SEDIMENTOLOGICAL AND TRANSPORT CONTROL ON HYDRATE SATURATION DISTRIBUTION IN ARCTIC GAS-HYDRATE-BEARING DEPOSITS

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ABSTRACT
A mechanistic model is developed to explain/predict gas hydrate saturation profile in sub-permafrost formations in the Arctic. The model assumes that the gas hydrate profiles are converted free gas accumulations when base of gas hydrate stability zone (BGHSZ) moves down the gas column. Three key elements are considered in the model: (1) volume change during hydrate formation and consequent fluid phase transport; (2) the descent of BGHSZ through the column and (3) sedimentological (i.e. grain size) variation with depth. The model shows that substantial amount of fluid (of order of one pore volume of aqueous and/or gaseous phase) must have migrated within or into the gas column during hydrate formation. The model matches the hydrate saturation distribution from Mt. Elbert well in the Alaskan North Slope if the volume of gas that migrated within the column is approximately equal to the volume of water that migrated into the column. Evaluation of typical relative permeability curves suggests that the required flow of the phases was unlikely to have been co-current but rather a counter-current flow of gaseous phase from below and aqueous phase from above.

Keywords: Mount Elbert, BGHSZ, stoichiometric, hydration number, relative permeability

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