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Evidence for textile production in Rabati, Georgia, during the Bedeni phase of the Early Kurgan period

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A R T I C L E I N F O

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Loom weights
Bone tools
Dyes

A B S T R A C T

Georgian-Australian excavations in the multi-period settlement site of Rabati, located in southwest Georgia, have produced substantial evidence of textile manufacturing in the Early Kurgan, Bedeni period (2400–2000 BCE). The results of Palynological, Non-Pollen Palynomorph (NPP), Archaeobotanical, bone and fired clay tool analyses presented here have identified fibres of flax and hemp. The presence of cotton is the earliest evidence for this fibre in the region, pointing to trade in the commodity rather than its local cultivation. Also identified were coloured fibres and the possible sources of dye found in the Early Kurgan contexts at the site are discussed. The large number of textile manufacturing implements concentrated in one area of Rabati may indicate that this production was commercial rather than a domestic activity. An active, local textile industry during this period of growing social complexity has significant implications for the development of the emerging elite elements in an increasingly stratified society.

1. Introduction

Significant new data from the Rabati settlement presented here shed light on the Early Kurgan, Bedeni phase economy with wider implications for social practices. Harlow and Nosch wrote: “The effects of the fibre revolution are yet to be clearly acknowledged as one of the ‘big themes’ of ancient history” (2014: 6). In many respects, this statement still holds true because of the poor state of preservation of textiles in the archaeological record. Not only has Rabati yielded quantities of bone and fired clay implements associated with textile manufacture, but through Non-Pollen Palynomorph (NPP) analysis of residues on them, we now have unequivocal evidence that the tools are linked to hemp, flax and possibly wool production dating to the Bedeni phase. There are also traces of cotton which, it would seem, is the earliest evidence for the presence of this fibre in the Caucasus representing long-distance trade interactions. In addition, purple stained pottery may possibly be attributable to dye substances used in the settlement. This, along with the presence of dyed fibres among the samples analysed, suggests that fabrics were enhanced with colour. The absolute date for these contexts falls in the second half of the third millennium BC (Bedianashvili et al., 2021).

The southern Caucasus region had a reputation for textile production. Based on ancient Greek and Roman sources, Colchis (south-western Caucasus) was one of the centres of flax textile production. Strabo noted in the first century AD: “Their linen industry has been famed far and wide; for they used to export linen to outside places” (Geography 11.18). Although contested, the earliest possible evidence of dyed flax fibres worldwide was that found in the upper Palaeolithic levels in Dzudzuana cave, Georgia, dated to the 30,000 BCE (Kvavadze et al., 2009; cf. Bergfjord et al., 2010; response by Kvavadze et al., 2010a). Evidence of flax textile fibre also was found in eastern Georgia in the Arukhlo and Gadachrili Gora Neolithic settlements (Kintsurashvili et al., 2020).

In Early Bronze Age, Kura-Araxes contexts, there is evidence of textiles impressed on pottery walls and fibres detected through NPP analysis of samples taken from settlements (Kvavadze et al., 2020). In the Early Kurgan period, however, textile evidence is much more tangible. Increasing social complexity was marked by advances in metallurgical technology, wealth displayed by valuable personal adornments and by

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Fig. 1. Map indicating the GAIA project sites of Rabati and Chobareti and Georgian settlement sites with Early Kurgan remains (© GAIA Project; Wikicommons base map, modified by C.S.).

rich burials in substantial tumuli or kurgans. An abundance of textiles in kurgans indicates their importance not only in rituals specific to mortuary practices, but also their economic value within communities (Kalandadze and Sakhvadze, 2016; Kintsurashvili et al., 2020). Although textiles figure prominently in kurgans, previously little evidence of textile production was known from the few excavated Early Kurgan settlements (Fig. 1; Carminati, 2016; Mindiashvili, 2012; Orjonikidze, 2014). Hence, the finds presented here from Rabati form a significant contribution to Early Kurgan culture and economy.

2. Background – Excavations at Rabati

The Rabati settlement, in the village of Zveli, is located in south-west Georgia within the historical Meskheti region. The settlement formed an artificial mound with medieval fortification walls situated on a north-facing cliff of Erusheti mountain (Fig. 2). From an altitude of 1480 m, it overlooks the narrow valley of the Kura River. This favourable location contributed to the *longue durée* of the Rabati settlement spanning from the Early Bronze Age to late Medieval period.

Rabati settlement was first surveyed by Tariel Chubunishvili in 1974 and later in 1977 by Otar Gambashidze (Chubinishvili et al., 1976: 14–20; Gambashidze and Kvijinadze, 1981; 1982). It was not until 2016, however, that the Georgian-Australian Investigations in Archaeology (GAIA) project, directed by Antonio Sagona†, initiated systematic investigations at the site. In 2016, 2018 and 2019 excavations were conducted in two locations in the central and western areas (Fig. 2: A–B). A substantial Kura-Araxes stone structure was exposed in the central trench, which dates to 3000–2800 cal BC (Fig. 3; Bedianashvili et al., 2021). This structure was superimposed by later Bedeni deposits (dated 2466–2026 cal BC), mostly represented by burnt layers (Trench B10.2). Bedeni culture was better represented in the western sector (Trench D9 and D10; Fig. 2A and Fig. 4). Here pits, fire installations and fragments of plaster surfaces were partially disturbed by medieval activities.

Apart from some burnt timbers in the northwest corner of D9.2, there were no remnants of any walls or post holes associated with the plastered surfaces. It seems that these were open-air areas where certain activities were conducted, notably textile production. Large numbers of bone textile manufacturing tools and loom weights were dispersed in squares D9.1, 2 and 3 and also in D10.4 (Fig. 5). Importantly, traces of fibres in soil samples from these trenches and in the residue on the artefacts support these findings.

3. Evidence for textile production at Rabati

3.1. Bone tools

The Rabati bone tool collection currently stands at 146 (Fig. 6: 1–17). These were generally in good condition, while some split bone implements were expedient, there is no evidence yet for a specific on-site manufacturing area for these tools. The bone tools from D9 best represent the Bedeni industry. Thirty-two bone tools were recorded in trench D9.2. There were 15 points, eight miscellaneous bone tools, two pins, two antler combs, a needle, one spatula and a spindle whorl, a piece of worked tooth and another of worked antler. The points are further divided based on the technique used for their manufacture. Five were constructed from long bone splinters (subtype 1.1), seven from splitting a long bone via the split-and-groove technique (subtype 1.2; metapodial, tibia, and radius bones; Fig. 6: 9), two from unsplit long bones (subtype 1.3; an ulna and metapodial; Fig. 6: 8), and a single rounded point made from an antler tine (subtype 1.5). Of note, is a complete point made from a split tibia of a medium-sized animal, which displays staining on the very tip (Art. 390). It is 80 mm long, 17 mm wide, and 9 mm thick and is more polished towards the point. The large number of points, not only in D9.2, but from the site in general, is common for assemblages across the Near East, the Caucasus and Anatolia during the Bronze Age. Points are also linked to basketry and leather production. Further micro-wear analysis is needed to better understand the intricate role these tools played at the site.

Two pins (Art. 184 and Art. 283; Fig. 6: 6–7) have circular shafts and pointed tips, some with high degrees of polish. The needle (Art. 190; Fig. 6: 3) has a perforation at one end drilled from both sides and it carries longitudinal striations on the shaft, visible using a x3 eye magnifying glass. While the tip is missing, it is highly polished indicating extensive use.

Two antler weaving combs are recorded. The first (Art. 274; Fig. 6: 16) has three teeth (one is broken), with two circular holes and an oval perforation on its shaft. The teeth are highly polished and honed thin from extensive use-wear visible at x3 magnification. The other comb (Art. 275; Fig. 6: 17) was found on the surface and shares a similar morphology: a larger oval-shaped and two small circular perforations on

Fig. 2. A – plan of excavated squares D–E/8–11; B – plan of squares A–B/10–11; C – plan of Rabati indicating: fortification walls to the north (bold lines); the three excavated areas including medieval structures to the far west; medieval and recent village buildings (shaded; images © GAIA Project).

its body. The seven teeth are smaller, thinner (two are intact) and highly polished with clear evidence of grooving; possibly the result of use.

The slightly damaged spindle whorl (Art. 174; Fig. 6: 15) is plano-convex and made from the femoral head of a medium-sized animal. Drilling of the perforation was carried out on the convex side, evident by the recessed area around the hole which forms during the drilling process; the other side was flat and without a drilled recess (Shamir, 2007: 263). The presence of spindle whorls indicates that hand spinning was practiced on site (Michel and Nosh, 2010: 33; Jørgensen, 2018).

Various levels of polish are visible on the eight miscellaneous worked bone items, but they are too fragmentary and devoid of diagnostic markers (not illustrated). One miscellaneous piece of worked bone (Art. 278), a fragmented split rib bone, is of importance for this study as it displays patches of darker staining. Polishing and rounding on the sides of the shaft indicate use, but it does not have any recognisable formal shape. The piece of worked tooth is a highly polished medium-sized animal incisor. There are transverse striations on the shaft of the object, possibly suggesting its use in a twisting motion.

3.2. Fired clay loom weights and spindle whorls from Rabati

The weights were found in D9 (Fig. 7: 1–13; Table 1); all were pierced longitudinally, cylindrical in shape and some were waisted (Fig. 7: 7–12). The weights do not carry any markings or decorations with exception of Art. 272 (Fig. 7: 6), which has small, randomly placed shallow punctures over the surface. Only three were complete and the weights range from 22 to 59 gm (Table 1).

Concerning finds from the Bronze Age Aegean (from c. 2600 BCE), Barber brought attention to this type of bobbin used to manufacture cord and braid in the fashion of the Japanese *kumihimo* technique but

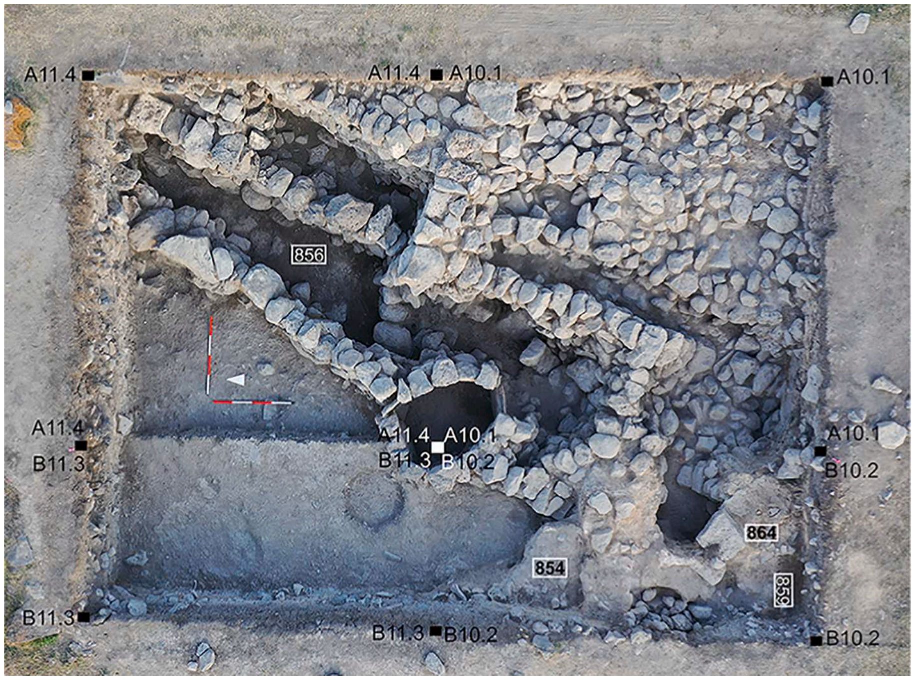

Fig. 3. Aerial view of the substantial Early Bronze Age, Kura-Araxes architecture in Trench A–B/10–11 (image © GAIA Project).

Fig. 4. Aerial view of Trench D-E/9–11; the Bedeni phase levels are in D9.1–3 (image © GAIA Project).

lamented the lack of evidence for actual textiles (Barber, 1997: 515–516). To date, no such evidence of true braid has been preserved in the Bedeni kurgans, but some top-stitched patterns, striped fabric and more complex loom weaves have been illustrated from Ananauri kurgan 3, which was assigned to the Bedeni phase of the Early Kurgan period and dated to 2400 BCE (Kalandadze and Sakhvadze, 2016). The waisted bobbin shape (Fig. 7: 7–12) is attested in Early Bronze Age contexts in Köhne Shahar in Iran (Samei & Alizadeh, 2020: Fig. 14). Less clear is whether elongated, somewhat cylindrical, fired clay objects (described as 'small and gracile') from Köhne Shahar were loom weights, if so then the technology they represent may have been developed at an early date in the region.

One fired clay spindle whorl in this sector (Fig. 7: 16; Table 1) is a biconical example, which weighs 35 gm; conical (Fig. 7: 15) and disc shapes were also identified (Fig. 7: 14, 17). From published accounts of experimental tests, it was found that heavier whorls (c. 30 gm) are better suited to the production of flax thread as they rotate at a greater speed, which keeps pace with the fast rate at which flax fibres can be fed onto the spindles (Grömer et al., 2016: 87–88). Based on dimensions of spindle whorls from Arslantepe and their experiments, Laurito and colleagues found that the weight and diameter of whorls determined the character of the fibres produced (Laurito et al., 2014: 163).

There is certainly some evidence of textile impressions on pottery walls in the region including examples from the northern Caucasus in Maikop cultural contexts (3700–3200 cal BC) and from third to second millennium Bronze Age settings (Sagona, 2018a; Shishlina et al., 2000; 2003). Significantly, impressions on Early Bronze Age Kura-Araxes wares at Chobareti near Rabati and Sos Höyük in eastern Turkey (Fig. 8: 3) include needle made textiles, notably-two-needle knitting (Fig. 8: 1) and cross-knit looping made (Fig. 8: 2) with an eyed needle (Sagona, 2018a). Bundles of textiles found in kurgan burial sites, provide important evidence for fabric and basketry in the Bedeni phase

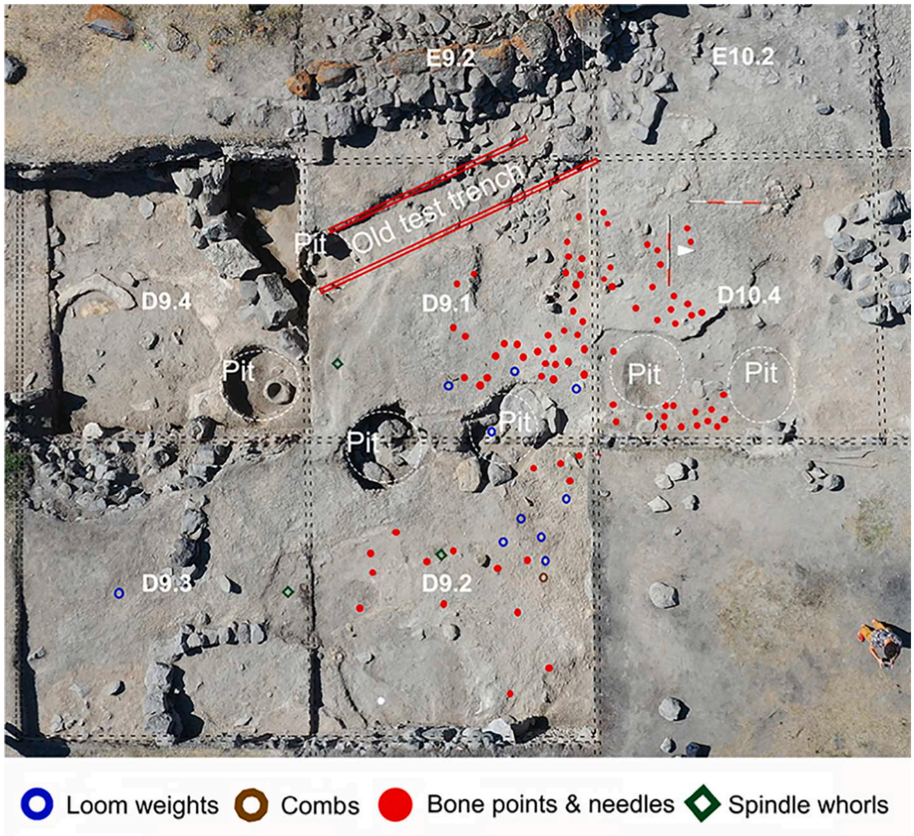

Fig. 5. Aerial view of Trench D9 with the locations of loom weights and bone and antler textile manufacturing tools found during excavation (image © GAIA Project).

(Fig. 9: 1–2). Based on the thread diameter (0.5–1 mm thick) of wool textiles found in Ananauri Kurgan 3, it was determined that c. 40 gm weights were used on the looms during weaving (Kalandadze and Sakhvadze, 2016: 124–126; Mårtensson et al., 2009; Stapletonet et al., 2014: 222).

4. Palynological and Non-Pollen palynomorphs (NPP) analyses

4.1. *Methodology of analyses undertaken on bone and fired clay implements*

Samples for palynological analysis were obtained from the textile manufacturing tools, from vessels and cultural layers (Table 2) in squares A–B10–11 and D9–11. The samples were processed in the National Museum of Georgia laboratory according to the standard protocol. At the first stage, artefacts were boiled in 10% KOH solution, then washed, centrifuged, and a heavy liquid was added. At the final stage, acetolysis was performed to dye palynomorphs (Table 2). In addition, textile tools were completely boiled in potassium alkali and, using this method, organic remnants were isolated from a small number of soil samples that existed on bone and stone artefacts; a method first used by Eliso Kvavadze (Kvavadze et al., 2013). Pollen grains and NPP remains were examined with a Motic BA 310E microscope. Atlases and modern reference collections were used for identification (Beug, 2004; Reille, 1992; 1995; 1998; Shumilovskikh et al., 2021; van Hoeve and Hendrikse, 1998).

4.2. *Results of the palynological and NPP analyses*

The palynological and NPP spectra of the material contain markers characteristic of agriculture, such as an abundant amount of pollen grains of cultivated cereals and associated weeds from the palynological group, and cereal phytoliths and starch from the group of NPP.

Textile fibres from the NPP group were important. The samples obtained from Rabati came from three sources – soils samples, organic residues on vessels and textile tools – and the results were divided into these groups accordingly. Remains of textile fibres were well represented in each of them. The first group, where flax fibres prevailed, consisted of 12 soil samples obtained from the plastered surfaces (Fig. 10). Hemp fibres were identified and two samples also contained cotton fibres (in D10.4 Loc. 166, S. 182 and D10.4 Loc. 186, S. 197).

The second group comprised organic remains extracted from the interior surface of the body wall of the vessel. Twelve samples showed that among the NPPs identified, textile fibres were present in almost all samples (Fig. 11). Flax and hemp predominated (Fig. 12: 1–4). Twisted and dyed pink fibres (Fig. 12: 5–6) point to the process of spinning and dyeing.

Craft tools formed the third group (spindle whorls, antler combs, awls and loom weights; Fig. 13). Ten artefacts were studied palynologically. In every sample, textile fibres were observed in large numbers. The palynological spectrum of organic remains obtained from the comb (D9.2 Locus 208, Art. 274) was particularly interesting. Despite its small size, extensive flax and hemp fibres were present. Unlike other artefacts, hemp and flax fibres were found in roughly equal numbers on the comb possibly indicating that these two fibres were blended together to obtain a mixed flax and hemp thread. Among them, blue and twisted fibres were detected. Blended hemp and flax fabric has many advantages: it is a good thermal insulator, it does not irritate the skin and it is cool in summer. As well as being resistant to high humidity, hemp it is not prone to insect damage (Asim, 2018; Crini et al., 2020). It does have negative properties, as it is rather rough and its fibres easily disintegrate. When hemp is mixed with other textiles, however, such as flax, cotton and silk, it gains extra strength and softness. Significantly, of the palynological remains, only in this sample were pollen grains of the plant *Serratula*

Fig. 6. Bone and antler textile manufacturing tools from Rabati: *bone needles* – 1. Art. 289, 2. Art. 292, 3. Art. 190, 4. Art. 276, 5. Art. 382; *pins* – 6. Art. 184, 7. Art. 283; *points* – 8. Art. 295, 9. Art. 189, 10. Art. 287, 11. Art. 386, 12. Art. 302, 13. Art. 277; *possible netting spacer or toggle* – 14. Art. 180; *spindle whorl* – 15 Art. 275; *antler combs* – 16. Art. 274, 17. Art. 275 (images © GAIA Project).

identified. Plants of this genus have long been used to obtain a yellow dye (Brunello, 1973; Gargadenneca et al., 2009).

From sample D9.1 Art. 272, a loom weight (Table 1), flax, hemp and cotton fibres, including pink ones (Fig. 14), were observed. A single wool fibre on the same object was also recorded, but it had no spun twists, so it is impossible to determine if this is a remnant of textile or simply came from animal fleece. Wool fibre is often poorly preserved, so its detection in samples through the palynological method is often impossible. Importantly, unlike other samples where flax fibres predominate, in the sample D9.3 from Art. 483, cotton fibres prevail (Fig. 7: 13). A single pink cotton fibre was also observed (see section 7.1 for a discussion concerning cotton trade).

5. Archaeobotanical analysis

5.1. Methodology

Soil samples were collected from sealed contexts of archaeological interest including floor levels, hearths, pits, ovens, pots and activity areas. In the 2019 season, a total of 59 samples (678.2 L of soil) were collected, including 37 samples from Bedeni contexts in B10.2 and D9.2. Soil samples were floated and a 0.3 mm mesh was used to catch the flot (Kakhiani et al., 2013). In the laboratory, samples from B10.2 and D9.2 were sieved into a > 2 mm coarse and >0.25 mm fine fractions and split into representative subsamples using a riffle splitter. A minimum of 200 ml of each sample was sorted for charred macro-remains, representing the whole to a quarter of the >2 mm fraction and an eighth or more of the fine fraction in proportion to the coarse fraction. Charred seed identification was made with reference to Jacomet (2006), seed atlases (Anderberg, 1994; Berggren, 1969; 1981; Cappers et al., 2006) and the seed reference collection held in the Department of Archaeology at the University of Sheffield.

5.2. Results of archaeobotanical analyses

Archaeobotanical data from 17 Bedeni samples in Trenches B10.2

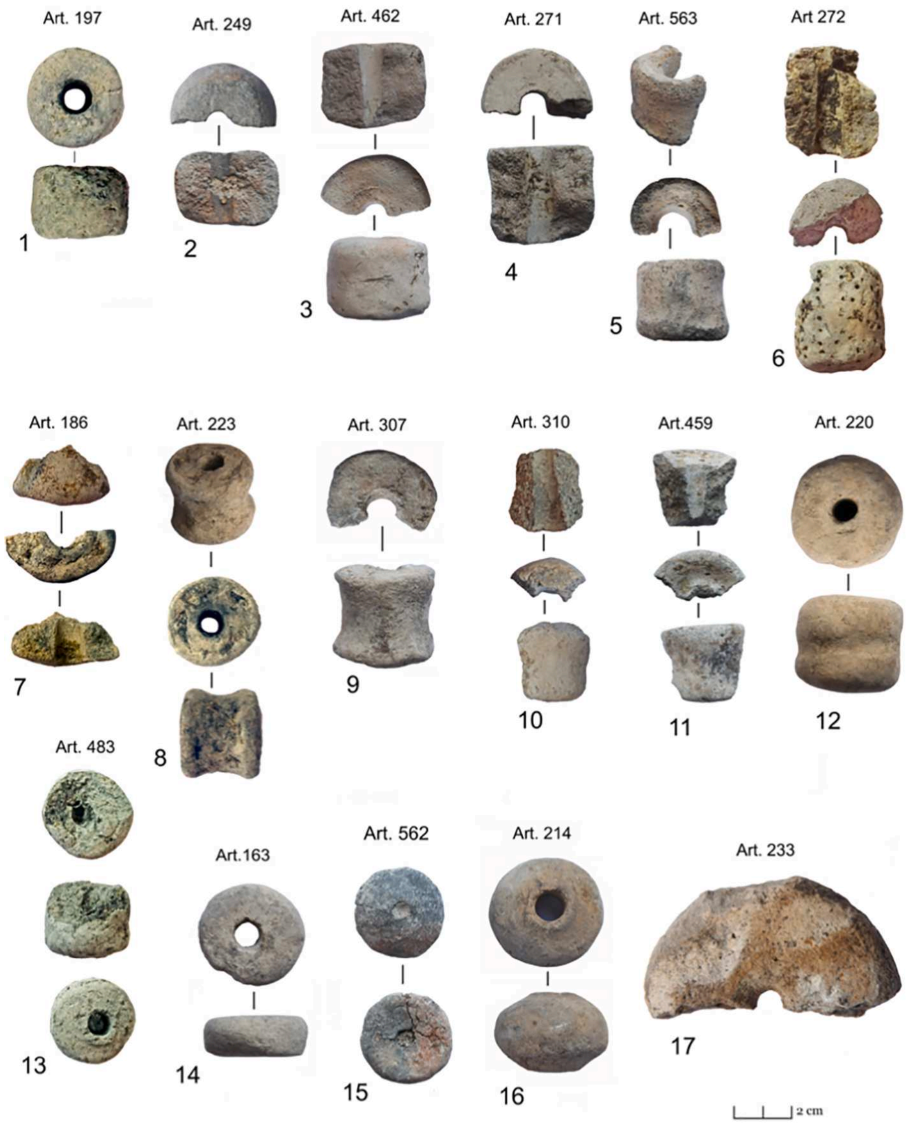

Fig. 7. Fired clay textile manufacturing tools from Rabati: *loom weights* – 1. Art. 197, 2. Art. 249, 3. Art. 462, 4. Art. 271, 5. Art. 563, 6. Art. 272, 7. Art. 186, 8. Art. 223, 9. Art. 307, 10. Art. 310, 11. Art. 459, 12. Art. 220, 13. Art. 483; *spindle whorls* – 14. Art. 163, 15. Art. 562, 16. Art. 214, 17. Art. 233 (images © GAIA Project).

and D9.2 are presented in Table 3. Overall, Trench D9.2 was much richer in charred plant remains than Trench B10.2. Free threshing wheat is the most abundant cereal grain present in these trenches and, based on identifiable rachis internodes, appears to be hexaploid bread wheat (*Triticum aestivum*). Barley grains are also common and a predominance of hulled straight grains together with identifiable rachis internodes indicates these are hulled 2-row barley (*Hordeum distichum*). In D9.2, there are rare emmer and einkorn glume wheat grains (*T. diccocum* and *T. monococcum*) and an emmer spikelet fork. A small number of pulses are present in both trenches including lentil, (*Lens culinaris*), pea (*Pisum sativum*) and bitter vetch (*Vicia ervilia*). Both trenches contain seeds of common crop weeds including *Lolium, Trifolium/Melilotus, Chenopodium album, Buglossoides arvensis* and *Galium.* Material from D9.2 appears to be charred refuse including amorphous charred lumps of potential food residues. Trench B10.2 is comparatively poorer in charred remains and instead contains mineralised sheep/goat and rodent dung pellets. No seeds or stems of flax, hemp or cotton matching the textile fibres found at the site were identified in either trench. This may mean the textile fibres were imported to the site as raw materials, threads or cloth (see sections 7.1 and 7.2).

In Trench D9.2, cereal grain is more abundant than either cereal chaff or wild/weedy seeds indicating that the grain was probably already threshed and cleaned of weeds prior to being deposited in this area of the mound. The presence of free threshing cereal rachis internodes, from both bread wheat and barley (Fig. 15), demonstrates that cereals were grown near to Rabati since free threshing cereal chaff is easily separated from grain after harvest and is rarely transported or stored with the grain (Hillman 1985). Importantly, this suggests that the Bedeni inhabitants of Rabati cultivated crops in the surrounding fields and probably practiced a settled agricultural economy.

6. Possible indicators of dye use and dye substances

The archaeobotanical evidence for possible sources of specific plant dyes was limited. The only potential dye plant evidence was of field gromwell (*Buglossoides arvensis*) seeds present in the samples, which

Table 1
Fired clay loom weights and spindle whorls from Rabati, ordered according to loci; [111] square brackets indicate loci; 'obj.' records field number of objects; 's.' was used when an object was recorded as a sample in the field; date of excavation; C/B indicates condition of the artefact (C complete, B broken; table by C.S.).

Artefact number	Context	Weight in grammes	C/B	Description
	Loom weights			
Art. 186	D9.2 [200] obj. 2, 31.7.2018	10	B	segment from one end; bobbin shape; longitudinal straight hole
Art. 197	D9.2 [206] obj. 11, 5.8.2018	30	C	bobbin shape; straight hole; Dm 3.1; H 2.25 cm; Dm of hole 0.8 cm
Art. 220	D9.2 [200] obj. 21, 11.8.2018	59	C	bobbin shape
Art. 223	D9.2 [200] obj. 12, 7.8.2018	22	C	bobbin shape; curved along its length; longitudinal straight hole
Art. 272	D9.1 [1006] obj. 24, 22.7.2019	23	B	c. half remains, bobbin shape; straight hole, H3.9 cm, Dm 3.2 cm
Art. 271	D9.1 [1007] obj. 13, 18.7.2019	28	B	c. half remains; bobbin shape; longitudinal straight hole; H 3.2 cm, Dm 3.5 cm
Art. 307	D9.2 [208] s.75, 8.8.2018,	27	B	c. half remains
Art. 310	D9.3 [1304], 29.7.2019	9	B	c. one quarter remains; bobbin shape; longitudinal straight hole; H2.7 cm, Dm c. 2.3 cm
Art. 459	D9.1 [1019] ob. 57, 2.8.2019	10	B	c. one quarter remains; bobbin shape; longitudinal straight hole
Art. 462	D9.1 [1009] obj. 57, 2.8.2019	23	B	c. half remains; bobbin shape; longitudinal straight hole
Art. 483	D9.3 [1304] obj. 5, 31.7.2019	18	B	over half remains; bobbin shape; longitudinal straight hole
Art 563	D10.1 [111]	–	B	Loom weight; waisted bobbin shape; longitudinal straight hole
	Spindle whorls			
Art. 214	D9.2 [208] obj. 19, 10.8.2018	35	C	spindle whorl; biconical; straight hole
Art 562	D9.3 [1312]	–	C	Conical spindle whorl; straight hole

produces a purple dye from its roots (Pustovoytov et al., 2004). Field gromwell, however, is a common arable weed and no concentration of these seeds was found at Rabati, unlike at Mokhra Blur (Areshian, 2007), to suggest it was intentionally collected for dye extraction. Moreover, these seeds are primarily mineralised and may be intrusive. Obtaining dyes of different hues from any number of plant sources remains a possibility. For instance, pollen analysis identified concentrations of *Cerealia* and *Triticum* in all of the samples subjected to analysis from ceramic fragments, textile working tools and associated soil samples (Figs. 16–19). These can be used to produce yellow dye (Khan et al., 2021).

6.1. *Purple stained pottery*

Noteworthy are purple stained interiors of pottery fragments in D9.2 loci 208 and 222 (Fig. 20). These sherds are classified as Common Ware, a rather poor quality, handmade domestic or household ware, which was contemporary with the highly burnished and well-produced black fine wares (Bedianashvili et al., 2019; Rova et al., 2010; 2017).

Fig. 8. Textile impressions in Early Bronze Age, Kura-Araxes ceramic fragments: 1. two-needle knitting from Sos Höyük (1999) L17D-M17C locus 4218, pottery bag 16A; 2. cross-knit looping from Sos Höyük M16 locus 573, Art. 2417 (images 1–2 © North-Eastern Anatolia Archaeological Project); 3. woven tabby fabric from Chobareti inv. no. SPF G42.2-F42.1/1; 4. possible scale pan weight, Art. 528 (images 3–4 © GAIA Project).

Reports of red and purple stained pottery have been made for Tell Mozan (north-east Syria) from a Late Akkadian level (c. 2200 BCE; Buccellati and Kelly-Buccellati, 1996; 2000):

> "This sherd displayed a bright red interior surface, obviously not the result of the original treatment of the vessel, but rather the remains of its former contents. Given that it was found in the royal palace it was suggested that the vessel had possibly contained red wine, known to reflect the status of the consumer in the period" (Barnard et al., 2011: 980).

Analysis of the Tell Mozan example failed to identify the substance that had stained the interior. As the stained pottery shared the same contexts as textile tools in Rabati, there is the possibility that dye may have been a by-product of viniculture within this textile production area, but equally the staining could be related simply to wine consumption.

Purple pigments were already sought after in Early Bronze Age, Kura-Araxes contexts. Gromwell seeds in a pit at Mokhra Blur (Armenia), linked to the production of purple pigment (for paint or possibly body adornment), may have been a craft specialisation of one household with, however, wider implications concerning domestication of field gromwell as an Early Bronze Age crop (Areshian, 2007: 36). In other Near Eastern contexts, purple was a symbol of economic and social status, with the better-known dye, Tyrian purple, obtained from Gastropodes of the *Muricidae*, discussed in Near Eastern texts (James et al., 2009: 1114–16, James et al., 2011: 450–460).

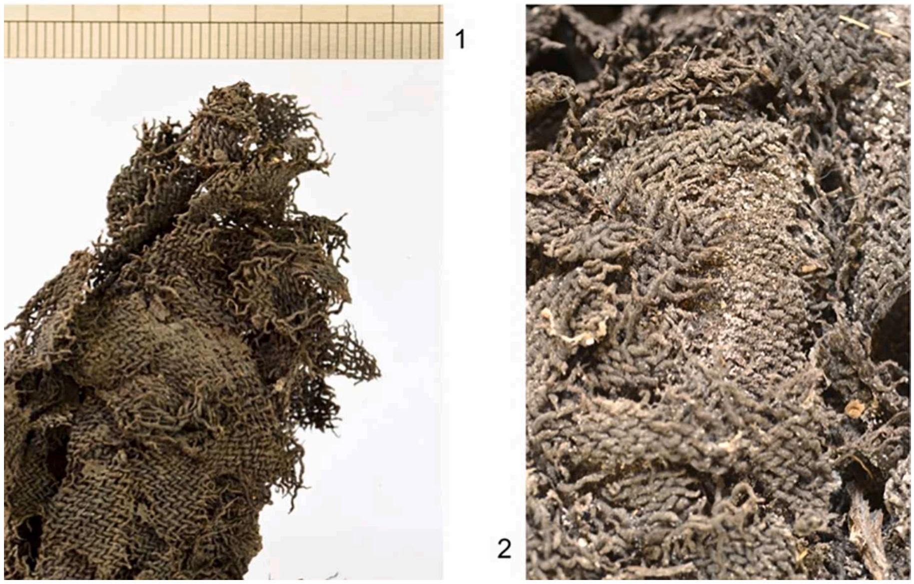

Fig. 9. 1. Flax tabby fabric bundle from a burial in Bedeni kurgan 10, Georgian National Museum; 2. detail of the tabby weave (photo: A. Sagona archive).

Table 2
Context of the samples taken for pollen and NPP analyses; [111] square brackets define loci; A. – artefact; B. – pottery bag; obj. – field object number; S. – sample; (table by I.M.).

Rabati 2019 Samples		
Soil samples from cultural layers	Vessel surface	Weaving tools
D9.2 [242], S.226	D9.2 [249], [237]	D9.2 [208], A.274, S.14
D9.2 [226], S.224	D9.2 [242], B.153	Nine points were analysed together: D9.2 [202] A. 219, obj. 16; D9.2 [228], obj. 61; D9.3 [1304] A. 390, obj. 2, D9.3 [1304] A. 390, obj. 9; D10.4 [182] obj. 85; D10.4 [181] obj. 30, Art. 388, D10.4 [182] obj. 53, Art. 415, D10.4 [181] obj. 50, Art. 391; D10.4 [186] obj. 84
D9.2. [242], S.265	D9.2 [242], B.153	A11.4 [804], obj.7
D.9.2 [228], S.177	D10.4 [127]	D9.1 [1019], A.444
D9.2 [222], S.176	D9.2 [228], S.170	D9.2 [200], A.220, obj.21
D9.2 [228], S.180	D9.2 [223], B.60	D9.1 [1006], A.272, obj.24
D10.4 [176], S.141	D9.2. [223], S.84	D9.2 [208], A.214, obj.19
D10.4 [166], S.182	D9.2 [221], S.19	D9.2 [200], A.223, obj.12
D9.2 [242], B.153	D9.4, B.79	D9.3 [1304], A.483, obj.5
D9.2 [224], S.199	D9.2 [228], B.98	B11.3 [806], A.233, obj.15
D10.4 [166], S.170	D9.1 [1017], A.63	
D10.4 [186], S.197	D9.2 [242], B.153	

7. Discussion

7.1. Craft specialisation – Textile production

Fabrics were an integral part of daily life, not just for clothing, but for numerous household purposes. From the proportion of fibres, flax appears to have been the main textile worked at the settlement. The earliest evidence of flax textiles in Georgia comes from Gadachrili Gora, a sixth millennium BC Neolithic site (Kvavadze et al., 2015: 243; Kalandadze and Sakhvadze, 2016). In Early Bronze Age contexts, early in the development of Kura-Araxes ceramic technology, textiles were used in the construction of pottery and fabric impressions were trapped in vessels walls (Sagona, 2018b). Well preserved flax and woollen fabrics were also present in funerary contexts in the Early Kurgan period. For example, the Paravani kurgan chamber floor was covered with flax textile (Kvavadze et al., 2020).

Antler combs are a previously unknown form prior to the Early Kurgan period. Similar tools from this period at Uzerlik-Tepe settlement in Azerbaijan (Kushnareva, 1959: 410) and Ilto settlement in eastern Georgia were associated with vertical looms (Isakadze, 1970: 138). Although palaeo-environmental data suggests that wild hemp grew in the south Caucasus around 7,000 BP, there is no evidence that it was cultivated in the Bronze Age settlements. Nonetheless, Chobareti, Dzedzevbi, Gudabertka and Kvatskhelebi settlements all produced evidence of hemp in the Kura-Araxes period (Kvavadze et al., 2020: 111). The use of hemp for textiles was probably introduced to the south Caucasus through contact with the Yamnaya culture to the north, where hemp was widely used for domestic and ritual purposes (Clarke and Merlin, 2013; Long et al., 2017). Moreover, the Yamnaya culture appears to have cultivated hemp. In the subsequent Catacomb culture, extensive hemp use can be traced to ritual activities in burials (McPartland and Hegman, 2018: 627–634). Connections between the Yamnaya and Catacomb cultures is especially relevant to the Bedeni phase as some kurgans demonstrate links to the Pontic Steppes, such as ochre usage introduced into Bedeni burial traditions (Djaparidze, 1993).

Notable among the textile fibres documented in the Rabati settlement is cotton. Previously, the earliest evidence of this fibre in the south Caucasus was known only from the Late Bronze Age Saphar-Khraba barrows, of the fifteenth–fourteenth centuries BC (Kvavadze et al., 2010b: 479–494). In the north Caucasus, the evidence for cotton-like fibre is documented as early as fourth millennium BC (3700–3200 cal BC), in Majkop contexts in the Novosvodnaya kurgan (Shishlina et al., 2003: 331–344).

Cotton would appear to have been imported to Rabati, which is not out of kilter with economic practices in the Southern Caucasus region at this time as lapis lazuli, amber and tin also point to distant trade (Abramishvili, 2017: 493–500; Kohl and Lyonnet, 2008; Lyonnet, 2016). It is likely that cotton cloth and/or thread were also acquired from more southern regions such as Pakistan where it dates to c. 5000 BCE in the site of Mehrghar (Shishlina et al., 2003: 338). Local cultivation of cotton in the Caucasus region is unlikely as, prior to the first millennium AD,

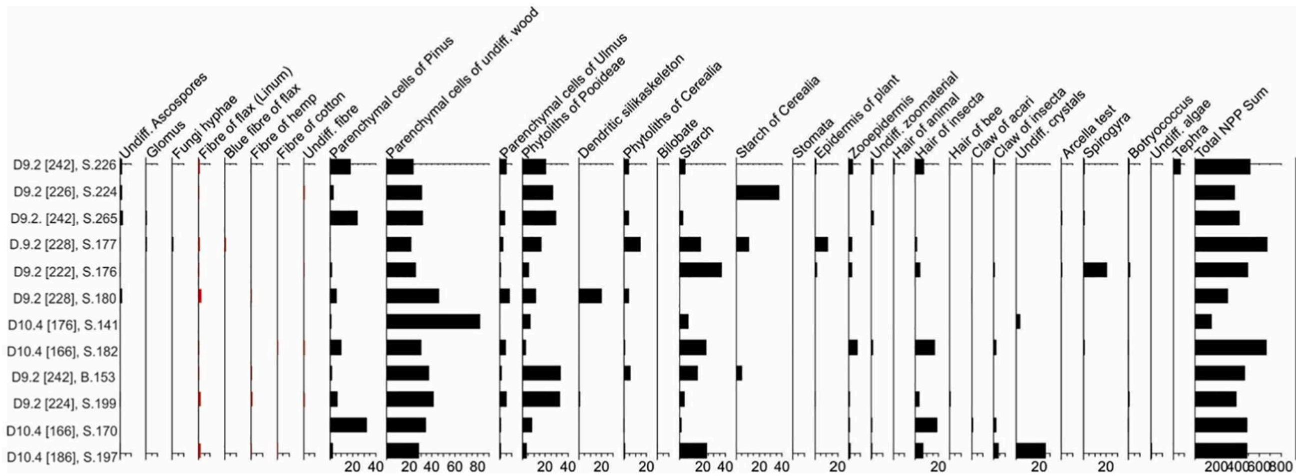

Fig. 10. NPP diagram indicating the percentages of organic materials obtained from soil samples (group 1) from cultural layers in Rabati (image by I.M.).

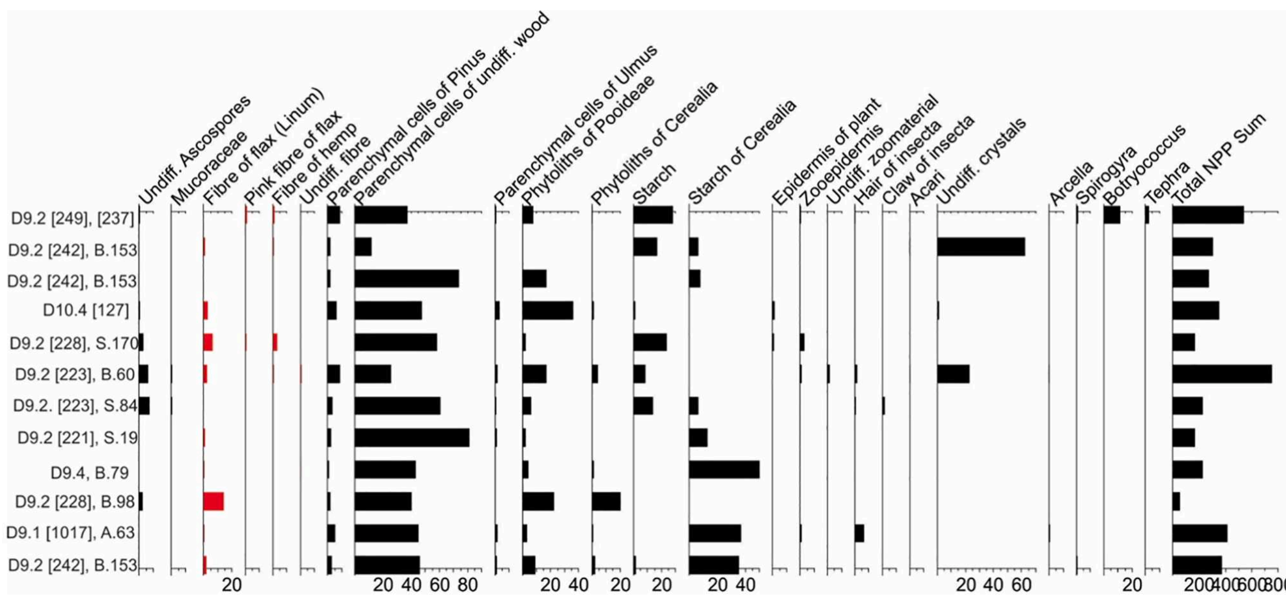

Fig. 11. NPP diagram indicating the percentages of organic materials obtained from residues (group 2) on ceramic vessel in Rabati (image by I.M.).

there is no evidence for the spread of annual cultivars suited to growing in cold winter conditions outside of Africa (Brite and Marston, 2013; Fuller, 2008).

It should also be noted that early historical accounts indicate that cloth could be unravelled and reworked into more favoured products motivated by cultural or fashion trends, or to take advantage of different textile technologies available in the markets receiving imported fabric. For instance, this practice has been documented concerning the silk trade with the Daqin (variously identified as the eastern Roman Empire or central Asia) in third century AD where Chinese silk cloth was unravelled and rewoven as damask cloth for Persian and Indian markets (Feng, 2017: 100–102). As the cotton fibre was found in a loom weight (Art. 483) at Rabati, such a scenario involving unravelling cloth is a possibility. Regardless of the form in which cotton arrived in Rabati, as an imported commodity, it may have been greatly valued by the Bedeni community. Compared to other available textiles, cotton fabric was softer and comfortable to wear, and it was likely to have been valued as an exotic product used for display, enhancing the social status of elite individuals.

It has long been argued that the Secondary Product Revolution included the development of wool as a significant fibre with economic implications for local and inter-regional commerce (Schoop, 2014; Sherratt, 1981). In this model, flax and other crop-based fibres are surpassed by wool, which has the advantages of exploiting marginal lands for sheep herding thus freeing up 'prime agricultural land' (Schoop, 2014: 242; after McCorriston, 1997: 525). Is this, however, the pattern we are observing at Rabati? Flax for bast fibres require more labour hours and produced less fibre than herders tending sheep raised for their wool. Similarly, shearing and spinning woollen yarn is less labour intensive that processing plant fibre (Becker et al., 2016: 102–103: 102–103; Gleba, 2012: 222). That we have ample evidence for plant-based textiles at Rabati in Bedeni contexts strongly suggests that such cloth had taken on an added, possibly high commercial value that outweighed the cost-effective merits of woollen textiles. Wool may have been processed along with plant fibres in Rabati, but due to its fragile nature, it has escaped detection. In an ever-increasing stratified society, textiles played a role in market forces among elite groups for whom such items formed part of their accumulated wealth. Cloth made from fibres that require a greater degree of cultivation and processing like flax and hemp and possibly imported cotton thread may have been valued as high-end products.

The Rabati region is characterised by extensively modified terraced

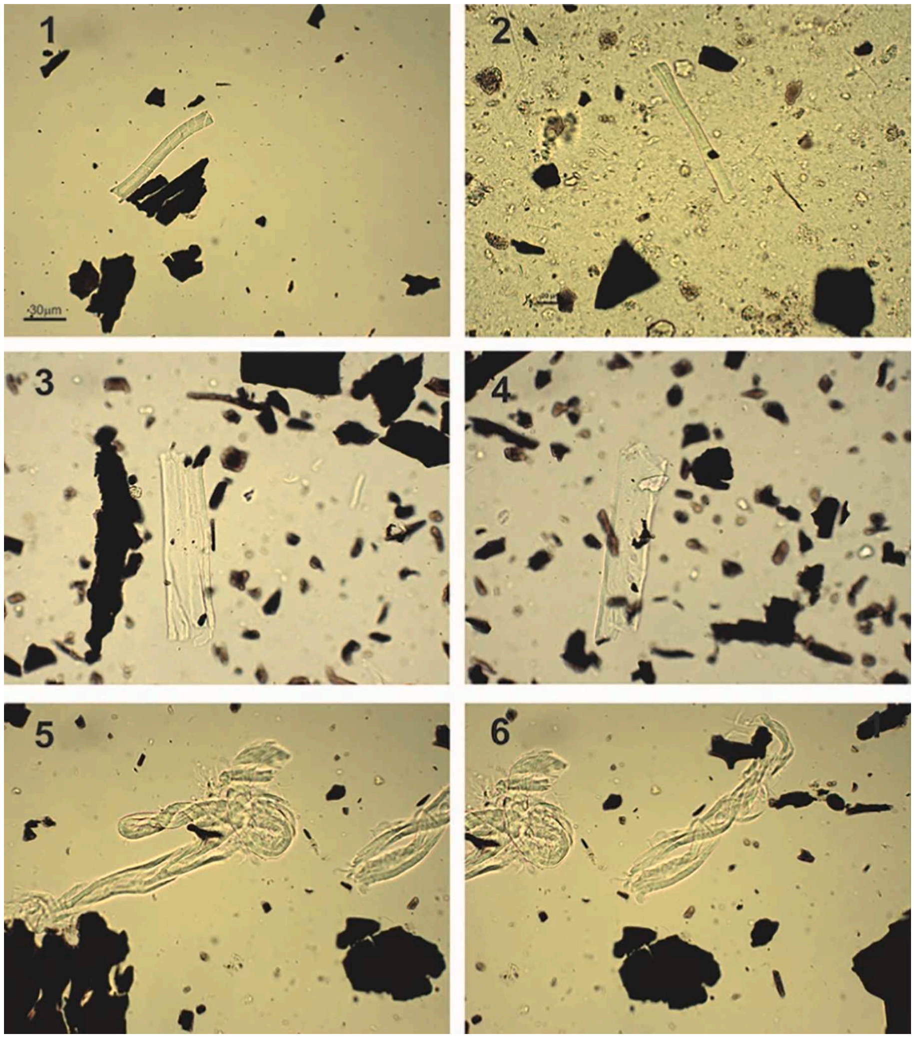

Fig. 12. Textile fibres obtained from residues on ceramic vessels (group 2) and from manufacturing tools (group 3). 1–2 flax fibres; 3–4 hemp fibres; 5–6 twisted fibres of flax (images by I.M.).

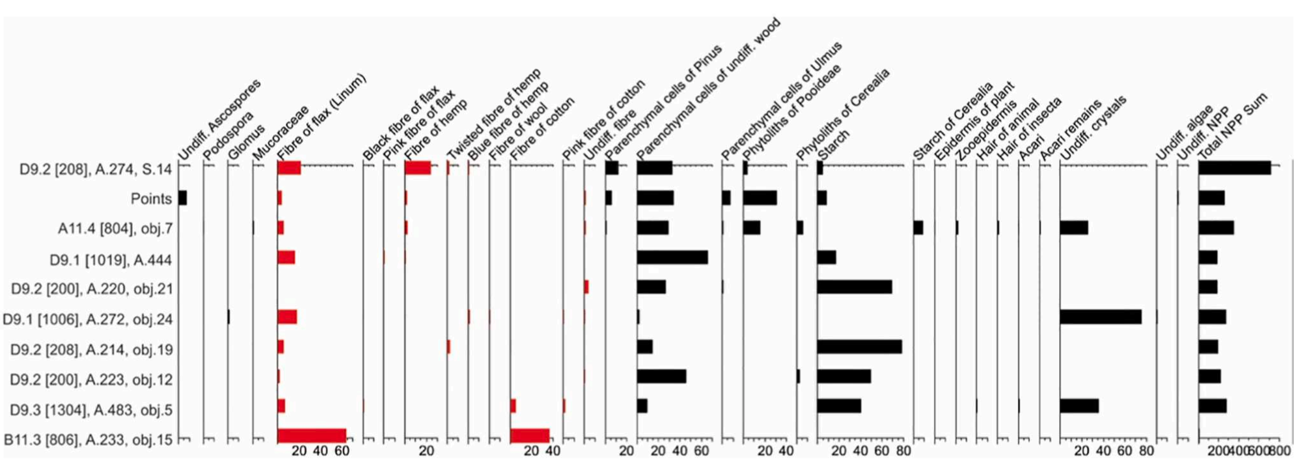

Fig. 13. NPP diagram indicating the percentages of organic materials obtained from textile manufacturing tools in Rabati (image by I.M.).

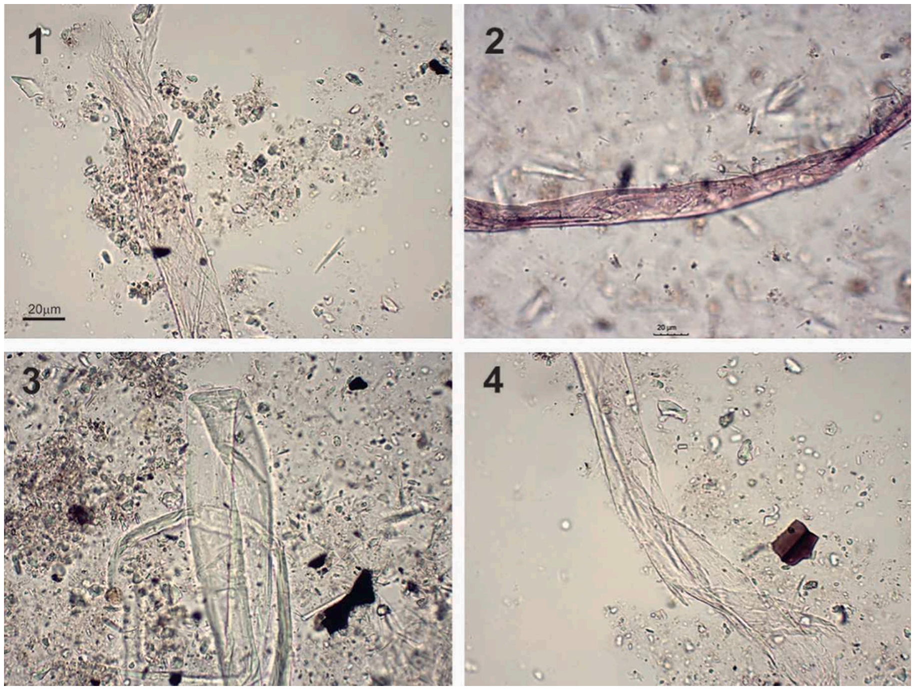

Fig. 14. 1–2, 4 Fibres of cotton obtained from textile working tools; 3 twisted cotton fibre (images by I.M.).

zones (Anderson et al., 2014) and it could be asked, as it has been for Europe generally, how much of this transformation was driven by the textile market over the centuries (Harlow and Nosch, 2014: 5). Significantly, it has been documented through ethnographic accounts and palynological analysis that, in recent history, the lower terraces in the immediate area around the site of Rabati, were used to cultivate flax (Kvavadze et al., 2020: 114). Hence, the capacity for the location to support such crops is not in doubt.

7.2. Bedeni economic strategies and social implications

Excavations at Rabati are generating information concerning Early Kurgan economy from a settlement context. Bedeni deposits dated to 2466–1864 cal BC follow the Early Bronze Kura-Araxes levels, but it would seem with a hiatus between the two phases (Bedianashvili et al., 2021). Early Kurgan society is often interpreted as leading a mobile, pastoral lifestyle (Japaridze, 2003; Kushnareva, 1997). Yet, archaeobotanical and palynological evidence from Rabati indicates an emphasis on plant resources during the Bedeni phase, with a textile industry based primarily on flax and on cereal cultivation within a settled agro-pastoral economy; with cultivation comes an attachment to land. At least some of the community needed to be present throughout the year to sow, nurture, protect and harvest crops suggesting that Rabati was permanently occupied.

While there is the potential for cultivated flax and gathered wild hemp (but not cotton) to be exploited at the site, there are no traces of fibre related plants in the palynological or archaeobotanical assemblages. It is likely that flax was cultivated close to Rabati in fields alongside cereal and pulse crops as part of a broad arable strategy. As there is no certain proof, however, of hemp cultivation in the Near East before the Iron Age (Zohary et al., 2013: 107), wild hemp may have been collected. Similarly, both Trenches D9.2 and B10.2 contain cleaned grain suggesting that cereal processing occurred elsewhere around the site. Flax and hemp require retting of stems in water to release the strands of fibres. It is likely that initial processing of textile crops and discard of waste products (stems and seeds) occurred elsewhere nearer to water. Alternatively, the lack of archaeobotanical evidence for fibre plants may indicate that refined fibres, or ready-made thread were brought to the settlement, which were later spun and woven into cloth.

7.3. Colour and display in Bedeni society

Herodotus, writing in the fifth century BC, gave an account of the diverse peoples in the Caucasus, west of the Caspian Sea. Of interest are his comments about their textiles:

> “Here it is said, there is a tree whose leaf, when crushed and mixed with water, serves the inhabitants to paint images on their garments; and the images are not washed out, but grow old with the stuff, as though woven with it from the first” (Herodotus 1962 translation, Clio. I. 203)

Textiles played a significant role in conveying social hierarchies and economic status at this time. Often only traces of organic material survive in the archaeological record, consequently textiles do not share the same degree of scholarly attention as other manufactures (Kvavadze et al., 2015; Sagona, 2018a: 298; Völling, 2014). In the Bedeni kurgans, however, alongside of rich grave goods were well preserved textiles (Kalandadze and Sakhvadze, 2016; Kintsurashvili et al., 2020). Cloth was used to shroud the deceased. Other fabrics furnished wooden four-wheeled chariots or figured as rolls of textile among the grave goods. In the Paravani barrow, a ceremonial wagon was covered with copious amounts of flax textiles (Kvavadze and Kakhiani, 2010; Shishlina et al., 2003). Indeed, some of these funerary traditions were foreshadowed in earlier Kura-Araxes burial kurgans such as Uzun Rama (Azerbaijan) where textiles were found rolled, in the others on the bones (Jalilov, 2018: 103). In addition to the textiles at Uzun Rama, the burial also

Table 3
Archaeobotanical data from seventeen Bedeni samples in Trenches B10.2 and D9.2 (table by C.L.).

Trench	B10.2		D9.2	
Loci	859; 864		200; 222; 226; 228; 234; 237–244; 241; 242; 248; 252	
Number of Samples	6		11	
Total Soil Volume (L)	138		109.7	
Total Flot Volume (ml)	2152		3360	
Cereal grain:	Total	Ubiquity	Total	Ubiquity
Triticum aestium/durum grain	1	17%	76	73%
Triticum cf. *aestium/durum* grain	2	17%	79	82%
Triticum dicoccum grain	–	–	2	9%
Triticum monococcum grain	–	–	8	27%
Triticum monococcum 2-grained	–	–	3	18%
Triticum indet grain	4	50%	55	55%
Hordeum hulled grain	2	33%	14	55%
Hordeum hulled straight grain	2	17%	22	73%
Hordeum hulled twisted grain	1	17%	–	–
cf. *Hordeum*	–	–	7	27%
Cereal indet. Grain	6	50%	54	82%
Cereal chaff:				
Triticum aestium/durum rachis internode	–	–	2	9%
Triticum aestium rachis internode	–	–	8	9%
cf. *Triticum aestium/durum* rachis internode	–	–	3	9%
Triticum dicoccum spikelet forks	–	–	1	9%
Triticum spikelet fork	–	–	4	9%
Hordeum distichum rachis internode	–	–	6	9%
cf. *Hordeum* rachis internode	–	–	6	18%
Cereal culm node	–	–	13	18%
Cereal culm base	–	–	2	18%
total cereal items	18	83%	359	100%
Pulses and fruits:				
cf. *Lens culinaris*	–	–	3	9%
Pisum sativum	–	–	3	18%
Vicia ervilia	5	50%	1	9%
Indet. pulse	–	–	2	18%
Celtis (mineralised)	–	–	1	9%
Wild/Weedy plants:				
Sambucus	–	–	1	9%
Chenopodium album	5	33%	100	36%
Buglossoides arvense (charred)	–	–	9	18%
Buglossoides arvense (mineralised)	22	67%	164	91%
Lithospermum officinale (mineralised)	–	–	2	9%
Neslia pod	1	17%	2	9%
Cyperaceae	–	–	14	27%
Eleocharis	–	–	24	18%
Lathyrus/Vicia	3	33%	–	–
Trifolium/Melilotis	4	33%	60	27%
Lamiaceae	–	–	2	9%
Lolium	3	33%	7	45%
Poaceae	–	–	27	36%
Polygonaceae/Cyperaceae	–	–	13	27%
Fallopia convolvulvus	–	–	2	9%
Fumeria (mineralised)	1	17%	–	–
Rubus (mineralised)	1	17%	2	9%
Galium	2	17%	9	18%
Hyoscyamus nigra (mineralised)	1	17%	28	27%
Thymelaea	–	–	1	9%
Urtica mineralised	3	17%	–	–
bud charred	–	–	2	9%
Nutshell indet. Charred	–	–	1	9%
Indet wild	2	17%	33	45%
Other:				
Dung fragment (sheep/goat)	17	50%	–	–
Rodent pellet	8	50%	–	–

Table 3 (*continued*)

Trench	B10.2	D9.2
Grains: insect damage	–	36%
Pulse: insect damage	–	9%
Charred amorphous lumps	–	27%
Dung indet. fragments	67%	18%
Small animal bones	50%	36%
Bone fragments	–	55%
Burnt bone	–	45%
Snail shells	17%	45%
Fish vertebrae	17%	36%

contained eight pieces of bone spindle whorls, essential tools for spinning fibre (Jalilov, 2018: 99).

The well-preserved, Bedeni Barrow 5, contained a range of lavish items that included fragments of flax and hemp, basketry, woollen fabrics and felt rugs, fleeces of sacrificed animals, as well as wooden furniture and utensils, jewellery, finely knapped obsidian, flint arrowheads and a wide range of pottery (Sagona, 2018a: 316–320). Of interest are remnants of fabric associated with an individual who, according to the excavator, Gobejishvili (1969), was likely to have been a servant of the principal interment. This fabric was dyed a carnelian red colour.

7.4. Trade and commerce

The written evidence for dyed textiles from Bronze Age Syria and Mesopotamia includes terminology for purple dyed fabrics, the types of commodities produced with them, as well as their relative prices. The texts refer to shellfish dyes and the plant-based purples available to craftsmen of the ancient Near East. In the Akkadian written record, garments made of flax (Sum. gada, Akk. kitû) are frequently mentioned in royal inventories and as gift items exchanged among kings in the Bronze Age (cf. Biga, 2010). In cuneiform documents from the late third and second millennia BCE, the terminology for artificially coloured wool seems to be distinguished from those for un-dyed wools. Terms for shades of red, blue and purple fabrics are the most abundant in the written sources from all periods, a clear indication that the people of the ancient Near East were particularly fascinated with these colours and formed a ready market for coloured cloth (Thavapalan, 2016: 16).

A question that cannot be answered with certainty at this stage is that if cotton thread or cloth was imported to Rabati from distant sources, then just how far did the textiles products, which were made in Rabati travel as a result of trade? For now, we can draw on the evidence of possible weights found in the same context under discussion, which might point to a commercial aspect of textile production at the site. That commerce was an element of this industry is a possibility for which we have some evidence (Table 4). From D9.2 came Art. 323, a small ball weighing 6.4 gm that might qualify as a scale weight in terms of its size and shape. Another item, Art 528 (Fig. 8: 4), weighing 25.8 gm is in the range of four times the weight of Art. 323 (not illustrated). Peyronel (2014) discusses some weights from Ebla in the third millennium BC, linked specifically to wool production. The smaller division was represented by a weight of 6.6 gm, close to Rabati Art 323, and the larger wool mina was c. 650–680 gm. Tepe Gawra and Byblos had a similar range (Peyronel, 2014: 127). Noteworthy is the comment:

> "The use at Ebla of a weight system for wool is also very interesting, since we have unequivocal evidence of the use of wool as means of payment (and standard of equivalence), together with silver." (Peyronel, 2014: 128)

The underlying significance of wool as a trade commodity, which was *valued by the gramme* resonates with the evidence for textile production at Rabati.

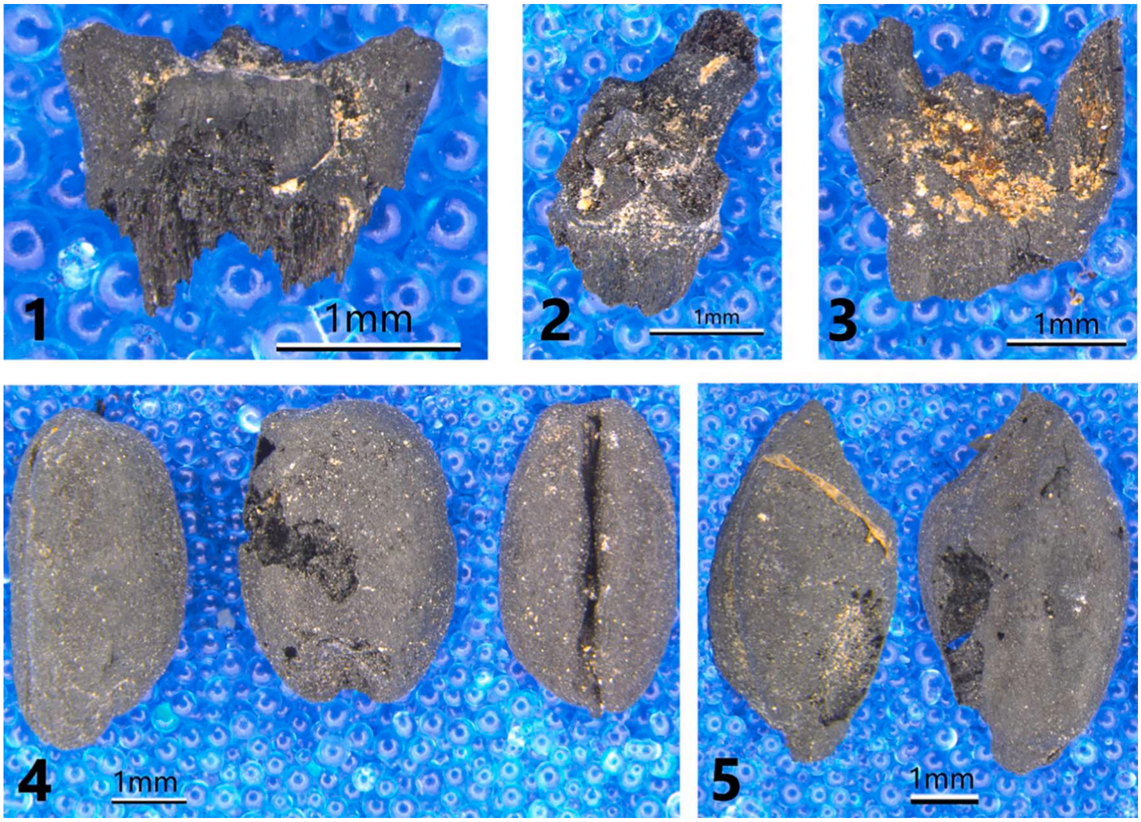

Fig. 15. Bedeni period charred crop remains from Trench D9.2 at Rabati: 1. 2-row barley rachis internode (*Hordeum distichum*); 2. Bread wheat rachis internode (*Triticum aestivum*); 3. Glume wheat spikelet fork (*Triticum sp.*); 4. Free threshing wheat grains (*Triticum aestivm/durum*); 5. Einkorn grains (*Triticum monococcum*). Scale bar 1 mm (images C.L.).

8. Conclusions

Rabati has provided important data not just concerning Bedeni textile production, but its role in social formation and as a burgeoning economic activity in the region. The recent findings are expanding our understanding of Bedeni settlement practices, the contexts of which are securely dated by ^{14}C evidence to 2466–1864 cal BC. Archaeobotanical analysis, clearly demonstrates that this community was settled with an agricultural economy. While cloth bundles are well-attested from contemporary kurgan burials in the Caucasus, from the 34 samples subjected to NPP analysis from the settlement, it is clear that its inhabitants were producing textiles, as indicated by the large number of fibres remaining on the textile tools. As the fibres were attached to the tools, there can be no doubt that such implements were actively used for this purpose. The abundance of fibres on pot surfaces indicates that textiles were also used hygienically to cover vessels to avoid food contamination and were not just used for garments. The presence of cotton as a likely long-distance, imported product also points to the extent of trade in textiles in the third and second millennium BC and the value placed on them. These aspects complement notions expressed in ancient texts of Syria and Mesopotamia. During this period, textile workers were also exploiting dye substances as indicated by coloured fibres on the implements and pollen grains of the plant *Serratula*, which yields yellow dye. Grain plants, Cerealia and *Triticum*, may have been put to a similar use. In addition, the variety of hues evident in the fibres indicates that the threads and the cloth made from them could have been dyed in a range of colours. Such embellishment of cloth has greater implications for the growing social complexity evident in the kurgan burials and for the role textiles served in personal display among sectors of the ancient community.

CRediT authorship contribution statement

Giorgi Bedianashvili: Conceptualization, Funding acquisition, Resources, Writing – original draft. **Andrew Jamieson:** Conceptualization, Writing – original draft. **Catherine Longford:** Formal analysis, Writing – original draft. **Inga Martkoplishvili:** Formal analysis, Funding acquisition, Writing – original draft. **Jarrad Paul:** Formal analysis, Writing – original draft. **Claudia Sagona:** Conceptualization, Formal analysis, Writing – original draft, Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

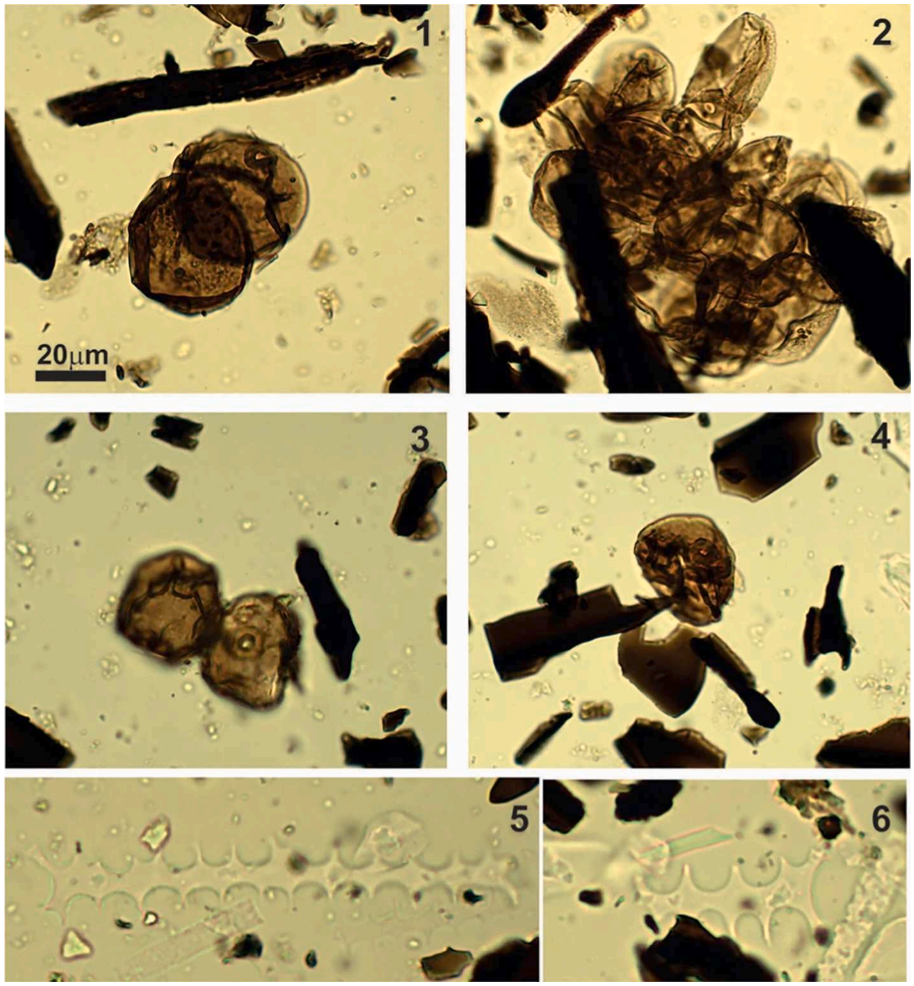

Fig. 16. Pollen grains and phytoliths of Cerealia obtained from cultural layers and pots in Rabati: 1. 3–4 pollen grains of Cerealia; 2. a clump of Cerealia pollen; 5–6. phytoliths of Cerealia glumes (images I.M.).

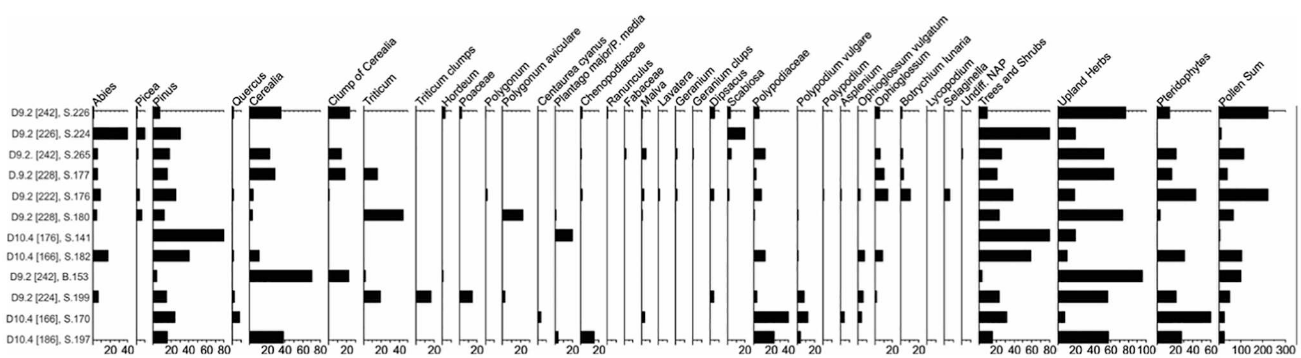

Fig. 17. Diagram indicating the percentages of pollen grains obtained from cultural layers in Rabati (image by I.M.).

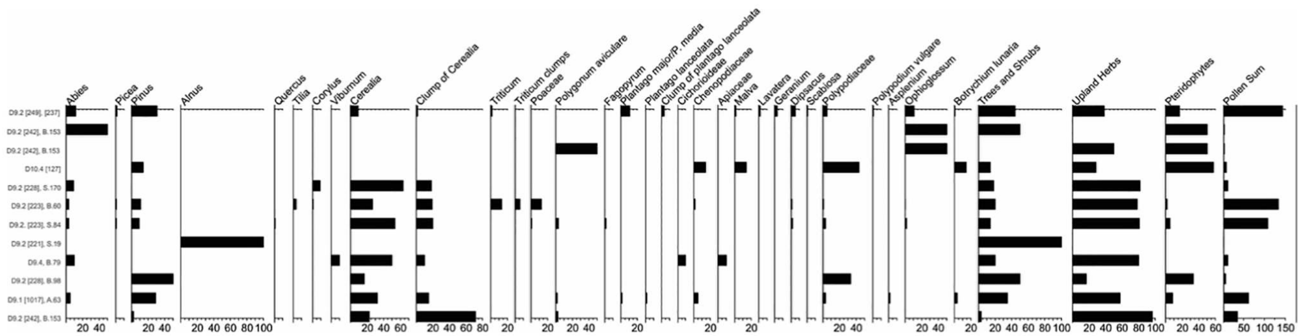

Fig. 18. Diagram indicating the percentages of pollen grains obtained from ceramic vessels in Rabati (image by I.M.).

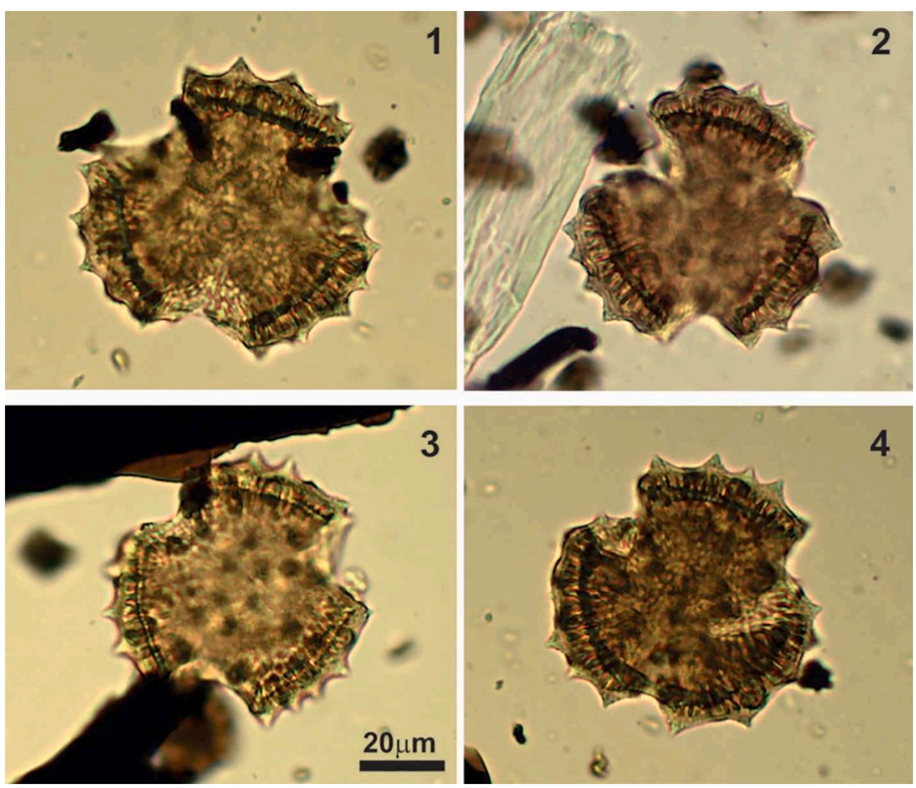

Fig. 19. Pollen grains of *Serratula* obtained from textile manufacturing tool in Rabati (image by I.M.).

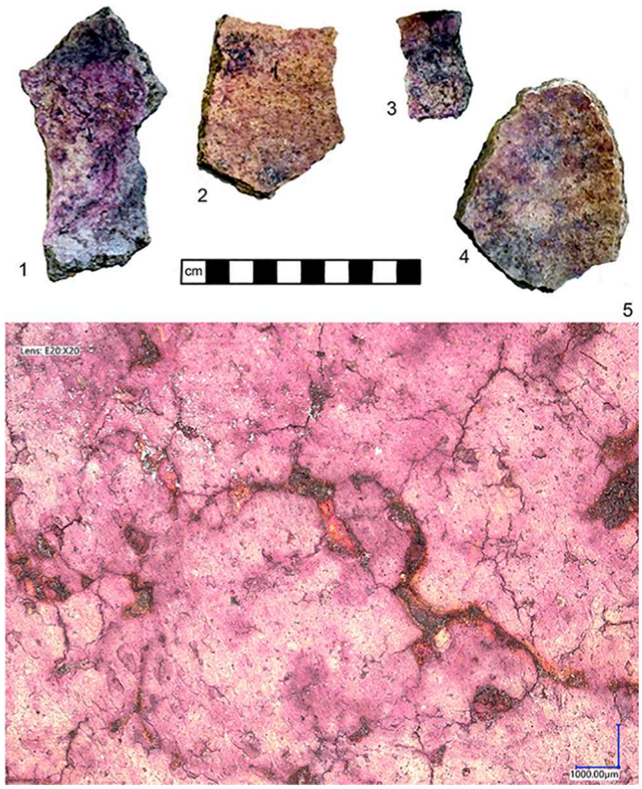

Fig. 20. 1–4 Ceramics for Rabati with clear traces of red to purple pigment on the interiors from Trench D9.2 locus 222, pottery bag 84 (© GAIA Project, photo C.S.); 5 detailed photograph of pigment (photo C.L.). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

Table 4
Details of possible scale weights in Rabati Trench D9.2 (table by C.S.).

Art. number	Context	Weight type	Weight in grammes	Description
323	D9.2 [228], obj. 31, 24.7.2019	stone (complete)	6.4	ball, pale grey stone
528	D9.2 [222] obj. 6, 11.7.2019	basalt (complete)	25.8	ball (Fig. 8: 4)

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