Impact of Brine Spontaneous and Forced imbibition on effective permeability in gas shales

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Abstract. Gas shale reservoirs are developed by using hydraulic fracture technology that implies the water imbibition into the formation. In this case, it is important to understand the influence of water imbibition on effective permeability of the shale matrix.

In this study we present the impact of brine spontaneous and forced imbibition of the effective permeability to gas for a shale sample from the Vaca Muerta formation.

NMR T2 and T1T2 and Step-Decay gas permeability measurements have been performed at each step of progressive saturation by forced imbibition of brine (saturation increased by pressure steps). The techniques were used to gain insight into the effective gas permeability at different water saturation of forced imbibition process.

Permeability and NMR measurements at progressive forced brine imbibition process allow describing pore size distribution and permeability over brine saturation increase of the oil wet (organic) pores. NMR T1T2 images allow to monitor water imbibition process and determine the contribution of organic porosity to permeability at each saturation stage.

Measurements results revealed the effective permeability degradation by a factor 10 between dry and spontaneous imbibition samples states. The following forced imbibition saturation increase show effective permeability degradation up to a factor 100.

The results demonstrate that water imbibition have a strong impact on effective permeability in gas shales.