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# In-situ synchrotron X-ray tomographic study of stress-dependent porosity and permeability behaviour of fractured coal

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Coal seams are characterised as fractured reservoirs, consisting of natural fractures/cleats running through the coal matrix. The porosity and permeability of fractured coal are highly stress-sensitive. A bundled matchstick model is widely used to describe the cleat system. Based on this model, the well-known cubic law can describe the permeability change in response to fracture porosity/aperture change. However, this correlation is problematic, since the matchstick model assumes that fractures can be adequately represented as parallel plates with a constant aperture. In fact, fractures appear in all sizes with their apertures being rough and variable. In addition, although fracture properties, such as aperture distribution, tortuosity and connectivity, are affected by changes in stresses, the effect of stresses on the fracture properties and thus permeability has not yet been well studied. In this study, in-situ synchrotron X-ray tomography was conducted on a fractured anthracite coal at a resolution of 18.1 μm using a novel X-ray transparent tri-axial cell. We provided a detailed characterization of the fracture network and permeability change due to increased effective stress from 0.5 to 11.0 MPa. Results show that the permeability decreased by one order of magnitude following an exponential function. Large fractures were quickly compressed and isolated to smaller fractures and the fracture contact areas increased in response to increased stresses. Preliminary studies on the correlation between permeability and CT-resolved porosity/aperture is not consistent with the cubic law. This may indicate that fractures cannot be adequately represented as smooth parallel plates. A mixture of tube and plate model is proposed to better describe fracture geometry considering its rough nature.

## Speakers Gender

Male

## Travel Funding

Yes

## Level of Expertise

Student

## Do yo wish to take part in the poster slam

Yes

**Primary author(s) :** Mr ZHANG, Guanglei (Monash University ); Prof. RANJITH, Pathegama Gamage (Monash University )

**Presenter(s) :** Mr ZHANG, Guanglei (Monash University )

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