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The Impact of Temperature on the Threshold Capillary Pressure of Fine-Grained Shales

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Abstract : The threshold capillary pressure of shale caprocks is an important parameter in CO_2 storage modeling. A correct estimation of the threshold capillary pressure is not only essential for CO_2 storage modeling but also important to assess the overall economical and environmental impact of the design process. A standard step by step approach has to be used to measure the threshold capillary pressure of shale and non-wetting fluids at different temperatures. The objective of this work is to assess the impact of high temperature on the threshold capillary pressure of four different shales as they interacted with four different oil based muds, air, CO_2, N_2, and methane. This study shows that the threshold capillary pressure of shale and non-wetting fluid is highly impacted by temperature. An empirical correlation for the dependence of threshold capillary pressure on temperature when different shales interacted with oil based muds and gasses has been developed. This correlation shows that the threshold capillary pressure decreases exponentially as the temperature increases. In this correlation, an experimental constant (α) appears, and this constant may depend on the properties of shale and non-wetting fluid. The value for α factor was found to be higher for gasses than for oil based muds. This is consistent with our intuition since the interfacial tension for gasses is higher than those for oil based muds. The author believes that measured threshold capillary pressure at ambient temperature is misleading and could yield higher values than those encountered at in situ conditions. Therefore one must correct for the impact of temperature when measuring threshold capillary pressure of shale at ambient temperature.

Keywords : capillary pressure, shale, temperature, thresshold
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