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Morphotectonic significance of the main lineaments in the Iberian Massif (Portugal and Spain)

Interpretação morfotécônica dos principais lineamentos no Maciço Ibérico (Portugal e Espanha)

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ABSTRACT

Lineaments are traditionally associated with analysis of aerial photographs and satellite and space images; although in their original definition they were merely considered as significant lines of landscape, caused by joints and faults which are observed mainly on topographic maps and less frequently in geological ones (Hobs, 1904). In essence, they are surface features represented by alignments of ridges and furrows which are considered to reveal the deep, subsurface, architecture of the rock basement (Antón, 2004).

Tectonic characterization of topographic features has recently become a major concern due to the increased interest on neotectonics and sismotectonics. The observed lineaments – alignments of geomorphic features such as hills, ravines and scarps – are considered here as surface expression of deep-seated features, following the general accepted consensus. They must represent a very complete image of the regional brittle tectonic fabric.

With this perspective, we have generate a DEM map at scale 1:100.000 for the central-western Variscan (Iberian) Massif and extracted from it the main, apparent, lineaments. We have chosen this regional scale as the most appropriate for describing an enlarged regional brittle fabric of the western Iberian Variscan basement as well as for establish a tectonic-related frame for the main geomorphic features characterizing the area here studied (Vegas et al., 2012).

Three main sets of lineaments have been identified on the basis of their orientations and spatial linkages: a) NNE-SSW to NE-SW (N10-30° to N45°), b) ENE-WSE to E-W (N80° to N90°) and WNW-ESE (110°) and c) NNW-SSE (N130°- N140°) to N-S. They are conspicuous in all the area investigated but some of them do predominate in specific regions obscuring the occurrence of the others (Figure 1).

With these premises, the lineaments of the Group a) are unequivocally related either to the N10° trending Vilariça and Regua-Verin faults or to the N45°-trending Plasencia (Messejana-Plasencia) Fault or Dike-fault System. These three faults have been

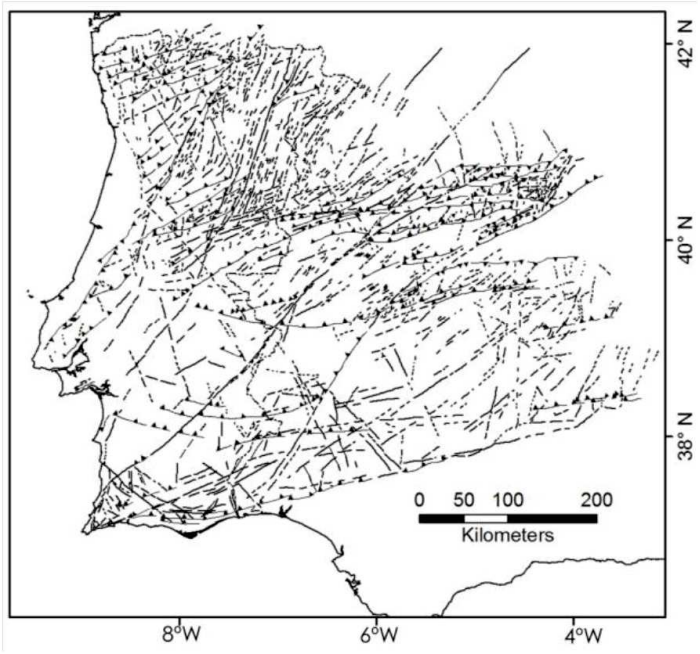

Figure 1. Map of lineaments in the West-Central Hesperic Massif. Lines indicate fractures or faults with mainly transcurrent movement; barbed lines indicate thrusts.

described as transcurrent, left-handed strike-slip faults with small lateral movement with regard to its length, a maximum of 3 km lateral off-set for more than 500 km length in the Plasencia Fault.

The lineaments of the Group b) – ENE-WSE to E-W (N80° to N90°) and WNW-ESE (110°) – correspond to thrusts and reverse faults that cause, or are linked to, basement uplifts. This is the case of the Ponsul Fault and the lineament corresponding to Northern Border of the Central System. Thereafter, the slightly curved, festoon-like lineaments are here classified as thrusts that delimitate regularly highs and depressions in the topography.

The lineaments of the Group c) – N130°-140° and N-S – show a much less influence in the topography. They contribute passively to the formation of the reliefs and must be correlated to previous faults (or brittle fabric) that does not take or take an insignificant part of the Cenozoic deformation. Within these lineaments one can mention the Porto-Tomar lineament guessed to be a Variscan first-order structure.

The overlook of an extensive area permits also the ascription of the main topographic features to the general frame drawn by the observed lineaments. In this sense, it is possible to establish the interdependence between the overall attitudes of the main geomorphic units – i.e. the regional arrangement of the reliefs in the studied area – and the tectonic structures. This allows a first interpretation of the main geomorphic features in terms of the recent tectonic evolution resulted in the Paleogene and Neogene compressive events (N-S and NW-SW directed respectively, De Vicente and Vegas, 2009). Those main geomorphic features correspond to (Figure 2):

- Two broad, relatively flat areas, the Northern and Southern Mesetas comprising the Variscan basement and its Cenozoic cover of the broad Duero and Madrid (Upper Tagus) basins.
- Three E-W oriented swaths of basement uplifts that constitutes the main elevations of the western Iberian Peninsula, the Central System, most prominent relief – the main divide, the backbone of the early geographers – and the more modest ranges of the Montes de Toledo and the Sierra Morena Ranges in the Southern Meseta.
- Two NNE-SSW oriented, relatively narrow topographic

corridors composed of anastomosed, elongated ridges and basins, the Vilariça and Regua corridors. Their constrictive northern terminations constitute the reliefs of the NW Portugal-Leon ranges

- Three Cenozoic basins in the interior of the Variscan basement of the southern Meseta, Campo Arañuelo – between the Central System and the Montes de Toledo – Castelo Branco and Guadiana. Other minor basins in the Southern Meseta must be included in this type of features
- Two open-to-the-sea Cenozoic basins, Lower Tagus and Sado

To these morphotectonic units, two basement elevations can be added: the Alentejo and Calatrava Swells that correspond clearly to the Neogene compressive event.

The extraction of lineaments from a large-scale, 1:000.000, DEM map for the West-Central Variscan basement of the Iberian Peninsula has made possible the realization of a lineament map which provides a manageable method to link regional geomorphic features to intraplate tectonics. Also the lineament map brings a regional frame that enlarges the brittle tectonic fabric and serves to complete the mapped faults and fractures in the studied area.

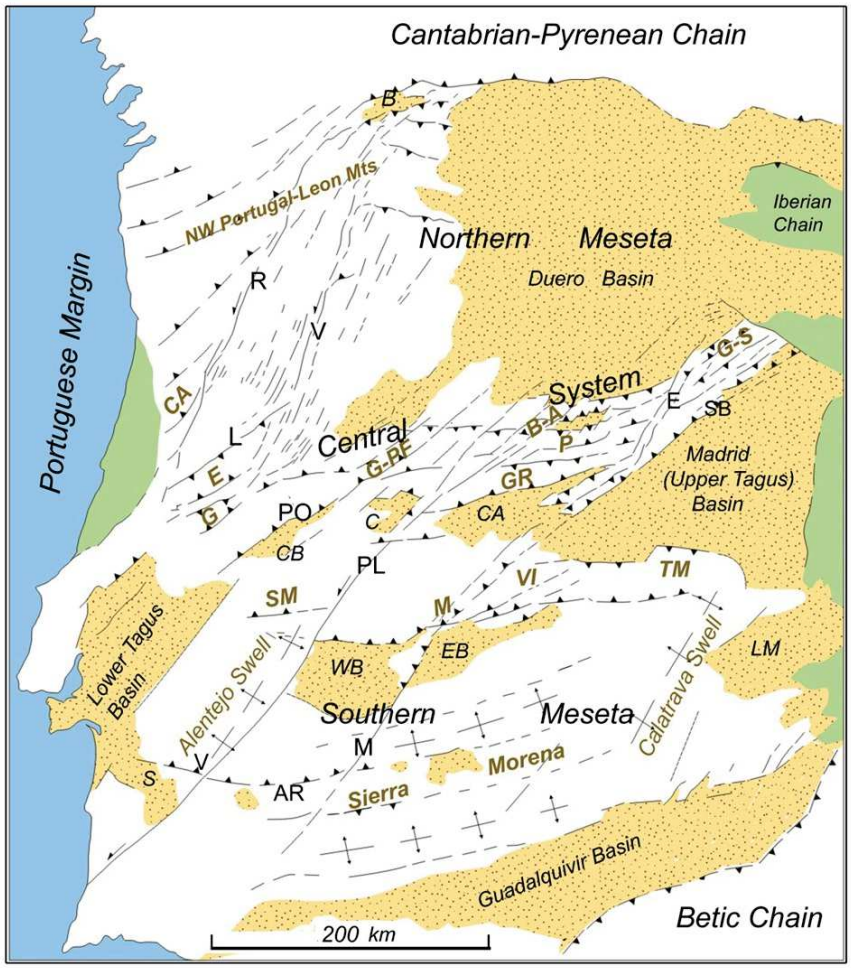

Figure2. Major lineaments and morphotectonic units in the Iberian Massif. Thin lines indicate lineaments related to strike-slip fault and sheared zones; barbed lines correspond to thrust-related lineaments. *Long fault corridors*, PL: Plasencia-Messejana, M: Merida, E: El Escorial, R: Regua, V: Vilariça. *Thrusts and ridges*, AR: Ardila, CA: Caramulo, B-A: Bejar-Avila, E: Estrela, G: Gardunha, GR:Gredos, G-RF: Gata-Sierra de Francia, G-S: Guadarrama-Somosierra, L: Lousã, M: Montanchez , P: Paramera, PO: Ponsul, SB: Southern Border (Central System), SM: São Mamede, TM: Toledo Mountains VI: Villuercas. *Cenozoic basins*, C: Coria, CA: Campo Arañuelo, CB: Castelo Branco, EB: East Badajoz, LM: La Mancha, S: Sado, WB: West Badajoz

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