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ORIGINAL ARTICLE

Botanical and zoological remains from an early medieval grave at Tsitsamuri, Georgia

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Abstract A multidisciplinary analysis of pollen, seeds, mites and molluscs from organic remains in the Tsitsamuri burial (4th–6th century A.D.) provides strong evidence of the season of internment. The presence of *Trifolium campestre* flowers, abundant *Achillea*-type pollen, ripe seeds from various early summer flowering plants, remains of *Acari* mites and immature *Helicella derbentina* mollusc shells indicate that the burial took place in early summer. Textile fragments were also analysed and indicate that the body was wrapped in a shroud made of flax. The deceased was interred on a bed made of plants gathered from the local environment. The whole complex of botanical and zoological material indicates a cultural landscape in which agriculture, viticulture, horticulture and pasturing were carried out. The climate of that period was probably slightly wetter and warmer than today.

Keywords Archaeobotany · Palynology · Palaeoecology · Molluscs · Non-pollen palynomorphs

Introduction

Palaeobotanical and palaeozoological remains from burials provide important insights into burial traditions and reveal something of the local environment at the time of burial (Downes et al. 1994; Tipping 1994; Bunting et al. 2001; Kvavadze and Narimanishvili 2006; Kvavadze et al. 2007a; Hannon et al. 2008). As important as pollen and seed remains are non-pollen microfossils, including fungal spores, fibres from the corpse's clothing, and remains of insects responsible for decomposition of the clothing and other items in the grave (cf. Van Geel et al. 2003). Woody remains are often preserved in *kurgans* (larger burial mounds), while pollen spectra from the contents of pottery found in the burial are also informative (Rösch 1999, 2005; Pokorny and Marik 2006; Kvavadze et al. 2007b).

Tsitsamuri burial No. 101 is one of a number of family sarcophagi in an extensive mediaeval cemetery (4th–6th centuries A.D.), excavated in summer 2006 by the Archaeological Institute of Mtskheta. The burial is situated near the village of Tsitsamuri, 25 km from Tbilisi, the Georgian capital (Fig. 1). The base of the sarcophagus is 1.6 m below ground level and 1 m high. Excavation revealed the remains of three individuals located at different stratigraphic levels. We studied the area at the bottom of the sarcophagus where the earliest remains were buried. Alongside the skeleton, some bronze and metal pins and a silver ring with a cross motif were discovered. The head of the metal pin was decorated with a coral pomegranate, a symbol of fertility. A small glass bottle was found which may have contained fragrant oil. Poor

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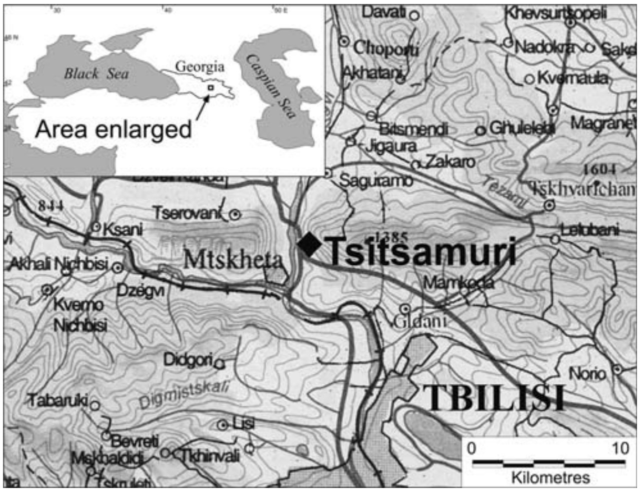


Fig. 1 Map of Georgia showing the location of the Tsitsamuri cemetery complex

preservation of the skeleton bones precluded gender identification of the deceased.

Tsitsamuri village is situated at an altitude of 500–540 m on a plain between the Saguramo mountains and the river Aragvi. The climate of Tsitsamuri is semi-arid. In neighbouring Tbilisi, precipitation averages 450 mm per annum. The average annual temperature is 11.8°C, 23°C in July and 1.2°C in January (Svanidze and Papinashvili 1992). The present-day vegetation has been greatly modified by human activity. Locally, the vegetation consists of cereal crops and woodland-steppe vegetation with thickets of *Paliurus spina-christi, Spiraea hypericifolia, Prunus spinosa* and *Rosa canina.* Secondary woods of *Carpinus caucasica, C. orientalis, Quercus iberica* and *Fraxinus excelsior* grow on the slopes of the Saguramo Range (Ketskhoveli 1959). Some relict 'Colchic' species, such as *Buxus colchica* and *Hedera helix*, also occur in *Fagus orientalis*-dominated woods on the range, thanks to its particular microclimate.

Materials and methods

During excavation, a layer of dark brown organic matter was observed, extending from the skeleton's head to its knees. The organic nature of the deposit was confirmed by the presence of plant seeds. Two samples were collected for archaeobotanical investigation—one from beneath the skull, and another from beneath the hip-bones.

Preparation for pollen analysis was performed by a standard method (Moore et al. 1991). Samples were boiled in KOH, followed by centrifuging in Cadmium heavy liquid and acetolysis. Woven fabric found in the grave was pretreated by boiling in KOH and acetolysis. Pollen was identified using current pollen atlases and the pollen collection at the Institute of Palaeobiology, Tbilisi. Pollen grains of *Hordeum*-, *Triticum*- and Cerealia-types were differentiated using the pollen key of Beug (2004). Seeds and palaeozoological remains were manually extracted from the organic matter; botanical nomenclature throughout follows Czerepanov (1995).

Results

Palynological data (E. Kvavadze): Preservation and concentration of the palynomorphs appeared to be good, which is typically the case in Georgian sarcophagi. Even the hair of the deceased and parts of the clothing often survive (Nicolaishvili 1979; Nicolaishvili 1985). This is probably because these graves were not covered with earth, but with stone.

Pollen spectra are dominated by *Achillea*-type 27%, with clumps of *Achillea* pollen also prevalent. Subdominants include Poaceae (10%), *Plantago lanceolata* (9%) and *P. media/major*-type (3%), with lesser amounts of *Taraxacum*-type, *Xanthium*-type, *Papaver, Malva, Artemisia* and *Trifolium*-type pollen (Table 1). Many of these taxa can be regarded as anthropogenic indicators (sensu Behre 1986).

Ruderal taxa comprise up to 50% of the pollen represented (Fig. 2). Indicators of agricultural activity are also present, among which cereals are predominant (*Triticum*-type, *Hordeum*-type and other Cerealia-type). Some arboreal taxa, such as *Juglans regia, Corylus* and *Vitis vinifera*, might be indicative of horticulture. *Convolvulus, Polygonum aviculare*-type and *Centaurea* are typical crop weeds. *Cirsium*-type, Caryophyllaceae, *Ranunculus*-type, Cichorioideae and Chenopodiaceae are indicative of pastures (Fig. 2).

Trees and woodland are represented by *Pinus* pollen and smaller quantities of *Carpinus* (probably from *C. caucasica*), *Quercus* (probably from *Q. iberica*), *Fagus* (probably from *F. orientalis*) and *Tilia* (probably from *T. caucasica*). *Juglans, Corylus* and *Vitis* occur, and single grains of *Picea* (probably from *P. orientalis*), *Alnus, Ostrya* and *Buxus*.

The group of non-pollen fossils is extremely rich. *Chaetomium* fungal spores occur on decomposed fabric (Van Geel and Aptroot 2006) and are predominant in the samples from Tsitsamuri grave (Table 1). As well as a piece of woven fabric, thought to be of flax, the palynological material includes decomposed *Linum* fibres (Table 1; Fig. 3). Cotton fibres occur, some with clear evidence of colouring. *Thecaphora* spores, which parasitize wheat crop weeds such as *Convolvulus* are recorded. There are also sub stantial amounts of epidermal cells of herbaceous plants, especially cereals, and algal zygospores of *Spirogyra* and the amoeba *Arcella*.

Table 1 Quantitative and percent composition of palynomorphs in Tsitsamuri grave No. 101, Georgia

Taxa	No.	%	Taxa	No.	%
Picea	1	0.2	Boraginaceae	9	1.9
Pinus	12	2.5	*Malva*-type	2	0.4
Juglans regia	4	0.8	*Papaver*	2	0.4
Alnus	1	0.2	*Plantago major*-type	15	3.1
Fagus	1	0.2	*Plantago lanceolata*-type	42	8.6
Carpinus	5	1.0	*Apium*-type	10	2.1
Ostrya carpinifolia	1	0.2	*Trifolium*-type	5	1.0
Buxus	1	0.2	*Medicago minima*-type	7	1.4
Quercus	1	0.2	*Sparganium*-type	1	0.2
Tilia	2	0.4	*Typha*-type	1	0.2
Vitis vinifera	2	0.4	Indeterminate NAP	7	1.4
Corylus	3	0.6	Cotton fibres	8	1.1
Cerealia-type	7	1.4	Flax fibres	3	0.4
Triticum-type	9	1.9	Poaceae epidermis	2	0.3
Hordeum-type	3	0.6	Ascospores undiff.	26	3.7
Poaceae	49	10.1	*Glomus*	3	0.4
Artemisia	2	0.4	*Sordaria*-type	26	3.7
Chenopodiaceae	5	1.0	*Sporormiella*	3	0.4
Caryophyllaceae	7	1.4	*Podospora*	19	2.7
Cichorioideae-type	25	5.1	*Thecaphora*	4	0.6
Taraxacum-type	2	0.4	*Chaetomium*-type	50	7.2
Aster-type	17	3.5	Dinoflagellata	3	0.4
Xanthium-type	3	0.6	*Spirogyra*	4	0.6
Achillea-type	130	26.7	*Arcella*	7	1.0
Carduus-type	4	0.8	Acari claws	5	0.7
Cirsium-type	12	2.5	Acari chelae	12	1.7
Centaurea-type	18	3.7	Acari undiff.	2	0.3
Polygonum aviculare-type	10	2.1	Acari hair	13	1.9
Convolvulus	22	4.5	Helminth eggs	5	0.7
Fabaceae	4	0.8	Faunal remains undiff.	17	2.4
Saxifragaceae	9	1.9	Total pollen	486	
Ranunculus-type	3	0.6	Total palynomorphs	698	

Microzoological material was also observed in these samples (Fig. 3), including setae, chelae and claws of mites (Acari, Oribatida) as entire mites. Other insect remains identified include intestinal parasite (helminth) eggs and *Apis* sp. (honey bee) hairs.

Seed data (L. Rukhadze): Plant macrofossil material from the burial includes seeds, fruits, nuts and even whole flowers (Fig. 3). In all, 63 taxa were identified, corresponding to 55 species, 49 genera and 25 families (Table 2). The assemblage is quite complex, as it contains representatives of meadows, woods, gardens and fields. Weeds of cereal crops and gardens are prevalent. As in the pollen material, the seed complex contains many ruderal

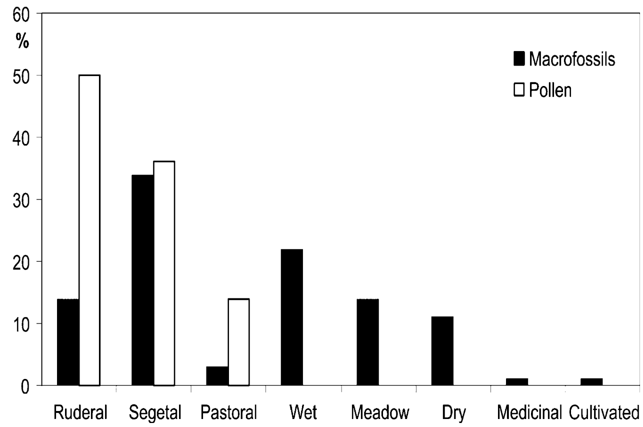
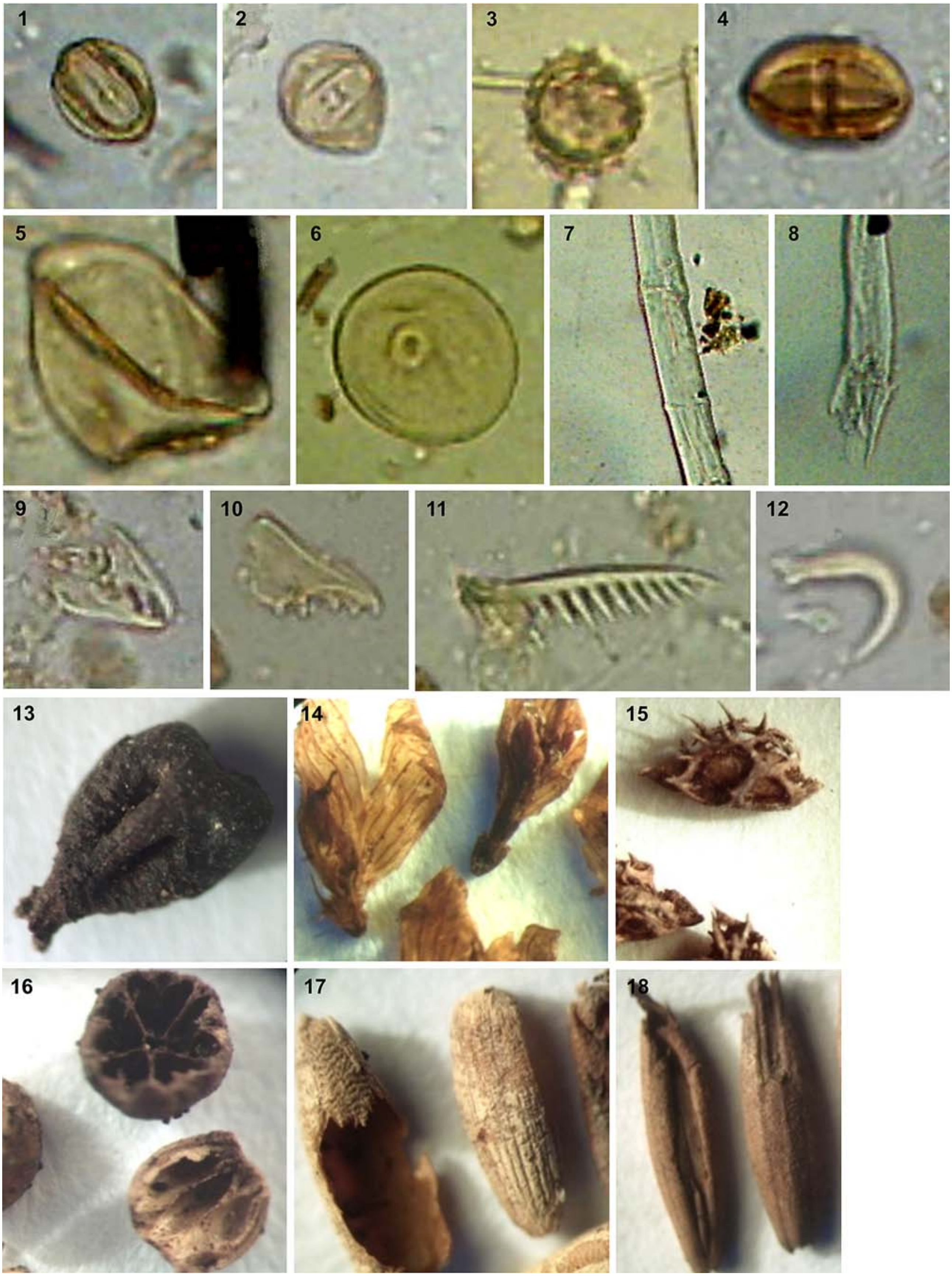


Fig. 2 Representation of anthropogenic indicator pollen in the Tsitsamuri grave material (sensu Behre 1986) compared to anthropogenic classification of the macrofossil data (sensu Dobrokhotov 1961)

elements, but fewer true pasture elements (Fig. 2). Species such as *Schoenoplectus tabernaemontani, Dichostylis micheliana, Carex panicea* and *Potentilla anserina* may indicate the presence of standing water in the landscape. *Carduus nutans, Thalictrum flavum* and *Sorghum halepense* are species common to river banks. *Berberis* cf. *vulgaris, Rubus* cf. *fruticosus, Ranunculus bulbosus, Thalictrum minus, Potentilla argentea, Ajuga reptans* and *Prunella vulgaris* are characteristic of woodland margins, woods and clearings. Many of the species represented are from damp habitats, while taxa from dry habitats are fewer in number.

One find of considerable interest is a perfectly preserved *Vitis vinifera* seed (Fig. 3), distinguished from wild *V. sylvestris* pips on morphological grounds (Rukhadze and Bokeria 2007). Other species in the assemblage such as *Heliotropium suaveolens* and *Ajuga chia* may also indicate viticulture. *Linum catharticum* (wild flax) fossils were found (Fig. 3). Weeds of flax crops including *Poa pratensis, Tribulus terrestris, Potentilla argentea, P. erecta* and *Lappula echinata*, indicate the occurrence of flax locally. A piece of flax textile was found together with the *Linum* macroremains (Fig. 4).

Malacological data (L. Mumladze): Two forms of terrestrial molluscs were identified. The first was scarce and could only be identified to genus level as *Orsula* sp. (Fig. 4). The second type was represented by seven specimens and identified as *Helicella derbentina*. Every specimen of this mollusc was immature, as indicated by the immaturity of the orifice (Likharev and Ramelmeier 1952). *Helicella* reproduces in March–April, reaching sexual maturity at the end of summer. In warm weather, the snails adhere to grass stems and were probably incorporated into the burial when grass was added as bedding.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◀ **Fig. 3** Palynological and macrobotanical remains from the Tsitsamuri grave: *1 Vitis vinifera*; *2 Medicago minima*-type; *3 Achillea*-type; *4 Centaurea*-type; *5 Triticum*-type; *6* Cerealia-type; *7* flax fibre showing characteristic segmentation; *8* cotton fibre; *9–10 Acari* chelae; *11 Acari* hairs; *12 Acari* claw; *13 Vitis vinifera* seed; *14 Trifolium campestre* flowers; *15 Onobrychis viciaefolia* seeds; *16 Linum catharticum* seeds; *17 Carduus albidus*; *18 Avena fatua* florets. See Electronic Supplementary Material (ESM) for magnification scale and additional photographs

Discussion and conclusions

When considered as a whole, the pollen and plant macrofossil data from Tsistamuri show some strong similarities. Both assemblages contain large proportions of ruderal plants, with indications of agriculture, horticulture and viticulture. The presence of dung spores and helminths indicate that grazed vegetation was incorporated into the burial as bedding for the deceased, and that pasturing was part of the Tsitsamuri landscape of the early Middle Ages.

The data demonstrate that the area was largely a cultural landscape, a conclusion that is consistent with the archaeological evidence. Over 100 graves dating to the 4th–6th centuries A.D. have been identified in the Tsitsamuri area (Nicolaishvili 1979, 1985).

In the pollen and macrofossil assemblages, a grape pip and numerous *Vitis* pollen grains have been found, which indicate viticulture. Macrofossils include typical vineyard weeds and pollen spectra include unusually high percentages of *Juglans regia* and *Corylus*, suggesting that walnuts and hazelnuts may have been cultivated. Whilst alone these taxa could be considered as part of the woodland flora, together they constitute indicators of human activity.

Agriculture is indicated by an abundance of weed seeds and their pollen. *Triticum*- and *Hordeum*-type pollen was found in substantial quantities. Macrofossil data might suggests that *Linum* was cultivated in the local area, although this is not supported by the pollen data because of the poor pollen production of *Linum*. The piece of flax

Table 2 Plant macroremains from the Tsitsamuri grave with ecological classification according to Dobrokhotov (1961)

Taxa represented	No.	%	Xerophile	Mesophile	Segetal	Ruderal	Meadow	Pasture	Medicinal	Cultivated
Ajuga raptans	400	35.0		+			+			
Lamiaceae undiff.	100	8.8	+			+	+	+	+	
Potentilla anserina	80	7.0		+	+	+		+		
Setaria verticillata	66	5.8	+							
Linum catharticum	45	3.9		+			+			
Thalictrum minus	40	3.5		+	+		+			
Ajuga chia	33	2.9	+		+					
Arenaria serpyllifolia	31	2.7		+	+	+	+			
Heliotropium suaveolens	27	2.4			+				+	
Onobrychis viciaefolia	27	2.4	+		+					
Trifolium campestre	26	2.3		+	+		+			
Euphorbia helioscopia	20	1.8	+		+	+				
Potentilla argentea	18	1.6		+	+		+	+		
Thalictrum flavum	18	1.6		+			+			
Alyssum parvifolium	16	1.4	+				+			
Echium vulgare	15	1.3	+		+	+				
Eryngium campestre	15	1.3			+		+			
Thymelaea passerina	15	1.3								
Carduus albidus	14	1.2		+	+	+	+			
Avena fatua	12	1.1	+		+					
Daucus carota	12	1.1			+					
Potentilla erecta	8	0.7	+		+	+				
Potentilla sp.	8	0.7		+						
Lappula echinata	7	0.6			+	+				
Spergularia campestris	7	0.6		+	+			+		
Euphorbia falcata	6	0.5	+		+					
Euphorbia lathyrus	5	0.4	+							
Tragus racemosa	5	0.4			+	+				

Table 2 continued

Taxa represented	No.	%	Xerophile	Mesophile	Segetal	Ruderal	Meadow	Pasture	Medicinal	Cultivated
Amaranthus retroflexus	4	0.4	+		+					
Euphorbia platyphyllos	4	0.4	+		+					
Ranunculus bulbosus	4	0.4		+			+			
Cirsium vulgare	3	0.3			+	+				
Xanthium cf. *spinosum*	3	0.3			+	+				
Berberis cf. *vulgaris*	2	0.2	+							
Crataegus cf. *pentagyna*	2	0.2	+							
Fumaria officinalis	2	0.2			+		+			
Medicago minima	2	0.2			+	+				
Petroselinum crispum	2	0.2		+						
Sorghum halepense	2	0.2		+	+		+	+		
Stachys annua	2	0.2			+	+				
Tribulus cistoides	2	0.2			+					
Verbena officinalis	2	0.2		+	+	+				
Aegopodium podagraria	1	0.1		+	+					
Althaea hirsuta	1	0.1			+	+				
Androsace septentrionalis	1	0.1			+					
Carex panicea	1	0.1		+						
Centaurea sp.	1	0.1					+			
Dichostylis micheliana	1	0.1		+						
Euphorbia sp.	1	0.1	+							
Fallopia convolvulus	1	0.1		+	+		+			
Lapsana communis	1	0.1	+		+	+	+			
Neslia paniculata	1	0.1			+					
Ornithogalum pyrenaicum	1	0.1		+	+	+				
Papaver dubium	1	0.1			+					
Poa nemoralis	1	0.1		+	+		+			
Prunella vulgaris	1	0.1		+	+		+			
Rubus cf. *fruticosus*	1	0.1		+						
Salvia verticillata	1	0.1			+	+				
Schoenoplectus tabernaemontani	1	0.1		+						
Vitis vinifera	1	0.1		+						+
Indeterminate	12	1.1								
Total macrofossils	1,142									

textile is from the remains of a shroud in which the deceased was wrapped. According to tradition, the burial shroud was always of flax (Nicolaishvili 1979, 1985). Coloured cotton fibres suggest that the deceased was interred in his or her clothing made of coloured fabric (ESM Fig. 5).

An important aspect of the pollen and macrofossil assemblages is the prevalence of hydrophilic elements in both. Most notably, the low Chenopodiaceae (1.3%) and *Artemisia* (0.5%) pollen content of the burial material indicates local conditions wetter than at present. In the Tbilisi–Mtskheta region in which Tsitsamuri is situated, the pollen proportion of Chenopodiaceae is typically 25–50% and *Artemisia* 5–15% (Kvavadze and Stuchlik 1991; Kvavadze and Gabashvili 1998; Connor et al. 2004). The presence of such taxa as *Typha, Sparganium, Schoenoplectus, Dichostylis, Carex, Arcella* and *Spirogyra* in the spectra is indicative of the existence of open water and wet meadows in the burial environs, which is not the case today.

Palaeoecological data from the Tbilisi–Mtskheta region support the suggestion of a wetter climate during the 4th–6th centuries A.D. (Connor and Kvavadze 2005). Pollen data from Lake Jvari, 3 km south of Tsitsamuri, exhibit relatively high proportions of arboreal taxa around this time, while Chenopodiaceae percentages are

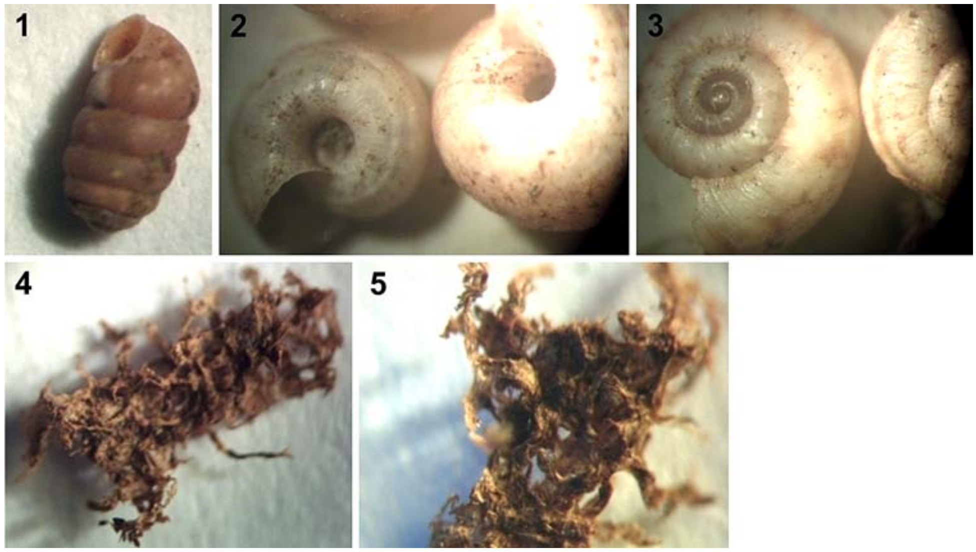

Fig. 4 *1–3* Molluscs; *4–5* linen textile fragments from the Tsitsamuri grave. See ESM for magnification scale and additional photographs

relatively low (Connor 2006). High lake levels, dated to 1630 ± 40 and 1510 ± 40 years B.P., are recorded in southern Georgian lake sediments (Kvavadze et al. 2007c). We interpret this as an indication of generally wetter climatic conditions across the region in the early Middle Ages.

Differences between the pollen and macrofossil data are enlightening. For example, the trees represented in the pollen spectra are absent from the macrofossil material, and yet the existence of woodland is supported by macrofossils of woodland herbs. Furthermore, *Achillea* and *Plantago* are well represented and dominant in the pollen spectra, but are absent from the macrofossil assemblage. The fact that *Achillea*-type pollen occurs in such large quantities and as pollen clumps suggests that entire stamens were incorporated into the burial. This in turn indicates that these plants were in flower at the time of the burial. Macroremains of *Achillea* are probably not preserved due to their fragility. *Trifolium campestre* flowers, however, were preserved, proving that flowering plants accompanied the burial. Several of these plants, including *Achillea* and *Plantago*, have been useful medicinal plants since ancient times and may have had special cultural or ritual significance for the deceased.

The abundance of *Trifolium* flowers and *Achillea* pollen provides an insight into the timing of the burial. Both these herbs flower in early summer (Ketskhoveli 1973–1987). Almost all of the plants represented in the seed assemblage set seed in June (Ketskhoveli 1973–1987). The zoological material adds further weight to this conclusion. The mites identified have an active phase during the warmer months and the immature molluscs are characteristic of the beginning of summer. The combination of pollen, plant macrofossil and zoological evidence allows us to conclude that the burial's bedding material was gathered in early summer (probably June) from a landscape with considerably more complexity than the present one.

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