Controls on Shale-Hydraulic Fracturing Fluid Physicochemical Interactions: Implications on Hydrocarbon Production and Contaminant Release

Shikha Sharma[1], Vikas Agrawal[1], Brennan Ferguson[1], Shaun Donmoyer[1], Alexandra Hakala[2], Mengling Stuckman[2]
[1]West Virginia University; [2]National Energy Technology Laboratory

9.29.2020 - 10.1.2020 – AAPG Annual Convention and Exhibition 2020, Online/Virtual

Abstract

The physicochemical interactions that ensue in the shale reservoir after the introduction of hydraulic fracturing fluids (HFF) during hydraulic fracturing operations can have significant impact on hydrocarbon (HC) production and release of contaminants in the produced water. From production perspective, processes like precipitation, formation of organometallic complexes, and adsorption on organic surfaces can clog fractures and inhibit gas flow which may impact late-stage production. On the other hand dissolution reactions can create new pathways for gas and fluid flow and increase productivity. Further, the myriad of these pH and eH driven chemical reactions release inorganic and organic contaminants in the produced water and hence have environmental implications. We conducted laboratory experiments to understand how variations in mineralogy (specifically minerals like calcite, pyrite, mixed clays, quartz), maturity (VR_o ranging from 0.8 to 3.0), molecular composition of organic matter, and composition of HFF control the chemical changes that take place during the shut-in phase of HF operations. The experiments were conducted using autoclave reactors to simulate subsurface high P-T conditions. We utilized samples collected from Marcellus Shale collected from different parts of the basin. Synthetic fracturing fluid was prepared in our laboratory based on the information obtained from FracFocus.Org. We also altered the composition of this synthetic HFF to better understand the controls on some of these Shale-HFF reactions.Our results demonstrate that to

increase the efficiency of HC production and to devise better produced water disposal/recycling strategies, the chemical composition of HFF needs to be specifically tailored for wells in specific parts of the basin rather than using a broad spectrum HFF.