INTEGRATION OF WIRELINE LOGS AND ROCK MECHANICS FOR STRESSES AND CRITICALLY STRESSED FRACTURES ANALYSIS IN JURASSIC TIGHT SANDSTONES OF WESTERN SIBERIA

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ABSTRACT

The geomechanical properties analysis of wellbore stability, mud losses, fracture propagation and sanding has gained particular importance in the last decades as a response to the increasing exploration and development of complex tight formations, which represent major engineering challenges in drilling and production. This work is focused on cause analysis of problems related with drilling, completion and production of tight sandstones package in Jurassic sediments of Western Siberia. Existing geological understanding of these sandstones does not take into account dispersion of earth stresses directions and magnitudes that result in significant problems during exploration and production activities. The studied Jurassic formation is composed of sandstones with low matrix porosity. It is renowned that the relatively few fractures and faults in fractured rock masses often serve as the primary conduits for fluid and that fractures and faults have a strong influence on bulk permeability. Previous studies have shown that shear displacement and dilation of fractures can be sources of mechanical instability and significant fluid pathways in these tight rocks. The analysis of mechanical properties in conjunction with fracture identification and stresses orientation provide ultimate understanding of these reservoirs.

Conventional wireline logs, borehole image logs, core triaxial testing, drilling and completion data were integrated to build geomechanical model in 22 wells. These models are to analyze critically stressed fractures, using pore pressures and geostatistical model, to allow propagations of rock mechanical properties into the geological framework. The ductile/brittle zones were recognized based on Poisson ratio and Young modulus values, combined with the fracture density from borehole images. Critically stressed fracture analysis technique was selected to identify hydraulically conductive and non-conductive fractures. The analysis is calibrated on triaxial tests and acoustic measurements from core samples.

Calculated earth stresses and fracture conductivity significantly affect drilling and production performance, where the fracture instability is mainly driven by stress concentrations. The outcomes of the project help to distinguish conductive natural fractures and zones promising for artificial fracturing, avoid mud losses and increase production.

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