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Geothermal anomalies in central-northern Greenland imposed by the Iceland mantle plume passage

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Radar soundings and deep ice core measurements for the Greenland Ice Sheet (GIS) indicate unexpectedly high local values of geothermal heat flow (GHF) in areas where Early Proterozoic lithosphere is thick and stable and they should be low. Basal ice melt is rapid and ice flow fast where GHF is abnormal, indicating a strong regional GHF influence on the present-day thermodynamic state of the GIS, and possibly its future evolution. By combining modelled climate-driven GIS and lithosphere with constraints from interdisciplinary data, we detect a west-to-east laterally continuous area of high GHF in central-northern Greenland. This area closely coincides with a west-to-east negative anomaly in seismic velocity, and recent high-resolution tomography models tie this to the present-day location of the Iceland mantle plume. Plate paleoreconstructions and analysis of magmatism in eastern and western Greenland suggest that between around 80 and 35 Ma Greenland lithosphere passed over this mantle plume. We argue that the mantle plume caused long-lived, non-stationary effects that still affect the thermal state of the Greenland lithosphere today and that these thermal effects are the origin of rapid basal ice melting over vast areas of central and northern Greenland.