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Indo-Atlantic plate accelerations and tectonic reorganisations in the Late Cretaceous: no need for plume-push forces

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Observations of the apparent links between plate speeds and the global distribution of plate boundary types have led to the suggestion that subduction may provide the largest component in the balance of torques maintaining plate motions. This would imply that plate speeds should not exceed the sinking rates of slabs into the upper mantle. Instances of this 'speed limit' having been broken may thus hint at the existence of driving mechanisms additional to those resulting from plate boundary forces. The arrival and emplacement of the Deccan-Réunion mantle plume beneath the Indian-African plate boundary in the 67-62 Ma period has been discussed in terms of one such additional driving mechanism. Its spatial and temporal coincidence with an abrupt speed-up of the Indian plate has led to suggestions that the arrival of plumes at the base of the lithosphere can introduce a push force capable of overwhelming entire circuits of plates and triggering plate tectonic reorganizations.

We challenge the occurrence of a pulse of anticorrelating accelerations and decelerations in seafloor spreading rates around the African and Indian plates and, with it, the proposal that plume-related forces in the Indian Ocean had a significant impact on the Indo-Atlantic plate circuit in late Cretaceous and Paleogene times. Using existing and newly-calculated high-resolution models of plate motion based on seafloor spreading data, we show that the increase in divergence rates previously documented for ridges bordering the Indian plate is artefactual. Records from spreading centers throughout the Indo-Atlantic plate circuit show an ubiquitous increase in plate divergence rates at 67-64 Ma, which is best explained in terms of a timescale error affecting chrons 29-28. Corrected for this error, the motion of the circuit's plates show little change around Deccan times. Furthermore, we find that Post-Deccan reorganization of the Indo-Atlantic plate circuit can be explained in terms of long-term plate boundary evolution without the need to invoke a large additional plume push force in the 70-60 Ma period.