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Geomorphic windows into Neoproterozoic ice ages: a complex subglacial topography from the Yuermeinak Formation of NW China

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The erosive behaviour of ice masses produces a suite of classic and characteristic landforms, which despite being well presented in Quaternary deposits are rarely preserved in Neoproterozoic strata. In the context of severe Neoproterozoic glaciations, an understanding of the types of bedform produced potentially sheds light on the character of the ice sheet thermal regime. We describe, for the first time, an outcrop of the Yuermeinak Formation (Ediacaran) from the Tarim Craton, NW China, which contains a host of clear glacial features, including erosional bedforms. At the base of the section are streamlined, undulating drumlins that are onlapped by glacial strata. The basal surface locally hosts glacial striae, providing a clear sense of ice flow direction. This also represents the first description of a Precambrian glacially striated pavement from the Tarim Craton. The remainder of the section is characterised by shales punctuated by cm-scale medium to granular sandstones and metre scale diamictite beds. The sandstones are normally graded to massive, possibly representing gravity flows. Locally abundant bullet-shaped clasts, bearing striae parallel to their long-axes, are indicative of subglacial sculpting. Their occurrence within diamictites allows an interpretation of a subglacial tillite that draped the basal striated bedforms. Stratified diamictites are consistent with rain out of debris from an overlying ice shelf. The presence of dropstones within the section is further supported by pebbles and cobbles that vertically penetrate shale laminae and sandstone beds, exhibiting classic dropstone characteristics. Taken together, these lines of evidence paint the picture of a wet-based, possibly streaming ice mass, that terminated in a standing body of water.