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Fluvial transport and tectonics: cyclic growth of relief in orogenic high plateau setting

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Surface processes redistribute material away from high relief into deflected basins. Relief under compressive tectonics generally grows in association to thrust faulting, as part of crustal and lithospheric thickening against the gravity force. The unloading action of erosion thus triggers and facilitates faulting activity, which may even be associated with little change in relief. We combine a numerical model of fluvial transport and lake generation and a 2D finite difference Lagrangian model of mechanical deformation. We define an initial symmetrical tectonic setting of a continental lithosphere containing at its center a zone of pre-thickened crust, so that as soon as a compressive velocity is applied, a crustal scale high plateau emerges bounded by $\sim 30^{\circ}$angle faults (Mohr-Coulomb failure is assumed). While an erosion model assuming sediment flow proportional to slope induces a symmetrical growth of the high plateau, the geometry of relief changes when one accounts for fluvial erosion and lake generation. A cyclicity is observed upon the uplift of either left or right Cordilleras that border the high plateau, related to the outlet of the internal basin. A cycle is defined by the time necessary for the following processes to occur: the endhoreic basin opens through an outlet, triggering erosion and taking away mass from the Cordillera. This in turn enhances thrust faulting in the crust underneath, eventually resulting in closing again the drainage outlet. The other Cordillera may then become the next outlet to the internal basin, repeating the same process. This cyclicity naturally depends on both numerical and physical parameters that we explore in this study: mesh size, frequency of interpolation from one code to the other, but also on convergence versus erosion rates. At the time scale of about 20 Myr, despite the regularity of alternating left and right outlet and cordilleran height, the orogen appears acquires an asymmetry that may then

further develop to a large scale.