

# **A new Late Villafranchian locality of vertebrate fauna - Slivnitsa (Bulgaria) and the carnivore dispersal events in Europe on the Pliocene / Pleistocene boundary**

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## **Introduction**

The investigations of the Villafranchian mammal faunas on the Balkans are very important for the clarification of the faunal dispersal events in Europe on the Pliocene / Pleistocene boundary. Up to now, these faunas have been practically unexplored in Bulgaria. Two new and very rich Villafranchian localities were discovered recently in this country - of Varshets (MNQ17) with 19 large mammalian species and of Slivnitsa (SPASSOV, 1997). They give us some important faunal and zoogeographical information.

## **Slivnitsa site and its fauna**

The site is a former cave in a limestone quarry. The latter is situated in a hilly carst area („Kozyaka“) within 30 km NW of Sofia, in close vicinity to the western part of the town of Slivnitsa.

The fauna is represented by the remains of 20 bird species (Dr Z. Boev, National Museum of Natural History - Sofia, pers. comm.), by rodents (Dr V. Popov, Institute of Zoology - Sofia, pers. comm.) and by Macromammalia. The mammalian megafauna (Table 1) has been studied on the basis of about 900 discernible bone fragments. The Bovidae taxons have been determined by Spassov and Cregut-Bonnoure and the rest - by Spassov. The gathering of Bovidae remains (9 species at least) and especially of Caprinae - 7 species at least from practically all genera known in Europe from that time is unique. These remains are particularly valuable for the investigation of the poorly studied villafranchian Caprinae fauna of Europe. Among the remains Bovidae dominate markedly over Cervidae.

Table 1

**Check-list of the Villafranchian large mammals from the Slivnitsa site (Bulgaria)**

**?PRIMATES**

**aff. Cercopithecidae**

? *Papio* (*Paradolichopithecus*) *arvernensis* aff. *geticus* (Necrasov, Samson, Radulesco, 1961)

**CARNIVORA**

**Canidae**

*Canis* ex gr. *etruscus* Major, 1877

*Vulpes* cf. *alopecooides* Major, 1877

**Mustelidae**

*Meles thoralis* Viret, 1951

Lutrinae gen.

**Hyaenidae**

Hyaenidae gen. (non *P. brevirostris*)

**Felidae**

*Panthera* cf. *gombaszoegensis* (Kretzoi, 1938)

*Homotherium crenatidens* (Fabrini, 1890)

**ARTIODACTYLA**

**Cervidae**

*Cervus rhenanus* Dubois (= *C. philisi*) - „*Dama*“ *nestii*

*Eucladoceros* cf. *senezensis* ? *senezensis* (Deperet, 1910)

**Bovidae**

*Gazellospira* cf. *torticornis* (Aymard, 1854)

*Procamptoceras* cf. *brivatense* Schaub, 1923

*Gallogoral meneghinii* (Rutimeyer, 1878)

*Pliotragus* cf. *ardeus* (Deperet, 1883)

*Megalovis* sp.

*Hemitragus* sp. nov.

*Ovis* sp.

Bovidae gen. et sp. indet.- I

Bovidae gen. et sp. indet.- II

**PERISSODACTYLA**

**Equidae**

*Equus* cf. *stenonis* Cocchi, 1867

**Biostratigraphic analysis of the fauna**

The fauna of Slivnitsa shows similarities with a number of well-known West-European sites from the beginning of the Pleistocene, for example those from the Olivola unit. The fauna of Slivnitsa shows a particularly close similarity to that of Seneze. The most recent analyses place Seneze together with the sites dated from the final phase of the Pliocene rather than from the beginning of the Pleistocene (TORRE et al., 1993; BOEUF, 1997). However, this is not in contradiction with its being taken as a mark of the MNQ18 zone.

The data from the analysis of the rodents from Slivnitsa show the absence of true (hypsoodont) field-voles and the presence of their Pliocene ancestors. The

tooth-morphotypes of the *Mimomys tornensis* correspond to an evolutionary stage placed probably just before the Pliocene / Pleistocene boundary (V. Popov, pers. comm.). This data places Slivnitsa in the Final Pliocene rather than in the beginning of the Pleistocene and as it seems, before the Olivola unit which begins approx. 1.7 - 1.64 million-year (AZZAROLI, 1983; TORRE et al., 1993). This circumstance, together with the characteristics of the mammalian megafauna (the prevalence of the Bovidae over the Cervidae; the presence of the *Panthera* s. str. and the *Canis* s. str. genera), gives us an opportunity to establish fairly close time limits within which the fauna from Slivnitsa site may be placed. At the same time this shows that some faunal phenomena, often taken as characteristic for the beginning of the Pleistocene in Europe (BONIFAY, 1990; TURNER, 1992), started in fact as early as the end of the Pliocene. These are the proliferation of the Bovidae (Caprinae) faunas as well as the entering into the continent of the *Panthera* and the *Canis* genera from the East. The faunal closeness between Slivnitsa and Seneze sites indicates again that the fauna, characteristic for Seneze („Seneze faunal unit“ of TORRE et al., 1992), should be placed at the end of the Pliocene but at the beginning of the Late Villafranchian.

In the period between St.-Vallier / Varshets and Seneze / Slivnitsa the aridity has led to the large-scale invasion of the Bovidae (Caprinae) mentioned above. With the appearance of some single species (for example *Pachycrocuta brevirostris*), the image of this more „steppe“ succession has only been confirmed between Seneze and Olivola. From the point of view of the biozonation of the fauna, a biozone MNQ18-A (end of the Pliocene - beginning of the Late Villafranchian) may be established for the Slivnitsa / Seneze faunal unit and the Olivola unit should represent a MNQ18-B (the Pliocene / Pleistocene boundary) rather than the MNQ19 in which the Tasso faunal unit should be placed (SPASSOV, in press) (Fig. 3a). Slivnitsa will be placed more precisely in the first part of MNQ18-A: in MNQ18-A1 (pre-Olduvai cooling). The MNQ18-A2 could include the Olduvai episode (warming): sites Valea Graunceanului, Romania (Fig. 3b) (The biochronological position of the included in fig. 3b SE European localities will be discussed in a separate paper).

### **The *Canis* and *Panthera* remains**

From biostratigraphic point of view the remains of members of the *Canis* and *Panthera* genera in the Slivnitsa fauna are of particular interest.

#### ***Canis ex gr. etruscus* Forsyth Major, 1877**

**Material:** right upper C1 (SL100); right lower C1 (SL106); fragment (with preserved paracona and metastyl crista of a right upper P4 (SL104); distal fragment of a lower P4; tibia - dist. (SL103) (Fig. 4).

**Comparison and discussion.** Both the stratigraphy of Slivnitsa and the dimensions (Tables 2-4) and / or the morphology of the remains show that they do not belong to any of the known Early Pliocene canids and that here we have *Canis sensu stricto*.

Table 2  
**Canis - dimensions of the P<sup>4</sup>**

	Length of metastyle crista	Breadth of metastyle crista
<i>C. lupus</i>		
(NMNH - Sofia)		
No 888 ♀	8.0	10.6
No 892 ♀	8.9	8.8
No 894 ♀	9.0	8.9
No 890 ♀	8.3	9.4
No 895 ♀	8.8	8.6
No 899 ♀	8.8	9.0
No 889 ♂	10.2	11.3
No 243 ♂	9.7	10.1
No 885 ♂	8.8	9.6
No 887 ♂	8.9	10.2
No 897 ♂	9.7	11.2
<i>C. latrans</i> ♀		
(NMNH - Sofia)	7.1	7.3
<i>C. arnensis</i> (type)		
Slivnitsa (SL104)	8.6	9.4
<i>C. mosbachensis</i>		
(Sotnikova, 1989)		
Lakhuti - 2	-	8.0 ; 8.1
<i>C. etruscus</i>		
(col. Univ. - Lyon)		
No 211751	9.0	8.6
No 212940	9.0	8.0

Table 3  
***C. etruscus* - dimensions of the tibia**

	Distal breadth
Slivnitsa	23.1
<i>C.e.mosbachensis</i>	
Escale (Bonifay, 1971)	
CD 625	22.1
CD 1232	19.8
E 2770	20.7
H 940	20.0
H 1034	20.3
H 1038	20.8
H 1707	20.5
H 3348	18.8
H 3349	19.3
H 7261	21.2
German Shepherd Dog - ♀	27

The lower canine corresponds to the smallest specimen from Slivnitsa and may belong to a *C. arnensis*. The upper P4 and possibly even the upper C1 correspond, as it seems, to large animals - weighing about 30 kg (one and the same specimen ?) - which does not exclude their belonging to a small *C. falconeri*. However, the tibia

is small for the latter species and big for the former one. The tibia together with the lower P4 should be of *C. etruscus*, and seems to fall within the limits of the individual variability of this species together with all the other remains. It is not impossible that the different remains belong to two separate species (see the next Chapter), but it is more reasonable to presume that in this case all remains belong to *C. etruscus*. The considerable dimensional differences between the individual remains may be explained by sexual dimorphism.

**The history of the Canis genus in Europe: Slivnitsa and the „Canis event“.** With the *C. cipio* Crusafont, 1950, the existence of the *Canis* genus in Europe as early as the Late Miocene was accepted as well established until quite recently. The history of the genus in the Ruscinian fauna on the continent was

Table 4  
Dimensions of the upper and lower canines in different *Canis* species

	Mesiodistal Diameter	Vestibulo-lingual Diameter
<b>C<sup>1</sup></b>		
Slivnitsa - SL 100	11.3	7.4
<i>C. etruscus</i> (Italy)		
Col. Lyon 21175	10	5.7
Col. Lyon FSL212940	10.7	6.3
<i>C. etruscus</i> - Greece (Coufos, Kostopoulos, 1997)	11.0	6.8
<i>C. (Xenocyon) spelaeoides</i> (Musil, 1971)	14.1-16.2	8.7-11
<i>C. lupus</i> - Bulgaria ♂♂ + ♀♀ (n = 10)	13.3 (12.5-14.4)	9 (8.0-9.4)
<i>C. arnensis</i> (type)	9.6	6.6
<i>C. arnensis</i> - Greece (Coufos, 1987)	9.8; 9.8	5.8; 5.8
<b>C<sub>1</sub></b>		
Slivnitsa - SL 106	10.0	6.1
<i>C. arnensis</i> (type)	10.4	6.3
<i>C. arnensis</i> - Greece (Coufos, 1987)	9.3	7.2
<i>C. neschersensis</i> (type) ( <i>C. e. mosbachensis</i> )	10.4	6.5
<i>C. lupus</i> - Bulgaria ♂♂ + ♀♀ (n = 5)	12.9 (12.2-14.2)	-

associated with such forms as *C. adoxus* Martin, 1973 (accepted by some authors as *Vulpes*), *C. michauxi* Martin, 1973, and even with the enigmatic „*Vulpes*“ *odessana* Odintzov, 1967. Most recently, the Early Pliocene „*Canis*“ from Central Asia was separated in the more primitive genus *Eucyon* Tedford et Qiu, 1996 (also including the Turolian „*C.*“ *monticensis* Rook from Italy and the „*V.*“ *odessana*). At the same time, as it seems, the other European pre-Villafranchian *Canis*-like forms will also turn to be close to but different from *Canis* (ROOK, 1992; TORRE et al., 1992; TEDFORD & QIU, 1996). If the other not very well known *Eucyon*-like forms such as those of *C. adoxus* and *C. michauxi* really turn out to be different from *Canis* s. str., we will have to accept that *Canis* made its way to Europe only at the begin-

ning of the Late Villafranchian - the so called „*Canis* event“.

The earliest positive appearance of *Canis* s. str. (*C. etruscus* s. str.) up to now is in Olivola (TORRE et al., 1992; ROOK & TORRE, 1996). It is quite possible that the somewhat later *C. mosbachensis* is just a subspecies of the above species.

Until now, the first appearance of *Canis* sensu stricto in Europe - the so called „*Canis* event“ (AZZAROLI, 1983; TORRE et al., 1992; TURNER, 1992), associated with the rush of the Asian wave of coyote/wolf-like *Canis* - was earliest detected in Seneze and in Costa S. Giacomo („Seneze faunal unit“) and most clearly in the somewhat later „Olivola unit“. (As judged from the teeth-dimensions, the elongated rostrum and the big diastema between the teeth, the problematic *C. senezensis* Martin may turn out to be identical with *C. etruscus* rather than *C. arnensis* Del Campana. Stratigraphically Seneze is placed earlier than Tasso where *C. arnensis* appears. However, it should not be forgotten that KOUFOS (1987) identifies the canid from Gerakarou as a *C. arnensis*. The fauna of this site is biochronologically close to that of the sites from the „Olivola unit“ and is obvi-

ously older than that of Tasso).

It is true that Kurten and Crusafont Pairo registered the presence of *C. falconeri* earlier - in P. de Valverde (MNQ17) - by the presence of one upper P3 and several other tooth-fragments. However, Masini and Torre followed by ROOK (1994) have had some doubts as to the belonging of these fragments to *C. falconeri*. In our opinion, the remains have been really falsely determined. In fact, the tooth assumed as P3 may be interpreted as a lower P4.

It should be also noted that the find from Costa S. Giacomo is of a not very certain stratigraphic position and probably not earlier than that from Olivola (?). The stratigraphic place of Seneze is still disputable. A number of authors distinguish two stratigraphic levels in this site (Dr V. Eisenmann, Mus. Nat. Hist. Natur., Lab. Pal. - Paris, pers. comm.). However, we have to point out that according to the most recent studies - including our comparisons - the main (earliest) level of Seneze belongs to the final phase of the Pliocene (BOEUF, 1997) and is comparable to Slivnitsa.

Considering the disputable points mentioned above, it may turn out that Slivnitsa is probably the earliest site marking the Late Villafranchian „*Canis* event“ in Europe. At the same time it places the rush in Europe of the small wolf-like primitive forms from the East in the final phase of the Pliocene rather than in the Early Pleistocene. We should also point out, that Seneze can be included in the final Pliocene, but not in the MNQ17, as it was noted by ROOK & TORRE (1996). So, the first appearance of *Canis* s. str. (Slivnitsa / Seneze is in MNQ18-a, see Chapter Biostratigraphy).

### *Panthera cf. gombaszoegensis* (Kretzoi, 1938)

**Material** (Col. Nat. Mus. Natur. Hist. - Sofia): left femur dist. (SL107); left tibia dist. (SL102). Provisionally we may also add here tibia prox. and epistropheus (Fig. 5).

Table 5  
*P. gombaszoegensis* - dimensions of the tibia

	Max. distal breadth	Max. antero- posterior diameter - distal extremity
SL 102	43.4	27.2
<i>P. onca</i> ♂	45.6	27.4
<i>P. pardus</i> ♂	36.0	25.7
<i>P. pardus</i> ♀	33.6	22.6
<i>P. pardus</i> ♀	30.0	19.6
<i>Megantereon</i> (Seneze)	47.6	≈ 30.0
<i>Acinonyx perrieri</i> (Mus. Bale) 1949 - 13/51	39.5	30.0

**Comparison and discussion.** The remains are clearly distinguished from Hyaenidae and Ursidae and bear felid features. Most probably, these are remains of one and the same specimen - presumably a female - recently grown up with an approximate weight of 85-90 kg (Table 5, 6).

- COMPARISON WITH  
MEGANTEREON MEGAN-  
TEREON (a specimen from

Table 6  
*P. gombaszoegensis* - dimensions of the femur

	Distal breadth in condyles	Distal length in the medial condyle	Distal length in the lateral condyle
Sl 107_	53.2	54.7	50.6
<i>P. onca</i> ♂			
NMNH - Sofia / M612	55.4	57.1	55.4
<i>P. pardus</i> ♂			
NMNH - Sofia	45.0	47.0	48.6
<i>P. pardus</i> ♀			
NMNH - Sofia / M881	44.3	41.8	42.9
<i>P. pardus</i> ♀			
NMNH - Sofia / M715	39.0	37.7	39.3
<i>Megantereon</i> (Seneze)	63.7	-	-
<i>Acinonyx perrieri</i>			
(Mus.Bale) 1949 - 13/50	55.5	-	-

Seneze, Basel  
Museum of  
Natural History):

**The femur of  
*Megantereon*.**

In spite of the wider distal extremity, the trochlea is narrower even in absolute dimensions. In spite of some deformations of the fossil bone, it is notable that the trochlea

is narrowing in proximal direction in contrast to the case of SL107. As a result of this and because of the bigger width of the area of the condyls, the distal surface of the bone has a subtrapezium-like shape with a very broad base. The condyls are more asymmetrical and the medial one projects more in caudal direction (Fig. 1, C).

**The tibia dist. of *Megantereon*.** It differs from SL102 by the existence of a longitudinal crest instead of tuberculum on the caudal surface just above the lateral joint facette of the cochlea and by the existence of two instead of three longitudinal crests on the caudo-mesial surface just above the joint (Fig. 2, A). The medial of the tree crests in *Panthera* may vary in size and is often strongly reduced but still present.

- COMPARISON WITH *ACINONYX PARDINENSIS* (a specimen from Perrier; a cast, coll. MNHN - Paris):

**The femur of *A. pardinensis*.** The trochlea is narrower, taller and more concave. A longitudinal crest for muscles insertion is formed on the lateral surface

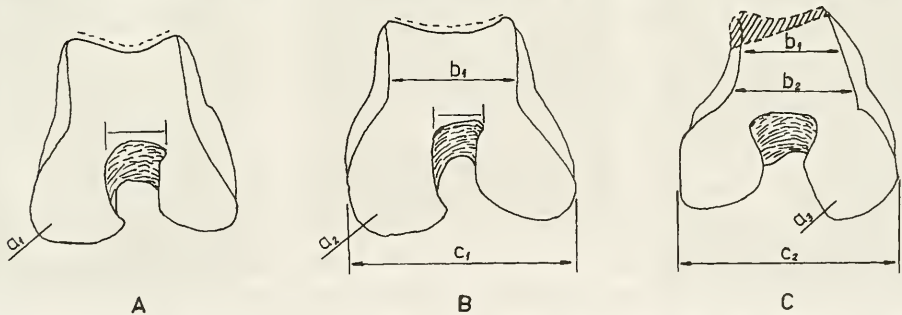


Fig. 1. Femur, distal view: A - *Acinonyx pardinensis* (sketch after the Seneze specimen); B - Slivnitsa (No. SL 107) ; C - *Megantereon megantereon* (= „*M. cultridens*“) (sketch after the Seneze specimen); a1 - a3 - condylus medialis,  $b_1 > b_2 > b_3$ ,  $c_1 < c_2$

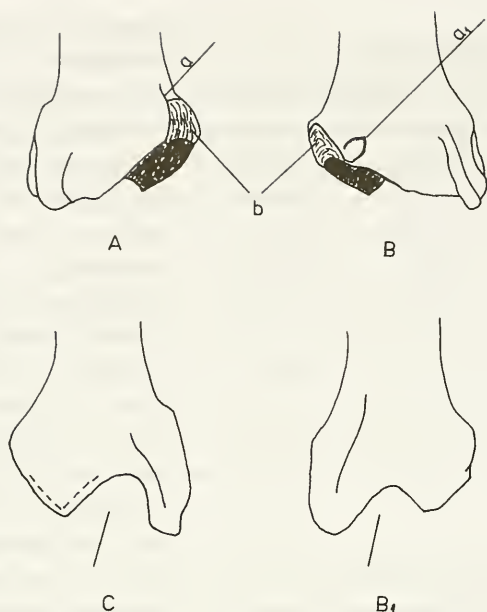


Fig. 2. Tibia, distal part. Caudal view: A - *Megantereon megantereon* (sketch after the Senezé specimen); B - Slivnitsa (No. SL 102); a - crista, a1 - tuberculum, b - fibular facet. Cranial view: C - *Acinonyx pardinensis* (sketch after the Senezé specimen); B1 - Slivnitsa (No. SL 102)

cranial surface of the distal end (mesial in respect to malleolus medialis) is very broad (Fig. 2, C).

#### - COMPARISON WITH PANTHERA:

The features of both bones are very similar to those of the *Panthera* genus species. The tibia particularly resembles that of the tiger but has a more developed supratrochlear tuberculum (see above, Fig. 2, B). The femur has mixed features - of a lion and of a jaguar (however, according to Hemmer, the tooth-features of *P. gombaszoegensis* also show such mixed characteristics). The leopard is distinct to a very great extent from SL107, particularly regarding the proportions between the medial and the lateral length of the femoral distal end (the development of the trochlear rims).

As judged from one deteriorated fragment from La Breche de Chateau, the shape of the trochlea in *P. gombaszoegensis* is very similar to that of SL107.

The remains may be assigned to the smaller and older Villafranchian subspecies of *P. g. toscana*. Up to now, only the scarce remains from Escale, La Breche de Chateau (France) and Palan-Tiukan (Azerbaijan), as well as a rather uncertain remain from Laetoli (Tanzania), are associated with the postcranial skeleton of *P. gombaszoegensis*. Judging from the remains from Slivnitsa, the Villafranchian form was a rather slender and running steppe form.

above the condylus lateralis. The distal end is longer in the cranio-caudal direction. Fossa intercondylaris is wider (Fig. 1, A). (These features are also similar in the contemporary cheetah). The diaphysal part of the bone is more delicate.

**The tibia of *A. pardinensis*.** The tuberculum on the caudal surface, above the lateral facette of the cochlea existing in SL102 (Fig 2, B) is practically absent here (it is quite weak in the recent cheetah). The surface of the joint has different proportions - smaller mesio-lateral and bigger cranio-caudal diameters than those of SL102. The incisura on the



**The Slivnitsa site and the early migration of the *Panthera* genus.** As it seems, Slivnitsa marks the earliest presence of *P. gombaszoegensis*. The latter was registered in Tegelen (2.2 - 1.7 million years) but it seems to come from the upper strata (TURNER, 1992). Until now, the earliest more certain find of carnivore of prey was from Olivola, Italy (the beginning of the Early Pleistocene) (TORRE et al., 1992; TURNER, 1992). This leads us to the suggestion that it is possible to register even though a bit earlier some migration phenomena from the East in Eastern or South-Eastern Europe.

### Conclusions

As it seems (SPASSOV, 1997), Slivnitsa falls into the temporary cooling - known in Georgia as „the Meria cooling“ - registered within the boundaries of the Beregovka warming (2 - 1.82 million years) (ZUBAKOV & BORZENKOVA, 1990). Some data imply that a refreshing of the Black Sea waters took place during the Meria. This suggests a temporary closing of the Bosphorus. The subsequent faunal contact with Asia Minor may be one of the reasons for the high concentration of Caprinae species in Slivnitsa as well as for the appearance of *C. ex. gr. etruscus* and *P. cf. gombaszoegensis*. Probably Slivnitsa marks the earliest presence of *Panthera* s. str. in Europe and the first presence also (together with Seneze) of *Canis* s. str. on the continent. This fact could be explained by the geographical situation of Bulgaria - on the frontal position of the migratory route from the East via the Bosphorus.



Fig. 4. *Canis ex gr. etruscus*: A - canines SL 100 (labial view), SL 106 (lingual view); B - upper P<sup>4</sup> fragment - SL 104 (lingual view)

Fig. 5. *P. gombaszoegensis*: femur distal, lateral view

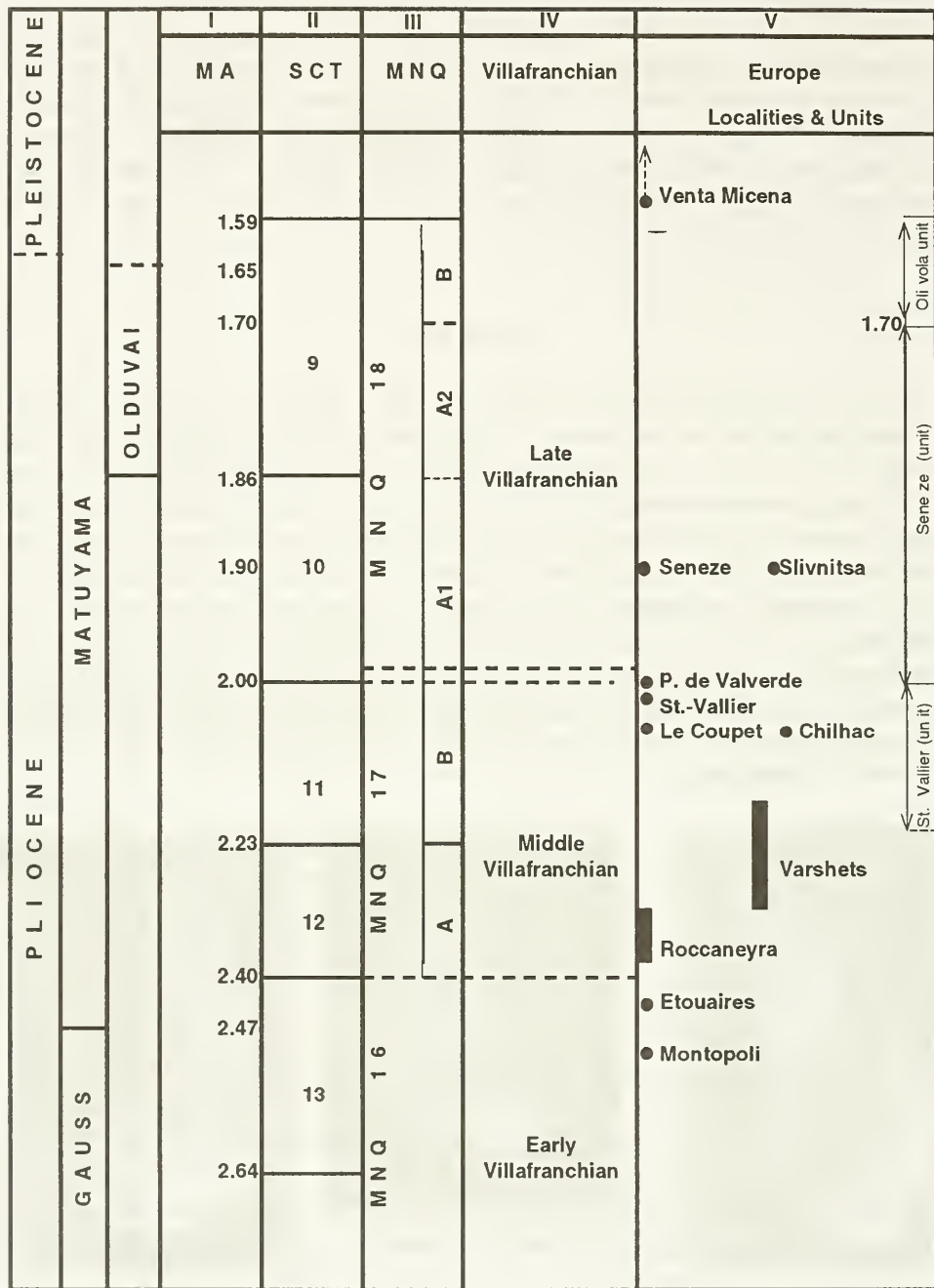


Fig. 3A. Biochronology of the Late Pliocene - Early Pleistocene events of W Europe (author's view on the basis of the correlation table in SPASSOV, 1997; in press)

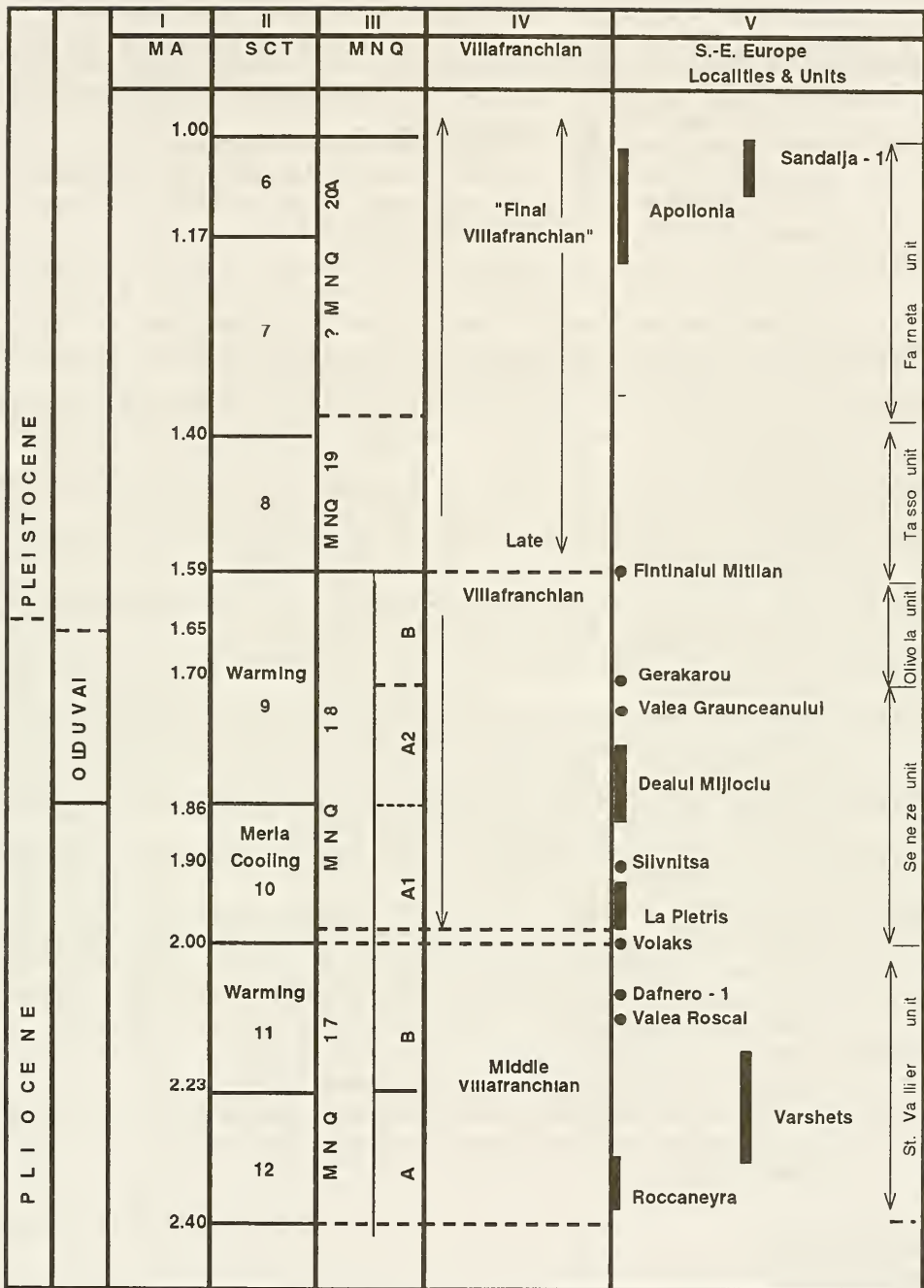


Fig. 3B. Biochronology of the Late Pliocene - Early Pleistocene events of SE Europe (author's view)

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# Сливница: ново късновилафранкско находище на гръбначна фауна и разселването на хищниците в Европа от изток на границата между плиоцена и плейстоцена

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(Резюме)

Наскоро бе открито богато вилафранкско находище в карстова каверна край Сливница (м. Козяка). То дава важна фаунистична, зоогеографска и биостратиграфска информация.

Фауната на кучорогите (особено *Caninae*) е изключително богата в таксономично отношение. Представени са почти всички известни от това време родове от това подсемейство. *Bovidae* доминират определено над *Cervidae*. Това е индикация за преобладаване на откритите ландшафти. Същевременно това обстоятелство и други данни свързани с таксономичния състав поставят Сливница много близо до известното находище *Seneze* (Франция). Можем да поставим Сливница в началото на късния вилафранк, но заедно с това в края на плиоцена (*Seneze unit*). Биостратиграфската единица *Seneze unit* би трябвало да бъде поставена в зона *MNQ18*, преди *Olivola Unit* и същевременно преди епизода *Olduvai*. Можем да я означим като *MNQ18-a1*.

В настоящата работа са описани останки от *Panthera gombaszoegensis* и *Canis ex gr. etruscus*. Плиоценската възраст на Сливница, в която присъстват тези хищници, показва, че явлението на разселването им от изток в Европа започва не в началото на плейстоцена (както е прието да се мисли), а още в края на плиоцена. Останките от *Panthera s.str.* са изглежда първите на континента - обстоятелство, което може да бъде обяснено с географското положение на страната на предна позиция в зоната на миграции. Именно по това време започват масови миграции на бозайници от Азия с вероятно временно затваряне на Босфора. То е свързано със захлаждането, регистрирано в климатохронологичната зона *SCT10*, в която попада Сливница.