Supplementary material

The full mitochondrial genomes of Mangalica pig breeds and their possible origin

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Supplementary Table S1. Mitogenomes used in this study.
References for Table S1.
Supplementary Figure S1. Phylogenetic tree of the mitogenomes in Table S1.
Supplementary Figure S2. Alignment of Mangalica mitogenomes.
Supplementary Figure S3. The number of SNP differences between Mangalica mitogenomes.
Supplementary Figure S4. D-loop haplotypes of the individual pigs in the European clade of the phylogenetic tree (Fig. 1), according to Marincs et al. (2013).
**Supplementary Table S1.** Mitogenomes used in this study.

| Accession number | Country of sequence deposition | Origin | Breed | Reference |
|------------------|--------------------------------|--------|-------|-----------|
| KF888634         | China                          | Asian  | Bama  | Yang et al. 2016 |
| KP126939         | China                          | Asian  | Bama xiang | Unpublished |
| EF545583         | China                          | Asian  | Bamei | Wu et al. 2007b |
| GQ220328         | China                          | Asian  | Banna | Unpublished |
| KP789021         | China                          | Asian  | Bearded pig | Unpublished |
| AY574045         | South Korea                    | European | Berkshire | Unpublished |
| KC505410         | China                          | European | Berkshire | Unpublished |
| KP765602         | China                          | European | Berkshire | Unpublished |
| EF545590         | China                          | Asian  | Bihu  | Wu et al. 2007b |
| MF183222         | Hungary                        | European | Blond Mangalica | This study |
| JN601067         | USA                            | European | Blond Mangalica | Cannon et al. 2015 |
| JN601066         | USA                            | European | Blond Mangalica | Cannon et al. 2015 |
| KP765603         | China                          | Asian  | Chenghua | Unpublished |
| KM250424         | China                          | Asian  | Congjiang | Ran et al. 2016 |
| KP294522         | China                          | Asian  | Dabieshan | Unpublished |
| GQ220329         | China                          | Asian  | Dahe  | Unpublished |
| KM200762         | China                          | Asian  | Dahuabai | Unpublished |
| KF472179         | China                          | Asian  | Daweizi | Xu et al. 2015a |
| KM044240         | China                          | Asian  | Diannan | Wang et al. 2016 |
| KJ737417         | China                          | Asian  | Ding Yuan | Unpublished |
| MF183225         | Hungary                        | European | Duroc | This study |
| AY337045         | South Korea                    | European | Duroc | Unpublished |
| KF767444         | China                          | European | Duroc | Unpublished |
| FJ236997         | Spain                          | European | Duroc | Unpublished |
| FJ236996         | Spain                          | European | Duroc | Unpublished |
| AJ002189         | Sweden                         | European | Duroc | Ursing and Arnason 1998 |
| KM101042         | China                          | Asian  | Guanling | Unpublished |
| AY574046         | South Korea                    | European | Hampshire | Unpublished |
| KJ737418         | China                          | Asian  | Hang  | Unpublished |
| KJ737419         | China                          | Asian  | Huai  | Unpublished |
| KJ737420         | China                          | Asian  | Huo shou | Unpublished |
| EF545587         | China                          | Asian  | Huzu  | Wu et al. 2007b |
| EF545588         | China                          | Asian  | Huzu  | Wu et al. 2007b |
| FJ236991         | Spain                          | European | Iberian | Unpublished |
| FJ236992         | Spain                          | European | Iberian | Unpublished |
| FJ236993         | Spain                          | European | Iberian | Unpublished |
| FJ236994         | Spain                          | European | Iberian | Unpublished |
| FJ236995         | Spain                          | European | Iberian | Unpublished |
| EU117375         | Spain                          | European | Iberian | Unpublished |
| AY334492         | South Korea                    | Asian  | Jeju  | Unpublished |
| DQ334861         | South Korea                    | Asian  | Jeju  | Unpublished |
| Accession | Origin  | Breed                  | Region     | Other Information |
|-----------|---------|------------------------|------------|-------------------|
| DQ334860  | South Korea | Asian | Jeju | Unpublished       |
| DQ274110  | South Korea | Asian | Jeju | Unpublished       |
| KC469586  | China     | Asian | Jinhua | Yu et al. 2013   |
| KJ737421  | China     | Asian | Laiwu | Unpublished       |
| KJ720205  | China     | Asian | Laiwu | Unpublished       |
| AF034253  | Taiwan    | European | Landrace | Lin et al. 1999  |
| NC000845  | Taiwan    | European | Landrace | Lin et al. 1999  |
| KM101043  | China     | Asian | Lantang | Ran et al. 2016   |
| KC250274  | China     | Asian | Lantang | Yu et al. 2013   |
| EF375877  | Taiwan    | Asian | Lanyu Type I | Wu et al. 2007a  |
| DQ972936  | Taiwan    | Asian | Lanyu Type II | Wu et al. 2007a  |
| AY574048  | South Korea | European | Large White | Unpublished |
| KC250275  | China     | European | Large White | Yu et al. 2013   |
| KP257598  | China     | Asian | Liangshan | Unpublished       |
| KP681242  | China     | Asian | Lingao | Unpublished       |
| KJ737422  | China     | Asian | Longlin | Unpublished       |
| KM433673  | China     | Asian | Longlin | Hu et al. 2016   |
| KJ737423  | China     | Asian | Luchuan | Unpublished       |
| KP126954  | China     | Asian | Luchuan | Zhang et al. 2016 |
| KM275217  | China     | Asian | Luchuan | Unpublished       |
| KJ746662  | China     | Asian | Ma shen | Unpublished       |
| KJ746666  | China     | European | Mangalica | Unpublished       |
| KM998967  | China     | Asian | Meishan | Unpublished       |
| JN601071  | USA       | Asian | Meishan | Unpublished       |
| JN601070  | USA       | Asian | Meishan | Unpublished       |
| KF971862  | China     | Asian | Min | Unpublished       |
| KJ746663  | China     | Asian | Neijiang | Unpublished       |
| KC505406  | China     | Asian | Neijiang | Unpublished       |
| KF472178  | China     | Asian | Ningxiang | Xu et al. 2015c  |
| DQ466081  | China     | Asian | Nuogu | Unpublished       |
| KJ746664  | China     | Asian | Penzhou | Unpublished       |
| KC505407  | China     | Asian | Penzhou | Unpublished       |
| KC469587  | China     | European | Pietrain | Yu et al. 2013   |
| KF660222  | China     | Asian | Qianshao | Unpublished       |
| EF545582  | China     | Asian | Qingping | Wu et al. 2007b   |
| EF545581  | China     | Asian | Qingping | Wu et al. 2007b   |
| KP257599  | China     | Asian | Qingyu | Unpublished       |
| MF183223  | Hungary   | European | Red Mangalica | This study       |
| KM044239  | China     | Asian | Rongchang | Wang et al. 2016   |
| EF545567  | China     | Asian | Saba | Wu et al. 2007b   |
| KM094194  | China     | Asian | Sandu | Wang et al. 2016   |
| KF472177  | China     | Asian | Shaziling | Xu et al. 2015d   |
| MF183224  | Hungary   | European | Swallow-belly Mangalica | This study   |
| JN601069  | USA       | European | Swallow-belly Mangalica | Cannon et al. 2015   |
| JN601068  | USA       | European | Swallow-belly Mangalica | Cannon et al. 2015   |
| Accession | Country | Region | City | Status |
|-----------|---------|--------|------|--------|
| KF601700  | China   | Asian  | Taoyuan | Unpublished |
| DQ534707  | Taiwan  | Asian  | Taoyuan | Unpublished |
| KM073256  | China   | Asian  | Tibetan | Unpublished |
| KC493612  | China   | Asian  | Tibetan | Unpublished |
| KC493611  | China   | Asian  | Tibetan | Unpublished |
| KC493610  | China   | Asian  | Tibetan | Unpublished |
| KC493609  | China   | Asian  | Tibetan | Unpublished |
| KC493608  | China   | Asian  | Tibetan | Unpublished |
| KC493607  | China   | Asian  | Tibetan | Unpublished |
| JN601073  | USA     | European | Turopolje | Cannon et a. 2015 |
| JN601072  | USA     | European | Turopolje | Cannon et a. 2015 |
| EF545577  | China   | Asian  | Wei    | Wu et al. 2007b |
| KP681244  | China   | Asian  | Wenchang | Unpublished |
| KP765604  | China   | Asian  | Wuhuang | Unpublished |
| KC505408  | China   | Asian  | Wujin   | Unpublished |
| KM259826  | China   | Asian  | Wuyi    | Xiao et al. 2016 |
| KF767443  | China   | Asian  | Wuzhishan | Unpublished |
| KP681243  | China   | Asian  | Wuzhishan | Unpublished |
| KJ909516  | China   | Asian  | Wuzhishan | Unpublished |
| KC250273  | China   | Asian  | Xiang   | Yu et al. 2013 |
| EF545593  | China   | Asian  | Xiang   | Wu et al. 2007b |
| KJ746665  | China   | Asian  | Ya cha  | Unpublished |
| KC505409  | China   | Asian  | Yanan   | Unpublished |
| EF545589  | China   | Asian  | Yimenghei | Wu et al. 2007b |
| KF752550  | China   | European | Yorkshire | Xu et al. 2016 |
| KF569218  | China   | European | Yorkshire | Xu et al. 2015b |
| JN601075  | USA     | European | Yorkshire | Cannon et a. 2015 |
| JN601074  | USA     | European | Yorkshire | Cannon et a. 2015 |
| EF545576  | China   | Asian  | Zang    | Wu et al. 2007b |

1 Phylogenetic analysis placed these individuals into the Asian clade, indicating introgression of Asian mtDNA into these animals.
References for Table S1.

Cannon MV, Brandebourg TD, Kohn MC, Đikić D, Irwin MH, Pinkert CA. (2015). Mitochondrial DNA sequence and phylogenetic evaluation of geographically disparate Sus scrofa breeds, Anim Biotechnol 26:17-28.

Hu X, Xiao D, Li W. (2016). The complete sequence of the mitochondrial genome of Longlin pig (Sus scrofa). Mitochondrial DNA Part A 27:1736-1737.

Lin CS, Sun YL, Liu CY, Yang PC, Chang LC, Cheng IC, Mao SJ, Huang MC. (1999). Complete nucleotide sequence of pig (Sus scrofa) mitochondrial genome and dating evolutionary divergence within Artiodactyla. Gene 236:107-114.

Ran ML, Wang MF, Yang AQ, Li Z, Chen B. (2016). The complete mitochondrial genome of Congjiang miniature pig (Sus scrofa). Mitochondrial DNA Part A 27:1787-1788.

Ursing BM, Arnason U. (1998). The complete mitochondrial DNA sequence of the pig (Sus scrofa). J Mol Evol 47:302 306.

Wang LY, Xu D, Xiao DF, Ma HM. (2016). The complete mitochondrial genome sequence of Diannan small-ear pig (Sus scrofa). Mitochondrial DNA Part A 27:1309-1310.

Wu CY, Jiang YN, Chu HP, Li SH, Wang Y, Li YH, Chang Y, Ju YT. (2007a). The type I Lanyu pig has a maternal genetic lineage distinct from Asian and European pigs. Anim Genet 38:499-505.

Wu GS, Yao YG, Qu KX, Ding ZL, Li H, Palanichamy MG, Duan ZY, Li N, Chen YS, Zhang YP. (2007b). Population phylogenomic analysis of mitochondrial DNA in wild boars and domestic pigs revealed multiple domestication events in East Asia. Genome Biol 8:R245.

Xiao D, Hu X, Chen Y, Gong Z, Chen L. (2016). The complete sequence of mitochondrial genome of Wuyi Black pig (Sus Scrofa). Mitochondrial DNA Part A 27:1585-1586.

Xu D, He CQ, Li QH, He J, Ma HM. (2015a). The complete mitochondrial genome of the Daweizi pig. Mitochondrial DNA 26:640-641.

Xu D, He CQ, He J, Yang H, Ma HM. (2015b). Mitochondrial DNA sequence of the hybrid of Duroc (♂) x [Landrace (♂) x Yorkshire (♀)] pig. Mitochondrial DNA 26:682-683.

Xu D, Li QH, He CQ, Chai YL, Ma HM. (2015c). The complete mitochondrial genome of the Ningxiang pig. Mitochondrial DNA 26:623-624.

Xu D, Li QH, He CQ, Wang LY, Ma HM. (2015d). The complete mitochondrial genome of the Shaziling pig. Mitochondrial DNA 26:619-620.

Xu D, Yang H, Ma H. (2016). The complete mitochondrial genome of the Yorkshire pig (Sus scrofa). Mitochondrial DNA Part A 27:641-642.
Yang H, Xu XL, Xu D, Ma HM, Li LL. (2016). The complete sequence of mitochondrial genome of Bama miniature pig (Sus scrofa). Mitochondrial DNA Part A 27:238-239.

Yu G, Xiang H, Wang J, Zhao X. (2013). The phylogenetic status of typical Chinese native pigs: analyzed by Asian and European pig mitochondrial genome sequences. J Anim Sci Biotechnol 8:9.

Zhang Y, Xie Z, Deng X, Xie Z, Liu J, Xie L, Luo S, Huang L, Huang J, Zeng T, Wang S. Mitochondrial genome of the Luchuan pig (Sus scrofa). (2016). Mitochondrial DNA Part A 27:4139-4141.
Supplementary Figure S1. Phylogenetic tree of the mitogenomes in Table S1.
The genome sequenced Mangalica individuals (Molnár et al. 2014) are labelled by a diamond. Scale bar represents branch length (substitution per site).
Supplementary Figure S2. Alignment of Mangalica mitogenomes.

Indels are represented by vertical white lines in the aligned sequences. Black arrow indicates the larger 90/50 bp indel.
Supplementary Figure S3. The number of SNP differences between Mangalica and Turopolje mitogenomes.

In the matrix, numbers and colored scales indicate the number of SNP differences between the individuals.

| Sample Name | Blond Mangalica _4S_MF183222_Hungary | Swallow-belly Mangalica _15F_MF183223_Hungary | Red Mangalica _13V_MF183224_Hungary | Mangalica_KJ746666_China | Blond Mangalica _43-5_JN601066_USA | Blond Mangalica _43-6_JN601067_USA | Swallow-belly Mangalica _1_JN601068_USA | Swallow-belly Mangalica _2_JN601069_USA |
|-------------|--------------------------------------|---------------------------------------------|----------------------------------|-------------------------------|--------------------------------------|--------------------------------------|-----------------------------------|-------------------------------------|
| Blond Mangalica _4S_MF183222_Hungary | 0 | 7 | 33 | 19 | 19 | 16 | 16 |
| Swallow-belly Mangalica _15F_MF183223_Hungary | 7 | 33 | 19 | 19 | 16 | 16 |
| Red Mangalica _13V_MF183224_Hungary | 32 | 18 | 18 | 15 | 15 |
| Mangalica_KJ746666_China | 24 | 24 | 17 | 17 |
| Blond Mangalica _43-5_JN601066_USA | 0 | 7 | 7 |
| Blond Mangalica _43-6_JN601067_USA | 7 | 7 |
| Swallow-belly Mangalica _1_JN601068_USA | 0 | 7 | 7 |
| Swallow-belly Mangalica _2_JN601069_USA | 0 | 7 | 7 |
The order of the individuals from the top to the bottom is the same as in Fig. 1 in the main text. The same haplotypes are highlighted by the same color (also see Fig. 1 in the main text).