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3D geophysical and geological modelling of the Kautokeino Greenstone Belt in Finnmark, North Norway

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In this study, we developed a novel three-dimensional (3D) crustal model for the Kautokeino Greenstone Belt (KKGB) in North Norway. This approach is based on the 3D density modelling and aeromagnetic data, integrated with qualitative interpretation of geophysical and geological data. Incorporation of the high-resolution geophysical data with surface observation allows for improving the existing geological maps by identifying several new structures. Moreover, integrating modern and accurate geophysical analysis techniques with the existing petrophysical databases enables to pertain the shallow and deeper structures throughout the area. To have a better control over the regional setting of the KKGB, we expanded the study area, including the northern part of Finland and Sweden. Integrated Gravity and magnetic measurements enabled us to follow the KKGB underneath the covering sedimentary rocks of Caledonian nappes and link them with their outcrop in the tectonic windows in the northern part of the belt. The proposed 3D crustal model shows that the Kautokeino Greenstone Belt is longer (and possibly broader) than what has already been suggested. In this respect, this approach suggests that the belt reaches depths of approximately 5-6 km and is located as a varying dipping structure between the Jergul Gneiss Complex (JGC) in the east and Ráiseatnu Gneiss Complex (RGC) in the west. The Raiseatnu Complex (RGC) to the west of the KKGB is characterised by magnetic anomalies trending NNW–SSE directions. This is different from the JGC and the RGC is more similar to the KKGB in terms of the greater number of anomalies and their shapes. This gneiss complex shows short-wavelength and circular anomalies compared to the more subdued and smoother anomaly pattern of the JGC. In the new 3D model, a large portion of the greenstone belt assumed to be part of the RGC complex either migmatized portion of KKGB or the latest phase of it. A set of high- and low-density structures assumed for modelling of the measured gravity anomalies of the region. This leads to find out most of the high gravity anomalies that are due to dense rocks of amphibolite-facies volcano-sedimentary rocks. While the low gravity anomalies are originated by a combination of quartzite and granitoids. In a large scale, this approach shows a similarity of the Proterozoic greenstone belts to their older Archean counterparts such that most of the deformation is caused by gravitational tectonics. This study shows that integration of geological and geophysical data can considerably improve the 3D understanding of complex, poorly exposed terranes of the Finnmarksvidda region in Norway. Integrated 3D density modelling using gravity data constrained by surface petrophysical samples assists to refine and establish realistic 3D subsurface models.