Control of lithosphere structure on surface deformation in the Central Barents Sea: insights from dynamical modeling

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The Barents Sea is located in the Northern European Arctic. The Eastern Barents Sea features one of the deepest sedimentary basins in the world whereas large parts of the Western Barents Sea is covered by a shallow sedimentary platform. Seismic tomography data (Levshin et al., 2007; Ritzmann and Faleide, 2009) show slower S-wave velocity in the upper mantle beneath the East Barents Sea compared to the West Barents Sea, indicating a steep deepening of the Lithosphere-Asthenosphere Boundary (LAB) in the Central Barents Sea from West to East. Additionally, the Central Barents Sea is marked by a South-North succession of regularly-spaced inverted structures (uplifted domes) such as the Fedinsky High and the Sentralbanken High. The origin of these inverted structures is under debate. The interpretation of recent seismic data in the Central Barents Sea suggests that part of the inversion is contemporaneous with the Late-Triassic-Early Jurassic westwards thrusting of Novaya Zemlya. This suggests that the origin of domes might be linked to compressional events on the eastern side of the Barents Sea.

A 2D thermo-mechanical model of lithosphere shortening is used to explore the effect of LAB geometry on the surface deformation in the Central Barents Sea. The model is based on a Lagrangian finite element method (Gac et al., 2013). The model consists of a crust - mantle lithosphere characterized by non-linear temperature and pressure dependent visco-elastic-plastic rheologies. The mechanical model is coupled with a thermal model taking into account heat advection and diffusion. Sedimentation and gravity are also taken into account. Contractional boundary conditions are applied on vertical sides of the model resulting in buckling of the crust. Several models are run for different geometry of the LAB. Preliminary results are shown. 3D conceptual models are then proposed to explain the 3D distribution of inverted structures in the Central Barents Sea.

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