Imperial College London

100 Years and Beyond:
Future Petroleum Science & Technology Drivers

23-24 September 2013

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17th September 2013

Dear Delegates, Speakers and Guests,

On behalf of the Organising Committee, representing our Convenors (Imperial College London and the Geological Society), I am delighted that you have found the time to join us here at Imperial College to celebrate the 100th anniversary of the inauguration of the BSc Oil Technology degree at the Royal School of Mines, which was the first petroleum-related degree in the UK. I hope you will find that this two-day meeting does justice to the inspirational founders of the course and to the thousands of students, supported by numerous faculty, who have studied courses spawned by the original oil technology course. We are indebted to all our speakers, covering petroleum industry leaders, prominent academics and distinguished alumni, who have so willingly agreed to contribute to this special occasion. The theme of the conference is '100 Years and Beyond: Future Petroleum Science & Technology Drivers'. During the next two days we wish to both celebrate 100 years of petroleum-related education at Imperial College and to look forward to the next 100 years of energy-related science and technology, including emphasis on some of the key future drivers.

The programme is divided into four main components: (1) global energy-related issues, (2) exploration trends and related technologies, (3) reservoir management and improved production-related topics, and (4) long-term sustainable energy, unconventional petroleum systems, climate change and carbon sequestration. This brief snapshot highlights the challenges facing society at large, and the industry, in terms of the supply of petroleum-based energy, the environmental consequences and the need for skilled and motivated graduates who must operate in this new and rapidly changing environment. The original BSc Oil Technology course was remarkable for its vision in training multi-skilled graduates. Similar needs continue today, but with a much greater array of science and engineering topics to grasp and an equally diverse suite of technologies to apply. The first students who entered the Oil Technology course were at the forefront of a new land-based, conventional oil & gas exploration and production industry. Today, 100 years on, Geoscience and Engineering students, from throughout the world, sit at the threshold of new and exciting developments in both conventional and unconventional petroleum exploration & production, including the Shale Oil & Shale Gas revolution, as well as other longer-term energy sources.

On behalf of everybody involved in delivering this meeting I would like to thank you all for your attendance and I trust that you will have a memorable two days.

Yours sincerely,

Professor Howard Johnson (Chair, Organising Committee)

Organising Committee:

Professor Howard Johnson (Chair)
Dr Mike Ala
Professor Alastair Fraser
Professor Peter King
Professor Mark Sephton
Professor Mike Warner
Steve Whalley (The Geological Society)
Laura Griffiths (The Geological Society)
Dr Jonathan Craig (The Geological Society)
Daphne Salazar (Secretary)

Richard Hardman CBE

Richard Hardman has been involved in the exploration for oil and gas for over 50 years. A geology graduate of Oxford University he was employed by BP in Libya in 1960, progressed to work on the North Sea with Amoco in 1969, and finally in 1982 lead a conspicuously successful Amerada Hess North Sea Exploration team until he retired from full-time work in 2001. Since then he has held various advisory positions the longest of which are with FX Energy, exploring for gas in Poland and with Atlantic Petroleum exploring the North and Norwegian Seas.

Knowledge dissemination and training of geoscientists has been a priority. He was President of the Earth Science Teachers Association from 1993 to 1995: President of the Geological Society from 1996 to 1998: a member of the Natural Environment Research Council from 1998 to 2003: and chaired the Science and Strategy Board from 2000 to 2003.

He was made a Commander of the Order of the British Empire in 1998

Abstract: Opening Address

The basis of our civilisation is cheap, easy to use energy. Proof of this statement was confirmed in 2008 when oil prices rose to almost $150/barrel. A world recession ensued and several banks and insurance companies were only saved from bankruptcy by government action. The Oil Technology School of Imperial College is in the fore-front of the battle to maintain living standards and keep civilisation from reverting to a more barbarous age. In the past the School has provided able scientists to lead the search for and production of large deposits of hydrocarbons. From now on the task will be even more difficult as field sizes and profitability declines. Shale oil and gas could have a bright future in Europe but strong opposition is mounted by those whose very ability to protest depends on oil and gas. Future graduates of the Imperial College Oil and Technology Course will not only have to be brilliant engineers they will have to be advocates for safe delivery of fossil fuels with minimal environmental impact until the time comes, perhaps in 50 years, when the task of providing cheap convenient energy is taken up by alternative sources such as sun-light, wind, waves and nuclear fusion.

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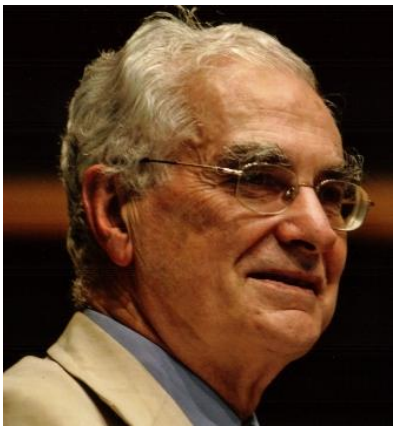
Monday 23 September
Session One: Global Overview

Lord Oxburgh



Ron Oxburgh (Lord Oxburgh of Liverpool) trained as a geologist/geophysicist (Oxford & Princeton). He subsequently taught and researched in those disciplines at Oxford, Cambridge, Stanford and Caltech. At different times he has been Chief Scientific Adviser to the UK Ministry of Defence, Rector of Imperial College London, Chairman of Shell Transport & Trading, Chairman of the Lords' Select Committee on Science and Technology and President of the Carbon Capture and Storage Association. He is Chairman of GEO and 2OC and an adviser to Deutschebank, McKinsey, Climate Change Capital and to the Government of Singapore on energy, environment, research and higher education**.**

Abstract: Energy Tends in the 21st Century

The pattern of energy use in the 21st Century will depend as much on politics and economics as it does on resources and technology. The political question is whether governments take decisive action on climate change, primarily by changing their sources of energy and limiting demand. The particular problem for the western democracies is that the benefits are long term and the immediate costs are high.

The unique properties of fossil fuels – their high energy-density, portability and wide availability – allow energy to be instantly available anywhere and make them difficult to replace; as long as the internal combustion engine remains important there will be a need for high energy-density fluids.

Conversion to a non-fossil fuel global economy is not easy, inexpensive or speedy. The most plausible near-term strategy is to replace the higher C-intensity fossil fuels (coal and oil) with gas while as far as possible immobilising their emissions by carbon capture and storage. The present generation of CCS technologies will work well but is too expensive for global adoption but there are good prospects for cost reduction.

For the longer term energy must be derived from renewable and nuclear sources and used more efficiently. Because the most abundant forms of renewable energy are intermittent, their future role will depend on developing cost-effective long- and short-term energy storage. If concerns over safety can be satisfied the main limitation on nuclear is its relative inflexibility to ramp up and down quickly to follow changes in demand.

The future of global emissions will to a significant extent depend on China as a growing world economic and industrial power and as the world's largest emitter. There are signs that China takes climate change very seriously and will exert its influence externally and internally to limit global emissions

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Lord Browne

Lord Browne of Madingley was born in 1948. He joined BP in 1966 as a university apprentice. He holds degrees from Cambridge University and Stanford University, California. He is a Fellow of the Royal Society, the American Academy of Arts and Sciences and the Royal Academy of Engineering. He has numerous honorary degrees, fellowships and awards.

He joined the Board of BP in 1992 and became its Group Chief Executive in 1995 until 2007. He has been the Chairman of the Advisory Board of Apax Partners LLC (2006-7), non-executive director of Intel (1997-2006), DaimlerChrysler AG (1996-2001), Goldman Sachs (1997-2007) and SmithKline Beecham (1996-1999). He was voted 'Most Admired CEO' by Management Today from 1999 -2002. He was knighted in 1998 and made a life peer in 2001.

He is presently a Partner of Riverstone Holdings LLC, a company which invests in renewable and conventional energy. He is Chairman of the Board of Trustees of Tate, Chairman of the Trustees of the Queen Elizabeth II Prize for Engineering and Chairman of the International Advisory Board of the Blavatnik School of Government at Oxford University. He is a member of a variety of other advisory boards.

Abstract: Beyond 2013: Clean Energy and its Future Role in the Energy Mix

Is time up for the petroleum engineer? Despite an abundance of fossil fuels, this century will be dominated by the pursuit of clean and sustainable energy. Lord Browne will offer an optimistic vision of the role that engineering and petroleum technology can play in the search for low-carbon energy.

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Scott Tinker, Bureau of Economic Geology, UT Austin

Scott Tinker is Director of the Bureau of Economic Geology, the State Geologist of Texas, Director of the Advanced Energy Consortium, a Professor holding the Allday Endowed Chair and acting Associate Dean of Research in the Jackson School of Geosciences at the University of Texas at Austin. Scott spent 17 years in the oil and gas industry prior to coming to UT in 2000. Scott is past elected President of the American Association of Petroleum Geologists (AAPG), past president of the Association of American State Geologists, and current president of the Gulf Coast Association of Geological Societies. Tinker has been a Distinguished Lecturer for the AAPG and Society of Petroleum Engineers, a Distinguished Ethics Lecturer for the AAPG, and is the current GSA Halbouty Distinguished Lecturer. Tinker is a Fellow of the Geological Society of America, holds appointments on the National Petroleum Council, the Interstate Oil and Gas Compact Commission, the Geoscience Advisory Board at Sandia National Lab, Trinity University Board of Visitors, and several other private, professional, and academic advisory boards. Tinker was recently named a “Top Producer in Texas” by Texas Monthly magazine. Tinker’s degrees are from the University of Colorado (Ph.D.), the University of Michigan (MS), and Trinity University (BS). Tinker’s passion is building bridges between academia, industry and government and towards that end he has given nearly 500 invited and keynote lectures, visited nearly 50 countries, and most recently produced and is featured in the acclaimed documentary film on global energy, SWITCH.

Abstract: The 21st Century Energy Mix

The transition from a fossil-energy present to an alternate-energy future will span the 21st century. The pace of change will be driven by energy affordability, availability, reliability and environmental sustainability. Orchestrating a transition via poorly-informed policy, or unachievable technology acceleration, could have unintended consequences. Fossil fuels represent 85% of the global energy mix today. New conventional oil and natural gas frontiers include ultra-deep water, the Arctic, pre-salt, ultra-deep reservoirs, and other extreme environments. Unconventional oil and natural gas represent a vital and growing part of the global fossil energy mix; future expansion has challenges that vary by region. Coal remains a vital global resource and carbon sequestration offers the greatest promise for large-scale removal of CO2, yet capture of CO2 at scale from existing power plants is prohibitively expensive; enhanced oil recovery using anthropogenic CO2 could offset some of the cost. Nuclear energy is clean, efficient, and scalable and will play a growing global role. Scaling up low density alternative energy sources such as solar, wind, biomass and geothermal is an investment-heavy task, but can be accomplished with well-considered policy and technology advances, especially in energy storage and transmission. Efficiency, including vehicles, insulation and lighting, and industrial systems, is key to environmental sustainability.

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Ed Daniels, Shell

Responsibilities:
Chairman Shell UK Limited
Executive Vice President, Downstream Technology

Edward Daniels has been Executive Vice President of Global Solutions Downstream within Shell's Projects & Technology (P&T) organisation since July 2009. In addition to his P&T position, Ed was appointed Chairman of Shell UK from January 1 2013.

In his P&T role, Ed has responsibility for technology support to Shell's downstream assets and products (including fuels and lubricants), as well as commercial activities spanning refining and chemicals licensed technology, services and catalysts for the oil and gas, petrochemical and other processing industries. These activities are delivered primarily through teams working out of Shell's technology centres in Amsterdam, Houston, Bangalore, Hamburg and Chester in the UK.

Receiving a Masters of Chemical Engineering degree from Imperial College London in 1988, Ed joined Shell in the same year to work in its UK refining business. He undertook a number of sales and marketing assignments and studied for his MBA with Henley Business School, which he was awarded in 1995.

Ed then held several international posts starting in Singapore, where he managed sales and marketing projects for Asia Pacific. In 2003 he returned to the UK as General Manager Global Base Oil Lubricants, then moved to the USA as President of Shell's catalyst businesses CRI/Criterion Inc., before being appointed to his current P&T role.

In June 2011, Ed was elected as Technical Vice President of the Council of the Institution of Chemical Engineers (IChemE), the global professional institution for chemical and process engineers. He attained Chartered Engineer status in 2010 and was elected as a Fellow of the IChemE the same year. He is a Member of the CBI President's Committee and a Member of CBI Energy and Climate Change Board.

Ed is a British national with Welsh heritage. He is married with three daughters.

Abstract: Technology for a Sustainable Energy Future

By mid-century, our planet could be home to more than 9 billion people with 75% living in cities – up from 50% today. More people will enjoy higher living standards; gaining access to hospitals, public transportation and reliable electricity. But these positive developments could place pressure on our world's resources. The world will need 30-50% more energy, water and food by 2030. Ensuring sufficient supplies of these resources, while avoiding serious climate change, are immense challenges. *The world faces an additional resource consumption puzzle. Supplies of water, energy and food are coming under pressure from an expanding global population. But tackling this problem is made all the more difficult by the powerful connections between these different resources: rising energy consumption puts added strain on the world's water stocks and vice versa. Technology and innovation have always played a key role in moving the energy industry forward* One approach Shell has taken is to responsibly develop resources from challenging locations such as deep water. *Innovation is pushing the boundaries of what is safely achievable in deep water: finding oil and gas resources and developing them through subsea and surface facilities while protecting lives and the environment.* Ed Daniels will also talk about how the energy industry needs to explore new forms of partnership and collaboration with governments, academia - including Shell's newly-formed research collaboration for fuels and lubricants with Imperial College - , interest groups, and businesses from other sectors. Together we can drive breakthroughs and new technologies that will diversify the world's energy supply, increase the use of cleaner fuels and improve efficiency.

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Mike Ala, Imperial College & Dominion Energy

Michael Ala has been closely associated with the oil industry for more than 30 years both as an exploration geologist with an independent oil company and as a consultant. He has a BSc in Oil Technology and an MSc, PhD and DIC in Petroleum Geology from Imperial College.

In 1972 he joined Seagull Exploration International and was involved in exploration studies and prospect evaluation in many parts of the world including Africa, northwest Europe, eastern Mediterranean, the Caribbean, South America and the Middle East. In 1976 he became the company's General Manager in London, responsible for its north European and Middle Eastern operations.

Since 1981 he has been a member of the academic staff in the Earth Science Department of Imperial College, rising to the post of Director of the internationally recognized MSc Petroleum Geoscience Course in 1994. Dr Ala has published more than 60 research and review articles covering the Middle East and West Africa, focusing on the petroleum geology and oil industry of Iran and is on the Editorial Board of the international Journal of Petroleum Geology. He was also Editor in Chief of Seventy-Five Years of Progress in Oil Field Science and Technology, published in 1990. Since 1982 he has been organizing and presenting numerous industrial training programs in Europe, north Africa, west Africa and southeast Asia. Currently, Dr Ala is completing a textbook entitled The Acquisition and Interpretation of Openhole Logs.

He is co-founder (1988) and Director of Hydrocarbons Venture Limited, a UK based organisation involved in consultancy and participation in exploration projects. Until 2008, he was Chairman of Azar Energy Qeshm, a company he co-founded in 2003 with the aim of participating in the Iranian oil and gas sector projects. In 2007 he joined the board of Dominion Energy as a non-Executive Director. Dominion's principal activity is the exploration and development of oil and gas fields in North Africa in general and in Tunisia specifically.

Abstract: Celebrating 100 Years of Petroleum Education at Imperial College

The second decade of the twentieth century witnessed the birth of petroleum related departments in a significant number of academic institutions and state organizations in USA and Europe.

At the Royal School of Mines (RSM), the history of the introduction of petroleum related studies began in 1911, when Professor William Watts, Head of Geology Department 1904-30, arranged for a series of six lectures to be given by Dr Arthur Wade on Oil Field Geology during the 1911-12 session. They proved so popular that the course was extended in the 1912-13 session to twelve lectures, supplemented by practical laboratory work.

Encouraged by Sir Alfred Keogh, Rector of Imperial College, 1910-22, Watts established the programme as a four year degree course, **The Technology of Oil**, in 1913, appointing Vincent Illing as Demonstrator in Petroleum in the same year. Over the next 42 years, Illing presided

over the development of the course from its infancy to maturity. He retired as the Professor of Oil Technology in 1955 and established the reputation of the RSM as one of the leading centres of training and research in the world for petroleum technologists. During the Second World War the Technology of Oil was condensed into a three year course and renamed **Oil Technology.**

The Oil Technology Chair remained vacant for six years following Illing's retirement and was not filled until 1961. During the interregnum the department was administered by Dr Douglas Hobson. Hobson is surely the 'unsung hero' of the course; he is often overlooked and not generally recognised as one of the key figures despite his outstanding contributions on many fronts. In 1955 he introduced a postgraduate course entitled **Petroleum Reservoir Engineering**, the first of its kind in Britain. There were also parallel developments in geophysics. Although the subject had been taught at the RSM since 1910, geophysics was constituted as a postgraduate course in 1955 with the appointment of John Bruckshaw to the Chair of Applied Geophysics. The staff included Dr Ronald Mason who had risen to international prominence in the late 1950s when he discovered the magnetic anomalies on the floor of the Pacific Ocean off California which provided the key to the development of the concept of seafloor spreading in the 1960s. He was appointed as the Professor of Pure Geophysics in 1967.

In 1961 the Oil Technology chair was filled with the appointment of Dan Gill. His contributions included the introduction of the **MSc Petroleum Geology Course** in 1963 – which raised the profile of the department and resulted in student numbers increasing significantly - and the establishment in 1969 of an organic geochemistry laboratory, the first of its kind in a UK academic institution dedicated specifically to the study of petroleum source rocks.

As the result of some internal reorganisations, the postgraduate Petroleum Reservoir Engineering course was transferred in 1974 from Geology to the Department of Mining and Mineral Technology. The title of the course was changed to Petroleum Engineering and Dr Colin Wall was appointed as the Professor of Petroleum Engineering. Wall substantially revised the undergraduate course and updated and revamped the MSc programme. The Oil Technology undergraduate programme was renamed Petroleum Engineering and moved in 1976 to the Department of Mineral Resources Engineering, the successor to the Department of Mining and Mineral Technology. The MSc Petroleum Geology Course remained in the Geology Department and Gill's title changed to the Professor of Petroleum Geology. He retired in 1978.

Robert Stoneley succeeded Gill in 1978. Stoneley revitalized the MSc course by introducing two new options in addition to the existing Exploration Geology discipline: Petroleum Geophysics was introduced in 1982 and Reservoir Geology in 1987. He also refurbished the organic geochemistry laboratory established by Gill in 1969 and was a founder and long term chairman of the Joint Academic Petroleum Exploration Committee (JAPEC), an organisation providing training courses for the oil industry.

Mason retired in 1984 and was replaced in 1985 by Dr Michael Worthington, under whose stewardship geophysics took a new direction, becoming more oriented towards the petroleum industry in terms of both teaching and research. Worthington left the RSM in 2001 and the programme went into abeyance for the next six years. It was reinstituted in 2007 with the appointment of Dr Helmut Jakubowicz to the chair and renamed Petroleum Geophysics.

Jakubowicz left the RSM in 2013 and has been succeeded by current incumbent, Professor Michael Warner.

In 1986, while remaining on the staff, Wall relinquished the position of Head of Petroleum Engineering and was succeeded in that capacity by Professor John Archer. Archer established a highly successful Applied Reservoir Engineering Research Group which carried out pioneering work in the field of reservoir modeling and characterisation and, together with Wall, contributed enormously to the maintenance of the position of the RSM as one of the leading centres of petroleum engineering education and research in the world. In the 1990s the Department of Mineral Resources Engineering was renamed the Department of Earth Resources Engineering.

Stoneley retired in 1994 and was replaced by the present incumbent, Professor Howard Johnson. Under Johnson's aegis the MSc course was renamed Petroleum Geoscience, extensively revised, its scope expanded to include fractured and carbonate reservoirs and field development geology.

Following Archer's departure in 1997, Dr Alain Gringarten was appointed as the Professor of Petroleum Engineering. Gringarten is a world renowned authority in well test analysis and has pioneered many advances in the subject including the 'Gringarten type curves' for wells exhibiting complex production behaviour. On the teaching side, he updated the Petroleum Engineering MSc curriculum by emphasising the importance of a multidisciplinary approach, raising the profile of the course and expanding student numbers. In September 2013 he was succeeded by the present incumbent, Professor Martin Blunt, one of the pioneers of streamline-based simulation that is now widely used in the oil industry.

As in the 1970s, RSM departments underwent major changes in the late 1990s and early 2000s. In 1998 the Geology and Earth Resources Engineering Departments were amalgamated with the Centre for Environmental Technology to form the T H Huxley School of Environment, Earth Sciences and Engineering (THHS). This did not turn out to be a happy marriage and the THHS was demerged in 2001. Environmental Technology was renamed The Department of Environmental Science and Technology and Petroleum Geoscience, Petroleum Engineering and Petroleum Geophysics were merged to form the Department of Earth Science and Engineering, the current home of the descendents of the Oil Technology Course. The 1974 division of the course has thus been reversed and its offshoots have come back together and are flourishing in the same department. We can be confident that they will continue for many more years to serve the industry by providing it with a band of specialists who will match the conspicuous achievements of their predecessors.

Mighty oaks indeed have grown from that small acorn planted in 1913.

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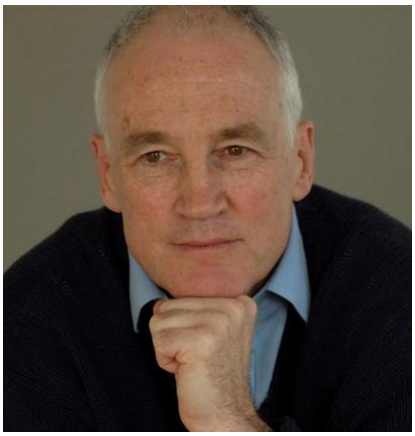
Monday 23 September
Session Two: Exploration Trends

Mike Daly, BP



Dr. Daly graduated from the University College of Wales in geology, and after several years as a field geologist in Africa he completed a Ph.D. at Leeds University. He is an alumnus of Harvard Business School.

Dr. Daly joined BP Exploration in 1986, working as a technical specialist in structural geology. In the early 1990's he joined BP's global basin analysis group that set the direction of BP's exploration strategy. This work has underpinned BP's exploration and reserves replacement performance for two decades. Following this strategic work he has occupied a series of exploration business and functional roles in South America, the North Sea and new business development globally.

In 2000 he became the President for BP's Middle East and South Asia businesses. In July 2006, Dr. Daly was appointed BP's Head of Exploration and New Business Development and in October 2010 was appointed Executive Vice President, Exploration and a member of the BP Executive Team. Mike is a member of the Board of the British Geological Survey and a Visiting Professor in Natural Resources at Oxford University. He is also a member of the Arctic Council of the World Economic Forum.

Abstract: Future Trends in Global Oil and Gas Exploration

Four major trends will define global exploration over the coming two decades. Each will be enabled by new technology pushing the technical limit of imaging and our ability to operate safely.

Firstly, the deepwater success of the past 20 years will start to decline this decade. Industry will continue to test new ideas and move to ultra-deep water and HP/HT environments. However, the success of the past will be increasingly difficult to repeat, and by the 2020's, deepwater exploration will be in decline.

Secondly, the ice bound continental margins of the Arctic Ocean will start to be explored. Russia owns about 50% of the arctic continental shelf and an estimated 75% of the estimated arctic offshore resources. Arctic exploration and development will be led by Rosneft in Russia; the other ice-bound arctic margins will follow.

Thirdly, exploration will move back onshore, to re-explore in and around existing basins with new technology and play concepts. Key to this move back into 'Old Geography' will be new onshore seismic capability that generates marine quality 3D images of onshore geology.

Finally, the USA's success in the mechanical creation of permeability by hydraulic fracturing will slowly spread to test the world's great source rocks. The prolific source rocks of Russia, the Middle East and North Africa may be the most responsive, but the lack of a 'Lower 48' operating environment will delay significant commercialisation.

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Malcolm Brown, BG Group

After completing his BSc Geology in 1976, Malcolm worked initially in Libya and Saudi Arabia. He took his MSc in Petroleum Geology at Imperial College in 1982 before joining BG Group. During his career he has worked in a variety of hydrocarbon provinces including the North Sea, West Africa and South America, based in the UK and Houston. He was Exploration Director with worldwide responsibilities from 1996 to 2000.

Between 2001 and 2003 Malcolm managed the Group's Central North Sea production assets and then spent two years as Group Head of Health, Safety, Security and Environment. Malcolm returned to lead Exploration in 2005 and is responsible for global exploration. In this period BG Group has been involved in five giant pre salt oil discoveries in Brazil, and more recently large discoveries in Tanzania and Australia.

Malcolm was appointed Executive Vice President on January 1st 2013 reporting to the CEO, joining the BG Group Executive at the same time.

Abstract: Exploration & Production Developments in the South Atlantic

BG Group partnered with operator Petrobras in the Brazil 2nd Licence round in 2000 where deep water Santos Basin acreage was first offered. The JV won 3 blocks: BMS-9 (with YPF), BMS-10 (with Chevron) and BMS-11 (with Petrogal). The first well Parati, spudded in 2005, penetrated dry Cretaceous sandstones on the flanks of a salt diaper but demonstrated the existence of a working hydrocarbon system in the pre-salt section. The second well Tupi 1, completed in 2006 discovered a thick oil column in microbial carbonates in a large NE-SW trending high mapped at base salt level and tested at 4900 bopd. In 2007 Tupi Sul, 9.5 km away proved the excellent quality reservoir extension to the south. Further discoveries were made in Carioca and Guara in BMS-9 and Iara and Iracema in BMS-11. Following a 3 month extended well test on Tupi the JV committed to the first of a sequence of FPSOs. This FPSO started production in October 2010 and produces circa 100,000 bopd from just 4 wells. This was followed by two further FPSOs in 2013. The agreed BMS-9 and 11 development plans includes 15 FPSOs by 2018 with a gross capacity of 2.6mmboed.

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Tony Doré, Statoil

Tony Doré obtained his PhD in geology from University College London and joined the petroleum industry in 1977. He has held senior technical and leadership positions with Statoil for 19 years, and is currently based in London. He has worked petroleum provinces all over the world, with emphasis on NW Europe, the Arctic and the Americas. Tony has published on stratigraphy, NE Atlantic - Arctic evolution, basement reactivation, basin modelling, passive margin structure, hyperextension, exhumed petroleum systems and exploration risk analysis. He has edited books on basin modelling and resource quantification for the Norwegian Petroleum Society, acted as Geology Editor for First Break, and edited two Geological Society Special Publications dealing with passive margins. He was Editor-in-Chief of the journal Petroleum Geoscience between 2006 and 2009. Tony was chairman of the Geological Society Petroleum Group 2001-2003, chaired the 2003 Petroleum Geology of NW Europe conference and was joint editor of the subsequent proceedings (2005). He is on the advisory boards of several universities and currently holds an Honorary Professorship at Durham University. His awards include the Petroleum Group Medal (2006) and an OBE in 2010 for services to geology.

Abstract: Unlocking Arctic Resources – New Realities and Long-Term Perspective

A quick tour through the plate tectonic evolution of the high Arctic illustrates why the Arctic is considered a favourable setting for both source rock and clastic reservoirs. Estimates vary widely, but the general consensus is that the Arctic contains a significant proportion of the world's undiscovered conventional resources, with gas probably predominating over oil. Thus, the region can contribute a major part of the world's energy mix in the next century. This thinking has provoked a marked surge in activity in recent years, with significant offshore acquisition and some landmark discoveries.

However, the right geological setting and yet-to-find resources only marks the beginning of the Arctic challenge. Development of enabling technologies is critical to facilitate exploration and production in cold, remote and ice-bound areas. These technologies, and the necessary R&D efforts, will vary according to the type of Arctic regime, varying from workable (shallow water, manageable ice conditions) to extreme (deep water, major seasonal ice). Engagement with local stakeholders, and environmental sensitivity, must underpin all Arctic activity. Environmental concerns focus especially on ice-related issues, from the effect of hypothetical oil spills in ice to the larger issue of the yearly retreat of the polar ice. License periods originally developed for more favourable climates add to the challenge of properly evaluating offshore Arctic acreage.

All of these factors contribute significantly to cost, which is without doubt the most critical immediate issue in Arctic exploration and development. The high cost, low margin regime currently being experienced by the offshore petroleum industry is doubly exacerbated by the harsh climate and difficult logistics of the high Arctic. The recent surge in acquisition in the Arctic has thus been counterbalanced by a number of delays and setbacks. For this reason a stepwise approach to the Arctic is likely over the next two decades, with oil developments preceding gas, and cautious progress from workable to more extreme ice conditions. Ultimately, the technologically challenging and expensive Arctic adventure is not one to be undertaken alone, and collaboration models will become increasingly critical as exploration progresses.

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Monday 23 September

Session Three: Exploration Technologies

Bruce Levell, University of Oxford and formerly VP for Emerging Technologies in Shell

Bruce, University of Oxford and formerly VP for Emerging Technologies in the Innovation Research and Development group within Royal Dutch Shell. He is responsible for:
(1) identifying and testing emerging technologies relevant for improving Shell's current core businesses
(2) creating options through technology for Shell during the expected Energy Transition of the next few decades

Bruce decided at age 14 that he wanted to be a geologist and has spent his working life practicing geology in Petroleum Exploration. He graduated from Oxford University with a BA and PhD in Geology and joining Shell in 1978.

He began in research on specialist geological technologies. Various operational assignments followed: Sabah and Sarawak, Malaysia, then Houston, USA, London. and Oman. From 2003 to 2008 he was Vice President responsible for Global New Ventures investments in Shell's World-wide Exploration unit based in the Hague. In 2008 he was appointed Chief Scientist: Geology for the Shell Group. He also has staff responsibility for staff in the Specialist Geology disciplines. In September 2009 he was additionally appointed to his current function of Vice President of Emerging Technologies. In June 2009 he was honoured by industry peers with the award of the Silver Medal of the Petroleum Group of the Geological Society of London.In 2013 he became a visting professor in the Department of Earth Sciences at Oxford University.Bruce is married with three sons, and enjoys amateur astronomy, sailing , and (geological) travel.

Abstract: Future Geoscience technologies for unlocking hard resources

Technology application for Exploration can be viewed from the perspectives of:

Technology Push- those technologies which are developing rapidly or have reached a stage where they enable new approaches ("solutions looking for problems")
Business Pull – technologies that need to be deployed or in some cases invented to solve known problems ("necessity is the mother of invention").

In the technology push domain advances are: big data processing capability, analytical techniques- moving from off-line to on-line, automation and robotics, sensors, and communications are some of the major growth areas.
In the Business Pull domain current drivers are the need to: optimize well designs and engineer wells safely, rapidly determine the areas of top quartile well performance in unconventional plays, image beneath complex overburdens, and quickly determine the prospectivity of frontier basins, reduce the footprint of operations

Technology is rising to all these challenges as will be illustrated in this talk. However an additional challenge to technology providers is how to support technology application in the context of increasingly stretched human resources. ("Doing more with less"). This implies further technology solutions in "softer" areas like better data and knowledge management, workflows, more effective training and support, and remote operations.

NOTES:

David Bamford, Winward Exploration

David Bamford is a non-executive Director of Tullow Oil (since 2004, and is Chairman of the Remuneration Committee).

With a PhD in Geological Sciences from the University of Birmingham, he has had over 23 years exploration experience with BP where he was Chief Geophysicist from 1990 to 1995, General Manager for West Africa from 1995 to 1998, and Head of Exploration, directing BP's global exploration programme, from 2000 to 2003.

He is a geophysicist by background and an explorer by recent history, and is well known as both around the oil & gas industry. In addition to acting as a director or advisor to several small companies, including his own consultancy, he has written regularly for journals such as Geoexpro, OilVoice, ROGTEC etc, and co-founded both Finding Petroleum and OilEdge as vehicles for on-line communication in the oil & gas industry.

Abstract: Geophysical technologies that will disrupt and transform exploration

Our industry is extremely conservative when it comes to taking up new technologies.

For example, in any survey of the 'most important technologies' in the oil & gas industry, two of the top 3 'usual suspects' – horizontal drilling and 3D/4D seismic - are great exemplars of the decades it takes for new ideas to achieve market dominance in our industry, having been first used in the 1940's and 1960's respectively!

So I thought I would review those 'disruptive' technologies that I believe have the potential to transform our industry, perhaps especially onshore as we tire of the extreme costs of operating in deep water.

Choosing just four, I will argue in favour of:

- Remotely Piloted Aircraft
- Full Tensor Gravity Gradiometry
- Wireless Seismic
- Permanent Reservoir Monitoring.

I appreciate that my final choice does not relate to exploration but I am leaning here on the old adage that "the best place to find oil is in an oil field"!

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Tuesday 24 September

Session Four: Development Trends

Dominique Marion, Total

Dominique Marion is currently Vice-President Reservoir Evaluation and Management at Total. He was previously Corporate Reserves Manager and Reservoir Engineering Manager at the head quarter in Paris. During his career with Total, he held various international assignments in Africa, Middle East and Northern Europe. He graduated from Ecole Nationale Supérieure de Géologie in Nancy, France and holds a PhD in Rock Physics from Stanford University, California. He is a member of the Society of Petroleum Engineers.

Abstract: Future Trends in Reservoir Management

The purpose of reservoir management is to maximize economic value of hydrocarbon fields with the implementation of production optimization techniques and recovery mechanisms that are specifically designed on a field by field basis.

Successful reservoir management relies on comprehensive analysis of reservoir behavior and production mechanisms throughout the life cycle of a field together with accurate model representation of the reservoir-well - facilities system. These are keys elements to plan and conduct successful production optimization operations.

This paper will discuss future trends in reservoir management focusing on data acquisition, reservoir characterization and modeling techniques that are emerging within the industry to develop new fields or rejuvenate mature fields.

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Xudong Jing, Shell

Dr. Xudong Jing is currently the Research and Innovation Director at Shell (China) Projects and technology responsible for R&D and technology applications in the areas of unconventional gas, enhanced oil recovery and emerging technologies. He is also Shell's coordinator for external R&D and Innovation cooperation with universities and institutes in Asia and a visiting professor at Imperial College London. Previously, Dr. Jing served as Shell's R&D Program Manager for Improved and Enhanced Oil Recovery leading research and innovation teams in several international locations from Middle East, Europe to North America. Before joining Shell in 2001, Dr. Jing worked for Imperial College London as lecturer, then reader in petroleum engineering. Dr. Jing holds a PhD in Petroleum Engineering from Imperial College London and served as President of the Society of Core Analysts (www.SCAweb.org) and Technical Editor and Global Talent Council member for the Society of Petroleum Engineers (www.SPE.org).

Abstract: Technology Trends & Needs In Enhanced Oil Recovery

With the world's energy demand estimated to double by 2050, oil and gas will continue to play an important role in the energy picture for the foreseeable future. Since relatively easy-to-produce oil and gas has largely gone, there is need to focus on the more difficult hydrocarbons and on increasing recovery factors from existing fields.

A great industry challenge exists to increase oilfield recovery factors from the current average level of just over 30% - which means for every barrel of oil produced, 2 barrels are left behind. This challenge becomes, in turn, a unique opportunity for petroleum engineers and geoscientists to make a sizeable contribution to additional reserves through Improved and Enhanced Oil Recovery (EOR).

Enhanced Oil Recovery includes technologies that change the physical properties of injected and/or reservoir fluids (e.g. via thermal, chemical or miscible gas injections) – in addition to other Improved Oil Recovery methods such as better reservoir management, infill drilling, workovers and production optimization.

Advances in technology in many areas all contribute to the realization of the EOR promise. We will discuss some examples: fractured carbonate reservoirs, chemical and gas EOR, and energy-efficient thermal EOR. The EOR work scope starts with detailed field reviews followed by extensive laboratory tests, advanced EOR modeling in sector and full field models, and field trials to de-risk the opportunity. Once the feasibility study has been successfully concluded the field operating unit can initiate field developments. A full suite of well and reservoir monitoring technologies have been developed to understand sweep and flood front development which is fundamental for the success of any EOR project.

A successful EOR practice requires a number of long-term commitments in human and capital resources, technology R&D and deployment, and focus on sustainable development such as energy efficiency and minimization of CO2 footprint.

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Martin Blunt, Imperial College

Martin Blunt joined Imperial in June 1999 as a Professor of Petroleum Engineering. He served as Head of the Department of Earth Science and Engineering from 2006-2011. He Previous to this he was Associate Professor of Petroleum Engineering at Stanford University in California. Before joining Stanford in 1992, he was a research reservoir engineer with BP in Sunbury-on-Thames. He holds MA and PhD (1988) degrees in theoretical physics from Cambridge University.

Professor Blunt's research interests are in multiphase flow in porous media with applications to oil and gas recovery, contaminant transport and clean-up in polluted aquifers and geological carbon storage. He performs experimental, theoretical and numerical research into many aspects of flow and transport in porous systems, including pore-scale modelling of displacement processes, and large-scale simulation using streamline-based methods. He has written over 200 scientific papers and is Editor of Transport in Porous Media. In 2011 he was awarded the Uren Award from the Society of Petroleum Engineers for outstanding contributions to the technology of petroleum engineering made before the age of 45.

Abstract: Peering into the pore space: putting the physics back into petroleum engineering

I will provide an overview of recent developments that allow us to image - in the laboratory - fluid displacement in the sub-millimetre sized pore space of rocks, under the high pressures and temperatures representative of hydrocarbon reservoirs. This, coupled with huge advances in our ability to model fluid flow, and a suite of innovative theoretical developments, is leading to a revolution in the way in which we describe fluid flow underground.

I will show how this improved understanding of the physics of flow can lead to better design of improved oil recovery schemes. A return to the laboratory and the study of fundamental physical and chemical phenomena may help us realise the challenge of boosting recovery factors from existing fields to meet the energy needs of the 21st century.

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Tuesday 24 September

Session Five: Development Technologies

Jan Dirk Jansen, TU Delft

Jan Dirk Jansen is professor of Reservoir Systems and Control and department chair in the Department of Geoscience and Engineering of Delft University of Technology (TU Delft) in the Netherlands. In 2010-2011 he spent a year as Cox visiting professor at the Department of Energy Resources of Stanford University. Earlier, he spent many years in the petroleum industry in research and operational positions in the Netherlands, Norway and Nigeria. His current research is focused on the application of systems and control theory to subsurface flow, and in particular the use of adjoint-based optimization and model-order reduction methods.

Abstract: Smart Fields: Model-Based Control and Optimization of Subsurface Flow

‘Smart’ or ‘Intelligent’ oil field technology, also known as ‘Closed-loop reservoir management (CLRM)’, has developed over the past decade from a hardware-driven niche application to a concept for model-based control and optimization of subsurface flow. Inspired by systems and control theory, as applied in refineries and the process industry, and data assimilation methods, as applied in meteorology and oceanography, CLRM aims to form a bridge between the geosciences and the reservoir and production engineering disciplines. The underlying hypothesis is that recovery can be significantly increased by changing reservoir management from a ‘batch-type’ to a near-continuous model-based controlled activity. Key elements are the optimization of field development and production strategies under geological uncertainty, data assimilation for frequent updating of geo- and reservoir models, and model reduction to limit the computational efforts to simulation of only the essential processes. The underlying theory makes use of system-theoretical concepts like controllability, observability and identifiability of subsurface flow and the relevant parameters. In this presentation I’ll give an overview of CLRM and the underlying concepts, and will discuss barriers to implementation and potential solutions.

NOTES:

Geoff Maitland, Imperial College

Geoff Maitland studied Chemistry at Oxford University where he also obtained his doctorate in Physical Chemistry. After a period as an ICI Research Fellow at Bristol University, he was appointed to a lectureship in Chemical Engineering at Imperial College in 1974. His research focused on molecular interactions and the transport properties of fluids, including the rheology of polymer systems. He spent a secondment with ICI Plastics Division from 1979-81 and became a senior lecturer in 1983. In 1986 he moved to the oil and gas industry with Schlumberger, where he carried out research in oilfield fluids engineering, including the use of colloidal systems for well construction, reservoir stimulation and production enhancement. He held a number of senior technical and research management positions in Cambridge and Paris, most recently as a Research Director. He rejoined Imperial College in September 2005 as Professor of Energy Engineering and his current research covers clean and efficient fossil fuel production with particular emphasis on carbon dioxide mitigation processes, methane hydrate production and energy-related reactor engineering. Geoff was awarded the Hutchison Medal by the Institution of Chemical Engineers in 1998 and served as President of the British Society of Rheology from 2002-2005. He was awarded the IChemE Chemical Engineering Envoy Award for 2010 for his media work explaining the engineering issues involved in the Gulf of Mexico oil-spill. In 2011 he chaired the independent review of the UK Offshore Oil and Gas Regulatory Regime ('The Maitland Report') and in 2012 was awarded the Rideal Lecture Award by the Royal Society of Chemistry.

Abstract: Novel Production Methods & Maximising Recovery of Non-Conventional Hydrocarbons

This talk will look ahead at how reservoir production processes might develop in the future, with a particular focus on non-conventional hydrocarbons and an emphasis on reducing the overall carbon footprint of fossil fuel production and use. It will examine enhanced oil and gas recovery techniques and whether new approaches are possible to maximise recovery factors by producing oil and gas to surface in the traditional way. Alternative paradigms will be discussed whereby production is accompanied by subsurface processing to produce to surface only the high value, and preferably lower carbon content, components and products whilst leaving low value materials and pollutants behind. The presentation will also consider the likely increasing role of gas in future decades and the production challenges this raises.

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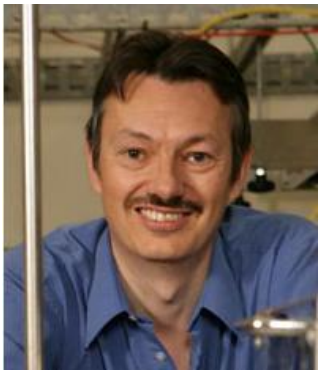
Nigel Brandon, Imperial College



Prof. Nigel Brandon OBE FREng holds the Chair in Sustainable Development in Energy, and is Director of the Energy Futures Lab, at Imperial College London. The Energy Futures Lab supports and integrates the work of over 600 researchers in the energy sector across Imperial College. His research interests are focussed onto electrochemical power sources such as fuel cells and batteries. He joined Imperial in 1998 following a fourteen career in research roles with BP and Rolls-Royce. He was a founder of the fuel cell company Ceres Power in 2001, awarded the 2007 Silver Medal from the Royal Academy of Engineering for his contribution to engineering leading to commercial exploitation, the 2011 Baker Medal from the Institution of Civil Engineering, and an OBE in 2012 for his contribution to UK-China science.

Abstract: Developments in Long-Term Sustainable Energy

We face an increasing challenge in moving towards lower carbon energy systems, whilst continuing to deliver affordable and secure energy supplies. The paper will discuss options relating to the development of low carbon energy systems to meet needs for the provision of transport fuels, electricity and heat, and highlight the need to develop smarter energy systems integrating a range of energy vectors, including gas and electricity.

NOTES:

Tristan Aspray, ExxonMobil

Trıstan Aspray was educated in England, receiving a Bachelors Degree in Geological Sciences from Cambridge University in 1992 and a Masters Degree in Basin Evolution and Dynamics from London University in 1993.

Trıstan joined Esso Exploration and Productıon UK Limited in 1994 as a Petroleum Geologist, workıng on Central North Sea fields. In subsequent assignments he has worked on exploration and development projects in a variety of areas, including the Gulf of Mexico, Libya, Egypt, Vietnam and Russia. In 2008 he became an Upstream Advisor to ExxonMobil's Management Committee in Dallas, Texas. Tristan was then seconded into XTO Energy, a major producer of unconventional gas in the United States which was acquired by ExxonMobil in 2010.

Tristan assumed his current role of Europe Exploration Operations Manager in September 2011, and is based in Leatherhead, ın the UK. He is married and his interests include hiking, history, cycling and wildlife photography.

Abstract: Unconventional Gas: Global Impact So Far, Challenges and Future Potential

Significant resources of unconventional gas are present across the globe in low-permeability sandstones and limestones (tight gas), coal layers (coal bed methane) and organic-rich shales (shale gas). Production from such reservoirs began over half a century ago with tight gas development in countries such as the United States and Germany. More recently, a combination of the established technologies of horizontal drilling and hydraulic fracturing has led to a rapid rise in U.S. shale gas production, initially from the Barnett Shale of North Texas.

This increase in shale gas production has provided significant benefits for the U.S. economy, including the creation of 1.7 million jobs to date, and the generation of an estimated $2.5 trillion in tax revenues by 2035. A number of terminals originally built to import liquefied natural gas (LNG) are now being modified to export this commodity. Rapid growth in liquids production from shales has also reduced U.S. oil import requirements. Lower natural gas prices have catalyzed both an industrial renaissance and large-scale switching of power generation from coal to gas, which has resulted in significant reductions in U.S. carbon dioxide emissions. Tens of thousands of wells have now been drilled in multiple U.S. shale gas plays, generating significant technical and operational learnings that have produced both economic and environmental benefits.

Shale gas development outside the U.S. is currently more limited. This is partly due to the opposition that the industry faces in a number of countries. Opponents of shale gas and hydraulic fracturing cite a variety of concerns, including the risks of groundwater contamination and increased methane emissions. Much of the debate on shale gas has become subjective and emotive, with dramatic internet images and media headlines frequently gaining more attention than the results of objective studies and actual operating experience. Extensive dialogue with all stakeholders from local to national levels can help redress this, and is essential prior to operations.

Global population and economic growth, concentrated in the non-OECD countries, is driving a rapidly growing demand for energy, and in particular electricity. Generating power with natural gas reduces carbon dioxide emissions by 60 percent relative to coal, and provides a significant emissions reduction opportunity. Natural gas also complements intermittent renewable forms of energy such as wind. Within Europe, development of indigenous natural gas, including gas from unconventional reservoirs, strongly supports all three pillars of the European Union's Energy Policy: security of supply, competitiveness and de-carbonization. Global development of shale gas will proceed at a slower pace than in the U.S. but will benefit from the learnings made so far.

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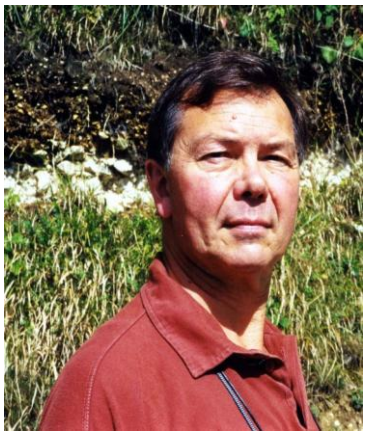
Dick Selley, Imperial College



Dick Selley is a Senior Research Fellow and Emeritus Professor of Petroleum Geology at Imperial College. He has spent all his professional life at the college apart from several gap years working for oil companies in the N Sea and abroad. Dick is the 'Rip van Winkle' of UK shale gas. It is over 25 years since he drew attention to the UK's shale gas resources to industry, academe and HMG. All were unimpressed and his initial work could only find a publisher in the USA. In recent years he has published, lectured and consulted extensively on shale gas. Dick was the first witness summoned to give evidence to the Parliamentary Select Committee of Enquiry into shale gas in 2011. He is a member of the joint Royal Society: Royal Academy of Engineering shale gas committee. Dick has received various national and international honours including the Silver Medal of the Geological Society of London awarded for excellence in petroleum geoscience. He is an Honorary Member of the Petroleum Exploration Society of GB.

Abstract: Perspectives on Future Shale Gas Developments in Northwest Europe

Arguably the first European gas to be produced (accidentally) from shale was the Netherfield No.2 well in Sussex in 1875. The first intentional production of gas from shale was from wells drilled into Lower Cretaceous shale in the Basque region of Spain in the 1950's. Research at Imperial College identified the shale gas resources of the UK in the early 1980's. The Carboniferous shales of N England were deemed the most prospective. After the renaissance of the US shale gas industry at the start of the present century exploration in Euroland began seriously. According to the US EIA (2011) Europe has 2,587 Tcf (Trillion Cubic Feet) Risked Gas in place, and 624 Tcf Technically Recoverable Resource. The main prospective shales are Upper Cambrian, Lower Carboniferous, Jurassic and Cretaceous. These have all been tested with varying degrees of success, principally in Poland, northern Germany and Sweden. The main inhibitors to shale gas exploration and production are not geological and technical, but environmental and political. Bans on 'fracking' are haphazard across the Europe. Governments' decisions on whether to permit or ban 'fracking' are largely dependent on the availability of other energy sources. The true economic viability of shale gas only become established after a sustained drilling campaign and production tests.

NOTES:

Joe Cartwright, Oxford University

Joe Cartwright was appointed as the Shell Professor of Earth Sciences in October 2012. He leads the newly established Shell Geoscience Laboratory at the Department of Earth Sciences, which forms part of a major initiative in energy resources in the Department and more widely in the University. Joe was formerly Director of the 3DLab and Research Professor in Geophysics at Cardiff University, where his main role was to build research partnerships with the petroleum industry and undertake fundamental research into the movement and entrapment of petroleum in the Earth's crust. Previously, he was a senior lecturer at Imperial College London. In his quest for a better understanding of how oil and gas form and accumulate, he has led field campaigns in SE Asia, Southern Africa and North America, building on formative experience gained immediately after graduating from Jesus College when he worked for a time with Shell as an exploration seismologist. His DPhil was at Wolfson, on continental rifting.

Joe's research interests encompass the study of a diverse range of processes that influence petroleum habitats, and include: the propagation of faults, interactions between faulting and sedimentation, diagenesis, fluid flow and soft sediment deformation. As a proud Welshman, his external interests unsurprisingly centre on choral singing, but he also paints, walks the hills of his homeland and plays village cricket.

Abstract: Recent & Future Trends in Mudrocks

Taken at face value the answer to the hidden question in the title is compaction. The assemblage of complex processes that lead to lithification during burial as clays evolve towards shales and slates, is a true feast for modern research. Long considered the forgotten second cousin of reservoir rocks, the physical, biological and chemical changes in mudrocks are bewilderingly complex, but are now recognised as essential to document and understand if resources are to be unlocked efficiently.

This presentation examines a small subset of the research currently undertaken on mudrocks, and uses this review to explore the impact of some of the current gaps in knowledge on risk analysis of conventional hydrocarbon seals and resource estimates and economic viability of shale gas reservoirs. We focus on two themes here: changes in physical properties due to diagenesis of mudrocks and natural fracture systems in mudrocks.

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Tina van de Flierdt, Imperial College

Dr van de Flierdt holds a Senior Lectureship in Isotope Geochemistry at the Department of Earth Science and Engineering at Imperial College London. She is a geologist by training whose academic background includes a PhD in Natural Sciences from ETH Zurich (Switzerland), and a postdoctoral fellowship and research scientist position at the Lamont-Doherty Earth Observatory of Columbia University (USA).

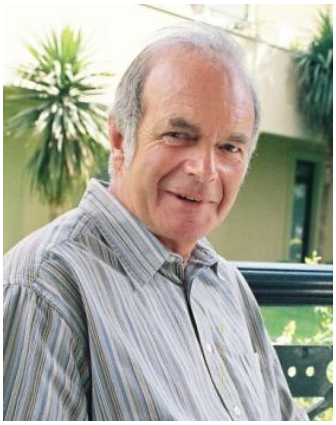
Dr van de Flierdt works on the development and application of novel geochemical tools to address fundamental questions in ocean chemistry and climate change of the past. She co-leads the state-of-the-art MAGIC isotope facility at Imperial College London, which allow her to analyse small abundance variations in naturally occurring isotopes with very high precision. Some of her key research questions evolve around assessing and understanding the impact of anthropogenic pollution and climate change on ocean chemistry and ocean circulation. Of particular societal relevance is her work on the stability of polar ice sheets under warmer than present temperatures.

Abstract: Drilling back in the future – Past stability of the East Antarctic ice sheet

One important component of today's climate system is the presence of massive ice sheets on both poles, comprising the majority of all fresh water on our planet earth. In the light of continuing global warming, a question of major societal importance is the stability of these large ice sheets. If completely melted, they could raise global sea level by some 65m. The present situation with ice caps over Greenland and Antarctica is however just a snapshot in the geological history, which has seen waxing and waning amounts of ice at both high latitude sites. In my talk I will discuss in particular the history of the large East Antarctic ice sheet during the Pliocene warmth, a time when global temperatures were similar to those predicted for the end of this century and carbon dioxide levels were similar to today. New research has now shown that under such conditions low lying areas of the East Antarctic ice sheet were vulnerable to melting with important implications for the future.

NOTES:

Bryan Lovell, Past President of the Geological Society



Dr. Bryan Lovell, OBE, CGeol, has been Senior Research Fellow in Earth Sciences at the University of Cambridge since 1996. He was formerly with BP Exploration. Lovell studied at Oxford and Harvard Universities in the 1960s and was Lecturer in Geology at the University of Edinburgh in the 1970s. His current research is on the control of high-frequency changes in regional sea-level exercised by heterogeneites in mantle convection; his current consultancy interests are focused on carbon capture and storage. Lovell was President of the Geological Society of London from 2010 to 2012

Abstract: Challenged by Carbon: The Oil Industry and Climate Change

The message from the rocks is that we should stop pulling the fossil carbon trigger – now. Otherwise we shall cause a global warming event, like the one 55 million years ago. Such an event would be fine for Earth, but not so good for us. Geologists know that you can't argue with a rock, so this message presents a particular challenge to those of us involved with the oil and coal industries. We can respond by playing a leading role in making the essential transition to a low-carbon economy. For some years to come, a great deal of the world's electricity will continue to be generated by burning coal. A new industry, comparable in size to the present-day oil industry, can store safely underground a large part of the carbon dioxide captured from coal-fired power stations. Our expertise will be central to that process. Who wants to join in?

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Fire Safety Information

Basic Fire Procedure

On discovering a fire;

Raise the alarm by breaking the glass at the nearest Break Glass Point which will be located by main exit doors and along evacuation routes.

On hearing a continuous ringing of the fire alarm;
STOP what you are doing
LEAVE by the nearest fire exit
WALK calmly, do not run
DO NOT stop to collect personal belongings
DO NOT attempt to put out the fire

The fire exit routes are clearly identified by 'green running person' signs with appropriate directional arrows.

After any evacuation stand well clear of the building you have exited from. You may be directed to specified assembly points by College staff who will monitor and attend any alarm in progress. DO NOT re-enter the building until told it is safe to do so by the Fire Office or College Security staff.

Assembly Points