Geophysical Research Abstracts,
Vol. 10, EGU2008-A-09009, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-09009
EGU General Assembly 2008

Is rapid exhumation of the High Himalaya of Central Nepal driven by ramp overthrusting, the formation of mid-crustal duplex, or out-of-sequence thrusting?

Frédéric Herman (1,5), Jean-Philippe Avouac (1), Gweltaz Mahéo (2), Laurent Bollinger (3), Ken Farley (1), Mark Harrison (4)

(1) Caltech, (2) ENS Lyon, (3) CEA, (4) UCLA, (5) Now ETH

In an attempt at determining plausible kinematic models of the Himalaya of central Nepal over the last 15 Myrs, we have applied a formal inverse approach based on the Neighbourhood Algorithm. The forward models consider the possibility of either thrusting localized along a single major thrust fault (the Main Himalayan Thrust (MHT)) with non-uniform underplating due to duplexing, or out-of sequence thrusting in addition to thrusting along the MHT and with uniform underplating rate. The models are computed using a thermokinematic FEM model (PECUBE), and tested against thermochronological, thermometric and thermobarometric data compiled from the literature and complemented with some new (U-Th)/He data. The formal inversion approach allows definition of best fitting values of model parameters and their uncertainties. In addition to the geometric parameters, model variables include overthrusting rates; radiogenic heat production in the High Himalayan Crystalline (HHC) sequence; the timing of enhanced rock uplift /exhumation rates corresponding to the formation of the duplex or out-of-sequence thrust re-activation. A model with out-of-sequence thrusting can provide a satisfactory fit to the data (with a minimum reduced χ^2 of 0.79) but requires a large overthrusting rate of 15 ± 1mm/yr and implies a total convergence rate $\geq$30 mm/yr. The duplex model, with a minimum reduced χ^2 of 0.69, is more consistent with observation. According to this model the 20 mm/yr convergence rate is partitioned between an overthrusting rate of 5 ± 1 mm/yr and an underthrusting rate of 15 ± 1 mm/yr. Modern uplift rates are estimated to increase from about 0.8 ± 0.2 mm/yr in the Lesser Himalaya to 3.5 ± 0.5 mm/yr at the front of the high range, 95 ± 5

km from the MFT. The effective friction coefficient is estimated to be 0.07 ± 0.01 and the radiogenic heat production of HHC units is estimated 2.2 ± 0.1 μW/m3. The mid-crustal duplex initiated at 10 $\pm$2 Ma, leading to an increase of uplift rate at front of the High Himalaya from $\sim$0.9 to 3.5 mm/yr. Thus the analyzed dataset appears more consistent with a duplex model relative to out-of-sequence-thrusting. We then couple the thermo-kinematic model in 3D with a landscape evolution model (CASCADE) and are able to reproduce some the major geomorphic and geologic characteristics of Central Nepal with the duplex formation model. Given the excellent fit of the duplex model to the geologic, petrological, geophysical and geomorphic constraints, there appears little basis to support a channel flow-type model in a Himalayan context over the last 15Myrs.