Detailed Rock Evaluation and Strategic Reservoir Stimulation Planning For Optimal Production in Horizontal Gas Shale Wells

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Heterogeneity in lateral wellbores is primarily controlled by vertical variations in rock characteristics and wellbore geometry. Rock properties and fracture distribution within gas shale reservoirs have significant implications to horizontal stimulation. A lateral and associated pilot wellbores in the Barnett Shale are analyzed with triple combo, geochemical, advanced sonic and borehole imaging tools. Strong relationships between drilling-induced fractures, minimum horizontal stress and mineralogy are observed. These data are integrated and used to subdivide the reservoir based on lateral heterogeneity. This technique can guide lateral stage organization and perforation placement. A large number of fractures are observed on borehole images. Transverse, drilling-induced fractures are the most abundant fracture type. These are discontinuous features propagating from the top and bottom of the hole with a low apparent dip. Natural fractures occur with much less frequency. These features also have a low apparent dip and are typically more continuous around the wellbore. Most natural fractures are healed, some are re-opened. Inspection of mineralogy, minimum horizontal stress and fracture data on a compressed scale allows for straight forward zoning and eight zones are identified. Summations of minimum horizontal stress, vertical Poisson's ratio, horizontal Young's modulus, clay content and calcite volume are performed. Correlation between minimum horizontal stress and transverse drilling-induced fractures is strong and inversely proportional. These fractures are less frequent in zones with high Poisson's ratio and/or high horizontal Young's modulus. Mineralogy, minimum horizontal stress, mechanical properties and drilling fracture density are highly correlative on a large scale. High drilling-induced fracture density suggests high rock failure potential. In the absence of geohazards, staging intervals based on detailed rock analyses increases the potential for maximum reservoir contact and optimal gas drainage. Induced hydraulic fractures propagate in the path of least resistance therefore it is crucial to isolate high stress zones from low stress zones and naturally fractured zones from un-fractured zones in order to maximize stimulation effectiveness. Once the lateral wellbore is properly staged, perforation points that best promote hydraulic fracture initiation and conductivity within each zone are selected using a similar approach.