Fracture Characterization Combining Borehole Acoustic Reflection Imaging and Geomechanical Analyses

Paper Ref : SPWLA-2022-0099

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Abstract:

The assessment of fracture fluid conducting capability in reservoirs is of great significance for hydrocarbon production, especially for tight reservoirs with fractures as the main reservoir fluid transport conduits. In recent years, the dipole shear-wave reflection imaging technology has been effectively applied to identify near-well formation fractures and determine their orientation; but the evaluation of the fluid conducting effectiveness of the acoustically-imaged fractures remains a challenging task. To accomplish this task, this paper proposes a method that combines the dipole acoustic reflection imaging with a geo-mechanical analysis to determine the stress state on the fracture surface. The fracture orientation and inclination, as obtained from the borehole reflection imaging, are combined with in-situ stress condition to calculate the effective stress state of the fracture surface using a 3D Mohr diagram analysis, which, when compared with the Mohr-Coulomb failure criterion, determines whether the fracture is in the critically stressed state and is therefore fluid conductive. Most importantly, our analysis shows that the typical 180-degree fracture orientation azimuth uncertainty in the dipole shearwave imaging does not affect the determination of the stress state on the fracture surface in the Mohr-diagram analysis, so that the two methods can be effectively combined to form a new method for evaluating the fluid conducting effectiveness of fractures. The application examples from fractured reservoirs show the effectiveness of the new evaluation method, and the evaluation results can be used to provide useful information for field development and production planning.

Bio:

Xiao-Ming Tang is professor of Geoscience at China University of Petroleum, Qingdao, China. He received a Doctor of Science degree from MIT in 1990 and worked for the petroleum industry for more than twenty years. He has broad interests in oil and gas exploration, including seismic wave theory, borehole geophysics, petrophysics, and rock mechanics.