Erosion-induced reactivation of the Main Central Thrust zone: Comparison of model results with tectonic and thermochronologic data

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Recent thrust-sense deformation in the vicinity of the Main Central Thrust (MCT) zone in the Himalaya of central Nepal can be attributed to tectonics, erosion, or a combination of both. In the same area, contrasting cooling-age patterns in medium- and low-temperature thermochronometers have been interpreted to imply a recent (2.0–0.9 Ma) significant increase in erosional exhumation rates, likely attributable to recent climate changes. No comparable evidence exists for changes in local plate convergence rates. We use numerical models with constant convergence velocity but contrasting erosion rates to show that increased erosion and recent thrusting may be directly connected. In the models, increasing erosivity by a factor of 3 over 3 Ma fundamentally changes the style of deformation, reactivating the dormant model MCT system in the region corresponding to observed thrust faults. The high-erosion model also reproduces the observed cooling-age patterns, whereas the equivalent low-erosion model does not reproduce either observation. Other model predictions, and their implications for the effects of increased erosion on the southern flank of the Himalaya, include: 1) no associated reactivation of normal faulting on the South Tibetan Detachment (STD) system; 2) enhanced upper-crustal extension in the vicinity of the north Himalayan gneiss domes (NHGD); 3) reinvigorated mid-crustal channel flow beneath the NHGD; 4) possible destabilization and wholesale southward flow of the upper crust between the MCT and NHGD, with the potential for catastrophic earthquakes. The first three questions are testable and address the persistent question of the existence and current location of the low-viscosity channel. In particular, the model predicts that it has been stagnant beneath the Tibetan plateau under a relatively low-erosion regime, but has been, or could be, reactivated by more aggressive erosion driven by climate change. The potential for destabilization of the south flank of the orogen has important geological and societal implications.

Atlantic Geology, 2008, Volume 44, Number 1