Technical Approach and Optimized Workflow for Unconventional Reservoir Prospect Appraisal – A Case Study of the Middle Cretaceous Shilaif Formation, On-shore Abu Dhabi

Chad Hartman[1], Stefan Steiner[2], and Abdulla Al Mansoori[2]

[1]SWeatherford Laboratories
[2]ADCO – EUFR

Abstract

The most cost effective and intelligent method for evaluating a potential unconventional gas or oil resource involves a phased approach, with clearly defined criteria that must be fulfilled prior to further capital expenditures. Taking this approach will substantially mitigate risk as the investment capital required for each subsequent phase increases by orders of magnitude.

During the early phases of exploration and prospect appraisal of unconventional reservoirs, drilling, coring, and logging of a number of stratigraphic wells must be conducted to properly develop an accurate sub-surface model. The complexity and heterogeneity of unconventional reservoirs demands it. To drill and complete a lateral well can easily cost upwards of $MM10 USD, 70% of which will be spent on the required hydraulic fracture stimulation. To mitigate risk, and ensure maximum production from every well, an operator must have a clear understanding of reservoir properties, established within a geological and stratigraphic framework.

Proper and accurate measurements of various geochemical, petrological, petrophysical, and geomechanical parameters are critical to successful unconventional resource assessment. Numerous other geologic, reservoir, and fluid analyses are equally important when assessing unconventional resource potential. When attempting to assess the risks, economics, and potential success of an unconventional resource one of the primary objectives is to collect sufficient core data to enable accurate core-to-log calibration. In this technique, traces are derived that enable characterization of hydrocarbons-in-place and key reservoir properties over the entire logged interval (at the same resolution of the log digits) from a discrete set of core data. Core calibrated petrophysical models are critical for unconventional reservoirs because standard petrophysical modeling techniques are problematic or irrelevant.

Additionally log based cluster analysis allows one to partition similar or dissimilar rock types because the cumulative response of the entire log suite at a given depth is controlled by the discrete properties of the rock under investigation. By coupling log based cluster analysis to core calibrated petrophysical modelling potent additional value is provided to resource assessment in that each cluster can then be characterized based on its associated physical properties which facilitates facies classification and ranking. Once this process is completed for a given stratigraphic well the same cluster analysis algorithms can potentially be applied to other wells in the field allowing for the recognition of similar facies and their associated physical attributes. In this manner vertical sweet spots can be mapped throughout the field.

Based on the resulting core and log evaluation, placed firmly in a stratigraphic and geological frame work, informed decisions are then made possible to determine economic potential, lateral well placement, and an optimal completions strategy. A case study wherein this early phase exploration and prospect appraisal strategy was applied to the Middle Cretaceous Shilaif Formation, on-shore Abu Dhabi, will be presented.