Modelling the Formation of Residual Oil Zones (ROZ) in the Permian Basin

Frank Male
Bureau of Economic Geology

9.29.2020 - 10.1.2020 – AAPG Annual Convention and Exhibition 2020, Online/Virtual

Abstract

Residual oil zone (ROZs) reservoirs can only be produced by enhanced oil recovery (EOR) technologies. As a result, ROZs in the Permian basin and elsewhere have become attractive targets for CO2-EOR and have a large potential for CO2 sequestration consequential to the EOR activity. Several San Andres reservoirs, including Seminole, Wasson Denver Unit, and Goldsmith oil fields, are currently from producing oil from ROZs. The oil production of oil saturation, and how it varies within ROZ, is important to modelling both EOR and sequestration. The current project is the first study of ROZs based on extensive studies of cores, wireline logs, and production data from ROZs in the San Andreas Formation. The commonly accepted model for the formation of ROZ is based on the hydrodynamic effects of tectonically-controlled increased water flows in aquifer at the base of oil fields. This hypothesis makes no testable predictions. An alternative model is that ROZs represent the pathways of migrating oil. In this work, the nature of these two processes were modeled using Eclipse, a commercial, full-physics, reservoir simulator. These simulations were designed to identify any distinctive distribution of oil saturations in ROZs or other feature that may be unique to one of these potential mechanisms. A special emphasis was on understanding the impact of reservoir heterogeneity on the variation of capillary pressures throughout ROZ. Heterogeneities in capillary pressures appear to dominate the distribution of oil saturation within the ROZ and will also strongly influence potential in ROZs in the San Andres and Canyon Reef formations of Permian Basin, has been estimated as 12 billion barrels. Understanding the magnitude the performance for both oil production, from CO2 injection, as well as associated CO2 storage.

Finally, we discuss the implications of our results to the understanding both optimizing oil production and incidental CO2 storage in ROZs.