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THE TOKAJ MTS. OBSIDIAN – ITS USE IN PREHISTORY AND PRESENT APPLICATION

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Abstract: Homogeneous acid volcanic glass of low water content has been an object of human attention since the prehistory. There exist archaeological evidences dealing with the use of obsidian from the Tokaj Mts. (eastern Slovak Republic and the north-eastern part of Hungary, as well) Late Tertiary volcanic province in the Late Palaeolithic. There at present exist attempts to use it as a jewelry raw material. Obsidian namely in combination with silver, nickel alloys and gold can be effectively used as a modern jewelry material.

Key words: Slovak Republic, obsidian, praehistory, nowadays utilisation

1. Introduction

One of typical geological processes, acted on the territory of the Slovak Republic, was Late Tertiary volcanic activity. Its various products are known from several volcanic mountains concentrated as a girdle on the inner side of the Carpathians belt. As far as its mineral and chemical composition is concerned, the rock products are represented by calc-alkaline clan, on isolated places also by alkaline basalts. Based on the geological surrounding of the site, where the lavas of the mentioned types penetrates the Earth´s surface, products of the volcanic activity have various appearances. One of the characteristic rock-types is the acid volcanic glass of the obsidian category. Disintegration of glassy lava bodies into blocks is the consequence of internal tension of the rhyolitic lava pouring into a water basin. Country rocks of the obsidian are various, mostly fine-grained mixed rocks of sedimentary as well as volcanic origin (= tuffites). Characteristic raw materials of prehistory –in archaeology cultures of the Palaeolithic– are very fine-grained till in observation by naked eyes amorphous siliceous matters and the acid volcanic glass - obsidian.

In the Tokaj Mts. (spread both on the territory of the Slovak Republic and Hungary) obsidian blocs are cropping out in the hilly area, or they are deposited several meters in depths. Individual blocks have dark, mostly blackish and greyish tints, in some cases also of deep-green, or brownish tint have been documented. Thin sections studies brought evidences of the presence of acid plagioclases as well as Na-K feldspars and in some spots also cristobalite radial crystals in discussed type of volcanic glass. Dark silicates, (namely dark micas) are represented mostly by their crystallites of 0,3 mm dimensions. Such our observations are in general agreement with those of Rózsa et al. (2003).

The most abundant obsidian blocks do occur just between the villages Viničky and Veľká Bara. Suitable environmental conditions enable the human tribes to settle this area already in the Palaeolithic. Archaeological excavations at sites of Cejkov, Kašov, Bara, Hrčel-Pivničky, and the others, offered plenty of stone implements made of obsidian. Archaeological aspects of the Tokaj Mts, obsidian are treated namely in papers by Janšák (1935); Bánesz (1961); Kaminská, (1995); Kaminská and Ďuda (1985) and Šiška (1999). In the very last time Illášová et al. (2008) published a little monograph devoted to the obsidian just from the Viničky site and the general characteristics of the area under consideration.

In Europe there are only several obsidian occurrences, but majority of them are known from the Eastern Mediterranean. So implements made of this characteristic raw material type occurring in the Tokaj Mts. were spread over the long distances in the neighbouring countries as well as in Germany and on Balkans. Evidences for this statement

are presented in papers by Warren et al. (1977), Williams (1983), Williams et al. (1984) and Rosania et al. (2008), resp. They are based (Williams and Nandris 1977) on similar chemical composition (main oxides, trace elements including REE, and isotopic data) of obsidian implements deposited in museums in Germany with obsidian from field occurrences just from the Tokaj Mts.

2. Background

From the geological point of view, obsidian occurrences are a part of extrusive body of rhyolitic lava 11–12 Ma, which under the postmagamtic hydrothermal activity is intensively secondary decomposed. So individual blocks of obsidian occurrences are present within the soft light-colored rocks of sedimentary and volcanic origin (=tuffites). On the Slovak Republic territory, Late Palaeolithic as well as Neolithic implements made of obsidian, as well as of other local raw materials –namely of limnoquartzite (= limnosilicite), occurring in the central Slovakia Žiar nad Hronom Late tertiary basin were described from the whole country territory (Hovorka and Illášová, 2002).

There exist written sources dealing with the raw material of chipped industry just from the Viničky area (see again Fig. 1). Obsidians (or the most probably ready-made implements) from this area were spread over practically the whole central and south-eastern Europe, where cutting tools and even untouched cores were found.

3. Material and Methods

The presented results are based on individual pieces of obsidian found on surface of vineyard of Viničky and Malá Bara willages. We have choosed, by naked eye, homogenous obsidian pieces with neither cracks nor zones of weathering. Obsidian pieces under consideration sized 2 to 12 cm. From the whole set of obsidian pieces we have choosed one hundred of them with stereoscopic microscope, for consequent cutting for cabochon and platelets. Realised laboratory tests proved the suitability of obsidian from Tokaj Mts. area for gemmological purposes for such conclusion is also the low amount (25-30%) of refuse from the total. All mentioned technologies have been realised in laboratories of DRAHOKAM Turnov (Czech Republik).

4. Results

Obsidians of the eastern Slovakia rank among the group of unaltered volcanic glasses generally with

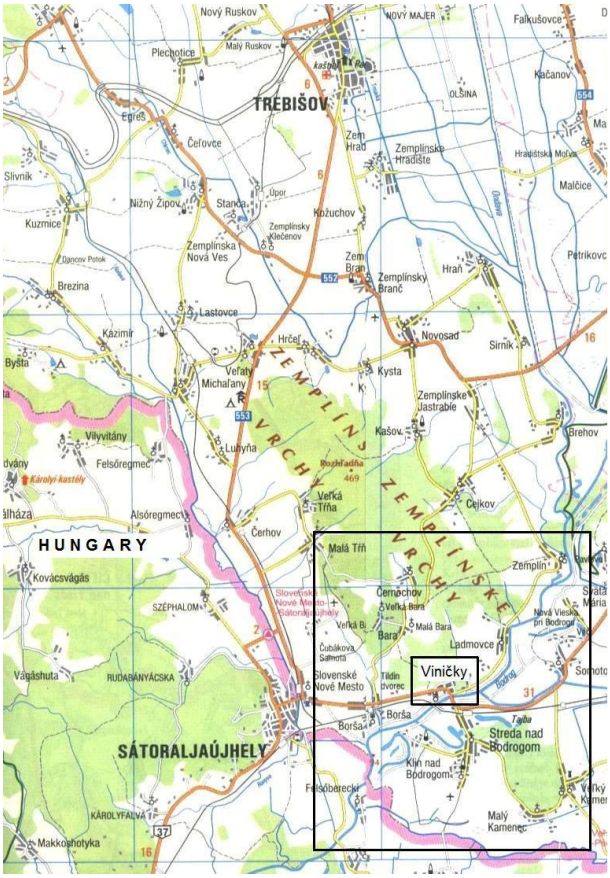

Fig. 1 Map of Tokaj Mts. and surroundings. Going north, except for Poland, Moravia (the easternmost county of the Czech Republic) and Bohemia, deposits of these obsidian-made tools and weapons are expected to occur up to the town Zauschwitz southward of Liptz (The Linear Pottery and Stroke Ware Cultures: Baumann and Fritzsche, 1973). On this place cutting tools, shaving blades and also untouched cores were found. The area covers the length of approximately 750 km. Other obsidian implements expected to come from the discussed area were found near Bodman (the northwestern Germany: Maier, 1955). Implements made of obsidian from the Zemplin county occurrences are traced southward to Macedonia and Balkan peninsula (850 km: Kilikoglou et al., 1996).

SiO_2 content about 75 %. The SiO_2 content in obsidians from the vicinity of Viničky village ranges from 74,65 to 75,79 % (Tab. 1); specifically from particular occurrences in the Viničky site (columns 1-5, Tab. 2). Higher acidity of local lavas led to higher SiO_2 content and lower H_2O content (0,01-0,66 %) in comparison with the world average (Šalát and Ončáková 1964). This is the reason of their higher devitrification resistance and at the same time of their technological suitability for production of decorative artefacts and jewelry, as well. Density of the Tokaj Mts. obsidians ranges between 2,3-2,4 g/cm^{-3}, porosity is noticeably un-

der 1 %, hardness at Mohs scale 5-5,5. Index of refraction is 1,48-1,51.

Fig. 2. Pieces of obsidian – the largest sized 10 cm in length - (a, up), obsidian of high quality (103 x 94 x 60 mm) - (b-down).

Obsidian pieces are of various sizes, which varied from 1 to 20 cm in diameter (Fig. 2a-b). Their colour is black, black-grey, in thin cuts grey to pale grey, sometime brownish. Production of jewelry and haberdashery are handicrafts. Banded obsidian forms are attractive. So-called silver obsidian varieties from here are known as well. Silvery shade is caused by the content of gaseous-fluid inclusions or crystallites. Fluid textures are pronounced.

For the practical use in the prehistory, types of homogeneous character (Fig. 3a-c) were mostly used. For ornamental purposes in subrecent and recent times dark obsidian with the presence of light microliths (representing accumulation of feldspars and cristobalite mostly of radial orientation and fine-grained character) are known; rarely also banded types, in which light stripes are present in prevailing dark obsidian. For obsidian a low content of water (below of 1 %) is characteristic.

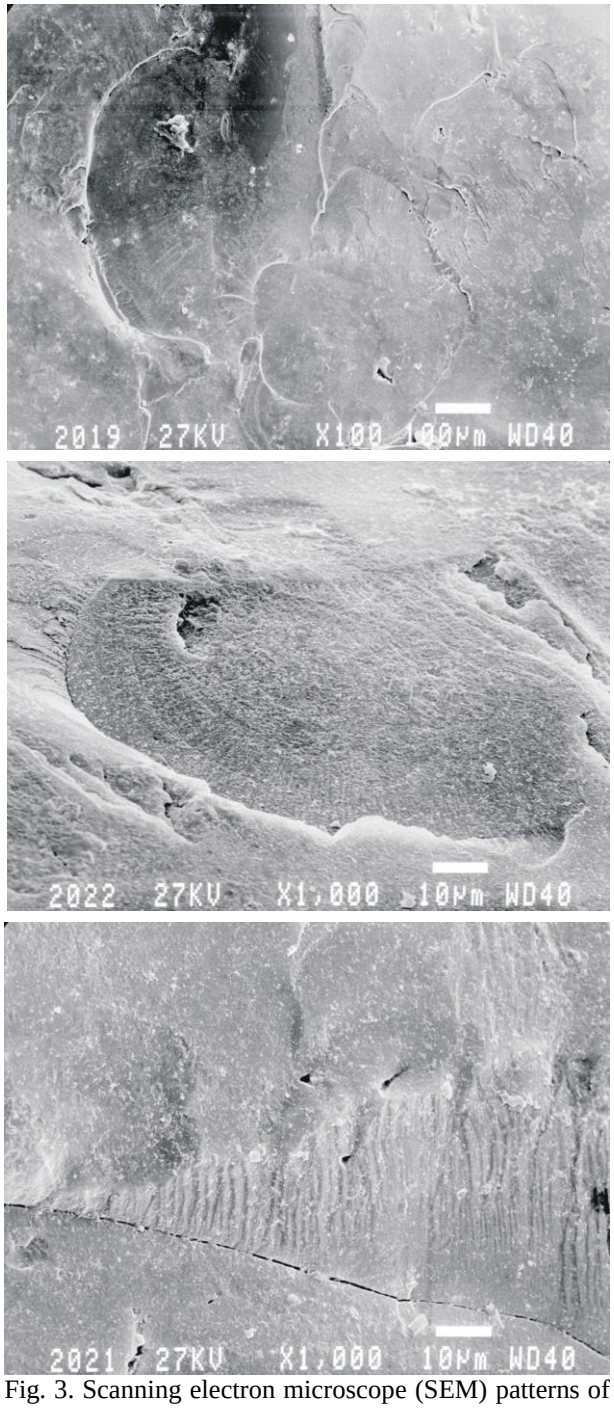

Fig. 3. Scanning electron microscope (SEM) patterns of obsidian from Viničky village. Patterns with non-distinct parallel orientation, low content microlit and for glasses typical splitting planes.

Jewelry and haberdashery production are kinds of traditional craft industry oriented at production of minute ornamental hangings and the various types of parts of weapons, decorations for human bodies, hair, clothes and others (necklaces, pendants and earings) and finally for small souvenirs making. They can occur in modern jewels in shape of mugle or faceted gems in order to represent Slovak decorative gems. From the above-mentioned aspects is clear that there should be paid more attention to the Tokaj Mts. obsidians especially because of its modern practical use as a raw material for decorative products.

Table 1. Obsidian – chemical composition from various occurrences.

Locality	**1**	**2**	**3**	**4**	**5**	**6**	**7**
SiO_2	74,14	74,59	72,8	69	73,8	75,9	69,7
TiO_2	-	0,11	0,1	0,57	0,13	0,25	0,37
Al_20_3	13,74	13,37	13	15,2	13,8	12,8	10,7
Fe_20_3	0,65	0,53	0,69	2,94	0,98	0,85	6,35
FeO	1,74	0,95	1,4	0,15	0,83	0,57	-
MnO	0,19	0,02	0,08	0,11	0,05	0,05	0,13
MgO	0,24	0,53	0,6	0,81	0,29	0,16	-
CaO	1,3	0,67	1,26	2,6	1,09	0,48	0,37
Na_2O	2,98	4,47	4,37	3,36	3,97	3,74	6,54
K_2O	4,31	4,51	5,04	4,12	3,98	4,2	4,52
H_2O^+	0,18	0,32	-	-	0,33	0,15	-
H_2O^-	0,05	0,04	-	-	0,07	0,01	-
P_2O_5	0,17	0,02	-	0,13	0,02	0	-
CO_2	-	0,22	-	-	-	0,05	-
S	-	-	-	-	0,05	-	-
s.ž.	-		0,2	-	0,33	-	-
Total	100,7	100,4	99,5	99	99,7	99,2	98,7

1 – Viničky, Tokaj county, Slovakia (Šalát, Ončáková 1964); 2 – Milos, Greece (Pesty, 1970); 3 – Lipari, Greece (Cobella et al., 1978); 4 – Sardínia, Italy (Coulon et al., 1978); 5 – Armenia (Karapetjan and Meliksenjan, 1981); 6 – Yellowstone, U.S (Laurse and Lanford, 1978); 7 – Rift-walley, Ethiopia (Gibson, 1970).

Obsidian is homogenous, suitable to cut and also to polish material. When it is dressed, presence of minute crystalline inclusions makes no obstruction; they even can be of some decorative quality in the raw material choice. Considering their homogeneity, losses at its cutting or polishing are relatively low. This is true when flat slices are cut from obsidians.

Verification of technological properties: losses caused by cutting into slices were watched together with those caused by polishing and other properties that can influence the final cut quality (Turnovec, 1985). We tested 500 g of obsidian fragments. Results of obsidian raw material recovery are comparable to commercial coloured chalcedonies, morion or smoky quartz.

Another way of the Tokaj Mts. obsidian dressing was simple tromling/tumbling of fragments. Massive fragments that had been freed from surface crust were put into tromling apparatus. The result was excellent and the recovery from the raw material was 90 %. In general, many minerals are convenient for tromling – massive and grainy as well as crystalline ones. This method is simple and undemanding.

The most common obsidian cuts are cabochons (Fig. 4). Losses caused by cutting and polishing in their production were examined (Tab. 3). As far as obsidians are partially transparent, they can be dressed also as faceted stones (Fig. 5) and made plates (Fig. 6). Convenient shapes are mainly step cuts, less brilliant cuts.

Table 2. Obsidian chemical composition: Viničky, Tokaj county, Slovakia

	1	2	3	4	5	6
SiO_2	74,59	68,51	66,93	75,1	75,4	75,75
TiO_2			0,4			0,02
Al_2O_3	13,44	15,6	15,74	14,07	14,15	13,73
Fe_2O_3	0,58	2,11	3,37	0,37	0,35	1,01
FeO	2,64	1,62	1,57	0,84	0,72	-
MnO	0,03		0,3	0,04	0,04	-
MgO	0,34	0,52	1,07	0,36	0,28	0,03
CaO	1,42	2,2	3,3	1,23	1,14	1,25
Na_2O	3,15	2,51	3,12	3,54	3,62	2,25
K_2O	3,05	0,55	3	4,37	4,36	4,92
P_2O_5	0,17	0,11	0,16	St.	-	
$+H_2O$						
$-H_2O$						
Total	100,36	100,39	100,36	100,12	100,24	100,36

Obsidian Viničky – various blocks (Šalát, Ončáková, 1964) in fine-grained volcaniclastics.

Obsidian blocks are homogeneous in color and composition. But there exists blocks, on the surface of which minute white flaky units (similar to the snow flakes) composed of cristobalite occur. Such types are called „flake obsidians“. Though obsidian is the product of rapid cooling of acid lavas, in the majority of thin sections minute crystals of biotite (dark micas) and magnetites (iron oxide) are visible there. Their distribution on the area of thin sections is irregular; size of individual crystals ranges within 20 - 200 μm.

Realised X-ray diffraction procedure (Illášová et

al., 2006) expressed on appropriate diffraction patterns shows any pronounced peaks. The only one wide reflection equal to 22,5^{o} 2Θ, which is equal to obsidians from the Melos and Lipary Islands (the eastern Mediterranean), as well as obsidian from Georgia. Among the analyzed set of obsidians from the European localities (Tab. 1) it is evident, that obsidians from the eastern Tokaj Mts. has the most acid character. So they are derivatives of the proper rhyolitic lavas (Biró et al., 1986; Bigazzi et al., 1990).

Fig. 4. Cut cabochon oval, (sized approximately: 10 x 8 x 5 mm) and cut cabochon – tear (length: 22 mm).

Another way of studied obsidian dressing was simple tromling/tumbling of fragments. Massive fragments that had been freed from surface crust were put into tromling apparatus. The result was excellent and the recovery from the raw material was 90 %. In general, many minerals are convenient for tromling – massive and grainy as well as cryptocrystalline ones. This method is simple and undemanding. As far as obsidians are partially transparent, they can be dressed also as faceted stones and made plates. Convenient shapes are mainly step cuts, less brilliant cuts.

5. Discussion and conclusion

During the last decade of the 20th century and the

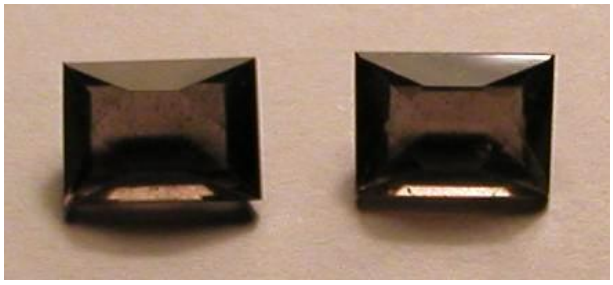

Fig. 5. Step square cut (sized approximately 12x10x5 mm).

Fig. 6. Oval plate (sized approximately30 x 20 x 5 mm)

first years of the 21st, in the European post communistic countries boom of precious stones as well as noble metals (namely gold and platinum) is evident. Elevated demand of precious stones, and jewelry is achieved in general of: a) elevated import of precious stones; b) synthetically made imitations of them, and c) use of new non-traditional precious and semi-precious stones.

Among such nontraditional semi-precious stones belongs also obsidian from the Tokaj Mts. (both on territories of the Slovak Republic as well as of Hungary) occurrences. Till now realised laboratory tests offer data on the appropriate quality of accidentally chosen blocks of obsidian for jewels production. Polished obsidian (mostly of cabochon morphology) in combination with silver and gold resp., are attractive, and what is important, not very expensive. To test the public interest for, from the obsidian made jewelry, several exhibitions of discussed type jewelry in Nitra (Ski) and Turnov (CSV) were organized (Illášová and Turnovec, 2004). Interest of the public was strong, i.e. - almost all presented obsidian-made jewels were sold. Accepting the renaissance of obsidian in a life of society, this raw material belongs to those ones, which have been used since pre-history and is used till present.

Table 3. Gemmological quality of Slovak obsidians

Variety cabochons:	**Pieces**	**Extract**	
	2, 643 g	40,80%	shape tear (15 x 7 x 4 mm)
	1,774 g	24,00%	length of triangle 14, 14 12 mm
	2, 186 g	25,20%	round, diameter 10 mm
	7, 464 g	26,1	round 2 piece diameter 10 mm
	6,038 g	86,7	cabochon 2 piece: round, diameter 10 mm, ovalny 5 x 7 mm
	5,593 g	46,30%	cabochon (4 piece) elipse 5 x 7 mm, 5 x 7 mm; round, diameter 10 mm and 10 mm
Extract in percentage from 4,3 g raw material: from 36 % to 47 %, sporadic different			
Variety fazets:	**Pieces**	**Extract**	
	2,618 g	36,31%	
	1,912 g	23,53%	
	2,28 g	21,35%	
	7,39 g	22,08%	
	6,22 g	44,40%	
	5,721 g	40,13%	
Extract in percentage at fazetes shape (common step square or rectangle) from 4,36 g raw material is from 28 to 49 %, sporadic different			
Flat plates:	500 g	31-57%	

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