



Dynamics of mid-Paleocene North Atlantic and African plate boundaries linked by European intra-plate deformations

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The process of continental break-up provides a large-scale experiment that can be used to test causal relations between plate tectonics and the dynamics of the Earth's deep mantle. Detailed diagnostic information on the timing and dynamics of events, which are not resolved by plate kinematic reconstructions, can be obtained from the response of the interior of adjacent continental plates to stress changes generated by the plate boundary processes. Here we demonstrate a causal relationship between North Atlantic continental rifting at ~ 62 Ma and an abrupt change of the intra-plate deformation style in the adjacent European continent. The rifting involved a left-lateral displacement between the N American-Greenland plate and Eurasia, which initiated the observed pause in the relative convergence of Europe and Africa. The associated stress change in the European continent was significant and explains the sudden termination of ~ 20 Myr of Late Cretaceous to earliest Paleocene contractional intra-plate deformation within Europe to be replaced by low-amplitude intra-plate stress-relaxation features. The pre-rupture tectonic stress was large enough to have been responsible for precipitating continental break-up, without the necessity of invoking a thermal mantle plume as a driving mechanism. The model explains the simultaneity of a number of diverse geological events and how the intra-continental stratigraphic record can reveal accurate details about the timing and dynamics of processes causing stress changes not resolved by reconstructions based only on plate kinematics.