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RAW MATERIALS OF NEOLITHIC/AENEOLITHIC STONE BASES AND CRUSHERS FROM THE NITRIANSKY HRÁDOK SITE (WESTERN SLOVAKIA)

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Abstract: The polycultural site of Nitriansky Hrádok-Zámeček, 35 km SE of the town Nitra, is characterized by its rich collection (several hundreds!) of stone bases and crushers. They are made mostly of metaconglomerates, in less amount also of andesites, basalts, granodiorites, metaquartzites and sandstones. The provenances of the raw materials are Tribeč Mts (metaquartzites, metaconglomerates, granodiorites), Late Tertiary volcanic mountain ranges of Pohronský Inovec Mts, Štiavnické vrchy and Kremnické vrchy (andesites and basalts) as well as the Neogene sediments (sandstones) of southern Slovakia.

Key words: Neolithic/Aeneolithic, Slovakia, stone bases and crushers, raw material.

Introduction

The authors of this paper in the framework of the national as well as international IGCP/UNESCO Project No. 442 during the last years have concentrated on the problems of "small" tools or implements of daily use. In this paper we deal with the raw materials of stone bases and crushers from the above mentioned site.

The raw material studies of Neolithic/Aeneolithic implements realized on the archaeological site of Nitriansky Hrádok-Zámeček (western Slovakia, Fig. 1) during the most recent years have brought new aspects into the given problem. Using standard modern petrographical laboratory methods, the information on the stone raw materials used by the Neolithic/Aeneolithic populations have been significantly enlarged. Among the raw materials those of very local, distant, and very distant sources were described as well.

The Neolithic revolution (agriculture and domestic animals treatment as the main activities for food supply) brought several necessities in daily activities. A need of higher amount of stone raw materials on one side, and the trend towards use of stone bases spread all over the country — but till now no petrographical studies of their raw material have been done. As stone bases have been found on several archaeological sites, their mutual comparison and determination of the rock types used seems to be supplementary information to the material culture of the Neolithic/Aeneolithic populations living on the southern slopes of the Carpathian mountains and basins among individual mountain ridges.

The archaeological site of Nitriansky Hrádok-Zámeček is of polycultural character. The oldest population was that of the Lengyel culture (Pavúk & Šiška 1971). The site was settled in the Aeneolithic as well as in the Early Bronze Age (the Maďarovce culture). Finds from the Hallstatt period were also discovered on the site together with those from the Late La Téne, Roman, Migration periods and the Middle Ages (Točík 1981). The place is situated on the alluvial elevation of the river Nitra and Cítenka brook. The underlying strata are formed by loess, flood and wash sediments. Rich finds of stone industry help to create the picture of daily activity of people living in individual historical periods. Stone tools and implements for land cultivation (thoes), wood treatment (axe-hammers, adzes), grain grinding, etc. are characteristic. They were made by various manufacturing techniques and of various raw materials (Illášová & Hovorka 1999).

Stone bases and crushers studied in thin sections from a large set of finds of Neolithic/Aeneolithic stone implements are summed up in Table 1.

Stone bases and crushers from the Nitriansky Hrádok site belong to two cultures:

i) the Lengyel culture, and

ii) the Baden culture (Middle Aeneolithic)

From the review presented in Table 1 it follows that

a) people of both cultures used the same raw material types for stone bases and crushers,

b) the quantitative proportions of the raw materials used are also very close each to other, which allows us to suppose

c) gradual development of the younger (i.e. Baden) culture from the older one at the discussed place.

Fig. 1. Location of the Nitriansky Hrádok site.

Stone bases

The following features were studied on them: i) main morphological characteristics: outer shape, shape of working platform and traces of working activities, i) metric data — measurements and weight, i) other visible traces — e.g. traces of fire, i) raw material and its qualities or pertinency of its usage, i) function of bases.

Outer shape

According to the observed outer signs the stone bases were divided into two typological groups: a group of oval bases, the working platform of which was eliptical and the base of oval shape; in the other group bases were of flat square shapes. According to the raw material, e.g. inner structure of the rock, types and kinds of raw materials used, were determined. The techniques used were rough-hewing, flaking-off, chipping and in final phase also polishing, aimed in perfect ovalness mainly of basal side of bases. Petrographical characterization of rocks resulted from microscopic analysis.

The set included also two semi-products (Fig. 2A,B). They are unfinished or not yet used bases. Their shape is oval, but reached only by rough-hewing.

Shape of the working platform

The stone bases are of oval (loaf) shape. Basal part was round. According to working activities, preserved working platforms of the bases were flat, dented or slightly embossed.

Traces of working activities

On working platforms of the bases traces of working activities in different directions were observable — in a longitudinal or in latitudinal direction (Table 1). In the longitudinal direction the working platform is often slightly dented or flat — traces are visible along the whole length from one edge to the other or they are concentrated in central part of bases. The working place is remarkably dented. In latitudinal direction the working platform in slightly embossed or flat traces are observable from one edge to the other. Traces of working activities oriented in various directions — multilateral traces, that is in longitudinal as well as latitudinal directions, equally on the entire base. In this case the working platform is dented, or flat (Fig. 2C,F).

Table 1: Microscopically determined raw material types.

		Lengyel culture	
Raw material	***Stone bases***	***Crushers***	***Number***
Metaconglomerate	3		3
Quartzite	1	6	7
Sandstone			
Limestone		1	1
Granodiorite/tonalite	3		3
Basalt		1	1
Andesite	1	1	2
Number	***8***	***9***	***17***
		Baden culture	
Raw material	***Stone bases***	***Crushers***	***Number***
Metaconglomerate	4		4
Quartzite		4	4
Sandstone	1		1
Limestone			
Granodiorite/tonalite	2		2
Basalt			
Andesite	4		4
Number	***11***	***4***	***15***

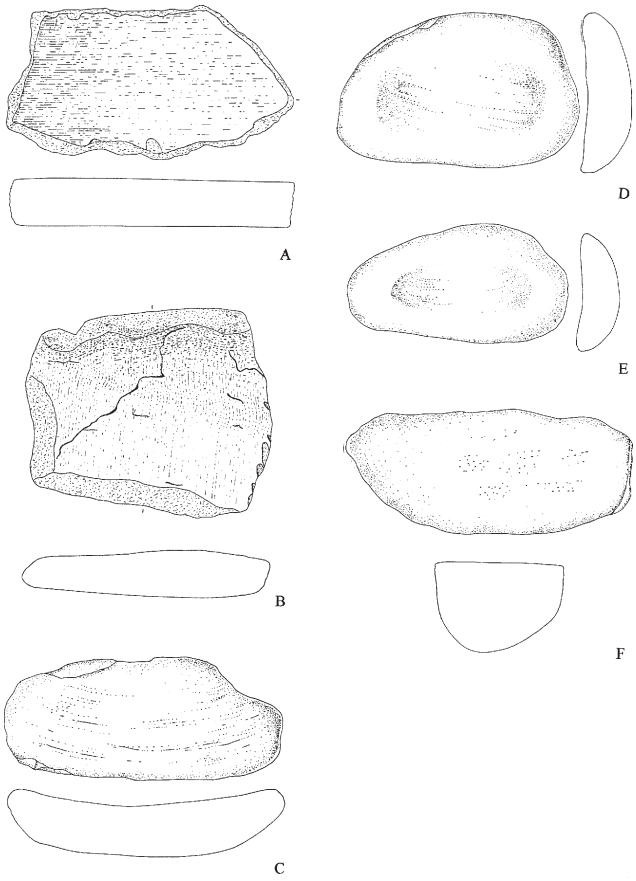

Fig. 2. A–B — Semiproducts of stone bases made from limestone, **C** — stone base with work traces in horizontal direction, **D–E** — stone bases with traces of working activities concentrated in central parts, **F** — stone base with traces of working activities in all directions. Size 1:3.

Metrical data

According to their metrical data (length : width : thickness), the bases were divided into 4 groups (Illášová & Hovorka 1999):

i) small bases with the average size of 200×140×50 mm, weight ca. 2 kg;

i) medium-size bases of 270×150×52 mm, weight 2–3 kg;

i) big bases of 340×190×90 mm, weight ca. 4 kg;

i) very big bases — working tables, stakes with weight over 5 kg.

Traces of fire

On 2 Neolithic bases traces of fire were observed.

Function of bases

Analysing all observed signs on stone bases we will try to interpret their function. Up to now, oval stones, very often with oval working platform, frequently named loaf-shaped, were regarded as stone bases, without any further identification of working activity. The character of traces on the working surface depends not only on function but also on the raw material from which a base was made. In general, we can say, that remarkable traces on working platform caused by crushing or grinding are visible on bases of volcanic rocks, such as andesite, but also on metaconglomerate, metaquartzite, mylonite. Less remarkable traces are observable on bases made of granite/granodiorite, those made of sandstones of different granularity are classified as whetstones.

i) Bases with slightly dented working platform and with traces of working activities concentrated in the central part could serve for grain-crushing or for treatment (homogenization) of loam (Fig. 2D,E).

i) Bases with flat working platform and with traces of working activities in various directions could serve for various activities — sharpening, whetting, polishing of stone, of metal or bone artefacts, probably of smaller size than was the working platform (Fig. 2F).

i) Bases with flat working platform and with traces of working activities in a longitudinal direction could serve for sharpening of metal, bone or stone tools by grinding along the whole surface. The working surface was by thus equally whetted away. Treated artefacts were of the same size or bigger than the working surface (Fig. 2C).

On the Neolithic/Aeneolithic stone bases no traces of working activities have been found in direction of their shorter dimension. Such working traces from this site are documented from the Early Bronze Age (Illášová 2000). Neolithic/Aeneolithic stone bases from Nitriansky Hrádok-Zámeček site belong to the category of small bases. Two documented pieces are exceptions. One of them (Aeneolithic) belongs to category of big stone bases, while the other is a working table.

Crushers

The set of crushers included 13 pieces (Table 1, Fig. 3). The crushers belong to the stone bases with the presupposed function of grain-crushing. They are river pebbles with evident traces of working activity — macrodeformations mainly along their circumference.

From the typological point of view the crushers are presented as: — river pebbles often of homogenous petrographic type — flat rounded or egg-shaped with weight from 400 to 600 g and size of approx. 60×50×40 mm. Raw materials of crushers are mainly metaquartzites, limestones, basalts and andesites.

Raw materials and their provenance

On the basis of the fact that bases and crushers, in comparison to those instruments (and weapons) of daily use, are larger and heavier, raw materials used for their construction were of more-or-less local origin only. This aspect fundamentally influenced type of local raw materials used in the given time-period.

Common features which mainly influence the technical properties of given raw materials are their compactness and the presence in their composition of harder constituents. In common rock-types such a constituent is represented by quartz crystals. An optimal feature (abrasive effect) occurs in cases when quartz or other hard crystals (in the given rock-type) have a phyric habit. In such case hard crystals dominating by their size over other rock constituents are placed in a fine-grained (or even glassy) rock-matrix. In this case abrasive effect of the given stone base or crusher is optimal.

We have documented the following raw material types used for stone bases and crushers make.

Basalts

The characteristic feature of basalts is their phyric fabric. Alkaline basalts contain phyric olivines and both, ortho- and clinopyroxenes, but calk-alkaline basalts include little or no olivine, while plagioclase is present as a phyric phase. The groundmass in both cases is fine-grained, or in some places even glassy. It is composed of plagioclase laths, short-columnar pyroxenes and euhedral olivines of the IInd generation. Ore phases (mostly in the form of equidimensional small crystals) are also present.

Basalts (both mentioned subtypes) on natural cleavage planes are smooth, or slightly rough.

After some use, the surface become more rougher and the abrasive effect is stronger. Among the basalt stone bases a fine-porous type has also been found. In this case the abrasive effect is based on the presence of small (less than 2 mm) cavities.

The basalts are among the geologically youngest volcanic rock in the whole of Central Europe. Their weathering resistence is high, and fresh rock appearance is also detectable after water (river) transport.

Basalts belong to one of the main rock-types in the province of the Central Slovakia Late Tertiary volcanic area. From the petrological and especially the genetical point of view they belong to two distinct clans: a) calc-alkaline basalts (basaltic andesites) and, b) alkaline basalts. They are concentrated as lava flows and agglomerate lavas in the broader vicinity of the Žiarska kotlina Depression. Blocks up to 15 cm in diameter can be found in the river Hron valley bed deposits.

Andesites

This, the most common volcanic rock in the province of the Central Slovakia Late Tertiary volcanic mountains, occurs in plenty of varieties. They are classified on the basis of their variable mineral composition, grain-size, textural patterns etc. Also in the case of andesites used as the raw material for base and crusher construction their phyric structure is the leading aspect of their high abrasivity. Apart from the general characteristics mentioned above, small plagioclase laths oriented in one direction in their groundmass and forming a fluidal pattern, are characteristic of some varieties of andesite (Fig. 4).

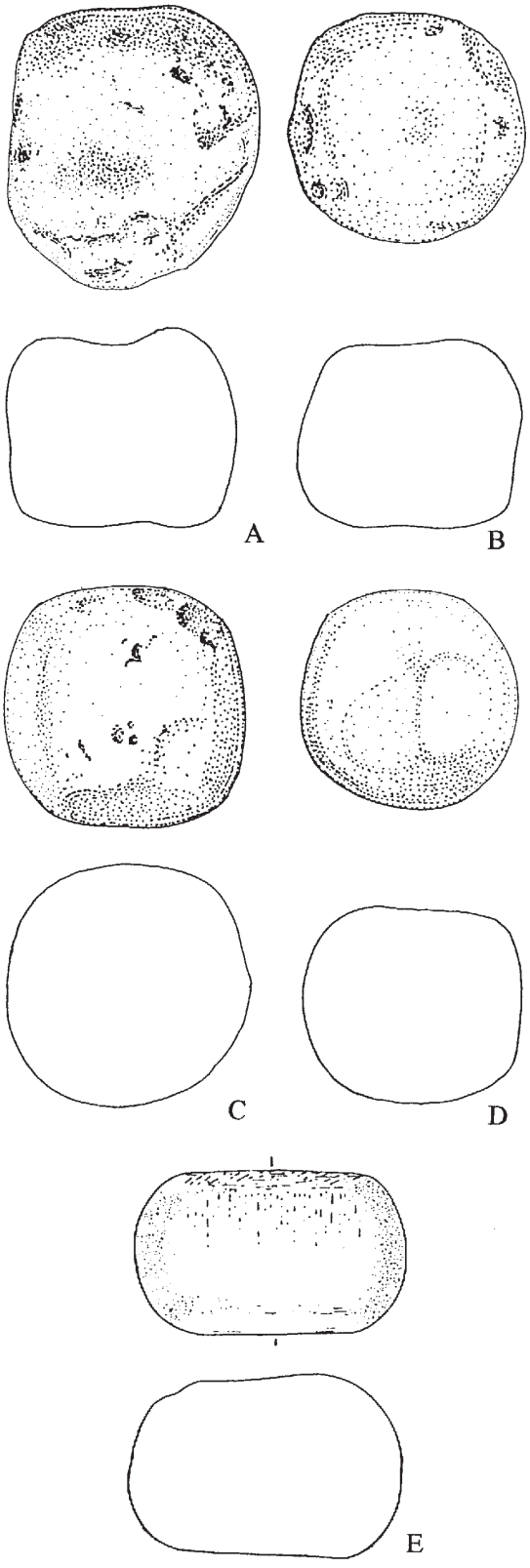

Fig. 3. Crushers. The crusher belongs to the stone bases with presupposed function of grain-crushing. They are river pebbles with clear traces of working activity. **A** — andesite, size 64×56×45 mm, **B** — metaquartzite, size 52×52×42 mm, **C** — basalt, size 51×56×56 mm, **D** — metaquartzite, 51×51×62 mm, **E** — metaquartzite, size 37×62×42 mm.

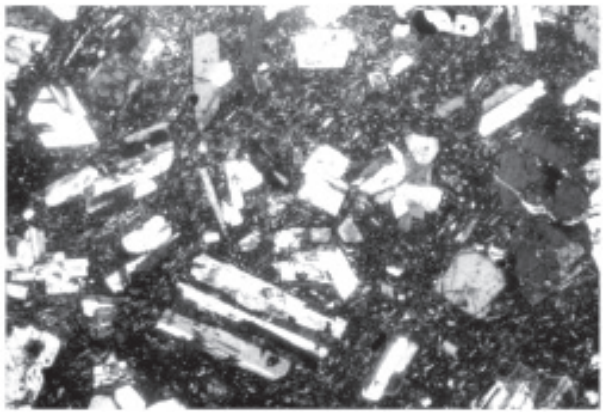

Fig. 4. Porphyritic fabric of two pyroxene andesite with nonpronouncedly fluidal matrix. Nitriansky Hrádok, magn. 27×, X polars.

Smaller stone bases and crushers are most probably made from blocks (bigger pebbles) transported by the river Hron, while larger ones are made from blocks of andesites mainly from their natural occurrences in the Vtáčnik and Pohronský Inovec Mts. In the last mentioned case andesite blocks (or most probably ready made bases and crushers) have been transported from "one-day's-walk-distance".

Granodiorites/tonalites

Granodiorites/tonalites are the most wide spread plutonic rock type in the Slovak Western Carpathians. They built up the central part of the Tribeč Mts, which are situated approximately 25–30 km to the N or NNE of the Nitriansky Hrádok-Zámeček site.

Granodiorite/tonalite (the difference between those types are insignificant from the point of view of the topics discussed in this paper) are even-grained, in less amount also porphyritic rock types composed of quartz, feldspars and micas (dark as well as light ones). As a result of their hardness quartz crystals are dominant and for the abrasive effects the most significant.

As the great majority of granodiorite/tonalite massifs in the Western Carpathians of the Slovak territory are of Variscan (Carboniferous) age, consequent Alpine tectonic-metamorphical processes caused secondary recrystallization especially of feldspars of granitoid rocks (term used for granites/granodiorites/tonalites in the broad sense). This recrystallization caused softening of this mineral, so the difference in hardness between quartz and feldspars (as the main constituents of granodiorites/tonalites) was increased.

We have documented 5 bases and 4 semi-products made from granodiorites/tonalites of above character. The provenance of the raw material type is the Tribeč Mts, especially its southernmost part, which forms an elevated horst-like block supplying adequate rock-blocks.

Limestones

Our raw material studies of Neolithic/Aeneolithic industry already allow us to make the following statement: limestones as raw materials for implements with practical uses have been utilized only very sporadically. But they have been used as the

raw materials of various implements of ornamental or symbolic nature, such as the tag, the decoration etc. Also in this case the exception proves the rule.

One crusher is made from a limestone. It is dark-grey/black in colour and traces of macrodeformations are expressed by light hair-like calcite veinlets. On the basis of its appearance we consider the limestone to be of the Middle Triassic age.

Sandstones

Sandstones form a varied broad group of clastic sedimentary rocks. Depending on their source areas sandstone composition differs significantly. If we suppose local provenance of this raw material type, sandstones of the Neogene age are the most probably used. Also in this case quartz clasts are the most important as abrasive media (Fig. 5). Their amount in this rock-type varies, but they are mostly one of the prevailing mineral components of the given rock.

Individual quartz clasts (up to 1–2 mm in size) are joined into the compact rock by cleyey or carbonaceous matrix. Soft matrix and hard clasts together represent a material of very suitable technical properties for use as smoothers, or polishers of stone implements. As the site studied is located on the periphery of the Late Tertiary volcanic mountains, it is common for the sandstones to also contain volcaniclastic admixture (originally volcanic ash) or volcanic tuffitic material. This is the case with several implements of the described category.

Metaquartzites

In all studied cases this raw material type has been represented by anchimonomineral rock-types composed of quartz clastic grains which are lithified by siliceous cement. Such rock has appropriate hardness and special types of metaquartzite were used as crushers of corn until the Middle Age.

As well a prevailing quartz crystals, quartzite also contains clastic crystals of micas, feldspars and rarely also other rock-constituents. In comparison to quartz all of them are softer and in extreme cases they are completely weathered enabling pores of small dimension to originate.

Metaquartzites of appropriate technical properties form part of the Mesozoic mantle unit occurring on the crystalline core of the Tribeč Mts. So also in this case one-day's-walk-distance is an important factor for practical use of the Lower Triassic Tribeč Mts metaquartzites as a raw material for stone bases and crushers.

Metaconglomerates

From the geological point of view conglomerates, and their metamorphic derivatives, represent a very significant rock horizon. The majority of conglomerates are product of sedimentation in water basins just after transgression, and in the majority of cases their clasts reflect the geological structure of their basement.

In respect to the site of Nitriansky Hrádok-Zámeček Permian and Lower Triassic metaconglomerates of the Tribeč Mts should be mentioned. Their fine-grained varieties (Fig. 6) composed of preivailing quartz clasts (2–8 mm) with sandy matrix, are especially suitable for making stone bases and crushers. Slight metamorphic recrystallization of the Alpine age made Permian and Triassic conglomerates more compact and pronouncedly harder. Such properties are for stone bases and crushers favourable.

Conclusion

The archaeological site of Nitriansky Hrádok-Zámeček (western Slovakia) is of polycultural character. The place is situated on the alluvial elevation of the river Nitra and Cítenka brook. The underlying strata are formed by loess, flood and wash sediments. Rich finds of stone industry help to create the picture of daily activities of people living in individual periods. Stone tools and implements for land cultivation (thoes), wood treatment (axe-hammers, adzes), grain grinding, etc. are characteristic. They were made by various manufacturing techniques and of various raw materials (Illášová & Hovorka 1999).

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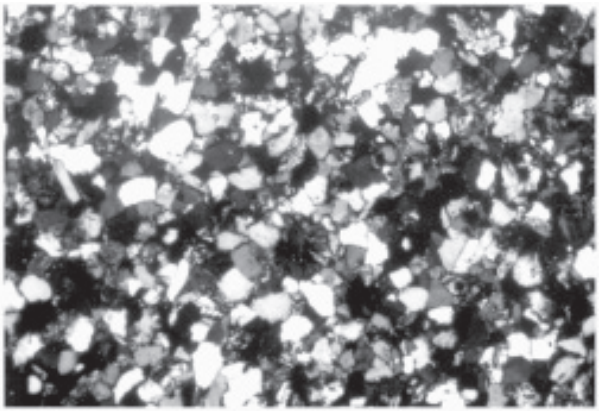

Fig. 5. (Neogene ?) sandstone with calcareous cement. Nitriansky Hrádok, magn. 45×, X polars.

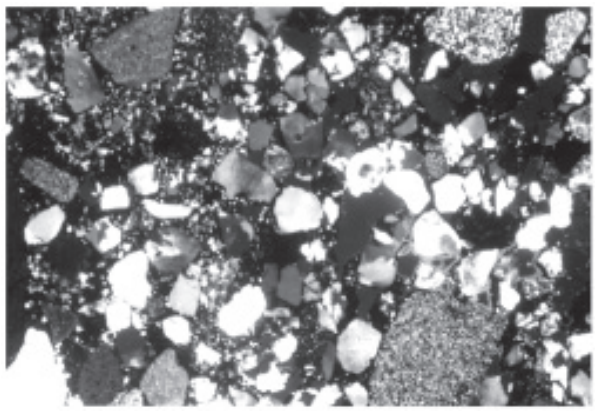

Fig. 6. (Permian ?) metaconglomerate with detritic-hematite cement. Nitriansky Hrádok, magn. 7×, X polars.

raw materials used by the Neolithic/Aeneolithic populations have been significantly enlarged.

The Neolithic/Aeneolithic population of given site used only more or less local raw materials for production of stone bases and crushers. Under "local" we mean distances of "one-day's-walk" which is the case with all determined raw material types.

The dominant abrasive component of raw materials used is quartz or silicate-group minerals. Their presence in combination with softer matrix, the local presence of fine pores or weathered components (feldspars) of matrix enabled use of the above mentioned rock-types as suitable abrasive matter. On the basis of the discrete grain-size of individual raw material types they have been used in various technologies, for example fine-grained sandstones or limestones have been used as smoother or polisher rather than as the stone bases or crushers.

The bases and crushers from the site of Nitriansky Hrádok-Zámeček represent a rich collection of finds revealed in testing pits and sectors.

The stone bases, including crushers, probably served as: a) stone bases for crushing of grains, seeds or fibrous organic products, for homogenization of clay used for pottery production, b) whetstones — for shaping of polished stone implements, c) working tables — for various working activities.

The prevailing raw material of stone bases from the site of Nitriansky Hrádok-Zámeček was metaconglomerate. They are coarse grained rocks with prevailing quartz and rounded pebbles of for example granitoid rocks.

The provenience of the raw materials were probably the Tribeč Mts, a one-day's-walk-distance from the site. The andesites and basalts from the Late Tertiary volcanic mountain ranges have their origin in central Slovakia (Pohronský Inovec, Kremnické and Štiavnické vrchy) Mts.

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