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Improved lithospheric density model and heat flow estimation of the Arabian peninsula constrained by GOCE full tensor gravity gradients

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We show a forward model approach of the Arabian peninsula to derive the density structure of the lithosphere constrained by GOCE gravity gradients. Pre-existing information about the crustal structure, Moho and LAB depth are very sparse. Conventional crustal thickness models are based on inversion of near-surface gravity constrained by few seismic data. These models do not explain the gravity gradients observed by the GOCE satellite mission. To overcome this misfit, we optimized initial models for isostasy, gravity and the full gravity gradient tensor in orbit height (225 and 255 km) by forward modelling and inversion. Results show that the gravity gradients in orbit height provide additional information about the area which result in a refined model with lateral density variations in the crust and significant LAB and Moho depth variations over the area. In addition, for a satisfying fit vertical density gradients and separation between upper and lower crust has to be introduced. The final structures are compared to global crustal model Crust 1.0 and misfits are discussed.
The goal of explaining the full gravity tensor in one model constraints the model procedure much more than only using gravity or the vertical gravity gradient alone. Thus, the density modelling benefits from the use of the full gravity gradient tensor and should be used for large scale models. Finally, the new model is used to calculate an improved heat flow model of the whole area to derive better maturity maps for hydrocarbon exploration.