Hydrocarbon Phase Prediction in Unconventional Resource Plays Using Geochemical and PVT Data

Jackie D. Reed[1], Kevin Ferworn[2], Stephen Brown[2], and John Zumberge[2]
[1]Reed Geochemical Consulting, Hilton Head South Carolina
[2]GeoMark Research, Houston Texas

The economic viability of an unconventional resource play can be very dependent on the hydrocarbon phase produced. For example, the lack of robust price support for gas plays in 2010 has made unconventional oil plays become more economically attractive.

Various geochemical parameters from both sediments and fluids can be used to understand and even predict the hydrocarbon phase and associated production levels for any given play. Hydrogen index values, gas composition and gas isotopic values can be used to distinguish wet gas and gas condensate plays from dry gas plays and suggest gas BTU values. Additionally, the integration of geochemical and PVT data is an especially useful tool for determining the likely phase in a play where the possibility of oil exists

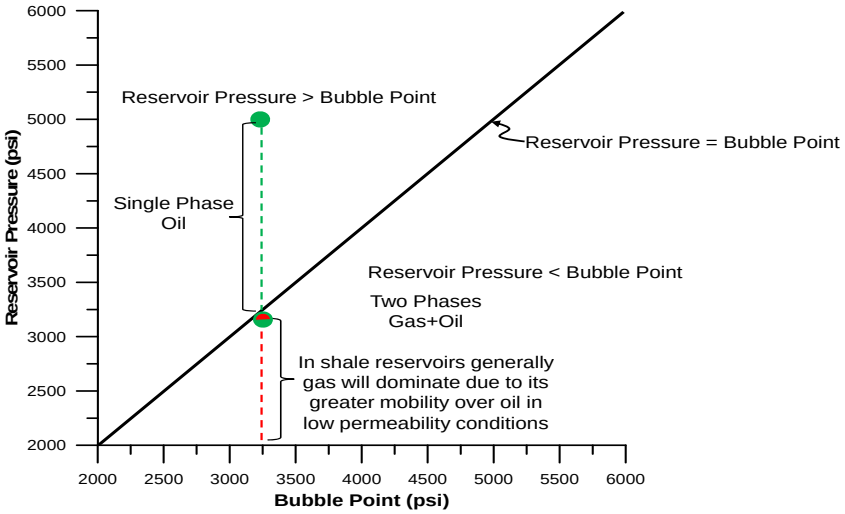

Figure 1:

The gas oil ratio (GOR) and bubble point of oil is controlled by the type of source organic matter and its maturity. The more mature the shale in a resource play, the higher will be the GOR and bubble point of the oil it generates. The control on hydrocarbon phase during production is a function of the bubble point of the oil and the reservoir pressure. If the pressure in the shale reservoir is greater than the bubble point of the oil, the production will be single phase oil (Figure 1).

In shale at peak oil window level maturity, the GOR will likely be in the range of 600 - 1,500 scf/stb depending on the type of source organic matter. If reservoir pressure is not maintained and it drops below the bubble point, both oil and gas will form. However, in low permeability shale reservoirs gas is generally favored due to its much greater mobility over oil in those conditions. At that point, the GOR

from well that was, for example, 800 scf/stb will go up significantly and rapidly, often to values >20,000 scf/stb (see Figure 2).

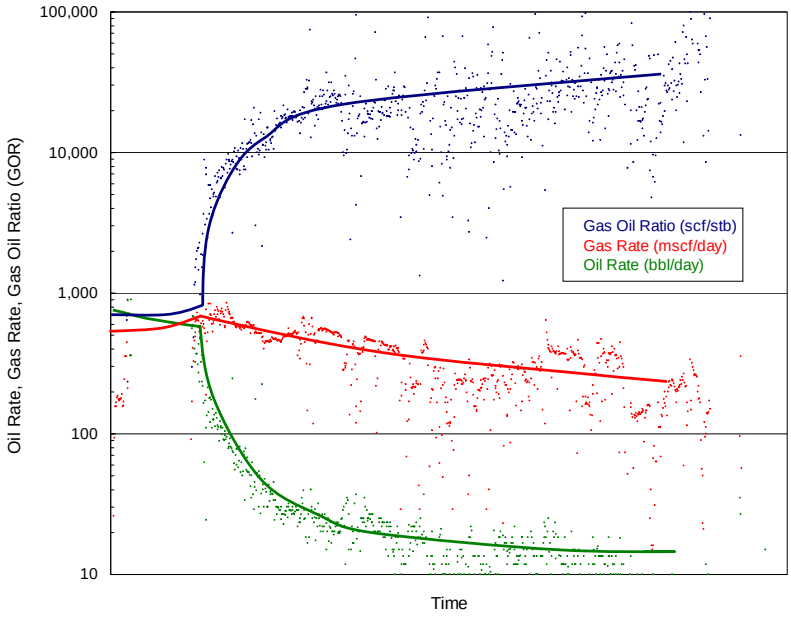

Figure 2

Phase prediction using geochemical parameters will be shown for different conditions using examples from the Marcellus, Haynesville and Eagle Ford plays for comparison. We will show that these predictions compared favorably to regional production results.

Because of the vast number of wells drilled in resource plays PVT measurements are not commonly used to understand and predict future well PVT properties (GOR, FVF, API etc.). However, utilizing a large database of geochemical and PVT data, we will show that the more commonly collected geochemical data can be used to accurately predict PVT properties such as thermogenic GOR.