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Tree-ring indicators of debris-flow activity in the mining area of Călimani Mountains, Romania

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Debris flows (DFs) occurring in both natural and anthropogenic-disturbed areas may severely disturb trees along their paths. In the last decades, dendrogeomorphic investigations were largely applied to reconstruct the spatiotemporal activity of DFs in natural areas, while studies regarding the effects on tree growth patterns of contaminated sediments originating from mining areas and transported by DFs are lacking. In this study, we apply the dendrogeomorphic methods to reconstruct the spatiotemporal pattern of DF activity but also to analyse the growth of disturbed trees in the mining area of Călimani Mountains (Eastern Carpathians, Romania). During the second half of the twentieth century, in the central part of the Călimani Mountains, the mining activities for sulfur-rich ore extraction and processing resulted in significant environmental changes of the slope and channel morphology. Sediment transfers by DFs originating from the spoil heap talus area and following the stream channels started during the mining period (1970-1997), and are still ongoing today, more than two decades after the cessation of the mining activities. Norway spruces (Picea abies (L.) Karst.) living either along the channels or on the margins of two sediment retention reservoirs, and heavily disturbed by DFs, were sampled using Pressler borers and a chainsaw. Several tree-growth anomalies at macroscopic at microscopic scales were identified and allowed the reconstruction of past DF events in this mining-disturbed area. The study confirms the usefulness and potential of dendrogeomorphic approach for tracking sediment transfers not only in natural environment, but also in anthropogenic-disturbed surroundings. Therefore, the tree-ring approach must be seen as a novel and very precise information tool, which can be applied either to calculate sedimentation rates and for the monitoring of the magnitude and extent of sediment transfers in mining areas. Further dendrogeomorphic investigations on various coniferous and broadleaved tree species living in similar mining environments will confirm their high potential for the reconstruction of the dynamics of hydrogeomorphic processes.

Keywords: Debris flows (DFs), dendrogeomorphology, mining area, sediment transfer, Călimani Mountains (Eastern Carpathians, Romania)