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## Focused Sampling and Downhole Fluid Analysis — A West Africa Perspective

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### Abstract

The acquisition of quality reservoir fluid samples is crucial for the correct evaluation of reserves and for the design of production facilities. Very frequently these samples are acquired with a production test, but in many cases there is no DST or it may not test all potential zones. As a result the industry has an increasing reliance on samples acquired with Wireline Formation Testers (WFT). These samples, however, come with an important caveat. In wells drilled with oil base mud the invading filtrate can contaminate the acquired sample to the point where results from laboratory measurements may be uncertain or even useless.

A recently introduced focused probe technology for WFT tools has greatly improved the quality of oil samples acquired in wells drilled with OBM and has also reduced the time to acquire them. This probe has been very successfully deployed in a number of locations in the world including the Gulf of Mexico and the North Sea where very low or negligible contaminations have been reported. However, deployment has been more tentative in higher mobility poorly consolidated reservoirs such as the Deepwater Tertiary reservoirs of West Africa. In these environments unconsolidated sands frequently fail and partially plug the probe which can reduce the effectiveness of the focusing. Additionally, clean-up can often be quite fast with a conventional probe and can produce acceptable quality samples so the case for the focused probe is less obvious.

However, rising rig spread rates and the need for ever cleaner samples dictate that the speed and quality of focused samples needs to be realized. Additionally, not every reservoir in West Africa is a Deepwater Tertiary. Much production (and exploration) still takes place from low permeability carbonate and carbonate rich reservoirs.

In this paper we examine focused probe sampling results from wells drilled in very high mobility, unconsolidated reservoirs in Nigeria and Angola as well as lower permeability carbonates. We will discuss the hardware choices and reasoning for implementation with a particular emphasis on the use of low rate pumps to minimize drawdown and sanding. We additionally discuss the special filters implemented to reduce plugging. In several of these examples laboratory measurements indicated the acquired samples had no detectable levels of contamination.

### Introduction

Focused sampling has been used on formation testers for the past several years. The technique has had success in the Gulf of Mexico (Weinheber 2006), North Sea (O'Keefe 2006), India (Kundu 2007) and Saudi Arabia (Beaiji, 2007). Additional success has been recently reported in West Africa in lower permeability carbonate formations (Contreiras 2008). Focused sampling also enables, in-situ real time fluid analysis to be performed with more accurate results and improved efficiency. In recent years the capabilities of fluid analyzers utilizing optical spectroscopy have also been extended to measure gas-oil ratio (GOR) and a more advanced hydrocarbon composition in five groups: methane (C1), ethane (C2), propane to pentane (C3-C5), hexane and heavier hydrocarbons (C6+), and carbon dioxide (CO2). Other sensors measure downhole fluorescence for single phase assurance, density and viscosity, pH and resistivity of formation water, pressure and temperature.