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Pore Scale Visualization of CH₄-CO₂ Mixed Hydrates Phase Transitions During Stepwise Depressurization

Monday, 31 May 2021 10:10 (15 minutes)

In this study, we investigate the dissociation pattern of CH₄/CO₂ mixed hydrate in porous media using high-pressure micromodel. We formed CH₄/CO₂ mixed hydrate from gaseous CH₄ and liquid/gaseous CO₂ to mimic the scenario where a CH₄ hydrate reservoir has been injected with CO₂. Direct visualization was carried out using a high-pressure, water-wet, silicon-wafer based micromodel with a pore network of actual sandstone rock. Mixed hydrate was formed at reservoir conditions ($P = 44\text{--}75$ bar and $T = 1.7\text{--}3.6^\circ\text{C}$) from either a two-phase system (liquid water and CH₄/CO₂ gas mixture) or a three-phase system (liquid water, CH₄ gas, and liquid CO₂).

A stepwise pressure reduction method was applied to record multiple dissociation pressure points for a given mixed hydrate system, and the molar concentration of CH₄/CO₂ corresponding to each dissociation point was calculated. The effect of hydrate and fluid saturation on fluid flow during dissociation was also analyzed.

The results showed that liberated gas during stepwise pressure reduction was trapped by surrounding hydrate, and reformation of CO₂ hydrate occurred rapidly when liquid water was present. The reformed CO₂ hydrate shielded the CH₄ hydrate that was still not dissociated and complete dissociation was accomplished when the pressure was brought below the stability pressure of pure CO₂ hydrate.

Time Block Preference

Time Block C (18:00-21:00 CET)

References

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