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Preserved Ross-age(?) root beneath the Transantarctic Mountains and origin of the thinner crust beneath the northern Wilkes Subglacial Basin

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The Wilkes Subglacial Basin, in the hinterland of the Transantarctic Mountains, represents one of the least understood continental-scale features in Antarctica. Aeromagnetic data suggests that this basin was imposed on a much earlier Ross age back arc region that developed along the former active margin of the East Antarctic Craton (Ferraccioli et al., 2009, Tectonophysics). However, the deeper crustal structure of the basin and its relation with tectonic evolution remains both disputed and poorly constrained. Here, we present new airborne gravity data that reveal the crustal architecture of the northern Wilkes Subglacial Basin. Our gravity models indicate that the crust under the northern Wilkes Subglacial Basin is likely to be 30–35 km thick, i.e. 5–10 km thinner than imaged under the adjacent Transantarctic Mountains, and $\sim$15 km thinner than predicted from some previous flexural and passive seismic models beneath the southern Wilkes Subglacial Basin region. We infer that crustal thickening under northern Victoria Land reflects Ross-age (ca 500 Ma) orogenic events and accretion, followed by partial preservation of the orogenic root since then, as opposed to reflecting the edge of a Mesozoic plateau, which has previously been inferred to have occupied West Antarctica (Bialas et al. 2007, Geology). Airy isostatic anomalies along both flanks of the Wilkes Basin reveal major inherited tectonic structures, which likely controlled the basin location and hence support aeromagnetic interpretations of the Wilkes Subglacial Basin as a structurally controlled basin. The positive anomaly along the western margin of the basin appears to define the tectonic boundary between the East Antarctic Craton and the Ross Orogen, and the anomaly along its eastern flank is interpreted as reflecting high-grade and denser rocks of the central Wilson Terran,e with respect to lower grade meta-sediments and magmatic arc rocks of the western Wilson Terrane and Wilkes Basin region. Our forward models indicate that the crust is $\sim$5 km thinner beneath the northern Wilkes Basin, compared to formerly contiguous segments of the Delamerian Orogen in south-eastern Australia. We put forward four possible explanations for the thinner crust we modelled beneath the northern Wilkes Subglacial Basin: i) back-arc basin formation or orogenic collapse processes, coupled with major crustal-scale tectonic segmentation within the Ross\Delamerian orogens, ii) Jurassic to Cretaceous intraplate extension in East Antarctica, prior to later break-up between Australia and East Antarctica, iii) major glacial erosion within the Wilkes Subglacial Basin since East Antarctic Ice Sheet initiation, ca 34 Ma, or most likely- iv) a combination of these tectonic and erosional processes and their associated isostatic responses.