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The First Record of Late Miocene Bat from European Russia

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Abstract. A single bone fragment of a Vespertilionine bat was discovered in the rich Late Turolian (MN12-13) vertebrate fauna of Morskaya 2 site near Taganrog (Sea of Azov region). This is the first record of bat remains from Late Miocene deposits of the European Russia. The morphology of the discovered fossil, represented by mandibular fragment with two molars, resembles the recent genera *Vespertilio* and *Eptesicus*. Comparative analysis with recent and fossil species of these two taxa allows us to assign this fossil to *Vespertilio* cf. *villanyiensis*.

Key words: Vespertilionini, Late Miocene, Sea of Azov region, Russia.

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I. INTRODUCTION

Fossil records of Vespertilionidae in European assemblages are very rare until the beginning of the middle Miocene when compared to the common and numerous records of Rhinolophids, Hipposiderids and Megadermatids. There are only few early Miocene deposits in Europe where Vespertilionids predominate: Schaffhausen 1 (Germany, MN1), Sansan (France, MN6) (BAUDELOT 1970, 1972) and a number of sites in the NW Bohemian brown coal basins (MN3-5, Czechia) (HORÁČEK 2001).

The Miocene is a key period in the evolution of the Vespertilionidae. At this time a significant species radiation of this family took place (SIGE & LEGENDRE 1983). Climatic deterioration and pronounced seasonality occured during the late Neogene and disadvantaged most specialized representatives of the Emballonurids and the Mollosids. In contrast, the Vespertilionids apparently profited from the disappearance of these bats by taking a wider range of habitats (HORÁČEK 2001).

The overwhelming majority of Neogene and Quaternary bat records comes from karstic deposits. A rich bat fauna is known from the cave deposits of Podlesice (Kraków-Częstochowa Upland, Poland). This fauna, whose age is Lower Pliocene (early Ruscinian), contains remarkable fossil bat remains representing the family Vespertilionidae (KOWALSKI 1974; WOŁOSZYN 1987).

Bat remains from alluvial deposits are badly documented. Most Quaternary orictocenoses also have karstic origins. The only assemblages of bats from alluvial deposits are known from Pleistocene of Hungary (KRETZOI 1956; TOPAL 1981) and Austria (RABEDER 1973).

Records of bat remains older than Middle Pleistocene were unknown from European Russia until now. Therefore, the discovery of Chiropteran fossil in a fluvial deposit at Morskaya 2 near Taganrog (Sea of Azov region, 47°17.5' N 39°06.0' E) is very important.

The varied and rich vertebrate fauna from the Late Miocene site at Morskaya 2 was recently reported by TESAKOV & TITOV (2003) after extensive excavations and screen washing operations. The mammalian fauna currently includes more than twenty forms, with the rabbit *Hypolagus igromovi* GUREEV 1964 and mice of the genera *Apodemus* and *Occitanomys* dominating. The locality, initially described by V. V. BOGATCHEV (1918), was originally dated to the Late Pliocene (e.g. POPOV 1948; VASILIEV 1969). At present, the faunal composition gives a date of Late Miocene, Turolian, zones MN12-13. This corresponds to the Maeotian-Early Pontian of the Black Sea marine stages.

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II. MATERIAL AND METHODS

The investigated specimen was measured by binocular microscope with ocular micrometer. The 11 measurements were taken to the nearest 0.01 mm. The dimensions of lengths for individual teeth and tooth row: from mesial to distal margins of crowns respectively. The dimensions of tooth width: overall distance from lingual to buccal margins of crowns. During measuring the tooth was oriented with the conids vertical in occlusal view. The abbreviations are $M_{1\text{-}3}$ = length of $M_{1\text{-}3}$; $M_{1\text{-}2}$ = length of $M_{1\text{-}2}$; M_1 = length of M_1; M_2 = length of M_2; CM_1 = length of CM_1; CM_3 = length of CM_3; Hmd = height of corpus mandibulae measured on the lingual side below M_1; trM_1 = width of M_1 trigonid; trM_2 = width of M_2 trigonid; tlM_1 = width of M_1 talonid; tlM_2 = width of M_2 talonid.

Reference material, deposited at the Zoological Museum of Moscow University was used for the comparison of the investigated specimen. We used 11 specimens of *Vespertilio murinus* LINNAEUS, 1758 non SCHREBER, 1775, 11 of *Eptesicus* (*Amblyotus*) *nilssonii* (KEYSERLING & BLASIUS, 1839), 5 of *Eptesicus* (*?Amblyotus*) *gobiensis* BOBRINSKOY, 1926, a single *Eptesicus* (*?Amblyotus*) *bobrinskoi* KUZYAKIN, 1935 and two of *Eptesicus* (*Eptesicus*) *bottae* (PETERS, 1869). The similarly constructed *Hypsugo savii* (BONAPARTE, 1837) was rejected in this analysis because of its distinctly smaller size. Right mandibular branches of fully-grown specimens were used, from which a set of twenty measurements were taken.

Data was processed by the Statistica for Windows 5.1 software package. Numerical data were standardized with respect to dispersion to minimize size influence and then analyzed with Discriminant Function and Principal Component Analysis. In DF the analysed fossil specimen was included as undetermined.

III. SYSTEMATIC PALEONTOLOGY

Order **Chiroptera** BLUMENBACH, 1779

Suborder **Microchiroptera** DOBSON, 1875

Family **Vespertilionidae** GRAY, 1821

Tribe **Vespertilionini** s. str.

Vespertilio cf. ***villanyiensis*** HORÁČEK 1997

Description. The specimen (coll. of Taganrog Pedagogical Institute, TGPI, No M-2/66) is represented by a right lower jaw with damaged ends: the posterior part is broken at the retromolar zone and the anterior part at the level of canine alveolus. The M_1 and M_2 have damaged hypoconide areas (see Fig. 1). Only the roots of the M_3 are present in its alveoli. At the anterior end two P_4 alveoli and one for the P_2 are present. The number of alveoli suggests the whole dental formula of lower jaw is: $I_{\overline{?3}}$ $C_{\overline{1}}$ $P_{\overline{2}}$ $M_{\overline{3}}$.

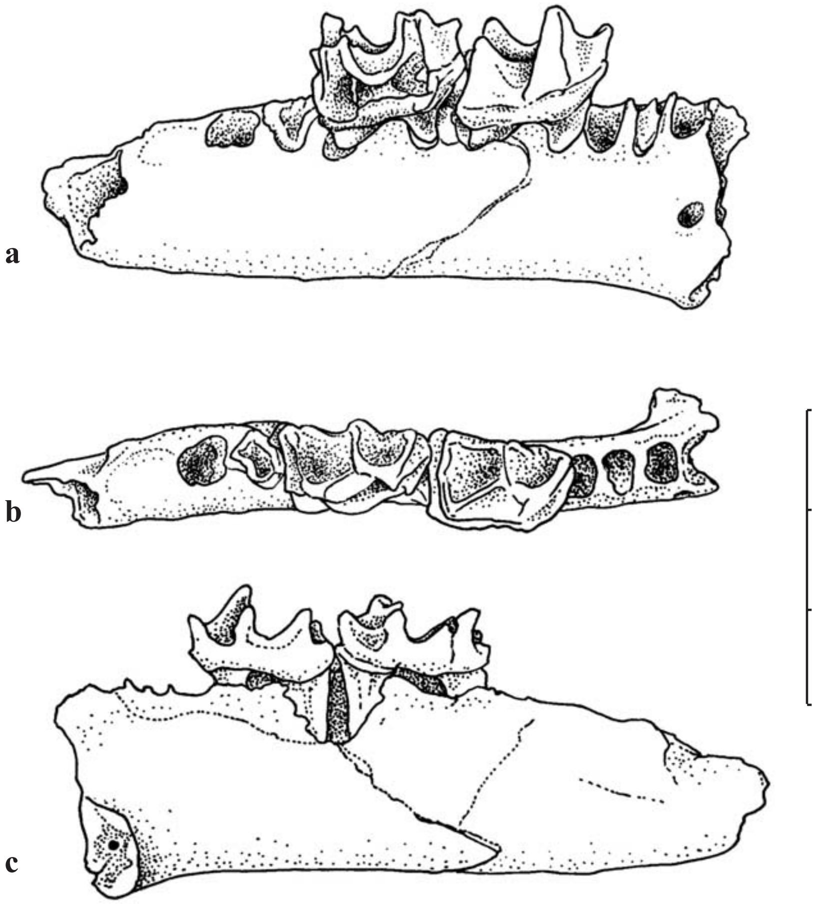

Fig. 1. Lower jaw of *Vespertilio* cf. *villanyiensis:* a – buccal view; b – view from above; c – lingual view. Scale = 3 mm.

P_2: single-rooted apparently conical tooth, probably slightly compressed in antero-posterior direction because of its oval alveolus.

P_4: the alveoli shape suggests that it is a two-rooted tooth with more reduced first root than the second, as in recent *Eptesicus* or *Vespertilio*.

M_1: two-rooted tooth; the second root larger than the first. The trigonid is higher than the talonid but more narrow in occlusal view. The highest cusp in the trigonid area is the protoconid and in the talonid area, the hypoconid. The paralophid is slightly convex in the anterior direction. The hypoconulid looks like a small cingular appendage. The crown is of the obvious myotodont type with a well-developed distinct cingulum. Like in many other representatives of the tribe Vespertilionini s. str., our specimen possesses an M_2 that is almost identical to its M_1 with some minor differences. The length of the M_1 slightly exceeds that of the M_2. The trigonid of the M_2 is more elongated in a bucco-lingual direction, thus in occlusal view it looks shorter but wider than that of the M_1.

The shape of the alveoli of the M_3 suggests that the degree of reduction of this tooth is similar to that of the recent *Eptesicus (Amblyotus)* or *Vespertilio*. In the described sample a part of a mandible symphysis is also included, which begins at the middle point of the P_2. The mental foramen is positioned at the P_2 level, almost at the mid-line of the lower jaw (see Fig. 1a).

Comparison. The following Neogene and early Anthropogene bat species, similar to the recent genera *Vespertilio* and *Eptesicus*, were described from Europe up to the present time: *Paleptesicus priscus* ZAPFE 1950, *Eptesicus campanensis* BAUDELOT 1970, *E. aurelianensis* ZIEGLER 1993, *E. noctuloides* LARTET 1851, *E. praeglacialis* KORMOS 1930, *E. kowalskii* WOŁOSZYN 1987, *E. mossoczyi* WOŁOSZYN 1987, *Samonycteris majori* REVILLOD 1922, *Vespertilio villanyiensis* HORÁČEK 1997 (nomen nov. pro *V. majori* KORMOS 1934 non NINNI 1878), *Hanakia fejfari* HORÁČEK 2001, *Miostrellus riesgoviensis* RACHL 1983, and *M. egeriensis* HORÁČEK 2001. The systematic positions and possible relationships of the majority of these species are not clear and need additional fossil evidence. Unfortunately, the morphological comparison of our specimen with some of the named fossil species is impossible. The lower jaw and teeth of the *Paleptesicus priscus* are unknown (ZAPFE 1950, 1970; HORÁČEK 2001). The last author noted the considerable morphological specificity of *P. priscus* and its possible relations with the recent South Asian genus *Eudiscopus*, which seems to be very distant taxonomically from Eptesicoids (KRUSKOP et al. 2003). *Miostrellus egeriensis* is known from a calvarium, impressed into a clay stone, and a latex cast of the left maxillary row (HORÁČEK 2001). Therefore, comparison of our specimen with this species is also impossible.

Attribution of our specimen to the monotypic genus *Samonycteris*, described from Middle Miocene of Samos Island (Greece) (REVILLOD 1922; ZIEGLER 2002), seems to be very doubtful. The *S. majori* stands out from other European fossil Vespertilionids by lacking an I^2 (MENU 1987) and thus looks similar to recent genera *Scotophylus* and *Nycticeinops*.

The Early Miocene *Myotis*-like species *Hanakia fejfari*, included by HORÁČEK (2001) into the Eptesicini tribe, has three lower premolars, as in *Myotis* and *Plecotus*, and a strongly reduced M_3, like in recent *Eptesicus* s. str. and specially in *Eptesicus serotinus*.

E. campanensis, known from the Middle Miocene of France and Portugal (BAUDELOT 1972; ANTUNES & MEIN 1977), is notably bigger than the specimen from the Sea of Azov region (see Table I). It has robust teeth and a considerably reduced M_3, like in recent *E. serotinus* (HORÁČEK 2001), while the alveoli shape of our specimen suggests the moderate degree of M_3 talonid reduction. *E. kowalskii*, described from Podlesice (central part of Kraków-Częstochowa Upland, Poland), is close in size to the recent *E. serotinus* and *E. campanensis* (WOŁOSZYN 1987).

The Early Pleistocene species *E. praeglacialis* is morphologically similar to the recent *E. serotinus* but somewhat larger. All these forms, and also *E. aurelianensis* from the Lower Miocene of Bavaria (ZEIGLER 1993; HORÁČEK 2001), exceed the Azov specimen in size (see Table I). In contrast, *Amblyotus*-like *E. noctuloides* from the Miocene of France (BAUDELOT 1972) is smaller than our specimen (see Table I).

Table I

The size comparison of recent and fossil species of tribe Vespertilionini

Species	N	M_{1-3}	M_{1-2}	Hmd	C-M_1	C-M_3	M_1	trM_1	tlM_1	M_2	trM_2	tlM_2	Author
cf. *Eptesicus noctuloides*		3.5	2.41.3				1.3	0.75	0.85	1.25	0.76	0.82	HORÁČEK 2001
E. aurelianensis					6.16								HORÁČEK 2001
E. companensis		5.9		2.75		8.6	2.13	1.23	1.38	2.39	1.54	1.51	HORÁČEK 2001, ZIEGLER 2002
E. praeglacialis		5.8-5.7				8.9-8.8							STORCH 1974
E. kowalskii		~5.240	3.763	2.26-2.45	4.2-4.39	~7.53	1.78-189	1.05-1.09	1.23-1.24	1.89	1.14	1.21	own data
Miostrellus riesgoviensis		3.05-3.15				4.23-4.65							HORÁČEK 2001
E. mossoczyi	2	~3.8	~2.5	1.48-1.67	~2.86	~5.63				1.36-1.37	0.85-0.89	0.82-0.89	own data
E. nilssonii	11	3.60-4.10	2.6-2.8	1.5-1.55	3.15-3.3	5.4-5.85	1.30-1.50	0.70-0.80	0.85-0.95	1.25-1.50	0.75-0.85	0.85-0.95	own data
E. gobiensis	6	3.90-4.55	2.65-3.15	1.6-1.65	3.2-3.45	5.75-6.15	1.45-1.50	0.75-0.85	0.90-1.00	1.40-1.50	0.80-0.90	0.95-1.00	own data
Vespertilio murinus	11	3.80-4.55	2.6-2.85	1.6-1.8	2.7-3.15	5.15-5.65	1.35-1.45	0.80-0.90	0.85-0.95	1.30-1.45	0.85-0.90	0.90-1.00	own data
Vespertilio villanyiensis	1	4.37	2.29		3.33	6.25	1.545	0.90	1.04	1.45	0.90	1.04	by HORÁČEK**
Vespertilio cf. *villanyiensis*	1	~3.95*	3.15*	1.85	<3.00*	~ 5.60*	1.60	0.82	0.90	1.65*			own data

* – The measurements for *Vespertilio* cf. *villanyiensis* are approximate because the specimen was reconstructed after damage (for details see in the text).
** – The measurements for *Vespertilio villanyiensis* were kindly given by Professor Ivan HORÁČEK.

E. mossoczyi, the second *Eptesicus* species described from Podlesice, was a smaller form, similar in size to recent *E. nilssonii* (see Table I). However, this fossil species has a number of features which can be interpreted as progressive. As it was supposed by WOŁOSZYN (1987), it is more likely that *E. mossoczyi* represents a separate terminal stage of an extinct phyletic line of *Eptesicus.*

Apparently the lower jaw from the Sea of Azov region looks most similar to the Early Pleistocene species *Vespertilio villanyiensis* from the Hungarian site Villány-Kalkberg (Villány 3 sensu KRETZOI 1956), which is most likely a synonym of *Vespertilio murinus* LINNAEUS 1758 (HORÁČEK 1997). However, the foramen mentale of our specimen and *Vespertilio villanyiensis* (see Fig. 1a) is situated at the mid-line of the jaw branch, in contrast to the recent *Vespertilio murinus*, in which it is usually displaced downward (see Fig. 2). The fossil record of the genus *Vespertilio* is sparse. The only known fossil species differs from the recent *Vespertilio* mainly in the less compressed unicuspid teeth in which it is somewhat similar to *Amblyotis* (HORÁČEK 2001). The latter feature can be seen in our specimen also. The affiliation of the jaw fragment from the Sea of Azov Region to the genus *Vespertilio* is also supported by the results of its comparison with recent Palaearctic representatives of the genera *Vespertilio* and *Eptesicus*.

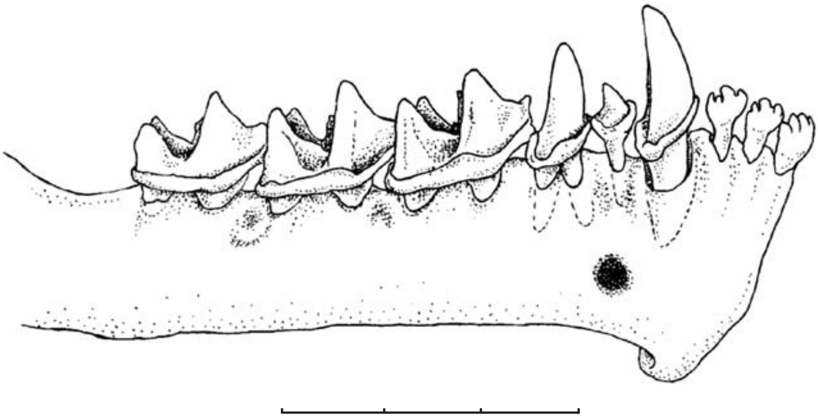

Fig. 2. Position of foramen mentale of *Vespertilio murinus*: buccal view. Scale = 3 mm.

In the scatterplots in Figs. 3-4 the two first Principal Components, and Discriminant Functions of the four recent species *V. murinus, E. nilssonii, E. gobiensis*, and *E. bobrinskoi* are shown together with our specimen (marked as *V.* cf. *villanyiensis*). Unfortunately, no fossil specimens (including the type of *V. villanyiensis*) could be used in the same analysis, since some of the measurements upon them were missing.

In both cases (see Fig. 4) we have two major, well-segregated clusters, formed by the *Vespertilio* and *Amblyotus* specimens, respectively. In the case of the DF analysis (see Fig. 3) specimens of *Eptesicus bottae* are situated outside and at a distance from both of these clusters, however the PCA (see Fig. 4) combined them with *Vespertilio*. In both cases the investigated fossil specimen demonstrates distinctly higher affiliation with *Vespertilio* than with *Eptesicus*. Nevertheless, the Squared Mahalanobis distance of this specimen from recent *V. murinus* (251.75) exceeds that between species of *Eptesicus* (*Amblyotus*) (74.84) and even between *E. nilssonii* and *V. murinus* (188.11), demonstrating a high level of specific distinctiveness.

Based on the morphological data, we suggest that the Late Miocene specimen from the Sea of Azov Region of European Russia most likely belongs to the genus *Vespertilio*.

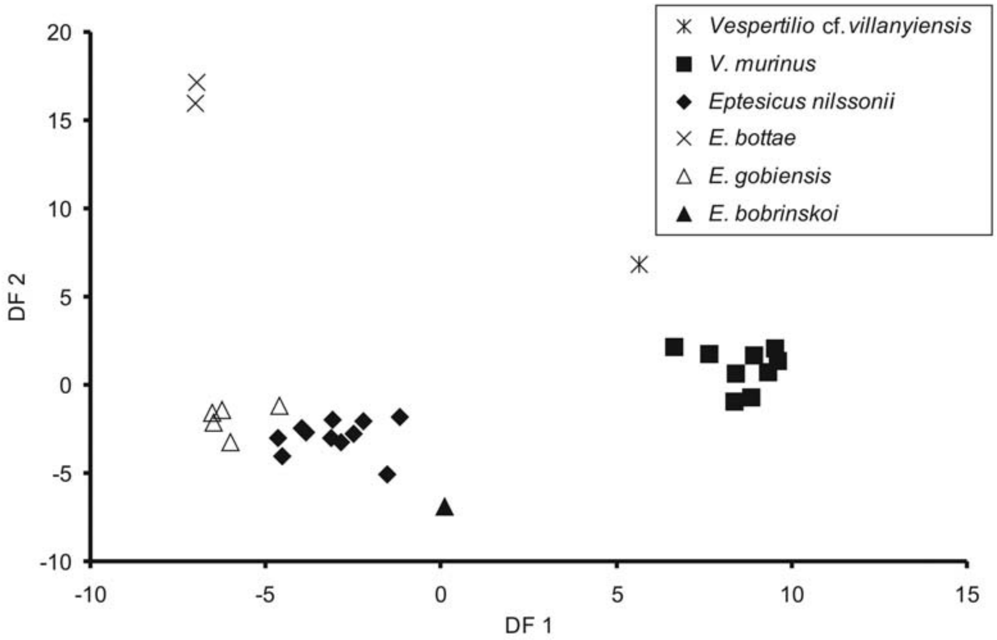

Fig. 3. Scatterplot of the first two discriminant functions for *Eptesicus* species, *Vespertilio* cf. *villanyiensis* and *V. murinus*.

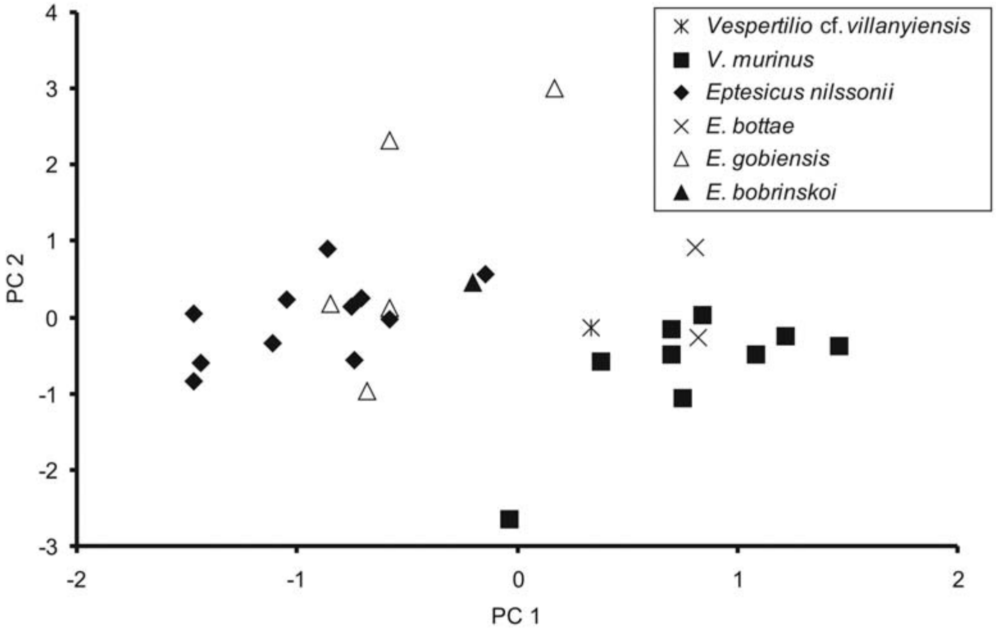

Fig. 4. Scatterplot of the first two principal components for *Eptesicus* species, *Vespertilio* cf. *villanyiensis* and *V. Murinus*.

The Azov specimen *V.* cf. *villanyiensis* looks morphologically similar to *V. villanyiensis*, however, it differs somewhat in certain measurements from the type specimen as described by HORÁČEK (1997). Thus, the length dimensions for the M_2 and the length of M_{1-2} (see Table I) are larger in *V.* cf. *villanyiensis*. But these differences may appear as the result of damage to the Azov jaw between the M_1 and the M_2 (see Fig. 1), which was further reconstructed. Unfortunately, the crown of the M_2 is also defective (see above).

The length of the M_1 of *V.* cf. *villanyiensis* somewhat exceeds that of *V. villanyiensis* (see Table I). We suppose this difference may be the result of intraspecific size variability of individual teeth in the *Vespertilio murinus* group. Unfortunately, more detailed size comparison of *V. villanyiensis* and *V.* cf. *villanyiensis* is impossible because the Azov fossil specimen is quite fragmentary.

Taking into account all that mentioned above, we are unable to ascertain the exact specific affiliation of the Azov specimen, because of insufficient comparative material, thus we are obliged to use an open nomenclature and designate this specimen as *V.* cf. *villanyiensis*.

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