Geophysical Research Abstracts
Vol. 21, EGU2019-5396, 2019
EGU General Assembly 2019

Reconstruction of the sedimentary structure and subsidence of the Congo Basin using geophysical data and numerical models

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The Congo basin (CB) occupies a large part of the Congo Craton (∼1.2million km2) covering approximately 10% of the continent [1]. It contains up to 9 km of sedimentary rocks from Mesoproterozoic until Quaternary age. The formation of the CB started with a rifting phase during the amalgamation of the Rodinia supercontinent at about 1.2 Gyr ago and the main episodes of subsidence occurred during the following post-rift phases in the Neoproterozoic and Paleozoic, separated by late Pan-African compressional inversion [2]. After a new compressional inversion at the end of the Permian, sedimentation resumed during the Mesozoic and since Cretaceous, the CB has been subjected to an intraplate compressional setting due to ridge-push forces related to the spreading of the South Atlantic Ocean where most of sediments are being eroded and accumulated only in the center of the basin [2].

In this study we first interpreted the seismic reflection profiles and well logs data located inside the central area of the CB (Cuvette Centrale), to reconstruct the stratigraphy/tectonic evolution of the basin. Afterwards, we compared geological and geophysical information to estimate the velocity, density, the thickness of the sedimentary layers and the depth of the basement/lithostratigrapic units. The results have been interpolated to obtain 3D maps of thickness, velocity and density of each sedimentary layer/bedrock. In this way, it was possible to get clues on the composition and rheology of the uppermost part of the crust. These results have been used as input parameters for 3D numerical simulations testing the main mechanisms of formation/evolution of the CB. For this aim, we used the I3ELVIS code [3] to simulate the initial rift phases. The first tests have been conducted considering that the Congo craton is composed of four cratonic blocks of Archean age [2] and applying extensional stress in two orthogonal directions (N-S and E-W), to test the hypothesis of the formation of a multi extensional rift in a cratonic area. We made these numerical tests for different geometries, temperature and rheology of the cratonic blocks and simulating the sedimentation during the subdience phases. The results of these first numerical experiments show strong agreement with the structure of the basin.

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