OS43B-05: Investigating the influence of lithologic heterogeneity on gas hydrate formation and methane recycling at the base of the gas hydrate stability zone in channelized systems

Thursday, 14 December 2017
14:40 - 14:55
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In marine environments, gas hydrate preferentially accumulates in coarse-grained sediments. At the meso- to micro-scale, however, hydrate distribution in these coarse-grained units is often heterogeneous. We employ a methane hydrate reservoir simulator coupling heat and mass transfer as well as capillary effects to investigate how capillary controls on methane solubility affect gas and hydrate accumulations in reservoirs characterized by graded bedding and alternating sequences of coarse-grained sands and fine-grained silt and clay.

Simulations bury a channelized reservoir unit encased in homogeneous, fine-grained material characterized by small pores (150 nm) and low permeability (~1 md in the absence of hydrate). Pore sizes within each reservoir bed between vary between coarse sand and fine silt. Sands have a median pore size of 35 microns and a lognormal pore size distribution. We also investigate how the amount of labile organic carbon (LOC) affects hydrate growth due to microbial methanogenesis within the sediments.

In a diffusion-dominated system, methane movies into reservoir layers along spatial gradients in dissolved methane concentration. Hydrate grows in such a way as to minimize these concentration gradients by accumulating slower in finer-grained reservoir layers and faster in coarser-grained layers. Channelized, fining-upwards sediment bodies accumulate hydrate first along their outer surfaces and thence inward from top to bottom. If LOC is present in thin beds within the channel, higher saturations of hydrate will be distributed more homogeneously throughout the unit. When buried beneath the GHSZ, gas recycling can occur only if enough hydrate is present to form a connected gas phase upon dissociation. Simulations indicate that this is difficult to achieve for diffusion-dominated systems, especially those with thick GHSZs and/or small amounts of LOC. However, capillary-driven fracturing behavior may be more prevalent in settings with thick GHSZs.

Plain Language Summary

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