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Drainage integration and sediment dispersal in the actively extending central Italian Apennines

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Evidence for re-organisation of river networks during crustal extension is observed in many (active and ancient) rifts around the world. In the actively extending central Italian Apennines, drainage integration is evidenced by the cessation of lake sedimentation in hangingwall basins and the development of drainage systems that extend from the interior of the mountain belt to the coast. We combine field data from this area on normal fault development and regional surface uplift within a landscape evolution model to investigate the process of drainage integration and its impact on regional sediment dispersal under a range of erosional conditions. We use the numerical model CASCADE (developed by Braun and Sambridge) for calculating fluvial erosion/deposition and lake filling in response to normal faulting. The fault-related topography is simulated by means of a linear elastic dislocation model, using a published map of active faults in the area. Regional surface uplift is constrained from published field observations of paleoshorelines and basin stratigraphy. Using this modeling approach we demonstrate the phenomenon of drainage integration, showing how it leads to the gradual disappearance of lakes and the transition to an inter-connected fluvial transport system. While headward erosion is often considered as the main underlying mechanism, our model results suggest a key role for basin over-filling and lake over-spilling and we discuss its implications for regional drainage network evolution. We also demonstrate how drainage integration leads to a sudden change in sediment dispersal patterns and the progressive removal of sediment from the rift interior. Overall, we use our numerical models to discuss the relative importance of tectonics and surface processes for long-term landscape evolution in the central Italian Apennines and put published field observations (e.g. local depositional patterns in rift basins) in a regional and long-term tectonic perspective.