

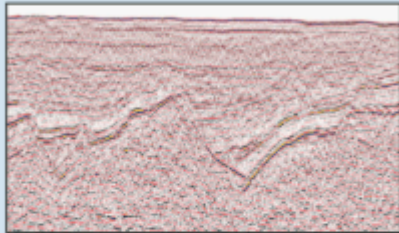
# CCS-M Malaysia Case Study Workshop

KL, 2-4 June 2015

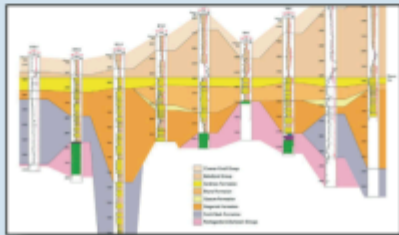
# Screening process

1. Identification of sedimentary basins.
2. Review, data coverage (availability of existing well and seismic data).
3. Determine if a basin is generally suitable for storage of supercritical CO<sub>2</sub> (reservoir – seal pairs existing below ~800 m).
4. Qualitatively and/or quantitatively ranking of sedimentary basins in order of suitability.
5. Quantitative CO<sub>2</sub> storage capacity estimation using probabilistic method (Monte Carlo)

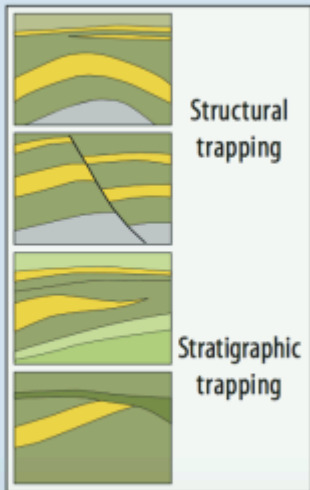
# Evaluation process for safe CO<sub>2</sub> storage sites



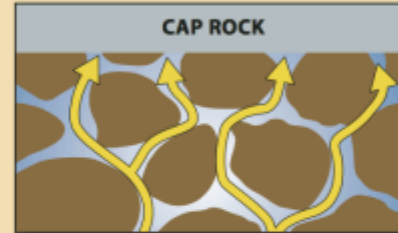
Evaluation of data coverage and knowledge



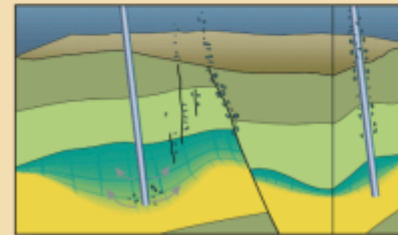
Stratigraphy (reservoir and seal)



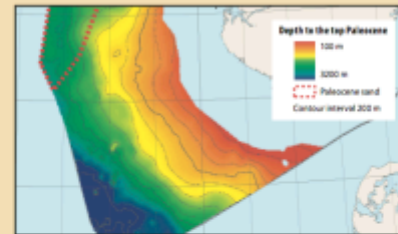
Trapping



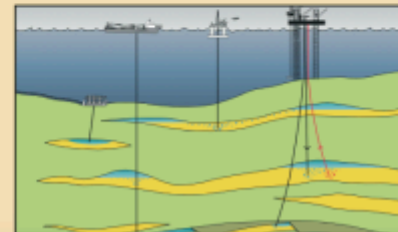
Characterization of reservoir/injectivity



Characterization of seal efficiency



Map potential storage area



Estimate storage capacity

# Qualitative screening

Basin Criterion		Classes				
		1	2	3	4	5
1	Tectonics (Seismicity)	High	High/Medium	Medium	Medium/Low	Low
2	Size	Small (<5000km <sup>2</sup> )	Medium (5000-25000km <sup>2</sup> )	Large (25000-50000km <sup>2</sup> )	Very Large (>50000km <sup>2</sup> )	
3	Depth	Shallow (<1,500m)	Deep (>3,500m)	Intermediate (1,500 - 3,500m)		
4	Type	Non-marine	Non-marine and marine	Marine		
5	Faulting intensity	Extensive	Moderate	Limited		
6	Hydrogeology	Poor (fractured rock system, short flow system)	Intermediate (faulted-fractured rock system, intermediate flow)	Good (regional, long-range flow systems; topography or erosional flow)		
7	Geothermal	Warm basin (>40°C/km)	Moderate (30-40°C/km)	Cold basin (<30°C/km)		
8	Hydrocarbon potential	None	Small	Medium	Large	Giant
9	Maturity	Unexplored	Exploration	Developing	Mature	Over-mature
10	Coal and CBM	None	Shallow (200-800m)	Deep (>800m)		
11	Reservoir	None	Potential	Poor	Good	Excellent
12	Seal	None	Potential	Poor	Good	Excellent
	Reservoir/Seal Pairs	None	Poor	Good (Single)	Excellent (Multiple)	
13	Onshore / offshore	Deep offshore (>200 m)	Shallow offshore (<200 m)	Onshore		
14	Infrastructure	None	Minor	Moderate	Extensive	
15	CO <sub>2</sub> sources	None	Few	Moderate	Major	
16	Data availability	Poor	Moderate	Good	Excellent	



## Effective storage capacity

$$M_{\text{CO}_2\text{e}} = A \times h \times \phi \times \rho_{\text{CO}_2\text{r}} \times S_{\text{eff}}$$

- $M_{\text{CO}_2\text{e}}$ : effective storage capacity
- $A$ : area of aquifer
- $h$ : average height of aquifer  $\times$  average net to gross ratio
- $\phi$ : average reservoir porosity
- $\rho_{\text{CO}_2\text{r}}$ :  $\text{CO}_2$  density at reservoir conditions
- $S_{\text{eff}}$ : storage efficiency factor

# Monte Carlo simulation: sample input

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## Input for Monte Carlo Simulation for Capacity Estimation

Parameter	Unit	Score (P90)	Score (P50)	Score (P10)	Distribution
Area of storage region	km <sup>2</sup>	10000	16000	30000	Triangular
Gross thickness of saline formation	m	200	500	900	Triangular
Average porosity of saline formation over thickness interval	%	19	22	25	Triangular
Density of CO <sub>2</sub> at average reservoir conditions	t/m <sup>3</sup>	0.5	0.6	0.7	Triangular
E-storage efficiency factor (% of total pore volume)	%	4	4	4	
Calculated storage potential	gigatons	31.0	48.8	78.3	



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CCS-M Training Course (T2)  
CO<sub>2</sub> Storage Capacity Assessment  
Bangkok 20-23<sup>rd</sup> August 2013



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