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Multidisciplinary insights into the seismotectonics of the Swiss Alps and its foreland

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Information on structure and mechanics of fault systems and their connection with present-day seismicity is key to the understanding of neotectonic processes in the Swiss Alps and the northern Swiss Foreland. Precisely determined focal depths in combination with high-resolution structural models can provide important insight into deformation styles of the uppermost crust (e.g. thin- vs. versus thick-skinned tectonics). Detailed images of seismogenic fault zones combined with estimates on deformation rates from geodesy, on the other hand, will improve the assessment of the hazard related to natural and induced earthquakes in those regions. In the framework of various projects, studies have been recently undertaken to image seismogenic fault zones at high resolution, with a special focus on southwest and northeast Switzerland because of their high societal relevance. Southwest Switzerland, is the region with one of the highest natural seismic hazard in the country. A large part of the present-day seismic activity is related to an earthquake lineament located in the southern part of the Rawil depression, which is dominated by strike-slip faulting. The possibility of large magnitude earthquakes critically depends on the question as to whether this activity is related to a single fault of considerable lateral and vertical extension or not. Field data demonstrate oblique normal faulting and fault segmentation at surface related to mountain uplift at the curvature of the Alpine Arc. Studies of seismogenic structures and neotectonic processes in the northeast Molasse basin, on the other hand, are of special interest, since the region is one of the target sites for radioactive waste repositories and future geothermal plants.

On-going densification of the seismic network in Switzerland and new detection algorithms have significantly lowered the detection threshold of microearthquakes and improved data coverage in most parts of the country over the last ten years. To systematically image seismogenic fault structures in Switzerland, we propose to update currently available local and regional velocity models with high-quality travel-time data compiled in the recent years, to further improve the accuracy of absolute hypocentre locations. To resolve the fine-scale structure of seismogenic faults, we apply large-scale relocation of seismicity using cross-correlation and double-difference methods. Imaged structures are tectonically interpreted in combination with existing and newly derived focal mechanisms, geological, and geodetic data.

In this presentation, the proposed procedures are applied locally to both study regions to test and calibrate the procedures. Local velocity models are derived and seismicity is systematically relocated and compared with previous relocation studies in these regions. Results for Rawil are compared with most recent geological fault models and available GPS data are used to estimate upper bounds of slip-rates related to a potential Southern Rawil Fault. In future work, the proposed procedure will be applied to the entire earthquake catalogue of Switzerland and resulting double-difference relocations will serve as reference catalogue for planned real-time applications.