Study on evaluation of the relative permeability between water-supercritical CO_2 in low permeable sedimentary rock (~Aug 2015).

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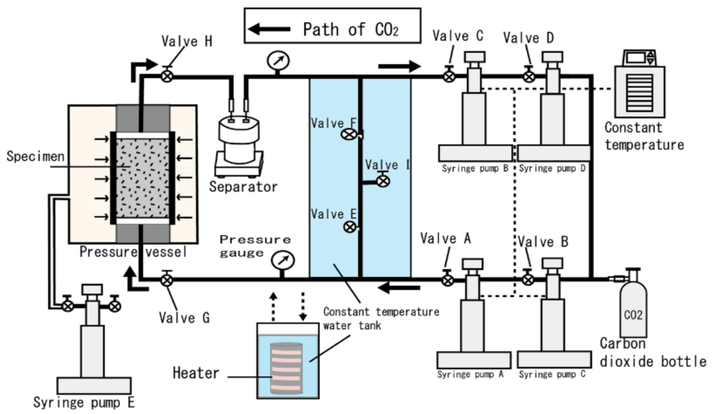
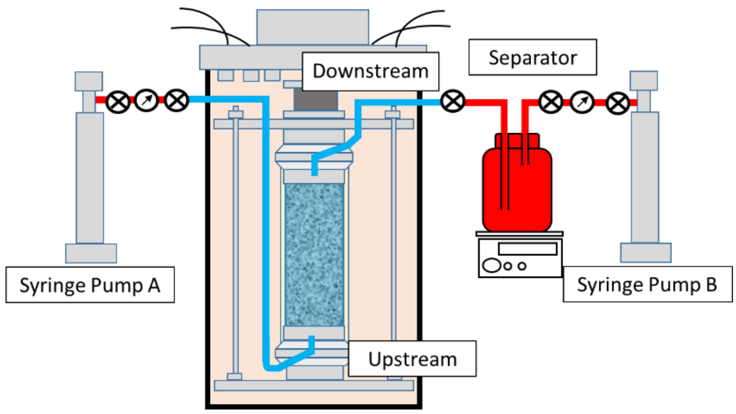
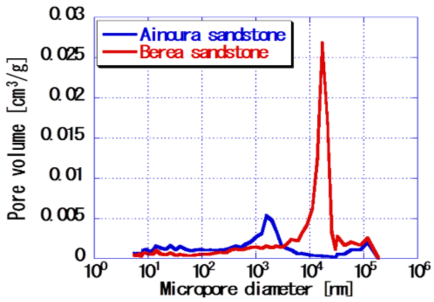
CCS is applied in oil or natural gas reservoir layers with overlying cap rock. However, there are only few proper sites for CCS in Japan. Instead of relying on structural aquifers, CCS has considered injecting CO_2 into the low permeable sedimentary rock of deep underground. In order to perform CCS in the low permeable sedimentary rock, it is necessary to clarify the behavior of long term storage properties of CO_2. In the two phase (water- CO_2) flow, relative permeability is domestic parameter of permeability and storativity property. To determine the relative permeability, saturation of CO_2 has been measured and 3D core-scale flow-simulation has been conducted.

In this study, injection of supercritical CO_2 has been conducted on the specimen of Ainoura sandstone (unit weight: 2.37 g/cm^3, porosity: 11.9 %) saturated with water by using flow pump method. In addition, separator has been installed in the experimental system to measure CO2 saturation in the specimen. Experimental conditions have been set up to reproduce the similar condition of deep underground reservoir. Subsequently, CO_2 flow simulation is conducted to estimate the effect of relative permeability curve on two-phase flow by using 3D core-scale flow-simulation (TOUGH2).

As a result, the change of the differential pressure between both ends of the specimen has been observed and CO_2 saturation of the specimen has been obtained by mass-balance method from the experiment. Flow-simulation examined the effect of the relative permeability curves. In addition, CO_2 saturation by numerical simulation shows good agreement with the value obtained from the experiment. This result of flow-simulation indicates that CO_2 behavior in the specimen has potential to be reproduced precisely.



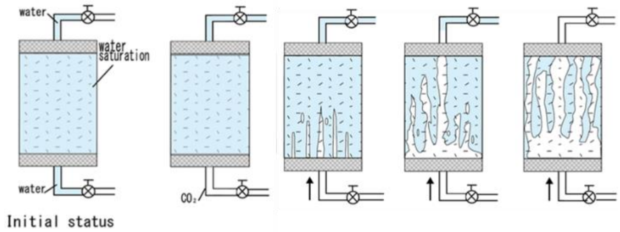


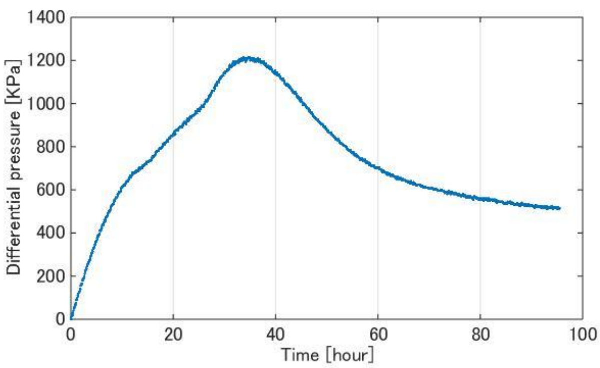


Pore throat-size distribution of the specimens.

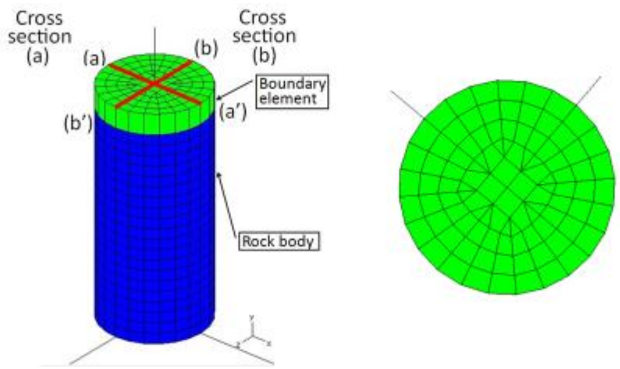
Property of specimen and test condition.

Specimen	Ainoura sandstone
Porosity [%]	11.9
Unit weight [g/cm³]	2.39
Confining pressure [MPa]	20
Initial pore pressure [MPa]	10
Tempature [°C]	40
Flow rate [μL/min]	10
Permeability [cm/s]	1.49×10^{-8}

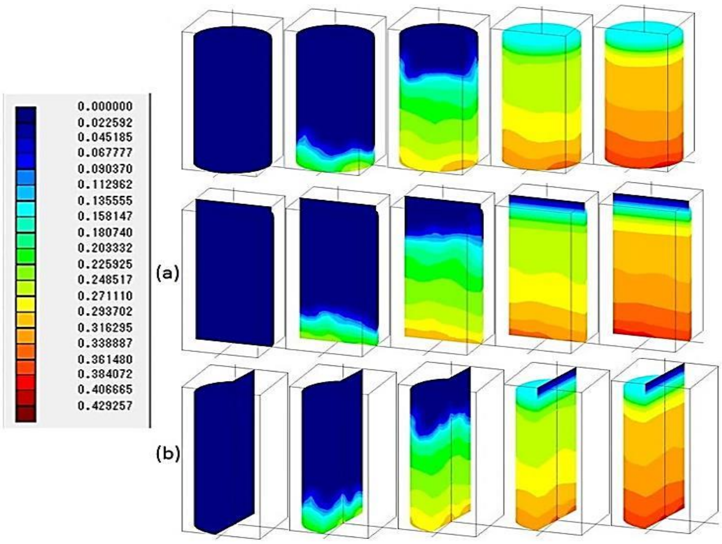




Experimental result: The change of differential pressure between both ends of specimen.



Simulation model



Simulation result: The change of CO2 saturation of the specimen.