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Numerical Model-Software for Predicting Rock Formation Failure-Time Using Fracture Mechanics

Authors

Authors and affiliations

Emmanuel E. Okoro, Email author Samuel E. Sanni, Amarachukwu A. Ibe, Paul Igbinedion , Babalola Oni

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Abstract

Real-time integrated drilling is an important practice for the upstream petroleum industry. Traditional pre-drill models, tend to offset the data gathered from the field since information obtained prior to spudding and drilling of new wells often become obsolete due to the changes in geology and geo-mechanics of reservoir-rocks or formations. Estimating the complicated non-linear failure-time of a rock formation is a difficult but important task that helps to mitigate the effects of rock failure when drilling and producing wells from the subsurface. In this study, parameters that have the strongest impact on rock failure were used to develop a numerical and computational model for evaluating wellbore instability in terms of collapse, fracture, rock strength and failure-time. This approach presents drilling and well engineers with a better understanding of the fracture mechanics and rock strength failure-prediction procedure required to reduce stability problems by forecasting the rock/formation failure-time. The computational technique built into the software, uses the stress distribution around a rock formation as well as the rock's responses to induced stress as a means of analyzing the failure time of the rock. The results from simulation show that the applied stress has the most significant influence on the failure-time of the rock. The software also shows that the failure-time varied over several orders of magnitude for varying stress-loads. Thus, this will help drilling engineers avoid wellbore failure by adjusting the stress concentration properly through altering the mud pressure and well orientation with respect to in-situ stresses. As observed from the simulation results for the failure time analysis, the trend shows that the time dependent strength failure is not just a function of the applied stress.

Because, at applied stress of 6000–6050 psi there was time dependent failure whereas, at higher applied stress of 6350–6400 psi there was no time dependent strength failure.

Keywords

Time-to-failure Numerical model Software development Rock strength Stress distribution Fracture mechanic Oil and gas operation

Notes

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