

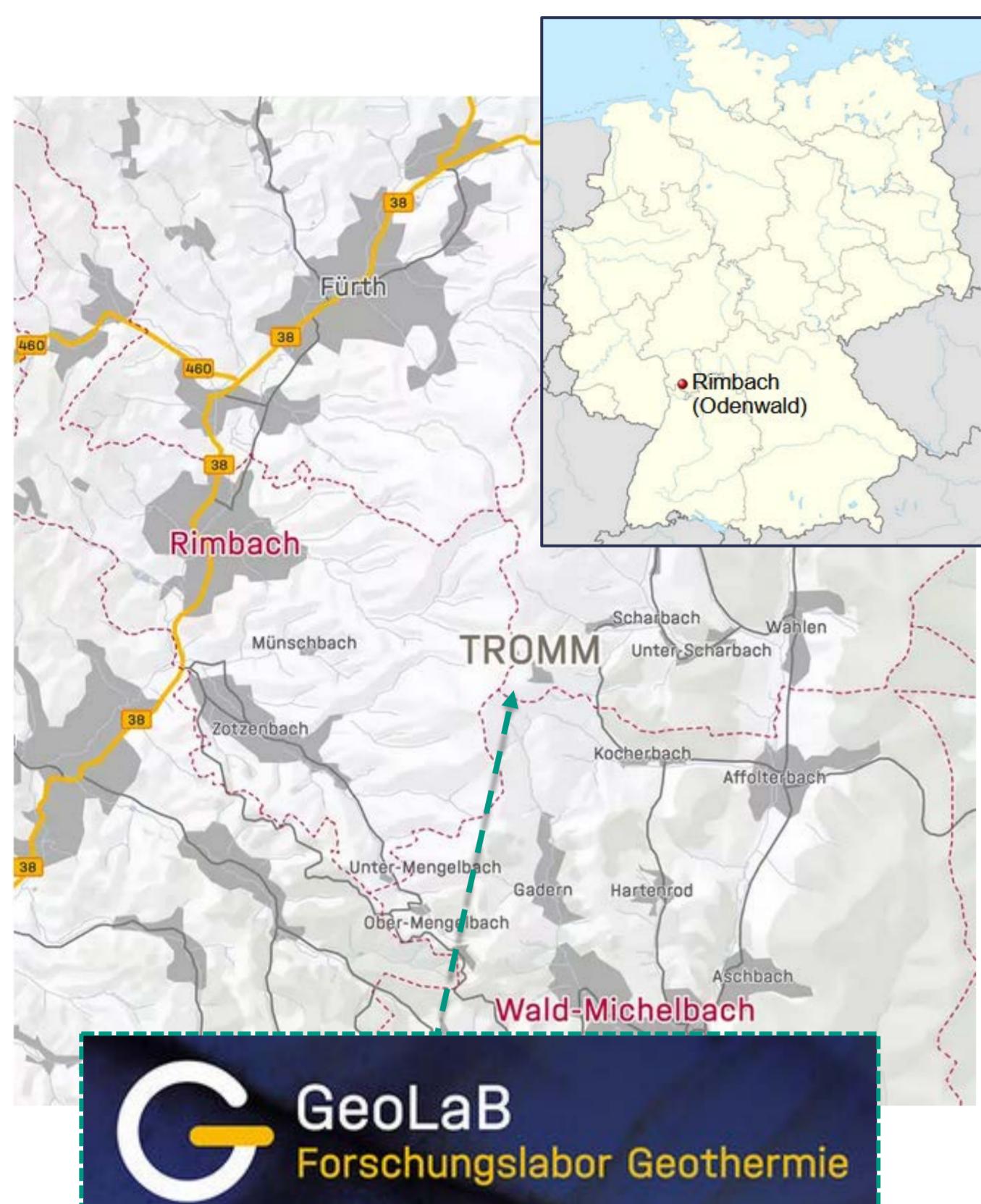
# DFOS from GeoLaB-1 exploration well

## Cementation and drilling monitoring

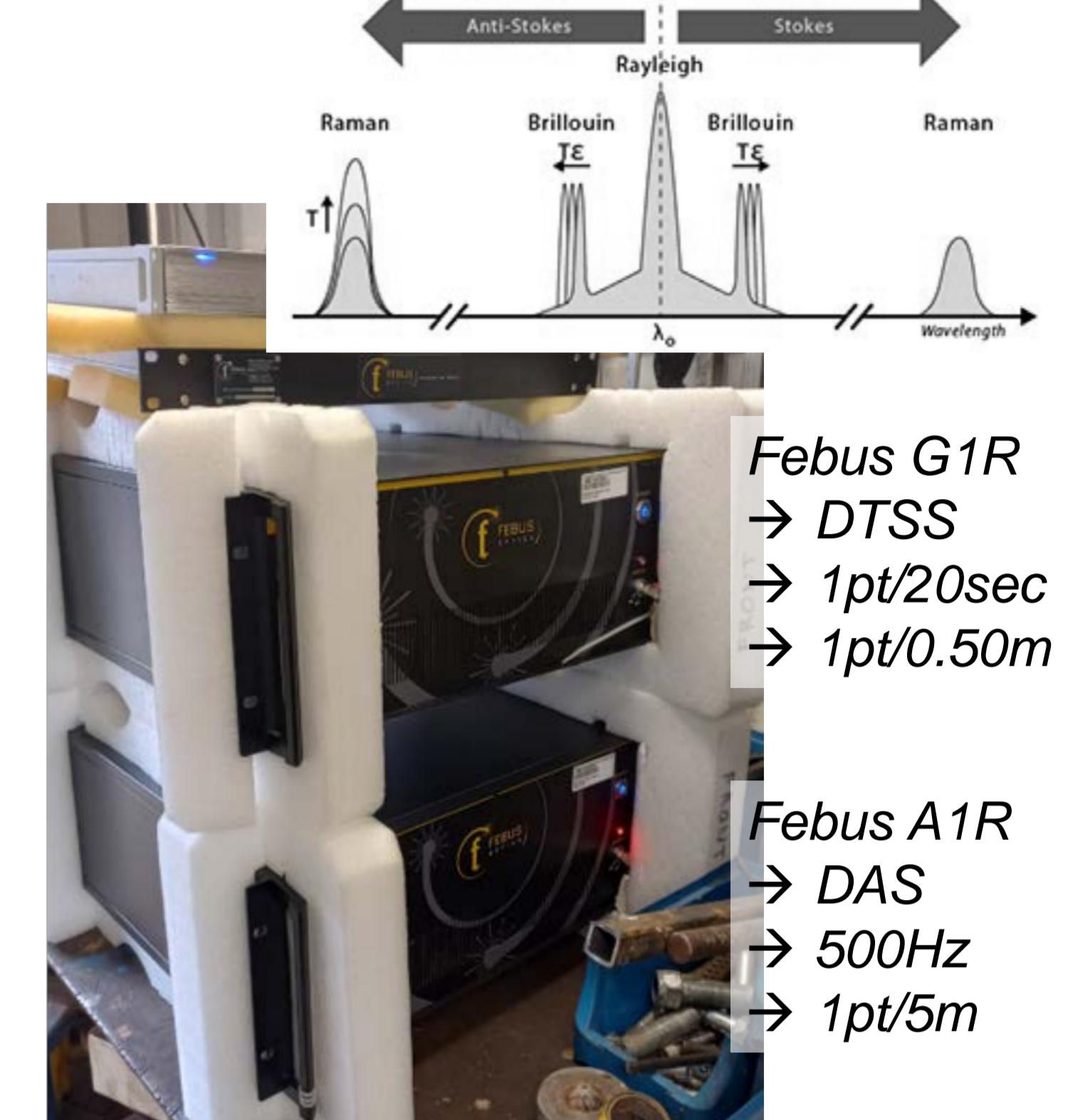
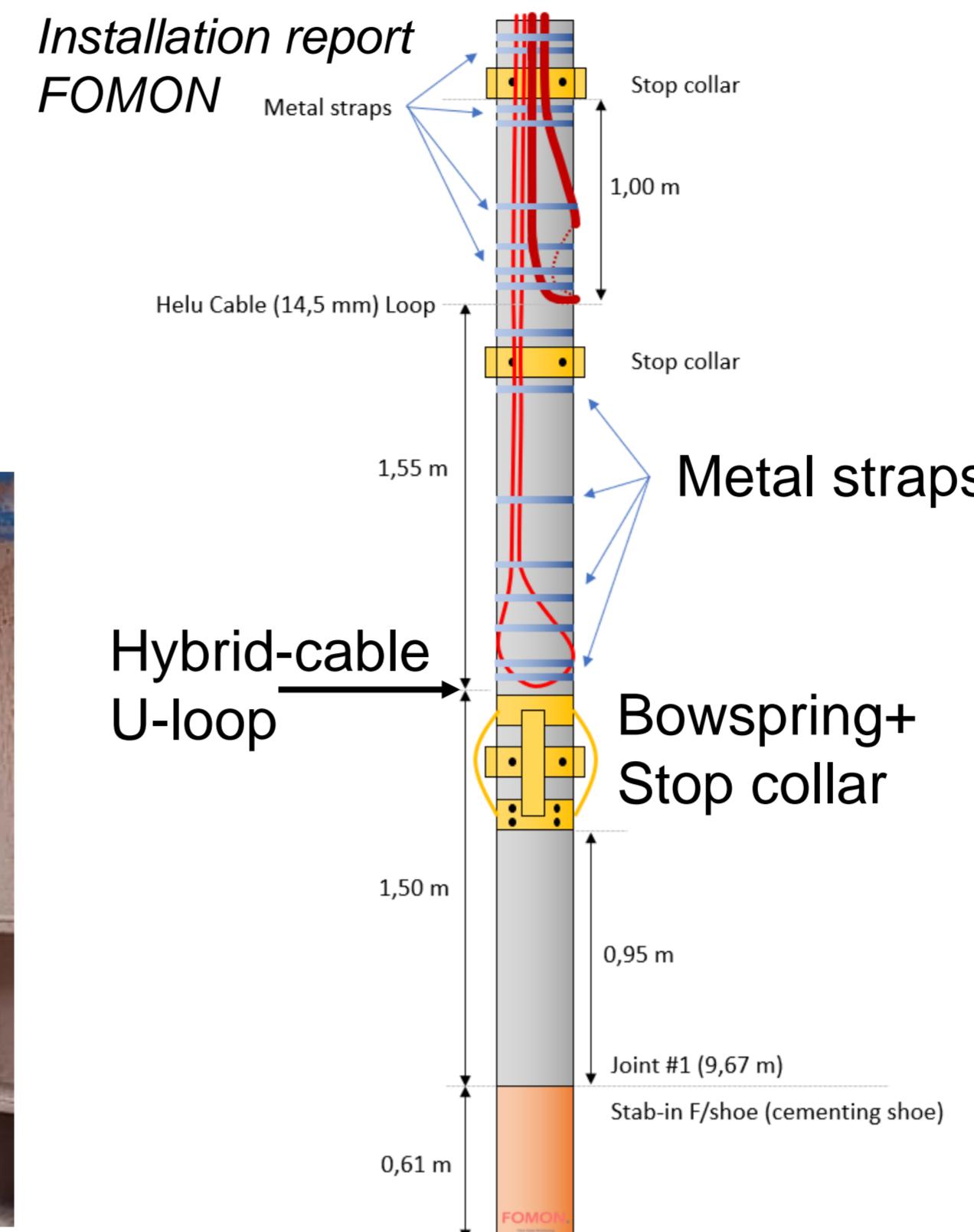
 Jérôme Azzola<sup>1</sup>, Simon Blaise<sup>1</sup>, Emmanuel Gaucher<sup>1</sup>
<sup>1</sup> Karlsruhe Institute of Technology, Institute of Applied Geosciences, Karlsruhe, Germany

### Research environment and technical aspects

- **GEOLAB** – Flow experiments under controlled conditions
- **EXPLORATION PHASE** – Find out more about the geological structures in Tromm area



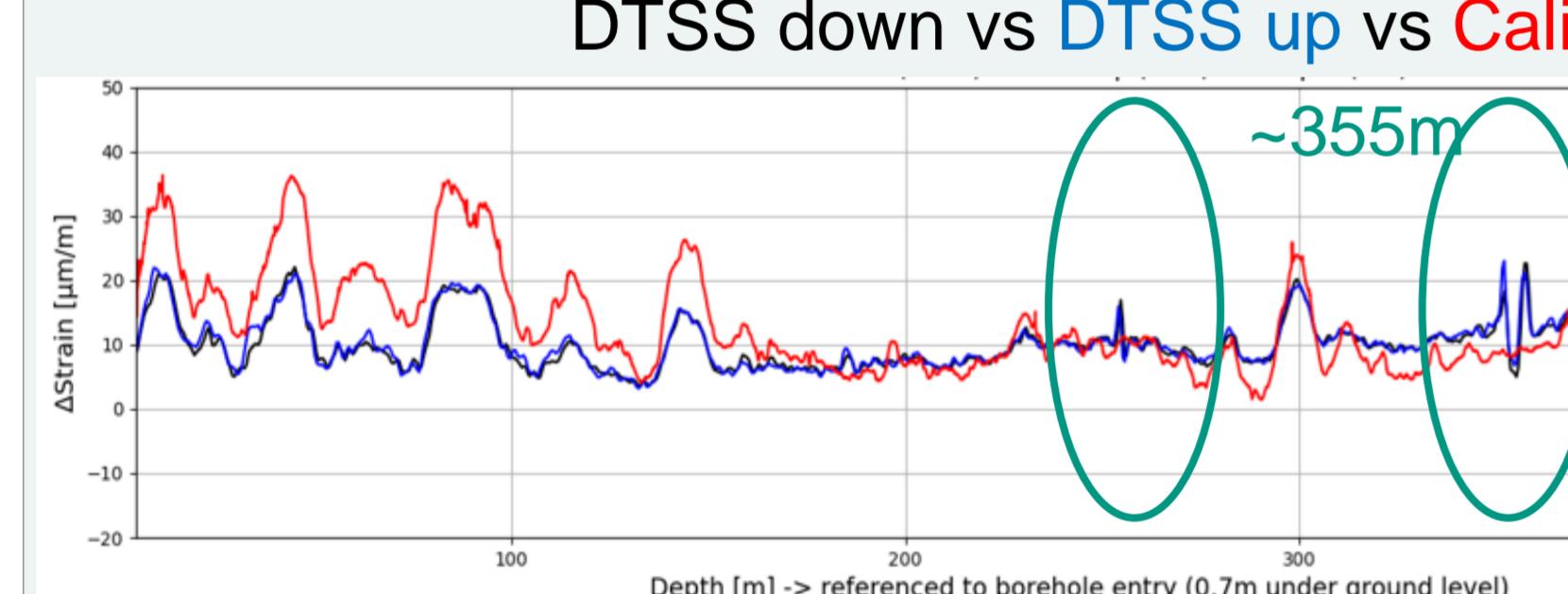
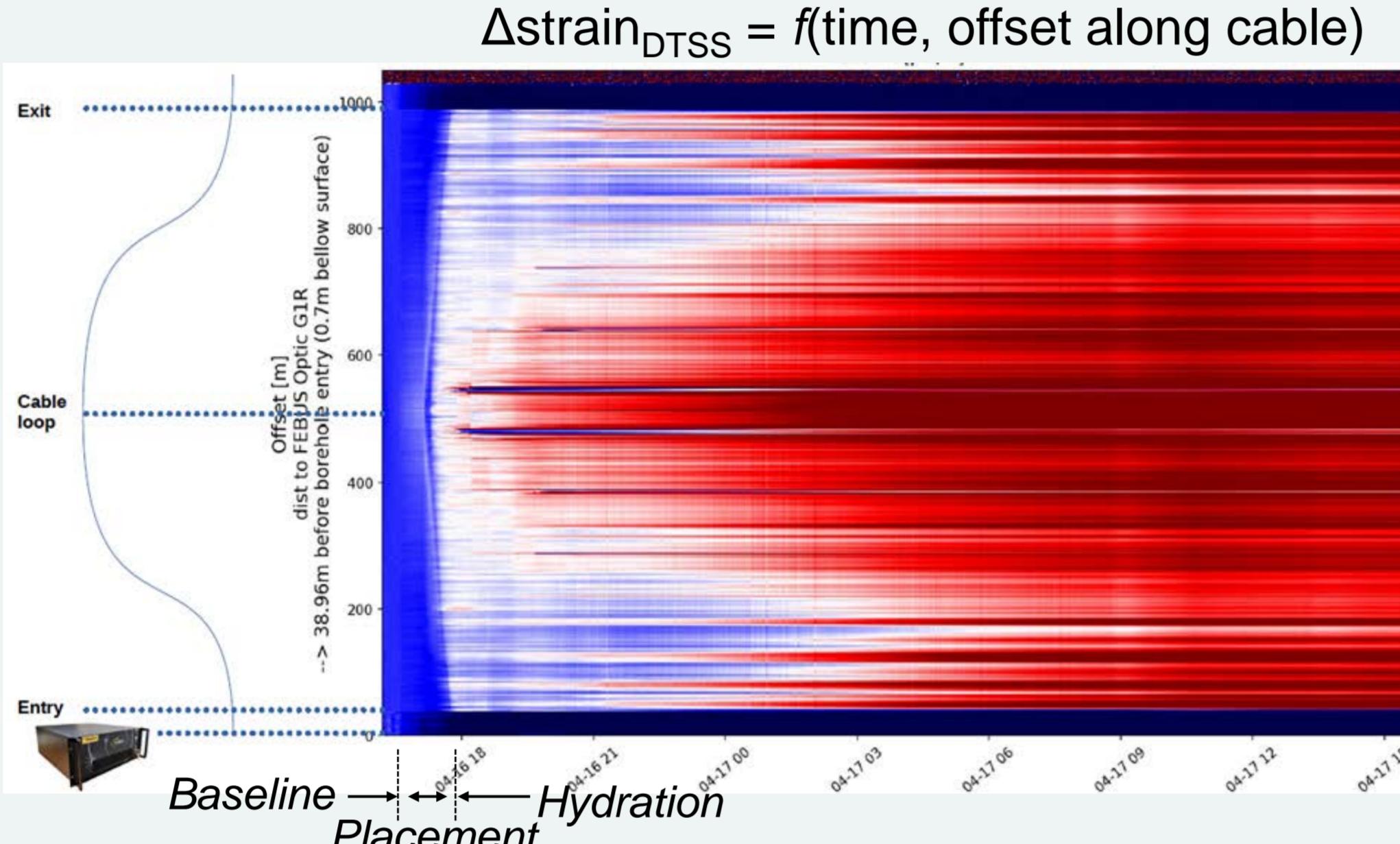
- **GeoLaB-1 (with FOC U-loop) and -2 exploration wells drilled from the same pad**
- **DAS / RAYLEIGH** → Dynamic sensing of strain(-rate), high sampling-rate
- **DTSS / BRILLOUIN** → Static sensing of strain (thermal and mechanical effects)



### Assess the cementation and analyse thermo-mechanical processes from DAS + DTSS data

#### Calibration of measurement points; correlation with logging data

- U-loop installation
- Mirror effect
- DTSS: no amplitude calibration
- Relative strain rather than absolute measurements
- Calibration of sensing points location / fiber refractive index
- Correlation with independent measurements (Caliper log)

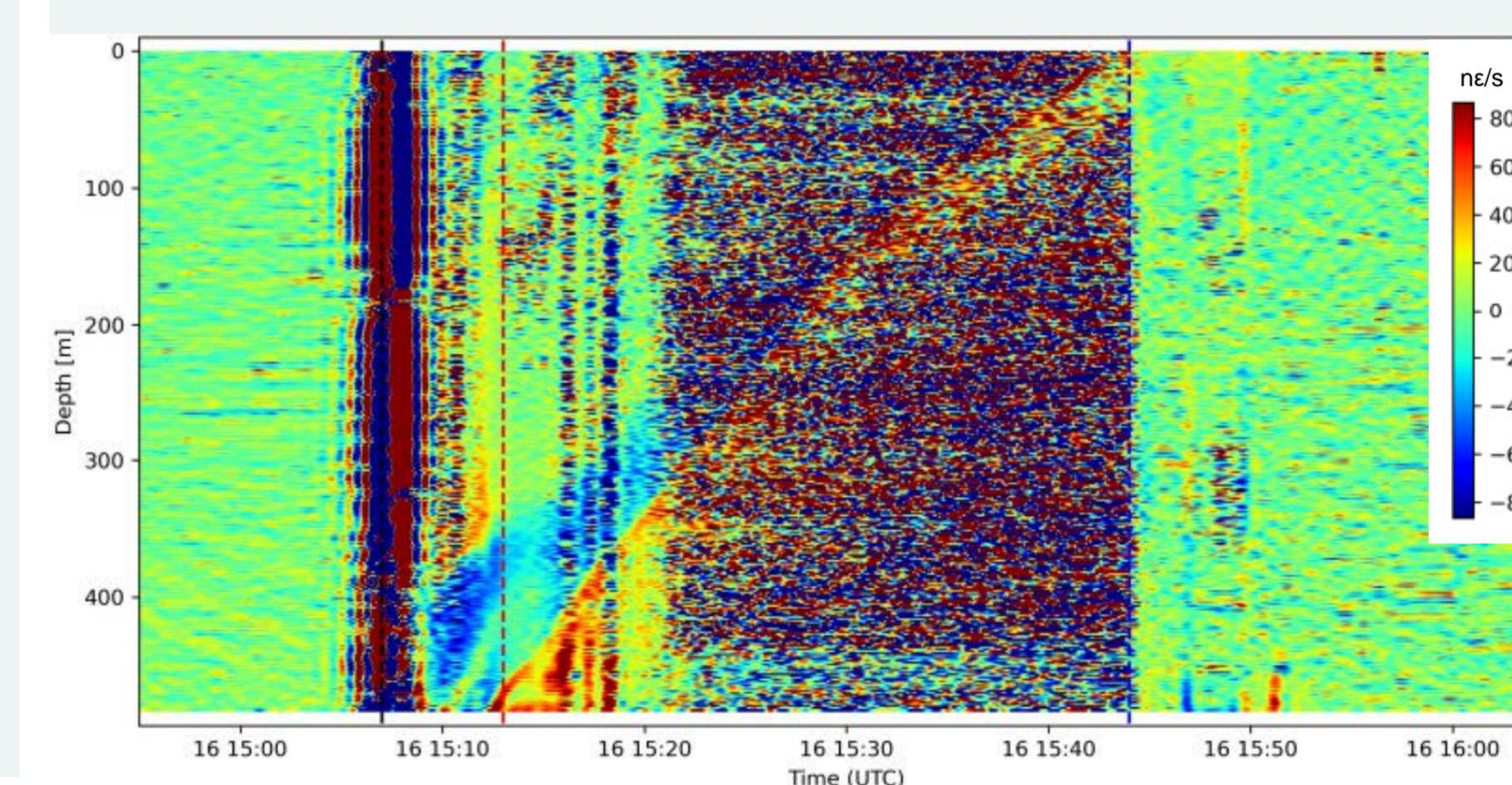
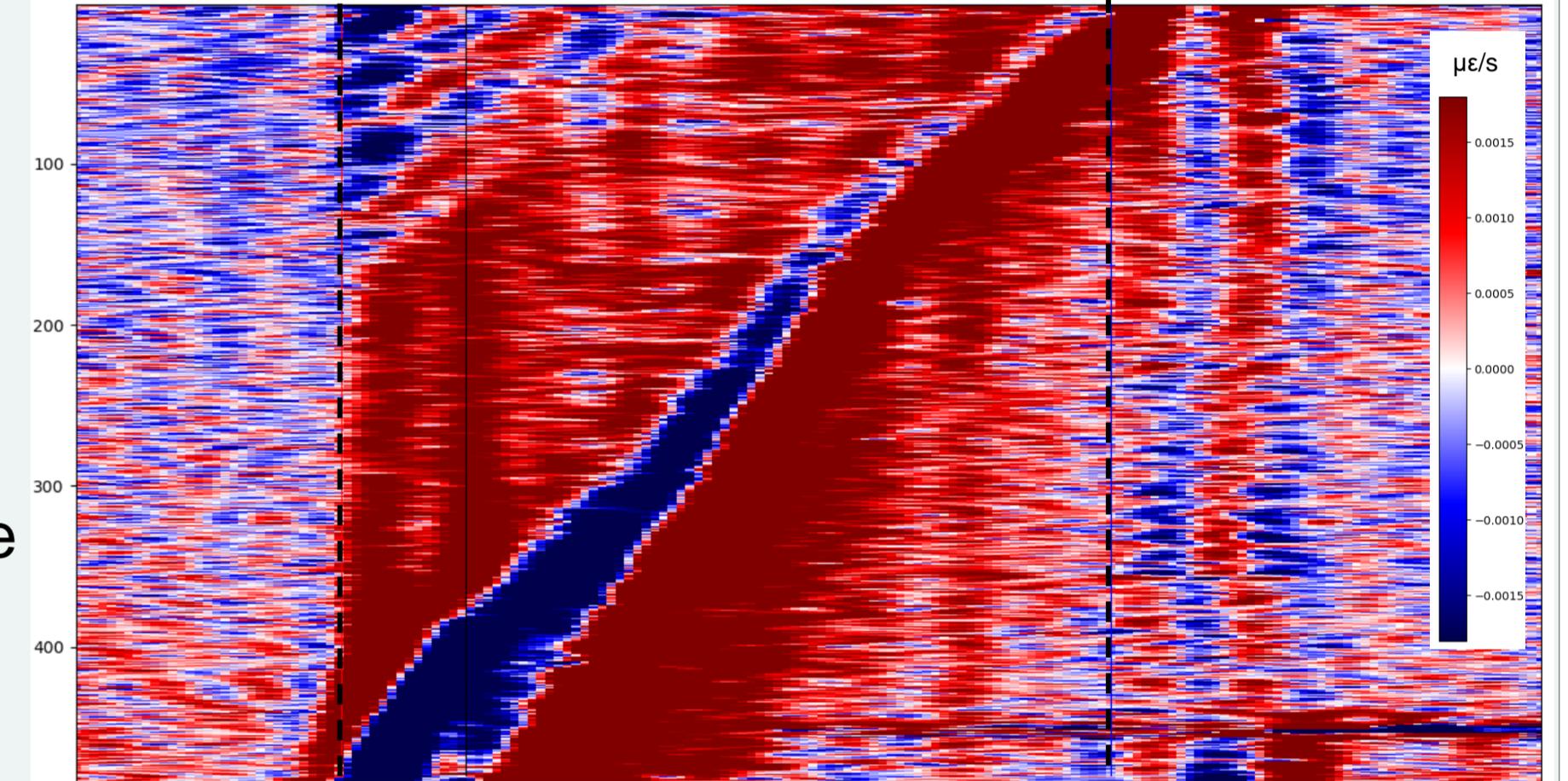


- Significant correlation during cement hydration
- Thermal response: ↑space, ↑cement, ↑strain
- Additional local mechanical response

#### Data processing and observation of cement placement

##### DTSS data:

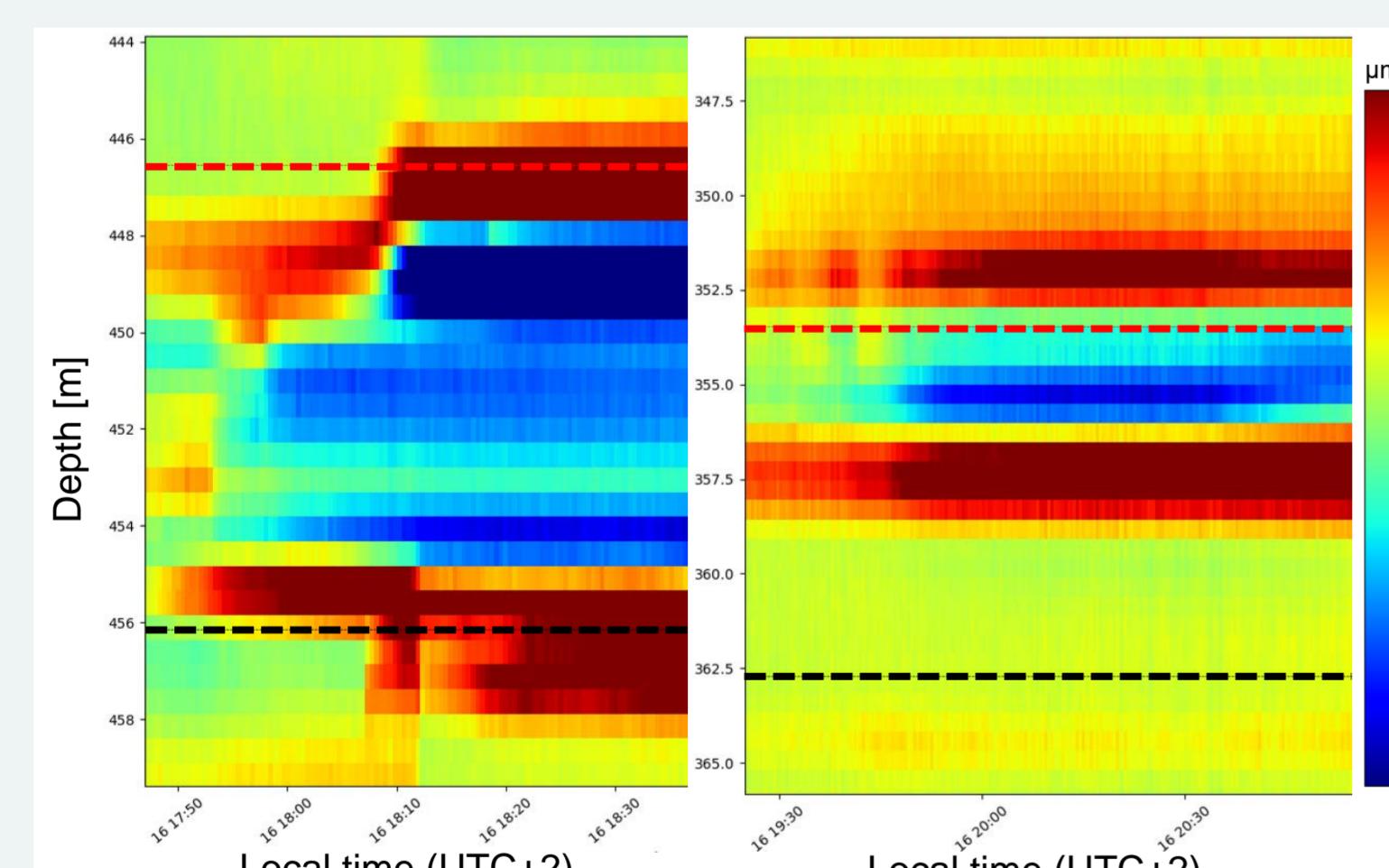
- Differentiation with time
- $d\text{DTSS}/dt$
- Lowpass filtering
- Below 0.2 Hz
- Cable compression (blue)
- Mudcake rises in borehole
- Cable extension (red)
- Higher temperature
- Cement reaches cable



##### DAS data (strain-rate)

- Lowpass filtered
- below 0.02 Hz
- Strong noise due to pumping at surface

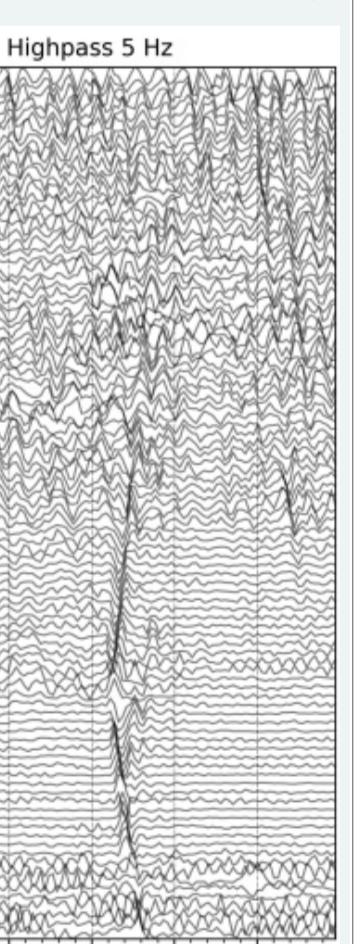
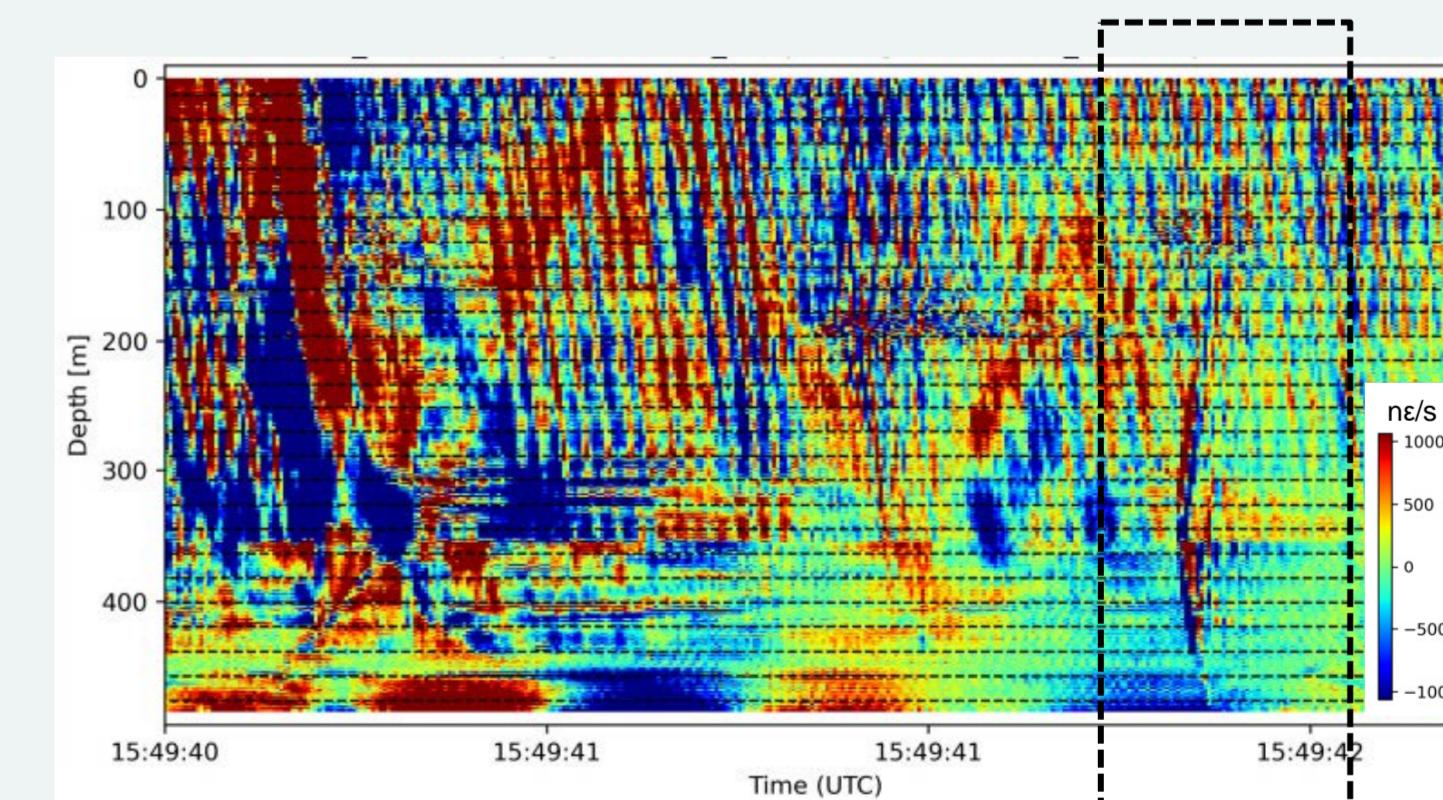
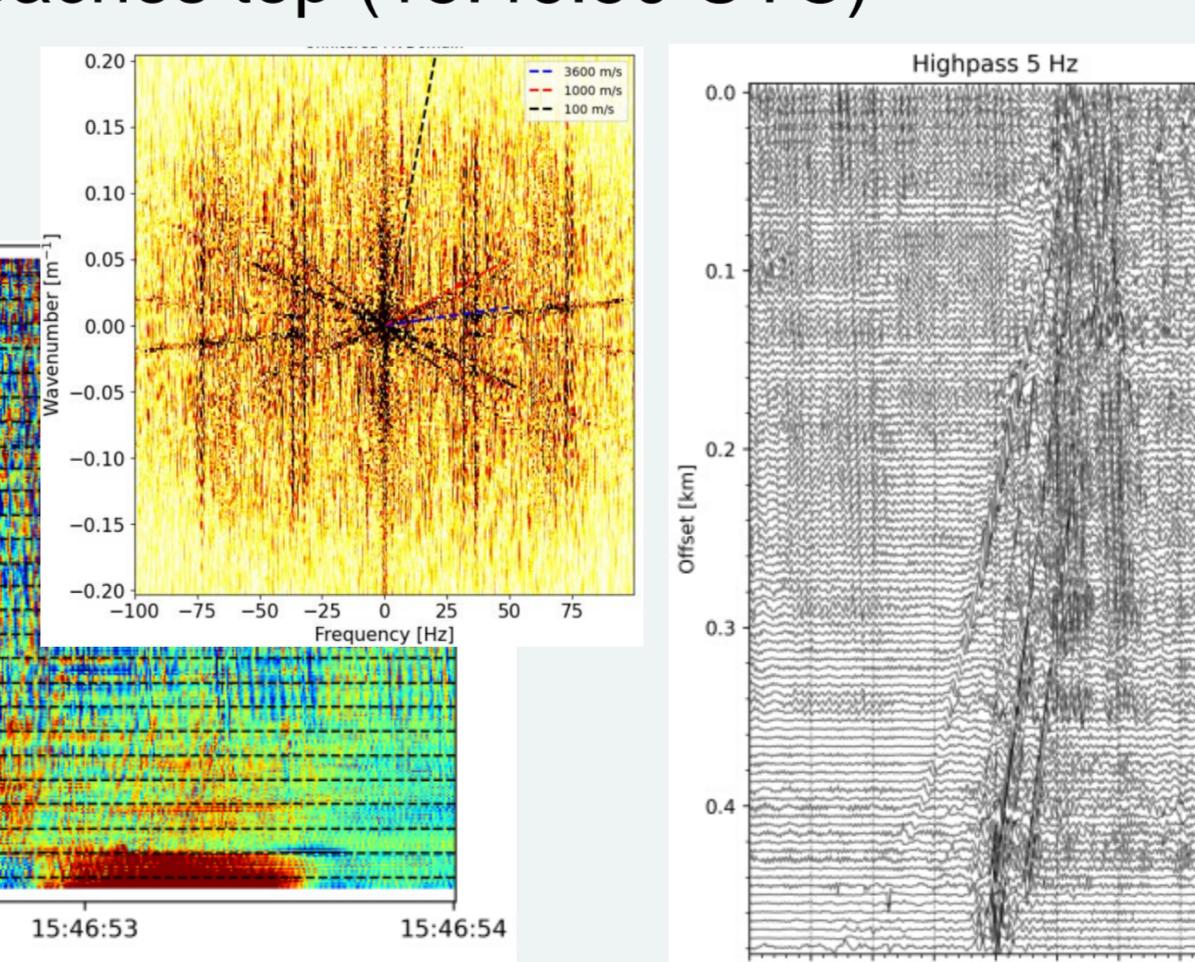
- dDTSS traces at depths with additional mechanical responses (around 450 and 355m)
- Connected to **stop colars / centralizers**



#### Cement hydration and mechanical effects on DTSS/DAS data

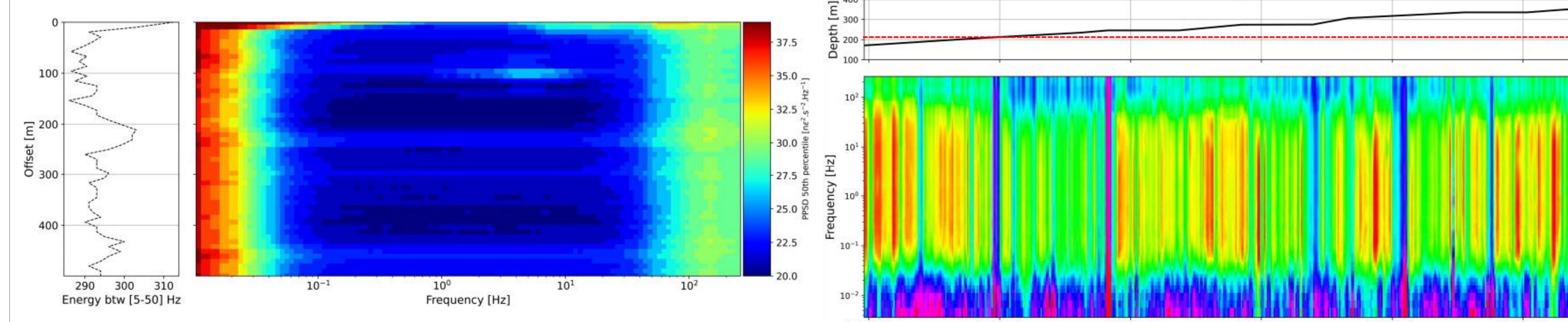
- DAS at higher frequencies, signals propagating at ~3500 m/s from bottom to top + reflection
- 170s after cement reaches top (15:46:50 UTC)

→ In connection to mechanical strain build-up (15:49:41 UTC)



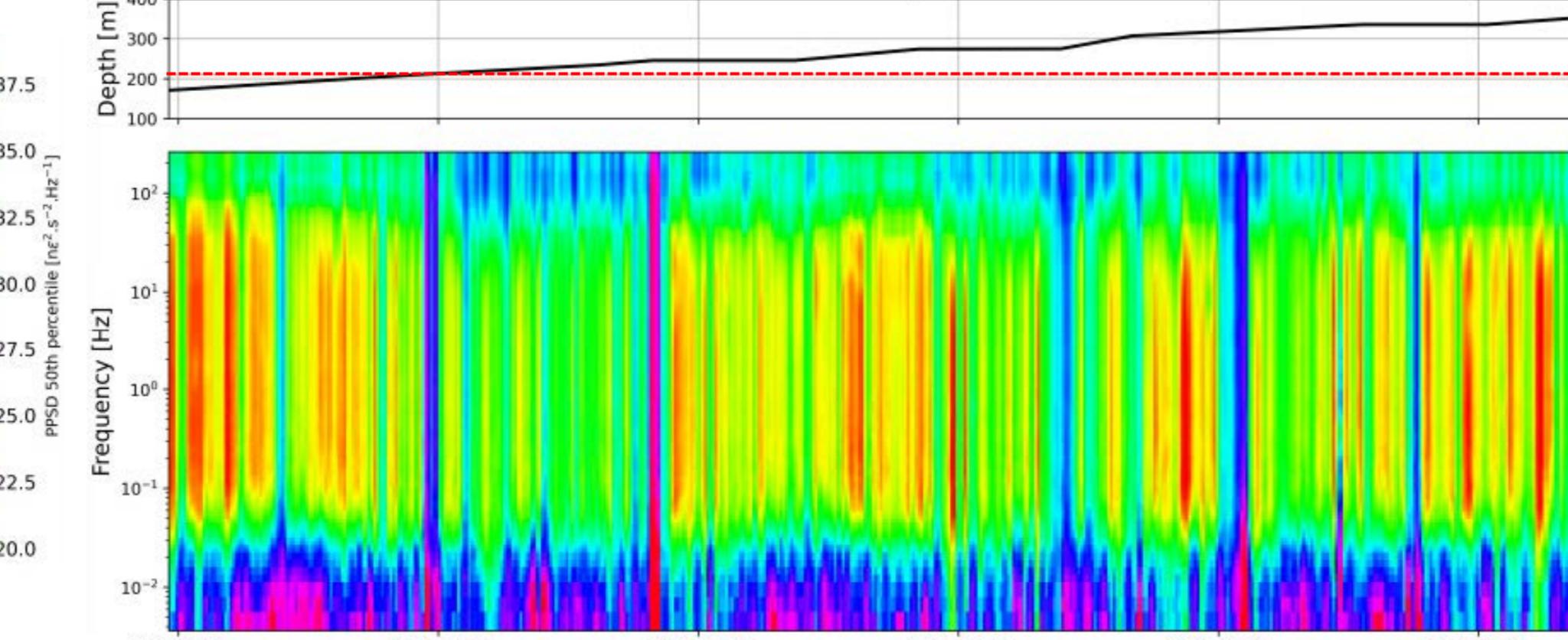
#### Monitor drilling of GeoLaB-2 with DAS, from GeoLaB-1

- Spectral content of DAS data over depth



- No clear systematic signature on strain-rate due to drilling in GeoLaB-2
- Data likely to be affected by anthropogenic surface noise affecting the IU

- Spectral content of DAS data over time, with drill-bit depth



#### Take home messages

- DTSS provides valuable insights into cementation dynamics and quality assessment.
- Lower frequency signal less evident on DAS data, while higher frequencies offer complementary information.
- Careful control of recording conditions is essential to ensure high data quality.

#### Acknowledgment

This research was supported by the GeoLaB team and the the program "MTET—Materials and Technologies for the Energy Transition" of the Helmholtz Association