



## Hontomín Technology Development Plant (Spain)

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**Workshop “CO<sub>2</sub> storage pilot projects in Europe”**  
11<sup>th</sup> CO<sub>2</sub>GeoNet Open Forum, Venice May 11<sup>th</sup> 2016

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- 7.- Collaboration

# Hontomín TDP

## The origin. Main goals

Fundación Ciudad  
de la Energía

### Project OXYCFB 300 “Compostilla”



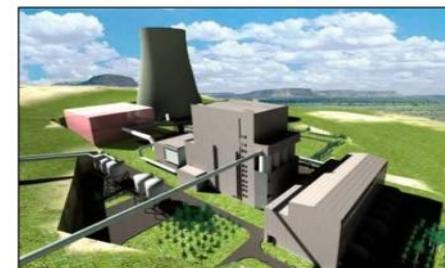
European Energy Programme for Recovery

#### Storage main goals

- Refine CO<sub>2</sub> storage technologies in “on-shore” deep saline aquifer conditions (fractured carbonates)
- Identification of **cost reduction** action for the whole of the process
- Potential **risk assessment** and corrective measures proposal
- Support for developing **alternative geophysical technologies** to characterize the seal-reservoir complex
- Tools development for **dynamic modelling** (hydraulic, hydrodynamic and chemical scope)

#### Objectives Phase I

Technology development for CO<sub>2</sub> 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

Technology upscaling development from pilot to industrial size in  
“Real Life Conditions”

# Hontomín TDP

## Decision making. Site location

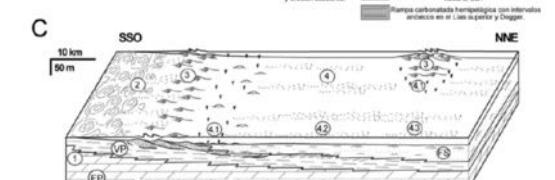
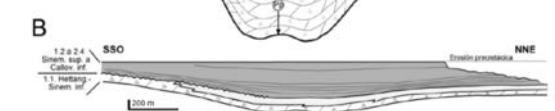
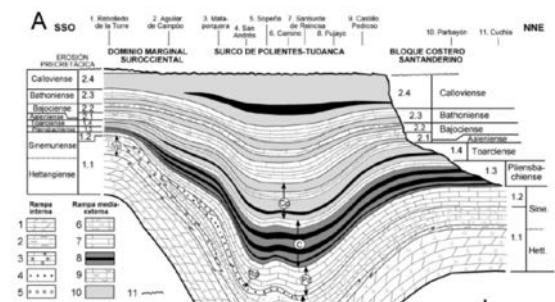
### Why Hontomín?

#### 1. Regarding the project goals:

- Deep saline aquifer
- Fractured carbonates
- Enough capacity for upscaling (2-4 Mt)

#### 2. High knowledge level on the geological formations and especially related with the seal and reservoir complex.

#### 3. The populations are located in small villages around the site with implantation of traditional oil sector activities in the area.

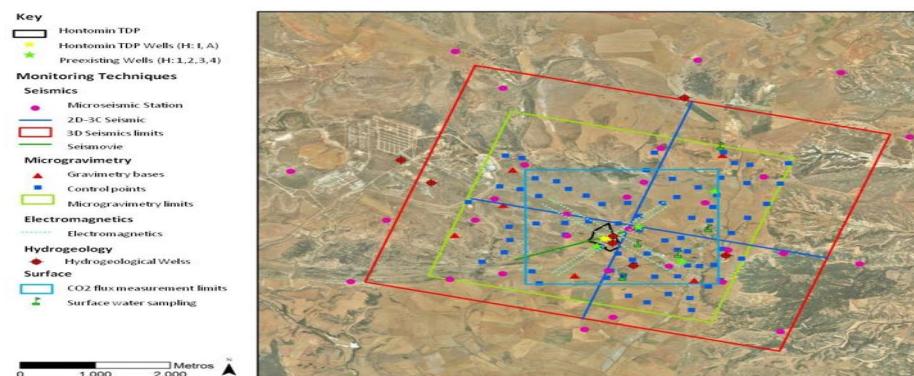


# Hontomín TDP

## Decision making. Site location

### Geophysical Campaigns

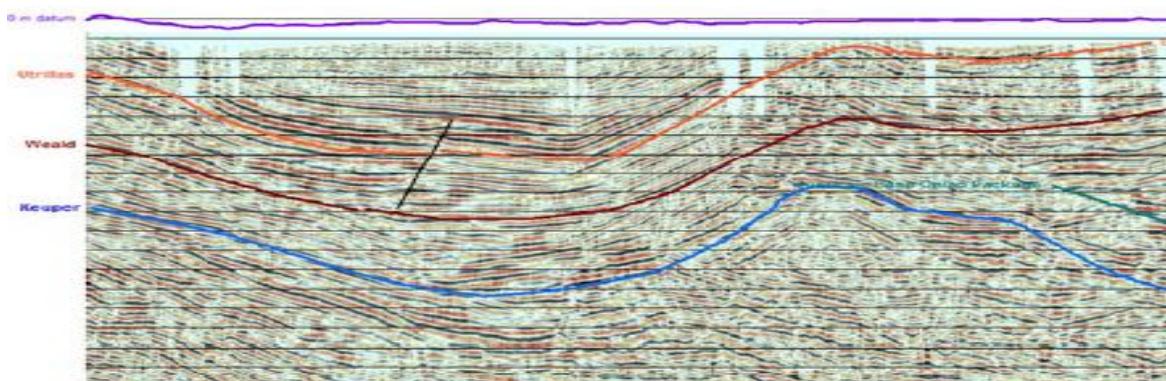
- ❖ Induced seismicity 2D-3D. Target: For determining the geometry, tectonic structure, top allocation, formation thickness, petrophysical properties and the rest of the data needed to develop the geological static model (Project OXYCFB300)
- ❖ Electromagnetical Techniques CSEM, Magnetotelluric . Target: To define the base lines needed to track the CO<sub>2</sub> plume evolution for developing of future works to control de injection evolution. Different techniques have been deployed for this goal (LEMAM, ERT, Magnetotelluric, etc) in the projects OXYCFB300 and EM Hontomín.
- ❖ Microgravimetry. The target is to determine the base line and the alternative technique for the CO<sub>2</sub> plume tracking. (Project OXYCFB300)
- ❖ DIN SAR and GB SAR. The use of satelital images and ground radar technique to analyze the surface subsidences produced by the injection. (Project OXYCFB300)



# Pilot Technical Characteristics

## Features of the seal and reservoir complex

1. **Site:** on-shore deep saline aquifer storage (1.600 m depth)
2. **Location:** Hontomín (Burgos), Castilla y León Region, Spain
3. **Nature of the cap rock:** carbonates (Marly Lias 150 m width)
4. **Nature of the store rock:** carbonates (limestones and dolomites)
5. **Capacity of the site:** 100.000 T CO<sub>2</sub>  
(administrative requirement, Spanish Law 40/2010 CO<sub>2</sub> Geological Storage)
6. **CO<sub>2</sub> injection strategies:** liquid, supercritical and alternative
7. **Safe storage operation:** irregularities and leakage control
8. **Public acceptance:** positive

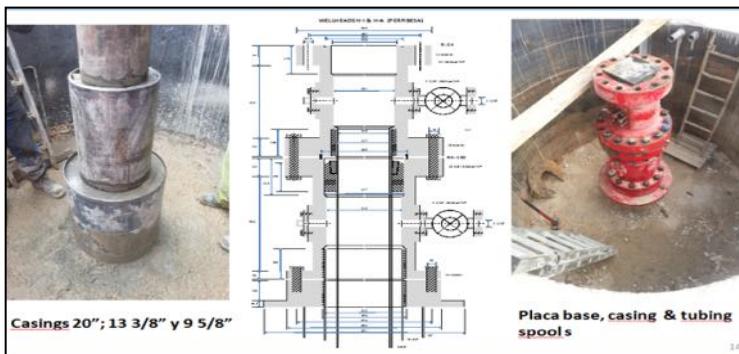
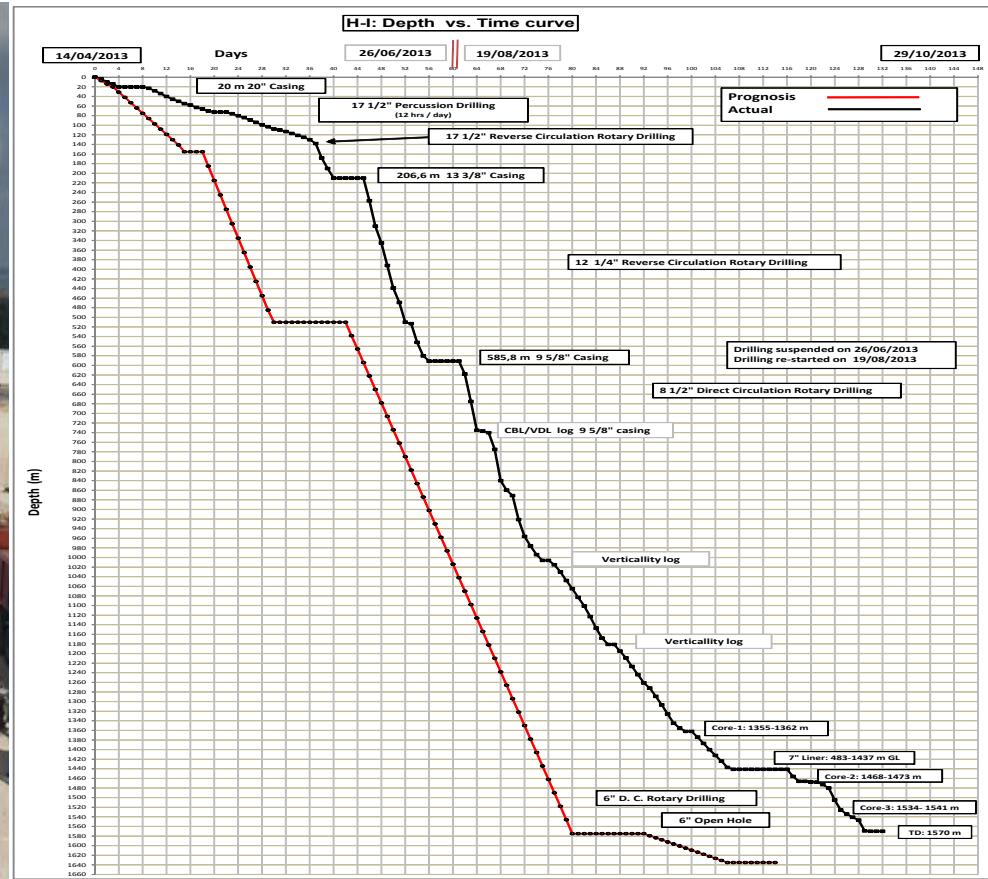
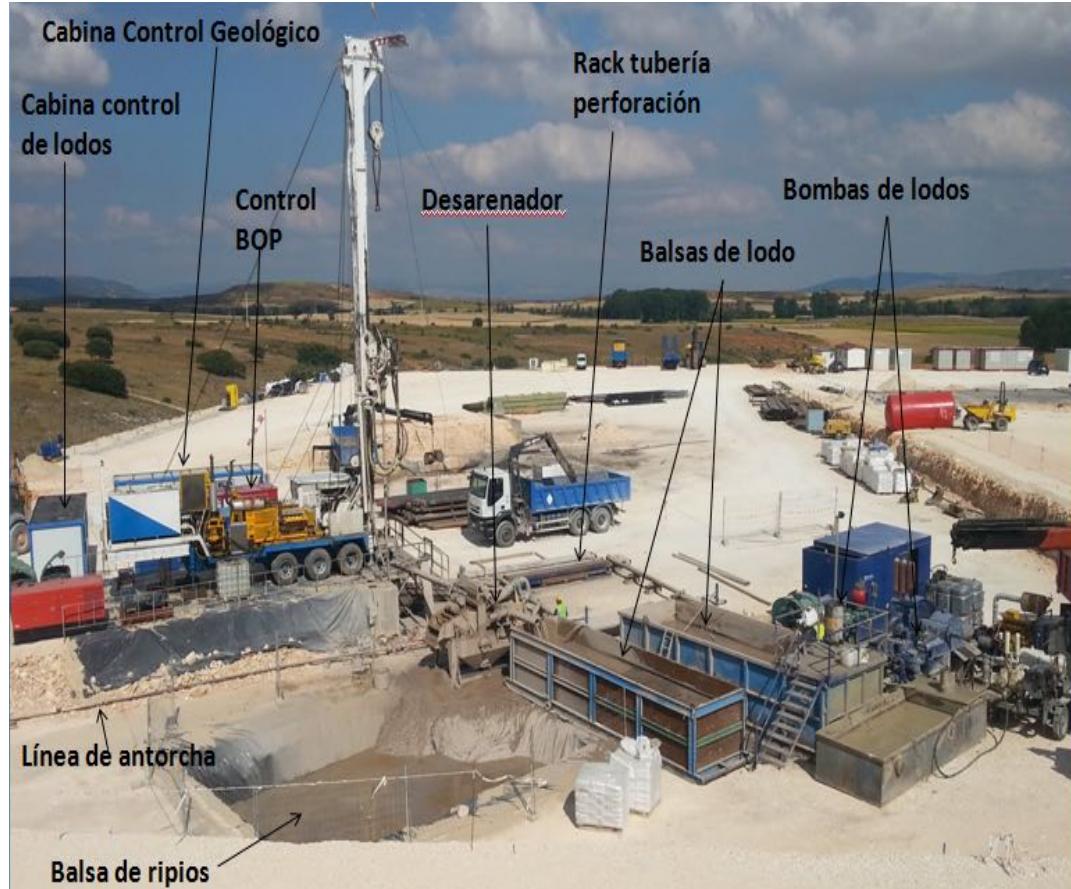


SONDEO HONTOMÍN HA		REVISADO 17-07-2013
LITOLOGÍA	DESCRIPCIÓN LITOLÓGICA GENERAL	
PERFORADO REVISIÓN	CALIZAS MARINAS PREDOMINANTEMENTE CALIZAS, EN PARTE TRANSICIÓN GRUESAS DURAS, MODERADAMENTE DURAS A DURAS, COMPACTAS. CALIZAS PREDOMINANTES DE COLOR BEIGE, MARRÓN DORSAL, AMARILLAS, BLANCAS, MODERADAMENTE DURAS A COMPACTAS.	
205m		
CENOMANIENSE (90-150 m MD)	CALIZAS MARINAS DURAS-BEIGE, MODERADAMENTE DURAS, BLÍBES, IRREGULARES, CONTIENEN ALGUNOS CANTOS VOLCANICOS. ASILLOS IRREGULARES MODERADAMENTE PLÁSTICOS Y DURAS. CALIZAS MODERADAMENTE BLANCAS, BEIGES, BLANCAS A DURAS Y COMPACTAS. ASILLOS GRISOS, PLÁSTICOS Y DURAS. MARGAS GRISAS, GRUESAS DURAS, MODERADAMENTE DURAS. TRAZAS DE CARBÓN Y PINTA.	
559m		
ALBO-CENOMANIENSE-F. UTRILLAS. (205-559 m MD)	ARENASCAS QUARCÍTICAS GRISAS, BLANCAS TRANSLÚCIDAS, GRUESAS A FINAS, SUBANGULARES-SUBREDONDEADOS POBREMENTE SELECCIONADOS. INTERESTRATIFICADAS CON ARCILLAS MARRONES, PLÁSTICAS, LAVABLES. TRAZAS DE PINTA. ARENASCAS QUARCÍTICAS, GRISAS DORO, MEDIAS A FINAS Y CON TRAZAS DE CARBÓN Y PINTA. PRESIDENCIA DE GRAVAS Y ARCILLAS ALTA.	
WEALD. (559-963 m MD)	ARENASCAS GRUESAS, MEDIAS, FINAS, GRIS DORO Y ARCILLAS MARRÓN CLARO, GRIS DORO, LAVABLES. TRAZAS DE GRAVAS.	
963m		
1.004m		
PURBECK (963-1004 m MD)	ARENAS SARCÓFAGAS, CON ARCILLAS ALTAZAS. INTERSTRATIFICADAS, GRUESAS A FINAS, LAVABLES Y PLÁSTICAS. ASILLOS ALTAZAS, PLÁSTICOS, LAVABLES. ARENAS ROJAS, BLÍBES A DURAS, DE GRANO FINO A MUY FINO CON CEMENTO CARBONÍTICO. PINTA. CALIZAS ARGILLICAS, MUDISTONES/WACKERLONES, CEMENTO GRANULAR BLANCO, MARRÓN, AMARILLA Y BLANDAS, A MODERADAMENTE DURAS, INTERSTRATIFICADAS CON ARCILLAS ROJAS, GRUESAS LAVABLES Y ARENAS BLANCAS A VERDE CLARO, TABLERAS DE GRANO FINO A MUY FINO.	
1.027m		
Falla @1321.8m MD		
Fractura @1407m MD		
1.380m		
1.422m		
TD.: 1554m MD		
MARGAS GRISAS, MEDIO DURAS A DURAS, CON RIELES DE ARCILLAS ALTAZAS, SEPARADAS POR CALIZAS, BLÍBES A MEDIO DURAS. LITOSFERA CALIZADA, GRUESAS ALTAZAS, BLÍBES, LAVABLES, INTERSTRATIFICADAS CON MARGAS GRISAS ALTAZAS, MEDIO DURAS Y BLÍBES A DURAS. MARGAS GRISAS, MEDIO DURAS A DURAS, GRISAS.		
Fractura @1502m MD		
1.540m		
MARGAS ALTAZAS, MEDIO DURAS A DURAS, GRISAS ALTAZAS, LAVABLES, INTERSTRATIFICADAS CON MARGAS GRISAS ALTAZAS, MEDIO DURAS Y BLÍBES A DURAS. DOLOMÍTAS, GRISAS ALTAZAS, DE TEXTURA MICROGRANULAR, DURAS, LOCALMENTE MICROSTRATIFICADAS, RELENAS POR ARCILLA.		
Fractura @1540m MD		
1.540m		
CARINOLAS (ANHIDRÍTICO) (1540m MD)	ARENITAS ALTAZAS LOCALMENTE MICROGRANULARES, BLÍBES, GRISAS ALTAZAS, DURAS CON INTERSTRATIFICACIONES DE DOLOMÍTAS LOCALMENTE MICROFRACCIONADAS, RELLENAS DE DOLOMÍTA.	

# Well drilling

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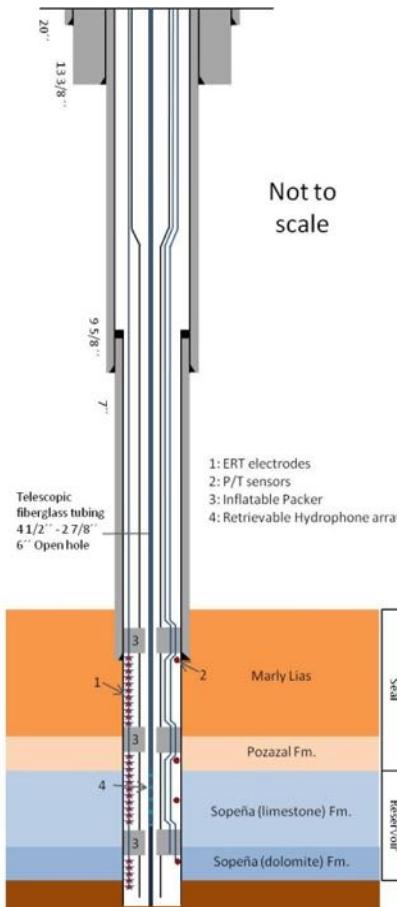
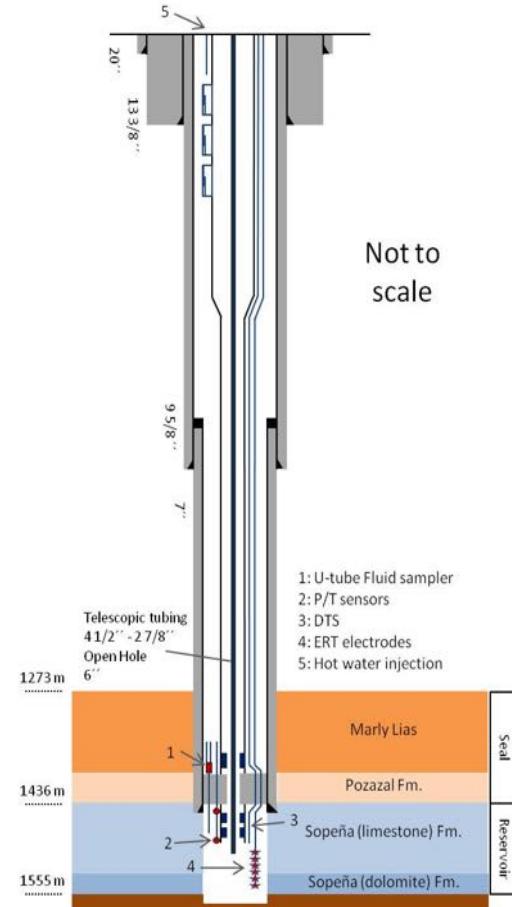
Cost efficiency up to 60% regarding traditional methods



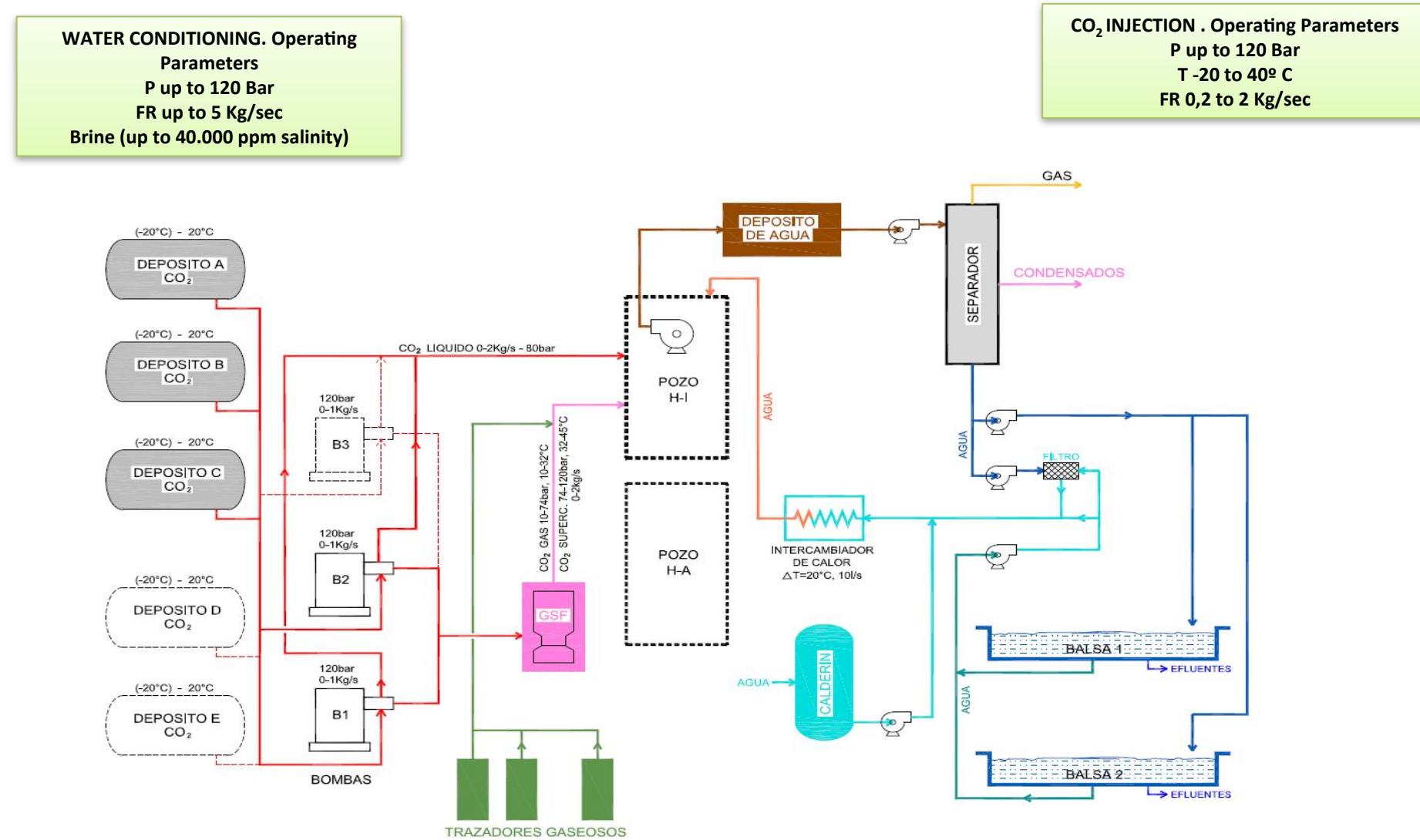
# Pilot Technical Characteristics

## Wells and deep monitoring

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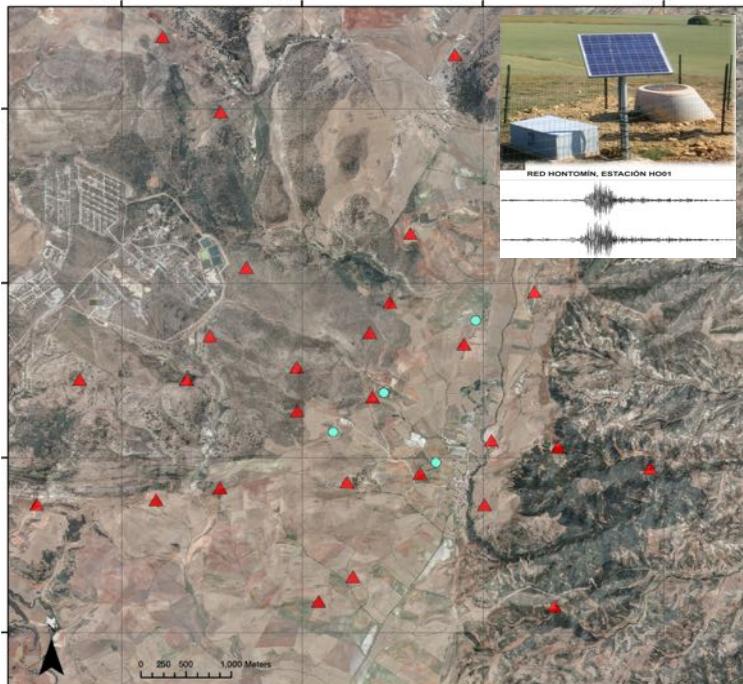
# Pilot Technical Characteristics. Facilities



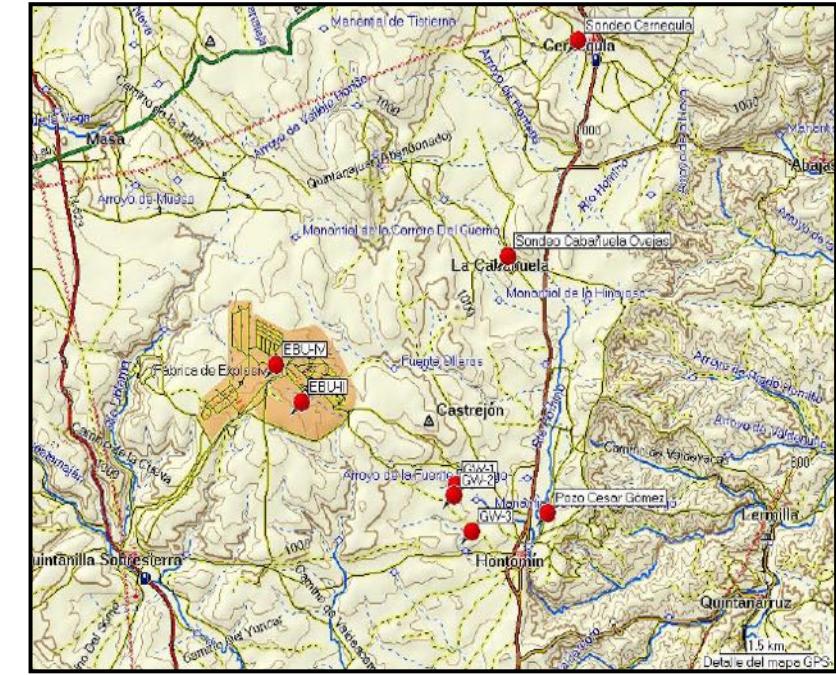
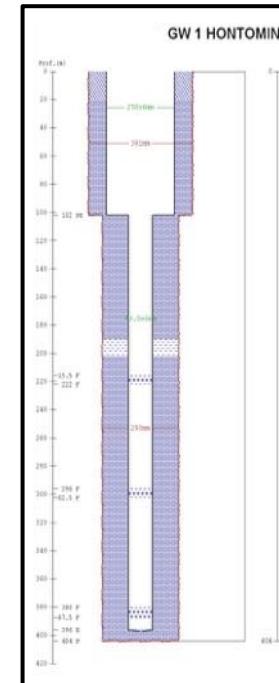
# Pilot Technical Characteristics. Facilities

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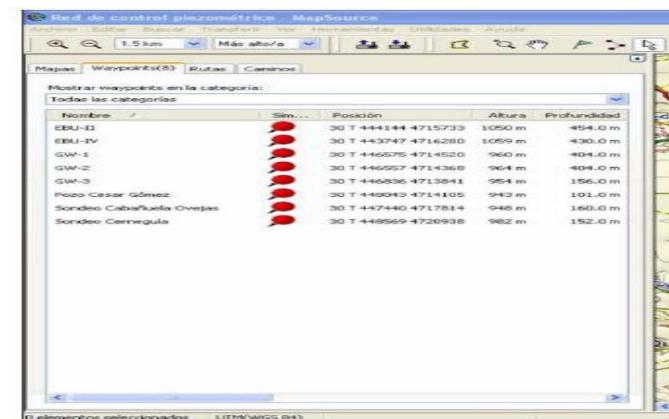
Seismicity Monitoring  
Network



Hydrogeological Monitoring  
Network



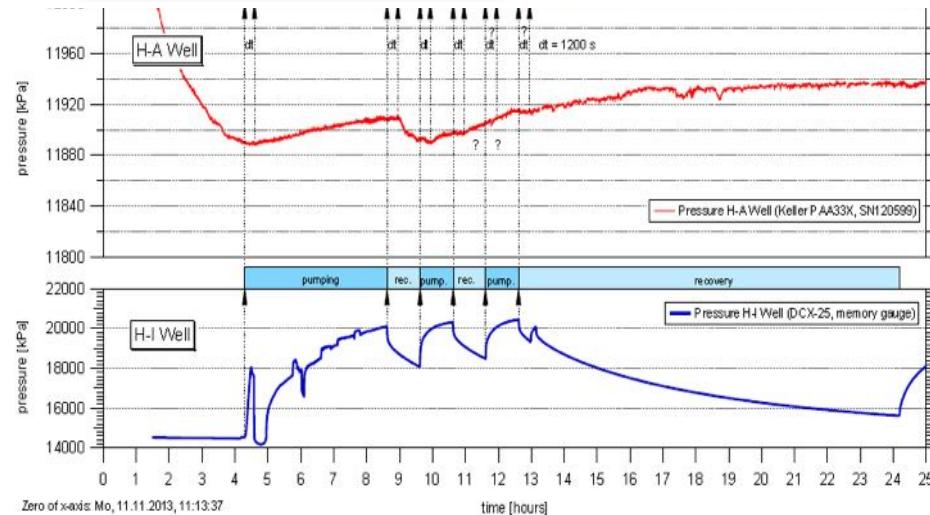
**30 passive seismic stations**  
**20 sensors SARA SS 45 (4,5 Hz)**  
**10 sensors Lennarzt LE 3D (20 seconds period)**  
**1 accelerometer**  
**Specific software (Control Room)**



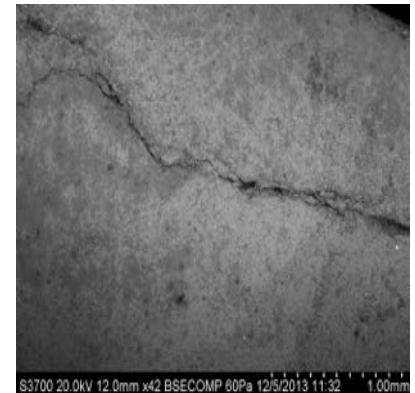
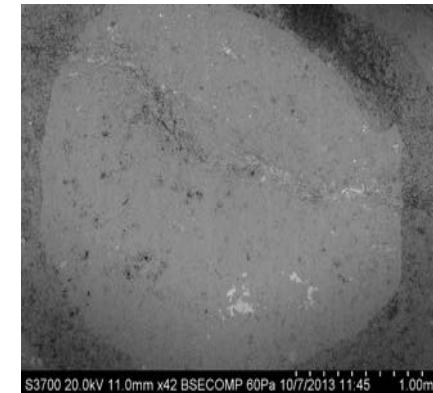
# Hydraulic Characterization

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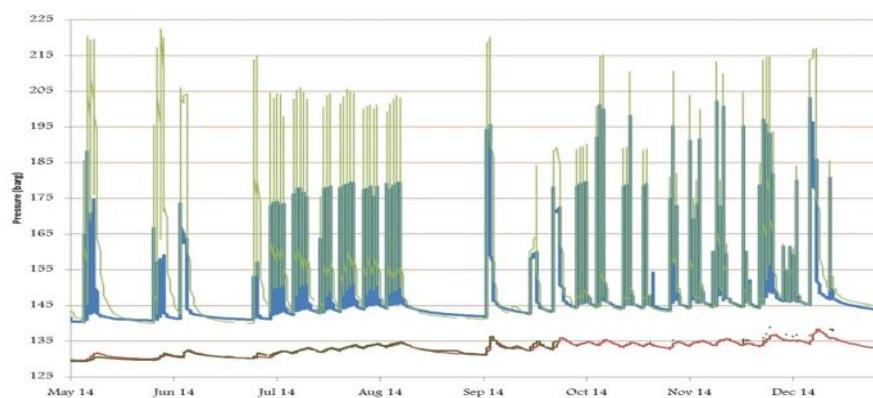
## Connectivity Tests



## Laboratory works



## Brine injection



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

# CO<sub>2</sub> Injection

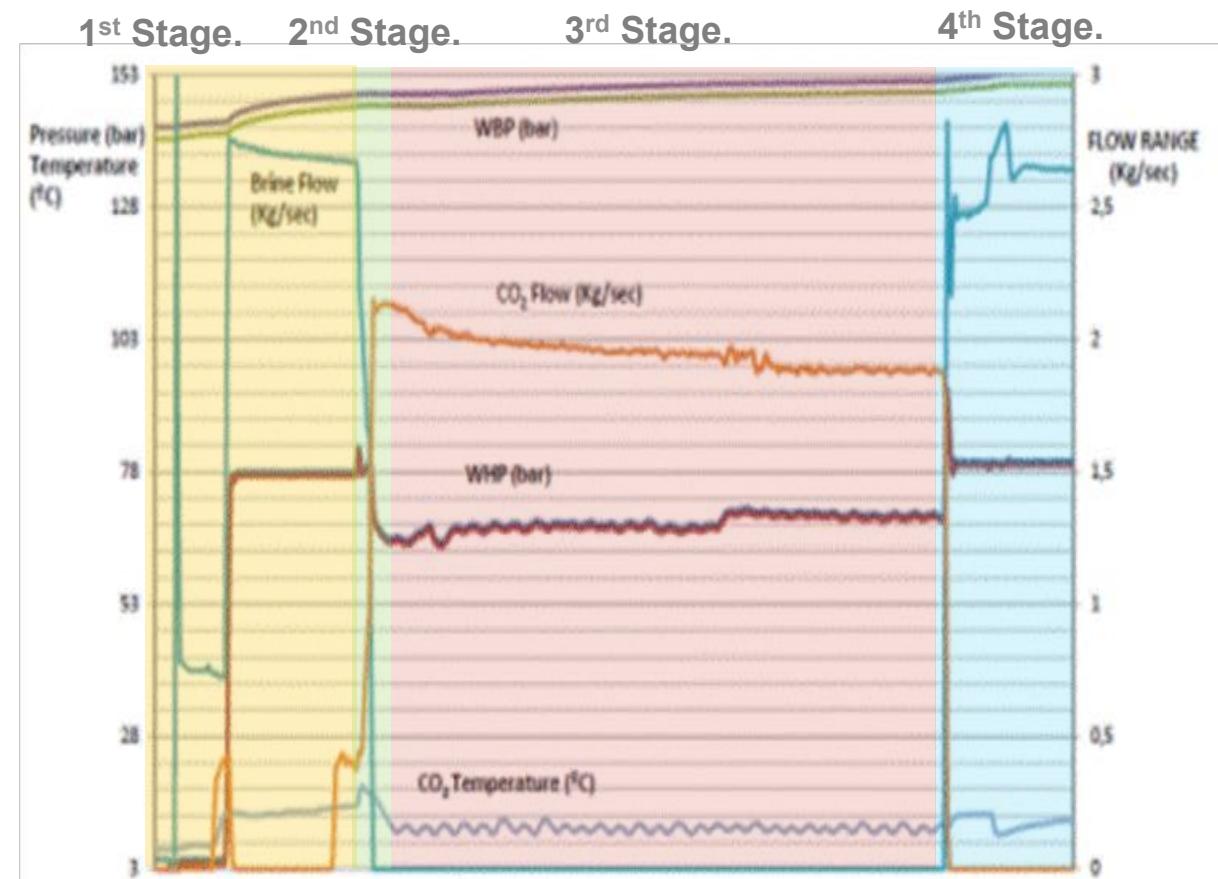
Injection conducted according transport conditions “OXYCFB300 Project”

1<sup>st</sup> Stage. Well pressurization with brine

2<sup>nd</sup> Stage. CO<sub>2</sub> conditioning to be injected

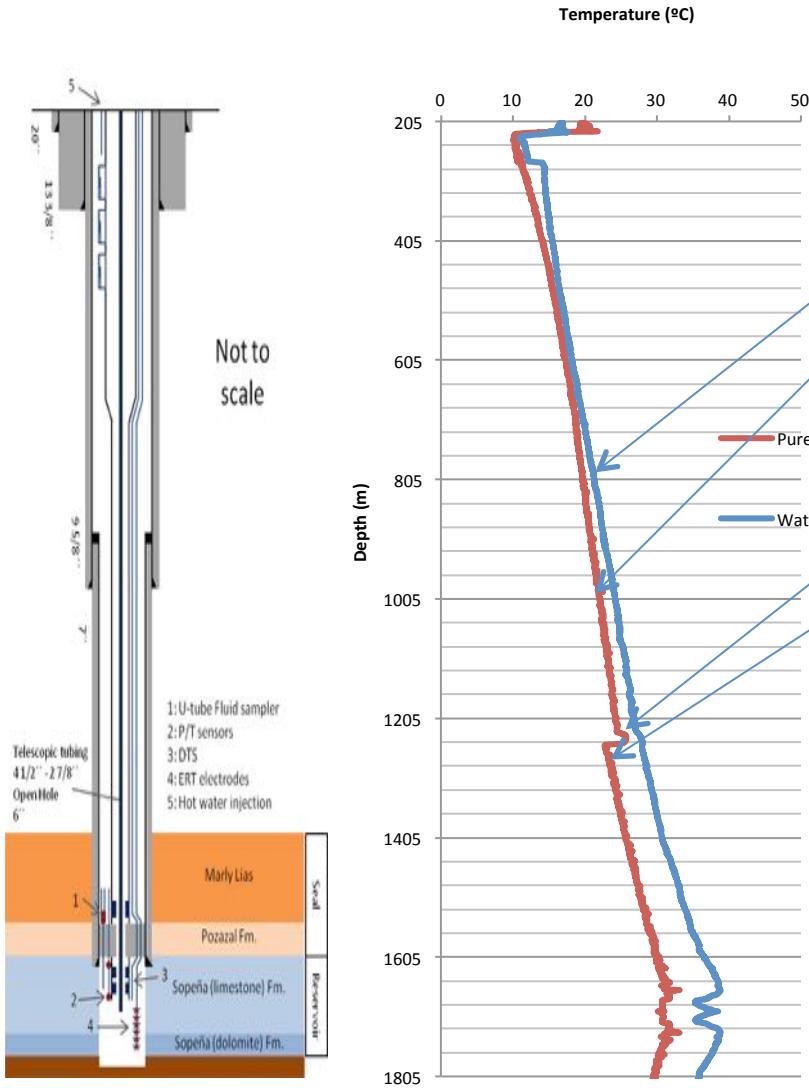
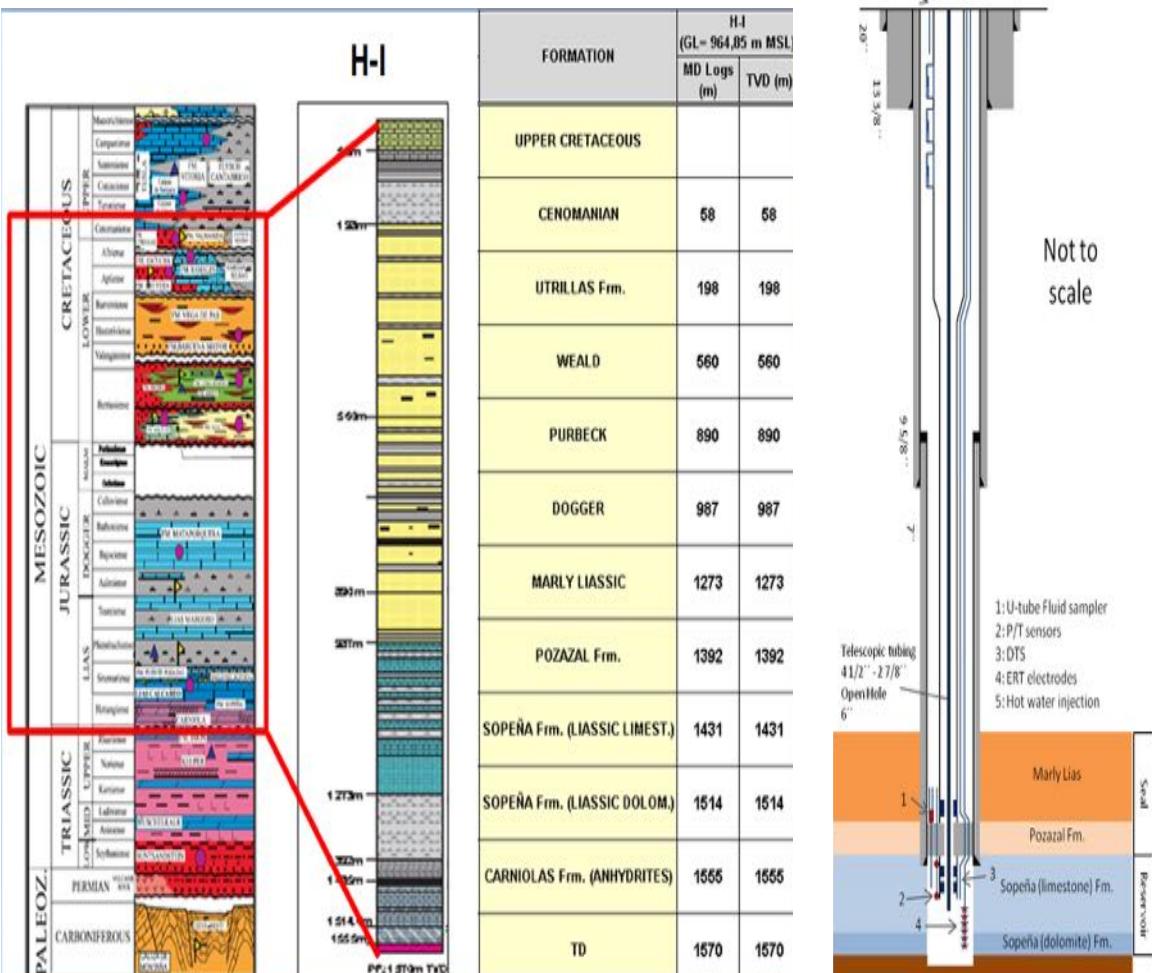
3<sup>rd</sup> Stage. CO<sub>2</sub> injection

4<sup>th</sup> Stage. Tubing cleaning



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

# CO<sub>2</sub> Injection



Distributed Temperature System  
Timely R.  $\Delta t=60-300$  sec  
Spatial R.  $\Delta L=0,25$ m

Thermal gradient fairly homogeneous

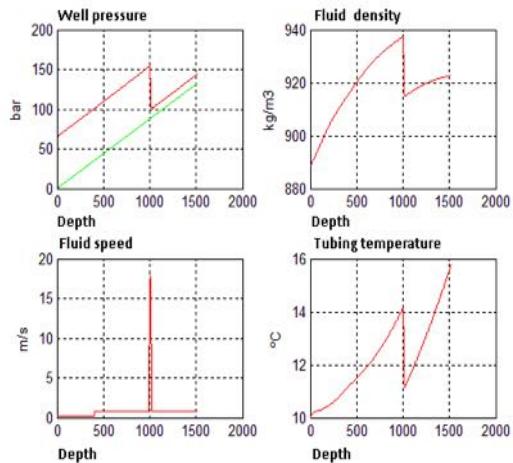
Injection cooling due to cryogenic conditions

Drop pressure valve (choke 1.000 m depth):

Pre-heating due to friction

Joule-Thompson effect

Choke behaviour



The injection of carbon dioxide was performed in liquid-phase flow

## Collaboration

### Project ENOS- ENabling Onshore CO<sub>2</sub> Storage in Europe



Proposal endorsed by :



Call H2020: LCE 15-2014/2015  
Collaboration

Hontomin– Batelle site in Michigan Basin (USA)-Otway(Australia) / LBr1–Kansas Wellington Field.

### Open for collaboration

*"In my mind, pilots are key to the global implementation of CCS at the moment. They're building our knowledge base and they're key to building public confidence in our technology to get us to larger-scale implementation".*

John Gale  
General Manager of the IEA GHG R&D Programme

A faint, light-gray network diagram consisting of numerous small, semi-transparent gray circles of varying sizes scattered across the slide, connected by thin gray lines that form a complex web of relationships.

# Thank you for your attention

Further information:

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Y TURISMO

