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Linking the Earth's surface with the deep-mantle plume beneath a region from Iceland to the city of Perm

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Current tomography models consistently reveal three large-scale regions of strongly reduced seismic velocity in the lowermost mantle under the Pacific, Africa and a region that extends from below Iceland to the city of Perm (the Perm Anomaly). We have carried out mantle dynamic simulations (Glišović et al., GJI 2012; Glišović & Forte, EPSL 2014) of the evolution of these large-scale structures that directly incorporate: 1) robust constraints provided by joint seismic-geodynamic inversions of mantle density structure with constraints provided by mineral physics data (Simmons et al., GJI 2009); and 2) constraints on mantle viscosity inferred by inversion of a suite of convection-related and glacial isostatic adjustment data sets (Mitrovica & Forte, EPSL 2004) characterised by Earth-like Rayleigh numbers. The convection simulations provide a detailed insight into the very-long-time evolution of the buoyancy of these lower-mantle anomalies. We find, in particular, that the buoyancy associated with the Perm Anomaly generates a very long-lived superplume that is connected to the paleomagnetic location of the Siberian Traps at the time of their eruption (Smirnov & Tarduno, EPSL 2010) and also to location of North Atlantic Igneous Provinces (i.e. the opening of North Atlantic Ocean).