



**UNCONVENTIONAL RESERVOIR ENGINEERING PROJECT**  
**COLORADO SCHOOL OF MINES**



## **Introduction & Status Report**

**UREP**

# **Unconventional Reservoir Engineering Project**

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**UNCONVENTIONAL RESERVOIR ENGINEERING PROJECT**

Spring 2013 Semi-Annual Affiliates Meeting, May 3, 2013, Golden, Colorado

## AGENDA

08:00 am – 08:30 am	Breakfast and Registration
08:30 am – 08:40 am	Welcoming Remarks
08:40 am – 09:00 am	UREP Status and Progress Summary
09:00 am – 10:00 am	Research Reports – Part I
10:00 am – 10:15 am	Coffee Break
10:15 am – 11:00 am	Research Reports – Part II
11:00 am – 12:00 am	Research Reports – Part III
12:00 pm – 01:00 pm	Lunch Break
01:00 pm – 02:00 pm	Research Reports – Part V
02:00 pm – 02:15 pm	Coffee Break
02:15 pm – 03:00 pm	Research Reports – Part IV
03:00 pm – 03:15 pm	Coffee Break
03:15 pm – 05:00 pm	Advisory Board Meeting
05:00 pm	Adjourn



## 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



## PROJECT

- OBJECTIVES

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

- Develop a more comprehensive understanding and perception of flow and transport in nano-porous reservoir rocks to form the basis of unconventional reservoir engineering tools and practices. Understand mechanisms associated with n-pore size environments



## PROJECT

### • TASKS

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

- Rock-fluid interactions in nano-pores
- Flow and transport mechanisms



## PROJECT

- DELIVERABLES

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

- Flow and transport mechanisms and constitutive relationships
- Chemical equilibrium for black-oil hydrodynamic simulator
- Principles of characterization and upscaling



## PROJECT

- OBJECTIVES

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

- Define the interface conditions and fluid transfer mechanisms between nano-porous matrix and fractures to more realistically account for the contribution of ultra-tight, unconventional rock matrix



## PROJECT

### • TASKS

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

- Fluid flow between fractures and nano-porous rock matrix
- Models of flow from nano-porous matrix to multi-level fractures





## PROJECT

- DELIVERABLES

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

- Conditions of pressure- and flux continuity at the interface
- Thermodynamics and blockage mechanisms at the interface
- Flow models for nano-porous matrix with multi-level fractures



## PROJECT

- OBJECTIVES

### PROJECT 3

#### **Production from Tight, Fractured Formations in Close Proximity of Source Rocks (Liquid-Rich Reservoirs)**

- Define and model the support of source rocks on production from contiguous fractured formations for the analysis and prediction of production from liquids-rich reservoirs



## PROJECT

### • TASKS

## **PROJECT 3**

### **Production from Tight, Fractured Formations in Close Proximity of Source Rocks (Liquid-Rich Reservoirs)**

- Flow and transport from source rock to producing layers
- Production models for source-rock supported liquid-rich reservoirs
- Flow characteristics and analysis of well performance



## PROJECT

### • DELIVERABLES

## **PROJECT 3**

### **Production from Tight, Fractured Formations in Close Proximity of Source Rocks (Liquid-Rich Reservoirs)**

- Source-rock contribution to liquid-rich production
- Models of flow in source-rock supported liquid-rich reservoirs
- Thermodynamics and blockage mechanisms at the interface
- Flow characteristics and performance prediction methods



## PROJECT

- OBJECTIVES

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

- Progressively incorporate the results of the UREP research projects and new findings into a numerical unconventional-reservoir simulator developed by NITEC



## PROJECT

## • TASKS

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

- Black-oil simulation of unconventional, liquid-rich reservoirs
- Unconventional reservoir simulation in n-porosity environment



## PROJECT

### • DELIVERABLES

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

- Black-oil and n-porosity simulation of liquid-rich reservoirs
- Number of pore systems from capillary pressure curvature
- Connectivity mapping of inter-porosity systems
- Simulator executable, documentation, and test cases by NITEC



## PROJECT

- OBJECTIVES

### **PROJECT 5** **Analysis and** **Prediction of Well** **Performance in** **Unconventional** **Reservoirs**

- Develop and improve models and interpretation methods for pressure- and rate-transient data and long-term production performance to help reservoir management





## PROJECT

### • TASKS

## **PROJECT 5**

### **Analysis and Prediction of Well Performance in Unconventional Reservoirs**

- PTA and RTA in unconventional reservoirs
- Interference models for wells in unconventional reservoirs
- Decline-curve-analysis methods for unconventional reservoirs



## PROJECT

- DELIVERABLES

### **PROJECT 5** **Analysis and** **Prediction of Well** **Performance in** **Unconventional** **Reservoirs**

- Improved models of PTA RTA in unconventional reservoirs
- Analysis and interpretation guidelines
- Interference analysis for fractured unconventional reservoirs
- Improved decline-curve analysis techniques



## Current Members

Baker Hughes  
Cimarex Energy  
EOG Resources  
Kappa Engineering  
Noble Energy  
Shell Canada  
Total  
Hess  
ConocoPhillips  
Petrobras



## People

### CSM Faculty

Dr. Erdal Ozkan

Dr. Xiaolong Yin

Dr. Manika Prasad

### CSM Students

Tuba Firincioglu (PhD)

Ikay Eker (PhD)

Ali Albinali (PhD)

Elham Parsa (PhD)

Wisam Assiri (PhD)

Feng Xiao (PhD)

Caglar Komurcu (MSc)

Ozlem Ozcan (MSc)

Filiz Geren (MSc)



## People

### Collaborators

Dr. Rajagopal Raghavan

Dr. Leslie Thompson

Dr. David Craig

### Research Partner

NITEC – Chet Ozgen



## People

### New Students Accepted for Fall 2013

Ralf Holy (PhD)

Natalia Syulyukina (PhD)

Khalid Bin Moqbil (PhD)

Andreas Lumban Gaol (MSc)

Saleh Hassan (MSc)

Chulhwan Song (MSc)

Efosa Uwaifo (MSc)

Mauricio Vinassa (MSc)



## Financial Status

Membership Fee: \$45,000/year

Received the membership fee from 6 companies: \$255,000

Expenditures: \$115,000



## Projects

1. Bubble Point Suppression in Unconventional Liquid-Rich Reservoirs and Its Impact on Oil Production – T. Firincioglu (Completed)
2. Handling Bubble-Point Suppression in Reservoir Simulation – C. Ozgen (In Progress)
3. Numerical Solution and Modeling Issues in Confinements – C. Ozgen (In Progress)
4. Capillary Pressure in Unconventional Reservoirs – C. Ozgen (In Progress)
5. Impact of Confinement on Dew Point Pressure in Unconventional Gas Condensate Reservoirs – E. Parsa (New Project)





## Projects (Continued)

6. High-Compressibility Effects in Unconventional Reservoirs; Modeling and Implications on Production Data Analysis – C. Komurcu/L. Thompson (In Progress)
7. Nano-scale Flow and transport: Experiments and Numerical Simulations – X. Yin (New Project)
8. Fracture-Matrix Interaction from Pore-Scale Direct Numerical Simulations (DNS) – F. Xiao (In Progress)
9. Experimental Investigation of Osmotic Pressure and Surface Forces in Nano-Porous Unconventional Reservoirs – M. Prasad (New Project)
10. Modeling the Effect of Osmotic Pressure on Diffusion in Nano-Porous Matrix – F. Geren (New Project)



## Projects (Continued)

11. Investigation of the Interface Conditions Between Nano-Porous Matrix and Fractures of Unconventional Reservoirs – A. Albinali (In Progress)
12. Application of Fractals to Modeling and Analysis of Naturally Fractured Unconventional Reservoirs – O. Ozcan (New Project)
13. Fractal Modeling of Liquid-Rich Reservoirs – I. Eker (New Project)
14. Fractal Formulation of Flow Toward Wells in Fractured Unconventional Reservoirs – R. Raghavan/C. Chen (In Progress)
15. Non-Local, Memory-Dependent Fractional Diffusion in Nano-Porous Reservoirs – E. Ozkan (In Progress)

