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Carbon dioxide sorption capacities of gasified coal seams and their surrounding rocks

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Underground coal gasification (UCG) is considered a viable approach for the development of deep and structurally complex coal deposits that are not economically extractable by conventional mining techniques. The combination of UCG and the subsequent combustion of the resulting synthesis gas in a combined cycle plant with the storage of carbon dioxide formed during this process could provide a relevant contribution to the so called clean coal technologies. Carbon dioxide captured from the flue gas of the combined cycle plant would be injected into already gasified coal seams using the existing UCG borehole infrastructure.

Within the present study different coal seams and their surrounding rocks were sampled in all German hard coal mining districts. The coal samples were treated in a laboratory gasification device to produce combustion residues comparable to those formed in the UCG process. High-pressure carbon dioxide sorption experiments were then conducted on the original coal samples, their gasified residues and the surrounding rocks.

The results indicate a significant increase of porosity and carbon dioxide sorption capacity of the residual coal after gasification. Furthermore, notable carbon dioxide sorption capacities were observed for the surrounding rocks. The assessment of the carbon dioxide storage potential in gasified coal seams has to take explicitly into account the newly generated pore space, the increased sorption capacity of the gasified coals and the sorption capacity of the surrounding rocks. Furthermore, the reduction of subsurface void volumes due to mechanical compaction after gasification as well as the resulting enhanced accessibility of adjacent seams have to be equally considered.