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Load distribution in the mantle across the Norwegian continental margin (Vøring and Møre Basins) and adjacent oceanic areas - results from isostatic, 3D load and 3D gravity modelling

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The Norwegian continental margin is a passive volcanic located between the exposed Fennoscandian Caledonides in the east and the Cenozoic oceanic domain in the west. It evolved in response to several rifting events since post-Caledonian times. One of the significant stages of extension occurred during the Late Jurassic-Early Cretaceous, leading to formation of the deep Vøring and Møre Basins. Finally, in the Late Paleocene-Early Eocene, the continental break-up resulted in the formation of relatively young oceanic lithosphere. A 3D density-model for the Norwegian continental margin and adjacent areas has been created based on a 3D structural model derived from refraction seismic profiling, inversion of teleseismic receiver functions, reflection seismic lines and well data. According to the results of the 3D gravity modelling a relatively lightweight mantle underlies the oceanic crust, whereas mantle density is larger below the continental crust of the margin. Furthermore, the obtained 3D density-model has been further evaluated by isostatic modelling. Therefore the initial, gravity-constrained model has been extended downward to 100 km to estimate the lateral variation of the average mantle density from the continent to the ocean. Therefore three end-member models have been evaluated that differ in the geometry of the transition from less dense mantle below the ocean to denser mantle below the continent. The lateral variation of mantle densities beneath the Norwegian continental margin and adjacent areas has been calculated using Pratt isostasy for the crustal configuration constrained by seismic and gravity data. The results of the isostatic modelling also indicate that continental mantle is denser than mantle beneath the oceanic domain,

which is in agreement with the results of 3D gravity modelling. In addition two different transition geometries between a less dense mantle below the ocean (3200kg/m3) and a denser mantle below the continent (3300kg/m3) have been tested. For all models the 3D load distribution has been determined with a FE method, to estimate the depth to the level of mass compensation. Within the upper mantle, the continental part of the model is characterized by smaller load in comparison to the oceanic part for a defined constant depth level. This difference in load distribution decreases with depth and becomes negligibly small below 60 km depth indicating that masses are compensated at those depths. The lower density of the oceanic mantle compared to the continental mantle maybe the expression of the younger and still cooling lithosphere below the ocean after the Late Paleocene-Early Eocene continental break-up compared to an older and colder continental mantle.