CO₂ STORAGE PROPERTIES OF SYDNEY BASIN COALS

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Introduction and background

Gas storage in coal involves adsorption, hydrostatic pressure and capillary forces. At a given set of P-T conditions, a coal can adsorb higher amounts of CO₂ than CH₄, depending on coal rank. During early coalification, coal generates large amounts of carbon dioxide but the amount of this gas stored in coal is low due to its dissolution in water. Many Australian coals, however, contain large amounts of CO₂ (in some cases close to 100%), where the CO₂ is mainly derived from magmatic sources (Smith and Gould, 1980).

The presence of high gas contents (both CH₄ and CO₂) in coal seams has been the cause of numerous gas outbursts during underground coal mining in Australia during the last 50 years. High CO₂ contents are detrimental for CBM production due to a reduction in calorific value of the produced gas. Experience during the long history of coal mining in Australia shows that the CO₂ content changes markedly within short distances within a coal seam (Lama and Saghafi, 2003).

Due to the common occurrence of CO₂ in Australian coals and its implications to coal mining, the mechanism of CO₂ storage and flow in coal have been intensely researched during the last two decades. With the increasing interest in CO₂ sequestration to abate greenhouse gas emissions coal seams containing CO₂ are also of interest as natural analogues for CO₂ storage.

The capacity of coal to store carbon dioxide, together with its ability to allow the movement of this gas through its pore and fissure systems are two major factors that influence the gas contents and its release during mining and CBM production. For example in the case of gas outbursts, the coal contains large amounts of gas in an adsorbed state and the gas is released over a short period.

Measurement of adsorption isotherms

In the present study fifteen coal samples, ranging in rank from high volatile to medium volatile bituminous, from various coal seams in the Sydney Basin were selected for determination of adsorption isotherms. The samples include cores from exploration boreholes and from horizontal holes drilled from within underground mines. The adsorption capacities were measured, up to 5000 kPa, by a gravimetric method using 300 g of coal with particle size below 150 µm.

To express the adsorptive behaviour of coal, a mono-layer gas adsorption mechanism is assumed and modelled by a Langmuir, two parameter hyperbolic type equation. The volume parameter (Vₐ) indicates the maximum storage capacity of coal at high pressures. The analyses of the present work were all measured at a 27°C except for two samples which were measured at 33 and 39 °C. The adsorbed volumes were normalised to the