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Long-term landscape evolution of the Wilkes Subglacial Basin, East Antarctica

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Reconstructions of the bedrock topography of Antarctica since the Eocene–Oligocene Boundary (ca. 34 Ma) provide an important boundary condition for modelling past Antarctic ice sheets. This is particularly vital in regions where the bedrock presently lies below sea level, since these sectors are thought to be most vulnerable to future change. Here we use 3D flexural modelling to reconstruct the evolution of the topography of the Wilkes Subglacial Basin and Transantarctic Mountains, which are situated beneath the East Antarctic Ice Sheet. We estimate the spatial distribution of glacial erosion and restore this material to the topography, which is also adjusted for the associated flexural isostatic responses. We constrain our erosion estimates and the pace of landscape evolution since 34 Ma using offshore sediment stratigraphy, as revealed by IODP core records. In our reconstructions, the 2 km-deep troughs within the Wilkes Subglacial Basin were much shallower at the Eocene–Oligocene Boundary due to the restoration of selectively eroded material. Our models provide a better-defined boundary condition for modelling early ice sheets, and show that the majority of glacial erosion and landscape evolution occurred prior to 14 Ma, which we interpret to reflect a more dynamic and erosive early East Antarctic Ice Sheet. Our flexural modelling shows that the inherited (pre-34 Ma) topography is consistent with long-wavelength elastic plate flexure and influenced by the inherited crustal structure.