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Linking geomorphology and high resolution seismic imaging for defining the evolution of a formerly glaciated valley in Vinschgau/Val Venosta, Eastern Italian Alps.

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Understanding the sedimentary architecture of Quaternary valley fills, in relation to past climate changes, represents an essential condition for estimating the evolution of the contemporary mountain landscape. Mountain drainage basins are considered as systems that are largely affected by environmental changes, during glacial-interglacial transitions and consequently represent natural archives that record the main processes depending on climate variations.
In this paper, we aim to reconstruct the post-Last Glacial Maximum (LGM) evolution of a cross-sectional transect of the Venosta Valley (Eastern Italian Alps), with a special focus on the confluences between the Adige River and its tributaries Gadria-Strimm and Lasa streams. We acquired and processed four high-resolution dense, wide-aperture seismic profiles to obtain seismic data of quality and resolution adequate to 1) study the internal architecture of the debris-flow fans; 2) delineate the morphology of the bedrock valley bottom and the associated sedimentary fills above it; and 3) evaluate the geometric relationships between the debris-flow fans and the hosting valley fills. We integrated the results of the high-resolution seismic imaging with existing speleothem and radiocarbon dating, and with four newly acquired sedimentary cores and about twenty new radiocarbon dates.
The new set of radiocarbon ages, allowed us to define timelines across the seismic imaging, and consequently across the stratigraphic profiles to calculate average sedimentation rates between the dated samples, within each core. Our results show that the onset of paraglacial sediment evacuation from the three tributary systems was primarily controlled by basin aspect, a proxy for incoming solar radiation that typically affects the timing and pace of deglaciation. We further show that the debris-flow sediment flux associated with the formation of the Gadria fan, the best-constrained tributary system in the study area, describes a primary sedimentary wave trend over the last 14 millennia. To our knowledge, this represents the first empirical validation of the paraglacial conceptual model for steep headwater systems dominated by debris flows.