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Tectonic control of the Guadiana Basin drainage development (Iberian Peninsula, Spain)

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Far from plate margins, where tectonic activity is of low intensity over long time periods, relief evolves over million years and is the outcome of long-term interplay between building and erosion processes. Forms created by individual tectonic structures are difficult to recognise due to extensive reworking or their disappearance altogether yet, on the regional scale, the decisive role of tectonics in relief building is evident. This is the case of the Atlantic divide of the Iberian Peninsula in which we examined the drainage basin of the Guadiana River. It is the southern one of a series of E-W to NE-SW trending sedimentary basins infilled with continental materials and separated by parallel mountain chains. Such tectonic units arose from the convergence of European and African plates during the Alpine orogeny. Alpine tectonics reshaped the ancient post-Variscan landscape to create elevated and depressed zones that were to control river patterning.
To examine the relationship between Alpine crust deformation drainage, we undertook a spectral analysis of the topography and we constructed subenvelop maps of the drainage network. We consider that the harmonic surfaces that better describe the main topographic and tectonic features of the area should represent, on the one hand, relationships among the main drainage basins and tectonic units (mountain chains and sedimentary basins) on a regional (peninsular) scale, and on the other hand, show the Alpine structures controlling the current landscape within the large morphotectonic units. On a regional scale the wavelengths of 200 km suits the Guadiana basin and its divides. The basin is described as a gentle depression which an amplitude of 500 m. The subenvelop map shows spaced curves with smooth contours characteristics of plateau zones. The eastern part of the Guadiana Basin shows the characteristics of a perched plain where subenvelops barely indicate the presence of incision, adopting open slightly concave contours. Further downstream, the river Guadiana penetrates Variscan foothills, where it flows through canyons. In its lower section, the Guadiana drainage basin recovers its plateau morphology as it flows again in another Tertiary basin.
The organisation of the plateau zones shows that the drainage pattern is better evolved hydrologically when it crosses sedimentary basins. The rivers have easily incised Tertiary sediments and main river courses mainly run E-W, parallel to the main mountain chains that feed them. As we reach the Iberian Massif outcrops, river channels become entrenched and the network undergoes numerous direction changes. Where changes occurs from a plateau to an incision zone, tectonic accidents with approximately N-S tilts (N20º W-N20º E) can traced, the ones that control the steps between the basement and the Tertiary basins.
Regional wavelengths represent crust folds that controlled the development of the peninsula's drainage network. Drainage is channelled towards depressed area corresponding to synforms, while divides are identified with antiforms. Besides folds of great wavelength, smaller folds and fault activity control the formation of wet, flow convergence lows and elevated drier zones orientated parallel to the average direction of the large geological units. Evolution of tectonic activity forces in this way drainage network integration patterns. The scarcity of a thick sedimentary and fossiliferous record has prevented to date accurately the main events of rivers successive development. At the moment morphostructure analysis is still the best way to adquire relevant information about long-term landscape evolution (Mesozoic-Present) in the Iberian Plate interior.