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Modeling of transport phenomena during gas hydrate decomposition by depressurization and/or thermal stimulation

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In the context of the German joint project SUGAR (Submarine Gas Hydrate Reservoirs: exploration, extraction and transport) we conducted a series of experiments in the LArge Reservoir Simulator (LARS) at the German Research Centre of Geosciences Potsdam (Beeskow-Strauch et al., this volume). These experiments allow us to investigate the formation and dissociation of hydrates at large scale laboratory conditions. Processes inside LARS are modeled to study the effects of sediment properties as well as physical and chemical processes on parameters such as hydrate dissociation rate and methane production rate. The experimental results from LARS are used to provide details about processes inside the pressure vessel, validate the models through history matching, and feed back into the design of future experiments.

In experiments in LARS the amount of methane produced from gas hydrates was much lower than expected. Previously published models predict a methane production rate higher than the observed in experiments and field studies (Uddin and Wright 2005; Uddin et al. 2010; Wright et al. 2011). The authors of the aforementioned studies point out that the current modeling approach overestimates the gas production rate when modeling gas production by depressurization. Uddin and Wright (2005) suggested that trapping of gas bubbles inside the porous medium is responsible for the reduced gas production rate. They point out that this behavior of multi-phase flow is not well explained by a "residual oil" model, but rather resembles a "foamy oil" model.

Our study applies Uddin's (2010) "foamy oil" model and combines it with history matches of our experiments in LARS. First results indicate a better agreement between experimental and model results when using the "foamy oil" model instead of conventional models featuring gas flow in water. Further experiments with LARS, including hydrate dissociation by depressurization and thermal stimulation by in-situ combustion will be used to transfer this approach back to reservoir models and to test this approach.

References

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