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REVEALING THE SUBGLACIAL EROSION AND LANDSCAPE EVOLUTION HISTORY BELOW THE EAST ANTARCTIC ICE SHEET USING DETRITAL THERMOCHRONOLOGY

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To constrain modification of the subglacial landscape of East Antarctica by glacial erosion since the inception of the East Antarctic ice sheet at 34 Ma we compare the detrital geo- and thermochronologic record of a pre-glacial Eocene fluvial-deltaic sandstone and a Quaternary glacial diamictite taken, respectively, from ODP hole 1166A (Leg 188) and core JPC34 (Nathaniel B. Palmer Cruise 01-01) both from Prydz Bay. These sediments represent the products of erosion from the Lambert catchment – the World's largest outlet glacier system, draining over 15% of the total area of East Antarctica. Detrital zircon U-Pb age distributions from both sediments are remarkably similar indicating a common bedrock source area following the transition from fluvial to glacial conditions. The pre-glacial Eocene fluvial sandstone is characterized by uniformly old apatite fission-track (AFT) and (U-Th)/He (AHe) age distributions with means and standard deviations of 291±88 Ma, and 221±71 Ma, respectively. Such ages signify very slow pre-34 Ma long-term erosion rates within the catchment of <0.02 km/Myr, despite the presence of the >2500m high Gamburtsev mountains, and are consistent with widespread remnants of a pre-glacial planar erosion surface throughout the Lambert catchment. The Quaternary diamictite AFT and AHe age distributions are significantly younger (209±47 and 82±27 Ma, respectively) despite their common bedrock source. They represent an average reduction in lag-time of ca. 50 Ma (AFT) and ca. 100 Ma (AHe), diagnostic of a substantial increase in erosion rates within the catchment since 34 Ma to local time-averaged rates of >0.05 km/Myr. The old AFT and AHe ages present near the surface at 34 Ma would have meant a rapid decrease in ages with increasing temperature and depth at this time, with little subsequent erosion being required to expose younger aged apatite grains to the sediments supply. Modeled predictions of this age-temperature (depth) profile indicate the JPC34 AFT and AHe ages represent grains resident at temperatures of 40-55°C prior to the onset of glacial erosion at 34 Ma. This is in excellent agreement with published morphologic estimates of 1.5 km of glacial incision into the pre-glacial peneplain at the head of the Lambert glacier system implying a realistic geothermal gradient of 27-37°C/km at 34 Ma.

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