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CO_2-ECBM related coupled physical and mechanical transport processes

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The interrelation of cleat transport processes and mechanical properties was investigated by permeability tests at different stress levels (60% to 130% of in-situ stress) with sorbing (CH4, CO_2) and inert gases (N2, Ar, He) on a sub bituminous A coal from the Surat Basin, Queensland Australia. From the flow tests under controlled triaxial stress conditions the Klinkenberg-corrected "true" permeability coefficients and the Klinkenberg slip factors were derived. The "true"-, absolute or Klinkenberg corrected permeability shows a gas type dependence. Following the approach of Seidle et al. (1992) the cleat volume compressibility (cf) was calculated from observed changes in apparent permeability upon variation of external stress (at equal mean gas pressures). The observed effects also show a clear dependence on gas type. Due to pore or cleat compressibility the cleat aperture decreases with increasing effective stress. Vice versa we observe with increasing mean pressure at lower confining pressure an increase in permeability which we attribute to a cleat aperture widening. The cleat volume compressibility (cf) also shows a dependence on the mean pore pressure.

Non-sorbing gases like helium and argon show higher apparent permeabilities than sorbing gases like methane. Permeability coefficients measured with successively increasing mean gas pressures were consistently lower than those determined at decreasing mean gas pressures. This permeability hysteresis is in accordance with results reported by Harpalani and McPherson (1985).

The kinetics of matrix transport processes were studied by sorption tests on different particle sizes at various moisture contents and temperatures (cf. Busch et al., 2006). Methane uptake rates were determined from the pressure decline curves recorded for each particle-size fraction, and "diffusion coefficients" were calculated using several unipore and bidisperse diffusion models. While the CH4 sorption capacity of moisture-equilibrated coals was significantly lower (by 50%) than of dry coals, no hysteresis was observed between sorption and desorption on dry and moisture-equilibrated samples and the sorption isotherms recorded for different particle sizes were essentially identical. The CH4 uptake rates were lower by a factor of two for moist coals than for dry coals.

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