THE EXPRESSION OF CONVERGENCE RATE AND SLAB PULL IN FORELAND BASINS

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Cenozoic orogenic belts of the Mediterranean region display different structural and morphological characteristics that are predominantly controlled by the dynamic environment in which each belt evolved. Belts that formed in environments dominated by convergence due to external plate motions generally have high topography, marginal thrust belts consisting of shallow water passive margin sediments and molasse, cores of high-grade metamorphic rocks, significant involvement of crystalline basement, extensive post-collisional convergence, and commonly develop antithetic thrust belts. Those belts that form in environments dominated by slab pull generally have low topography, marginal thrust belts dominated by flysch, low-grade metamorphism, lack significant involvement of continental crystalline basement, lack antithetic thrust belts, lack significant post-collisional convergence, and commonly display extensional deformation in the back-arc to inter-arc region. The forces operating in these two different dynamic settings are clearly expressed in the deflection of the foreland lithosphere adjacent to the thrust belts. In settings where deformation is driven by large-scale plate convergence and where plate convergence is occurring more rapidly than subduction, flexural bending of the foreland lithosphere occurs primarily in response to loading of the lithosphere by thrust sheets; the depth and geometry of these foreland basins are roughly consistent with the size of the adjacent mountain belt. In settings where deformation is driven by forces acting on the subducted slab (probably largely related to the negative buoyancy of the subducted slab) and subduction is occurring more rapidly than large-scale plate convergence, flexural bending of the foreland lithosphere occurs primarily in response to forces transmitted to the foreland from the subduction zone. In these settings loading of the foreland lithosphere by thrust sheets contributes to the loading of the foreland in only a minor way (or in some cases not at all) and the foreland basin is typically much deeper and sits much farther in front of the adjacent mountain belt than would be expected from the size of the mountain belt itself. The systematic pairing of topographically high mountains with relatively shallow foreland basins in tectonic settings dominated by large-scale plate convergence is conducive to the protracted history of molasse deposition observed in these belts, as sufficient material is usually available to keep the foreland basins filled with coarse clastic material. In contrast, the systematic pairing of topographically low mountains with relatively deep foreland basins in tectonic settings dominated by slab-pull is conducive to the protracted history of flysch deposition observed in these belts, as the sediment source is commonly insufficient to fill the adjacent foreland basin, resulting in deposition of predominantly fine-grained material in deep water conditions via submarine fan development. The Late Paleozoic Ouachita thrust belt of the south-central US, and its associated foreland basin, displays most if not all of the characteristics of more recent thrust belts that formed in an evnironment dominated by slab pull.