Abstract

Drainage systems adapt to changes in the surface slope and thus have the potential to record the evolution of tectonic structures that produce surface uplift. The development of new mountain fronts can drive the abandonment of earlier drainage networks by way of fluvial captures. Here we analyze the evolution of topographical relief in a transcurrent tectonic setting where a relic drainage network inherited from late Miocene extension is still preserved. The recent drainage network is advancing thanks to tectonic driven rock uplift related to the Alhama de Murcia strike-slip fault and associated structures; overprinting the previous extensional related drainage. For this, we carried out a structural and a qualitative and quantitative relief analysis to understand how the relief has evolved and which are the active structures that currently control the drainage configuration. We identify river capture sites and present a geomorphic index analysis using SLk anomalies, hypsometric curves, mountain front sinuosity, the comparison between longitudinal and projected river profiles with the SLk values and the position of active faults and folds, and a slope analysis of the area. This analysis mainly allows the understanding of the drainage network evolution. The results show 1) the reactivation of the ending part of the main basins by the current uplift of Tercia Range, 2) progressive capture processes related to the growth of the Rambla de Lebor and Totana transverse drainages upon a previous drainage pattern inherited from a late Miocene extensional setting evidenced by the presence of wind gaps, abrupt changes in flow direction, oblique relationship between current river direction and paleosurfaces maximum slope direction and changes in the lithologic composition of terraces, and 3) basin shapes controlled by the interference between a NE-SW-directed drainage network controlled by extensional structures and another NW-SE one controlled by transpressive structures (Alhama de Murcia Fault).
From extension to transpression: drainage response to the Alhama de Murcia strike-slip fault growth (Eastern Betics)

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ABSTRACT

Drainage systems adapt to changes in the surface slope and thus have the potential to record the evolution of tectonic structures that produce surface uplift. The development of new mountain fronts can drive the abandonment of earlier drainage networks by way of fluvial captures. Here we analyze the evolution of topographical relief in a transcurrent tectonic setting where a relic drainage network inherited from late Miocene extension is still preserved. The recent drainage network is advancing thanks to tectonic driven rock uplift related to the Alhama de Murcia (AMF) strike-slip fault and associated structures; overprinting the previous extensional related drainage. The objective of this study is to understand how the relief has evolved and which are the active structures that currently control the drainage configuration.

In order to analyse the topography of the studied area we carried out a structural analysis of fault segmentation, the identification of fluvial captures, as well as the calculation of several geomorphic indexes for the main drainage basins.

CONCLUSIONS

The geomorphic indexes are consistent with a relief reaction due to Alhama de Murcia fault activity: 1) Smf values lower than 1.4 in the mountain fronts controlled by the fault (figure 6 and table 1); 2) positive SLK anomalies (figure 5, anomalies 8, 9 and 10); and 3) the reactivation of the ending part of the main basins evidenced by convex shaped hypsometric curves (figure 3); and 4) knick points in the river topographic profiles that coincide with the position of the tip fault line and SLK anomalies (figure 4, Pintado). The southern segment is more active than the northern one according to the mountain front sinuosity values.

The development of new mountain fronts related to sinistral-reverse Alhama de Murcia fault segments in the Eastern Betics since the middle Pleistocene has promoted the growth of transverse drainage systems like the Rambla de Lebor and Totana. These ramblas are capturing a previous NE-SW oriented drainage network inherited from Late Miocene extension. The interference between the old NE-SW oriented basin and the more recent NW-SE directed ones has resulted in the formation of basins with L-shape.

The capture processes are evidenced by the presence of wind gaps, abrupt changes in flow direction and SLK anomalies. The minimum linear long-term retreat rate of the newly developed drainage is 10mm/yr.

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