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Late Cretaceous-Cenozoic intraplate deformation in Congo basin: effect of the South-Atlantic opening?

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The large intracontinental Congo Basin developed since the Neoproterozoic in the middle of the Congo-Tanzania plate. It has been affected by several compressional tectonic deformation phases during the early Palaeozoic and the early Mesozoic. Seismicity and earthquake focal mechanisms show that it is still submitted to compressional forces. We observe evidence for compressional tectonic deformation and tectonic uplift in boreholes (Samba and Dekese), along its western margin in the Kinshasa-Brazzaville region, and also in the morphological evolution of the drainage pattern. This deformation seem to have started during the Late Cretaceous, after the full separation of South America from Africa and the initiation of the South-Atlantic mid-oceanic ridge in the Albian, at about 100-120 Ma.

We know that mid-oceanic ridge generate ridge-push forces in the oceanic lithosphere, which can be transmitted to the adjacent continental plates. According to the relations of Wiens and Stein [1] between ridge-push forces and basal drag in function of the lithospheric age of oceanic plates, the deviatoric stress reaches a compressional maximum between 50 and 100 Ma after the initiation of the spreading ridge. This broadly corresponds to the Paleocene for the South-Atlantic Ocean (~70-20 Ma). Earthquake focal mechanism data show that the West-Congo margin and a large part of the Congo Basin are still currently under compressional stresses with an horizontal compression parallel to the direction of the active transform fracture zones. We studied the fracture network along the Congo River in Kinshasa and Brazzaville that affect Cambrian sandstones and probably also the Upper Cretaceous-Paleocene sediments. Their brittle tectonic evolution is compatible with the build-up of ridge-push forces related to the South-Atlantic opening. Further inland, low-angle reverse faults are found affecting Jurassic to Mid-Cretaceous cores from the Samba borehole in the Congo Basin and strike-slip movements are recorded as a second brittle phase in the Permian cores of the Dekese well, at the southern margin of the Congo Basin. An analysis of the topography and river network of the Congo Basin shows the development of low-amplitude (50-100 m) long wavelengths (100-300 km) undulations that can be interpreted as lithospheric buckling in response to the compressional intraplate stress field generated by the Mid-Atlantic ridge-push.

[1] Wiens, D.A., Stein, S. (1985) Tectonophysics 1166: 143-162.