Introduction to Carbon Capture and Storage
(이산화탄소 포집 및 저장 개론) (38535-01)

- 2020 Midterm Examination -

Student ID: **Name:**

Notice

- Fill your name below:

  "I, _____, swear I solve all problems by myself in this midterm examination. I will take any disadvantages if any dishonesty such as cheating is acted on my solution."

  5 points will be deducted from your total score if you do not fill in your name above.

Problem 1.

Answer to each question shortly.

1-1. What is the name of the first commercial-scale (i.e., large-scale) CCS project in the world? [2 pts.]

1-2. What is the name of the only commercial-scale CCS project utilizing InSAR data in the world? [2 pts.]

1-3. Why are the buoyancy force and capillary pressure important for the geological carbon storage? [2 pts.]

1-4. What is the main difference between enhanced geothermal system (인공지열발전) and geological carbon storage in terms of pressure maintenance? [2 pts.]

1-5. According to OECD/IEA 2017, CO_2 emissions remained flat in 2016 for the third year in a row, even though the global economy grew. What is one of the main reasons for this phenomenon? [2 pts.]

Problem 2.

2-1. Draw a phase diagram of pure CO_2 with its critical point. [4 pts.]

2-2. How much are critical pressure and temperature of pure CO_2? [4 pts.]

2-3. What is dense phase? [4 pts.]

2-4. What is supercritical fluid? [4 pts.]

2-5. What happens to the phase diagram if impurities are added to the pure CO_2? Draw a phase diagram of water-containing-CO_2 system (i.e., CO_2-hydrate phase diagram). [4 pts.]

Problem 3.

Compare three conventional geological storage options for CO_2 storage projects. For a fair comparison, describe each option with ten sentences. [15 pts.]

Problem 4.

4-1. Draw a graph that compares four trapping mechanisms of CO_2 in terms of time since cessation of injection (years) and trapping contribution (%). [10 pts.]

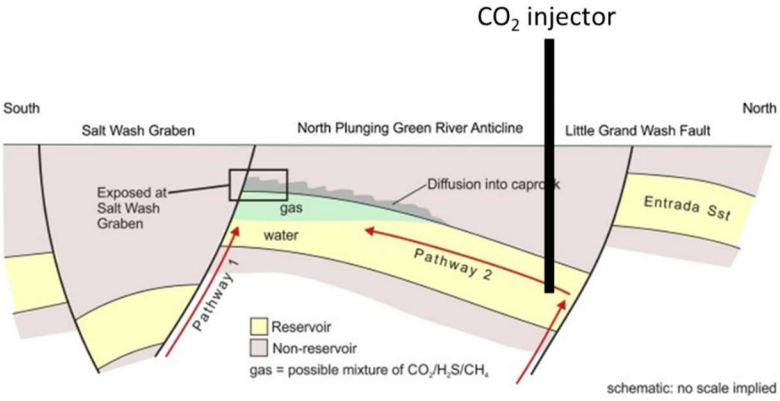
4-2. Explain how residual gas saturation is controlled by pore geometry. [10 pts.]

Problem 5.

Explain the effects of scales of reservoir heterogeneity on reservoir properties (e.g., porosity and permeability) from the point of microscopic view to that of megascopic view. [10 pts.]

Problem 6.

A field-operator are planning to inject and store CO_2 permanently in a geological structure with rollover anticline and thrust-faults as follows:



6-1. Draw a fault-seal risk web and seal probability condition. [10 pts.]

6-2. The field-operator provides the following geological data in cooperation with geologists, geophysicists, and petroleum engineers:

- Caprock capacity = 0.9
- Caprock geometry = 0.9
- Caprock integrity = 0.7
- Fault juxtaposition property = 0.8
- Fault zone property = 0.5
- Post-injection reactivation of fault = 0.6

Note that every geological condition above is a probability value ranging between 0 and 1.

Based on the geological data above, assess the overall trap potential of this storage site. [10 pts.]

6-3. Based on the overall trap potential, what is your engineering judgement on the feasibility of this geological carbon storage site? [5 pts.]

---------- This is the End of the Midterm Examination ----------