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Integration of Rock Mechanical Reservoir Model and Microseismic Date to Establish Accurate Stimulated Reservoir Volume

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Summary

Unconventional resources development has had a great success in North America, while people still face many challenges during development process. The hydraulic fracturing treatment is applied in the ultra-low permeability tight reservoir to create conductive fractures. A stimulated reservoir volume is usually estimated to demonstrate and evaluate hydraulic fracturing results, which is fundamentally generated by microseismic data. However, real shale deformations could not be totally and precisely reflected by microseismic data. Most microseismic signals are generated by shear fracturing, while hydraulic fracturing can induce tensile fracturing as well, which could not be well recorded in microseismic data. The insufficient geophones coverage or a long distance between geophones and fracturing location can also make microseismic signal undetectable. From geological aspect, rock mechanical properties have a great influence on hydraulic fracturing results. But all shale plays are different, even in the same Formation or Member rock mechanical properties of each shale sub-intervals are also varied significantly. The changes of rock mechanical properties directly affect hydraulic results and rock petrophysical properties. Under the same hydraulic fracturing operation condition, a more brittle interval can form more and complicate fractures, and the formed fractures tend to perpetuate longer than the ductile shale interval. In this study, we utilize geological and petrophysical data to build different rock mechanical facies, which is based on how the rock is prone to form hydraulic fractures. We first calculate rock mechanical facies in near wellbore zones, then a whole reservoir rock mechanical model is established by a pixel-based model method. Compared with a rock mechanical reservoir model and the original stimulated reservoir volume, mismatch areas are located. In these areas, the microseismic signal threshold that is used to eliminate noise and get accurate signal are further modified based on mismatch degrees. Consequently, an improved stimulated reservoir volume is generated by the modified microseismic data and rock mechanical reservoir model.