



Late Cenozoic vertical tectonic displacements in mainland Portugal (West Iberia)

J. Cabral (1), P. Cunha (2), A. Martins (3), A. Ribeiro (1)

(1) Lisbon University and LATTEX, Portugal, jcabral@fc.ul.pt, (2) Coimbra University, Portugal, (3) Évora University, Portugal.

The morphology of the Portuguese mainland is characterized by erosional plateaus elevated to different heights, cut on metasedimentary rocks and granites of the Palaeozoic Hesperian Massif. The relief distribution (43% in area below 200 m, 30% above 400 m, and only 0.5% above 1200 m) reflects the amplitude of the vertical movements. About 95% of the areas above 400 m of altitude are located in the northern and central parts of the country. In the central region, uplift was the greatest, rising the Portuguese Central Range to a maximum elevation of nearly 2000 m. This ENE-WSW trending mountain chain is roughly aligned with the Spanish Central System.

Although difficult to age precisely, the vertical movements are reasonably well characterized mainly by geomorphologic criteria and through the study of the Mesozoic and Cenozoic sedimentary record. During Cretaceous times, the western sector of the Hesperian Massif, as for much of Iberia, had a relatively low and gentle topography close to sea level. Interplate interaction at the Pyrenean and Betic collision zones, during Eocene-Oligocene and Miocene times respectively, originated intraplate compressive stresses which acted upon cratonic Iberia reactivating major Late-Variscan faults. By middle Eocene times, significant uplift had occurred in N Iberia and two SW-NE elongated grabens (Mondego and Lower Tagus Tertiary basins) start to open, symmetrically with the opening of the Spanish Douro and Madrid Tertiary basins. This was coeval with the tectonic inversion of the Mesozoic rifted Algarve basin, located at the SW border of Iberia. In the Miocene, compression was intensified causing inversion of the Mesozoic Lusitanian basin at the W. It also generated NE-SW trending upthrust basement blocks and related fore-deep basins, as the Portuguese Central Range/Western Mountains and the correlative piedmont basins, as well as push-up blocks and pull-apart basins along strike-slip faults zones trending NNE-SSW. Gentle

lithospheric folding also developed large wavelength topographic highs and lows.

Yet, the regional geomorphologic and stratigraphic data indicate that the vertical displacements of the crust at the Portuguese mainland during the Cenozoic were relatively modest. In areas subjected to subsidence, the old polygenetic erosional surface was covered and preserved under a sedimentary cover. Outside the basins it was subjected to erosive retouching in regions of relatively minor and slow uplift, while more intense erosion of Variscan rocks occurred in faulted blocks, where stepped erosional surfaces were developed, the older often being still preserved as a plateau at the top. This contrasts with the intense Neogene rock uplift and denudation proposed by several authors for uplifted areas of Iberia, based upon fission track studies (e.g. Cloetingh et al. 2002, 2005).

The general change from sedimentary infill to fluvial incision during the Late Pliocene suggests an increase in the regional uplift rate. Drainage entrenchment since the Gelasian caused exhumation of the Cenozoic sedimentary cover and re-exposure of old erosional surfaces in wide areas. Assuming an age of 2.6 Ma for the culminant surface of the regional sedimentary basins, incision rates of 0.05 to 0.13 mm/yr can be estimated over that period. For the coastal region, vertical movements were evaluated from raised marine terraces, and average uplift rates of around 0.1 mm/yr since the Piacenzian were estimated.

These uplift rates are low comparatively to values obtained for other regions subjected to active tectonics, although the rates inferred for the Portuguese coastal region are high comparatively to other continental margins. A geodynamic model of activation of the Portuguese passive margin by horizontal compressive stresses seems to be compatible with values of this magnitude.