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Assessment of relative tectonic activity in the Trichonis Lake graben (Western Greece) using geomorphometry

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In tectonically active areas fluvial systems and mountain fronts are controlled by the type, geometry, and recent activity of faults. The aim of this study is to investigate the contribution of neotectonics to the development of the fluvial landscape of the broader Trichonis Lake area (located in western continental Greece) through quantitative geomorphological analysis. The Trichonis Lake graben is a well-known tectonic depression of Quaternary age, which cuts across the early Tertiary NW-SE fold and thrust structures of the Pindos Mountain belt. It strikes WNW–ESE for a distance of 32 km and has a width of 10 km. The graben at the north and south flanks of the lake is bounded by E-W and NW-SE trending faults. Recent seismic activity (a shallow earthquake sequence in 1975 and a 2007 earthquake swarm) showed the existence of a NNW-SSE normal fault that dips to the NE and bounds the south-eastern shore of the lake. The studied catchments are developed on the hanging walls of these active normal faults.

To evaluate the relative tectonic activity in the study area, various morphometric indices were measured for 35 catchments (slope of the valley sides of the catchment, hypsometric integral, catchment asymmetry factor, relief ratio, Melton's ruggedness number, stream-gradient index, ratio of valley floor width to valley height, and catchment shape) and 20 mountain fronts (mountain-front sinuosity index) around the lake. For the measurement of the geomorphometric variables a digital elevation model (DEM) with 2-m spatial resolution was derived from topographic maps at 1:5000 scale with 4-m contour lines, and a series of maps showing the spatial distribution of the variables were produced in a GIS environment. For each morphometric variable the catchments were classified into three classes. The combination of these morphometric variables allowed us to yield two new indices of relative tectonic activity (named IRTA - Index of Relative Tectonic Activity and IAT - Index of Active Tectonics). Based on the values of IRTA and IAT, the catchments were classified into three classes of relative tectonic activity (low, medium, and high).

The quantitative analysis showed that the development of the landscape of the central part of the northern flanks of the graben has been highly influenced by the tectonic uplift since these catchments are characterized by high IRTA and IAT values, that correspond to high values of relative tectonic activity. The study of the fault-generated mountain fronts showed that although both graben flanks have low sinuosity index values the central segment of the north flank of the graben has slightly lower values which are indicative of active tectonics and uplift. The results are consistent with previous studies and field observations.