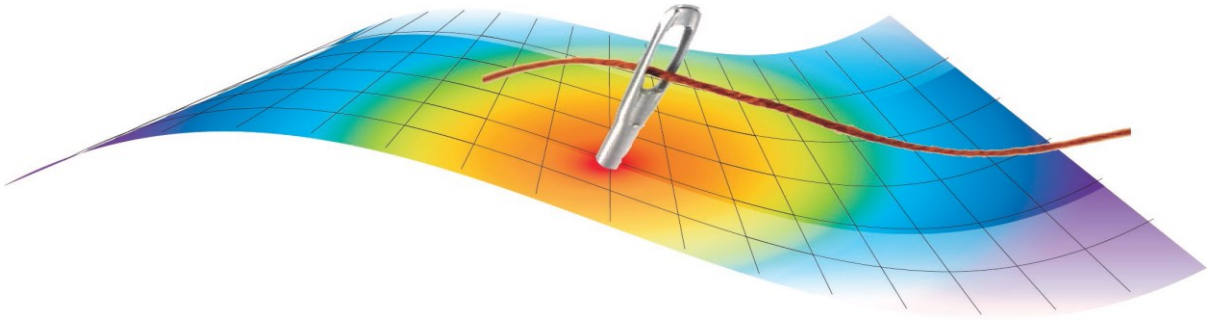
Well Placement, Geosteering and Geomechanics

One Day Seminar
Tues 18th March
Burlington House
London



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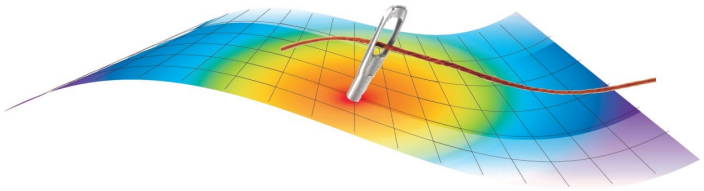
	Time	Speaker	Affiliation	Title
	09.30-09.40	Peter Fitch	LPS	Welcome and Introduction
1.	09.40-10.10	Jon Skillings	Baker Hughes	Reservoir Navigation – A brief history of geological well-bore placement techniques to optimise recovery
2.	10.10-10.50	Angus Jamieson	University of the Highlands and Islands / Merlin ERD Ltd	Minimising Uncertainty in Wellbore Positioning
	10.50-11.10	*Break*		
3.	11.10-11.40	Neil Cardy	Baker Hughes	Well Placement and Geological Uncertainty
4.	11.40-12.20	Giorgio Nardi	Weatherford	Distance to Bed inversion with GuidewaveTM : models and real cases
	12.20-13.30	*Lunch*		
5.	13.30-14.10	Christophe Dupuis	Schlumberger	Well placement and reservoir mapping
6.	14.10-14.50	Philip McCurdy	Senergy	The Petrophysics Elephant in the Geomechanics Room
	14.50-15.10	*Break*		
7.	15.10-15.50	Adrian Rodriguez Herrera	Schlumberger	Trajectory Optimization Under Complex Stress Fields: Exploration Surveys in the Gulf of Mexico
8.	15.50-16.30	Paul Johnson	Weatherford	Conventional image geosteering techniques
9.	16.30-17.00	John Bennett	Independent	Realtime Operations Geology in Angola
	17.00…	*Discussion and Closing Remarks*		
		Wine & Savouries		



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Important Notice

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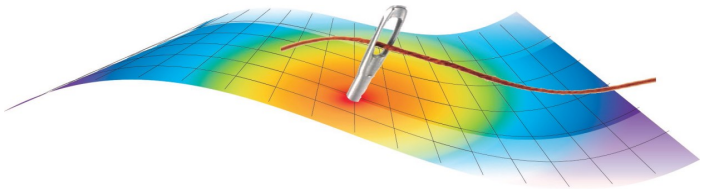
While the speakers and authors have taken care to present material accurately, they cannot be held responsible for any errors or omissions.

The aim of this seminar is to provide a reasonable and balanced discourse on the titled subject. Consequently it cannot consider in detail all possible scenarios likely to be encountered and caution is encouraged in applying these principles. The LPS and its agents cannot be held responsible for consequences arising from the application of the approaches detailed here.



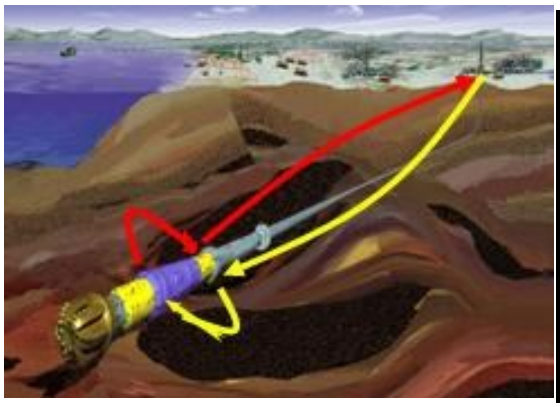
1.

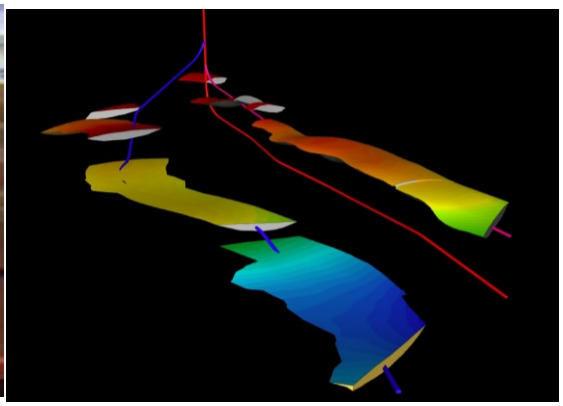
Reservoir Navigation – A brief history of geological well-bore placement techniques to optimise recovery

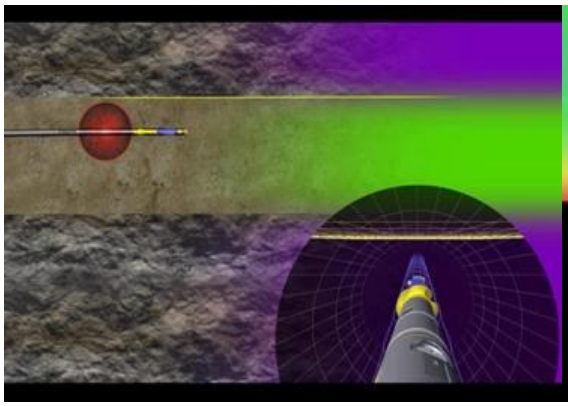
Jon Skillings, Reservoir Navigation Services, Baker Hughes

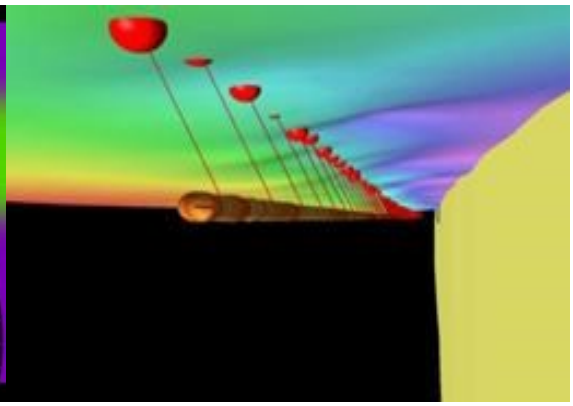
This presentation will cover the development of integrated drilling & evaluation tool technology to support optimal well bore placement.

Past & present techniques will be reviewed with a glimpse of what is to come. From the very first offshore horizontal wells on the Troll field in the late 1980's, to modern day producers in the North Sea targeting marginal and attic reserves, the requirement to drill & complete increasingly complex wells and place them in the "sweet spot" has driven technology forward. A number of recent North Sea case histories will be referenced.









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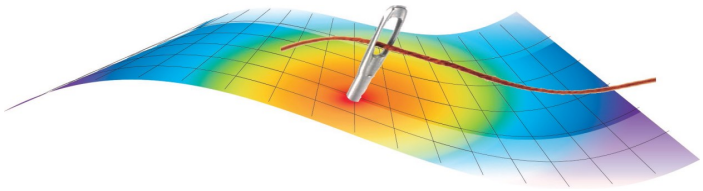

2.

Minimising Uncertainty in wellbore positioning.

Angus Jamieson, University of the Highlands and Islands / Merlin ERD Ltd

This talk will touch on the various tools and techniques available for wellbore positioning and their associated uncertainties. It will also cover some of the recent techniques to improve wellbore positioning accuracy.

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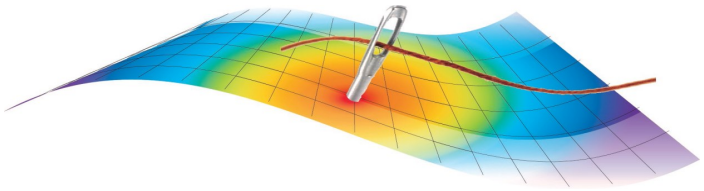

3.

Well Placement and Geological Uncertainty

Neil Cardy, Baker Hughes

Well placement ultimately depends on the geology, where the formations are, what they are and their specific properties including pore pressure and competency. The best single source of information about the geology while drilling is the cuttings and their analysis by the mud loggers.

Since about 1930 mud and cuttings have been correlated to well depth and analysed to obtain formation evaluation. In the late 1930's a method for determining the relative amount of gas in the drilling fluid was developed. In the early 1940's a systematic method for analysing and describing cuttings came into use and resulted in the formation of what we now call mud logging.

The information obtained by the mud loggers is critical for well placement answering such questions as:

- What are we drilling in?
- Are the formations coming in on depth?
- Are the formations what we expect?
- Is there over pressure?
- Is the formation competent?
- Where are we in the formation?

The answers to these questions can change the planned wellpath, the casing depths and even enable geosteering in formations where traditional methods cannot.

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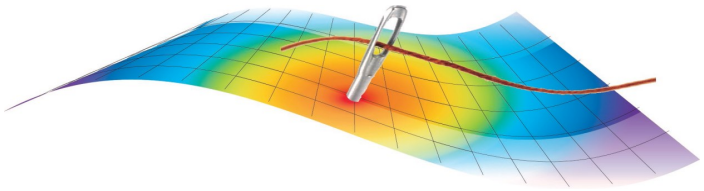

4.

Distance to Bed inversion with Guidewave™ : models and real cases

Giorgio Nardi, Weatherford Drilling Services

One of the main features of the azimuthal resistivity acquisition is the possibility to calculate in real time the distance to the bed boundaries (DTB). These parameters are calculated with inversion of the data acquired by the tool. Guidewave™, with its longitudinal and crossed array of transmitters and receivers, working at 3 different frequencies, allows several data input combinations to the inversion. It is important to have a good understanding of the inversion capabilities and limitations. An accurate forward modeling response of the tool, in a given stratigraphic scenario, also allows the defining of the best data for input into the DTB inversion. Different hypothetical modeling scenarios are exposed together with examples of real pre-well models. At the end 4 case studies from actual jobs in Middle East, South-East Asia and Latin America are presented.

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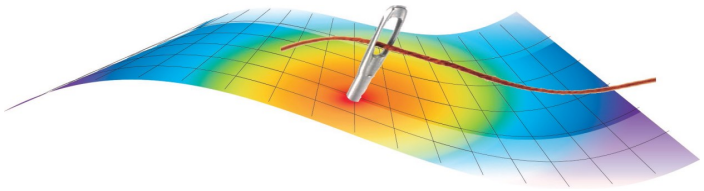

5.

Well placement and reservoir mapping

Christophe Dupuis, Schlumberger

The Deep Directional Resistivity (DDR) LWD tool has been adopted by several operators since the start of the field test program in the North Sea. The service has been run in a variety of environments, with geosteering and reservoir (lithology and fluid) mapping objectives.

The presentation will include a review of what makes DDR capable of imaging resistivity contrasts over 100ft around the wellbore in real-time, without having to input any assumptions about the formation profile. The versatile tool layout, giving the depth of investigation and the distance to bit of the deep measurements will be explained, and the principles behind the measurement physics will be detailed.

The assumptions and possibilities given by the innovative automatic multilayer inversion of the measurements will be explained, and the interpretation of bedding and associated uncertainty from the inversion results available on a continuous basis during actual jobs.
The new addition to the fleet is the DDR8, designed for 12¼ inch landing sections where it is useful to see the reservoir top in advance to mitigate the risks associated with landing in (or a few meters above) it.

We will discuss results of a recent well in the Norwegian sector of the North Sea, where the reservoir top was observed 50ft below the wellbore, and the OWC 65ft below the wellbore shortly after, before touching the reservoir. The results of the reservoir section, also geosteered with a DDR tool, will be presented.

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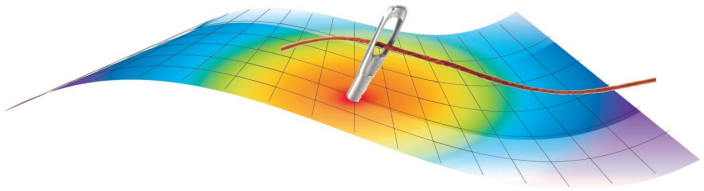

6.

The Petrophysics Elephant in the Geomechanics Room

Phil McCurdy, Colin McPhee, and Gill Daniels, Senergy Energy Services, Edinburgh, UK

Successful well placement and well construction in geomechanically sensitive formations requires an understanding of the mechanisms that cause formation failure, and the development of a field validated methodology to predict the critical conditions for well and completion instability. The objective is a fit for purpose coupled geomechanical-stability model which can be used for well/formation failure predictions.

The key inputs in the geomechanical model come from petrophysical analysis of log and core data. Unfortunately, the deep-seated intellectual compartmentalisation in the industry means that the importance of a rigorous and consistent petrophysical interpretation, which recognises and accounts for shortcomings and uncertainties in the data, is often overlooked by well engineers and production technologists, with serious technical and economic consequences for well construction and completion. Several case studies and field examples are presented which not only illustrate the common pitfalls in evaluating petrophysical input to geomechanics models but also demonstrates how to avoid them. For example:

- How inconsistent and incorrect log interpretations can invalidate strength models.
- How poor laboratory test practices, inadequate QC, and core damage on coring and core recovery can turn a strong rock into an apparently weak rock, increasing preventable well construction and completion costs.
- How incorrect assumptions in sonic log interpretation can give misleading stress estimates
- How easy it is to misinterpret wellbore failure features from image logs.

The presentation provides best practice recommendations and workflows to ensure that core and petrophysics data are fit for purpose prior to geomechanical analysis. They have demonstrably improved the quality of data input and have ensured a more coherent and consistent data evaluation strategy. Geomechanics has uncertainties which are recognizable and manageable. A pro-active and integrated petrophysical data quality control strategy can eliminate data redundancy and reduce uncertainty in wellbore stability and formation failure evaluation.

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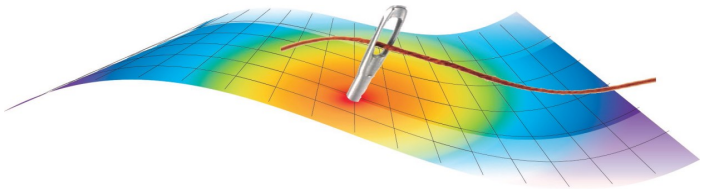

7.

Trajectory Optimization Under Complex Stress Fields: Exploration Surveys in the Gulf of Mexico

Adrian Rodriguez-Herrera, Schlumberger

We provide a description of the use seismic-driven 3D geomechanical models for updating well locations and configurations, aimed at maximizing wellbore stability conditions within a geological context. We introduce geospatial optimization algorithms; both constrained and unconstrained, their theoretical background and deployment examples; allowing well trajectories to be optimized (related to operational drilling windows) upon the existence of a spatial distribution of an equilibrated stress field. Incorporating the effects of both structural features and rock property heterogeneity through the geomechanical modelling of an exploration survey in the Gulf of Mexico, results allow for a comprehensive review of the wellbore stability issues and a direct mapping to their in-situ causes. It aims at improving current drilling engineering processes as we demonstrate the manner in which subsequent alterations to a preconceived well plan are provided with an immediate update of the pore and fracture gradients, in addition to other the geomechanical stability indicators. It avoids multiple iterations of geomechanical studies, performed when modifying well trajectories, primarily in high stress variability environments prone to high sensitivity to drilling direction.

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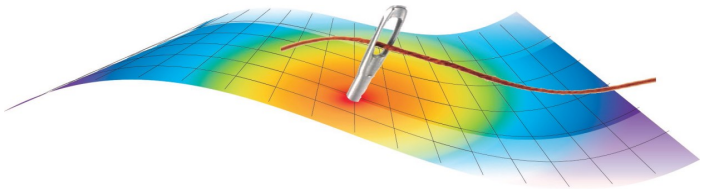

8.

Conventional Geosteering Image Techniques

Paul Johnson, Weatherford

This is an introduction to the basic concepts of “reactive” geosteering with azimuthal geosteering tools. We’ll measure image cusps, explain what they mean and show how to calculate bedding dip and examine the various techniques for calculating dip and creating geological models using this information. We will also examine the common mistakes made by geosteerers who rely on these tools. The tools examined will be Weatheford’s SAGR, HAGR, AZD sensors and (with time allowing) we’ll have a brief introduction to the upcoming CrossWave azimuthal sonic tool.

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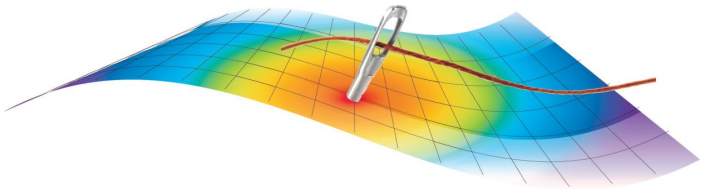

9.

Realtime Operations Geology in Angola

John Bennett

In Oct 2012 there was an Operations Geology one day conference on Operations Geology which was the first of its kind and highlighted the great variety of approaches undertaken within that role. This presentation will summarise the key responsibilities of an Operations Geology team in Angola, intertwined with sampling the unique delights of living and working in the 'world's most expensive city'.

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