GMN technical meeting - meeting details

Major Topic:	**Basin Modelling for Pore Pressure** *(75% focus)*
Minor Topic:	**Depleted Drilling/ Water Injection (***25% focus*)

Start:	Thursday 3rd October: 09:00
Finish:	Friday 4th October: 16.35

Venue: Meeting room to be confirmed: Shell Centre, 2 York Road, London SE1 7NA

Host: Shell UK Limited

Secretariat: Debbie McIntosh, OTM Consulting; Debbie.mcintosh@otmconsulting.com
Tel: +44 (0)1372 631950
Dawn Dukes, OTM; dawn.dukes@otmconsulting.com
Tel: +44 (0)1372 631954

Hotels:

Premier Inn (right next door)
https://www.premierinn.com/gb/en/hotels/england/greater-london/london/london-waterloo-westminster-bridge.html

Hampton by Hilton
https://hamptoninn3.hilton.com/en/hotels/united-kingdom/hampton-by-hilton-london-waterloo-LONWLHX/index.html?WT.srch=1&WT.mc_id=zIMDPDA0EMEA1MB2PSH3PPC_Google_search4cid178176531_aid12024451011_me_kkwd-3194106815635Brand_Nano6LONWLHX7en&utm_source=Google&utm_medium=ppc&utm_campaign=paidsearch&campaignid=178176531&adgroupid=12024451011&targetid=kwd-319410681563&gclsrc=aw.ds&

Park Plaza by Radisson
https://www.radissonhotels.com/en-us/hotels/park-plaza-london-waterloo?facilitatorId=PARKPLAZAPPCBMM&cid=a%3Aps%20b%3Aggl%20c%3Aemea%20i%3Abrand%20e%3Apph%20d%3Acese%20f%3Aen-US%20h%3Agbwater&gclid=EAIaIQobChMI6ZqO9Pzy4wIVy-F3Ch1SFgeJEAAYASAAEgKxyvD_BwE&gclsrc=aw.ds&checkInDate=2019-10-02&checkOutDate=2019-10-04&adults%5B%5D=1&children%5B%5D=0&searchType=lowest&promotionCode=

Dinner - Thursday: Wine-tasting/ buffet: Please advise OTM in advance of any dietary requirements

Travel to Meeting: See page 11

Thursday 3rd October 2019			
Arrival with tea/ coffee			*09.00*
1	Safety notice	Shell, Tom Sinclair	09.30
2	Welcome and objectives for the meeting	Debbie McIntosh, OTM	09.35
3	Introductions	All	09.45
4	Basin modelling for geopressured prediction: a highly specialist niche within a specialist field	Tullow Oil, Benjamin Quaillet	10:00
Tea/ Coffee			11.00
5	Basin modelling	Shell, Tom Sinclair	11.20
6	Examples of basin modelling for pressure evaluation	OMV, Robert Pierpoint	12.20
Lunch at venue			*12.40*
7	Basin modelling for pore pressure: issues, application and future development to assist in exploration well planning and execution	Repsol, Toby Harrold, André Vayssaire	13.40
Tea/ Coffee			*14.40*
8	Muds, models and pore pressure prediction: a brief history	Durham University, Andy Aplin	15:00
9	Breakout discussion: Have these improved inputs improved pore pressure predictions?!	Led by the Guest Speaker Andy Aplin	16.00
End of day 1			*17.00*
Dinner			*19.00*

otm

Friday 4th October 2019			
Arrival with tea/ coffee			*08.30*
10	PSM-based pressure prediction as a complementary tool to classical pore pressure prediction	Eni, Domenico Italiano	09.00
11	Integrating seismic, geomechanics and basin modelling: Case study in the Dutch Central Graben	Wintershall, Susan Weniger	10.00
Tea/ Coffee			*11.00*
12	Depleted drilling/ water injection	OMV, Jennie Aumayr	11.30
13	Discussion on wellbore strengthening techniques	Led by Stephan Petmecky, CNOOC	12.00
Lunch			12.30
14	Digitalisation of PPP: Group discussion to determine the way forward for a 2020 meeting around this topic	All	13.30
15	Roundtable discussion: GMN views and conclusions on basin modelling for pore pressure and depleted drilling/ water injection	All	15.00
Tea/ coffee			*15.30*
16	Meeting wrap up to include discussion on: • Additional members • Future topics • Host for next meeting • GMN administration Any follow-up action as a result of the meeting	Led by Debbie McIntosh, OTM	16.00
End of Day 2			*16.35*

Attendees for GMN Meeting

	Company	First Name	Last Name
1	CNOOC Petroleum Europe	Stephan	Petmecky
2	Eni S.p.A	Gianfranco	Bagnoli
3	Eni S.p.A	Giulia	Gallino
4	Eni S.p.A	Domenico	Italiano
5	OMV Exploration & Production	Jennie	Aumayr
6	OMV Exploration & Production	Robert	Pierpoint
7	OTM Consulting	Dawn	Dukes
8	OTM Consulting	Debbie	McIntosh
9	Repsol S.A.	Toby	Harrold
10	Repsol S.A.	André	Vayssaire
11	Shell UK Limited	Isaac	Foo
12	Shell UK Limited	Tom	Sinclair
13	Shell UK Limited	Quintijn	Clevis
14	Tullow Oil	Benjamin	Quaillet
15	Wintershall DEA	Susan	Weniger
	Guest speaker		
16	Durham university	Andy	Aplin

Apologies:

Company	First Name	Last Name
TOTAL E&P	Olivier	Chailan
Wintershall DEA	Georg	Röser
Woodside Energy Limited	David	Tassone

Topic

Two topics are planned for the October 2019 Geopressure Management Meeting. Members have chosen to talk on either or both topics depending on their experience. The breadth of these topics is to give all companies the opportunity to contribute.

The main discussion topic for the meeting (which is expected to take up around 75% of the time) is:

<p align="center">Basin Modelling for Pore Pressure</p>

1. Introduction

Basin models have been used for a number of years as a method to estimate pore pressure on a regional, prospect and well scale. It contrasts with seismic and offset well analysis in that it can give very valuable information not only about the present-day pore pressure but also its evolution through time. The difference in calculation technique can be very valuable in reaching a final integrated interpretation as well as a means to test different geological scenarios and their impact on the pore pressure estimation. After some years of lower profile activity, the technique appears to be more popular again in both industry and academia. This session is aimed at sharing the current state of play within different oil companies and what are considered best practices for performing studies and integrating them with other types of analysis. There are a number of themes that can be explored below in the talks. Case studies of where the technique has been applied and what was learned from them would be very helpful for all attendees:

- How is Basin modelling for PPP currently used in companies? From Frontier exploration for testing concepts and models through to accurate PPP in well calibrated basins?
- Given the infinite options for the geology and lithology properties in the models, what approaches are used to reduce the uncertainty to an acceptable level and how do they weight their impact on the outputs? Do people:
    a) Work with default options from industry software?
    b) Create their own company lithology databases?
    c) Use published examples?
- With improved computing capacity, are people performing more 3D studies relative to 2D that used to be more popular due to their ease and speed of use? – Value added over cost and time.
- Basin modelling to improve velocity-based PPP – this technique was proposed and published and looked to be very insightful in areas of complicated imaging particularly in subsalt areas. Is the approach being applied at present day and, if so, has it evolved since first publications?
- Are people incorporating more complicated stress distribution into their basin modelling when working in areas of complex burial history and non-uniaxial burial conditions? Tools exist to do this work in traditional software packages or more complex fully coupled geomechanical forwards models. Does anyone have examples away from simple vertical driven compaction for discussion? Does the technique represent a full forward modelling or simply an addition of extra stress through time?
- What would you consider the key challenges and pitfalls in performing and using the results from such studies when applying it to well planning or execution?

The minor discussion topic for the meeting (which is expected to take up around 25% of the time) is:

Depleted Drilling / Water Injection

2. Introduction

As fields are developed and hydrocarbons are produced, the initial conditions of the field will evolve from the starting conditions. Production will reduce the pore pressure which will reduce the stresses as well as inducing various degrees of compaction and subsidence. Injection of fluid to maintain pressure will often result in local changes in stress and pressure that represent hazards for nearby or future wells, especially in instances of out of zone injection. There are a number of hazards to be managed associated with the reduction of drilling window or local increases in pore pressure that are quite different to the challenges faced when planning a wildcat exploration well. This session is to encourage people to share how they are involved in planning and executing wells in depleted areas or in the vicinity of injection wells. Examples of success or lessons learned from the less successful operations are extremely valuable.

- Who owns this work in your company? How many of us practitioners are involved in the process of modelling the impact of depletion or injection?
- What are the roles of pore pressure practitioners and other disciplines involved in planning activities? Where do pore pressure engineers get their data from for this type of work?
- How are people modelling the impact of depletion or injection? How are people constraining the stress path during depletion and what do they do when no constraint exists?
  Do people work with:
  a) Complicated coupled models to get the answer
  b) More empirical models local data to calibrate (Leak offs and losses)
  c) Published relationships?
- Management of hazards: how are people monitoring for changes and representing the impact of changes to the project team?
- Execution: how are practitioners involved in supporting the operations? Sand frac gradients, LCM strategy, stress cages?

3. Presentations

Each company is asked to prepare slides for approximately 50 minutes of presentation and 10 minutes for Q&A.

As witnessed at previous meetings, the demographic of the group continues to evolve and with this we politely request that presentations are sourced from each company's global resource pool and not only from the North Sea (unless of course your company only holds North Sea acreage). The meeting is a technical forum and these presentations are intended to provide a background to stimulate the discussion period. Please ensure you include case studies; and come armed with company and other industry experiences, to bring the lessons learnt and best practices to life more effectively.

4. Organisation

Please advise OTM who will be attending if you have not done so already, as there is a limit on numbers in the reserved meeting room.

We also need to know if you require remote access (teleconference/ videoconference) to the meeting including all names of those who wish to attend remotely.

5. Abstracts

1. Benjamin Quaillet, Tullow Oil

Basin Modelling for Geopressured Prediction: a highly specialist niche within a specialist field

Basin Modelling is an extremely promising tool, which has had its place in the pore pressure prediction and fracture gradient (PPFG) arena for many years now; whether it is in the realm of wildcat exploration or in more mature basins. It complements the more basic PPFG predictions derived from seismic velocities and offset well analysis. Interestingly, this discipline has never really taken off within Tullow. For various reasons, using basin modelling for pore pressure predictions in Tullow has never been a high priority. It remains a highly specialist niche within a specialist field. Though Tullow has a strong basin modelling/geochemical team - geopressured prediction is not its current focus at this time, instead Tullow prefers to focus on using actual empirical/offset well data, normal compaction curve analysis supplemented with velocity analysis rather than basin modelling based techniques. With the recent industry downturn and technical developments in geopressured prediction this is not likely to change anytime soon.

2. Tom Sinclair, Shell

Basin Modelling

Abstract to follow

3. Robert Pierpoint, OMV

Examples of Basin Modelling for Pressure Evaluation

OMV exploration has intermittently employed basin modelling and associated skill sets to formation pressure prediction and toward attempting to understand subsurface pressure distribution and their controls over the last 5 years. The hydrocarbons provinces studied include offshore Bulgaria, Madagascar, New Zealand, and Norway. Pressure evaluations are integral to safe drilling practise and cost, and for data acquisition optimization, but are also finding their uses in understanding hydrocarbon phase distribution in basins and plays. We will show a few brief examples of where OMV are employing these practises, discuss the business need, and summarise general workflows being employed.

4. André Vayssaire and Toby Harrold, Repsol Exploracion S.A.

Basin modelling for pore pressure: issues, application and future development to assist in Exploration well planning and execution"

Basin Modelling is an incredibly powerful approach to derive pore pressure that is not used as much it should be (or as much as we would like!).

Sometimes it is the infinite flexibility of the approach and the fact that it is dominated by petroleum systems analysts rather than pore pressure specialists that puts people off using the approach in their day to day pore pressure prediction roles. At Repsol we use a simple and practical approach based around standard basin modelling approach but with a limited number of lithologies. We often start with a unique lithology for the entire model to have clear understanding of the disequilibrium compaction effect on the entire block. Next, we start to include carrier beds to reflect the plumbing system prognosed by the G&G team. Once we have this initial picture, we make a comparison with the available data (offset wells, seismic velocities etc.) before we start to adjust lithologies to see what match we get to observed / inferred pore pressures.

We do not tweak the parameters like porosity depth laws, permeabilities values… but prefer to replace one lithology by another one with a different clay content.

We have observed that while some pressure models show an excellent match to the present-day conditions, they have unrealistic pressure histories which is particularly unfortunate as we believe the value of using basin modelling for pore pressure is that we can take into account the entire geological setting and history. These aberrations are often due to inappropriate porosity permeability laws chosen for sediments, single pass simulations to save time instead of multiple loops and other reasons that will discuss during the presentation.

The shale lithology models we use are several years old now and we believe they can be improved on if there is interest within the industry.

Repsol's present focus is on using classical simulators like Permedia, Temis and PetroMod for pressure prediction for exploration wells. We are also testing new ways of calculating pressure at basin scale using physics based artificial intelligence from Belmont Inc. that infers the results instead of calculating it. This is of course possible after a step of deep learning on numerous classical forward models.

Figure 1: Overpressure from seismic compared to overpressure from a 2D basin modelling.
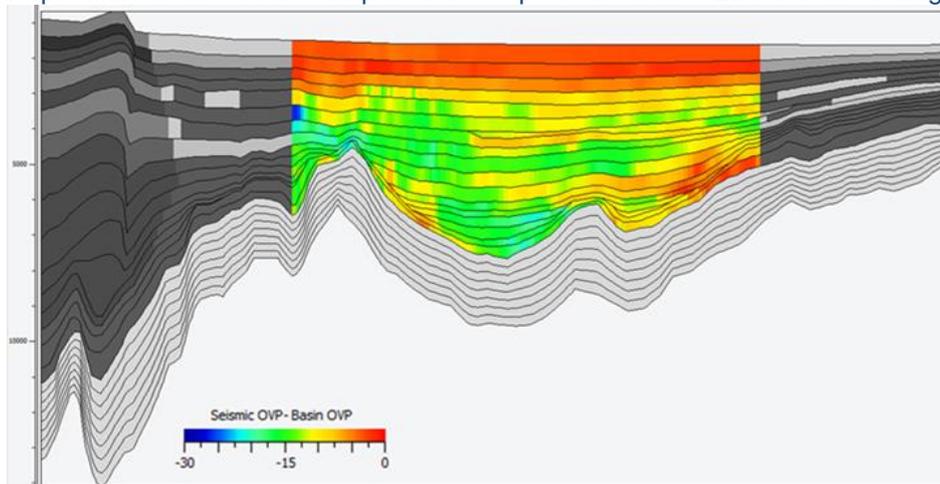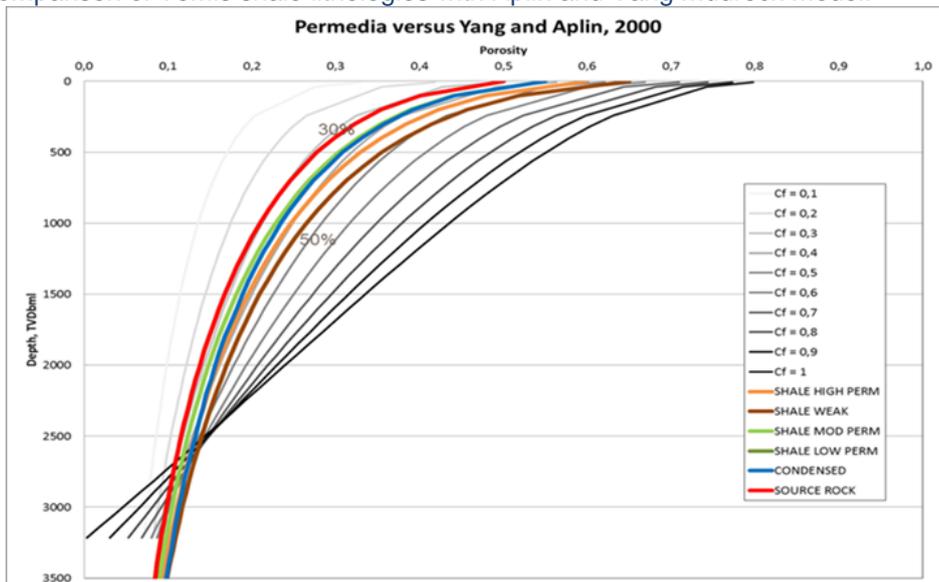

Figure 2: comparison of Temis shale lithologies with Aplin and Yang mudrock model.

5. Guest Speaker, Andy Alpin, Durham University

Muds, models and pore pressure prediction: a brief history

Basin models require well-constrained input parameters, none more so than the mechanical and fluid flow properties of the major basin lithology: mudstones. In this presentation I will outline improvements that have been made in this realm over the last 25 years, from simple porosity-vertical effective stress relationships, through flow properties of heterogeneous Genetic Mudstone Units, to 2D/3D geomechanical models encompassing both mechanical and non-mechanical processes.

To discuss: have these improved inputs improved pore pressure predictions?!

Biography

I am a primarily a petroleum geoscientist with a particular interest in shales and mudstones. After PhD and postdoctoral research in marine and isotope geochemistry, I spent several years with BP and many at Newcastle University, before joining the Department of Earth Sciences at Durham University in 2013. With students and RAs, I have worked on many problems linked to the physical and chemical properties of fine-grained sediments, including seals to petroleum reservoirs and CO2 storage sites, leakage, gas shales, and pore pressure estimation. Aiming to apply high quality science to help answer industrially and societally important questions, much of my work has an industrial context and involves collaboration with a diverse range of earth and other physical scientists. I have been involved with and led several, major Joint Industry Projects, have published around 100 peer-reviewed papers and was awarded the Wallace E. Pratt Memorial Award for Best Paper in AAPG Bulletin in both 2009 and 2013.

6. Italiano Domenico, Eni

PSM-based pressure prediction as a complementary tool to classical pore pressure prediction
D. Italiano & S. Doering (Eni Petroleum Systems Group)

In ENI recently PSM-based pressure prediction was performed for a number of exploration projects. Data quality and availability in these areas is substantially different ranging from frontier to near field exploration settings. For the Nile Delta a super-regional petroleum systems modelling was carried out including also a calibrated pressure model. A huge amount of data was available for the Plio-Pleistocene succession whereas deeper targets such as the Oligocene are less drilled and have a more frontier like character in terms of pressure prediction. Using a relatively simple model with almost uniform lithological properties we achieved good results and a blind test for a wildcat well proved to be very successful. We intend to apply PSM-based pressure prediction more regularly in settings where added value can be expected.

7. Susan Weniger, Wintershall

Integrating seismic, geomechanics and basin modeling: Case study in the Dutch Central Graben

Traditionally, basin modelling has been used in prospect assessment and play evaluations. Currently, we are working on integrating basin modelling throughout the life cycle of an asset. As more data becomes available, the basin model is updated and adjusted to be fit-for-purpose.
The workflow may start with a regional basin model based on horizons interpreted from seismic. In the presented case study of the Dutch North Sea, a model was initially built to re-evaluate the Posidonia-Chalk petroleum system. The study is based on a new assessment of seismic data. The model is thermally well calibrated to the available vitrinite reflectance and temperature data. The good thermal calibration results in more confidence in the maturity estimations.
At first, an acceptable pressure calibration was achieved using the few wells with pressure data. To take the model to the next level for migration and pore pressure predictions, lithofacies maps are necessary. Seismic attributes were integrated into the model to aid in the distribution of lithofacies.

The pore pressure results from a parallel geomechanical study are also incorporated into the model as additional calibration data.

The updated calibration of the regional model of the northern part of the Dutch North Sea sector will be presented. By integrating the findings from seismic attributes and geomechanics, the model is well suited for an initial pore pressure prediction far field. Moreover, the excellent pressure calibration provides more confidence in the effective stress is a primary input in any Touchstone reservoir quality prediction. The presented case study is the first application of the power of basin modelling throughout the life-cycle of an asset within Wintershall Dea and can be applied to new exploration areas as well as developing fields.

8. Jennie **Aumayr**, OMV

Depleted Drilling/Water Injection:

Several of OMV's fields have a long production history. Drilling depleted intervals and finding alternative methods to extend the field life, such as pressure support with water injection are performed routinely. Some examples will be presented and issues discussed.

9. Stephan Petmecky, CNOOC

Discussion on wellbore strengthening techniques

Group discussion session on wellbore strengthening techniques led by Stephan who will give general examples and lead the discussion on whether other operators do work with wellbore strengthening techniques and how they are being applied. BP was very rigorous with this, whereas most others seem to have a less structured approach.