Geophysical Research Abstracts
Vol. 15, EGU2013-4439-2, 2013
EGU General Assembly 2013

Research sites of the H2STORE project and the relevance of lithological/mineralogical rock variations for hydrogen storage at depths

Steven Henkel, Dieter Pudlo, Reinhard Gaupp, and the H2STORE team

Friedrich-Schiller-University Jena, Institute of Geosciences, Burgweg 11, D-07749 Jena, Germany (dieter.pudlo@uni-jena.de, ++49-3641-948622)

The H2STORE collaborative project will investigate potential geohydraulic, petrophysical, mineralogical, microbiological, and geochemical interactions induced by hydrogen injection into depleted gas reservoirs and presently used/planned CO_2- and gas storage sites.

In this context the University Jena performs e.g. mineralogical-geochemical studies on reservoir and cap rocks to evaluate the relevance of sedimentological/facies structures for fluid (hydrogen)-rock interactions which will control fluid pathways. These reactions are most important in controlling petrophysical features, like porosity and permeability. Thereby reservoir sandstones and sealing mudstones of various composition, originated from different depths (= p-/T-conditions) of five German regional areas are analyzed. Combined with laboratory experiments this approach will enable the characterization of specific mineral reactions at different physico-chemical conditions and of various geological positions.

These locations comprise

- the Rotliegend Formation of the Altmark (northern Central Germany),
- the Keuper Formation of the Brandenburg-Berlin area (eastern Central Germany,
- the Buntsandstein Formation of the Emsland (NW-Germany),
- the Buntsandstein Formation of the Thuringian Basin (Central Germany),
- the Tertiary Formation of Bavaria (SE-Germany).

The sites are characterized by significant differences in depositional and burial history as well as in the source areas of their detrital rock components. Thus the content and composition of their detrital and authigenic mineral phases and textures will vary. Late diagenetic authigenic mineral formation is mainly determined by primary mineral content, fluid access and p-/T-conditions. Therefore, in summary, primary and authigenic mineral content, sedimentary textures and structures as well as fluid composition will control petrophysical features, like porosity and permeability as well as fluid-rock-interactions, most important during fluid (hydrogen) injection in potential reservoir rocks. The recent depths of investigated sites vary between $\geq$ 3.0 km (Altmark area) to $\sim$ 0.8 km in the Thuringian Basin. However, maximum burial depths, which are probably established during Triassic-Cretaceous and Neocene times and dominated the fluid-rock-reactions, are about 4.0 - 7.8 km in the Altmark and 2.8 – 1.8 km in the Thuringian area.

Due to their capacity of hydrogen adsorption at interlayers and their chemical reactivity the behaviour of clay minerals during hydrogen storage is most important. At the selected locations site-specific different proportions of (authigenic) clay minerals are substantiated. Thereby illite > illite-smectite interlayers > chlorite $\geq$ kaolinite are common. In general, such reactions involving authigenic clay minerals are accompanied by the dissolution of detrital feldspars and lithoclasts as well as of the pore filling cements (e.g. carbonate, anhydrite) and Fe-mobilization. Moreover injection of fluids (hydrogen) will cause physical processes, like fingering and gas trapping in the formation fluids and will induce bio-geological reactions with the microbiological community, present at depths.

Therefore selected research sites are characterized by variable primary and authigenic mineral content establish at different depths (= p-/T-conditions), which comprise various formation water compositions and (micro-) biocenoses. Investigation of such features and their reproduction in laboratory experiments enables an evaluation of potential fluid (hydrogen)-rock interactions, which will be relevant during hydrogen storage and synthetic natural gas (SNG) production during methanization processes in pore space reservoirs; most important for Power-to-Gas (P2G) technology.