AAPG Geosciences Technology Workshops 2023

16-18 JANUARY 2023 | MUSCAT, OMAN

PETROLEUM SYSTEMS OF THE MIDDLE EAST

WORKSHOP BROCHURE

WHAT TO EXPECT FROM THE AAPG EXPERIENCE

The American Association of Petroleum Geologists (AAPG) and our suppliers, venues and services partners are committed to providing a clean and safe environment and experience for all our event participants. We remain alert to COVID-19 risks and are closely following and adapting to all applicable health and safety guidelines. While conditions vary between countries, cities, municipalities, and facilities, safeguarding measures you may encounter at AAPG events include physical distancing and masking, readily available hand sanitizer, enhanced cleaning and disinfecting protocols, temperature health checks and screenings, minimized touchpoints and cashless payment options.

As personal safety is a shared responsibility, we ask that all participants ensure that they are feeling well and in good health, with no fever or other symptoms related to COVID-19, before showing up at an AAPG event. Any specific delegate obligations will be published in pre-event communications and clearly displayed on signage throughout our venues.

Given the ever-changing nature of the pandemic recovery, registrants will receive regular updates and instructions concerning the latest health and safety requirements.

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WORKSHOP OUTLINE

The sedimentary basins of the Middle East have been proved to contain vast hydrocarbon reserves, sourced by some of the most prolific petroleum systems in the world. This is the product of a range of factors, not least the long-lived, relative stability of the Arabian Plate and the presence of multiple, prolific organic source rocks. The economic importance of this area to global energy supply has ensured that there have been major efforts addressing the complexities of the various petroleum systems over the decades since the original discoveries.

The petroleum system concept allows us to describe the relationship between a pod of active source rock and its associated hydrocarbon accumulations (Oil or Gas), as well as all the geological elements that contribute to these accumulations. While the initial major discoveries in the Middle East were associated with Mesozoic carbonates, subsequent exploration has also proven source rocks and reservoirs ranging in age from Precambrian to Tertiary. Additionally, the range of reservoir lithologies and trapping styles is also very varied. The result is that the Middle East hosts a diverse variety of petroleum systems, diverse in age and character and many have features unique to this region.

By investigating petroleum systems, we can potentially reduce the risk of hydrocarbon charge and help define the commerciality of potential prospect and leads. Predicting oil versus gas, making predictions on oil quality or condensate-gas ratio can allow informed decisions to be made pre-drill. Advances have been made in the recent past to address subjects as diverse as, non-hydrocarbon gases, the potential for unconventional hydrocarbons, the role of hydrodynamics, the presence of tilted fluid contacts, the formation of microbial gases, phase prediction and in-reservoir fluid alteration processes.

The purpose of this workshop is to address these and other subjects and to discuss the main challenges present in our current understanding of petroleum systems in the Middle East.

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 16 December 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.

$1,550 AAPG Member
$1,750 AAPG Non-Member
$1,750 Join & Save
$850 AAPG Young Professional Non-Member
$750 AAPG Young Professional Member
$500 Academia
$350 AAPG Student Non-Member (Masters)
$250 AAPG Student Member (Masters)

*To avail a member rate you must be an active member of AAPG.
**To register as a 'Student / Young Professional' you must either be a current masters student or a young professional 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 2 January 2023.

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 e-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 enrollment is insufficient to ensure proper effectiveness. Substitutions for individuals can be made at any time. A paid enrollment may be transferred one time to a future workshop if the request is received prior to the 30-day cut-off date.

SESSIONS DESCRIPTIONS

DAY 1 MONDAY 16 JANUARY

SESSION 1: PETROLEUM SYSTEMS IN THE MIDDLE EAST

The definition of a petroleum system can vary, but it is generally defined as the concept which unifies the various constituent physical geological components and processes required to generate and form a hydrocarbon accumulation. The essential components consist of one or more source rocks, reservoirs, seals or cap rock and overburden rock. The essential processes are the formation of one or more traps and the generation, migration and accumulation of hydrocarbons. In order for a petroleum system to be successful, these essential components and processes must also be correctly placed spatially and temporally, relative to each other. Different petroleum systems are found to operate on very different scales. Some systems may be very small, too small for a commercial application, but others result in hugely prolific systems, which are responsible for accommodating billions of cubic meters of hydrocarbon within.

The study of petroleum systems has evolved and become widespread over the last 20 to 30 years and is now an integral part of petroleum geology. Its application is particularly important in exploration for oil and gas fields whether this is in an established petroleum province or in frontier basins. In fact, the principal focus of many exploration campaigns is upon understanding and reducing the risk associated with each element of the petroleum system, prior to the drilling of any exploration wells. An exploration well drilled into a target within a petroleum system where all of the constituent parts are well understood and documented, will be associated with significantly lower risk compared to a well drilled into a target with poorly understood or undefined elements of the petroleum system.

The intention of the opening session is to introduce some of the petroleum systems of the Middle East. The introductions should include descriptions of key components of different systems in order for the audience to gain or complement existing understanding of petroleum systems.

SESSION 2: SOURCE ROCKS

Source rocks are composed of organic content-rich sedimentary rocks deposited in various depositional environments (including marine, lacustrine, and deltaic) that either have generated or could potentially generate hydrocarbons depending on their richness, quality and thermal maturity.

The sedimentary basins of the Middle East contain a variety of conventional and unconventional hydrocarbon resources. The source rocks, from which these resources are derived, are spread throughout multiple stratigraphic formations. Most of the source rocks in the Middle East belong to the Mesozoic, Paleozoic, and Proterozoic eras, with the Early Cambrian, Silurian, Upper Jurassic, and Mid Cretaceous periods being the most important source rock intervals. Subsurface and outcrop data provide a unique insight into the characteristics of these source rocks.

This session aims to provide insights into source rock analysis in the Middle East to support exploration, appraisal, and subsequent development activities. The main topics that will be covered in this session will focus on various characteristics of source rocks, such as stratigraphy, depositional environments, source rock geochemistry, geomechanics, petrophysical evaluation, and source rock modelling techniques.

DAY 2 TUESDAY 17 JANUARY

SESSION 3: CONVENTIONAL AND UNCONVENTIONAL RESERVOIRS

Siliciclastic and carbonate reservoir rocks, are critical elements within conventional petroleum systems. Previous studies have focused on describing and characterizing reservoir rocks in the subsurface and using outcrops as analogs. It is widely accepted that siliciclastic and carbonate reservoirs significantly differ in their depositional and post-depositional (diagenetic) processes. Hence, one needs to apply different strategies to better explore and exploit these reservoirs. In the Middle East, siliciclastic reservoirs dominate the Paleozoic era, while carbonate reservoirs are predominant from the Mesozoic to Cenozoic era. This provides a unique opportunity for researchers to present a novel approach in determining reservoir distribution, properties, quality, and heterogeneity by integrating traditional concepts and advanced technologies.

Traditionally, the quality of reservoir rocks is determined based primarily on their porosity and permeability. However, the boom in unconventional exploration in the last decade to meet the global demand for natural gas and greener energy has shifted the paradigm that the reservoir needs to be highly porous and permeable. For unconventional reservoirs, shale or heterolithic facies with low-matrix porosity and pervasively cemented rocks become the primary targets. Unlike in the conventional system, knowledge of microporosity, natural fractures, and geomechanical properties are essential to better characterize and predict the distribution and quality of unconventional reservoirs.

Studies have established that depositional and post-depositional processes are the primary controlling factors of reservoir quality in both siliciclastic and carbonate rocks. Characterizing and predicting these processes and how they impact porosity and permeability in the subsurface present some real challenges to the petroleum industry and academia. With unconventional reservoirs gaining more attention as a future energy solution to the depleted conventional reservoir, better reservoir characterization and prediction are urgently required to improve exploration and exploitation efforts.

Recent technological advances have allowed more in-depth reservoir characterization and prediction, including advanced seismic modelling, artificial intelligence (AI), and stratigraphic forward modelling. Advanced 2D and 3D seismic processing, interpretation, correlation with wells and attribute modelling have been some of the main tools to map and characterize reservoir rock properties and quality in the subsurface. Furthermore, recent successes in applying stratigraphic forward modelling has shown the capability of forward modelling in predicting reservoir quality and its controlling parameters, along with facies distribution in different depositional environments. Similarly, the rapid growth of AI technologies has democratized and transformed how data in oil and gas are analyzed. For example, machine learning and big data have emerged as tools and novel approaches to unravel hidden trends of reservoir properties from subsurface datasets.

This session is dedicated to discussing different aspects related to reservoir description, characterization, and prediction by using integrated approaches and advanced novel technologies. Furthermore, case studies from the surface and subsurface are particularly welcomed to improve our understanding of how reservoir rocks and properties differ across basins and geological periods in the Middle East and globally.

SESSIONS DESCRIPTIONS

SESSION 4: IN-RESERVOIR ALTERATION PROCESSES & CONTAMINANTS

The original physical and chemical characteristics of hydrocarbons are primarily inherited from the type, quality and maturity of the source rock from which they were derived. This is the basis of the basin modelling concept. However, once in the reservoir, the accumulated hydrocarbons can be altered chemically and physically by many processes. These processes include biodegradation, water washing, oil to gas cracking, seal leakage, deasphatning, gravity segregation, gas washing and thermochemical sulfate reduction, amongst others. Certain processes may combine and are typically destructive, which can ultimately result in hydrocarbon accumulations which are very technically challenging to produce or be sub-economic.

Cool temperatures and access to meteoric water tend to result in heavier oil and eventual alteration into tars, which can become immobile through severe bacterial attack, or/and excessive water washing. Tars and asphalts at the bottom of the hydrocarbon column can result from gravity segregation over long residence times, and good vertical permeability through the reservoir.

Changes in pressure and temperature (PT) conditions, of the reservoir, can result in dramatic effects on the hydrocarbon phase. If the reservoir pressure decreases below a certain point (dew point or bubble point pressure), a single-phase dense gas system or single-phase oil system will convert to a two phase free gas over oil. Phase separation or gas washing can result in abnormally heavy oil in deep reservoirs and very light oils in shallow reservoirs. Gas from deeper maturating oils and source rocks can pass through a reservoired oil accumulation, stripping the lighter hydrocarbons as it migrates through.
The density of oil phase hydrocarbons inversely varies with maturation, due to the combined effects of kerogen maturation and increased burial and hence thermal stress on the reservoired accumulations. As the reservoir is buried to greater depths, increased temperatures are experienced, more gases are generated from the liquids, which destabilize the liquid hydrocarbons and cause asphaltene precipitation. The same process can also occur due to mixing of hydrocarbons with significantly different densities (e.g. oil and gas). As the reservoir is buried to even greater depths with higher temperatures (>170°C), the liquid hydrocarbons become less stable and start to crack to gases and pyrobitumen. Thermal cracking can also happen at relatively low temperatures (>120°C) when sulfate in aqueous form is present. This can result in destruction of liquid phase hydrocarbons to lighter forms or gases and reduction of sulfate to H2S. This process can result in very high H2S content (sometimes >90%) at the expense of accumulated hydrocarbons.

The ability to accurately predict non-hydrocarbon contaminants, such as H2S and CO2 is important for development planning and economic assessment. Presence of these contaminants in high quantities has an adverse impact on the economic value of hydrocarbons. CO2 and H2S are corrosive and toxic. These gases can corrode equipment, impair flow rates, create condensation/ water problems in piping systems and decrease density. The process of removing these compounds is expensive and this cost needs to be included in the economic assessment. A vast quantity of scientific work have been undertaken in order to understand the origins of these contaminants in petroleum reservoirs and various models have been brought forward to predict them quantitatively in subsurface accumulations, and yet there are still surprises, which can be costly and fatal. An accurate understanding of these contaminants is pivotal for safe drilling and profitable development.

This session of the workshop is dedicated to in-reservoir alteration processes acting upon in-situ hydrocarbons and hydrocarbon contaminants. Contributions are welcomed, which are related to any of the aspects discussed.

DAY 3 WEDNESDAY 18 JANUARY

SESSION 5: TRAP & SEAL

Traps and seals are both key play elements governing the occurrence of subsurface hydrocarbon accumulations. Traditionally, the most common traps observed are relatively simple three or four way structural dip closures. There are also many documented examples of much more complicated traps, additionally involving one or more sealing faults. Stratigraphic traps, which rely on lateral facies changes are also observed. As technology and geological understanding has evolved over the years the search for traps has encompassed more complicated trap geometries, which now include structural, stratigraphic and combination traps as well as less common diagenetic and fluid-composition traps.

Top and lateral seals are commonly associated with “tight” impermeable facies, often deposited within deep water environments during transgressive or highstand systems tracts across geologic time. Moreover, seals can occur and be mapped both regionally and locally. The deliberate interpretation and understanding of the anatomy of seals is a key aspect to resolving hydrocarbon entrapments within regional petroleum systems.

Conventional seal studies usually describe and map top seals; however, seal capacity characterization and modelling are becoming areas of greater focus. Understanding of lateral seal distribution and its capacity is becoming more important in characterizing stratigraphically trapped hydrocarbon accumulations.

This aims of this session are to discuss advances in the understanding and characterization of conventional and unconventional traps, top or lateral seal facies distribution, the contribution of regional stresses, diagenesis, hydro-fluid dynamics and other factors that control effective trap formation. It is also intended that data and technology that can be used in the modelling and understanding of seal formation, capacity and integrity will also be discussed.

SESSION 6: INTEGRATED CHARGE STUDIES & GEOLOGICAL RISK ASSESSMENT

The play-based exploration approach, which is commonly applied by major E&P companies, often starts with a basin-scale investigation during which integrated charge studies are often performed. These studies are used to describe the regional context and basin framework that controls the extent and potential of the petroleum systems in which the oil and gas in a basin are generated and trapped. Petroleum systems understanding forms the basis for all subsequent play and prospect risk analyses. Petroleum systems modelling is the tool with which digital models are constructed from all of the available G&G data. These models are then used to simulate generation and entrapment processes through geologic time, allowing exploration efforts to be focused in particular areas and potentially de-risk individual targets.

Geological risk assessment is a fundamental and integral aspect of current industry best practices in petroleum exploration. Risk describes the likelihood of something happening or not happening, or of a factor being present or absent. For example, will the reservoir be present and of sufficient quality. Uncertainty describes a situation where the expected outcome cannot be definitively predicted with a single value, because there is a range of possible outcomes. Subsurface risk and its inverse parameter, probability of hydrocarbon discovery (chance of success), are required to describe and communicate the uncertainty in the subsurface associated with the geological components and processes of a particular target or play.

Some of the key objectives of integrated charge studies are to help understand and evaluate the key uncertainties related to essential petroleum system elements and processes required for the petroleum system to succeed. Such studies provide essential basin and play scale information for petroleum resource assessment, prospect risking and evaluation. Additionally, integrated charge studies support the establishment of an integrated basin-play-prospect portfolio to enable properly informed corporate decision making.

In order to meet the challenges of modern, complex prospects and play types, the industry needs to continue to develop new approaches to assist in the evaluation of risks associated with the petroleum system. The rigorous understanding of all of the elements and process will enable the quantification and reduction of the uncertainty and risks associated with exploration.

This session aims to focus on integrated charge studies and their broad application in further understanding petroleum systems. Particular areas of focus include their ability to help address risk assessment challenges through the use of high resolution petroleum system models, automatic calibration of numerical petroleum system models, application of machine learning methods, multi-scale (from basin to prospect) process-based models, prediction of the reservoir fluid properties, sensitivity analysis and quantitative risk assessment of multiple modelling realizations.