

The Effects of Maceral Composition on Coalbed Methane Reservoir Properties: Differences between Australian and Northern Hemisphere Coals

Faiz, Mohinudeen M.¹, Neil Sherwood¹ (1) CSIRO Petroleum, North Ryde, Australia

A variety of influences affect gas reservoir properties of coal, and a thorough understanding of their relationships are critical for coalbed methane (CBM) exploration and production programs. One of the controlling factors on sorption capacity and gas content is maceral group composition, but different relationships have been found in different investigations. For example, several studies on Northern Hemisphere coals have shown that vitrinite-rich coals have higher sorption capacities than inertinite-rich coals but some studies have shown no systematic variation and others have indicated that, at low ranks, some inertinite has a higher sorption capacity than vitrinite. Analyses of organic petrology, sorption isotherms, and gas contents for a suite of coal samples from boreholes in the Sydney Basin, Australia allow a comprehensive investigation of the relationships between reservoir characteristics and coal composition. On the basis of data from Australian cases, the CH₄ sorption capacities show no systematic variation between inertinite- and vitrinite-rich coals of similar rank. This lack of relationship is most likely due to the Australian coals containing an abundance of semifusinite that has sorption capacities similar to those of vitrinite. The results also show that gas contents and vitrinite abundance are negatively correlated. This relationship is mostly likely caused by an elevated permeability of vitrinite-rich coals, leading to gas leakage and undersaturation. Because relationships between maceral group contents and reservoir properties may vary between, and within CBM exploration acreage, predictions on prospectivity and producibility on the basis of published findings are likely to be misleading. In addition, other factors, such as thermal history, pressure, hydrodynamics and regional stress may overwhelm the effects of coal composition and these also need to be considered in prospect evaluation.

Replicating the US Coal Seam Gas Success in Queensland, Australia

Davies, Nicholas P.¹, Dr Robert W. Day¹ (1) Arrow Energy NL, Brisbane, Australia

US commercial Coal Seam Gas (CSG) production commenced in 1982 and by 2004 totaled 1800 PJ p.a. Queensland production began in 1996 from Permian Bowen Basin coals, reaching 55PJ p.a. (or almost 55% of the State's gas sales) by 2005, with Jurassic Surat Basin production imminent. In its early years, the CSG industry in the US was fostered by substantial tax concessions. Similar, though more modest assistance has flowed from a Queensland Government requirement that 13% of electricity sold in the State be generated by gas rather than coal, as part of a greenhouse gas reduction strategy. As in the US, a projected increase in gas demand and an attendant short-fall in gas supply was an insufficient stimulus of itself to initiate a new industry.

Notwithstanding differences in geology, drilling and completion techniques, pipeline infrastructure, market size and maturity, other interesting similarities are apparent when comparison is made of the first few pioneer years of the CSG industry in the US and Queensland. Cumulative developments in drilling and CSG production during the initial 5 years in each country closely parallel one another. In both countries, fewer than 50 wells were drilled to achieve 20 PJ p.a. of CSG production. Despite a tripling of the number of wells drilled, production remained static before rising rapidly two or three years later. Exponential growth similar to that of the US is anticipated in Queensland. However, the disparity in total CSG resource in each country (800,000 PJ in the US vs 250,000 PJ in QLD) will remain.

Occurrence of coal seam methane in South African Coal Seams and Igneous Intrusions in Karoo Basin

Pinetown, Kaydy¹, Abouna Saghafi², Phil Grobler³ (1) Norwich Park Mine, N/A, South Africa (2) CSIRO Energy Technology, Newcastle, Australia (3) Sasol Mining Ltd, Secunda, South Africa

South African coals have not yet been extensively studied for coal seam methane resources. The main reason is that most of the 240 Mt of coal produced annually is sourced from surface and shallow underground coal mines where mining takes place at shallow depths of ~80m to ~120 m. At these depths, coal mining is considered relatively free of gas hazards. Therefore, gas content or other gas related properties of coal seams are not measured on a regular basis. Gas content measurements undertaken at some mines of Highveld coalfield indicates methane content of up to 1.3 m³/t for coal seams at 110 m depth. This level of gas content cannot explain the occurrence of gas outburst events in coal mines such as those that occurred in Twistdraai Mine in the Highveld coalfield. Occurrences of gas outbursts suggest that high gas content in adsorbed and free phase might be present in some sections of the coal seams. Coal seams might be quite friable in those sections, allowing pulverisation during outburst. The survey of gas outburst events indicates that the locations of high gas emissions were mainly in the vicinity of igneous intrusions, namely dolerite intrusions. This study, which is the first of its kind, was undertaken to investigate potential locations for the occurrence of coal seam methane in South African coal seams in respect to the igneous intrusions and their enhancement effect on methane release and gas storage of these coals. In addition, CO₂ storage properties of coals were measured and the role of dolerite intrusions, as enclosures and gas traps, are being investigated, as a preliminary evaluation of CO₂ sequestration of some South African coals.

Coal Bed Methane potential of South Australia

Sansome, Alan¹, Peter Tingate² (1) Department of Primary Industry and Resources South Australia, Adelaide, South Australia, Australia (2) University of Adelaide, Adelaide, SA, Australia

Coal measures in South Australia are primarily of Permian, Triassic, Jurassic and Tertiary age, and almost all have been evaluated for coal extraction potential, but not as yet for CBM. Companies have lodged exploration licences to evaluate the CBM potential of these basins, but no exploration on the ground has occurred.

Extensive Permian coal measures occur in the intracratonic Arckaringa, Pedirka and Cooper Basins. Coals in the Cooper Basin are a proven source of conventional oil and gas and occur at depths from 2000–3500m (bituminous to anthracite rank). Coals in the Perdika and Arckaringa Basins are shallower and immature for oil and gas generation (sub-bituminous), but may have potential for biogenic generation. These deposits are similar in age to proven eastern

Australian CBM producing basins (i.e. Bowen, Surat).

Triassic coal measures are intracratonic remnants of broader deposystems, Leigh Creek coals are the only extracted coal in SA. The coal is sub-bituminous in rank, and is mined at the margins of the basin, but extends to depths in excess of 1000m

Tertiary coals are low grade shallow lignites (<100m) that occur in both intracratonic and structurally controlled basins around the southern margins.

A collaborative research project is currently in progress between PIRSA and the Australian School of Petroleum, to evaluate the CBM potential of the State (as well as potential for enhanced CBM, underground coal gasification and GTL). As part of this project an inventory of SA coal deposits and their characteristics will be made. Information will include coal seam properties, their distribution, structure/sedimentology and hydrology.

Latest Learnings From the World's Largest "Dry" CBM Play: Horseshoe Canyon Coal and Rock Package, Southern Alberta, Canada

Gagnon, Paul G.¹, Brian McKinstry², James Lee¹, Richard Wade¹, Kelly Young³, Robert J. Jackson⁴ (1) Western Gas Resources Canada Company, Calgary, AB (2) Western Gas Resources Canada Company, Calgary (3) Western Gas Resources Canada Company, Calgary, (4) BOE Solutions, Calgary,

The Horseshoe Canyon Formation hosts Canada's first commercial coalbed methane (CBM) development. The coals are typically thin with low gas measured gas contents; however, 20 or more seams may be present and completed. Driven by new geologic and engineering insights industry re-evaluated the CBM potential for these coals.

Until recently, the Horseshoe Canyon Formation coals were thought to have sub-economic gas concentrations, as for decades, operators routinely drilled through the zone to deeper conventional oil & gas targets. The introduction of accurate gas content measurement techniques, improved drilling practices and novel completion strategies have unlocked the exploration and development model that is employed today. Today, in excess of 3,500 Horseshoe Canyon wells each produce an average of 100 mcf/d in a play area that may encompass 12,000 square miles.

The Horseshoe holds the potential of having far more impact to Canada than all of the CBM basins were to the U.S. in the first 10 years of CBM production. It is estimated that CBM production in Western Canada could one day reach 16% of the total Canadian gas production. With 3,000 forecasted new wells drilled per year, the ultimate potential development could be as many as 30,000 wells delivering a potential 15 Tcf of marketable natural gas.

This presentation will focus on those integrated geologic and engineering practices that were developed to achieve success and will serve as a tool kit for global exploration of analogous coals.