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Wood anatomical analysis of Alnus incana and Betula pendula injured by a debris-flow event

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Vessel chronologies in ring-porous species have been successfully employed in the past to extract the climate signal from tree rings. Environmental signals recorded in vessels of ring-porous species have also been used in previous studies to reconstruct discrete events of drought, flooding and insect defoliation. However, very little is known about the ability of diffuse-porous species to record environmental signals in their xylem cells. Moreover, time series of wood anatomical features have only rarely been used to reconstruct former geomorphic events. This study was therefore undertaken to characterize the wood anatomical response of diffuse-porous Alnus incana (L.) Moench and Betula pendula Roth to debris-flow-induced wounding. Tree microscopic response to wounding was assessed through the analysis of wood anatomical differences between injured rings formed in the debris-flow event year and uninjured rings formed in the previous year. The two ring types were examined close and opposite to the injury in order to determine whether wound effects on xylem cells decrease with increasing tangential distance from the injury. Image analysis was used to measure vessel parameters as well as fiber and parenchyma cell (FPC) parameters. The results of this study indicate that injured rings are characterized by smaller vessels as compared with uninjured rings. By contrast, FPC parameters were not found to significantly differ between injured and uninjured rings. Vessel and FPC parameters mainly remained constant with increasing tangential distance from the injury, except for a higher proportion of vessel lumen area opposite to the injury within A. incana. This study highlights the existence of anatomical tree-ring signatures — in the form of smaller vessels — related to past debris-flow activity and addresses a new methodological approach to date injuries inflicted on trees by geomorphic processes.