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.

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 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 inter-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 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.

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.

**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 cnvarro@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.

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*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.

**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 the event or for no-shows having given confirmation of attendance. No exceptions will be made. If the 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 enrollments do not exceed the break-even point of 50 attendees. Substitutions may 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.

**REGISTRATION DEADLINE**

To guarantee your seat, please make sure to register by 2 January 2023.
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.

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 predominantly from the Mesozoic to Cenozoic era. This provides an excellent 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 microtexture, 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 properties differ across basins and geological periods in the Middle East and globally.
As the reservoir is buried to even greater depths with higher temperatures, asphaltene precipitation occurs. The same process can also occur due to long residence times and good vertical permeability through the reservoir. Changes in pressure and temperature (PT) conditions, of the reservoir, can be altered chemically and physically by many processes. These processes include biodegradation, water washing, oil to gas cracking, seal leakage, deasphalting, 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 eventually alter into tar, which can become immobile through severe bacterial attack, oil/and excessive water washing. Tar 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.

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 as 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 asphaltum. 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, 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. 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, diageneisis, 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.

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-prospects 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 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.