Geophysical Research Abstracts
Vol. 14, EGU2012-9107, 2012
EGU General Assembly 2012
© Author(s) 2012

Linkage between fluid-rock-interactions and facial, petrographical, and geochemical properties of Buntsandstein aquifer sandstones of the Thuringian Basin, Central Germany

U. Hilse, D. Beyer, C. Kunkel, M. Aehnelt, D. Pudlo, T. Voigt, and R. Gaupp
Friedrich-Schiller-University Jena, Institute of Geosience, Burgweg 11, 07743 Jena, Germany

This study is part of a collaborative research project examining the basin wide movement of fluids in the subsurface (INFLUINS – integrated fluid dynamics in sediment basins). The Lower Triassic Buntsandstein is a major aquifer in Thuringia and adjacent areas in central Germany. The sediments exhibit an overall trend of base level and associated environmental changes. In the Lower Buntsandstein, deposition started with sediments indicating a playa-like setting. The Middle Buntsandstein consists of sediments of wide floodplains with very shallow rivers and eolian reworking in the lower part, and of deeper, long-ranged braided to meandering river systems in the upper part. Outcrop samples and core material were used for investigations and following discussion.
For understanding fluid-rock-interactions in these sediments it is important to investigate the linkage between facies, rock composition, and mineral surfaces exposed to the pore space, as well as bulk rock and mineral chemistry. Compared to the clay rich lacustrine sediments of the Lower Buntsandstein the more porous fluvial and eolian sandstones of the Middle Buntsandstein represent better pathways for fluid migration in the present and past. The lacustrine and fluvial sandstones are mostly arkoses and subarkoses, whereas the eolian sandstones are often characterized by quartzarenitic composition. Facies variations and associated compositional differences are reflected in the geochemical composition of the rocks determined by ICP-MS/OES and XRF measurements. Sandstones of the Lower Buntsandstein are characterized by high contents of e.g. Al, Na, K, Fe, and Li, caused by the enrichment of clays and feldspars in the lacustrine sediments. Due to their higher compositional maturity, the fluvial (and eolian) sediments of the Middle Buntsandstein exhibit an increase of stable minerals towards the top, which is also reflected in geochemical data (increasing Si by decreasing Al, Na, K).
By scanning electron microscopy and cathodoluminescence four generations of carbonate cements can be distinguish. Depending on fluctuating composition of fluids and varying Eh- and pH-conditions during carbonate precipitation different zones within carbonate cements were formed reflected in distinct manganese and iron content.
During uplift descending meteoric waters induce hydration of anhydrite cements to gypsum. Late diagenetic feldspar corrosion due to meteoric influence delivers Al and Si for precipitation of kaolinite minerals (replacement of feldspars). These minerals are found in former feldspars or are transported into underlying sediments precipitating in pore space. Under surface conditions also dissolution of gypsum cements and oxidation of iron took place.
Ongoing studies will further verify the effects of fluids on the sediments, which are most likely strongly depending on sedimentary facies and associated petrographical and geochemical features thus determining aquifer characteristics.