Shale Gas Petrophysical Properties From Imbibition Experiments

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Abstract

Unconventional shale gas has been emerging as an important source of energy in the United States, Canada, and recently worldwide. Based on the Energy Information Administration (EIA), by 2040, world energy demand will increase approximately 30%, and shale deposits worldwide will add 50 percent to the global technically recoverable natural gas resources. For this reason, governments, investors, and companies have begun to explore the commercial potential of shale resources around the world. For instance, China and Argentina recently started joint-venture projects with multinational companies, and Mexico lifted the government’s 75-year-old monopoly on oil and gas production, opening some of the world’s largest shale formations for development. Shale development requires technology, such as extensive horizontal drilling techniques and large hydraulic fracture operations to increase the well - reservoir contact ratio as much as possible, and to stimulate the low permeability of these reservoirs to allow fluid to flow to the wellbore. Up to 20 metric tons of aqueous fluid is injected into a typical horizontal well to induce fracture networks. Although this aqueous fluid is typically essentially fresh water, produced water or flowback is often very saline, suggesting that the flow-back water is leaching salt from the formation. However, it is not currently known whether the recovered salt comes from connate water, from dissolution of mineral salt, interaction between bound water and frac fluid, or connectivity with high salinity aquifers. If salt is produced from interaction of stimulation fluids and the formation, it is not known whether it is produced mainly from the rock matrix (e.g. interaction with clay mineral surfaces), or from micro or macro fractures. Finally, field observations reveal an interesting phenomenon during injected water flowback. In practice, only a small fraction of the injected fluid is recovered during the clean-up phase and the mechanisms

responsible for inefficient water recovery are still poorly understood. Water flowback data and its condition, such as salinity and volume, can give us an insight on the petrophysical properties by understanding the mechanisms that might play a role on the rock/fluid interaction. An experimental approach is discussed in this project to achieve this goal by using imbibition experiments at different conditions and on different shale gas samples. The objective of this project is to understand these two flowback observations in shale gas reservoirs by 1) modeling the interaction between fluids and reservoir cores and 2) identifying the petrophysical parameters controlling the mechanisms present at the imbibition experiment.

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