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Long term stability in Deep Mantle structure: Evidence from the $\sim$ 300 Ma Skagerrak-Centered Large Igneous Province (the SCLIP)

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Igneous rocks of intra-continental rifts are generated by decompression melting in response to extension but magmas generated by deep-seated mantle plumes may also find their way into intra-continental rifts by 'upside down drainage'. Consequently it can be hard to be confident that a particular set of igneous rocks in a rift is plume related. Uncertainty of this kind has long plagued research on the Oslo graben in SE Norway. We have addressed that problem within the broader framework of Permo-Carboniferous magmatism and rifting in NW Europe, and show on the basis of (i) huge volume ($>$0.5 * 10^6 km^3), (ii) large areal extent and (iii) brevity of eruption interval ($\pm$ 4 My), that the flare-up of igneous activity at 297 Ma in NW Europe which generated a Skagerrak-Centered Large Igneous Province (SCLIP) is the product of a deep-seated mantle plume: the Skagerrak Mantle plume. We confirm our location for the Skagerrak plume and show its derivation from the core-mantle-boundary (CMB) by restoring it, using a new reference frame, to its $\sim$ 300 Ma position. That position (ca. 11^{o}N, 16^{o}E, south of Lake Chad, Central Africa) lies vertically above the edge of the African Large Low Velocity Province (LLVP). We have previously shown that eruption locations vertically above the edge of one or other of the Earth's two LLVPs at the CMB characterize nearly all the LIPs erupted since 200 Ma. Recognition of the SCLIP plume source enables us to show that the edge of the African LLVP at the CMB has not moved significantly with respect to the spin axis of the Earth during the past 300 My which is a 30% longer duration for the stability of a deep mantle structure than we have previously been able to demonstrate.