Operations Geology Conference: 'Bridging the Gaps'

2-3 November 2016

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The Petroleum Group
The Geological Society, Burlington House, London

Welcome to the 2016 Operations Geology conference held under the auspices of the Petroleum Group of the Geological Society. The committee would like to record their appreciation for their sponsorship and support of the event. Additional sponsorship has been provided by a number of companies which, given the state of the industry, we are extremely grateful and thankful for.

As you are all aware the oil industry is undergoing very difficult times. Activity is low, many jobs have been lost, contracts have been in exceedingly short supply and the future is very uncertain. The title of the conference, 'Bridging the Gaps', was decided upon almost 15 months ago, before the downturn really started to bite, and the topics are probably even more relevant now. Some of the conference themes such as integrating teams and working smarter are about optimising our processes, enhancing communications and working better together and we hope that the presentations and posters will show us ways in which we can do just that. In these tough times, there is also a requirement to cut costs but without compromising safety. Presentations on another theme, 'Focus on the Wellsite', will describe new technologies and processes which will help us to become more efficient.

The convening committee was also keen to test the state of our discipline and to find out exactly who we are and what we do and not rely on conjecture. A survey was commissioned to acquire some hard data from the operational geoscience community and the results of this survey will be presented both orally and as a poster set. At the 2014 conference a mandate was given by the attendees to investigate a competency management system for operational geoscience and a progress report will be presented.

We are also confident some controversial views will be aired which will no doubt engender both discussion and debate about not only of where we are now but also the future of the discipline.

While the convening committee had the initial ideas for the conference, the success of any conference is dependent on the dedication of the speakers. In such difficult times, it must have been particularly hard to find the time and put in the extra effort, to submit an abstract and prepare a presentation. The committee would like to take this opportunity to thank our contributors for their abstracts, presentations and posters. A very big thank you also to all of you attending the conference, not an easy decision to make in these constrained times.

Finally, as with our predecessor conferences, this has been put together by a band of volunteers. If you are interested in helping to plan the next conference in 2018 then please indicate so on the conference feedback form.

Tim Herrett (Chairman)
On behalf of the Conference Convening Committee.

Hozefa Godhrawala (Centrica)
Chris Hayes (RPS)
Peter Mears (Total)
Nick Pierpoint (Independent)
Jim Raggatt (Independent)
Chris Samson (Independent)
Richard Smout (Independent)
Pat Spicer (Independent)
Louise Young (BP)

Geological Society Special Publication
Operations Geology: A Specialist Discipline in Petroleum Geology

Following the 2014 conference a few volunteers agreed to prepare a Special publication for the Geological Society. This effort, with contributions from both the 2012 and 2014 events, is still in preparation.

Volume Objectives:

Operations Geology has evolved as a specialist discipline within Petroleum Geology over the years, without any formal recognition or definition. The role commonly provides a crucial, two way, link between the subsurface community, that defines the targets for drilling and whose lifeblood is the data that is gathered in the drilling process, and the engineers, who actually construct these wells, and who need to understand the properties of and hazards within the rocks to be drilled.

The importance of the role in the modern oil industry, with an increased focus on safer and more efficient drilling operations, has prompted moves to change this informal state of affairs. Work is progressing to develop a means for establishing a system of competence measurement and supporting training courses that will facilitate formal recognition. The aim of this proposed Special Publication is to bring together a set of papers that will help play a part in this process, by defining the scope and highlighting the critical importance of Operations Geology in the 21st century.

Progress:

Approximately 20 authors/author groups have accepted invitations to submit and editorial work is in full swing on about 9 of these.

It had been hoped that the volume would have been published in time for this conference, but industry pressures have competed for folks' time and progress has been slow. There is therefore time to add to the scope of the volume. If you particularly enjoy any paper presented at this conference, please encourage the presenter to write it up for submission.

Pat Spicer on behalf of the editorial board
(Pat Spicer, Richard Smout, Louise Young and Nick Pierpoint)

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09.30	**Tim Herrett (Independent):** Results of the 2015 Operational Geoscience Survey
10.00	**Christine Telford (Independent):** Update of the Operational Geoscience Competency Initiative
10.30	**Coffee Break (Co-chair: C. Hayes & N. Pierpoint)**
11.00	**Gary Nichols (Nautilus/RPS):** Training and Technical Excellence in the Energy Industry.
11.30	**Catherine Proctor (Independent):** How I Became A Gender-Related Statistic: Retaining Staff in Operations-Based Roles
12.00	**Jonathon Watts (HRH):** Real-time Mass Spectrometry at the Wellsite Creates an Improved and More Cost Effective Understanding of Hydrocarbon Reservoirs
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POSTER PROGRAMME

Shaun Coogan (Quad Operations) RhoVe Methof – A New Empirical Pore Pressure Transform
Stephen Forder (Consultant Operations Geologist) Operations Geology; Expanding the Envelope
Tim Herrett Results of the 2015 Operational Geoscience Survey*
Stuart Huyton (Gaia Earth Science Limited) Tenders, Bids and Evaluation (TBE) for Wireline Logging & M/L WD
Steve Jenkins The Role of the Geoscientist in Decommissioning
Emma King (TAQA) 3D Offset Well Analysis in Petrel™
Rudolf Knezevic (OMV Australia) Adjusting of Lag Time Based on Air Gap Analysis
David Rendall (Apache) Modern Approaches to Old Problems – Leveraging Analogue Data in a Digital World
Pat Spicer So, you know you are a Competent Operational Geoscientist ……. but can you prove it?*

**No Abstract as poster is part of an Oral presentation.*

Oral Presentation Abstracts

(Presentation order)

Wednesday 2 November

Session One

State of the Discipline

KEYNOTE: Bridging the Gaps – A Professional Engineer's Perspective

Steven A Flynn
Former BP Group Head of Health Safety Security & Environment

Outline
Operational geologists are asking themselves some critical questions about professionalism in their discipline. This talk will shine a light on some of the key issues, by drawing lessons from a related discipline – engineering:

- **Building Bridges** – engineers first came together in professional associations in the early Nineteenth Century. However, a series of high profile catastrophes, notably the Tay Bridge disaster in 1879 in which at least 60 people were killed, led engineering institutions to confront technical shortcomings and ethical standards.

- **Space Shuttle Challenger** – is a classic case study for the conflict between professional ethics and pressure to deliver. It shows how major engineering failures go beyond technical issues, and involve dealing with the management process and organisational Culture.

- **Deepwater Horizon** – brings the discussion closer to home, and is a reminder of the safety critical role played by technical and operational professionals in the petroleum industry. It helps illuminate some of the key questions that every profession needs to consider.

- **Questions for the Operational Geology Discipline**:
    - What are the purpose, scope and boundaries of your discipline?
    - What are the safety critical aspects of your job, and how does the business and working environment affect decisions?
    - What qualifies you to take the decisions you do, and how is entry controlled – what are the hurdles?
    - What are the checks and balances – do you need to sign up to a professional code?
    - Will you choose to lead?

Results of the Operational Geoscience Survey

Tim Herrett
Tim Herrett Ltd

The operational geoscience discipline, incorporating mainly operations geologists but also well planners, pore pressure specialists, geomechanics experts and wellsite geologists, has it seems changed significantly over the years. No longer is it exclusively a well execution phase role involving data acquisition and distribution. Now it is a wide ranging, responsible and dynamic role encompassing safety critical functions through the entire life of a well.

That is the perception at least.

The 2016 operations geology conference will be the third to be held but one question that we are still to answer specifically is 'who are we' and what exactly do we do? Just what do we mean by the operational geoscience community? What are our demographics? What education levels do we have? What are the usual career path(s) for operations geologists and what is the mix of consultants and staff? Are we adequately appreciated and remunerated for the work we do?

The convening committee for the 2016 conference decided that it would be a good idea to answer these questions by conducting a survey of operational geoscientists and trying to reach as wide an international audience as possible.

The survey, conducted anonymously using a commercial online website, attempted to answer some fundamental questions and also to either confirm or dispel a number of preconceived ideas about the profession with some hard data.

Approximately 120 people from 26 countries fully completed the survey and, indeed, the respondents gave confirmation just how wide ranging and technically challenging the role has now become. There are a number of varied but well defined career paths which emphasise how important mudlogging is as a starting point. Surprisingly there appear to be more staff than consultants and, in common with the rest of the industry we will lose some highly experienced exponents of operational geoscience in the next few years.

Although while some of the respondents feel they are well appreciated in their role, others feel they are not and there is a perception gap between what it is thought we do and what we actually do. Our worth and skills still seem to be undervalued. There is still work to be done to raise the profile of operational geoscience in the industry and demonstrate how we can add much value.

NOTES:

Towards a Competency Management System for Operational Geoscience

Christine Telford
Independent

At the Operations Geology Conference in 2014 a presentation was made highlighting the issues around the lack of a recognized competency system for operational geoscience. This is despite the fact that the discipline is involved in numerous safety critical tasks throughout the lifetime of a well. Other related industries such as civil engineering and engineering geology both have competency systems and registered levels of expertise which, unless you have achieved them, restricts the work that can be performed. The origin of these systems lay in response to issues of competence behind major engineering disasters, such as the collapse of the Tay Bridge in 1879.

A robust measure of competency is not only useful for the assessed person but also for management who hold responsibility for critical assurance. Given the safety focus of the industry and the potential litigious consequences then this is surely a necessary forward step.

Subsequent to a mandate given by the attendees of the 2014 conference a steering group of five members was formed in September 2015 to initiate the process for establishing a UK industry wide competency management system for operational geoscience professionals.

A route map consisting of 3 phases was developed by the steering group.

Phase 1: Learning and communication. Investigating competency systems in other organisations and gaining backing of key stakeholders. Establishing initial frameworks to take forward.
Phase 2: Establishment of broader based steering group who would build on phase 1 and work the competency detail
Phase 3: Implementation of a competency management system.

As of October 2016 we are transitioning from Phase 1 into Phase 2.

NOTES:

Training and technical excellence in the energy industry.

Gary Nichols
Nautilus/RPS Training

The oil and gas industry has a good record for Continuing Professional Development but it is now more important than ever to emphasise the value of training at times when some companies are reluctant to pay for it. That value has to be recognised by both the company and the individual. For companies technical training must be targeted and cost-effective: it must satisfy current business needs and be delivered in flexible ways to fit in with project schedules. For the individuals they need to be able to see how the training directly helps them with their current job and at the same time build up knowledge and skills that allow them to further their careers.

There is growing scope for a greater variety of approaches to technical CPD. Classroom events can be mixed with different distance learning modes, including on-line materials, webinars and virtual workshops, to form blended learning packages. These can be more readily tailored to suit the needs of both the individual and the company, can be more flexibly delivered and ensure that the face-to-face element of teaching is most productive. Geoscientists value time spent learning in the field, but field courses are relatively expensive and time-consuming. To get the most out of field time, 3D imagery can be used to create elements of virtual fieldwork that enhance the fieldwork by adding more quantitative learning. Virtual outcrops can also be used to enhance the classroom learning experience and bring aspects of field experience to those who do not get the opportunity to go on field classes. The requirement for CPD will remain as important as ever, but the nature of the training element is evolving to reflect changing individual and business needs.

Individual technical excellence and the collective quality of a team are not easy to quantify, but a combination of experience and effective training is clearly valuable. These can be formally recognised by achievement of a professional status such as Chartership, establishing a benchmark that is demonstrable and transferable. As the energy industry relies even more on the technical excellence of its staff, developing skills and having a means of recognising them has never been more important.

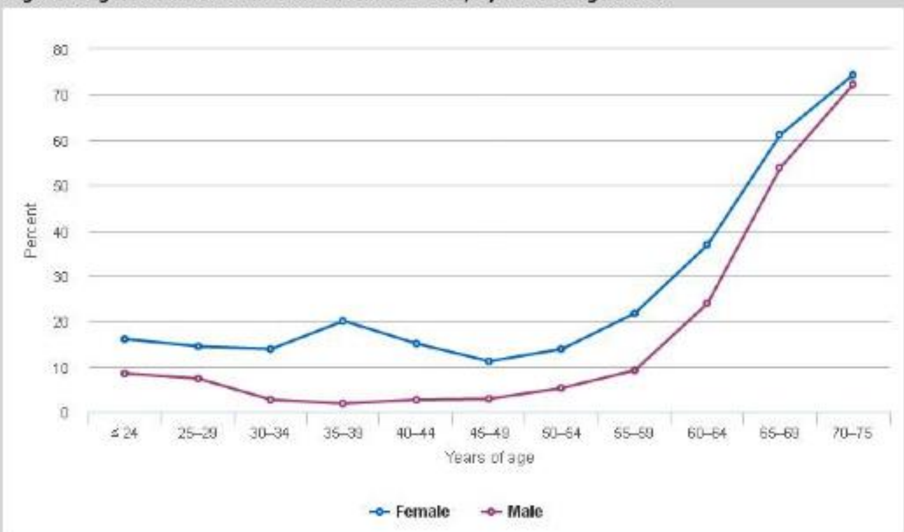
NOTES:

How I Became A Gender-Related Statistic: Retaining Staff in Operations-Based Roles

Catherine Proctor
Independent

The rate of unemployed women, who have their highest degree in science and engineering, peaks between ages 30-45 according to the National Science Board's Science And Engineering Indicators 2016 Report. Though family is cited as a factor in their departure from the work force, a 2012 Harvard Business School alumni study showed women (61% vs. 33% of men) instead move towards employment that offers more work arrangement flexibility. The loss of mid-career employees is an important concern for businesses and individuals as these are prime professional years where the significant investment of early career training and professional experience is fully realized as well as providing a pipeline of diverse and qualified candidates for future leadership roles.
The demanding nature of real-time operations can make employee departures a risk to the health of our discipline. As a former operations geologist, I address the framework for this sometimes complicated conversation as well as potential flexible work arrangements for operations-based roles in order to maintain greater continuity of staff and gender diversity.
Flexible work arrangements include: flexibility in scheduling; amount of hours worked; or place of work. There are several combinations of these options that would be successful in an unpredictable job role such as operations where we are attempting to offer more control over the schedule. Two examples are: 1. Increased sharing of operations so that handoffs can be executed on a set schedule such as sharing night and weekend duty and/or 2. Flexibility to change work schedules in response to well activity.
By being able to clearly articulate the issues involved and offer more stability in the unpredictable schedule of operations, we can help bridge the gap at the mid-career level. Thus stemming the loss of employees and allowing companies to capitalize on the benefits of experienced staff.

Highest degree holders in S&E not in the labor force, by sex and age: 2013



NOTE: Not in the labor force includes those neither working nor looking for work in the 4 weeks prior to February 2013.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT) (2013), http://sestat.nsf.gov.

Science and Engineering Indicators 2016

Bridging the Mid-Career Gap

Alternate Work Arrangements

Scheduling
- Flextime
- Compressed week
- Shift arrangements
- Break arrangements

Number of Hours
- Part time
- Job share
- Part year

Location
- Home
- Satellite
- Alternate location

Real-time Mass Spectrometry at the Wellsite creates an improved and more cost effective understanding of Hydrocarbon Reservoirs

Mariël Reitsma and **Jonathan Watts**
HRH Geology

The use of advanced gas detection and real-time interpretation can aid operational decisions, impact the outcome of a well and help improve cost effectiveness during the drilling phase of a well. The Spectra service is a mass spectrometry based service that has successfully identified known and previously unknown hydrocarbon pay zones and has helped reduce the interpretational and operational reliance on expensive LWD and wireline runs.

Our single mass spectrometry method can detect straight chain alkanes upto C9, cyclic and aromatic hydrocarbons, Helium, CO_2 and bit burn generated alkenes all within one minute. This extensive data set can answer a large range of questions which cannot be addressed in the same detail with a conventional mudlogging gas chromatograph. For example proximity to pay, fluid contacts, reservoir compartmentalisation, fault locations and paleo-migrational pathways have previously been identified.

On a recent well gas ratios indicated an additional pay zone in a stratigraphic interval that was overlooked for production potential during the well planning phase. This zone was detected in real-time with no LWD tools present and would have been overlooked without advanced gas interpretation. The oil present in this zone gave the same geochemical signature as the fluids in the target reservoir (Figure 1). This discovery resulted in a further production test being added to the well testing phase.

Spectra is also used in geo-steering operations as an aid in accurate well placement in horizontal reservoir sections and extended laterals. Using the hydrocarbon fingerprint and monitoring for changes in real-time allows for quick adjustments to the well path as it is being drilled, potentially replacing expensive geo-steering LWD tools. Alternatively, used alongside LWD tools, the data set is further refined to track hydrocarbon 'sweet' spots more accurately. Spectra allows the well to be steered not just through the productive hydrocarbon interval but keeps it within the preferred API gravity range as well.

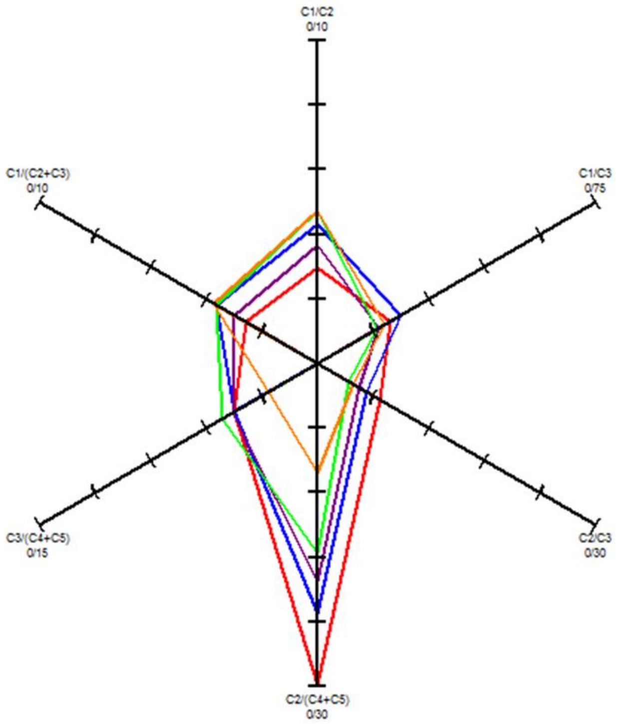


Figure 1: Fluid fingerprints of the target reservoir (blue, purple) and the additional pay zone (red, orange, green).

NOTES:

Wednesday 2 November

Session Two

Focus on Wellsite

Application of real-time chemical stratigraphy in support of the safe drilling of HPHT wells: Examples from the Shearwater Field, Central North Sea, UK

Daniel Atkin[1], Manuel Vieira[2], James Watson[2], Ben Taylor[2] and Dave Jones[2]
[1] *RPS Ichron*
[2]*Shell U.K. Limited*

HPHT conditions can pose a number of challenges in drilling operations necessitating careful well-planning and the acquisition of robust real-time data in order to reduce uncertainty and potential HSE risks. We present here data from a series of HPHT wells drilled in the Shearwater Field, UKCS, where chemical stratigraphy was utilised in conjunction with other geological data in order to aid real-time stratigraphic placement. Systematic changes in geochemical composition have been identified and used to build a chemostratigraphic zonation to aid delineation of lithostratigraphic boundaries. Synthetic Gamma-Ray (Synth GR) curves based on the geochemical composition of cutting samples have also been implemented in support of real-time geological interpretations.

Application of these techniques provided a valuable source of data, particularly through critical "drill-in-liner" sections that are devoid of conventional LWD logs. The identification of key geochemical zones and provision of a Synth GR profile were utilised in the placement of key casing points and identification of cryptic top reservoir section calls (Fulmar Formation). These data also served as a back-up during LWD tool failure resulting from excessive temperatures. The successive addition of geochemical data accumulated with each well-site exercise permitted continued refinement of the zonation framework, with derived Synth GR profiles exhibiting an extremely close relationship with subsequent wireline logs. Chemical stratigraphic data are shown to be robust and repeatable at the field-scale, enabling close stratigraphic control through critical sections.

The implementation of real-time chemical stratigraphy in the Shearwater Field is shown to be an effective tool in reducing stratigraphic uncertainty and potential risk, whilst also providing a low-cost back-up in the event of conventional wire-line logging tool failures.

NOTES:

Well Placement and Geosteering in a Big Data Environment: Data Management and Interpretation to Maximise Operational Efficiency

Gary Aillud[1], N. Baker[2], M. Al Isber[2]
[1] *ADCO (Abu Dhabi Company for Onshore Petroleum Operations)*
[2] *Petrolink*

Since the inception of geosteering and drilling horizontal wells in the 1980s, advancements in reservoir characterisation, downhole tool technology and real time data transmission has led to more complex well planning in order to maximise reservoir contact and sweep efficiency. This has been driven largely by advances in LWD technology and the ability to acquire more complex geological data sets and improvements in date transmission. The challenge for today’s geoscientists is how to maximise the use of these datasets for timely and operationally efficient decision making.

To date publications on well placement tend to focus on improvements in technology, the availability of data and geosteering in challenging drilling environments. There is very limited discussion on how data is being used in real time or near real time, to update the reservoir model and allow for more effective geosteering decision making and subsequently success of the well.

This paper outlines an example of a workflow developed on a restricted data set from onshore Abu Dhabi. This was developed using LWD/MWD and limited surface parameter data. It integrates a recent real time adaptation of a widely used basin and field scale correlation algorithm Real Time Stratigraphy (RTS). RTS transforms the raw gamma ray data and provides a powerful correlation tool that has been effectively used to land wells and pick casing points using restricted data sets in potentially complex reservoir geometries. The workflow outlines the use WITSML data to visualise and interpret geological using multiple software applications in an efficient way in order to efficiently update geological and petrophysical models allowing for optimal well placement and reservoir contact whilst reducing potential lost time from delayed decision making. The result maximises the use of real time dataset availability not only in well placement decision making but also to improve turn around an efficiency in model update for future well planning and field development decisions.

NOTES:

The Gigital Path-wau from Core Barrel to Oil Barrel

Colin Maxwell
Geologix

Sedimentologists have, since coring began, expressed their interpretations with ultimate creativity, flexibility and personality using pencil and paper. To assimilate these interpretations into a digital workflow requires subsequent digitising of grain size, facies, structures, fossils and mineralisation for; correlation, reservoir characterisation and storage of raw data. This conversion to bits and bytes can take as much as 4 hours to complete with both geologist and technician involved in the conversion and quality control process. The workflow beyond is already entirely digital but this initial bottle neck exacerbates the time between cutting core and providing valuable geological data to the reservoir model and is most notably felt in wells where this information is required quickly.

Digital data intrinsically requires logical organisation and standardisation of the subject in question. Describing core directly into a software application via a stylus on full workstation level tablets can provide not only the experience the geologist seeks but also the structure to the data the rest of the process requires for efficient use. Company approved log templates, including a uniform library of symbols, patterns and structures, provide a common interpretive environment that benefits correlation and retrospective analysis. Moreover predefined export profiles expose raw data that can be consumed by corporate data stores and by other enterprise level applications in the critical path of reservoir characterisation.

Using applications that optimise the journey of their information can as of now; free up geologists time to engage more with the core, expedite the data quicker to the formation characterisation process and provide clear, standardised data sets with which to conduct retrospective and legacy formation studies.

NOTES:

Operations Geology Conference, 2-3 Nov 2016, London Utilizing time-based data models for calibration of depth-based interpretation for pore pressure during drilling

Cory Moore, Eamonn Doyle[1], Karol Jewuła[1], Łukasz Karda[1], Tim Sheehy[1], **Stephen O’Connor[1]**
Obren Djordjevic[2]
[1] *Ikon Science*
[2] *Murphy Exploration & Production Company*

Monitoring of borehole operations in realtime is vital on wells drilled today, to provide the well team with the best information in a timely manner to mitigate predrill uncertainties and drill safely and proactively, to have the best chance of reaching planned targets. Recent proposals by the United Sates Bureau of Safety and Environmental Enforcement indicate realtime monitoring might soon be mandatory on many offshore US wells.

Pore- and fracture pressure estimation and prediction are extremely important aspects of realtime monitoring, which often rely solely on depth-based drilling and petrophysical data. If calibrated correctly depth-based models can be fairly accurate; however, the depth-based model has a relatively low resolution, with data points at 0.5 foot or 0.2 meter intervals, and of course is only updated and providing useful data when new hole is being drilled, ie measured depth is increasing. Unfortunately realtime pore pressure models that only contain depth-based information are potentially flawed because many useful calibration points occur during well construction while the bit is off bottom that are not seen in depth-based data and are therefore impossible to capture in the depth-based model. Operations such as connections, off-bottom circulating, wiper trips, flowchecks etc. all produce high resolution, time-based information that has to be used in proper realtime monitoring. When analysed, such data provide invaluable additional information to permit further calibration of the models. Building a time-based model in parallel to the depth-based model gives a far more robust picture of downhole conditions.

This paper will use real examples from the Gulf of Mexico to explain the importance and benefits of constructing a time-based model for use alongside the depth-based model. It will also demonstrate how discrepancies between depth-based models and time-based models can arise, illustrating the inherent weaknesses in the depth-based-model-only approach.

The result of using all available data, in both depth and time domain, is a more robust, integrated model on which to base the pore pressure estimation and prediction and ensure the well team gets the best possible information.

Example figure follows:

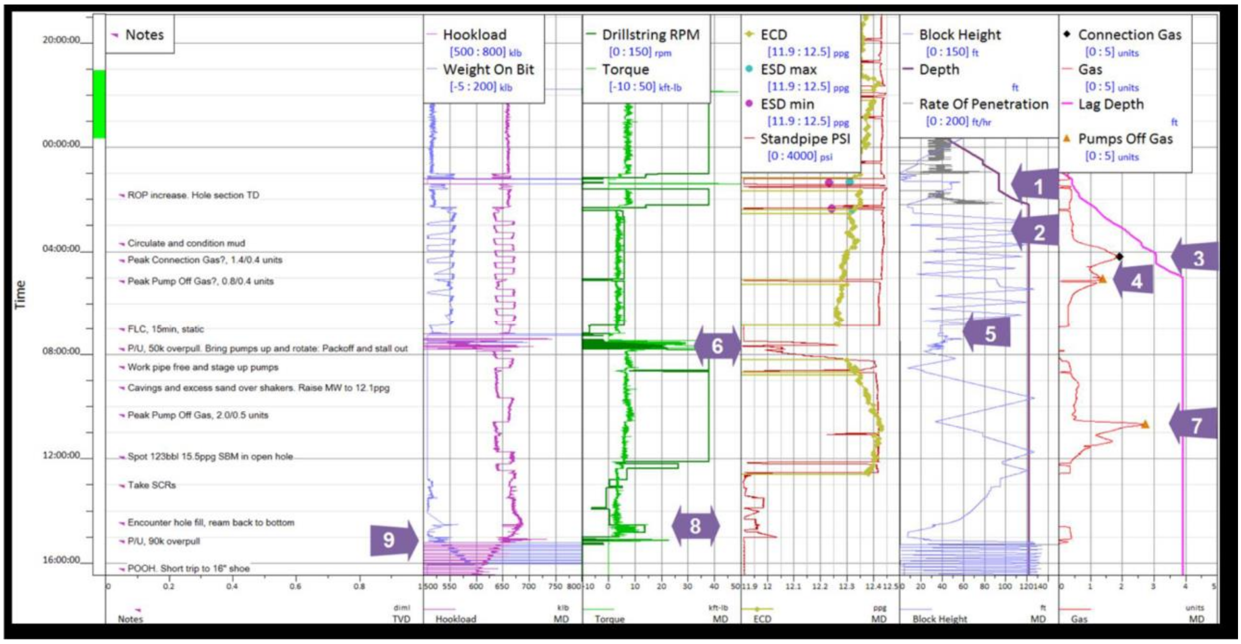


Figure 1. Time-based data plot of a pack-off event

Item 1: A single joint of drill pipe was picked up to drill to section TD.
Item 2: At section TD the hole was circulated clean without raising the mud weight.
Item 3: While circulating at section TD a connection gas from the last connection (item 1) is seen.
Item 4: While circulating at section TD a pumps-off gas is circulated out from when the pumps were brought down after drilling ceased.
Item 5: A 15 minute flowcheck after the hole is circulated clear of all cuttings shows the well is static
Item 6: The hole packs off and the pipe is stuck when the mud pumps are brought back up after the flowcheck (Item 5).
Item 7: A pumps-off gas from the flowcheck (item 5)
Item 8: Hole fill is encountered when returning to bottom, which requires reaming

NOTES:

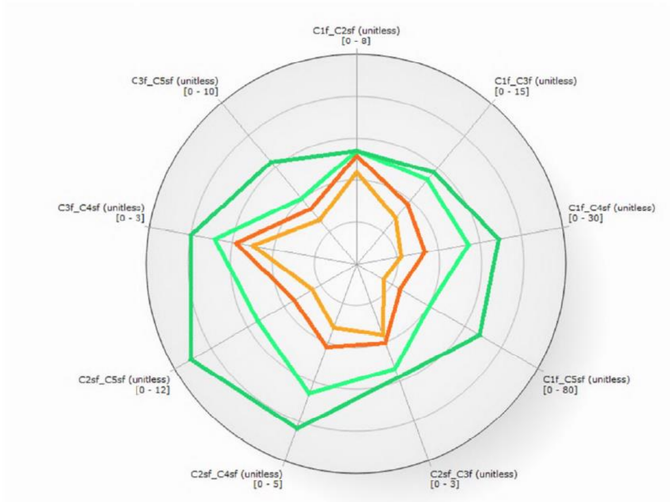
Quantitative Gas While Drilling Systems

Maria-Carolina Maninat
Total EP UK

Surface acquisition of well site data have improved with mudlogging companies bringing new techniques to evaluate cuttings, surface gas and drilling optimisation and performance. Acquisition and interpretation of the gas from the well at surface has been a standard practice at the wellsite for many years. It has been used primarily for safety and identification of potential reservoir zones together with downhole measurements. As new measurement technologies emerge, mudlogging companies have developed equipment aimed at better and efficient gas extraction at surface. The extraction and proper correction of gas data aims to quantify gas data which can then be compared with downhole fluid analysis, PVT samples and laboratory analysis.

Currently, TEPUK has been testing results from several gas chains (standard gas chain and advanced mud gas chains) which are being compared to laboratory analysis and PVT sample. A standard gas chain comprises of a constant volume degasser coupled with Flame Ionization Detector (FID) to deliver TG + C1-C5 gas data for safety and Gas While Drilling (GWD) studies which allows identification of reservoir layers, potential seals and fluids. However, this level of acquisition does not allow determination of the nature of the fluids: gas, condensate, oil or heavy oil.

New technologies in Advanced Mud Gas (AMG), provides the benefits as a standard gas chain with accurate quantification of C1-C5 (**Figure 1**). The AMG gas chain consists of a constant volume and temperature degasser coupled with improved FID system. The improved FID system allows high resolution quantification of C1 and C2, with contamination (alcohols and amines) free C3-C5 and correction of the recycled gas (Gas IN and OUT corrections). This technology allows the possibility to identify fluid composition close to PVT sample when compared to the same range of cuts (**Figure 2 & 3**). This data coupled together with Continuous Real Time (CRT) isotopes logging allows identification of fluid type and gas associations. This presentation outlines acquisition of gas data in recent CNS and NNS wells drilled by TEPUK, and highlights how the data is used by operations and asset geologists, and how drillers are now appreciating the value of high-end real time gas data.



Fluids	0% 20% 40% 60% 80% 100%	%C1	%C2	%C3	%iC4	%nC4	%iC5	%nC5	Whs	Bhs	Chs
1a		56.28	15.08	13.98	1.48	7.86	1.76	3.57	43.72	2.51	1.05
1b		63.92	13.98	11.72	0.95	5.76	1.11	2.56	36.08	3.54	0.89
2a		69.49	14.63	9.17	1.03	3.41	0.90	1.37	30.51	5.31	0.73
2b		71.65	14.79	8.59	0.78	2.80	0.56	0.84	28.35	6.43	0.58

Figure 1: Fluid facies distinguished with AMG gas chain

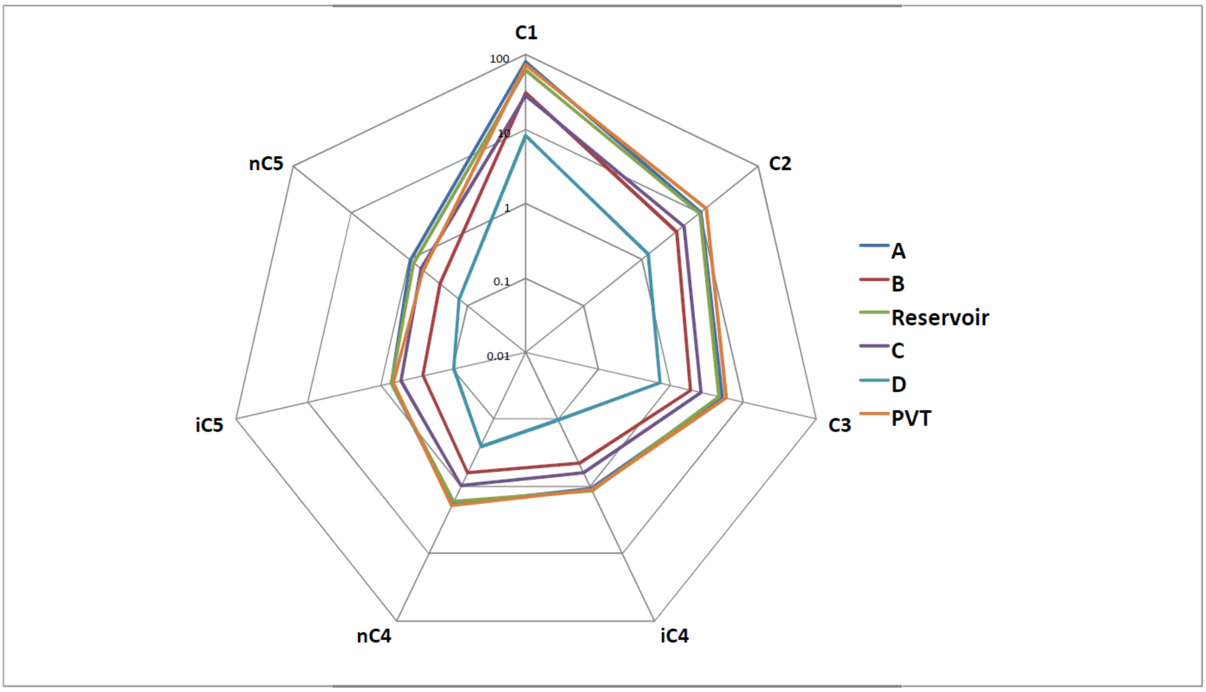


Figure 2: AMG gas facies and comparison with the PVT sample

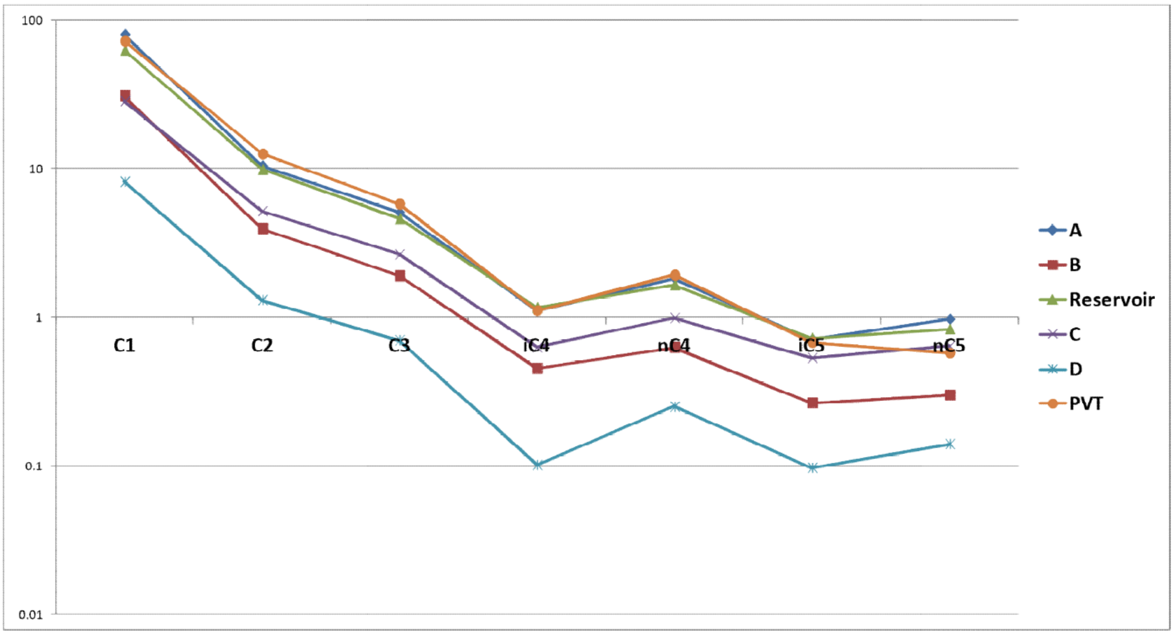


Figure 3: AMG gas facies and comparison with the PVT sample

NOTES:

Formation Pressure Test Efficiency Enhancement through Dynamic Cutoffs

Bataller, F.J., **Rojo, Daniel**, El Jaafari, K., Beda, G.
Repsol E&P

It is widely known that one of the most time, and effort, consuming (and costly) in logging operations is formation pressure sampling. Apart from the time needed for clean-up phase and then sampling the reservoir fluid, getting an accurate and representative formation pressure measurement could be challenging, predicting and avoiding the invalid points when selecting depths for pressure, especially in complex lithology with relatively low to very low permeability.

This paper focuses on the latter issue, and proposes a workflow that assesses the best intervals for formation pressure and sampling and its chances of success in order to optimise the operations and the strategy. This workflow is based on offset well data and e-log data acquired in runs prior to the formation pressure testing, and has been successfully applied in a recent exploration campaign. We also present an alternative for wildcat exploratory wells, where the lack of offset data is very significant.

The methodology is based on analysing the relationship between valid and non-valid pressure measurements with different logs (Density, Neutron, NMR, Resistivity and Gamma Ray). Statistical parameters for the chances of success for the selected depth points were also calculated, after finding these relationships in different databases. Intervals with a higher chance of success can therefore be provided and specific depths in which there is a low rate of success to acquire measurements can also be anticipated. This methodology helps optimizing the fm. Pressure program, avoids wasting time in tight intervals, and facilitates standardising criteria for pressure points selection.

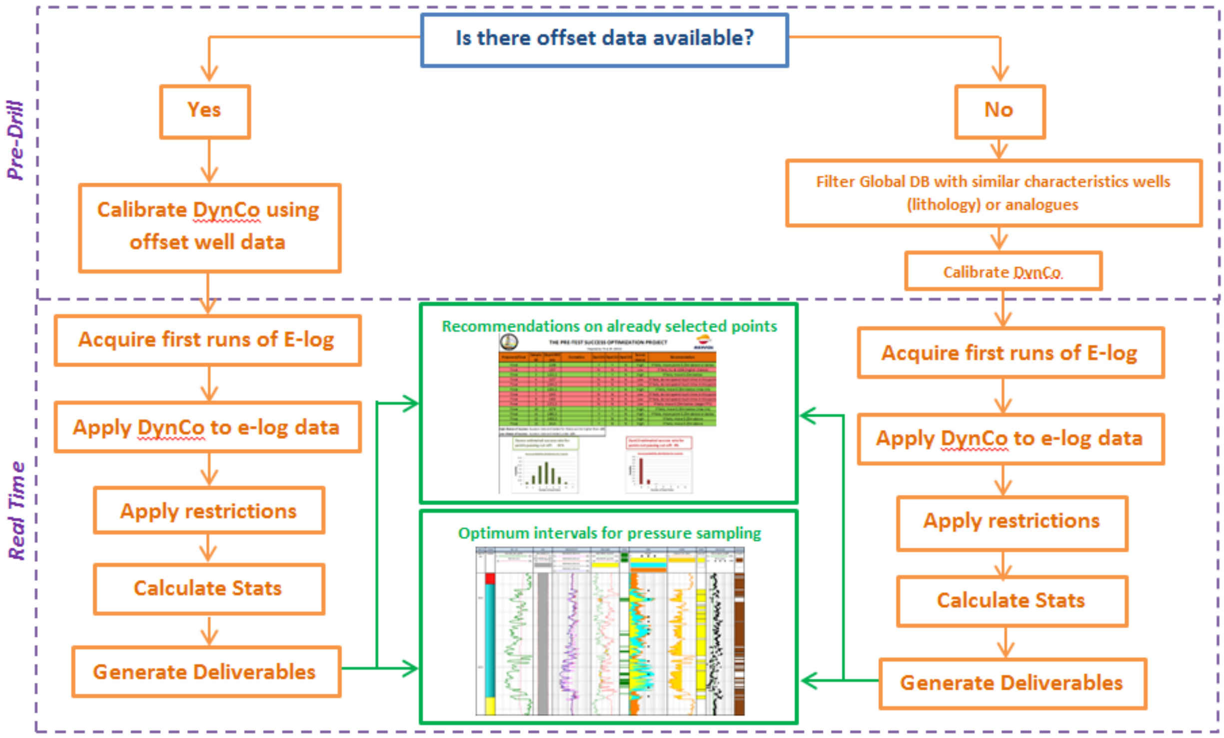


Figure 1: Analysis workflow and deliverables

NOTES:

Thursday 3 November

Session Three

Working Smarter

KEYNOTE: Operations Geology Competency – A Lost Cause or Not?

Alan Mitchell
Former Global Operations Geology Manager at TOTAL SA. Now retired.

The changes in our industry over the last 20 years have led, for a variety of reasons, to a progressive rarefication and dispersion of professionalism in operations geology. An overview of those changes and their consequences will be followed by a discussion on why we should try and re-establish the previously high standards of our profession.

Technological evolutions (some say revolutions) such as LWD and real-time control centres have led to a gradual reduction of the responsibilities of the well-site geologist and the level of the decisions he is required to make.

This has, in turn, led to a reduction in the competency required onsite by many operators and consequently to a lack of professional development. The result of this degradation is that operations geologists in town have less and less actual well-site experience. As a result, decisions in real-time centres may be made by people less and less competent to make them.

In parallel the senior generation of hard-core operations geologists and well-site geologists who have been at the heart of our profession for the last 30 to 40 years are reaching the end of their careers. The current worldwide crisis in the industry will do nothing to help that situation. The probability is that, of the senior population that was working a couple of years ago, less than 60 or 70% will still be available for the upturn. Hopefully I’m not being too optimistic!

It is also reasonable to limit the upper age limit, especially at the well-site. We all abhor fatalities on rigs and they should certainly not be due to old-age!

Last but not least, I will attempt to illustrate the ways forward to redevelop competency, attract new talent, and convince the industry that we can regain those standards and reassure them that we have training and competency evaluation processes comparable (or superior) to other professions.

This final section will be closed by a discussion on whether or not our profession should have some form of certification.

NOTES:

Deep development drilling in a hostile subsurface environment, technical challenges and the application of new technologies. Operations geology in the Karachaganak Field Kazakhstan

Mark Tringham, Temirzhan Kalim, Vincenzo Meli & Ruslan Nurgaliyev
Karachaganak Petroleum Operating b.v.

The giant Karachaganak oil and gas condensate field onshore West Kazakhstan has been intensively developed over the last 4 years with a 3+ rig program completing 24 new wells and 12 side-tracks. These wells have been targeting a ~200m thick oil column in Carboniferous reef carbonates which underlie a Carboniferous/Permian gas condensate cap which is up to 1450m thick. Typically these new wells and side-tracks have been drilled to depths of -5100m TVDSS and around 6500m MD, with over 1200m of sub-horizontal development within the oil zone. Particular drilling challenges include a mechanically very unstable over-burden section comprising Late Permian salt and Permo-Triassic claystone. Within the carbonate reservoir mud losses commonly occur into paleo-karst or fracture systems. These have required both conventional LCM treatments and the provision of closed hole drilling capability in one area of the field.

As the field development has progressed and better quality seismic data obtained, it has become clear that differential pressure depletion is occurring, with baffles or seals developed along some reef clinoform and other surfaces. Additionally it has been recognized that fractured intervals, while providing zones of enhanced productivity, also pose a risk for possible water break-through from the underlying aquifer. Because these factors are affecting reservoir depletion and productivity there has been a desire for enhanced well data acquisition. This has comprised over 1km of new coring in vertical pilot holes and new wireline and LWD log data acquisition programs. The logging has included image logging in an OBM environment using TLC and tractor conveyance methods. The improved data has been designed to refine knowledge of sedimentary and structural characteristics and in turn help optimize future development planning. The field development is on-going and the recent stratigraphical, structural and petrophysical results are integral to the future plans.

Figure 1: Location Map Karachaganak Field and North Caspian Basin

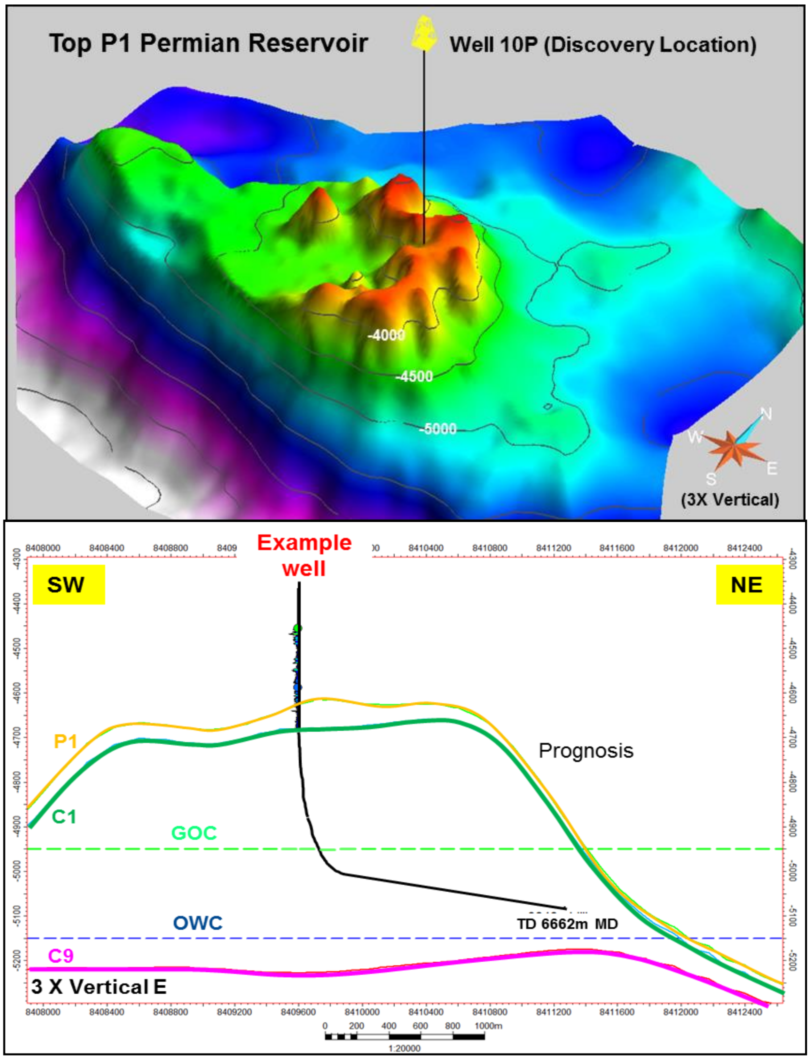


Figure 2: Karachaganak structure & a typical well profile

NOTES:

A petro-physical approach to the investigation of shallow geology

Francis Buckley and Lewis Cottee
LR-Senergy Survey & Geoengineering

Top-hole drilling hazard interpretations are generally limited to a probability assessment of encountering perceived drilling hazards and a prognosis of lithologies based on sparse well data and/or regional stratigraphic models. However, an approach based on petrophysical analyses of available well and seismic data can provide a more robust assessment of top-hole lithologies and a more confident interpretation of shallow gas anomalies and over-pressured formations. Generation of offset-well acoustic-impedance curves provides the starting point for these investigations and, though the requisite data are rarely present in top-hole wireline suites, the Faust and Gardner equations can supply acceptable mathematical approximations.

Absolute impedance inversions facilitate more confidant interpretations of lithological units, especially when combined and cross-plotted with additional datasets such as GR, resistivity, porosity and S-wave sonic.

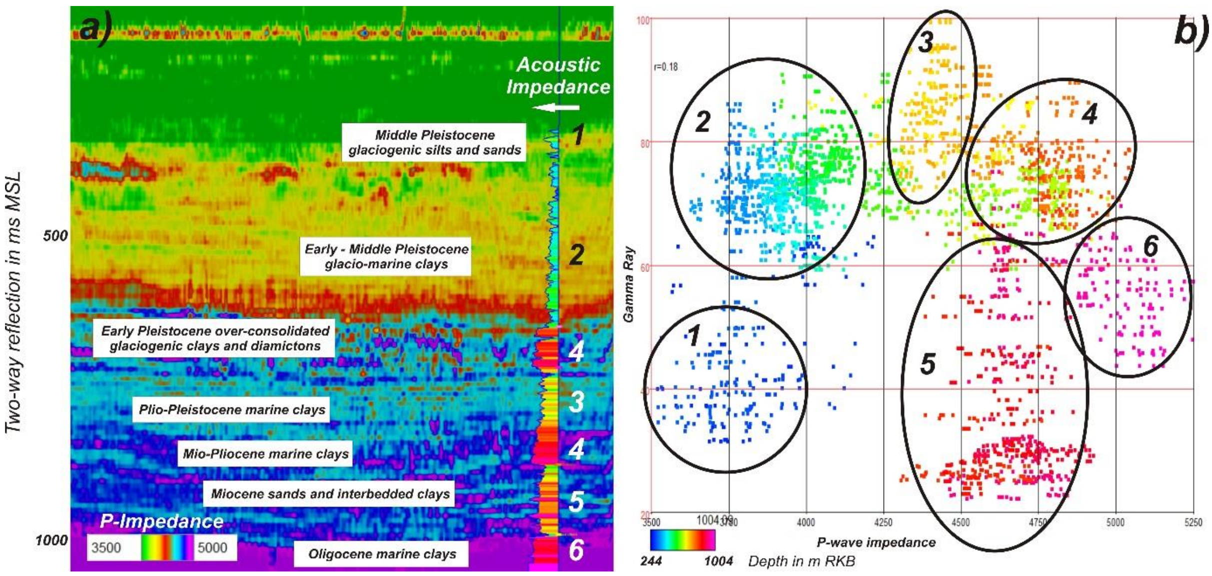


Figure 1 a) Seismic inversion section overlaid with well-log impedance curve; b) Gamma Ray and P-wave impedance cross-plot showing differentiation of top-hole lithologies

Anomalous seismic events interpreted to represent a probability of encountering shallow gas, using traditional interpretation methods may be further investigated using AVO cross-plotting techniques, including fluid factor calculations, and the potential for over-pressured gas accumulations or flow sands may be estimated from pore pressures calculated from seismic velocities.

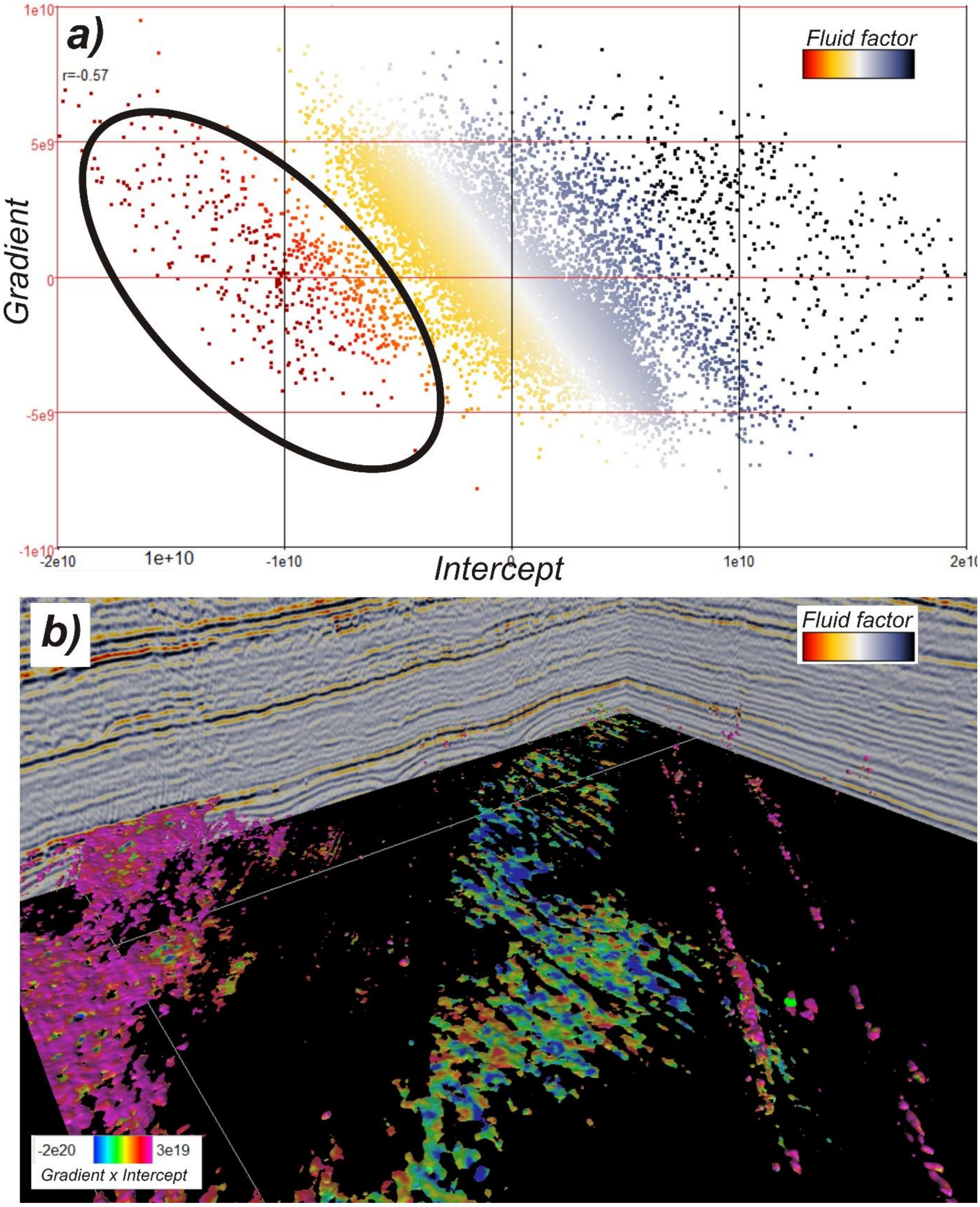


*Figure 2 Shallow seismic anomalies investigated using AVO and fluid factor methodology; a) Gradient and intercept cross-plot overlaid with fluid factor values with gas sand response highlighted; b) 3D perspective view of fluid factor display sections and geobody extraction of gas sand response overlaid with gradient*intercept response*

These methods, and other more complex investigation techniques, such as pre-stack AVO, elastic inversion and stochastic inversion are rarely practised in the course of shallow geohazard studies, but they have the potential to significantly enhance more traditional interpretation techniques.

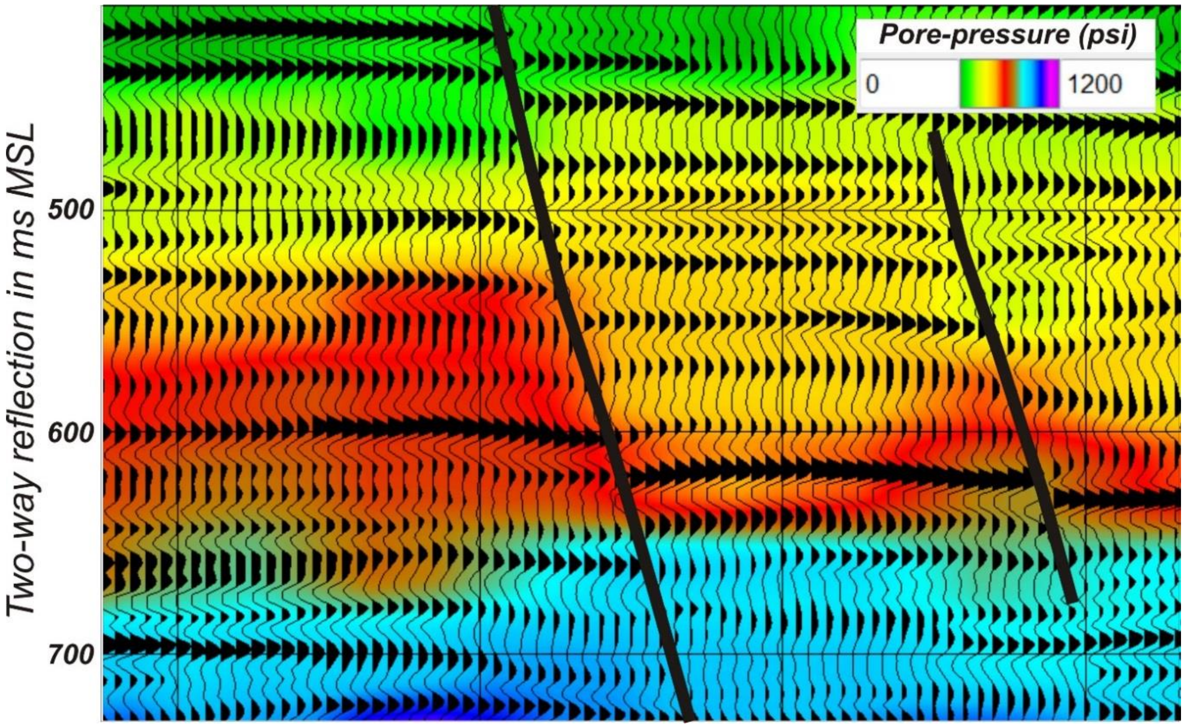


Figure 3 Pore pressure estimation from 3D seismic velocity cube, overlaid with seismic traces and fault interpretation illustrating raised pore-pressures on foot-wall of normal fault

NOTES:

Cygnus "in a tight squeeze": Mobile salt an expensive problem - integrating new technology to mitigate the risk.

Keren Simpkin[1], Eva Gerick[1], Nick Hart[2]
[1] *ENGIE E&P UK Limited*
[2]*Independent*

Mobile salts in the Cygnus Field (Figure 1) caused significant challenges running the production liner in the first 44/12a-A4 well, whilst the A3 well suffered liner collapse due to the rapid squeezing action of these salts. The well had to be side-tracked and re-drilled at significant cost. Sonic (acoustic) tools can help identify and differentiate between types of salt. The particularly mobile salts are characterised by slower sonic transit times (75-80 us/ft compared to 67-70 us/ft in the surrounding Halite) but the drilling environment has historically been too noisy for Logging While Drilling tools to obtain viable real-time data. A new tool, *SonicScope 675*, has overcome this by being able to process the data while drilling. This tool was successfully used in the A3Z well enabling accurate real-time logs to be produced and the intervals of the riskiest, potentially rapidly mobile salts to be identified. This allowed critical, timely action to be taken: the key interval was under reamed to delay the rapid onset of salt squeeze, a thicker-walled 7-5/8" liner was run across the risk zone and the cement setting time was reduced to produce a strong cement bond before the salt could crush the liner. This strategy has now been adopted for all wells on the field, avoiding the cost of expensive side-tracks and ensuring the long-term production on Cygnus.

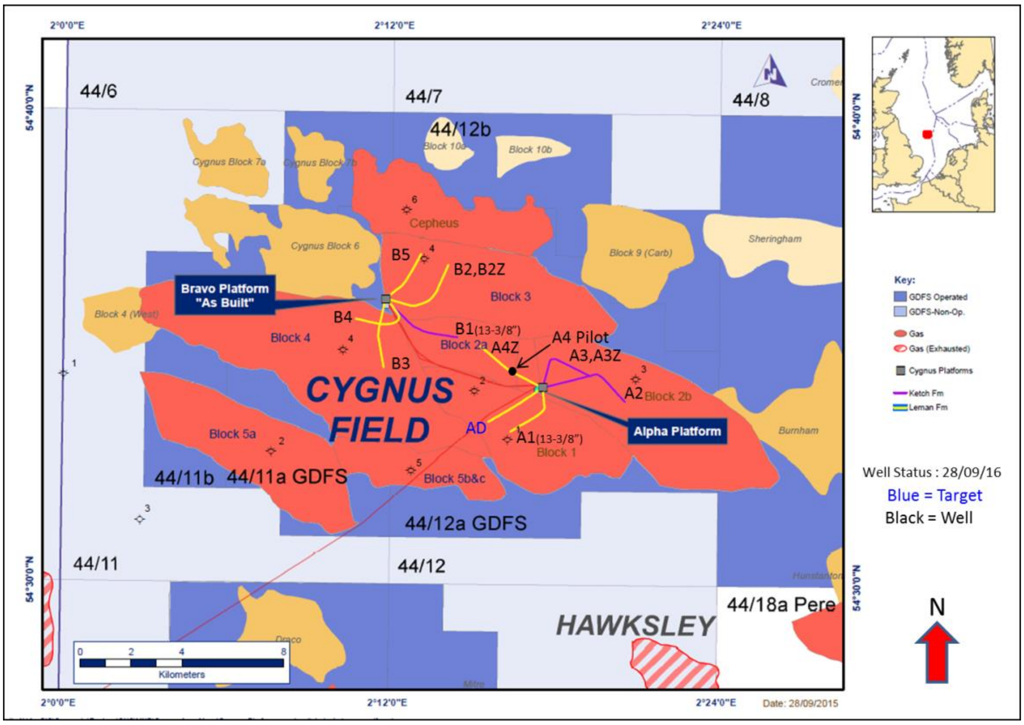


Figure 1: Map of the SNS Cygnus Field

Understanding Uncertainty in Pore Pressure Prediction

Stephen O'Connor[1], Alex Edwards[2], Sam Green[1], Ed Hoskin[1], Jakob Heller[3], Guy Markham[1], Amy Ellis[1]
[1] *Ikon GeoPressure, Durham*
[2] *Ikon GeoPressure, London*
[3] *Ikon GeoPressure, Kuala Lumpur*

Robust pre-drill pore pressure models are typically obtained using offset well data and seismic velocities. Recent feedback from the industry seems to suggest that there is no general consensus on the impact of uncertainty on well design in terms of risks and costs, and the methods by which this uncertainty may be quantified. We present here a review talk aimed to highlight the understanding of, and the reduction of, this uncertainty during well planning.

The first task is to recognise where uncertainty can occur, that is, which inputs are likely to have the most significant effect if associated uncertainties are propagated though the model. The model inputs can be a specific data type i.e. density or an interpretation of data i.e. a fluid gradient or overburden, each with an intrinsic uncertainty of differing magnitude.

A secondary challenge is that the choice of pore pressure algorithm itself can impact or constrain the final pore pressure model simply due to the mathematical nature of the relationship used. This is particularly true of shales, where "human" influence such as the definition of an NCT can introduce additional bias.

Finally, what is the applicability of standard statistical techniques to the uncertainty process, for instance the Monte Carlo simulation? Can we accurately compare different models? The discussion will include a review of scenario modelling, standard deviation, and basin modelling approaches, and this talk will conclude by introducing a potential way forward, one where we could consider both data-driven uncertainty in conjunction with a more process-driven approach.

The ultimate aim is to help us make operational decisions based on uncertainty analysis.

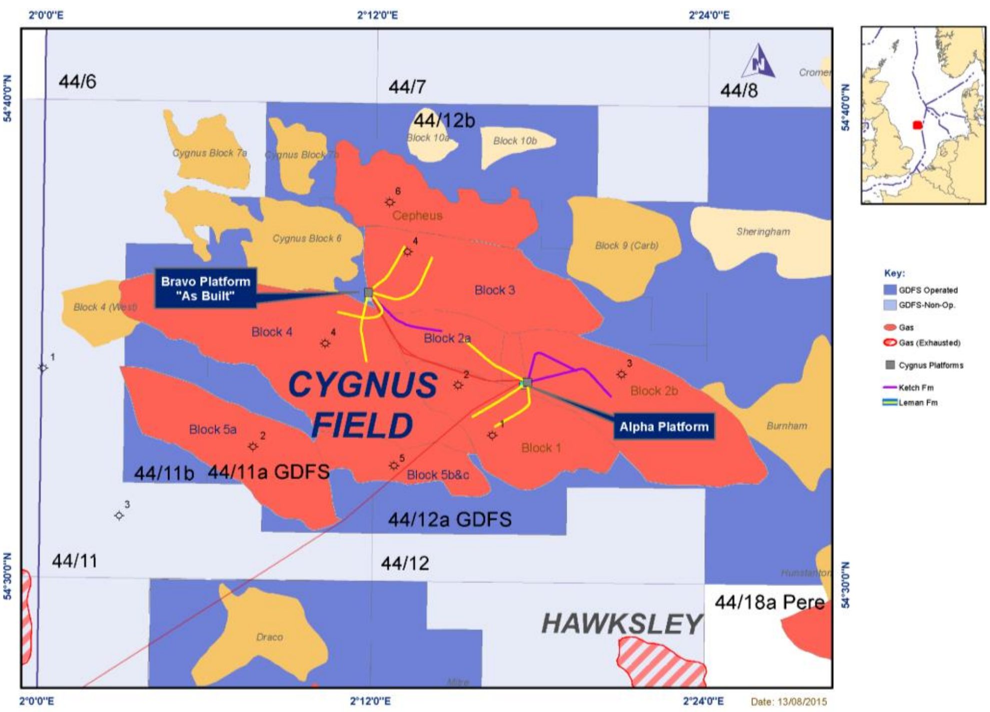
NOTES:

Precise well placement in the Cygnus gas field and the delivery of high performing wells in a highly layered reservoir.

Ian Dredge
GdF Suez

The Cygnus gas field is being developed by ENGIE E&P UK Limited and is one of the largest discoveries in the Southern North Sea in the last 30 years. The field has two gas bearing reservoirs; the Carboniferous Westphalian, Lower Ketch 2 and the Permian Lower Leman sandstone formation. The Lower Leman Sandstone Formation is the main reservoir target with 7 of the 10 wells in the development to produce from it. The Lower Leman Sandstone Formation is highly layered comprised of fluvial influenced playa shoreline facies. The better reservoir quality intervals are restricted to thinly bedded laterally extensive sand rich intervals related to drier climatic events. The decision to employ an active geosteering methodology to preferentially target these intervals in the first Leman production well, 44/12a-A4Z, has been gradually advanced over time.

Through the successful use of multiple real-time LWD data sources for precision reservoir navigation, the higher porosity and permeability layers have been preferentially targeted. The team has delivered impressive results in a challenging reservoir and maximized productivity at start up. This has been a highly collaborative effort between the Subsurface and Drilling teams, both onshore and offshore and the LWD service provider.



NOTES:

Thursday 3 November

Session Four

Integrating Teams

Integrated planning process and effective communication to mitigate drilling losses on the Rumaila Field, southern Iraq

Kirstin McBeath, Dave Saucier, Ken Tough, Matthew Pointing and Mark Taylor
BP Iraq

Rumaila is a supergiant oil field in southern Iraq, producing from a number of stacked clastic and carbonate reservoirs. The field has been on production since the 1950s and the current well count is now above 1000. Every well drills through the Dammam Formation, a relatively shallow karstified and dolomitised carbonate sequence comprised of compact limestone and vuggy dolomite (depth range: 400-800mBGL, thickness range: 200-250m). This formation is infamously known locally for its high risk of severe to complete mud losses while drilling, sulphurous water flows and associated well control events. It also presents significant challenges to data acquisition, cementing and zonal isolation. Through the years, drilling of the Dammam Formation has led to a significant amount of non-productive time (NPT) and associated remediation costs. On the Rumaila Field alone, the Dammam losses were responsible for over 25% of the total NPT over the last 5 years.

In response, a multi-disciplinary risk management plan was established with the aim of predicting, preventing and mitigating losses to the Dammam Formation. Mitigations were developed by the Drilling team with support from the Subsurface team to produce an engineered solution to reduce the impact of losses when they occur (U. Arshad et. al, 2015). This solution is based on a detailed Dammam geological description (Figure 1), a new loss circulation strategy, and improved cementing practices.

Meanwhile, the Subsurface team initiated an integrated study to further improve the understanding of the Dammam Formation and the ability to predict losses to aid in its reduction. Detailed intra-Dammam 3D seismic interpretation was performed and integrated with static / dynamic well data and drilling NPT events to understand the relationship between loss events and seismic character (Figure 2). The result of the integrated study was a composite risk map to communicate the likelihood of losses and the predicted depth interval of the event (Figure 3). At the planning stage, the map is used to optimise the surface location of new wells, where surface infrastructure allows, with a view to minimising / eliminating the risk of losses. At the execution stage, the map is presented at all pre-spud meetings to communicate the risk of Dammam losses with the rig crews to help inform the expected loss circulation response. Early results from recently drilled wells indicate a significant reduction in loss curing time.

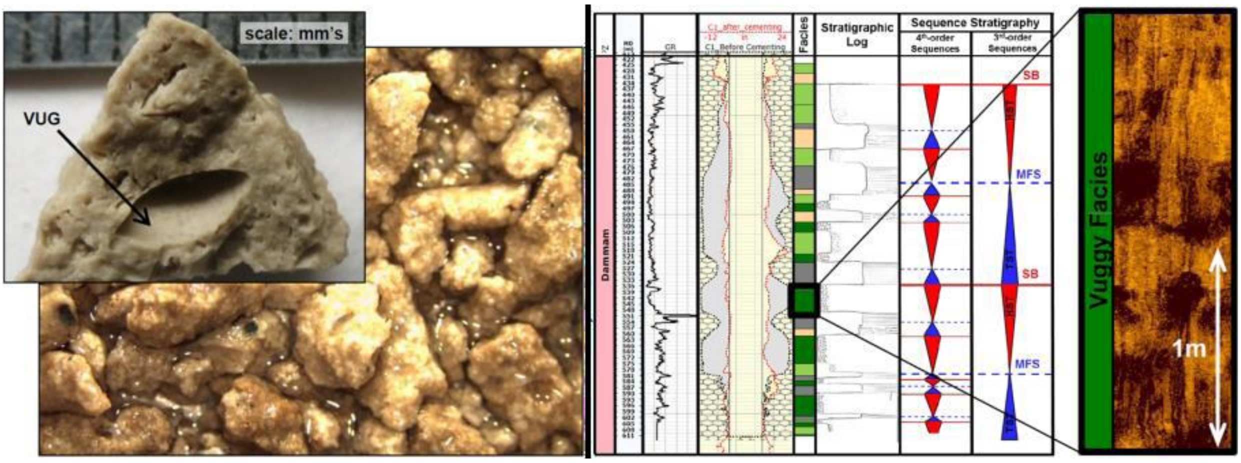


Figure 1: Samples of the Dammam Formation and associated image log showing large vugs.

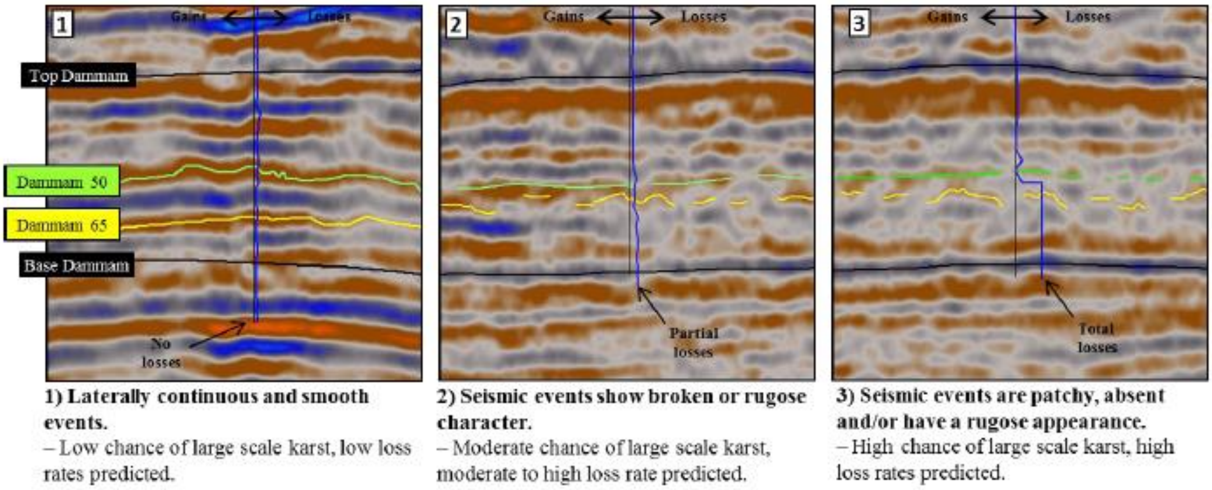


Figure 2: Changes in seismic character to the Dammam 50 and Dammam 65 events link to the presence of karstification and scale of loss events.

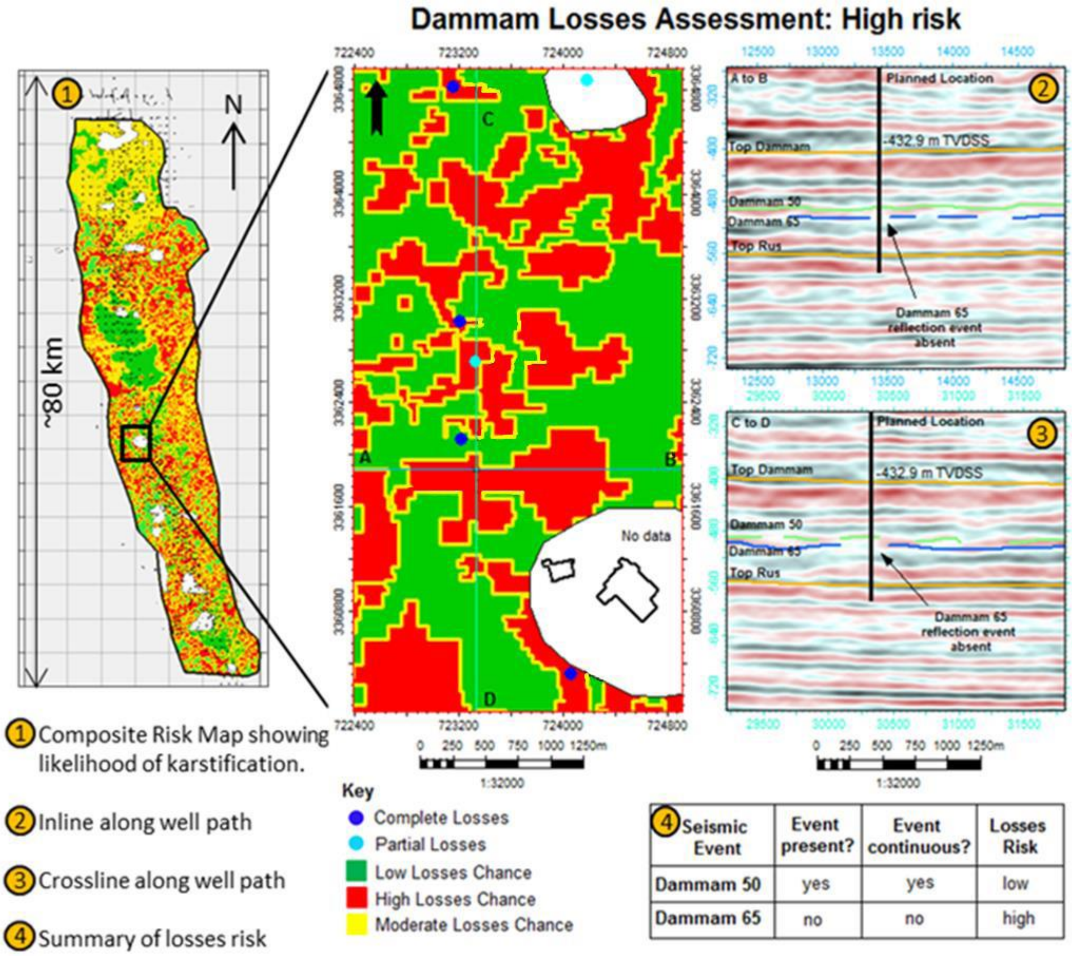


Figure 3: Dammam losses composite risk map.

NOTES:

Real-Time Integrated Subsurface Analysis to Determine Commerciality of the Pegasus West Exploration Discovery

Stuart Walters, A. Colbeck, V. Turner, H. Godhrawala and R. Trythall
Centrica E&P

The Pegasus West (43/13b-7) exploration well was drilled in Q3 2014 in Quadrant 43 of the Southern North Sea **Fig 1.1** with the aim of testing gas presence and quality within the Carboniferous. The overall objective was to assess whether the well was to be suspended for development, saving considerable point forward capex. Key to this decision was determining effective gas-in place (GIIP), as bulk GIIP estimations are not a reliable basis for development.

A detailed workflow was established **Fig 1.2** prior to spud with decision points and outcomes outlined including: 1) Decision to run core over two prognosed high reservoir quality sandstones. 2) Selection of a wireline programme giving critical data over minimal runs. 3) Decision to well test (DST) based upon horizontal permeability x thickness (k.h) calculations from core and wireline data. 4) Suspend or plugged and abandoned decision through assessment of minimum connected volume (MCV), effective GIIP, and minimum economic field size (MEFS) via DST analysis of individual sandstones.

A balance of minimising well cost without jeopardising project safety and objectives was paramount. Operations were carried out efficiently through conducting static model, petrophysical, DST and economic analysis in-house. New working practices and tools were used within the data acquisition programme to give fresh insight into reservoir characterisation. Communication between wellsite geology, drilling, subsurface, biostratigraphy, wireline and LWD operations was integral to cost effective and safe operations.
Through adopting the workflow the well was drilled within original authorised for expenditure time and budget. All decision points passed successfully, including recovering two cores over the highest quality sandstones, running wireline operations without delays and performing three isolated DSTs with a combined flow rate > 90MMscf/d **Fig 1.3**. The DST had an interpreted MCV of >53 BScf, which exceeded the MEFS of 40BScf; therefore the well was suspended.

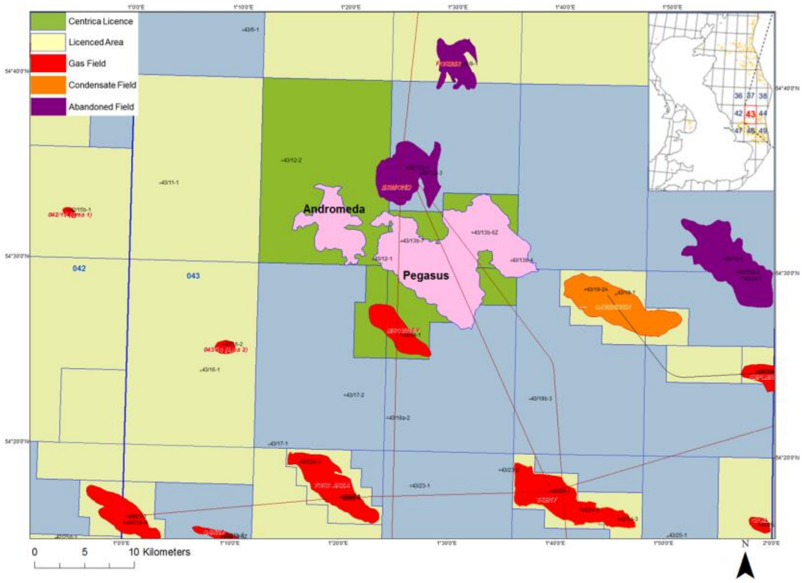


Figure. 1.1 — Location map of Pegasus and Andromeda with offset wells.

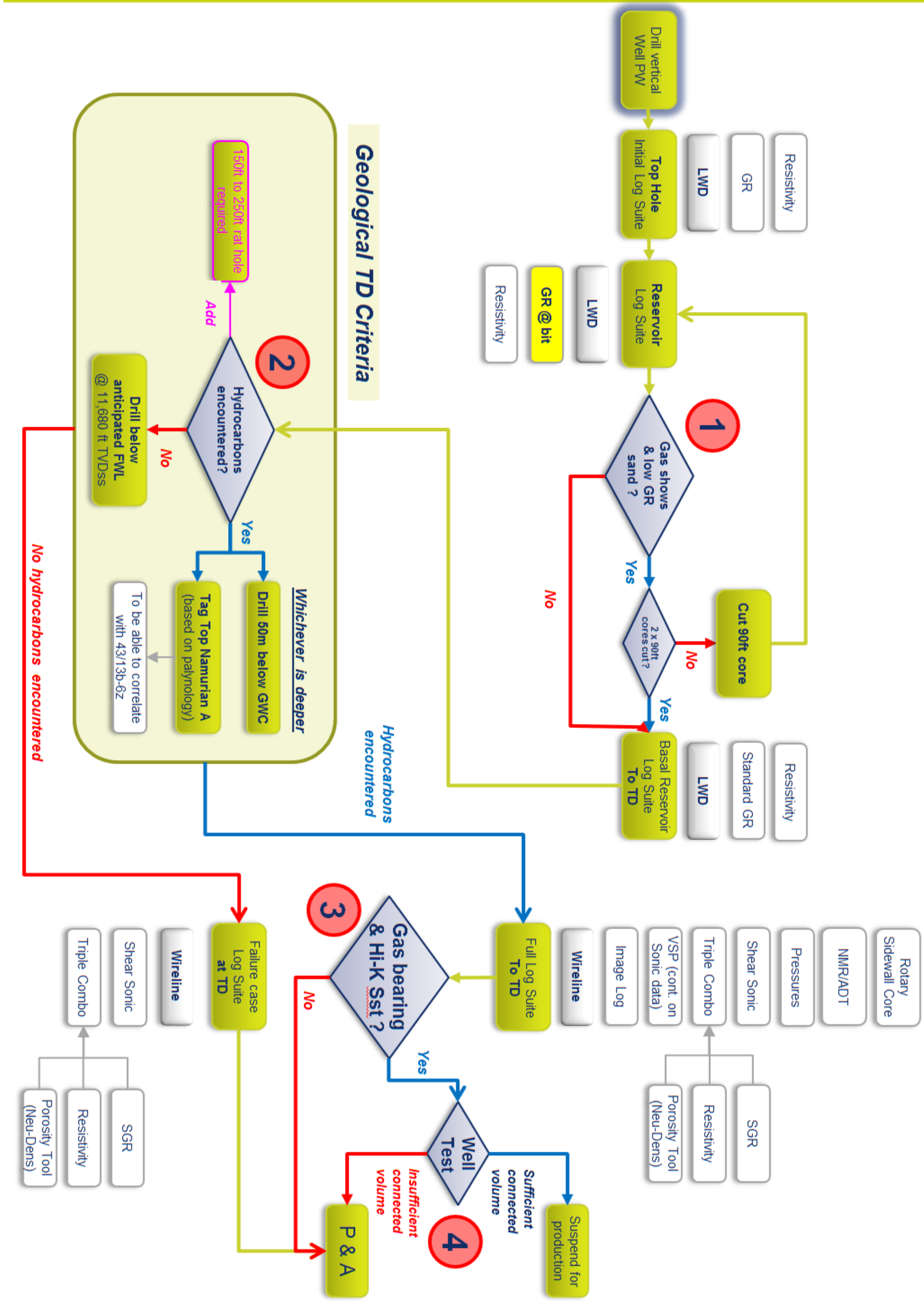


Figure 1.2 — Decision tree for reservoir section of 43/13b-7 well.

Figure 1.3 — Image of flaring during one of the isolated well tests for the Pegasus West 43/13b-7 well Q3 2014.

NOTES:

Understanding a complex overburden to deliver safe & productive wells at the giant Shah Deniz gas-condensate field, offshore Azerbaijan

Gavin Price[1], David Hall, Enrico Tranchina, Karl Kaiser
[1] BP

The Stage 2 development of Azerbaijan’s Shah Deniz gas-condensate field - SD2 - constitutes a vast infrastructure project via which gas will flow from reservoirs beneath the Caspian Sea, all the way to Western Europe. The programme represents a 40-50 billion USD investment, and requires the drilling of some 26 subsea development wells. Significant reductions in well cost may be achieved by minimising the amount of non-productive time (NPT) during drilling.
The likelihood of experiencing NPT associated with subsurface geological conditions may be minimised in a number of ways. The SD2 development has featured robust subsurface interpretation and data integration, methodical application of learnings from previous Shah Deniz drilling, meticulous pre-drill well planning, and clear communication of subsurface conditions to all parties involved in designing and executing the well. To fully enable this, a dedicated team was established to provide an integrated subsurface description (ISD) of the overburden and reservoir section at Shah Deniz. A three year plan described the key ISD products designed to reduce subsurface-related NPT and contribute towards the safe and efficient drilling of wells.

ISD products include an ‘ever-green’ geological model of the field, with overburden, reservoir and aquifer descriptions, plus 3D models of structure, stress and pore pressure. In particular, the complexity of the pore pressure regime at Shah Deniz represents one of the principle risks to safe delivery of the wells required for SD2. Delivery of a detailed overburden ISD has been enabled by comprehensive interpretation and integration of all well and seismic data acquired over the past 18 years.

This presentation will focus on the types of overburden workfronts undertaken, how they impact well planning and how knowledge of subsurface conditions is communicated across multiple disciplines.

NOTES:

The Importance of Geology on Drilling Optimisation

Neil Cardy
Consultant Drilling Optimisation Engineer

Drilling optimisation is usually thought of as a specialized form of drilling engineering. It has a variety of definitions in the industry, but they all typically refer to improving efficiency, reducing rig time and costs, mitigate risk and so optimize drilling performance. This is usually done using some form of continuous performance improvement process or optimisation cycle based on analysing offset wells to benchmark performance. Procedures or operations that were either inappropriate or not performed efficiently are identified, along with non-productive or lost time incidents. These are collated into a hazard and risk table along with recommendations on how to reduce the risks. The final report may include recommendations on bit type, drilling system, drilling parameters, connection and other operational procedures related to the drilling team, which is why it is viewed as an engineering report.

However, drilling performance is dependent on the interaction of the bit, drilling system and drill string with the formation. A good knowledge of the geology of the formations being drilled and their impact on the drilling process is essential to understanding the performance and how it can be improved. Formation related issues such as hardness and abrasivity obviously have a direct impact on penetration rates, however the geology can also have less immediate effects such as swelling or sloughing shales, which can lead to time-consuming operations such as reaming.

This presentation discusses examples where the geology has impacted drilling performance and shows by understanding the detailed geological environment, performance improvements can be realised.

NOTES:

Bridging the Gaps: a Petrophysicist's role in Pressure and Sampling; Operations in Low Mobility Carbonates.

Louise Anderson
Total E&P Ltd

An integrated approach is essential for successful down hole data acquisition, especially when contending with extreme HP, HT or HP/HT environments and low mobility formations. A strong team ethic, with excellent communication is critical for well objectives to be met. In close cooperation with the Operations Geologist, when organising an acquisition program, the Petrophysicist is involved at all stages including: planning, data acquisition, and data validation/interpretation. Their role is to bridge the gaps between logging tool technology, interpretation of data and communication of results. Additionally they need to be aware of the latest down hole tool developments and capabilities, drawing on new emerging technologies to try and obtain results in formations which have previously proved extremely challenging.

For any pressure testing job, the Petrophysicist will aid in the choice of the most appropriate tools (taking into account cost, timing and objectives). Using a suite of existing log data, they will choose targets in collaboration with the Operations, Asset and Wellsite Geologists, along with the Asset Reservoir Engineer. The Petrophysicist will oversee the pressure job real time alongside the Operations and Wellsite Geologists in order to optimise tests. Following operations, the Wellsite Geologist will summarise all points taken, and on delivery of individual test files, the Petrophysicist will validate pressure points, and provide a preliminary interpretation.

Close collaboration with service providers is also an essential part of the role. In recent operations, a new pressures-only tool was run for the first time in the North Sea with good success in low mobility formations. Newly developed large face-probes have proved extremely useful in obtaining pressures (and fluid samples) in both low mobility matrix and fractures; removing the need for a straddle packer and significantly reducing the time taken for the run. Formations with mobilities as low as 0.003mD/cP, which in the past would have been simply classified as tight, have been successfully tested.

NOTES:

Poster Presentation Abstracts

RhoVe Method - A New Empirical Pore Pressure Transform

Saun Coogan
Quad Operations

A new empirical pore pressure transform has been developed using modifications to methods first proposed by Alberty and McLean, 2003, and Alberty, 2011. The rhob-velocity-effective stress (RhoVe) method is a two parameter approach that utilizes a stand-alone, model-driven sequence of “virtual” rock properties, which at intermediate positions (fractional solutions), are consistent with Bowers method default values for Deepwater Gulf of Mexico (DWGoM) fine-grained clastics (Bowers, 1995, 2001).

Paired velocity-depth compaction trends were iteratively solved by using published theoretical porosity trends for either smectite or illite (Lahann and Swarbrick, 2011), and published velocity-depth normal compaction trends (Ebrom and Heppard, 2010). By using the appropriate velocity-density functions, normal effective stress for each end member and fractional solution, can be calculated by integrating the discrete end-member or intermediate velocity-depth profile, now converted to density-depth.

The RhoVe method uses a single transform to convert both compressional sonic and bulk density to common estimates of effective stress and pore pressure where convergence of the two transformed properties offers a robust solution. Model-driven velocity-effective stress and density-effective stress relationships can be used to calibrate pore pressure for an offset well - with the archived velocity-density-effective stress solutions applied to an undrilled location, or applied to an active well of interest in real-time.

The method produces robust solutions as tested on multiple deepwater Gulf of Mexico wells, and extends the predictability of high-velocity, low-effective stress rock types such as those found in the deep water Gulf of Mexico Wilcox-equivalent Paleogene and older section.

Operations Geology; Expanding the Envelope.

Stephen Forder
Consultant Operations Geologist

The Petroleum Exploration industry is currently at a stage where, more than ever, companies need to innovate and think through their processes, to be more operationally efficient. Along with this, there is a perennial drive to reduce exploration and appraisal well costs.

Ambiguous or marginal well results & interpretations create an additional requirement for appraisal drilling, which often leads to unsuccessful appraisal attempts.

Utilising an Australian Onshore & Offshore well database of over 2,500 Exploration & Appraisal wells from 1990 to 2013, it can be shown that 42% of onshore and 47% of offshore appraisals over that period failed to lead to development projects.

This paper proposes that redefining and expanding the role of the Operations Geologist would assist in maximising the potential to obtain definitive well interpretations and, thereby, reduce the uncertainty that leads to unnecessary appraisal expenditure.

The road from Geological Well Proposal, through well planning and tendering to ultimate drilling and evaluation is necessarily lengthy. Specific bodies of work are often conducted by different teams. Although drilling engineering and administrative teams generally assign dedicated personnel to the full scope of this workflow, Geotechnical asset teams are often poorly represented during specific stages.

An additional factor is that the current industry trend of hiring new graduates as staff geologists and not exposing them to wellsite operations has resulted in a general lack of operational awareness, experience and appreciation within G&G teams. This highlights the need for an 'operationally aware' geologist to ensure that the requirements of the Geotechnical Order are correctly translated through the well design and tendering processes and implemented throughout the operational phase, to obtain the best well evaluation outcome.

A project workflow for an expanded Operations Geologist role is presented, leading to a well-evaluation decision tree with quantifiable benefits that accrue from this approach.

Tenders, Bids and Evaluation (TBE) for Wireline Logging & M/LWD

Adrian Leech
Gaia Earth Sciences Limited

Wireline logging and M/LWD are two of the most complex services involved in the process of drilling an exploration or appraisal well. As such, it is critical that the complete service requirements of the subsurface and drilling groups are efficiently communicated to potential vendors. Otherwise this can lead to confusion and delays during the TBE process, which may result in well delivery issues for the lifetime of the project. (Some issues may be operational, others financial.)

The TBE process must be clear and fair for both the company and vendor. The company needs to be confident that the vendor can safely provide the required services and fully satisfy the data requirements. The vendors need to submit unambiguous and competitive bids that exhibit a clear understanding of the company's requirements whilst ensuring that operating standards will be met.

The aim of this talk is to illustrate how the TBE process can be followed in a clear and efficient manner. Although the operations geologist is involved in the management of other service lines (e.g. mudlogging) this talk will mainly focus on TBE of electric wireline and M/LWD services.

Poster submission for the Operations Geology Conference 2/3 November 2016
The role of the Geoscientist in Decommissioning

Stephen Jenkins[1] & Andrew Hockey[2]
[1] *Ikon Science Ltd*
[2] *Consultant to Ikon Science LTD & Non-Executive Director, Fairfield Energy Ltd*

The UK's new regulator, the Oil and Gas Authority (OGA) and industry body Oil and Gas UK have set out clear guidelines for the decommissioning of UKCS oil and gas infrastructure and wells. Prolonged low oil prices have brought into focus the need to consider the cost and timing of decommissioning in the mature North Sea basin. Whilst there have been conferences and presentations on the subject of decommissioning, specific discussion on the regulatory requirement to isolate and seal wells in perpetuity has been limited. Understanding of the subsurface is crucial because liabilities for abandoned wells remain with the licensees indefinitely including the liability for leakage after decommissioning is complete.

Various estimates for the cost of offshore decommissioning exist and the proportion of total decommissioning cost related to the plugging and abandoning of wells was recently put at 44% by the OGA. Uncertainty regarding topside removal cost estimates is reducing and operators can expect to exert tight cost control in this area. Subsurface conditions are more uncertain and thus costs may be more difficult to estimate and manage without a full understanding of the risks involved.

Plugging and abandoning wells requires firstly the isolation of distinct permeable zones and secondly the isolation between hydrocarbon bearing zones, distinct pressure regimes and water bearing zones. The Geoscientist will be called upon to pull together the relevant information to inform the operator of the geology, the well structure, stress state and the pressure regimes. This requires an understanding of the virgin and depleted reservoir conditions, particularly whether the reservoir is likely to return to the virgin state or remain depleted. The Geoscientist's assessment will play a significant part in containing the cost of plugging and abandoning wells and will also be crucial in minimising the long term liability of subsequent leakage from plugged wells.

Operations Geology Conference 2016 Poster Abstract – Integrating Teams 3D Offset Well Analysis in Petrel™

Emma King
TAQA

A vital part of planning wells is thorough offset well analysis; this is essential for safe and efficient drilling campaigns. When completed accurately and presented properly it provides the platform for the well planning and hazard analysis process to be conducted efficiently.

Utilising Petrel™ to create a single collaborative database to store and present the information allows us to use our resources more effectively; focus on geological and geometrical similarities; perform offset well analysis with better repeatability and clearly conveys the key messages.

A study was carried out in conjunction with Schlumberger to catalogue the offset well data for TAQA's North Cormorant and Cormorant East fields. A Schlumberger engineer worked with our team to collate and populate the information within Petrel™. The model was then used to perform a full hazard analysis on the fields for an upcoming drilling campaign, it led to a markedly improved hazard identification process that delivered results with a greater degree of confidence in less time.

Visualising the hazards in a 3D space within Petrel™ allowed us to clearly show all the hazards that have occurred in these two fields relative to our projected well bore. This new way of representing the data received positive feedback from the Subsurface, Drilling and Offshore teams allowing for a greater understanding and a more collaborative approach across the departments.

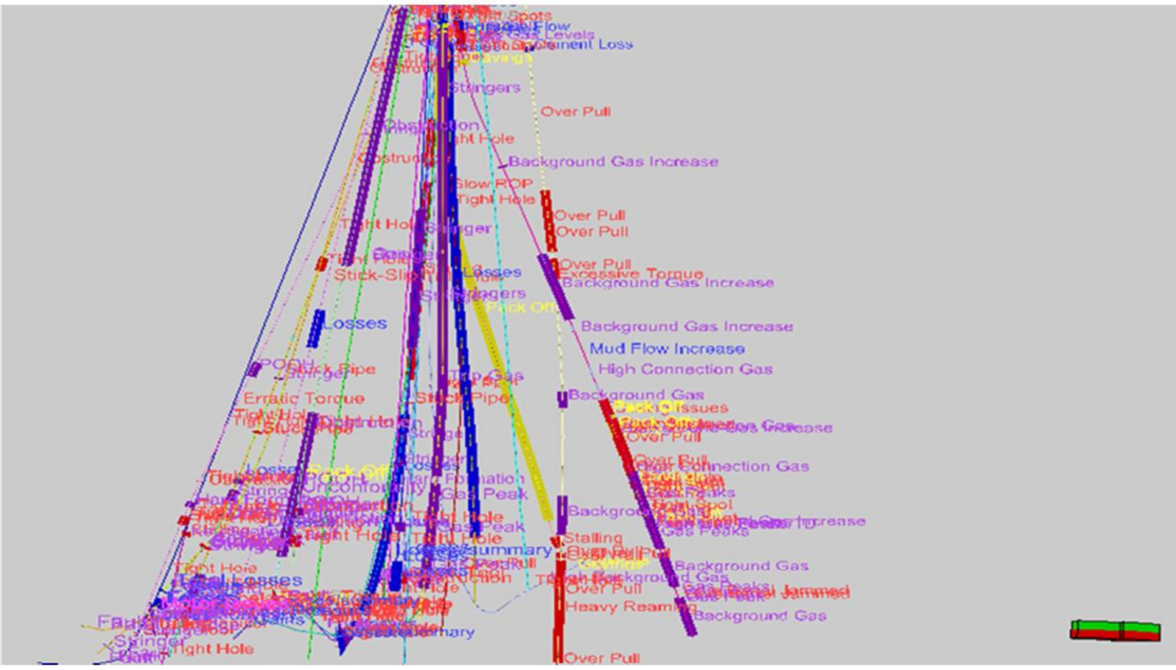


Figure 1: All hazards within a field displayed in 3D

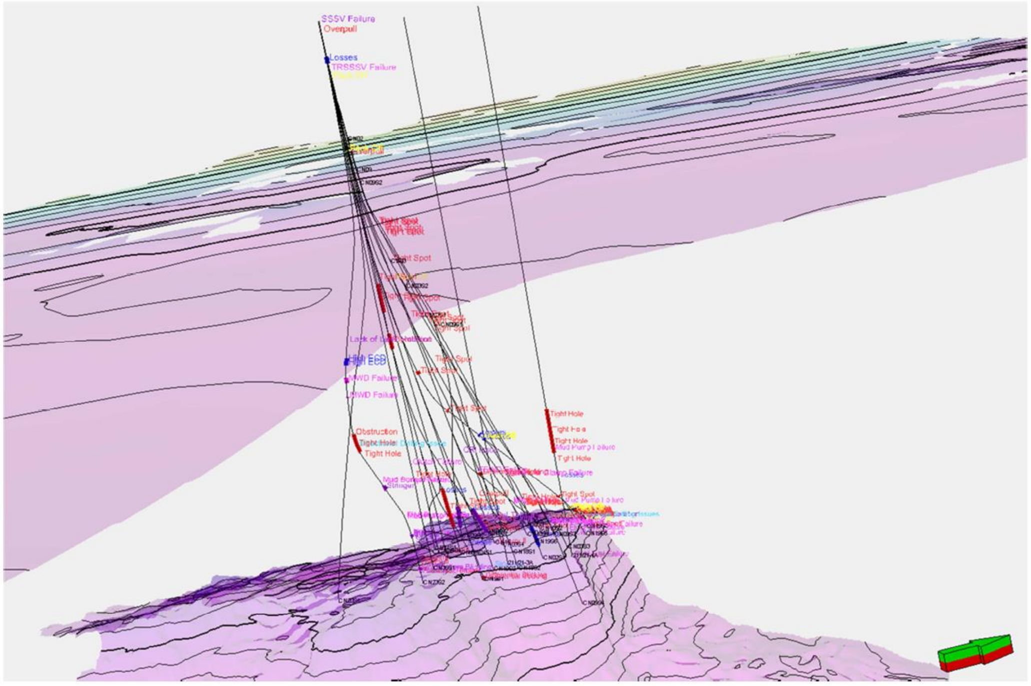
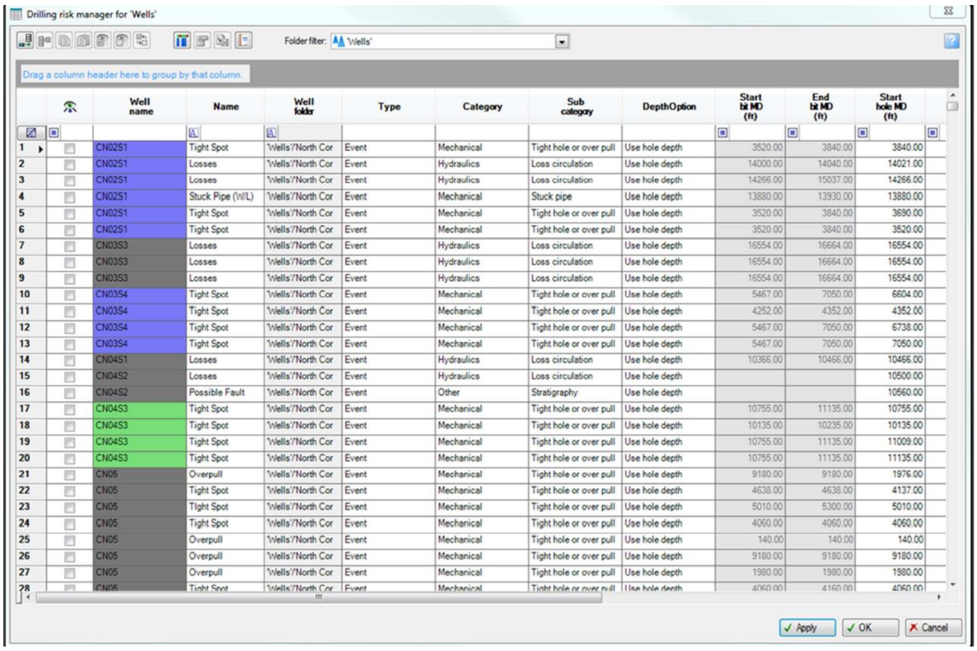


Figure 2: Wells and hazards can be displayed alongside surfaces or other data within the project.


Drilling risk manager for 'Wells'

Folder filter: 'Wells'

Drag a column header here to group by that column.

		Well name	Name	Well folder	Type	Category	Sub category	DepthOption	Start bit MD (ft)	End bit MD (ft)	Start hole MD (ft)
1		CN02S1	Tight Spot	'Wells'/North Cor	Event	Mechanical	Tight hole or over pull	Use hole depth	3520.00	3840.00	3840.00
2		CN02S1	Losses	'Wells'/North Cor	Event	Hydraulics	Loss circulation	Use hole depth	14000.00	14040.00	14021.00
3		CN02S1	Losses	'Wells'/North Cor	Event	Hydraulics	Loss circulation	Use hole depth	14266.00	15037.00	14266.00
4		CN02S1	Stuck Pipe (W/L)	'Wells'/North Cor	Event	Mechanical	Stuck pipe	Use hole depth	13880.00	13930.00	13880.00
5		CN02S1	Tight Spot	'Wells'/North Cor	Event	Mechanical	Tight hole or over pull	Use hole depth	3520.00	3840.00	3690.00
6		CN02S1	Tight Spot	'Wells'/North Cor	Event	Mechanical	Tight hole or over pull	Use hole depth	3520.00	3840.00	3520.00
7		CN03S3	Losses	'Wells'/North Cor	Event	Hydraulics	Loss circulation	Use hole depth	16554.00	16664.00	16554.00
8		CN03S3	Losses	'Wells'/North Cor	Event	Hydraulics	Loss circulation	Use hole depth	16554.00	16664.00	16554.00
9		CN03S3	Losses	'Wells'/North Cor	Event	Hydraulics	Loss circulation	Use hole depth	16554.00	16664.00	16554.00
10		CN03S4	Tight Spot	'Wells'/North Cor	Event	Mechanical	Tight hole or over pull	Use hole depth	5467.00	7050.00	6604.00
11		CN03S4	Tight Spot	'Wells'/North Cor	Event	Mechanical	Tight hole or over pull	Use hole depth	4252.00	4352.00	4352.00
12		CN03S4	Tight Spot	'Wells'/North Cor	Event	Mechanical	Tight hole or over pull	Use hole depth	5467.00	7050.00	6738.00
13		CN03S4	Tight Spot	'Wells'/North Cor	Event	Mechanical	Tight hole or over pull	Use hole depth	5467.00	7050.00	7050.00
14		CN04S1	Losses	'Wells'/North Cor	Event	Hydraulics	Loss circulation	Use hole depth	10366.00	10466.00	10466.00
15		CN04S2	Losses	'Wells'/North Cor	Event	Hydraulics	Loss circulation	Use hole depth			10500.00
16		CN04S2	Possible Fault	'Wells'/North Cor	Event	Other	Stratigraphy	Use hole depth			10560.00
17		CN04S3	Tight Spot	'Wells'/North Cor	Event	Mechanical	Tight hole or over pull	Use hole depth	10755.00	11135.00	10755.00
18		CN04S3	Tight Spot	'Wells'/North Cor	Event	Mechanical	Tight hole or over pull	Use hole depth	10135.00	10235.00	10135.00
19		CN04S3	Tight Spot	'Wells'/North Cor	Event	Mechanical	Tight hole or over pull	Use hole depth	10755.00	11135.00	11009.00
20		CN04S3	Tight Spot	'Wells'/North Cor	Event	Mechanical	Tight hole or over pull	Use hole depth	10755.00	11135.00	11135.00
21		CN05	Overpull	'Wells'/North Cor	Event	Mechanical	Tight hole or over pull	Use hole depth	9180.00	9180.00	1976.00
22		CN05	Tight Spot	'Wells'/North Cor	Event	Mechanical	Tight hole or over pull	Use hole depth	4638.00	4638.00	4137.00
23		CN05	Tight Spot	'Wells'/North Cor	Event	Mechanical	Tight hole or over pull	Use hole depth	5010.00	5300.00	5010.00
24		CN05	Tight Spot	'Wells'/North Cor	Event	Mechanical	Tight hole or over pull	Use hole depth	4060.00	4060.00	4060.00
25		CN05	Overpull	'Wells'/North Cor	Event	Mechanical	Tight hole or over pull	Use hole depth	140.00	140.00	140.00
26		CN05	Overpull	'Wells'/North Cor	Event	Mechanical	Tight hole or over pull	Use hole depth	9180.00	9180.00	9180.00
27		CN05	Overpull	'Wells'/North Cor	Event	Mechanical	Tight hole or over pull	Use hole depth	1980.00	1980.00	1980.00
28		CN05	Tight Spot	'Wells'/North Cor	Event	Mechanical	Tight hole or over pull	Use hole depth	4060.00	4160.00	4060.00

Apply | OK | Cancel

Figure 3: Drilling Risk Manager within Petrel™

Adjusting of Lag Time Based on Air Gap Analysis

Rudolf Knezevic, ANDREA Holler, Oliver Knoop
OMV Austria

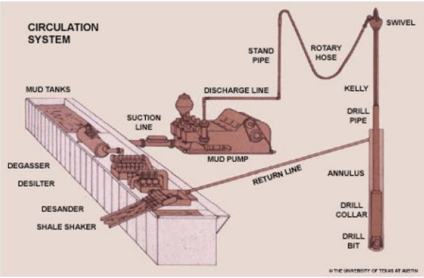
Lag time is time required to pump a sample, freshly cut by the drill it, up to surface. The method developed applies to all kinds of mud as well as all dimensions of casting. Sole requirement is a detectable level of hydrocarbons.

$$\frac{Va}{Fr}$$

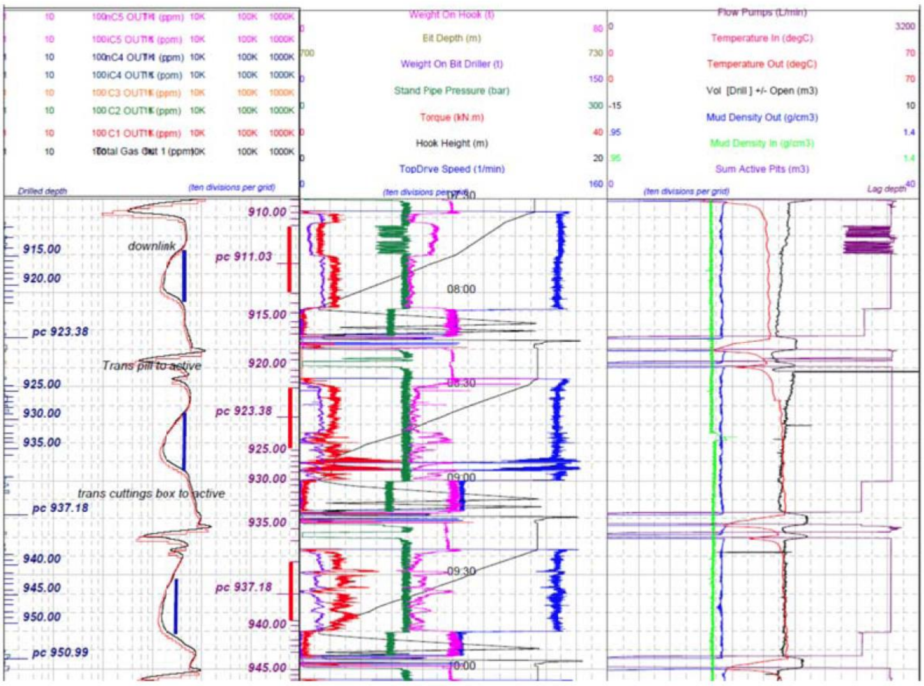
Va.. annular Volume: e.g. bit size, string geometry, wash out, sloughing shales, thief zones , influx

Fr..flow rate: e.g. strokes/min, pump efficiency

The mathematical approximation to determine the lag time is to divide the annular volume by the flow rate. This neglects certain effects (e.g. wash out, pump efficiency, slip velocity) which are often present in oil wells. The proposed method controls lag time more effectively and allows an update on every pipe connection:



On every pipe connection carried out during drilling, the pumps are stopped; the drill string is put in slips to add a new joint (stand) of DP. Pumps are restarted, the sting is lowered to bottom and drilling commences. The new joint of DP connected to the string contains only air, which will be compressed by the drilling mud following the air bubble. This bubble can be detected when it arrives at the hydrocarbon detector. Since the time for the round trip (travel time of the bubble down hole and back to bell nipple) can be divided into the time to the bit (=constant, function of inner string volume) and bit to surface (= dynamic, depending on effects mentioned above)



Plot of RT data versus time:

The total gas and the Methane concentrations simultaneously decrease by value as the air bubble, trapped during the connection resurfaces at the bell nipple Compare sections of gas on left track (blue vertical bar,) with corresponding depth ticks on same track (marked by red air).

Modern Approaches to Old Problems – Leveraging Analogue Data in a Digital World

David Rendall
Apache

Communication between the wellsite and operations teams based remotely is of course vital. The ability to transmit thoughts, ideas and instructions clearly both to and from the wellsite can have a huge bearing on the current operation and when correctly captured can aid future operations too. Visual communication often delivers a message most effectively and provides opportunity for comparison. Readily retrievable data makes this an efficient task.

Today's technology provides us with readily accessible data which can be manipulated in any number of software packages. It provides us with new opportunities for communications and for maintaining a record of our wellsite activities. In mature oilfields the operator will typically also have a wealth of legacy paper-based data which can provide useful insight for infill drilling. However, this originally paper-based dataset, though large, cannot be readily manipulated nor can it be easily used in conjunction with modern digital data.

Recording events which occur during drilling and formation evaluation operations is useful but presents some challenges. Who is best placed to record such events? And who is best placed to maintain and retrieve the records? How should they be stored and how much will a system cost to implement?

This presentation looks at how we can apply modern approaches and software to leverage our data in a digital world to deliver more effective information for a range of scenarios we can encounter during operations.

It will show how this can be achieved in a cost effect manner, without huge outlay, using systems already in place in many offices and utilising largely internal resources even while continuing to manage day-to-day operations.

Burlington House
Fire Safety Information

If you hear the Alarm

Alarm Bells are situated throughout the building and will ring continuously for an evacuation.
Do not stop to collect your personal belongings.
Leave the building via the nearest and safest exit or the exit that you are advised to by the Fire Marshall on that floor.

Fire Exits from the Geological Society Conference Rooms

Lower Library:
Exit via Piccadilly entrance or main reception entrance.

Lecture Theatre
Exit at front of theatre (by screen) onto Courtyard or via side door out to Piccadilly entrance or via the doors that link to the Lower Library and to the main reception entrance.

Piccadilly Entrance
Straight out door and walk around to the Courtyard or via the main reception entrance.

Close the doors when leaving a room. **DO NOT SWITCH OFF THE LIGHTS**.

Assemble in the Courtyard in front of the Royal Academy, outside the Royal Astronomical Society.

Please do not re-enter the building except when you are advised that it is safe to do so by the Fire Brigade.

First Aid

All accidents should be reported to Reception and First Aid assistance will be provided if necessary.

Facilities

The ladies toilets are situated in the basement at the bottom of the staircase outside the Lecture Theatre.

The Gents toilets are situated on the ground floor in the corridor leading to the Arthur Holmes Room.

The cloakroom is located along the corridor to the Arthur Holmes Room.

Ground Floor Plan of the Geological Society, Burlington House, Piccadilly