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Testing causes for the European mid-Paleocene inversions

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For a period of approx. 20 Myr during the Late Cretaceous, the Paleozoic and Mesozoic rifts and basins on the European continent experienced compressional shortening and inversion. On the order of 10e3m of erosion occurred along the inversion axes; the convergence of Africa and Europe has conventionally been held responsible. A second stage of inversion of the same structures occurred in the mid-Paleocene; however, this differed in structural style by being domal and non-ruptural with amplitudes on the order of 10e2m. Furthermore, within the chronostratigraphic resolution, the onset of the mid-Paleocene phase occurred synchronously at about 60 Ma. The different styles of inversion call for different explanations and, recently, the second phase of inversion has been explained by a relaxation or rotation (rather than further compression) of the in-plane stress field of the first Late Cretaceous phase. This model explains the domal, non-ruptural inversion style, the amplitude of the inversion, and the formation of secondary marginal troughs that controlled the deposition of post-mid Paleocene Paleogene sediments in central and northwest Europe. The problem addressed in this paper is the possible cause of the mid-Paleocene stress relaxation (or rotation). If the cause of the Late Cretaceous inversion phase is to be found in stresses generated at the boundaries of the plate and transmitted into the interior of the plate through the competent lithosphere, then it is likely that the relaxation phase is caused by a change in the plate boundary conditions. As the relaxation phase is synchronous across the plate, whatever change occurred must have affected the entire plate almost simultaneously. The main stress generating processes at the boundaries of the European plate in mid Paleocene times comprise 1) the African-European plate interaction, 2) the mid-ocean rift system of the Atlantic Ocean, and 3) the uplift of the North Atlantic lithosphere

by the rising Iceland plume. Of these, the effects of 2) and 3) are relatively straightforward, giving rise to compression radiating away from the region of action, while the effects of 1) are ambiguous with the possibility of compression, extension, shearing, or acting as a passive back-stop. We use a thin elastic flexural model, pre-loaded with the Late Cretaceous European inversion structures, to calculate small-amplitude intra-plate vertical deflections as a function of plate boundary stress and test different hypotheses about the cause of the mid-Paleocene stress relaxation.