

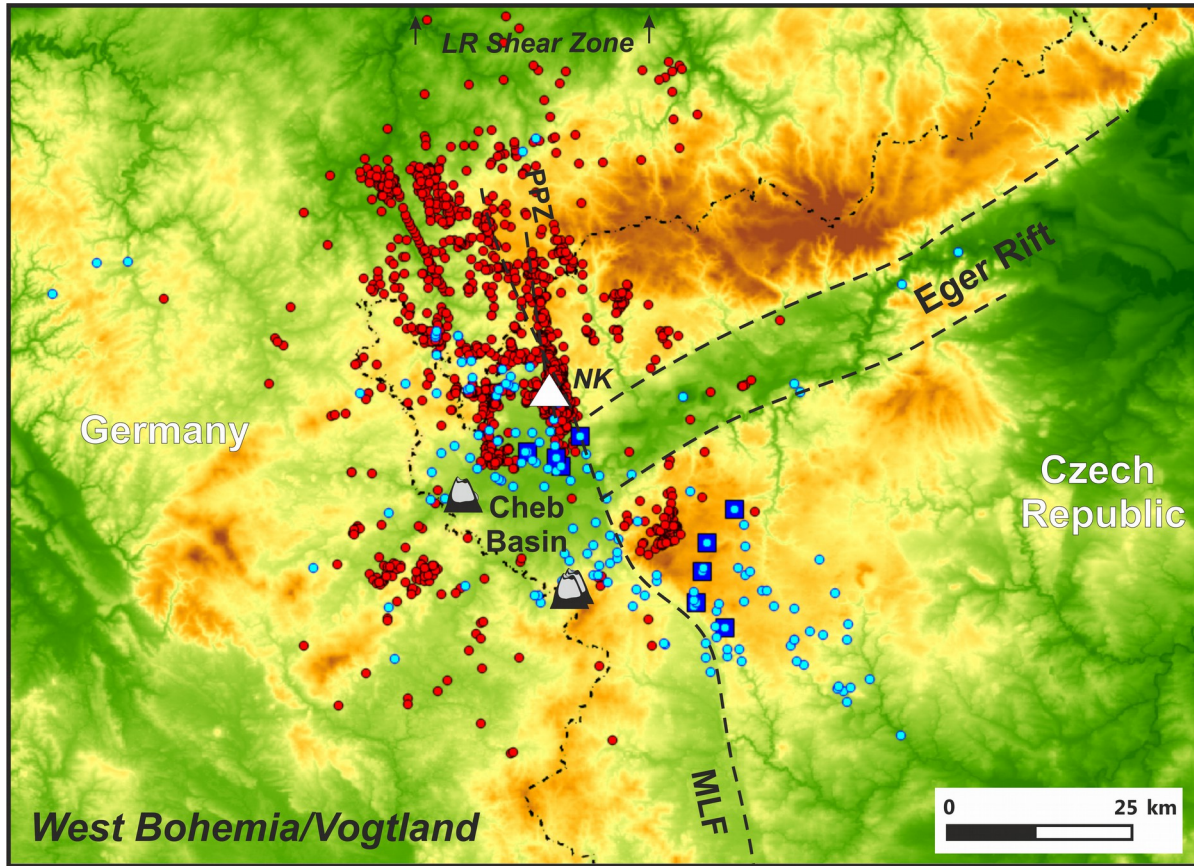
ICDP project Drilling the Eger Rift – present status and further plans

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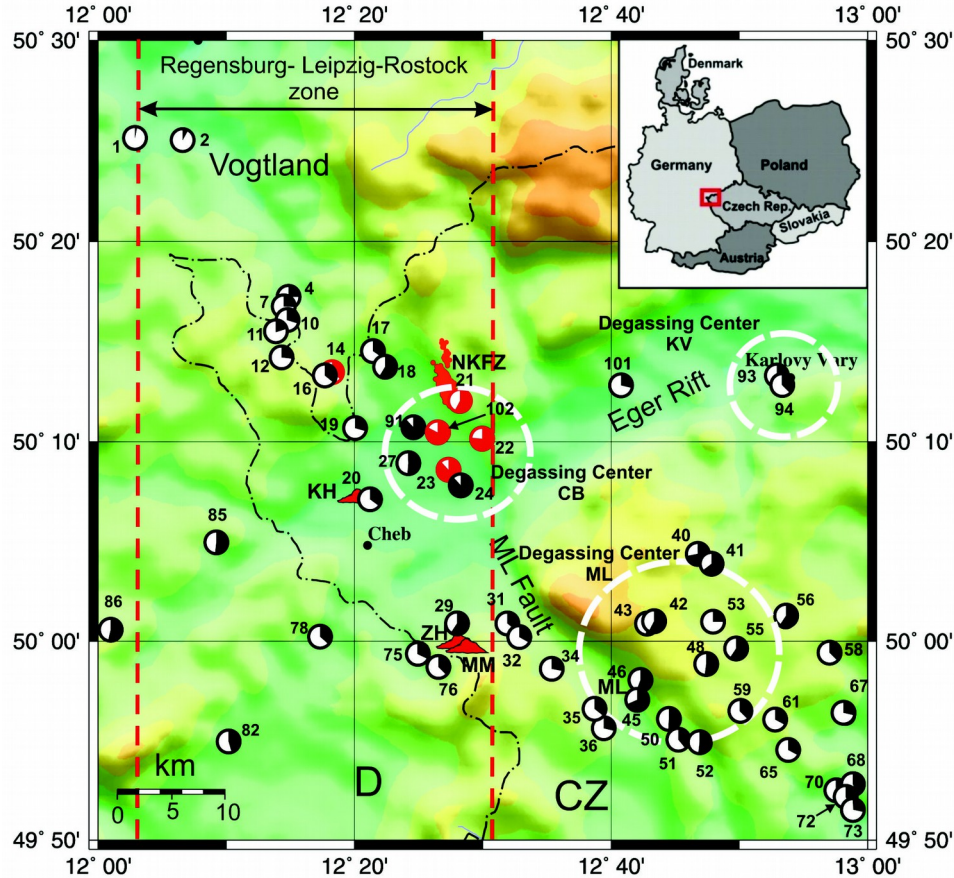


ICDP Eger in NW Bohemia/Vogtland: A unique field lab



- intra-continental rift
- Small, shallow basin at intersection with major faults (resources/hazard)
- Several quaternary volcanoes and Maars

Diffuse CO₂ degassing – evidence for magmatic processes



Bräuer et al., 2014, Weinlich et al., (1998)

¹³δC and CO₂ flux; max flux at Bublak is ≈ 28.00 l/h

(³He/⁴He = 1 Ra)

1 Ra: atmosphere

8±2 Ra: mid-ocean ridge basalt

≈5 Ra: ocean island (hot spot)

≈6 Ra: West Bohemia

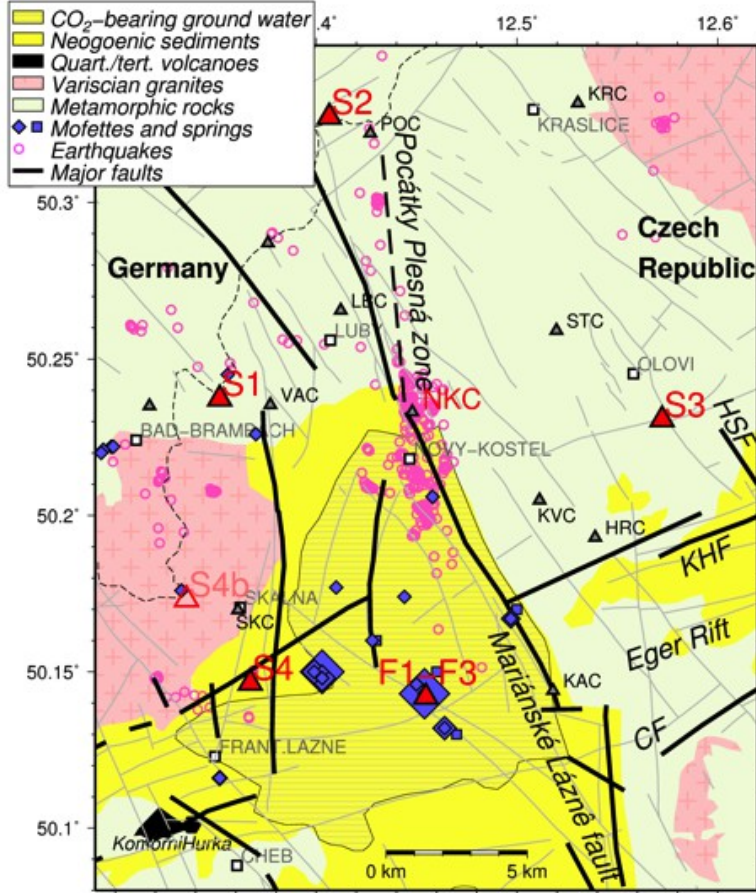
→ CO₂ originates from mantle-type magmas,
source reservoirs > 30 km depth

ICDP Eger – objectives



- Substantially increase the number of detected weak earthquakes with precise relative location and focal mechanisms in the wider region of the Cheb Basin:
- Correlate CO₂ flux and chemical fluid composition with variations of stress in the crust.
- Analyzing microbial activities at CO₂ mofettes and maar structures in context to changes of habitats
- Collecting unaltered volcanic breckzie from maar structures and paleo tracers of CO₂ flux
- Understanding the triggering mechanism of fluid-induced earthquake sequences

ICDP Eger – drilling objectives



- 4 drill sites for seismic monitoring
 - 1 collocated with Maar drilling
- 1 drill site (3 wells) for fluid monitoring
 - 2 of which used for micro-biology
- Implement 3D high frequency arrays
- Continuous hydrophysical/chemical fluid monitoring at depth

ICDP EGER: Project status



S2 Tisová

(490 m in phyllites): drilled in 2017 – donated by ore-prospection company

S3 Studenec

(400 m in phyllites): finished (October 2018)
site of STC station

Hartoušov (basin, CO₂)

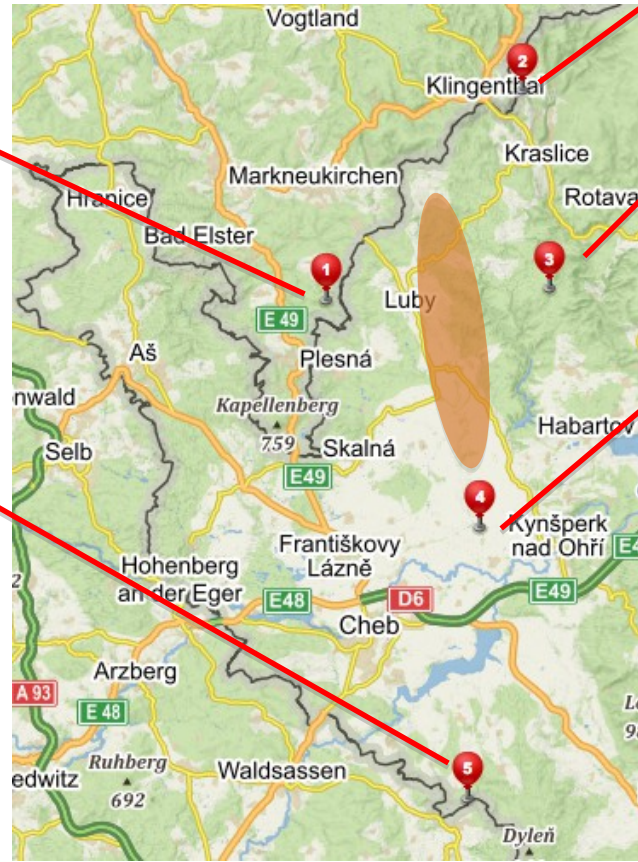
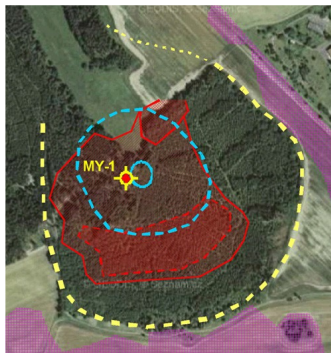
F1 (30m), F2 (108m): finished (inkind contrib.)
F3 (300-400m): preparation – drilled in 2019

S1 Rohrbach

(400m in crystalline): drilled in 2019

S4 Mýtina

(300-400m in maar): preparation, drilling planned for 2020



Planned / existing drillings and 3D-3C arrays

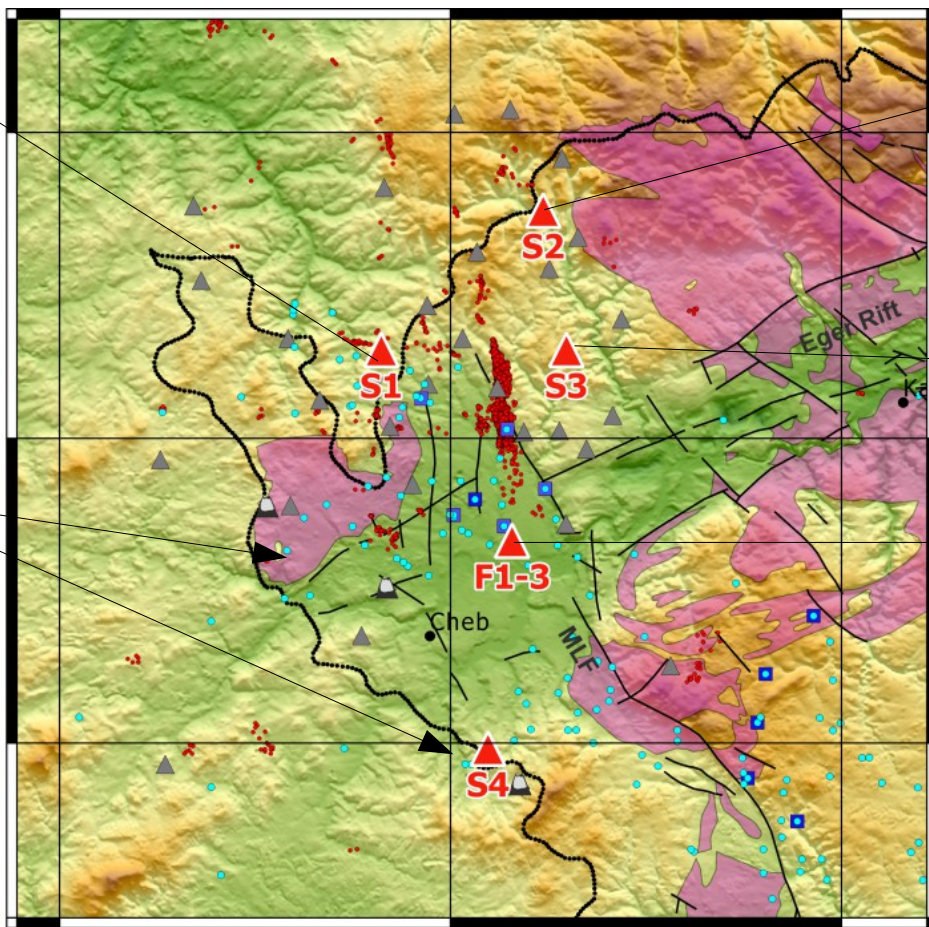
S1 Landwüst
3D-3C array
fibre-optic cable

S2 Tisová-Kraslice
borehole array / sensor

S3 Studenec
borehole array / sensor

S4 t b d f
borehole sensor

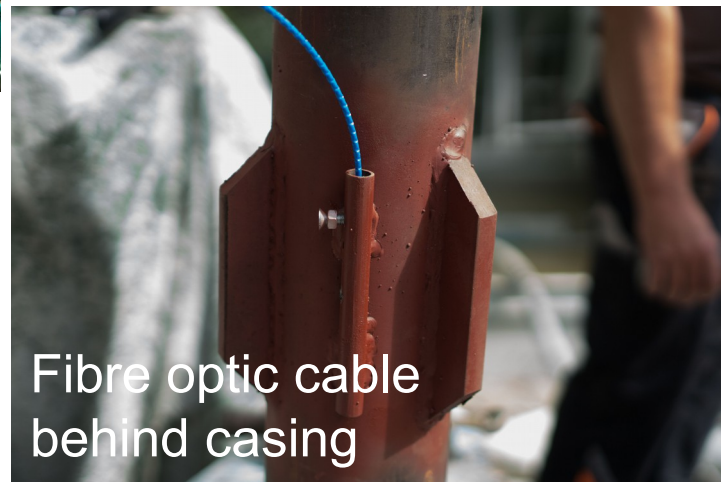
F1-3 Hartoušov
fluid monitoring
borehole sensor



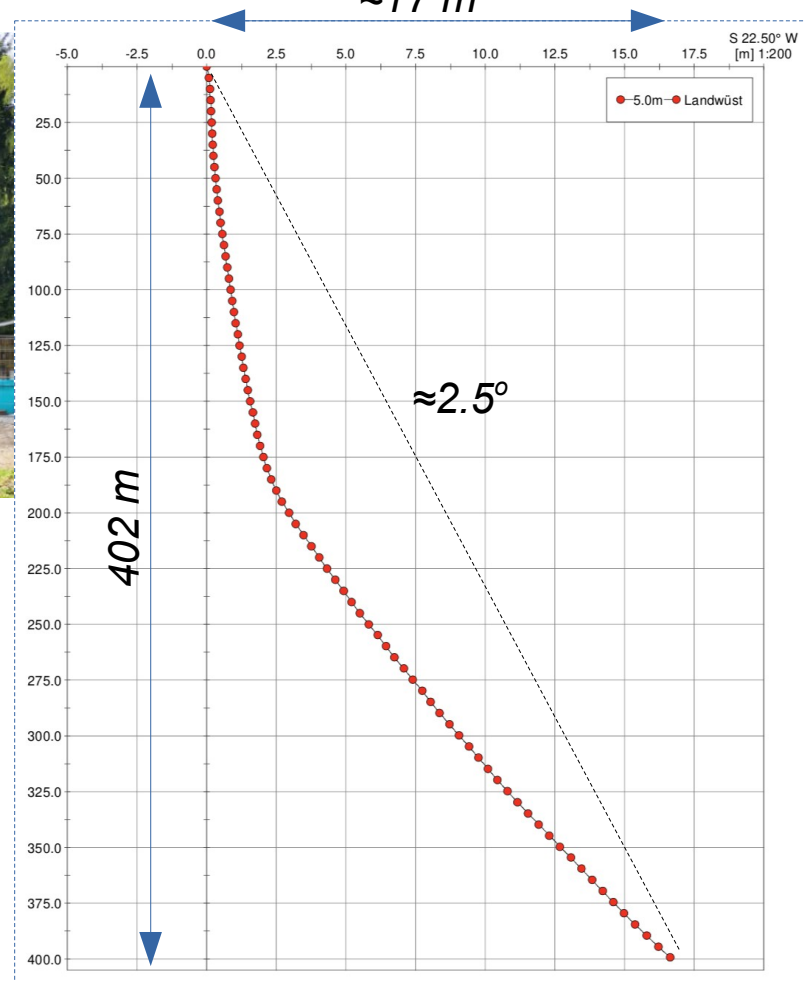
S1 drill site Landwüst - Germany



Drilling to 400 m May – August 2019



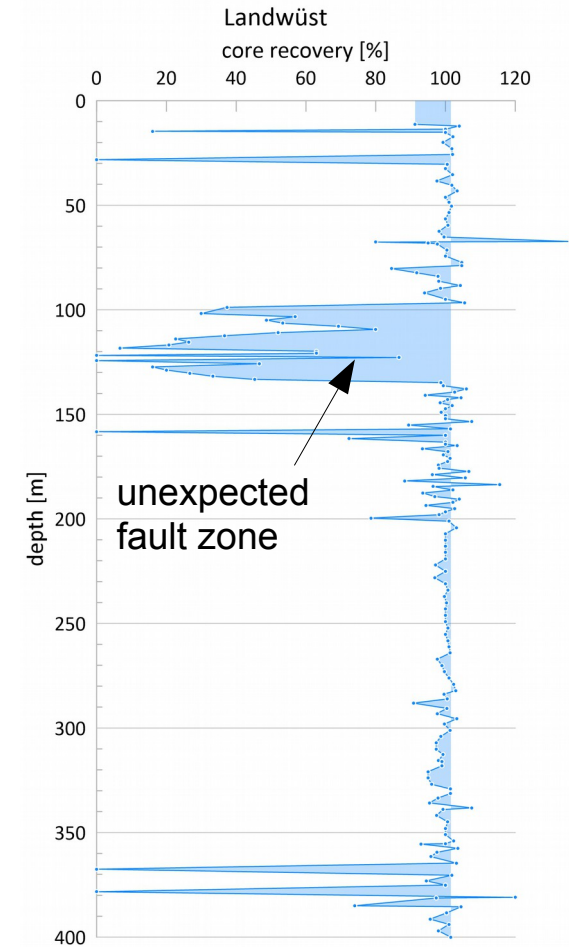
Fibre optic cable behind casing



S1 core scanning at BGR Spandau



Cores / samples available after formal applications



Seismological monitoring wells in Czechia



S2 (Tisova/Kraslice) Nov 2017



- 450 m
- 6.4°



S3 (Studeneč) December 2018



- 408 m
- 9°



Fluid monitoring & seismology boreholes in the Hartoušov CO₂ mofette

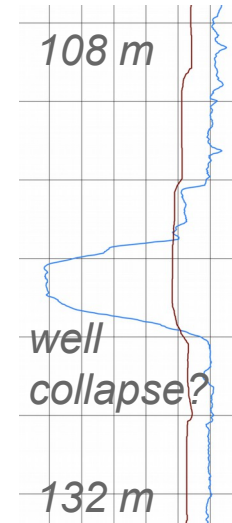


F2: 2016 & August 2019 $\approx 70\text{ m}$

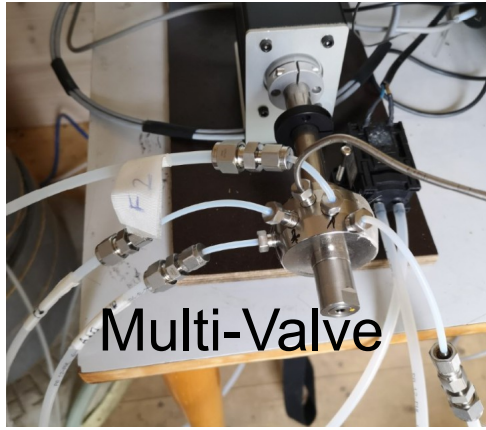


- $\Delta P_f \approx 6\text{--}36\text{ MPa}$
- toxic - CO₂
- natural reserve
- geo-bio studies

F3 Aug–Sep 2019 $\approx 239\text{ m}$



Hartoušov continuous multi-well fluid/gas monitoring

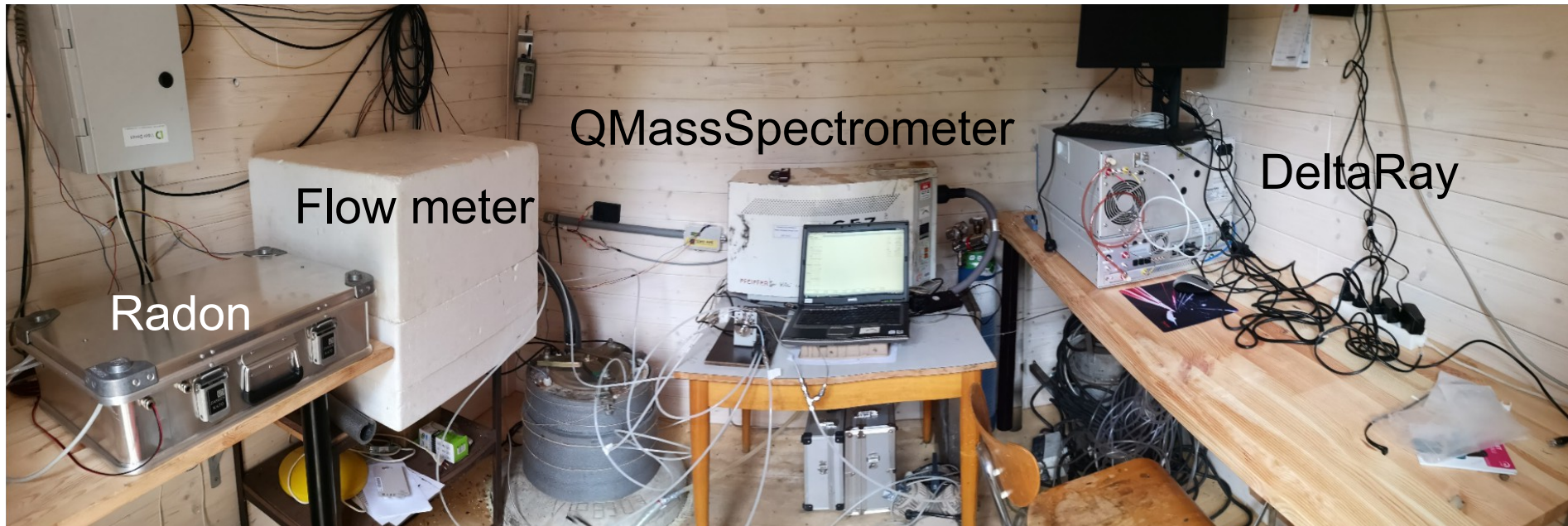


Multi-Valve

- gas multiplexer to sample 3 wells (F1-F3)
- suite of new sensors
- chemistry & isotopes



Radon



Flow meter

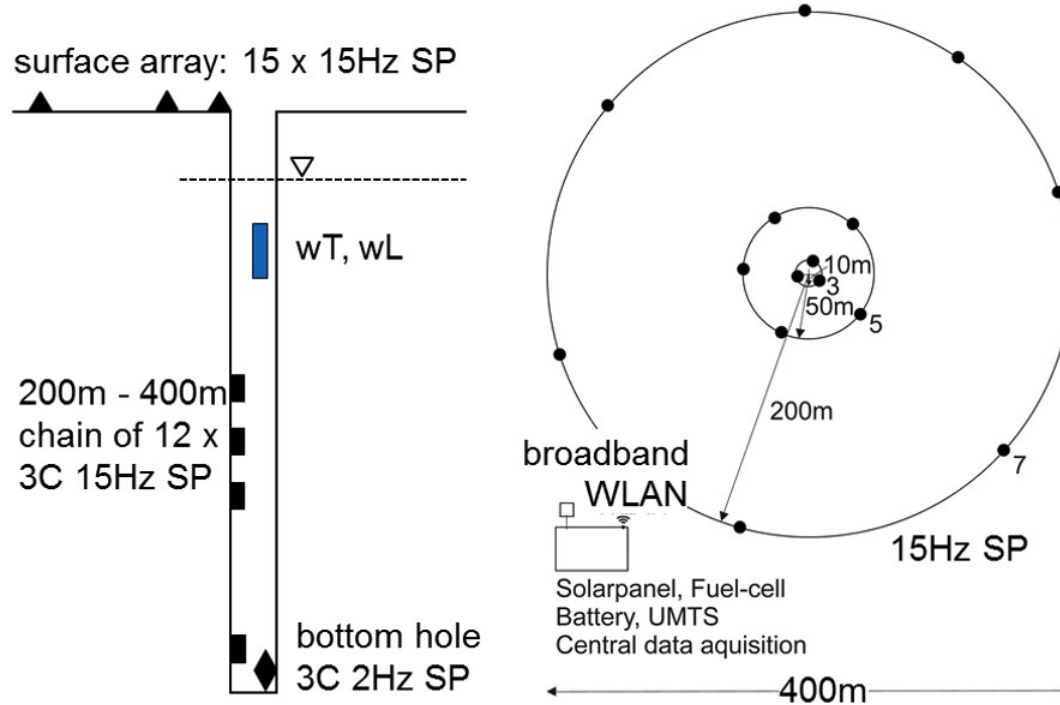
Radon

QMassSpectrometer

DeltaRay

EGER: Seismological monitoring using shallow boreholes and 3D arrays

(b) S1-S3: Seismological monitoring

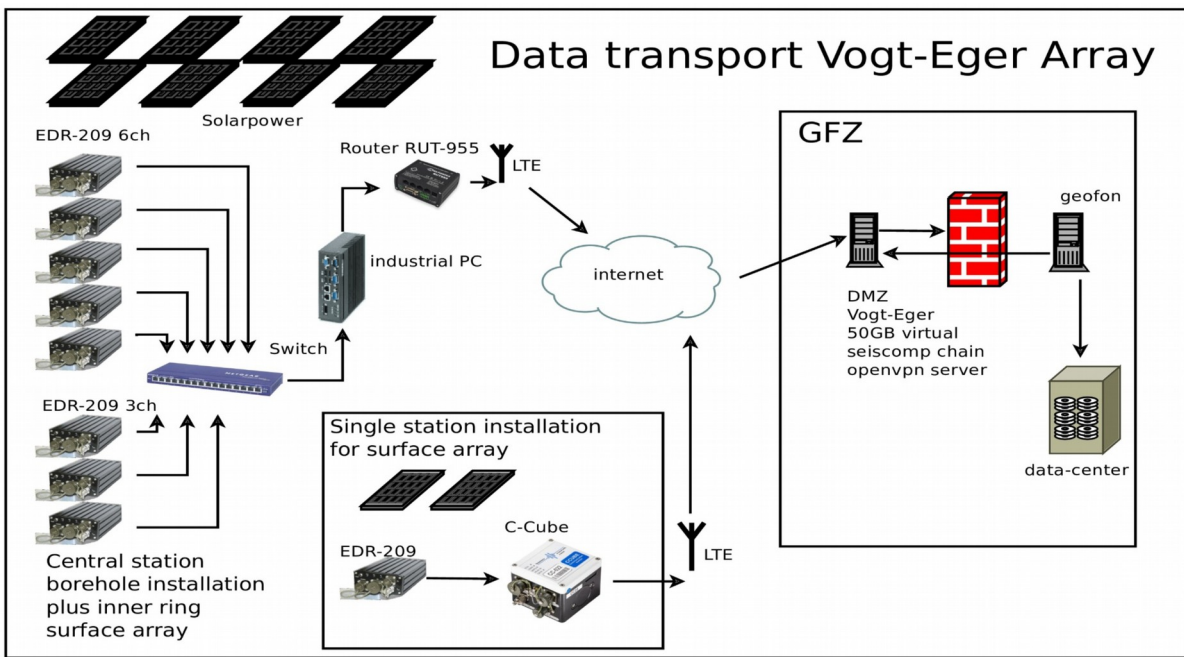


*A shallow drilling only,
but a big step in resolution*

Seismic 3D-3C array: expected rate of digital data

Normal operation: 75 channels @ 400 Hz → $75 \times 400 \times 86400 \times 2.5 = 6.5 \text{ Gbyte / day}$

During swarms: 75 channels @ 1000 Hz → **16.2 Gbyte / day**



Virtual network **"ICDPEGER"**:

- 3D-3C array data (e.g. Landwüst)
- BB sensors (bottom and top of well)
- Environmental data (P_0 , T , ...)
- Fluid-parameter (at F-wells):
 - P at different depth levels / rate
 - comp. (CO_2 , He, CH_4 , Ar, N_2 , H_2 , ...)
 - isotopes (e.g. ^{13}C , ^{18}O , CO_2)
- Stations from permanent networks ?
- Fibre optic cable (DAS) at S1 ?

Eger: Geophysical Data Availability

Process of defining MoU on (continuous) data availability and distribution is starting now

- ✓ All ICDP data be associated to virtual network (ICDPEGER) on IDA node standard
 - seismic ++
 - fluid parameter (ΔP , q , CO_2 , He, CH_4 , Ar, N_2 , H_2 , ...)
 - environmental
- ✓ Continuous data from permanent network be associated to virtual network
- ✓ Most (all) continuous data be available though GEOFON
- ✓ Data (parts of data) may be restricted for limited time period (embargo)

→ if some groups have need to receive parts of data in real time, now right time !

Geomicrobiological Analysis

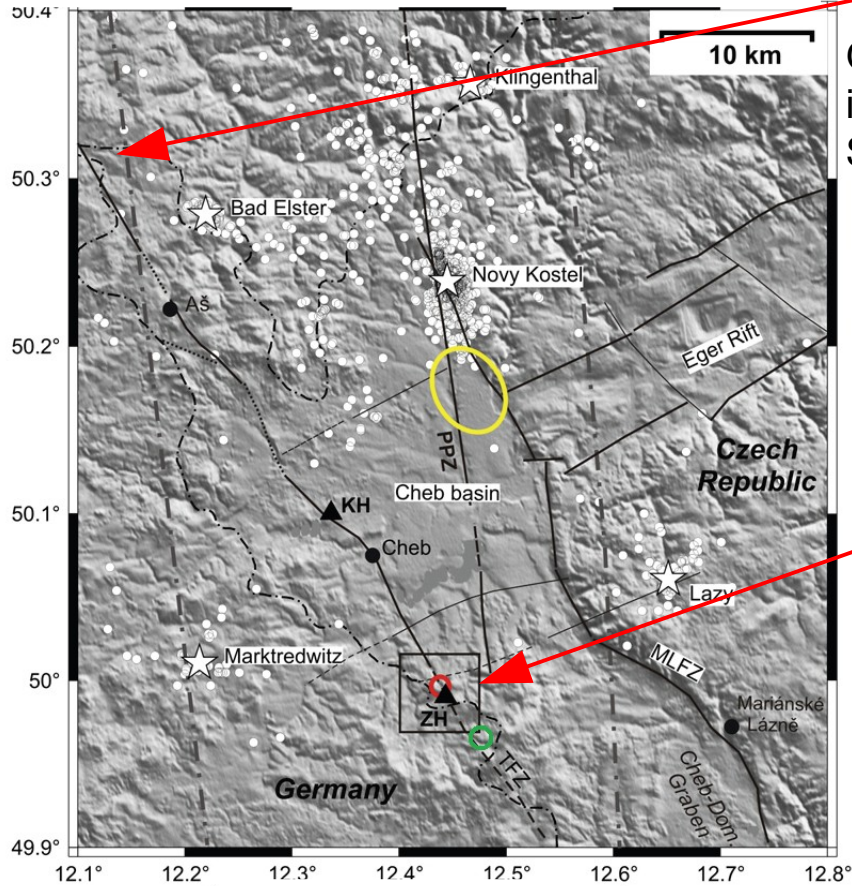
- Daniel Lipus and Jens Kallmeyer (GFZ Potsdam)
- 30 core samples processed for DNA extraction
 - *DNA extracted from 25 samples (biological duplicates need to be completed)*
 - *DNA could not yet be extracted from 5 samples*
 - *DNA recovery: 0.01 – 0.7 ng/μl*
- Microbial abundance data for 20 samples
 - *Range: 10^3 – 10^7 16S rRNA gene copies per gram*
 - *Matches 2016 data in upper core segment*
- 16S rRNA amplicon libraries for 15 samples
 - *Allows taxonomic classification*
 - *Expected to be completed by April for all samples*
- Metagenome libraries for 2 samples (Goal: 5 by April)
 - *Needed for functional annotation*



EGER: Quaternary volcanism more active than thought

Komorní Hurka (Kammerbühl)

Železná Hurka (Eisenbühl)

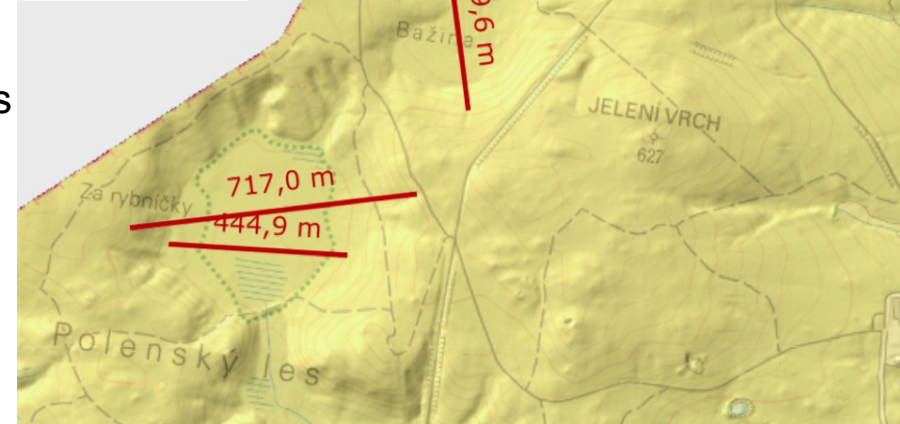


Mrlina et al. (2011)

One of these maars is the target of the S4 borehole

- Aims:
- paleoclimatic record
 - sampling volcanic breccia
 - sampling the interface between the bedded breccia and country rock
 - installing downhole seismometer

Liba Maar



Mytina Maar, Neualbenreuth Maar



Summary

- Western Eger Rift: persistent occurrence of earthquake swarms and CO₂ discharge, quaternary volcanism
=> unique natural laboratory for studying the interactions between deep CO₂, tectonics and deep microbial life
- Surface observations approached their edge
=> observatory in depth
- Network of five ~400 m boreholes with seismographs and fluid sensors to increase the sensitivity and suppress the atmospheric influence
- Three seismic boreholes S1-S3 and fluid borehole F3, drilling of the paleoclimatic+volcanologic+seismic borehole S4 planned for 2020