Integration
geoscience
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geoConvention 2013

Using Continuous Real-Time Compositional Gas Data for Horizontal Drilling and Detection of Natural Gas Liquids (NGL)

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 well economical. These processes become easier when compositional gas data is available.

Introduction

Knowing whether a well bore is a zone containing Natural Gas Liquids or Dry Gas is very important to type of hydrocarbons that will be produced. Horizontal wells can be kept in the Liquids zone by steering the well bore vertically.

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.

Theory

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.

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, and CO2. This data is available at 1 second intervals, a remarkably higher frequency than gas chromatographs are able to provide.

Examples

Twelve horizontal wells drilled in the Niobrara “B” section in the Wattenberg field of eastern Colorado were compared. The production data for the first few months will be compared to the compositional gas data collected during drilling. Horizontal plots displaying the calculate wetness and balance ratios show the zones of oil production. The wetness and balance ratios show which zones have higher oil concentrations and how faults effect these concentrations.

Well	Average wetness	avarage first 5 month oil	avarage first 5 month gas	avarage five 5 month water	avarage first 5 month gas/oil	in zone %	Avg. Fm. Dip	Avg. Wellbore Angle	Structure
A	43.0	4338.8	13436.4	2526.0	3.5	57	90.04	90.03	minor folds
B	50.5	5505.2	8666.8	3204.1	1.7	62	89.56	90.02	Faults, folds
C	40.2	3964.1	8699.2	1783.9	2.5	10	90.23	91.04	Major faulting
D	44.9	3232.0	7782.8	823.8	2.7	29	89.4	89.96	Major faulting, some folding
E	46.3	6261.4	13594.3	955.9	2.5	50	89.4	90.19	Faults, folds
F	38.7	5984.1	12413.5	3043.9	2.3	81	89.7	90.03	Minor faulting
G	47.0	5202.8	11391.9	2223.1	2.4	87	89.74	89.95	Minor faults/folds
H	39.1	6638.4	20879.4	2194.4	3.7	71	90.34	89.98	Many small faults
I	33.3	5938.0	18816.9	3336.4	3.7	70	90.34	90.53	Minor faults/folds
J	36.9	8408.6	30107.4	2612.8	3.8	60	89.58	89.88	Faults, folds
K	44.5	7141.0	13982.2	2537.6	2.2	77	89.67	89.94	One major fault
L	42.5	7220.4	10833.3	3684.1	1.6	60	90.4	91.29	Minor folding

Figure 1: Production data compared to compositional gas data.

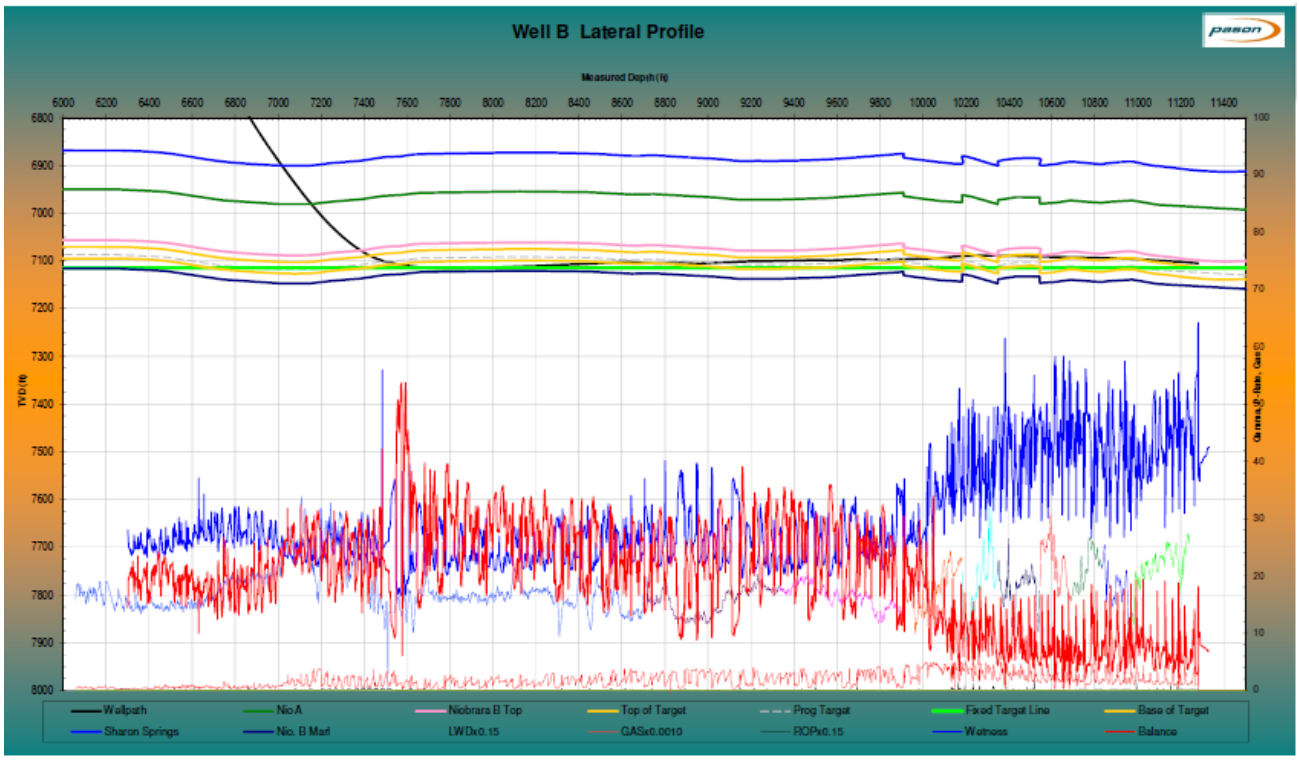

Figure 2: Horizontal well profile showing wetness and balance ratios.

Conclusions

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.

Acknowledgements

I would like to thank PDC Energy for the use of the well data.