Coal has a complex porosity system that ranges from micro-, meso- and macro-pores, to visible fractures (butt and face cleats, joints and fractures; Laubach et al. 1998). Butt cleats and orthogonal face cleats, which contribute to the coal permeability, are the main conduits for gas and water flow in coal. After stress magnitude, the permeability is strongly dependent on the cleats spacing, geometry and orientation to stress, aperture size, connectivity, degree of mineralisation and topology (Close and Mavor, 1991; Laubach et al. 1998; Zhao and Yao, 2014; Jing et al. 2016). Discrete fracture models (DFM) or discrete fracture network (DFN) models are commonly used to analyse coal permeability and fluid flow (Gong et al. 2014). Zhou and Yao (2014) studied the effect of cleats aperture and spacing on coal permeability and used 2D cleat models. Gao et al. (2014) analysed the strength and deformability of coal based on DFM with bending planes, face cleats and butt cleats. Jing et al. (2016) built DFNs for coal cleats based on micro-computed tomography imaging (µCT) and then using a Monte Carlo method to assign to the remaining reservoir. This latter point is the problem, as the borehole only confidently intersects the small scale coal network, and the larger scale joints and faults are under represented.

This study presents a workflow to build a grid based DFN near the wellbore using the multi-point facies simulation (MPS) method. Core from three wells were measured for face and butt cleats spacing. An image log from one well was interpreted for cleats azimuth which was used in MPS as hard data. Firstly, we coded a program to generate cleats distribution based on the coal seam observed in core. Then the generated cleats were imported into Petrel to be used as the training image. We then build a 2D grid with cells of 1000×1000 and grid size of 1 mm in x and y direction which is used in MPS modelling. Finally, ten realisations of cleats distributions near the wellbore were generated. Results show that this presented workflow is efficient in modelling cleats distribution by integrating image logs in interpretation and core observed cleats.

**INTRODUCTION**

Coal has a complex porosity system ranging from micro-, meso- and macro-pores, to visible fractures (butt and face cleats, joints and fractures; Laubach et al. 1998). Butt cleats and orthogonal face cleats, which contribute to the coal permeability, are the main conduits for gas and water flow in coal. After stress magnitude, the permeability is strongly dependent on the cleats spacing, geometry and orientation to stress, aperture size, connectivity, degree of mineralisation and topology (Close and Mavor, 1991; Laubach et al. 1998; Zhao and Yao, 2014; Jing et al. 2016). Discrete fracture models (DFM) or discrete fracture network (DFN) models are commonly used to analyse coal permeability and fluid flow (Gong et al. 2014). Zhou and Yao (2014) studied the effect of cleats aperture and spacing on coal permeability and used 2D cleat models. Gao et al. (2014) analysed the strength and deformability of coal based on DFM with bending planes, face cleats and butt cleats. Jing et al. (2016) built DFNs for coal cleats based on micro-computed tomography imaging (µCT) and then using a Monte Carlo method to assign to the remaining reservoir. This latter point is the problem, as the borehole only confidently intersects the small scale coal network, and the larger scale joints and faults are under represented.

This study presents a workflow to build a grid based DFN near the wellbore using multi-point facies simulation (MPS, a pixel-based sequential simulation algorithm; Strebelle, 2002; Strebelle and Journal, 2001; Fassett et al. 2015) method and image log data which has a high resolution to 5 mm but much smaller fractures can be imaged if there is a sufficient electrical contrast with the background (Weatherford, 2013).

Core from three wells, A, B and C shown in Figure 1 were measured for face and butt cleats spacing (55 points from well A, 138 from well B and 60 from well C). Image logging data from well B was used to interpret cleats, faults and fractures.

This study presents a workflow to build cleats distribution near a wellbore by integrating the image log interpreted cleats, cleats spacing data from core coal observation and MPS method. The built cleats and matrix model can help to analyse near-wellbore coal properties, coal seam gas production, and well testing performances. More training images from µCT scanned cleats (Figure 7) will be used in the well testing (Figure 8) or production data will be used to optimise the cleats distribution model.

**METHODOLOGY**

Coal observation

- Conceptual model

- Training image

- Cleat spacing

- Cleat azimuth

- Cleat distribution near wellbore

**DISCUSSION AND FUTURE WORKS**

This study presents a workflow to build cleats distribution near a wellbore by integrating the image log interpreted cleats, cleats spacing data from core coal observation and MPS method. The built cleats and matrix model can help to analyse near-wellbore coal properties, coal seam gas production, and well testing performances. More training images from µCT scanned cleats (Figure 7) will be used in the well testing (Figure 8) or production data will be used to optimise the cleats distribution model.

Acknowledgements: We thank all the coal seam gas companies that provide data to the Queensland Department of Natural Resources and Mines (QDNR). This research has been supported by the EC for the ELYCIP (Contract 269154) project within the 7th Framework Programme of the European Union and the Australian Research Council (DP110103833). We thank I. K. Allendorf for providing the license for Petrel, and Peaks for providing the license for background.

**REFERENCES**


Jing, D., and Fang, X. (2016). Coal cleats distribution and fault which was assumed as the azimuth of face cleats. Journal of Natural Gas Science and Engineering, 26, 95-103.

