Transient venting in hydrate systems due to warming

Kristopher Darnell, The University of Texas

ABSTRACT

We simulate the effect of ocean warming on a sub-seafloor methane hydrate deposit (Figure 1). We show that hydrate is melted at the base of the hydrate stability zone (HSZ) and that the dissociated gas migrates upward creating its own three-phase equilibrium pathway through the HSZ. When hydrate saturations are sufficiently large, the free gas breaches the seafloor and vents into the ocean. This model contrasts previous work, which has suggested that free gas does not migrate through the HSZ. The observations of methane venting in the Arctic and at Blake Ridge may result from this type of process.

CLICK ON IMAGE FOR LARGER VIEW

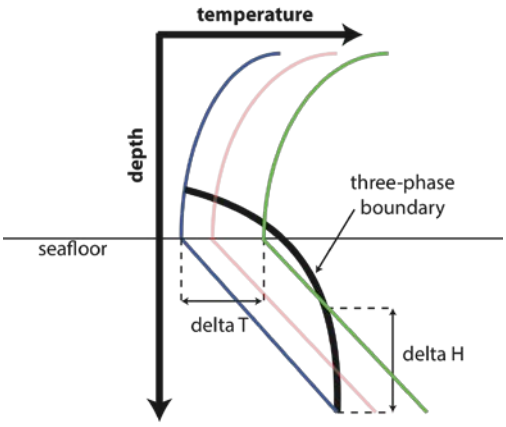


Fig. 1: Temperature v. depth. The blue line shows an initial temperature profile where the base of the HSZ is the intersection of the blue line with the thick black line. Temperature perturbations to the pink or green line change the height of the new HSZ.

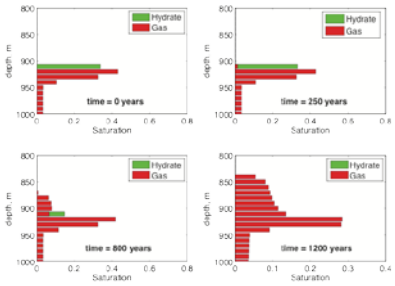
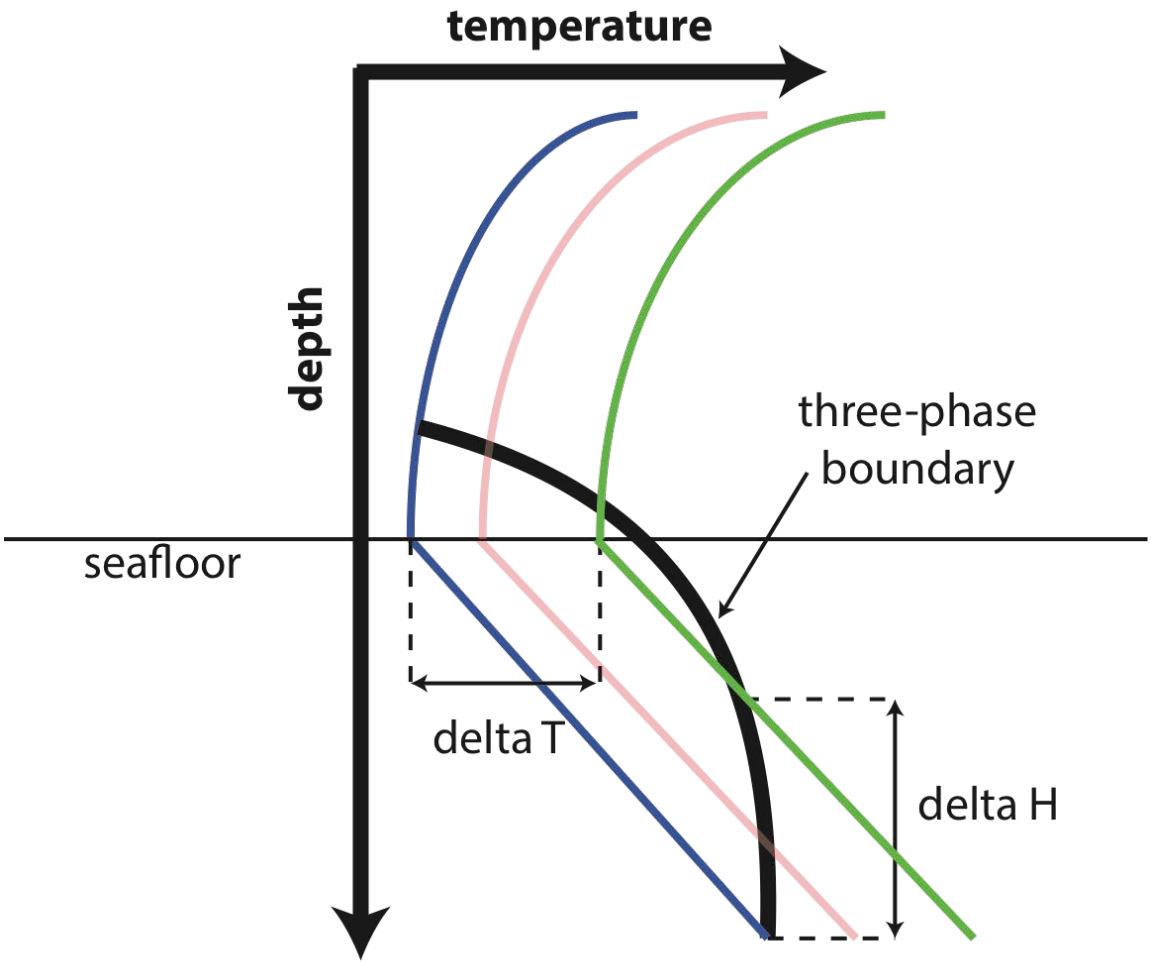


Fig. 2: The gas and hydrate saturations from a simulation with a small hydrate layer in 800 m water depth undergoing a 5 C temperature perturbation at the seafloor (seafloor temperature before perturbation is 5 C)



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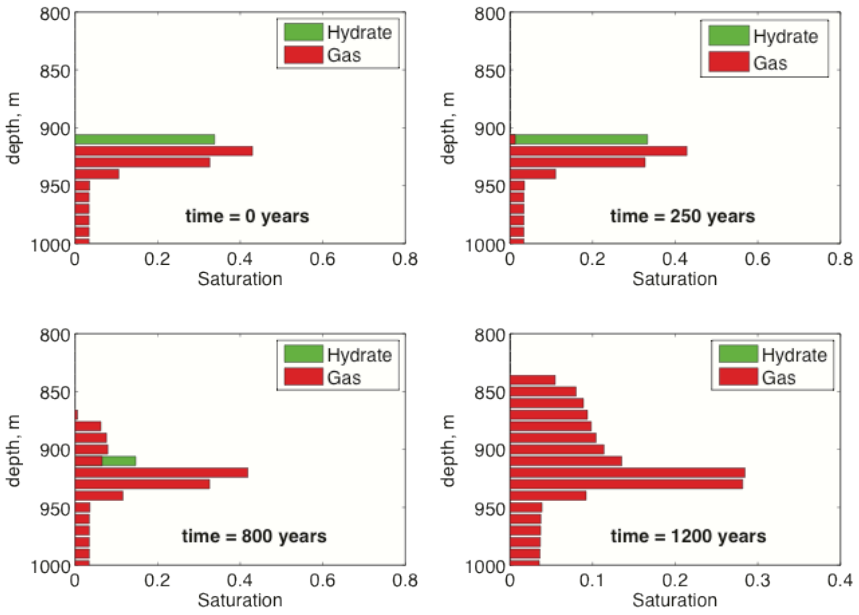

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