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Climate vs. Tectonics. What triggers the formation of intramountain basins and high plateaus?

D. Garcia-Castellanos (1), M. Gerbault (2), A. Tassara (3), I. Jiménez-Munt (1), M. Fernàndez (1).

(1) Instituto de Ciencias de la Tierra Jaume Almera (CSIC, Barcelona); (2) IRD (Toulouse); (3) Frei Univ. Berlin

High plateaus are often interpreted as the result of tectonic compression interfering with pre-existing structural heterogeneities of the continental lithosphere (e.g. weak crustal rheology, thermal anomalies or hydrated mantle). Our computer simulations suggest that climate at the early stages of tectonic shortening can trigger drainage closure and the formation of large intramountain basins that help transferring the accommodation of shortening towards the external parts of the orogen. These results come from a quantitative model designed to simulate in cross-section the long-term evolution of internally-drained basins resulting from tectonic compression and climate-controlled sediment transport. Fault-propagation accommodating tectonic shortening is calculated using a minimum-work approach. A stream-power law is used to calculate river incision and transport to the lakes developing in topographic basins created by tectonics. According to the model predictions, dry climatic conditions in the highlands (promoted by the orographic isolation of the uplifting topography) favor the defeat of the rivers draining the orogen, promoting lake formation, intramountain deposition, and eventually the formation of a long-lived internally-drained high-plateau. Drainage closure extends the life and volume of the intramountain basin by preventing erosion along any outlet river. In turn, this additional mass trapped within the orogen enhances propagation of deformation into the undeformed foreland, which further isolates the central parts of the orogen from incoming humid wind and precipitation. This feedback phenomenon may explain the formation of long-living high-plateaus without invoking tectonic or inherited structural heterogeneities in the crust/lithosphere. It also suggests that internally-drained high-plateaus might be a natural stage of orogenesis if this started under dry climatic conditions.