

# Downhole Fluid Analysis Confirms North Sea Reservoir Connectivity for Statoil

InSitu Fluid Analyzer system accurately characterizes high-purity fluid collected with Quicksilver Probe focused extraction

## CHALLENGE

Collect high-quality fluid samples for real-time characterization of two reservoirs in a North Sea well.

## SOLUTION

Deploy the InSitu Fluid Analyzer\* system for downhole fluid analysis (DFA) of high-purity fluid samples extracted with Quicksilver Probe\* focused extraction.

## RESULTS

Determined fluid composition in both reservoirs in real time, with the accuracy and resolution of the analysis confirmed by subsequent laboratory analysis.



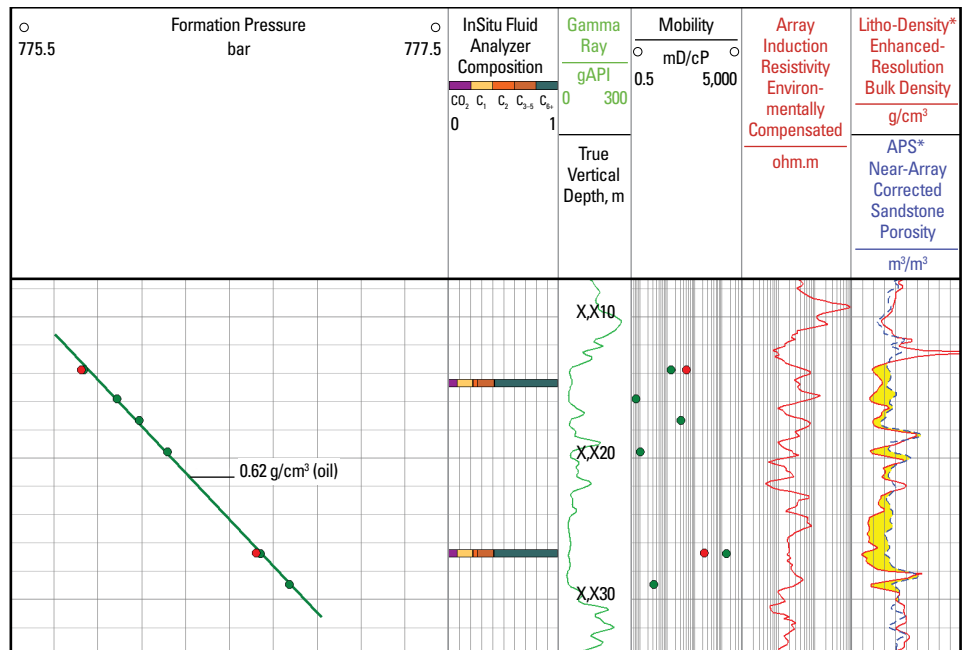
## Two reservoirs to characterize

Statoil required high-quality samples for analysis from an offshore exploration well with an upper reservoir suspected to contain oil and a lower reservoir with gas condensate at the following conditions:

- 2-g/cm<sup>3</sup> oil-base mud
- 45- to 140-bar overbalance
- temperature up to 148 degC
- 50- to 1,500-mD/cP mobility.

Real-time DFA was planned to also determine whether the upper reservoir was accessed by an offset well. If the fluids in both wells were similar, that would be a strong indication of fluid communication. Because light oil was expected, which often displays compositional grading, two DFA stations were planned, one each at the top and bottom of the upper reservoir, to investigate if the composition changes with depth.

No offset data existed for the lower reservoir, so DFA and high-quality sample collection for laboratory analysis were critical. An additional goal for Statoil was assessing the added value of using the InSitu Fluid Analyzer system to conduct DFA.



Data summary for the upper reservoir. Green points were acquired during the pressure survey. Red points indicate sampling stations.

## CASE STUDY: Real-time DFA confirms reservoir connectivity, North Sea

### InSitu Fluid Analyzer and Laboratory Analytical Results

Analysis	True Vertical Depth, m	Stock-Tank Liquid Contamination, <sup>†</sup> wt%	GOR, m <sup>3</sup> /m <sup>3</sup>	C <sub>1</sub> , wt%	C <sub>2</sub> , wt%	C <sub>3-5</sub> , wt%	C <sub>6</sub> , wt%	CO <sub>2</sub>	Density, g/cm <sup>3</sup>			
									InSitu Fluid Analyzer System	Quicksilver Probe Extraction	Pressure-Corrected InSitu Fluid Analyzer System	Pressure-Corrected Quicksilver Probe Extraction
InSitu Fluid Analyzer	X,X14.7	–	521	14.4	4.2	15.3	57.8	8.3	0.592	0.596	0.589	0.596
Laboratory	X,X14.7	0.5	504	15.2	4.8	11.3	59.8	8.6	0.587		0.587	
InSitu Fluid Analyzer	X,X26.8	–	515	14.4	4.2	115.1	58.2	8.2	0.592	0.596	0.588	0.596
Laboratory	X,X26.8	1.0	486	14.8	4.7	11.3	60.6	8.4	0.588		0.588	
InSitu Fluid Analyzer	X,X77.8	–	1,788	32.5	9.1	18.4	35.0	5.0	0.468	0.447	0.448	0.447
Laboratory	X,X77.8	2.5	1,958	35.0	10.5	13.5	32.7	7.7	0.437		0.437	

<sup>†</sup> Laboratory data not corrected for contamination

### Real-time analysis of pure reservoir fluid

The InSitu Fluid Analyzer system was chosen to conduct DFA of fluid acquired with Quicksilver Probe extraction. Because the well was drilled with oil-base mud, it was important to extract virtually contamination-free fluids. The innovative probe design used by Quicksilver Probe extraction diverts filtrate-contaminated fluid so that high-purity reservoir fluid is drawn to a separate flowline.

The InSitu Density\* reservoir fluid density sensor of the InSitu Fluid Analyzer system was also installed in the Quicksilver Probe extraction tool. The InSitu Fluid Analyzer system was placed downstream of the pump, where it would be at hydrostatic pressure. The InSitu Density sensor in the tool would measure at flowing pressure, slightly below formation pressure. The dual measurement would be used to assess the resolution of the analysis.

### Connectivity revealed

The DFA results for composition from the InSitu Fluid Analyzer system and density from the two sensors confirmed the fluid content of the two reservoirs. No significant compositional grading was found in the upper reservoir fluid, and the DFA characterization was sufficient to indicate connectivity to the offset well.

The high quality of the DFA composition and density data was confirmed by the close match to subsequent laboratory analysis of the samples. The very high resolution of the InSitu Fluid Analyzer system's measurements is demonstrated by the similar values obtained for the two upper reservoir stations, which were acquired under similar conditions in a short time span by the same toolstring.

Significant amounts of CO<sub>2</sub> were encountered in both the oil and the gas reservoirs. Knowing the quantity and distribution of CO<sub>2</sub> with a high degree of accuracy is critical for the operator. In addition, the comparable DFA and laboratory CO<sub>2</sub> measurements are well within established accuracy specifications, suggesting that the CO<sub>2</sub> distribution in similar reservoirs can now be quantified with confidence by using DFA.

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