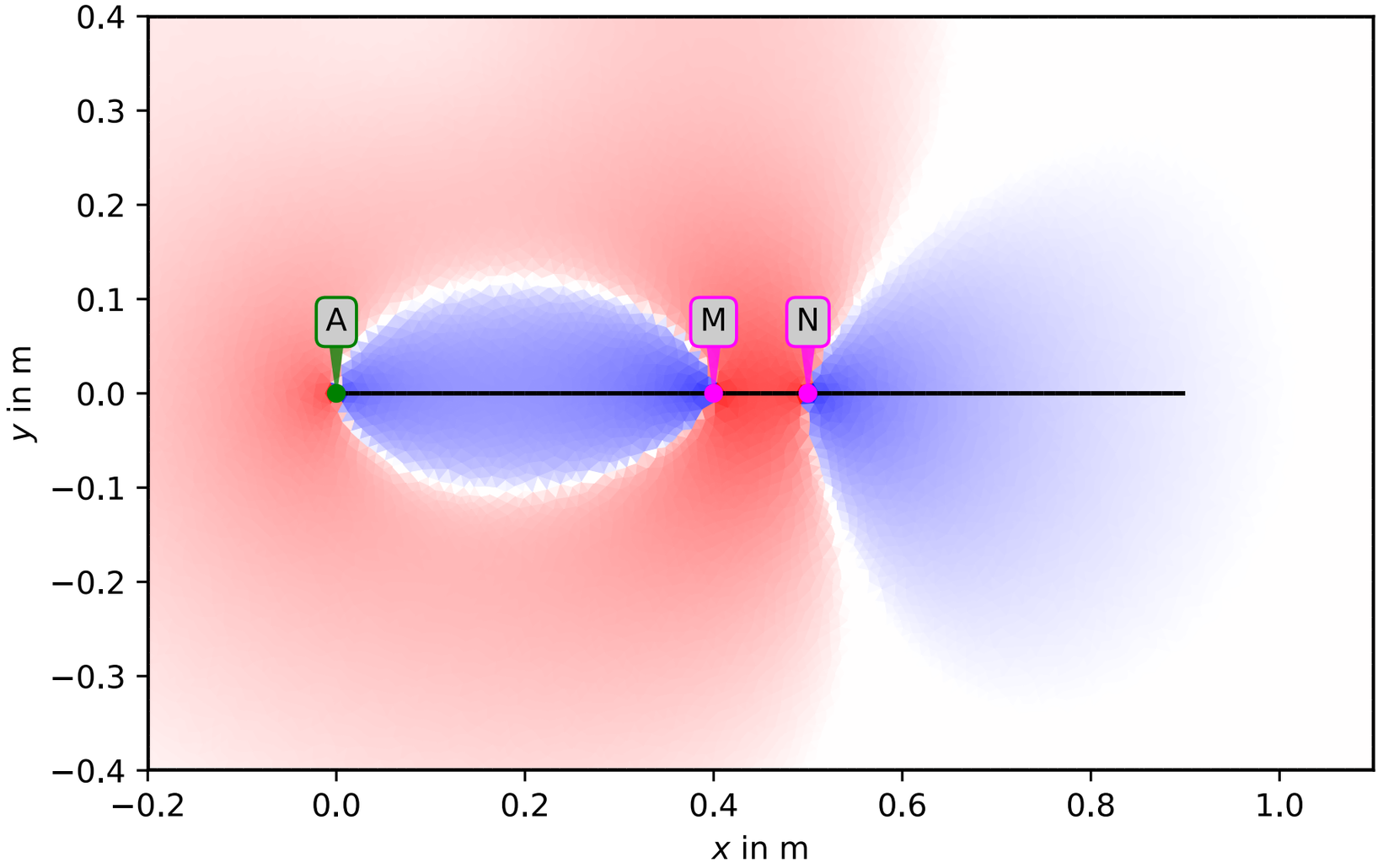
Sensitivity KN



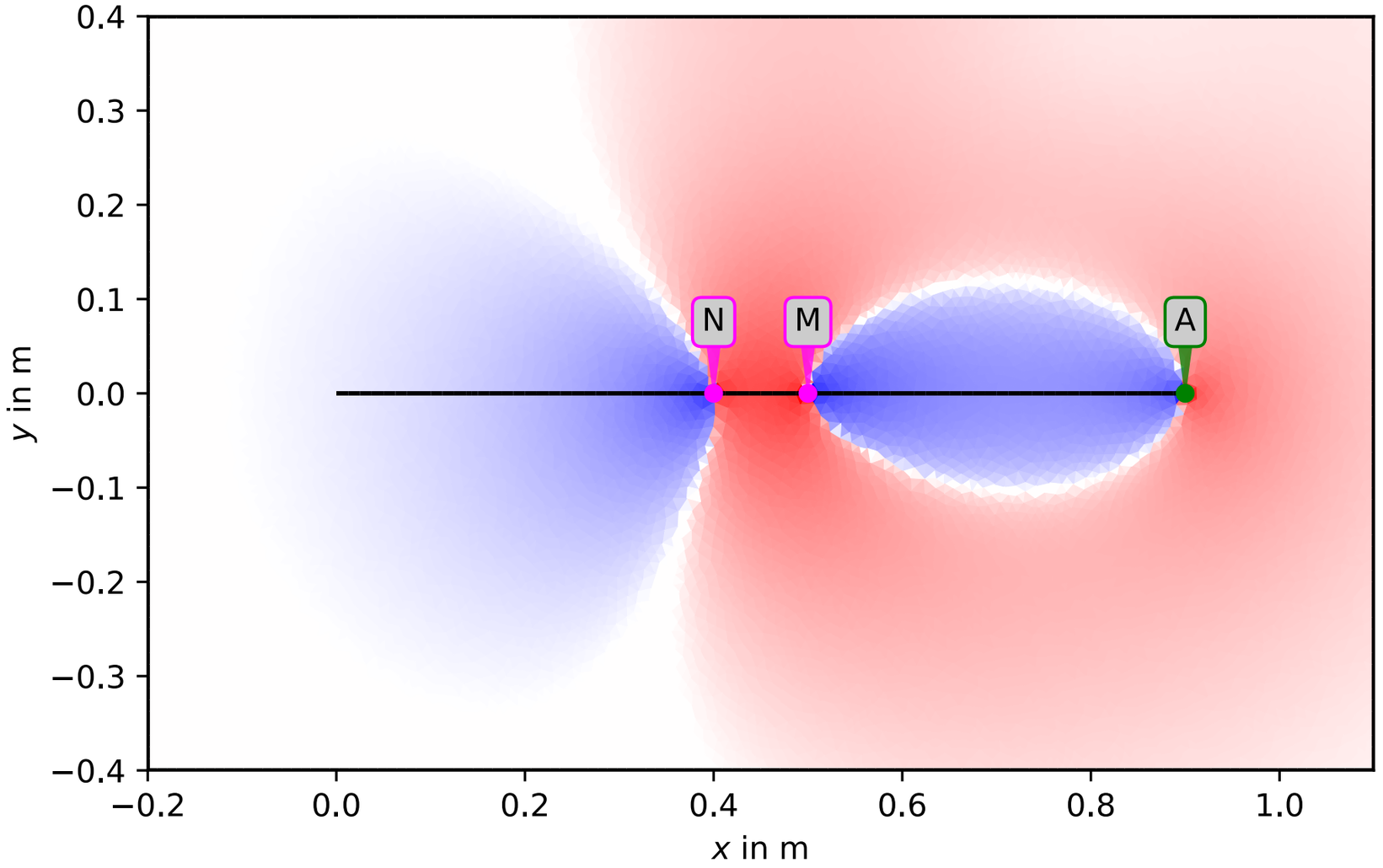
Sensitivity SL



Sensitivity UK



Sensitivity OK



Geology & rock types

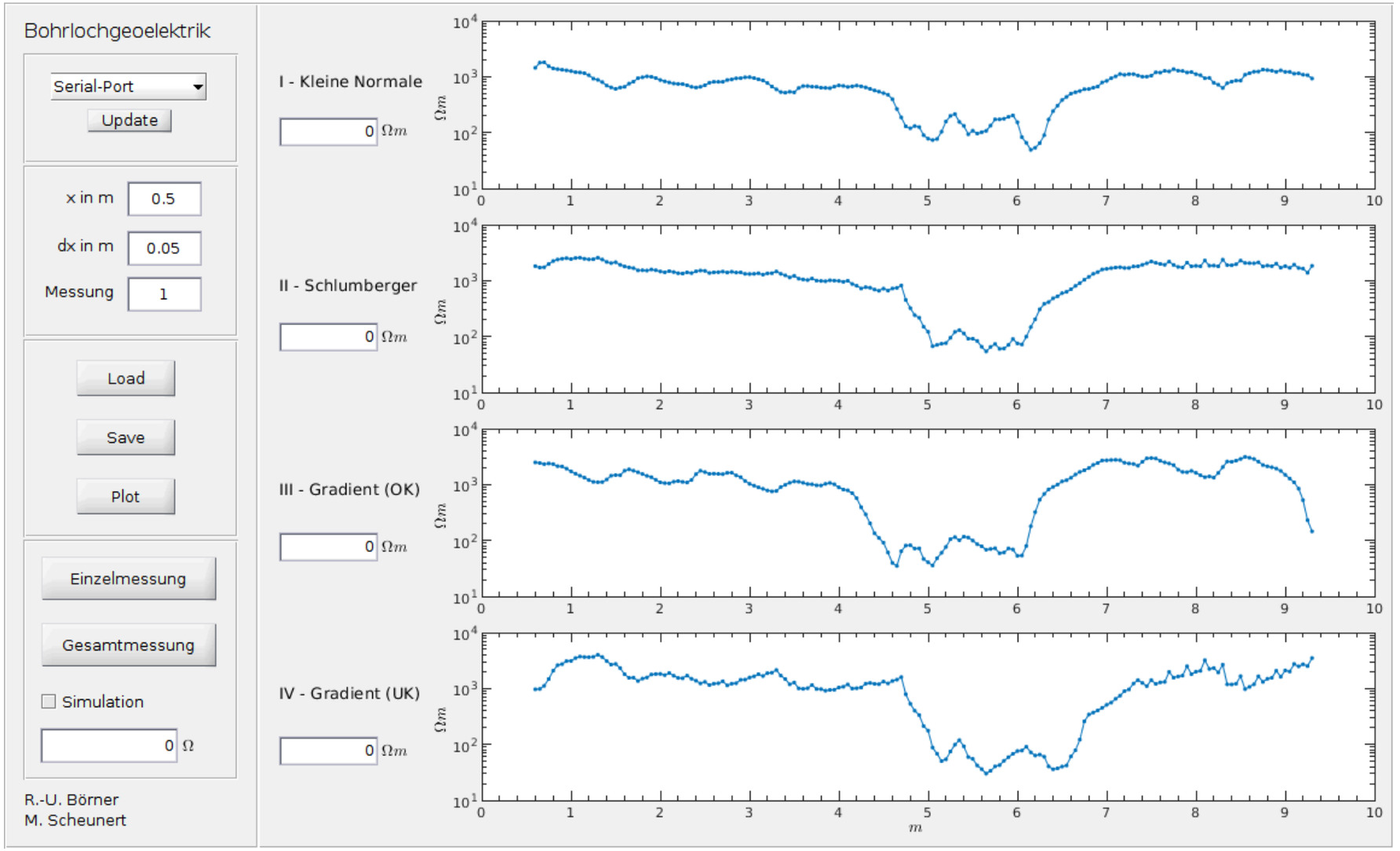
Rock types

- Gneiss (*Freiberger Graugneiss*)
- sulfidic ore zone

Objective

- determine location of the ore zone
- estimate resistivity of both formations

Data acquisition



Data analysis

Matlab

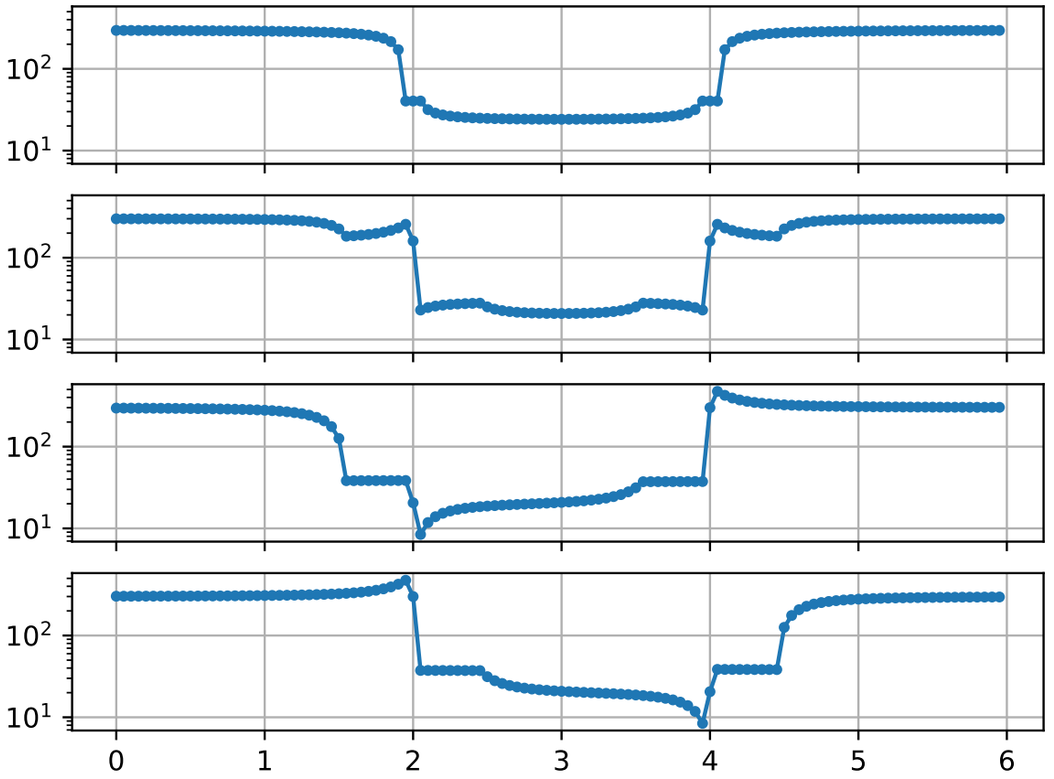
- functions in folder matlab: dike2.m, getDike.m

Python

- functions in folder python
- create environment with *numpy*, *matplotlib*

Python

```
1  from dike import getDike
2  x = np.arange(0, 6, 0.05)
3  KN, SL, OK, UK = getDike(
4      300, 20, x, thick=2, pos=2)
```



Report

1. Compute geometric factors for the three arrays
2. Load the data and plot them
3. Compute the theoretical response of a dike
4. Change the parameters (position & thickness of dike, background & dike resistivity) by trial and error
5. Interpret your results
6. Explain why SL data can be retrieved by UK&OK? Check with data

Further reading

- Course material DC resistivity & Electromagnetics methods (in German), including sensitivity and borehole ERT
- Doetsch, J., Coscia, I., Greenhalgh, S., Linde, N., Green, A. & Günther, T. (2010): The borehole- fluid effect in electrical resistivity imaging. Geophysics 75(4), F107-F114, doi:10.1016/j.jappgeo.2011.04.008.