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Relations among tectonic shortening, climate, and relief in mountain ranges.

Jean-Daniel Champagnac (1), Peter Molnar (2), and Christian Sue (3)

(1) Geological Institute - Earth Surface Dynamics Sonneggstrasse 5, NO E 45 CH-8092 Zürich (champagnac@gmail.com), (2) Department of Geological Sciences, and Cooperative Institute for Research in Environmental Sciences, University of Colorado, Boulder, Colorado, 80309, USA., (3) IUEM/UMR6538/UEB/UBO, Brest University, France

With a compilation of topographic, geomorphic, tectonic, and climatic characteristics of more than 50 mountain belt worldwide, we explore the correlations among various characteristics. Topographic data, from the GTOPO30 DEM, include several parameters: maximum elevation, mean elevation, and maximum averaged elevation, calculated above sea level and above individual base levels. Geophysical Relief (calculated over 3 different radius, 1km, 5km and 15km) provides a measure of relief and hence for erosion. Tectonic parameters comprise geodetic shortening rates and average strain rates obtained by dividing shortening rate by the orogen's width. Climatic data are mean precipitation rates and a qualitative measure of glaciation factor ranging from 1 (no glaciation) to 5 (full glaciation), for both LGM and present day.

The database has been split in two parts: one for all mountain belt, including non-convergent settings, and another one, with only actively compressional orogens. Sizes of areas considered span two orders of magnitude (the largest being the Gobi Altai, Mongolia, the smallest the Wind River Range, Wyoming, USA). Bigger orogens (Himalayas, Andes...) have been separated into several sub-orogens.

For the global database, measures of geomorphic, erosional, and tectonic parameters are self-consistent; correlation coefficients are $\sim$0.9. Those for climate are less so, with a correlation coefficient of 0.4, as links between glaciation and precipitation are weak. For convergent settings only, the correlation coefficient of between strain rate and convergence rate is $\sim$0.8. There is, however no correlation between strain rate and belt's width (-0.28). For the global database, the correlation between the convergence rate (including "zero" values) and most topographic and geomorphic parameters is quite good ($\sim$0.7), except for mean elevation ($\sim$0.5). For the convergent belts only, the correlation becomes lower for all geomorphic parameters ($\sim$0.5). Surprisingly, the correlation between the strain rates and the geomorphic parameters is always poor ($\sim$0.3 for all belts, and close to 0 for convergent orogens!). The correlation between glaciation and geomorphic parameters is intermediate ($\sim$0.5).

The correlation between glaciation and erosion is intermediate and decreases with the size of Geophysical Relief calculation (from 0.65 to 0.45). The correlation between erosion and convergence rate is intermediate ($\sim$0.5), and increases slightly with the magnitude of Geophysical Relief (from 0.5 to 0.6).

This study highlights low correlations (0.5) between tectonic shortening or strain rates with both topographic parameters, such as maximum or relative elevation, mean elevation or mean relief and erosional parameters, suggesting that tectonic and erosional processes exert comparable influences in creating topography and relief.