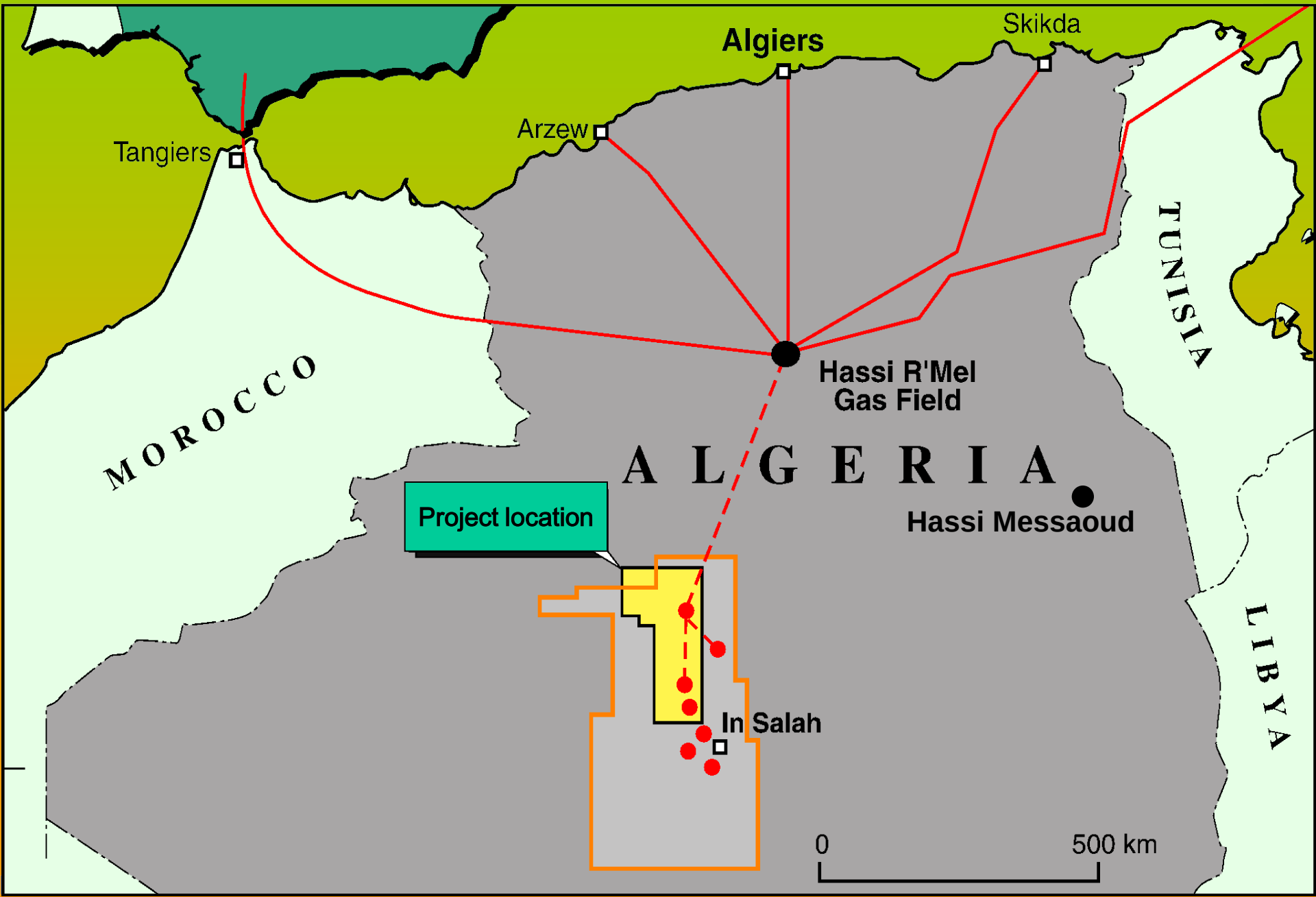
In Salah Gas

IN SALAH GAS (ISG)

Mohamed Keddam
Alger
31st May 2010

In Salah Gas


Algiers
Skikda
Arzew
Tangiers
TUNISIA
MOROCCO
Hassi R'Mel
Gas Field
ALGERIA
Project location
Hassi Messaoud
LIBYA
In Salah
0
500 km

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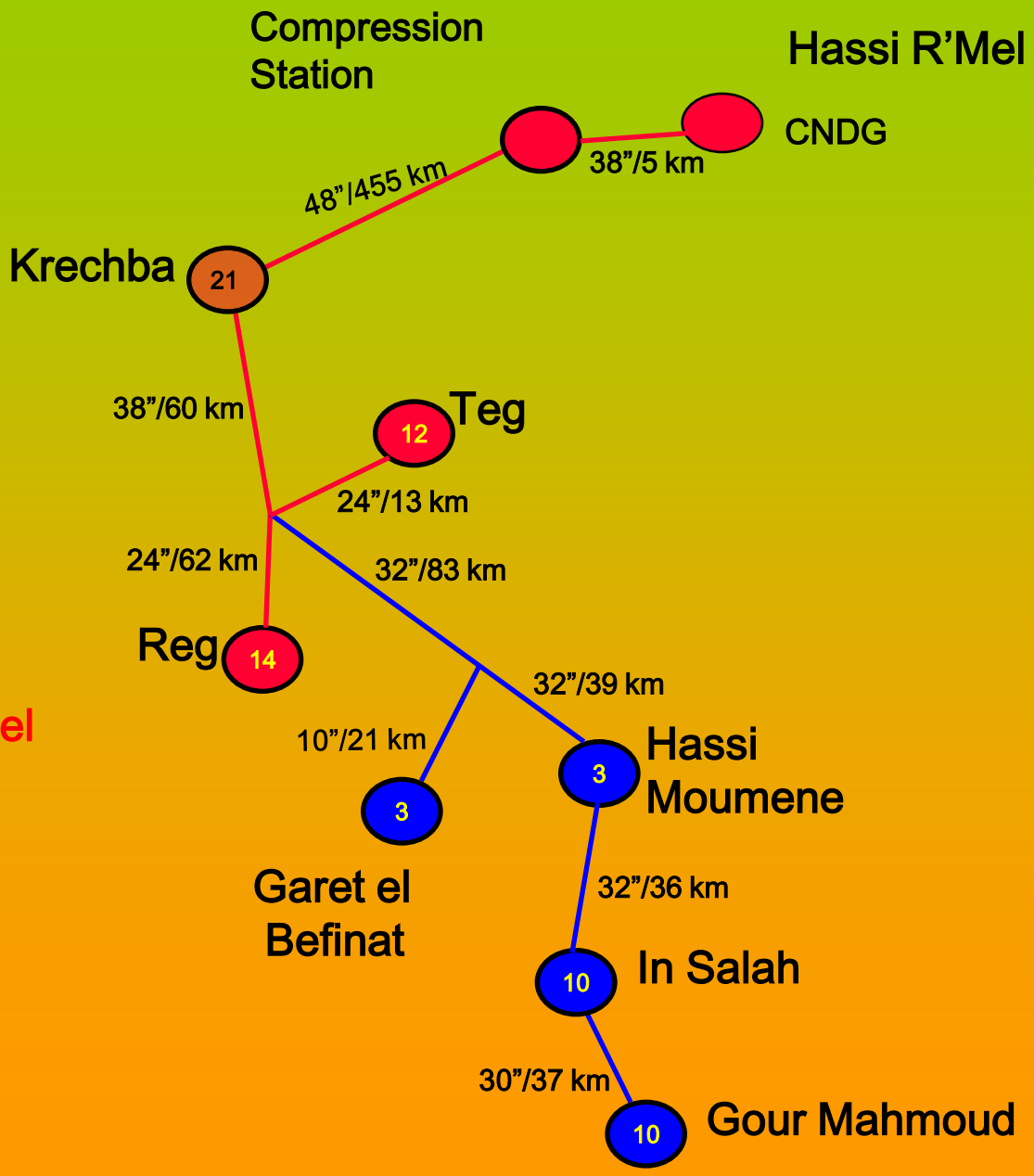
<u>Phase 1</u>:

Drilling of 25 wells
- 22 producers
- 3 injectors

Construction of 3 CPF
Compression Station at Hassi R'Mel
A 48" Pipeline, 460 km long



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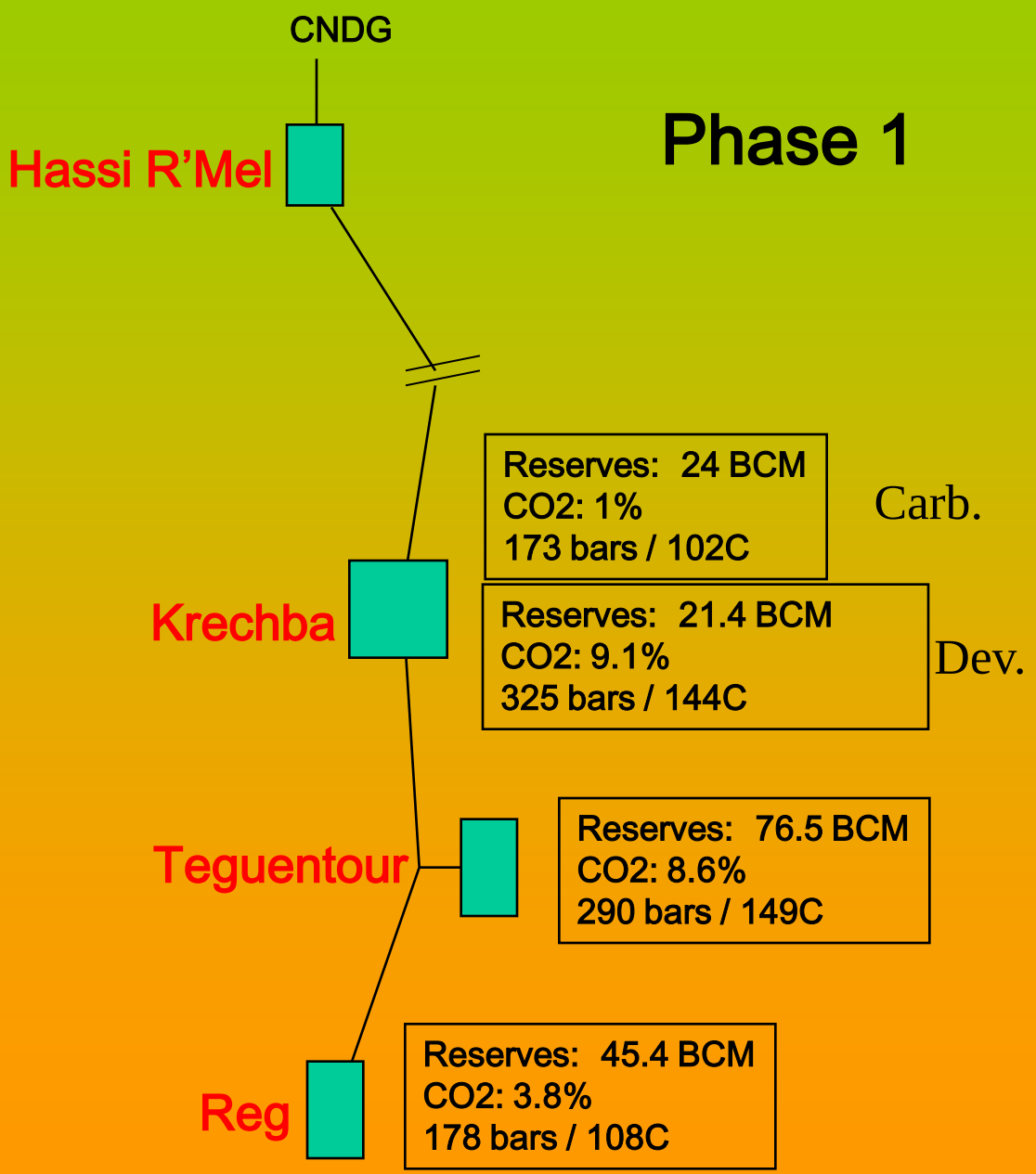
CNDG
Hassi R'Mel
Phase 1
Reserves: 24 BCM
CO2: 1%
173 bars / 102C
Carb.
Krechba
Reserves: 21.4 BCM
CO2: 9.1%
325 bars / 144C
Dev.
Teguentour
Reserves: 76.5 BCM
CO2: 8.6%
290 bars / 149C
Reg
Reserves: 45.4 BCM
CO2: 3.8%
178 bars / 108C

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Key elements

A multi-phase Project, of multiples fields

▪ Reserves in place	340 BCM
▪ Recoverable Reserves	232 BCM
▪ Start of the Project, phase 1	November 2001
▪ First gas	July 2004
▪ Plateau	9 BCM / year
▪ Duration of the plateau	14 years
▪ Duration of the Contract	30 years
▪ Investment phase 1	1.7 billion dollars
▪ Compression start up	As from 2010
▪ Investment for Compression	0.8 Billion dollars
▪ Southern Fields Production	As from 2012
▪ Estimated investment for Southern Fields	1.5 billion dollars
▪ Total number of wells for the two phases	73

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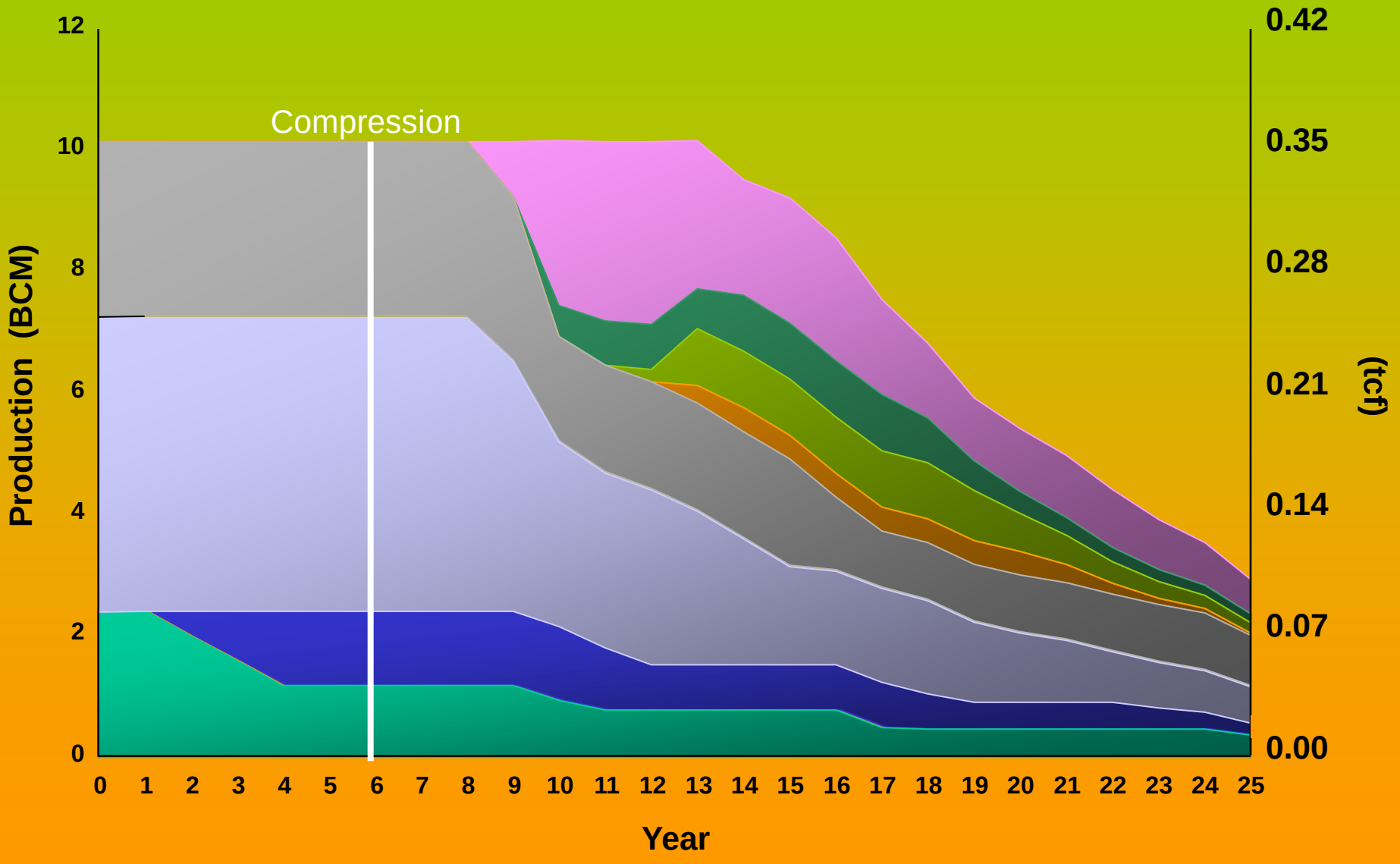
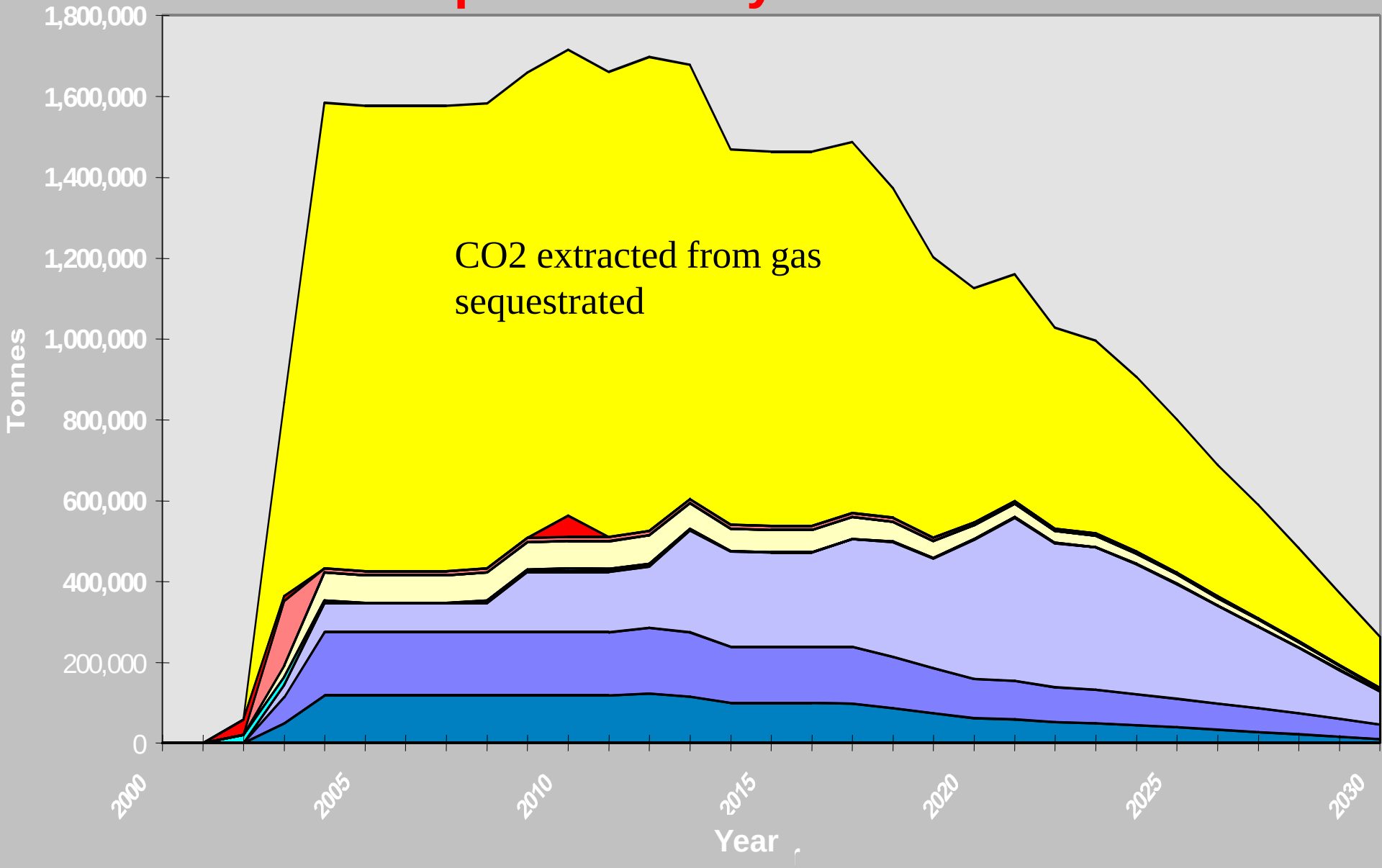
Production profiles



CO2 produced by source



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Some Figures

- 0,7 billion of m3 per year of CO_2 re-injected
- 60% reduction of greenhouse effect gas
- 20 Million tons of CO2 re-injected through out the life of the project
- Analogies
  - Equivalent of 200 000 cars running 30 000 km / year
  - 200 km^2 forest equivalent
- Re-injection Capex: 100 Million
- Estimated Re-injection Opex: 10 Million/year

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SEQUESTRATION OPTIONS

- Site choice criteria
  - Integrity and tightness of the reservoirs
  - Sufficient storage capacity
  - Good porosity
  - Moderate Pressure

- Carboniferous Reservoir at Krechba
  - Tight reservoir and high storage capacity
  - Availability of seismic data.
  - Existence of exploration and evaluation wells
  - A unique facility of CO_2 extraction

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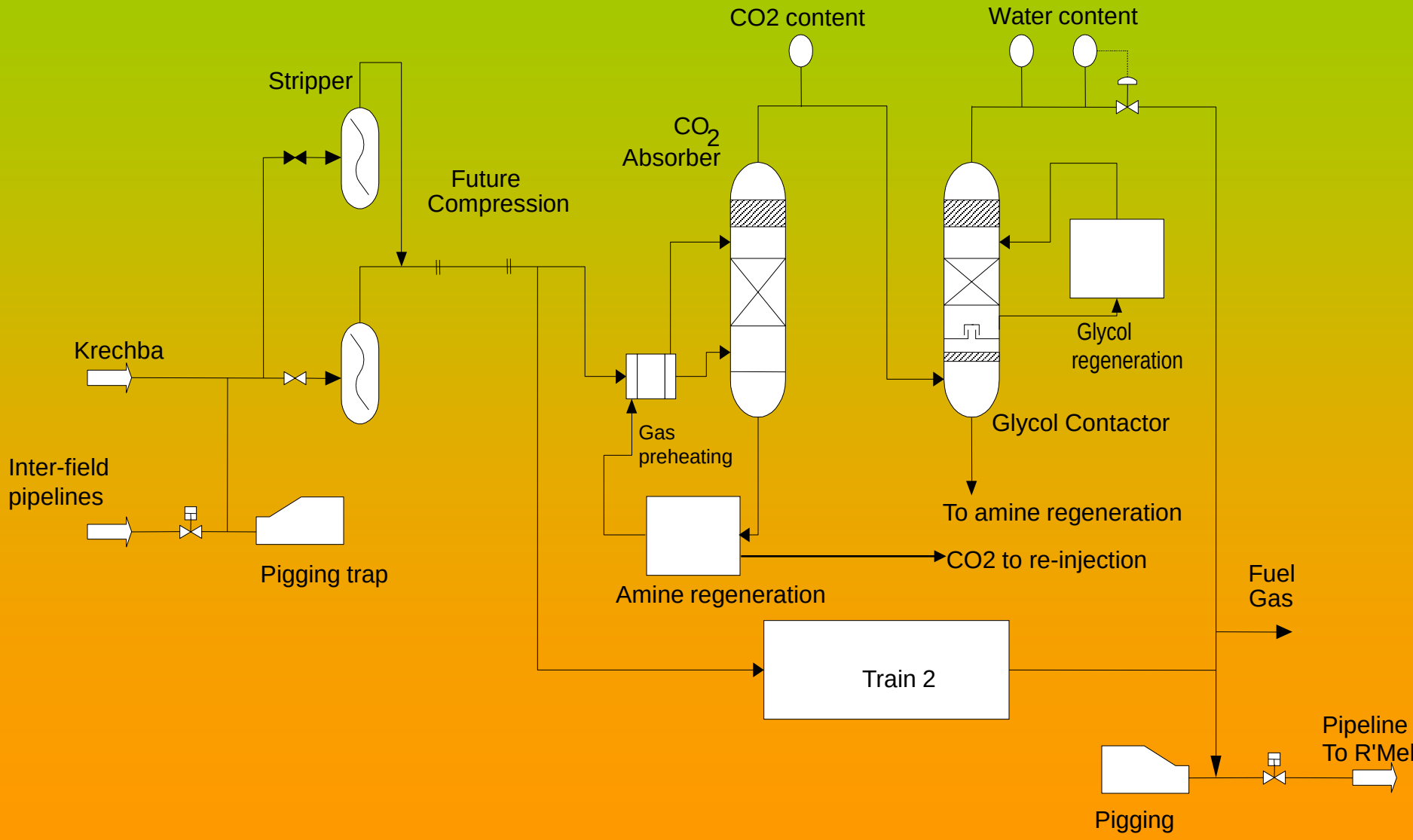
CO2 extraction and dehydration



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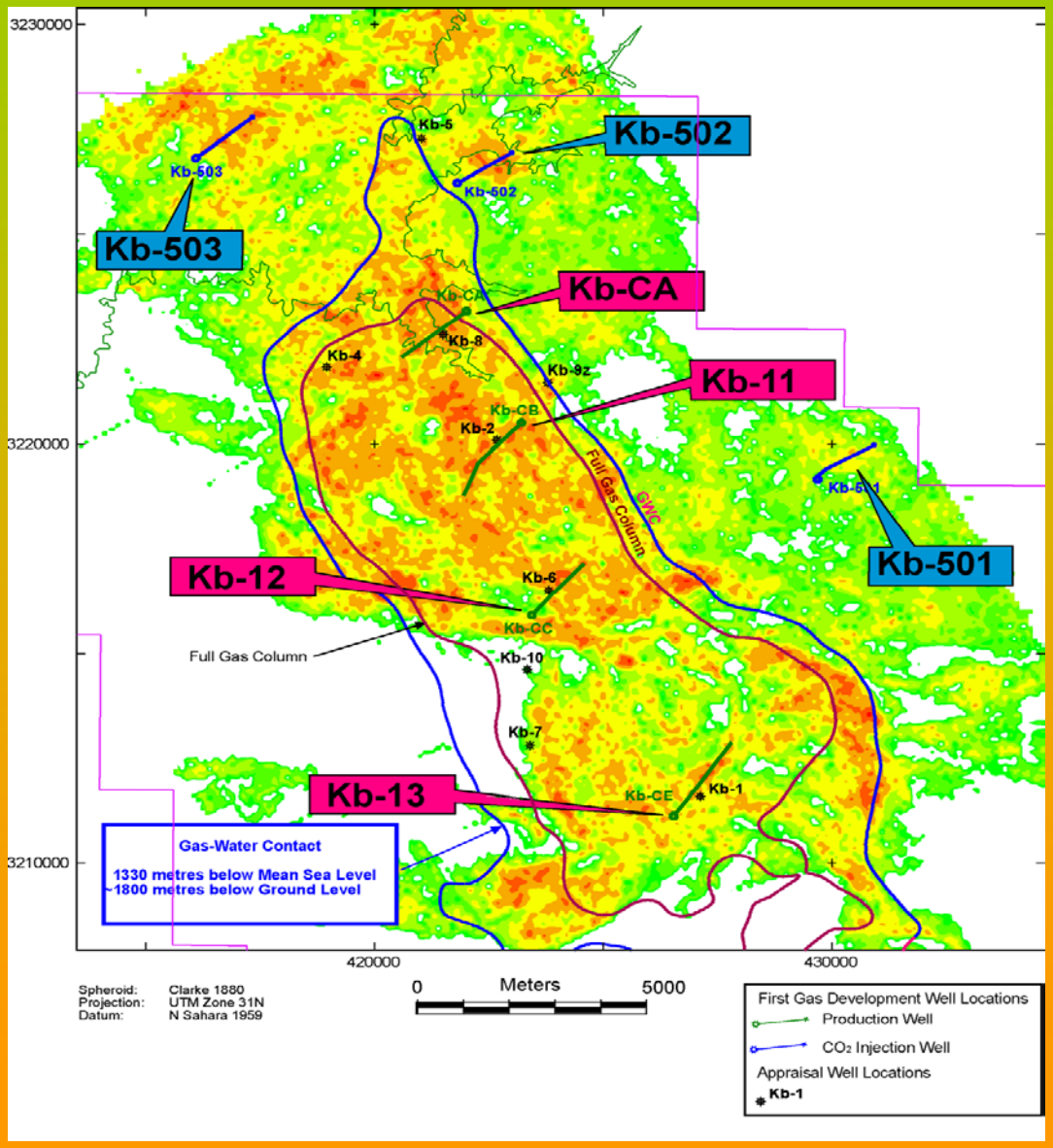
Wells location



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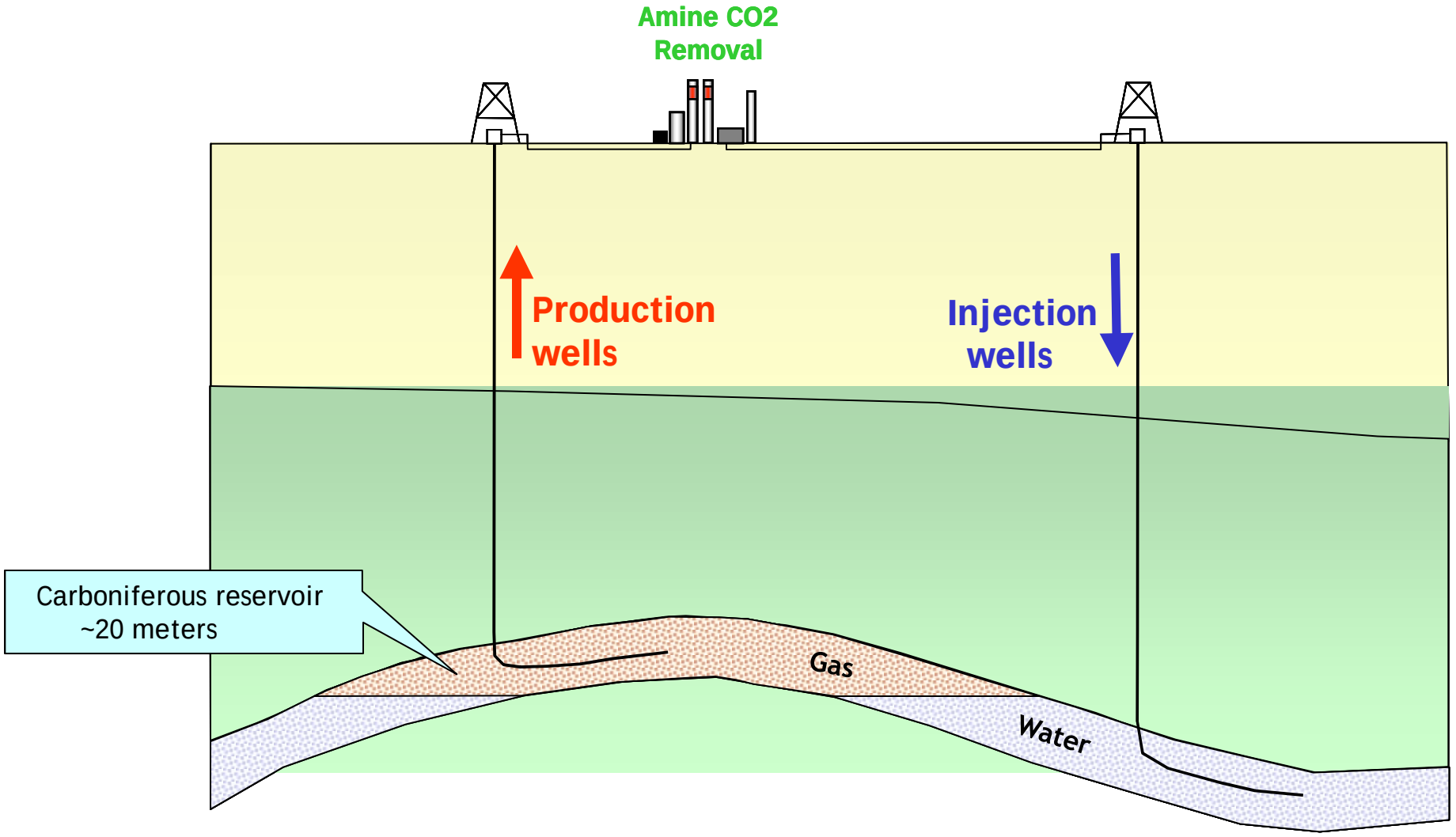
CO2 injection pattern



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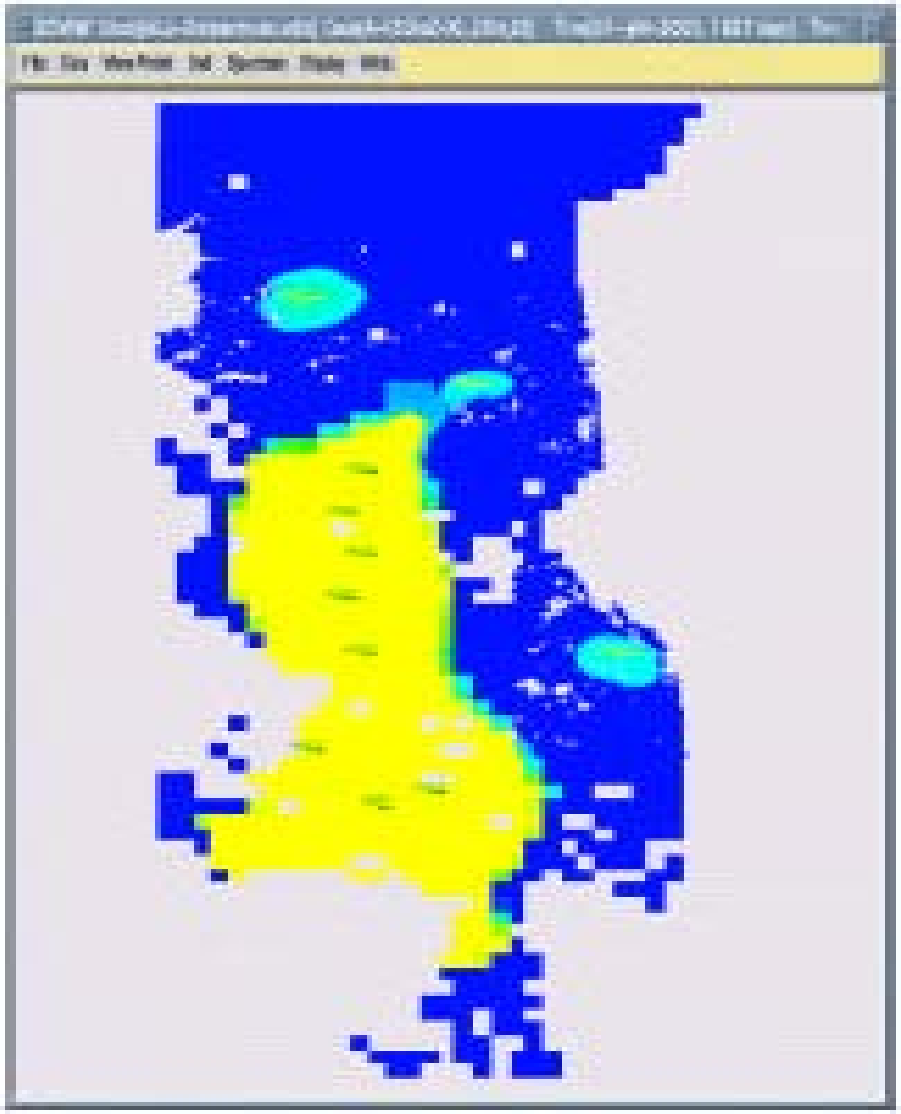

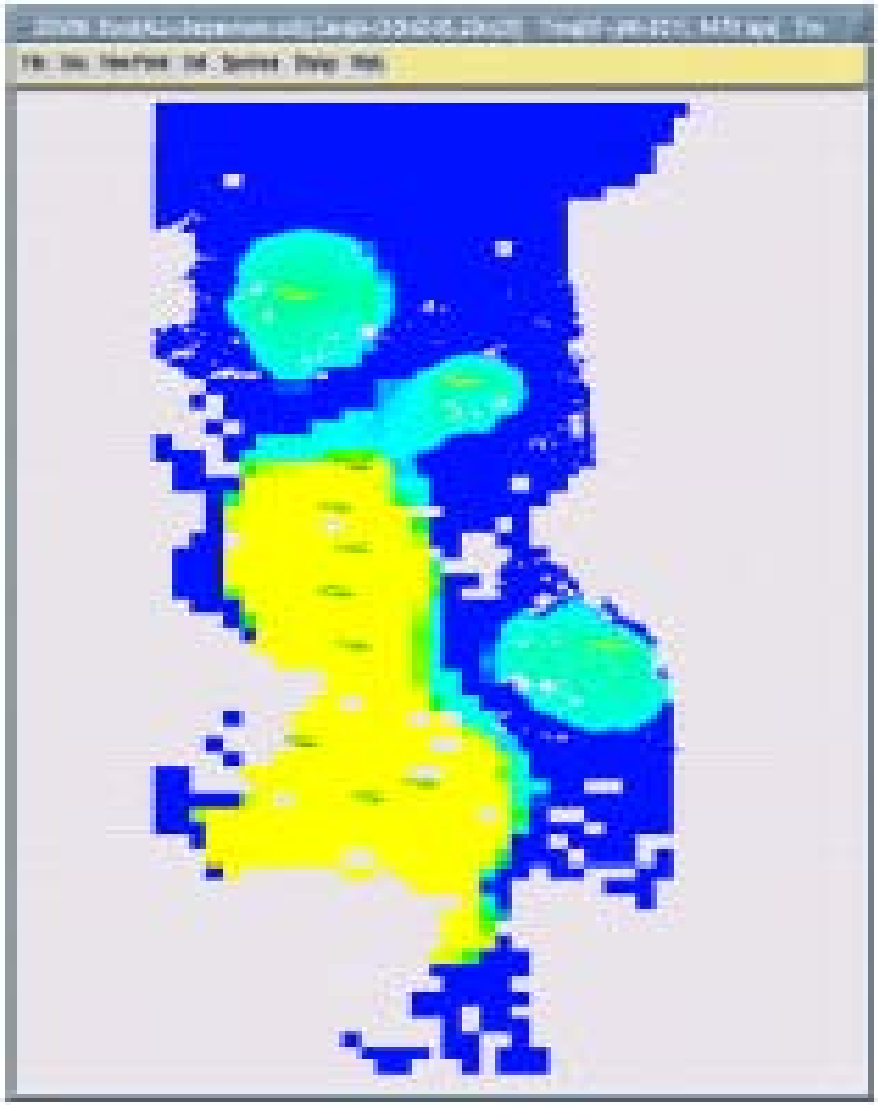

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CO2 compression system parameters

- **CO2 Extraction from produced gas (average content 7%) using Amine**
- **Extracted CO2 is sent to the re-injection system**
- **2 compressors disposed in parallel are used for the compression of the whole extracted CO2**

  - Suction Pressure : 0,15 to 0,30 bars
  - Discharge Pressure : 150 to 200 bars
  - 4 stages of compression
  - All the casings and impellers are made of stainless steel

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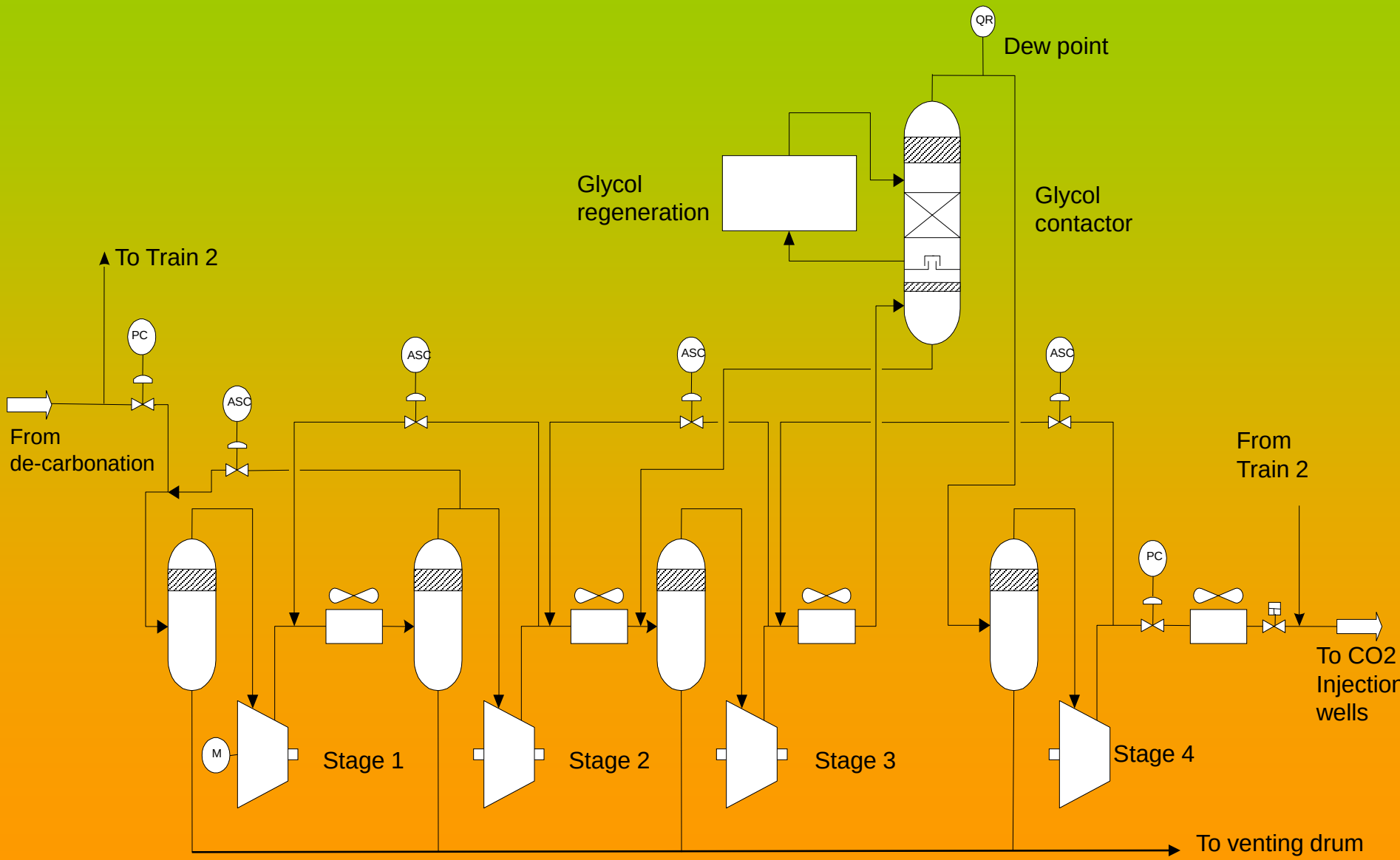
CO2 Compression



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Reservoir challenges

- Injection pressure limited to 160 bars in order to avoid any risk of fracturing the reservoir
- Low absorption at the start of the project. Stimulation required

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Conclusion

The experience of CO2 sequestration introduced by In Salah Gas Project showed that:

- The solution is technically feasible
- Is Economically acceptable
- The monitoring and satellite pictures show that the CO2 evolves in accordance with predictions and simulations
- Geologically, the solution is viable
- Could be generalized, provided that there be a receiving reservoir