



Norway Council
www.spe.no

The First

SPE Norway magazine



*To gather members
To share knowledge*

The future of the oil price; prospects of M&A among O&G companies—the best analytics in Scandinavia report!
p.16

Innovative methodology which already has won a place in NCS Exploration
p.26

New analytics technology for Oil & Gas
p.42

Special Topic

...they found the borders of Arctic continental shelf!

Exploration manager of RN Nordic Oil, Dr. Natalia Kukina and her 14 Arctic academic expeditions...

p.30



FIRSTGEO

We are subsurface

Capable. Reliable. Valuable.

Season's Greetings

We would like to take this opportunity to wish all our customers a Happy Holiday Season and a prosperous New Year

For the past two decades, First Geo has delivered expert subsurface advice and products to E&P companies worldwide. Our focus is on geophysics, geology, petrophysics, reservoir engineering and well management.

First Geo is the leading provider of operations and wellsite geology services. Our consultants have superior knowledge of the Norwegian Continental Shelf, including the Barents Sea, as well as international experience.

Clients engage us through all phases of a field's life cycle, from exploration to tail end.



Inside this issue

www.spe.no

The First 

Would you like to join the editorial team of "The First" magazine?

Contact Maria/Vita or your local Section.

Follow SPE Norway sections in social media:



[SPE Oslo](#)

[SPE Stavanger](#)

[SPE Bergen](#)

[SPE Northern Norway](#)

Editorial content

News from SPE Norway Sections 4

Regional sections visible to international audience

SPE Bergen One Day Seminar (April 2016) 7

SPE Norwegian Arctic Subsurface and Drilling Challenges Workshop in Harstad (March 2016) 12

Finance & Management

Update from Finance

Country-by-country reporting – especially relevant for E & P companies 16
by Svein A. Andresen, Partner and Per Fossan-Waage, Director PwC

Expert comment from Swedbank Research

Teodor Sveen Nilsen, Senior Financial Analyst from Swedbank Research, met our editor Maria Djomina and told about estimates for long term oil price and future outlook of the oil and gas industry globally and locally 17

High deal activity continuing into 2016

by Daniel Rennemo, Deals Partner in PwC 18

International Trade & Investment

The UK: A springboard to global growth

by Roy S. Kristiansen, Senior Market Adviser, UK Trade & Investment 21

Insurance

A bird's eye view on Energy Insurance

by Nikolai Jørgensen, SPE Oslo Treasurer and Trainee Broker in Marsh Energy Practice 24

Exploration

Induced polarization: detecting HC signatures in reservoir overburden

by Vitaliy V. Yurchenko, PhD, Senior Geoscientist, VP of Sales and Marketing ORG Geophysical AS 26

Cover Story

Exploring the Borders of Arctic Shelf

Dr. Natalia Kukina, Exploration Manager of RN Nordic Oil, is sharing with us her incredible career within academia and in the industry plus expeditions 30

New analytics technology for Oil & Gas

How to win in a "zero sum" game

by Ole Evensen, Business Development Executive, IBM WW Chemical & Petroleum Upstream lead 42

Mature wells

7 well decommissioning executed by following structured process

by Claudio Pellegrini, Subsea Intervention Manager and James Ryan, Subsea Engineer, AGR Perth 46

The First is SPE Norway Regional publication and is distributed to a multidiscipline audience. Circulation: 200 printed copies, 4,500 electronic copies

The editorial team takes no responsibility for accuracy or content of the articles provided. Technical articles, professional overviews, sponsors inputs and SPE section news have no editorial fee.

If you would like to support production of our magazine by publishing commercial information about your product/company, the advertising rates are: 250 NOK/ half page, 500 NOK full page.

Editors

Vita V. Kalashnikova
vita@pss-geo.com
Maria Djomina
Maria.Djomina@agr.com

The editors are working on voluntary basis.

The electronic version of this Issue and previous Issues are available on SPE Norway web-

A Note from the Editor

Your opinion counts!

You are reading the 3rd issue of our SPE Norway magazine published this year. When putting together the content for the magazine, we aim to spread news and information about events, gatherings and seminars organised by our sections in addition to providing a wide selection of technical and commercial know-how. «The First» magazine reflects the values and targets that the newly established SPE Norway Council tries to achieve by their meetings and activity. Unite our members and create a strong social community of professionals within O&G in Norway.

Our magazine is also about having fun. Thank you to all authors of the summer photos that were sent in for the competition in our previous issue. We are always very grateful for images taken offshore, onshore or geologically interesting places in Norway - you can become the star of our cover!

In order to continue publishing the content which engages you and provides you with the most relevant updates, please take a few moments to complete a survey which helps the editorial team in their planning of the upcoming issues.

The survey can be downloaded [here](#).

I wish all SPE members, sponsors and supporters a Merry Christmas and a safe and prosperous New Year! And don't forget to share your articles, technical papers and photos with your colleagues to secure continuous publication of our magazine.

The Christmas issue of «The First», as always, provides a combination of financial outlook for the new year put together by the top ranked professionals from Swedbank and PricewaterhouseCoopers. Read our reports on new technological innovations and opportunities for expansion into new markets in the UK sector. We also have a special feature from the area of exploration in which Natalia Kukina, Exploration Manager in RN Nordic Oil allows us to join her multiple expeditions to the Arctic.

Maria Djomina



Maria Djomina
 Editor The First /
 Communications Manager,
 AGR
 Maria.Djomina@agr.com

Photo: Marte Herud, AGR



SPE Norway Council



Norway Council

SPE Norway Council established

Dear all SPE Norway members and readers of «The First!»

It is my pleasure to inform you that on the 30th of June this year the SPE Norway Council was formally established and we had our first meeting during this year's ATCE in Houston (October).

During this we decided that the Council should consist of two persons from each Norwegian section. Each member with equal voting powers and who have experience from serving on local section boards. The SPE North Sea Director, Carlos Chalbaud, will act as an advisor to the Council and provide guidance and support.

Norway is an important country in the world of oil and gas and thus we have many SPE members—more than 2,500 professionals and around 700 student members. SPE Norway will be a national Council for the SPE in our country and focus on the coordination of the SPE activities at national level and on the collaboration with SPE International.

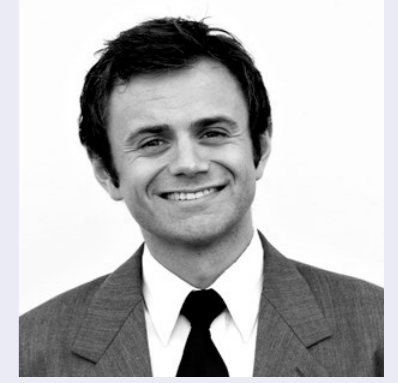
The Council will take part in typical activities that unite our sections and are of national importance, we will help grow the total member base in Norway, focus on marketing of SPE and its importance towards the Norwegian industry, and interact with other professional societies and interest group inside Norway.

The origination of SPE Norway is a clear sign that Norway is an important region for the SPE. The reason SPE has such a strong presence in Norway is based on all the hard work that each local section is carrying out every season and providing a technical and social arena for Oil and Gas professionals. I have the honour of chairing this Council in its first year and will do my very best to move this initiative forward.

In addition to the undersigned, the SPE Norway Council consists of the following persons: Christine Madsen, Igor Orlov, Roald Johansen, Marius Stammen, Hein Andre Langåker, Geir Ove Egge and Hugo Harstad.

I wish you all happy holidays and a great start to the New Year!

Karl Ludvig Heskestad
 SPE Norway Council Chair



Karl Ludvig Heskestad
 SPE Norway Council Chair /
 Senior Engineer Business
 Development at Det norske



SPE Bergen

Message from the Board of SPE Bergen section

Oil & Gas industry in Norway has had a challenging year resulting in many projects delayed, rates reduced, operations cancelled and many people being made redundant.

The industry has diverted its focus to efficiency and cutting costs, which has also affected our work in SPE Bergen section since we notice companies being less willing to engage themselves in industry events. Nevertheless, we experience great optimism and commitment from our SPE members to further contribute and develop the SPE Bergen Section. This is very admirable and very much appreciated.

SPE Bergen section would like to thank all its members for their commitment and engagement in SPE Bergen activities. Our networking and knowledge exchange events like SPE Bergen Lutefisk Dinner and TechNights gather a growing number of local professionals for an opportunity to learn and exchange ideas with their industry peers.

SPE Bergen Board would like to send their holiday greetings to all SPE community and we are looking forward to meeting you at SPE events next year!

Board of SPE Bergen Section



*by Thorbjørn Kaland
Program committee chair*

Intervention, Efficiency and Optimization.

The exhibition part of the conference will as well show the latest of technology from a long list of companies.

Regardless of good presentations and exciting technology, the most important reason to join the conference is the networking and the opportunity to meet old and new colleges, friends and potential collaboration partners. Do not leave the conference and the city before you have joined the great dinner, party and entertainment.

In times of low activity and good colleagues being laid off, it is more im-

the presentations home as digital papers.
The fact that just a fourth of the submit-

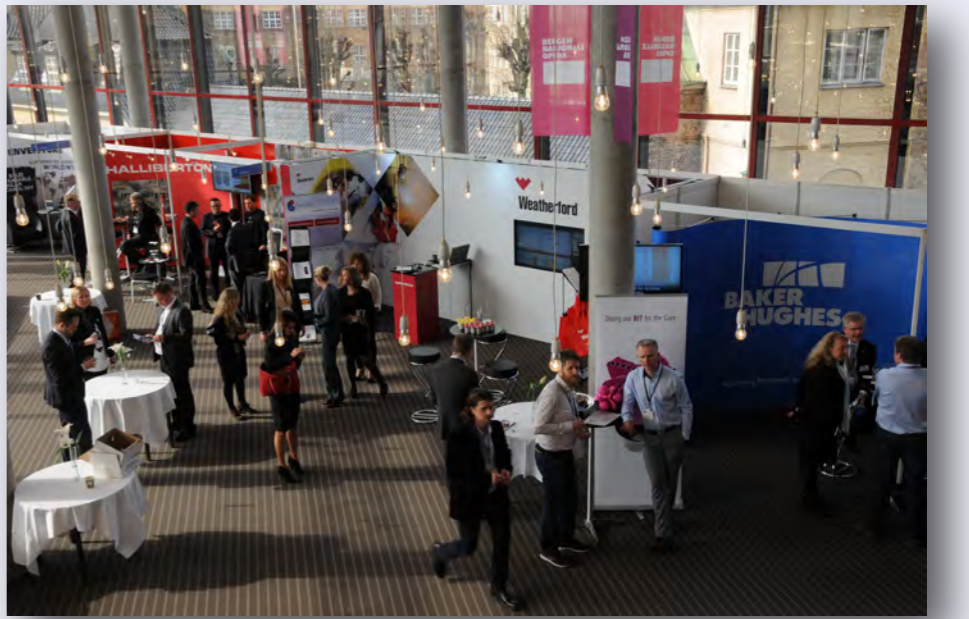
Grieghallen is not just the main concert hall in Bergen, but a very popular meeting place in the heart of Bergen.
The preparations for this great 23 year old tradition is all in track. We are proud to announce a strong program with challenging, innovative and interesting speeches, posters and papers to be presented.

The Program committee have just completed the long process of reading, analyzing and rating 154 submitted abstract.

40 presentations only could be selected, whilst 29 more abstracts were invited to present a poster. The presenters represent 11 countries.

All the presentations and poster will be published as SPE papers. This gives you as a conference participant a golden opportunity to come and upgrade your competency with the latest news from petroleum science and activity in oil fields, as well as bringing all

ted abstracts could be provided a podium, shows the high quality of the program and the conference in general.
The participants may choose between 8 sessions covering Reservoir, Drilling, Production, Operations, Completions,



portant than ever to gather, meet people, upgrade competency and make new relations. Our unfortunate colleagues who have lost their employment are especially invited to visit the conference and find new opportunities.



SPE Bergen Lutefisk Dinner 2015

SPE Bergen Section had once again a pleasure to invite local Oil & Gas community to the annual event SPE Bergen Lutefisk dinner that was hosted on the 26th of November. This dinner has become a yearly tradition gathering local professionals for networking and knowledge exchange in an informal setting.

Despite a challenging year Oil & Gas industry has had in 2015 so far, Lutefisk dinner has managed to gather together almost 200 attendees from 18 companies. This high attendance shows the relevance of these kind of events even in tough times, as it gives an opportunity to further develop ones network and establish important business relations in addition to being updated on market perspectives.

This year, once again, we had a pleasure to welcome Rystad Energy as keynote speakers. Simon Sjøthun, Project Manager in Rystad Energy, has given an insightful presentation on latest trends in NCS and market's outlook going forward. Even though, according to Simon, we should be prepared for a challenging year in 2016, from 2017 we should expect positive developments.

SPE Bergen Section is determined to continue Lutefisk Dinner tradition as we see it as a very relevant and useful event for our members and local Oil & Gas community. Therefore, we will look forward welcoming even a greater number of attendees in November 2016!



SPE Bergen chair Bjørn Slisener holding his opening speech



Conference program chair Thorbjørn Kaland presenting next events and the First magazine

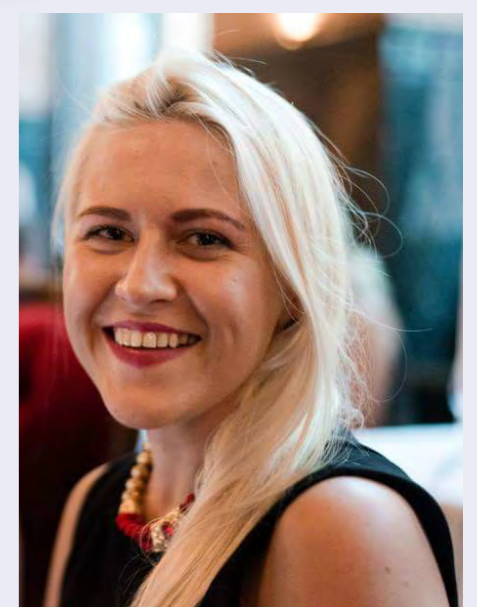


Have not been to the Lutefisk dinner yet?

See what you've missed!!!

Are you SPE Bergen section member, sponsor, follower?
Would you like to submit an article, advertisement or some news?

Then, contact
Giedre Malinauskaite
SPE Bergen Marketing officer
Mobile: +47 47 16 16 41
Email: giedre.malinauskaite@fourphase.com





Harstad/Narvik SPE Student Chapter exhibits at Nordområdekongressen

18 - 19 November a group of students from the Harstad/Narvik SPE Student Chapter attended the Nordområdekongressen, which is a conference held every other year in Narvik and in Harstad. This year the conference was held in Narvik at the Scandic hotel, with around 140 delegates attending. The conference was primarily aiming towards opportunities on the Norwegian continental shelf in the North, with expectations of substantial growth in oil and gas production.

The Harstad/Narvik SPE Student chapter were also present in the exhibition area, showing videos from some of the activities we have attended since our founding.

From the presentation by Erik Sverre Jensen, COO at Lundin Norway AS, where he spoke about their plans for the Northern Norwegian continental shelf.



Text and photo by Eivind Skoglund Hansen, Harstad/Narvik SPE Student Chapter

Kick-off, UiT the Arctic University of Norway SPE Student Chapter

The 29th of October, we in UiT the Arctic University of Norway SPE Student chapter arranged our first kick-off! We had the honor of having Subsea 7, Aker Solutions and Rambøll at our event. They were to give some insight in their companies and their foreseeing's about the future in the oil and gas industry, especially in the high north.

The social gathering began with a short introduction from the president of

Tromsø Student Chapter, Caroline Sørensen. She talked about what SPE's main focus is, how the organization is run and how the students can benefit from being a part of it. Caroline did also highlight that being a member of SPE is a great opportunity to build a professional network from an early stage. After the introduction, the speakers told about the company they were representing. The audience got information about the oil and gas industry but also what their thoughts about Northern Norway as a region, were. The representatives emphasized that more and more companies are planning to settle down here,

but didn't conceal the fact that the industry is in a rough period. SPE Northern Norway section bought pizza and beer for the occasion, and encouraged students to talk to the companies in a social and informal setting. The social gathering got fully booked a while ahead, and we in Tromsø SPE Student Chapter think it was a great success. We want to thank all the students that came to the kick-off, despite the hectic exam-period, and we're looking forward to the next event!

*Tromsø SPE Student Chapter
Marius Paulsen Haugen*



Event Calendar 2015/2016

16 Feb
2016 19:30 [Distinguished Lecturer Duane A. McVay, Texas A&M University](#)
The Value of Assessing Uncertainty (What You Don't Know Can Hurt You)

9-10 Mar
2016 08:30 [SPE Norwegian Arctic Subsurface and Drilling Challenges Workshop](#)
The workshop will focus on the subsurface and drilling challenges that are new and specific to the North from both a cost effective and standardization perspective in the Arctic Region.



SPE Norwegian Arctic Subsurface and Drilling Challenges Workshop

9 - 10 March 2016

Harstad, Norway | Harstad Kulturhus

Welcome to SPE Norwegian Arctic Subsurface and Drilling Challenges Workshop in Harstad, 9th – 10th March 2016!

The event previously known as the SPE Workshop in Arctic Norway, presented by the SPE Northern Norway Section, will now be organized by the section and **SPE International**. Our section's goal to make this annual event into an SPE Global Event has been reached after only 3 years!

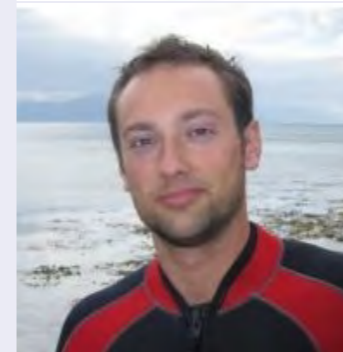
The workshop will focus on the subsurface and drilling challenges that are new and specific to the North from both a cost effective and standardization perspective in the Arctic Region.

You will gain insight in how operators are working hard to lower the break-even for their field developments while still keeping them sustainable and how the service companies plan to solve the technological challenges.

Deadline for submitting presentation proposal for the SPE Norwegian Arctic Subsurface and Drilling Challenges Workshop is 18th December.

We look forward to meeting you in Harstad and experiencing a flavor of the Arctic!

<http://www.spe.org/events/16ahar/>



Tor Jørgen Verås
SPE Stavanger Web Chair
Tel: +47 48290938
tj.veraas@balliburton.com

SPE Stavanger section

SPE Stavanger is known for big events with many attendants. We are always happy to organize technical gatherings, and meet our members and sponsors.

We have had **more than 100 guests at all our events since September.**

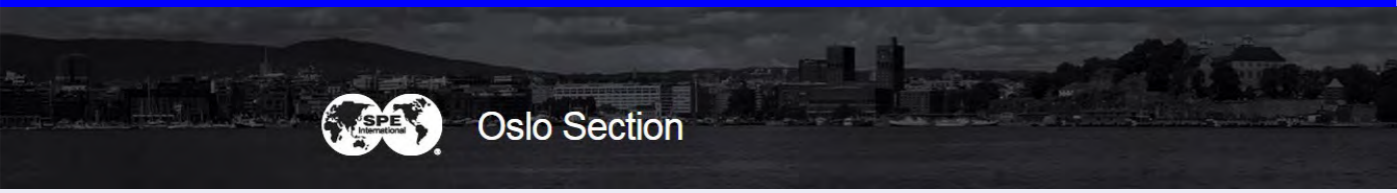
You are very welcome to join our friendly SPE family in Stavanger! Our next event will be held December 9th. See the [Stavanger website](#) for more information.

If you have questions regarding event registration, or you would like to have information about our past events, feel free to contact us.

Here is a list of our recent activities:

- **September Meeting:** Distinguished Lecturer by Dr. L. Brun Hilbert, Jr. of Exponent Failure Analysis Associates Inc presented Well Design and Integrity: Importance, Risk, and Scientific Certainty
- **October Meeting:** Optimized Well Interventions for increased recovery by Borre Tingstveit, Well Interventions Manager, Statoil
- **SPE Stavanger YP Quiz Night** with food and drinks
- **November Meeting:** Standardisation of Well Completion Designs for Statoil wells on the NCS by Jan Roar Drechsler, Principal Engineer, Statoil
- **SPE Stavanger YP Xmas Party:** Lots of traditional Christmas food and drinks. Entertainment by the local rappers Kriminell Kunst
- **December Meeting:** The Maria Field Development by Bernhard Siethoff, Subsurface Manager, Wintershall Norge AS





News from the Oslo Section

Past events

On the September 16, Oslo Section had a Kick-off event in beautiful Mirror room in the Grand Hotel welcoming nearly 100 people.

The evening was opened by Distinguished Lecturer, Dr. L. Brun Hilber, who presented *Well Desing and Integrity: importance, Rick and Scientific Certainty*. The SPE Oslo Board had prepared a surprise and invited professor Curtis Whitson from NTNU, who is a very well-known expert on PVT and fluid dynamics. He presented about integrated field operation and optimization. Both presentation were thought to be very important and interesting.

On November 10th, *Optimism in Reservoir Production Forecasting: Impact of*

Geology, Heterogeneity, Geostatistics, Reservoir Modeling, and Uncertainty was presented by Dr. William (Scott) Meddaugh. The lecture was well re-

ceived and got lots of disunion after. You can read a summary of the presentation in this Issue.



New Board members



PhD, Steven Mueller
YP Chair Oslo

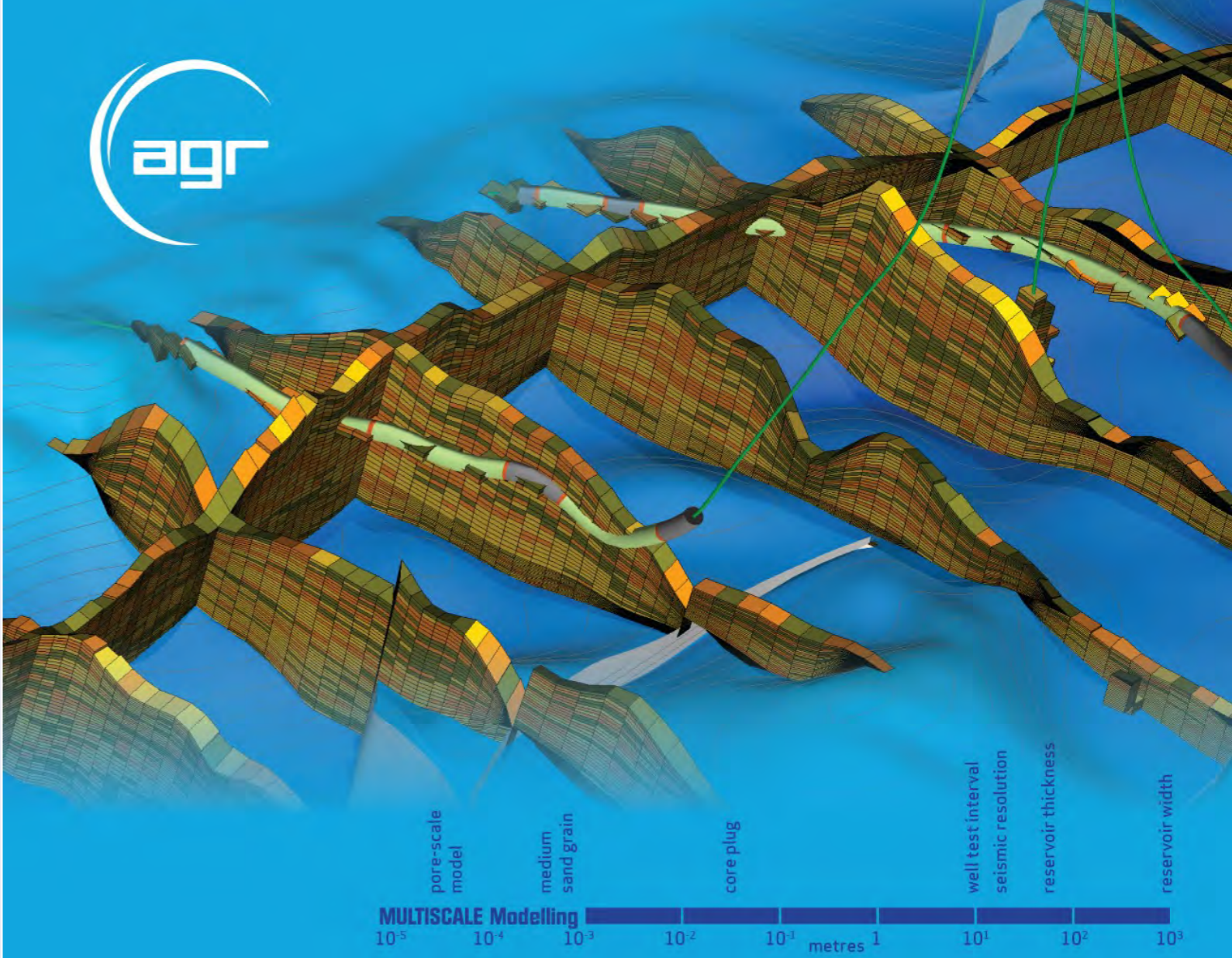
SPE Oslo section is very proud to present two new members to its Board: Steven Mueller and Nikolai Jørgensen.

Steven has a background in petroleum geosciences and holds a PhD degree from the University of Oslo. His PhD research focuses on reconstruction of the depositional environment of Triassic units from Spitsbergen and Austria using geochemistry and micropaleontology. In his spare time, Steven enjoys reading, outdoor activities, travelling around the world and meeting with people from different cultures. Steven is grateful to be elected as YP Chairman and hopes to provide a diverse and interesting program for the SPE Oslo Young Professionals and connect with SPE members across Norway. He would like to invite all YP members to get in touch with suggestions for events and to participate in organizing the society events together.

Nikolai Jørgensen joined Marsh AS's Energy Practice in March 2014 and is training to become a qualified Norwegian insurance broker. He joined SPE fairly recently to learn more about the industry and meet bright minds in the field. Nikolai took on the position of Treasurer in 2015 to contribute positively to the SPE in Oslo.



Nikolai Jørgensen
Treasurer



Multiscale Reservoir Modelling

Better Answers in Shorter Time.

Model Design, Construction, Evaluation and QC

Contact AGR's Geological Modelling Team:
Anna-Lena Hellman, + 47 92 44 35 80, anna-lena.hellman@agr.com



Country-by-country reporting – especially relevant for E & P companies

by Svein A. Andresen, Partner and Per Fossan-Waage, Director, PricewaterhouseCoopers



Svein A. Andresen
svein.a.andresen@no.pwc.com
Partner

PwC has extensive experience with the E & P sector and the relevant legal requirements. Below PwC partner Svein Andresen and director Per Fossan-Waage give a summary of the country-by-country reporting requirements, where work is underway to revise the rules.

Entities that are engaged in the extractive industries or the logging of primary forests shall prepare and publish an annual report with details of their payments to governments at the country and project level. The main purpose of the statutory provisions is to promote greater transparency to accountability of governments in their management of revenues from the country's natural resources.

The reporting requirements on payments are vested both in the Accounting Act (Regnskapsloven – RL) §3-3d and the Securities Trading Act (Verdipapirhandelloven - Vphl) §5-5a.

Entities that carry out the activities described above, are based on similar EU rules. Norwegian rules, however, expand the rules and require the reporting entity to provide information also regarding its investments, sales revenue, production volume and purchase of goods and services split between the individual countries where the company operates.

For listed companies in the extractive industries the Board will also need to confirm that the report is prepared in accordance with applicable legal requirements.

The rules of RL §3-3d and Vphl §5-5a only cover companies that meet two of the following three requirements;

- Annual sales income over 320 million NOK
- A total balance of more than 160 million NOK
- Average number of employees over 250.

In June 2015 a majority of the Norwegian Parliament resolved to amend the regulations (forskriftene) so that the country - by-country reporting should also require information about the subsidiaries and support functions to third countries that may be tax havens, not only information regarding the countries where the specific extraction activities take place. Furthermore, the authorities are considering to extend the scope of the rules, so that these are applicable to a wider range of companies. Work is also underway to establish a supervising body that will oversee the

companies that are subject to the rules of the country-by-country reporting. This work is not completed and will not apply to the fiscal year ended December 31, 2015.

If you have more questions to the country-by-country reporting requirements, please contact Svein or Per by E-mail.

About the authors:

Svein is a Partner at the PwC Kristiansand office and is a State Authorized Public Accountant. He started working for PwC in 1993. He is responsible for the audit of several shipping and oil service companies listed on Oslo Børs. Svein is member of the CMAAS section of PwC – the Capital Markets Accounting and Advisory Services section - which assists listed companies with capital market transactions. As such, he has been involved in a number of market transactions and has in-depth knowledge of the requirements for companies listed on Oslo Børs and Axess, knowledge he shares as responsible for a number of internal and external publications and seminars.

Per is a State Authorized Public Accountant and joined PwC in May 2013. Prior to PwC Per worked as listing officer at Oslo Børs for several years, where he was in charge of a number of IPOs as well as the E & P companies' oil reserve reporting. He has also worked as Chief Accountant for Frontline and CFO for Northern Oil, an E&P company listed on Oslo Børs. He works as Director at PwC CMAAS and has over the years been involved in a variety of capital market transactions. He is responsible for several of PwC's internal and external publications as well as seminars covering the capital markets, including facilitating the SPE Oslo Section's full-day E & P seminar at PwC, together with Oslo Børs.



Per Fossan-Waage
per.fossan-waage@no.pwc.com
Director

Expert comment from Swedbank Research



Teodor Sveen Nilsen,
Senior Financial Analyst, Swedbank Research
tsn@swedbank.no

The editor of "The First", Maria Djomina met Teodor Sveen Nilsen, Senior Financial Analyst from Swedbank and asked some questions regarding the expectations to long term oil price, future outlook of the oil and gas industry globally and locally.

"We expect the oil price to go up in the long term future but remain hesitant at which level it will land. In many of our calculations we estimate the price level to stay around 75 USD/barrel to guarantee breakeven for future development projects.

It is more difficult to estimate how the price will develop itself. We've tried to estimate how much the offshore costs can be reduced for a generic offshore project. We've witnessed 20 per cent decline in spending in 2015 vs. 2014 caused as a result of low margins, tightening of outsourcing budgets and humble amount of new projects executed. However, this trend is not sustainable for the service companies.

The estimates we are currently working with assume that the investments for new offshore field development projects can go down by at least 15-20 per cent when market normalises. But we remain the view that price will need to cover the marginal costs for the production and assuming the costs can be

pushed down by 15-20 per cent in long term, we land on oil price level which is lower than a few years back.

The evidence points that the major part of produced fossil fuels globally will in the future be mainly delivered from onshore fields. Despite many dynamic influencers the industry and production from fossil fuels meets, we still believe that offshore business remains to be an important part of the Norwegian economy.

As for new companies and licence holders on the NCS, we have seen an increased interest from Japanese, East European and national Middle East companies. This largely lies in the fact that Norway is a stable country to conduct business in; the regulations around tax, qualification process are set and well developed.

We spend quite significant time on analysing the production expectations to non OPEC countries and we expect the investment level

of companies in these countries to fall by 13-14 per cent next year. Although the project costs have sunk due to lower rig rates, capital cost and other attributes, the activity level will remain in direct correlation with the price making the oil companies careful in planning many new projects in 2016.

Johan Sverdrup is a key project for the future of Norwegian oil and gas. But the production levels reached its peak in 2001 and Norway will need to learn that the energy produced from fossil fuels will decrease in the future."

Teodor holds a Masters degree in Economics from BI Norwegian School of Management and MBA in Corporate Finance from the Norwegian School of Economics (NHH). He has previously worked at PricewaterhouseCoopers with particular focus on valuation of intangible assets, and at Kaupting Bank. Teodor has been with Swedbank since 2010 and works as oil and gas equity analyst.

Teodor is a Chartered European Financial analyst (AFA) and is ranked among top 3 E&P analysts in Norway.

High deal activity continuing into 2016

by Daniel Rennemo, Deals Partner in PricewaterhouseCoopers

After a slow start to the year, M&A activity within the E&P segment in Norway has taken off in the third and fourth quarter of 2015. In recent months, LetterOne's investment company DEA has acquired E.ON's Norwegian E&P business, relative start-ups Tellus Petroleum has partnered up with Dutch player Sequa Petroleum to acquire a package of assets including stakes in Maria, Knarr and Yme from Wintershall and picked up a 15% stake in Gina Krog from French giant Total., Det Norske has closed two corporate transactions (Svenska Petroleum and Premier Oil's Norwegian arm) within weeks of each other to name but a few of the announced deals. "The First" talked to Deals Partner in PwC Stavanger, Daniel Rennemo, who specializes on providing transaction services within the oil and gas sector, to get the inside update.



Daniel Rennemo, Partner PwC

1. Which were the biggest transactions conducted between licensees operating on NCS in 2015?

2015 has been a really interesting year for E&P transactions in Norway. Shell's acquisition of BG announced in April focused the global financial community's on the sector with many predicting it was the first of a number of megamergers within the industry.

That has not materialized as of yet, but instead there have been a number of mid-sized local deals in Norway, but also other oil and gas hotspots. Both BG and Shell have sizeable organizations in Norway with Shell by far the bigger and more established on the NCS.

There aren't any figures out on the allocation of value to that portion of the bigger deal, but of the larger pure play NCS deals, the acquisition of E.ON Norge by DEA (previously known as RWE DEA) announced in October, Tellus' acquisition of a package of Wintershall Norge assets and Lotos Petroleum's acquisition of a package of assets from ExxonMobile were the bigger deals.

Based on disclosed transaction

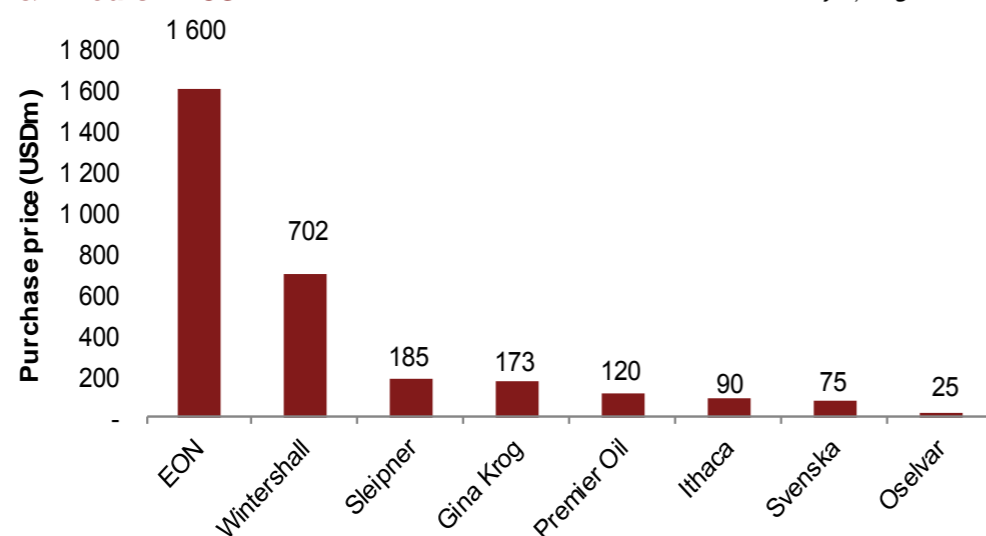
value (or enterprise value), DEA's acquisition of E.ON clocked in at USD 1.6 billion, followed by Tellus' asset deal at USD 602m which could rise to 702 million depending on how the oil price develops up to 2019.

LetterOne's acquisition of RWE DEA which included assets in Africa, Middle East and other parts of Europe including the Norwegian business was valued at €5.1bn, but there are no reliable figures as to the deal value allocated to the Norwegian business.

So it's been a busy year so far, with a number of corporate deals, individual asset deals, farm-ins and farm-downs, and the bigger package of asset deals. There's been deals involving the majors (typically as sellers, with Shell being the only exception), deals with Mid-sized players with ambitions to grow, and private-equity backed companies taking the more opportunistic approach.

And there is still time to go before New Year's Eve!

E&P Deals - NCS



PwC analysis, Mergermarket

2. What has caused increase of transactions in last 18 months?

The overall trigger, in my mind, is the fall in the oil price and the subsequent price volatility or uncertainty as to how the oil price will develop. The effects of the oil price uncertainty cascades down into 5 key drivers or themes:

First, availability of funding. The various oil companies have very different levels of financial strength, and have employed different capital structures to fund their business. A number of the firm's that have been able to secure funding with a longer maturity profile, that have maintained lower leverage or have owners willing to support them with fresh capital, e.g. like a number of the private equity backed independents, have a strong balance sheet to make opportunistic acquisitions designed to take advantage of significantly reduced valuations.

Examples of this on the NCS include HitecVision backed Pure E&P acquiring Oslo Stock Exchange listed Rocksource and the Hungarian vertically integrated oil company MOL Group acquiring Ithaca Petroleum's Norwegian business.

Second, Cash flow. All of the major oil companies (e.g. ExxonMobil, Shell, ConocoPhillips, Statoil, Total etc) have committed

to high dividend payout ratios paid out on a quarterly basis to their shareholders. As the cash flows from their upstream businesses have diminished with the fall in the price of oil, making them unable to service their investment program and debt and dividend payouts, they are faced with a difficult dilemma: Cut dividend and watch the share price plummet as investors punish management for breaking its promises to them, or maintain the dividend payouts and solve their cash flow issues by other means.

So far, the majors have been very reluctant to make reductions to their dividend distributions, opting instead to reduce opex and capex significantly. One way of improving their investing cash flows has been to sell off businesses or assets, or ideally generate cash from the sale of a development project thereby also reducing the capex commitment going forward.

Examples of this includes Total's sale of a 15% stake in Gina Krog and Wintershall's sale of 15% of Maria.

Third, the emergence of consolidators. With a number of sellers in the market, at strongly discounted prices compared to 18 months ago, there is an emergence of consolidators who use the market conditions to realise their strategic ambitions. LetterOne has clearly taken on this role, closing both the

RWE and E.ON deals in 2015, as has Det Norske and Tellus.

Fourth, disposal of non-core assets. In order to preserve cash, improve their balance sheet and secure the value of the business, a number of companies are carrying out strategic reviews of their portfolios with the aim to optimize their asset base given their beliefs for the future and capital priorities. For some, this has meant that Norway has been defined as non-core, including Ithaca Petroleum Norge and E.ON, while others have taken the same view on specific assets or licences on the NCS, eg narrowing their geographic focus or reducing their exposure to exploration assets.

Finally, cost. Reducing the cost level is high on the agenda for most E&P companies on the NCS.

A number of companies have looked to M&A activities to achieve cost reductions, e.g. DONG have reduced its head count by transferring its Tromsø team to PGNiG and selling off its infrastructure investments to CapeOmega.

3. Are the transactions financed by company's own capital or banks?

The sources of funding varies. We know, though, that funding through the bond markets has become increasingly more difficult with the fall in the oil price and that banks



are more reluctant to increase their lending to the sector as the underlying cash flows to service the debt have been strongly reduced.

As such, the companies that have been able to carry out the majority of the deals have been backed by strong owners – be it an international group with access to various sources of funding including internal cash flows, private equity backed acquirers or the backing of wealthy individuals like LetterOne.

4. Have you defined certain challenges that are similar to the transactions conducted in 2015?

For a long time the biggest hurdle for deals to be completed was the gap in price expectations from sellers and buyers. As buyers and sellers used very different assumptions for oil price, they were simply not able to agree on pricing.

For instance, Wintershall's sale of assets, which attracted considerable interest, was concluded only after an uncharacteristically long sales process that kicked-off late September 2014 and ended in June 2015.

So despite the strong interest, agreeing on a price required both Wintershall as sellers and the various parties interested as buyers to spend time on analyzing the oil price development and build the new price scenarios into their models. As a consequence, the original time schedule for the deal was ex-

tended.

5. How do you foresee the M&A market develop in 2016?

The dynamics for continued high deal activity that we discussed earlier are still very much at play, and we know there are a lot of assets and corporates available, so I think there will continue to be high deal activity also going into 2016.

The NCS is highly diversified with more than 60 different companies qualified, and with new players rumoured to be considering entry to Norway, you have the basis for an active transaction market. Therefore I think we'll continue to see a number of smaller and mid-sized deals, the volume of which depends on how successful the ambitious players are in securing funding for growth.

As for the megadeals, I am more uncertain. None of the majors, except for Statoil, have said that the NCS is core to their business going forward so I would rather look to one of the bigger players exiting Norway than investing further. But, there are very few buyers with sufficient funding available for the really big deals.

6. A few comments to global M&A market of E&P companies.

Similar to what we are seeing in Norway,

the same themes are present also for the international markets.

However, we've noted from the calls we do within the PwC oil and gas network with transaction professionals that M&A activity has been slower elsewhere than in Norway. The big exception is onshore in the US, where deal activity is very high. Again on the international stage, it will be interesting to see if there are any deals involving the majors and some of the stronger unconventional players in the US onshore space. If one of the bigger onshore companies, with a good asset portfolio and a talented pool of people fall or go into financial distress, I'd expect one of the US majors to pounce. I would definitely recommend staying tuned in, as I am certain there will be some interesting stories to unfold in the near future.

About Daniel Rennemo:

Daniel is a Partner at PwC Stavanger office and is a State Authorized Public Accountant. He has broad experience from numerous diligence, transactions and capital market projects in a career of more than 12 years with PwC. During his time in PwC, Daniel has worked almost exclusively with clients in the oil and gas, and oil services industry.

Please contact Daniel at daniel.rennemo@pwc.com



Society of Petroleum Engineers

Renew Your Membership

Membership renewal notices go out in September, with payments for the following year due by 31 December. Members who haven't paid their dues by 1 January will lose membership privileges until their dues are paid.

The UK: A springboard to global growth

by Roy S. Kristiansen, Senior Market Adviser, UK Trade and Investment



Roy S. Kristiansen
Senior Market Adviser
UK Trade & Investment
roy.kristiansen@mobile.ukti.gov.uk

UK Trade & Investment

Before diving into the UK sales pitch, we should perhaps place ourselves in context; UK Trade & Investment (UKTI) is a government department. We help UK based companies of all sizes to grow and become more profitable by exporting their products and services. We also support all types of overseas businesses and business people to establish and/or expand their presence in the UK.

And with local offices both in the UK and around the world, you're never far from a UKTI adviser. In Norway, UKTI are part of the British Embassy in Oslo.

Why the UK?

More companies locate their businesses in the UK than anywhere else in Europe.

The reasons for this are many; a large and growing domestic market, highly business friendly environment, London's leading position in finance and business services, the joint lowest corporate tax regime in the G20, home to 4 of the 6 top rated universities in the world, the largest air transport system in Europe, it is the highest rated major economy in the Global Innovation Index...the list can go on.

In addition to being a full EU member, the UK also has free or preferential trade agree-

It has been a bumpy ride in the world of business over the past year or so, and arguably nowhere more so than within the oil & gas industry. Uncertainty, risk, cuts, consolidation, streamlining...the media seems reluctant to offer any glimmer of hope for the industry. However, there is arguably also some truth in the slightly tired cliché of "never letting a good crisis go to waste", and for many companies this may just be the time to grab market shares, acquire new technology, diversify or enter new geographies. Internationalisation and increased international trade is certainly positive in terms of boosting economic development, and although being anything but unbiased on the subject, we in UK Trade & Investment (UKTI) would argue that the UK is the first location Norwegian companies should look to.

ments with many non-EU countries.

It is also easier to do business in the UK than any other major European economy.

Opportunities for Oil & Gas

Oil and gas is the UK's largest industrial sector. 42 billion barrels of oil equivalent (boe) have been produced from the UK Continental Shelf (UKCS) and 23 billion boe could still be produced.


The UK is a global centre for expertise in the oil and gas industry, and it offers a number of opportunities for overseas companies and investors. And whilst also the UKCS currently is experiencing a decline in activity due to the combination of being a mature basin and low oil price, there are still great opportunities, also in the short-term. To exemplify, analysis made by UKTI sector experts earlier this autumn highlighted 107 listed contracts to be let in Q4 2015 alone, spanning a diverse range including upstream, downstream, decommissioning and shale.


In addition, we are also seeing increased appetite for strategically driven investment; companies are setting up or expanding UK operations based on global opportunities rather than those provided by the UK market alone. London is a global centre for finance, but also for HQs and EHQs in the global energy industry, as well as for long-

UK ease of doing business: the headlines

 Easiest major economy in Europe to do business in


 Economy growing at the fastest rate in the G7 in 2014

 Largest deficit reduction of any major advanced economy

 Flexibility to choose a company structure that suits your needs

 Corporate governance based on principles, not burdensome regulation

 Fair and open public procurement procedures

 London is the world's leading centre for commercial litigation and arbitration

 Ground-breaking approach to reducing regulatory burdens is saving business time and money

haul business travel. This is a proposition more and more businesses are finding attractive, using the UK as an efficient spring board for global growth.

UKTI services – what do we do

Our services can largely be divided into two; trade services and services for inward investors.

The trade services are tailored to support UK companies, including the UK subsidiaries of foreign investors, export. Our export services incorporate anything from helping clients understand how to do business overseas or increasing their profile and credibility in new markets, to market research or assistance in overcoming barriers to entry or expansion.

The investment services, which are perhaps likely to resonate more within a Norwegian-based readership, consist of free of charge assistance in locating and expanding your

business in the UK. Whether you are an entrepreneur, start-up, medium to large business or an institutional investor, UKTI offers support for your investment or expansion.

Our services can help you:

- find the right location to establish or expand your business
- set up your business in the UK
- identify and access market opportunities
- meet people who can help you grow your business
- understand the UK tax system
- recruit, train and retain staff
- access different finance options
- understand visa requirements for yourself and your workers.

And our support does not stop once you are based in the UK. We will continue to help your business expand within the UK or to European and global markets.

UKTI successfully supported 48 foreign direct investments within the Energy, Environment and Infrastructure (EEI) sectors globally in the UK financial year 2014-15. 11 of these successes involved Norwegian businesses, ranging from the set-up of small sales offices to massive projects like the Dudgeon offshore wind farm or the NSL electricity interconnector. The figure thus far this year from the EEI sector in Norway is 6 UKTI network supported investments, coming from a range of subsectors like traditional oil & gas supply chain, shale gas, marine pollution control, onshore and offshore wind.

Are you looking for new and innovative products or services?

We also want to bring to your attention that the UK Government has recently launched its most ambitious export campaign ever.

The *Export is GREAT* campaign aims to inspire and support 100,000 additional UK exporters to sell their goods and services overseas by 2020, with a mission to turn the UK into the world's greatest exporting nation. As part of this purposeful drive, UKTI at the British Embassy in Oslo offers a free service to Norwegian companies to help source products or services to your specification from the UK. You simply tell us what you are looking for and we will alert UK companies accordingly.

So to sum up, whether you are a budding entrepreneur, working for an SME or a large corporate, whether your company is keen on sourcing from the UK, looking to establish a presence or grow operations in the UK – UK Trade & Investment and the British Embassy in Oslo are here to help, so please do not hesitate to get in touch.

About the author:

Roy has worked for UK Trade & Investment since 2002, initially covering trade work before moving over to inward investment. He has been employed as Senior Market Adviser since 2007, working to attract, retain and add value to Norwegian foreign direct investment to the UK. Roy has primary focus on the energy, environment and infrastructure sectors. He holds a Bachelor's degree in International Marketing from BI Norwegian Business School.

UK tax: the headlines



Corporation tax rate of 20 percent in 2015 will be the lowest in the G7 and joint lowest in the G20



A tax system rated as the most business-friendly of all the world's major economies



Generous tax reductions available for research and development (R&D) and commercialisation activity



Lowest employer social security contributions among the EU's five largest economies



New private pension system that is simple and flexible for employers and employees alike

For more information, please visit

www.gov.uk/ukti

INNOVATION IS GREAT BRITAIN

Nearly 50 years of North Sea oil and gas production has created a business infrastructure of over 3,000 companies. For a world-leading supply chain, choose the UK.

Offshore oil rig
North Sea, UK

gov.uk/ukti



A bird's eye view on Energy Insurance

by Nikolai Jørgensen, SPE Oslo Section Treasurer, Trainee Broker in Marsh Energy Practice



Nikolai Jørgensen
SPE Oslo Treasurer,
Trainee Broker
Nikolai.Jorgensen@
marsh.com

Insurance is a risky business. It is therefore a requirement for many worldwide commercial activities.

Insurance traces its roots back to 3000 BC in the Kingdom of Mesopotamia, where seafaring merchants saw a need to collectively insure cargoes being shipped to other ports. However, it was much later with the establishment of Lloyds of London that insurance as we see it today has developed.

Energy insurance is a small, but rather unique and complex field of insurance. The global market can now provide a theoretical maximum of USD 7BN dollars risk transfer for Exploration and Production (E&P) Companies. Large Energy Insurance markets include Lloyds of London, the Middle East, the Far East and the US. The market goes through cycles and can like other markets be a buyers' market or a sellers' market. At present, insurers are still overall in a profitable position, which increases the influx of keen new players into the global market. The current market is therefore a ruthlessly competitive buyers' market, or as the insurance industry denotes - "soft".

An E&P Company's insurance program generally comprises Property Damage, Operators Extra Expense, Third Party Liability and Business Interruption. Handling or placing the client's insurance program on the insurance market is no simple matter as values and coverage for the individual ele-

ments are often high. In addition an insurance programme needs to be tailored to meet the client's needs for insurance as Energy clients vary in size, areas of operation and expertise. One would perhaps like to imagine that buying such insurance is as easy as shopping for fish or beef. The reality is a little different. Insurance brokers bridge an intricate link between the E&P companies and the global insurance market. The insurance broker is a neutral party acting for the client and ensures that the client gets access to competitive terms and pricing for insurance. Furthermore, throughout the policy period, the broker will add value by assisting the E&P Company with the administration of the insurance program and the risks as they evolve.

Personally, as a relative rookie to the field of insurance broking and E&P companies, I am reminded by my peers of a steep learning curve, small details with enormous impact and that I must never stop learning. It is interesting and challenging. Yet, in a competitive commercial environment which is at present extremely tough for our Energy clients, we are as brokers reminded that our role is a small piece of the puzzle - it is *only* insurance.



Society of Petroleum Engineers

<http://www.spe.org/industry/>

Industry Resources



OnePetro

Multi-society technical paper library.



Petro Wiki

E&P industry wiki and glossary



Energy 4 Me

Essential E&P education for the classroom



SPE Connect

Networking, forums, and discussions.

Full Cycle: From Raw Seismic gathers to Lithology and Fluid cubes

Seismic processing/Preconditioning
 Rock Physics modeling
 AVO and Frequency decomposition
 Inversions
 3D lithology and fluid cubes delivery

base of reservoir

clastic shale
 brine sandstone
 shaly sandstone
 shale
 sandstone
 hydrocarbons

www.pss-geo.com

PSS-Geo

Contact PSS-Geo team
 Oslo +47 22 56 07 15 / Stavanger +47 518 40 860

Oslo
 Monday, December 7,
 2015, 5:30 PM

Stavanger
 Wednesday, December 9,
 2015, 6:30 PM

Don't forget to register for your SPE Christmas dinner!!!

Induced polarization: detecting HC signatures in reservoir overburden

by Vitaliy V. Yurchenko, PhD, Senior Geoscientist, VP of Sales and Marketing at ORG Geophysical AS



Vitaliy V. Yurchenko
PhD, Senior Geoscientist,
VP of Sales and Marketing,
ORG Geophysical AS
vyu@orggeophysical.no

In the exploration business, where more than half of the projects end up with dry exploratory wells, inherent financial risks often reach eye-watering levels. At the current downturn, when the exploration budgets suffer substantial cuts, the industry should be on the lookout for efficient ways to mitigate these risks. Measurements of induced polarization (IP) can make the quesswork much easier by catching epigenetic alterations that occur in a plume above petroleum reservoirs. The method is certainly not a panacea to all explorationist's headaches, and the mechanisms that provide anomalous IP responses are often debated. Nevertheless, the blind tests proved it to be one of the most efficient tools to detect presence of hydrocarbons.

It all started in 1912, when Conrad Schlumberger patented a method of ore prospecting by induced polarization. Later he admitted that his experiments in the field were unsuccessful. 100 years later and with better luck, ORG Geophysical launched its first survey in the North Sea in 2012, detecting presence of petroleum reservoirs with 90% success rate. That year ORG introduced a highly efficient method of detecting IP anomalies called Differentially-Normalized Method of Electrical Prospecting (DNME), a technology originally developed by Russia's Siberian Geophysical Research and Production Company (Davydycheva et al. 2006, Veeken et al. 2009).

The method relies upon the fact that no cap rock is perfectly seal-

potential. While all the mentioned effects produce measurable IP, pyrite and to some extent other iron sulfides provide the most distinctive footprint on the electro-magnetic signal in time domain.

The physics of the IP effect is as follows (Telford et al. 2004). When a mineral grain with electron and/or hole type of electric conductivity (as in the case of pyrite, for instance) is immersed in electrolyte with ionic conductivity (such as pore fluid, i.e. brine) a contact potential will occur at their interface. Consider the two pore passages (Figure 1): in the upper one the current is entirely electrolytic. In the lower pore, the presence of a mineral with net surface charges on either

decays as the ions diffuse back to their original equilibrium state. For this reason the IP effect is observable as a relatively long-lived imprint of the imposed DC-field after the current is shut off.

IP is quantified by a chargeability η and a characteristic relaxation time τ . These parameters enter into the Cole-Cole expression for the frequency dependent conductivity of mineralized porous media (Flekkøy 2013)

$$\sigma(\omega) = \sigma_{\infty} \left(1 - \frac{\eta}{1 + (i\omega\tau)^c} \right)$$

and are obtained from inversion of field data: the electric potential and the electric potential gradient. The former one appears to be particularly sensitive to IP. Inver-

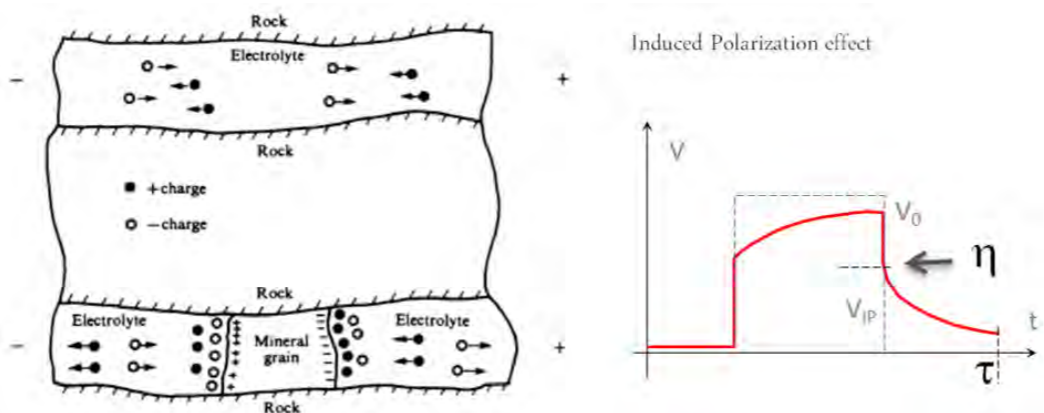


Figure 1. Induced polarization. Left: Electrolytic charge flow in the upper pore and contact potential at the grain interface (adopted from Telford et al.) Right: IP shows up as a slow voltage decay after a current pulse

ing, so minor amounts of hydrocarbons will always seep into the overburden. This will result in a formation of reduction zone in the halo above HC reservoirs. Among other effects it facilitates formation of epigenetic pyrite, growth of bacterial cultures and onset of the so-called self-

face, results in an accumulation of ions in the electrolyte adjacent the facets. Because ionic charge transfer in the electrolyte is much slower than in the metallic (or semiconductor) grain, the pileup of ions is maintained by the external voltage. When the current is interrupted, the residual voltage

sion parameters are typically constrained within a geo-electrical model, which includes up to 7 or 8 layers with distinctively different electrical properties. Technically it is possible to substantially increase the number of layers, thus refining the model, but it is redundant for practical reasons.

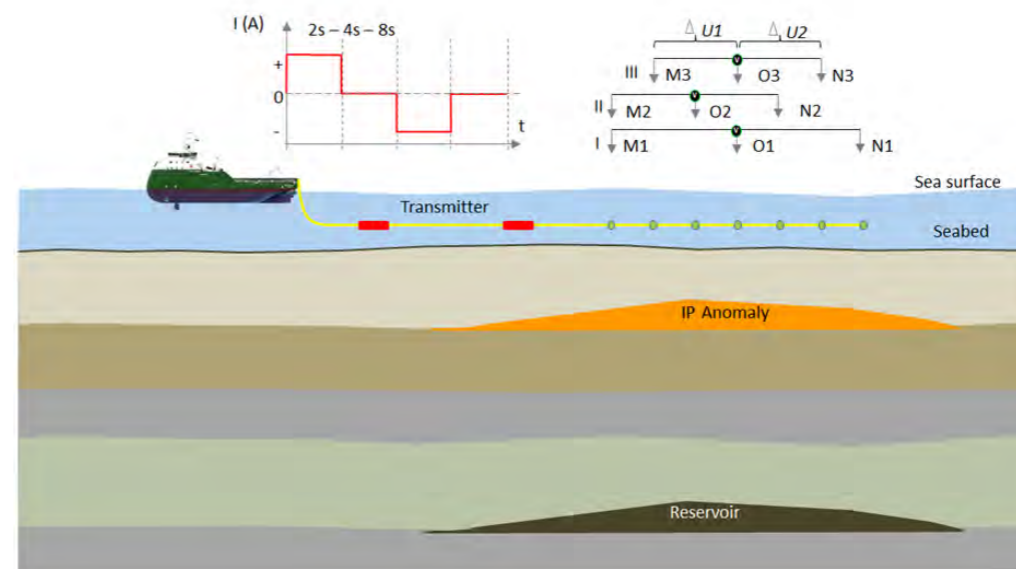


Figure 2. Acquisition system. Towed dipole-dipole array. Current is applied between the two transmitting electrodes. Potential differences are measured by receiver electrodes MON with three different offsets I, II, III

The layers are selected based on a priori information, such as seismic and electric well logging, whenever available.

Unlike the EM methods that tend to detect resistive anomalies at reservoir depth, this method's target is the geochemical alteration zone situated in sedimentary rocks, some distance above hydro-

carbon accumulations. The fact that the target volume is quite shallow, and the IP signature quite pronounced, allows a towed system with relatively short offsets (see Figure 2) to be used. Marine IP measurements are performed by towing a streamer at 2-4 knots and applying 4 to 8 seconds long current pulses of alternating polarity ($\pm 1000 - 1250$ A). Time decay

of voltage gradients is measured during pauses of the same length. The streamer consists of 2 transmitting electrodes and 7 receiving electrodes with 200 m spacing, as shown in Figure 2. Upon denoising and de-trending, the data are stacked in pickets with the centers approximately 1 km apart (Figure 3), each of which are inverted either separately or using

cross-picket regularization algorithms. When the survey area is dominated by complex 3D structures, a 3D inversion can be performed. The final result is a distribution of chargeability in the target layer. Right panel in Figure 3 shows an extract from a 2012 case study on the Norwegian Continental Shelf (NCS): clear IP anomalies were observed over discoveries.

To the date, ORG has successfully tested the method on different play models typical for NCS; fields with the reservoir depth from less than 200 m (Peon) down to 4000+ m, including carbonate reservoirs (Hod, Valhall), which pose an almost unpassable challenge for EM methods (see the map in Figure 4). So far in more than 20 blind tests, i.e. when the outcomes of IP surveys were presented prior to drilling, there have been basically only two disappointments, marked red in the table in Figure 5. Both cases are thoroughly scrutinized and we at ORG Geophysical hope to return to SPE readers soon with detailed analysis. Besides an obvious practical value for the company, such an analysis might also provide an important insight into the true origins of IP anomalies.

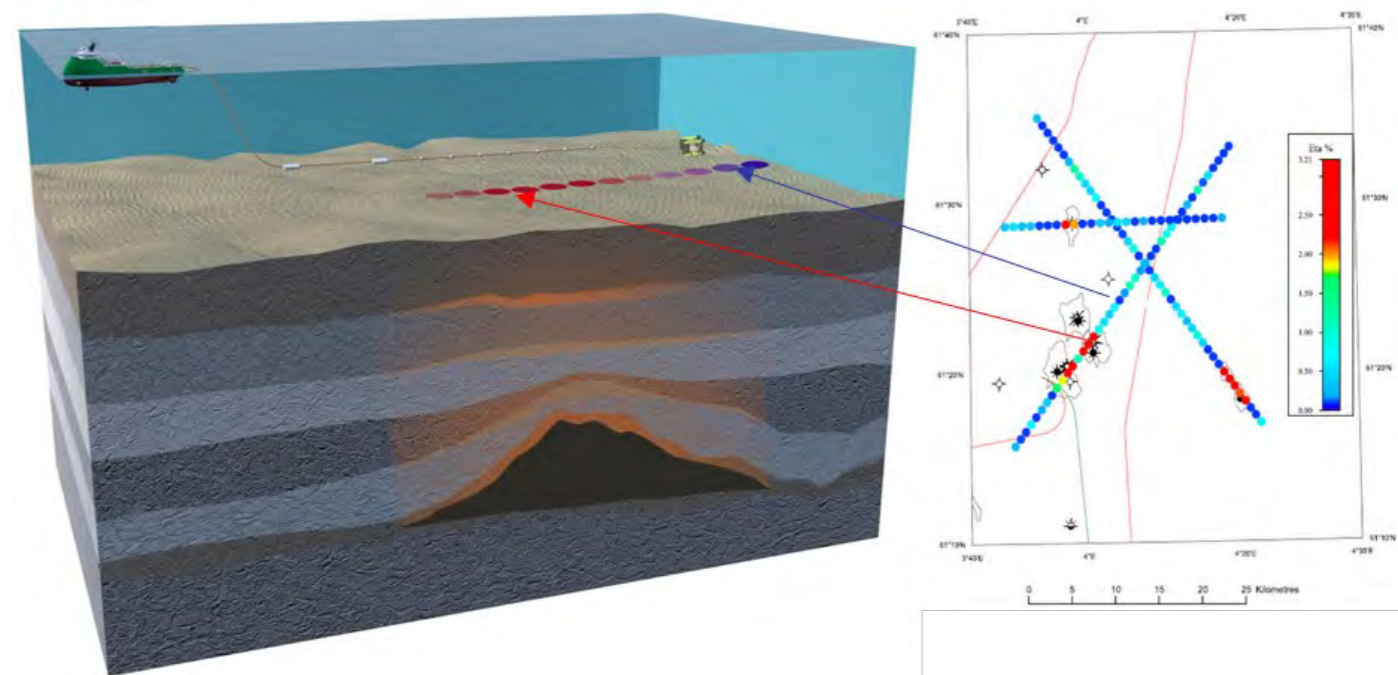


Figure 3. Data are stacked into pickets. The map on the right hand side shows distribution of chargeability in the target layer

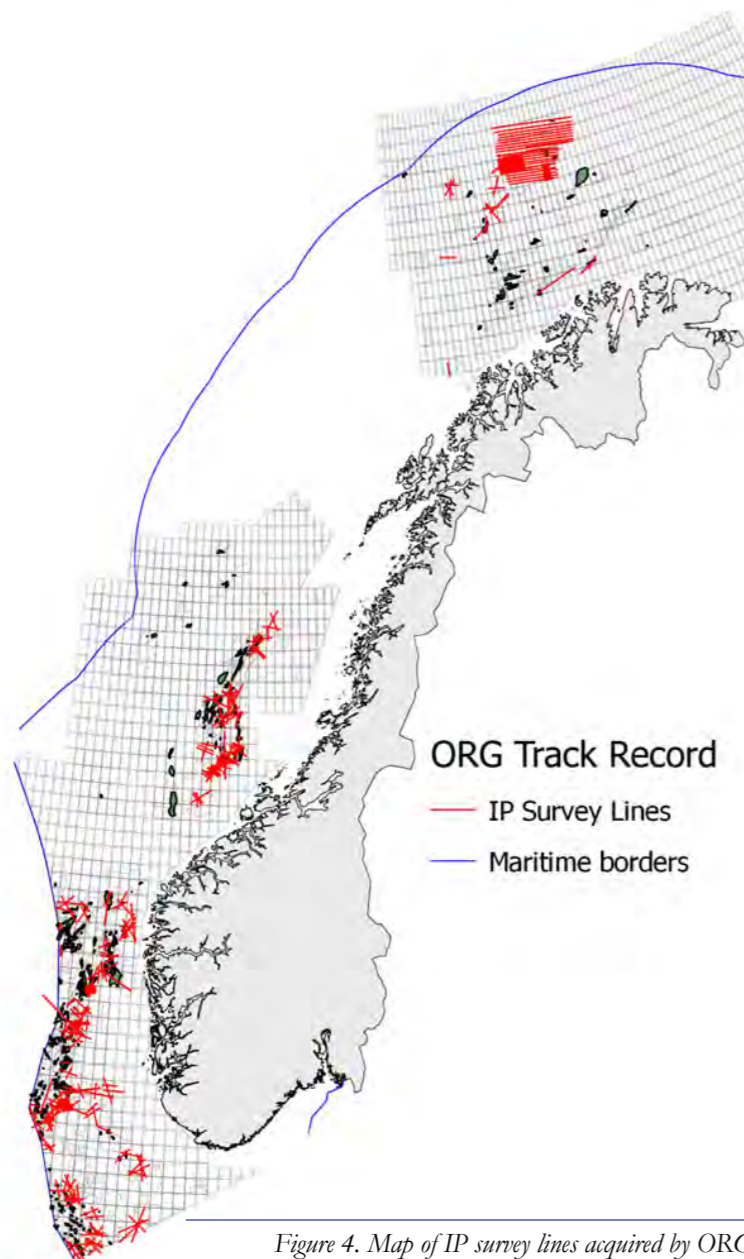


Figure 4. Map of IP survey lines acquired by ORG Geophysical (detailed maps are available on request)

Well name	Top reservoir(m)	Reservoir age	Tecnology prediction	Drilling result	Operator	Spudded	Completed
8/10-05S	2750	LIurassic	No HC	Dry	Centrica	01.01.2014	06.03.2014
8/10-05A	2263	LIurassic	No HC	Dry	Centrica	06.03.2014	22.05.2014
8/10-06S	1945	LIurassic	No HC	Dry	Centrica	31.05.2014	06.07.2014
25/05-09	2240	Palaeocene	HC	21m oil	Total	01.01.2014	25.02.2014
31/10-01	2357	Palaeocene	No HC	Dry	Tullow	01.07.2014	25.07.2014
31/02-21S	3217	LIurassic	No HC	Dry	Tullow	27.04.2014	04.06.2014
31/03-04	2082	LIurassic	No Hc	Dry	Tullow	23.11.2013	05.01.2014
6407/01-06S	4250	LCretaceousc	HC	9m gas	Wintershall	07.12.2012	24.01.2013
6407/01-07,07A	3345	LCretaceous	No HC	9mgas/12m cond	Wintershall	23.03.2014	20.04.2014
6506/09-03	4692	MJurassic	HC	47m gas/cond	Statoil	16.06.2013	27.08.2013
6507/10-02S	1957	MJurassic	HC	12m oil/12m gas	Faroe	10.11.2013	10.02.2014
25/06-05S	<2500	MJurassic	HC	10m gas/cond	Total	13.03.2015	10.04.2015
10/04-01	<2400	MJurassic	NoHC	Dry	Wintershall	22.06.2015	13.07.2015
02/11-11	<3400	LCretaceous	No HC	Dry	Edison	21.06.2015	27.07.2015
30/11-10/10A	<3900	MJurassic	No HC	100m oil	Statoil	02.11.2014	31.12.2014
6407/08-07/07A	<3000	MJurassic	No HC	Dry	Statoil	27.04.2015	14.05.2015
6507/11-11	<2900	MJurassic	No HC	Dry	Tullow	25.05.2015	01.07.2015

Figure 5. Results of the blind tests on NCS. The first column is the NPD well name (<http://factpages.npd.no/factpages/>), the second column is the depth of the top reservoir, the third column is the age of the corresponding formation, the fourth column is the IP forecast, followed by the drilling outcome in fifth column, operator in the sixth and start/completion dates in the remaining two columns. The list is currently updated

Another great advantage of the IP time domain method is that it is suitable for shallow water. So far the best results have been obtained for the seas up to 450 m deep, though deep water systems are under development and soon to be tested.

Towed streamer gives a clear operational advantage too. Eventually it makes the technology more time efficient. This, along with the company's modest pricing policy, explains how ORG managed to gain a valuable experience at such a high pace. From the start in 2012, more than 12 000 km of survey lines have been acquired, most of which belong to our multi-client library.

Finally, on behalf of ORG Geophysical, I would like to wish all SPE members and their loved ones happy holidays and all the best in the New Year!

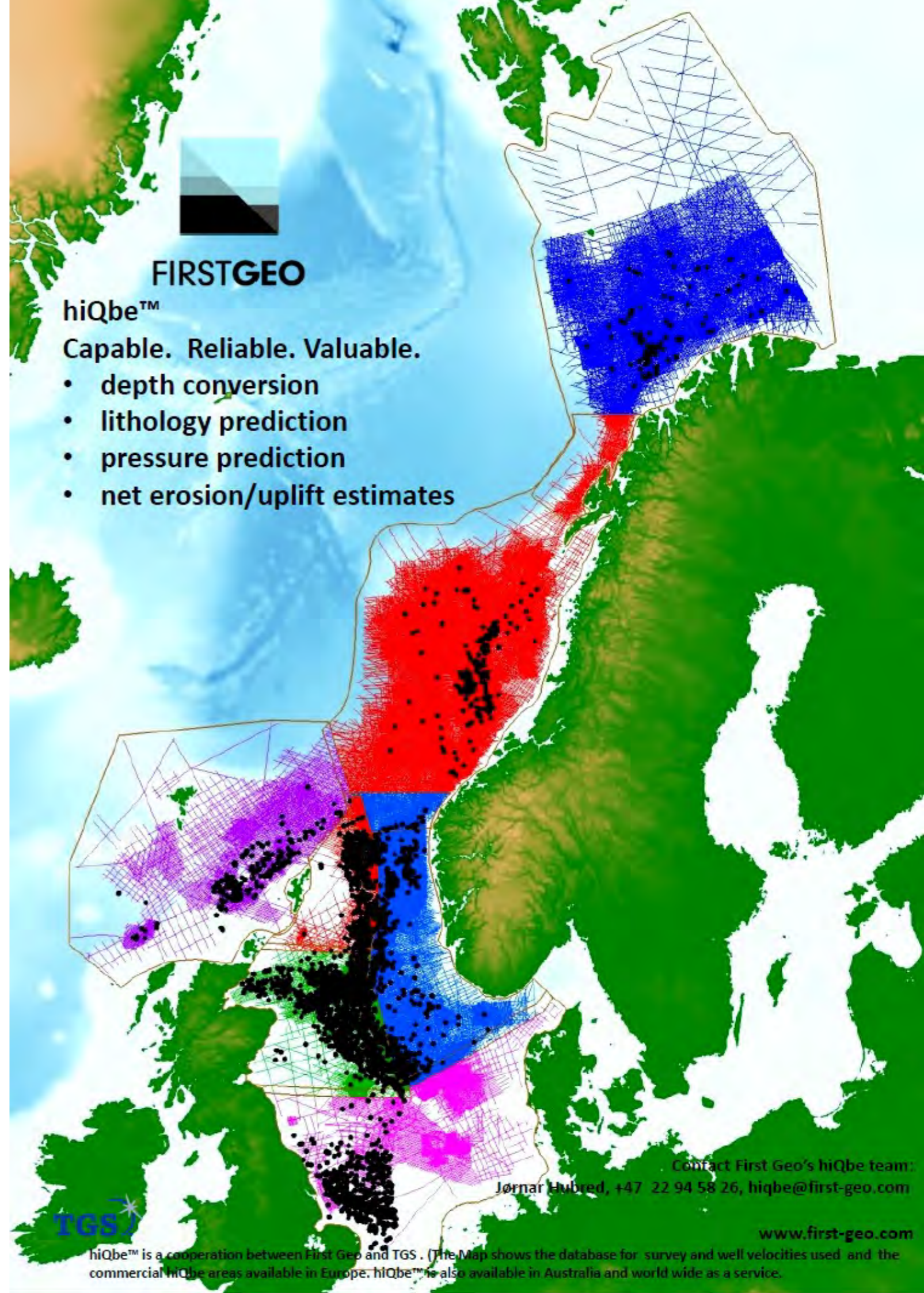
References:

Davydycheva, S., Rykhlini, S. N., and Legeydo P., Electrical prospecting method for hydrocarbon search using the induced-polarization effect, Geophysics, 71 (4), pp. G179-G189, July 2006

Veeken, P. C.H., Legeydo P. J., Davidenko Y., Kudryavceva E., Ivanov S., and Chuvaev A., Benefits of the induced polarization geoelectric method to hydrocarbon exploration, Geophysics, 74 (2), pp. B47-B59, January 2009

W.M. Telford, L.P. Geldart, R.E. Sheriff, Applied Geophysics. 2nd Edition, Cambridge University Press, 2004

Flekkøy, E.G., A physical basis for the Cole-Cole description of electrical conductivity, Geophysics, 78 (5), pp. D355-D368, September 2013



hiQbe™ is a cooperation between First Geo and TGS. (The Map shows the database for survey and well velocities used and the commercial hiQbe areas available in Europe. hiQbe™ is also available in Australia and world wide as a service.

www.first-geo.com



Dr. Natalia Kukina
Exploration Manager
RN Nordic Oil

Exploring the Borders of Arctic Shelf...

by Vita Kalashnikova,
edited by Maria Djomina

14 Arctic climate and fundamental geological research expeditions brought to unexpected result – the borders of Arctic continental shelf!

The main goals of the marine-geological research program were to study changes in paleoclimate of the Arctic Ocean during Late Quaternary period and track the long-term history of the Cenozoic Arctic Ocean with its environmental evolution from a warm to an ice-covered Polar Ocean.

Exploration Manager of RN Nordic Oil
Dr. Natalia Kukina is sharing with us her incredible discoveries.

- Fundamental research
- multi-national projects
- RN Nordic Oil vision today

Biography

Dr. Natalia Kukina was born and raised in Murmansk. In 1989 she graduated from the Kirovsk Mining College (Murmansk region), specializing in geology, prospecting and field exploration. Her career began with a description of the well core drilled in the Barents Sea, late 80s. There was no computer and lithological columns available and all description were hand-written. An example of notes recorded can be seen as

[scan copy in the CGG & Robertson Red Books.](#)

The physical and mechanical analysis of the very first wells of Shtokman (Barents Sea) was performed by Natalia in laboratory of Rock Physics in "Arcticmorneftegasrazvedka" company. In 1994, as a student (1991-1996) of the St. Petersburg Mining Institute (Technical University) (now renamed to the National University of the mineral resource "Gorniy"), she began to participate in scientific expeditions of high-latitude regions in the Arctic - *the archipelago of Franz Josef Land, Svalbard, Novaya Zemlya.*

During 12 years Natalia spent in the Murmansk Marine Biological Institute of the Russian Academy of Sciences (MMBI RAS),

[she had been in](#)

[14 marine Arctic expeditions](#)

(the Barents Sea, Kara Sea, Norwegian-Greenland basin, Fram Strait, in the central part of the Arctic Ocean in areas of the Lomonosov Ridge, Knipovich and Alpha). 10 of them were done on the German ship PFS Polarstern.

The studies were conducted in the framework of fundamental research projects and the memorandum of cooperation between

the MMBI RAS and the Alfred Wegener Institute in Germany. The expeditions were a unique opportunity to obtain factual data for the basis of realization next projects:

1) *The processes of the contemporary sedimentation and paleo situation in the water areas of the Franz-Josef Land, north-east of the Barents Sea and north-west of the Kara Sea;*

2) *Flows of the sediment material on the Arctic Seas' shelves under conditions of marine periglacial in the Late Pleistocene;*

3) *The Pechora Sea - Late Pleistocene Paleogeography, present state of the shelf and coastal zone, and a forecast for the 21th century.*

4) *Processes of sedimentation on the glacial shelves and paleoclimate changes in the Arctic.*

While performing geological and geophysical work in the Arctic, research institutes from Norway, Germany, Russia, Canada, France and Denmark had constructed the regional geological, tectonic and other maps. Studies of such international scale allowed to prove that the underwater ridges of the

[Central Arctic complex \(the Lomonosov, Mendeleev-Alpha Ridge\) have continental nature and have components of the continental shelf.](#)

In 2004 Natalia received an invitation from professor A.P.Lisitsyn and the job transfer to the Institute of Oceanology named after Shirshov in Moscow. By that time, she already had obtained a PhD and had 5-years' experience in teaching at Murmansk State Technical University in the Department of Oil and

Gas. And, between 2005-2007, she was the editor of the lithology and minerals section in the peer reviewed journal - a main data base of all Russian geo-science abstracts.

In 2006, Natalia worked in the State Reserves Committee, MNR Rosnedra as an expert of Russian hydrocarbon deposits. That was a radical change from the creative scientific activity to management role. And, a year later she decided to go back to science. In 2007, Natalia joined the Halliburton Int. for geological and facial modelling of hydrocarbon fields. Then she carried out exploration work onshore (2007-2011) in a joint venture with ENI in Russia. After that Natalia was responsible for the evaluation of the resource prospects: from strategy, economic, business planning, and risk assessment to the development of proposals for TNK-BP investment portfolio expansion (2012-2013). A further merger of TNK-BP and Rosneft (May 2013) opened possibilities for Natalia to manage projects in Norway. In December 2014 she had moved to Oslo and have been working as Exploration Manager in RN Nordic Oil AS.

Interpretation project "Norway" started in 2013 under the umbrella of RN-Exploration, a subsidiary company of Rosneft. RN-Exploration coordinates the exploration work and supports RN Nordic activities in start-up period.

Natalia is an author of more than 50 scientific publications and one monograph.





PFS Polarstern, German Arctic research ship

The biggest contribution of Natalia's expeditions was through different studies of paleo environmental reconstruction and history of sedimentation in different regions of the Arctic shelf. Core samples were

to the recovery of paleo oceanographic environment during the Holocene in the area of the Plateau Yermak. Determination of the magnetic properties of glacial and interglacial deposits in the area allowed to perform more detailed stratigraphic correlation.

The transition from the last glacial period to the modern interglacial period had strong and fast fluctuations of the climate system. The sediments of northern latitudes of the Atlantic

Expeditions and Discoveries

14 Arctic expeditions were designed in a frame of 4 big research programs: Kara-Barents basin, Svalbard, Norwegian-Greenland Basin and Central Arctic Ocean. These programs saw collaboration between research institutes of Russia, Germany, Norway, France, Canada. Natalia participated from the Russian research side, where the main purpose for the expedition was to investigate global system of climate changes. This fundamental research program let scientists to define sub-programs, which made valuable inputs to the world's geological studies.



take from the board of Polarstern by hydropneumatic percussion method, and first analyses were performed on them as well. In incredible Arctic condition which were further complicated by water depth (till 3000m), the expedition team successfully managed to lift up core samples with length of 12-17 meters from the Quaternary period. Since Arctic sedimentation rate is slow, at some places they even reached hard layers till Cretaceous.

1997-2004 Expeditions

The main objective of the marine geology group work program was to reconstruct the paleoclimate of the late Quaternary period in the Arctic Ocean and adjacent continental areas by studying of paleoceanographic circulation distribution of that period's sea ice. On the expeditions in the period, special attention was given

Ocean are known as distinct cyclical in nature, which is likely reflecting the warm and cold periods (for example, during warm and cold periods Allrod early Dryas, Holocene) which makes controversial opinion on sustainable Holocene interglacial (Bond et al., 1997; Bianchi & McCave, 1999). To investigate whether or not Holocene climate fluctuations and associated changes in thermohaline overturn left significant traces in high-resolution sediments from the Yermak Plateau was thus one of the major tasks.

The rate of Holocene sedimentation in the Arctic Ocean is too low, which does not allow to determine the short-term climate fluctuations. However, the XIII/2 expedition cut column sample PS2837-5 (water depth 1042 m) on the western slope of the Plateau Yermak (81° 13'N) penetrated a thick Holocene layer. This region is controlled by an Atlantic waters temperature that influence on the position of the ice sea surface boundary in the summer, as well as impact on sediment transfer in a sea.

Why was sedimentation much faster in this region and what was the sources and ways of sediments transfer there, the expedition team tried to find out during the XV/2 expedition trip.

The western slope of the Plateau Yermak is very steep and most likely that it is affected

by turbidity currents. The samples of sediment were decided to take along the western and eastern slopes of the Yermak Plateau.

Places of the samples were defined using echo sounding (PARASOUND) acquisition results and sea depth (900-1500m). The expedition team has also access to Atlas PARASOUND including an Atlas Deso 25 printer and PARADIGMA digitizing and post-processing software (Spiess, 1992).

At the upper shoulder of the western Yermak Plateau very hard seismic reflectors were observed. It was chosen for core sample as an evidence for an outcropping salt plume. The core penetrated about 5m structure depth. There was only 47cm of clayey sediment in the core tube. The highest resolution core that had ever been taken from the Yermak Plateau (PS2837-5, Stein and Fahl, 1997) was taken from the western part in a water depth of 1044m.

The shallow *Greenland shelf* was investigated between 79° and 81°75' N. Water depths ranged between 20 and 300m. A seafloor was obviously affected by grounding ice. There were also a few channels, all of them filled with material similar to the adjacent areas, and many places where the influence of gravity flows becomes evident.

The Svalbard shelf area around 20°E had mostly diffuse reflectors and a very uneven relief. Series of steep more than 80m high ridges may be interpreted as morain ridges.

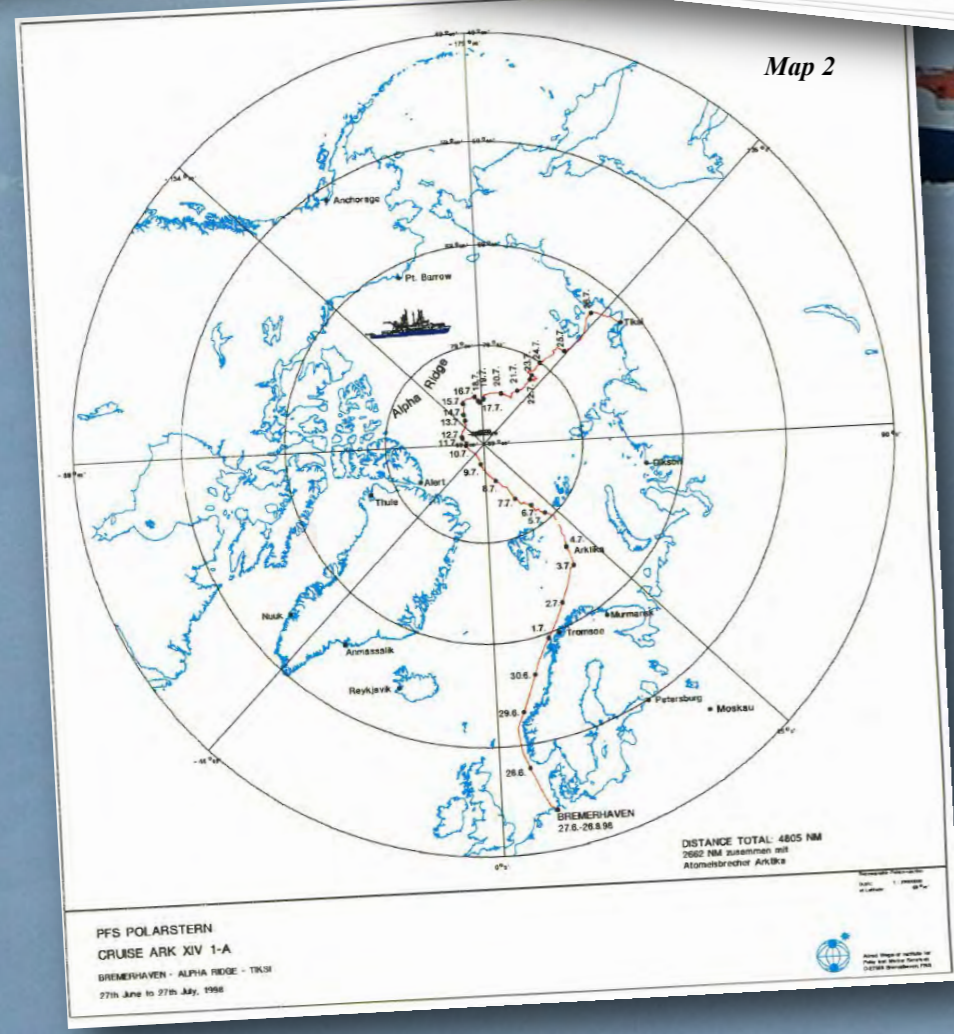
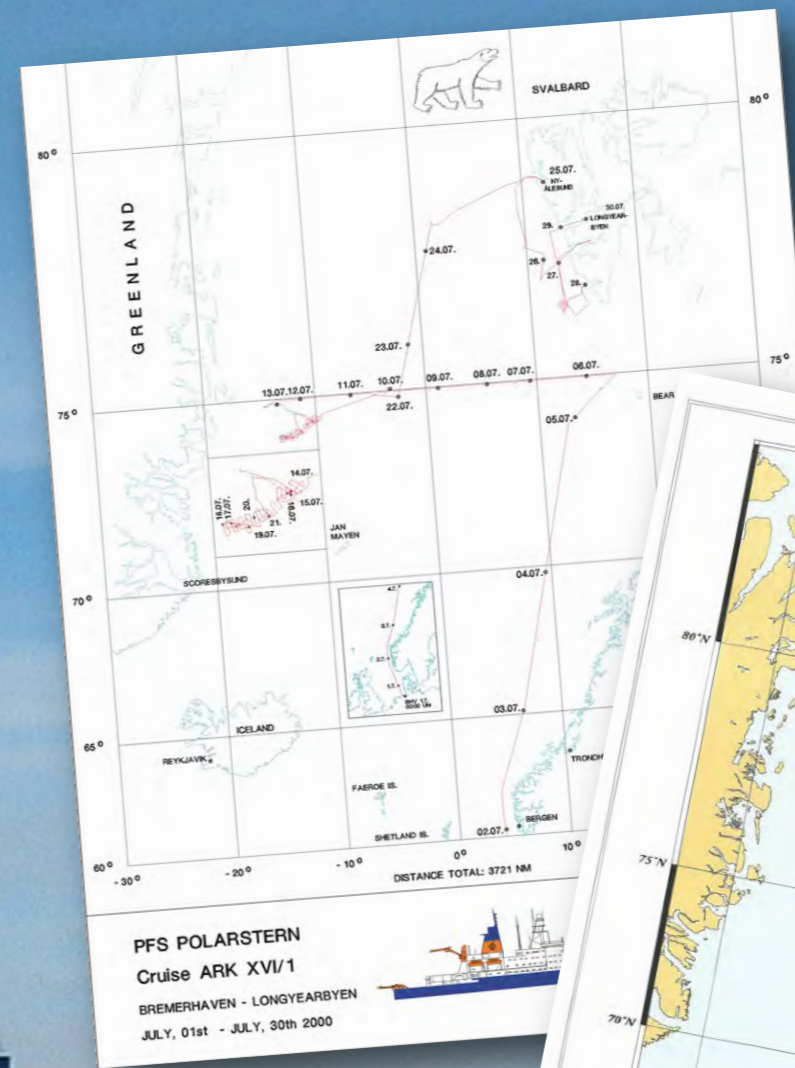
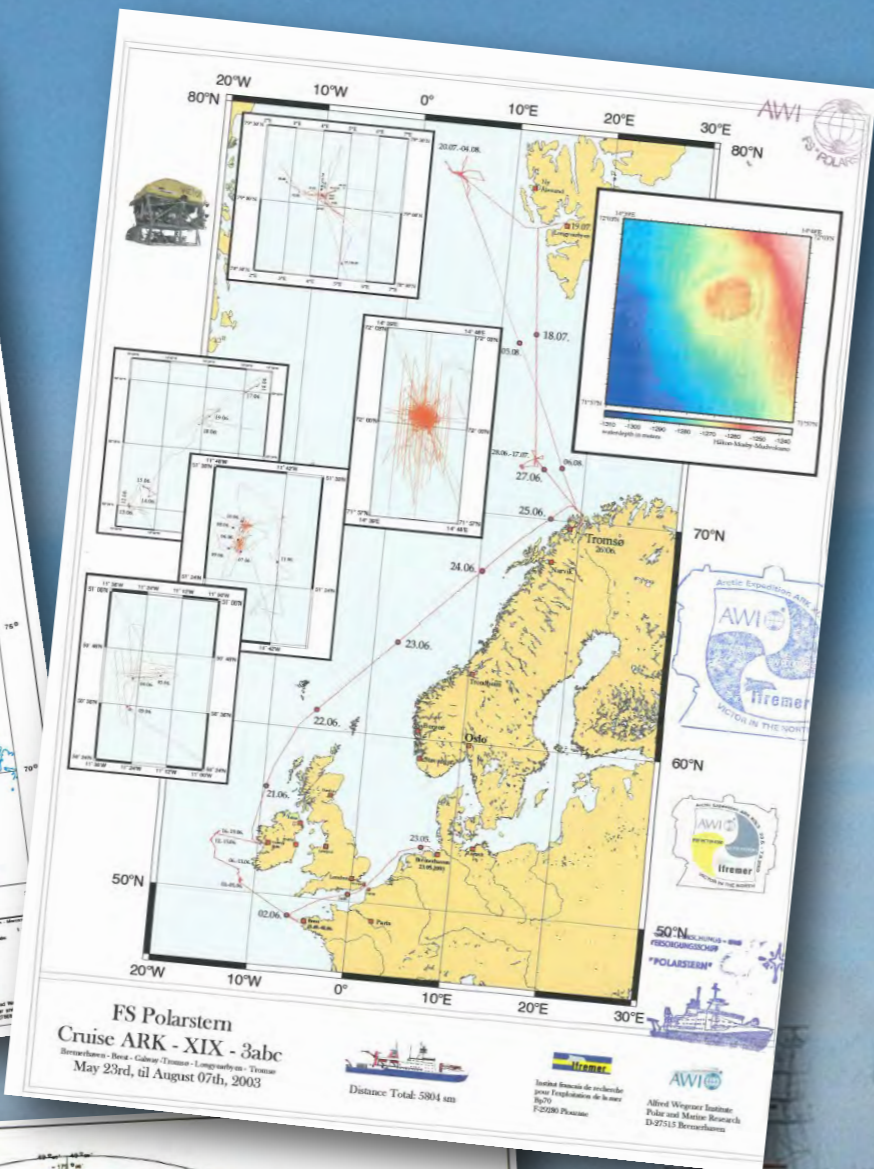
The most of the *Deep Sea* areas (about 2500m) were characterized by influences of turbidities that leave discrete layers of slumping that produce diffuse large sediment bodies with a chaotic internal structure. Sometimes the initial layering was still visible on the deep slope although large parabolic structures indicate sliding sediments at a large scale. These structures were found in the area of the Molloy Deep and north of the Svalbard. However, in some places discrete layering continued down to more than 3000m.

The following coring gear was used during ARK XV/2 expedition: GKG (giant box corer): 60cm long, 50cm x 50cm. - MUC (multiple corer): 12 tubes, 60cm long, 6cm in diameter. - SL (gravity corer): 5m/8m/10m/13m long, 12cm in diameter. KAL kasten corer): 5.75m/l 1.5m long, 30cm x 30cm. Onboard investigations included core descriptions, spectrophotometric color scans, smear slide analyses (SL), x-ray analyses, physical property analyses: p-wave velocity, wet bulk density, magnetic susceptibility for all cores, all kasten cores, 1 gravity core.



Natalia performed SL analyses on sediments about 50 long cores. For all period of expeditions over 1000 smear slides were investigated under the light microscope. SL investigations were performed to estimate the min-

eral compositions and to determine the contents of biogenic and terrigenous components. Based on these analyses the terrigenous particles in the sediments were predominated. The principal minerals include



The route maps of international expeditions on the research vessel Polarstern.

Map 1 - Research cooperation between MMBI and AWI in 1999 (ARK-XV/2).

The expedition started and ended in Tromsø (Norway), July 21, 1999 - September 8, 1999.

The aim of the expedition was 1) to study changes in the paleoclimate, paleo-oceanographic circulation distribution of sea ice in the mid Quaternary period; 2) reconstruction of changes in natural conditions of the Arctic Ocean in the Mesozoic and Cenozoic; 3) to study the evolution of sea levels and the dynamics of sediment in the ocean.

Map 2 - 2000-2004 Norwegian-Greenland Basin Research Expedition ARK-VI/1 started on July 1, 2000 from Bremerhaven, Germany. The aim of expedition was to define 1) the age, environment (foraminifera); 2) particle size distribution, geochemical and mineral composition (light and heavy subfraction) sediments; 3) vertical flows of organic carbon (organic geochemistry, kerogenpetrographic); 4) and perform an assessment of the Greenland Sea paleo productivity (biomarkers, bio-opal).

Other maps are showing routes of sub-expeditions performed in frame of the same project.



quartz, feldspar, terrigenous carbonate and clay minerals. Quartz contents ranged from 15% to 53%. Quartz/feldspar ratios ranged from 0.95 to >3. Feldspar contents were up to 30%. Terrigenous carbonates (i.e. calcite, dolomite) occurred between 0.1% and 10.9%. Opaque minerals tend to increase down core. The highest amounts of Opaques (5.3%) were observed in Core between 270 and 430cm core depth. Biogenic carbonate was between 0.1 and 6.3% with a maximum at 0-140cm in the core. Heavy minerals determined in the various cores include amphiboles, pyroxenes, epidote, biotite, garnets, chlorite, titanite, Fe-Mn-nodules, hydroxides, and iron and black ores. Amphiboles and pyroxenes dominate the spectrum although in intervals of some cores Fe-hydroxides (i.e. limonite and hydrogetite) dominate the association (as example see Figure 1-2). Further investigations at the home laboratory intensified the mineralogical studies.

2000-2002 Svalbard Expedition

Surface sampling

Paleoconstructions of the geological history of Svalbard's shelf has fundamental scientific challenge. The specific of evolution marine ecosystem in conditions of continuous melting ice sheets, sediment material types, intensive sediment genesis and changing of sea water salinity, are interconnected with anthropogenic influence in the modern period. The aim of the geological investigations was to identify the modern periglacial processes and their influence on the geological, geomorphological and sedimentological areas of the archipelago, and to determine the influence of the ice sheets edges on the frontal zones formation in the littoral areas.

Sea-Ice sediments Investigations

Sediments in the Sea-Ice are important factor for erosion and distribution of sediment content of the Arctic Ocean. The main results of the field works there were 1)to track possible ice paths based on sedimentological parameters in surface deposits, and to study sea-ice

material in source and melted areas; 2)to define the sample composition, grain size distributions and mineral assemblages between sea-ice sediments in the different areas of the Arctic Ocean.

Expedition to the "Fram Strait" comprised investigation of *terrigenous sediment supply* in the Arctic Ocean controlled by river discharge, oceanic currents, sea-ice and iceberg transport, and down-slope transfers. Most of these mechanisms also influence on biological processes in the water column as well as at the sea floor.

The Project was focused on the quantification and characterization of terrigenous discharge in the Arctic Ocean and its change through Late Quaternary period. This study allowed to obtain the estimates of sedimentary bases, identifications of major move processes and reconstruction of oceanic currents. The biggest interest was in a detailed sedimentological, mineralogical and micro paleontological study of surface sediments and sediment cores.

Benthic foraminifers. The modern distribution of benthic foraminifera and its stable carbon isotope signals were characterized in relation to the modern Arctic environment (bathymetry, water mass properties, sea-ice distribution, etc.). Based on the precise description of that time medias, an actual model was suggested, which then was applied to the fossil records and allowed to reconstruct changes in paleoenvironment (such as water mass properties, surface-water productivity etc.) during late Cenozoic times.

Expedition's Result

The broad analysis of the cores show only small variations which points to similar lithology in the cores. Only one of the southernmost core differs by a larger number of peaks in the density and P-wave velocity curves, which indicates a higher amount of ice rafted debris in this core. Sediment thickness shows increasing sedimentation rate which is also observed in cores from the northeastern Yermak Plateau and in the cores from the slope off Eastern Greenland (Nam, 1997). Taken the preliminary stratigraphic correlations from the core logging data and the macro- and microscopic sediment investigations, then, it turns out that **high sedimentation rates at the shoulder of the western Yermak Plateau are neither a function of water depth (below 1000m) nor a function of latitude.** The reason for the increase in sedimentation rate in the Norwegian—Greenland Sea is **the rapid change of colder arid and warmer humid phases during the last glacial/interglacial cycle.**

In 2000, the oceanographic research work have been carried out on 75° parallel towards coastal areas of Greenland from the

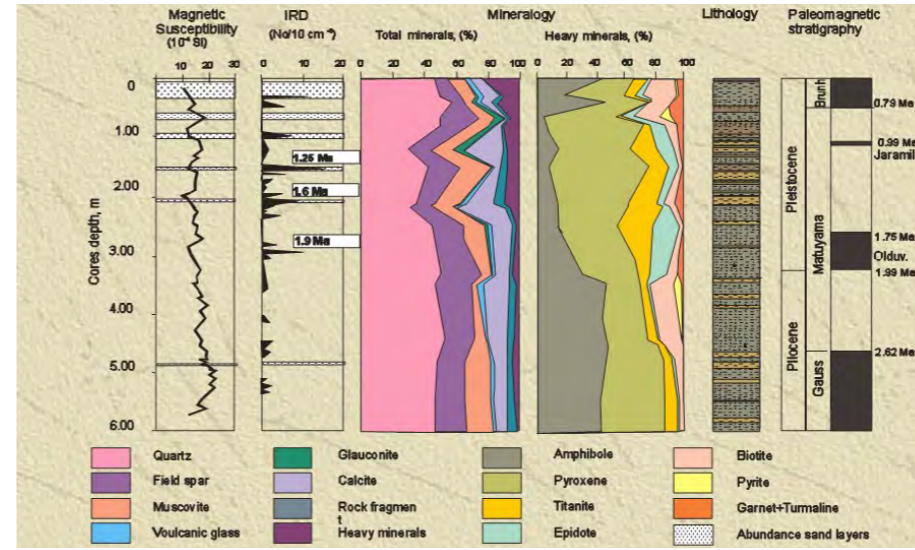


Figure 2. Lithology, Mineralogy and paleomagnetostratigraphy of bottom sediment physical properties and paleomagnetic stratigraphy from Jokai et al., 1999, Stein et al., 1999)

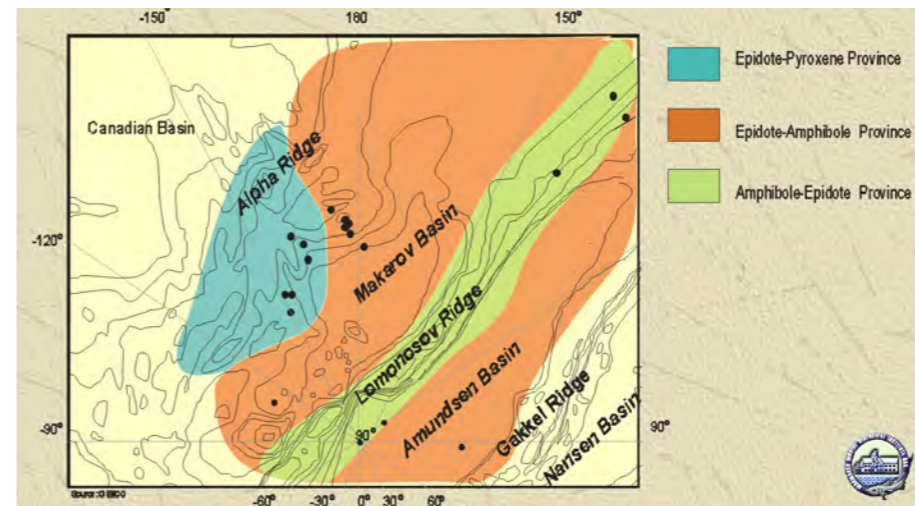


Figure 1. Mineralogical Provinces of the surface layer of bottom sediment Location map of the sediment cores studied. Arrows indicate part of the Cruise route of Polarstern Arctic '91 and ARK-XIV/1a

island Medvezhy. In the southwestern part of the Greenland Sea biological and geological work were conducted, including the study of the distribution and concentration of plankton and benthic organisms, sediment sampling, and determination of geochemical composition of sediments. The main purpose of geological research was to analyze the flow of sediment to the great deeps of the sea (by taking new samples), which will help to create paleoreconstruction of climatic changes in the Quaternary period. Sediment samples were taken for sedimentological, geochemical and microfossils studies, which allowed to assess the impact of sediment transport slope processes and to distinguish these deposits from glacial and glacial-marine sediments. That only proved the earlier assumptions about climate phases. The rate of the sedimentation in the warm period (interglacial) increased.

The more interesting conclusion of the expedition came unexpectedly. A collection of the cores and analysis of different sub-programs, which were dedicated to climate changes, allowed Russia to apply and to prove that Russian shelf continues until Mendeleev-Alpha Ridge.

"The publications which were made by Alfred Wegener Institute and Bedford Institute in Canadian '98 and '12 show geological Arctic map. There is a conference which dedicated to this big study going every 2 years. It is not just a study which funded by all institute, it is a very fundamental research which includes plates tectonic, the Arctic development, sedimentation in different ages, ice influence on the plates move — fundamental geological problems. The expe-



Svalbard. Expedition Polarstern, 2004



Svalbard. Expedition MMBI RAS, 2000

SPE Arctic Exploration

ditions in which I participated are going every year. And, I was just a participant of such research.

I wish to continue this study, it is not finished yet, and people work years on it. The person who has ever worked in science will never reconstruct his/her mind. You always will use your "foundation" - knowledge base. An academic work gives understanding and skills to capture information from different sources. Starting from regional and tectonic study, then we focused on detailed data: drilled well, core... and having such knowledge base, you can be an expert, and can be responsible for the decisions. I think it is very important! Every person who passed these stages, I believe, can be proud of it. I'm still learning. 26 years of experience, but I'm still learning. That what I learned in Russian Academia helps me to see the picture in "3D. 3D modelling is our "golden key" to exploring the Earth's storage of reserves. So, something like this!"

- says Natalia.

Boat life and the Arctic stories

No expedition is without a story. Very likely that there is none. Though, on one of the frosty sunny days the team PFS Polarstern were making a barbecue. Inspired by the big activities in the Arctic, and that bears get used to see visitors, apparently the smell of grilled meat makes miracles.

Going after the smell polar bear approached the ship. Begging for a piece of barbecue, the bear arranged a half an hour photo shoot: danced, took different poses, made a real Arctic show for the crew. Despite of all his efforts the Arctic rule assumes a ban on animals feedings. But, that handsome guy had definitely deserved a good piece of meat!

Oil Exploration work in RN Nordic Oil

Long successful scientific work with the Arctic climate and paleosedimentation changes studies, the administrative positions brought Natalia to the geo-exploration work. Diverse experience, fundamental academic school and international scientific projects made her a highly competent expert. Most of the fundamentally important studies conducted in the oil&gas companies today are unavailable for public sharing due to commercial confidence. These make scientific process a bit slow. Natalia wishes to bring as much as possible of scientific component to the operator's work: to publish and to share a study result.

"We would like to develop new competences

of Arctic shelf: it is an expansion of our competence on the shelf exploration and development and of creative team implementing new and innovative technology. We also focus on joint collaboration across border area. That's why, last year we organized Russian-Norwegian near-border project. As you know, Rosneft holds a big number of licenses in the Russian shelf, so we use these data and the data which RN Nordic Oil acquired on the Norwegian continental shelf. We are working on regional and geology-geophysics collaborative interpretation. We are creating regional paleogeographical, structural maps, making stratigraphic correlation. This work is challenging because we have an old data on the Russian side. Therefore, we think we do a big job by tying the stratigraphic complexes to Russian part which even have different top names."



The Arctic rules assume a ban on the animals feeding
Archive of Expedition Polarstern

The editors would like to thank Dr. Natalia Kukina for allowing us to print this material and for the time she dedicated to our magazine.

References

More information from the expeditions you can find in *Berichte Zur Polarforschung (AWI)*

Frederichs, T. (1995): Regionale und altersabhängige Variation gesteinsmagnetischer Parameter in marinen Sedimenten der Arktis, *Rep. Polar Res.*, 164, 212p.

Nam, S.-I. (1997): Late Quaternary glacial history and paleoceanographic reconstructions along the East Greenland continental margin: Evidence from high-resolution records of stable isotopes and ice-rafted debris, *Rep. Polar Res.*, 241, 157 p.

Niessen, F., Kleiber, H.P. & Nehrke, G. (1997), *Physical properties and core logging*. In: Stein, R. & Fahl, K. (eds): *Scientific Cruise Report of the Arctic Expedition ARK-XIII/2 of RV Polarstern in 1997*. *Rep. Polar Res.*, 255, 115-120.

Nowaczyk, N. (1991): *Hochauflösende Magnetostratigraphie spätquartärer Sedimente arktischer Meeresgebiete*, *Rep. Polar Res.*, 78, 187p.

The physical properties of the cores taken during ARKXV/2 will be available in the PANGAEA database on web page <http://www.pangaea.de>.

The Expedition ARKTIS-XV/2 of Polarstern" in 1999, Edited by Wilfried Jokat with contributions of the participants, *Ber. Polarforsch.* 368 (2000)ISSN 01 76 -5027.

WARNING

RESERVOIR ENGINEERS

DO NOT TRY TNAVIGATOR

SIDE EFFECTS MAY INCLUDE: ADDICTIVE EASE OF USE, FASTER RUN TIMES, A HIGHER LEVEL OF RESOLUTION, UNIVERSAL COMPATIBILITY, MAY CAUSE COMPETITOR INDIGESTION, CAN CAUSE LESS STRESS AND MORE PRODUCTIVITY, MAY COST LESS THAN OTHER RESERVOIR SIMULATION SOFTWARE, HAS BEEN KNOWN TO CREATE EXCITABILITY IN USERS, CAN LOWER CYCLE TIME, MAY CAUSE PROMOTIONS WWW.TNAVIGATOR.COM

The bear posed for a photo shoot

From the archive of Expedition Polarstern

How to win in a “zero sum” game

by Ole Evensen, Business Development Executive, IBM WW Chemical & Petroleum Upstream lead



Ole Evensen
Business Development Executive,
IBM WW Chemical & Petroleum Upstream lead

The primary approach to add oil and gas reserves is through exploration. The recent years increase in “Proved Reserves Addition Cost” (PRAC) has been a growing concern, and the 60% drop in crude prices since the summer of 2014 finally changed the game. Today it may be cheaper to buy resources than to explore and develop new. Business Development, buying and selling licenses or assets, has become the game no company wants to miss – but how will you compete?

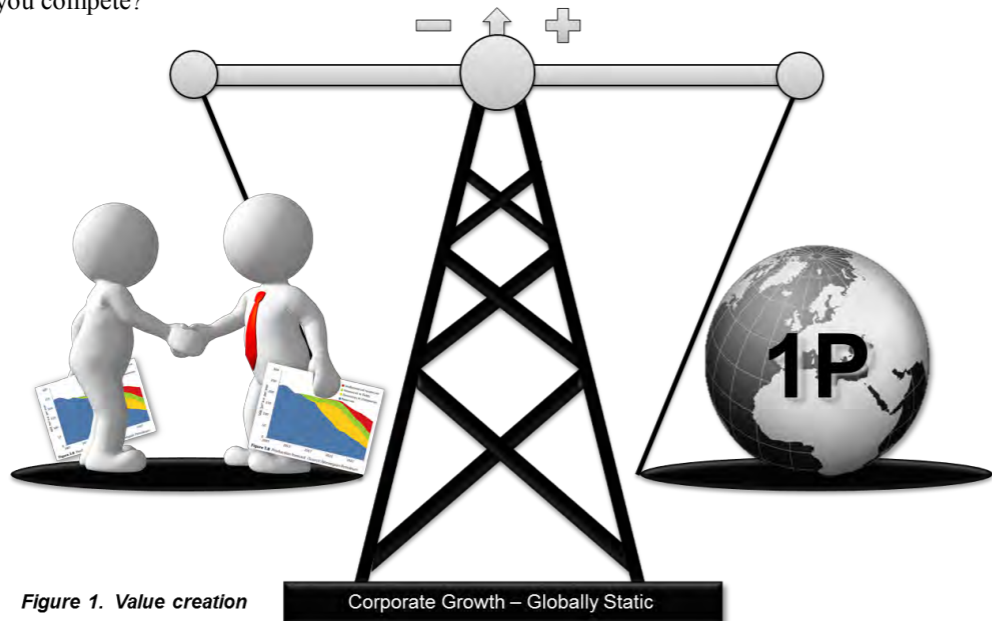


Figure 1. Value creation

The intrinsic challenge is that one company's upside implies the counterparts downside. Good Buy = Bad Sell. Like playing poker basically is a redistribution of wealth, a “zero sum game”. The reality is different, but from an global perspective it does not add value – as the effort does not involve discovery and addition of new hydrocarbon reserves. It is basically a change of ownership – or a new cut of the “cake of proven reserves”. (See figure 1)

The lack of proven reserves addition will influence “the game”. As economically producible reserves decline and exploration effort remains low, the supply outlook will drop. This will eventually support oil price recovery. Simply stated; with a global Reserve Replacement Ratio

(RRR) of less than “1” the production volumes – and low prices – are not sustainable. The current “window of opportunity” to buy heavily “discounted” reserves will close. But, until this happens, we will see asset distribution and competitive positions change, favoring cash rich and agile “portfolio players”.

Business Development, in all aspects of Upstream, whether Mergers, Acquisitions, Divestments, Farm-In/Up/Down/Out – have always been critical to realize an oil company's strategy. Lack of exploration success have been supported by commercial reserves adjustments. With the reduced exploration programs and even debooking of reserves – the commercial Portfolio

Management is no longer a side act, it has taken a leading role – and will remain until exploration efforts are revitalized.

The label “Zero sum game” will provoke people who will argue that “different approaches to value creation” is an element of trading. One man's trash may be another man's treasure. We can imagine buyers advocating a transaction by calculating synergies with existing fields, unique capabilities to increase recovery rates or fulfilling strategic or contractual obligations. I agree! A deal will always have a elements of unique value creation. The intent is frequently not realized, and a number of acquisitions ends up as “same cash-flow with new owners”. It still may make sense from individual companies

About author

Ole Evensen is Global Upstream Leader in IBM Chemical & Petroleum unit. He has more than 20 years international experience from working with Oil & Gas and Services companies where he has been a strategic advisor and program manager for operational improvement initiatives. As a consulting partner he has served National and International Oil Companies in Europe, Middle East and Africa. His current focus is E&P operational improvement, where new technology can utilize unstructured and real-time “big data” for optimization and better decision support. His academic background is from Harvard Business School, MBA degree from Henley Management College, a Bachelor's Degree from UiS. He is a regular speaker at industry events, writer in industry journals and host a blog in [IBM Insight on Business – WW Chemical and Petroleum](http://IBMInsightonBusiness-WW-ChemicalandPetroleum). LinkedIn: <https://no.linkedin.com/in/evensen> Mail: ole.evensen@no.ibm.com

perspectives, as they may have different cost - and availability - of capital, willingness to risk – and tax positions. However - it still has zero direct impact on global reserves.

How do you play the “zero sum asset game” - and create a competitive advantage?

As in all “games” there are some qualifying criteria. Capital is critical, and for many oil companies a serious challenge. The power balance will favor the party with capital and efficient decision making.

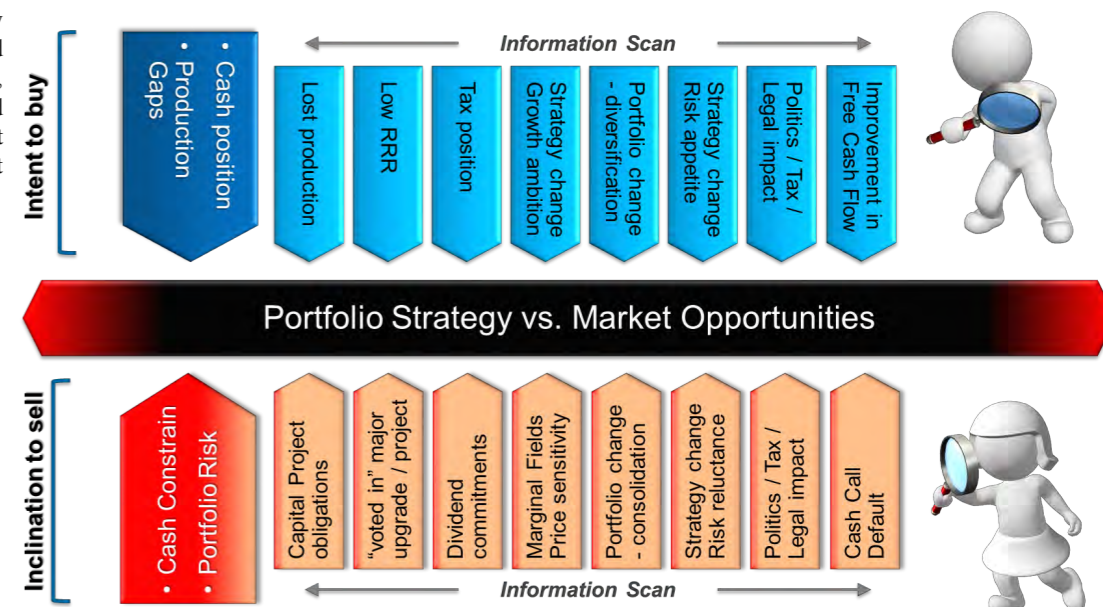


Figure 2. Market Intelligence – Cognitive Analytics

The challenge of creating shareholder value through Business Development is to create a competitive advantage. To illustrate the point: In a transparent market – where all information is available to all parties – the outcome would be expected to be equal opportunities - and prices based on supply and demand balance. The reality is that the Oil & Gas market is not transparent, therefore not an “even playing field”. The key to succeed is to create an “Information Advantage”. Imagine an “Information Asymmetry” favoring you –enabling you to identify opportunities – ahead of others, to analyze the situation and create a proposition that builds on your strengths – and your understanding of the transaction partners weaknesses and needs.

New Information Technology will play a key role to realize this – to identify “information indicators” that can help us understand if a company will be inclined to sell – or have an intent to buy. Having analytics technology that can scan tens of thousands of news sources for “information signatures” of strengths – will provide such an information advantage. A new generation of analytics technology – referred to as “Cognitive Analytics” does this today, in other industries. It is now adopted by Oil & Gas companies who wants to exploit the current

Creating the Information Advantage

Imagine the work-flow, or process, that describes the

window of opportunity, and permanently “up the game” of Business Development. The differentiating technology to realize these ambitions must be able to access, understand and contextualize a number of “difficult to use” information sources. Providing insight and perspectives that is not readily available to competitors, in a timeframe that allows for a speed or first-mover advantage is what we label a “Positive Information Asymmetry”. Information is a strength when it may provide a competitive advantage. It is similarly a weakness if “ignorance” – when you do not have the insight your competitors have. While traditional analytics is a basic capability in most organizations, the “Cognitive” dimension implies the ability to analyze and interact with what we refer to as unstructured data. Most of the data we use every day is unstructured, from the newspaper we read, the radio we listen to, on-line sites we access to explore, reports we read, studies we initiate, governmental or corporate information sharing etc. About 80% of all data in an organization is unstructured – and is today “hidden” from traditional analyses.

Identify Market Opportunities –

earlier than competitors. When it is common knowledge that a company will be divesting assets, you will find logical explanations – or “drivers” that may explain why. These drivers are the early indicators a Cognitive system have the capability to monitor. It may be “first news” indicating that a company will be in a cash squeeze – where selling assets is a likely outcome. One piece of information may not show the full puzzle, but when you imagine coinciding news like – “we will maintain dividend policy” or “we have sanctioned project X” as well as “Cost overrun on project Y” – the picture becomes clearer. Collectively it can create a “probability of intent” to divest. See Figure 2.

Recognizing intent ahead of competitors may help us:

- Create a better Win/Win proposal
- Execute transaction, (Due diligence)
- Learn from transactions.

The question will naturally be “what”. This is where more

competitive intelligence will help clarify the picture. There are a number of news, public and private sources that can help you establish a view of competitors portfolios – with associated information about the assets prospectivity, free cash flow, capital expenditure and timelines. In situations of cash constraints it will be more likely that a company will divest assets with low generation of free cash flow, capital obligations – and even risks. While the information is not evidence, it will allow you to generate scenarios of competitive behavior. If you have identified companies with specific assets of interest, you may select to *Monitor & Detect* information from these companies – to see information patterns that may be favorable to your strategy. To succeed, you must...

Understand buyer/seller situation → Or a “Comparative SWOT”.

Any E&P company must have a picture of its Strengths and Weaknesses. This will shape strategy and help the company pursue *Opportunities* that are most in line with its Strengths - while in consideration of *Weaknesses*. Your understanding of your own SWOT becomes more meaningful when you compare it with a possible transaction partner or competitor. Imagine you are a minor oil company with restricted access to cash. With an “information advantage” you may

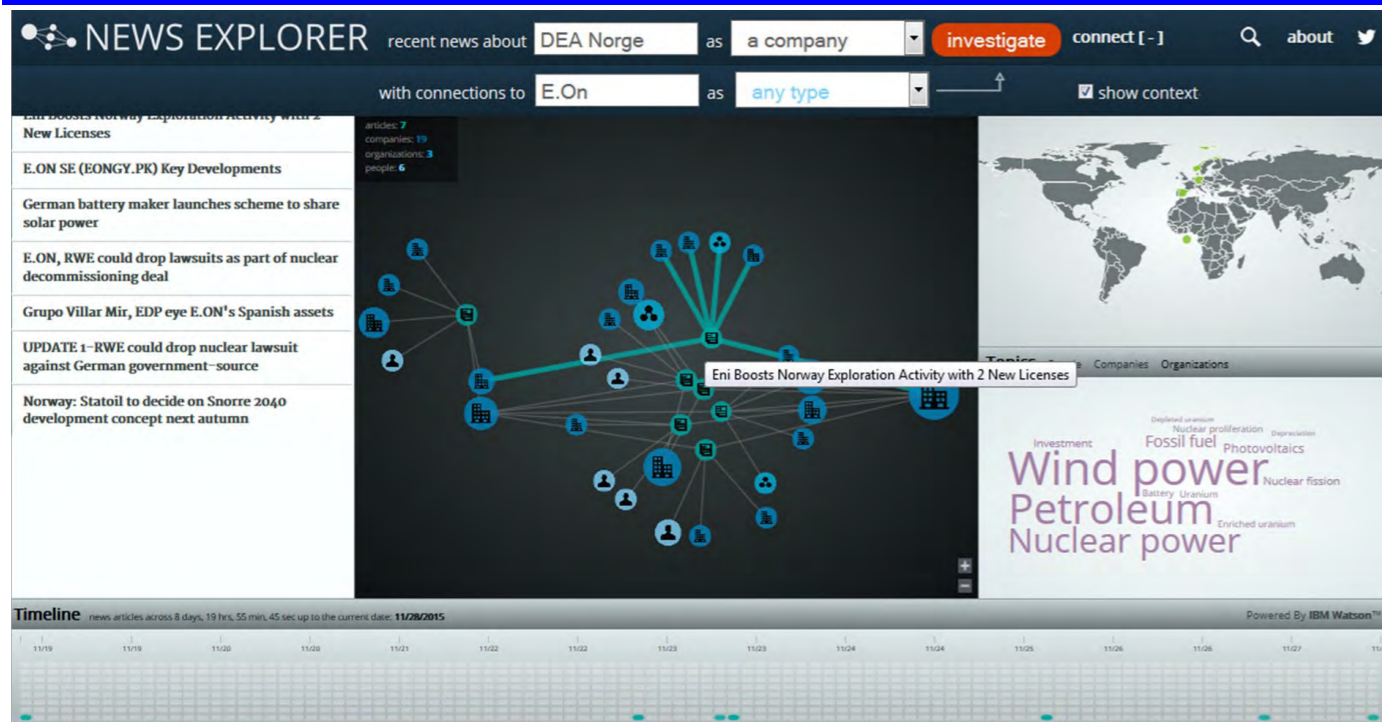


Figure 3. Cognitive Analytics example <http://news-explorer.mybluemix.net>

be the first to approach a company and propose an asset swap, rather than a cash transaction. If your owner is a Private Equity company they may appreciate a higher risk in the portfolio than a company with a wide shareholder base. Understanding your SWOT is key to the next step...

Construct Win/Win proposal.

Understanding the situation of a transaction partner may come from a study or subscribing to trusted advisors. The flip-side is that the same information is available to others - hence no information advantage. You will certainly benefit from having this information to establish a basic understanding of transaction partner, but your advantage will come from your ability to add color and facts to the picture that is available to everybody. Capital market presentations, general IR information, governmental websites, news quotes etc. may offer valuable insight into aspects that can help construct a proposal. It may be reserves challenges, portfolio skew, country presence, asset level challenges, country risk, governmental relations... Understanding a transaction

partner is Vital. It is however surprising how "limited" view corporate Portfolio Owners sometimes have of the organizations own assets. Hence the last key reason to introduce cognitive analytics...

Understand Internal Portfolio

situation - should be considered basics. Working with Business Development and Portfolio Managers has learnt me that the reality is different. Most oil companies have applications or databases that can aggregate a portfolio view for all fields, where reserves, investments, projected production and contingent resources can be viewed. The challenge is the assumption that the data represents undisputable facts - "one truth". As an example: Is the data used to prioritize our portfolio - such as production profiles, reserves growth projections, investments, budgets etc. - credible and reliable? If you want to nominate candidates for divestments - under capital constraints - would you not consider aspects such as: Assets history of delivering on promise? Production, OpEx, cost improvement, improved recovery, facility integrity, commercial agility. What about the asset team - dedication to one/many assets, experience related to asset challenges or even

turnover/stability. You want to see the potential Upsides, Downsides and Risks that does not come from consolidated numbers. A number of information sources may help answer these questions. If the asset is Operated By Others (OBO) the same answers must be answered, and in addition - consider if the asset is a priority asset in the Operators context.

The information to assess and understand other operator is available, from unstructured data sources containing joint operating agreements, commercial agreements, budgets, reports, audits and the information generated in license committees. A Cognitive Analytics tool may also continuously scan news sources to identify challenges.

An example, Figure 3, illustrates a Cognitive News-scanner (available to try) that discovers connections between Organizations, Companies and People. The "Topics" analysis shows the most frequent keywords, the map shows where data is captured and the data sources (news feeds) where the data originates from.

Lessons Learned. The final aspect of succeeding in any game - is to learn from history, whether success or failure. Even Cognitive

Analytics cannot help you improve if you do not assess yourself. Conducting a "post deal review" should be mandatory and comprehensive. Did the transaction meet our expectation and valuation, reward and risk? If yes / No - above/below - then why?

A review will provide valuable insight into the suitability of their decision making process, stage gates - and become a valuable addition to the data made available to your Cognitive "relevant analogy for comparison" when a new opportunities is being assessed.

While it is hard to predict future oil prices, and for how long Exploration will remain in the shadow of trading - it is not hard to predict that the companies with an information advantage will end up in a better position. My curiosity is whether the supermajors will move faster than the mid-cap and more agile companies. It will also be interesting to see how organizations ignoring new analytics technology will face the "information disadvantage" - and try to defend their position.

Why Are Reservoir Forecasts So Optimistic?

by Dr. W. Scott Meddaugh

Short Summary of the SPE 2015-2016 Distinguished Lecture



Dr. W. Scott Meddaugh

An SPE paper by Nandurdikar and Wallace (2011) reported that petroleum industry projects produce on average only about 75% of the oil and/or gas forecast at the time of project sanction. For those projects that the authors attributed the production shortfall to reservoir "issues" (as opposed to well, facilities, or "other" issues), the average project produced only about 55% of the forecast volumes. They highlighted possible sources of forecast optimism including optimistic subsurface assumptions, failure of internal assurance processes, and the lack of accountability for production volumes including project/decision look-backs. Ravjvanshi et al. (2012) also highlighted the tendency of production forecasts to be optimistic and suggested possible causes including unrealistic subsurface assumptions, reservoir modeling limitations, and human bias. Merrow (2011) noted that the industry tends to make project decisions based on insufficient "Basic Data" and that technical teams understanding of their "Basic Data" is limited by their "misplaced confidence that they understand a reservoir based on nearby producing fields".

Several possible contributors to forecast optimism were highlighted in the talk including the potential impact of (1) sparse data; (2) "non-randomness" of sparse data; (2) use reservoir models with

smaller areal grid block (cell) sizes; (3) increased use of actual reservoir lookbacks to assess impact of sparse data on in-place volumes and forecasts; and, (4) increased use of independent external peer reviews to reduce project team human bias.

Based on results summarized by Meddaugh et al (2011) and Meddaugh (2015) the largest contributors to forecast optimism are "pro-project" human bias and dynamic model grid parameters (e.g. small grid cells). Each of these may account for about 25% of the observed forecast optimism. Sparse data may also have a similarly large impact but only if discovery and early appraisal wells are drilled in so-called "safe" regions with better than average reservoir properties. Well location optimization workflows and areal upscaling are likely moderate contributors to forecast optimism, each accounting for perhaps 5-10% of the observed forecast optimism. Geostatistical model parameters and vertical upscaling are overall minor contributors to forecast optimism, each accounting for perhaps 2-5% of the observed forecast optimism.

A number of workflow improvements can reduce forecast optimism including: (1) incorporating larger range of uncertainty - respect the potential impact of sparse data as well as the potential "non-randomness" of sparse data; (2) use reservoir models with

larger range of uncertainty - respect the potential impact of sparse data as well as the potential "non-randomness" of sparse data; (2) use reservoir models with

References

- Meddaugh, W.S., N. Champenoy, W.T. Osterloh, and H. Tang, 2011. *Reservoir Forecast Optimism - Impact of Geostatistics, Reservoir Modeling, Heterogeneity, and Uncertainty*, SPE 145721, San Antonio.
- Meddaugh, W. S., 2015. *Improving Reservoir Forecasts by Understanding the Relative Impacts of Sparse Data, Reservoir Modeling Workflow and Parameter Selection, and Human Bias*, SPE 175009, Houston.
- Merrow, Edward W. 2011. *Industrial Megaprojects - Concepts, Strategies, and Practices for Success*. John Wiley & Sons, Inc. New Jersey.
- Nandurdikar, N and L. Wallace, 2011. *Failure to Produce: An Investigation of Deficiencies in Production Attainment*, SPE 145437, Denver.
- Ravjvanshi, AK, RG Meling, and D. ten Haff, 2012. *Instilling Realism in production Forecasting: Dos and Don'ts*, SPE 155443, San Antonio.

Support for the SPE Distinguished Lecturer Program is provided by The SPE Foundation through member donations and a contribution from Offshore Europe

Biography:

Joined the Midwestern State University in 2013 as the RL Bolin Distinguished Professor of Petroleum Geology after has 32 years with Chevron's technical and research companies. Experience includes reservoir development projects mainly in the United States, Canada, Venezuela, Middle East, West Africa, and Australia. Served as Subsurface Team Leader for a major capital steamflood project in Kuwait/Saudi Arabia while posted to Saudi Arabia Chevron from 2009-2013. Member of the SPE, AAPG, EAGE, SEG, and GSA. Associate Editor for the SPE Reservoir Evaluation and Evaluation Journal and technical editor for a number of industry technical publications. Received a PhD in geology from Harvard University in Geology. He has authored or co-authored over 30 peer reviewed and SPE technical papers on forecast optimism, reservoir characterization, and modeling and has presented over 100 talks at technical meetings worldwide. Major interests are reservoir characterization and development forecasting, geostatistics, and uncertainty assessment. Developed and led over 100 public and private short courses in geostatistics, reservoir modeling, and uncertainty assessment.

7 well decommissioning executed by following structured process

by Claudio Pellegrini, Subsea Intervention Manager; and James Ryan, Subsea Engineer, AGR Perth



Claudio Pellegrini (right), Subsea Intervention Manager and James Ryan (left), Subsea Engineer, AGR Perth

Abandonment Delivery Process

A key to success of any project is to follow a structured approach and apply proven processes. Abandonment projects are not so common thus a proven delivery process did not exist. As the need for a structured approach was deemed paramount, a well delivery process was adapted and altered as a framework the project could follow from the onset.

This outlined a phased approach to the project, each phase defined key steps that needed to be followed to proceed to the next phase. This gave the project team clear visibility to not only the key factors affecting project success but also to all interrelated factors. This facilitated with aspects such as early identification of issues and also aided strategic alignment of both the company and the contractors. Utilising this defined mapping process was vital to achieving holistic management of the project.

Project Scoping

The Puffin field lies in water depths of approximately 105m. Production commenced in 2007. Both production wells required gas lift and were tied back to a floating production, storage and

offload (FPSO) vessel. Production ceased in 2009. Prior to disconnection of the FPSO, all subsea production infrastructure was purged of hydrocarbons, flushed, tested and left in-situ. The wells were shut in with approximately 1600 psi of gaslift gas left in the annulus. Subsequent ROV campaigns to monitor the wells detected a minor gas leak on the Puffin-8 well, this led to the decision to P&A this well. Further cost analysis provided justification for combining the P&A of the Puffin-7 well and the 5 temporarily suspended wells into the campaign.

Project Planning Abandonment Barrier Philosophy

The UK O&G guidelines 2012 were adopted as the key guideline for barrier placement. These guidelines focuses on the key concept of restoring the reservoir caprock and isolating all distinct permeable zones both from each other and from the surface. For the Puffin wells caprock reinstatement was all was required to P&A the wells. For operational efficiency and minimisation of operational risks a combination barrier plug was chosen in accordance with the guidelines.

Equipment

The dual bore Puffin trees required a dual bore riser system to be run in order to connect to the trees and reenter the wells. On topside a surface flow tree (SFT) was utilised to maintain well barriers and act as an interface between the riser and topside equipment such as slickline PCE, cementing unit and a bleed back package. A risk assessment highlighted the possibility of hydrocarbon returns thus a bleed back package and tote tanks were included in the equipment spread to enable for the management of any hydrocarbons that may be encountered.

New Technology

To mitigate the risk involved with cementing through the dual bore riser system, special ROV operable connectors were designed and manufactured to connect to the subsea flow support bases (FSB). Flowlines were cut from the FSBs during the pre-abandonment campaign. During the main campaign the cement connector were attached to the FSBs off critical path, a cement umbilical was run from the topside cement unit and stabbed into the cement connectors, this allowed the cement to bypass the riser system and be

This article describes the planning and execution of the Puffin field abandonment which was successfully executed in 2014. The Puffin field is located in the Timor Sea about 200 kilometres off the coast of Western Australia. The field consisted of two gas lifted production wells and five temporarily suspended wells.

The article gives an outline of the processes, technologies and methodologies which were adapted in planning and executing the project. Finally, the article concludes with a look at the main challenges and the key lessons learnt.

pumped directly into the FSB.

Cost Estimation

A probabilistic cost estimation software was utilised to obtain a P10 – P90 cost spread for the abandonment. All phases of the abandonment project from planning to execution were included in the model with associated risks assigned. Once all phase data was incorporated in the model a spread of regional cost data was input. The software then generated a spread of time/cost estimates for the project. This provided clear visibility to areas where the project had high risk of cost blowouts and thus allowed the project team to place more focus on these areas and develop contingency plans to mitigate these risks.

Methodology

The primary abandonment methodology was to carry out a through tubing abandonment and leave the tubing in the wells. Leaving tubing in the wells optimised the program execution times and mitigated the risk of having to recover tubing. Confirmed annuli TOCs and good original cementing data meant running CBLs or performing section milling operations would not be required, this confirmed these

wells were very suitable for through tubing abandonments. Contingency plans were also in place to allow for temporary suspension of the wells, this would enable removal of the trees and running of the marine riser system so the production tubing could be removed if required.

The basic primary abandonment program consisted of the following steps.

- Remove tree caps
- Run dual bore riser system and establish connection to tree
- Bullhead well
- Set slickline plug in tubing tail pipe
- Pressure test tubing
- Connect FSB cement connector (off critical path)
- Perforate tubing above packer
- Circulate out annulus gas
- Circulate cement plug into position
- Tag and test Plug
- Cut tubing and remove SST
- Remove FSB
- Cut casing strings
- Recover PGB, wellhead and casing strings

In order to run the dual bore riser system, pull tubing (if necessary) and accommodate the large equipment spread a semi-submersible rig was chosen to execute the abandonments.

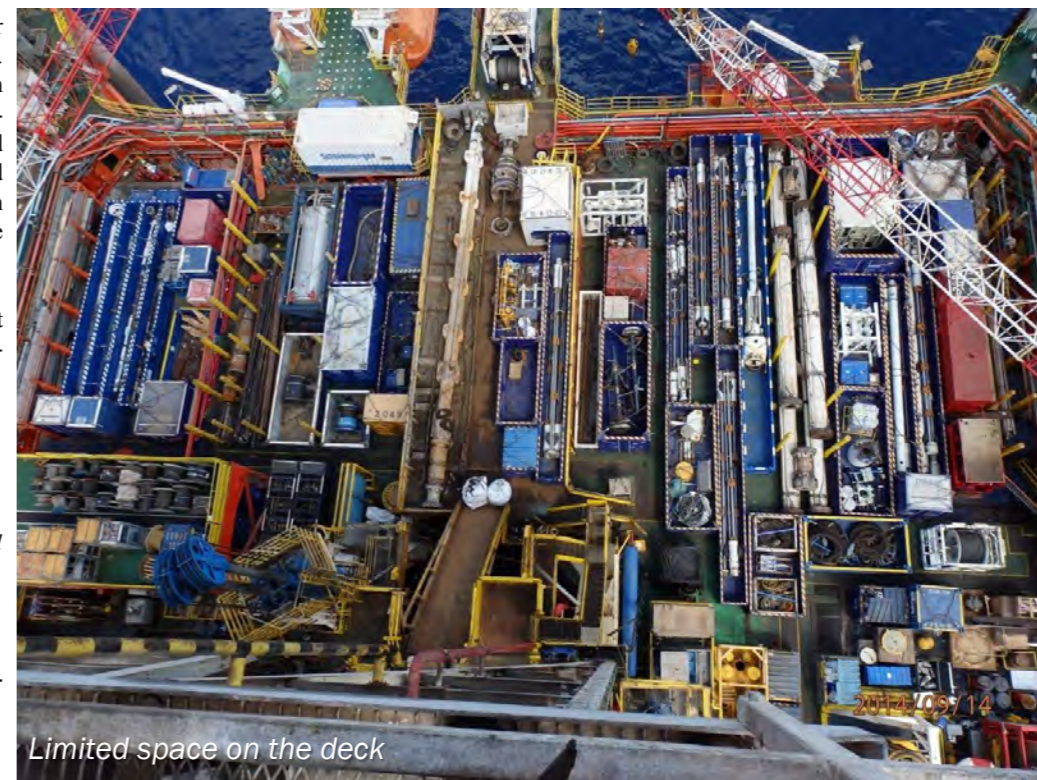
Project Execution

Pre-Abandonment Campaign

A crucial component for the success of any abandonment campaign is to incorporate a pre-abandonment campaign. For Puffin this was executed in July 2014. The main components of this were, cleaning operations, removal of production PODs, removal of FSB flowlines, annulus pressure monitoring and seabed survey. Additional operations which were unknown prior to the campaign also had to be carried out, such as the removal of sheared guidewires from guideposts. The campaign ran for 25 day and came in within AFE. The success of the pre-abandonment campaign was attributed to saving approximately 11 rig days.

Main P&A Campaign

The main campaign commenced offshore operation in August 2014



and ran for 67 days. The campaign required 6 rig moves to abandon all 7 wells, only the two production wells were close enough to allow keding between wells. Three of the suspended wells were completed first to allow a ramp up into full abandonment mode. Initial set up, connection and bullheading of the first production well (Puffin-7) went without major issues, however attempts to drift the tubing failed with numerous gauge cutters runs getting hung up 1000m from target depth. The decision was made to kedge to Puffin-8, this had key benefits in that it kept operations moving forward, it allow time to develop forward plan for Puffin-7 and it enabled testing of Puffin-8 well for similar issues. Puffin-8 had no tubing issues and thus the through tubing abandonment was executed without issue. To complete the Puffin-7 abandonment, firstly, the annulus gas was lubricated out. Lubrication of the annulus gas was successful but unexpected quantities of hydrocarbons were also returned, the inclusion of a bleed back package on-board enabled the hydrocarbons to be effectively dealt with. Next the tubing was severed above the obstruction, e-line plugs were set in the production and annulus bores and the tree was removed.

The BOP stack and marine riser were then installed allowing the tubing hanger and tubing above the obstruction to be removed. To remove the remaining tubing an overshot tool was run to attempt to blind backoff the tubing to the packer. Due to the poor tubing condition blind backoff attempts only succeeded in retrieving small sections of tubing. Next an external tubing cutter was run on wash pipe. The recovered 130m section showed cuts in a box joint suspected to have been caused by gas migrating into the production tubing. Tubing below this section was found to be in good condition. All remaining tubing was then removed by rerunning the overshot tool and carrying out an e-line run to part the tubing at the required depth. Once all tubing was removed a bridge plug was set and tested in the 9 5/8" casing and a combination cement plug was then set using the cement stinger. The program was then completed as per the original program. The final two suspended wells were then abandoned without issue. The team's ability to respond quickly to operational changes in addition to managing to gain time on the easier wells brought the project in within 1% of AFE.

To contact the authors, please write to claudio.pellegrini@agr.com.

The article was originally published in SPE News Australasia (www.spenewsaustralasia.org)



www.agr.com
AGR. Pioneering Achievements™

Conclusion

Abandonment projects can be

Thank you!

