London Petrophysical Society

Everything Formation Testing

Thursday 5th December 2024
Geological Society, Burlington House, London
09:00-17:00 GMT

London Petrophysical Society - "Everything Formation Testing" - Thursday 5 December 2024				
Start Time	End Time	Name	Company	Talk Title
09:00	09:30	Doors Open and Registration		
09:30	09:40	Edwin Wraith	LPS	LPS VP Seminars - Introduction
09:40	10:10	Shyam Ramaswami	Shell	The role of Formation Testing in Project Lifecycle Decision Making
10:10	10:40	Mike Millar	Independent	Back to Basics: A review of the acquisition, quality control and use of formation pressures
10:40	11:10	Yon Blanco	SLB	Asphaltene Characterization using Downhole Fluid Mapping While Drilling - Fluid Characterization Case Study For Completion Optimization
11:10	11:30	Break		
11:30	12:00	John Babadimas	Woodside Energy	Early and Accurate Quantification of Mercury Contaminant Levels in Gas-Condensate Reservoirs
12:00	12:30	Ansgar Cartellieri	Baker Hughes	Real-Time Prediction of Formation Fluid Properties While Drilling – Technology and Case Studies
12:30	13:00	Iain Whyte	Islay Subsurface & Engineering Ltd	LWD and Eline Formation Testing & Sampling; Practical tips for job optimisation, designing a “fit for purpose” programme and some real life examples of sh!t that’s gone wrong!
13:00	14:00	Lunch		
14:00	14:30	Javier A. Franquet	Baker Hughes	In-situ stress calibration methodologies benchmark from Straddle Packer Microfrac Testing
14:30	15:00	François -Xavier Dubost	SLB	A Technology Update on In-situ Geomechanics
15:00	15:30	William Dawson	bp	The World's Tightest Hydrocarbon Sample*
15:30	15:50	Break		
15:50	16:20	Richard Jackson	SLB	Integrating Dual-Flowline Fluid Property Measurements For Quality Control and Monitoring During Focused Sampling
16:20	16:50	Martin Leonard	Petromac Wireline Express	Resolving the Unique Challenges of Formation Testing Using an Innovative Wireline Conveyance System
16:50	17:00	Jack Willis	LPS	LPS President - Closing Remarks
17:00	President's Evening at The King's Head			

Register via the LPS website: https://lps.org.uk/events/

The role of Formation Testing in Project Lifecycle Decision Making

Shyam Ramaswami, Shell International E&P BV

Early de-risking of dynamic reservoir properties is becoming increasingly critical as project realization cycles shorten and geology gets more complex. Formation Testing at various scales allows for much quicker input to Decision Quality (DQ) than traditional methods, spanning from early Appraisal Decisions all the way to production impairment mitigation and impact on facilities. With the advent of newer technology bridging traditional gaps on what Wireline Formation Testing in particular, Formation Testing plays a stronger role in Project Decision making more than ever before. This talk will go through the key static and dynamic uncertainties in projects that can be typically addressed with Formation Testing methods, both small scale (Wireline) and larger Scale (Welltests and beyond), with focus on three key themes – Fluids, Connectivity and Reservoir Deliverability. For each of the scales, this talk will dive into some of the key methods and technologies, some tried and tested methods, and other industry leading technologies, like large interval testing on Wireline in Namibia, and link those back to the key Decisions that they impact, focusing on optimizing value of Project Delivery.

Shyam Ramaswami *is the Manager of FEAST, a global E&A Formation Evaluation team in Shell. He has 22 years of experience in the industry, initially working with SLB as a field engineer then operations manager, prior to joining Shell in 2009. In Shell, Shyam has extensive experience in defining and managing Subsurface Uncertainties, particularly in the Front End of projects, in Exploration, Appraisal and early Development. His team comprises of industry experts from Petrophysics, Reservoir Engineering, Geochemisty, Flow Assurance and Process Engineering. He has a passion for linking information and Decision Quality across the lifecycle of projects and will be talking to us today on how to better understand and communicate that early in projects.*

Back to Basics: A review of the acquisition, quality control and use of formation pressures

Mike Millar, Independent

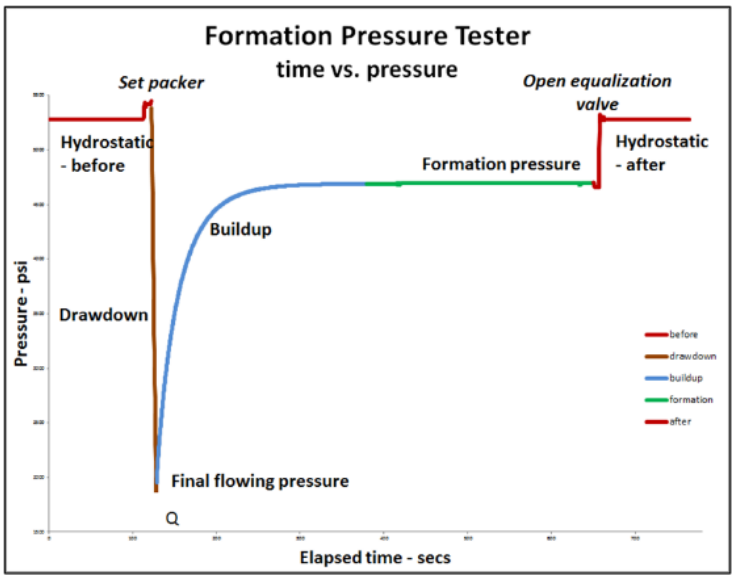
This presentation will take a 'back to basics' look at the planning, acquisition, quality control and use of formation pressure tester data, whether logged by LWD, Wireline, or any other conveyancing method.

Using real examples of good and bad data, the talk will give the tools and insight petrophysicists need to have the confidence that the formation pressure data they use is fit for purpose.

The presentation will emphasise the fundamental importance of the operating companies working closely with the service providers during the planning and acquisition of Formation Pressures to ensure that the very best quality data are acquired in a safe and cost effective manner.

Drilling a well changes the rocks and fluids that are drilled through, and we will look at how pressure and temperature measurements can be affected by the drilling process. FPT tools are designed to be run in specific ways under specific conditions, and we will explore how variations from these can materially affect the reliability and accuracy of the data acquired.

Unless we know where the pressure measurements come from they have little value, so depth measurement reliability is just as important as accuracy in other log measurements, and is just as subject to uncertainty and potential error.



Mike Millar *is a retired petrophysicist, who spent more than 39 years working on exploration and development projects across the world. He has worked for a number of companies including Esso, BakerHughes, PetroCanada, and BG Group. His roles have covered everything concerning logs, pressures and cores from tendering for services, programme design and implementation, data quality assurance through to evaluations and input to static and dynamic models.*

Mike has served on the LPS committee in the roles of secretary, treasurer, and president. He was on the organising committee of the SPWLA 2018 symposium held in London, and presented the one-day workshop on Log Quality Control at the Symposium. In 2022 he was given the Award for Meritorious Service by the SPWLA in recognition of his outstanding service to the Society.

Asphaltene Characterization Using Downhole Fluid Mapping While Drilling- Fluid Characterization Case Study For Completion Optimization

Yon Blanco, SLB

A novel workflow is presented where logging-while-drilling downhole fluid analysis (LWD-DFA) data is combined with surface mud logging to identify and quantify asphaltene distribution in the development phase of a North Sea field known to have complex fluid variations and compartmentalization. Data from two pilot wells was used for calibration and validation of optical densities from LWD-DFA and Wireline downhole fluid analysis (WL-DFA) acquired in wells drilled during the appraisal phase versus historical laboratory measured asphaltene data. Subsequently, three horizontal producer wells were drilled and the new validated/calibrated LWD-DFA data was used for fluid characterization and asphaltene distribution mapping in real time enabling decisions for drilling and completion design.

To de-risk and resolve this fluid variability and compartmentalization in the three horizontal production wells in the field development plan, a digitally enabled workflow coupling surface logging techniques with LWD-DFA was implemented. Identification of the presence of heavy hydrocarbon components (asphaltenes) and their mobility was of paramount importance. Continuous composition measurements were obtained via Advanced Mud Gas Chromatography to identify the heavier components and were further supplemented by Fast Field Total Organic Carbon (TOC) analysis at discrete depth intervals. This rich dataset, when merged with petrophysical LWD data, allowed fluid analysis station depths to be optimally selected and analyzed with LWD-DFA based optical spectrometry.

Historical laboratory data and Wireline DFA data were used to build correlations between optical densities at different wavelengths and the asphaltene content in wt%. These correlations were first validated while drilling two pilot wells and then utilized while drilling the three horizontal producers. Using these correlations, LWD-DFA optical densities obtained at each selected fluid analysis depth were used to predict asphaltene distribution along the well trajectories while drilling. Dynamic parameters during the pumping/clean-up phase of the LWD-DFA stations such as pressure drawdown, GOR, composition, optical densities, resistivity, temperature were monitored and controlled in real time to reach the targeted level of contamination and collect high-quality single-phase samples for further fluid analysis in the laboratory.

The asphaltene real time data became critical during the drilling of the producer wells for completion design. High quality fluid composition data as well as physical single phase hydrocarbon samples were acquired with integration of surface logging, advanced petrophysical measurements and downhole fluid analysis in the reservoir section of each producer well. Moreover, the newly acquired data was integrated with previously acquired Wireline DFA measurements in neighboring wells to evaluate variations in fluid properties measured insitu, particularly modelling asphaltene content gradients with Flory-Huggins-Zuo (FHZ) equation of state to investigate vertical and lateral connectivity. Clear demarcation of the various compartments observed in the appraisal wells was achieved to successfully de-risk drilling and completions operations.

The examples show the significance of applying LWD-DFA to characterize fluid distribution in horizontal well trajectory and to complement existing well placement workflows to optimize reservoir exposure, all done while drilling. Field development decisions are enabled in the while drilling phase to optimize well and completion design and serve to further refine subsequent well placement.

Yon Blanco *is a Principal Reservoir Engineer at SLB currently supporting the LWD reservoir portfolio in the Eastern hemisphere located in Bucharest, Romania. He joined Schlumberger in 1994 and has held several positions in field operations, Technology Center and Operations support for both Wireline and Drilling & Measurement. He holds an Electronic Engineering degree from Universidad Simon Bolivar, Venezuela and a diploma in Petroleum Engineering from Heriot Watt University, United Kingdom*

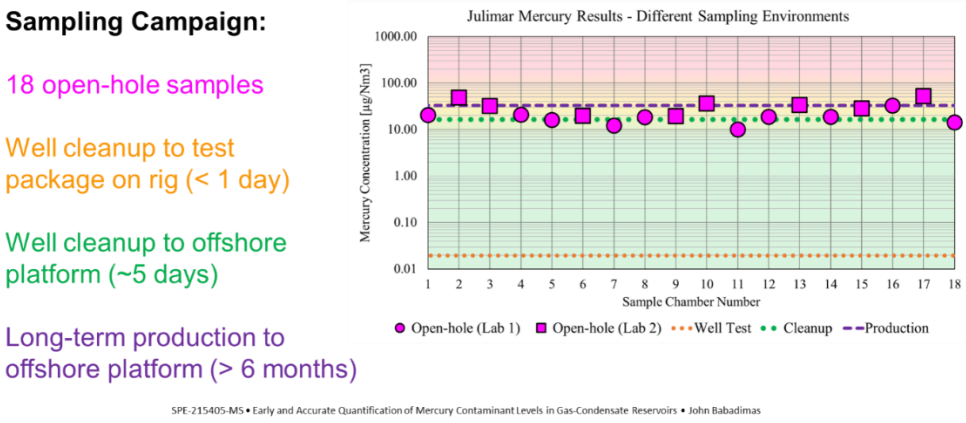
Early and Accurate Quantification of Mercury Contaminant Levels in Gas-Condensate Reservoirs

John Babadimas, Woodside Energy

Mercury is a trace contaminant present in natural gas and condensates. Production facilities must be designed to remove anticipated mercury contamination in natural gas streams to meet process safety, health, environmental, regulatory and sales requirements. Early and accurate quantification of mercury concentration levels is therefore critical for the safe and economic development of gas resources. This paper introduces reservoir fluid sampling and mercury analysis techniques demonstrated to accurately determine the mercury concentrations in gas-condensate reservoirs.

By implementing a combination of procedural changes, sampling tool modifications and improved measurement techniques, it is possible to acquire reservoir fluid samples with formation sampling tools and accurately measure mercury concentrations representative of that produced from the reservoir.

The case study of a gas-condensate field is used to demonstrate that by following the novel techniques introduced in this paper, reservoir fluid samples acquired from wells using formation sampling tools and analysed for mercury can accurately represent the mercury concentration levels measured later during the production phase. Processing facilities can then be appropriately designed or modified early in the field development lifecycle to remove any anticipated mercury in natural gas process streams.



SPE-215405-MS: https://doi.org/10.2118/215405-MS

John Babadimas *is a Petrophysicist with Woodside Energy based in Perth, Australia. He is currently working on the Sangomar deepwater oil and gas development, offshore Senegal. John joined Woodside Energy in 2016 as a Graduate Petroleum Engineer, holding assignments as a Reservoir Engineer, Production Engineer and Petrophysicist. He has been involved in operations and studies across a wide range of Woodside's assets in Australia, Southeast Asia and West Africa. John holds a Bachelor of Engineering (Petroleum, Civil & Structural) from the University of Adelaide, Australia, and is a member of SPE and SPWLA*

Real-Time Prediction of Formation Fluid Properties While Drilling – Technology and Case Studies

Ansgar Cartellieri, Philipp Schapotschnikow, Wolfgang Weinzierl, Baker Hughes

Artificial intelligence and modern machine learning enables new possibilities for data evaluation and prediction. For the challenging drilling environment, where automated and complex systems are required due to the very limited communication to surface, this provides new methods and techniques that are especially beneficial for logging while drilling (LWD) formation testing tools.

For modern LWD sampling services the quantitative identification of the chemical composition and the determination of physical properties of reservoir fluids is essential. In this context, the applicability of optical spectroscopy along with the measurement of physical fluid properties like, pressure, temperature, and density for the composition analysis of gaseous and liquid mixtures has been investigated and verified. Therefore, a new ruggedized visible to near infrared sensor developed to work under the harsh downhole conditions has been qualified. This sensor allows a more precise detection of the most relevant reservoir fluids even at high environmental temperatures. This includes the different hydrocarbons from C1 to C6+ as well as CO2. Various types of data analytics as well as pre-processing methods were evaluated and compared to a benchtop Fourier-transform infrared spectrometer as a common lab measurement reference device. The results showed a good transferability of the predictions among various sensors independent from the chosen model. For real time prediction the algorithm has been implemented and processed on the embedded device within the drill-string as the limited bandwidth does not allow the transmission of the large data sets gathered from the utilized sensors.

The presentation will discuss results and predictions derived from the new algorithms. Therefore, different modeling systems, used for chemometrics and applied to new sensors for reservoir fluid analysis under in-situ conditions already while drilling the well, have been selected and compared. The presented fluid analytical data to develop and train the models is predominantly taken from field applications or gathered with synthetic model fluids in a lab.

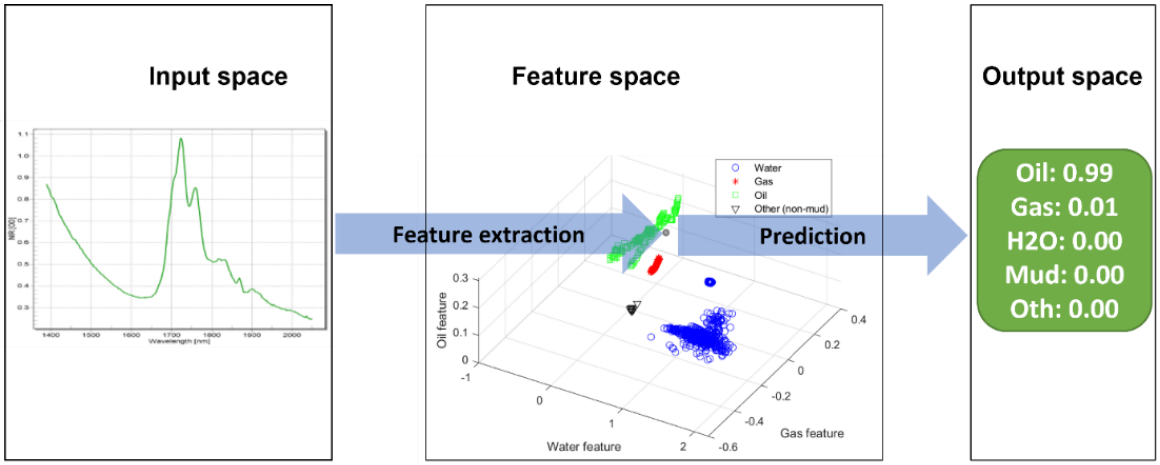


Figure 1: Visualization of the development approach to derive a quantitative fluid fraction.

Ansgar Cartellieri *is métier lead and senior principal for fluids, formation testing and sampling within Baker Hughes Drilling Services. He is with Baker Hughes since February 2006 and currently located in Celle, Germany. Ansgar holds a master's degree in chemical engineering from the Technical University in Hamburg and a Ph.D. in Mechanical Engineering from the Helmut-Schmidt-University Hamburg.*

LWD and Eline Formation Testing & Sampling; Practical tips for job optimisation, designing a "fit for purpose" programme and some real life examples of sh!t that's gone wrong!

Iain Whyte, Islay Subsurface & Engineering Ltd

Designing a successful pressure testing and sampling programme starts with understanding your objectives, and appreciating the uncertainties of the measurement being made. This talk will start by providing some practical, economic and results driven guidance on tool selection and method of acquisition. We will look at both LWD and Eline methods, and talk about depth control among other things.

With so many different tools on the market, how do you choose the right tool for your application, and can I trust what I am being "sold"? The talk will discuss appropriate technology deployment from the speakers own experience. We don't always need a hammer to crack a walnut, but sometimes we do need to deploy the "fancy toys".

Finally, the speaker will share some experiences of when things didn't go quite so well, how to detect an issue and what to do about it, and how to avoid reoccurrence! We will talk about probe plugging, gauge stabilisation, compartmentalisation vs depth error and lots more.

Iain Whyte *graduated from Robert Gordon University with a Hons degree in Applied Physics in 1995. In 1996 he joined Atlas Wireline Services as a Cased Hole Wireline Engineer, which later became Western Atlas, Baker Atlas and ultimately Baker Hughes. The role took him all over the world, logging in diverse circumstances! In 2003 Iain joined Wellserv (Weatherford) as General Field Engineer. In 2004 he joined BP to support Black Sea exploration offshore Turkey. He stayed at BP until 2010 covering Operations and Studies Petrophysics in Norway, Angola and Azerbaijan. In December 2010 Iain started Islay Petrophysics LTD, predominantly to work for Tullow Oil as Group Lead of Petrophysics Operations. 14 years later, Iain still consults to Tullow, but has also grown the consultancy company into what is now Islay Subsurface & Engineering LTD. Iain has served in various positions on LPS Committee, including President and Past President roles. Iain grew up as a farmer and whisky distiller's son on the tiny Island of Islay he still calls "home".*

In-situ stress calibration methodologies benchmark from Straddle Packer Microfrac Testing

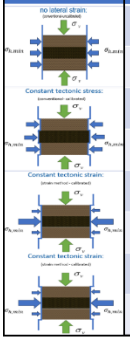
Javier Franquet, Baker Hughes Company

Obtaining a consistent workflow to determine the tectonic lateral stress boundary conditions is a critical subsurface input for building reliable 3D geomechanical models. These models are used to predict cap-rock integrity and seal assessment in CO2 injection projects. This paper compares multiple workflows and tectonic calibration techniques using constant and variable lateral strain values across several formations from Late-Cretaceous to Middle-Triassic.

Tectonic lateral strains are obtained from 29 microfrac tests conducted across different bore-hole sections of a well drilled in the Middle East. The rock mechanical properties are derived from density, neutron porosity, and acoustic cross-dipole logging data acquired before the downhole formation testing run. Formation breakdown, fracture reopening, and closure pressures are measured on each straddle packer microfrac station across both clastic and carbonate formations. The minimum and maximum horizontal strains are fine-tuned to back-calculate the magnitude of the minimum and horizontal stress until the predicted fracture closure and formation breakdown match the result of the multiple microfrac tests.

Cross-plot correlation coefficients are calculated between log-predicted and microfrac-obtained fracture closure and formation breakdown to compare different methods of tectonic strain derivation. One method uses a constant value for the minimum and maximum strains while a second method uses variable strain values with depth allowing different tectonic lateral conditions on each formation. Model sensitivity analysis about the methodology of assuming constant poroelastic Biot coefficient values versus estimating Biot from formation porosity logs was also reviewed. The average minimum and maximum horizontal strain values obtained are 0.0001 and 0.0003 obtaining a satisfactory match with the microfrac subsurface measurements. A total of 8 tectonic boundary condition models are compared combining multiple tectonic stress and strain values using constant and lithology-dependent poroelastic Biot's coefficient. The variable strain method obtains better correlation coefficients for both fracture closure and formation breakdown producing a more accurate match with the in-situ measurements.

This study reveals a novel methodology to derive accurate and formation-dependent lateral strain tectonic boundary conditions for calibrating geomechanical models across the field in subsurface CO2 injection projects. Accurate prediction of formation breakdown pressure is fundamentally required to constrain the CO2 injection rate and downhole pressure for safe and contained carbon sequestration and storage.

				Fracture Closure			Formation Breakdown		
Tectonic boundary condition	Model	Tectonics	Biot	FCP R^2	FCP Slope	FCP Ave Error	FBP R^2	FBP Slope	FBP Ave Error
	#1A	No Tectonics	Constant Biot = 0.8	0.9871	1.1484	732 psi	0.9749	1.1004	1142 psi
	#1B	No Tectonics	Variable Biot = f(ϕ)	0.9790	1.1665	866 psi	0.9594	1.2784	1956 psi
	#2A	700 psi + 5%	Constant Biot = 0.8	0.9904	0.9929	391 psi	0.9807	0.9490	893 psi
	#2B	700 psi + 5%	Variable Biot = f(ϕ)	0.9883	1.0250	452 psi	0.9803	0.9838	857 psi
	#3A	Linear Strain Interpolation	Constant Biot = 0.8	0.9960	1.0253	275 psi	0.9839	1.0297	719 psi
	#3B	Linear-to-Linear w/ DTs	Variable Biot = f(ϕ)	0.9932	0.9715	336 psi	0.9836	0.9224	885 psi
	#3C	Lithology dependent	Constant Biot = 0.8	0.9961	1.0155	264 psi	0.9887	1.0285	650 psi
	#3D	Lithology dependent	Variable Biot = f(ϕ)	0.9966	0.9991	166 psi	0.9829	1.0708	917 psi

Javier Alejandro Franquet *is the Global Formation Evaluation and Testing Segment Lead for Baker Hughes' Reservoir Technical Services. He holds a BSc in Mechanical Engineering (Universidad Simon Bolivar - Venezuela), an MS in Geosciences and Petroleum Engineering (Institut Francais du Petrole - France), an MS in Petroleum Engineering (Texas A&M University - USA), and an executive MBA (HULT - Dubai). He has 28 years of petroleum applied geomechanics and formation evaluation experience in conventional and unconventional reservoirs. Javier has managed large multi-discipline teams in product development, region operations in the Middle East, and global technical sales across multiple product lines from drilling and evaluation to cementing and production enhancement. He has conducted more than 270 straddle packer stress tests worldwide. He has authored more than 60 technical papers in geomechanics and stress testing. He holds four US patents in downhole stress measurements, and he co-authored the geomechanics chapter of the Unconventional Development book edited by Ahmed and Meehan in 2016. Javier was selected as SPE Distinguished lecturer during 2020-2021 season talking about in-situ stress calibration for field developments.*

A Technology Update on In-situ Geomechanics

Francois-Xavier Dubost, SLB

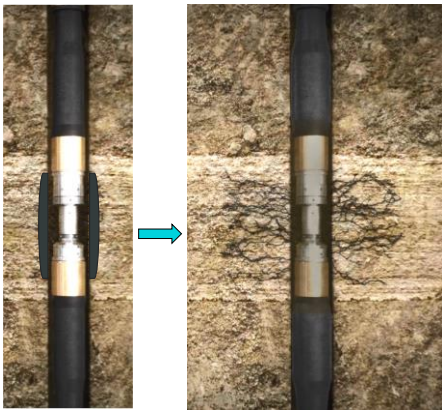
Accurate in-situ stress measurements are essential subsurface calibration points for geomechanics, particularly in challenging formations like caprocks, shales, and unconventional reservoirs. For carbon capture and sequestration (CCS) projects, underground storage sites or more traditional waterflooding projects in oil and gas, stress testing plays a crucial role to optimize injectivity. While extended leak-off tests (XLOT) are common, recent innovations in wireline formation testing— newer dual packer systems, sleeve fracturing and advanced flowback techniques —have improved breakdowns and reliability in closure stress measurements. These developments allow for multiple cycles and more precise stress measurements in low-permeability formations or tight formations previously difficult to breakdown and evaluate.

Additionally, a risk-mitigation workflow has been developed, enabling real-time stress profile updates, chance of success of breaking down calculations and improvements in mechanical earth models (MEMs).

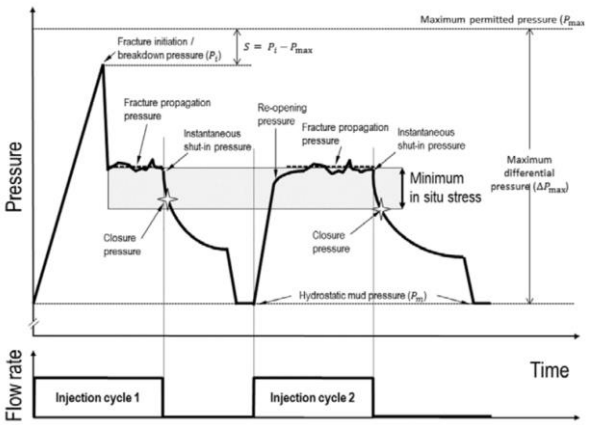
In this webinar we would like to present a technology update and discuss 3 case studies to illustrate the different hardware, and digital upgrades that have been recently made. We will refer to:

- Technology developments for CCS caprocks in-situ stress testing in Norwegian Continental Shelf, highlighting developments with flowback techniques.
- Geological exploration in Northeastern Switzerland for nuclear waste disposal sites, where novel toolstrings were employed.
- A digital workflow employed in the North Dakota CCS project.

These innovations offer robust data for improving stress modeling and enhancing reservoir management.



Minimum horizontal stress from closure pressure



Francois-Xavier Dubost *is a reservoir engineer advisor with SLB, and technical director reservoir for the Reservoir Performance Evaluation division. Francois is graduated from Herriot Watt University with an MSc in Reservoir Evaluation and Management, and has enjoyed a 29 year long career to date with SLB working in different regions and roles around the globe. Although his activities focus on reservoir technologies, and their measurements and interpretation, Francois has also experienced work in the consulting business line of SLB running reservoir dynamic simulations and conducting reservoir studies for operators. He has authored and co-authored over 30 publications and filed over 10 patents, and served as SPE Distinguished Lecturer for the 2023-2024 cycle.*

The World's Tightest Hydrocarbon Sample*

*At the time

William Dawson, bp

A wireline sampling programme was configured to address key uncertainties in the toxic and corrosive components of the formation fluids in the potential development of a challenging formation. Previous attempts via well-test on hydraulically stimulated wells had proven ambiguous and so wireline formation testing is the only remaining technology to address these parameters.

The presentation highlights the challenges faced due to this formation's tendency to break out owing to high horizontal stress anisotropy. This significantly limits packer placement and packer type selection. It discusses the strategies employed to pretest and sample low mobility rock, emphasizing the importance of controlling flow rate and area through the appropriate combination of both pump and packer type.

A phased strategy to understanding the H2S content was adopted, noting the plant's operating limits would be between the least sensitive coupon, and the expected H2S concentration that would be scavenged by the chosen tool configuration. The talk briefly discusses cost vs data, and being clear on what are the objectives of the sampling.

The presentation closes by describing considerations for an operator such as clean-up times, and conveyance choices with some potentially counter-intuitive outcomes.

William Dawson *is a petrophysics Discipline Lead at bp in Sunbury since 2007 following degrees in Physics from the University of Edinburgh, and an MSc in Reservoir Evaluation and Management from Heriot Watt. He has worked across various bp assets including 7 years in Oman and 3 years in Trinidad.*

Integrating Dual-Flowline Fluid Property Measurements For Quality Control And Monitoring During Focused Sampling

Richard Jackson, Kai Hsu, Hua Chen, Evgeniya Deger, Morten Kristensen and Francois Dubost, SLB

Focused sampling techniques for wireline formation testers represented an important breakthrough in downhole fluid sampling since it enabled the capture of clean and representative reservoir fluid samples much faster than with conventional methods. During production cleanup prior to sampling, the properties of the contaminated fluid are measured in real-time using optical spectrometers and downhole fluid analysis (DFA) sensors. These measurements in combination with interpretation algorithms have been developed to allow quantification of mud filtrate contamination and to monitor the progress and efficiency of focused fluid sampling operations. However, accurate and real-time quantification and prediction of mud filtrate contamination levels using downhole fluid analysis measurements remains a challenging problem; especially for difficult sampling environments and complex sampling tool geometries (e.g., multi-drain focused probes).

We describe the method for monitoring and control of focused sampling, through the integration of dual-flowline downhole fluid analysis measurements acquired by a single optical spectrometer, and comparison with a numerical flow-model of the contamination cleanup process (Fig.1). This workflow enables direct comparisons to be made of fluids, optical density (OD), and contamination levels in both flowlines (sample (L1) and guard (L2) for dual flowline formation tester tools. We also describe a method to express the rates of contamination changes in the sample and guard line in terms of the derivatives of optical density (OD), and we derive the ratio of the two OD derivatives. These types of comparisons allow us to monitor and control the efficiency of focused sampling, and evaluate the contamination levels in both the sample and the guard flowlines.

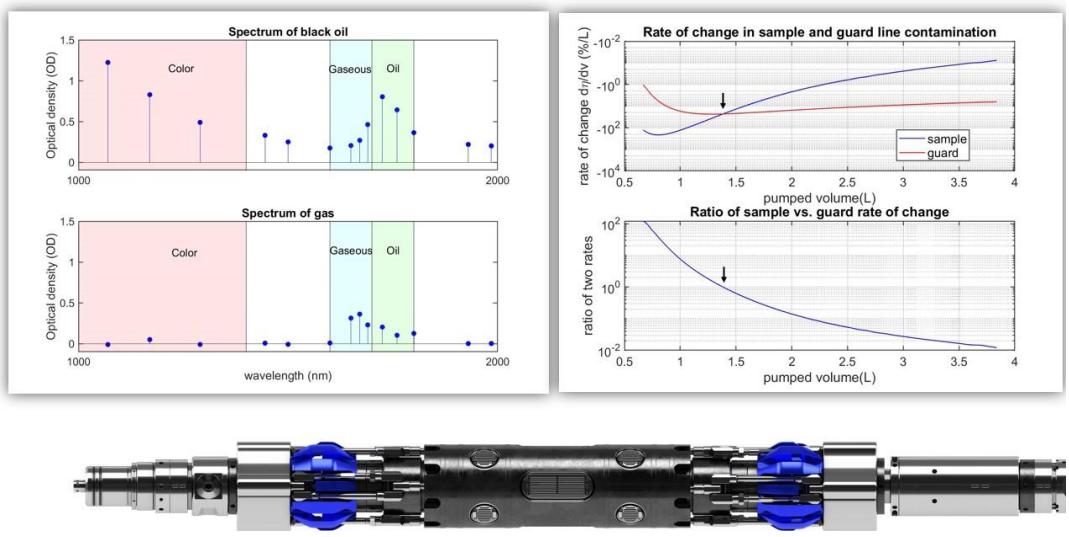


Figure 1: Focused fluid sampling efficiency and optical spectroscopy measurements

In this contribution we have described a new method for the integration and analysis of dual flowline sampling measurements for the real-time monitoring of the dynamic behavior and cleanup responses during focused sampling. We provide two case studies to illustrate the application of this combined workflow. The methods and workflow described in this contribution, will help to improve the quality control and monitoring of fluid sampling operations and provide alternate techniques to evaluate contamination and provide better control for the efficiency of focused sampling applications.

Richard Jackson *is a Reservoir Engineering Advisor with SLB and based in Houston; and currently focused on projects in offshore USA, Guyana, Suriname and Trinidad. He joined Schlumberger in 1997 as a reservoir engineer in Aberdeen, UK. He has since had various assignments working in the North Sea, Middle East, Nigeria and Gulf of Guinea, India, North and South America, and Sub-Saharan Africa. Technical interest areas include flow modelling and numerical simulation, formation testing, downhole fluid analysis, and pressure transient analysis. He holds BSc and PhD degrees from the University of London and Southampton, and conducted Post-Doctoral Research at Heriot-Watt Institute of Petroleum Engineering.*

Resolving the Unique Challenges of Formation Testing using an Innovative Wireline Conveyance System

Martin Leonard, Petromac

Formation Testing has long been a critical part of Wireline logging, but comes with a unique set of challenges:

- Long sampling times and inaccurate mobilities due to formation damage.
- Differential sticking due to long stationary periods.
- Sanding, which can plug probes and flowlines, cutting sampling programs short.
- Lost seals from poor probe orientation.
- Wireline tool hang-up.

These challenges can be addressed using the Petromac Conveyance system, which has the unique ability to orient the Formation Testing tool in the wellbore.

When drilling the wellbore, gravity dictates that the drill pipe rests on the low side of the wellbore. Consequently, cuttings are ground into the formation under the weight of the drill-pipe as it reciprocates and rotates, resulting in damaged and compacted rock.

The system enables samples to be taken on the high, undamaged side of the wellbore. This was demonstrated in a well in Vietnam; mobilities were much greater on the high side than the low side. This dramatically reduced sampling times and identified hydrocarbon bearing zones previously seen as not viable.

In unconsolidated, low compressive strength formations, sanding is an issue. Conversely, it can be beneficial to take samples on the compacted low side of the hole. In a job in the Gulf of Mexico, running probe up in an unconsolidated formation, resulted in plugging of the flowline and no data. After changing the orientation to the low side, the client was able to sample.

Formation Testing tools, by design, will tend to sit obliquely in larger boreholes, due to their extension kits. The result can be lost seals or damaged rubber packers which can necessitate a trip out of hole to change. With the Petromac system, the toolstring can be accurately oriented to set perpendicular to the high or low side of the hole, resulting in fewer lost seals and longer packer life.

Differential sticking has always been a major risk when sampling because of the long time spent on station. The system helps mitigate this risk by greatly decreasing the contact area on the formation as well as reducing the drag coefficient from static to rolling: eliminating sticking risk allows operators to be more aggressive with their sampling programs.

Tool hang-up on ledges can often cause delays in data acquisition. As the toolstring is oriented in the wellbore, a holefinder with an upturned nose, similar to a ski, can seamlessly navigate over wellbore ledges.

Martin Leonard *spent more than 20 years with Schlumberger in a variety of positions around the globe, gaining deep technical experience in all aspects of wireline logging. He served as Schlumberger's Wireline Cables and Conveyance Product Champion, allowing him to focus on inherent issues with traditional wireline conveyance and develop unique solutions. His expertise and drive allowed for a natural transition into his role as Petromac's General Manager. He is also the de facto Technical Champion within Petromac, developing numerous tools and strategies for modeling and deployment scenarios.*