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The lithosphere-scale density and temperature configuration beneath the Barents Sea and Kara Sea region

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The Barents and Kara Sea region on the European Arctic shelf is bounded by the Proterozoic East-European Craton in the south and the young Cenozoic passive margins in the north and the west. Poly-orogenic episodes in late Precambrian to late Paleozoic times have led to amalgamation of the crystalline basement, which subsequently experienced multiple phases of subsidence resulting in the formation of ultra-deep sedimentary basins. These deep basins vary strongly in their configuration across the shelf. In the southwestern Barents Sea numerous narrow and fault-bounded rift basins are defined while the eastern Barents Sea and southern Kara Sea are marked by a wide and bowl-shaped sag basin.

A key to understand the evolution and the causative mechanisms behind uplift and subsidence in the Barents Sea and Kara Sea is the present-day lithospheric density configuration. In a first step, a 3D structural model was developed resolving five sedimentary units, the crystalline crust and the lithospheric mantle. To provide best constrained geometries for the resulting 3D-structural model, interpreted seismic refraction and reflection data, geological maps and previously published 3D-models were analysed and integrated.

The sedimentary units were assigned lithology-dependent matrix densities and porosities to calculate bulk densities which also consider the effects of erosion, compaction but also in response to published maximum ice sheet thickness. The density configuration of the lithospheric mantle and the asthenosphere down to 250 km depth is derived using an existing velocity-density model. To calculate an initial density configuration of the crystalline crust, the concept of Pratt's isostasy is applied. Finally, the gravitational response of the corresponding 3D-model is calculated and compared with the observed gravity field to further investigate the composition of the crust and the configuration of potential high-density bodies in the deeper lithosphere.

To assess the major controlling factors of the thermal field, the obtained 3D density model is used to calculate the lithosphere-scale 3D conductive thermal field of the Barents Sea and Kara Sea region. Therefore, the predicted thermal field is validated with measured borehole temperatures.