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Geomorphological evidence for recent tectonic deformation in northern Switzerland

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Two major tectonic structures of western Europe interfere in north-western Switzerland: the Paleogene Upper Rhine graben, which is part of the European Cenozoic Rift system, and the Miocene Jura fold-and-thrust belt. These structures evidence a change in the tectonic stress field in the past: E-W extension in the Paleogene caused the rifting of the Upper Rhine graben. In the Lower Miocene, the stress field changed to overall NW-SE compression, still prevalent today. These contrasting stress regimes led to the development of differently oriented fault sets, partly followed by their reactivation and/or inversion (Giamboni et al. 2004). Due to the resulting complex fault pattern and the availability of differently oriented faults, recent deformation can be assumed to be spatially distributed.

The occurrence of large earthquakes in the past (e.g., Basel 1356: estimated MW=6.9 (Earthquake Catalogue of Switzerland ECOS 2003)) demonstrates ongoing tectonic activity in the region and the potential for destructive earthquakes in the future. Further indication of recent tectonic activity comes from geodetic measurements (precise levelling, compiled by Müller et al. 2002) and morphological studies (e.g., ridge of relatively soft bedrock in a glacially eroded valley, Haldimann et al. 1984). However, geologically relevant long-term deformation rates cannot be inferred from the seismological and geodetic datasets alone, which cover only very short time spans. The existence of a great number of differently oriented faults prone to be reactivated in the current stress field makes the localisation of displacements even more difficult.

In order to better characterise the recent deformation pattern, it is therefore necessary to enlarge the time frame of observation. A geomorphological analysis enables us to

take information about past tectonic activity into account that has been accumulated and stored in the topography. In particular, the method allows to detect vertical movement which is caused by blind faults and folds. We believe that especially the analysis of river systems will contribute significantly to the knowledge of current tectonics in the study area.

Precise levelling measurements yield higher uplift values in the Folded Jura as compared to the autochthonous Tabular Jura in the north, suggesting ongoing thrusting in the Folded Jura and/or (downward) tilting to the north due to either ongoing compression or isostatic rebound (Müller et al. 2002). With the aim of better constraining the type and rate of movements, we study the effects of river network adjustment, concentrating on the investigation of river gradients, terrace deformation and channel geometries. The results will be compared to seismological data (available focal mechanisms and focal depths) in order to establish a link between surface deformation and (potentially seismogenic) subsurface structures.

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