STATE OF ALASKA
DEPARTMENT OF NATURAL RESOURCES

Alaska Geologic Materials Center

Data Report #429

Canrig Drilling Technology Ltd. 2014, Quantitative Fluorescence Technology – Dual Wavelength (QFT2) analysis of cuttings from the Sterling Unit #23-15 well

Received Jan 2014

CANRIG
Drilling Technology Ltd.

QFT Report

Sterling Unit 23-15

Kenai Borough – Cook Inlet, Alaska

07/29/2012

Cell (337) 380-5298
Office (337) 364-3603

Compiled by: Geoff Davison

Table Of Contents

2. Introduction and Scope of Work.

Canrig Drilling Technology, Ltd, Gulf Coast Division was commissioned by Sarah Rittenhouse of Hilcorp to run a Texaco patented QFT2 (Quantative Fluorescence Technology – Dual Wavelength) analysis of selected samples from the Sterling Unit 23-15 well (API# 50133100120000) that was drilled in the Sterling Unit of the Kenai Peninsula, Alaska.

The Sterling Unit 23-15 well was drilled in 1961 by the Marathon Oil Company. According to the State archive data, it appears that the 9 7/8" hole was drilled from 12988' to 14832' where the hole was logged and plugged back to circa 8400'.

The following is a list of the samples that were to be analyzed:

Sterling Unit 23-15 w cuttings, QFT2 analyses for the interval 13020' to 14830' with a 30' sample interval..(Total 61 Samples)

These samples were sent from the Sarah Rittenhouse (Hilcorp) via FedEX and arrived intact within 3 days of shipment.

.

3. Well Data Availability.

I was able to access the Public Data and LAS E-Log Data for the well online from the Alaska Oil And Gas Conservation Commission and these documents and logs gave me a clearer insight into the drilling of the well. They will be referenced to in this document.

Copies of these documents are appended to the end of this report.

4. Sample Condition and Discussion

The apparently unwashed samples came in individual brown sample envelopes.

The samples themselves were totally dehydrated and generally had a moderately crumbly consistence

Also referencing the wireline log header the section of interest was drilled with a "NAT Clay" mud system.

5. Analysis Methodology

Cell (337) 380-5298
Office (337) 364-3603

All the samples were processed using the technique prescribed by Texaco using Isopropyl Alcohol as the solvent and new filters each time.

No attempt was made to rehydrate the samples prior to the adding of the alcohol, they were just lightly crushed.

6. Sterling Unit 23-15 Data and Plots

Basic Well Data.

Over the zone of interest that was analyses, the following is the basic data as gleaned from the Alaska Oil And Gas Commission.

Well	Sterling Unit 23-15
Start Depth	221'
End Depth	14832'
Field	Sterling Unit
Location	Sec 15, T5N, R10W SM,2715' FNL, 1520' FWL
County.	Kenai
State	Alaska
Country	US
API#	50133100120000
Elevation	221' KB

Wireline Logs

Logged	07/07/1961
To Depth	14638'
Mud Type	"NAT CLAY"
Hole Size	9 7/8"

Logged	07/11/1961
To Depth	14832'
Mud Type	"NAT CLAY"
Hole Size	9 7/8"

05/29/2012
Cell (337) 380-5298
Office (337) 364-3603
Compiled by: Geoff Davison

QFT Data Results –

Depth	Wt%Oil	API
13030	0.022	41
13060	0.028	43
13090	0.028	45
13120	0.036	45
13150	0.037	47
13180	0.027	43
13210	0.033	39
13240	0.076	46
13270	0.048	48
13300	0.038	48
13330	0.043	49
13360	0.036	48
13390	0.034	43
13420	0.055	44
13450	0.031	45
13480	0.032	46
13510	0.029	46
13540	0.035	46
13570	0.055	46
13600	0.035	44
13630	0.042	49
13660	0.044	41
13690	0.044	45
13720	0.039	43
13750	0.033	46
13780	0.048	47
13810	0.037	45
13840	0.029	45
13870	0.032	47
13900	0.023	46
13930	0.021	46
13960	0.027	48
13990	0.024	46
14020	0.06	50
14050	0.033	49
14080	0.031	46
14110	0.029	47
14140	0.04	46
14170	0.034	50
14200	0.03	49

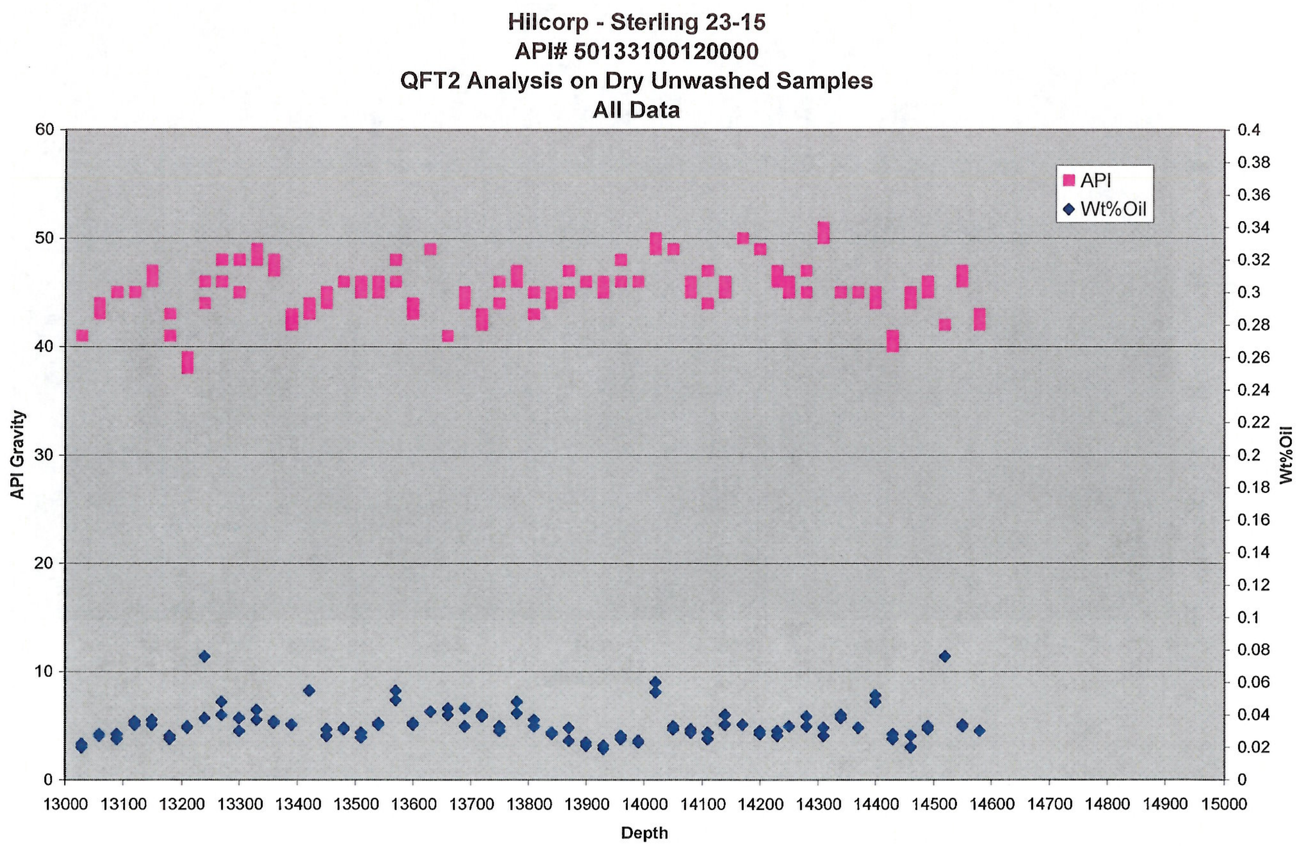
Cell (337) 380-5298
Office (337) 364-3603
Compiled by: Geoff Davison

Depth	Wt%Oil	API
14230	0.03	47
14250	0.033	46
14280	0.039	47
14310	0.032	51
14340	0.04	45
14370	0.032	45
14400	0.052	44
14430	0.028	41
14460	0.027	45
14490	0.033	46
14520	0.076	42
14550	0.034	46
14580	0.03	43
14620	0.03	40
14640	0.025	42
14680	0.038	48
14710	0.035	44
14740	0.031	38
14770	0.033	44
14800	0.029	44
14830	0.033	41

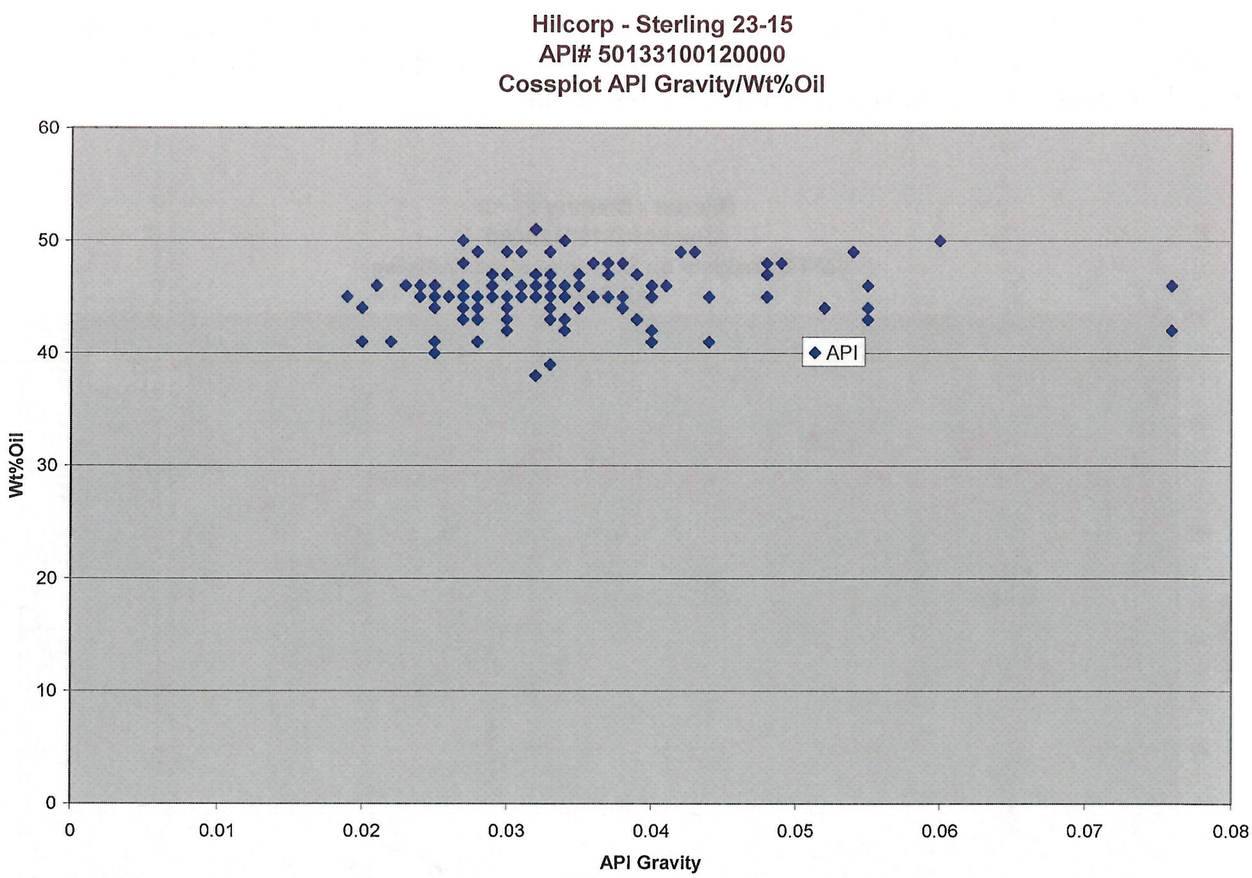
Cell (337) 380-5298
Office (337) 364-3603

Data QA

As a matter of routine I prepared 2 samples of each sample where material was available. the second prepared sample was run as a cross check and did frequent recalibrations of the machine as another cross check.



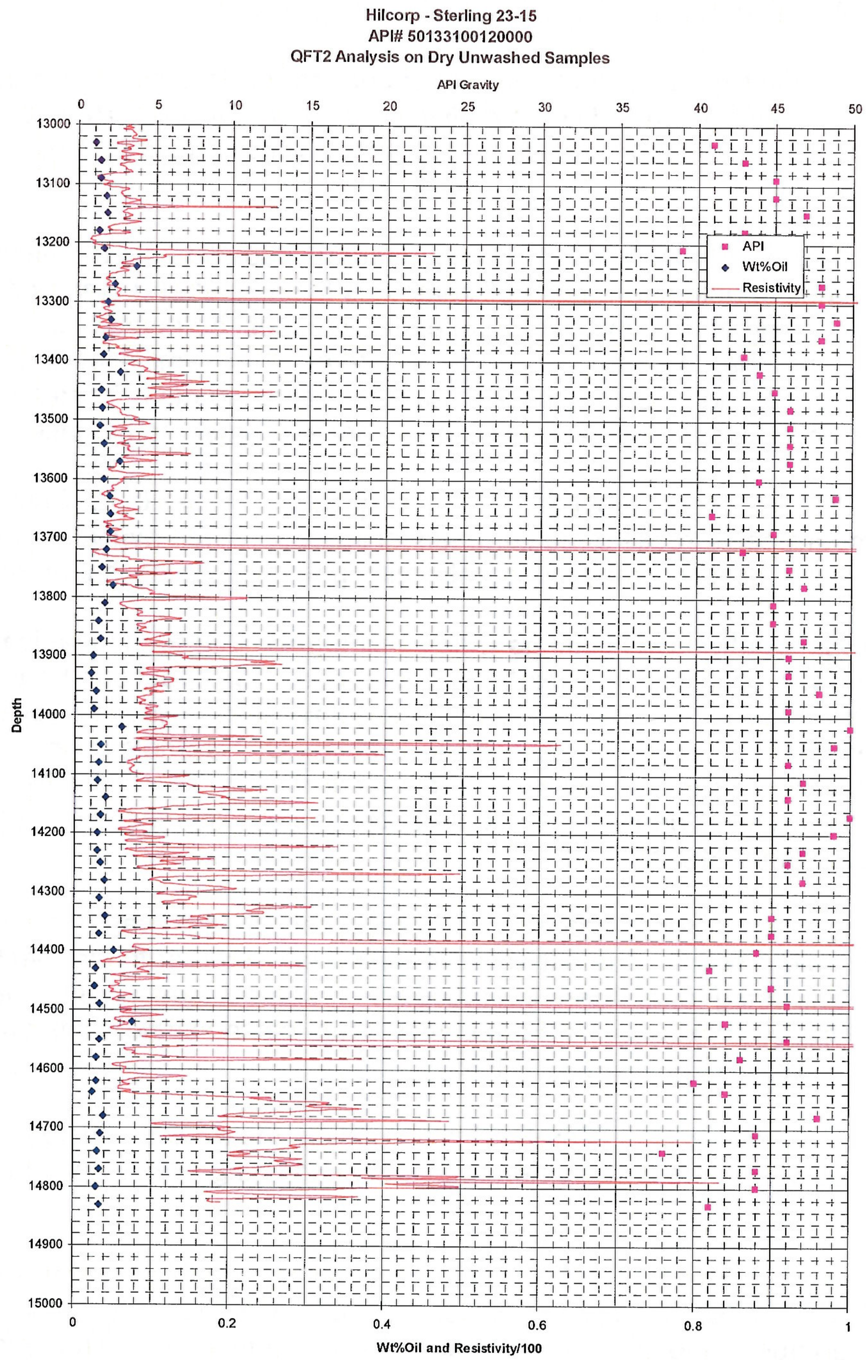
Cell (337) 380-5298
Office (337) 364-3603



05/29/2012
Cell (337) 380-5298
Office (337) 364-3603

Compiled by: Geoff Davison

Data Plots



05/29/2012

Cell (337) 380-5298
Office (337) 364-3603

Compiled by: Geoff Davison

Appendix A - Factors Affecting QFT2 Analysis

The ideal QFT sample would consist of uncontaminated cuttings from a well defined depth interval which still contain all in-place hydrocarbons. Real world samples, unfortunately, are subjected to numerous processes which affect QET oil extraction and measurement.

Formation Flushing: One of the most serious impediments to relating QFT oil content estimates to actual formation oil content is flushing ahead of the bit due to overbalanced drilling and bit hydraulics. In extreme cases, detected hydrocarbons may actually decrease when a porous pay zone is entered (for example when the lithology changes from oily shale to loosely packed sand). Evaluation of QFT readings should always take into consideration sample permeability and pressure balance.

In general, cuttings should be only lightly ground in order to minimize extraction of oil from impermeable rocks of no commercial interest. When available, e-logs having deep and shallow resistivity may aid in determining when flushing is important.

Cuttings Quality: Drill cuttings which disintegrate due to mechanical weakness or to bit action will lose their hydrocarbons to the mud. This effect can be pronounced for un-cemented sands and when PDC bits are employed (generating "rock flour'). In order to retain as much oil as possible in the cuttings, QFT samples should be washed only lightly if at all prior to spin drying. For the same mason, samples collected for possible laboratory QFT analysis should be subjected to minimal handling (wet, unwashed usually preferred).

Borehole Washout: Collected cuttings normally contain variable amounts of rock from up-hole intervals, due either to sloughing formation or to the mechanical action of the drill string (stabilizers in particular). In some cases it will be clear that certain rock types are extraneous (for instance when caving shale chips are present) and these may avoided by hand selection

Most often, however, it is preferable to analyze the entire collected sample and to note on the log when hole enlargement may be contributing significantly to the QFT readings

Sample Collection: The QFT Log, obviously, can have no better depth resolution than the collection depth interval. As a practical matter, usually a 30 ft or 1Dm interval is used due to the labor and time involved in running QFT. The logger should

Cell (337) 380-5298
Office (337) 364-3603

take care that the QFT sample is representative of the entire interval rather than just the ending depth. This may require combining more frequently captured visual examination samples.

When drilling zones of interest, QFT should be run at more frequent intervals when possible (such as every 10 ft) to improve log resolution. Samples should also be caught during strong gas shows as an aid in interpreting both the gas and QFT readings.

Mud System Contaminants and Additives: At job start the logger should visit the drill floor and mud engineer's area to determine what types of organic compounds may end up in the mud system. If possible, samples should be obtained and QFT analyses made to determine what, if any, effect these compounds may have. In general, whenever a QFT increase is seen without an accompanying gas increase, the possibility of fluorescence from the mud system should he considered. The suction pit mud may be monitored for background fluorescence by analyzing 0.5 ml mud samples using QET (IPA solvent if wet, heptane if dried).

The most common mud contaminant, particularly after trips, is pipe dope. The presence of pipe dope is usually signaled by an isolated spike in the QFT readings with no corresponding gas peak. The estimated API gravity for the increase will be high (about 50). Figure 14 gives an example of how QFF2 responds to various levels of pipe dope. (This particular sample was obtained from an offshore well; in general, pipe dopes will vary in their specific formulation and fluorescence.) Pipe dope contamination is to some extent an avoidable problem; the rig floor crew should be made aware that its presence in the mud system can result in false QFT shows.

Asphaltic additives, such as "Soltex1" or "Black Magic~', also give false shows, in this case of low apparent API gravity. IPA extracts will give considerably less response than heptane extracts due to limited solubility of asphaltic's in IPA (see example, Figure 15). In some cases, asphaltic additives are visible under the microscope and the sample can be cleaned up by hand. Finally, bulk addition of fluorescing hydrocarbons such as these! or crude oil to the mud will create major problems for QFT (see Figure 16 for diesel example). If at all possible, this practice should be avoided.

Coal Beds and Non-Producible Asphalt: Non-producible formation hydrocarbons contain soluble aromatics and will give QFT shows. The QFT response for coal is variable in both estimated oil quantity and gravity depending on. the coal maturity. Formation asphalt gives much the same QFT response as asphaltic mud additives (low estimated API gravity, greater heptane solubility). Usually visual examination of the sample will serve to detect these sources of QFT interference.

Cell (337) 380-5298
Office (337) 364-3603

Detection of coal is often accompanied by dry gas (predominantly methane) whereas formation asphalt may have little or no associated gas.

Loss of Volatile Hydrocarbons: While most fluorescing aromatics are of relatively low volatility, excessive drying time and temperature will result in loss of the lighter components. This is particularly true for condensates where the majority of the aromatics are small single ring compounds. To minimize losses, the QFIT dry sample process using heptane solvent specifies air drying rather than heat lamp or oven drying. When very light oils are of interest, the wet WA extraction is preferred since the drying step is avoided altogether.

QFT can be usefully employed in after-the-fact analysis of dry samples which have stored many years. The analyst must, however, be aware that many light components have been lost and the APT gravity estimates will in all probability be low for light oil zones.

Oil Base Mud: The use of oil base mud severely limits the ability of QFI to unambiguously detect cuttings hydrocarbons. Even though modem synthetic base mud's have low fluorescence when newly prepared, the mud base oil acts much like the QFT extraction solvent. As cuttings are circulated out, a process which make several hours, any formation oil present tends to be extracted into the mud, particularly for permeable cuttings of commercial interest. Since the fluorescing components are of generally low volatility, they remain in the mud system and are re-circulated thus causing a gradual rise in QFT background. Once the mud becomes contaminated, distinguishing the source of QFT readings becomes problematical. Apparent QFT shows are often due to increases in sample porosity or mud retention rather than actual cuttings hydrocarbons.

In summary, to effectively use QFT2 the logger and log analyst must be aware of the numerous factors affecting the reported results. Many of these factors, particular formation flushing and cuttings quality, are outside of the logger's control. The log should contain sufficient annotation to aid follow-up interpretation. In particular, mud weights, bit types and cuttings from coring operations should be noted.

The logger can, however, take the drilled intervals. In most grinding will provide the best caving shale. etc. can he remove is not possible, but the goal of any formation oil present in the steps to insure that the samples are as representative as possible of cases simple spin-drying of representative cuttings with minimal samples. In some cases, obvious contaminants such as cement, can be removed by hand. Providing hard and fast rules covering all situations sample preparation is to retain to the maximum degree possible cuttings while avoiding extraneous sources of fluorescence.

Cell (337) 380-5298
Office (337) 364-3603

Appendix B - State Archives Over Interval Analyzed.

Union Oil Company of California, Operator Page 3
Sterling Unit #23-15

(History - Cont.)

DATE 1961	DEPTH	REMARKS
May 11	5198	Drilled 12¼" hole to 4306 and drilled ahead with 11" bits.
May 12	5934	Drilled 11" hole to 5685 and drilled ahead with 10-5/8" bits. Survey 5904-0° 15 min.
May 15	6715	Drilled 10-5/8" hole. Ran Schlumberger E-Log. Run #2.
June 6	11,156	Drilled 10-5/8" hole. Ran Schlumberger E-Log Run #3.
Jne.22	12,988	Drilled 10-5/8" hole to 12,988 and drilled ahead with 9-7/8" bit.
Jly.8	14,638	Drilled 9-7/8" hole. Ran Schlumberger E-Log Run #4.
Jly.11	14,832	Drilled 9-7/8" hole to total depth. Ran Schlumberger E-Log Run #5.
Jly.13	14,832 Plug 8,400'	Pumped in 50 sax Ideal cement at 14,140. 50 sax " " " 13,420; 100 sax " " " 8,767. Drilled out cement from 8349 to 8400 with 9-7/8" bit.
Jly.14	14,832 Plug 8,400	Ran in and cemented new 7" 26# and 32# J-55 and N-80 casing at 8388'. CP at 5510 with 950 sax Ideal cement.
Jly.15		Landed casing and installed tubing head. Reinstalled Shaffer double hydraulic blowout preventer. Tested casing and blowout preventer with 2100# for 20 min.
Jly.17	14,832 Plug 8,250	Drilled out cement and cleaned out to float collar at 8349. Ran Schlumberger Gamma Collar Log. Perforated ten half-inch jets from 8274 to 8276 and squeezed 45 sax to formation at 4,000#. Estimated top of plug 8250.

Jly.20 — 14,832 Plug 2,896

Perf.Depth	No.Sax Squeezed	Final Pressure
6037	45	4100# Max.
6004	66	4800#
5265	27	4800#
5242	120	4500#
3393	67	4500#
3170	65	4400#
2970	52	2000#
2930	279(five stages)	3500#

Cell (337) 380-5298
Office (337) 364-3603