OOIP Utilizing GEOCHEM [ECS] Data, Triple Combo Data Only, and Pyrolysis S1 Data, Permian Wolfcamp "A" and "B" Shales, Midland Basin, Texas*

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Abstract

As a result of a very complete data set including Pyrolysis S1 data over an interval of 8035ft to 8497ft at 5ft intervals on a Wolfcamp well in the Midland Basin of Texas enabled the author an opportunity to compare different methods of calculating Oil in Place. The first OOIPstb calculation was done using only resistivity (AIT90), bulk density (ρb), and neutron porosity (ϕnls) data with TOC determined by the Schmoker Equation. The volume of clay (Vcl), volume of quartz (Vqtz), and total porosity (ϕtotal) were determined by the Simultaneous Equation Method developed by Rick Lewis with Schlumberger. Effective porosity (ϕe) was calculated as ϕe = ϕtotal – (Vcl*ϕclay). Using a permeability cut-off of ka > 100nD {ka = [(0.0108*ϕoil) – 0.000256]*10^6} the OOIPstb/160 acres over for the Wolfcamp "A" is 3.4mmbo and 7.5mmbo [no cutoff]. The Wolfcamp "B" is 2.7mmbo [ka > 100nD] and 10.8mmbo [no cutoff].

The next OOIPstb calculation was done using AIT90, ρb, and ϕnls data along with GEOCHEM [ECS] data. TOC was determined by the Schmoker Equation. The ϕtotal was determined with a variable matrix analysis using Vqtz, Vcalcite, Vkerogen, Vcl, and Vpyrite. Effective porosity (ϕe) was calculated as ϕe = ϕtotal – (Vcl*ϕclay). Using a permeability cut-off of ka > 100nD {ka = [(0.0108*ϕoil) – 0.000256]*10^6} the OOIPstb/160 acres over for the Wolfcamp "A" is 4.6mmbo and 8.4mmbo [no cutoff]. The Wolfcamp "B" is 3.2mmbo [ka > 100nD] and 10.7mmbo [no cutoff].

The third method to determine Oil in Place was based on the method outlined by Downey el al. (2011) using Pyrolysis S1 data. The equation used is listed below:

$$\text{Oil in Place/160acres} = \Sigma[1241.34*\rho b*S1*(1/\rho oil)*0.5']$$

Using the above OOIP equation with S1 values calculated from the TOClab Pyrolysis S1 Transform illustrated above, the calculated Oil in Place/160acres are Wolfcamp "A" 5.6mmbo [no cutoff] and 2.9mmbo [ϕe > 4% cutoff], and for the Wolfcamp "B" 9.6mmbo [no cutoff] and 3.5mmbo [ϕe>4% cutoff].

The general agreement of OOIPstb determined from Triple Combo/GEOCHEM [ECS] and Triple Combo only with Oil in Place from Pyrolysis S1 data suggest that the use of a permeability cut-off of ka > 100nD and ϕe > 4% may have validity in establishing a net pay cut-offs for the Wolfcamp. In addition, the OOIPstb values calculated with only the Triple Combo data [AIT90, ρb, and ϕnls] gave reasonable values [6.1mmbo] versus [7.8mmbo] using GEOCHEM [ECS] data is important, because a great many wells have only Triple Combo data.

The calculation of OOIP using Pyrolysis S1 data has the advantage in that values for formation water resistivity (Rw), porosity (ϕ), tortuosity factor (a), cementation exponent (m), and saturation exponent (n) are not required.