# The Iberian Chain: tertiary inversion of a mesozoic intraplate basin

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## ABSTRACT

*The Mesozoic Iberian basin developed inside the Iberian plate in the eastern end of the Tethys sea. As a result of the Tertiary convergence between the Iberian plate with the European and African plates, the Iberian basin was contractionally inverted, giving rise to the Iberian and Catalan Coastal chains and the surrounding Tertiary basins. The Bouguer anomaly map of the area shows that the Iberian Chain has crustal roots which would have produced during the Tertiary contractional period.*

***Key words:*** *intraplate deformation, crustal-scale deformation, contractional basin inversion. Iberia.*

The Mesozoic Iberian basin spread in the present day Iberian and Catalan Coastal Chains and parts of the surrounding Ebro, Duero and Tajo Tertiary basins (Fig. 1). It developed since the late Permian, and four periods can be distinguished during its evolution (Álvaro *et al.*, 1979; Salas *et al.*, 2000): 1) late Permian-Triassic rifting, in which a Germanic-type Triassic sedimented in half grabens mostly oriented NW-SE; 2) early to middle Jurassic post-rift thermal subsidence, with late Triassic to middle Jurassic alkaline magmatism; 3) late Oxfordian to early late Albian rifting, which produced four localized, strongly subsident (up to 5 km of sediments) subbasins (Cameros, Maestrat, Columbrets and South Iberian basins); 4) late Albian to late Cretaceous post-rift thermal subsidence. As a result, the thickness of the Mesozoic rocks varies from 1.000 to 7.000 m within the Iberian Chain. Cumulative Mesozoic crustal extension across the Iberian Basin is difficult to estimate but may have been as much as 45 km.

Most of the Iberian Rift System was inverted during the Paleogene, forming the Iberian and Catalan Coastal Chains. These chains show intraplate contractional structures (thrusts, folds and strike-slip faults) that strike NW-SE, NE-SW and E-W. The Paleogene phase of contractional intraplate deformation was directly related to the collisional interaction of the Iberian craton with Europe during the Pyrenean orogeny (Guimerà and Álvaro, 1990) during the Eocene to early Miocene times, and with Africa during the Miocene (Betic Chain). The Ebro Basin is the southern flexural foreland basin of the Pyrenees.

The Iberian Chain (Fig. 2) is a double-vergent fold-and-thrust belt whose overall structure is defined by two arches striking NW-SE with a wave-length ranging from 71 to 119 km; within them Tertiary contractional deformation is basement involved. The cores of both arches are located on a thickened crust (deduced from the gravimetric anomalies) which mimics their shapes; the arches are neatly separated by the Almazán basin and merge towards the SE (Teruel area), where a wide gravimetric minimum can be observed, which corresponds to the area of thicker crust (up to 43 km, Salas and Casas, 1993). Hence, both arches are crustal-scale structures.

Many of the structures of the Iberian and Catalan Coastal Chain are interpreted as being associated with the compressional reactivation, during the Palaeogene and early Miocene, of the major extensional faults which bounded Mesozoic rift basins. The kinematics of reactivation of such faults depended largely on their orientation with respect to the regional compression (approximatively N-S, perpendicular to the Pyrenees, Guimerà and Álvaro, 1990).

The magnitude of Paleogene crustal shortening (Fig. 3) is estimated by 75 km ± 12 km during the Paleogene contractional phase by comparing the present-day crustal profile with a profile restored to end-Mesozoic times, prior to the Tertiary compression (Guimerà *et al.*, 1996). From geological cross-sections, a shortening of 38 km is reached across the northern arch, whereas in the southern arch shortening is estimated as being 19 km; a total shortening of 57 km is then obtained (Salas *et al.*, 2000), taking into account only plurikilometric folds and thrusts, giving a

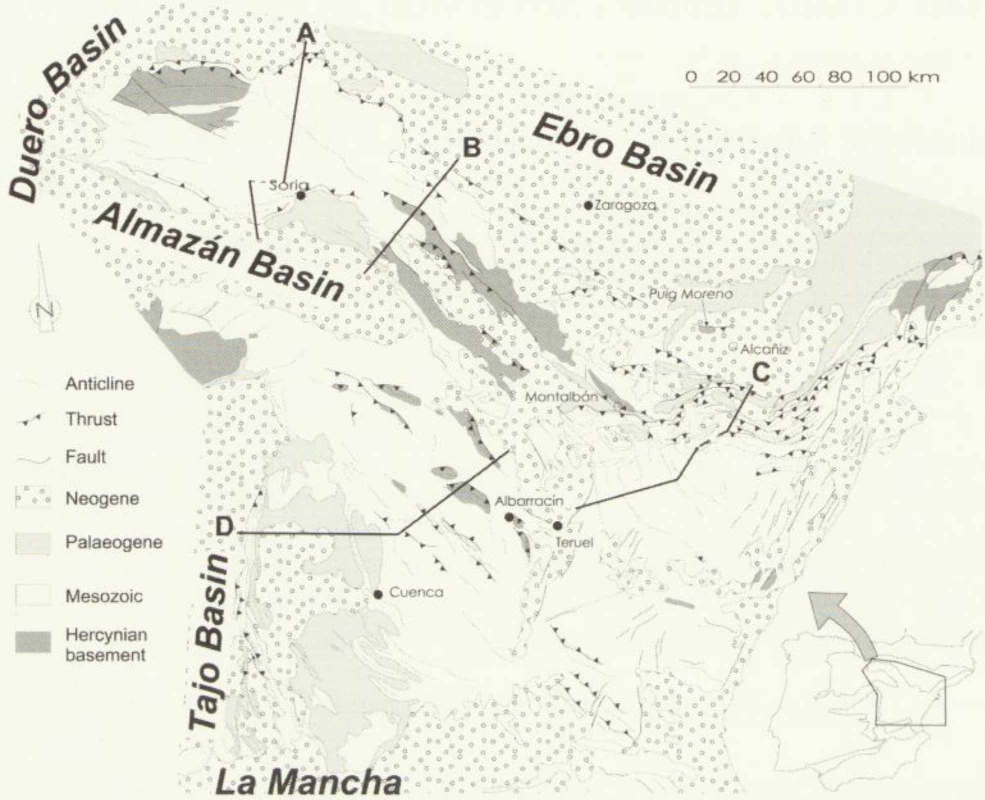


FIGURE 1: *Geological map of the Iberian Chain and surrounding Tertiary basins, showing location of structural cross-sections of figure 3.*


FIGURE 2: *Bouguer contour anomaly map of the Iberian Chain and surrounding areas (after Mezcua* et al., *1996). Contour intervals are 10 mGal. The boundaries between the main structural divisions of the Iberian Chain (gray lines), the basement-involved area (stippled) and the location of the two crustal arches (the thicker black line separates them) are also shown.*

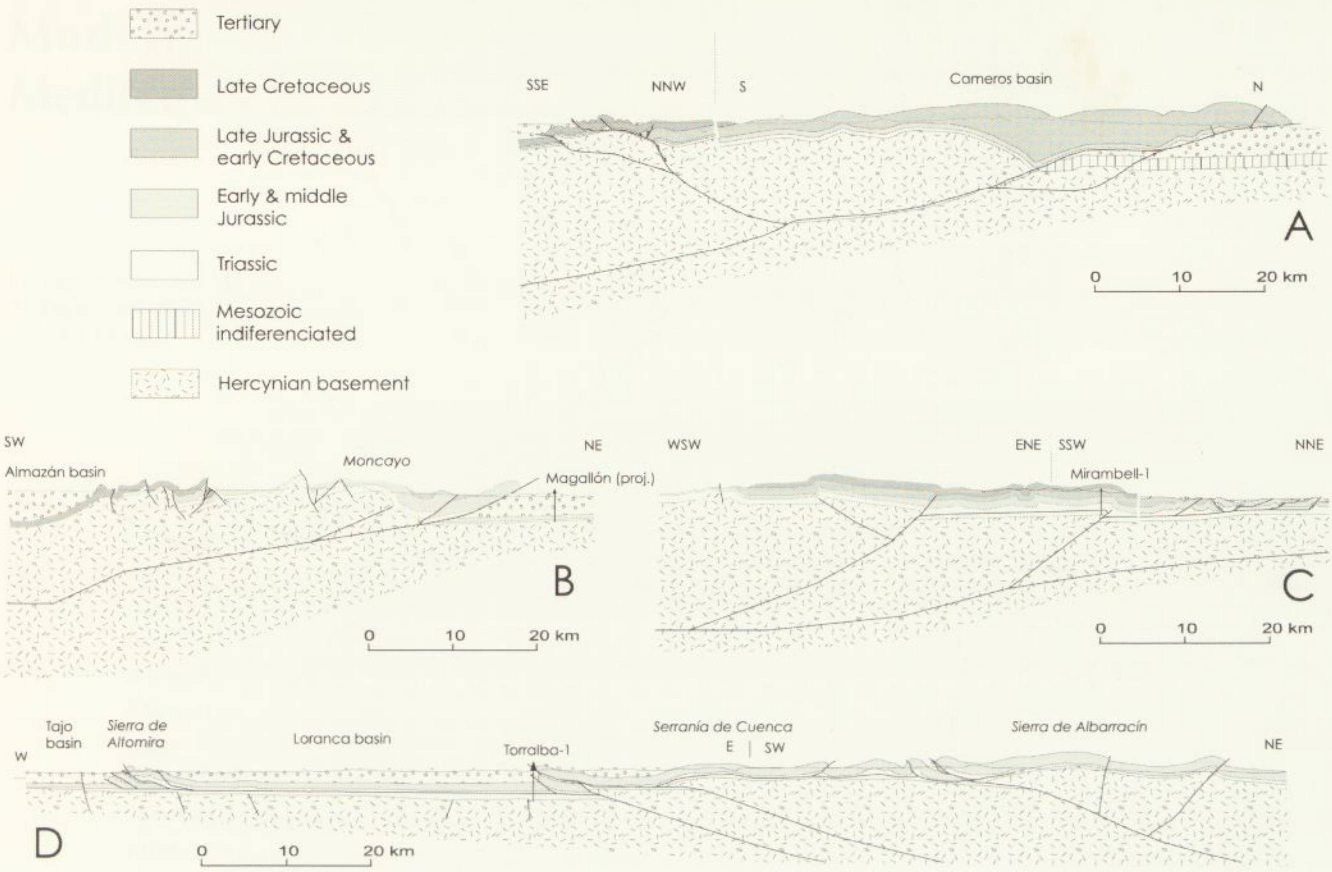


FIGURE 3: *Structural cross-sections of the Iberian Chain. Location in figure 1.*

conservative estimate: probably the total shortening should be larger. Hence, shortening deduced from the cross-sections and the crustal model compare fairly well.

The geometry and dimensions of the Paleogene thrust system, involving the basement of the Iberian Chain, indicates an upper to mid crustal detachment level that can account for upper crustal shortening. Therefore, shortening at deeper crustal and lithospheric levels must have been accommodated either by ductile mechanisms (Guimerà *et al.*, 1996), or by an incipient subduction mechanism (Salas and Casas, 1993). As indicated by the post-inversion crustal configuration of the area, syn-inversion deformation of the crust was probably of the heterogeneous pure-shear type (heterogeneous thickening), resulting in the development of a deep crustal keel (Guimerà *et al.*, 1996). Whether this keel is associated with an offset of the Moho discontinuity or not remains unsolved.

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