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Numerical modelling of river reorganization along strike-slip faults

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Most studies of climate-tectonic interactions have focused on steady state orogens that evolve through orogen-normal convergence. Yet, most orogens have a major component of strike skip (wrenching). Although river captures occur in various kinds of geomorphic settings, they are frequently produced in such orogens by strike-slip faulting. The impacts of river captures are not well quantified because compelling diagnostic features and good quality proximal records are rarely found. CASCADE numerical simulation code (Braun and Sanbridge, 1997) has been modified to model horizontal motion across a strike-slip fault and to witness the evolution of river drainage organization.

Two river geometries are used to study the effect of horizontal movement on river drainage system. (1) The first one simulates the deformation of an "isolated crosswise stream". The continued horizontal displacement of streams leads to stream deflection and formation of a deep valley along the fault. The elongation of the river is not limited by the presence of other streams, and the lengthening process lowers river gradients and likely diminishes the river's erosional efficiency. (2) The second geometry simulates two parallel crosswise rivers. In this case, lenghtening ends when drains are brought into contact by strike-slip faults. The physical barrier between them is tectonically removed. Further work is in progress to test the influence of capture on the basin incision. First results seem to show an expected transient increase in local relief and therefore basin incision.

Through elongation and capture, deformation in a wrench zone produces a constantly evolving pattern of stream reaches with various incision rates. Drainage basins located upstream from the wrench zone experience a series of sudden captures and longer intervening periods of lengthening and slowing erosion. This results in oscillations in incision rate and internal drainage adjustments. Erosion and landscape, in these wrenched systems, thus operate in permanent disequilibrium.

Braun, J. and Sambridge, M., 1997, Modelling landscape evolution on geologic time scales: a new method based on irregular spatial discretization, Basin Research, v.9, pp.27-52.