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# Geological storage of CO2: The effect of impurity gases in CO2 streams on the sorption behaviour of CO2 in coal

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# ABSTRACT

Due to the continued dominance of fossil fuels in global industry, $CO_2$ capture and geological storage (CCS) is a vital technology in efforts to combat climate change. Capture technologies are implemented to purify $CO_2$ streams from industrial sources, and these streams are injected deep underground in specialised geological storage media. However, impurity gases could still comprise greater than 5% of the captured stream and be co-stored with the $CO_2$. The presence of impurities underground could be detrimental or beneficial to $CO_2$ storage; but as yet, the influence of many impurities is unclear.

Coal seams, which have been classified as 'unmineable', are unconventional $CO_2$ storage media that hold importance in areas where saline aquifers are not readily available. The major storage mechanism in this medium is sorption, which must be quantified experimentally for storage capacity estimations. An important impurity in CCS is $SO_2$, which has very strong sorbing properties and the potential to affect coal storage capacity. In this study, the effect of different concentrations of $SO_2$ on $CO_2$ sorption in a typical South African coal was investigated via laboratory-scale volumetric adsorption experiments.

After sorption experiments of binary $CO_2$-$SO_2$ mixtures, with $SO_2$ concentration from 0% to 6.7%, were run for 48 hours at 85 bar and 40°C, it was clear that $SO_2$ sorbed very strongly to the coal and its sorption is preferential to that of $CO_2$. The results show that $SO_2$ interacts with $CO_2$, and can potentially enhance or inhibit $CO_2$ sorption, depending on the model used to describe the density of the $CO_2$-$SO_2$ mixture. The effect of $SO_2$ is seen to be significant even at low concentrations (< 2% $SO_2$), and it is recommended that its effect is taken into account when storage capacity estimations on coal seams are carried out.