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Gas-Liquid Interactions in Natural Geothermal Conduits: Implications for Artificial Gas-Lift Applications.

D. Robertson[1], E. Joseph[1], N. Fournier[2], and F. Witham[3]

[1]Seismic Research Centre, University of the West Indies, Trinidad
[2]GNS Science, Taupo, New Zealand, [3] Rolls-Royce Motor Cars Limited, West Sussex, United Kingdom

Abstract

How do activities at a volcano-hydrothermal system relate to the petroleum industry? The Boiling Lake in Dominica is believed to be supported by a gas bubble layer above a natural gas-lift system, namely an intermittent/continuous geothermal gas bubble contribution through narrow cracks/high permeability zones. Within the petroleum industry, an artificial gas-lift method is sometimes required to access/retrieve oil in older/low pressure systems.

During 2004-2005, Dominica's most renowned geothermal feature, the Boiling Lake, experienced sporadic interruptions in geothermal activity. The lake stopped boiling, repeatedly emptied and refilled, and then returned to its long-term stable conditions. Descriptions of similar instabilities at the Boiling Lake have occurred only six times during 150 years of its recorded history. The extensive stability of the lake and possible triggers of its unrest are being investigated through numerical modelling of the lake and the network beneath it.

The authors present findings from analytical and numerical modelling of a gas-lift styled conduit, in which we consider the effect of gas-inlet cross-sectional area, relative velocity and periodicity on fluid flow rate within a conduit. We also consider the effects of matrix/fracture poroelasticity on the efficiency of fluid flow within such systems. In general, liquid velocity increases with increasing gas velocity. Frictional boundary effects increase with decreasing gas-inlet cross-sectional area or decreasing permeability.