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The role of lithospheric inheritance in rifting and continental breakup of the Labrador Sea

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During the final stage of continental rifting, stretching localizes in the future distal domain where lithospheric necking occurs resulting in continental breakup. In magma-poor margins, the lithospheric necking is accompanied by crustal hyperextension, serpentinization and exhumation of the mantle in the continent-ocean transition domain (COT). In magma-rich margins, the necking is accomplished by the emplacement of large amounts of volcanics in the COT, in the form of seaward dipping wedges of flood basalts (SDRs).
Inherited crustal and lithospheric heterogeneities have a great impact on the late stage of rifting leading to continental breakup. Changes in the thickness and structure of the pre-rift crust influence the amount of lithospheric necking and continental hyperextension, and thus the degree and timing of mantle serpentinization. Whereas, changes in the initial composition and the thermal structure of the mantle lithosphere can favour either magma-poor or magma-rich continental breakup.
In the Labrador Sea, the Archean to Proterozoic inheritance resulted in a pre-Mesozoic lithosphere characterized by a thicker crust and a hot depleted subcontinental mantle in the south, and by a thinner crust and a cooler primitive subcontinental mantle in the north. These changes occurred across two major suture and shear zones that can be traced onshore the Canadian Shield and SW Greenland. The thickening of the crust was coupled with a thickening of the ductile middle crust which enhanced continental stretching, hyperextension and resulted in a wider domain of exhumed serpentinized mantle. The lack of a ductile layer in the north limited the amount of stretching preventing hyperextension and thus mantle serpentinization and exhumation. The emplacement of volcanics in the continent-ocean transition was controlled by the timing of the thermal anomaly resulting from the proto-Icelandic plume. The effect of the latter extended underneath most of the Labrador Sea domain, however, the depleted nature of the mantle lithosphere in the south, coupled with the high degree of serpentinization, prevented melting from taking place.