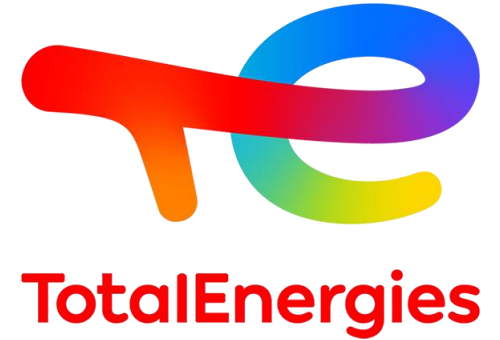




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ASTRA* - An efficient workflow for assessing carbon storage resources in saline aquifers

SPE Aberdeen 6-7th Oct. 2026

Agenda

1. Industry challenge
2. ASTRA
 1. Need for a tool
 2. Principle
 3. Workflow
3. Case study
 1. Inputs
 2. Output
 3. Scenarios Sensitivity
 4. Take home message

* Aquifer **ST**orage **R**esource **A**ssessment

1. Industry challenge



	Screening stage	Feasability stage	Detailed project stage
Timing	Weeks Short Deadlines	Month(s) Tight deadlines	Several Months or more
Object	Leads	Prospect	Prospect maturation
Objectives	Ranking	Confirm risk(s) and Storage Potential	Ready to drill

Feasability stage

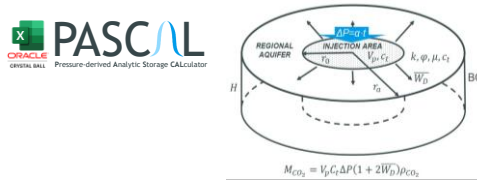
- Exploration phase: to be efficient in term of cost and timing
- Fit for purpose study in order to assess Risking and Storage Potential of a selected target
- In position to decide GO/NOGO for « heavy » studies (Prospect Maturation/Conceptual Phase)

Need for a tool to assess quickly CO2 storage ressources in an acquifer

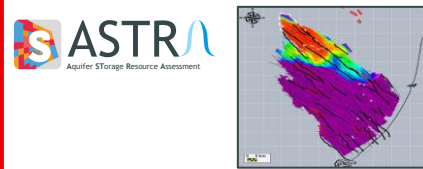
2. ASTRA – The right tool at each step of evaluation

Probabilistic pressure constrained methods

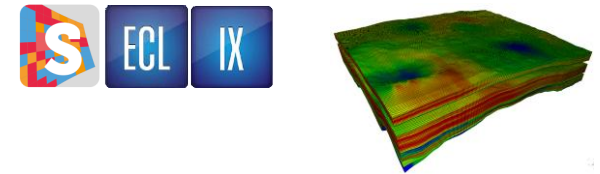
1D Analytical - PASCAL



2D modelling - ASTRA



3D Conventional modeling - IX



Screening stage

Feasibility stage

Detailed project stage

INPUTS

Homogeneous store parameters

2D heterogeneous geomodel
(simplified)

3D heterogeneous geomodel

ENGINE

Analytical aquifer outflow function

Numerical pressure solver

Flow simulator (Eclipse or Intersect)
with explicit CO₂ injection

OUTPUTS

- Distribution of resources
- **Delta pressure profile (1D)**

- Distribution of resources
- **Delta pressure maps (2D)**

- Distribution of resources
- **Delta pressure field (3D)**
- **CO₂ saturation field (3D)**

IMPLEMENTATION TIME

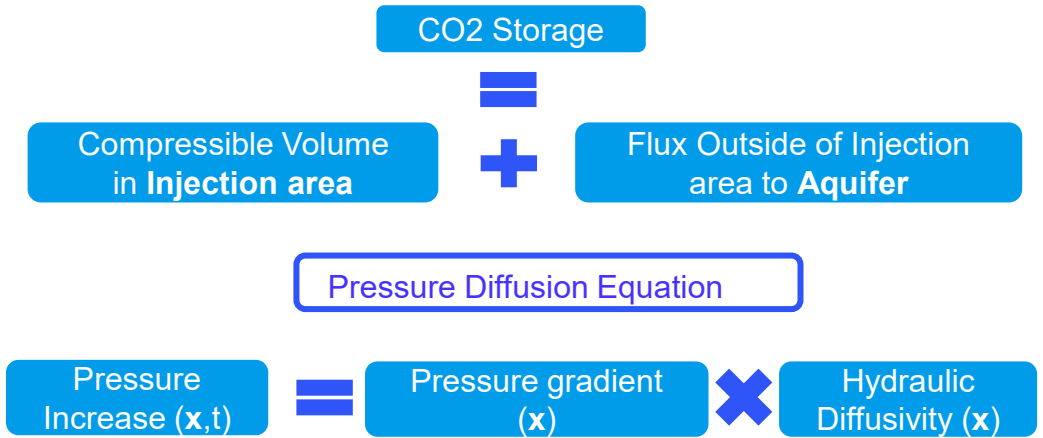
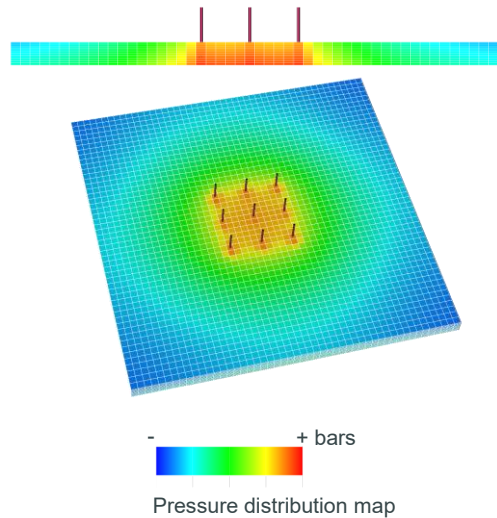
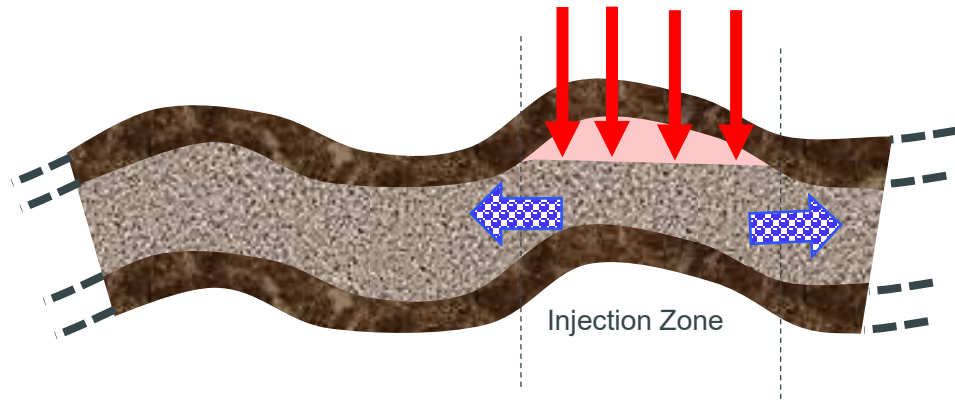
1 **hour** to few hours

1 **day** to few days

Few **weeks/months**

Project maturation

2. ASTRA Theory - Pressure Solver



Aquifer Storage Resources Assessment

Concept: Equivalence between mass of CO₂ and pressure distribution in aquifer.

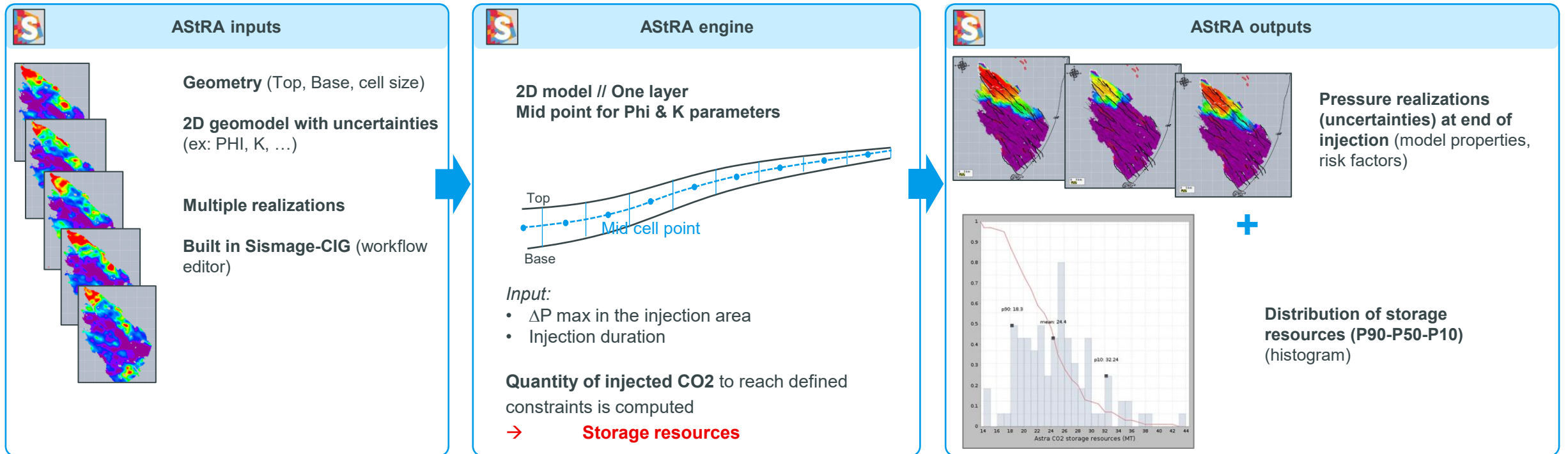
The equivalence is based on the replacement of water in the pore space by CO₂ at reservoir P,T conditions under the applied injection overpressure.

Method: estimate injected CO₂ resources purely from pressure constraints (no explicit CO₂ injection modelling)

Storage Resources range can be derived over a **large set** of geological model realizations

PRESSURE CONSTRAINED RESOURCE EVALUATION WITH ASTRA

AStra computes distribution of storage resources based on a 2D geomodel with uncertainties and a set of constraints/targets associated to the storage



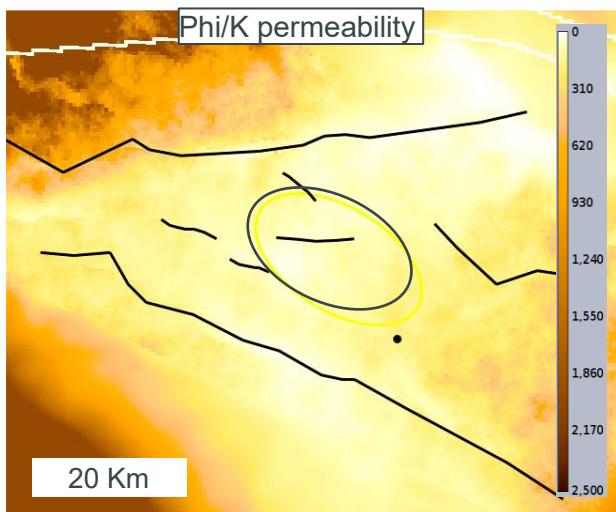
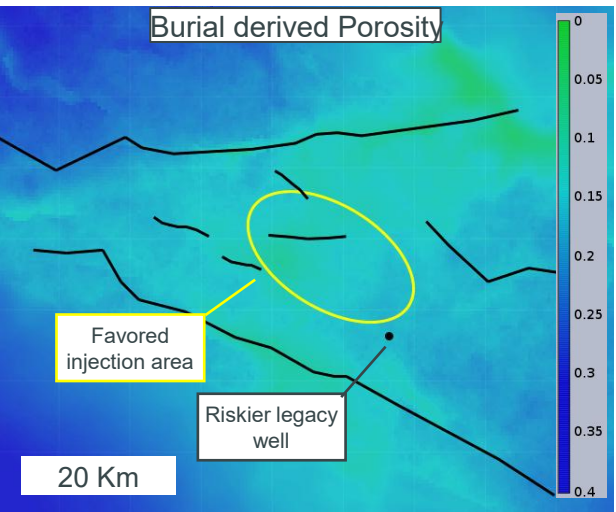
A fit for purpose workflow

3. Case Study - feasibility study prior 3D model



FIRST RUN

INPUTS

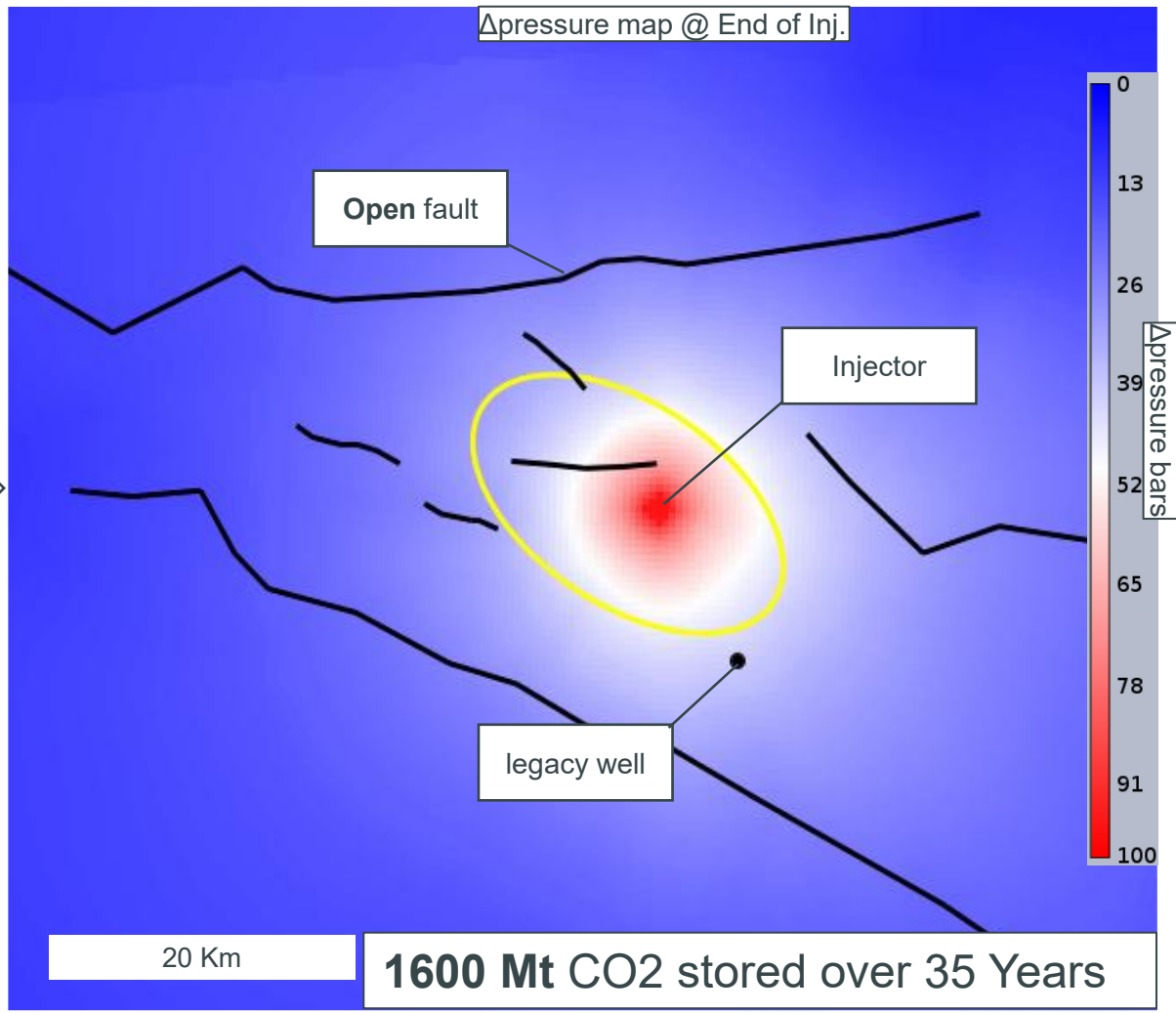


• 35 years of injection
• 100 bars Geomech. constraint

Res. Top & Base depth map,
T°C, virgin pressure (hydrostatic),
Pore compressibility,
Geomechanical constraints (100 bars)

...

OUTPUTS



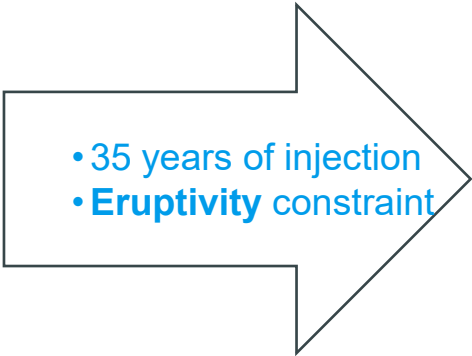
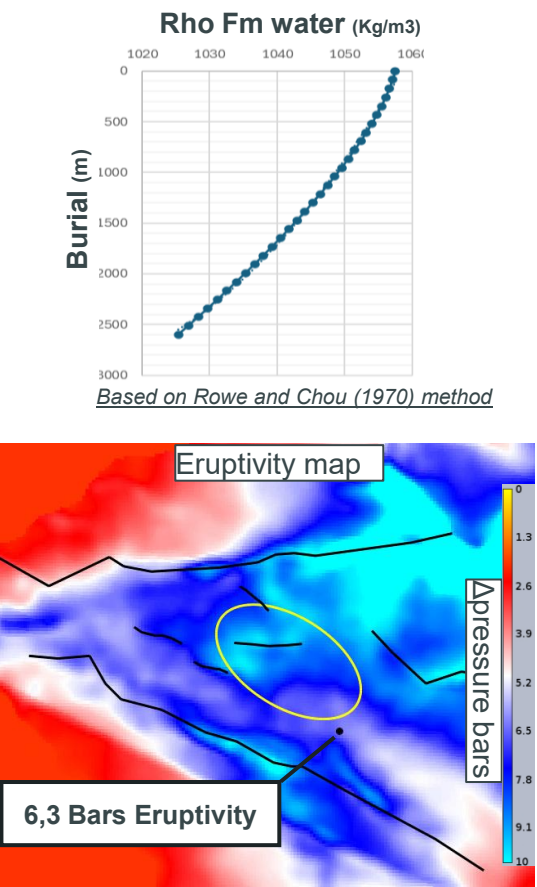
1600 Mt CO2 stored over 35 Years

Target reached

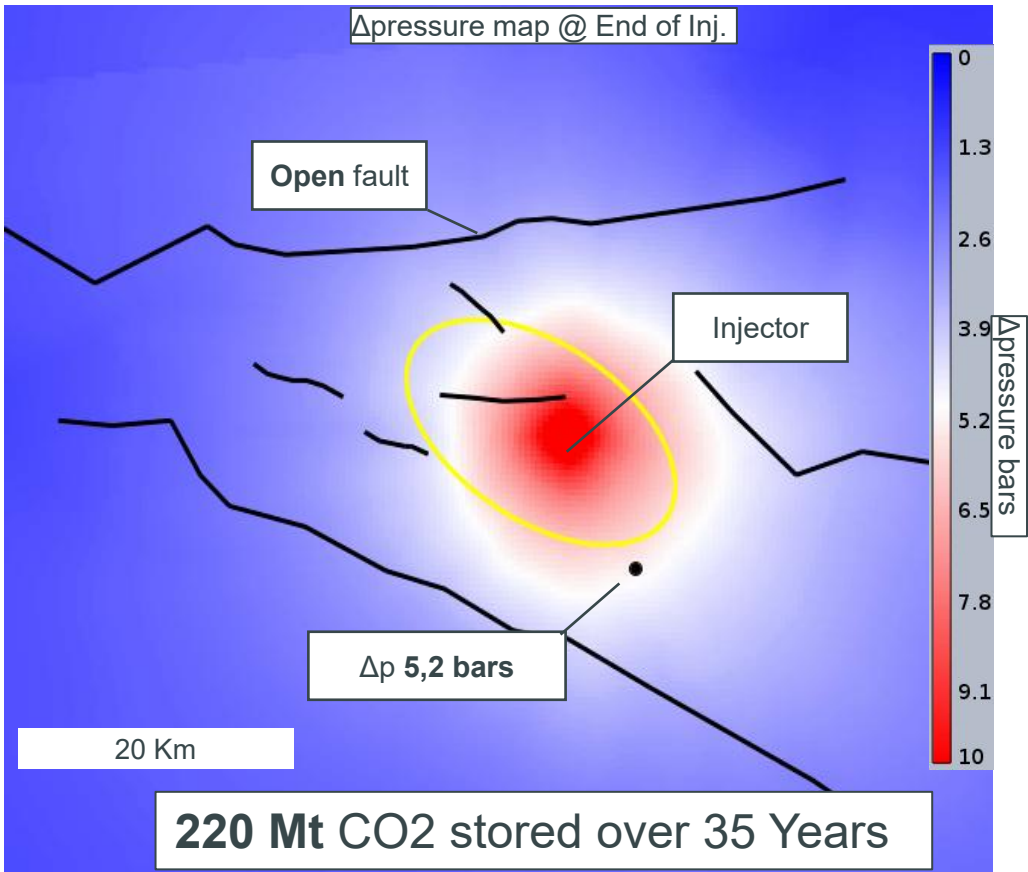
3. Case Study - feasibility study prior 3D model



ERUPTIVITY constraint
PRESSURE CONSTRAINT



OUTPUTS



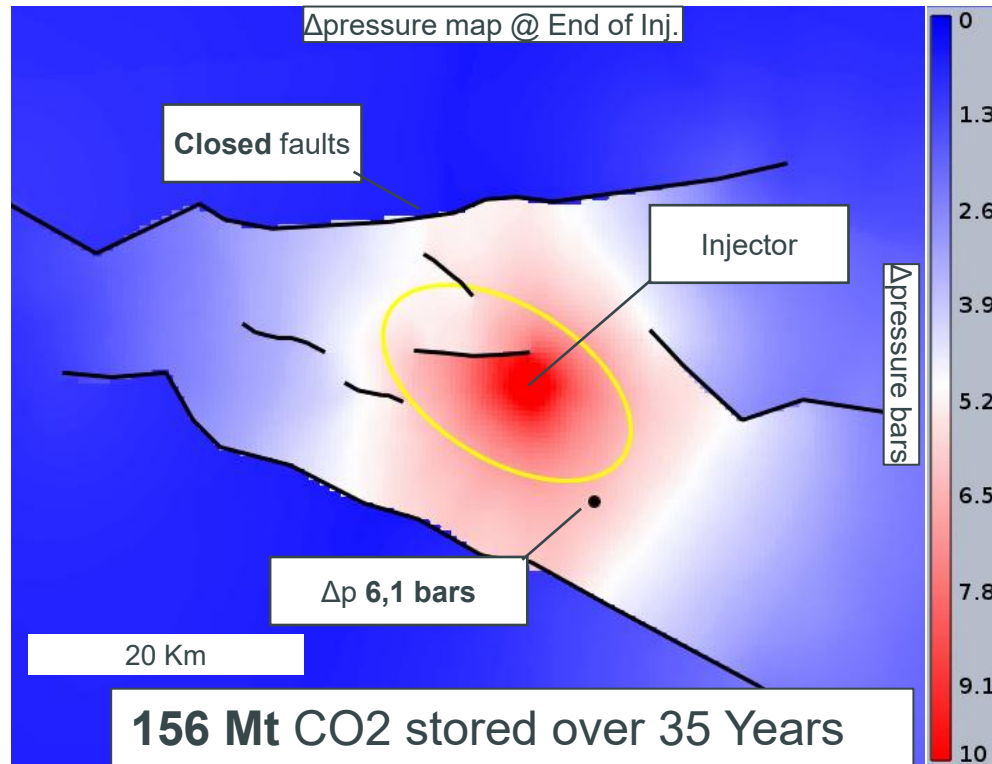
Target reached with reduce pressure limit

3. Case Study - feasibility study prior 3D model

ERUPTIVITY + SENSITIVITIES

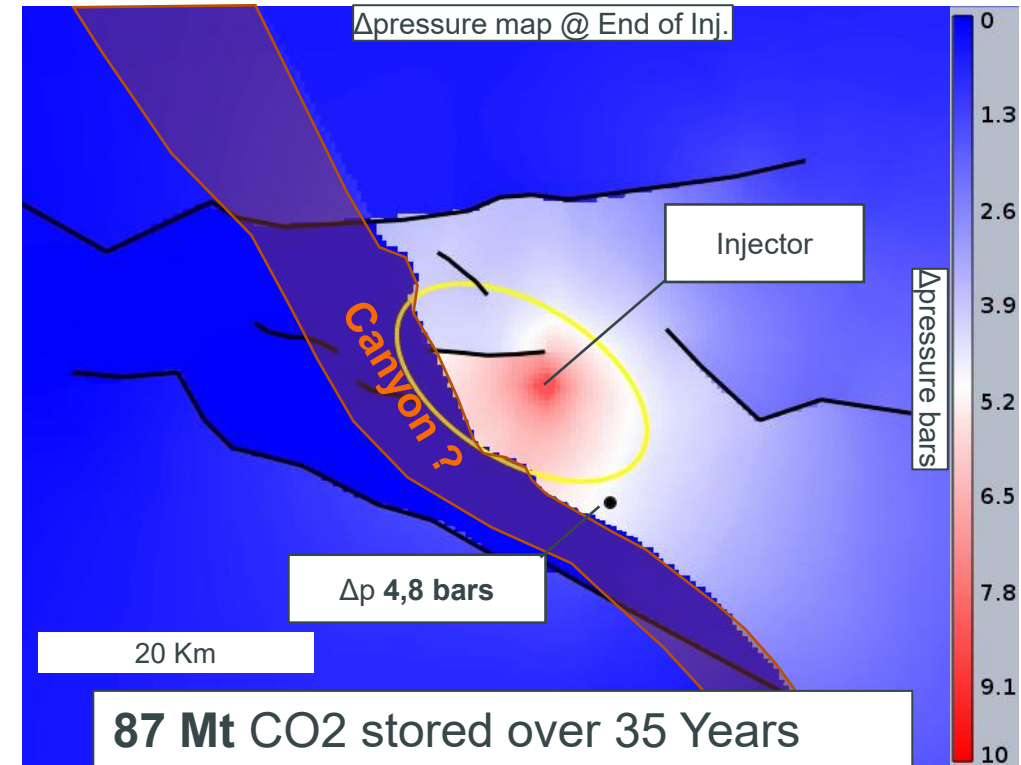


What if the faults are closed?



Target reached with closed faults

What if there is a potential barrier?



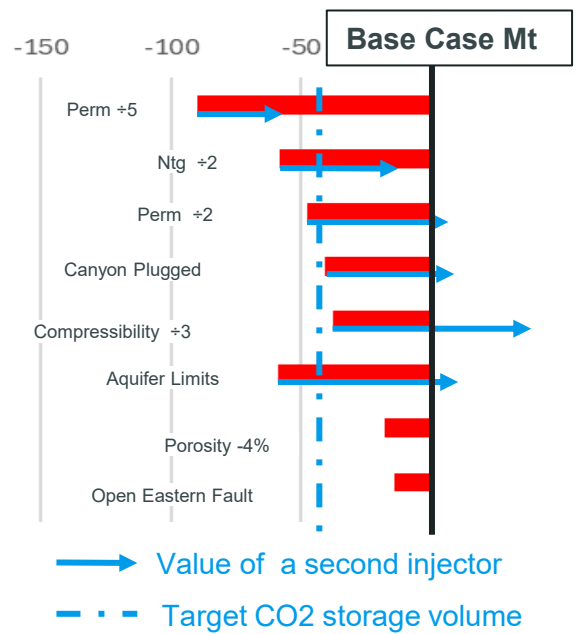
Target reached with clay plugged canyon

3. Case Study - feasibility study prior 3D model

ERUPTIVITY + SENSITIVITIES + 2nd INJECTION ZONE



Mono parameter Sensitivities



	Target reached with 1 injector	Target reached with 2 injectors
Perm/5	X	X
Ntg/2	X	✓
Perm/2	X	✓

- Identified main impacting parameters
- Identified problematic scenarios
- Highlighted the value of a second well as a mitigation

➔Astra confirmed the potential of this storage site, no show stopper was identified, the project moved on with a conventional 3D model

3 . Take away message



Fast decision making & ranking of opportunities requires to be reactive & efficient

"ASTRA provides a rapid probabilistic estimate of storage resources during feasibility project phase."

Limits

- Does not provide CO2 plume extension
- Does not capture 3D heterogeneities (horizontal barriers & layering, vertical K profile, vertical pressure)
- Does not integrate well performance
- Not sufficient to evaluate and design a project

Benefits

- Easy to build (2D modelling)
- Very quick to run (<1mn for a deterministic case)
 - Sensitivities (fault, petrophysics...)
- Multi-realizations to provide a probabilistic range of resources
- Helps identify key parameters to derisk
- Confirm project feasibility before 3D modelling
- Can be used by all geoscientists