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Radiocarbon dating and chronology of the Early Upper Paleolithic at Kostenki

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Abstract

Investigations during the last 5 years at Kostenki (central Russia, Voronezh area) have uncovered several new archeological assemblages dating to the earliest phase of Upper Paleolithic occupation (36^12(?) ka). These discoveries, in conjunction with an expanded scope of research at Kostenki, have forced a reassessment of the East European early Upper Paleolithic record and generated a set of new questions. The paper addresses one of the most important of these questions—the problem of two discordant chronological time-scales, one based on radiocarbon evidences and another on various analyses by pertinent disciplines (paleomagnctism, palynology, tephrochronology, and others).
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1. Introduction

The Kostenki sites (Voronezh region) (Fig. 1) have long occupied a critical place in the Paleolithic archeology and Quaternary geology of Eastern Europe (Hoffecker et al., 2002, 2004). Together with the Molodova sites in western Ukraine, they provide the most important stratigraphic sequence for this part of the world and the chronological framework for most Paleolithic sites in the vast region that lies between the Carpathian and the Ural Mountains. The chronology of the Molodova sites, which was developed by Chernysh (1973, 1987), Ivanova (1965), and Ivanova and Tseitlin (1987), has been subject to some recent revisions regarding the middle time range of sequence (i.e. Haesaerts et al., 2003, 2004a), while new revisions to the Kostenki chronology pertain to the earlier periods.

2. Kostenki chronology: history of research

The history of chrono-stratigraphic and paleo-cultural studies at Kostenki parallels in many respects the development of both Russian Paleolithic archeology and paleogeography. During the 1950s and 1960s, as a result of field research by A.N. Rogachev, M.N. Grishchenko, G.I. Lazukov, and A.A. Velichko, archaeological layers at Kostenki were subdivided into three principal chronological groups on the basis of stratigraphic position (Klein, 1969; Velichko and Rogatchev, 1969). Cultural layers in the loessic loams underlying the modern chernozem were assigned to the late (Illrd) chronological group. Layers assigned to the middle (Ilnd) and earliest (1st) chronological groups were those deposited in the upper and lower humic beds, respectively, subdivided by the volcanic ash horizon (Fig. 2).

During the 1980s, a radiocarbon chronology was developed for all three chronological groups (Praslov and Soulerjytsky, 1997; Sinitsyn et al., 1997; Praslov and Sulerzhitsky, 1999; Sinitsyn, 1999);

- chronological group III: 27,000-20,000 years BP,
- chronological group II: 32,000-27,000 years BP,
- chronological group I: 36,000-32,000 years BP.

At the same time, a number of new questions and problems arose, including correlation of the temporal boundaries of the chronological groups with the past climate fluctuations as reconstructed by other studies (e.g., oxygen isotope climatostratigraphy). Especially important were questions concerning the age of the two older chronological groups

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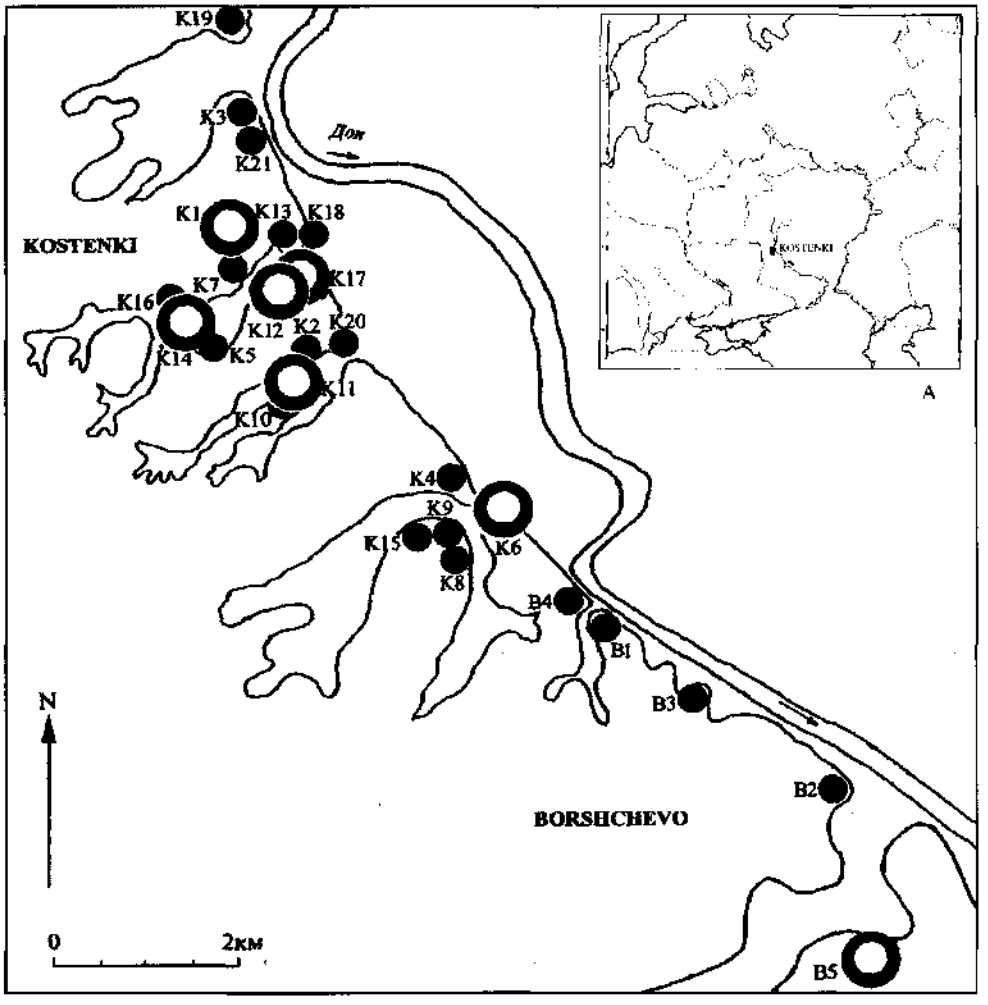

Fig. 1. Kostenki-Borshchevo group of sites. A large circle marks sites with volcanic ash. A—position of Kostenki-Borshchevo area on Russian Plain.

and the dating of the volcanic ash horizon that separated them. After more than four decades of research, the primary stratigraphic subdivisions of these sites—loessic loams, upper humic bed, and lower humic bed—remained unchanged, but debate continued regarding the chronology of the major units.

Seven of the Kostenki sites contain cultural layers of the earliest chronological group (I): Kostenki 1 (V cultural layer), Kostenki 6, Kostenki 8 (IV cultural layer), Kostenki 11 (V cultural layer), Kostenki 12 (II, III, IV, V cultural layers), Kostenki 14 ("cultural layer in the volcanic ash horizon", IVa, "horizon in fossil soil", IVb—"horizon of hearths"), and Kostenki 17 (II cultural layer). These constitute a total of 13 occupation levels.

According to the widely published traditional point of view, the material culture of sites assigned to the earliest chronological group is represented by the Streletskian and Spitsynian cultures (Praslov and Rogachev, 1982; Boriskovsky, 1984; Hoffecker, 1988, 2002; Anikovich, 1991, 1992, 1997, 1999, 2000, 2003: Amirkhanov et al., 1993; Cohen and Stepanchuk, 1999, 2000-2001, 2001; Djindjian et al., 1999; Chabai, 2003). Recently, Sinitsyn (2000, 2003b) proposed, on the basis of new field research, that four cultural traditions are represented in the earliest group, and that these may be assigned to two distinct chronological subgroups.

Sites of the middle chronological group (II) are more numerous: Kostenki 1 (III cultural layer); Kostenki 5 (III cultural layer), Kostenki 8 (II, III cultural layers), Kostenki 11 (III, IV, "northern locality"), Kostenki 12 (I, la cultural layers), Kostenki 14 (II, 111 cultural layers), Kostenki 15, Kostenki 16, Kostenki 17 (I cultural layer), Borshchevo 3, Borshchevo 4, Borshchevo 5 (II cultural layer)—a total of 17 settlements. Three coexisting cultural entities (Aurignacian, Gravettian and Gorodtsovian) are recognized within the second chronological group.

Owing to the considerable depth (up to 7 m) of the lowermost cultural layers at the Kostenki sites, the width of exposed stratigraphic profiles is usually limited. The most representative sections have been exposed at Kostenki 1, 12, 14, and 17. The sequences of radiocarbon and luminescence dates, pollen and paleomagnetic diagrams along with the complex profile of the "stratigraphic sondage" (Fig. 3) render these sites critical for developing

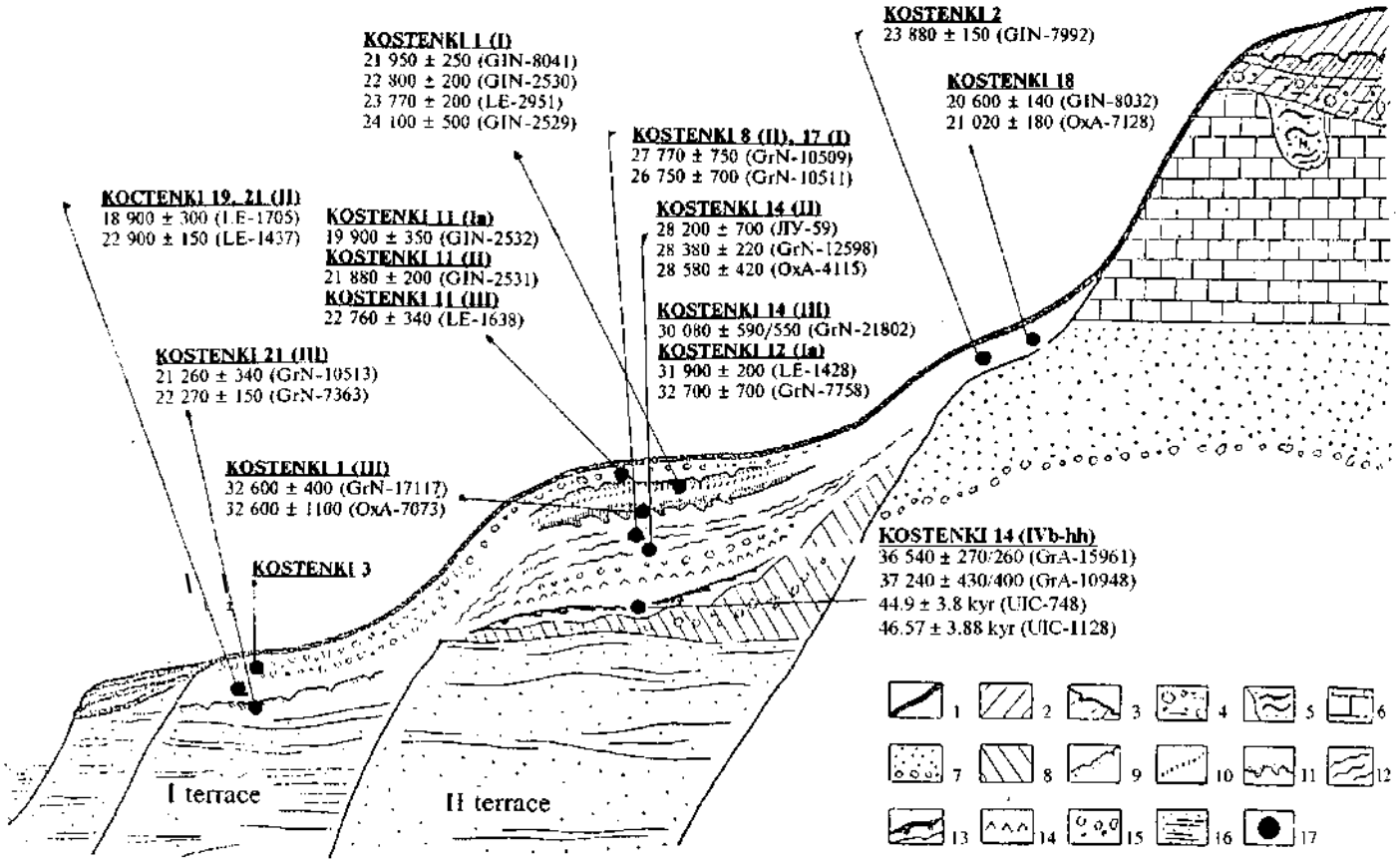

Fig. 2. Stratigraphic position of sites of Kostenki group and radiocarbon ages (according to Sinitsyn et al., 1997 with modifications). 1. Modern soil. 2. Sediments of watershed. 3. Above-moraine fossil soil of the watershed. 4. Moraine of Don glaciation. 5. Sediments of karst cavities of the Neogene epoch. 6. Turonian chalk. 7. Cenonian sands. 8. Alluvio-colluvial deposits. 9. Fossil soil of Gmelin-type. 10. Traces of the initial soil formation at the level of upper cultural layers of Kostenki 1,11,14. 11. Cryomorphic fossil soil of III cultural layer of Kostenki 1. 12. Horizons of the Upper Humus Bed. 13. Lower Humus Bed. 14. Volcanic ash. 15. Cretaceous detritus. 16. Alluvial sands. 17. Cultural layers of Paleolithic sites.

the numerical chronology of the earliest group of cultural layers at Kostenki.

The focus of this paper is the chrono-stratigraphy of the earliest group of Upper Paleolithic sites (chronological group T), in the light of new evidence in the context of problems of dating and numerical chronology.

3. Perspectives from Kostenki 14

The most significant challenge to the traditional point of view has emerged from the dating and numerical chronology of Chronological Group I at Kostenki. The cultural layers of this group underlie the volcanic ash horizon. Two chrono-stratigraphic markers are of special importance for the dating of these layers:

(1) the volcanic ash horizon, which has been identified at seven Kostenki-Borshchevo sites (Kl, K6, K11, K12, K14, K17, and B5) and at other localities in the region (Fig. 1);
(2) the paleomagnetic Lashamp-Kargopolovo Excursion, which has been identified in four stratigraphic profiles (K14, K17, K12 and a "stratigraphic sondage").

At present, Kostenki 14 (Markina gora) provides the most complete sequence of cultural and geological deposits in the area. Nine cultural layers at the site lie in clear stratigraphic context, and four of them are associated with buried soils, the lowermost of which have been identified in this area for the first time (Sinitsyn et al., 2002, 2004; Sinitsyn, 2004).

3.1. Stratigraphy

Like other sites in the Kostenki area, Kostenki 14 occupies a promontory location. The site is found on a small promontory formed by the confluence of the large Pokrovskii ravine and its right tributary—Ermishin ravine.

The stratigraphic profile on the eastern slope of the promontory (Fig. 4), where the 1998-2004 excavations took place, represents the classic Kostenki sequence. Cultural layer I lies in the loessic loam, while cultural layers II and **III** are contained in the Upper Humic Bed. In the central part of the promontory, Cultural layer IV lies directly under the Upper Humic Bed in colluvial deposits. In the eastern and western parts, this layer is buried in the Lower Humic sediments underlying the volcanic ash

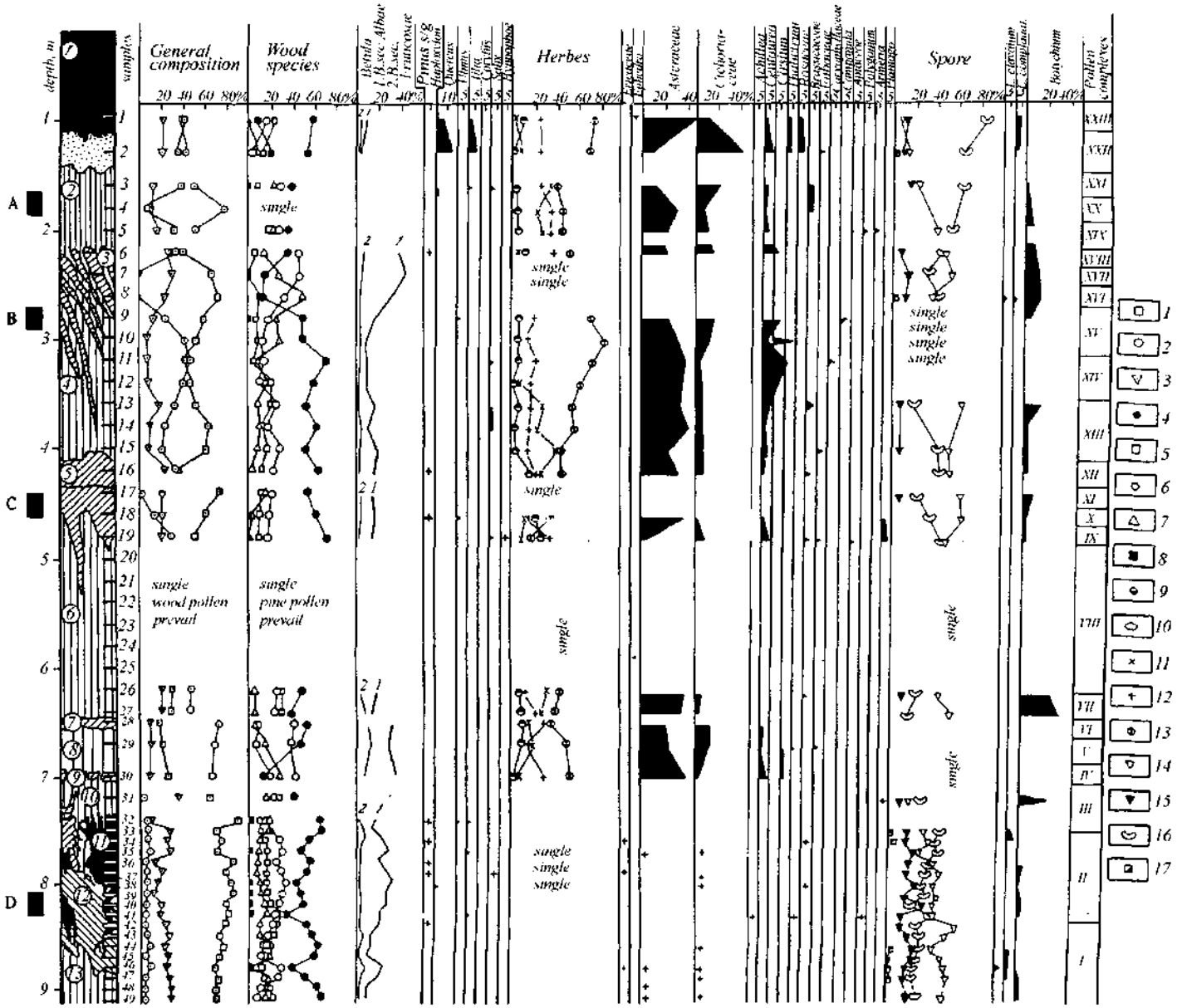

Fig. 3. Kostenki. Stratigraphic sondage/Pollen diagram (Spiridonova, 1991). 1—wood species; 2—herbaceous species; 3—spores; 4—Pinus; 5—Alnus; 6 -Betula; 7—Picea; 8—total pollen of broad-leaf species; 9 -grass; 10—sedge; 11—Chenopodiaceae; 12— wormwood; 13—total pollen of herbaceous; 14—Bryalcs; 15—Sphagnum; 16—Polypodiacea; 17—Lycopodiacca. A-C—paleomagnetic excursus: A—Gottenborg (12kyr); B—Mono (24kyr); C—Lashamp-Kargopolovo (40kyr); D—Blake (about llOkyr).

horizon, and on eastern slope, it is represented by two horizons that were designated "cultural layers IVa and IVb" in 1953.

During the 1998-2003 excavations, a minimum of four cultural layers were identified in the deep sequence of deposits that underlie the volcanic ash. Another cultural layer containing a high density of material was documented in the volcanic ash in 2000 (Sinitsyn, 2003a).

A principal problem in the study of Kostenki 14 is the classification of the cultural layers. The problem was first addressed during excavations by A.N. Rogachev in 1953-1954, and was published widely in the literature. Only the upper cultural layer is continuously distributed across the entire area of the promontory on which the site is located, while the others have more restricted distributions and their stratigraphic relationships remain problematic. Revision of the traditional classification seems to be premature at present, given the fact that almost each season of excavation yields new cultural layers. It is more appropriate at this time to introduce provisional designations alongside the traditional classification.

The "cultural layer in the ash" was identified between cultural layers III and IVa in 2000. The existence of the "cultural layer in the fossil soil" (associated with the Laschamp Excursion) and "horizon of mammoth bones" between cultural layers IVa and IVb were confirmed in

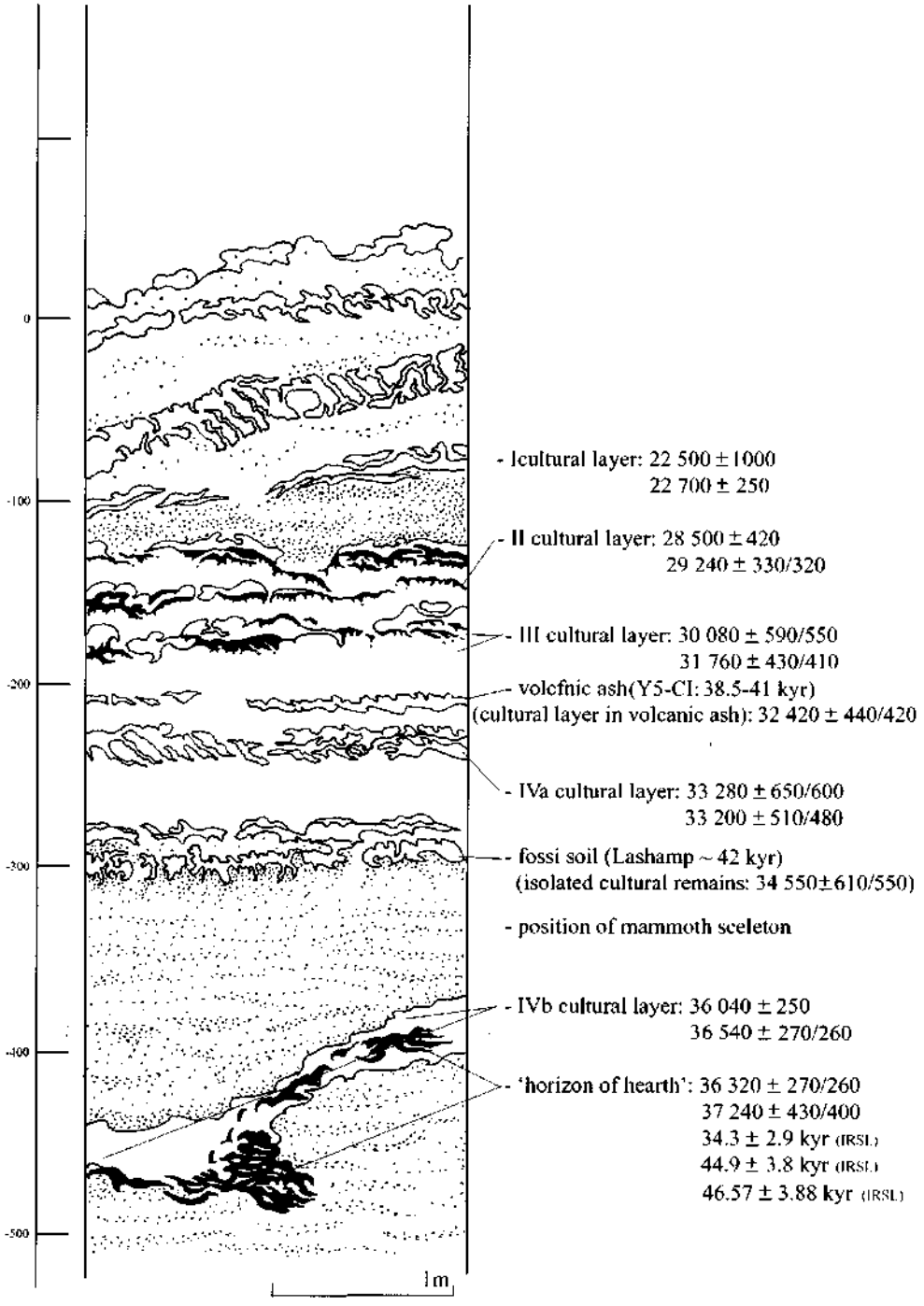

Fig. 4. Kostenki 14. Stratigraphic sequences and chronology of the site.

2001, although isolated remains had been encountered earlier in these levels. The "horizon of hearths" lies beneath cultural layer IVb, but has not been designated as number V, because most probably they represent the remains of one settlement, the first in situ and the latter in a redeposited context. The "horizon of hearths" comprises a number of sharply limited lenses of redbrick burnt loam within black humic sediment that also exhibits a restricted spatial distribution. Identified as the remains of an in situ hearth, the red lenses of burned loam are located on the narrow margin of small promontory probably formed by the convergence of two flowing channels. The most important aspect of this cultural layer is the unique preservation of the features of daily activity, which were not previously known among the occupation layers assigned to this chronological group.

Although the archaeological collection from the "horizon of hearths" is not numerous, it contains bone mattocks and a lithic assemblage similar to that found in Cultural layer IVb. Most probably, both are remnants of

one settlement in primary and secondary depositional setting, respectively. The opposite side of the channel was identified in 2002 and 2004 as a collapsed block of sediment containing similar cultural remains. As the artifacts of the lowermost cultural layer were associated with different lithologies, the following nomenclature were used: "horizon of hearths" as traces of a cultural layer in situ; cultural layer IVb/1 as the redeposited remains of the "horizon of hearths" in bedded slope sediments; cultural layer IVb/2 as transported sediment blocks on the opposite side of the channel; and cultural layer IVb as remains buried in bedded sediments that were redeposited by stream action.

The cultural layer deposited in the volcanic ash horizon also can be assigned to the earliest chronological group, although the question of its taxonomic position constitutes a separate problem.

3.2. Radiocarbon and luminescence dating

Nearly 50 radiocarbon dates obtained from Kostenki 14 (Sinitsyn et al., 2002; Haesacrts et al., 2004b) appear to support the traditional point of view regarding the dating of the three chronological groups:

Date	Lab#	Material
I culturallayer		
19,700±1300	LE-5567	Mammoth bone
19,900 ±850	GIN-8024	Mammoth rib
20,100±1500	LE-5269	Bone
22,500±1000	LE-5274	Bone
22,780 ±250	OxA-4114	Bone
II culturallayer		
19,300 ±200	LE-1400	Bone
25,090 ±310	LU	Same sample
25,600 ±400	GIN-8030	Bone
26,400 ± 660	LU-59a	Bone (fr. A)
28,200 ±700	LU-59b	Bone (fr. B)
26,700 ±190	GrA-10954	Charcoal
27,860 ±270/260	GrA-13292	Charcoal
29,240 ±330/320	GrA-13312	Charcoal
28,380 ±220	GrN-12598	Charcoal
28,580 ±420	OxA-4115	Bone
III Cultural layer		
14,300 ±460	GIN-79	Bone
28,370 ±140	GrA-15960	Charcoal
29,320 ±150	GrA-15955	Charcoal
30,080 ±590/550	GrN-21802	Charcoal
31,760 ±430/410	GrA-13288	Charcoal
IV Cultural layer		
27,460 ±390	OxA-4116	Horse bone
27,710 ± **410**	OxA-4117	Horse bone
Cultural layer in volcanic ash		
32,420 ±440/420	GrA-18053	Charcoal
20.640±170/160	GrA-18230	Bone
IVa Cultural layer		
27,400 ± 5500	LE-5271	Horse bone
29,700 ±400	GIN-8025	Horse bone
32,060 ±260	OxA-9567	Charcoal
32,180 ±450/420	GrA-13293	Charcoal
33,280 ±650/600	GrN-22277	Charcoal
33,200 ± 510/480	GrA-13301	Charcoal
Cultural layer in fossil soil (with Laschamp ex.)		
20,890 ± 280	GrA-18231	Bone
34,550 ± 610/550	GrA-13279	Charcoal
IVb cultural layer—"horizon of hearths"		
32,600 ±280	OxA-9568	Charcoal
34,140 ±340	Beta-177778	Charcoal
34,940 ±630/590	GrA-13302	Charcoal
35,28O±33O	OxA-9569	Charcoal
35,330 ±240/230	GrA-15958	Charcoal
35,870±250	GrA-15962	Charcoal
36,010 ±250/240	GrA-15965	Charcoal
36,040 ±250	GrA-15957	Charcoal
36,320 ±270/260	GrA-15956	Charcoal
36,540 ±270/260	GrA-15961	Charcoal
37,240 ±430/400	GrA-10948	Charcoal

In addition to the radiocarbon dates, five luminescence dates have been obtained from various levels of Kostenki 14. These dates were produced by S.L. Forman (University of Illinois at Chicago) with the use of the infrared-stimulated luminescence (IRSL) method:

Upper Humic Bed: 24.6+ 1.6 ka (UIC-1126)
15 cm above volcanic ash horizon: 24.0 +2.5 ka (UIC-1127)
Cultural layer IVb—horizon of hearths: 34.3 ± 2.9 ka (UIC-749)
Cultural layer IVb—horizon of hearths: 44.9±3.8ka (UIC-748)
Cultural layer TVb: 46.57±3.88 ka (UIC-1128)

The first two IRSL dates suggest ages younger than those of the radiocarbon dates from the same levels (i.e., cultural layers II and III and sediments immediately above the volcanic ash horizon). The third date (UIC-749) is broadly correlative to the radiocarbon dates from the "horizon of hearths". The two dates of greater than 40 ka (UIC-748 and U1C-1128) are older than the radiocarbon estimates.

3.3. Palynological data

A pollen diagram based on samples collected from the profile exposed in 1999 (Spiridonova, 2002a, b) is generally in accord with the traditional chronology (Malyasova and Spiridonova, 1982; Spiridonova, 1991, 2004).

In the context of available data from Kostenki 1 and Kostenki 17, the profile from Kostenki 14 appears to contain the oldest record (Spiridonova, 2002a). Stratigraphic units of

the lowermost cultural layer (IVb—"horizon of hearth") may be correlated with a cold phase during the mega-interstadial of the Last Glaciation (corresponding to MIS 3) dating to ca. 40 ka.

The fossil soil in which the paleomagnetic Laschamps Excursion was identified (associated with isolated cultural remains) is characterized by a pollen spectrum comparable to one of the cold events of the early phase Middle Valdai.

3.4. Chrono-stratigraphic markers

Two important chrono-stratigraphic markers have been identified in profiles at Kostenki 14: the volcanic ash horizon arid a paleomagnetic excursion. Both of them are potentially of great significance for the numerical chronology of the Kostenki sites, especially the oldest chronological group.

3.4.1. Volcanic ash horizon

According .to the general stratigraphic scheme for the Kostenki-Borshchevo area, a layer of tephra delineates the boundary separating Paleolithic sites of the Ilnd and 1st (oldest) chronological groups. During the 1980s, comparative-analytic studies indicated that the origin of the Kostenki tephra was related to the catastrophic eruption of *Campi Flegrei* in Italy with an estimated age of 38 ka (Melekestsev et al., 1984).

The current estimate of the age of Kostenki tephra is based on (1) the oldest radiocarbon dates for the sites of the Ilnd chronological group and (2) correlation of the ash layer at Kostenki with one of a series of well-known eruptions of the *Campi Flegrei* volcanic system, available for comparative study in this temporal range.

Three eruptions dating to 32-33, 35, and 38 ka were formerly regarded as the source of the Kostenki tephra (Lefèvre and Gillot, 1994). More recent research has established that the ash horizon is the Y5 tephra derived from the Campanian Ignimbrite eruption dated by Ar/Ar to 38.5^1 ka (Kholmovoy, 1989; Tsekhovskii et al., 1998; Kholmovoy and Nesterova, 2001; Ton-That et al., 2001; Fedele et al., 2003; Pyle et al., 2003). The Y5 tephra is widely distributed in Eastern Europe and the eastern Mediterranean. However, a radiocarbon date of 32 ka on a charcoal sample from the cultural layer in volcanic ash coincides with the age of ashes distributed in Central Europe (Pawlikowski, 1992) that are younger than the Y5 tephra.

The most ancient radiocarbon dates available for the Ilnd chronological group fall in the range of 31-32ka: 32,700 ± 700 (GrN-7758) for cultural layer la of Kostenki 12 and 31,760±430/410 (GrA-13288) for cultural layer III of Kostenki 14 (Sinitsyn et al., 1997; Sinitsyn, 1999, 2004). The minimal age of the ash layer on the Russian Plain probably falls within 32-33 ka. The maximum age is difficult to determine because of the variability of radiocarbon dates for cultural layers beneath the ash.

3.4.2. Paleomagnetic stratigraphy

A paleomagnetic excursion identified in the sediments of the fossil soil between IVa and IVb cultural layers represents a second chronological marker (Gernik and Guskova, 2002). The position of the Lashamp-Kargopolovo Excursion—estimated at ca. 42 ka—is another piece of evidence (along with the dating of the Y5 tephra and the older 1RSL dates) that suggests that the cultural layers beneath the volcanic ash date to at least 40 ka.

3.5. *Archeological evidence*

Because the archeological assemblages of the lowermost cultural layers (IVa and IVb—"horizon of hearth") that underlie the volcanic ash horizon have no analogs among known archeological materials, only the cultural layer in the ash horizon provides some basis for archaeological dating of the oldest levels at Kostenki 14.

The techno-typological characteristics of both the lithic and nonlithic artifact assemblages, in conjunction with the personal ornaments, indicate an Aurignacian affiliation for the cultural layer in the volcanic ash horizon (Sinitsyn, 2003a). The nearest analog may be found in cultural layer III of Kostenki 1, which is widely attributed to the Aurignacian (Hahn, 1977; Sinitsyn, 1993). A radiocarbon date of 32,420 ± 440/420 (GrA-18053) from the volcanic ash horizon coincides closely with a date of 32 ka for cultural layer III at Kostenki 1 (although cultural layer III also yielded a date of 38 ka). This time range corresponds to the period of the most widespread continental distribution of Aurignacian-Dufour assemblages. However, older Aurignacian assemblages are dated to ca. 40 ka (e.g., Bocquet-Appel and Demars, 2000; Davies, 2001; Van Andel and Davies, 2003), which coincides with the age of the Y5 tephra.

3.6. Chronology of Kostenki 14: summary

As a result of the research described above, Kostenki 14 has yielded evidence of two temporal scales: (1) a "short chronology" based on the radiocarbon dates, and (2) a "long chronology" based on the dating of the Y5 tephra, paleomagnetism, and palynology. The long chronology is also supported by the older IRSL dates from Kostenki 14.

The "short chronology" was developed during the 1980s and 1990s on the basis of what was initially a small series of radiocarbon dates. The "long chronology" was also first developed in the 1980s as a consequence of the analysis of the volcanic ash (Melekestsev et al., 1984). More recently, it has acquired additional support from paleomagnetic studies and IRSL dating.

According to the short chronology, the lower cultural layers of Kostenki 14 were deposited ca. 32-37 ka. According to the long chronology, they were deposited at least 38 ka ago, and possibly earlier (40-45 ka). If the volcanic ash horizon is dated to 38.5-41 ka, it alters not

only the upper limit of the Chronological Group I, but also the lower limit of Chronological Group II.

4. Other Kostenki sites

When placed into the context of other Kostenki sites, the problem of the numerical chronology of the earlier chronological groups acquires added complexity.

4.1. Kostenki 1

A series of radiocarbon dates for cultural layers **III** and V of Kostenki 1 provides additional support for the "short chronology":

Kostenki 1, **III** *cultural layer.*

20,900±1600 (GIN-4848) charcoal;
> 22,000 (GIN-2942) mammoth tusk;
24,500±1300 (GIN-4850) charcoal;
25,400 ± 400 (GIN-6248) charcoal;
25,600±100 (GIN-4852) burned bone;
25,700 ± 600 (GIN-4902) burned bone;
25,730 ± 1800 (LE-3541) charcoal;
25,900 ± 2200 (GIN-4849) charcoal;
25,820 ±400 (GrN-22,276) charcoal;
26,200±1500 (GIN-4885) charcoal;
32,600 ± 400 (GrN-17117) charcoal;
32,600 ±1100 (OxA-7073) human bone;
38,080 ±5460/3200 (AA-5590) charcoal.

Kostenki 1, V *cultural layer:*

18,800 (GIN-6247) charcoal;
27,390 ±300 (LE-2030) mammoth tooth;
30,170 ±570 (LE-3542) charcoal;
32,300 ±220 (GrA-5557) charcoal;
34,900 ±350 (GrA-5245) charcoal;
37,900 ±2800/2100 (GrA-5245) charcoal.

The date of 38 ka from cultural layer **III** (AA-5590), always considered curious, may be significant in the context of the competing chronological scales, because it is consistent with the long chronology and the dating of the Y5 tephra. Palynological data from Kostenki 1 also may provide some evidence for the long chronology, indicating an older age for cultural layer V than the radiocarbon dates (Spiridonova, 1991, 2002b).

4.2. Kostenki 12

Perhaps the most important supporting evidence for the long chronology has emerged from recent research at Kostenki 12—primarily on the basis of a sequence of IRSL dates.

As at Kostenki 14, the cultural layers of Kostenki 12 that underlie the volcanic ash horizon (cultural layers III-V) are associated with a series of buried soils identified during the excavations of 1999-2004. The radiocarbon dates of cultural layers attributed to Chronological Group I (cultural layers I and la) conform to the traditional chronology and widely accepted age of the Upper Humic Bed;

I *cultural layer.*

23,600 ±300 (GIN-89) humus;
24,000 ±800 (GIN-8019) bone;
26,300 ± 300 (GIN-8574) bone.

la *cultural layer.*

28,500 ± 140 (GrA-5552) charcoal;
28,700 + 400 (LE-1428a) bone;
30,240 ±400 (LE- 1428b) bone;
31,150 ± 150 (LE-1428c) mammoth tooth (collagen);
31,900 ±200 (LE-1428d) mammoth tooth (DTA);
32,700 ±700 (GrN-7758) charcoal.

III *cultural layer:*

> 31,000 (GIN-8021) bone;
36,280 ±360/350 (GrA-5551) charcoal.

The IRSL date of 27,680±2360 (UIC-916) for cultural layer I accords well with radiocarbon chronology. Recently, two more **IRSL** dates have been obtained from units overlying cultural layer I. Dates of 18,200±1600 (UIC-1418) and 25,500 ± 2200 (UIC-1419) from sediment above and below the Gmelin Soil, respectively, also are concordant with the radiocarbon chronology.

Below the level of the volcanic ash horizon, five IRSL dates yield ages consistent with the dating of the Y5 tephra: 44,330 ±3700 (UIC-915); 43,470 ±3670 (UIC-946); 46,910 ±3860 (UIC-947), also 44,150 ±3780 (UIC-945) from the buried soil containing cultural layer V, and 51,060 ± 4430 (UIC-917) for underlying loams (Anikovich et al., 2002, 2004; S.L. Forman, pers. comm., 2002; Anikovich, 2003; Levkovskaya et al., 2004). Although the tephra horizon is not directly observable in the profiles exposed during the 1999-2003 excavations, analysis of samples collected in 2003 from sediments between the Upper and Lower Humic Beds yielded traces of volcanic ash (B. Carter, personal communication, 2004).

4.3. Kostenki 17

Evidence from Kostenki 17, one of the most important sites in the area, remains somewhat limited, because field research has not been conducted here for some years. Nevertheless, the stratigraphic position of the paleomagnetic Lashamp-Kargopolovo excursion is reported to lie in

the Lower Humic Bed and in association with cultural layer II (N.D. Praslov, personal communication).

5. European context

In the wider context of research on the early Upper Paleolithic in Europe as a whole, there is also evidence for both a "short chronology" and a "long chronology". Although the existing chronology for the European Upper Paleolithic is almost completely based on radiocarbon dating, the calibration of radiocarbon dates and use of other dating methods suggests that the traditional chronology may require revision (Holliday, 2001, 2004; Rink, 2001; D'Errico and Sánchez Goñi, 2003; Van Andel and Davies, 2003). Where the dating methods of ESR, EPR, OSL, and TL (in various forms) are used together with radiocarbon dates, the results are similar to those at Kostenki (Conard and Bolus, 2003; Conard et al., 2003; Svendsen and Pavlov, 2003; Teyssandier and Liolis, 2003). New research indicates that problems of contamination by younger carbon in radiocarbon samples older than 35 ka are more serious than previously thought (Bird et al., 1999).

6. Conclusion

The formation of a "short chronology" and a "long chronology" for the earliest cultural layers at Kostenki is a critical issue confronting research on the early Upper Paleolithic of the Kostenki-Borshchevo area and the East European early Upper Paleolithic in general. New data, including the identification of important chrono-stratigraphic markers in the form of a tephra horizon and paleomagnetic excursion, support a "long chronology" for the lowermost cultural layers at Kostenki. The "short chronology" is primarily based on radiocarbon dating, which probably underestimates the age of these cultural layers. Perhaps the principal objection to the long chronology lies in the archaeology of the cultural layer in the volcanic ash at Kostenki 14 and cultural layer III at Kostenki 1. These assemblages may be assigned to the Aurignacian-Dufour industry and exhibit strong parallels with European Aurignacian sites dated to ca. 32 ka, but not to those dating to 38^0 ka.

An apparent resolution of the problem of two chronological scales was offered by Haesaerts (2004) in his presentation at the field seminar 2004 at Kostenki. Being based on the GRIP and GISP2 calibration curves (Shackleton et al., 2004), and data from the Cariaco Basin in Venezuela (Hughen et al., 1998), Haesaerts has shown good agreement of the IRSL dates, paleomagnetic, palynological and tephrochronologic evidence with the calibrated radiocarbon dates from the lower part of the sequence (i.e., beneath the volcanic ash) at Kostenki 14. However, this resolution of the scales raises some new questions and problems, which fall outside the scope of this paper.

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