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Restoration of the Cretaceous uplift of the Harz Mountains, North Germany: Evidence for thick-skinned thrusting

David C. Tanner (1) and Charlotte M. Krawczyk (2,3)

(1) Leibniz Institute for Applied Geophysics, Hannover, Germany (davidcolin.tanner@liag-hannover.de), (2) Helmholtz Centre Potsdam, GFZ German Research Centre for Geosciences, Telegrafenberg, 14473 Potsdam, Germany, (3) TU Berlin, Ernst-Reuter-Platz 1, 10587 Berlin, Germany

Fault prediction and kinematic restoration are useful tools to firstly determine the likely geometry of a fault at depth and secondly restore the pre-deformation state to discover, for instance, paleogeometry. The inclined-shear method with constant slip uses the known geometry of the surface position and dip of the fault and the geometries of the hanging and footwall beds to predict the probable shape of the fault at depth, down to a detachment level.

We use this method to determine the geometry of the Northern Harz Boundary Fault in northern Germany that was responsible for the uplift of the Harz Mountains during Late Cretaceous inversion. A shear angle of 30° was most likely in this case, as indicated by geological and geophysical data. This suggests that the detachment level is at a depth of ca. 25 km.

Kinematic restoration of the Harz Mountains using this fault geometry does not produce a flat horizon, rather it results in a 3.5 km depression. Restoration also causes a rotation of fabrics within the Harz Mountains of approximately 11° clockwise. Airy-Heiskanen isostatic equilibrium adjustment reduces the depression to ca. 1 km depth, as well as raising the Moho from 41 to 36 km depth. We show that this model geometry is also a very good fit to the interpreted DEKORP BASIN 9601 deep seismic profile.