



Double-rift nucleation above inherited crustal weaknesses using 2D numerical models, example of the Pimenta Bueno and Colorado grabens, Parecis Basin, Brazil

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Abstract

Weak mechanical heterogeneities inherited from previous tectonic cycles are known to work as nucleating rifting-seeds during subsequent continental rift development. However, during rift-to-drift evolution the common occurrence of double-rifting, in which two main rift branches evolve before only one of them renders continental break-up, is still not fully understood. We have performed a numerical study inspired by the initial stages of development of the Pimenta Bueno and Colorado sub-parallel grabens of the Parecis Basin in the centre-west of Brazil. These structures seem to have been formed as the result of the reactivation of inherited basement heterogeneities. We studied the influence of pre-existent rifting-seeds in the nucleation, and potential tectonic interference, of early formed grabens during rifting of a continental crustal segment. We considered not only the influence of the number and distance at which the seeds are located, but also the potential mechanical control exerted by different archetypal crustal rheological configurations. Our results show that none of these factors alone can explain the mechanics underlying the formation of early rifting geometries and the subsequent crustal break-up configurations. It is only when their combined influence is considered that a coherent explanation for these diversified geometries and modes of evolution arises. Moreover, in view of this new insight, it becomes apparent that double rifting is what to expect when only a single rifting-seed is present in the crust, or even in the absence of any inherited weaknesses, providing a possible explanation for the ubiquity of this type of rifting pattern in nature.