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Tectonic geomorphology of the Qilian Shan: insights into the Late Cenozoic landscape evolution and deformation in northeastern Tibetan Plateau

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Geomorphometric indices, as slope, relief and mean elevation, show the existence of high-relief steep range front along the northern Qilian Shan, and sub-summit low-relief intermontane basins within the Qilian Shan. Comparison of rates of regional uplift and erosion indicates the high-relief frontal ranges are approaching topographic steady state. Geomorphic inspection on selected drainage basins reveals that the low-relief intermontane basins have been developed within interior Qilian Shan despite of variable drainage settings. Large-scale geomorphological overview of the Qilian Shan reveals a geomorphic similarity to the Tibetan Plateau, providing a prototype to study the landscape development of the Tibetan Plateau. For the intermontane basins, spatially different planform geometry is observed. Basins in the northwest are much narrower and typically linearly aligned; instead, the southeastern ones are comparatively wider and more rhomb-shaped. Thrust faulting and crustal shortening near the termination of the Altyn Tagh fault might contribute to formation of the narrower northwestern basins, and the wider southeastern basins are more likely controlled and confined by rhomb-shaped blocks along the strike-slip Haiyuan, Elashan, and Riyueshan faults. By considering drainage basin width as a strain indicator, our estimation of the total shortening rate across the Qilian Shan coincides with the late Quaternary and present geodetic rates. This finding then supports accelerated shortening in northeastern Tibetan Plateau occurred at 10-15 Ma, and further, the slip rates might have been relatively consistent since Middle Miocene along the eastern segment of the Altyn Tagh fault.