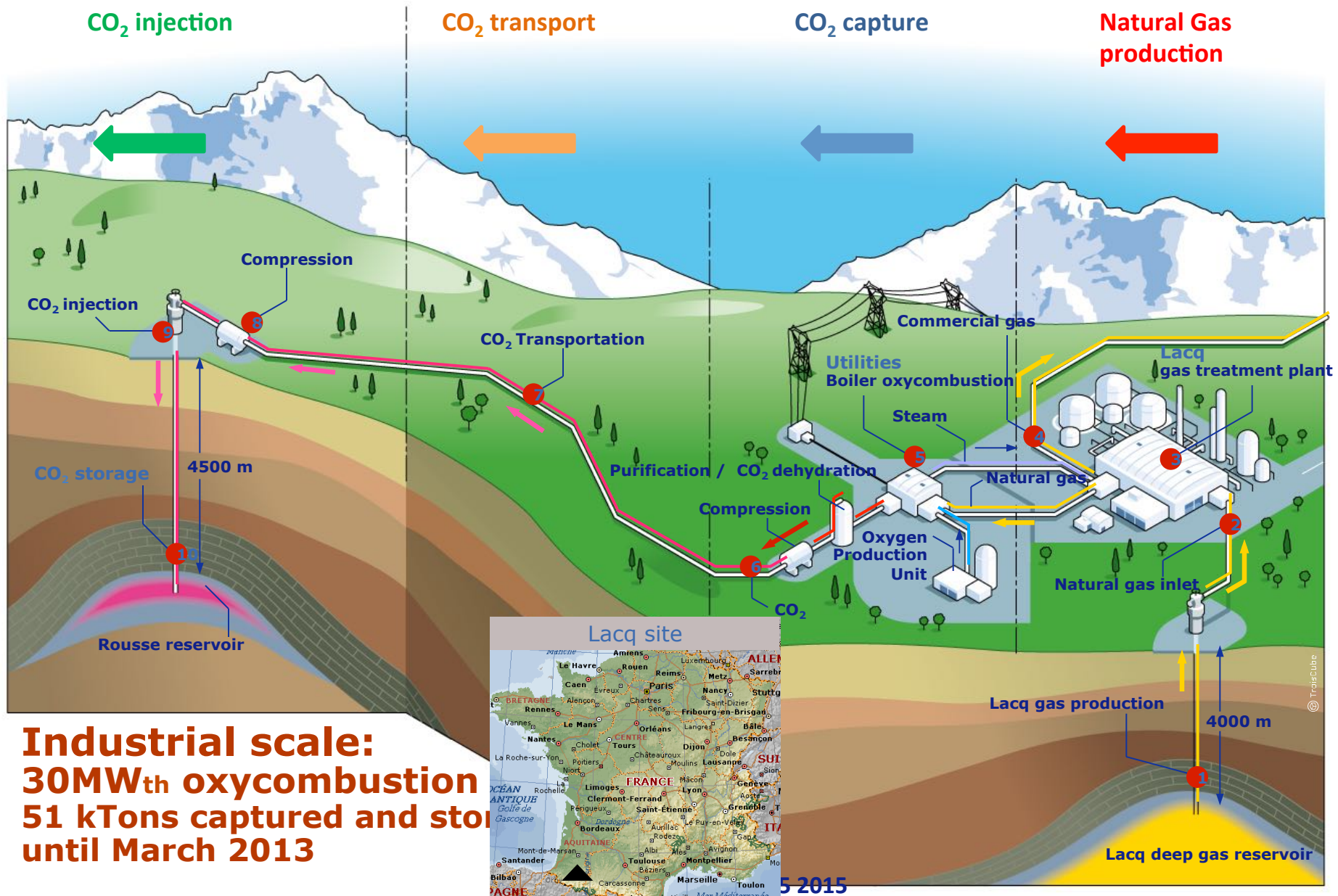# Carbon Capture and Storage
the Lacq pilot
results and perspectives

Dominique Copin

TOTAL

LACQ CCS: A COMPLETE INDUSTRIAL CHAIN BASED ON GAS-FIRED COMBUSTION

CO_2 injection

CO_2 transport

CO_2 capture

Natural Gas production

Compression

CO_2 injection

CO_2 Transportation

Commercial gas

Lacq gas treatment plant

Utilities
Boiler oxycombustion

Steam

CO_2 storage

4500 m

Purification / CO_2 dehydration

Natural gas

Compression

Oxygen Production Unit

CO_2

Rousse reservoir

Natural gas inlet

Lacq site

Lacq gas production

4000 m

Lacq deep gas reservoir

Industrial scale:
30MWth oxycombustion
51 kTons captured and stor...
until March 2013

THE LACQ CCS PROJECT COMBINES 4 CHARACTERISTICS

➢ It is an integrated project from capture (combustion) to storage.

➢ It is based on gas-fired combustion.

➢ It uses oxycombustion technology.

➢ CO2 is stored in a depleted natural gas reservoir.

MAIN RESULTS GLOBALLY

- ➤ No accidents recorded over the period.

- ➤ Proof of the technical feasibility of an integrated CO_2 capture-transport-geological storage chain.

- ➤ Satisfactory availability rates.

Lacq CO2 capture facilities
©Laurent Pascal

5 km

City of PAU

Rousse injection well

© Total

PILOT TECHNICAL DESCRIPTION: SURFACE FACILITIES

Air separation unit

Cryogenic unit (Air Liquide)

O_2 : 240 t/d

Oxy-combustion Boiler

Existing 1957 boiler revamped by Alstom to oxy-combustion boiler. Oxyburners developed by Air Liquide

(30 MWth, 40 t/h steam @ 60b, 450°C)

Direct Contact Cooler

wet CO_2

Direct Contact Cooling

Venturi scrubber

Cooling of flue gases
From to 200°C to 30°C

Dehydration Unit

Outlet : < 20 ppm of water

Wet CO_2 compressor

From 1barg to 27 barg

Transport and Storage

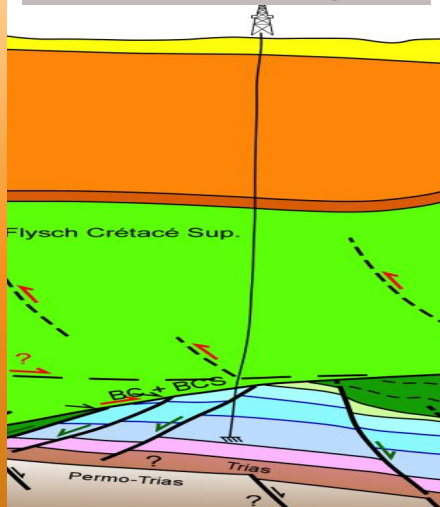# MAIN RESULTS OF THE CAPTURE PHASE (LACQ)

➢ Test and Validation of Oxycombustion on a 30 MWth boiler.

➢ Collection of data needed to design a 200 MWth boiler.

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TRANSPORT AND STORAGE

Capture

Rousse storage

Depleted gas reservoir @ 4500m/GL

## RSE-1 injection well head

## Rousse compressor

Pinlet: 27bar Poutlet: 51bar

RESERVOIR STORAGE

- Jurassic fractured dolomitic reservoir
- Depth # 4500m/MSL
- Temp. # 150°C
- Initial P: 485 bars
- P before inj: # 40 bars
- Final pressure: # 90 bars
- Initial CO_2 = 4,6%
- Initial H2S < 1%
- Av. Porosity: 3%
- Av. Perm. = 5mD
- Av. Water saturation: 30%- 40%
- Only one well: RSE-1, producing from 1972 to 2008, 0.9 GSM3 .

Rousse depleted gas field
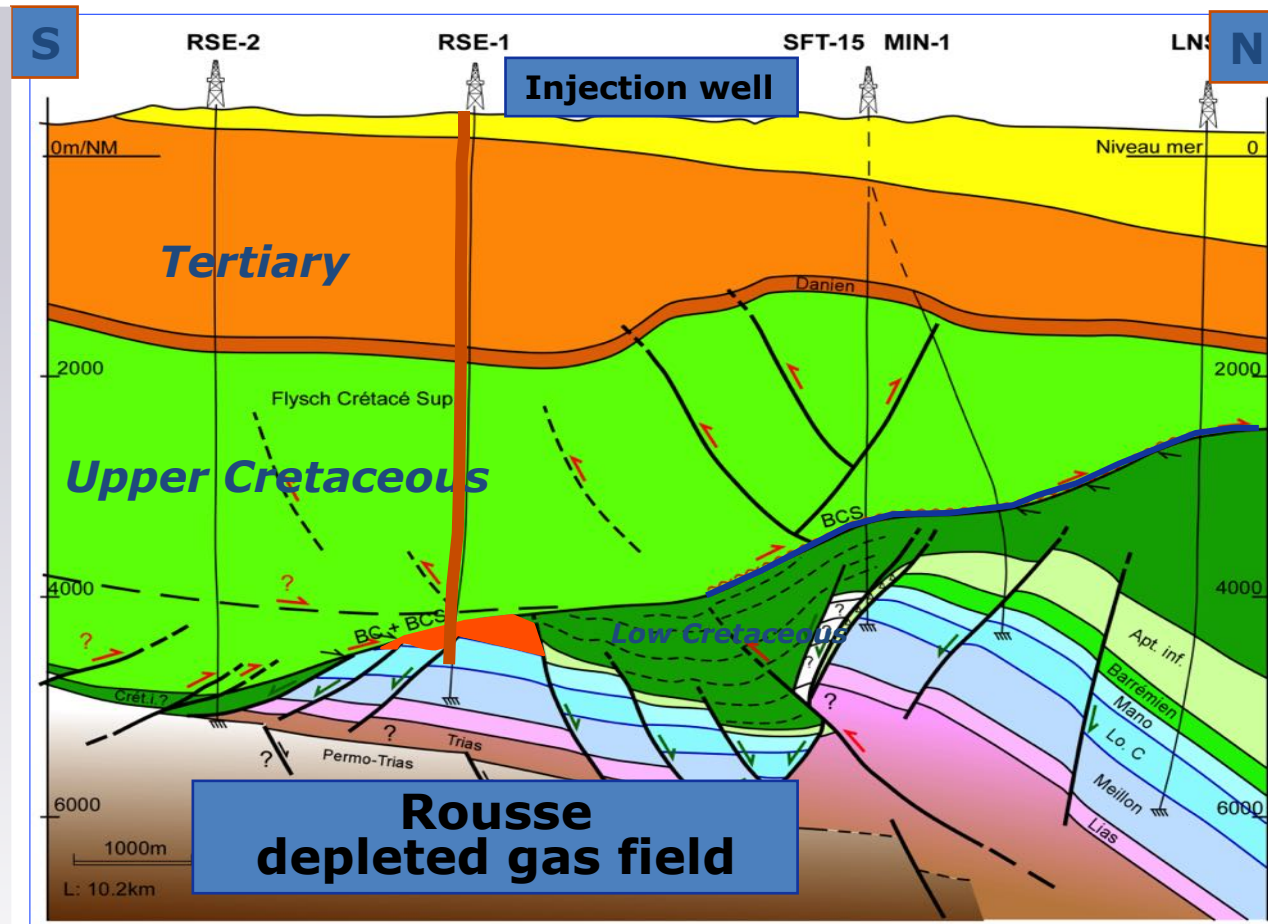
INJECTIVITY INDEX

> *There is no evidence of increasing or decreasing injectivity index*

> *In line with geochemistry studies , no modification of reservoir matrix*
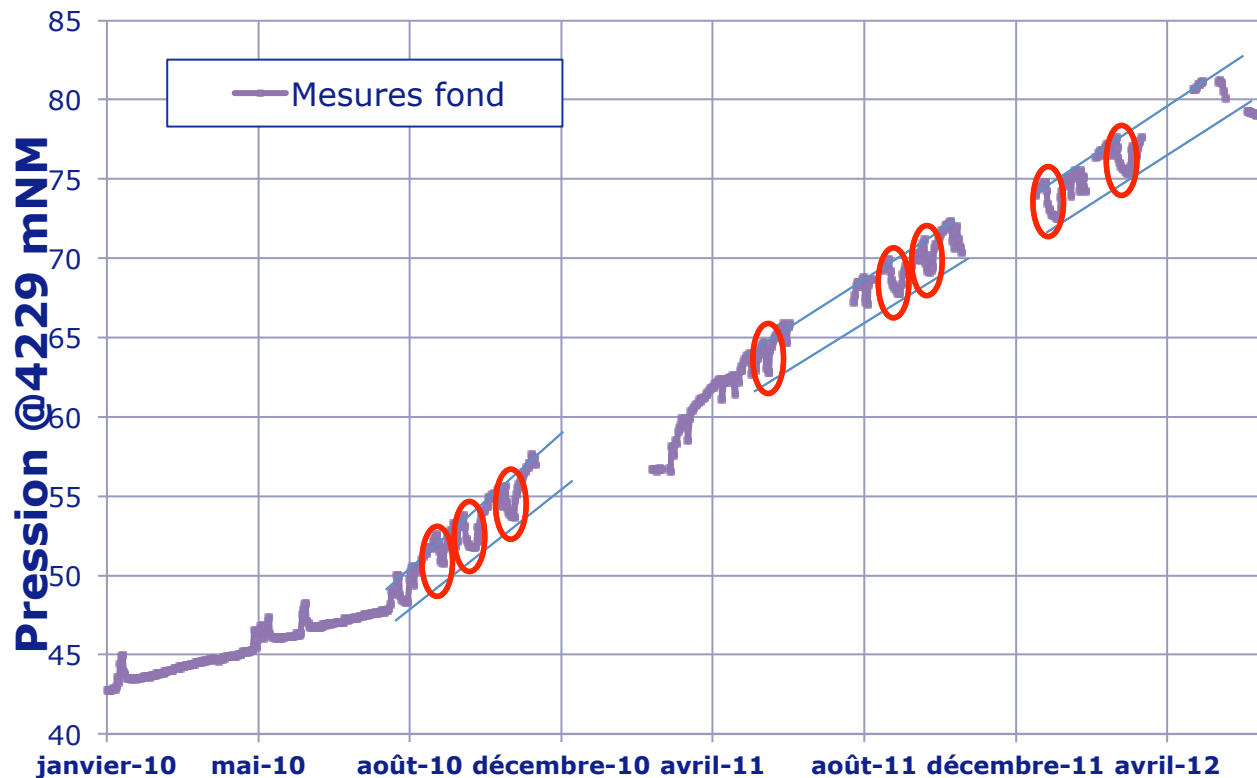
ROUSSE WELL SPECIFIC COMPLETION
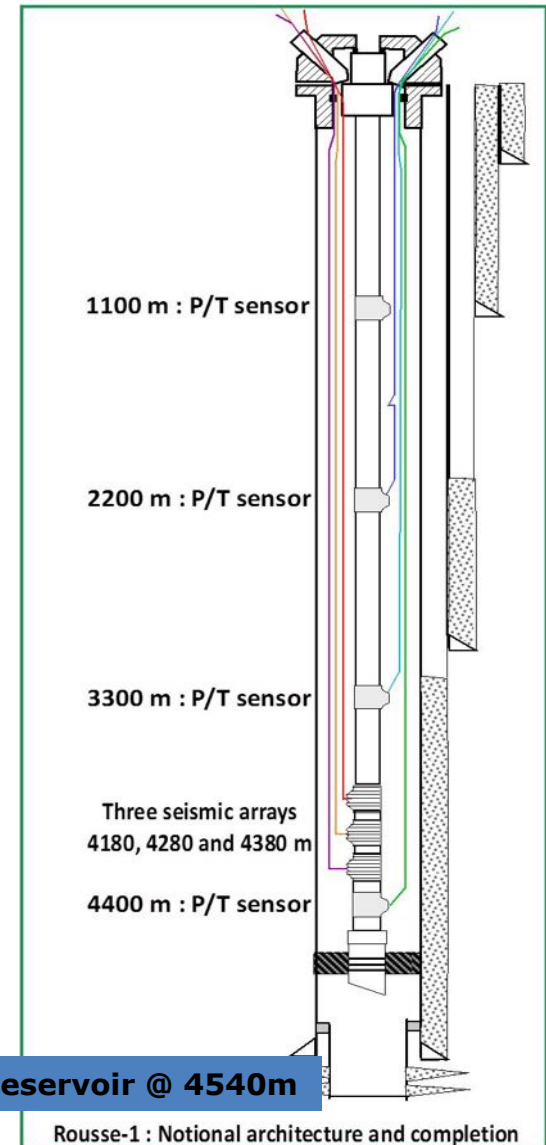
- **4 Pressure and Temperature sensors**

  Objectives :
  - Calibrate of pressure loss models
  - Calibrate of reservoir models
  - Monitor of well injectivity

- **3 Micro-seismic sensors**

  Objectives
  - To assess the impact of the injection near the wellbore

1100 m : P/T sensor

2200 m : P/T sensor

3300 m : P/T sensor

Three seismic arrays
4180, 4280 and 4380 m

4400 m : P/T sensor

Top reservoir @ 4540m

Rousse-1 : Notional architecture and completion

MICROSEISMIC MONITORING

- **surface:**

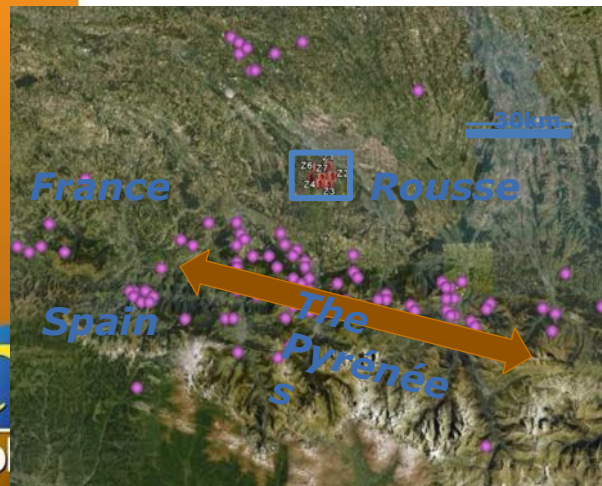only three events located at the vicinity of the injection well by the surface equipment :

$$-1.1 < M < -0.3$$

- **bottom-hole:**

Sources to be defined (depletion, Pyrenees, injection):

Very good sensitivity :

$$-3.1 < M < -1.4$$

- **No incidence on reservoir integrity (fully in agreement with geomechanical studies)**

MAIN RESULTS OF THE STORAGE PHASE (ROUSSE)

➢ A method to characterize the storage reservoir.

➢ A method to monitor the integrity and environmental impact of a CO2 storage site.
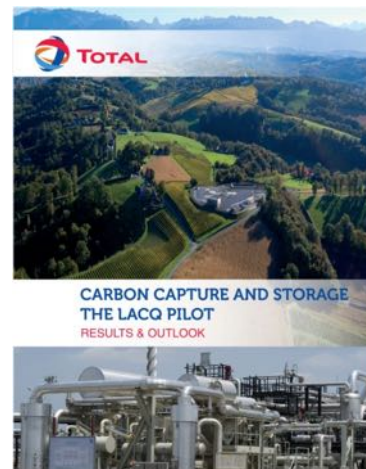

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PUBLIC SUPPORT AND ACCEPTANCE

➢ " Transparency " in our communication with local communities was one of the key success factors in securing public support.

➢ A brochure was published in 2014:

http://www.total.com/sites/default/files/
atoms/file/Captage-Carbon-capture-and-
storage-the-Lacq-pilot

➢ A scientific book on lessons learned from the Lacq CCS pilot is about to be published.

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PERSPECTIVES

➤ Switching from Coal to Gas is a significant strategy for reducing GHG emissions.

➤ This switch will reduce constraints relating to potential CO2 storage capacity limits or costs that hinder the development of CCS.

➤ Gas CCS demonstrators and R&D are needed.

➤ CO_2 Storage Capacity estimations are key to the assessment of the development potential of CCS.