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Please fill in your abstract title.	Interdependence of Flow and Geomechanical Processes During Short- and Long-Term Gas Displacement EOR Processes in Fractured Shale Oil Formations

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Abstract

Objectives

The main objective of this study is to identify and describe quantitatively the short- and long-term geomechanical response of a multi-fractured shale oil reservoir during the course of production induced by gas displacement. The study analyzes (a) the behavior of the propped hydraulic fractures, including changes in aperture and proppant redistribution, (b) the evolution of secondary fractures in the matrix or closure of natural fractures, and (c) changes in the flow properties (porosity and permeability) of the matrix.

Methods, Procedures, Process

In this numerical simulation study, we use the TOUGH+Millstone simulator that describes the coupled flow, thermal and geomechanical processes associated with the flow of fluids in shale reservoirs. We focus on the analysis of the 3D minimum repeatable element (stencil/domain) that can describe a hydraulically-fractured shale reservoir under EOR operations using two different displacement gases (CO2 and CH4). This stencil is discretized using a very fine (to a mm-scale) grid. We compare the solutions to two reference cases (one for each displacement gas) that does not involve geomechanical considerations and proppant redistribution, and we monitor continuously the rate and composition of the production stream and the evolution of the spatial distributions of strains, stresses and displacements in the domain, as well as possible mechanical failure criteria that can lead to the evolution of secondary fractures.

Results, Observations, Conclusions

In all cases, consideration of geomechanical effects leads to (a) a reduction in the hydraulic fracture aperture, (b) a reduction in the matrix porosity and permeability, (c) a reduction in the extent/volume of the production zone, and (d) a geomechanical failure early in the production process, possibly leading to the evolution of secondary fractures. The impact of all these results is an overall reduction in production

Novel/Additive Information

A novel component of this study is the simultaneous consideration of all processes (including flow, thermal, geomechanical, physical-chemical) associated with the flow and production of fluids from shale oil reservoirs during gas-drive EOR operations. Additionally, the study quantifies the system behavior for a range of production scenarios (continuous displacement, huff-and-puff, bottomhole pressure management) and provides important information that can guide the design and management of production from shale oil reservoirs.