CASE STUDY

Geochemical Analyses Integrated with PVT Data Confirm Reservoir Continuity

EXECUTIVE SUMMARY

Combining engineering 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.

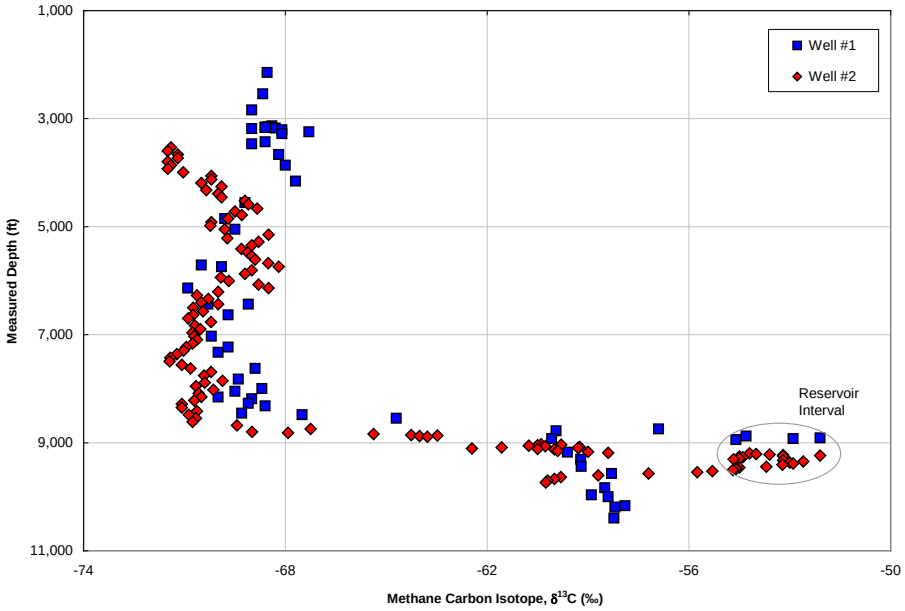

Figure 1. Mud-gas Methane Carbon isotope logs for two adjacent wells.

OVERVIEW

After discovering a promising reservoir in Well #1, including the acquisition of fluid samples with formation test tools, Well #2 was drilled and then surface well-tested. Seismic data suggested the wells likely penetrated a consistent sand body, but possible faulting was noted. Formation pressure gradients were similar, and it was expected that geochemical and pressure-volume-temperature (PVT) data could be used to confirm reservoir connectivity.

CHALLENGE

- Combine traditional engineering techniques with geochemical analyses to provide a more in-depth evaluation of the reservoir
- Evaluate reservoir continuity between two nearby wells

SOLUTION

- Acquire mud gases and PVT samples from each well
- Conduct full fluid analytical program, including gas isotopes, stock tank oil liquid “fingerprints,” and reservoir fluid PVT studies

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"…excellent reproducibility in the gas isotopes around the reservoir interval, suggesting likely communication between the two wells."

RESULT

Confirmed reservoir continuity between Well #1 and Well #2 based on the integration of geochemical and PVT data, including the incorporation of downhole pressure gradients.

PROJECT DETAILS

Geochemical Analyses

Figure 1 (first page) shows a measured depth log plot of Methane Carbon isotopes from mud gas samples collected while drilling. Much of the background data down to approximately 8,500 ft MD is biogenic gas (nearly pure Methane). However, there is a rapid transition to high concentrations of thermogenic gas just above 9,000 ft MD. From this point, although slightly depth shifted, there is excellent reproducibility in the gas isotopes around the reservoir interval, suggesting likely communication between the two wells.

Figure 2 (below) presents two stock tank liquid fingerprints from Gas Chromatographic (GC) analyses. Selected components have been identified on the figure (roughly between C6 and C8). This range was selected because the drilling mud contamination in Well #1 is in the C12+ range. Since there are no noticeable differences in the traces, there is further strong evidence for reservoir continuity.

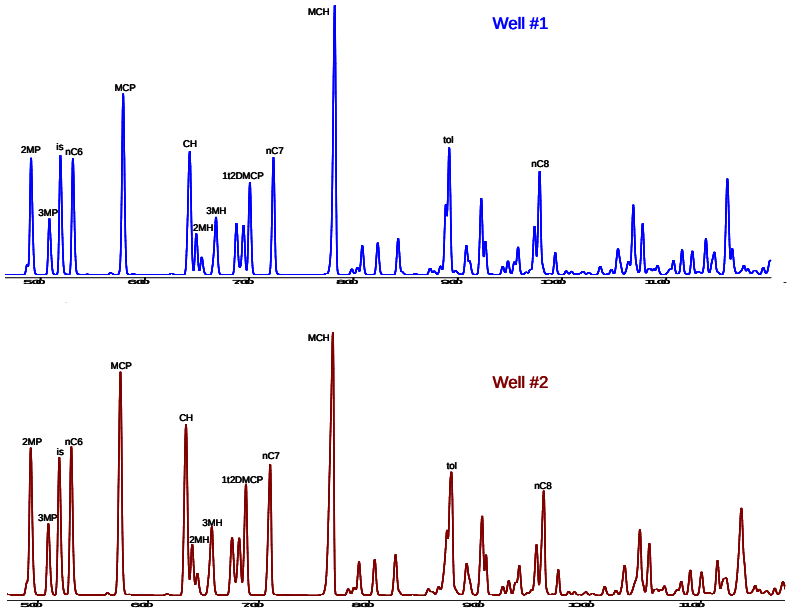

Figure 2. Stock tank oil liquid GC fingerprints demonstrating reservoir connectivity.

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PVT Data

In addition to the geochemical evaluations, PVT data were used to confirm fluid continuity. Since the formation tester samples in Well #1 were contaminated with drilling fluid, the fluid properties were mathematically decontaminated. The PVT fluid properties (Table 1) included Methane, Ethane, and Propane Carbon gas isotope values, measured on the PVT "flash" gases obtained during the study. Not only are the PVT and gas analyses very consistent, the gas isotopes closely match the original values from the mud gas samples collected while drilling.

Fluid Property	Well #1 (Oil-based mud free)	Well #2 (Recombined)
PVT Gas Oil Ratio	21,000 scf/stb	21,250 scf/stb
API Gravity	43.7°API	43.7°API
Pressure Gradient	0.129 psi/ft	0.130 psi/ft
Flash Gas C1 Carbon isotope	-52.2 ‰	-52.3 ‰
Flash Gas C2 Carbon isotope	-33.1 ‰	-33.0 ‰
Flash Gas C3 Carbon isotope	-32.5 ‰	-32.7 ‰

Table 1. PVT fluid properties.

CONCLUSION

Based on the complete set of data (pressure gradients, mud gas isotopes, liquid fingerprints, PVT properties, and flash gas isotopes), reservoir continuity is confirmed between Well #1 and Well #2.

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