



X-ray imaging technology to optimise gas drainage systems

School of Petroleum Engineering

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Never Stand Still

Faculty of Engineering

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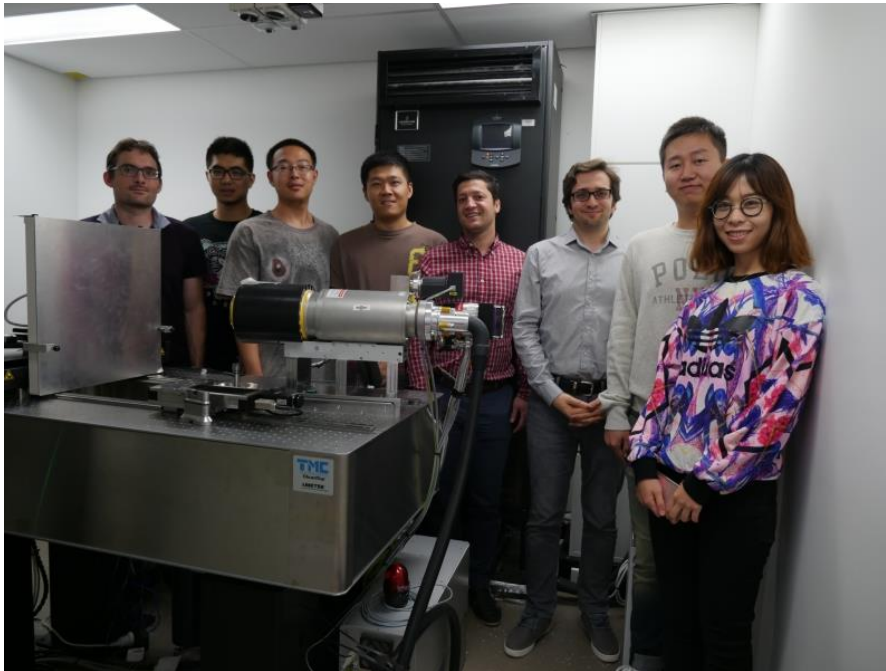


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Our Group

X-ray micro-tomography Imaging Laboratory



3D images of reservoir rock

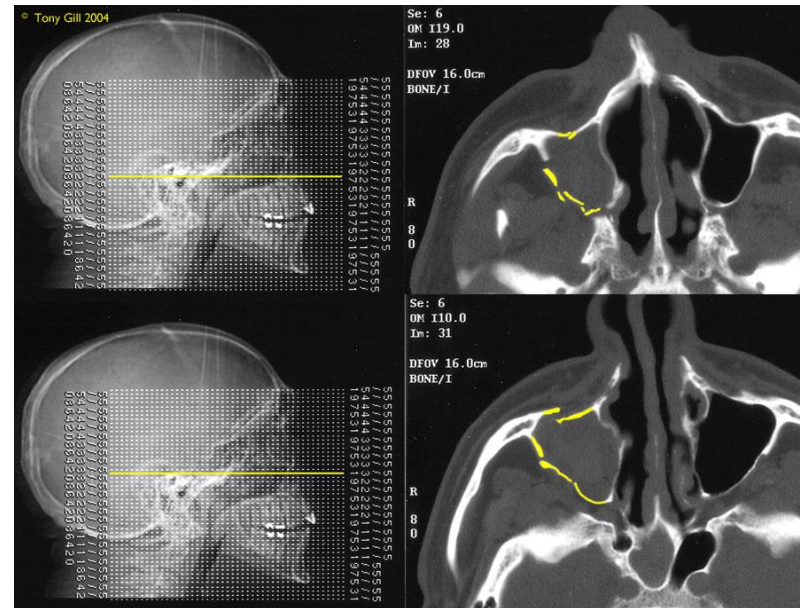
- 75 mm diameter cores → 50 micrometer resolution
- 2 mm diameter cores → 2 micrometer resolution
- <1 mm diameter cores → 800 nm resolution

Supercomputing Facilities



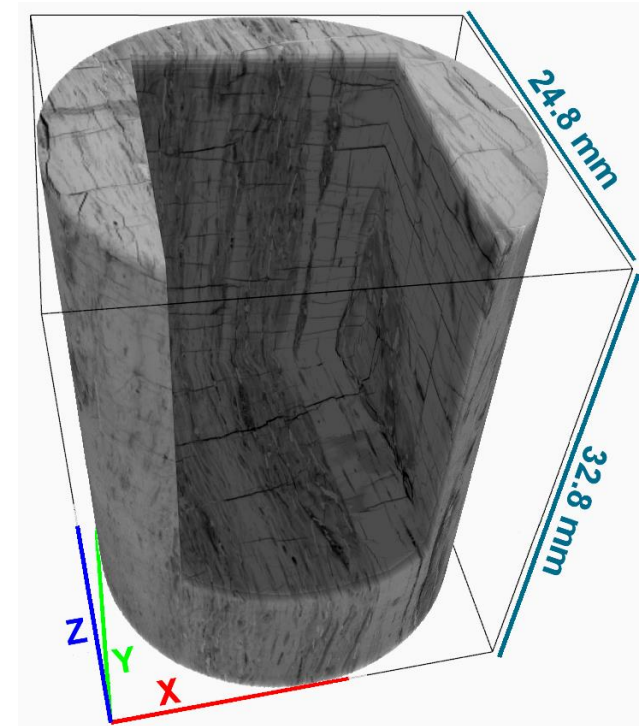
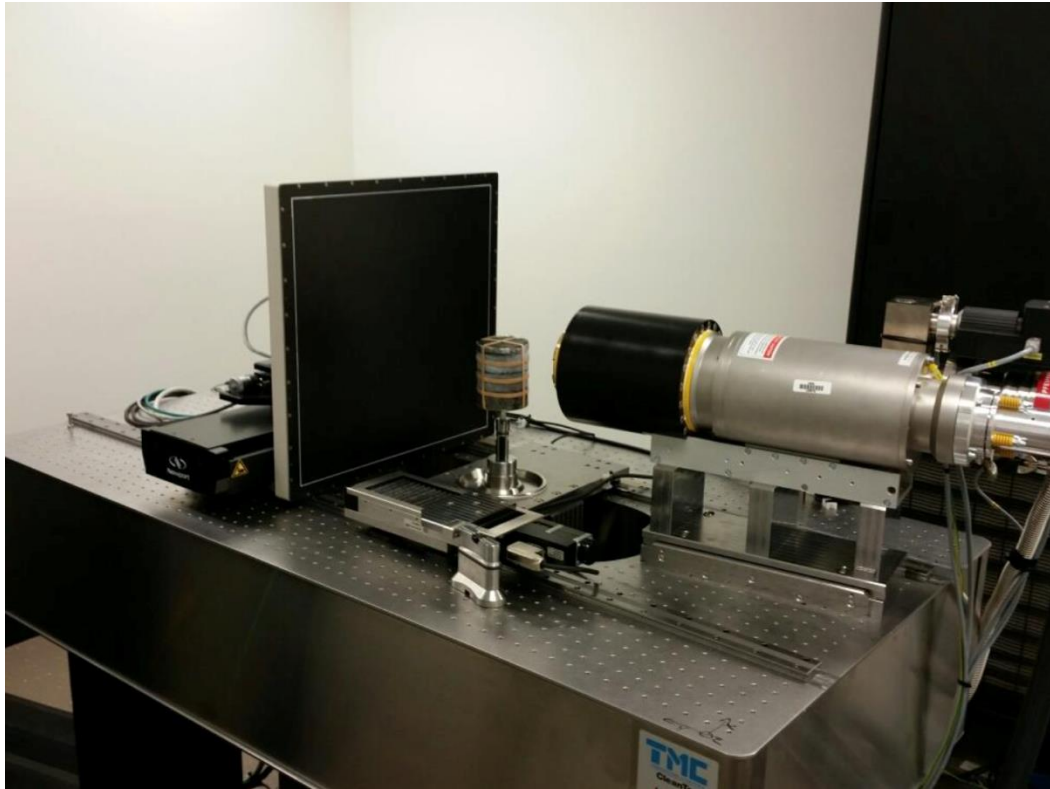
- allocated 1.8 million core-hours
- Advanced image processing
- 3D flow simulations

CT technology revolutionised medics, how can it help miners?



1972

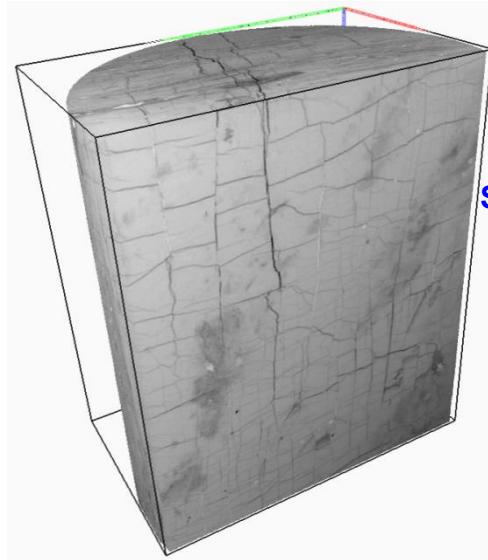
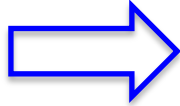
X-ray micro-Computed Tomography



Digital Coal Work Flow



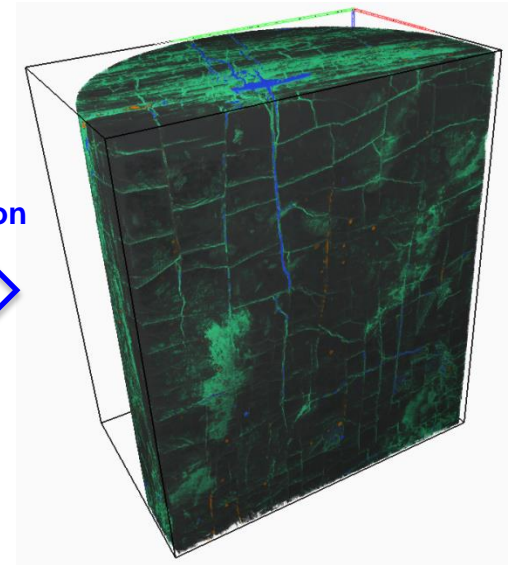
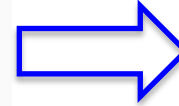
MicroCT



Core analysis

- cleat spacing
- cleat orientation
- Litho-type banding

Segmentation

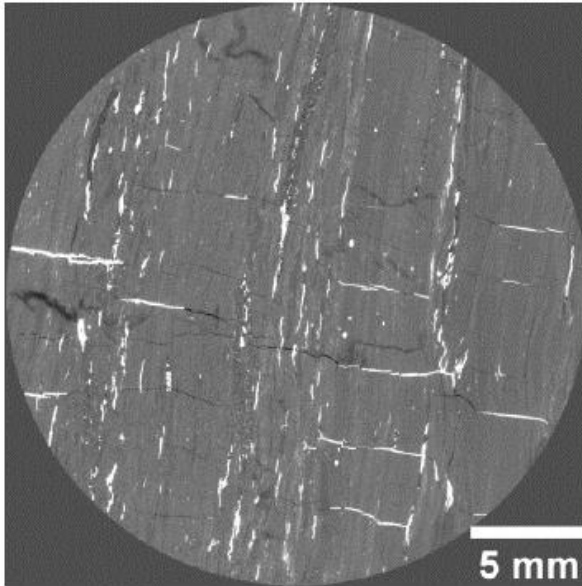


Quantification

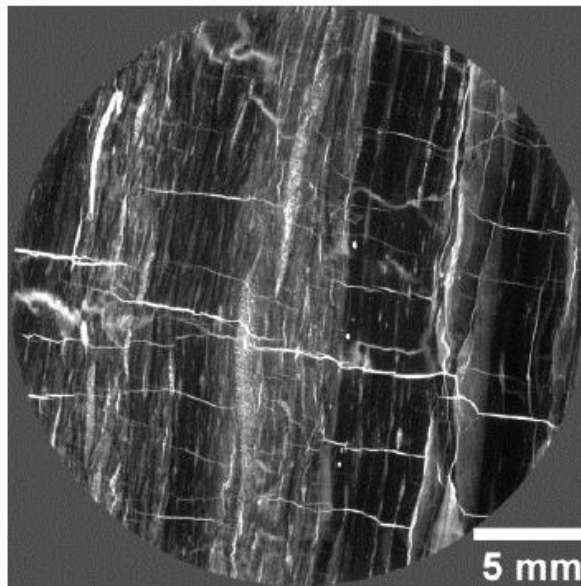
- Identification of minerals
- Aperture width
- Porosity
- Permeability
- Relative Permeability

Image Technique

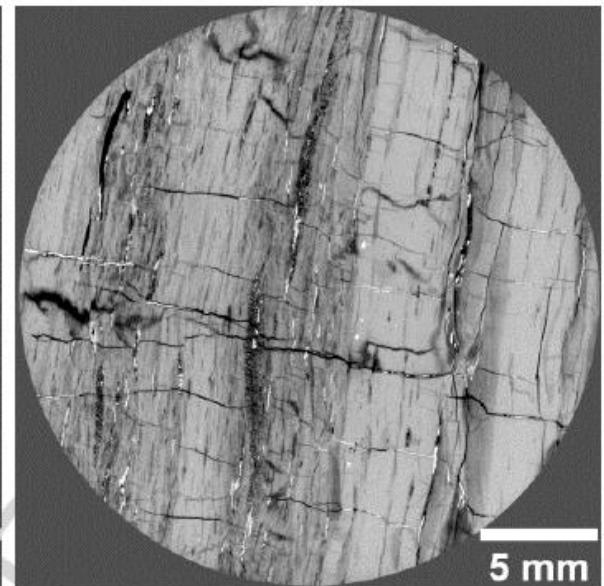
Dry Image



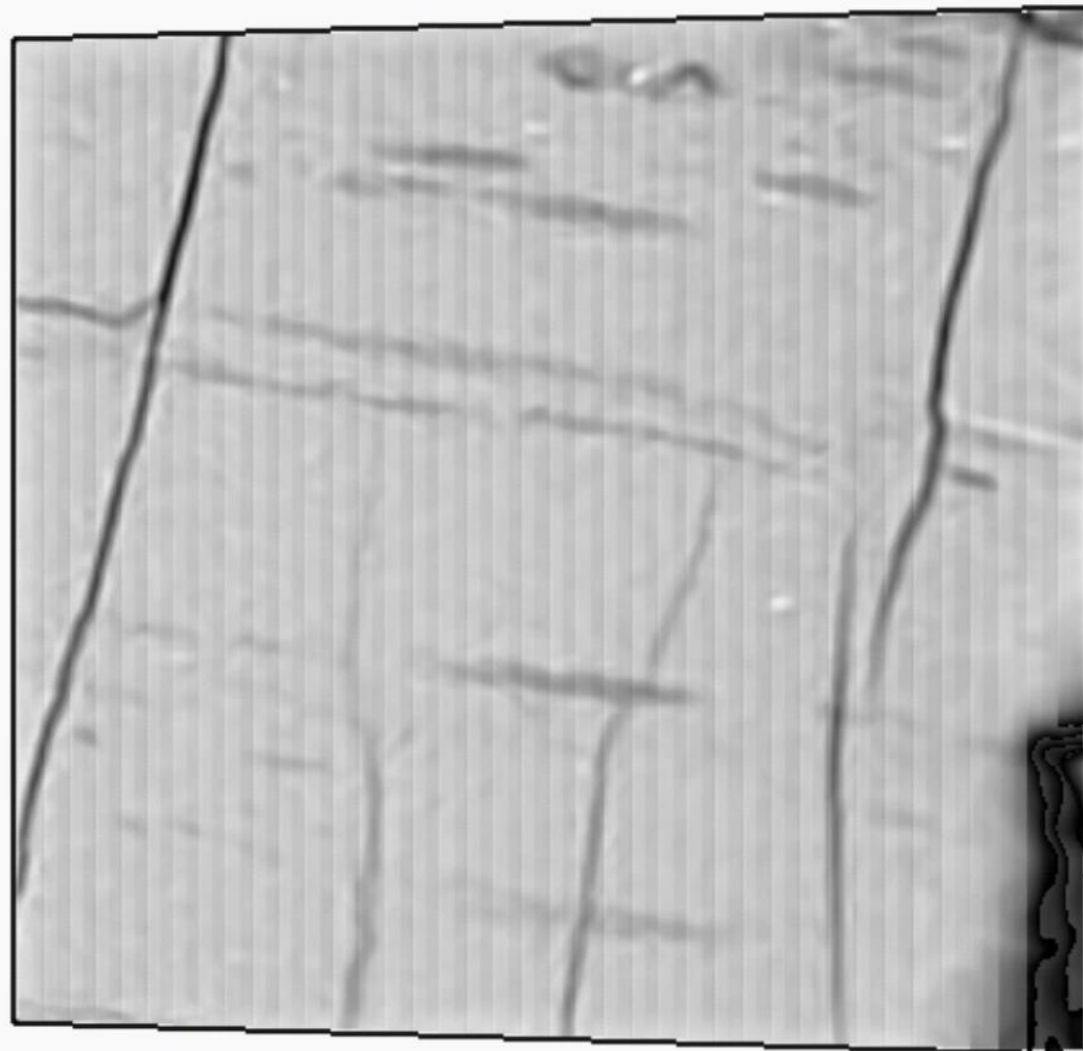
Wet Image

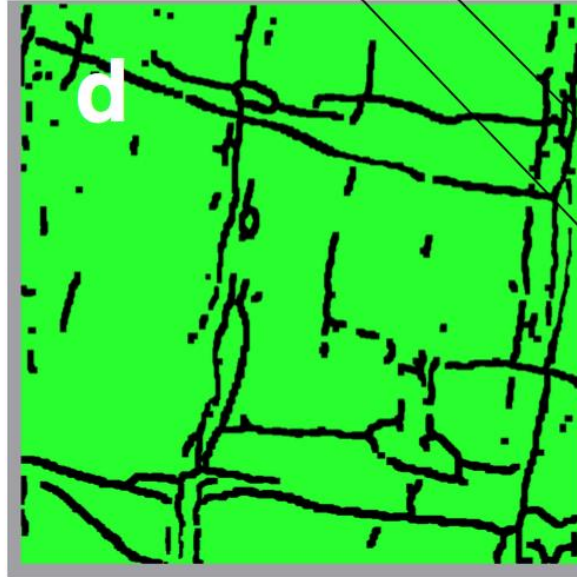
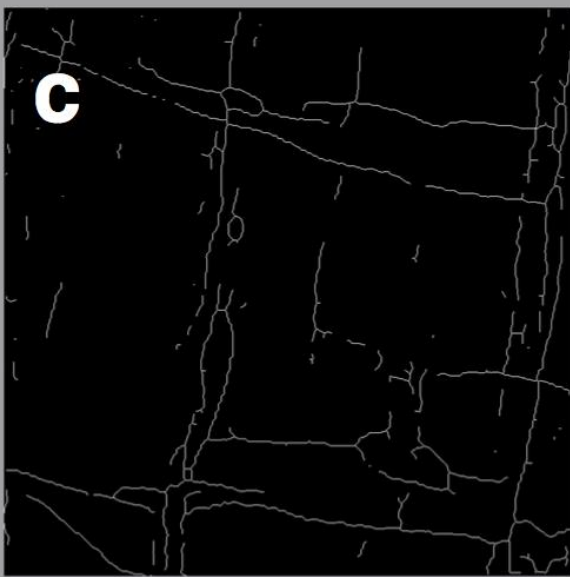
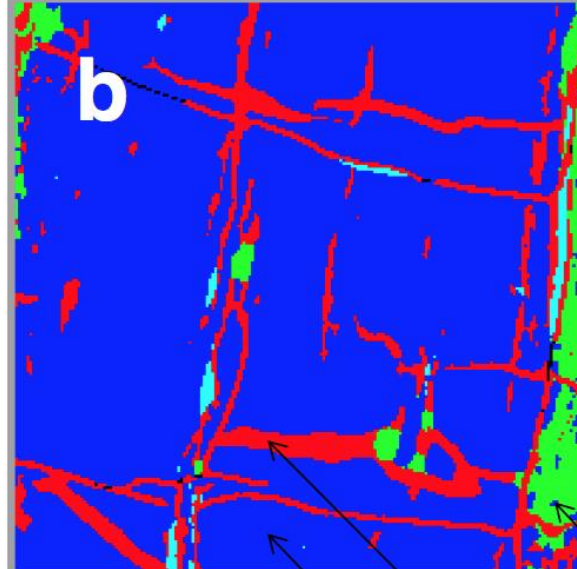
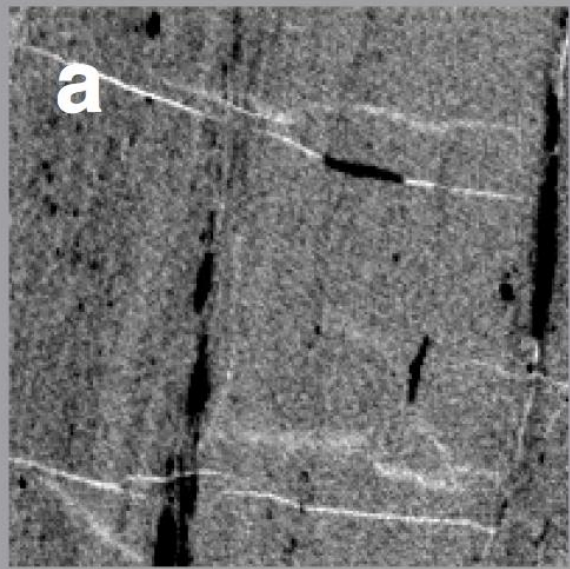


Wet - Dry



- The coal sample is saturated with a contrast agent highlight the porous regions, i.e. cleats and micro-porosity
- Wet-Dry = dark regions are either cleat or micro-porous regions
- Technique identifies coal features that are not visible in the original dry image





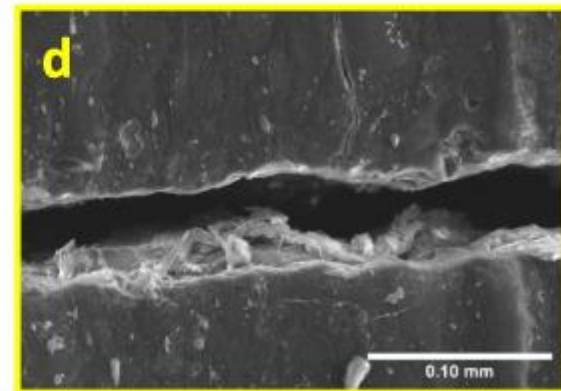
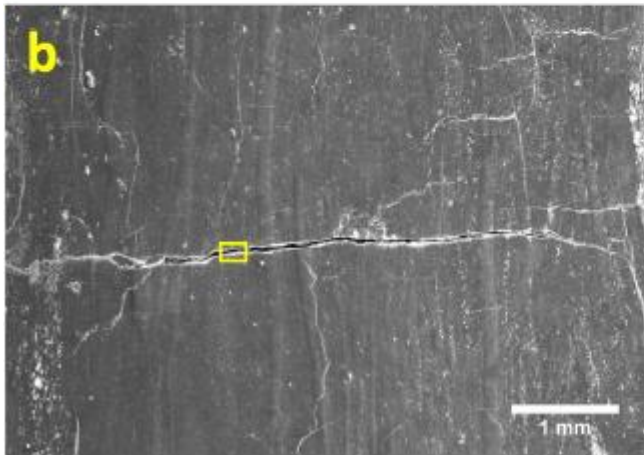
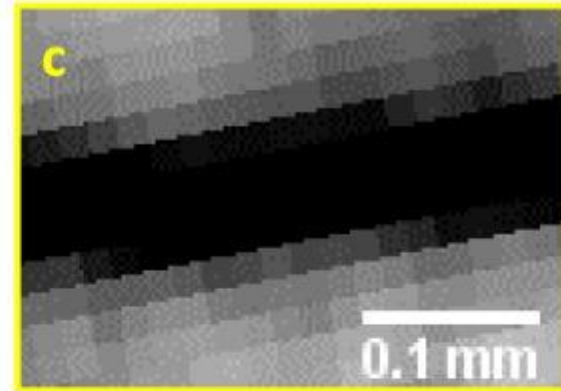
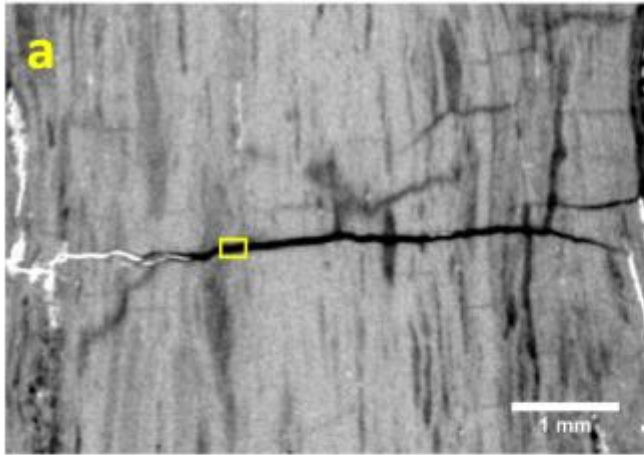
- a) Dry micro-CT image
- b) Segmented micro-CT image
- c) Extracted medial axis of pore space
- d) Widening the medial axis based on intensity values and SEM calibration. This image can be used for further analysis.

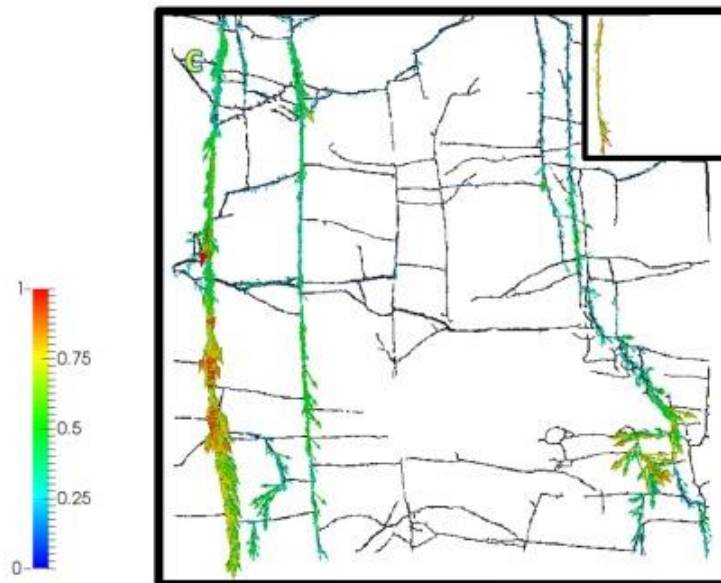
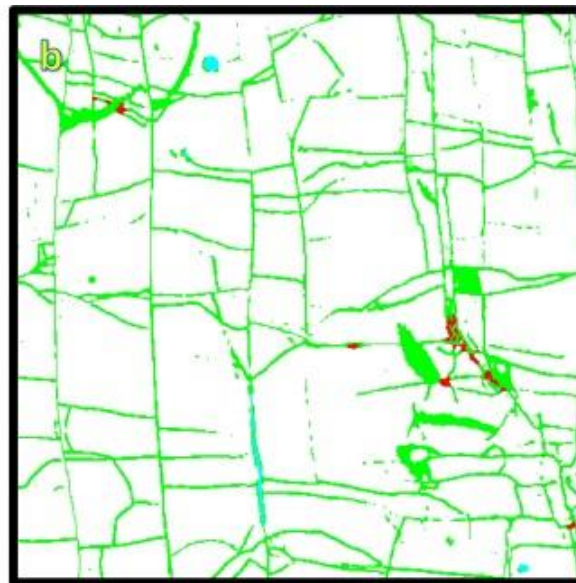
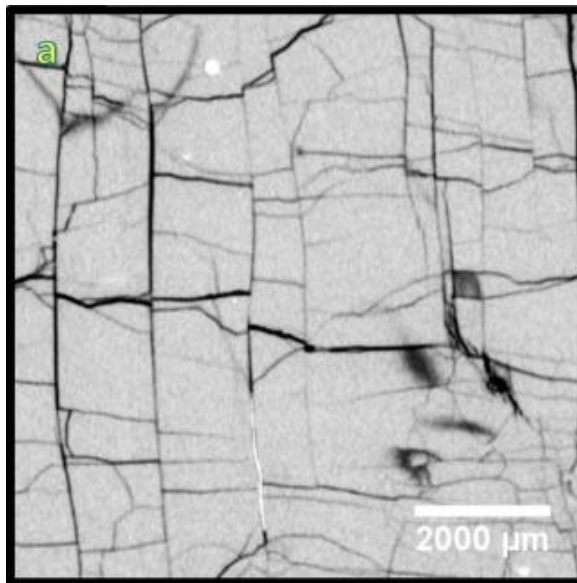
Micro-porous region

Sub-resolution fracture

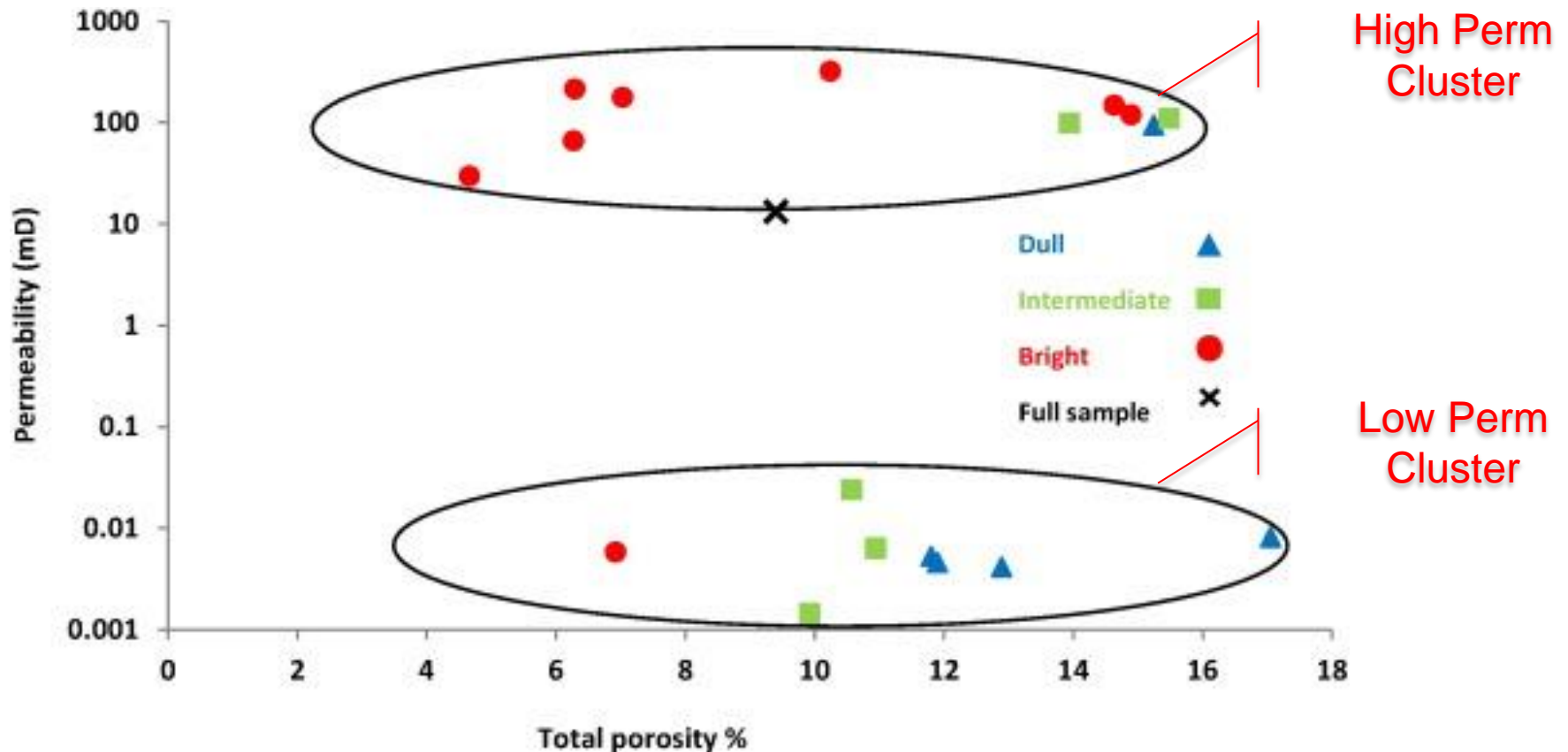
Macerals

SEM combined with CT imaging

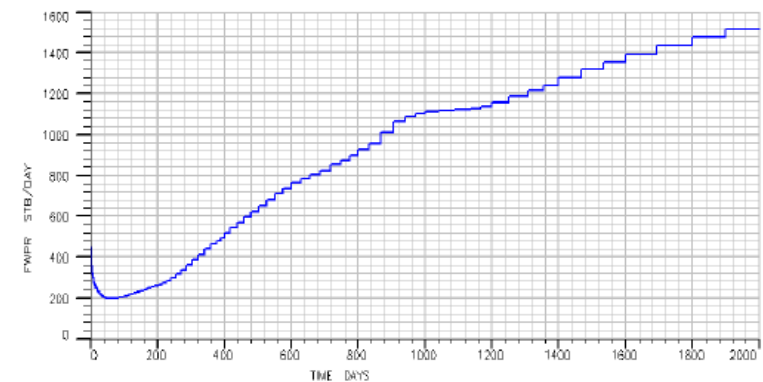
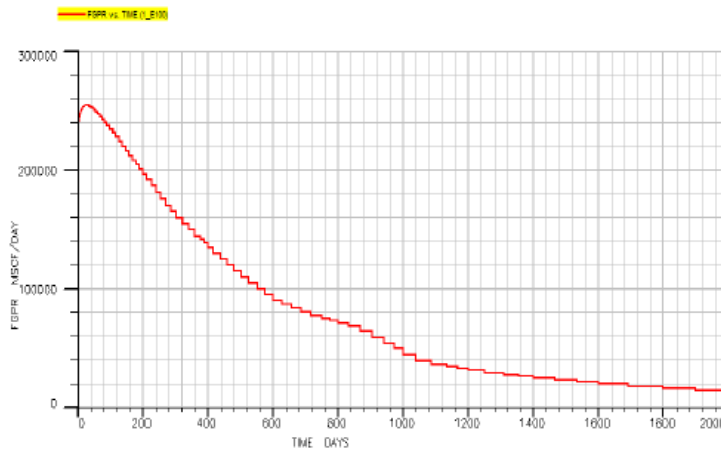
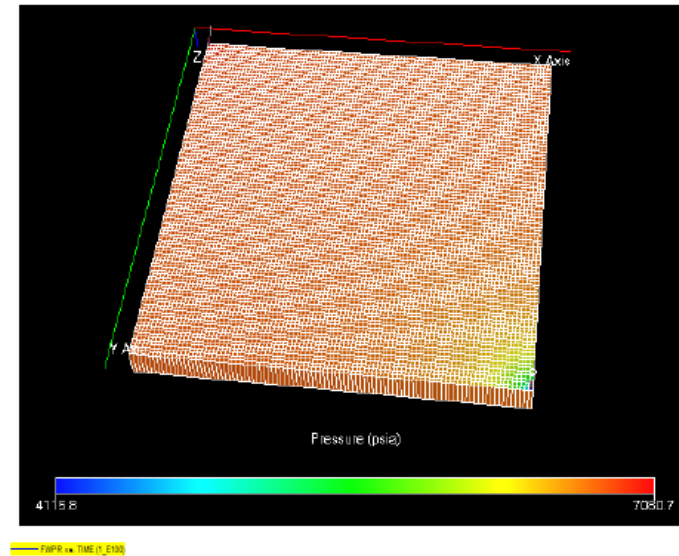
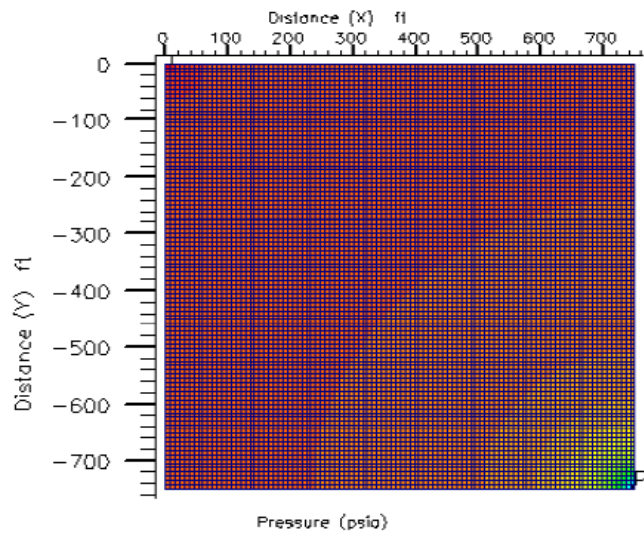




Permeability-Porosity Curve



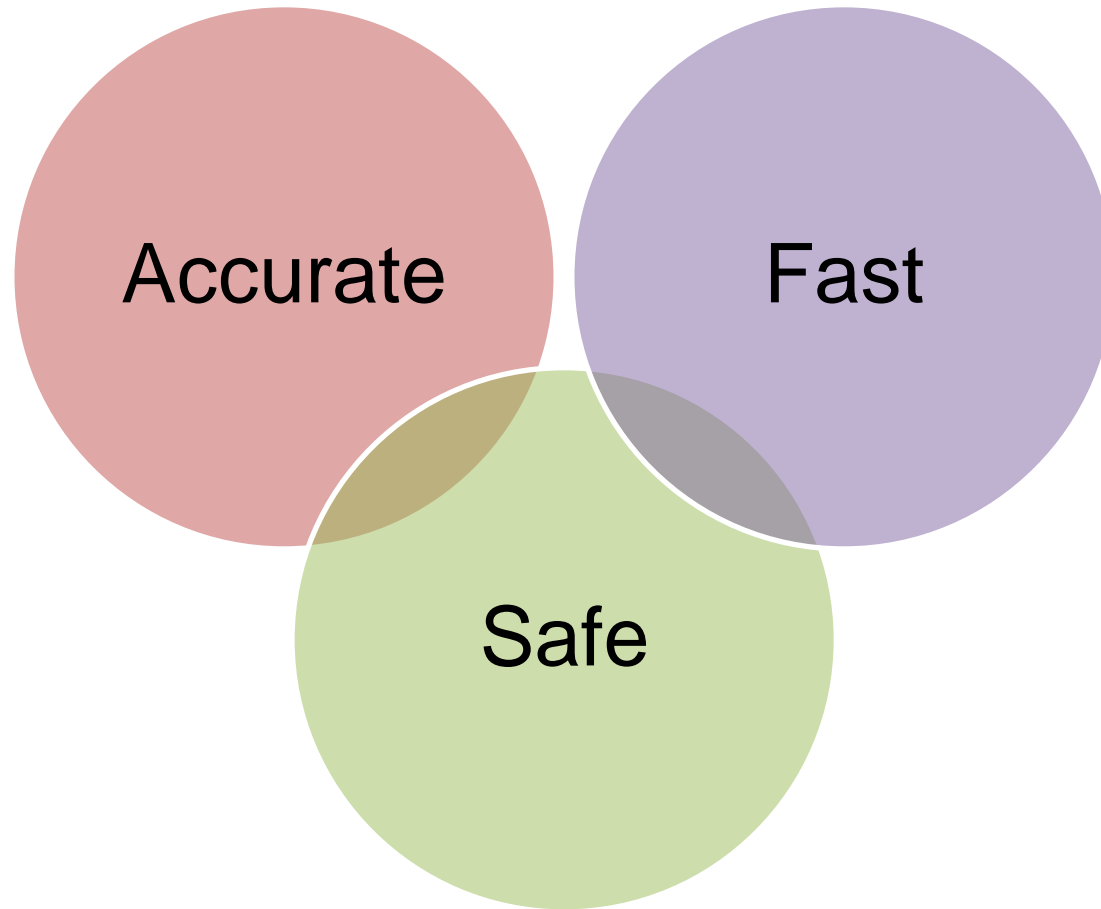
Inclusion of adsorption/ desorption into a full model



Our workflow suggested for drainage systems

- Taking **some samples** from the mines.
- **X-ray image** them and obtain in-situ permeability, relative permeability and adsorption/desorption characteristics.
- Use **geostatistics** to make the whole mine model based on limited samples.
- Optimise well placement, **design** drainage strategies, etc.

Advantages



1. Coal samples from mines
2. Gas drainage data to calibrate our model

Thanks. Visit our website:

www.mutris.unsw.edu.au