

Can UNFC2009 be used to classify injection projects?

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Background

- Programme of work for 2009-10 includes an agreement to explore how the UNFC could be used in classifying injection projects (e.g., CO₂ storage, natural gas storage, wastes) and that a report be presented thereon to the eighth session
- Small work group needs to be set up to address this – currently only one member
- This presentation is an attempt to focus on some of the challenges with injection projects, CO₂ injection in particular, as an introduction to a discussion and further work in the work group

Different Types of Injection Projects

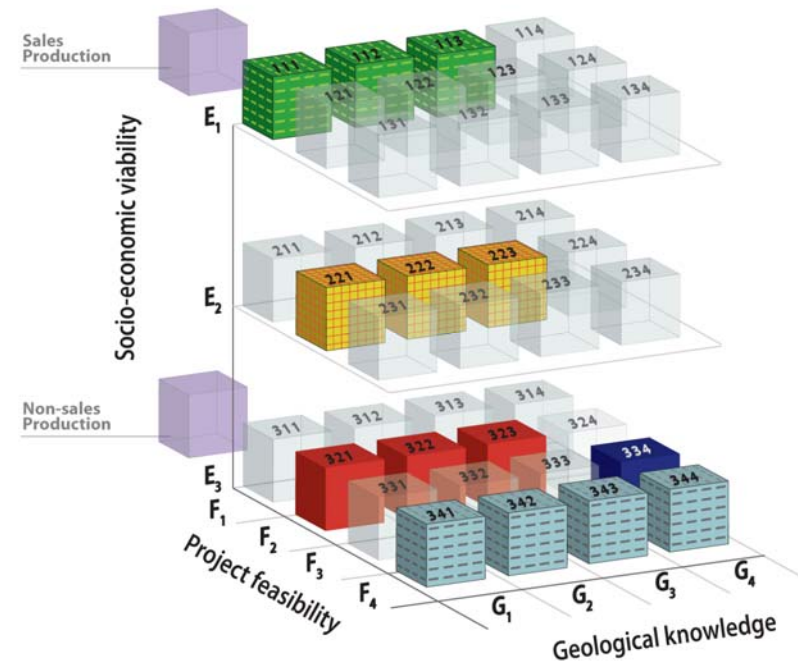
- **Hydro carbon gas injection**
 - Pressure support and increased oil recovery
 - Temporary gas storage
- **CO₂ injection** 
 - Permanent storage, also referred to as sequestration
 - Long term storage
 - Increased recovery from a hydro carbon reservoir (EOR)
 - Large part of the CO₂ is produced with the oil and re-circulated
- **Disposal/storage of other waste products/gases**

Injection project activities - the simple picture

We need to:

- Understand the geology and dynamic behaviour of the recipient reservoir
- Design a technical concept and evaluate the project feasibility
- Calculate the costs and evaluate the economic and social viability of the project
- Make decisions

These are all activities that we know from oil and gas extraction projects and that are well defined in the UNFC2009



Disposal of CO₂ by injection in to geological media

- World wide capacity is significant, although unevenly distributed
 - World wide interest is growing due to climate awareness
 - Projects under consideration in several countries
- Current projects in operation have proven the concept, but most are small
 - Can the same principles be applied in much larger, commercial projects?
- Many similarities with oil and gas accumulations and extraction projects
 - We have experience and technology that can be directly applied
- Also many challenges that may be more complex
 - Every potential site requires individual attention
 - Direct application of any classification system may not be straight forward

CO₂ Storage Principles

Capacity

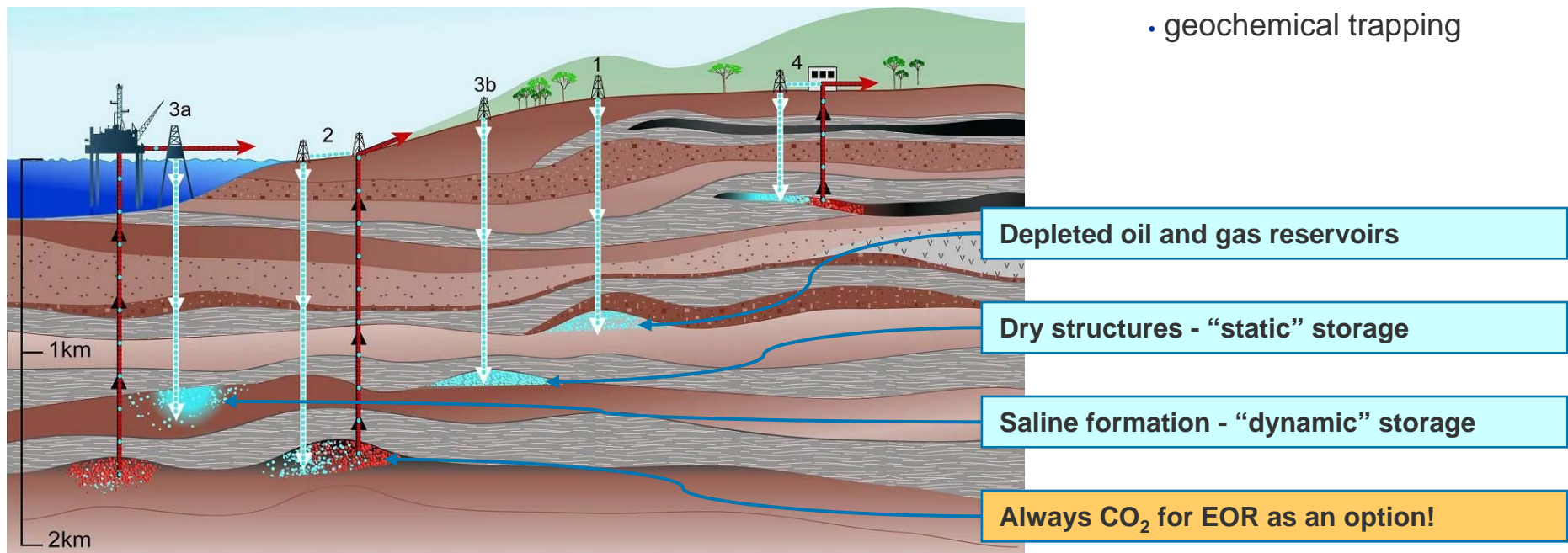
- CO₂ in dense phase
- Large “in-place” pore-volume
- Storage efficiency
- “STOOIP” difficult to calculate

Injectivity

- Reservoir quality (permeability)
- Geochemical reactions
- Injection strategy (no of wells)
- Handle pressure increase

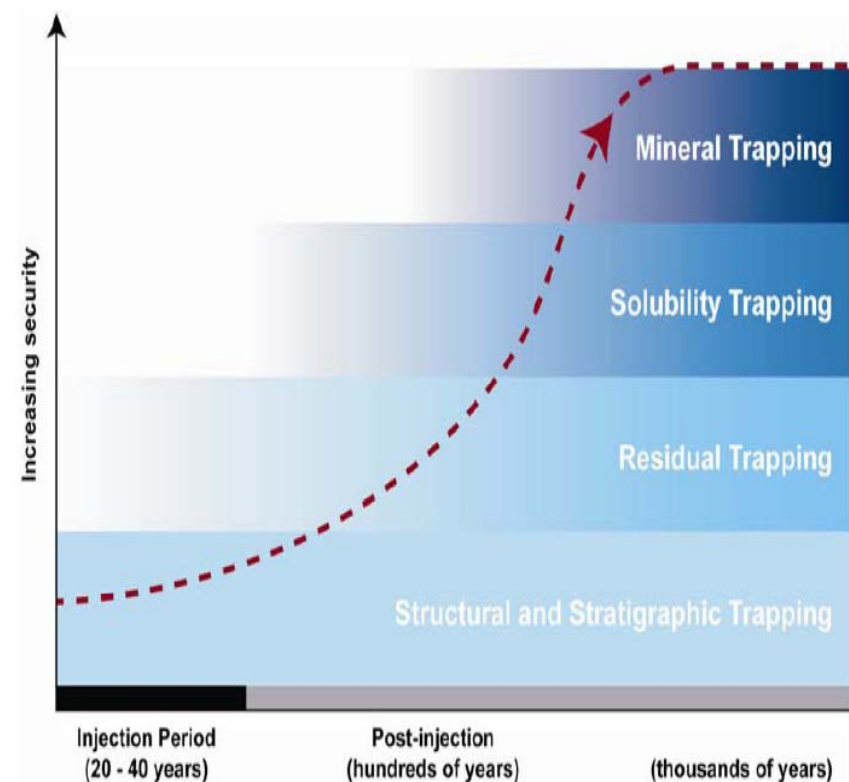
Confinement

- Seal capability (lateral extent, geomechanics, etc)
- Trapping mechanisms
 - geometry (structural)
 - residual trapping
 - geochemical trapping

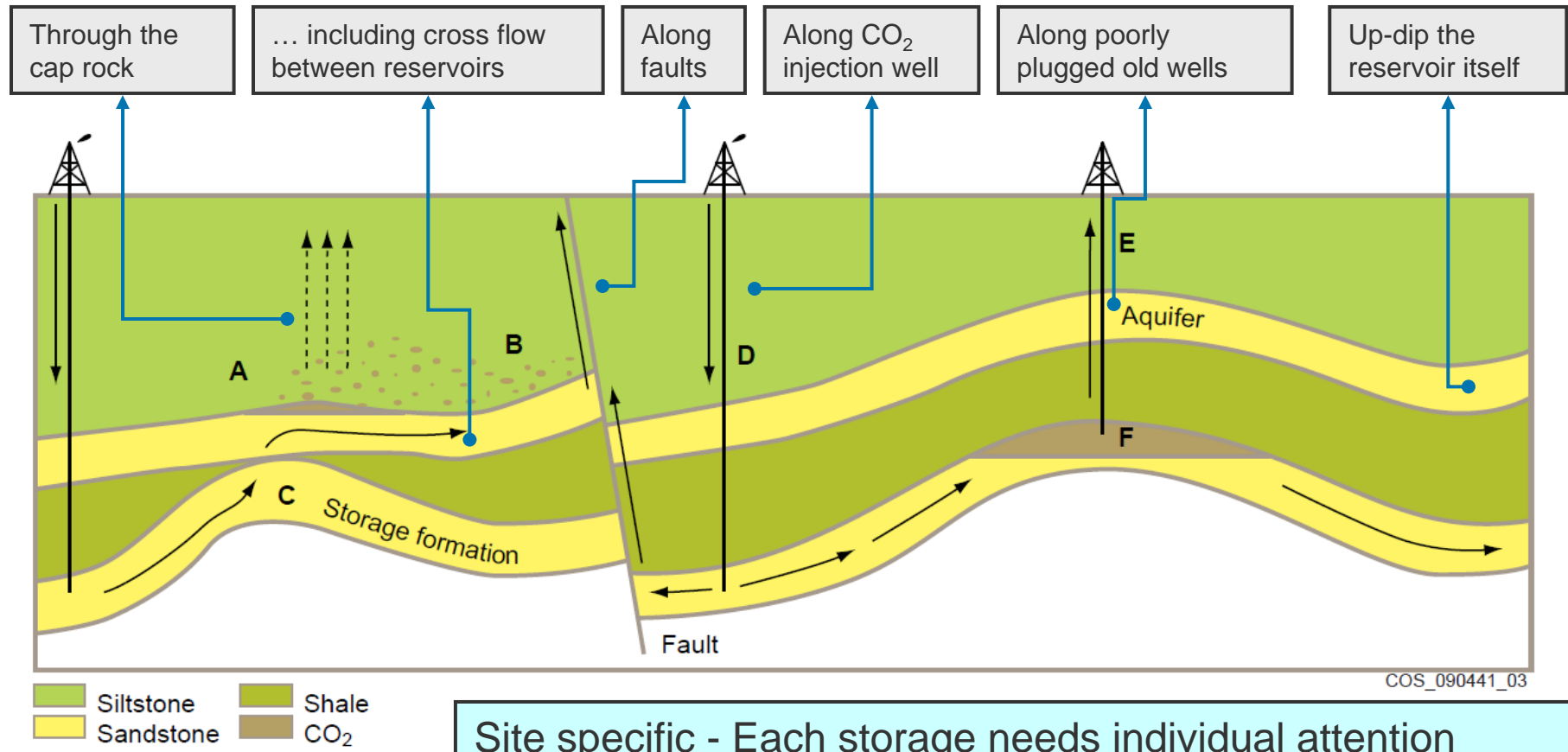


CO₂ Trapping Mechanisms

- Physical trapping
 - Static trapping of mobile CO₂ in stratigraphic and/or structural traps (or man made caverns)
 - Residual trapping in the pore space at irreducible gas saturation
- Chemical trapping
 - CO₂ dissolved in subsurface fluids
 - CO₂ adsorbs onto organic material in coals and shales



Storage Permanence – Leakage Risk

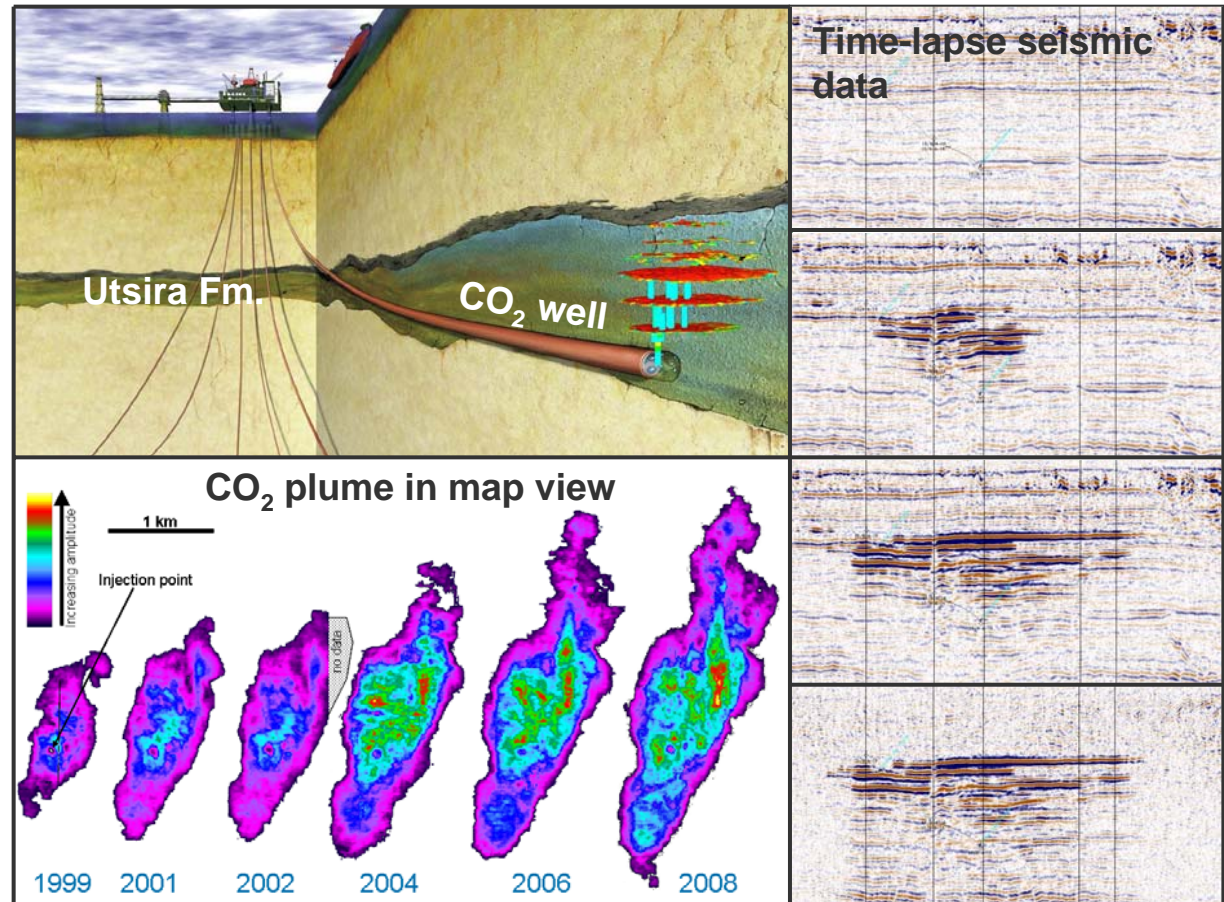


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Handle pressure increase, produce water?

Continuous monitoring and control - also after injection has ceased

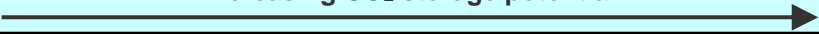
- It ain't over just because we stop injecting!
- CO₂ will continue to migrate in the subsurface
- Monitoring and control activities may have to continue for a long time
- How and for how long will vary from one project to another



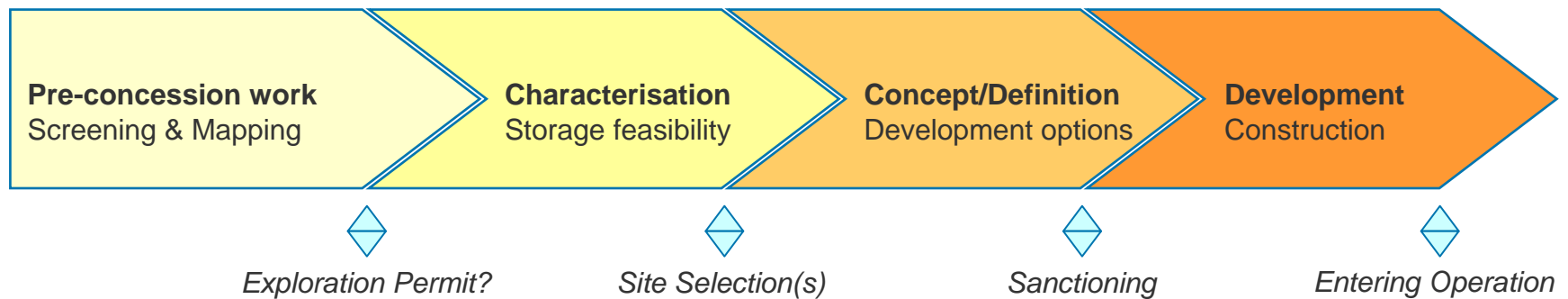
Expectations from potential user groups and other stakeholders

- Classification of a **recipient reservoir** versus classification of an **injection project**
 - Governmental and environmental stakeholders may expect a classification of the actual recipient to be used for screening possible locations around the world
 - Oil and gas companies and other commercial users will expect a more project oriented system

Example of large scale screening criteria

Criterion		Increasing CO ₂ storage potential 				
		Category				
		1	2	3	4	5
1	Seismicity	Very high	High	Intermediate	Low	Very low
2	Size	Very small	Small	Medium	Large	Very large
3	Depth	Very shallow	Shallow		Deep	Very deep
4	Reservoir-seal pairs	Poor		Intermediate		Excellent
5	Geothermal effects	Warm basin		Moderate		Cold basin
6	Conflict of use (natural resources)	High		Medium		Low
For ranking purposes:						
7	Business opportunity	Limited		Moderate		Extensive
8	Logistics (distance to emitters, infrastructure)	Poor		Intermediate		Excellent
9	Data availability	Poor	Little	Medium	Good	Very good

CVP process applied to CO₂ injection projects



UNFC2009 - extraction projects

Total commodity initially in place	Extracted	Sales production			
		Non-sales production			
		Class	Categories		
			E	F	G
	Future recovery by commercial projects/operations	Commercial Projects	1	1	1,2,3
	Potential future recovery by contingent projects/operations	Potentially Commercial Projects	2	2	1,2,3
		Non-Commercial Projects	3	2	1,2,3
	Additional quantities associated with known deposits		3	4	1,2,3
	Potential future recovery by successful exploration activities	Exploration Projects	3	3	4
	Additional quantities associated with known deposits		3	4	4

UNFC2009 – injection projects?

	Injection project				
		Class	Categories		
			E	F	G
		Commercial Projects			
		Potentially Commercial Projects			
		Non-Commercial Projects			
		Screening Projects			

UNFC2009 – injection projects?

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	Potential future storage by contingent projects/operations	Potentially Commercial Projects	2	2	1,2,3
		Non-Commercial Projects	3	2	1,2,3
	Potential future storage by successful exploration activities	Screening Projects	3	3	4

Different challenges for different projects

- Permanent storage without re-production (such as CO₂ sequestration)
 - Simple solution could be to just turn the UNFC around as shown
- Injection and reproduction (temporary storage)
 - Reservoir will need to be classified as both a recipient and as a producer
 - Classified as two separate projects or one?
- Gas injection and reproduction from oil and gas reservoir containing indigenous gas
 - Difficult or impossible to differentiate between produced and reproduced gas and thus for instance what can be counted as reserves and not, in particular if ownership is different.

Summary – Use of UNFC2009 for Injection Projects

- Challenges related to injection and storage are many
- A simple approach could be to apply the main principles of the UNFC2009 as a project based classification tool:
 - Is the injection project economically and socially viable? (E)
 - Is the injection project technically feasible? (F)
 - How much can we expect to inject and store? (G)
- Projects with both injection and reproduction can be a bigger challenge
- Possibilities but not least limitations must be well understood by stakeholders and potential users
 - Development of specifications and guidelines may be even more important if injection projects are included

Thank you

Any volunteers to join a small working group?

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