

Laboratory-scale hydraulic fracturing experiments for verification of EGS design tools

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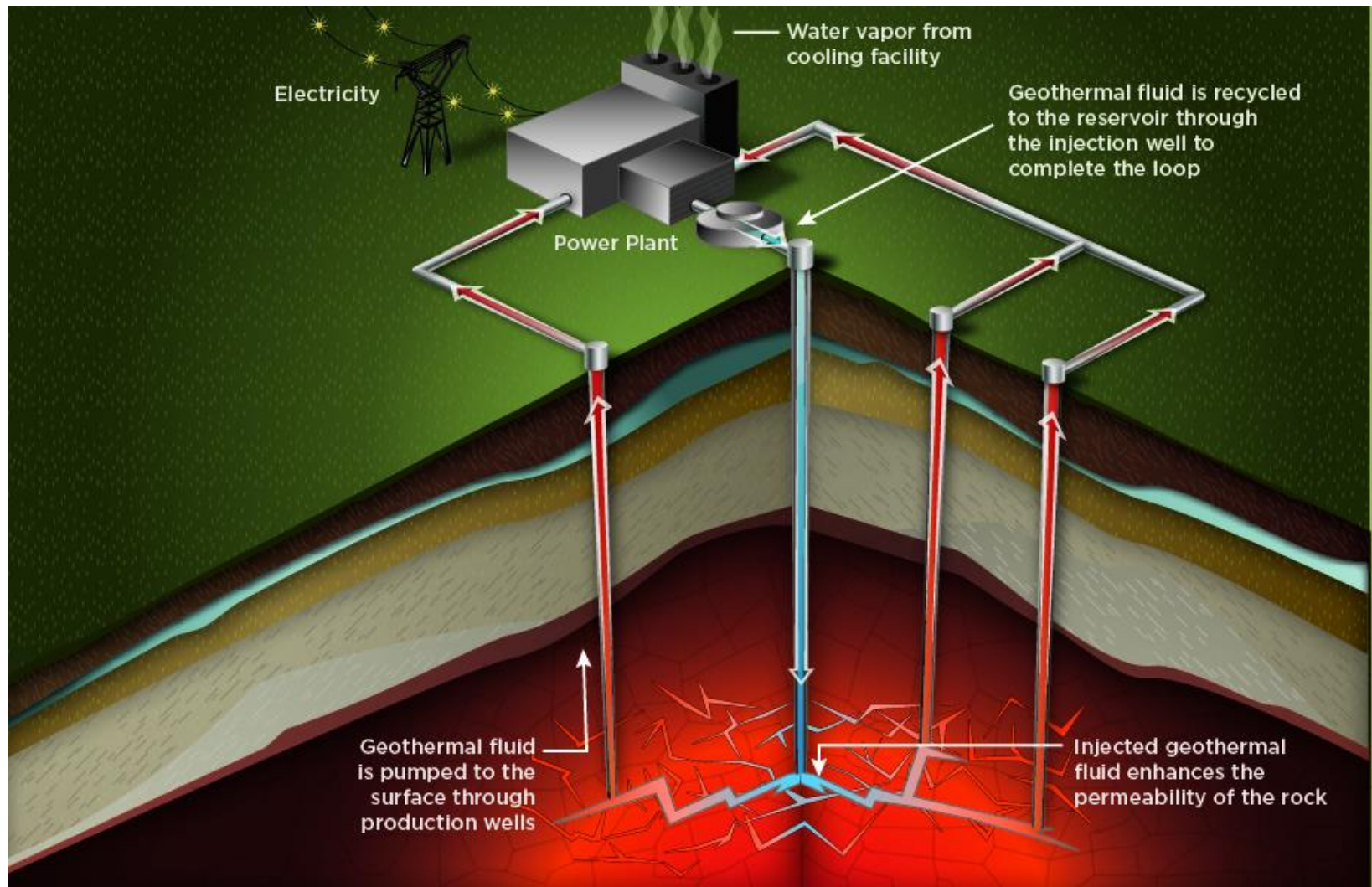


- Introduction
- Objective
- Experimental setup
- Experimental protocol
- Results



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 727550

Introduction – Enhanced/ Engineered Geothermal Systems



Source: <http://energyinformative.org/>

How accurately the numerical simulators are able to represent the complex coupled processes of fracture growth, propagation and interaction?

Aim: Generate benchmark hydraulic fracturing datasets against which numerical codes for hydraulic stimulation design tools can be validated

Development of a triaxial setup for performing laboratory-scale experiments

Project – HDR 1
(BMWi)

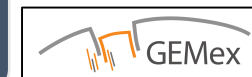


Federal Ministry
for Economic Affairs
and Energy

Generate hydraulic fracturing datasets
under controlled conditions in
laboratory-scale



Verification of numerical codes using
the **laboratory-scale** data set



and beyond..

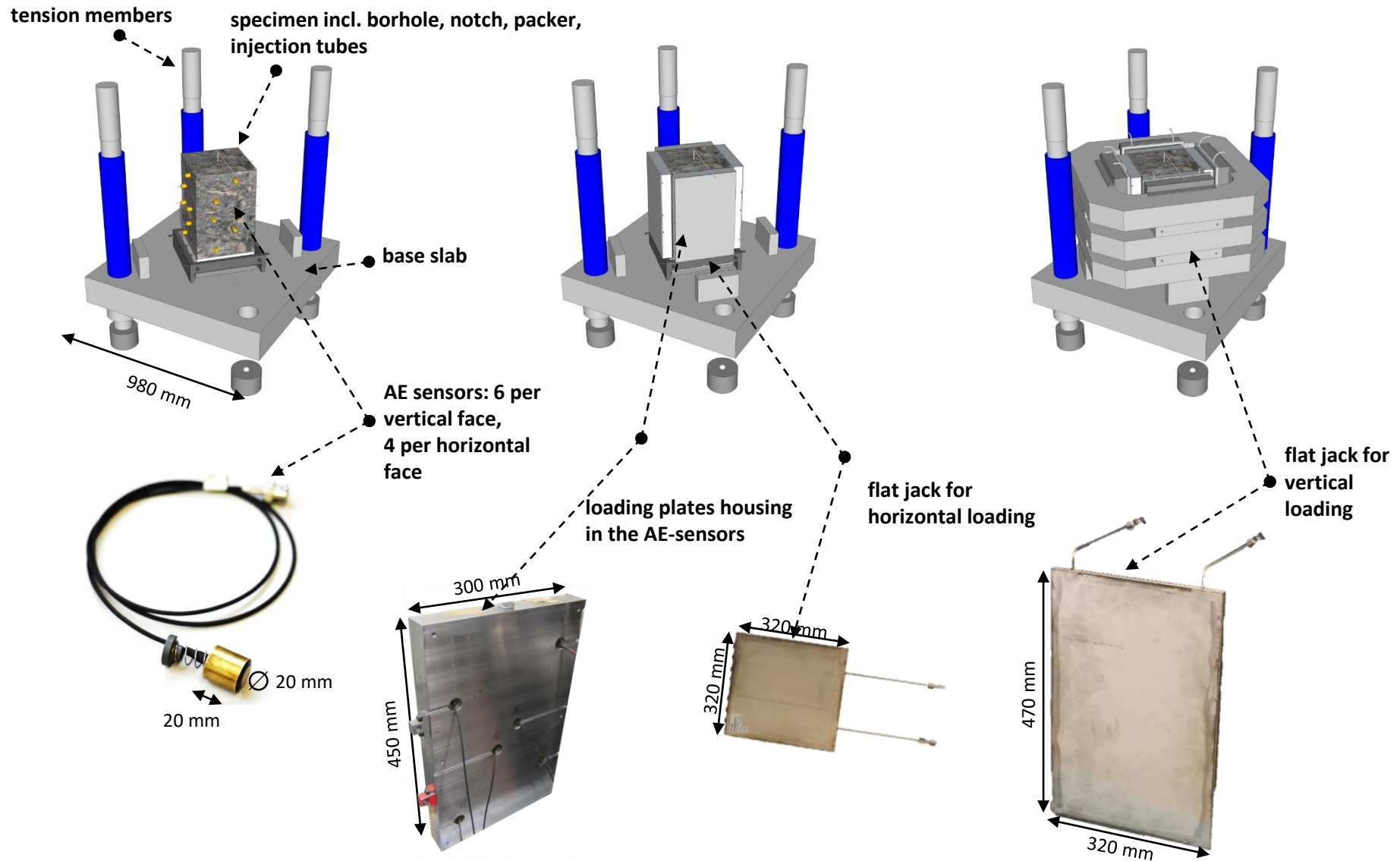


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Hydraulic Fracturing Experimental setup



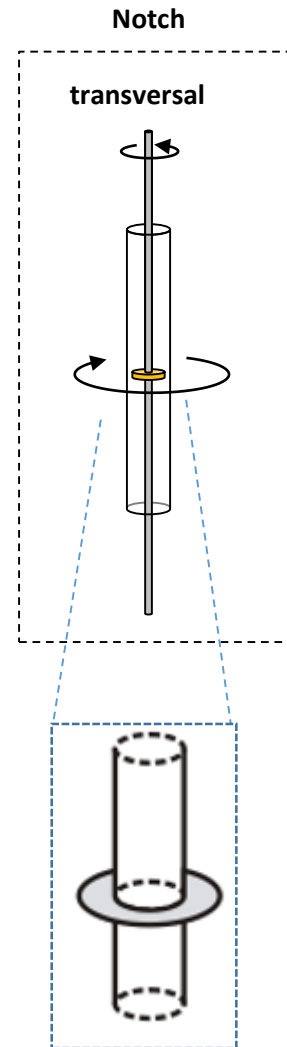
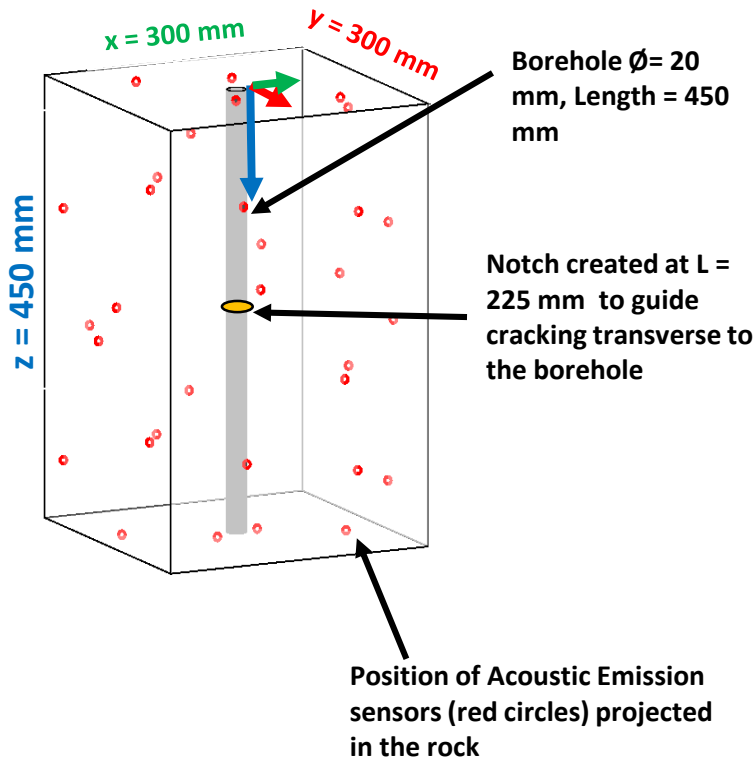
Hydraulic Fracturing Experimental setup

Confining Pressure

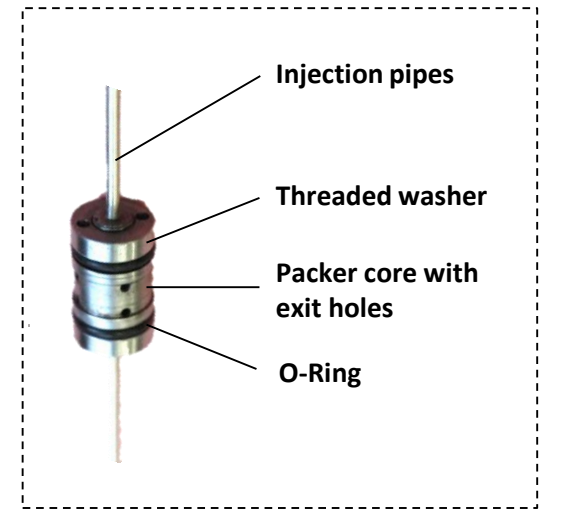
$\sigma_z = 5 \text{ Mpa}$

$\sigma_x = 15 \text{ MPa}$

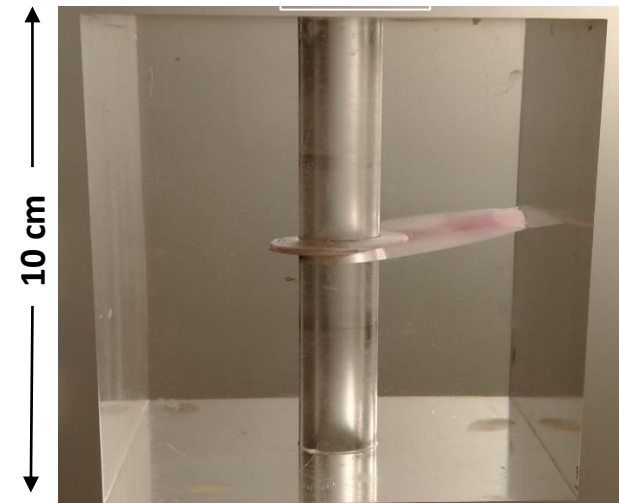
$\sigma_y = 15 \text{ MPa}$



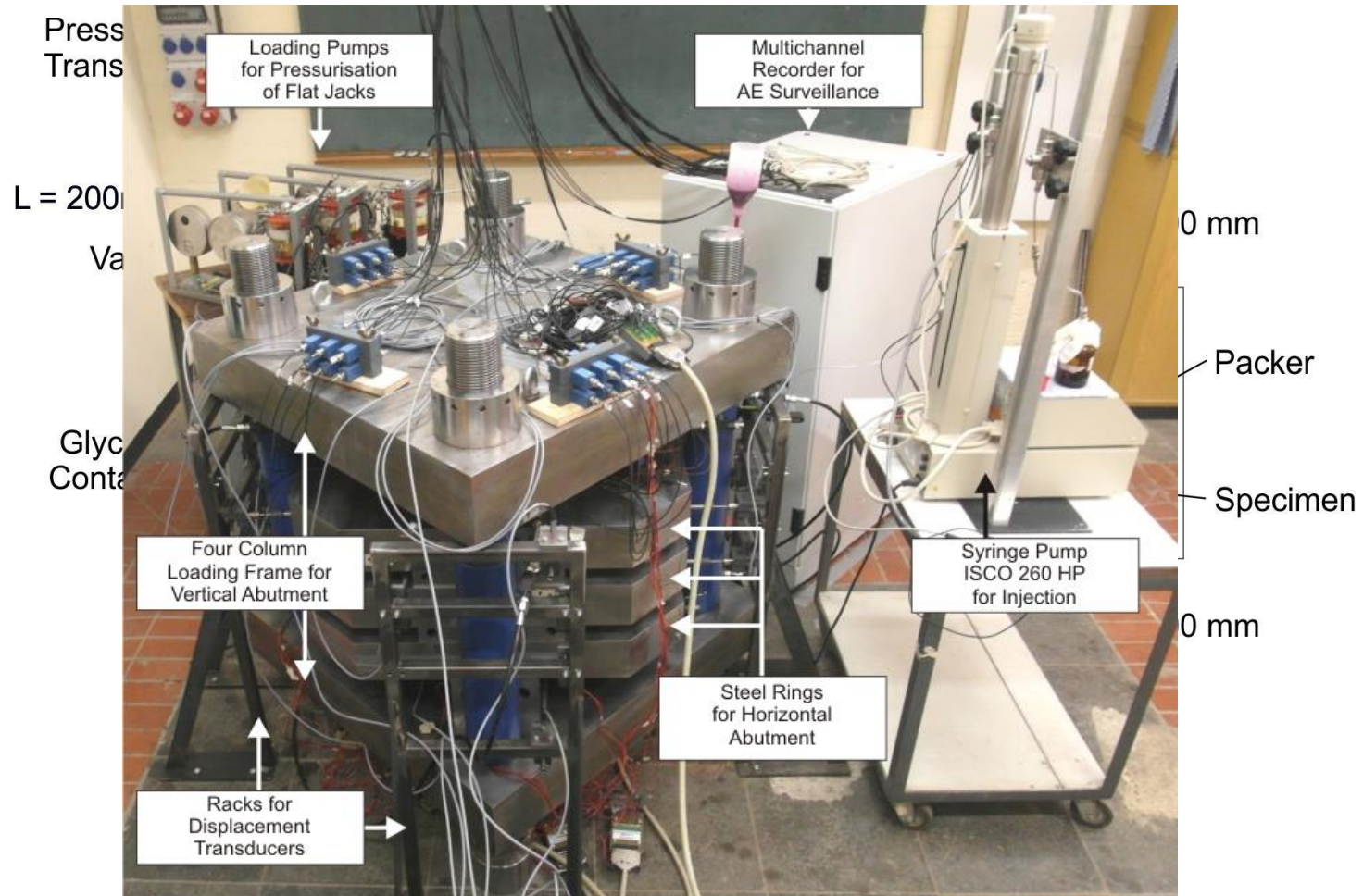
Packer



10 cm



Hydraulic Fracturing Experimental setup



Samples



Type	Granite
Location Type	River Bed
Date	21.03.2017
Location	Las Minas
Country	Mexico
State	Veracruz
Coordinates	694726, 2179109



Type	Marble
Location Type	Quarry,
Date	21.03.2017
Location	Pueblo Nuevo
Country	Mexico
State	Veracruz
Coordinates	693048, 2180273

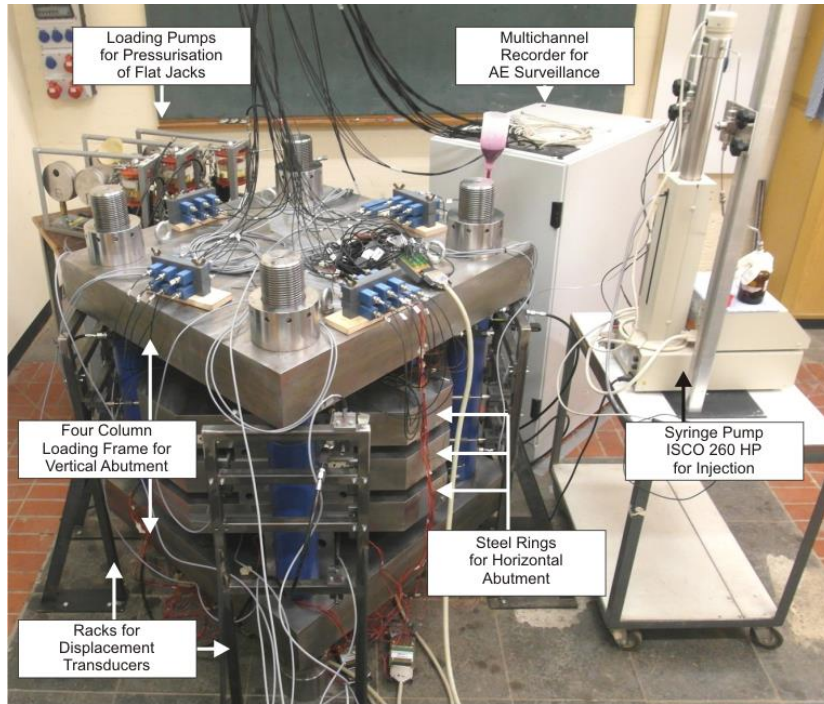
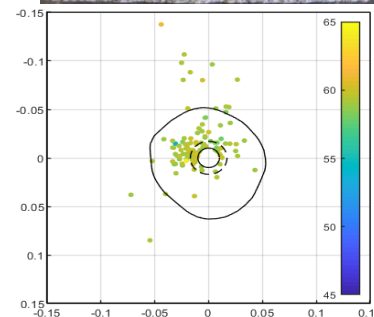
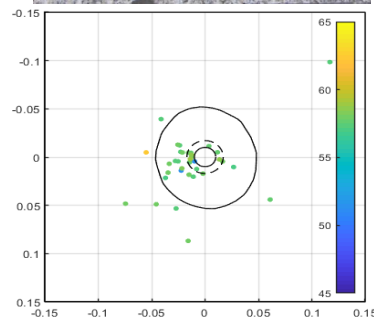
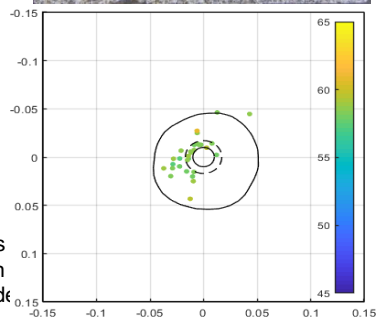
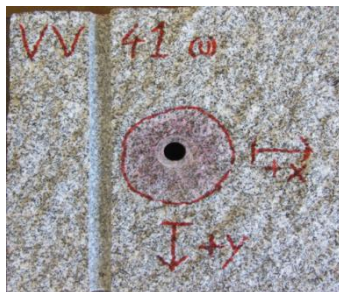
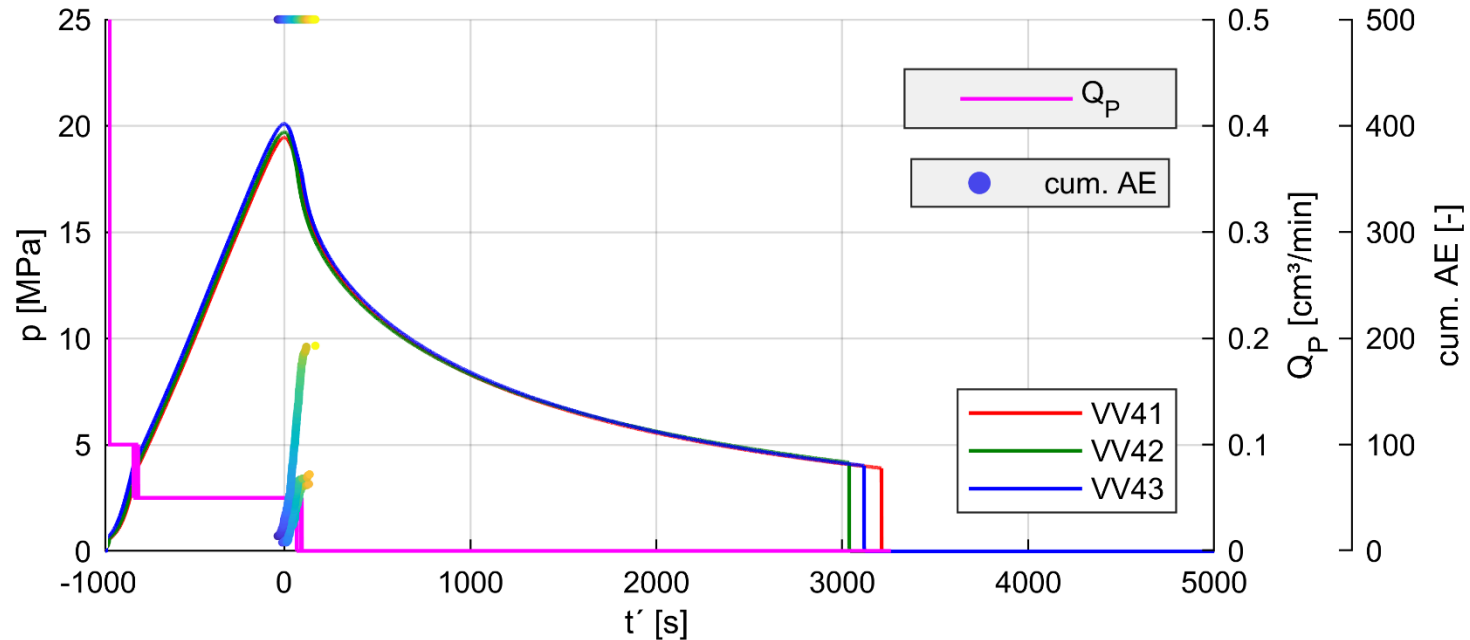


Photo of the actual set up

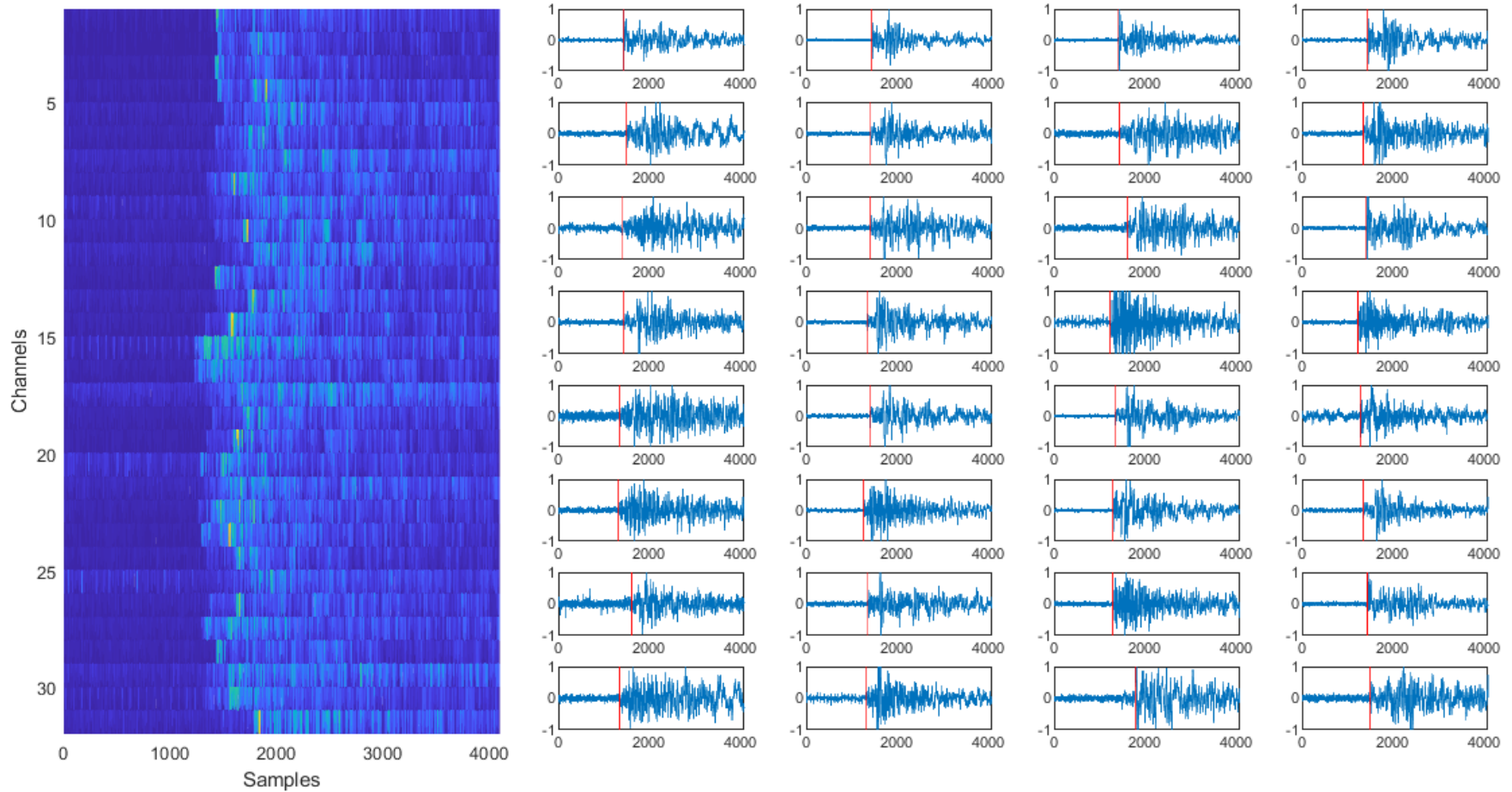
1. Apply confining stresses σ_x , σ_y and σ_z .
2. Leakage tests are performed to ensure that the system is tight.
3. High pressure fluid is then injected into the system to initiate fracture.
4. Acoustic emission events are measured using 32 sensors to monitor fracture propagation

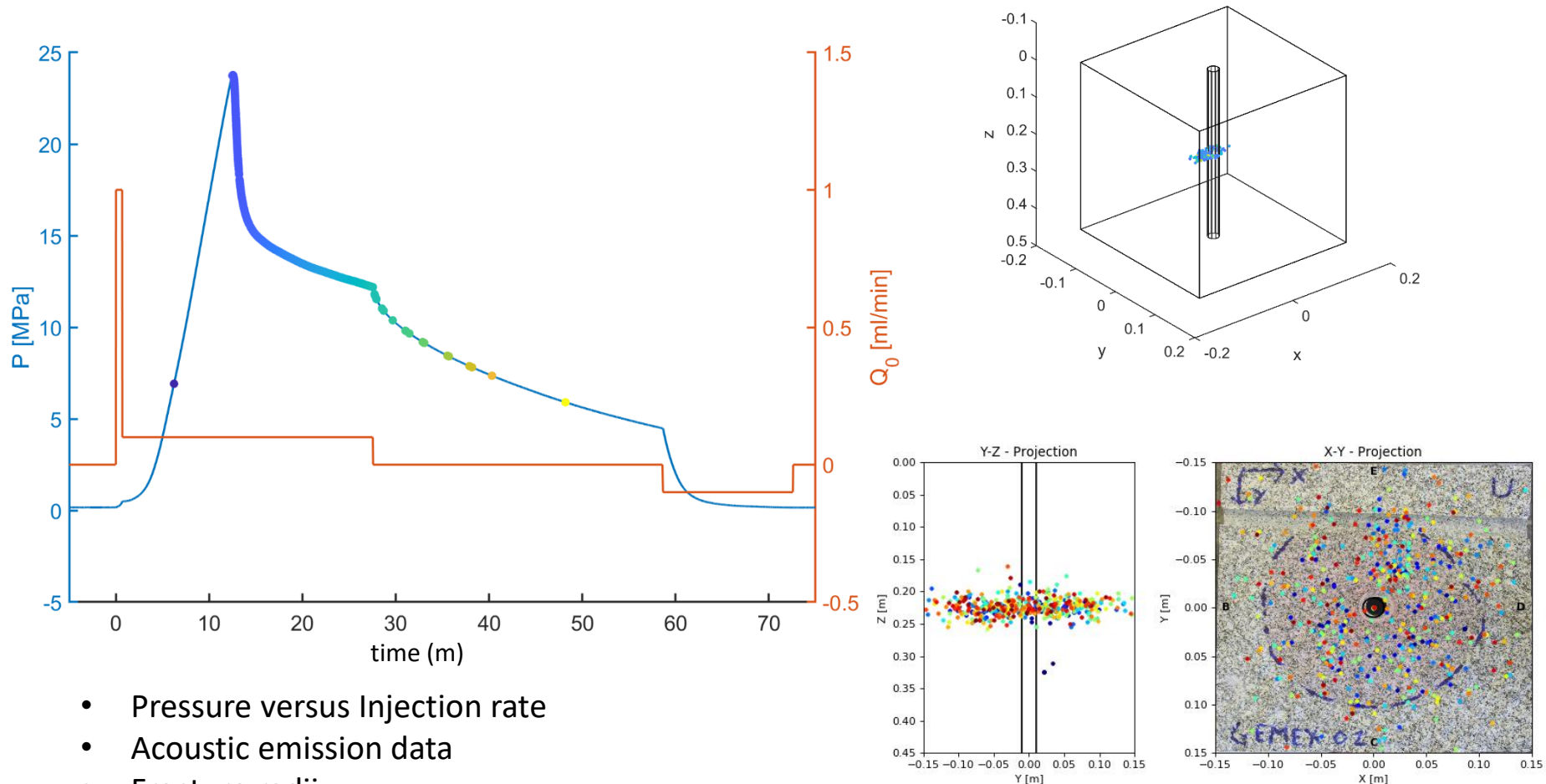
Experimental results



Example of an Acoustic Emission event recorded by 32 sensors

GMuG Data Acquisition System with 32 acoustic sensors





- Pressure versus Injection rate
- Acoustic emission data
- Fracture radii
- Properties of rocks and fluids
- Boundary conditions

GEMEX Partners

- GFZ
 - **Fracod2D V5**
 - Particle Flow Code (**PFC2D**)
- UFZ
 - **OpenGeoSys**
- TNO
 - **MFRAC**

External Partners

- ETH Zurich
 - **GEOS**
- CSIRO Australia
 - Complex Systems Modeling Platform (**CSMP**)

GEMex DELIVERABLE 6.5



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