Detecting infiltration pathways by means of multi-method geophysical interpretation: an urban case study

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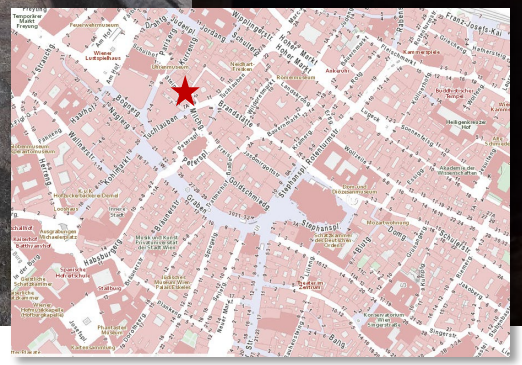
Objectives and setting

- Reported water infiltration into cellar rooms with 2 days delay after rainfall
- Cellars are old and any excessive soil moisture will weaken structural integrity

- Geophysical imaging to investigate possible water infiltration pathways



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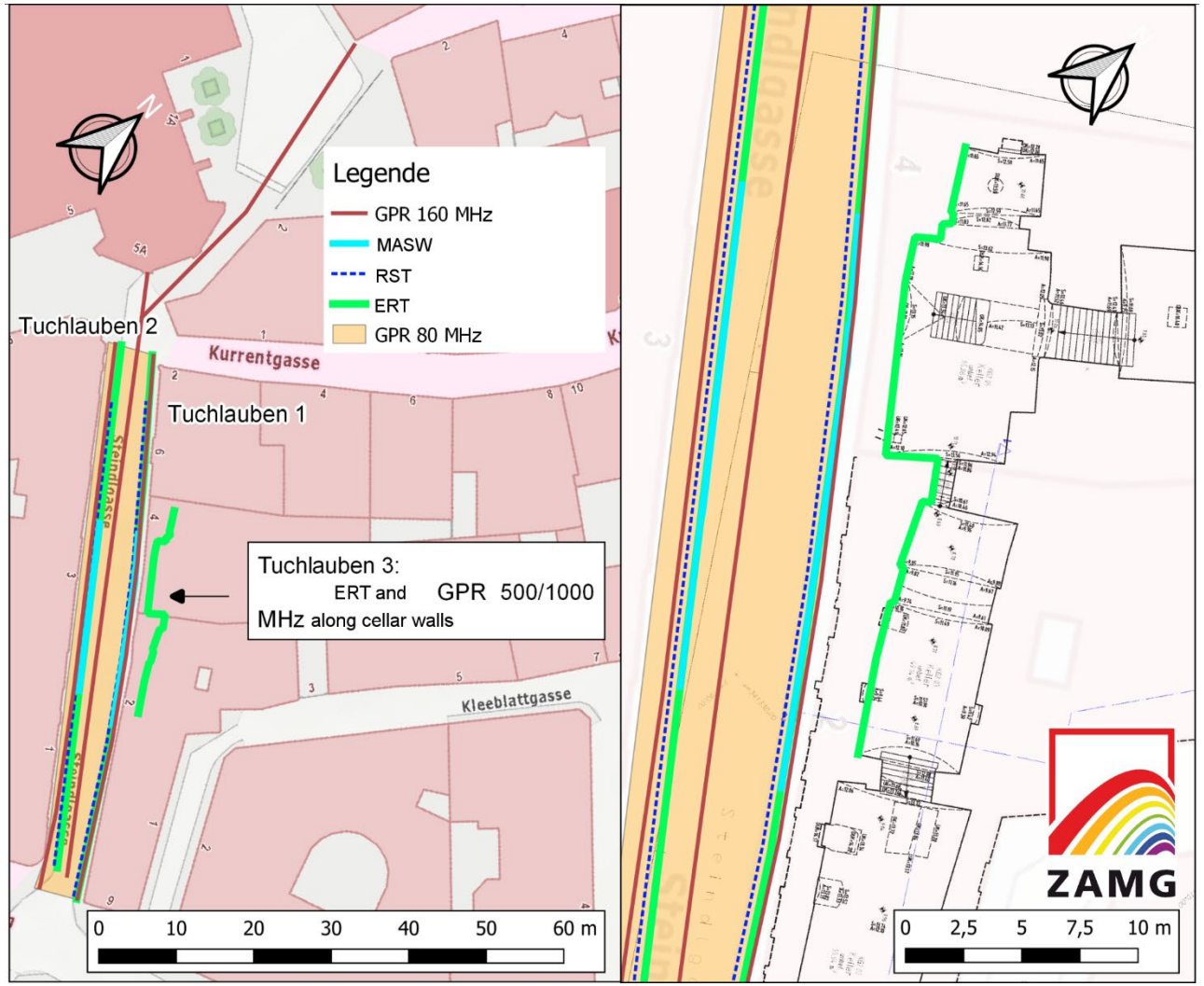
Geophysical imaging appraoch

- Combination of geophysical methods: mitigate effects of urban setting



- Low and high frequency ground penetration radar (GPR) measurements:
  - 80 and 160 MHz on street
  - 500 and 1000 MHz on cellar walls
- Electrical resistivity tomography (ERT):
  - Street: 72 electrodes with 1 m spacing
  - Cellar: 60 electrodes with 0.5 m spacing
- Seismic measurements collected with 24x 4.5 Hz geophones streamer with 2 m spacing:
  - Refraction seismic tomography (RST)
  - Multichannel analysis of surface waves (MASW)

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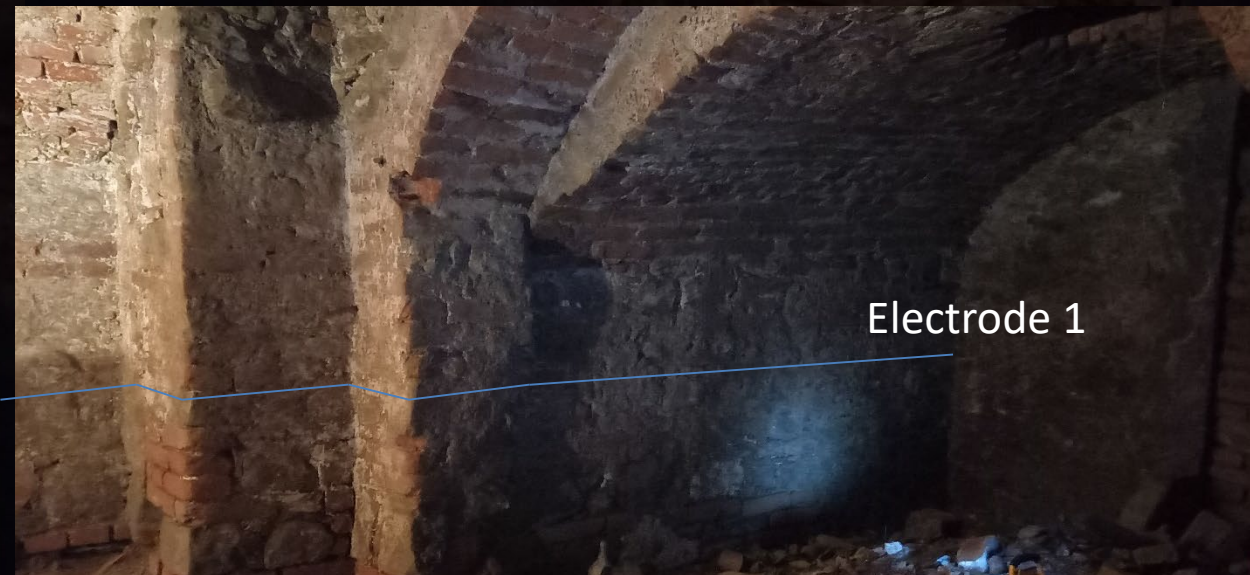
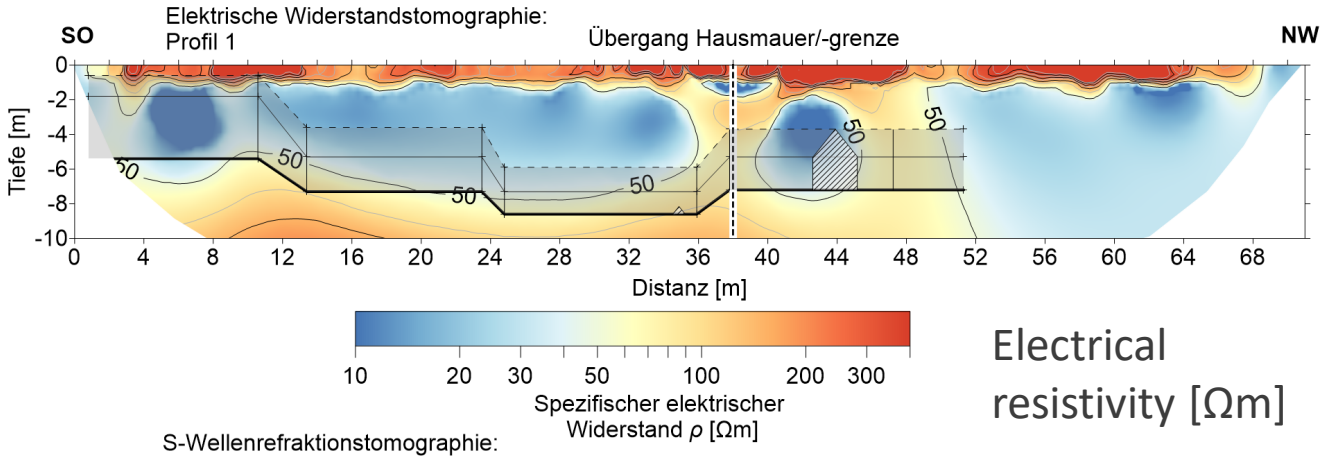
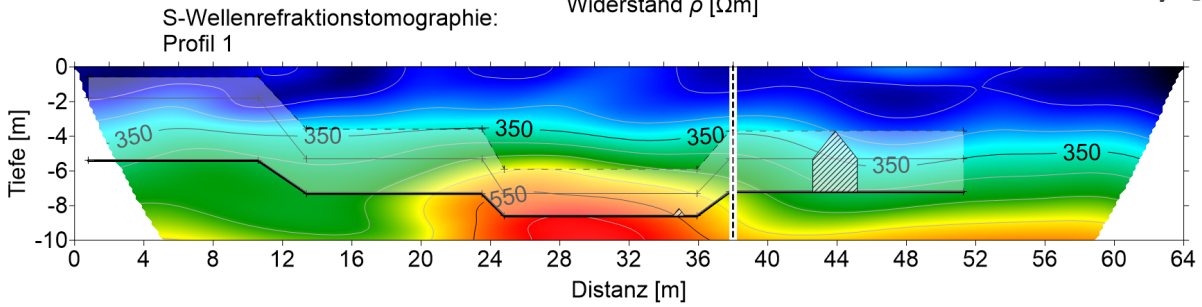
Geophysical imaging appraoch

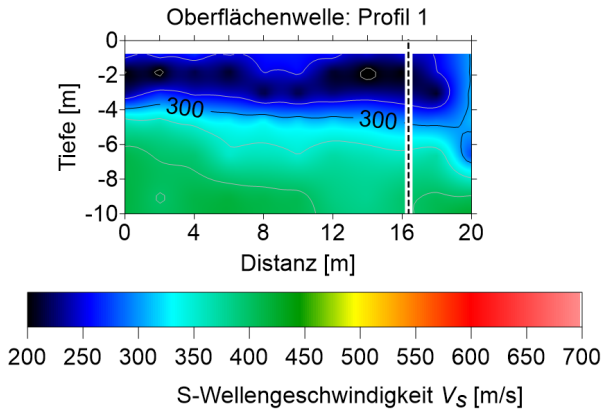


Results – Street: ERT, RST and MASW along profile Tuchlauben 1

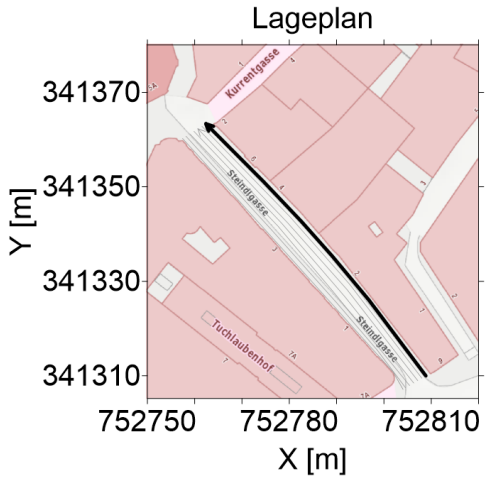


Electrical resistivity [Ωm]





Shearwave velocity [m/s]



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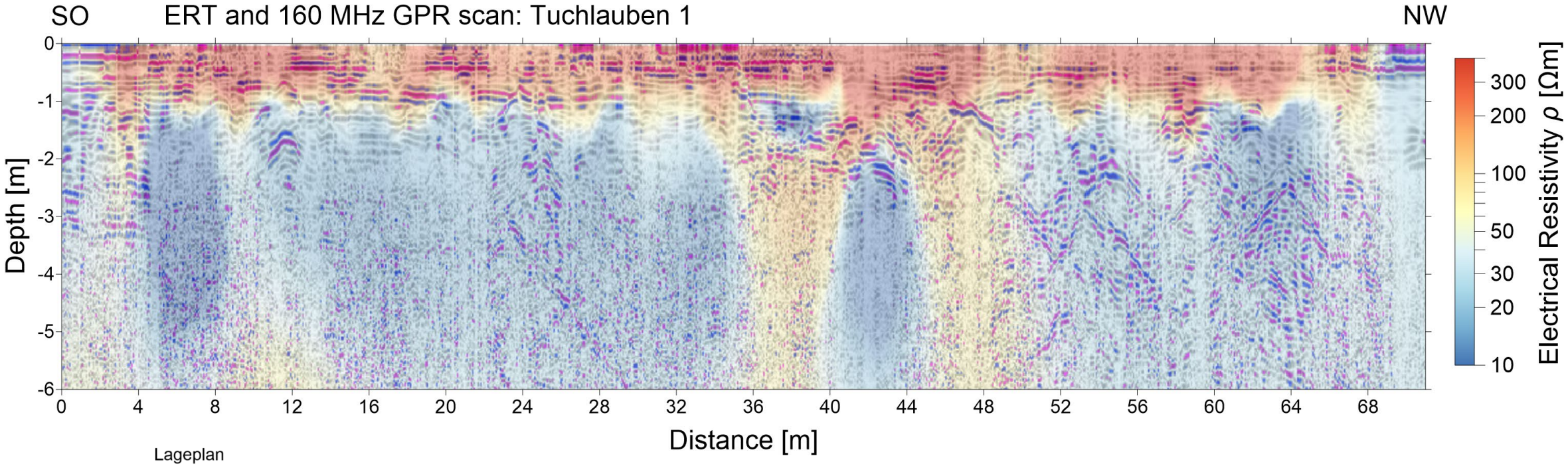
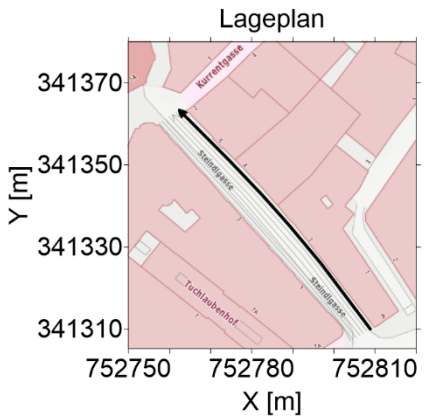
Results – Street: ERT and GPR (160 MHz)





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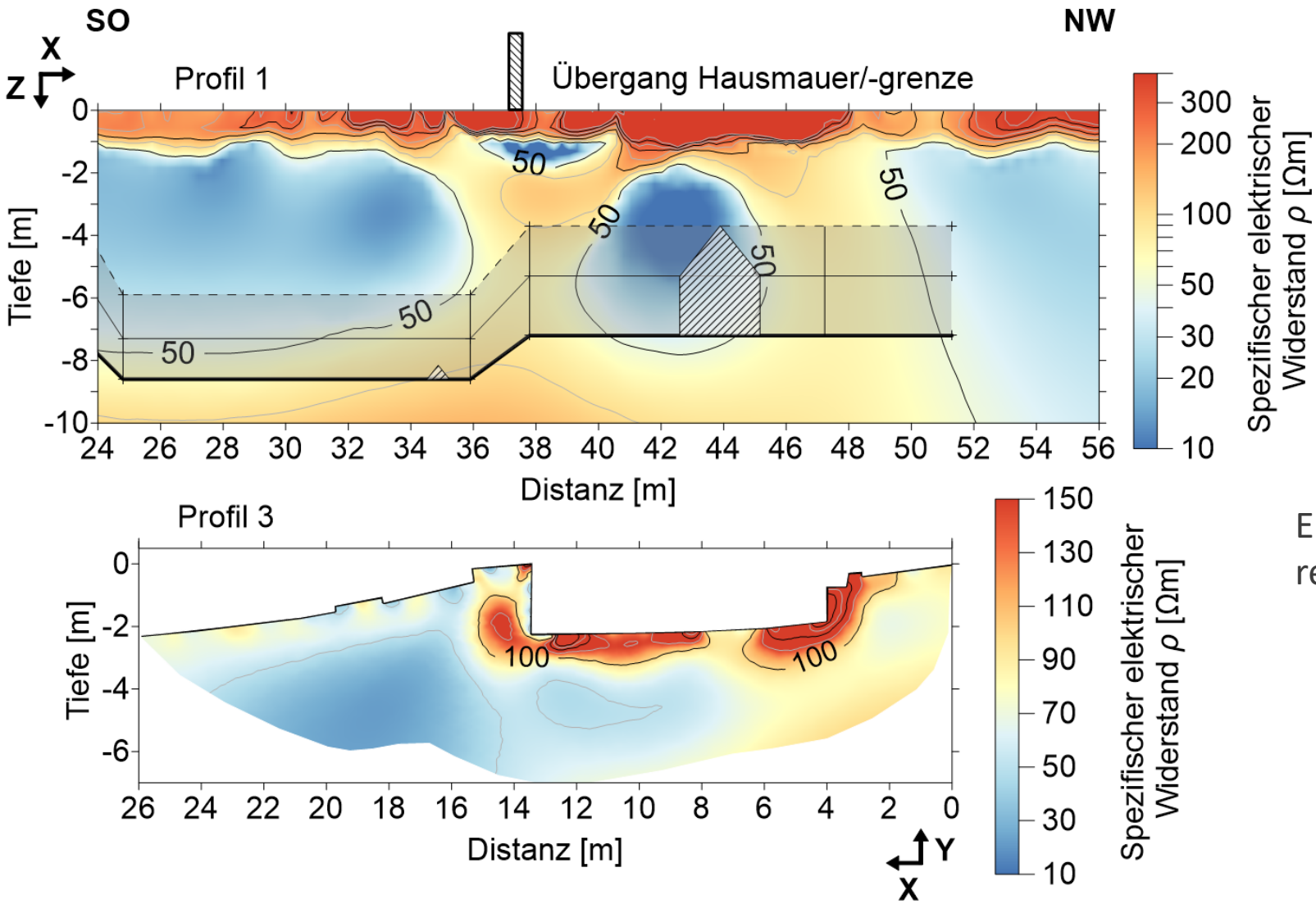
Results – Cellar and street: ERT



Electrical resistivity [Ωm]

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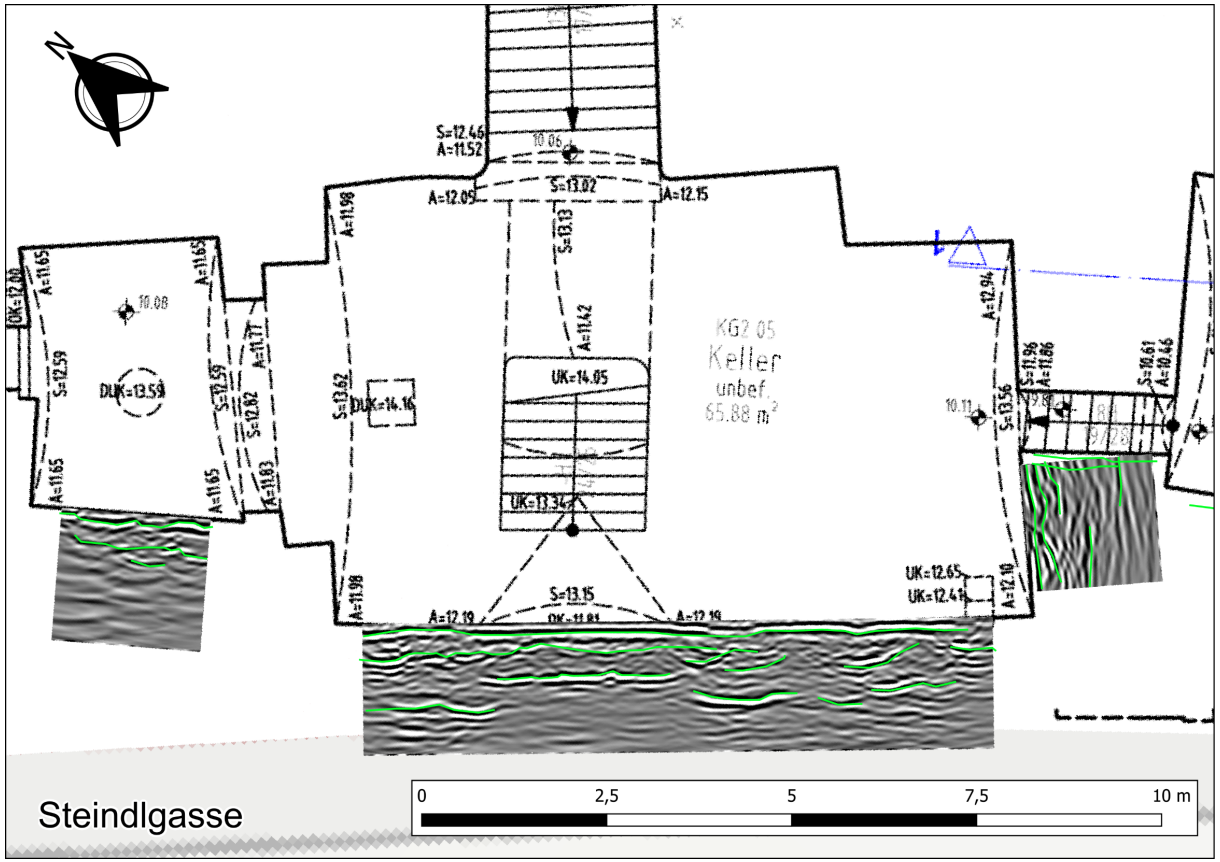
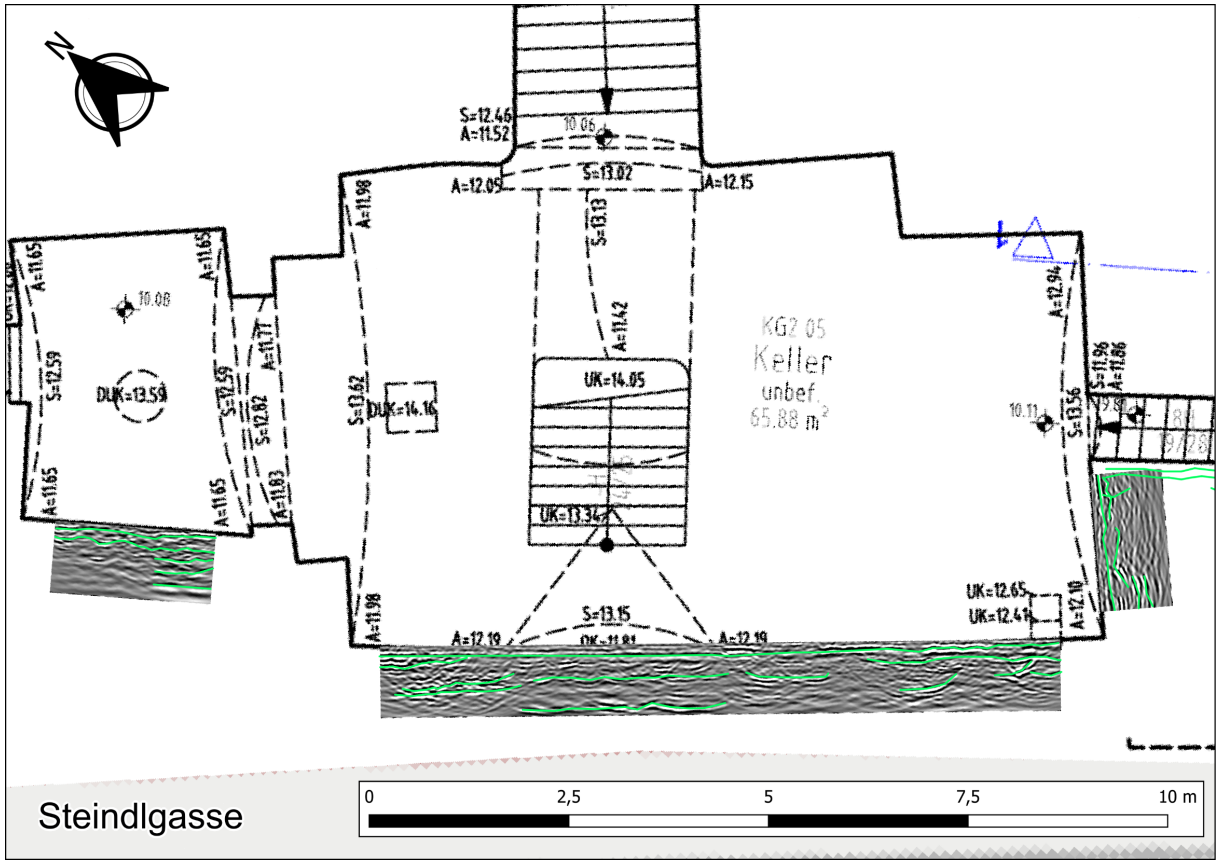
Results – Cellar: GPR





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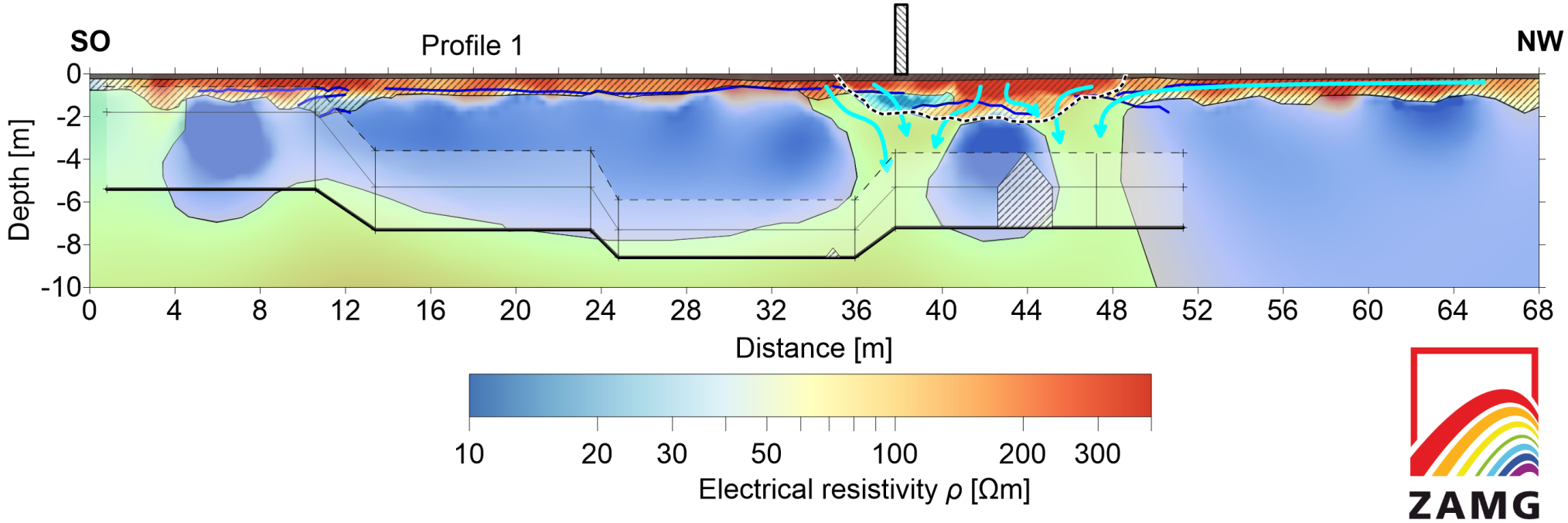
Interpretation: imaging infiltration pathways (1)



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Legend

- Infiltration pathways
- Coarse sedimente with fine-grained portion
- Fine-grained sediment
- Highly loosened sediment
- Highly loosened sediments (waterlogged) or lense of fine-grained sediment
- Pavement/street
- GPR structures
- Bomb crater

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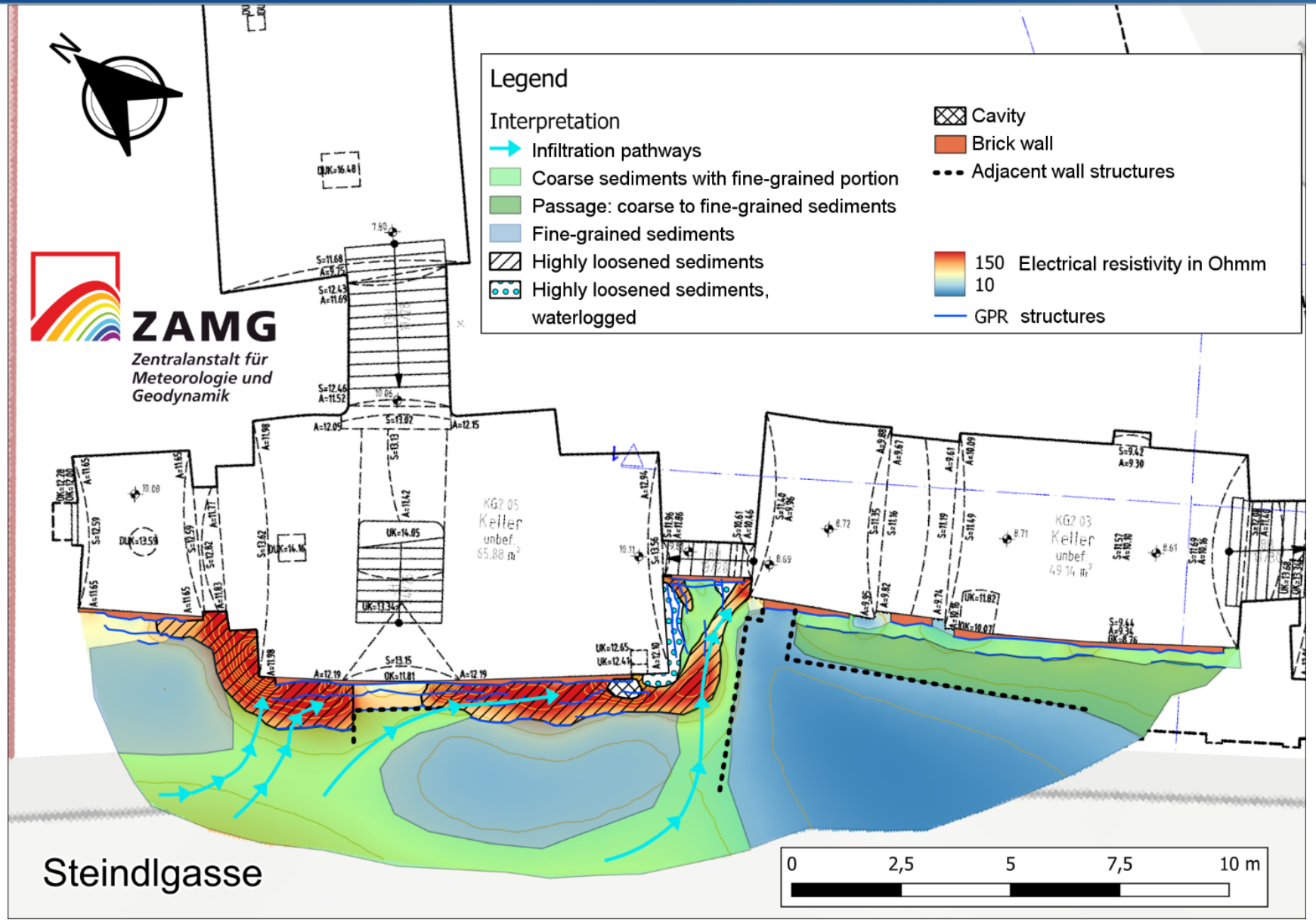
Interpretation: imaging infiltration pathways (2)



Conclusions

- Joint analysis of geophysical imaging results allowed the interpretation of possible infiltration pathways
- However, independent verfication based on hydrological testing and drilling is still ongoing

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