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# Topography controlled by large scale distributed deformation along the western Africa-Eurasia limit: Tectonic constrains.

G. de Vicente and R. Vegas

Applied Tectonophysics Laboratory. Complutense University of Madrid. Spain
(gdv@geo.ucm.es)

Topography pattern in the Iberia-Morocco zone (at least up to the Atlas), has been recently recognized as large scale folds of regular wavelength, developed both in the Upper Crust and in the whole Lithosphere (Cloetingh et al., 2000. Teixell et al., 2001). This regularity can be observed not only on continental lithosphere, but also on oceanic lithosphere (Muñoz-Martín et al., 2007). This topographic framework can be recognized along more than 2000 km in a NW-SE to N-S trend, and is the result of a very distributed deformation (Vegas..) that affected the western Africa-Eurasia limit during the Cenozoic.

The current research of this particular lithosphere-controlled topography points out to some conclusions on the tectonic environment and the deformation conditions:

1. Considering the macrostructural characteristics of the whole ranges of the Iberian peninsula (including those not nucleated on previous rifted zones, as the Spanish Central System), as well as the principal fault corridors, It is suggested the presence of important changes in the tectonic transport directions. Most of these different tectonic transports were simultaneously active during the Oligocene – lower Miocene. The main vergences are centripetal towards the Duero and Tagus Cenozoic basins. If the associate paleostresses show themselves, a ***neutral point*** necessarily appears in the peninsular interior, which implies some ***constrictive conditions*** of the related deformation (De Vicente et al., 2005). In these circumstances almost every discontinuity is potentially active, so the presence of first order faults (discontinuities affecting the entire upper

crust) can nucleate the deformation imposing, for its previous orientation to the Cenozoic deformation, the stresses characteristics and tectonic local transport.

2. Tectonic modelling results show that lithosphere folding cannot develop without mechanically coupled lithospheres (Cloetingh et al., 2000). Recent paleomagnetic studies (Palencia *et al.*, 2003; Palencia, 2004) indicates that no important relative motion, in the paleomagnetic sense, has occurred at the boundary between Africa and the Iberian Peninsula since the Eocene. This in agreement with the idea that the ***Iberian Plate was moored to Africa*** during the Tertiary (Vegas et al., 2005). It indicates that boundary stresses responsible for the intrapate cenozoic deformation of Iberia-NW Africa zone, inasmuch from Eocene up to Middle-Upper Miocene, must be referred to the Iberia-Europe interface, the Pyrenean border. At least in the Iberian peninsula, the absence of metamorphism or volcanism (even in the main orogenic zone, the Pyrenees, and excluding the Valencia Through extensional processes) up to the Upper Miocene, can point out to a “cooled” reologycal conditions of the cenozoic deformation. From this point of view, Betics-Rif orogen can be considered as a decoupling process by the means of changing the reology (“heating”) within the Alboran domain . The remaining slow convergence initiated at 9 Ma seems to be very distributed over a wide area ? between the Anti-Atlas and the Pyrenees ? and causes the formation of the new Africa-Iberia frontier, in fact a not fully- fledged compressive plate boundary.

3. From the active stresses analysis (De Vicente et al., 2007), along the Euasia-Africa western boundary, the type of stresses progressively changes easternwards from triaxial extension to uniaxial compression along the Terceira Ridge, The Gloria Fault zone and the Gulf of Cadiz. This is accompanied by a clock wise rotation of the $S_{hmax}$ trend, from N137ºE up to N162ºE. Both tendencies are break on the Betics-Alboran-Rif zone, where uniaxial extension predominates with a N155ºE $S_{hmax}$. In the Tell (N Algeria), uniaxial compression reappears (N150ºE $S_{hmax})$. In the Iberia foreland zones, the extension increases from South to North and from West to East, so in the NE corner of the Iberian Peninsula, traxial extension appears, whereas the SW zone is close to uniaxial compression. Western most part of the Central Iberian Ranges (Montejunto and Sintra in Portugal) undergoes active NE-SW thrusting. Since during the Pliocene, easternwards Central Ranges of similar trends were also active (Guadalupe), it seems to be clear that manteaining a NW-SE $S_{hmax}$, extension has migrated westwards since the Pliocene up to the current situation. It points out to the idea that western most part of Iberia and Morocco are still mechanically coupled. This process must have been simultaneous to the Bet-

ics extensional collapse what avoided the transmission of compressive stresses towards the foreland. Considering this idea, the ***neotectonic period*** throughout the Iberia foreland, ***increases towards the west***. Close to the Atlantic border, same tectonic stresses have been acting for tens of million years.

4. Erosion processes predominate up today in the considered zone. Most of the Iberian cenozoic basins underwent a large stage of endorheic lacustrine sedimentation during the Neogene, that developed an incising river network during Late Miocene-Quaternary, when tectonic deformation was minor. As tectonism ends, shallow lakes at high altitudes undergo a faster capture and extinction. Such capture is relatively abrupt (in the order of hundreds of thousands of years according to the model predictions) and produces a sudden increase in sediment discharge that might start after several million years of tectonic quiescence (García-Castellanos et al., 2005). These results suggest that climate and drainage reorganizations, controlled the timing of surface sediment transport since the Late Miocene in the Iberian Cenozoic basins. From this analysis, the ***endorheic-exorheic transition*** of the intraplate basins is a delayed effect of the mechanical decoupling between Iberia and Africa.