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Rock/Fluid Interactions in Unconventional Reservoirs

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Summary

Water is not inert during hydraulic fracturing; it interacts with the unconventional reservoir rock in many ways. This presentation highlights the various mechanisms of interaction between the hydraulic fracturing fluid and the formation rock. Knowing the impact of the fluid system on the respective reservoir rock, one can design the hydraulic fracturing treatment to optimize hydrocarbon production.

Introduction

Exploitation of unconventional gas and oil reservoirs requires injecting large quantities of water-base fluids during hydraulic fracturing treatments. On average only 5–30 % of treatment fluids are recovered during flowback from these wells. The large quantity of residual treatment water remains either in the created fracture network or imbibes into the rock matrix immediately surrounding the fracture network. As such, this residual water is spatially located at the critical junction between the reservoir and the hydraulic fracture completion. In addition to potentially causing the loss of relative permeability to hydrocarbons in the matrix rock surrounding the fracture, this residual treatment water disrupts the chemical equilibrium of the rock, hydrocarbon, and connate water system – leading to a physically and chemically altered zone of rock immediately adjacent to the fracture face. Loss of rock strength in the altered zone due to chemo-mechanical effects is a particularly serious problem.

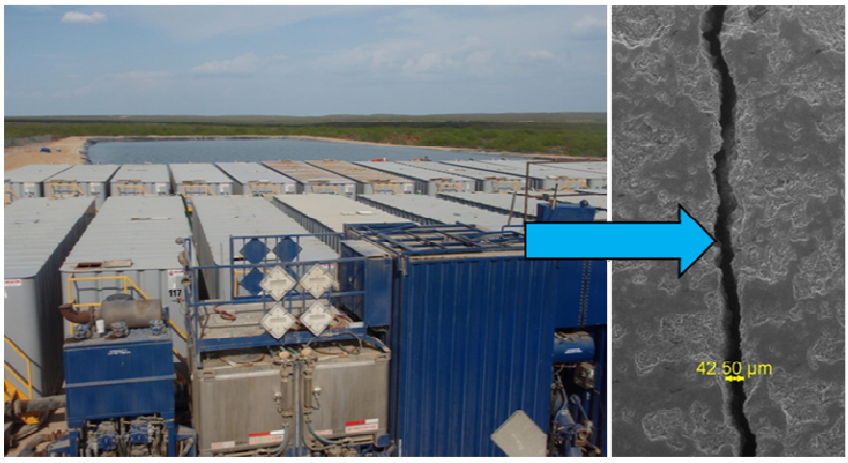

Figure 1, *During hydraulic fracturing, large amounts of water contact the rock.*

Theory and/or Method

Hydrocarbon production from viable unconventional reservoirs is largely influenced by fracture conductivity and fracture-face permeability. Fracture-face permeability determines the transition of hydrocarbons from the rock matrix across the rock/fracture interface into the fracture network. It can be influenced by many factors, including water retention, chemomechanical rock softening, proppant embedment, and chemical scale formation. Fracture conductivity, which determines the transport of hydrocarbons in the fracture network to the wellbore, can also be severely influenced by rock/fluid interactions as well as other factors like stress conditions and time.