Photo: Vienken, UFZ

Slides supporting the abstract: **A novel approach towards the reliable characterization of complex sedimentary aquifers**

by Thomas Vienken, Alraune Zech, Emanuel Huber, Peter Huggenberger, Manuel Kreck, Marco Pohle, Peter Dietrich, and Ulrike Werban

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HELMHOLTZ CENTRE FOR ENVIRONMENTAL RESEARCH – UFZ

Introduction – Test site location

Tagliamento braided river system
NW of Udine, Italy
with complex sedimentary structures

Location of field work

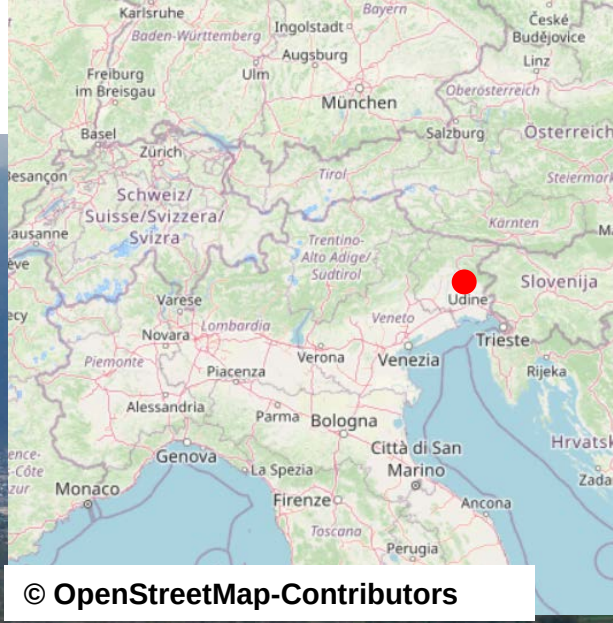
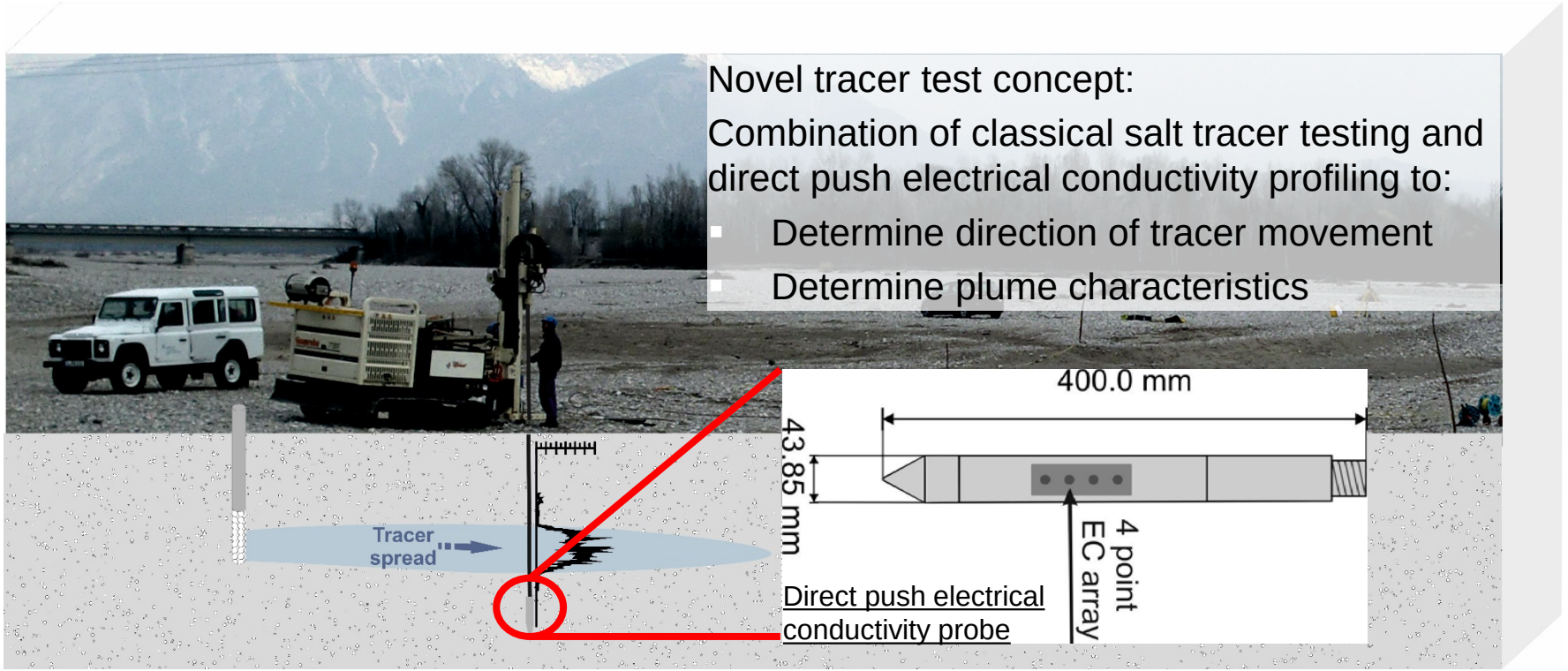


Photo: Thomas Vienken, UFZ

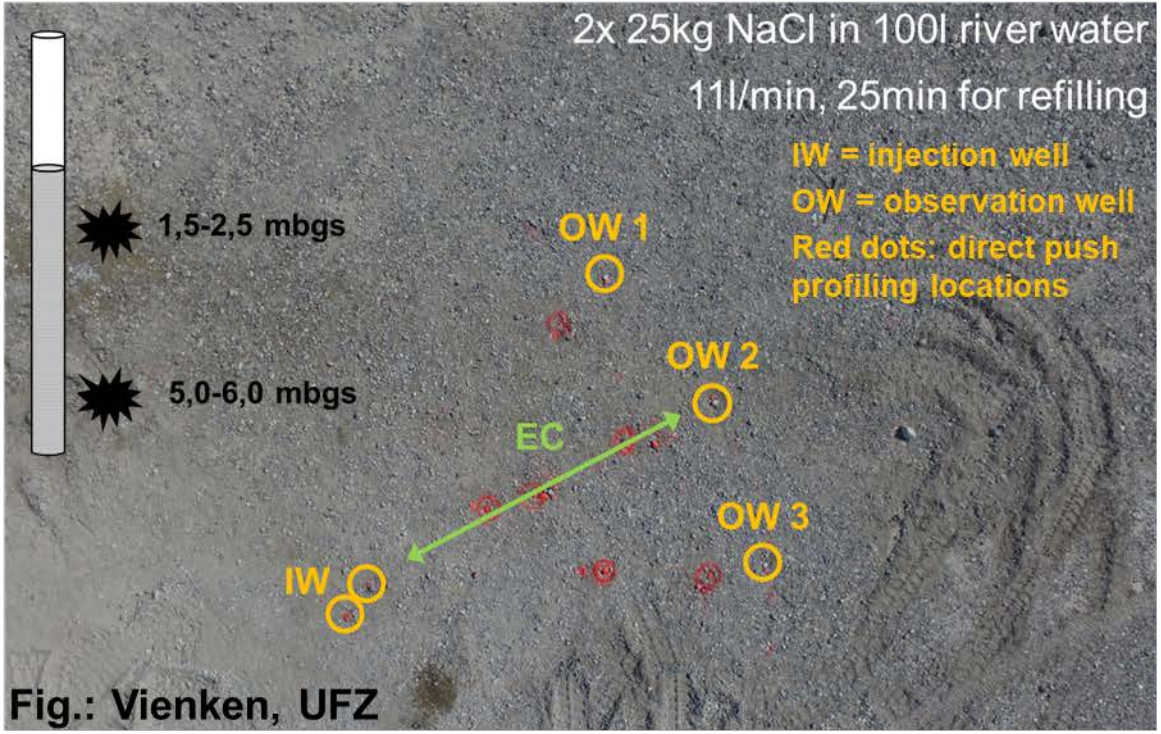
Introduction - direct push-based tracer test concept

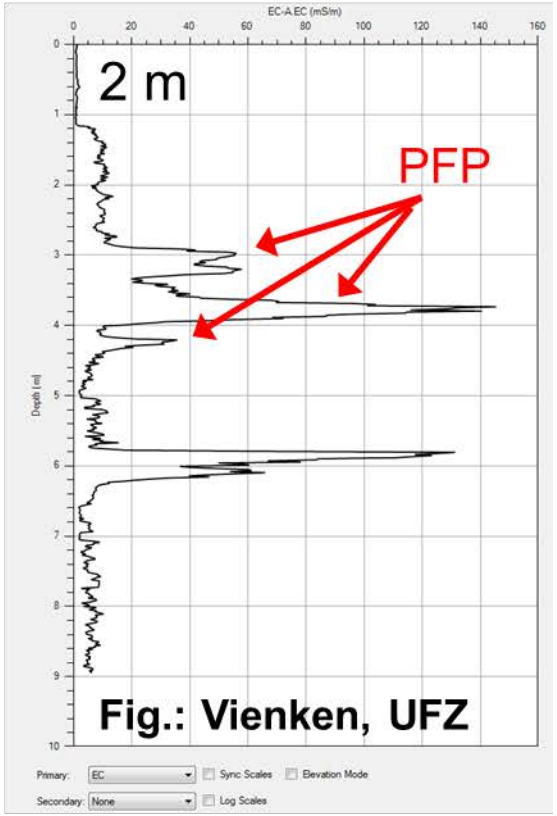


Tracer test concept is explained in detail in: Vienken, T., E. Huber, M. Kreck, P. Huggenberger, and P. Dietrich (2017), How to chase a tracer – combining conventional salt tracer testing and direct push electrical conductivity profiling for enhanced aquifer characterization, Adv. Water Resour., 99, 60-66.

Introduction - direct push-based tracer test concept

Proof of concept, simultaneous injection of salt tracer at two different depths and direct push electrical conductivity profile 2 m downstream of injection wells

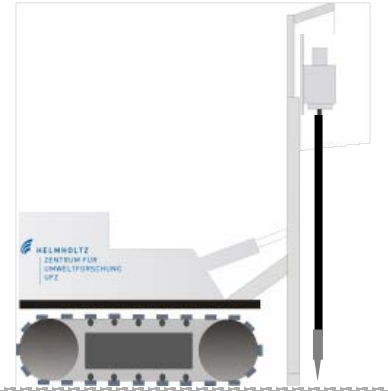




Refinement of tracer test concept

Development of a concept for vertical high resolution tracer monitoring along main propagation axis

- Not purely well-based
- Reliable, fast and efficient



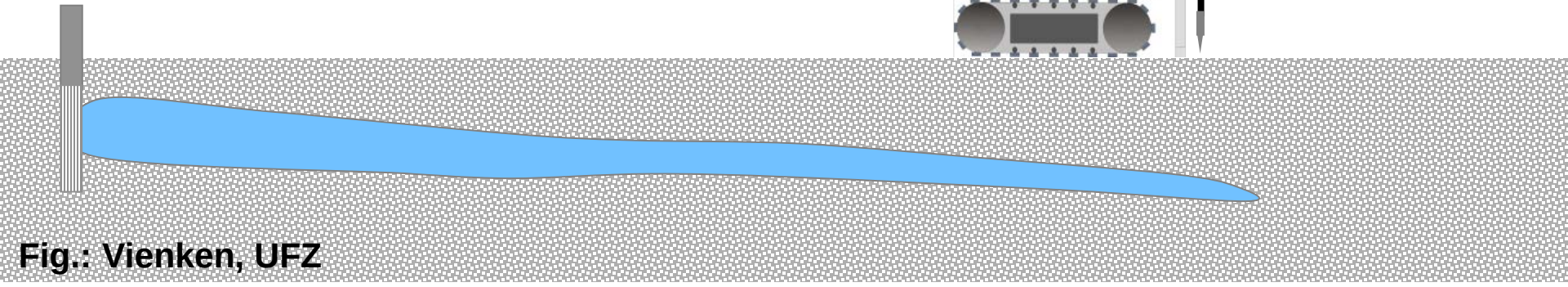
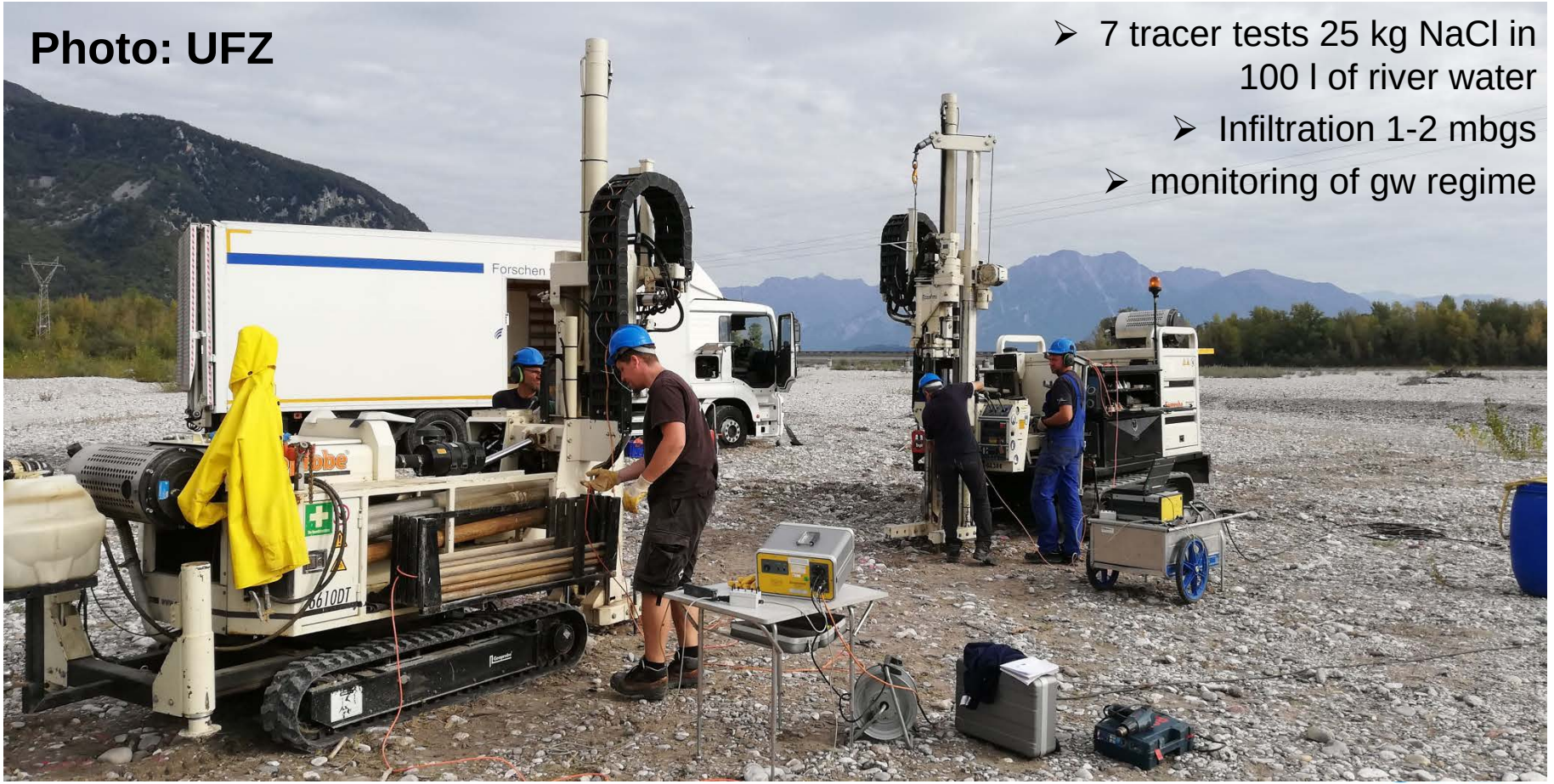


Fig.: Vienken, UFZ

1 m 2 m 3 m 4 m 5 m 6 m 7 m 8 m

New concept to investigate tracer distribution



- 7 tracer tests 25 kg NaCl in 100 l of river water
- Infiltration 1-2 mbgs
- monitoring of gw regime

Refinement of tracer test concept

30 minutes after start of tracer injection

Direct push electrical conductivity logging repeat measurements at fixed locations each meter along tracer main propagation axis during different time steps.

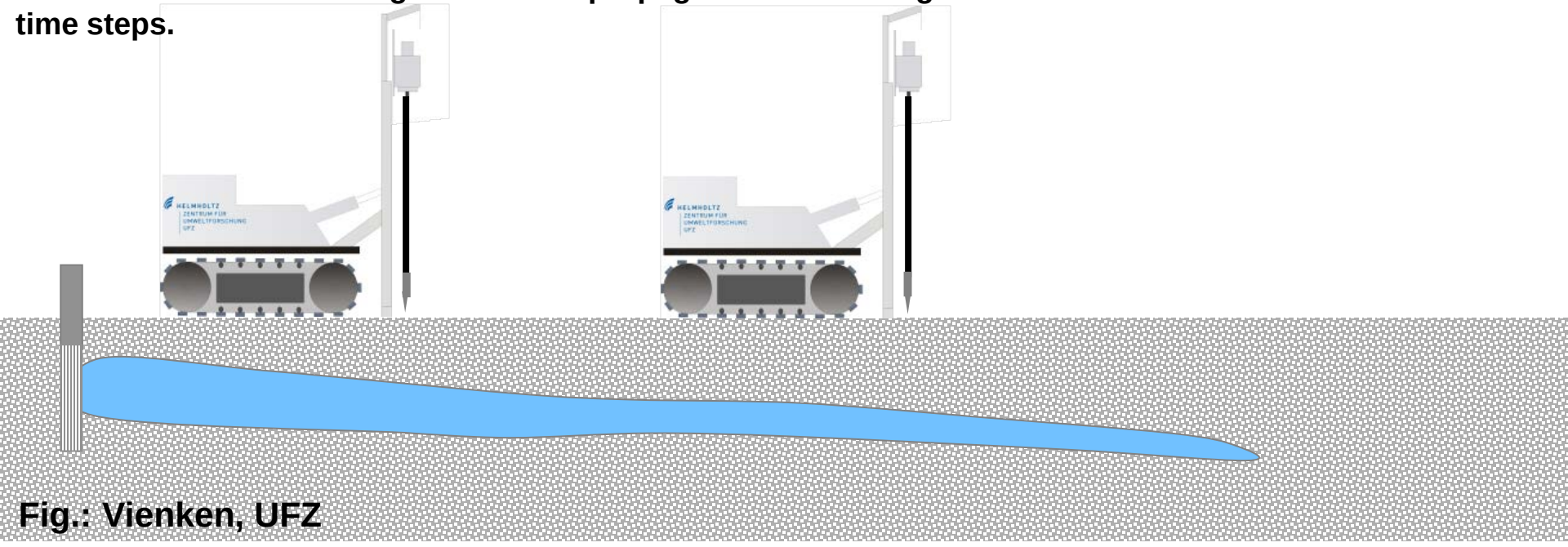


Fig.: Vienken, UFZ

Refinement of tracer test concept

60 minutes after start of tracer injection

Direct Push electrical conductivity logging repeat measurements at fixed locations each meter along tracer main propagation axis during different time steps.

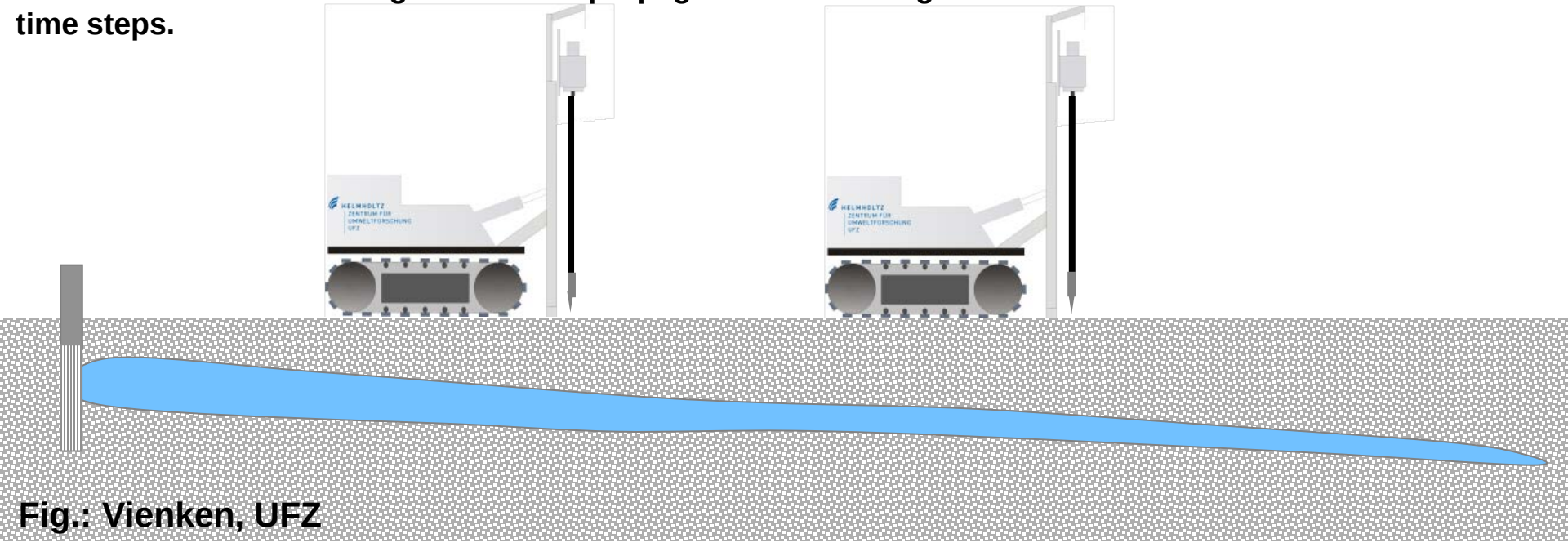


Fig.: Vienken, UFZ

Refinement of tracer test concept

120 minutes after start of tracer injection

Direct Push electrical conductivity logging repeat measurements at fixed locations each meter along tracer main propagation axis during different time steps.

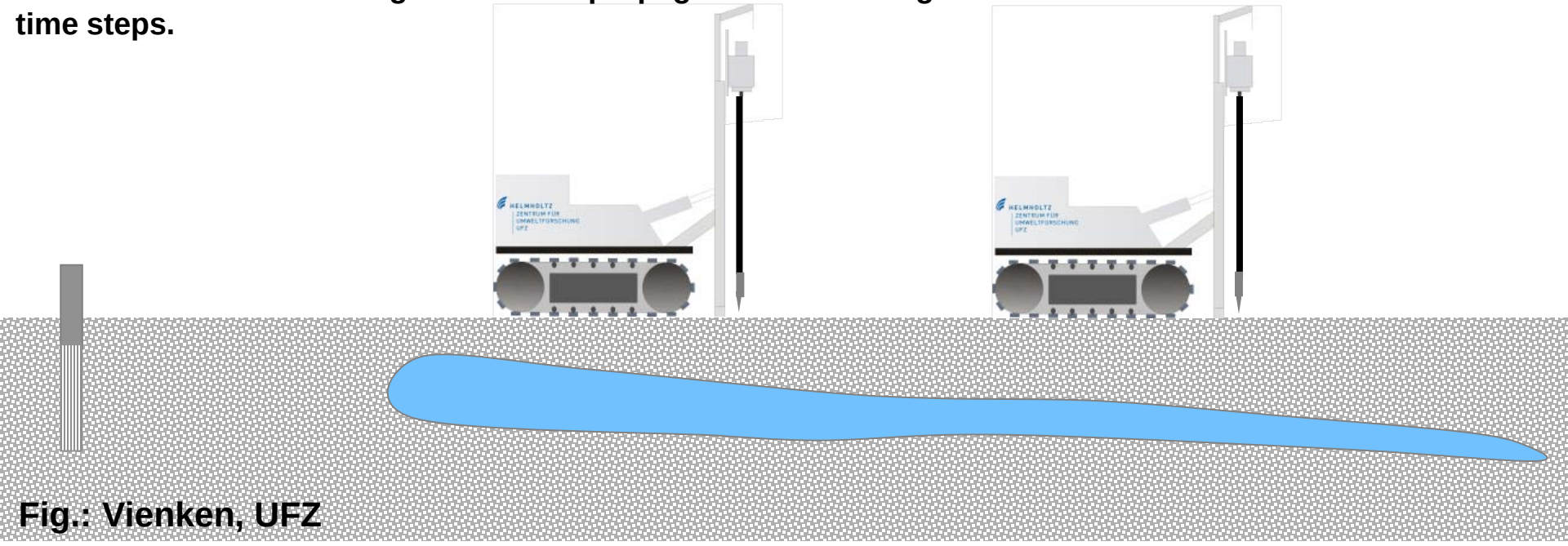
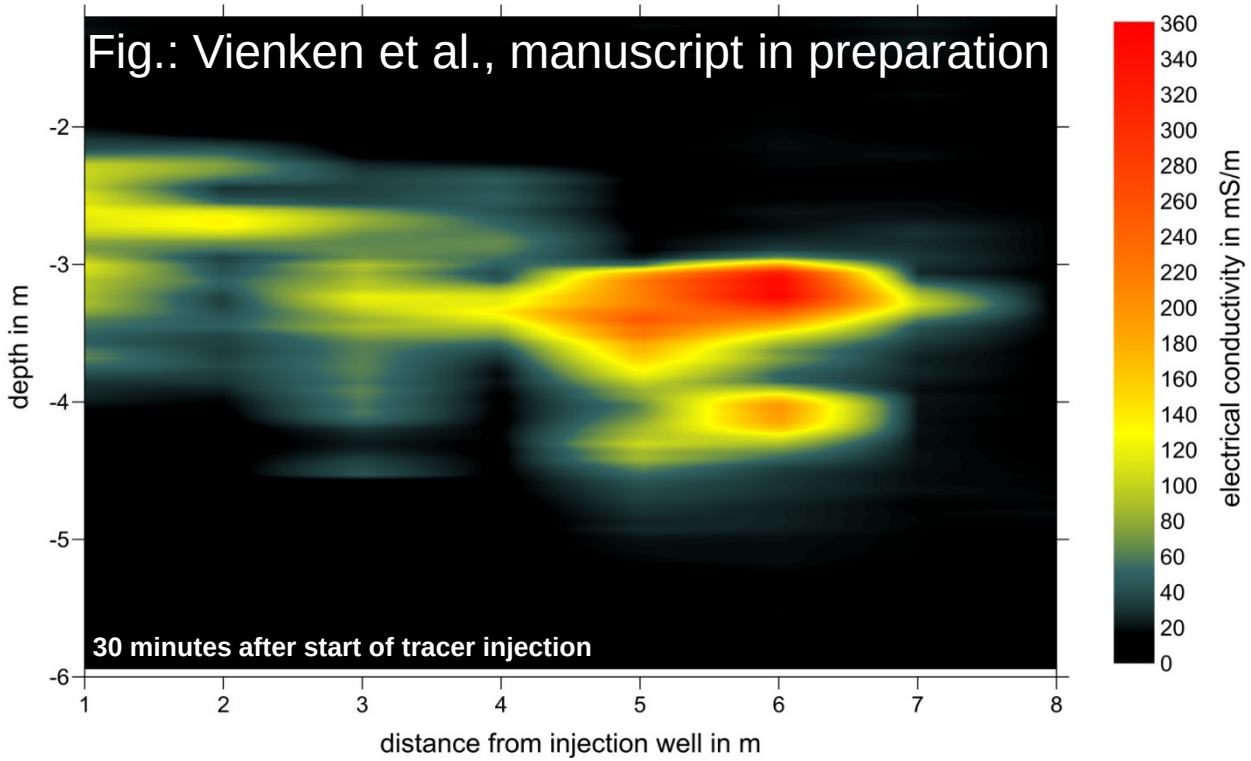


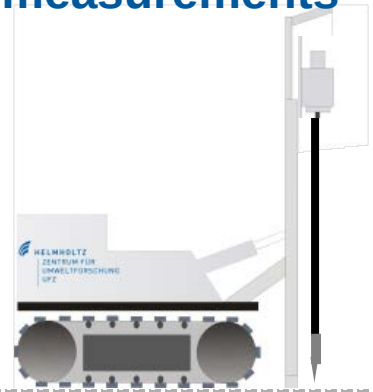
Fig.: Vienken, UFZ

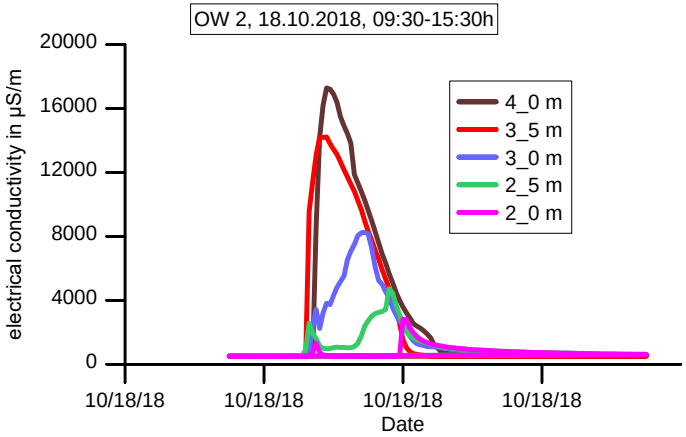
New concept to investigate tracer distribution – first results

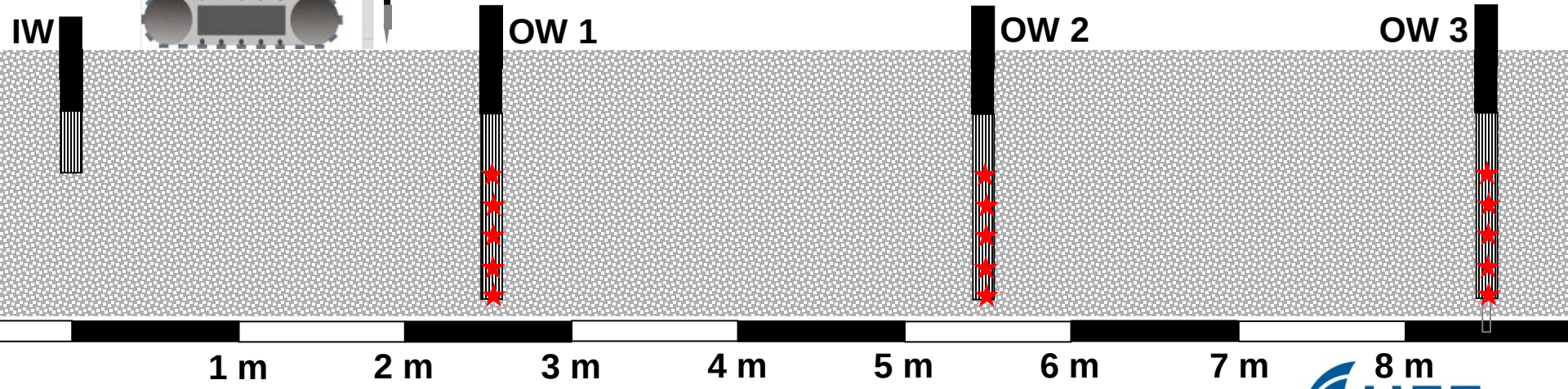
Picture generated based on 8 direct push electrical conductivity profiles (1.5 cm vertical resolution) collected 30 minutes after repeat tracer tests – increase in electrical conductivity indicates presence of tracer and differences in tracer concentration



Next steps: Set up of flow and transport model, parametrization using GPR data and breakthrough curve measurements







Refinement using additional techniques for innovative tracer monitoringe

CMD Mini Explorer (GF Instruments), verticale Dipol (HI-Mode), max. penetration depth for chosen settings 6.7 m

Conclusion

Innovative concept for direct push-based in-situ tracer detection:

- Overcome current limitations of well-based or surface geophysics monitoring
- Visualization of in-situ measured tracer distribution
- Unravel tracer spread in complex sedimentary deposits