P 1.17

Fault anatomy and microtectonics of the La Sarraz strike-slip fault system

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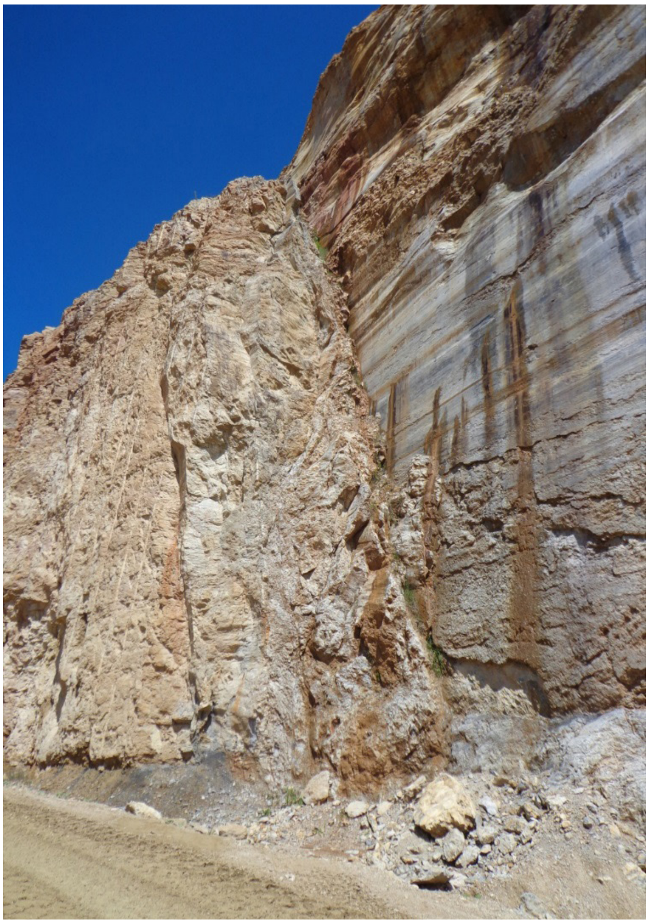
The comprehension of the distance to failure (criticality) of the faults in the Alpine foreland is of strategic importance for the development of geothermal resources in Switzerland. Fault maturity consists of several processes leading to a complex anatomy. In turn, this complex anatomy will have an important impact on the fault properties, behaviour and stability.



Our study is part of a larger joint venture between Swisstopo, the Department of Geosciences of the University of Fribourg and the Center for Hydrogeology and Geothermics of the University of Neuchâtel on Stress State, Fault Criticality and Fluids.

The subproject of Fault anatomy, porosity and pore connectivity: the La Sarraz Fault system combines different laboratory and field techniques to better understand the porosity and permeability associated to fault zones. The objective is to identify and describe deformation in outcrops, in hand samples and in thin sections from the undeformed edges of the fault zones to the highly strained fault core.

The Mormont – La Sarraz fault system located at the transition of the Jura Mountains and Molasse Basin; is an outstanding natural laboratory for this purpose. This NW-SE oriented dextral strike-slip fault system is exposed in the Eclépens quarry and is sinistraly conjugated to the Pontarlier N-S fault system.

At marco-scale we can observe striation fibers along a polished undulating fault plane. Variable sized lenses ranging from centimeter to meter scale are seen inside the fault zone and main fault plane. Lonzenge-shaped locally sigmoid lenses are found to be parallel to foliation and confirm the dextral sense of shear on the main fault. These structural features aid in identifying stress/shear direction and facilitate quantifying the displacement offset along the numerous faults.

Several rock samples were taken from carefully chosen locations in the fault gouge with which we identified the Mormont strike-slip fault to be molded by cataclasis and pressure dissolution.

Evidence of cataclasis is most visible at meso-scale, where the abundance of stylolites, microfractures, displacements, and rotations of rigid particles with no permanent lattice distortion are observed. The majority of stylolites and microfractures are NE-SW orientated which are oblique to the WNW-ESE oriented main fault plane. Interconnecting network of stylolites is abundant in the ooilitic limestone and reflects an increase in porosity from the fault edge to the core fault zone.

It can be shown in ooid-rich samples (Urgonian formation) that pressure solution is a major process. Calcite crystals reveal double twinning (twinning inside twinning) indicating intracrystalline deformation mechanisms. Calcite veins with variable quantities of pyrite transect the rock samples at all scales indicating the presence of sulphur-rich fluid circulation in the quarry.