

The equids from Liventsovka and other localities of the Khaprovskii Faunal Complex, Russia: A revision

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Supplementary materials

Table S1. Variability Size Index (VSI) of *E. (Allohippus) vireti* from Saint-Vallier, France. Computation and histogram for 546 bone breadths (in mm). The graduations in abscissa correspond to one, two, three, etc. standard deviations from the mean. The ordinate axis is graduated in number of measures. Abbreviations: n, number of measurements; x, mean; min, minimal observed value; max, maximal observed value; s, standard deviation; Hum, humerus; Fem, Femur; Rad, radius; Mc, metacarpal; Tib, Tibia; Calca, calcaneum; Mt, metatarsal; Ph1, first phalanx; Ph2, second phalanx; Ph3, third phalanx; A, anterior; P, posterior; dist, distal; prox, proximal; art, articular; SI, size index. [See separate XLS file.]

Table S2. Variability Size Index (VSI) of 230 breadths of bones from the Khaprovskii Complex. Computation, histogram and detailed distribution for most specimens noted by accession numbers and reference letters of photographs in Figs. 4, 5. The graduations in abscissa correspond to one, two, three, etc. standard deviations from the reference *Allohippus vireti* of Saint-Vallier. The ordinate axis is graduated in number of measures. Same abbreviations as in Table S1. [See separate XLS file.]

Table S3. Variability Size Index (VSI) of *E. (Allohippus) senezensis* from Senèze, France. Computation and histogram for 279 bone breadths (in mm). The graduations in abscissa correspond to one, two, three, etc. standard deviations from the reference *Allohippus vireti* of Saint-Vallier. The ordinate axis is graduated in number of measures. Same abbreviations as in Table S1. [See separate XLS file.]

Table S4. Measurements (in mm) of third metacarpals of Liventsovka, Khapry, Morskaya, Montopoli, and Loc. B equids.

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Fig. S3. Upper cheek teeth from Liventsovka, occlusal views.

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Table S4. Measurements (in mm) of third metacarpals of Liventsovka, Khapry, Morskaya, Montopoli, and Loc. B equids. Metacarpals referred to *E. (Allohippus)* aff. *major* are marked by *. Approximate measurements between brackets. Abbreviation: j, juvenile; T.K., specimens measured by Tatiana Kuznetsova; V.E., specimens measured by Vera Eisenmann.

	V.E.	V.E.	V.E.	V.E.	V.E.	V.E.	V.E.	V.E.
RGU		39	183	235 rolled	241	286	307*	
ROMK L	15*		2119					325
Greatest length		259	279	275	270	272	272	267
Minimal breadth	42.5	35	39	35	38		40	36
Depth at same level	30.5	29	30.7	25,5	29	31	31	
Proximal articular breadth	60	49.5	[54]	47	55	55	59	52.5
Proximal articular depth	[39]	32.7			35	35		
Facet for Carpale 3		40			45	46		
Anterior facet for Carpale 4		14.5			16.5	15.5		[14]
Posterior facet for Carpale 4		8			9	10		
Facet for Carpale 2		4.5						
Distal supra-articular breadth	57	50	[53]	[43]	53.5	51	54	[47]
Distal articular breadth	54	48.5	[50]	[40]	51	50.1		
Depth of sagittal crest	[39]	35			38.6	38		
Smallest depth of medial condyle	33.5	28.5	31	[26]	30.8	30.1	32	28.5
Greatest depth of medial condyle		30.1			32	32		
Smallest depth of lateral condyle	33	27	29		30.1	29	31	28

	V.E.	T.K.	V.E.	V.E.	V.E.	T.K.	V.E.	V.E.
	Fig.4(B)							
RGU	326	372*	396*	398	399	429*	460*	489*
ROMK L		192	465					
Greatest length	300	265		258	264			271
Minimal breadth	42	38	[42]		40.1		38	39
Depth at same level	33.8	30			28		29	29
Proximal articular breadth	62	58.5	57		58	56.5		
Proximal articular depth	38	39			37	37		37
Facet for Carpale 3	49	48		48.5	46			
Anterior facet for Carpale 4	19	19		19	16			19.5
Posterior facet for Carpale 4	13			2				
Facet for Carpale 2	0							
Distal supra-articular breadth	60	54	57	49	51.2		53	55
Distal articular breadth	59.5	55	53.5	48	50		54	55
Depth of sagittal crest	>42.5	39	38		40		38.5	39
Smallest depth of medial condyle	35	32	30.5	29	32		32	34
Greatest depth of medial condyle	38.5	34	34		34.1		34	35
Smallest depth of lateral condyle	35	31	29.5	28	31		31	32

	V.E.	V.E.	V.E.	V.E.	T.K.	V.E.	V.E.	V.E.	V.E.
		Fig.4(C)						Fig.4(D)	
RGU	573	576*	599	602 juv*	634*	665	753*	931	1341*
Greatest length	263	267		280	276			286	270
Minimal breadth	38	39	36.5		41	36.5	41.5	41,8	42.5
Depth at same level	27,7	29	28		30.8	29	30	34,8	32.5
Proximal articular breadth	[56]	55		58	60.3	51		63	62
Proximal articular depth		34.5		37.5	39	37			38
Facet for Carpale 3		45		46.5	50			59,6	49
Anterior facet for Carpale 4		15.2		16.5	13			60	19
Posterior facet for Carpale 4		11.7			13			43	
Facet for Carpale 2		0							
Distal supra-articular breadth	[51]	51.1	51.7	55	56				57
Distal articular breadth	[48]	51.7	50	53	55				
Depth of sagittal crest		37		38	42				
Smallest depth of medial condyle		30	30.5	32	35				
Greatest depth of medial condyle		32		34	35.7				
Smallest depth of lateral condyle		29.8	30	32	33.2				

	V.E.	V.E.	V.E.	V.E.	V.E.	V.E.	V.E.
RGU	1358*	1437			1668*	1769 rolled	no number
ROMK L			1592	1657 juv			Fig. 4(A)
Greatest length			260			270	252.8
Minimal breadth	41.5	41	35		41	35	35.6
Depth at same level	29	31	27		30	28	30.2
Proximal articular breadth	57				59		51.2
Proximal articular depth	[36]				38		
Facet for Carpale 3					49		51.6
Anterior facet for Carpale 4					18.5		50
Posterior facet for Carpale 4					12		36
Facet for Carpale 2							
Distal supra-articular breadth	57	56	48	50.3		[48]	
Distal articular breadth		55	46.5	[46]			
Depth of sagittal crest		41		[32.4]			
Smallest depth of medial condyle		33	29	27.9			
Greatest depth of medial condyle		35	32	29.5			
Smallest depth of lateral condyle		33	27.5	28.4			

	V.E.	V.E.	V.E.	V.E.	V.E.	V.E.	V.E.
	Khapry	Khapry	Khapry	Khapry	Morskaya	Montopoli	Loc. B
	GIN sw RPI no nb*	GIN 300-27*	GIN 300- 28*	GIN 300- 46*	GIN 301-34*	IGF 1282	IVPP no nb
Greatest length			260		278		258
Minimal breadth	41.5	41	35	[38]	40		37
Depth at same level	29	31	27	[27]	30		30
Proximal articular breadth	57				61		[52]
Proximal articular depth	[36]				39		[34]
Facet for Carpale 3							[41]
Anterior facet for Carpale 4							[16]
Distal supra-articular breadth	52	[55]	50	53,5	55	57.7	51
Distal articular breadth	52,5	[55]	51	53,5	55	57.5	49
Depth of sagittal crest	37		38,5	39	40	41.5	35.3
Smallest depth of medial condyle	32	33,5	32	31	33	31.1	29
Greatest depth of medial condyle	33,5	36,5	33,1	34	35	34.4	31
Smallest depth of lateral condyle		32	31	30	33		

Table S5. Measurements (in mm) of third metatarsals of Liventsovka. * marks a specimen referred to *E. (A.)* aff. *major*. Approximate measurement between brackets. According to Titov (2008: table 3) ROMK L 1219 was found *in situ* in fluvial facies of Liventsovka sands inside the gravel layer 2. Abbreviations: juv, juvenile; T.K., specimens measured by Tatiana Kuznetsova; V.E., specimens measured by Vera Eisenmann.

	T.K.	V.E.	V.E.	V.E.	V.E.	V.E.	V.E.	T.K.	V.E.
ROMK L	1829	1973	1974		157	2120	2121	2122	2122
RGU		37*	38*	111		184	185*	186	186
	Fig.5(G)				juv			juv	juv
Greatest length	304	306	316			315	317	302	303
Minimal breadth	37,7	39	40	40.5		40.2	37	32.8	33
Depth at same level	32,8	35.7	34	36		37	33	30.7	30
Proximal articular breadth	56	51.5	57.5			54	53.5	45.2	
Proximal articular depth	44	41				47		[38.4]	
Proximal depth	46.3					48	44.5	[42]	41
Facet for Tarsale 3	51	47				[50]	49	[43.5]	
Facet for Tarsale 4	14	10					13		
Facet for Tarsale 2	7.3						9.5		
Distal supra-articular breadth	53	54	60	58	49	53.5	51		48
Distal articular breadth	53	51	55		50	53	50		46
Depth of sagittal crest	39	39	42		38	38.5	40		
Smallest depth of medial condyle	29	31	33.9		29	32	33		29
Greatest depth of medial condyle	32	34	35.1		31.2	34	[33.5]		
Smallest depth of lateral condyle	29.3	29.5	33		28	31	31	28.1	28

	V.E.	V.E.	V.E.	T.K.	V.E.	T.K.	V.E.	V.E.
ROMK L	2124	297	1910	375*		387		432
RGU	188 juv		354*		381		417	
	Fig. 5(C)							juv
Greatest length	305			298		293,6		
Minimal breadth	[30]	34.2	38	39		35.2	35	39.4
Depth at same level	[28]	31.2	35	35		31.5	36	37.4
Proximal articular breadth	51.5			51.5		51.4	52.5	
Proximal articular depth	41					40.4		
Proximal depth	42					41.4	44	
Proximal maximal depth						[43]		
Facet for Tarsale 3	49					[43.5]		
Facet for Tarsale 4						11		
Facet for Tarsale 2	10					[6.5]		
Distal supra-articular breadth	47.7	46.2	51	[51.5]	61	50.6		53.2
Distal articular breadth	46	43,4		[49.5]	60	49		
Depth of sagittal crest	>35	35.1	38	[34.2]	44	35.3		[37]
Smallest depth of medial condyle	29	27.4		30.2	35	27.5		[31.7]
Greatest depth of medial condyle	31	28,9			>37,5	30.2		32
Smallest depth of lateral condyle	27.2	30		29.8	33.5	27.4		

	V.E.	V.E	V.E	V.E	T.K.	V.E	V.E	V.E	T.K.	V.E
ROMK L	165?									
RGU	Fig.5(B)	451*	466	483	483	487	490	514	514	515*
					juv		Fig.5(F)		juv	
Greatest length	269	330	307	275	274.7	292	324	308	307	318
Minimal breadth	34.4	40	35	33	32.5	34	43	36	36.1	39
Depth at same level	32.6	37	35	30	29.8	32		32	30.5	35
Proximal articular breadth		57.5	51	44	43.6	51.5	>59		48	54
Proximal articular depth		46		36	34.1	40	48		38.5	43
Proximal depth		47.5	43		36	43	52.5	41	41	45.5
Facet for Tarsale 3		55	50	41	41,5	47	>52		43,5	50
Facet for Tarsale 4					8	12	12.5			15
Facet for Tarsale 2						9				9
Distal supra-articular breadth		57.5	51.7	41	41.1	47.5	60	43		52
Distal articular breadth		53.5	48	40	40	48	58	42.5		50
Depth of sagittal crest		41	39		29.7	34.1	45.5		31.4	37
Smallest depth of medial condyle		34	32	26	26.3	27	36	28	28	32
Greatest depth of medial condyle		35.5	33.5		25.8	29	38.1		28.5	33.5
Smallest depth of lateral condyle		33	30	25	24.2	25	34	27	27	31

	V.E	T.K.	V.E	V.E	T.K.	V.E	V.E	T.K.	V.E
ROMK L	537	612		778	778	965	1066	1066	1114*
RGU			667						
									juv ?
Greatest length				329	329		317	317	315.5
Minimal breadth	36	36.7	38.1	41.5	41.4		41	40.5	32
Depth at same level	36.6	33	37	37.6	36.5		38	38.1	30.1
Proximal articular breadth	55.2		57	61	61.2		58.5	59.2	[50.5]
Proximal articular depth	42.1			45	45.3		46.7	45.5	
Proximal depth	44.6		46	51.6	49.2		50	50	41.4
Proximal maximal depth					51.2			50.8	
Facet for Tarsale 3				57.5	57		61.1	55.5	
Facet for Tarsale 4	12.2			15	15		14.5	14.6	
Facet for Tarsale 2	7.5			11	12		7.3	7	
Distal supra-articular breadth		50.4		60.7	60.8	54.7	58.5	58.5	50.7
Distal articular breadth		47		57.5	57.6	51.6	57	57	47.7
Depth of sagittal crest		[41.5]		45	45.2	39.2	44	44.8	36.3
Smallest depth of medial condyle		30.1		35	33.7	29	34.5	34.8	31
Greatest depth of medial condyle		32.5		39	38.8	32.5	38	37.8	31.7
Smallest depth of lateral condyle		29.5		34	33.7	32.5	33.5	33.8	31

	T.K.	T.K.	T.K.	V.E	T.K.	V.E	V.E.	T.K.	T.K.
		<i>in situ</i>	Fig.5(D)						
ROMK L	1174	1219*	1220	1359	1457*	1717	1770	1822*	
RGU									no nb
			juv						
Greatest length			297.2				307	315	
Minimal breadth	[38]	38	34.7	37			33	40	[39.3]
Depth at same level	36.5	35.3	33.5	36.5			33.5	34.8	38.5
Proximal articular breadth			[36.1]	54		[54]	52	[53.2]	53,5
Proximal articular depth	47.2			41.2		39.5	41.7		43.1
Proximal depth	49.6		[38.5]	[44.4]		43	43	44.8	44.2
Proximal maximal depth				46.5				[46.5]	45.4
Facet for Tarsale 3			[43.3]	50		55	47.4		
Facet for Tarsale 4				14.5			12.8		
Facet for Tarsale 2				8.3		9.5	8.5		
Distal supra-articular breadth		52.7	44.3		50.3		49.5	57.8	
Distal articular breadth			40.5		[46]		49.5	[52.8]	
Depth of sagittal crest		[38.5]	[25.1]		[32,4]		37	37	
Smallest depth of medial condyle		31.5	[24]		28.4		29	32	
Greatest depth of medial condyle		34.2	[25.5]		29.5		31.5	33.3	
Smallest depth of lateral condyle		[28.6]	[23.2]		27.2		27	30.3	

Table S6. Measurements (in mm) of third metatarsals of Khapry Complex and Loc. B equids. * marks a specimen referred to *E. (A.) aff. major*. Approximate measurements between brackets. Zdansky 1935: measurements published by Zdansky (1935). Abbreviations: j, juvenile; T.K., specimens measured by Tatiana Kuznetsova; V.E., specimens measured by Vera Eisenmann.

	T.K.	V.E	V.E	V.E.	V.E.	Zdansky
						1935
	Khapry?	Khapry	Merjanovka	Volovaya Balka		Henan Loc. B
	RGU 664	GIN 300-127	Mer 1759*	no nb	no nb Fig. 5(E)	no nb
Greatest length		297.2		ca 281	ca 342	293
Minimal breadth	33	34.7	37		46.8	34
Depth at same level	28	33.5	36.5		43.6	
Proximal articular breadth		[36.1]	54	52	66.6	
Proximal articular depth			41.2	ca 41		
Proximal depth		[38.5]	[44.4]			
Proximal maximal depth			46.5			
Facet for Tarsale 3		[43.3]	50			
Facet for Tarsale 4			14.5			
Facet for Tarsale 2			8.3			
Distal supra-articular breadth	43	44.3			66	
Distal articular breadth	43	40.5			62.8	49.5
Depth of sagittal crest		[25.1]		39	52.6	
Smallest depth of medial condyle	27	[24]				
Greatest depth of medial condyle		[25.5]				
Smallest depth of lateral condyle		[23.2]				

Table S7. Measurements (in mm) of first anterior phalanges of Khapry and Liventsovka equids. Approximate measurements between brackets.

	Khapry	Khapry	Liventsovka	Liventsovka	Liventsovka
	no number	no number	RGU 305		RGU 187
ROMK L				60	2123
	Anterior	Anterior	Anterior	Anterior	Anterior
Greatest length	98	94	92.5	95	93
Anterior length	88	85	87.5	87	87
Smallest breadth	39	36	42.5	40	37,7
Proximal breadth		55.5	60.5		54
Proximal depth		37	42	38.5	36
Supra-articular breadth		49	54	49.5	47,5
Greatest length of trigonum phalangis	[63]	60	64	61	-
Smallest length of trigonum phalangis		54	58	54	-
Posterior length		85	86	86	88
Medial supratuberosital length		72.5	71	71	70
Lateral supratuberosital length		72.5	71.5	71	72
Medial infraratuberosital length		14.5	[14]	15	[16]
Lateral infraratuberosital length		14	[15]	14	[15]
Distal articular breadth	[48]	47.5	50.5	48	

	Liventsovka	Liventsovka
	ROMK L 475	ROMK L 989
	Anterior, juv	Anterior
Greatest length	90	93
Anterior length	82	80
Smallest breadth	32	38
Proximal breadth	48	60
Proximal depth	32	39.5
Supra-articular breadth	41	51.2
Greatest length of trigonum phalangis	[56]	57
Smallest length of trigonum phalangis	[50]	49
Posterior length	81	82
Medial supratuberosital length		67
Lateral supratuberosital length	66	65
Medial infraratuberosital length		15
Lateral infraratuberosital length	15	13.5
Distal articular breadth	41	50

Table S8. Measurements (in mm) of first posterior phalanges of Khapry and Liventsovka equids.

	Khapry	Liventsovka	Liventsovka	Liventsovka
	PIN 300-6	ROMK L 132	ROMK L 287	ROMK L 1672
	Posterior	Posterior	Posterior	Posterior
Greatest length	101	94	96.1	95.5
Anterior length	94	85	87	87
Smallest breadth	41.5	36.2	42	44
Proximal breadth	66	57	68	67
Proximal depth	45	41	45	44
Supra-articular breadth	55	48	55.5	55
Greatest length of trigonum phalangis	64	60	57.5	56
Smallest length of trigonum phalangis	54	51	51	50
Posterior length	89	83	86	86
Medial supratuberosital length	70	69	65	66
Lateral supratuberosital length	73	69	70	65
Medial infratuberosial length	20	15	20	19
Lateral infratuberosial length	16	69	16	20
Distal articular breadth	50		52	52

Table S9. Measurements (in mm) of second anterior phalanges of Liventsovka equids.

	no nb 1*	no nb 2*	no nb 3*	no nb 4*	no nb 5*	no nb 6
Greatest length	50.1	50.5	53.1	50	50	48.5
Anterior length	37	39	41	39	37	36
Smallest breadth	51	52	50	51	47	47
Proximal breadth	57	60.1	60.5	60.5	55	52
Proximal depth	36.3	33.1	36	34	34.5	33
Distal articular breadth	54	54	57	54	52,5	49
Distal depth	30	30	29	27.5	30	30

	no nb 7	no nb 8	no nb 9
Greatest length	45.5	46	47
Anterior length		33	
Smallest breadth	44	45	45
Proximal breadth	50	49.5	50
Proximal depth		32	32
Distal articular breadth	47	47	46.1
Distal depth	30	28	28.5

Table S10. Measurements (in mm) of second posterior phalanges of Liventsovka equids. Approximate measurements between brackets.

	ROMK L L 429	no nb 10	no nb 11	no nb 12	no nb 13	no nb 14*
Greatest length	52	50	49	47	49	50.5
Anterior length	38	37	38	36,5	38	38
Smallest breadth	43.5	41	42	40.5	42	48
Proximal breadth	51	49	51	49.5	50	58
Proximal depth	33	32.1	34	34	33.5	34
Distal articular breadth	45	44	44	42	45.5	50
Distal depth	26	26.7	28	27	27	30

	no nb 15*	no nb 16*
Greatest length	51	49.3
Anterior length	38	37
Smallest breadth	48	
Proximal breadth	58	[56]
Proximal depth	35	33
Distal articular breadth	50.2	[50]
Distal depth	29.5	

Table S11. Measurements (in mm) of third anterior phalanges of Liventsovka equids. Approximate measurements between brackets.

	no nb 1	no nb 2	no nb 3
Anterior length	59	54	53
Dorsal length	61	59	57
Plantar length	63		60
Height	42.5		44
Plantar breadth	75	[72]	73.5
Articular breadth	50		48
Articular antero-posterior diameter	27	25,5	28.5
Plantar 'circumference'	174		150

Table S12. Measurements (in mm) of third posterior phalanges of Liventsovka equids.

	no nb 4	no nb 5	no nb 6
Anterior length	50	53	52
Dorsal length	51	56	55
Plantar length	54	58	58
Height	41	40	43
Plantar breadth	68	67.5	ca 63
Articular breadth	47	45	43.5
Articular antero-posterior diameter	26	26	26
Plantar 'circumference'	142	147	140

Table S13. Measurements (in mm) of humeri of Liventsovka equids. Approximate measurements between brackets. According to Titov (2008: table 3) ROMK L 1262 was found *in situ* inside the gravel layer 1. Abbreviation: j, juvenile.

	juv	juv					juv	
	ROMK L 110*	ROMK L 434	ROMK L 462	ROMK L 463*	ROMK L 481*	ROMK L 600*	ROMK L 725*	ROMK L 1225*
Greatest length				300				
Posterior length	283	331.5	308	290.5				
Smallest breadth	39.5	[42]	41.3	39				39
Depth at same level	49.5	55.2	52	45.4				49.5
Proximal breadth				104				95.5
Proximal depth								115
Distal breadth	78	[90.4]	88	81.7	85.7	78.2	81.3	
Distal medial depth	85.2		98	88.5	93.4	87		
Height of medial condyle	51.5	57.8	60.7	53	53	54	50	
Smallest height of trochlea	38.5	48	44.4	39.1	42	38	38.2	
Height of trochlea	[49]	57.8	55.3	[45,4]	[53,2]	49.1	[48,9]	
Height of lateral condyle	[40]	47.5	43	40.2	[42]	[40,3]	42.5	

			in situ		
	ROMK L 1242*	ROMK L 1257	ROMK L 1262*	ROMK L 1552	ROMK L 1632
Greatest length		329			
Posterior length		314	293		
Smallest breadth		42.5	42.5		
Depth at same level		51.8	53.2		
Proximal breadth		102		[>120]	
Proximal depth		130.5		130.4	
Distal breadth	89.5	92.8	86		
Distal medial depth	96.5	102	95.3		
Height of medial condyle	56.3	65	54.2		
Smallest height of trochlea	43.5	48	43		47
Height of trochlea	[53.2]	58	[53]		57.8
Height of lateral condyle	43	45.2	[44]		47

Table S14. Measurements (in mm) of radii of Liventsovka equids. Approximate measurements between brackets. According to Titov (2008: table 3) ROMK L 859 was found *in situ* in fluvial facies of Liventsovka sands pit between gravel layers 1 and 2. A fragmentary *Canis cf. senezensis* cranium was found at the same level. Abbreviation: j, juvenile.

	RGU 666*	ROMK L 17*	ROMK L 112	ROMK L 288*	ROMK L 534j*	ROMK L 577*	ROMK L 680*
Greatest length	365				376	375	
Medial length	347				358	351.5	
Smallest breadth	42		[59]	47.4	45.3	45.4	43
Smallest depth	29		[42.1]	33.7	32.5	33	32.5
Greatest proximal breadth	89			95.8	90.8	91	85.5
Proximal articular breadth	82			84.9	82.5	83	79.4
Proximal articular depth	40			[41.5]	[42.2]	42.3	41
Greatest distal breadth	77	81	98.3		[78]	84.7	
Distal articular breadth	66	68.7	80.4		[65.2]	68	
Distal articular depth	40	39.5	46		[42.6]	44.4	
Breadth of medial condyle	27	27	30.6		30	27.9	
Breadth of lateral condyle		16	20.4			[15]	

	in situ						
	ROMK L 859*	ROMK L 1232*	ROMK L 1266	ROMK L 1431	ROMK L 1434	ROMK L 1451*	ROMK L 1771*
Smallest breadth					54		45.6
Smallest depth					42.2		32.5
Greatest proximal breadth	88.7	83.3	100.5		99	86.5	89.4
Proximal articular breadth	84.5	78	95.2	92	94.5	79.6	83.9
Proximal articular depth	37.8	39.5	46	48	48	38.3	40.3

Table S15. Measurements (in mm) of femora of Liventsovka equids. Approximate measurements between brackets. Abbreviation: j, juvenile.

	waterworn	waterworn				waterworn	waterworn	waterworn
ROMK L				1799/18	1799/19			
RGU	146	204	325	546	547	691	692	760j
Greatest length			463		425			
Medial length		397	427		403			
Smallest breadth	51.2	46.6	49		50	43.6	44.2	47
Depth at same level	58.5	57	56		55.9	51.2	48.7	55.6
Greatest proximal breadth		[119.5]	140	121	131.5			
Proximal depth			89	81.4	96			
Caput femoris depth		[64]	66	61.2	70			
Greatest distal breadth	103.3	[108.8]	103		106	[90.4]		96.2
Greatest trochlear breadth		[68]	76		74.5			72.4
Greatest medial distal depth	[131]	[127]	142		138.2	[124]	[111]	130.8

	waterworn	waterworn			waterworn	Garbuzlaj
ROMK L	1812/7					1785/36
RGU	885	1231	1509	1665	1666	54
Greatest length	406					414
Medial length	377					382
Smallest breadth	48.5	52.2	51.9	53.3	[42,5]	44
Depth at same level	54	55.5	61	57	55	53
Greatest proximal breadth	[120]					[117.3]
Proximal depth						[91.3]
Caput femoris depth	[61]					63.5
Greatest distal breadth	[92.4]				[99]	109
Greatest trochlear breadth	[64.5]				[70]	70
Greatest medial distal depth	[116]		[111]	[111.5]		

Table S16. Measurements (in mm) of tibiae of Liventsovka and Khapry equids. Approximate measurements between brackets. According to Titov (2008: table 3) ROMK L 986 was found *in situ* in fluvial facies of Liventsovka sands above the gravel layer 3 and RGU 273 inside gravel layer 2. Abbreviation: juv, juvenile.

	juv		juv	juv		Khapry		
		<i>in situ</i>						
ROMK L	1788/2	1189/5	1789/5		1795/4	1783/237		
RGU	249	273	275*	278*	289*	364	452*	468
Greatest length	372	420		374				
Lateral length	355	410		356				
Smallest breadth	43.5	50.3	46.8	50.8	51			47.5
Smallest depth	33.4	30.8	[30.5]	32.6	33			29.5
Proximal breadth		[100]		103.2		[106]		
Proximal depth				89.5		[85.5]		
Distal breadth	[64]	83.3	71.3	78.5	78.5		79	74
Distal depth		53	[44,5]	52.9	52		51.5	54
Length of fossa digitalis						68		
Breadth of fossa digitalis						25		

				<i>in situ</i>				
RGU	613	719	779		1033	1072	1157	1222
ROMK L				986				
Greatest length			409	415		462	398	
Lateral length			394	391		429	375	
Smallest breadth	54.1	44	52	54.7		52	45.8	55.6
Smallest depth	39.2	31.6	39.4	37.5		42	36.8	40.5
Proximal breadth	118.5	[96]		[109,3]	[96,1]	123.3	108.2	
Proximal depth		[80.2]			[85]	100	[102]	
Distal breadth			85.2	85.1		95.4	83	93.5
Distal depth			57.2	58		62.5	55.5	60.8
Length of fossa digitalis	[54.]	46.2				68.2	60	
Breadth of fossa digitalis	[29.1]	18		[23.8]		25.7	23.1	

RGU	1228	1697	1707	1789
Greatest length		395	445	
Lateral length		373	414	
Smallest breadth		48.3	61.4	
Smallest depth		37.6		
Proximal breadth	111.6	109	123.6	
Proximal depth		[100]	117.1	
Distal breadth		80.4	96.5	67.8
Distal depth		54.8	61.3	[47.5]
Length of fossa digitalis		64.8	64	
Breadth of fossa digitalis		20.4	[30.5]	

Table S17. Measurements (in mm) of calcanea of Liventsovka equids. Approximate measurements between brackets.

	RGU	ROMK L	ROMK L	ROMK L	ROMK L
	306	211	254	1656	24
Greatest length	128	117.5	94	138	128
Length of proximal part	88	79	63	89	88
Smallest breadth	24	21	16.5	27	26.1
Proximal breadth	35	34	24.5	40	
Proximal depth	58	50	41	61	
Distal breadth	60	51	41	61	66
Distal depth	56	54	43	60	61
Maximal diameter of sustentaculum tali	43	34	30	45.5	[41.5]
Articular diameter of sustentaculum tali	24	21	16.5	27	26.1

Table S18. Measurements (in mm) of tali of Liventsovka equids. Approximate measurements between brackets.

			Gratest length	Oblique Length	Medial length of trochlea	Greatest breadth	Trochlear breadth	Distal articular breadth	Distal articular depth	Medial depth
rolled	RGU	209	67	65	63.5	59	29			49
rolled	RGU	210	70	66	67	66	31	55	38	[55]
	ROMK L	536	85	79	80.5	76	38	67	48	67
	ROMK L	1486	71	67.6	68.7	70.3	32.7	56.5	38.9	58
	ROMK L	549	70	65.7	69.5	68.5	30.3	58	39.5	[55.7]
	ROMK L	300	68.3	66.1	[62.3]	67	31	57	38	56
	ROMK L	162	65	61	62.5	63	29	52	35	51
	ROMK L	1384	68	65	[61.5]	65.2	32.5	55	38.1	[53]
	ROMK L	486	75	73.5	[74]	69	34.5	[61]	[38.5]	[54]
Juv	ROMK L	141		[59]		56.5	27.5	48	32.5	

Table S19. Measurements (in mm) of crania of Khapry, Liventsovka, and Fan Tsun (SE Shansi) equids.

	Gromova 1949 Tabl.1	V.E.	V.E.	V.E.	V.E.
	subadult	subadult	adult	old	
	Khapry	Khapry	Liventsovka	Liventsovka	SE Shansi
	ZIN 31078	ZIN 31078	ROMK L4	RGU 11	FAM60 B 719
P2-Orbit		234			
1 Basilar length	ca 580	ca 600	ca 550		
2 Overall Palatal length			ca 310		300
2-5 Palatal length sensu stricto		164	ca 154		145
3 Vomerine length	134				
4 Post-vomerine length	123				
5 Muzzle length	ca 160	ca 164	ca 152	ca 140	151
6 Diastema					130
7 Premolar length (P2-P4)		113			92
7bis Molar length (M1-M3)		[95]	81.5		[71]
8 Length of cheek teeth (P2-M3)	207	206	ca 184		[163]
9 Length of Choanae		[79]			
10 Greatest choanal breadth			ca 47		43
10bis Least choanal breadth					
11 Facial breadth	173	168			145
12 Length from Basion to anterior borders of P2	423	430			
13 Frontal breadth	ca 230	ca 226	217		[215]
14 Bizygomatic breadth			204.5		
15 Cranial breadth			[98]		
16 Breadth of the supra-occipital crest			70		
17 Muzzle breadth at the posterior borders of P2	ca 70	ca 70	68.5	65.5	[60]
17bis Least muzzle breadth (between the crests)				39	[40]
19 Height of the infra-orbita bar		15			
20 Height of the external auditive meatus			16		
21 Antero-posterior orbital diameter		75	69		
22 Dorso-ventral orbital diameter	60	64			51
23 Anterior ocular line		ca 492	ca 423		425
24 Posterior ocular line			202.5		
25 Facial height in front of P2					
26 Facial height between P4 and M1		144			124
27 Facial height behind M3	148	146			
28 Cranial height	109	112			
29 Breadth of the occipital condyles		97,2	87		
30 Breadth of Foramen Magnum		42	37		
31 Length of the naso-incisival notch		217			210
32 Cheek length		188			170

Table S20. Measurements (in mm) of Mandibles of Liventsovka equids.

	adult	adult		old	adult	juvenile	
	L 1911			<i>In situ</i>			L 2028
	RGU 355	RGU 395	RGU 562	ROMK L 95	ROMK L 1322	ROMK L 1233	RGU 92
2 Radius of Mandibular angle	145						[125]
3 Length of Diastema							
4 Occlusal length of P2-4		113.5		99			99
4bis Occlusal length of M1-M3	97	105.5		97.5			88
5 Occlusal length of P2-M3		221		197			186
8 Height of ascending ramus	249						
9 Height in front of P2		76	71		65	68	62
10 Height between P4 and M1	92	[90]					77
11 Height behind M3	123						109
12 Muzzle length							

	Male	Male	
	adult	very old	young adult
	ROMK L 229	ROMK L 264	ROMK L 16
1 Greatest length	537		
3 Length of Diastema	138	140	>137
4 Occlusal length of P2-4	101	103,5	115
4bis Occlusal length of M1-M3	96	95	105
5 Occlusal length of P2-M3	200	198	[222]
6 Length of Symphysis	127	[106]	
7 Breadth at posterior borders of I3	64	[60]	
8 Height of ascending ramus	[263]		
9 Height in front of P2	83		81
10 Height between P4 and M1	99.5		[106]
11 Height behind M3			
12 Muzzle length	165.5	[157]	

Table S21. Upper cheek teeth series measurements (in mm) of Khapry complex equids. * marks a measurement taken at mid-crown. Approximate measurements between brackets. For ZIN 31078 the measurements are those of Gromova (1949: table V, A). Abbreviations: L, occlusal length; Lp, protocone length; W, occlusal width without cement; H, crown height.

		Liventsovka ROMK L 4	Liventsovka RGU 214	Liventsovka RGU 327	Khapry RGU 389- 391	Khapry PIN 300-1 to 7	Khapry PIN 275-1 and 2	Khapry ZIN 31078
			old	old				
P2	L				38,4			[47]
	Lp				7			9
	W				30			[31]
	H				51			
P3	L	31.5			32,5	33		35
	Lp	10			10,3	9		11
	W	28			31	31.5		33
	H	[65]			66	64		
P4	L	30.1		30	31	33		33
	Lp	11		7	11	10		12
	W	28.7		27.8	31.5	32		30
	H			[30]	74	66		
M1	L	26	26	25,5	30	29		32
	Lp	9	9	7	10	10		10.5
	W	27	27	27,2	29.5	29		29.5
	H		[31]	[32]	58	55		
M2	L	27.5	26		31	30.1	27.5	32
	Lp	11	10.1		10.9	10.2	10	11
	W	27	26.7		30	28.3	27.5	28
	H				66	60	39	
M3	L	27	31,2		37*	31*	33	[32]
	Lp	10	11		11.7	12	11.7	11
	W	21	24		27*	27	26	23
	H	51			64	58	35	

Table S22. Isolated upper cheek teeth measurements (in mm) of Khapry complex equids. * marks a measurement taken at mid-crown. Approximate measurements between brackets. According to Titov (2008: table 3) ROMK L 1267 was found *in situ* in fluvial facies of Liventsovka sands pit between gravel layers 2 and 3 and ROMK L 51 inside gravel layer 2. Abbreviations: L, occlusal length; Lp, protocone length; W, occlusal width without cement; H, crown height.

			L	LPT	W	H
Khapry	RGU 386	P2		10	28	65
Khapry	RGU 386*	P2		7	26	
Khapry	RGU 385	P	33	9	33	45
Khapry	RGU 389	P	34	10	31	63
Khapry	RGU 389*	P	32.1	9	30	
Khapry	PIN 300-83	P2	46	7	28	41
Khapry	PIN 300-96	P	35	10	33.7	56
Khapry	PIN 300-96*	P	33	10	34	
Khapry	PIN 300-50	P	34.5	11*	34	48
Khapry	PIN 300-55	P	33	9.5	31.5	61
Khapry	PIN 300-76	P		8.5	[33]	55
Khapry	PIN 300-94	M	31	11.7*	29.5	64
Khapry	PIN 300-78	M	29	10	29.5	51
Khapry	PIN 300-79	M	30	12	30	48
Khapry	PIN 300-77	M	32	10.6	29	
Khapry	PIN 300-77*	M	30	[11]	30	
Khapry	RGU 387	M	29	10	30.5	37
Khapry	RGU 390	M	27.7			62
Khapry	RGU 1425	M	29	9	27	54
Khapry	RGU 1531	M	35	11	27	43
Khapry	RGU 388	M	30.1	10	26	40
Khapry	PIN 300-51	M3	31	11.5	27	17
Morskaya	PIN 301-3	P	32	13		
Morskaya	PIN 301-3*	P	30.3	10.5	30	
Morskaya	PIN 301-6	M	30.5	10.7	29	69
Morskaya	PIN 301-6*	M	29	9.5	28.5	
Mokryj Chaltyr	RGU 1479	P2	44	7	31	65
Mokryj Chaltyr	RGU 1479*	P2	42.5	8	29.5	
Mokryj Chaltyr	RGU 1478	P	32	12	30	73
Mokryj Chaltyr	RGU 1478*	P	31.2	11	30	
Mokryj Chaltyr	RGU 1008	P	32	9.6	30	66
Mokryj Chaltyr	RGU 1008*	P	31	10	30	
Mokryj Chaltyr	RGU 581	M	28	10.3	27	65
Liventsovka	RGU 567	P2	49	9	32.3	68
Liventsovka	RGU 567*	P2	47	8.2	30	
Liventsovka	RGU 148	P2	42*	7*	26*	61
Liventsovka	RGU 202	P2	43	7.5,	29	51
Liventsovka	RGU 202*	P2	41	[8]	26	
Liventsovka	ROMK L 110	P2	48	8	32	48
Liventsovka	ROMK L 51	P2		7	28	52
Liventsovka	ROMK L 349	P2				60
Liventsovka	ROMK L 911	P2	43	7.5	29	49
Liventsovka	ROMK L 1868	P	35		34	70

			L	LPT	W	H
Liventsovka	ROMK L 324	P	33	10.2	31	62
Liventsovka	ROMK L 690	P	35	11	32	51
Liventsovka	ROMK L 1533	P	30	10.1	30	53
Liventsovka	ROMK L 131	P	35	15	33	78
Liventsovka	ROMK L 131*	P	33	13.6	32.2	59
Liventsovka	ROMK L 1836	P	33.5	7	29	64
Liventsovka	ROMK L 1836*	P	33.2	9	30	
Liventsovka	ROMK L 1768	P3	35	15.2	30	80
Liventsovka	ROMK L 1768	P4	33	12.1	32	
Liventsovka	ROMK L 1786	P	34.7	10	32.3	40
Liventsovka	ROMK L 1326	P		10.1		71
Liventsovka	RGU 149	P	33	11.8	30	71
Liventsovka	RGU 149*	P	31	10	31	
Liventsovka	RGU 215	P	34	10.8	32	64
Liventsovka	RGU 215*	P	33	10	33	
Liventsovka	RGU 236	P	33	9.1	33	54
Liventsovka	RGU 566	P	31	9.1	30	46
Liventsovka	RGU 512	P	33	11	32	62
Liventsovka	RGU 512*	P	32	11	32	
Liventsovka	RGU 468	P	30	10.1	30	45
Liventsovka	RGU 574	M	28*	9.7*	28*	73
Liventsovka	RGU 575	M	29	10		57
Liventsovka	RGU 575*	M	27	11		
Liventsovka	RGU 470	M	30	>11	29	40
Liventsovka	RGU 471	M	25	10	27	43
Liventsovka	RGU 358	M	29*	11.7*	29*	78
Liventsovka	RGU 213	M	29.5	9.5	27.7	63
Liventsovka	RGU 213*	M	28.1	10.1	28	
Liventsovka	RGU 216	M	29	10.7	25	66
Liventsovka	RGU 216*	M	26	10	26	
Liventsovka	RGU 237	M	29		29	61
Liventsovka	RGU 237*	M	28	13	29	
Liventsovka	RGU 266	M	30	11	32	44
Liventsovka	RGU 635	M	28.1	10.8	30	48
Liventsovka	ROMK L 122	M	31*	11*	29*	83
Liventsovka	ROMK L 339	M	29	10.5	28.5	53
Liventsovka	ROMK L 1239	M	21			56
Liventsovka	ROMK L 1553	M	28	9.5	28	55
Liventsovka	ROMK L 1553*	M	27.7	10	27.5	
Liventsovka	ROMK L 1532	M	31*	13*	30*	79
Liventsovka	ROMK L 763	M	25.1*	11*	29*	79
Liventsovka	ROMK L 765	M3	29*	11*	26*	66
Liventsovka	ROMK L 1267	M3	29*	12*	25*	50
Liventsovka	ROMK L 1429	M3	31*	11	24*	72
Liventsovka	ROMK L 1430	M3	28	11	24	33

Table S23. Lower cheek teeth series measurements (in mm) of Liventsovka equids. * marks a measurement at mid-crown height. Approximate measurements between brackets. According to Titov (2008: table 3) ROMK L 95 was found *in situ* in fluvial facies of Liventsovka sands pit between gravel layers 1 and 2. Abbreviations: L, occlusal length; Lpf, postfossette length; Ldn, double knot length; W, occlusal width without cement; H, height.

		ROMK L 95 <i>in situ</i>	RGU 1302	ROMK L 16	ROMK L 229	ROMK L 1278	ROMK L 281	ROMK L 1233-838
Age		old	young	young				young
P2	L	39.5		40	37			34
	Lpf	14.5		19	17			17
	Ldn	18.1		17	17			13.5
	W	16		17	16.9			16
	H	[30]		[77]				[67]
P3	L	33	32	36	33.5			29.5*
	Lpf	12.5	16	16.5	17.7			14.5*
	Ldn	19	19	18.5	20			17*
	W	18	18	18	17.7			16*
	H			85				73
P4	L	31.5	32	34	32	34.5		
	Lpf	12	15		16	15		
	Ldn	17.6	18		19	19		
	W	18	16		18	16.7		
	H			91		72		
M1	L	29	36	35	29,5	32	29	27*
	Lpf	9	15	15	11	10	9	9*
	Ldn	15,5	17,5	17,7	17	17	15	14*
	W	16	15	15,5	16,1	16	17,5	14*
	H	79	81		56	[55]	30	78
M2	L	30			30		12	
	Lpf	10			14		16	
	Ldn	15			16.1		17.1	
	W	15			16.7			
M3	L	38		[38]	37		39	
	Lpf	8.5			12		12.7	
	Ldn	14.8			16		15.5	
	W	14.5			15.5		16	
	H			80			[50]	

		RGU 395	RGU 860	RGU 264	RGU 511-570	RGU 92	RGU 572	RGU 355	RGU 562	RGU 1322	RGU 662
Age				old			very old				
P2	L	41.5	37	37	39	36	34		37	39.5	
	Lpf	16	15	15	18	17			16	18	
	Ldn	18.3	15.5	17.5	19	16			15.5	19	
	W	17	15	17	17	15	14.5		16	16.5	
	H		35		54						
P3	L	35	31	32.5	36	32	28			35	
	Lpf	16	15	13	17.5	16				15.5	
	Ldn	20	18	20	19.5	19				21	
	W	19	16	18	20	17	17			18	
	H		45		64					61	
P4	L	35	29	31.5	34.5	31	28	32	35		28.3
	Lpf	14	13	11	15.5	13.5	12	16	17		13
	Ldn	18	17	17	18	18	18	17.2	18		15.3
	W	18	16	18	19	18	18	17	18		14.5
	H		52			[67]		>55	70		70
M1	L	32	26.7	27	31	27	25	29	30		27
	Lpf	11.7	9.5		14	10		10	12.1		9.1
	Ldn	16.7	15		16.5	15.1		16	15		14.6
	W	16	14.5		17	16	16	15	16		14
	H		44		62	46			61		55
M2	L	33	27	28		27	28	30	29		
	Lpf	11	10	9		10		10	12.1		
	Ldn	16.2	14.1	15		15.1		16	15.5		
	W	16	14	16.5		15	16	15	16		
	H		48						66		
M3	L	37		36		33	35		34		
	Lpf	11		12		9.7	7.5		10		
	Ldn	16		14.7		14.1	15		15		
	W	13.5		15		13.1	14		14		
	H										

Table S24. Isolated Lower cheek teeth measurements (in mm) of Khapry complex equids. * marks a measurement at mid-crown height. Approximate measurements between brackets. According to Titov (2008: table 3) ROMK L 869 was found *in situ* in fluvial facies of Liventsovka sands pit between gravel layers 1 and 2. Abbreviations: L, occlusal length; Lpf, postfossette length; Ldn, double knot length; W, occlusal width without cement; H, height.

			L	Lpf	Ldb	W	H
P2 unworn	Khapry?	RGU 575	37*			16,5*	63
P2	Khapry	PIN 300-86		17	19	17	40
P2	Khapry	PIN 300-87	39	17	16.1	15.2	[57]
P2	Khapry	PIN 300-90	39.2	19	17.3	16.5	50
P	Khapry	PIN 300-90	33	14	17.7	19	49
P	Khapry	PIN 301-129	33	13	18	18	59
P	Khapry	PIN 301-129	32*			19.2*	
P	Khapry	no n°	35	14	18		73
P	Khapry	no n°	33*			18*	
P	Khapry	PIN 300-35	32	14	18.7	18	42
P	Khapry	PIN 300-100	34	17.2	20	19	35
M1 associated	Khapry	PIN 300-102	30	10	15,2	15,2	54
M2 associated	Khapry	PIN 300-108	30	9,5	16,5	16,7	47
M	Khapry	PIN 300-98	32	12,7	18	16	64
M	Khapry	PIN 300-84	29	11	16	15,5	39
M	Khapry	PIN 300-85	[31]	13	18	14	67
M	Khapry	PIN 300-107	[32]	14	18		
M3	Khapry	PIN 300-101	[36]	10	16	15	56
M3	Khapry	PIN 300-89	36	10	15	13.5	52
M3	Khapry	PIN 300-91	38	11	16.5	14.5	38
P3 associated	Morskaya	PIN 301-7	33	17	19.3	17	59
P4 associated	Morskaya	PIN 301-4	32	14	18.7	17	69
P	Morskaya	PIN 301-5	30	13.5	17.7	19	50
P	Morskaya	PIN 301-33	31	15	17	18	54
M	Morskaya	PIN 300-33	27	11	15	15	52
M3	Morskaya	PIN 300-33	36	10	14.5	14	51
P2 associated	Volovaya Balka	PIN 302-10	40.5	18.5	17.5	16	
P3 associated			36	17	19	17.5	
P4 associated			35.5	16	17	17	86
P2	Liventsovka	RGU 837	38.5	16.5	17	17	51
P2	Liventsovka	RGU 1605	40	15	17	17	33
P2 unworn	Liventsovka	RGU 1049	32.5*			14*	54
P	Liventsovka	RGU 766	33.5	15.7	19	18	57
P	Liventsovka	RGU 464	36	17.5	20	18	71
P	Liventsovka	RGU 663	35	17	21	19	72
P	Liventsovka	RGU 1259	36	16.2	20	18	77
P	Liventsovka	RGU 708	35	17		17.2	66
P <i>in situ</i>	Liventsovka	RGU 869	31*			17*	72
P	Liventsovka	RGU 1762	32.5	15	20	17	52
P	Liventsovka	RGU 889	32	13.7	18.2	17	53
P	Liventsovka	RGU 217	30.5	12	18	17.7	35
P	Liventsovka	RGU 573	32*	15*	18*	16*	

			L	Lpf	Ldb	W	H
M	Liventsovka	RGU 1554	28.5	9	15	15.1	44
M	Liventsovka	RGU 1655	29	10.5	16.8	16	33
M	Liventsovka	RGU 472	30.5	12	16	15	60
M	Liventsovka	RGU 467	26.5	7.2	14.5	14.5	46
M3	Liventsovka	RGU 329	33*			13.5	73
M3	Liventsovka	RGU 568	37	11	13.7	15	69
M3	Liventsovka	RGU 263	35.1	9.5	16	14	43
M3	Liventsovka	PIN 270-28	34	9	15	14	69
P2	Mokryj Chaltyr	RGU 969	38.5	16	16	16	51
M	Mokryj Chaltyr	RGU 970	31				54

Table S25. Statistics for *E. (Allohippus) aff. major* and *E. (Allohippus) livenzovensis* MC. Abbreviations: n, number of measurements; x, mean; min, minimal observed value; max, maximal observed value; s, standard deviation; v, coefficient of variation ($v = 100*s/x$).

Statistics for *E. (Allohippus) aff. major* MC

		n	x	min	max	s	v
Greatest length	1	8	272.4	265.0	280.0	5.26	1.93
Minimal breadth	3	13	40.5	38.0	42.5	1.59	3.92
Depth at same level	4	12	30.1	29.0	32.5	1.05	3.49
Proximal articular breadth	5	12	58.6	55.0	62.0	2.03	3.46
Proximal articular depth	6	11	37.6	34.5	39.0	1.45	3.85
Distal supra-articular breadth	10	15	54.3	50.0	57.0	2.13	3.91
Distal articular breadth	11	13	53.7	51.0	55.0	1.35	2.52
Depth of sagittal crest	12	12	38.8	37.0	42.0	1.34	3.46
Smallest depth of medial condyle	13	14	32.3	30.0	35.0	1.37	4.23
Greatest depth of medial condyle	14	12	34.2	32.0	36.5	1.19	3.47
Facet for Carpale 3	7	8	47.9	45.0	50.0	1.90	3.96
Anterior facet for Carpale 4	8	9	17.4	13.0	20.0	2.36	13.54

Statistics for *E. (Allohippus) livenzovensis* MC

		n	x	min	max	s	v
Greatest length	1	9	264.5	252.8	279.0	8.18	3.09
Minimal breadth	3	9	36.6	35.0	39.0	1.42	3.88
Depth at same level	4	9	29.1	27.0	31.0	1.37	4.71
Proximal articular breadth	5	8	53.0	49.5	56.0	2.32	4.38
Proximal articular depth	6	3	34.2	32.7	35.0	1.33	3.88
Distal supra-articular breadth	10	11	50.6	47.0	53.5	1.99	3.93
Distal articular breadth	11	10	48.8	46.0	51.0	1.68	3.44
Depth of sagittal crest	12	5	36.0	32.4	38.6	2.49	6.91
Smallest depth of medial condyle	13	9	29.5	27.9	31.0	1.14	3.86
Greatest depth of medial condyle	14	4	30.9	29.5	32.0	1.29	4.19
Facet for Carpale 3	7	3	43.7	40.0	46.0	3.21	7.36
Anterior facet for Carpale 4	8	4	15.1	14.0	16.5	1.11	7.33

Table S26. Statistics for *E. (Allohippus) aff. major* and *E. (Allohippus) livenzovensis* MT. Abbreviations: n, number of measurements; x, mean; min, minimal observed value; max, maximal observed value; s, standard deviation; v, coefficient of variation ($v = 100*s/x$).

Statistics for *E. (Allohippus) aff. major* MT

		n	x	min	max	s	v
Greatest length	1	8	314.4	298.0	330.0	9.31	2.96
Minimal breadth	3	9	38.9	37.0	40.0	1.05	2.71
Depth at same level	4	9	35.0	33.0	37.0	1.10	3.13
Proximal articular breadth	5	8	53.7	50.5	57.5	2.65	4.94
Proximal articular depth	6	5	44.7	41.4	47.5	2.20	4.92
Distal supra-articular breadth	10	11	53.5	50.3	60.0	3.38	6.32
Distal articular breadth	11	9	50.6	46.0	55.0	2.83	5.60
Depth of sagittal crest	12	11	37.8	32.4	42.0	2.83	7.51
Smallest depth of medial condyle	13	10	31.7	27.9	34.0	1.82	5.74
Greatest depth of medial condyle	14	9	33.4	29.5	35.5	1.82	5.45
Facet for Tarsale 3	7	4	50.3	47.0	55.0	3.40	6.77
Facet for Tarsale 4	8	3	12.7	10.0	15.0	2.52	19.87

Statistics for *E. (Allohippus) livenzovensis* MT

		n	x	min	max	s	v
Greatest length	1	6	297.1	281	308	10.12	3.41
Minimal breadth	3	7	34.6	33	36.7	1.44	4.15
Depth at same level	4	6	31.6	30	33	1.00	3.18
Proximal articular breadth	5	4	51.6	51.4	52	0.27	0.52
Proximal articular depth	6	6	41.9	41	43	0.93	2.21
Distal supra-articular breadth	10	6	48.4	46.2	50.6	1.74	3.60
Distal articular breadth	11	5	47.2	46	49	1.30	2.76
Depth of sagittal crest	12	5	35.7	34.1	39	1.90	5.33
Smallest depth of medial condyle	13	8	28.1	27	30.1	1.13	4.01
Greatest depth of medial condyle	14	5	30.3	28.9	32.5	1.50	4.94
Facet for Tarsale 3	7	3	48.1	47	49	1.01	2.09
Facet for Tarsale 4	8	2	11.5	11	12	0.71	6.15

	Liventsovka	Khapyry	Morskaya	Volovaya Balka	Merjanovka
Leporidae					
Rodentia (small)					
<i>Trogontherium cuvieri</i>					
<i>Nyctereutes megamastoides</i>					
<i>Canis cf. senezensis</i>					
<i>Ursus cf. etruscus</i>					
Mustelidae gen.					
<i>Lutra</i> sp.					
<i>Pannonictis nestii</i>					
<i>Pliocrocuta perrieri</i>					
<i>Pachycrocuta brevirostris</i>			Carnivora ?		
<i>Lynx issiodorensis</i>					
<i>Acinonyx</i> sp.					
<i>Homotherium crenatidens</i>					
<i>Anancus a. alexeevae</i>					
<i>Archidiskodon m. gromovi</i>					
<i>Hipparion</i> sp.					
<i>Equus livenzovensis</i>					
<i>Equus</i> sp.					
<i>Stephanorhinus</i> sp.					
<i>Elasmotherium chaprovicum</i>					
<i>Sus strozzii</i>					
<i>Paracamelus cf. gigas</i>					
<i>Paracamelus alutensis</i>					
<i>Eucladoceros</i> sp.					
<i>Arvernoceros</i> sp.					
<i>Cervus (Rusa) philisi</i>					
<i>Libralces gallicus</i>					
<i>Palaeotragus priasovicus</i>					
<i>Gazellospira gromovae</i>					
<i>Gazella</i> sp.					
Tragelaphinae					
<i>Leptobos</i> sp.					

Fig. S1. Faunal list adapted from Titov (2008: table 1).

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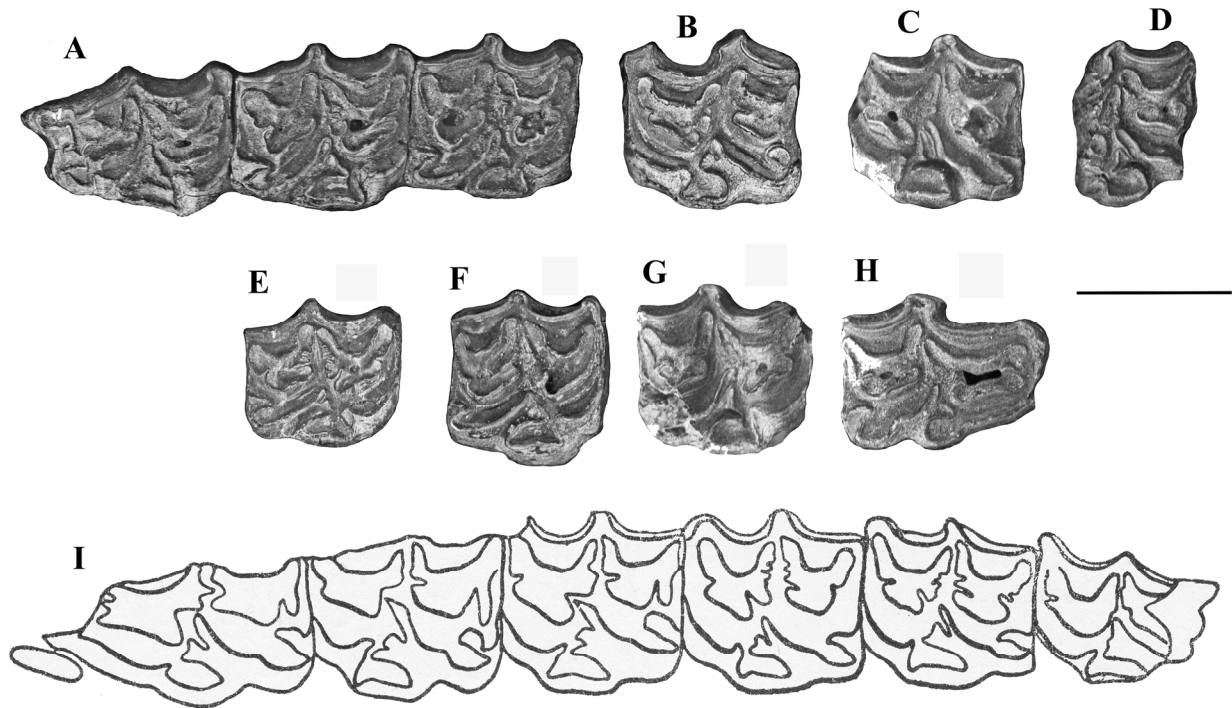


Fig. S2. Upper cheek teeth from Khapry, occlusal views. **A.** ZIN 3178, left P2-M3 (after Gromova 1949, fig 4). **B.** RGU 391, right M1-M3. **C.** RGU 391 right P. **D.** RDU 389, right P2. **E.** ROMK L 1425, right M2. **F.** RGU 387, right M. **G.** RGU 385, left P. **H.** PIN 300-76, left P2. **I.** RGU 391, left P. B, C, D, H, and I very probably belonged to the same animal. Scale bar: 3 cm.

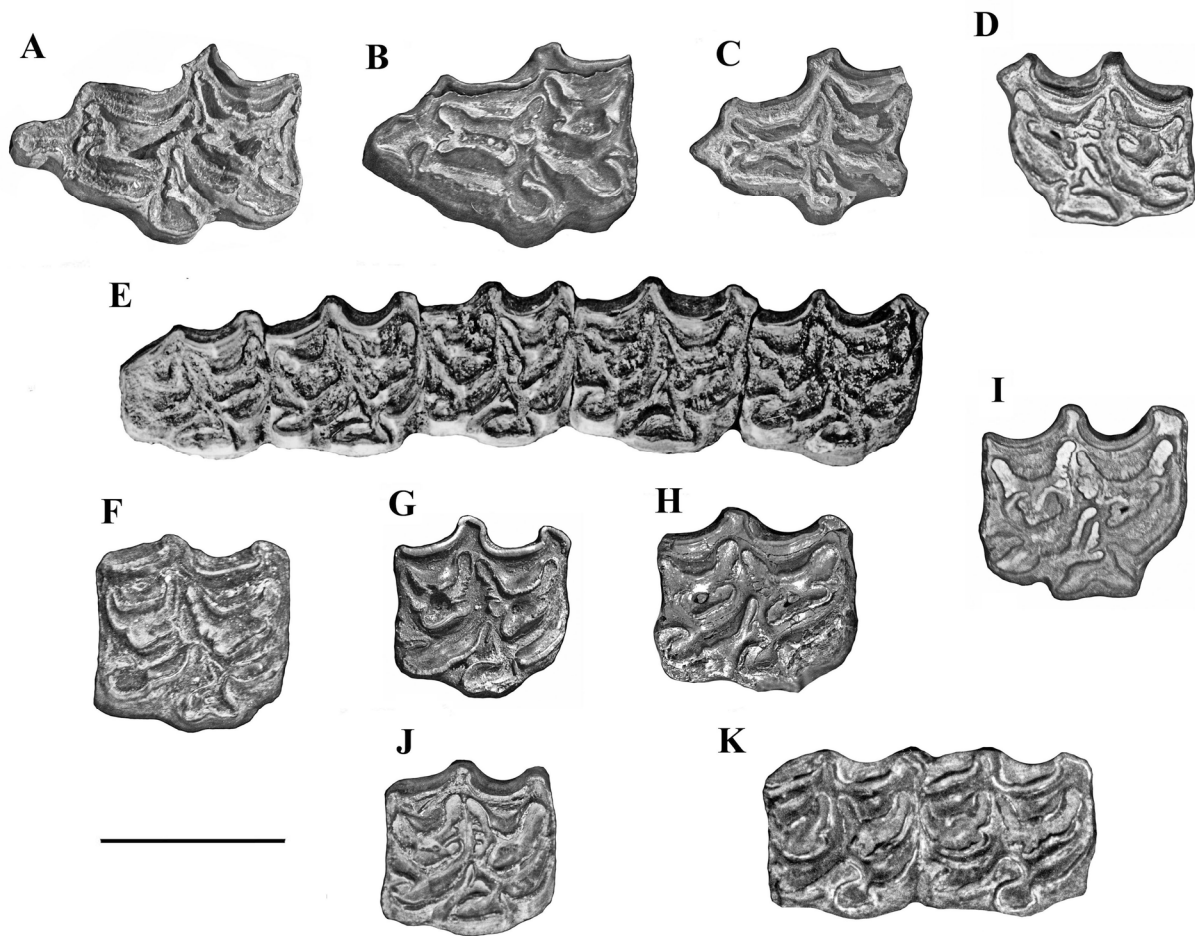


Fig. S3. Upper cheek teeth from Liventsovka, occlusal views. **A.** RGU 567, left P2. **B.** ROMK L 911, left P2. **C.** ROMK L 51, left P2. **D.** RGU 149, left P. **E.** ROMK L 4, right P3-M3. **F.** ROMK L 1786, right P. **G.** ROMK L 1533, right P. **H.** ROMK L 1836, right P. **I.** ROMK L 131, right sectioned P. **J.** RGU 213, right M. **K.** RGU 327, right P4-M1. Scale bar: 3 cm.

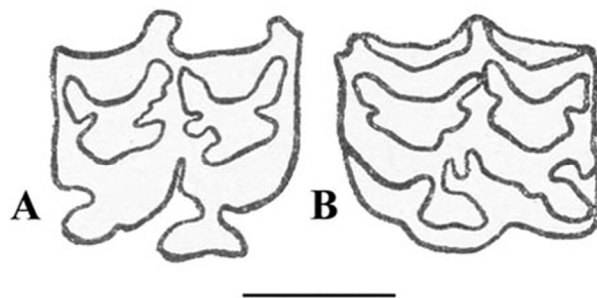


Fig. S4. Upper cheek teeth from Morskaya and Volovaya Balka, occlusal views (after Gromova, 1949: fig 4). **A.** Morskaya no n°, left M. **B.** Volovaya Balka no n°, right dP. Scale bar: 2 cm.

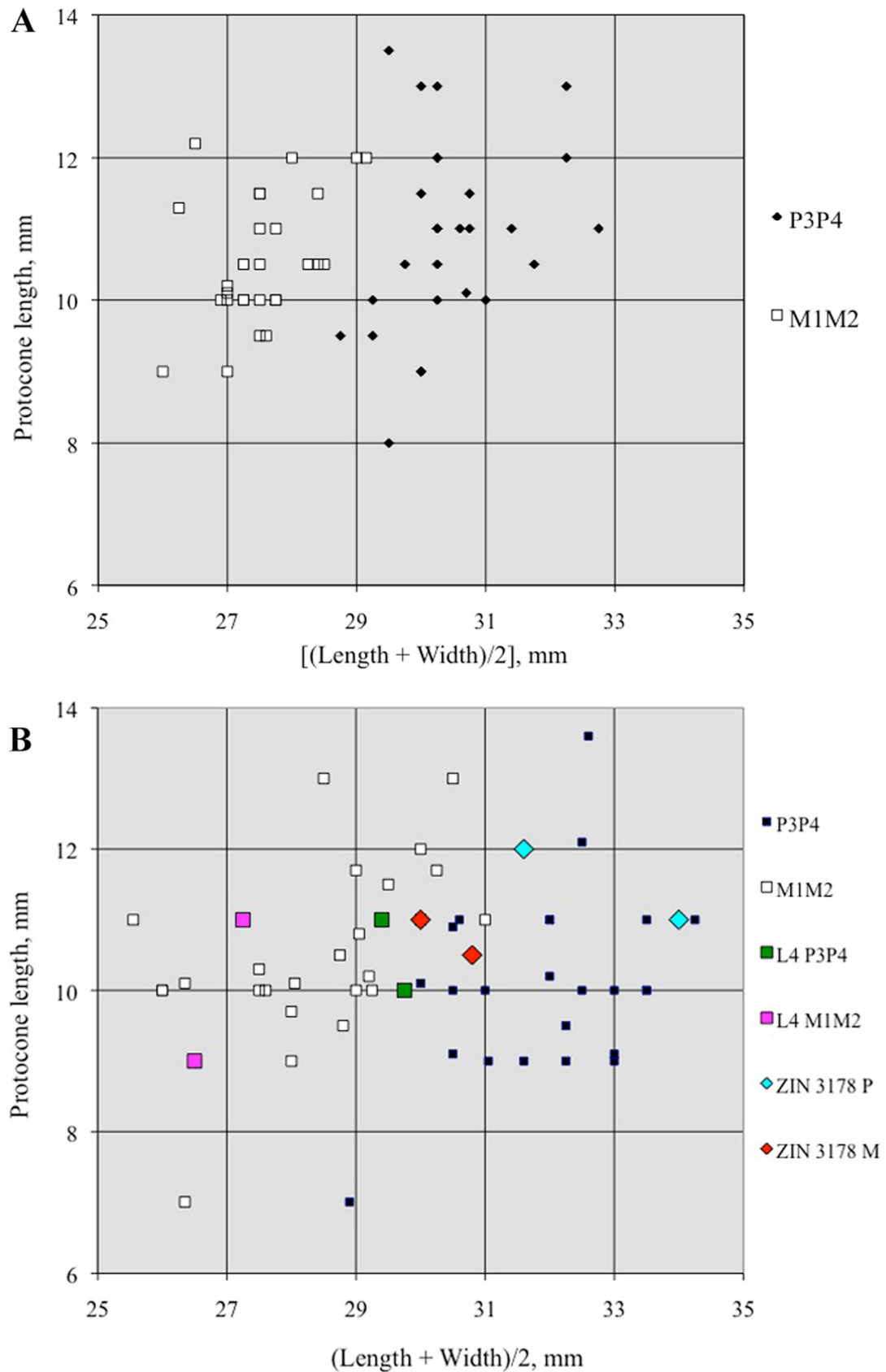


Fig. S5. Scatter diagrams of Upper P3P4 and M1M2 of the Khaprovskii Complex (A) and of *E. (Allohippus) vireti* from Saint-Vallier, France (B).

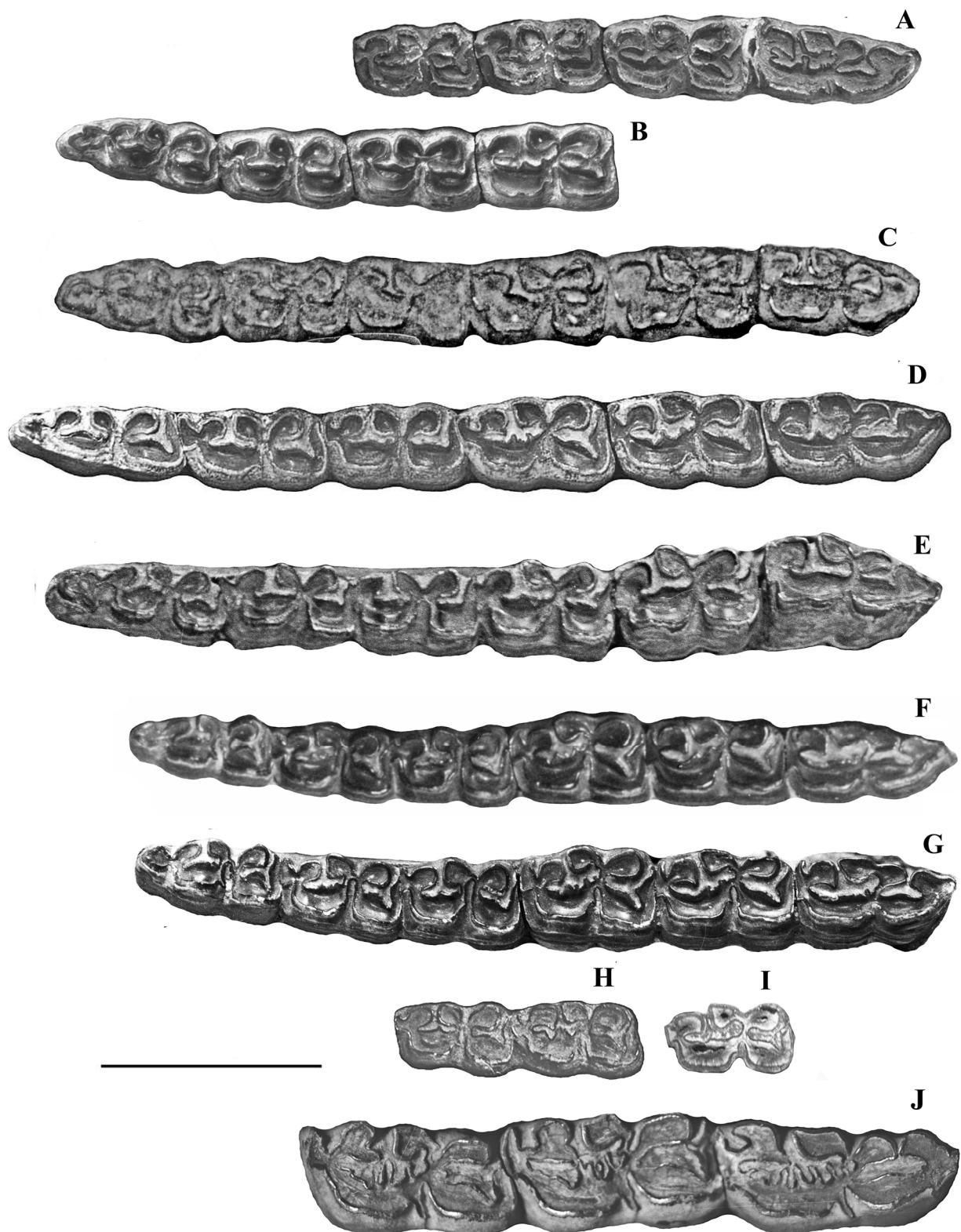


Fig. S6. Lower right cheek teeth from Liventsovka and Volovaya Balka, occlusal views. **A.** Liventsovka RGU 562, P2-M1. **B.** Liventsovka RGU 355, P4-M3. **C.** Liventsovka ROMK L 264, P2-M3. **D.** Liventsovka ROMK L 395, P2-M3. **E.** Liventsovka ROMK L 95, P2-M3. **F.** Liventsovka RGU 2028, P2-M3. **G.** Liventsovka ROMK L 92, P2-M3. **H.** Liventsovka RGU 662, P4-M1. **I.** Liventsovka ROMK L 1233, sectioned P. **J.** Volovaya Balka, GIN 302-10, P2-P4. Scale bar: 5 cm.

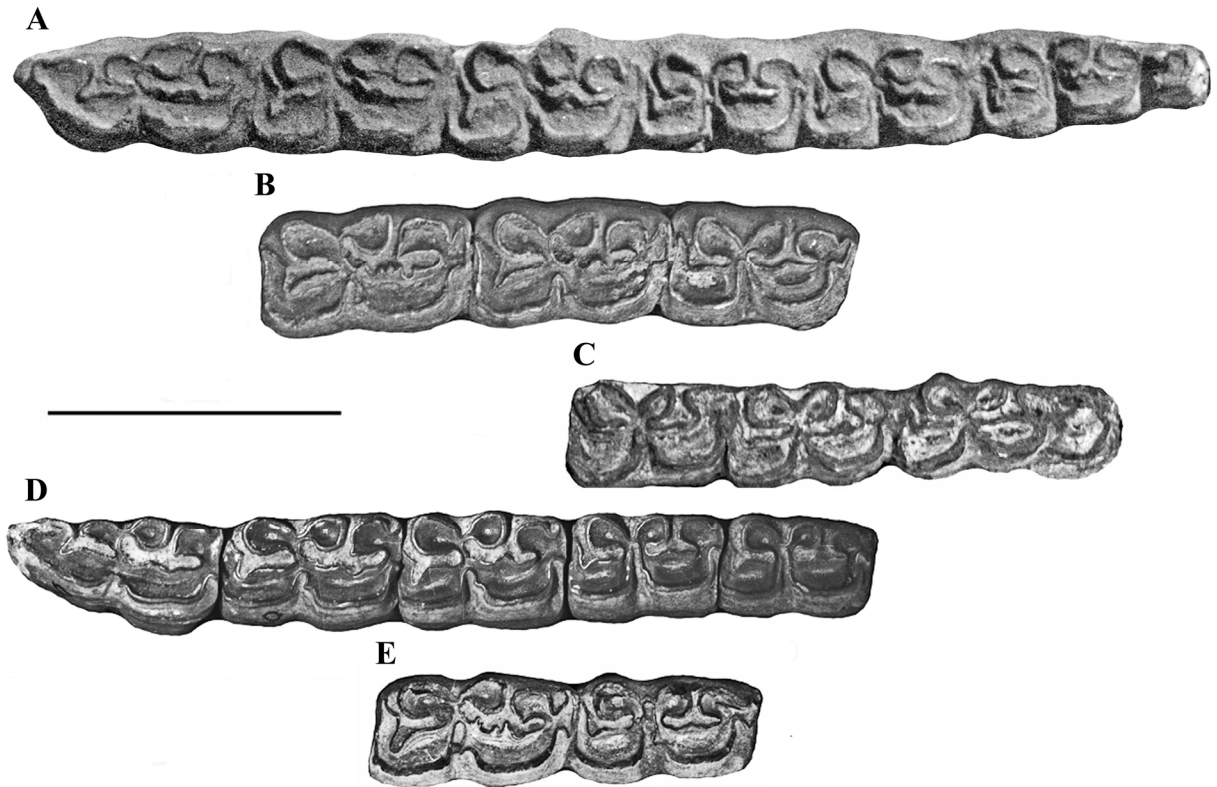


Fig. S7. Lower left cheek teeth from Liventsovka, occlusal views. **A.** ROMK L 229, P2-M3. **B.** RGU 570, P3-M1. **C.** ROMK L 281, M1-M3. **D.** ROMK L 860, P2-M2. **E.** ROMK L 1278, P4-M1. Scale bar: 5 cm.

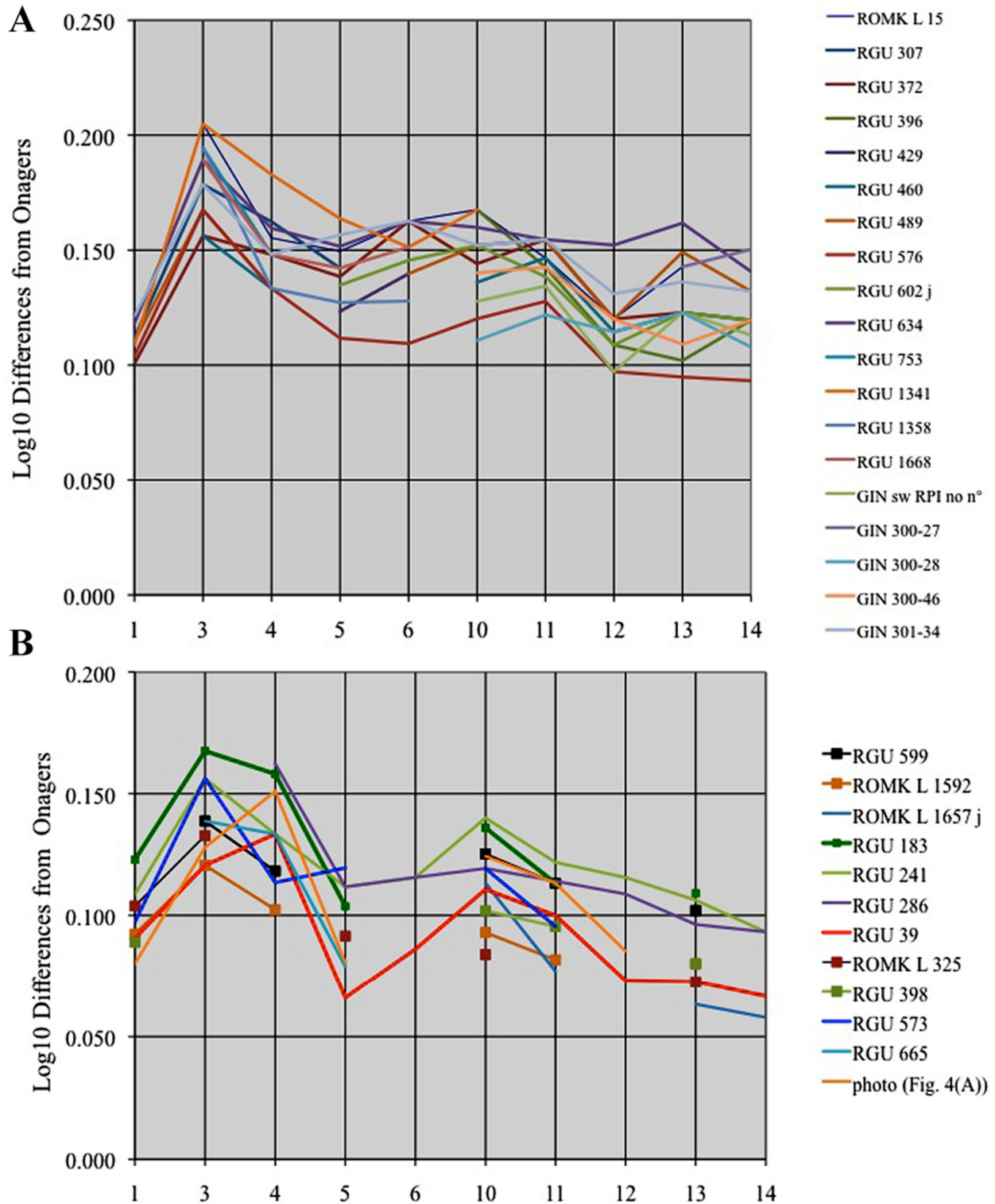


Fig. S8. Simpson's diagram of all MC referred to *E. (A.) aff. major* (A) and to *E. (A.) livenzovensis* (B). 1: Maximal length; 3: Breadth at the middle of the diaphysis; 4: Depth of the diaphysis at the same level; 5: Proximal breadth; 6: Proximal depth; 10: Distal supra-articular breadth; 11: Distal articular breadth; 12: Depth of the sagittal crest; 13: Least depth of the medial condyle; 14: Greatest depth of the medial condyle.

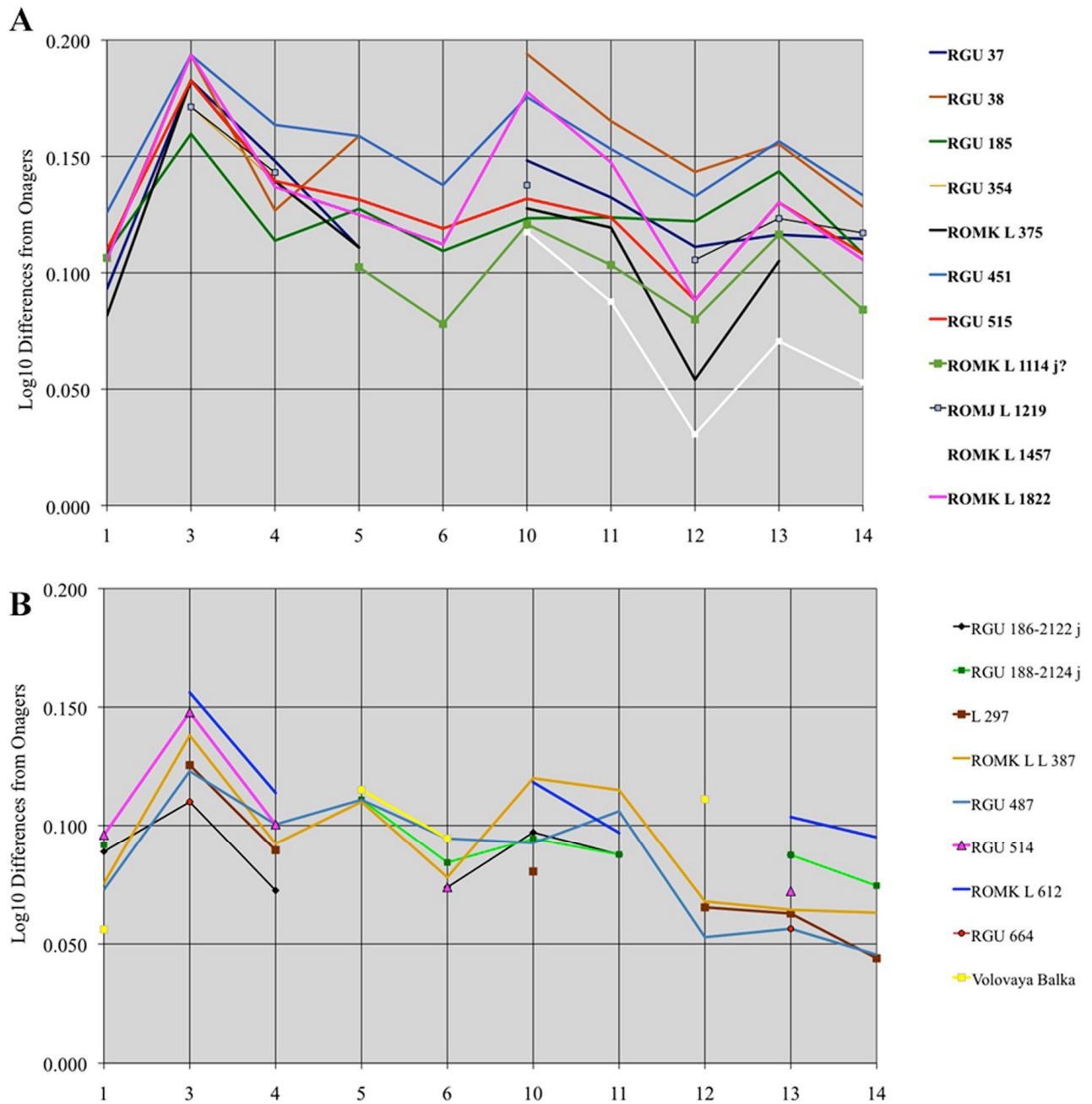


Fig. S9. Simpson's diagram of all MT referred to *E. (A.) aff. major* (**A**) and to *E. (A.) livenzovensis* (**B**). 1: Maximal length; 3: Breadth at the middle of the diaphysis; 4: Depth of the diaphysis at the same level; 5: Proximal breadth; 6: Proximal depth; 10: Distal supra-articular breadth; 11: Distal articular breadth; 12: Depth of the sagittal crest; 13: Least depth of the medial condyle; 14: Greatest depth of the medial condyle.

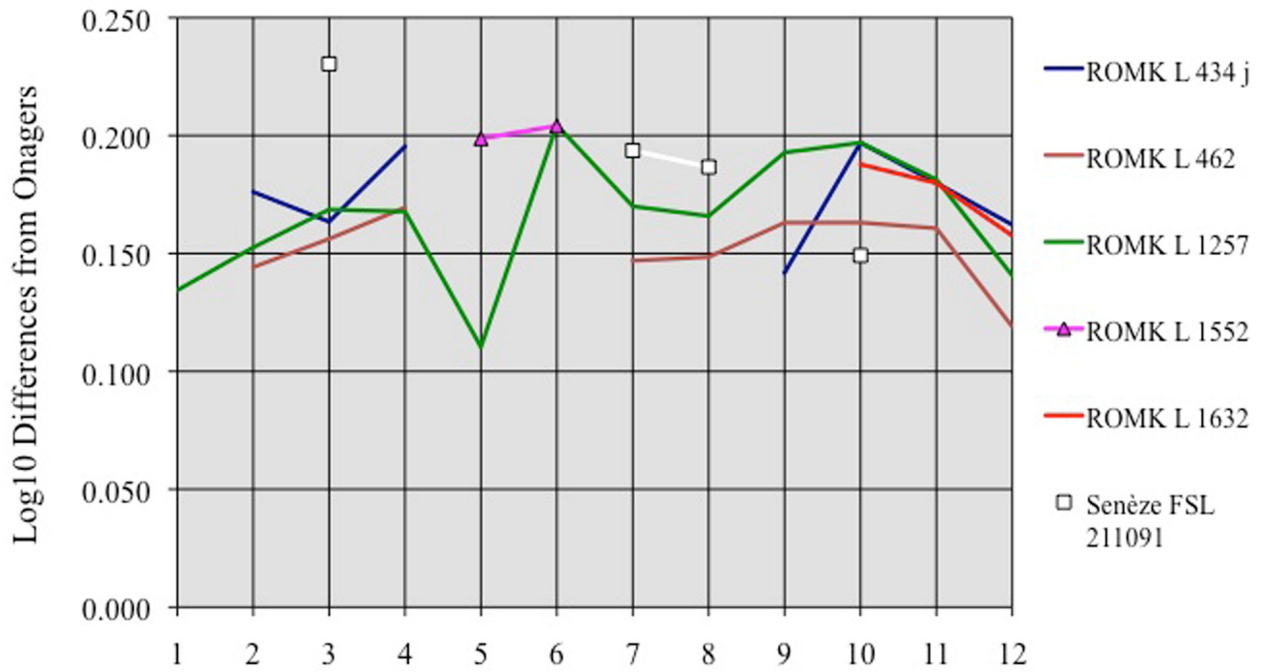


Fig. S10. Simpson's diagram of large Humeri from Liventsovka compared to *E. (A.) major* from Senèze.

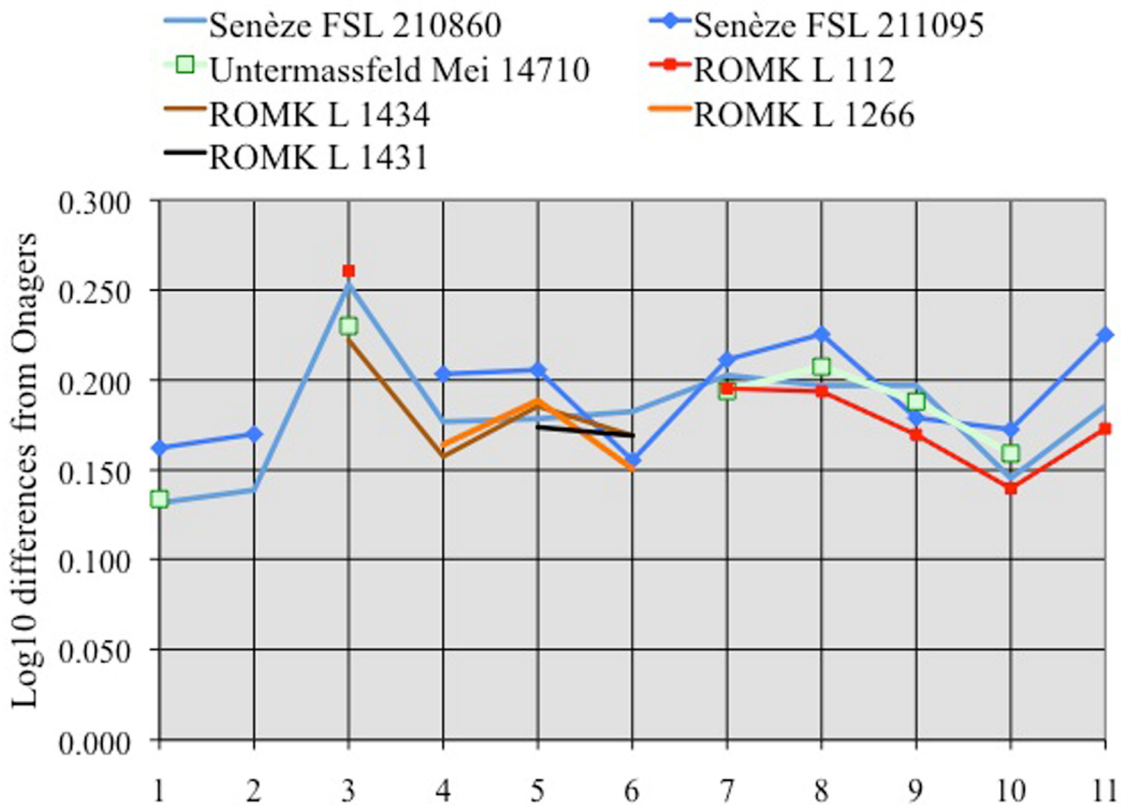


Fig. S11. Simpson's diagrams of large Radii from Liventsovka compared to *E. (A.) major* from Senèze and *E. (Sussemionus) sp.* from Untermassfeld, Germany.

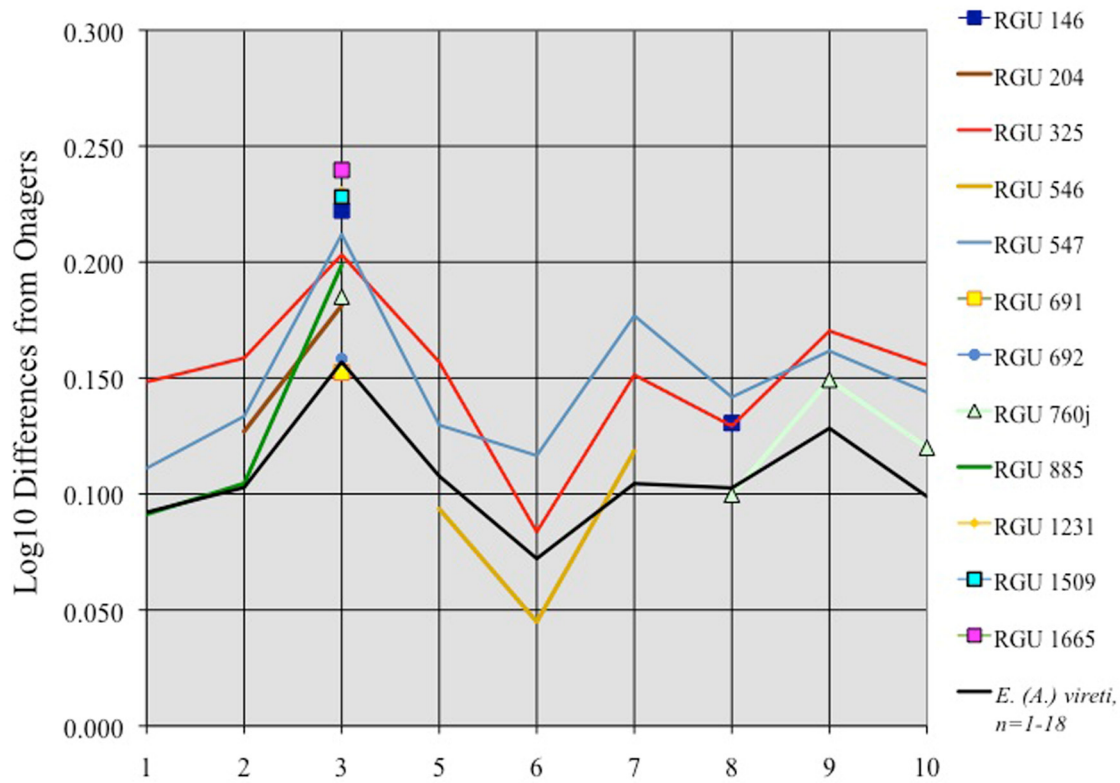


Fig. S12. Simpson's diagram of large Femora from Liventsovka compared to *E. (A.) vireti* from Saint-Vallier.

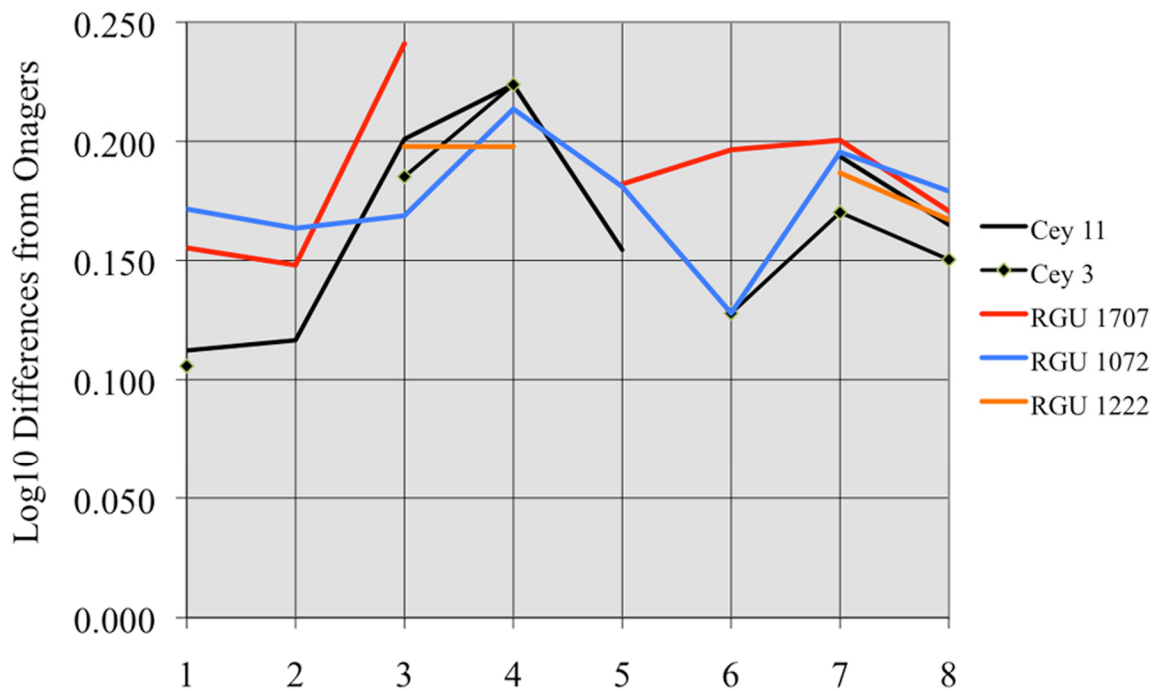


Fig. S13. Simpson's diagram of large Tibiae from Liventsovka compared to *E. (A.)* sp. from Ceysaguet, France.

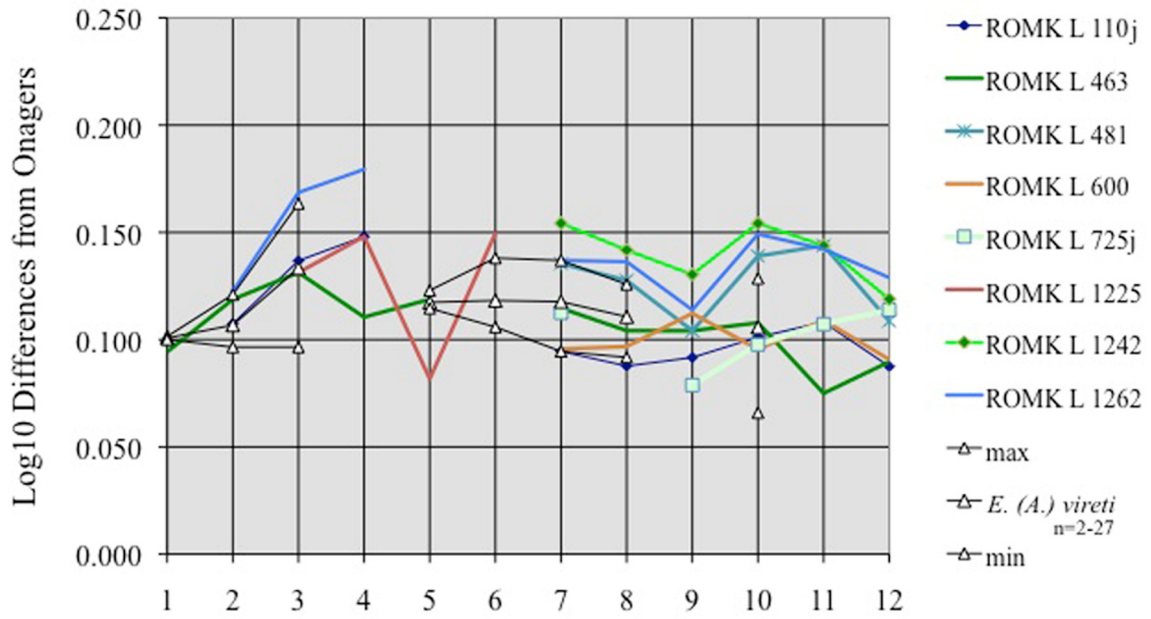


Fig. S14. Simpson's diagram of *E. (A.) livenzovensis* Humeri compared to *E. (A.) vireti* from Saint-Vallier.

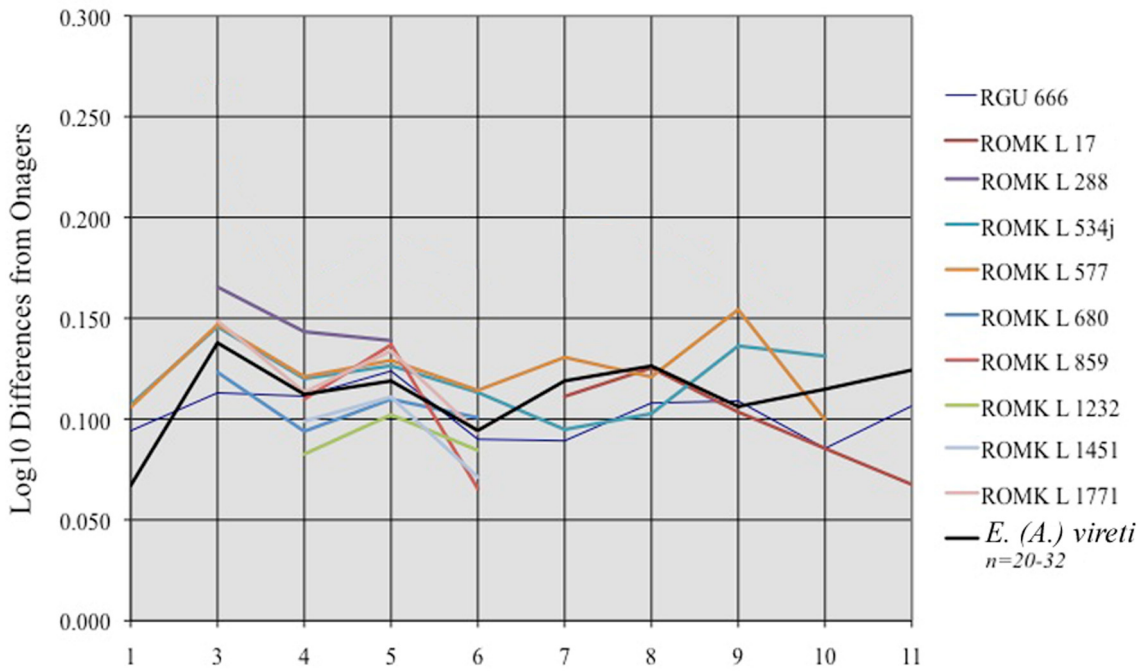


Fig. S15. Simpson's diagram of *E. (A.) livenzovensis* Radii compared to *E. (A.) vireti* from Saint-Vallier.

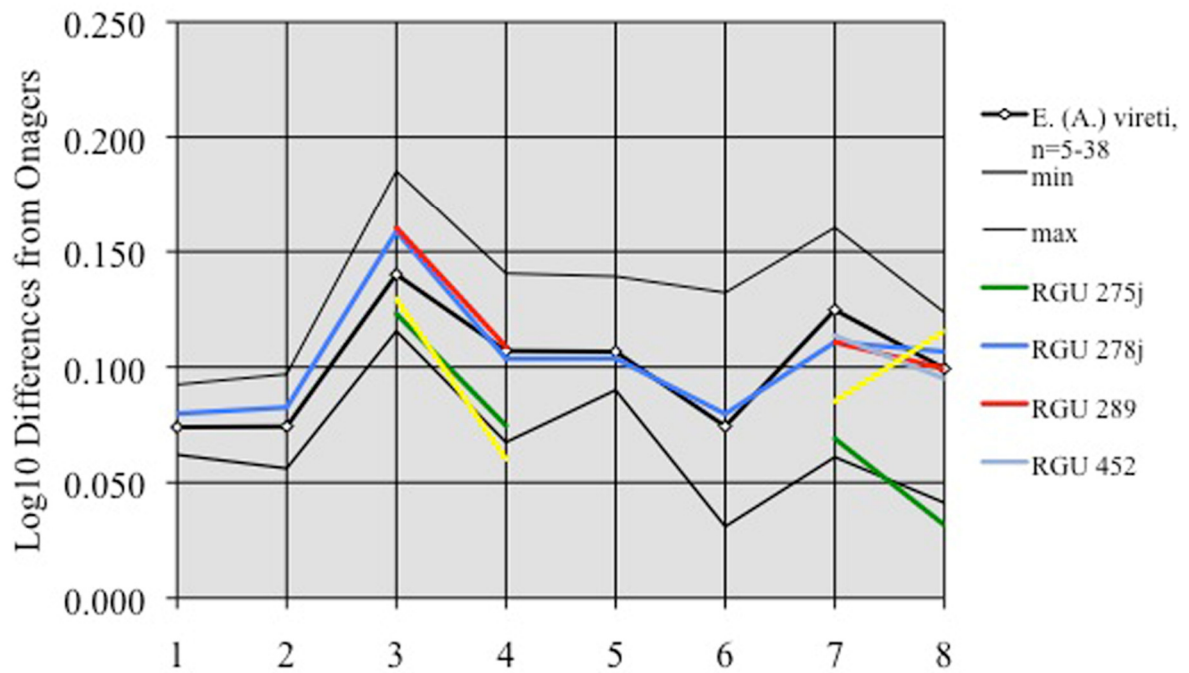


Fig. S16. Simpson's diagram of *E. (A.) livenzovensis* Tibiae compared to *E. (A.) vireti* from Saint-Vallier.

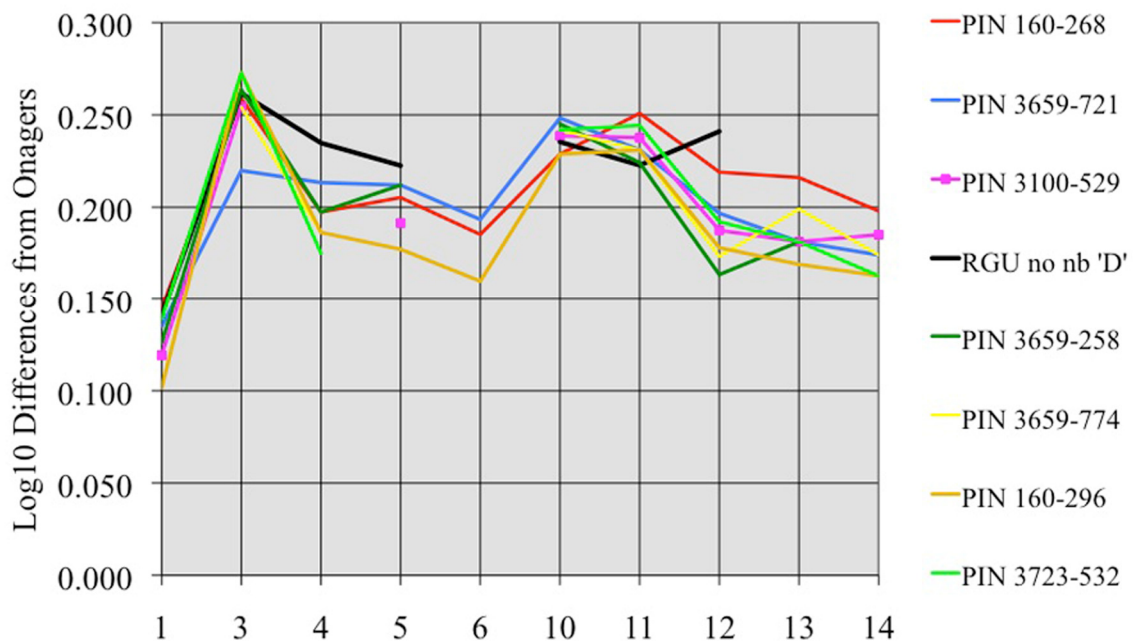


Fig. S17. Simpson's diagrams of MT RGU no number (Fig. 5(E)) compared to MT of *E. (Sussemionus) verae* from Adycha.

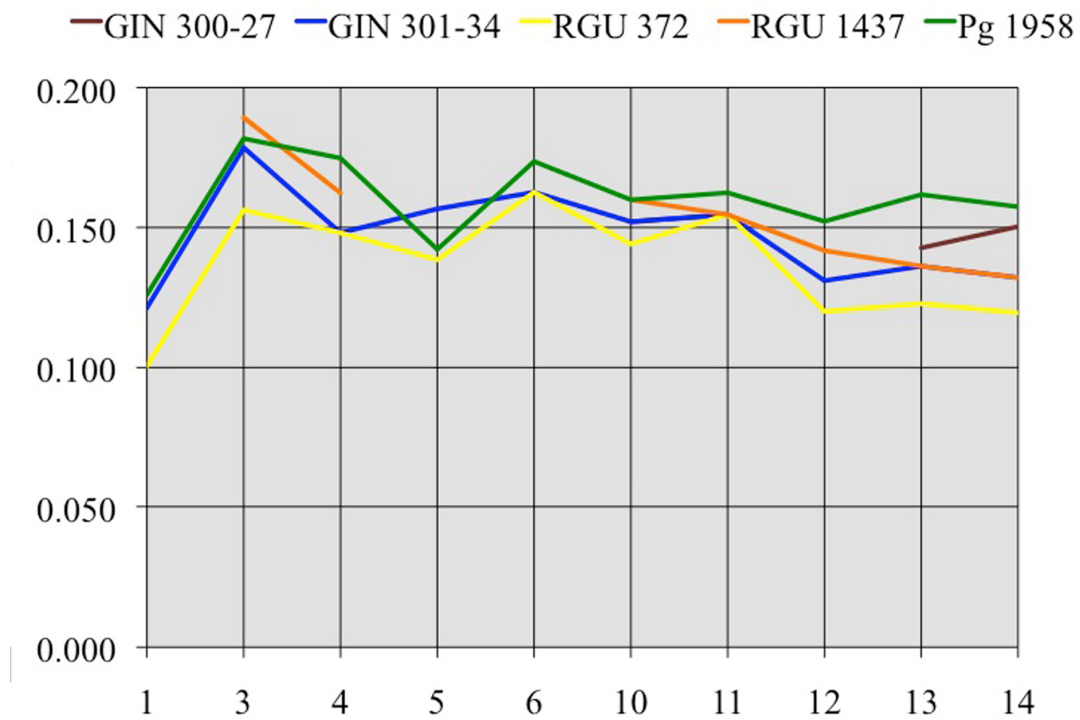


Fig. S18. Simpson's diagrams of MC GIN 300-27 from Khapry, GIN 301-34 from Morskaya and RGU 372 and RGU 1347 from Liventsovka compared to MC of *E. (A.)* sp. from Tegelen, Netherlands.

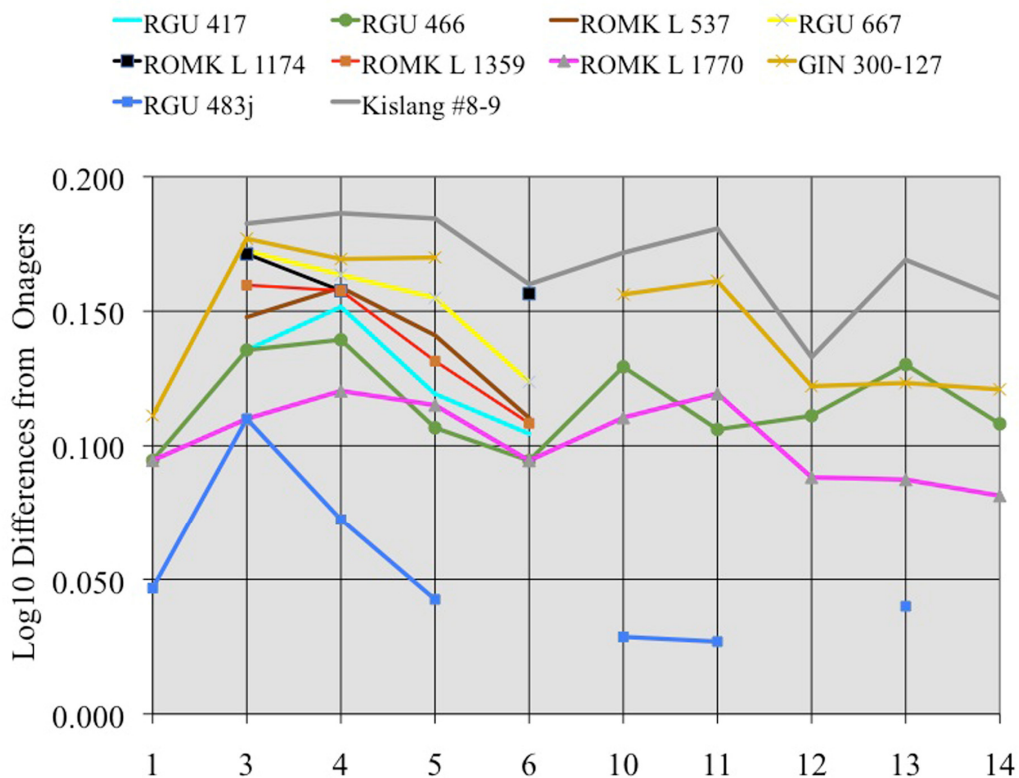


Fig. S19. Simpson's diagrams of various *incertae sedis* MT compared to a MT from Kislant, Hungary.

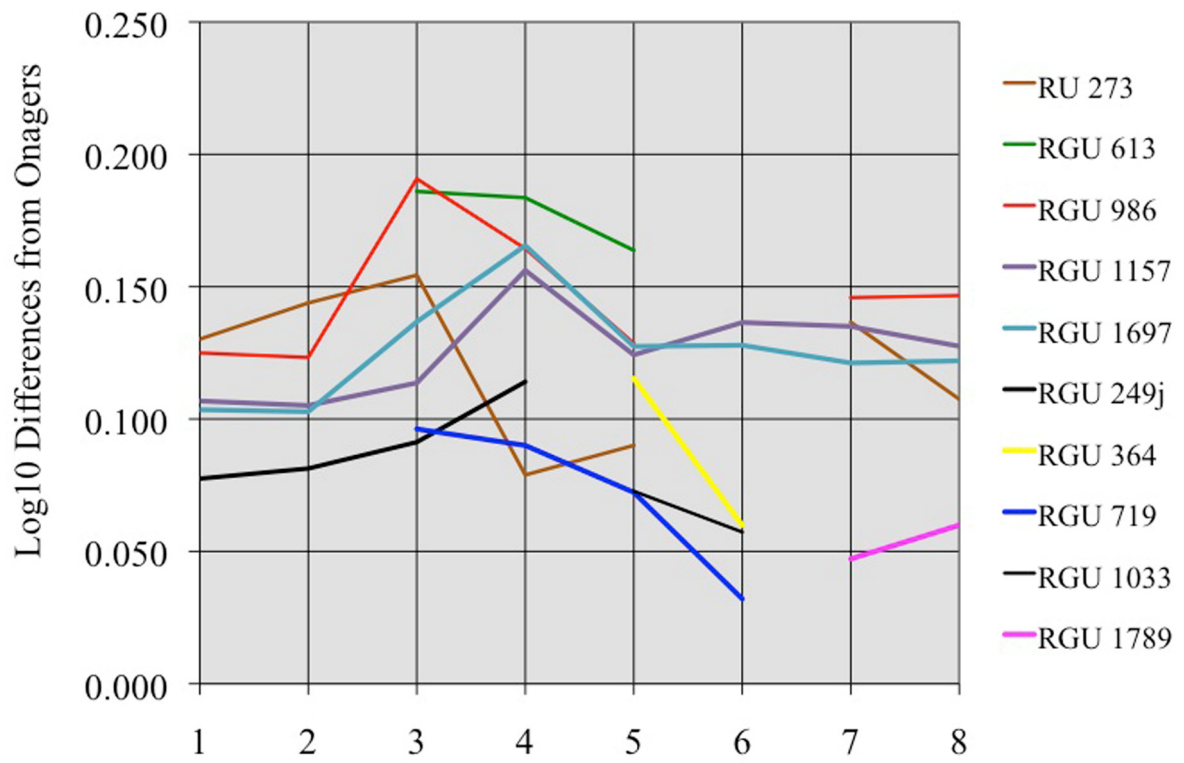


Fig. S20. Simpson's diagrams of various *incertae sedis* Tibiae.