Contribution ID: **22**

Type: **Oral Presentation**

Multiscale characterisation of gas diffusion in coal

Monday, May 30, 2022 11:20 AM (15 minutes)

Coal is not only a combustible sedimentary rock, but also a source rock for coal seam gas (CSG). It is typically a dual porosity medium, consisting of fractures and porous matrix. Gas flow in coal matrix is under concentration gradient, which is characterised by diffusivity. It is a controlling factor for both CSG production and the gas drainage process in coal mining industry. Therefore, experimental and modelling study of gas diffusion in coal is of great significance.
Common experimental methods to measure diffusion coefficient include particle method and courterdiffusion method. In this work, we apply the courterdiffusion method, as it can measure the bulk sample, while particle method requires the sample to be crushed into particles to eliminate fractures and mesopores. During the test, two gas chambers of 100% helium and 100% methane with the same pressures are connected to each side of a coal sample. Courter diffusion process is initiated due to the concentration difference. After different diffusion times, the gas concentrations of two gas chambers are measured. Applying Fick's fist law, diffusion coefficient can be calculated. In addition, the test is conducted using krypton gas and helium gas. Since krypton, similar as methane, has high X-ray attenuation values. So, under X-ray micro-CT imaging, the krypton diffusion process can be visualised, where coal matrix with different krypton concentrations will present different greyscale values in the micro-CT images. Gas diffusion in coal is then modelled by a multicomponent gas diffusion model with dual-continuum modelling approach.
In this work, time-dependant diffusion coefficients of bulk coal samples can be studied. The gas diffusion process is modelled and validated with micro-CT images. The obtained true diffusion coefficient can be applied to in a wide range of areas, such as CSG development, gas drainage design and greenhouse gas emission estimation in coal mining.

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Time Block Preference

Time Block A (09:00-12:00 CET)

Participation

In person

Primary authors: Dr JING, Yu (UNSW); Ms BAATAR, Lkhamsuren (UNSW); Ms YUAN, Meng (UNSW); Prof. MOSTAGHIMI, Peyman (UNSW)

Presenter: Dr JING, Yu (UNSW)

Session Classification: MS08

Track Classification: (MS08) Mixing, dispersion and reaction processes across scales in heterogeneous and fractured media