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## A mantle plume origin for the Scandinavian Dyke Complex: a “piercing point” for 615 Ma plate reconstruction of Baltica?

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The origin of Large Igneous Provinces (LIPs) associated with continental breakup and the reconstruction of continents older than c. 320 million years (pre-Pangea) are contentious research problems. Here we study the petrology of a 615 - 590 Myr dolerite dyke complex that intruded rift-basins of the magma-rich margin of Baltica and now is exposed in the Scandinavian Caledonides. These dykes are part of the Central Iapetus Magmatic Province (CIMP), a LIP emplaced in Baltica and Laurentia during opening of the Iapetus Ocean within the Caledonian Wilson Cycle. The >1000 km long dyke complex displays lateral geochemical zonation from enriched to depleted basaltic compositions from south to north. Geochemical modelling of major and trace elements shows these compositions are best explained by melting hot mantle 75-250°C above ambient mantle. Although the trace element modelling solutions are non-unique, the best explanation involves melting a laterally zoned mantle plume with enriched and depleted peridotite lithologies, similar to present-day Iceland and to the North Atlantic Igneous Province. The origin of CIMP appears to have involved several mantle plumes. This is best explained if rifting and breakup magmatism coincided with plume generation zones at the margins of a Large Low Shear-wave Velocity Province (LLSVP) at the core mantle boundary. If the LLSVPs are quasi-stationary back in time as suggested in recent geodynamic models, the CIMP provides a guide for reconstructing the paleogeography of Baltica and Laurentia 615 million years ago to the LLSVP now positioned under the Pacific Ocean. Our results provide a stimulus for using LIPs as piercing points for plate reconstructions.