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Late Quaternary Environmental Changes from Aeolian and Fluvial Geoarchives in the Southwestern Kalahari, South Africa: Implications for African Intertropical Convergence Zone (ITCZ) and Southern Hemisphere Westerly Wind (SWW) Dynamics

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Precipitation in southern Africa – tropical summer rains in the north and the east and extratropical winter rains in the southwest – is strongly influenced by the seasonal shift of the Intertropical Convergence Zone (ITCZ). The displacement of the southern ITCZ since the Last Glacial Maximum (LGM, ∼22-18 ka BP) is disputed. Presented here are the first results of geomorphological and sedimentological field work as well as new 14C data and optically stimulated luminescence (OSL) records of fluvial and aeolian geoarchives in the catchment area of the lower Molopo River, southwest Kalahari. From investigations on fluvial deposits of the Molopo River, sand dunes and their relationship to the pans of the Namibian/South African pan belt we conclude a period between ∼35-23 ka BP with dune development, likely during the last glacial winters, when wind intensities strengthened due to the enhanced anticyclonic circulation over the southern African interior, and pans as well as river valleys were dry. During the summers, the impact of increased precipitation according to the influence of the ITCZ is assumed for the region, supported by aeolian input within the fluvial sediments.

By applying refined field and laboratory methodologies combined with a thorough literature evaluation, we provide a reconstruction of the late Quaternary climatic dynamics and a model of a southward shift of the ITCZ during the LGM at the same time as a northward shift of the Southern Hemisphere Westerly Winds (SWW). As a result, the southwest Kalahari received summer and winter rains after ∼23 ka BP resulting in pluvial conditions in the southwestern Kalahari that led to pan flooding throughout the year, the subsequent cessation of lunette dune development due to disabled deflation, and perennial flow in parts of the lower Molopo River, whereas the Auob and Nossob Rivers as well as the southernmost Molopo River were dry after ∼20 ka BP. Perennial or at least periodical discharge in the lower Molopo River stopped around 15 ka BP. Holocene fluvial activity at around 8 ka and 1 ka BP documented by OSL ages of the youngest fluvial deposits within the Molopo River bed north of 27°15'S is assumed to indicate periodical flow of the Kuruman River.

The corresponding reconstruction of glacial climate circulation patterns over the southern African subcontinent resolves disputed palaeoclimate reconstructions and has important implications for modelling of past and future climate scenarios.