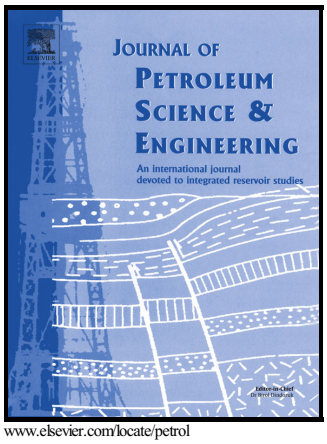

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Analytical Model to Determine Optimal Fluid Injection Time Ranges for Increasing Fluid Storage and Oil Recovery: A Reservoir Compaction Approach

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Abstract

Reservoir compaction and pore collapse are induced with fluids (oil, gas, and water) productions. They are responsible for both recovery and environmental problems. Our objective is to develop a generic integrated framework for reservoir compaction to determine optimal time ranges of fluids (CO_2 or water) injection in a reservoir for increasing oil recovery and their storage. The framework consists of a model with a methodology. We derive the model using the concept of body-centered pores in a cubic lattice at microscopic level. The model describes the relationship between porosity and stresses, and estimates reservoir compaction as a function of fluid withdrawal, time, and stresses.

On the basis of the model developed, we propose a methodology named a failure-line method to determine the critical point of irreversible brittle pore collapse. Thus, the best fluid injection time range is before touching this critical point. We use inversion analysis to determine, compare and validate our results with experimental and field data available, and found a good match. As a result, the developed model and methodology can be an efficient and cost effective tool to investigate the effect of production on reservoir compaction, variation in porosity, and to determine an optimal time range for fluid injection. The model assumes that there are no consistent capillary and gravity forces.