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Some geomorphological perspectives on the structure associated with the Petrinja M6.2 earthquake in Croatia

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After the earthquake of 29/12/2020 in Petrinja (ML6.2, ImaxVIII-IX EMS), an attempt was made to characterize the active structure associated with the earthquake. As a first step towards this goal, we performed a geomorphological analysis in order to contribute to the identification and characterization of the surface expression of the active Pokupsko dextral strike-slip fault. We focused on the area between the southernmost parts of Vukomeričke Gorice and the southernmost parts of Hrastovica Mountain, where the NW-SE striking Pokupsko fault has slipped during and after the recent earthquake (Ganas et al., 2021). Using available 1 : 5 000 scale topographic maps and various 10 m resolution digital elevation model visualizations, we mapped lineaments that could represent relatively recently active fault segments. We used a quantitative approach to perform stream sinuosity analysis (e.g., Leopold et al., 1964; Zamolyi et al., 2010) on major streams crossing the structure to identify distinct changes in channel patterns that may be associated with vertical movement along the predominantly strike-slip fault. We observed changes in the shape of the valleys, especially the changes in width, height, and direction. By summarizing various geomorphological indicators of active fault segmentation at the surface with available geological data (Pikija, 1987) and so far limited field observations, we provide insights into the structure of the Pokupsko fault.
Preliminary results show good agreement between lineament mapping, changes in valley shape, changes in the stream sinuosity index, and (to some extent) previously mapped faults. In addition, some of the changes in stream sinuosity correspond to locations where coseismic surface ruptures occurred during the December 29 earthquake (Budić et al., this session; Pollak et al., 2021). Results suggest that the several-kilometer-wide zone of uplifted Neogene deposits results from the dextral-transpressive structure, which at the surface consists of a series of subparallel fault strands branching off the main fault that runs along the SE slopes of the Hrastovica Mountain. The SW-most fault strands are associated with significant changes in the shape of the valleys: the wide valleys of Petrinjčica, Utinja and Šanja change to narrow and deeply incised as they cross the uplifted structure. Paleocene and Eocene rocks, which otherwise underlie the

Neogene, outcrop in the NE parts of the fluvial breakthrough valleys, indicating the uplift of the Hrastovica Mountain. Topographic data show a decrease of the mountain range elevation towards the SW. This evidence suggests that the main fault runs on the NE side of the mountain, strikes NW-SE and dips steeply towards the SW. The fault strike deviates between Župić and Farkašić. The fault plane solution for the December 29 earthquake suggests a nearly pure strike-slip fault, while geomorphic evidence strongly indicates areas of active uplift along the fault, further supported by the general antiformal structure. We interpret this as an indication of either a general current transpressional character of the fault or as local kinematic variations due to segmentation and changes in the strike of the fault; further analyses are pending.