UBC Shale Gas & LNG Industry Symposium

INVITATION

Date: Friday February 22, 2013 – (8.00 AM to 5.30 PM)

Earth Sciences Building, 2207 Main Mall, UBC Campus, Room 5108 (top floor)

British Columbia has recognized the potential of both conventional and unconventional oil and gas resources from coal-bed gas to tight gas, shale gas, carbon management (carbon sequestration) and conventional energy resources. Extraction, transportation and processing of these energy resources may provide both scientific and technical challenges. This one day symposium provides industry and the regulators the opportunity to explore collectively the extensive expertise and research in support of resource modeling, hydrology, seismic analysis, drill fluid dynamics, viscoelastic fluid mechanics, ground water hydrology, ground water remediation, geochemical composition of aquifers, reservoir characterisation shale gas as well as applied engineering solutions and needs associated with processing and transportation (LNG).

Symposium Covers:

- Is natural gas a bridging fuel to a reduced carbon economy?
- Perspectives on shale gas development in Europe and North America?
- What is the resource base for shale gas in BC based on energy prices?
- What is the latest research around shale gas development including impacts such as: frac modeling, water, seismicity, remediation, well design, transportation and processing of natural gas for export (LNG engineering design methodologies for wells, well sites, pipelines, processing plants, and liquefied natural gas facilities);
- What are the lead times and costs of LNG plants, and natural gas prices in Asian markets?
- Engineering aspects around supply chain for pipelines and shipping of LNG?

Who Should Participate:

- Industry, regulators, engineering companies and scientists.

Registration Cost $100.- Taxes included

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THE UNIVERSITY OF BRITISH COLUMBIA

BC Oil & Gas COMMISSION

UBC Shale Gas & LNG Industry Symposium

Registration

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Register on line – click on the following link (click on link) http://www.pims.math.ca/industrial/all-events

Please note registration is a two-step process, by registering first with PIMS and then proceed to payment page, We apologize for this slight inconvenience, as we want to mail tax receipts for participating in this symposium.

Program

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7:30 **REGISTRATION & REFRESHMENTS & NETWORKING**

8:00 – 8:15 **OPENING REMARKS (Dr. Eric Hall and Dr Simon Peacock)**

8:15 – 10:00 **NATURAL GAS MARKETS - Introductions Michael Schoen**

- **Paul Jeakins**, **Commissioner and CEO** with the BC Oil and Gas Commission. The landscape of natural gas in BC; challenges, opportunities, legislation (eg. disclosure of frac fluids, recycling frac fluids, environmental monitoring and controls, excise tax and revenues).

- **Dr. Luthi, Professor of TU Delft, Holland**, The European perspective: importance of natural gas, and shale gas to the global energy mix and on its role as a bridging fuel to a reduced or non-carbon energy economy. Holland is a critical hub for gas distribution in Europe.

  Colin Coe, Senior Advisor Navigant , gas supply and demand in North America, the role of LNG in the Asia Pacific region,global LNG supply and demand,lead times for LNG project development and costs.

- **Ken Culotta, Partner, King & Spalding**. The US perspective: US LNG export projects and contracting mechanisms; export authorizations; FERC siting approval; US LNG tolling model

  Q&A and Panel Discussion, Paul Jeakins, Dr. Luthi ,Colin Coe & Ken Culotta

10:15 – 10:40 **REFRESHMENT & NETWORKING BREAK – POSTER SESSIONS**

10:40 – 12:30 **TECHNICAL PRESENTATIONS**

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- **Mayka Kennedy, Commissioner, BC Oil & Gas Commission.** Overview of research needs in support of industry and regulator

- **Jeremy Moore, Manager Groundbirch, Shell,:** Tight gas development issues in North American (Groundbirch & Deep Basin)

- **Wally Kozak, Chief Engineer, Calfrac Ltd.** – Real and / or perceived issues around well completion – industry perspective. 'Industry', including business, academia, regulators and investors are incented by competitive pressures to make continuous improvements in technologies and practices to improve performance and covers advances in well construction and completions technology toward a material impact on Industry's performance.

- **Dr. Amanda Bustin**, **UBC**, Hydraulic fracturing induced seismicity: a look into the cause and risk, as well as prevention and mitigation techniques, including examples from the Bowland Basin, England and the Horn River Basin, British Columbia.

- **Dr. Eberhardt, UBC**, Numerical modelling of influence of natural fracture systems and stress field on hydrofrac propagation, stress field disturbance and hydrofrac interaction (e.g. simulfrac, zipper frac), and frac fluid diffusion after shut-in on the triggering of fault slip and induced seismicity

- **Dr. Beckie, UBC** : Hydro-geological and ground water modeling;risk factors to ground water from fracking; techniques to mitigate the risk of ground water contamination and the recycling of frac water.

- **Dr. Peirce, UBC,** Numerical Models of Hydraulic Fracture Propagation

12:30 – 13:30 **LUNCH & NETWORKING – POSTER SESSIONS**

13:30 – 16:00 **TECHNICAL PRESENTATION**

- **Dr. Uli Mayer, UBC Surface casing vent flows (SCVF) and gas migration (GM) outside well casings**. Gas migration near production wells or faulty abandoned wells may cause uncontained surface effluxes of CH_4 and other gases, or may enter aquifers that are utilized for water supply.

- **Dr. Loretta Li, UBC** Gas migration in subsurface soils

- **Dr. Wijewickreme, UBC**, reduction of pipeline damage risk due to ground movements (arising from earthquakes or natural landslides) , and key research work that is ongoing at UBC and globally

- **Dr. Alfantazi, UBC**, risk and mitigation of Microstructure and Corrosion of Welded Advanced High Strength Steels for Gas Transportation Pipelines

15:15 – 15:45 **REFRESHMENT BREAK & NETWORKING – POSTER SESSIONS**

15:45

- **Dr. Peter Englezos, UBC,** Natural Gas Hydrates.
- **Dr. King, Manager of Simulations, Ausenco** will simulate the loading and transportation of LNG and discuss navigational restrictions, LNG storage capacity requirement, number of berths, and managing the production rate from LNG trains.

16:30 **CLOSING REMARKS**

16.30 – 17:30 **NETWORKING RECEPTION – POSTER SESSIONS**

Additional speakers may be added/exchanged.

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Profiles

Industry and Government Profiles

Mr. Colin Coe, Senior Consultant, Navigant
Mr. Coe has over 30 years of experience in the energy business, twenty five in the natural gas sector and the past seven in LNG. Colin started his career with Shell Canada Products in British Columbia in 1977 and transferred to Shell Canada Resources in Calgary where he became Senior Economist, evaluating opportunities for the newly deregulated natural gas industry. In 1986 he returned to Vancouver to work with BC Hydro in their Power Smart program before being recruited to head up long term gas marketing for CanWest Gas Supply, the privatized version of the BC Petroleum Corporation. After 8 years with CanWest, Colin was recruited by Calpine to head up their west fuels group to acquire gas supply for their power generation units. Colin was then recruited by Woodside Energy – one of Australia's leading LNG companies – as VP Marketing to assist them in the integration of North American markets – Australian supply and Asian markets. In this role Colin spent considerable time working in Australia and dealing with key Asian LNG buyers.

Mr. Ken Culotta, King & Spalding
Mr. Ken Culotta, is a partner in the Houston office of King & Spalding, one of the world's largest, and most experienced energy practices, and was a founding member of the firm's London office. His twenty-seven years of experience encompass a broad range of domestic and cross-border oil, gas and mining industry transactions and the unique public and private law issues involved in structuring, documenting and negotiating them. His portfolio is global; Mr. Culotta is fluent in Spanish and German and has extensive experience in Latin American and European energy matters.

Paul Jeakins, BC Oil & gas Commission
Mr, Paul Jeakins, Commissioner and CEO with the BC Oil and Gas Commission. A native of Vancouver, British Columbia, Mr. Jeakins graduated from the University of Alberta in 1985 with a Bachelor of Science in Forestry and recently completed his Master's thesis in environment and management. Prior to joining the Commission in 2006, Mr. Jeakins was a partner in a resource consulting firm. His roles at the Commission have included Chief Operating Officer, Deputy Commissioner of Regulatory Affairs and Stewardship and Manager of Audits. In his current position as Commissioner and CEO, where he is the strategic and operational leader of the Commission. He brings 25 years of expertise to the role in organizational leadership, financial management, regulatory and strategic planning and decision making. He is also Vice Chair of Camput: Canada's Energy and Utility Regulators' Energy Resources Committee and a Board member of Petroleum Technology Alliance Canada (PTAC). Based out of Victoria, he divides his work time between the Commission's offices in Fort St. John, Dawson Creek, Fort Nelson and Kelowna, and regularly travels to Calgary.

Dr. Harry King, Ausenco
Dr. King, Manager of Simulations , Ausenco, heads a team of 20 engineers at Ausenco's Vancouver office where he designs simulations of supply chain logistics for Tier 1 clients in the petroleum industry. He has simulated the Cheniere LNG plant in Louisiana, the largest LNG plant in North America, and has also simulated the only LNG plant in Canada, which is owned by Irving Oil, in New Brunswick.

Wally Kozak, Chief Engineer, Calfrac Well Services Ltd.
Wally has over 30 years of broad engineering experience in the oil and gas industry–both with operating and service companies. From the operating side, Wally has over twenty years of production engineering, well completions and work-over experience backed up by several years of production operations, midstream operations, business development and acquisitions/divestiture activity in Canada, Europe and the FSU. Wally has been involved with unconventional resources since 1993. Wally has a B.Sc. in Chemical Engineering from the University of Alberta and is a member of APEGGA. Currently, he is Chairman of the Canadian Society for Unconventional Resources (CSUR).

Dr. Stefan M. Luthi, Technical University of Delft
Dr. Luthi, Professor in production geology and head of Applied Geology at the Delft University of Technology holds the Schlumberger chair**.** He joined Schlumberger Oilfield Services in 1982 as a regional geologist for the Middle East, based in Dubai. He then was transferred to the Schlumberger-Doll Research Center in Ridgefield, CT (USA), where he spent ten years as a senior research scientist and program manager. In 1991/1992 he was invited for one year as a visiting professor to the department of geophysics at the Universidade Federal do Pará in Belém, Brazil. In 1996, Stefan was transferred by Schlumberger to Paris as chief geologist for Europe, Africa and CIS, and in 1998 he was transferred to Luanda, Angola, as interpretation manager for Africa. In 1999 he accepted his present position at the Delft University of Technology. His specializations are reservoir characterization using new quantitative approaches, sedimentology, petrophysics, and reservoir management. He has published over 50 papers in scientific journals and one textbook. He is involved in numerous research projects nationally and internationally. He is a member of many international societies (AAPGP, EAGE, EGU, SPWLA etc.), member of the Koninklijke Hollandsche Maatschappij der Wetenschappen and Dutch delegate to the International Continental Scientific Drilling Programme.

UBC Principal Investigator Profiles

Akram Alfantazi
Dr. Akram Alfantazi is a Professor in the Department of Materials Engineering and Associate Dean, Research and Graduate Studies of the Faculty of Applied Science at UBC where he has been teaching for 13 years. He is a Fellow of the Canadian Institute of Mining, Metallurgy and Petroleum (CIM) and a recipient of the Killam Award for Excellence in Mentoring (Mid-Career Category) for 2010. Dr. Alfantazi teaches both undergraduate and graduate courses as well as specialized courses to the metallurgical community. He has contributed to over 100 refereed journal and conference proceedings, published 23 major technical reports and co-edited 5 proceedings from international conferences. He is an internationally recognized authority on high temperature/pressure corrosion and the corrosion of nano-crystalline materials. His areas of research are: corrosion engineering and electrometallurgy.

Susan Baldwin
Dr. Susan Baldwin is an associate professor at UBC in the Department of Chemical and Biological Engineering and is currently studying the use of microbial communities in the bioremediation of mine drainage. She holds a doctorate from the University of Toronto in Biomedical Engineering and an MSc in Mechanical Engineering from the University of Cape Town, South Africa. Dr. Baldwin completed her postdoctoral training at McGill University in Montreal in the modeling of hydrometallurgical reactors and at Delft University of Technology in the Netherlands in hydrometallurgy with a focus on iron oxidation.

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Roger Beckie
Dr. Beckie' is a Professor in the Department of Earth, Ocean & Atmospheric Sciences. His research group is focused on shale gas and drill site impact on aquifers and ground/surface water resources, including assessment of surficial aquifers which are impacted hydraulically and geochemically. Their applied research is in response to "real-world: problems with a focus on contaminant spills and depth integrated biodegradation;multicomponent reactive modeling of the density driven oxidation of PCE and TCE.; spill remediation research; design of the Optimal Monitoring Frameworks for Detection of Contamination in A Three-Dimensional Watershed-Scale Porous/Fractured Aquifer System using a stochastic random fracture network generation program and three-dimensional discrete fracture, saturated-unsaturated flow and transport models to design a three-dimensional double-layered porous/fractured aquifer. Reactive transport modeling – reaction induced advective diffusive gas transport- is to develop a reactive transport model for variably saturated media that includes reaction-induced advective-diffusive gas transport. In this model, a variety of homogeneous and heterogeneous reactions can be described as equilibrium or kinetics processes.

Amanda Bustin,
Dr. Amanda Bustin, Research Associate, holds a BASC in geological engineering from the University of British Columbia and a PhD in geophysics from the University of Victoria. She has worked as a post-doctoral fellow and research associate at the University of British Columba on a variety of unconventional gas projects with the main focus on reservoir assessment and exploitation, including projects throughout North America, Europe and India. Her expertise includes petrophysics, unconventional reservoir modeling, geophysical analyses and interpretation, geomechanics, laboratory analyses, and general applied organic geochemistry and petrology.

Marc Bustin,
Dr. Bustin¸ Professor of Petroleum and Coal Geology in the Department of Earth and Ocean Sciences, has consulted in the area of fossil fuel resource evaluation and functioned as director and technical advisor for a variety of small through large petroleum companies in Europe, Africa, North America and Asia. Dr. Bustin has published over 180 reviewed scientific articles on fossil fuels. Dr. Bustin has designed and managed shale gas and coalbed methane evaluation and development projects world-wide, including China, Botswana, Europe, Australia, SE Asia, India and basins throughout North America. Dr. Bustin received his PhD in geology in 1980 from the University of British Columbia and is a registered Professional Geoscientist in the province of British Columbia. He is or has been an associate editor of the Canadian Society of Petroleum Geology Bulletin, Sedimentary Geology, International Journal of Coal Geology and the Canadian Journal of Earth Sciences. He is member of the ICCP, AAPG, TSOP and GSA. Dr. Bustin is the recipient of the A. L. Leverson memorial award from the AAPG, received the Thiesson Medal from the International Committee for Coal Petrography for his contributions to coal sciences/organic petrology, the Sproule Award in 2003 for contributions to the study of unconventional gas resources and the Gilbert H. Cady Award (2009) from the Geological Society of America for his contributions to coal science and the Medal of Merit from the Canadian Society of Petroleum Geology (2009). Bustin is an elected Fellow of the Royal Society of Canada. Bustin is a registered professional geologist in the province of British Columbia.

Erik Eberhardt
Dr. Eberhardt isProfessor of Rock Mechanics and Rock Engineering and Director of the Department of Geological Engineering His research focuses on the advancement and integration of state-of-the-art numerical modelling techniques with innovative geotechnical field measurements to better assess, understand and mitigate geo-risk associated with engineering activities. In relation to petroleum geomechanics and hydraulic fracturing, Dr's Eberhardt research includes: brittle fracture propagation, hydraulic fracturing and fluid injection into a naturally fractured rock mass, fault slip and induced seismicity, poroelasticity and wellbore stability. Often, the presence of

natural fractures and their influence on fracture propagation is not accounted for in hydrofrac and borehole stability design calculations. Research activities also include frac fluid/rock interactions -- diffusion, fracture flow-- and coupled hydro-mechanical interactions; development of better frac models; and reservoir engineering of shale gas and shale oil reservoirs and induced seismicity related to fracturing shale gas and shale oil wells. Dr. Eberhardt is a registered Professional Engineer in the province of British Columbia, former Chair of the Canadian Rock Mechanics Association, and recipient of the 29th Canadian Geotechnical Society's Colloquium prize.

Peter Englezos
Dr. Peter Englezos is Professor and Department Head of Chemical and Biological Engineering at the University of British Columbia where he has been teaching for 23 years. Dr. Englezos is a fellow of the Canadian Academy of Engineering. He is a member of the Association of Professional Engineers and Geoscientists of BC; the Canadian Society for Chemical Engineering; the American Institute of Chemical Engineers; and the Pulp and Paper Association of Canada. He has published extensively on clathrate hydrates and has also developed expertise on several aspects of papermaking chemistry or "wet-end" chemistry. The link connecting these apparently different areas is that the systems under study are aqueous, multiphase systems. In order to tackle these complex systems his research methodology is based primarily on chemical thermodynamics aided by kinetics, mass transfer, colloid chemistry and optimization methods. The experimental approach involves macroscopic techniques and a suite of molecular level studies. His research interests are: natural gas hydrates, shale gas, carbon dioxide capture and sequestration, super-hydrophobic surfaces and novel applications

Ian Frigaard
Dr. Frigaard's research interests are in non-Newtonian fluid mechanics and understanding industrial processes that exploit the non-Newtonian properties of fluids. Many ofhis industrial research projects come from the petroleum industry. His group conducts research that combines mathematical, experimental and computational approaches in a strongly interdisciplinary environment. The complex and non-Newtonian fluid flow laboratory carries out interdisciplinary research involving fluid mechanics and addresses both fundamental topics and those with a strong industrial or applied motivation. Frequently the focus is on either complex fluids or non-Newtonian fluids. Physically, the main laboratory is in the Mathematics Department, but membership spans the Chemical and Biological Engineering, Mechanical Engineering and Earth Ocean Sciences departments. Much of Dr. Frigaards work centre around oil field cementing, well cementing, well plugs, and restarting waxy crude pipelines,

John Grace
Dr. John Grace is Professor of Chemical and Biological Engineering and Canada Research Chair in Clean Energy Processes at the University of British Columbia, where he has been teaching for 33 years. He has served as President of the Canadian Society for Chemical Engineering; Chair of the Chemical Institute of Canada; member of the Canadian Engineering Accreditation Board; an editor of the journal, Chemical Engineering Science; a Council member of the Natural Sciences and Engineering Research Council of Canada, a member of the Advisory Board on Energy Science and Technology for Natural Resources Canada. In addition to being a Fellow of the Canadian Academy of Engineering and the Royal Society of Canada, he is a Fellow of the Chemical Institute of Canada and of the Engineering Institute of Canada. Dr. Grace's primary research interests are concerned with fluidized bed reactors and related multi-phase systems. Fluidized beds are used for a wide variety of chemical and physical purposes, for example in catalytic, gas-solid and three-phase reactors, drying, coating and thermal treatment. He is a leading, world expert in fluidized bed combustion and gasification of biomass and coal, a novel process for steam reforming of natural gas to make pure hydrogen, and greenhouse gas mitigation.

Felix Hermann
Dr. Felix J. Herrmann received his Ph.D. degree in Engineering Physics from the Delft University of Technology (the Netherlands). He was visiting scholar at Stanford's Mathematics Department in 1998, Post-doctoral fellow at MIT's

Earth Resources Laboratory from 1999 to 2002, and a senior Fellow at the UCLA's Institute for Pure and Applies Mathematics in 2004. Dr. Herrmann is leading one of the most innovative geophysics research and large date oil and gas imaging/modeling teams which is recognized by "big" oil and gas industry. His team works on: Seismic acquisition: Novel sampling techniques to increase efficiency leading to improved images at reduced costs; Processing: Next-generation of processing techniques that remove fundamental impediments to handle increasingly large data sets; Imaging: New fast high-res wave-equation based imaging technology for marine data; Full- waveform inversion: New fast & robust wave-equation based inversion using techniques from machine learning & statistics; Compressive sensing: Theoretical research in support of new acquisition technology – 'acquiring more with less'; Optimization: Theoretical research in support of large-scale imaging and inversion.

Howard Harshaw

As a human dimensions of natural resources researcher, Howie's work is framed as applied social science. Howie integrates social science into the planning and management of natural resources, and has worked regularly in interdisciplinary teams to provide theoretically based empirical research contributions to broader landscape-based projects examining sustainability issues. Howie is a Research Associate in the UBC Faculty of Forestry (Forest Resource Management Department), where he examines the human dimensions of natural resources in an effort to understand the relationships that people have with nature, and to investigate the interactions of resource development and quality of life. Current and past research has examined issues related to sustainable forest management, species at risk management and policy, outdoor recreation management and policy, energy, biofuel development, and nature-based tourism. Howie teaches at both the undergraduate and graduate levels, and supervises graduate students in their research. Recently Dr. Harshaw completed an in-depth consultation for BC Oil & Gas Commission in relation to North East Sector unconventional oil and gas exploitation

Steven Hallam

He is currently an Assistant Professor and Canada Research Chair in Environmental Genomics in the Department of Microbiology and Immunology, as well as program faculty in Bioinformatics. Pertaining to unconventional oil and gas, his work is centred around oil remediation, oil sands, coal bed methane, hydrocarbon reservoirs, bitumen, methane, bioremediation and shale gas extraction. He is currently undertaking exploratory research in frac fluid optimization including frac fluid bioremediation. Hallam's Research Group is exploring / monitoring the microbial community structure and function of conventional and unconventional oil and gas reservoirs, identifying active microbial groups mediating hydrocarbon conversion processes. His research also includes degradation within subsurface reservoirs transforms light oils into more viscous and acidic forms with higher sulfur and metal content, conversion of oil into methane generates heavy oil or oil sands deposits. Conversion processes have been implicated in the renewable production of natural gas within coal-bed seams and shale deposits. His research is intendend to improve our understanding of how methane in hydrocarbon resources is generated and identify the enzymes involved in the natural cracking of hydrocarbons that produce methane and carbon dioxide.

Loretta Li

Dr. Li is a professor in the environmental group of the Civil Engineering Department at UBC. She is an expert in the environmental mobility of contaminants in soil, groundwater, surface water and sediment. She is the recipient of a Killam grant, which has furthered her exploration into the nature of contaminant migration, an understanding of which will lead to the development of rational design of containment, remediation and treatment systems to prevent the pollution of water resources. Applications of this research could be critical to regulators, engineers and practitioners involved in contaminated site issues, helping to resolve environmental problems. Dr. Li's research focuses on environmental risk assessment, fate and transport of contaminants (metal, organic, gases), remediation and environmental risk assessment. Much of British Columbia Contaminated Sites Vapour standard (Schedule 11 and Technical Guidance 4), protecting human health, is based on work by one of her PhD students in 2004 "volatile organic compound migration and intrusion into building slabs." Investigation of factors controlling gas migration in

subsurface work continues in her group. Given the environmental emphasis and legal and policy implications of her work, much of the research involves regulators and government partners.

Ulrich Mayer
Dr Mayer is Professor Groundwater Hydrology, Groundwater Hydrology / Reactive Solute Transport. His areas of research are reactive transport modeling (flow and geochemistry modeling), mine hydrology and geochemistry, unsaturated zone processes and gases in the unsaturated zone, and contaminant hydrology related to petroleum and ethanol spills. Dr. Mayer's concentrates on the geochemical evolution of low-temperature groundwater systems with a focus on groundwater contamination and remediation. Dissolved inorganic and organic chemicals are commonly affected by a variety of physical and chemical processes, which influence their mobility, but also alter the geochemical composition of the aquifer material. This is particularly true in the vadose zone, where the exchange of gases with the atmosphere can enhance the progress of geochemical reaction processes. Due to the complexity of these systems and the strong non-linear coupling between the processes, existing conceptual models are often incomplete and data interpretation from field and laboratory studies is not always intuitive. Oil and gas groundwater and gas solubility research**:** In shallow groundwater systems, gassolubility is limited and if gas production is significant (e.g. due to denitrification or methanogenesis), gas bubbles will form. This leads to the partitioning of insoluble gases such ad Ar and N_2 into the gas bubbles. Due to its non-reactive nature, Ar in particular can be used to quantify this process, and calna can also be used to investigate transport away from a reactive zone. In unsaturated media, zones of Ar depletion or enrichment can be used as an indicator for advective gas transport.

Dawn Mills
Dr. Mills holds a Ph.D. in Native Law, History and Anthropology from the University of British Columbia Faculty of Law that focused on Gitxsan property law, their land tenure systems and the code in which the community derives this law and practice. Her current research examines Aboriginal rights, title and Treaty rights in relationship to metal/non-metal resource extraction from the intersection of constitutional, public and private law concerns. This includes how First Nations respond to the constitutional principles of continuity. Dr. Mills holds an Adjunct position at the Norman B. Keevil Institute of Mining Engineering at UBC. Dr. Mills also conducted regulatory reviews on oil and gas jurisdictions.

John Meech
Dr. Meech is a professor in the Department of Mining and Mineral Process Engineering at the University of British Columbia. He is also the director of CERM3, the Centre for Environmental Research in Minerals, Metals, and Materials. The centre is specifically working on several new methodologies to mine more effectively and efficiently with regard to economic, technical, social and environmental concerns. A graduate of McGill University and Queen's University, Dr. Meech spent 4 years in Zambia with Roan Consolidated Mines Ltd working on R&D projects in milling and smelting. In 1974, he joined the Mining Department at Queen's University, Kingston, On. In 1989, Dr. Meech joined UBC.

Along with Drs. Mory Ghomshei and Ferri Hassani, John is a proponent of pipeline projects creating an excellent opportunity to be a corridor that can seed renewable energy projects such as small-scale hydro, wind, and geothermal. For example it is estimated that 2,000 Megawatts of wind, geothermal and small-hydro are available along the Northern Gateway corridor. While oil flows westward from the Alberta bitumen fields, the generated "green" electricity will flow eastward to help the Canadian oil sand industry offset as much as 10 megatons of carbon emissions per year. The generated carbon credits are equivalent to the emissions associated with the extraction of 500,000 barrels per day of oil from oil sand, i.e., the daily flow rate of oil to be carried by the pipeline.

Madjid Mohseni

Dr. Madjid Mohseni is Professor of Chemical and Biological Engineering at UBC where he has taught for 13 years. He is Director of RES'EAU-WaterNET, which is Canada's first program (and the only NSERC Strategic Network) devoted exclusively to the objective of developing innovative and affordable solutions for providing drinking water to small, rural and First Nations communities. The program was launched in April 2009 and its research goals are to: classify raw source waters of small and rural communities; develop a source water-technology sensor which can be used for identifying the most suited technologies for a particular class of source water. Other areas of research are advanced oxidation technologies and bioprocess engineering which have great potential to lead to a cleaner environment through the removal of organic contaminants from air and water and by developing and evaluating technologies for drinking water treatment.

Anthony Peirce

Dr Peirce, Professor of Mathematics**,** as Principal Investigator, he has more than ten years of experience in the numerical and analytic modeling of hydraulic fracture (HF) propagation, collaborating with researchers both in industry (Schlumberger, CSIRO Australia, CSIR South Africa) as well as in academia. His current research interests are around: Shale gas hydraulic fracing modeling that identify characteristics of the fracture geometry such as *fracture length* and *height growth* ; hydraulic fractures (HF) are a class of brittle fractures that propagate in pre-stressed solid media due to the injection of a viscous fluid, reactive flow and free boundary problems including: understanding the behavior of reactive fluids flowing through porous media and fundamental understanding of the fracturing and post-fracture behaviour of brittle rock.

Douwe Steyn

Dr. Steyn's research is primarily driven by an interest in the polluted atmosphere, particularly at the regional scale and cover both field measurement and numerical modelling studies. Dr. Steyn also collaborate closely with Dr. Peter Jackson (UNBC), Christian Reuten (research associate), Bruce Ainslie (research associate), Ian McKendry (UBC Geography). Dr. Steyn has a particular interest in atmospheric model evaluation/validation, and is collaborating with Stefano Galmarini (JRC, Ispra) and ST Rao (USA EPA). He is also a member of the steering committee of the Air Quality Model Evaluation International Initiative. His work also includes atmospheric boundary layers, particularly in regions of complex topography and coastline and also has strong interest in mesoscale meteorology and environmental fluid mechanics. In terms of the oil and gas industry, Dr. Steyn is interested in researching accurate emission inventory for shale gas and oil production regions, research and install optimum air quality monitors networks that allow for minimal baseline assessment, which can be used for air quality modeling studies. Such studies and modeling research in combination with an air quality model can also determine spatio-temporal patterns of air quality levels leading to the optimal design of a permanent air quality network in the region. His current interest is specifically the BC North East Sector.

Leslie Smith,

Dr. Smith's research interests include: groundwaterand pore fluids influence the mechanical properties of earth materials which can be an important factor in the transfer of heat and mass in subsurface environments. Research topics currently being addressed include: Mathematical modeling of fluid flow and solute transport in fractured geologic media, with applications to problems of groundwater contamination. Hydrogeological processes within waste rock piles. Hydrogeologic aspects of continental and oceanic hydrothermal systems. Design of ground water monitoring networks

Malcolm Scoble

Dr. Malcolm Scoble is a Professor with the Norman B. Keevil Institute of Mining Engineering at UBC where he has been teaching for 16 years. He holds a Chair in Mining and Sustainability. From 2003 he has been central to the development of the UBC Certificate in Mining Studies (CMS), which has over 150 registered, lifelong learning students worldwide. CMS has been connected to the new International M Eng. program in mining engineering

which began in 2008. Dr. Scoble has been teaching in that program to students at Rio Tinto's Oyu Tolgoi mine in Mongolia and the Mongolian University of Science and Technology (MUST) in Ulaan Bataar. He has also contributed to the development of a new Executive Masters of Business Administration degree in Mining (EMBAMin) with UBC's Sauder Business School. In recent years Dr. Scoble's research focus on mining methods and technology has become more diversified as principles of sustainable development are integrated into mining engineering. He has recruited Dr. Dawn Mills, a PhD in First Nations Law and Anthropology, with the support of Finning International Ltd and various Canadian First Nations groups to research impacts of mining on rural communities and to develop programs to support sustainability in mining.

Janis Shandro

Dr. Shandro is a post-doctoral researcher with NETHRN-BC (New Emerging Team for Health in Rural and Northern British Columbia). She is currently based at the Population Health Laboratory at the University of Victoria and at the Keevil School of Mining at UBC. Her doctoral research, conducted at the University of British Columbia, focused on characterizing demographic, economic, and health impacts associated with the boom bust cycle in BC mining communities. Dr. Shandro's current research is focused on BC rural community economic sustainability and public health issues associated with the extractive industry in British Columbia. Over the past decade she and Dr. Scoble, with leading health researchers, have pioneered an innovative program of research focused on the health and sustainability of communities associated with the extractive industry in British Columbia. Their research is funded by national and provincial funding sources (NSERC, CIHR and the Vancouver Foundation) and a current project, in partnership with three Aboriginal communities in Northern British Columbia, is focused on mitigating health impacts associated with extractive industry development.

Dharma Wijewickreme

Dr. Dharma Wijewickreme is a Professor of Civil Engineering at the University of British Columbia (UBC). He joined UBC in 2001 after serving in geotechnical consulting practice for about 11 years where he acquired extensive experience in the fields of seismic retrofit of bridges and structures, ground improvement, and pipeline geotechnical engineering. Over the last 12 years, Prof. Wijewickreme has launched a series of new research initiatives with particular reference to pipeline and earthquake geotechnical engineering and has attracted industry funding leading to intra-university and inter-university research collaborations. In order to study the performance of buried pipelines subject to ground movements, Prof. Wijewickreme has established a new Advanced Soil Pipe Interaction Research (ASPIReTM) facility (equipped with a 2.5x5.0x3.0 m soil chamber for full-scale buried pipe testing) with funding from oil and gas industry. This facility has directly contributed to new solutions for reduction of soil loads on buried steel pipelines, and nonlinear analysis of polyethylene gas pipelines. His research on liquefaction of silts and mine waste has provided direct input to the development of geotechnical Seismic Design Task Force Design guidelines for buildings in Vancouver and guidelines in the Canadian Foundation Engineering Manual CFEM (2007).