



## Resistivity methods for mapping and characterising fractured rock - an overview

Reinhard Kirsch

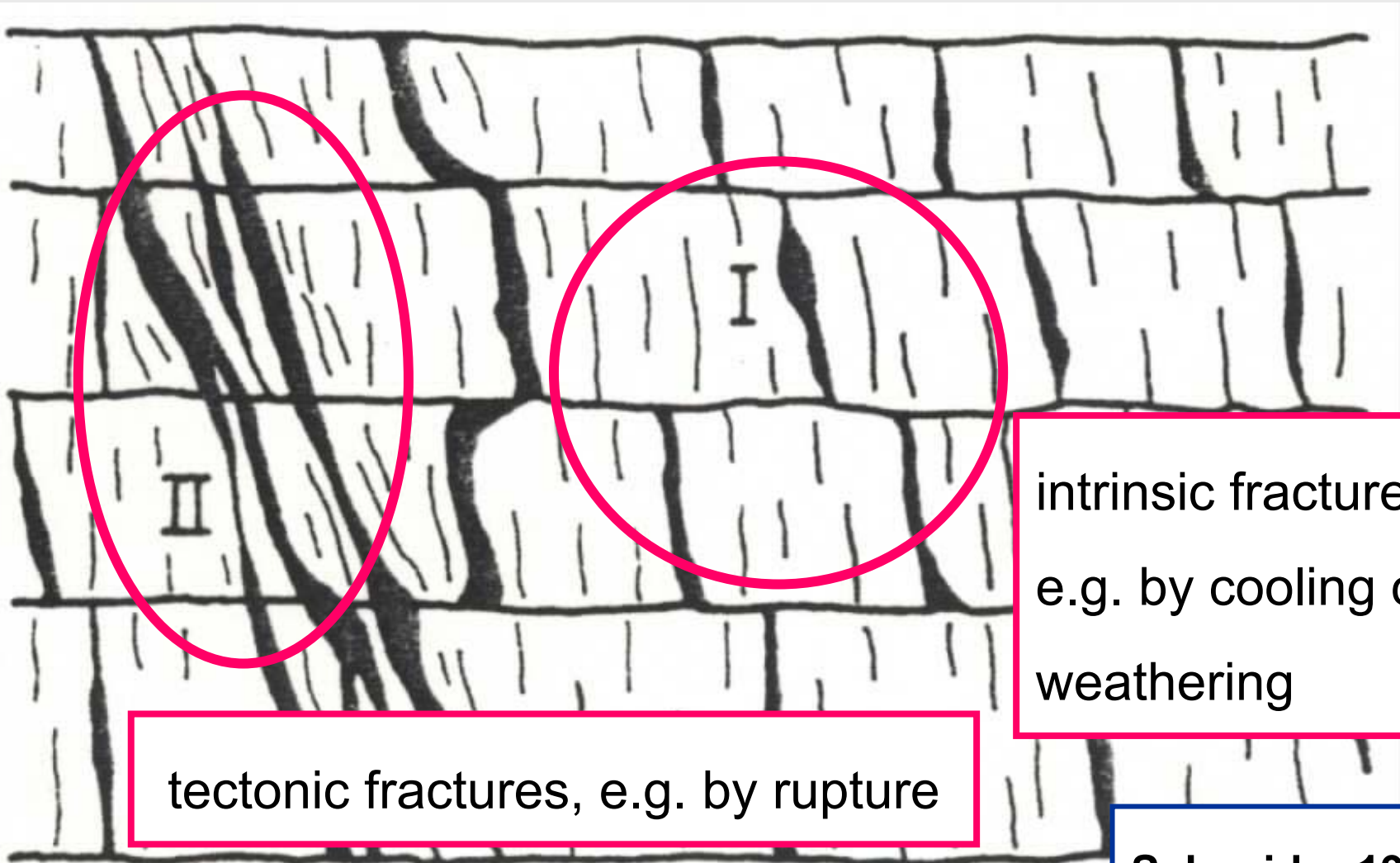
# fracture zones



## Fractured rocks:

- \* important groundwater reservoir
- \* pathways for contaminant spread
- \* instable ground for construction

# fracture zones

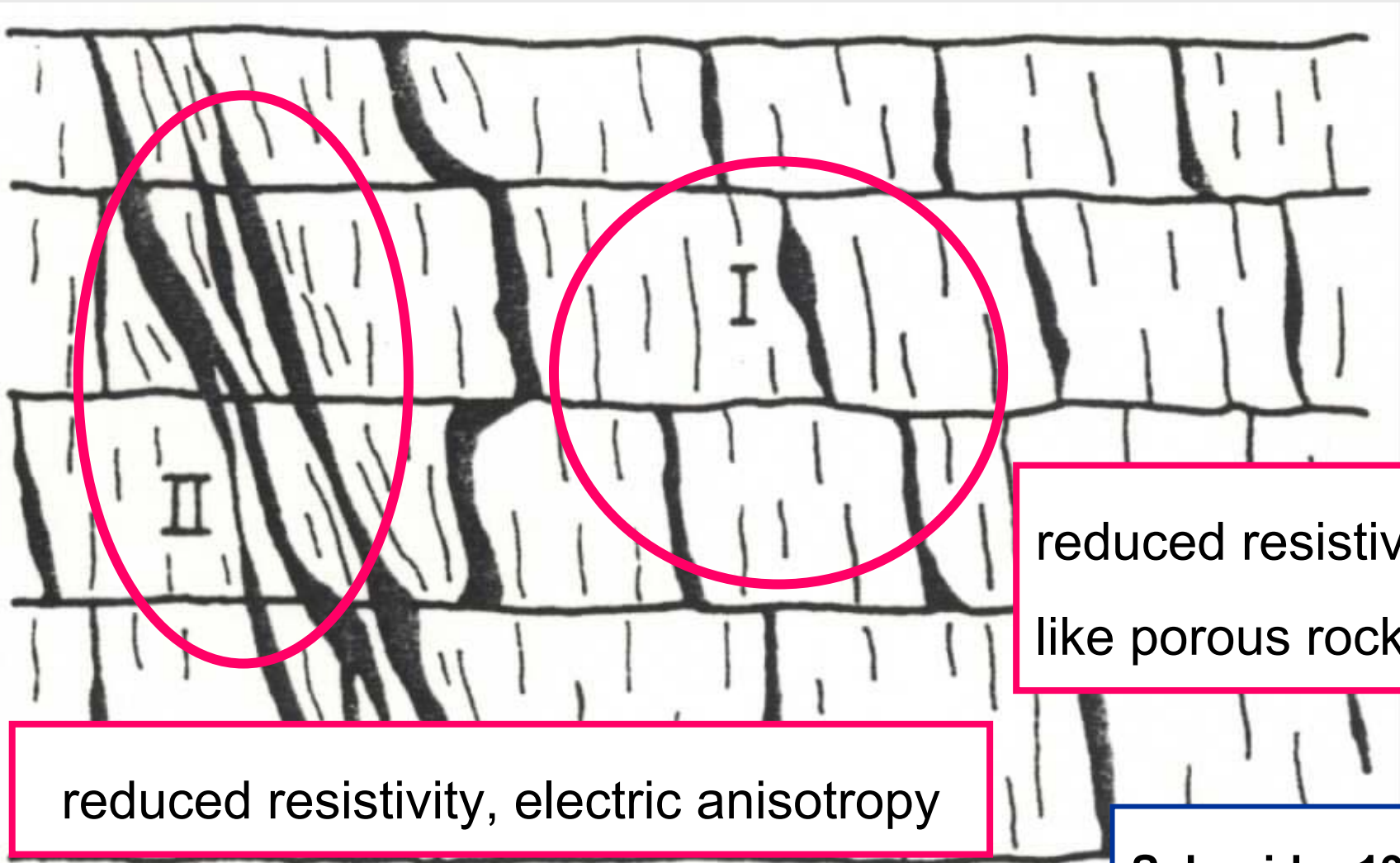


tectonic fractures, e.g. by rupture

intrinsic fractures,  
e.g. by cooling or  
weathering

Schneider 1988

# fracture zones



reduced resistivity,  
like porous rock

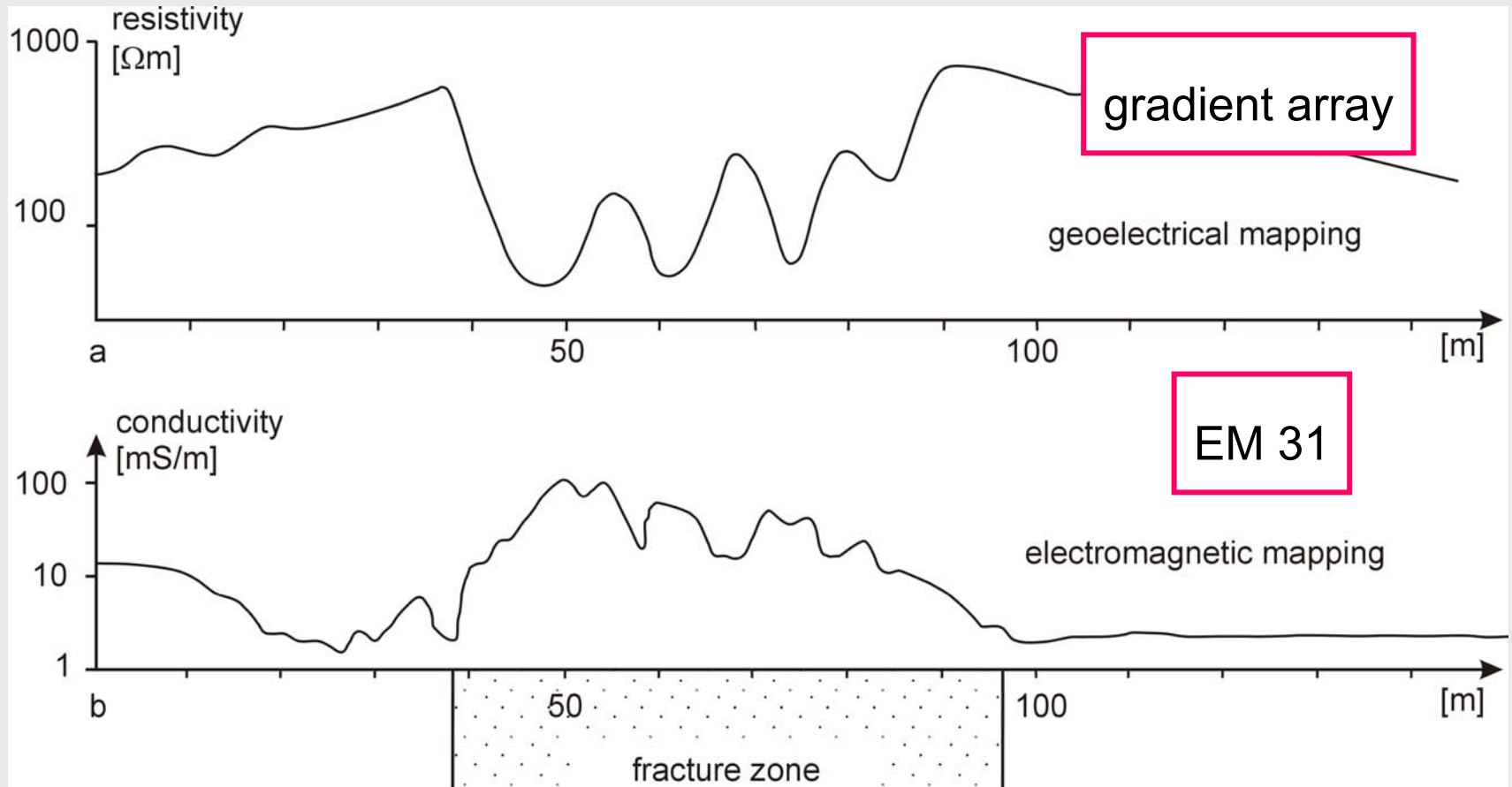
reduced resistivity, electric anisotropy

**Schneider 1988**

# fracture zones



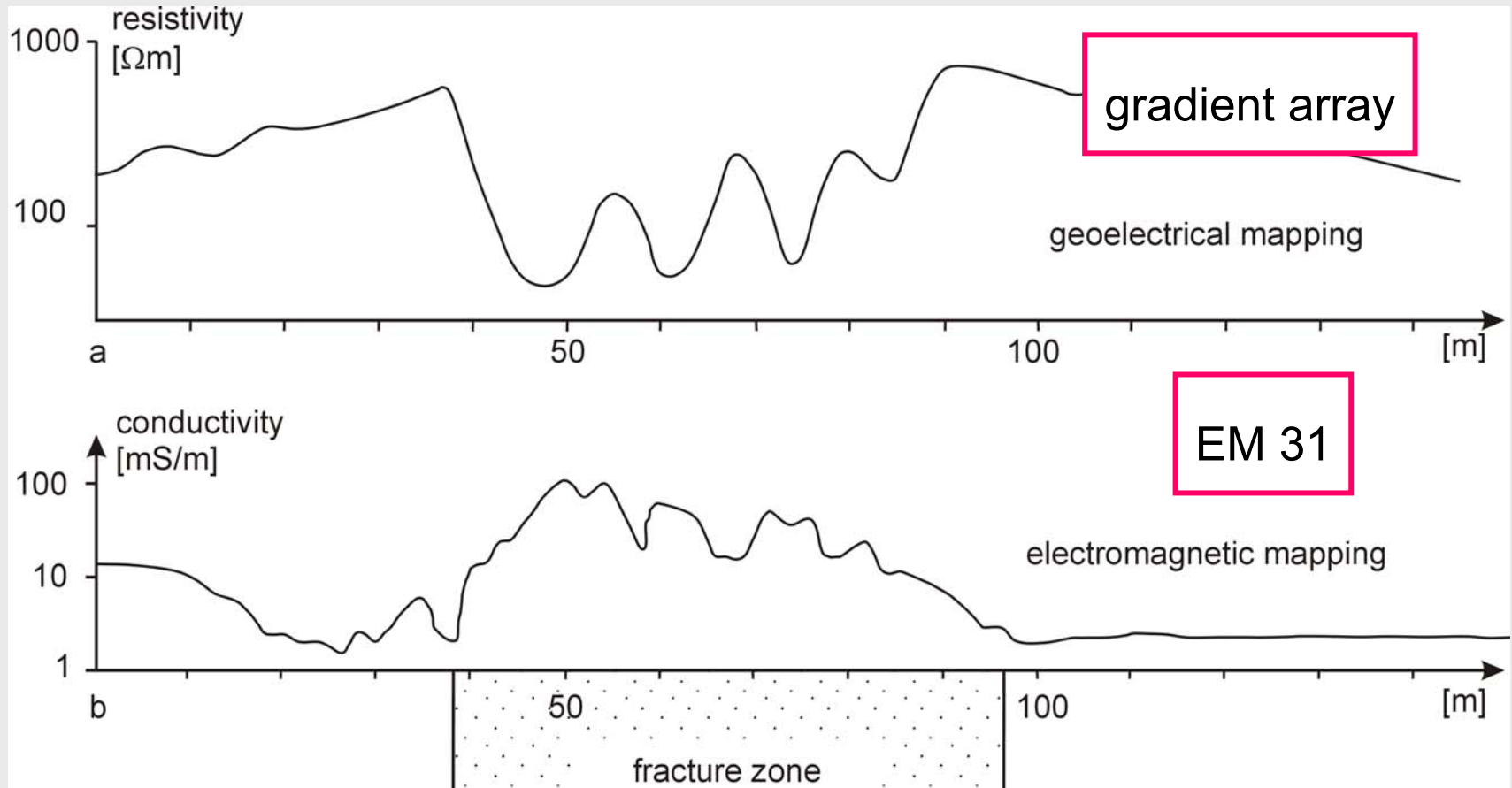
## a broad fracture zone (compared with electrode or coil spacing)



# fracture zones

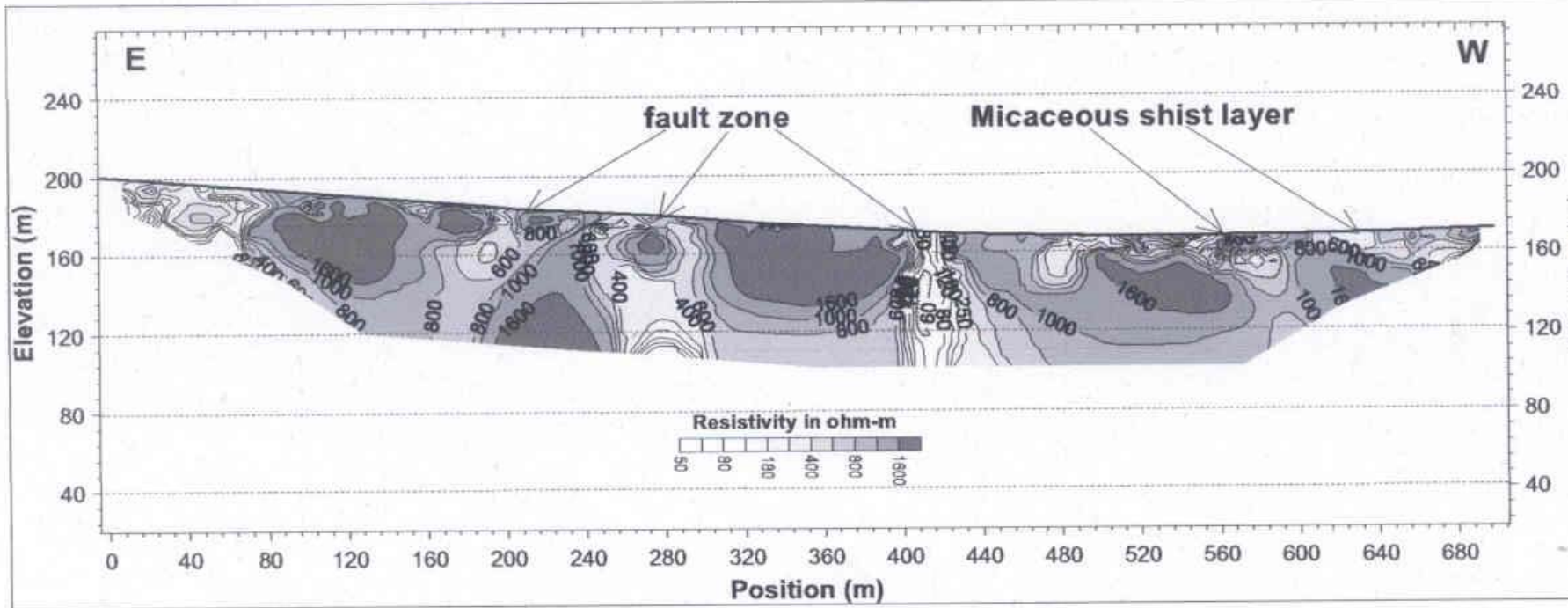


even a dry fracture zone can be highly conductive  
due to clayey weathering products





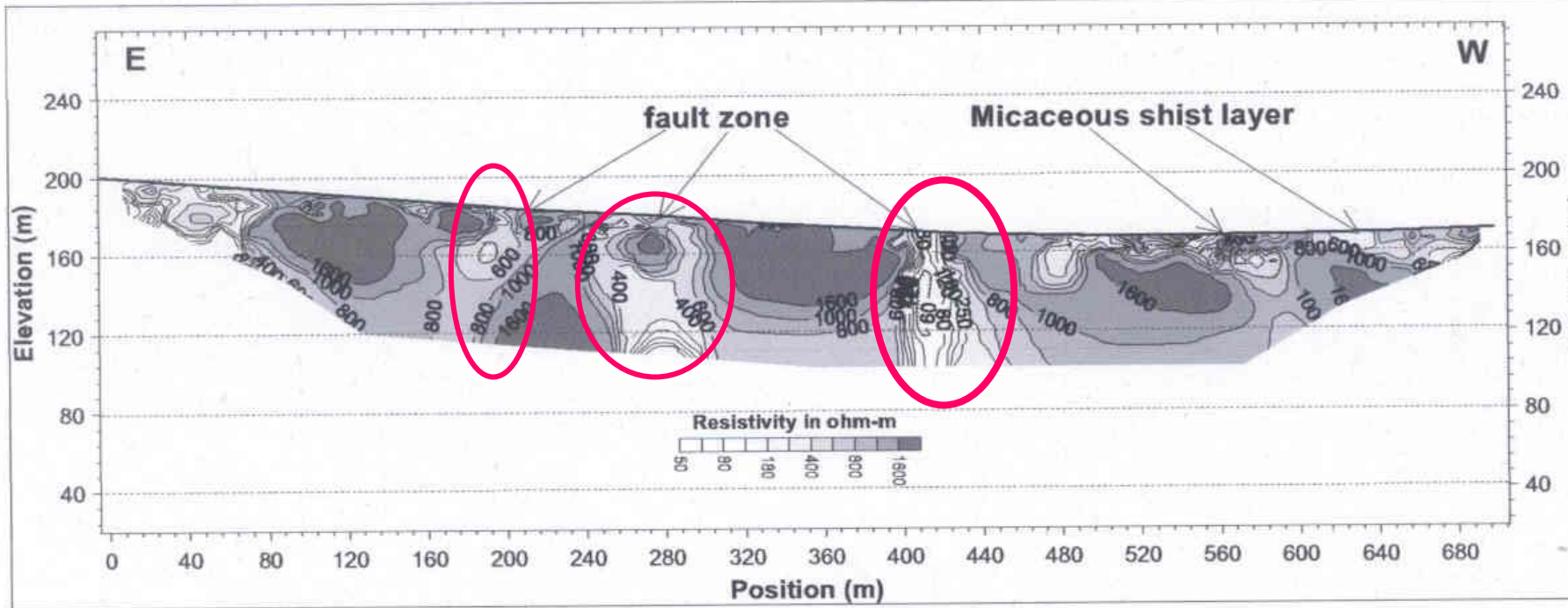
## 2-D resistivity mapping of fault zones



# fracture zones



indicated by low resistivities

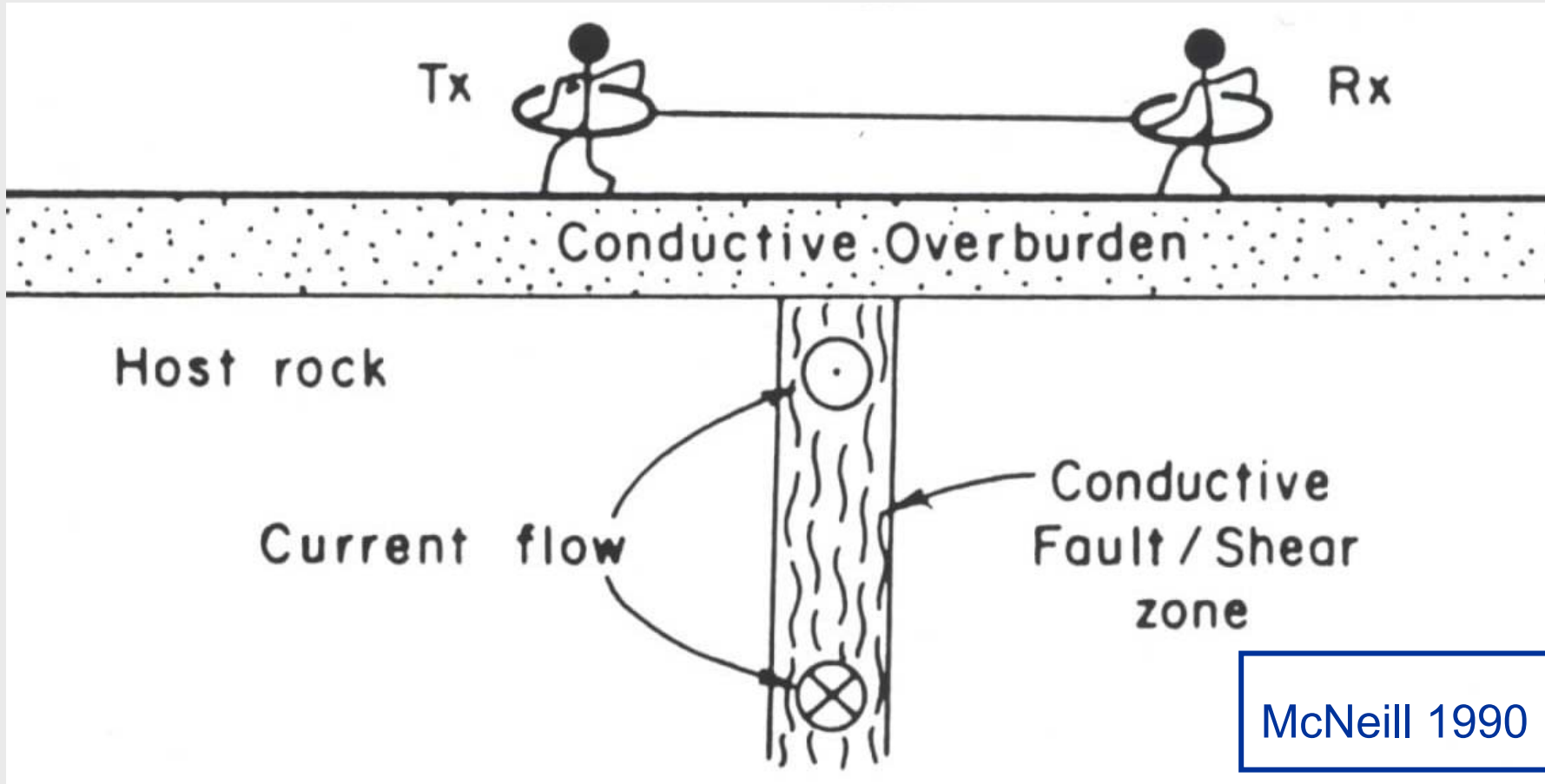




# fracture zones



when the fault zone is narrow....

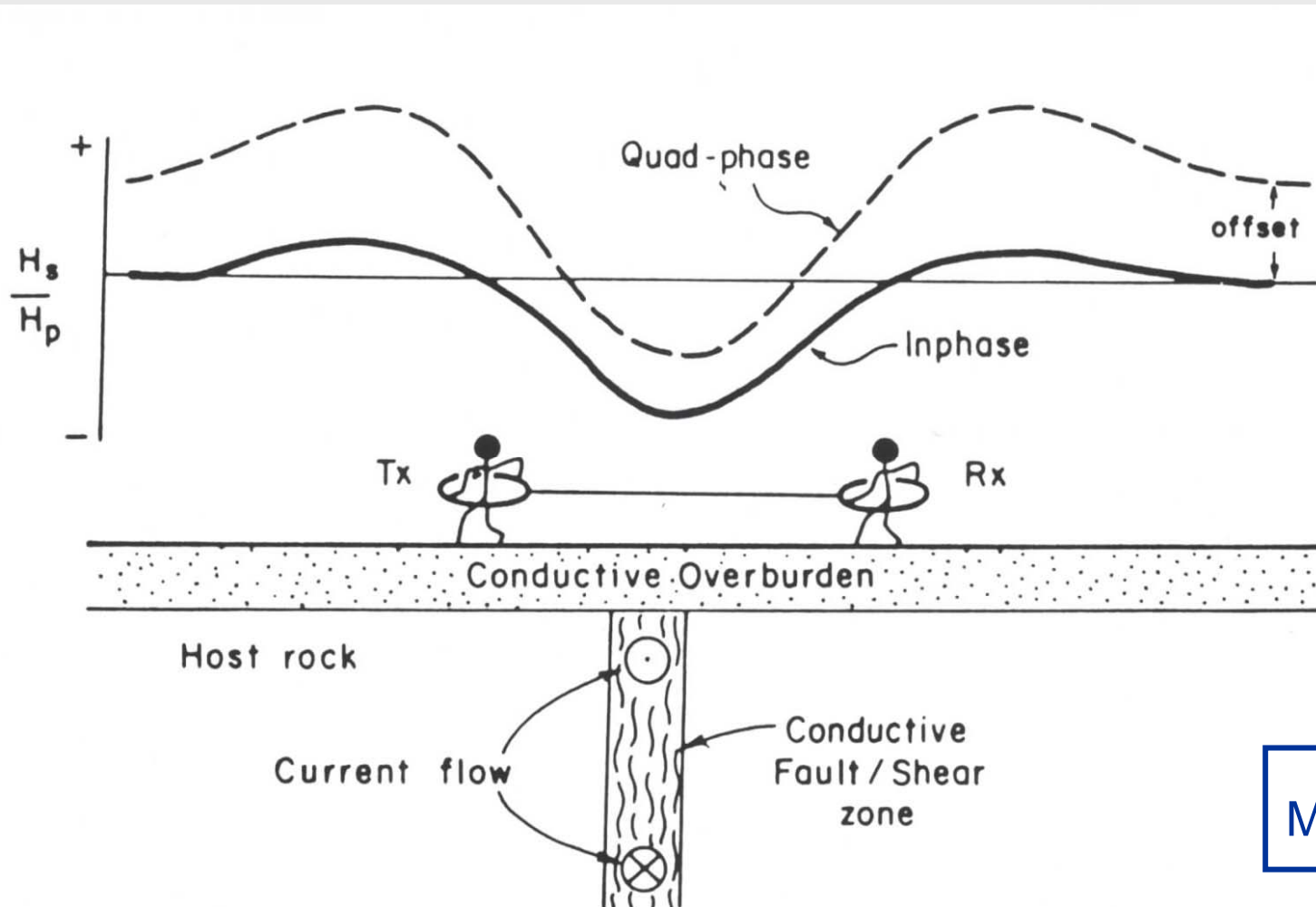


McNeill 1990

# fracture zones



.....it is indicated by an anomaly of the EM signal

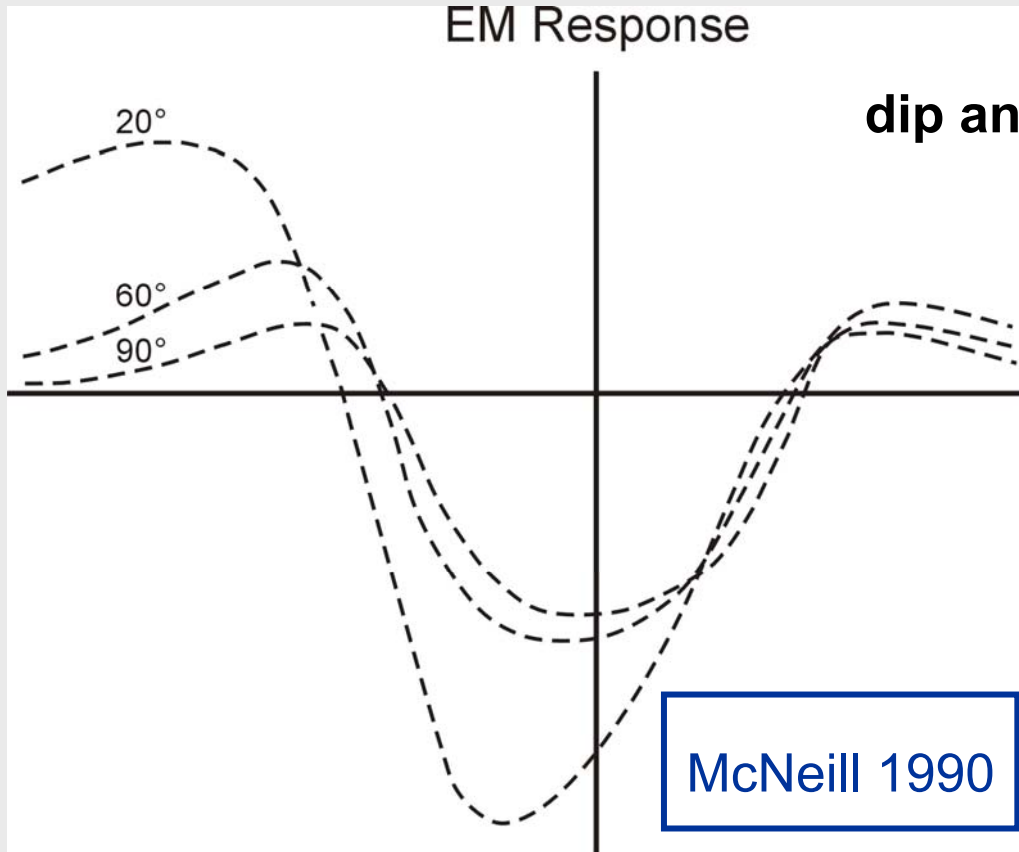


McNeill 1990

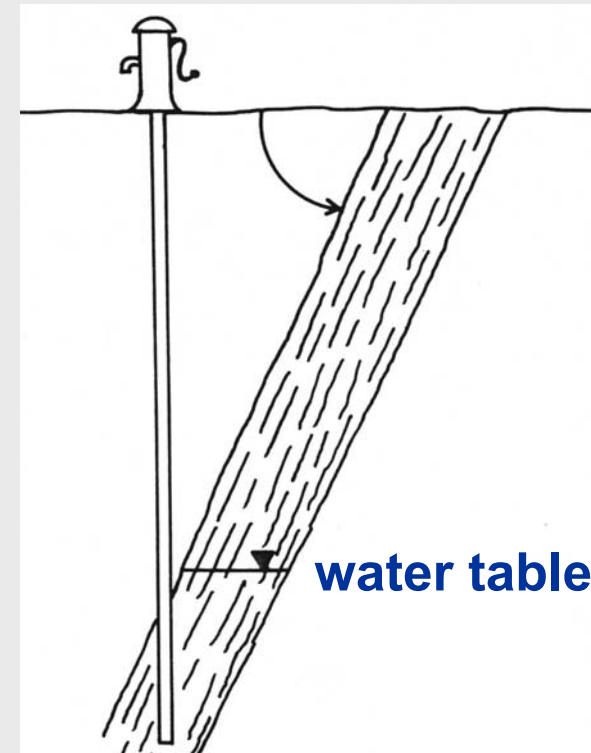
# fracture zones



a dipping fracture zone can result in an asymmetric EM signal

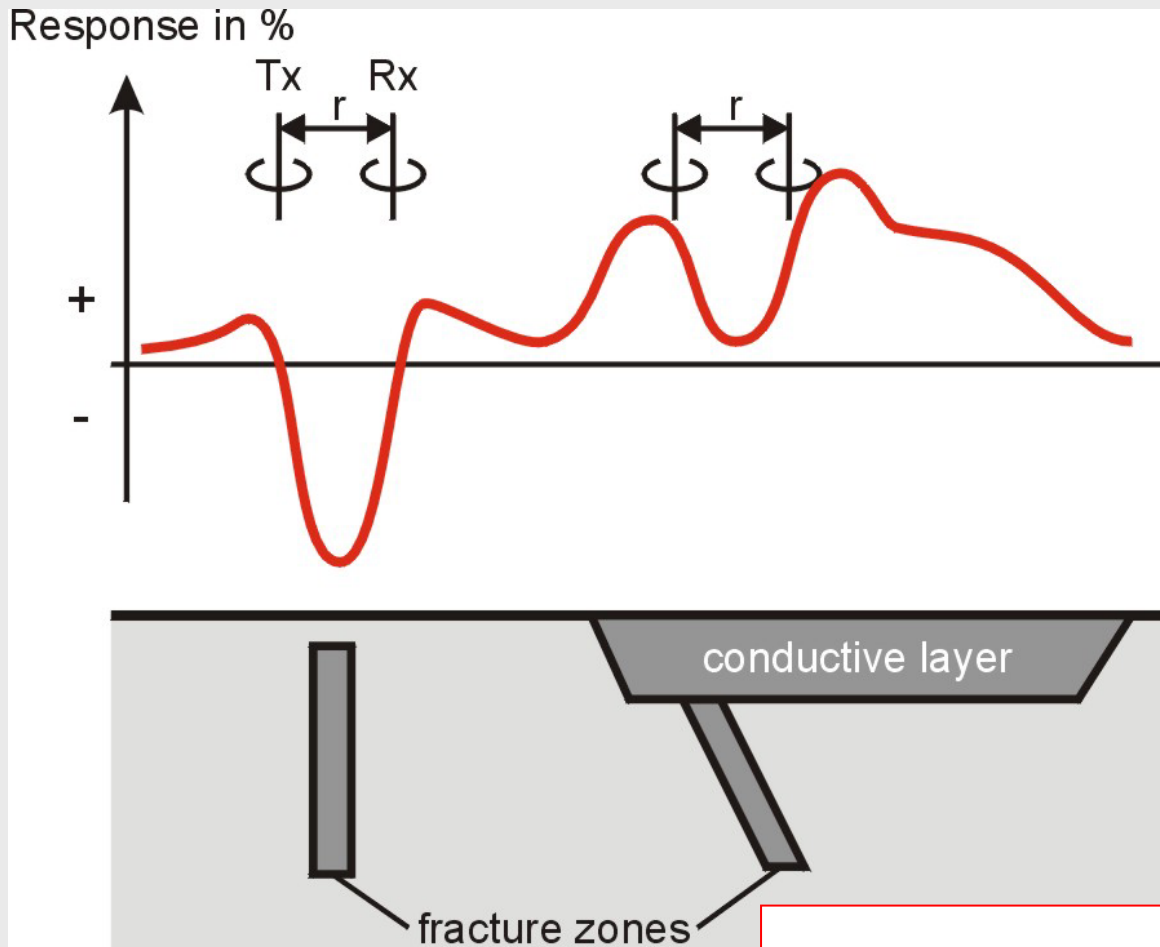


dip angle important for drill location





## conductive overburden: anomaly may be not negative

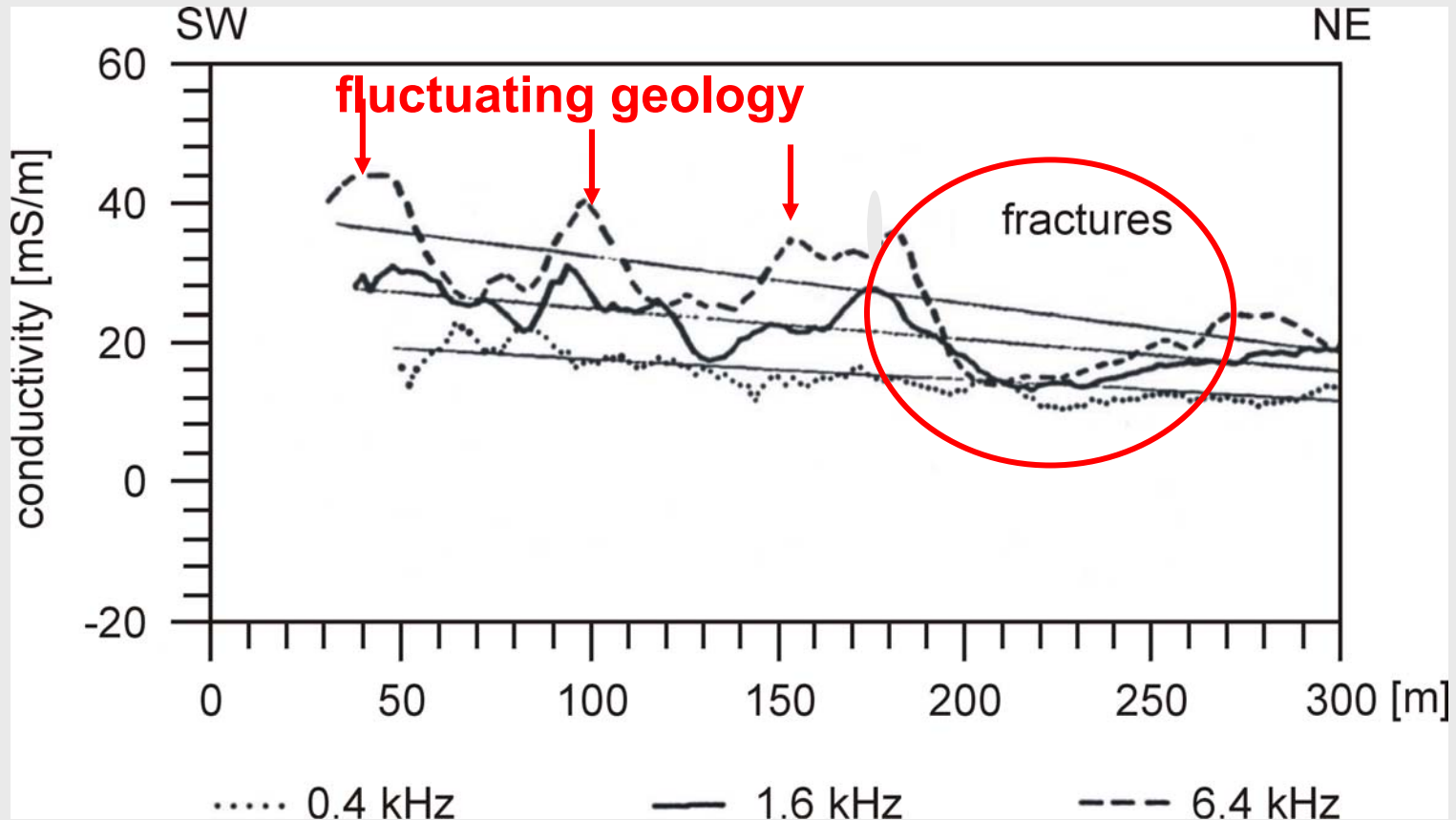


after Grissemann and Ludwig 1986

# fracture zones



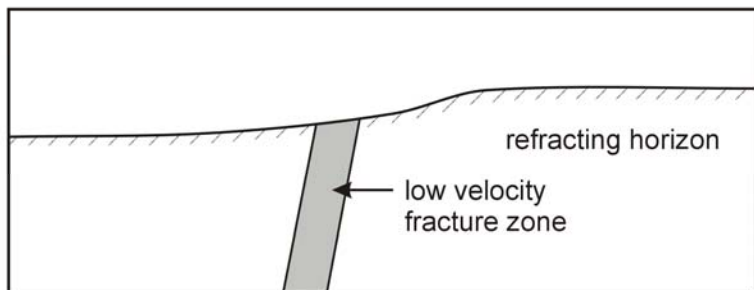
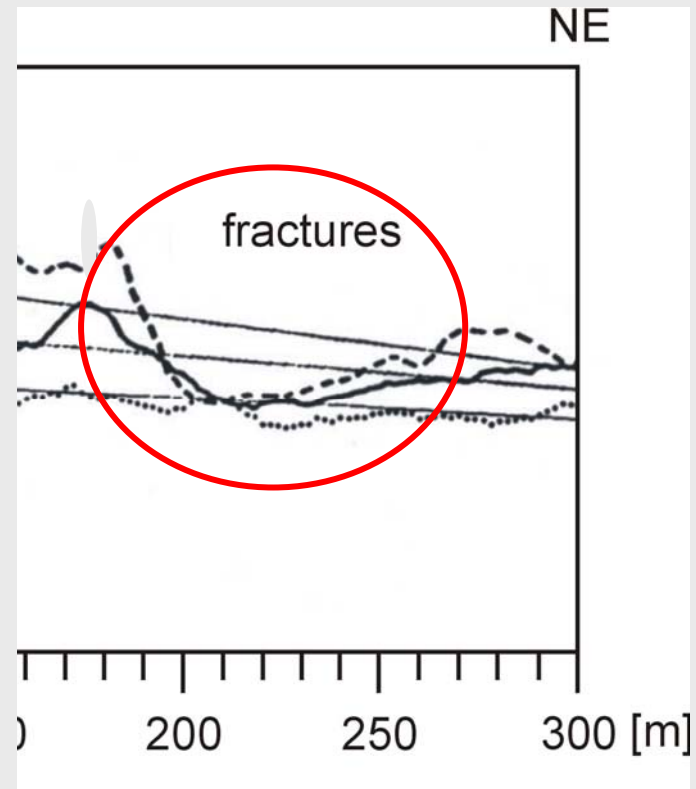
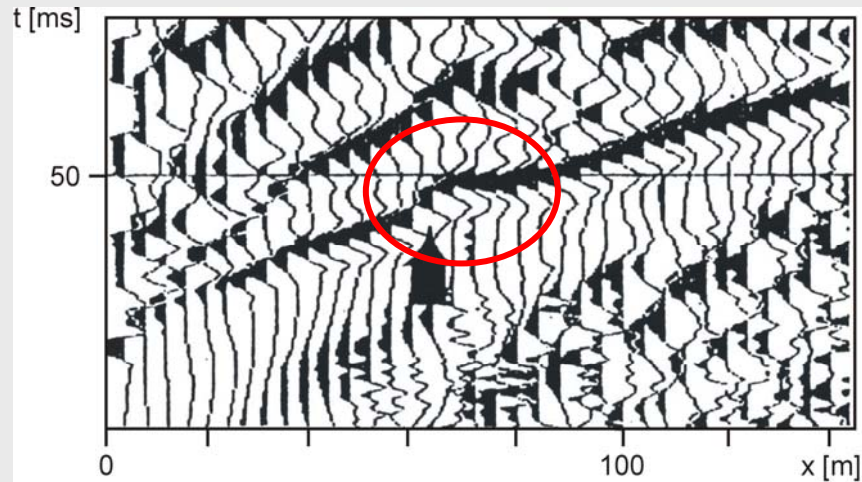
so missinterpretations of resistivity peaks are possible



# fracture zones



**this fracture zone is associated with a seismic traveltime drop**

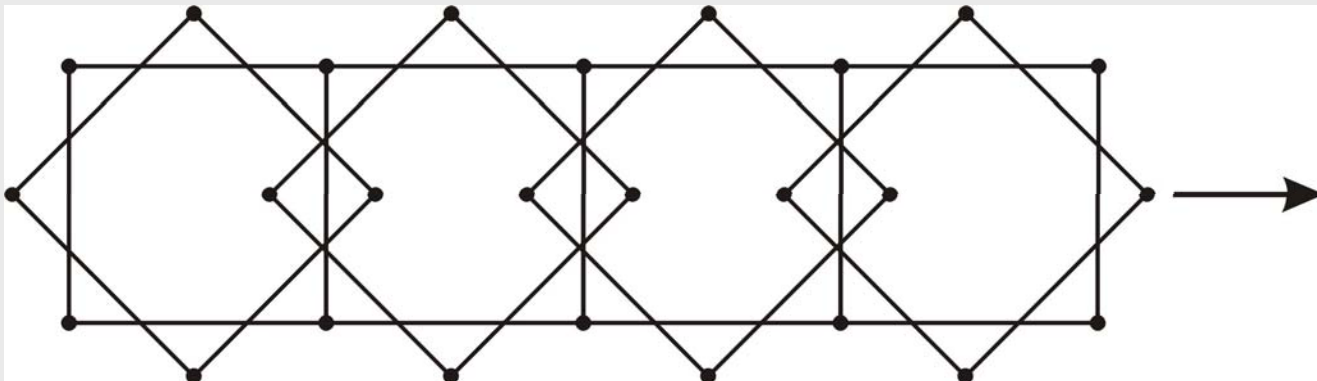
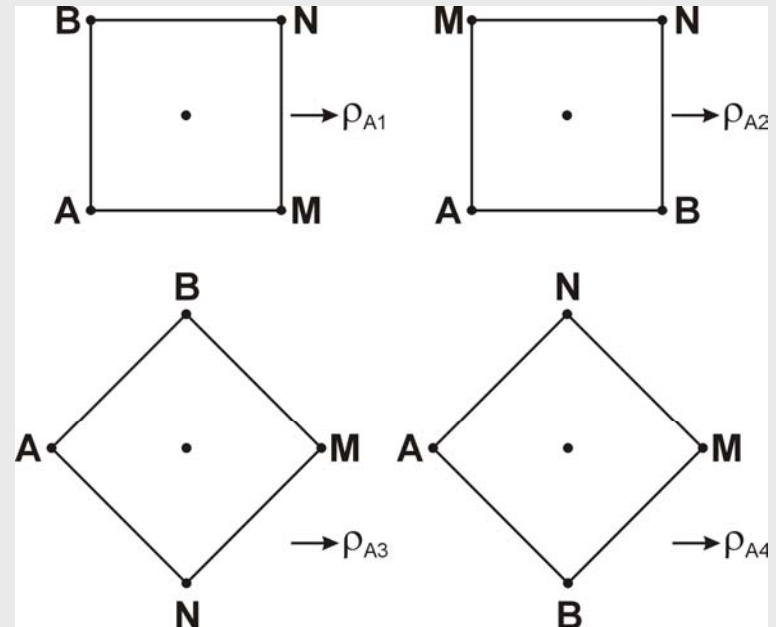


# fracture zones

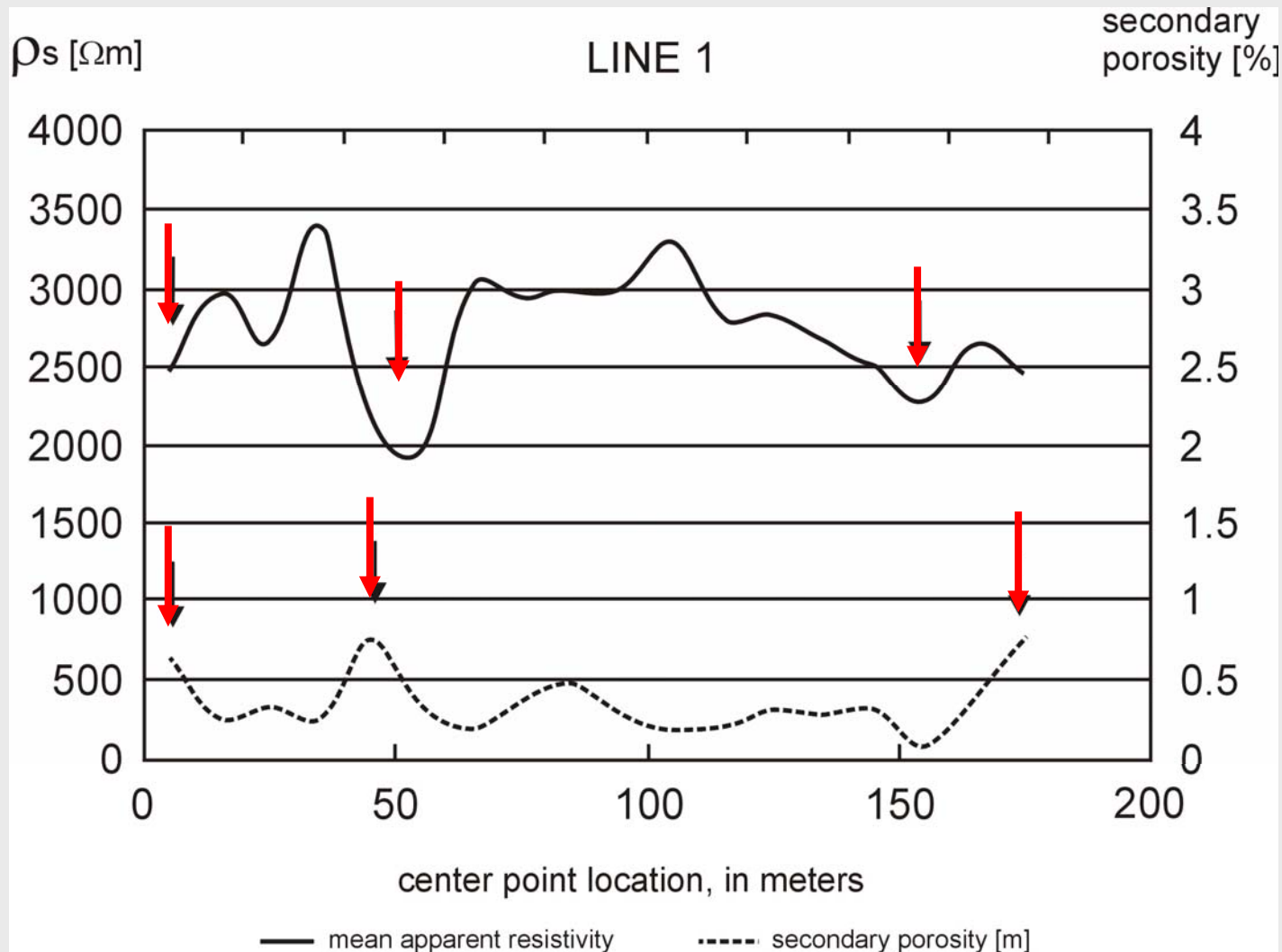


## square array configuration:

- apparent resistivity
- resistivity anisotropy
- secondary porosity



# fracture zones



**fractures  
found**

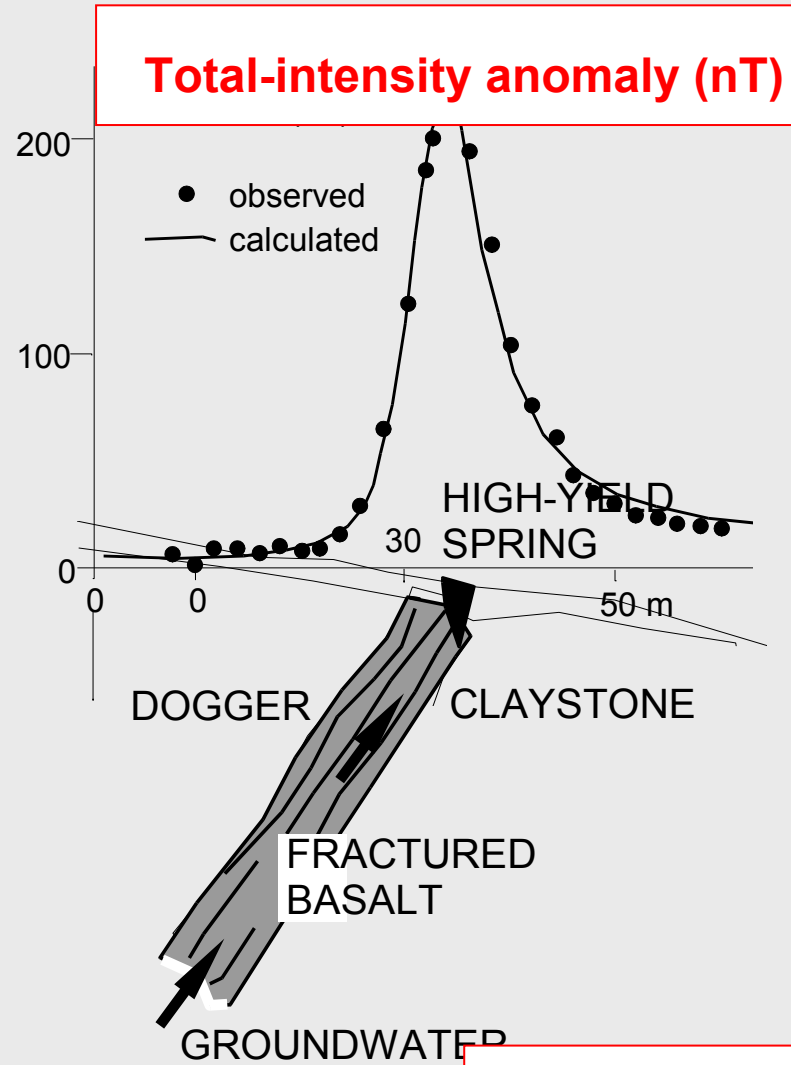
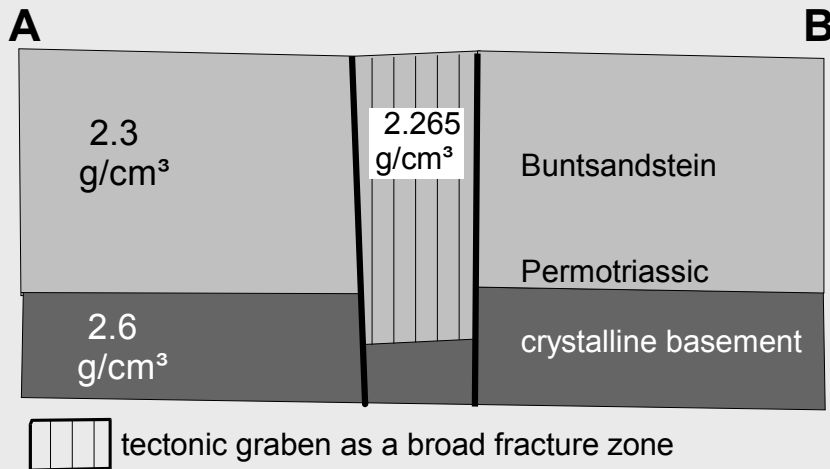
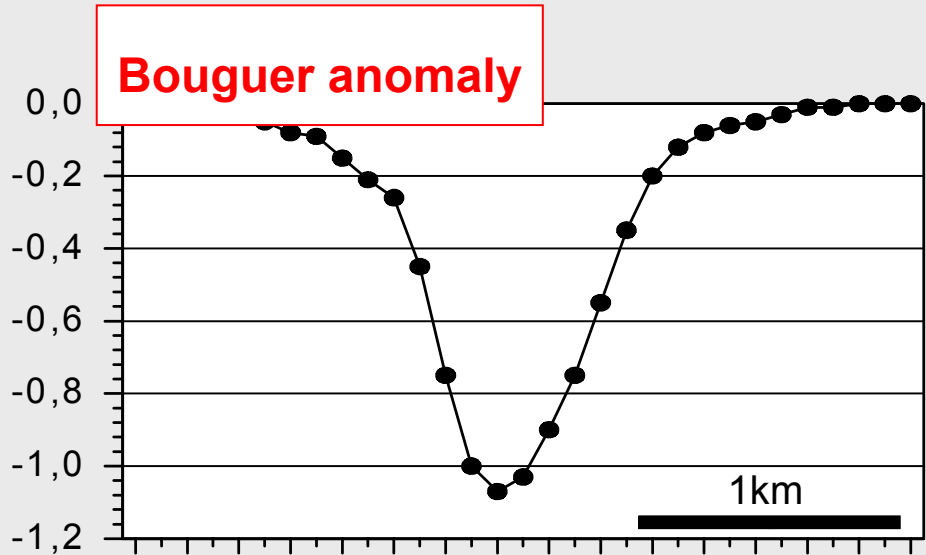




# fracture zones



don't forget gravity and magnetic



**Ernstson 2005**



## Conclusions

- fracture zones can contain important groundwater reservoirs
- fracture zones are normally characterized by low resistivity and electric anisotropy
- typical anomalies of electromagnetic signals indicate fracture zones, but might be misinterpreted
- porosity of fracture zones can be determined by square array mapping

