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# Topographic Responses Against to Tectonic Forcing in Active Orogenic Belts: Derived From 10Be and Landscape Analysis in East Margin of Tibet Plateau

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Earth surface landscape evolution always follow a transient model called "Geomorphic Cycle". In this model, earth surface is rapidly uplifted and growing by tectonic forcing, then sharped and lowered by the ensuing increasing erosion processes. Understanding the dynamic interactions between mountain building with erosion and determinate the stage of mountainous landscape evolution has been a key issue especially in active orogenic geomorphological research.

Hypsometry is the relative proportion of area at different elevations within a region. The hypsometric curve (area-altitude curve) is a percentage that represents horizontal cross-sectional area of a drainage basin to relative elevation above the outlet, in detail, represents the relative amount of the basin area below (or above) a given height and related to the degree of dissection of the basin. This integral provides a simple morphological index of the elevation distribution within the area considered, which is a suitable indicator for the relative dominance of fluvial incision or hillslope processes in landscape evolution process because it could give 3-D information for a 2-D approach. The area below the hypsometric curve is called hypsometric integral (HI), value varies from 0 to 1, and it is used to quantitatively characterize the curve. Different crustal movements will modify the course of change in the hypsometric curve and its integral, convex-up hypsometric curves with high HI values are associated with poorly dissected landscapes where hillslope processes dominate, concave-up shapes with low values of the HI are typical of deeply dissected landscapes. With the current development of geographical information systems (GIS), the calculation of hypsometric curves has become easier. The spreading of digital elevation models (DEMs) offers good raw material to analyze hypsometry, researchers could extract hypsometric curves from Digital Elevation Models through ArcGIS software. The geomorphic development resulting from concurrent tectonics and denudation is divided into developing, the culminating and the declining stages. In the past, the stages of landscape development have sometimes been explained by hypsometric curves and integrals. However, this parameter is ambiguous since areas with different types of hypsometric curve can yield the same hypsometric integral value. So, this value is limited that only considered to indicate the state of denudational processes in the terrain, rather than the stage of the geomorphic cycle due to the quantitatively examined fluvial processes are not included in the model used here. In addition, topographic indices (eg., slope angle; local relief; normalized steepness index) can also provide valuable information for explaining the competition relationship between tectonics and erosion processes. Therefore, linking HI with topographic parameters could quantitatively describe the landscape evolution modeling.

Quantitative erosion rate is a potential useful toolkit to describe the state of fluvial processes, could help to test landform evolution theories and have potential to locate geomorphic stage owing to its sensitivity to the tectonics and landscape evolution. Especially the terrestrial cosmogenic nuclide $^{10}$Be, allow us to quantify landscape response rates in catchment-wide for the mountainous system. The eastern margin of the Tibetan Plateau, as the frontier of plate collision, the representative intense crustal movements and unique topography endowed this zone been a natural testing ground for the study of crustal deformation mechanisms and their interactions with surface shaping processes.

The key issue for this study is characterizing the geomorphological implications for hypsometric integral and introducing quantitative fluvial process coupling with hypsometric integral to locate evolution stage of the topography in geomorphic cycle. From this study, we combined the analysis of erosion rates derived from $^{10}$Be concentrations, catchments river long profiles to examine a new model to determine the stage of landscape evolution in a part of geomorphic cycle. According to our results, we suggest that erosion rate could couple with hypsometric theory to locate the stage of the geomorphic cycle and it can be quantitatively divided into growing, balance and the decaying stages.