Impossible Kostenki and two African mysteries within the framework of traditional paradigm

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Summary

Here is considered three important and very revealing problems related to genesis of modern humanity relevant to colonization of Africa by our direct ancestors: the impossibility of the sustainable existence of such an Upper Paleolithic site as Kostenki, from which re-population of Africa began after European catastrophe – explosion of Archiflegreo stratovolcano, existence of "ghostly" African archaic population and inexplicable delay of Upper Paleolithic revolution (MSA/LSA transition) in western Africa by 15 – 25 kyr from eastern Africa and by 25 – 40 kyr from Levant and Europe. It is shown that these problems, in accordance with the concept presented in works [1 – 4], become not only natural consequences of the process of modern mankind development, but also additional evidence that this is exactly how it happened.

Keywords: *Pleistocene – Sapiens – Archeology – Paleogenetics – Exodus from Europe*

I. Introduction

In works [1 – 3] from the standpoint of system analysis, a dynamic process of development of a small group of sapiens who left Africa about 130 ka BP is described, which led to the fact that they, having turned into modern humanity – Homo sapiens sapiens, became the only human species, to about 30 ka BP completely dominant on Earth. All elements of this process, description of which in the form of a network – a directed graph of 88 points, was obtained as a result of using system analysis of the available information, are fully consistent with archaeological, anthropological, paleogenetic, paleoclimatic, geological, physical and other data known to us. Moreover, there was also stated in works [1 – 3] that the described concept answers almost all questions about the origin and ways of modern humanity colonization of the Earth and removes contradictions and problems for that scientific community related to the topic under consideration takes interest.

In subsequent paper [4], this statement was confirmed by considering seven paradoxes related to the genesis of modern humanity on a graph of 108 points already, which, within the framework of the proposed concept, turned out to be simply natural consequences of the described process. This line is continued in this paper – it considers 2 more problems that arose when trying to more in-depth consideration of African sapiens populations development in the last 40 – 10 ka BP, as well as a somewhat unexpected, but, as it turned out, directly related to them problem of impossibility of existence of Kostenki famous Paleolithic site in the form in which it seemed to archaeologists who excavated it. Again, as before, it is shown that all these apparent problems and paradoxes find their natural resolution within the framework of the described concept.

II. Invasion of Africa

It has already been shown earlier that from a system analysis of modern humanity genesis follows that representatives of Homo sapiens sapiens, who became the progenitors of at least the vast majority of male population of modern Africa, came there from Europe about 36 ka BP after the eruption of Archiflegreo stratovolcano about 39.3 ka [5], which led Cro-Magnons, who had recently completed a victorious war with local Neanderthals, to disaster (see [1 – 4]). However, in those works this line was only outlined, but now we will consider it in more detail.

To do this, to 108 archaeological points mentioned initially on the map of Old World, we add (Fig. 1) another 8 – Cavallo grotto (black dot in the south of Apennine Peninsula), Bondi cave in Western Georgia (yellow dot), and 6 points in Africa: Fincha Habera in Ethiopia, Ndutu and Mumba in Tanzania (3 yellow dots), Laminia and Saxomununya in Senegal, and Ivo Eleru in Nigeria (3 crimson dots in Figure 1), see below. As the result, a network consisting of 116 points is shown in Fig. 1. The light gray circle covering Europe and North Africa is an approximate area affected by shock waves during the explosion of Archiflegreo stratovolcano with a pressure drop on the shock wave of about 1 kPa, and the inner darker one – with drop of about 10 kPa, a double square with red borders the colors in the center of the gray circles indicate location of Archiflegreo volcano.

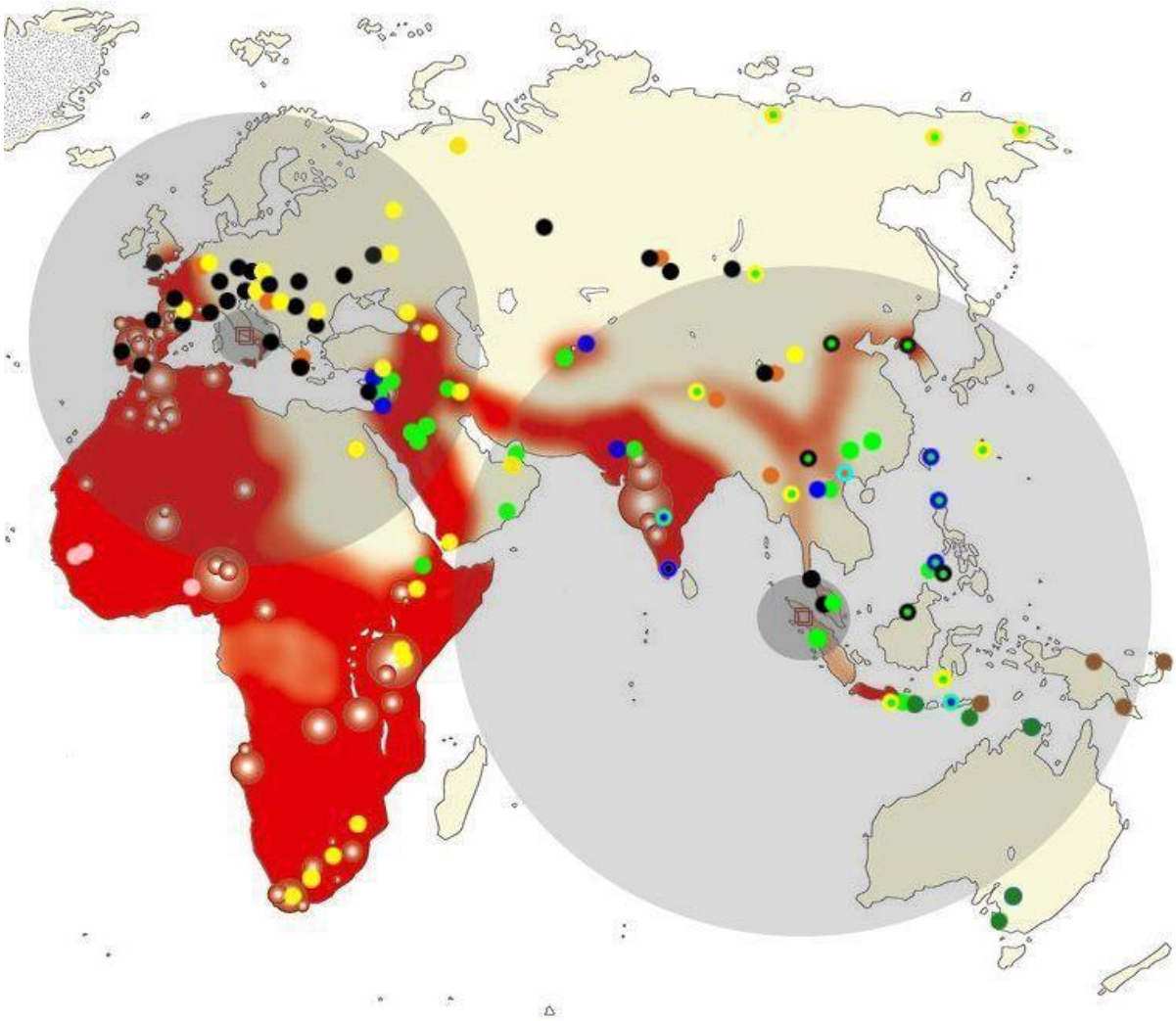

Fig. 1 – Places of considered Pleistocene sites and zones of catastrophic eruptions impact of two volcanoes against the background of Acheulean findings distribution
Gray circles are approximate zones of damage by shock waves during explosions of Toba (72 ka BP) and Archiflegreo (39.3 ka BP) stratovolcanoes, internal with a border of 10 kPa, external – 1 kPa, see [1 – 3]. Light green dots describe sites of sapiens in the period 130 – 72 ka BP; blue dots – 72 – 47.5 ka BP for northerners and easterners (for the latter – with a central light green dot), and for southerners – dark green dots. Black dots correspond to the period of 47.5 – 39.3 ka BP for northerners and easterners (as well as for the latter – with a central light green dot), and for southerners – dark brown dots. Yellow dots corresponds to period 39.3 – 30 ka BP, crimson dots – to period 30 – 10 ka BP. Dots of other colors refer to non-sapient hominin species.

A significant part of sapient population of Europe died in this catastrophe, those who lived too close to the volcano, such as all inhabitants of southern Italian cave of Cavallo [6], many died due to the fact that a layer of volcanic ash formed from central Italy on vast territories of periglacial Europe to the east and northeast, extending like a tongue up to Southern Urals [1 – 3, 5]. In addition, as usual in such cases, there was a global cooling that lasted several years and practically destroyed food base of mammoths and ungulates in European periglacial mammoth steppe, which put Cro-Magnons living there on the verge of starvation. However, some of the survivors were able to escape during these several critical years, making their way to the places of accumulation of dead animals, including Kostenki, a group of Pleistocene sites located in the bend of Don River, along which animals tried to leave covered with ash dead zone, as it was possible to get drunk from large rivers only [1 – 3].

It was shown [1 – 3] that the salvation of a small part of European Cro-Magnons after the catastrophe was facilitated by the fact that some of them survived about 10 of the most difficult years inside the zone covered with ash from the volcano in Kostenki. It was then that populations of Grimaldians (Cro-Magnons of Southwestern Europe) and, apparently, Brünners (Cro-Magnons of Central Europe, from Brno-Předmosti vicinity [2, 3]) appeared there. Then the "races" (populations) of Brünners and local inhabitants of Russian Plain – "Cro-Magnons in the narrow sense of the word" (according to G. F. Debets, see [1]) crossed northern border of the ash zone up Don and went, respectively, to the west and to the north, and Grimaldians from Markina Gora (Kostenki-14) and, perhaps, from some other neighboring sites, went along Don River through the ash to the south. Perhaps this was facilitated by some conflict that arose between them (see below). Then, after a long campaign, they invaded Africa for about

36 ka BP, and, as a result, their descendants became its main population. Archaeological data were presented from 9 points of this route, from which, according to logistical calculations, it followed that Grimaldians appeared on African coast of Bab el-Mandeb Strait about 36 ka [1 – 3].

Recently, information has appeared about four more sapient sites that appeared chronologically exactly along this path: Bondi in Western Georgia, Fincha Habera in Ethiopia, and Ndutu and Mumba in Tanzania (a line of yellow dots from Kostenki in the center of the Russian Plain to Boomplaas in the very south Africa in Fig. 1), see Table 1 (BAT (s) is the boundary of ash trace, southern). The movement along Don River from Kostenki to the border of the trace had to take place at the pace of "death march" [1 – 3], and the time for this was spent negligibly little on the time scales we are considering.

Table 1

N	Exit point	Arrival point	Distance (km)	Exit time (ka BP)	Arrival time (ka BP)	Sources (ka BP)
1	**Kostenki**	**BAT (s)**	750	39.3	39.3	39.3 [5, 7]
2	**BAT (s)**	**Mezmai**	640	39.3	39.0	39 [8, 9]
3	**Mezmai**	**Bondi**	535	39.0	38.8	38.4 – 38.8 [10]
4	**Bondi**	**Yafteh**	1560	38.8	38.1	37.9 ± 1.1 [11]
5	**Yafteh**	**Jebel Faya**	2165	38.1	37.2	37.6 ± 2.6 [12]
6	**Jebel Faya**	**Strait**	2910	37.2	35.9	–
7	**Strait**	**Nazlet Hater**	3900	35.9	34.2	32.8 ± 2.4 [13]
8		**Fincha Habera**	1100	35.9	35.4	47 – 31 [14]
9	**Fincha Habera**	**Ndutu**	1630	35.4	34.7	60 – 32 [15]
10	**Ndutu**	**Mumba**	70	34.7	34.7	35.3 ± 0.6, 33.5 ± 0.9 [16]
11	**Mumba**	**Txina-Txina**	2835	34.7	33.45	33.2 ± 0.7 [17]
12	**Txina-Txina**	**Rose Cottage**	920	33.45	33.05	31 – 27 [18, 19]
13	**Rose Cottage**	**Hofmeyr**	350	33.05	32.9	36.2 ± 3.3 [20, 21]
14	**Hofmeyr**	**Boomplaas**	515	32.9	32.7	34 – 32 [19, 22]
15	**Fincha Habera**	**Laminia**	7350	35.4	20.7	22 – 21 [23]
16	**Laminia**	**Saxomununya**	90	–	–	11.6 [23]
17	**Laminia**	**Iwo (Iho) Eleru**	2405	20.7	15.9	16.3 – 11.7 [23, 24]
18	**Iwo Eleru**	**Saxomununya**	2310	15.9	11.3	11.6 [23, 24]

Line of 13 yellow dots in fig. 1 from Kostenki in the center of Russian Plain to Boomplaas in the very South of Africa through the Western Caucasus, Zagros, Arabia and East Africa can be traced so clearly that there is no need even to draw it. The northern branch from it is represented by Nazlet Hater point in Egypt Nile Valley.

III. "Impossibility" of the existence of Kostenki Upper Paleolithic site complex

The described scenario explains the uniqueness of Pleistocene site complex in Kostenki-Borshchevo area. Now we know 26 archaeological sites (settlements) there (of which 11 are multi-layered), excavated over a period of approximately 120 years from 1879 to 1998 [7], so, in fact, we managed to count 63 or 61 layers (habitats) as such, if we do not distinguish between layers IVb, IVb1 and IVb2 in Kostenki-14. Over time, as excavations continue, number of layers and, accordingly, sites in the narrow sense of the word, may well change somewhat. For example, at the key site of the complex, Kostenki-14 (Markina Gora), after discovery of a cultural layer there in a layer of volcanic ash, an additional cultural layer K14/LVA was identified, located between the previously found layers III and IV. Apparently, the same thing happened at Borshchevo-5 site – a third cultural layer was identified, associated with the ash horizon, and 2 even lower [25]. The discovery of new sites could have influenced these data more strongly – here the opinion of highly qualified archaeologists, who excavated there with their own hands for many years, is unanimous: "most likely, there is much more sites and settlements", but finds of new sites have ceased, "because ... archaeologists were no longer allowed into private territories" [26]. In addition, "the discovery of such sites in the north, in Popov Log and in area of Rudkino village, which have not yet been archaeologically studied, is

quite possible and even very likely" [27]. But even with the current state of knowledge about Kostenki – Borshchevo archaeological complex, they are enough to declare that the world's largest Kostenki complex of Pleistocene sites is on a patch of land on Russian Plain in the middle reaches of Don River near modern Voronezh (double black and yellow dot north of Black Sea/lake in Fig. 1) is impossible [1 – 4].

For the stable full-fledged existence of ~ 20 – 25 hunter-gatherers clan, on average, land areas of the order of 500 km^2 were required, 20 – 25 km^2 per person [28]. And, maximum size of hunting area, which determines the range of hunting sorties, would be at least 25 km for a circular area, and about 30 – 35 km for areas of real shape, which is approximately equal to the daytime hike of a hunter on foot. With 10 – 18 clans living in Kostenki at the same time, that is, with a population of 250 – 450 people (see below), an area of standard hunting grounds of the order of 5000 – 9000 km^2 would be required, and the characteristic size of the hunting area would have to be at least 100 – 150 km.

True, it is argued that the area in the vicinity of Kostenki was significantly richer in living creatures than on average, and that on this bend of Don River there was a completely unique situation for Paleolithic era. The river valley below Kostenki is compressed by the heights on both banks, and upstream during the summer flood a pond was formed. Don flooded the lowland for a short time, which, in conditions of a very dry climate of Ice Age, had a very favorable effect on its productivity [26]. That is, it turned out, as it were, a small northern Pleistocene Egypt. Indeed, a system analysis of this complex forced us to agree with this statement. Apparently, a productivity of this spot near banks of Don River was no less than 3 times higher than that which any arbitrarily chosen area of the periglacial steppe could give. This is confirmed by the fact that 3 sites were located here at the distance of several hundred meters from each other for at least 2 – 3 kyr – this is a completely "stationary" mode of existence (see below), and a typical "run" of hunters at the same time yet should not exceed the same 30 – 35 km. Otherwise, they would simply settle at sufficient distances from each other. Then, when moving to a settlement of 12 – 18 sites, the characteristic length of a hunting trip would be 60 – 85 km, which would lead to going beyond the borders of "little northern Egypt". And then the distances outside these boundaries would increase by another ~ √3 times, and they would begin to approach the values that were defined above, that is, to ~ 100 – 150 km, "which is completely incommensurable with the capabilities of foot hunters, at best for the delivery of prey using drags. And such a settlement cannot exist stably for any long time" [1].

It should be noted that after period of excavations in Kostenki in 2001 – 2006 with the involvement of foreign archaeologists, their participants, obviously, under impression of the picture of many new, old and already abandoned archaeological excavations on the slopes of literally 3 – 4 adjacent coastal ravines, there was a conviction that role of this group of sites in the genesis of European sapiens turned out to be much greater than previously thought. A participant in these works, American archaeologist John Hoffecker, in interview with BBC radio station, said then that Cro-Magnon colonization of Europe began from their cradle – from Kostenki [29], he also called Kostenki "the center of the world" [30]. This was evidenced by paleomagnetic and radiocarbon analyzes of ash, spores, and pollen of plants dated at least 42 – 40 ka BP, as well as data from the thermoluminescence method (OSL), which gave an even greater age, 50 ka BP [31], or more precisely, up to 47.8 ± 3.5 ka BP for the cultural layer IVb Kostenki-14 and 52.4 ± 3.9 ka BP for lower humus layer in Kostenki-12 [32] (however, it is not clear what relation this layer actually has to determination of the occupation time of this place).

But more important for the topic under consideration here is that, as can be understood from copies of the same text scattered on Internet, archaeologists had a well-founded opinion that the Pleistocene population of Kostenki was much larger than anywhere else at that time. As example, we can cite a fragment of this text from a completely official report by Commissioner for Human Rights in Voronezh Region T. D. Zrazhevskaya at a conference held in Kostenki Museum-Reserve in 2019 [33], obtained by copy/paste more than 10 years after its first appearance on the network: "American scientist, professor of archeology from University of Colorado, John Hoffecker, made a sensational statement in the journal "Science": Homo sapiens first appeared on the territory of the middle reaches of Don River, and only then moved to Europe; he is sure that formation of the beginnings of future human civilization took place in Kostenki. Evidence for theory that Kostenki is the "cradle" of Europeans was paleomagnetic and radiocarbon analysis of ash, spores and pollen from plants found in the sites. Russian researchers have found that the oldest materials are 40 – 42 thousand years old. And their colleagues from the United States, using thermoluminescent methods, came to the conclusion that their age is even more – 50 thousand years". And the most important thing for the issue under consideration here can be read further: "Thanks to the efforts of Russian researchers, there is now every reason to believe that the oldest proto-city on the planet with a population of 200 – 300 people was located on the territory of Kostenki".

Thus, we can conclude that this group of archaeologists really recognized that 200 – 300 people lived in Kostenki at the same time, and this information was widely spread, at least in the regional space – in Voronezh region. However, it did not become a world property, without being included in refereed articles (see, for example, [31, 32]), apparently due to the opposition of reviewers who perfectly understood what was stated here in 3 – 4 paragraphs above – such a Pleistocene settlement in the form of a proto-city is fundamentally impossible. And the first proto-cities could have arisen only at the beginning of Holocene, about 30 kyr later, after Neolithic revolution, with completely different level of development of human productive forces.

Let us now move from the preamble to a direct consideration of factual side of the matter. Table 2 presents all available information, using which it is possible to draw the necessary conclusions on the question: "What is the maximum number of people who were or could be in Kostenki at the same time during European catastrophe?"

Table 2

Name	NL	T	Layer	Database	Date (ka BP)**	Date (ka BP)	Ref.
K1*	5	2	K1/I	LE-3280/LE-4352	*18.3 ± 0.6/24.6 ± 3.9*	*~ 28.0*	[34, 35]
			K1/III	GIN-4848/AAA-5590	*20.9 ± 1.6/38.1 ± 3.2*	*~ 42.1*	
				–	29.1 ± 0.3/32.3 ± 0.5	**36.1 – 37.4**	[35]
			K1/IV	GrA-53616	38.25 ± 0.70/0.55	**43.5 – 41.5**	
			K1/V	LE-2030/GrA-5245	*27.4 ± 0.3/37.9 ± 2.8*	*~ 42.0*	[34]
				GrA-53612/OxA-26650	42.1 ± 1.0/42.8 ± 0.9	**45.5 – 43.5**	[35]
			–	–	–	**≥ 39.3**	[36]
K2	1	2	–	GIN-93/GIN-7993	*11.0 ± 0.2/37.9 ± 0.9*	*~ 42.0*	[34]
K3	1	1	–	GIN-8022	*19.8 ± 0.2*	–	
K4	2	1	K4/II	GIN-7995/OxA-30194	*22.8 ± 0.1*/25.3 ± 0.2		[34, 37]
K5	3	2	K5/II	GIN-7996/GIN-8571	*20.6 ± 0.15/22.9 ± 0.15*		[34]
K6	1	2	–	–	–	**≥ 39.3**	[36]
K8	5	2	K8/I	GIN-7998/ GIN-7997	*22.0 ± 0.15/22.9 ± 0.1*	–	[38]
			K8/II	OxA-7109/GrN-10509	*23.0 ± 0.3*/27.7 ± 0.75	**~ 31.5**	[34, 37]
K10	1	2	–	GIN-8573/GIN-8027	*22.6 ± 1.0/28.3 ± 0.3*	–	[34]
K11	5	2	K11/Ia	LE-1403/GIN-8577	*12.0 ± 0.1/19.9 ± 0.35*		[38]
			K11/II	TA-34/GIN-2531	*15.2± 0.3/21.8 ± 0.2*		
			K11/III	LE-1638a/LE-1638б	*16.0 ± 0.1*/22.8 ± 0.35	**~ 27.1**	[34, 39]
			–	–	–	**≥ 39.3**	[36]
K12*	6	2	K12/I	GIN-89/UIC-619	*23.6 ± 0.3*/ –	*27.9/27.7*	[34, 37]
			K12/Ia	GrA-5552/GrN-7758	28.5 ± 0.15/32.7 ± 0.7	**~ 37.1**	[34, 40]
			K12/III	GrA-5551	*36.3 ± 0.35*	*~ 40.1*	[34]
			–	–	–	**≥ 39.3**	[36]
K14*	7/9	2	K14/I	LE-5567/OxA-4114	19.7 ± 1.3/*22.8 ± 0.25*	–	[38]
			K14/II	OxA-7109/GrA-13312	*23.0 ± 0.3*/29.2 ± 0.3		
			K14/III	GIN-79/GrN-13288	*14.3 ± 0.45*/31.8 ± 0.45	**~ 35.8**	[34, 37]
			K14/ LVA	GrA-18230/OxA-X-2642	*20.6 ± 0.15*/35.2 ± 0.4	**39.7 – 38.3**	[41]
				–	–	**39.5 – 37.5**	[10]
				OxA-X-2395-15	33.25 ± 0.5/33.9 ± 0.6	**~ 39.3**	[42]
				–	–	**≥ 39.3**	[36]
			K14/IV	OxA-4116/OxA-4117	*27.5 ± 0.4/27.7 ± 0.4*	–	[34, 38]
				OxA-33981/OxA-33982	35.8 ± 0.7/36.35 ± 0.75	**41.7 – 38.9**	[41]
			K14/IVa	OxA-4117	*33.3 ± 0.65*	*~ 38.5*	[34]
			K14/IVb	–	–	42.3 – 41.3	[43]
				UIC-1128/UIC-749	–	*47.8 – 34.2*	[32]
K15	1	2	–	LE-1430/GIN-8020	*21.7 ± 0.55/25.7 ± 0.25*	*~ 30.0*	[34]
K16	1	2	–	LE-1431/GIN-8031	*25.1 ± 0.15/28.2 ± 0.6*	*~ 32.2*	[34]
K17	2	2	K17/I	GIN-8076/GrN-10511	*21.1 ± 0.6*/26.8 ± 0.7	~ 30.9	[32, 38]
			K17/II	GrN-10512/GrN-12596	32.2 ± 2.0/36.8 ± 1.7	41.7 – 38.9	[32, 41]
				–	–	**≥ 39.3**	[36]
K18	1	2	–	GIN-8028/OxA-7128	*17.9 ± 0.3*/21.0 ± 0.2	–	[34, 37]
K19	1	1	–	GIN-107/LE-17056	*11.8 ± 0.5*/18.9 ± 0.3		[34]
K21	3	1	K21/III	LE-1043/TA TL	*17.0 ± 0.3*/26.8 ± 2.0		[34, 44]
B1	1	1	–	GIN-8085/LE-3727	*15.6 ± 0.1/17.2 ± 0.15*		[34]
B2	3	1	B2/I	LE-4837	*13.5 ± 0.7*		[38]
			B2/III	LE-4834	*13.5 ± 0.3*		
B5	5	2	B5/II	LE-6808/LE-6946	*13.3 ± 0.2*/20.8 ± 0.4		
			B5/III	–	–	**≥ 39.3**	[36]

* – the most ancient sites

** – uncalibrated

Table 2 contains information about 20 out of 26 archaeological sites of this complex and 37 layers out of 61, that is, everything that we know about the time period of interest to us from the first appearance of sapiens here,

European catastrophe and the founding of sites in its course and up to temporary abandonment of this complex after some stabilization of situation in the territories surrounding Kostenki. "Name" column indicates the abbreviated names of the site, "NL" column indicates the number of cultural layers of each site, "T" indicates terrace where the site is located and then (in "Layer" column) the layers are indicated in columns of the table described further to the right. If the information cannot be attributed to a specific layer or site is single-layer, a dash is put here. "Database" column indicates where the dates were taken from, given in "Date**" columns below – uncalibrated (for radiocarbon dates) and "Date" – calibrated. Moreover, if there are two dates separated by a slash, then the first of them indicates the earliest dating of all known, and the second – the latest. Last column "Ref." indicates the sources of information. In some cases, databases are not listed in the sources (then there is a dash in the "Database" column), but in all these cases it is known that these data were obtained relatively recently.

The databases have the following designations: GIN – Geological Institute (Russian Academy of Science), LE – Institute of History of Material Culture (Russian Academy of Science), AAA – University of Arizona, GrA, GrN – Center for Isotope Research, University of Groningen, OxA – Oxford Radiocarbon Accelerator Unit, TA – Institute of Zoology and Botany (Estonian Academy of Science), UIC – University of Illinois, Chicago.

It is known that first radiocarbon dates in the time range ~ 40 kyr, that we are now interested in, turned out to be completely unsatisfactory for simple reason that half-life of radioactive carbon isotope C^{14} is 5.73 kyr [45], and during this time it remains in the sample about 0.5 % of its original value. So any, even small, external contamination of samples with C^{14} isotope leads to their strong rejuvenation. Here, for example, the first dating of site K2 (sample GIN-93 was analyzed circa 1970) is 11.0 ka BP, and the last one (GIN-7993, circa 1995) is 3.4 times older – 37.9 ka BP. Approximately the same was obtained at site K14/III: on the GIN-79 sample, the date is 14.3 ka BP, and on the recent GrN-13288 sample, it is 31.8 ka BP, which is 2.2 times older. Therefore, only after the development of methods for thorough cleaning of samples from contamination was it possible to obtain any adequate data. In addition, since 1998, procedures have been used to recalculate the date determined from the remains of C^{14} isotope (uncalibrated) to a historical (calibrated) date, and since then 5 such calibration curves have been developed, the last one in 2020, and more than one, and three: different for both hemispheres (northern – IntCal20, southern – SHCal20) and separately for marine samples (Marine20) [45].

So, strictly speaking, now no one calibrated radiocarbon date cannot be compared with another, if there is no known when and where they were obtained, and by what calibration they were recalculated. Perhaps, saves only the inaccuracy of determining non-calibrated dates, which often exceeds all possible deviations in recalculations, at least for dates carried out relatively recently, say, after the introduction of IntCal09 scale in 2009. Therefore, all dates from Table 2 were divided into 3 groups: erroneous and unreliable (relatively old dates written in oblique type), probably reliable (obtained after about 2000 – straight type), and the most reliable (after 2010 – 2015 – bold type). The time of their receipt is approximately determined by the sample number for each database separately. From this, as well as from a comparison of the analyzed data with each other and with other external dating, an approximate limit of sample numbers was determined, above which the data can be considered at least probably reliable: LE > 4500, GrA, GrN > 10000, OxA > 10000. All dating of samples with GIN code was recognized as unreliable (not reliable enough). The dating of a single sample of TA TL 2018 is considered reliable, AAA-5590 is not completely, and TA-34 is unreliable dating. Thermoluminescent data (UIC base) are all considered unreliable. The dating of ≥ 39.3 ka BP from the volcanic ash layer [25, 36] is very reliable, but gives only the lower limit of a possible date. Records of type ~ 28.0 in the "Date" column were obtained by recalculating the data from the right half (after the slash) of the "Date**" column using IntCal20 calibration curve. Dashes mean either the absence of data, or (in the "Date" column), the absence of need to make calibration recalculations due to the fact that it is already clear from the uncalibrated data that these dates are much later than the date of the catastrophe – 39.3 ka BP.

Thus, 20 of known 26 archaeological sites are considered (see Fig. 2), that is, more than ¾ of the total number, including all 11 multilayer sites. Of these 20 sites, 14 are located on the so-called second terrace of Don bank, and 6 are on the first one, closer to its bank (see Table 2). Of the remaining 6 one-layer sites, 4 (K7, K9, K13, K20) are from the second terrace and 2 (B1, B2) are from the first. It follows from dating analysis that 9 sites are no younger than 39.3 kyr, all of them are from the second terrace, and all, except for sites K2 and K6, are multilayer, with the number of layers from 5 to 7/9, except for the two-layer K17. Their short names in Table 2 are in direct bold type. Of these, three – K1, K12 and K14 clearly arose long before the catastrophe, the earliest date is 45.5 ka BP refers to the site K1/V and completely coincides with the date of the arrival of Cro-Magnons from Pamir foothills (from Khatlon Valley), obtained in a completely different, logistical way [1 – 3]. All these three sites are located at a distance of 1.1 – 0.4 km from each other along the edges of one ravine (see Fig. 2), forming a close group – something like a "Pleistocene village" of "small northern Egypt" hunters, capable of feeding ~ 3 clans or, approximately 60 – 75 people on the area of about 500 km^2. It must be assumed that its resource capacity was exhausted by this. These sites in Table 2 are marked with asterisks.

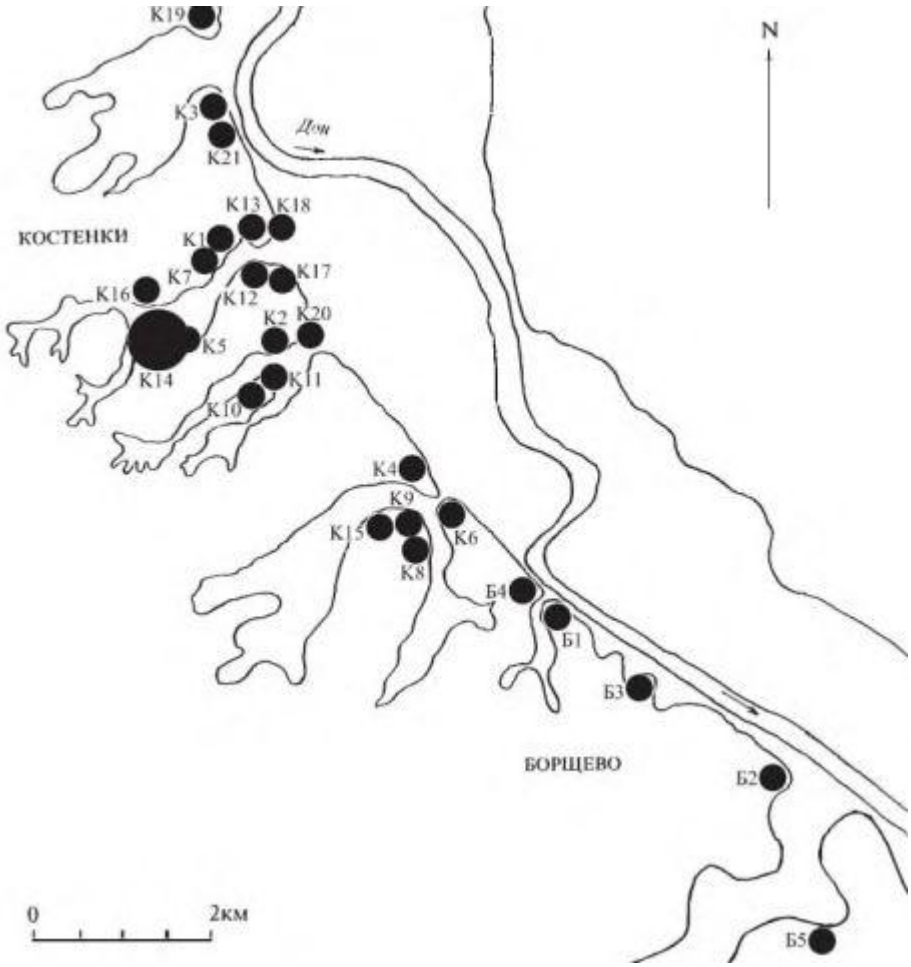

Fig. 2 – Archaeological sites found in the area of Kostenki – Borshchevo so far [46]

More "younger" 5 post-catastrophe sites from the second terrace are all single-layer, that is, they existed for a relatively short time, and direct regular font is used for their names in table 2. All 6 sites from the first terrace from Table 2 (including 3 multilayer sites with 2 – 3 layers) are "young". And this is quite natural. At the initial stage of settlement, Don, as already mentioned, was a very large river that flooded the first terrace during the summer flood, and Cro-Magnons settled higher – on the second terrace. After catastrophe, there was a short sharp cooling, and then, gradually, with some fluctuations, the climate of Ice Age became more and more severe up to 18 – 15 ka (see [1]). The summer melting of glaciers decreased, and Don River dried up. Therefore, then Cro-Magnons went down to the first terrace closer to the water.

It follows that two of the sites from the first terrace not considered in Table 2 are of no interest to us. And of the remaining four unconsidered sites from the second terrace, 1 – 2 could have arisen together with others at the time of the catastrophe. Thus, estimates lead to 10 – 11 sites in Kostenki that existed during the catastrophe.

But this is not all. Paper [10] presented data both on the timing of the explosion of Archiflegreo stratovolcano and on the dating of a large number of artifacts in Kostenki-14 in the layer called LVA, in which volcanic ash was found, and next to it directly below ash in layer IVa. It is clearly seen (especially for Bayesian estimates – these are darker marks in Fig. 3) that they accumulated at this very moment, and at a rate several times higher than the accumulation of artifacts before and shortly after the catastrophe in relatively "normal" periods of time, see Fig. 3. In layers II and III, 3 samples were found for about 2.9 kyr, and in layers IVa and LVA, associated with volcanic ash, the duration of residence in which, taking into account the accuracy of dating on the scale under consideration, tends to 0 (nominally, on an interval of 2 kyr long), they were found 9. Assuming that the rate of their accumulation is approximately proportional to the number of inhabitants of this point, it is possible to estimate the excess of their number at the time of the catastrophe as four or five times, compared with their "normal" number for Pleistocene. Therefore, the image of Kostenki-14 site in Fig. 2 from paper [46] in the form of a point with much larger dimensions than the others was very successful.

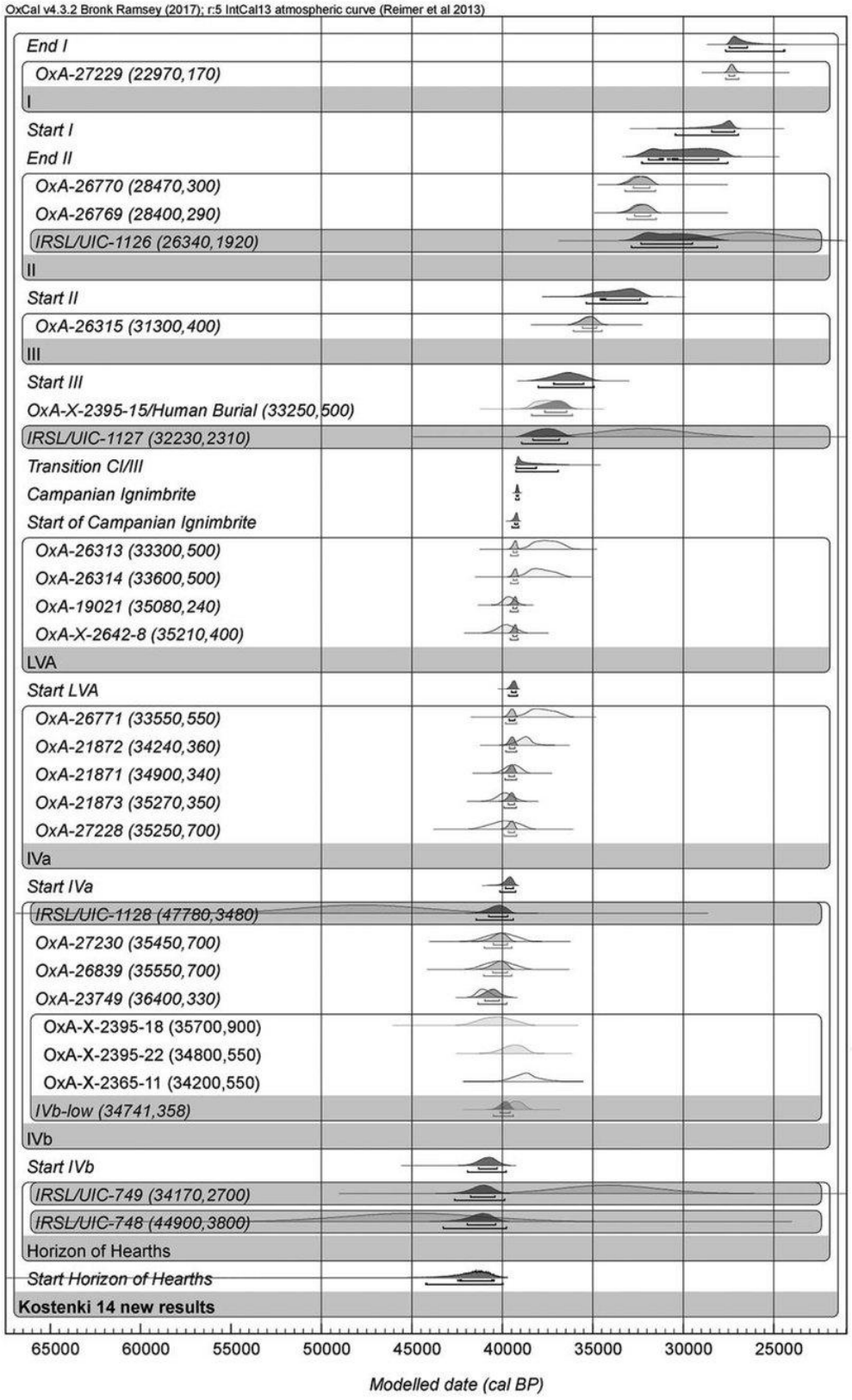

Fig. 3 – Accumulation of artifacts at Markina Gora site (Kostenki-14) over time [10]

Thus, it can be reasonably assumed that during European catastrophe in Kostenki-14 there were simultaneously up to 4 – 5 Cro-Magnon (more precisely, Grimaldian) clans, as follows from the analysis of paper [10] in the context of the settlement of Africa), and more precisely, it should have been a mixed group of people (first germ of a tribe) who survived during the "death march" and were previously part of many clans, with a total number of 4 – 5 "rated clans", that is about 100 – 125 people. Thus, the minimum population estimate in Kostenki at that time rises to 14 – 16 "rated clans". In addition, as mentioned above, archaeologists believe that there are still many unfound sites, and it is also possible that, apart from Kostenki-14, at least on some sites at the time of the disaster more than one clan

was collected. Using a very conservative estimate of rated clans numbers that lived then in Kostenki refugium, we come to a minimum value of 15 – 18 clans or 400 – 450 people, which is about 1.5 times more than according to the estimate of 10 – 15 years ago by archaeologists practicing there, soon rejected obviously because of the impossibility of living of such a large number of people in this territory in Pleistocene.

However, if we consider not a proto-city – a long-term settlement, but a temporary camp for displaced persons or a refugium in which they saved their lives for the shortest most difficult period of the time after disaster (~ 10 years), then nothing is impossible here. This could well be until all meat and bone marrow of mammoths and ungulates, deceased from thirst, starvation and cold, which had died at watering places, at crossings across Don River and taken out by water to bends of the riverbed, will not end. However, even Fig. 2 shows that at the distance of about 6 km from Kostenki-19 to Kostenki-6 there are 3 rather steep bends of Don River. And the most southeastern site Borshchevo-5 is only 4.5 km from the next sharp bend in the river. At the same time, the bends of Don in the vicinity of Kostenki arise due to outcrops of hard rocks, and, therefore, they could not change their position noticeably for 40 kyr.

S. N. Lisitsyn, after he personally experienced certain difficulties during summer excavations of the ash horizon, put forward an argument about the impossibility of life on a continuous or almost continuous ash field, because small particles of volcanic ash penetrate everywhere, including lungs, and lead to disease and even death [26]. However, he did not take into account the fact that Archiflegreo stratovolcano exploded during cold season [1 – 3], and the ash that fell to the ground was soon covered with snow, and due to severe global cooling, this continued without interruption for several years. At the same time, the snow over the ash accumulated only and hid it. And after warming and melting of snow, the ash was partially washed away with water and partially mixed with mud and could no longer cause excessive problems for people's health.

It is important also that in Kostenki-14 camp in LVA layer, a skeleton of a hunter killed with a spear in stomach was found [47] (he was a Grimaldian, according to G. F. Debets). From this, the conclusion clearly follows again that it was there that Grimaldians settled after "death march" from northern environs of Adriatic, which were less affected by the disaster than Italy and Greece [1 – 3]. Even A. N. Rogachev, who discovered this burial almost 70 years ago, rejected any possibility of attributing the burial to cultural layer III, since it lay below it [48]. The grave containing the body crossed the horizon of volcanic ash at the site – Campanian ignimbrite was clearly visible in the walls, but was absent from the burial mound [42]. That is, the tribesmen of the murdered man raked snow and ash or already a mixture of ash and dirt after warming came, dug a shallow hole in the ground to the level of permafrost, put a corpse bound hand and foot there [47] and covered the grave with the earth taken out before this. In paper [42] the uncalibrated date of the buried skeleton was determined to be 33.25 ± 0.5 ka BP (with using accelerator mass spectrometry (AMS)), after which it was corrected (refined) according to so-called "Marie Rose" procedure to 33.9 ± 0.6 ka BP, and after calibration on IntCal09 scale, a date of ~ 39.3 ka BP was obtained, which completely coincides with the time of European catastrophe.

A shell pendant "of Black Sea mollusk Tritia nitida" was found at this site in excavation season of 2020, as it was said in the source [43], that is "fundamental importance ... as direct evidence of connections, possibly origin, of the ancient population" of Kostenki, first of all, of course, the inhabitants of Kostenki-14. However, it should be noted that this mollusk is a common dweller of European marine waters and lives, for example, in Adriatic Sea [49]. It was Grimaldians, who lived along Mediterranean shores, including not far from the shores of Adriatic. And, fleeing the consequences of Campanian eruption, they took with them compact and light jewelry, dear to hearts of their women. The vicinity of their Divje Babe site [50], which lay relatively close to Adriatic coast and was not affected by volcanic ash, could well have been a gathering point for survivors before going east along the northern border of the ash trail following migrating ungulates (see [1 – 3]).

But Black Sea was then, during Valdai glaciation, in a state of post-Karangat regression with a decrease in water level to 90 m, and was practically a fresh lake. Therefore, only freshwater mollusks existed there, and the pendant found in Kostenki-14 could not have been of Black Sea origin. Of course, at the same time, Mediterranean Sea went also through a phase of Grimaldian regression, even with a slightly greater decrease in level [51], but it did not lose its connection with World Ocean and remained a sea with salt water, in which the mollusk Tritia nitida continued to live. This happened because the minimum depth of Strait of Gibraltar is 338 m [52], while the depth of Bosporus Strait between Black and Mediterranean Seas is 12 times less, only 27.5 m [53].

All these considerations are in excellent agreement with the general modern ideas about the presence in Kostenki of an early "layer of original cultures (IUP) (or one culture with a wide range of variability)", and a later one, within which European-type Aurignac coexisted from Early Upper Paleolithic of Europe (EUP) (in the "ash horizon" of Kostenki-14 (layer K14/LVA) and in the layer K1/III), and Streltsy culture [46]. So Grimaldians (and possibly Brünners) moved into Kostenki-14 and Kostenki-1 sites that already existed than (if they had not already been abandoned by that time), probably even pushing local Cro-Magnons, because behind the shoulders of newcomers from west there was a phenomenally successful war with Neanderthals and a proto-tribal organization, forced by circumstances. And even as refugees, they retained their former skills. This was soon demonstrated by Grimaldians.

After several years of the refugee stay in Kostenki, the Earth warmed up, the mammoth steppe outside ash plume began to gradually revive again, and our ancestors, unbroken by the catastrophe, left Kostenki, which had lost their value at that time, and returned to the steppe, local Cro-Magnons with Brünners (if they reached Kostenki during the catastrophe) moved to the north along Don River [1 – 3], and Grimaldians chose a different path – naturally, along bank of Don also, but to the south. This, and the skeleton of the slain hunter in their camp, suggests that the separation may have been "forced". It is also obvious that there were more Cro-Magnons, local and who arrived at the camp from the Russian Plain from a relatively nearby neighborhood, and even more so, together with Brünners, who were also noted by G. F. Debets in Kostenki, and Grimaldians, despite their fighting skills didn't have to choose. But in the end, their possibly forced journey to the south ended with a grand success – invasion of Africa and its settlement.

During this march, they visited western Georgian Bondi Cave approximately ~ 0.5 kyr after Kostenki – Grimaldians ate everything that was around and went further (the average value of the time a large group of people appeared there was 38.4 kyr according to the calibration IntCal13 [10] and approximately 38.8 kyr according to the latest IntCal20 calibration, see Table 1). In the paper [10], one can see a picture of the accumulation of artifacts during this period, which is completely similar to that shown in Fig. 3 for the "ash" layer K14/LVA.

In general, it is simply amazing that in this paper, for analysis of "chronological factor in understanding the Middle and Upper Paleolithic of Eurasia", Bondi Cave was chosen, where Grimaldians stopped during their campaign, and, among all the sites of Russian Plain, Markina Gora (Kostenki -14), where the burial of Grimaldian hunter was previously found, although the authors of the paper [10] probably did not even think about the possibility of settling Africa by Grimaldians from Adriatic coast through Kostenki. So Kostenki nevertheless turned out to be the "cradle", but not of European humanity, as archaeologist John Hoffecker [29] stated 15 years ago, and, apparently, his colleagues in the excavations thought, but of its African branch.

And the very existence of "impossible Kostenki" in form of refugium, in which Cro-Magnon survivors of the European volcanic catastrophe were saved for a short but critical time, can be considered the eighth paradox of the genesis of modern humanity, continuing the series of 7 paradoxes overcame during systemic analysis described in paper [4].

It should be noted that in report by Institute of History of Material Culture (Russian Academy of Sciences) on the field season of 2020 [43], it is also mentioned that Kosteki-6 site "according to radiocarbon dating" has an age of "more than 50 kyr". First, it should be borne in mind that even the latest radiocarbon recalculation scale IntCal20 reaches the limit of its applicability at such a time, and therefore the reliability of the results obtained with its help is lost. Secondly, from a system analysis of the logistics of settlement of Pamir's Cro-Magnons, it follows that the probability of their appearance in Kostenki earlier than ~ 45.5 ka BP directly from Khatlon is very small (which is in good agreement with the hitherto known radiocarbon data (see K1/V in Table 2)), and through Levant they came there a little later [1 – 3]. All of the above, of course, does not completely exclude the possibility of appearance in Kostenki of Neanderthals more than 50 ka BP or even much earlier, especially since their paths from Europe to northeast Asia, for example, to Altai, should have passed somewhere nearby.

IV."Ghost" African archaic population

Let us return now to south march of Grimaldians. From Table 1 it follows that Grimaldians reached area of Ethiopia – Tanzania approximately 35 ± 0.5 ka BP, and from the excavations of Fincha Habera high-mountain shelter (height 4 km above sea level) it became clear that some of them remained to live there: "The surrounding glacial climate provided fresh water, and therefore vegetation, which created a unique environment that allowed these hunter-gatherers to find permanent residence here" [14]. The recent descendants of periglacial Europe inhabitants returned to their habitual habitat, and those who did not want to stay here moved further south to the desired coolness (see Table 1), since the resource capacity of this territory was apparently small. Incidentally, at about the same time in Asia, sapiens settled in Nwya Devu Tibetan site at altitude of about 4.6 km [54].

So, active settlement of Africa by Grimaldians began about 35 ka BP. At the same time, a decade-old work on genetic analysis of "three contemporary sub-Saharan African populations" genomes (which were divided into 14 subpopulations) showed that for 12 of them, "impurities" (inserts) were found in three non-coding autosomal parts of genome, "introgressed ~ 35 kya from an archaic population that split from the ancestors of anatomically modern humans ~ 700 kya" [55]. These inserts are marked by numbers 4, 18 and 13 in Fig. 4.

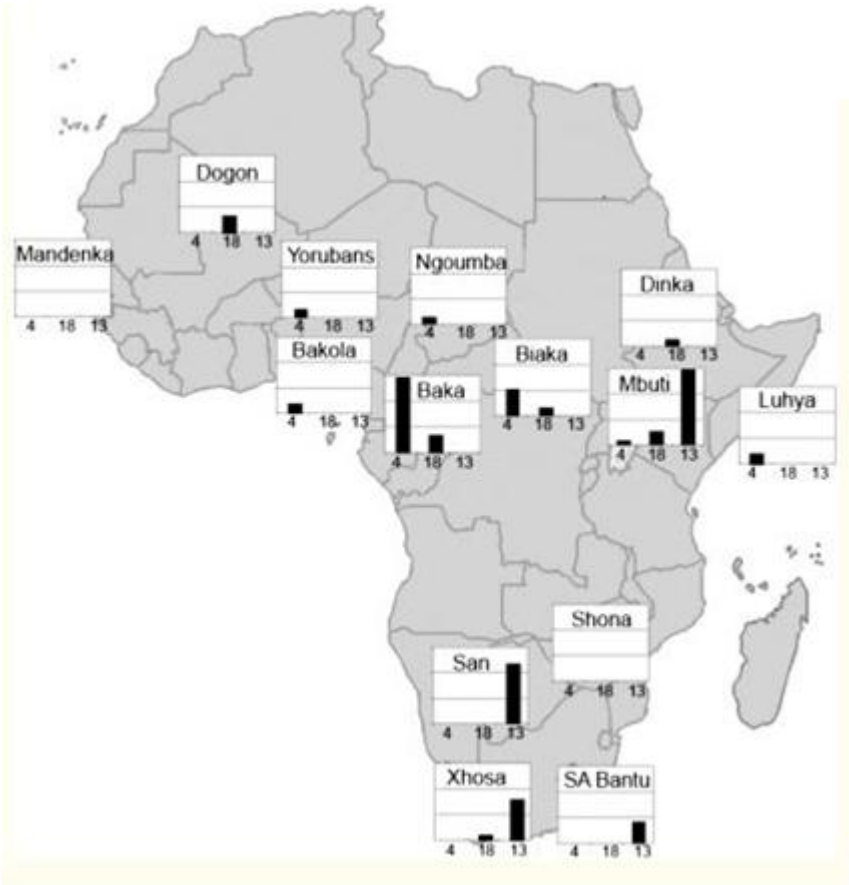

Fig. 4 – Frequency of introgression of three sequenced "inserts" into genome of some modern sub-Saharan populations [55]

In paper [55] it was concluded on the base of these data that in genome of original African population these inserts came from contacts with a "ghost" archaic population that 35 ka BP appeared out from nowhere and immediately disappeared again into darkness. This line of searching for "African ghosts" that introduced impurities into the genome of modern Africans was continued by other paleogenetics, see, for example, very recent works [56, 57], in which, for other samples (Yoruba and their neighbors in West Africa), they came to approximately similar conclusions: interbreeding with "ghosts" occurred about 43 ka BP (95 % confidence interval – from 6 to 124 ka BP), which, of course, in fact, does not differ at all from the estimate of 35 ka BP from the article [55], and the "ghosts" separated from ancestors of modern people almost at the same time – about 625 ka BP (95% confidence interval – from 375 to 965 ka BP).

This may well be called the ninth paradox discussed in this article – the notorious "ghosts" did not leave any traces anywhere, except, as it were, in the genome of some Africans. However, it suffices to compare the data of [55] presented in Figs. 4, with the distribution of Y- and mitochondrial haplogroups among the same peoples [58, 59], and this paradox disappears, and the "ghosts" immediately dissipate without a trace like smoke, and instead of them, well-known sapiens populations come to the fore.

Khoisans and Pygmies are direct descendants of relict African population. This follows from the fact that these populations contain very large proportions of the most ancient Y-haplogroups A and B. According to the database [58], the share of haplogroup A among Khoisans is about 41.5 %, and a somewhat later haplogroup B is 11.5 %. The remaining 47 % are "Asian" haplogroups, with the overwhelming predominance of haplogroup E. In Pygmies, the share of haplogroup A is approximately 3.5 %, and the share of haplogroup B is 56 %. The rest is "Asian" haplogroups (40.5 %, just like Khoisans) with the dominance of haplogroup E. That is, in general, these peoples retained about 55 % of the original Y-chromosomes, and 45 % were "introgressed" by newcomers from Eurasia, mainly with haplogroup E. From this it becomes clear that Khoisans and Pygmies are not "purebred" African relics, but still they retained a little more than half of the "relict" Y-chromosomes. Well, the "relict" mtDNA haplogroups transmitted through female line dominate in them to an even greater extent – L0 haplogroup (formation time is 200 – 130 ka BP) reaches an average frequency of 73 % among Khoisans [59]. Among Pygmies, with the exception of Eastern Pygmies (Mbuti), haplogroup L1 (formation time 170 – 100 ka BP) occurs with a frequency of 77 – 100 %. And in Mbuti, the rather ancient mtDNA haplogroup L2a (107 – 87 ka BP) also prevails with a frequency of 64 %, as well as L0a, which comes from Khoisan ancestors [60]. It is also worth remembering that Y-haplogroup E in Eurasia is present mainly in the vicinity of the coasts of Mediterranean and Red Seas, and it was in Mediterranean Italy that the term "Grimaldians" arose itself [61, 62].

Now let's look at Fig. 4 again. It can be seen that insert 18 is present as an insignificant admixture in 6 out of 14 populations. Insert 13 (moreover, in very significant amounts of 12 – 15 %) is present in Khoisans (San) and Pygmies (Mbuti), as well as in significantly smaller quantities (4 – 8%) in the genomes of Xhosa peoples and South African Bantu (SA Bantu), relatively recent newcomers to South Africa from afar. They were in close contact with ancient Khoisans, who lived here since ancient times, Xhosa especially, – they even partially borrowed "click" Khoisan language [63]. It is known that women usually give language to their children (as, for example, happened with Hungarian after total extermination of Hungarian men in the 13th century), and that the newcomers almost always do not have enough women. From this, the paths of appearance of insert 13 in the genome of South African Bantu and their close relatives Xhosa, in which (in both) the Y-haplogroup E predominates [63], is obvious. The same, in general, were the ways of appearance of traces of "pygmy" inserts 4 and 18 in all other populations, where they are present.

And among Pygmies themselves, inserts 4 and 18 arose after separation of their ancestors from the ancestors of Khoisan, and insert 4 at that is 15 % among current Western Pygmies (Baka). To Eastern Pygmies (Mbuti), insert 13 seems to have passed to them from the ancestors of Khoisan through their women. All these inserts 4, 18 and 13, which could well have been in the genomes of ancestors of modern Eurasian sapiens when they left Africa about 130 ka BP, most likely were eliminated when they passed through the "bottleneck" of 72 ka BP, and in European sapiens of haplogroup E – even two (72 and 39.3 ka BP). At the same time, inserts 4, 18, 13 have been preserved in archaic sapiens of Africa. Thus, archaic African sapiens actually turned out to be elusive "ghosts" – the main ancestors of modern Khoisans and Pygmies, not encoding autosomal insertions of which, acquired by some of them hundreds of thousands of years ago, were introgressed into genomes of descendants of Mediterranean Cro-Magnons who invaded Africa from Russian Plain 36 – 35 ka BP through native African women who became mothers of mestizos, together with descendants of Grimaldians, both paternal and maternal, who supplanted local sapiens basically. So the time of introgression in paper [55] was determined quite accurately.

V. "Inexplicable lag" of Upper Paleolithic revolution in West Africa

Let us now consider the last, tenth paradox – a huge gap (of the order of 15 – 25 kyr) between the time when Upper Paleolithic revolution took place first in East and then in West Africa [23, 64]. At the same time, the backlog from Levant, for example, from the beginning of "cultural leap" in Boker Tachtit Cave from Negev desert, in western Africa, reaches 40 kyr [65]. This is demonstrated by the results of excavations at West African Senegalese sites of Laminia and Saxomununya [23] and Nigerian Ivo Eleru [24], see Table 1. If we proceed from natural assumption that Upper Paleolithic revolution was brought to Africa "on the soles of their feet" by European Cro-Magnons (Grimaldians) who settled hominin's cradle, then this gap becomes not only natural, but also necessary. In accordance with the description presented here earlier, the relatively few aliens that appeared on African coast of Bab el-Mandeb Strait about of 36 ka BP divided into groups, one of which moved north to Nile River, and the second, leaving about 35.5 ka BP on the highlands of Ethiopia near Fincha Habera refugium, part of its composition, marching across East Africa, reached 32.5 ka BP to its southern tip, bringing Upper Paleolithic revolution (MSA/LSA transition) there, see Table 1 and references [1 – 3].

Further, as the number of settlers increased, their gradual resettlement from Ethiopia and South Africa took place. If we assume the rate of this settlement is on average the same as that of their ancestors when occupying free territories in Asia during the period of development of periglacial territories, i.e., 0.5 km/year [1 – 3], then reaching the western margin of Africa, the Laminia site (south-western point in a close pair of crimson points in Fig. 1) from Ethiopian Fincha Habera (yellow point in eastern Africa on the border of red fill) would require about 14.5 kyr, and already distant descendants of Grimaldians would have ended up in Senegal just in time for the moment that was defined by archaeologists as the beginning of Upper Paleolithic revolution in this region [23], bringing it there finally as well – the last refugium of archaic (see Table 1). At the same time, settlement should have taken place near the border of a narrow strip of steppes and semi-desert from the north, where natural conditions were more familiar to highlanders of Ethiopia and descendants of periglacial Europe inhabitants than, say, African rainforests, which lay south of this path and became at that time a refugium for ancestors of modern pygmies. And Saxomununya site, located very close to the northeast, was not inhabited at that time, since at that moment there was a desert there.

And it was precisely by the time of new Africans arrived in Laminia, another cold snap began in frames of Ice Age, the desert began to advance on the steppe from the north, and they were forced to move south and east, closer to the last remnants of a more humid zone in Central Africa (see Fig. 5, [66]). Thin yellow stripe in the west of Africa, stretching in a latitudinal direction and expanding and going south in its eastern part, indicated by label 6, is a strip of steppes. To the north of it there is a semi-desert (5, olive fill) and an extreme desert (7, light fill), which at that time reached the place where Laminia site was located. The picture corresponds to the period of the strongest cooling about 18 ka BP. The migration process is shown in Table 1 as Laminia – Ivo Eleru transition, where a 16 – 12 ka BP skull was found, either the last representative of relict archaic Homo population or a hybrid with the archaic African population [24, 67]. And with the humidification that began at 15 ka BP [23], it was possible to return to the northeast and settle in Saxomununya by ~ 11.5 ka BP, finally bringing the Upper Paleolithic revolution there as well.

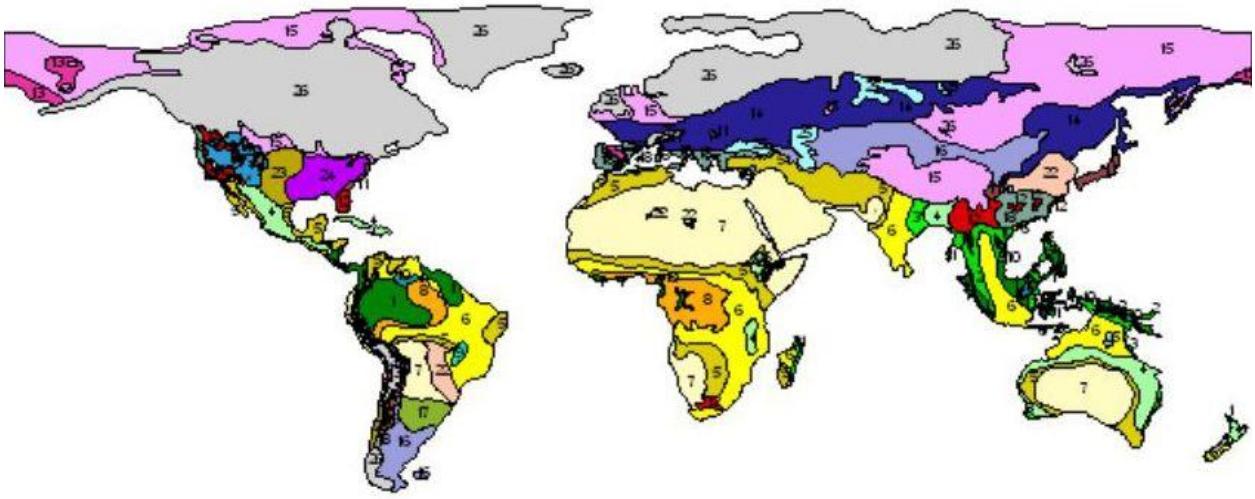

Fig. 5 – Distribution of natural zones over surface of the globe during the period of maximum glaciation of 18 ka BP [66]

Of course, nothing directly proves that in reality there were just such transitions of African sapiens 20 – 10 ka BP, however, from the whole complex of data considered, it is clear that movements of this type, on the whole, correctly describe the general nature of human population migrations in West Africa south of Sahara to that time. And they simply explain the gaps in the dates of Upper Paleolithic revolution in East and West Africa, as well as in nearby points – not by some special constancy of West African climate or something similar, as, for example, in the source [68], but by simple and obvious consideration that only by this time the bearers of this new stone technology were finally able to get here, to Saxomununya, providing here, apparently, the last MSA/LSA transition in the Old World, not counting the very small enclaves that are in rigid isolation due to particularly unfavorable environmental conditions.

Conclusion

The paper considers 3 paradoxes – problems that are associated with the genesis of modern humanity. They are the following contradictions, insoluble within the framework of any variant of traditional description of this process:

- fundamental impossibility of Kostenki group sites existence in Pleistocene and its existence in reality;
- presence of traces of alleged African "ghosts" only in the genome of a part of Africans, and nowhere else;
- inexplicable delay of the Upper Paleolithic revolution (MSA/LSA transition) in western Africa by 15 – 25 kyr behind East Africa and 25 – 40 kyr behind Levant and Europe.

It is shown that all the features of modern humanity genesis described above, which manifest themselves as unresolvable paradoxes within the framework of the previous paradigm, become not only a natural consequence of this process in accordance with the concept described in [1 – 4], but also additional evidences that it is precisely that's how it happened.

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