Modelling the contribution of individual seams to Coal Seam Gas production

Vanessa Santiago, The University of Queensland
Ayrton Ribeiro, The University of Queensland
Suzanne Hurter, The University of Queensland
INTRODUCTION

In coal seam gas (CSG) fields, some of the individual seams hardly contribute to comingled gas recovery.

The *interaction between individual coal layers* can influence the response of other seams to pressure during multi-seam gas drainage (Jiang et al. 2016).

(modified from Mavor and Nelson 1997)
METHODOLOGY

Sensitivity Study
Application of analysis on a Surat Basin well

<table>
<thead>
<tr>
<th>Porosity</th>
<th>Initial Pressure (kPa)</th>
<th>Radius (m)</th>
<th>Permeability (mD)</th>
<th>Thickness (m)</th>
<th>Compressibility (1/kPa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 - 4%</td>
<td>6066 - 8203</td>
<td>136 - 620</td>
<td>50 - 500</td>
<td>2 - 6</td>
<td>4 - 20E-5</td>
</tr>
</tbody>
</table>

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SENSITIVITY RESULTS

Coal Seam Radius

[Graph a] R1/R2 = 1.0

[Graph b] R1/R2 = 4.6

Time (Date)

Gas Rate RC (m³/day)

Gas Rate RC same radius
Water Rate RC same radius
Gas Rate RC different radius
Water Rate RC different radius

R = 620 m
R = 136 m

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SENSITIVITY RESULTS

Fracture Compressibility

a) Heterogeneous Seams
b) Homogeneous Seams

Gas Rate RC cf = 4 and 20E-5 /kPa
Gas Rate RC cf = 20 and 4E-5 /kPa
Gas Rate RC cf = 12E-5 /kPa
Water Rate RC cf = 4 and 20E-5 /kPa
Water Rate RC cf = 20 and 4E-5 /kPa
Water Rate RC cf = 12E-5 /kPa

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SENSITIVITY RESULTS

- **Initial Porosity**: later and lower gas peak rates
- **Initial Reservoir Pressure (i.e. seam depth)**: earlier and higher gas peak rates
- **Seam Radius**: later gas peak rates
- **Initial Permeability**: higher gas peak rates
- **Seam Thickness**: higher gas peak rates
- **Fracture Compressibility**: lower gas peak rates

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UNDERSTANDING WELL PRODUCTION CURVES OF MULTIPLE COAL SEAMS IN COMMINGLED PRODUCTION

\[ \alpha = c f \phi R^2 \left/ \frac{h k_0 P_0^2}{\alpha_{\text{ratio}} = \frac{\alpha_{\text{top}}}{\alpha_{\text{bottom}}}} \right. \]

\[ \alpha_{\text{top}}/\alpha_{\text{bottom}} = 4.3 \]

\[ \alpha_{\text{top}}/\alpha_{\text{bottom}} = 21.7 \]

\[ \alpha_{\text{top}}/\alpha_{\text{bottom}} = 108 \]
UNDERSTANDING WELL PRODUCTION CURVES OF MULTIPLE COAL SEAMS IN COMMINGLED PRODUCTION

For two-layered reservoirs:

\[ \alpha_{\text{ratio}} < 1.0 \]

- the top seam experiences fast depletion
- total gas production rates may decrease drastically
APPLICATION OF ALPHA RATIO ON A COXON CREEK WELL, SURAT BASIN.
CONCLUSIONS

The contrast between coal seam radii within a stack of multiple seams plays an important role in interlayer interference and gas production profiles of commingled CSG wells.

Fracture compressibility strongly affects gas production curves.

In a two-layered stack of seams with $\alpha_{\text{ratio}} < 1.0$, gas rates and recovery may be greatly reduced.

The explicit simulation of gas production from stacked coal seams may inform considerations for the design of well tests and use of permanent monitoring tools.
Acknowledgements

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