Newsl. Stratigr.	33 (2)	77–97	4 Fig., 3 Tab.	Berlin · Stuttgart, 8. 2. 1996

Ruscinian of the territory of the former Soviet Union

by M. A. Pevzner, E. A. Vangengeim, I. A. Vislobokova
M. V. Sotnikova and A. S. Tesakov*

with 4 figures and 3 tables

Abstract. Stratigraphic succession and position in the magnetochronological scale have been established for 22 reference localities of the Ruscinian mammals situated on the territory of the former Soviet Union (FSU). The oldest faunas (beginning of the MN 14) occur in Western Siberia. In the European part of the former Soviet Union the oldest faunas are correlated with the middle part of the MN 14 zone. Most of the localities belong to the end of zone MN 14 and to the zone MN 15.

At the boundary of zones MN 14 and MN 15 changes in quantitative ratios of mammals are observed. An important faunal event took place within the MN 15 zone. A number of form appeared at this time; they subsequently underwent intense development in the Villafranchian.

East European faunas have much in common with faunas of the Central Europe and Eastern Mediterranean. Faunas of Western Siberia and Northern Kazakhstan were more influenced by Asian centers of evolution.

Introduction

Finds of mammalian remains from the Early Pliocene (the Ruscinian) deposits of the FSU have been known since the end of the last century. However, until recently the Ruscinian of this region had been only poorly studied. In correlation tables published recently (Table 1) no more than 10 localities for the territory of the FSU are normally listed (Mein 1990, De Bruijn et al. 1992).

The purpose of the present work is to present new data obtained by the authors and by other researchers, and to define the stratigraphic position and geological age of some previously known localities.

The Ruscinian is very unevenly distributed in the territory of the FSU. Most localities (about 60) are concentrated in the south of the European part, but most of these have yielded only isolated or scanty mammalian remains. Only a few localities have substantial faunistic lists.

The second group of localities (about 20), with mainly remains of small mammals, was discovered in recent years in the Asiatic part of the FSU, in Kazakhstan and in the south of West Siberia. A single site in Eastern Siberia was found on the island of Olkhon in Lake Baikal.

* Authors' addresses: M. A. Pevzner, M. V. Sotnikova, A. S. Tesakov and E. A. Vangengeim, Geological Institute Ran, Pyzhevsky per. 7, 109017, Moscow, Russia.
I. A. Vislobokova, Paleontological Institute RAN, Profsoyuznaya 123, 117647, Moscow, Russia.

0078-00421/96/0033-0077 $ 5.25
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Table 1 Stratigraphic postion of Ruscinian mammal localities after different researchers.

MN	MEIN, 1990	De BRUIJN et al., 1992	This paper	
			European part of FSU	Asian part of FSU
15			Odessa (Catakombs) Kotlovina (l.h.) Etuliya (m.h.) Luchesty VII Etuliya (l.h.)	 Andreevka Biteke (Algabas.)
	Kagul Odessa (Catakombs)			
			Budey Musait 5	Nizhn. Ilyinka
14			Obukhovka	
	Kuchurgan Kamenskoe Antipovka	Kuchurgan Kamenskoe Antipovka	Grebeniki 2 Antipovka	Peshnevo
	Chugunovka Frunzovka		Nov. Andriashevka Chugunovka	Olkhon (Saraiskoe, hor. 4)
		Kosiakino		
	Kosiakino			Cherlak Novaya Stanitsa

It should be noted that almost for all the faunas there are no monographic descriptions. Only some groups of mammals have been monographically described.

Localities in the European part of the FSU

Most of sites are situated in north-western margin on the Black Sea (Fig. 1) and are associated with deposits of Pliocene fluvial plains. They are located between rivers Prut and South Bug (Fig. 2) and occur in the Stol'nicheny, Kuchurgan, and Karboliya fluviatile deposits. These deposits are preserved on most elevated parts of watersheds; only in the southern region of Prut River do they lie below sea level (VANGENGEIM et al. 1995).

The Stol'nicheny fluviatile deposits occur between the Prut and Dniester Rivers and consist chiefly of small and medium-size quartz sands with lenses of clays, silts, gravel, and pebbles. They rest on various levels of the continental Balta Formation* or (in southern regions) upon marine deposits of the Lower Pontian. The maximum thickness of the Stol'nicheny deposits is 40–50 m. Mammalian remains are very rare in these deposits. Isolated finds of large mammals allowing no specific determinations are known here: *Dicerorhinus* sp., *Hipparion* sp.,

* The Balta Formation consists of continental clayey and sandy deposits of the Miocene fluviatile plain, which ranges in age from upper Middle Sarmatian up into the Meotian.

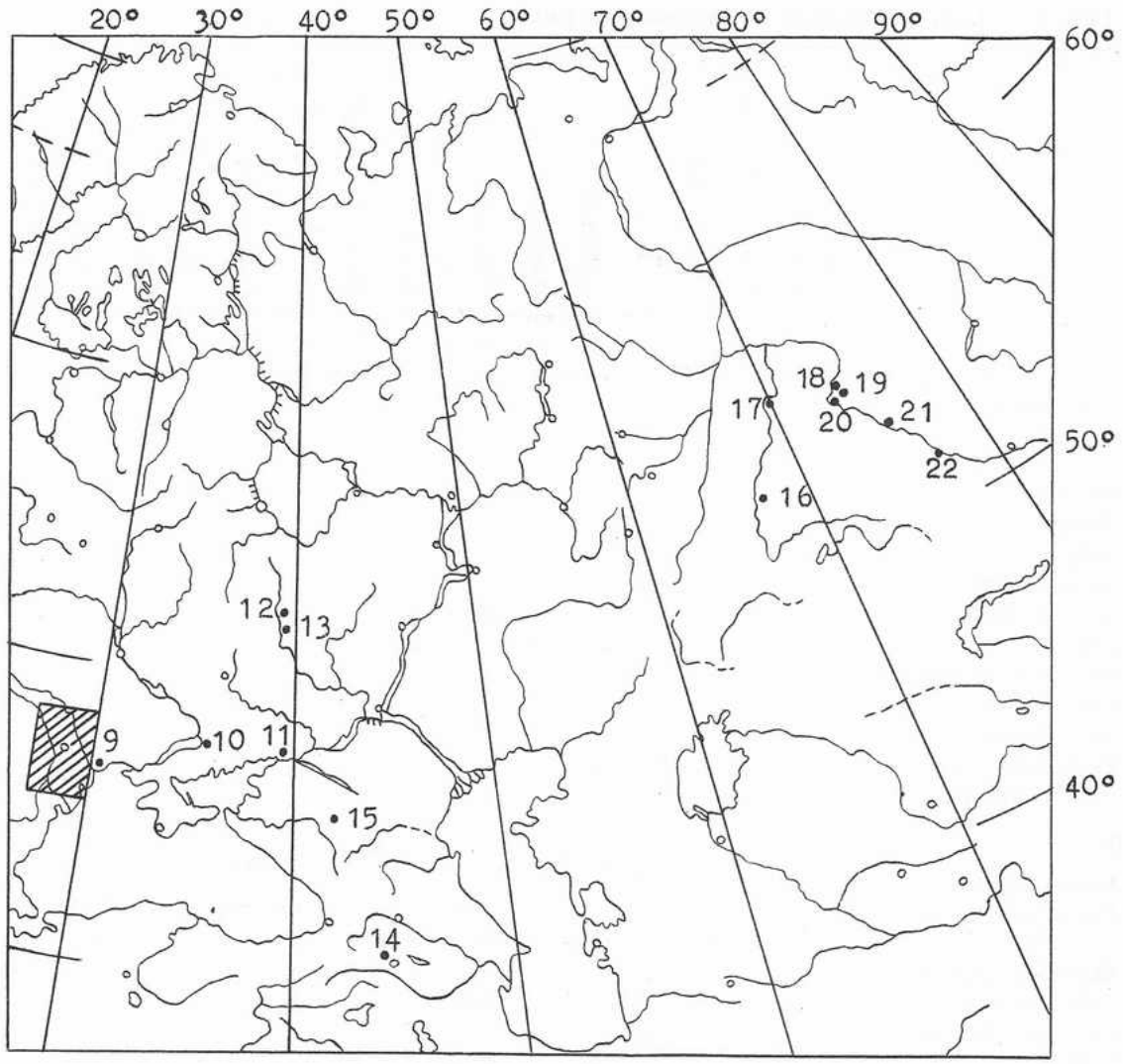


Fig. 1. Main localities of Ruscinian mammals: **9** – Odessa (catacombs); **10** – Kamenskoe; **11** – Obukhovka; **12** – Antipovka; **13** – Chugunovka; **14** – Nurnus; **15** – Kosiakino; **16** – Biteke; **17** – Peshnevo; **18** – Nizhnjaya Iljinka; **19** – Andreevka; **20** – Novaya Stanitsa; **21** – Cherlak; **22** – Pavlodar.
Mammalian localities from the hatched rectangle are shown in Figure 2.

Cervidae (*?Pliocervus*), *Gazella, Proboscidea*. We managed to collect a restricted small mammal assemblage from the Mugureny locality (Fig. 2, Table 2).

The Kuchurgan fluviatile deposits are confined to the watershed of Dniester and South Bug Rivers and are exposed mainly on the flanks of Kuchurgan Valley. These deposits consist of medium and fine grained sands with abundant lenses of gravels and pebbles and rare clay lenses. They lie on deposits of various parts of the Balta Formation. Their thickness reaches 10 to 15 m. These deposits contain remains of large and small mammals, shells of fresh-water molluscs are rare. In the literature a number of localities associated with Kuchurgan deposits have simply been termed "Kuchurgan" (Dubrovo & Kapelist 1979, Gabunia 1981, Mein 1990,

Table 2 List of mammals of the FSU european part.

	Mugureny	Nov. Andriashevka	Chugunovka	Antipovka	Grebeniki 2	Musait 5	Obukhovka	Budey	Musait 7	Etulia (l. h.)	Etulia (m. h.)	Lucheshty VII	Kotlovina (l. h.)	Odessa	(Catacombs)
	6	7	13	12	8	3_1	11	4	3_2	1_1	1_2	5	2	9_1	9_2
Insectivora															
Erinaceus sp.			1	1			2								
E. (Hemihinus) sp.														+	
Desmana sp.1			4									+			
Desmana sp.2			1												
Talpa sp.	4	2		1	2		3		2						
Soricini indet.				1											
Soricidae indet.	1	2			7		64	5						+	1
Crocidura sp.			1												
Blarinoides sp. (small)							32								
Blarini indet.		2													
Soriculini indet.		2													
Paranourosorex sp.							5								
Amblicoptus sp.	1	2													
Lagomorpha															
Proochotona eximia CHOM.		16 cf			8 cf		71	4 cf						+	
Ochotona pseudopusilla GUR. et SCHEVT.			61	145			4 cf								
O.antiqua ARG. et PIDOPL.	1 cf	60			65		126 cf	9	1	+	+	+		+	
O. ex gr. *antiqua*							6								
Ochotona sp.				1											
Ochotonidae indet.														+	9
Pliolagomys gigas (ARG. et PIDOPL.)									2 cf	cf	cf			+	
Pliolagomys sp.							2					+			
Lagomyidae indet.						1	168						29		
Prolagus cf. *michauxi* LOPEZ	1	3			8										
Hypolagus cf. *brachygnathus*							1								
Alilepus ukrainicus GUR.														+	
Alilepus sp.		1													
Trischizolagus dumitrescui RAD. et SAMS.		4			12			2							
Trischizolagus sp.							18								

Table 2 continued.

	Mugureny	Nov. Andriashevka	Chugunovka	Antipovka	Grebeniki 2	Musait 5	Obukhovka	Budey	Musait 7	Etulia (l. h.)	Etulia (m. h.)	Lucheshty VII	Kotlovina (l. h.)	Odessa	(Catacombs)
	6	7	13	12	8	3_1	11	4	3_2	1_1	1_2	5	2	9_1	9_2
Hypolagus ex gr. *gromovi* GUREEV			35	26											
Hypolagus sp.	2														
Leporidae indet.							72	1					4		
Rodentia															
Pliopetaurista sp.	3	6	2		1			2							
Blackia polonica MEIN		2													
Tamini indet.		2			3										
Steneofiber sp.														+	
Castor ex gr. *fiber* L.								1							
Trogontherium minus NEW.	3 cf	1 cf	1	3	4 cf		10 cf						1 cf		
Castoridae indet.							2								
Hystrix sp.														+	
Eliomys cf. *intermedius* FRIANT								2	1						
Myomimus elimyoides (KRET.)							10						1		
Myomimus sp.		2					2								
Glis minor Kow.		1													
Myoxidae indet.														+	
Gliridae indet.			1												
Paralactaga sp.							1								
Nannospalax macovei (KORM.)	5	25			13		206	47	4 sp						
N.odessanus TOP.												cf	75	+	3
N. ex gr. *macovei-odessanus*			24	29											
Prospalax sp.	4	8	1		3			1				+			
**Rhagapodemus* cf. *frequens* KRETZOI							1								
**Rhagapodemus* sp.													1		
Orientalomys similis (ARG. et PIDOPL.)														+	4
Orientalomys sp.							29								
Apodemus cf. *dominans* KRET.		5			1			1	4						2
Apodemus sp. 1		2			2		} 35							} +	} 3
Apodemus sp. 2		8													

Table 2 continued.

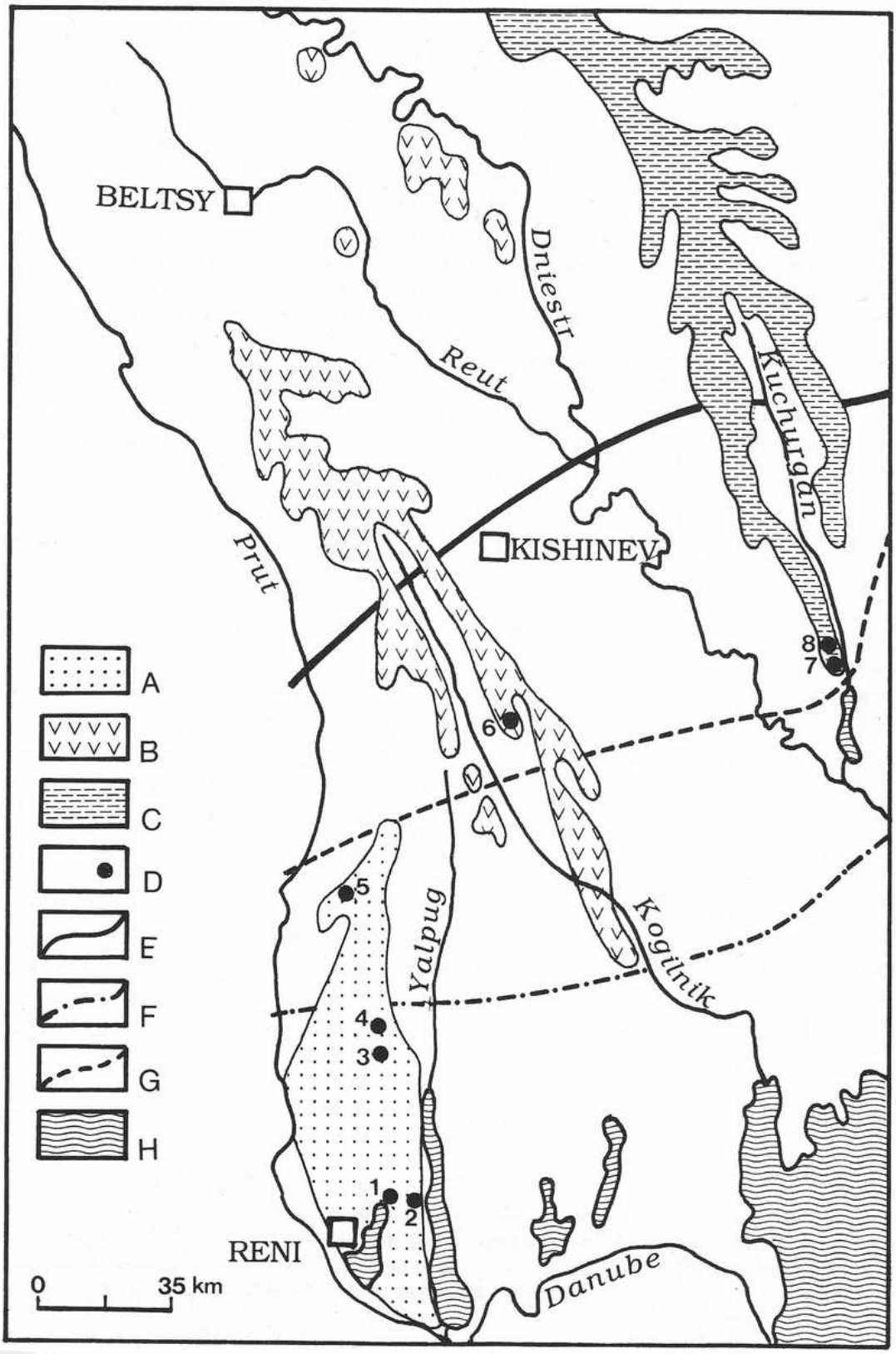
	Mugureny	Nov. Andriashevka	Chugunovka	Antipovka	Grebeniki 2	Musait 5	Obukhovka	Budey	Musait 7	Etulia (l. h.)	Etulia (m. h.)	Lucheshty VII	Kotlovina (l. h.)	Odessa	(Catacombs)
	6	7	13	12	8	3_1	11	4	3_2	1_1	1_2	5	2	9_1	9_2
Micromys sp.							3								
Occitanomys adroveri (THALER)		10													
Occitanomys sp.								1							
Muridae indet.	1		2												
Estramomys cf. *simplex* JANOSSY							4								
Eomyidae indet.															1
Baranomys sp.			1	1			1								
Trilophomys sp.									1	+		+			
Germanomys sp.							1								
Cricetulus sp.				2							+	+			
Cricetinus gritzai PIDOPL.														59	
Cricetinus sp.							15								
Pseudocricetus aff. *kormosi* (SCHAUB)		12			7										
"*Cricetus*" sp. (large)									7						4
Odessamys simionescui (SCHAUB)							204	27	1						32
O.palatocristatus TOP. et SKOR.													24	+	
Cricetinae (small)			4	4			59							+	
Cricetidae indet.										+			7		
Kowalskia polonica (FAHLB.)		6			1										
Kowalskia cf. *magna* (FAHLB.)		5													
Kowalskia sp.	1														
Epimeriones sp.			1		1										
Pseudomeriones sp.		1													
Dolomys odessanus NESIN													3		
Dolomys gromovorum ALEX.												+	16		
Pliomys kowalskii SCHEVT.										+	+	+	9		
Pliomys ex gr. *kowalskii-jalpugensis*														+	5
Pliomys sp.															88
"*Pliomys*" sp.n.															6

Table 2 continued.

	Mugureny	Nov. Andriashevka	Chugunovka	Antipovka	Grebeniki 2	Musait 5	Obukhovka	Budey	Musait 7	Etulia (l. h.)	Etulia (m. h.)	Lucheshty VII	Kotlovina (l. h.)	Odessa	(Catacombs)
	6	7	13	12	8	3_1	11	4	3_2	1_1	1_2	5	2	9_1	9_2
Promimomys insuliferus (Kow.)		45	51	66											
***Promimomys* sp.n.									12	+	+	+	27	+	1
P.moldavicus (Korm)					20	+	708	31							
P.constantinovae (Alex.)										+	+	+	43		
P. ex gr. *occitanus* (Thaler)								2							
P. sp.1	1														
P. sp.2 (large)		1				+									
Carnivora															
"Canis" sp.								+							
"Canis" odessanus (Odinz.)											+	+			+
Pannonictis pliocaenica (Korm.)											+				
Primates															
Macaca sp.					1										
Artiodactyla															
Paracamelus alexejevi Hav.											+	+			+
Paracamelus cf. *alexejevi* Hav.						+			+						
Paracamelus alutensis (Stef.)													+		
Paracamelus sp.						+			+		+				
Procapreolus sp.												+			
Croizetoceros ramosus (Cr. et Job.)												+			
Croizetoceros sp.											+		+		
Cervus sp.											+				+
Gazella sp.															+
Ioribos (?) sp.									+						

* In the author's viewpoint presence of these forms is doubted.

** In localities Kotlovina (2), Odessa (9_1), Etulia (1), and Lucheshty VII (5) these forms have been determined as *Promimomys moldavicus* (Topachevsky & Skorik 1977, Topachevsky & Nesin 1989, Shushpanov 1985, Alexandrova 1989).


BELTSY
KISHINEV
RENI
Dniestr
Reut
Prut
Kuchurgan
Yalpug
Kogilnik
Danube
A
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1
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6
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8
0
35 km

De Bruijn et al. 1992). The large mammals from these deposits include *Macaca* sp., *Dolichopithecus ruscinensis* Dep., Canidae indet., *"Canis"* sp., *Ursus* ex gr. *ruscinensis-minimus, Mustella* sp., Hyaenidae indet., *Lynx cf. issiodorensis* (Cr. & Job.), Machairodontinae indet., *Zygolophodon borsoni* (Hays), *Anancus arvernensis* Cr. & Job., *Hipparion* sp., *Tapirus* cf. *arvernensis, Dicerorhinus megarhinus* De Cristol, *Propatomachoerus provincialis* (Gerv.), *Eostyloceros pidoplitschkoi* Korot., *Paracervulus kuchurganicus* Korot., *Croizetocerus ramosus* Cr. & Job., *Procapreolus cusanus* Cr. & Job., *Plioportax ucrainicus* Korot (Korotkevich 1988).

The "Kuchurgan" includes no less than dozen localities and, according to our studies, spans a considerable time interval. Because it can be stratigraphically subdivided in greater detail, the term is inappropriate for biostratigraphic schemes. Lists of small mammals, based on our original collections from the localities of Novaya Andriasnevka and Grebeniki (Fig. 2), are given in Table 2.

The Karboliya fluviatile deposits are located in the watershed area of the Prut, Danube and Yalpug Rivers. These deposits include lacustrine facies. They lie on a red weathering crust developed on deposits of the Lower Pontian. In some places the crust is eroded and the Karboliya Beds rest directly upon marine Lower Pontian deposits. All of the sequences slope to the south-west. In the north, the Karboliya Beds are overlain by younger loess-like mantles or by red or brown buried soils of different age. In the south they are overlain by younger flood plain deposits containing an Early Villafranchian mammalian fauna, or by fluvial deposits of the Late Pliocene or Quaternary terraces of the Prut and Danube. Maximum thickness of the Karboliya Beds amounts to 60 m in the north and 110 m in the south-west. The lower part of the section is normally represented by sandy and clayey sediments. They are predominantly horizontally bedded with rare gravel interlayers. The upper part of the section is substantially sandy with a large number of layers and lenses of pebbles and gravels showing cross-bedding. Shells of molluscs are rather rare, but present throughout the sections. Some mollusc species make it possible to correlate the Karboliya Beds with deposits of the Lower Romanian and the zone NSM/10 of I. Andreescu, exposed on the right bank of Prut River in the Dacian Basin (Andreescu 1975, Khubka 1982, Vangengeim et al. 1995).

The most complete sections of the Karboliya fluviatile deposits are exposed in the valley banks of Bolshaya Saltcha and Kagul Rivers. These two areas that are often referred to in the literature as the faunal localities of the "Moldavian Roussilion". However, as in the case with the "Kuchurgan", the use of this name is unjustified because many of the localities belong to different stratigraphic levels. Mammal remains are common throughout the section but are more abundant in the upper part.

A general list for the whole Karboliya Beds includes: *Macaca* sp., *Dolichopithecus ruscinensis* Dep., *"Canis" odessanus* (Odintz.), *Mustella* sp., *Pannonictis pliocaenica* Korm., *Lynx* sp.,

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Fig. 2. Distribution of deposits of Pliocene fluvial plains between Prut and South Bug Rivers.
A – Karboliya fluvial Beds; **B** – Stol'nicheny fluviale deposits; **C** – Kuchurgan fluvial Beds; **D** – Locations of fossil mammals (numbers in the map: **1** – Etulia; **2** – Kotlovina; **3** – Musait; **4** – Budey; **5** – Lucheshty; **6** – Mugureny; **7** – Novaya Andriashevka; **8** – Grebeniki 2; Presumed coastlines: **E** – Late Sarmatian Sea; **F** – Meotean Sea; **G** – Early Pontian Sea; **H** – Modern coastline of the Black Sea. Distribution of fluviatile formations is after G. M. Bilinkis (1987).

Machairodontinae indet., *Zygolophodon borsoni* (HAYS), *Anancus arvernensis* CR. & JOB., *Hipparion* sp., *Dicerorhinus megarhinus* DE CRISTOL, *Propatomachoerus provincialis* (GERV.), *Hippopotamus* sp., *Paracamelus alexejevi* HAV., *Eostyloceros pidoplitschkoi* KOROT., *Paracervulus australis* SER., *Croizetocerus ramosus* CR. & JOB., *Cervus* (*Rusa*) *warthae* CZYZ., *Procapreolus* sp. (= *Cervus moldavicus* JANOVSK.), *Procapreolus cusanus* CR. & JOB., *P.* cf. *wenzensis* CZYZ., *Parabos* sp., Bovidae indet., *Gazella* sp.

Remains of small mammals have been collected from the lower part of Karboliya Beds immediately above red crust of weathering at the Musait 5 (Table 2,3/1; collection of L. P. ALEKSANDROVA) and Budey (Table 2,4; original collection) locality, from the upper part of Karboliya Beds at localities Musait 7 (Table 2; 3/2; original collection), Lucheshty VII (Table 2,5; collections of L. P. ALEKSANDROVA), the lower and middle beds of Etulia (Table 2, 1/1, 1/2; SHUSHPANOV 1985), and from the lower bed of Kotlovina (Table 2,2; TOPACHEVSKY & NESIN 1989).

The Odessa catacombs locality (Fig. 1) represents a different taphonomic type. The locality is a fissure filling in Lower Pontian limestone. Deposits that fill caves, fissures, pits are represented by indistinctly stratified red-brown clay, including limestone debris that is sometimes concentrated in layers (ODINTZOV 1962). Bones of large and small vertebrates are common throughout the sections, with major local accumulations. In some caves red-brown clays are overlain by more sandy yellow-brown clays without fossils. Carnivores of this locality include *Nyctereutes* sp., *"Canis" odessanus* (ODINTZ), *Vulpes praecorsac* KORM., *Arctomeles ferus* (ROSTSH.), *Ursus* ex gr. *ruscinensis minimus, Agriotherum* sp., *Pliocrocuta pyrenaica* (DEP.), *Chasmaporthetes lunensis odessanus* SOTN., *Lynx issiodorensis* (CR. & JOB.), *Megantereon* sp., *Homotherium* sp. (SOTNIKOVA 1989). *Anancus arvernensis* CR. & JOB., *Tapirus* cf. *arvernensis*, *Paracamelus alexejevi* HAV. (DUBROVO & KAPELIST 1979) and *Hipparion* sp. also occur. The small mammals are listed in Table 2 (9/1: TOPACHEVSKY & SKORIK 1977, 1992; 9/2: original collection of the authors). Other mammal localities further to the east in the south Russian Plain occur along the Don River and near Stavropol.

The Obukhovka locality is situated in the lower course of the Don River, to the north-west of the city of Novocherkassk (Table 2, 11). Mammal remains came from 2 to 2.5 meter-thick gravel bed that lies on Miocene sands and is overlain by fluvial deposits containing remains of Middle Villafranchian mammals (TOPACHEVSKY et al. 1988).

The Antipovka and Chugunovka localities (Table 2, 12, 13) are situated along of upper course of Don River to the south of the city of Voronezh. They are confined to the lower part of a buried Lower Pliocene fluvial terrace. The base of the terrace is formed by Cretaceous chalk. The fluvial deposits are 19 meters thick and consist of cross-bedded sands, loams, and clays. These deposits are covered with red-brown clays 4 m thick (AGAJANIAN & KOWALSKI 1978, UPPER PLIOCENE ... 1985).

The Kosiakino locality is near the city of Stavropol and has been known since 1938. It appeared in many stratigraphic schemes as the typical Ruscinian locality. It is associated with fluvial sand and gravel deposits. They have thickness of 9 m and lie on middle Sarmatian limestones. Judging from the original geological description, the section contains several members that may represent separate alluvial cycles. Bones were common throughout the sequence. There was no layer-by-layer collecting and mammal remains are listed for the entire section. The assemblage contains, along with typical Ruscinian species, *Chilotherium, Aceratherium, Deinotherium,* and some other forms (GABUNIA 1959), that do not survive the upper boundary

of Turolian. The Turolian elements may be either redeposited from older beds or there may be bone-bearing beds of different age in the section. We do not believe that this locality can be used for biostratigraphy.

Localities in the Asian part of the FSU

Localities of Ruscinian mammals in the south of West Sibiria and in North Kazakhstan (Fig. 1) are associated with fluvial deposits of old rivers or lacustrine deposits exposed along Irtysh and Ishim Rivers and their tributaries (Zazhigin & Zykin 1984). A number of fluvial and lacustrine sedimentary bodies are recognized here. They are considered to be formations. In most cases they have a two-part structure. The lower parts are formed by sands and silts with interbeds of gravels and pebbles; the upper parts are chiefly represented by clays and loams, containing occasional interbeds of hydromorphic soils. In some sections only the lower, channel part of fluvial cycle is preserved. Maximum thickness reaches 20 m. Sometimes these deposits lie on the Miocene or Oligocene sediments. In a number of cases within the Pliocene part of the section younger alluvial cycles overly older ones. All lacustrine and fluvial deposits of the Lower Pliocene contain an abundant fauna of fresh-water and land molluscs. The fauna combines both endemic and thermophilous Sino-Indian elements (Zykin et al. 1991).

V. S. Zazhigin (Zazhigin & Zykin 1984) described assemblages ("complexes") of small mammals for each fluvial or lacustrine cycle. They are, beginning with the oldest (type localities noted in brackets), the Novaya Stanitsa complex (Novaya Stanitsa), the Cherlak complex (Cherlak), the Peshnevo complex (Peshnevo), the Krutaya Gorka complex (Nithnjaya Iljinka), the Algabass complex (Biteke River near the mouth of Kizil-Aigir River) and the Andreevka complex (Andreevka). The small mammals of these complexes are listed in Table 3. The list for the Peshnevo complex given by V. S. Zazhigin is composite based on materials from three localities: Peshnevo, Borki and Petropavlovsk. The list of small mammals from the Pavlodar 2 locality (Cherlak complex) is given here according to the determinations of V. S. Zazhigin (Zykin 1982). The easternmost of the known localities is situated on the north-western shore of Olkhon Island (Saray Bay) in Lake Baikal. In the shore cliff there is an exposure of variegated clayey and sandy deposits. These sediments are of diluvial and alluvial fan origin and have a thickness of 15 m. Several fossiliferous beds occur in the section, ranging from the Middle Miocene to Late Pliocene. A layer with Ruscinian fauna (Table 3) occur in the middle part of the section, within carbonate clays of the Student member of the Sasin Formation (Bed 4). It is underlain by deposits that contain a Late Turolian fauna and is overlain by sediments with an early Villafranchian fauna (Pokatilov 1985).

Stratigraphic sequence and position within the magnetochronological scale

Remains of voles genus *Promimomys* are represented almost in all reference sections, and are particularly important for establishing the stratigraphic sequence of localities.

We understand the genus *Promimomys* to be cementless brachyodont arvicolids having the *Mimomys* ridge and enamel islet in the first lower molar, and both anterior and posterior enamel islets in the third upper molar. Primitive members of *Promimomys* (*P. insuliferus* and the older forms) have been attributed by a number of researchers to the separate genus *Polonomys*

Table 3 List of mammals of the FSU asian part.

	Novaya Stanitsa	Cherlak	Pavlodar 2	Olkhon	Peshnevo complex	Nizhnjaya Iljinka	Biteke (Algabas complex)	Andreevka
	20	21	22	23	17	18	16	19
Insectivora								
Desmana sp.	+	+				+		+
Soricini gen.?					+			
Soricidae gen.?				+				+
Sorex sp.	+	+			+	+	+	
Paranourosorex sp.		+						
Neomyini gen.?		+					+	
Lagomorpha								
Prolagus sp.				+				
Ochotona sp.	+	+	+	+	+	+		+
Ochotonoides sp.				+	+	+	+	+
Leporinae gen.?					+		+	
Hypolagus sp.						+		
Rodentia								
Sciuridae gen.?		+						
Steneofiber sp.	+	+						
Trogontherium sp.								+
Scirtodipus sp.			+					
Plioscirtopoda sp.							+	
Eozapus sp.			+	+				
Sicista sp.		+						
Micromys sp.				+				
Muridae gen.?	+	+	+					
Lophocricetus cf. *sibiricus* (sp.n.)	+	+			+			
Lophocrietus sp.			+					
Kowalskia sp.				+	+			
Microtodon sp.	+		+	+	+			
M. (*Wartamys*) cf. *kowalskii* KRET.		+						
M. (*Wartamys*) sp.n.		+						
Baranomys sp.n.	+	+						
Baranomys cf.*longidens* (KOW.)							+	
Baranomys aut *Microtodon* sp.							+	
Cricetidae gen.? (large)	+	+						
Cricetinae gen.?			+		+			+
Cricetulus sp.								+
Microtoscoptes sp.			+					
Stachomys trilobodon KOW.				+				

Table 3 continued.

	Novaya Stanitsa	Cherlak	Pavlodar 2	Olkhon	Peshnevo complex	Nizhnjaya Iljinka	Biteke (Algabas complex)	Andreevka
	20	21	22	23	17	18	16	19
Promimomys sp.n.1	+							
Promimomys sp.n.2		+						
P.insuliferus KOW.				+				
P.antiquus ZAZHIGIN					+			
P. cf. *dawacosi* VAN DE WEERD						+		
P.gracilis (KRETZ.)							+	+
P. sp.				+				
Mimomys sp.n.							+	+
Prosiphneus sp.	+	+		+			+	
Carnivora								
"*Canis*" sp.			+	+				
Perissodactyla								
Hipparion cf. *tchikoicum* IVAN.							+	
Artiodactyla								
Eeostyloceros maci VISLOB.				+				

or to the American genus *Prosomys* (AGAJANIAN & KOWALSKI 1978, TOPACHEVSKY & NESIN 1989, FEJFAR et al. 1990).

Although the generic independence of these early forms is evident, we prefer to use the name *Promimomys* s. l. for all primitive Ruscinian voles that match the above definition until there has been a revision of the group. The ages of some localities have been determined on the basis of biometric studies of members of the genus *Promimomys* (PEVZNER & VANGENGEIM 1994) and paleomagnetic data. These ages are: Mugureny – 5.8 Ma; Novaya Andriashevka – 4.4 Ma ± 0.06 Ma; Musait 5 – 3.8 + 0.05 – 0.04 Ma; Budey – 3.76 + 0.03 – 0.02 Ma; Etulia (lower horizon) – 3.61 ± 0.01 Ma; Lucheshty 7 – 3.591 ± 0.007 Ma; Etulia (middle horizon) – 3.583 ± 0.005 Ma.

The oldest of the listed localities is Mugureny. At this locality a primitive, still undescribed form of *Promimomys* is present. It is more advanced than *Promimomys* from the Lower Pontian, but more primitive than *P. insuliferus*. It is difficult to assign this locality either to the Turolian or to the Ruscinian on the basis of faunal composition. But jugding from its position in the magnetochronological scale, it is close to the boundary of the Ruscinian and Turolian (Fig. 3).

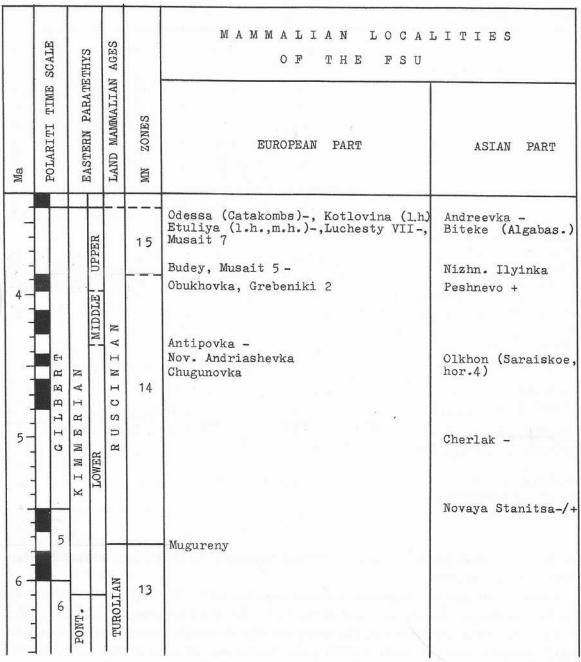

Fig. 3. Position of mammalian localities in the magnetochronologic and stratigraphic scales of the Eastern Paratethys: + normal polarity, – reversed polarity.

The locality Novaya Andriashevka, with *P. insuliferus*, is situated in the magnetic polarity time scale at the level of the Sidufiall Subchron of the Gilbert Chron. The precise position of the Antipovka and Chugunovka localities, which also yielded *P. insuliferus*, in relation to Novaya Andriashevka cannot as yet be determined without close study of dental morphology of this form. In Figure 3 these localities are arbitrary placed near the level of the Nowaya

Andriashevka locality, but the reversed magnetization of sediments in Antipovka indicates different ages for these localities. The Antipovka locality can thus be correlated with an interval of reversed polarity above or below the Sidufiall Subchron. Some researches consider the localities Antipovka and Chugunovka to be synchronous and even cite their forms together in a composite faunal list. But despite the close geographic positon, the faunas of the two localities differ markedly. Though mammal remains are less numerous in collection from the locality Chugunovka, its fauna is more diverse than at Antipovka: There are 16 forms in the first locality and 12 forms in the second, with 8 forms common to both faunas. Apart from this, the bone-bearing bed of the Chugunovka locality has a lower hypsometric position as compared with that of the locality Antipovka (Upper Pliocene ... 1985). This is a possible evidence of its older age.

The younger group of localities, including Grebeniki 2, Musait 5, and Budey, yielded remains of *Promimomys moldavicus*. In the magnetic polarity time scale we place the locality Grebeniki 2 at the level of the older boundary of the Kochiti Subchron (Vangengeim et al. 1995). In stratigraphic terms, the Musait 5 locality, with reversely magnetized sediments, and the Budey locality are situated above this Subchron. The Obukhovka locality with *P. moldavicus* may be situated between the Grebeniki 2 and Budey localities, to judge from the quantitative ratio of lagomorphs and vole remains.

The next group of localities that have similar ages is Etulia, Lucheshty VII, and Musait 7. They have in common the presence of a new form *Promimomys* sp. nov. (called *P. moldavicus* in previous publications), and the appearance of *Pliomys* and *Dolomys*. In the magnetochronological scale all of these localities are situated within a reversely magnetized interval of the Gilbert Chron between the Kochiti Subchron and the upper boundary of the Chron. Two other localities, Kotlovina (lower horizon) and Odessa (catacombes), can be attributed to the group. The latter locality is apparently the youngest because *Pliomys* ex gr. *kowalskii* from its fauna in somewhat more advanced than specimens of this species from the fauna of Kotlovina.

In the Asiatic part of the former Soviet Union the oldest locality that contains remains of primitive *Promimomys* (sp.nov.) is Novaya Stanitsa. The age of this locality is determined on the basis of paleomagnetic data as 5.5 Ma. It is placed at the boundary between Chron 5 and the Gilbert Chron. In its evolutionary development specimens of *Promimomys* from the reversely magnetized deposits of the Cherlak locality are more advanced than those from the Novaya Stanitsa locality, and are more primitive than *P. insuliferus* (Zazhigin & Zykin 1984). Therefore, in the magnetic polarity time scale the Cherlak locality can be placed in the second half of reversely polarized interval between the Chron 5 and the Thvera Subchron. According to V. S. Zazhigin *P. antiquus* from the Peshnevo locality has an intermediate position between *P. insuliferus* and *P. davakosi* (= *P. moldavicus*). Normal magnetization of the bone-bearing bed (Zykin et al. 1991) indicates that the locality belongs in the Kochiti Subchron (3.86–3.98 Ma). The evolutionary advancement of *P.* cf. *davakosi* from the fauna of Nizhnjaya Iljinka apparently corresponds to that of the vole from the localities Musait 5 and Budey. Therefore, we place the Nizhnjaya Iljinka locality at about the same level.

The two youngest Early Pliocene complexes of V. S. Zazhigin, with type localities situated along Biteke River (the Algabass complex) and near the Andreevka village (the Andreevka complex), contain forms of the genus *Mimomys* that are more primitive than the earliest

hitherto known *Mimomys, M. hajnackensis* from the early Villafranchian. The form from the Biteke locality is more primitive than the vole from the Andreevka locality. Taking into consideration the reversed magnetization of fossiliferous deposits of the Andreevka locality, both faunas can be correlated with the end of the Gilbert Chron.

The Olkhon locality (Sarai Bay, Bed 4) has no reliable paleomagnetic data. Arbitrary we place it in the middle of the Gilbert Chron on the basis of the presence of *Promimomys insuliferus*.

Position of localities in the continental stratigraphic scale and characterization of the fauna

The position of the Ruscinian boundaries within the magnetochronological scale is based on the following line of evidence: The La Alberca locality, transitional between the Turolian and Ruscinian, is associated with marine Messinian deposits of the *Globorotalia mediterranea – G. conomiozea* subzone of the N17 zone (DE BRUIJN et al. 1975, MEIN 1985). The upper boundary of the N17 zone is situated within the reverse Subchron of Chron 5 (CITA 1983). Therefore, the bundary between the Turolian and Ruscinian (MN 13/MN 14) is not younger than the Subchron of the Chron 5. It is not older than the first half of Chron 5 because the Kalmakpai locality in Kazakhstan has been dated as terminal Turolian and is correlated with this time (VANGENGEIM et al. 1993). According to the data presented by E. MOISSENET et al. (1990), the upper boundary of the Ruscinian (MN 15/MN 16) coincides with the lower boundary of the Gauss Chron, the boundary of MN 14 and MN 15 is drawn at the upper limit of the Kochiti Subchron.

With these dates in mind, the following can be concluded. The early part of Ruscinian (MN 14) is represented by the Siberian localities Novaya Stanitsa and Cherlak that have yielded very primitive forms of *Promimomys* unknown in Central and Western Europe. There are as yet no analogues of these faunas in the European part of the FSU. Among the Siberian localities, the upper half of the MN 14 zone is represented only by the locality of the Olkhon Island with *Promimomys insuliferus* and by the Peshnevo locality with *Promimomys antiquus*. In the European part of the FSU this part of the Ruscinian is known in the localities Novaya Andriashevka, Chugunovka, Antipovka, and Grebeniki 2, and may also be present in Obukhovka and in all localities of the Kuchurgan Gravel, which have not been considered in this paper.

The localities Musait 5 and Budey in the European part of the FSU, and Nizhnjaya Iljinka in West Siberia are assigned to the lower part of the zone MN 15. The upper part of the zone is represented in the European part of the FSU by the localities Etulia (lower and middle horizons), Musait 7, Lucheshty VII, Kotlovina (lower horizon), and Odessa (catacombs). In the Asian part of the FSU these are the localities Biteke (the Algabass complex) and Andreevka.

The characteristic feature of faunas of the younger half of the early Ruscinian in the European part of FSU is a marked predominance of Lagomyidae, presence of *Kowalskia, Epimeriones, Pseudomeriones, Baranomys* and a relatively high diversity of Murids. Abundant large and advanced Muntiacinae, represented by the genra *Paracervulus, Eostyloceros, Muntiacus,*

are documented in faunas of large mammals. Small and primitive cervines *Pliocervus* and *Croizetoceras* and capreolines *Procapreolus cusanus* (Cr. & Job.) are present as well. Remains of *Zygolophodon borsoni* occur frequently too.

The small mammal fauna of the late Ruscinian shows an abrupt decrease of abundance of Lagomyidae and increase of Arvicolinae. A small form of hamster, *Odessamys*, appeared. *Trilophomys* became a common form. No remains of *Kowalskia, Epimeriones, Pseudomeriones* are found. In the end of the late Ruscinian the diversity of murids decreased. In the large mammal fauna muntiacins became less numerous; *Procapreolus* was more frequent: the first primitive Cervines of the *Cervus* (*Rusa*) appeared. *Zygolophodon borsoni* became extremely rare but *Anancus arvernensis* became more numerous. Camels appeared (after the Pontian time) and became frequent by the end of the late Ruscinian.

It should be noted that East European faunas of the late MN 14 and early MN 15 zones contain the single dominant species of *Promimomys – P. moldavicus* as understood by Radulesco & Samson (1989) and Vangengeim et al. (1995). The most significant change at the level of the boundary MN 14/MN 15 (the upper limit of the Kochiti Subchron) is a change in quantitative ration of Arvicolinae and Lagomorpha (Fig. 4).

A relatively sharp boundary occurs within the late Ruscinian, marked by the appearance of the genera *Pliomys* and *Dolomys*. These forms reached high frequencies by the end of Ruscinian and underwent a flourishing radiation in the Villafranchian. At the same time the frequency of *Promimomys* decreased considerably; *Nannospalax macovei* was replaced by *N. odessanus*. This limit apparently corresponds to the lower boundary of the Czarnotian as unterstood by M. Kretzoi.

At the very end of the Ruscinian (Odessa, catacombs) characteristic Villafranchian genera of carnivores, such as *Megantereon* and *Homotherium*, appeared. These genera are present together with typical Ruscinian forms, such as *"Canis" odessanus, Pliocrocuta pyrenaica* and *Chasmaporthetes l. odessanus*. The latter form has a complicated talonid in the first lower molar as known from forms from Spain (Layna) and China (Sotnikova 1994).

In the Asian part the FSU differences between the early and late Ruscinian faunas are less pronounced. For the early Ruscinian V. S. Zazhigin reports the presence of *Kowalskia, Microtoscoptes* and dominant *Baranomys* and *Microtodon*. In the late Ruscinian *Baranomys* and *Microtodon* are less frequent (Zykin et al. 1989).

A remarkable feature of the second half of the zone MN 15 is the appearance of extremely primitive members of the genus *Mimomys* that had already acquired external cement in their molars, along with the presence of *Promimomys gracilis* and the first appearance of *Plioscirtopoda*. This level is an apparent analogue of the lower boundary of the Czarnotian.

The Ruscinian faunas from the European and Asian parts of the FSU show substantial differences. Unfortunately, we are unable to compare data on large mammals due to the very low number of large mammal localities in Asian part. The known remains of hipparions in Siberian faunas belong to *Hipparion* ex gr. *tchikoikum* Ivanjev. This form is not known in the European localities. In the European part scarce remains of *Hipparion* resemble minor forms of the West European Ruscinian. Reported presence of *H. crassum* among these forms (Alexeeva 1977) lacks support from later evidence.

Analysis of small mammal faunas from Eastern Europe shows that they are more similar to faunas of Central Europe. Elements of Central Asian origin play a major role in the faunas of

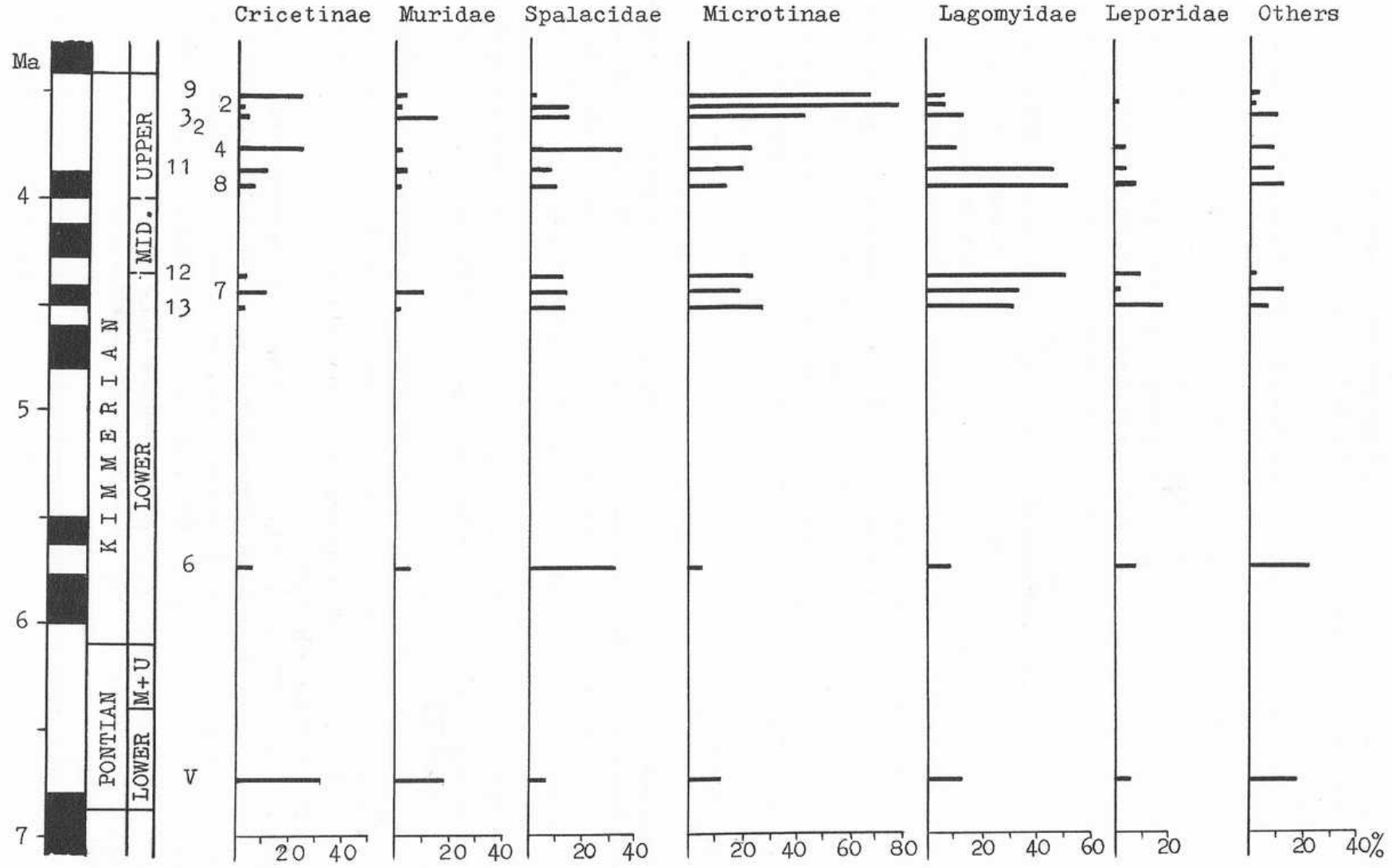

Fig. 4. Ratios of small mammals in studied localities (%). V – Vinogradovka; **6** – Mugureny; **13** – Chugunovka; **7** – Novaya Andriashevka; **12** – Antipovka; **8** – Grebeniki 2; **11** – Obukhovka; **4** – Budey; **3/2** – Musait 7; **9** – Odessa (catacombs); **2** – Kotlovina (lower horizon).

West Siberia and Kazakhstan. It is clear that these faunas are attributable to different paleozoogeographic provinces of the Palearctic region.

Distinctive characters of European faunas as compared to Asian faunas are: 1) Presence of the families Pteromyidae (represented at least by two genera), Gliridae (up to 4 genera), Spalacidae (2 genera), and Eomyidae; 2) Presence of the genera *Pliolagomys, Estramomys, Dolomys*; 3) Abundance of Leporidae (up to 3 genera).

The most characteristic features of faunas from the Asian part of the FSU are: Presence of the family Miospalacidae (genus *Prosiphneus*), genera *Ochotonoides, Microtoscoptes,* abundance of *Microtodon*, diverse and occasionally numerous Dipodidae.

Some forms had a wide distribution over the whole area: *Promimomys* (same species), *Kowalskia, Desmana, Prolagus* and perhaps *Ochotona*. The West Siberian overlap of *Baranomys* (the common form of the European fauna) and *Microtodon* (characteristic form of Central Asia) is of particular interest. All these forms may serve as a good marker for correlation of faunas from West and East Palearctic.

Another remarkable fact is the presence of specific small canids throughout the territory of the FSU from Moldova to Kazakhstan and to Lake Baikal. These forms, currently arbitrary attributed to the genus "*Canis*", have been known from Miocene faunas of North America, and Mio-Pliocene assemblages of West Europe and China (Rook 1992, Tedford & Qiu, in press). The group had a large area of distribution and a relatively short time of existence. This makes it useful for correlation and tracing of dispersals.

Conclusions

There are 80 localities of Ruscinian mammals in the territory of the former Soviet Union (60 – European, 20 – Asian). Most of them are known by limited materials. Only 20 localities have more or less complete faunistic lists consisting chiefly of small mammals. Some reference localities have been correlated with paleomagnetic scale. Analysis of these faunas shows that the earliest faunas of the beginning of the MN 14 zone are known in West Siberia. The earliest faunas of the European part of the FSU are attributable to the middle of the MN 14 zone. The bulk of the localities belong to the end of this zone and to the MN 15 zone.

Substantial changes in quantitative ratios are observed in the European faunal communities at the boundary of the MN 14 and MN 15 zones. One of the most distinct events in the faunistic history of the area studied occurs within the MN 15 zone (lower boundary of the Czarnotian). This level is marked by the appearance of a number of large and small mammals that developed further in Villafranchian time.

The faunas studied belong to two different paleozoogeographic provinces: Siberian and European. The former, comprising communities of West Siberia and North Kazakhstan, reflect the influence of Asian centers; the latter is more similar to Central European and East Mediterranean faunas. However a number of forms are common for both European and Asian faunas. They may serve as a means of making long distance correlations.

The present research was supported by the grant N MQD000 of the International Science Foundation.

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Typescript received 19. 4. 1995