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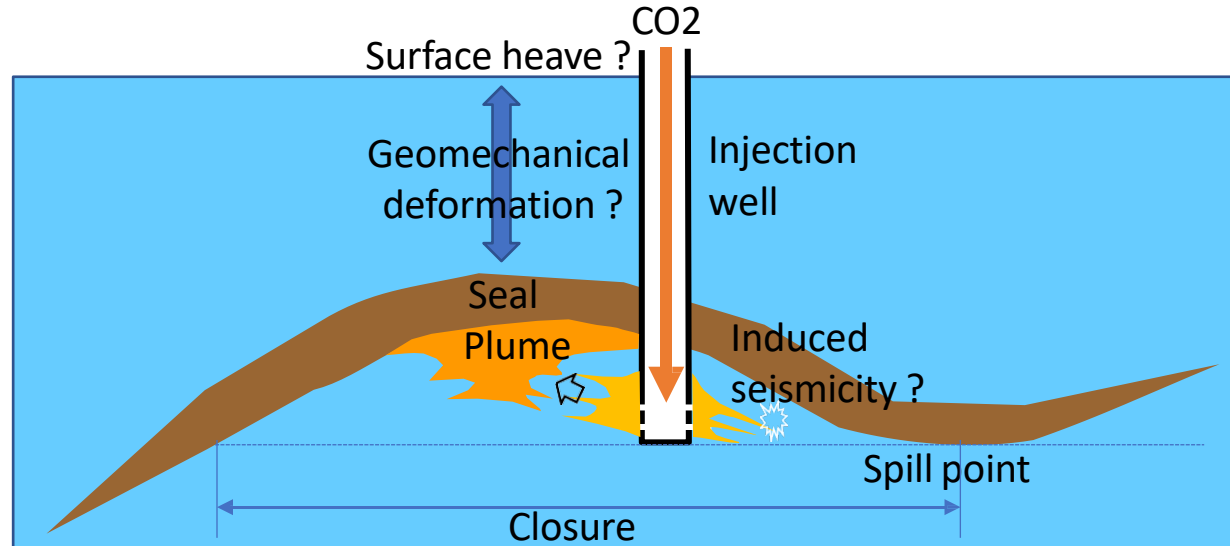
**2022** Empowering Energy  
Transition

5<sup>th</sup> ISES 2022

**EMPOWERING  
ENERGY  
TRANSITION**

## Deep-dive Workshop 10 Technology to ensure safe CO<sub>2</sub> storage

## Application of E&P's established technology



Activity	Subject	Established in
Site selection	Geological storage identification	Oil & gas exploration
Injection	CO2 handling, seal integrity assurance	CO2-EOR, Gas-based IOR
	CO2 containment / re-production	Underground gas storage
Monitoring	Geomechanical events detection	Hydraulic fracturing, Sand control
	Plume management	Sweep control in EOR, Infill well placement

## How to ensure integrity of CO2 storage ?

Injection operation

Seal integrity assurance

Cap rock (bottomhole & formation pressure limit)

Wellbores (cement seal of injectors & legacy wells)

Plume control (numerical modeling & perforation program)

Monitoring

Storage conditions (measurement / sampling at observation well)

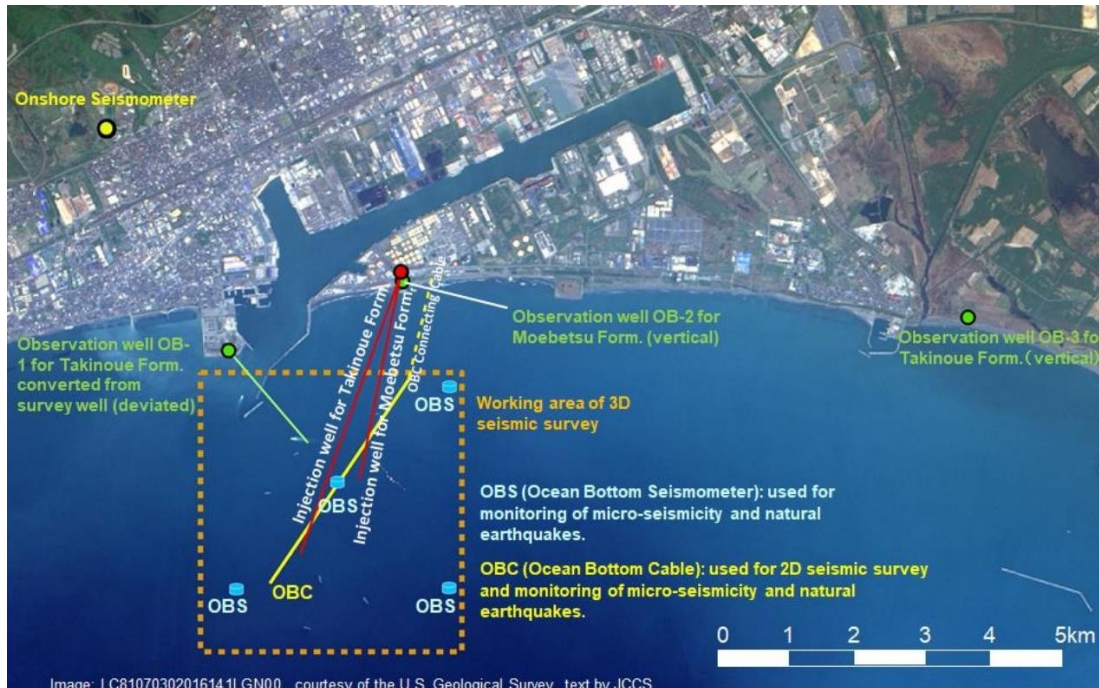
Geomechanics (passive seismic detection, surface heave analysis)

CO2 plume evolution (surface / cross-well seismic survey)

**Environment (air / seawater & soil quality, marine organism activities)**

## What are the long-term impacts to soil and environment due to storing CO2?

Example: Tomakomai CCS Demonstration Project by Japan CCS Co., Ltd.



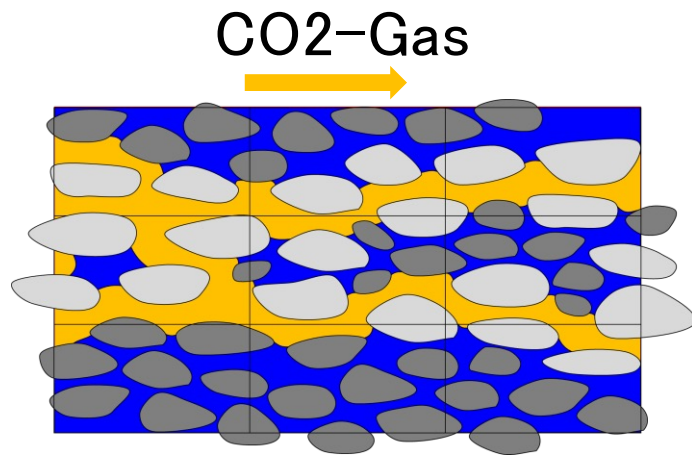
... “Chemical properties of **seawater**” and “Situation of **marine organisms**” did not differ greatly with the baseline surveys ... and there were **no major trends deviating from those of the baseline surveys.**”

... phenomena indicating CO2 leakage or the risk thereof were not confirmed ...

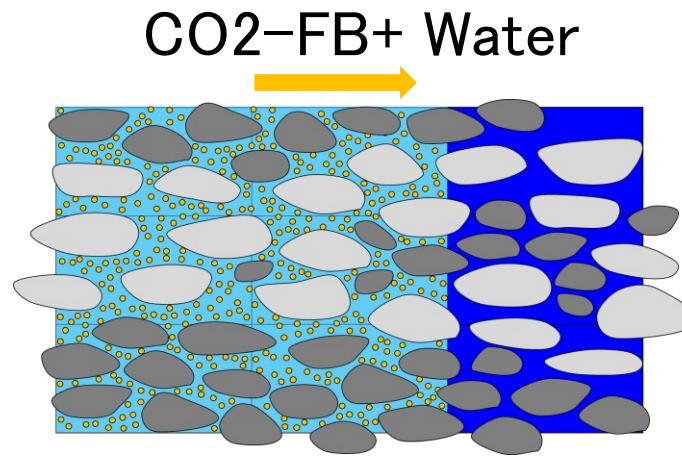
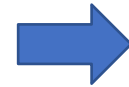
Source: “Report of Tomakomai CCS Demonstration Project at 300 thousand tonnes cumulative injection (“Summary Report”)”, May 2020, Ministry of Economy, Trade and Industry (METI), New Energy and Industrial Technology Development Organization (NEDO), from Information Archives of Japan CCS Co. Ltd. web-site

## Technology development for **storage**

(Example) CO<sub>2</sub> fine / ultra-fine (FR/UFB) bubble to promote aquifer storage



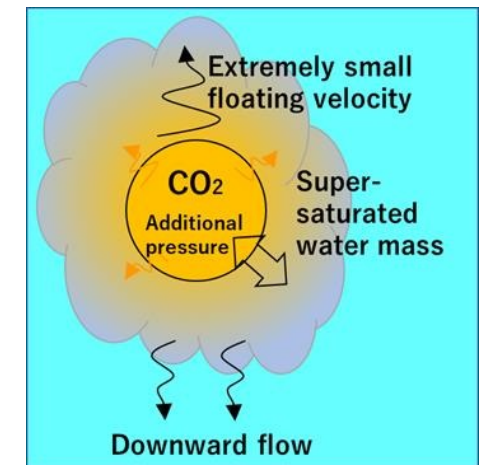
Gas displaces water  
 ⇒ Different density & viscosity  
 ⇒ Low storage factor



Water displaces water  
 ⇒ Stable sweep front  
 ⇒ Storage factor  
 a CO<sub>2</sub> volume fraction +  $\alpha$



CO<sub>2</sub>-UFB+ Water



“Sink” CO<sub>2</sub> bubbles  
 ⇒ Relax top-seal requirement?

• **Purpose of the Joint Study:**

Carbon capture and storage (CCS) opportunities, including suitable carbon dioxide (CO<sub>2</sub>) storage solutions in Malaysia including;

- De-carbonization of Bintulu LNG complex (capture, transport and underground storage of CO<sub>2</sub>)
- CCS Hub at Bintulu including storage of CO<sub>2</sub> from outside Malaysia

• **Volume of CO<sub>2</sub> injection:**

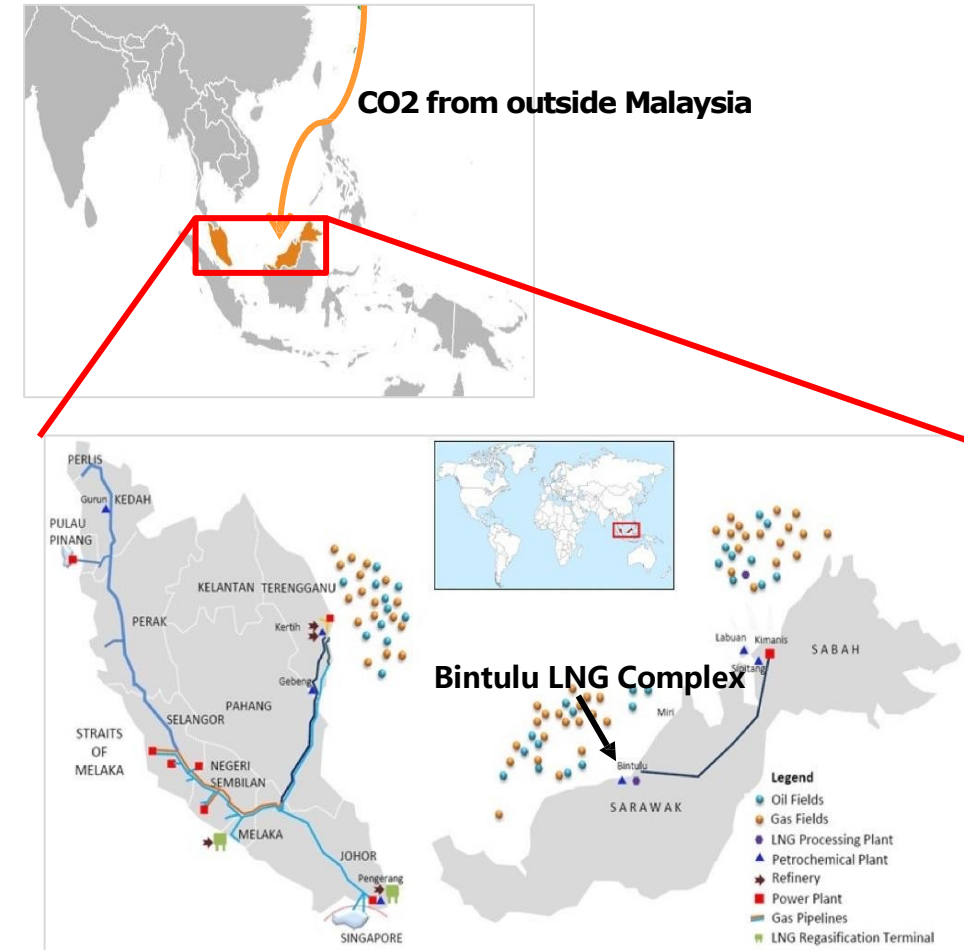
- CCS International CCS Project level such as 5MM tCO<sub>2</sub>e/year

• **Schedule:**

- 27/1/2022: PERTONAS – JAPEX signed MoU for Joint Collaboration Study
- 28/7/22: JGC and "K" LINE joined MoU
- Duration: 20 months

• **Main Study contents:**

- Estimation of emissions and capture volumes
- Investigation and Selection of CCS site
- Investigation of optimal capture and transportation methods
- Monitoring method of CO<sub>2</sub> stored underground
- Economics evaluation and study of business model
- Research of applicable regulations including JCM



Source : The Malaysian Advantage from Petronas home page  
 add BLC name on the map