Geochemical and Geophysical Implications of CO_2 Flooding for Bakken Reservoirs

Peng Luo[1], Weiguo Luo[1], and Ian Coulson[2]

Abstract

Saskatchewan's Bakken oil reservoirs are endowed with an estimated 25 to 100 billion barrels of original oil in place; however, their primary recovery factor remains rather low due to high capillary trapping. While waterflooding could suffer from unfavourable injectivity, carbon dioxide (CO_2) flooding provides a promising option for significantly boosting the recovery factor.

The middle member oil-bearing zone has diverse lithology vertically and areally, in the presence of highly saline formation brine. Any design of a CO_2 flooding process in Bakken reservoirs has to account for the complex geochemical CO_2−rock−brine interactions. For example, reaction of CO_2-saturated brine with calcite and anhydrite results in compositional, mineralogical, permeability, and porosity changes in reservoir rocks. Also, carbonic acid may react with cations from formation brine and form carbonate precipitates.

This presentation summarizes the complex interactions among CO_2, rock, and brine in Bakken reservoirs. Experimentally, CO_2 core flooding was conducted on Bakken middle member core plugs with a variety of lithologies under reservoir conditions. Scanning electron microscopy-energy dispersive spectroscopy (SEM-EDS) and X-ray diffraction (XRD) were performed to analyze morphological and mineralogical changes on pre- and post-flood core samples. Detailed experimental results point to the importance of alterations in porosity, permeability, relative permeability, and wettability, which will help oil producers determine the viability and optimal locations of CO_2 flooding process in Bakken reservoirs.

[1]Saskatchewan Research Council, Regina, SK; [2]University of Regina, Regina, SK

Dr. Peng Luo is currently Team Lead at Enhanced Oil Recovery (EOR) Processes, Energy Division, Saskatchewan Research Council (SRC). His major technical responsibility is to conduct applied research and development on EOR technologies and laboratory engineering design for the petroleum industry's EOR projects. His main expertise is gas flooding and chemical EOR for conventional heavy/medium/light oil reservoirs and tight oil reservoirs in Western Canadian Sedimentary Basin..