

Introduction

Reducing anthropogenic CO₂ emissions is one of the greatest goals of the present and future environmental scientists. Carbon capture and sequestration is considered to be an efficient technology in eliminating carbon-dioxide at large, stationary carbon-emitting industrial sources. To ensure the long term stability of the geologically trapped CO₂, behavior of the CO₂-reservoir-porewater system should be predictable on geological timescales.

Natural CO₂ reservoirs are very important in studying the safety of geological storage of industrial CO₂. In these natural occurrences we can study long term rock-fluid reactions, which cannot be reproduced in laboratories or with computer models. Nevertheless, this information is essential to assure the long term safety of CCS-technology.

The Mihályi-Répcelak area (Western Hungary) is the oldest known and produced CO₂ occurrence in Hungary. In this area there are dozens of CO₂ sites that are suitable for industrial production. As a consequence many of the data are publicly available. Using these information we can build a comprehensive picture about the composition of the fluid system, which is essential to understand the interactions within the given rock-fluid system.

The Mihályi-Répcelak natural CO₂ site is lying in the northwestern part of Hungary, in the Little Hungarian Plain, where the studied system is composed of 28 reservoirs (26 CO₂ and 2 non-combustible gas). The CO₂ is mainly contained by the Pannonian sedimentary sequence (mostly sandstone, siltstone and clay) in a depth of about 1400 m (Mészáros et al., 1979). The average thickness of reservoirs is 5-10 meters and the cap rock is always Pliocene clay marl. The carbon dioxide is produced since 1933 for industrial purposes (Mészáros et al., 1979).

Well bores provide one of the most direct ways to obtain physical and geometric information about subsurface formations. Information provided by the well-boring is indispensable in processing and interpretation of seismic data, determination of the real formation boundaries and of the exact geological setup of a formation. The opportunity of making the corrections, trouble shooting, intercalibration, temperature correction and the indication of formation boundaries of the well logs are very important and useful, because we can get new information from the subsurface. The new interpretation can provide new, more accurate image from the test area.

Therefore, well-log data of a given study area are of prime importance. We can trace different sedimentary sequences and formations and gain high resolution petrophysical information, i.e., porosity, permeability, clayeyiness, water resistivity, etc. These parameters could be calculated from the well-logs.

On the other hand, pore water compositions are available from the well-log database, and rock samples from the well-bore. With these data we can study the geochemical reactions on the fluid (CO₂+pore water)-rock system on geological timescale.

Method and/or Theory

We have investigated 28 wells from the area of Mihályi-Répcelak (10 wells from the area of Mihályi and 18 wells from Répcelak area). Mono (resistivity) and dual log (resistivity and SP) interpretation has also been carried out for the region. Thereby, the two methods for clayeyiness and effective porosity could be compared. We have traced the formations within the Lower Pannonian sedimentary sequence. The carbon-dioxide is mainly trapped in the stratigraphically lowest formation in the area Répcelak and a stratigraphically higher formation in the Mihályi area. We have calculated the porosity (figure 1), permeability, clayeyiness, depth and thickness maps of the formations using well log information.

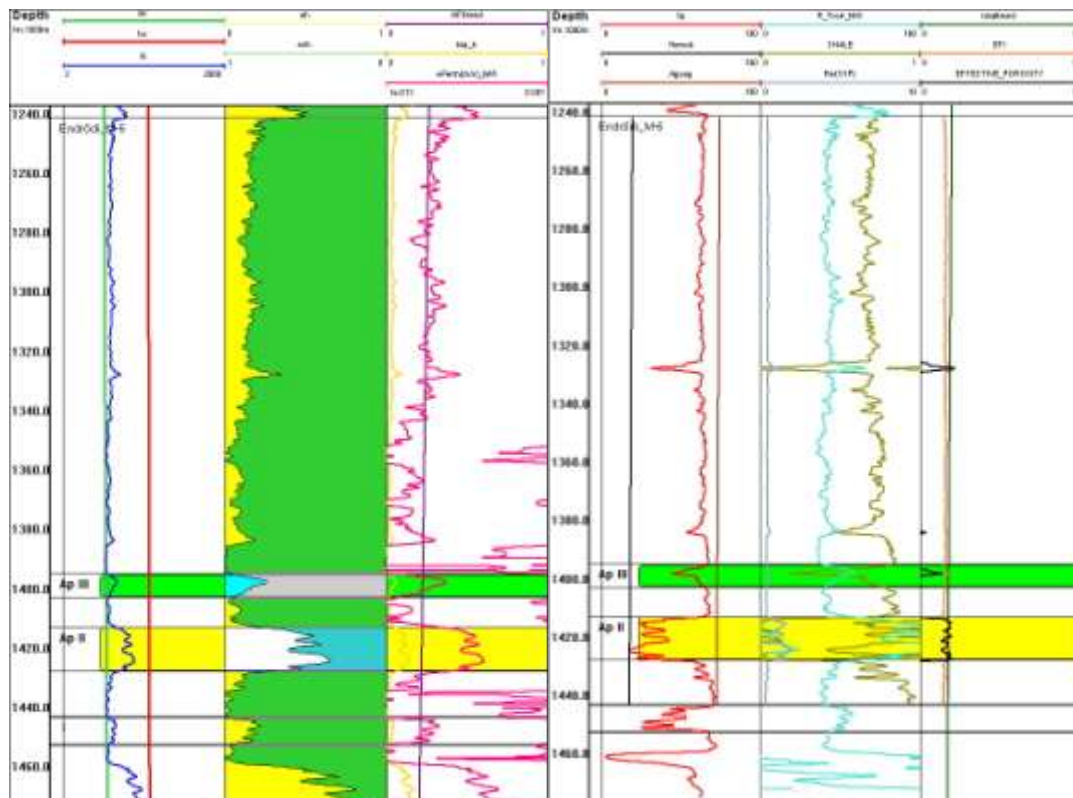


Figure 1: Representation of Mono (resistivity) and dual log (resistivity and SP) interpretation from Mihályi-Répcelak area, the yellow and green areas show CO₂ reservoirs.

In addition to well-log analysis, we are also studying core samples from the study area. The rocks were selected in order to represent CO₂ reservoir lithologies, their cap rocks and underlying sedimentary sequences. We have used conventional methods, i.e., polarization microscope and also applied SEM (figure 2) to obtain control of the main mineralogical composition and textural character of the rocks. Detailed analysis of samples from the cap rock and underlying rock layers with XRD, nanoscale SEM, and DTA are also carried out. The applied methods are expected to show the mineralogical, textural changes in the lithologies as a consequence of CO₂.

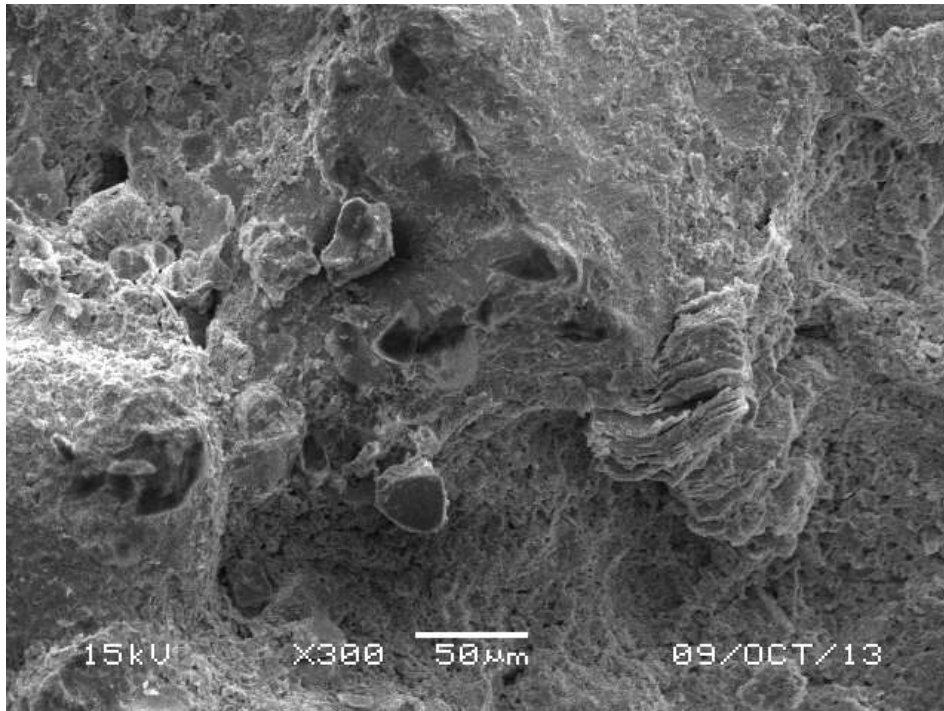


Figure 2: Secondary SEM image of the rock sample from Mihályi-Répcelak area. This sample has been in contact with wet CO₂ fluid system for geological times. Note, that the grains are coated by clay (kaolinite).

Conclusions

In Mihályi-Répcelak area we can study a fluid-rock system in natural environment, where CO₂ has been present on geological time scale. With investigation of these systems we can answer some very important question concerning the safety of CO₂ storage.

Based on the mineralogical composition of the available core samples and water chemistry data from the studied area and using mineralogical composition of a CO₂-free brine containing sandstone from the same formation, geochemical modelling was carried out to determine the major fluid-rock interactions and their rate, which could have taken place in the reservoir. These interactions are believed to have a major impact on long term safety of carbon-dioxide geological storage as they may strongly affect the petrophysical parameters of storage and sealing lithologies that could be traced using well-log data.

References

Mészáros, L., Dallos, E., Vágó, L., Czupi, J., Paulik, D., Darabos, A., Marton, T., Simán, Gy., Ferenczy, Z. [1979] Final report of the Mihályi exploration area, resource estimation of carbon dioxide and non-flammable mixed gas reservoirs (in Hungarian) – Országos Kőolajipari Tröszt. 116 p.