Report on the Geoarchaeological Survey in the area of Sabaloka, Sixth Cataract, Sudan
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Czech Institute of Egyptology, Faculty of Arts, Charles University in Prague

Expedition Director:
Lenka Suková, Czech Institute of Egyptology, Charles University in Prague

Expedition Members:
Václav Cílek, Institute of Geology, Academy of Sciences of the Czech Republic, Prague
Lenka Lisá, Institute of Geology, Academy of Sciences of the Czech Republic, Prague
Pavel Lisý, Institute of Geology, Academy of Sciences of the Czech Republic, Prague

NCAM Representative:
Murtada Bushara

Introduction

The objective of the geoarchaeological survey (environmental geology project) in the area of Sabaloka, the Sixth Cataract, was to attain better understanding of the interaction between man and his natural environment during the Holocene when rapid climatic changes were shaping both the landscape and the human society.

The project was divided into three interconnected parts:

1) study of alluvial deposits of the Nile;
2) study of the history of dry *wadis* as the tributaries of the Nile; and
3) study of rock crusts and desert varnish in connection with rock art.

The village of Miseiktab, Sabaloka, at the northern end of the Sixth Cataract, was chosen as the base camp of the expedition, whence the survey and fieldwork were conducted by means of boat and on foot.

Out of ten days in the field, the first three days were dedicated to the reconnaissance by the whole team of the area of the Sixth Cataract by boat and to the survey of the Jebel Rawayan. As from the fourth day of the fieldwork, the team split into two separate working groups: a geological one that carried out the excavation, documentation and sample-taking of the profiles in the fluviatile sediments, and an archaeological unit that engaged in the on-foot survey of the selected areas significant from the archaeological as well as geological point of view.

1) The study of alluvial deposits of the Nile

Working group: Lenka Lisá, Pavel Lisý

Introduction to the sedimentological part of the project

One of the main aims of the Czech geoarchaeological expedition working in the area of Sabaloka in autumn 2009 was to study the sedimentological record of the Nile alluvial zone. The first stage of this research is supposed to give us the general idea about the degree of deposition and erosion within the Sabaloka gorge, about the age and possible climatic record hidden in the alluvial deposits, and the degree of anthropogenic influence. The area included in this study covers approximately 25 kilometers of the Nile banks within the Sabaloka gorge and close to the Sixth Cataract. The narrow gorge of Sabaloka (approximately 500–800 meters) is surprisingly wide enough for material deposition, so the deep sections of alluvial silts and clays redeposited during the Nile flooding events are very well preserved there. The alluvial plain within the gorge is generally 5 meters high above the water level and at some places extends over tens of meters.

Methodological approach

The first stage of our research consisted in the study of the available references as well as in the study of the alluvial plain geomorphology from the Google Earth images in the resolution of 5 meters. After the necessary field recognoscation from the boat we finally got a better idea about the geomorphology and the general sedimentological patterns of the alluvial plain within the Sabaloka gorge. Three sites that were the most suitable to give us the average sedimentological record for this area were chosen for sections. The sections were dug in four or five steps; they were documented, described, and sampled for different kinds of methodological approach. Bulk samples for geochemical analyses, granulometry, pH, organic matter content, magnetic properties studies and palaeobotanical studies were taken from every ten centimeters (or less, depending on the lithological and textural or structural changes) of the sections. Additional material was sampled into small Kubiena boxes and tubes for the micromorphological analyses and OSL dating, respectively.

Methodological problems

Since the profiles are not cleaned, it is impossible to read the sedimentological pattern exactly. On account of the fact that the land in the area is owned by farmers and the cleaning of the profiles would damage the river banks, we had to discuss the possibility of cleaning the banks with farmers

personally and to pay them for the permission to dig the sections. This kind of methodological problems was time consuming.

Location of the sections

The first section sampled during the expedition was the section through the alluvial and colluvial deposits in the centre of the village of Miseiktab, Sabaloka, on the east bank of the Nile (SUD-A; N16˚20.316´; E032˚42.048´). The remaining three sections were located on the west bank in the positions where water erosion had created steep banks. The Nile alluvial plain was formed predominantly by cross-bedded sandy loam, sand, and silty loam. Buried soils as well as clays were very common. The most northerly of the sections, the Section B, was dug approximately 500 meters below the Cataract (SUD-B; GPS position N16˚20.323´; E032˚42.037´). The position is more in the open landscape and is not limited by the narrow banks of the Sabaloka gorge. A significant number of buried soils as well as sandy aeolian layers were very well preserved there. The Section C (SUD-C; GPS position N16˚16.821´; E032˚38.578´) was located in the southern part of the Sabaloka gorge near the place where the Nile is entering the gorge. Again, a great number of buried soils and cross-bedded sandy loams were preserved in this section. The site was rather in a closed landscape, and no aeolian sandy input from the desert was macroscopically recognised there. The last section marked as D (SUD-D; N16˚17.621; E032˚40.859´) was located approximately in the centre of the Sabaloka gorge. There were preserved mostly layered redeposited soils, but also thick layer of grey clay at the bottom of the section and a few layers of buried soils were revealed.

Samples taken from the sections in the alluvial plain at the Sabaloka gorge

Four sections in total were sampled during the expedition. The first of the sections is through the alluvial and colluvial deposits exposed in the centre of the village of Sabaloka (SUD-A), while the other three sections are in the recent alluvial zone of the Nile River (SUD-B, SUD-C, and SUD-D). Samples were taken for different types of analyses, so there are different sets of samples labelled ”for geochemical analyses”, “for micromorphology”, “for OSL dating“, or “for magnetic studies“.

The bulk samples were taken from every ten centimeters of the section or less (depending on the lithological, structural, or textural differences). The weight of every such sample is approximately 200 grams, and it will be used for different methodological approaches. The Section A was sampled with lower resolution. Micromorphological samples were taken into small paper Kubiena boxes and were taken occasionally according to the lithological changes or interesting textural features. The Section A was sampled into big Kubiena boxes (5x7 cm). Samples for dating were taken into plastic tubes. Each set of one sample includes 20 centimeters long plastic tube, 500 grams of bulk sample and sometimes small plastic tube for porosity measurement. The principle of OSL dating method is to

measure the relict intensity of the luminescence signal since the time the quartz grains were exposed to the sun for the last time (before being buried in alluvial zone). Therefore, the important fact is that those samples cannot be exposed to the light. There are no dating samples for the section A. One of the sections (Section D) was sampled also for magnetic properties study. Every 1.5 cm of the section was sampled into small plastic cubes.



Fig. 1 – Section SUD-C – detail



Fig. 2 – Section SUD-B

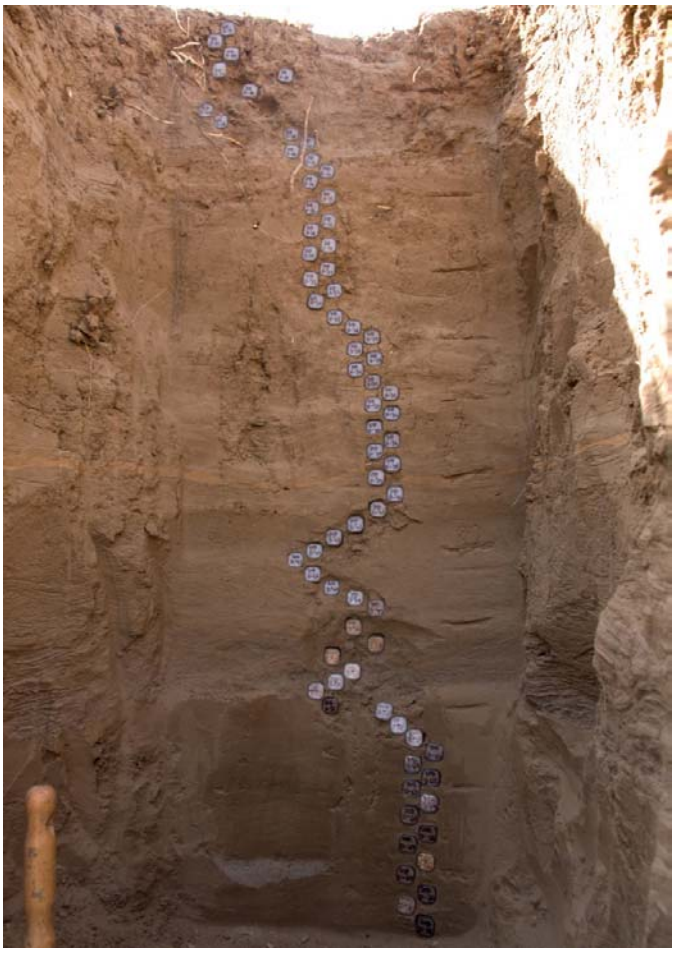


Fig. 3 – Section SUD-C – uppermost part

2) The study of the history of dry *wadis* as the tributaries of the Nile

Working group: Lenka Suková, Václav Cílek, Murtada Bushara

Introduction

The history of dry *wadis* as the tributaries of the Nile constituted the second aim of the environmental geology project carried out in the area of Sabaloka, the Sixth Cataract, in autumn 2009. In order to obtain information on the local climatic and landscape changes, we planned to dig several 1–2 meters sections in loose sediments under *wadi* cliffs or overhanging rocks where in geomorphologically protected environment the Holocene sediments usually form alternating sequence of sandy (dry) and loam (humid) layers.

Methodological approach

The first stage of this part of the research consisted in the study of the available archaeological and geological publications as well as in the study of the topography and geomorphology on the available maps of the area of Sabaloka (1:250,000 and 1:100,000) and high-resolution Google Earth images. Several areas or features significant from the point of view of geology, archaeology, and landscape were selected in the course of the study to be later explored in the field.

Following the reconnaissance of the area of Sabaloka by boat, we conducted an on-foot survey of the selected *wadis* and hills on both banks of the river, aimed at the study of the geomorphology and landscape, raw materials distribution, and archaeological record in the delimited areas of interest. With the view to covering all of the selected areas of interest and obtaining a general idea of the history of use of the area by man in the past, the documentation of the archaeological sites observed in the course of the survey was reduced to taking GPS points using GARMIN Oregon 400t device (standard deviation reaching cca 5 meters) of the most significant features observed, narrative description of the sites, and photographic and drawn documentation of their context.

Results of the survey

In the course of the survey, excavation in the dry *wadis* was found to be almost impossible due to the presence of block fields and cemented screes. One of the profiles studied in more detail was situated on the west bank of the Nile in the “Valley of the Coin”. It consisted of almost 3 m of loose screes, screes with calcified silt matrix, screes cemented with calcium carbonite, and heavily weathered bedrock.

Another profile was studied on the east bank of the Nile in the village of Miseiktab, Sabaloka (SUD-A; N16˚20.316´; E032˚42.048´). The profile reaching the depth of 3.2 m was excavated in the outwashed fan. The upper part of the profile was formed by chaotic sediments deposited by torrential rains, while the lower part of the profile consisted of alluvial loams of the Nile which is now situated more than 400 meters to the west.

The reconnaissance by boat and, most importantly, the on-foot survey of the selected areas revealed a most interesting settlement pattern and land use of the Sabaloka gorge in the past. The site types observed in the course of the survey include: settlements – mostly in the form of abandoned terraced villages (also visible on Google Earth images) –, cemeteries, isolated graves, stone features, occupation scatters, and buildings (forts?). From most of the sites, pottery sherds and/or stone industry were collected from the surface for further analysis by specialists.

List of Archaeological sites surveyed in the area of Sabaloka

UMM TILEH AND JODA

Agglomeration of four terraced villages (habitation structures on man-made terraces) on the east bank of the Nile. Two of the villages briefly surveyed. The southern one, above Joda, is formed by six (or more) terraces (GPS N16°18.899´, E032°41.555; N16°18.994´, E032°41.569´); the northern one, above Umm Tileh, by nine (or more) terraces (GPS N16°19.112´, E032°41.564´). To the south of Umm Tileh, a system of routes leading into the hinterland observed. Possibly cemetery above Umm Tileh (no GPS point taken).

Finds: Fragments of pottery of various types (sherds bearing decoration – impressed or incised – collected from the surface for further analysis), grinding stones, and occasional stone industry.

Tentative dating: Prehistoric (?), Late Meroitic to Islamic Period.

Two important habitation structures on a significant rock separating Umm Tileh and Joda, just above the river (GPS N 16°18.953´, E032°41.513´, N 16°18.957´, E032°41.512´). The spot offers a great view of the river upstream and downstream as well as of the opposite (west) bank of the Nile.

Finds: Scatters of stone industry on rhyolite and quartz observed in or around the structures.

Tentative dating: Prehistoric (Mesolithic/Neolithic).

RUM

(GPS N 16°17.239´, E032°40.472´)

A small site situated about 8 metres above the river, preserved stone walls (sometimes up to the height of 0.8 – 1 metre) and supporting terraces. Bricks also observed. Approximately square disposition of the building (about 10 x 10 metres). Badly visible destroyed terraces (three or more) situated in the background of the site. The structure located at the end of a number of routes leading from the hinterland to the Nile bank.
Finds: Scatter of pottery of various types in the structure as well as around, with concentration of rough ware (water containers) on the eastern side of the building. Scatters of Mesolithic stone industry (mostly on white quartz).
Tentative dating: Mesolithic; Medieval to Islamic Period.

AB ZIBIL

Important terraced village that consists of two distinct settlement areas separated by a *khor*. The northern area is located on a hillock marked by a naturally standing tall stone (of *menhir* type, GPS N16°17.430′, E032°41.211′). The southern one covers almost the whole area from the river up to the hilltop (GPS N16°17.455′, E032°41.123′; N16°17.457′, E032°41.139′; N16°17.408′, E032°41.130′). The place is well visible from the Nile. The terraced village is close to the agglomeration at Jebel Ab Agib on the west bank of the Nile (see below).
Finds: Fragments of pottery of various types; iron slug – remains of a kiln (GPS N16°17.425′, E032°41.106′). Several sherds and pieces of slug taken for further analysis.
Tentative dating: Late Meroitic to Islamic Period.

Isolated tumulus located in the alluvial plain below the northern settlement area (GPS N16°17.498′, E032°41.307′).
No associated artefacts observed.
Tentative dating: Uncertain.

JEBEL IRAU

A short survey of the southern slope of the mountain known already from the literature (Chittick 1963; Elzein 2004), was performed in connection with the rock art research planned at this site (documentation, samples of rock varnish to be taken for analysis, see below). The brief survey on the slope revealed the presence of terraces which correspond in characteristics and pottery material to the terraced villages recognised in the area of Sabaloka and which do not form part of the village situated on the top of the mountain. In addition, two or possibly three phases of fortification were observed at the site, with the most recent phase represented by walls constructed of two face blocks

with rubble in between). Unfortunately, the survey of the *jebel* could not be completed due to the site being part of the military zone established in the area.
Finds: Sherds of pottery, decorated pieces taken for further analysis.
Tentative dating: Post-meroitic to Islamic Period.

MALAHA

Tumuli cemetery located to the east of the channel separating the Rawayan Island from the mainland (GPS N 16°14.714′, E032°37.293′). Well visible on the Google Earth image as well. The cemetery extends over approximately 500 m. The tumuli are formed by loose sand and clayey sediments, unlike other tumuli observed at other places in the area of Sabaloka. The height and type of the gravel tumuli suggest Postmeroitic date of the cemetery (comparable to the cemeteries at Tanqasi and Ez-Zuma), the same date suggested by the incised patterns of decoration on some pottery sherds.
Finds: Scatters of pottery sherds and occasional stone implements on the surface. Several pottery sherds collected for further analysis.
Tentative dating: Post-meroitic.

JEBEL RAWAYAN

The survey of Jebel Rawayan, the only table mountain (mesa) of the area, significant from the point of view of geology, landscape, and archaeology, was conducted with the aim to facilitate better understanding of the geology, raw materials distribution and extraction, and archaeology of the whole region.
The top of the mountain is formed by highly silicified Nubian sandstone, which has been repeatedly extracted since the Palaeolithic times, as indicated by the abundance of stone industry of various periods noticed in the course of the survey. At the slope of the mountain, numerous concentrations of Mesolithic/Neolithic industry were observed in addition to Palaeolithic artefacts, with some concentrations containing a greater number of artefacts on rhyolite as well as silicified sandstone, quartz and other raw materials (GPS N16°15.468′, E032°36.664′, N16°15.397′, E032°37.363′; N16°14.983′, E032°36.907′; N16°14.999′, E032°36.907′).
The slopes of the mountains have been affected by two large landslides. The southern one is covered by a number of man-made stone pits (GPS N16°15.116′, E032°36.996′; N16°15.113′, E032°37.002′, N16°15.118′, E032°37.010′; N16°15.115′, E032°37.011′). At the top of the mountain at least sixty small quarries or pits of unknown age were observed (GPS N16°15.241′, E032°36.993′), together with stone industry on silicified sandstone, basalt, amphibolites, and sparse pieces of rough ware of Late Meroitic date or later.

GPS N16°15.495′, E032°37.162′
Silicified sandstone quarry, 3 blocks with traces of chisel marks, another quarry in the vicinity.

GPS N16°14.975′, E032°36.828′
Silicified sandstone quarry, traces of chisel marks.

GPS N16°15.163′, E032°36.978′
Silicified sandstone quarry situated on a terrace (or platform) in the middle of the southern slope of the mountain. Chisel marks observed on the blocks. Good potential for the study of quarrying, strategy, routes, activities and the general land use.

GPS N16°15.490′, E032°37.153′
Kiln of approximately circular shape.
Finds: Scatter of slug, no traces of iron observed (several pieces of slug taken for analysis).

Group of tumuli
A discreet group of three or four tumuli of small size was observed on the western side of the mountain.
No GPS point taken. No surface finds collected.

Abris and caves at Jebel Rawayan
A number of abris and caves were observed and briefly surveyed on the western to northwestern side of the mountain, approximately 70 metres below the top of the mountain. They seem to be important from the archaeological point of view. More detailed study was rendered impossible by the presence and attack of African wild bees (nests were observed in one of the caves).
Finds: Fragments of possibly Wavy Line and impressed pottery were lost due to the attack of wild bees (GPS N16°15.432′, E032°36.500′).

AREA TO THE WEST OF THE VILLAGE OF ALHUQNA
Tumuli cemeteries situated on the mildly inclined pediment of the north-western corner of the Sabaloka mountains (to the east of the wash cone). The site is well visible on the Google Earth images as well as in the field from the Nile and from the desert. About 100 to 120 tumuli of at least two different types observed, the fact of which – together with the spatial separation of the groups

of tumuli – suggest there were at least two cemeteries (GPS N16°20.636´, EE032°39.209´; N16°20.814´, E032°39.056´; and GPS N16°20.670´, E032°39.390´; N16°20.669´, E032°39.475´). Some of the tumuli have been robbed (robbers´ pits leading either from the side or the top of the tumulus), which others seem to be left intact.
Finds: very sparse pottery sherds, several fragments collected at the foot of a tumulus at N16°20.685´, E032°39.434´ for further analysis.
Tentative dating: (Post-)Meroitic or Transient Period.

Discreet groups of tumuli were observed also between the wash cone and the Nile (GPS N16°20.363´, E032°40.097´; N16°20.328´, E032°40.329´).
Finds: No pottery was observed or collected for analysis.
Tentative dating: Uncertain.

WAD MUKHTAR

A square to rectangular fortress situated on the west bank of the Nile, just at the Sixth Cataract. Corner bastions, gate on the western side and rectangular tower (or another gate) on the eastern side of the fortress, with projections of walls on the northern and southern side of the structure.
Area of the fortress – 1,849.5 m2 (measured by means of GPS).
Finds: Scatters of pottery, decorated sherds taken for further analysis.
Tentative dating: Medieval to Islamic Period.

"VALLEY OF THE COIN"

Another agglomeration on the west bank of the Nile, located in the *khor* leading from the river bank deep into the mountains (GPS N16°17.760´, E032°40.329´; N16°17.768, E032°40.336´). Remains of stone foundations of circular or semicircular structures observed (the same type observed also at other sites in the area).
Several box graves noticed in the area (GPS N16°17.748´, E032°40.339´; N16°17.748, E032°40.335´), however, they do not show definite north-south or east-west orientation.
Finds: Fragments of pottery, decorated sherds collected for further analysis. Coin (GPS N16°17.740´, E032°40.348´) collected for identification.
Tentative dating: Medieval or Islamic Period.

JEBEL AB AGIB (WAD ABU AGIB)

One of the largest and most interesting sites of the terrace type surveyed. Located on the hilltop, it is less destructed from the slope erosion. The site seems quite complex.

Dwellings (habitation areas)

Situated on the terraces facing the Nile, approached by man-made path winding up the slope in the zig-zag manner. At places the path is cca 2 meters wide. Edges of the path made of larger stones, with the path within having been originally cleared and filled with material of smaller size (GPS N16°17.386´, E032°40.204´).

Finds: Abundance of pottery of various types – rough ware predominates (water containers), also decorated ware noticed, which corresponds to the pottery types and decoration patterns observed in the other terraced villages. Small collection of sherds from surface finds taken for further analysis. Concentrations of lower and upper grinders of various shape and raw material, ceramic weights for weaving (?) (GPS N16°17.365´, E032°40.158´; N16°17.355´, E032°40.149´).

Glass bracelet (no GPS point taken). Stone industry very sparse.

Fragments of ostrich eggshell (GPS N16°17.364, E032°40.154´), taken for further analysis.

Graves

A significant number of graves of various types observed in the saddle, separated from the habitation areas. In addition to simple stone-filled grave-pits (GPS N16°17.360´, 032°40.117´; N16°17.337´, E032°40.077´) and box graves (?), several circular graves – tumuli – made of one or two rings of larger stones, with smaller stones within were noticed; the inner diameter of the ring is about 2.5 m (GPS N16°17.369´, E 032°40.114´; N16°17.363´, E032°40.098´, N16°17.337´, E032°40.072´). From the southwest, the graveyard area is delimited by a stone wall (GPS N16°17.338´, E032°40.071´; N16°17.348´, E032°40.078´).

Finds: Fragments of ostrich eggshells (GPS N16°17.369´, E 032°40.114´), collected for further analysis. scatter of pottery sherds (mostly rough ware, with occasional decorated pieces), lower grinder. Small collection of finds taken for further analysis.

Water cistern

(GPS N 16°17.469´, E 032°40.120´, 482 m a.s.l.)

“Oasis” on the top of the Jebel – stone-free circular area (approx. 797 m2) covered with acacia trees and *tabas* plant, which might have been used for collection of rain water. No channels or other works observed.

Finds: No associated artefacts noticed.



Fig. 4 – Ab Zibil, one of the abandoned terraced villages on the east bank of the Nile (view from north-west).



Fig. 5 – Layout of fortress observed at Wad Mukhtar on the west bank of the Nile (view from west).



Fig. 6 – North-western slope and foot of the Jebel Rawayan (view from east).

3) The study of rock crusts and desert varnish in connection with rock art

Working group: Lenka Suková, Václav Cílek, Murtada Bushara

Introduction

The third task of the geoarchaeological team working in the area of Sabaloka in autumn 2009 was to survey the selected areas of research for rock art. Bearing in mind the abundance of petroglyphs documented in the region of the other cataracts as well as in the Nubian Nile valley prior to the flooding of the area, we were hoping to find similar record left in the landscape by the former inhabitants or people moving through the area.

Moreover, on the basis of the fact that rock surface hardening usually appears during wet phases while salt erosion often takes place in humid events of otherwise dry climatic periods, we were expecting to be able not only to obtain the general idea about the rock art distribution and characteristics in the area, but also to take samples of the rock crusts and desert varnish for analysis to attempt to distinguish climatic history as well as to find a suitable tool for basic dating of the rock art.

Methodological approach

The first stage of this part of the research involved the study of the available references relating to the archaeology of the Sixth Cataract as well as to the rock art hitherto documented in other areas of the Sudan.

The search for petroglyphs was conducted in the scope of the on-foot survey of the selected areas of interest. Rock surfaces were surveyed in general for rock images as well as studied in greater detail to understand their characteristics as well as the processes of erosion and exfoliation.

One day was reserved to the survey of Jebel Irau on the east bank of the Nile, where rock engravings were previously reported by Chittick (1963) and where we planned to take samples of the rock crust and desert varnish.

Results of the survey

This part of the programme could not be fulfilled as the team had originally expected, since no examples of rock art other than the images reported from Jebel Irau were found in the area. We believe that the main reason for this state is the lack of suitable rock surfaces and the considerable erosion and exfoliation of the local rocks.

Unfortunately, we could neither carry out adequate documentation and sample-taking at Jebel Irau as originally planned, since the area had been recently incorporated into the military zone on the east bank of the Nile and the Czech mission was refused access to the area. A single sample of the rock on which the rock drawings had been made was procured by the NCAM representative, Murtada Bushara, who was allowed to enter the area, photograph the setting, and collect a sample of the rock for comparison.

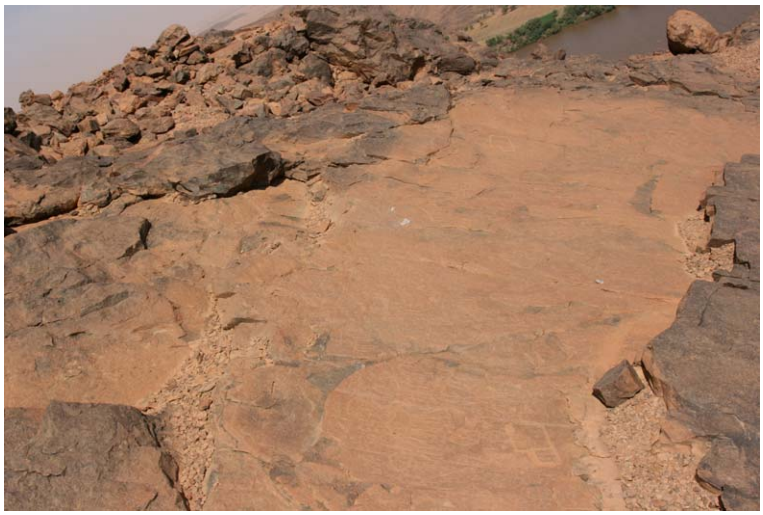


Fig. 6 – Location of the rock drawings on the top of the Jebel Irau.