Effect of CO_2 injecting pressure on structural transition and replacement efficiency in sI and sH hydrates

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The replacement of natural gas hydrate with CO_2 has been suggested as a promising natural gas production approach that differs from depressurization and thermal stimulated technologies. In this study, sI and sH hydrates which were formed from methane and methane + methylcyclopentane (MCP), respectively, were replaced with CO_2. To confirm the effect of the experimental pressure on the replacement efficiency, the experiment was conducted at the lowest stable pressure of CO_2 hydrate and the highest pressure at which CO_2 was not liquefied at the experimental temperature. In order to identify replacement efficiency in both sI and sH hydrates, the gas composition of hydrate phase was measured by gas chromatography. In addition, Raman spectroscopy and powdered X-ray diffraction were used to observe the migration of CO_2 and CH_4 molecules in each cage of sI and sH hydrates. For replacement in the sH hydrate, a structural transition of initial sH hydrate into sI hydrate was observed and replacement efficiency was increased with an increase in experimental pressure. However, for sI hydrate, replacement efficiency was found to be almost similar irrespective of experimental pressure.