

# **SPE/AAPG/SEG Unconventional Resources Technology Conference (URTeC 2021)**

Houston, Texas, USA  
26 - 28 July 2021

Volume 1 of 5

ISBN: 978-1-7138-5868-3

**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© (2021) 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](mailto: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](mailto:curran@proceedings.com)  
Web: [www.proceedings.com](http://www.proceedings.com)

## TABLE OF CONTENTS

### VOLUME 1

#### **THEME 9: EUR AND PERFORMANCE PREDICTION - DCA AND BEYOND I**

Establishing the Basis for Multi-Segment Arps Decline Models .....	1
<i>John Lee</i>	
Transfer Learning with Recurrent Neural Networks for Long-Term Production Forecasting in Unconventional Reservoirs .....	19
<i>Syamil Mohd Razak, Jodel Cornelio, Young Cho, Hui-Hai Liu, Ravimadhav Vaidya, Behnam Jafarpour</i>	
Understanding the Effect of Nanopores on Flow Behavior and Production Performance of Liquid-Rich Shale Reservoirs.....	35
<i>A. Khanal, M. Khoshghadam, H. S. Jha, W. J. Lee</i>	
Rate-Transient Analysis of Communicating Wells Using the Dynamic Drainage Area (DDA) Concept.....	52
<i>Hossein Ahmadi, Hamidreza Hamdi, Christopher R. Clarkson</i>	
Shale Gas Development Potentials of the Jurassic Weald and Wessex Basins, South-East England: A Techno-Economic Evaluation .....	67
<i>Bassey Okon Bassey, Ekenyong Anakiri Ana</i>	
Fluid Characterization and Volumetric Assessment in the Montney...One Tricky Fluid System .....	84
<i>Aaron J. White, Wesley Feick, Nina Prefontaine, F. Brent Thomas, Juan Marin, Jared Ponto, Ronnel Apil, Carter Clarkson</i>	

#### **THEME 5: EXPERIMENTAL ROCK MECHANICS I**

Connecting Geomechanical Properties with Potential for Proppant Embedment and Production Decline for the Emerging Caney Shale, Oklahoma.....	104
<i>Margaret Benge, Yunxing Lu, Allan Katende, Jonny Rutqvist, Dustin Crandall, Adam Haecker, George King, Joseph B. Renk, Mileva Radonjic, Andrew Bunger</i>	
Experimental Study on Expansion Law of Micro-Fractures Induced by Shale Hydration.....	117
<i>Liang Tao, Zhijun Li, Kun Shi, Junping Lv, Yi Liu, Yuhang Zhao, Zhihong Zhao, Mirinuer Halifu</i>	
The Effect of Capillary Condensation on the Geomechanical and Acoustic Properties of Tight Formations: An Experimental Investigation.....	128
<i>Aamer Albannay, Binh Bui, Daisuke Katsuki</i>	

#### **THEME 13: PRODUCED WATER AND INDUCED SEISMICITY...ESG PERSPECTIVES**

ESG Reporting in the Oil and Gas Industry - A Permian Basin Water Management Perspective .....	153
<i>Robert Bruant, Kelly Bennett, Samantha Fox, Sarah Willard, Abigail Michel</i>	

Application of Electro-Oxidation Technology for Water Treatment and Its Impacts on Rock Wettability.....	162
<i>Yanze Zhang, Lin Yuan, Sanjeev Jakhete, Mohtada Sadrzadeh, Hassan Dehghanpour</i>	

Managing Induced Seismicity: A System for Mapping the Geospatial Intersection of Saltwater Disposal Formations, Active Injection Intervals, Injection Pressures, and Volumes, Geologic Fault Lines and Seismic Events in the Permian Basin.....	178
<i>Casee Lemons, Jose Cortina, Joshua Adler</i>	

## **THEME 8: CASE STUDIES**

Heavy Oil Polymer EOR in the Challenging Alaskan Arctic - It Works! .....	188
<i>A. Dandekar, B. Bai, J. Barnes, D. Cercone, J. Ciferno, R. Edwards, S. Ning, W. Schulpen, R. Seright, B. Sheets, D. Wang, Y. Zhang</i>	
Predicting Oil Recovery Under Uncertainty for Huff-N-Puff Gas Injection: A Field Case Study in Permian.....	203
<i>Esmail Eltahan, Reza Ganjdanesh, Kamy Sepehrnoori, Mathew D. Thuesen, Jack C. Nohavitz</i>	
Drawdown Management Strategies — Midland Basin Case Studies .....	219
<i>Y. Pradhan, E. Gildin, T. A. Blasingame</i>	

## **SPECIAL SESSION: HFTS-2 PART I**

Subsurface Characterization of Hydraulic Fracture Test Site-2 (HFTS-2), Delaware Basin .....	241
<i>Fadila Bessa, Kanay Jerath, Chris Ginn, Patrick Johnston, Yu Zhao, Tim Brown, Ruben Lopez, James Kessler, Brian Nicklen, Vinay Sahni</i>	
Overview of Hydraulic Fracturing Test Site 2 in the Permian Delaware Basin (HFTS-2).....	259
<i>Jordan Ciezobka</i>	

## **THEME 1: OPTIMIZING DEVELOPMENT STRATEGIES I**

High Viscosity Friction Reducer Testing, Trialing, and Application Workflow: A Permian Basin Case Study.....	279
<i>Nancy Zakhour, Soodabeh Esmaili, Jonathan Ortiz, Jack Deng</i>	
Applying State-Of-The-Art Completion Techniques in Vaca Muerta Formation .....	299
<i>Pablo A. Crespo, Marcelo Pellicer, Henry Jacot</i>	

## **THEME 5: HYDRAULIC FRACTURING: MONITORING, MODELLING, AND ANALYSIS IV**

Modeling the Effect of a Natural Fracture Network and Its Properties on Multi-Stage Stimulation.....	313
<i>Branko Damjanac, Maurilio Torres, Christine Detournay</i>	
3D Digital Mineral Mechanical Modeling of Complex Reservoir Rocks for Investigation of Fracture Propagation at Microscale .....	321
<i>Victor Nachev, Andrey Kazak, Sergey Turuntaev</i>	

## **THEME 1: PARENT-CHILD AND WELL SPACING**

Understanding the Interaction Between Parent and Child Using Analytical and Numerical Approaches in Permian Basin – an Operator Perspective .....	332
<i>S. Esmaili, J. Deng, E. Wolfram, V. Muralidharan, I. Harmawan, J. Cassanelli</i>	
Multi-Disciplinary Fracture and Spacing Study in the DJ Basin.....	346
<i>Jason Brand, Jessica Barhaug, Roger Reinmiller, Ronald Parker, Bilu Cherian</i>	
Unconventional Reservoir Development Performance Reviews – the Northern Midland Basin Case Study.....	366
<i>Hongjie Xiong, Andrea Thompson, John Tackett, Maryam Schellstede</i>	

## **THEME 15: UNLOCKING THE PRODUCTION AND RECOVERY POTENTIAL OF UNCONVENTIONALS**

Impact of EOR Huff-N-Puff on Rock Microstructure.....	384
<i>Sidi Mamoudou, Ali Tinni, Mark Curtis, Carl H. Sondergeld, Chandra S. Rai</i>	
CO <sub>2</sub> -Soluble Surfactants for Enhanced Oil Recovery from Shale .....	397
<i>Lauren C. Burrows, Foad Haeri, Deepak Tapriyal, Peter Lemaire, Parth G. Shah, Adel Alenzi, Robert M. Enick, Dustin M. Crandall, Angela Goodman</i>	
Water-Oil Displacement in Shale: New Insights from a Comparative Study Integrating Imbibition Tests and Multiscale Imaging.....	414
<i>Sheng Peng, Priyanka Periwal, Robert M. Reed</i>	
Effect of Pore Geometry and Heterogeneous Surface Wettability on the Nanoconfined Phase Behavior in Nanopore Networks of Shale Rocks .....	434
<i>Sidian Chen, Jiamin Jiang, Bo Guo</i>	

## **THEME 15: GEOSCIENCE TOOLS AND METHODS FOR UNDERSTANDING THE ROCK**

Permeability from NMR in the Unconventional Point-Pleasant Formation .....	445
<i>Xinglin Wang, Philip M. Singer, Yunke Liu, Zeliang Chen, George J. Hirasaki, Zheng Yang, Scott J. Seltzer, Boqin Sun, Marcus Wigand, Jon E. Burger</i>	
Hydraulic Fracturing Geochemical Impact on Fluid Chemistry: Comparing Wolfcamp Shale and Marcellus Shale .....	457
<i>Wei Xiong, Johnathan Moore, Dustin Crandall, Christina Lopano, Alexandra Hakala</i>	
A Novel Method to Develop Chemostratigraphy Using X-Ray Fluorescence Spectral Raw Data .....	470
<i>M. Hussain, A. Amao, K. Al-Ramadan, L. Babalola, J. Humphrey</i>	
Brittleness and Geomechanical Properties Estimation Using Wireline and Seismic Data in the Duvernay Shale Basin, Canada .....	477
<i>Carmen C. Dumitrescu</i>	
Linking Depositional Environment Interpretations and Stratigraphic Architecture to Source Rock Richness and Mechanical Property Distribution in the Delaware Basin .....	493
<i>Buddy Price, Robin Domisse, Xavier Janson</i>	

## **THEME 9: EUR AND PERFORMANCE PREDICTION - DCA AND BEYOND II**

Continuous Lookback, Calibration, and Adjustment Reduces Biases and Improves Reliability of Production Forecasts .....	505
<i>Malik Alarfaj, Duane A. McVay</i>	
Deconvolution of Time-Varying Bottomhole Pressure Improves Rate-Time Models History Matches and Forecasts of Tight-Oil Wells Production.....	526
<i>Leopoldo M. Ruiz Maraggi, Larry W. Lake, Mark P. Walsh</i>	
The Utilization of the "Rate-Integral" to Assist with Decline Curve Analysis of Poor-Quality Unconventional Time-Rate Data.....	549
<i>E. W. Bryan, D. Symmons, D. Ilk, T. A. Blasingame</i>	
Evaluation of "Tight Oil" Well Performance and Completion Practices in the Powder River Basin – "Time Slice" Analysis .....	595
<i>Brett Murray, Richard Ness, George Koperna, Steven Carpenter</i>	

## **THEME 11: INTERNATIONAL AND EMERGING CHALLENGES OF UNCONVENTIONAL RESOURCES: INTEGRATED GEOSCIENCE AND ENGINEERING**

Subsurface Technology Sharing from Oil and Gas to Geothermal Resources .....	613
<i>Silviu Livescu, Birol Dindoruk</i>	
Efficient Modeling of Enhanced Geothermal System with 3D Complex Hydraulic and Natural Fractures .....	632
<i>Hongbing Xie, He Sun, Wei Yu, Joseph Leines-Artieda, Kamy Sepehrnoori</i>	
Stacked Completion and Production of Lacustrine Shale Oil Deposit Lateral Wells in the Kongdian Formation, China.....	651
<i>Pingqi Zhao, Guofeng Wen, Tianlu Ni, Haihua Shen, Hongbo Yuan, Lingjiang Yang, S. Wu</i>	

## **THEME 10: INNOVATIVE TECHNOLOGIES TO REDUCE COMPLETIONS COSTS**

Investigating Effects of Adding Surfactant to Cement Spacer on Mud Removal Performance and Cement Bond with Formation - An Experimental Study.....	658
<i>Ahmed GH Mansour, Talal Gamadi, Hossein Emadibaladehi, Otman Algadi, Sarkis Kakadjian</i>	
Case Study of a Wireline Deployable Spearhead Acid in the Denver-Julesburg Basin .....	680
<i>K. Yocham, D. Allison, M. Schwartz</i>	
Efficient Prediction of Proppant Placement Along a Horizontal Fracturing Stage for Perforation Design Optimization.....	688
<i>Jiehao Wang, Amit Singh, Xinghui Liu, Peggy Rijken, Yunhui Tan, Sarvesh Naik</i>	

## **THEME 8: EAGLE FORD**

Multi-Well Modeling in the Eagle Ford: An Investigation of Redevelopment, Infill and Refrac Opportunities .....	710
<i>Caner Karacaer, Elif Agartan, Philip Chapman, Jon Roberts, Dustin Glazier, Chet Ozgen</i>	

Experimental Study of Hydrocarbon Vaporization for EOR Applications .....	732
<i>Judah Odiachi, Felipe Cruz, Ali Tinni</i>	
A Simulation Study to Evaluate Operational Parameter Ranges for a Successful Cyclic Gas Injection in Different Areas of Eagle Ford .....	744
<i>M. Gaddipati, B. Basbug, T. Firincioglu</i>	

## VOLUME 2

Extending the Effective Fracture Lengths Through Mitigation of Water Trapping to Improve Eagle Ford Gas Production.....	765
<i>Luchao Jin, Blaine Spies, Shashidhar Rajagopalan</i>	

### **THEME 2: ADVANCES IN SPECIAL CORE ANALYSIS AND CORE-FLOOD TESTING**

Live Oil and Methane Production from Fractured Shale Cores .....	783
<i>Nathan J. Welch, Luke P. Frash, Meng Meng, Wenseng Li, Anne Menefee, Marcus Wigand, J. William Carey</i>	
Investigation of Diffusion and Sorption in Shale Under Variable Net Stress.....	796
<i>Ye Lyu, Devang Dasani, Theodore Tsotsis, Kristian Jessen</i>	
Using NMR and Steady State Permeability Measurements to Study Drilling Fluid Invasion into the Tight Mississippian Ratcliffe Carbonate and Its Impact on Oil Production .....	812
<i>A. Mathur, S. Ali, C. Woodland, K. Hudson, C. Barnes, William D. Von Gonten, Jr., C. Belanger</i>	
Workflow for Determining Relative Permeability Behavior in Low Permeability Media Using MICP Drainage-Imbibition Measurements .....	820
<i>James Greene, Kent Newsham, Mitch Pavlovic, Kanay Jerath, Coralee Cox, Matthew McAllen</i>	

### **THEME 2: DRIVERS FOR UNDERSTANDING RESERVOIR QUALITY AND COMPLETION QUALITY**

Direct Measurement of Permeability and Its Evolution with Stress .....	847
<i>Deepak Gokaraju, Obren Djordjevic, Abhijit Mitra, Lori Hathon, Andreina Guedez, Robert Patterson, Alessandra Simone, Munir Aldin, Samuel Aldin, Akshay Thombare, Sudarshan Govindarajan</i>	
Wettability Alteration and Improved Oil Recovery in Unconventional Resources.....	861
<i>Fabio Bordeaux Rego, Esmail Eltahan, Kamy Sepehrnoori</i>	
Not All Shales Play the Same Game: Comparative Analysis of US Shale Oil Formations by Reverse Engineering and Petroleum Systems .....	877
<i>Rasoul Sorkhabi, Palash Panja</i>	

### **SPECIAL SESSION: HFTS-2 PART III**

Analysis of Completion Design Impact on Cluster Efficiency and Pressure-Based Well Communication in HFTS-2 Delaware Basin .....	892
<i>Andrea Vissotski, Amit Singh, Peggy Rijken, Richard Reverol</i>	

Hydraulic Fracture Characterization by Integrating Multidisciplinary Data from the Hydraulic Fracturing Test Site 2 (HFTS-2).....	909
---	-----

*Zhishuai Zhang, James DiSiena, Dimitri Bevc, Ivan Lim Chen Ning, Yunhui Tan, Laura Swafford, Mike Craven, Kelly Hughes, Andrea Vissotski*

An Integrated View of Hydraulic Induced Fracture Geometry in Hydraulic Fracture Test Site 2 .....	922
---	-----

*Gustavo A. Ugueto, Magdalena Wojtaszek, Paul T. Huckabee, Alexei A. Savitski, Artur Guzik, Ge Jin, J. Andres Chavarria, Kyle Haustveit*

## **THEME 1: OPTIMIZING DEVELOPMENT STRATEGIES II**

Maximizing Project Value in Vaca Muerta Shale Formation, Part 2: Simultaneous Optimization of Well Spacing and Completion Design - Case of Study .....	938
--	-----

*Alejandro Lerza, Sergio Cuervo, Sahil Malhotra*

Simul-Frac Journey in the Permian Basin .....	953
---	-----

*Amos S. Kim, Seung Han, Andrew Ruhl, Kristen Belcourt, Ross Cazenave*

## **THEME 5: EXPERIMENTAL ROCK MECHANICS II**

Investigation into the Fabric and Textural Controls Over Effective Grain Stiffness for Accurate Biot Coefficient and Pore Compressibility Prediction .....	960
--	-----

*Laurent Louis, Gregory Boitnott, Erek Hutto, Gustavo Carpio, Michael Foster*

Laboratory Study Shows How Real Perforations Affect Unconventional Fracture Initiation.....	971
---	-----

*Fokko Doornbosch, Quan Guo, Carlos E. Guedes, Carlos E. Baumann*

Triaxial Direct-Shear Reveals the True Magnitude of Shear Fracture Roughness Effects on Flow.....	985
---	-----

*Meng Meng, Luke P. Frash, J. William Carey, Nathan J. Welch, Wenfeng Li, Samantha K. Peterson*

## **THEME 5: HYDRAULIC FRACTURING: MONITORING, MODELLING, AND ANALYSIS I**

Mechanical Stratigraphy Modeling, the Foundation of Unconventional Geomechanical Analysis .....	995
---	-----

*Roda Bradley, Vahid Mostafavi*

A Geomechanical Analysis of Shale Hydraulic Fracturing Containment .....	1014
--	------

*Amirhossein Kamali, Ahmad Ghassemi*

Quasi-Static Fracture Height Growth in Laminated Reservoirs: Impacts of Stress and Toughness	
--	--

Barriers, Horizontal Well Landing Depth, and Fracturing Fluid Density .....	1026
---	------

*Mehran Mehrabi, Yanli Pei, Mahdi Haddad, Farzam Javadpour, Kamy Sepehrnoori*

## **THEME 6: ADVANCES IN APPLIED PETROLEUM GEOCHEMISTRY AND ITS APPLICATIONS**

Produced Gas and Condensate Geochemistry of the Marcellus Formation: Insights into Petroleum Maturity, Migration, and Alteration in an Unconventional Shale Reservoir.....	1046
--	------

*Christopher D. Laughrey*

Raman Microscopy Analysis of Wyoming CarbonSAFE Pilot Well Thin Sections for Mineralogy and Organic Matter Characterization.....	1062
--	------

*Grant A. Myers, Trevor Brown, Shavinka Fernando, Erin Phillips, Fred McLaughlin*

Application of Geochemistry to Assessing Refrac Jobs in the Bakken/Three Forks Hybrid Play .....	1080
<i>Hui Long, Eric Michael, Yongshe Liu, Nathan McMahan, Alisdair Farthing</i>	

Adsorption Capacity of Hydrocarbon and Kerogen: A Molecular Dynamics Simulation Investigation .....	1089
<i>Zhe Cao, Zhiqiang Feng, Changwu Wu, Zhongmin Zhang, Jinrui Guo, Xueyan Lyu, Hang Jiang</i>	

#### **THEME 4: RESERVOIR CHARACTERIZATION USING PETROPHYSICS, GEOMECHANICS, AND MICROSEISMIC**

Improving Microseismic Denoising Using 4D (Temporal) Tensors and High-Order Singular Value Decomposition.....	1093
<i>Keyla Gonzalez, Eduardo Gildin, Richard L. Gibson, Jr.</i>	

An Integrated Analytics and Machine Learning Solution for Predicting the Anisotropic Static Geomechanical Properties of the Tuscaloosa Marine Shale.....	1110
<i>Cristina Mariana Ruse, Jamal Ahmadov, Ning Liu, Mehdi Mokhtari</i>	

#### **SPECIAL SESSION: HFTS-2 PART II**

Fracture Description of the HFTS-2 Slant Core, Delaware Basin, West Texas .....	1121
<i>J. F. W. Gale, S. J. Elliott, B. G. Rysak, C. L. Ginn, N. Zhang, R. D. Myers, S. E. Laubach</i>	

Microseismic at HFTS2: A Story of Three Stimulated Wells .....	1133
<i>Vladimir Grechka, Bo Howell, Zhao Li, Denise Furtado, Collin Straus</i>	

Mechanism of Microseismic Generation During Hydraulic Fracturing – with Evidence from HFTS 2 Observations.....	1145
<i>Yunhui Tan, Jiehao Wang, Peggy Rijken, Zhishuai Zhang, Zijun Fang, Ruiting Wu, Ivan Lim Chen Ning, Xinghui Liu</i>	

HFTS-2 Completions Design and State-Of-The-Art Diagnostics Results.....	1161
<i>Nancy Zakhour, Matt Jones, Yu Zhao, Kate Orsini, Vinay Sahni</i>	

#### **THEME 4: MEASURING STRESS, STRAIN, AND PRESSURE**

A New Pore Pressure Prediction Model for Naturally Fractured Shales and Stacked Plays: The Effect of Active Hydrocarbon Generation - A Powder River Basin Case Study.....	1185
<i>Daniel Orozco, Roberto Aguilera</i>	

Relating Microseismicity to Geomechanical Strain .....	1205
<i>Adam M. Baig, Ben Witten, Aaron Booterbaugh</i>	

Optimizing Completion Designs for the East Texas Haynesville Utilizing Production Flow Allocations from Lower-Cost Fiber Optic Sensing DAS/DTS Systems .....	1214
<i>M. Weber, D. Weatherly, V. Mahue, R. A. Hull, K. Trujillo, R. Bohn, E. Jimenez</i>	

Earth Model Building in Real-Time with an Automated Machine Learning Framework – a Midland Basin Example.....	1232
<i>Altay Sansal, Muhlis Unaldi, Edward Tian, Gareth Taylor</i>	

## **THEME 15: EVALUATING AND APPLYING ADVANCED METHODS TO CREATE VALUE IN UNCONVENTIONALS**

Ordovician Source Rock Potential on the Broome Platform of the Onshore Canning Basin in the Far North of Western Australia .....	1244
<i>Jop van Hattum, Aaron Bond, Ryan Taylor-Walshe</i>	
Credible Inventory Characterizations: Earning Back Trust in an Abandoned Investment Sector.....	1264
<i>David P. B. Allen</i>	
Experimental Controls on the Transition Between Planar and Branched Hydraulic Fractures .....	1280
<i>Wenfeng Li, Luke P. Frash, J. William Carey, Meng Meng, Nathan J. Welch, Hari Viswanathan</i>	
Controlling Strontium Scaling in the Permian Basin Through Manipulation of Base Fluid Chemistry and Additives .....	1291
<i>Eleanor Spielman-Sun, Adam D. Jew, Jennifer L. Druhan, John R. Bargar</i>	
An Analytical Rate-Transient Analysis Model in Unconventional Light Oil Reservoirs Exhibiting Reservoir Heterogeneity and Multiphase Flow .....	1301
<i>Jinchang Li, Bin Yuan, Christopher R. Clarkson, Xuan Zhu, Yue Li</i>	

## **THEME 9: EUR AND PERFORMANCE PREDICTION AND TYPE WELL PROFILES**

A Proposed Methodology to Assess Production Performance for Shale Oil and Gas Wells.....	1321
<i>E. L. Dougherty, T. A. Blasingame</i>	
A Physically Consistent Decline Analysis Method for Unconventional Wells .....	1336
<i>Jorge A. Acuña</i>	
Using Bayesian Leave-One-Out and Leave-Future-Out Cross-Validation to Evaluate the Performance of Rate-Time Models to Forecast Production of Tight-Oil Wells.....	1350
<i>Leopoldo M. Ruiz Maraggi, Larry W. Lake, Mark P. Walsh</i>	
Type Wells – a Physics-Blind Statistical Myth? Our RTA Driven Construction Methodology Proves Otherwise! .....	1374
<i>Sriniketh Sukumar, W. John Lee</i>	

## **THEME 3: EMERGING GEOLOGICAL EVALUATIONS, TOOLS AND WORKFLOWS: DATA DRIVEN METHODS**

Unlocking the Human Factor: Geosteering Decision Making as a Component of Drilling Operational Efficacy.....	1394
<i>Amine Tadjer, Sergey Alyaev, Dylan Miner, Igor Kuvaev, Reidar Brumer Bratvold</i>	
Use of Machine Learning Production Driver Cross-Sections for Regional Geologic Insights in the Bakken-Three Forks Play .....	1410
<i>T. Cross, K. Sathaye, J. Chaplin</i>	
Real-Time Analysis of Rig-Site Drilling Data Using Automated System to Assist Geosteering and Completion Decision Making.....	1422
<i>Michael Ghazizadeh, Arman Khodabakhshnejad, Daniel Lowrie</i>	

## **THEME 8: FACILITIES AND ARTIFICIAL LIFT**

Coupling Physics-Based Full Field Hydraulic Model with Advanced Data Analytics: Evolution of Surface Pipeline Operations .....	1440
<i>L. Donnelly, M. Albers, J. Cameron, K. Frame, K. Zhang, H. Lu, S. Atmaca, N. Rodriguez</i>	

## **THEME 2: HIGH AND LOW FIELD NMR APPLICATIONS**

Log and Core NMR T1-T2 and T2-D Mapping of the Bakken Reservoir Complex .....	1458
<i>Dick Merkel, Michelle Stephans, Cameron Thompson, Kim McLean</i>	
Measurement of Effective Tortuosity in Unconventional Tight Rock Using Nuclear Magnetic Resonance.....	1475
<i>Son Dang, Sanchay Mukherjee, Carl Sondergeld, Chandra Rai</i>	

## **VOLUME 3**

NMR Quantification of Wettability and Water Uptake in Unconventionals .....	1489
<i>M. J. Dick, D. Veselinovic, R. J. M. Bonnie, S. Kelly</i>	
T1-T2 NMR on Shale Cuttings .....	1503
<i>M. J. Dick, D. Veselinovic, Taylor Kenney, Derrick Green, Adam Haecker, Matthew Boyce</i>	

## **SPECIAL SESSION: HFTS-2 PART IV**

Observations and Modeling of Fiber-Optics Strain on Hydraulic Fracture Height Growth in HFTS-2 .....	1513
<i>Jiehao Wang, Yunhui Tan, Peggy Rijken, Xinghui Liu, Amit Singh, Yan Li</i>	
New Fracture Diagnostic Tool for Unconventionals: High-Resolution Distributed Strain Sensing Via Rayleigh Frequency Shift During Production in Hydraulic Fracture Test 2.....	1532
<i>Gustavo A. Ugueto, Magdalena Wojtaszek, Somnath Mondal, Artur Guzik, Dana Jurick, Ge Jin</i>	
A Systematic Interpretation of Subsurface Proppant Concentration from Drilling Mud Returns: Case Study from Hydraulic Fracturing Test Site (HFTS-2) in Delaware Basin.....	1548
<i>Debotyam Maity, Jordan Ciezobka</i>	
Analysis and Integration of the Hydraulic Fracturing Test Site-2 (HFTS-2) Comprehensive Dataset.....	1561
<i>Venkateswaran Sriram Pudugramam, Yu Zhao, Fadila Bessa, Jake Li, Nancy Zakhour, Tim Brown, Jichao Han, Iwan Harmawan, Vinay Sahni</i>	

## **SPECIAL SESSION: HFTS-2 PART V**

Novel Geochemistry Determined from High Pressure, High Temperature Simulation Experiments of Hydraulic Fracture Test Site 2 .....	1578
<i>Djuna Gulliver, Preom Sarkar, Kara Tinker, Nicholas Means, James Fazio, Wei Xiong, Alexandra Hakala, Christina Lopano, Scott Leleika, Amanda Harmon, Jordan Ciezobka</i>	
Inference of Induced Fracture Geometries Using Fiber-Optic Distributed Strain Sensing in Hydraulic Fracture Test Site 2.....	1593
<i>Stephen Bourne, Kees Hindriks, Alexei A. Savitski, Gustavo A. Ugueto, Magdalena Wojtaszek</i>	

Key Learnings from Hydraulic Fracturing Test Site - 2 (HFTS-2), Delaware Basin .....	1609
<i>Yu Zhao, Fadila Bessa, Vinay Sahni, Sriram Pudugramam, Shunhua Liu</i>	

## **THEME 1: OPTIMIZING COMPLETIONS, PERFORATIONS, AND STIMULATION STRATEGIES**

Constant Concentration Proppant Schedules for Slickwater Frac Design in Unconventional Resources .....	1620
<i>Amit Singh, Sahil Malhotra, Dean Wehunt, Seung Han, Christopher Lannen, Xinghui Liu, James Cooper, Amos Kim</i>	
Simple Yet Practical Production Data Characteristics of Cluster Spacing and Stage Length Configurations: A Permian Case Study .....	1635
<i>S. Esmaili, N. Zakhour, J. Deng</i>	
Integration of Geology, Geomechanics, and Completion Data in Modeling for Future Well and Completion Optimization: An Unconventional Diyab Case Study .....	1652
<i>H. Pourpak, W. Newby, S. Taubert, H. Al Marzoqi, M. Z. Baig, A. Lefebvre-Prudencio, Y. Wu, C. Pointer, F. Cafardi, V. De Gennaro, M. L. Nistor</i>	

## **THEME 1: PERMIAN STACKED PAY DEVELOPMENT STRATEGIES**

New Insights into Hydraulic Fracture Dynamics: Learnings from a Pressure Monitoring Well in the Permian Basin.....	1672
<i>Vivek Muralidharan, Soodabeh Esmaili</i>	
Impact of Completion Design on Various Infill Scenarios: A Data Driven Permian Case Study .....	1694
<i>Chad Darneal, Kyle Frieauf, Kristie McLin, Bharath Rajappa, Hui Zhou, Phuong Hoang, Justin Hammond, Herbert Swan</i>	
Ordovician Source Rock Potential on the Broome Platform of the Onshore Canning Basin in the Far North of Western Australia .....	1714
<i>Jop van Hattum, Aaron Bond, Ryan Taylor-Walshe</i>	

## **THEME 5: HYDRAULIC FRACTURING: MONITORING, MODELLING, AND ANALYSIS II**

Physics-Based and Data-Driven Models to Predict Production Drivers in the Vaca Muerta Formation .....	1734
<i>Leonardo Cruz, Jesus Ochoa</i>	
Evaluating the Effect of Formation Properties and Completion Design Parameters on Cluster Efficiency Using Advanced Modeling .....	1744
<i>Varahanaresh Sesety, Ahmad Ghassemi</i>	
Modeling and Optimization of Proppant Distributions in Multi-Cluster Hydraulic Fracture-Natural Fracture (HF-NF) Networks .....	1757
<i>Yidi Wu, George J. Moridis, Thomas A. Blasingame</i>	
Numerical Simulation of Proppant Transport and Deposition in Complex Hydraulic-Natural Fracture Networks .....	1777
<i>Dharmendra Kumar, Baohua Liu, Ahmad Ghassemi</i>	

## **THEME 5: HYDRAULIC FRACTURING: MONITORING, MODELLING, AND ANALYSIS III**

Propagating of Hydraulic Fractures from Horizontal Wellbores: Effects of In-Situ Stress and Near Wellbore Stress Redistribution.....	1787
<i>Qian Gao, Desheng Zhou, Ahmad Ghassemi, Xiong Liu, Yafei Liu, Minhao Guo</i>	
A Novel Workflow from StimPlan to EDFM for Complex Hydraulic Fracture Modeling and Production Simulation .....	1802
<i>Yukun Yan, Jiayao Deng, Dante Guerra, Wei Yu, Jijun Miao</i>	

## **THEME 7: DATA-DRIVEN FORECASTING AND COMBINING PHYSICS-BASED AND MACHINE-LEARNING METHODS**

Are Unconventional Well Performance Gains Exhausted? Investigating the Drivers of Year-Over-Year Production Improvements Across the Major US Unconventional Plays Using Machine Learning .....	1822
<i>T. Cross, J. Chaplin, K. Sathaye, A. Cui</i>	
A Novel Probabilistic Approach for GOR Forecast in Unconventional Oil Reservoirs.....	1830
<i>Yuewei Pan, Guoxin Li, Jianhua Qin, Jing Zhang, Lichi Deng, Ran Bi</i>	
Machine Learning and Artificial Intelligence Provides Wolfcamp Completion Design Insight .....	1850
<i>R. Shelley, H. Melcher, O. Oduba</i>	
A Physics-Guided Deep Learning Predictive Model for Robust Production Forecasting and Diagnostics in Unconventional Wells .....	1862
<i>Syamil Mohd Razak, Jodel Cornelio, Young Cho, Hui-Hai Liu, Ravimadhav Vaidya, Behnam Jafarpour</i>	
Characterization of Hydraulic Fracture Properties in Eagle Ford Shale Oil Reservoir Using EDFM-AI with Two Fracture Design Scenarios .....	1870
<i>Chuxi Liu, Anuj Gupta, Wei Yu, Ravimadhav N. Vaidya, Ning Li, Kamy Sepehrnoori</i>	

## **THEME 10: INNOVATIVE TECHNOLOGIES: NEW MATERIALS AND WORKFLOWS**

The Effect of Chemical Partition Behavior on Oil Recovery by Wettability Alteration in Fractured Tight Reservoirs .....	1886
<i>Tesleem Lawal, Mingyuan Wang, Gayan A. Abeykoon, Francisco J. Argüelles-Vivas, Ryosuke Okuno</i>	
High Resolution Acoustic Imaging for Geometric Quantification of Eroded Perforations in Hydraulically Fractured Wells.....	1897
<i>T. Littleford, K. Wardynski, A. Battistel, G. Simpson</i>	

## **THEME 7: MACHINE-LEARNING FOR SUBSURFACE APPLICATIONS**

Statistical Analysis of Fractures from the Hydraulic Fracture Test Site 1.....	1917
<i>Frank Male, Bethany Rysak, Robin Dommis</i>	
Vision-Based Sedimentary Structure Identification of Core Images Using Transfer Learning and Convolutional Neural Network Approach.....	1932
<i>Baosen Zhang, Shiwang Chen, Yitian Xiao, Laiming Zhang, Chengshan Wang</i>	

Machine Learning Applications for a Qualitative Evaluation of the Fracture Network in the Wolfcamp Shale Using Tracer and Completion Data .....	1943
<i>Abhash Kumar, Chung Yan Shih, Guoxiang Liu, Paul Holcomb, Song Zhao, Richard Hammack, Jeffery Ilconich, Grant Bromhal</i>	
Do We Really Need Deep Learning? a Study on Play Identification Using SEM Images .....	1952
<i>Hanyan Zhang, Max T. Kasumov, Deepak Devegowda, Mark E. Curtis</i>	
Deep Learning for Quantitative Hydraulic Fracture Profiling from Fiber Optic Measurements.....	1971
<i>Weichang Li, Han Lu, Yuchen Jin, Frode Hveding</i>	

## **THEME 2: PORE-NETWORK IMAGING AND FLUID FLOW MODELING**

Evolution of Gas Transport Mechanisms in Micro/mesopores of Organic-Rich Shales During Hydrocarbon Recovery.....	1979
<i>Zhengru Yang, Christopher R. Clarkson, Amin Ghanizadeh</i>	
Evaluation of Electron Tomography Reconstruction Methods for a Barnett Shale.....	1997
<i>Laura Frouté, Emeric Boigné, Matthias Ihme, Anthony R. Kovscek</i>	

## **THEME 15: NOVEL COMPLETION METHODS TO OPTIMIZE COSTS AND MAXIMIZE RECOVERY**

Optimizing the Selection and Application of Chemical Additives in Shale Reservoirs .....	2011
<i>Jerry Yan, Wei Wang, Wei Wei, Gregory Winslow</i>	
Systematic Comparison of Proppant Placement in SRV Along Two Fractured Wells at the Hydraulic Fracturing Test Site: A Case Study from Midland Basin. ....	2021
<i>Debotyam Maity, Jordan Ciezobka</i>	
Predicting Estimated Ultimate Recovery from Flowing Material Balance Analysis Considering Rock and Connate Water Expansion for Unconventional Gas Reservoirs .....	2032
<i>Aykut Atadeger, Mustafa Onur, Leslie G. Thompson, Barry A. Ruddick</i>	
Predictive Analysis of Well Interference in Tight Oil Reservoirs .....	2055
<i>Shayan Tavassoli, Esmail Eltahan, Katie Smye, Guin McDaid, Emery Goodman</i>	

## **THEME 8: IMPROVING RECOVERY FROM FLOWBACK TO EOR POTENTIAL**

Flowback Strategy Optimization for Permian Unconventional Bone Spring Sands and Wolfcamp Wells.....	2069
<i>Xueying Xie, Samuel U. Amadi, Courtney S. W. Leiker, Shunhua Liu, Erik A. Kinzler, Mei Han, Maria G. Melendez Castillo, Santiago P. Rivera</i>	
Comparison of CO2 and Lean Gas Cyclic Injection ('Huff-N-Puff') in Artificially-Fractured Shale Core Samples.....	2089
<i>C. Song, C. R. Clarkson, H. Hamdi, A. Ghanizadeh</i>	
Fracturing Fluid Loss in Unconventional Reservoirs: Evaluating the Impact of Osmotic Pressure and Surfactant and Methods to Upscale Results.....	2103
<i>Bin Pan, Christopher R. Clarkson, Adnan Younis, Chengyao Song, Chris Debuhr, Amin Ghanizadeh, Viola I. Birss</i>	

Innovative Modeling to Quantify the Impact of Natural Fractures, Optimize Well Spacing and Increase Productivity in the Marcellus Shale .....	2119
<i>Farid Mohamed, Dolapo Oтуlana, Ivan Salazar, Han Xue, Li Fan, Dan Shan, Jim Bennett, Kabiru Abubakar, Kyle Barrie, Bryce Yeager, Marcia Simpson, Creties Jenkins</i>	

## **THEME 9: FUTURE OF PRODUCTION FORECASTING AND PRODUCTION DIAGNOSTICS**

Well Performance and Completion Efficiency Assessment in the Delaware Basin Using the Diffusive Time of Flight.....	2139
<i>Jaeyoung Park, Yuxing Ben, Vivek Muralidharan</i>	
Impact of Fracture Conductivity on Production: How Much Proppant Do We Really Need in Unconventional Reservoirs?.....	2157
<i>Sarvesh Naik, Amit Singh</i>	
Fast Probabilistic Forecasting of Oil Production Using Monte Carlo Simulations on Data Driven Acquisition of Decline-Curve Parameter Distributions.....	2175
<i>V. B. K. Chavali, W. J. Lee</i>	
Application of Bayesian Optimized Deep Bi-LSTM Neural Networks for Production Forecasting of Gas Wells in Unconventional Shale Gas Reservoirs .....	2195
<i>Y. Kocoglu, S. Gorell, P. McElroy</i>	

## **THEME 3: EMERGING GEOLOGICAL EVALUATIONS, TOOLS AND WORKFLOWS: EXAMPLES FROM THE FIELD AND BEYOND**

Mesoscopic Characterization of the Heterogeneity Within Tight Carbonate Gas Reservoir, Outcrop Study, Saudi Arabia.....	2216
<i>Mutasim Osman, Osman Abdullatif</i>	

## **VOLUME 4**

Regional Comparison of the First Depositional Cycle of the Vaca Muerta in the Northern and Central Portions of the Neuquén Basin. ....	2238
<i>Jacob M. Proctor, Diego Acebal, Gabriela Davalos, Sebastian Olmos, Josefina d'Hiriart</i>	
Eagle Ford and Bakken Productivity Prediction Using Soil Microbial Fingerprinting and Machine Learning .....	2252
<i>M. H. A. A. Zijp, T. Mallinson, J. Zwaan, A. G. Chitu, P. David</i>	

## **THEME 6: ANALYTICAL ADVANCES IN APPLIED PETROLEUM GEOCHEMISTRY**

Stratigraphic Distributions of Volatile Compounds in Samples of the Cretaceous Mowry Shale, Wind River and Bighorn Basins, Determined by Vacuum Extraction and Cryotrap-Mass Spectrometry .....	2262
<i>Christopher M. Smith, Michael P. Smith</i>	

## **THEME 6: PROVEN AND POTENTIAL APPLICATIONS OF TIME-LAPSE GEOCHEMISTRY**

Applications of Time-Lapse Geochemistry (TLG) to Delaware Basin Field Development.....	2284
<i>Ye Wang, Frances Esson, Eric Michael, Isaac Perez, Bairta Biurchieva, Phuong Hoang, Kristie McLin</i>	
A Novel Approach to Understanding Multi-Horizon Fluid Flow in Unconventional Wells Using Produced Water Time-Lapse Geochemistry: Powder River Basin, Wyoming.....	2300
<i>Peter Jones, Drew Dressler, Tyler Conner, Josh O'Brien, Trevor Klaassen, Sean Bingham</i>	
Produced Water Chemistry Surveillance and Application in the Permian Basin .....	2320
<i>Wei Wang, Wei Wei, Mehrnoosh Saneifar, Baosheng Liang, Jason Parizek, Hanh Nguyen, Mauro Menconi, Fei Yang, Cameron Khalili</i>	
Machine-Learning Assisted Production Allocation Using a 3-D Full Field Geochemical Model of Produced Oils in the Eagle Ford and Austin Chalk of South Texas .....	2339
<i>Jason Jweda, Hui Long, Eric Michael</i>	

## **THEME 4: NOVEL SEISMIC INVERSION AND ATTRIBUTE APPLICATIONS**

Seismic Investigation of Lithological Controls on Effective Stress .....	2359
<i>Bill Goodway, Evan Mutual, David Cho, David McHarg, David Miller, Lindsay Miller</i>	
Illuminating Fine Scale Geology and Creating Robust Seismic Attributes Using High Trace Density Seismic Data in the Midland Basin .....	2364
<i>Andrew Lewis, Bruce Karr, Ron Bianco, Stonnie Pollock</i>	
Total Organic Carbon Content Estimation of Bakken Formation, Kevin-Sunburst Dome, Montana Using Post-Stack Inversion, Passey (DLogR) Method and Multi-Attribute Analysis.....	2382
<i>Silas Adeoluwa Samuel, Rui Zhang</i>	

## **THEME 8: NORTHERN SHALES**

Bakken Unconventional Well Gas-Oil Ratio (GOR) Behavior Characterization.....	2402
<i>Yongshe Liu, Brian Coffman, Nathan McMahan, Alisdair Farthing</i>	
Effects of Molecular Level Forces on the Diffusivity Characteristics of Hydrocarbons in Shale Reservoirs.....	2416
<i>Yakup Coskuner, Xiaolong Yin, Erdal Ozkan</i>	
Quantifying the Diminishing Impact of Completions Over Time Across the Bakken, Eagle Ford, and Wolfcamp Using a Multi-Target Machine Learning Model and SHAP Values .....	2430
<i>T. Cross, D. Niederhut, A. Cui, K. Sathaye, J. Chaplin</i>	

## **THEME 2: ROCK-FLUID AND FLUID-FLUID INTERACTIONS - PVT DATA ACQUISITION/ANALYSIS**

Core-Flood Effluent and Shale Surface Chemistries in Predicting Interaction Between Shale, Brine, and Reactive Fluid.....	2439
<i>Asli S. Gundogar, Jennifer L. Druhan, Cynthia M. Ross, Adam D. Jew, John R. Bargar, Anthony R. Kovscek</i>	

Comprehensive Laboratory Testing for Screening Completion Fluids to Maximize Productivity of Hydraulically Fractured Reservoirs.....	2456
---	------

*Evan Kias, Rahul Kumar, Bradley Abell, Ashish Mathur, Colton Barnes, Brian Chin, Chad  
Belanger, Safdar Ali*

Rethinking Mineral Scaling: What, Where, and Why is it Occurring in the Stimulated Rock Volume .....	2470
---	------

*Adam D. Jew, John R. Bargar, Joshua W. Brownlow, Matthew M. Laughland*

Molecular Simulation of Multi-Scale Multi-Component Hydrocarbon Phase Behavior in Liquid- Rich Shale Reservoirs.....	2483
---	------

*Fangxuan Chen, Ran Bi, Hadi Nasrabadi*

## **THEME 2: EMERGING PETROPHYSICAL EVALUATIONS**

Determination of Pore Fluid Salinity in Tight Rocks Without Fluid Extraction .....	2496
--	------

*Judah Odiachi, Ali Tinni, Carl H. Sondergeld, Chandra S. Rai*

Determining Organic Kerogen Maturity, Wettability, and Producibility from Induction Dielectric, Resistivity, and Spectroscopy Measurements.....	2505
--	------

*John C. Rasmus, Dean Homan, Gong Li Wang*

Impact of Kerogen Geochemistry on Methane and Water Adsorption Using Molecular Simulations .....	2525
--	------

*Archana Jagadisan, Isa Silveira de Araujo, Zoya Heidari*

## **THEME 1: NAVIGATING TECHNOLOGIES THAT DELIVER BOTTOM-LINE RESULTS**

DAS Recorded Body and Tube Wave Generated by Perforation Shots: Analysis and Numerical Modeling for Completion Monitoring and Reservoir Characterization.....	2539
--	------

*Shuang Zhang, Aleksei Titov, Vikram Jayaram, Hector Bello, Robert Hurt, Ge Jin*

Child Well Fracture Sequencing for Improved Production .....	2550
--	------

*Roberto Suarez-Rivera, Barry Clark, Doug Sassen, Christopher Quinn*

## **THEME 5: DIAGNOSTICS AND MONITORING WITH GEOMECHANICAL MODELS**

Evaluation and Insights from Instantaneous Shut-In Pressures .....	2564
--	------

*Nicolas Roussel, Herbert Swan, Jon Snyder, Dung Nguyen, David Cramer, Annie Ouk*

Quantification of Thermal Effects on Cross-Well Low-Frequency Distributed Acoustic Sensing Measurements.....	2583
---	------

*Yongzan Liu, Kan Wu, Ge Jin, George Moridis*

Quantitative Assessment of Induced Seismicity from Hydrocarbon Production and Produced Water Disposal in Azle Area, North Texas .....	2595
--	------

*Timothy Tyrrell, Jaeyoung Park, Rongqiang Chen, Akhil Datta-Gupta, Suvrat Lele*

## **CONOCOPHILLIPS SPECIAL SESSION: OPTIMIZING THROUGH COMPLETION DESIGN AND PRODUCTION ANALYSIS**

Well Performance Management: Case Study for Montney .....	2623
---	------

*Vishal Bang, Kc Yeboa, Rashad Javadli, Clayton Robinson*

Production Diagnostics with Time Lapse Geochemistry.....	2634
<i>Yishu Song, Eric Michael</i>	

### **THEME 3: RESERVOIR CHARACTERIZATION, GEOLOGICAL EVALUATIONS, AND STUDIES OF UNCONVENTIONAL PLAYS**

Geostatistical Simulation of Facies and Petrophysical Properties for Heterogeneity Modeling in a Tidal Depositional Environment: A Case Study from Upper Shale Member in a Southern Iraqi Oil Field.....	2646
<i>Watheq J. Al-Mudhafar</i>	

A Principal Component Analysis Approach to Understanding Relationships Between Elemental Geochemistry Data and Deposition, Niobrara Formation, Denver Basin, CO .....	2662
<i>Rana Elghonimy, Steve Sonnenberg</i>	

### **THEME 2: ADVANCED FORMATION EVALUATION AND ITS IMPACT IN HYDROCARBON RECOVERY**

Porosity Measurement of Shale Core Plugs Without Chemical Cleaning.....	2675
<i>Jin-Hong Chen, Stacey Althaus, Mohammed Boudjatit</i>	

### **THEME 9: EUR AND PERFORMANCE PREDICTION**

Integration of Gas-To-Oil Ratio into Production Decline Analysis to Predict Flow Regime Transition .....	2684
<i>S. G. Lapierre</i>	

Understanding Well Performance of Unconventional Extended Laterals in New Mexico, Delaware Basin.....	2709
<i>Mei Han, Spencer McKone, Michael Harty, Xueying Xie</i>	

Implementing the K-Means Clustering Algorithm for the Type Well Generation Workflow in the Eagle Ford Shale .....	2724
<i>Serhii Kryvenko, Mikhail Gorditsa, Gabriel Siegel</i>	

### **THEME 4: QUANTIFYING NATURAL FRACTURE PROPERTIES AND RESERVOIR PRESSURE**

Underpressure Distribution and Origin of the Tight Gas Reservoirs in Middle Jurassic J2sh Formation of the Central Sichuan Basin, Southwestern China.....	2736
<i>Qiaochu Wang, Dongxia Chen, Gao Xianzhi, Yi Zou</i>	

Quantifying Crack Properties of Source Rocks from Elastic Stress Sensitivity.....	2745
<i>Jihui Ding, Anthony C. Clark, Tiziana Vanorio, Adam D. Jew, John R. Bargar</i>	

Automated Reconstruction of Fracture Networks .....	2753
<i>Javier O. Guerrero, Bernard Chang, Dany Hachem, Maša Prodanovic, D. Nicolas Espinoza</i>	

Applications of Machine Learning for Estimating the Stimulated Reservoir Volume (SRV).....	2767
<i>Ali Rezaei, Fred Aminzadeh, Eric VonLunen</i>	

## **THEME 12: MAXIMIZING AND DELIVERING VALUE**

Characterization and Remediation of Scale in Three Horizontal Wells in the Point Pleasant Formation, Appalachia, PA .....	2783
<i>Amanda Roberts, Ernesto Fonseca, Thomas Tekavec</i>	
A Retrospective Look at Completion Design Optimization Based on Market Conditions.....	2799
<i>Kasey L. Ferguson, Nicholas J. Johnson, Brad D. Rowley</i>	
Machine Learning Methods in the Williston: A Case Study in Productivity Decay and the Implications for Inventory Exhaustion .....	2812
<i>B. L. Myers, B. Davis, R. Duman, T. Cross</i>	
Data to Decision: A Unified and Rapid Workflow for Unconventional Reservoirs Blending Data Analytics, Physics-Based Completion Optimization, and Investor- Oriented Economics .....	2825
<i>George Voneiff, Peter Bastian</i>	

## **THEME 10: FRICTION REDUCERS AND OTHER COMPLETION FLUIDS**

Experimental Investigation of Proppant Placement in Multiple Perforation Clusters for Horizontal Fracturing Applications .....	2846
<i>Faraj Ahmad, Jennifer Miskimins, Xinghui Liu, Amit Singh, Jiehao Wang</i>	
Universal Behavior of Polyacrylamide-Based Friction Reducers: Achieving Quantitative Lab Evaluation to Analytical Scale-Up Model Development for Field Performance Prediction .....	2865
<i>Nabijan Nizamidin, Gojko Matovic, Do Hoon Kim, Timothy Theriot, Harold Linnemeyer, Seung Han, Taimur Malik</i>	
Case Study: Boosting Friction Reduction with Surfactant Solutions .....	2885
<i>Brian Seymour, Alhad Phatak, Vinita Gupta, Vinny Gupta</i>	
Innovative Cationic Viscoelastic Friction Reducer for Hydraulic Fracturing Application.....	2895
<i>Fateeh Malekahmadi, Nicole Carrejo Moringo, Lance Adams, Brian Price, Yifan Li, Sarkis Kakadjian, Jarrett Kitchen, Keith Trego</i>	

## **THEME 3: NEW IDEAS AND WORKFLOWS FOR RESERVOIR CHARACTERIZATION OF UNCONVENTIONAL RESERVOIRS**

Quartz Fabric in Shales: Quantification and Assessing Its Influence on Geomechanical Properties .....	2915
<i>M. Rebecca Stokes, Andrew P. Rathbun, Paul C. Montgomery, Michael C. Cheshire, E. Russ Peacher</i>	
Horizontal Well Evaluation to Determine Geological Facies, Mechanical Properties, and Natural Fracture Changes Using Slim Through-The-Bit Dipole Sonic and Oil-Based Microimaging Tools. ....	2929
<i>Edgar Velez, Elia Haddad, Firas Al Shaikh, Ghada Barbour, Kyle Barrie</i>	
The Giant, Continuous Three Forks Play, Williston Basin .....	2944
<i>Stephen A. Sonnenberg</i>	

### **THEME 3: STRUCTURAL GEOLOGY AS APPLIED IN UNCONVENTIONALS**

Delaware Basin Wolfcamp Fm. Maturation and Post-Permian Basin Evolution Based on 2D Restorations and Basin Modeling.....	2963
<i>Rachel Hoar, Mauro Becker, Alan Yu</i>	
A Streamlined Approach to Fault Stress Analysis and Natural Fracture Prediction .....	2973
<i>Seth Busetti</i>	
Anisotropy in Fracture Networks: Scale-Dependent Clustering and Flow Behavior .....	2982
<i>Ankur Roy, Ajay K. Sahu</i>	

### **VOLUME 5**

Application of Artificial Intelligence Tools for Fault Imaging in an Unconventional Reservoir: A Case Study from the Permian Basin .....	2991
<i>H. Garcia, L. Plant</i>	

### **THEME 8: FLOW AND PHASE BEHAVIOR**

Use of Hydrocarbon Gas to Replace CO <sub>2</sub> for Shale Oil Huff-N-Puff EOR.....	3005
<i>Tongzhou Zeng, Yujia Guo, Kishore K. Mohanty</i>	
The Gas Huff-N-Puff PVT Experiment.....	3015
<i>S. Mydland, M. L. Carlsen, C. H. Whitson</i>	
Discovery Science of Hydraulic Fracturing and Shale Fundamentals.....	3034
<i>Mohamed Mehana, Javier E. Santos, Chelsea Neil, Matthew R. Sweeney, Jeffery Hyman, Satish Karra, Hongwu Xu, Qinjun Kang, James William Carey, George Guthrie, Hari Viswanathan</i>	

### **THEME 6: UNDERSTANDING AND PREDICTING PRODUCIBLE FLUIDS**

Identifying the Origin of Large Variations in Gas-Oil Ratios at Horizontal Wells Landed in Upper Wolfcamp Reservoirs in the Delaware Sub-Basin Using Gas Isotope, SARA, and HRGC Data .....	3049
<i>Jennifer J. Adams, Alan S. Kornacki</i>	
Left Behind: A Thrilling Post-Expulsion Adventure of Producible Hydrocarbons Remaining in Source Rocks.....	3069
<i>Shawn Wright, Nicholas J. Hogancamp, John Guthrie, Jennifer Wolters</i>	

Determining the Proportions of Producible Oil, Non-Producible Sorbed Petroleum, and Immobile Bitumen in Upper Wolfcamp Core Samples, Delaware Sub-Basin.....	3090
<i>Alan S. Kornacki</i>	

Hydrocarbon Drainage Index Optimizes Lateral Placement .....	3110
<i>Rick Schrynenmeekers</i>	

### **THEME 7: DATA-DRIVEN PRODUCTION FORECASTING AND OPTIMIZATION**

Autoregressive and Machine Learning Driven Production Forecasting - Midland Basin Case Study .....	3123
<i>I. Gupta, O. Samandarli, A. Burks, V. Jayaram, D. McMaster, D. Niederhut, T. Cross</i>	

Technical Resource Potential Estimation Using Machine Learning and Optimization for the Delaware Basin.....	3137
<i>Hardikkumar Zalavadia, Yuxing Ben, Raquel Gordillo, Steven Lauver</i>	

Machine Learning Approach to Improve Calculated Bottom-Hole Pressure .....	3155
<i>Esmail Eltahan, Reza Ganjdanesh, Wei Yu, Kamy Sepehrnoori, Ryan Williams, Jack Nohavitsa</i>	

## **THEME 2: EMERGING PETROPHYSICAL EVALUATIONS AND COMPLETION QUALITY**

Semiautomated Lateral Landing Advisor for On-Time Decisions Utilizing Digital Borehole Sonic Services and Next-Generation Cloud-Based Fracturing Design.....	3176
--	------

*Edgar Velez, Juan David Estrada, Adam Donald, Romain Prioul, Ting Lei, Erik Wielemaker, Violeta Lujan*

Improved Nanoscale Image-Based Reservoir Characterization Using Supervised Machine Learning .....	3190
---	------

*Shannon L. Eichmann, Poorna Srinivasan, Kevin Kenga, Mohammed Khan, Fabian Duque, Felix Oyarzabal, James Howard, Shawn Zhang*

A Study of Graphite-Sand-Water Mixtures and Their Conductivity as a Function of Frequency and Petrophysical Properties .....	3204
--	------

*Dean Homan, John C. Rasmus, Gong Li Wang, Siddharth Misra, Yuteng Jin*

Evaluating the STACK and SCOOP Rock and Petroleum System History: Combined Rock Volatiles and Petrophysics Data of Cored Wells Across the Anadarko .....	3222
--	------

*M. P. Smith, A. Leavitt, O. Djordjevic, J. Sinclair, R. Brito, C. M. Smith, P. S. Gordon, T. M. Smith, J. Hustedt*

## **THEME 5: GEOMECHANICAL MODELS AND EXPERIMENTAL ROCK MECHANICS**

Well Interference Testing Using Fiber Optics Production Analysis.....	3233
---	------

*Marcel A. Grubert, Xinyang Li, Todd Bown, J. Andres Chavarria*

Mitigating the Effect of Ash Layers on Hydraulic Fracture Connectivity.....	3241
---	------

*Bradley Abell, Roberto Suarez-Rivera, J. T. Mayo*

## **THEME 9: WELL SPACING AND WELL INTERFERENCE IMPACT**

Analysis of Well Interference in Delaware Basin: A Physics-Based and Data-Driven Approach .....	3259
---	------

*Esmail Eltahan, Shayan Tavassoli, Brian Casey, Guinevere McDaid, Emery Goodman*

Evaluation of Parent Well Production Changes Caused by Child Well Frac Hits Using a Pressure Integration Approach.....	3282
--	------

*Yifei Guo, Pradeepkumar Ashok, Eric van Oort, Matthew Isbell, Erin Butler, Austin Riopelle*

Spacing Classification System Delivers Enhanced Confidence in Modeling Unconventional Resource Plays .....	3294
--	------

*Stan Valdez, Rob Quigley, Tori Najvar, Austin Beckendorf, Adam Taberner, Louis Skrobarczyk, Grant Olsen, John Lee*

## **THEME 13: FOCUS ON METHANE: THE REGULATORY CHALLENGES AND MONITORING FOR THE FUTURE**

Unconventional Regulations: How the Development of Unconventional Resources Has Impacted Oil & Gas Regulations in the US.....	3314
<i>Deb Ryan, John Benton, Evan Halpern</i>	
Carbon Neutral Fuel from Light Tight Oil – a Value Proposition.....	3324
<i>Christine A. Ehlig-Economides</i>	
Strategy Optimization and Technology Evaluation for Oil and Gas Methane Emission Detection .....	3339
<i>R. Kou, A. Lazarus, S. Sridharan, V. Jayaram</i>	
Monitoring Leaks at Oil and Gas Facilities Using the Same Sensor on Aircraft and Satellite Platforms .....	3355
<i>Angel E. Esparza, Jean-François Gauthier</i>	

## **THEME 10: WORKFLOWS TO IDENTIFY FRACTURE GEOMETRY/METHODS FOR SUBSURFACE RESERVOIR CHARACTERIZATION**

New Insights on Near-Wellbore Fracture Characteristics from High-Resolution Distributed Strain Sensing Measurements .....	3367
<i>Yongzan Liu, Ge Jin, Kan Wu</i>	
Analytical Tracer Interpretation Model for Fracture Flow Characterization and Swept Volume Estimation in Unconventional Wells .....	3385
<i>Lokendra Jain, Shashvat Doorwar, Daniel Emery</i>	
New Approach to Reveal Compartmentalization in Montney Horizontal Wells for Completion Design Optimization.....	3405
<i>Jean-Yves Chatellier, Tristan Euzen</i>	

## **THEME 10: NOVEL PROPPANTS, LOW ENVIRONMENTAL IMPACT FLUIDS AND ADDITIVES**

Proppant Delivered Scale Inhibition - Unconventional Case Histories .....	3425
<i>Terry Palisch, Josh Leasure</i>	
Newest State of the Art Neutrally Buoyant Proppant Facilitates Placement Throughout Created Vertical Fractures to Provide Substantial Production Uplift in Unconventional Wells.....	3436
<i>Harold D. Brannon, Nicole Hoffman</i>	
Experimental Investigation of Foam Rheology in Rough Fractures.....	3457
<i>Anuradha Radhakrishnan, Keith Johnston, David DiCarlo, Maša Prodanovic</i>	

## **THEME 3: REGIONAL GEOLOGICAL EVALUATIONS AND STUDIES OF UNCONVENTIONAL PLAYS**

Examining the Origins and Yield Impact of a Stratified Oil Column in the Montney Formation, NE BC.....	3468
<i>Dallin Laycock, Elizabeth Watt, Rick Tobin, Shaina Kelly, Michelle Johnston, Eric Michael</i>	

Evaluating the Liquids Potential and Distribution of West Virginia's Marcellus Liquids Fairway.....	3481
<i>Christopher Smith, Susan Pool, Philip Dinterman, Jessica Moore, Timothy Vance, Timothy Smith, Patrick Gordon, Michael Smith</i>	
Paleoredox Conditions of Early Carboniferous Upper Bakken Shale, Williston Basin .....	3503
<i>Dipanwita Nandy, Sanyog Kumar, Steve Sonnenberg</i>	
High-Resolution Reservoir Characterization of the Lewis Shale, Greater Green River Basin, Wyoming.....	3523
<i>Ligia Carolina Mayorga-Gonzalez, Stephen A. Sonnenberg</i>	

#### **THEME 4: TOOLS AND TECHNIQUES FOR MEASURING FRACTURE INTERACTIONS**

Measurement Environment's Effect on DTS Surveys: A Case Study on Fiber Cable-Wellbore Coupling .....	3544
<i>Kagan Kutun, Ge Jin, Jennifer L. Miskimins</i>	
Improving Understanding of Depletion Around Fractures Using Drilling Data and Formation Image Logs .....	3559
<i>Kevin Wutherich, William Katon, Brian Sinosic, Jason Glascock</i>	
Modeling of Distributed Strain Sensing (DSS) and Distributed Acoustic Sensing (DAS) Incorporating Hydraulic and Natural Fractures Interaction.....	3569
<i>Kildare George Ramos Gurjao, Eduardo Gildin, Richard Gibson, Mark Everett</i>	

#### **THEME 8: MODELING**

A Reduced Physics Modeling Approach to Understand Multiphase Well Production Performance for Unconventional Reservoirs.....	3589
<i>Diego Molinari, Sathish Sankaran</i>	
A Multi-Factor Approach to Optimize Horizontal Shale Wells Flowback and Production Operation.....	3618
<i>Y. Liu, R. M. Jones, H. Lu, K. Putri, S. Atmaca, N. J. R. Gonzalez</i>	
An Experimental Investigation Demonstrating Enhanced Oil Recovery in Tight Rocks Using Mixtures of Gases and Nanoparticles .....	3631
<i>Zach Quintanilla, Williams Ozowe, Rod Russell, Mukul Sharma, Robin Watts, Frank Fitch, Yusra Khan Ahmad</i>	

#### **THEME 7: THE NEW FRONTIER: COMBINING PHYSICS-BASED AND MACHINE- LEARNING METHODS**

A Physics-Informed Machine Learning Workflow to Forecast Production in a Fractured Marcellus Shale Reservoir.....	3642
<i>Michael R. Gross, Jeffrey D. Hyman, Shriram Srinivasan, Daniel O'Malley, Satish Karra, Maruti K. Mudunuru, Matthew Sweeney, Luke Frash, Bill Carey, Bill Guthrie, Tim Carr, Liwei Li, Dustin Crandall, Hari Viswanathan</i>	
Using the Adaptive Variable Structure Regression Approach in Data Selection and Data Preparation for Improving Machine Learning-Based Performance Prediction in Unconventional Plays .....	3650
<i>Cyrus Ashayeri, Mehdi Korjani, Iraj Ershaghi</i>	

Physics-Assisted Transfer Learning for Production Prediction in Unconventional Reservoirs .....	3670
<i>J. Cornelio, S. Mohd Razak, A. Jahandideh, Y. Cho, H-H. Liu, R. Vaidya, B. Jafarpour</i>	

Merging Physics and Data-Driven Methods for Field-Wide Bottomhole Pressure Estimation in Unconventional Wells .....	3684
<i>Diego Molinari, Sathish Sankaran</i>	

### **THEME 13: FOCUS ON METHANE: PRODUCED WATER AND INDUCED SEISMICITY**

Well Development, Production, and Challenges in the Lewis Shale in the Wamsutter Field, Wyoming .....	3709
<i>Ligia Carolina Mayorga-Gonzalez, Stephen A. Sonnenberg</i>	

Managing Climate Related Risk Through Continuous Methane Monitoring .....	3722
<i>Khalid Soofi, Amanda Morris, David Camille</i>	

Completion Design Evolution for Saltwater Disposal Injection Wells in the Bakken Play .....	3737
<i>Darren D. Schmidt, Jeffrey W. Bader, Ashleigh Day, Mark Bohrer</i>	

New Technology Closes Micro-Annular Flow Paths in the Wellbore, Stopping Downhole Gas from Escaping to the Surface .....	3750
<i>C. Green, R. Evans, B. Fry, W. S. Wruck</i>	

### **ALTERNATE**

Evaluation of Formation Integrity After Flooding Hydrocarbon Reservoirs with Thermochemical and Chelating Agent Solutions .....	3759
<i>Amjad Hassan, Ayman Al-Nakhli, Abdulaziz Al-Majed, Mohamed Mahmoud</i>	

### **Author Index**