# CASE STUDY

## Estimating GOR and Other Fluid Properties from Pressure Gradients and Geochemical Analyses


### EXECUTIVE SUMMARY

Pressure gradients are useful indicators of in-situ reservoir fluid density and, correspondingly, fluid type. Combined with an understanding of the geochemical nature from stable carbon gas isotopes collected while drilling, early predictions of reservoir fluid properties can be made.


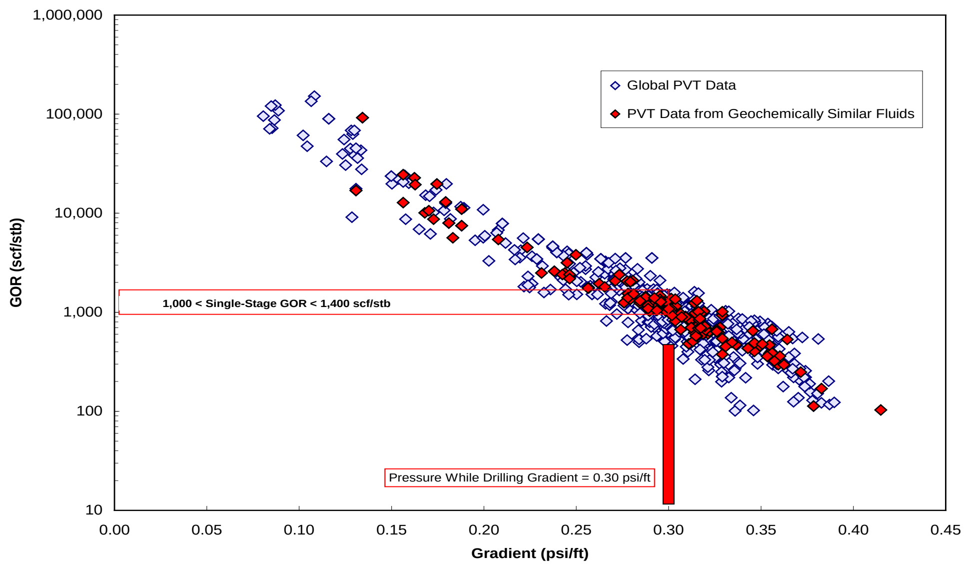


*FIGURE 1. PRESSURE GRADIENT VS. GOR DATA FROM A GLOBAL PVT / GEOCHEMISTRY DATABASE.*

### OVERVIEW

This case study demonstrates an integration of geochemical and downhole pressure gradients. In this example, fluid samples were not successfully collected and a well test was not conducted to obtain surface samples. The only available information was pressure data and mud gas samples collected while drilling. Analysis of those values was integrated with our large pressure-volume-temperature (PVT) and geochemical databases for estimating PVT properties—until actual samples could be collected in later wells.

### CHALLENGE

- Lack of formation tester fluid samples
- No well test to obtain surface samples

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## SOLUTION

- Collect pressure data and mud gas samples while drilling
- Use GeoMark's geochemical and PVT database of reports and studies to estimate PVT properties

## RESULT

Pressure gradients and geochemical gas isotope data were combined with GeoMark's PVT database to estimate fluid properties when physical samples were unavailable.

## PROJECT DETAILS

**Geochemical Analyses**

**Pressure Gradient Analysis**
Figure 1 (first page) is a plot of formation pressure gradient against gas oil ratio (GOR), in standard cubic feet per stock tank barrel. Note that pressure gradients in psi/ft can be converted to reservoir fluid density (in g/cc) by dividing by 0.433. The blue data points are from a global database of PVT reports around the world. While somewhat scattered, they follow an expected trend of lower GORs for the fluids with the highest density. The overlying data points are also drawn from PVT studies, but are geochemically and geographically filtered to fluids with similar origins based on classifications from the database. As shown in the figure, with a pressure gradient of 0.30 psi/ft, it is likely that the reservoir fluid GOR will be greater than 1,000 scf/stb and less than 1,400 scf/stb.

**Gas Isotope Analysis**
Figure 2 (below) is an alternative approach to estimating the GOR based solely on gas isotope analyses. This figure shows the relationship between Propane gas carbon isotopes and reservoir fluid GORs for geochemically and geographically similar fluids, again drawn from the database. Specifically, samples with significant "biogenic Methane" have been removed. This additional source of light gas causes GORs to rise, but in this example the mud gases showed no evidence of biogenic gas.

The rise in the GOR values as the isotopes get "more positive" is related to source rock maturity; mature rocks generate lighter and lighter fluids. Therefore, it is possible to estimate GOR (or other PVT properties) based on gas isotope values.



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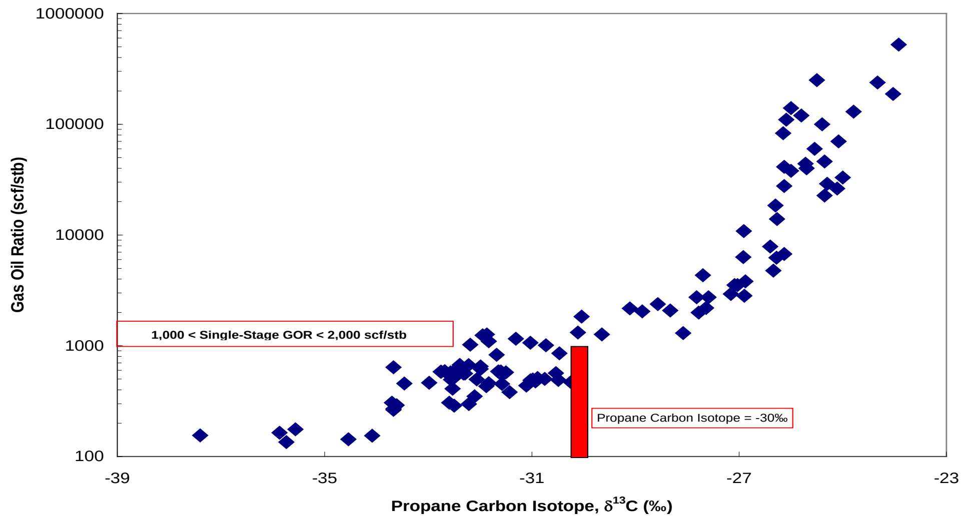


*Figure 2. Gas isotope vs. GOR data from a geochemically filtered global PVT / geochemistry database.*

The Propane carbon isotope value is -30‰, which correlates to a GOR greater than 1,000 scf/stb, corresponding nicely with the prediction based on the pressure gradient.

## CONCLUSION

Fluid properties can be better understood, and even predicted, with an understanding of the geochemical history.

Contact a GeoMark representative for more information.

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