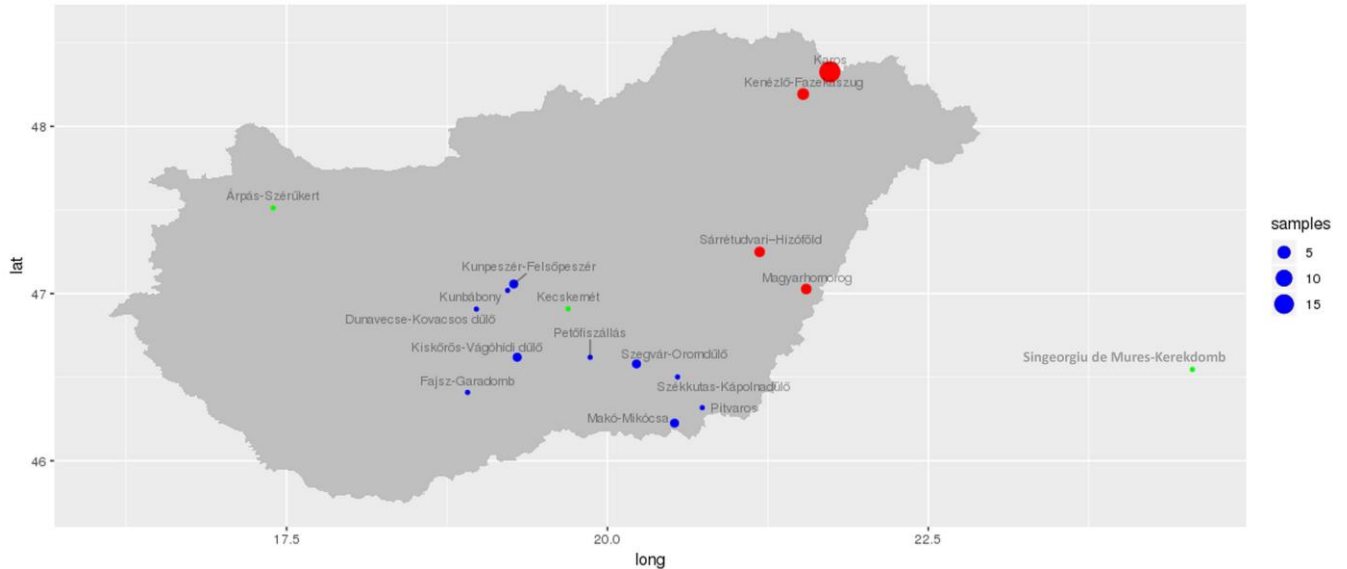


## Supplementary Information

### Y-chromosome haplogroups from Hun, Avar and conquering Hungarian period nomadic people of the Carpathian Basin

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#### Archaeological and anthropological background:



**Location of the cemeteries** reported in this study. Red dots indicate Conqueror cemeteries, blue dots Avar age cemeteries, green dots Hun age cemeteries. Dot size is proportional to sample size as indicated. Map was created with the maps package of R [24].

#### *Hun age graves:*

##### **Árpás-Szerűkert-1**

The lonely grave of a young man was discovered near present day Árpás village (Árpás-Dombföld, Szerűkert, Hungary) in Győr-Moson-Sopron County. The deceased was laid on its back, in a shallow grave with North-South orientation, among the ruins of the Roman Mursella municipium. Grave goods included golden belt buckle, golden trouser and boot-buckles, sabretache with iron knife and forceps. Further findings were jar, glass cup, large bronze bowl, cattle leg bone, sheep sacrum and a golden coating of a probably wooden animal sculpture. The jar and glass cup have Roman parallels, but the funerary custom, costume accessories and animal sculpture have hun age eastern steppe analogies. The finding was dated to the second half of the 5th century AD<sup>1</sup>, when the Huns ruled Pannonia.

##### **Singeorgiu de Mures-Kerekdomb-Grave 1 (Cx. no.41)**

During the construction of the bypass route between Corunca-Ernei (Mureş County, Romania), in the course of preventive excavations, the Archaeological Department of the Mureş County Museum discovered a Roman village and a necropolis dating from the Migration Period (according to the funerary offerings and the funeral rites), near Sângeorgiu de Mureş. The excavations brought to light 19 houses, 15 pits and 3 single-graves. According to the archaeological material the settlement can

be dated to the second half of the 3rd century and the beginning of the 4th century, and the funerary offerings date the cemetery to the end of 4th century and the beginning of 5th century.

The graves were discovered on the upper part of the second terrace of the Terebici River, situated in line. Two graves were located inside the village. Grave no.1 was a partial horse burial oriented North-South, typical for the Migration Period (Huns, Alans, Goths etc.), located inside the settlement, trenched in a Roman period house<sup>2</sup>. Unfortunately, the grave was robbed and the right side of the human skeleton and a significant part of the horse skeleton was destroyed. The preservation of human remains was relatively good, it belonged to a 25–29 years old male with artificially deformed Mongoloid (Eastern-type) skull. The funerary offerings included a grey jug, a bone comb with cap, decorated with concentric circles and bronze plate, four silver bolts, iron knife, golden dagger gripe decorated with almandine and Cornish stone insets. The other burial (grave no. 3 Cx. no 58) was completely robbed, just the mold of the human skeleton in secondary position and remains of a wood construction on the grave's grounds could be observed.

#### **Kecskemét-Mindszenti-dűlő-RL 11/2785.**

During preventive excavation of the expansion of the Mercedes factory on the outskirts of Kecskemét town (Bács-Kiskun County, Hungary) in 2017, near a late Sarmatian-Hunnic age settlement a lonely nomadic niche grave was found, containing a wealthy young male with artificially strongly deformed Mongoloid skull<sup>3</sup>. Grave orientation was North-South, grave goods included a dagger-sword, crescent shaped gold hair ring, a decorated gold leaf, which was probably the decoration of the knife's handle, a belt buckle, another buckle which was suspended the sword, two boot buckles and a Murga-type pottery. All of the buckles were made of silver and plated with gold, which show Hunnic analogies. The grave can be dated back to the Hunnic period on the basis of its findings. The rite of this burial and the findings differ from the traditions of the Sarmatians, who lived in this area during this period. The richness of the grave goods refer to the high social rank of the deceased. The presence of this man suggests that after the arrival of the Huns into the Carpathian Basin, they appointed one of their nobilities as leader of this late Sarmatian community. The deceased could belong to this nobility. (BK)

#### ***Avar age burial sites:***

During the early Avar period (620/625–650/660 AD) the upper third of the Danube–Tisza interfluvium played a prominent historical role, where the solitary, richly furnished burials of high-ranking individuals indicate the seats of various princely leaders<sup>4</sup>. A closed bloc can be noted in this area, where the concentration of prestige items strongly indicates the presence of a power center. One element common to all of the lavish assemblages is that they were recovered from solitary burials, from graves lying far from their community, and that they came from burials with a uniform burial rite, whose main characteristic is the lack of a horse burial or of a horse harness (Kunbábony, Petőfiszállás). Ring-pommel swords with golden fittings and a triple-lobed suspension loop, an emblem of the central power, are the perhaps most typical artifacts among the grave goods. The burials with weapons of the military elite formed a ring around these centers (Fajsz-Garadomb, Dunavecse-Kovacsos dűlő, Kunpeszér-Felsőpeszéri út). The exceptionally lavish Kiskőrös-Vágóhíd cemetery raised the possibility that the power center had survived into the middle Avar period (650/660–700/710). The region's prominent status is indicated by the richly furnished solitary burials and the smaller cemeteries with their swords and sabers adorned with precious metal fittings, the gold earrings and plait clamps, the gilded belt fittings, the metal vessels, the gold foil costume accessories and the coffins and funerary shrouds adorned with gold or gilt bronze ornaments<sup>5</sup>.

#### ***Avar age graves:***

**Dunavecse-Kovacsos dűlő:** During preventive excavation of the M8 motorway on the outskirts of Dunavecse town (Bács-Kiskun County, Hungary) two early Avar period graves (feature 701 and 702) were found by Andrea Lantos 50 m from each other in 2004–2005. The feature 701 was a NW–SE

orientation prestigious male grave, who was buried with belt decorated with pressed silver mounts, sword, bow and quiver <sup>6</sup>. A Byzantine jug was put near the head of the dead. The horse harness (stirrups, bit and head and breast collar and breeching) was put on the chest of the dead, the saddle decorated with bone mount was imposed on his foot. The grave was dated to 630–650/660 AD. (CSB).

**Fajsz-Garadomb:** Eight early Avar-age graves arranged in two irregular and loose line was excavated on the outskirts of Fajsz village (Bács-Kiskun County, Hungary) by Mihály Kőhegyi in 1962. The cemetery, mostly composed of armed men's graves, was the burial site of a large family or genus belonging to the middle class or leadership of Avar society. The skeletons were taxonomically Mongoloid. The deads were buried at 630–650/660 AD.

In the grave 4 lied a Mongoloid mature male skeleton; the man wore silver earrings and a belt decorated with pressed silver pseudo buckle mounts <sup>7</sup>. His bow and quiver with arrowheads was put into the grave. The dead was buried at circa 630 AD. (CSB)

**Kiskőrös-Vágóhídi dűlő:** 67 graves arranged in seven burial-groups of a larger Avar-age cemetery were excavated on the outskirts of Kiskőrös town (Bács-Kiskun County, Hungary) between 1934–1938 <sup>8</sup>. The population of the cemetery taxonomically was Mongoloid. Based on the numerous prestige objects and the gold decorate plates of the clothing and shrouds it seems to be probable, that the cemetery is the richest Middle Avar-age cemetery of the Carpathian Basin, which was used by the rich community of the power elite. The cemetery was dated between 660–720 AD.

In the grave no. I a Mongoloid mature (Sayanic) man was buried with a head-gear decorated with gold mounts and a belt decorated with round shape mounts in the middle with glass fittings. His sword was kidnapped from the grave. A silver snapper calyx was put near the dead. The dead was buried between 660–700 AD. (CSB)

**Kunbábony:** The richest known Avar-age grave was found in the border part called Bábony of Kunszentmiklós town (Bács-Kiskun County, Hungary) by Elvira H. Tóth and Attila Horváth, in 1971 <sup>9</sup>. Two armed man were buried near each other.

In the grave 1 was buried a man who died at the age of 60-70. His skull was Mongoloid type (Baikal type). The old man wore gold earrings, belts decorated with gold mounts. His swords, knives, quiver and bow decorated with gold plates was put into the grave. Between the folded bones were found a gold jug, vessels decorated with gold mounts and a big amphora. dead was covered with shroud decorated gold plates. The Avar leader was buried on a bed decorated with gilded plates, which was covered with a coffin cap. 211 pieces of gold finds were found in the robbed male grave, the total weight of which was 2.33 kg. The grave-goods were dated to 630–660 AD., the burial was around 660 AD. (CSB)

**Kunpeszér-Felsőpeszéri út, Homokbánya:** 32 graves were excavated on the outskirts of Kunpeszér village (Bács-Kiskun County, Hungary) by Elvira H. Tóth <sup>10</sup>, in which 15 graves were dated to the early Avar period, the others were buried in the 8<sup>th</sup> century AD. The early Avar graves were located on the large area, this was not a cemetery, but a loose burial site. Most of the dead were taxonomically Mongoloid <sup>11</sup>. The male graves were rich, they were buried with belt decorated silver and gilded mounts, swords decorated with gold and silver plates, bow, quiver and arrowheads. The female graves were less rich. In the graves were found simple burial attachments.

In the graves 6 and 30/B were buried adult mans. In the grave 6 were found belts decorated with silver and gilded bronze rosette shape mounts, bow and quiver made by birch bark and ten arrowheads. The man buried in the grave 30/B, wore belt decorated with silver round shape mounts; bow, quiver and sword decorated with P shaped silver ears were put into his grave. The graves were buried between 630–660 AD. (CSB)

**Makó-Mikócsa-halom:** During preventive excavation of a factory on the outskirts of the Makó town (Csongrád County, Hungary) a complete early Avar-age cemetery contained 251 graves was excavated by Csilla Balogh, in 2009–2010<sup>12</sup>. On the basis of the burial customs (NE–SW orientation, catacomb and niche grave, large number of the partial sacrificial animals), who joined to the Avars in the Eastern European steppe region the cemetery seems to be used by a population of Eastern European origin<sup>13</sup>. Most of the population was Europid, some skulls had Mongoloid feature. The cemetery was used by the community between 568-630/650 AD.

In the niche grave 56/58 was buried a Mongoloid young man with belt decorated mounts, bow and arrowheads. Into the pit was put a horse with horse harness. The grave was dug between the last third of the 6<sup>th</sup> century and the first third of the 7<sup>th</sup> century.

In the niche grave 218/227 was buried a mature man from Europid taxon origin with belt and shoes decorated with metal mounts. In his grave were found a sword decorated with silver plates, a bow, a quiver with arrowheads and some lamella of an armor. Beside the right leg of the dead, tools for wood, bone/horn and metal processing led (saw, rasp etc.) and in the crucible made by iron plate were found some semi-finished bone bow-application. Based on the unique find-collection in Eurasia and other bone features, the man buried in the grave seem to have been also a master of. The grave can be date to the end of the 6<sup>th</sup> century of the beginning of the 7<sup>th</sup> century. (CSB)

**Petőfiszállás:** During preventive excavation of the construction of the M5 motorway on the outskirts of the Petőfiszállás village (Bács-Kiskun County, Hungary) a lonely rich armed male grave was discovered by Csilla Balogh and Erika Wicker<sup>14</sup>. In the grave a Mongoloid type (Saian type) 40-45 years old man was buried. His ranking belt were decorated with pressed gold mounts, his weapon belt with pressed silver round shaped with gold inlay. He wore gold earrings. In the grave were found a sword decorated with gold plates, quiver decorated with bone mounts, arrowheads and a bow. The grave was dated between 630–650/660 AD. (BCS)

**Pitvaros-Víztározó** 225 graves of the late Avar cemetery on the outskirts of the Pitvaros village (Csongrád County, Hungary) was excavated between 1993–1996 by Lívía Bende<sup>15</sup>. On the basis of the special burial customs the community, which has used this cemetery, seems to have been the descendants of the population of the Eastern European origin known in the early Avar period. The small community, which has opened the cemetery, stretched from the western part of the Transtisza region to the area inside the rivers around the middle of the 7<sup>th</sup> century. The community kept their special burial customs all the way (catacomb graves, partial sacrificial animals etc.). The cemetery was used between 650/660 and the end of the 8<sup>th</sup> century.

The skull of the Europid type mature man buried into the catacomb grave 72 was slightly distorted. The burial customs, primarily the catacomb grave is a characteristic of the population of the Eastern European origin, but the man wore the Meroving-type belt decorated with metal inlay, which was supposed to be a gift from a Meroving cultures community of the Transdanubia<sup>16</sup>. The grave was dated to the turn of the 7<sup>th</sup>-8<sup>th</sup> centuries. (BCS)

**Szegvár-Oromdűlő:** On the outskirts of the Szegvár village (Csongrád County, Hungary) 500 graves of the large Avar-age cemetery were discovered by Gábor Lőrinczy, between 1980 and 1997<sup>17</sup>. On the basis of the special burial customs (NE–SW orientation, complex grave types as niche and catacomb graves, numerous partial sacrificial animals etc.) the cemetery is connected to the population of Eastern European origin, which joined to the Avars in the Eastern European steppe region. The excavated part of the cemetery was used from the end of the 6<sup>th</sup> century to the middle of the 7<sup>th</sup> century.

In the catacomb grave 81 an adult man (his skull was Mongoloid type) led, who was buried according to the burial customs of his community, but the man wore the belt decorated with cast Alpine-type mounts<sup>18</sup>. This belt was most likely a gift to the wearer.

In the niche grave 540 a man led too, into the grave the partial horse with horse harness was put. (BCS–LG)

**Székkutas-Kápolnadúló:** 534 Avar-age graves were discovered on the outskirts of the Székkutas village (Csongrád County) by Katalin B. Nagy between 1965 and 1987<sup>19</sup>. The catacomb graves and the partial sacrificial animals were characteristic of the cemetery. The cemetery was used from the middle of the 7<sup>th</sup> century to the beginning of the 9<sup>th</sup> century.

The grave 51 was a catacomb grave, the grave 239 was simple pit grave, but both were so-called horse-tool funeral, that is into the grave was put just the horse harness. In the graves were buried mature men. On the basis of the Gatér-type belt mounts, the grave 51 seems to have dug rather at the end of the 630 to 650/660 period. The grave 239 was dug later, in the second half or the third quarter of the 7<sup>th</sup> century on the basis of the belt mounts killed from plate. (CSB)

### **Conqueror cemeteries:**

Description of the Karos-Eperjesszög I-II-III, Kenézlő-Fazekaszug I-II and Sárrétudvari-Hízóföld cemeteries were given in<sup>20,21</sup>.

### **Magyarhomorog-Kónya-domb**

This small cemetery is located at the northern border of present day Magyarhomorog village in Hajdú-Bihar County, in the eastern part of the Hungarian Great Plain. It was established in the 10th century on a small plateau on the eastern shore of the swamps of the Sebes Körös River and belongs to the short-lived quarters type of the early Hungarians. The cemetery was excavated by István Dienes and László Kovács<sup>22,23</sup>. In the 17 tombs there were 11 men, three women and three infants buried in three rows of graves. Four graves (1, 9, 16, 23) were typical partial horse burials of the early Hungarians containing horse cranium with leg bones and harness objects. 7 men and the oldest child (12-14 years old) were buried with parts of archery equipment. The possibly richest man's grave (9) was robbed, and into another man's tomb (15) later a body of a wolf was dug. Decades later, at the beginning of the 11th century, a large village cemetery of 523 graves was built on the same ridge.

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**Summary of anthropological data: NA = lack of data**

LabID	Sample site/grave or accession number	Age	Age	Anthropological type	Y- Haplogroup
<b>Hun period</b>					
Hun/1	Singeorgiu de Mures/1	V. century	25–29	Mongolid, artificially deformed skull	Q1a2
Hun/2	Kecskemét-Mindszenti-dűlő/2785	V. century	18-20	artificially strongly deformed skull with Mongolid features	R1b1a1b1a1a1
Hun/3	Árpás-Szerúskert/1	V. century	25-30	Mongoloid (broad-faced) with Europid characters	R1a1a1b2a2
<b>early Avar period</b>					
FGD/4	Fajsz-Garadomb/4	630–650/660	NA	Mongoloid	C2
PSZ/1	Petőfiszállás	630–650/660	40-45	Mongoloid, Sayanic type (broad-faced, brachyran)	G2a
SzO/540	Szegvár-Oromdűlő/540	600–650/660	18-20	NA (fragmented)	I1
SzO/81	Szegvár-Oromdűlő/81	600–650/660	30-35	Europid (Cromagnoid-B-x)	N1a1a1a1a3
KFP/6	Kunpeszér-Felsőpeszér/6	630–650/660	26-35	NA (fragmented)	N1a1a1a1a3
KFP/31	Kunpeszér-Felsőpeszér/30B	630–650/660	23-39	NA (fragmented)	N1a1a1a1a3
SzK/51	Székkutas-Kápolnadűlő/51	630/650–660	40-59	fragmented skull with Mongolid features	N1a1a1a1a3
KB/300	Kunbábony ( <b>khagan</b> )	630–650/660	60-70	Mongoloid, Baicalic type with some Europid features	N1a1a
MM/58	Makó-Mikócsa/56-58	568–630	18-39	Mongoloid	N1a1a
MM/227	Makó-Mikócsa/218-227	568–630	40-59	Europid	R1a1a1b2a
DK/701	Dunavecse-Kovacsos dűlő/701	630–650/660	NA	NA	R1a1a1b2a
<b>middle and late Avar period</b>					
PV/72	Pitvaros/72	650/660–700/710	40-59	NA (fragmented), slightly artificially deformed skull	C2
KV/3369	Kiskőrös-Vágóhíd/3369	650/660–700	40-59	Mongoloid (Sayanic)	N1a1a1a1a3
SzK/239	Székkutas-Kápolnadűlő/239	650/660–700/710	40-59	fragmented skull with Mongolid features	E1b1b1a1b1a
<b>Conqueror period</b>					
K1/13	Karos I/13	895- mid Xth c.	40-59	Europid (Cromagnoid-A)	E1b1b
K1/1438	Karos I/1438	895- mid Xth c.	18-39	Europid (Eu-t-p)	J1
K1/1	Karos I/1	895- mid Xth c.	18-39	NA	N1a1a1a1a4
K1/10	Karos I/10	895- mid Xth c.	40-59	NA	R1a1a1b1a2b
K1/3286	Karos I/3286	895- mid Xth c.	40-59	Europid (Cromagnoid-A)	R1a1a1b2a2
K2/6	Karos II/6	895- mid Xth c.	60-	Europid (Eu-t-p)	E1b1b1a1b1a
K2/33	Karos II/33	895- mid Xth c.	15-17	NA	G2a2b
K2/26	Karosc II/26	895- mid Xth c.	18-39	NA	I1
K2/16	Karos II/16	895- mid Xth c.	60-	Europid (Cromagnoid-B)	I2a1a2b

K2/52	Karos II/52 ( <b>leader</b> )	895- mid Xth c.	40-59	Europid (Armenoid-t-p)	I2a1a2b
K2/51	Karos II/51	895- mid Xth c.	40-59	NA	N1a1a1a1a4
K2/29	Karos II/29	895- mid Xth c.	18-39	NA	N1a1a1a1a2
K2/61	Karos II/61	895- mid Xth c.	60-	Europo-Mongoloid (p-t)	R1a1a1b2a2
K2/36	Karos II/36	895- mid Xth c.	40 – 59	Europid (CrC-p)	R1a1a1b1
K2/41	Karos II/41	895- mid Xth c.	40 – 59	Europo-Mongoloid (p-CrC)	R1a1a1b1a2b
K2/18	Karos II/18	895- mid Xth c.	60-	NA	R1a1a1b1a2b
K3/12	Karos III/12	895- mid Xth c.	40 – 59	Europid (CrC-p)	I2a1a2b
K3/1	Karos III/1	895- mid Xth c.	40 – 59	Europid (p-t)	R1b1a1b1a1a1
K3/13	Karos III/13	895- mid Xth c.	40 – 59	NA	R1b1a1b1a1a1
K3/3	Karos III/3	895- mid Xth c.	60-	NA	R1b1a1b1a1a1
KeF1/10936	Kenézlő-Fazekaszug I/10936	895- mid Xth c.	18-39	Europo-Mongoloid	Q1a
KeF2/1025	Kenézlő-Fazekaszug II/1025	895- mid Xth c.	18-39	East-Mediterranean	R1b1a1b
KeF2/1027	Kenézlő-Fazekaszug II/1027	895- mid Xth c.	40 – 59	NA	N1a1a1a1a2
KeF2/1045	Kenézlő-Fazekaszug II/1045	895- mid Xth c.	18-39	Europo-Mongoloid	N1a1a1a1a2
MH/15	Magyarhomorog/15	Xth c.	40-45	Europid (Cromagnoid-B) with some Mongoloid characters	I2a1a2b
MH/16	Magyarhomorog/16	Xth c.	40-45	Europo-Mongoloid Turanid (Cromagnoid-B)	I2a1a2b
MH/9	Magyarhomorog/9	Xth c.	40-45	Europid (Cromagnoid-B-x)	I2a1a2
SH/41	Sárrétudvari–Hízó föld/41	Xth c. second half	18-39	Europid	R1b1a1b1a1a2b
SH/81	Sárrétudvari–Hízó föld/81	Xth c. second half	18-39	Europid	J2a1a