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Imaging bedrock topography and geological controls on ice streams flowing in the Wilkes Subglacial Basin sector of East Antarctica

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The northern Wilkes Subglacial Basin (NWSB) in East Antarctica underlies the catchments of the Matusevich, Cook, Ninnis and Mertz Glaciers, which are largely marine-based and hence particularly sensitive to past and future ocean and climate warming.

Here we use airborne radar, aeromagnetic and airborne gravity data to image bedrock topography, subglacial geology and deeper crustal structure and assess its influence on ice sheet dynamics in the NWSB. The previously identified Central Basins extend beneath the fast flowing Cook ice streams, indicating that potential ocean-induced changes could propagate further into the interior of the ice sheet. By analogy with the better exposed Rennick Graben in northern Victoria Land, these deep subglacial basins are interpreted here as grabens that steer fast glacial flow. With the aid of depth to source estimates and forward magnetic and gravity models, we image the 3D variability in geological basal boundary conditions, including Beacon sediments and Jurassic basaltic rocks and uplifted basement blocks within and along the flanks of these grabens.

A remarkable contrast in magnetic anomaly signatures is observed over the coastal and inland segments of the Cook ice stream catchment. We model several km thick early Cambrian to late Neoproterozoic sedimentary basins in the basement of the coastal region, in contrast to a prominent Proterozoic basement high at the onset of fast glacial flow further inland. We further hypothesise that this difference affects geothermal heat flux at the base of the ice sheet, which could in turn influence basal melting and subglacial hydrology.