



UNCONVENTIONAL RESERVOIR ENGINEERING PROJECT
COLORADO SCHOOL OF MINES



UREP

Unconventional Reservoir Engineering Project

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UNCONVENTIONAL RESERVOIR ENGINEERING PROJECT

Fall 2013 Semi-Annual Affiliates Meeting, Nov. 7-8, 2013, Golden, Colorado

UREP – Membership Status

Members:

- | | |
|----------------------|-------------------|
| 1. Baker Hughes | 7. Noble Energy |
| 2. EOG Resources | 8. ConocoPhillips |
| 3. Shell Canada | 9. Total |
| 4. Cimarex Energy | 10. Saudi Aramco |
| 5. Kappa Engineering | 11. Petrobras |
| 6. Hess Corporation | 12. ... |

Each phase of the Consortium is for two years (currently at the first year of the first phase)

The cost of membership is \$45,000 per year



UREP - Objectives

The objectives of UREP are to

attain a more complete understanding of nanoporous unconventional reservoirs

and develop more appropriate tools and practices for unconventional reservoir engineering

The approach of UREP is to

dispute the conventional perceptions

and build a new understanding with a bottom-up approach



UREP - Focus

Current focus areas of UREP are

- the discerning physical characteristics of nano-pore, micro-fractured formations,
- unconventional flow mechanisms and unaccounted capillary and surface-forces relationships in extremely small (nano-meter size) confinement
- unaccustomed multi-phase flow concepts and constitutive relations
- new fluid exchange mechanisms between fractures and the tight rock matrix.



UREP - Projects

PROJECTS

PROJECT 1
Flow and Transport of
Hydrocarbon Fluids in Nano-
Porous Reservoirs

PROJECT 2
Fluid Transfer Between Nano-
Porous Matrix and Multi-Scale
Fractures

PROJECT 3
Production from Tight,
Fractured Formations in
Proximity of Source Rocks

PROJECT 4
Simulation of Flow and
Transport in Fractured Nano-
Porous Reservoirs

PROJECT 5
Analysis and Prediction of
Well Performance in
Unconventional Reservoirs



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UREP - Progress

1. Effect of confinement on phase behavior
 - Bubble point suppression: methodology and correlation: complete
 - Capillary condensation: in progress
2. Black-oil simulator for unconventional reservoirs
 - Bubble-point suppression: incorporated
 - Multi-porosity systems: in progress
 - Capillary condensation: in progress
3. Unconventional flow mechanisms
 - Slip flow: theoretical phase complete, in experimental phase
 - Concentration driven diffusion in heterogeneous nano-porous media, in progress
 - osmosis: membrane properties of nano-porous system: in progress, experimental study: in planning
4. Fundamental flow modeling and characterization
 - Anomalous diffusion: in progress
 - Characterization of fractured heterogeneous nanoporous media: in progress



UREP – Perceptions

1. Coupled flows...fluxes not linearly additive
2. Highly nonuniform velocity field, nonequilibrium pressure and concentrations
3. No clear scale separation, no-continuum, anomalous diffusion
4. New perceptions, new objectives of reservoir characterization (new parameters to be described and quantified).
5. New understanding of upscaling
6. Field scale reservoir modeling and management tools



UREP - Production

1. Bubble-point suppression theory, formulation, and correlation
2. COZSim: Black-oil simulator upgraded for unconventional reservoirs
3. Production design criteria
4. PhD dissertation of Tuba Firincioglu
5. MS thesis of Juan Carlos Carratu
6. Two SPE papers on bubble-point suppression
7. One manuscript on the state of the art in unconventional reservoir engineering

