Chapter 5

Pollen Study of Kabazi V

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At Kabazi V, sediments were sampled for pollen analysis between a depth of 6.45-4.90 m, with 30 samples taken in 5 cm intervals (Fig. 5-1). The sampled sediments had accumulated within the rock shelter (Yevtushenko 1998a; Chapter 1, this volume) and represent fine loose whitish carbonate products that had resulted from the destruction of its roof and walls. The collected samples were processed a total of two times: firstly, using our standard technique (Gerasimenko 1999, 2004), and later on using heavy liquids with different density; sodium pyrophosphate processing was excluded. Microfossils were found in just eight samples, and these in only small amounts (see below). In other samples pollen were practically absent; in all of these, 0-2 microfossils were observed per slide, which included the spores of Filicales (ferns) and/or pollen of herbs and sedges. The admixture of quartz in slides was also poor. Only at the base of the sequence (6.45-6.25 m) did samples contain significant amount of quartz sand, which is indicative of an influx of colluvial material into the rock shelter during formation of these deposits. Whereas the sample from level 6.45-6.40 m was relatively rich in pollen (see below), in samples from the interval 6.40-6.25 m, broken and folded pollen grains of herbaceous plants, and possibly of Betulaceae, occurred in notable numbers. Two levels higher up in the sequence contained mainly unidentified pollen grains (5.90-5.85 and 5.55-5.50 m).

Sample #1 from the bottom of the sequence, at a depth of 6.40-6.45 m (Fig. 5-1), yielded 54 microfossils, 35 of which are spores, most of which (21) could be assigned to Filicales, while the remaining 19 include Bryales and a few (3) Lycopodiaceae. The amount of arboreal pollen (AP) is low: 4 grains of *Pinus*, one grain of *Alnus*, and one grain of Caprifoliaceae (*Viburnum*). Non-arboreal pollen (13 grains) comprise Cyperaceae (7 grains), Poaceae (2), Rosaceae (3), and a single grain of Lamiaceae.

Sample #4, collected from a depth of 6.25-6.20 m (Fig. 5-1), provided a large number of microfossils, but most of these proved poorly preserved and could not be identified (in spite of the absence of sand in the sample). Among the identified pollen from this sample (52) there were 13 pollen grains from trees, 24 grains of non-arboreal pollen (NAP), and 15 spores. *Alnus glutinosa* dominates the AP spectrum (7 grains). Other arboreal taxa include *Pinus* (3 pollen grains, one of which is badly broken), *Betula* (2),

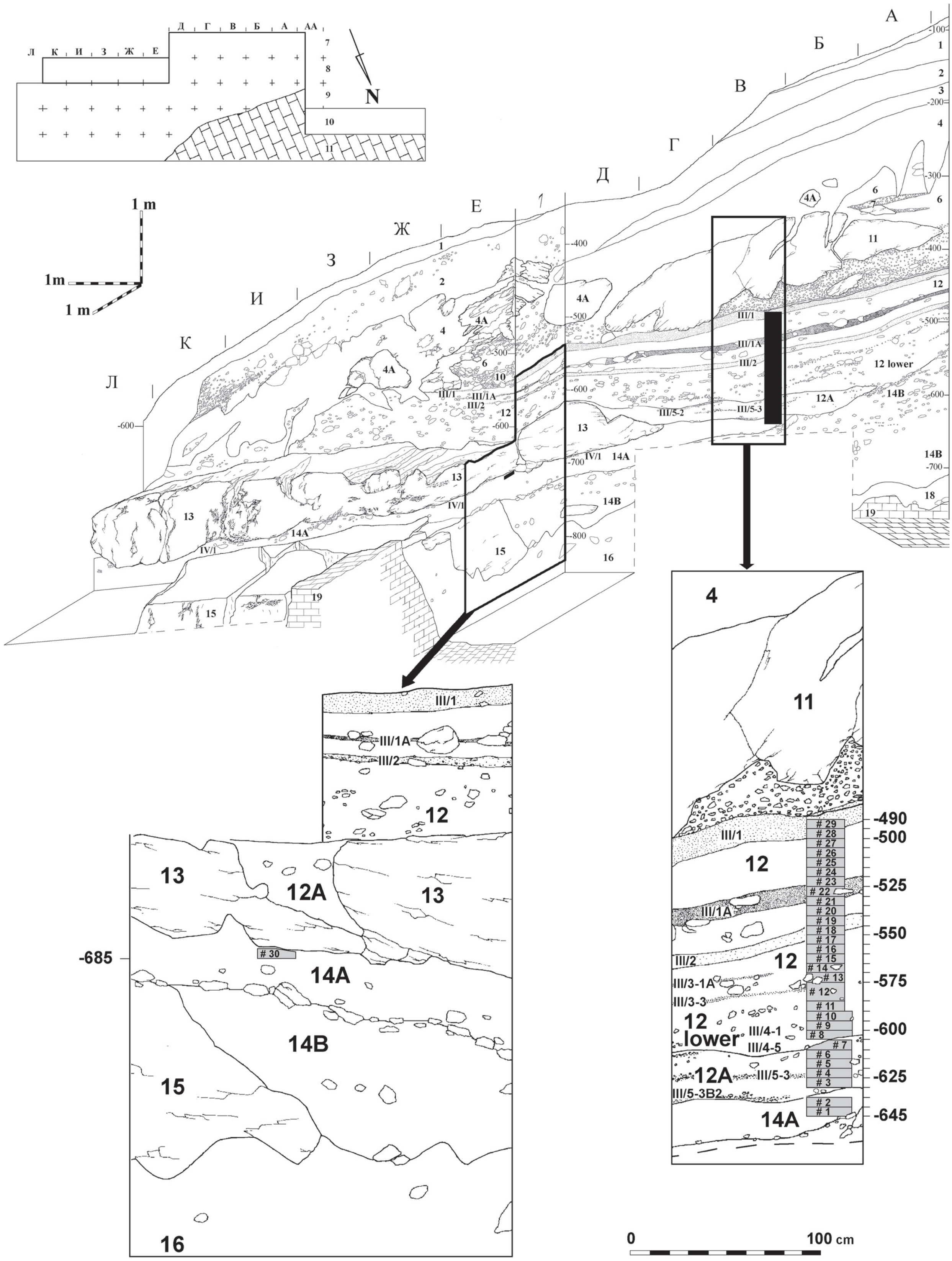

Fig. 5-1 Kabazi V: sections along square lines 6/7 and Д/Е; arabic numbers (e.g. #12) show the position of collected pollen samples in the deposits. For a detailed description of the sections see Chapter 1.

and *Fagus* (one well-preserved pollen grain). In the NAP, Asteraceae pollen dominate (10 grains), while Brassicaceae, Cyperaceae, and Poaceae occur in the same number (3-4 of each, respectively), with single Rosaceae, Fabaceae, and Lamiaceae pollen grains also found. Spores include mainly Filicales (12) and only a few Bryales and Lycopodiaceae.

Sample #7 from a depth of 6.10-6.05 m (Fig. 5-1) displays a slightly higher content of Filicales than other samples (4-5 per slide), but no pollen were found.

Sample #8 (Fig. 5-1) was collected from a depth of 6.05-6.00 m (80 microfossils) and is distinguished by its high content of Bryales spores (46) and a predominance of AP (21) over NAP (8). AP comprise *Pinus* (13 grains) and *Betula* (8), while NAP include mainly Lamiaceae pollen (5) and a few grains of Cyperaceae and Asteraceae. *Betula pendula* pollen was identified, and five spores of Filicales were also found, as well as many unidentified pollen of herbs, and possibly pollen of the Betulaceae family.

Sample #14 was taken at a depth of 5.70-5.65 m (Fig. 5-1). Most of the total number of 32 microfossils were spores (12 Filicales and 10 Lycopodiales). AP were represented by *Alnus* (5 grains), and NAP included Cyperaceae (3 grains) and single Lamiaceae and Rosaceae pollen, respectively. The next **sample #15** (5.65-5.60 m) displays a slightly higher content of Filicales than other samples (4-5 per slide), but no pollen were found.

Sample #22 (Fig. 5-1) was collected from a depth of 5.30-5.25 m (65 microfossils), and is similar to **sample #8** (6.05-6.00 m). It has a high content of Bryales spores (23), with a few Filicales (4 spores), and also many unidentified herbal pollen. Arboreal pollen (14 grains) included *Pinus* (6 grains), *Betula* (5), Rhamnaceae (2), and a single pollen grain of *Crataegus*. *Betula pubescens* pollen was also identified. NAP (24 grains) comprise Cyperaceae (12 grains), Asteraceae, Lamiaceae and Rosaceae (3 grains of each), Chenopodiaceae (2) and Brassicaceae (1 grain).

Sample #29 (Fig. 5-1) stems from the top of the sequence (4.95-4.90 m). It yielded 31 microfossils represented by Filicales spores and herbal pollen. The latter (20 grains) include Lamiaceae (6 grains), Rosaceae (3), Fabaceae (1), Chenopodiaceae (4), Asteraceae (3), Cyperaceae (2) and Poaceae (1). Arboreal pollen was not found in this sample.

The pronounced lack of pollen at Kabazi V is striking in contrast with earlier results from investigations at Kabazi II where relatively rich pollen spectra were found in nearly all levels of the sequence (Gerasimenko 1999, 2005). However, it should be noted that Kabazi II and Kabazi V, although both located on the slope of a cuesta on the Alma River valley, differ in one significant way: whereas Kabazi V deposits accumulated in a rock shelter, Kabazi II was an open-air site (Chabai 2004c). This factor might very well explain the very low content of plant microfossils at the latter site.

Kabazi V is characterised by alternating Micoquian and Levallois-Mousterian cultural levels, and at some levels Micoquian and Levallois-Mousterian artefacts are mixed. In Crimea, the co-existence of Micoquian and Levallois-Mousterian industries occurred during the interval between 50/45-29/28 kyr BP (Chabai 2004c), which fits well with C^{14}-AMS dates obtained (Chapter 3, this volume) from the lower sub-unit III/5 (38.78±0.36) and the upper sub-unit III/1A (30.98±0.22) as well as ESR ages of 26-30 and <41 kyr (Rink *et al.*, 1998). On the other hand, U-series (McKinney 1998) and TL/OSL datings (Chapter 3, this volume) suggest an Early Glacial age for Kabazi V between 60 and 100 kyr BP.

A main characteristic of microfossil composition in all levels of Kabazi V is a high ratio of spores. Indeed, this is a typical feature to have been observed at other rock-shelter sites of Crimea, e.g. Zaskalnaya V (Gubonina 1985), and particularly Buran Kaya III (Gerasimenko 2004). A predominance of spore plants, most of which are shade-resistant, might represent local environments at cave entrances. The characteristic feature of the Buran Kaya III spore population was a rather high amount of *Botrychium* and Lycopodiaceae (including boreal species) during the stadials, whereas Filicales (ferns) and Bryales (green mosses) occurred through the whole studied interval (the end of Middle Pleniglacial – Late Pleniglacial). At Zaskalnaya V, Filicales, namely Polypodiaceae, became abundant only during the interstadials (Gubonina 1985). The same evidence is observed in the pollen diagram of Kabazi II (Gerasimenko 1999), though the proportion of Polypodiaceae at this open-air site is much smaller than in the caves. A predominance of Polypodiaceae over Bryales during interstadials is very expressive in the archaeological and natural sites of the Carpathian area (Gerasimenko 2006, 1994). In the warmer Crimean Mountains, ferns (Polypodiaceae) could survive cold climate in the caves, and a prevalence of their spores might rather be an indicator of humidity. Indeed, the significant amount of Polypodiaceae spores also means that conditions could not have been very cold.

At Kabazi V, Filicales (Pterideae and Polypodiaceae) or Bryales dominate in all studied levels, with Lycopodiaceae (club-mosses) only becoming significant between 5.70-5.65 m (sub-unit III/3). This information indicates that whereas interstadial environments probably prevailed during the formation of the studied layers at Kabazi V, deposits assigned to sub-unit III/3, marked by an increase in club-mosses, might also have formed during a stadial.

The considerable ratio of arboreal pollen in the pollen spectrum at Kabazi V (with exception of the lowest and uppermost deposits), combined with an absence of pollen of herbaceous xerophytes (with exception of the uppermost deposits), is also suggestive of a relatively humid climate during the formation of the main part of the Kabazi V sequence studied here. The relative abundance of *Pinus, Alnus* and *Betula* might be explained by the more effective transport of their pollen through the air, compared to other taxa. On the other hand, pollen of Chenopodiaceae is also characterised by high dissemination abilities, and is usually well preserved. Thus, the absence of the latter is a more direct indication of a relatively humid environment, with the expansion of mesophytic herb cover during the formation of the studied sequence. In the NAP the majority of samples, pollen of Lamiaceae and Rosaceae (both belong to Herbetum mixtum group) dominate alongside Cyperaceae (sedges), which are typical for mountain meadow-steppes.

During the formation of the main part of the studied sequence, meadow steppes evidently alternated with boreal (southern-boreal?) forest. At Kabazi V, there is no direct evidence of southern-boreal vegetation (only a single pollen grain of *Fagus*), but it should not be forgotten that pollen of broad-leaved taxa are much less capable of air transportation than pollen of coniferous and small-leaved taxa, which would have meant a much more limited access of the former to the rock shelter. It has already been shown that Interstadial vegetation around neighbouring Kabazi II was southern-boreal (Gerasimenko 1999). An abundance of Polypodiaceae spores has also been interpreted as an important marker for the presence of broad-leaved trees (Gubonina 1985). A few pollen grains of bushes, which grow in mixed and deciduous forests (*Viburnum, Crataegus,* Rhamnaceae), were found at Kabazi V, though at Kabazi II the pollen of these plants also occur in the deposits of stadials (evidently from refugia sites in the Crimean mountains).

Judging from the low content of botanical microfossils at Kabazi V, only a very tentative subdivision into phases of vegetational and environmental dynamics can be suggested.

At the beginning of its formation, sample #1 from unit IV (Fig. 5-1), wet meadows (with a high ratio of sedges) predominated around the site, ferns and mosses grew near the entrance to the rock shelter. There existed an intense runoff (strong sand input into the cave). The presence of *Viburnum*, which is a moisture-loving plant, might confirm a reconstruction of humid environments, but, generally speaking, arboreal vegetation possibly had a limited distribution in the river valley (cool climate?). On the other hand, a predominance of Polypodiaceae does indicate that the climate could not have been very cold.

Samples from the depth interval of 6.25-6.05 m, sub-unit III/5 (Fig. 5-1), evidently reflect slightly warmer and drier conditions. Warming is indicated by an increase in the tree population (particularly *Alnus*) and the appearance of broad-leaved *Fagus*. Although ferns and hygrophytic sedges were still a significant element in the vegetation cover, the ratio of mesophytic herbs (Lamiaceae, Rosaceae, Asteraceae, few Fabaceae and Brassicaceae) increased considerably at this time. Meadows around the site were replaced by meadow-steppe. This could reflect an increase of evaporation in a warmer climate. Pollen counts for the Asteraceae family, which includes plants of disturbed substrata and xerophytic species, also increase at this level, as does the number of evidently re-deposited (distorted and unidentified) herbal pollen. Silt colluviation could have occurred at this time due to slow runoff.

At the depth 6.05-6.00 m, sub-unit III/4 (Fig. 5-1), green mosses absolutely prevailed over ferns near the cave entrance. The arboreal vegetation represented by pine and birch, spread and formed forest-steppe ecotones. Wet-loving Polypodiaceae and *Alnus* were strongly reduced. Humidity was decreasing continuously compared to the preceding phases, though the climate did not become warmer.

At the depth 5.70-5.65 m, sub-unit III/3 (Fig. 5-1), a sharp increase in Lycopodiales can be interpreted (as explained above) as a tentative indicator of cooling. Birch-pine forest seems to disappear. Wet meadows spread, and a few *Alnus* grew near the river.

At the depth 5.30-5.25 m, level III/1A (Fig. 5-1), environments were similar to those of sub-unit III/4. The entrance to the rock-shelter was covered by green mosses. The woods, which evidently expanded onto the slopes, consisted of pine and birch, and a few *Rhamnus* and *Crataegus* occurred. Sedges and mesophytic herbs formed patches of meadow-steppe.

The uppermost of the investigated samples, depth 4.95-4.90 m, level III/1 (Fig. 5-1), indicates an environmental change – a sharp reduction of arboreal vegetation and some xerophytization of meadow-steppe coenoses. Pollen of Chenopodiaceae first appeared at a depth of 5.30-5.25 cm (level III/1A), but at the top of the sequence Chenopodiaceae predominated over Cyperaceae. This fact, and particularly the absence of arboreal pollen, gives reason to assume a cooling and an increase in aridity.

Thus, pollen data from Kabazi V indicate that environments changed from wet and cool, transitional stadial to interstadial (unit IV), to warmer and progressively drier (sub-units III/5 and III/4), then to cool and wet, stadial? (sub-unit III/3), and then again to warmer and drier (level III/1A), and finally to cool and dry, transitional from interstadial to stadial (level III/1).

The spread of boreal trees (*Pinus, Betula, Alnus*) indicate that the climate was cooler than at present, as it is typical for an interstadial. Single pollen grains of *Fagus* (beech), Rhamnaceae (buckthorn) and *Crataegus* (hawthorn) might indicate the presence of some elements of a temperate vegetation. The latter are expected to have existed in refugia in the Crimean Mountains. At Kabazi II, Rhamnaceae and *Crataegus* also occurred during the stadials, but *Fagus* appeared only a few times during the formation of the Kabazi II sequence – at the end of the Last Interglacial, during the second Early Glacial stadial and during the Moershoofd interstadial (Gerasimenko 2005). Judging from the age of the Kabazi V industries (see above), the first and the second *Fagus* appearances seems to be too old to permit a correlation with the *Fagus* marked level at Kabazi V. Instead, a correlation with the first half of Middle Pleniglacial might be possible. On the other hand, the rather high proportion of *Betula* and *Alnus* pollen, observed in the studied deposits at Kabazi V, is more typical for the Odderade interstadial at Kabazi II. Nevertheless, pollen counts at Kabazi V are insufficient and could be strongly distorted due to under-representation of broad-leaved pollen in rock-shelter deposits compared to open-air site ones. At the other Crimean rock-shelters (Zaskalnaya V and Buran-Kaya III), the Middle Pleniglacial interstadial deposits also have few or no pollen from broad-leaved trees and high counts of Polypodiaceae spores.

Abstract

ПАЛИНОЛОГИЧЕСКОЕ ИЗУЧЕНИЕ СТОЯНКИ КАБАЗИ V

ГЕРАСИМЕНКО Н.П.

Палинологически проанализированы 29 образцов из отложений стоянки Кабази V. Однако палиноморфы были выявлены в небольших количествах (32-80) лишь в восьми из них, при этом значительная их часть представлена спорами. Разительный контраст по количеству и составу микрофоссилий с таковыми стоянки Кабази II очевидно объясняется различными условиями формирования палиноспектров открытой и пещерной стоянок. Преобладание спор в спорово-пыльцевых спектрах пещерных стоянок Крыма ранее было выявлено на памятнике Буран Кая III (Gerasimenko 2004) и для некоторых слоев стоянки Заскальная V (Gubonina 1985). При этом, также как на стоянках Закарпатья (Gerasimenko 2006), прослеживалось преобладание спор папоротников в отложениях интерстадиалов и спор плаунов в стадиальных отложениях.

Другими характерными особенностями состава палиноморф стоянки Кабази V являются – полное отсутствие пыльцы травянистых ксерофитов на уровнях от культурного

слоя IV до горизонта III/1А, а также отсутствие палиноморф широколиственных пород, в том числе и в слоях с преобладанием спор папоротников и преобладанием микрофоссилий древесных пород среди пыльцы. Единственное хорошо сохранившееся пыльцевое зерно бука выявлено в пачке горизонтов III/5. Преобладание древесной пыльцы и спор папоротников над пыльцой трав характерно для спектров интерстадиальной растительности.

Несмотря на низкое содержание микрофоссилий, изменение их качественного состава по разрезу стоянки позволяет предварительно наметить следующие ландшафтно-климатические изменения.

В основании разреза, культурный слой IV характеризовался очень высоким содержанием спор папоротников (встречены и плауны) и преобладанием микрофоссилий трав над древесной пыльцой. Группа трав представлена осоками и разнотравьем. В группе древесных преобладает пыльца сосны (единично встречены микрофоссилии ольхи и калины). Низкое участие пыльцы деревьев на фоне преобладания мезофитных трав может свидетельствовать о влажном, но довольно прохладном климате (возможно переходном от стадиала к интерстадиалу). Вокруг входа в пещеру господствовали влажно-луговые ландшафты с высоким участием папоротников и осок.

Пачка горизонтов III/5 характеризуется снижением участия спор (среди них представлены почти исключительно папоротники) и пыльцы осок, повышением роли древесной пыльцы. Спорово-пыльцевые спектры близки к лесостепному типу. В группе пыльцы древесных ольха преобладает над сосной, встречено пыльцевое зерно бука. Группа трав представлена разнотравьем богатого состава, но доминирует пыльца сложноцветных. Вероятно, в это время вблизи стоянки сырые луга сменились луговыми степями, а в пойме расширились площади черноольшанников. Климат стал суше и очевидно теплее.

Пачка горизонтов III/4 характеризуется максимальным содержанием спор зеленых мхов и преобладанием пыльцы древесных пород (сосны и березы) над пыльцой травянистых растений (разнотравье). На склоне распространялся светлый березово-сосновый лес с мохово-разнотравным покровом. Зеленые мхи росли у входа в грот. Резкое сокращение роли папоротников и ольхи свидетельствуют о продолжении тренда снижения переувлаженения.

Лесостепные и лесо-луговые условия, существовавшие во время формирования пачек горизонтов III/5 и III/4, на Средне-Европейской равнине были бы отнесены к интерстадиальным, но для интерстадиалов западных предгорий Крыма реконструировано существенное участие в составе растительности широколиственных пород. Одной из причин отсутствия этой пыльцы в пещерных отложениях Кабази V может быть значительно более низкая летучесть микрофоссилий широколиственных пород в сравнении с сосной и мелколиственными породами.

Пачка горизонтов III/3 отличается очень высоким участием спор, в том числе, плаунов. Последнее позволяет предполагать похолодание во время его формирования, сопровождавшееся переувлажнением у входа в грот. Среди микрофоссилий представлены почти исключительно гигрофиты: ольха, осоки. По своим характеристикам спектр напоминает условия стадиалов раннего валдая или начала среднего пленигляциала, связанные с распространением влажных лугов.

Горизонт III/1А характеризуется спорово-пыльцевым спектром лесостепного типа, со значительным участием спор зеленых мхов. Можно предположить, что луговые степи с единичными кустами крушиновых и боярышника чередовались в это время с сосново-березовыми перелесками. У входа в пещеру росли зеленые мхи, а роль папоротников была очень незначительна. Снижение увлажнения вероятно связано с повышением испарения в условиях интерстадиального потепления климата.

Горизонт III/1 резко отличается по полному исчезновению пыльцы деревьев и впервые наблюдающемуся преобладанию пыльцы трав над спорами. В составе пыльцы трав господствует разнотравье, но в заметном количестве появляются и микрофоссилии ксерофитов – маревых. Так как этот слой содержит также довольно много спор папоротников, он, вероятно, может быть отнесен к переходному от интерстадиала к стадиалу.

Если принять версию, что малолетучая пыльца широколиственных пород не попадала в пещерные отложения, полученные спорово-пыльцевые данные не противоречат имеющимся C^{14}, AMS и ESR датировкам, относящим слои стоянки к интервалу между 38 и 26-30 тыс. лет назад (Rink *et al.*, 1998; Глава 3 в этом томе). В то же время, высокое участие пыльцы березы и ольхи, а также и травянистых мезофитов на соседней стоянке Кабази II более характерны для раннего гляциала или первой половины среднего пленигляциала. Пыльца бука, прослеженная в нижней части разреза Кабази V, на стоянке Кабази II встречена на трех уровнях – в конце последнего интергляциала, во время второго раннеледникового и в первом среднепленигляциальном интерстадиале. Корреляция со средним пленигляциалом совпадает с археологическими данными о возрасте отрезка сосуществования микокских и леваллуа-мустьерских индустрий, представленного на памятнике Кабази V (Глава 18 в этом томе). Учитывая малочисленность палинологических данных, считаем, что их результаты имеют в данном случае лишь вспомогательное значение.