

The Impact of Drilling Unloading on Wellbore Stability of Shale Formations

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ABSTRACT

It is easy for wellbores to lose stability during drilling through shale formations where induced fractures and cracks might be generated due to drilling unloading in rocks around the wellbore and the consequent reduces rock strength which thereby can cause wellbore instability. To ensure consistent wellbore stability while drilling through shale, the author simulated stress change process during drilling unloading with a triaxial testing system to analyze the impact of unloading on shale mechanical properties. Further, the relationship between shale cohesion, internal friction angle and the unloading amplitude was set up with the regression method, and a wellbore stability model was established that took into consideration the unloading effect by introducing the newly defined relationship into normal wellbore stability model. Testing results demonstrated that unloading will reduce shale strength and accordingly shale strength reduction will increase with the increase of unloading. Considering the unloading effect, wellbore collapse pressure will increase for the shale (especially for shale under high in-situ stress and strong anisotropy). When the angle between the borehole and the minimum horizontal stress is comparatively small, the effect of unloading on the shale wellbore stability is limited. The research results indicated that the effect of unloading on wellbore collapse pressure of shale should not be overlooked, and it should be taken into account in designing the drilling fluid.