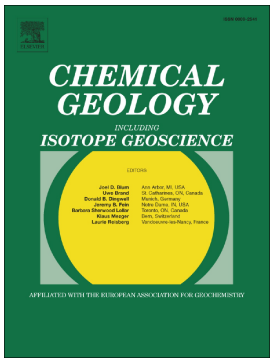

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PII: S0009-2541(18)30127-X
DOI: doi:10.1016/j.chemgeo.2018.03.015
Reference: CHEMGE 18695

To appear in: *Chemical Geology*

Received date: 22 August 2017
Revised date: 26 January 2018
Accepted date: 8 March 2018

Please cite this article as: Hamed Lamei Ramandi, Min Liu, Sahand Tadbiri, Peyman Mostaghimi , Impact of dissolution of syngenetic and epigenetic minerals on coal permeability. The address for the corresponding author was captured as affiliation for all authors. Please check if appropriate. Chemge(2017), doi:10.1016/j.chemgeo.2018.03.015

Impact of dissolution of syngenetic and epigenetic minerals on coal permeability

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Abstract

Permeability of coal is the key parameter in coalbed methane recovery. Minerals are known to occlude flow paths and reduce coal permeability. Herein, pore space variation of coal due to dissolution of syngenetic and epigenetic minerals is numerically simulated. A high-resolution helical micro-computed tomography (micro-CT) scanner is used to acquire 3D images from internal structure of a coal sample that contains both syngenetic and epigenetic minerals. Two subsets are then obtained from the micro-CT image and segmented to separate syngenetic minerals, epigenetic minerals and macerals. The syngenetic and epigenetic minerals individually and together are dissolved and their impact on porosity and permeability is studied. The minerals are identified through Scanning Electron Microscopy with Energy Dispersive Spectroscopy (SEM-EDS). The dissolution process is performed based on a first order kinetic reactive model. The numerical model combines lattice Boltzmann and finite volume methods. The results show that coal permeability significantly increases when a reactive solution is introduced. It is observed that the permeability increase with porosity increase is approximately 50% greater when only epigenetic minerals are dissolved. It is demonstrated that dissolving syngenetic minerals that are contiguous to the connected flow network can enhance the permeability through increasing the available connected void spaces. Also, it is shown that the gap, which at some cases occurs due to mineral detachment from the fracture wall, has a direct impact on dissolution performance. Overall, this study improves the understanding of dissolution phenomena in different types of coal minerals.

Keywords: mineral dissolution, syngenetic and epigenetic minerals, micro-CT imaging, reaction modelling