Background & Objectives

Interburden is the mixture layer located between the coal measures. Many existing coalbed methane (CBM) wells have already drilled through these undeveloped layers (Fig. 1). However, the potential of coal seam interburden reservoirs (Fig. 2), mainly consisting of mud, clay and organic matter, has not yet been well researched or developed, when compared to that of coal or shale. This project aims to develop and validate an alternative stimulation method to replace traditional fracturing techniques, such as hydraulic fracturing, to effectively crack the thick but malleable mudstone layers without importing any outside chemical fluids into the subsurface or causing clay swelling, to improve the gas recovery from CBM wells.

Properties of Coal Seam Interburden

1. Interburden mainly consists of clay mineral and organic matter which are relevant to its pore structure and gas adsorption ability.
2. The mechanical strength of interburden affects the PAED developed, when compared to that of coal or shale. This project aims to understand the mechanism of interburden breakage by PAED and simulate the multiphysics coupling using finite element method.

Experimental Setup for PAED Stimulation

Develop and employ PAED simulation technique to crack the interburden specimens at the labscale. The schematic of PAED setup is shown in Fig. 4. Experimentally measure the coal seam interburden properties and simulate the multiphysics coupling using finite element method.

Results

After the stimulation on C2 by PAED (Fig. 6), the permeability (Fig. 8) and porosity (Fig. 9) of testing C2 mortar specimen have both increased due to the impact of shock waves.

In the current stage, the porosity of C2 mortar specimens before (a) and after (b) stimulation have improved (Fig. 10), particularly the front part which is close to wave source. The fracture and void of coal specimen before (a) and after (b) PAED stimulation on Gluluguba-2 coal (Fig. 7).

Parameter settings for testing

- Shockwave generation:
  - Charging voltage: 20 – 60 KV
  - Capacitance: 2 – 12 uF
  - Discharging period: nanoseconds ~ 70 ns
  - Pulse number: adjustable
  - Electrodes gap: 5 mm
- Permeability measurement:
  - Inlet pressure: 2 bar
  - Outlet pressure: atmosphere

Testing Sample Information

In the current stage, to explore and summarize the most efficient discharging circuit and parameter settings for strong shock wave fracturing, preliminary tests on homogeneous mortar sample and identified coal sample were carried out. The testing specimens here are C2 mortar with the compressive strength of approx. 30 MPa. The sample were carried out.

Acknowledgement & References

The assistance from the School of ITEE and CCSG at UQ is highly appreciated.