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Characteristics and age of an uplift signal in the Biga Peninsula (NW Turkey) from a mix of geomorphic indices

Alain Demoulin (1,2), Turkan Bayer Altin (3), and Arnaud Beckers (1)

(1) University of Liege, Dept. of Physical Geography and Quaternary, Liege, Belgium (ademoulin@ulg.ac.be), (2) Fund for Scientific Research – FNRS, Brussels, Belgium, (3) Dept of Primary School Teaching, Faculty of Education, Niğde University, Turkey

Situated in the area where the western end of the North Anatolian Fault Zone meets the extensional domain of the North Aegean Sea, the Kazdag Mountain range (Biga Peninsula, NW Turkey) is known to have undergone Plio-Quaternary uplift. However, no detailed chronology of this presumably ongoing uplift phase was so far available. In order to obtain a first-order estimate of the time of the last tectonic perturbation (uplift rate change) in the region, we performed a morphometric study of the fluvial landscape at the scale of the Biga Peninsula, coupling the recently developed R/SR analysis of the drainage network with concavity and steepness measures of a set of 29 rivers of all sizes. Defined as the ratio of two-by-two differences between hypsometric integrals describing respectively a catchment's topography, its drainage network "composite profile" and the trunk stream profile, the R metric is a measure of the catchment's incision response to a relative base level lowering. The SR index is then simply the slope of the regional relation R = f(ln A), a feature characteristic of the time elapsed since uplift caused an erosion wave to propagate in the drainage system. We obtained a SR value of 0.324 ± 0.035 that, according to the t = f(SR) relation established by Demoulin (2012), yields an age range of 0.54-1.29 Ma and a most probable value of 0.82 Ma for the time of the last uplift signal in the Biga Peninsula. We also carried out an analysis of knickpoint migration in a subset of rivers, modelling their propagation by the stream power law under different assumed ages so as to compare the obtained values of the K coefficient with values mentioned in the literature. The positive results of this analysis, yielding realistic K values for ages around 0.8 Ma, lend independent support to our morphometric estimate of the uplift time, moreover corroborated by published observations suggesting basin inversion of the Bayramiç and Çanakkale depressions at the same epoch. We relate this episode of increased uplift rate to the early-to-mid Pleistocene tectonic transition identified in the Eastern Mediterranean realm by Schattner (2010) and marked by a brief compressional episode. Finally, while the dependence of river profile concavity on basin size confirms that the landscape of the peninsula is still in a transient state, the spatial distribution of profile steepness values characterized by higher values for streams flowing down from the Kazdag massif shows that the latter undergoes higher uplift rates than the rest of the peninsula. This indicates that, after the regional Middle Pleistocene episode of accelerated uplift had come to an end, a local component of uplift persisted associated with either transpressive conditions along SW-trending segments of the North Anatolian Shear Zone or normal faulting along the southern border of the massif.

References

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