



A Petroleum Conference Organised by PIP-ISPSPG

A one-day conference and exhibition on Ireland's offshore hydrocarbon potential

Abstracts Volume



This annual event is organised by the Petroleum Infrastructure Programme (www.pip.ie)

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ATLANTIC IRELAND 2013

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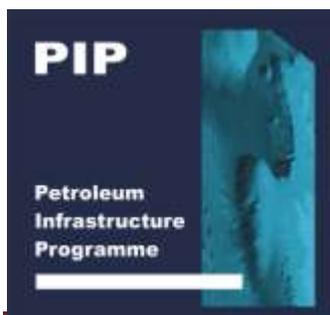
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ATLANTIC IRELAND 2013

A One Day Conference and Exhibition on
Ireland's Offshore Hydrocarbon Potential
Sponsored by PIP-ISPSG

PROGRAMME AND SHORT ABSTRACTS

- Location:** Burlington Hotel, Dublin, Ireland
- Date:** 11th November 2013 – 08.00 to 19.00hrs
- Audience:** Researchers, exploration companies, geophysical contractors, government departments and agencies, international guests

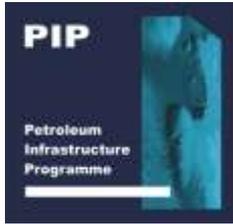


Edited by:

Martin Davies & Tom Moore

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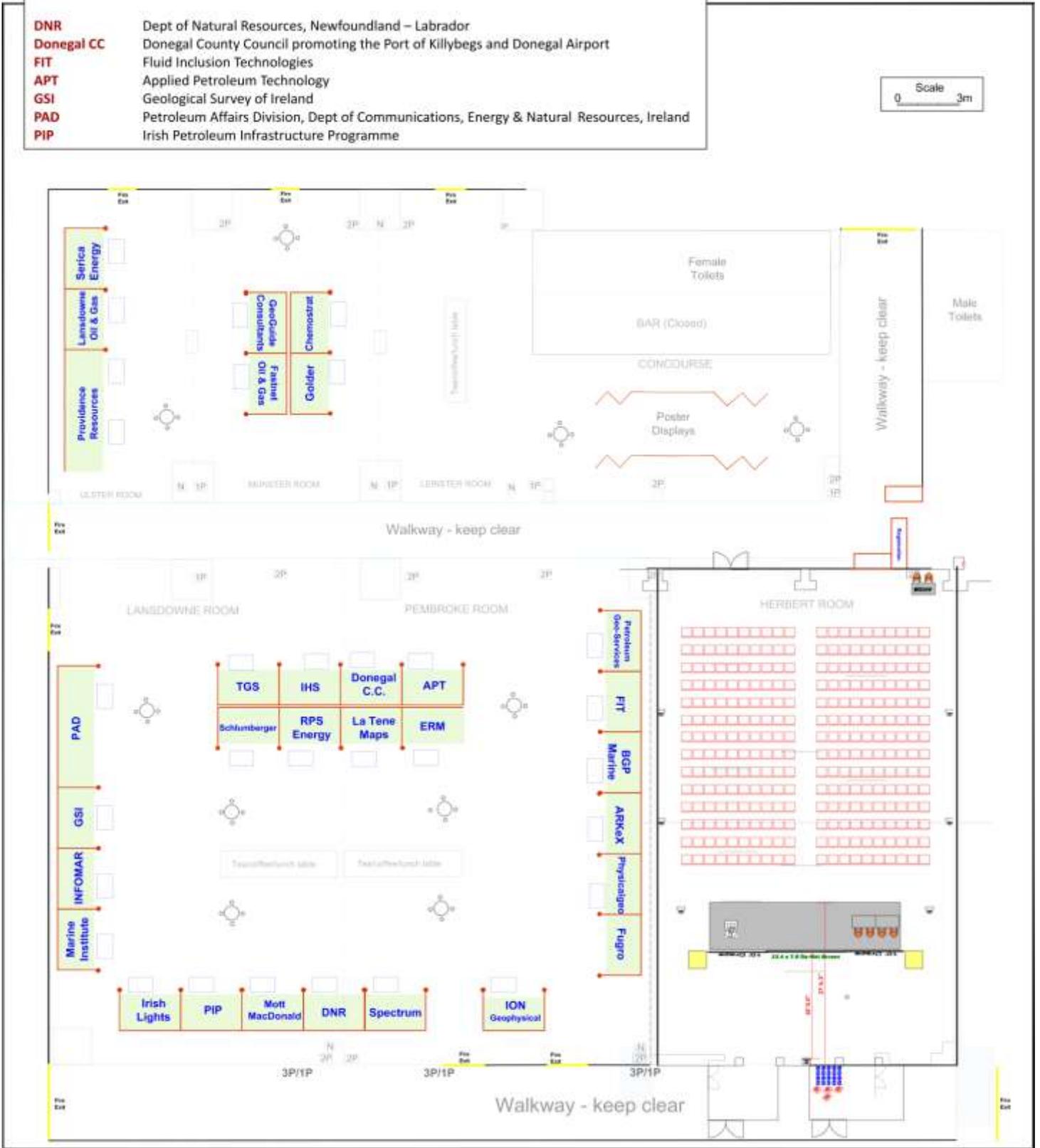
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Exhibition Layout

KEY:

- DNR** Dept of Natural Resources, Newfoundland – Labrador
- Donegal CC** Donegal County Council promoting the Port of Killybegs and Donegal Airport
- FIT** Fluid Inclusion Technologies
- APT** Applied Petroleum Technology
- GSI** Geological Survey of Ireland
- PAD** Petroleum Affairs Division, Dept of Communications, Energy & Natural Resources, Ireland
- PIP** Irish Petroleum Infrastructure Programme



Fourth Conjugate Margins Conference 2014

Go Deep: Back to the Source

Delta Hotel and Conference Centre
St. John's, NL Canada

Wednesday August 20 - Friday August 22, 2014



www.conjugatemarginsnl.ca

Newfoundland and Labrador

The island of Newfoundland played a pivotal role in the “discovery” of North America by Europeans. From the days of the Viking Leif Eriksson’s settlement at L’Anse aux Meadows over 1000 years ago to the time of John Cabot’s voyage in 1497, European explorers have awoken to the natural resource wealth of the “new land”. The importance of access to rich fish stocks brought permanent European settlement in the early 1500’s with St. John’s established as one of the earliest communities.

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Today St. John’s is a vibrant modern city where the oil and gas industry is driving economic growth. Conjugate Margins 2014 invites you to come back to the source to experience the history, geology and scenic beauty of Newfoundland and participate in this important international conference that will explore the structural and stratigraphic evolution of the margins on both sides of the Atlantic.

Conference sessions topics

Atlantic Margins

Geodynamics

Deepwater Systems

Structural and Tectonic Settings

Petroleum Exploration

Who should attend

All those interested in the latest hydrocarbon exploration related research on the Central, North & South Atlantic Conjugate Margins, including E&P companies, geological and geophysical contractors, consultants, university researchers, government agencies and departments.

Call for abstracts

Visit the website for further information.

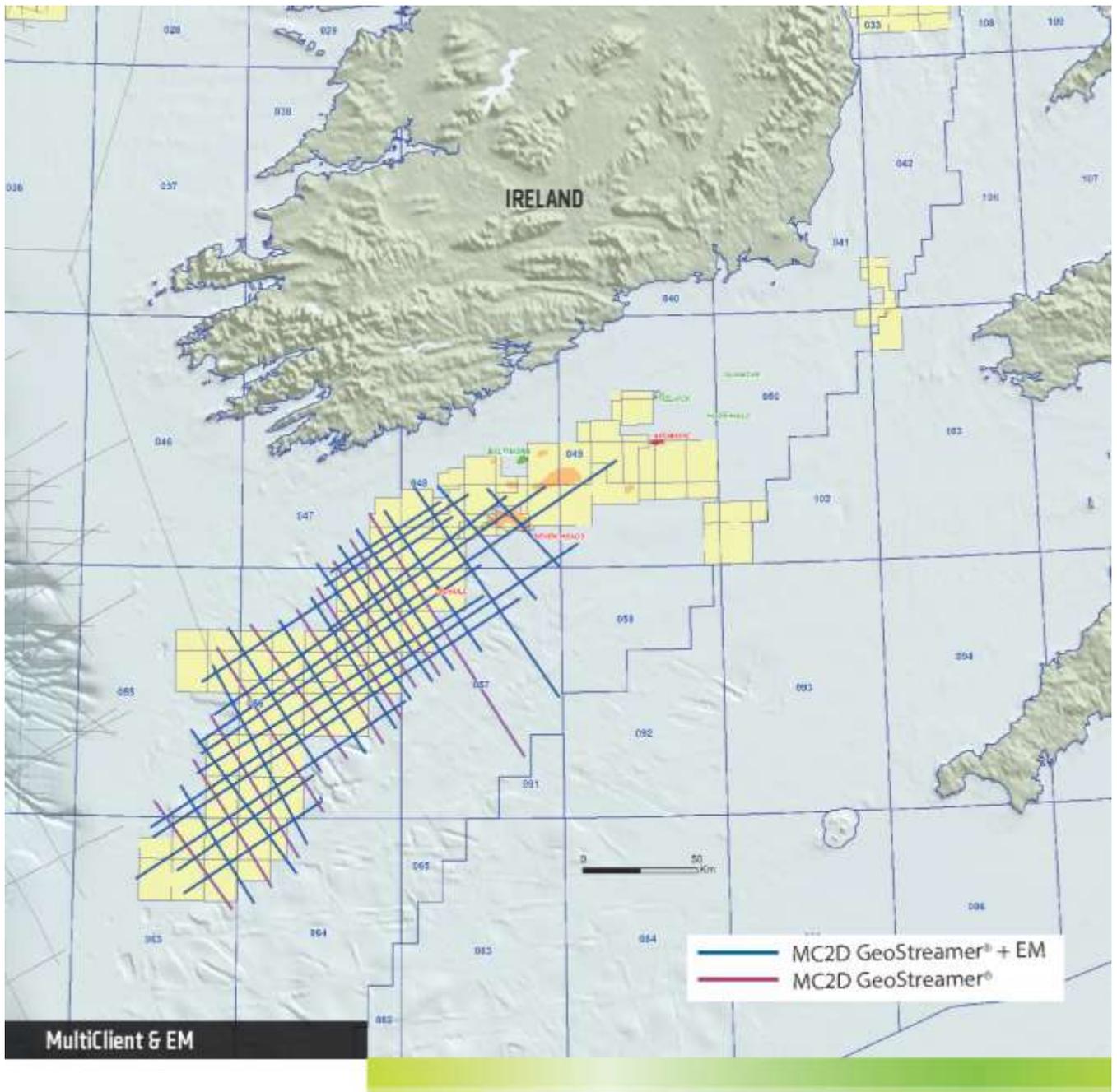
Sponsorship and exhibition opportunities

A trade exhibition will run during the conference in parallel with the scientific program. More information on opportunities to exhibit and/or sponsor will be posted on the website.

Further information

Please visit the conference website for regular updates: www.conjugatemarginsnl.ca
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ATLANTIC IRELAND 2013

Technical Programme



**A Petroleum Conference
Organised by PIP-ISPSPG**

Monday 11th November
Atlantic Ireland 2013
DoubleTree by Hilton Hotel Dublin - Burlington Road
Upper Leeson Street, Dublin 4

Oral Programme

Monday 11th November 2013

08.00 - 08.50	Registration - Coffee / Tea available in Exhibition Room and Poster Room
08.50 - 09.00	Nick O'Neill (PIP) – Welcome to Delegates and brief resume of PIP
09.00 - 09.20	Address by Minister of State (DCENR) – Fergus O'Dowd, TD
<div style="display: flex; align-items: center;"><div style="text-align: center; margin-right: 10px;"><p>kindly sponsored by:</p></div><div><p>Session 1 - Regulatory Matters Co-Chairs – Ronan MacNioclais (PwC), Fergus Cahill (IOOA)</p></div></div>	
09.20 – 09.35	Michael Manley (DCENR) – “An Overview”
09.35 – 09.55	Mick Hanrahan / Clare Morgan (DCENR/PAD) – “Status of exploration Offshore Ireland and a major new seismic survey”
09.55 – 10.10	Ciarán Ó hÓbáin (DCENR/PAD) – “Regulatory Framework applying to Oil and Gas Exploration, Development and Production Activities
10.10 – 10.25	Sheenagh Rooney (CER) – “Petroleum Safety Framework – a new oil and gas safety regulatory system for Ireland”
10.25 – 10.30	Discussion
<p>10.30 – 11.15 Tea / Coffee Break – sponsored by: </p>	
<div style="display: flex; align-items: center;"><div style="text-align: center; margin-right: 10px;"><p>kindly sponsored by:</p></div><div><p>Session 2 - Petroleum Systems Co-Chairs – Peter Haughton (UCD), Jayne Baird (Woodside Energy)</p></div></div>	
11.15 – 11.30	Koen Verbruggen (GSI) – “NAG-TEC Irish research and other GSI/MI-funded research”
11.30 – 11.45	Sarah Laird (Neflex) – “Predicting Late Jurassic and Cretaceous plays in the Porcupine and Rockall basins – a sequence stratigraphic approach”
11.45 – 12.00	Steve Boldy (Lansdowne) – “North Celtic Sea Basin – the potential in deeper targets”
12.00 – 12.15	Ceri Roach (Chemostrat) – “Chemostratigraphic characterisation of the Jurassic and Cretaceous successions of the Porcupine Basin”
12.15 – 12.30	Andre Stout (Physicalgeo) – “Going deeper – Jurassic and Triassic potential of the Irish Atlantic margin”

This annual event is organised by the Petroleum Infrastructure Programme (www.pip.ie)



Monday 11th November
Atlantic Ireland 2013

DoubleTree by Hilton Hotel Dublin - Burlington Road
 Upper Leeson Street, Dublin 4

**A Petroleum Conference
 Organised by PIP-ISPSPG**

12.30 – 12.45 Ian Atkinson (Nalcor Energy) – Exploration activities and results offshore Newfoundland

12.45 – 12.50 Discussion

12.50 – 14.05 Lunch - sponsored by:  and 

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Session 3 - New Data and Innovation

Co-Chairs – Rob Hardy (Tonnta Energy), Chris Bean (UCD)

14.05 – 14.15 Peter Haughton (UCD) – UCD's new Petroleum Geoscience MSc course

14.15 – 14.30 Maarten Ligtdag (Shell) – "Ocean Bottom Cable Seismic over the Corrib Gas Field: A first for Ireland"

14.30 – 14.45 Chris Anderson (PGS) – "Towed Streamer Electromagnetics: Resistivity in Context" with reference to recent survey in Fastnet Basin

14.45 – 15.00 Jagat Deo (Seismic Image Processing) & Pavel Gofman (Deco Geophysical) – "A new demultiple workflow to attenuate all order free surface & pegleg multiples – eSRME/ePEG examples from Barryroe, North Celtic Sea Basin"

15.00 – 15.05 Discussion

15.05 – 15.45 Tea / Coffee Break – sponsored by: 

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Session 4 - Prospects2Go

Co-Chairs – Paul Dailly (Kosmos Energy), Ian Atkinson (Nalcor Energy)

15.45 – 15.55 Paul Griffiths (Fastnet Oil & Gas) – Unlocking the potential of the Early Cretaceous petroleum system in the Mizzen Basin using Fastnet's newly acquired 3D seismic

15.55 – 16.05 Graham Pritchard (Serica) – Prospects2Go – Prospectivity in Licence FEL 1/06 in the Slyne Basin

16.05 – 16.15 Annemarie Smyth (Providence) – Prospects2Go

16.15 – 16.25 Peter Mikkelsen (Fastnet Petroleum) – Prospects2Go - Prospectivity in Fastnet Basin Licence Option

16.25 – 16.45 Steve Laux (Cairn Energy) – Closing Keynote Address

16.45 – 16.55 Discussion

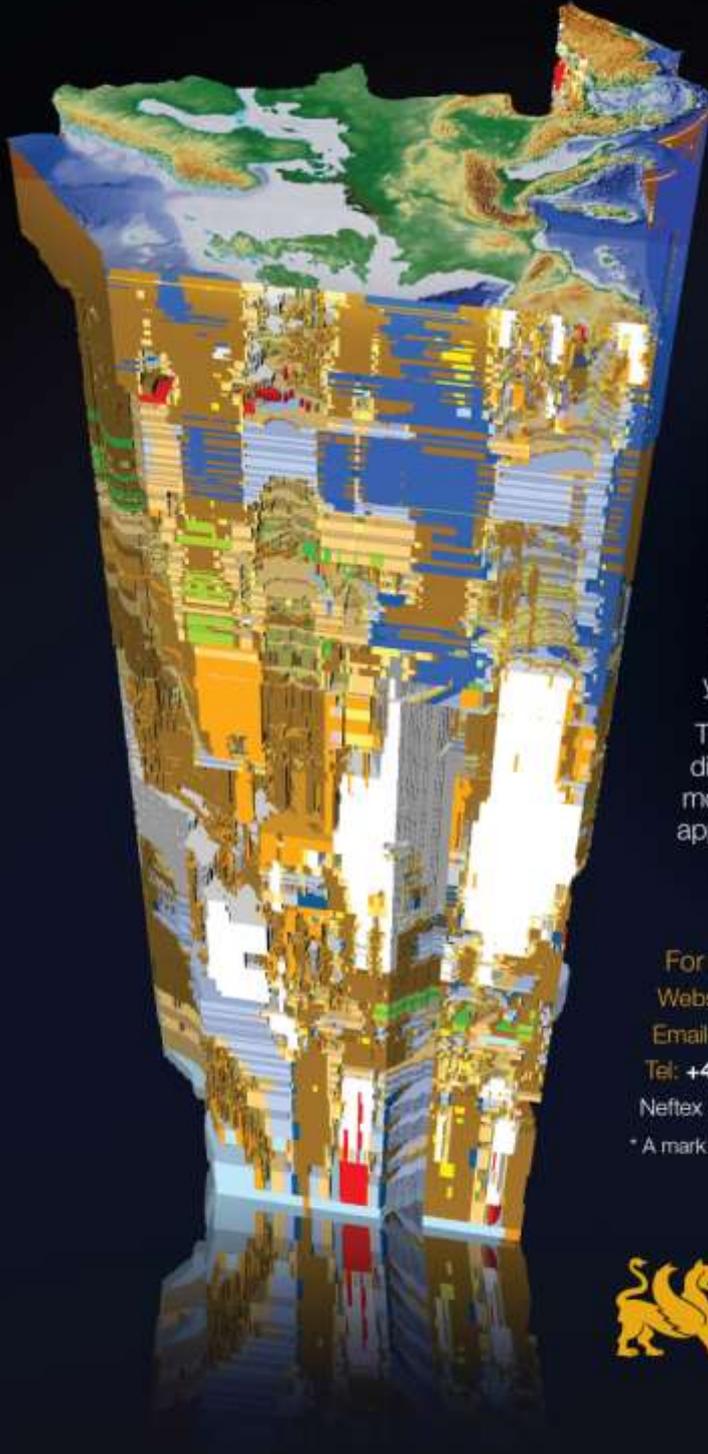
16.55 – 17.00 Martin Davies (PIP) – Closing Remarks

17.00 – 19.00 Posters and Reception – sponsored by: 



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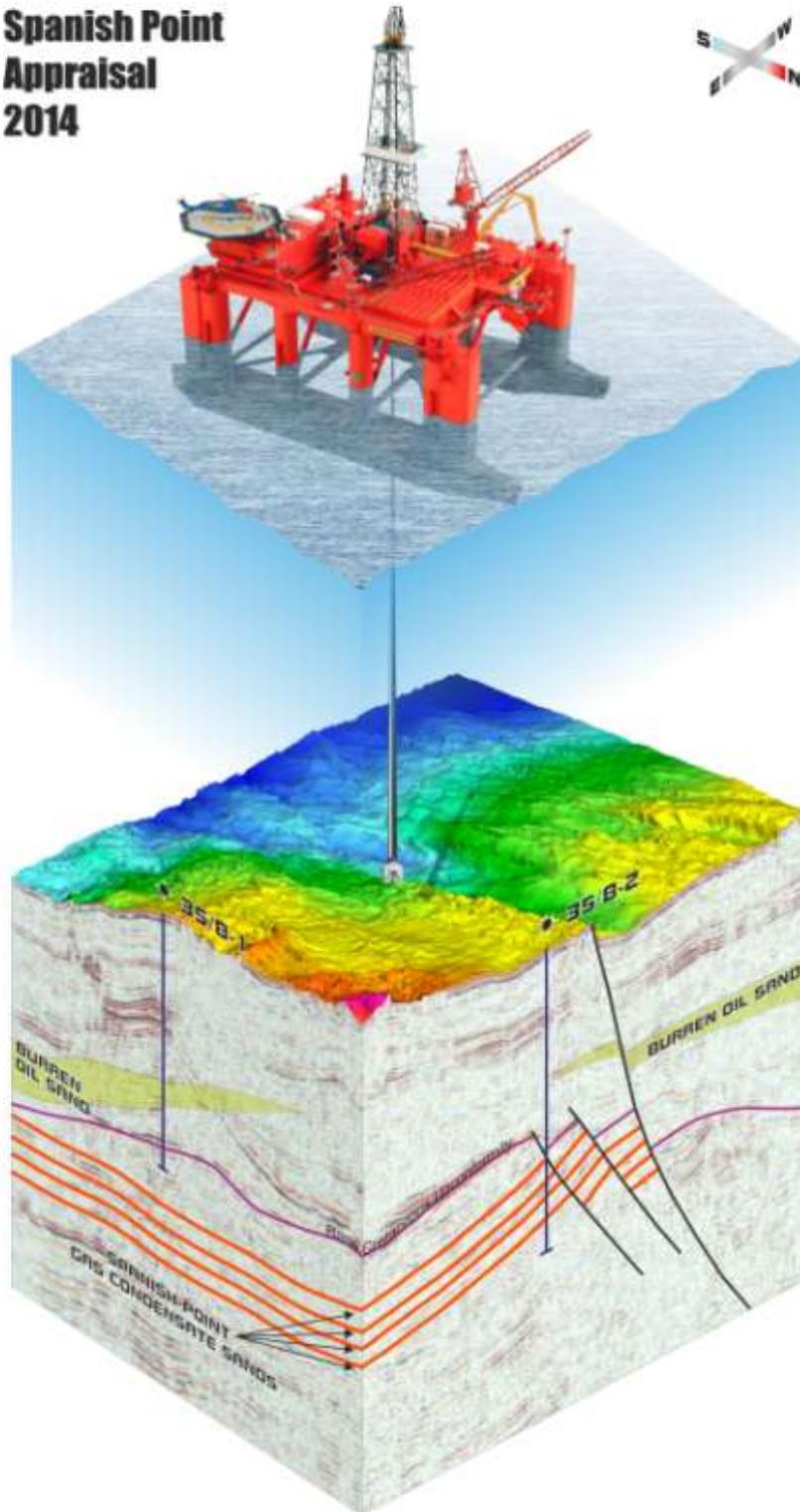
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Drilling Ahead...

**Spanish Point
Appraisal
2014**



For illustrative purposes only.



ORAL ABSTRACTS (in order of presentation)

Speaker is underlined

An Overview

Manley, M.¹

¹ *Dept. of Communications, Energy and Natural Resources, 29-31 Adelaide Road, Dublin 2*

Status of exploration Offshore Ireland and a major new seismic survey

Hanrahan, M.¹, Morgan, C.¹

¹ *Petroleum Affairs Division, Dept. of Communications, Energy and Natural Resources, 29-31 Adelaide Road, Dublin 2*

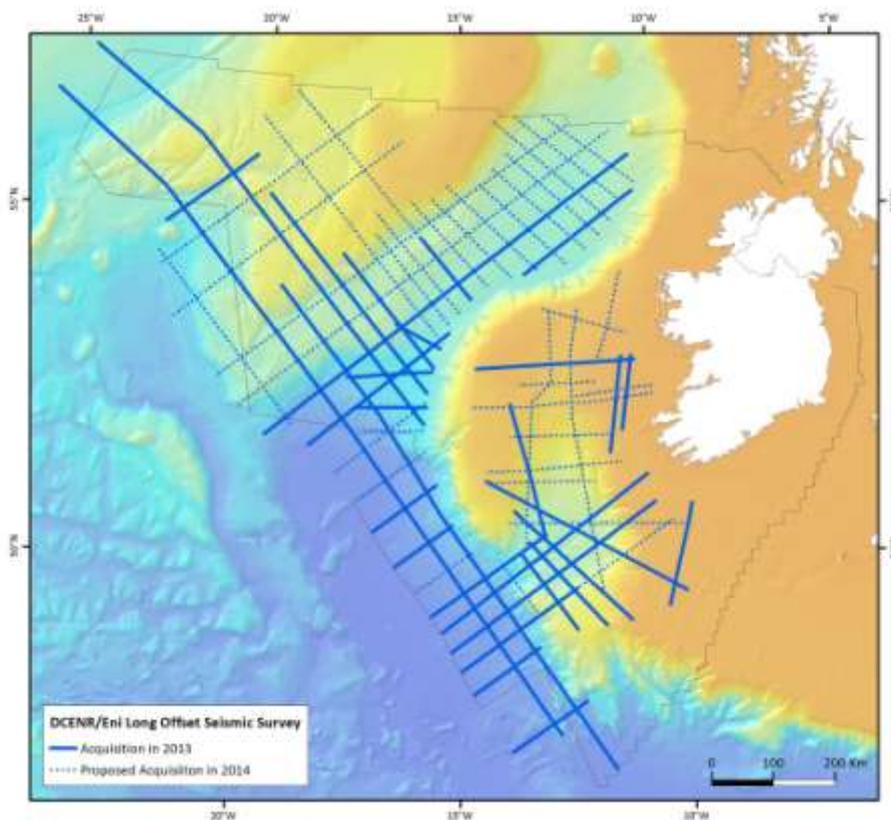
The results of the 2011 Atlantic Margin Licensing Round were positive and 13 two year new Licensing Options were awarded to 12 companies. Typical work programmes focused primarily on evaluation of existing data, seismic reprocessing and prospectivity studies. A wide variety of exploration targets are recognised from Tertiary to Permo-Triassic; from non-marine fluvial and aeolian to basin-floor fans with a significant proportion of the Licensing Options having Cretaceous deep marine sandstone objectives. Up to 75% of a Licensing Option area may be converted into a 15-year Frontier Exploration Licence. A significant measure of the success of the outcome of the 2011 Round has been the high number of applications received by the Department to convert Licensing Options awarded in the Round to Frontier Exploration Licences. Furthermore, the recent entry of new exploration companies to the Irish Atlantic Margin, namely Cairn Energy, Kosmos Energy and Woodside Energy; all with significant international deepwater exploration experience is testament to the success of the Round.

Interest in the Celtic Sea area has re-ignited, partly due to the drilling success at Barryroe and a record number of new Licensing Options, with associated substantial work programmes, including seismic acquisition, have been awarded in the Celtic Sea and the Fastnet Basin.

There has been a significant increase in seismic activity offshore Ireland in 2013. The Department/Eni acquired a substantial major regional 2D long offset seismic survey this year. Some

ATLANTIC IRELAND 2013

10,175km of new 2D seismic data were recorded across the Atlantic basins including the Porcupine, Rockall, Hatton, Fastnet, Clare Basins and along the conjugate margin. This is the largest 2D seismic survey acquired to date in Irish waters. The data were acquired by BGP. The survey reached the 2013 production target. It is hoped to complete the remainder of the seismic survey (8,000km) in 2014. Initial indications are that the survey has good quality data that will be valuable in understanding the prospectivity offshore Atlantic Ireland. In addition to the Department's seismic survey there were five additional seismic surveys this year and a number of geophysical 'firsts' offshore Ireland. The first Ocean Bottom Cable (OBC) 3D seismic survey was acquired for Shell across the Corrib field; the first seismic undershoot was acquired on behalf of Fastnet Oil & Gas to provide continuous 3D subsurface coverage beneath the Kinsale field and the first ElectroMagnetic survey was acquired as part of a large 2D seismic programme acquired by PGS for Charge Oil in the North Celtic Sea Basin. A 3D seismic survey was acquired for Fastnet Oil & Gas in the Mizzen Basin and the largest 3D seismic survey to date was acquired for Kosmos Energy in the Porcupine Basin.



This year also saw the drilling of the much anticipated deepwater Dunquin North exploration well in the Porcupine Basin. The well, which was operated by ExxonMobil on behalf of its partners Eni, Repsol, Providence Resources, Atlantic Petroleum and Sosina Exploration, encountered a thick high porosity carbonate reservoir system, which however has proved to be water bearing with no commercially recoverable hydrocarbons.

Despite the continued low level of drilling activity, it is encouraging that the current exploration status offshore Ireland is healthy and the exploration momentum offshore Ireland has increased significantly this year.

Regulatory Framework applying to Oil and Gas Exploration, Development and Production Activities

Ó hÓbáin, C.¹

¹*Petroleum Affairs Division, Dept. of Communications, Energy and Natural Resources, 29-31 Adelaide Road, Dublin 2. Email: Ciaran.ohobain@dcenr.gov.ie*

The regulatory framework applying to oil and gas exploration, development and production activities in Ireland has been the subject of significant revision in recent years, with the aim of strengthening its effectiveness, transparency and robustness. Understanding how the revised framework applies to exploration, development and production activities is important to oil companies, to seismic contractors and to companies providing expert support services to the industry across a range of disciplines.

Petroleum Safety Framework – a new oil and gas safety regulatory system for Ireland

Rooney, S.¹

¹*Commission for Energy Regulation, Commission for Energy Regulation, The Exchange, Belgard Square North, Tallaght, Dublin 24*

Background

The *Electricity Regulation Act 1999*, as amended inter alia by the *Petroleum (Exploration and Extraction) Safety Act, 2010* (the 'Act') gives the Commission for Energy Regulation (CER), responsibility for the safety regulation of petroleum exploration and extraction activities in Ireland, including specifically a requirement for the CER to "establish and implement a risk-based petroleum safety framework" (the 'Framework'). The establishment of the Framework commenced in 2010 and the Framework is scheduled to go operational November 30th 2013, from which point onwards the safety regulation of petroleum exploration and extraction activities will rest with the CER.

Key provisions of the Act

The CER's principal objective in carrying out its new petroleum safety functions is to "protect the public by fostering and encouraging safety...of designated petroleum activities." The CER's general duty is to "do all things necessary and reasonable to further its objectives and...exercise its powers and perform its function in the public interest." Its functions under the Act are to:

1. Regulate designated petroleum activities of petroleum undertakings with respect to safety;
2. Monitor and enforce compliance of undertakings with their obligations under the Act;
3. Investigate and report to the Minister on petroleum incidents;
4. Issue Safety Permits; and
5. Provide safety information to the public when appropriate.

The key mechanism by which the CER will regulate designated petroleum activities (Well, Production and Decommissioning) under the Framework is through a permissioning system. Under this system petroleum undertakings will only be able to undertake designated petroleum activities upon approval of a safety case by the CER, and the issuance of an associated safety permit for that activity. This approach is consistent with other safety case regimes and best practice internationally.

The safety permit, including any conditions attaching to it, will be supplemented with a compliance monitoring regime. As part of the compliance monitoring regime, the CER will implement a rigorous audit and inspection system to allow it to meaningfully assess ongoing compliance by petroleum undertakings with the requirements of the Act.

A fundamental point to be made about the Act and the functions conferred upon the CER is that the Act places the regulation of the safety of petroleum activities within a criminal framework. This imposes an additional responsibility on the CER to ensure that it acts fairly and reasonably in the discharge of its functions, and emphasises the seriousness with which achieving the objective of a safe petroleum exploration and extraction industry is regarded. The outcomes of audits and inspections can form the basis of enforcement action and ultimately prosecutions to be taken by the CER under the Act.

The Petroleum Safety Framework Implementation Project

The Petroleum Safety Framework Implementation Project (the 'Project') was set up in 2010 to establish and implement the provisions of the Act in full and to ensure the CER had in place the people, processes and procedures to enable the effective operation of the Framework.

The five phases of the Project were:

- a) Scoping and Planning;
- b) High Level Design;
- c) Detailed Design;
- d) Internal Readiness; and
- e) Implementation.

Phase A included a review of international petroleum safety regulatory regimes as well as a report on the existing petroleum regulatory regime in Ireland, to inform the development of the Framework. Phase B of the Project involved the development of the *High Level Design of the Petroleum Safety Framework* (the 'High Level Design'), which was published in June 2012. The High Level Design set out the following main components of the Framework:

1. ALARP Demonstration Requirements;
2. Permissioning System;
3. Compliance Assurance System;
4. Incident Investigation System;
5. Agreed Interfaces, Co-operation and Co-ordination with other Regulatory Authorities;
6. Enforcement System;
7. Safety Reporting and Published Safety Information System; and
8. Continuous Improvement.

Phase C involved the development and publication of detailed guidance on a number of topics associated with the above components, including: ALARP Demonstration Guidance; Safety Case Guidelines, and the Compliance Assurance System. All Framework documentation is published on the CER website.

Phase D involved the putting in place of the people, processes and procedures to enable the effective operation of the Framework, which includes the development of a comprehensive internal suite of operational procedures and the resourcing of internal and external specialist technical petroleum safety team members to discharge the CER functions under the Act.

Phase E, the implementation of the Act includes the development of bespoke transition plans for existing petroleum undertakings from the current safety regulatory regime to the Framework.

Guidance for Petroleum Undertakings

The Framework is scheduled to go operational November 30th 2013. Petroleum undertakings planning to undertake designated petroleum activities are encouraged to engage with the CER as early as possible and to review the Framework documentation available on the CER website.

For further information see www.cer.ie

NAG-TEC Irish research and other GSI/MI-funded research

Verbruggen, K.¹

¹ *Geological Survey of Ireland, Beggars Bush, Haddington Road, Dublin 4*

INFOMAR (Integrated Mapping for the Sustainable Management of Ireland's Marine Resource) is Ireland's national marine mapping programme, funded by Government and implemented as a joint venture between the Geological Survey of Ireland (GSI) and the Marine Institute (MI) and is the successor to the Irish National Seabed Survey (INSS). The programme covers the remaining Irish waters to be mapped, <200m deep, c.125,000 square kilometres, and is producing integrated mapping products including updated charting (with UKHO) as well as seabed substrate maps and digital DTMs. The programme uses ship-mounted acoustic multibeam sonar and geophysical technology to provide vital information on water depth for safe shipping, as well as analyse the properties of the seabed for information that can guide fishing, ocean renewable development, environmental protection, marine archaeology and all offshore development. The data is made available free of charge via the web. Highlights in 2013 included the completion of mapping of the Southern Priority Area in the Celtic Sea, and mapping in Dingle Bay, Shannon Estuary and Dundalk Bay. The programme also saw further use of multi-spectral satellite for bathymetric mapping; collaboration with the Sustainable Energy Authority of Ireland Agency to map an area off west Clare as a potential wave energy site; and completion of a collaborative shipwreck investigation in Donegal with National Monuments Service. INFOMAR's 23 sponsored research projects, half of which involve or are led by Industry partners, covering a range of topics from geology, to renewable energy, software development and oceanography, all completed in 2013 and are now online at www.infomar.ie

Further Marine Research initiatives involving GSI and MI include the EU funded:

EMODNET (European Marine Observation and Data Network), compiling data across the EU on geology, bathymetry, chemistry and biology of oceans and broad scale habitat maps. This programme commenced a second phase, involving EU wide data collection, in 2013.

INIS-HYDRO, InterReg funded programme to map and develop hydrographic and sampling standards between Ireland, Northern Ireland and Scotland.

MESH-ATLANTIC, producing offshore habitat mapping, including in Kenmare River Ireland.

In 2013 the EU published the Atlantic Strategy which outlines extensive areas of potential marine related research and is expected to help inform emerging opportunities under the EU Horizon2020 programme, commencing 2014.

TELLUS BORDER, GSI with GSNI, QUB and Dundalk IT are also completing this project in 2013. This project completed airborne geophysical mapping and soil, stream and water geochemistry across the six border counties of Ireland, extending the dataset already obtained in Northern Ireland. www.tellusborder.eu

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IRCAG, the Irish Research Centre for Applied Geoscience, is a proposal being developed by the Irish Geoscience university departments in response to a call by Ireland's research funding body, SFI, for Research Centres. The proposal being developed is for an ambitious six year programme in response to the topic advertised as "Geoscience underpinning economic development" and could lead to a substantial uplift in Irish geoscience research.

GSI are part of the Northeast Atlantic Geoscience (NAG) group, a cooperative framework agreement between the National Geological Surveys of the Northeast Atlantic comprising; Ireland, Great Britain (including Northern Ireland), the Netherlands, Norway, Germany, Iceland, and Denmark and Greenland (including the Faroe Islands).

The first large scale project undertaken by the NAG consortium NAGTEC is co-sponsored by Surveys and Oil Industry companies in order to tackle the common theme of interest: Tectonic development of the North Atlantic. NAGTEC, which is lead by GEUS, the Danish Geological Survey, will result in the production of an Atlas and accompanying GIS database for the NAG region (Fig 1.) by July 2014. The Atlas aims to provide: quantitative analysis of key basin parameters, regional correlations of key stratigraphic units, unconformities, and geologic formations, an understanding of the connectivity and similarities between known prospective regions and unexplored areas, as well as comprehensive analysis of conjugate margin pairs by the systematic compilation of all Tectonostratigraphic information over the region.

By creating this tectono-stratigraphic atlas of the North-eastern Atlantic, NAGTEC will achieve the first systemic, standardised correlation of tectono-stratigraphic information comprising the entire north eastern Atlantic region. It is hoped that the result of the project will promote understanding of the geology and regional exploration priorities.

The final products will be available to the contributing surveys and sponsoring Oil Companies for a moratorium of two years for the Atlas and five years for the GIS. Expiry of the moratorium on the hard copy atlas is scheduled for June 2016, followed by the release of the web GIS in 2019. On completion of data products, the surveys expert research personnel will also publish details of the scientific research undertaken and new understanding of the NAGTEC region in peer reviewed scientific publications. The project will also highlight key data gaps, which may be pursued by further research or projects.

The long term benefits to Ireland are predicted to be significant, as it is hoped NAGTEC will support petroleum exploration and lead to stimulation of further research offshore Ireland. An additional benefit is the highlighting of our territorial waters as a potential exploration area to sponsoring companies not yet working in the Irish area. The Irish contribution to the NAGTEC project is co-ordinated by Maria Judge, an INFOMAR consultant at the Geological Survey of Ireland, and employs fulltime (NAGTEC funded) technical support from a post-doctoral researcher, Dr Kenneth McDermott, who is based at the School of Geological Sciences UCD under the supervision of Professor Pat Shannon.

Predicting Late Jurassic and Cretaceous plays in the Porcupine and Rockall basins – a sequence stratigraphic approach

Laird, S.F.¹, Evans, K.¹, Booker, M.¹, Wiltshire, M.¹

¹ *Neftex Petroleum Consultants*

Exploration in frontier areas is constrained by the knowledge of what play elements are likely to be present, both with respect to their geological timing and spatial distribution. It is also important to understand the potential quality of source rocks and where they will be mature and what the quality of the reservoir intervals will be. Sequence stratigraphy can act as a framework allowing prediction and mapping of key source rocks and reservoirs on maximum flooding surface (MFS) and lowstand (LST) gross depositional environment (GDE) maps. In the case of the Porcupine and Rockall basins it is critical to consider the palinspastic context when identifying appropriate analogues to aid in the prediction of play elements and to understand sediment provenance and associated issues of reservoir distribution and quality. The prediction of plays in these Irish basins can be greatly enhanced by integrating appropriate analogue data from the Norwegian Sea and the Faroe-Shetland Basin and through an understanding of the relatively well explored petroleum systems of the Canadian conjugate margin.

Key play elements in the Irish offshore include Jurassic source rock development as a result of widespread organic enrichment in the Kimmeridgian, enhanced by restriction along the North Atlantic margin. This resulted in source rock deposition in the Norwegian Sea and Barents Sea (Spekk and Hekkingen formations) and in the Jeanne d'Arc Basin (Egret Member). Organic enrichment of this age has also been noted in the Porcupine Basin (Croker and Shannon, 1987). While this source rock is important throughout the North Atlantic margin and in the North Sea there is a risk that this interval may be overmature (Naeth et al., 2005), or too thin, in the deeper parts of the Porcupine and Rockall basins to be an effective source rock. As a result it is important to review the potential for a younger and shallower source rock, and a good candidate is likely present in the Early to Middle Cretaceous (Croker and Shannon, 1987). This source rock, considered the predominant source for oil in the 35/8-2 well (Naylor and Shannon, 2011), may include organic enrichment associated with the Aptian Oceanic Anoxic Event (OAE 1A). Elevated TOCs corresponding to this event are recorded offshore Norway, the Faroe-Shetland Basin (Carrack Formation) and in the North Sea (*Fischschiefer horizon*), *although the enriched intervals are generally quite thin*. The overall thickness of a potential Early-Middle Cretaceous OAE 1A source rock and its depth of burial and hence maturity would be critical to its potential as a source rock in the deeper part of the Porcupine and Rockall basins.

Understanding the geodynamic context of potential plays is important in predicting reservoir presence and quality. Jurassic sands have long been recognised to have reservoir potential within the Porcupine Basin but the quality of the sands drilled to date has been mixed (Robinson and Canham, 2001). By understanding uplift along the North Atlantic margin and of onshore Ireland, the history of deposition and erosion, and the timing of globally significant lowstands it is possible to predict when key reservoir intervals may have been deposited and their likely provenance. The latter is particularly important to assess the quality of those sands, particularly with regards to targeting plays in the southern part of the Porcupine Basin. Reservoirs of the Late Jurassic Rona Member in the Faroe Shetland Basin (Verstralen et al., 1995) and time equivalent plays offshore Norway associated with a major LST can also be used to predict plays within the Rockall Basin sourced from surrounding basin highs.

Reservoir potential associated with Cretaceous lowstands in the Porcupine and Rockall basins will also be reviewed. Following Early Cretaceous uplift and erosion on the Canadian margin proven reservoirs of the Ben Nevis and Hibernia formations were deposited (Williams et al., 1999). On the Irish margin similar uplift and erosion is recorded and reservoir potential recognised. Shallow marine sands of the Wealden Formation and the Greensand Group equivalents are reservoirs in the North

Celtic Sea Basin (for example at the Kinsale Head and Ballycotton fields and the Barryroe discovery). These transgressive sands can be modelled between the LST and MFS maps and are helpful in predicting the potential distribution of shallow marine and LST fan sands associated with Early and Middle Cretaceous LSTs that may lie down systems tract in the Porcupine Basin. Early to Middle Cretaceous sand plays in the Porcupine Basin, with the potential erosion and reworking of sands from the surrounding highs and from the Irish shelf with the expectation of good primary reservoir quality, are of particular interest given the variable reservoir quality of Jurassic sands drilled to date in the Porcupine Basin. In the Late Cretaceous the potential for the deposition of fan sands along the western margin of the Rockall Basin will be analysed using regional analogues. Sands in the Norwegian offshore sourced from Greenland (Vergara et al., 2001) were deposited corresponding to a major Late Cretaceous LST and are a potential analogue. This is best reflected by viewing Late Cretaceous North Atlantic lowstand maps within their palinspastic context.

Key risks associated with major plays in the Porcupine and Rockall basins will be assessed within the context of the geodynamic evolution of the North Atlantic and considering the implications for deposition, provenance, preservation and maturity of key play elements.

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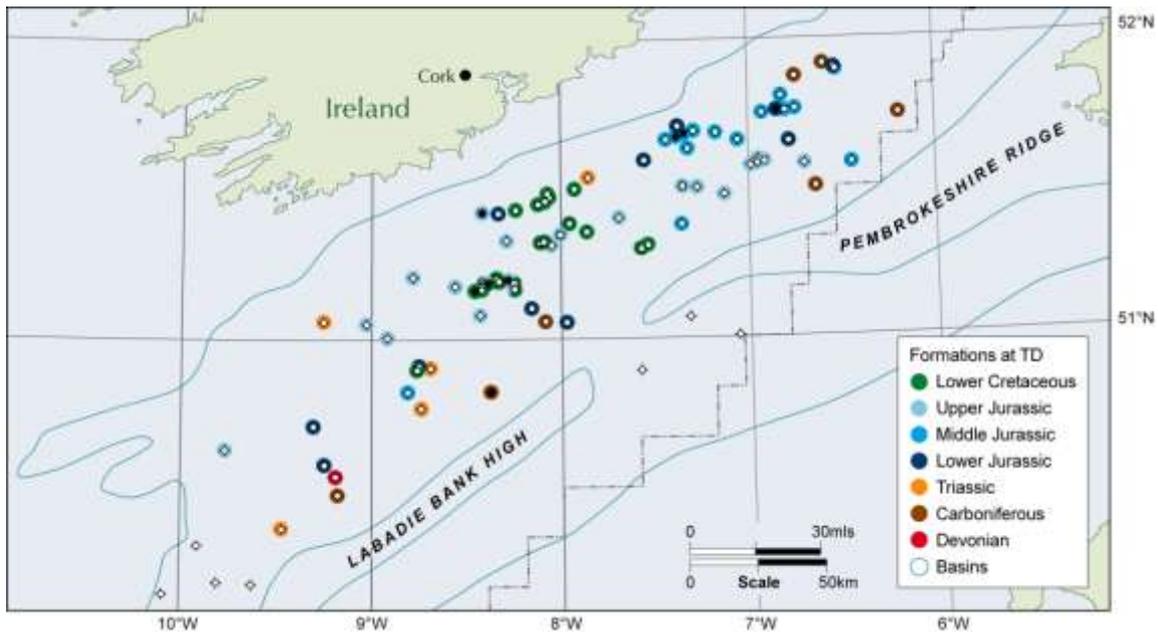
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North Celtic Sea Basin – the potential in deeper targets

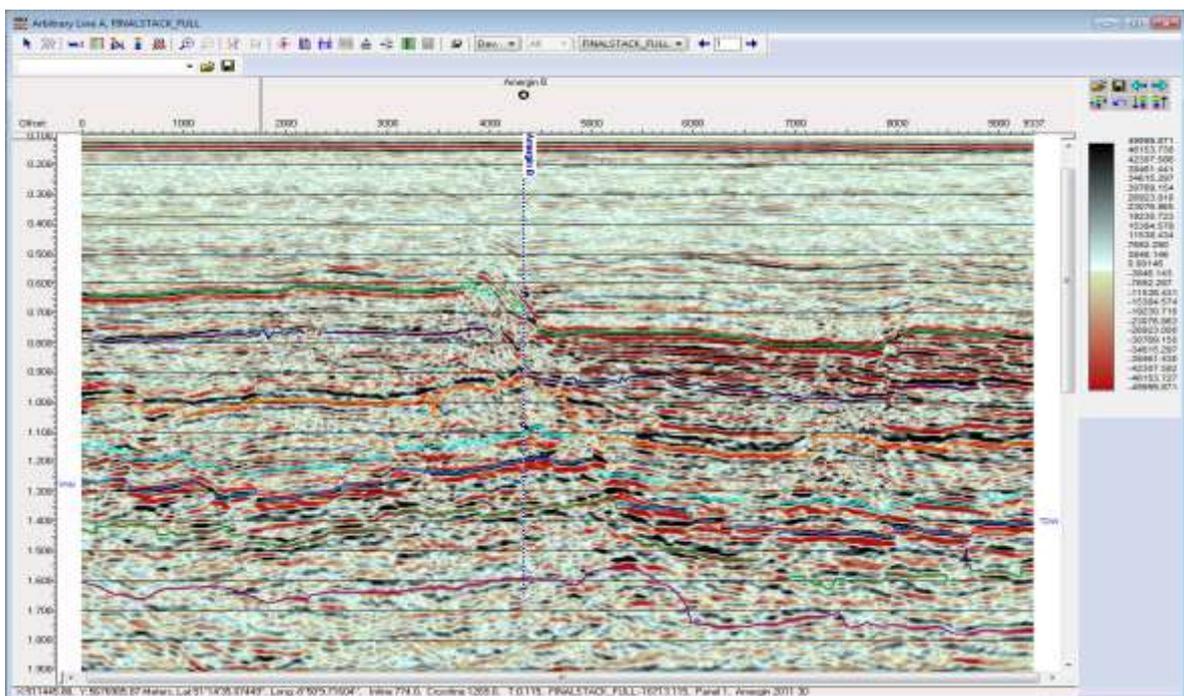
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More than 40 years of exploration of the North Celtic Sea Basin has seen more than 80 wells drilled. However, more detailed analysis of these wells shows that there has been a focus on drilling shallow inversion structures, with only a few wells penetrating the full Jurassic section and reaching total depth below 10,000ft. Recent improvements in seismic imaging have clarified the presence of rifted Jurassic fault-blocks and these form attractive exploration targets.



TD Formation of wells in the NCSB



Seismic Line through Amergin Tilted Fault Block

Chemostratigraphic characterisation of the Jurassic and Cretaceous successions of the Porcupine Basin

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The Porcupine Basin, located offshore Western Ireland has a proven petroleum system, however, reservoir quality is strongly influenced by sediment provenance. A lack of well control, coupled with marked lateral variations and multiple sediment input points, all contribute to difficulties in correlating and mapping more prolific areas.

A pilot chemostratigraphic study has been conducted on the Jurassic and Cretaceous successions encountered in four exploration wells from the Porcupine Basin, with a view of correlating and identifying sediment provenances active during the late Mesozoic.

Chemostratigraphy involves the characterisation and correlation of sedimentary strata using up-sequence variations in their inorganic geochemistry and can be used to highlight variations in clay minerals, heavy minerals and lithic components, which in turn, can provide information on changes in palaeoclimate and palaeoenvironment, sediment provenance and any diagenesis or weathering that the sediments may have been subjected to. The geochemical data acquired within this study allowed for the construction of an independent, inter-well correlation across the Porcupine Basin. This correlation is based on the identification of ten chemostratigraphic packages, which can be identified as follows:

P1, P2 and P3: Late Jurassic and characterised by high Ti/Al, Ti/Fe and Mn/Ca values. P2 represents a thin, but readily identifiable package which can be correlated across the wells by its high K/Rb values.

P4: Late Jurassic / Early Cretaceous package defined by low K/Rb and Ti/Fe values coupled with high Rb/Y values.

P5 and P6: Early Cretaceous packages characterised by upwards increases in Ti/Fe and Ti/Al values associated with increased clay content. P6 can be further defined by high Ti/Fe values and low K/Rb values.

P7 and P8: Early / Late Cretaceous calcareous claystones grading to chalk successions characterised by high Si/Zr and K/Rb values. In addition, the calcareous claystones of P7 have elevated Fe/Al values.

P9: Palaeocene package characterised by high Cr and Ti values associated with increased volcanic activity, coupled with high Ti/Nb and Mn/Ca values.

P10: Palaeocene / Eocene successions characterised by lower Ti/Fe values than the sequences below.

The establishment of a chemostratigraphic correlation not only provides independent stratigraphic control, but importantly, supplies a framework on which to constrain the main sandstone bodies encountered. These were then targeted for further provenance assessment, namely, U/Pb zircon dating via LA-ICP-MS. The zircon populations acquired, in conjunction with the sandstone geochemistry, allowed for the assessment of any provenance changes occurring throughout the well sections.

Typically, petrographic data are used as a 'first tier' technique for the recognition of provenance variations. These are then investigated further by traditional heavy mineral analysis, and subsequent grain chemistry and grain isotopic approaches; these forming third and fourth tier techniques. However, bulk mineralogy and certain components of heavy mineral assemblages can suffer dissolution via burial diagenesis, which can compromise the provenance signals. Furthermore, heavy mineral populations can be modified by the drilling process, whilst the relative proportions of heavy mineral species can also vary between core and cuttings material, hampering the integration of data from the limited cored sections and the more readily available cuttings intervals. As a result, more reliable provenance information can often be gathered from grain based techniques. Zircons are chemically and physically stable heavy minerals and therefore are common in sandstone heavy mineral suites. Zircon U/Pb geochronological studies typically focus on the diversity of zircon grain ages as a means to identify possible changes in source terrain. The acquisition of zircon age dates by LA-ICP-MS enables the approach to be used as a second tier technique, as large numbers of grains can be quickly analysed per sample, resulting in the acquisition of robust assemblages.

At present, only six samples have been subject to zircon age dating, with a view of assessing both the overall recovery and the provenance potential of the data. Overall zircon recovery was adequate enough to ensure viable populations were acquired, and as such, one sample has been processed from the Eocene, three from the Cretaceous and two from the Middle Jurassic aged strata.

The zircon age spectra of the Jurassic sandstones are characterised by strong Proterozoic and early Phanerozoic assemblages, with only few Archean grains being recorded. The Cretaceous sandstones possess a similar zircon spectrum, although in contrast, a clear Caledonian peak is developed and overall, the proportion of Meso- and Palaeoproterozoic grains are higher, whilst a minor increase in Archean grains is also noted. The Eocene sandstone sample has a similar spectrum to the Cretaceous assemblage but is differentiated by an increase in Archean grains.

Albeit small, the current zircon age dataset demonstrates a degree of variation in zircon assemblages that provide impetus to undertake further analyses, in conjunction with grain textural, heavy mineral and grain chemistry studies, which can be used to establish a comprehensive characterisation of provenance changes within the Porcupine Basin and surrounding source areas.

Going deeper - Jurassic and Triassic potential of the Irish Atlantic margin

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Recent focus on the Irish Atlantic Margin has been on the Cretaceous petroleum systems. Cretaceous reservoirs and possibly source rocks have been observed in the recent Dunquin well, drilled by Exxon, and Cretaceous clastic plays have been targeted on the margins by Kosmos Energy. These plays have been presented by Physicalgeo in the past at the Atlantic Margin and Conjugate Margin conferences.

Improved seismic imaging, through new acquisition and modern broadband reprocessing is now revealing further prospectivity in the pre-Cretaceous section. Also, hydrocarbon discoveries on the conjugate Canadian margin, made by Statoil, in Jurassic and Triassic reservoirs, have further focused attention in these more traditional play fairways.

The Jurassic section on the Irish Atlantic Margin has proven, excellent quality reservoirs in Lower Jurassic shoreface sandstones, Middle Jurassic fluvio-deltaic facies and Upper Jurassic submarine fan sandstones. Wells have encountered hydrocarbons in all cases. Triassic reservoirs are

dominated by the Sherwood sandstone continental reservoir, a thick, high net:gross sandstone section, widely present across the region.

These reservoirs can be charged by Upper and Middle Jurassic marine source rocks, as seen at Dooish, Connemara and Spanish Point. The Lower Jurassic Pliensbachian source rock is the likely source for the Bandon and 62/7-1 discoveries. Triassic reservoirs have also been sourced from the underlying Carboniferous coals in the Corrib field.

Improved seismic imaging has revealed prospective structures in these proven systems. However, prospectivity has also been identified where older reservoirs can be charged by younger source rocks, such as Triassic Sherwood traps being sourced by Jurassic or even Cretaceous source rocks.

Newfoundland and Labrador Exploration update: New discoveries, new geosciences data and new basins

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The Canadian province of Newfoundland and Labrador (NL) is currently experiencing its highest levels of exploration and development activity and its oil production, though declining, is still high. In 2011, NL production represented 10% of Canada's total oil production, 32.5% of Canada's conventional light oil and more than 85% of Atlantic Canada petroleum output. Development work is proceeding on the Hibernia Southern Extension and White Rose Growth projects and the sanction of the Hebron Project is scheduled to occur in Q1 of 2014. The most recent exploration activities offshore Newfoundland includes drilling, acquisition of large 2D and 3D seismic surveys and satellite seep survey studies carried out in the Mesozoic Labrador, Jeanne d'Arc, Flemish Pass and Laurentian basins and in the Paleozoic Anticosti and Magdalen basins off Western Newfoundland.

Five exploration wells (Margaree, White Rose H-70, Federation, Harpoon and Bay du Nord) were drilled this year in three basins. The Flemish Pass Basin has delivered three new oil discoveries in as many years. In January 2011, a significant oil discovery licence was awarded by C-NLOPB to Statoil and Husky for the Mizzen O-16 well. This well tested 3774 bopd of 21-22° API oil from a 25 m section of porous and permeable sandstone. In June 2013, Statoil announced a light oil discovery at the Harpoon O-85 well approximately 10 km southeast of the Mizzen discovery. This was immediately followed up with the announcement of another discovery at the Bay du Nord C-72 well in August, 2013. Bay du Nord was announced as a 300-600 mmbbls recoverable light oil (34° API) accumulation, while Harpoon's resources remain to be evaluated. All these recent discoveries are located on the NL's "Late Jurassic source rock superhighway" that projects across the Atlantic into the Porcupine and Rockall basins off western Ireland. With three successful exploration wells and a number of undrilled prospects remaining, Flemish Pass Basin is likely to be the next oil producing area offshore Newfoundland. If geochemical common traits are found, the Flemish Pass discoveries may have important implications for the Porcupine Basin off Ireland. The recently completed Kinematic Plate Reconstruction of the North Atlantic, jointly funded by PIPCo and Nalcor, places the Porcupine and Flemish Pass basins in proximity to each other at the time of the Late Jurassic when prolific source rock were deposited in the basins of the North Atlantic. Geochemical studies are underway to determine the extent of the Kimmeridgian/Tithonian source rock "superhighway" that can now be traced from the proven areas of the Jeanne d'Arc and Flemish Pass basins towards the Porcupine, Rockall and Orphan basins.

A total of 4,312,042 ha (43,120 km²) are licensed by the C-NLOPB for offshore exploration in three main areas: Grand Banks and vicinity, Labrador Sea and Western Newfoundland. As of the fall of

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2013 there are 27 active Exploration Licences in the Grand Banks and vicinity distributed in five basins. The most recent C-NLOPB issued Call for Bids to be concluded in 2013 includes nine large parcels comprising a total of 2,409,020 hectares distributed in four regions of the NL offshore area situated in the Flemish Pass, Carson, Anticosti and Magdalen basins. The Carson Basin located near the oil proven Jeanne D'Arc and Flemish Pass basins presents a great opportunity for major oil discoveries.

In 2009, Nalcor Energy initiated an exploration strategy to better understand the frontier basins in the province's offshore through the acquisition of new geoscience data. The intent was to reduce exploration risk and stimulate more exploration activity. In 2010, a satellite seep survey was conducted by Astrium that indicated the presence of oil seeps in some unexpected areas, like the deep water off Labrador. In 2011, Nalcor partnered with the MKI consortium (TGS and PGS) to acquire a large, long-offset, broadband 2D seismic survey in the area off Labrador. Over 70% of this 22,000 km. survey area had no previous data coverage. The survey has extended the previously known basins into the slope and deepwater, has delineated three new deepwater basins and improved our understanding of the petroleum geology of Canadian Labrador margin.

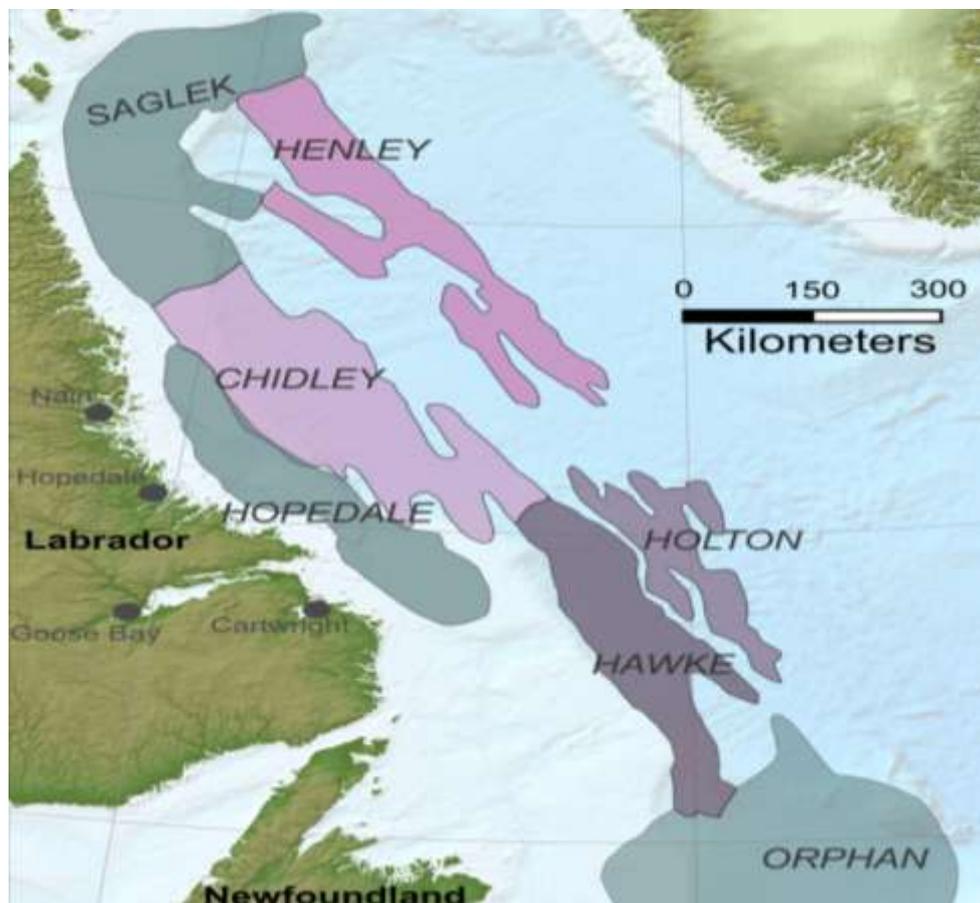


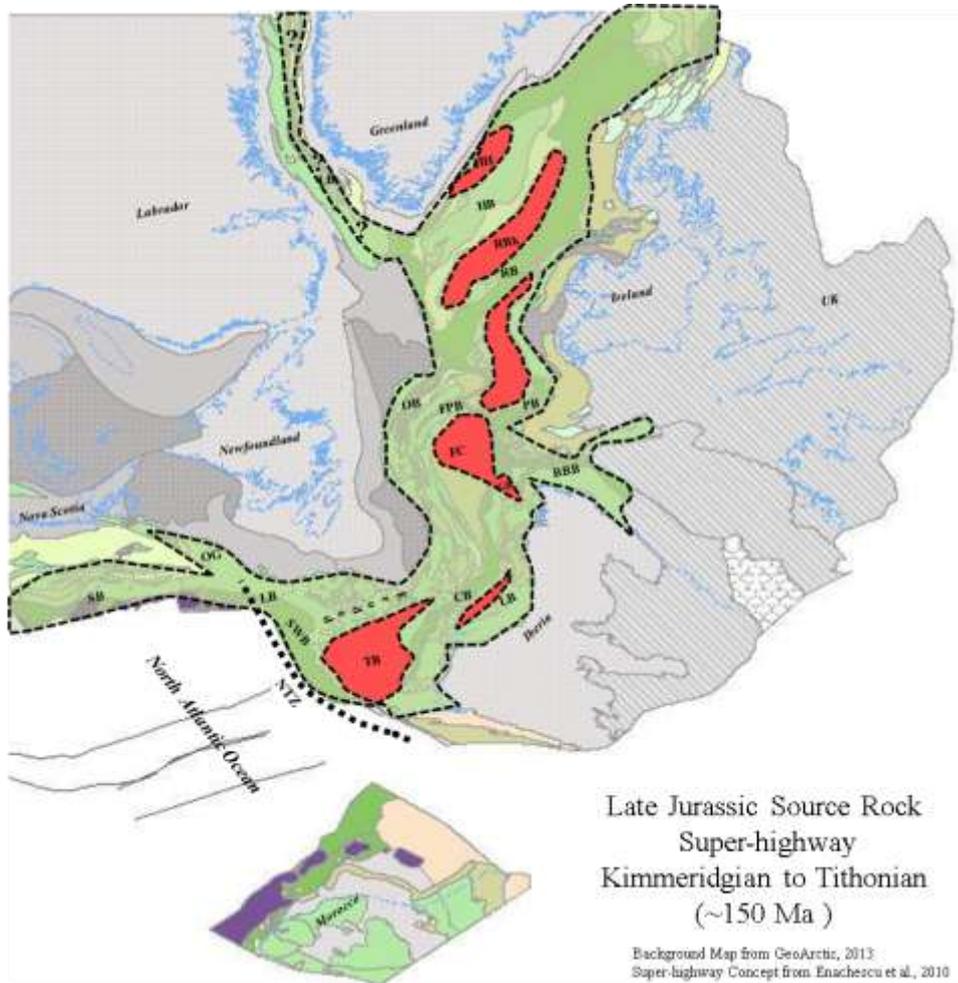
Figure 1: Offshore Labrador basins: Saglek, Hopedale, Hooke and the newly delineated Henley, Chidley and Holton

In 2012, the survey was extended south to the Orphan and Flemish Pass basins. By the end of this year, 50,000 km. of new regional seismic data will be shot and available for licensing. This dataset has provided a number of new insights and leads in this frontier region and has better imaged exciting undrilled prospects in the Flemish Pass Basin where Statoil recently announced their “high-impact” Bay du Nord light oil discovery. Early seismic AVO analysis on multiple seismic lines has revealed attributes that may be positive hydrocarbon indicators. They especially show interesting anomalies within basin floor fans that may be analogous to those off West Africa.

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Additional offshore Newfoundland and Labrador studies include regional pore pressure, rock physics and source rock studies, as well as, biostratigraphy and seabed core analyses. The finished reports will be made available on the Nalcor's website to any interested company.

All of this exploration and development activity in the region points to the potential of major increases in production and development in the years to come. Newfoundland and Labrador is on the threshold of an amazing new era for the petroleum industry.



UCD's new Petroleum Geoscience MSc Course

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After an 18-year break, the UCD School of Geological Sciences has re-launched a taught Masters programme in Petroleum Geoscience. The original very successful Masters in Petroleum Geology was set up and co-ordinated by Prof. Patrick Shannon, with strong support from industry including funding of a lectureship, guest lecturers for short courses and the provision of teaching and research data. Over a period of 13 years approximately 55 geoscientists from a wide range of countries were trained, many of whom are still working in senior positions in the industry and in geoscience institutions. Key to re-entering the MSc market has been recent funding for additional academic and support staff who will help deliver the course. This came thanks to a tranche of funding from Tullow Oil plc that will also cover external training in Tullow countries-of-operation and the hosting of visiting academics at UCD who will also link in to the MSc programme. There is strong demand for MSc

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places both globally and at home and it is also appropriate that Irish graduates have the opportunity to be trained here in Ireland rather than being forced to train abroad. The distinctive skill set of the Irish geoscience graduate is still something valued in the industry and the aim is to instil this in a new set of Masters graduates.

The new course builds on the wider experience and key research expertise of the various UCD groups now active in the petroleum geoscience field (primarily but not exclusively the Marine and Petroleum Geology Group, the Fault Analysis Group and the Geophysics Group). This will give the UCD course a distinctive flavour. Currently the School has particular strengths and a strong international presence in marine geology, deep-water and carbonate sedimentology, fault analysis, reservoir modelling, basin analysis and geophysical imaging, all of which will feed into the course. In addition, some specialist topics (petrophysics, well-site geology) will be taught by invited industry instructors. The School also has the benefit of in-house expertise in a wide range of field areas and hence is able to integrate significant and relevant field-based instruction into the course. This includes recent behind-outcrop boreholes and associated data in County Clare (see poster session). School investment in a dedicated teaching space has provided a modern learning environment and 'home' for course participants, including access to a personal seismic workstation and a full range of associated software for the duration of the course. An IT support specialist has also been appointed specifically to run the new network of workstations and to assist students with IT and software issues encountered during project work.

The course involves a full-time, one year 90-credit programme comprising two semesters of taught content and a three-month research project that can involve an industry placement. The first intake of 11 students commenced September 2013 with an overview module in Petroleum Systems and a week-long field course in Co. Clare. The remainder of the first semester has parallel modules dealing with seismic data acquisition and processing, depositional systems and sequence stratigraphy, basin analysis and structural geology. Semester 2 is dominated by a pair of 10 credit modules, one on exploration and appraisal and one dealing with production geoscience and reservoir modelling. Students will be introduced to a full suite of industry software including Kingdom Suite®, Petrel®, Genesis® and Traptester® in the course of practical and project work. In addition, spring-time field trips will examine the structural evolution of the Bristol Channel, the petroleum geology of the Wessex Basin, UK, and basin evolution and tectonics and sedimentation in the Spanish Pyrenees. In Semester 3, students will undertake a short research project tailored to their particular interests and where possible building on links with external companies (in some cases companies or government agencies who are funding/part-funding students on the course).

Success of the course will partly rely on an active partnership with industry both at home and abroad. We are extremely grateful to a number of companies who have already helped us. Clearly Tullow for making delivery of the course possible and for contributing to some of the modules, but also other companies for helping out with field trip costs and allowing access to practical datasets and to working cores and associated data. We hope that other companies can engage with us as we continue to develop the course and we are particularly keen to see offers of potential practical and project datasets and, where appropriate, summer internships. There is also scope to participate in our field courses and this provides a useful springboard for further interaction. As we start recruiting for our second intake in 2014, we are also keen to hear from companies who might fund or co-fund scholarships to allow those without access to funding to take the course. The aim is to grow our numbers to around 20 with a mix of Irish-based, European and International students.

Ocean Bottom Cable Seismic over the Corrib Gas Field: A first for Ireland

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Introduction

In 2012 and 2013 Shell E&P Ireland acquired an Ocean Bottom Cable (OBC) seismic survey over the Corrib Gas field. The Corrib Field is located in blocks 18/20 and 18/25, approximately 65 km off the northwest coast of County Mayo. The field extends over an area of 15 km² with water depths between 330 m and 370 m. The reservoir is the Triassic Sherwood Sandstone at approximately 3km depth. Figure 1 shows the location and a schematic cross section of the Corrib field.

The legacy seismic data are hampered by the presence of shallow and rugose near sea bed volcanics causing severe scattering of the seismic energy. In addition very strong multiples are created by the seabed and the hard layers within the shallow overburden.

In order to increase the understanding of the reservoir, a significant improvement over the legacy seismic quality is required. The best possible seismic data quality is essential to support a robust static and dynamic reservoir model with which to manage the field.

After an extensive survey design phase, OBC seismic was selected as the preferred geophysical solution.

The paper will present how the survey was acquired and show the first preliminary results obtained from the OBC which, at this intermediate stage of processing, shows a significant improvement when compared with the legacy seismic data.

Ocean Bottom Cable (OBC) acquisition

OBC seismic has various advantages compared with conventional towed streamer acquisition:

1. Dual sensor recording enables enhanced multiple suppression.
2. The recording of very low frequencies, which are essential in order to penetrate through the highly reflective and absorbing shallow overburden. These are also essential for fault imaging.
3. It enables efficient acquisition of wide azimuth data. This will increase the signal/noise ratio and further attenuate persistent multiples.

The main objectives of the OBC survey over the Corrib field were to improve the imaging of the top reservoir and improve the understanding of the fault patterns.

For the Corrib OBC survey a parallel acquisition template was selected. The basic acquisition template and acquisition parameters are shown in Figure 2. A total of 42 receiver line positions were deployed resulting in a subsurface coverage of 200 km².

Initial results

The data processing is currently ongoing, but the initial results look promising.

Figure 3 shows a comparison between the legacy towed streamer data and the preliminary OBC results. Note that only the P-wave data has been processed. On the OBC data the top reservoir is now clearly imaged, whilst this pick is ambiguous on the legacy data. In addition the fault definition in the OBC data has been improved. This improvement is partly due to the higher fidelity low frequency content of the OBC data as well as the acquisition process itself. Also note the improved multiple attenuation that has been achieved due to both the dual sensor recording as well as the wide azimuthal acquisition.

Conclusion

The acquisition of an OBC data set over the Corrib Field has proven successful in substantially improving imaging at the reservoir level in a geophysically challenging data area.

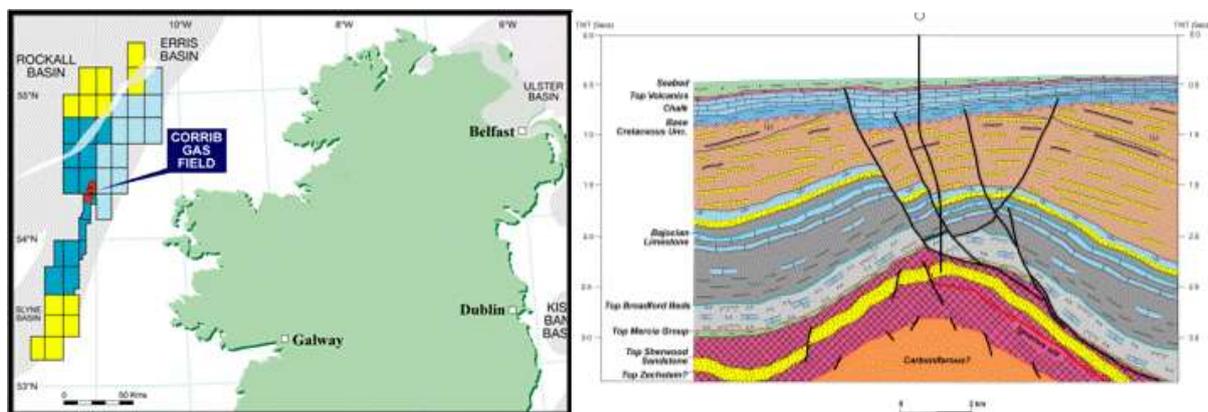


Figure 1: Location of the Corrib Gas field and a schematic cross section through the Corrib Field.

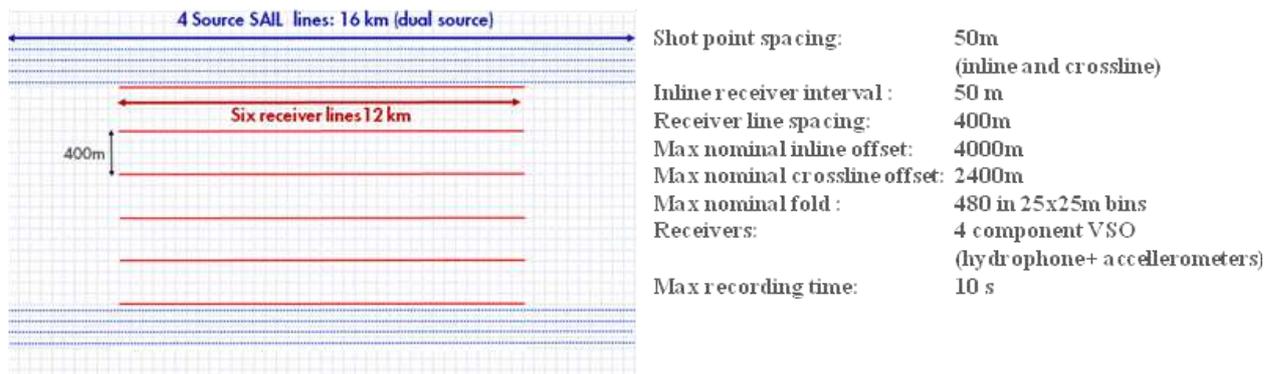


Figure 2: The OBC acquisition parameters. Note that a parallel shooting template was used. The shotlines were shot parallel to the receiver lines. A maximum nominal fold of 480 was achieved.

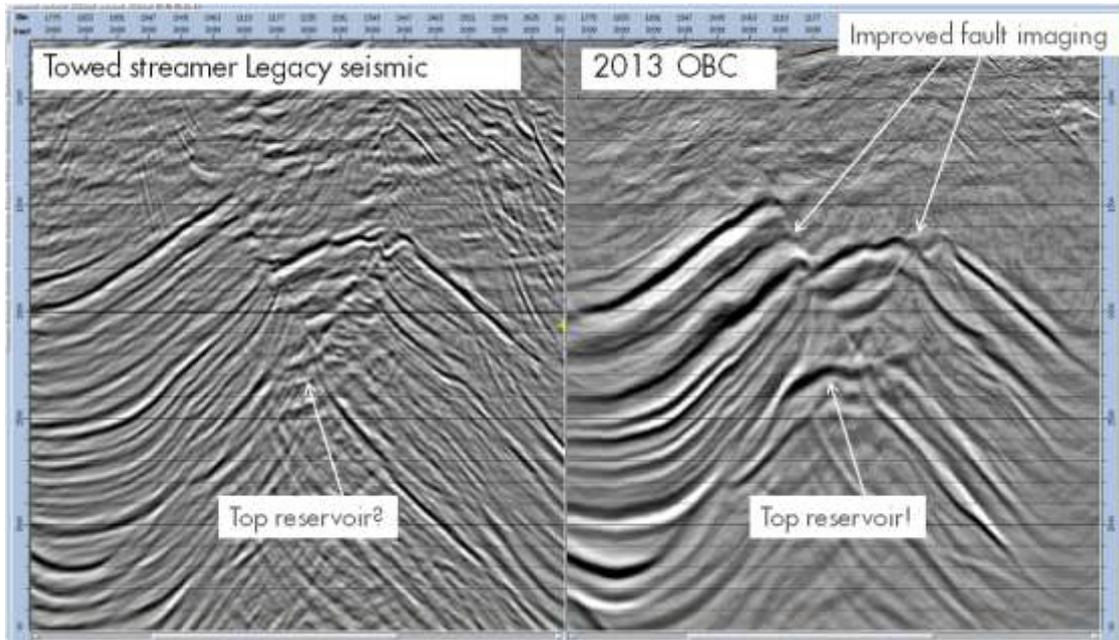


Figure 3: Section comparing the legacy seismic data with the new OBC data after Pre Stack depth migration. The reservoir is clearly imaged and fault imaging has improved significantly.

Towed Streamer Electromagnetics: “Resistivity in Context” with reference to recent survey in Fastnet Basin

Anderson, C.¹

¹PGS

Resistivity in Context – The concept

Discoveries are becoming less obvious and fewer large fields are being found. Adding resistivity information to seismic can highlight prospective areas that may have been overlooked. As a major seismic company we view the insight gained from the combined datasets as having the significant value. Structural interpretation is supplied from the seismic data, and resistivity values from the EM system. Both technologies seek to deliver risk mitigation in the pursuit of oil and gas discoveries; the high-level value proposition is the same in each case.

Towed Streamer Electromagnetic system configuration and development milestones

Figure 1 shows the Towed Streamer EM configuration, it looks very similar to a towed streamer seismic layout. The degree to which a seismic vessel needs to be adapted to operate the EM system is minimal therefore specialised vessels are not required. The Towed Streamer Electromagnetic system deploys a receiver cable at up to 100m depth and a powerful horizontal dipole source at 10m depth. A specially coded broadband source function propagates an EM field which penetrates the earth. The highly sensitive receiver electrodes housed in the streamer detect the fluctuations in the field from which subsurface resistive anomalies can be derived.

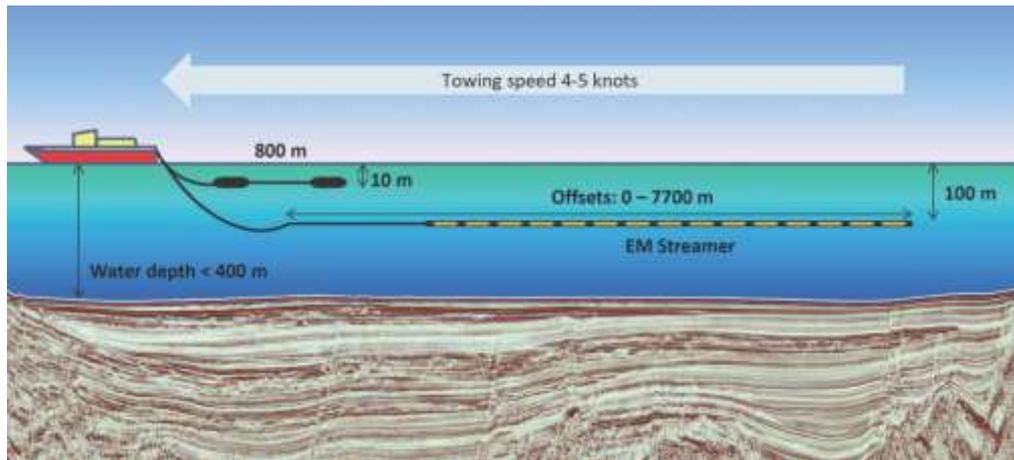


Figure 1: Towed streamer EM System configuration

Recent Surveys

Most recently the system was deployed for a month-long project off Southern Ireland in the Fastnet basin. Of the 3500 km of seismic lines acquired 2800 km were acquired with simultaneous EM data. The entire project achieved production rates similar to those expected of a standalone seismic survey. No impact on the project's time-line was caused by the simultaneous deployment of the EM system. With a proven petroleum system in place and already producing, the latest survey provides a fresh approach to the area with the latest technologies available for regional exploration. Further to this a set of regional lines have also been acquired in the Barents Sea during late September.

Applications

Detection and delineation: We show examples from 2012 where two known reservoirs in the North Viking Graben area of the UK North Sea have been surveyed with the Towed streamer EM system. The detection of resistive anomalies is discussed as is the combination of the EM results with a priori seismic data. We go on to show the results of a data-drive 2.5D EM inversion clearly delineating the reservoir anomalies above a resistive basement.

3D mapping: Figure 2 shows an example of a 3D inverted dataset also combined with Seismic data. The interpretation can benefit from treating the resistivity information as an additional attribute and can be significant in determining the limits of hydrocarbon-charged zones.

Quantitative interpretation: A work in progress is to create a workflow that can benefit from both Seismic and EM data to improve quantitative interpretation. We show examples of data from the Peon reservoir that has been used for such a project by our clients.

Efficiency and value

We present production figures for the Fastnet survey and for the data acquired in 2012. We also present a simple model for 3D coverage and demonstrate the economy of scale that can be achieved with towed streamer acquisition.

Three Key developments

S/N – noise: We present plots and refer to previous publications that demonstrate the noise characteristics of the system are suitable for the purpose and also demonstrate effective noise reduction techniques.

Anisotropy: We show that contrary widely held opinion the inline electric field is sensitive to electrical anisotropy. Both horizontal and vertical resistivity can be recovered from data in up to 600m water depth.

Synthetic Aperture Processing: We refer to previous publications and show an example of sensitivity enhancement by using synthetic aperture processing. This is key to future development specifically in the area of improved sensitivity to smaller or deeper targets.

Simultaneous Seismic and EM configuration

We show a diagrammatic representation of the dual EM and Seismic acquisition system and explain some of the operational procedures.

Summary

Towed Streamer EM development has been a major R&D focus within PGS since 2004, complemented by the acquisition of MTEM Ltd. in 2007. Successful field trials with prototype systems were completed over the Peon and Troll fields (North Sea) during 2009, 2010 and 2011. During October 2012 the first client funded surveys were acquired in the UK and Norway, paving the way for commercial operations to be commissioned during 2013. This new approach to Controlled Source Electromagnetics (CSEM) provides significant benefits.

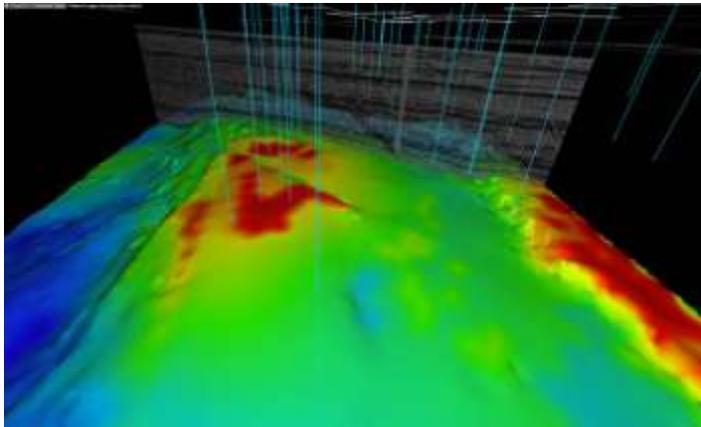


Figure 2: Horizon Plot of Troll West Oil Province and Troll West Gas province 3D Inversion.

A new demultiple workflow to attenuate all order free surface & pegleg multiples – eSRME/ePEG examples from Barryroe, North Celtic Sea Basin

Deo, J.¹, Loginov, A.², Gofman, P.², Clifford, S.¹, Byrne, K.³

¹ *Seismic Image Processing*

² *Deco Geophysical*

³ *Providence Resources Plc*

Summary

The abstract considers some practical applications of multiples suppressions techniques in shallow water. Each individual case requires an individual approach. We offer several strategies for modeling and subtraction of multiples that are effective in shallow water. These strategies include combining of fully data driven multiples (eSRME) and model-based multiple modeling (ePEG). The application in this paper is related to the high velocity Upper Cretaceous Chalk at seabed in the North Celtic Sea Basin which has hampered geophysical imaging in the past. Attenuation of high frequency component at the seabed along with strong seabed and peg-leg multiples has yielded poor signal to noise on previous surveys but new demultiple algorithms developed by SIP and Deco are removing more multiple from the datasets without destroying the primary data. This gives gathers with higher signal to noise ratio and which yield a cleaner and accurate migration. Data examples from recent

test reprocessing of the Barryroe 3D survey will be presented to demonstrate the uplift which can be achieved.

Introduction

The problem of multiples suppression in shallow water is highly relevant at Barryroe due to the presence of shallow water layer and a thin high velocity Upper Cretaceous Chalk layer which leads to a powerful and complex field of multiple waves significantly complicating the interpretation of seismic data. The problem of multiples suppression may be difficult due to the complicated geological structure of the study region and the lack of near offsets in the input data. Nevertheless, our experience shows that combining different approaches of multiples field modeling and subtraction can provide effective demultiple.

Basic schemes of multiples wave removal

A two-step approach of the multiples suppression is considered:

1. Modeling multiples field
2. Subtracting model from the observed wavefield

There are several methods for modeling multiples but we work with the approach suggested by Berryhill and Kim, 1986. This method (we will use term ePEG for it in this paper) takes sea-floor topography into account and so requires a precise water-bottom profile. We are using an integral method for generating synthetic water bottom reflection based on Huygens principle.

For subtraction we can formulate the basic requirements which correspond for a good operator as suggested by Finikov and Poluboyarinov 2007.

1. Must be non-stationary, calculated in different time windows, as well as be able to accommodate polynomial amplitude distortions within a single window.
2. There should be a multi-channel and allow the simultaneous adaptive subtraction of two or more models.
3. To be averaged over a sufficiently large number of traces in a sliding window in the common offset order, which suits for additional primary energy preservation proof by averaging out the undesirable multiples-to-primaries adaptation.

The practical implementation of SIP/DECO iterative SRME methods (eSRME) is based on building models separately for eSRME and ePEG 1st order, 2nd order, 3rd order etc.... All the multiple models can be made and then combined as a complex objective function to minimise the multiple wave patterns using a high level adaptive subtraction with operator properties as defined above. We summarise the process as follows with an example from the Barryroe 3D survey.

Workflow:

- Selecting the strategy of SRME iterations
- Testing pre-processing parameters
- Adaptive subtraction design
- Control over primaries preservation through migrated image comparison

SRME Multiple models

It is possible to increase the accuracy of multiples model iteratively. Subsequent iterations are computed by convolving two different datasets: "input" dataset and "operator".

The "input dataset" is raw seismic data (containing primaries and multiples), "operator" is the data after previous demultiple iteration (acting as an estimate of primaries). As a result we get a more accurate model in the case of a shallow water "input dataset" being the 1st iteration of multiples

modeling, “operator” is the data after previous demultiple iteration. As a result 2nd order multiples are modelled separately. Other operator variations are possible providing separate models of multiples of the certain type. This strategy extended to cover multiples in different domains. The example from the Barryroe 3D survey required four-different models and initial raw stack results are shown in Figure 1.

Example: (Data courtesy of Providence Resources)



eSRME/ePEG applied on BarryRoe

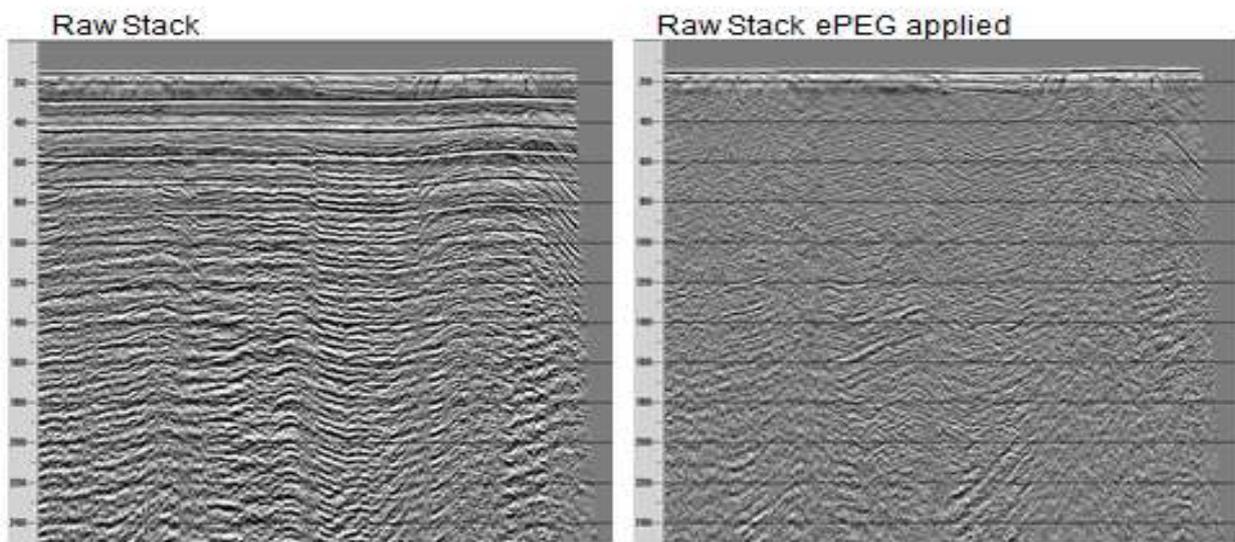


Figure 1: The chalk sea bed reflector is generating a sequence of multiples of greater amplitude than the Underlying primary. Previous attempts were not successful. This is an ongoing project.

Unlocking the potential of the Early Cretaceous petroleum system in the Mizzen Basin using Fastnet's newly acquired 3D seismic in Mizzen and "Deep Kinsale"

Griffiths, P.¹

¹ *Fastnet Oil & Gas Plc*

The Mizzen Basin is an informal term to differentiate the southwest extension of the North Celtic Sea Basin from the Fastnet Basin. It covers an area of at least 4,000 sq. km. and represents one of the least explored areas of the Irish Offshore. Esso/Marathon drilled the only well in the basin in 1975, prior to the development of the giant Hibernia oil field in the Jeanne D'Arc Basin offshore Eastern Canada and the Seven Heads Oil Field (later to be re-named "Barryroe" and successfully re-appraised in 2011/12) in the late 1970's. Despite encountering good oil shows in the 56/12-1 well in thick early Cretaceous reservoir sequences, no further exploration was carried out in the basin aside from 2D seismic surveys in 1983, 1987 and 1993 by different companies. Esso/Marathon were targeting the Lower Jurassic and Triassic in the 56/12-1 well in an analogous setting to the extensive drilling programme being carried out in the Fastnet Basin at the same time. The Early Cretaceous potential of the Mizzen Basin was never followed up, probably due to the waxy nature of the discovered oil at Seven Heads.

The development of the Hibernia oil field and "running room" created by follow-up discoveries, Ben Nevis, Terra Nova, White Rose, South Tempest and Nautilus amongst others, has been superseded by discoveries in the Flemish Pass Basin including Harpoon, Mizzen (200 mm BO recoverable) and the most recent Statoil discovery made in 2013 which is estimated to be in the range 300 – 600 mm BO recoverable and ranks as Statoil's 12th largest discovery since 2010. All the major discoveries occur in predominantly faulted traps within a proven Late Jurassic and Early Cretaceous Petroleum System. The extension of the Jeanne D'Arc trend of discoveries into the Flemish Pass Basin confirms the regional significance of this petroleum system. The successful "Barryroe" re-appraisal of the Seven Heads oil field supports this trend continuing into the North Celtic Sea Basin, albeit over-printed by later Tertiary inversion and complicated by a change in source rock facies to non-marine lacustrine, which generates a light but waxy oil. This reflects restricted marine communication with the Flemish Pass/Jeanne D'Arc Basins in the latest Jurassic and earliest Cretaceous caused by basin sills/transfer faults developed in the area of the Fastnet High at the edge of the future development of the North Atlantic Ocean.

Critically the Mizzen Basin is located within the Late Jurassic and Early Cretaceous petroleum system fairway in an intermediate position between the marine source facies of Eastern Canada and the non-marine source facies of the North Celtic Sea Basin. Although clearly forming part of the North Celtic Sea inversion province, the pre-inversion history of the basin is anticipated to be analogous to the Jeanne D'Arc, Flemish Pass and North Celtic Sea Basins. During the early Cretaceous the Mizzen Basin was connected westwards into the South Porcupine Basin and ultimately to the offshore Eastern Canadian basins, as evidenced by the progressive development of thick marine shales south-westwards along the axis of the North Celtic Sea Basin and in 56/12-1. Subsequent uplift related to the development of the North Atlantic may have removed locally the early Cretaceous sedimentary record. The Late Jurassic and Early Cretaceous history of sedimentation and structural development of the Mizzen Basin is important for assessing the location and potential development of deep-water turbidite fans in the South Porcupine Basin, particularly in respect of mineralogical composition, diagenetic history and source terrain; potential bed thickness; intraformational seal development; and quality of and maturation history of potential; Late Jurassic and earliest Cretaceous source rocks. The Mizzen is a potential shallow water analogue for alluvial and deeper shelf fan development in the early Cretaceous and potentially may at one time have fed clastic debris into the South Porcupine Basin.

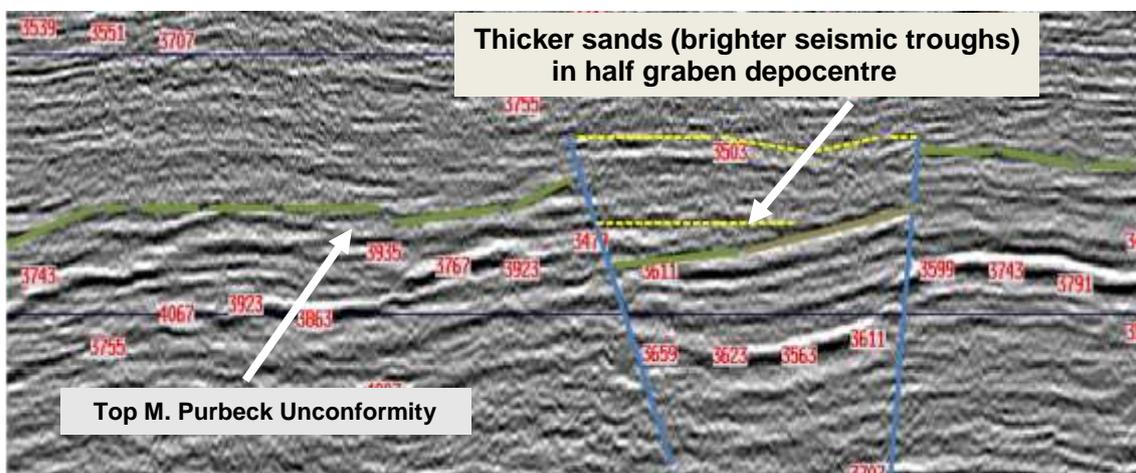
The Jeanne D'Arc and Flemish Pass Basins are characterised by hydrocarbon trapping styles that can also be recognised in the Mizzen Basin and in "Deep Kinsale". Intra-Berriasian and Pre(?) - Barremian Unconformities, marking a period of waning extensional fault activity initiated at the intra-Berriasian unconformity, can be correlated within the offshore Eastern Canada, North Celtic Sea and Mizzen Basins. Early hydrocarbon traps in Hibernia were associated with rollover anticlines into listric faults during this period of extensional faulting, whilst tilted fault block traps developed later along intra-basin transfer faults related to gentle graben warping. Similar trap styles can be identified in the Mizzen Basin and in Deep Kinsale, where it can be shown that these traps formed robust closures prior to Miocene basin inversion and were capable of being charged prior to the switching off of oil expulsion contemporaneous with exhumation during basin inversion.

Fluvial-deltaic reservoir development in Hibernia occurred during the Berriasian to Valanginian, equivalent to the Upper Purbeck and Lower Wealden oil-bearing reservoirs of the North Celtic Sea and Mizzen Basins. Source rock development occurred in the Kimmeridgian, prior to the development of a Late Kimmeridgian to early Berriasian unconformity. The equivalent source rocks in the North Celtic Sea and Mizzen are predominantly younger, from very latest Kimmeridgian to earliest Berriasian in age (mostly Lower and Middle Purbeck lacustrine/lagoonal shales).

In the Mizzen Basin and at Deep Kinsale the preliminary results, which reflects work in progress, of Fastnet's new 3D seismic data have enabled the Jurassic-Cretaceous boundary to be better defined based on seismic sequence stratigraphy correlated to well penetrations and seismic sequence geometries. This overrides and supersedes the previously confusing bio stratigraphic divisions of "Purbeck" and "Lower Wealden" based principally on long-ranging, facies-controlled ostracod assemblages. This facilitates a better understanding of the individual elements of the regional petroleum system as they apply specifically to the Mizzen Basin and Deep Kinsale.

A key unconformity is recognised from the 3D seismic within the Berriasian which is approximately equivalent to the top of the "Middle Purbeck". The principal source rock interval lies below this in the Lower Purbeck (latest Jurassic) to lowermost Cretaceous ("Middle Purbeck" as confirmed by 49/19-1) and reflects global anoxic events. Berriasian-age faults cut the source rocks to provide the conduits for later migration into the overlying early Cretaceous reservoir units.

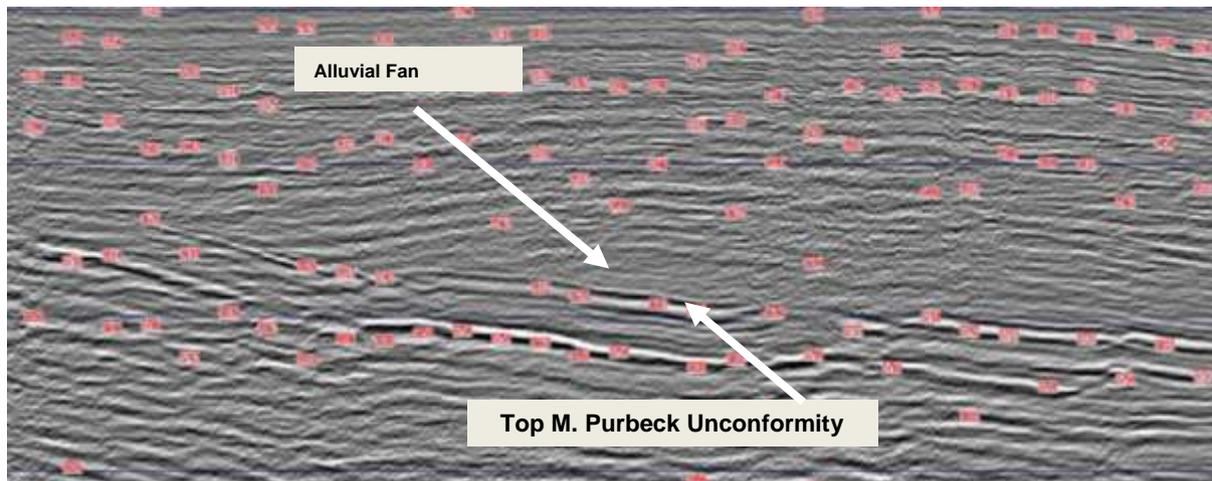
Examples from the 3D seismic volume show that the top of the "Middle Purbeck" is locally incised by an influx of down-cutting fluvial-deltaic sands infilling fault block topography over-printed on broadly southerly dipping half grabens formed during extension at the Berriasian Unconformity. Thicker, laterally more continuous sands are developed immediately above the unconformity as a result of uplift of clastic entry points into the developing graben systems combined with a global fall in earliest Cretaceous sea level. Confined channel systems with thicker sands and higher net to gross ratios are predicted where syn-depositional faulting focused river systems (see below).



Preliminary Pre-Stack Migration "Deep Kinsale" Inline – Velocity Picking QC Section

Thinner reservoir sands and lower net to gross ratios are anticipated higher in the sequence as the effect of faulting wanes. Potential alluvial fan geometries, differential compaction features and anastomosing channel systems can be recognised in the 3D seismic volume. Upward-fining cyclic sedimentation is evident from well data and is supported by seismic sequence stratigraphy, reflecting delicate balances between fault-controlled subsidence and sea level fluctuations. This is significant with respect to the potential development of persistent intraformational seals and explains the complicated distribution of oil reservoirs in the Hibernia Field and in the Seven Heads (Barryroe) oil field. The tops of thicker sand sequences are usually defined by seismic troughs as the sands are generally harder than the enveloping shales.

The importance of the new 3D seismic data from a petroleum exploration perspective is that the data demonstrate for the first time the potential continuity of sand bodies, particularly within the larger alluvial fan systems (see below) for which there are a number of world-wide development analogues: Brae and Buzzard in the North Sea, for example. The data provide some basis for reservoir mapping to help de-risk future development planning. It is also clear that the 3D seismic has highlighted areas above the Berriasian unconformity with potential for thicker sands that have not to date been tested by the sparse database of historical wells. It is also evident that there are very large areas in the order of tens of square kilometres at the reservoir objective levels that lack any degree of fault compartmentalisation.



Preliminary Pre-Stack Migration "Deep Kinsale" Inline – Velocity Picking QC Section

The new 3D seismic database is facilitating reconstruction of pre-inversion trap geometries that is helping to define robust older structural and structural/stratigraphic traps that existed at the time of peak expulsion of hydrocarbons (at the end of the Cretaceous and again in the Eocene/early Oligocene) from the latest Jurassic and earliest Cretaceous source rocks. The developing seismic sequence stratigraphy is also helping to assess and de-risk topseal, whilst clearer fault definition is helping to define reservoir "sweet-spots" and the efficiency of migration pathways.

Within the area of the active and proven Late Jurassic – Early Cretaceous petroleum system fairway, Fastnet is developing and maturing multiple prospects for drilling comprising: four-way dip closures; tilted fault blocks; stratigraphic pinch-outs; fan geometries; and combination structural/stratigraphic traps. Focus is on developing the tools necessary to predict the areas of stacked reservoir development to ensure high productivity conventional wells capable of draining significant oil resources.

Prospects 2 Go (Serica Energy)

Boyne prospect drilling opportunity, FEL 1/06, Slyne Basin, Atlantic Ireland

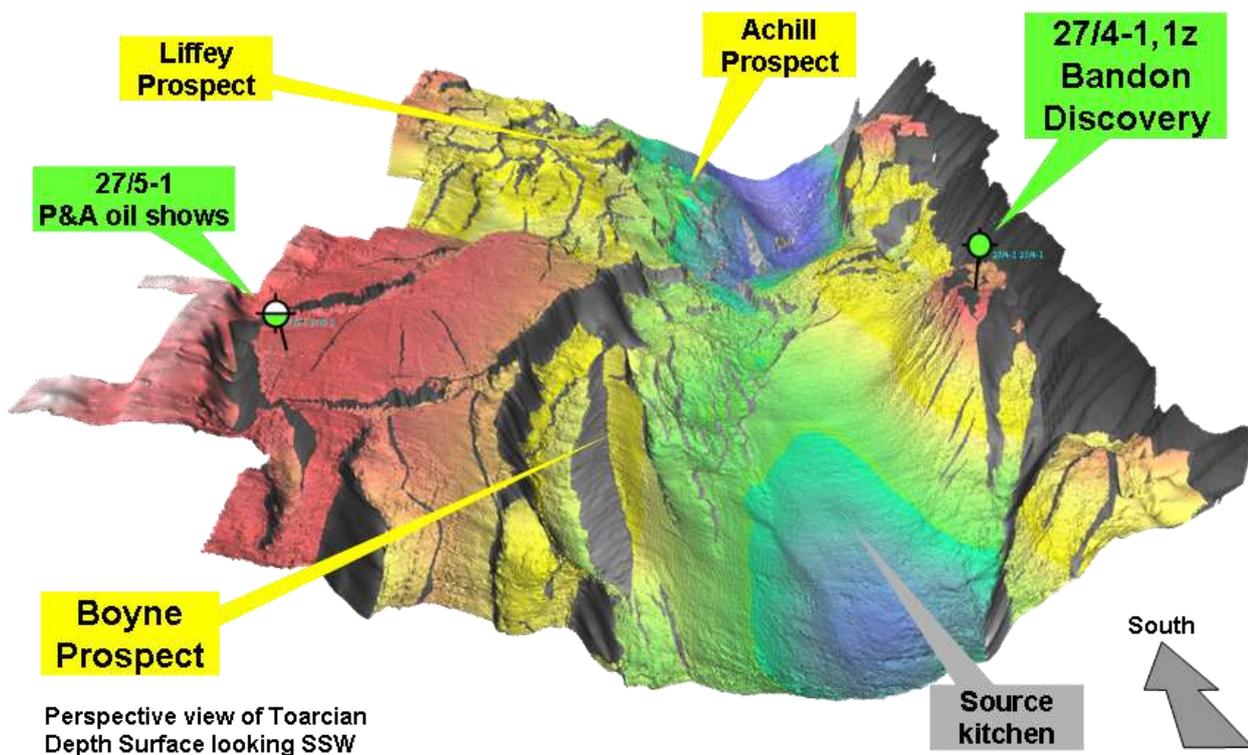
Pritchard, G.¹

¹ Serica Energy, 52 George Street, London, W1U 7EA

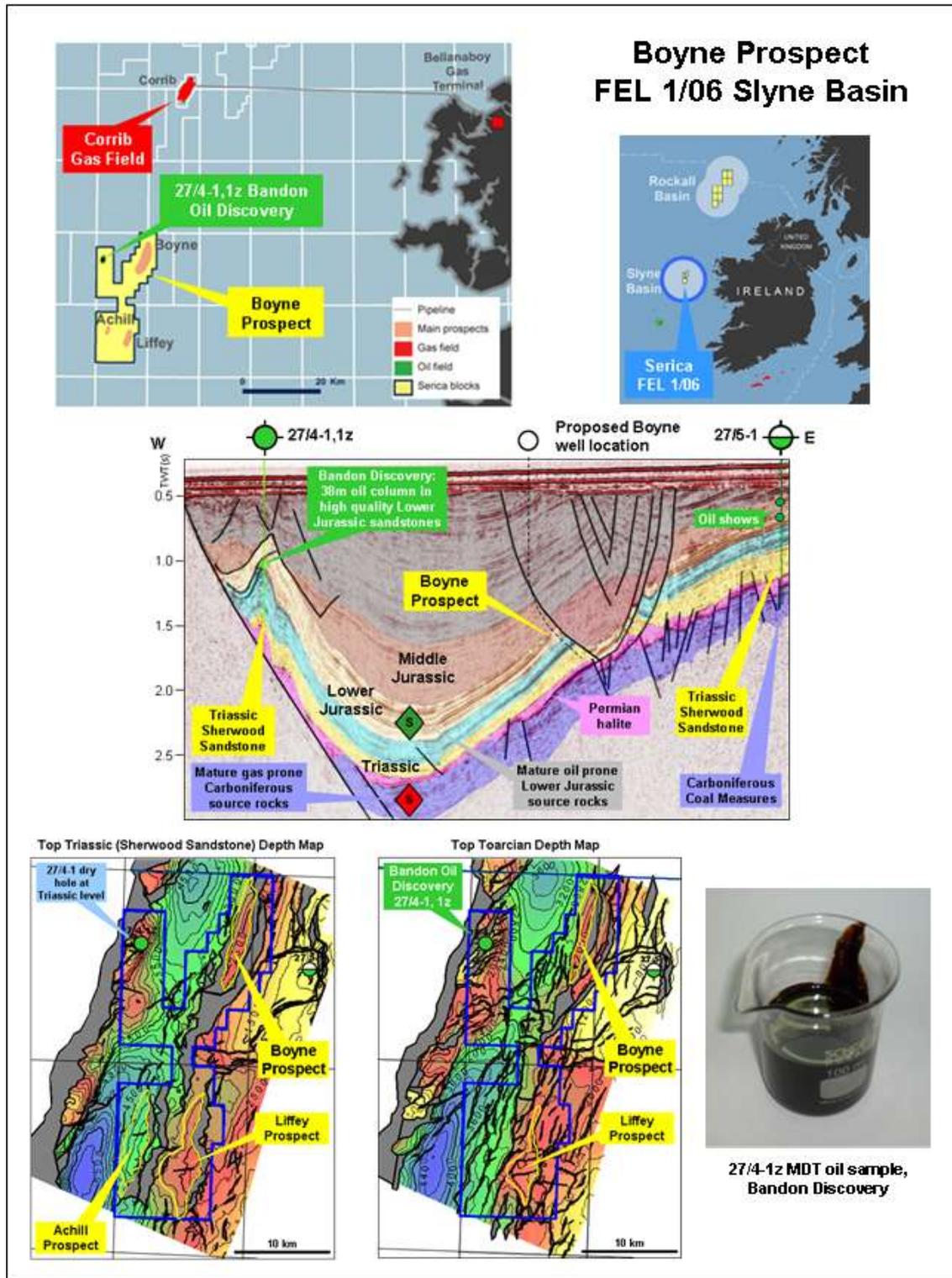
Serica Energy (50%, Operator) and RWE (50%) are jointly seeking a partner to participate in the drilling of an exploration well on the Boyne Prospect, Slyne Basin, Atlantic Ireland, in return for significant equity in the licence.

The Boyne Prospect is located to the east of the nearby Bandon oil discovery (27/4-1,1z), drilled by Serica in 2009, which encountered a 38m oil column within high-quality Lower Jurassic sandstones. This well confirmed both a new play offshore Ireland, and a working hydrocarbon system, with oil sourced from organic-rich Lower Jurassic marine shales in the centre of the Slyne Basin. Wells 27/4-1 and nearby 27/5-1 also encountered reservoir quality Triassic Sherwood Sandstone, which forms the reservoir in the Corrib Gas Field some 40 kms to the north. East of Boyne, thick, potentially gas-prone coal measure source rocks were proven by the 27/5-1 well.

The Boyne Prospect is a clearly defined tilted fault block, with stacked reservoir potential at both Lower Jurassic and Triassic levels. The prospect lies in close proximity to both the Lower Jurassic and Carboniferous source kitchens, and carries a recoverable resource range of 9 – 45 – 96 mmbo in the Jurassic, and 33 – 513 – 1213 bcf in the Triassic (P₉₀ – mean – P₁₀ range; based on Serica in-house estimates, June 2013). A site survey has been acquired over the Boyne Prospect, which is ready to drill. The licence is located in relatively shallow water, with water depth over the Boyne Prospect around 230m.



Perspective view of Toarcian
Depth Surface looking SSW



In the event of success at Boyne, there is substantial upside potential in the form of nearby Liffey and Achill Prospects.

Companies interested in pursuing this opportunity should contact:

Clara Altobell, International Asset Manager

Tel: +44 (0) 207 487 7300,

Email: clara.altobell@serica-energy.com

Serica Energy, 52 George Street, London, W1U 7EA

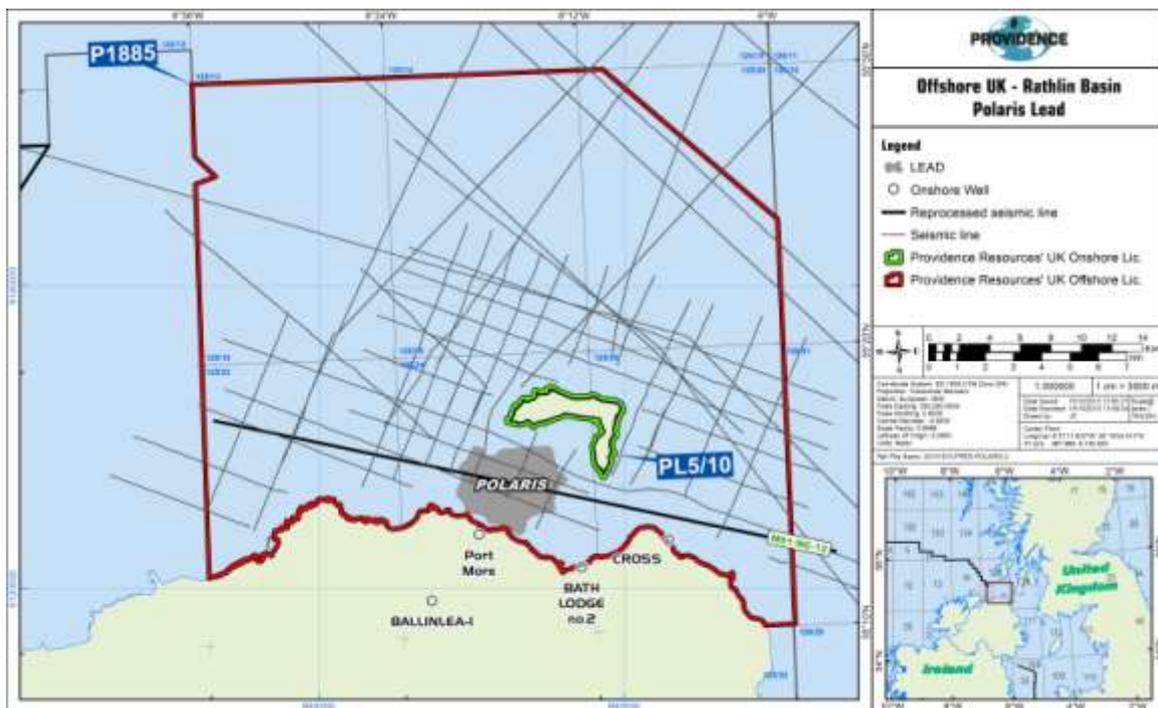
Prospects 2 Go - Frontier oil exploration opportunities, Rathlin Trough, Offshore Northern Ireland

Smyth, A.¹

¹ Providence Resources plc

The Rathlin Trough is a trap door half graben basin, which extends from onshore Co. Antrim, Northern Ireland into the offshore area. The basin contains a sedimentary fill analogous to that of the East Irish Sea Basin, offshore Liverpool, which ranges in stratigraphic age from Carboniferous through to Cenozoic, and where significant volumes of oil and gas have been discovered to date.

Historically the basin has been overlooked in terms of hydrocarbon prospectivity, having only one deep geothermal exploration well drilled in the 1960s, prior to the recent drilling of the Ballinlea-1 well in 2008. This deep hydrocarbon exploration well, which was drilled in the onshore part of the basin by Rathlin Energy, was reported to have recovered good quality oil to surface from a Carboniferous aged sandstone reservoir in a structurally down-dip location. Planning has commenced for a follow-up appraisal well to be drilled on an up-dip location on the Ballinlea structure in 2014. No offshore wells have been drilled to date in the basin. In 2011 Providence Resources (100%) was awarded acreage over Rathlin Island by the DETINI for a five year period. Following on from this in 2012, c. 6 offshore blocks were awarded (100%) by the DECC for a six year term.



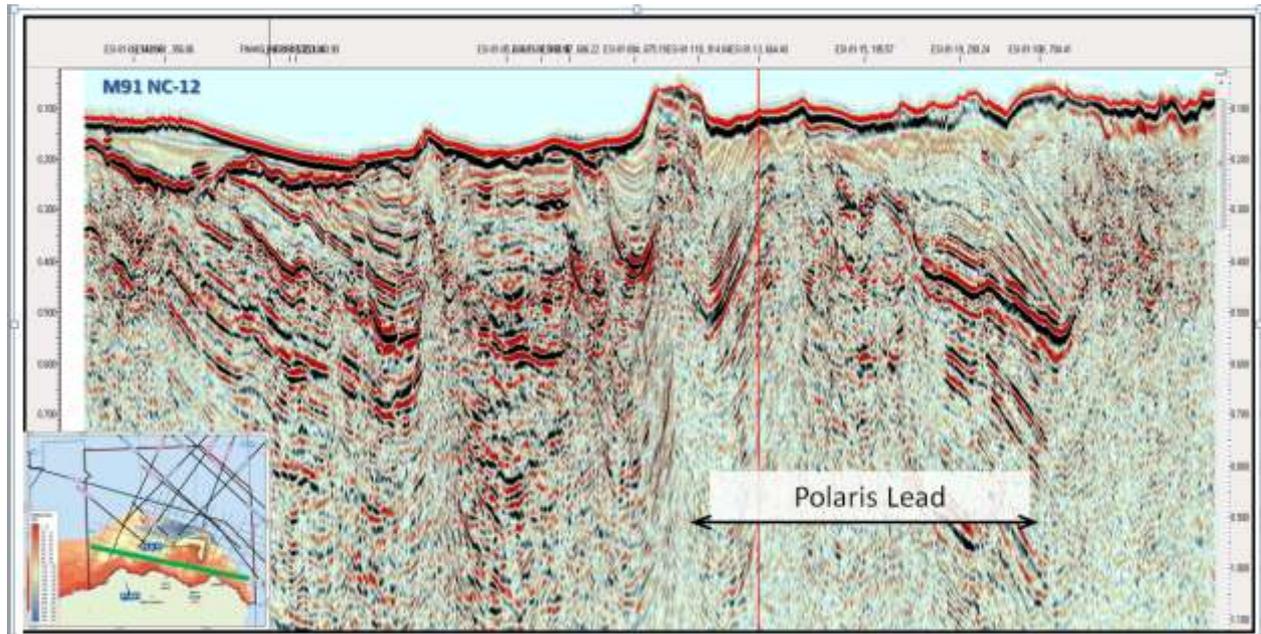
Map showing acreage position, and location of Polaris Lead, along with 2D seismic coverage of the area.

Existing seismic shot in the 1980s is of extremely poor quality and is severely affected by seabed multiples, due to the presence of acoustically hard water bottom conditions which result from the subcrop of shallow chalk & volcanics. Reprocessing of the available data has resulted in some uplift in imaging; however coverage within the c. 1130 sq km licence area is sparse. A regional Full Tensor Gradiometry (FTG) survey was shot by Bell Geospace on behalf of Providence over the entire acreage in 2012 to help map the basin and identify prospective targets.

The "Polaris" exploration lead is located in the Rathlin Sound, and has been high-graded as the primary target in the acreage using a combination of seismic and FTG data. The target is situated in

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a water depth of c. 80m, and is located along the same structural trend as the Ballinlea-1 oil discovery.



M91-NC-12 2D Seismic line through the Polaris Lead (Data courtesy of Apache North Sea)

The proven petroleum play as demonstrated by the Ballinlea-1 well consists of Lower Carboniferous Viséan sandstone reservoirs interbedded with deltaic source rock and sealed by intraformational Viséan shales. Onshore outcrop data have confirmed the presence of high porosity laterally continuous Carboniferous-aged reservoir sandstones. A second, as yet unproven play exists in Triassic Sherwood Sandstone reservoirs, capped by Triassic Mercia Mudstone and sourced from Lower Carboniferous deltaic coals and shales.

Scoping volumetrics indicate a most likely case of 530MMBO STOIP at the Polaris location based solely on a Lower Triassic reservoir objective. Further upside exists in the underlying Carboniferous and in similar additional targets which have been identified in the Polaris area. The work plan going forward is to shoot a seismic programme to firm up the Polaris structure and identify an optimum drilling location.

Prospects 2 Go - Prospectivity of SW Fastnet Basin

Mikkelsen, P.¹

¹ *Fastnet Petroleum Ltd*

Introduction

Blocks 63/3a, 63/4, 63/8, 63/9 & 63/10 lie in the SW part of the Fastnet Basin, about 200 km SW of Cork. They cover an area of 1,200 km² and lie in water depths of approximately 430 feet (130m). They were awarded to a group consisting of:

Fastnet Petroleum Ltd (operator)	50%
Excalibur Exploration Ltd	50%

as Licence Option 12/1 by the Irish Energy Ministry on 2nd May 2012 for a three year period. The initial work programme involved the reprocessing of vintage 2D seismic, structural remapping, a basin

modelling study and petrophysical analysis of existing wells. This has been completed and has confirmed the prospectivity of the licence and identified prospects with a total potential resource of ~200 mmbo.

The next step is to acquire approximately 800 km² of 3D seismic to delineate the prospects and leads identified to a point where a commitment to drill can be made and the Licence Option be converted into a full Exploration Licence. Discussions are in hand with seismic contractors to carry out this programme during the April-July 2014 weather window. The group would welcome the entry of one or more companies to support this forward programme.

Fastnet Basin Exploration History

The Fastnet Basin was explored sporadically in the 1970s to 1981. A total of eleven wells were drilled resulting in two small oil discoveries. Of these, three wells were drilled on the current LO acreage, including the two discoveries, based on a total of 1250 km poor quality 2D seismic data. Excellent quality, thick Jurassic sandstone reservoirs were encountered in all three wells and two showed live oil columns with well 63/10-1 flowing good quality oil to surface, albeit at modest rates from a gross 15m oil column.

Brabant/EDC held the acreage from 1996-2001 and acquired a further 400 km 2D seismic data in 1996 - seismic quality was improved but was moderate at best. Brabant drilled one well in 2001 (63-4-2) which again encountered excellent quality reservoir, with minor oil shows, but was a dry hole. Post well analysis showed the well to have been drilled off structure and Brabant relinquished the acreage within two months of completing the well.

The proven petroleum system involves Lower Lias sandstone reservoir trapped within fault bounded structural closures and charged by the underlying Lower Lias marls, equivalent to the Lower Jurassic Black Ven Marls, the primary source interval for the Wytch Farm giant oil field. Excellent seal is provided by very thick, homogenous overlying Upper Lias shales. The general lack of shows in the Wealden sands, compared to the numerous shows in the Lias sands gives further evidence of this seal efficacy.

All exploration drilling was based on poor to moderate quality 2D seismic data. No exploration activity has taken place in the Basin since 2001 until the current Joint Venture decided to revisit the area to evaluate the remaining prospectivity.

Prospectivity

The studies undertaken by the current JV have confirmed that the Fastnet Basin has very attractive remaining exploration potential.

The reprocessed seismic data has given a good uplift in quality, allowing more confident mapping of the primary section of interest. The new seismic interpretation has shown clearly that the old dry wells failed because they were drilled outside of a valid structural trap. The two wells with live oil columns are shown to have been drilled on the edge of moderate closures. Importantly the mapping has demonstrated that there are a number of undrilled, fault bounded, structural closures, mainly located along an uplifted structural hinge zone ("Intermediate Block") immediately updip of the source kitchen.

The Basin modelling study has shown that at least c. 900 mmbbl have been expelled and migrated towards this area - more than adequate to fill all of the mapped structures.

Total Prospective Resources of c. 200 mmbbl oil have been calculated from six prospects/leads. The largest of these is the O'Driscoll North feature, which is estimated to have mean resources of 83 mmbbl, well above the commercial threshold needed for development. The other prospects would offer excellent opportunities for tie-back to form a clustered development.

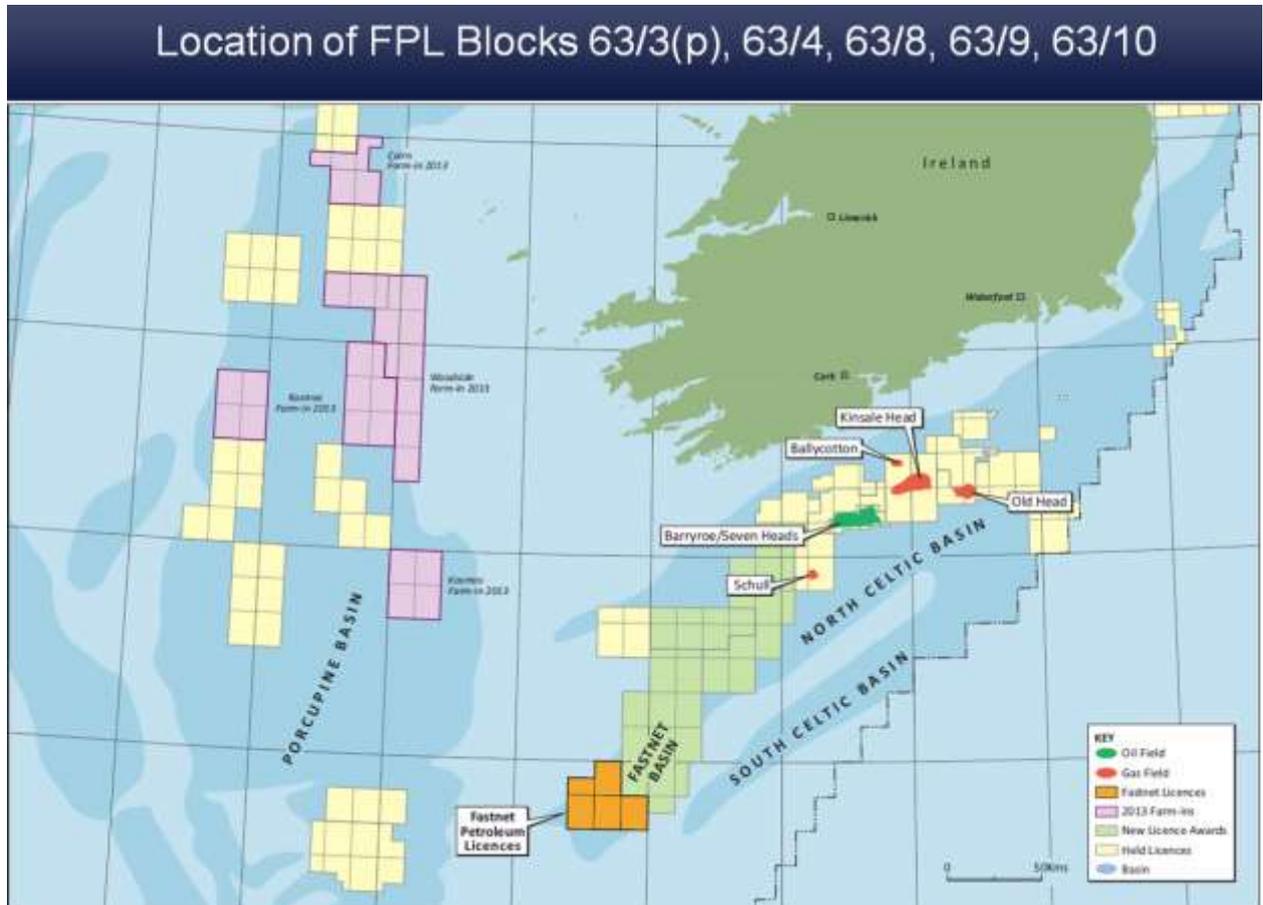
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Peter Mikkelsen (Exploration Manager),

Fastnet Petroleum Ltd, London, UK

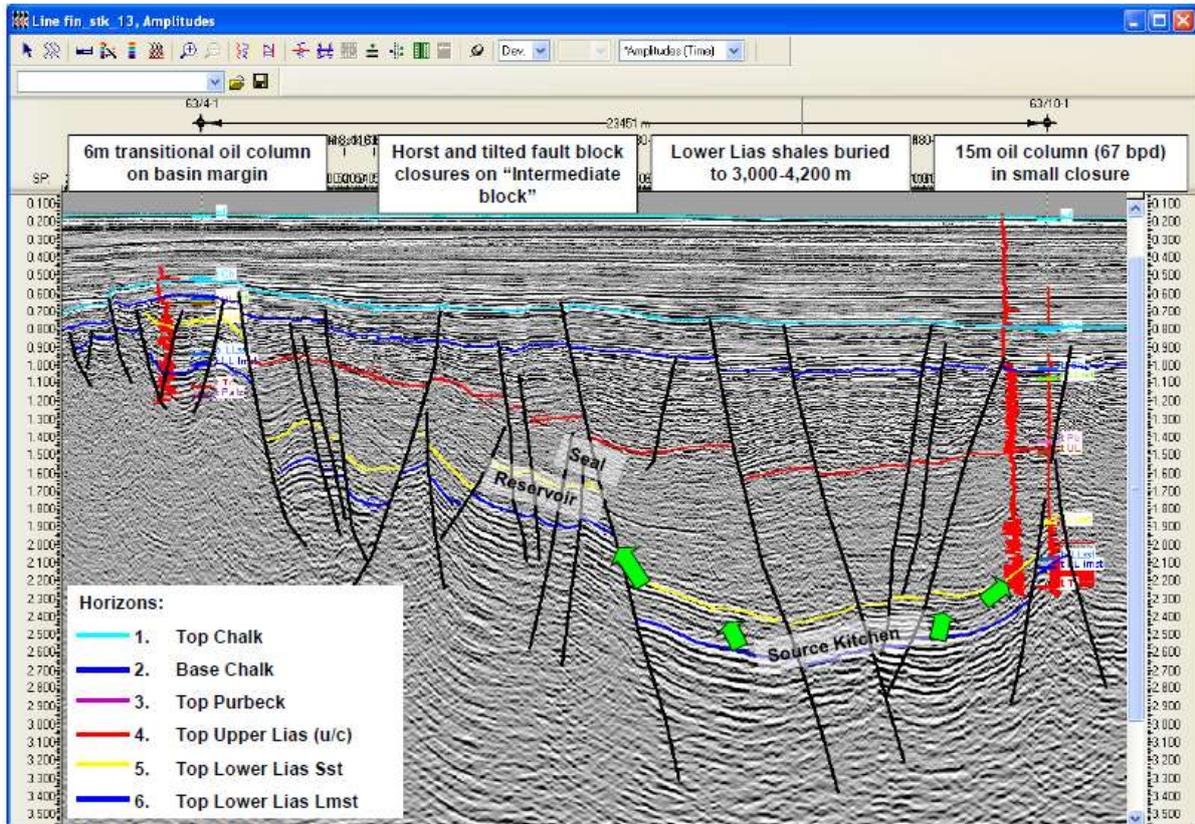
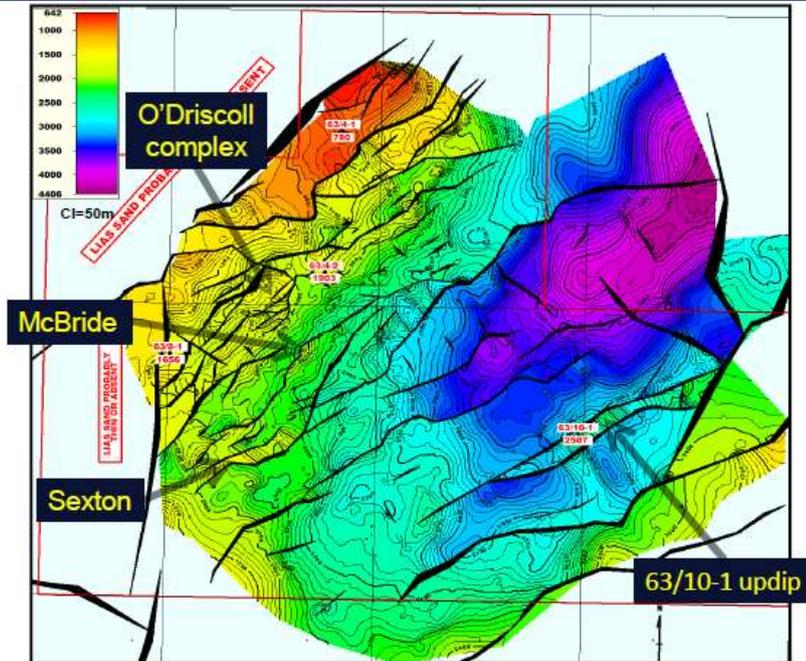
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Lias Sand Depth Structure Map, with highlighted Main Prospects.

Prospective (Unrisked) Resources				
Monte Carlo Recoverable MMBO				
Prospect	P90	P50	Mean	P10
ODN	44	80	83	128
ODS	9	18	19	30
ODE	2	3	3	5
OD (all)			105	
Sexton	26	48	50	77
McB	11	20	21	32
63/10-1	7	14	16	28
TOTAL			192	



Cairn Energy Plc entry into Ireland as part of its North Atlantic Margin exploration strategy

Laux, S.¹

¹ Cairn Energy Plc

Cairn's recent entry into the Porcupine Basin, Ireland forms part of the company's exploration strategy to acquire quality acreage in underexplored prospective basins around the conjugate North Atlantic Margin (NAM). Over the past three years Cairn has built a NAM acreage position covering over 135,000 km² in six countries (Greenland, Ireland, Spain, Morocco, Mauritania and Senegal). A planned six well exploration drilling campaign testing large 3D seismic defined prospects in four of these countries will commence in Morocco in October 2013.

In Ireland, Cairn subsidiary Capricorn Ireland Limited, has recently acquired by farmin a 38% Operated working interest in blocks FEL 2/04, FEL 4/08 and LO 11/2 covering 2,750 km². FEL 2/04 contains the unappraised Spanish Point gas condensate and Burren oil discoveries drilled by Philips Petroleum in the period 1978-1981. 3D seismic surveys acquired over these discoveries in 2009-2011 by previous Operator Providence identified Spanish Point as an Upper Jurassic fault bounded structure with a potential 300m hydrocarbon column length and aerial closure of 20km². Cairn will drill a 2.5 km stepout downflank appraisal well on the structure with a planned spud date in Q2 2014 with the Blackford Dolphin rig. In the event of success the well will be suspended for flow testing and followed by a possible second appraisal well to test the adjacent fault block. The results of this drilling campaign will also impact on the prospectivity of adjacent block FEL 4/08 to the north where several interesting structural/stratigraphic leads have been identified across the Spanish Point structural spill point.

Cairn and its JV partners also plan to acquire 500 km² of 3D seismic in 2014 in LO 11/2 to the south of the Spanish Point and Burren discoveries. The seismic will address the prospectivity of Upper Jurassic fault blocks on the Ruadan High and Cretaceous stratigraphic fan plays on the eastern margin of the main Porcupine Basin and in the Moling sub basin to the east of the Ruadan High. This seismic will overlap and merge with the Spanish Point 3D seismic to the north to facilitate good seismic-well ties in the area and create a better regional understanding of the Mesozoic sequence stratigraphy.

The Cairn farmin and other recent farmins to adjacent acreage by midsized international oil companies herald an exciting new phase of exploration activity in the Porcupine Basin.

Email address: steve.laux@cairnenergy.com

STANDS (in alphabetical order)

APT Stand

APT is a commercial company offering high quality analyses and consultancy services to the oil industry within the fields of petroleum geochemistry, biostratigraphy, production monitoring, sedimentology, structural geology and basin modelling.

APT was established in March 2000 and is owned by the Institute for Energy Technology, one of Norway's largest and leading research centres and a group of ex-Saga Petroleum employees. APT purchased the Saga Petroleum geochemistry and biostratigraphy laboratory facilities following the take-over of Saga Petroleum by Norsk Hydro. APT is closely integrated with the "Reservoir and Exploration Technology" and "Environmental Technology" departments at IFE. APT acts as the commercial arm of petroleum geological services for IFE and as an indicator for research directions, through close contact with oil companies.

During its short existence APT has provided services to 21 oil companies and 13 consultancy/research organisations within the various disciplines and embracing exploration and production problems, concession rounds, well studies, surface geochemistry and none – exclusive regional studies.

ARKeX Stand

ARKeX is a leading supplier of gravity and magnetic services to the exploration industry. As well as being a release agent for offshore PAD and DECC gravity and magnetic data, ARKeX can also supply non-exclusive data on behalf of the BGS and most of the major seismic companies. ARKeX offers processing and re-processing of gravity and magnetic data, and are able to merge overlapping data of different vintages into one contiguous data set. Drawing on nearly 25 years industry experience of international projects, ARKeX can interpret integrated potential fields and seismic data to produce geological models in areas where seismic alone is insufficient. In areas of inadequate data coverage, ARKeX is able to acquire both airborne and marine magnetic and gravity gradiometry data.

BGP Marine

BGP Marine supply marine seismic data acquisition services to the oil and gas industry worldwide. We offer high-quality 2D, 3D, 4D and OBC marine seismic data acquisition services with our state-of-the-art equipment, dedicated employees and highest HSE industry standards. Surveys undertaken worldwide using our fleet of modern seismic vessels are both efficient and cost effective while maintaining the highest safety and environmental standards.

BGP Marine have been acquiring marine seismic data for over 10 years, and during this time have provided high-class data acquisition and processing services to many independent, national and international oil companies. We have successfully operated in Ireland, the North Sea, East & West Africa, the Red Sea, Sudan, the Bay of Bengal, the South China Sea, Iran and Indonesia. BGP is continually investing in new technologies to improve the acquisition and processing quality.

Between 2006 and 2011, BGP launched seven seismic vessels building its offshore acquisition capabilities. We currently offer a newly built 12-streamer vessel (BGP Prospector, 2011), one six-streamer vessel, three 2D/3D streamer vessels and a 4-C Ocean Bottom Cable crew. A fleet

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expansion of more vessels in the coming years will further demonstrate BGP's commitment to long term success in the marine seismic marketplace.



BGP Prospector

Our multi-national crews are highly experienced and capable of handling a diverse range of acquisition challenges. BGP has collected over 138,000km² of 2D-streamer data, 36,000km² of 3D-streamer data and 1,400km² of 3D-4C OBC data since 2007. In addition, BGP has the capability of providing integrated Design/Acquisition/Data Processing/Interpretation solutions to our clients. Data acquisition services also include marine gravity and magnetic data collection.



BGP Explorer (Killybegs)

As a core member of IAGC and a contractor member of IMCA, BGP strictly adheres to the highest industry standards and has developed an internal HSE management and QC/QA management systems for all its seismic activities to reflect this commitment.

For further information on any of BGP Marine's services please contact:

Mr Steve Callan - Regional Sales & Marketing Manager
BGP Marine, Global House,
1, Ashley Avenue, Epsom, Surrey,
KT18 5AD, United Kingdom
Email: steve.callan@bgpintl.co.uk
Phone: + 44 (0) 75 3559 2529
Web: http://www.bgp.com.cn/09/service/Acq_Marine.htm

Chemostrat Ltd Stand

Chemostrat Ltd is the world leader in providing high quality stratigraphic services. The company is now at the forefront of a new revolution by creating a multi-disciplinary service matrix that incorporates a range of traditional and state of the art analytical and interpretative techniques that can be tailored to tackle a wide range of geological challenges focusing on providing cost effective and workable solutions for our clients.

One component of the 'service matrix' has been the establishment of a Provenance Unit to provide a more detailed forensic level characterisation of sand composition. The methodology involves applying an appropriate combination of services, such as high resolution chemostratigraphy, enhanced petrographic analysis, heavy mineral analysis, grain chemistry and grain geochronology from the service matrix. This approach can be applied to both the field scale, to improve the modelling of reservoir architecture correlation, and to basin scale with mapping of sediment dispersal patterns, sediment input points along base and margins, to model the history of sedimentation and its relationship to tectonic activity.

Chronostratigraphy is key to the establishment of basin wide correlations by providing a stratigraphic framework that can be traced through the succession regardless of lateral facies variations. Our Special Stratigraphic Services (SSS) unit incorporates a wide range of isotopic dating techniques (C, O, Re/Os, U/Pb) for shales, carbonates and volcanic ash bands, and palaeomagnetic and magnetic susceptibility data to provide time lines and identify sequence boundaries to enhance chemostratigraphy correlations. In addition, Chemostrat has the interpretative resources to integrate biostratigraphic, wireline and sedimentological data into the SSS work programme in order to establish a comprehensive and robust basin wide correlation model that provides a template for further GIS based basin wide provenance, palaeoenvironmental, and reservoir quality mapping studies.

The shale gas revolution has only served to highlight the need to increase the understanding of shale composition and physical properties to improve exploration, drilling and production. Chemostrat is demonstrating the value of elemental data in shale resource applications, and our new service matrix can be applied to provide a bespoke shale service work programme that can be applicable to exploration, geosteering and completions optimisation. This work programme can be adapted for basin scale and involves chemostratigraphic and isotopic correlation, elemental mapping of anoxia, organic preservation, and terrigenous input in conjunction with TOC and XRD data for basin evaluation. Furthermore, the acquisition of real time chemostratigraphic data at well-site can be employed to aid geosteering and the optimisation of field development with improved planning of targeted lateral wells.

Chemostrat has also established a work programme to integrate elemental and mineralogical data with petrophysical parameters to enhance reservoir quality modelling. For example, elemental data can also be used to calculate mineralogy and provide an estimate of TOC and proxy for relative brittleness (RBI) that following calibration ensures elemental data can be multipurpose, practical and more cost effective as a means of modelling which is critical for well completions in shale plays. Elemental data can also be used to refine the petrophysical modelling in carbonate plays detecting subtle variations in dolomite, anhydrite or salt that can hold the key to reservoir quality. Furthermore, mineral abundances can be measured from elemental data in turbo-drilled cuttings where textural mineralogical characteristics have been destroyed by the drilling process.

The company has also invested heavily in research and development resulting in the establishment of a comprehensive suite of calibrated portable and field ready analysers. Chemostrat can provide wellsite XRF and FTIR for geosteering, mineralogy, organics and rock properties studies, and hand-held XRF and magnetic susceptibility measurements for high resolution core and cuttings analysis in the field remote core stores and the laboratory. In addition, the company has also established an

isotopic dating and elemental fingerprinting service for oils and source rocks, which can be integrated with traditional organic geochemistry and maturity data to assist in establishing petroleum systems in frontier basins.

Chemostrat has great experience in producing quality, integrated non-proprietary studies. These studies are on a regional to sub-regional scale, with content ranging from inorganic chemostratigraphy only, to fully integrated multi-disciplinary studies that investigate provenance, palaeogeography and sedimentology. The library currently consists of 18 non-proprietary studies covering the more traditional UKCS, Southern North Sea and Norwegian Continental Shelf, but also more frontier areas such as the Norwegian Barents Sea, the Vøring Basin, Faroe-Shetland Basin (UK), as well as the North Grand Banks area (Newfoundland). Additional studies are underway in the Duvernay area (Canada) and Tanzanian Indian Ocean Margin, while extensions to the Faroe-Shetland and Grand Banks studies are also underway.



DNR Stand

Newfoundland and Labrador has sustained significant levels of industry interest in its highly prospective offshore and onshore basins. Since first oil sixteen years ago, the province's four producing fields in the Jeanne d'Arc Basin – Hibernia, Terra Nova, White Rose and North Amethyst – have produced in excess of 1.4 billion barrels of oil. Hebron, expected to be the province's fifth producing field, was recently sanctioned at a capital cost of \$14 billion with first oil planned for 2017. Statoil's recent discoveries of oil in the Flemish Pass Basin at their Mizzen, Harpoon and Bay du Nord prospects bodes well for future development in this region. With substantial undiscovered resources and the recent discovery of new offshore basins the potential for additional discoveries in the region remains strong.



Donegal County Council Stand

The Donegal County Council stand promotes the facilities in the County available for the offshore oil industry. This includes the deep water port of Killybegs and the airport at Carrickfinn.

Killybegs is a modern, vibrant and forward looking harbour operation. Located in County Donegal in the North West of Ireland it is well placed for servicing offshore energy exploration along Ireland's West Coast and indeed Europe's Western approaches.

Killybegs has deep water all-weather harbour infrastructure along with hydraulic and mechanical services to play a pivotal role in the development of offshore energy. The town of Killybegs has a proud maritime heritage. Developed initially as a fishing port it has, since 1999, played an important role in facilitating offshore exploration and in particular the development of the Corrib Field. It has also been the harbour of choice for wind farm developers, with turbines being delivered for wind farms throughout the north and west of Ireland. In a further development, Killybegs has become the port of call of many cruise ships that benefit from modern berthing and quayside facilities along with direct access to the Highlands of Donegal. Killybegs in essence has evolved into a multifunctional port serving the fishing, energy and cruise sectors. Therefore the presence of this expertise, adaptability and flexibility ensures that Killybegs can meet any challenge. A “can do” attitude pervades.

All the companies listed below have selected Killybegs as their port of choice in support of their offshore activities.

Exploration & Production Companies

Shell
Statoil
Lundin
Serica / AGR
Eni

Subsea / Offshore Construction Companies

Allseas
Technip
Van Oord
Tideway
CTC Marine

Seismic Companies

PGS – Fugro Survey
CGG Veritas – Bergen Oilfield Mgt.
TSS Nopec – Seabird Exploration

Renewable Energy Companies

Enercon
Gamesa
GE Wind Energy
Ocean Energy
Siemens
Vestas
Wavebob
West

In recent years Donegal Airport at Carrickfinn has also provided a hub for the offshore oil and gas industry for many of the major oil Companies. It is strategically located for the support of air services to offshore operations in the West and North West. Helicopters are based at the Airport and fixed wing charters operate to/from Scotland and Norway for the duration of the contracts. Other airport operations include air corps, search and rescue services, private charters and general aviation.

ERM Stand

Atlantic Margin – a challenging environment

The 2011 offshore licensing round, covering a quarter of a million square kilometres of the Irish Continental Shelf, was the largest ever for the country. The last year has seen an increase in the oil and gas sector's interest in Ireland with several well-known companies joining the pursuit. The Irish government has been busy over the past few years making improvements to the system in order to ensure that the attractiveness of the fiscal terms are bolstered by robust planning, permitting and regulatory regimes. For example, the new Petroleum Safety Framework requires operators in Ireland to produce a safety case for the first time. ERM's integrated multidisciplinary capabilities enable operators to benefit from our unique ability to understand and anticipate the demands of the new Irish Petroleum Safety Framework. This is particularly so in the critical field of oil spill response planning.

It is expected that interest in the 2014 licensing round will surpass the successes of 2011, capitalising on recent data acquisition and a clearer understanding of the potential resources that lie off the west coast of Ireland. Although it is speculated that Irish oil and gas plays could prove very fruitful, operators need to be mindful of the full spectrum of risks specific to operating in the Irish Atlantic Margin.

Non-technical risks

A big challenge for companies moving into the region is managing what can best be described as the non-technical risks associated with their plans. In ERM's experience, non-technical issues, which includes everything from partner and stakeholder relationships to environmental sensitivity, can account for up to 75% of cost and schedule failures on major oil and gas projects. While new technologies and higher energy prices have helped to extend the boundaries of exploration, companies still need to demonstrate that they are responsible citizens to a range of stakeholders, including regulators, NGOs and local communities.



ERM has extensive experience working with clients to manage the gamut of risks associated with oil and gas exploration in frontier areas. These can range from managing stakeholder consultation to providing core services in such fields as oil spill contingency planning, contractor and management

system auditing, preparation of safety cases and environmental and social impact assessments. In addition to our direct experience supporting the planning and permitting of Irish oil and gas projects, we bring a 40 year track record supporting E&P projects around the world.

Faced not only with challenging operating conditions but also local sensitivities in relation to proposed drilling activities, operators must demonstrate that they are well prepared with actions and forward planning to manage any adverse risks and impacts. Only through effective engagement with stakeholders and transparency (flexibility) in relation to plans can opposition be overcome. We believe that our experience as both an advisor and local partner can deliver tangible benefits to companies seeking to harness the potential of the Atlantic Margin.

The New Operating Environment

As operations in the Atlantic Margin expand, a key challenge will be for operators to demonstrate that they are giving sufficient priority to social and environmental considerations, including the management of risks throughout the project cycle. What communications strategy should be adopted? What will be the impact of seismic surveying and drilling on biodiversity and ecosystems? How will the operator mitigate the risks of an oil spill? How will waste be managed? What impact will there be on the local population and what are the broader climate change implications? What is required of the new safety case regime? Operators must be prepared well in advance for these and the many other challenges. Demonstrating responsibility and an understanding of local sensitivities is now seen as an essential element of an operator's licence (or indeed privilege) to operate. This can apply at all stages of the permitting process and as part of an increasingly tough and testing oil and gas operating environment.

As a leading sustainability consultancy, ERM offers a unique combination of disciplines to help meet the needs of oil and gas clients in Ireland. ERM is currently engaged on the safety cases, impact assessments, stakeholder engagement and the various permitting requirements for several oil and gas projects in Ireland and is assisting its clients, their partners and contractors in developing robust systems in which management can have confidence and on which external stakeholders, including regulators, pressure groups and shareholders can rely.

ERM is able to combine local knowledge with a proven international capability – acquired by working on some of the most controversial projects in the world – to produce solutions that satisfy all stakeholders. This means working with clients to identify both risks and opportunities relating to a project, ensuring that proposals are supported by sound technical knowledge and helping to convey what are frequently complex sustainability messages.

In short, companies operating in the region need to ensure that they engage early having developed robust (and sustainable) plans and permit applications. As noted in this article, ERM is well placed to help with these challenges.

Fastnet Oil and Gas Plc Stand

Fastnet Oil & Gas plc is an independent oil and gas exploration company focused on early stage exploration and appraisal opportunities in Africa and Ireland. The Company completed its IPO in June 2012 and its shares are traded on the AIM market of the London Stock Exchange and ESM market of the Irish Stock Exchange.

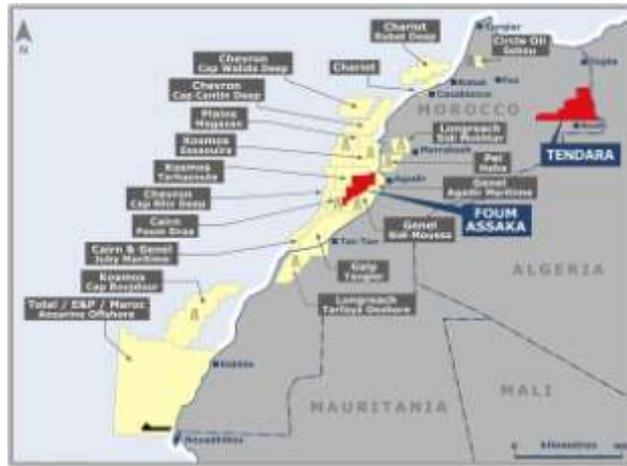
Fastnet has a highly experienced management team with a proven track record of generating significant shareholder value in the oil and gas industry. The Company has moved quickly to assemble an exciting portfolio of exploration prospects both onshore and offshore Morocco and in the Celtic Sea, offshore Ireland.

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Fastnet's current assets include:

- A 25% Gross (18.75% net) carried interest in the highly prospective Fom Assaka licence area, offshore Morocco. The licence operator is Kosmos Energy who hold a 40% Gross (29.925% net) working interest while BP hold a 35% Gross (26.325% net) working interest
- A gross interest of 50% in the Tendrara licence onshore Morocco (net interest 37.5% after including the ONHYM carry through exploration of 25%) after earn-in well and receipt of regulatory approvals.
- Four offshore licensing options in the Celtic Sea (Molly Malone, Mizzen, Shanagarry and Block 49/13).
- An exclusive option to farm-into the Deep Kinsale Prospect in the Celtic Sea.
- An interest in a net profit bonus arrangement relating to the Connemara prospects offshore Ireland.

Morocco



Fastnet, through its wholly owned subsidiary, Pathfinder Hydrocarbon Ventures Ltd, entered Morocco in May 2011 and was awarded the highly prospective Fom Assaka offshore licence. Since then there has been significant activity in this historically underexplored region with Morocco now considered a key exploration frontier. The recent farm in to the onshore Tendrara licence in May 2013 has cemented Fastnet's position as a leading oil and gas exploration company in Morocco with a total licence area of 21,165 km². The Fastnet management team has extensive knowledge and experience of exploration in Morocco and is focused on unlocking significant value through a sustained drilling programme over the next three years.

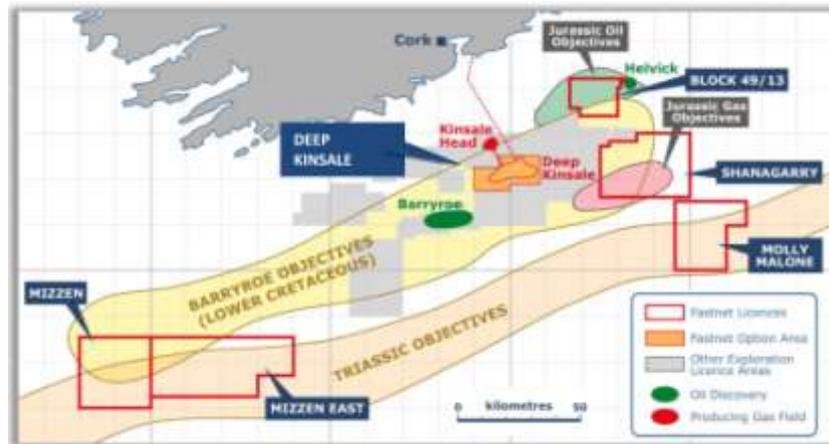
The Fom Assaka Offshore Licence consists of four exploration permits in the North-West Agadir Basin, to the south-west of the Moroccan port of Agadir. The licence area covers an area of 6,478 km². The region contains evidence of a working hydrocarbon system with oil shows being encountered in previous onshore and offshore drilling, as well as good reservoir potential. The Agadir Basin is an under-explored basin with a variety of exploration plays, including its core geologic theme in the late Cretaceous formation. Fastnet is partnered with Kosmos Energy and BP in the Fom Assaka Offshore Licence and will drill an exploration well in H1 2014.

The Tendrara Lakbir Onshore Licence covers an area of 14,548 sq. km. It covers the majority of the Tendrara Basin, which lies between the Middle Atlas to the north and the High Atlas to the south and which is one of Morocco's prospective basins for Triassic gas. Five wells drilled within the Licence Area have encountered gas-bearing Triassic sands of the Tagi Formation (the "Tagi"). The Tagi is the host reservoir for Morocco's producing Meskala gas field, along strike to the west in the Essaouira Basin. All these gas discoveries have been charged from the prolific Silurian source rocks that are an integral part of the proven Palaeozoic-Early Mesozoic petroleum systems covering large parts of

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Libya, Algeria and Morocco. Fastnet is partnered with OGIF (37.5%) and ONHYM (25%) in the Tendrara Lakbir Onshore Licence and will drill an exploration well in Q2 2014.

Celtic Sea



With an area of 4,028 km² under licence, Fastnet has one of the largest acreage positions of any independent in the Celtic Sea. The licences granted to Fastnet were selected due to their attractive petroleum geology, major reserves potential, existing seismic availability and based on our management's past experience in these specific areas.

In June 2013 Fastnet completed a 3D seismic programme covering 1,910 km², the largest ever 3D seismic programme in the Celtic Sea. The Directors anticipate that this will de-risk and unlock resource potential and should increase the likelihood of attracting an industry major to participate in a future drilling programme given the scale and materiality of the prospective structures already identified. Final processing and interpretation of the data is expected to be completed by December 2013, with preliminary results available from November 2013.

Fluid Inclusion Technologies (FIT) Stand

Fluid Inclusion Technologies (FIT), Inc., is a laboratory-based petroleum service organisation offering a variety of analytical services including some previously proprietary technologies. The most widely applicable of these new technologies is Fluid Inclusion Stratigraphy (FIS) - a rapid analytical technique that involves the automated analysis of volatile compounds trapped within micron-sized cavities in rock material taken from well cuttings, core or outcrop samples. These "fluid inclusions" are representative samples of subsurface fluids, and are not subject to fractionation during sampling or evaporative loss during sample storage for any length of time. The new procedure yields valuable information on Pay/Bypassed-Pay, Product Type, Migration, and Seal Integrity, unattainable via more traditional methods and, over the past ten years, has been instrumental in the discovery of significant petroleum reserves, influenced exploration and acreage acquisition decisions and provided innovative options for resource estimation, petroleum production and enhanced oil recovery operations.

An equally impressive aspect of FIS technology is the rapid turnaround time: large sample sets (i.e., 100s to 1000s of samples) from single or multiple wells can be analysed, the results interpreted, and the findings delivered virtually anywhere in the world in a matter of days. Thus, the results can play a crucial role in decision making regarding current plays as well as provide valuable new insights through the analysis of archived cuttings.

The geochemical services offered by Fluid Inclusion Technologies (FIT), Inc., including FIS Analysis are variable and problem specific. By combining patented techniques, emerging geochemical

methodology and standard microscopic methods, all of which complement each other, we provide a unique and unequalled industry product. A partial listing of proven applications of our analytical services includes:

- petroleum migration pathway mapping
- characterisation of seals to oil and gas
- identification of dry holes proximal to undiscovered hydrocarbons
- delineation of pay or bypassed pay within penetrated sections
- identification of fluid pressure compartments
- characterisation of petroleum-water transition zones
- delineation of reservoir compartmentalisation

For further information including applications and more technical aspects of the geochemical and petrological services we provide, please browse through our Slideshow Overview of Fluid Inclusion Technologies. This presentation is available on CD and in some cases as a command performance.

Fugro Stand

www.fugro.com

Fugro *collects, processes and interprets* data related to the earth's surface and the soils and rocks beneath and provides advice based on the results to clients in many sectors.

Fugro's range of services is represented at this exhibition by the following four operating companies.

Fugro GeoConsulting Limited

Fugro GeoConsulting merges the talents of Fugro's Geophysics, Geology, Geohazards and Geotechnical Engineering consultancy resources. This creates a consultancy group which can provide the complete integrated solution for identifying and quantifying seabed and sub-seabed risks. Our expertise offers a multitude of services including Desk Top Studies, Shallow Regional and Wellsite Geohazard Assessments, Site Investigation and Laboratory Testing, Data Interpretation and Integration, Geotechnical Analysis and Foundation Engineering.

The benefits derived from this integrated approach are numerous, and include:

- Early understanding of shallow geohazards
- Optimised survey programmes
- Enhancing the value of the datasets through more effective integration
- Fit for purpose foundations
- Optimised project solutions

For more information please visit www.fugrogeoconsulting.com

Fugro Survey Limited

Fugro Survey Limited provides a wide range of offshore survey and positioning services including; geophysical, geotechnical and environmental surveys; pipeline & cable route surveys; acoustic pipeline inspection; hi-res shallow seismic; offshore positioning and construction support services including positioning for rig moves, heavy lift, pipe/cable lay and field development support. Operations are conducted primarily on the North West European Continental Shelf, Mediterranean and West Africa regions. From bases in Aberdeen and Great Yarmouth the company operates a fleet of five dedicated geophysical survey vessels; the latest and best equipped fleet of its kind in the region. In addition the company also owns and operates two 'state of the art' Autonomous Underwater Vehicles (AUVs) which are typically deployed for deepwater surveys.

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For more information please visit www.fugrosurvey.co.uk

Fugro EMU

As part of the Fugro Group, Fugro EMU works closely with its sister companies to deliver fully integrated environmental solutions to the oil and gas sector. Fugro EMU employs a large dedicated team of environmental specialists providing Consultancy, Survey, Biology, and Chemistry services for a range of offshore and coastal industries.

We have been providing marine environmental services to the oil and gas industry for 40 years, successfully securing regulatory approval, consents and permits for operators undertaking exploration, development and decommissioning activities.

Fugro EMU provides the following oil and gas services:

- Strategic Environmental Assessment (SEA)
- Environmental Impact Assessment (EIA)
- Environmental Permitting and Consenting (e.g. EAA, PUDAC)
- Oil Spill Contingency Planning
- Environmental Baseline, Habitat, Marine Mammal Observation and Seabird Surveys
- Benthic Taxonomy, Chemical and Sediment Analysis
- Oil Spill Fingerprinting

For more information please visit www.fugroemu.com

Fugro GEOS

Fugro GEOS is a global leader in the provision of commercial meteorological and oceanographic (metocean) services and systems. These are provided on a fully integrated worldwide basis to meet and support client needs in offshore and coastal environments.

A good understanding of metocean conditions enables clients to reduce uncertainty in engineering specifications, provides help in operational planning, leads to reduced costs, and enhances safety and operational efficiency.

With over 30 years' experience in a diversity of projects, Fugro GEOS is well placed to respond to the metocean needs of clients, providing solutions through cost-effective, high quality and technically advanced measurement, consultancy, information systems, ocean observing systems, forecasting services and platform and riser response monitoring.

For more information please visit www.geos.com

GeoGuide Stand

GeoGuide provides internationally based experienced consultants for the design, management, supervision and quality assurance of land and marine based seismic surveys together with Technical Audit. GeoGuide can assist with the control of the seismic processing, both in the field, on-board the vessel or when being performed at in-house processing centres.

Our consultants are selected for each project based on their broad experience and supported by excellent management and communication skills. Their expertise covers all aspects of Land, Marine and Transition Zone surveys. This includes explosives, airgun and Vibroseis sources.

All GeoGuide consultants who work offshore have up to date medical certification to UKOOA or equivalent standard and valid offshore survival and fire fighting certificates including HUET.

We are therefore able to offer the following service provisions:

Seismic Project Management

All of GeoGuide's consultants have many years experience in the seismic industry. Project managers are experienced field supervisors with additional geophysical and project planning skills. Often these consultants have significant Operations Geo experience and the positions they fill are largely in that role or similar. This therefore also requires a strong and proven interest in HSE management, good organisational skills and experience in contract/tender work.

Survey Planning and Design

The right design is essential; A compromise between the most appropriate geophysical parameters and economically viable cost, whilst still fulfilling the clients geological and geophysical needs. Our design team can do just that, with a wealth of experience in the survey design of 2D and 3D Land, Marine and TZ projects worldwide. We use the latest versions of Gedco's OMNI design and Claritas processing software packages to assist in the design study. Our philosophy is to fully integrate the client in the project with discussions prior and whilst the work is being performed, with a presentation of the final results at the clients offices.

Seismic In-Field Supervision

Technically capable, diligent, pro-active, organised and a good communicator. This describes the professional skills required of our in-field supervisors. If these guys were in any other business they would be CEOs and company chairmen. What is it about the seismic industry that keeps them so focused on the teamwork and the satisfaction of a job-well-done? Thank goodness they do.

Survey Positioning QC

We include the invaluable work done by our positioning specialists in the supervision group described above. It is also worth noting that we can also evaluate and reprocess navigation data. Each of our navigation specialists is familiar with several of the nav-processing and QC tools available.

Technical Audit

We believe very strongly of the good sense in performing a check of the equipment and set-ups at the start of the survey. While GeoGuide has several very good audit engineers we are quite happy to also bring in help from other companies if they have better availability or particular skills.

HSE

GeoGuide recognises in this modern age that Health, Safety and Environmental consideration is becoming an important and necessary requirement to all major and minor Oil Companies. We are therefore pleased to be able to offer as a continued improvement of our services to existing and future clients, high quality HSE QC Consultants for both on and offshore seismic projects. All HSE consultants currently listed with us are trained to NEBOSH standard and we believe that this additional facility will complement our already existing range of services.

Contract (ITT) Preparation and Bid Evaluation

For both Acquisition, and Processing projects a competitive tendering process is recommended to elicit the best bids and to ensure the client is not left commercially disadvantaged. GeoGuide Consultants can assist in producing and evaluating the Invitation to Tender (ITT) documents. The ITT will detail the scope of work, geological setting, survey objectives, acquisition parameters, technical specifications and contractual requirements. The contractors capable of undertaking the work to the required standards will be invited to tender for the work. Following the receipt of proposals a full technical and commercial review would be performed. GeoGuide consultants, on behalf of, and in discussion with, the client can negotiate tender clarifications and costs such that ultimately the final contract can be awarded.

Data Processing Supervision

GeoGuide provides Data Processing specialists for in-field work and for the QC of data processing at processing centres and client offices. It may not always be necessary to have a data processing specialist on every acquisition crew but there are many fast-turnaround jobs and surveys in which processed results effect the further acquisition that it is critical to ensure that the work is correctly performed. It is a miniscule insurance cost when viewed in proportion to the cost of a modern seismic survey.

Specialist In-House Processing Services (including AVO and Inversion)

GeoGuide have hands-on processing experience. An in-house team of processing experts which, using Claritas software, have the ability to undertake processing projects; small scale 2D production processing jobs, through to 3D merges. We can also undertake more specialised AVO and Inversion work using Hampson Russell software. Our Processing Consultants can also assist the Client in production of the Processing ITT and can evaluate the contractors proposals and negotiate final contract conditions.

Marine Environmental Services

MMO's and PAM Operators, PAM Equipment and Technical Support, ESAS Seabird Observers, Wind Farm Seabird and Marine Mammal Surveys, Environmental Scientists, Fisheries Liaison Officers, Environmental Impact Assessments.

See www.geoguide.co.uk

Golder Stand

Golder Associates deliver a wide range of integrated services to the oil and gas industry, assisting clients in overcoming their challenges. Our team of experts understands the diverse technical and culture demands involved with oil and gas exploration, which means we can help maximise the opportunities. Golder services include geotechnical and coastal engineering, marine sciences and met-ocean data collection and analysis. We bring together a multi-disciplinary team to help our clients through the exploration and development, planning, permitting, design, construction and closure phases of offshore oil and gas projects. Our services include:

- Environmental & Biophysical Surveys
- Regulatory Permitting & Compliance
- Geotechnical Engineering including Permafrost
- Marine Sciences & Ocean Engineering
- Coastal Resources
- Met-Ocean Data Collection & Analysis
- Program Management
- Stakeholder Consultation
- Environmental and Social Impact Assessment
- Reservoir Appraisal and Development

For more information, please contact sarah.white@golder.com or visit www.golder.com



GSI Stand

The GEOLOGICAL SURVEY OF IRELAND (GSI), founded in 1845, is the National Earth Science Agency. It is responsible for providing geological advice and information, and for the acquisition of data for this purpose. GSI produces a range of products including maps, reports and databases and acts as a knowledge centre and project partner in all aspects of Irish geology. It is a division of the Department of Communications, Energy & Natural Resources (DCENR) and has about 50 multi-disciplinary staff.

Operational Programmes

GSI serves its customer needs through a range of operational programmes and support services:

- The Information Management Programme underpins all of our activities in the delivery of geological information to our customers, and is recognised as the most important corporate priority.
- The Surveying Programmes (Bedrock Geology, Quaternary Geology, Marine Geology and Geophysics) are long-term, and feed information to the Applied Programmes, as well as producing maps and reports used directly by a wide range of external customers.
- The Applied Programmes (Groundwater, Minerals, Geotechnical, Geological Heritage) are largely project-oriented, and provide solutions to specific customer needs, their various activities helping to build their respective databases.

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The Geological Survey of Ireland is responsible for gathering, storing and disseminating geological information. It carries out its duties of gathering information by:

- field mapping and recording of data (which does not involve topographic surveying - that function is carried out by the Ordnance Survey). This may be part of a long-term systematic survey, or may take place as part of a specific project, for example a Groundwater Protection Scheme for a particular County;
- the compilation and interpretation of geological data gathered by others. The data may have been collected by university staff or students as part of academic research, it may be open-filed information from Mineral Exploration companies, or it might be reports of geotechnical investigations;
- the drilling of boreholes for stratigraphic data, quaternary sediments or aquifer characteristics, using its own drilling rig.

The GSI maintains an ever-growing store of earth-science information:

- paper maps and reports, ranging from the original sets of six-inch hand-coloured manuscript maps of the 19th Century, through reports submitted to GSI by outside bodies, to published reports and maps;
- physical materials, such as rock samples, thin sections, an extensive fossil collection, and an enormous store of drill core;
- a library of earth sciences journals and books;
- digital information, which at present consists principally of metadatabases, but will be complemented over the next few years by digital versions of most current paper reports and maps, together with a country-wide Geographic Information System.

The geological information held by the GSI is used by staff to answer queries, produce reports, and compile special or series maps. The Public may also access these data, either via our free Document Management System or for a nominal handling charge.

Tellus Border is a €5 million mapping project that will collect scientific data on soils, water and rocks across the six border counties - Donegal, Sligo, Leitrim, Cavan, Monaghan and Louth. Information from the project will help manage the environment and support sustainable development of our natural resources. The project is a follow-on from the Tellus project successfully completed in Northern Ireland recently. The Tellus Border project team announced the full findings from the project and associated research at their final conference in late October this year. Tellus Border data and data products are now available online at tellusborder.eu

NAGTEC: GSI's involvement in the NAG initiative, a cooperative framework of North Atlantic Geological surveys; has instigated our involvement in the NAGTEC project, a new tectono-stratigraphic atlas and web GIS detailing the development of the North Atlantic. NAGTEC is co-funded by the NAG Surveys and a consortium of oil and gas companies. Final product compilation and reporting is underway ahead of the project's completion in June 2014, when the sponsoring companies will be presented with an A3 atlas and Web GIS that have a moratorium of two and five years respectively. The survey's expert researchers will produce their regional interpretations of various aspects of the evolution of the north Atlantic, in peer reviewed publications. Please see nagtec.org for more information.

IHS Stand

IHS is a global information company with world-class experts in the pivotal areas shaping today's business landscape; energy, economics, geopolitical risk, sustainability and supply chain management. Businesses and governments rely on our products, services and solutions to make faster and more confident decisions. From prospecting to market, energy businesses turn to IHS for analysis, critical information and analytical software to make high-impact decisions that develop strategies with speed and confidence.

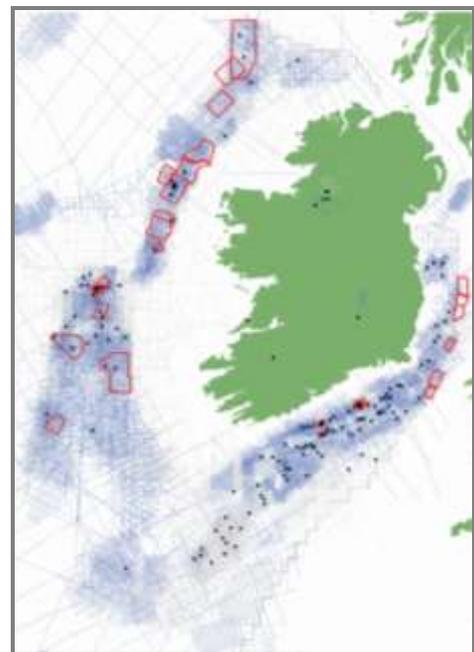
Our International Energy information provides global coverage of energy data sourced through both the public and private domain using an unparalleled communication network with operators, national oil companies, government agencies and service companies. Our data is gathered and reported daily by more than 140 in-country correspondents and experts ensuring that the depth and breadth of our coverage is second to none.

Irish Released Data

As the official and sole data release agent for Ireland's Department of Communications, Energy and Natural Resources, IHS has all the released Irish 2D/3D seismic surveys and well data available, to help you assess an area quickly and cost effectively.

Provided in workstation-ready format, our complete content offering underpins faster and more efficient workflows, to enable;

- Improved understanding of reservoir formation geometry and characterisation
- Accurate delineation of any hydrocarbons present
- Increased accuracy of play fairway analysis
- More effective well planning and reservoir management
- Low risk asset acquisition

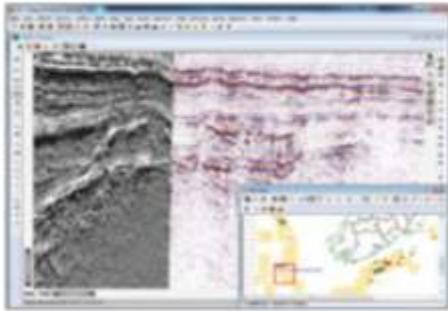


Location of 2D and 3D seismic surveys and wells in Ireland

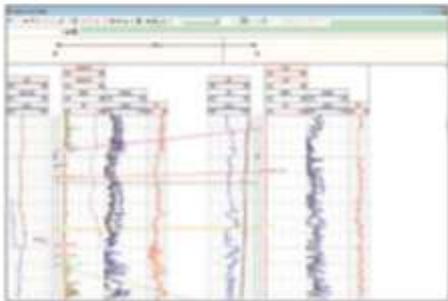
This comprehensive dataset covers all of Ireland's major prospective basins in the following data types:

- **Seismic Data** – Original SEG-Y data, reconstructions of paper/film and IHS Kingdom[®] exported data with navigation in trace headers. Delivered via DVD or hard-drive.
- **Released Well Data** – Scans of original logs and reports in TIFF and PDF format.
- **Digital Well Logs** – Merged and edited into workstation ready LAS format.
- **Digital Well Attribute Data** – Directional Surveys, Checkshot Surveys, Core Header and Analysis Data in workstation ready formats.
- **Pressure Data** – Sourced from well data, all fracture and formation pressures tests and LC/KICK events are interpreted and qualified using IHS flags for QC. All geopressure related drilling events are also captured and categorised before being presented in a consistent and standardised format.

IHS Energy Information and Geoscience Software



2D Irish seismic displayed in IHS Kingdom



Well correlation using IHS Kingdom and Wireline log data

Enhance your interpretations with IHS critical information and IHS Kingdom software.

IHS Kingdom provides geoscientists and asset teams with the breadth of functionality needed for all aspects of their portfolio management from prospect to production. Kingdom provides tools for both quick-look and in-depth geophysical and geological data interpretation, resulting in faster interpretation and modeling, simplified sharing of complex data, and more confident decision making.

In addition, with the new IHS Kingdom Gateway plug-in for Petrel* software, you are now free to use the industry-leading seismic and geological interpretation tools in Kingdom with a seamless connection to the modeling capabilities in Petrel software. Interpreters will no longer have to break their interpretive train of thought to move critical information between Kingdom and Petrel software.

** is a mark of Schlumberger.*



Other IHS Energy Services

IHS Energy is responsible for developing and supporting products to serve the complete oil and gas asset lifecycle. These products include information, software, solutions and insight that are critical for oil and gas professionals to make the decisions needed to manage their assets, from strategic planning through exploration, production and delivery.

IHS Across the Asset Lifecycle



Exploration & Development



Production



Transportation



Refining & Power



Marketing

For more information regarding our subsurface data, energy information or software, please call **+44 (0)1344 328 155** email emea.energy@ihs.com

INFOMAR Stand

Integrated Mapping for the Sustainable Development of Ireland's Marine Resource (INFOMAR) is Ireland's National Marine Mapping Programme, the follow-on project to the Irish National Seabed Survey (INSS), and is a joint venture of the Geological Survey of Ireland (GSI), Dept. of Communications, Energy and Natural Resources and the Marine Institute (Dept. of Agriculture, Food and Marine). This project is currently scheduled to run for a twenty-year period (2006-2026) at c.€4m per annum (€84m) with priority in the first ten years being given to mapping 26 Bays and three Marine Areas. Approval was given in 2006 (2006-08), and the project was included in the National Development Plan (NDP) under the Strategy for Science, Technology and Innovation Programme (SSTI) - Geoscience. Further approval, was given in 2008, for continuance at €4m p.a. funding for the life of NDP to end 2013. The survey is primarily a multibeam sonar survey of an area about ten times the size of Ireland. This acoustic technique is providing detailed bathymetry data and knowledge of the nature of the seabed and overlying sediment. Magnetic and gravity techniques are helping to evaluate the nature and structure of the deeper geology. The primary role of INFOMAR is to acquire baseline information to promote and encourage research in marine science. The survey also represents an opportunity to build up national marine expertise and to disseminate strategically important information to government agencies, third level institutions and the private sector.

Products deriving from INFOMAR are available both in paper and digital form.

Total mapping coverage of the INSS to end of 2005 was 432,000 km² and taken along with an earlier DCENR Petroleum Affairs Division, over 81% of the Irish designated seabed area (at end 2005) had been mapped. There remains a crucially important body of work to follow in mapping commercially valuable inshore and other waters outside the scope of that achieved by the INSS. A range of diverse navigation, environmental and cultural international legislative obligations must also be addressed.

The INFOMAR Programme is intended to address these outstanding issues while also delivering an enhanced data management and delivery service for data gathered under both the INSS and INFOMAR. This data delivery strategy is intended to promote the creation of value added products.

The 26 bays and three priority areas were identified during an extensive stakeholder exercise that was conducted in the period between 2002 and 2005. This exercise included consultation with over 50 organisations, government departments, coastal local authorities, industry sectors and consultancy companies.

The INFOMAR programme is consistent with policy and legislation: In July 2012, the "Harnessing our Ocean Wealth" report sets out the Irish government's vision, high-level goals and integrated actions to enable Ireland's marine potential to be realised. As specified in this policy, INFOMAR represents an important potential enabler of its overarching goals; 1) a thriving maritime economy, 2) achieving healthy ecosystems and 3) increasing the engagement with the sea. INFOMAR serves to support the overarching policy direction of the EU as specified in the European Commission's 'Marine Knowledge 2020' initiative.

Contact: archie.donovan@gsi.ie or Tel +353 1 6782798

ION Stand

THE COMPANY

ION Geophysical Corporation (NYSE: IO) is a leading provider of geophysical technology, services, and solutions to the global oil & gas industry. ION's offerings are designed to allow E&P operators to obtain higher resolution images of the subsurface to reduce the risk of exploration and reservoir development, and to enable seismic contractors to acquire geophysical data safely and efficiently.

OUR STRATEGY

Since our founding in 1968 as Input/Output, a manufacturer of land seismic equipment, ION has evolved to become a leading provider of advanced, integrated geophysical solutions that help oil & gas companies and seismic contractors overcome their greatest imaging and operational challenges.

Proven Innovators

ION has a rich history of innovation. We were the first to commercialise MEMS digital sensors, cableless acquisition technology using digital sensors, and the first to make streamer steering technology available industry wide. Our streamer positioning systems and command & control software have become the industry standards aboard marine seismic vessels. We were at the forefront of multicomponent, wide-azimuth acquisition and processing, and the first to make reverse time migration (RTM) available on a commercial scale. Since 2002, our BasinSPANS seismic data libraries have provided E&P companies a superior alternative to traditional 2D spec data and we are the only company with the technology to acquire seismic data under ice.

Unique Business Model

First and foremost, we are a technology company driven to develop and apply proven, innovative technologies and services to help our clients find and produce hydrocarbons as safely and efficiently as possible. Whether a company is sizing up the prospectivity of a frontier basin or working to extract maximum value from a mature reservoir, our team of experienced problem solvers can help them meet their objectives. Our strategy is to participate in the highest value of all aspects of the geophysical cycle - planning, acquisition, processing, and interpretation.

Major Offerings

ION's offerings can be grouped into six major categories:

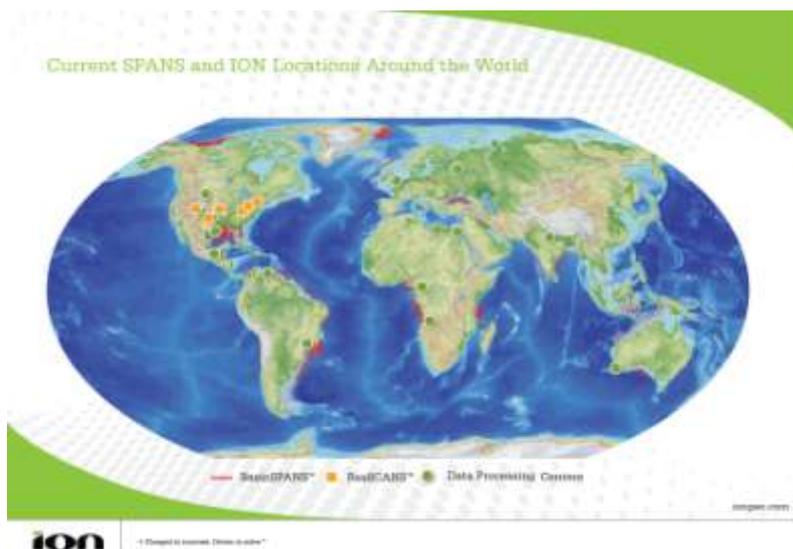
Seismic data processing and reservoir imaging services. By reputation, our GX Technology (GXT) group is one of the most technologically advanced seismic imaging teams in the industry. GXT operates processing service centres in Europe, West Africa, Russia, and the Americas from which we undertake complex imaging projects for oil & gas companies operating in both the marine and land environments. GXT competencies in advanced imaging include data conditioning, pre-stack depth migration (PreSDM), reverse time migration (RTM), tomographic and azimuthal velocity model building, and reservoir fracture detection. The GXT group has a large research effort in the rapidly emerging areas of converted wave and full-wave imaging, including the effects of subsurface anisotropy on recorded seismic data.

Integrated geophysical programs. Where seismic data does not exist or is not sufficient to meet an oil and gas company's imaging objectives, ION's GeoVentures group offers a start-to-finish, integrated imaging solution that includes survey design and planning, acquisition project management, advanced processing services, reservoir characterisation services, and final image rendering. GeoVentures is unique in that we outsource field acquisition to experienced seismic contractors, thereby utilising existing industry acquisition capacity while enabling us to focus on the most value-adding elements of the seismic program. Within a GeoVentures program, ION acts as project originator, "virtual contractor," and advanced imaging services provider.

Seismic data libraries. On many multi-client GeoVentures programs, ION retains the title to the data and is free to license it to others. The majority of the data libraries licensed by ION consist of ultra-

deep 2D lines that oil & gas companies use to better evaluate the evolution of regional petroleum systems. Known as BasinSPANS, these ultra-deep 2D data programs cover virtually all major offshore petroleum provinces. And through our new ResSCAN 3D programs, we are applying the proven BasinSPAN formula of the right technology, the right expertise, and the right business model to help operators reduce development costs in both conventional and unconventional reservoirs.

Survey design software & services. Our software products and advisory services help our customers design their seismic surveys and make the tradeoffs between subsurface image quality and cost. The company has a special competence in designing surveys for the most challenging imaging applications, including full-wave (multicomponent) seismic surveys, imaging projects in desert and Arctic environments, and time-lapse (4D) programs.



Marine seismic data acquisition equipment. ION is one of the leading providers of seismic imaging systems and software for both towed streamer and seabed acquisition. ION's comprehensive toolkit allows for one-stop shopping when outfitting modern streamer vessels or ocean bottom cable (OBC) crews, or when designing and implementing marine 4D programs. Our offerings span streamer positioning and control systems, sources and source control systems, streamer acquisition systems, VectorSeis-based seabed acquisition systems, marine acquisition software, and data integration and quality-assurance services.

Land seismic data acquisition equipment. Since our founding as a land seismic equipment company, ION has been at the forefront of technological innovation in land seismic equipment. In March 2010, ION and BGP (subsidiary of China National Petroleum Corporation) joined forces to form a new and independent company, INOVA. Poised to become the land seismic technology company of the 21st century, INOVA draws upon ION's rich tradition of innovation in land seismic product development, and the practical operating insights BGP has acquired as the world's largest land seismic contractor. INOVA's product portfolio of land seismic acquisition systems, sources, and sensors includes Hawk™, their autonomous node cableless recording system, G3i™, their rugged mega-channel recording system for cable-based acquisition, and their award-winning VectorSeis® digital, full-wave sensor.

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→ Charged to innovate. Driven to solve.™

Irish Lights Stand

The Commissioners of Irish Lights is the General Lighthouse Authority for all of Ireland, its adjacent seas and islands. CIL carry out the obligations of the British & Irish Governments in relation to the provision of Aids to Navigation (AtoN) around the coast of Ireland commensurate with the amount of traffic and degree of risk under the Safety of Life at Sea Convention (SOLAS).

CIL's Vision Statement to provide valuable Aids to Navigation and allied services while delivering an essential public safety service at an economic cost.

In addition, there is an obligation on CIL to inspect and approve the AtoN systems and to audit the subsequent management of AtoNs provided by Ports and Local Lighthouse Authorities. CIL also has obligations regarding the marking or removal of wrecks in areas of general navigation.

The legal basis for the operations of the Commissioners of Irish Lights dates back to an Act passed by the Irish Parliament sitting in Dublin in 1786 which set up a body called "The Corporation for Preserving and Improving the Port of Dublin". Various Acts were passed over the years and in 1867 a new Act separated the Port of Dublin Corporation from the Corporation for the Preserving and Improving the Port of Dublin. It was not until 1935, following Irish independence, that the functions of Irish Lights were finally regularised when adaptations were made by an Order of the Executive Council, entitled: Irish Lights Commissioners Adaptation Order, 1935.

The cost of the Service to mariners is met from the General Lighthouse Fund which derives its income mainly from light dues that are charged on commercial shipping calling at UK and Irish ports. The Irish Government contributes to the Fund under the terms of an agreed formula. The Irish Lights service is part of an integrated system of Aids to navigation around the coasts of Britain and Ireland. Trinity House and Northern Lighthouse Board are our sister providers.

Irish Lights affairs are run by a Board of 12 Commissioners, 4 Officials from Dublin Corporation, the Chief Executive and 4 Heads of Department.

Irish Lights is now based at Dun Laoghaire on Dublin Bay where the workshops, buoy yard and administration are all located on the same site. From here Irish Lights oversee the provision and maintenance of lighthouses, buoys, beacons and radio aids to marine navigation. There is a 24 hour monitoring service of the major AtoNs from this site. A contracted helicopter is used to transfer maintenance teams to and from offshore lighthouses. The dedicated vessel *Granuaile* is deployed to maintain and service the AtoNs provided, mainly buoyage, but is also engaged in project support, lighthouse replenishment, surveying and wreck marking or removal. *Granuaile* is also a strategic asset of the Irish State and is available for appropriate commercial contracts.

Contact:

Dave Ward,
Commercial Services Manager,
Commissioners of Irish Lights,
Harbour Road,
Dun Laoghaire,
Ireland
Tel: 01 271 5400
Email: dave.ward@cil.ie

La Tene Maps Stand

La Tene Maps is a knowledge based company based in Dublin, Ireland specialising in the research and production of maps, educational posters and associated data products. The company works mainly in many natural resource and energy areas including Aquaculture, Fisheries, Oil and Gas Exploration, Renewable Energy, Electricity and Power Generation.

We produce and publish a range of maps and posters for clients and ourselves. The company has a whole series of maps covering many parts of the world.

The company is also involved in production of confidential maps and graphics for clients and also sells a small range of maps and posters produced by itself and other companies through its secure online store.

The company's research arm is active in its own right and participates in EU research projects as well as research projects for Government departments, state bodies and private companies.

La Tene Maps has produced every full colour map on the Irish Oil and Gas exploration sector since the mid 1980s. At the 2013 Atlantic Ireland conference and exhibition the company will be displaying some maps on Irish natural resources including maps on mineral exploration and the latest edition of the "Ireland and the Irish Sea – Oil and Gas Exploration" an Oil and Gas Concession map for the Irish and West British Sectors. Also on display will be draft copies of the new "Onshore Britain – Oil and Gas Exploration and Production" and a new map which looks at North Sea Oil and Gas Production /Decommissioning.

Printed Oil & Gas exploration maps published by La Tene Maps are available free to bone-fide team members with operators or consortia members working in areas covered by the map. The maps are also distributed free at various conferences and exhibitions. Printed, Digital Print and pdf files are available for purchase by all interested persons.

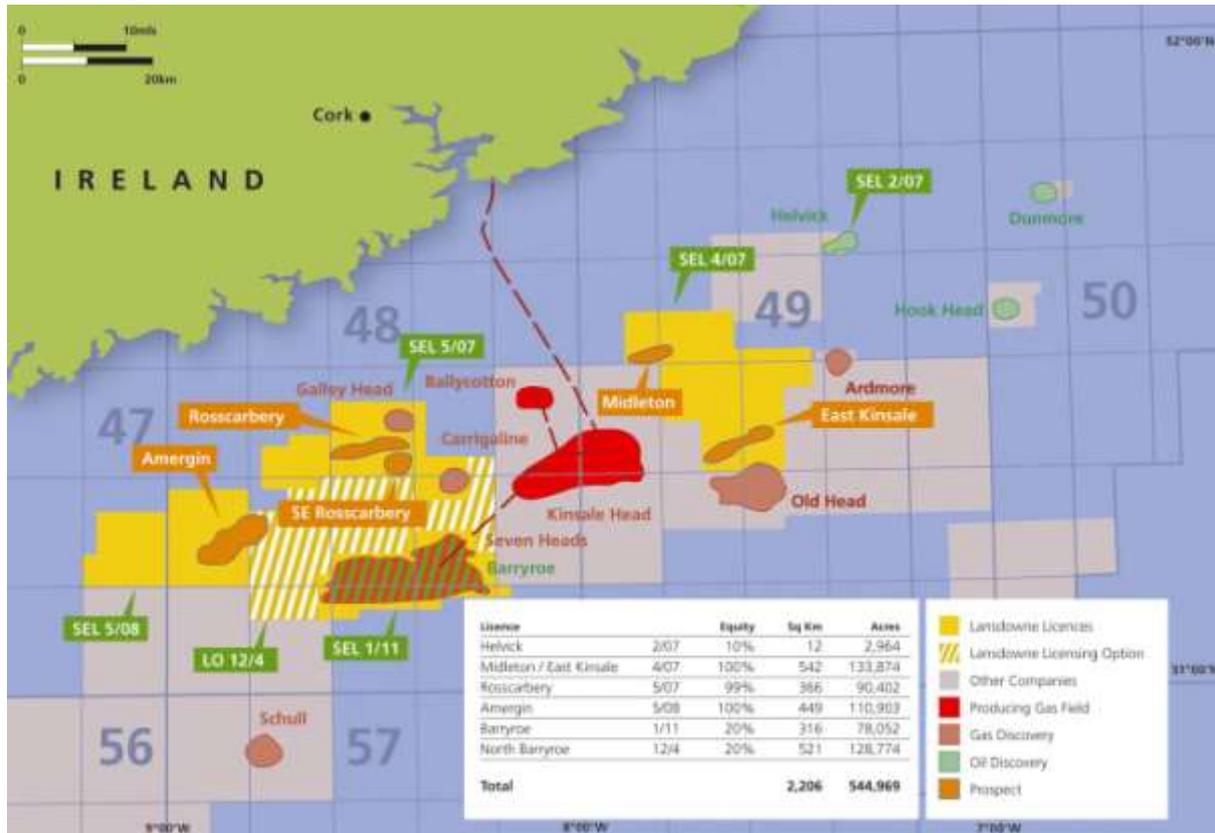
For further information on our capabilities and/or the maps we produce contact:

John Coleman, La Tene Maps
Station House, Shankill, Co, Dublin
Tel: +353 12847914 E: johncoleman@latene.com W: www.latene.com

Lansdowne Oil and Gas Stand

Lansdowne Oil and Gas Stand

Lansdowne Oil & Gas plc holds rights, through its wholly owned subsidiaries, to five Standard Exploration Licences and one Licensing Option in the Irish offshore. Lansdowne continues to apply a technically focused approach to exploitation of its extensive licensed areas in the North Celtic Sea Basin (“NCSB”), off the south coast of Ireland.



Lansdowne holds a 20% equity interest in the Barryroe Oilfield operated by Providence Resources. In 2012 the 48/24-10z Barryroe appraisal well successfully tested at a stabilised rate of 3,514 bopd and 2.93 mmscfd. Independent CPR estimates of Barryroe have yielded total gross on-block 2C recoverable resources of 346 MMBOE (69 MMBOE net to Lansdowne).

Recent improvements seen in seismic imaging through modern 3D seismic acquisition and processing techniques places Lansdowne in an advanced position to explore for additional commercial oil and gas fields in all its licensed areas.

Lansdowne has matured both oil (Amergin) and gas (Midleton and Rosscarbery area) prospects to be ready to drill and discussions with potential farm-in joint-venture partners are ongoing.

Marine Institute Stand

The Marine Institute is Ireland's national agency responsible for Marine Research, Technology Development and Innovation (RTDI). They seek to assess and realise the economic potential of Ireland's 220 million acre marine resource; promote the sustainable development of marine industry through strategic funding programmes and essential scientific services; and safeguard our marine environment through research and environmental monitoring.

The Marine Institute worked in partnership with the [Geological Survey of Ireland](#) (GSI) on the [Irish National Seabed Survey](#) (INSS), a multimillion European initiative supported by the Irish government. The survey aimed to map Ireland's 220 million acres of territorial seafloor, a natural resource that is approximately ten times the size of Ireland's land area.

Phase 1 of the Irish National Seabed Survey (INSS) is now complete, and they are currently in Phase 2: Integrated Mapping for the Sustainable Development of Ireland's Marine Resources (INFOMAR). While Phase 1 concentrated on outer deep-sea territorial waters, Phase 2 has moved inshore to coastal waters. INFOMAR aims to map the remaining 13% of the Irish territorial seafloor, concentrating on specific areas of interest such as priority bays and areas of biological interest.

The Marine Institute operate two Research/Survey vessels, the 65 m RV Celtic Explorer and the 31 Meter RV Celtic Voyager. The Institute also operates a 3000m rated work class ROV. The Marine Institute has provided a range of turnkey survey services to the oil and gas industry utilising both vessels over the past ten years including Analogue and HR digital site surveys, Acoustic Pipeline inspection surveys, ROV Pipeline and cable surveys, Pipeline route surveys, Geotechnical surveys and environmental surveys .

For further information please contact :

Aodhan Fitzgerald

Research Vessel Operations

Marine Institute

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Mott MacDonald Stand

Mott MacDonald's offshore heritage dates back to the early 1960s when our team of engineers and specialists was designing platform topsides for the North Sea for Shell. Today we have main oil and gas offices in London, Abu Dhabi, Oman, Dubai and Mumbai and work on onshore and offshore facilities and pipelines at all stages of development. Mott MacDonald also have offices in Dublin and Cork.

ATLANTIC IRELAND 2013

For Ireland, we have completed development planning, concept identification and definition, cost estimating, safety, risk and environmental assessment for the Atlantic margins, Irish Sea and Celtic Sea. We have recently worked for Providence Resources, Bluestack Energy, Kinsale Energy, San Leon and ISPSG/PIP.

For more information please contact guy.woodason@mottmac.com

PAD / DCENR Stand

The role of Petroleum Affairs Division (PAD)

The core role of the Petroleum Affairs Division of the Department of Communications, Energy and Natural Resources (DCENR) is to develop and implement policies which have the aim of maximising the benefits to Ireland from exploration for, and production (E&P) of, Ireland's indigenous oil and gas resources, while ensuring that activities are conducted safely and with due regard to their impact on the environment and other land/sea users.

DCENR seeks to achieve this through a range of strategies which have the following key objectives:

- maximising the level of oil and gas exploration and production activities in Ireland with a view to optimising the return to the State.
- ensuring that the regulatory framework in place is robust, clear, promotes certainty and is in keeping with international best practice, while encouraging exploration, development and production activities to be carried out in an effective and timely manner.
- maximising the area of continental shelf under Irish jurisdiction.

In pursuing these strategies it is DCENR's aim to achieve the twin objectives of contributing to ensuring Ireland's security of energy supply while providing a fair financial return to the State from its natural resources.

The Petroleum Affairs Division of DCENR is responsible for promoting the opportunities for the private sector to invest in oil and gas E&P in Ireland and regulating such activity through its licensing terms and conditions. The Department actively promotes Ireland as an attractive location for international investment building on the outputs of applied research projects and focused interpretative reports, together with the release of basic geological, geophysical and well data to the industry.

DCENR's regulatory approach is primarily focused on ensuring effective and timely exploration. The department seeks to achieve this by agreeing appropriate work programmes with operators and monitoring delivery of the work programmes to ensure that they are carried out in full and in accordance with best industry practice, having particular regard to safety, the environment and other land/sea users.

The PAD/DCENR Stand will display a series of posters covering promotion of exploration in Ireland's waters.

The Integrated Petroleum Affairs System (IPAS) (www.pad.ie/ipas) provides access to information relating to authorisations, wells, potential field and seismic surveys using search screens or through map interface.

Petroleum Geo-Services Stand

Petroleum Geo-Services (PGS) offers a broad range of products including; seismic and electromagnetic services, data acquisition, processing, reservoir analysis/interpretation and MultiClient library data. We help oil companies to find oil and gas reserves offshore worldwide, utilising the industry's most advanced acquisition technology to yield a clearer image.

Overview

PGS was founded in Norway in 1991, with two seismic ships and some highly innovative ideas on how to reshape the industry. Today we share the same drive to innovate as inspired our founders, though the team is bigger:

- 13 offshore seismic vessels
- 21 data processing centres
- 35 offices worldwide, employing over 70 nationalities

PGS has a presence in over 22 countries with regional centres in London, Houston and Singapore. Our headquarters is in Oslo, Norway and the PGS share is listed on the Oslo stock exchange (OSE:PGS).

PGS possesses the world's most extensive 3D MultiClient data library comprising over 586,000 sq km* worldwide. Additionally the developing MultiClient 2D portfolio (over 350,000 line km*) is available in frontier and developing hydrocarbon areas and includes a growing proportion of GeoStreamer® data that demonstrates excellent imaging qualities. PGS MultiClient products also include the MegaSurvey, MegaSurveyPlus, and MegaProject data packages which provide contiguous 2D and 3D coverage across vast areas.

Recent work by PGS in Ireland has focused on the Atlantic Margin MegaProject -- a large database of 2D and 3D seismic data which has been assembled from released datasets and PGS MultiClient surveys. All the data has been matched, merged, and balanced to provide a regionally consistent, coherent seismic dataset. The Atlantic Margin MegaProject is being offered for licensing and includes 4,700 sq km of high-end 3D MultiClient data, a comprehensive 2D data package, and four regional gridded horizons.

Another recent 3,500 line km MultiClient 2D program in the Fastnet Basin involved simultaneous acquisition of high quality broadband seismic and towed streamer EM.

*Total acreage cited above includes data acquired with third parties.

Contact:

Petroleum Geo-Services

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Physicalgeo Stand

We are a small yet dynamic and driven oil and gas consultancy based in Berkshire. Our focus is on quality geoscientific commercial consulting, non-exclusive reports and software provision.

The principal consultant, Andre Stout, has been serving the community for over 14 years, for majors, minnows and all in between. He has a track record as an oil finder and is in high demand for his services.

Andre has worked on the Atlantic Margin from the Barents Sea to West Africa for companies such as Shell, BP, Chevron, Total, Maersk, Tullow and Nexen. He is familiar with the elements required for successful evaluation of potential; from field development and appraisal through to new basin entry.

Andre is a member of the SEG, EAGE and PESGB.

Contact Andre directly on andre@physicalgeo.com

Further business support is provided by Alison Egan, a marketing specialist with a history of excellent client management. She initially trained in Retail Management and followed this with a Diploma from the Chartered Institute of Marketing.

Contact Alison directly on alison@physicalgeo.com

Other specialists in the oil and gas industry are brought in as required, from data analysts to commercial engineers, using a network of trustworthy contacts.

South Porcupine Basin: Seismic interpretation and evaluation of prospectivity

In order to support the industry in the 2011 license round (closed May 31st 2011) and two high profile farm-in opportunities, Physicalgeo have prepared a comprehensive evaluation of this untested Mesozoic rift basin. We have accessed ALL available seismic data (100,000km+) over this huge area and are in a unique position to support you in your evaluation of this exciting province.

The South Porcupine Basin, sometimes known as the Porcupine Seabight Basin, is a deepwater basin, 150km to the southwest of the Irish coast. Similar petroleum systems are present to those found in the shallower water North Porcupine Basin, where oil and gas fields have been discovered. Crucially, there is potential for better reservoir quality and more numerous source rocks than found in the North Porcupine Basin. Although oil, gas and seismic amplitude anomalies do exist in this basin, proving a working petroleum system at many levels.

Also, the Porcupine Basin is NOT affected by the level of igneous intrusives as seen in other Atlantic Margin basins. The 'igneous' provinces recognised by previous authors are potentially structural features, salt intrusions and mud volcanoes!

PIP Stand

The Petroleum Infrastructure Programme (PIP) was set up by the Petroleum Affairs Division (PAD) of the Department of Communications Energy and Natural Resources (DCENR) in 1997. The ISPSG Group, the successor to the joint industry Rockall Studies Group and Porcupine Studies Group, was set up in 2002 and concentrates on the regional exploration elements of the PIP objectives with an aim to address common industry problems anywhere in the Irish Offshore.

The overall aim of PIP is to promote hydrocarbon exploration and development activities by:

- Strengthening of local support structures
- Funding of research data gathering and 'land-based' research in Irish offshore areas
- Providing a forum for co-operation amongst explorationists and researchers

Research under the Programme goes beyond normal licence area-specific work and is designed so as not to duplicate the efforts of other groups or of commercial contractors. It is also considered essential that local researchers should be given an opportunity to participate in the research projects. PIP is funded by oil companies with licences offshore Ireland and the PAD.

Project Proposals were sought this summer under the following Themes:

- Regional geological and geophysical data gathering and studies aimed at improving knowledge of petroleum systems and exploration potential;
- Special engineering studies to improve Exploration and Production cost effectiveness and recommendations on better procedures and practices;
- Environmental studies.

Some 40 project proposals were received and are currently being evaluated. The results of this "PIP Open Call" should be available by end November 2013. For further information on the Petroleum Infrastructure Programme, please visit the website - www.pip.ie

Dunquin

Eirik Raude

Drilling Operations 2013



Barryroe

GSF Arctic III

Drilling & Testing
Operations 2011/2012



Barryroe

Polarcus Samur

Seismic Operations 2011



Spanish Point

BOS Angler

Seismic Operations 2009



RPS Group Stand

RPS is an international consultancy providing advice upon the exploration and production of energy and other natural resources and the development and management of the built and natural environment. We employ 5,000 people in Ireland, the UK, the Netherlands, the United States, Canada, Brazil, Africa, the Middle East, Australia and Asia. (www.rpsgroup.com)



In Ireland, RPS is the leading environmental and oil and gas exploration consultancy. We have over 500 staff and eight offices throughout the country. Our international presence allows us to undertake co-ordinated and integrated projects throughout the world.



RPS provides integrated technical, commercial and project management support services in the fields of geoscience, engineering and HS&E. We help clients develop natural energy resources across the complete asset life cycle, combining technical and commercial skills with a wide knowledge of environmental issues.

We have an annual portfolio of over 500 projects, a client-focused organisation, adapting to clients' needs and provide a world-class flexible service to deliver projects on time and within budget.

Operations Support



operations management.

For almost thirty years, RPS Energy (www.rpsgroup.com/energy) and its predecessors have provided a full range of operations support for international oil & gas projects. This includes projects in renewables and nuclear energy. The wide ranging expertise and experience of this group is a world-class resource that allows us to support the operations behind the exploration for, and development of, energy assets around the world, from consenting and licensing support, environmental support, geotechnical services, MetOcean, health and safety, technical support and project or

Technical Studies

RPS has worked in almost every petroleum basin in the world and has been involved in every Irish exploration operation since 2010. Every year we undertake hundreds of projects ranging from niche specialist work to large multi-disciplinary exploration and development studies. These include geophysics, petrophysics, biostratigraphy, reservoir engineering, sedimentology and sequence stratigraphy.



Advisory



RPS provides independent, technically-informed advice and management support, using experienced consultants to work individually or with our clients' teams. Whether working on business process or specific assets and portfolios, we can provide support across the complete oil & gas value chain, from E&P through to downstream strategy development projects. RPS also supports country entry, policy and fiscal development and regional and strategic assessments.

Integrated Risk Management Solutions

RPS Integrated Risk Management Solutions provides specialist HSE & risk management consultancy services to the energy industry and other major hazard industries. We specialise in the management of health, safety, environmental, social, security and other related business risks in the oil and gas, nuclear and renewable sectors.

Marine and Coastal Services

RPS is a leading provider of marine and coastal consultancy services to both public and private sectors. Our team of experts have extensive experience of holistic assessments in seas, coasts and estuaries, assisting developers with advice on all phases of a project lifecycle.

We undertake management of large-scale multi-disciplinary projects and we provide survey and consultancy support for planning applications, consents issues under the environmental permitting regulation (EPR) and marine construction consents through environmental impact assessments where required. We have a team of over 50 marine and coastal experts based in 10 offices across the UK and Ireland (www.rpsgroup.com/ireland), as well as marine teams based in Australia, the US and Canada making RPS well placed to take on any project.

Services include policy development and appraisal; planning and development control; conservation and biodiversity protection; risk, impact and liability assessment; environmental survey and monitoring; physical processes and modelling; coastal and marine engineering; economic, socio-economic and financial analysis; stakeholder engagement, and spatial analysis and data support.



Training Programmes

RPS has historically delivered training courses in our core discipline areas and as part of our knowledge transfer commitments, usually associated with the technical studies we undertake.

In 2011, Nautilus joined the RPS Group adding industry leading training capabilities across the E&P value chain. Training services can be accessed through scheduled programmes, or alternatively bespoke programmes, including competency assessment and capability development consultancy, can be built to meet specific client requirements (www.nautilusworld.com).

www.rpsgroup.com

Serica Energy Stand

Serica Energy plc is an oil and gas exploration, development and production company with activities in Europe and Africa. The Company is development operator for the Columbus gas-condensate field in the UK North Sea and is exploring for oil and gas in the UK North Sea and East Irish Sea, as well as in the Atlantic margin offshore Ireland, Morocco and Namibia, which it sees as emerging new play areas.

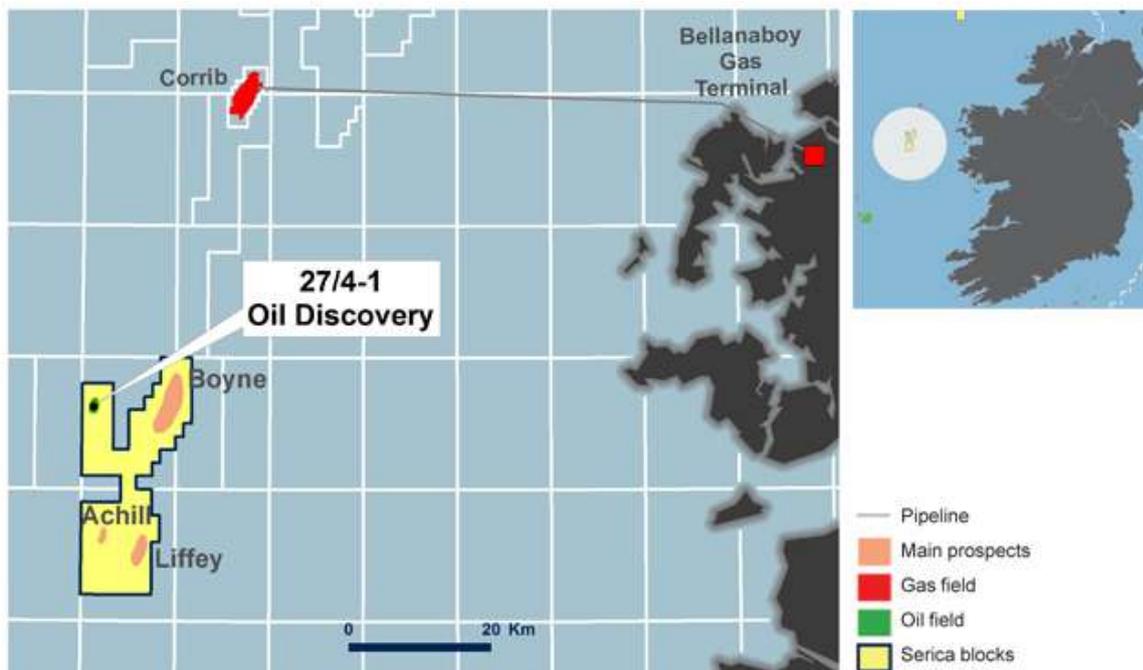
Serica is listed on the London Stock Exchange and on the Toronto Stock Exchange in Canada, with the share symbol “SQZ” on both markets.

Serica Energy in Ireland

Serica Energy (UK) Ltd holds three licences in offshore Ireland; FEL 1/06, FEL 1/09 and LO 11/1.

FEL 1/06

Bandon Oil Discovery; Boyne, Achill and Liffey Prospects

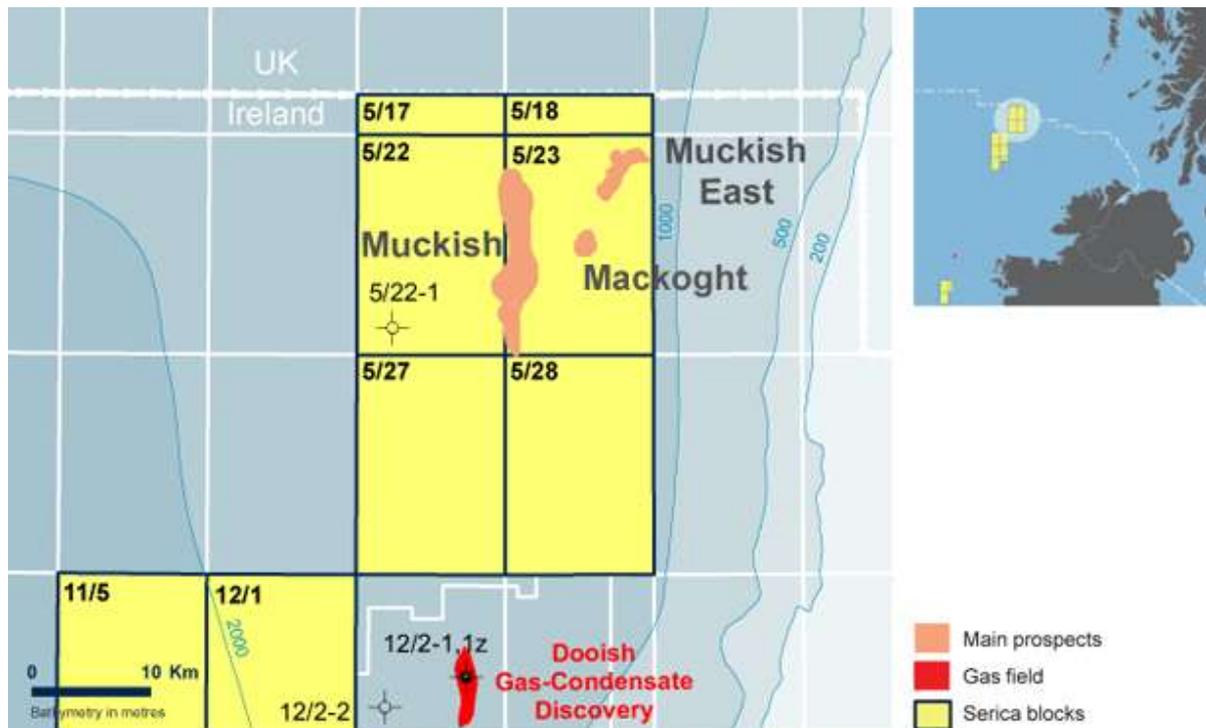


Serica was awarded Licence FEL 1/06 in December 2006, comprising blocks 27/4, 27/9 and part block 27/5, in the Slyne Basin off the west coast of Ireland. Following a mandatory 50% relinquishment (confirmed in September 2012), Licence FEL 1/06 now covers an area of approximately 305 square kilometres. The blocks lie some 40 kilometres south of the Corrib Field.

As the result of reprocessing approximately 500 square kilometres of 3D seismic, four large Sherwood sandstone gas prospects were originally mapped, Bandon, Boyne, Achill and Liffey. In December 2008, Serica completed a farm-in agreement with RWE, under which RWE acquired a 50% interest in FEL 1/06 in return for drilling the first exploration well. Well 27/4-1 was spudded on 11th May 2009 to test the Bandon prospect and reached a total depth of 1900 metres in the Sherwood sands. No gas was found but an oil accumulation in shallower high-quality Jurassic sands was encountered and a sidetrack well 27/4-1z was drilled to confirm the discovery. Oil samples were taken in both wells for analysis. The discovery of oil has opened a new oil play in the Slyne Basin and enhanced the prospectivity of the blocks. Two deeper Jurassic oil prospects have now been identified at Boyne and Liffey, each with an underlying gas prospect in the Sherwood as proven by the Corrib field.

FEL 1/09

Muckish Prospect



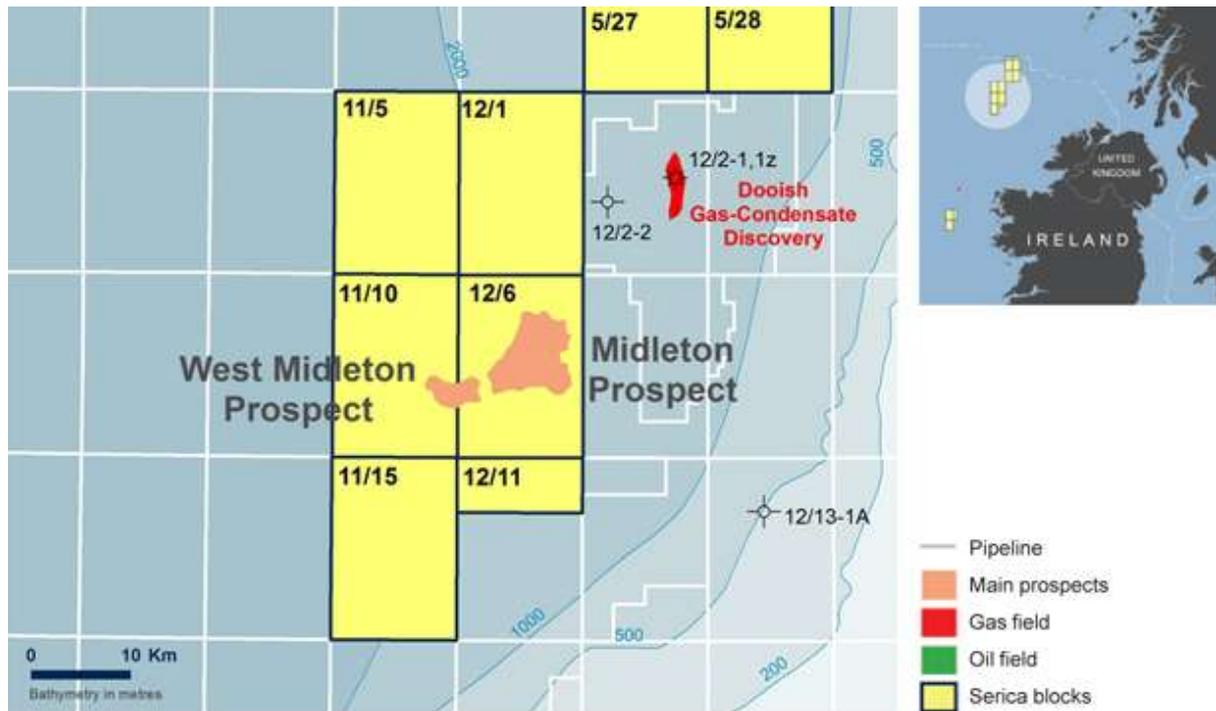
These six blocks (collectively licence FEL 1/09) were awarded to Serica in July 2009. The licence covers a total area of 993 square kilometres and lies in the north-eastern part of the offshore Rockall Basin. The Rockall Basin has an areal extent of over 100,000 square kilometres in which only three exploration wells in the Irish sector have been drilled to date; the basin is therefore highly underexplored.

FEL 1/09 contains a very large pre-Cretaceous fault block prospect (Muckish) covering an area of 31 square kilometres in a water depth of 1,450 metres. Although wet gas or gas-condensate is considered to be the most likely hydrocarbon phase that could be found, oil is also possible. Muckish is analogous to the nearby gas-condensate bearing Dooish structure drilled by Enterprise in 2002, which encountered a 214 metre hydrocarbon column. Two further prospects, Muckish East and Mackoght have also been identified in the licence area and are obvious follow-up prospects in the event of success at Muckish. Serica has acquired 2D long-offset seismic lines and reprocessed the existing 3D seismic volume, which has helped de-risk the Muckish prospect as it demonstrates that it has distinct similarities to the nearby Dooish discovery. Serica is commencing plans to drill the Muckish prospect and is actively seeking partners to share the drilling cost.

LO 11/1

Midleton Prospect

Licence LO 11/1 covers Blocks 11/5, 11/10, 11/15, 12/1, 12/6 and 12/11 (part), an area of approximately 1,230 square kilometres in the Rockall Basin, south-west of the Dooish Discovery. The blocks contain two large pre-Cretaceous fault block prospects mapped on 3D seismic data, Midleton and West Midleton. These prospects complement the Muckish prospect lying in Serica's acreage just to the north-east in FEL 1/09. Serica is currently awaiting approval to convert the licence option to a Frontier Exploration Licence



Spectrum Geo Stand

Company Overview

Spectrum is established as a key player in the seismic services market. The company focuses on delivering high-quality Multi-Client seismic data and holds one of the world's largest 2D marine libraries.

Spectrum is one of the seismic industry's fastest growing companies. The Spectrum group seeks to build on the company's reputation as a reliable seismic service provider and serves a global clientele from offices strategically located throughout the world.

We provide innovative Multi-Client seismic surveys and high quality Seismic Imaging services to the global oil and gas industry from offices in the UK, USA, Norway, Brazil, Australia and Singapore. The Spectrum group also includes substantial regional processing centres in Egypt and Indonesia, all with complete data processing capabilities.

The Spectrum library of Multi-Client data specialises in regional coverage and includes projects from many of the foremost oil producing regions of the world. Our experienced teams of geoscientists integrate seismic interpretation with well data and remote sensing information (gravity, magnetic, SAR seep, electro-magnetic, etc) to evaluate the hydrocarbon potential of the basins we work in. This information helps us to plan future Multi-Client projects targeting key plays and solving the imaging problems to provide a valuable exploration tool to our clients.

The company strategy focuses on both the major, established hydrocarbon-producing regions of the world in addition to key frontier areas identified by our experienced team of geoscientists. Data comprises new acquisition, reprocessing and interpretation reports. New projects are carefully selected to ensure they are relevant to future hydrocarbon exploration. The Multi-Client department often works closely with local governments to commission new surveys or reprocess archived data to successfully rejuvenate exploration interest within a region.

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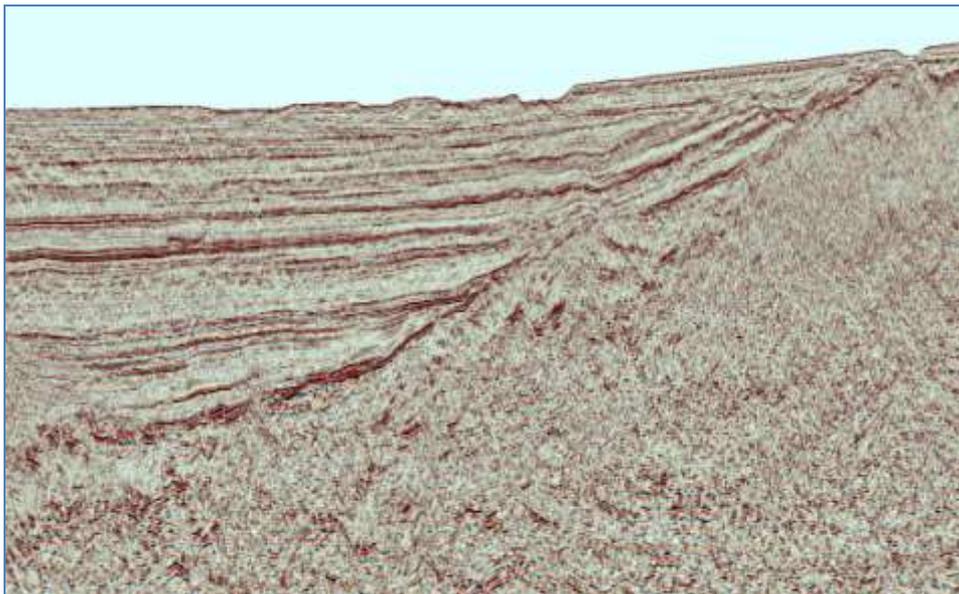
Ireland Multi-Client Coverage

The Spectrum Multi-Client library comprises over 1.2 million kilometres of high quality 2D and 3D marine seismic data. This includes significant coverage across the Atlantic Margin, off the Irish coast. Spectrum holds eight 2D Multi-Client surveys in total which exceed 14,000 km over the Porcupine, Erris and Rockall Basins. Much of this 1990's vintage data has since undergone modern seismic reprocessing including the Porcupine and ISROCK surveys which were updated as recently as 2013.



Spectrum Multi-Client coverage across Ireland

The deep water offshore Atlantic Margin of Ireland (Porcupine, Erris and Rockall Basins) is a vast underexplored area, with significant hydrocarbon prospectivity. Discoveries have already been made in the North Porcupine Basin, and the nearby Slyne Trough, plus along the UK Western Margin to the north. Conjugate basins offshore Canada have also yielded hydrocarbon discoveries. It is therefore highly likely that there are large remaining undiscovered accumulations in reservoirs of Triassic, Jurassic, Cretaceous and Tertiary age.



Spectrum reprocessed PSDM seismic example in the Porcupine Basin

For more information please contact: mike.johnson@spectrumasa.com

+44(0)1483 730201

www.spectrumasa.com

TGS Stand

TGS provides multi-client geoscience data to oil and gas Exploration and Production companies worldwide. In addition to extensive global geophysical and geological data libraries that include multi-client seismic data, magnetic and gravity data, digital well logs, production data and directional surveys, TGS also offers advanced processing and imaging services, interpretation products, permanent reservoir monitoring and data integration solutions.

- Multi-client seismic data
- Magnetic and gravity data
- Digital well logs
- Production data
- Directional surveys
- Advanced processing
- Imaging services
- Interpretation products
- Sequence stratigraphic studies
- Permanent reservoir monitoring
- Data integration solutions

TGS specialises in planning, acquiring and processing multi-client geophysical data in major and emerging offshore exploration plays worldwide. Resources are centred on a core collection of multi-client exploration data products. These data sets are diverse in location, acquisition technique and specifications and are united by a common approach to quality assurance, advanced processing and expertise. TGS' 2D and 3D seismic library is among the strongest, most highly regarded in the region. Gravity and magnetic data products complement the regional interpretation.

TGS has a large geophysical database in Ireland including:

- Over 15,000 km of multi-client seismic data
- Facies Map Browser
- Seep data

These data provide the exploration tools for evaluating open acreage. Examples from TGS' long offset database are on display in the booth.

For more information, contact

TGS

Email: EURsales@tgs.com

<http://www.tgs.com/>

Schlumberger Multiclient Stand

With more than 40 years of experience in seismic data acquisition, processing, and imaging, Schlumberger Multiclient offers the industry's most comprehensive 2D and 3D multiclient seismic data library of the world's major hydrocarbon basins.

Our library addresses all geophysical and geological challenges from basin-scale 2D surveys to full-azimuth broadband 3D prospecting and appraisal surveys.

Schlumberger Multiclient offers an integrated approach to multiclient surveys. Our services range from survey design and modelling to incorporation of multiple measurements and geological knowledge into a shared earth model, and they often employ the most advanced imaging techniques on the market today.

Schlumberger Multiclient experts work in industry-standard Petrel and Omega integrated software platforms, enabling clients to interact with the data and collaborate with our geologists and geophysicists during the imaging stages of projects.

POSTER ABSTRACTS (in alphabetical order)

Ocean wave generated microseisms in the NE Atlantic: An emerging passive seismic imagery tool

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Introduction

Microseisms are continuous background 'low-frequency' seismic signals, detectable throughout the world on land-based (terrestrial) broad-band seismic stations. They show preferential levels of power in discrete frequency bands. 'Secondary' microseisms are the most energetic and occur at seismic periods of 10 sec to 5 sec (frequencies of 0.1 to 0.2 Hz). They are caused by pressure fluctuations on the sea floor generated by ocean wave-wave interactions.

Traditionally regarded as a source of seismic noise, recent advances have led to three clear practical applications in microseism studies. (i) There are clear correlations between microseism excitation amplitudes and ocean wave activity and they can, under certain conditions, be used as a proxy for ocean wave height. That is, we can estimate wave heights from land-based seismic stations. (ii) They can be used to estimate ocean wave generated forcing variations on the sea floor and, through locating spatially varying microseisms, they can be used to estimate the temporal and spatial variability of ocean wave related sea floor interactions (and identify areas where these interactions are strongest, for example, with potential implications for geohazards). (iii) They can be used to construct seismograms for seismic imagery, without the need to 'shoot' seismics.

Using microseisms as an imaging tool

Point (iii) above is part of a current revolution in seismology. Put simply, it is possible to construct 'seismograms' between two seismic stations (A and B, say) merely by cross correlating the microseism noise recorded at both stations (A & B), at the same time. The resulting seismograms are equivalent to shooting an impulsive source at the location of station A, and recording that shot at station B. The microseism generated 'A to B seismograms' are not perfect reconstructions as, theoretically, the microseism sources should completely surround stations A & B (or the seismic wavefield should be scattered such that it has been effectively homogenised). As the NE Atlantic is known to be one of the dominant microseism source regions in the world, it is clear that microseism sources are not, in general, uniformly distributed in space and hence the conditions above are not fully satisfied.

Microseism studies in Ireland

As outlined, the NE Atlantic is a world hotspot for microseism generation. Under the SFI funded WaveObs project and the UCD Earth Institute's ENS PhD programme we are studying microseisms on specifically installed broadband seismic networks in Ireland. Our aims are (i) to use terrestrially recorded microseisms as a proxy for Ocean Wave height estimations and (ii) to use Ireland as a test bed for studying the limitations of seismogram reconstructions based on microseism correlations at land-based stations. Figure 1 shows an example of the locations of dominant microseism generation through ocean wave interactions with the sea floor for May 2012. It is clear that the microseism sources are not homogeneously distributed in space.

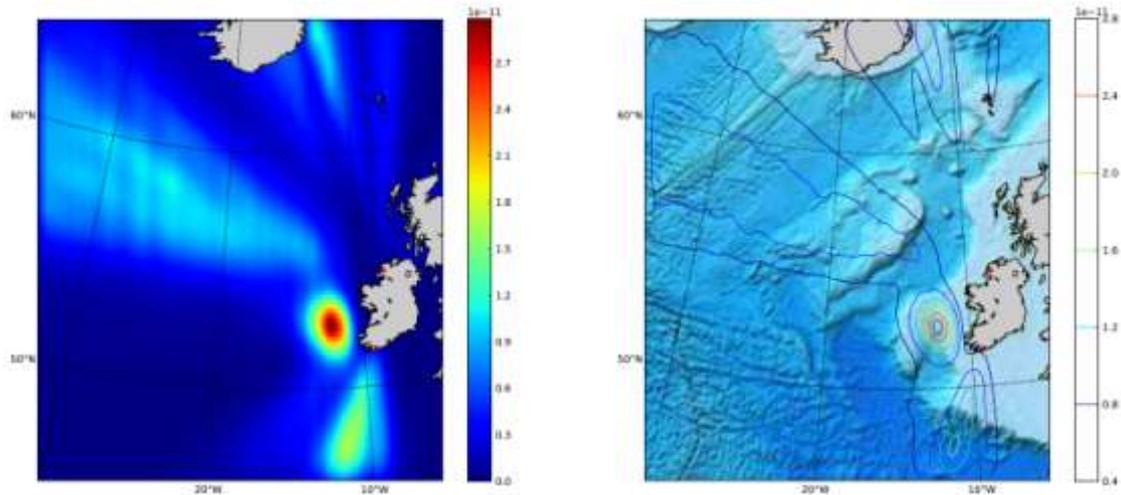


Figure 1 Two representations of the dominant location of microseisms for May 2012. These are located using ‘backazimuth pointing’ from two arrays (clusters of 7+ broad band seismic stations) deployed in Donegal and Cork (marked with red dots). The Northern Porcupine Seabight is an area with strong ocean-seabed interactions. NOTE: for other time periods the sources can be predominantly located in other places (not only the Porcupine).

As can be seen from Figure 1, the microseism sources are not randomly distributed, as required for the full reconstruction of seismograms through microseism cross-correlation. We have begun to use Ireland as a test bed to better understand the consequences of this finding for seismogram reconstruction and hence for seismic imagery using reconstructed seismograms. Ireland is an ideal location for this type of study because of its close proximity to variable and strong microseism noise sources in the NE Atlantic. Figure 2 shows initial results for seismograms reconstructed through cross-correlating recorded microseism noise at various seismic stations (elements) from an 11 element array in Co Donegal. As can be seen in these initial tests, whilst seismograms are partially recovered, they vary as a function of the direction of the noise sources (backazimuth), a variable which must be considered when assessing the quality of the ‘noise correlation’ seismograms.

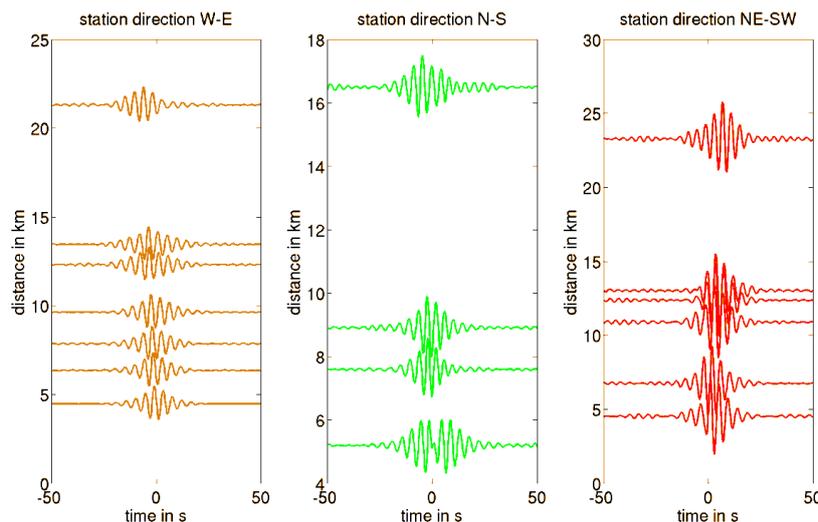


Figure 2. Seismograms recovered through cross correlation functions calculated with one day of data from the Donegal array, sorted by interstation direction. Different waveforms for different directions can be seen because the microseism noise sources are not uniformly distributed.

The thermal history of the Western Irish onshore

Cogné, N.¹ and Chew, D.¹

¹ *Trinity College Dublin*

The thermal history of a passive margin yields key information on its tectonic evolution, as phases of tectonic activity (e.g. exhumation or burial) can be inferred from periods of enhanced cooling or heating. Constraining the timing of these thermal pulses onshore improves our understanding of the evolution of the adjacent offshore basins. We present here the results of a thermochronological study (apatite fission track and U-Th/He dating) on selected targets along the western coast of Ireland. We performed four vertical thermochronology profiles in Counties Kerry, Mayo and Donegal. Such an approach allows us to detect smaller (and younger) phases of cooling / heating compared to previous studies.

The fission track and U-Th/He ages range from the Late Jurassic to Early Cretaceous. Inverse modelling of the ages and track length data shows that during post-Variscan exhumation the samples cooled to temperatures of around 80°C. A rapid cooling event (down to temperatures as low as 20°C) occurred during the Late Jurassic and this event is attributed to rift-related exhumation (Fig. 1). This demonstrates that much of the present-day topography in Western Ireland developed due to rift-shoulder uplift linked to the main phase of Mid-Late Jurassic extension in the Western Irish offshore basins.

During the Cretaceous and Early Tertiary slow reheating is inferred to temperatures of about 50-60°C, and is probably linked to a small phase of sedimentation onshore. Finally a rapid cooling event during the Neogene is observed. This late cooling phase could be linked to a reactivation of the margin under compressive forces (i.e. due to Alpine collision and/or mid oceanic ridge-push), but this event could be also an artefact of the fission track-annealing model.

This onshore study is now being complimented by a new thermochronological study on the Porcupine High and on the wells of the western offshore basins. The first results from the Porcupine High show a remarkable similarity with the onshore part of the margin.

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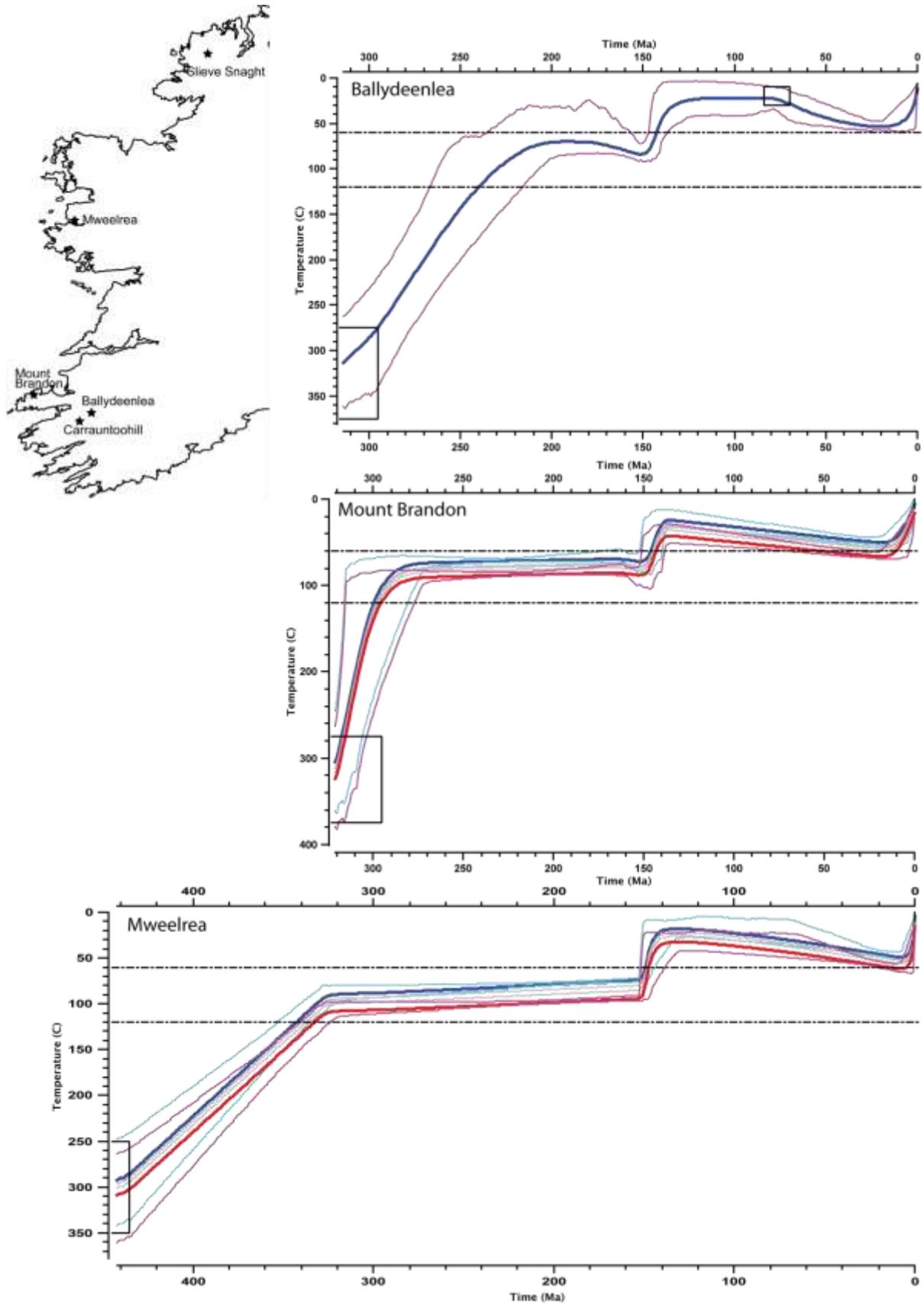


Figure 1: Results of inverse modelling of the data of Ballydeenlea sample and Mount Brandon and Mweelrea profiles.

The Loop Prospect – a new subsurface training resource in West Clare integrating outcrops, wireline, cores and sea floor imaging

Haughton, P.¹, Manzocchi, T.¹, Shannon, P.¹

¹ *UCD School of Geological Sciences, University College Dublin, Ireland*

Over the last four years, >1350 m of large diameter (PQ) split core has been acquired behind the high sea cliffs of the Loop peninsula in west Clare and at Ballybunion in Co. Kerry. The cores have targeted all levels of the Pennsylvanian Ross Sandstone Formation, an important 500 m thick deep-water reservoir analogue. This has been a collaborative project involving Statoil ASA and UCD together with Dr Andrew Pulham and the late Professor Trevor Elliott. In addition, a TCD group are contributing a parallel biostratigraphy project that is providing important insight into the internal subdivision of the Ross. The cores and associated data are driving a new understanding of the deep-water succession from bed level up and confirm that the mix of bed types in the Ross and the elements into which they are arranged have close affinities with potential reservoirs elsewhere (e.g. sub-salt Wilcox and Miocene in the Gulf of Mexico). Whilst detailed description and technical work on the split cores is currently underway, attention has now turned to derivative products that can enhance the training experience in west Clare, the location of already significant industry and academic field-based training. One of the main objectives of the Clare coring programme has been to promote west Clare as an accessible, effective and topical destination for global subsurface training courses that are now a significant component of the local economy on the Loop.

The running this autumn of an applied reservoir geology field course on the Loop for the new UCD Petroleum Geoscience MSc group provided a first opportunity to tailor the new datasets for training. A hypothetical prospect, the Loop prospect, was devised. The prospect straddles the tip of the Loop and extends out under the Atlantic where a recent INFOMAR seafloor image of the Ross exposed on the sea floor provides a pseudo time slice through the reservoir. A grid of dummy seismic sections provide the structural framework and allow students to first create a top reservoir map incorporating several faults, one of which runs onshore and can be inspected in the cliffs. The eastern part of the reservoir is exposed in the high sea cliffs either side of Loop Head and is also cored in parts of the -03 and -08 behind outcrop boreholes. The latter have been combined to provide a 'discovery well' in the Loop prospect along with an oil-water contact with a 60 m cored section in the upper part of the reservoir. The well includes a sealing mudstone above the sandy section. The students created a log of the core and reconciled it with the wireline logs prior to going in the field. They were then able to match the log remotely to the cliffs to the north of Loop Head and examine a correlative section one kilometre away on the south side of the peninsula where they could walk on the reservoir and describe its architecture. The core and cliff observations informed ideas on the level of reservoir heterogeneity that might be anticipated, and thoughts on how to use the wireline logs to estimate net:gross ratios in sections where core is unavailable. A second dummy well in the offshore part of the prospect was devised to have higher net sand fraction (more channelised as it is updip according to the palaeoflow) and a deeper oil-water contact implying reservoir compartmentalisation. Estimates of Gross-Rock Volume measured from the top reservoir map and well fluid contacts, combined with net:gross estimates determined from the well-logs, and other properties (porosity, formation volume factor, oil saturation, recovery factor) taken from a published analogue (values for the Magnus MSM reservoir were used: the actual Ross has a remarkably low measured porosity of 0.5%!) provided P10, P50 and P90 reserves estimates of 120, 156 and 236 million barrels of oil; the uncertainty reflects the range in student calculations. A development plan comprising six producer and two injector wells applied to a P50 reservoir simulation model built with two different representations of the heterogeneity (one up-scaled using a local averaging method, one in which explicit flow units are separated by explicit shale layers) highlights the importance of the heterogeneity model on predictions of recovery factors.

Licciardi, A., N. Piana Agostinetti. Crustal structure of Ireland from receiver functions analysis, Atlantic Ireland Conference, Dublin, November 11, 2013.

Polat, G., S. Lebedev, P. W. Readman, B. M. O'Reilly, F. Hauser. Anisotropic Rayleigh-wave tomography of Ireland's crust: Implications for crustal accretion and evolution within the Caledonian Orogen. *Geophys. Res. Lett.*, 39, L04302, doi:10.1029/2012GL051014, 2012.

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Establishing baseline seismicity of the Irish Frontier Basins: Understanding seismic hazard and regional crustal structure offshore Ireland using broadband seismometer arrays onshore

Lebedev, S.¹, Agostinetti, N.P.¹, O'Reilly, B.M.¹, Bean, C.J.¹

¹ *Dublin Institute of Advance Studies, Geophysics Section*

The natural baseline seismicity in the Irish Offshore is poorly known. It has been difficult to map because of the lack of broadband seismic data, off- or on-shore. Such data have now become available on-shore, with multiple broadband seismic networks deployed across the island in the last few years (Fig. 1). The unprecedented new datasets offer new opportunities to (i) map and evaluate the baseline seismicity in the Irish Offshore and (ii) determine 3D crustal seismic-velocity structure across the region (relevant to basin evolution and hydrocarbon prospectivity).

Seismicity in and around Ireland is relatively low, and until recently Ireland has often been considered largely aseismic. This was due, however, to the absence of a dense digital network and an associated research programme aimed at detecting micro-earthquakes (below magnitude 3.0). In the last few years, multiple broadband seismic networks have been deployed across the island (Fig. 1). These have included the 20-station Ireland Array (Lebedev et al., 2013), 18-station Wave-Obs coastal array (Bean and co-workers, UCD), and five stations of the INSN (Blake and co-workers, DIAS). Preliminary analysis of the new data shows abundant, previously unknown micro-seismicity onshore, with entire earthquake sequences identified, for example, in Donegal (Lebedev et al., 2012).

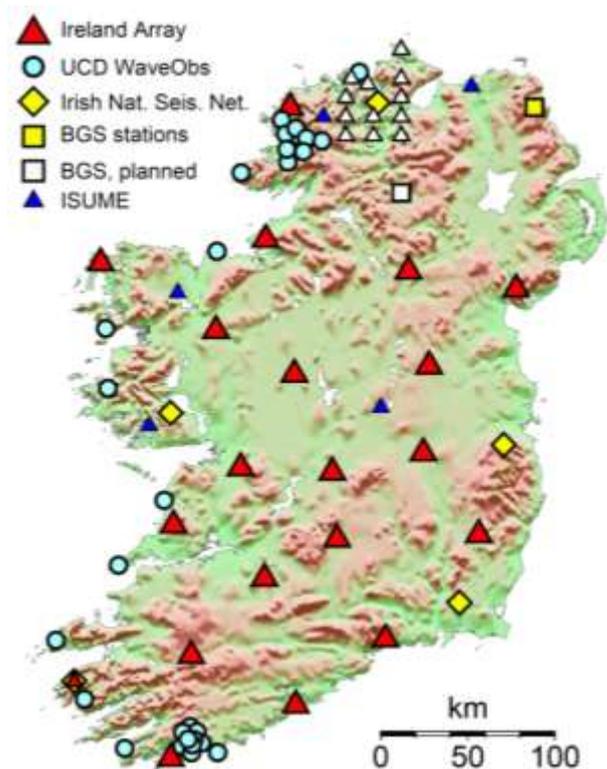


Figure 1. Broadband seismic stations in Ireland in the last 3 years. Coverage is particularly dense across the west of the island, facilitating the proposed study of seismicity and crustal structure off-shore.

Importantly, the occurrence of intermediate-size earthquakes off-shore, west of Ireland, indicates that this area is more seismically active than Ireland itself (Fig. 2). Events with magnitudes 4.0 and larger have occurred in the Rockall Trough, Porcupine Seabight, and, in 2012, 100 km off the coast of Co Mayo in the Slyne-Erris Trough (Fig. 2). Based on well-known earthquake-size scaling laws, one can expect roughly 10 times more magnitude 3.0 earthquakes than mag. 4.0 events, with 100 times more of mag. 2.0s and 1000 more of mag. 1.0s. A very small proportion of such smaller earthquakes has been mapped to date (Fig. 2).



Red circles indicate earthquake epicentres, with circle sizes scaled with the event magnitude. Micro-seismicity to the west of Ireland is poorly known.

Knowledge of baseline seismicity is crucial for evaluating the risks associated with hydrocarbon exploration and production and in monitoring any induced seismicity due to future exploration and production activity west of Ireland. An environmental baseline study aimed at establishing baseline seismicity of the Irish Frontier Basins can now be performed using the new data onshore. It will reveal areas with a high incidence of tectonic earthquakes. It will lead to the first, preliminary probabilistic seismic hazard maps for the offshore region, important in petroleum exploration and development planning.

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DIAS, Irish Seismicity website: http://www.dias.ie/irish_seismicity

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Lebedev, S., C. Horan, A. J. Schaeffer, P. W. Readman, M. R. Agius, L. Collins, N. Piana Agostinetti, A. Licciardi, J. Adam, F. Hauser, B.M. O Reilly and T. Blake. Ireland Array: Probing the crust and mantle beneath Ireland and North Atlantic, Atlantic Ireland Conference, Dublin, November 11, 2013.

Crustal structure of Ireland from receiver-function analysis

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¹ Geophysics Section, Dublin Institute of Advance Studies

² UCD School of Geological Sciences, University College Dublin, Belfield, Dublin 4, Ireland

The Iapetus Ocean closure during the Caledonian Orogeny in the Paleozoic led to a multi-phase continental collision between different paleocontinents in the North Atlantic region. Ireland's crust was assembled at that time, its structure modified since then primarily by stretching and magmatism. Several active seismic experiments have been carried out onshore since 1982 in order to retrieve crustal structure and properties. However, most of them were focused on the southern part of Ireland and less attention has been paid to the region north of the Iapetus Suture Zone (ISZ). In the last few years the number of broadband seismic stations onshore Ireland has increased dramatically. In particular, the deployment of the Ireland Array (IA) network yielded, for the first time, an almost uniform seismic coverage of the island, providing new data for a regional-scale study of Ireland. We integrated the 20 stations belonging to IA with those from permanent (Irish National Seismic Network, INSN, and British Geological Survey, BGS), temporary (University College Dublin, UCD) and previous seismic experiments (ISLE/ISUME) achieving a total number of 34 broadband stations uniformly distributed across Ireland (Fig.1).

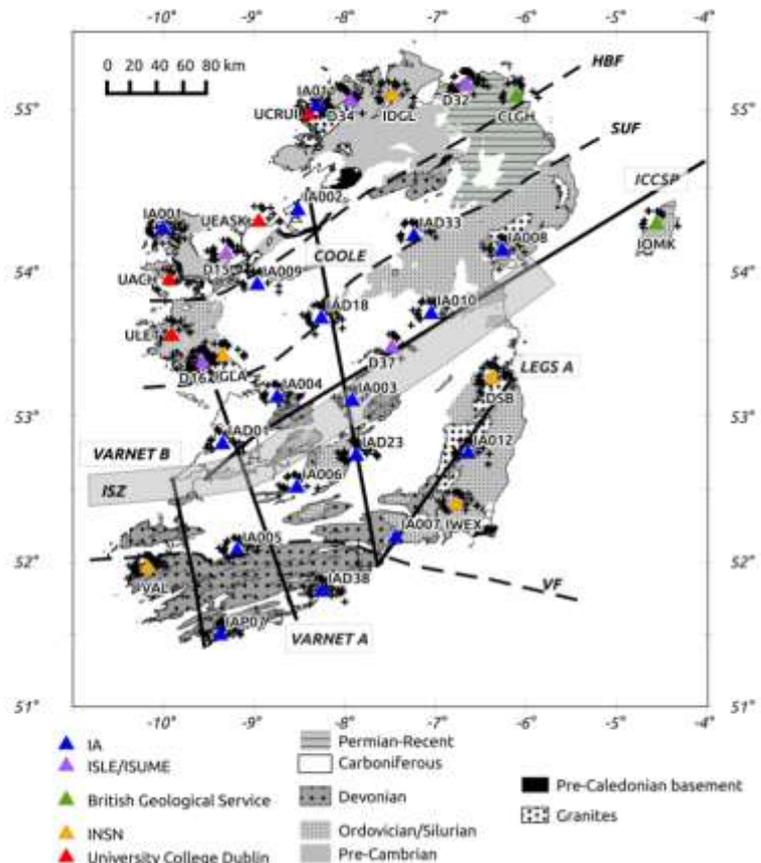


Figure 1. Geological map of Ireland and location of the 34 broadband stations used in this study. Solid black lines correspond to active seismic experiments onshore Ireland. Dashed lines, main tectonic lineaments: ISZ, Iapetus Suture Zone; SUF, Southern Uplands Fault; HBF, Highland Boundary Fault; VF, Variscan Front.

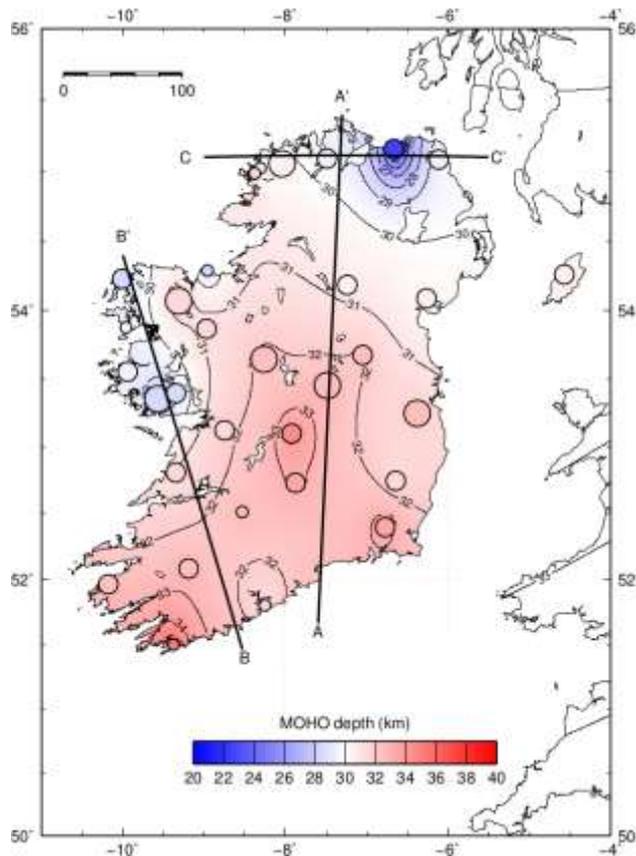


Figure 2. Interpolated Moho depth map of Ireland from single station point measurements. Each circle represents a station with the size proportional to RFs quality.

An intriguing, anomalous value of 23 km has been found for the crustal thickness at station D32 in the north-east part of Ireland. In this area the crustal structure has been analysed in more detail through the computation of probabilistic, 1D isotropic V_s profiles, by means of a transdimensional Monte Carlo inversion of the RF data-set (Fig.3).

We carried out a regional-scale study of Ireland's crust aimed to estimate its thickness and highlight major seismic discontinuities, through the application of the teleseismic receiver functions (RF) method. Our results show a nearly flat Moho in the southern part of Ireland, with the mean crustal thickness there of 32-33 km. In the northern part, in contrast, we observed a higher spatial frequency variation of Moho topography with a general thinning of the crust (27-30 km in thickness) moving towards the northern and western coasts (Fig.2). The discontinuity that marks the boundary of these two slightly different Moho depth patterns seems to correspond to the Southern Upland Fault (SUF), while no major crustal thickness variations have been observed across the ISZ. We compared these results with those from previous seismic studies in Ireland (both from active and passive experiments), finding a generally good agreement in the areas sampled by the previous studies.

Posterior sampling – D32

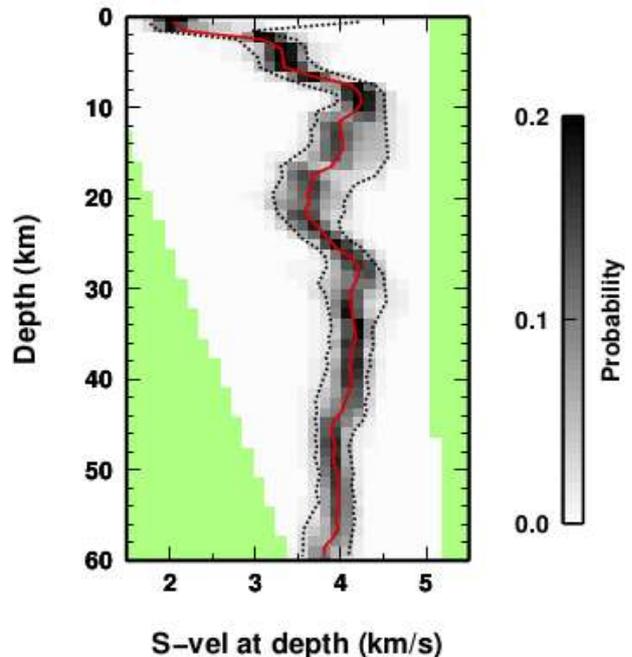


Figure 3. Results from the RJMCMC inversion at station D32. Posterior distribution for V_s at depth. The mean value of V_s is drawn with a red line, while dotted black lines indicate the $\pm 2\sigma$ confidence interval.

Treatment of wastewater from offshore oil and gas industry by using nanotechnologies – A feasibility study

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Water treatment is quickly emerging as one of the most significant challenges facing the offshore oil/gas industry. With large volumes of water used in the oil/gas production process, water is increasingly moving from an operations issue to one of strategic significance. Water produced during oil and gas extraction operations, referred as produced water (PW), constitutes the industry's most important waste stream on the basis of volume. Depending on geological conditions and field position, PW may have complex composition including organic or inorganic ingredients such as salts, metals, oils, phenols, organic acids, dissolved hydrocarbons and some compounds which may be added to it during oil separation process. For a long time, only non-polar oil in water (OIW) was regulated by government, while little attention was given to dissolved organics in PW (NTP, 2005). Current researches are paying more attention to the consequence of dissolved organic components, heavy metals and production chemicals on living organisms, since their long-term effects on the environment are not fully documented and understood. The EU Water Framework Directive (WFD) is committed to 'zero discharge' in response to the need for a more protective system to tackle aquatic pollution (Directive 2000/60/EC, 2000). Since 2005, oil operators in Norway agreed to implement a zero environmental harmful discharge. Similarly, OSPAR commission has agreed on zero discharge of pollutants into the sea (OSPAR Commission, 2008). Most oil and gas companies around the world are now working towards the implementation of 'zero-discharge' of contaminants in PW (Pollestad, 2005).

Nanomaterial, with relatively large surface areas and extremely high surface reactivity, could be an inexpensive and effective solution to treat PW and facilitate the achievement of "a zero environmental harmful discharge" goal in oil/gas industries. A number of advanced materials have been developed for treatment of PW. For example, Lei et al. (2013) have reported that porous boron nitride (BN) nanosheets have great potential for effective cleaning of oil mixed wastewater. The BN nanosheets shows excellent sorption performances for a wide range of oils, solvents and dyes, with mass uptakes reaching 3,300%, due to a combination of superhydrophobicity, porosity and swelling ability. Furthermore, the saturated material can be cleaned for reuse by simply washing, burning or heating in air because of its strong resistance to oxidation. These easy recycling routes further demonstrate the great potential of porous BN nanosheets for water purification and treatment on offshore oil platforms.

The overall objective of this project is to study the feasibility of using nanomaterials to treat PW from offshore oil and gas industry. The specific objectives are (1) to review the best available technologies for offshore PW treatment, (2) to identify, synthesise and characterise potential nanomaterial for PW treatment and (3) to evaluate the efficiency and cost effectiveness of these nanomaterials.

A number of nanomaterials which have potential to be used for treatment of PW have been fabricated and characterised in CRANN at TCD (Figure 1). Two-dimensional (2D) nanostructures with a large lateral size and a small thickness constitute an important cornerstone for modern materials science. These nanostructures, such as nanosheets and nanodisks, possessing high surface area and exotic electronic properties, are important for absorption of organic matters and heavy metals. In this study, different nanomaterials fabricated in CRANN will be tested for organic matter and heavy metals removal from PW.

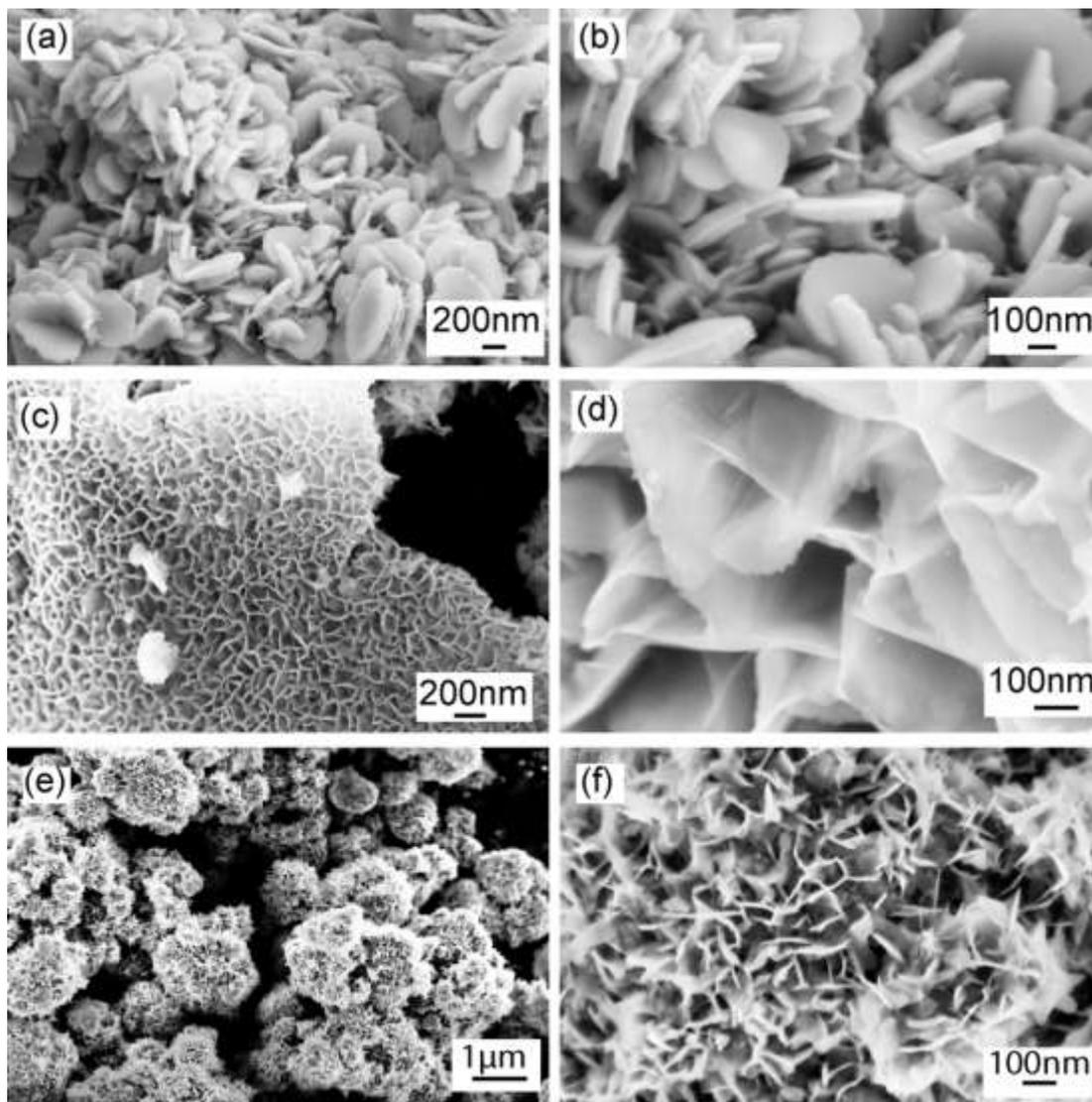


Figure 1. Scanning electron microscopy (SEM) images of the milled MnO₂ (a, b), SnO₂ (c, d) and rutile TiO₂ (e, f) after the hydrothermal treatment in 2 M NaOH aqueous solution at 120°C for 4 h.

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The Application of Fluid Inclusion Studies to Investigations of Hydrocarbon Systems

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Introduction

Fluid inclusions can be simply considered as microscopic (usually <50 microns in longest dimension) vacuum flasks that contain a sample of fluid trapped during (or after) the formation of rock-, cement- and vein-forming minerals e.g. quartz and calcite. Solid, liquid and vapour phases are commonly observed in fluid inclusions under the petrological microscope. Fluid inclusion studies can provide key geological information of fundamental importance to the petroleum exploration industry. For example, the migration history of hydrocarbons can be readily recorded in well samples or they can be used to search for oil in core and cuttings in wells that have been previously abandoned.

Fluid inclusion studies

When specially prepared translucent wafers (~100 μ m thick) of a mineral or rock sample are mounted on the stage of a transmitted light microscope, the internal details of fluid inclusions are resolvable using high powered objective lenses (~ x100). Thus microscopic examination can be carried out routinely and is a necessary first step in all fluid inclusion studies. A first approximation of the chemistry of fluid inclusions is then obtained by microthermometry. This is a non-destructive analytical method which depends upon the accurate interpretation of phase changes which occur with varying temperature. The method involves the use of a special heating/freezing stage (Linkam THMSG 600 heating-freezing stage), capable of achieving temperatures ranging from -190o to +600oC, mounted on a transmitted light microscope. In this way chemical and physical characteristics of the trapped fluid can be ascertained e.g. gaseous species present (e.g. CO₂ and CH₄), fluid salinity and the minimum pressure and temperature of fluid entrapment.

Hydrocarbon-bearing fluid inclusions are commonly detected by their fluorescence under ultra-violet light. They are a very valuable indication of migrating hydrocarbons, and in frontier basins can be the first direct evidence for an active hydrocarbon system (Figure 1). The distribution of oil inclusions is a good guide to those levels that have functioned as reservoir or carrier beds. Studies of the distribution of hydrocarbon inclusions can help to understand:

- (i) mechanisms of hydrocarbon migration;
- (ii) filling history of reservoirs;
- (iii) fluid compartmentation in reservoirs;
- (iv) relationships between hydrocarbon migration and deformation;
- (v) relationships between hydrocarbon emplacement and reservoir diagenesis.

The Geofluids Research Laboratory

Since its establishment in the early 1990s the laboratory has carried out numerous fluid inclusion studies for the oil and gas exploration sector including the offshore Irish Massif (Porcupine, Rockall, Celtic Sea and Fastnet Basins), Central Europe, China (Eocene Dongying depression of Bohai Bay Basin), Canada (Newfoundland Basin), South America (Petroleum Charge Studies of the Llanos Field, Colombia), Africa (Sudan Basin petroleum studies) and numerous North Sea oil projects. These projects have exposed the Geofluids Laboratory to a wide range of hydrocarbon based projects in disparate geological settings. The laboratory uses an array of fluid inclusion study methods (including Polarising light and UV microscopy, Microthermometry, Laser Raman Spectroscopy and Scanning Electron Microscopy) during the life-cycle of a typical fluid inclusion project.

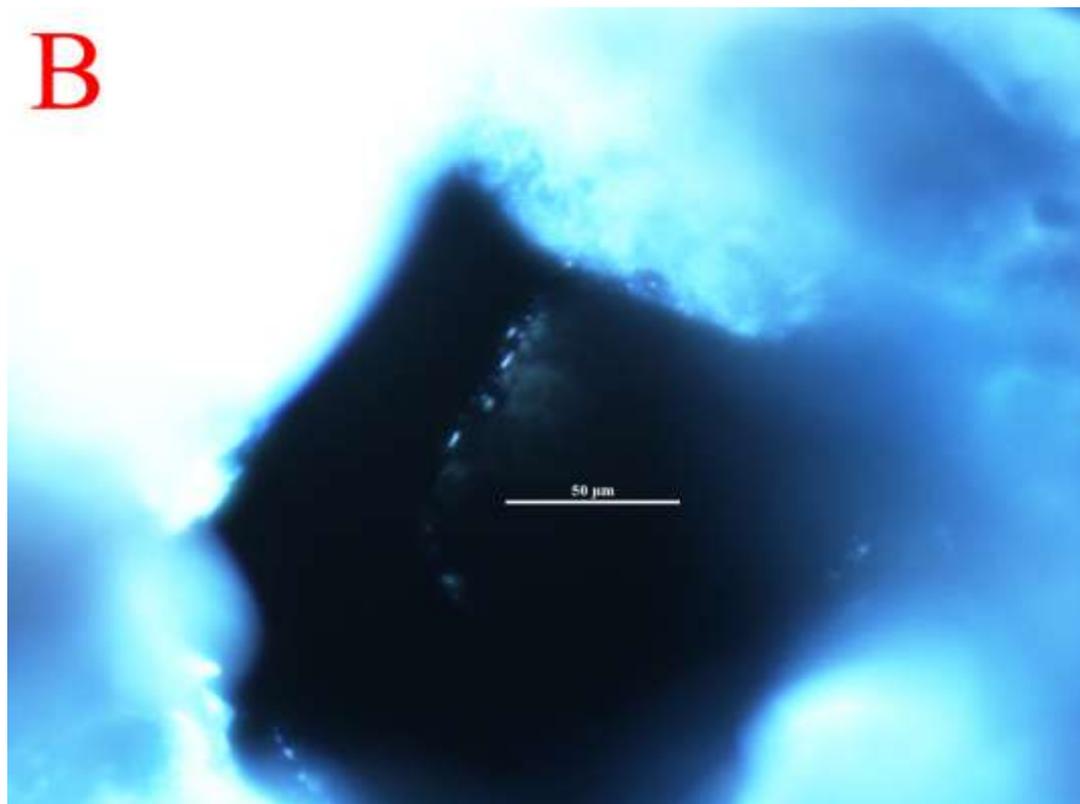
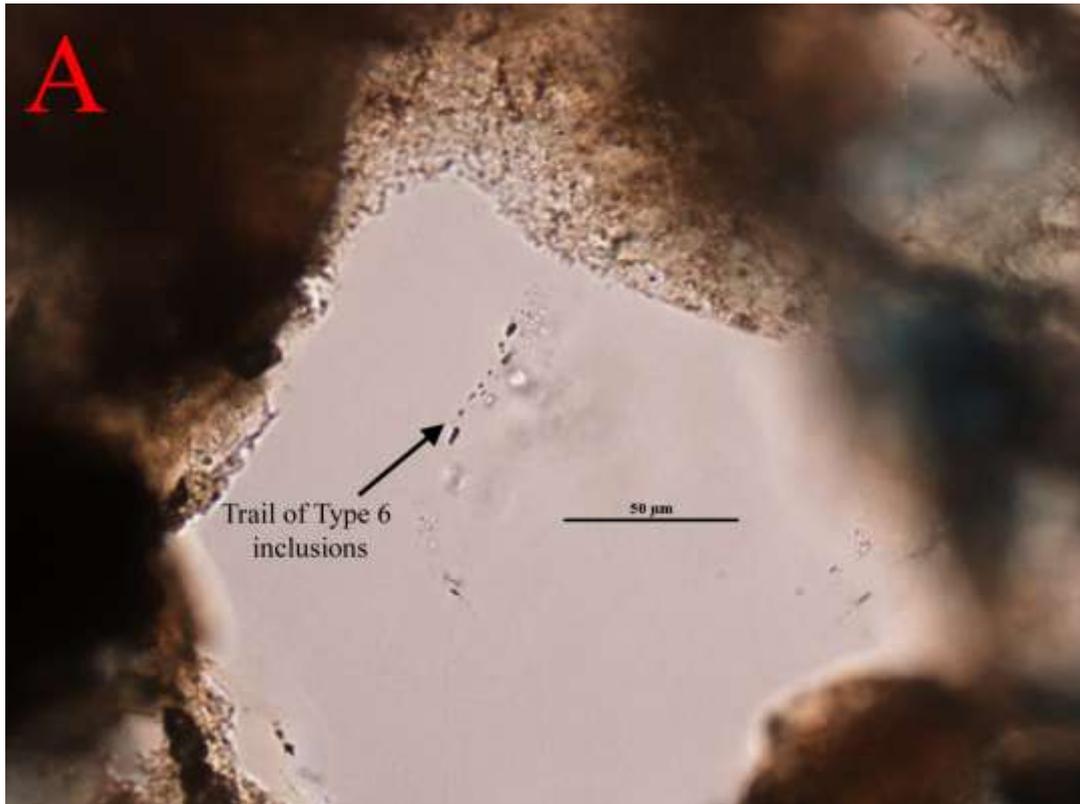


Figure1: Oil migration in a North Sea sandstone: detrital quartz grain displaying trails of oil-bearing fluid inclusions (in A) and in B same trails showing blue colour fluorescence under UV light. Scale bar: 50 microns.

Ireland's Unseen Majority – Microbial Diversity of the Seabed

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Despite their size, prokaryote (bacteria and archaea) biomass is estimated to represent between 15 and 30% of total living biomass^{1,2}. Prokaryotes play major roles in marine ecosystems, in global biogeochemical cycling^{3,4} and in degradation of anthropogenic pollutants. Molecular phylogenetic approaches have revolutionised microbiology and have revealed that the complexity of microbial life is orders of magnitude greater than previous estimates based on cultivation-based approaches⁵. This highlights how little we currently know about the microbial world and the clear potential of this vast untapped resource for human application. Here we present the first in-depth analysis of microbial community diversity and composition in the Irish Sea. As well as discovering for the first time 'who' is out there, we wanted to assess what factors play a role in prokaryote abundance and diversity. Our results have shown that the vast majority of bacteria found have not been cultured and could provide future novel biotechnological and biomedical applications. Furthermore, broad physical and hydrographic conditions may play a key role in prokaryote abundance and diversity. Contamination of the marine environment with persistent organic pollutants is a global concern and has been documented in the Irish Sea⁶. Therefore we are aiming to explore the potential for pollutant degradation among marine bacteria and hope to identify and isolate groups with high bioremediation potential.

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The Provenance and Petrography of Early Tertiary sands in the Porcupine Basin

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The Porcupine Basin, a north-south oriented deep-water basin offshore west of Ireland, is one of the largest sedimentary basins in the North Atlantic. A thick succession of Cretaceous and Tertiary sediments was deposited in a general thermal subsidence setting, interrupted by periods of minor rifting and regional epeirogenic movements and overprinted by eustatic sea-level changes. Petroleum exploration wells in the north of the basin have encountered reservoir quality sands of Cretaceous and Tertiary age. However, little is known about the composition of these sands or their provenance. Determining the sand source(s) will allow more accurate re-construction of palaeogeography and ancient drainage system scales and pathways for both the Cretaceous and the Tertiary.

Standard optical petrography, scanning electron microscopy and laser ablation multi-collector inductively coupled plasma mass spectrometry (LA-MC-ICPMS) were used to constrain the source of the Eocene Marine Sands. Analysis of 14 samples from four wells in the east central part of the Porcupine Basin has focused on the Eocene marine and deltaic sands (lower to middle Eocene respectively). The sampled sandstones are medium- to fine-grained, sub-arkosic in composition and occasionally contain high proportions of lithic fragments. In addition, the Eocene marine sands are also often calcareous and contain abundant nummulites.

In order to constrain their likely provenance, the Pb isotopic composition of detrital K-feldspar was determined using LA-MC-ICPMS. The $^{206}\text{Pb}/^{204}\text{Pb}$ and $^{207}\text{Pb}/^{204}\text{Pb}$ data reveal two distinct populations that vary through the stratigraphy and appear in all four sampled wells (35/8-1, 35/13-1, 35/18-1 and 36/16-1). One population of K-feldspar grains is recorded in both Eocene marine and deltaic sands and appears to correspond to the late Caledonian Galway granites, onshore Ireland. However, these data also overlap with the Pb isotopic signature of some of the granite plutons in Donegal, onshore NW Ireland. Interestingly, granites in SE Ireland and Scotland cannot entirely be ruled out as a source. The second Pb population, found only in Eocene marine sand samples, cannot at present be linked to any characterised source, suggesting that these grains are derived from an as yet unidentified crystalline basement in the Irish offshore shelf area.

This work is part of an MSc research project funded by Petrel Resources plc.

Geophysical and geochemical survey of a large marine pockmark on the Malin Shelf, Ireland

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Marine pockmarks are a specific type of seabed geological setting resembling craters or pits and are considered seabed surface expressions of fluid flow in the subsurface thus being attractive surveying targets for the oil and gas industry. In this study a large composite pockmark on the Malin Shelf, off the northern coast of Ireland was surveyed and ground-truthed to assess its activity and investigate fluid related processes in the subsurface. This pockmark is one of the largest, possibly composite feature, among more than 200 pockmarks discovered in the Malin Deep. Geophysical (including acoustic and electromagnetic) data confirmed the subsurface presence of signatures typical of fluids within the sediment. No active seepage was observed during several surveys in this area however shallow seismic profiling revealed a large shallow gas pocket and typical gas related indicators such as acoustic blanking and enhanced reflectors present underneath and around the large pockmark (Figure 1). Sulphate profiles indicate that gas from the shallow reservoir has been migrating upwards, at least recently. However there are no chimney structures observed in the sub-bottom data and the migration pathways are not apparent. Electromagnetic data show slightly elevated electrical conductivity on the edges of the pockmarks and a drop below regional levels within the confines of the pockmark, suggesting changes in physical properties of the sediment. Nuclear Magnetic Resonance (NMR) experiments were employed to characterise the organic component of sediments from selected depths. Very strong microbial signatures were evident in all NMR spectra but microbes outside the pockmark appear to be much more active than inside. These observations coincide with spikes in conductivity and the lateral gas bearing body suggesting that there is an increase in microbial activity and biomass when gas is present.

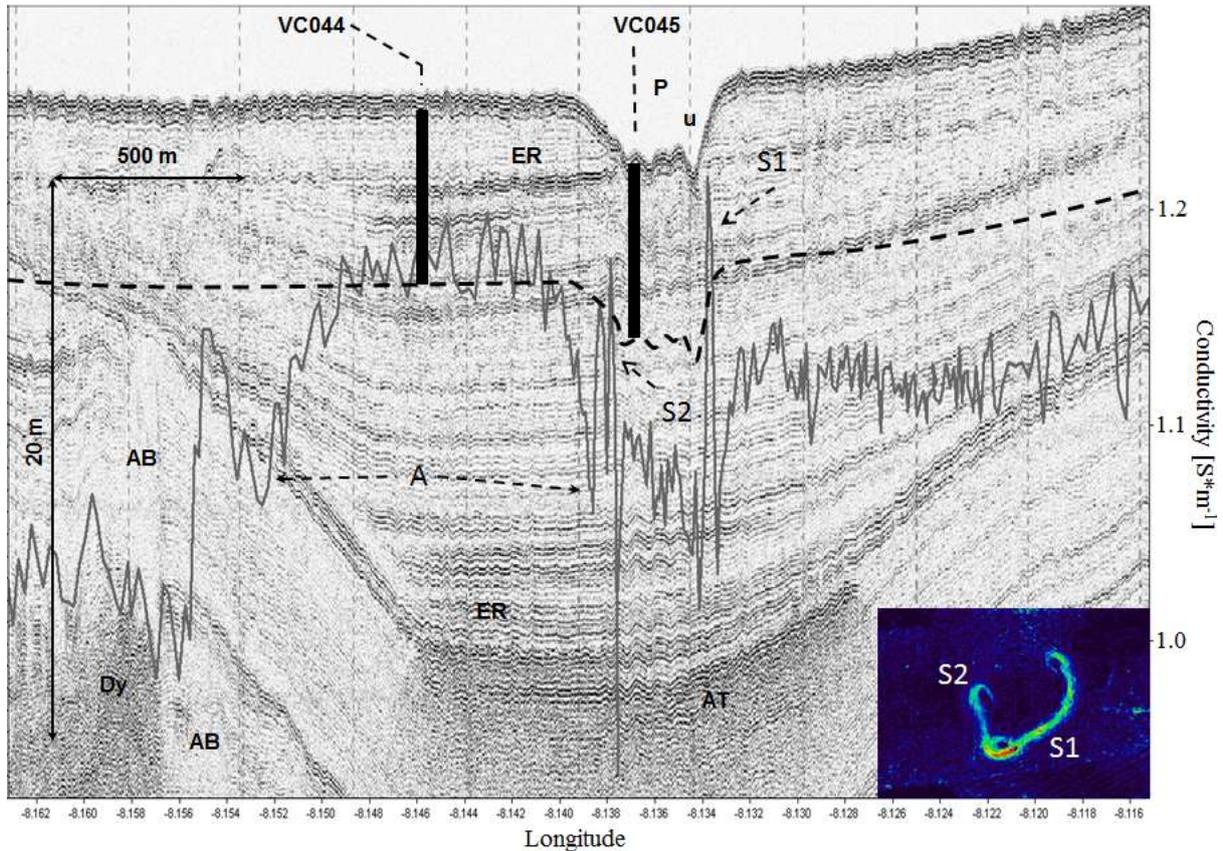


Figure 1: Sub-bottom 3.5 kHz profile (pinger) of the composite pockmark (P) in the Malin Deep microbasin with one of the pockmark units (u) visible. The pockmark is 750 m wide (measured from opposing ends) with three sub-circular units approximately 50 m wide and 8.5 m deep. Overlaid grey line shows conductivity measurements derived from towed EM system and the dashed black line denotes the depth range for the system. High conductivity values present in both sides of the pockmark (S1 and S2) are associated with disturbed sediment on the edges of the unit pockmarks. The largest conductivity anomaly (A) correlates accurately with the extent of the strong reflector in the sub bottom record associated to gas facies and cannot be explained by changes in sediment structure. Gas enhanced reflectors (ER), acoustic turbidity (AT) and numerous vertical acoustic blanking (AB) signals particularly in the vicinity of igneous body (Dy) are clearly visible. Although the identity of Dy is not obvious from the pinger data shown here, the total intensity magnetic data, sparker and 2D seismic data confirmed its identity, geometry, spatial distribution and intrusive character (data not shown; GSI, 2003). Vertical bold lines depict approximated locations of two 6 m long vibrocores collected at the site, length of the lines is to scale.

List of Delegates

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Name	Organisation
Gordon Donald	ADTI
Chris Rayburn	AGR Petroleum Services
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Helen Kerr	APT (UK) Ltd
Lyndsey	APT (UK) Ltd
Patrick Barnard	APT (UK) Ltd
Shay Fennelly	Aquaphoto
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Mark Pearson	Ardilaun Energy
Martin Keeley	Ardilaun Energy
Susan Mc Keon	Ardilaun Energy
Heidi Herbert	ARKeX
Lyndsey Smith	ARKeX
Alyson Harding	Atlantic Petroleum
Noel McGettigan	Atlantic Towage
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Steve Laux	Cairn Energy
Tom Campbell	Cairn Energy
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