



Geoarchaeological Research in the Egyptian Eastern Desert: Unique Cave Sediments of the Archaeological Site Sodmein Cave, Landscape Evolution and Palaeoenvironment in a Hyperarid Area

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Introduction

Sodmein Cave can be interpreted as one of the rare living sites in the time frame between 120 ka and 7 ka before today in northeast Africa. Nowadays, a hyperarid climate is dominant in the area, but the excavated sequence - with more than 4 m of stratified occupation debris of mainly Middle Stone Age (MSA) deposits - indicate for the Pleistocene regional wetter conditions.. Main objective of the PhD is to understand the site formation and sediment accumulation within the cave and to derive environmental changes outside the cave from these results. Altogether, with geomorphological investigation of different archives in the area around Sodmein Cave, we get an idea of the palaeoenvironment and landscape evolution during the last 120 ka. One focus of research is directed to old wadi terraces with strongly developed desert pavement formation and MSA artefact concentrations, which are most likely in-situ located. With attention of the archaeological results, the PhD will present a integrated geoarchaeological work and a better understanding of the palaeoenvironment and landscape evolution in the Egyptian Eastern desert.



Significant archives and landscape elements in the research area



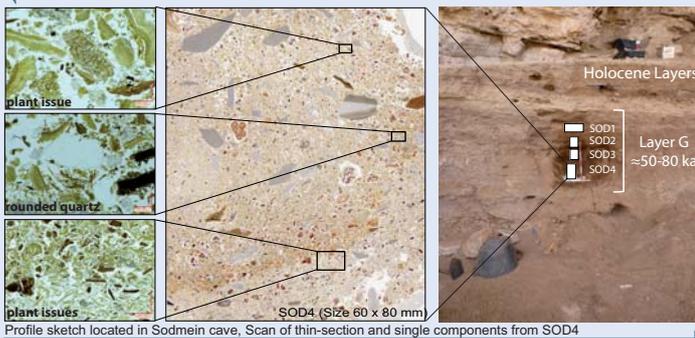
“on-site”

I. Micromorphology in 2D

Cave sediments imply particular conditions and taphonomic processes, especially in hyperarid environments. Such processes and its context can be analysed and visualised by micromorphology. Due to the high amount of very well preserved plant remains and coprolites in the archaeological sequence of the cave, the thin sections not only offer information about sediment accumulation processes and pedofeatures, but also of fauna and flora activity. Sodmein Cave can serve as an example for the specific taphonomic and sedimentation processes in caves in hyperarid environments.

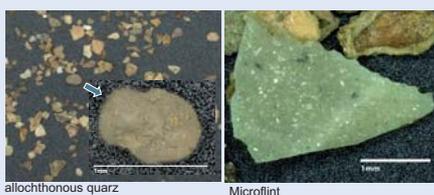


Downscaling of the observation level



Upscaling of the interpretation level

II. Micromorphology in 3D



The study combines the two-dimensional analysis of thin sections with a 3D analysis of sediment samples, using the digital microscope Keyence VHX-2000. Especially the surface analysis of sand grains or microflint can give detailed information about the origin, patina and transport history of the particles which is not always possible in thin-sections, because of the transition from three to two dimensions.

III. Sedimentological analysis

Additional sediment analysis (e.g. grain-size distribution, CaCO₃, Corg, XRF, etc.) will enlarge the semi-quantitative results from the micromorphology, to get a multi-proxy sediment characterisation.

“off-site”

I. GIS

The analysis of satellite images and DEM's provides especially, in desert areas, useful information's on landscape dynamics. For our area we use high resolution multispectral satellite images (Quickbird, 2,4m resolution) and a DEM derived from WorldView2 stereo-images (1m resolution) was used. One of the important landscape elements are old wadi terraces, which developed a strong desert-pavement with dark desert varnish on the surface and can easily identify by analysing the satellite images.



South-western area of Sodmein Cave with some of the wadi terraces

II. Wadi Terraces and Desert Pavement



One approach for analysing the terrace surfaces is to describe single squaremeters, by documenting it with hyperspectral pictures using a RIKOLA hyperspectral Camera. This characterise the structure and colour of the desert pavement. Furthermore, the detailed recording of the hyperspectral signature serves as a ground check for upscaling and mapping further potentially old surfaces by using satellite images. The development of different desert pavement on different terraces can serve as a relative age indicator and compared with absolute dating of the terraces (OSL, cosmogenic nuclides), a reconstruction of landscape dynamics and wadi activity can be made.

III. Sediment Archives



Single sediment archives can provide a record for reconstructing palaeoenvironment. These archives were found in small basins, at the interface to the main wadi channel protected by terraces. The playa sediments indicating conditions of temporary water filling of these basins and representing for the first time in this area stratified sediment archives. By analysing and dating these sediments, important informations for climate and water availability can be made. Artefact findings in the surrounding of these basins strengthen the high potential for reconstruction human-environment interactions, within a geoarchaeological research approach.

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