



Folding or faulting? Geomorphic indicators of active tectonics at the Sava Folds – Ljubljana Basin transition (Central Slovenia)

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Sava Folds area in central Slovenia was affected by neotectonic N-S shortening during Pliocene and possibly Quaternary. The E-W trending synclines in Neogene strata can be traced westward into the basement of the Ljubljana Basin, a transtensional structure of Pliocene – Quaternary age. In some interpretations, this synclinal folding is also affecting the overlying Quaternary infill of the basin. The structural and timing relationships between folding and transtensional subsidence remain unclear, which lead some authors to believe that folding may be still ongoing.

We investigated recent tectonic activity in the Tunjice Hills at the northwestern margin of the Sava Folds region at the transition into the northern part of the Ljubljana Basin. Structurally, Tunjice Hills represent the westernmost outcrop of the Tuhinjski Syncline of the Sava Folds. The Hills are built of over 1000 meters of Oligocene and Miocene siliciclastic rocks and sediments forming an overturned syncline. We analysed seven major streams that run across the Tunjice Hills in the general N-S direction, perpendicular to the fold axis. Channel sinuosity, hypsometrical curves and integrals, longitudinal profiles, and concavity indices were determined for each stream. Swath profiles were used to additionally constrain areas of potential tectonic activity.

Tectonic activity is indicated in the central and westernmost part of Tunjice Hills from increased values of sinuosity index, less concave hypsometric curves, higher hypsometric integral values, and low values of maximal concavity and concavity factor. From the spatial distribution of geomorphic indicators we interpret that tectonic activity here is aligned to segments of the Sava Fault, a regional-scale dextral strike-slip fault which acted as a master fault of the transtensional Ljubljana Basin. We found no indications of tectonic activity in eastern part of the Hills towards the Sava Folds proper. Here, our analysis implies that streams are in a more mature erosional stage, indicated by high values of concavity and low values of hypsometric integral. Separate swath profiles were created for the eastern, central and western parts of Tunjice Hills. In the western and central swath profile we find a large step in all three profiles (maximum, mean and minimum), which indicates the presence of an active fault running along the central part of the Hills. In the eastern swath profile this step is not seen, which further supports the conclusion that this area is not tectonically active.

Our results therefore strongly suggest that recent tectonic activity in the Tunjice Hills is occurring along active strands of the Sava Fault zone, whereas the evidence of active folding in Sava Folds trend was not found.