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An 11th-Century Wool 2/2 Twill from a Burial in Shekshovo, Russia

Introduction

During the excavations in 2011 of the Shekshovo 9 burial site, located in the Ivanovo region, Upper Volga, 180 km north-east of Moscow, directed by N. Makarov, I. Zaytseva and A. Krasnikova of the Institute of Archaeology, remains of a remarkable burial with preserved textile came to light (Makarov et al. 2016, 98-100).

Shekshovo 9 is one of the well-known Viking Age burial places of the Suzdal principality, which formed the north-eastern part of medieval Rus'. Field investigations in Shekshovo began in 1852, when Alexej Uvarov excavated 244 barrows with cremations and inhumations with grave goods of the 10th-12th centuries in the framework of his extensive excavation campaign in the Suzdal area. The burial site was

rediscovered in 2011 after long-term surveys. The area has now been completely levelled by ploughing and there are no traces of grave mounds on the cultivated land (Fig. 1). Excavations conducted in 2011-2014 revealed the remains of 10 levelled burial mounds with both destroyed and intact cremations and inhumations, remains of ground cremations, dispersed in the ploughed topsoil and 12 flat inhumations in the ground pits (Makarov et al. 2013a). Of special interest is the platform of a large mound, 17 m in diameter, surrounded by a circular ditch: the remains of barrow 1 (Fig. 2) where the textile was found.

On the ancient surface soil at the centre of the platform, investigations disclosed the battle axe decorated with silver inlay (Fig. 3) with the remains of a wooden handle and a silver, gilded, horse-shoe-shaped brooch



Fig. 1. Shekshovo burial site (1) and dwelling site (2). Photo: the excavators.



Fig. 2. Overview of site. Photo: the Institute of Archaeology, Academy of Sciences, Moscow.



with a piece of textile in close proximity to each other. The textile was found between the arc and the tongue of the brooch (Fig. 4). The artefacts were identified as grave goods from a male burial on the platform of the barrow, despite the fact that the remains of the deceased have entirely disappeared due to ploughing. The battle axe was decorated with geometric ornamentation, a cross and two Ruric symbols (special symbols of the princes of the Ruric dynasty), which are known from the coins of the princes Vladimir and Yaroslav, as well as some other objects. Weapons with the Ruric symbols are unique finds in graves and in cultural deposits. Horse-shoe-shaped brooches were used both in female and male costume. Two brooches of similar type are known from graves in the Suzdal region and in the Middle Dnieper, but their find context is not clear in either case. The burial is dated on the basis of the artefacts and hand-made pottery from the ditch to the first half of the 11th century AD (Makarov et al. 2013b).



Fig. 3. Battle axe. Photo: the Institute of Archaeology, Academy of Sciences, Moscow.



Fig. 4. Shekshovo brooch with textile. Photo: Institute of Archaeology, Academy of Sciences.



Textile analysis

The bundle of textile fragments submitted for examination measures c. 1 cm² and consists of several layers of fabric (Figs. 5 and 6); they are of similar type and weave. The fragment is degraded and partly mineralised due to its contact with the metals.

Weave

The fabric is woven in a 2/2 twill with a thread count of c. 25 x 20 threads per cm (Figs. 7, 8 and 9). No traces of seams or edges are present.

Thread

The threads are rather homogeneous and on average 0.4 mm in diameter. All threads are z-spun. The threads in system A are quite tightly spun with a spin angle of c. 45 degrees, while the threads in system B are less tightly spun and have an angle of 20-30 degrees, suggesting that system A is the warp. System A has c. 2.2-2.5 threads per mm, and system B has c. 2 threads per mm. This gives a thread count of 22-25 threads/cm in the warp and c. 20 threads/cm in the weft (See Figs. 10 and 11).

Fibres

The surface of the fibres is degraded, but surface remains of scales indicate that it is wool. The fibres are quite dark. Light microscopy illustrates that the scales are either highly damaged or have disappeared (Fig. 12).



Fig. 5-8. The bundle of textile fragments measures c. 1 cm². Photo: Irene Skals, Department of Conservation, National Museum of Denmark.

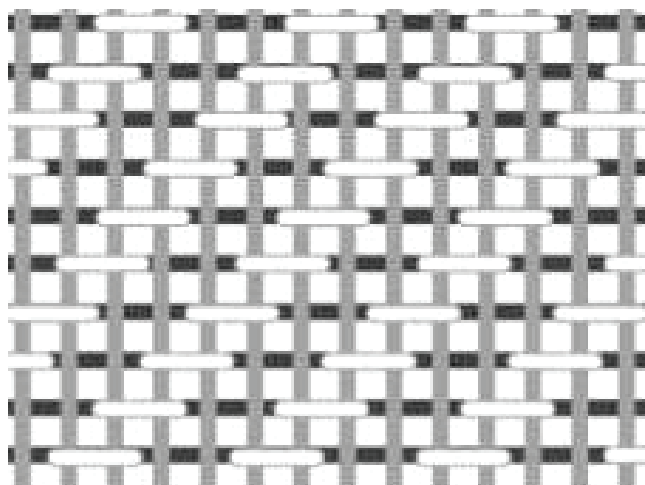
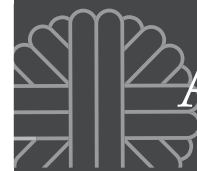


Fig. 9. Graphical representation of a 2/2 twill weave.



Fig. 10. The textile fragments. Photo: Irene Skals, Department of Conservation, National Museum of Denmark.



Fig. 11. The textile fragments. Photo: Irene Skals, Department of Conservation, National Museum of Denmark.



Fig. 12. The fibre in light microscopy. Photo: Irene Skals, Department of Conservation, National Museum of Denmark.



Fig. 13. Shekshovo sample magnification $\times 40$. Photo: Ina Vanden Berghe, Koninklijk instituut voor het kunstpatrimonium, Federaal wetenschapsbeleid.

Dye and pigment analyses

Analyses were carried out by KIK-IRPA textile research unit (KIK analytical report 2013.12004, 13.09.2013). Organic dye compounds were analysed by HPLC-DAD on a single sample of thread (Fig. 13). Potential dyes were recovered from the fibres by two complementary extraction protocols, and thereafter analysed individually. (The identification of natural organic colorants was performed using High Performance Liquid Chromatography and photo diode array detection system (Alliance, Waters USA). Dye recovery was executed using (1) extraction with a hydrochloric acid, methanol, water solution followed by ethyl acetate extraction, and (2) by extraction in dimethylsulfoxide, followed by oxalic acid extraction

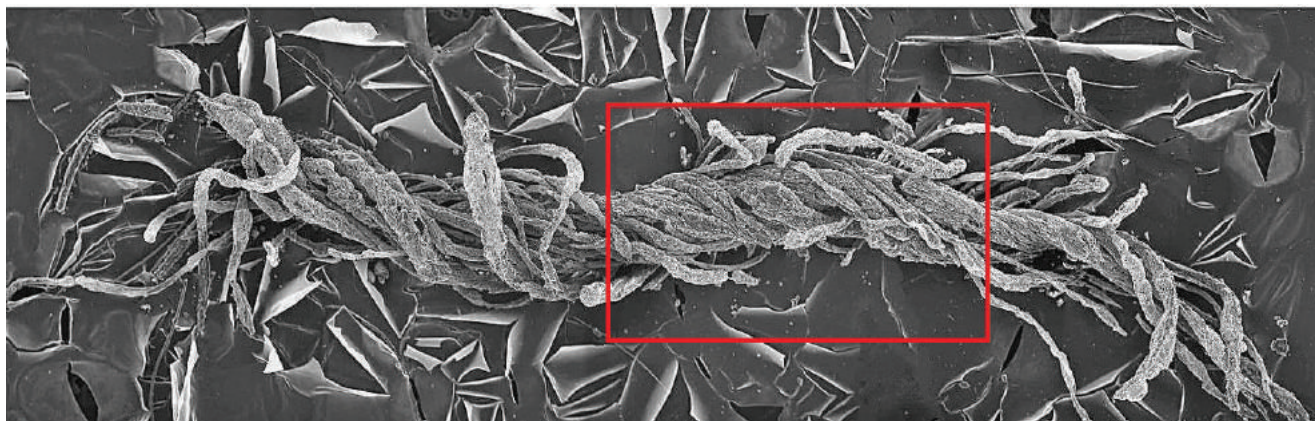


Fig. 14. SEM picture of black fragment with secondary electrons (magnification x80). Image: Ina Vanden Berghe, Koninklijk instituut voor het kunstpatrimonium, Federaal wetenschapsbeleid.

(see Vanden Berghe et al. 2009, 1910-1921). No organic dye compounds were found.

The presence of inorganic pigments was investigated by element analysis using scanning electron microscopy and energy dispersive X-ray detection (SEM-EDX, Jeol JSM 6300 and an Oxford Instruments detector). Prior to the analysis, the sample was coated with carbon to avoid charge effects. This revealed the occurrence of silver in the entire thread, as well as iron, copper, silicon and aluminium. Aside from the analysis of the thread as a whole (red selected area, see Fig. 14), point analyses were performed on fibres on the inside and surface of the threads (see Fig. 15 and Table 1).

Silver (Ag), iron (Fe) and copper (Cu) most likely derive from contact with the accompanying battle axe or other objects in the near surroundings of the textile. Humidity of the area may have caused the migration of these elements. The presence of iron could possibly also be indicative of black dyeing of the textile if combined with tannin. However, no such indication of tannin was found by HPLC analysis to support this hypothesis.

Aluminium (Al) and silicon (Si) are possibly indicative of aluminium silicates in the soil. Similar to the minor amounts of magnesium (Mg), potassium (K) and calcium (Ca), essentially found on the fibre surface, their presence can be attributed to contamination by the environment.

Strontium isotope analyses

Strontium isotope analyses were conducted with the aim of investigating the provenance of the textile fibres' material. The textile sample used in the strontium isotopic investigations weighed only 6.89 mg.¹ Since the HPLC analyses revealed no evidence of organic dyes, the investigations did not incorporate the APDS step to remove contamination of organic

dye-stuffs but included a multistep pre-cleaning procedure specifically developed to remove dust particles (mostly silicates, based on hydrofluoric acid leaching) as well as potential carbonate particles (based on hydrochloric acid leaching, see Frei 2014).

Baseline

The geology of the area is highly complex, consisting of several cratons covered by sedimentary platforms and interrupted by mountain chains. Shekshovo lies on the East European craton, which is characterised by geologically old Precambrian igneous and metamorphic rocks. In order to establish a preliminary baseline of the site, samples of plants, soil and mussels from the Shekshovo area were analysed to provide the bioavailable strontium isotopic range of the area.² The results are presented in Table 2 and point to the complex geological background of the area as revealed by the quite large spread resulting from the strontium isotope analyses of the local plants, soil and mussels, from $^{87}\text{Sr}/^{86}\text{Sr} = 0.71041$ (mussel) to 0.71575 (flower).³

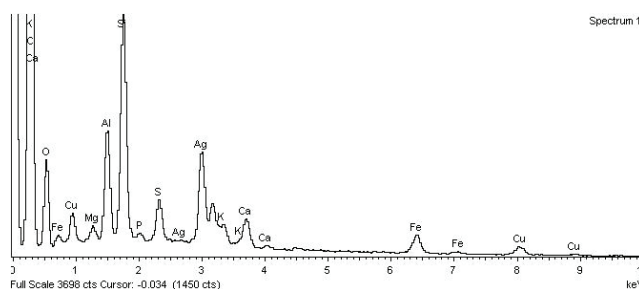


Fig. 15. SEM-EDX spectrum 1. Image by Ina Vanden Berghe, Koninklijk instituut voor het kunstpatrimonium, Federaal wetenschapsbeleid.

SEM-EDX Description	Type of analysis	Main elements	Minor elements
Global analysis of the thread	Selected area	Si, Al, Ag, O, S, Fe, Cu, Ca	K, Mg, P, C
Fibres inside the thread	Point analysis	Si, Al, O, Ag, Fe	S, Mg, Cu, K, P, C
Fibres on the surface	Point analysis	Ag, O, Si, Cu, Al, S, Ca, Fe	Mg, K, C
	Point analysis	Si, Ag, O, Al, S, Cu, Fe, Ca	Mg, P, C

Table 1. Detected inorganic elements in the sample. Table by Ina Vanden Berghe.

As the nature of these samples is quite different, they seem to indicate micro-geological environments like, for example, the mussels, which have the lowest strontium isotope composition. However, the various types of plants/flowers were collected in order to detect a broad range of root catchment levels, and to obtain a wide estimation of possible lithogenic soil variations. Hence, if we assume that these samples provide the extreme ends of the bioavailable strontium isotope range, then the baseline for the area lies between \sim $^{87}\text{Sr}/^{86}\text{Sr} = 0.7104$ to 0.7157 .

Textile sample

The strontium isotope composition of the wool and the corresponding leachates from the pre-cleaning steps are presented in Table 2. The strontium isotope

composition of the wool (residue) yielded $^{87}\text{Sr}/^{86}\text{Sr} = 0.70999$. When compared to the Shekshovo baseline range presented above, the textile sample thus points to wool of non-local origin, as it has a strontium isotope ratio that lies outside the bioavailable range, i.e. the wool sample is less radiogenic than the lowest baseline sample measured in the area (Fig. 16). However, future baseline investigations accompanied by a detailed local geological map are highly recommended in order to better determine the isoscape of the area.

Historical context

To date, textile finds have been rare in the Suzdal region and the textile find from Shekshovo presented here is therefore a first insight into the textile techniques of this time and area. The high thread count of the twill

Lab. Nr.	chemical procedure	material	$^{87}\text{Sr}/^{86}\text{Sr}$	error (ppm)
KF 674	Textile (residue)	wool	0,70999	74
KF 674	HF leachate	wool	0,73485	7
KF 674	HCl leachate	wool	0,70817	3
<i>Baseline</i>				
KF 670 A		mussel	0,71041	10
KF 670 B		mussel	0,71046	9
KF 672		flower	0,71537	8
KF 673	Leachate	soil	0,71122	9
KF 797		<i>Asteracea s.</i>	0,71392	7
KF 798		<i>Populus tremula</i>	0,71352	10
KF 799		<i>Equisetum s.</i>	0,71575	11

Table 2: The strontium isotope composition of the textile, the leachates from the pre-cleaning steps and from plants, soil and mussels.

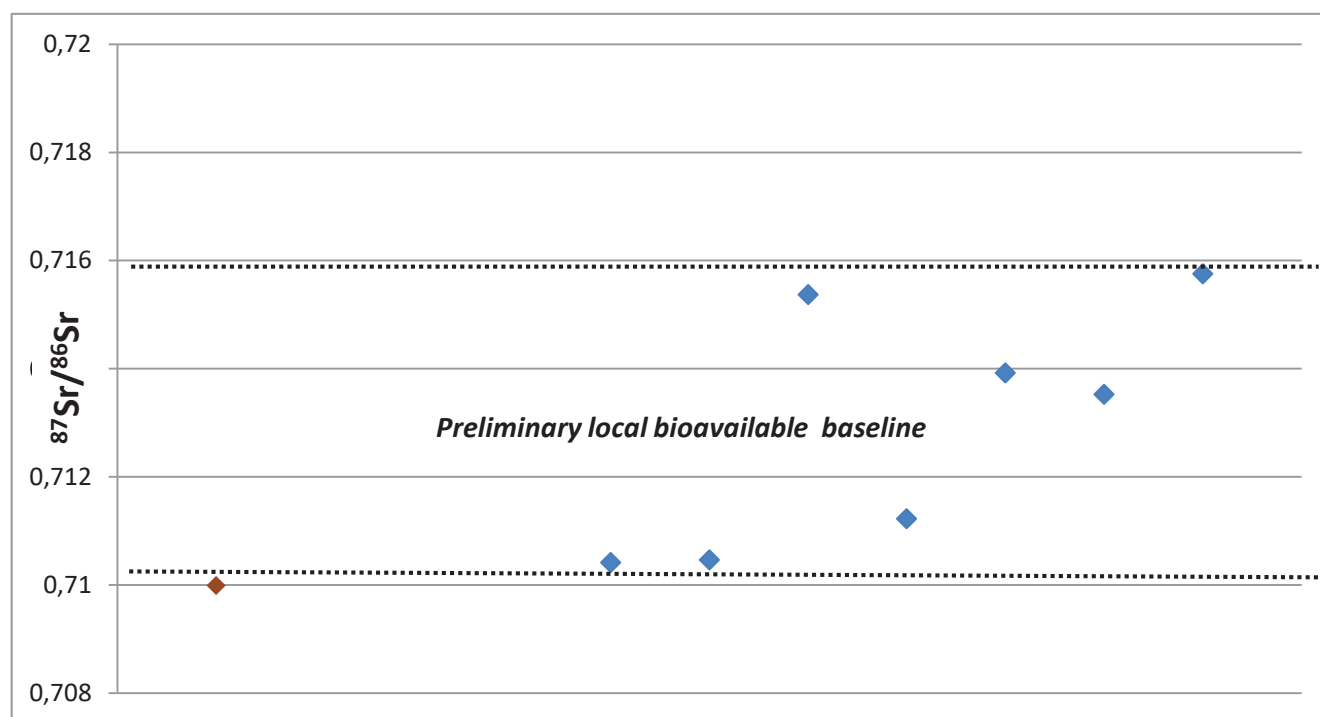


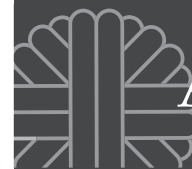
Fig. 16. Strontium isotope diagram depicting the bioavailable strontium isotopic range of the Shekshovo area – the so-called isoscape. Each baseline sample is marked in blue and the resulting preliminary baseline is marked between the two dotted lines. The strontium isotope composition of the wool thread is marked in brown and lies outside the preliminary local baseline, indicating that the wool is of non-local provenance.

demonstrates a very fine quality of fabric, and could suggest it was used for (male) clothing. No organic or inorganic evidence for dyeing was found on the black woollen textile fragment from Shekshovo. The presence of silver, iron and copper is most probably due to contamination (migration) from the battle axe or other surrounding metal objects. The presence of iron together with tannin might have suggested black dyeing of the textile, but no tannin was found. So it is more likely that the blackening occurred in the burial due to the migration of the metals onto the fabric. In the geochemical tracing analyses, a preliminary baseline of the bioavailable strontium isotopic range was established based on samples of plants, soil and mussels from the Shekshovo area. It revealed the expected complex geological background of the area with a rather large strontium isotope bioavailable baseline spread ($^{87}\text{Sr}/^{86}\text{Sr} = 0.7104$ to 0.7157). It is important to note that the strontium isotope composition of the textile is less radiogenic than the baseline range ($^{87}\text{Sr}/^{86}\text{Sr} = 0.70999$) suggesting a non-local origin of the wool.

This type of twill, 2/2 twill of z-spun yarns, is very common to early medieval northern Europe and Russia. Among textiles from 9th- to 11th-century graves in Lithuania, the vast majority are 2/2 twills,

although with lower thread counts than at Shekshovo (Pečeliūnaitė-Bazienė 2010, 189-194, especially 190-191). Fabrics of 2/2 twill and z/z spun yarn have come to light in graves dating to the turn of the 1st to the 2nd millennium AD, especially in eastern Finland and Karelia (Bender Jørgensen 1992, 97-98), but with lower thread counts than the Shekshovo fabric. Finland also has contemporary finds of 11th century 2/2 twills (Bender Jørgensen 1992, 97-98, 254-255). Fine quality 2/2 twills, although dated earlier, are also known from Viking Age Hedeby and Birka (Geijer 1938; Hägg 1985; 2015; Bender Jørgensen 1986).

Nahlik (1963, 254-258) analysed the types of fabrics found in Novgorod, and defined a certain type of local fabric, which is a twill weave with the characteristic fine, even yarns, and rather high density of warp in relation to weft, that distinguishes it from the fabric type found at Shekshovo. Khvoschchinskaia (1992, 128-133) has reviewed several thousand textiles from the mid-10th century AD from the area of Novgorod, and she concludes that the Novgorod textiles continue the Ladoga textile traditions of the 8th and 9th centuries of z spun yarns and 2/2 twills: "In Novgorod and Ladoga, as well as in northern Europe, the majority of wool textiles are 2/2 twill" (Khvoschchinskaia 1992, 130). In contrast, in Western Europe, textiles from



early medieval Dutch settlements were composed of nearly 50% woven in a diamond twill, but 2/2 plain twills also represent a large group (Brandenburgh 2010, 41-79). Textile scholar Lise Bender Jørgensen considers the plain 2/2 twill z/z spun yarn as “an eastern feature” (Type 4 in Bender Jørgensen 1992, 99) and she notes that it is attested at the sites of Mikkeli Tuukkala in southeast Finland and Kaukola Kekomäki in Karelia, whereas sites in southwest Finland do not have samples of this type. This would suggest placing the Shekshovo fabric in a documented and recognised North-Eastern textile tradition. The 2/2 twills with high thread count are, however, also well-attested in Scandinavian Viking-Age burials (Geijer 1938; Hägg 1985, 2015; Bender Jørgensen 1986; Andersson Strand 2011, 1-17;). Despite the numerous examples of comparanda, it must be concluded that no exact parallel has been identified in the region; it may also be relevant to search for parallels further east, and the 2/2 twill in itself does not necessarily place Shekshovo textile technology in a western tradition.

Conclusion

The new analyses presented here suggest that the Shekshovo garment in the burial was made of a fine quality, white or light-coloured wool, undyed, and probably not from local wool but traded from elsewhere. The fabric could have been woven elsewhere, or the wool was transported to Shekshovo and woven by skilled craftspeople locally. Either way it ended up as a valuable item of clothing in a high-status male grave.

Notes

1. Generally, it is recommended that samples should weigh a minimum of c. 20 mg.
2. These samples were collected and provided by N. Marakov and M. Dobrovolskaya in 2014.
3. Further baseline investigations of the area are necessary to provide a more final baseline knowledge, which may eventually answer certain questions that as yet remain unanswered.

Acknowledgements

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