

# CHEMICAL OXIDANT STIMULATION OF COAL SEAMS TO INCREASE COAL SEAM PERMEABILITY

Candidate: Zhenhua Jing (PhD)  
Supervisors: Dr Karen Steel  
Prof Jim Underschultz

## Coal flooding test & CT scanning



Fig. 3 Coal stimulation rig and CT Scanning Image

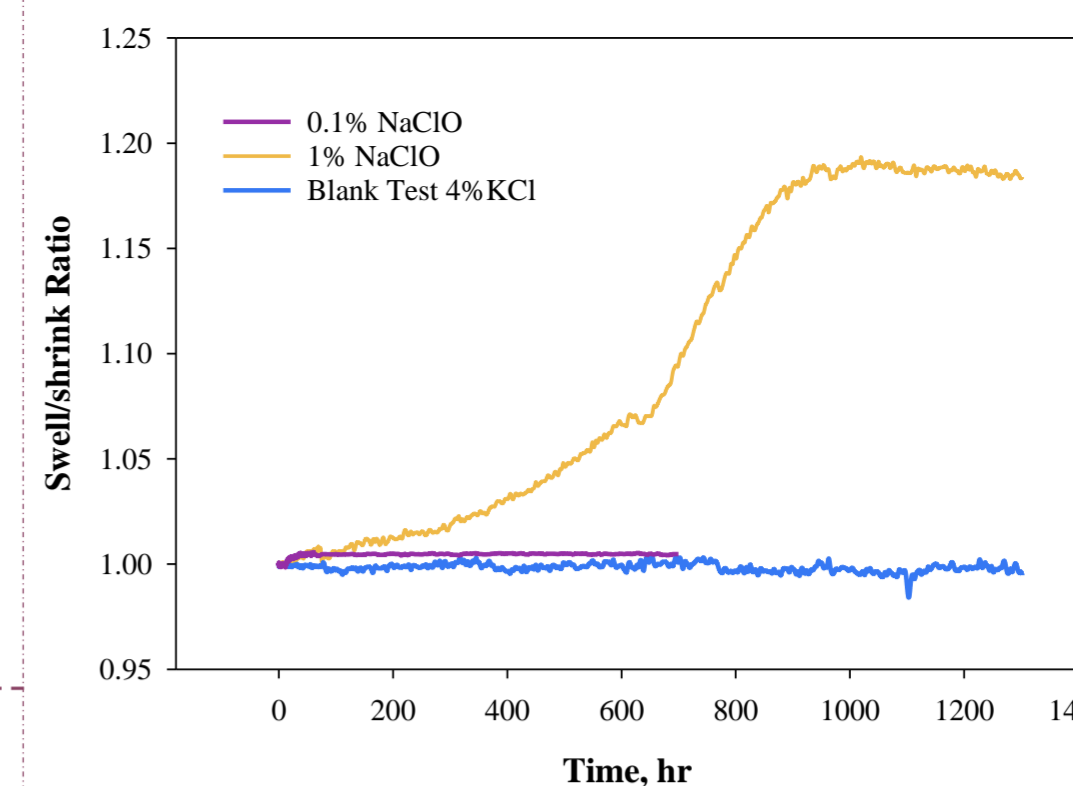


Fig. 6 Swell/shrink ratio graph in NaClO

Coal dissolves and appears to swell at the same time, which may be undesirable.

## Results & Discussion:

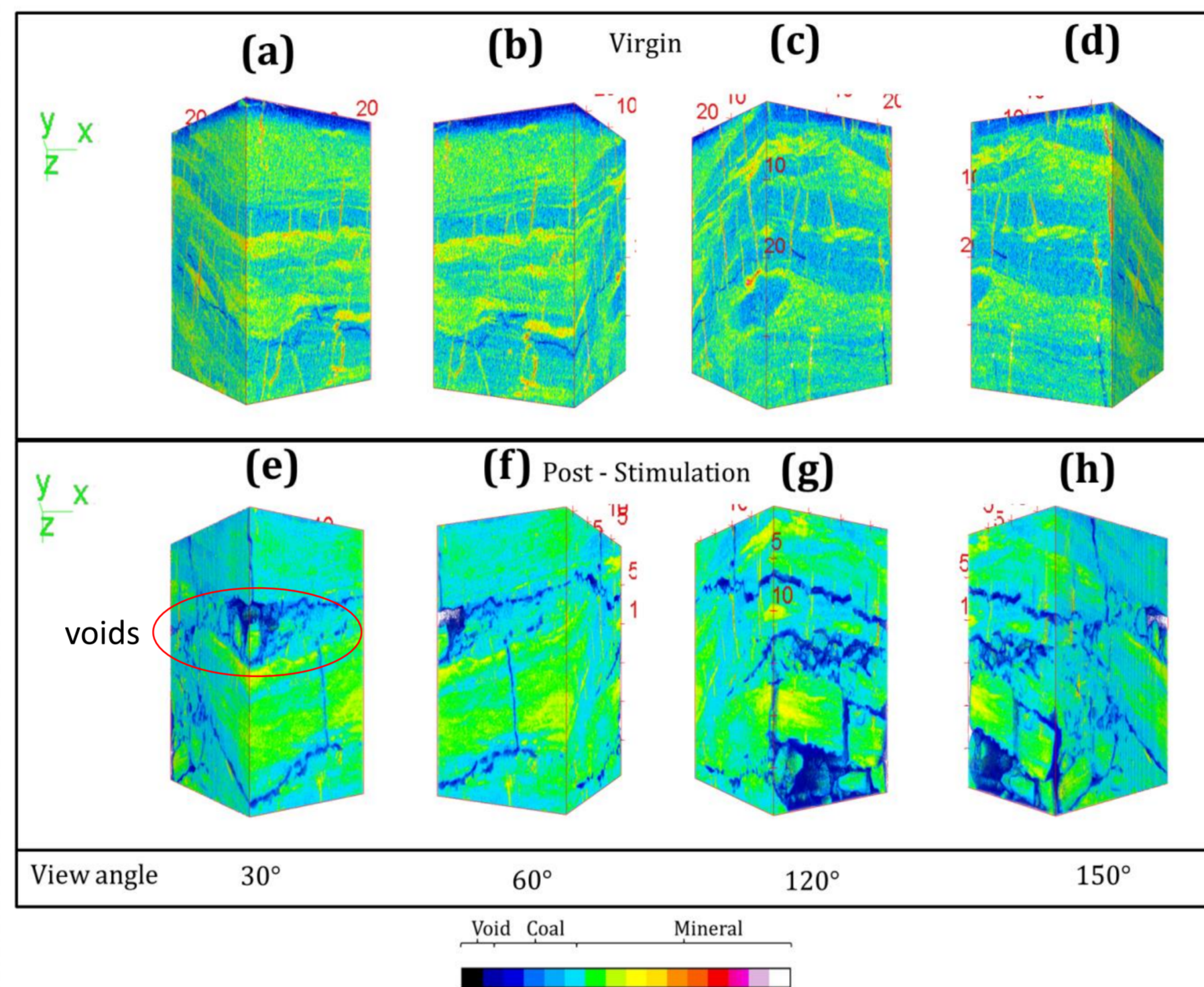


Fig. 4 Coal CT Scanning 3-D views before and after H<sub>2</sub>O<sub>2</sub> and NaClO oxidation.

- Exclusively massive void space was generated in bright coal band after oxidation.
- No attack on dull coal
- No change in vertical permeability.
- Horizontal permeability expected to be very high. Need to be investigated.

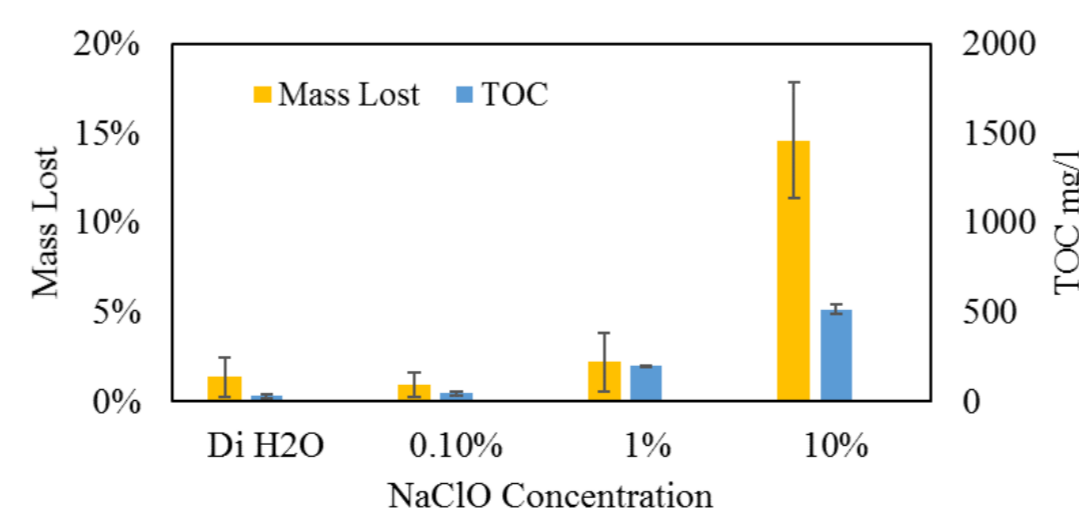


Fig. 5 Mass loss and TOC after coal oxidation in NaClO

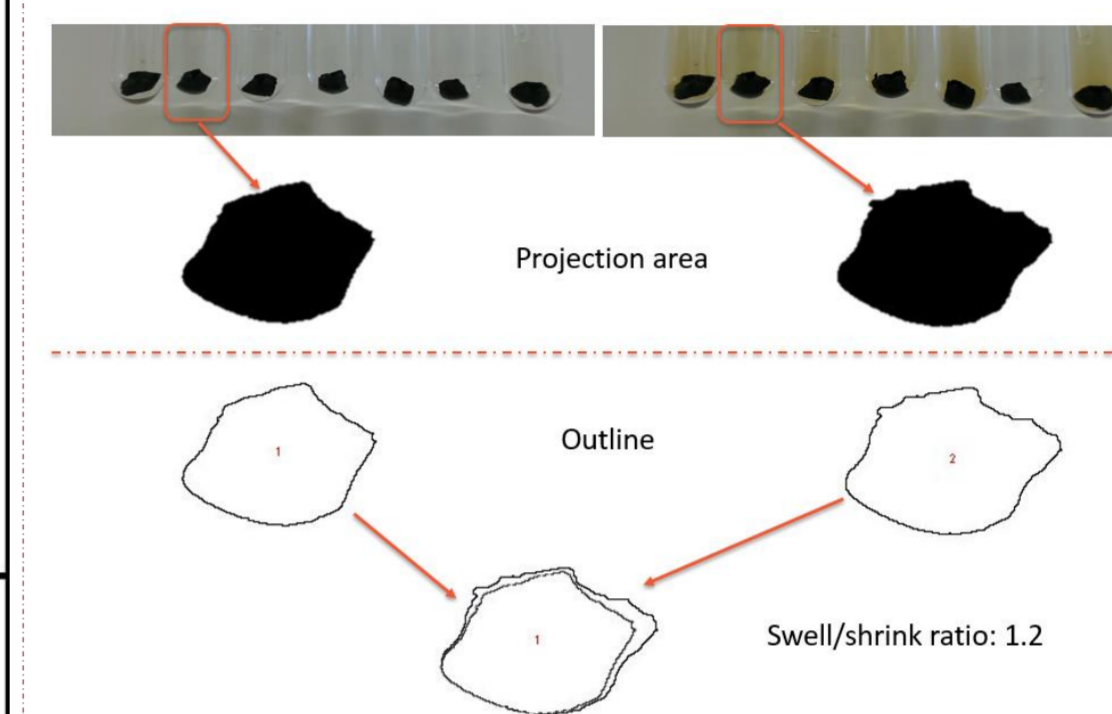


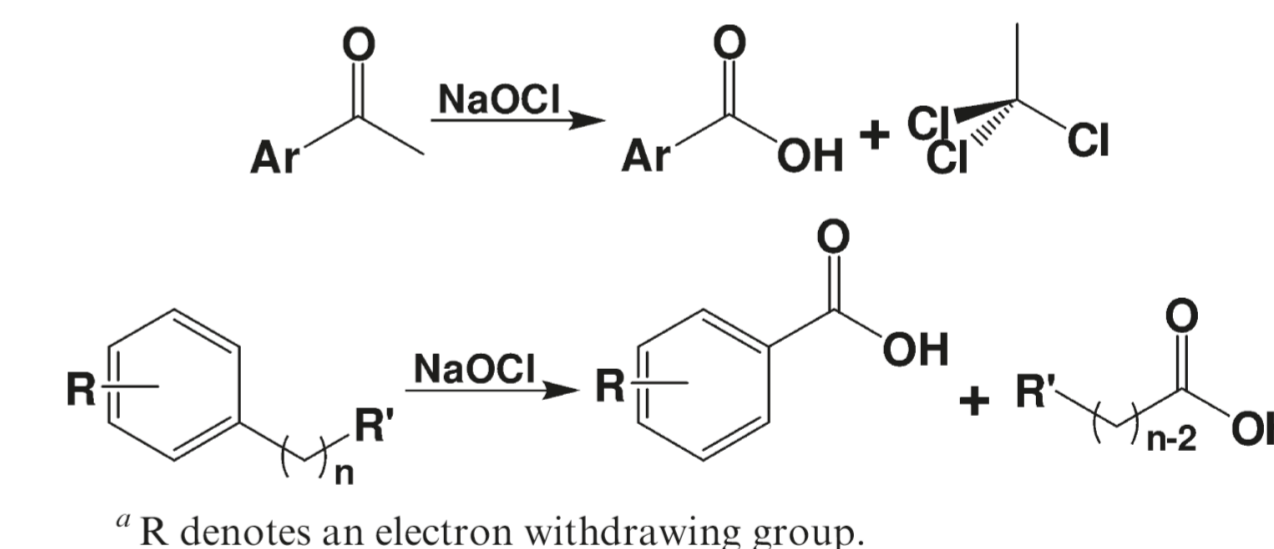
Fig. 7 Schematic of coal particle size change.

- The swell of the coal is not uniform.

- Particle size and shape are both changed.

## Oxidative mechanism and product

NaClO was reported to oxidize the side chain on the benzene ring rather than the benzene ring itself.



The products from coal oxidation in NaClO are mainly composed of benzene carboxylic acids, chloro-substituted alkanedioic acids and CO<sub>2</sub> if strong oxidation happens [1].

## Conclusion

- Coal tends to swell in NaClO without confining pressure. Coal swell/shrink ratio increases with increasing oxidant concentration.
- NaClO can lead to coal dissolution and breakage.
- Oxidants can generate massive void space in bright coal band.

[1] Yao Z.; W X.; Lv J. et al. Energy Fuels 2010, 24, 1801-1808.

This research has been conducted with the support of the Centre's industry members – APLNG, Arrow Energy, QGC and Santos.

## Introduction

Low permeability renders many coal seam gas (CSG) resources sub-economic. Oxidants are capable of reacting with coal to form soluble products, and could therefore be used to increase cleat aperture.

## Desired effect of oxidants on coal permeability

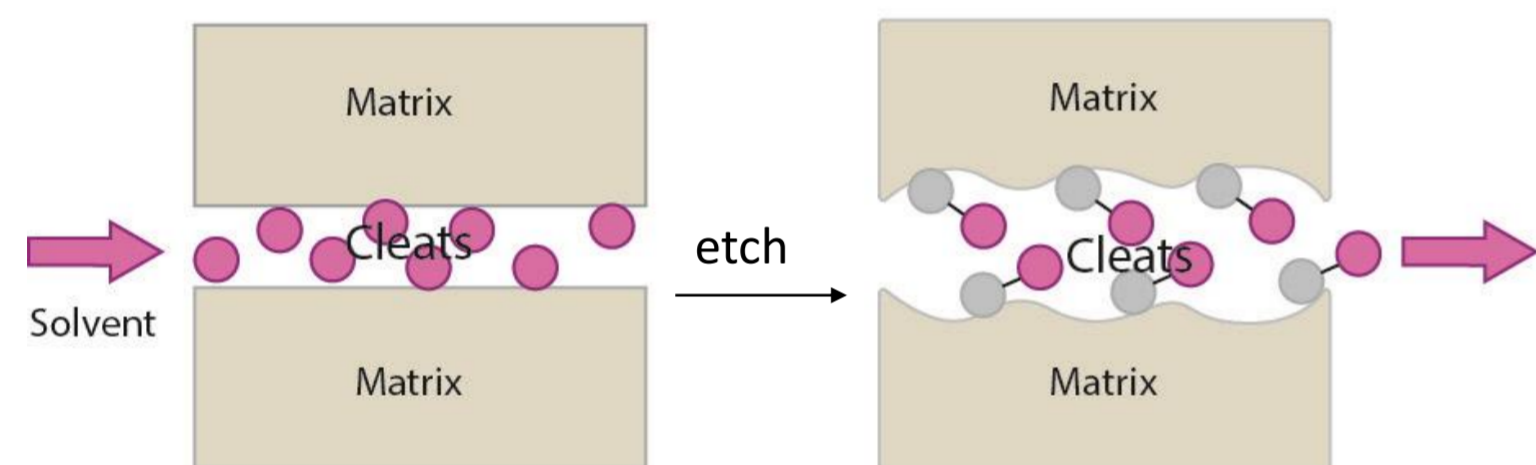


Fig. 1 Schematics of cleat aperture increasing by oxidation

Coal cleat surface could be etched, leading to an increase in cleat aperture. Expectation: Increase in permeability.

## Methodology:

- Swell/shrink Test: Camera observation & image analysis

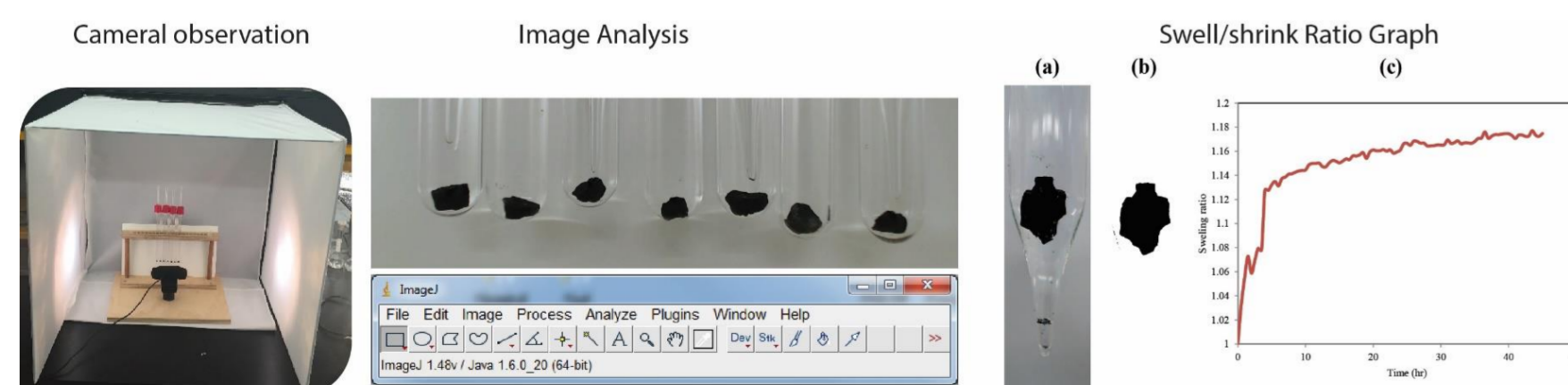


Fig. 2 Schematic of swell/shrink test procedure

$$\text{Swell/shrink Ratio} = \frac{\text{Treated sample projection area}}{\text{Un-treated projection area}}$$

