

# Discovering the Prehistoric Past of the North-East Africa with GIS

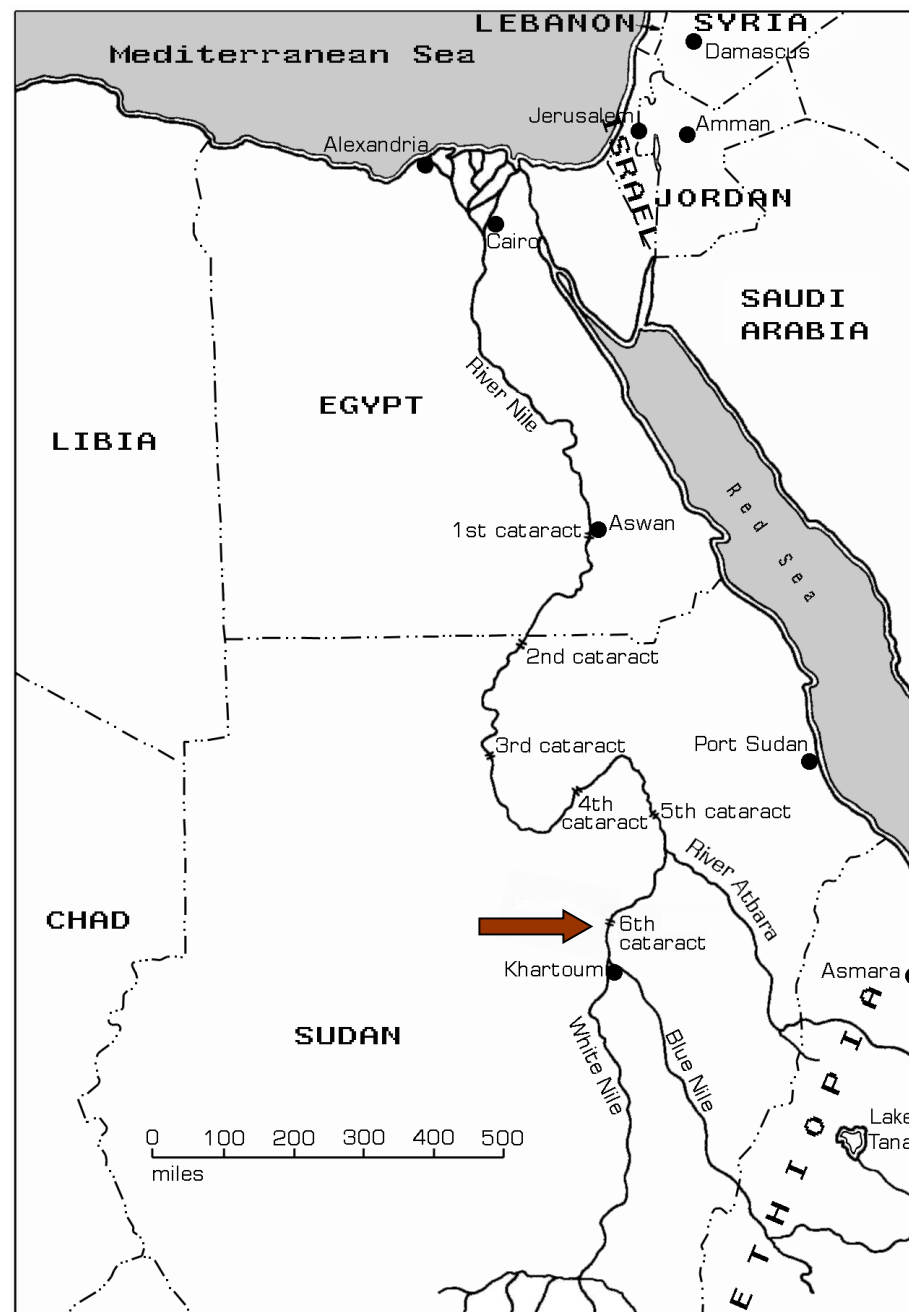
Dr. Jan Pacina, [Jan.Pacina@ujep.cz](mailto:Jan.Pacina@ujep.cz)

J. E. Purkyne University, the Czech Republic, Europe

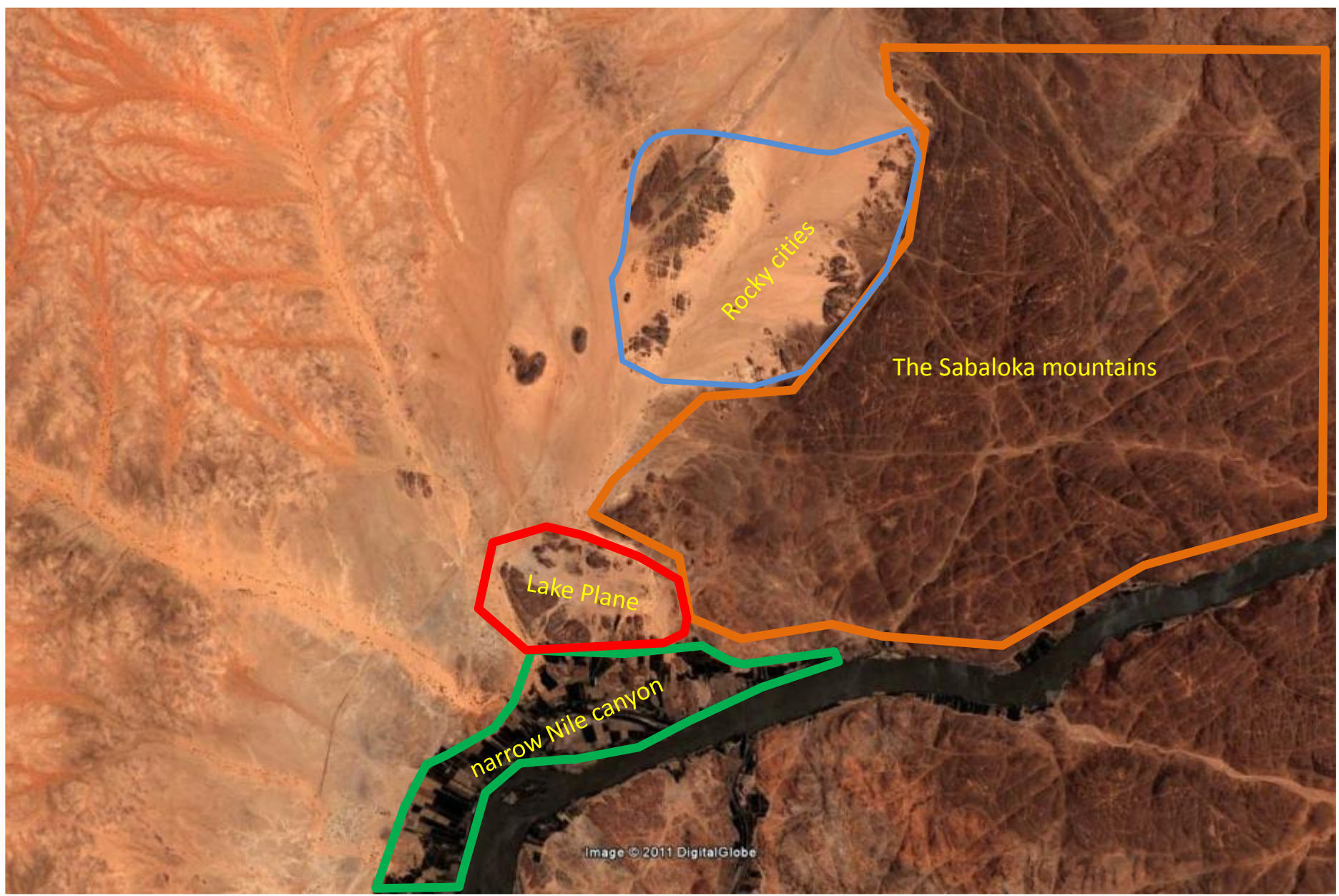


# The Sabaloka project

- **2009-2011**  
landscape archaeological research along the Nile river. Discovered more than 100 archaeological sites.
- **2011-2015**  
interdisciplinary research of prehistoric settlement and its interactions with the environment on the river Nile west bank within the **Sabaloka Dam Archaeological Salvage Project (SDASP)**



# Area of interest









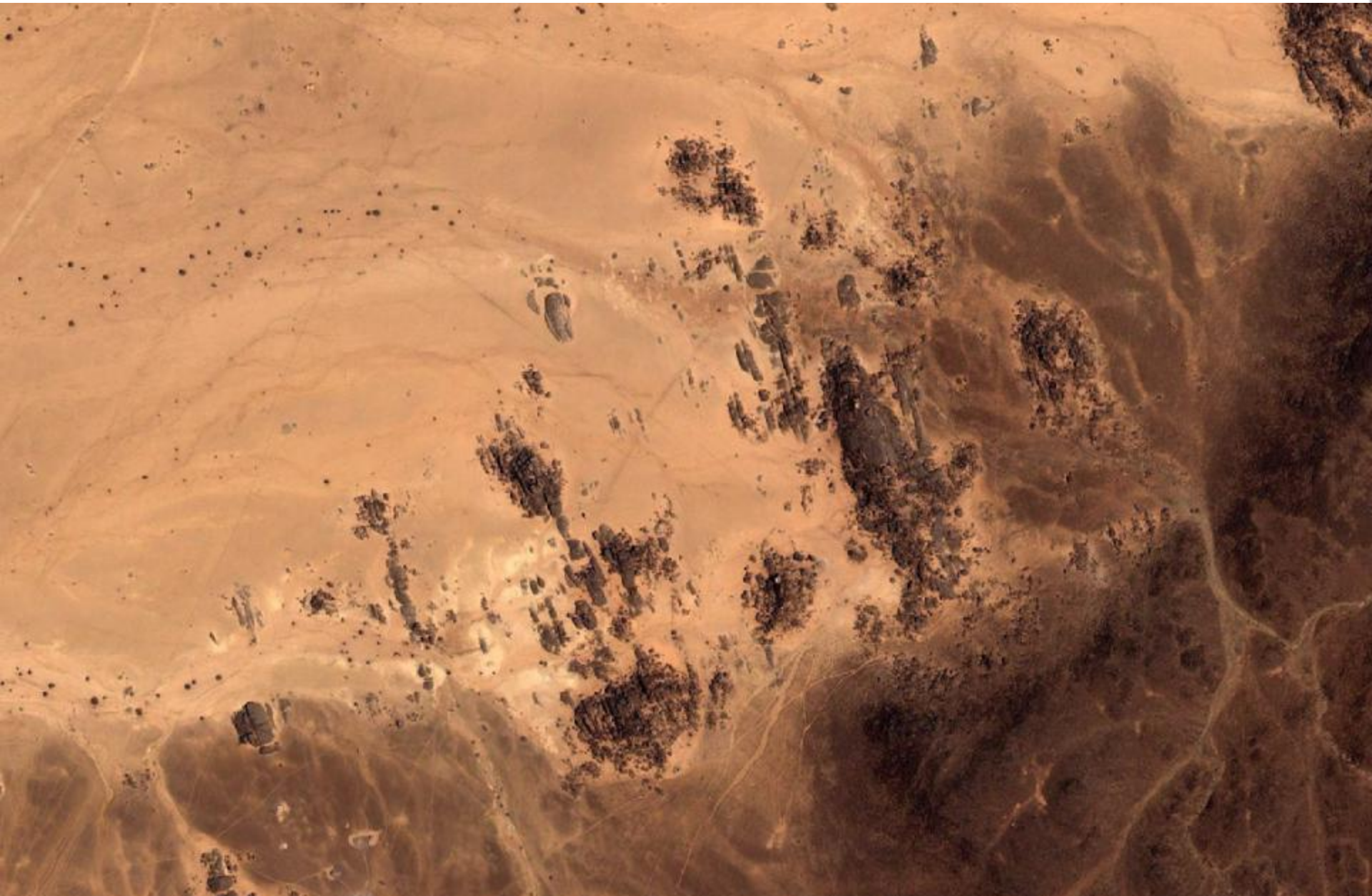








# The Rocky Cities











































# Surveying technology import conditions

- strict conditions for surveying technology import
- permission from the Sudan National Survey Authority required
- custom duty (toll) for the imported technology (GPS/total stations)
- better situation in the past years
- for „walkie-talkies“ permission from the Ministry of telecommunications required



Certificate of Payment of Duty in Deposit by Transit and Temporary Importation

Name of Person paying deposit: *SAN PA CIMA*

Particulars of Articles Imported:

Quantity	DESCRIPTION	Weight	VALUE	
			in SDG	in US\$
	PIPE		167.2	2111.11
	TALKIE			
	9110009100999			
	9110009100999			
	TER 300			
	641587221			
	WALKIE TALKIE			
	CARTON			
	21121688			
Total Customs Duty Collected in Deposit on Receipt No. _____			167.2	

Date: *23.10.2011*

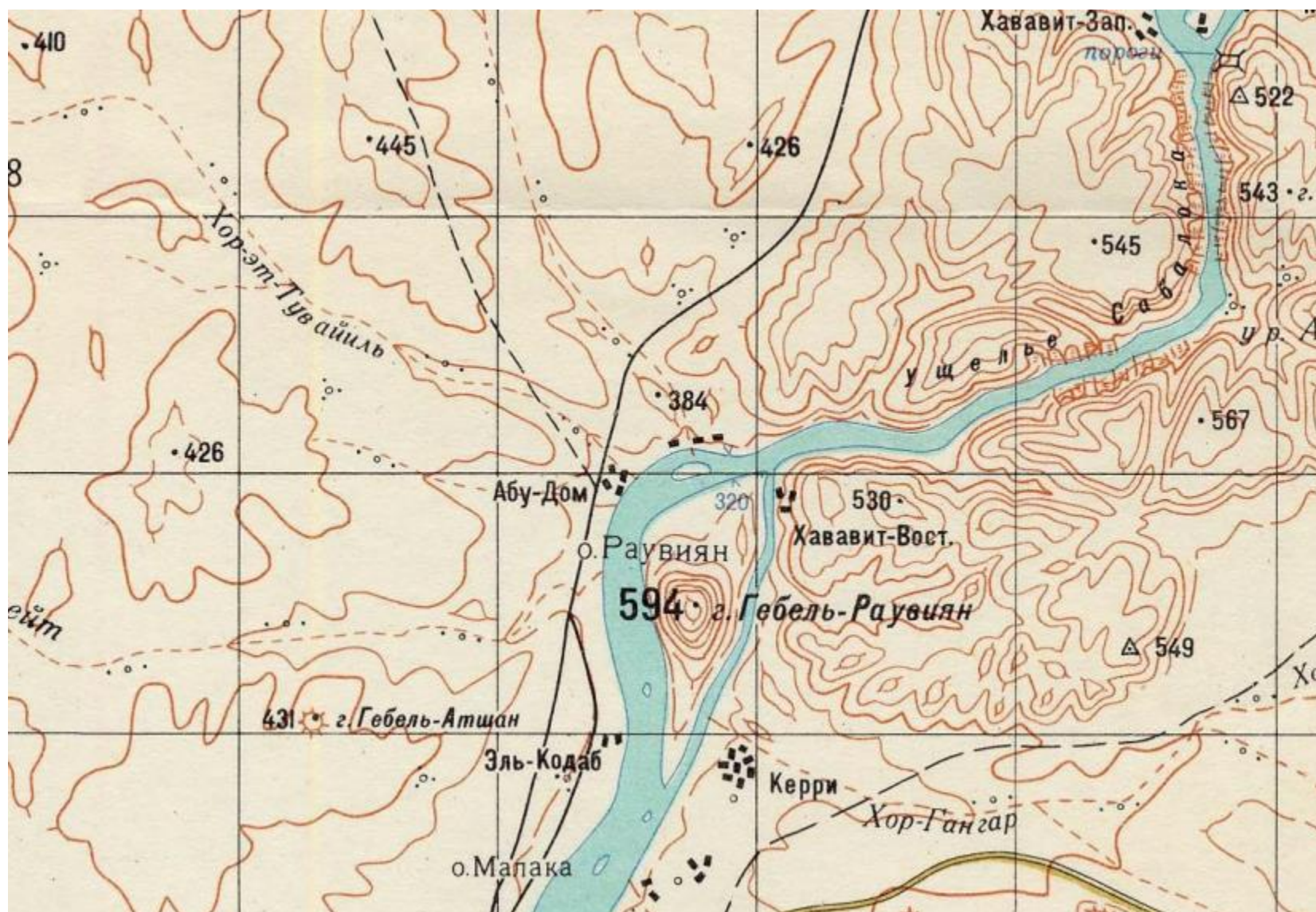
Signature: \_\_\_\_\_

Stamp: \_\_\_\_\_

1. A refund of the deposit collected may be claimed by the depositor provided that the articles are re-exported not later than six months after their importation into the Sudan.

2. The depositor should make his claim for refund at the time of re-export to the Chief Customs Officer at place of re-export and support the claim by producing this certificate together with the deposit receipt.

# Available basemaps





# Current state of GIS in Sudan

Table (1): Summary of Status as Collected by the Author

No.	Organization/Department	Availability of Functional GIS System	Availability of Recent Digital Topographic Maps	Availability of Recent Aerial Photography/ Satellite Imagery	Availability of GPS Equipment	Availability of GIS Development Plan	Year
1	Sudan National Survey Authority.	There are several photogrammetric systems: - Analog Photogrammetric stereo plotters. - Aerial Cameras, none of them is working	No	The most recent aerial photography was taken in 1996 for Khartoum State. Plus some satellite images(Landsat and Quickbird)	There are some	Starting	2008
2	Khartoum State (Engineering Issues Department).	There is good hardware setup and some GIS/ Image processing software such as (ArcGIS and ERDAS Imagine)	No	Digital aerial photography/ recent satellite imageries are: - SPOT 2001 - IKONOS 1999 - Raw Aerial Photos 2008	There is a good set of Trimble GPS and at least one base station	Getting better rapidly	2008
3	Sudan Engineering and Digital Information Centre (SEDIC).	A good photogrammetric system and some workstations exist	No	There are color unprocessed aerial photographs taken in 2000.	Use and sell GPS devices	Not clear	2008
4	Sudan National Remote Sensing Authority.	- Analog Photogrammetric lab but not functioning. - There are some PCs and some GIS and Image processing software such as (ArcGIS and ERDAS Imagine) mainly for training and research.	No	Some Landsat imageries (MSS, TM, and ETM+ ) available	No	Not clear	2008
5	University of Khartoum Faculty of Engineering (Department of Surveying).	- Some PCs and software available for training and research - Photogrammetry equipment: old long-outdated optical and mechanical projection instruments	No	Few stereo Model for teaching purpose	No	Not clear	2008
6	Sudan Central Bureau of Statistics.	None	No	Available maps were prepared for census; and generally they show administrative boundaries. The most recent maps were prepared in 2002 and currently under update	Some handheld GPS receivers which are used by surveyors to collect general locations of settlements	map available for census purpose from satellite imagery	2008
7	Khartoum State Water Corporation	There are several workstations /PCs used for data conversion and collection	There is a project for water network paper map conversion	No	No	Have a GIS project to convert as built CAD data to GIS	2008

Abdullah Elsadig Ali, Director General, Sudan National Survey Authority, Khartoum  
Eighteenth United Nations Regional Cartographic Conference for Asia and the Pacific

# Coordinate systems

- Adindan – Sudanese national coordinate system
- S42 – soviet maps
- WGS 84 – own measurements
- local coordinate systém for own precise measurements





# Fixed points and local coordinate system



# Methods

- surveying
- close range photogrammetry





# Surveying tools

## Total station TCR 303

- in combination with prism
- longest measurements—
- temperature limit 50°C (1)

## GNSS

- Trimble Juno ST
- Garmin GPSMap 62s

+ builder's tapes,  
folding rules, ...



# Surveying tools

- kite Elliot Rhombus Mega Power Sled, size  $300 \times 170$  cm, string ca 200 m, wind range 2–5 Bft + GoPro Hero 3+
- Sony Nex-7 camera



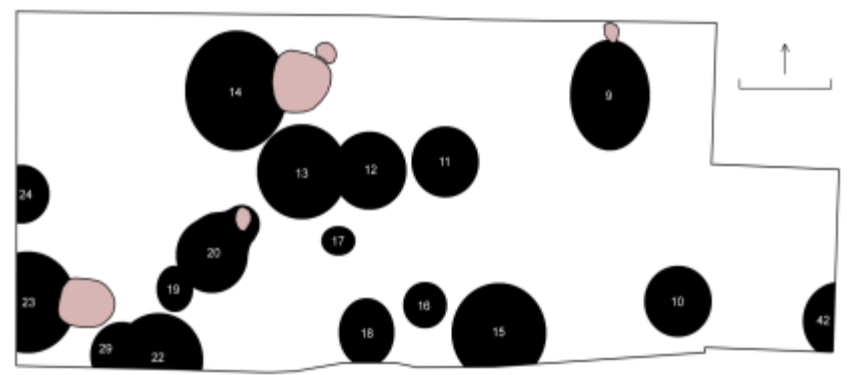
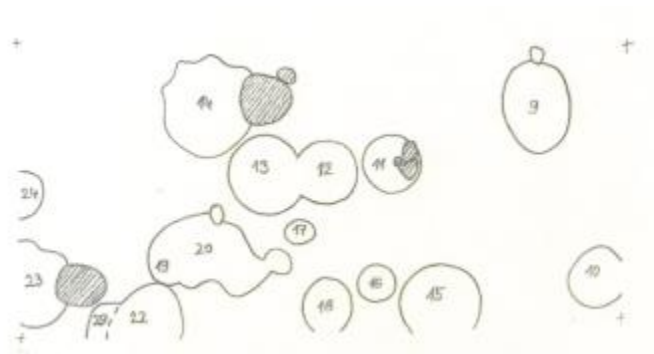
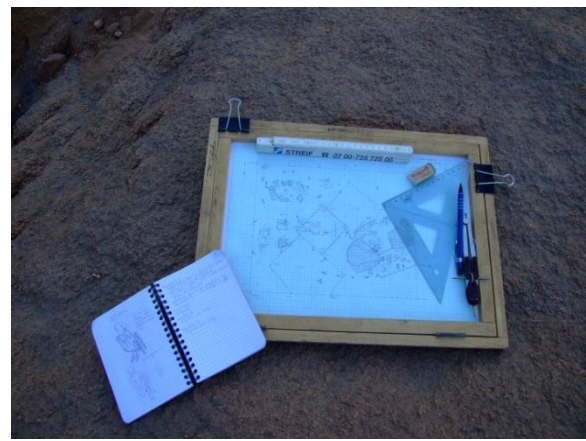
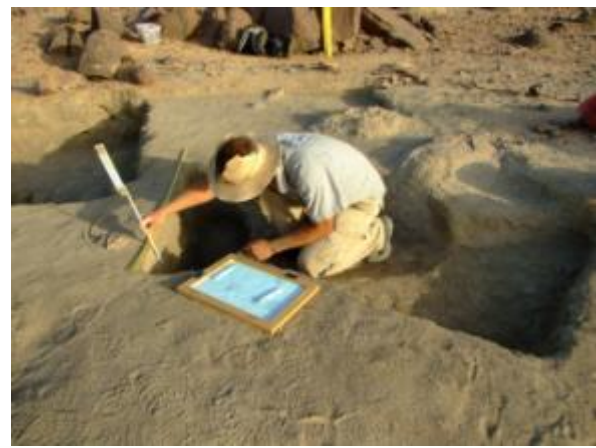


# Surveying results

- measured points and point clouds
- archaeological sites 3D models
- detailed orthophotos of selected sites

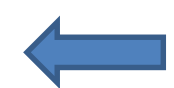
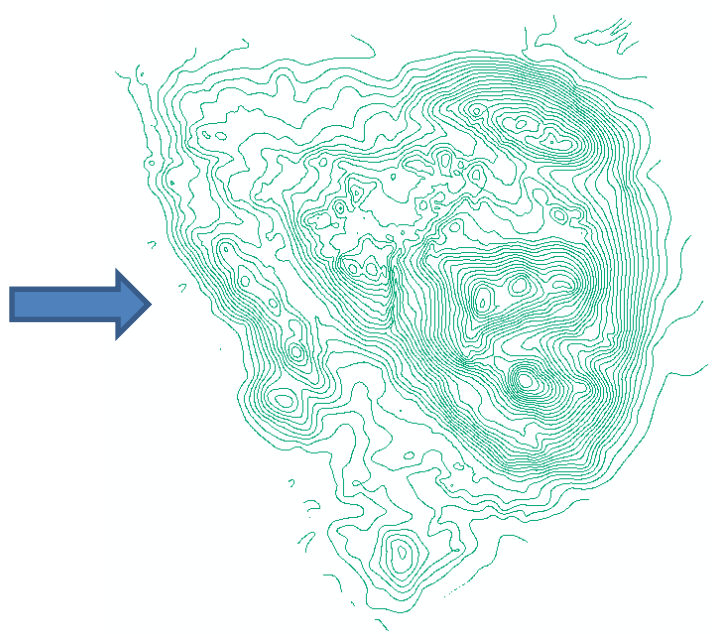
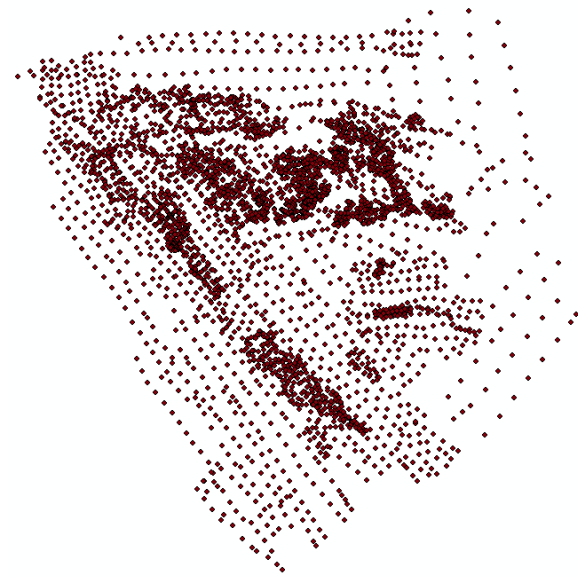


# Data processing workflow



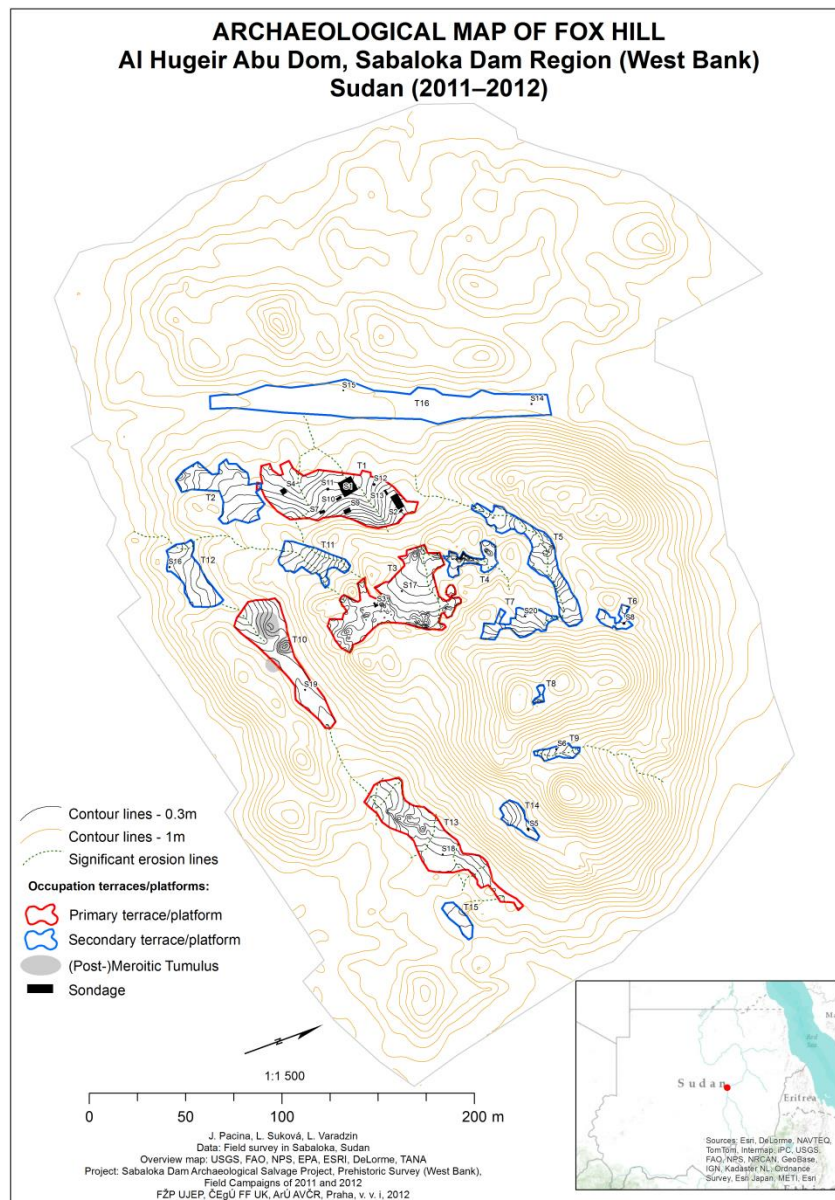


# Data processing workflow



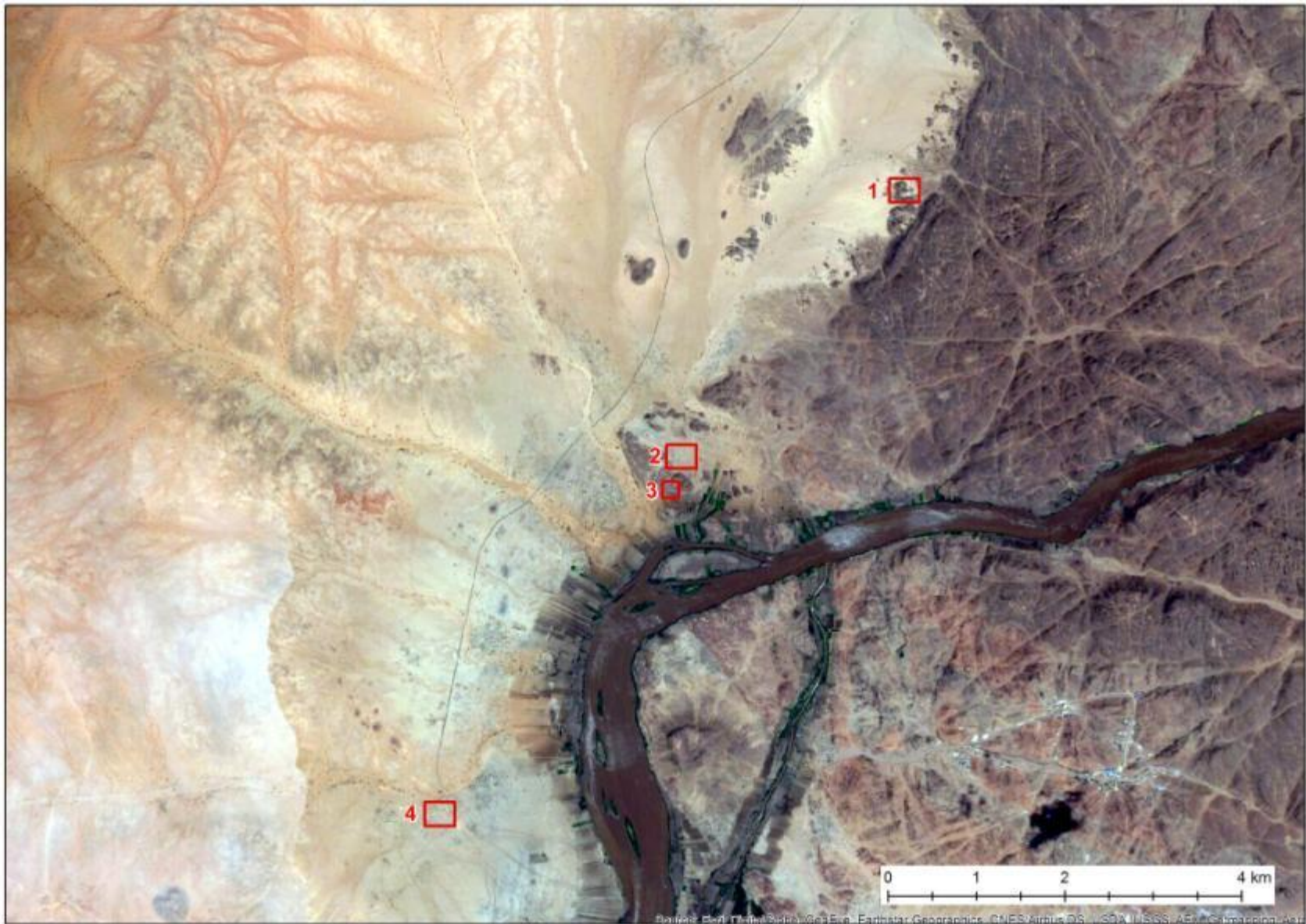
Archaeological data

# Resulting archaeological map – Fox Hill





# The usage of KAP





# Lake plane







# The Spinx site

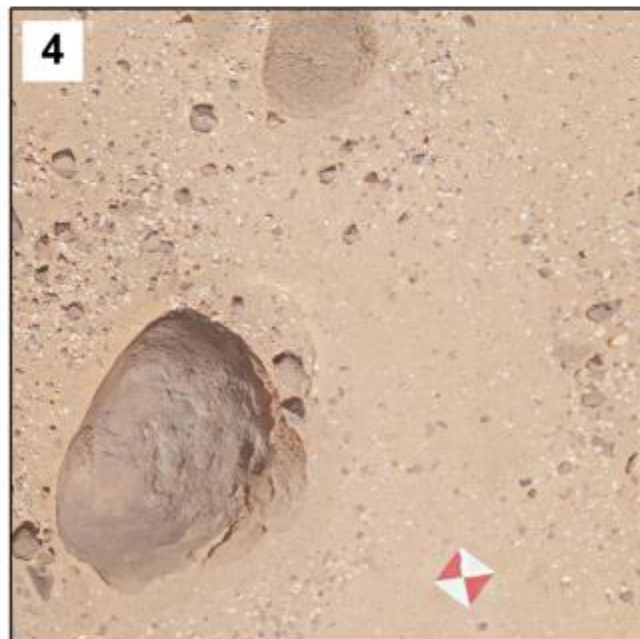
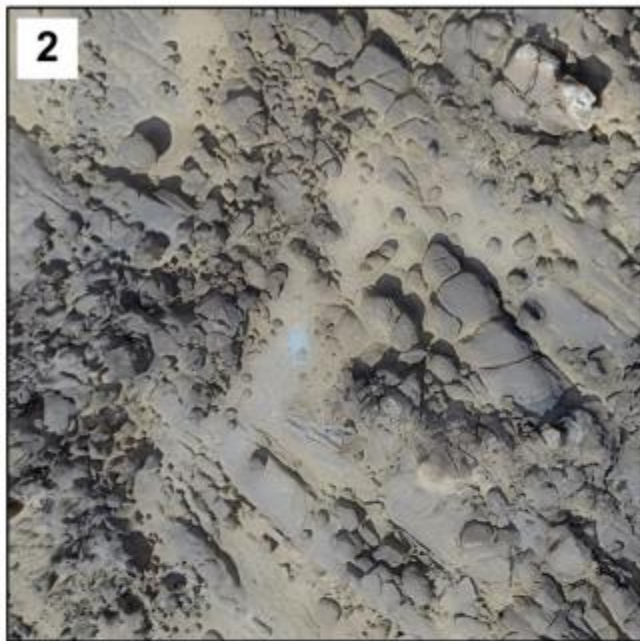
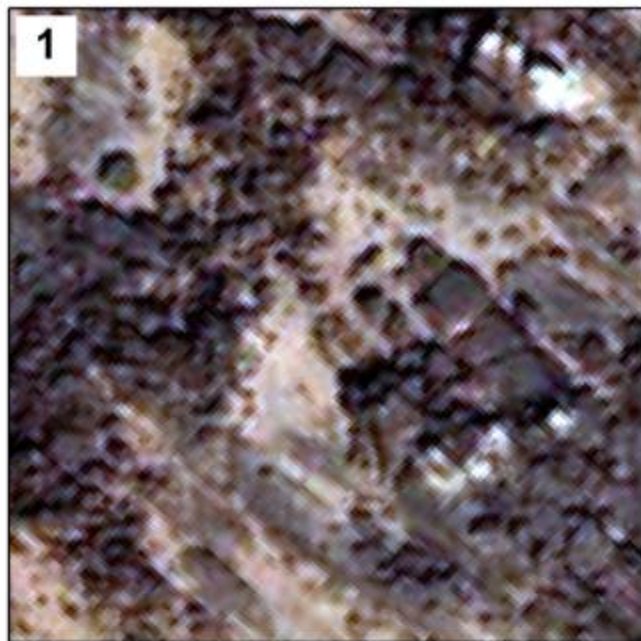




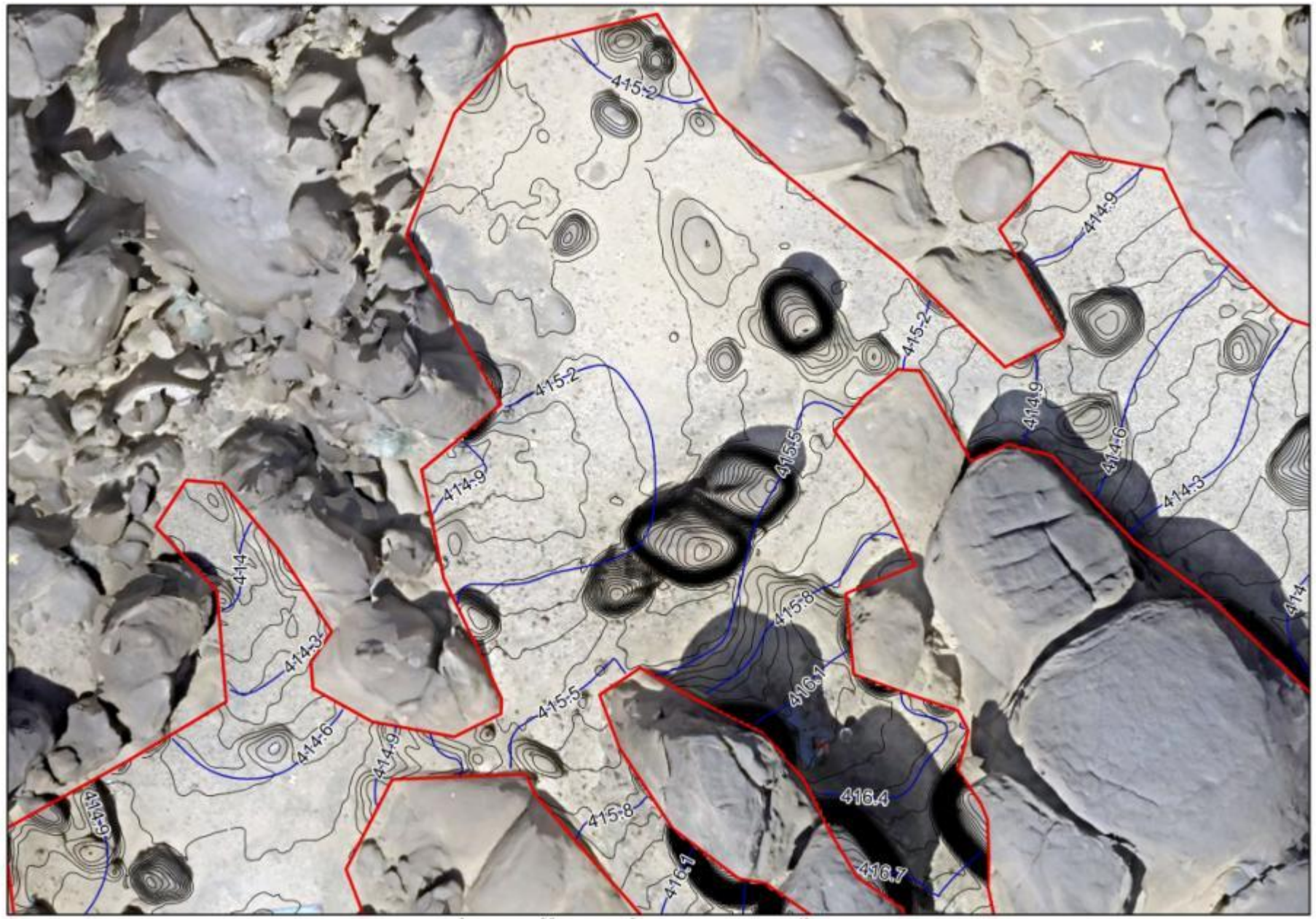














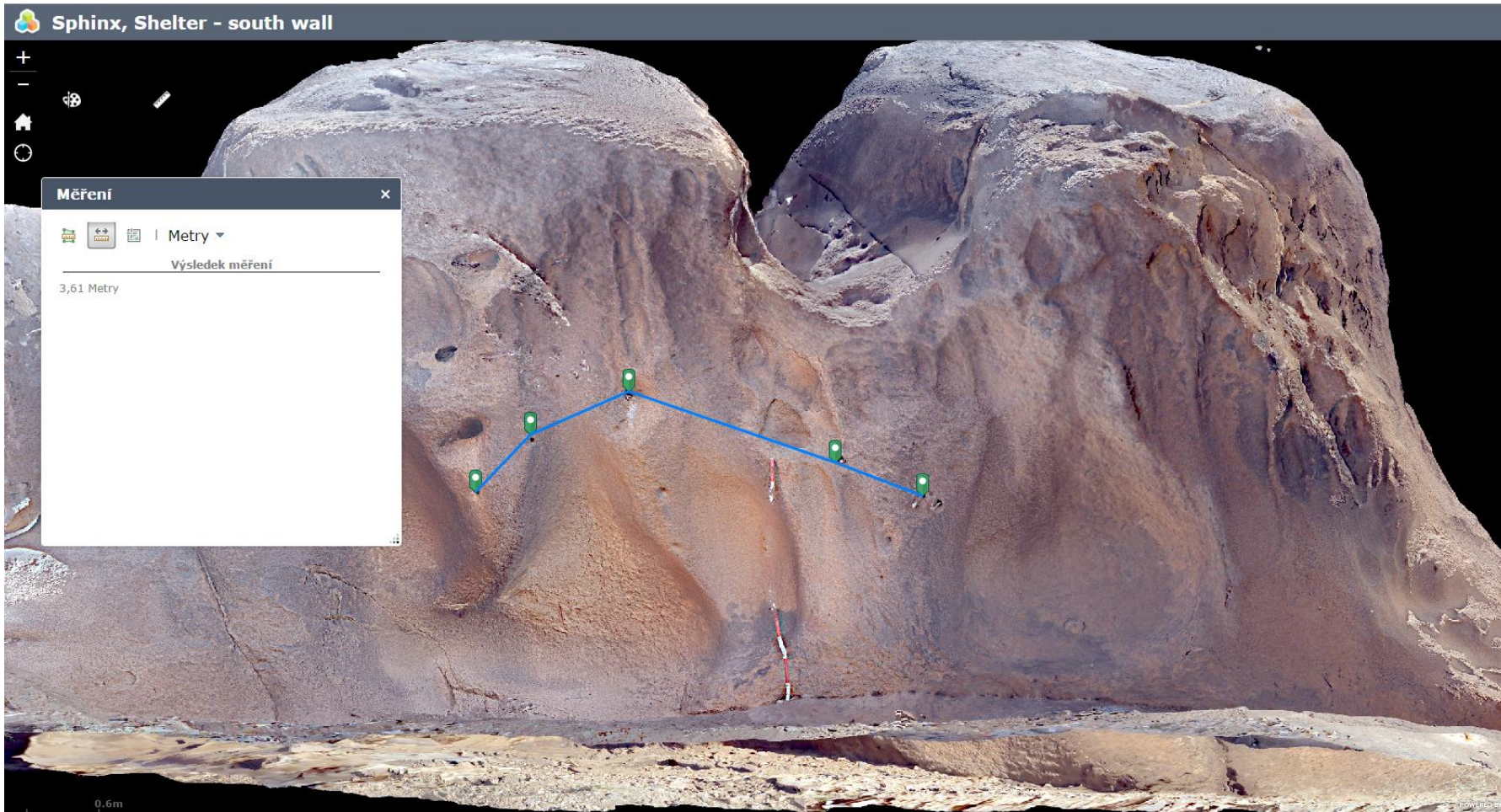
# Reconstructing an extinct type of architecture



In cooperation with L. Varadzin and L. Sukova-Varadzinova

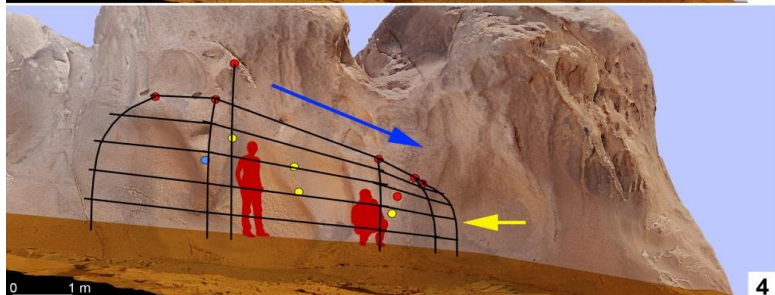
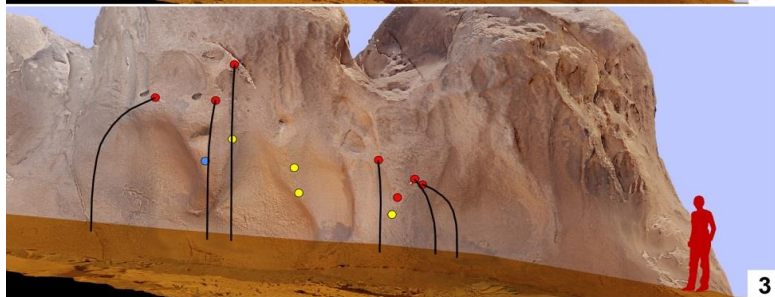
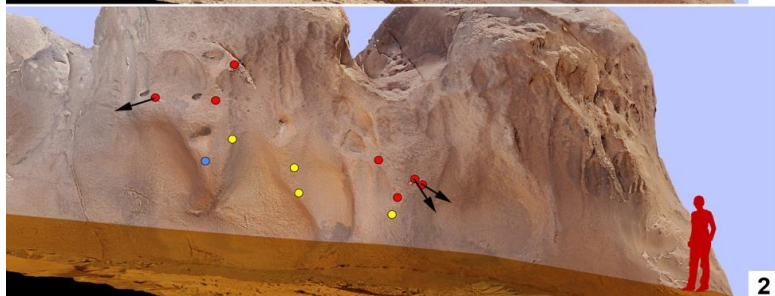
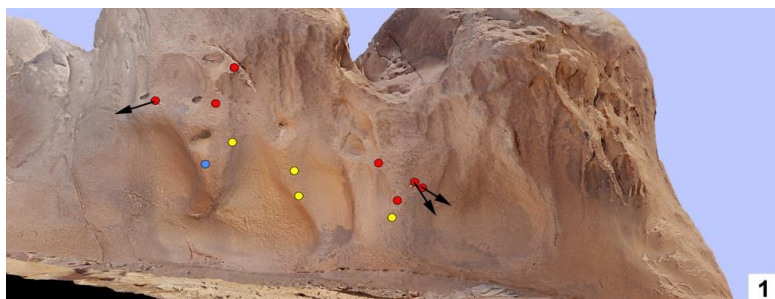


# Reconstructing an extinct type of architecture





# Reconstructing an extinct type of architecture

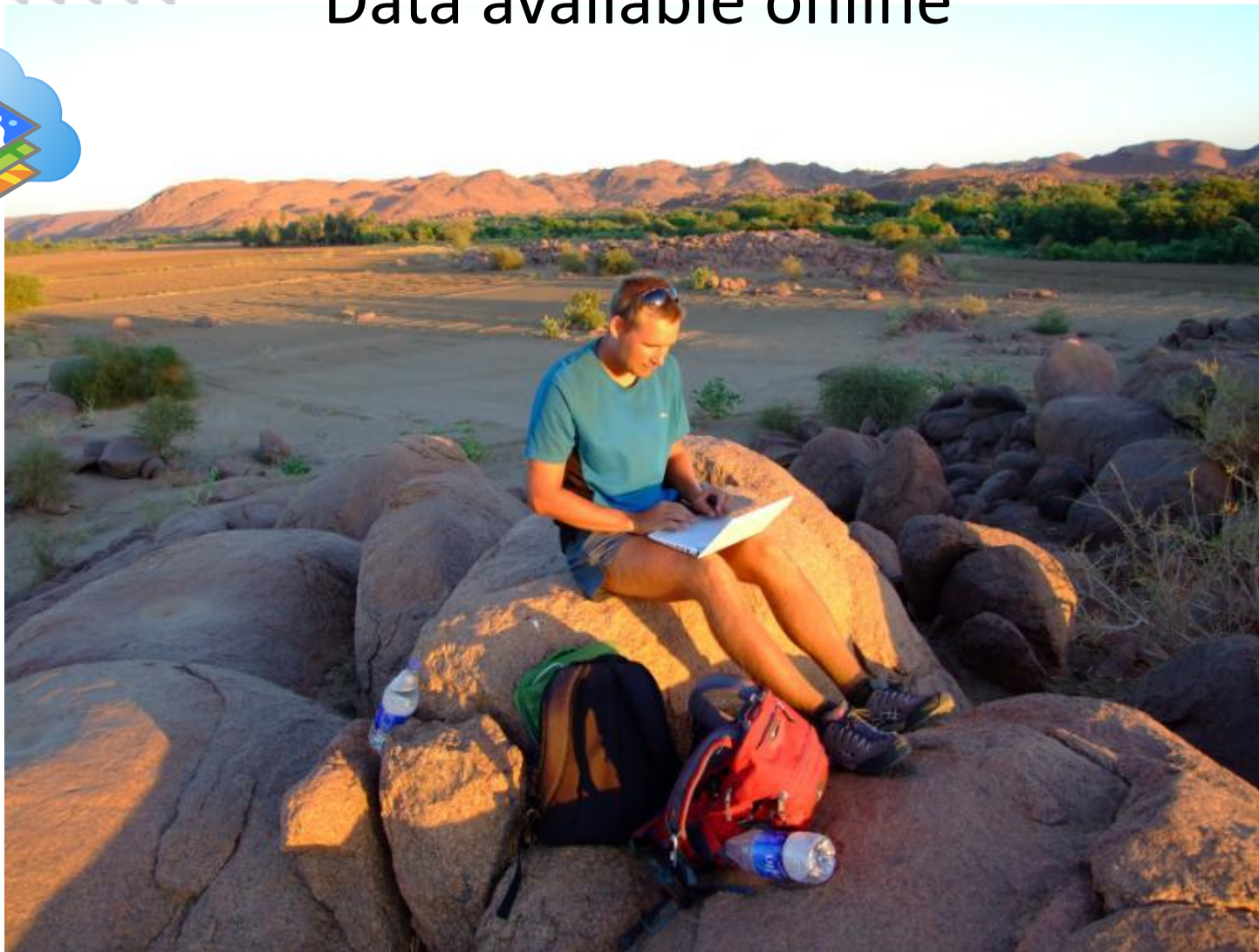




# Data available online



ArcGIS  
Online



[Sabaloka Web App](#)  
[Spinx Web App](#)



# Thank you for your attention

Jan.Pacina@ujep.cz

<http://mapserver.ujep.cz/>