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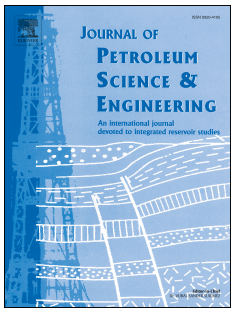

Time-dependent modeling of subsidence due to drainage in bounding shales: Application to a depleted gas field in Louisiana

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Time-dependent Modeling of Subsidence due to Drainage in Bounding Shales: Application to a Depleted Gas Field in Louisiana

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Abstract:

Hydrocarbon production is an important process contributing to the subsidence in Louisiana. Releveling data from National Geodetic Survey show that subsidence along several major oil and gas fields accelerated after production when reservoirs were nearly depleted. The Valentine gas field in coastal Louisiana is chosen to analyze the subsidence during and after production based on three-dimensional finite element modeling. An elastic-viscoplastic constitutive model is adopted to interpret the accelerated postdepletion subsidence by overcoming the limitation of traditional theories within the framework of poroelatsicity and poroplasticity. The elastic-viscoplastic model integrates a failure envelope, an elliptical cap yield function, and Perzyna's theory of overstress viscoplasticity. The elastic-viscoplastic model is applied to both the simplified disc-shaped reservoir and the bounding shales. The material properties of the elastic-viscoplastic model are calibrated based on a computational technique along with available laboratory and field data from the literature. The numerical modeling results can approximately reproduce both the observed subsidence during production and the delayed subsidence after production using the calibrated material properties. The time-dependent subsidence is predominantly attributed to the delayed compaction that arises from the slow pore pressure diffusion in the bounding shales after the reservoir is depleted. The calibrated finite element model is capable of predicting the time-dependent compaction and subsidence, along with the three-dimensional temporal and spatial distribution of pore pressure, void