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Climatic induced shift in rainfall zones preserved in Kalahari salt pans

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Environmental changes in southern Africa come along with variations in atmospheric and oceanic circulation as well as anthropogenic caused landuse changes. The reconstruction of the paleoclimate and paleoenvironment is complicated by the fact that regions with a markedly arid climate are rare in continuous sedimentary archives. Lacustrine systems with constant sedimentary records are absent due to low precipitation and high evaporation. Ephemeral lakes (playas, salt pans) are a characteristic geomorphological feature of arid landscapes. In the southwestern Kalahari salt pans are temporarily flooded during summer season when isolated showers occur in their local catchment areas. So, they are potential archives preserving environmental signals in phases of sedimentation. So far, Kalahari pans were mainly interpreted as erosional structures formed by deflation processes as indicated by marginal lunette dunes. The principle processes in salt pan formation are complex and so far under discussion. Our study follows a multidisciplinary approach integrating sedimentological and geochemical methods to understand the formation of salt pans as a prerequisite for using them as geoarchives by reconstructing the paleoenvironmental and paleoclimatic conditions from its sedimentary record.

Our sedimentological investigations of core material reveal that all five salt pans from Namibia and South Africa included in this study possess a few meter thick sedimentary filling of siliciclastic and evaporitic sediments. The age-depth models, developed on the basis of comprehensive ^{14}C dating of bulk organic matter, indicate a quasi-continuous accumulation of sediments since the late Pleistocene. Two differing patterns of sedimentation rates were identified showing a clear SW-NE trend. The geochemical analyses (XRD, XRF) prove changes in weathering, wetness and temperature which point to climatic changes during the last 40,000 aBP. Our results indicate an influence of the Antarctic sea ice expansion during the Last Glacial Maximum (LGM) which resulted in a northeastward shift of the rainfall zones in southern Africa. During the LGM the southwestern salt pans were located in the winter rainfall zone (WRZ) under colder and wetter conditions than today resulting in high sedimentation rates. Presumably, the precipitation gradient was inverse to the present one. Sedimentary processes in the pans are mainly controlled by local runoff, evaporation and to a minor degree by eolian transport resulting in a net accumulation. The detailed integrated analysis of the paleoenvironmental information recorded in these sedimentary archives will play a pivotal role in reconstructing the response of the southwestern Kalahari to past climatic changes.

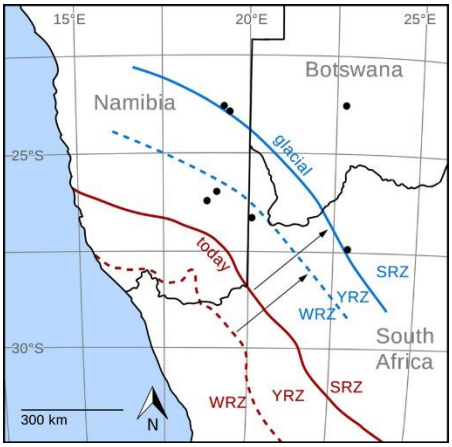

Figure 1: Modern and last glacial spatial pattern of rainfall zones in southwestern Africa. WRZ - winter rainfall zone; YRZ - year-around rainfall zone; SRZ - summer rainfall zone.