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Slope Deposits and (Paleo)Soils as Geoarchives to Reconstruct Late Quaternary Environments of Southern Africa

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Although it is clear that large, rapid temperature changes have occurred during the last glacial-interglacial cycle and the Holocene in southern Africa, we have only limited, and often imprecise, knowledge of how the major moisture-bearing atmospheric circulation systems have reacted to these changes. Using slope deposits and soils as palaeoclimatic geoarchives we will overcome these constraints. The role of many geoarchives in the reconstruction of the Quaternary climate in southern Africa remains controversial, since the paleoclimate data are based on evidence from marine cores, lake sediments, speleothems and spring sinter, fluvial sediments, aeolian sands and dust, colluvium, and coastal sediments. To elucidate climate controls on Quaternary landscape evolution and to use these data for palaeoclimatic reconstructions, thus far slope deposits and soils have been investigated. Climatic controls on these cycles are incompletely known. The availability of results from earlier fieldwork, micromorphology, Optical Stimulated Luminescence (OSL), 14C dating and stable carbon isotope analysis will permit a thorough assessment of slope deposits and soils in terms of their palaeoenvironmental potential. The knowledge of suitable areas and sites in different climatic zones of southern Africa where slope deposits and soils have already been found document the late Quaternary climatic history and even climatic anomalies (e.g. Younger Dryas period at Eksteenfontein, 8.2 ka event at Tsumkwe, 4 ka event in the Auob valley, Little Ice Age in the Namib Desert). The findings will show the late Quaternary history of precipitation fluctuations, of the shifting of the ITCZ (and the ABF – Agulhas-Benguela Front), of wind intensities and directions, and of extreme precipitation events.

The project will employ state-of-the-art geoscience methodology to interpret the record of precipitation changes of the late Quaternary, including the shifting of the summer and winter rain belts, the chronology of catastrophic floods, the wind intensity and direction, and the role climatic factors may have played for prehistoric cultures. We will use shallow geophysical surveys as ground penetrating radar, electrical resistivity tomography and seismic refraction to differentiate sediments and the layers within them. Drilling is needed to recover samples and cores. Remote sensing will basicly help to calculate the spreading of slope deposits in mountainous areas and escarpments. Sedimentological and pedogenetical lab analysis (XRF, XRA, element analysis etc.) is used to identify finger prints of special sediment units, their sources and transportation rates. OSL and other dating methods will give the needed chronostratigraphical informations.

High resolution late Quaternary records are provided by analysing the interstratification of slope deposits and soils with fluvial, lacustrine and aeolian sediment sequences. Earlier research has shown that aeolian and fluvial processes were active at the same time in the southwestern Kalahari during the LGM, documented by sequences of alternate bedding of aeolian, colluvial and fluvial sediments. The interfingering of slope deposits with fluvial flood sediments (slackwater deposits) in Namib Desert valleys document extreme precipitation events in the upper highland catchments and rains at the same time in the desert itself. The program will generate space and time transgressive models of slope deposit formation and soil development and identify key parameters controlling slope processes. These results will provide a solid base for evaluation and assessment of precipitation conditions and erosion/sedimentation processes for southern Africa under global warming conditions.