QUANTITATIVE ANALYSIS IN MEGAGEOMORPHOLOGY

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Megageomorphology is the study of regional topographic features and their relations to independent geomorphic variables that operate at the regional scale. These independent variables can be classified as either tectonic or climatic in nature. Quantitative megageomorphology stresses the causal relations between plate tectonic factors and landscape features or correlations between climatic factors and geomorphic processes. In addition, the cumulative effects of tectonics and climate on landscape evolution that simultaneously operate in a complex system of energy transfer is of interest.

Regional topographic differentiation, say between continents and ocean floors, is largely the result of the different densities and density contrasts within the oceanic and continental lithosphere and their isostatic consequences. Regional tectonic processes that alter these lithospheric characteristics include rifting, collision, subduction, transpression and transtension. The magnitude of topographic change that results from these processes may in the first approximation be described by isostatic responses to lithospheric thickening, thinning, or heating. For example, rooted topographic highs are related to crustal thickness while rootless topographic highs may be supported by thermal incursions into the lithosphere.

Theoretical models that relate topographic response to changing lithospheric characteristics are essential tools in quantitative megageomorphology. The well known McKenzie model for the evolution of passive margins is an excellent example of a model that in many cases is well constrained by stratigraphic data and predicts the sinking of passive margins as a function of a cooling lithosphere in isostatic equilibrium. The modeling of foreland basins as a flexural downwarping in response to thrust-induced loading is another simple model that relates tectonics and topographic evolution.

Larger scale geomorphic studies also have direct application to megageomorphology. The impact of tectonism on geomorphic systems, where measurable, provides vital information and empirical constraints on the rates at which tectonic processes operate. For example, morphometric data gathered in areas where the tectonic history is known may ultimately be useful as multivariate training sets for classifying areas where the tectonic history is unknown. Too, the evolution of fault scarps and consanguine features, has provided data on the ages of prehistoric faulting events and resulted in a totally new field of study referred to as paleoseismology.

Climatic impacts on regional geomorphic systems have direct significance on the rates at which processes operate. Regional climatic differentiation with regard to geomorphic process (as opposed to form) is an understudied field within megageomorphology. There should be a focus on the physical constraints that climate and climatic changes places on the operation of geomorphic systems and clear understanding of the importance of time series and hysteresis in climatic geomorphology. Climate geomorphic systems that are simple and can be inverted, or have unique solutions, are those that hold most promise for helping us understand climatic variation in space and time.