**Workshop #1: Shales as unconventional gas and oil reservoirs: geology and engineering**

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***DAY 1. (Marc Bustin/Amanda Bustin)***

**Introduction**

* Shales as Unconventional Gas and Oil Reservoirs
* Basin Centred Gas
* Coalbed methane
* Shale Gas and Oil
* What Makes Gas/Oil Shales Unique?

**Origin of Gas and Oil producing Shales**

* Controls on worldwide distribution of source rocks

**Tectonic controls on accumulation and preservation of organic rich rocks**

* Sedimentology of organic rich rocks- controls on kerogen type and abundance, mineralogy and

**Diagenesis**

* Organic diagenesis- hydrocarbon generation, migration and retention; development of organic porosity and migration paths
* Inorganic digenesis of fine grained rocks, development, destruction and preservation of pore structure

**Composition and Origin Shale Gas/Oil**

* Characterizing retained hydrocarbons, controls on composition of retained hydrocarbons in fine grained rocks
* Hydrocarbon charging, role of capillarity, sorption and diffusion

**Methods of Characterizing Shales Gas and Shale Oil reservoirs**

* Conventional and unconventional methods of characterizing reservoir system- with examples
* Petrophysics, geophysics, petrology- with worked examples

***DAY 2. – Morning (Marc Bustin/Amanda Bustin)***

**Reservoir Characterization of Shales**

**Measuring Gas and Liquid Content and Quantifying hydrocarbons-in-place**

* Measuring liquids Content and Mobility and Quantifying Liquids-in-Place
* PVT behavior of complex shale reservoirs
* Predicting gas: liquid ratio in place and gas:liquid ratios during production

 The magic circle of reservoir pressure-viscosity-pore structure: what we know and what we don’t know

**Mechanical Stratigraphy, Fractures and In-Situ Stress**

* Geomechanics of shales and integration of geomechanics in exploration, drilling and development.
* Optimising completion strategies with geomechanics

**Shale Reservoir Characterization- Diffusion and Permeability**

**Reservoir Exploitation**

**Mitigation exploration and exploitation risks**

**Drilling**

**Completions**

**Development Strategies and Prospect Assessment**

* Environmental risk- induced seismicity prediction and mitigation; groundwater protection
* Stakeholder management
* Fluid-Rock Rock-Fluid Fluid-Fluid Interactions & Implications
* Drilling and Completion Considerations.

**Viscous, capillary pressures and gravity forces in reservoir dynamics**

**Wettability, Surface tension, interfacial tension**

**Rheology**

**Fluids in drilling and completions- fluid design and stability**

**Imbibition**

**Osmosis and Diffusion**

**Scaling, corrosion, salting**

**Core contamination**

**Mapping capillary pressures**

**Connate water**

**Flow-back fluid analyses**

**Impact of soaking**

**Geochemical models for fluid blending and compatibility testing**

**Proppant- choices, embedment, plugging of proppant pack**

**TENORMS- risk and mitigation**

**Enhanced oil recovery from tight rocks**

**Technological challenges and research needs and opportunities for optimisation of exploration, drilling, completion and production**

***DAY 2. – Afternoon (John Hattner)***

**Evaluation of Shale Reservoir Quality Using a Multidisciplinary Workflow with Crushed Rock Core Analysis**

**Emerging Technologies**

* Multiple Hearing Rate Pyrolysis
* High frequency NMR measurements with Core
* Multiple Frequency Dielectric Dispersion Measurements

**Underutilized Existing Technologies**

* Rotary Sidewall Core Analysis
* Drill Cuttings Analysis
* NMR T1 and T2 Full Waveform Analysis
* Thermal Maturity Analysis
* Simple Resistivity-Based Water Saturation Models

**Results from Recent Research**

* Effects of Evaporation and/or Adsorption During Sample Preparation for Crushed Rock Analysis
* Impact of the Presence of Bitumen on the Interpretation of Rock Eval Pyrolysis and Cruched Rock Fluid Saturation Analysis

**Integrated Analysis Workflows**

* Integration of New and Existing Well Log and Core Measurements to Better Quantify Reservoir Fluid Volumes
* Data Acquisition Necessary for the Correction of Laboratory Core Measurements

**Example Applications**

* Oil Window
* Wet Gas Window
* Dry Gas Window

**Recommended Well Log and Core Analysis Protocols**

**Future Developments**

* Improved Open-Hole NMR T1-T2 Data Acquisition
* Improved Fluid Identification and Quantification with T1-T2 Maps Surface Fitting
* Integration of Multiple Heating Rate Pyrolysis wit SARA Analysis
* Quantification of Organic Nano-Pore Size Distributions and Volumes with Improved Adsorption Isotherm Analysis and Hight Frequency NMR Measurements with Core