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Uplift and tilting of the Shackleton Range in East Antarctica driven by glacial erosion and normal faulting

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The bedrock topography of Antarctica is a key boundary condition governing past and present ice sheet dynamics. Unravelling the long-term evolution of the subglacial landscape is therefore important for understanding past Antarctic ice sheet dynamics and stability, particularly in marine-based sectors of the ice sheet. Here, we model the evolution of the bedrock topography beneath the Recovery catchment, a sector of the East Antarctic Ice Sheet characterised by fast-flowing ice streams that occupy overdeepened subglacial troughs. We use 3D flexural models to quantify the effect of erosional unloading and mechanical unloading on border faults in driving isostatic bedrock uplift of the Shackleton Range and Theron Mountains, which are flanked by the ice streams. Inverse spectral (free-air admittance) and forward modelling of topography and gravity anomaly data indicate that the effective elastic thickness of the lithosphere (Te) in the Shackleton Range region is $\sim$20 km. Our models indicate that glacial erosion has driven 40–50% of total peak uplift in the Shackleton Range and Theron Mountains. A further 40–50% can be attributed to mechanical unloading associated with normal fault systems of inferred Jurassic and Cretaceous age. Our results indicate that the flexural effects of glacial erosion play a key role in mountain uplift along the East Antarctic margin, augmenting previous findings in the Transantarctic Mountains. The results suggest that at 34 Ma, the mountains were lower and the bounding valley floors were close to sea-level, which implies that the early ice sheet in this region may have been relatively stable.