Kostenki 12: pollen, fauna, molluscs

A summary of the pollen results from Kostenki 12 is included in Anikovich et al. (2004, pages 32-34 and Figure 11). This first version (as Pospelova remarked) is based on the profile of 2001. A much more substantial account is given in Levkovskaya et al. (2005). Figures 1 and 2 in that article differ somewhat from the earlier version. Figure 2 is reproduced here; the key fits both Figure 1 (attached to my summary of the palaeomagnetic results and taphonomy at Kostenki 12) and Figure 2. The faunal results are given in Anikovich et al. (2004, pages 31-32) and Anikovich et al. (2005, pages 75-77). The results for molluscs and diatoms quoted by Levkovskaya were obtained respectively by A.F. San'ko and G.K. Khursevich. What follows is based essentially on Levkovskaya et al. (2005).

The new version is based on samples taken in different years from different points in the excavated area. In 2001 the samples were collected by Anikovich from the eastern wall. In 2002 and 2003 the samples were collected by Levkovskaya herself, first from the western wall in the south-west corner (where the lowest fossil soils were best developed and were least affected by human activity), and then from the eastern wall in the vicinity of the points from which the palaeomagnetic samples were taken. In the laboratory, the traditional Soviet method of preparation devised by V.P. Grichuk was first employed, but far better results were achieved when M. Carciumaru's method was used. Statistically significant results were obtained for the majority of the samples; %s were not calculated unless there was a minimum of 100 specimens in the samples concerned. The scanning electron microscope work was done together with L.A. Kartseva; it assisted in the production of the palynoteratical diagrams and the analysis of the sequence in terms of so-called thermomers and cryomers, the latter characterised by underdeveloped and dwarf pollens. Levkovskaya gives credit to E.N. Ananova (1966) for first recognising such "abortive" complexes. The results are summarised in terms of a number of "megastages" which are described in six parts (A-F) taking the story in detail up to the deposition of the volcanic ash layer and its erosion (lithic layers 11 and 10) but not beyond.

A. Deposits beneath cultural layer V

<u>Megastage M1</u> Thermomer I Pollen zone 1 Palynoteratical horizon P1
[Lithological horizon 20 Magnetic zone 11]
AP 30%. Alnus and Betula albae equally dominant, plus Picea and Pinus sylvestris, Corylus, and a few Ulmus and Carpinus. Almost no abnormal pollens. Reconstructed phytophase F1. Mixed woods and mesophil meadows. A damp interstadial, the first favourable climatic episode at the site, correlates with Oerel (Behre and van der Plicht, 1992).

<u>Megastage M2</u> Cryomer I Pollen zone 2 Palynoteratical horizon P2
[Lithological horizon 19 lower part Magnetic zone 10]
A maximum of abnormal pollens and microtherms. There are many unidentified pollens, but they are probably Betulaceae. Microtherms present are Alnaster fruticosus, Betula humilis/fruticosa, and Alnus. This vegetation is characteristic of the present day tundra zone (Vasil'chuk, 2005). There are also indications that there was a watercourse nearby. This conclusion is supported by the finding of diatom algae Aulocoseira sp., a lake plankton.

Reconstructed phytophase F2. Shrub vegetation with dominant Betula and Alnaster. A cold damp climate, correlates with a stadial estimated to have occurred 60-50 ka years ago (Mangerud et al., 2004).

Megastage M3 Thermomer II Pollen zone 3a Palynoteratical horizon P3
[Lithological horizon 19 upper part]
Few abnormal pollens. The beginning of a broad leafed AP and also a spores maximum. AP mainly microtherms, particularly Ulmus laevis. Spores dominated by Botrychium sp. Note the appearance of Ephedra sp. (up to 6%, now characteristic only for the southern part of the former USSR) and of Carpinus orientalis. Both are xerophil.
Reconstructed phytophase F3. Climate warm and dry. Elm woods in the ravines, thickets of xerophil bushes on the slopes, NAP varia in dry meadows. Not a complete analogue for the present day wooded steppe. M.P. and V.P. Grichuk (1960) regarded these conditions as characteristic for the initial phase of an interstadial. It must come immediately after the preceding cold period. Spiridonova (1991) put the beginning of the Grazhdanskii interstadial here, and suggested that its length was 10,000 years.

B. Cultural layer V

Megastage M3 Thermomer II Pollen zone 3b Palynoteratical horizon P3
[Lithological horizon 18 Soil horizon D Magnetic zone 9]
The detailed analysis proceeds in part by the separate recording of individual samples, in particular sample 4, which was collected in 2002 in an area not affected by anthropogenic activities. It produced over 400 pollen grains, and served to define pollen zone 3b. The taxa are listed as follows, in this order.

1 Ulmus laevis. 2 Quercus sp. 3 Alnus sp. 4 Betula albae. 5 Carpinus betulus.
6 Carpinus orientalis. 7 Corylus avellana. 8 Lonicera sp. 9 Salix sp.
10 Pinus sylvestris. 11 Picea sp. 12 Ephedra sp. 13 Ericaceae. 14 Liliaceae.
15 Caryophyllaceae. 16 Polygonum aviculare. 17 Cichoriaceae. 18 Asteraceae.
19 Cyperaceae. 20 Plantago sp. 21 Plantago major. 22 Poaceae. 23 Chenopodiaceae.
24 Artemisia. 25 Myriophyllum sp. 26 Botrychium cf. matricariifolium – Botrychium ramosum. 27 Fungi gen. [plus UID].

Samples 103 and 105, also taken in 2002, add Fabaceae to this list.

Samples 413 and 415 were taken one above the other in 2003, therefore from the eastern wall. The same species as above occur, with the addition of Quercus robur. Ulmus is dominant, which has environmental implications, since it prefers soils with a high level of groundwater (but not stagnant). Swampy conditions are also indicated by the presence of Myriophyllum, and (already in the layer below) Menyanthes trifoliata as well as Trapa natans. The suggestion is that Myriophyllum could have been deliberately gathered. It is considered that the NAP component (especially Chenopodiaceae and Plantago) may reflect human activity in another way (colonisation of ground cleared by settlement) as well as (in the upper sample) the possible onset of colder conditions.

Reconstructed phytophase F4. In general, AP is up to 60%, one of the biggest maxima in the sequence, with dominant Ulmus laevis (30%) and Picea in second place (16%). Woods may have occupied the slopes as well as the valley bottoms. The watersheds were occupied by steppe vegetation. There are clear signs of human activity, even if locally limited. The vegetation of the floodplain is in some ways reminiscent of the present wooded steppe zone of European Russia, but there is no complete analogy.

It is considered that the palynological results are consonant with the faunal data provided by I.E. Kuz'mina as follows (NISP/MNI): Mammuthus primigenius 3/1, Coelodonta antiquitatis 1/1, Rangifer tarandus 1/1, Cervus elaphus 61/1, Canis lupus 1/1. Cervus elaphus indicates a mild wooded climate.

According to A.F. San'ko, there are no periglacial indicators among the molluscs from the lower part of this horizon, but there are such indicators from the upper part. This is consonant with the suggestion already made on palynological grounds of an incipient cooling at this point. The following list for the upper part is provided in increasing order of frequency (where * marks a damp indicator and ** a damp and cold indicator):

Vallonia tenuilabris ladacensis (Neville) (1); ** Pupilla loessica (Ložek) (2); * Pupilla muscorum densegyrata (Ložek) (4); Cochlicopa lubrica (Müller) (5); Vallonia tenuilabris (Braun) (15); Trichia hispida (Linnaeus) (20); * Pupilla sterri (Voith) (109); Vallonia costata (Müller) (146); ** Succinea oblonga elongata (Sandberger) (341); Pupilla muscorum (Linnaeus) (465).

Damp indicators therefore account for 75.6% of the total, whereas damp and cold indicators account for 31%.

It is considered that the time period represented corresponds to the Glinde interstadial at about 51-48 ka years ago (Behre and van der Plicht, 1992).

C. Deposits immediately above cultural layer V

<u>Megastage M3</u>. Cryomer II. Pollen zone 4. Palynoteratical horizon P4.
[Lithological horizon 17 Magnetic zone 8 lower part]
AP down to 28%. A second peak of underdeveloped and dwarf pollens, though not so severe as the first. The dwarf forms include NAP varia 52%, Chenopodiaceae 18%, Betula sp. 15%, Cyperaceae 6%. On the floodplain there was a partial replacement of the elm woods with meadows and thickets of microtherm bushes mainly Betula humilis.
A colder and damper climate, but warmer indicators did not entirely disappear, e.g., Quercus, Corylus, Carpinus orientalis. This reflects the fact that this cold episode was of short duration (reflected in the thin interrupted deposits).

<u>Megastage M3</u>. Thermomer III. Pollen zone 5. Palynoteratical horizon P5.
[Lithological horizon 16 Soil horizon C Magnetic zone 8 upper part]
There are two unusual peaks here, for Acer sp. (16.9 %) and Ephedra (29.5 %), and there is quite a high figure for Carpinus orientalis as well (5.2 %). This tree has now an exclusively southern distribution, in Moldavia, the Crimea, and the Caucasus. Ulmus laevis on the other hand has dropped to 6 %. NAP (34.6 %) is represented mainly by Chenopodiaceae, but also present are Liliaceae, Caryophyllaceae,

Cyperaceae, Plantago, and Polygonum. Note Elaeagnus sp. and Cannabis sp. as well. The latter is a wild steppe grass.
In general, a dry and warm phase is indicated, representing a temperature maximum in the Lower Humic Bed. It should correspond to Moershoofd (or the Grazhdanskii interstadial) at approximately 46-45 ka years ago.

Megastage M3. Cryomer III Pollen zone 6 Palynoteratical horizon P5.
[Lithological horizon 15 Magnetic zone 7 mid part]
AP shows continued prevalence of Ulmus, plus Picea and Betula humilis/fruticosa. NAP reduced. A damper climate.

D. Cultural layer IV

Megastage M3. Thermomer IV Pollen zones 7-8 Palynoteratical horizons P5 and P6a.
[Lithological horizon 14 Soil horizon B Magnetic zone 7 upper part]
AP decreases from the base upwards, from 17 % to 8 %, Ulmus likewise, from 10.8 % to 6 %. Other species represented are Alnus, Pinus, Carpinus orientalis, Carpinus betulus, Quercus, Corylus, Tilia, Betula, and Picea. NAP is marked by the dominance of various types of mesophil plants. In the lower part these are mainly Fabaceae and Liliaceae, but in the upper part there is no single dominant species. Species present include Plantago lanceolata, Cichoriaceae, Rosaceae, Caryophyllaceae, Polemonium sp., Botrychium sp., and Lycopodium sp. In both pollen zones 7 and 8, there are some water or swamp plants, including Cyperaceae, Menyanthes trifoliata, Myriophyllum sp., and Polygonum amphibium. The xerophil pollens decrease upwards, from 29 % to 0.5 %, including Chenopodiaceae, with a few Artemisia and Ephedra.
Essentially, this constitutes a third elm thermomer, but it was a lot damper than the two preceding elm climaxes.

Levkovskaya in this case does not comment on the fauna. According to Kuz'mina it is as follows: Mammuthus primigenius 30/1, Equus latipes 9/2, Bison priscus 3/1, Alces alces 1/1, Rangifer tarandus 5/1, Lepus tanaiticus 1/1. Her comment is that this shows a warm temperate climate and a wooded steppe landscape.

E. Deposits separating cultural layers IV and III

Megastage M3. Cryomer IV and Thermomer V. Pollen zones 9a and 9b.
Palynoteratical horizon P6b.
[Lithological horizon 13 Magnetic zone 6]
Levkovskaya's sample 10 is marked by a pronounced dominance of NAP (87.4%) and a corresponding reduction in AP (12.6%). This horizon also marks the beginning of another peak in underdeveloped and dwarf forms constituting the third such event from the base on the palynoteratical diagram. 608 pollen grains of different taxa were identified as abnormal. In AP, Alnus (or Alnaster?) is dominant, others species represented being Ulmus, Carpinus betulus, Corylus, Tilia, Salix, Betula, with a few Picea and Pinus. The varied NAP spectrum includes Fabaceae, Umbelliferae, Rosaceae, Polygonaceae, Cichoriaceae, Chenopodiaceae, Cyperaceae, Polygonum sp., and Polemonium sp. There are a few water or swamp forms such as Menyanthes trifoliata, Myriophyllum sp., and Polygonum amphibium.

Levkovskaya comments that it is not easy to reconstruct the prevailing climatic conditions at this time. On the one hand, the presence of broad leafed trees indicates a favourable environment, but the palynoteratical data indicate crisis conditions. There are three possible explanations for the apparent contradiction. 1, this might be the beginning of a broad leafed expansion following a cold spell. 2, mixing might have been occasioned by erosion and redeposition. 3, the situation might have been affected by the intrusion of long-distance pollens.

In general, the conclusion is that lithological horizon 13 marks the end of the Moershoofd interstadial which is variously dated at 43-42.5 or 41-40 ka years ago. The combination of a large NAP element and dominance of Alnus in AP is reminiscent of the situation described by M.P. Grichuk for the basal horizon at Kostenki I beneath the lowest cultural layer (Lazukov, 1957: 88, Figure 3).
This horizon also marks the final phase of the "Ulmus" Megastage M3 at this site.

F. The upper deposits beneath the volcanic ash

<u>Megastages M4 and M5</u>. Cryomer V and Thermomer VI Pollen zones 10-12
Palynoteratical horizons P6c and P7. Cultural layer III.
[Lithological horizon 12 Soil horizon A Magnetic zone 5]
Most palynomorphs are covered by mineral colloids, which makes them unrecognisable. Nonetheless, the characteristics of three phases are sketched out.

1. A pronounced NAP maximum. These include Artemisia s.g. seriphidium (indicative of dry conditions) as well as Chenopodiaceae. AP includes Alnus, Alnaster, Betula, Pinus. In general, this is interpreted as showing a cold arid steppe on the interfluves with a few trees in the valley bottoms.
2. AP up to 45%. The beginning of M5. Picea (the characteristic species for this Megastage) plus Ulmus, Corylus, Quercus. This is a periglacial wooded steppe, the optimum warm phase at this time.
3. A maximum number of spores. AP only a few Picea and Pinus. Tundra or wooded tundra, with some swamps or meadows.

NAP varia which occur throughout are listed as follows: Ephedra sp., Knautia L., Limonium sp., Cichoriaceae, Asteraceae, Ericaceae, Plantago sp., Liliaceae, Polemoniaceae, Caryophyllaceae, Armeria sp., Polygala sp., Myriophyllum sp.

As a whole, the data show the instability of conditions at this time, although this is a decisive moment in terms of a movement from elm to spruce dominated AP assemblages. There is an erosional discontinuity both at the base and the top of cultural layer III. The site was still at a contact point between the slope and the floodplain, as indicated by the molluscs: Pupilla macrosum (L), Vallonia costata (Müller), Succinea oblonga elongata (Sandberger), and Trichia hispida (L).

The fauna as listed by Kuz'mina is as follows: Mammuthus primigenius 38/1, Equus latipes 191/6, Capreolus capreolus 1/1, Alces alces 1/1, Rangifer tarandus 133/6, Canis lupus 1/1. Levkovskaya agrees with the conclusion reached by Hoffecker et al. (2005) that horse preceded reindeer at the site, which would correspond to phases 2 and 3 listed above.

The seemingly short time span of phase 2 and the fact that it is closely bracketed by cold phases throws doubt on its correlation with Hengelo. On the basis of the interstadials detected at Strelitsa (Bolikhovskaya, 1995) and Kostenki 17 (Fedorova, 1963) Hengelo should have been longer than that. On the other hand, the erosion evident at the top of horizon 12, which truncated the sequence, may mean that we have the start of Hengelo here. Horizon 11 (with volcanic ash) was definitely redeposited, and horizon 10 (which truncated it) was formed by water action. This is shown among other things by the presence of diatom algae Cocconeis placentula Ehrh. found in one of the erosion gullies. The Y5 volcanism itself is dated to c. 39,300 years ago.

<u>Later deposits at the site</u>

The article by Levkovskaya et al. (2005) contains very little information on the later sequence, but a few details are given in Anikovich et al. (2004).

Lithological horizon 10 witnesses a new geobotanical crisis, with many underdeveloped and dwarf pollens, indicative of a predominantly treeless xerophil environment. This is pollen zone 13a or palynoteratical horizon P8a.

Cultural layer Ia (lithological horizon 9) is characterised by NAP (varia) indicative of meadows and a small amount of AP (Picea and Pinus). The fauna is as follows: Mammuthus primigenius 17/1, Coelodonta antiquitatis 1/1, Equus latipes 9/2, Rangifer tarandus 1/1. It is suggested that this is characteristic of a mild climate and a wooded steppe landscape. Pollen zone 14 or palynoteratical horizon P9.

Cultural layer I (lithological horizon 8) is described as a cold and damp interstadial environment, with Larix-Picea woods, and some swampy ground.
The fauna is as follows: Mammuthus primigenius 25/1, Equus latipes 23/2, Bison priscus 2/1, Rangifer tarandus 2/1, Saiga tatarica 1/1, Canis lupus 1/1. As in Ia, this is said to indicate a mild climate and a wooded steppe landscape.
Pollen zone 15 or palynoteratical horizon P10. Thermomer VII.

<u>Correlations for the cultural layers below the volcanic ash</u>

This is discussed in Levkovskaya et al. (2005). Cultural layers V and IV are older than any other such layers with a pollen record at Kostenki. There are few coniferous pollens, unlike the later deposits. Thus, Picea and Pinus reach a maximum of 8% and 5% of the total sum or 20% and 17% of AP, not more. Ulmus laevis is dominant. Kostenki I, Kostenki 17, and Kostenki 14 all start later, i.e., they come after Moershoofd, and it is then that they are characterised by dominant Picea and Pinus (Spiridonova, 2002). The possibility for correlating the deposits at Kostenki 12 with Glinde and Moershoofd is good. It should be noted that the vegetation in Glinde and Moershoofd has much in common, therefore it is legitimate to combine them here in one “elm” Megastage M3. The presence of active springs (as shown among other things by the appearance of diatom algae) at Kostenki is an important factor, and what is presented here may even be characterised as a “floodplain model” of the environment. Comparisons are made to the climate curves produced by Genty et al. (2003) and Bond et al. (1993) (Levkovskaya et al., Figure 2).

Conclusions

The principal conclusions reached by Levkovskaya et al. (2005) are summarised in 13 points.

1. For the four soil horizons beneath the volcanic ash at Kostenki 12 a “floodplain model” for the changing environment in the period 55-40,000 years ago has been worked out (a chronology which is not based on radiocarbon dates).
2. Kostenki 12 in its early stages was near a watercourse, perhaps a spring with calcified water. This is supported by the appearance of deposits similar to travertine at the base of cultural layer III, apart from the diatom algae.
3. For this period there were 6 thermomers divided by 5 cryomers, constituting 5 megastages.
4. During two megastages (M2 and M4) there was a crisis situation. M2 (lower part of lithological horizon 19) was cold and damp, whereas M4 (lower part of lithological horizon 12) was very dry. M2 correlates with the glacial maximum period c. 60-50 ka years ago, whereas M4 (on the basis of a comparison to Genty et al., 2003) should date to about 42,300 years ago. Extreme conditions are also noted for the formation of lithological horizon 11, the layer with volcanic ash.
5. During M1 (lithological horizon 20) and M3 (upper part of lithological horizon 19 and 18-13) there were interstadial conditions. M5 (mid and upper parts of lithological horizon 12) may have been the initial phase of an interstadial, the optimum portion of which has been eroded away, or it may be regarded as a minor independent climatic oscillation.
6. M3 had four “elm” optima separated by cold phases, of which one was significant. This is pollen zone 4, which divided Glinde (one optimum) from Moershoofd (three optima). Soil horizons D, C, and B, and part of lithological horizon 13, formed in these optima. Cultural layers V and IV were connected with Glinde and Moershoofd 2 respectively.
7. Broad leafed woods, dominated by Ulmus laevis, existed in the floodplain refugium during M3 from c. 50,000 to 42,300 years ago. Later, after the crisis of M4, the emergence of woods dominated by Picea (M5) can be noted in the floodplain.
8. Cultural layers V and IV are the oldest in the Kostenki region. The only comparison palaeoclimatically is to an analogous horizon at the base of Kostenki I, but this is below the lowest cultural layer.
9. The sequence at Kostenki 12 can be successfully correlated with world wide climatic changes.
10. Cultural layer III began in a cold phase (M4) about 42,300 years ago.
11. Cultural layer V in its upper part is already transitional to a colder phase (from pollen zone 3b to 4).
12. Cultural layer IV (in an interval corresponding to Moershoofd 2 or the third optimum of M3) existed in favourable but damp conditions.
13. Cultural layer III existed in complex conditions (corresponding to pollen zones 10-12). Because of the large number of unidentified pollens, the results here are preliminary, but the deposits are older than 39,300 years ago (dated volcanic ash).

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Caption

Levkovskaya et al. (2005) Figure 2. Interregional correlations. A. Pollen diagram for Kostenki 12. D. $\delta^{13}C$ isotope record from stalagmite in Villars cave [Genty et al. 2003]. E. Percentage of Neogloberigina pachyderma in Atlantic Ocean sediments [Bond et al. 1993].

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