Understanding of Natural Fractures in the Woodford Shale to Improve Hydrocarbon Production

Romina Portas[1] and Roger Slatt[2]

[1]ConocoPhillips
[2]University of Oklahoma

Abstract

The Woodford Shale is a prolific unconventional source rock play in Oklahoma. Better IP rates and EURs are achieved using horizontal drilling and multi-stage completions of naturally fractured rock. Therefore, understanding natural fracture networks and distributions are the key to finding sweet spots.

The main objective of this work is to document and understand the natural fracture patterns within the Woodford Shale in the exposed vertical walls of a quarry using laser imaging detection and ranging (LIDAR) data, 2D seismic lines, and the logs and core acquired in a well drilled behind one of the quarry's wall. Some specific goals were to determine if the fractures align with the general strike of faulting in the area of study and to define if the fracture sets are confined to the Woodford Shale or extend into the underlying Hunton Group.

Integration of manual and LIDAR measurements on the exposed fractures present at the outcrop revealed two sets with nearly vertical dip. Group 1 is a systematic fracture set with parallel orientations, regular spacing and mineral filling, having a median strike direction of N85°E. Group 2 is a nonsystematic fracture set, younger than Group 1, having a median strike direction of N45°E. The average fracture spacing is 1.2m (4ft), with no lateral lithology or bedding change identified. The present-day stress field in the area has an ENE-WSW direction that matches the strike of fractures in Group 2, different from the paleostress that generated fractures in Group 1.

The Woodford Shale has three informal members and the Lower one is not present in the area of study. There is a greater abundance of fractures in the Upper Woodford Shale than in the Middle Woodford Shale, probably because of the former's higher content of quartz.

The 2D seismic lines imaged the Upper-Middle Woodford contact and the Woodford-Hunton unconformity surface. The faults interpreted on seismic follow the same extensional trend as the regional faults observed in the surrounding area and locally extend between the Woodford Shale and Hunton Group without thickness changes.

Improved understanding of the Woodford Shale fracture networks' orientation, spacing, length and timing as well as their inter-formation extent is a key factor in the location and drilling orientation of future horizontal wells as it will affect completion effectives and economics.