Integrated Geomechanics Solution for an Unconventional Oil Shale Reservoir in Mexico

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ABSTRACT

Mexico has excellent potential of technically recoverable shale gas and shale oil resources stored in Cretaceous and Jurassic shale formations distributed along the onshore Gulf of Mexico region. These unconventional reservoirs will require massive stimulation treatments or special recovery processes. The lessons learned on the first exploratory wells drilled in these unconventional reservoirs in Mexico, underscore the importance of proper well landing, thorough geomechanical characterization, and use of advanced fracture modeling tools for an optimized hydraulic fracturing design in the development of the shale plays. A fully integrated geomechanical workflow was implemented to support the characterization of reserves of a horizontal exploratory well located in the Tampico-Misantla basin targeting the Jurassic Shale formation. The data acquisition program for the vertical pilot well and the horizontal well comprised the integration of core data from laboratory tests and borehole sonic data to characterize the mechanical properties of the reservoir. The workflow started with the construction of a 1D geomechanical model using an anisotropic stress model, and then continued with the construction of a 3D geomechanical model to fully characterize the in-situ stress state using finite element modeling. The product of the workflow was a hydraulic fracturing model coupled with the 3D geomechanics simulator. This enabled modeling fracture initiation and propagation as well as geomechanical changes during stimulation and production. The 1D anisotropic geomechanical model, made it possible to characterize the mechanical behavior of the lithological units, and the model showed a moderate to high degree of mechanical anisotropy in the Jurassic Shale formation. The fully integrated approach provided important indication to solve the problem of hydraulic fracture containment and to select the optimal location for the stimulation clusters. Results were evaluated using various techniques, including micro seismic monitoring; and well testing. This integrated Geomechanics solution provides a deep understanding of completion quality indicators and well completion design; requirements of the reservoir responses to hydraulic fracturing at the well scale and field scale, to optimize decision making and maximize production.