



## **Contribution of terrigenous rocks of South Belgian coal deposits in geological storage of CO<sub>2</sub> : the sandstones case**

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Sequestration of CO<sub>2</sub> in unmined coal seams is one of the different options for storing CO<sub>2</sub> in geological reservoirs. In favorable situations, it could be coupled with the retrieving of adsorbed methane from coal (ECBM), which can make this solution economically more attractive. However, in the case of South Belgian coal measures, both weak permeability of the coal and frequent faulting/folding of the seams are likely to decrease the efficiency of this technique.

Westphalian A and B sediments from South Belgium are containing only about 2.5% vol. of coal; the other rocks consisting of shales/siltstones (~80%) and sandstones (~20%). For all these lithologies, the main processes of CO<sub>2</sub> sequestration are 1) adsorption in coal and clay minerals that are partly forming shales, and within rock porosity in the case of sandstones and, to a lesser extent, in the shales/siltstone porosity. In a previous assessment of the sequestration potential in Westphalian coal measures of South Belgium, Baele et al. (2007) showed that coal and shales each account for 25% of the total sequestration potential, and the rest, i.e. 50%, is related to sandstones on a basis of 2% porosity.

Beside their significant additional storage capacity, sandstones have also a better permeability than the other finer-grained and organic lithologies. Additionally, sandstones are known to occasionally cut the coal seams (wash-out), thus providing insights in increasing accessibility of injected CO<sub>2</sub> into the coal. On the other hand, some sandstone banks are fossil braided rivers that induced peripheral fractures by differential compaction during burial diagenesis (Van Tongeren et al., 2000). These fractures are thus likely to have increased accessibility from high-injectivity sandstones to surrounding lithologies that could significantly contribute to storage capacity.

The aim of this study is to refine the contribution of the westphalian South Belgium sandstones to the geological storage of CO<sub>2</sub>. Measurements were performed on forty rock samples in order to determine their mineral compositions and petrophysical properties. Mineral compositions were determined by light and cathodoluminescence petrography (CL), XRD, SEM, EDS and TOC. Effective porosity and permeability were measured by lab tests on cylindrical core samples.

Effective porosities measured in sandstones is ranging between 1.5% and 6% with an average of 3.5%, which is nearly twice the value taken in the previous capacity evaluation. The neutron porosity log of the Saint-Ghislain borehole yields porosity values ranging between 5 and 20% of limestone-equivalent porosity; these values suggest higher in-situ porosity, likely due to fractures in the coal measures.

Permeability was estimated from lab permeameter tests to a few milli-darcies. Nevertheless this value, which is fairly low for a conventional reservoir, is higher than that of other Westphalian lithologies. Like porosity, in-situ permeability is expected to be higher.

Westphalian sandstones mineral compositions shows mainly quartz, feldspars, clay minerals, coal grains that are cemented by either quartz overgrowth or a matrix consisting of fine detrital (mainly clays) and alteration minerals (authigenic carbonates, pyrite, and clays). These results are comparable to investigations of Westphalian C and D sandstones of North Belgium (Bertier et al., 2006). In the case of Westphalian sandstones, it was observed that the effective porosity is essentially located within this fine-grained matrix, explaining their weak permeability.

Results from this study show other promising insights for the sequestration of CO<sub>2</sub> within Westphalian sandstones of South Belgium. Carbonate minerals, which occur with 2% vol. in average, could significantly increase the porosity and especially the permeability, due to their dissolution by water acidification caused by CO<sub>2</sub> injection. Adsorption onto coal fragments and clay minerals in the sandstones has an estimated sequestration potential similar to that of storage in rock porosity. Finally, for reservoir safety purpose, a preliminary assessment of the mineral trapping potential shows that the whole sequestered CO<sub>2</sub> (within the porosity and by adsorption) could react with CO<sub>2</sub>-sensitive minerals such as chlorites and feldspars in the long term.

References :

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