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Geomechanical Evaluation of HPHT Tight Gas Reservoir in Western China

K. Qiu* (Schlumberger)

SUMMARY

Succesful hydraulic fracturing is critical to develop Keshen HPHT tight gas reservoir located in Tarim Basin, Western China. Understanding of geomechanical properties in the Keshen reservoir provides essential input to optimization of hydraulic fracturing. Under HPHT environment, the mechanical properties of the reservoir rock exhibits very different mechanical behavior.
To this end, a comprehensive laboratory testing program was performed to investigate the mechanical behavior of the sandstone of the reservoir rock when subjected to realistic in-situ stresses, pore pressures and temperature. The triaxial tests not only provided measurements on reservoir mechanical properties such as the Young's modulus, Poisson's ratio, rock strength, but also revealed their dependence on confine stress and temperature. Pore volume compressibility tests measured the pore volume compressibility and porosity reduction with depletion of the reservoir that is important for estimation of compaction drive of the reservoir. Since Biot elastic constant is essential to estimate effective stress state in the reservoir, two testing methods were devoted to measure it, one is through pair drained and undrained compaction tests from twin samples, and the other is the pore volume compressibility tests. Proppant embedment tests revealed the stress sensitivity of the propped fractures and potential embedment of proppant on the fracture surface. Based on the core test results, 1D mechanical earth models were constructed for the wells in the field. The reliability of the MEM was validated through comparison between wellbore stability predictions with observation of borehole failure from the microresistivity image. The integrated understanding of the mechanical properties and in-situ stresses provided critical input of hydraulic fracturing design and execution.
The paper provides the detail of laboratory test programme and results, explains the workflow for 1D mechanical earth model building, and highlights unique mechanical properties of the HPHT reservoir sandstone formation.