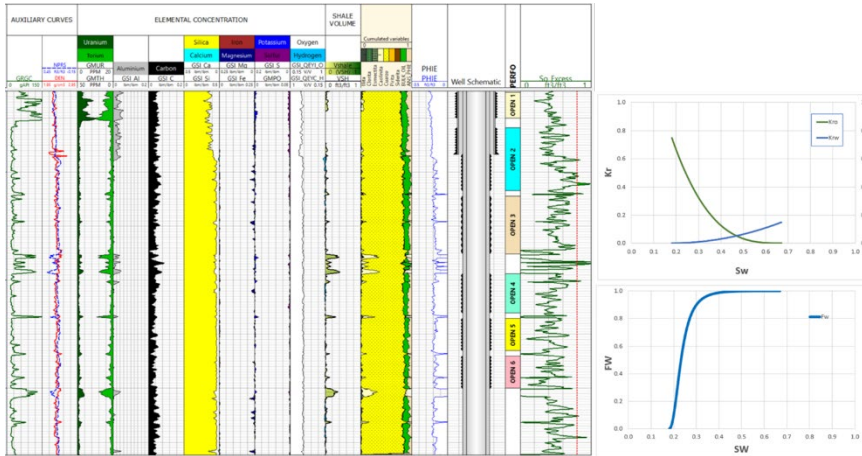


Geochemical Spectroscopy Instrument Enabled Comprehensive Cased-Hole Formation Evaluation, Saved \$100,000, Reduced Risk During Re-Entry



Composite log with the information obtained: GR-DEN-NEU, elemental concentration, well schematic (to see double liner and liner change) with the re-entry perforated open intervals, mineralogy, porosity, and oil saturation. Integrated with field generic fractional flow curves from relative permeabilities to understand high BSW in production.

LOCATION

Llanos Basin, Colombia

WELL TYPE

Deviated

FORMATION

Sandstone

HOLE SIZE

8-1/2 and 6-1/8 in.

LINER SIZE

7 and 5 in.

TEMPERATURE

143°F (61°C)

PRODUCTS/SERVICES

- Geochemical spectroscopy tool
- Compact photo density (MPD) tool
- Compact dual neutron (MDN) tool
- Spectral gamma ray (MSG) tool
- Compact tools
- Interpretation and Evaluation Services

Objectives

- Evaluate a re-entry to a deeper zone. In the shallow intervals, there were no longer production options.
- Log 673 ft (205 m) using spectroscopy and define zones of interest for production processes. The top of the section included 117 ft (35.6 m) in a double liner to validate oil saturation time lapse and re-perforate.
- Integrate results with the field generic fractional flow curves from relative permeabilities and compare with production data to better understand the complex production conditions in these reservoirs.

Our Approach

- The initial wellbore consisted of an 8 1/2-in. hole that encompassed two shallow units of interest proposed as the main target of the well and only the top of the deeper unit of interest. This interval was later cased with 7-in. liner, perforated, completed, and put into production until recently.
- Upon reevaluation of the original information, the operator found no options to perforate for production. As a result, the plan was to drill a deeper, nearby well to obtain openhole log information from the unproduced reservoir for the drain areas that should be in the original fluid saturation conditions.



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Our Approach (continued)

- The operator defined the preferred option: re-enter into the bottom of the original hole until it covered the deeper reservoir total thickness. Field personnel drilled with a 6 1/8-in. hole to TD. After drilling, they tried to record a triple combo openhole log using conventional wireline conveyance, but due to operational sticking and the need to optimize costs, they decided to pull the tool out to avoid further risk and cased the well with a 5-in. liner.
- The Weatherford proposal was to log the geochemical spectroscopy instrument (GSI) in the cased-hole environment along with the spectral gamma ray, compensated density, and neutron tools in the same toolstring to define an oil saturation model from the deeper reservoir and provide a comprehensive cased-hole formation evaluation solution.
- When the operator's reservoir engineer and Weatherford's Interpretation and Evaluation Services specialist received the data from field, they initially were faced with the challenge of performing double liner environmental corrections in the 117 ft (35.6 m) section. However, the data was fixed by sections, from iron excess evidenced according to the knowledge of the reservoir lithology in this field.
- The interpretation of the GSI data showed the main lithology (sandstones) was as expected, and low hydrocarbon saturations considering typical basic sediment and water (BSW) on these reservoirs.
- Based on the GSI interpretation, the operator defined the intervals to perforate, and the well started producing with high BSW. The results showed 395 BOPD and 7,500 BWP, according with the GSI results and fractional flow curves from the field. This outcome matched the cased-hole reservoir evaluation results, validating through production the method and technology.

Value to Customer

- The acquisition and analysis of spectroscopy data—including lithology, porosity, and fluid saturation, using the same tools and data quality as in openhole logging—empowered the operator to make decisions about the potentially productive zones.
- The production data confirmed the high Sw evaluated through the GSI saturation analysis, demonstrating the consistency of the measurement.
- Weatherford technology and IES analysis allowed the operator to have a solid petrophysical analysis, identifying and characterizing petrophysical and mineralogical properties of the deeper reservoir.
- Being able to log in the cased-hole environment saved \$100 000 USD in rig time, but the potential savings by avoiding fishing operations, lost-in-hole payments, or legal issues from radioactive sources proved much higher.

