School of Underground Mining, Methane Session

CBM / CMM in Australia: Technical Success Factors

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Introduction to coal & CBM in Australia

• Australia is the world’s largest coal exporter (~400 Mt), and most of our domestic energy is supplied by coal (~70%). ~75% is exported.
• Coal has been mined since ~1803, and it is unrealistic to think that this will change significantly in the short term, however it is under community pressure.
• Coal is getting deeper, and this means more gas.
• Australia is also a significant producer of CBM, currently exporting ~19.3 Mtpa to Asian markets. All of this gas comes from one state (QLD) and two basins (Bowen & Surat – mainly the latter).
• The CBM industry is much younger than the coal industry, only really starting around 2000.
Coal in Australia

Still expanding, but for how long?
Where is the coal?
Coal / CBM: two strands interlinked by geology, technology and geography

- Overlap of ideas but plenty of mutual distrust and lack of understanding.
- Constant tension over access to resources, almost exclusively in the Bowen Basin. Few examples of complimentary activities.
- Purely a QLD issue as CBM is dead in NSW, *for non-technical reasons*.
- Many individuals who walk the divide, but these are a small percentage ...
- *Some* cross-fertilisation of ideas.
- To miners gas is a menace, to CBM operators it is the main game.
Peculiarities of this common space ...

- Most of the CBM gas exported from Australia comes from the Surat Basin (Walloon Coal Measures), and the southern Bowen Basin (Comet Ridge area). *There is virtually no mining in these places, and few people.*
- The Bowen has much more gas in areas where mining is common, but little CBM development – a conundrum. *Why? Perm is the main issue.*
- Australia has a domestic gas supply crisis on the East Coast, at the same time as we export large amounts from Gladstone to Asian markets. *A political hot potato.*
- The pressure is on for miners to stop venting / flaring mine gas. The argument about fugitive emissions simmers away and again, is caught up in politics. *To have a carbon tax, or not to have ... ???*
Technical success factors

• For CBM:
  – Access to large areas of agricultural land with as few (as possible) stakeholders.
  – High perm fairways (e.g. Comet Ridge, Undulla Nose, and Moranbah).
  – Scale. Many holes over vast distances.

• For CMM:
  – Technology: successful drilling techniques (directional).
  – Strong operational experience in managing gas underground.
  – “Overengineering” ... i.e. redundancy that errs on the side of safety.
The data ... gas content & composition

- CO₂ dominated
- CH₄ dominated
- No gas composition data
The same patterns are repeated throughout the Sydney – Bowen Basin complex

- CO₂ dominance from 0-100m depth.
- CH₄ starting to dominate thereafter, and usually almost 100% by 300m depth. This CH₄ was biogenic in origin.
- After that a mixed gas zone of CO₂ and CH₄, with the CO₂ gone by ~700m. These patterns independent of seam dip, i.e. gas layering has nothing to do with individual coal seams.
Level of undersaturation with depth

Highly undersaturated shallow

“Dry” coals.

Averages 10-20% from 250-600m
What about permeability data ... ?

Typical Bowen Basin data – totally different in the Walloons
Permeability universally declines with depth

Example of cross over of permeability and gas content with depth
Implications for coal mining gas capture

- Perm will decline rapidly with depth, usually < 5mD from ~300m, and often < 1 mD.
- Gas content to increase from ~0m3/t at 100m to 5-10m3/t by 300m.
- Gas saturation usually high, ~80-90-% ... not a lot of water to produce before CDP (Critical Desorption Pressure) is reached.
- Gas composition generally dominated by methane in shallow underground workings (and good perm) then a mixed gas regime of CH4 and CO2 thereafter.
- These patterns are generally consistent throughout the basin, with some minor local variations.
- Implications: ‘easy’ gas drainage until the perm starts to dive after 300m! More drilling, closer spacing ... more cost!
Implications for the CBM operators (Bowen)

- A lot of the ‘easy’ gas resides in mining lease areas (where the shallow high perm exists), outside of this area can expect difficult extraction due to low perm.
- This observation applies almost universally for the Sydney – Bowen Basin in Australia, less so for the Surat (where little mining take place).
- This creates a source of tension between miners and CBM operators.
- To extract gas from a mining lease a CBM operator needs a “Co-development agreement”.

Example of overlap that appears to work ...

- CBM company extracting gas up to 5 years ahead of mining development.
- Use chevron pattern of extraction (2 SIS laterals to single vertical).
- Mining company supplements this drilling by UIS (Underground In-Seam) to ensure compliance with gas threshold levels.
Gas character of this “co-development” area

- Very rapid gas content increase with depth.
- Generally good perm until about 450m.
- All methane.
How SIS configuration might look

1. CPW drilled
2. Directional well intersects CPW
3. Air introduced
4. In-seam section drilled

MRD WELL

CONTROL PRESSURE WELL

VERTICAL PRODUCTION WELL

PUMP (ESP)

Surface casing
Build section casing
Vertical well casing
Vertical well casing

700–2000M
Advantage of this approach

- SIS provides long drainage time & orderly access to gas resources.
- May be used for on-site generation (48 MW power station in this instance).
- Valuable contribution made from SIS lateral for geological interpretation (improved geo model & lower longwall risk).
- Improved borehole management through Controlled Pressure Drilling (CPD).
- More expensive, but more effective.
- Possibility of multiple seam approach to deal with goaf gas.
SEAM ENTRY POINT

VERTICAL PRODUCTION WELL

SINGLE LATERAL OPTION

Possible additional goaf wells

Tailgate return

BUILD

1500m

Return inbye face line

Travel road

BI-LATERAL OPTION

Alternative approach: parallel MRD SIS either side of gateroads
How SIS has been used to assist geological interpretation
May include high capacity rig applications
Use of oilfield drill pipe
Example of application parallel to gateroads
Linked to petroleum style modelling
Use of SIS in Australia

• Favoured approach provided:
  – Surface access is not a major issue.
  – Up front capital is available.
  – Utilisation of mine gas a consideration.

• Overlooked in circumstances such as:
  – ‘Traditional’ approach at site is UIS (e.g. South Coast, NSW).
  – Major issues with surface access.
  – Preference is to delay capital expenditure and treat gas management as an operational issue.
  – Low gas contents.
  – Short term perspective.
UIS in Australia

- At its worst, it is reactive and subject to crisis management.
- Huge amounts of redundancy due to bad practice / lack of time.
- A multitude of sins hidden by poor operator.
Here you can see the development of order ...
Limitation to UIS
What actually happens with inseam drilling…

**OVERBALANCED**

**UNDERBALANCED**

**PROBLEM ZONE**

**WATER FLOW**

Circulation Fluids passing through & around the obstruction.

(from Thomson and MacDonald, 2003).
Where we are at presently

• Technical success factors for CBM & CMM do not currently overlap much, some of the problems (i.e. low perm) do.
• SIS and UIS are complementary drilling techniques that assist gas management in Australia.
• CBM technology (mainly drilling) and expertise (reservoir modelling, completion understanding) have assisted the improvement of knowledge in CMM.
• Some way to go however due to entrenched operational systems.
• Both CBM & CMM (ultimately) face the same technical hurdles, in particular low permeability with depth.
• Pressure is on to improve coal mine gas utilisation, and on-site generation like to be the norm moving forward.
• Questions ????