

SPE Canadian Energy Technology Conference 2022

Calgary, Canada
16 - 17 March 2022

Volume 1 of 2

ISBN: 978-1-7138-4826-4

Printed from e-media with permission by:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571



Some format issues inherent in the e-media version may also appear in this print version.

Copyright© (2022) by Society of Petroleum Engineers
All rights reserved.

Printed with permission by Curran Associates, Inc. (2022)

For permission requests, please contact Society of Petroleum Engineers
at the address below.

Society of Petroleum Engineers
P. O. Box 833836
Richardson, Texas 75083-3836

Phone: (800) 456-6863
Fax: (972) 952-9435

books@spe.org

Additional copies of this publication are available from:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571 USA
Phone: 845-758-0400
Fax: 845-758-2633
Email: curran@proceedings.com
Web: www.proceedings.com

TABLE OF CONTENTS

VOLUME 1

HO - FOAMS, ADDITIVES & POST-SAGD

Steam Additives to Reduce the Steam-Oil Ratio in SAGD: Experimental Analysis, Pilot Design, and Field Application	1
<i>Siavash Nejadi, Julian Ortiz, Javier Sanchez, Xiaomeng Yang, Hosein Kalaei, Sayeed Abbas</i>	
What is Next for SAGD?: Evaluation of Low GHG and High-Efficiency Tertiary Recovery Options	18
<i>Randy Agra Pratama, Tayfun Babadagli</i>	
Nanoparticle Assisted Foam Stability Under SAGD Conditions	41
<i>Sepideh Maaref, Apostolos Kantzas</i>	

UR - UNCONVENTIONAL GEOSCIENCE AND RESERVOIR CHARACTERIZATION I

A New Method for Determination of Rock Fabric Number from Well Logs in Unconventional Tight Oil Carbonates	62
<i>Brenda Azuara Diliiegros, Roberto Aguilera</i>	
Profile Ultrasonic Velocity Measurements Performed on Slabbed Core: Implications for High-Resolution Permeability Prediction in Low-Permeability Rocks	81
<i>Tariq Mohammed, Amin Ghanizadeh, Christopher R. Clarkson, Zhengru Yang</i>	

SHINING A LIGHT ON THE SUBSURFACE THROUGH ADVANCING TECHNOLOGIES AND DIGITIZATION

Advanced Reservoir Control Systems Paving the Way for Digital Offshore Operations and Analysis	96
<i>Elias Garcia, Kevin Robertson</i>	
Enhancing Reservoir Engineering Workflows with Augmented and Virtual Reality	110
<i>Stephen Cartwright, Steven Samoil, Bryson Lawton, Die Hu, Siqi Xie, Eric Wang, Amir Aminbeidokhti, Seher Dawar, Rachel Dalton, Parisa Daeijavad, Frank Maurer, Zhangxin Chen</i>	
Distributed Temperature Sensor Analytics: Estimating SAGD Depletion from Temperature Fall Off Data	136
<i>Anthony Nguyen, Dylan Hematillake, Robert Glover, Carolina Diaz-Goano</i>	

CLEAN TECHNOLOGY

Design of a Solar Parabolic Trough Capable of Producing Steam for Enhanced Oil Recovery in Trinidad and Tobago	155
<i>Ahlijah Gajadhar, Raffie Hosein</i>	
Exploring Green Energy Applications in the Oil and Gas Industry	174
<i>Cenk Temizel, Cengiz Yegin, F. Bahar Hosgor, Hakki Aydin, Shah Kabir</i>	

HO - LABORATORY & SIMULATION STUDIES

Coupling a Thermal Reservoir Simulator with a Dynamic, Multiphase Wellbore Flow Simulator to Rigorously Model Complex SAGD Well Geometries and Completions	195
<i>Jose A. Rivero, Christopher Istchenko, Carlos Nascimento, Jia-Ming Cao, Hossein Aghabarati, Michael Bergen</i>	
A New Insight into the Determination of True Residual Oil Saturation and Oil Relative Permeability from the Experimental Data in Heavy Oil/Water Systems.....	211
<i>Sajjad Esmaeili, Apostolos Kantzas, Brij Maini</i>	
Effect of Temperature on Gas/Oil Relative Permeability in Viscous Oil Reservoirs	234
<i>Saket Kumar, Hemanta Sarma, Brij Maini</i>	

UR - UNCONVENTIONAL GEOSCIENCE AND RESERVOIR CHARACTERIZATION II

Estimating Leak-Off Characteristics Due to Hydraulic Fracture and Natural Fracture Interaction Utilizing XFEM-Based 3D Hydraulic Fracture Model	255
<i>Junghun Leem, Ikhwanul Hafizi Musa, Chee Phuat Tan, M Fakharuddin Che Yusoff, Zahidah Md Zain, James Kear, Dane Kasperczyk, Zuorong Chen, Saeed Salimzadeh</i>	
Characterization of the Giant Chicontepec Tight Oil Paleochannel in Mexico and Integration With Actual Cumulative Oil Production	264
<i>Alejandra Gutierrez Oseguera, Roberto Aguilera</i>	

ANALYTICS IN UNCONVENTIONAL RESOURCES

Machine Learning Based Integrated Approach to Estimate Total Organic Carbon in Shale Reservoirs – A Case Study from Duvernay Formation, Alberta Canada	282
<i>Gaurav Sharma, Derek Hayes</i>	
Refracturing Candidate Selection in Tight Oil Reservoirs Using Hybrid Analysis of Data and Physics Based Models	296
<i>Die Hu, Zhengdong Lei, Stephen Cartwright, Steven Samoil, Siqi Xie, Zhangxin Chen</i>	

UNLOCKING CCUS POTENTIAL FOR COMMERCIAL SCALE

Carbon, Capture, Utilization and Storage CCUS: How to Commercialize a Business with No Revenue	315
<i>Rohit Madhva Terdal, Nathan Steeghs, Craig Walter</i>	
Study of Carbon Capture in Oilsands Production and Upgrading	321
<i>Jon Isley, Matthew Gutscher, Benjamin Henezi</i>	

HO -PUMPS & FLOW CONTROL DEVICES

Performance Analysis of Autonomous Inflow Control Valve in a SAGD Late Life Process with Non-Condensable Gases.....	332
<i>Soheila Taghavi, Haavard Aakre, Britt M. E. Moldestad</i>	

UR - ALTERNATIVE APPROACHES FOR PRODUCTION FORECASTING AND ECONOMICS

- No Reservoir Model? No Problem. Unconventional Well Spacing Optimization With Simple Tools 348
Patrick Miller, Darcy Redpath, Keane Dauncey
- A Novel Procedure for Analyzing Production Decline in Unconventional Reservoirs Using Probability Density Functions 370
Hamzeh Alimohammadi, Mehdi Sadeghi, Shengnan Nancy Chen
- Statistical and Machine-Learning Methods Automate Multi-Segment Arps Decline Model Workflow to Forecast Production in Unconventional Reservoirs 387
Himanshu Shekhar Jha, Aaditya Khanal, John Lee

EMERGING ENERGY - HYDROGEN

- Hydrogen Production and Char Formation Assessment through Supercritical Gasification of Biomass 402
Mohamad Mohamadi-Baghmolaei, Parviz Zahedizadeh, Abdollah Hajizadeh, Sohrab Zendejboudi
- Three Step Plan to Put Canada at the Front of the Petroleum Sector's Race to Net-Zero..... 411
Humera Malik, Forogh Askari

KNOWLEDGE SHARING EPOSTERS 1

- The Cyclically Restored in Situ Petrophysics CRISP Method for Analysis of Petrophysical Properties of Unconsolidated Oil Sands Reservoirs: Overview and Testing Update 415
Graham Spray, Xiaojun Cui, Darcy Brabant

KNOWLEDGE SHARING EPOSTERS 2

- Enhancement of Production Data in Tight Gas Reservoir Through an Automated Multiphase Measurement Skid for Remote Operation 425
Carlos Garay Andrade, Julio Sanz Vera, Fabian Salas, Claudio Pucci, Alejandro Castro, Vlamir Bastos, Ewaldo Schubert, Bertrand Theuveny
- A Novel Approach to Post-Combustion Carbon Capture Processes in Natural Gas Plants By Reduction of Solvent Regeneration Time..... 445
Wilson Ekpotu, Queen Nwabueze, Joseph Akintola, Martins Obialor, Idongesit Ansa

KNOWLEDGE SHARING EPOSTERS 3

- Multiscenario Development Planning by Means of the Digital Twin of the Petroleum Field..... 453
Artur Aslanyan, Arkadiy Popov, Ivan Zhdanov, Evgeniy Pakhomov, Danila Gulyaev, Rushana Farakhova, Rodion Guss, Mariya Dementeva
- Evaluating the Prospect of Oil Production in Tight Winterhouse Formation Rocks in Western Newfoundland 473
Jessica Hawco, Elliott Burden, Edison Sripal, Lesley James

Using Machine Learning Method to Optimize Well Stimulation Design in Heterogeneous Naturally Fractured Tight Reservoirs 491
Huifeng Liu, Longlian Cui, Zundou Liu, Chuanyi Zhou, Maotang Yao, Haoming Ma, Qi Liu

Powering Offshore Installations with Wind Energy 508
Blair MacDougall, Phil Nash, Bruce Doyle, Joshua Hudson, Rick Murphy, Justin Meyers

KNOWLEDGE SHARING EPOSTERS 4

Assess the Impact of Shallow Water Flow Geohazard on Drilling Operations in the Riserless Sections of Deepwater Well Construction..... 525
Nitin Kulkarni, Lloyd Heinze

The Application of Complex Displacement in Cyclic Steam Stimulation CSS & Steam Flooding SF Development in Liaohe Oilfield: A Field Performance Study 537
Jianfeng Liu, Xiaoming Wu, Shouguo Sun, Ling Hao

Improving the Steam Quality injected in a Heavy Oil Reservoir by Using a Cyclonic-Type Condensate Separator: A Field Pilot 545
Andres Solano Arias

Holistic Real-Time Drilling Parameters Optimization Delivers Best-in-Class Drilling Performance and Preserves Bit Condition - A Case History from an Integrated Project in the Middle East 561
Khaled Abdelaal, Ken Atere, Keith LeRoy, Aaron Eddy, Russell Smith

KNOWLEDGE SHARING EPOSTERS 5

Quantification of Phase Behaviour and Physical Properties of Alkane Solvents/CO₂/ Water/Heavy Oil Systems under Equilibrium and Nonequilibrium Conditions..... 574
Daoyong Yang, Yunlong Li, Desheng Huang

Fluor Solvent Offers Significantly Lower GHG Intensity CO₂ Removal from Natural Gas Than MDEA for Horn River..... 614
Morgan Rodwell

HO - NON-SAGD HEAVY OIL ENHANCED OIL RECOVERY

Measuring Connectivity in Complex Reservoirs: Implications for Oil Sands Development 621
Siavash Nejadi, Stephen M. Hubbard

The Effects of Asphaltene Precipitation on Bitumen Recovery during Non-Thermal Cyclic Solvent Injection in Cold Lake Oil Sands- An Experimental Study..... 631
Lin Yuan, Mohammad Yousefi, Hassan Dehghanpour

Characterization of Dynamic Wormhole Growth and Propagation During CHOPS Processes by Integrating Rate Transient Analysis and Pressure-Gradient-Based Sand Failure Criterion 646
Liwu Jiang, Jinju Liu, Tongjing Liu, Daoyong Yang

VOLUME 2

UR - RESERVOIR MODELING, DYNAMICS & SURVEILLANCE I

- Sealed Wellbore Pressure Monitoring in the Montney: Early Learnings 676
Adam Chin, Patrick Miller, Darcy Redpath, Keane Dauncey, Daniel Nakaska, Farhan Alimahomed
- Characterizing a Complex Induced Fracture Network: A Case Study of a Diagnostic Fracture Injection Test in the Heterogeneous Overpressured Montney Formation 694
Erfan Sarvaramini, Maurice Dusseault
- Child/Parent Well Interactions; Study the Solutions to Prevent Frac-Hits 712
Alireza Haghighat, James Ewert

EMERGING ENERGY-GEOTHERMAL

- On Numerical Modelling of the Hydraulic-Fractured Closed Loop Systems: Single Producer 735
Mazda Irani, Sahar Ghannadi, Nick Daprocida Nick Daprocida, Pierre Lacoste-Bouchet, Vince DiStefano
- Optimizing Geothermal Heat Extraction from End of Life Oil & Gas Wells Using a Transient Multiphase Flow Simulator 748
David Sask, Peter Graham, Carlos Nascimento

TECHNICAL PERSPECTIVES ON CCUS - MODELING, MINERALIZATION, AND SWEEP

- CO2 Mineral Trapping in Basaltic Formation During CO2 Storage 764
Zakaria Hamdi, Raja Zuhaili Aimran Raja Zainal Raffik, Oluwole Talabi, Urval Patel, Eric Mackay, Mahmood Bataee
- A Step-Change Improvement in Fluid Diversion, Oil Sweep Efficiency, and CO2 Storage Using Novel Nanoparticle-Based Foam..... 779
Ali Telmadarreie, Christopher Johnsen, Steven Bryant

OFFSHORE I

- Consideration of Various Parameters and Scenarios in the Simulation of Hydrate Formation 787
Farzan Sahari Moghaddam, Ali Hamid, Majid Abdi, Lesley James
- Quantitative Production Steering through High-Definition Boundary Detection Service for the Sustainable Development of the Bottomwater Reservoir 807
Junli Huang, Qingyou Meng, Botao Chang, Chao Wang, Youliang Zeng, Xingbao Wu, Chengwen He
- Natural Gas Hydrate Equilibria in Brine Including the Effect of Inhibitors on Hydrate Formation..... 820
Farzan Sahari Moghaddam, Maziyar Mahmoodi, Marziyeh Zare, Fatemeh Goodarzi, Majid Abdi, Lesley James

HO - HEAVY OIL ANALYTICS

- Machine Learning Enhanced Upscaling of Anisotropic Shear Strength for Heterogeneous Oil Sands 841
Bo Zhang, Zhiwei Ma, Dongming Zheng, Rick Chalaturnyk, Jeff Boisvert
- The Impact of Increase in Lateral Length on Production Performance of Horizontal Thermal Wells 863
Hossein Izadi, Morteza Roostaei, Mahdi Mahmoudi, Seyed Abolhassan Hosseini, Mohammad Soroush, Giuseppe Rosi, Jesse Stevenson, Aubrey Tuttle, Colby Sutton, Juliana Leung, Vahidoddin Fattahpour
- Integrating Domain Knowledge with Machine Learning to Optimize Electrical Submersible Pump Performance..... 875
Abhishek Sharma, Praprut Songchitruksa, Rajeev Ranjan Sinha

UR - RESERVOIR MODELING, DYNAMICS & SURVEILLANCE II

- Method for Drawdown Analysis of a Multi-Stage Hydraulically Fractured Horizontal Well That Penetrates an Unconventional Naturally Fractured Reservoir 883
Alejandra Gutierrez Oseguera, Roberto Aguilera
- Using the FMB Model to Determine Which Wells Out of a Group of Wells Belong to the Same Common Pool..... 898
S. Hamed Tabatabaie, Hamid Behmanesh, Louis Mattar
- Rate-Pseudopressure Deconvolution Enhances Rate-Time Models Production History Matches and Forecasts of Shale Gas Wells 915
Leopoldo M. Ruiz Maraggi, Larry W. Lake, Mark P. Walsh

THEORETICAL AND MULTISCALE INVESTIGATIONS

- A CPP Model to Asphaltene Precipitation; Mapping p-p Interactions onto an Equation of State..... 943
Sepideh Alimohammadi, Lesley James, Sohrab Zendehboudi
- An Experimental Study of Single Component Adsorption/Desorption Isotherms 962
Jeremy Wolf, Sepideh Maaref, Benjamin Tutolo, Apostolos Kantzas

OFFSHORE II

- Use of Rigorous Multiphase Flow Models for Leak Detection and Online Flow Assurance 983
Kjetil Havre, Christian Trudvang, Gustav Kjørrefferd, Sonia Smith, Colin C King, Jaqueline Vinicombe, Trevor Roberts
- Assessment of Oil Recovery Methods for Reservoirs in the Flemish Pass Basin 1002
C. LaFitte, L. A. James
- Theoretical Development of a Digital-Twin Based Automation System for Oil Well Drilling Rigs 1050
Mohammed Mokhtar Said, Rick Pilgrim, Geoff Rideout, Stephen Butt

UR - BREAKTHROUGHS IN PRODUCTION ANALYSIS AND RESERVOIR MANAGEMENT

- Deconvolution Overcomes the Limitations of Rate Normalization and Material Balance Time in Rate-Transient Analysis of Unconventional Reservoirs..... 1074
Leopoldo M. Ruiz Maraggi, Larry W. Lake, Mark P. Walsh
- Flowback Pattern-Recognition to Distinguish Between Formation and Fracturing Water Recovery 1111
Zhanyuan Liu, Tamer Moussa, Hassan Dehghanpour
- Effective Pressure Maintenance and Fluid Leak-Off Management Using Nanoparticle-Based Foam..... 1122
Ali Telmadarreie, Shuliang Li, Steven Bryant

ANALYTICS APPLICATIONS IN PRODUCTION OPTIMIZATION

- Pump Jack Timer Optimization Using Detailed, High-Quality Pressure Monitoring 1130
Ryan Gordon
- Cyclic Solvent Process Commercial Optimization..... 1135
Xu Gong, Hossein Shahandeh, Gordon MacIsaac, Hamed Motahhari, Mark Beckman, Lu Dong

OPTIMIZING DRILLING AND COMPLETIONS

- Mitigating Surge and Swab by Changing Tripping from a Batch to a Continuous Process 1146
Rick Pilgrim, Stephen Butt
- Tripping Optimisation for Drilling Systems Automation: Potential of Digital Twins, Transient Models and Control Systems to Reduce Invisible Lost Time in Well Construction 1160
Matthew J. Forshaw, Rafael A. Madeira, Pedro J. Arévalo
- Bacteria Control in Unconventional High Temperature Downhole Conditions During Completions 1171
Matt Graham, Jeff Kramer

CLEAN TECHNOLOGY FOR EMISSION REDUCTION

- Improvement of Energy Efficiency in Gas Condensate Stabilization Unit: Process Optimization Through Exergy Analysis..... 1177
Abdollah Hajizadeh, Mohamad Mohamadi-Baghmolaei, Fatemehsadat Mirghaderi, Reza Azin, Sohrab Zendejboudi, Taghi Saneei, Hamid Rajaei, Sajjad Keshavarzian
- Steam-Solvent Process: A Gamechanger in Cutting Emissions in In-Situ Recovery of Oil Sands 1194
M. A. K. Chowdhuri, Alex Filstein, Haibo Huang

KNOWLEDGE SHARING EPOSTERS 7

- Critical Assessment of the Hybrid Impact of Surfactants on Modified Salinity Water Flooding..... 1215
Ahmed Belhaj, Navpreet Singh, Hemanta Sarma

KNOWLEDGE SHARING EPOSTERS 8

Understanding Field Performance of Paraffin Inhibitors Using Differential Scanning Calorimetry..... 1235
Matthew Shuya, Holley Baron, Cristino Tiberio

KNOWLEDGE SHARING EPOSTERS 9

Thermal Stimulation on Enhanced Coalbed Methane Recovery Under Microwave Heating Based
on a Fully Coupled Numerical Model 1246
Jingyi Zhu, Hao Wang, Zhaozhong Yang, Xiaogang Li, Jie Zhou

Electromagnetic Induction Heating Technology for Enhanced Heavy Oil and Bitumen Recovery 1257
Ahmed Sherwali, Mehdi Noroozi, William G. Dunford

An Experimental Investigation of Asphaltene Aggregation Under Carbon Dioxide Injection Flow
in Ultra-Low-Permeability Pore Structure..... 1272
Mukhtar Elturki, Abdulmohsin Imqam

KNOWLEDGE SHARING EPOSTERS 10

Sand Management Practices for Extended ESP Run Life, a Study Case from a Mature Field in
Ecuador..... 1290
Xianglin Xu, Alexander Albuja, Alvaro Izurieta, Xuepeng Wan, Hua Yang, Zhengwen Wang

Pore-Scale Modellings on the Impacts of Hydrate Distribution Morphology on Gas and Water
Transport in Hydrate-Bearing Sediments 1304
Zhuoran Li, Jiahui You, Guan Qin

Author Index