**Supplemental Information: Equations used in Figure 4**

The relations used to compute the curves in Figure 4 were first published by Whipple and Meade[1]. That paper did not, however, provide full details on the relations for the hypothetical fixed-width mountain range used in this review as a foil for comparison to predictions for critical-taper systems. All relations used for the fixed-width case in Figure 4 are reported below for the convenience of the interested reader.

All calculations use the orogen-scale erosion rule[2] given by:

$$E = C\left(\frac{1}{2}W\right)^{a}(\tan\alpha)^{b}, \qquad (1)$$

where $E$ is erosion rate (positive downward), $C$ is the coefficient of erosional efficiency (a function of climate, rock properties, and sediment load), $W/2$ is the range half-width, and $\tan\alpha$ is the regional topographic gradient (or topographic taper).

For simplicity, for the fixed-width system computations, I assume $a = b = 1$. Noting that range relief ($R$) for a symmetrical range is by definition the product of regional topographic gradient and range half-width ($R = 1/2\,W(\tan\alpha)$), in this case the orogen-scale erosion rule reduces to a simple linear function of relief[3]:

$$E = CR \qquad (2)$$

Following England and Molnar[4], I define surface uplift ($U_s$) as the difference between near-surface rock uplift ($U$, measured relative to fixed baselevel) and erosion rate:

$$U_s \equiv U - E \qquad (3)$$

Near-surface rock uplift rate is specified because the vertical component of rock velocity often varies with depth – equation (3) is only valid at or near the surface.

The surface uplift rate is by definition equal to the rate of change of relief ($dR/dt$). For an isostatically compensated range, the rate of surface uplift is a function of the change in crustal thickness, which is determined by the difference between the tectonic rate of crustal thickening ($F_A/W$) and the rate of erosion ($E = CR$), and the densities of crust ($\rho_c$) and mantle ($\rho_m$) (Airy isostasy):

$$\frac{dR}{dt} \equiv U_s = \left(\frac{\rho_m - \rho_c}{\rho_m}\right)\left(\frac{F_A}{W} - CR\right) \qquad (4)$$

This well-known differential equation can be solved directly:

$$R(t) = R_f + (R_i - R_f)e^{-C\left(\frac{\rho_m - \rho_c}{\rho_m}\right)t} \quad (5)$$

where $R_i$ is the initial steady state, $R_f$ is the final steady state and equation 5 describes the evolution of range relief following a change in climate from an initial state ($C_i$) to a final state ($C$) at time $t = 0$. Initial and final steady-state relief is found by setting $dR/dt = 0$ in equation 4:

$$R_i = F_A/(WC_i)\,;\;\; R_f = F_A/(WC) \quad (6)$$

The exponential relation in equation (4) has a characteristic response time (equal to the e-folding time) given by:

$$\tau = 1\Big/ C\left(\frac{\rho_m - \rho_c}{\rho_m}\right) \quad (7)$$

All variables in Figure 4 are plotted against non-dimensional time ($T^* = t/\tau$). A relation for erosion rate is found by combining equation (2) and (5):

$$E(t) = CR_f + C(R_i - R_f)e^{-C\left(\frac{\rho_m - \rho_c}{\rho_m}\right)t} \quad (8)$$

Total erosional efflux is of course the product of erosion rate and range width ($W$). Rock uplift rate is found by substituting (8) into (3) and solving for rock uplift rate using (4):

$$U(t) = \frac{\rho_c}{\rho_m}C(R_i - R_f)e^{-C\left(\frac{\rho_m - \rho_c}{\rho_m}\right)t} + \frac{F_A}{W}$$

All computations involving the critical-taper wedge case were done using relations in Whipple and Meade[1] (their equations 7, 14, 15) and assuming $p = 1$ in their equation (6) for simplicity.

## References Cited


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