

Hydraulic Fracturing Treatments and the Impact of Formation Heterogeneity

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It goes without saying that hydrocarbon bearing formations are not homogeneous and isotropic. However, that is the way they are often looked at when considering hydraulic fracturing. Unconventional shale reservoirs are plagued by these assumptions also. Completion strategies in many shale operations call for horizontal sections up to 4500 ft. or longer. This is then segmented into 10 to 15 stages of equal length. Within each stage, perforation sets (4 to 6 sets) are evenly spaced from which hydraulic fractures are initiated. This scenario gives no consideration to the formation/reservoir variation that exists.

By using this approach, the variations in the formation are not considered and treatment adjustments are not made based on reservoir characteristics. This raises the question of proper treatment. Should a different treatment be applied to different reservoir rock? Proper assessment of the formation along the lateral could have the impact of improving treatment efficiency and dollars spent and also improve production from the well.

Formation evaluation tools are currently available to characterize the formation based on composition, mechanical properties, and stress conditions. These evaluation tools include 3D seismic data and interpreted attributes, chemostratigraphic evaluation of drill cuttings and LWD, processed log data in the open hole, and processed log data from the cased hole with proper calibrations.

There are fracture design models that attempt to apply more sophisticated analyses of the formation characteristics and how they change vertically and horizontally away from the wellbore. Gathering the full suite of information to populate the reservoir description is critical to take advantage of the full capability of these frac models.

Microseismic monitoring of the fracturing process can follow the development of the fracture as it is created. Evaluating the events as they occur can provide information and insight into fracturing effectiveness. Observation of the microseismic events can indicate the volume of reservoir that has been contacted and direct future stimulation treatments in the same reservoir.

Iterations of treatment design and formation response can provide the information needed for long term evaluation and treatment optimization. This is not a short term project but rather a long term field wide study to maximize the reservoir asset. Presentation materials will illustrate the visualization capabilities available to bring together the acquired data and the interpretation of the effectiveness.