Proposal - State Of The Art Of Conventional Vs. Unconventional Geomechanics Characterization

Author block:  F. Elisabeth, Saudi Aramco; C. Teran, M. Bentosa Gutierrez, ARAMCO

Abstract

Objectives/Scope: For the past sixty years, geomechanics have grown to become a key discipline to overcome oil industry drilling, completion and production challenges. Following the exploitation of unconventional plays, geomechanics have been identified as an invaluable discipline to reach and unlock resources from these complex and challenging systems. This paper provides a review of the differences involved in building mechanical earth model and oilfield geomechanics applications for conventional versus unconventional tight rocks.

Methods, Procedures, Process: Unconventional plays have complex geology and heterogeneous rock properties. Unconventional geomechanics led to greater emphasis of advanced and integrated techniques. Geomechanical assumptions, equations and models used to characterize conventional plays adapted and evolved evaluating alternative methods for pore pressure prediction, rock mechanics characterization of a heterogeneous and highly anisotropic rock, evaluation of in situ stresses, and its response to drilling and hydraulic fracture. Unconventional geomechanics integrates time dependent behaviour, hydraulic fracturing observations, micro seismic and reservoir modelling in order to provide insights of effectiveness of drilling and hydraulic fracturing operations, well spacing optimization and evaluation of the potential induced seismicity.

Results, Observations, Conclusions: The physical and mathematical model in the analysis of mechanical properties of the rock and the prediction of the in-situ stresses is resolved in conventional formation using isotropic models and measurements. The estimation of formation pressure in conventional plays used to rely on the analysis of events and measurements during drilling, testing and production of wells and mathematical model developed from relaxed basin without major tectonism events. Unconventional formations provided a unique opportunity to look into the importance of mechanical anisotropy and its impact on drilling and completions. Anisotropic stress and viscoelastic stress relaxation models have shown greater consistency with downhole and laboratory measurement tests. Long-term flowback production from impermeable formations provides more reliable estimation of formation pressure and an understanding of the lower limits of underbalanced drilling without flow. Finally, in terms of exploitation scheme of non-conventional reservoirs, geomechanical parameters such as stress regime and orientation of stress, natural fractures and formation internal layering largely impact the exploitation success of those plays. For conventional deposits, the geomechanics characterization of stress regime and orientations address mainly the possible prediction of problems related during production of weak formation such as solids production, compaction and subsidence among others.

Novel/Additive Information: Over the years, geomechanics has been integrated with geoscience and engineering disciplines to solve the present challenges in the extraction and production of hydrocarbons. It is possible today to establish differences in methodology, application and concept between a traditional conventional approach versus an unconventional geomechanics characterization of rock.