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Compression and subsequent phase transitions as a mechanism for basin formation

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The East Barents basin is one of the world's deepest sedimentary basins, with a depth up to 20 km. The origin of this sedimentary basin is a matter of debate due to the enormous depth, the lateral extend of the basin and very few signs of extensional faulting. A standard framework for predicting the subsidence of rift-basins is thinning of the lithosphere as it was introduced by McKenzie. This concept has been investigated for the East Barents Sea and it has been shown that it cannot be applied there. With standard crustal extension and thinning models being apparently insufficient to explain the dramatic and rapid subsidence, alternative models have to be developed. We propose that phase transitions lead to a partial or complete densification of the lower crust in a compressional setting and therefore might be the responsible mechanism in the formation of deep intra-continental basins such as the East Barents Sea. Subsidence due to crustal densification can happen without a significant temperature increase in contrast to models involving stretching or magmatic underplating. In addition, the basin will not relax and uplift again after the completion of the reaction and isostatic re-equilibration through subsidence, but remain isostatically balanced at depth. It is often assumed that only mafic magmatic material is dense enough to cause the subsidence. However, we show that much more common metapelitic rock types can also yield high densities in a certain P-T-composition space. While a metabasaltic rock at 700˚C and 1.5 GPa has densities of 3.2 g/cm^3, an Al- and Fe-rich metapelitic rock like the Fjørtoft Gneiss can even yield somewhat higher densities. We propose buckling under a horizontal force in a compressional setting as a mechanism to shift the crust-mantle boundary to greater depths, which can create the conditions necessary for the phase transitions to occur. While the crustal rocks equilibrate to the higher tempera-

tures in the mantle, mineral reactions take place and denser minerals are formed. In order to investigate this mechanism further, we will have to determine what minimum force is required for buckling to occur and how much the lithosphere can be expected to buckle under horizontal compression in the case of the East Barents Sea basin.