Geological and thermodynamic factors affecting the stimulation-response characteristics of a production test interval, Mallik 2007 Gas Hydrate Production Research Well

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Scott R. Dallimore[1] ,J . Fred Wright[1], F. Mark Nixon[1], Masanori Kurihara[2], Koji Yamamoto[3], Tetsuya Fujii[3] , Kasumi Fujii[3], Masaaki Numasawa[3],Masato Yasuda[3], Yutaka Imasato[4]

1 Natural Resources Canada, Geological Survey of Canada, Canada
2 Japan Oil Engineering, Tokyo, Japan
3 Japan Oil, Gas Metals National Corporation, Technical Research Centre, Chiba, Japan
4 Schlumberger K.K., Fuchinombe, Japan

ABSTRACT

A short-duration production test was undertaken at the Mallik site in Canada's Mackenzie Delta as part of the JOGMEC-NRCan Mallik 2007 Gas Hydrate Production Research Well Program. Reservoir stimulation was achieved by simple depressurization of a highly concentrated gas hydrate interval between 1093 to 1105mKB. Comprehensive well logs and sediment core samples obtained in previous 2002 Japex/JNOC/GSC et al Mallik research well program provided detailed descriptions of reservoir physical properties including mineralogy, grain-size distribution, porosity, pore water geochemistry, formation pressure/temperatures and gas hydrate saturation levels. Laboratory experiments conducted on reconstituted core and generic quartz analogs have clarified the intrinsic nature of in-situ gas hydrate stability within the Mallik reservoir, provided insight into dissociation kinetics, and confirmed the range of expected thermal conductivity values for gas hydrate bearing reservoir sediments. These data have supported the development and parameterization of numerical simulators for evaluating gas production from hydrate in response to localized depressurization of the reservoir, and are invaluable for the selection of optimal intervals for production testing. Evaluation of available data has indicated that gas hydrate in the lower portions of the Mallik reservoir are poised at the phase equilibrium threshold, such that minimal stimulation (by temperature and/or pressure forcing) will initiate vigorous dissociation of gas hydrate. Our analysis also suggests that gas hydrate at many locations within the approximately 200 m thick reservoir is less stable than previously assumed, based on interpretation of the influence of pore water salinity on in situ gas hydrate stability. Results from the short-duration production test confirm a vigorous reservoir response to stimulation by depressurization, with variable rate and increasing gas flow during the testing period. However, the 2007 production test has identified significant sand and water flow concerns that must be addressed prior to undertaking a longer-duration production test in the near future.