Using Compositional Gas Data for Horizontal Drilling and Practical Detection of Natural Gas Liquids (NGL)

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Summary

The oil and gas industry has seen a rapid increase in horizontal drilling and the corresponding need for reliable formation data to make steering decisions. Additionally, finding Natural Gas Liquids (NGLs) and properly completing a well have become more critical to making a gas well economical. These processes become easier when compositional gas data is available.

Introduction

Total gas detectors commonly used in Canada provide a real-time gas trace, but fail to provide compositional information of the hydrocarbons in the formation. This compositional information can be useful when making drilling and completion decisions. Gas chromatographs provide an accurate composition, but are limited in that they require additional technical staff onsite and have a very low data frequency. Due to the associated costs, the use of Gas Chromatographs has virtually disappeared from use in Canada. Curiously, they are still widely used in the US.

A revolutionary new technology utilizing tunable filter spectroscopy allows the collection of real-time, accurate compositional gas data without additional technicians on location. This technology enables the development of instruments that deliver the best of both worlds; real time compositional gas data in a rugged unmanned solution. This eliminates the need for complicated, expensive and temperamental gas chromatographs, while replacing the total gas detectors that are currently the industry standard.

Theory and/or Method

Through the use of tunable filter spectroscopy compositional data is collected. The gas readings are broken down into individual concentrations of methane, ethane, propane, n-butane, i-butane, n-pentane, i-pentane, o-pentane and CO2. This data is available at 1 second intervals, a remarkably higher frequency than gas chromatographs are able to provide.

The compositional data collected with this technology forms the basis for plots of the wetness, balance, and character ratios. These ratios are critical geological indicators used to define the oil/gas and oil/water contact points and detect the presence of natural gas liquids in the formation. Additionally this data can be used to infer geological properties of the formation being drilled and thus make better steering, drilling, and completion decisions.

The following figure shows how to calculate wetness and balance ratios using compositional gas data.

$$\text{Wetness Ratio} = \frac{(C2 + C3 + C4 + C5)}{(C1 + C2 + C3 + C4 + C5)} \times 100$$

$$\text{Balance Ratio} = \frac{(C1 + C2)}{(C3 + C4 + C5)}$$

Figure 1: Calculating Balance and Wetness Ratios.

The following figure shows how to interpret balance and wetness ratios and use them to predict reservoir fluids and production potentials.

Balance Ratio	Wetness Ratio	Reservoir Fluid / Production Potential
> 100		Very Light, Dry Gas. Typically non-associated and non-productive such as the occurrence of high pressured methane, metagenic cracking below the oil window, bacterial methane, etc
< 100	< 0.5	Possible production of light, dry gas
Wetness < Balance < 100	0.5 - 17.5	Productive gas, increasing in wetness as the curves are closer together
< Wetness	0.5 - 17.5	Productive, very wet gas or condensate or high gravity oil with high GOR (Balance < Wetness indicates liquid, but Wetness still indicates gas)
< Wetness	17.5 - 40	Productive oil with decreasing gravity as the curve separation increases
<< Wetness	17.5 - 40	Lower production potential of low gravity, low gas saturation oil
	> 40	Very low gravity or residual oil

Figure 2: Interpreting Balance and Wetness Ratios.

Examples

The chart below shows how compositional gas data can be used to detect natural gas liquids in a formation and how it could aid in completion decisions. In the example below 3 zones are shown with relatively high total gas concentrations. Only the zone in the middle (20-40) shows promise for producing NGLs.

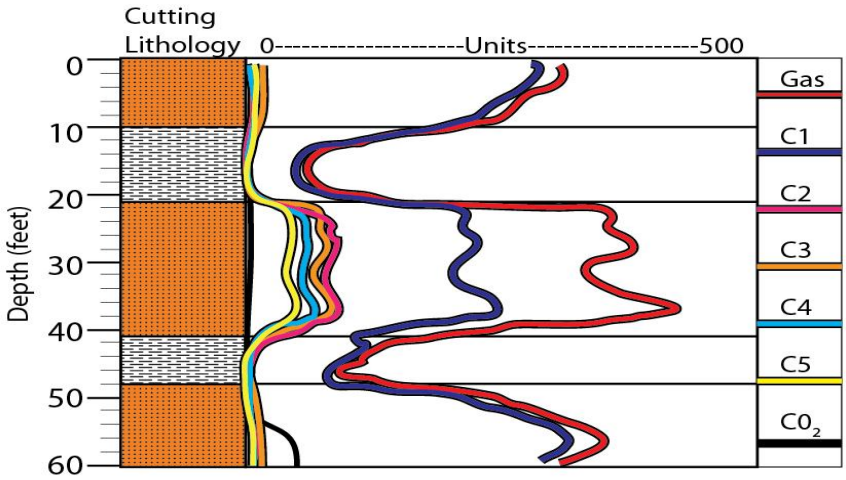

Figure 3: Using Compositional Gas Data to Detect Natural Gas Liquids (NGLs).

The chart below shows an example of how wetness and balance ratios can be used to infer fluid contact points and to make informed steering decisions.

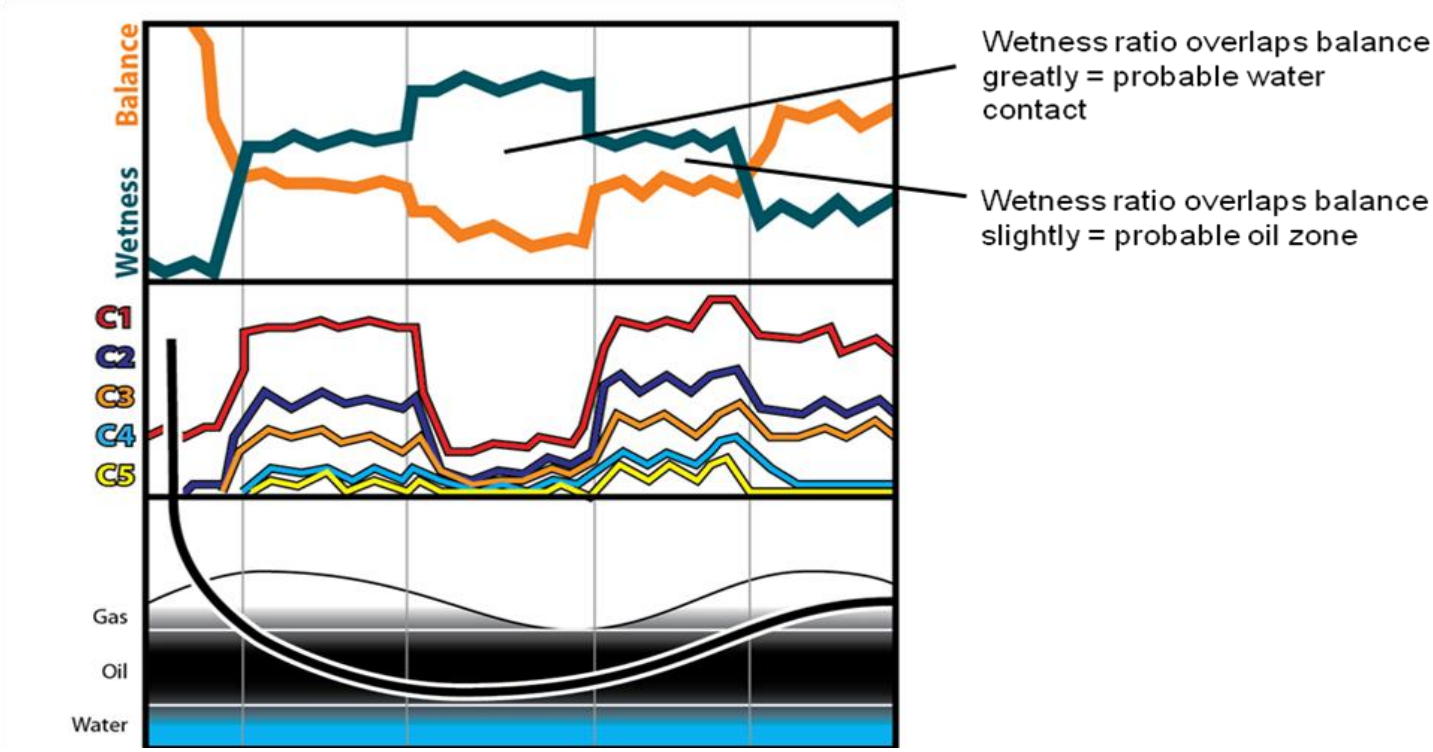

Figure 4: Using Wetness and Balance ratios for geo-steering applications.

Conclusions

The use of compositional gas data in the drilling industry can be a very useful and profitable tool. Gas Chromatographs, while supplying this data, can be prohibitive due to cost, complexity, and need for on site technicians. Tunable filter spectroscopy is a viable technology for the drilling environment that enables the measurement of compositional gas data at a much higher rate than is offered by a gas chromatograph. Instruments utilizing tunable filter spectroscopy can be used to replace traditional total gas detectors as well as gas chromatographs while remaining economical unmanned solutions.