Research Proposal

Fractional Modeling of Liquid-Rich Reservoirs Adjacent to Source Rocks

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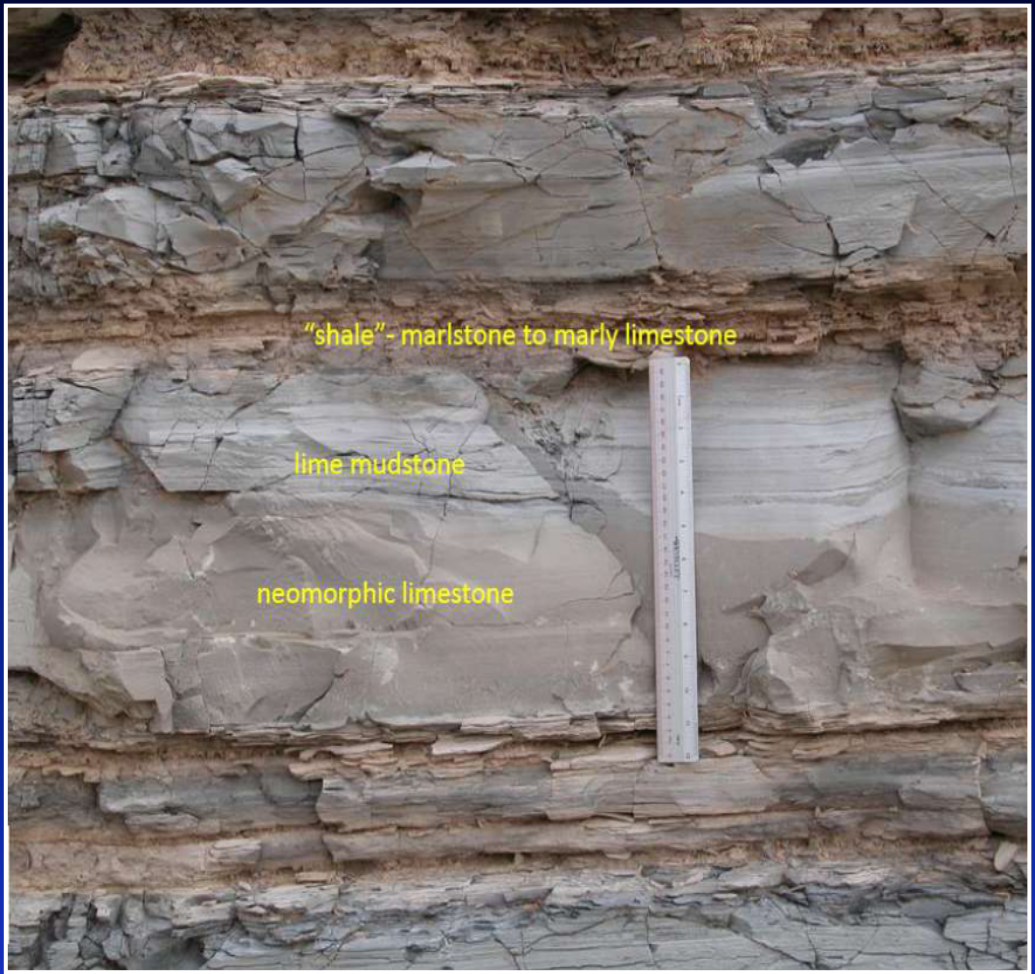
Problem Statement

Layered Unconventional Reservoirs

Producing layers sandwiched between layers of very tight (source) rock

Horizontal wells
Hydraulic fractures
Multiple phases
…



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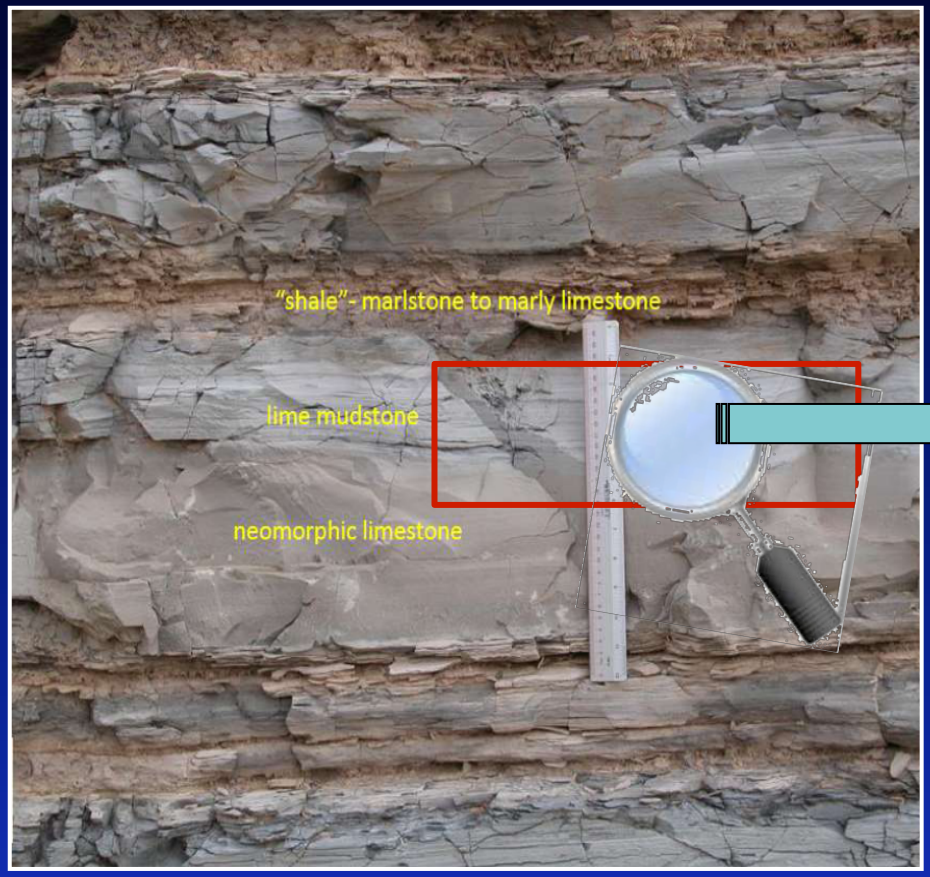
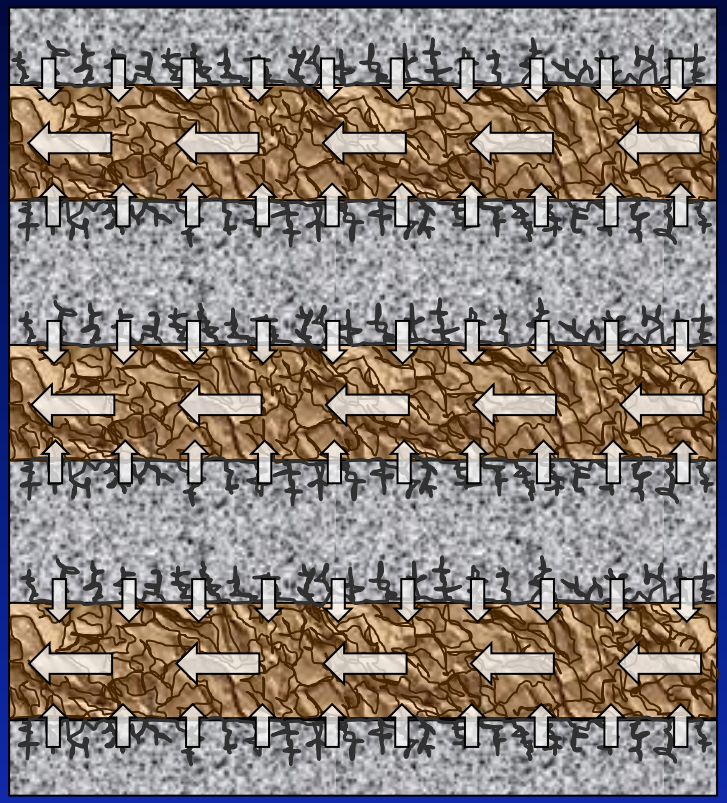




Production from thin, fractured layers

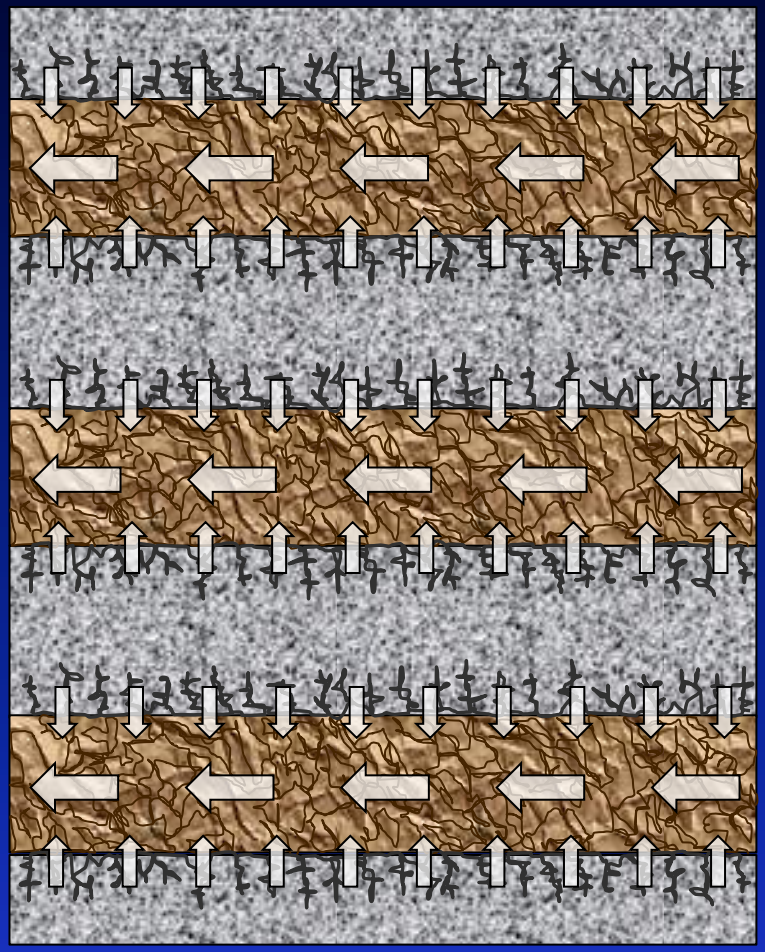
Problem Statement

Support from the source rock layers

Source rock may feed into the producing layer if it has fractures
(a transient dual-porosity model)

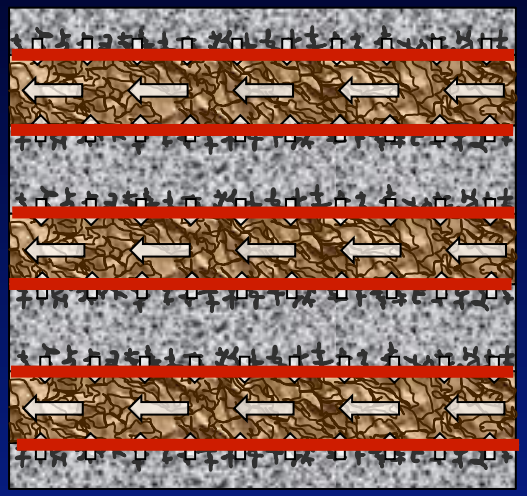
Productive layers are usually adjacent to thermally mature, kerogen-rich shales.

In these cases, both the source and producing rocks have a high fracture density along with a large residual oil content



Literature Review

Modeling the diffusion between the source & producing layers



NFR system Representation :

- Double-porosity models – Euclidian Geometry (Warren-Root)
- Random arrays of fractures (Cacas et al, Long & Hestir)

FRACTALS

(Beier, Chang & Yortsos, Camacho-Velazquez, Monteiro et al.))

a shape made of parts similar to the whole in some way (Mandebrot)

NON-LOCAL ANAMOLOUS DIFFUSION

Literature Review

- *Case -1*

Sahimi and Yortsos (1970), Chang and Yortsos (1990)

Characterize the fractals and represent heterogeneity by fractal statistics and diffusion in single layer by space variable only.

- *Case – 2*

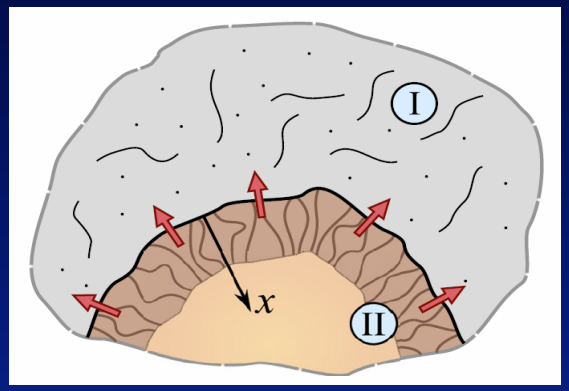
Flamenco-Lopez and Camacho (2003), Camacho et al. (2008), Camacho et al. (2011)

Investigate the production-decline behavior and transient-well response with a finite difference and analytical solutions by using Case-1 approach.

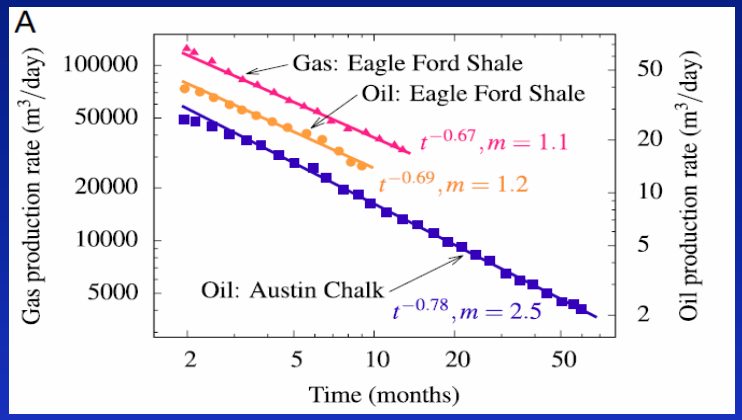
Literature Review

- *Case -3*

Monteiro, Rycroft and Barenblatt (2012)



Model the fluid and gas flow in nanoporous rocks by power law.



Compare the production decline with time by using power law

$$Q: \ (t - t_0)^{-(m+1)/(m+2)}$$

Objectives

- Develop a model to understand the flow mechanisms in extremely tight fractured layer systems.
- Understand the interaction between the carbonate and source rock layers
- Develop a methodology to analyze and interpret production data

Phase 1 – Single-phase flow

Phase 2 – Multiphase flow

Scope of Research

- Describe the fluid flow taking place in layered unconventional reservoirs
- Investigate the possible flow mechanisms in the source rock layers i.e. fractures/diffusion/desorption due to the pressure depletion in the adjacent carbonate layers
- Model the support from the source rock layers to neighboring carbonate layers through the interface and cross-border fractures
- Analyze the well performance with the proposed production models
- Extend the results to multi-phase flow

Approach

Space dependent only

Existing models for layered systems

Existing numerical simulation for layered systems

PHASE 1

Time & Space dependent

New approach for modeling layered

New approach for numerical simulation

PHASE 2

Multiphase flow application

PHASE 3

Thank you