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The youngest generation GOCE products in unraveling the mysteries of the crust of North-Central Africa

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The newest GOCE observations produce reliable gravity data in remote areas with a resolution that is sufficient to distinguish tectonic lineaments. We use the data to formulate a model of the crust in Central-North Africa, in an area influenced by the presence of two great cratons with deep lithospheric keels, the West-African craton and the Congo craton. In the study area the crust is affected by rifting and magmatism (Benue trough and Cameroon) by basin fill (Chad basin) and by an unknown process that has produced a 1200km long line of increased density, the Chad-line (Braitenberg et al., 2011). The presence of increased localized density for the latter is demonstrated by the gravity signal it produces and which is recovered by GOCE. We integrate seismological investigations, the lithospheric flexure model, and a sediment thickness model to formulate a starting density model, for which we calculate the gravity field. This field reproduces the GOCE-observations to first order, but presents some significant residuals which we use to invert for the masses missing in our starting model. The inversion is accomplished combining spectral inversion methods with an algorithm that minimizes the constrained nonlinear multivariate potential field function iteratively. The spectral approach includes depth estimates with the continuous wavelet transform (Li et al., 2011) which we use as starting solutions of the inversion. Main results are the evidence of dense magmatic products trapped at the base of the crust beneath the Benue trough, implying that the volcanic deposits that reached the surface are only a portion of the entire melting process, as another portion is residing at lower crustal levels, at the mantle-crust transition. Another result concerns a model for the arched linear positive gravity anomaly situated on the Saharan Metacraton: our present model locates the body at upper crustal depths. The knowledge of the depth and nature of this intracrustal body is important for investigating the issue whether it contains mineral deposits, and to which percentage, and whether these are shallow enough to be exploitable.

References

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