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Growth and evolution of alluvial fans in response to extensional tectonics. A case study in central Italy

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Subsidence of hanging-wall basins in continental extensional settings produces the re-organization of the rivers network in terms of sediments delivery within the basins and enhanced headward erosion at the faults footwall.
We studied 134 alluvial fans which drain the footwall of a normal fault-bounded continental basin in central Italy together with their catchments. The basin-bounding faults rate is in the order of 0.2 mm/yr in the last 0.8 Myr. Tectonic subsidence produced a complete re-organization of the rivers network as a response to the base-level fall, triggering headward erosion, piracy effects at the expenses of nearby catchments, and cases of drainage inversion. The mapped rivers inversions and catchments piracy were related with the distribution of a quantile regression of the alluvial fans Vs basin areas. Despite the two parameters are well fitted by a power law relationship, we find that the data-set is subdivided into two main parts. All the fans corresponding to captured rivers lay above the regression line (in the fan area field), whereas those corresponding to capturing rivers, are below the regression line (in the basin area field).
Such configuration is likely to occur in many datasets worldwide where alluvial fans evolution is controlled by normal extension and our findings can help interpret the scatter of fan vs basin areas distribution.
We propose a general model of alluvial-fan growth in active extensional settings in which the detection of these features can lead to the identification of the most active fault segments in an active area. Such approach can help better constrain faults activity in a time-window which bridges long-term deformation to present-day deformation inferred from geodesy and/or seismology increasing our understanding of faults steadiness/unsteadiness behaviour.