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Detecting the ancient cores of Antarctica in a new integrated lithospheric model

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Gravity gradient data, measured in the course of ESA's GOCE satellite mission, are sensitive to geometry and density variations of the main lithospheric layers, i.e. ice and sediment thickness, the Moho depth and the temperature and composition of the upper mantle. In combination with the latest seismological models of the Antarctic lithosphere, we analyse and evaluate the gravity gradient signals in order to localize and delineate density variations within the lithosphere in a 3D. Based on this, integrated and self-consistent modelling is performed, considering temperature and petrology of the lithosphere, seismic body wave velocities and isostasy.
Our results indicate that Antarctica is largely in isostatic equilibrium, but that differences exist in the mode of compensation for West and East Antarctica. The thin and hot lithosphere of West Antarctica implies a younger and more fertile mantle composition than the cratonic parts of East Antarctica. We identify regions with low densities in the deep lithosphere, most probably representing strongly depleted Archaean or Paleoproterozoic mantle composition. These constraints may have profound implications for our understanding of Antarctica's evolution. By involving thermal parameters of the crust, we are able to predict continent-wide surface heat flux values, which can serve as a basis for ice velocity and glacial isostatic adjustment modelling.