Breakdown Pressure of Green River Shale With sc-CO2 and Water Monitored Using X-ray Computed Tomography (MR13B-0072)

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Introduction
- The very steep drop in the first 30-40 months of producing gas wells (Fig. 1) supports that natural and induced fractures are the main production contributors in this period.
- Aqueous fracturing disadvantages: liquid loading, long flowback periods and swelling and dispersion of some clay minerals.
- Properties of supercritical CO2: Greater adsorption capacity in shale (Fig. 2), inducing thermal stress when it expands, and unique physical properties.
- Understanding fracture behavior (e.g. breakdown pressure) is important for fracturing job design and fracturing avoidance during CO2 sequestration and stimulation jobs.

Figure 1: Gas wells production profile for different shale basins in the US (U.S. Energy Information administration (2013))

Experimental Setup and Methodology

Factors influencing breakdown pressure
- Rock properties
- Fluid properties
- State of stress
- Pressurization rate
- Borehole size

Figure 3: Modified after Burnham and McConaghy (2014)

Experimental Work

Possible explanations for large BP for sc-CO2 treated samples:
- Different mineral composition: larger ductility than Li et al., (2016) samples
- Reaction to kerogen: large total organic content
- Viscoplastic behavior: observed during experiments

Figure 5: Mineral composition of Green River shale along with treated samples– Modified after Burnham and McConaghy (2014)

Conclusions
- A general trend of large breakdown pressure and unstable fracture propagation for sc-CO2 treated samples was observed.
- sc-CO2 reaction to kerogen is expected to increase ductility of samples and hence result in larger breakdown pressure magnitudes.
- Mineral composition variation plays a major role in breakdown pressure.
- Fracture complexity evaluation is limited as sample size decreases.

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