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Geological and geophysical properties of cap rock in a natural CO_2 occurrence, Mihályi-Répcelak area, Western Hungary

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The physical and geochemical consistency of the cap rock is primarily important for safe geological storage of CO_2.. As a consequence of CO_2 injection reactions took place between the minerals of the reservoir, the cap rock and CO_2 saturated pore water. These reactions may change the mineral composition and petrophysical properties of the storage reservoir as well as the cap rock that provides the only physical barrier that retains carbon dioxide in the target reservoir formation.
Study of the natural CO_2 occurrences delivers information to understand which properties of a cap rock provide the sustainable closure and retainment. Knowledge of the long term effect of CO_2 on the behavior of the cap rock is an important input in the selection procedure of a potential CO_2 injection site. Yet, very few data exist on geochemical properties and reactivity of the cap rocks. During normal commercial operations the reservoir is typically cored, but not the cap rock.
This study may enhance our knowledge about possible mineralogical reactions, which can occur in clayey-aleuritic cap rocks. The Mihályi-Répcelak natural CO_2 occurrence is believed to be leakage safe. There is no known seepage on the surface. It is suggested that the aleuritic clay rich cap rock occurring at the natural reservoir can stop CO_2 migration into other reservoirs or to the surface. The most important characteristics of cap rocks that they have low permeability (<0.1 mD) and porosity (eff.por. = 4%) and high clayeyness (approx. 80%). However, we demonstrate that in addition to these parameters the geochemical properties of cap rock is also important.
In order to characterize the natural CO_2 occurrence, we applied the following analysis, like XRD, FTIR, SEM. The petrophysical properties are determined from the interpretation of geophysical well-logs and grain size distribution.
The most important result of this study that adequate petrophysical properties do not completely define the suitability of a cap rock. The effective porosity (∼4 %), permeability (0.026 mD) and clayeyness (∼80%) data imply that the studied aleurolites are good cap rocks. The mineral composition of cap rock is similar to that of reservoir rock, however, the ratio of components is different. The mineralogical analysis and petrography yield to the reaction between CO_2 and the cap rocks. The most visible effect of CO_2 presence is the dawsonite precipitation after albite dissolution within the cap rocks. Therefore, the CO_2 may migrate through the cap rocks in geological time scale, however the total system could be leakage safe.