Contribution ID: **211** Type: **Poster**

Characteristics and mechanism analysis of gas-water two-phase flow in ultra-low permeability sandstone

Wednesday, 16 May 2018 17:30 (15 minutes)

Abstract: Eight gas-water relative permeability curves of natural ultra-low permeability cores were tested from a new steady experiment at eight different permeability levels. The absolute permeability is the gas permeability at irreducible water saturation. The results show that the curve have displayed a very sharp decrease in gas relative permeability while a slow increase in water relative permeability at low water saturations. And at high water saturation, there is a steep increase in water relative permeability and a sluggish decrease in gas relative permeability. The curves have narrow two-phase co-flow area. With the decrease of cores'permeability, the relative permeability curve and the equipotential flow point (cross point saturation) moves to the right, and the irreducible water saturation gradually increases and the residual gas saturation decreases. When the core permeability is less than 0.13mD, the relative permeability of water phase at the residual gas saturation will be greater than the relative permeability of gas phase at irreducible water saturation.
This is because the smaller the permeability, the smaller the pore size. And the flow rate of the gas is bigger than the velocity of the water, so it's easier to cause velocity sensitivity, and the clay mineral blocks the pore throat that reduces the gas permeability.
Keywords: ultra-low permeability, gas-water relative permeability, improved steady-state method

References

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Session Classification: Poster 3

Track Classification: MS 1.24: Pore structure characterization and micro-scale effect on fluid flow in unconventional reservoir