Journal of Archaeological Science: Reports 19 (2018) 651–657

Contents lists available at ScienceDirect

Journal of Archaeological Science: Reports

journal homepage: www.elsevier.com/locate/jasrep

Elucidating recent history by tracing genetic affinity of three 16th century miners from Sweden

Maja Krzewińska[a], Anna Kjellström[a,b,*], Ylva Bäckström[c], Anne Ingvarsson[d], Natalija Kashuba[a], Ricardo Rodríguez Varela[a], Linus Girdland-Flink[e], Anders Götherström[a]

[a] Archaeological Research Laboratory, Dept. of Archaeology and Classical Studies, Stockholm University, Lilla Frescativägen 7, SE-106 91 Stockholm, Sweden
[b] Osteological Research Laboratory, Dept. of Archaeology and Classical Studies, Stockholm University, Lilla Frescativägen 7, SE-106 91 Stockholm, Sweden
[c] Department of Archaeology and Ancient History, LUX, Lund University, Box 192, SE-221 00 Lund, Sweden
[d] Gustavianum, Akademigatan 3, SE-753 10 Uppsala, Sweden
[e] Research Centre in Evolutionary Anthropology and Palaeoecology, School of Natural Sciences and Psychology, Liverpool John Moores University, Life Sciences Building, Byrom Street, Liverpool, L3 3AF, United Kingdom

ARTICLE INFO

Keywords:
Ancient DNA
Mobility
Forced labor

ABSTRACT

Objectives: Sala Silver Mine in central Sweden was an important manufacturer of silver from at least the 16th till the early 20th century, with production peaking in the 16th, mid 17th and 19th centuries. The job opportunities offered by the mine attracted people to the area resulting in the development of a small township with an associated cemetery in the vicinity of the mining center. People affiliated to the mine were buried on the cemetery for around 150 years. Written sources reveal that common criminal convicts from Sweden-Finland and war prisoners from the numerous wars fought by Sweden during the time were exploited in the mine, and some of them were likely buried on the cemetery. The cemetery has been excavated on several occasions and the recovered human remains were divided into two different groups based on burial custom, demography and biochemical results. One group was believed to contain war prisoners; the aim of this study was to produce and interpret genomic data from these individuals to test if their genetic ancestry is consistent with the hypothesis that they were non-locals.
Materials: Teeth from seven different individuals were sampled for dentine.
Results: Three of the analyzed teeth contained sufficient amounts of endogenous human DNA for the generation of genomic sequence data to a coverage of 0.04, 0.19 and 0.83, respectively.
Discussion: The results show that despite seeming heterogeneity the three individuals grouped within the range of genetic variation of modern and contemporary Swedes, yielding no statistical support to the hypothesis that they were foreign captives. However, due to the lack of contemporary or modern Danish genomic data we cannot refute these individuals originated in Denmark which was suggested as one of possible sources of the 17th century Swedish prisoners of war.

1. Introduction

Silver mining constituted an important contribution to the Swedish economy during the 16th–18th centuries CE. The most important mine was located in Sala in east central Sweden (Fig. 1). The earliest records mentioning an operational mine in Sala date to the beginning of the 16th century. Before being abandoned in 1908, approximately 450 tons of silver had been extracted from the mine (Jansson and Geovetenskaper, 2007; Norberg, 1978). A village, Salberget, including a small church, was located in close vicinity of the mine. The cemetery of the church was used for approximately 150 years between the end of the 15th century to mid-17th century (Bäckström and Price, 2016; Price et al., 2017). The site was excavated in 2004, 2008, 2009 and 2011, revealing in total 102 skeletons in 93 graves (Bäckström et al., 2009; Bäckström and Ingvarsson-Sundström, 2010, 2014; Onsten-Molander et al., 2005). The cemetery is believed to have been used for all social groups in the village and mine, including local families, miners and other workers, foreign specialists, but also forced labor in the form of prisoners of war and individuals convicted of various crimes. Landless manual workers came from Sweden and present day Finland; the specialists arrived from Germany, the Netherlands and Austria, and the prisoners, according to the historical records, originated in Denmark,

* Corresponding author at: Osteological Research Laboratory, Dept. of Archaeology and Classical Studies, Stockholm University, Lilla Frescativägen 7, SE-106 91 Stockholm, Sweden.
E-mail address: anna.kjellstrom@ofl.su.se (A. Kjellström).

https://doi.org/10.1016/j.jasrep.2018.03.035
Received 23 August 2017; Received in revised form 29 March 2018; Accepted 31 March 2018

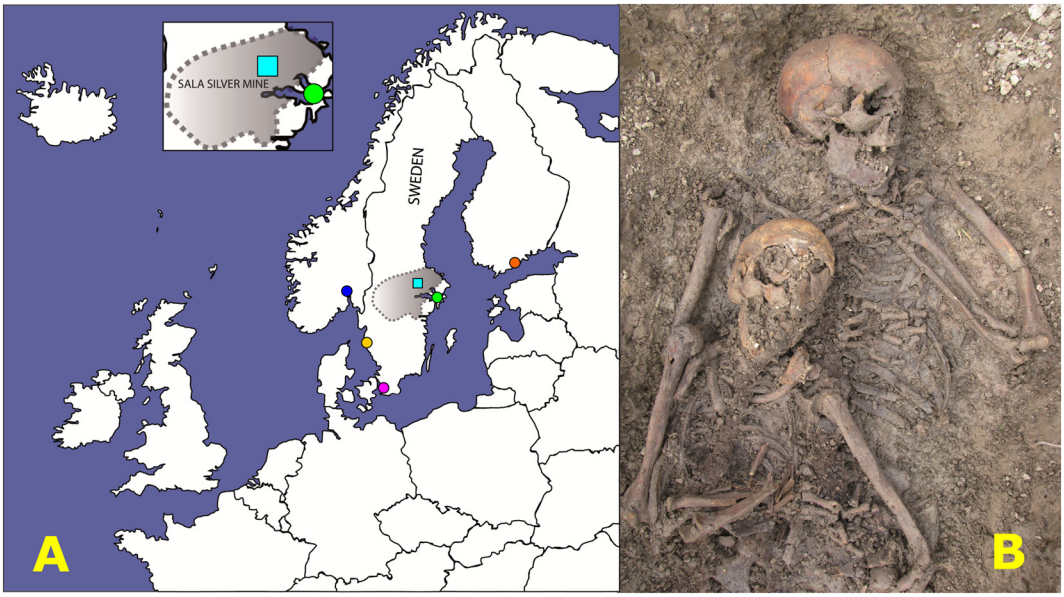

Fig. 1. A) Map of Northern Europe with the location of Sala silver mine (blue square) within Bergslagen mining district (area shaded grey) and major cities marked with dots: navy blue - Oslo, yellow – Gothenburg, green – Stockholm, orange - Helsinki. B) Skeletons no 6990 and 6994 in double grave 6975. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)
Photograph by: Lena Persson.

Russia and Poland (Boëthius, 1951; Eriksson et al., 2003; Frankius, 2008; Norberg, 1978). During the excavations, two different types of burials were discovered, which are believed to mirror the social hierarchy. The first type consisted of 85 coffin-burials (including nine cenotaphs) with 80 skeletons in which men, women and children were buried in shrouds. A majority of the coffins contained single burials. Only three of these graves contained more than one individual; one cist held two children and two cists contained an adult male and a child. The second type of burial, containing only men (22 individuals, primarily younger men), were nine earthen burials located primarily in the southern part of the cemetery, i.e. further away from the church/chapel. Most of the graves in the latter category were multiple inhumations containing between two to eight individuals interred in their everyday clothes (Bäckström and Ingvarsson-Sundström, 2010). The men in latter group show a high frequency of perimortem fractures and one individual was buried with an iron shackle around the neck (Bäckström and Ingvarsson-Sundström, 2010; Bäckström and Price, 2016). Two isotope studies, using strontium (Sr), oxygen (O) and lead (Pb), have demonstrated significant differences in values between the individuals associated with the two burial types (Bäckström and Price, 2016; Price et al., 2017). The sampled skeletons from coffins exhibit values consistent with being local, possibly families or household members, from the Sala area, while the isotope values from men in the earthen burials are consistent with non-local origin. Due to the simple burial type, the many perimortem fractures, the finding of the man with the iron collar, and the isotopic values, it has been suggested that the men in the earthen burials were prisoners of war forced to work in the mine (Boëthius, 1951; Bäckström and Price, 2016; Eriksson et al., 2003; Norberg, 1978; Price et al., 2017). Here, genome-wide sequence data was generated for three individuals from the earthen burials in order to explore their genetic relationship to modern-day European populations. Seven skeletons were selected for the analyses. The sampling strategy focused primarily on investigating mobility in the mining community by investigating correlation between Sr-analysis results and genetic affinities of individuals. Lower 87Sr/86Sr mean values around 0.712 (earthen graves) were linked to the southern Baltic region and higher 87Sr/86Sr mean values of around 0.722 (coffin graves) were interpreted as more 'local'. Therefore, the individuals chosen for DNA analyses consisted of four skeletons from earthen graves with lower Sr values (Sk6854, Sk6866, Sk6990, Sk6994) (Bäckström and Price, 2016), and three skeletons from coffin graves with higher Sr-values (Sk5498, Sk7031 and Sk7980) (Bäckström and Price, 2016).

2. Materials and methods

The anthropological analysis of the skeletons from the Salberget village involved international standard techniques (Bäckström and Price, 2016). Samples for the genetic analysis were taken from mandibular teeth of seven male individuals from the earthen burials. Three samples contained enough DNA (> 1% endogenous DNA) allowing for further analysis (Table 1). One of the men (Sk6866) was buried together with seven other individuals in Grave 6826 (Bäckström and Ingvarsson-Sundström, 2010). The other two men were found together in a double grave (Grave 6975), where one of the individuals (Sk6990) was buried on top (in the arms) of the other (Sk6994) (Fig. 2). All three were buried according to Christian tradition; on their backs with their heads to the west.

Table 1
Summary statistics of the genomic and anthropological data from the three analyzed individuals.

	Sk6866	Sk6990	Sk6994
Age	15–19 years	Middle adult	Young adult
Osteological sex	Male	Male	Male
Molecular sex	Male	Male	Male
Sampled material	Second premolar	Second incisor	Second incisor
Genome coverage	0.04	0.19	0.83
mtDNA genome	260.8	366.6	379.8
SNPs overlapping HO db	16,550	83,210	242,251
SNPs overlapping EGDP db	1,476,314	6,907,830	20,272,957
mtDNA haplogroup	U5b2a	T2b21b	I1a1b
Y chr haplogroup (ISOOG)	R1b1a	R1b1	I2a2a
Contamination estimate	1.6% (0.85%–2.36%)	2.08% (1.54%–2.62%)	1.29% (0.81%–1.78%)