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3D gravimetric modelling of Kuhmo Greenstone Belt area, Eastern Finland

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In our paper we present a 3-D structure and elastic properties of the Achaean Kuhmo greenstone belt (2.8 - 2.76 Ga) in the Finnish part of the Karelian Craton. Although the surface position of the belt is relatively well constrained by geological studies, its 3-D structure is poorly known and it is not clear to what depth the belt extends. The belt is marked by a regional-scale positive Bouguer anomaly, indicating that strong density contrast exists between the belt and surrounding bedrock. However, laboratory measurements of bulk density of rocks sampled at the surface do not indicate presence of large amounts of high density rocks within the belt. In addition, seismic velocity models of the SVEKA'81 wide-angle reflection and refraction profile and results of the recent FIRE1 reflection profile did not show any Vp or Vs velocity contrasts between the belt and its surrounding. In our paper the density at the surface is constrained using the results of laboratory measurements of bulk density of the main rock types of the belt and seismic velocities and density of the main rock types of the belt estimated from modal mineralogy using Monte-Carlo simulation.

Based on both gravity forward modelling and inversion, the Kuhmo Greenstone Belt is a surface structure that is 10 - 12 km wide with depth less than 7 km and average density of 2.84 g/cm3. The belt has no deep "root" in the middle crust and lower crust. The average density of the surrounding rock west of the belt is similar to the density east of the belt. Therefore, the difference in Bouguer anomaly west and east of the belt is explained by the regional trend produced by the Moho uplift. The high density and low seismic velocities of the belt can be explained by high content of amphibole, biotite and muscovite.