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Controls of bifurcation geometry on bed deposition patterns during experimental channel abandonments.

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Abandoned channels are major features of fluvial systems as their distribution and sedimentary fills control the architecture of alluvial plains and the connectivity between fluvial reservoirs. The extent and geometry of the bodies formed by bedload deposition in abandoned channel, e.g., sand-plugs and sand-bars, depend on a number of factors, one of which is the geometry at the bifurcation point.

In this study we build on existing modeling experiments, which focused on the global repartition of water or sediment between two active channels. We present a novel series of experiments designed to test the conditions for channel abandonment by modifying the bifurcation angle between channels, the flow incidence angle and differential slope. The surface evolution of disconnecting channels was monitored to constrain construction processes and geometry of sedimentary bodies.

For a given bifurcation geometry, three scenarios were tested: a free evolution, a simulated levee breach – i.e. opening of a branch after channel aggradation in the other one - and a rise of the free water surface in one branch. We find that: (i) sand-plug extension is inversely proportional to the flow incidence angle, which we were able to quantify experimentally for the first time. (ii) The flow incidence angle has a greater influence on disconnection potential than the absolute value of the bifurcation angle, and we quantify thresholds above which disconnection becomes possible. (iii) The few sediment fluxes we tested have limited impact on channel fills geometry, although they increase sediment filling rates. (iv) Independently of their final length-scale, sand-plugs develop in very similar patterns from one scenario to another. In contrast, their length and distribution vary with the forcing scenario. Analyses of sand-plug and sand-bars chronology further show that they form at different stages of the channel abandonment process. In the future this may be compared to field data gathered on the geomorphic evolution of abandoned channels.