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Microstructural record of cataclastic and dissolution-precipitation processes from shallow crustal carbonate strike-slip faults, Northern Calcareous Alps (Austria)

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The concept of coseismic slip and aseismic creep deformation along faults is supported by the variability of natural fault rocks and their microstructures. Faults in carbonate rocks are characterized by very narrow principal slip zones (cm to mm wide) containing (ultra)cataclastic fault rocks that accommodate most of the fault displacement. Fluidization of ultracataclastic sub layers and thermal decomposition of calcite due to frictional heating have been proposed as possible indicators for seismic slip. Dissolution-precipitation (DP) processes are possible mechanism of aseismic sliding, resulting in spaced cleavage solution planes and associated veins, indicating diffusive mass transfer and precipitation in pervasive vein networks.

We investigated exhumed, sinistral strike-slip faults in carbonates of the Northern Calcareous Alps. The study presents microstructural investigations of natural carbonate fault rocks that formed by cataclastic and dissolution-precipitation related deformation processes. Faults belong to the eastern segment of the Salzachtal-Ennstal-Mariazell-Puchberg (SEMP) fault system that was formed during eastward lateral extrusion of the Eastern Alps in Oligocene to Lower Miocene. The investigated faults accommodated sinistral slip between several tens and few hundreds of meters. Microstructural analysis of fault rocks was done with scanning electron microscopy and optical microscopy. Deformation experiments of natural fault rocks are planned to be conducted at the Sapienza University of Roma and should be available at the meeting.

The investigated fault rocks give record of alternating cataclastic deformation and DP creep. DP fault rocks reveal various stages of evolution including early stylolites, pervasive pressure solution seams and cleavage, localized shear zones with syn-kinematic calcite fibre growth and mixed DP/cataclastic microstructures, involving pseudo sc- and scc′-fabrics. Pressure solution seams host fine grained kaolinit, chlorite and illite while the protolith shows only weak evidence of detrital clay content. Our studies suggest that velocity weakening and strengthening mechanisms alternated during the accumulation of displacement along the SEMP fault zone.