

# **Second EAGE/SPE/AAPG Shale Gas Workshop in the Middle East 2014**

## **Moving Forward to the Next Level**

**Dubai, United Arab Emirates  
21-24 September 2014**

**ISBN: 978-1-63439-487-1**

**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© (2014) by the European Association of Geoscientists & Engineers  
All rights reserved.

Printed by Curran Associates, Inc. (2014)

For permission requests, please contact by the European Association of Geoscientists & Engineers  
at the address below.

EAGE  
PO Box 59  
3990 DB Houten  
The Netherlands

Phone: +31 88 995 5055  
Fax: +31 30 634 3524

[eage@eage.org](mailto:eage@eage.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: 845-758-2634  
Email: [curran@proceedings.com](mailto:curran@proceedings.com)  
Web: [www.proceedings.com](http://www.proceedings.com)

# TABLE OF CONTENTS

## WELL DELIVERY AND COMPLETIONS

<b>KN3: Shale Gas Project Development .....</b>	1
<i>C. Hartman</i>	

## CASE STUDIES AND INTEGRATED SHALE GAS PROJECTS I

<b>KN4: Conditions to Export the Shale oil and Tight Gas Revolution out of North America.....</b>	3
<i>C. PHILIPPE</i>	

## GEOCHEMISTRY OF SHALE GAS

<b>P01: Differentiation of Natural vs. Drilling Induced Fractures in Shale Gas Wells Using Borehole Images– Critical for Determination of In-situ Stress.....</b>	5
<i>T. Mahmood, K.A. MacPherson</i>	
<b>P02: Characteristics and Genetic Mechanism of Upper Triassic Xu-5 Member Shale Gas Reservoir in West Sichuan Depression .....</b>	7
<i>H Meng, D.K. Zhong</i>	
<b>P03: Petrophysical Analysis for Shale Gas Potential, Onshore Bahrain.....</b>	11
<i>N.K. Alwast, R.A. Mireault, A.N. Mukhtar</i>	
<b>P04: Economic Success of Shale Gas Plays.....</b>	16
<i>B.G. Choi, J.W. Choi, S.H. Cho, J.W. Choi</i>	
<b>P05: Shale in Telisa Formation, Central Sumatera Basin as a Prospective Shale Gas Resource Based on Geochemical Data Analysis.....</b>	18
<i>M.T. Gandapradana, K. Meninta, S.M. Gomaa</i>	

## SHALE GAS BREAKTHROUGHS

<b>P06: A Roadmap to Representative Data at the Nanoscale in Shale .....</b>	22
<i>H. J. Lemmens</i>	
<b>P07: Geochemical Studies of Black Shales for Shale Gas Prospects of the Semri Group, Vindhyan Basin, Exposed around Maihar Area.....</b>	25
<i>U. Bhan</i>	
<b>P08: Spectral Gamma Ray Signatures for Qusaiba Shale.....</b>	27
<i>A. Sahin, M.O. Abouelresh</i>	
<b>P09: Challenges Associated with Shale Gas Development in Asia.....</b>	31
<i>H. Parikh, A. Patel, R. Chaudhari</i>	
<b>P10: Geological Characteristics of The Lower Silurian Qusaiba Shale, Rub Al-Khali Basin, Saudi Arabia .....</b>	38
<i>A. Mustafa, A. Sahin, M.O. Abouelresh, M. Hariri</i>	

## SHALE EVALUATION STRATEGIES I

<b>SG01: Unlocking the Full potential of the Middle East Shale Assets .....</b>	43
<i>A.M. Bouhlel, M. Mayerboeck, K. Eder</i>	
<b>SG02: Kingdom Shale Gas Hydrocarbons as an Emerging Resource Play .....</b>	49
<i>A. Ahmed, A. Hakami, H. Alsahfy, F. Oyarzabal</i>	
<b>SG03: Resource Play Analogues in North America to Optimize Exploration and Development of Resource Plays in Middle East and North Africa .....</b>	51
<i>L. Marlow</i>	

## SEISMIC FOR SHALE GAS

<b>SG04: Seismic Acquisition, Processing and Interpretation for an Unconventional Basin in Saudi Arabia .....</b>	55
<i>A. Alghamdi, H. Alsahfy</i>	

<b>SG05: Tuwaiq Mountain Rock Physics Model</b> .....	57
<i>M.S. Bin Gubair, A. Bakhorji</i>	
<b>SG06: Shale Gas Sweet Spot Identification Seismic Method : A Case in Longmaxi, Sichuan Basin</b> .....	60
<i>L. Liu, Z. Yusheng, Y. Gang, C. Fei, L. Xueli</i>	

## **ROCK MECHANICS**

<b>SG07: Core and Petrographic Sequential Analysis of Organic-Rich Shale</b> .....	63
<i>M.O. Abouelresh</i>	
<b>SG08: Fracture Modes in the Silurian Qusaiba Shale Play, Northwest Saudi Arabia and their Geomechanical Implications</b> .....	68
<i>M.S. Ameen</i>	
<b>SG09: Geomechanics Model Development: Robust New Proposal for Determination of Mohr-Coulomb Failure Envelope</b> .....	70
<i>H. González Pérez, G. Jin, G. Agrawal</i>	

## **GEOCHEMISTRY OF SHALE GAS**

<b>SG10: Creating a 3-D Hydrocarbon Profile in Shale Plays Using Amplified Geochemical Imaging and Downhole Geochemical Logging Techniques</b> .....	76
<i>R.J.S. Schrynenmeekers</i>	
<b>SG11: Fingerprinting Investigation of Selected Crude oils From Middle East using Results of Compound Specific Isotope Analysis of Biomarkers</b> .....	80
<i>H. Alimi</i>	
<b>SG12: Influence of Drilling Fluid on the Geomechanical Properties of Unconventional Cores</b> .....	82
<i>H. González Pérez, P. Yadav, A. Nair, J. Jin</i>	

## **SHALE EVALUATION STRATEGIES II**

<b>SG13: Developing a Completions Playbook: Maximizing the Value of Unconventional Assets</b> .....	88
<i>B.D. Clark, R. Malpani</i>	
<b>SG14: Leveraging Lessons Learned to Minimize the Overall Investment in Unconventional Plays</b> .....	91
<i>C. Fredd</i>	

## **RESERVOIR ENGINEERING**

<b>SG15: Unconventional Shale Permeability Quantification: Direct Measurement of the Effects of Capillary Condensation and Gas Composition</b> .....	95
<i>G. Jin, H. González Pérez, G. Agrawal</i>	
<b>SG16: The Application of Adsorption Isotherm Data to Define Gas-in-Place Volumes for Shales-Gas Reservoirs</b> .....	100
<i>L. Rutherford</i>	
<b>SG17: Integrated Reservoir Characterization of a Posidonia Shale Outcrop Analogue: From Serendipity to Understanding</b> .....	102
<i>M.H.A.A. Zijp, J.H. Ten Veen, R.M.C.H. Verreussel, D. Ventra</i>	

## **WELL DELIVERY AND COMPLETIONS**

<b>SG18: Relevant Factors and Issues to be Successful in Unconventional Shale Reservoirs</b> .....	106
<i>E. Pacheco</i>	
<b>SG19: Adaptive Drilling Fluid System using Nanotechnology Uniquely Designed for Shale Gas Reservoir Developments in the Middle East Region</b> .....	108
<i>T. Huang, G. Agrawal</i>	
<b>SG19A: First Successful Proppant Fracture for Unconventional Carbonate Source Rock in Saudi Arabia</b> .....	110
<i>N.I. Mulhim, R. Coleman, A. Saihati, A. Hakami, M. Al Harbi, K.S. Asiri</i>	

## **SHALE GAS BREAKTHROUGHS**

<b>SG20: Eliminating Common Multistage Fracturing Problems with a New Degradable Alloy Fracture Ball</b> .....	124
<i>I. Aviles, S. Wilson</i>	
<b>SG21: Hydraulic Fracture Geometries in Laminated Rocks when Initiated from Horizontal Wells Drilled in Tectonically Stressed Environments</b> .....	127
<i>G. Waters</i>	

## **CASE STUDIES AND INTEGRATED SHALE GAS PROJECTS I**

<b>SG22: Goals, Strategies, and Tactics in Sampling and Characterization of Unconventional Reservoirs: Developing a New Playbook</b> .....	130
<i>J. Levine, M. Aqel</i>	
<b>SG23: Technology-Driven Approach to Develop Shale Gas in Saudi Arabia</b> .....	133
<i>R. Tineo, K. Bartko, B. Coffin, C. Jarrett, R.A. Urbina</i>	
<b>SG24: Addressing Uncertainties in Estimates of Recoverable Gas for Underexplored Shale Gas Basins</b> .....	135
<i>J.H. ter Heege, M.H.A.A. Zijp, G. de Bruin, J.H. ten Veen</i>	

## **CASE STUDIES AND INTEGRATED SHALE GAS PROJECTS II**

<b>SG25: Exploiting Shale Gas Potential in Pakistan: Necessities and Way Forward</b> .....	139
<i>I. Noor, C.M. Saqib</i>	
<b>Author Index</b>	