Gas production from gas shale has become a major source of fossil energy in United States. Because of low porosity and ultra-low permeability, shale reservoirs often reach peak production in a very early stage as compared to the conventional sandstone reservoirs. Various attempts have been made to describe the fluid flow behavior in these reservoirs. Slip flow, diffusion and adsorption/desorption are mainly considered as primary flow mechanisms in shale nano-pores while Darcy flow can be attributed for flow in natural fractures. The emphasis of this research is to model a shale reservoir using COMSOL Multiphysics. This poster focuses on comparing the performance of various specie transport flux models by accounting for inter-molecular interactions and gas-rock interactions.

**Diffusion Flux Models**

- Wilke Model
  \[ N_i = (-D_{el,m} \nabla C_i) \text{ where } D_{el,m} = \frac{1}{\sum_{j=1}^{n} \left( \frac{x_j}{D_j} \right)} \]

- Wilke-Bosanquet Model
  \[ N_i = (-D_{eff} \nabla C_i) \text{ where } \frac{1}{D_{eff}} = \frac{1}{D_{el,m}} + \frac{1}{D_{el,k}} \]

- Maxwell-Stefan Model
  \[ N_i = -\nabla C_i + \sum_{j=1}^{n} \frac{x_j N_j}{D_j} \]

- Dusty-Gas Model
  \[ N_i = \sum_{j=1}^{n} \frac{x_j N_j}{D_j} - C_i \frac{\nabla v_i}{D_{el,k} \tau} - \nabla C_i \]

**Results for Binary Component Model**

- Wilke
- Wilke-Bosanquet
- Maxwell-Stefan
- Dusty Gas

**Conclusions**

- Investigate mechanisms of gas transport in shale nano-scale pores to develop better insight on competitive adsorption of CO\(_2\) on pore walls compared to CH\(_4\) and other hydrocarbon gases.
- Develop a rigorous modeling framework that accounts for diffusion, adsorption, and Darcy flow in a shale reservoir dual-pore system using different flux models.
- Compare predictions of species transport for different flux models and establish an appropriate methodology for validation using data from an actual reservoir.