Real-Time Borehole-Based Microseismic Monitoring of Hydraulic Fracturing Treatments in Adjacent Horizontal Wells in the Barnett Shale: Example of a Faulted Reservoir

Stokes, Jerry S.[1]; Moros, Horacio [2]; Le Calvez, Joel H.[3]; Brosnan, Kimberly [3]; Greer, Joe [3] (1) Mid-Continent Geological Inc., Colleyville, TX. (2) Eagleridge Energy LLC, Dallas, TX. (3) Schlumberger, Addison, TX.

Large amount of gas are currently being produced from unconventional shale reservoirs. These plays are mainly technology- and economics-driven. These reservoirs must be effectively hydraulically fracture stimulated. Large-scale faulting and fracturing are critical factors controlling stress distribution hence hydraulically-induced fracture system development. Almost all predictive models used to estimate recovery in stimulated wells are based on assumptions that lead to oversimplified fracture geometry. To avoid making assumptions and to better understand the created fracture geometry, borehole-based monitoring of the induced microseismicity may be used. We present the results of a multi-stage, multi-lateral microseismic monitoring campaign performed in the Barnett Shale formation in Denton County, Texas. The primary objectives of this project were to drill and to successfully complete Barnett shale wells in and around faults located on the prospect acreage using 3D surface seismic and microseismic monitoring of the hydraulic fracture process. Three horizontal wells were drilled 500 ft apart with the center well landed about 80 ft shallower than the outside laterals. All three laterals have been placed in the Lower Barnett Shale section. 3D surface seismic indicates that the surface locations are on top of a major fault complex with the lateral sections drilling away from the major fault system and through a smaller fault. We stimulated the wells using real-time microseismic monitoring in order to avoid the faulted zones and to modify as needed perforation scheme and stimulation schedule. All three Paddock wells have been successfully completed with initial production of over 3 MMCF gas per day each. Initial production and early decline rates have proven that the completion process performed on these wells have been successful in avoiding the faulted areas. This ongoing project in the Fort-Worth Basin highlights how integrating information gathered at different scale from different investigation method both in the geosciences and engineering domains is improving our understanding of the relation that exist between surface seismic, borehole measurements and the physical response of the reservoir formation when it is stimulated using hydraulically-induced fracturing. Evaluation of the production results appear to show that large-scale faulting features are not necessarily detrimental as long as treatment schedule and placement is properly controlled.