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Bridging the Gap between Seismicity and Exhumed Faults: Insights from a Seismically Active Strike-Slip Fault Zone in the Rawil Depression (Northern Valais, Switzerland)

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The Rawil depression north of the Rhone Simplon fault zone (southwestern Swiss Alps) was host of the Mw = 5.8 Sion earthquake in 1946 (Fäh et al., 2011). It is nowadays one of the seismically most active regions in Switzerland and seismicity forms a cluster, which is elongated approximately in WSW-ENE direction over 40-50 km. In November 2019, a remarkable earthquake sequence occurred within the center of this cluster north of the village of Anzère, with more than 300 earthquakes up to ML = 3.3 recorded by the Swiss Seismological Service within 20 days.

Detecting associated full-scale 3D fault patterns solely based on earthquake hypocenters is challenging because of commonly too limited spatial resolution and insufficient number of seismic events. Within the framework of SeismoTeCH, we aim to improve these limitations by a combination of high-precision hypocenter relocation techniques, reconstruction of subsurface fault patterns and correlative links between surface and subsurface data. Assuming that a fault is seismically active multiple times and that the seismic stress-release is initiated at different locations along the fault, we can calculate 3D fault plane orientations from the hypocenter locations. Together with the 17 focal mechanisms derived for the Anzère sequence, we are able to gain geometrical and kinematic information of the seismic faults in 3D. Our analysis reveals a seismically active transpressional step-over structure within a dextral strike-slip fault zone. With remote sensing and field observations, we detect exhumed faults with similar orientations and kinematics that presumably represent step-over structures, interconnecting previously known strike-slip fault zones.

Although seismic activity occurs at depths between 3-5 km, we conclude that the observed surface fault systems in the Rawil depression can be correlated in terms of fault patterns with those assumed at depth. The linkage of the recent seismicity with structural observations of exhumed, potentially paleo-seismic faults in combination with recent hypocenter relocation techniques therefore have great potential to provide further insights into fault linkage and earthquake rupturing processes.

References

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