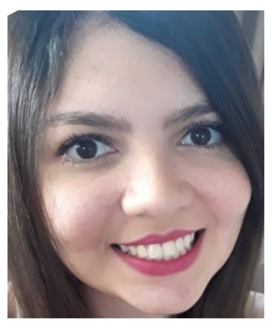

Modelling the Contribution of Individual Seams to Coal Seam Gas Production

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energi SIMULATION

BACKGROUND

In coal seam gas (CSG) fields, where single wells tap stacked multiple seams, it is likely that some of the individual seams hardly contribute to gas recovery. Strong contrast in reservoir properties among the seams may lead to interlayer interference causing production from some seams to be inhibited and lower overall well productivity in comingled gas operations.

However, it is still not well understood how the combined properties of individual seams influence the shape of the total production curves.

Well tests of groups of seams in a single well indicate that large contrast in reservoir properties and initial pressure in individual seams are possible. In the Walloon coals (Surat Basin, Australia), almost half of the seams may not produce any gas in early time (Furniss et al. 2014) and modelling them is challenging (Cardwell 2018).

WHY / PURPOSE

- To gain understanding on how initial reservoir parameters of individual coal seams affect overall CSG production curves
- To perform a sensitivity study on the main seam parameters affecting gas production profiles and well performance in multi-seam comingled production.
- Use the outcome of the simulation study to inform well test design and monitoring strategies.

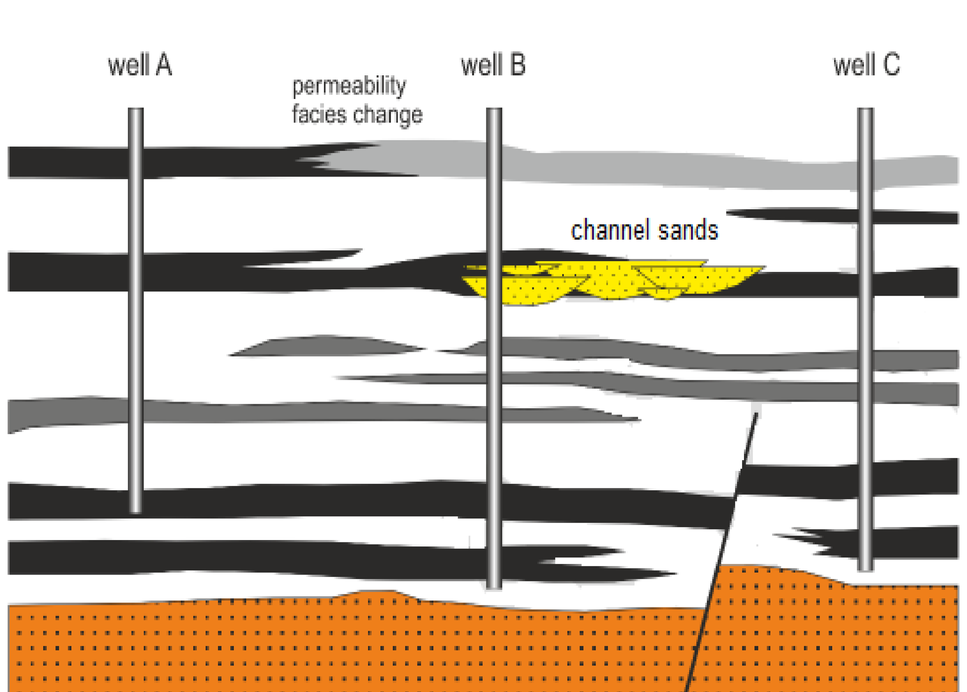

Figure 1: Coal seams can be vertically and laterally heterogenous (*modified from Mavor and Nelson, 1997*)

METHODOLOGY

Single well simulation sensitivity study of 2 coal stacked coal seams:

Table 1: Range of parameters of the sensitivity analysis.

	Porosity	Pressure (kPa)	Radius (m)	Permeability (mD)	Thickness (m)	Compressibility (1/kPa)
Minimum	0.02	6066	136	50	2	4E-5
Base	0.03	7066	620	100	4	1E-4
Maximum	0.04	8203	620	500	6	2E-4

Table 2: Input for the reservoir simulator (base case)

Parameter	Value
Radial Grid	9x18x5
Thickness	4 m
Interburden	10 m
Spacing	0.015 m
Sorption time	10 days
Coal density	1,500 kg/m^3
Langmuir Pressure	4,309 kPa
Maximum number of moles of adsorbed gas	0.46 mol CH_4/kg rock
Poisson's ratio	0.37
Young's Modulus	2.76 GPa
Volumetric Strain	0.01266

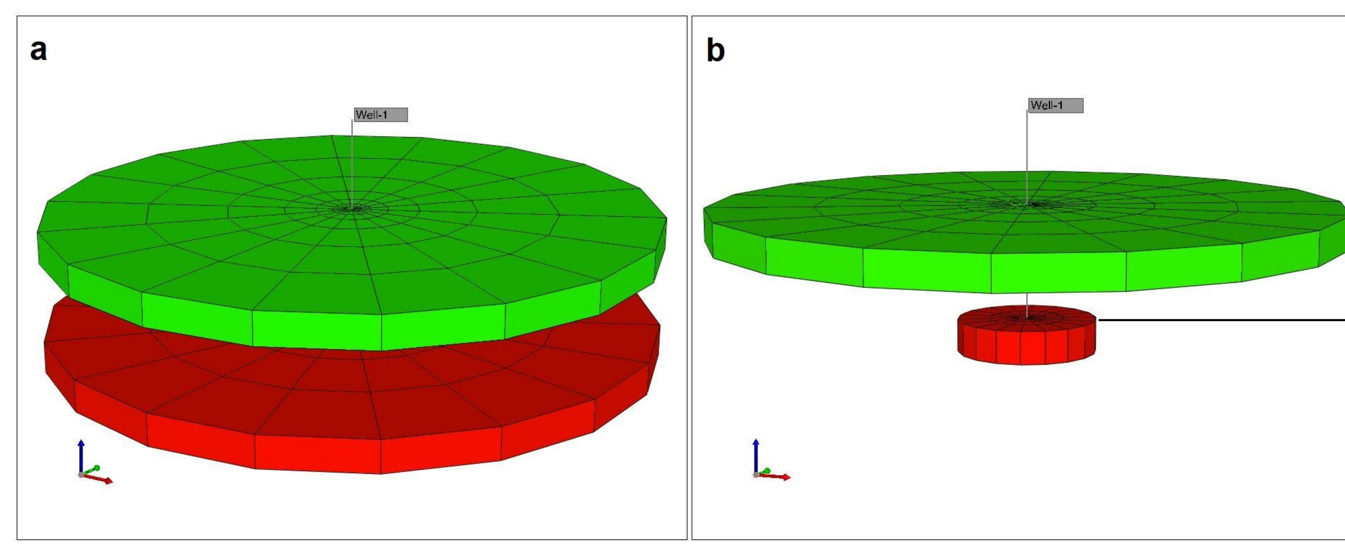

Figure 2: Conceptual model of the two-seam base case a) same radii; b) different radii.

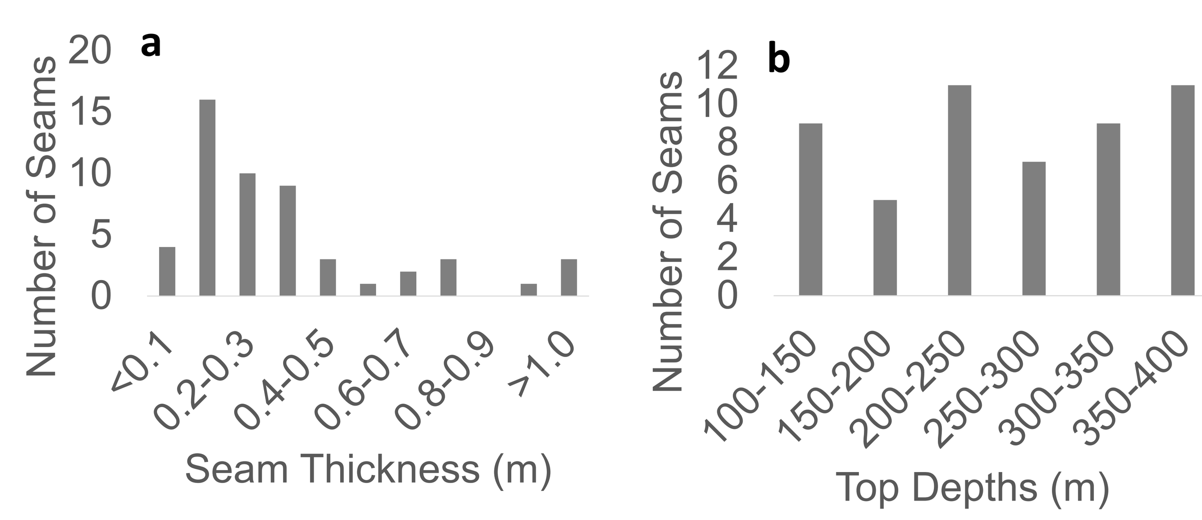

Figure 3: Histograms of a) seam thicknesses and b) depths in a Coxon Creek well (Surat Basin, Queensland, Australia).

Stacking order of seams

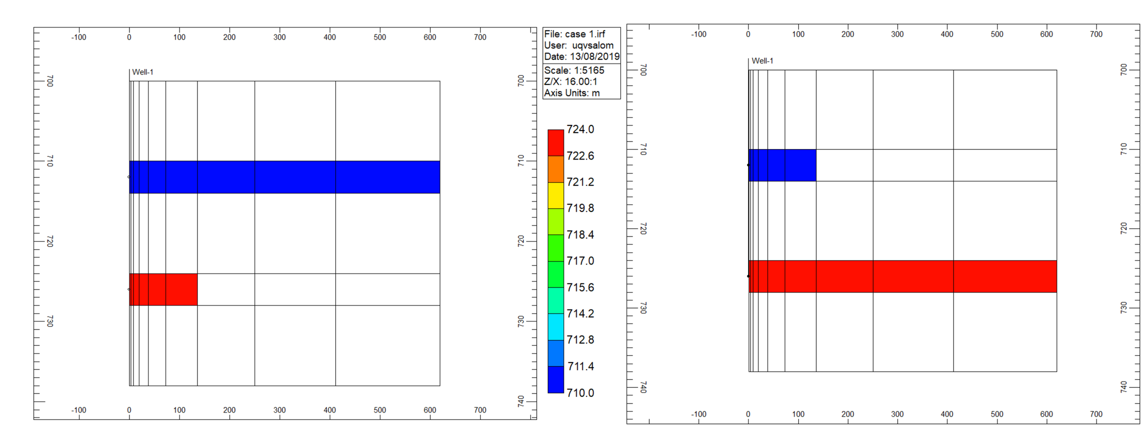

Figure 4: Conceptual model of 2 coal layers of different radii (i.e. extent):
a) large seam is at the top of the stack
b) small seam is at the top of the stack.

RESULTS

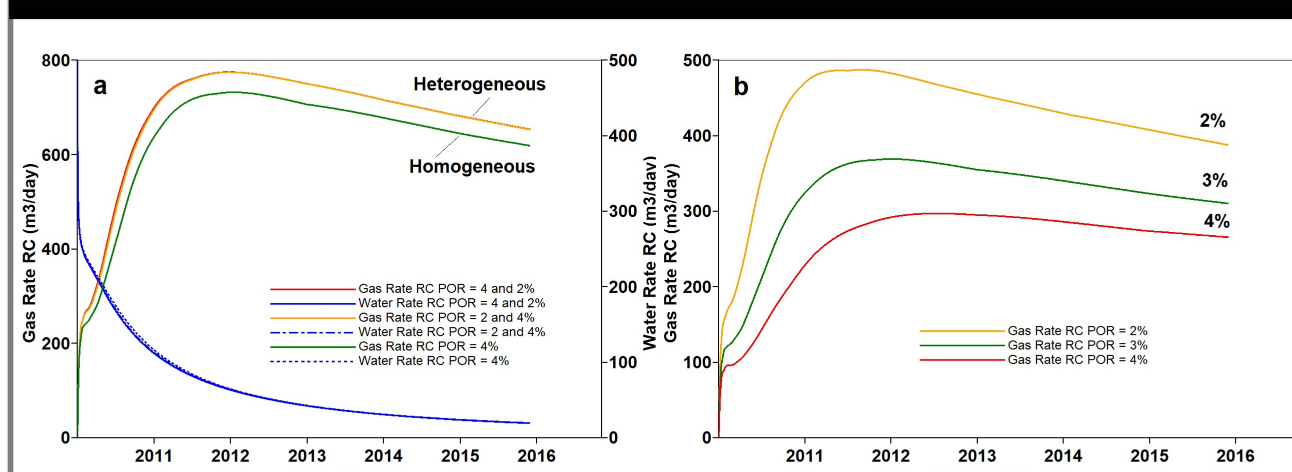

Figure 5: Effect of **fracture porosity** on a) total production curves b) individual seam rates.

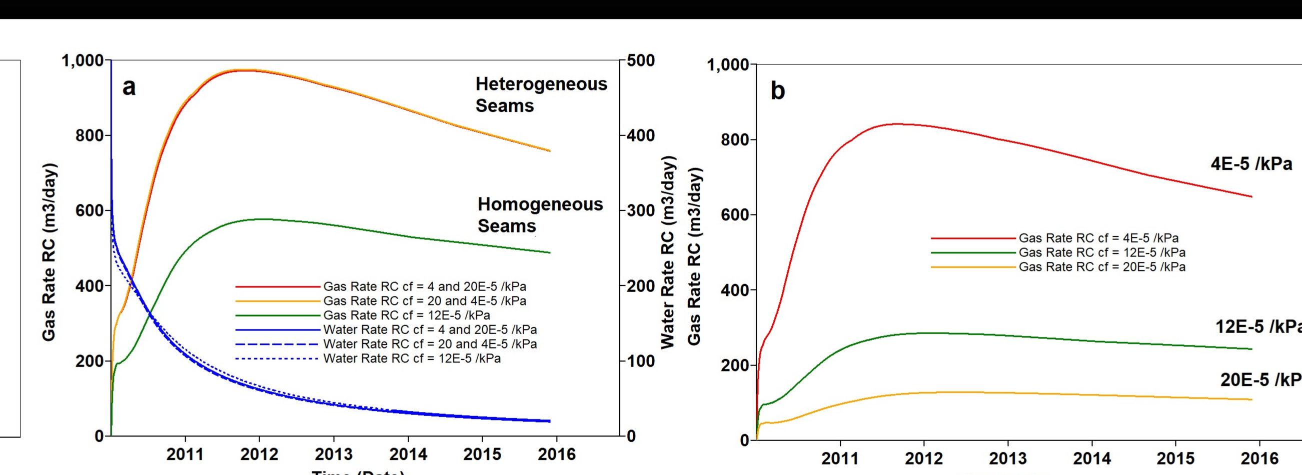

Figure 8: Effect of **coal compressibility** on a) total production curves b) individual seam rates.

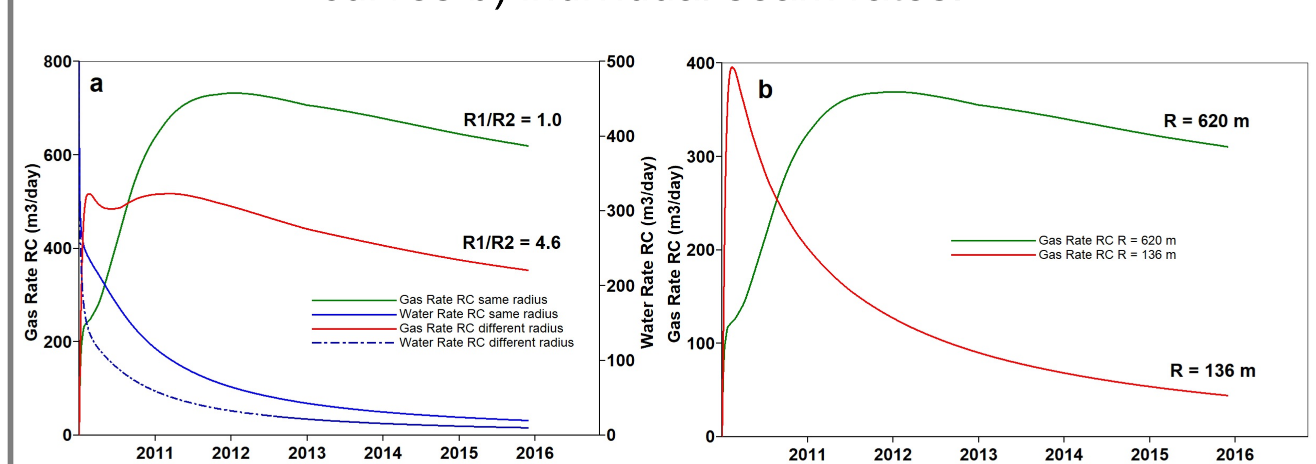

Figure 6: Effect of **seam radius** on a) total production curves b) individual seam rates.

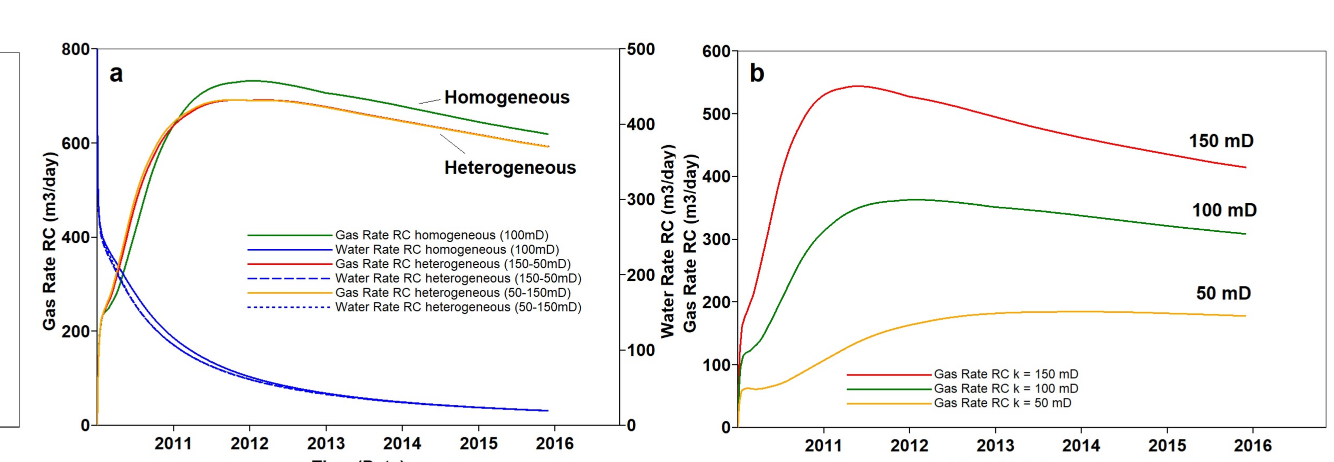

Figure 9: Effect of **fracture permeability** on a) total production curves b) individual seam rates.

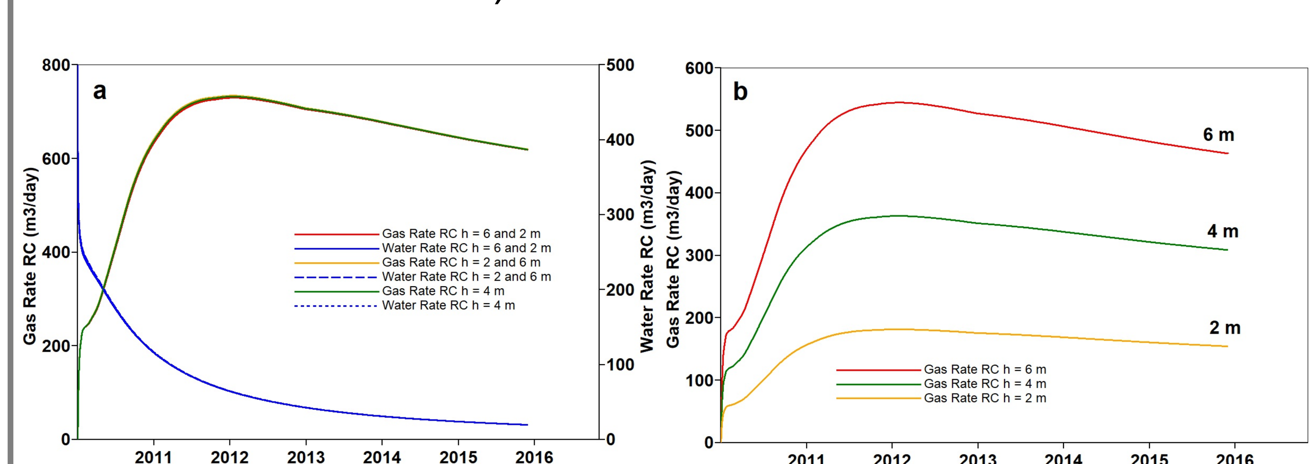

Figure 7: Effect of **seam thickness** on a) total production curves b) individual seam rates.

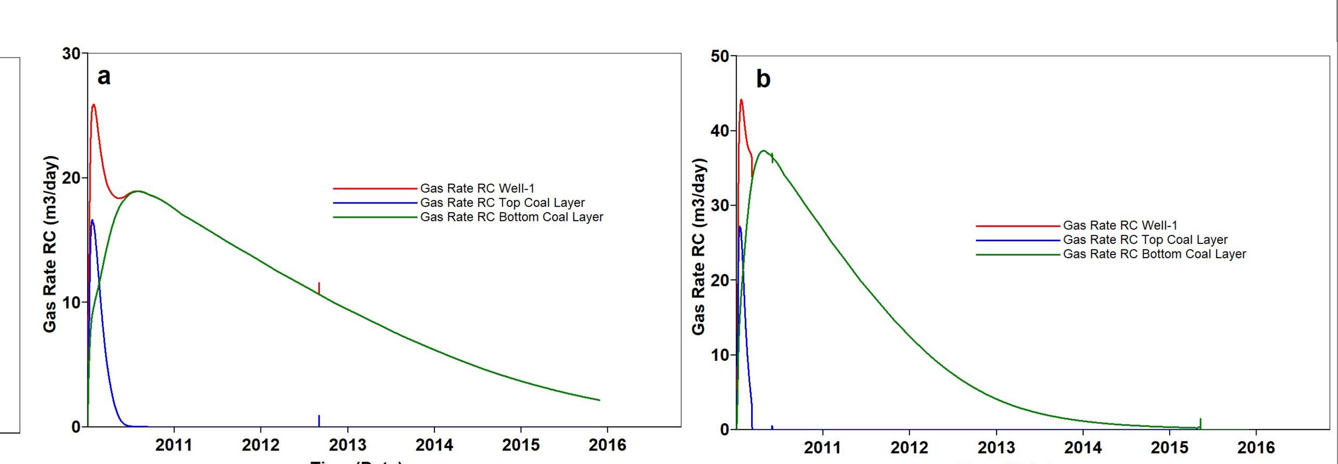

Figure 10: Effect of the **stacking order** of different radius seams on total production curves and individual seam rates with initial permeability of a) 100mD b) 200mD.

Cardwell, 2018. Dynamic modelling of the Walloon Coal Measures: and unsavoury cocktail of reservoir variability, mismatched resolutions and unreasonable expectations, SPE-191917-MS, 17pp.

Furniss JP, Schouten J, Bottomley W, 2014. Reservoir characterisation using distributed temperature sensing in CSG development: application in the Surat Basin, Queensland, SPE-171537-MS, 21pp.

Mavor M and Nelson CR, 1997, Coalbed reservoir gas-in-place analysis, Gas Research Institute, Chicago (USA).

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