Natural tracer profile in a deep claystone formation (Opalinus Clay of Mont Russelin, Switzerland).

M. KOROLEVA[1] M. MAZUREK[1] A. GAUTSCHI[2] AND T. BIGLER[3]

[1] Institute of Geological Sciences, University of Bern Baltzerstrasse 3, CH-3012 Bern, Switzerland; koroleva@geo.unibe.ch; mazurek@geo.unibe.ch

[2] Nagra, Hardstr. 70, CH-5430 Wettingen, Switzerland; andreas.gautschi@nagra.ch

[3]Physics Institute, University of Bern Sidlerstrasse 5, CH-3012 Bern, Switzerland; tbig@climate.unibe.ch

Natural tracers in pore water of Opalinus Clay, a 180 Ma old shale formation, were studied in cores drilled from a tunnel penetrating an anticline of the Jura Mountains in NW Switzerland. This thin-skinned mountain belt was folded between 10 and 3 Ma in the late stages of the Alpine collision. Six 4 m deep boreholes were drilled to cover a profile from the core of the anticline to its SE limb.

In the core of the anticline, a water with Cl^- content similar to that of modern sea water was collected from an extensometer borehole in the underlying Liassic claystone close to the contact with the Opalinus Clay. Water seepages into the tunnel containing fresh water were collected in the Dogger limestone overlying Opalinus Clay in the SE limb of the anticline. The horizontal distance between the locations where the saline and the fresh water samples were taken is ca. 400 m and is largely constituted of Opalinus Clay. In order to identify and quantify the large-scale transport process(es) in Opalinus Clay and to assess the long-term-evolution of pore water, the contents of Cl^-, Br^-, $\delta^{18}O$, δ^2H and helium were analysed using dedicated techniques.

The Cl^- distribution in pore water shows a regular and well defined profile from Liassic claystones with the highest values (about 450 mmol/kgH_2O), decreasing across Opalinus Clay and reaching approximately 140 mmol/kgH_2O in the Dogger limestone in the southern limb of the anticline. The distribution of stable water isotopes and helium also shows systematic variations. Both δ^2H and $\delta^{18}O$ are highest in the centre of the anticline (about -38‰ and -4.6‰, respectively) and decrease to -59‰ and -8.3‰, respectively, in the Dogger in the limb. Similarly, helium contents decrease from $4.19*10^{-4}$ to $1.74*10^{-4}$ ccSTP/gH_2O. In contrast to Cl^-, both water isotopes and helium show an anomaly related to a major fault zone close to the contact between Opalinus Clay and a tectonic slice of underlying Toarcian rock.

The available data are consistent with a model considering very old, possibly connate pore water in the centre of the anticline, which evolves towards fresh water in the limb. Calculations testing the hypothesis that the spatial distribution of tracers can be explained as due to diffusion are under way, and the mechanisms that resulted in the geochemical anomaly in the fault are evaluated.