CASE STUDY

Geochemical & PVT Analyses Provide Strong Evidence for Continuous Reservoir with Gas Cap Above an Oil Leg

EXECUTIVE SUMMARY

Combining fluid properties and geochemical analyses is an effective way to expand our understanding of reservoir fluids. Geochemical data provide cause-and-effect insights (biodegradation, multiple charge history, etc.) that account for differences in fluid properties. And, combining the two techniques is imperative in determining reservoir continuity.

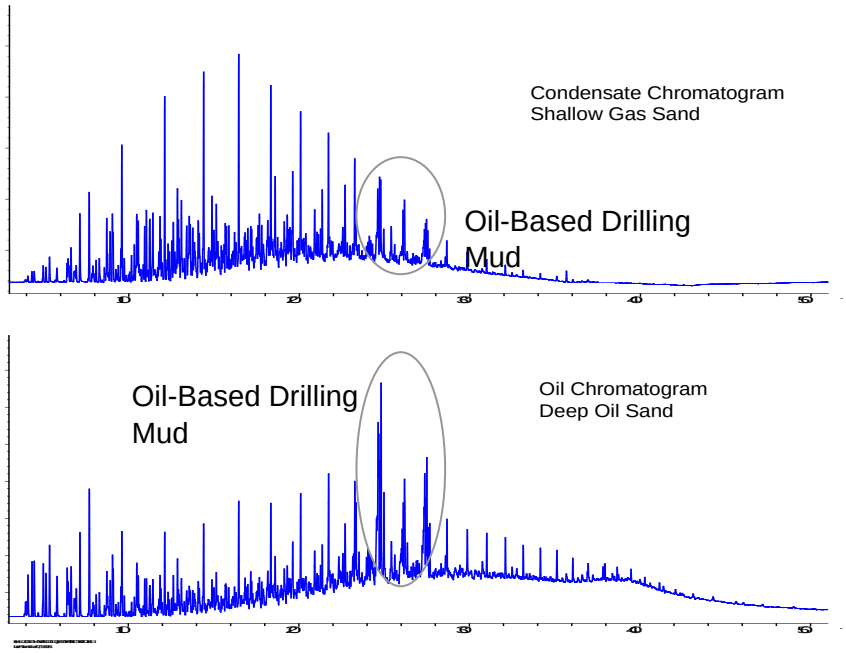

Figure 1. Stock tank condensate and oil liquid GC "fingerprints" with oil-based drilling mud.

OVERVIEW

This case study considered a single well with a shallow gas sand overlying an oil formation. Formation testing confirmed the fluids and noted a gas pressure gradient (of 0.12 psi/ft) above the oil leg (pressure gradient = 0.32 psi/ft). However, a "shaly" section was found between the intervals, so it was not possible to measure intermediate formation pressures and (from their intersection) a possible gas/oil contact.

CHALLENGE

- Determine if the gas condensate and black oil represented a continuous reservoir or two separate accumulations

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"…excellent agreement between the mud-free saturation pressures and the reservoir pressure measured by the formation test tool."

SOLUTION

- Collect formation tester fluid samples from the gas and oil sands
- Undertake pressure-volume-temperature (PVT) and geochemical analyses on live and stock tank fluids
- Integrate the results to look for consistencies in fluid properties, liquid fingerprints, and gas stable carbon isotopes

RESULT

The PVT and geochemical analyses provided strong evidence for a continuous reservoir with a gas cap above an oil leg.

PROJECT DETAILS

Geochemical Analyses

Figure 1 (first page) presents the complete liquid fingerprints (C1 through C36) of the condensate from the shallow gas reservoir and the stock tank oil from the oil leg. Highlighted in the middle of each trace is the oil-based drilling mud. As expected, the condensate has a much higher concentration of light components.

PVT Data

PVT fluid properties (once mathematically decontaminated for drilling mud) and gas isotopes can be used to determine the presence of a gas/oil contact. If in contact, the fluids will be "saturated" with the gas at its dew point pressure and the oil at its corresponding bubble point pressure. Table 2 (below) shows there was excellent agreement between the mud-free saturation pressures and the reservoir pressure measured by the formation test tool (7,635 psia).

Fluid Property	Shallow Gas Sand	Deep Oil Sand
Saturation Pressure (Mud free)	7,600 psia	7,680 psia
Flash Gas C1 carbon isotope	-62.9 ‰	-62.9 ‰
Flash Gas C2 carbon isotope	-32.5 ‰	-32.6 ‰
Flash Gas C3 carbon isotope	-28.2 ‰	-28.4 ‰

Table 1. PVT fluid properties.

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Furthermore, the Methane, Ethane, and Propane carbon isotopes measured on the different atmospheric flash gases were nearly identical.

CONCLUSION

The fluid properties and stable carbon isotopes confirm communication between the fluids and that the system exists as a single reservoir.

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