

**FLOW
PROFILER
GAS**



FLOWPROFILER™ Gas is the industry's first comprehensive after-frac flow profile tracer technology that simultaneously evaluates both frac fluid clean-up and natural gas production over time.

Engineered with a comprehensive array of water and gas tracers, FLOWPROFILER™ Gas is specifically designed for multiple stage completions in both vertical and horizontal well applications, providing critical information such as:

- **Simultaneous Zonal Flowback**
 - Quantify Frac Fluid Clean-Up
 - Quantify Gas Contribution
 - Correlate to Production Log Analysis
- **Indexing Gas Production to Geologic Horizons**
- **Evaluating Production Over Time**
- **Well Spacing Issues**
 - Frac Communication with Offset Wells
 - Production Communication with Offset Wells

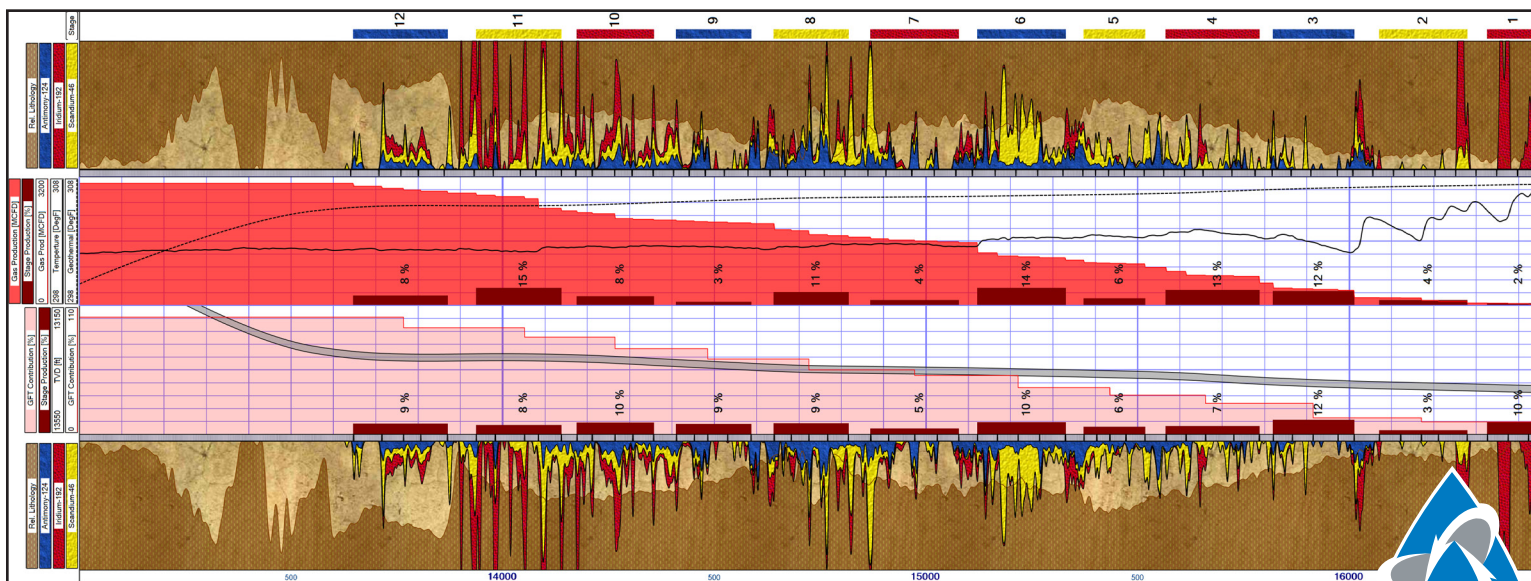
The FLOWPROFILER™ Gas service involves injecting both a unique Chemical Frac Tracer (CFT) in the fluid phase of each frac stage and a unique Gas Frac Tracer (GFT) at the beginning of the proppant segment of each frac stage. Flowback water samples are collected in

accordance with a predetermined sample schedule. Once first gas is experienced, both water and gas phase samples are collected simultaneously and sent to ProTechnics' Chemical Tracer Laboratory for detailed analysis to ensure the most accurate and timely results and reports.

The combined knowledge of both the zonal water and gas profiles provides unique datasets to aid in understanding the total after-frac flow profile for use in evaluating individual well production and for making critical future well decisions.

FLOWPROFILER™ Gas tracers are:

- **Not Naturally Occurring In Reservoir**
- **Chemically Inert in Reservoir Environments**
- **Thermally Stable at Reservoir Temperatures**
- **Gas Soluble**
- **Predictable and Repeatable Analytical Detection**
- **Detectable at Low Concentrations**(low parts per billion, ppb)



The log image above combines the FLOWPROFILER™ Gas and Completion Profiler® results in order to compare the Gas Production (Completion Profiler®, downhole measurement) versus the Gas Tracer Contribution (FLOWPROFILER™ Gas, surface measurement). The comparison illustrates very good agreement for most of the stages and excellent agreement between toe, middle and heel lateral segments. The upper and lower log tracks show the SpectraScan® proppant tracer imaging which exhibits good cluster coverage with poor stage containment



FLOWPROFILER™ Gas - % Contribution

Key	20.0%	16.8%	13.6%	10.4%	7.2%	4.0%	0.1%										
Traced Segment	12	11	10	9	8	7	6	5	4	3	2	1					
Stim Date (2014)	6/26	6/26	6/26	6/26	6/26	6/26	6/26	6/26	6/26	6/26	6/26	6/26					
Formation	Woodbine																
Perforations	13640 - 13862	13932 - 14139	14172 - 14356	14403 - 14580	14631 - 14809	14862 - 15071	15109 - 15324	15370 - 15516	15561 - 15778	15817 - 16009	16055 - 16252	16299 - 16496					
Sample Date	GFT 8100	GFT 8000	GFT 20050	GFT 20040	GFT 20020	GFT 8400	GFT 8200	GFT 8700	GFT 8600	GFT 20030	GFT 20000	GFT 20010					
7/4/2014	6.3	3.7	1.7	12.2	18.9	7.7	13.2	1.9	7.2	16.4	4.7	6.0					
7/4/2014	5.8	4.9	9.1	11.5	17.0	7.4	12.9	1.3	5.6	14.5	2.8	6.9					
7/5/2014	7.4	3.5	12.6	7.0	17.1	6.4	15.9	1.1	5.2	11.0	4.0	8.8					
7/6/2014	7.1	3.9	13.8	7.5	17.2	7.8	13.5	1.2	4.8	9.8	3.4	10.0					
7/7/2014	22.1	7.4	0.8	4.7	10.1	6.6	19.1	3.9	4.5	10.5	3.6	6.6					
7/8/2014	29.7	10.3	9.7	2.7	7.2	4.4	10.8	2.8	4.2	6.5	2.4	9.2					
7/9/2014	5.1	11.2	14.3	3.1	11.9	7.8	15.1	3.3	6.6	12.4	4.0	5.1					
7/10/2014	24.8	18.4	0.8	7.9	6.4	5.6	14.6	4.6	4.3	3.5	5.0	4.1					
7/11/2014	10.6	11.9	12.2	15.2	11.0	3.8	8.9	8.8	6.8	6.4	3.7	0.8					
7/12/2014	8.5	11.5	10.7	13.4	9.6	3.7	8.3	10.5	8.0	7.1	4.6	4.0					
7/14/2014	7.0	8.1	13.4	13.3	9.7	3.5	8.0	8.6	6.8	9.3	2.2	10.0					
7/16/2014	6.5	7.8	10.8	10.6	7.1	5.3	9.0	5.8	5.6	17.1	2.7	11.8					
7/18/2014	6.0	7.7	9.2	9.1	7.2	5.6	9.3	7.5	7.8	12.6	4.7	13.4					
7/20/2014	4.2	6.5	8.9	9.2	9.1	3.6	7.1	11.7	12.9	12.2	3.4	11.3					
7/22/2014	5.1	6.5	11.8	8.0	7.1	2.8	8.9	7.7	9.0	14.4	2.3	16.2					
7/24/2014	3.5	3.6	6.7	4.5	3.6	3.2	7.2	4.9	6.1	29.8	3.6	23.2					
Time Weighted Avg. %	9.1	8.0	9.9	8.8	9.3	4.8	10.4	6.4	7.0	12.4	3.4	10.5					
Trend																	
Segment Hydrocarbon Recovery	10.0	9.6	10.0	10.0	10.0	6.4	10.0	6.3	7.4	10.0	4.1	10.0					

The average of 3.4 in the purple-shaded box shows the smallest % hydrocarbon is coming from this traced segment

The average of 12.4 in the green-shaded box shows the largest % hydrocarbon is coming from this traced segment

Segment Hydrocarbon Recovery is a score of 0-10 based on overall average % contribution. Segment 2 has the lowest score because it has the poorest contribution

Comparison of Gas Tracers and Production Profile Log Results - Stage to Stage												
Traced Segment	12	11	10	9	8	7	6	5	4	3	2	1
GFT Contribution, %	9.1	8.0	9.9	8.8	9.3	4.8	10.4	6.4	7.0	12.4	3.4	10.5
Gas Production, %	8.0	14.5	7.5	3.0	11.0	4.5	14.3	6.0	12.8	12.0	4.4	2.0

Comparison of Gas Tracers and Production Profile Log Results - 3 Lateral Segments									
GFT Contribution, %	35.8			31.0			33.3		
Gas Production, %	33.0			35.8			31.2		

	CFT 2400	CFT 1500	CFT 2100	CFT 1600	CFT 2200	CFT 1900	CFT 2000	CFT 1700	CFT 1300	CFT 1200	CFT 1100	CFT 1000
% @ Last Sample	8.6	10.2	7.3	9.4	8.6	3.5	7.6	12.0	3.4	11.5	9.2	8.7
Time Weighted Avg. %	9.2	11.9	6.7	11.3	8.4	4.6	7.9	12.5	5.2	11.7	5.8	4.8
Trend												
Segment Load Recovery	10.0	10.0	7.9	10.0	10.0	5.4	9.5	10.0	6.6	10.0	6.5	5.0

Segment Load Recovery is a score of 0-10 based on how effectively a traced interval is unloading frac fluid. Segment 7 has the poorest recovery of load fluid and a score of 5.4

To learn more about FlowProfiler™ or any of ProTechnics' other services, go to www.corelab.com/protechnics or give us a call at 713-328-2320.