Field- and microscopic investigation of iron oxide and calcite coated fractures in glauconitic sandstones, quarry Strombauamt, Greifenstein, Lower Austria

Rücklinger, Lisa (Uniersität Wien, Wien, AUT);
Gier, Susanne (Universität Wien, Wien, AUT);
Neuhuber, Stephanie (BOKU, Wien, AUT);
Decker, Kurt (Universität Wien, Wien, AUT)

In the quarry "Strombauamt" at Greifenstein, Lower Austria, iron oxide coatings occur on structural discontinuities in massive sandstones. Since these sandstones are outcrop analogues of hydrocarbon reservoir rocks in the subcrop of the Vienna Basin, their capability to reduce permeability was investigated. The mineralogy, chemical composition and (micro-)structures were analysed to assess the origin of these crusts. The sandstone belongs to the Greifenstein Formation of the Rhenodanubic Flysch Unit and was deposited during the Upper Paleocene to Lower Eocene. The iron crust bearing beds are up to 10 m thick massive sandstones of a channel fill in a classical turbidite succession.

A 250 m E-W section at the southern wall of the quarry shows the deposits which are partly dissected by faults encrusted with iron oxides. The red to orange crusts are prominent features within the thick-bedded sandstones at the base of the quarry, but do not continue into the overlying thin-bedded sandstones. Occasionally, the crust is covered by synkinematic calcite fibres that formed on the fault planes, and/or idiomorphic calcite and quartz. Structural evidence indicates that at least some of the iron encrusts deformation bands, which formed early after the deposition of the sandstone in yet unlithified sediment. Iron-encrusted fractures are mostly dipping steeply to the west or the east.

The sandstones are glauconite-rich quartz arenites cemented by calcite. X-ray diffraction used to determine the mineralogical composition of the crust identifies mainly quartz, K-feldspar, calcite, mica (glauconite) and traces of goethite as evidence of an iron mineral. The iron coating following some joints affects the outermost 0.5 mm up to 5 mm of the sandstone forming a macroscopically distinct red zone. SEM microscopy combined with EDAX shows that the iron mineral is an iron oxide that either forms thin coatings around most of the grains or crosscuts through minerals in the form of veins. Broken grains that are later cemented by the iron oxide also show evidence of tectonic influence.

In further investigations, sandstone plugs with and without iron crusts will be analysed with a gas permeameter. The iron content of the different calcite cements as well as the exact composition of the iron oxides will be determined with an electron microprobe, which will tell us more about the history of fluid flow and cementation. Furthermore, stable oxygen and carbon isotope of the calcite could be used to determine the origin of the fluids.

With the present results, we propose that iron rich fluids that filled the fractures in the compacted sediment induced the precipitation of iron oxide on grain boundaries, possibly twice. Some of these fractures were later filled with secondary calcite indicating shear along the fractures.

The source of iron can either be external or from within the sandstone itself. The sandstone contains abundant glauconite, a mineral that forms in shelf areas with reduced oxygen availability and thus contains divalent (mobile) and trivalent (immobile) iron. Therefore, glauconite can be a source of divalent iron that oxidizes rapidly to form iron oxides. An internal source of iron has the following implications: (1) sediment deformation when the sediment was only partly consolidated to allow diffusion from within the sand(stone) and (2) presence of an electron source giving electrons to the pore water to allow oxidation.