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Evaluation of potential CO_2-storage options in coal seams of the Münster Cretaceous Basin, Germany

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The Münster Cretaceous Basin, located in the northern part of North Rhine-Westphalia (NRW), Germany, forms a synclinal structure of Upper Carboniferous and Permian rock formations, covered with Cretaceous clayey marls of up to 1000 m thickness.

Considering the structure and the regional hydrogeology of this basin, it may not appear to be an ideal storage reservoir for carbon dioxide. However, the Cretaceous and Permian bedrocks cover huge deposits of hard coal, which can potentially store significant amounts of injected CO_2 by physical sorption. In order to evaluate the overall CO_2 storage potential, tectonics, hydrogeology, coal geology, petrophysics and stratigraphy of the area have been examined in detail. Gas (CH_4, CO_2) sorption experiments on Carboniferous coals have been performed in order to estimate the sorptive CO_2 storage potential. Quantitative coal volume estimations of this area have been performed by means of the KVB (coal inventory calculation) model of the Geological Survey of North Rhine-Westphalia. This database contains comprehensive coal volume information for the coal districts in NRW and relates coal volumes to depth, coal seam thickness and location. The coal bearing strata are overlain by two different cap rock sequences: In the western part of the basin the Carboniferous is covered by Zechstein evaporites while the central and eastern parts are covered by the clayey marls of the Emscher formation of Coniacian to lower Campanian age.

The regional hydrogeology is characterized by a deep saline aquifer of Cenomanian and Turonian formations which separate the Carboniferous from the Emscher forma-

tion. The aquifer has a N-S-trending hydraulic gradient. Due to the synclinal structure of the basin, aquifer brines are hydrogeologically connected with shallow fresh water aquifers in the southern part of the basin and, hence may represent leakage pathways for CO_2 to the surface. However, due to very slow mass transport within the aquifer such leakage effects are considered to occur only on the time scale of several thousand years.

In this study two potential sites for CO_2 storage in unminable coal seams have been identified, one in the western part covered by a caprock of Zechstein evaporites and one in the central part of the basin covered by the Emscher facies. Hard coal volumes are estimated to amount to 37 km^3 within the site in the central part and to 3.5 km^3 within the western location. Such volumes could theoretically provide sorption capacity for billions of tons of CO_2. The effective storage capacity is, however, expected to be significantly lower due to poor injectivity and accessibility.