Portable Quick Crush Gas Content Measurement
A Step Change for the Coal Industry

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Presentation outline

- Why do we need a portable gas content measuring device?
- Does such an instrument exist?
- What does it look like and how does it work?
- What do the results look like?
- Do the results fit accepted theories on gas desorption?
- Case study results
- Conclusions

Existing gas content measurement and limitations

- Slow desorption method for measuring Q_1, Q_2 and Q_3
- Fast desorption method made possible with quick crush to speed up obtaining results. Developed in early 1990's and refined over the years, but still dependent on samples being sent to laboratory
- Need for measurements on site, preferably at the mining face in the case of rapid results for compliance
- Should be capable of establishing total gas content and desorption rate data
- A portable gas content device was developed sometime ago for measuring H_2S content of coal

Portable Gas Content Analyser (PGCA)

- Early prototype PGCA
- Consists of robust crushing head, sturdy stainless steel chamber and fittings for gas flow control
- Portable gas analysing system
- Upgraded version now available

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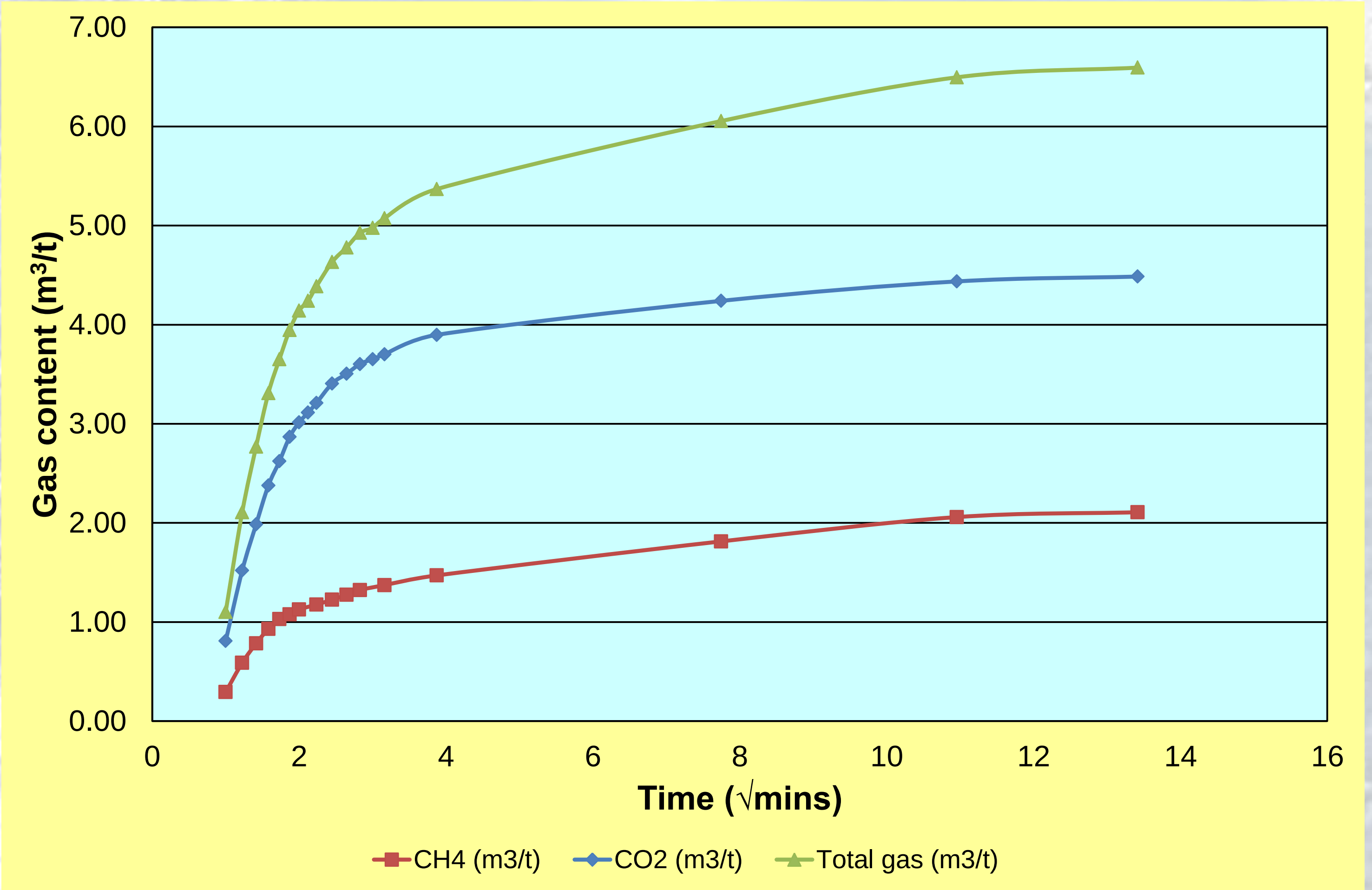
High volatile bituminous coal (352m)



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Gas desorption model

- Simple unipore diffusion model fails to describe the complete gas desorption from coal
- Bidisperse pore model is more appropriate
- Consists of macropore (rapid) diffusion described by

$$\frac{V_a}{V_{a\infty}} = 1 - \frac{6}{\pi}\sum_{n=1}^{\infty}\frac{1}{n^2}\exp\left[-n^2\pi^2 D_{ea} t\right]$$

- Micropore (slow) diffusion described by

$$\frac{V_i}{V_{i\infty}} = 1 - \frac{6}{\pi}\sum_{n=1}^{\infty}\frac{1}{n^2}\exp\left[-n^2\pi^2 D_{ei} t\right]$$

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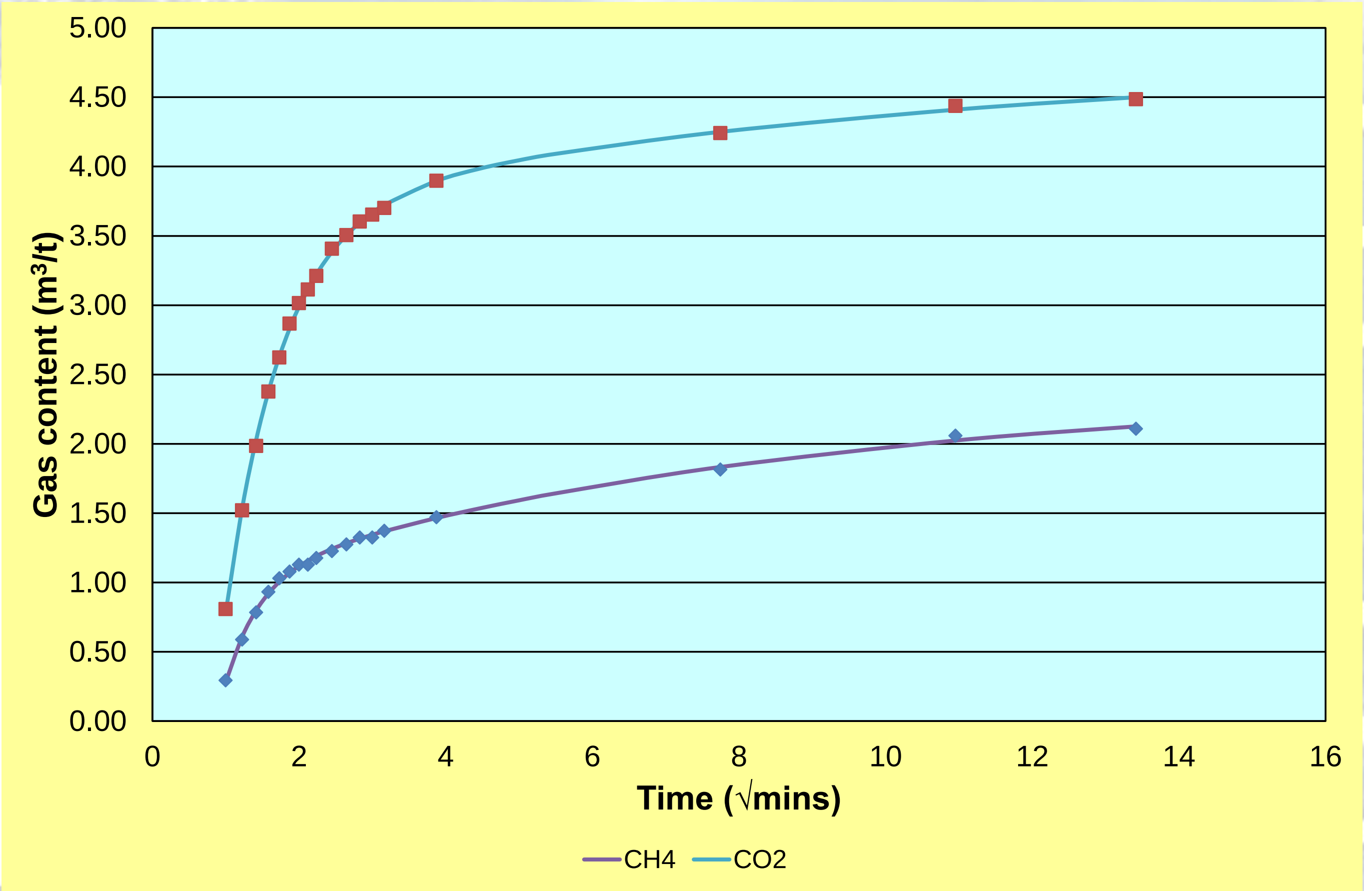
Desorption model curve-fitting



$$CH_4 = 2.398 - 6.218e^{-2.094t} - 1.534e^{-0.129t}$$

$$CO_2 = 4.79 - 10.465e^{-1.341t} - 1.258e^{-0.109t}$$

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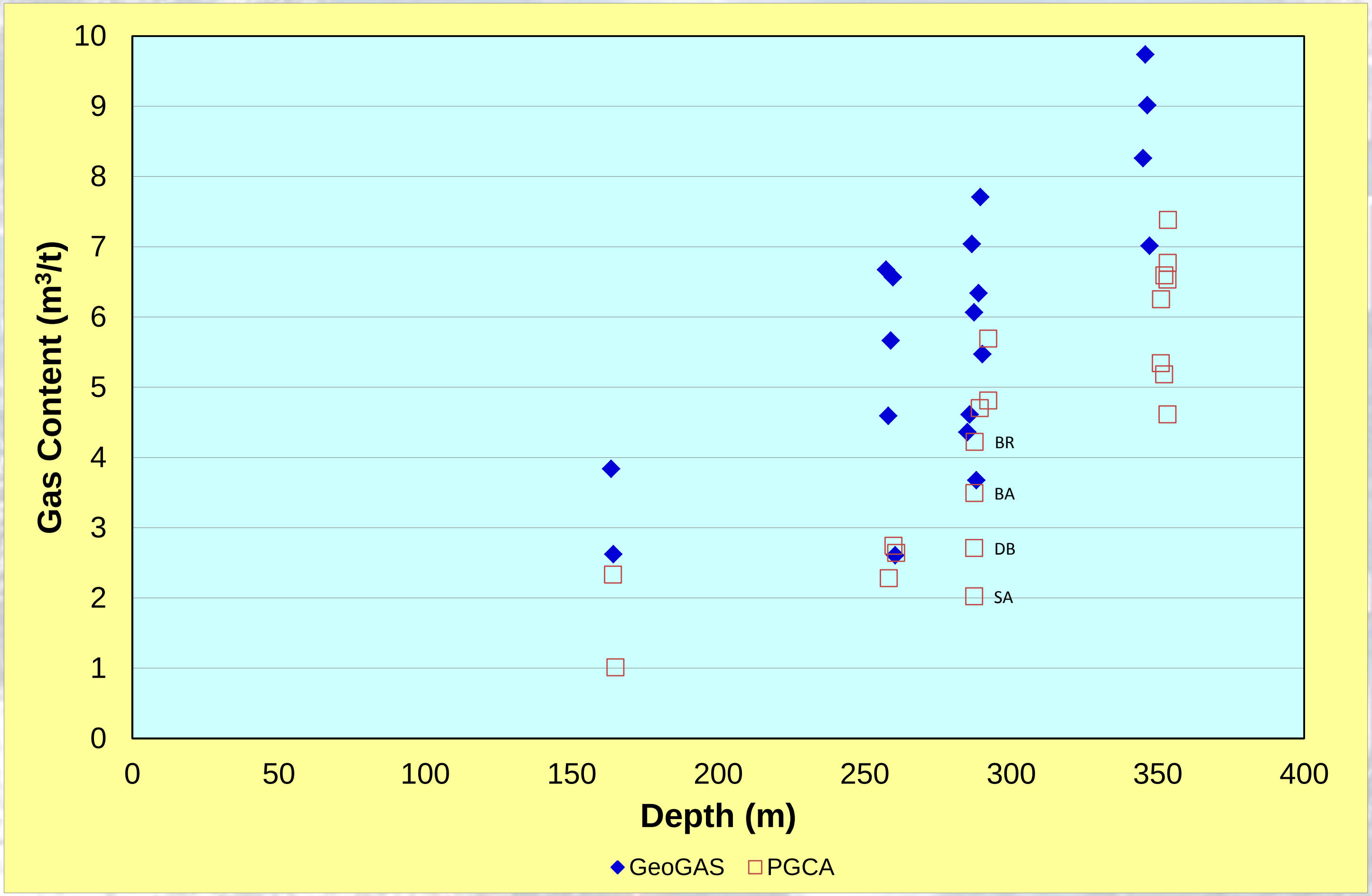
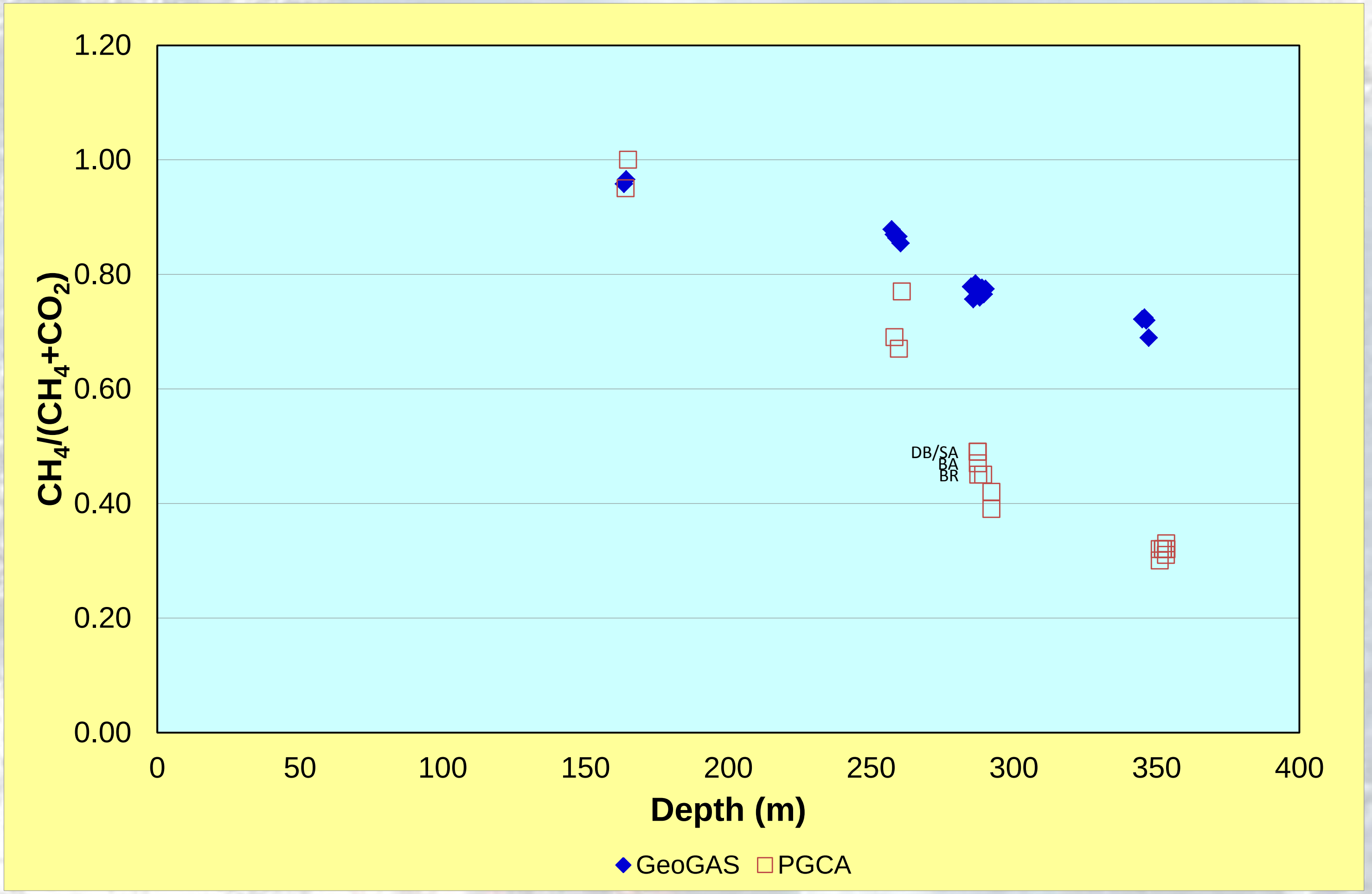
Gas contents from borehole cores



Gas composition trend



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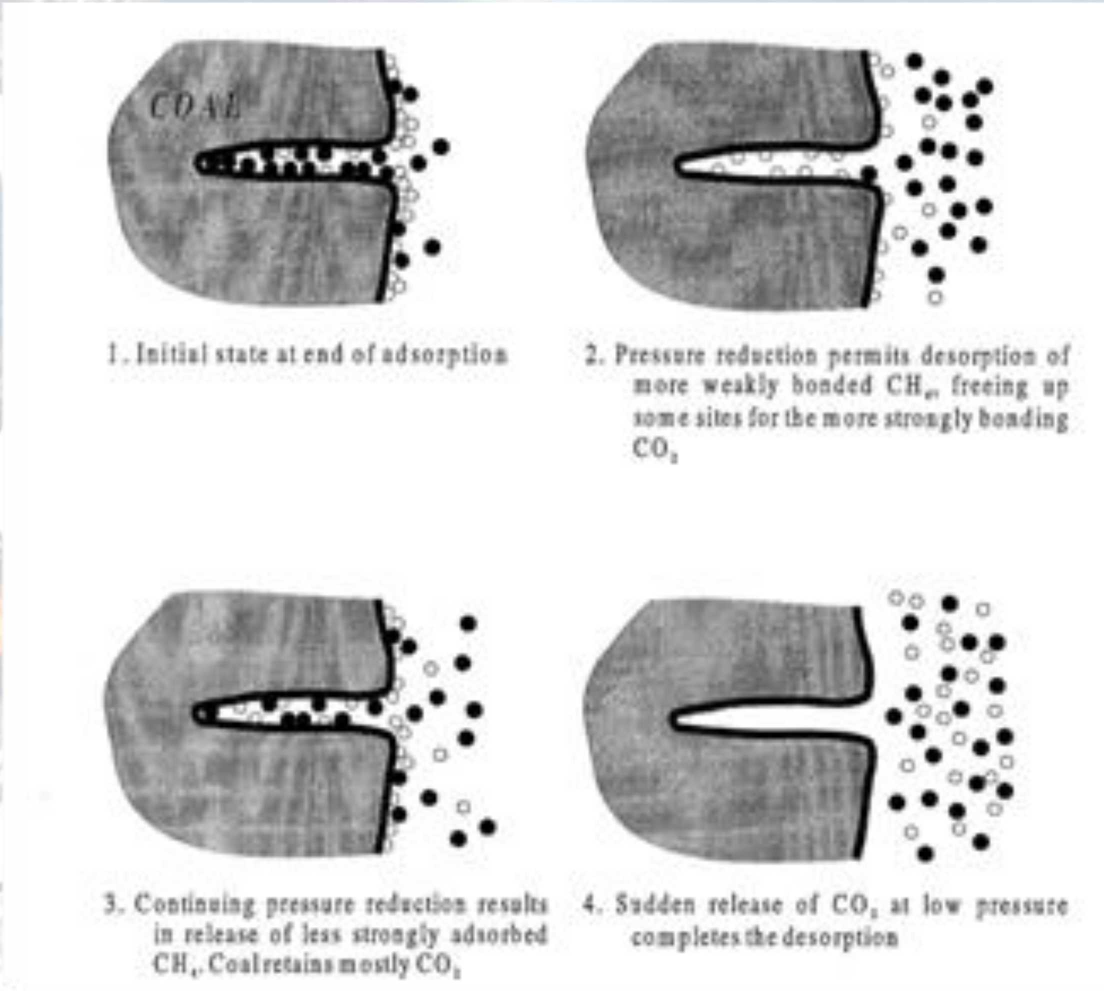
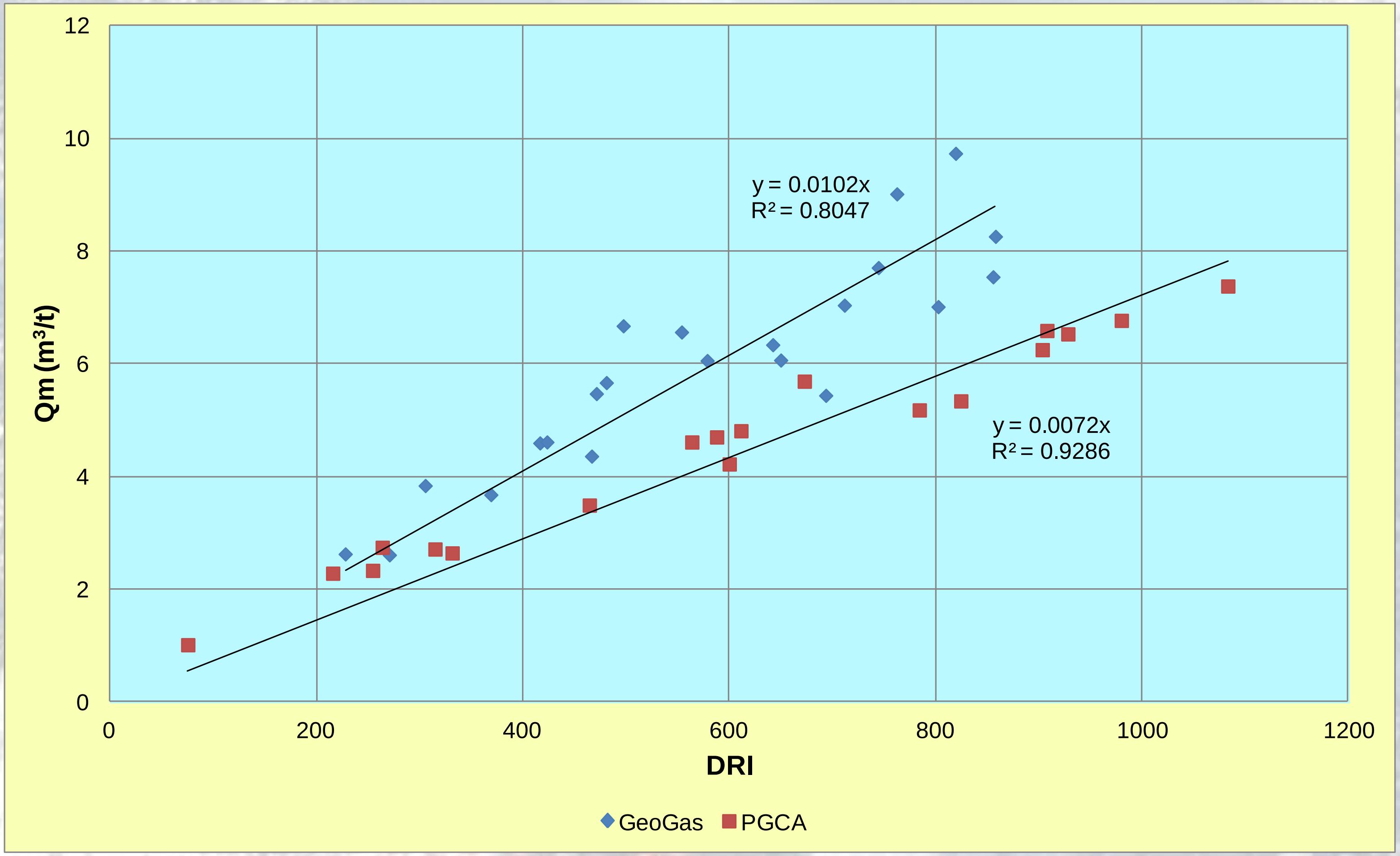
Schematic of mixed CH_4/CO_2 desorption (Crosdale, 1998)



Desorption rate and gas content



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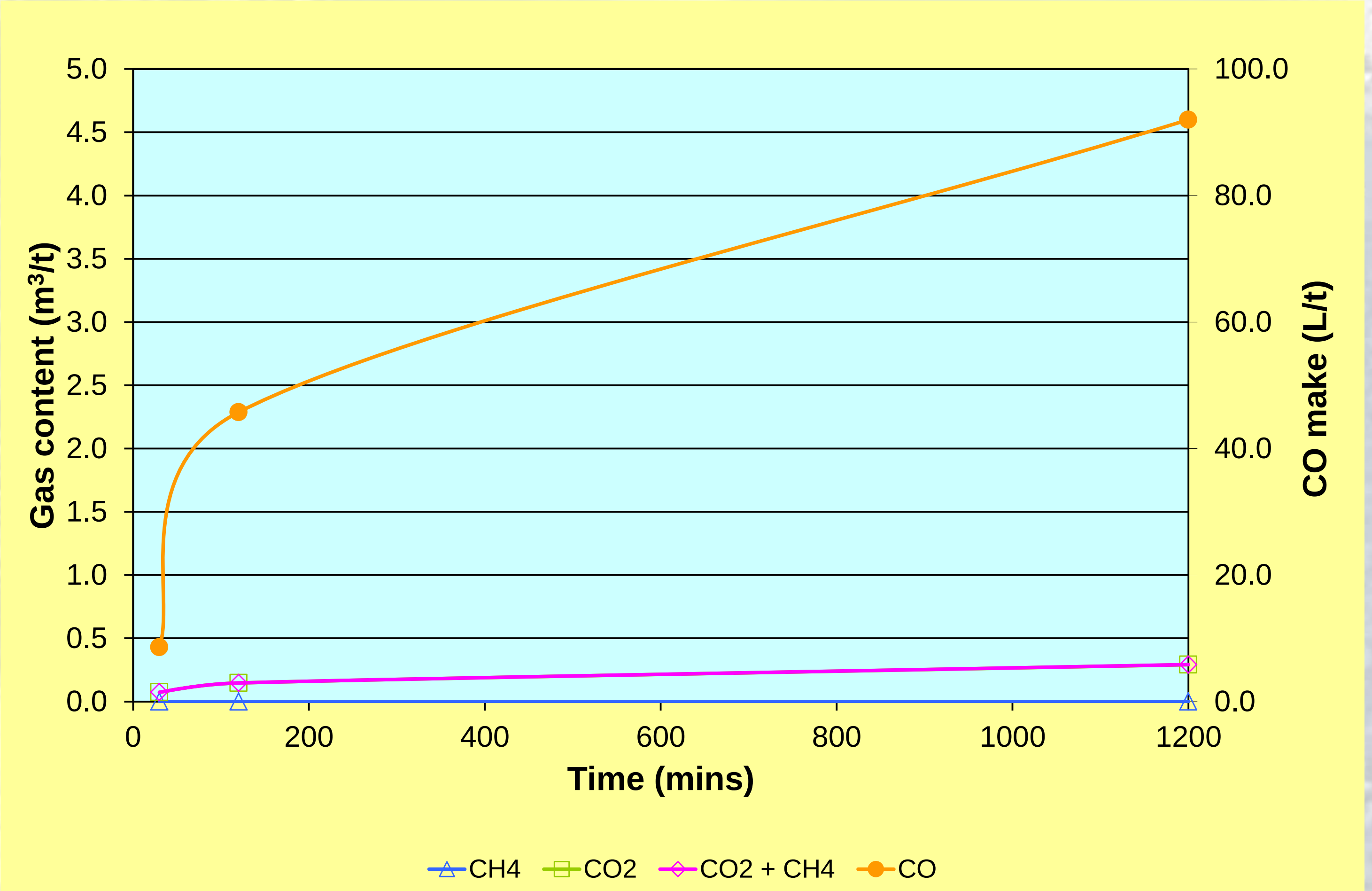
Reactive lignite gas content and CO production



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Examples of gas content and sponcom results for various coals

Sample ID	Gas Content				Spontaneous Combustion Indicators		
	CH_4 (m^3/t)	CO_2 (m^3/t)	CH_4+CO_2 (m^3/t)	H_2S (L/t)	CO make (L/t)	Graham's ratio	R_{70} (°C/h)
CLER13#	0.24	0.12	0.35	0.12	3.77	0.25	5.96
CLER16#	0.25	0.07	0.32	0.00	3.70	0.19	5.69
CLER17#	0.24	0.12	0.35	0.00	2.82	0.23	5.08
NARR1B5#	0.48	2.40	2.88	0.00	4.12	0.23	7.69
NARR2B5#	0.23	3.21	3.44	0.00	4.21	0.22	7.59
PI22SP1A*	0.00	0.29	0.29	0.61	91.99	2.97	26.17

#values obtained after 20 hours; *values obtained after 4 hours

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Conclusions and PGCA potential

- Accurate gas content results
- Rapid determination of gas drainage effectiveness
- Potential for quick desorption rate index assessment for outburst proneness
- Identifies hydrogen sulphide prone areas
- Preliminary sponcom indication
- Can distinguish between coal types through the seam profile
- Can be used for greenhouse gas inventory

References

- Crodsale, P, 1998. Degassing of methane and carbon dioxide: Prediction of gas composition, ACARP Report C5037

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Questions?