3   DSR – Sochi Region Sites

3.1   Introduction

Four sites were sampled in the Sochi Region, Northwest Caucasus (Figure 3.1): Navalishinskaya, Malaya Vorontsovskaya, Akhshtyr, and Kepshinskaya. All were east facing karst caves, between 150 and 300 m above sea level, and between 54 and 120 m above their respective valley bottoms. In total, 107 luminescence and related samples, 87 tephra, magnetic and sedimentary samples, 14 pollen and 6 AMS samples were taken from the four sites, between the 7-15th of July 2004 (Table 3.1. and Table 3.2).

The background and history of past investigation of the sites were assessed prior to sampling. These reviews can be found in Section 3.5 of this report, and tabulated notes from these pre-field assessments are located in Appendix 3.1. A general description of the samples, and tabulated information relating to each luminescence sample is presented in Appendix 3.2. In situ measurements of environmental gamma dose rate were made at the locations of all dating samples. A general description of the measurements, and tabulated information relating to each measurement is presented in Appendix 3.3.
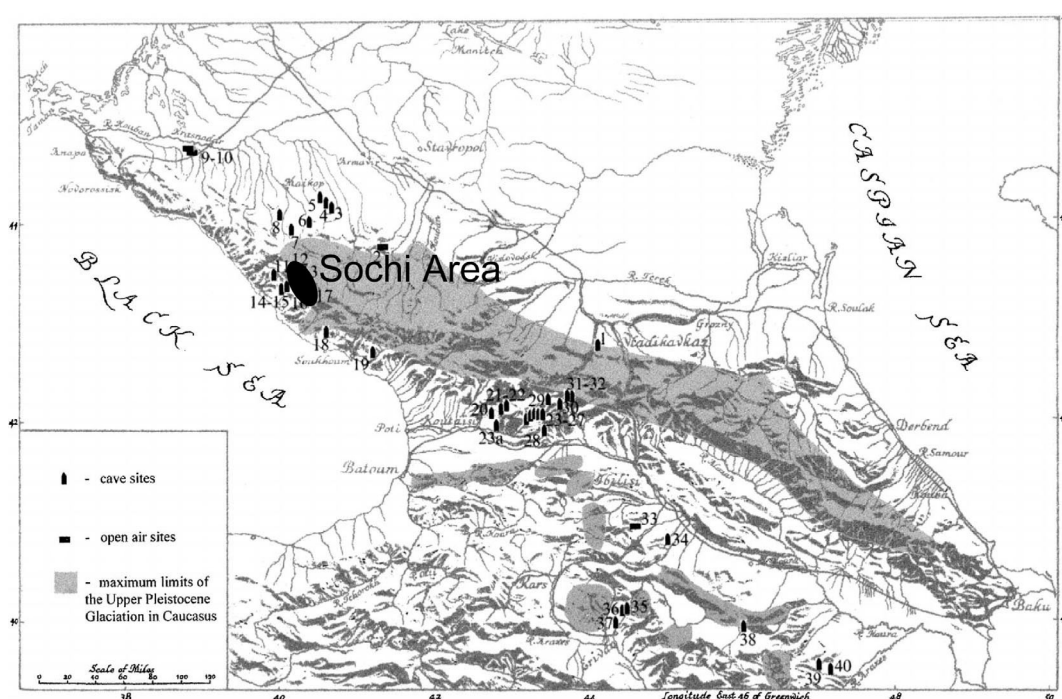

Figure 3.1. Location of the Sochi Region in the Caucasus region, and the positions of other Middle Palaeolithic sites (From Golovanova and Doronichev, 2003)

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Site	Section	Context	Sample		Field gamma spectrometry		Ass. Samples
			Number	Type	Measurement	Dose rate (mGy/a)	
Navalishinskaya	-	Present cave floor	EFD4L016-21	Pots ~0.2 kg	-	-	-
Navalishinskaya	~ Q-Z	Profiling, 5 cm	EFD4L022-46	Small Bags ~1 g	-	-	-
Navalishinskaya	~ Q-Z	Layer 1	EFD4L047	Tube ~1 kg	EFD4G018	0.22 ± 0.01	LStn Clast
Navalishinskaya	~ Q-Z	Layer 3 (upper)	EFD4L048	Tube ~1 kg	EFD4G019	0.25 ± 0.01	LStn Clast
Navalishinskaya	~ Q-Z	Layer 3 (lower)	EFD4L049	Tube ~1 kg	EFD4G020	0.25 ± 0.01	LStn Clast
Navalishinskaya	~ Q-Z	Layer 4 (upper)	EFD4L050	Tube ~1 kg	EFD4G021	0.24 ± 0.01	LStn Clast
Navalishinskaya	~ Q-Z	Layer 4 (lower)	EFD4L051	Tube ~1 kg	EFD4G022	0.22 ± 0.01	LStn Clast
Navalishinskaya	~ Q-Z	Ash below layer 5	EFD4L052	Tube ~1 kg	EFD4G023	0.26 ± 0.01	LStn Clast
Malaya Vorontsovskaya	~ O-P	Profiling, 5 cm	EFD4L053-72	Small Bags ~1 g	-	-	-
Malaya Vorontsovskaya	~ O-P	Layer 2	EFD4L073	Tube ~1 kg	EFD4G025	0.36 ± 0.02	-
Malaya Vorontsovskaya	~ O-P	Layer 3 (upper)	EFD4L074	Tube ~1 kg	-	0.35 ± 0.02	-
Malaya Vorontsovskaya	~ O-P	Layer 3 (lower)	EFD4L075	Tube ~1 kg	EFD4G027	0.41 ± 0.02	-
Malaya Vorontsovskaya	~ O-P	Layer 4	EFD4L076	Tin ~ 1 kg	EFD4G028	0.38 ± 0.02	-
Malaya Vorontsovskaya	7 m in from O-P	Present cave floor	EFD4L077	Pot ~ 100 g	-	-	LStn Clast
Malaya Vorontsovskaya	Above cave	Present soil	EFD4L078&79	Bag ~ 500 g	EFD4G026	0.42 ± 0.02	-
Akhshtyr	Γ-B	Profiling, 10 cm	EFD4L080-100	Small Tubes/Bags ~1 g	-	-	-
Akhshtyr	Γ-B	Layer 2	EFD4L101	Tube ~1 kg	EFD4G035	0.28 ± 0.02	LStn Clast
Akhshtyr	Γ-B	Layer 3a	EFD4L102	Tin ~1 kg	EFD4G036	0.76 ± 0.04	-
Akhshtyr	Γ-B	Layer 3	EFD4L103	Tin ~1 kg	EFD4G037	0.75 ± 0.04	-
Akhshtyr	Γ-B	Layer 5	EFD4L104	Tin ~1 kg	EFD4G038	0.89 ± 0.04	-
Kepshinskaya	Just inside cave	Present cave floor	EFD4L105	Pot ~0.2 kg	-	-	LStn Clast
Kepshinskaya	-	Profiling, 10 cm	EFD4L106-120	Small Tubes ~1 g	-	-	-
Kepshinskaya	-	Layer 3 (upper)	EFD4L121	Tube ~1 kg	EFD4G045	0.69 ± 0.04	-
Kepshinskaya	-	Layer 3 (lower)	EFD4L122	Tube ~1 kg	EFD4G046	0.39 ± 0.02	-

Table 3.1. Luminescence and related samples taken, and measurements made at sites in the Sochi region.

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Site	Section	Context	Sample Number	Sample Depth	Sample Type	Associated Sample(s)
Navalishinskaya	~ Q-Z	Layer 1a	EFD4S038-43	0-30 cm	T/M/S	EFD4L022-27
Navalishinskaya	~ Q-Z	Layer 3	EFD4S044-50	30-65 cm	T/M/S	EFD4L028-34
Navalishinskaya	~ Q-Z	Layer 4	EFD4S051-57	65-100 cm	T/M/S	EFD4L035-41
Navalishinskaya	~ Q-Z	Ash below layer 4	EFD4S058	100-105 cm	T/M/S	EFD4L042
Navalishinskaya	~ Q-Z	Layer 5	EFD4S059-60	105-115 cm	T/M/S	EFD4L043-44
Navalishinskaya	~ Q-Z	Ash below layer 5	EFD4S061	115-120 cm	T/M/S	EFD4L045
Navalishinskaya	~ Q-Z	Layer 6	EFD4S062	120-128 cm	T/M/S	EFD4L046
Navalishinskaya	~ Q-Z	Layer 4	EFD4X063	87 cm	Calcite	-
Navalishinskaya	-	Cave roof	EFD4X064	-	Stalactite	-
Navalishinskaya	~ Q-Z	Layer 1a	EFD4P065	31 cm	Pollen	EFD4L047
Navalishinskaya	~ Q-Z	Layer 3 (upper)	EFD4P066	47 cm	Pollen	EFD4L048
Navalishinskaya	~ Q-Z	Layer 3 (lower)	EFD4P067	67 cm	Pollen	EFD4L049
Navalishinskaya	~ Q-Z	Layer 4 (upper)	EFD4P068	90 cm	Pollen	EFD4L050
Navalishinskaya	~ Q-Z	Layer 4 (lower)	EFD4P069	105 cm	Pollen	EFD4L051
Navalishinskaya	~ Q-Z	Ash below layer 5	EFD4P070	118 cm	Pollen	EFD4L052
Navalishinskaya	~ Q-Z	Ash below layer 4	EFD4C071	100-105 cm	AMS	-
Navalishinskaya	~ Q-Z	Ash below layer 4	EFD4X072	100-105 cm	General	-
Malaya Vorontsovskaya	~ O-P	RHS wall of cave	EFD4X073	-	General	-
Malaya Vorontsovskaya	~ O-P	Layer 1	EFD4S074	0-7 cm	T/M/S	
Malaya Vorontsovskaya	~ O-P	Layer 1a	EFD4S075-76	7-20 cm	T/M/S	
Malaya Vorontsovskaya	~ O-P	Layer 2	EFD4S077-78	20-30 cm	T/M/S	
Malaya Vorontsovskaya	~ O-P	Layer 3	EFD4S079-87	30-74 cm	T/M/S	
Malaya Vorontsovskaya	~ O-P	Layer 4	EFD4S088-89	74-82 cm	T/M/S	
Malaya Vorontsovskaya	~ O-P	Layer 5	EFD4S090-92	82-98 cm	T/M/S	
Malaya Vorontsovskaya	~ O-P	Layer 2	EFD4P093	24 cm	Pollen	EFD4L073
Malaya Vorontsovskaya	~ O-P	Layer 3 (upper)	EFD4P094	42.5 cm	Pollen	EFD4L074

Site		Layer	Sample	Depth	Type	Pollen
Malaya Vorontsovskaya	~ O-P	Layer 3 (lower)	EFD4P095	67 cm	Pollen	EFD4L075
Malaya Vorontsovskaya	~ O-P	Layer 4	EFD4P096	77 cm	Pollen	EFD4L076
Malaya Vorontsovskaya	~ O-P	Layer 3 (upper)	EFD4C097	32 cm	AMS	-
Malaya Vorontsovskaya	~ O-P	Layer 3 (lower)	EFD4C098	52 cm	AMS	-
Malaya Vorontsovskaya	~ O-P	Layer 3 (lower)	EFD4C099	53 cm	AMS	-
Akhshtyr	Γ-B	Layer 2	EFD4S100-101	0-48 cm	T/M/S	-
Akhshtyr	Γ-B	Layer 3a	EFD4S102-107	48-78 cm	T/M/S	-
Akhshtyr	Γ-B	Layer 3	EFD4S108-113	78-110 cm	T/M/S	-
Akhshtyr	Γ-B	Layer 4	EFD4S114-119	110-142 cm	T/M/S	-
Akhshtyr	Γ-B	Lens Z	EFD4S120-121	142-157 cm	T/M/S	-
Akhshtyr	Γ-B	Layer 5	EFD4S122-124	157-178 cm	T/M/S	-
Akhshtyr	Γ-B	Layer 6	EFD4S125	178-186 cm	T/M/S	-
Akhshtyr	Γ-B	Layer 7	EFD4S126-127	186-210 cm	T/M/S	-
Akhshtyr	Γ-B	Layer 5	EFD4X128	-	General	-
Akhshtyr	Γ-B	Layer 6	EFD4X129	-	General	-
Akhshtyr	Γ-B	Layer 7	EFD4X130	-	General	-
Akhshtyr	Γ-B	Layer 2	EFD4P131	37 cm	Pollen	EFD4L101
Akhshtyr	Γ-B	Layer 3a	EFD4P132	67 cm	Pollen	EFD4L102
Akhshtyr	Γ-B	Layer 3	EFD4P133	99 cm	Pollen	EFD4L103
Akhshtyr	Γ-B	Layer 5	EFD4P134	172 cm	Pollen	EFD4L104
Akhshtyr	Γ-B	Hearth at top of layer 4	EFD4C135	-	AMS	-
Kepshinskaya	-	Layer 3	EFD4S136-145	0-102 cm	T/M/S	-
Kepshinskaya	-	Layer 4	EFD4S146-150	102-148 cm	T/M/S	-
Kepshinskaya	-	Layer 3 (upper)	EFD4P151	25 cm	Pollen	EFD4L121
Kepshinskaya	-	Layer 3 (lower)	EFD4P152	94 cm	Pollen	EFD4L122
Kepshinskaya	-	Layer 3	EFD4C153	Unknown	AMS	-

Table 3.2. Tephra, magnetic susceptibility, sedimentary, pollen, AMS and general samples made at sites in the Sochi Region.

Of the 107 luminescence related samples, 16 were full luminescence dating samples in steel tubes or tins, with associated in situ dose rate measurements made using a field gamma spectrometer (Table 3.1). Six such samples were taken from Navalishinskaya (Figure 3.2, Figure 3.3, Figure 3.4), which had a relatively clear stratigraphic sequence containing evidence for climatic fluctuations, both Upper and Middle Palaeolithic layers, and a number of ashy layers interpreted as representing human occupation (Section 3.5.1). Four samples were taken from Malaya Vorontsovskaya (Figure 3.5, Figure 3.6, Figure 3.7), where the stratigraphy was less complex and the Upper Palaeolithic deposits showed signs of disturbance (Section 3.5.2). Four samples were also taken at Akhshtyr (Figure 3.8, Figure 3.9, Figure 3.10). This site contained both Upper Palaeolithic, and an extensive sequence of Middle Palaeolithic deposits, although the degree to which this material was in-situ is debatable. However, interest was focussed on the uppermost Middle Palaeolithic layers where human remains had been found (Section 3.5.3). Only two samples were taken from Kepshinskaya (Figure 3.11, Figure 3.12, Figure 3.13), to bracket the single layer of archaeological interest (Section 3.5.4).

In addition to the full luminescence dating samples, 81 small samples were taken in zip lock bags or small tubes (Table 3.1). These were designed to provide profiles of more limited luminescence information for the sampled sections (Figure 3.3, Figure 3.6, Figure 3.9, Figure 3.12). These may indicate changes in luminescence behaviour and hence highlight variations in sediment source down section. Furthermore, for the better quality samples a change in stored dose with depth can be used to assess the datability of the sequence. The best quality profiling samples (generally small tubes in soft sediment) might be used to measure approximate dates in their own right.

Ten modern surface samples were also taken in plastic pots or black bags (Table 3.1). Where possible, at least one "representative" modern sample was taken close to the sampled archaeological section. This was not possible at Akhshtyr because the inside of the cave had been surfaced with gravel for visitor access. At Navalishinskaya, a series of surface samples were taken at different distances from the entrance to the cave, to enable progressive bleaching of the OSL signal to be examined. In addition to a surface sample from the cave at Malaya Vorontsovskaya, two samples were taken from the hill slope above, to assess Liubin's suggestion that

some of the sediment in the cave may have worked its way into the cave through small cracks in the roof.

A total of 87 samples were taken for combined volcanic tephra, magnetic susceptibility and sedimentary analysis (see samples marked T/M/S in Table 3.2). These were taken from newly prepared continuous vertical cleaned profiles at the four caves. A total of 25 samples came from a 128 cm long section made at Navalishinskaya, 19 came from a 98 cm long sequence at Malaya Vorontsovskaya, 28 samples from a 210 cm section at Akhshtyr, and 15 from a 148 cm profile at Kepshinskaya. The intention was for all this material to go to Cambridge University for investigation by David Pyle and Nick McCave. A small number of general samples (designated with the EFD4X prefix in Table 3.2) were taken for specific geochemical reasons, or to characterise particular materials or sedimentary contexts.

Pollen samples were taken at all points where full luminescence dating samples were removed, the purpose of this sampling being to permit the optically stimulated luminescence measurements to be firmly tied in with existing palynological data by means of the correlation of pollen compositions. Altogether 16 pollen samples came from the 4 sites in the Sochi region, with the sediment being removed from the immediate surroundings of the steel tubes, i.e. in the vicinity of where the gamma dosimetry readings had been made.

Only a few AMS 14C samples were taken from the four sites in this region. This was due to a number of reasons. It firstly reflects the focus of our project, which is primarily non-14C in its application of dating methodologies and hence few resources are available for the measurement of such samples. Secondly we believe many of the sequences are beyond the effective range of the radiocarbon method (those contexts which are within the range of radiocarbon have, to a degree, already been analysed) and so sampling was not justified. Thirdly, the very limited amount of new excavation that we were undertaking, as against the removal of backfill coupled with the cleaning of existing stratigraphic sections, meant that suitable in situ radiocarbon dating material was rarely encountered. Thus, in total, no more than 6 radiocarbon samples were taken from the Sochi caves.
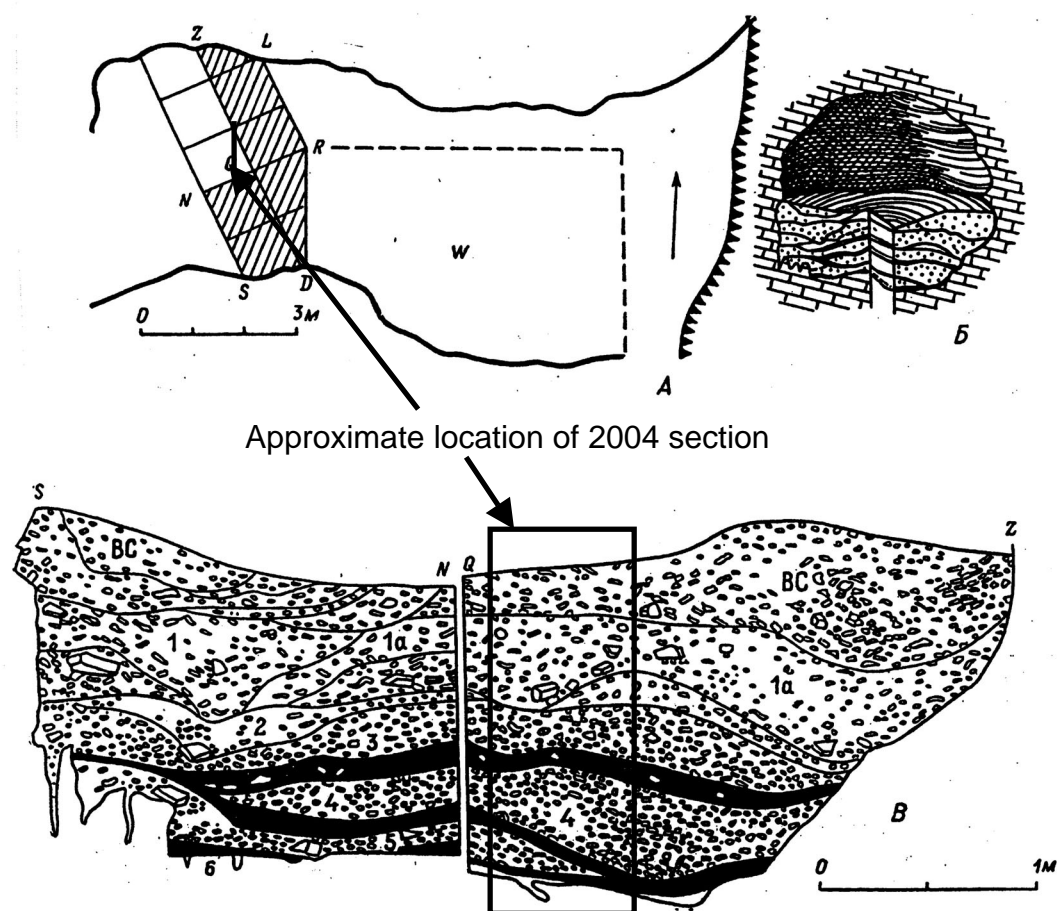
A. Top left. This shows the plan of the entrance to the main northern gallery.
W = Zamyatnin's excavation of 1936. N-Q-Z-L-R-D-S = Liubin's excavation of
1965. Top right = A transverse view of the main gallery at the point where the
excavations of 1936 were carried out (i.e. facing west).
B. Transverse section along the lines S-N and Q-Z of Liubin's excavation of 1965
(i.e. facing west).

Figure 3.2. A. Plan of Navalishinskaya cave showing previously excavated areas. B.

Sections SN and QZ with approximate location of the sequence sampled in the

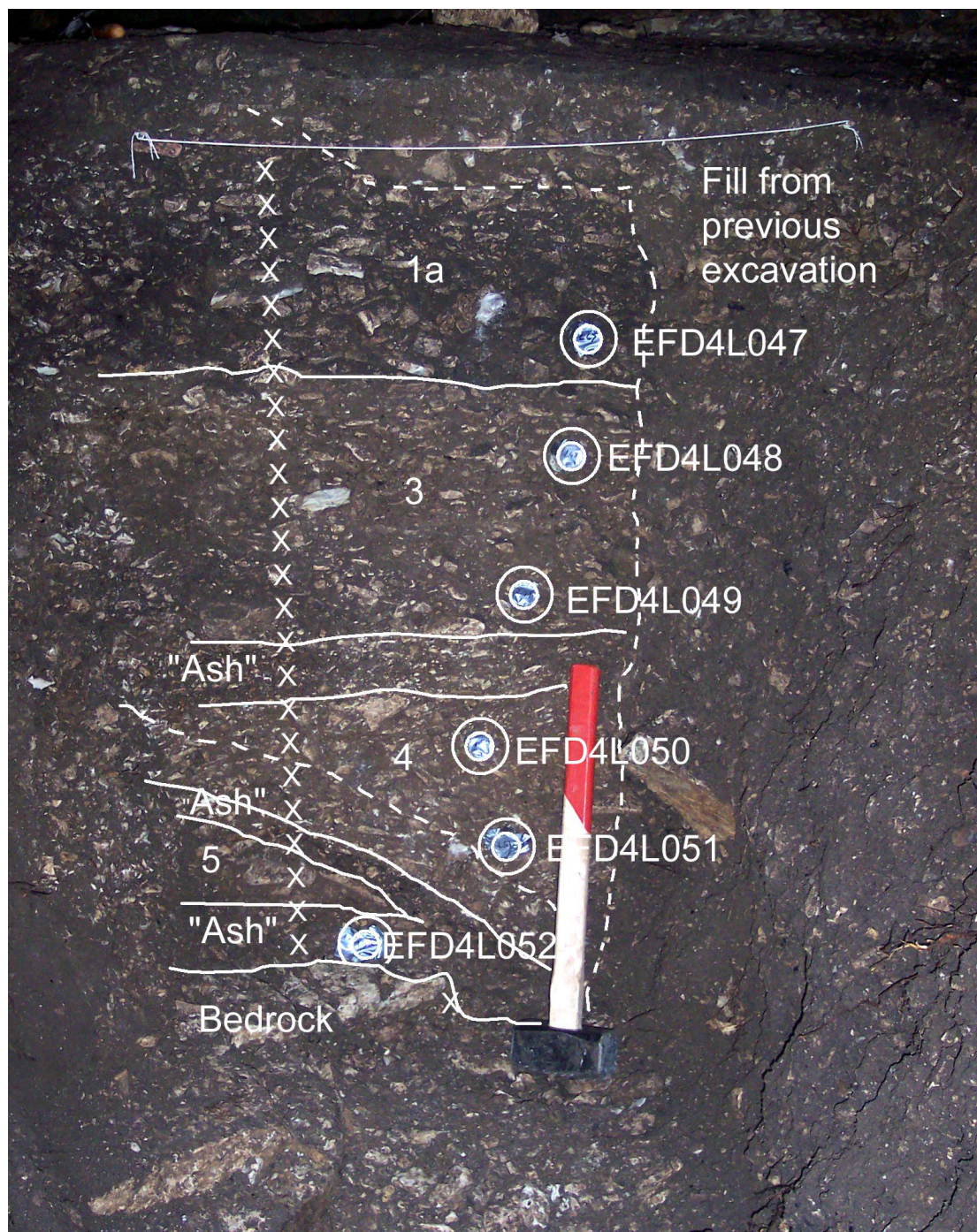present project (Figure 3.3). Adapted from Liubin (1989).

Figure 3.3. Section through the stratigraphy of Navalishinskaya cave. Luminescence sampling positions are shown as concentric circles, representing the diameters of the luminescence sampling tube and of the field gamma spectrometer probe. "X" marks the locations from which small bag samples of loose sediment were taken for luminescence profiling.
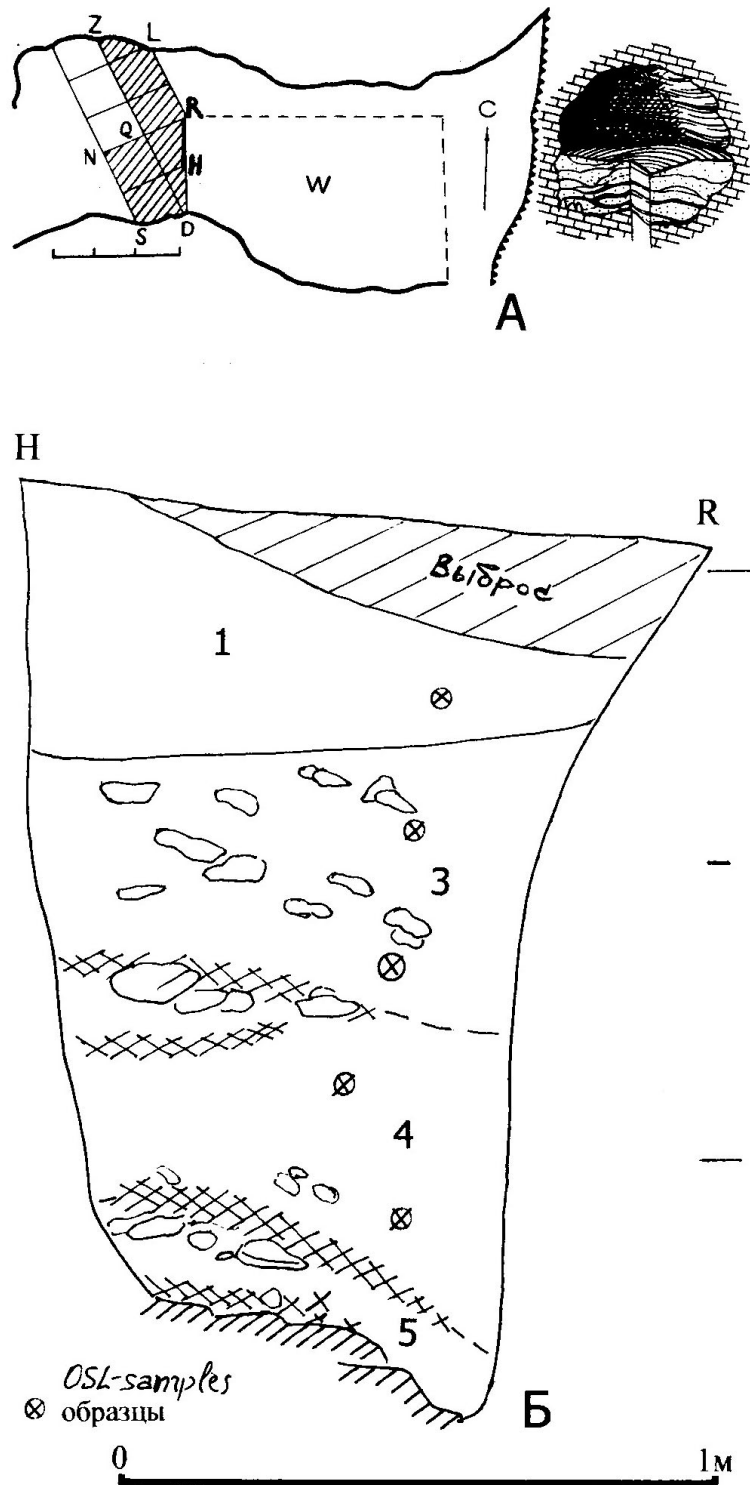
Figure 3.4. Navalishenskaya: plan and 2004 section, with OSL sampling positions.

Malaya Vorontsovskaya cave (according to Liubin and Chistyakov). A: longitudinal
section along the line R-B-L-P. B: Plan of the mouth of the cave. (a) (diagonal
hatching) 1964-1965 excavation. (b) (vertical hatching) 1983-1984 excavation. On
the left hand side (on the platform) are the areas excavated by Krainov (1940) and
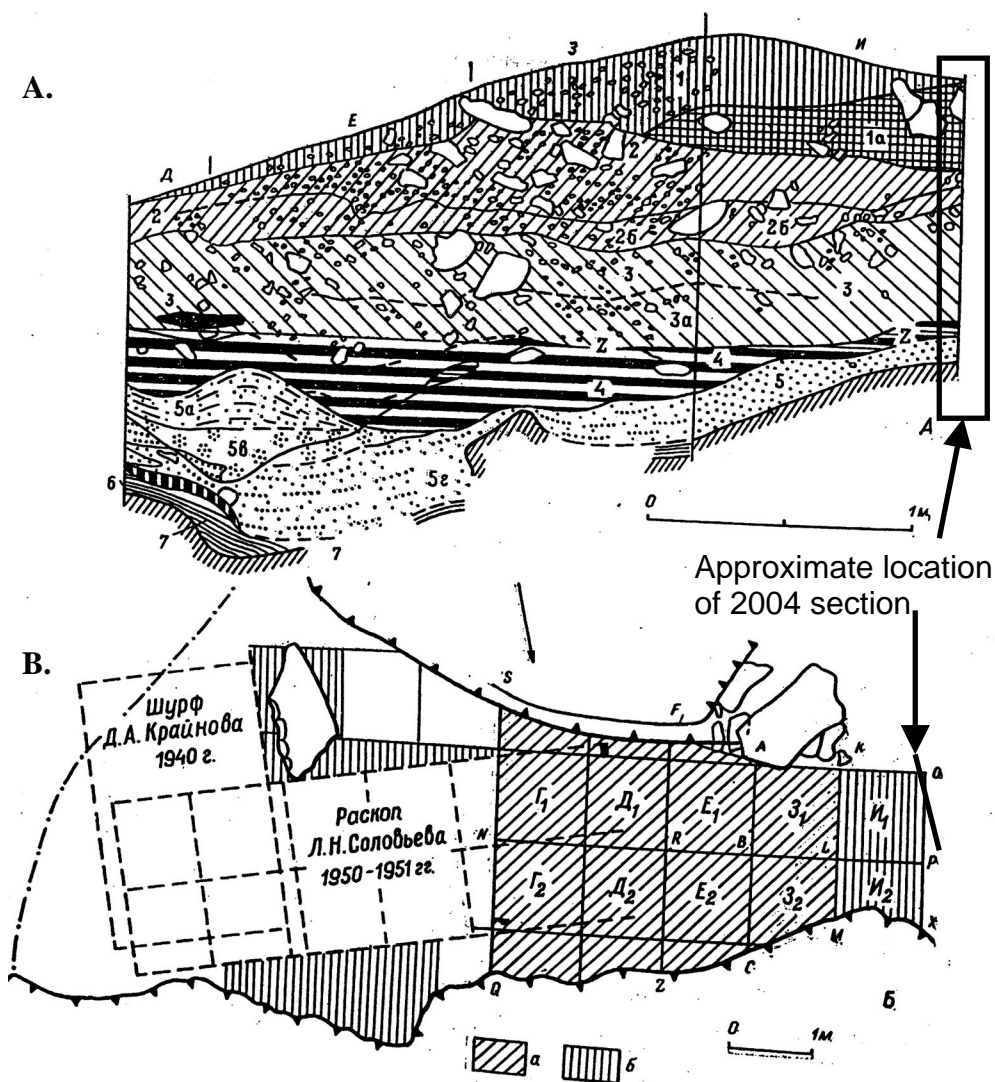Soloviev (1950-1951).

Approximate location
of 2004 section

Figure 3.5. **A**. Section R-B-L-P at Malaya Vorontsovskaya. **B**. Plan of Malaya
Vorontsovskaya cave showing previously excavated areas, with approximate location
of the section sampled in the present project (Figure 3.6). Adapted from Liubin
(1989).
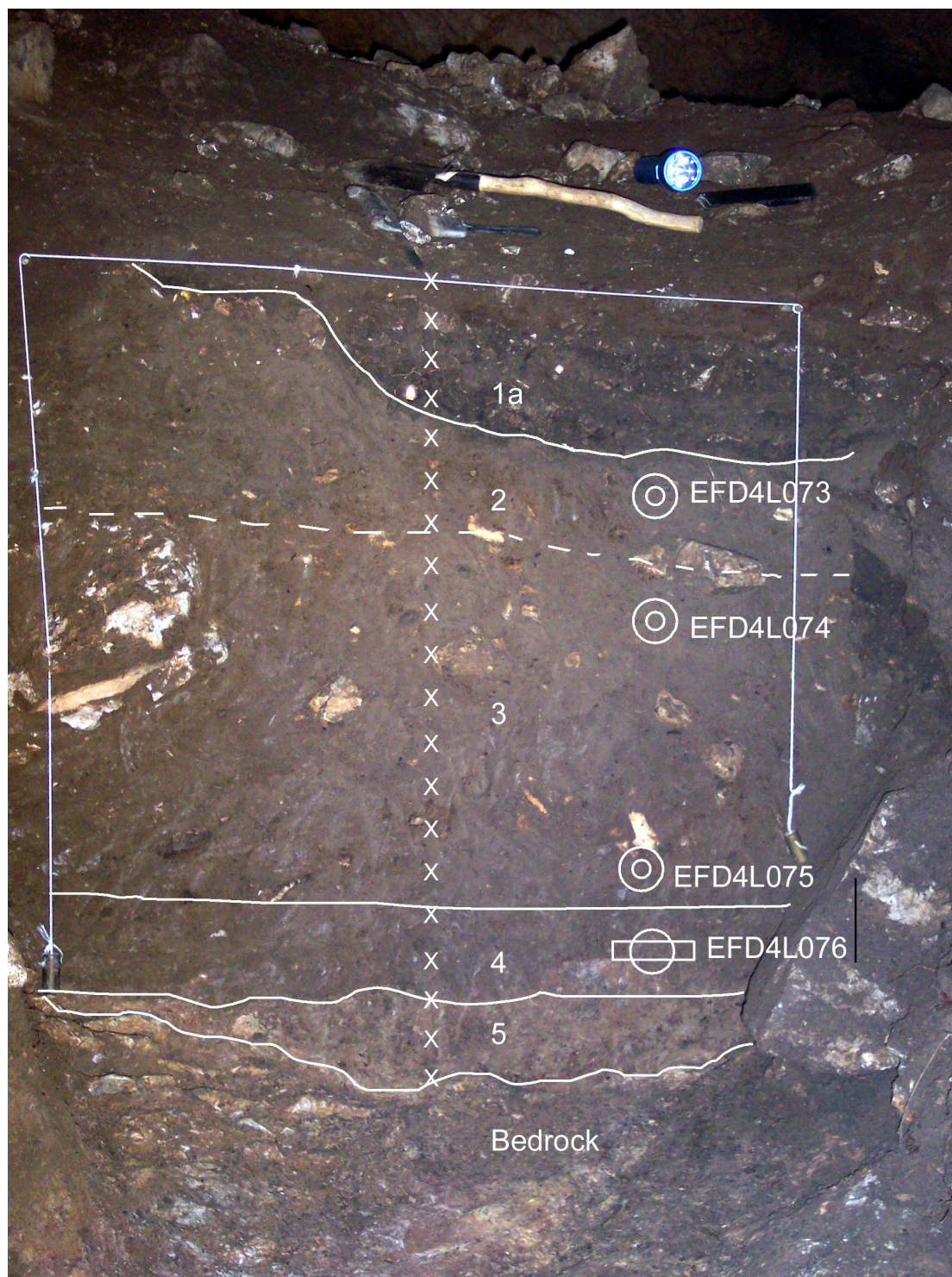
Figure 3.6. Malaya Vorontsovskaya, position of this profile approximates to Section O-P in Figure 3.5. Luminescence sampling positions are shown as circles or rectangles, representing the diameters of the sampling tubes or the sizes of the tins. Larger overlain circles indicate the diameter of the field gamma spectrometer probe. "X" marks the locations from which small bag samples of loose sediment were taken for luminescence profiling.
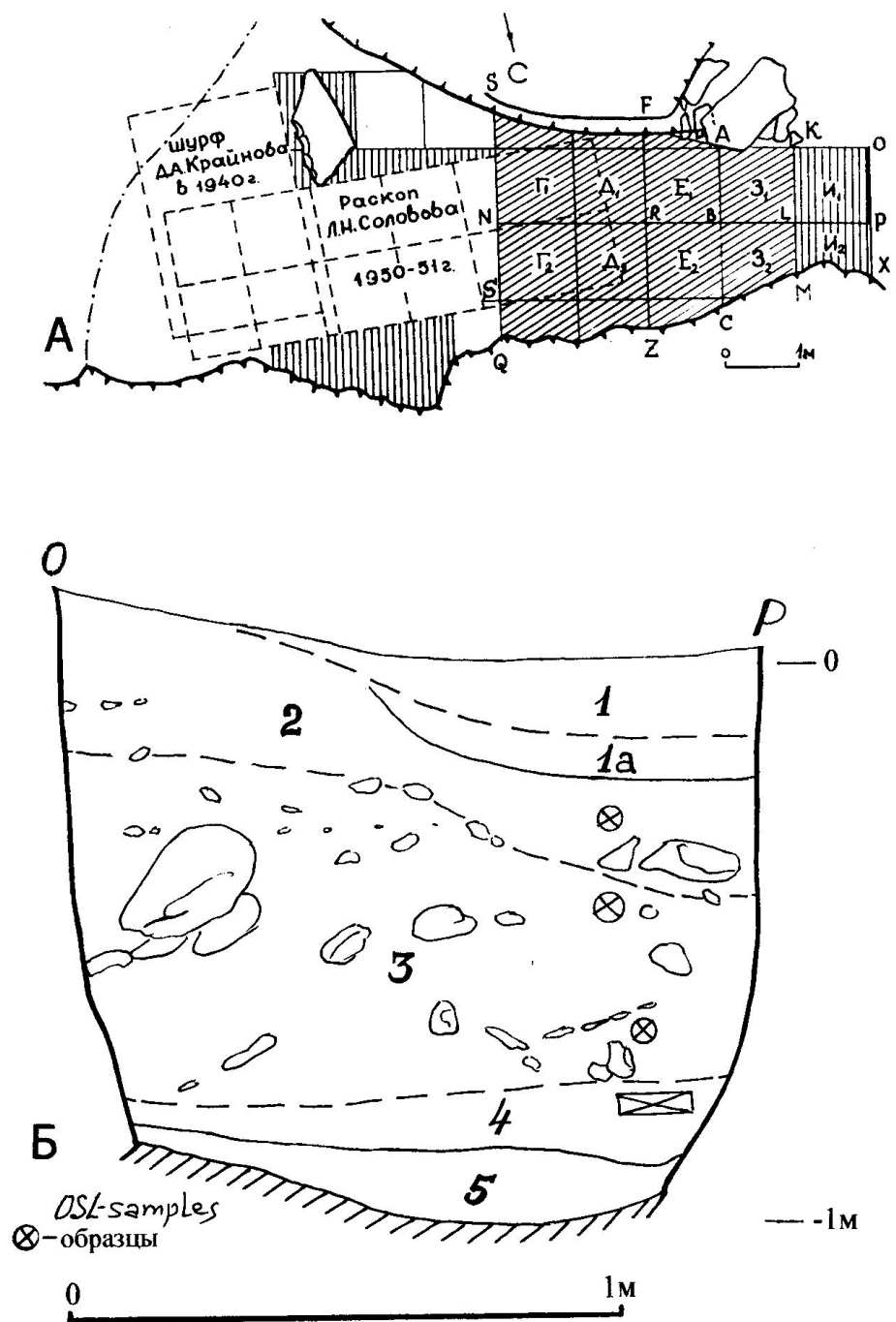
Figure 3.7. Malaya Vorontsovskaya: plan and 2004 section, with OSL sampling positions.
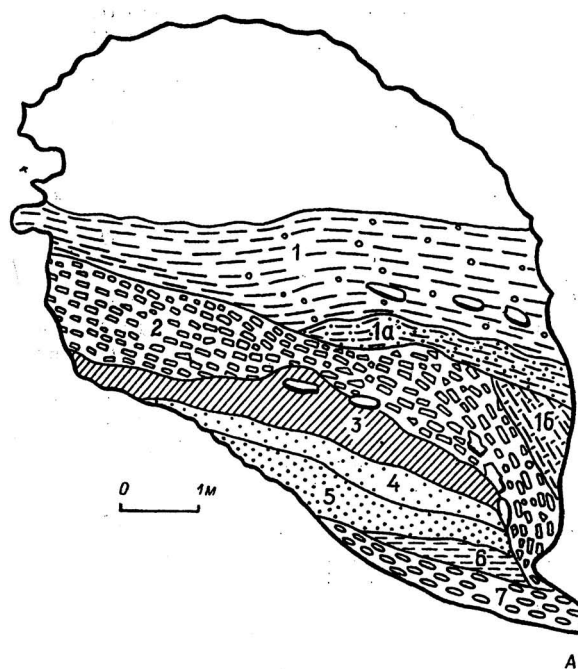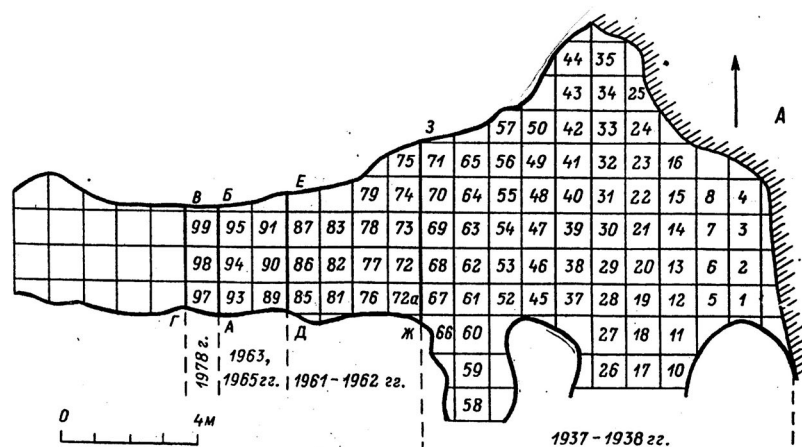
Figure 2. Section along the line Z-Zh, western edge of Zamyatnin's dig 1937-38.

Figure 3.8. **A**. Plan of Akhshtyr cave showing the previously excavated areas.

B. Section Z-Ж. Adapted from Liubin (1989).
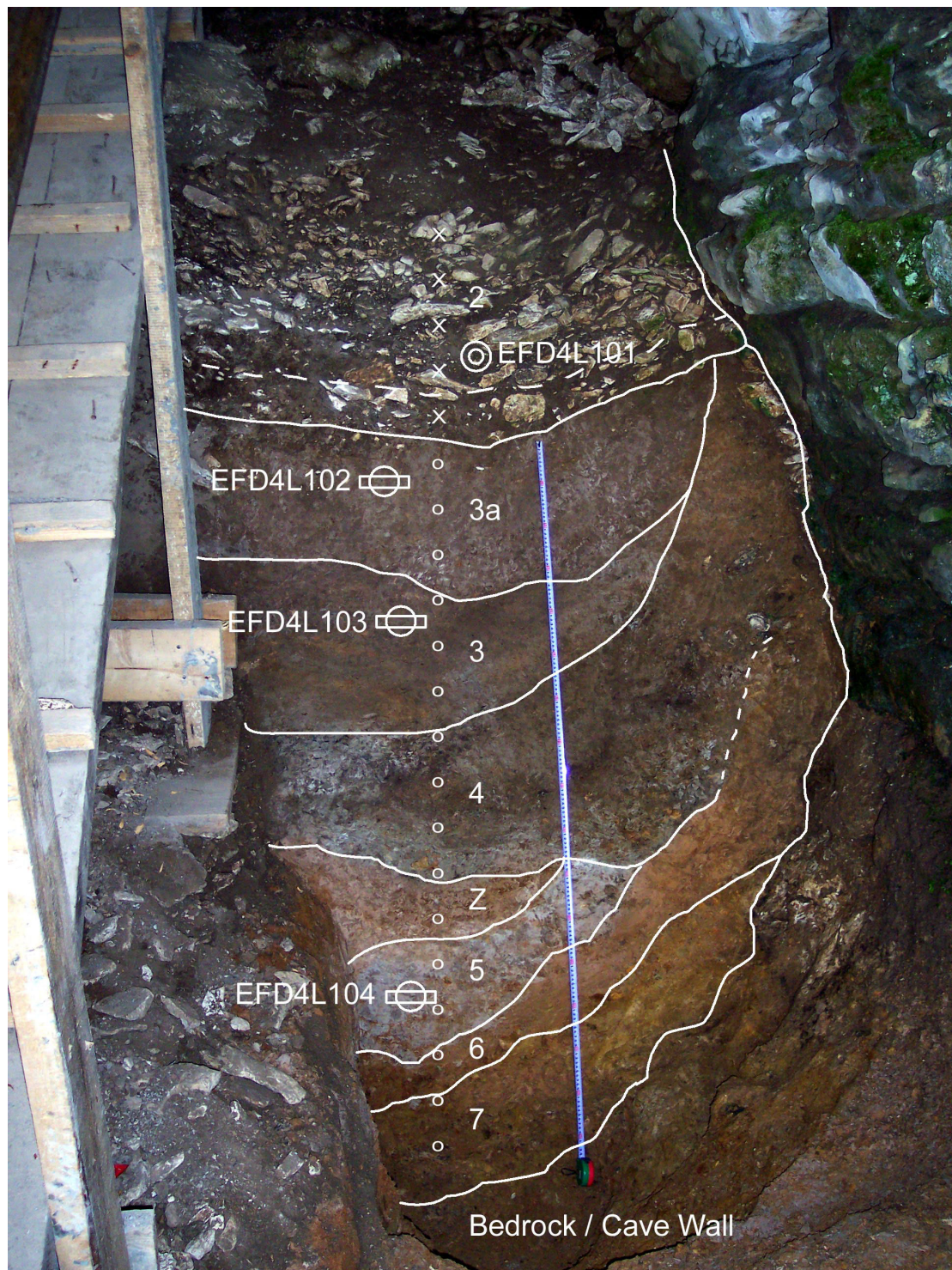
Figure 3.9. Akhshtyr, Section Γ-B, squares 99 and 100 (Figure 3.8). Luminescence sampling positions are shown as circles or rectangles, representing the diameters of the sampling tubes or the sizes of the tins. Larger overlain circles indicate the diameter of the field gamma spectrometer probe. "X" or "o" marks the locations from which small bag samples of loose sediment or small tubes of intact sediment were extracted for luminescence profiling.
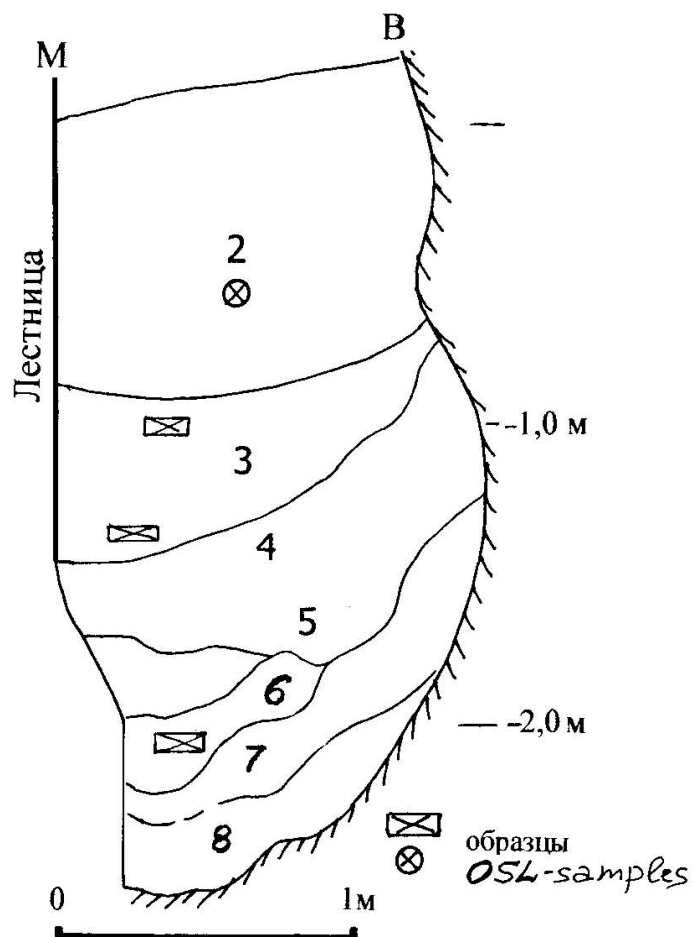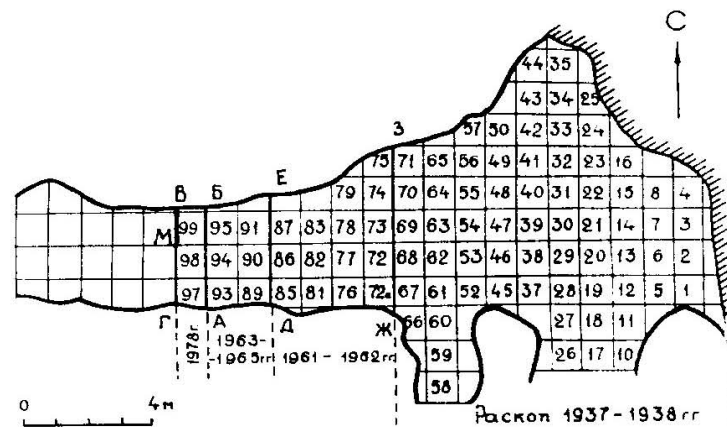
Figure 3.10. Akhshtyr: plan and 2004 section, with OSL sampling positions.
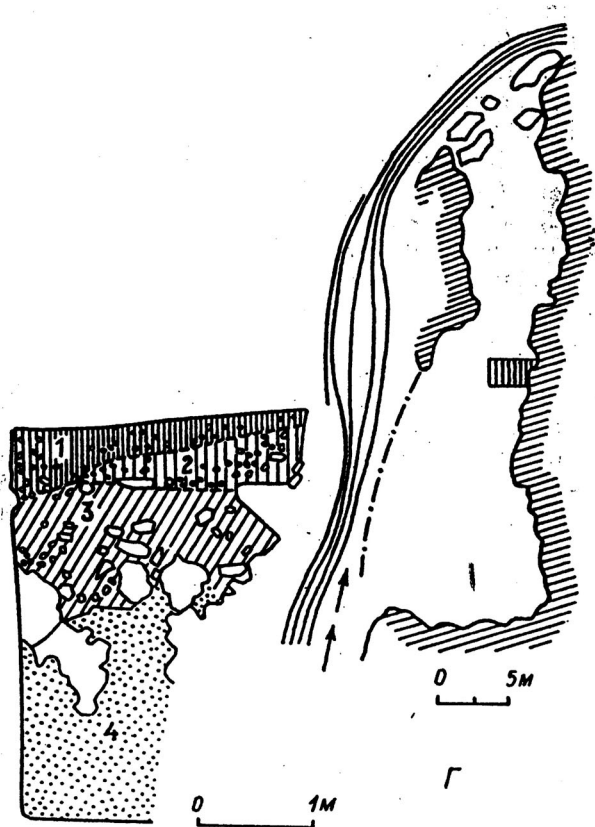
Figure 3.11. Section through the stratigraphy at, and plan of, Kepshinskaya cave. The section is equivalent to that sampled in the present project (Figure 3.12). Adapted from Liubin (1989).

Figure 3.12. Kepshinskaya. Luminescence sampling positions are shown as circles or rectangles, representing the diameters of the sampling tubes or the sizes of the tins. Larger overlain circles indicate the diameter of the field gamma spectrometer probe. "o" marks the locations from which small tubes of intact sediment were extracted for luminescence profiling.

Figure 3.13. Kepshinskaya: plan and 2004 section, with OSL sampling positions.

3.2   Luminescence samples

Luminescence dating samples were generally taken in stainless steel tubes (l = 15 cm, $\varnothing$ = 3 cm) (Appendix 3.2). The ends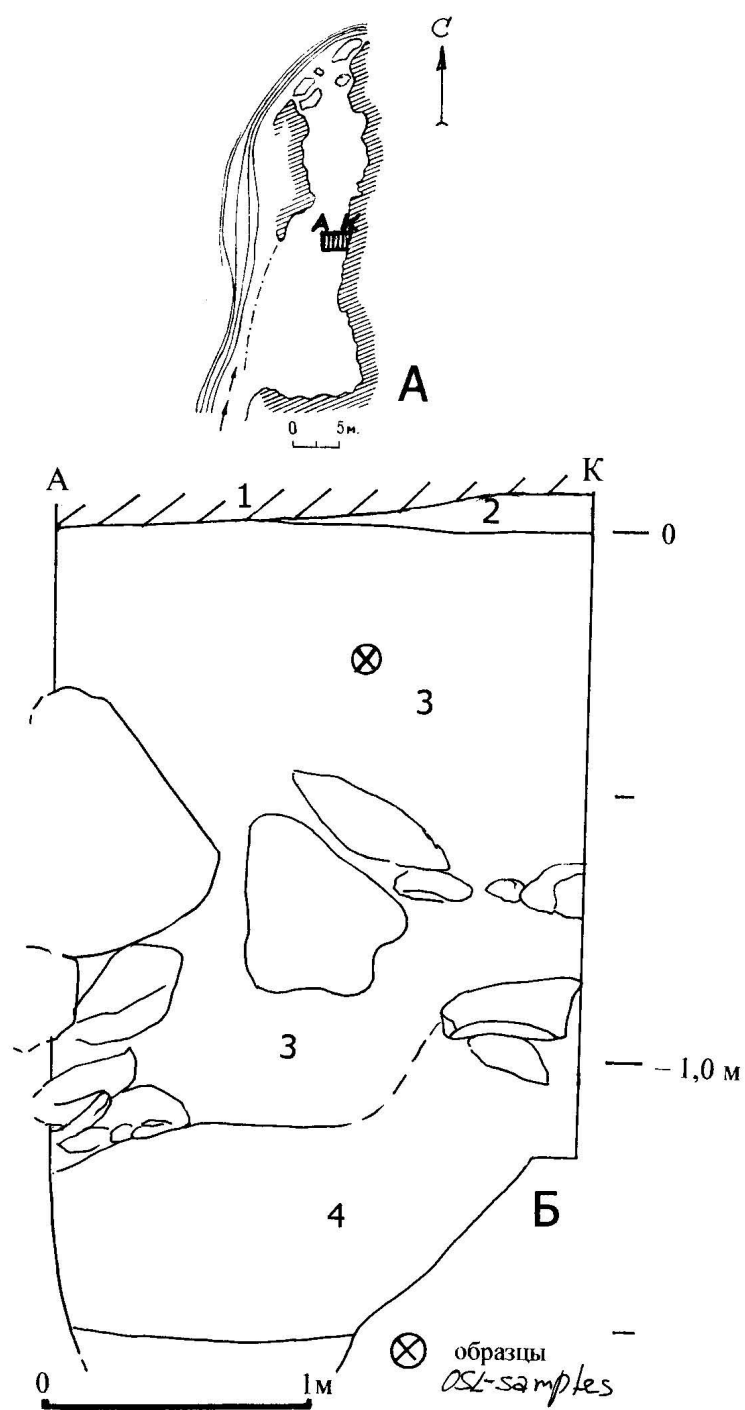 of these tubes were taped to retain the sample material and water following very brief light exposure. In softer/less stony sediments, steel kubiena style tins (12.5 x 3 x 4 cm) were sometimes used. These were particularly advantageous for sampling thin or discontinuous layers, since there was greater assurance that the sample did not cut into other layers. After extraction the tins' lids were used to scrape off the outer layers (of light exposed material) as they were placed. These were taped on to seal the samples.

The tubes/tins were then labelled and sealed in labelled zip-lock bags, with additional loose sediment for gamma spectrometry measurements in the laboratory. This sediment was collected from a 6 cm $\varnothing$ hole made around the sampling position using a larger steel "over tube". The resultant hole facilitated placement of a 2" NaI probe for field gamma dose rate measurements (Section 3.3, Appendix 3.3). The zip-lock bags were packed in groups of two or three in labelled and sealed black bags. Other samples are described individually in the text, but were all ultimately packed in labelled and sealed black bags before being packed in a larger black bag containing all samples from the site and/or region.

3.3   Gamma Spectrometry

In situ determinations of gamma dose rate were made by field gamma spectrometry at the point of sampling for all "full" luminescence-dating samples (Appendix 3.3). The measurements were conducted using a Rainbow multi-channel analyser with a 2" x 2" NaI probe. Gamma emissions were measured in the approximate range 10 – 3072 keV in 1024 channels, such that all emissions from 40K, and the U and Th decay series could be observed. These account for the vast majority of gamma radiation present in a "natural" environment. In situ "infinite medium" gamma dose rates were calculated from counts integrated above energies of 450 keV, above 1350 keV, and from the empirically corrected total energy integral. The proportion of total counts above 450 keV, and above 1350 keV, will be similar for 40K, and the U and Th decay series when they are in secular equilibrium. Thus, in a mixed field conversion from counts to dose rate can be made directly by integrating

above these energies, with little effect from variations in the relative concentrations of 40K, and the U and Th decay series. In the present study conversion was made using factors measured for another but similar instrument, which have been adopted as standard in the SUERC laboratory for 2" x 2" detector dimensions.

The field gamma spectrometry measurements were made for 10 minutes (600 s) each, which yielded counts >450 keV of between 1931 (EFD4G041, Kepshinskaya, Niche in limestone wall of cave) and 26133 (EFD4G038, Akhshtyr, Layer 5). In situ gamma dose rates were calculated by hand following field measurements, using integrated counts above Channel 150, and assuming that the instrument gain setting was correct: i.e. It had not varied since the instrument was last set such that the 40K peak (1461 keV) was at Channel 487, and channel width was thus ~3 keV. Recorded spectra were later processed using proprietary software ("Rainbow 3"), which included energy recalibration to the location of the gamma emission from 40K observed in each spectrum.

For measurement, the NaI probe was generally placed in a 6 cm diameter hole cut around each sampling point using a larger "overtube". It was not generally possible to drive the tube into the sections the "ideal" distance of 30 cm, which would ensure that no more than ~1% of the detected gamma field would come from outside the sampled section. However, hole depth and the approximate geometry of the sediments around the measurement points was assessed and recorded. It was ensured that hole depth was sufficient for the large majority (>~90%) of the detected gamma field to come from sediments in the immediate vicinity of the luminescence sampling point. The relatively enclosed nature of the sections being sampled ensured that the remainder of the field would be close to an average for the section, such that averaging effects of no more than ~3% might be expected. Since this is less than other expected sources of uncertainty, no attempt was made to correct for it. Other sources of uncertainty in the dose rates include the accuracy of the dose rate conversion factors, instrument reproducibility (over and above counting statistics), variation in water content during burial, and U-Series disequilibrium effects. The instrument related factors are currently being assessed, and the sample related factors will be assessed during later work on the samples in the laboratory. The dose rates quoted in this report should thus be regarded as preliminary, but are likely to be correct within uncertainties of ~5%.

3.4 Tephra, Magnetic Susceptibility, Sedimentary, Radiocarbon and Pollen samples

3.4.1 Tephra, Magnetic Susceptibility and Sedimentary Samples

The samples taken for tephra, magnetic susceptibility and sedimentary analysis consisted of loose sediment scraped with a knife from a cleaned prepared vertical section and placed into zip-locked polythene bags. Sampling was contiguous and normally covered 5 cm of sedimentary accumulation although this had to be adjusted on occasion to take account of layer boundaries in order to avoid mixing material from separate units. During sampling the larger clasts were generally excluded in favour of fine-grained sediment, since the latter was deemed more suitable for the intended analyses.

3.4.2 Radiocarbon samples

Sampling for radiocarbon was constrained by the paucity of appropriate material suitable for measurement by AMS. Normally only where cultural material was prevalent in a layer was it feasible to locate good radiocarbon samples. Animal bone and charcoal were the only materials found *in situ* from clear stratigraphic horizons that were considered worth retaining for age determination. The concentration on using previously excavated sections rather than digging new areas precluded the recovery of a bigger more representative group of ^{14}C samples. It proved necessary to separate the charcoal from the enclosing sediment by laboratory wet sieving. However, beyond this no treatment was applied to the ^{14}C samples.

3.4.3 Pollen samples

Within this project sampling for pollen was, in general, limited since most of the sites had already been palynologically studied and it was felt that there was little need, or resource, to duplicate the earlier findings. However, because the sections we were sampling were commonly not those that had been palynologically studied, it was deemed advantageous to take new samples in order to permit correlation of the OSL determinations with the proxy environmental and climate pollen data. With this in mind individual zip-locked polythene bags of sediment were recovered from around the locations where the OSL steel tube samples were sited.

3.5   Pre sampling site reviews (by P. Allsworth-Jones)

3.5.1   Navalishinskaya

Summary in Liubin (1989). A karst cave on the right bank of the canyon formed by the river Kudepsta, at the locality known as Shirokii Pokos, south of the village of Krasnovol'sk in the Sochi region of the Krasnodar district. 10-12 km from the sea. 200 metres above sea level, about 100 metres relative height. Two entrances, two parallel 30 metre long galleries, joined by a stalactite passage 8 x 8 metres in extent. The northern main entrance and the southern small entrance both face east. The main gallery at the front is 4 metres high and 5 metres wide. The maximum thickness of deposits in this gallery is 2.5 metres.

The site was discovered by M.Z. Panichkina in 1936. She put down a test pit at the entrance to the main gallery. Also in 1936 S.N. Zamyatnin dug in two places in the main gallery. (1) a test pit (1x2 metres) in the mid part. (2) a trench (22 square metres) in the entrance part. In 1965 V.P. Liubin excavated 5.5 square metres adjoining the western wall of Zamyatnin's trench. The entire excavated area amounts to 29.5 square metres.

The situation of the trenches in the main gallery is shown in the attached diagram (A). Liubin's stratigraphy is also shown here (top right and B). Reports on the site quoted are Zamyatnin (1940, 1950, 1961), Liubin (1966, 1968), and Liubin and Shchelinskii (1967). In addition, further information is provided by Chistyakov (1996, 95-98), and he quotes two more articles which are relevant, Grichuk et al. (1970) and Muratov and Fridenberg (1974).

3.5.1.1   Stratigraphy

According to Zamyatnin the succession was as follows.

(1) Black-brown clay with rubble. 50-90 cm.
(2) Brown clay with rubble, divided by three ash lenses (a-b-c). 70cm-1.1 m.
The lower part of lens b was heavily brecciated, and the bones were dark and mineralised.

Layer 1 was Upper Palaeolithic, layer 2 Middle Palaeolithic.

According to Liubin the succession was as follows.

(1) and (1a) grey-brown loams with sharp-edged rubble. Up to 95 cm. (No mention is made of the uppermost deposits, labelled BC, probably means 'upper levels', non-palaeolithic).

(2) Greenish-grey loam with a yellowish tinge, and slightly weathered rubble. 5-20 cm.

(3) Yellowish-greenish loam, with somewhat more weathered rubble. 15-40 cm.

(4) Light brown loam, with rubble. 15-47 cm.

(5) Dark brown loam, with rubble. 5-20 cm.

(6) Yellow loam, eluvial limestone horizon. Up to 10cm.

The rubble in layers 4 and 5 is more corroded, and is sometimes covered with a phosphate crust. At the base of layers 3, 4, and 5 there are black ashy lenses. Layers 1, 1a, and 2 are Upper Palaeolithic. Layers 3, 4, and 5 are Middle Palaeolithic.

Not mentioned by Liubin is a conclusion come to by Grichuk et al. (quoted in Chistyakov, 1996) that (unlike the situation in Akhshtyr and Malaya Vorontsovskaya) there was no significant water action in this cave. The proof of this is taken to be the good preservation of ash lenses in both the Upper and the Middle Palaeolithic layers.

3.5.1.2 Fauna

Determined by V.I.Gromov and N.M. Yermolova. There is an absolute predominance of cave bear throughout, 98.3%. In the Upper Palaeolithic levels, there are a few remains of Cricetus cricetus, Alces machlis, Capra sp., and Canis lupus. In the Middle Palaeolithic there is Canis lupus, Alopex lagopus (?), and Capra sp. The presence of cold loving species in Upper Palaeolithic layer 2 is not considered to be surprising in view of the pollen data from the same level, indicating a cold damp climate with an abundance of open spaces.

3.5.1.3 Palynology

Described in a report by Klapchuk (1970). Seven samples, one each from layers 1, 1a, 2, 4 and 5, two from layer 3. Pollen grains are abundant but poorly preserved. The pollen spectra indicate fluctuating climatic conditions.

Layer 5. Coniferous forests. AP: Pinus 60%, Picea 25%, Abies 13.5%. NAP: small areas were occupied by Gramineae 20%, Chenopodiaceae 10%, and Sonchus 30%.

Layer 4. Warmer and moister. Predominant taiga. AP: Abies 72.3 %, Picea 10.5%. Increased alder and hazel. NAP: reduced role of Gramineae 12.8%, increased role of Compositae (Sonchus, Cirsium, Artemisia, etc.).

Layer 3. Warmer, relatively dry. Area occupied by taiga somewhat reduced. AP: deciduous trees appear (oak 2.1-7.8%, hornbeam 3.9-6.2%, lime 10.4-13.7%). NAP: open areas occupied by Compositae, rare Caryophyllaceae.

Layer 2. Moister and colder. AP: indicated by peaks of Abies and Picea, and disappearance of deciduous species. NAP: Compositae.

Layers 1 and 1a. Cold and dry. No AP (Pinus grains could be brought in from far away) NAP represented by Sonchus.

3.5.1.4 Archaeology

Poor assemblages in all layers. Indicates short lived occupations. Middle Palaeolithic can be preliminarily described as Denticulate Mousterian. The large number of denticulates in the Upper Palaeolithic requires examination, to determine whether these are due to cultural or natural factors.

3.5.1.5 Chronology and Palaeogeography

Liubin suggests that there is a significant chronological gap between the Middle and Upper Palaeolithic layers. This is indicated by the existence of pockets at the top of layer 3, the lens-like interrupted nature of layer 2, and the rounding of the rubble in layer 2. The pollen diagrams indicate perhaps two cold maxima in the last glaciation, during which the vegetation zones in the Sochi Black Sea coast area were lowered by 1200-1400 metres (the Picea-Abies woods at present are at a height of 1200-1900 metres). The abundance of exfoliated rubble in all levels can be explained by the instability of the local slab-like limestone, the passage-like character of the cave, and the climatic conditions prevailing during the last glacial period, when there was intense frost weathering of the roof and walls of the cave. In Liubin's view, the hostile environment of the last glacial period is also indicated by the thin ash lenses which (he agrees) were present at the base of all the Middle Palaeolithic layers. The cave was visited briefly from time to time, as shown by the poverty of the lithic assemblages. These were temporary camps of cave bear hunters, and when they were present the people were obliged to keep fires going all the while.

Liubin makes no mention of a radiocarbon date for layer 3 of 20,600+/-650 BP (from the IIMK RAN laboratory) (Muratov and Fridenberg 1974, quoted in Chistyakov 1996), presumably because he believes it must be too young.

3.5.1.6 The 2004 sampling strategy in relation to stratigraphy

In 2004 a new section was prepared at the back of the cave, corresponding to part of the line Q-Z as excavated by Liubin in 1965. The layer numbering used was as in Liubin's summary (1989).

first version 20 June 2004; revised 17 August 2005.
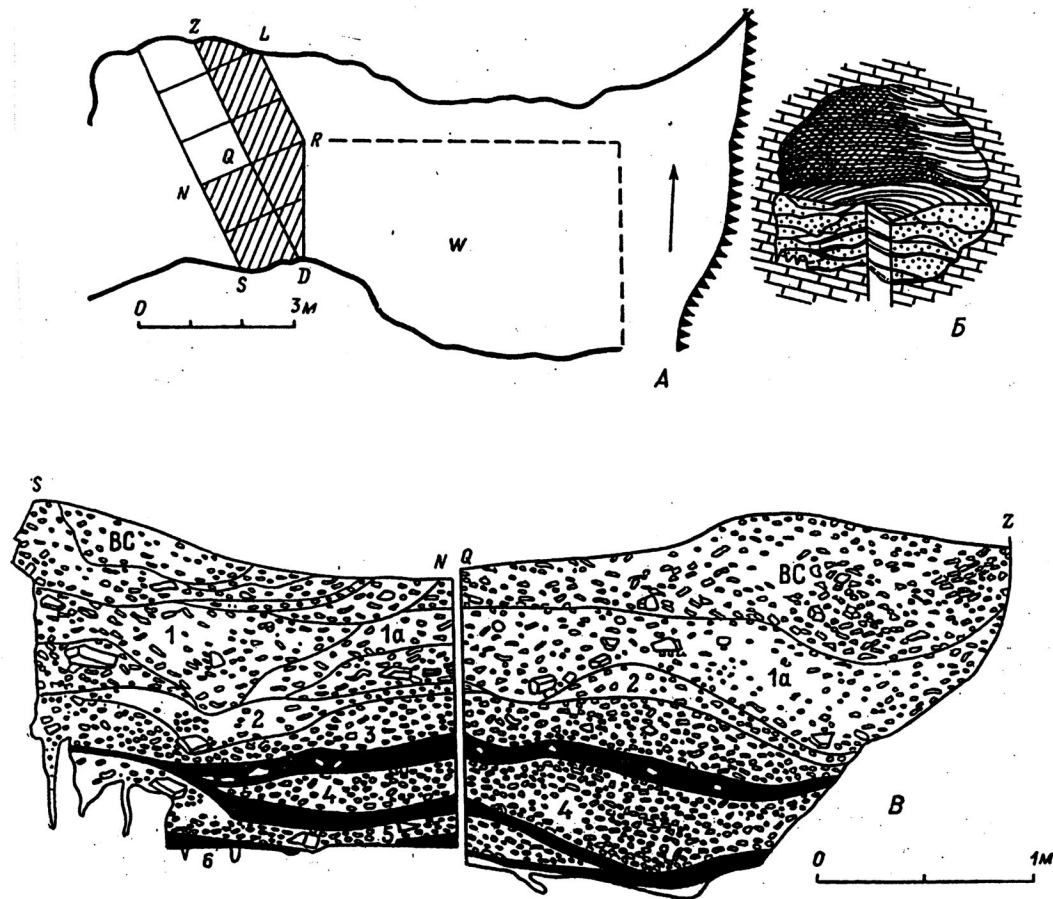
A. Top left. This shows the plan of the entrance to the main northern gallery.
W = Zamyatnin's excavation of 1936. N-Q-Z-L-R-D-S = Liubin's excavation of
1965. Top right = A transverse view of the main gallery at the point where the
excavations of 1936 were carried out (i.e. facing west).
B. Transverse section along the lines S-N and Q-Z of Liubin's excavation of 1965
(i.e. facing west).

Figure 3.14. Navalishinskaya plan and section

Nava Lishenskaya Cave
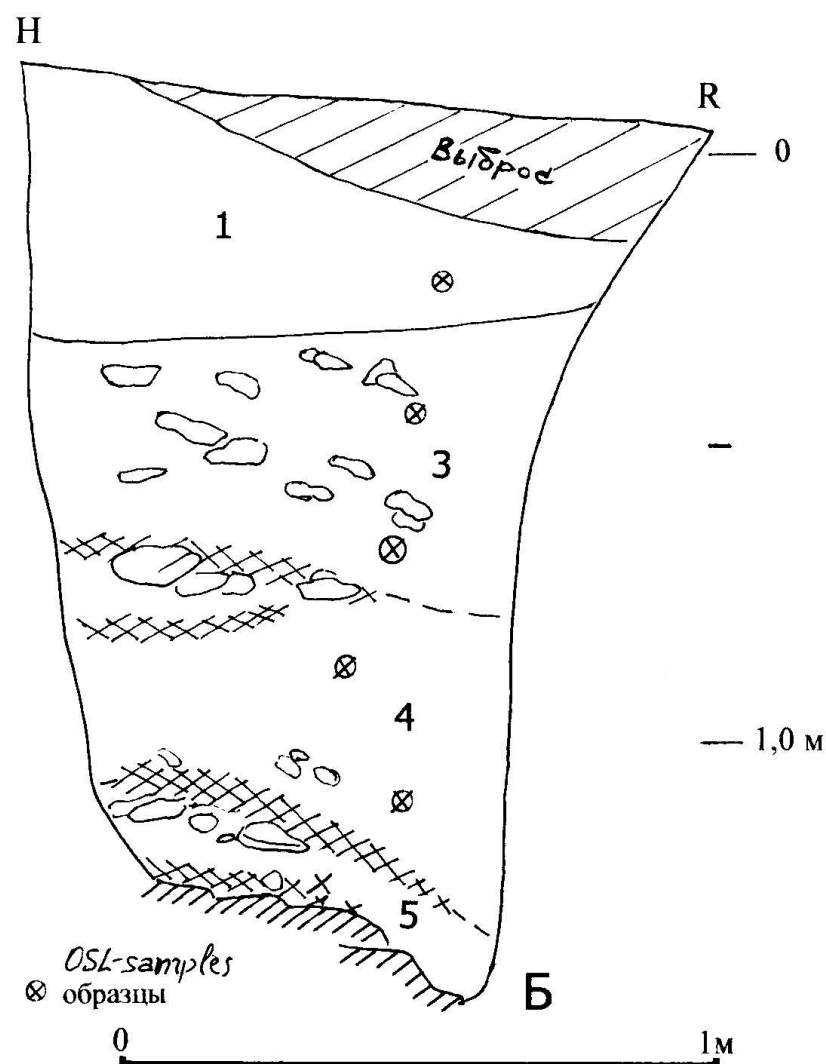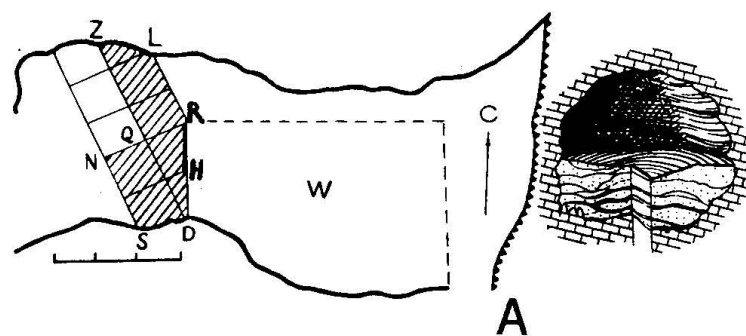
Рис. 13. Навалишенская пещера: А – План пещеры с указанием разреза R-H, откуда брались образцы; Б – Разрез R-H с указанием точек взятия образцов

Figure 3.15. Navalishinskaya, 2004 section with OSL sample positions

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3.5.2   Malaya Vorontsovskaya

Summary in Liubin (1989). Reports on the site quoted are Krainov (1947), Soloviev (1956), Liubin (1965, 1966), Liubin and Soloviev (1971), Chistyakov (1986), Liubin and Chistyakov (1985), Muratov and Fridenberg (1984), and Semenov (1972).

Since then Chistyakov's book on "The Mousterian Sites of the North-eastern Part of the Black Sea Region" has been published (1996), as well as a new palynological analysis by G.M. Levkovskaya (1992). These works add to and modify the earlier conclusions in some respects.

This cave is in the foothills on the southern slopes of the Western Caucasus, at the southern end of the limestone ridge named Alek, on the right side of the canyon of the river Vostochnaya Khosta near its source. The site is 16 km from the sea, in the Sochi region of the Krasnodar district. Its height above sea level is 290 metres, and its relative height is 54 metres. Its entrance opens to the south-east towards the river. It was formed in limestone along the line of a tectonic fault. It has the form of a horizontal tunnel about 70 metres in length, consisting of three small halls and six galleries, the width of which varies from 2 to 8 metres, and the height from 1.5 to 6 metres. The Mousterian site in the cave was discovered in 1940 by D.A. Krainov, who excavated a test pit at the entrance (3x2 metres). L.N. Soloviev excavated a trench in 1950-51 also at the entrance (2x6 metres). V.P.Liubin carried out an excavation in 1964-65 (11 square metres near the entrance, and a 2x2 test pit in the mid part of the cave), and in 1983-84 and 1986 D.A. Chistyakov excavated a further 12.5 square metres. The position of the excavations up to 1984 is indicated on the attached plan made by Liubin and Chistyakov (Figure 3.16). A second plan was published by Chistyakov (1996, Fig. 2) and is reproduced here (Figure 3.17). The advantage of this plan is twofold. Firstly, it shows the position of the 1986 excavations, on the southern and eastern sides of Krainov's test pit (vertical hatching). Secondly, it shows in more detail the numeration for the various sections which have been drawn and described in this cave.

At the present time, 34-36 square metres of the cave have been excavated. (It should be noted that the various excavations in part overlap). The excavated area covers the gallery at the mouth of the cave and the entrance to the round hall inside. The mid and far parts of the cave have been investigated by means of test pits (in the first Liubin's 2x2 and in the second a 1x1 put down by V.M. Muratov in 1965). The thickness of the deposits varies from 1 to 1.8 metres.

3.5.2.1 Stratigraphy

Up to 1989, there were said to be 16 sections, which Liubin described as mostly incomplete, due to the methodological shortcomings of the early works, their fragmentary nature and the lack of agreement among them. Most are published. A number of factors have complicated the correlation between the sections in different areas: a marked facies differentiation of the deposits within a single horizon, the presence of a number of layers which thanks to erosion have been preserved only as remnants along the walls or lenses in erosional pockets, and the increasing complication of the stratigraphic columns the further you go from the entrance, which Liubin describes as normal in such caves. The elucidation of the relationship between the sections in the gallery at the mouth of the cave and the platform in front of the entrance has also been complicated by the absence of a single longitudinal section through the deposits, the broken up nature of the sections in this part thanks to the trenches dug in 1950-51, and a threefold change which has occurred in the numbering of the layers.

The most complete sequence has been established by Liubin and Chistyakov at the junction of the gallery at the mouth of the cave and the round hall, on the basis of the work done in 1965 and 1983. Transverse sections were drawn along the lines A-B-C, K-L-M, and O-R-X on the plan. The attached section (Figure 3.16) is the longitudinal section along the line R-B-L-P. The succession according to Liubin (1989) is as follows.

(1) humified layer, with sharp edged rubble in its mid and lower part. Includes (1a?) an ashy lens up to 35 cm thick. Overall thickness 20-45 cm.

(2) brownish-grey compact loam, up to 40 or 50% packed with rubble. Small limestone blocks, up to 10 or 20 cm in size, in places form lenses. Overall thickness 20-40 cm. Two subdivisions are described separately.

(2a) dark brownish-green lumpy loam, with less rubble, but more blocks, up to 10-35 cm in size, not present everywhere. Up to 30 cm.

(2b) greyish-brown slightly lumpy loam, practically without rubble. That which is present is rounded and sometimes has a dark brown (phosphate?) covering. 5-25 cm.

(3) yellowish-brown loam, more compact and clayey, with alternating lenses of different colours (brown, greyish-green) compactness and extent of rubble filling. In general there is not much rubble, it is rounded, and covered with a dark brown crust. 45-50 cm.

(Z) dark brown lumpy loam, sometimes with gravel coloured black with iron manganese stains. Up to 25 cm.

(Z1) finer loam, light with a violet tinge, present as lenses. Up to 25 cm.

(4) dark brown loam, compact, lumpy, with a small amount of rubble. The rubble (as in Z and Z1) is rounded and corroded. Up to 20 cm.

(5) cave alluvium. Sand, sandy loam, gravel, pebbles. Z, Z1, and 4 lie directly on 5, discordantly, filling pockets in its upper surface. (No thickness given).

(6) reddish loam lenses. Up to 17 cm.

(7) layered travertine on the floor of the cave (phosphoritic sandstone). Up to 10-20 cm. In all layers (particularly Z, Z1, and 4) there are shale pebbles which evidently come from the alluvium at the base.

Muratov and Fridenberg (1984, quoted in Liubin 1989) divide the deposits in the cave into three parts. (1) horizons 1-3 exfoliated. (2) horizon 4 exfoliated and colluvial. (3) horizons 5 and 6 alluvial. Horizon 5 (our Z, Z1, and 4) they consider due to stream action within the cave. In Liubin's view, it is difficult to agree with this, since Mousterian artefacts were found here, together with the remains of 4 food refuse dumps. In his view, the first people settled in the cave only after the water which created the alluvial deposits had ceased to flow in it.

Layer 1 contained archaeological material of different ages: above, Cherkessian pottery, below, a few Upper Palaeolithic type flints. Layers 2, 2a, 2b, 3, Z, Z1, and 4 are Mousterian. Layers 5, 6, and 7 were sterile.

In addition to this R-B-L-P profile, account should be taken of three more profiles, all near the cave entrance, since among other things they feature in Levkovskaya's revised account of the pollen record. First is the transverse section V'-U'-G' established in 1984 (Chistyakov, Fig. 10; here Figure 3.18). Second are the longitudinal and transverse sections D-Z and Z-V''-U'' obtained in 1986 (Chistyakov, Figs. 96 and 97; here Figure 3.19). The results of the excavations of 1986 are reported in Appendix 2 of Chistyakov's book, compiled by his widow Zh.K. Chistyakova (1996, pages 131-133). Broadly speaking, the last two sequences are similar to V'-U'-G', hence the latter only will be summarised here, but attention will be drawn to any significant differences which are present in the other two sections.

(I)   light grey loam, with sharp edged rubble. Mixed archaeological material, including ceramics, domestic and wild animal bones.

(II)   grey brown loam, with sharp edged rubble. Upper Mousterian layer.

Lens (α)   thin layers together forming a grey ashy deposit. Described by Soloviev as a hearth. While not totally rejecting the idea, Chistyakov is inclined to regard this as an epi-genetic alteration of layer III, not connected with human activity.

(III)   three horizons, where (1) and (3) are similar to each other and (2) is distinct. (1) and (3) are light yellow loams, packed with medium-rounded carbonate-coated rubble. (2) is a slightly darker loam, practically without rubble, but with greenish shale and sandstone pebbles.

Lens (β)   greyish yellow sandy loam without rubble. [Confusingly enough, there is a lens (α) at this point in section Z-V''-U'', described as a grey ashy and brown layered deposit, not specifically said to be the equivalent of (β)]

(IV)   dark brown loam, with very little rubble. Pebbles at the base in an alluvial matrix. Archaeological material throughout. Basal *insitu* Mousterian layer.

(V)   oblique to (IV), remnants of natural alluvial deposit, lilac-grey. A few archaeological remains at the top are regarded as displaced.

(VI)   Yellow ? eluvial deposit, only 1-2 cm thick.

"H"   **not** shown except in section D-Z, again obliquely truncated, remnants of natural alluvial deposit, light yellow loam, loose in texture.

In his account, Chistyakov emphasised that the deposits in general had undergone significant water action. This was shown for example by the refitting of an artefact from two pieces present in two different layers of the Z-V''-U'' section (1996, Fig. 104, 3 a and b).

3.5.2.2 Fauna

The fauna from layers 2-4 (excavations of 1950-51 and 1964) was studied by N.M. Yermolova, I.M.Gromov, N.I. Burchak-Abramovich, and E.A. Tsepkin. The remains are typical for food debris: small fragments of long bones, skulls, and other elements which had no nutritional value. There is a small spectrum of species represented. <u>Rodents</u>. Microtus roberti Thom.-gud. Satun. <u>Mammals</u>. Ursus spelaeus, Canis lupus, Martes sp., Cervus elaphus, Capreolus capreolus, Capra caucasica, Alces alces, Sus scrofa. <u>Birds</u>. Anas platyrhyncha L., Anas querquedula L., Aquila chrysaetos L., Pyrrhocorax pyrrhocorax L. <u>Fish</u>. Salmo trutta labrax. 95% of the bones belong to cave bear, the only other relatively frequent species being Capra caucasica.

The fauna from the lower part of layer 1 includes Ursus spelaeus, Capra caucasica, Alces alces, Pyrrhocorax, and Microtus roberti. As mentioned in Liubin and Soloviev (1971) the finds from layers Z1 and 4 also included Sus scrofa and Capreolus capreolus. The picture obtained from these studies requires filling out with the results obtained in the excavations of 1965, 1983-84, and 1986, when a more abundant material was found.

3.5.2.3 Palynology

Results were obtained by M.N. Klapchuk (1970) and G.M. Levkovskaya (as reported by Liubin 1989, without any specific reference being given). Klapchuk obtained 7 samples from section A-B-C in 1965. Levkovskaya obtained 15 samples

from section O-P-X in 1983 and 11 from section V'-U'-G' in 1984. Klapchuk's results as reported by Liubin were as follows.

(1) Layer 4 lower part. AP predominant 89%. Coniferous 65% (Abies 61%, Picea 3%, Pinus 1%). Deciduous 35% (lime 32%, oak 3%).

(2) Layer 4 upper part and layer 3. NAP 20%, AP 80%. Coniferous: Abies 91%, Pinus 3%.

(3) Layer 2a. AP 99%. Coniferous 22% (Pinus 20%, Abies 2%.) Deciduous 77% (beech 34%, hornbeam 32%, oak 8%, elm 3%, hazel, etc.).

(4) Layer 2. AP 43%. Coniferous 65% (Pinus 36%).

Levkovskaya, according to Liubin, generalised the results from all three sections (n=33) and distinguished 7 pollen horizons, which he described in summary fashion (1989, 81). Levkovskaya's general conclusion was that there were two climatic optima, divided by a phase of colder and more continental climate. Liubin was critical of these results on the grounds that she had generalised the pollen characteristics of two distinct sectors, inside and outside the cave. The sectors were in fact separated from each other by the 1950-1951 trench, and had a different layer numbering, as well as differences in their stratigraphic columns. Levkovskaya's conclusions in his view also did not take into account the characteristics of the upper part of layer 2 and the lower part of layer 1 (where, according to Klapchuk, there was a new worsening of the climate, Pinus for the first time reaching 36%).

In her new study (1992) Levkovskaya confined herself to two available sections in the outer portion of the cave, leaving aside A-B-C and O-P-X. The sections were V'-U'-G' (again) and Z-V''-U'' (Chistyakov's excavations of 1986). Since the sections are very close together, she combined the results, agreeing that they were the most representative. She distinguished ten pollen zones (from the base up) which could be amalgamated into six groups, as follows. %s refer to AP, NAP, and spores taken together. Levkovskaya emphasised that this sequence could not be regarded as final, since the interior of the cave has not been taken into account, but nonetheless a fairly comprehensive scheme is proposed.

Group 1.

Pollen zone I. Lens "H". [as already pointed out, this lens is in fact in section D-Z].
The oldest deposits in the cave.

AP dominant. Juglans regia up to 42%, Pterocarya pterocarpa up to 10%. Alnus, Taxus, Buxus, Ulmus. NAP up to 30%. A warm moist climate with prominent exotics. Probably last interglacial. **Optimum 1**.

Group 2.

Probably two phases, not homogeneous.

Pollen zone II. Layer V and base of IV.

First phase, AP 83%, NAP 17%. Alnus 52%, Taxus 18%, Quercus and Carpinus.

Second phase, AP has no deciduous species, Picea, Alnus, Betula, Pinus.

A climate colder than "H".

Pollen zone III.

Layer IV base. Pollen grains few.

Carpinus orientalis, Paliuris spina Christi. Xerophytic bushes in dry areas. G.N. Lisitsyna found charcoal of Juniperus.

Pollen zone IV.

Layer IV mid.

AP 65%, NAP 35%. Juglans regia 25%, Buxus 20%, Alnus 13%, Fraxinus 7%.

NAP dominant Cyperaceae. A warm interstadial. Some redeposition of interglacial pollen grains cannot be excluded, although the preservation conditions are uniformly good. **Optimum 2**.

Group 3.

Pollen zone IV.

Layer IV top.

AP 42%, NAP 0, spores 58%. Markedly distinct. AP has no deciduous species, mainly Picea and Pinus. Spores of mushrooms indicate that the cave floor was damp. The predominance of 'dark' coniferous species shows that that this was a moist cold climate, with a mean annual temperature >3.5°C colder than present.

Pollen zone V.

Lens (β) Layer III (3). Similar in some ways to zone IV.

AP 36%, with coniferous and deciduous species. Pinus, Fagus, Ulmus, Quercus, Tilia, Carpinus, Zelcova. NAP dominant Polypodiaceae and Cyperaceae, plus Compositae and Gramineae. Some pollen and spores are indicative of damp meadows, Sanguisorba, Sphagnum, Myriophyllum.

G.N. Lisitsyna found charcoal of Pinus and Fraxinus.

The presence of deciduous trees indicates some improvement. A moist cool interstadial. **Optimum 3**.

Pollen zone VI.

Layer III (2). Base of layer only. Not unlike top part of V.

AP 33%, dominant 'dark' coniferous species, no deciduous. Spores mainly mushroom. A climatic worsening indicated.

The group as a whole is compared with a phase recognised at the Dzigutsky peat bog in the Sukhumi region, when the 'dark' coniferous belt occupied quite a low altitude. The age of this phase is estimated at about 47-38,000 BP.

Group 4.

Pollen zone VII.

Layer III (1).

AP 14.4%, including dwarf species, NAP 25.6%, spores 60%, mainly mushroom.

NAP Gramineae, Cyperaceae, Ranunculaceae, Myriophyllum.

A sub-Alpine climate is indicated.

Still on the basis of a comparison to Dzigutsky, it is suggested that this phase can be dated to around 38-35,000 BP. There is a radiocarbon date of 35,470+/-590 BP (LU-545) in the corresponding level at Dzigutsky, which would compare well with the date from layer III in section F-R-Z at Malaya Vorontsovskaya.

Group 5.

Pollen zone VIII.

Lens (α). A sharp boundary between this and the preceding pollen zone.

AP 75%, deciduous 20%, 'dark' coniferous 14%. A varied spectrum, including dominant Corylus and Tilia, plus Abies, Picea, Carpinus, Carpinus orientalis, Quercus, Castanea, Staphylea, Acer, Ostrya, and rare Juglans.

NAP dominant Asteracea and Chenopodiaceae, later varia.

Two phases can be discerned in what was a moderately warm interstadial. In the first deciduous AP exceeded Abies, in the second the roles were reversed.

It is suggested that this phase is equivalent to Klapchuk's layer 2a inside the cave, and that chronologically it might cover the period from about 32 to 28,000 BP.

Optimum 4.

Group 6.

Pollen zone IX.

Layer 2. Another sharp boundary between this and the preceding pollen zone.

AP 18.2%, NAP 9.2%?, spores 72.6%, mainly mushroom, also Woodsia.

AP mainly deciduous, including Tilia, Fagus, Quercus, Corylus, plus Alnus, Betula, and Juniper.

NAP dominant Liliaceae, including Verbascum thapsus and Armeria.

G.N. Lisitsyna found charcoal of Juniper, Pinus, and Ulmus.

A cold stage.

Pollen zone X.

Layer 1.

AP, dominant deciduous, including Carpinus, Ulmus, Quercus, Fagus, Corylus, plus Alnus, Betula, Buxus, Ligustrum, and Jasminum.

NAP dominant varia, including Liliaceae, Compositae, and Campanula.

Many mushroom spores again, plus Polypodiaceae.

G.N. Lisitsyna found charcoal of Pinus.

In general, similar to the preceding phase, but more wooded. Suggested to date to about 14,000 BP, on the basis of the radiocarbon date from layer 1 in section K-L-M.

3.5.2.4 Archaeology

3666 artefacts from 1950-1951, 1964-1965, 1983-1984; 434 more found in 1986. Raw material: flint 76.2%, plus shale, limestone, and cemented silt (alevrolit). Most tools (88.6%) are small (up to 5 cm) which may be explained by a severe lack of raw material, and therefore much utilisation and re-utilisation. Some of the artefacts also show signs of natural damage including pseudo-retouch and polishing. Liubin and Soloviev (1971) have characterised the industry in all layers as a Denticulate

Mousterian, whereas Chistyakov calls it a Typical Mousterian with many denticulates. Not Levallois. IR=35-45.

3.5.2.5   Palaeogeography and dating

Liubin comments that the stratigraphic data indicate repeated changes in the natural environment. The cave was situated at different times in deciduous and then in coniferous woods, then at the boundary of wooded and sub-Alpine zones. Today it is in the lower part of the moist sub-tropical Kolkhid wooded zone, and the coniferous zone begins at a height of 900-1000 metres, hence one can speak of important shifts in the zones over time.

There are two radiocarbon dates. (1) LE-700 14,100 +/- 100 BP. Charcoal from a hearth in layer 1, section K-L-M. (2) GR-6031 35,680 +/- 480 BP. Burnt bone from a hearth in layer 3, section F-RZ-Z.

2004 sampling strategy in relation to stratigraphy.

Samples were taken from the O-P-X section at the back of the cave, in a position approximating to the line O-P. The layer numbering follows that of the longitudinal section R-B-L-P, with the exclusion of layer Z.

first version 21 June 2004; revised 16 August 2005.

3.5.2.6   Note

Liubin (1989) summarised Levkovskaya's results as follows. She had generalised the results from three sections (n=33) and distinguished 7 pollen horizons. This account has been superseded by the new results from V'-U'-G' and Z-V''-U''. But since the 1989 version was the one that was available in the field in 2004 reference is made to it in the luminescence forms and so it is included here for clarity.

(1)   Layer IV at the base of the V'-U'-G' section, lens 'beta', alluvial layer V). A few grains of xerophilic plants (*Paliuris* cf. *spina* Christi Mill.) and hornbeam (*Carpinus* cf. *orientalis* Mill.).

(2)   The base of the A-B-C section, layers III 1 and 2 of the V'-U'-G' section, layer Z2 of the O-P-X section. Coniferous AP is predominant. There is the suggestion that the base of the horizon corresponds to the mid part of the coniferous zone, whereas the top of the horizon corresponds to the upper part of the zone.

(3)   Layer 3 of the O-P-X section, layer III 1 of the V'-U'-G' section, the mid part of the A-B-C section. Further cooling and drying. Significant area occupied by Gramineae-Cyperaceae meadows; *Abies-Picea* and *Pinus* woods with some hazel and scattered birch; deciduous trees in favourable niches. Probably conditions correspond to the boundary between the wooded and the sub-Alpine zones.

(4)   Lenses 'alpha' and 'beta' of the V'-U'-G' section, the upper third of the A-B-C section. Expansion of deciduous woods (up to 48%), *Abies* about the same, and much hazel. Conditions correspond to the upper part of the wooded zone.

(5)   Layer II of the V'-U'-G' section, layer 2a of the A-B-C section. Corresponds to the deciduous wooded zone, no coniferous represented. 56% beech, hornbeam, oak, etc.

(6)   Layer I (of the V'-U'-G' section?). Similar to the foregoing, but birch appears (up to 30%).

(7)   Layers 1 and 2 of the O-P-X section. Few pollen grains, evidently mixed.

Malaya Vorontsovskaya cave (according to Liubin and Chistyakov). A: longitudinal section along the line R-B-L-P. B: Plan of the mouth of the cave. (a) (diagonal hatching) 1964-1965 excavation. (b) (vertical hatching) 1983-1984 excavation. On the left hand side (on the platform) are the areas excavated by Krainov (1940) and Soloviev (1950-1951).
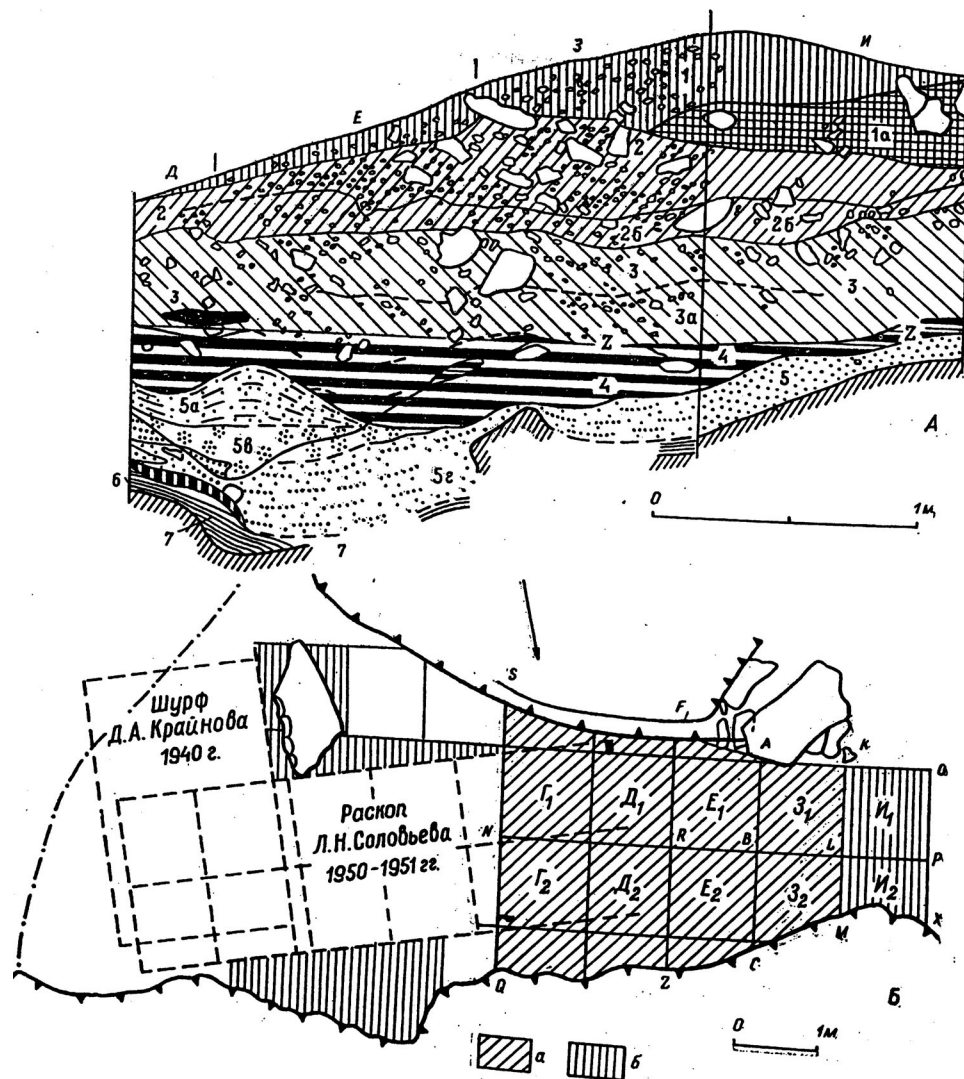
Figure 3.16. Malaya Vorontsovskaya plan and section according to Liubin and Chistyakov
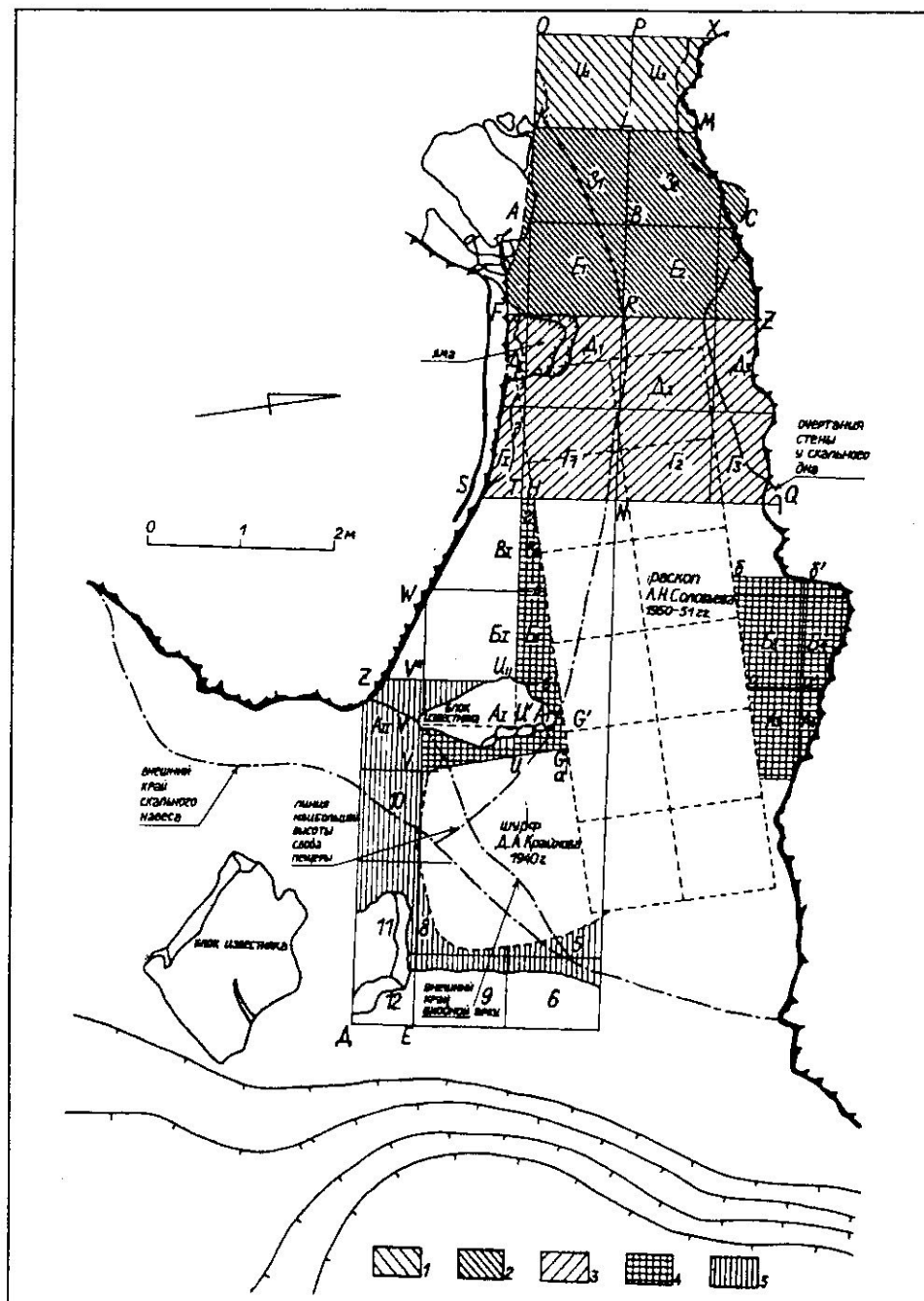
Рис.2. Малая Воронцовская пещера. План. 1 - раскоп 1983г., 2 - раскоп
1965 г., 3 - раскоп 1964 г., 4 - раскоп 1984 г., 5 - раскоп 1986 г.
Fig. 2. Plan of the Malaya Vorontsovskaya cave. 1 - zone excavated in 1983, 2 -
965, 3 - 1964, 4 - 1984, 5 - 1986

Figure 3.17. Malaya Vorontsovskaya plan after Chistyakov (1996)

150
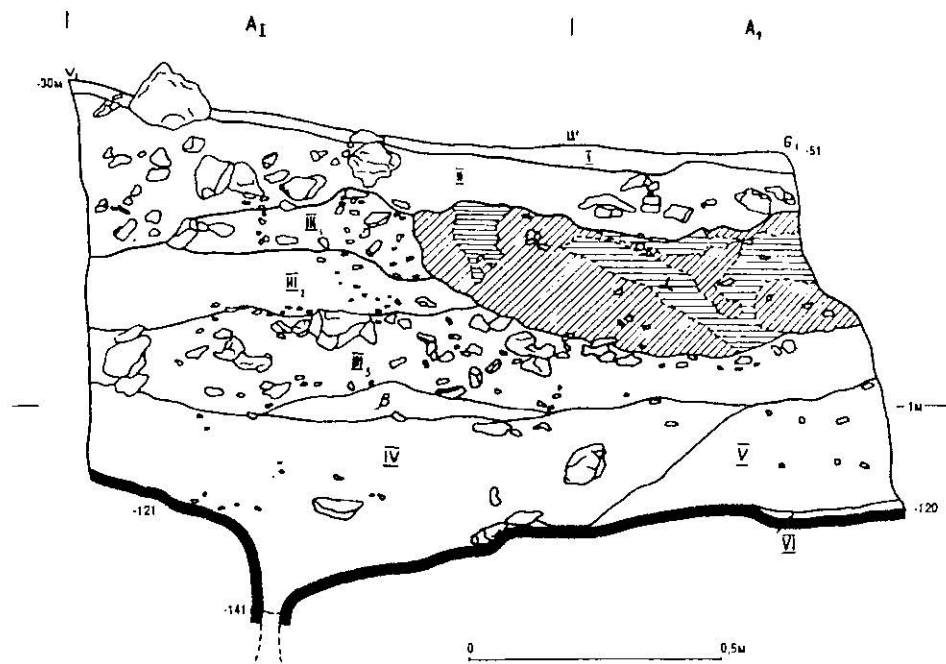
Рис. 10. Малая Воронцовская пещера. Поперечный разрез V'-U'-G'.
Fig. 10. Malaya Vorontsovskaya cave. Cross-section V'-U'-G'.

Figure 3.18. Malaya Vorontsovskaya section V'-U'-G' after Chistyakov (1996)
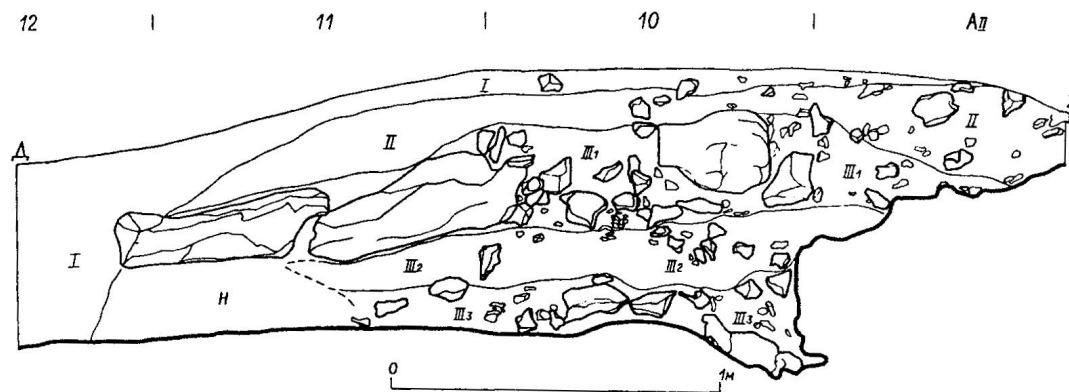
Рис. 96. Малая Воронцовская пещера. Раскоп 1986 г. Продольный разрез DZ.
Fig. 96. Malaya Vorontsovskaya cave. Zone excavated in 1986. Longitudinal section DZ.
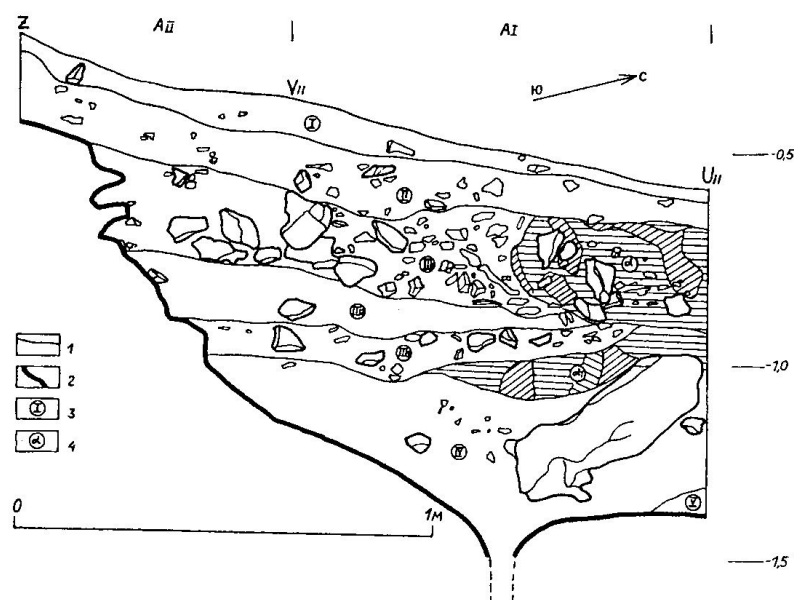
Рис. 97. Малая Воронцовская пещера. Раскоп 1986 г. Поперечный разрез Z - V''- U'' . 1 - границы между слоями, 2 - скальный пол, 3 - обозначение слоев, 4 - обозначение линз.
Fig. 97. Malaya Vorontsovskaya cave. Zone excavated in 1986. Cross-section Z-V''-U''. 1 - boundaries between layers, 2 - rock floor, 3 - designation of layers, 4 - designation of lenses.

Figure 3.19. Malaya Vorontstovskaya sections DZ and Z-V''-U'' after Chistyakov (1996)

Malaya
Vorontsovskaya Cave
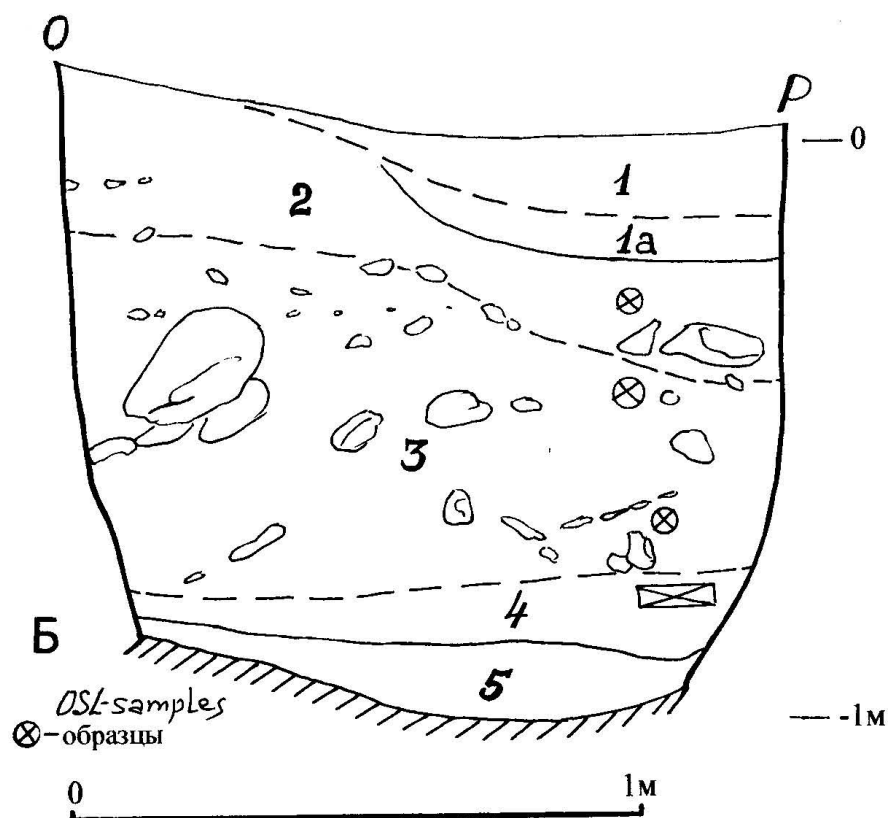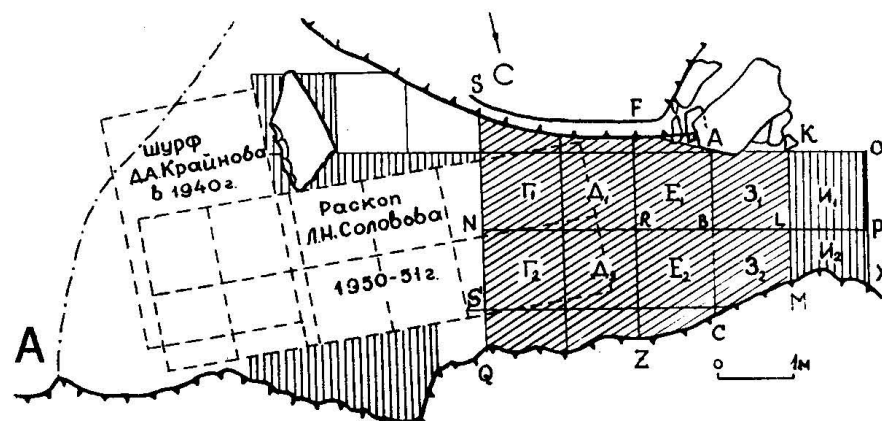
Рис. 12. Малая Воронцовская пещера: А – План пещеры с указанием разреза N-S, откуда брались образцы; Б – Разрез N-S с указанием точек взятия образцов

Figure 3.20. Malaya Vorontsovskaya, 2004 section with OSL sample positions

3.5.3   Akhshtyr

Summary by Liubin (1989).   Sources quoted by him include Gromov (1948), Zamyatnin (1940, 1950, 1961), Panichkina and Vekilova (1962), Vekilova (1966, 1967, 1973), Grishchenko (1971), Vekilova and Grishchenko (1972), Vekilova et al. (1978), Grichuk et al. (1970), Vekilova and Zubov (1972), Zubov (1978), Zelikson and Gubonina (1985), Chistyakov (1985), Cherdyntsev, Kazachevskii, and Kuzmina (1965), and Cherdyntsev, Alexeev, and Kind (1965).

Chistyakov's book on "The Mousterian Sites of the North-eastern Part of the Black Sea Region" was published subsequently (1996).   Liubin refers to the work of Muratov and Fridenberg as summarised in Vekilova et al. (1978), but reference should also be made to their earlier article, in which they compared Akhshtyr to other sites in the Western Caucasus (Muratov and Fridenberg, 1974).

The site is a   karst cave of corridor type on the southern edge of the Akhshtyr anticline, in the canyon of the river Mzymta, at a height of 120 metres above the level of the river.   15 km from the sea, about 300 metres above sea level.   The cave is located in slab-like Carboniferous limestone.   Maximum thickness of deposits 5-6 metres.   The 160 metres long axis of the cave is oriented west-east, and there is a steep slope to the river 2-5 metres from the present day drip line.   Entry to the cave is possible only via two passages in the southern wall of its 10 metre wide mouth (see Figure 3.21).   The height of the cave here prior to excavation was 1.5-2.0 metres.   It is the driest, lightest, and most roomy part of the site.   In the main corridor the cave narrows sharply to 3-5 metres in width, and becomes damp and dark.   In the past, judging by the extension of the Lower Mousterian horizon beyond the bounds of the present day drip line, the cave will have been longer (Zamyatnin, 1961, table XLVI).

The Mousterian site in the cave was discovered by M.Z. Panichkina, who dug a test pit here in 1936.   In 1937-1938 S.N. Zamyatnin fully excavated the entrance part to an extent of 80 square metres.   In 1961 Panichkina and E.A. Vekilova began excavations in the main corridor, which were carried on by Vekilova alone in 1962-1963 and 1965.   About 40 square metres were excavated at this time (see Figure 3.21).   In 1978

at the time of the Franco-Soviet seminar a further 1x3 metre wide section was added inside the cave (Vekilova et al., 1978, pages 37-48).

3.5.3.1 Stratigraphy and lithology

At present, 9 sections have been published, by Gromov, Zamyatnin, Vekilova and Grishchenko, Muratov and Fridenberg. The number of layers distinguished varies from 2-3 (entrance passages) to 5 (before the slope to the river) to 15 (main corridor). The first descriptions were given by Zamyatnin and Gromov. Zamyatnin's section Zh-Z is at Figure 3.21.

1. Humus and ash layer, 1.3 m. (up to 2.5 m at the drip line, practically disappears in the main gallery). Mediaeval.
2. Brown with rubble, 0.6-1.0 m. (subdivided into 2a, 2, 2b). 2a Neolithic, 2 sterile, 2b Upper Palaeolithic.
3. Yellow clay, compact, lumpy, with a little rubble and fallen slabs of travertine, 0.4-0.5 m. (clay lumps and bones covered with a black coating). Upper Mousterian.
4. Violet brown clay, compact, 0.3-0.4 m. Sterile.
5. Yellow clay, calcareous, with a large amount of rubble at the entrance and a little in the main corridor, 0.3-0.6 m. Lower Mousterian.
6. Grey green clay, silty, compact, with pebbles, 0.2 m. In the upper part a few Mousterian finds.
7. Ochre yellow clay, with crystal and schist pebbles, brought in by the Mzymta, 0.2-0.4 m. Sterile. Layers 6 and 7 present only in depressions in the floor.

The excavations of Panichkina and Vekilova in 1961 produced a complication of the stratigraphy. 3 new levels were distinguished, which were numbered 3a, 4a, and 5a, in order to preserve the previous nomenclature.

3a. Intermediate between layers 2 and 3. Yellow brown clay, less compact than 2, with less rubble. Both Upper Palaeolithic and Mousterian artefacts.
4a. Below layer 4. Grey clay.
5a. Below layer 5. Ochre yellow lens.

Unlike before, a few Mousterian artefacts were found at the top of layer 4. At the top of layer 7 (not 6, as in Zamyatnin's case) were found a sidescraper and a handaxe of Late Acheulean appearance.

The excavations of 1963 and 1965 complicated the cultural stratigraphy even further. Layer 5a produced Mousterian artefacts as well. Hence Vekilova now spoke of four Mousterian horizons in the main corridor: 3a, 3 (including the finds at the top of layer 4), 5, and 5a. Certain changes were observed in layer 2: the top contained only Eneolithic, whereas the remainder of the layer corresponded to the 'Upper Pleistocene'.

M.N. Grishchenko (1971) studied the deposits at the entrance to the main corridor in 1962-1963 and 1968, and presented a composite section as follows (see Figure 3.22). He distinguished 15 levels grouped into 3 clear lithological horizons.

1. Upper. Brown with rubble, 2.5 m. Dark brown clays filled with limestone rubble and fallen travertine pieces (30 lenses with generally horizontal slabs) plus rare limestone blocks (up to 0.5 m).
2. Middle. 1.75 m. Clays and loams, dark grey, grey, greenish grey, layered, transitional at the top to brown, with heavily weathered rubble (the amount of rubble and its degree of weathering gradually increasing upwards) plus iron-manganese formations.
3. Lower. 0.75 m. Loams and clays of various colours, layered, with pebbles of different petrographic composition. The loams, clays, and pebbles all indicated their washing into the cave (through karst channels) from the surface of the plateau above. (Note the contrast with Zamyatnin's interpretation that this material was brought in by the Mzymta.)

Each of the three horizons was subdivided. **Upper**. Levels 3-6 correspond to Zamyatnin's 2a, 2, 2b. **Middle**. Levels 7-12 correspond to Zamyatnin's 3-6. **Lower**. Levels 13-15 correspond to Zamyatnin's 7.

The archaeological material was associated with the following levels (Vekilova and Grishchenko, 1972). At the top of level 3 (fine rubble with ash) were found Eneolithic remains. In levels 4-6 (brown rubble with hearth lenses) were found 'Mesolithic (?) and Upper Palaeolithic'. The first (uppermost) Mousterian layer corresponds to level 7 (formerly 3a), the second to level 8 (formerly 3), the third to level 11 (formerly 5), and the fourth to level 12 (formerly 5a).

V.M. Muratov and E.O. Fridenberg made a three fold division of the deposits which in principle is similar to the above, although, in Liubin's opinion unfortunately, they employed a new numbering system (Vekilova et al., 1978, 39; Chistyakov, 1996, table 16). In all, 9 layers were distinguished, but these were subdivided, making 15 units in all. Their system is as follows.

Group I. Layers 1, 2 (1-3), and 3 (1). Sharp-edged poorly cemented rubble. In general, layers 1 and 2 show signs of frost weathering and exfoliation, and are indicative of a dry continental climate. Layer 3 (1) however corresponds to 3a/7 in the previous systems. It contains the latest Mousterian and lithologically is regarded as transitional to Group II. According to Muratov and Fridenberg, the large number of limestone slabs in this layer, some of them vertical, are indicative of erosion and water action.

Group II. Layers 3 (2), 4 (1-2), 5 (1-2), 6 (1-2). Light-brown/ grey-blue/ greenish, vary-coloured, heavy gleyed loams, with little rubble. "The contacts between the horizons reveal traces of erosion which are indicative of wetter conditions" (Vekilova et al., 1978, 39). At the base of layer 6 (2) corresponding to 5a/12 in the previous systems there are particularly clear signs of erosion.

Group III. Layers 7, 8, 9. Ochre red clays with pebbles. Muratov and Fridenberg are inclined to date these layers to the early Pleistocene.

Vekilova introduced a final modification into the cultural stratigraphy of the cave when she singled out level 9 (Zamyatnin's layer 4) as another Mousterian layer. In the top part of this layer quite a number of finds were made. The number of Mousterian layers in the cave therefore has now reached five. 3a (7), 3 (8), 4 (9), 5

(11), 5a (12). The last (as already mentioned) included Acheulean handaxes. Two of these handaxes (as reproduced by Chistyakov, 1996, Figs. 55 and 56) are shown here at Figure 3.23). In Liubin's opinion, however, there are points which are not clear about the stratigraphic position of the layer in which they were found. This is probably due to the fact that it was much eroded and subject to facies change. Thus, in Grishchenko's section, level 12 is represented on the south side by a light greyish brown clay with a yellow tinge. Towards the middle of the corridor it becomes a vary-coloured clay, and then it changes into a compact greyish lilac coloured one. The "archaic" tools were found here, either on a raised part of the cave floor, or at the base of the layer, at its contact with layer 13.

3.5.3.2   Fauna

Identified by V.I. Gromov and N.M. Yermolova. From all the years of excavation there were 6119 identifiable bones, 92.4% of which belong to cave bear, observed in all layers up to the top of layer 2. They are particularly characteristic of the second Mousterian layer (3=8). The bones from the lower Mousterian layers are fewer and not so well preserved. In layer 3a (=7), the first (transitional) Mousterian layer, there is a probable admixture of bones from layer 2. A mixture of bones is even more likely in layer 2 (=3-6), with a variable thickness from 1 to 2.5 metres, and a variable archaeological classification: Neolithic-Upper Palaeolithic (Zamyatnin) Eneolithic-Mesolithic(?)-Upper Palaeolithic (Vekilova). In 1937-1938 the fauna from this layer was divided into Neolithic and Upper Palaeolithic (Zamyatnin, 1961), but in 1961-1963 and 1965 it was treated together as levels 3-6 (Vekilova and Grishchenko, 1972). The material may therefore be mixed Holocene and Pleistocene. From Upper Palaeolithic layer 2b (Zamyatnin) we have Vulpes vulpes, Ursus spelaeus, Martes sp., Cervus elaphus, Alces alces, Capreolus capreolus, Bison bonasus, Sus scrofa, Ovis sp., and Capra sp. From horizons 3-6 (Vekilova) we have also Canis lupus, Ursus arctos, and Sciurus sp. This is a predominantly wooded fauna. But it is only in 2b (as in the Upper Palaeolithic layers at Navalishinskaya) that we have Alces alces and greater numbers of Ovis and Capra. In the upper Mousterian layers 3a and 3 there is no Alces alces, there are only a few bones of Ovis and Capra, but the remaining species are the same, and the fauna as a whole is definitely of wooded character. In the lower Mousterian horizons we have only Canis lupus, Vulpes vulpes, Cervus

elaphus, Cervus euryceros, Bison bonasus, and one bone of Capra. Cervus euryceros in general is observed only in the older Mousterian complexes of the Caucasus.

3.5.3.3 Palynology

Details from Grichuk et al. (1970). 16 samples were taken from all layers in the main corridor. Only the first and second Mousterian layers (Vekilova's 3a and 3) proved informative, as well as an ash lens in the middle of the Upper Palaeolithic. The results are shown diagrammatically in Figure 3.24 (= Figure 2 in Vekilova et al., 1978). In this diagram, the top sample corresponds to the present day surface in the vicinity of the cave, the middle sample corresponds to layer 2, and the bottom sample corresponds to layers 3a and 3.

In layer 3 Picea orientalis /L./ Link. and Abies Nordmanniana /Stev./ Spach were predominant, and Polypodium vulgare L. was present. Picea-Abies woods (referred to as so-called 'dark' coniferous forests) are today characteristic of elevations at 1200-1900 m above sea level. But oak is also present, plus Polypodium serratum /Willd./ Futo, hence deciduous elements were not entirely squeezed out.

In layer 3a (transitional between Mousterian and Upper Palaeolithic) there is a noticeable reduction in the proportion of Picea, an increase in the proportion of Pinus, and the appearance of much NAP, including Compositae and Artemisia, as well as a few grains of hornbeam and elm. This indicates some reduction in the forest cover and an increase in the area occupied by xerophytic plants.

In layer 2 the ash lens produced evidence of pine woods and open spaces, a drier climate characteristic of this phase of the last glaciation. The presence of Carpinus orientalis is noted, as an indication that these were 'light' coniferous forests. But elements of deciduous woods and 'dark' coniferous species were preserved in favourable refugia (Zelikson and Gubonina, 1985), such as the steep river canyons of the Sochi Black Sea coast, where the cave is situated. In Liubin's opinion, this probably explains the basically wooded character of the fauna contained in layer 2, as well as the presence of Capra and Ovis.

3.5.3.4 Anthropological remains

Determined by A.A. Zubov. Found by N.M Yermolova when she was analysing the finds from layers 3 and 3a. A second upper left molar and three foot bones. The tooth comes from 3a. Assigned by Zubov to Homo sapiens fossilis, with

a combination of archaic and progressive traits. The assertion by Vekilova and Zubov (1972) that this tooth provides a proof of the 'appearance of modern man in the Mousterian' is possible but, in Liubin's opinion, not indisputable, in view of the fact that the layer in which it was found is transitional, and the bones located within it may be as mixed as the stone tools (Liubin, 1989, 70-71).

3.5.3.5 Archaeological materials

Stone inventory, hearth stains and lenses, food debris. Evident that at times of increased moisture people abandoned the site and parts of the cultural deposits were removed by erosion due to water action. The scraps remaining of the lowest cultural horizon with handaxes are evidence of this. The dark film on the bones from all the Mousterian layers was induced by moisture. The extant materials suggest that the most intensive occupation of the cave occurred in Zamyatnin's Lower Mousterian layer (5), although the bones from this horizon were particularly badly preserved. The Upper Mousterian layer (3) at the mouth of the cave also produced abundant finds. The pattern of distribution of the finds in the Upper Palaeolithic was somewhat different, but a number of hearths (up to 25 cm thick) were found here. In Liubin's view, the hearths were necessary to maintain warmth, but the relatively infrequent tools suggest that at this time the cave was visited only rarely and functioned as a hunting rather than a dwelling site.

3.5.3.6 Stone industry

Relatively few finds from Upper Palaeolithic layer 2. The five Mousterian layers produced a total of 3598 finds. According to Vekilova, the excavations in 1961-1965 produced the following totals: (3a) 194 (3) 483 (4) 298 (5) 394 (5a) 152. Mostly flint, a little schist. Much denticulate retouch. The oldest Mousterian layer (5a) produced four handaxes and hachereaux. In general, Vekilova described the material as a Denticulate Mousterian. D.A. Chistyakov, on the basis of his study of the materials from the 1937-1938 excavations, generally supported this classification. The high proportion of tools (Upper Mousterian 37.9%, Lower Mousterian 39.1%) supported the idea that this was a living site at that time and that flint working for the most part was conducted outside. Indices for the Upper and Lower Mousterian layers were respectively: IL 26.3 and 25.8, Denticulate 30.9 and 25.9, Upper Palaeolithic 15.6 and 16.6, IR 24.1 and 29.2.

3.5.3.7   Chronology and Palaeogeography

Considering the general position of the cave, as well as the colouring and deep weathering of the lower layers (13-15), Muratov and Fridenberg (in Vekilova et al., 1978) were inclined to date it to the early Pleistocene. The dating of the oldest level is not completely clear due to its eroded nature and the probable displacement of some of its constituents. Nonetheless, in Liubin's view, the Acheulean nature of the handaxes and their appearance in most cases in ochre-red or ochre-yellow clay does support the idea that they pre-date the last glaciation.

The second packet of deposits (7-12) in the opinion of the same authors reflects a regime of increased moisture. A series of erosional phases is suggested to belong to the early last glaciation. Indeed, in Liubin's opinion, the four layers 3a, 3, 5, and 5a, may belong to the first half of the Mousterian period. The upper boundary of this period is fixed by a U/Th date on fallen stalactites from layer (3a) at 35,000 +/- 2000 BP reported by Cherdyntsev, Kazachevskii, and Kuzmina (1965). The pollen data supports this interpretation, with the indication of the beginning of an arid phase, and a lowering of vegetational zones in the area by some 1200-1400 metres. The lower boundary of the period is hypothetical. But Liubin notes the concentration of rubble in the Lower Mousterian layer (5) observed by Zamyatnin at the entrance to the cave. This seems to be an indicator of an early last glaciation interstadial at several caves in the Caucasus (Dzhruchula, Kudaro I and III, and others).

The deposits of layer 2 (exfoliated rock) formed in conditions of dry continental climate of the last glacial maximum. The cave was surrounded by 'light' coniferous forests and open spaces. A radiocarbon date is available for the ash lens in the middle of the layer of 19,000 +/- 500 BP as reported by Cherdyntsev, Alexeev, and Kind (1965).

3.5.3.8   The 2004 sampling strategy in relation to stratigraphy

The sampling strategy in 2004, and the analysis and numbering of the layers at the cave, was carried out with the advice and assistance of Professor V.P. Liubin and E.V. Beliaeva. The layer numbering adopted is that of Zamyatnin (1961), with the addition of layer 3a following Panichkina and Vekilova (1962), and **not** that of Vekilova and Grishchenko (1972). Layer Z was recognised separately in the field.

First version August 2 2004; revised August 12 2005.
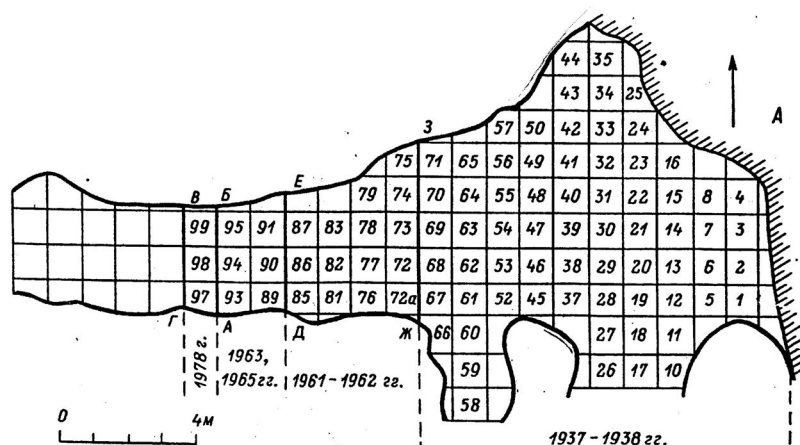
Figure 1. Akhshtyr. Plan of the excavated part of the cave.
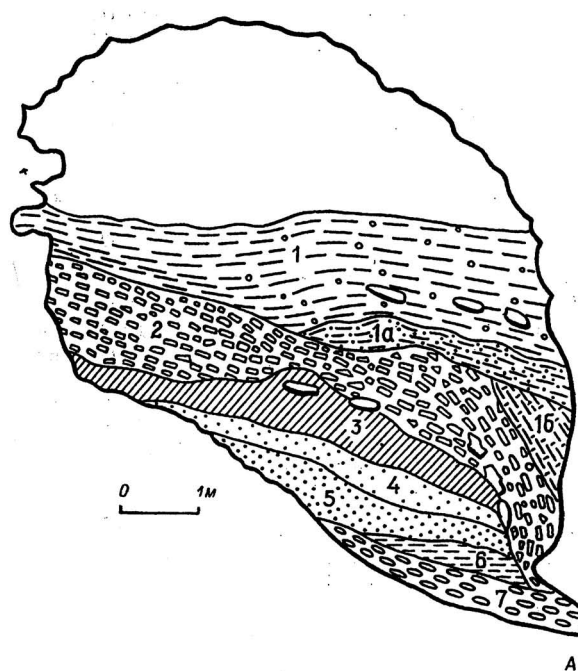
Figure 2. Section along the line Z-Zh, western edge of Zamyatnin's dig 1937-38.

Figure 3.21. Akhshtyr. Plan of the excavated part of the cave and section along the line Z-Ж, western edge of Zamyatnin's dig 1937-38.

Figure 3.22. Akhshtyr. Section along the line A-B, western edge of Vekilova's dig, according to Vekilova and Grishchenko
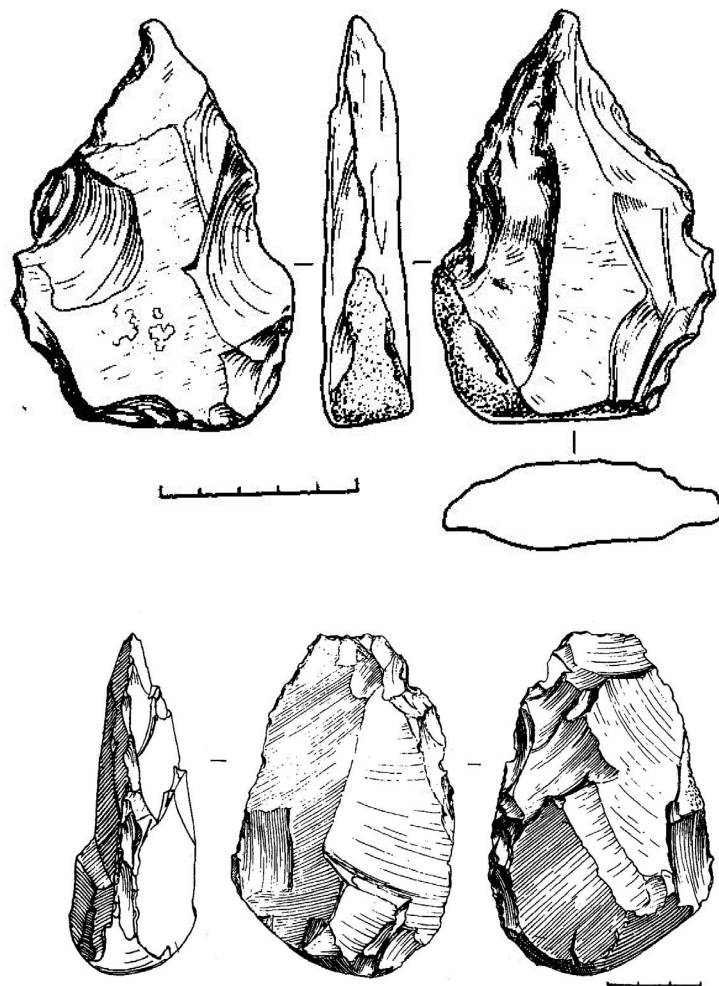
Figure 3.23. Akhshtyr handaxes from layer 7(12) after Chistyakov (1996)
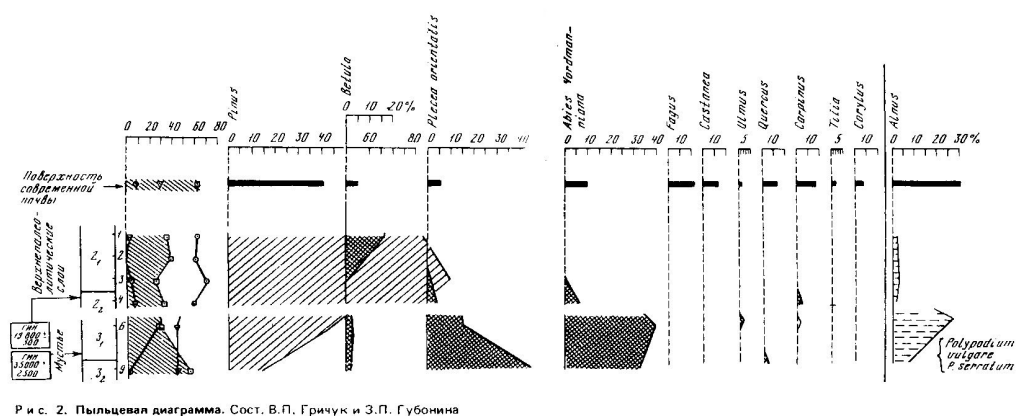
Р и с. 2. Пыльцевая диаграмма. Сост. В.П. Гричук и З.П. Губонина

Figure 3.24. Akhshtyr pollen diagram after Vekilova et al. (1978)

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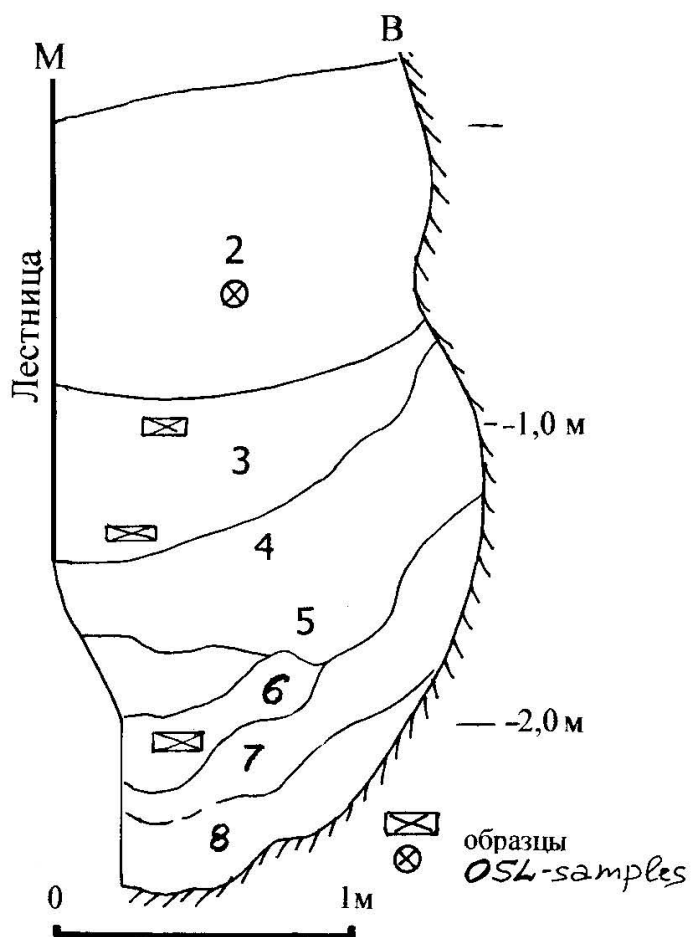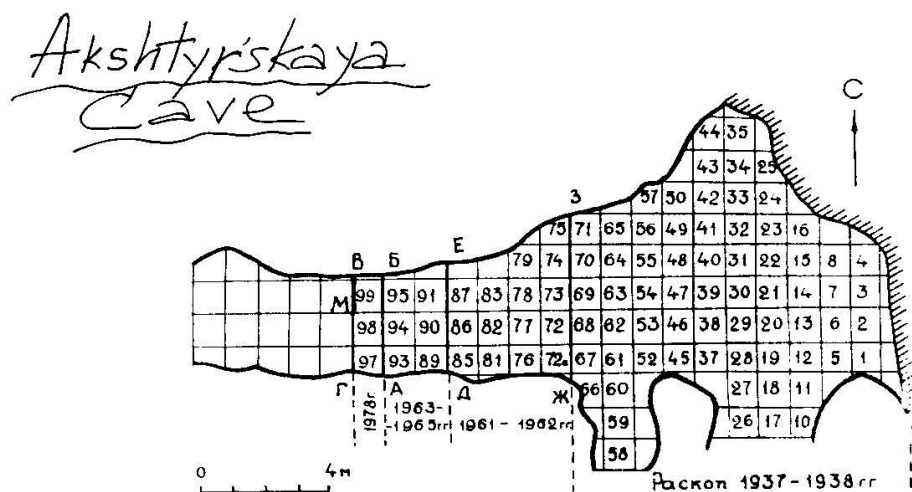
Рис. 15 Ахштырская пещера: А – План пещеры с указанием разреза М-В,
откуда брались образцы; Б – Разрез М-В с указанием точек взятия образцов

Figure 3.25. Akhshtyr, 2004 section with OSL sample positions

3.5.4   Kepshinskaya

Summary by Liubin (1989). The report quotes Liubin (1968, 1974) and Liubin, Burchak-Abramovich, and Klapchuk (1971). Some further information (and illustrations) in Chistyakov (1996). A 'through' gallery cave in the canyon of the river Mzymta, in the foothills of the Akhtsu limestone massif, 30 km south of the town of Adler in the Sochi region of the Krasnodar district. At an absolute height of 250 metres, relative height 70-80 metres, in the present day zone of Kolkhid deciduous woods. As Chistyakov says, the site really consists of two parts, the cave itself, and a (roofless) rock shelter to the north-east of it. The cave is oriented in a SW-NE direction. The land slopes down steeply to the river on the south-east. The main, north-east, entrance to the cave has the form of an arch, 6.5-7 metres wide and 2.5 metres high. The length of the gallery is 17 metres. Discovered by V.P. Liubin, who carried out a small excavation in 1966-67. The excavated area is 1.5x2.75 metres, with a depth of 3.55 metres. See the attached plan and section (Figure 3.26), where the direction north (and the "open" rock shelter) is in the bottom right hand corner.

3.5.4.1   Stratigraphy

(1) dark grey loam, with rubble and gravel. 20-60 cm.
(2) grey lumpy loam, with rubble and gravel. 5-40 cm.
(3) greenish-grey loam, heavy, compact, viscous, with large blocks of limestone in the mid and lower parts. 1.0-1.2 metres.
(4) alluvial sands and sandy loams. >2 metres.

Layer 1 is recent, with fragments of pottery. 2 and 4 are sterile. 3 is Mousterian. The metre-thick Mousterian layer was dug in 7 artificial horizons.

The samples taken in 2004 were from layers numbered as in Liubin's stratigraphic diagram.

3.5.4.2   Fauna

Determined by N.M. Yermolova, I.M. Gromov, N.I. Burchak-Abramovich.

Layer 1. Ursus arctus, Capreolus capreolus, Sus scrofa, Canis sp.

Layer 3. <u>Mammals</u>. Capra caucasica, Ursus spelaeus. <u>Rodents</u>. Microtus roberti Thom.-gud. Satun., Prometheomys schaposchnikovi Satun., Cricetus sp., Mesocricetus sp. <u>Birds</u>. Tetraogallus caucasicus Pall., Lyrurus mlokosiewiczi Tacz., Pyrrhocorax graculus L.

The pellets of raptor birds on the present day surface were examined. The bones of rodents found are exclusively those which inhabit wooded, wooded steppe, and meadow steppe areas. Glis glis L., Apodemus agrarius, Pitymys majori Thom., Talpa minuta Bl., Sorex.

3.5.4.3 Palynology

Determinations by M.N. Klapchuk. 20 samples. 1-3 Layer 1. 4-6 Layer 2. 7-14 Layer 3. 15-20 Layer 4.

Layer 4. Sample 20, at the base. The end of a warm period, indicated by predominant AP (79%), the basic components of which are conifers (89%) with some deciduous, including oak, hornbeam, and hazel.

Layer 3. Lower part, samples 14 and 13. Exclusively coniferous species.

Layer 3. Mid part, samples 12-8. The appearance of deciduous species.

Layer 3. Upper part, sample 7. Deciduous species 14%, including elm, hornbeam, lime. A progressive warming is indicated. The top of the Mousterian layer however was evidently truncated by erosion, and traces of the warm interstadial (?) come to an end.

Layers 2 and 1. Samples 6-1 reflect the end of the last glaciation and the Holocene. Sample 6, 93% of the AP is coniferous, so a cold climate is indicated. Sample 5, deciduous species constitute 26% (of the AP?). Samples 4-1, this rises to 57-79%.

Klapchuk's pollen diagram is reproduced here as Figure 3.28 (Fig. 19 in Liubin, Burchak-Abramovich, and Klapchuk 1971). For comparison, Klapchuk studied also

present day pollen samples from the area, shown here in Figure 3.29 (also Fig. 19 in Liubin, Burchak-Abramovich, and Klapchuk (1971).

3.5.4.4   Archaeology

In layer 3 (essentially at the base) 30 stone artefacts were found, including a Mousterian and 2 Levallois points, flakes, a retoucher on a shale pebble, and a sandstone slab with traces of working.

3.5.4.5   Chronology and palaeogeography

Liubin comments that the Mousterian layer seems to belong to the last phase of the first cold maximum of the last glaciation. Pollen spectra indicate the predominance of coniferous trees at the beginning of this phase, with some open spaces; the fauna includes a majority of birds and animals which presently are characteristic of the Alpine and sub-Alpine wooded zones. Thus, the nearest place where Capra caucasica, Prometheomys, Tetraogallus, Pyrrhocorax, and Lyrurus currently live is the Great Caucasus ridge and its high spurs. Tetraogallus and Pyrrhocorax live only in the high peaks (1800-3000 m), Prometheomys lives in the sub-Alpine meadows of the upper part of the wooded zone at a height not less than 1500 m, Capra caucasica and Lyrurus descend in winter to the upper limits of the woods at a height of around 700-1000 m. Therefore he concludes that the lowering of the boundaries of the vegetation zones in the Sochi area of the Black Sea coast at the beginning of the deposition of layer 3 may have been about 1200-1500 metres.

First version 22 June 2004; revised 16 August 2005.
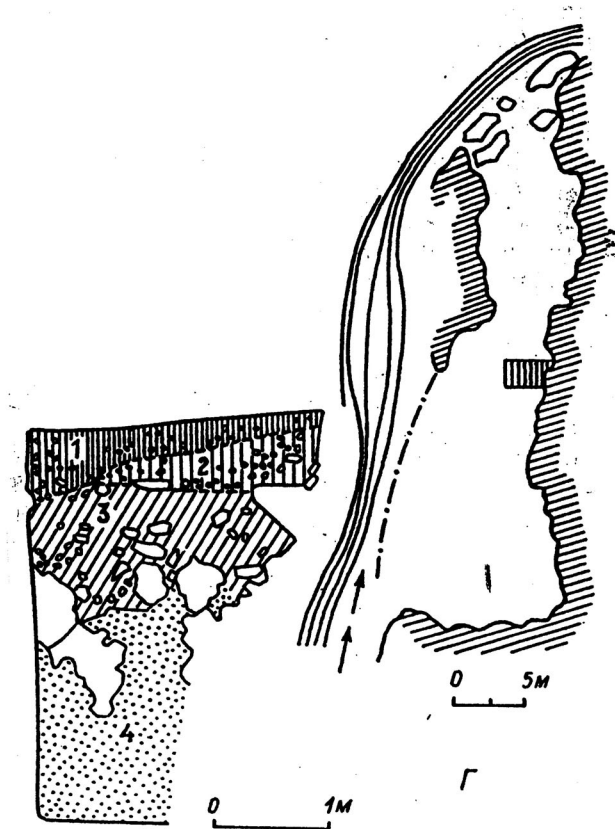
Figure 3.26. Kepshinskaya cave (after Liubin 1989). Plan and section. The shaded area on the plan indicates the excavated area
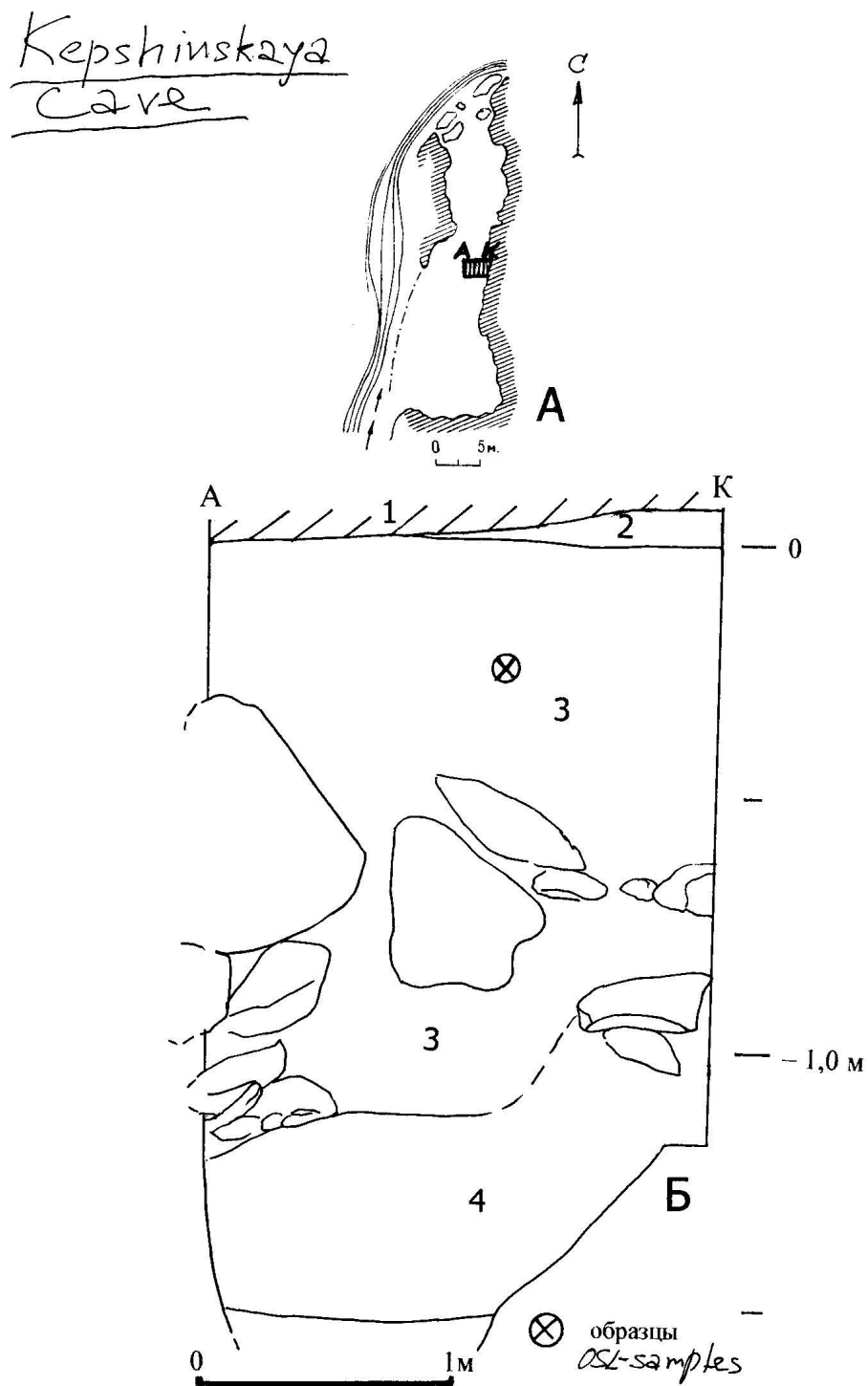
Рис. 14. Кепшинская пещера: А – План пещеры с указанием разреза А-К, откуда брались образцы; Б – Разрез А-К с указанием точек взятия образцов

Figure 3.27. Kepshinskaya cave, 2004 section with OSL sample positions
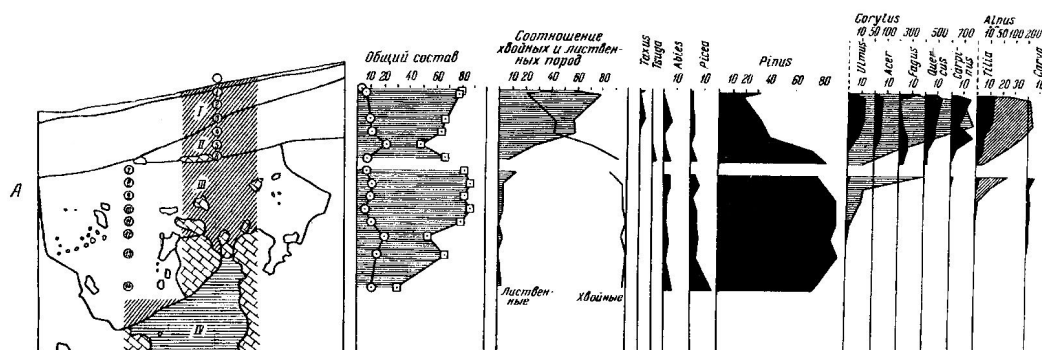
Figure 3.28. Kepshinskaya cave pollen sequence (after Liubin *et al*. 1971, fig. 19).

Second column on left: general composition.

Third column on left: deciduous (L) vs. coniferous (R).
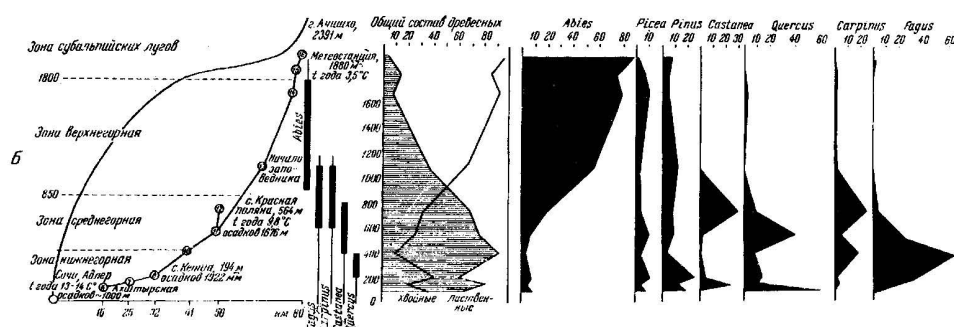
Figure 3.29.   (Liubin *et al*. 1971, fig. 19) Pollen frequencies for present soil samples.

On the left: Diagrammatic representation of vegetation zones and heights. From

below, lower mountain – mid mountain – higher mountain – sub-Alpine meadows

(with elevations).

Third from the left: coniferous (L) vs. deciduous (R) (with heights).

Appendix 3.1 **Pre-sampling site assessment forms (by Burbidge and**

Allsworth-Jones)

Site	Navalishinskaya			
General Description				
Karst cave on the right hand bank of the river Kudepsta canyon - Shiroki Pokos, South of Krasnovol'sk, Sochi Region.				
Geographic Description				
East facing, relatively open cave. 100m above valley bottom.				
Latitude	43°33.19'N	**Longtitude**	39°55.86'E	**Altitude**	258 m asl
Bedrock Geology				
Limestone				
Archaeology & Quaternary Stratigraphy:				
Excavation History				
Zamyatnin, 1936. Liubin, 1965 – section to be sampled.				
Periods/cultures represented				
Middle and Upper Palaeolithic, with hiatus in between, plus younger layers.				
Main activities represented				
Occasional occupation				
Common artefact types	e.g. Flint, quartzite, hearths/occupation, faunal, human etc.			
Hearths/Ashy layers. "Denticulate" tools (broken by frost action)				
Faunal remains				
Cave Bears				
Sedimentation types	e.g. Aeolian, fluvial, colluvial, anthropogenic, loessic, sandy			
Anthropogenic (ash), Exfoliation (rubble), Eluviation & Chemical weathering (of limestone rubble – links to climate), "Loams"				
Approx. depth of stratigraphy	2.5 m			
Approx. No. contexts / stratigraphic units	11 (1 late, 1 geological, 3 Upper Pal, 6 Middle Pal)			
Expected age range	50 ka? and younger			
Existing chronological control e.g. Typology, Anthropology, Faunal, ^{14}C etc				
Palynology, Typology, Fauna, and implied climate				
Artefacts/contexts of particular note				

Anthropogenic ash horizons through the Middle Palaeolithic, in different climatic conditions.
Also Middle Pal – Upper Pal hiatus.

Archaeological questions to be addressed

Too few artefacts for examining typological change and links.
Nature of occupation is predominantly Cave Bear.
Denticulate tool assemblages – not clear how much produced by Humans, and how much by natural (taphonomic) processes
Erosion at the end of the Middle Palaeolithic – How big? When? Why?

Chronological questions to be addressed

Middle Palaeolithic occupation dates – ashy layers
Constrain Middle –Upper Palaeolithic hiatus, and define length?

Regional connections

Cold to warm transition indicated in pollen – tie in with other sites.
Dates from ashy layers would indicate usage patterns in a changing climate.
Erosion at the end of the Middle Palaeolithic…

Importance of the site archaeologically

Sequence of Middle Palaeolithic deposits covering a range of climatic regimes.
Eroded implies hiatus to Upper Pal how big?

Importance of the site in terms of the regional chronology

Palynology: colder to warmer, but this time with a series of occupation layers.
Hiatus at the end of the Middle Palaeolithic – as at other sites.

Datability of the site

Poor except for potential of ashy layers.

Contexts on which to focus for sampling

Middle Palaeolithic ashy layers have good potential and high interest.
Deposits around the hiatus are less good but interesting.

Completed By	Checked By	Date
CIB		

Site	Malaya Vorontsovskaya

General Description

Karst cave. Horizontal tunnel along fault line. Excavated sections up to 10 m in at front. Mousterian & mixed.

Geographic Description

Right wall of the Vostochnya Khosta canyon (Alek ridge), 54 m above the present valley base, 290 m asl. Faces Southeast.

Latitude	43°37.77'N	**Longtitude**	39°54.74'E	**Altitude**	262 m asl

Bedrock Geology

Limestone, but note alluvial deposits at base containing shale pebbles.

Archaeology & Quaternary Stratigraphy:

Excavation History

Krainov; Soloviev – excavations at entrance, now all gone.
Liubin; Liubin and Soloviev; Chistyakov – excavations inside
Correlation difficult between the results of the different excavations

Periods/cultures represented

Middle Palaeolithic, plus mixed deposits.

Main activities represented

Cave Bear, but also evidence for long term Human occupation

Common artefact types	e.g. Flint, quartzite, hearths/occupation, faunal, human etc.

Hearths, Bone debris, Flint, plus 25% non-flint lithics

Faunal remains

Bone debris indicative of processing for food.
Cave Bear – relationship between Cave Bear and people.
Much faunal evidence excavated but not studied.

Sedimentation types	e.g. Aeolian, fluvial, colluvial, anthropogenic, loessic, sandy

Alluvial, Travertine, Exfoliated rock (much weathered), Anthropogenic (limited), Colluvium

Approx. depth of stratigraphy	1.8 m
Approx. No. contexts / stratigraphic units	9: 6 Archaeological: 4 Middle Palaeolithic, 2 Upper Pal and later
Expected age range	50 ka??? and younger

Existing chronological control e.g. Typology, Anthropology, Faunal, ^{14}C etc

Two uncalibrated ^{14}C dates: Layer 1 (U'Pal/Mixed) = 14 ka, Layer 3 (M'Pal) = 36 ka – thought to be "a bit too young"
Basic typological and faunal evidence.

Artefacts/contexts of particular note
Variety of non-flint tools – raw material shortage Butchery evidence – in general, no contexts indicated Layers Z and 4 = one phase, layers 2 and 3 = other phase: Pollen evidence is confused but indicates changes, the sediments are different. Hearths within a variety of contexts (not indicated in diagram)
Archaeological questions to be addressed
Nature of Human occupation: signs of long term occupation, but 95% Cave Bear
Chronological questions to be addressed
Appear to be many phases of Middle Palaeolithic, but they are unresolved. Therefore, separate these chronologically, and perhaps tie the pollen in, at least from one part. Find "too young" ^{14}C sampling position an check.
Regional connections
Tool assemblage doesn't tie in positively with other sites. The palynological record is confused, but it exists – help to tie it in
Importance of the site archaeologically
Large assemblage (largest in Sochi region). Many workers have used many approaches to examine the site, but this has yielded a confused picture. - Help to sort this out and integrate it with the rest of the Sochi group
Importance of the site in terms of the regional chronology

Largest artefact assemblage in Sochi group
   - anchor assemblage chronologically
   - pollen record too

Datability of the site
Hearths? Sediments don't appear *too bad*
Contexts on which to focus for sampling
Opportunistic sampling of hearths. Layers 2 & 3 *vs*. layers Z & 4: at least two phases of Middle Palaeolithic

Completed By	**Checked By**	**Date**
CIB		

3 DSR Sochi Region

No Pre-sampling site assessment form was filled in for Akhshtyr, as this site only became available whilst in the field.

Site	Kepshinskaya
General Description	
Limestone through cave 30 km South(?) of Adler, Sochi, in Krasnodar Region	
Geographic Description	
3.5 m section at the back of a relatively open through-cave in a river canyon. 70-80 m above the present valley bottom.	

Latitude Base of hill	c.43°36.75'N	**Longtitude**	c.40°02.91'E	**Altitude**	c.250 m asl at cave

Bedrock Geology
Limestone
Archaeology & Quaternary Stratigraphy:
Excavation History
Liubin, 1966-67
Periods/cultures represented
Recent prehistory – fragments of pot
Middle Palaeolithic – (Mousterian)
Main activities represented
Small occupation

Common artefact types	e.g. Flint, quartzite, hearths/occupation, faunal, human etc.
Few artefacts: flint, shale pebble, sandstone slab	

Faunal remains
Various mammals, birds, rodents – inconclusive of Human activity
Middle Palaeolithic: Alpine assemblage (1200 - 1500 m higher/colder than at present)

Sedimentation types	e.g. Aeolian, fluvial, colluvial, anthropogenic, loessic, sandy
Alluvial?, Unknown, Exfoliation from roof (odd, Layer 3 clayey)	

Approx. depth of stratigraphy	3.55 m
Approx. No. contexts / stratigraphic units	4 (2 archaeological horizons)
Expected age range	~50 ka onwards (recent Mousterian)

Existing chronological control e.g. Typology, Anthropology, Faunal, ^{14}C etc
Palynology, and archaeology implied, plus faunal
Artefacts/contexts of particular note
Context 3: Middle Palaeolithic tool assemblage. The tools are associated with the rubble-rich lower part of Layer 3. Layer 3 seals "alluvial" sands, and itself becomes finer textured in its upper part: Age constraint by dating the finer material above and below?
Archaeological questions to be addressed
Only date
Chronological questions to be addressed
The site has one archaeological assemblage in one pollen zone within a pollen (and hence climatic) sequence. Constrain the age of the archaeological horizon and the ages of the pollen zones.
Regional connections
Palynological zone correlations

Importance of the site archaeologically
Small assemblage, just part of the general picture, but has a palynological record

Importance of the site in terms of the regional chronology
Palynology

Datability of the site
"Alluvial" sands at the base of the sequence appear OK??

Contexts on which to focus for sampling
Upper Layer 4 and upper Layer 3, to constrain the lower part of Layer 3, which contains the Middle Palaeolithic assemblage.

Completed By	**Checked By**	**Date**
CIB		

Appendix 3.2   Luminescence sample forms

Site Code: Site Name: Navalishinskaya	Date 7/7/04	Context No Present cave floor	Luminescence Sample No EFD4L016 - 021
Description of sampling location:		**Sketch of surrounding area**	
Six modern surface samples taken back into cave from the entrance to test bleaching. Samples at "6 paces" spacing. No. 3 closest to section to be sampled. The cave is a tourist attraction, so material is brought in on shoes. No.s 5 & 6 sampled in the dark, but on the tourist trail through the cave.		EFD4L016 Entrance EFD4L017 6 paces in EFD4L018 12 paces in EFD4L019 18 paces in EFD4L020 24 paces in EFD4L021 30 paces in	

		Photo No:	
Gamma Dosimetry	**Reading** -	**Assoc. Sample** -	**Ref No** -
Details:			
N/A			
Description of Sample:			
Material (including clasts) scraped from surface (no greater than 1 cm depth), and placed in screw-top plastic pots. These were then put together into a zip lock bag, this into a black bag, and all sealed.			
Nature of Dating Problem:			
Bleaching of modern material at different distances into the cave.			

Completed By	Checked By	Date	
CIB		7/7/04	

Site Code: Site Name: Navalishinskaya	Date 8/7/04	Context No Whole section: Profile samples	Luminescence Sample No EFD4L022 - 46
Description of sampling location:		**Sketch of surrounding area**	
Small bag sample taken every 5 cm down section from areas cleaned by trowel, or from behind stones removed immediately before sampling each point. Depths noted on sample bags are correct, but some sample numbers out of sequence. Minimal light exposure.		EFD4L022 Layer 1a, 0-5 cm EFD4L023 Layer 1a, 5-10 cm EFD4L024 Layer 1a, 10-15 cm EFD4L025 Layer 1a, 15-20 cm EFD4L026 Layer 1a, 20-25 cm EFD4L027 Layer 1a, 25-30 cm EFD4L028 Layer 3, 30-35 cm EFD4L029 Layer 3, 35-40 cm EFD4L030 Layer 3, 40-45 cm EFD4L031 Layer 3, 45-50 cm EFD4L032 Layer 3, 50-55 cm EFD4L033 Layer 3, 55-60 cm EFD4L034 Layer 3, 60-65 cm EFD4L035 Layer 4, 65-70 cm EFD4L036 Layer 4, 70-75 cm EFD4L037 Layer 4, 75-80 cm EFD4L038 Layer 4, 80-85 cm EFD4L039 Layer 4, 85-90 cm EFD4L040 Layer 4, 90-95 cm EFD4L041 Layer 4, 95-100 cm EFD4L042 Ashy Layer, 100-105 cm EFD4L043 Layer 5, 105-110 cm EFD4L044 Layer 5, 110-115 cm EFD4L045 Ashy Layer, 115-120 cm EFD4L046 Sterile clay, 125-130 cm	
		Photo No:	
Gamma Dosimetry	**Reading** -	**Assoc. Sample** -	**Ref No** -
Details:			
Any dosimetry to be based on tube samples from the same section.			
Description of Sample:			
Small samples (~1g) trowelled out into small zip-lock bags, after cleaning off material or removal of stone under space blanket. Zip lock bags placed immediately into black bag, doubled and sealed after all samples collected.			
Nature of Dating Problem:			
Profile to examine approximate progression of sequence, and dating potential (bleaching etc.). Associated with pollen/magnetic susceptibility/particle size sampling profiles.			
Completed By	**Checked By**	**Date**	
CIB		8/7/04	

Site Code: Site Name:		Date	Context No	Luminescence Sample No
Navalishinskaya		8/7/04	1	EFD4L047
Description of sampling location:			**Sketch of surrounding area**	
Tube sample from lower part of layer 1: lowest Upper Palaeolithic. Dark humic loam in limestone rubble. Pollen "cold and dry", but also "abundant but poorly preserved": indicates reworking? 31 cm below datum 66 cm right from LHS of section 7 cm above boundary Layer 1 – Layer 3 Sealed by rubble fill from previous excavation. Seals layer 3 – Uppermost Middle Palaeolithic layer.				
			Photo No:	
Gamma	**Reading**		**Assoc. Sample**	**Ref No**
Dosimetry	EFD4G018		ZLB for lab γ + ZLB LStn clast	-
Details:				
Rainbow MCA, 2" x 2" NaI Probe, 600 s counting time Hole Depth = ? cm Est. Solid Angle = 4π but??? Gamma dose rate = 0.22 ± 0.01 Limestone sample taken from next to gamma spectrometry sample (ZLB included with sample (?))				
Description of Sample:				
15 cm × 3 cm ∅ stainless steel tube in zip lock bag with loose sediment for high resolution lab γ (Note: this was small relative to the lumpiness of the material). Total mass as sampled ~ 1 kg.				
Nature of Dating Problem:				
Date for oldest Upper Palaeolithic on site, and constrain Middle – Upper Pal transition. Palynology / climate (warm dry) – tie in other sites in the region.				
Completed By		**Checked By**		**Date**
CIB				8/7/04

Site Code: Site Name: Navalishinskaya		Date 8/7/04	Context No 3 (upper)	Luminescence Sample No EFD4L048
Description of sampling location:			**Sketch of surrounding area**	
Tube sample from upper part of layer 3: uppermost Middle Palaeolithic in the observed section (since layer 2 was not identified). Grey-brown humic "loam" in limestone rubble. Limestone sample taken from next to gamma spectrometry sample. Pollen "warmer, relatively dry", but also "abundant but poorly preserved": indicates reworking? Sealed by layer 1 – Lowermost Upper Palaeolithic Seals "ash" at top of / above layer 4 – actually little difference apparent in fine sediment matrix, but limestone clasts are smaller and more horizontally oriented.			47 cm below datum 66 cm right from LHS of section 10 cm below boundary Layer 1 – Layer 3	
			Photo No:	
Gamma Dosimetry	Reading EFD4G019		Assoc. Sample ZLB for lab γ + ZLB LStn clast	Ref No -
Details:				
Rainbow MCA, 2"×2" NaI Probe, 600 s counting time Hole Depth = ? cm Est. Solid Angle = 4π but??? Gamma dose rate = 0.25 ± 0.01 Limestone sample taken from next to gamma spectrometry sample (ZLB included with sample (?))				
Description of Sample:				
15 cm × 3 cm ∅ stainless steel tube in zip lock bag with loose sediment for high-resolution lab γ (Note: this was small relative to the lumpiness of the material). Total mass as sampled ~ 1 kg.				
Nature of Dating Problem:				
Date for youngest Middle Palaeolithic in section, and constrain Middle – Upper Pal transition. Palynology / climate (warm dry) – tie in other sites in the region.				
Completed By CIB		**Checked By**		**Date** 8/7/04

Site Code: Site Name: Navalishinskaya		Date 8/7/04	Context No 3 (lower)	Luminescence Sample No EFD4L049
Description of sampling location:			**Sketch of surrounding area**	
Tube sample from lower part of layer 3: upper Middle Palaeolithic layer. Grey-brown humic "loam" in limestone rubble. Limestone sample taken from next to gamma spectrometry sample. Pollen "warmer, relatively dry", but also "abundant but poorly preserved": indicates reworking? Sealed by layer 1 – Lowermost Upper Palaeolithic Seals "ash" at top of / above layer 4 – actually little difference apparent in fine sediment matrix, but limestone clasts are smaller and more horizontally oriented.			67 cm below datum 61 cm right from LHS of section 6 cm above boundary Layer 3 – "Ash" above Layer 4	
			Photo No:	
Gamma Dosimetry	**Reading** EFD4G020		**Assoc. Sample** ZLB for lab γ + ZLB LStn clast	**Ref No** -
Details:				
Rainbow MCA, 2"´2" NaI Probe, 600 s counting time Hole Depth = ? cm Est. Solid Angle = 4 π but??? Gamma dose rate = 0.25 ± 0.01 Limestone sample taken from next to gamma spectrometry sample (ZLB included with sample (?)) Gamma dose rate equal to that from EFD4L048 in upper layer 3.				
Description of Sample:				
15 cm × 3 cm $\varnothing$ stainless steel tube in zip lock bag with loose sediment for high-resolution lab γ (Note: this was small relative to the lumpiness of the material). Total mass as sampled ~ 1 kg.				
Nature of Dating Problem:				
Date for youngest Middle Palaeolithic layer in section, and constrain possible hiatus between layers 3 and 4 – equivalent to uppermost "ashy" layer in section diagram. Palynology / climate (warm dry) – tie in other sites in the region.				
Completed By		**Checked By**		**Date**
CIB				8/7/04

Site Code: Site Name: Navalishinskaya		Date 8/7/04	Context No 4 (upper)	Luminescence Sample No EFD4L050
Description of sampling location:			**Sketch of surrounding area**	
Tube sample from upper part of layer 4: Middle Palaeolithic layer below "hiatus". Grey-brown humic "loam" in limestone rubble. Lowest part of layer 4 has smaller Limestone rubble lying conformably with layer 5 and "ashy layer" below. Pollen "warmer, moister", but also "abundant but poorly preserved": indicates reworking? Sealed by "ash" at base of / below layer 3 – actually little difference apparent in fine sediment matrix, but limestone clasts are smaller and more horizontally oriented. Seals layer 5 via ashy layer. Also, the base of layer 4 itself is similar to the "ash" at the base of layer 3.			90 cm below datum 54 cm right from LHS of section 7 cm below boundary "Ash" above Layer 4 – Layer 4	
			Photo No:	
Gamma Dosimetry	Reading EFD4G021		Assoc. Sample ZLB for lab γ + ZLB LStn clast	Ref No -
Details:				
Rainbow MCA, 2"´2" NaI Probe, 600 s counting time Hole Depth = ? cm Est. Solid Angle = 4 π but??? Gamma dose rate = 0.24 ± 0.01 Limestone sample taken from next to gamma spectrometry sample (ZLB included with sample (?))				
Description of Sample:				
15 cm × 3 cm ⌀ stainless steel tube in zip lock bag with loose sediment for high-resolution lab γ (Note: this was small relative to the lumpiness of the material). Total mass as sampled ~ 1 kg.				
Nature of Dating Problem:				
Date for youngest Middle Palaeolithic layer in section, and constrain possible hiatus between layers 3 and 4 – equivalent to uppermost "ashy" layer in section diagram. Palynology / climate (warm moist) – tie in other sites in the region.				
Completed By		**Checked By**	**Date**	
CIB			8/7/04	

Site Code: Site Name:		Date	Context No	Luminescence Sample No
Navalishinskaya		8/7/04	4 (lower)	EFD4L051
Description of sampling location:			**Sketch of surrounding area**	
Tube sample from lower part of layer 4: Middle Palaeolithic layer between "ashes". Grey-brown humic "loam" in limestone rubble. Lowest part of layer 4 (just below sample) has smaller Limestone rubble lying conformably with layer 5 and the "ashy layer" between. Pollen "warmer, moister", but also "abundant but poorly preserved": indicates reworking? Sealed by "ash" at base of / below layer 3 – actually little difference apparent in fine sediment matrix, but limestone clasts are smaller and more horizontally oriented. Seals layer 5 via ashy layer. Also, the base of layer 4 itself is similar to the "ash" at the base of layer 3.			105 cm below datum 58 cm right from LHS of section	
			Photo No:	
Gamma	**Reading**		**Assoc. Sample**	**Ref No**
Dosimetry	EFD4G022		ZLB for lab γ + ZLB LStn clast	-
Details:				
Rainbow MCA, 2"´2" NaI Probe, 600 s counting time Hole Depth = ? cm Est. Solid Angle = 4 π but??? Gamma dose rate = 0.22 ± 0.01 Limestone sample taken from next to gamma spectrometry sample (ZLB included with sample (?))				
Description of Sample:				
15 cm × 3 cm ∅ stainless steel tube in zip lock bag with loose sediment for high-resolution lab γ (Note: this was small relative to the lumpiness of the material). Total mass as sampled ~ 1 kg.				
Nature of Dating Problem:				
Date for onset of accumulation of layer 4: non-anthropogenic accumulation. Palynology / climate (warm moist) – tie in other sites in the region.				
Completed By		**Checked By**		**Date**
CIB				8/7/04

Site Code: Site Name:		Date	Context No	Luminescence Sample No
Navalishinskaya		8/7/04	Ash below layer 5	EFD4L052
Description of sampling location:			**Sketch of surrounding area**	
Tube sample from lowermost black ashy layer in LHS of section. Pollen cold ("coniferous forests), but also "abundant but poorly preserved": indicates reworking? Sealed by 5: Dark grey-brown humic "loam" in limestone rubble. Seals limestone bedrock. 118 cm below datum 24 cm right from LHS of section 1 or 2 cm below boundary Layer 5 - "Ash" above bedrock				
			Photo No:	
Gamma	**Reading**		**Assoc. Sample**	**Ref No**
Dosimetry	EFD4G023		ZLB for lab γ + ZLB LStn clast	-
Details:				
Rainbow MCA, 2"´2" NaI Probe, 600 s counting time Hole Depth = ? cm Est. Solid Angle = 4 π but bedrock Gamma dose rate = 0.26 ± 0.01, but next to bedrock with dose rate of 0.070 ± 0.005 (EFD4G024) Limestone sample taken from next to gamma spectrometry sample (ZLB included with sample (?))				
Description of Sample:				
15 cm × 3 cm ∅ stainless steel tube in zip lock bag with loose sediment for high-resolution lab γ (OK relative to lumpiness of sample, but will not be very representative of surroundings further than 5 cm away due to proximity of bedrock). Total mass as sampled ~ 1 kg.				
Nature of Dating Problem:				
Date for oldest occupation deposit at site. Palynology / climate (cold) – tie in other sites in the region.				
Completed By		**Checked By**		**Date**
CIB				8/7/04

Site Code: Site Name: Malaya Vorontsovskaya		Date 10/7/04	Context No Whole section: Profile samples	Luminescence Sample No EFD4L053 - 72
Description of sampling location:			**Sketch of surrounding area**	
Small bag sample taken every 5 cm down section from areas cleaned by trowel, or from behind stones removed immediately before sampling each point. Minimal light exposure.			EFD4L053 Layer 1, 0-1 cm EFD4L054 Layer 1, 5 cm EFD4L055 Layer 1a, 10 cm EFD4L056 Layer 1a, 15 cm EFD4L057 Layer 2 top, 20 cm EFD4L058 Layer 2, 25 cm EFD4L059 Layer 2 bottom, 30 cm EFD4L060 Layer 3 top, 35 cm EFD4L061 Layer 3, 40 cm EFD4L062 Layer 3, 45 cm EFD4L063 Layer 3, 50 cm EFD4L064 Layer 3, 55 cm EFD4L065 Layer 3, 60 cm EFD4L066 Layer 3, 65 cm EFD4L067 Layer 3, 70 cm EFD4L068 Layer 4 top, 75 cm EFD4L069 Layer 4, 80 cm EFD4L070 Layer 5 top, 85 cm EFD4L071 Layer 5, 90 cm EFD4L072 Layer 5, 95 cm	
			Photo No:	
Gamma Dosimetry	**Reading** -		**Assoc. Sample** -	**Ref No** -
Details:				
Any dosimetry to be based on tube samples from the same section.				
Description of Sample:				
Small samples (~1g) trowelled out into small zip-lock bags, after cleaning off material or removal of stone under space blanket. Zip lock bags placed immediately into black bag, doubled and sealed after all samples collected.				
Nature of Dating Problem:				
Profile to examine approximate progression of sequence, and dating potential (bleaching etc.). Associated with pollen/magnetic susceptibility/particle size sampling profiles.				
Completed By CIB		**Checked By**	**Date** 10/7/04	

Site Code: Site Name: Malaya Vorontsovskaya		Date 10/7/04	Context No Section O – P Layer 2	Luminescence Sample No EFD4L073
Description of sampling location:			**Sketch of surrounding area**	
Tube sample from layer 2. Grey (greenish) – brown "loam". Relatively low stone content compared with other sites in region. Unconformably (?) sealed by (1a) – eroded surface? 1a contains archaeological material of various ages, from Upper Pal to much younger. Seals layer 3, but boundary is diffuse/uneven – stone assumed to be in top of layer 3. 24 cm below datum 19 cm left from planning line at RHS of section 5 cm below boundary Layer 1a – Layer 2 7 cm above stone at boundary Layer 2 – Layer 3				
			Photo No:	
Gamma **Dosimetry**	**Reading** EFD4G025		**Assoc. Sample** ZLB for lab γ	**Ref No** -
Details:				
Rainbow MCA, 2''´2'' NaI Probe, 600 s counting time Hole Depth = ? cm Est. Solid Angle = 4 π Gamma dose rate = 0.36 ± 0.02				
Description of Sample:				
15 cm × 3 cm $\varnothing$ stainless steel tube in zip lock bag with loose sediment for high-resolution lab γ. Total mass as sampled ~ 1 kg.				
Nature of Dating Problem:				
Uppermost Middle Palaeolithic layer at the site: Should post-date EFD4L074				
Completed By CIB		**Checked By**	**Date** 10/7/04	

Site Code: Site Name: Malaya Vorontsovskaya	Date 10/7/04	Context No Section O – P Layer 3 (upper)	Luminescence Sample No EFD4L074
Description of sampling location:		**Sketch of surrounding area**	
Tube sample from upper layer 3. Grey-brown "loam" with occasional limestone. Taken below stone to ensure that sample was not from layer 2. Sealed by layer 2: Diffuse/uneven boundary. Grey (greenish) – brown "loam". Seals layer 4: Darker and has less limestone 42.5 cm below datum 20 cm left from planning line at RHS of section 6 cm below stone at boundary Layer 2 – Layer 3			
		Photo No:	

Gamma	**Reading**	**Assoc. Sample**	**Ref No**
Dosimetry	EFD4G026	ZLB for lab γ	-
Details:			

Rainbow MCA, 2"´2" NaI Probe, 600 s counting time
Hole Depth = ? cm
Est. Solid Angle = 4 π
Spectrum lost: Field gamma dose rate = 0.35 ± 0.02

Description of Sample:

15 cm × 3 cm $\varnothing$ stainless steel tube in zip lock bag with loose sediment for high resolution lab γ. Total mass as sampled ~ 1 kg.

Nature of Dating Problem:

Constrain age range of layer 3 - thickest Middle Palaeolithic layer at the site:
Should predate EFD4L073 and post-date EFD4L075

Completed By	**Checked By**	**Date**
CIB		10/7/04

Site Code: Site Name: Malaya Vorontsovskaya	Date 10/7/04	Context No Section O – P Layer 3 (lower)	Luminescence Sample No EFD4L075
Description of sampling location:		**Sketch of surrounding area**	
Tube sample from lower layer 3. Grey-brown "loam" with occasional limestone. Sealed by layer 2: Diffuse/uneven boundary. Grey (greenish) – brown "loam". Seals layer 4: Darker and has less limestone 67 cm below datum 22.5 cm left from planning line at RHS of section 5 cm above boundary Layer 3 – Layer 4			
		Photo No:	
Gamma **Dosimetry**	**Reading** EFD4G027	**Assoc. Sample** ZLB for lab γ	**Ref No** -
Details:			
Rainbow MCA, 2"´2" NaI Probe, 600 s counting time Hole Depth = ? cm Est. Solid Angle = 4π Gamma dose rate = 0.41 ± 0.02 Material actually appears to have significantly higher dose rate than upper part of layer 3			
Description of Sample:			
15 cm × 3 cm $\varnothing$ stainless steel tube in zip lock bag with loose sediment for high-resolution lab γ. Total mass as sampled ~ 1 kg.			
Nature of Dating Problem:			
Constrain age range of layer 3 - thickest Middle Palaeolithic layer at the site: Should predate EFD4L074 and post-date EFD4L076			
Completed By	**Checked By**		**Date**
CIB			10/7/04

Site Code: Site Name: Malaya Vorontsovskaya	Date 10/7/04	Context No Section O – P Layer 4	Luminescence Sample No EFD4L076
Description of sampling location:		**Sketch of surrounding area**	

Tin sample from layer 4. Darker grey-brown "loam" than layer 3 with less limestone. Sealed by layer 3: Grey – brown "loam" with limestone. Seals layer 4: Alluvial sand and pebbles (silt-clay matrix) 77 cm below datum 19 cm left from planning line at RHS of section 7 cm below boundary Layer 3 – Layer 4 7 cm above boundary Layer 4 – Layer 5	
	Photo No:

Gamma	**Reading**	**Assoc. Sample**	**Ref No**
Dosimetry	EFD4G028	ZLB for lab γ	-
Details:			

Rainbow MCA, 2"´2" NaI Probe, 600 s counting time
Hole Depth = ? cm
Est. Solid Angle = 4π
Gamma dose rate = 0.38 ± 0.02

Description of Sample:

$3 \times 3 \times 12.5$ cm stainless steel tin in zip lock bag with loose sediment for high-resolution lab γ. Total mass as sampled ~ 1 kg.
Tin knocked in, 2nd tin used to push further into the section. Exposed layer scraped off and lid placed. Tin then dug out and 2nd lid placed. Insulation tape around lids and duct tape to secure.

Nature of Dating Problem:

Date for layer 4: Oldest Middle Palaeolithic layer at the site:
Thin layer discrete from layer 3, should predate EFD4L075

Completed By	**Checked By**	**Date**	
CIB		10/7/04	

Site Code: Site Name:	Date	Context No	Luminescence Sample No
Malaya Vorontsovskaya	10/7/04	Modern sample	EFD4L077

Description of sampling location:		Sketch of surrounding area	
Surface scraping from ~7m further into the cave than the sampled section: Just beyond the limit of excavation of Upper Palaeolithic material mentioned by Liubin. But is it spoil from that excavation? Also, it is much darker at this point in the cave…Plus much limestone.			

		Photo No:	
Gamma Dosimetry	**Reading**	**Assoc. Sample**	**Ref No**
	-	-	-

Details:

-

Description of Sample:

Plastic pot 50 – 100 g + Lstone Clast

Nature of Dating Problem:

Modern sample to examine bleaching of material in cave at present

Completed By	Checked By	Date	
CIB		10/7/04	

Site Code: Site Name: Malaya Vorontsovskaya	Date 10/7/04	Context No Modern soil above cave	Luminescence Sample No EFD4L078 & 79
Description of sampling location:		**Sketch of surrounding area**	
Bagged soil; samples from top and bottom of forest soil/colluvium. Large tube inserted for field gamma spectrometry measurement. Samples dug/removed from top and bottom of material in tube. NOT LIGHT PROTECTED.			
		Photo No:	

Gamma	Reading	Assoc. Sample	Ref No
Dosimetry	EFD4G026	-	-
Details:			

Rainbow MCA, 2"´2" NaI Probe, 600 s counting time
Hole Depth = 20 cm ~vertical into soil. Limestone fragments stopped further penetration of the over cutting tube.
Est. Solid Angle = 4π for reading low in hole.
^{137}Cs peak evident – from forest litter, thus use Ch2 (>1350 keV):
Gamma dose rate = Natural 0.42 ± 0.02, ^{137}Cs 0.125 ± 0.02

Description of Sample:

Zip lock bags with sediment, primarily for comparison on basis of composition and radioactivity.
Upper appears humic and dark brown.
Lower appears red-brown, clayey and contains limestone.
Note: Also, 1 bag forest litter collected outside cave entrance by David – zip locked, no sample number.

Nature of Dating Problem:

Comparison of material above and inside cave – composition and radioactivity – NOT colluvial bleaching experiment

Completed By	Checked By	Date	
CIB		10/7/04	

Site Code: Site Name: Akhshtyr	Date 13/7/04	Context No Whole section: Profile samples	Luminescence Sample No EFD4L080 - 100
Description of sampling location:		**Sketch of surrounding area**	

Description of sampling location	Sketch of surrounding area		
21 small samples taken every 10 cm down section from datum, from areas cleaned by trowel, or from behind stones removed immediately before sampling each point. Excavated into bags in Upper Pal layers (5), small tubes used in less stony Middle Pal layers (16). Minimal light exposure.	EFD4L080	0 cm	Layer 2
	EFD4L081	10 cm	Layer 2
	EFD4L082	20 cm	Layer 2
	EFD4L083	30 cm	Layer 2
	EFD4L084	40 cm	Layer 2
	EFD4L085	50 cm	Layer 3a
	EFD4L086	60 cm	Layer 3a
	EFD4L087	70 cm	Layer 3a
	EFD4L088	80 cm	Layer 3
	EFD4L089	90 cm	Layer 3
	EFD4L090	100 cm	Layer 3
	EFD4L091	110 cm	Layer 3-4 hearth
	EFD4L092	120 cm	Layer 4
	EFD4L093	130 cm	Layer 4
	EFD4L094	140 cm	Layer 4
	EFD4L095	150 cm	Layer Z
	EFD4L096	160 cm	Layer 5
	EFD4L097	170 cm	Layer 5
	EFD4L098	180 cm	Layer 6
	EFD4L099	190 cm	Layer 7
	EFD4L100	200 cm	Layer 7
	Photo No:		

Gamma Dosimetry	Reading -	Assoc. Sample -	Ref No -

Details:

Any dosimetry to be based on tube / tin samples from the same section.

Description of Sample:

Layer 2 (stony): Small samples (~1g) trowelled out into small zip-lock bags, after cleaning off material or removal of stone under space blanket. Zip lock bags placed immediately into black bag, doubled and sealed after all samples collected.
Below Layer 2: Less stony – 1 cm diameter x 2 cm length tubes. Black insulting tape around tubes upon excavation, labelled with duct tape and black bagged together.

Nature of Dating Problem:

Define progression of sequence

Completed By	Checked By	Date	
CIB		14/7/04	

Site Code: Site Name: Akhshtyr	Date 13/7/04	Context No Layer 2	Luminescence Sample No EFD4L101
Description of sampling location:		**Sketch of surrounding area**	

Tube sample from layer 2. Lowermost Upper Palaeolithic layer, brown loam with lots of limestone rubble. Sealed by: Layers above 2 had been removed by previous excavation. Seals: Layer 3a - Fine red-brown sediment with little stone – Middle Palaeolithic. Note: lowermost ~10 cm of Layer 2 has red-brown fine sediment similar to Layer 3a, but retains large amounts of limestone rubble. 37 cm below datum 70 cm left from cave wall 20 cm above boundary Layer 2 – Layer 3a 10 cm above change to redder fines in Layer 2	
	Photo No:

Gamma	**Reading**	**Assoc. Sample**	**Ref No**
Dosimetry	EFD4G035	ZLB for lab γ	-

Details:

Rainbow MCA, 2''´2'' NaI Probe, 600 s counting time
Hole Depth = 13 cm
Est. Solid Angle = 4 π
Gamma dose rate = 0.28 ± 0.02

Description of Sample:

15 cm × 3 cm ∅ stainless steel tube in zip lock bag with loose sediment for high-resolution lab γ and (separately bagged) limestone clast sample. Total mass as sampled ~ 1 kg.

Nature of Dating Problem:

Date for oldest Upper Palaeolithic layer at the site, which will also constrain the Middle Pal sequence. Age (derived from [14]C?) of 19 ± 5 ka given in pollen diagram, which indicates OIS2.
Sequence of Pollen and Magnetic Susceptibility (high in Upper Pal)
Should postdate EFD4L102

Completed By	**Checked By**	**Date**
CIB		14/7/04

Site Code: Site Name:		Date	Context No	Luminescence Sample No
Akhshtyr		13/7/04	Layer 3a	EFD4L102
Description of sampling location:			**Sketch of surrounding area**	
Tin sample from Layer 3a. Uppermost Middle Palaeolithic layer, red-brown silty clay. Sealed by: Layer 2 - Upper Palaeolithic layer - brown loam with lots of limestone rubble. Seals: Layer 3 – Similar to 3a but more sandy. 67 cm below datum 105 cm left from cave wall 10 cm below boundary Layer 2 – Layer 3a 20 cm above boundary Layer 3a – Layer 3				
			Photo No:	
Gamma	**Reading**		**Assoc. Sample**	**Ref No**
Dosimetry	EFD4G036		ZLB for lab γ	-
Details:				
Rainbow MCA, 2"´2" NaI Probe, 600 s counting time Hole Depth = 14 cm Est. Solid Angle = 4π Gamma dose rate = 0.76 ± 0.04 DR much higher than above $\Rightarrow$ Clay / Loess?				
Description of Sample:				
$3 \times 3 \times 12.5$ cm stainless steel tin in zip lock bag with loose sediment for high-resolution lab γ. Total mass as sampled ~ 1 kg. Tin knocked in, 2nd tin used to push further into the section. Insulation tape around lids and duct tape to secure. Surfaces exposed to light before is placed – remove.				
Nature of Dating Problem:				
Date for youngest Middle Pal on site. U Series on fallen stalactite gives age of 35 ka, but with $\pm$ 2 ka errors. The deposit should predate the 19 ka age from Layer 2, and a late OIS 3 age was allocated on the basis of pollen etc. Discussions on site indicate some evidence of a mixed archaeological assemblage in Layer 3a (presumably mixed Upper and Middle Pal), but it apparently includes human remains and may thus be important.				
Completed By	**Checked By**		**Date**	
CIB			14/7/04	

Site Code: Site Name: Akhshtyr	Date 13/7/04	Context No Layer 3	Luminescence Sample No EFD4L103
Description of sampling location:		**Sketch of surrounding area**	
Tin sample from Layer 3. Lower in uppermost Middle Palaeolithic layer, below evidence for mixing - red-brown silty clay (more sandy than Layer 3a). Sealed by: Layer 2 - Upper Palaeolithic layer - brown loam with lots of limestone rubble. Seals: Layer 4 – Grey clay with ashy hearths in upper part. 99 cm below datum 103 cm left from cave wall 10 cm below boundary Layer 3a – Layer 3 15 cm above boundary Layer 3 – Layer 4			
		Photo No:	

Gamma	**Reading**	**Assoc. Sample**	**Ref No**
Dosimetry	EFD4G037	ZLB for lab γ	-

Details:
Rainbow MCA, 2"´2" NaI Probe, 600 s counting time Hole Depth = 12 cm Est. Solid Angle = 4 π Gamma dose rate = 0.75 ± 0.04 DR much higher than Layer 2 $\Rightarrow$ Clay / Loess?

Description of Sample:
$3 \times 3 \times 12.5$ cm stainless steel tin in zip lock bag with loose sediment for high-resolution lab γ. Total mass as sampled ~ 1 kg. Tin knocked in, 2nd tin used to push further into the section. Outer surface scraped off as lid placed, but inner surface exposed to light before lid placed – tin distorted on insertion – remove. Insulation tape around lids and duct tape to secure.

Nature of Dating Problem:
More solid date for youngest Middle Pal on site, without mixing effects. The deposit should predate the 19 ka age from Layer 2, and a late OIS 3 age was allocated on the basis of pollen etc. Constrain age of "mixed" horizon.

Completed By	**Checked By**	**Date**
CIB		14/7/04

Site Code: Site Name: Akhshtyr	Date 13/7/04	Context No Layer 5	Luminescence Sample No EFD4L104
Description of sampling location:		**Sketch of surrounding area**	
Tin sample from Layer 5. Lowermost Middle Palaeolithic layer - grey clay. Sealed by: Layer Z – red clay. Seals: Layer 6 – red clay. 172 cm below datum 78 cm left from cave wall			
		Photo No:	

Gamma **Dosimetry**	Reading EFD4G038	Assoc. Sample ZLB for lab γ	Ref No -

Details:

Rainbow MCA, 2"×2" NaI Probe, 600 s counting time
Hole Depth = ? cm
Est. Solid Angle = 4π
Gamma dose rate = 0.89 ± 0.04
DR much higher than Layer 2 $\Rightarrow$ Clay / Loess?, also somewhat higher than Layer 3 $\Rightarrow$ different composition of clay???

Description of Sample:

$3 \times 3 \times 12.5$ cm stainless steel tin in zip lock bag with loose sediment for high-resolution lab γ. Total mass as sampled ~ 1 kg.
Tin knocked in, 2nd tin used to push further into the section. Outer surface scraped off as lid placed, but inner surface exposed to light before lid placed – tin distorted on insertion – remove. Insulation tape around lids and duct tape to secure.

Nature of Dating Problem:

Date for oldest Middle Palaeolithic layer, to indicate age range of occupation possibilities. Date of 112 ± 22 ka (Levkovskaya, pers. comm.), and ascribed to OIS 5 on the basis of pollen etc.
Note: possibilities of re-deposition
D.W.S. thinks: series of erosion and deposition,
E.V.B. thinks: re-deposition such that Layer Z = Layer 6, and Layer 4 = Layer 5.

Completed By	Checked By	Date
CIB		14/7/04

Site Code: Site Name: Kepshinskaya	Date 14/7/04	Context No Modern sample	Luminescence Sample No EFD4L105
Description of sampling location:		**Sketch of surrounding area**	
Surface scraping of colluvium from just into the cave proper, next to the section to be sampled. Animal (goat?) tracks evident in area of sampling – bioturbation! Bagged with adjacent clasts.			
		Photo No:	

Gamma **Dosimetry**	**Reading** -	**Assoc. Sample** -	**Ref No** -

Details:

-

Description of Sample:

Plastic pot 5 cm x 5 cm diameter, plus zip lock bag of limestone clasts. Total ~ 500 g

Nature of Dating Problem:

Test bleaching of modern material & presence of minerals from limestone. Second opening in cave results in through-colluviation – this would not have been present for much of the archaeological record. However, the presence of animal tracks gives a "natural" context.

Completed By	**Checked By**	**Date**
CIB		14/7/04

Site Code: Site Name: Kepshinskaya		Date 15/7/04	Context No Whole section: Profile samples	Luminescence Sample No EFD4L106 - 120
Description of sampling location:			**Sketch of surrounding area**	
15 small tube samples taken every 10 cm down section from datum, from areas cleaned by trowel, or from behind stones removed immediately before sampling each point. Minimal light exposure. Dog leg through rocky section to include the lower part of layer 3, in which had been found the artefacts.			EFD4L106 0 cm Layer 3 EFD4L107 10 cm Layer 3 EFD4L108 20 cm Layer 3 EFD4L109 30 cm Layer 3 EFD4L110 40 cm Layer 3 EFD4L111 50 cm Layer 3 EFD4L112 60 cm Layer 3 EFD4L113 70 cm Layer 3 EFD4L114 80 cm Layer 3 EFD4L115 90 cm Layer 3 EFD4L116 100 cm Layer 3 EFD4L117 110 cm Layer 4 EFD4L118 120 cm Layer 4 EFD4L119 130 cm Layer 4 EFD4L120 140 cm Layer 4 **Photo No:**	
Gamma Dosimetry	**Reading** -		**Assoc. Sample** -	**Ref No** -
Details:				
Any dosimetry to be based on tube / tin samples from the same section.				
Description of Sample:				
1 cm diameter x 2 cm length tubes. Black insulting tape around tubes upon excavation, labelled with duct tape and black bagged together.				
Nature of Dating Problem:				
Identify progression / discontinuities in sequence – assess value of dating. Potentially to define ages relative to tube/tin samples.				
Completed By		**Checked By**		**Date**
CIB				15/7/04

Site Code: Site Name:		Date	Context No	Luminescence Sample No
Kepshinskaya		15/7/04	Layer 3 (upper)	EFD4L121
Description of sampling location:			**Sketch of surrounding area**	
Tube sample from the upper part of layer 3, away from boundaries and stones. Yellowish brown silty clay. Sealed by: Layers 1 & 2, loose reddish clay-loam with limestone. Seals: Layer 4 – Yellow / greenish brown sandy silt 25 cm below datum 42 cm left from RHS of section 17 cm above large limestone clast in lower layer 3				
			Photo No:	
Gamma Dosimetry	**Reading**		**Assoc. Sample**	**Ref No**
	EFD4G045		ZLB for lab γ	-
Details:				
Rainbow MCA, 2"´2" NaI Probe, 600 s counting time Hole Depth = 18 cm Est. Solid Angle = 4 π Gamma dose rate = 0.69 ± 0.04 (fairly high = hottish clay)				
Description of Sample:				
15 cm × 3 cm $\varnothing$ stainless steel tube in zip lock bag with loose sediment for high resolution lab γ. Total mass as sampled ~ 1 kg.				
Nature of Dating Problem:				
Provide date for upper part of Mousterian – ties in pollen data. Constrain age of tool assemblage found lower in layer 3 amongst rocks. Layer 3 = "floating OI stage" – identify which one. Note: apparent unconformity at top of Layer 3 means that dates cannot indicate whole age range of Mousterian at Kepshinskaya.				
Completed By		**Checked By**	**Date**	
CIB			14/7/04	

Site Code: Site Name:		Date	Context No	Luminescence Sample No
Kepshinskaya		15/7/04	Layer 3 (lower)	EFD4L122
Description of sampling location:			**Sketch of surrounding area**	
Tube sample from the lower part of Layer 3, associated with tools etc. Yellowish brown silty clay - as for upper Layer 3, but many limestone clasts large and small (< 40 cm). Sealed by: Layers 1 & 2, loose reddish clay-loam with limestone. Seals: Layer 4 – Yellow / greenish brown sandy silt 94 cm below datum 18 cm left from RHS of section 15 cm above boundary with Layer 4 8 cm below large limestone boulder in lower layer 3				
			Photo No:	
Gamma	**Reading**		**Assoc. Sample**	**Ref No**
Dosimetry	EFD4G046		ZLB for lab γ	-
Details:				
Rainbow MCA, 2"´2" NaI Probe, 600 s counting time Hole Depth = 13 cm Est. Solid Angle = 4 π Gamma dose rate = 0.39 ± 0.02 DR much lower than EFD4G045 above – similar fine material but reduced solely because of more limestone?				
Description of Sample:				
15 cm × 3 cm $\varnothing$ stainless steel tube in zip lock bag with loose sediment for high resolution lab γ. Total mass as sampled ~ 1 kg.				
Nature of Dating Problem:				
Date for lower part of Mousterian layer containing tools, below large rocks. Tie in pollen, provide upper age for Mousterian at Kepshinskaya.				
Completed By		**Checked By**		**Date**
CIB				15/7/04

Appendix 3.3   Field gamma spectrometry forms

Log No.		Instrument	Rainbow No.1
Filename	EFD4G018.asc (EFD4G---.asc)	Detector	2"x 2"
Project	EFCHED	Conversion Factors	Ch1 = 1.95 E-02 Ch2 = 1.07 E-01 (mGy/a/cps)
Site	Navalishinskaya	Measurement Date	08/07/04
Context	1	Spectrum No.	6

		Field	Analysis (Package = Rainbow3)		
^{40}K in Ch.		487	(1432 keV)		
Ch. Width (eV)		3			
Count Time(s)	600	Ch1 (>450KeV)	Ch1 (>450KeV)	Ch2 (>1350KeV)	E
Integral Counts		6496	6511	1298	
Count Rate (cps)		10.82	10.85	2.16	
Dose Rate (mGy/a)		0.21	0.211	0.230	0.226
Error		0.003	0.01	0.01	0.01
Mean Dose Rate (mGy/a)			0.22		
Location and geometry Geometry: ~ π at surface of section, Hole depth = cm					
Estimated solid angle (π Rad.)	4π but???	4π Gamma dose rate (mGy/a)		0.22 ± 0.01	

TL Samples	
	EFD4L047

Date	08/07/04
Completed By	CIB
Checked By	

Log No.		Instrument	Rainbow No.1
Filename	EFD4G019.asc (EFD4G---.asc)	Detector	2"x 2"
Project	EFCHED	Conversion Factors	Ch1 = 1.95 E-02 Ch2 = 1.07 E-01 (mGy/a/cps)
Site	Navalishinskaya	Measurement Date	08/07/04
Context	3 (Upper)	Spectrum No.	5

		Field	Analysis (Package = Rainbow3)		
^{40}K in Ch.		487	(1521 keV)		
Ch. Width (eV)		3			
Count Time(s)	600	Ch1 (>450KeV)	Ch1 (>450KeV)	Ch2 (>1350KeV)	E
Integral Counts		7502	7370	1464	
Count Rate (cps)		12.5	12.28	2.44	
Dose Rate (mGy/a)		0.243	0.24	0.26	0.255
Error		0.003	0.01	0.014	0.01
Mean Dose Rate (mGy/a)		0.252			

Location and geometry
Geometry: ~ π at surface of section,
Hole depth = cm

Estimated solid angle (π Rad.)	4π	4π Gamma dose rate (mGy/a)	0.25 ± 0.01

TL Samples		Date	08/07/04
EFD4L048		Completed By	CIB
		Checked By	

3 DSR Sochi Region

Log No.		Instrument	Rainbow No.1
Filename	EFD4G020.asc (EFD4G---.asc)	**Detector**	2"x 2"
Project	EFCHED	**Conversion Factors**	Ch1 = 1.95 E-02 Ch2 = 1.07 E-01 (mGy/a/cps)
Site	Navalishinskaya	**Measurement Date**	08/07/04
Context	3 (Lower)	**Spectrum No.**	4

		Field	**Analysis (Package = Rainbow3)**		
^{40}K in Ch.		487	(1430 keV)		
Ch. Width (eV)		3			
Count Time(s)	600	**Ch1 (>450KeV)**	**Ch1 (>450KeV)**	**Ch2 (>1350KeV)**	**E**
Integral Counts		7412	7421	1445	
Count Rate (cps)		12.35	12.37	2.41	
Dose Rate (mGy/a)		0.24	0.241	0.256	0.253
Error		0.003	0.012	0.014	0.012
Mean Dose Rate (mGy/a)		0.25			

Location and geometry

Geometry: ~ π at surface of section,

Hole depth = cm

Estimated solid angle (π Rad.)	4π	**4π Gamma dose rate (mGy/a)**	0.25 ± 0.01

TL Samples		**Date**	08/07/04
EFD4L049		**Completed By**	CIB
		Checked By	

Log No.		Instrument	Rainbow No.1
Filename	EFD4G021.asc (EFD4G---.asc)	**Detector**	2"x 2"
Project	EFCHED	**Conversion Factors**	Ch1 = 1.95 E-02 Ch2 = 1.07 E-01 (mGy/a/cps)
Site	Navalishinskaya	**Measurement Date**	08/07/04
Context	4 (Upper - Mid)	**Spectrum No.**	3

		Field	**Analysis (Package = Rainbow3)**		
^{40}**K in Ch.**		487	(1432 keV)		
Ch. Width (eV)		3			
Count Time(s)	600	**Ch1 (>450KeV)**	**Ch1 (>450KeV)**	**Ch2 (>1350KeV)**	**E**
Integral Counts		6876	6999	1387	
Count Rate (cps)		11.46	11.67	2.31	
Dose Rate (mGy/a)		0.22	0.227	0.246	0.240
Error		0.003	0.012	0.013	0.012
Mean Dose Rate (mGy/a)		0.238			

Location and geometry
Geometry: ~ π at surface of section,
Hole depth = cm

Estimated solid angle (π Rad.)	4π	**4π Gamma dose rate (mGy/a)**	0.24 ± 0.01

TL Samples		**Date**	08/07/04
EFD4L050		**Completed By**	CIB
		Checked By	

Log No.		Instrument	Rainbow No.1
Filename	EFD4G022.asc (EFD4G---.asc)	Detector	2"x 2"
Project	EFCHED	Conversion Factors	Ch1 = 1.95 E-02 Ch2 = 1.07 E-01 (mGy/a/cps)
Site	Navalishinskaya	Measurement Date	08/07/04
Context	4 (Lower)	Spectrum No.	2

		Field	Analysis (Package = Rainbow3)		
^{40}K in Ch.		487	492 (1480 keV)		
Ch. Width (eV)		3			
Count Time(s)	600	Ch1 (>450KeV)	Ch1 (>450KeV)	Ch2 (>1350KeV)	E
Integral Counts		6588	6636	1292	
Count Rate (cps)		10.98	11.06	2.15	
Dose Rate (mGy/a)		0.214	0.216	0.229	0.227
Error		0.003	0.011	0.013	0.011
Mean Dose Rate (mGy/a)			0.224		

Location and geometry
Geometry: ~ π at surface of section,
Hole depth = cm

Estimated solid angle (π Rad.)	4π	4π Gamma dose rate (mGy/a)	0.22 ± 0.01

TL Samples		Date	08/07/04
EFD4L051		Completed By	CIB
		Checked By	

Log No.		Instrument	Rainbow No.1
Filename	EFD4G023.asc (EFD4G---.asc)	**Detector**	2"x 2"
Project	EFCHED	**Conversion Factors**	Ch1 = 1.95 E-02 Ch2 = 1.07 E-01 (mGy/a/cps)
Site	Navalishinskaya	**Measurement Date**	08/07/04
Context	5 (Lowest ashy layer)	**Spectrum No.**	1

		Field	Analysis (Package = Rainbow3)		
^{40}K in Ch.		487	480 (1426 keV)		
Ch. Width (eV)		3			
Count Time(s)	600	**Ch1 (>450KeV)**	**Ch1 (>450KeV)**	**Ch2 (>1350KeV)**	**E**
Integral Counts		7316	7551	1540	
Count Rate (cps)		12.19	12.59	2.57	
Dose Rate (mGy/a)		0.237	0.245	0.273	0.255
Error		0.003	0.013	0.015	0.013
Mean Dose Rate (mGy/a)		0.255			
Location and geometry Geometry: ~ π at surface of section, Hole depth = cm					
Estimated solid angle (π Rad.)	4π	**4π Gamma dose rate (mGy/a)**	0.26 ± 0.01		

TL Samples		Date	08/07/04
EFD4L052		**Completed By**	CIB
		Checked By	

Log No.		Instrument	Rainbow No.1
Filename	EFD4G024.asc (EFD4G---.asc)	Detector	2"x 2"
Project	EFCHED	Conversion Factors	Ch1 = 1.95 E-02 Ch2 = 1.07 E-01 (mGy/a/cps)
Site	Navalishinskaya	Measurement Date	08/07/04
Context	Limestone: hole in cave wall near to section	Spectrum No.	7

		Field	Analysis (Package = Rainbow3)		
^{40}K in Ch.		487	480 (1512 keV)		
Ch. Width (eV)		3			
Count Time(s)	600	Ch1 (>450KeV)	Ch1 (>450KeV)	Ch2 (>1350KeV)	E
Integral Counts		2187	2156	366	
Count Rate (cps)		3.645	3.59	0.61	
Dose Rate (mGy/a)		0.071	0.07	0.065	0.076
Error		0.001	0.004	0.005	0.004
Mean Dose Rate (mGy/a)		0.07			
Location and geometry					
Estimated solid angle (π Rad.)	4π	**4π Gamma dose rate (mGy/a)**	0.070 $\pm$ 0.005		

TL Samples	
-	

Date	08/07/04
Completed By	CIB
Checked By	

Log No.		Instrument	Rainbow No.1
Filename	EFD4G025.asc (EFD4G---.asc)	**Detector**	2"x 2"
Project	EFCHED	**Conversion Factors**	Ch1 = 1.95 E-02 Ch2 = 1.07 E-01 (mGy/a/cps)
Site	Malaya Vorontsovskaya	**Measurement Date**	10/07/04
Context	2	**Spectrum No.**	1

		Field	**Analysis (Package = Rainbow3)**		
^{40}**K in Ch.**		487	489 (1467 keV)		
Ch. Width (eV)		3			
Count Time(s)	600	**Ch1 (>450KeV)**	**Ch1 (>450KeV)**	**Ch2 (>1350KeV)**	**E**
Integral Counts		10413	10530	2163	
Count Rate (cps)		17.36	17.55	3.61	
Dose Rate (mGy/a)		0.34	0.34	0.38	0.36
Error		0.02	0.01	0.02	0.01
Mean Dose Rate (mGy/a)		0.36			

Location and geometry
Geometry: ~3.8 π at surface of section,
Hole depth = cm

Estimated solid angle (π Rad.)	4π	**4π Gamma dose rate (mGy/a)**	0.36 ± 0.02

TL Samples		**Date**	10/07/04
EFD4L073		**Completed By**	CIB
		Checked By	

Log No.		Instrument	Rainbow No.1
Filename	EFD4G026.asc (EFD4G---.asc)	Detector	2"x 2"
Project	EFCHED	Conversion Factors	Ch1 = 1.95 E-02 Ch2 = 1.07 E-01 (mGy/a/cps)
Site	Malaya Vorontsovskaya	Measurement Date	10/07/04
Context	3 (Upper)	Spectrum No.	2

		Field	Analysis (Package = Rainbow3)		
^{40}K in Ch.		487	486 (1455 keV)		
Ch. Width (eV)		3	Spectrum inadvertently overwritten		
Count Time(s)	600	Ch1 (>450KeV)	Ch1 (>450KeV)	Ch2 (>1350KeV)	E
Integral Counts		10823			
Count Rate (cps)		18.04			
Dose Rate (mGy/a)		0.352			
Error		0.02			
Mean Dose Rate (mGy/a)			0.352		

Location and geometry
Geometry: ~3.8 π at surface of section,
Hole depth = cm

Estimated solid angle (π Rad.)	4π	4π Gamma dose rate (mGy/a)	0.35 ± 0.02

TL Samples		Date	10/07/04
EFD4L074		Completed By	CIB
		Checked By	

Log No.		Instrument	Rainbow No.1
Filename	EFD4G027.asc (EFD4G---.asc)	Detector	2"x 2"
Project	EFCHED	Conversion Factors	Ch1 = 1.95 E-02 Ch2 = 1.07 E-01 (mGy/a/cps)
Site	Malaya Vorontsovskaya	Measurement Date	10/07/04
Context	3 (Lower)	Spectrum No.	3

		Field	Analysis (Package = Rainbow3)		
^{40}K in Ch.		487	503 (1509 keV)		
Ch. Width (eV)		3			
Count Time(s)	600	Ch1 (>450KeV)	Ch1 (>450KeV)	Ch2 (>1350KeV)	E
Integral Counts		12232	12111	2408	
Count Rate (cps)		20.34	20.19	4.01	
Dose Rate (mGy/a)		0.397	0.39	0.43	0.41
Error		0.02	0.01	0.02	0.01
Mean Dose Rate (mGy/a)		0.41			

Location and geometry
Geometry: ~3.8 π at surface of section,
Hole depth = cm

Estimated solid angle (π Rad.)	4π	4π Gamma dose rate (mGy/a)	0.41 ± 0.02

TL Samples		Date	10/07/04
EFD4L075		Completed By	CIB
		Checked By	

213

Log No.		Instrument	Rainbow No.1
Filename	EFD4G028.asc (EFD4G---.asc)	**Detector**	2"x 2"
Project	EFCHED	**Conversion Factors**	Ch1 = 1.95 E-02 Ch2 = 1.07 E-01 (mGy/a/cps)
Site	Malaya Vorontsovskaya	**Measurement Date**	10/07/04
Context	4	**Spectrum No.**	4

		Field	Analysis (Package = Rainbow3)		
^{40}**K in Ch.**		487	499 (1450 keV)		
Ch. Width (eV)		3			
Count Time(s)	600	**Ch1 (>450KeV)**	**Ch1 (>450KeV)**	**Ch2 (>1350KeV)**	**E**
Integral Counts		11142	11113	2276	
Count Rate (cps)		18.57	18.52	3.79	
Dose Rate (mGy/a)		0.362	0.36	0.40	0.38
Error		0.03	0.02	0.02	0.02
Mean Dose Rate (mGy/a)		0.38			

Location and geometry

Geometry: ~3.8 π at surface of section,

Hole depth = cm

Estimated solid angle (π Rad.)	4π	**4π Gamma dose rate (mGy/a)**	0.38 ± 0.02

TL Samples		**Date**	10/07/04
EFD4L076		**Completed By**	CIB
		Checked By	

Log No.		Instrument	Rainbow No.1
Filename	EFD4G029.asc (EFD4G---.asc)	Detector	2"x 2"
Project	EFCHED	Conversion Factors	Ch1 = 1.95 E-02 Ch2 = 1.07 E-01 (mGy/a/cps)
Site	Malaya Vorontsovskaya	Measurement Date	10/07/04
Context	Limestone grotto close to cave entrance	Spectrum No.	5

		Field	Analysis (Package = Rainbow3)		
^{40}K in Ch.		487	504 (1476 keV)		
Ch. Width (eV)		3			
Count Time(s)	600	Ch1 (>450KeV)	Ch1 (>450KeV)	Ch2 (>1350KeV)	E
Integral Counts		2423	2386	388	
Count Rate (cps)		4.03	3.98	0.75	
Dose Rate (mGy/a)		0.079	0.08	0.07	0.086
Error			0.004	0.005	0.004
Mean Dose Rate (mGy/a)		0.08			

Location and geometry
Geometry: ~ π at surface of section,
Hole depth = cm

Estimated solid angle (π Rad.)	3.8π	4π Gamma dose rate (mGy/a)	0.08 ± 0.01

TL Samples		Date	10/07/04
-		Completed By	CIB
		Checked By	

Log No.		Instrument	Rainbow No.1
Filename	EFD4G026.asc (EFD4G---.asc)	**Detector**	2"x 2"
Project	EFCHED	**Conversion Factors**	Ch1 = 1.95 E-02 Ch2 = 1.07 E-01 (mGy/a/cps)
Site	Malaya Vorontsovskaya	**Measurement Date**	10/07/04
Context	Soil on hillside above cave	**Spectrum No.**	6

		Field	Analysis (Package = Rainbow3)		
^{40}**K in Ch.**		487	486 (1458 keV)		
Ch. Width (eV)		3	3.0082		
Count Time(s)	600	**Ch1 (>450KeV)**	**Ch1 (>450KeV)**	**Ch2 (>1350KeV)**	**E**
Integral Counts		16482	16601	2362	
Count Rate (cps)		27.47	27.67	3.94	
Dose Rate (mGy/a)		0.53	0.54	0.42	0.55
Error			0.03	0.02	0.03
Mean Dose Rate (mGy/a)			0.50, but Natural = 0.42, ^{137}Cs = 0.125		

Location and geometry

Geometry: ~ 2π at surface,

Hole depth = 20 cm

Liubin has described how the cave sediments at Malaya Vorontsovskaya may derive from the soils above the cave, by being worked down into the caves through cracks in the limestone. If it is the same material it may have a similar dose rate.

^{137}Cs is clearly present near the modern surface, so use Channel 2 for the natural dose rate. Also, any very rapid transport would result in a ^{137}Cs signal from sediments inside the cave too.

Estimated solid angle (π Rad.)	4π	**4π Gamma dose rate (mGy/a)**	Natural 0.42 ± 0.02 ^{137}Cs 0.125 ± 0.02

TL Samples		**Date**	10/07/04
EFD4L078		**Completed By**	CIB
EFD4L079		**Checked By**	

Log No.		Instrument	Rainbow No.1
Filename	EFD4G030.asc (EFD4G---.asc)	Detector	2"x 2"
Project	EFCHED	Conversion Factors	Ch1 = 1.95 E-02 Ch2 = 1.07 E-01 (mGy/a/cps)
Site	Malaya Vorontsovskaya	Measurement Date	10?/07/04
Context	Path in forest near cave	Spectrum No.	7?

		Field	Analysis (Package = Rainbow3)		
^{40}K in Ch.		487	497 (1491 keV)		
Ch. Width (eV)		3	2.942		
Count Time(s)	600	Ch1 (>450KeV)	Ch1 (>450KeV)	Ch2 (>1350KeV)	E
Integral Counts		11378	11219	889	
Count Rate (cps)		18.96	18.69	1.48	
Dose Rate (mGy/a)		0.37	0.34	0.158	0.335
Error			0.01	0.02	0.01
Mean Dose Rate (mGy/a)			0.28, but Natural = 0.16, ^{137}Cs = 0.19		
Location and geometry Geometry: ~ 2π at surface, Hole depth = 0 cm ^{137}Cs is clearly present at the modern surface, so use Channel 2 for the natural dose rate. On path with forest litter, ~ 10 m below level of cave floor, showing evidence of ^{137}Cs in modern organic layers.					
Estimated solid angle (π Rad.)	2π	4π Gamma dose rate (mGy/a)	Natural 0.32 ± 0.04 ^{137}Cs 0.38 ± 0.04		

TL Samples	
-	

Date	10/07/04
Completed By	CIB
Checked By	

Log No.		Instrument	Rainbow No.1
Filename	EFD4G031.asc (EFD4G---.asc)	**Detector**	2"x 2"
Project	EFCHED	**Conversion Factors**	Ch1 = 1.95 E-02 Ch2 = 1.07 E-01 (mGy/a/cps)
Site	Malaya Vorontsovskaya	**Measurement Date**	10/07/04
Context	By car park	**Spectrum No.**	8?

		Field	Analysis (Package = Rainbow3)		
^{40}K in Ch.		487	480 (1440 keV)		
Ch. Width (eV)		3			
Count Time(s)	600	**Ch1 (>450KeV)**	**Ch1 (>450KeV)**	**Ch2 (>1350KeV)**	**E**
Integral Counts			6409	847	
Count Rate (cps)			10.68	9.41	
Dose Rate (mGy/a)			0.21	0.15	0.21
Error			0.01	0.01	0.01
Mean Dose Rate (mGy/a)			0.19, but Natural = 0.15, ^{137}Cs = 0.06		

Location and geometry
Geometry: ~ 2π at surface,
Hole depth = 0 cm

^{137}Cs is present at the modern surface, so use Channel 2 for the natural dose rate.

Next to car park, also showing (non deeply buried) ^{137}Cs.

Estimated solid angle (π Rad.)	2π	**4π Gamma dose rate (mGy/a)**	Natural 0.30 ± 0.02 ^{137}Cs 0.12 ± 0.02

TL Samples		**Date**	10/07/04
-		**Completed By**	CIB
		Checked By	

3 DSR Sochi Region

Log No.		Instrument	Rainbow No.1
Filename	EFD4G032.asc (EFD4G---.asc)	Detector	2"x 2"
Project	EFCHED	Conversion Factors	Ch1 = 1.95 E-02 Ch2 = 1.07 E-01 (mGy/a/cps)
Site	Akhstyr	Measurement Date	11/07/04
Context	Modern surface inside cave, close to wall	Spectrum No.	1

		Field	Analysis (Package = Rainbow3)		
^{40}K in Ch.		487	475 (1425 keV)		
Ch. Width (eV)		3			
Count Time(s)	600	Ch1 (>450KeV)	Ch1 (>450KeV)	Ch2 (>1350KeV)	E
Integral Counts		4488	4662	865	
Count Rate (cps)		~7.5	7.77	1.44	
Dose Rate (mGy/a)		~0.15	0.15	0.15	0.16
Error			0.01	0.01	0.01
Mean Dose Rate (mGy/a)			0.15		

Location and geometry
Geometry: ~ 2π floor, 4π including walls.
Hole depth = 0 cm

Halfway down cave – well inside

Limestone gravel (on clayey substrate) – material used to stabilise surface for tourist path

No ^{137}Cs

Estimated solid angle (π Rad.)	4π inc. walls	4π Gamma dose rate (mGy/a)	0.15 ± 0.01

TL Samples			Date	11/07/04
-			Completed By	CIB
			Checked By	

Log No.		Instrument	Rainbow No.1
Filename	EFD4G033.asc (EFD4G---.asc)	Detector	2"x 2"
Project	EFCHED	Conversion Factors	Ch1 = 1.95 E-02 Ch2 = 1.07 E-01 (mGy/a/cps)
Site	Akhshtyr	Measurement Date	11/07/04
Context	Mud piled at very end of cave	Spectrum No.	2

		Field	Analysis (Package = Rainbow3)		
^{40}K in Ch.		487	482 (1483 keV)		
Ch. Width (eV)		3			
Count Time(s)	600	Ch1 (>450KeV)	Ch1 (>450KeV)	Ch2 (>1350KeV)	E
Integral Counts		4426	4548	889	
Count Rate (cps)		~7.5	7.58	1.48	
Dose Rate (mGy/a)		~0.15	0.15	0.16	0.16
Error			0.01	0.01	0.01
Mean Dose Rate (mGy/a)			0.16		

Location and geometry
Geometry: ~ 1π mud, 4π including walls.
Hole depth = 0 cm

Very rear of cave – large grotto, on mud pile that may have washed in or may have been made so that people could climb up into the grotto.

No ^{137}Cs, peak in Ch 609 is ^{214}Bi

Estimated solid angle (π Rad.)	4π inc. walls	4π Gamma dose rate (mGy/a)	0.16 ± 0.01

TL Samples		Date	11/07/04
-		Completed By	CIB
		Checked By	

Log No.		Instrument	Rainbow No.1
Filename	EFD4G034.asc (EFD4G---.asc)	**Detector**	2"x 2"
Project	EFCHED	**Conversion Factors**	Ch1 = 1.95 E-02 Ch2 = 1.07 E-01 (mGy/a/cps)
Site	Akhshtyr	**Measurement Date**	11/07/04
Context	Outside entrance to cave	**Spectrum No.**	3

		Field	Analysis (Package = Rainbow3)		
^{40}**K in Ch.**		487	496 (1488 keV)		
Ch. Width (eV)		3			
Count Time(s)	600	**Ch1 (>450KeV)**	**Ch1 (>450KeV)**	**Ch2 (>1350KeV)**	**E**
Integral Counts		8847	8861	1232	
Count Rate (cps)		~14	14.8	2.05	
Dose Rate (mGy/a)		~0.28	0.29	0.22	0.29
Error			0.01	0.01	0.01
Mean Dose Rate (mGy/a)			0.267 but Natural = 0.22, ^{137}Cs = 0.07		

Location and geometry

Geometry: ~ 2π surface, ~3π cave & cliff behind.

Hole depth = 0 cm

Outside entrance of cave, close to gorge edge dropping down to river.

^{137}Cs is present at the modern surface, so use Channel 2 for the natural dose rate.

Estimated solid angle (π Rad.)	~3π	**4π Gamma dose rate (mGy/a)**	Natural 0.33 ± 0.02 ^{137}Cs 0.14 ± 0.02

TL Samples			**Date**	11/07/04
-			**Completed By**	CIB
			Checked By	

Log No.		Instrument	Rainbow No.1
Filename	EFD4G035.asc (EFD4G---.asc)	**Detector**	2"x 2"
Project	EFCHED	**Conversion Factors**	Ch1 = 1.95 E-02 Ch2 = 1.07 E-01 (mGy/a/cps)
Site	Akhshtyr	**Measurement Date**	13/07/04
Context	2	**Spectrum No.**	1

		Field	Analysis (Package = Rainbow3)		
^{40}**K in Ch.**		487	492 (1476 keV)		
Ch. Width (eV)		3			
Count Time(s)	600	**Ch1 (>450KeV)**	**Ch1 (>450KeV)**	**Ch2 (>1350KeV)**	**E**
Integral Counts		8237	8300	1609	
Count Rate (cps)		13.7	13.8	2.68	
Dose Rate (mGy/a)		0.27	0.27	0.29	0.28
Error			0.014	0.015	0.014
Mean Dose Rate (mGy/a)			0.28		
Location and geometry Geometry: ~3.5 π at surface of section, plus cave =~3.9 π Hole depth = 13 cm DR ~ 2 x 2 π DR from inside cave & see TL sample form					
Estimated solid angle (π Rad.)	4π	**4π Gamma dose rate (mGy/a)**	0.28 ± 0.02		

TL Samples		Date	13/07/04
EFD4L101		**Completed By**	CIB
		Checked By	

Log No.		Instrument	Rainbow No.1
Filename	EFD4G036.asc (EFD4G---.asc)	**Detector**	2"x 2"
Project	EFCHED	**Conversion Factors**	Ch1 = 1.95 E-02 Ch2 = 1.07 E-01 (mGy/a/cps)
Site	Akhshtyr	**Measurement Date**	13/07/04
Context	3a	**Spectrum No.**	2

		Field	Analysis (Package = Rainbow3)		
^{40}**K in Ch.**		487	486 (1444 keV)		
Ch. Width (eV)		3			
Count Time(s)	600	**Ch1 (>450KeV)**	**Ch1 (>450KeV)**	**Ch2 (>1350KeV)**	**E**
Integral Counts		21838	22262	4482	
Count Rate (cps)		36.4	37.1	7.47	
Dose Rate (mGy/a)		0.71	0.72	0.80	0.77
Error			0.04	0.04	0.04
Mean Dose Rate (mGy/a)			0.76		

Location and geometry

Geometry: ~3.5 π at surface of section, plus cave =~3.8 π

Hole depth = 14 cm

& see TL sample form

DR much higher than above $\Rightarrow$ Clay / Loess?

Spectrum appears balanced, but >450 lower than >1350 $\Rightarrow$ greater proportion of Th?

Energy range effects due to proximity of Layer 2 (with low dose rate)?

Estimated solid angle (π Rad.)	4π	**4π Gamma dose rate (mGy/a)**	0.76 $\pm$ 0.04

TL Samples		**Date**	13/07/04
EFD4L102		**Completed By**	CIB
		Checked By	

Log No.		Instrument	Rainbow No.1
Filename	EFD4G037.asc (EFD4G---.asc)	**Detector**	2"x 2"
Project	EFCHED	**Conversion Factors**	Ch1 = 1.95 E-02 Ch2 = 1.07 E-01 (mGy/a/cps)
Site	Akhshtyr	**Measurement Date**	13/07/04
Context	3	**Spectrum No.**	3

		Field	Analysis (Package = Rainbow3)		
^{40}K in Ch.		487	506 (1522 keV)		
Ch. Width (eV)		3			
Count Time(s)	600	**Ch1 (>450KeV)**	**Ch1 (>450KeV)**	**Ch2 (>1350KeV)**	**E**
Integral Counts		22701	22340	4288	
Count Rate (cps)		37.8	37.2	7.14	
Dose Rate (mGy/a)		0.74	0.73	0.76	0.76
Error			0.04	0.04	0.04
Mean Dose Rate (mGy/a)		0.75			

Location and geometry

Geometry: ~3.8 π at surface of section, plus cave =~4 π

Hole depth = 12 cm

& see TL sample form

Estimated solid angle (π Rad.)	4π	**4π Gamma dose rate (mGy/a)**	0.75 ± 0.04

TL Samples		**Date**	13/07/04
EFD4L103		**Completed By**	CIB
		Checked By	

Log No.		Instrument	Rainbow No.1
Filename	EFD4G038.asc (EFD4G---.asc)	**Detector**	2"x 2"
Project	EFCHED	**Conversion Factors**	Ch1 = 1.95 E-02 Ch2 = 1.07 E-01 (mGy/a/cps)
Site	Akhshtyr	**Measurement Date**	13/07/04
Context	5	**Spectrum No.**	4

		Field	Analysis (Package = Rainbow3)		
^{40}K in Ch.		487	499 (1441 keV)		
Ch. Width (eV)		3			
Count Time(s)	600	**Ch1 (>450KeV)**	**Ch1 (>450KeV)**	**Ch2 (>1350KeV)**	**E**
Integral Counts		26260	26133	5253	
Count Rate (cps)		43.8	43.6	8.8	
Dose Rate (mGy/a)		0.85	0.85	0.93	0.90
Error			0.04	0.05	0.04
Mean Dose Rate (mGy/a)			0.89		
Location and geometry Geometry: ~3.8 π at surface of section, plus cave =~4 π Hole depth = cm & see TL sample form					
Estimated solid angle (π Rad.)	4π	**4π Gamma dose rate (mGy/a)**	0.89 $\pm$ 0.04		

TL Samples		Date	13/07/04
EFD4L104		**Completed By**	CIB
		Checked By	

Log No.		Instrument	Rainbow No.1
Filename	EFD4G039.asc (EFD4G---.asc)	**Detector**	2"x 2"
Project	EFCHED	**Conversion Factors**	Ch1 = 1.95 E-02 Ch2 = 1.07 E-01 (mGy/a/cps)
Site	Akhshtyr	**Measurement Date**	13/07/04
Context	Niche in limestone wall of cave	**Spectrum No.**	5

		Field	**Analysis (Package = Rainbow3)**		
^{40}K in Ch.		487			
Ch. Width (eV)		3			
Count Time(s)	600	**Ch1 (>450KeV)**	**Ch1 (>450KeV)**	**Ch2 (>1350KeV)**	**E**
Integral Counts		2325	2308	438	
Count Rate (cps)		3.88	3.8	0.73	
Dose Rate (mGy/a)		0.076	0.075	0.077	0.081
Error			0.004	0.005	0.004
Mean Dose Rate (mGy/a)			0.078		

Location and geometry

Geometry: including cave wall ~ 4 π, but some dirt

Hole depth =   cm

Ledge cleaned, but some soil still around – not completely pure cave limestone signal

Estimated solid angle (π Rad.)	4π	**4π Gamma dose rate (mGy/a)**	0.078 ± 0.004

TL Samples		**Date**	13/07/04
-		**Completed By**	CIB
		Checked By	

Log No.		Instrument	Rainbow No.1
Filename	EFD4G040.asc (EFD4G---.asc)	Detector	2"x 2"
Project	EFCHED	Conversion Factors	Ch1 = 1.95 E-02 Ch2 = 1.07 E-01 (mGy/a/cps)
Site	Kepshinskaya	Measurement Date	14/07/04
Context	Forest litter on hillslope, ~200 m along from cave	Spectrum No.	1

		Field	Analysis (Package = Rainbow3)		
^{40}K in Ch.		487	489 (1467 keV)		
Ch. Width (eV)		3			
Count Time(s)	600	Ch1 (>450KeV)	Ch1 (>450KeV)	Ch2 (>1350KeV)	E
Integral Counts		6449	7089	691	
Count Rate (cps)		10.75	11.8	1.15	
Dose Rate (mGy/a)		0.21	0.23	0.12	0.22
Error			0.01	0.01	0.01
Mean Dose Rate (mGy/a)			0.19 but Natural = 0.12, ^{137}Cs = 0.11		

Location and geometry

Geometry: ~ 2π at surface,

Hole depth = 0 cm

^{137}Cs is present at the modern surface, so use Channel 2 for the natural dose rate.

Estimated solid angle (π Rad.)	2π	4π Gamma dose rate (mGy/a)	Natural 0.24 ± 0.02 ^{137}Cs 0.22 ± 0.02

TL Samples		Date	14/07/04
-		Completed By	CIB
		Checked By	

Log No.		Instrument	Rainbow No.1
Filename	EFD4G041.asc (EFD4G---.asc)	**Detector**	2"x 2"
Project	EFCHED	**Conversion Factors**	Ch1 = 1.95 E-02 Ch2 = 1.07 E-01 (mGy/a/cps)
Site	Kepshinskaya	**Measurement Date**	14/07/04
Context	Niche in limestone wall of cave	**Spectrum No.**	2

		Field	Analysis (Package = Rainbow3)		
^{40}K in Ch.		487	469 (1402 keV)		
Ch. Width (eV)		3			
Count Time(s)	600	**Ch1 (>450KeV)**	**Ch1 (>450KeV)**	**Ch2 (>1350KeV)**	**E**
Integral Counts		1817	1931	336	
Count Rate (cps)		3.03	3.22	0.56	
Dose Rate (mGy/a)		0.06	0.063	0.060	0.067
Error			0.004	0.004	0.003
Mean Dose Rate (mGy/a)		0.063			
Location and geometry Geometry: including cave wall ~ 4 π Hole depth = cm					
Estimated solid angle (π Rad.)	4π	**4π Gamma dose rate (mGy/a)**	0.063 ± 0.004		

TL Samples	
-	

Date	14/07/04
Completed By	CIB
Checked By	

Log No.		Instrument	Rainbow No.1
Filename	EFD4G042.asc (EFD4G---.asc)	Detector	2"x 2"
Project	EFCHED	Conversion Factors	Ch1 = 1.95 E-02 Ch2 = 1.07 E-01 (mGy/a/cps)
Site	Kepshinskaya	Measurement Date	14/07/04
Context	Surface outside cave	Spectrum No.	3

		Field	Analysis (Package = Rainbow3)		
^{40}K in Ch.		487	485 (1511 keV)		
Ch. Width (eV)		3			
Count Time(s)	600	Ch1 (>450KeV)	Ch1 (>450KeV)	Ch2 (>1350KeV)	E
Integral Counts		8635	8793	869	
Count Rate (cps)		14.4	14.65	1.45	
Dose Rate (mGy/a)		0.28	0.28	0.15	0.27
Error			0.01	0.01	0.01
Mean Dose Rate (mGy/a)			0.24 but Natural = 0.15, ^{137}Cs = 0.125		

Location and geometry

Geometry: ~ 2π ground surface, ~ 3 π including limestone cliff

Hole depth = 0 cm

^{137}Cs is present at the modern surface, so use Channel 2 for the natural dose rate.

Kepshinskaya is a through cave. This measurement was made outside the uphill entrance, close to the drop-off. The area was covered in leaf litter. This measurement was one of a series of surface measurements through the cave (EFD4G042, 43 and 44), to test how far in the ^{137}Cs signal was present, with possible implications for the rate of colluvial transport through the cave.

Estimated solid angle (π Rad.)	3π	4π Gamma dose rate (mGy/a)	Natural 0.23 ± 0.02 ^{137}Cs 0.19 ± 0.02

TL Samples		Date	14/07/04
-		Completed By	CIB
		Checked By	

Log No.		Instrument	Rainbow No.1
Filename	EFD4G043.asc (EFD4G---.asc)	Detector	2"x 2"
Project	EFCHED	Conversion Factors	Ch1 = 1.95 E-02 Ch2 = 1.07 E-01 (mGy/a/cps)
Site	Kepshinskaya	Measurement Date	14/07/04
Context	Surface inside cave	Spectrum No.	4

		Field	Analysis (Package = Rainbow3)		
^{40}K in Ch.		487	485 (1462 keV)		
Ch. Width (eV)		3			
Count Time(s)	600	Ch1 (>450KeV)	Ch1 (>450KeV)	Ch2 (>1350KeV)	E
Integral Counts		5713	5829	1137	
Count Rate (cps)		9.5	9.71	1.81	
Dose Rate (mGy/a)		0.18	0.19	0.20	0.20
Error			0.01	0.01	0.01
Mean Dose Rate (mGy/a)			0.20		

Location and geometry

Geometry: ~ 2π ground surface, ~ 4π including limestone cave

Hole depth = 0 cm

^{137}Cs is not present at the modern surface.

Kepshinskaya is a through cave. This measurement was one of a series of surface measurements through the cave (EFD4G042, 43 and 44), to test how far in the ^{137}Cs signal was present, with possible implications for the rate of colluvial transport through the cave. This measurement was made inside the uphill entrance, 8 m in from EFD4G042, just beyond where modern leaf litter was observed on the soil surface. The lack of ^{137}Cs signal here implies that it has not been washed/colluviated through on soil, and is still in the forest litter.

Estimated solid angle (π Rad.)	4π	4π Gamma dose rate (mGy/a)	Natural 0.20 ± 0.01

TL Samples		Date	14/07/04
-		Completed By	CIB
		Checked By	

Log No.		Instrument	Rainbow No.1
Filename	EFD4G044.asc (EFD4G---.asc)	**Detector**	2"x 2"
Project	EFCHED	**Conversion Factors**	Ch1 = 1.95 E-02 Ch2 = 1.07 E-01 (mGy/a/cps)
Site	Kepshinskaya	**Measurement Date**	14/07/04
Context	Surface inside cave	**Spectrum No.**	5

		Field	Analysis (Package = Rainbow3)		
^{40}**K in Ch.**		487	490 (1477 keV)		
Ch. Width (eV)		3			
Count Time(s)	600	**Ch1 (>450KeV)**	**Ch1 (>450KeV)**	**Ch2 (>1350KeV)**	**E**
Integral Counts		4375	4428	863	
Count Rate (cps)		7.29	7.38	1.44	
Dose Rate (mGy/a)		0.14	0.14	0.15	0.15
Error			0.01	0.01	0.01
Mean Dose Rate (mGy/a)			0.15		

Location and geometry

Geometry: ~ 2π ground surface, ~ 4π including limestone cave

Hole depth = 0 cm

^{137}Cs is not present at the modern surface.

Kepshinskaya is a through cave. This measurement was one of a series of surface measurements through the cave (EFD4G042, 43 and 44), to test how far in the ^{137}Cs signal was present, with possible implications for the rate of colluvial transport through the cave. This measurement was made inside the downhill entrance, 8 m down from EFD4G043, and 8 m up from the main entrance and section being sampled. The lack of ^{137}Cs signal here implies that it has not been washed/colluviated through on soil.

Estimated solid angle (π Rad.)	4π	**4π Gamma dose rate (mGy/a)**	Natural 0.15 ± 0.01

TL Samples	
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Date	14/07/04
Completed By	CIB
Checked By	

Log No.		Instrument	Rainbow No.1
Filename	EFD4G045.asc (EFD4G---.asc)	Detector	2"x 2"
Project	EFCHED	Conversion Factors	Ch1 = 1.95 E-02 Ch2 = 1.07 E-01 (mGy/a/cps)
Site	Kepshinskaya	Measurement Date	15/07/04
Context	3 (Upper)	Spectrum No.	1

		Field	Analysis (Package = Rainbow3)		
^{40}K in Ch.		487	498 (1494 keV)		
Ch. Width (eV)		3			
Count Time(s)	600	Ch1 (>450KeV)	Ch1 (>450KeV)	Ch2 (>1350KeV)	E
Integral Counts		20069	20018	4153	
Count Rate (cps)		33.45	33.4	6.92	
Dose Rate (mGy/a)		0.65	0.65	0.74	0.69
Error			0.03	0.03	0.03
Mean Dose Rate (mGy/a)			0.69		
Location and geometry Geometry: ~3.5 π at surface of section, plus cave =~3.8 π Hole depth = 18 cm & see TL sample form DR much higher than above ⇒ Clay / Loess? Spectrum appears balanced, but >450 lower than >1350 ⇒ greater proportion of Th?					
Estimated solid angle (π Rad.)	4π	4π Gamma dose rate (mGy/a)		0.69 ± 0.04	

TL Samples		Date	15/07/04
EFD4L121		Completed By	CIB
		Checked By	

Log No.		Instrument	Rainbow No.1
Filename	EFD4G046.asc (EFD4G---.asc)	Detector	2"x 2"
Project	EFCHED	Conversion Factors	Ch1 = 1.95 E-02 Ch2 = 1.07 E-01 (mGy/a/cps)
Site	Kepshinskaya	Measurement Date	15/07/04
Context	3 (Lower)	Spectrum No.	2

		Field	Analysis (Package = Rainbow3)		
^{40}K in Ch.		487	505 (1483 keV)		
Ch. Width (eV)		3			
Count Time(s)	600	Ch1 (>450KeV)	Ch1 (>450KeV)	Ch2 (>1350KeV)	E
Integral Counts		11728	11538	2265	
Count Rate (cps)		19.5	19.2	3.78	
Dose Rate (mGy/a)		0.38	0.37	0.40	0.39
Error			0.02	0.02	0.02
Mean Dose Rate (mGy/a)			0.39		

Location and geometry
Geometry: ~3.8 π at surface of section, plus cave =~4 π
Hole depth = 13 cm

& see TL sample form

DR much lower than EFD4G045 above – similar fine material but reduced solely because of more limestone?

Estimated solid angle (π Rad.)	4π	4π Gamma dose rate (mGy/a)	0.39 ± 0.02

TL Samples		Date	15/07/04
EFD4L122		Completed By	CIB
		Checked By	