Exhumed fjords of Namibia: A glimpse of the Late Paleozoic Ice Age in the Karoo Supergroup of the Kaokoland basin

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The Late Paleozoic Ice Age (LPIA) is the longest-lived and most extreme glacial period (from ca 360 to 260 Ma) of the Phanerozoic. Over this time span, ice masses are thought to have covered most of Gondwana, from South America to Australia. In southern Africa, the sedimentary, stratigraphic and geomorphic evidence of this glaciation is recorded in the Karoo Supergroup. The Kaokoland region of northern Namibia is characterized by a dense network of deep (200-700 m), large (5-15 km) and U-shaped incised valleys formed during the LPIA (Martin, 1981). A recent reappraisal of the morphology and sedimentary infill of these outstanding geomorphic features attests of their glacial origin. Valley flanks are spectacularly striated and scratched while valley floors are characterized by extensive whalebacks and roches moutonnées. Moreover, the sedimentary infill at the base of these valleys is mainly composed of coarse deposits (conglomerates, diamictites, erratics, striated clasts) interpreted as glaciogenic in origin. Of particular interest, however, is the presence of coarse (ranging from sand to boulders) glaciogenic sediments plastered on the sub-vertical and striated valley sides. Vitally, the elevation of these deposits in the valleys appears to correspond to a linear bench-like level, which may reflect a marginal moraine allowing for the maximum thickness of the LPIA glaciers to be derived, an unprecedented advance. For the first time in the characterization of a pre-Pleistocene glacial epoch, an ice thickness has been inferred. Collectively, these features prove that the valleys were carved and occupied by ice masses during the LPIA from which ice volume, and in turn their contribution to global eustasy, can directly be inferred. In addition, postglacial sedimentary succession abutting on valley flanks and showcasing marine, deltaic and estuarine affinities clearly indicate that these glacial valleys formed fjords in the immediate aftermath of the LPIA, after the retreat of the ice margins. Sealed by the Karoo Supergroup sediments through Carboniferous to early Cretaceous times, these major glaciogenic morphologic features have subsequently been exhumed during the Cenozoic. Thus, some desertic landscapes of northern Namibia correspond to a glacial relief inherited from the LPIA at ca ~ 300 Myr ago.

Martin, H., 1981, The Late Paleozoic Dwyka Group of the South Kalahari Basin in Namibia and Botswana and the subglacial valleys of the Kaokoveld in Namibia, in Hambrey, M.J., and Harland,