

From ice streams to meltwater channels: Detailed study of a vast ancient ice sheet of the LPIA in the Ennedi Plateau, Chad

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The sedimentary record of the Late Paleozoic glaciation is recorded and intensely studied all over Gondwana but understudied in northern Africa. Only two locations, in Niger and Chad, have thus far been found and only the former has been subject to field investigation. Across the Ennedi Massif in northern Chad, Paleozoic rocks are exposed in sandstone plateaux and exhibit a convincing geomorphological record of subglacial activity. Features consistent with ancient ice streams can be traced northwards into the Mourdi depression. Glacial lineations, moraines and exhumed channels in positive relief provide strong evidence for the existence of a vast ice sheet covering large areas of the Ennedi Plateau. Channel structures in positive relief provide insight into meltwater release during different stages of ice sheet development. Various ridges cross-cut one another in a possible proglacial system recording significant meltwater release. In this study, satellite images were manipulated using various techniques to extract lithological differences and mineral composition from the Ennedi Massif. We note (i) considerable mineralogical variation between known palaeo-ice stream and interstream areas across the plateaux which probably proxy lithological differences, (ii) the presence of a newly discovered palaeo-ice stream to the western extremity of the plateau, (iii) provide topographic and geomorphological evidence for a putative grounding zone wedge, supporting the interpretation of a marine terminating Paleozoic ice sheet and (iv) the architecture of braided and meandering channel systems including possible internal channel heterogeneities and point bar configurations. The application of band rationing and image manipulation techniques is the first step in the generation of an initial geological map specifically for the Late Palaeozoic glacial record of Chad, which needs to be ground-truthed in future geological fieldwork. Overall, the glacial record of the Ennedi Plateau throws significant new light on the 'big picture' of Paleozoic glaciation and expands the general understanding of deep-time glacial landsystems.