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The fate of internally-drained basins. Two examples from North Iberia: the Duero and Ebro basins

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The evolution of the two largest intramountain basins in Spain provides a conspicuous example of large-scale erosion/deposition not necessarily controlled by tectonic uplift/subsidence. Both basins underwent a large stage of endorheic lacustrine sedimentation during the Neogene, and both developed an incising river network during Late Miocene-Quaternary, when tectonic deformation was minor. Based on a numerical model that simulates the long-term evolution of tectonic lakes, we constrain the conditions under which such lakes and the associated basins may become endorheic (i.e., internally-drained, no drainage outlet) and we investigate their post-tectonic evolution until drainage reopening. The model accounts for tectonic vertical motions, a simplified hydrological balance, and a stream-power law for sediment transport, in cross-section. The model simulates the formation of a water body by tectonic uplift across a river, showing that, after cessation of tectonic forcing, these lakes are transitory phenomena over geological time scales. Other geometrical, lithological, and tectonic parameters being constant, a dry upstream climate (low precipitation/evaporation ratio) favors lake formation, drainage closure (endorheism), and significant lake life extension by preventing outlet erosion. As tectonism ends, shallow lakes at high altitudes undergo a faster capture and extinction. Such capture is relatively abrupt (in the order of hundreds of thousands of years according to the model predictions) and produces a sudden increase in sediment discharge that might start after several million years of tectonic quiescence. These results suggest that climate and drainage reorganizations, rather than tectonics, controlled the timing of surface sediment transport since the Late Miocene in the Ebro and Duero basins.