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Constraining basal heat flux in eastern Antarctica using new heat flow data from formerly contiguous geological terranes of southern Australia

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A critical parameter in any model of Antarctic ice sheet behaviour is the likely basal heat flux, which has a significant impact on ice viscosity and melt generation. Currently, this basal heat flux (which has components derived from both the convecting mantle and the lithosphere) is poorly constrained due to the logistical, financial and environmental challenges of obtaining boreholes that intersect basement rocks blanketed by thick ice cover. Consequently, we have pursued an alternative approach that employs heat flow measurements from analogous rock units in the Coompana Province of southern Australia, representing the geological counterparts of those beneath the Totten catchment in eastern Antarctica. The Coompana Province is underlain largely by Mesoproterozoic granitic and gneissic rocks characteristic of the Musgrave orogenic system, observed to extend into Wilkes and Queen Mary Land. Facilitated by mineral exploration drilling as part of the PACE (Plan for Accelerating Exploration) Copper Drilling Program undertaken by the Geological Survey of South Australia and Geoscience Australia, we have collected and compiled 10 new continuous temperature logs spanning 200 km across this previously uncharacterised region. Drill core samples have also enabled an accompanying dataset of thermal conductivity values to be obtained. Heat flow estimates range between 52–62 mWm-2, equivalent to global continental averages. All values are slightly lower than the single heat flow measurement of 72 mWm-2 obtained from Law Dome located on the conjugate margin of eastern Antarctica, and appreciably lower than the average of ∼80 mWm-2 for Proterozoic terranes of the central Australian heat flow province. Combined with existing data from adjacent parts of southern Australia, this provides the first regional heat flow characterisation of geological provinces previously contiguous with eastern Antarctica, allowing a more robust evaluation of the possible crustal component of sub-glacial heat flux through the application of these new values as a proxy for Eastern Antarctica.