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Plate tectonic chain reaction constrained from noise in the Cretaceous Quiet Zone

Derya Gürer^{1,2}, Roi Granot³, and Douwe J.J. van Hinsbergen²

¹Department of Earth Sciences, Utrecht University, The Netherlands

²School of Earth and Environmental Sciences, The University of Queensland, Australia

³Ben-Gurion University of the Negev, Israel

The relative motions of the tectonic plates show remarkable variation throughout Earth's history. Major changes in relative motion between the tectonic plates are traditionally viewed as spatially and temporally isolated events linked to forces acting on plate boundaries (i.e., formation of same-dip double subduction zones, changes in the strength of the boundary), or thought to be associated with mantle dynamics. A Cretaceous global plate reorganization event has been postulated to have affected all major plates. The Cretaceous 'swing' in Africa-Eurasia relative plate motion provides an ideal test-bed for assessing the temporal and spatial evolution of both relative plate motions and surrounding geological markers. Here we show a novel plate kinematic model for the closure of the Tethys Ocean by implementing intra-Cretaceous Quiet Zone time markers and combine the results with the geological constraints found along the convergent plate boundary. Our results allow to assess the order, causes and consequences of geological events and unravel a chain of tectonic events that set off with the onset of horizontally-forced double subduction ~105 Myr ago, followed by a 40 Myr long period of acceleration of the Africa relative to Eurasia that peaked at 80 Myr ago (at rates four times as high as previously predicted). This acceleration, which was likely caused by the pull of two same-dip subduction zones was followed by a sharp decrease in plate velocity, when double subduction terminated with ophiolite obduction onto the African margin. These tectonic forces acted on the eastern half of the Africa-Eurasia plate boundary, which led to counterclockwise rotation of Africa and sparked new subduction zones in the western Mediterranean region. Our analysis identifies the Cretaceous double subduction episode between Africa and Eurasia as a link in the global plate tectonic chain reaction and provides a dynamic view on plate reorganizations.