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Enhanced Oil Recovery



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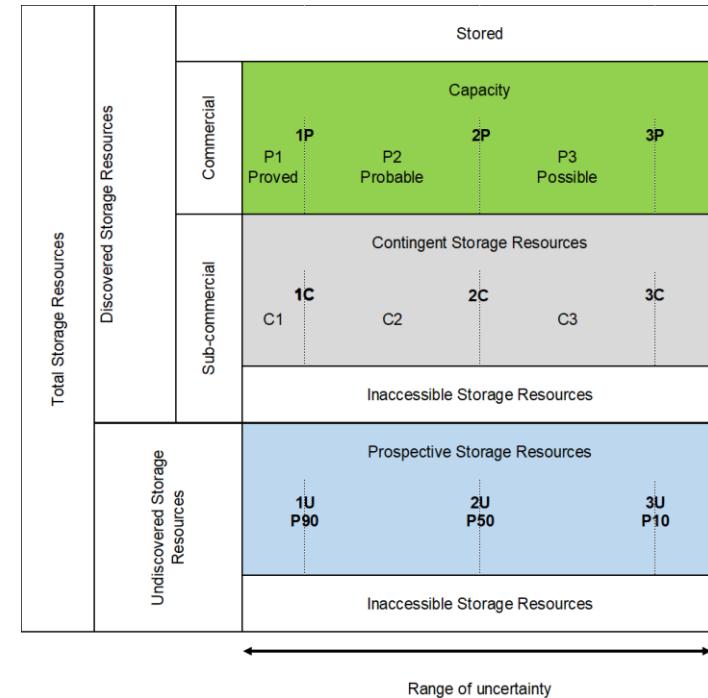
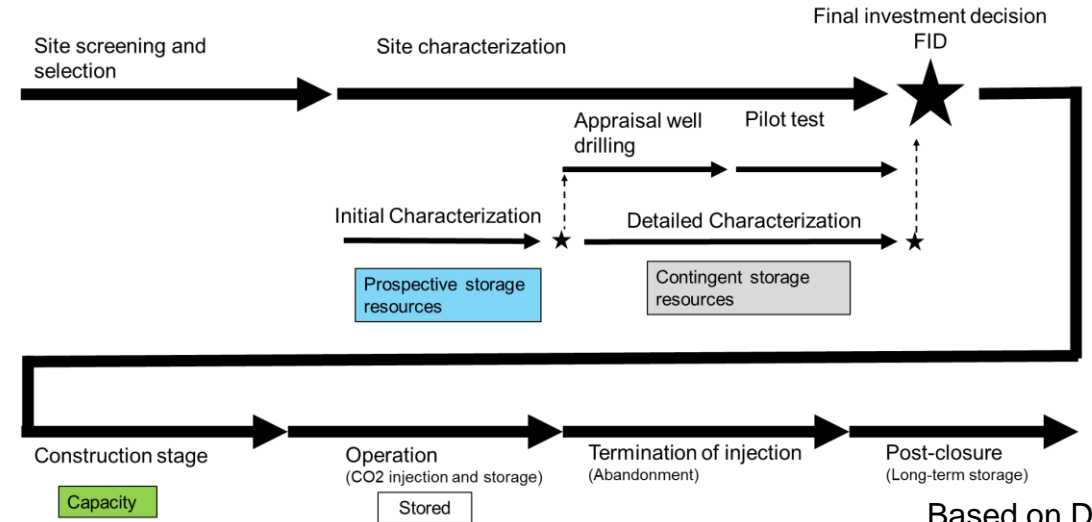
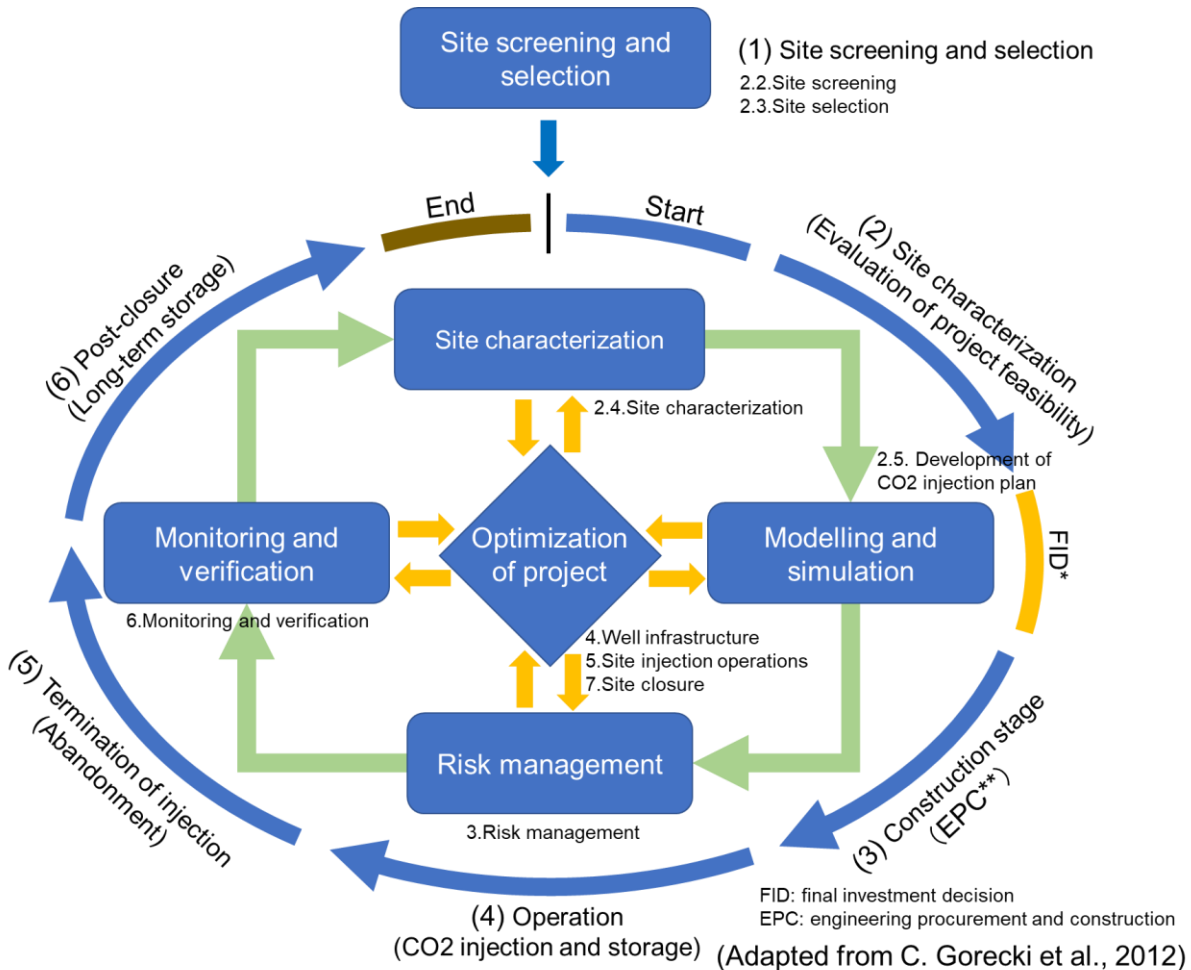
21 – 24 Nov

Designing a CO₂ injection pilot test in the Minami-Aga oil field

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Introduction : Typical workflow of CCS evaluation



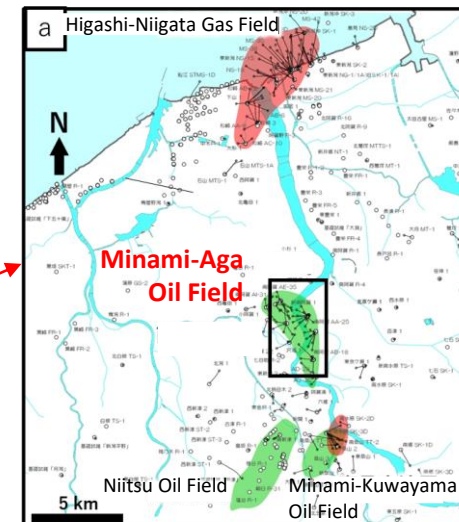
Introduction : Summary of the Minami-Aga oil field

- The purposes of the pilot test are
 - ✓ not to evaluate the feasibility of CCS in this field
 - ✓ but to verify the effectiveness of modern commercial monitoring tools for the detection of CO₂ in a reservoir. (CO₂ injection well)
 - ✓ to demonstrate the effect of CO₂-EOR efficiency improvement technology. (CO₂-foam injection well)

Field summary

Production started	1964
Cum. Recovered (2021)	~18 MMbbls
Well count	41 drilled, 32 completed
Reservoir	Shiya fm. (Tuffaceous sandstone)
Depth	~2100 mSSL
Pressure and temperature	~250 Bar (initial), ~100 °C
Thickness	~30 m (Gross)
Porosity	15~30%
Permeability	1 mD ~ 1000 mD
Oil gravity	36 °API

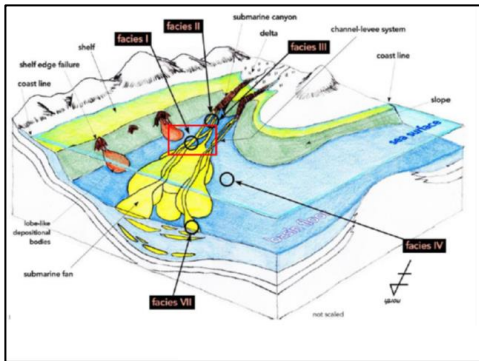
Field location



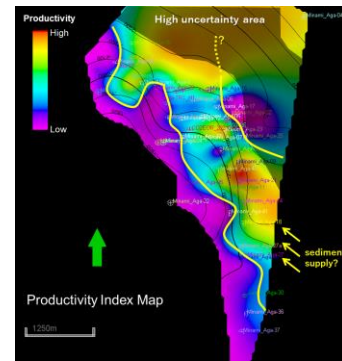
Reservoir characterization and single well numerical simulation

- The main challenge in reservoir characterization: Most old wells only had SP and Res. >> Production data fully utilized.

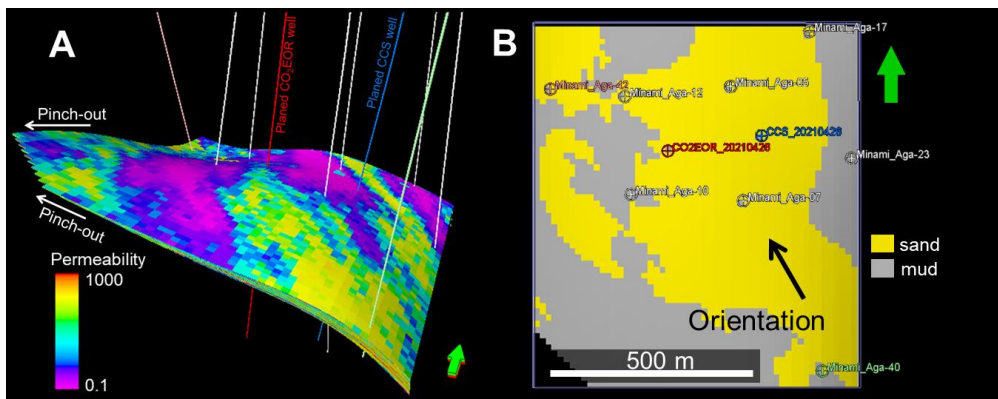
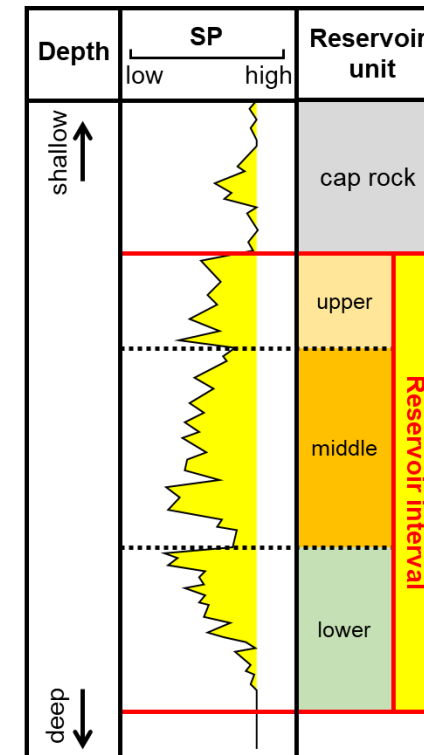
Depositional environment



Sand distribution



Revision of reservoir zonation (SP, Res)



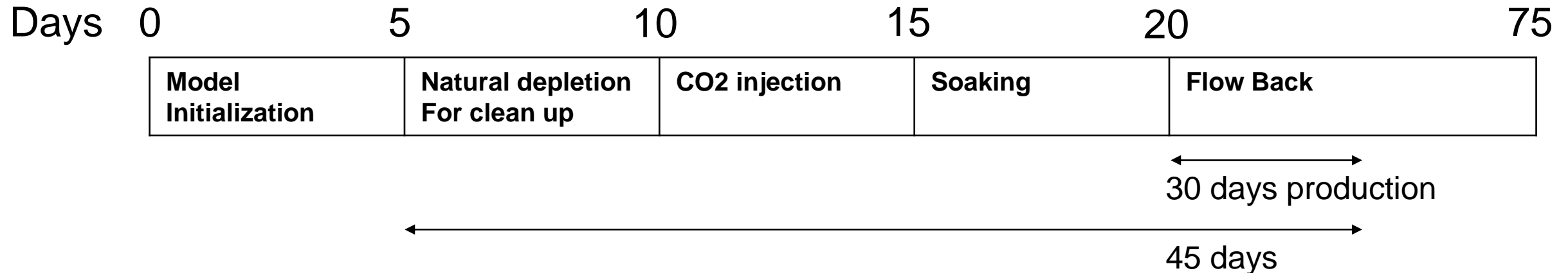
Reservoir characterization and single well numerical simulation

CO2 injection-well

- **Well completion**

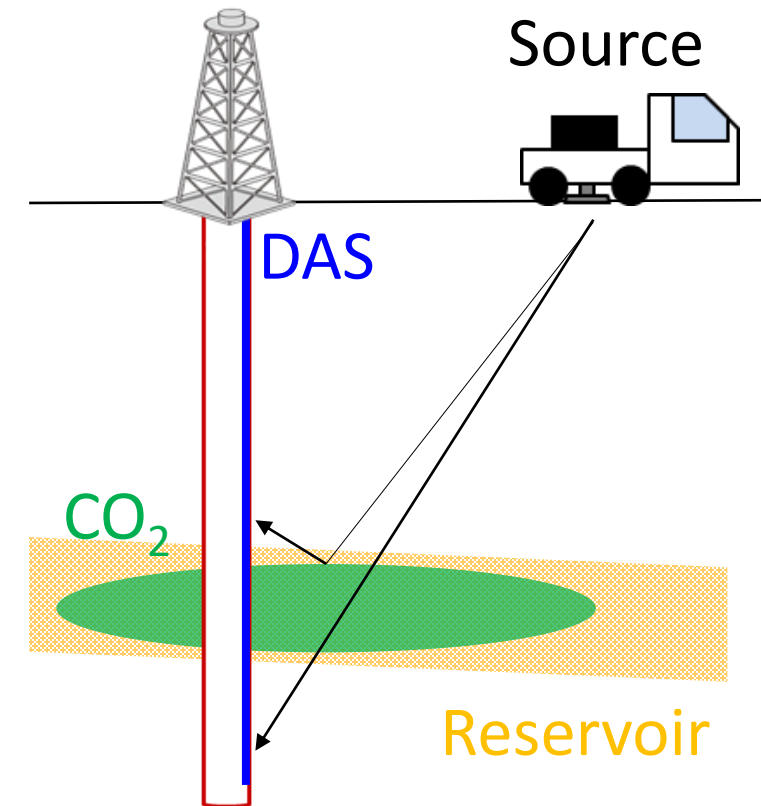
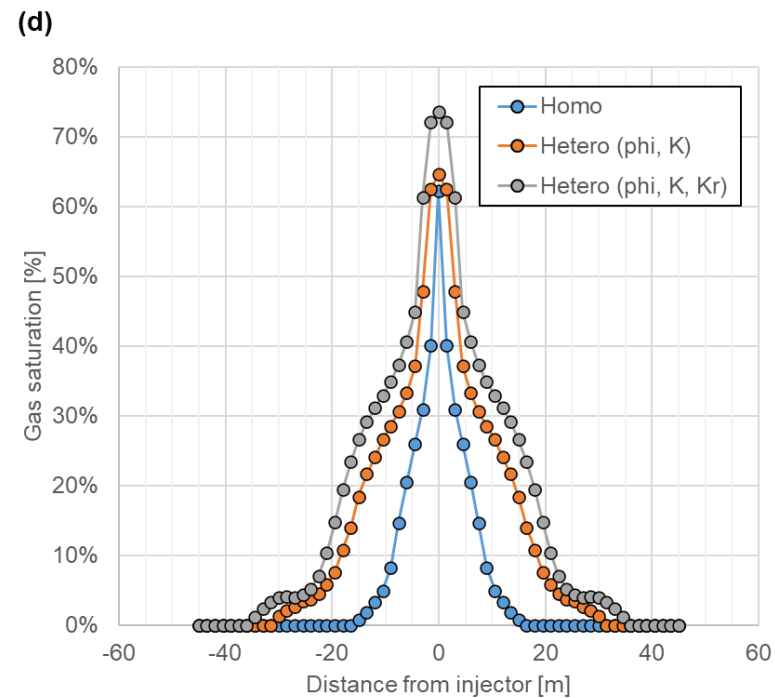
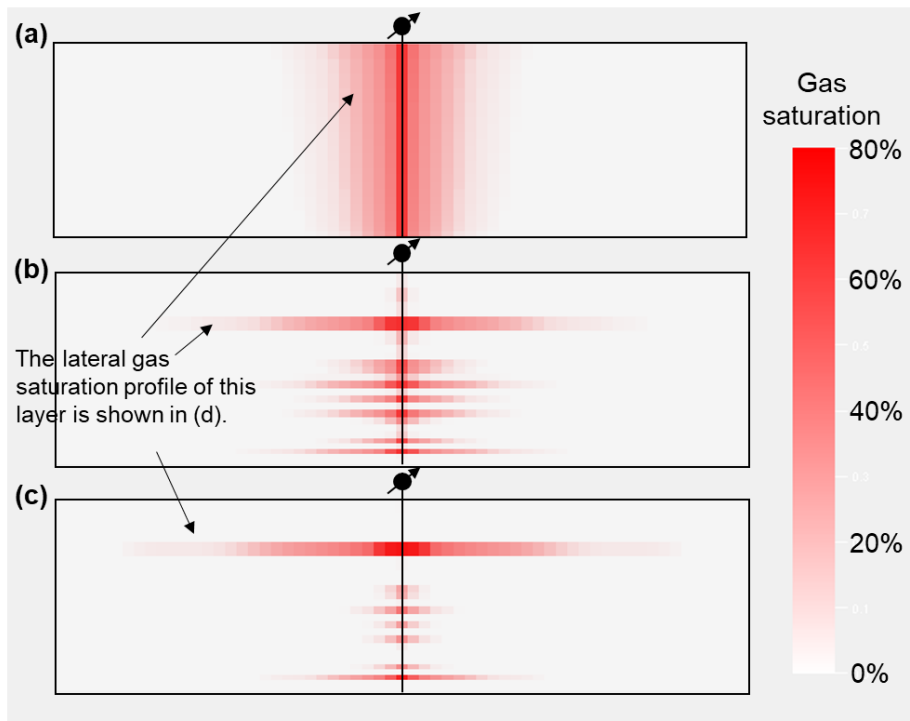
- ✓ Wellbore diameter: 8.5"
- ✓ Production: Bottom hole pressure constrain: 160 Bar (-20 Bar from Pres =180 Bar)
- ✓ Injection: at a rate of 20 T-CO2/D
- ✓ (For a moment) All the gross interval perforated (to see the preferential flow)

- **Injection scenario**



Reservoir characterization and single well numerical simulation CO₂ injection-well

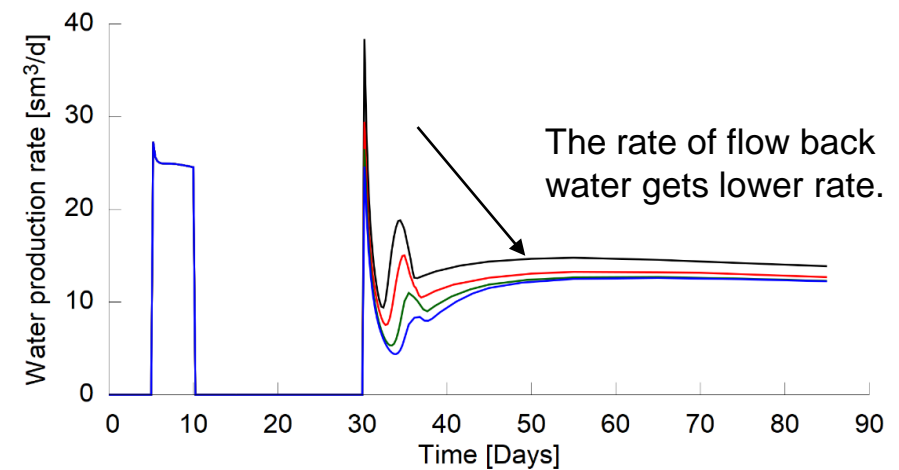
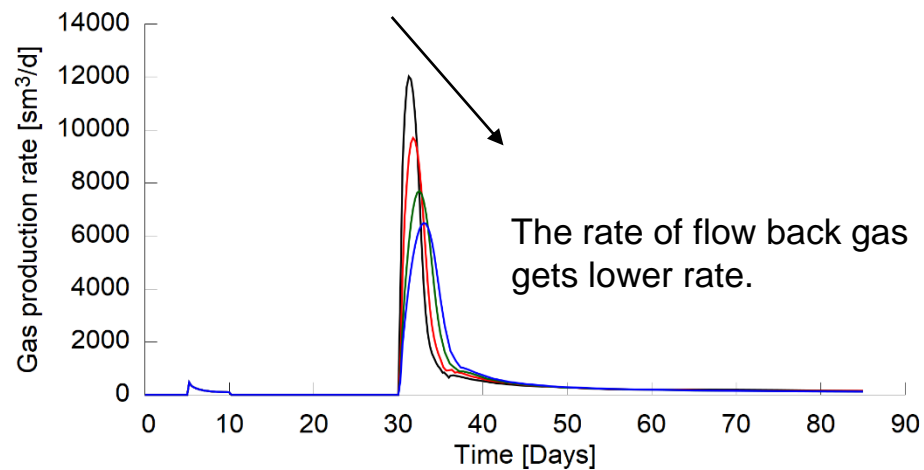
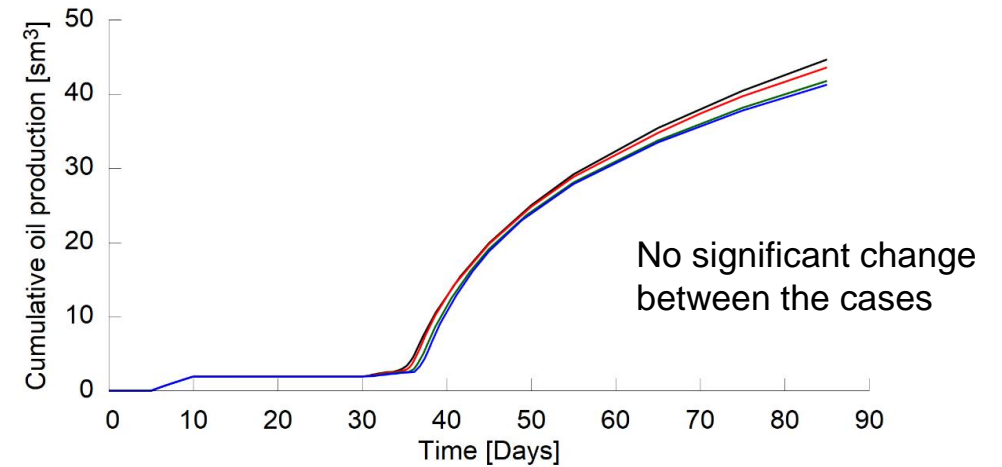
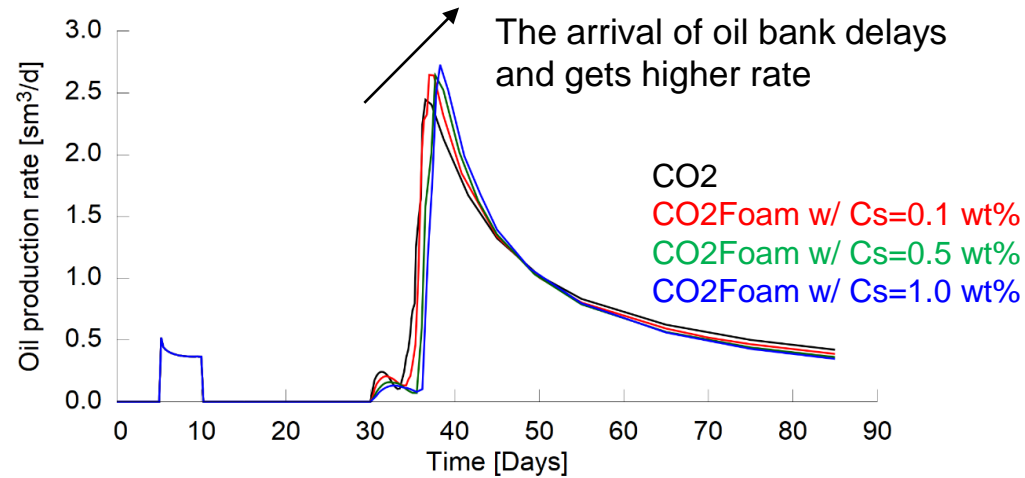
- The degree of reservoir heterogeneity influences on the areal extent of injected CO₂. This will be monitored with RST, DTS, and DAS-Vsp.



Reservoir characterization and single well numerical simulation

Foam injection-well

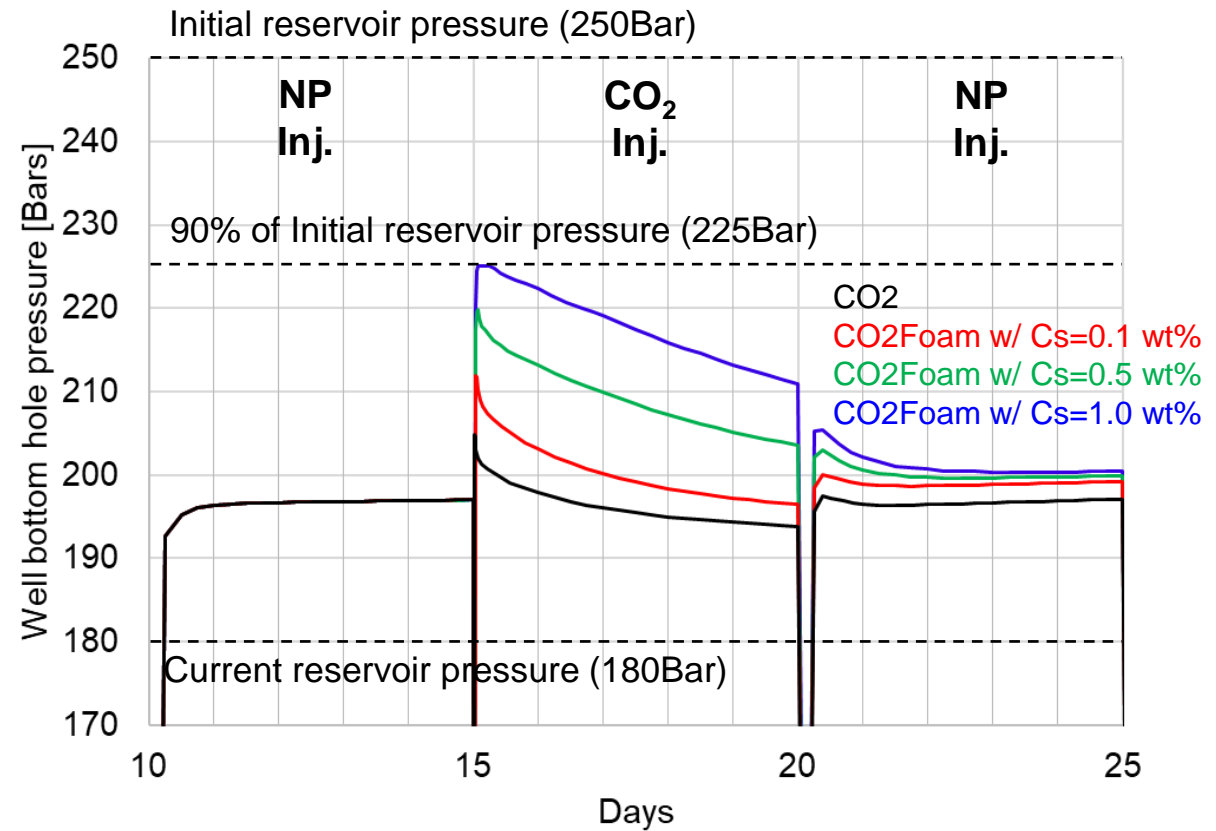
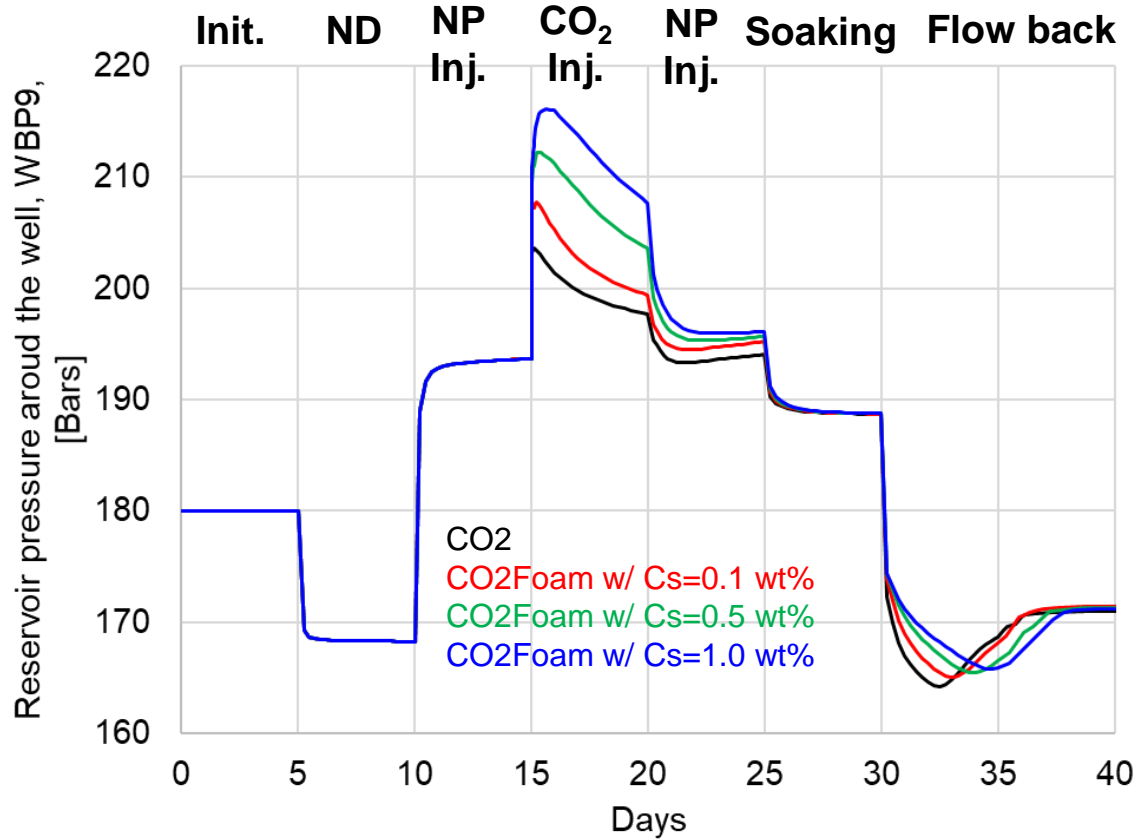
- In H'n'P test, we DO NOT expect more oil with foam injection.



Reservoir characterization and single well numerical simulation

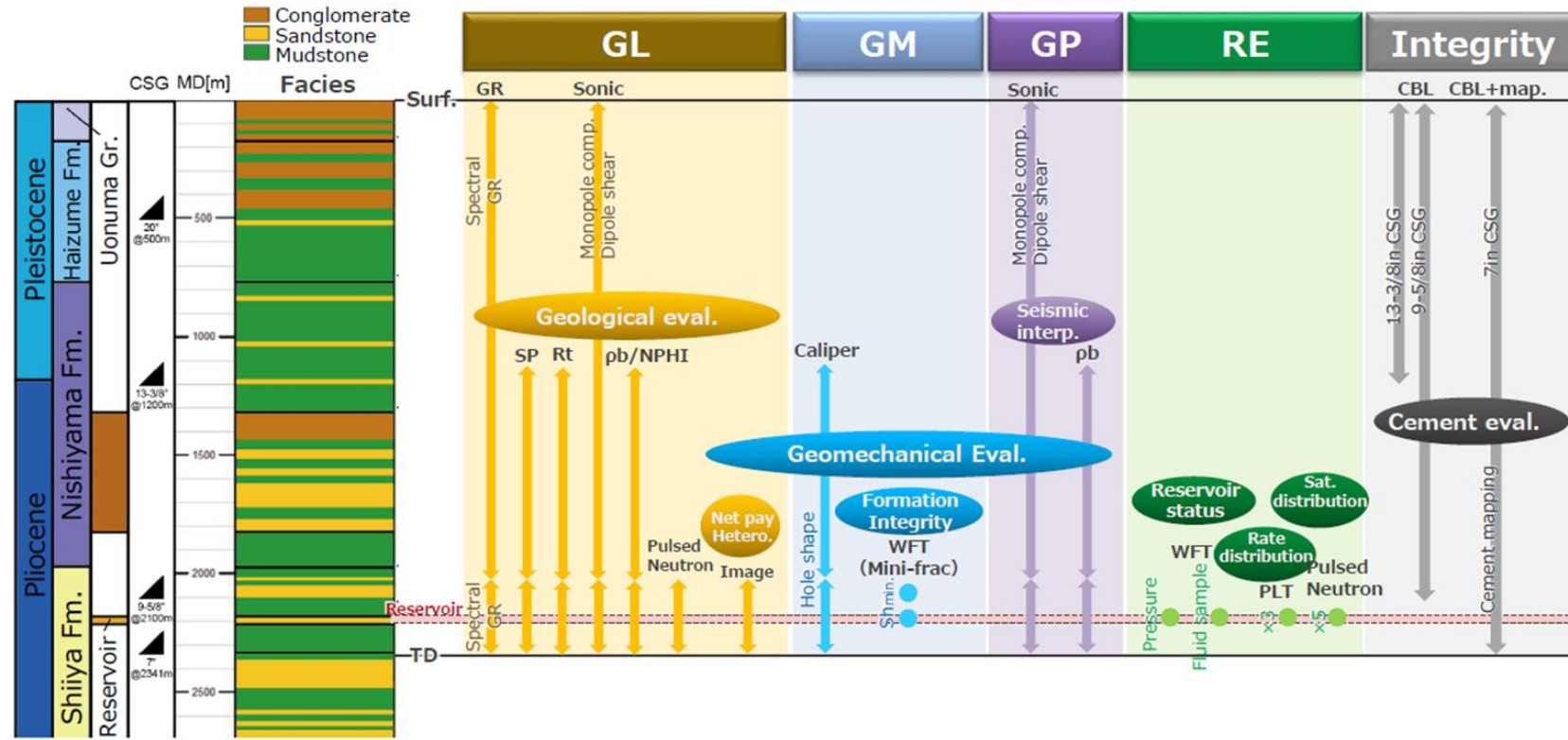
Foam injection-well

- In H'n'P test, we DO expect to see the signature of foam in pressure response. This will be confirmed through down hole pressure monitoring.



Monitoring Plan

- We will apply various commercially available monitoring tools to detect CO2 in a reservoir.
- For the interpretation of these monitoring, a proper reservoir characterization is a key.



Conclusion

- In a typical workflow of subsurface evaluation for a CO₂ storage project, pilot test execution plays an important role to reduce uncertainty in the evaluation of storage capacity and injectivity.
- We showed our planned CO₂ injection tests at the Minami-Aga oil field. Although these pilot tests are not designed to evaluate the feasibility of CCS in the field, but designed to validate technical applicability of several monitoring tools and CO₂ foam injection.
- The pilot test objectives must be defined prior to the execution. Reservoir characterization and simulation are a powerful tool to test the feasibility of monitoring which should be designed to provide the information that help judge the test objectives.

ITHANKS!

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