

Monitoring of a hydraulic stimulation experiment at the Bedretto Underground laboratory (Switzerland) with seismic velocity observations – first results

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1 Introduction

The geothermal testbed (“VALTER”) includes:

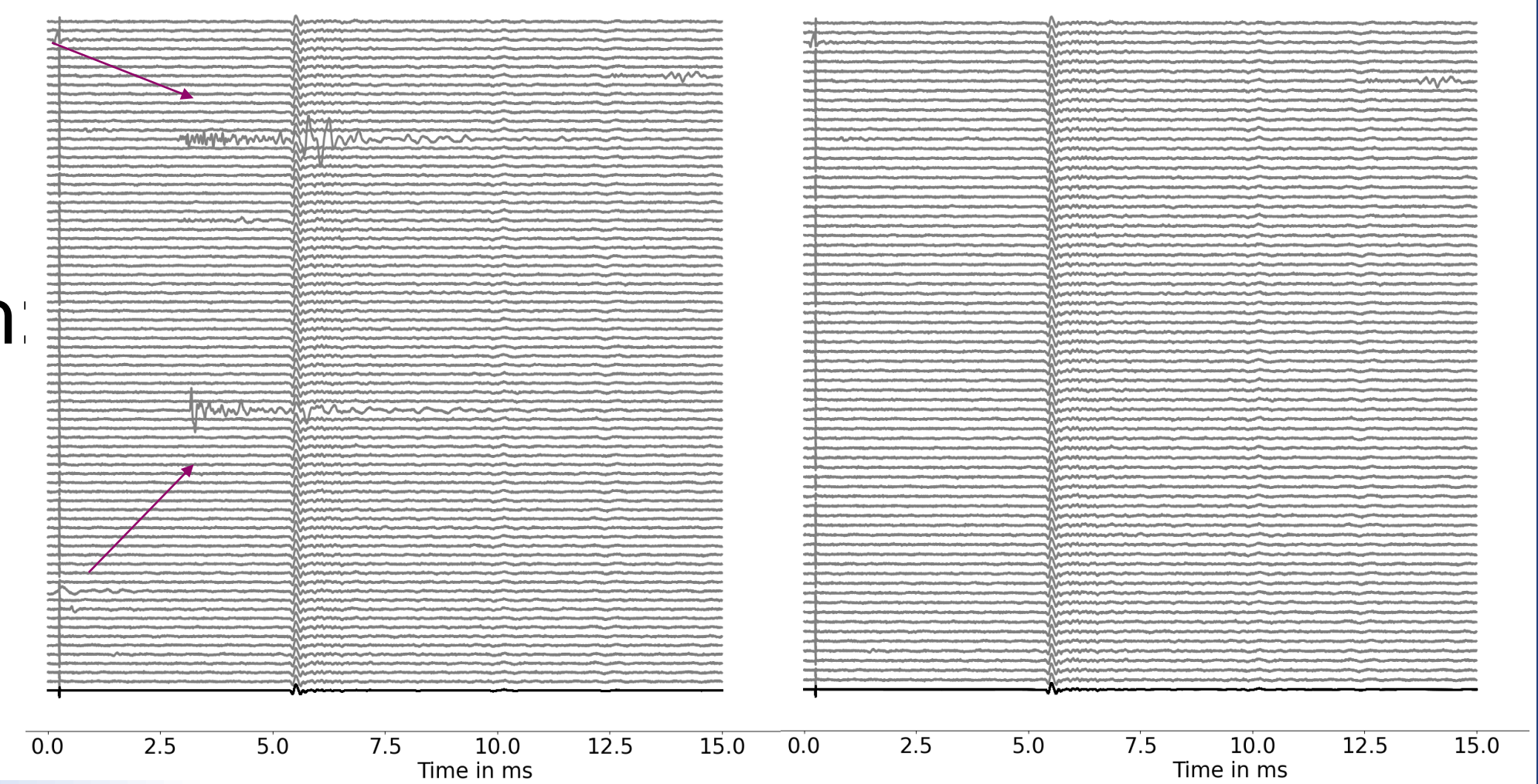
- **6 monitoring boreholes (MB)** of 250-400m length with a variety of different sensors
- **2 stimulation boreholes (ST)**

4 Data processing

stacking

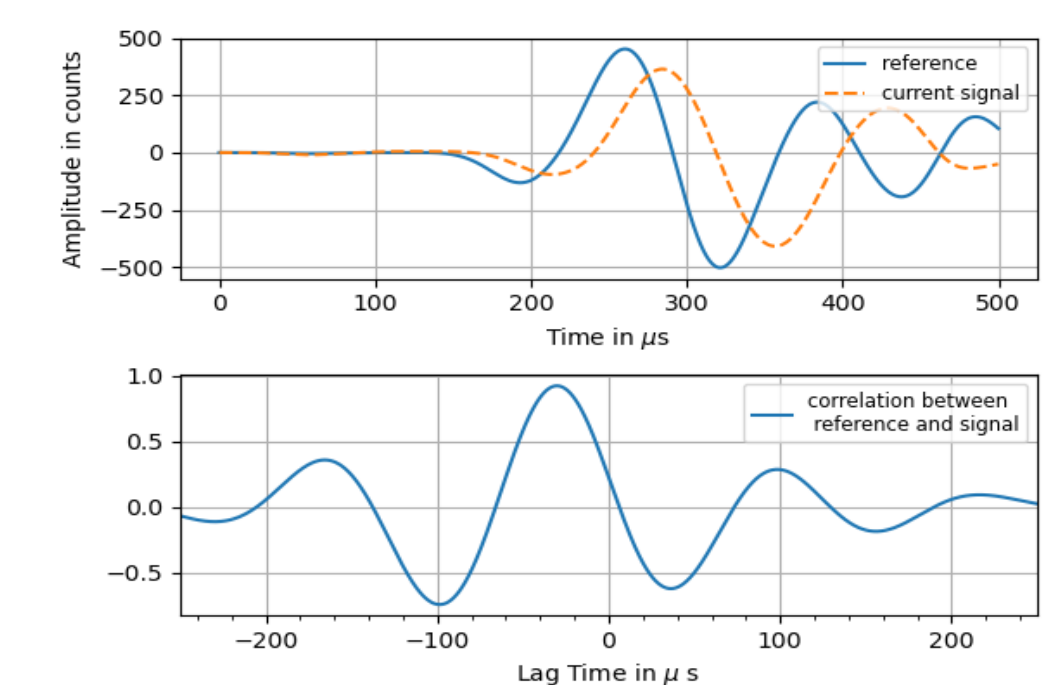
Processing steps

- Remove traces with:
 - Events
 - Failed shots
- PW stacking



Cross correlation

- Similarity = max. of the correlation function
- Time lag = shift of the maximum from zero



2 Motivation

a) Arrival time shift: variation in fluid and rock velocities

b) waveform coherence/ decoherence: structural changes (e.g. Obermann and Hillers, 2019)

5 First results

Small pressure drop – due to seismic event (yellow alert?) shut-in

3 The experiment

Acoustic Emission (AE) Sensor and Ultrasonic transducer (“Transmitter”) Sensor installation paper: Plenkers et al. (2023)

A time lag corresponds to one trace

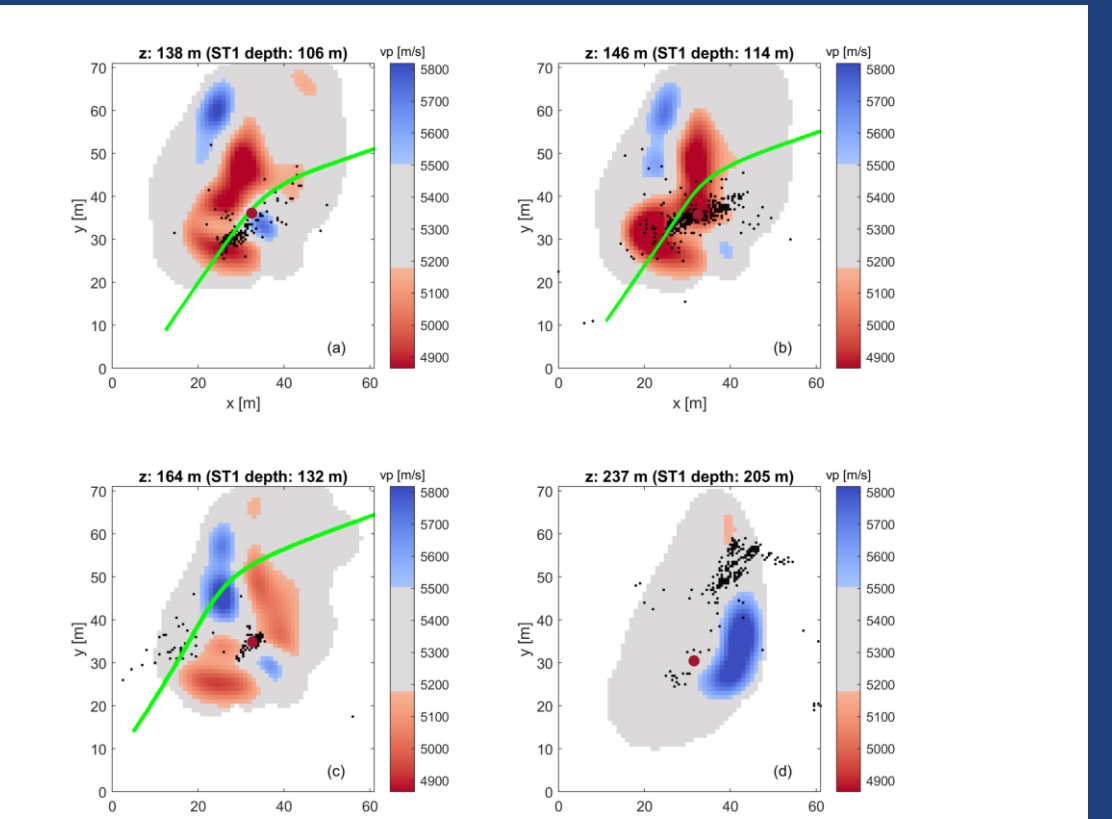
shut-in
interval open

Stacked traces!

6 Outlook – 4D Tomography

Background velocity model shows that seismic events tend to “avoid” very high or very low velocities. (due to stress gradient?)

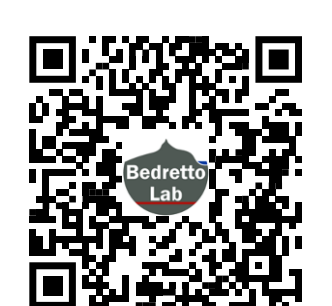
Next step: 4D traveltime tomography based on arrival time changes



Schwarz et al. 2025 (submitted)

Acknowledgements

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The BedrettoLab team

References:

1. Obermann, A. and Hillers, G. (2019): *Seismic time-lapse interferometry across scales*, <https://doi.org/10.1016/bs.agph.2019.06.001>
2. Plenkers, K., et al. (2023) *Multi-Disciplinary Monitoring Networks for Mesoscale Underground Experiments: Advances in the Bedretto Reservoir Project* doi: 10.3390/s23063315
3. Schwarz et al. (2025) (submitted): *New insights on the fault structure of a geothermal testbed and the associated seismicity based on active seismic tomography*