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Density heterogeneity of the upper mantle beneath the Siberian craton from satellite gravity and a new seismic crustal model (SibCrust)

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04/11/(13

Study region, Siberian Craton





Motivation and objectives

- How heterogeneous is the lithospheric mantle in Siberian craton?
- Are there density anomalies around kimberlites fields?
- Looking into the mantle density structure



Motivation and objectives

Goals:

- Correlate density structure of the upper mantle below Siberia with surface tectonic structure
- by calculating residual mantle gravity and density anomalies after removing crustal effects

Take advantage of new datasets:

- crustal seismic structure database (SibCrust, Cherepanova et al., Tectonophysics, in press)
- satellite only, gravity data from GOCE satellite



Truncated gravity data from GOCE

- GOCE DIR release 3 geopotential model (Pail et al., 2011)
- Truncation of free air gravity anomaly (spherical harmonic degree 10)
 - to eliminate those components that presumably are of deep mantle origin



The SibCrust model

- regional crustal velocity model: West Siberian basin and the Siberian craton (50N-70N, 65E-132E).
- all published seismic profiles, digitized



Study region of Siberian craton with seismic profiles



The SibCrust model column averaged P velocity



- 5 layers:
 - sediments,
 - upper crust,
 - middle crust,
 - lower crust,
 - lower-most crust.

Dots show the seismic profiles



Comparison of different conversion formulas from P-wave velocity to density



Crustal correction to gravity anomalies





Crustal correction to gravity anomalies



- Large anomalies in Anabar shield, and Tunguska basin
- Crustal contribution to gravity is large and spatially heterogeneous



GOCE gravity anomalies



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Mantle residual gravity (GOCE gravity minus crustal correction)





Conversion of gravity to density

Assumption - all density anomalies are in lithospheric mantle



- debate about lithosphere thickness in Siberian Craton



Mantle density anomalies



- Near zero density anomalies support an overall fit of the isopicnicity hypothesis
- Basins have positive anomalies
- Basement highs and Anabar shield have weak negative anomalies
- Kimberlites are around zero

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Mantle density anomalies (bottom) for 3 models of lithosphere thickness (top)



Conclusions

- Crustal correction to gravity is very important
- Near zero mantle density anomalies support an overall fit of the isopicnicity hypothesis
- Basins have positive mantle density anomalies
- Basement highs and Anabar shield have weak negative mantle density anomalies
- Kimberlites are around zero mantle density anomaly
- Work in progress:
 - Separate temperature and compositional density anomalies

Please see poster about SibCrust: Cherepanova et al., Poster B149 on Friday

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