THE OIL AND GAS INDUSTRY CONFEERENCE

Maximising Economic Recovery in the UK - The Next 40 years
Exploration - The 21st Century Agenda

Chaired By

Oonagh Werngren
Operations Director
Oil & Gas UK
Stimulating Exploration
Role of the Regulator

Glen Cayley
Senior Advisor
Oil and Gas Authority
Stimulating Exploration
Role of the Regulator

Glen Cayley
OGUK Conference
June 2015
E&A drilling sharp downward trend

2005: 300 wells
2014: 165 wells

Cost related

Cost related
Hit Rates, Volumes and finding costs

- Following the fall in well count the overall success rates (SR) have slipped.
- In last 5 years although technical SR >50% commercial SR c. 20% i.e. only 40% of wells with hydrocarbons move to firm developments the rest swelling the stranded discovered undeveloped small pools.
- Exploration volume yield <100mboe in 2014.
- Finding cost from <$5/Bbl to >15$/Bbl over 10 year period.
Dry Hole Analysis for c. 100 wells in the CNS/OMF 2003-2013

- Objectives: Most target the Jurassic 56%, Post BCU 38% <5% ‘Deep tests’
- One third drilled because of some sort of “DHI”: AVO, amplitude, gas cloud, “impedance” etc...
- Chance of Success
  - 34% CoS 20-30%
  - But 40% CoS > 31%: over-confidence in the risking assessment?
  - 3 or 2 risk elements = 87% failed; 1 risk element = 13% failed
  - Multiple risks in a mature well calibrated play = red flag
  - DHI’s not Alchemy do the basics
  - Need to improve top seal, fault seal, reservoir prediction use best available (better) seismic
Hydrocarbon Maturation

- There are over 200 small discoveries between 3-15 Mboe
- 1-2 Bboe hit by soaring drilling and development costs and or access to:
  - Internal and external funding,
  - Infrastructure
  - An aligned partnership
  - Suitable Rigs
  - Vessels
  - Crews
  - Critical Data

- Good News! Seismic costs, Rig rates, Vessel rates have fallen sharply. Other capital costs need to follow. A 30 – 40 % fall together with simpler solutions could unlock significant opportunity/value provide up to 15% of UK future production
Focus on increased exploration

- 21st Century Exploration Road Map
- Survey barriers to increased exploration
- Well Failure Analysis
- Frontier Initiatives:
  - Palaeozoic Study
  - Government funded seismic acquisition
- Advanced, Leading Edge Seismic seminar to revive mature exploration, unlock discovered undeveloped, 4D driven infill

14 - 24 Billion Barrels total of which 3-9 Billion Barrels YTF
Rockall Trough
4284 line km proposal

Mid North Sea High
10402 line km proposal
Progress in Rockall Imaging
Proactive Collaboration

21st Century Exploration Road Map

- New Plays Mapping
- 1st Pitfalls Conference
- Palaeozoic Kick-off
- CNS/MF PDA Kick off
- CNS, NNS Orcadian Basin, and Irish Sea studies
- Scoping Study
- Phase 1 Delivered
- £20m awarded
- Multi Company Seminars, Presentations & Final Report
- Seismic Business Case
- ITT, contract awards and acquisition
- License Round

ITT, contract awards and acquisition

CNS/MF

Palaeozoic

Kick-off

CNS/MF PDA

Kick off

New Plays

Mapping

1st Pitfalls

Conference

2nd Pitfalls

Conference

3rd Pitfalls

Conference

Q1 2013

Q2 2013

Q3 2013

Q4 2013

Q1 2014

Q2 2014

Q3 2014

Q4 2014

Q1 2015

Q2 2015

Q3 2015

Q4 2015

Q1 2016

Q2 2016

Q3 2016

Q4 2016

Q1 2013

Q2 2013

Q3 2013

Q4 2013

Q1 2014

Q2 2014

Q3 2014

Q4 2014

Q1 2015

Q2 2015

Q3 2015

Q4 2015

Q1 2016

Q2 2016

Q3 2016

Q4 2016
Advanced Seismic Technology

- Seminar 7th September
- Invitations from OGA
  - Geophysical experts
  - Exploration Managers
  - MD’s
- Location: BP visualisation Suite
- Chair Ron Roberts Apache

- What can technology unlock?
  - Salt diapirs
  - Palaeocene & Eocene
  - Fulmar Skagerrak plays
  - HPHT – Redevelopment 4D
  - Permian of CNS
  - Carboniferous SNS
  - Is the secret in the acquisition or processing?
Licensing Issues/considerations

- Timing license duration very tight for frontier and difficult geology
- Potential to further differentiate frontier and mature areas
- Frequency of acreage offerings
- Merits of ‘stratigraphic licensing’ with the ‘right to roam’ into fallow horizons on held acreage
- Model JOA’s majority versus unanimity
- Simpler access to infrastructure model agreements
OGA Exploration Deliverables 2015

- Shoot and process 15,000 km of new regional 2D seismic lines in the Rockall Trough and Mid North Sea and make it available to industry in Preparation for a licence round next year.

- The joint OGA and industry funded evaluation of the Palaeozoic play (Which ties in to the seismic)

- An analysis of the results of 97 wells in the Central North Sea, leading to greater understanding of risk and improved stewardship.
A workshop on 3D seismic technology to promote wider understanding of the cost benefit in the context of MER (Sept 2015)

Complete engagement with the geophysical Industry and draft new improved data management and access to data in particular legacy seismic data and consistent well data

Complete a strategic review of the UK licensing strategy providing improved access to prospective areas?
Questions for Industry

- Will industry respond by active participation in the 29th round by bidding further 3D seismic and firm wells?

- What further steps, fiscal, licence, or regulatory would increase the pace of exploration activity?

- What else could be done to support maximising economic recovery accelerating hydrocarbon maturation through exploration?

- Is the industry using this time to replenish the hopper of opportunities?
Exploration Activity, Fiscal Change and Investment Trends – a case for intervention

Brian Nottage
Hannon Westwood
Exploration activity, fiscal change and investment trends – a case for intervention
Market conditions

- Oil price
  - Steep fall from September last year
  - Slight recovery then further downward pressure
    - Brent under $64/bbl
    - WTI under $60/bbl
  - ICE forward curve shows slow recovery
    - Growing consensus around this
- E&P activity levels and investments expected to fall
  - Global rig utilisation falling
  - "27 North Sea rigs will be seeking new contract commitments in the coming months, nearly one-third of the entire fleet" (North Sea Reporter)
- Project cancellations/suspensions – UK and Norway
- Pressure to reduce costs
- Consolidations, asset sales, farm-outs expected
Challenging environment even before the fall in oil price

- UKCS – long term decline in E&A
  - 2014 - only 13 of the expected 25 wells actually drilled (excluding sidetracks)
  - Just 8-13 new exploration spuds forecast for 2015

- High unit costs for Capex and Opex

- Significant cost over-runs and start-up delays on a number of projects

- Declining revenues for E&P companies as production continued to fall

- Negative cash flow of £5.3 billion in 2014, the worst position since the 1970s.
Near-term developments – breakeven analysis
Challenging environment even before the fall in oil price

- UKCS – long term decline in E&A
  - 2014 - only 13 of the expected 25 wells actually drilled (excluding sidetracks)
  - Just 8-13 new exploration spuds forecast for 2015 (depending on oil price)
- High unit costs for Capex and Opex
- Significant cost over-runs and start-up delays on a number of projects
- Declining revenues for E&P companies as production continued to fall
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E&A Drilling Activity

- Activity down on UKCS
  - Decreasing since 2007
  - 8 new starts so far in 2015: 5 exploration and 3 appraisals (excl. sidetracks)

- Activity up on NCS
  - Increasing since 2005

- Netherlands stable since 2004
  - Recent increase
Exploration Performance

- Commercial volumes discovered erratic year-on-year
- Overall decline in volumes found
- Average commercial discovery size down from c 50 mmboe to < 20 mmboe
  - No significant discoveries (>100 mmboe) since 2008
  - Only 28% reserves replacement achieved
- Overall success rate relatively high and comparable to Norway
- Commercial success rate declining
Reasons for decline in UKCS exploration

1. Lack of funding for exploration/flight of capital
2. Lack of availability of drilling rigs
3. High tax levels and fiscal instability
4. Maturity of the basins and perceived lack of remaining prospectivity and materiality
5. High exploration costs – regulatory response to Macondo, 2010
6. Access to infrastructure

**UKCS Funding Sources**

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<th>Active on UKCS</th>
<th>%</th>
<th>Funding Source</th>
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<td>Internal</td>
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<td>Promote</td>
<td>31</td>
<td>22%</td>
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**Development vs E&A Wells**

- Development (incl S'track)
- Appraisal S'dracks
- Appraisal
- Exploration
- Exploration S'dracks

**UK E&A Spend**

- E&A Spend
- Average E&A Well Cost

Total Spend £ Million

Average E&A Well Cost EMM
Key Fiscal Changes

- **Investment Allowance:**
  - The allowance will exempt a portion of profits equal to 62.5% of a company’s qualifying investment expenditure, incurred on or after 1 April 2015, from the Supplementary Charge.
  - Available for projects in both new and existing fields.
  - Simplify the existing system of offshore field allowances.

- **Supplementary Charge:**
  - Reduced from 30% to 20% with effect from 1 January 2015.

- **Petroleum Revenue Tax:**
  - Reduced from 50% to 35%, resulting in a headline rate for PRT-paying fields of 67.5 per cent.
  - To encourage investment in incremental projects in older fields and extend the life of key infrastructure needed to make small new discoveries commercially viable.
  - With effect from 31 December 2015.
But what about exploration?

- Lack of an effective stimulus for exploration
- Falling exploration levels have resulted in few commercial discoveries
- Development hopper has not been replenished
- Investment levels will fall sharply despite the fiscal measures introduced by the Chancellor.
- The government gave an undertaking in the autumn statement to “consider options for supporting exploration through the tax system, such as a tax credit or similar mechanism, in a way that is carefully targeted and affordable”, …… but it has yet to deliver.
- The government did confirm the provision of £20m for seismic surveys, but this will have little effect
Exploration is the lifeblood for the long-term future of the UKCS and more robust action is needed from both HMT and OGA including:

- An appropriate fiscal stimulus; ca Norway
- State-sponsored seismic and pre-competitive geoscience in both mature and frontier areas;
- Early release and more effective sharing of data and information;
- Clarification of the remaining potential and prospectivity of the UKCS; and
- Revisions to licensing policy to include a long-term strategy and regular but more focussed licence rounds.

These actions are necessary for the UKCS to become more competitive internationally for exploration.
The consequences of inaction

Low exploration levels since 2008 have resulted in few new development opportunities.

This has damaged future investment potential in the UKCS.

Investment spike has run its course – fewer and smaller projects coming through.

C 3 bn boe and £40 bn of investment are at risk from continued low exploration levels.

Future radical fiscal and regulatory changes still required to stimulate exploration
  o prolong the life of the basin
  o maximise economic recovery
Questions..?

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Moray Firth – Central North Sea Post Well Analyses

Christian Mathieu
Team Leader, Exploration Road Map Project
Oil and Gas Authority
Moray Firth – Central North Sea
Post well analyses

21st Century Exploration Road Map Project
Christian Mathieu
Project Objectives, Time-Line and Status
2003 – 2013 Wells (E&A) to be looked at:

- 150 Exploration main bores + Exploration Side-tracks have been drilled over this 10 years period by 42 Operating Companies.

- Project tried and understood the reasons for failure of the dry wells and a few “technical” successes.

- 98 such wells (currently owned by 24 companies) have been reviewed >>> 104 segments successfully analysed.
Project Objectives

- Part of the 21st Century Exploration Road Map recommended by ETF ("Exploration Task Force") and aligned with Sir Ian Wood Review.
- Project entirely sponsored by DECC / OGA.
- Rigorous well failure analysis in Moray Firth (MF) and Central North Sea (CNS) conducted by DECC / OGA together with Industry. Wells drilled 2003-2013.

Objectives:
- To fully understand the reasons why a prospect was drilled (i.e. Geological and Petroleum settings)
- To better understand the reasons for success and failure in Exploring MF and CNS during the last 10 years
- To share the main findings with the Industry
- To test the Collaborative Model.


• 22 Companies (over 24) opened their “books” during “one to one” workshops

• Summary results for each well / each explored segment gathered into a Post Well Analysis Sheet

• Number of Post Well Analysis Sheets completed = 104 belonging to 97 wells (compared to 98 wells initially targeted)

• Preliminary findings have been presented at the O&GUK 2nd Pitfalls in Exploration Conference (London, 05th February 2015).

• Multi-companies workshops gathering companies having drilled in the same Geological Basin / Entity to be held (16th June – 09th July 2015).
Post well Analysis Sheet

- Upper section > general information about the well
- Left hand section = pre drill G&G prospect description and pre-drill risking
- Right hand section = Well results
- Right hand columns = * Good Match (M) No Match (W) Unknown (U)

- Basal section: Seismic data and reports used pre- and post-well.
- Summary results + What could have been done differently?
A few Statistics…
104 segments have been analysed, corresponding to 97 wells: 9 lacking overall Chance of Success (CoS) and/or detailed risking assessment.

93% Exploration wells – 7% Appraisal wells.

62.5% of these segments belong to post 20th Round licenses; 28.8% were drilled on licenses awarded during the Rounds 1st to 7th.

90.4% were dry holes; 8.6% Technical successes; 1% Commercial success

Objectives:
- 38% above BCU
- 56% Jurassic
- 2% Triassic
- 4% below Zechstein Salt

33% of the 104 analysed segments have been drilled because of some sort of “DHI”: AVO, amplitude, gas cloud, “impedance indicator”…etc…

Chance of Success
- 34% of the 98 segments with available pre-drill risking fall within the 21 to 30% CoS (i.e. what you would expect in such mature Basins).
- But 40% of these segments have CoS > 31%: this highlights a trend towards over-confidence in the risking assessment.

Number of causes for failure: 3 main reasons = 38.8%; 2 reasons = 48.6%; 1 reason = 12.6%

The main risk was not adequately predicted in 36%
Objectives

- 38% above BCU
- 56% Jurassic
- 2% Triassic
- 4% below Zechstein Salt

Trap types

- Stratigraphic Pinch-out, Channel...
- 28% Purely structural
- Tilted fault blocks
- 4 way dip
- Mound, reef...

Terms:
- Upper Jurassic
- Eocene
- Paleocene
- Lower Cretaceous
- Cretaceous

NB: Sum (>104 as several traps are Combined 4 way dip closure / stratigraphic upside):
- 55% Stratigraphic traps
- 45% Structural traps
Reasons for Failure
Main Reason for Failure (1/4)
Overall Main Reason for Failure

- Lack of Charge (Migration Shadow...) = 5.4%
- Bottom Seal = 5.4%
- Lateral Seal = 27.3%
- Target Reservoir absent = 22.7%
- Reservoir Quality / Connectivity = 5.4%
- Lack of Trap = 17.3%

- Top Seal = 5.4%
- SR Maturity = 2.7%
- DHI (mispicking of Top Reservoir) ~ 1%

• Seal ~ 38%
• Reservoir ~ 28%
• Trap ~ 17%
• Charge ~ 14%

Top seal efficiency is well assessed even when it fails
Source Rock maturity too… except on Basin margins

Absence of Target Reservoir and Top Seal Failure are acting effectively as “killing parameters”
Main Reason for Failure (2/4)
Tertiary Plays (Eocene-Palaeocene)

Lack of Trap = 34.6 %
Lateral Seal = 19.2 %
Lack of Bottom Seal = 15.4%
Reservoir Quality = 3.8 %
Target Reservoir absent = 7.7 %
Top Seal = 3.8 %
Migration issue = 7.7 %
“DHI” Issue = 7.7 %

- Sample size = 24 segments
- However, 20 (i.e. 77%) have been drilled because of some sort of DHI (AVO, amplitude, gas cloud, “impedance indicator”…etc…)
- Another 2 were drilled despite AVO indicated the sands would be wet.

• “When looking at prospects that are solely dependent on AVO it is necessary to examine the pre-conditioned gathers.
• Match amplitude response to shear log recorded in near by wells.
• Produce and risk the geological model unsupported by AVO. Does the play makes sense without AVO support?
• AVO responses are modelled outcomes, not unique solutions. They do not eliminate risk.”
Main Reason for Failure (3/4)
Upper Jurassic: Fulmar Fm. in an interpod setting

- Lateral Seal = 28.5%
- Target Reservoir absent ~ 43%
- Lack of Charge (Migration Pathways) = 28.5%

- Limited sample = 7 segments
- However all 3 reasons for failure highlight pretty well what is requested to find such a trap being hydrocarbon bearing.
- Migration effectiveness is the 2nd reason for failure in 5 over 7 cases >> detailed pre-drill Basin modelling should be carried out
Main Reason for Failure (4/4)
Upper Jurassic Deep water turbidites
(Buzzard, Ettrick, Peterhead...all kind of traps)

Reservoir Quality = 6.4 %
Target Reservoir absent = 29 %
Lateral Seal = 38.7 %
Top Seal = 12.9 %
Bottom Seal = 3.2 %
Lack of Charge = 3.2 %
SR immature = 3.2 %
Lack of Trap = 3.2 %

- Sample size = 27 segments
- The search for Buzzard look alike in adjacent Grabens failed; it was mostly driven by conceptual analogy and on “notional” prospects.
- 76.7 % are Stratigraphic traps

Well location
Lower Volgian Sand Bypass Zone
Lower Volgian Sand Fan
Lower Cretaceous
Base Cretaceous / Top KCF
Upper - Middle Volgian
Triassic Smith Bank Shales
Poddling of Fulmar & Shagarak Sands
Middle - Lower Volgian Sand Fan
Belle Chalk

Lower Volgian Sand Bypass Zone
Selected Interpretation Pitfalls
1) Map cut short
>> does not allow optimal understanding of the trap

No way to understand the prospect weak point!!
2) Seismic picking questionable
>> need for other advice (Peer review?)
>> need to improve QC

Pre-drill seismic picking

Post drill interpretation
3) Efficient seal and/or efficient sourcing pathway?

Thickness map of the Source Rock >

Fulmar prospect outline

Source Rock = Kimmeridge Clay Fm

Fulmar Prospect

Discovery 1

Discovery 2

WNW

ESE

Zechstein salt

Rotliegend basement

Smith Bank

Smith Bank

Skagerrak

Fulmar prospect outline

Source Rock = Kimmeridge Clay Fm

Fulmar Prospect

Discovery 1

Discovery 2

WNW

ESE

Zechstein salt

Rotliegend basement

Smith Bank

Smith Bank

Skagerrak
Conclusions
Conclusions – 1/2

- **Underestimation of the physical content of the seismic response:**
  - Well to seismic ties must be properly done >> impact on choice of the relevant horizon to be picked and / or on reservoir polarity
  - DHI type and robustness must be double checked
  - When looking at prospects that are solely dependent on AVO:
    - seismic data must be properly processed prior to any AVO study
    - **Produce and risk the geological model unsupported by AVO. Does the play makes sense without AVO support?**
  - **Seismic picking must not cut through valid seismic reflectors.** Dual polarity displays should help more rigorous picking particularly in Tertiary or relatively shallow Plays.
  - Prognosis of sand presence cannot only rely on “rules of thumb”, particularly when seismic data are poor /fair quality. Re-processing, acquiring new fit for purpose 3D data and rock physics modelling should be undertaken before locating wildcats on poor quality data

- **Cognitive bias:** Since the “X” discovery was just made, was there some kind of ”cognitive bias” which led to a too fast move to drill what was deemed to be an analogue amplitude feature / an analogue stratigraphic trap?

- **Drilling quality prospects should prevail against drilling as many wells as possible** >> food for thought for the new OGA?

- **In some instances, the operator was the sole licensee:** being not far enough away to assess the prospect this resulted in over-confidence. >> food for thought for the new OGA?

- **Access to information:** In some instance the lack of access to a well recently drilled updip of the prospect lead to the drilling of another dry well >> food for thought for the new OGA?
“Making accurate and unbiased prospect assessment is challenging. So is measuring assessment performance.”*

“Systematic tracking of Exploration results relative to pre-drill predictions is critical for improving both Assessment Performance and Exploration decisions”.*

“All efforts that can assist in delivering accurate, un-biased and consistent assessment will ultimately enhance company exploration performance.”*

In that respect the Post Well Analysis must be part of the full circle Quality Control process to be applied to the prospect assessment.

* from Charles Stabell (GeoKnowledge AS)
Thank you for your attention!

Thank you to all those who have been sharing with me on these post well assessments:

and cooperation from:
Progress on the Palaeozoic Study of the North Sea

Robert Gatliiff
Director, Energy & Marine Geoscience
British Geological Survey
21CXRM: The Palaeozoic Project
Robert Gatliiff (Director Energy & Marine Geoscience, British Geological Survey), Alison Monaghan (Project Manager) & the Project Team

17/06/15
Talk Outline

Background
Project Participation
Timetable
Progress
Vision

New, Different, Digital,
Live, Collaborative &
Inclusive
New exploration ....new
finds...new
developments
.....multidisciplinary....
data release..... training
Recommendations and Actions from the Sir Ian Wood Report

- Strategy for Maximising Economic Recovery (MER UK)
- Increase successful exploration
- Improve access to data – efficient access to well & seismic data
- An up-to-date readily accessible digital geology of the UKCS
- Better use of the expertise of the BGS

O&G UK, DECC & NERC/BGS - funded consultation with industry
- Palaeozoic Project most requested project

DECC using contract with BGS to initiate project
- Additional funding from industry
- Collaborative Project across industry and government
Background: British Geological Survey

- 40+ years working with DECC (Licensing rounds, Promote, independent analyses, unconventionals)
- National mapping programme and Regional Reports
- NERC Oil and Gas CDT
- Co-location with Heriot Watt University
- 516 scientists working with more than 40 universities
- 70 PhD students
- £48.5 million ~50% baseline from the NERC
- More than 150 current private sector customers
  - 20 bespoke science laboratories
  - National Geological Repository
**Project Participation: Contracts and funding**

- £525,000 DECC; £100,000 BGS; £50,000 O&G UK

- 45 contracts sent to committed or interested parties

- 27 signed contracts, 9 more returned in signing/negotiation = sponsorship £555,000 giving overall project budget c. £1.18 million

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<td>MOL OPERATIONS UK</td>
<td>Statoil (U.K.)</td>
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<td>Talisman Sinopec</td>
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Palaeozoic Project – Key Objectives

• Searching deeper and wider than the conventional hydrocarbon horizons
• Develop a strong, consistent regional data-set to provide a platform for more specific oil & gas exploration studies
• Develop new scientific understanding
  • that down-risks some of the critical play elements
  • that stimulates new ideas for plays and prospectivity
• Provoking
  • new data acquisition
  • additional analysis and interpretation programmes
• Leading to
  • licence activity
  • significant exploration well activity
  • economic commercial success rates
Phase 1: December 2014 - March 2015 (DECC funding):
Initial projects
Planning for main project
IP: data access issues

Phase 2: February 2015 – March 2016
Main collaborative project with Sponsors
Delivery to Sponsors 2016
Open 2017
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Project Preparation

Organising Contracts
Project Board and Technical Steering Committee
Contributions from operators
  Data, interpretations
Contributions from Spec companies
  Access to data
  Publication of results
Contributions from Service companies/ specialist services
  Expert services
  Software
CDA data supply
Academia
  NERC innovation funding
  NERC oil & gas CDT
Contributions from adjacent Geological Surveys
  TNO/EBN; GEUS; NGU/NPD; GSI/PAD
Data collation

Project is developing a consistent regional (digital) dataset to provide a platform for more specific oil & gas exploration studies e.g. stratigraphic tops, biostratigraphy, organic geochemistry, vitrinite reflectance. Focussed on the Carboniferous and Devonian

The underlying digital dataset is a key project deliverable

Strength of the project is to have access to DECC-CDA, BGS, Sponsors etc datasets

Example of well data locations (core and cuttings) for data collated on source rock organic geochemistry
Project progress – current ongoing work

Central North Sea-Mid North Sea High
- Seismic and well interpretation
- Gravity and density study
- Revision pre-Permian subcrop map
- Well log analysis, source and reservoir rocks
- Source rock geochemistry
- Maturity, burial/uplift, migration and charge modelling
- Regional petroleum systems and tectono-stratigraphic synthesis - between Millennium Atlas and block scale

Orcadian Basin and Irish Sea
Well and seismic data collation and interpretation
Ongoing work – seismic interpretation and agreements

- Discussions and agreements with seismic companies
- Permissions and confidentiality agreements for seismic data - making progress
- Agreement from seismic contractors for 5 km resolution grids as Project Results

Seismic datasets used Central North Sea-Mid North Sea High area. Wells penetrating Carboniferous or older strata shown.
Gravity features in NW part of study area

ENE (Iapetus) trend dominates

Gravity study aims to delineate Devono-Carboniferous basins in areas of variable seismic data coverage

Intra-Lower Palaeozoic density variations in the Southern Uplands (2.69-2.75 g/cc)

Oldhamstocks: basin or granite?

Tweed Basin

Northumberland Trough

Stainmore Trough

SUF offset?

Intrusion?

Gravity gradient zone parallel to the Permo-Carboniferous dyke trend

Major pre-Zechstein fault

G = Granite  NFF = Ninety Fathom Fault  PFF = Pressen-Flodden-Ford  SUF = Southern Upland Fault

Ongoing work – gravity and density study
Ongoing work – structure, development of Palaeozoic basins

Existing maps such as the one below show a relatively ‘blank’ area

Seismic, well and gravity interpretation are proving:

- Strong control by basement and inherited Caledonide structures (e.g. Iapetus, Tornquist trends)
- Structural trends and styles vary across the area
- Onshore to offshore structures mapped in more detail
- Numerous Devonian, Carboniferous basins, highs and platforms in this area
- Granites play a major role in basin configuration

Part of the BGS 1:1 500 000 Tectonic Map of Britain, Ireland and adjacent areas. Pharaoh et al 1996 ©BGS/NERC
Ongoing work – well correlations, palaeogeography

Taking a fresh, evidence-based approach. Key aspects:

• Biostratigraphy collated from CDA, Sponsors, BGS core store etc

*Biostratigraphic data donations/gathering has made a real difference*

• Integration with seismic on a regional scale

*Appreciation of regional basin configuration and ties, rather than block scale*

• Application of modern stratigraphy and insights onshore-offshore

• QC by project Sponsors
Ongoing synthesis

• Moving forward on risks, outcomes, focusing studies – different challenges in sub-areas of CNS

• Integrated studies now ongoing e.g. source rock extent, maturity, geochem characterisation etc

Using gravity & seismic data to delineate basins. Source rock

Source rock – presence, maturity, charge.

Timing of maturity, charge vs trap formation. Data quality

Northerly limit of source. Maturity, migration and charge

Using onshore data/knowledge

Additional Devono-Carb prospectivity?

Applying knowledge of proven play to north

Geologically based sub-areas within the CNS with wells penetrating Carboniferous and/or Devonian strata shown, with some key risks/outcomes shown
Technical Steering Committee (TSC) meetings and field workshop

TSC meetings well attended by Sponsors

Field workshop to Scremerston Fm - Yoredale Fm section May 2015

Photo credit: Sarah Hannis
Encouraging collaboration

Sponsors
BGS team
DECC/OGA
O&G UK

Presentations
Workshops
Company to company discussions
Encouraging feedback, input and QC

Technical Steering Committee

Data donations from Sponsors and others

One to one meetings BGS-Sponsors
Delivery of project with new seismic data
March 2016: in line with new licensing round
Vision

• First of several studies
• Leading to a free-to-use 3D model of UK geology
• Regular updates
• Encourage more release of data – well logs and seismic data on the web
• Crowd sourcing and wiki style innovations
• More sharing and collaboration
• Improve UK access to rival that of Norway or the Netherlands
• Make the UK an easier place to explore
THE OIL AND GAS INDUSTRY CONFERENCE

Maximising Economic Recovery in the UK - The Next 40 years
Exploration - The 21st Century Agenda
Panel Session

Chaired By

Oonagh Werngren
Operations Director
Oil & Gas UK