SOURCE ROCKS OF THE MIDDLE EAST: A WORLD CLASS RESOURCE FOR UNCONVENTIONAL?

WORKSHOP OUTLINE

With the recent shale oil boom in North America, source rocks became a subject of great interest and importance to oil and gas companies worldwide. There is a wealth of data available in the public domain to describe and characterise these prolific source rocks in the different American basins. For the Middle East, the unconventional resources are yet to prosper, hence the need to properly understand the hydrocarbon generators of this region.

The AAPG Geoscience Technology Workshop titled “Source Rocks of the Middle East: A World Class Resource for Unconventional?” aims to focus on the geological aspects of the unconventional revolution which is vital to ensure successful Exploration, Appraisal and subsequently Development of the basins in the region. The technical program of the workshop aims to cover a wide range of topics, specifically relevant to the Middle East Region, from the basin scale down to the core level. The titles of the sessions are as follow:

- **Session 1**: Stratigraphy and Sedimentology of Source Rocks in the Middle East Region
- **Session 2**: Existing Practices and Advances in Basin Modeling
- **Session 3**: Source Rocks Geochemistry
- **Session 4**: Source Rocks Geomechanics
- **Session 5**: Petrophysical Evaluation of Source Rocks
- **Session 6**: Unconventional Geophysics for Unconventional Plays

In addition to the aforementioned sessions, a dedicated and interactive core display session is offered. This session will link the ideas and concepts discussed during the oral presentations throughout the workshop to the core specimens on display, thus enhancing the knowledge and experience of the attendees.

One of the main distinguishers of this workshop is that it is based and focused on the geology of the source rocks more than hydraulic fracturing. Another key distinguisher is that it is dedicated to improving the understanding of regional source rocks rather than sharing the North American experience.

Workshop objectives

The workshop aims to provide a comprehensive understanding of the source rocks in the Middle East. The technical program is developed in a way that covers the depositional environments and transport processes, basin modeling and detailed rock characterisation including geochemistry, geomechanics and petrophysics. The sessions are focused on the existing best practices and the recent advances in each domain.

WORKSHOP GUIDELINES

**FORMAT**

The workshop will be 3 days, consisting of oral presentations, poster presentations and breakout sessions where participants can discuss and investigate a specific theme that is of mutual interest. The first day will feature an inaugural keynote speech by a high-profile professional from the industry.

**ATTENDANCE**

Registrations are invited from all relevant disciplines with experience and/or knowledge of the subject areas being addressed in the workshop. Registrations will be accepted on a first-come, first-served basis.

**CALL FOR POSTERS**

You are invited to prepare a poster for presentation at the workshop. If you are interested in participating, please send a short abstract to cnavarro@aapg.org by 23 August 2022. All posters will be produced as pull-up banners and delivered by AAPG. There will not be any other format available for poster display.

**REGISTRATION TYPES & FEES**

Fees are inclusive of onsite documentation, coffee breaks and luncheons.

- AAPG Member*: $1550
- AAPG Non-Member: $1750
- Young Professionals**: $750
- Academia: $500
- Students: $350

*To avail the Member rate you must be an active member of AAPG.
**To register as a young professional you must be under the age of 35 with less than 10 years of work experience.

**REGISTRATION DEADLINE**

To guarantee your seat, please make sure to register by 19 September 2022.

**CANCELLATION POLICY**

AAPG will refund the tuition, less a $100 processing fee, if the request is received no later than 30 days prior to the workshop. Cancellations must be made in writing. The registrar will accept cancellation notices by telephone, but all such notices must be followed up by fax or by mail. No refund will be made for cancellations received less than 30 days prior to a workshop being given. Nonpayment of tuition does not constitute automatic cancellation. If no cancellation notice is received by 30 days prior to a workshop, participants are liable for full tuition. AAPG reserves the right to cancel a workshop if enrolment is insufficient to ensure proper effectiveness. Substitutions for individuals can be made at any time. A paid enrolment may be transferred one time to a future workshop if the request is received prior to the 30-day cut-off date.
SOURCE ROCKS OF THE MIDDLE EAST: A WORLD CLASS RESOURCE FOR UNCONVENTIONAL?

26–28 SEPTEMBER 2022

DAY 1 MONDAY 26TH SEPTEMBER

SESSION 1: STRATIGRAPHY AND SEDIMENTOLOGY OF SOURCE ROCKS IN THE MIDDLE EAST REGION

Lying at the core of the world-class Middle Eastern hydrocarbon province is a series of exceptional source rock successions, which have contributed to mega-giant fields. These prolific organic-rich formations offer the potential for accessing this untapped potential.

A gradual shift from the conventional exploration approach to finding new hydrocarbon is especially in the Middle East, where complexities are associated with the predominant depositional characteristics of these conventional sources in the context of unconventional hydrocarbon exploration and is likely to form the foundation of an exciting new phase of exploration in the region.

SESSION 2: EXISTING PRACTICES AND ADVANCES IN BASIN MODELING

With the recent upturn in the E&P lifecycle and the challenges in finding giant fields, an agnosticism towards unconventional plays is understandable. However, this is not to say that the conventional plays are not productive. The Middle East is endowed with excellent source rocks that have contributed to mega-giants. The prediction of a suitable petroleum system is an integral part of this campaign. A gradual shift from the conventional exploration approach to finding new hydrocarbon is increasingly becoming the norm for the Middle East based on multi-scale and geological interfaces.

Interestingly, some of the organic-rich formations of the Middle East are very tight and may contain toxic compounds. To de-risk such plays, advanced basin modeling approaches use classical adsorption with lab-derived Langmuir parameters, but also compositional models acceding gas such as the Middle East has a world-class history of petroleum geoscience, and its resources are being reevaluated.

The application of geomechanics is required to have any success in unconventional plays, as horizontal drilling and hydraulic fracturing practices. Both these technologies require a proper understanding of the geomechanical properties and behavior of the reservoir rock as well as that of the overlying and underlying strata.

The complex depositional processes that produce source rocks result in multi-scale interfaces and geological interfaces that influence the mechanical properties and behavior of such reservoirs when subjected to natural and induced stresses. Geomechanical properties of these systems are highly anisotropic in nature, and thus unconventional reservoirs are now more commonly modeled as transverse isotropic for practical applications.

Additionally, most unconventional resource systems are riddled with geological interfaces of varying scale and complexity. These interfaces influence the mechanical properties and behavior of such reservoirs. The evaluation of mineralogy, porosity, TOC content, kerogen volume and maturity, etc. contributes to the understanding of the stress field hence, a 3D coupled geological modelling is essential.

The application of advanced basin modeling approaches classifies organic-rich source rocks as potential reservoirs. Unconventional production relies on hydraulic fracturing, which cannot be applied to conventional plays. Understanding the stress field, rock strength, effective stress and hydraulic fractures, and stimulation of unconventional resource systems is of utmost importance.

The focus of this session is to discuss the multidisciplinary role of geomechanics and its applications in stimulation processes. Basic understanding of the Middle East important learnings from worldwide source rocks are welcome but should be limited to strong analogs. Suggested topics are listed below:

1. Structural and tectonic influences on basin evolution.
2. Relevance of pore pressure and poro-elasticity in mechanical behavior of ultra-tight, nano-pore dominated rocks
3. Lab measurement of anisotropic mechanical properties (Young’s Moduli, Poisson’s Ratio, fracture toughness, biot coefficient, friction angle, cohesion, UCS, tensile strength, etc)
4. Geo-mechanical property predictions based on logs and geophysical data.
5. Fracture properties and fracture toughness.
6. Natural fractures: How much do they really matter?
7. Wellbore Stability Modeling
8. Hydraulic Fracture Modeling
9. Fracture Diagnostic Techniques (DFIT, FIT, LOT)
10. Casing deformation during completions and early production.

SESSION 3: SOURCE ROCKS GEOCHEMISTRY

With increasing exploration and development of shale oil plays as compared to the more mature shale gas reservoirs, there has been a significant increase in reservoirs that the basic component of a source rock is kergen (present organic material), which alters and matures to hydrocarbon after being exposed to continuous pressure and temperature. The formation of hydrocarbons is estimated, expulsion, and migration of the hydrocarbons from the source rock to the reservoir rock. Poor or lack of migration can result in a significant accumulation of producible hydrocarbons within the source rock itself.

Proper characterization of a source rock petroleum system involves understanding both organic and inorganic geochemistry. The objective of this session is to delve into relevant technical information for comprehensive geochemical evaluation of Middle-Eastern source rocks. We invite knowledge sharing and case studies related to the following topics:

1. Organic Petrology (maceral analyses, DM, vitrinite reflectance, maturity, etc)
2. Organic maturity and alteration studies (kerogen type and quality, transformation index, etc)
3. Rock Eval and LECO Testing of core and cuttings samples for overall TOC content and element analysis.
4. Chemo-stratigraphy (inorganic geochemistry) for basin modeling (ICP, XRF, isotope analysis, etc).
5. Gas and liquid chromatography of produced crude and oils extracted from core and cuttings samples.
6. SARA and Biomarker analyses (fingerprinting) of produced crude and extracted oil from rock samples.
8. Integration of depositional environments and bio-facies from rock and oil geochemistry.
9. Quality control and uncertainties in measurements associated with equipment, techniques, drilling mud contamination, Tmax-to-RO correlations; etc.

SESSION 4: SOURCE ROCKS GEOMECHANICS

Commercial development of unconventional reservoirs is only possible through the utilization of horizontal drilling and hydraulic fracturing practices. Both these technologies require a proper understanding of the geomechanical properties and behavior of the reservoir rock as well as that of the overlying and underlying strata.

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SESSION 5: PETROPHYSICAL EVALUATION OF SOURCE ROCKS

Organic shales are not only source rocks for conventional reservoirs, but they can become the primary reservoirs if the appropriate petrophysical and geological conditions are met. While unconventional plays have equally important aspects to evaluate, Reservoir Quality (RO) and Completion Quality (CQ), RO refers to the quality of the petrophysical properties that are preserved and CQ is related to the quality of the integration of geophysical data with geo-mechanics. The challenge is to better understand thermal maturity differences, and variations in fluid types as a function of depositional environments, organic matter preservation or lack of it, and paleo heat flow patterns.

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SESSION 6: UNCONVENTIONAL GEOPHYSICS FOR UNCONVENTIONAL PLAYS

Over the last decades, the oil and gas industry has evolved delivering new technologies that have entirely changed business fundamentals. A significant change is in the perception of organic, and the organic-rich rocks treated as a source rock reservoir rather than part of a conventional petroleum system. The Middle East has a number of very tight organic-rich formations that offer a great opportunity to be developed as part of unconventional plays. The challenge remains in developing fit-for-purpose technologies, critical to understanding reservoir properties, increasing production, and maintaining costs and time efficiency.

Geophysical data play a critical role in unconventional developments as a unique tool that delineates properties away from the wellbores. 3D seismic imaging data contributes to the mapping of structural complexities and weakness zones in the subsurface allowing for robust reservoir characterization. In the Middle East, we are able to make predictions for elastic properties linking rock minerals, porosity, and fluid properties. Surface seismic can be complemented by micro-seismic acquired data to estimate the simulated rock volume and stress fields on a reservoir scale. Finally, full dynamic integration of AVO attributes derived from seismic with paleo-stresses and structural evolution and with drilling and fracking data provides a new avenue of data mining. Furthermore, additional work is needed to facilitate the integration of geophysical data with geo-mechanics and geo-modelling to optimize reservoir development and reduce exploration risks.

This session welcomes the submission of unique case studies highlighting new approaches and advancements in geophysical data conditioning/integration workflows that prompts multi-disciplinary methodologies to unlock unconventional plays in the Middle East.

TO REGISTER PLEASE CLICK HERE

AAPG MIDDLE EAST
**PETROPHYSICS OF UNCONVENTIONAL SHALE PLAYS.**
**FROM BASIC CONCEPTS TO LATEST TECHNIQUES**

**COURSE ABSTRACT**

The petrophysical characterization of unconventional shale-type reservoirs has been one of the most approached and relevant issues in the oil and gas industry in the last 8 years. This is because after several years, the operators companies comprehended the impact that an appropriate characterization of the reservoir has on their project economics.

Another reason for this were the technical obstacles encountered in the measurement of petrophysical properties such as porosity, saturation and permeability due to the complexity of this type of reservoir. Obstacles and limitations not only relate to laboratory measurements but also to electrical logging tools.

As a consequence of this, nowadays, petrophysical evaluations in this type of reservoir do not have standardized workflows established and accepted worldwide as is the case for conventional reservoirs. This motivates the professionals involved in the study of this type of rocks to dedicate a lot of effort in the validation of the technologies used, and sometimes it is difficult for them to understand the results, the evaluation of uncertainties and the construction of petrophysical models with results and representative parameters of the subsurface conditions.

The proposed course focuses on providing key knowledge for a better characterization of the rock both in the aspects related to the matrix of uncertainties and the construction of petrophysical models with results and representative parameters of the subsurface conditions. The contents provided will cover a variety of studies based on the most diverse physical principles that will represent by mineralogy and kerogen as well as the fluids present. The approach will be based on the convergence of different technologies that support and give robustness to the results.

The contents that will be provided will include laboratory testing techniques and petrophysical evaluation of electrical well logs for unconventional shale-type reservoirs. The contents provided will cover a variety of studies based on the most diverse physical principles that will include the latest advances and techniques used in the industry such as Nuclear Magnetic Resonance, Spectroscopy, Dielectric, Computed axial tomography and SEM images, among others.

As a result of this, attendees will have tools that allow a more comprehensive understanding of this type of rocks, a better assessment of the uncertainty of the model used and the necessary steps to improve its precision, accelerating the learning curve. The contents provided will also allow knowing the critical parameters that must be taken into account for the definition of areas to be drilled.

**COURSE OBJECTIVE**

Understand the complexity of this type of reservoir and provide tools and concepts that allow the interpreter to resolve the main uncertainties of petrophysical characterization including the latest technological advances.

**COURSE TOPICS**

- Reservoir heterogeneity characterization from outcrops to lab data and electrical logging.
- Most relevant unconventional plays of the world. Main characteristics.
- The petrophysical model. Components and definitions, construction, uncertainties, strengths and weakness.
- Lab studies: porosity, saturation, mineralogy, organic geochemistry and permeability.
- Electrical logging response on unconventional shale plays: triple combo, NMR, NMR T1T2, nuclear spectroscopy, spectral GR, dielectric.
- The effect of maturity on kerogen.
- Challenges on water saturation calculation.
- Data integration. Interpretation workflows and core calibration.
- Course closure

**WHO SHOULD ATTEND**

Petrophysicists, geologists, geophysicists, geochemists, geomechanical engineers, reservoir engineers.

**COURSE INSTRUCTOR**

Alberto Ortiz is a geologist graduated from the Universidad Nacional de Córdoba, Argentina in 1999. He worked in large oil and oil services companies [Schlumberger, Total, YPF]. He started as a petrophysicist after finishing the Schlumberger’s Log Analyst Training School in 2000 [LAT]. At the beginning of his career, his activity was concentrated in Argentina and Brazil in the latter, providing support to the petrophysical characterization of both clastic and pre-salt carbonates offshore reservoirs. He was temporarily assigned in Qatar in 2004. In 2011 he joined YPF and two years later he was part of the team dedicated to the unconventional reservoir development project of Vaca Muerta.

During 8 years he actively participated in the evaluation and development of this type of reservoir in a multidisciplinary team, providing technical support & training, publishing technical articles and interacting with the different disciplines involved such as engineering, geomechanics and geophysics between others. He also coordinated research projects with the YPF research center and laboratories outside of Argentina. He was a distinguished speaker for 3 consecutive years for the SPWLA related to the petrophysical evaluation of the Vaca Muerta formation and is the first author of the AAPG Vaca Muerta memoirs. He has recently formed the Net Zero Carbon Solutions company. He is a teacher at universities in Argentina and Colombia and coordinator of the formation evaluation team at Argentinean Congress CONEXPLOR 2022.