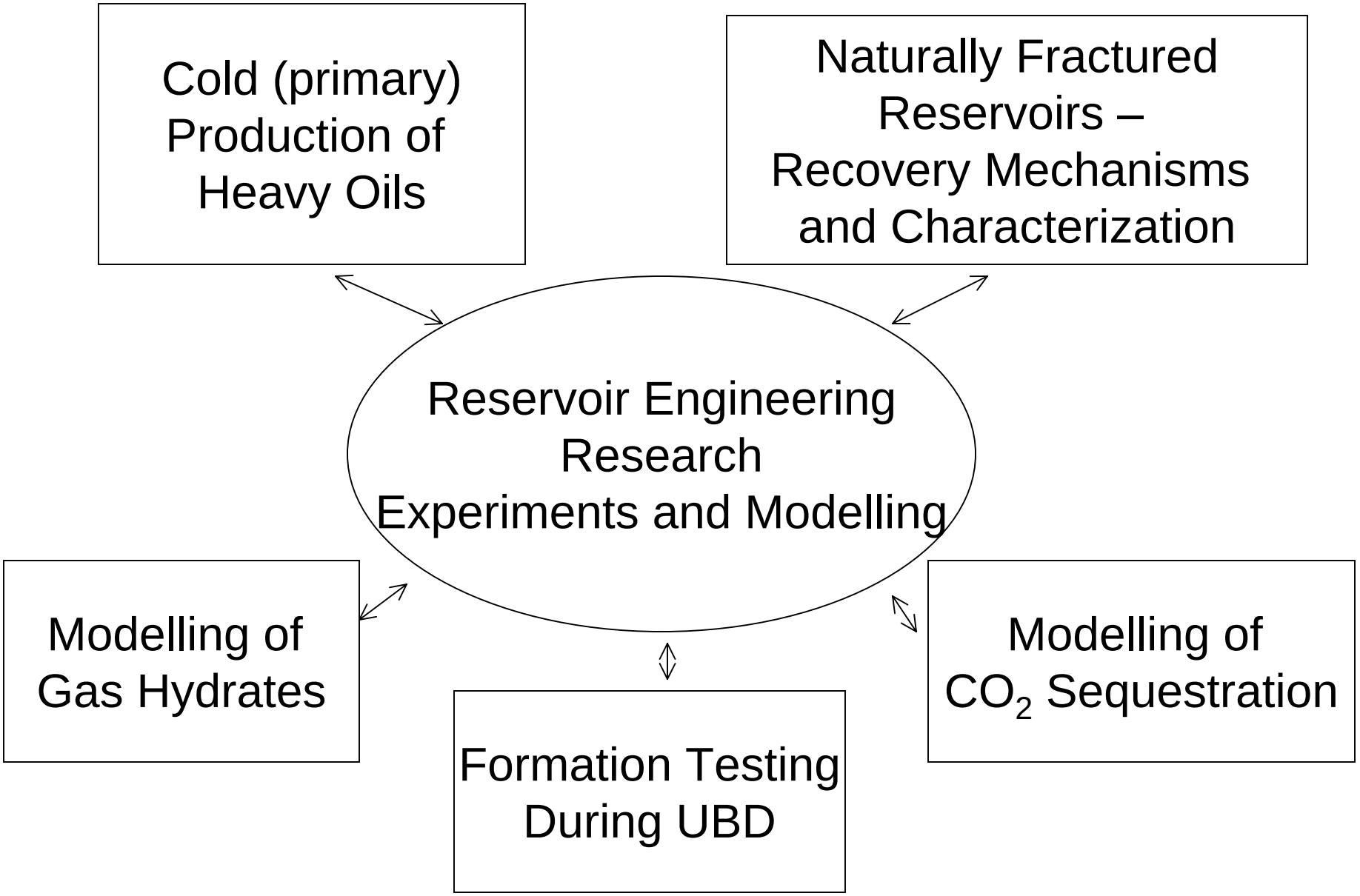

pooladi@ucalgary.ca

Cold production of heavy oil

Effect of Depletion Rate on Gas Mobility and Solution Gas Drive in Heavy Oil

R. Kumar;* M. Pooladi-Darvish, U. of Calgary; and T. Okazawa, Imperial Oil Resources Ltd.

Summary

Some heavy oil reservoirs in western Canada and Venezuela show anomalously high primary recovery under solution gas drive process. The pressure decline rate in these reservoirs is low compared to that expected under solution gas drive in conventional oil reservoirs. There is now increasing evidence that gas mobility is extremely low in these reservoirs.

The objective of this study is to conduct solution gas drive experiments in a sandpack saturated with a heavy oil and examine the effect of depletion rate. Depletion rate was varied by more than two orders of magnitude. The results showed that gas mobility was a function of depletion rate and decreased with increasing depletion rate. Other notable observations were that supersaturation increased with depletion rate and that critical gas saturation was 3 to 4%, slightly increasing with increasing depletion rate.

Interpretation of the results confirmed that gas mobility is quite low. Representation of the low mobilities using relative permeability required low values of the order of 10^{-5}–10^{-4}, which decreased with increasing depletion rate.

same conclusions for solution gas drive in a sandstone core. Dumore[14] conducted solution gas drive experiments in two high permeability sandpacks of 15 and 350 darcy. He suggested that conditions that lead to more gas dispersion led to higher recovery. The author showed that higher rate of pressure drop and higher permeability lead to more gas dispersion. All of the above authors were also interested in behavior of solution gas drive in light oils. Extensive research in solution gas drive in heavy oils was initiated following Smith's[1] publication reporting high oil recovery and production rate in some heavy oil reservoirs under primary depletion. He suggested that in these reservoirs, gas flows in the form of tiny bubbles in heavy oil. He further stated that these gas bubbles do not coalesce to form a continuous gas phase.

Maini *et al.*[6] suggested that a discontinuous gas phase is dispersed within the continuous oil phase and used the term "foamy oil flow" to describe the flow. Later, Bora *et al.*[15] studied the effect of rate of depletion on bubble nucleation and the foamy oil flow in a micromodel. They concluded that the higher rate of pressure drop results in the nucleation of more bubbles and more dispersed flow.

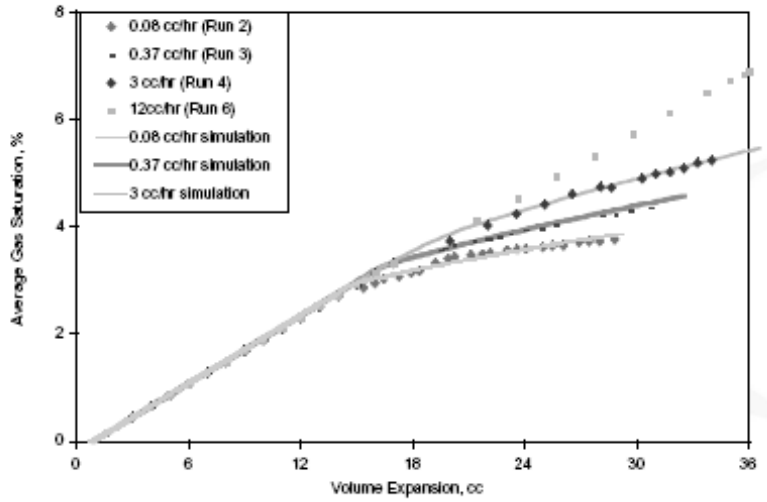

Fig. 4—Average gas saturation for various depletion rates: experimental vs. simulated data.

- What factors and processes lead to high recovery under foamy-oil flow?
- How can these factors and processes be included in simulation models?

pooladi@ucalgary.ca

Naturally Fractured Reservoirs

JCPT

Experiments and Modelling of Water Injection in Water-wet Fractured Porous Media

M. POOLADI-DARVISH*, A. FIROOZABADI
Reservoir Engineering Research Institute (RERI)
*Now at the University of Calgary

Winner of best paper award published in *JCPT* in 2000

- What recovery processes lead to higher recovery?
  (gas gravity drainage vs. water imbibition, double displacement)
- Accurate and efficient methods for upscaling

pooladi@ucalgary.ca

Modeling of gas hydrates

Distinguished Author Series

Mehran Pooladi-Darvish, U. of Calgary

Gas Production From Hydrate Reservoirs and Its Modeling

Abstract

It is estimated that the amount of natural gas trapped in hydrates around the world is approximately two orders of magnitude larger than the recoverable gas in conventional reservoirs. This estimate has attracted governments, especially those with limited access to other sources of fossil fuels, as well as several oil and gas producing companies, to take on projects for drilling and testing hydrate reservoirs.

depressurization and dissociation of the upper hydrates.[3] It is estimated that approximately 36% (5×10^9 m^3) of the gas withdrawn from the field came from the gas hydrate. Both this field experience and recent modeling studies[4] suggest that production life of gas reservoirs, such as those in the Mackenzie delta of Canada that include hydrate-bearing formations at their top,[5] is significantly increased because of the contribution from the top hydrates.

JUNE 2004

- Interpretation of production test data of Mallik, NWT
- What is the effect of hydrate on gas reserve of conventional gas reservoirs of the Mackenzie Detla?
- Development of well-testing techniques for hydrate reservoirs

pooladi@ucalgary.ca

Underbalanced Drilling

- How to estimate formation properties along a horizontal well, while drilling underbalanced (well-testing of UBD)

pooladi@ucalgary.ca

CO_2 Sequestration

- Modelling the long-time (century-wide) processes that lead to sequestration of CO_2 in geological settings

pooladi@ucalgary.ca