Defining the hard-to-drain coal seam

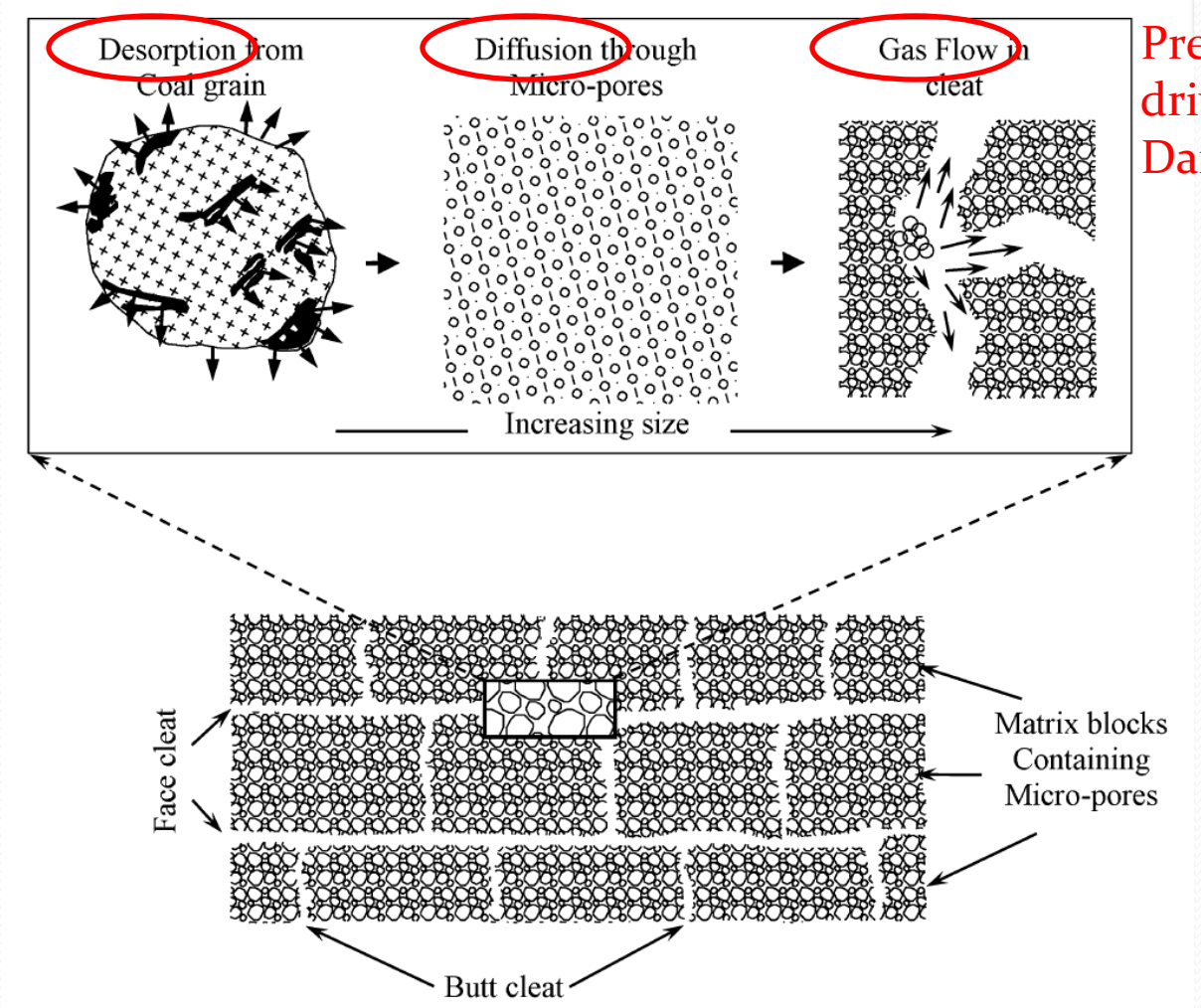
A/Prof. Ting Ren and Dr. Gongda Wang,

UNIVERSITY OF WOLLONGONG
AUSTRALIA

1. What is a hard to drain coal seam

- difficulties of reducing gas content below threshold values within a given/normal drainage lead time

2. Mechanism of gas flow and gas drainage



Pressure driven flow: Darcy's law

Migration of coal seam gas (Valliappan and Zhang 1996)

2. Mechanism of gas flow and gas drainage

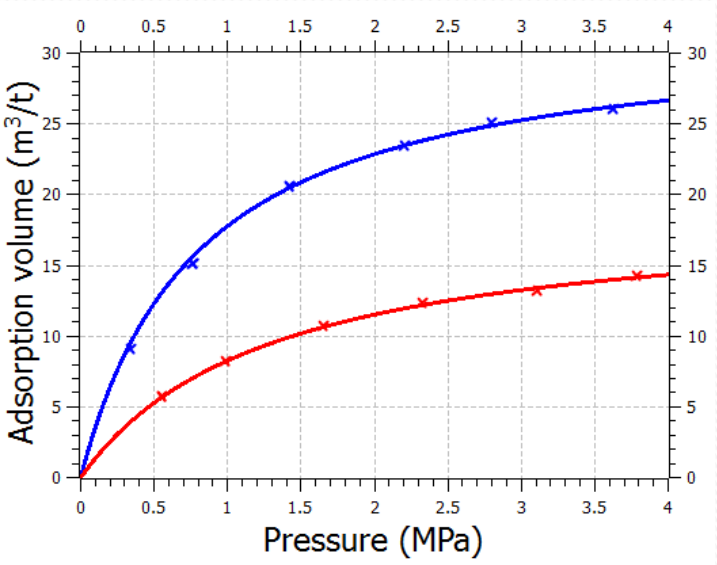
- **Adsorption and desorption:** plays a role of gas source and decides the amount of volume and the relationship between pressure and volume.
- **Diffusivity:** secondary constraint of gas flow rate in coal seam (between coal matrix and fracture)
- **Permeability:** primary constraint (between fracture and drainage borehole) of gas flow rate in coal seam

Our experimental results show the effective diffusivity of Bulli coal is at the 10e-6 (1/s) order of magnitude, which will not impede the common drainage efficiency.

Therefore, for a gas environment like pure methane, the sorption characteristics will not change much, and the permeability becomes the main controlling factor defining drainability of coal seam gas. That's why we always talk about 'permeability'.

3. Comparison between methane and CO_2 drainage

- Bulli seam has a distinguished characteristic of CO_2-coal adsorption is the larger Langmuir volume (maximum sorption volume) and lower Langmuir pressure (saturation).



A typical experimental result of adsorption isotherm

CH_4:
Langmuir volume: 22m^3/t
Langmuir pressure: 1.5 MPa

CO_2:
Langmuir volume: 30m^3/t
Langmuir pressure: 0.8 MPa

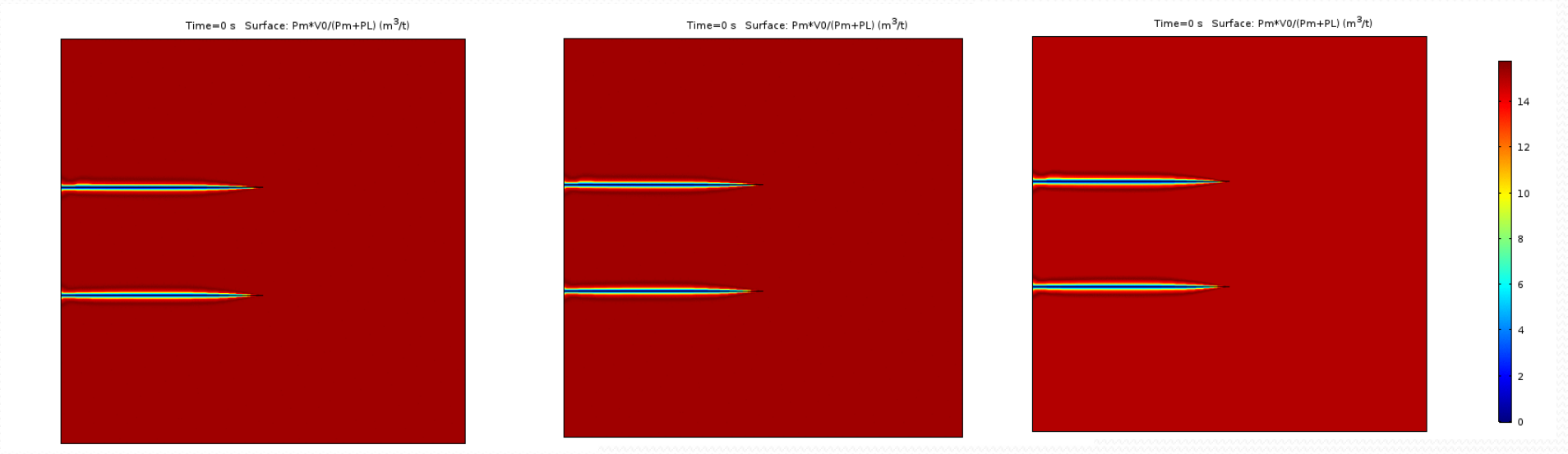
3. Comparison between methane and CO_2 drainage

Giving the same initial gas content

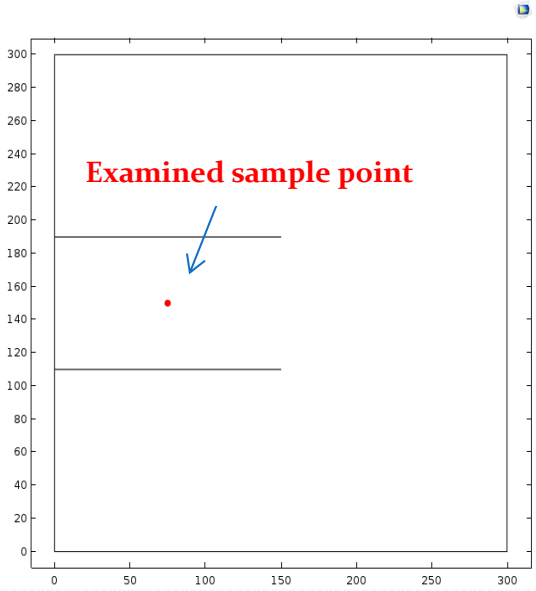
Case 1: Low perm CH_4
Langmuir volume, 22m^3/t
Langmuir pressure, 1.5MPa
Initial gas content: 15m^3/t
Permeability: 1mD

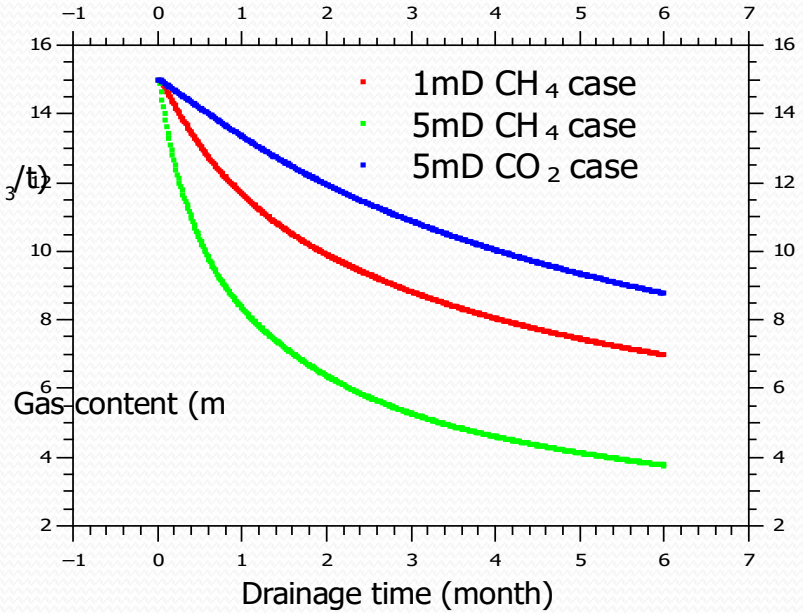
Case 2: High perm CH_4
Langmuir volume, 22m^3/t
Langmuir pressure, 1.5MPa
Initial gas content: 15m^3/t
Permeability: 5mD

Case 3: High perm CO_2
Langmuir volume, 30m^3/t
Langmuir pressure, 0.8MPa
Initial gas content: 15m3/t
Permeability: 5mD



3. Comparison between methane and CO_2 drainage

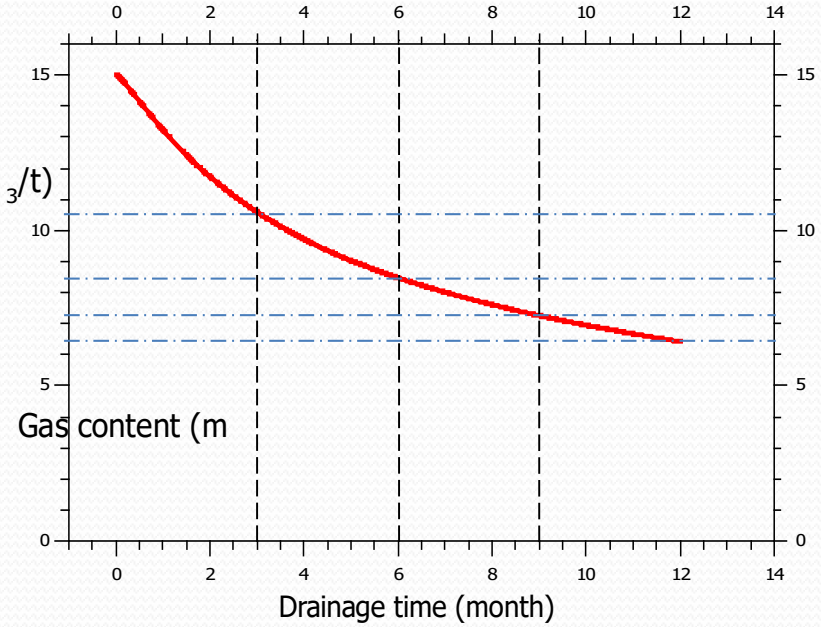




- The reduction of drainage efficiency caused by CO_2 composition is more obvious than the change of permeability from 5mD to 1mD.

- During the 6 months' drainage, the gas content can be reduced by about $2m^3/t$ /month for the high perm CH_4 area, $1.3m^3/t$ for the low perm CH_4 area, while only $1m^3/t$ for the high perm CO_2 area.

3. Comparison between methane and CO_2 drainage



Another important feature of CO_2 dominated coal seam is the drainage becomes harder and harder at the low gas content stage：

Using the parameters of case 3, drainage effect of 12 months is simulated. It can be seen that the gas content is reduced by about 1.3m^3/t/month in the first 3 months, 0.7m^3/t/month in the second 3 months, 0.33m^3/t/month in the third 3 months, while only 0.23m^3/t/month in the fourth 3 months.

4. Conclusion

- Permeability is not the only factor impacting the efficiency of gas drainage, even having a good permeability, a CO_2 dominate area could be hard to drain.

Thanks for your attentions.

Questions?