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Meso-Cenozoic intraplate contraction in Central and Western Europe: a unique tectonic event?

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From the British Isles to Poland, Europe experienced contractional deformation in Late Cretaceous and Paleogene time. The closest contemporaneous plate margins were the incipient Mid-Atlantic rift in the west and northwest, and the Mediterranean system of subduction zones in the south. Each of these plate margins was located more than 1000 km away from the site of deformation. This tectonic event thus represents an outstanding example of large-scale intraplate shortening and may serve as a template for comparison with modern examples. Its effects are seen in a ca. 500 km wide strip that stretches in NW-SE-direction along the Tornquist Line, a regional fault zone separating thick lithosphere of the Baltic Shield from much thinner lithosphere to the southwest. Most faults and folds also trend NW-SE, but some are linked by large N-S-striking transfer zones. In the southeast, the shortening structures are truncated by the Neogene Carpathian thrust front; their original extent is unknown. In the west, the fault zones fan out into more northerly trends in the Central North Sea and more easterly trends in the Channel area before dying out on the shelf. Late Cretaceous (ca. 90-70 Ma) shortening dominates from Poland to the North Sea, while the main shortening event in Southern Britain is of Paleogene age. Many Late Cretaceous to Paleogene structures have been conditioned by Permian or Triassic through Early Cretaceous extensional faulting, whereas some large basement uplifts and reverse faults have no demonstrable inheritance from earlier extension. The thick, mobile Zechstein salt has modified extensional and contractional structures, but both extend beyond its depositional borders. Even where thick evaporates underlie the Mesozoic sedimentary cover, the basement is typically involved in the deformation, except for localized thin-skinned imbricate thrusting and salt-cored anticlines. Different structural styles do not appear to correlate with the magnitude of shortening which is similar for transects across the inverted Lower Saxony Basin and areas of predominant basement thrusting. Bulk contraction of the entire deformed belt is unlikely to exceed a few tens of kilometers, corresponding to «10% of horizontal shortening. Shortening rate estimates are around 1 mm/yr both for well-constrained local structures and for order-of-magnitude estimates of the entire belt, suggesting that a limited number of faults were active at any given time. Space geodetic data indicate similar modern shortening rates across Central Europe on a decade scale, but there is no geologic evidence for focused deformation comparable to the Mesozoic event. Fold orientations, fault slip data and stylolite teeth indicate relatively uniform, SSW-NNE-directed shortening. This direction is consistent with the convergence direction of Africa, Iberia and Eurasia that was established between ca. 120 Ma and 85 Ma in the course of global plate motion reorganization. The European short-lived pulse of intraplate deformation was apparently caused by a switch to near-orthogonal convergence across former transform boundaries, whereas modern examples of intraplate shortening seem to be bound to coeval orogens.