

Influence of feed gas compositions on guest exchange behaviors in sII hydrate – CO₂ + N₂
replacement

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Replacement has been considered as a promising method for CO₂ sequestration as well as CH₄ recovery because CO₂ can be stably stored in natural gas hydrate (NGH) reservoirs without weakening geo-mechanical strength of the sediment layer via spontaneous guest exchange. Three structures of NGHs (sI, sII, and sH) in nature have been discovered in various explorations. Because of the distinctive characteristics of each structure, the replacement mechanism in each hydrate structure should be studied individually. In this study, the guest exchange behavior in sII (CH₄ + C₃H₈) hydrate – CO₂ + N₂ was investigated to elucidate the influence of feed gas compositions on the sII hydrate replacement. The extent of replacement was measured via gas chromatography. Structural transformation before and after replacement was confirmed via ¹³C NMR and PXRD analyses. The experimental results demonstrated that CO₂ was more selectively enclathrated in the sII hydrate at a higher CO₂ composition in the feed gas, even though replacement efficiency was not much different. The finding of this study would be helpful for understanding the replacement mechanism in sII hydrates using flue gas injection.