Hontomín, Spain. Prepared for regular injection

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Hontomín TDP

Storage main goals

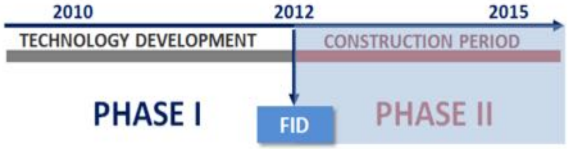
- ➢ Refine CO_2 storage technologies in **"on-shore" deep saline aquifer** conditions (fractured carbonates)
- ➢ Identification of **cost reduction** action for the whole of the process
- ➢ Potential **risk assesment** and corrective measures proposal
- ➢ Support for developing **alternative geophysical technologies** to characterize the seal-reservoir complex
- ➢ Tools development for **dynamic modelling** (hydraulic, hydrodinamic and chemical scope)

Project OXYCFB 300 "Compostilla"

European Energy Programme for Recovery

Objectives Phase I

Technology development for CO_2 oxy capture, inland transport and storage in saline aquifers supporting a future demo 300 MW CCS oxyCFB Power Station



- CIUDEN´s Tasks:

3 TDP for:

- Capture at 1:30 scale - Oxycombustion
- Transport - Closed-loop test rig 3 km long
- Storage - Saline aquifer for advanced injection & monitoring

Hontomín TDP

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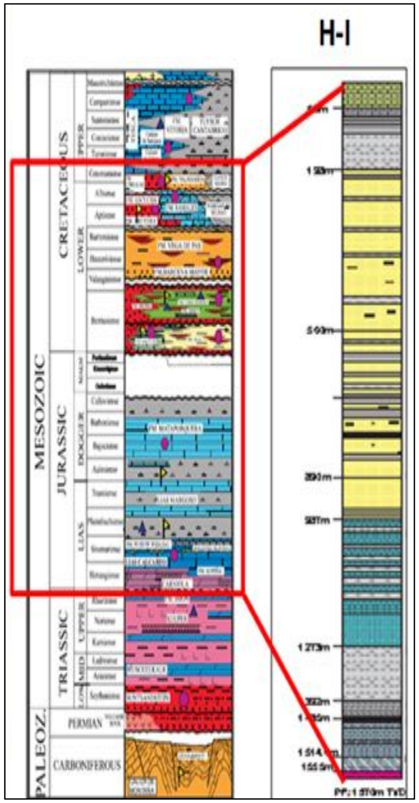
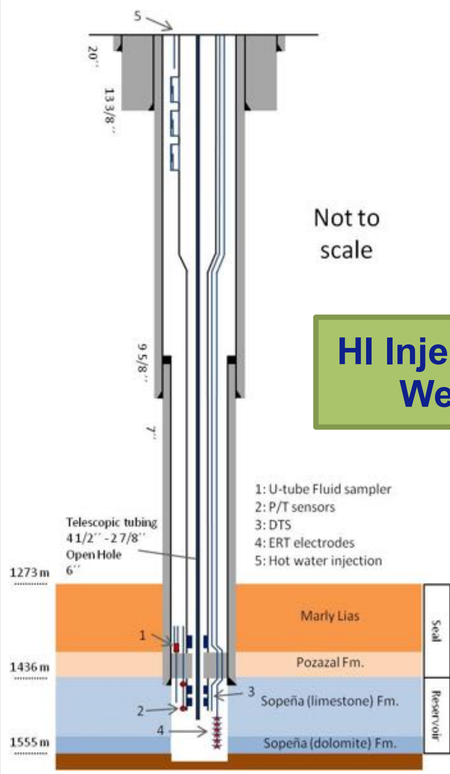
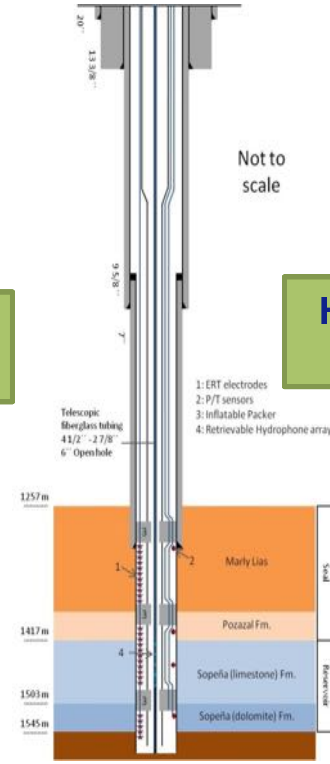




HI Injection Well



HA Observation Well

GeoNet

Site geophysical characterization

Activities and Monitoring	Activity classification	Information Obtained
Review existing 2D seismic and well log data	Modeling	Preliminary dome structure and geological layers in seal-reservoir complex.
3D seismic campaign	Field scale	Geological prognosis of the different formations, fault localization and compartmentalization into blocks. Basis for the development of the static model.
CSEM campaigns Soil Gas monitoring (CO_2 and others) and hydrogeological studies.	Field scale	Electromagnetic subsurface baseline parameters. Gas emission baseline Hydrogeological baseline *(B. Nisi et al., 2013)*.
Core analysis from HI and HA rock samples	Lab scale	Petrophysical parameters that condition the injection and CO_2 trapping. Hydrodinamic and geochemical effects of the injection of brine and CO_2 into the samples of core rock samples.
VSPs campaigns	Field scale	Better knowledge of layers and faults in the vicinity of the wells. CO_2 plume tracking in the vicinity of injection well.
HI and HA well logging	Field scale	Identify target carbonate layer and overlaying marl caprock. Extent, continuity and variability of formations. Preliminary data of permeability and porosity parameters.
Passive seismic control network	Field scale	Seismicity base line in the area of influence of TDP.
Hydrogeological control network	Field scale	Evolution of groundwater level and its nature.
Brine and CO_2 injection	Field scale	Basis for the development of safe and efficient injection strategies.
Gas phase tracer tests	Field scale	Evolution of CO2 saturation distribution with time. Effects of impurities in the operating parameters and chemical iteration with the rock mass *(J. de Elio et al. 2013)*.

Site hydraulic characterization

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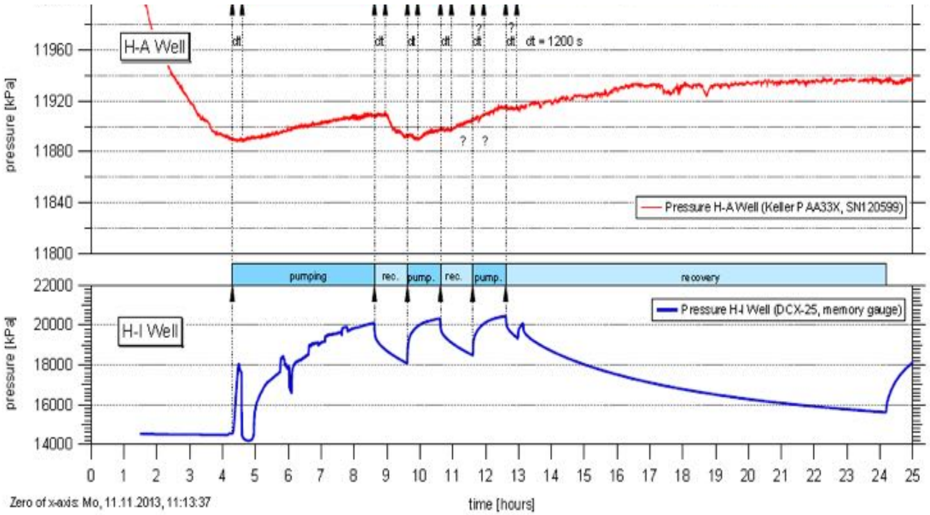
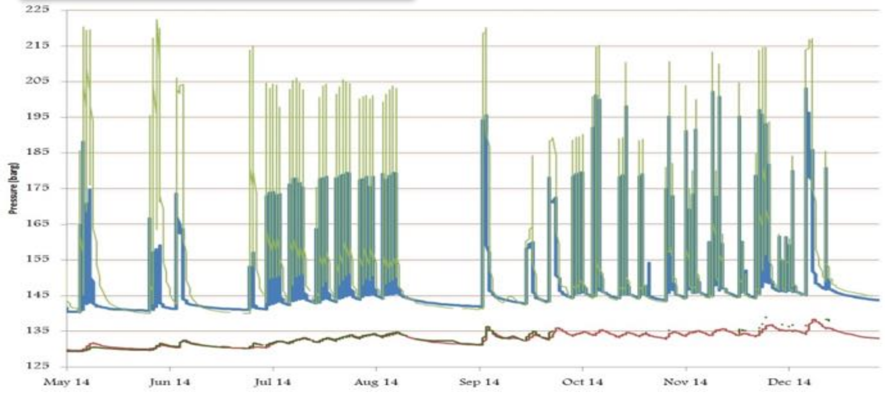
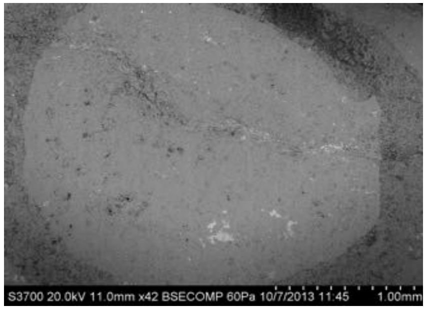
Connectivity Tests

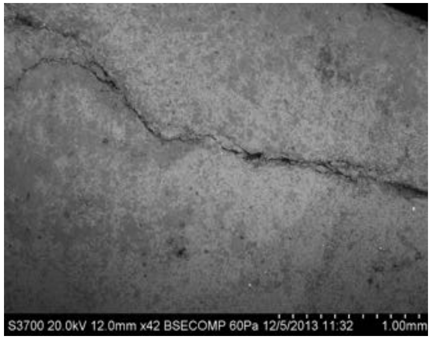


Brine injection



Laboratory works





Permeability increase through fracture network due to hydrodinamic and geochemical effects (Modeled by Saphir ™)

CO2 GeoNet

CO_2 Injection

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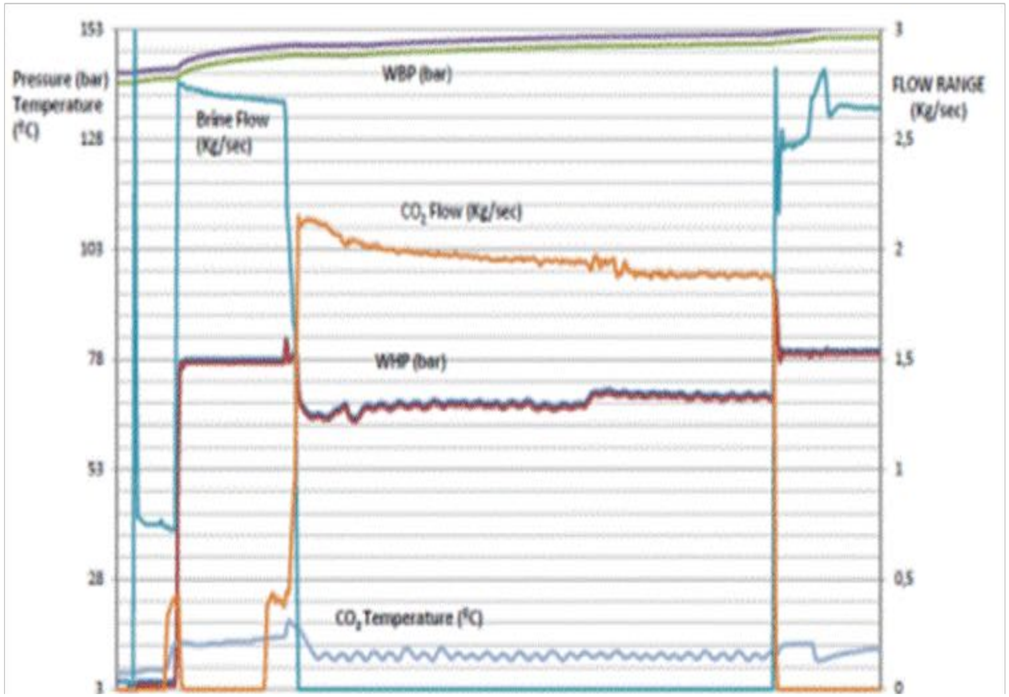
Injection conducted according transport conditions "OXYCFB300 Project"

1st Stage. Well pressurization with brine

2nd Stage. CO_2 conditioning to be injected

3rd Stage. CO_2 injection

4th Stage. Tubing cleaning



Tubing choke installed 1000 m depth for avoiding high bottom hole overpressure and unadmissible induced seismicity on surface

CO2 GeoNet

CO_2 Injection

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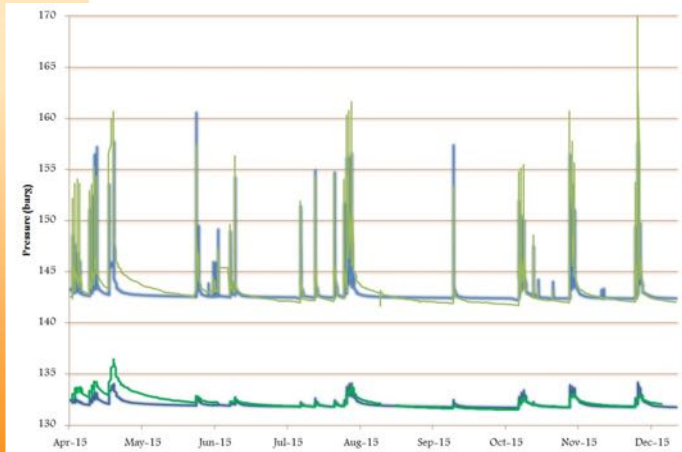
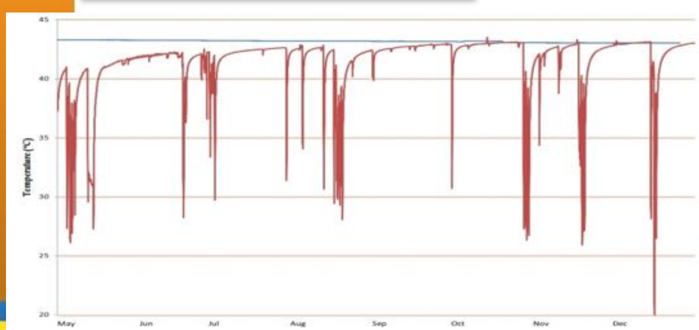
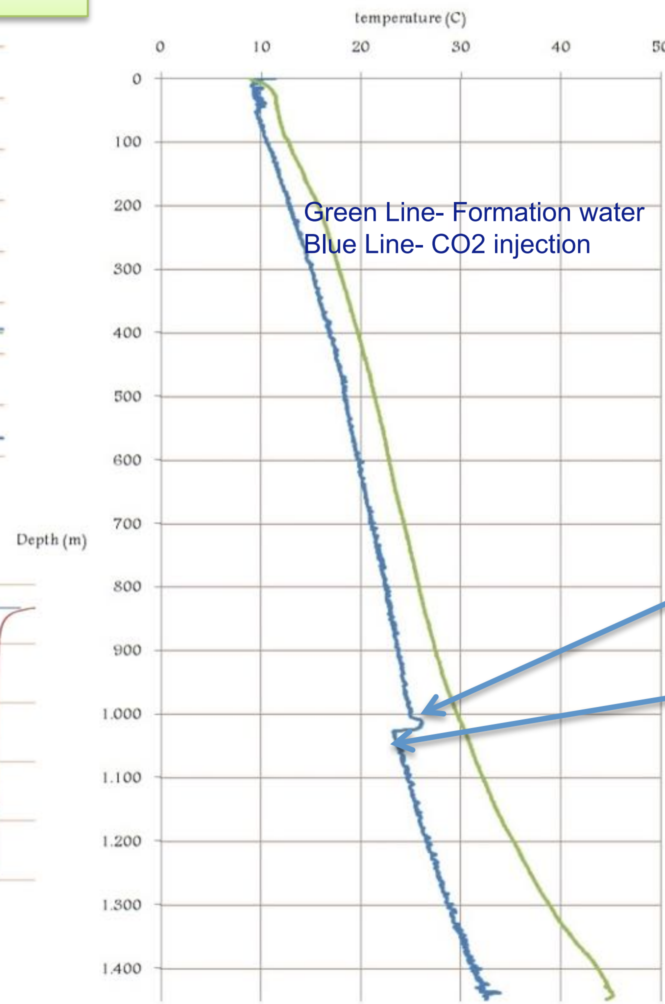
BHP hystory matching modeled by GEMTM



BHT history





Distributed Temperature System

Timely R. Δt=60-300 sec
Spatial R. ΔL=0,25m

Thermal gradient fairly homogeneous

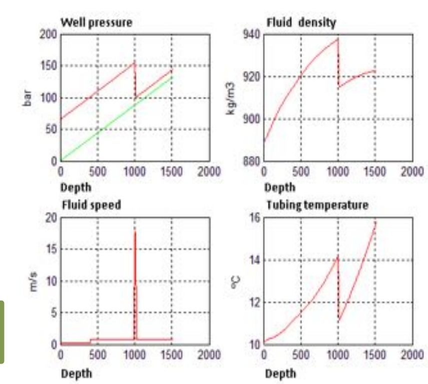
Injection cooling due to cryogenic conditions

Drop pressure valve (choke 1.000 m depth):

Pre-heating due to friction

Joule-Thompson effect

Choke behaviour



CO2 injection performed in liquid phase being stored in supercritical phase in reservoir

GeoNet

CO_2 Injection with impurities

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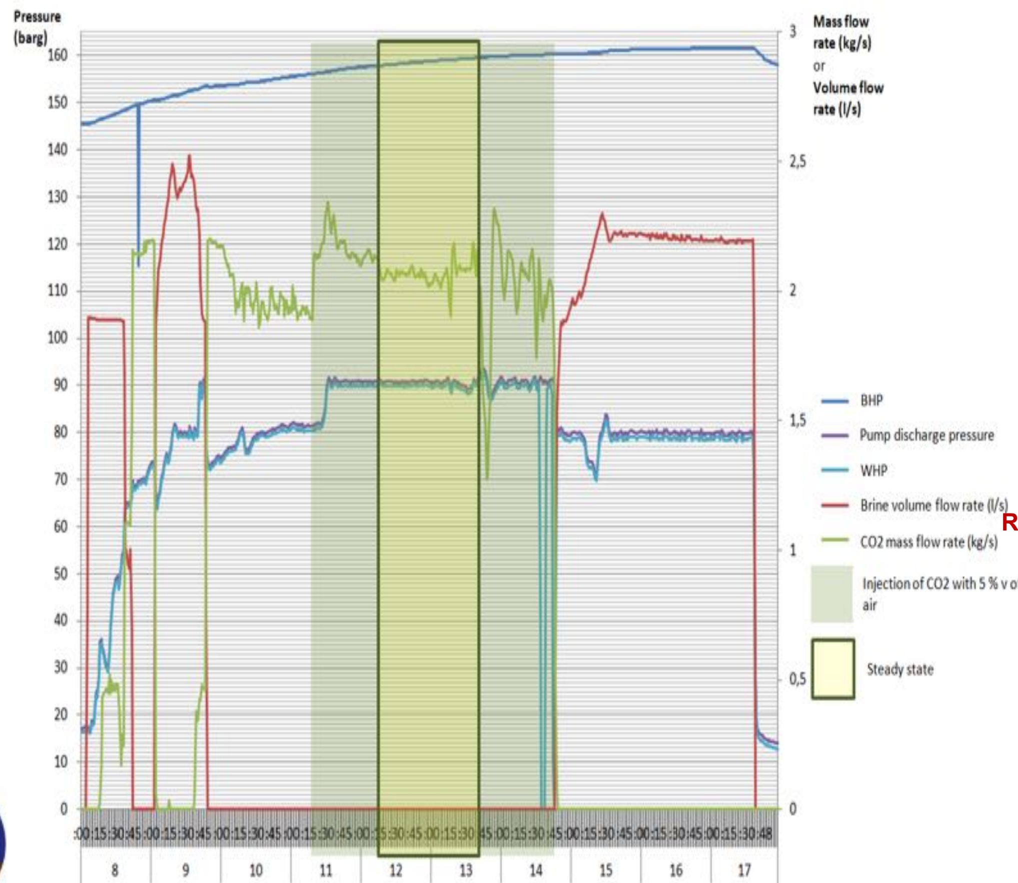
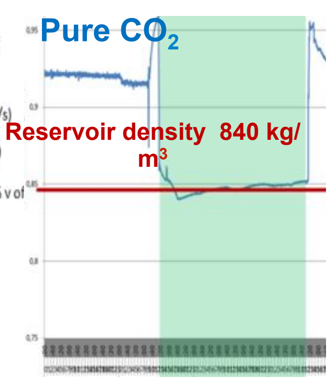
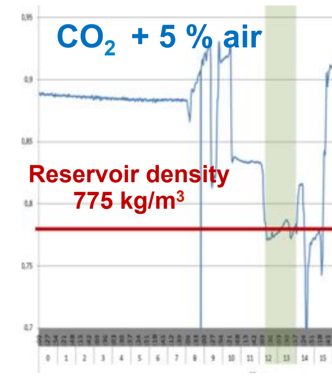
CO_2 Injection + 5% artificial air (21% O_2+ 79%N_2)







Effects of impurities

Operation inefficiency.- Increase WHP from 80 bar (CO_2 pure) to 90 bar (CO_2+ 5% air)

Reservoir capacity decrease.- Density 840 kg/m^3 (CO_2 pure) to 775 Kg/m^3 (CO_2+ 5% air)

Knowledge Gaps

- **Alternative injection strategies, safe and cost effective** in fractured carbonates with poor porosity and high anysotropy (i.e. cold injection avoiding the hidrate effects, solved with brine regarding the mixture acidification…)

- **Innovative geophysical techniques** for tracking the plume in this type of reservoirs.

- **Deep monitoring tools** to control the reservoir behaviour for the whole of the project life.

- **New dynamic modelling** for a realistic assessment of the site capacity and plume evolution, considering hydrodinamic and geochemical effects.

- Advanced tools for the **interpretation of the seismic response** related with the injection operations.

- New abandonment **well techniques**

- **Good practice guidelines** reagarding the different project stages (exploration, construction-commissioning, operation, abandonment and the liability transfer) as the first step for developing an updated European Legal Framework for CGS.

Thank you for your attention

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