Geomorphic constraints on Quaternary tectonic activity in the Basel area

*Fraefel Marielle, **Densmore Alexander L., *Schmid Stefan M.

* Institute of Geology and Paleontology, University of Basel, Switzerland
** Geological Institute, ETH Zürich, Switzerland

The border region of Switzerland, France and Germany in the vicinity of Basel is characterized by the adjoining tectonic units of the Upper Rhine Graben (URG), the Jura fold-and-thrust belt and the Black Forest massif. While the evolution of these partly overlapping and interfering structures is quite well understood on a large timescale (e.g., Dèzes et al. 2004), unanswered questions remain concerning the youngest (Quaternary) development of the region. Seismological data and geodetic measurements show that tectonic deformation has not stopped (Müller et al. 2002). A link between these short-term indications and the longer-term tectonic development is provided by the work of Giamboni et al. (2004), which demonstrates recent compressional deformation in the Ajoie region, at the border between the Jura and the URG. Whether this compression is limited to the Ajoie, or whether it also affects the easternmost part of the Jura, could not be determined so far. Its increased earthquake activity makes the south-eastern corner of the URG a promising place to look for other evidence of tectonic deformation. Moreover, a better understanding of the recent tectonic activity is essential to assess the seismic risk in this densely populated area. Competing hypotheses about the style of deformation (thin-skinned / thick-skinned) further motivate the search for additional constraints on recent movements.

To track down Quaternary tectonic activity in the eastern Jura mountains, we study the characteristics of the regional river network. Since rivers are very sensitive to tectonic uplift or tilting (as demonstrated by studies in areas with known tectonic deformation rates, e.g., Kirby & Whipple 2001), gradient changes along rivers can be used to infer tectonically active structures. The relation between river-terrace surfaces and the active channel is analysed to gain additional information on river evolution. One important advantage of this approach is that it allows for detecting any kind of vertical movement, be it seismic or aseismic, and occurring on faults (with or without surface rupture) as well as on folds.

First results show that many rivers in the study area have gradient irregularities which cannot be explained by varying erodibility of the underlying lithologies. Assuming that a climatic influence on the profiles can be neglected (compare Carretier et al. 2006), they are suggested to be the result of tectonic processes or of regional base-level fall, respectively. This interpretation is supported by an observed along-channel increase in altitude difference between the present-day river bed and different terrace levels. A comparison of the river profiles to a number of tributaries to the Rhine with catchments inside the Rhine Graben (Sundgau area) allows to distinguish between the effects of Rhine graben subsidence and down-cutting of the Rhine.

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