Pressures & Sampling Seminar
13th March 2012

		Name	Company	Talk Title
	09:00-09:25	**Registration**		
	09:25-09:30	**Iain Whyte / Mike Millar**	LPS	Welcome & Introduction
1	09:30-10:00	**Gregg Birrell**	Tullow Oil	Performance of Pressure and Sampling Tools in Extended Appraisal and Development Campaigns- Offshore Ghana
2	10:00-10:30	**Ross McCartney**	Oilfield Water Services Limited	Formation water samples – are you missing a trick?
3	10:30-11:00	**Michael O'Keefe**	Schlumberger	Fluid Profiling – the key to unravelling reservoir complexity
11:00-11:30		**BREAK**		
4	11:30-12:00	**Tony Van Zuilekom**	Halliburton	Advances in Multi-Phase Fluid Analysis and Sampling
5	12:00-12:30	**John Williams**	BP	Sampling while drilling
12:30-13:30		**LUNCH**		
6	13:30-14:00	**John Bennett**	Perenco	21st Century Formation Tester Sampling: Promises Much, Often Disappoints
7	14:00-14:30	**Gavin Sibbald**	Baker Hughes	Understanding the wireline mini DST
8	14:30-15:00	**Stuart Huyton**	Gaia	Formation Pressure Testing & Sampling: the Practical Aspects of Wellsite QC
15:00-15:30		**BREAK**		
9	15:30-16:00	**Tim Whittle SPE Distinuished Speaker 2011**	BG	The Determination Of Minimum Tested Volume And Future Well Production From The Deconvolution Of Well Test Pressure Transients
10	16:00-16:30	**James Christiansen**	Weatherford	Revolutionizing REServoir Evaluation
11	16:30-17:00	**Brian Moffatt**	Petrophase	Experiences in interpreting surface versus bottom hole samples.
17:00 onwards		**Discussion and Closing Remarks**		
		Wine & Savouries		

Performance of Pressure and Sampling Tools in Extended Appraisal and Development Campaigns- Offshore Ghana

Gregg Birrell, Tullow Oil Plc

Abstract

Tullow Oil, along with its partners, has conducted extensive deep water exploration, appraisal and development work on the Deepwater Tano and Jubilee Unit Areas, offshore Ghana. Wireline pressure and sampling has been used extensively in addition to LWD and conventional well tests as a basis for reservoir characterisation. Operations have been ongoing since 2007 and a sufficient dataset has been acquired to benchmark Downhole Fluid Analysis (DFA) results against PVT laboratory analyses. The present review includes results from LFA, CFA and IFA tools and looks at their ability to measure gas oil ratio, oil based mud contamination and hydrocarbon composition. In addition, limited results from DV Rod measurement of live fluid density are presented.

Although DFA is impressive in its ability to measure fluid properties downhole, the range of uncertainty in measurements is higher than that obtained by PVT laboratory analysis. An example is presented which shows that the range of uncertainty in DFA measurement remains too wide to allow for definitive analysis of fluid composition change associated with pool discontinuity or gravity / thermal induced compositional grading for reservoirs under study in Ghana.

Biography

Gregg Birrell is a senior reservoir engineer working for Tullow Oil on deepwater assets in Ghana. Gregg worked on the Jubilee field between discovery and first oil and is currently working with a development team on discoveries on the Deepwater Tano block. Prior to joining Tullow, Gregg managed the Reservoir Group at Fugro Robertson and worked as a reservoir engineer for Devon Energy in Canada.

Formation water samples – are you missing a trick?

Ross McCartney, Oilfield Water Services Limited

Abstract

It is common for formation water samples to be collected (e.g. via DST, formation testing) from just one location (water-leg/aquifer) during field appraisal. The sample analyses are then used in the calculation of reserves (i.e. using R_w), in development planning (e.g. scale and corrosion management planning, materials selection, etc), and subsequently during production (e.g. baseline data for monitoring).

But, there are risks associated with this approach: operational problems may mean the samples cannot be collected, the samples obtained may be of poor quality, and variations in formation water compositions across the reservoir in the hydrocarbon-leg and water-leg/aquifer, if present, will not be recognised. This leads to uncertainties in the results of those applications making use of the formation water analyses and decisions based on these results. Whilst such uncertainties have often been accepted, with the increase in development of HT/HP and subsea fields, where project economics may be marginal and solutions to unexpected problems (e.g. scale, corrosion, etc) may be limited or costly, there is an argument for collection of water analyses from multiple sources and locations during the appraisal of new fields. In addition, there are other applications of water analyses that cannot be undertaken without multiple data (i.e. compartmentalisation studies, produced water allocation).

In this respect, core is an underutilised source of water analyses. Core can be used to provide water analyses from multiple locations in both the hydrocarbon-leg and water-leg/aquifer. Some studies have shown that R_w and $^{87}Sr/^{86}Sr$ data obtained from these sources can be used for improved reserves estimation and compartmentalisation studies. But, there is scope to use core-derived water analyses for more applications.

In this presentation the most useful types of core-derived water analyses will be discussed (methodology, advantages, disadvantages, applications) and example field applications of these data will be provided. It is concluded that given the benefits of core-derived data and their relatively low cost, those not planning to obtain them on new developments may be missing a trick.

Biography:

Ross McCartney has been a consultant for 26 years and has more than 30 years experience in the oil, nuclear, and geothermal industries. He has worked on projects across the world for a range of major and minor operators and his principal areas of expertise are: interpretation of formation water and produced water analyses, geochemical and reactive transport modelling, scale prediction, and sampling and analysis of water.

Fluid Profiling – the key to unravelling reservoir complexity

Michael O'Keefe, Schlumberger

Abstract

A general change of the business environment in the petroleum industry is a migration from the "easy reservoirs" to unconventional reservoirs: complex reservoir fluids, compartmentalization, extreme pressure and temperature, ultra deep water and/or low or ultra low mobility systems. As we strive to complete more complex reservoirs, we are challenged to better understand the nature of the fluids contained within. Classical "black oils" are still encountered; however scenarios where volatile fluids that exhibit a bubble point are found in close proximity to fluids with dew points are not uncommon. Heavy oils can display a high degree of compositional grading with wide variation of viscosity through the reservoir, which directly affects productivity. In addition, knowing the CO2 content is paramount to completion engineering and facility design with high penalties incurred when CO2 quotas or production limits are exceeded.

Characterizing these fluids is challenging. Typically wireline formation testers with fluid analyzers are used for early fluid characterization and sampling. However, with the increasing fluid complexity subtle differences need to be understood. This requires comprehensive compositional analysis, high resolution answers and quantified accuracy. Undetected flow barriers in the reservoir may lead to disappointing production results. Equilibrated pressure over geologic time does not guarantee flow communication during the production time. The chemical content of the entire reservoir needs to mix to reach fluid compositional equilibrium. In contrast, only limited mass flow is needed for pressure equilibration. A deep understanding of the chemical and physical fluid properties of complex reservoir fluids is paramount.

An integrated approach using the best technology available helps to overcome the discrepancies. Fluid simplicity was often assumed in the past, resulting in an insufficient description of the reservoir contents. Accurate downhole fluid analysis gives warning of fluid complexities at a very early stage in the exploration/appraisal phase. The data acquisition program can then be matched to the complexity of the fluid column.

Biography:

Michael O'Keefe is Principal Reservoir Engineer for Schlumberger, based in London since June 2011. He provides technical support & advanced interpretation for formation testing, sampling, and fluid properties. His previous position from 2006 until 2011 was Product Champion for Downhole Fluid Analysis (DFA) where he managed the technology portfolio of formation testing services. Michael joined Schlumberger in 1990 as a wireline field engineer based in Bergen, Norway and has held positions in the North Sea, Saudi Arabia, Europe, Australia, Siberia, and the Far East.

Author of 22 technical papers and 16 patents, Michael is a recipient of the Performed by Schlumberger Gold Medal for Downhole Fluid Analysis in 2005, and Gold medal for Quicksilver Probe* in 2006, where as a member of the Quicksilver Probe development team he also won the Hart's Meritorious Engineering Award at the Offshore Technology Conference in 2006. He is also a Distinguished Lecturer for the Society of Petrophysicists and Well Log Analysts (SPWLA) during 2010-11.

Advances in Multi-Phase Fluid Analysis and Sampling

Tony Van Zuilekom

Abstract;

Fluid sensor to measure in-situ fluid density using a vibrating-tube in combination with other collocated fluid sensors has recently been introduced to the North Sea.

A vibrating-tube density sensor operates under the physical premise that its resonance frequency is directly related to the density of fluid within the tube is well suited to both single and multiple phase flow as the entire fluid flow are measured as it moves along the tube rather than a localized measurement.

This presentation will show examples of miscible and immiscible formation fluid testing with the immiscible fluids utilizing the volumetric binning visual aid, we will demonstrate the methods to calculate contamination and non evasive checks performed on the sample chambers comparing them to laboratory results.

Biography:

Tony van Zuilekom is the Regional Technical Manager for Halliburton Wireline and Perforating based in the Netherlands. He has been involved in a wide range of logging operations for many years holding both field operational leader positions and technology positions as a program manager for wireline sampling tools, including the Reservoir Description Tool (RDT™) and Hostile Formation Tester (HSFT™). He graduated from Sunshine Technical College with a degree in electrotechnology in 1984. In his professional career, Tony has had a wide range of both field operations and research and development assignments dealing with formation testing and well logging technology. During his 28 years at Halliburton, he has served in a number of international locations.

LWD Sampling, BHI FAS tool application in Trinidad

Authored by; Mark Mahadeo and Hilary Rose, BP

Presented by; John Williams, BP

Abstract;

In the last 20 years bpTT LLC (BP Trinidad and Tobago) has invested heavily in drilling technology and in particular Logging While Drilling (LWD) measurements. The most recent example of technology uptake has occurred on the Serrette Field, where bpTT trialled the Baker Hughes Inteq (BHI) LWD Formation Fluid Sampling Tool (FAS). This presentation outlines the rational for attempting the field test, the planning and execution of the job, the results from the operation and the potential advantages it could bring to the project.

The Serrette Field is a dry gas accumulation located approximately 45 miles NE of Galeota Point, offshore Eastern Trinidad. The stacked reservoirs are high quality thick, blocky and clean sands. The sands are generally well-sorted with porosity between 25-35%, permeability greater than 1000md, grain sizes approximately 100 - 150 microns, and clay content less than 5%. Sands are mineralogically mature with high quartz content, typically 90%, and with 5-10% lithics, minor feldspar and mica. Cementation is minimal; diagenesis is limited to mechanical compaction.

For most part, reservoir gas offshore Trinidad is lean and CGR composition varies between 0 and 40 bbl/mmscf. The objective of the field trial was to acquire representative fluid samples from the deeper TQ-52 sands and determine in situ CGR values. Accurate liquids allocation has considerable value in field management. In addition the well was planned with a 68 deg well angle which usually determines TLC wireline deployment to be considered with its associated rig time and cost. As an alternative, the FAS tools was chosen to replace wireline deployment on drill pipe and to attempt to limit the contamination seen in historic wireline sampling programmes by sampling soon after drilling and done in a more cost effective manner.

The job was planned for 6 samples, utilising the 4 fluid analysis sensors in the FAS tool to optimise clean out and sampling time while limiting time spent stationary in the reservoir.

Half the planned samples were acquired and initial results suggest that contamination of the samples from water based filtrate is low. Final PVT data are yet to be reviewed. A number of lessons were learned from the trail which will influence future fluid sampling operations in the field and provide information for qualitative comparison with the existing WL/TLC technology

21st Century Formation Tester Sampling: Promises Much, Often Disappoints

John Bennett, Perenco

Abstract;

Modern formation testers offer a very wide range of options, often luring Reservoir and petroleum engineers with their promise of easy solutions. Formation tester technology presentations could sometimes be mistaken for iPAD apps "Buy this APP & solution delivered, £0.59"

The reality is that consistently successful Formation tester operations, particularly sampling, is the exception rather than the rule.

This presentation explores the list of stakeholder and their objectives, and the effort and leadership required to bring this disparate grouping together.
Examples will show both successes and improvement opportunities

Understanding the wireline mini-DST

Gavin JG Sibbald, Baker Hughes Incorporated

Abstract;

A mini-DST is a small scale well test, using a formation tester tool, which is conducted to obtain local and reservoir scale parameters. Data is based on the pressure transients after fluid production from a small isolated section of the wellbore, typically 1m. This application for WFT adds to reservoir characterisation by allowing the measurement of horizontal and vertical permeabilities of different reservoir flow units.

To fully understand a mini-DST, it is important to consider what value the application will bring. Performing this application in the field needs thorough pre-job planning to understand if it is possible to obtain useable data in a realistic operational time period. The pre-job modelling evaluates which equipment is necessary and gives an indication of time for an adequate drawdown and buildup so that quality transient data is achieved. Real-time analysis is done during the operation, to quality check the data and advise the offshore crew on repeating the drawdown and the buildup to ensure an optimum dataset. A mini-DST can be part of the fluid sampling program. It is critical that the PVT properties of the formation fluid are known for an accurate interpretation, therefore sample collection is necessary to verify these properties. It is advised to run a real-time fluid characterisation module so that a low contamination formation fluid is sampled, upon which an accurate viscosity can be measured downhole and a real-time permeability measurement can be obtained.

The presentation will give an overview of what is needed in terms of prejob modelling, operations and real-time/post data analysis, in order to get a complete understanding of a mini-DST.

Biography:

Gavin Sibbald is a Reservoir Applications Engineer for Baker Hughes Geoscience UK. His current role involves planning and real-time support for formation testing and sampling for wireline and LWD in the UK Geomarket. He previously was a wireline general field engineer working extensively in Norway, Denmark and the UK sector. He holds an MSci in Geoscience from the University of London and is currently finishing an MSc in PE from Heriot-Watt.

Formation Pressure Testing & Sampling: the Practical Aspects of Wellsite QC

Stuart Huyton, GAIA Earth Sciences

Abstract;

Wireline tools do not run themselves!

Formation pressure testing and sampling tools (or Wireline Formation Testers, WFT), have come a long way since the days of the one-shot "Formation Interval Tester" and have evolved into the sophisticated tools that we see today such as the MDT, RCX and RDT.

As such, the practical aspects of wellsite QC start with initial job planning and risk assessment, where the tool-string is optimised for specific objectives rather than being the most complicated and expensive solution.

The selection of points (depths) for pre-tests will be discussed before looking at another, often overlooked but important, aspect of WFT QC which is depth control.

QC of pre-test acquisition must be performed in real time and an important part of this is the use of interactive software rather than graph paper and a rule.

The mysteries of sample acquisition and estimation of contamination levels will be explored in an attempt to answer the question, "when should we sample".

Finally, some suggestions will be made as to how the management of sampling data can be improved to streamline the acquisition process.

The Determination Of Minimum Tested Volume And Future Well Production From The Deconvolution Of Well Test Pressure Transients

Tim Whittle, BG
SPE Distinguished Lecturer 2010-11

Abstract:

Much effort has been placed on developing increasingly complex models to describe increasingly complex well and reservoir configurations. Regardless of the complexity of the system, pressure transients remain quite simple in character and consequently, despite considerable expenditure of time and effort, it may not be possible to obtain a unique analysis model from them.

The use of the derivative is now a standard technique in pressure transient analysis. Deconvolution is a more recent method that, thanks to improvements in the algorithms, is becoming accepted practice. The combination of these two powerful methods has significant implications on how pressure transient data can be analyzed. Before attempting to find a plethora of models that fit the observed data, there is much information that can be obtained from the data directly.

The deconvolved pressure derivative is a representative signature of the well and reservoir response over the period of pressure and rate measurements. It can be used to quickly and easily calculate the minimum connected reservoir volume in place and furthermore, by simple extrapolation, it allows a prediction of the well's future production.

Tested volumes and future well production can be estimated from pressure transient data before building complex models.

Biography:

Tim Whittle joined BG in Reading in 2007 and is their Group Technical Authority for Pressure Transient Analysis. He has worked in the oil industry for more than 30 years.

Starting as a field engineer with Flopetrol Schlumberger, he gained practical experience in well testing operations and then moved to an R&D role where he was instrumental in developing the derivative analysis method with Dominique Bourdet.

In 1985 he joined Scientific Software-Intercomp as a reservoir engineer focusing on numerical simulation. In 1990 he spent several years with Norsk Hydro as a well test analysis specialist and then became responsible for the development of SSI's well test analysis software product – Interpret. He has a Masters degree in Engineering Science from Cambridge University, has written several papers on well test analysis and has given many industry courses on the subject worldwide.

Revolutionizing REServoir Evaluation

James Christiansen, Weatherford

Abstract;

The art and science of understanding how a reservoir is going to produce has never been easy. A key part to this process is the instu experimentation that is performed by wireline formation testers. Wireline formation testing is challenging, and there is a new system that reduces measurement risk and uncertainty assists to make better decisions. The purpose of the paper will be to present a new alternative formation testing system that builds on past experiences and adds new methods to solve past challenges. The field test results of this system, including work performed in Canada, Europe and Columbia will be presented.

Biography:

James Christiansen is a Field Test Coordinator for Weatherford International. He received a Bachelor's degree in Geology from Tarleton State University. He began his career with Computalog Wireline, as a Cased Hole engineer. When Computalog was purchased by Precision Energy, he became an Open Hole engineer. James held positions in New Mexico, Oklahoma, Texas and Latin America prior to becoming a Field Test Coordinator.

Experiences in interpreting surface versus bottom hole samples

Brian Moffatt – Petrophase

Brian Moffatt, Jaimar Maurera, Mike Fawcett & Anna Bruzco (Petrophase Ltd)

Abstract;

Fluid Sampling is essential to characterising reservoir fluids for field development and predicting sales streams, yet despite millions being spent on acquiring samples often their full value is missed. There is a variety of options for taking fluid samples downhole (bottomhole flowing samples, formation testers) and at surface (separator samples, production samples). When samples from subsurface and surface agree, then we can smile at our luck! However often there is discrepancy between samples which requires interpretation to decide the most representative fluid composition. This talk presents some case studies showing how careful analysis can reveal the whole picture and extract greater value from sampling data.

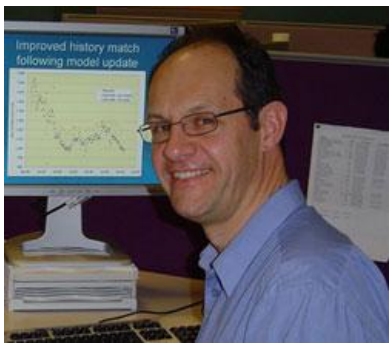
We will start with a condensate well which was sampled at surface and bottom hole. Both sets were quite different, so how do we decide which should be used to plan field development? How can we test the quality of samples here? The apparent answer that the reservoir was under saturated proved incorrect and we show how you can test this on your own fluids.

The re-interpretation of the data from an oil reservoir radically changed the understanding of the reservoir which changed the field development plans and predicted an increased recovery. The reinterpretation used data beyond the samples themselves and involved combining reservoir fluids compositions, studying the varying welltest surface GOR, the reservoir pressure gradients and laboratory PVT data. Only by applying joined up thinking across these domains could a coherent picture evolve.

Getting good samples from gas cap/oil systems is difficult as any pressure disturbance affects the oil and gas which are at their saturation pressure, yet we cannot perform welltests without pressure drawdown. An example is shown involving oil based mud contaminated downhole samples and comingled surface streams of varying GOR. Despite this inauspicious start it was possible to disentangle the data to give original state properties and compositions, an example where information from both subsurface and surface samples could give a full answer where neither alone sufficed.

The talk will conclude with benefits and applications of sampling for both reservoir fluids and contaminants.

Biography:



Brian has over 25 years experience in the chemical and oil and gas industries.

After building a PVT laboratory and operating well site sampling for British Gas he became project team leader for the Fluids team of the Gas Research Centre managing technical support and research projects in PVT, NMR, fluid flow in porous media, gas condensate recovery, oil migration and geochemistry.

Later Brian worked as a petroleum engineer with BG Group, then Helix-RDS before leaving to found Petrophase in 2004 with a vision to link disparate disciplines under petroleum fluid studies. By combining expertise with joined up thinking across PVT, thermodynamic

modelling, sampling, geochemistry, petroleum engineering and surface processing, Petrophase has achieved seven world first solutions, delivered great financial benefit to clients and won four industry awards.

Brian has presented many industry talks on reservoir fluids and published scientific papers on oil and gas behaviour. He is a member of the Energy Institute and the Society of Petroleum Engineers where he is co-chair of the SPE's *Phase Behaviour* Technical Interest Group.

Publications

- Distribution of Hydrogen Sulphide in the Buzzard Field" **SPE 123875**, Beilby, Clayton & Moffatt, (SPE Annual Technical Conference and Exhibition 2009)

- "Identifying and Meeting the Key Needs for Reservoir Fluid Properties - A Multi-Disciplinary Approach", Brian Moffatt and John Williams, **SPE 49067** (SPE Annual Technical Conference and Exhibition,1998)

- "An experimental investigation of geochromatography during secondary migration of petroleum performed under subsurface conditions with a real rock" Steve Larter, Berni Bowler, Ed Clarke, Colin Wilson, Brian Moffatt, Barry Bennett, Gareth Yardley and Dan Carruthers, Geochemical Transactions, October 2000

- "Quantification of the C_{30+} fraction of North Sea condensates by high temperature capillary chromatography," David Heath, Brian Moffatt, Roy Lowry and Steve Roland, Analytical Proceedings Including Analytical Communications, 32 (1995) 485

- Measurement of Flow Properties and Interfacial Tensions for Gas Condensate Systems **SPE 59774**, H.R. Zhang, BG Technology Ltd., B.J.A. Bjørkvik, SINTEF Petroleum Research, B.J. Moffatt, BG Technology Ltd.

- "Applications of Hydropyrolysis in Oil Exploration" Colin E Snape, Christopher Russell, William Meredith, Gordon D Love, Allan McGinn, Edward Clarke and Brian Moffatt. Journal of Organic Geochem 2004.07.004