

### Properties of intercalated methane hydrate in smectite clays

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In this study, we measured the thermodynamic properties of methane hydrates intercalated at various weight percent of clays and found the relatively weak promotion tendency. The structure and morphology of intercalated methane hydrate (IMH) samples were analyzed using the <sup>1</sup>H MAS, <sup>13</sup>C HPDEC MAS NMR, RAMAN, LT-XRD, and Cryo-FE-SEM. The <sup>27</sup>Al and <sup>29</sup>Si Solid-State MAS NMR spectra of IMH Cheto and Otay clays represent that the structural stability is preserved during the IMH formation, which is also indicated with XRD pattern showing no structural transformation but different d-spacing values due to clay-water suspension and IMH. In addition, Cryo-SEM images of IMH samples show that IMH Otay clay provide well-developed methane hydrate morphology, compared to the IMH Cheto clay.