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Morphometric analysis of northern and southern chinese Tian Shan piedmonts (Central Asia) : Evidence for an asymmetrical kinematical evolution

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Mountain landforms record the dynamical evolution of relief (Burbank & Anderson, 2001). In particular, drainage basins are useful tectonic markers to quantify the topographic and kinematical evolution of a mountain range (Ramsey et al., 2007).
In this work, we have studied drainage basins in the northern and southern piedmonts of the chinese Tian Shan (Central Asia). We have processed SRTM DEM (90 m resolution) to measure several morphometric parameters of drainage basins (half width, stream profiles, catchment area) and alluvial fans (mean radius, area, slope). We have compared how these parameters evolve longitudinally (Tian Shan piedmonts spread broadly East-West) and investigated relationships between each of them (Hack's law, drainage basin area versus alluvial fan area, etc.).
Our results suggest that drainage basins are more mature to the east in the northern piedmont and to the west in the southern foothills. Evidences are :
(1)catchment surface can be divided in several slope domains (i.e. areas of similar mean topographic gradient) with mean value around 30-35°, 10-15° and less than 5°. They taper westward in the northern piedmont and eastward in the southern piedmont.
(2)the half width of both piedmonts (i.e., the distance between the main divide and the deformation front) grows in opposite directions. It grows eastward in the northern piedmont (at a rate of 500 m/km in longitude) and westward in the southern piedmont (at a rate of 250 m/km in longitude).
(3)stream profiles are mostly concave along the piedmont except in the western side of the northern piedmont and in the eastern side of the southern one where they are convex in shape.
To our point of view, these morphological characteristics are not related to "lithological" or "orographic" effects because lithologies are similar in both foothills (it is detrital continental rocks) and precipitation rates should not vary significantly at the scale of the 100 km long piedmonts. We rather propose two possible explanations : 1) catchments should not have settled simultaneously along one piedmont. This settlement would be older eastward in the northern piedmont and westward in the southern one. This would therefore suggest a propagation of deformation to the west in the northern piedmont and to the east in the southern piedmont ; 2) the bulk shortening accommodated on both piedmonts should vary longitudinally. It would be higher eastward in the northern piedmont and westward in the southern piedmont. Such shortening fields at the scale of the whole mountain range would be complementary and could indicate an asymmetrical partitioning of deformation.

Key-words : Tian Shan, landforms, piedmonts, morphometry, relief dynamics.

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