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Late Paleozoic glaciated landscape in northern Africa as an outstandingly well-preserved analogue to Quaternary deglaciated areas

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The Ennedi sandstone plateau in Chad in north-central Africa exposes an outstanding example of an ice stream paleo-landscape that is of Paleozoic age. This assemblage of paleo-glacial structures is of comparable quality to that found in Quaternary deglaciated landscapes. A wide range of exceptionally well-preserved proglacial, ice-marginal and subglacial features are visible due to the absence of vegetation in the desert environment. Paleo-ice stream pathways contain swarms of large-scale glacial lineations distributed over the whole plateau that tell the story of a dying ice sheet during the late Paleozoic. A putative grounding zone wedge within a paleo-ice stream pathway allows the position of the former coastline to be reconstructed as it is assumed that ice streams terminated into a former ocean basin. Based on the convex topography and its position orthogonal to the large-scale glacial lineations, we present the first geomorphological interpretation of a grounding zone wedge in the Paleozoic record. Additionally, a unique system of inverted channel sediments in close proximity to glacial structures might record different phases of meltwater release during ice retreat. In summary, the Ennedi paleo-glacial landscape provides an excellent natural laboratory to understand the spatial relationship between subglacial, ice-marginal and proglacial components of a former ice sheet, with emphasis on exceptional outcrop quality that can be used to further our understanding of some Quaternary glaciated landscapes.