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Numerical modeling of the simulated gas hydrate production test at Mallik 2L-38 in the pilot scale pressure reservoir LARS – Applying the "foamy oil" model

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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. These experiments allow us to investigate the formation and dissociation of hydrates at large scale laboratory conditions. We performed an experiment similar to the field-test conditions of the production test in the Mallik gas hydrate field (Mallik 2L-38) in the Beaufort Mackenzie Delta of the Canadian Arctic. The aim of this experiment was to study the transport behavior of fluids in gas hydrate reservoirs during depressurization (see also Heeschen et al. and Priegnitz et al., this volume). The experimental results from LARS are used to provide details about processes inside the pressure vessel, to validate the models through history matching, and to 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 one observed in experiments and field studies (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. They suggest 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. Our results indicate a better agreement between experimental and model results when using the "foamy oil" model instead of conventional models of gas flow in water.

References

Uddin M., Wright J.F. and Coombe D. (2010) - Numerical Study of gas evolution and transport behaviors in natural gas hydrate reservoirs; CSUG/SPE 137439.
Wright J.F., Uddin M., Dallimore S.R. and Coombe D. (2011) – Mechanisms of gas evolution and transport in a producing gas hydrate reservoir: an unconventional basis for successful history matching of observed production flow data; International Conference on Gas Hydrates (ICGH 2011).