Core Evaluation of Hydrologic and Seismic Properties of Methane-Bearing Coals

Roland Gritto
Timothy J Kneafsey
Liviu Tomutsa

In the last 10 years, coalbed methane (CBM) has transformed from a coal-mine hazard to a clean burning source of long term natural gas. The benefit of methane as an energy source in conjunction with vast amounts stored in coal basins has led to the development of an industry that produces CBM. Reducing the emission of green house gases to the atmosphere through carbon dioxide injection into coal has added a dual benefit to the production of CBM, as carbon dioxide may be used to desorb methane from coal seams, sequestering the CO2. CBM is present in coal seams as a product of the coalification process. Methane gas is typically extracted by depressurizing the reservoir by removing water. This allows the gas to desorb from the coal matrix and flow through the cleat structure to a production well. In order to increase CBM production, more information is needed on the migration of methane through fractures and cleats. A better understanding of the replacement of methane by carbon dioxide in the coal seam is also needed to further understand this sequestration method. Laboratory experiments are underway to address these questions.

Tests on core samples are currently performed under in-situ pressure to gain insight on processes occurring in CBM extraction and carbon dioxide sequestration. We use electrical resistivity and x-ray computed tomography (CT) scanning to determine saturation and spatial phase distribution. Flowrate, in conjunction with upstream and downstream pressure measurements, is used to determine sample permeabilty. Additionally, simultaneous measurements of seismic waves are performed to obtain P- and S-wave velocities as well as amplitudes of body waves as a function of methane and carbon dioxide state and saturation in the coal. Initial results will be presented showing the permeability structure of a coal sample, and seismic waveforms obtained during methane production by depressurization and during gaseous and liquid CO2 injection. Mass transfer limitations that may ultimately affect processes and parameter changes, were not observed in the short-duration tests. Technique refinement and additional testing using a variety of coal samples are still needed to provide a larger database of coal behaviors under conditions of interest. The results of laboratory studies on CBM can be used to design field experiments to monitor temporal changes during CBM production.