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First Rock Density Model of Latvian Crystalline Basement

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The crystalline basement in the area of Latvia has not been studied in detail before. Historically it has been associated with possible economic minerals as iron, and other heavy metals (Brangulis, Kaņevs, 2002). The study of the crystalline basement in Latvia is encumbered by the depth of the rocks – it varies from 382 m to 1916 m below the ground surface. For this reason, most of the knowledge about the rocks comes from the sparsely situated 209 deep boreholes in the territory of Latvia (Brangulis, Kaņevs, 2002).
We used 4873 land gravimetric measurements to model the spatial density of the crystalline basement rocks in Latvia. The data has been gathered from 1999 to 2012 by Latvian Geospatial Information Agency specialists. In the gathering process, Scintrex CG-3 and CG-5 gravimeters were used. The precision of the measurements ±0,1 mGal. The data has never been interpreted or published before.
Firstly, we generated a new and updated Bouguer anomaly map for the Latvian territory using high precision gravity measurements mentioned above.
Secondly, we used the available information about the sedimentary rocks in Baltic States (Popovs et al., 2015) to generate a forward model with the gravity anomalies associated with the said rocks. Forward modelling was done with python based open-source software PyGMI (PyGMI, 2017). To acquire the gravity anomaly model of the crystalline basement rocks, modelled anomalies were subtracted from the land Bouguer anomaly measurements.
Thirdly, we used the combination of in situ geological data and acquired gravity anomalies to calculate the spatial density distribution for the crystalline basement rocks in Latvia by using inversion algorithms.
The resulting density model distinguishably shows the prominent features of the Latvian crystalline basement. Rock densities can easily be correlated with the rock lithology. Main features, such as Riga pluton and metamorphic rock domains are clearly distinguishable. It proves that the model could be used for investigation and exploration of the crystalline rocks in the territory of Latvia. It could also be used in research of the tectonic evolution of Baltica paleocontinent. Our results show potential for future scientific and economic gains.

References:

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