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CRC 806 - Our Way to Europe
Out of Africa – Late Pleistocene Rock Shelter Stratigraphies and Palaeoenvironments in Northeastern Africa

# Multi-Scale Dimensions of Relief in Geoarchaelogy:

## A base for reconstructing Late Pleistocene environments in the Eastern Desert of Egypt

## Introduction

Scale, spatial and temporal, is one of the most important issues to deal with, when reconstructing former environments and landscapes in context of geoarchaeology. We present remote sensing investigations of different scales in order to answer crucial questions about late Pleistocene terrain environment as one important aspect for the migration of anatomically modern humans in Northeast Africa.

Interdisciplinary research with different subjects, descriptions and interpretations, therefore often work with varying meanings of specific scales (e.g. Stein 1993). Nevertheless, these problems can be avoided by the explicit definition of scale and resolution, when discussing data availability, research questions, and the level of interpretation.

Fig. 1 shows the relationship between the dimension of a landform and their persistence (after Dikau 1988, Ahnert 1996, Bubenzer 2007). Not all, but a specific range of scales is significant for geoarchaeological investigations.

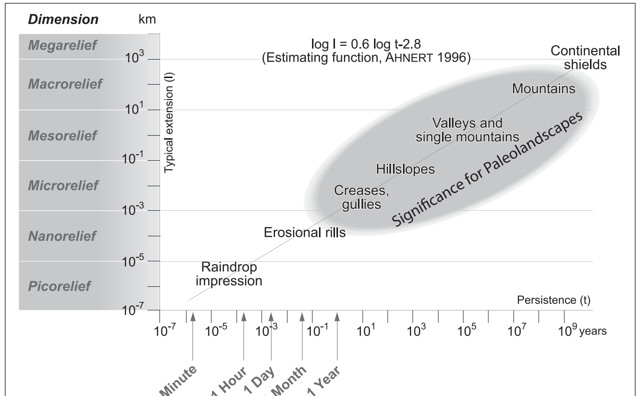

Figure 1

## Methodical Approach

In remote sensing investigations, the subject of scale is no longer a matter of data availability. During the last decades, data availability has grown significantly. Nowadays it is rather a matter of using the right data/scale for processing and interpretating research questions, than getting enough remote sensing data (except of high costs for high-resolution data).

Each scale of relief has its specific characteristics in terms of their informative value. It is important to consider, that the relief spheres interact with each other and changes from one to another scale can be also diffuse.

Fig. 2 shows the definition of scale levels for geologic-geomorphological objects of interest and the usage of different scale related data sources.

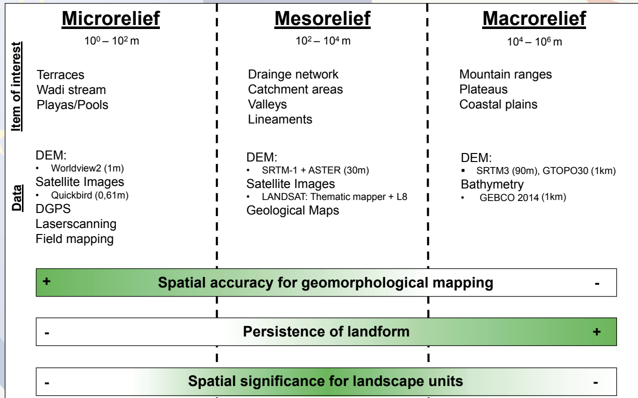

Figure 2

## 1.) Gebel Duwi

Map 1 shows a part of the limestone hogback of Gebel Duwi including the important MSA site Sodmein Cave.

Mapped in red colors are wadi terraces with strong occurrence of dark desert pavement indicating a long-term stability of these surfaces.

Map 1

**Key research questions & scale specific remote sensing investigations:**

*How was the landscape evolution during the Late Pleistocene in the area of Sodmein Cave?*

*Which geomorphic processes played a major role in the landscape formation and how did they protect / influence the occurence of further archaeological findings outside of Sodmein Cave?*

- Classification of different terrace units: high-resolution DEM & Laserscan
- Identification old surfaces based on strong desert pavements: high-resolution Sat-images
- Synoptical maps including tectonics and geomorphology: base for landscape formation

*Most important landform dimension:* **Microrelief**

## 2.) Eastern Desert

Map 2 displays the central part of the Eastern Desert between the Red Sea and the Nile Valley with its major drainage systems and two catchments affecting Gebel Duwi.

The mountainous landscape is highly eroded with deep incised wadi channels.

Map 2

**Key research questions & scale specific remote sensing investigations:**

*How was the connectivity between the Red Sea Coast, Eastern Desert and Nile Valley in terms of living environment for humans in specific timescales?*

*Which are the dominant landscape units influencing human mobility in the Late Pleistocene?*

*- Drainage network and catchment areas for surface runoff and water storage*
*- Roughness Index as one aspect for Least Cost Analysis for mobility of humans*
*- Topographic Position Index to identify different landscape units.*

*Most important landform dimension:* **Mesorelief**

## 3.) Northeast Africa

Map 3 shows Northeast Africa with exposed shelf areas during a maximum sea level drop of -120m (white areas).

A range of superior landscape units e.g. Western Desert, Eastern Desert, Nile Valley, Sinai can be distinguished, each with typical associated landforms.

Map 3

**Key research questions & scale specific remote sensing investigations:**

*Which corridors and/or barriers exist during the northward migration of Anatomical Modern Humans in the Late Pleistocene in Northeast Africa?*

*Which landscape associations where favored by humans and how many different landscape units build up a migration corridor?*

*-upscaling and summarizing of representative landform elements from lower scales*
*-modelling of exposed land areas during different timeslices of sea level lowstand*

*Most important landform dimension:* **Macrorelief**

### Spatial significance for human mobility

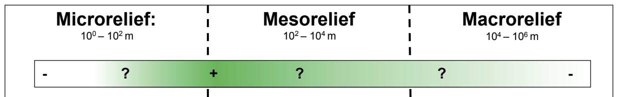

Figure 3

## Discussion & Outlook

To reconstruct Late Pleistocene environment, as one important aspect of geoarchaeological research in the Eastern Desert of Egypt, it is crucial to define explicit levels of scales. As shown by the classification of three main areas of interest (Sodmein Cave, Central Eastern Desert, Northeast Africa) each level has its own specific research question, which leads to focus on different dimensions of relief (Micro, Meso, Macro).

Future investigations have to integrate and discuss the different relief units with their specific landform scales in terms of spatial significance for human mobility and migration in the Late Pleistocene (Fig. 3 & 4).

### Spatial significance for human migration

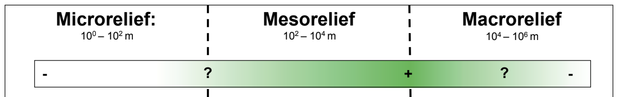

Figure 4

Ahnert,F. (1996). Einführung in die Geomorphologie. Eugen Ulmer, Stuttgart.
Bubenzer, O. (2007). Landscape in Geography and Landscape Ecology, Landscape Specification, and Classification in Geomorphology. In: Bollig, M. & Bubenzer, O. (eds.). African Landscape – interdisciplinary approaches. Studies of Human Ecology and Adaptation 4: 41-55. Springer (New York).
Dikau, R. (1988). Entwurf einer geomorphographisch-analytischen Systematik von Reliefeinheiten. Heidelberger Geographische Bausteine, 5.
Stein, J.K. (1993). Scale in archaeology, geosciences, and geoarchaeology. In Stein, J.K. & Linse A.R. (eds.) Effects on Scale on Archaeological and Geoscientific perspectives. Geological Society of America Special paper 283.

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