Uplift and tilting of the Shackleton Range in East Antarctica driven by glacial erosion and normal faulting - DTU Orbit (31/03/2019)

Unravelling the long-term evolution of the subglacial landscape of Antarctica is vital for understanding past 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 characterized by fast-flowing ice streams that occupy overdeepened subglacial troughs. We use 3-D flexural models to quantify the effect of erosional unloading and mechanical unloading associated with motion on border faults in driving isostatic bedrock uplift of the Shackleton Range and Theron Mountains, which are flanked by the Recovery, Slessor, and Bailey ice streams. Inverse spectral (free-air admittance) and forward modeling of topography and gravity anomaly data allow us to constrain the effective elastic thickness of the lithosphere (T_e) in the Shackleton Range region to similar to 20km. Our models indicate that glacial erosion, and the associated isostatic rebound, has driven 40-50% of total peak uplift in the Shackleton Range and Theron Mountains. A further 40-50% can be attributed to motion on 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 34Ma, 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.

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