

## Gas Transport in Shale: Core-Scale Permeability Measurements & Dual-Porosity Transport Modeling

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Stimulated reservoir volume (SRV) is the reservoir volume effectively connected to a wellbore through an in-situ fracture network (both natural and hydraulically induced/enhanced) and is an important parameter in reservoir production forecasting. Interpreting for SRV (and evaluating hydraulic fracture strategy success) in gas shale reservoirs is especially challenging because it requires either knowledge of the extent, distribution, and transport properties of the in-situ fracture network or knowledge of shale matrix transport properties (permeability), both of which are relatively poorly understood.

We perform transient pressure-pulse decay (TPPD) permeability measurements on intact shale cores to measure effective Darcy's law permeability to gas (Argon) to investigate the hypothesis that measurements at the core length scale can describe in-situ matrix transport (Darcy's law permeability). TPPD permeabilities range from nano- to microDarcy ( $1 \times 10^{-21}$ – $1 \times 10^{-18}$  m<sup>2</sup>) with high sensitivity (1-2 orders of magnitude variation) to effective stress, suggesting the closure of micro-fractures in some cores. It is not known whether these micro-fractures exist in-situ or are created during coring, but they nonetheless must be characterized to address how micro-fractures contribute to gas transport at the core-scale, and potentially at the reservoir scale if our hypothesis is correct.

To investigate the presence and transport role of potential micro-fractures in shale cores, the TPPD apparatus is being modified to attempt to experimentally identify dual-porosity behavior (if it exists and is observable). Our numerical dual-porosity modeling efforts have simulated various conceptual physical models, ranging from a single planar fracture imbedded in matrix to a "sugar cube" model, where the matrix is represented as many small cubes surrounded on all sides by fractures. We present synthetic experimental data for some of these cases. In future work, we intend to compare numerical fractured-core realizations with experimental results to illuminate gas transport at the core-scale, and potentially, through matrix at the reservoir scale.

**Keywords:** gas transport, shale, permeability, porosity