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Results of the Mineralogical Examination of the Dried Bricks from Tombs and Mastaba. Tell el-Farkha Archaeological Excavation Site. The Nile Delta. Egypt.

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Introduction

The Tell el-Farkha archaeological excavation site (Chicken Hill) is located in the Eastern Nile Delta on three hills, in the north of Ghazalah village. The hills are locally called 'koms' and are designated as follows: Kom W – western, Kom C – central, Kom E – eastern (Fig. 1).

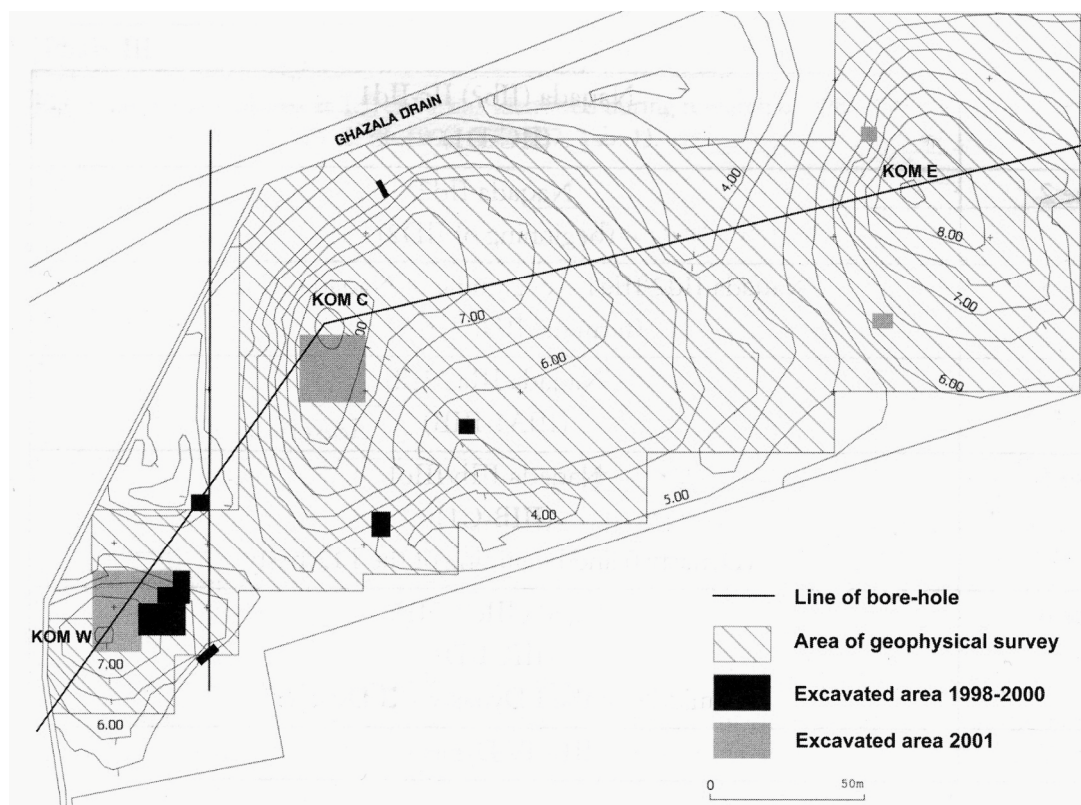


Fig. 1 Map position of Tell el Farkha in the Nile delta (Jucha M., 2005)

The discussed area covers about 4.5 ha and is located near the currently regulated canal (the Nile branches), which branches off in the north and west into the numerous small canals irrigating the nearby fields (Chłodnicki et al. 1992, Pawlikowski 2002, 2009, 2010, Pawlikowski, Wasilewski 2007, Abłamowicz et al 2009, Ciałowicza et al 2011, Pawlikowski, Słowioczek 2011). The site has been examined since 1998 by the Polish scientific expedition organised by the Jagiellonian University's Institute of Archaeology and the Poznan Archaeological Museum.

During the research works in the first excavation season held in the western kom (kom W) and centre (kom C). The geological and archaeological works were focused on researching the damaged south-eastern edge of the site. During next season the research was focused on the excavation as well as accompanying investigation (boreholes, examination of sedimentology, mineralogy etc.) The result of the works were numerous artefacts (pottery, flint tools, numerous settlement objects etc.). The full stratigraphic documentation reached the depth of over 4 m.

During last years the research was continued in the western part of the excavation site (Kom W) as well as at North and East parts of site.

Recently, the works in the area of Kom C are intensively performed. The research works in the area of Kom E enabled to discover a huge and rich graveyard with numerous tombs and actually the oldest mastaba built of the dried bricks.

Tombs (now around 120) and the bricks used to build them are the object of the research presented in this study.

The chronology of the tombs is in line with the chronology of the whole excavation site. There are several stages, which cover the period of ca. 5400 – 4800 BP.

Geology and archaeology

As mentioned before, the excavation site is situated on three hills jutting 5 m above the local delta's surface and about 8m above sea level. The interior of the hills consists of yellow sands dating from the Pleistocene. They are called gezira sands (hills). The sands surround the Nile silts. On the deposits (sands and silts) occur anthropogenic piles up to 6m thick.

The gezira sand is mainly composed of quartz grains with a small amount of plagioclase, potassium feldspars and heavy minerals (eg. amphiboles, pyroxenes etc.). Diameter of the grains has a range of 2-0.1 mm with the majority of 2-1mm grains. Quartz grains are covered with the iron oxide and carbonates. This layer gives the grains the range of colours from white and yellow to red and brown. Such a surface of grains is characteristic of the river deposits earlier worn smooth by the wind. The original components of the sands probably come from the eastern desert and the Ethiopian Highlands and were redeposited in the Delta by the Nile.

The sediments of gezira can be classified as sand from coarse-grained to fine-grained, of aqueous origin and of partly eolian origin. Molluscs' shells found in the roof prove the presence of a relatively dry climate in the final stage of its sedimentation.

The hills (W, C, E) are covered with a layer, which is a mixture of sand-mudstone deposits. Their thickness ranges from 5 to 50 cm. This layer is thinner on the hillsides and tops of the hill, whereas at the base it is thicker. The mudstone part in this deposit is the same as the brown and greyish silt described below.

The grey and grey-brown silt can be found in all contemporary areas of Delta. The thickness of this layer reaches at some places about 100 m. The X-ray diffraction analyses showed that the Nile silt found in Farkha site and that region mainly consists of (95%) smectite and illite. Also small amounts of kaolinite and organic material can be found. There are very few admixtures of other components. of sandy-mud layers contains admixtures of contemporary waste, rubbish and some sand. Microscopically were identified small grains of isotropic volcano glass.

Further research showed, that the Nile silt was used for the clay bricks production. They were dried in the sun after being shaped They were also used for local pottery production.

Bricks were used for building huge architectural objects such as houses, the mentioned mastaba and palace-like objects. They were also used in tomb construction.

Present above grey silts green and grey mud formed a layer on the northern and north-western side of the discussed hills. It is from 20 cm to over 1.5m thick. Similarly to the gery-brown and greyish mud, this layer consists of smectite, illite and kaolinite, however it contains from 5 to 7% of quartz grains, rutile, calcite and feldspars. The colour definitely depends on the sedimentation conditions. Archaeological artefacts appear mainly in the brown and greyish mudstone. The area rich in artefacts is continued in the sand-mudstone deposits (up to 2.5 m above sea level).

A part of the archaeological artefacts is situated (among others) in the grey and green mud at a depth of 2.1 -2.2 m above sea level. The mentioned deposits with artefacts contain charcoal, fragments of bones, pottery and flint tools (some originating in the Middle East). But the thin lenses of yellow-brownish and greenish sands present below are completely lack archaeological artefacts.

Many stages can be distinguished in the excavation site's settling development. All seasons of research shows that the oldest settlement in the examined excavation site came into being on the lower parts of the hill, on thin (0.5 m) mud deposits. The settlements of this village were excavated in the geological and archaeological trench (kom W). Nowadays these archaeological layers are seriously damaged and sometimes completely lacking natural traces of human being. They are covered with a layer of grey Nile silt. It has a changeable thickness and confirms big fluctuation of the Nile level at this time.

The oldest excavated brick structures represent the oldest brewery centre in the world. The bricks were found in two layers. High flood levels of the Nile damaged them in several

places. At that time the Nile deposits 1B were deposited in the Delta (Brink 1992). Such deposits were also noticed in the area of Tell el-Farkha.

Stages of the higher Nile level were simultaneous with breaks in occupation of some places of gezira in the period between functioning of brewery centres and the following stages of occupation. The elements of brewery structures were built of cylindrical shaped, burned, elongated bricks. They are composed of Nile silt but contain small admixture of the gezira sand.

Further evidence of human existence is clearly visible in the geological profiles of the hill. Observed walls of buildings are build of dried bricks. The bricks differ from the previous one (cylindrical) with shape and mineral composition.

The next, younger generation of brickwalls, was probably weakened and also destroyed by the Nile. Sedimentary structures in profiles observed at the northern and north-western part were mostly well seen and consisted of sequence of layers representing the natural silt and anthropogenic material.

Another walls of buildings were built of thick bricks, dried in the sun. Depoits representing this time document dry climatic phase.

The last climatic period determined at Tel el Fakha holds shows in sediments structures typical for wind and rain activity. Additionally destruction of the highest parts of building walls clearly confirm the existence of the mentioned processes.

The youngest settlement is noticeable in the southern part of the area and consists of a few walls. The geological profiles of northern part of site documents the structures had been partly flooded. The material redeposited was next filled mixed with the anthropogenic remains.

In conclusion one can say that many generations of excavated architectonic objects discovered in the site were destroyed by the Nile floods as well as by wind and occasionally by rains.

Experimental

Research included field study and microscopic examination.

Field study was focused on drayed bricks from tombs, documentation (films, photographs and drawings) as well as on samples of the dried bricks for microscopic analyses. Documentation of 9 tombs was made (no. 9, 63, 80,86, 91, 94, 98, 99, 104). Samples of the bricks in the tombs were also taken and examined in the site using polarizing light microscope transported to Egypt from Poland. Measurements were made (length and width) in the tombs with sufficient amount of brick. It appeared that these dimensions differed much. The thickness of bricks is more or less constant and is 7-8 cm. The research results were presented in photos tables and graphs.

Mineralogical analyses mainly included transmitted polarized light microscopic analyses of the dried b. The Japanese Meiji microscope was used. Mineral composition and grain size analyses were made on about 500 grains in each of the brick samples. On the basis of the analyses, adequate graphs of mineral and grain size composition were made. Photomicrographs of the brick structure were taken and the results' interpretations were made.

Results

Results were presented in the following order. Firstly, bricks from the tombs were characterized with a set of analyses for each tomb. Measurements of the bricks' size were made only in the tombs with sufficient amount of bricks. In other tombs, where single bricks were found, only mineralogical analyses were made.

In the second part, the results of mastaba bricks' analyses were presented. They were set in the order of the analysed outcrops of mastaba brickworks.

In this article tabular and graphic sets of the analyses were presented. Due to the limited size of the article, discussion and summary were put in conclusions.

TOMBS

TOMB NO. 9

A picture of tomb no. 9 with equipment (pottery) is presented in Fig. 1A but Fig. 1B presents the arrangement of the dried bricks in the crowning surrounding the upper part of the tomb.



Fig. 1A Tomb during the exploration

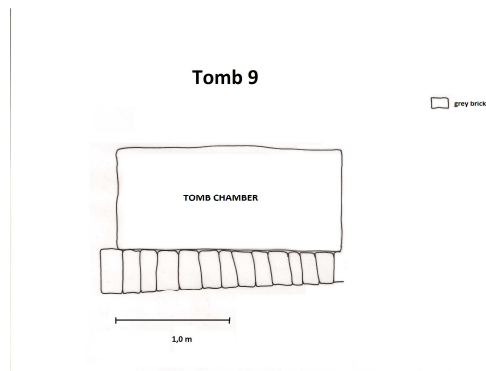


Fig. 1B Scheme of tomb after exploration

Dimensions of the bricks excavated in tomb no. 9 were presented in table 1A and in graphs (Fig. 1C, 1D, 1E)

Tab.1A

Size of bricks (cm). Tomb no.9

No.	length	width
1	36	19
2	36	17
3	36	19
4	32	15
medium	35	18

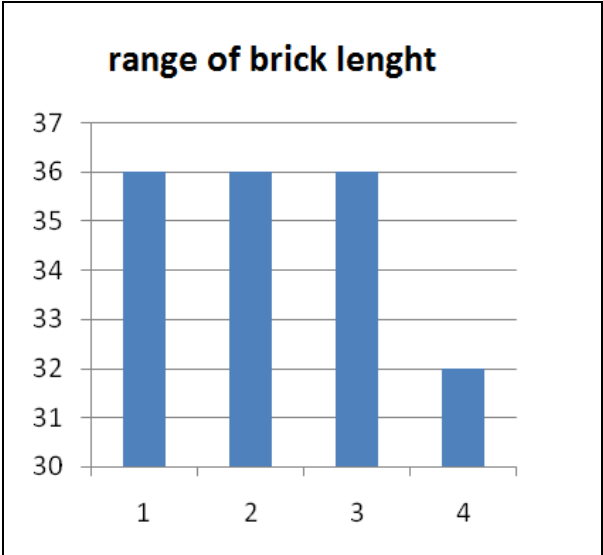


Fig.1C

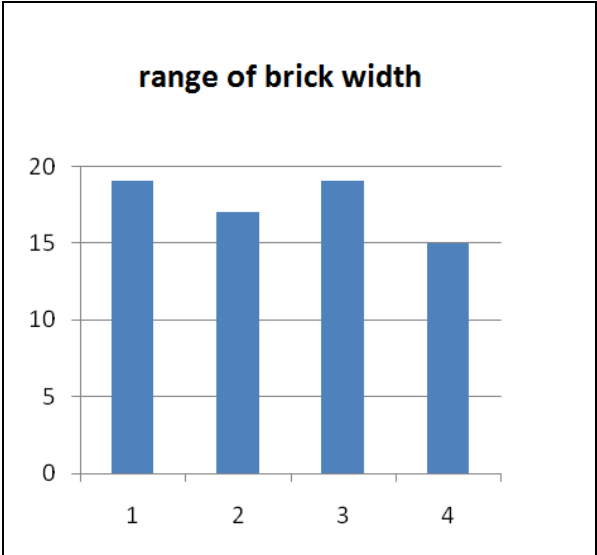


Fig.1D

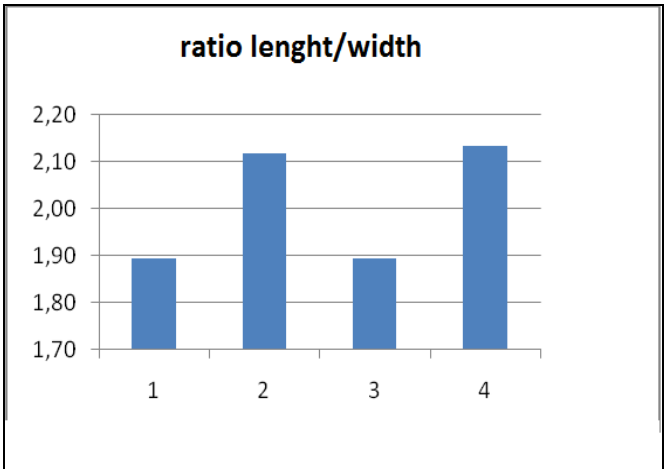


Fig.1E

TOMB NO. 63

A picture of tomb no. 63 with equipment (pottery) is presented in Fig. 2A but Fig. 2B presents the arrangement of the dried bricks in the crowning surrounding the upper part of the tomb.



Fig.2A Tomb during exploration

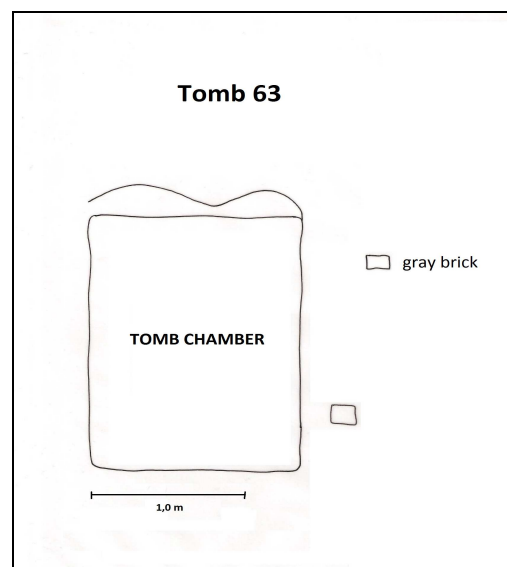
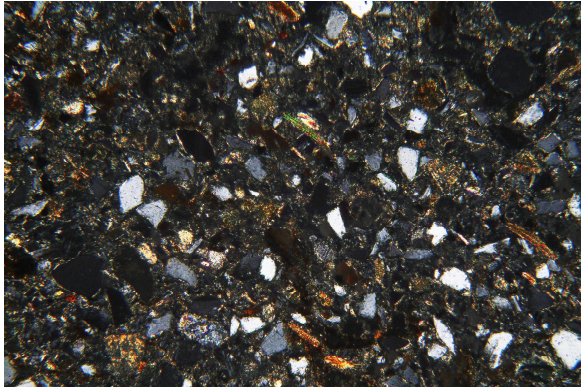


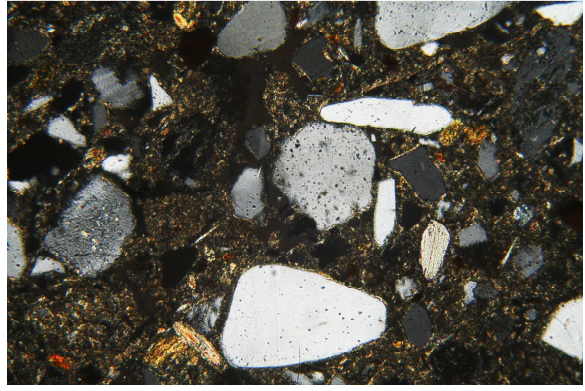
Fig.2B Scheme of tomb after exploration

The results of microscopic analyses

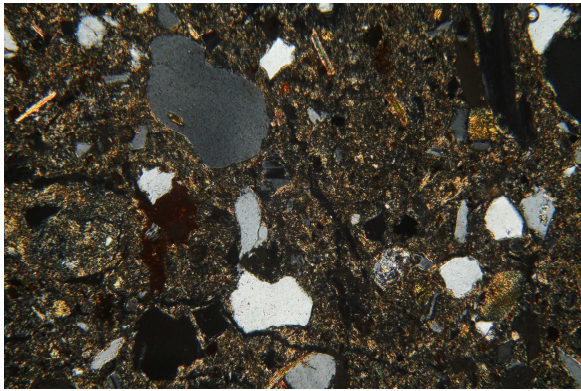
This tomb was seriously damaged (at the time of research) and it was difficult to distinguish bricks, therefore no measurements were made. However, mineralogical analyses of their remains (Fig. 2C) were made. Results of mineral and grain size composition analyses were also shown in tables 2A and 2B and in graphs 3C, 3D.



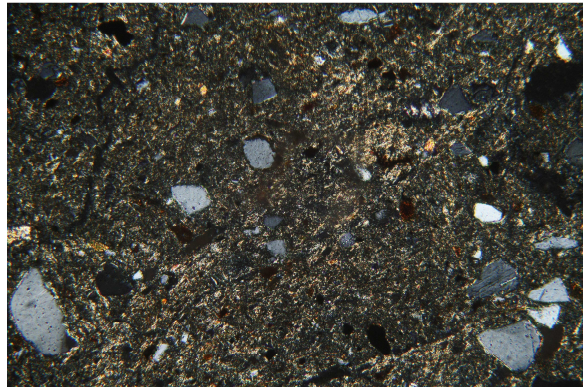
Tomb 63



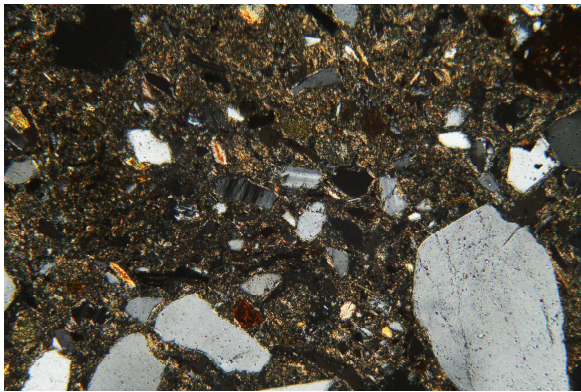
Tomb 68



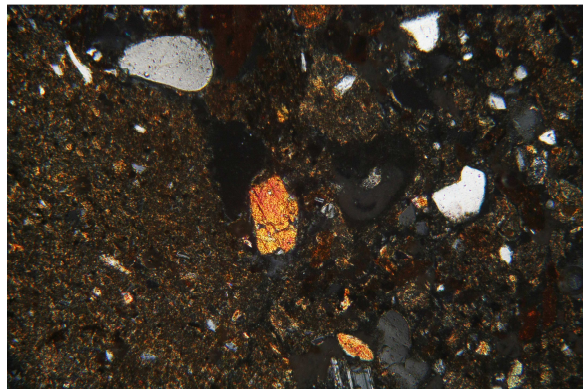
Tomb 80 (1)



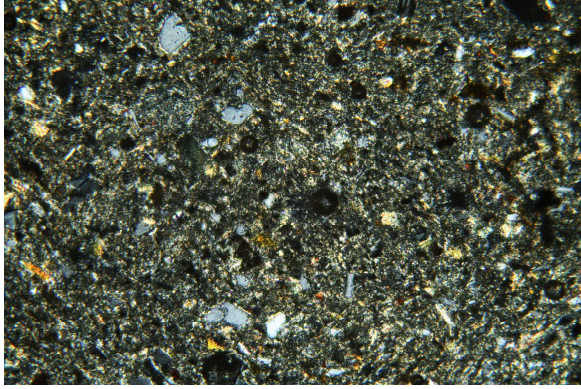
Tomb 80 (2)



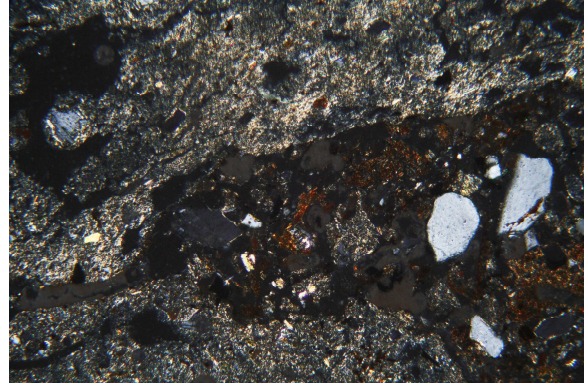
Tomb 86



Tomb 91



Tomb 94



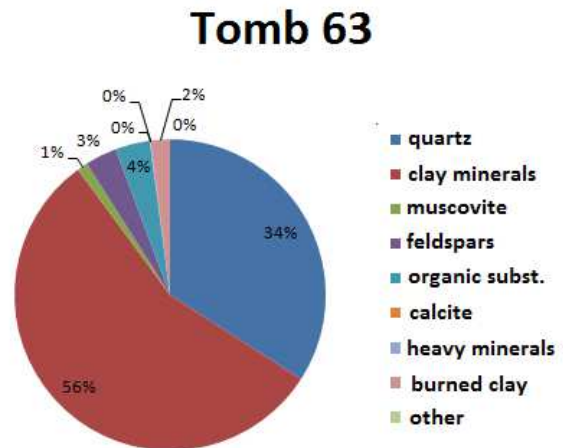
Tomb 89

Fig.2C Microscopic pictures of bricks from examined tombs. One can see light grains of quartz at fine mass (Nile silts). Polarizing light microscope, polaroids X, magnification 120 x.

Tab. 2A Mineral composition of bricks (%). Tomb 63

Component	
Quartz	34,1
Clay minerals	55,8
muscovite	1,1
feldspars	3,3
organic subst.	
calcite	3,6
heavy minerals	
burned clay	0,1
other	2

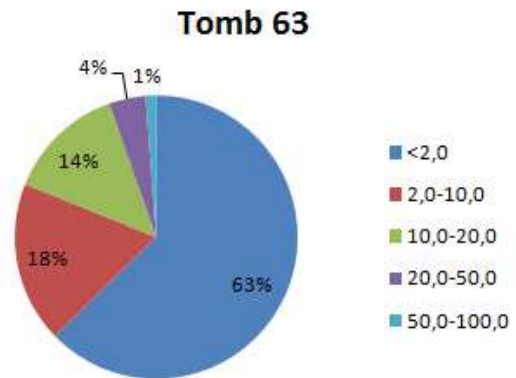
Fig.3C Diagram of content of minerals . Brick from tomb no.63



Tab.2B Grain size of brick from tomb 63 (vol. %)

Fig.3D Diagram of grain size composition

Size of grains (μm)	
<2,0	62,7
2,0-10,0	18,4
10,0-20,0	13,5
20,0-50,0	4,2
50,0-100,0	1,2



TOMB NO. 80

Tomb no. 80 had poor equipment (Photography 2D). After a few seasons since excavation, bricks remained only in the northern part of the crowning (Fig. 4A).



Fot.2D Tomb during the exploration

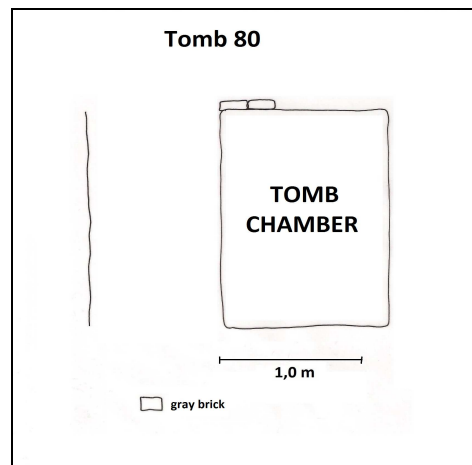


Fig.4A Scheme of tomb after exploration

Samples of two different bricks placed next to each other in the crowning were taken. Microscopic analyses (Photography 2C) and grain-size composition analyses (Table 2A, B, Fig. 4D, 4E, 4F, 4G) showed that the bricks highly differ in mineral and grain-size composition.

Tab. 2A Mineral composition of two bricks from tomb no.80 (%)

component	80(1)	80(2)
quartz	19,6	13,5
clay minerals	70,5	78,7
muscovite	1,2	1,3
feldspars	3,7	2,7

organic subst.		3,5
calcite	1	
heavy minerals	0,1	0,2
burned clay	3,9	
other		0,2

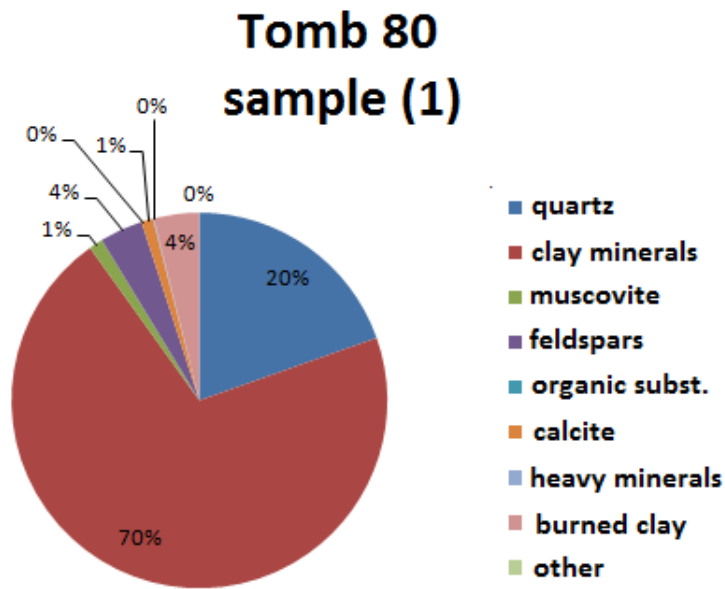


Fig.4D Diagram of content of minerals. Brick from tomb no.80 (sample 1)

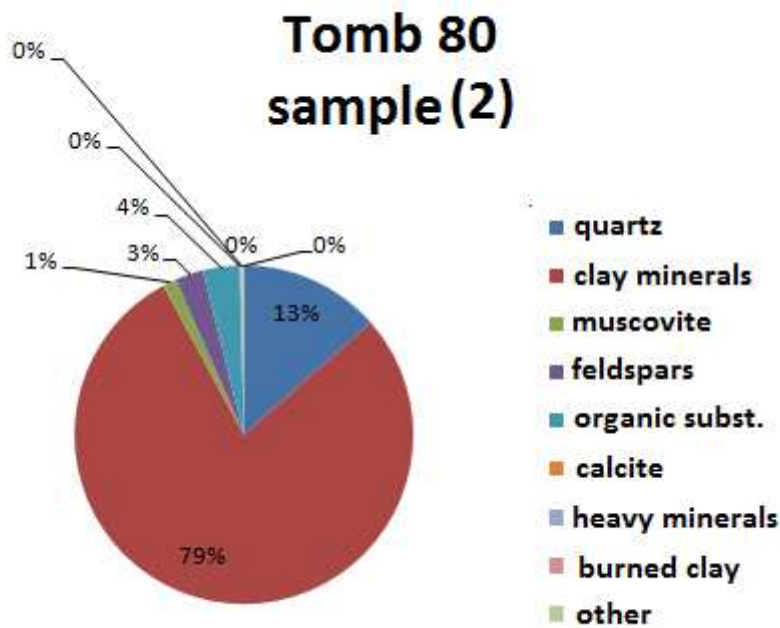


Fig.4E Diagram of content of minerals. Brick from tomb no.80 (sample 2)

Tab.2B Grain size of brick from tomb 80 (vol. %)

Size of grains (μm)	80(1)	80(2)
<2,0	91	93,1
2,0-10,0	5,2	5,5
10,0-20,0	1,3	1,1
20,0-50,0	0,7	0,3
50,0-100,0	1,1	

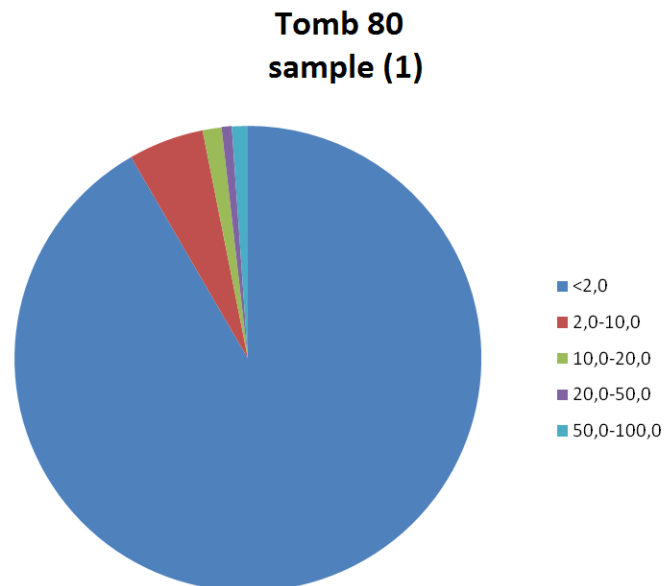


Fig.4F Diagram of grain size composition

**Tomb 80
sample (2)**

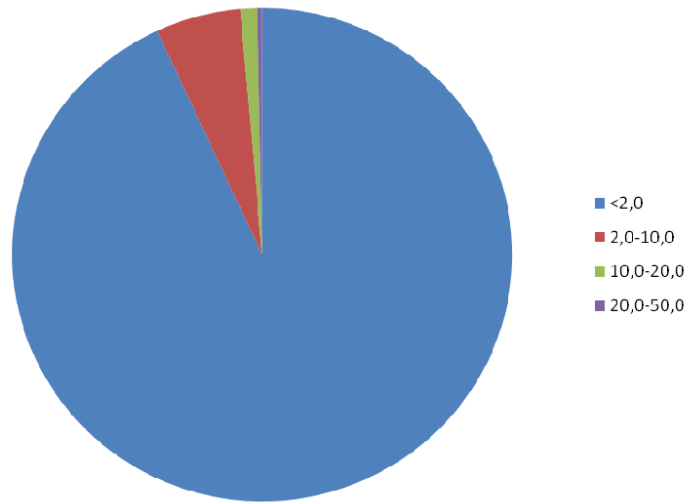


Fig.4G Diagram of grain size composition

TOMB NO. 86

After excavation, tomb no. 86 had a wide but irregular brick crowning (Photography 3A). Two years after excavations natural devastation processes caused that the brick crowning remained only in the southern part of the tomb. Bricks in the crowning highly differ in size (Table 3A, Fig. 5B, C).



Fot.3A Tomb during the exploration

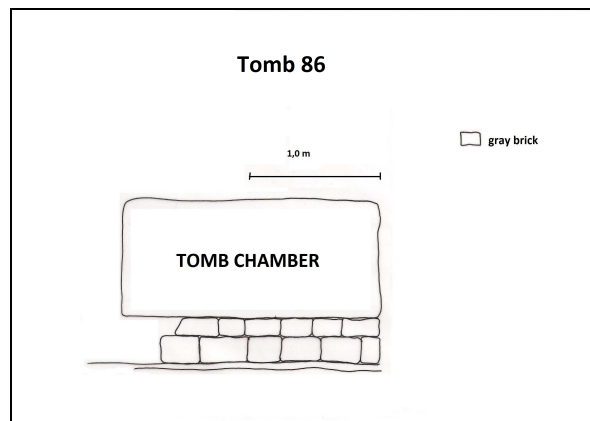


Fig.5A Scheme of tomb after exploration

Tab.3A

Size of bricks (cm). Tomb no. 86

No.	length	width
1	24	20
2	24	19
3	29	19

4	29	19
5	29	20
6	34	21
7	30	19
8	29	18
medium	29	19

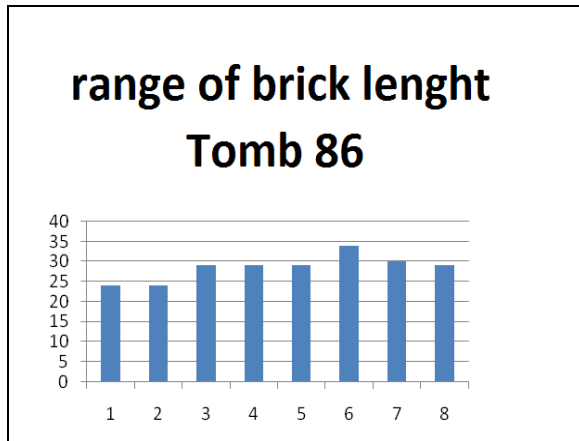


Fig.5B

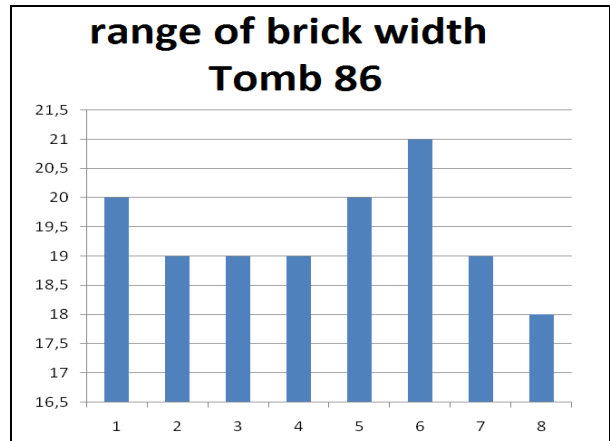


Fig.5C

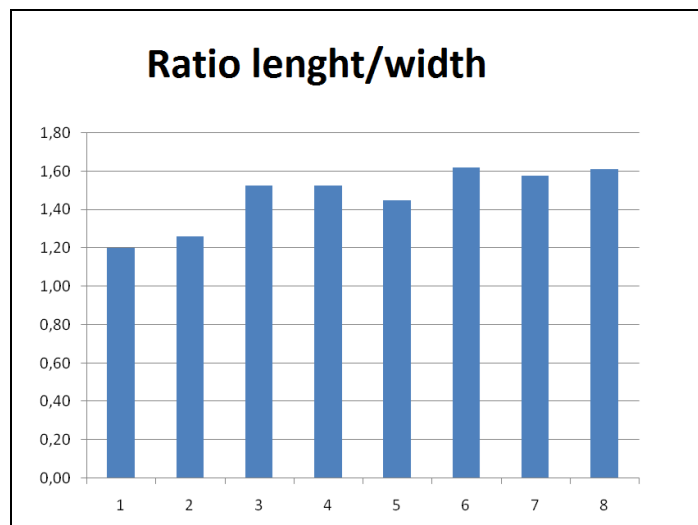


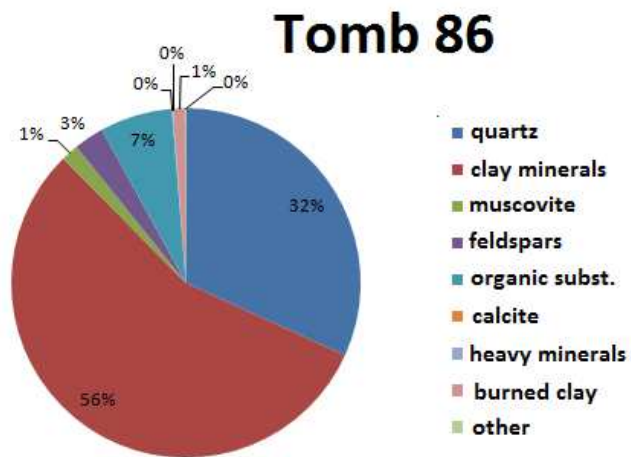
Fig.5D

Mineral composition of the bricks differs from mineral composition of the previously described bricks (Table 4B, Fig. 5E).

Tab.4B Mineral composition of two bricks from tomb no.86 (%)

Component	
quartz	31,8
clay minerals	55,8
muscovite	1,6
feldspars	2,8
organic subst.	6,7
calcite	
heavy minerals	0,1
burned clay	1,1
other	0,1

Fig.5E Diagram of content of minerals . Brick from tomb no.86

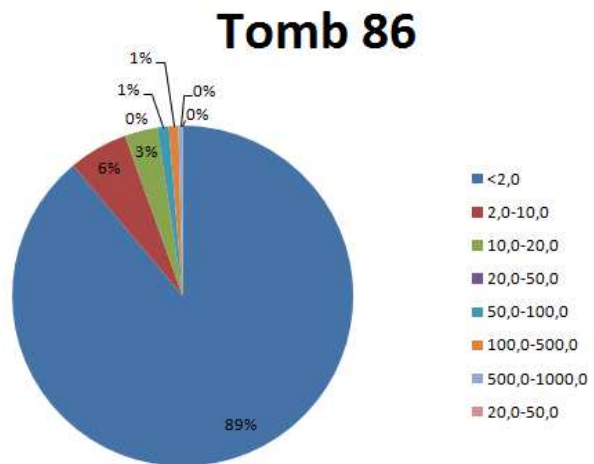


It mainly concerns the thick-grained quartz sand grains (Photography 2C, Table 4B, Fig. 5F).

Tab.4B Grain size of brick from tomb 86 (vol. %)

Size of grains (µm)	
<2,0	88,9
2,0-10,0	5,6
10,0-20,0	3,1
20,0-50,0	
50,0-100,0	1,1
100,0-500,0	0,9
500,0-1000,0	0,4

Fig.5F Diagram of grain size composition



TOMB NO. 91

Tomb no. 91 had quite rich equipment (Photography 4A) and the bricks remained mostly in the north-eastern part of the crowning (Fig. 6A).



Fot.4A Tomb just after exploration

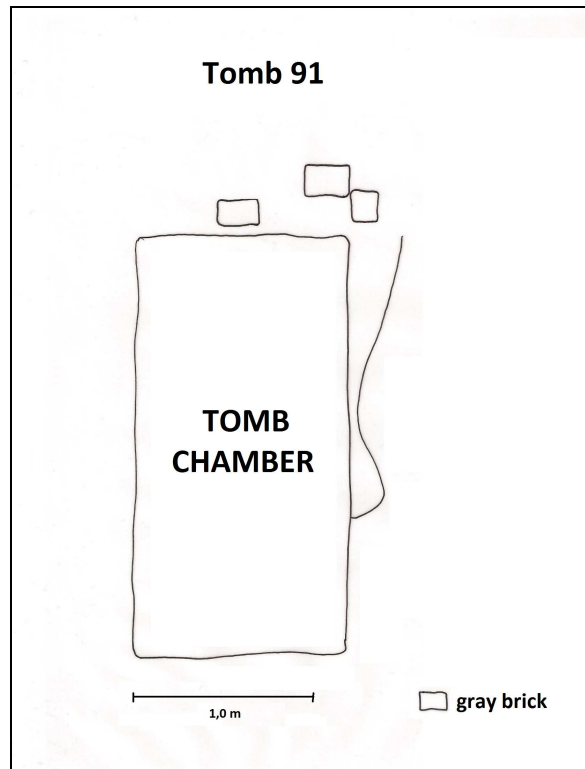


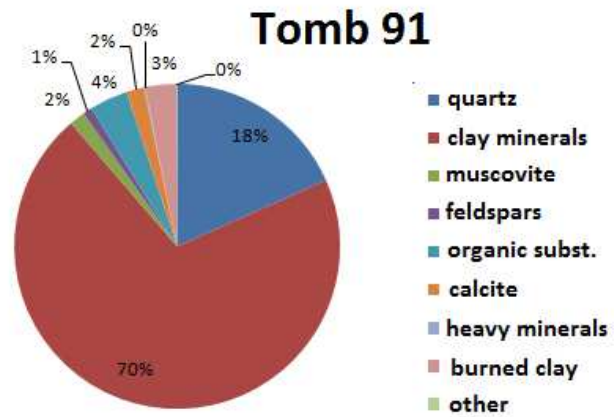
Fig.6A Scheme of tomb after exploration

Conditions and a small amount of well-preserved bricks did not allow the measurements. Only mineralogical analyses could be made. The mineral composition analyses (Photography 2C, Table 5A, Fig.6B) show, that also their main component is the Nile silt.

Tab.5A Mineral composition of two bricks from tomb no.91 (%)

Component	
quartz	17,8
clay minerals	68,2
muscovite	1,5
feldspars	0,9
organic subst.	3,7
calcite	1,7
heavy minerals	0,1
burned clay	3
other	0,1

Fig.6B Diagram of content of minerals . Brick from tomb no.91

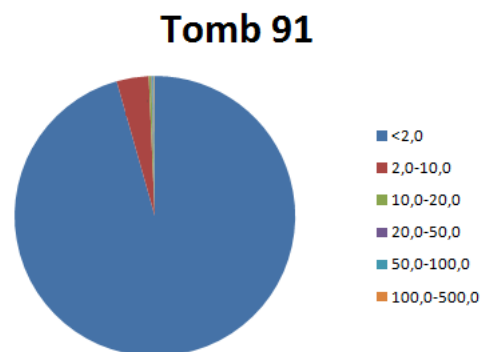


Both microscopic analyses (Photography 2C) and grain-size composition analyses (Table 5B, Fig. 6C) show that bricks in this tomb were made of pure local Nile silt without any admixtures.

Tab.5B Grain size of brick from tomb 86 (vol. %)

Size of grains	
<2,0	95,6
2,0-10,0	3,7
10,0-20,0	0,3
20,0-50,0	0,1
50,0-100,0	0,2
100,0-500,0	0,1

Fig.6C Diagram of grain size composition



TOMB NO. 94

After finishing excavations, the remains of exceptionally wide brick crowning (Photography 5A) were discovered. Two years later only small fragments in its north-western part (Fig. 7A) remained.



Fot.5A Tomb during the exploration

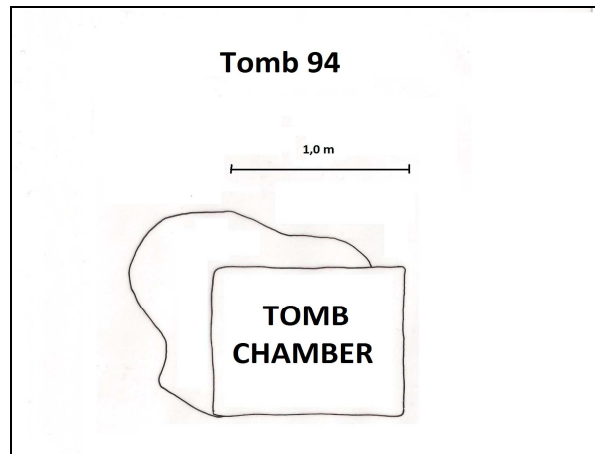


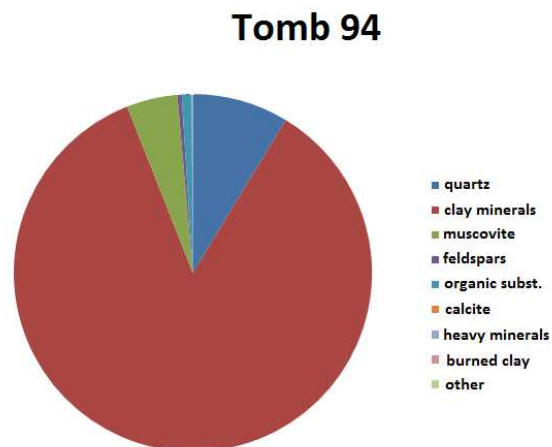
Fig.7A Scheme of tomb after exploration

Similarly to all analysed bricks, argillaceous minerals predominate in the mineral composition which confirms that the main component of bricks in this tomb is also the local Nile silt (Photography 2C). Also exceptionally fine grain-size composition of bricks indicates such origin (Table 5B, Fig. 7C).

Tab.5A Mineral composition of two bricks from tomb no.94 (%)

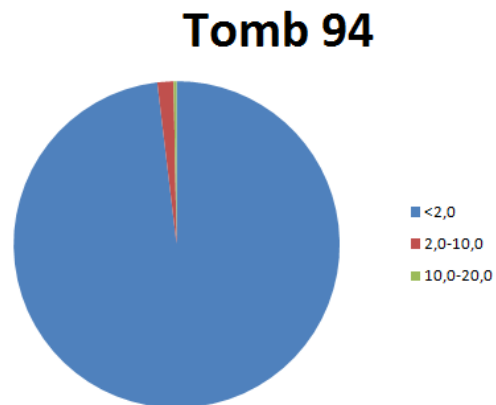
Component	
quartz	8,7
clay minerals	85,3
muscovite	4,6
feldspars	0,4
organic subst.	0,9
calcite	
heavy minerals	0,1
burned clay	
other	

Fig.7B Diagram of content of minerals . Brick from tomb no.94



Tab.5B Grain size of brick from tomb 86 **Fig.7C** Diagram of grain size composition (vol. %)

Size of grains (µm)	Vol. %
<2,0	98,1
2,0-10,0	1,6
10,0-20,0	0,3



TOMB NO. 98

It is a small tomb with poor equipment (Photography 6A). Bricks partly remained in the crowning and only on the western side (Fig.8A).



Fot.6A Tomb during exploration

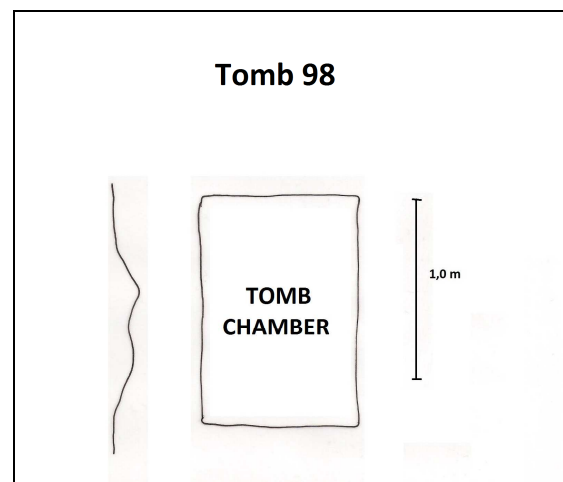


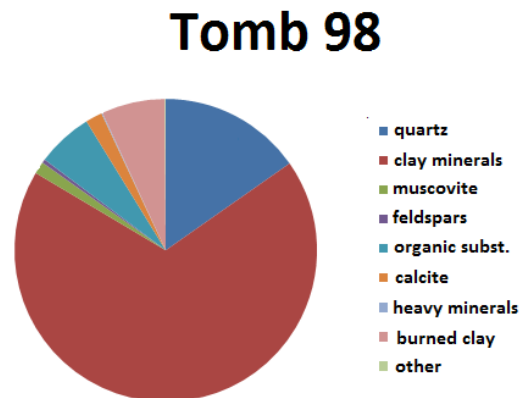
Fig.8A Scheme of tomb after exploration

Microscopic analyses (Photography 2C, Table 8A, Fig. 8B, C) show that also here bricks were made of pure clayey silt without any admixtures.

Tab.6A Mineral composition of two bricks from tomb no.98 (%)

Component	
quartz	8,7
clay minerals	85,3
muscovite	4,6
feldspars	0,4
organic subst.	0,9
calcite	
heavy minerals	0,1
burned clay	
other	

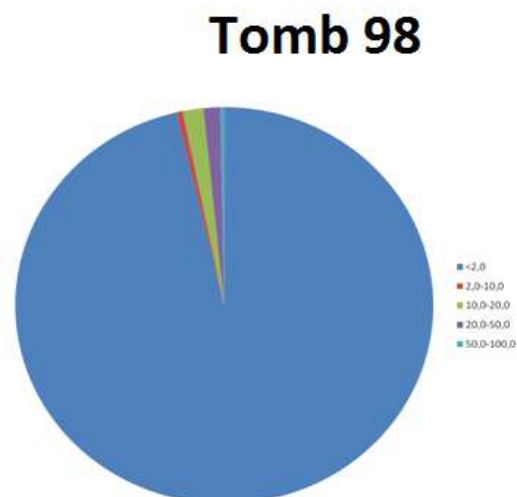
Fig.8B Diagram of content of minerals . Brick from tomb no.98



Tab.6B Grain size of brick from tomb 86 (vol. %)

Sizes of grains (µm)	
<2,0	96,3
2,0-10,0	0,5
10,0-20,0	1,6
20,0-50,0	1,3
50,0-100,0	0,3

Fig.8C Diagram of grain size composition



TOMB NO. 99

It is a small yet deep tomb with rather poor equipment (Photography 7A). Only small fragments (Fig. 7A) of the original wide brick crowning remained mainly on the western side (Fig. 9A).



Fot.7A Tomb during the exploration

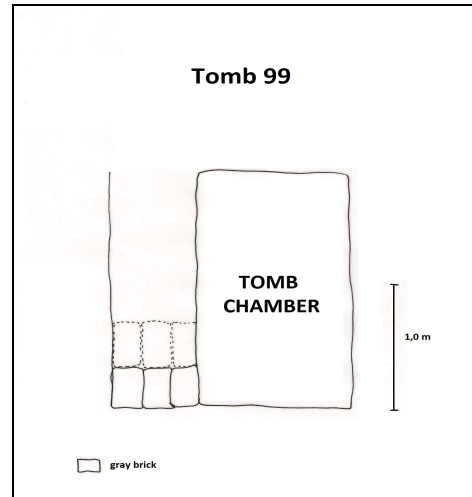


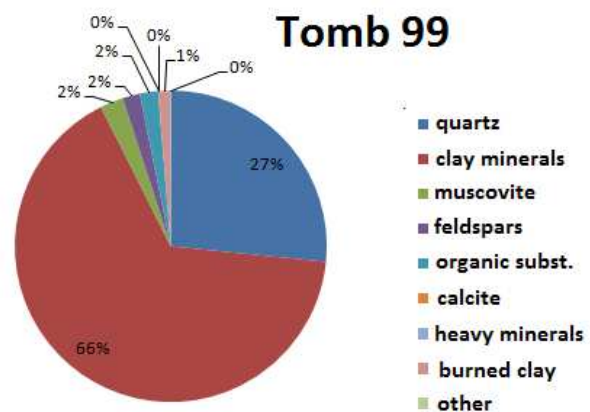
Fig.9A Scheme of tomb after exploration

Microscopic analyses indicate, that apart from the Nile silt (Photography 2C) in the crowning, quartz sand from the local source (gezira – Table 7A, 7B, Fig. 7B, C) was used for brick production.

Tab.7A Mineral composition of two bricks from tomb no.98 (%)

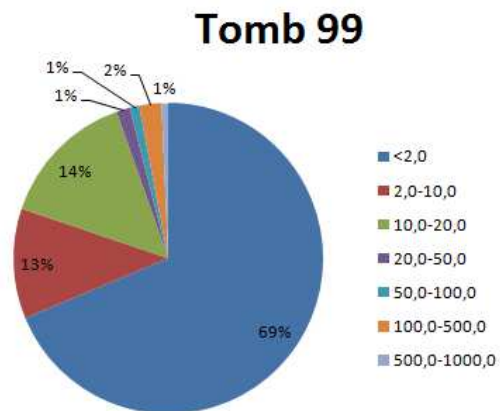
Component	
quartz	26,6
clay minerals	66
muscovite	2,4
feldspars	1,8
organic subst.	1,9
calcite	
heavy minerals	
burned clay	1,2
other	0,1

Fig.7B Diagram of content of minerals . Brick from tomb no.98



Tab.6B Grain size of brick from tomb **Fig.8C** Diagram of grain size composition 99 (vol. %)

Sizes of grains (µm)	
<2,0	68,7
2,0-10,0	11,5
10,0-20,0	14,4
20,0-50,0	1,4
50,0-100,0	1
100,0-500,0	2,3
500,0-1000,0	0,7



TOMB NO. 104

It is quite a big, irregular tomb with remains of the brick crowning (Photography 8A, Fig. 8A). Arrangement and dimension analyses of bricks showed that they differ in size. It concerns both width and length (Table 8A, Fig. 8A, B, C). The differences are as large as a few centimetres.



Fot.8A Tomb just after exploration

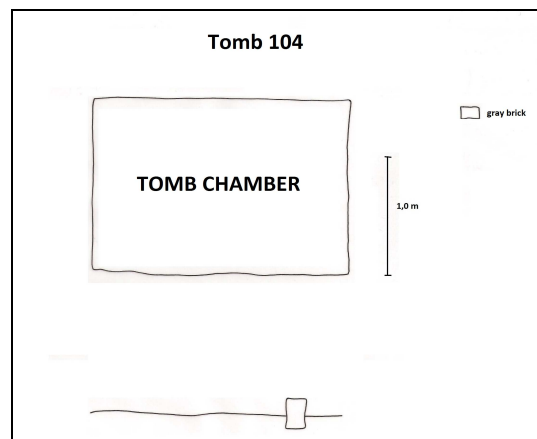


Fig.8A Scheme of tomb after exploration

The differences in length are larger than the differences in width.

No.	length	width
1	26	15
2	20	10
3	24	11
4	34	14
5	31	16
6	26	15
medium	27	14

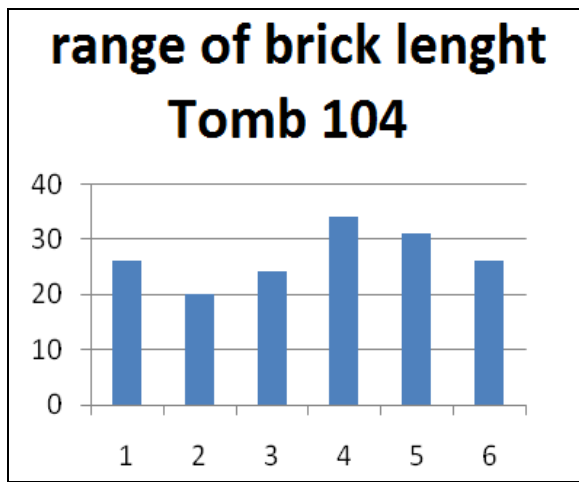


Fig.8B

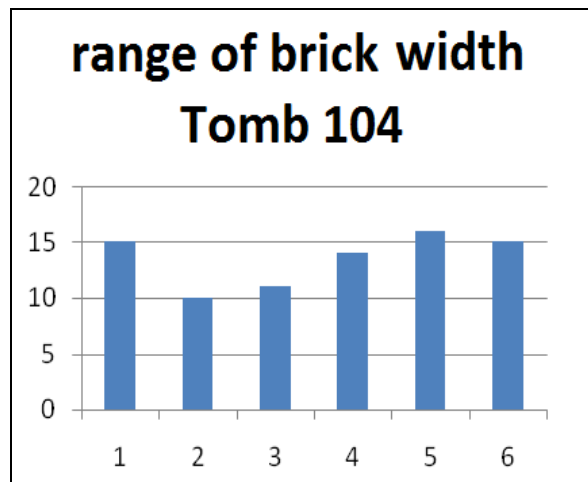


Fig.8C

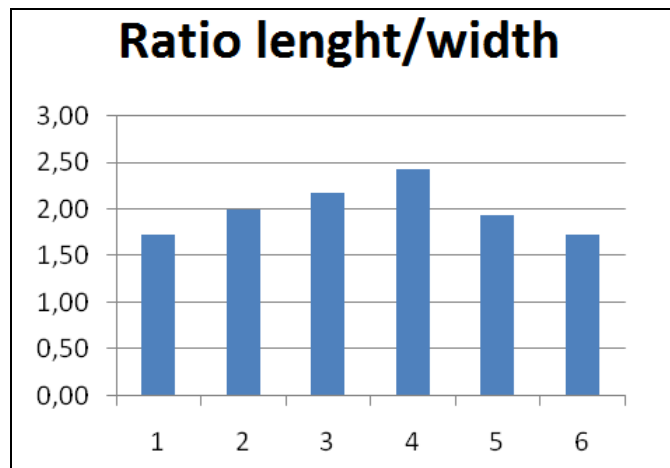


Fig.8D

Summary

The research shows both, variation of the bricks' dimensions and variation of the length to width ratio (Fig. 9A, B).

MASTABA

Fig. 9 presents morphological investigation of dried bricks from mastaba and their mineralogical and petrographic analyses..

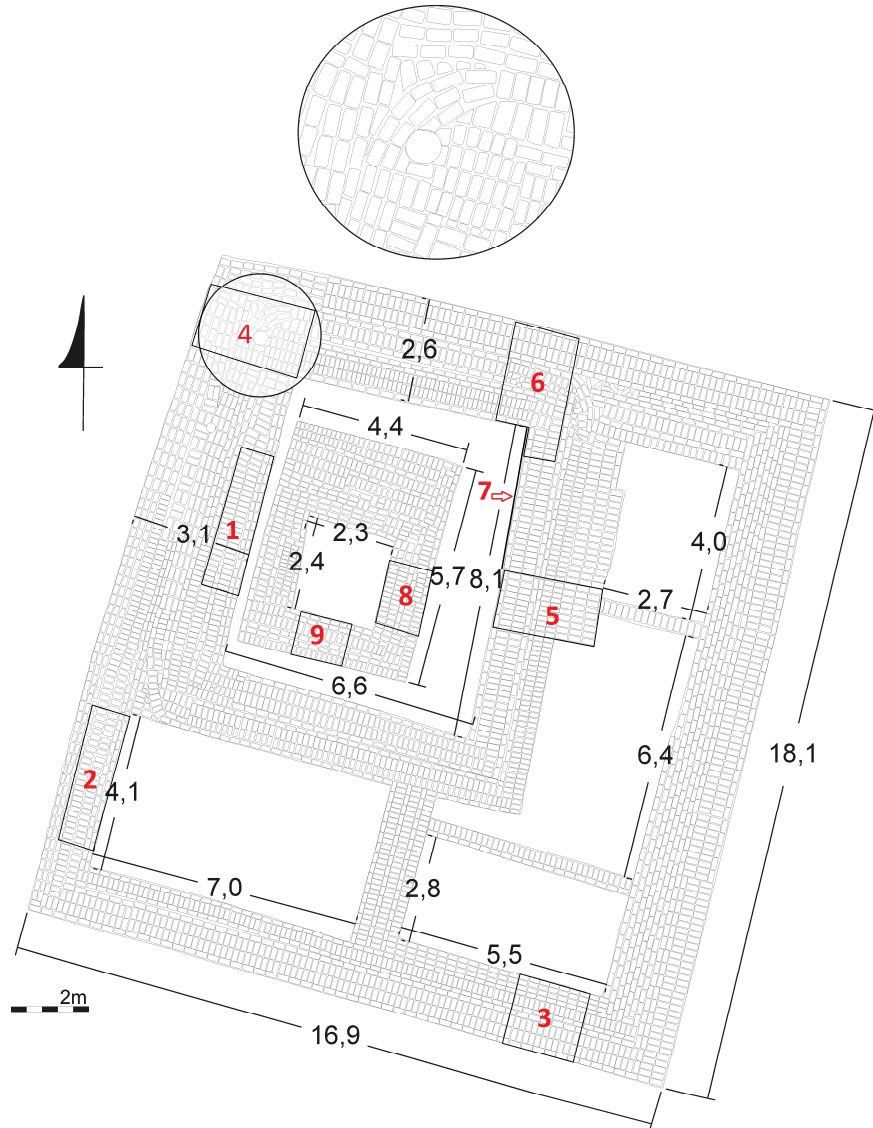
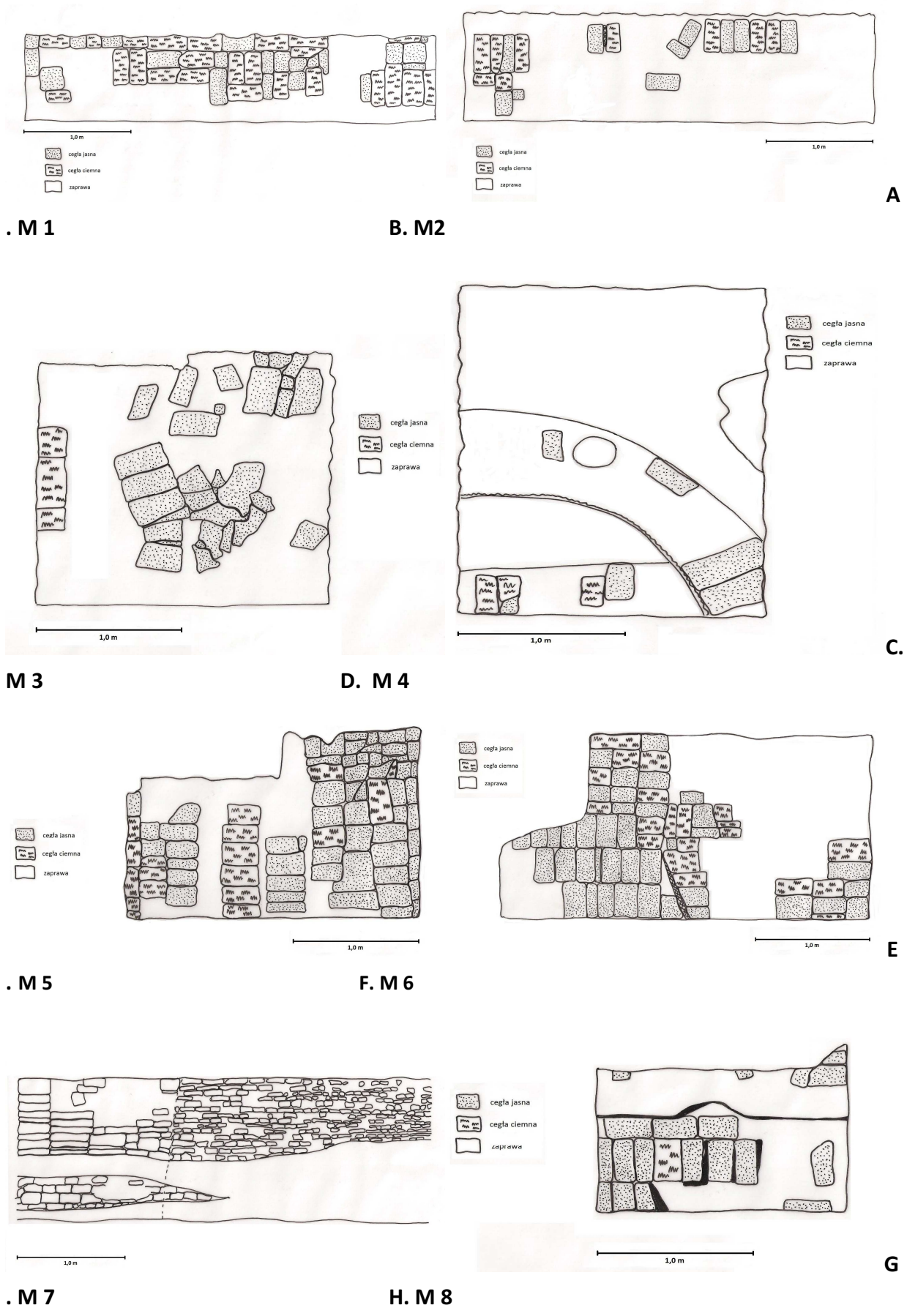


Fig.9 Drawing of mastaba from Farkha –size in metres (by M. Czarnowicz)



. M 1

B. M 2

A

M 3

D. M 4

C.

. M 5

F. M 6

E

. M 7

H. M 8

G

Fig. 10 A-H Outline of mastaba walls in the explored locations (M1-8)

Brickwork 1

The arrangement of bricks in this wall is shown in Fig. 10A. There are light bricks as well as dark ones in the proportion of 33% of light bricks to 67% of all dark bricks. Both light and dark bricks differ in sizes (Fig. 11A, B and 12A, B). The evidence are measurements of the sizes of the whole bricks.

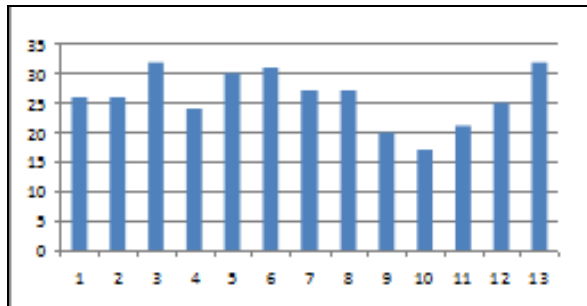


Fig.11A Length variability of light bricks in wall M1.

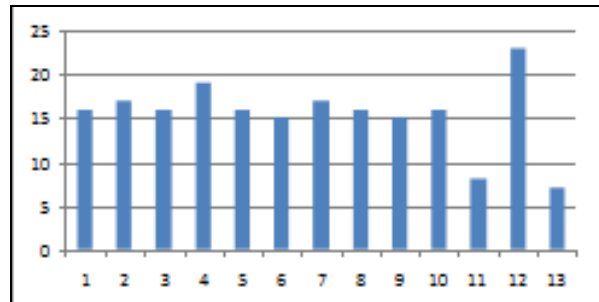


Fig.11B Width variability of light bricks in wall M1.

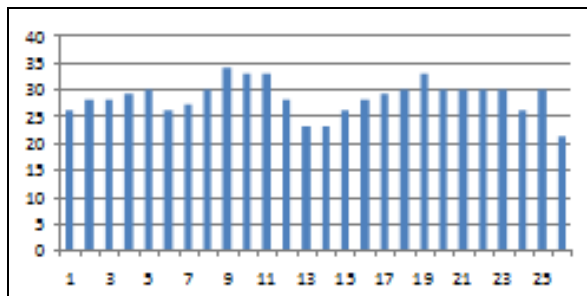


Fig.12A Length variability of dark bricks in wall M1.

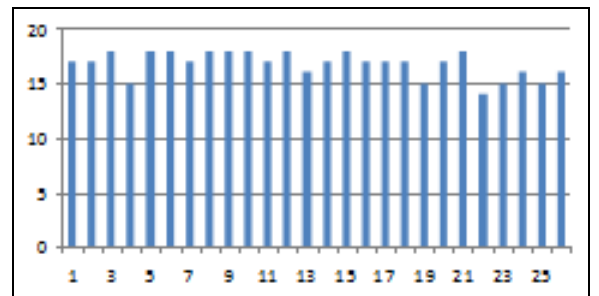


Fig.12B Width variability of dark bricks in wall M1.

Brickwork 2

The arrangement of bricks in this wall is shown in Fig. 10B. There are also light and dark bricks in the identical proportion as in Wall M2 i.e. light to all dark bricks, 33% to 67%.

Both light and dark bricks are different in sizes (Fig. 13A, B and 14A, B) and differences of sizes are similar like in Wall M1. Yet, the wall in point M2 is thicker by one row of bricks than in point M1. It is proven by measurements of sizes of the whole bricks.

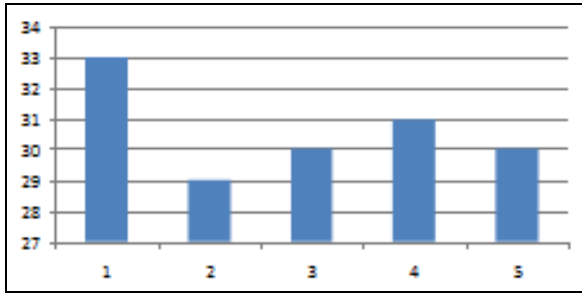


Fig.13A Length variability of light bricks in wall M2.

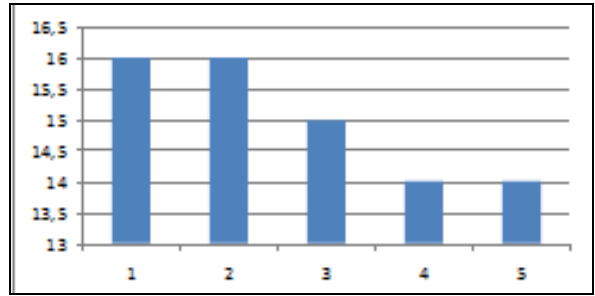


Fig.13B Width variability of light bricks in wall M2.

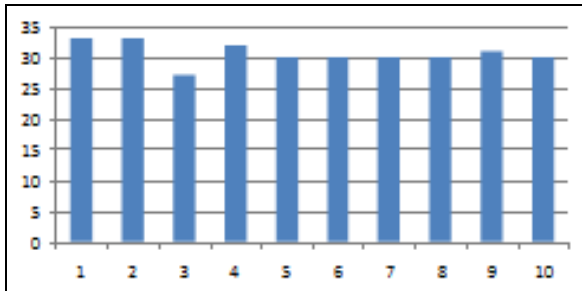


Fig.14A Length variability of dark bricks in wall M2.

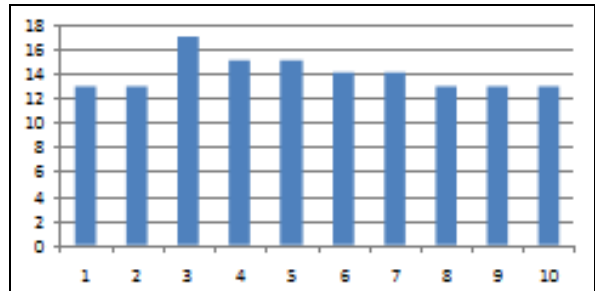


Fig.14B Width variability of dark bricks in wall M2.

Brickwork 3

The arrangement of bricks in this wall is shown in Fig. C. There are both light and dark bricks in the proportion light to dark ones (all) completely different from Brickwork 1 and Brickwork 2.

The variety of brick sizes in that wall is presented in Fig. 15A, B and 16A, B.

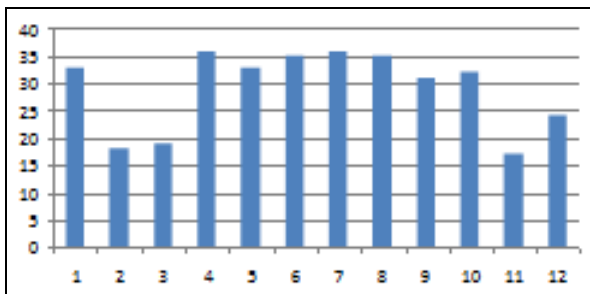


Fig.15A Length variability of light bricks in wall M3.

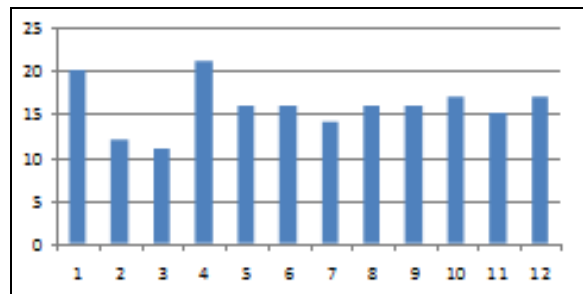


Fig.15B Width variability of light bricks in wall M3.

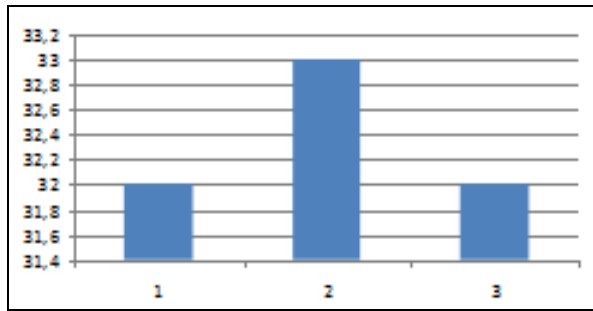


Fig.16A Length variability of dark bricks in wall M3.

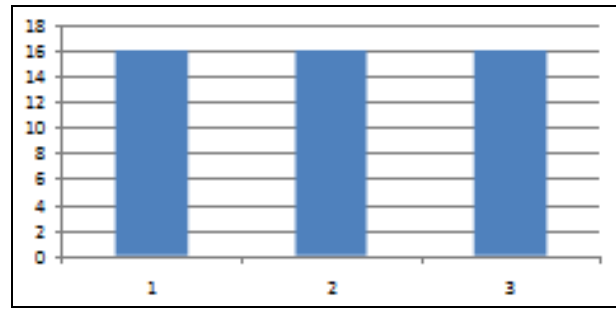


Fig.16B Width variability of dark bricks in wall M3.

Brickwork 4

The arrangement of bricks in this brickwork is shown in Fig. 10D. This wall consists only of light bricks.

The variety of brick sizes in that wall is presented in Fig. 17A, B.

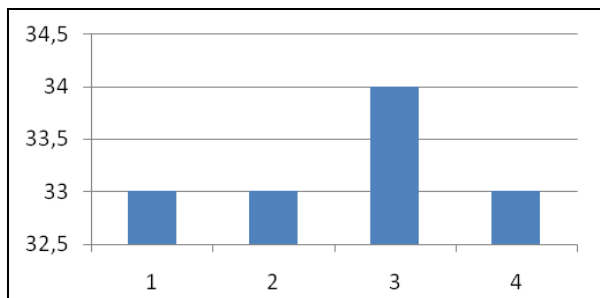


Fig.17A Length variability of bricks in wall M4.

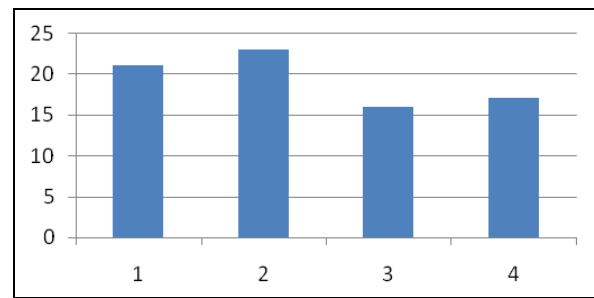


Fig.17B Width variability of bricks in wall M4.

Brickwork 5

The arrangement of bricks in this brickwork is shown in Fig. 10E. This brickwork consists of three walls – external, middle and internal.

In the external wall there are both light and dark bricks in the proportion light to dark 23%:77%.

In the middle and internal wall there are only sand bricks.

The variety of brick sizes in that wall is presented in Fig. 18A, B, 19A, B, 20A, B and 21.

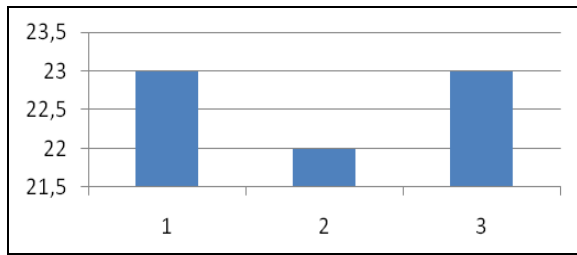


Fig.18A Length variability of light bricks in the outer part of the wall M5.

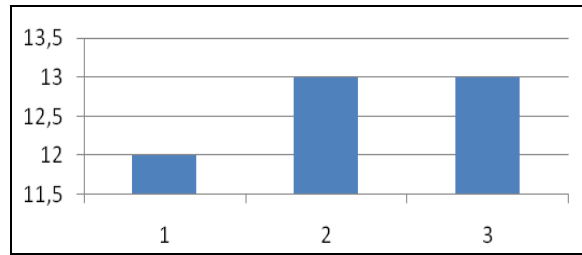


Fig.18B Width variability of light bricks in the outer part of the wall M5.

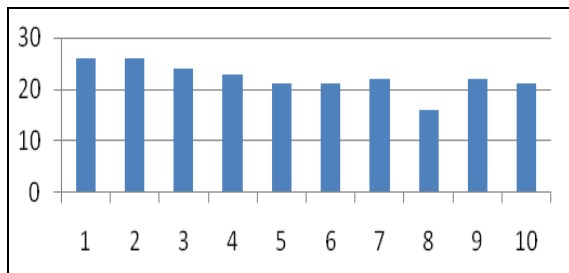


Fig.19A Length variability of dark bricks in the outer part of the wall M5.

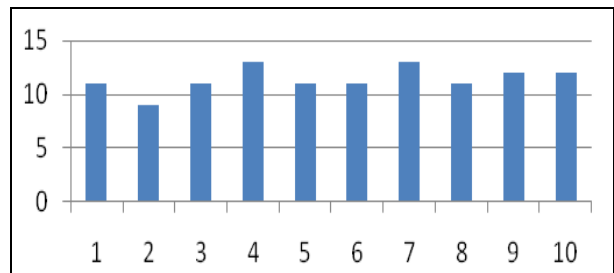


Fig.19B Width variability of dark bricks in the outer part of the wall M5.

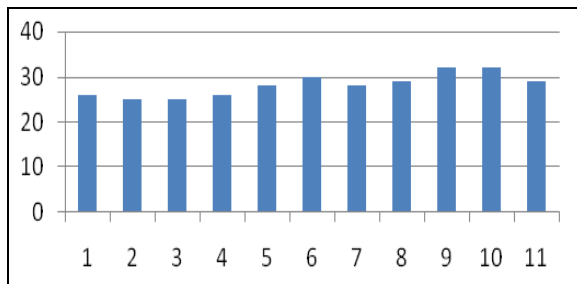


Fig.20A Length variability of bricks in the middle part of the wall M5.

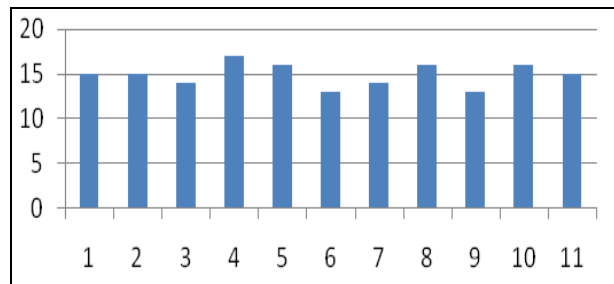


Fig.20B Width variability of bricks in the middle part of the wall M5.

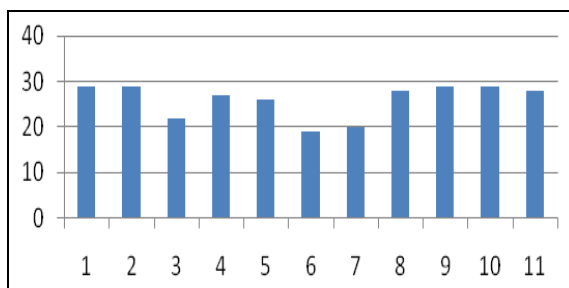


Fig.21A Length variability of bricks in the inner part of the wall M5.

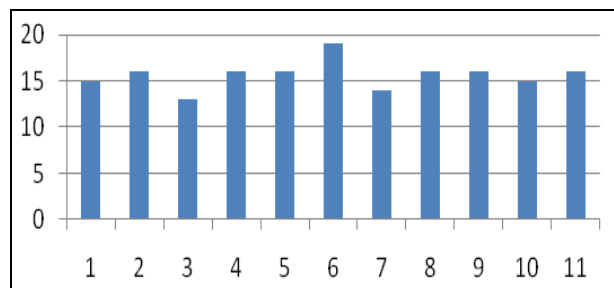


Fig.21B Width variability of bricks in the inner part of the wall M5.

The arrangement of bricks in this brickwork is shown in Fig. 10F. This brickwork consists of two walls: A and B. Wall A consists only of light bricks. Wall B consists of both light and dark bricks. However, during the measurement this distinction was not taken into account.

The variety of brick sizes is presented in Fig. 22A, B and 23A, B.

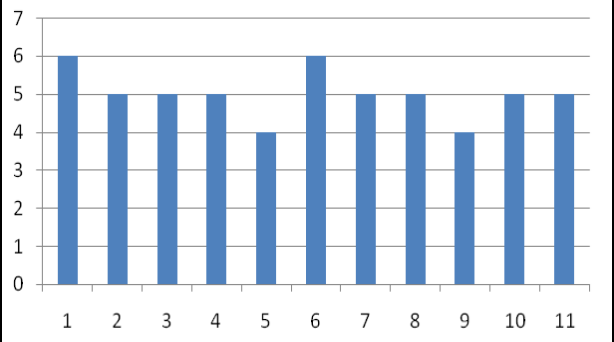
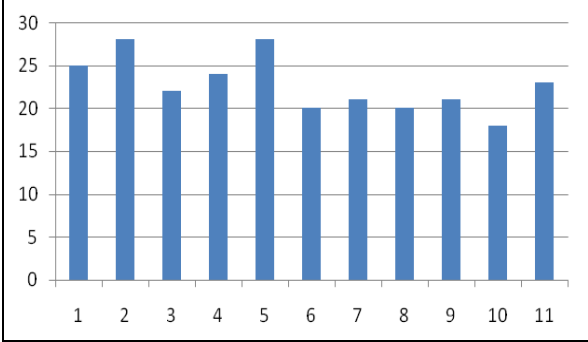


Fig.22A Length variability of bricks in the A part of the wall M6.

Fig.22B Width variability of bricks in the A part of the wall M6.

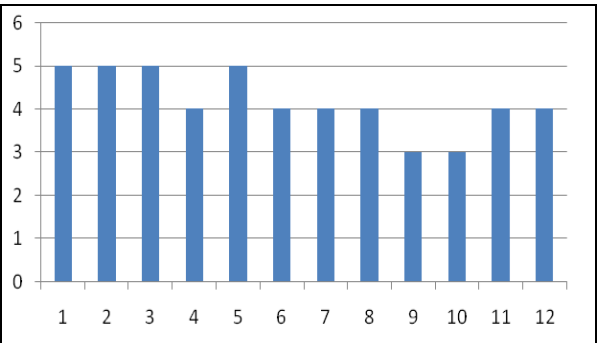
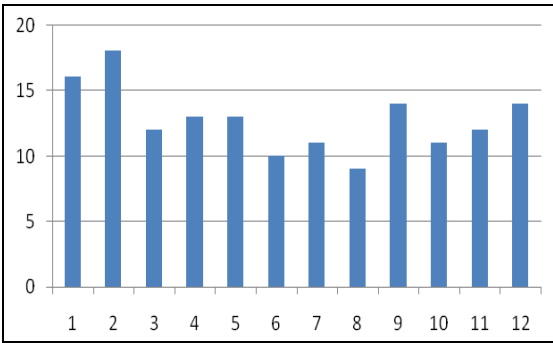


Fig.23A Length variability of bricks in the B part of the wall M6.

Fig.23B Width variability of bricks in the B part of the wall M6.

Brickwork 8

The arrangement of bricks in this brickwork is shown in Fig. 10H. This brickwork consists of two walls: external (A) and internal (B). The external wall consists only of grey bricks. The internal wall consists only of light bricks.

The variety of brick sizes is presented in Fig. 24A, B and 25A, B.

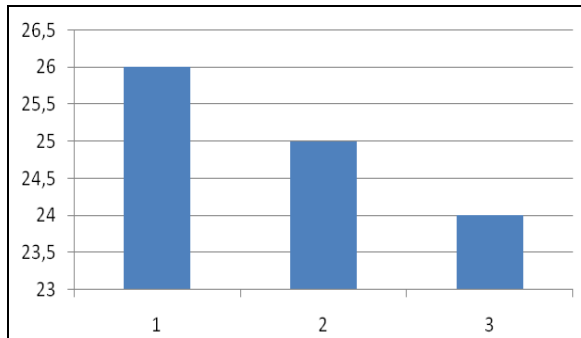


Fig.24A Length variability of bricks in the A part of the wall M8.

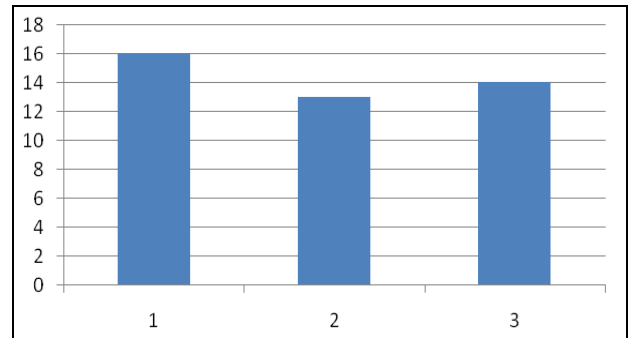


Fig.24B Width variability of bricks in the A part of the wall M8.

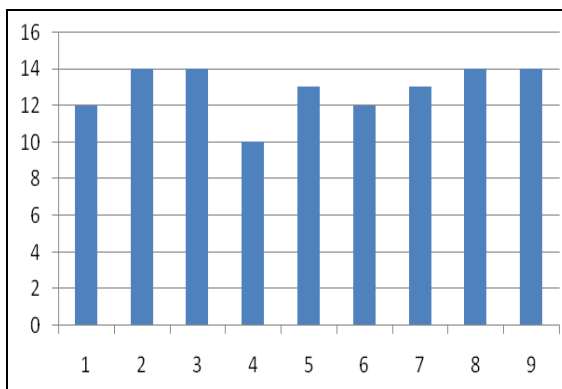


Fig.25A Length variability of bricks in the B part of the wall M8.

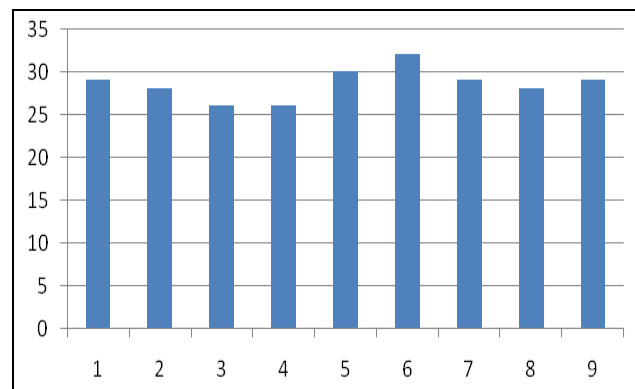


Fig.25B Width variability of bricks in the B part of the wall M8.

Conclusions

1. In different periods of site functioning, different tombs were built. They were small graves sunk into the ground and those constructed as small “houses”.
2. Bricks made of the dried Nile silt, mixed in different proportions with other components, mostly with local sand, were used to build tombs.
3. Bricks found in individual tombs have different length and width but thickness was more or less the same.
4. The use of various bricks for construction of mastaba confirm very fast building. It may suggest that the mastaba was build after death of person buried at mastaba. Additionally various size and composition of bricks used for mastaba construction confirm fast production of them by many workshops. These workshops used various material for bricks production i.e. natural silts mixed with sand as well as material with anthropogenic admixture from area of settlement.

Research shows that no precise (strict) prescription of size and mineral composition was kept when preparing bricks for tombs. They were made occasionally.

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