Palaeolithic chert mining in Egypt

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Ongoing research in the Nile valley, between Asyut and Qena, by the Belgian Middle Egypt Prehistoric Project of Leuven University has led to the discovery of a high number of Palaeolithic chert exploitation sites. Field evidence indicates that from the Acheulean on, man extracted chert from pits. During the Middle Palaeolithic, extraction ditches were introduced, while during the early Upper Palaeolithic period underground mining was practised.

KEY-WORDS: Palaeolithic, mining, Egypt

In the past, prehistoric research has only incidentally shown some interest in understanding chert extraction techniques. However, huge quantities of chert and/or flint were utilised in all periods of the Egyptian prehistory, even during pharaonic periods. Hence the question arises where and how prehistoric man obtained these raw materials. It is obvious that it was known from very early times that certain raw materials are of much better quality than others and that raw materials, fresh from their original bed, are generally better than those which have been buried in clay or gravel, or \textit{a fortiori} those which have been exposed to the elements. One may expect that prehistoric man looked carefully for the best raw materials available.

In the stretch between Asyut and Qena (Fig. 4), the Nile is entirely bordered by huge limestone cliffs. These cliffs and the adjacent plateau consist nearly entirely of limestone from the Thebes Formation of Lower Eocene age, overlying laminated green and grey shale of the Esna Formation (Said 1962). The Thebes Formation forms the magnificent cliffs bordering the Nile valley, and consists of thick massive limestone including several layers of chert nodules and some marls. These nodules have often been eroded and redeposited in river terraces, mainly by local wadis but also by the Nile. Often good chert nodules can be found on the lower desert surface, but they appear to be intensely affected by salt weathering.

Research in this area of the Nile valley by the Belgian Middle Egypt Prehistoric Project of Leuven University led to the discovery of several Palaeolithic chert exploitation sites of which Nazlet Safaha, Taramsa Hill and Nazlet Khater are the

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most important (Vermeersch et al. 1984, in press; Vermeersch, Paulissen and Van Peer 1990).

Chronological control is crucial to the generation of a regional framework of Palaeolithic occupation. Such control is however complicated by both a lack of radiocarbon datable materials and an anticipated age range which extends considerably beyond the datable range of the radiocarbon method. We are attempting to incorporate alternative dating strategies including optical dating and amino acid racemization (in collaboration with Dr. Stephen Stokes, Oxford University, and Dr. Gifford Miller, INSTAAR, Colorado) in order to develop an absolute, independent chronostratigraphy. The finalisation of these results is in progress and while a passing reference is made to some of the results here, details will be presented elsewhere.

1. NAZLET SAFAHA

The area of Nazlet Safaha (Fig. 4) is situated on the west bank of the Nile, downstream of the Dandara Temple (Vermeersch et al. 1986; Vermeersch, Paulissen and Van Peer 1990; in that publication the site has been named Nazlet Sabaha; in later publications the name has been unfortunately changed in Nazlet Safaha, whereas the former was in fact correct; for practical reasons we will retain the name Nazlet Safaha). It is located on a Nile cobble terrace remnant. The bars of the former channel deposits are 2 to 3 m thick and rest disconformably on very coarse Nile sands. The terrace deposits contain mainly metamorphous and igneous materials, but also quartz and round or ellipsoidal chert cobbles, the latter with a diameter of up to 0.2 m. The matrix material is composed of pebbles and coarse sands. The cobble deposit is overlain by a layer of variable thickness (about 0.5 m) of granular sands. In the area, several distinct sectors have been identified, but only sectors 1, 2 and 3 have been studied.

1.1. EXPLOITATION SYSTEM

Prehistoric man extracted the chert cobbles from the terrace deposits in open ditch or pit systems with a mean extraction depth of around 1.5 m and a maximal depth of about 1.7 m (Fig. 1). He dug a pit and created a steep front consisting of archaeologically sterile sands at the top covering the upper part of the cobble terrace at the base. Exploitation of the cobble layer is generally restricted to a depth of about 0.5 to 0.8 m. This means that only the uppermost part of the cobble unit, mostly six cobbles thick, was extracted. The extraction ditches exhibit vertical walls with only minor undercutting of the sandy deposits. This is dictated by the low consolidation of the granular sands. At some locations we observed large collapsed blocks of these sands in the prehistoric ditch fills.
Fig. 1. Nazlet Safaha 2. Extraction ditch layout (shaded area) with flint concentrations from 1 to 21.
The ditch width is highly variable and they display – especially in sector 2 – an irregular plan (Fig. 2). Many lateral bulges are present, giving the impression of starting a new ditch, that was abandoned later. The tortuous lay-out of the ditches suggests that exploitation was discontinuous in time or that prehistoric man was restricted in his planning capacities.

Fig. 2. Nazlet Safaha 2. Section through an extraction ditch: 1 — aeolian sands; 2 — dump deposits; 3 — sterile sand; 4 — terrace deposits; 5 — ditch edge; 6 — chert artefact.

The infillings of the exploited ditches are very heterogeneous and composed of patches of pure aeolian sands, patches of cobbles or a mixture of both, suggesting an infilling and consequently probably also exploitation in different steps (Fig. 3). Prehistoric man probably scraped off the sterile sands from small surfaces, dumped the sands in an already exploited area and extracted the cobbles individually. No excavation tools have been recovered, suggesting that they either did not exist or were made from organic materials such as wood, bone or antler, which have not been preserved. During the extraction procedure man sorted out the chert cobbles and sometimes also the largest quartz pebbles. Cobbles of other petrographic composition were dumped in the immediate vicinity, mostly in the ditch itself. Within the anthropogenic infillings of the prehistoric ditches, pure matrix material from the terrace deposits is rare. It seems that the matrix material occurs concentrated at the base of the infilling and on top of the in situ cobble deposits, suggesting that the matrix
was not removed from the ditch in the extraction process, at least for the lower cobble layers. Finally, the bulk of the matrix material accumulated on top of the in situ cobbles and prevented further extraction in depth.

Fig. 3. Nazlet Safaha 2. Block diagram of extraction structure: 1 — terrace gravels; 2 — sterile sands; 3 — dump deposits in extracted area; 4 — aeolian sands.

In the southern part of Nazlet Safaha 1, exploitation was so intensive that an area of more than 600 m² was completely exploited. The total areal extent of the exploited zone can be evaluated at about 2500 m². If we accept 0.75 m as the mean thickness of the extracted cobble layer, we arrive at a volume of 1875 m³ extracted cobbles. We
estimate that about 100 cobbles per m² were available for knapping purposes. This means that Nazlet Safaha 1 could have produced 200,000 cobbles for potential use. Excavations so far have been unable to discover the extent of the extracted area of Nazlet Safaha 2 and 3.

Locating and gaining direct access to the in situ cobble deposit in prehistoric times was probably possible from the left bank of the River Nile which was eroding these deposits as it does now. Moreover, the sand cover is thinning out towards the Nile so that it is likely that the cobbles were outcropping near the river and thus directly available at the surface. It must be stressed that, on the Safaha extraction sites themselves, prehistoric man could not directly observe the cobbles as they were buried under a nearly pure sand layer. Access to the cobble deposit always had to involve some digging in cobble free sands.

1.2. ARTEFACT PRODUCTION

Extraction provided chert cobbles which were utilised in nearby ateliers mainly for flake production. In most of the recovered assemblages the Levallois reduction strategy was dominant. The whole set of Levallois reduction elements are well represented. Levallois flakes especially are quite numerous. The classic Levallois method was exclusively present, suggesting a Late-Middle Palaeolithic K-group affiliation, at least for sector 1 and 2 (Van Peer 1991). However, in some assemblages, non-Levallois preferential platform cores (one or two platforms) are quite numerous. Judging from the generally low blade indices, reductions of these types must have primarily produced flakes or laminar flakes rather than true blades. True standardised blade production is represented in none of the assemblages. In most of the assemblages tools are very rare. The most common type, apart from retouched Levallois flakes, are notches and denticulates.

Notwithstanding the fact that chert extraction was performed, Levallois core to Levallois flake ratios are very low. This means that there are more Levallois flakes than Levallois cores. It would seem therefore that hardly any Levallois flake has been exported from the site. We know that classical Levallois cores are mostly intended to produce more than just one Levallois end product (Van Peer 1992). Thus, even with low ratios, it remains possible that a number of Levallois flakes has been exported from the site, as we would expect for this type of site. Indeed, the near total absence of tools suggests that we are not dealing with a living site. This hypothesis is corroborated by the fact that neither living structures nor hearths have been recognised. Living sites would contain many tools and few waste products. One would expect at least part of the artefact production to be exported to the latter, perhaps located in the floodplain. Given the presence of products from all reduction stages, a plausible scenario may be that groups, based in the former Nile plain, came to
the exploitation site from time to time to collect the number of artefacts required. At the same time, they might have completed their „stock‟.

1.3. CHRONOLOGY

The area is situated in the downslope area of a large pediment. The absence in the prehistoric ditch fillings of waterlaid deposits or erosional features, in addition to the evidence of aeolian activity, suggests that the climate during the exploitation periods was very arid with very few events of sediment transport by running water. Such a climate could have been present in the Nile valley since at least 60,000 years ago (Paulissen and Vermeersch 1987, 1989).

We have attempted to determine the absolute chronology of the excavations by dating both the scarce charcoal fragments and aeolian sand infills using the radiocarbon and optical dating methods, respectively.

A charcoal sample collected from a depth of 0.50 m in the prehistoric infillings at Nazlet Safaha 1 was 14C-dated to 37,200 ± 1300 BP (OxA-2601). Another sample, collected from a depth of 0.45 m in the prehistoric infillings at the same sector, provided a 14C-date of 6,680 ± 80 BP (OxA-1901). It appears that this latter sample was intrusive as it clearly refers to the Holocene wet period. Indeed, we were able to locate several root fragments which all belong to the Holocene wet period (Vermeersch et al. 1992).

Taking into account some indications of optical dating and the fact that the 14C date may be near the dating limit, we provisionally accept an age of more than 40 ka BP for the extraction activity at Nazlet Safaha 2.

2. TARAMSIA AND SURROUNDINGS

Taramsia 1 is an isolated hill, situated some 2.5 km south-east of the Dandara temple (Fig. 4, site 1). It culminates at 43 m above the actual Nile floodplain and at 15 m above the surrounding desert. A black desert varnish on the pavement cobbles creates the peculiar aspect of the Taramsia hill which appears as a unique black hill in a yellow desert (Fig. 5). On the eastern side of the hill a sheet of aeolian sand has accumulated. The hill is capped with a 4 m thick deposit of mainly chert cobbles of unknown age. This deposit is composed of more or less horizontal beds of cobbles, sometimes with a diameter of more than 0.4 m, but mostly in the order of 0.10-0.15 m. The cobbles are embedded in a strongly rubified matrix of coarse granular quartz sands, mixed with well rounded pebbles with a diameter up to 0.05 m. The in situ deposits are not consolidated, facilitating cobbles extraction, even without tools.
Chert is largely dominant in the cobble petrography of the deposits (about 93%). Of these cobbles about 50% present a rather spheroid to flat spheroid shape, the others are discoid or ellipsoid. About 60% of all cobbles are rounded to very well rounded whereas the others are rather angular.

2.1. EXTRACTION FEATURES

Excavations were carried out in different sectors during three seasons. Moreover, many stratigraphic trenches have been opened in order to study the stratigraphy of the aeolian deposits on the lee slope of the Taramsa hill. It soon became evident that large areas of the hill have been exploited for chert. Because of the limited area as yet excavated, it is not easy to register all extraction strategy types. Indeed, chert extraction was probably going on for a considerable length of time.

In some locations, it appears that chert extraction was organised in a procedure with at least two steps. Firstly, the upper terrace deposits, that generally are intensely weathered with many broken cobbles, were removed. Afterwards, the cobbles were extracted in large shallow pits from a nearly horizontal floor without removal of the red matrix. This matrix accumulated above the cobbles and finally prevented further extraction. This interpretation is based on our observation that a pure sand layer,
obviously reworked matrix, always covers the cobbles deposits \textit{in situ}. We estimate that such a method permits the extraction of a layer with a thickness of three to four cobbles. In the dump of this exploitation, foliates have been recovered but no knapping debris. It is assumed that the foliates were used in the extraction activity.

Later, when earlier pits may still have been visible on the hill top, extraction was restarted, eventually after removing the aeolian deposits. This second exploitation type shows a clear tendency to extraction from deeper pits. Such an increase in depth was obtained by chert extraction from a vertical front. The red matrix material was dumped nearby in the already exploited area. The pits of this second phase were generally not very large. On the floor of these pits and embedded in light yellowish brown aeolian sands, many concentrations of flint artefacts were recovered. These artefacts seem to be the result of a production of elongated flakes and blades according to a Levallois-related blade technology.

In some locations, several extraction pits intersected each other, each of them containing a different type of Middle Palaeolithic materials. This is a good indication of the fact that, on different occasions during a long period of time, people visited Taramsa Hill for chert extraction, starting their work in places which, on an earlier occasion, had already been partially exploited. In sector 91/02, during the first activity period, bifacial artefacts and foliates were produced. However, no extraction features from this period have been discovered. During a second activity period, extraction of cobbles took place from pits with a vertical front and led to the production of flakes, made according to the Nubian method. It seems that some foliates are still connected with this stage. In the third and last activity period, extraction also proceeded from pits with a vertical front but, now, production of elongated flakes and blades was achieved by a Levallois-related technology. We have no idea of the duration of the intervals between the three stages, but we presume that they lasted for a long period of time.

On the east side of Taramsa hill, a complex system of extraction ditches and knapping areas has been found (Fig. 6). In an earlier phase, activity by prehistoric people resulted in the aggradation of a 0.1 to 0.2 m thick cobbles deposit from which some bifacially worked artefacts and debitage of Nubian technique have been recovered. No extraction structures could be associated with this stage. Later, man came back and opened an extraction ditch starting from the steeper part of the eastern hillslope. Chert cobbles were extracted from a vertical front. On top of the original surface, just north of the ditch, a knapping atelier was producing large flakes and blades by a Levallois-related technology. As the extraction proceeded, the rather irregular ditch was extended upslope to the west. We presume that the knapping atelier gradually moved in the same direction, to keep in direct contact with the extraction ditch. When extraction came to its end, the ditch was filled up with teste
cobbles considered as not suited for knapping purposes. These dumped cobbles form a fan with the apex in the west, suggesting that they were dumped from a new extraction zone to the west. Finally, all features were covered by aeolian sands, making them invisible from the hill surface. In the aeolian sands some horizons with knapping debris have been identified, suggesting that aeolian accumulation took place when prehistoric man was still active on the hill. Once man left the hill, aeolian activity went on and slope evolution took place, so that a desert pavement was formed. The whole surface is sealed by an incipient soil.

2.2. PALAEOLITHIC ACTIVITY PHASES AND CHRONOLOGY

The presence of Palaeolithic man on the Taramsa Hill is attested by several different exploitation technologies and artefact assemblages. We can differentiate several phases.

The oldest artefact assemblage is represented by cores and flakes produced by the Nubian technique and also by foliates and bifaces. No extraction features could be directly related to these materials but their presence amidst large flaking debris suggests that some raw material was extracted from the hill deposits. Another assemblage, of which the chronological relation with the former remains unclear, is
characterised by the classical Levallois technology. A probably younger assemblage is of Nubian technology and comprises some fine foliates. The youngest assemblages are always related to pits and ditches filled by light yellowish brown aeolian sands. Artefacts have been produced by a Levallois-related technology for elongated flakes and blades. Even if only a small area on the Taramsa Hill has been explored by our excavations, we have the impression that extractions which produced such assemblages are the best represented. As far as we can see, very large areas of the hill were exploited.

A racemisation date on a fragment of an ostrich egg shell, collected from a deposit above a classical Levallois assemblage, gave a date of $>180$ ka. The same shell obtained a AMS-date (protein) of $18,480 \pm 290$ (OxA-4039) and another (carbonate) of $>49$ ka BP (OxA-4038). From charcoal associated with a Levallois-related blade assemblage, we obtained an AMS-date of $18,820 \pm 200$ (OxA-4017). An AMS-date of $38,100 \pm 1,400$ BP (OxA-2602) has been obtained on charcoal from an area with Nubian Levallois. Provisional optical dates suggest dates from more than $40$ ka for Levallois-related blade assemblages, whereas the other Levallois assemblages seem to have an age of $>100$ ka.

2.3. OTHER SITES IN THE SURROUNDINGS OF TARAMSA HILL

After the discoveries on Taramsa Hill, a survey of the cobble deposits around the hill was initiated to ascertain whether it is an unique place or just one of several such spots. This survey resulted in the discovery of many other extraction sites of which only a few will be mentioned.

On the surface of an isolated hill in the lower desert a few kilometres south of the Dandara temple (Fig. 4, site 2), numerous artefacts of probably Late-Acheulean age have been collected. Two small survey trenches, cut in the hill surface and restricted to a depth of 0.8 m, revealed the existence of a chert extraction pit. Characteristic was the presence of some shaping flakes originating from the knapping of handaxes, but also some handaxes and foliates could be collected. Some atypical (initial?) Levallois flaking was present. This hill was clearly subjected to chert extraction by Acheulean people. Logistic restraints did not allow us to proceed with large scale excavations.

On site Taramsa 2 (Fig. 4, site 19), situated near the desert edge, two small survey trenches were excavated. They showed that the cobble deposit had been mined by prehistoric man. Knapping techniques are rough and not specialised. Most often single platform cores had been utilised. When double platform cores occur, they do not display preparation scars. The Levallois method is clearly absent. Although most of the artefacts are tested cobbles, an important concentration of rough blades has been collected. Refitting of some artefacts was performed in the field. No typical extraction features have been encountered, but the cobble deposit has been extracted
to a depth of about 1.5 m. AMS-dates of > 44,800 (OxA-5231) and > 45,100 (OxA-5230) have been obtained.

At site Taramsa 3 (Fig. 4, site 16), situated on the same interfluvial elevation as Taramsa 2 but somewhat upslope, the upper 0.65 m of a cobble deposit is intensely fragmented by salt weathering. Prehistoric man extracted here three to four underlying cobble layers. He created a large pit, the base of which was later filled with a very heterogeneous extraction dump. On top of these deposits, numerous fresh artefacts and tested cobbles form a continuous pavement that is covered with grey aeolian sands. It is difficult to characterise the artefact assemblage. Cores are not numerous but of a single specific type. They resemble Levallois cores but are thicker and display a lower number of preparation scars. Preparations of the under-face of the cores have only proximal and distal scars. Flaking of Levallois-like points was performed by a continuous process. Bulb scars are deep. Small regular bladelets, a by-product of the flaking technique, are numerous. Tools are absent. Two possible side-blow flakes were collected. In the filling of the extraction pit, some Levallois products were also found. In addition to classical Levallois cores, points and flakes, some Nubian cores and even a single Halfa core are present.

Site Taramsa 4 (Fig. 4, site 18) is situated on a hill Southeast of Taramsa 3. A six metre long survey trench was excavated. It revealed the presence of at least two different extraction periods. In the first period a pit, at least 4 m wide and 1.1 m deep, was dug by prehistoric man. At the pit base, a thickness of about four to five cobbles was extracted. The fill consisted of a red or grey sandy matrix with numerous cobbles of which an important number was fractured by salt wedging before it was dumped. In this dump some artefacts were found. They most often display a clear red patina. On top of this dump, a salt crust with red weathering has developed. This weathering resulted in an intense fracturing and certainly refers to an important pedogenesis. It is the first time that exploitation units could be separated from each other by a palaeosol.

This palaeosol was partly disturbed by new extractions on the same spot. In the first instance, prehistoric man tried to extract cobbles from the older dump deposits. Meanwhile, he covered the soil surface of that time with a dump about 0.4 m deep, thus preserving the palaeosol. Finally, he was able to find and exploit an untouched cobble deposit some 4 m to the west. After extraction, the pit was used as a flaking atelier where knapping was performed by Levallois and Nubian methods. Afterwards, the pit was filled with grey aeolian sands.

2.4. EXTRACTION TECHNIQUES AT TARAMSA

An extensive survey of several cobble hills in the Taramsa area convinced us that a high number of chert extraction sites are present and preserved. The situation is such that wherever chert cobbles are present, the surface is littered with artefacts. We did not check the subsoil of each artefact concentration, but all those localities we have
checked gave clear evidence of chert extraction, some of it already starting from the Acheulean but most of the pits belonging to the Middle Palaeolithic period.

The different extraction and flaking technologies, observed within the exploitation systems, in the Taramsa area are probably related to a long period of time. The exploitation techniques were always simple but well adapted to the natural chert occurrences. The extraction consisted of digging pits and ditches, sometimes very large ones, on top of the hills. Suitable cobbles were extracted whereas the sand matrix from within the cobbles was left at the bottom of the pits. The exploitation front is most often vertical. The extraction dump was deposited in already exploited pits. Debitage-creating activity was performed near the extraction pits or ditches.

As far as we can see at present, the exploitation area at Taramsa covers a very large surface of more than 1500 ha. This is an unprecedented observation of primary importance for the Middle Palaeolithic period.

3. NAZLET KHATER 4

Nazlet Khater 4, near Tahta, Upper Egypt, is a typical underground chert-mining site (Vermeersch et al. 1984). It is situated on a Nile terrace remnant, 10 m above the present floodplain, near a protruding limestone cliff. A unit of about 1 m thick Nile deposits, composed of well-rounded channel lag gravels with chert cobbles, is situated between greenish silts and sands at the base and brown granuliferous silts at the top. These silts are covered with local limestone gravels.

3.1. EXTRACTION FEATURES

Three different types of Upper Palaeolithic digging activities are distinguished (Fig. 7):

1. Ditches with a width of ca 1 m and a depth of ca 2 m. From these ditches all gravel deposits have been removed.

2. Vertical shafts, dug down to a depth of 2 m through the channel lag gravel, ending on top of the greenish silts. Sometimes they have been enlarged at their base to form bell pits. Exploitation of this type can include the removal of the top layer of the greenish silts over some 0.5 m.

3. Underground galleries for chert extraction from the ditch walls or from the bottom of the bell pits. Proceeding from a central bell pit, the gravel unit has been exploited over several metres, creating short horizontal galleries, very often with subterranean connections. The largest galleries explored by us extend for more than 10 m². Most gravel deposits between the ditches have been extracted. The horizontal distribution of the ditches and the bell pits suggests that very large areas of the site have been undermined. Gallery roofs have collapsed here and there.
Fig. 7. Nazlet Khater.4 General layout: 1 — extraction ditch; 2 — vertical shaft; 3 — underground gallery; 4 — terrace deposits edge; 5 — excavation.

On walls of shafts and galleries, numerous cutting marks of picks used in gravel extraction are observed. Sometimes these cutting marks have been covered with a calcite crust, confirming their antiquity. Some picks have been recovered from the horizontal gallery fillings. They consist of gazelle and hartebeest horns of which the extremity is worn. Rough extraction activities have been performed by heavy hammerstones, of which numerous examples have been recovered in the galleries.

Some test pits were dug into the mining dump from apparently older extraction activities, but also into the basement limestone, where some small flat flint nodules were extracted. They suggest that prehistoric extractors were not clearly conscious of which area was already extracted and which was not.

The post-exploitation deposits in the ditches, in the bell pits and in the horizontal galleries, consist of anthropogenic gravel dumps at the base, covered with fine yellow aeolian sands. The gravel unit, containing Upper Palaeolithic artefacts, is generally
heavily encrusted by a thick calcrite. The overlying infillings of loose aeolian sands and the actual desert pavement completely obscure all Upper Palaeolithic diggings. The presence of in situ hearths in the aeolian sand unit indicates that the site was occupied during a period of active sand deposition.

The Upper Palaeolithic diggings were clearly intended for the subterranean extraction of chert cobbles from the Nile channel lag deposits (Fig. 8). The mining resulted in a nearly complete exhaustion of the channel lag cobbles. Their extent on the site was restricted, however, to about 800 m².

The mined flat elongated chert cobbles were utilised as raw material for an intensive debitage activity by early Upper Palaeolithic man. This resulted in the production of large quantities of artefacts, which have been recovered during the excavations. Debitage techniques are fully Upper Palaeolithic. No Levallois or Halfan technology is present, blade production being the ultimate purpose of the miners. Apparently the blades were exported to the living sites, which were situated in other geographical environments, probably under the actual floodplain. Tool shaping was clearly not an on-site occupation of the chert miners and blade producers. When present, tools are made from flakes or blades by flat retouching, sometimes bifacial, or by oblique retouching. Denticulates are the best represented tools, although some burins and end-scrapers are present. One carefully bifacially-flaked thin foliate has been found. Some bifacial axes have been collected; these are mainly flat, made from large flakes or blanks, with concave sides and a convex cutting edge.

3.2. OTHER EXTRACTION SITES AT NAZLET KHATER

A survey at Nazlet Khater 7, just to the north-west of NK-4, revealed the presence of other extraction areas where similar deposits are present. Extraction techniques, identical to those of NK-4, have been applied for chert exploitation. The Upper Palaeolithic miners tried also to initiate some extraction activities on the site NK-1, where they dug a pit. The exploitation, however, was aborted, probably because they had chosen an area which had already been exploited by Middle Palaeolithic man.

3.3. CHRONOLOGY

Hearth in situ and charcoal blown into ditches, bell pits and galleries gave ample dating opportunities. Provisional results of optical dating by S. Stokes from Oxford confirm the radiocarbon dates. The 14C-dates (Tab. 1) suggest that the mining activities at Nazlet Khater 4 and 7 were spread over a long period of time, ca 30,000–35,000 years ago.
Fig. 8. Nazlet Khater 4. Five successive phase of chert extraction.
Table 1. Radiocarbon dates for Nazlet Khater (all on charcoal)

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4. DISCUSSION

Comparison of the Middle and the Upper Palaeolithic quarrying strategies shows that both systems used ditches. However, the Upper Palaeolithic extraction system differs from the Middle Palaeolithic one in that the exploitation was more regularly planned, involving parallel ditches at fairly constant intervals enabling an exploitation of the areas between two ditches by undermining the sterile rocks, enabling a complete exploitation of the cobble deposits. It is clear that the Nazlet Khater 4 ditch exploitation system was more systematically conceived than that of Nazlet Safaha 2.

The Upper Palaeolithic underground mining system with bell pits and subterranean galleries, intentionally shaped to obtain a better exploitation possibility, represents a totally new strategy that appeared in the Egyptian Nile valley at least since about 35,000 BP.

Palaeolithic mining sites have been reported from some localities such as from the Swiss Jura (Schmid 1972) and from north-east Hungary (Simán 1986). At these latter sites, however, it was impossible to determine the exact age of the exploitation since later Neolithic extraction had thoroughly disturbed the evidence (Schmid 1980). Pre-Holocene flint extraction is well documented by a Final Palaeolithic open air pit for the extraction of chocolate flint at Orőnsko II-2 in Poland, dated between 12,000 and 11,000 BP (Schild 1987). For this site, however, no subterranean exploitation techniques have been recorded. Very old underground extraction of haematite, which is not intended for tool making but for painting purposes, is reported from the Lion Cavern in Swaziland (Beaumont 1973; Volman 1984). Here, Middle Stone Age (MSA) people were extracting hematite perhaps 120,000 years ago, utilising a large horizontal gallery, cut into the side of a specularite rich zone of a hematite cliff face.
A sample of charcoal from the upper layers of this site yielded a date of 43,200 ± 1350 –1200 BP (GrN-5313). Paint quarrying in open pits of early Upper Palaeolithic age has also been reported from sites near Lovas in Hungary (Mészáros and Vértess 1955). The Egyptian sites of Nazlet Safaha, Taramsa and Nazlet Khater clearly show that chert extraction in an organised way is much older than generally thought. At Taramsa, there are clear indications that Acheulean man extracted chert cobbles in a more or less systematic way by means of extraction pits. Middle Palaeolithic man was already well aware of the lithological and petrographical potentialities of buried cobble beds and was able to organise a systematic, albeit irregular, exploitation. It seems that systematic chert extraction can be traced back in time well before 100 ka BP. The well-dated sites of Nazlet Khater 4 and 7 represent, by far, the oldest subterranean chert mining sites in the world. In other parts of the world, in Europe in particular, systematic underground mining of chert and flint is known only from the Late Holocene, posterior to 6000 BP (Weisgerber, Slotta and Weiner eds 1980).

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