



Effects of multi-extensional tectonics in a cratonic area: 3D numerical modeling and implications for the Congo Basin

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The Congo basin (*CB*), also named Cuvette Centrale for its bowl shape, occupies a large part of the Congo Craton, which is composed of several amalgamated Archean cratonic blocks, surrounded by Paleo- and Meso- Proterozoic mobile belts. It started to form from a rift phase, during the late Mesoproterozoic (about 1100 Myr). This age, obtained from the interpretation of the almost 3000 km of seismic reflection profiles, is older than that assumed in previous studies and corresponds to a time prior to that of Rodinia assembly. In this tectonic scenario, the *CB* formation can be related to one of the final phases of the supercontinent Columbia break-up, resulted in several-failed rift. The extensional phase that produced the formation of a very heterogeneous basement, characterized by several basins and highs, NW-SE aligned, could have been likely the effect of the action of a slow multi-divergent velocity (i.e., multi-directional extension) on a cratonic lithosphere, which have induced the initial subsidence of the *CB* in a weaker part of the craton. The amalgamation of the cratons, composing the basement of the *CB*, likely left a weak zone in the suture areas, corresponding to the central part of the *CB*, which could have been more easily deformed, under the influence of tectonic stresses.

We implemented 3D geodynamic models, using the thermomechanical *3ELVIS* code to test the hypothesis that the complex structures of the *CB* basement are the product of a slow multi-divergent velocity, acting on a cratonic area. The results of the numerical models are used to implement forward gravity models to estimate the temporal variations of the gravity effect of the tectonic structures formed during the simulations. Finally, we compared the forward gravity models with the present-day gravity field, in order to demonstrate the consistency between the modelled and observed main structures of the *CB*. The main results, in terms of topography variations, well reproduce the first-order basement depth variations of the *CB*. In particular, they produce the formation of an almost circular depressed area in the central part of the model, intersected by two strongly subsided elongated structures, orthogonal each other, whose topography tend to increase with time. The comparison between the forward gravity models and the observed gravity anomalies (gravity disturbance variations), shows that two fields are characterized by a similar alternation of weak positive and strong negative gravity anomalies.

However, the modelled anomalies show a smoother trend and higher amplitude, being related to the density and topography variations induced by the upwelling of the asthenosphere, while the observed gravity field is strongly influenced by the sedimentation not simulated in our model.