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The extension of the Vøring margin (NE Atlantic) in case of different degrees of magmatic underplating

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The Vøring margin is a passive volcanic margin off-shore mid-Norway in the NE Atlantic. The margin has gone through a history of several rift phases, where the last rift phase ended with continental breakup and sea-floor spreading in the Early Tertiary. Continental breakup was associated with high rates of magma generation and flood basalts. The western part of the margin is characterized by a high velocity layer (Vp = 7.2 to 7.6 km/s) in the lower crust. The origin of this high velocity Lower Crustal Body (LCB) is debated. The LCB is studied with three scenarios of its extension history in order to learn more about its nature. The scenarios are: (a) The LCB is Caledonian crust. (b) Half the LCB is Caledonian crust and the other half is emplaced as magmatic underplating in Late Paleocene. (c) The entire LCB is emplaced as magmatic underplating. The crustal extension is usually obtained with the backstripping procedure. A problem with the backstripping procedure is that is does not account for the extension and thinning of the sedimentary basin. This is in particular a problem for the deep sub-basins of the Vøring margin, because the margin has gone through a history of several rift phases with a substantial amount of rifting. The extension of the margin transect is obtained with a procedure that accounts for the extension and thinning of the sedimentary basins. This procedure also accounts for magmatic underplating. The lithosphere is modeled with deposition of sediments and it involves four rift phases since the Early Devonian until today. The forward modeling is mass conservative and the present-day thicknesses of the formations, crust, LCB and magmatic underplate are reproduced. The state of the lithosphere and the sedimentary basins are shown and compared at the beginning and at the end of the rift phases. It is concluded that the scenario with the LCB as only underplating requires an unrealistic amount of extension. A more likely scenario lets underplating account for maximum half the LCB. The modeling shows that the Late Jurassic rift phase was much more prominent than the Late Cretaceous and Paleocene rift phase for all cases of underplating. A strong Late Jurassic rift phase is consistent with the accumulation space needed for the thick Cretaceous formations. There is no observations of magmatism from the Late Jurassic, although this rift phase is stronger than the Cretaceous and Paleocene rift phase. The modeling is based on a new interpretation of the Moho underneath the Utgard High, which is taken to be deeper and flatter than previously suggested.