Wellsite Geochemistry - New Analytical Tools Used to Evaluate Unconventional Reservoirs in the Wattenberg Field, Colorado

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A mobile pyrolysis instrument and GC tracer tool were combined to evaluate potential productivity of the Cretaceous shales during drilling of a tight gas sand well in Wattenberg Field, Colorado. Real-time results showed total organ carbon (TOC) generally exceeding 1% in the shales and the highest TOC was measured the Sharon Springs interval, which averages ~3% TOC. A cased-hole gamma ray log through the more prospective basal shales showed excellent correlation with TOC. Close correlation was also observed between mudgas total hydrocarbon content (THC) and cuttings residual oil content (S1). The highest in-situ residual oil saturation was found in the Niobrara Shale, which averaged 40 bbl/a-ft. There is a well defined thermal maturity depth trend in the Tmax data, which place the Pierre Shale in the main oil window and the basal shale intervals in the wet gas/condensate window. Recovered hydrocarbon compositions match the predicted maturity. Hydrocarbon yield calculations suggest that the Greenhorn/Graneros intervals may also be attractive shale gas targets.

The GC-Tracer tool analyzes real-time hydrocarbon (C1 - C8, benzene, toluene) and non-hydrocarbon gases (CO2, N2). The Source Rock Analyzer (SRA) uses drill cuttings to evaluate residual oil content in source rock (S1), remaining hydrocarbon generation potential (S2), thermal maturity (Tmax), and total organic carbon (TOC). Cutting samples were taken every 100’ throughout the majority of the well, while 10’ samples were collected in potential shale targets to more accurately monitor variability.

In unconventional reservoirs, such information can aid in the delineation of pay zones and be used to design horizontal completion and stimulation programs. Unfortunately, wellsite programmed pyrolysis of drill cuttings has not been practical in the past due to technical challenges with instrumentation and software. Previous pyrolysis units were too large for field use and the electronics were not rugged enough for the harsh conditions. Mobile pyrolysis instrumentation also needed an expanded linear range to handle the wide variety of sample types and fluid concentrations that could be experienced in the field. This case history demonstrates new analytical tools for well site geochemical evaluation. On site analysis can provide insights into potential productive shales and identification of intervals for additional evaluation.