Geomechanical Modeling to Address Subsidence/Uplift at Shallow Depths

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Abstract

Stress redistribution associated with injection/depletion can make wells technically challenging particularly in soft formations. Where a significant amount of subsurface deformation is expected, the integrity of the well, casing and surface structures becomes a major concern. It is observed that problems related to wellbore stability occur due to stress redistribution and failure of rocks during drilling which causes subsidence/uplift. Many of these issues are encountered at shallow depths where only limited log data is available.

The objective of this article is to identify geomechanical causes of the problems encountered during subsidence/uplift. Models derived from geomechanical modeling (using 3D seismic data) and 1D and 3D Mechanical Earth Models are then used to calculate various geomechanical parameters which then help in predicting potential areas of subsidence or uplift.

AVO inversion at wide angles can be used to estimate density from which vertical stress can be calculated using basic integration. Once the principle stresses are estimated, other useful parameters such as hoop stress can be used to predict how the well will behaves while drilling and under stimulation. Seismic data can be used to extrapolate information derived at wellbores to the inter-well regions.

This article discusses the methodology and its implementation on field data which shows that a tremendous amount of information on stresses and rock properties can be estimated from 3D seismic data. The principle stresses and elastic properties models calibrated with available log data and leak-off test data is then used to estimate the brittleness or UCS between wells and in the entire area of study. Finite element modelling can be done for predicting and understanding the changes that occur during production.