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An integrated thermo-compositional model of the African cratonic lithosphere from gravity and seismic data

Nils-Peter Finger[1,2], Mikhail K. Kaban[1,3], Magdala Tesauro[4,5], Walter D. Mooney[6], and Maik Thomas[1,2]

[1]Helmholtz Centre Potsdam German Research Centre for Geosciences - GFZ, 1.3 Earth System Modelling, Potsdam, Germany

[2]Free University Berlin, Berlin, Germany

[3]Schmidt Institute of Physics of the Earth, RAS, Moscow, Russia

[4]University of Trieste, Trieste, Italy

[5]University of Utrecht, Utrecht, Netherlands

[6]US Geological Survey, Menlo Park, USA

The presented model describes the lithospheric state of the cratonic regions of Africa in terms of temperature, density and composition based on joint analysis of gravity and seismic data. In addition, a new model of depth to the Moho was calculated from available seismic data. It was then used in combination with data on topography, sediments, and deep mantle anomalies to obtain residual mantle gravity and residual topography. These residual fields were corrected for thermal effects based on S-wave tomography and mineral physics constraints, assuming a juvenile mantle. Afterwards, the thermally corrected fields are jointly inverted to uncover potential compositional density variations. Following the isopycnic hypothesis, negative variations in cratonic areas are interpreted to be caused by iron depletion. Adapting the initially juvenile mantle composition allows to iteratively improve the thermal and compositional variations, culminating in a self-consistent model of the African lithosphere. Deep depleted lithospheric roots exist under the Westafrican, northern to central Congo, and Zimbabwe Cratons. The temperatures in these areas range from below 800 °C at 100 km depth to 1200 °C at 200 km depth. Higher temperatures and absence of depletion at depths below 100 km in wide areas of the eastern to southern Congo and the Kaapvaal Cratons indicate a thinner and strongly reworked lithosphere.