Stone artefacts from south-central Tibet, China

by Burkhard Frenzel, Huang Weiwen** and Liu Shijian****

Introduction

The Tibetan Plateau has in its eastern part a mean elevation of about 4.400 m a.s.l. and 4.600 to 4.700 m a.s.l. in the central and western parts. This causes even today very harsh climatic conditions, though the plateau is situated between 27,5° and 37,5° N only. Yet even in summer snowstorms are quite common. The dry climate allows in vast regions of central and western Tibet a very sparse steppe to desert-steppe vegetation to grow only, most of the lakes have saltwater, and even several rivulets contain saline water. Thus the problem is, when man came onto this unfriendly plateau and into the high mountain systems, which surround and top it. At present already several sites, documenting the activities of early historic and prehistoric man are known from various regions of the plateau. An et al. (1979), Wang and Fan (1987), Hou (1991), Schaller (1998), the Atlas of the Tibetan Plateau (1990), Wu (2000), and Huang (1994) mapped and discussed them, whereas Lehmkuhl et al. (1999) hypothesized about the climatological background, provided all the prehistoric sites they mapped really date from neolithic times. This provisional datation may be questioned since An et al. (1979), Hou (1991), Jettmar and Thewalt (1985), Wang and Fan (1987), Huang (1994), Wu (2000), and the Atlas of the Tibetan Plateau (1990) already point to mesolithic and even paleolithic sites. Thus the problem is

a) which regions of the Tibetan Plateau have been used by early historic and prehistoric man and

b) of which ages the relevant sites are.

If it should be correct that some of the hitherto known prehistoric sites date from paleolithic times, at least the Upper Quaternary climate history of this most interesting part of the globe should be known in its major outlines. Most of the scientists who had worked or who are still working there agree that Holocene climate from about 10.000 BP (uncalibrated ^{14}C-ages) to 5.500 or 3.500 BP was warmer (about + 1,5 to 2,0 °C in comparison to present-day conditions) and moister than it is today. These were the paleoecological conditions, which were modelled by Lehmkuhl et al. (1999). Yet concerning the last glacial conditions views strongly deviate from oneanother (Fig. 1): v. Wissmann (1959) and several other scientists state that during the last glacial maximum (LGM) relatively small mountain glaciations had occured there only. According to the results of the 1989, 1992 and 1996 joint German-Chinese expeditions to

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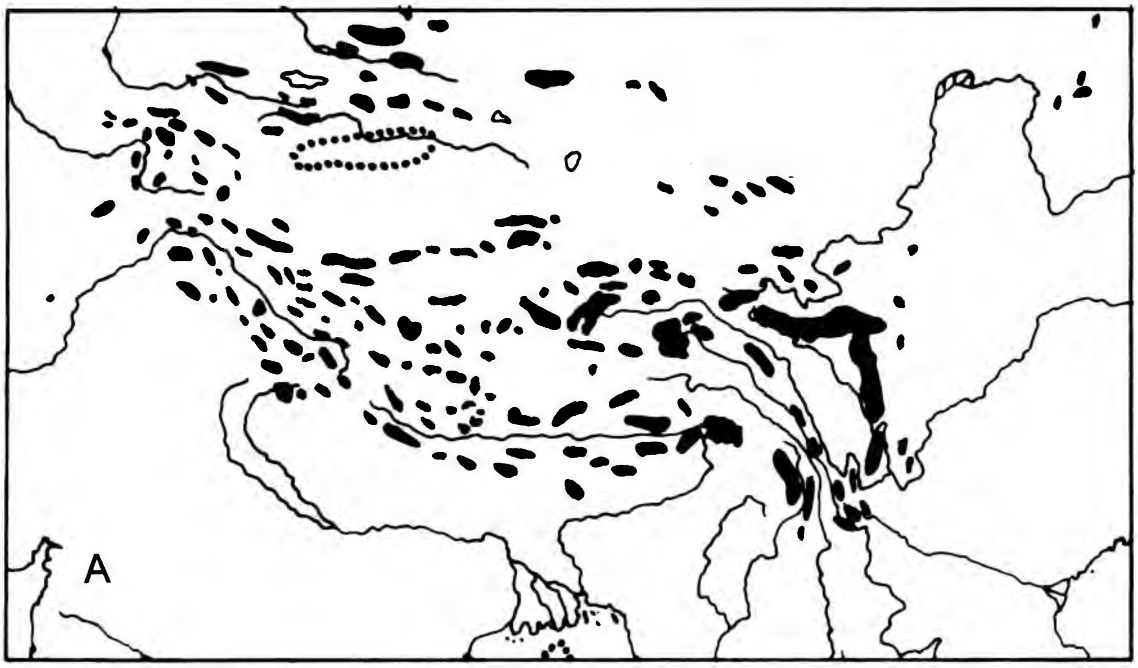
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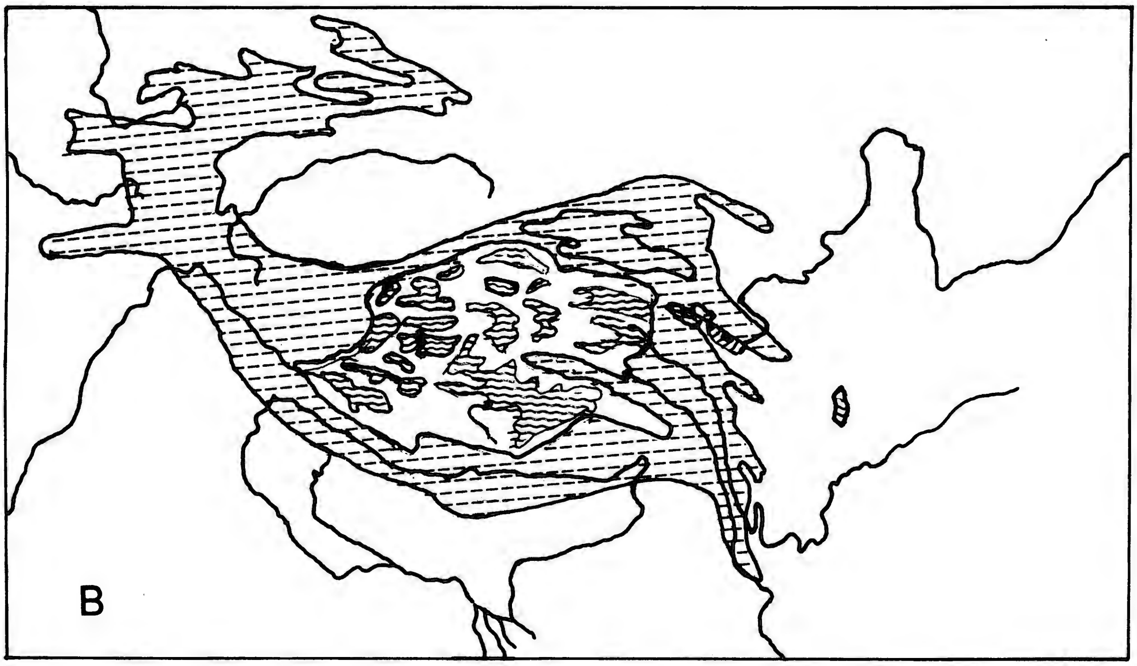
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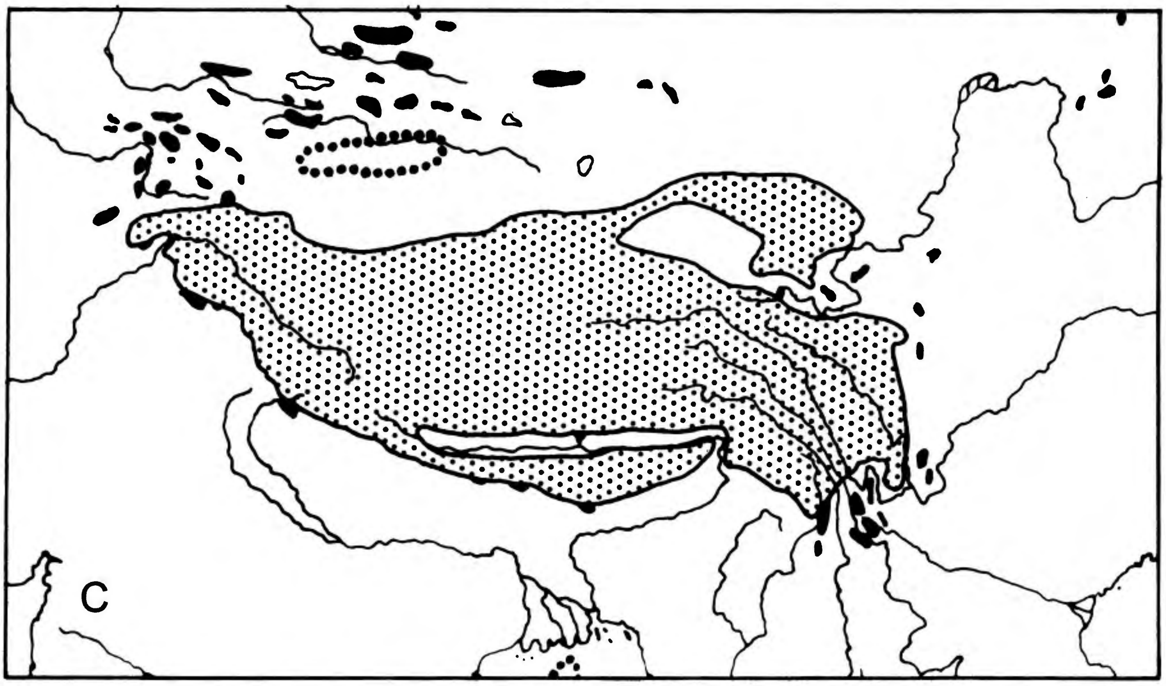

Fig. 1. Various reconstructions of the fullglacial situation of the Last Glaciation on the Tibetan Plateau and its surrounding mountain systems. – A: According to v. Wissmann (1959); black: mountain glaciations; dotted line: beaches of former Lop Nor. – B: According to Fiziko-Geografičeskiy Atlas Mira (1964); hatched area: region of various mountain glaciation systems; wavy lines: lakes. – C: According to Kuhle (1988, 1991); dotted areas: inland ice; black: mountain glaciations; dotted line: former Lop Nor.

Tibet and western Sichuan, in which I was involved, I take this view, too. The Russian Fiziko-Geografičeskiy Atlas Mira (1964) indicates for the same time huge lakes on the plateau, which is held to have been surrounded by mountain glacier systems; Wang and Chung (1965), as well as Kuhle (e. g. 1982, 1987, 1991, 1998, 2000) on the other hand reconstructed a huge inland-ice, which is said to have triggered the Nordic inland-glaciations of the Last or even of preceding glaciations. Evidently the paleoecological consequences of these quite divergent views would be extremely different for prehistoric man there. Thus, on the following pages there will at first be discussed these major paleoclimatological and paleoecological problems, before the stone artefacts, which could be collected during the 1996 German-Chinese expedition to western Tibet, will be described and analyzed.

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Paleoecological conditions on the Tibetan Plateau during the Last Glaciation

It is a well-known fact that the history of climate during the last glaciation has been extremely complex (see literature in Frenzel, 2001; Weißmüller, 1997). At present it is impossible to follow all these changes of climate on the Tibetan Plateau. Here the major trends can cautiously be deciphered only. Sometimes it is stated that nearly all the prominent phases of climatic change during the last glaciation can be followed exactly like those, which are documented in deep-sea records (Liu et al., 1994). Yet this is based on wiggle-matching of some incomplete pollensequences with $\delta^{18}O$- or magnetic susceptibility curves of deep-sea profiles. Due to the very incomplete information of these pollensequences it should be questioned whether this approach is admissible. Thus here only the major trends will be discussed.

The hypothesis of huge lakes, which are held to have characterized pleniglacial conditions of the last glaciation on the Tibetan Plateau (Fiziko-Geografičeskiy Atlas Mira, 1964), is based on observations, which were already made since Hedin (1909) and which can be documented much better now on satellite false colour images of the Tibetan Plateau (Atlas of false colour LANDSAT images of China, 1983). It becomes evident that nearly all the lakes (with the exception of thermokarst lakes) formerly stood much higher than they do at present, yet that their maximal surface areas was definitely much smaller than is indicated in the Fiziko-Geografičeskiy Atlas Mira. According to all the datations available at present concerning the ages of various fossil strandlines it can be shown that they date from the equivalent of deep-sea stage 3, from the Late-Glacial and from the Holocene (ca. 10.000 to 3.000 BP; Fang, 1991; Hövermann and Süßenberger, 1986; Hövermann et al., 1993; Huang, 1994; Frenzel, 1993, 1994; Frenzel and Gliemeroth, 1998; Kong et al., 1993; Zhang, 1993). It is possible that there had existed during the first interstadials of the last glaciation somewhat bigger lakes, too, yet this cannot be proven exactly at present (see Frenzel, 1994). It is worth being mentioned that the biggest lakes during the Upper Quaternary had existed on the Tibetan Plateau and in the desert regions to the north of Qilian Shan (Wünnemann et al., 1998; see more literature there) during the time equivalent of deep-sea stage 3, whereas during the LGM lake levels fell intensively there.

Thus though it is correct that on the Tibetan Plateau and within the present-day deserts to the north of it there had existed during the last glaciation big lakes, they had been much smaller than was indicated in the Fiziko-Geografičeskiy Atlas Mira (Fig. 1 B) and moreover they don't date from the LGM but from the preceding interstadial complex.

Wang and Chung (1965) and Kuhle (1982, 1987, 1991, 1998, 2000) on the other hand thought that the Tibetan Plateau was covered during the Last Glaciation by a huge inlandice (Fig. 1 C). This view is based on the occurrence of erratics, „roches moutonnées", polished rock surfaces, tills, glacial landforms and paleoclimatological and tectonical hypotheses. Yet repeatedly there do exist serious problems in accepting the data communicated. It is often very difficult to localize more or less exactly the areas where the „erratics" should have come from, due to the fact that the geology of most parts of the Tibetan Plateau is not well enough known. Moreover landforms, which are held to be of glacial origin, like „roches moutonnées" or polished rock surfaces do occur on the Tibetan Plateau repeatedly, yet even in very small areas the direction of the „roches moutonnées" changes often from hill to hill, and intensively blown sands and rock-varnishes polish rock surfaces intensively. No doubt, there do occur on the plateau erratics in the surroundings of several mountain systems. Yet there do exist two types of glacial landforms or of boulders: Typical glacial landforms, like terminal or lateral moraines, outwash plains etc. are in general confined to areas, which are not far away from mountain systems, which are in general higher than 4 900 m. They were mapped and dated repeatedly (e. g. Zheng and Shen, 1999; Li and Li, 1992; Zheng et al., 1991; Wu et al., 1999; Hövermann et al., 1993; Lehmkuhl, 1997; Lehmkuhl and Hövermann, 1996; Li et al., 1991; Frenzel, 1993, 1994) and were formed or deposited evidently during the glacial advances of the LGM. On the other hand there do exist relatively strongly weathered boulders beyond these landforms just mentioned, yet always not too far away from the mountain systems (Lehmkuhl and Hövermann, 1996; Hövermann et al., 1993). Repeatedly they were deposited before a phase of very strong weathering, which according to its degree of pedogenesis and the TL-age data available at present (results of the 1992 and 1996 expeditions), seem in general to date from the last but one glaciation, yet not from the first part of the last glaciation (e. g. equivalent of deep-sea stage 4). In some places, yet, these „big boulders" seem to date from this last mentioned stage, too (Lehmkuhl, 1997). Yet all these forms or sediments don't point to a former inlandice. Moreover our analyses of surface textures of quartz grains, investigated with the scanning electron-microscope of the Institute of Botany, Hohenheim University (Krinsley and Doornkamp, 1973; Kowalkowski, 1988; Frenzel, 1981; Frenzel and Liu, 1994) point to regionally very restricted last glacial glacigene processes only (Fig. 2). This is in accordance with what has been stated about the extent of the last glacial and the last but one glacial glaciers on the Tibetan Plateau. The wealth of data will be published elsewhere. But what has been mentioned here may suffice to state that according to the literature data and to our own observations and analyses the extent of the last glacial glaciers has been very small on the Tibetan Plateau only. Thus the picture given by v. Wissmann (1959) seems to approach reality much more than the hypothesis of an inlandice does.

To sum up, it seems that during the major stadials of the last glaciation there had happened on the Tibetan Plateau advances of more or less small valley glaciers only. The advances during the LGM were evidently in general in phase with those of most other parts of the Northern Hemisphere. During this stadial lake levels had fallen considerably. How small the lakes had been at that time indeed can not be shown at present on the Tibetan Plateau, in contrast to what is known from the Tengger Shamo and the Badain Shamo to the north of the Qilian Shan (Richthofen Gebirge) (Wünnemann et al., 1998). On the other hand the interstadial complex of deep sea stage 3 was characterized on the Tibetan Plateau and in the present-day desert regions to the north of the Kunlun-Qilian Shan system by big lakes, which evidently repeatedly contained freshwater.

An amelioration of climate, i.e. most of all an increase of moisture available had happened since about 13.000 B.P., by which the Holocene amelioration of climate, which led to the Holocene climatic optimum, was initiated. The climate data for the times mentioned, given in Frenzel et al. (1992) seem to reflect past realities quite well, still.

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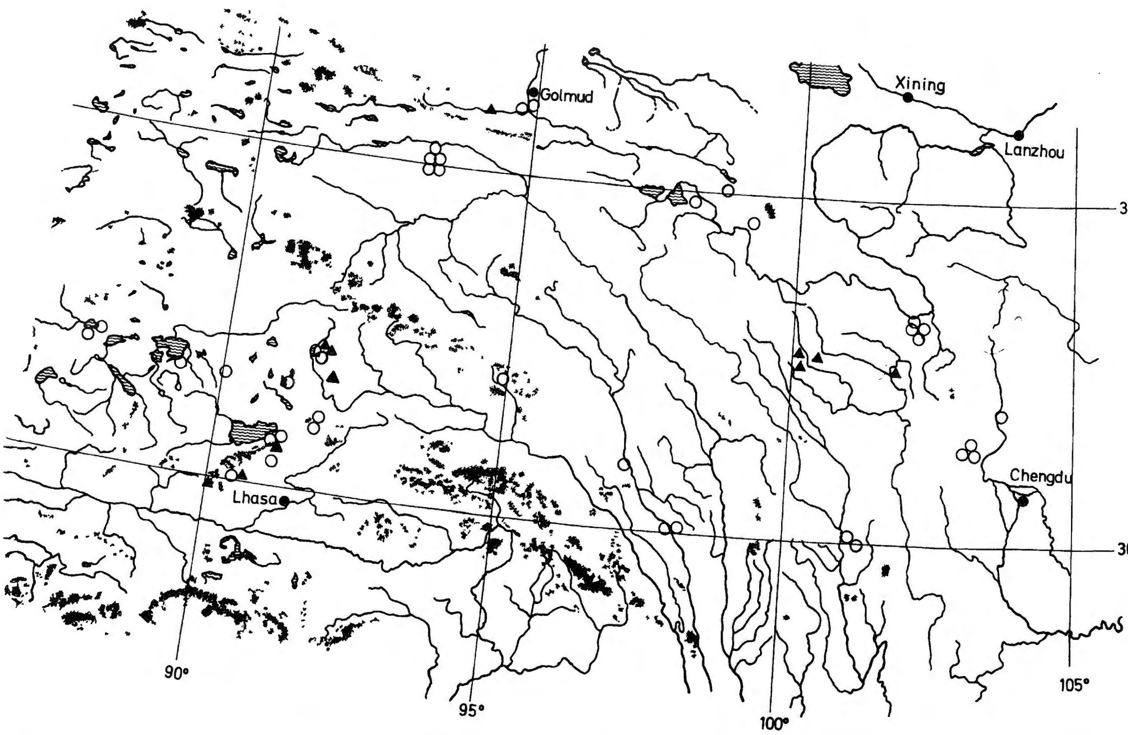

Fig. 2. Distribution pattern of glacigene surface textures of quartz grains, indicating the last glacial (probably LGM) distribution of glaciers. Triangles: glacigene surface textures; open circles: non-glacigene textures (aeolian, periglacial, slope deposits).

Scientific goals of the 1996 joint German-Chinese expedition to western and central Tibet

In continuation of the results of the 1989 and 1992 expeditions the 1996 expedition aimed at deciphering the paleoecological history of the Upper Quaternary in central and western Tibet. The expedition route is given in Fig. 3. Since paleoecology is most of all governed by climate several geological borings were made and geological profiles were dug up between about 4.000 and 5.500 m a.s.l., concentrating the efforts on the Tibetan Lake District and on the forested regions of southeastern Tibet and western Sichuan. For answering the question about the paleoecological evolution it is important to investigate by pollen-analyses the history of vegetation and flora at least since the times of the existence of the big fossil lakes and to try to understand to some extent since which times and how intensively man may have influenced vegetation and his environment even on the Tibetan Plateau. Thus the question as to traces of human activities was of importance. This led to the discovery of prehistoric sites, which will be discussed here. Regrettably during the preparation of the expedition it turned out to be impossible to incorporate a Chinese archeologist into the team, due to the fact that important excavations were going on simultaneously in southern China. Thus all our archeological material was given at the end of the expedition to Professor Dr. Huang Weiwen in Beijing for analyzing the material, in comparison to former relevant observations, made already in Tibet and Qinghai. Professor Huang had already participated in the 1992 expedition.

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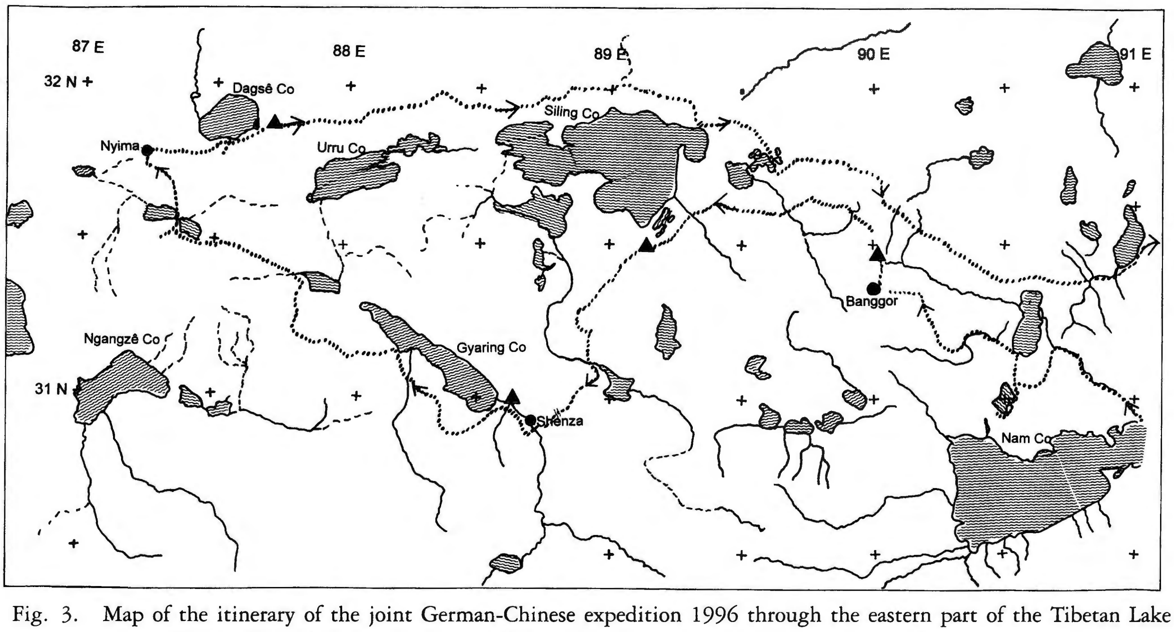

Fig. 3. Map of the itinerary of the joint German-Chinese expedition 1996 through the eastern part of the Tibetan Lake District (dotted line) and location of the prehistoric sites mentioned in the text (triangles).

The sites

During the 1996 expedition the distance between Chengdu and Lhasa, via Ya'an, Kangding, Garze, Qamdo and Nagqu was covered very fast so that prehistoric observations could not be made, though already during the 1989 and 1992 German-Chinese expeditions to northern and eastern Tibet I had found neolithic artefacts in the source area of the Hoang Ho (Huang, 1994). Yet it was the aim of the 1996 expedition to have as much time as possible within the Tibetan Lake District between the Nam Tso (Nam Co, Tengri Nor) in the east and the Ta k'o tz'u hu (Dagce Co) in the West. This last mentioned plateau has a mean elevation of about 4.600 m a.s.l. Here, the soft rolling landscapes of the Tibetan Plateau are towered by in general steep-sided, high mountain ridges and massifs, up to an altitude of about 6.500 to 7.000 m a.s.l. According to the Chinese Map of Snow, Ice and Frozen Ground in China (1988) the study area should be situated outside the area of continuous permafrost, yet according to the observations made during the expedition it soon became evident that at least discontinuous permafrost is widely spread there with a lot of permafrost areas. According to the Atlas of Tibet (1990) the region experiences mean July temperatures of about 8,5 to 9,0°C, with cold winters (ca. –12 to –14°C). The annual mean precipitation, which changes strongly from year to year, is about 320 to 400 mm in the eastern and southern parts, yet 200 to 300 mm only within the central part around the Siling and Dagce Co. The study area is situated beyond the natural timberline (Frenzel, 2000), within a very open steppe to desert-steppe vegetation, which is dominated by *Stipa* and other grasses in moister or sandy regions, and by various *Kobresia* species, yet only a very restricted number of dicotyledonous plants, within the desert-steppe region on remarkably saline soils or in swampy areas. Within the moister peripheral regions large herds of yaks and sheep are very common at present, yet within the inner parts they do occur only rarely. Here even today small herds of gazelles and of Tibetan antelopes can be observed.

As already stated in the preceding chapter nearly all the lakes of the Tibetan Lake District are surrounded by high fossil lake-level beaches (see Atlas of False Colour LANDSAT Images of China, images 151 through 149–38 and 150–39). These fossil beaches point to quite other climatical conditions prevailing there in the past than are met with at present. As already stated, they seem to date from about 45.000 to 25.000 BP (uncalibrated age data). Another typical element of the present-day landscapes there are huge swamps and terrigenous peat-bogs, which evidently are caused by permafrost or at least long lasting seasonal frost. Very often the surface of the peat layers is riddled with small steep-sided holes or hollows (about one meter in diameter, depth 40 to 50 cm). Between them are ridges of a very stiff peat (diameter of about one to two meters) forming a somewhat difficult to pass network. These are typical features of the Naka-type peat-bogs, which are characteristic of the permafrost areas in Central Asia.

Another very characteristic factor in the study area are strong winds and extremely effective whirlwinds (Fig. 4). They cause the uppermost sediment layers on mineral soils to be blown away in vast regions. Within the steppe-areas there has been formed during Holocene times a humus layer with a thickness of at most 10 to 15 cm. The roots have formed a remarkably dense network. Yet it can easily be destroyed by too intensively grazing herbivores. Moreover the humus horizon is at least within somewhat moister regions very often strongly damaged by burrows of several rodent species. If so, the humus layer can easily be blown away, too, exposing the mineral soil.

Prehistoric artefacts were found by us in four sites (Fig. 3). They are some 15 km to the north of the county settlement of Banggor (Bangoin); on the southeastern edge of Siling Co; between the county settlement Shen za and Lake Gyaring and on the eastern uppermost fossil beaches of Dagce Co. The elevation a.s.l. is always about 4.600 to 4.720 m.

Fig. 4. Whirlwind in the surroundings of Dagce Co, 1996 expedition. Photo taken on the highest fossil beach-level of Dagce Co, view to the west.

Fig. 5. Site to the north of Banggor. View from the area of numerous stone artefacts onto the fen-land-area in the east. Summer monsoon clouds.

a) Site to the north of the county-settlement Banggor

This site is situated at 31° 25′ 56″ N, 90° 01′ 09″ E, 4.716 m a.s.l. Here is a small lake, with a diameter of about 200 m, some 300 to 400 m to the east of about 100 to 150 m high hills, which protect the site from the westerly winds. The lake is fed by a natural source, so that a rivulet is always draining the lake, with slightly brackish water. The site is situated on the eastern beach of the lake. The soil surface slopes down from here to the east very faintly. The artefacts are lying below a humus layer of about 6 to 8 cm in thickness, yet in general this humus layer has been destroyed by the yaks and its last traces are being blown away. The artefacts are concentrated at a distance of about 10 to 20 m from the lake, yet many artefacts can be found even farther away to the east, up to some hundred meters in direction to the huge fen-land area (Fig. 5). Somewhat to the east in a depression of the land surface a peat-bog is situated, which is intensively influenced by frost action. We dug up this peat-bog. It has about 60 cm of fen-land peat, which covers a fine gravel, which in its turn contains near the lake mentioned the artefacts. ^{14}C-datations of the lowermost peatlayer and pollenanalyses are still going on. The site is extremely rich in artefacts, which seem to be distributed more or less randomly in the very vicinity of the small lake. Interestingly we had chosen the same site for erecting our tents as was used by prehistoric men. The samples were collected by Dipl.-Biol. Christine Roth, Dr. Achim Bräuning and by myself.

Concerning the already mentioned problem of typology and extent of the Upper-Pleistocene glaciation on the Tibetan Plateau it should be mentioned that tills are lacking in the study area and that no geomorphological features point to a former inland-ice or a mountain glaciation there. Moreover the scanning electron-microscope analyses of quartz-grain surface (Liu Shijian) reveal that the artefact containing stony sands at the bottom of the peat-bog mentioned only show features of periglacially moved grains, which lateron were strongly weathered. Thus, in this region no traces of a former glaciation do exist.

b) Site some kilometers to the southeast of Gyaring Co (Cha lin hu)

The coordinates of the site are 30° 59′20″ N, 88° 37′10″ E, 4.693 m a.s.l. The site is situated on top of the 31 m river terrace, near the mouth of the river, which falls into Gyaring Co. The strongly anastomosing river is moreover accompanied by a second terrace, at an elevation of 19 m above the river. The approximately 6.470 m high mountains have small valley glaciers and it seems that someone during the Last Glaciation (Last Glacial Maximum?) valley glaciers had moved down to the main valley. A sparse steppe vegetation clads the river terraces, whereas the bottom of the valley is covered by a huge fen-land, thermokarst features and several arms of the anastomosing river.

The artefacts are lying on the surface of the 31 m terrace amongst a lot of angular stones and gravels (Fig. 6). It seems that grazing animals have destroyed the humus layer, which formerly may have covered the gravels and artefacts. This destruction caused huge sand masses to climb up the mountain slopes for about 300 to 400 m, where these slopes are exposed to southwesterly winds (Fig.7). Thus the stratigraphy of the site is unknown. Regrettably the small collection of artefacts got lost during the expedition, yet the site is rich in stone artefacts.

Fig. 6. Site on the 31 m terrace between Shenza and Gyaring Co. Artefacts among prevailing frost-beaten and wind-polished gravel stones.

Fig. 7. View from the southwest across the valley of the Chumbu Zangbo to the area of the artefact-site between Shenza (to the right) and the Gyaring Co (to the left). The vast fenland-area, strongly influenced by frost actions is in front of the prehistoric site, the covering sands of wich are blown up the mountain slopes in form of sand-dunes for several hundred meters.

c) The Siling Co site (Se lin tso; Ch'i lin hu)

The present level of Siling Co stands at about 4.539 m a.s.l. It is surrounded up to an elevation of ca. 4.610 m by numerous fossil lake beaches. The site investigated is situated at the southeastern corner of Siling Co, at about 31° 30′ N, 89° 07′ E, at an elevation of 4.618 m a.s.l. Just in front of the site, about 8 m deeper, the highest fossil beach of Siling Co has formed.

The artefacts lie on a slope, which is oriented to the southwest, below vertically standing rocks of a calcareous sandstone. The artefacts are made of lydite and of a very dense basaltic material, which are lacking in the immediate vicinity. At least two places were found where the artefacts had been prepared (Fig. 8, 9). At the lower end of the slope a rivulet is running, which has a good freshwater, no brackish nor saline water. The places are protected against winds coming from the northern quadrant by the rocks mentioned. One has a good view from here onto the former beaches and the lake. Here, too, the artefacts are in general not covered by younger sediments, nor by humus. Evidently all this material has been blown away, due to the general destruction of the sparse desert-steppe vegetation, which is strongly overgrazen by herds of domesticated yaks. Thus some information about the former stratigraphical position of the artefacts may be obtained from the geological profile opened up by the rivulet mentioned:

0– 40 cm depth: brown fine sand (modern soil);
40– 46 cm : silty fine sand, humic;
46– 50 cm: fine sand with plant remains, perhaps charcoal;
50– 65 cm: brown fine sand with plant remains at a depth of 56 cm, very rich in water;
65– 68 cm: faintly humic fine sand;
68– 80 cm: humic silty fine sand;
80– 95 cm: humic fine sand with plant remains;
95–108 cm: humic fine sand, rich in water;
108–125 cm: humic fine sand, no water, with some layers of humic material;
125–132 cm: strongly humic silty fine sand;
132–145 cm: fine sand, rich in gravels; gravels in some layers;
145–166 cm: humic sand;
166–189 cm: sandy gravel;
189–195 cm: sand and gravel, with plant roots;
195–217 cm: humic fine sand, poor in small gravels;
217–248 cm: sand, gravel, not humic.

The prehistoric sites are situated at a distance of about 30 to 40 m from the profile just mentioned. They are very rich in stone material (Fig. 8, 9). Thus it can be suggested that the fine sands and silts from 0 to 132 cm below the surface of the river-profile correspond to silty material, which formerly lay on top of the stony slope sediments and the artefact layer, whereas the sands rich in gravels should correspond to the slope sediments in which the artefacts were found. These gravelly layers of the rivulet correspond to the uppermost layers of the highest fossil beach of former Siling Co, which are very rich in gravels, too. So it seems that the artefact layer is synchronous with the uppermost fossil beach. During our work on the geological profile cut by the rivulet, several samples were taken for TL- and ^{14}C-datations as well as for pollenanalysis. Work on these samples is still going on. Yet eight samples between a depth of 140 and 248 cm have been analyzed by Liu Shijian in view of the surface textures of quartz grains. It turns out that these stony sediments are characterized by frost weathering, periglacial slope transport and most of all by aeolian transportation. This corresponds well with the macroscopic features of those stones in between which the artefacts were found. No glacial influence could be detected here.

Fig. 8. Siling Co-site. One of the places where stone artefacts were produced.

Fig. 9. Siling Co-site. Another place of stone-artefact production.

d) Dagce Co site (Ta Tse T'so; Ta k'o tz'u hu)

The site is situated on the highest fossil beach on the eastern shore of Dagce Co (31° 52′ 43″ N, 87° 40′ 50″ E). The modern level of this lake is said to lie at an elevation of 4459 m a.s.l.; the artefacts were found at an elevation of 4.513 m a.s.l. Most of the higher beaches are very stony and whirlwinds, blowing out the finer material are very common features (Fig. 4). The modern vegetation is extremely poor, comprising only 8 to 10 taxa of higher plants. The most characteristic grasses are *Stipa sp.* and *Kobresia spp.* Small herds of the Tibetan antelope (*Pantholops hodgesoni*) and of the gazelle *Gazella subgutturosa* are grazing there. Sometimes small herds of horses do occur there, too, yet it was not clear, whether they were wild or domesticated animals. Again the artefacts are lying on the very gravelly surface. Though we had dug up several geological profiles in somewhat protected places, former lagoons, we never found artefacts within a well stratified profile. I collected a small number of artefacts only. They were analyzed by Huang Weiwen later on in Beijing, yet the number was too small to allow well-founded conclusions to be drawn. From one of the geological profiles four samples were taken for scanning electron-microscope analysis at a depth of between 240 and 294 cm from the soil surface. All of them point to dominating aeolian influences and some periglacial processes (Liu Shijian). Evidently the area has not been covered by glaciers, though far away to the north (ca. 30 km) modern glaciers could be seen on the 6420 m high mountain systems.

Burkhard Frenzel

Stone Assemblages

The overwhelming majority of stone artefacts was collected in the Banggor (Bangoin) and Siling Co sites. So the following descriptions and discussions concentrate on these two sites only.

Since there is no essential difference in the geological and geomorphological situation of the two sites mentioned above, i.e. the Baingoin (Banggor) and Siling Co site, we don't differentiate between both these sites when analyzing the stone artefacts. They consist of cores, flakes, tools and microliths, totalling 121 pieces and a lot of debris. These artefacts are in general made of black or greyish-black lydite, but occasionally of basaltic rock and of quartz, too. The localities, where this material comes from, could not be studied during the expedition, yet according to field-evidences it seems that at least lydite and basaltic rocks did not belong to the bedrock of the immediate vicinity of the sites to be discussed here.

Most of the artefacts are flakes. Their average sizes (n. 74) are: length 35.28 mm, width 36.03 mm, and thickness 10.79 mm. Out of them only two pieces are typical blades. There do exist three types of platforms of the flakes: plain (n. 50), faceted (n. 21), and punctiform (n. 3). Among the flakes with a plain platform, three have a distinct lip on the interior margin of the platform. The average interior platform angle of the flakes measures 115.68 degree, whereas the average exterior platform angle (angle de chasse) is 73.89 degree. According to this analysis, especially that of the exterior platform angle, evidently the direct percussion technique was made use of for the preparation of the flakes. On the other hand there is no evidence for the application of the indirect percussion method.

Cores can typologically be divided into those with alternating flaking, with one platform, multi-platform and discoid types. Core tablets and ridge blades occur in the collection. This suggests that this work was done before flaking. Fig. 10,1 shows a discoid core made of greyish black lydite from the Banggor site. Here at least thirty-three flake scars can be recognized, which are distributed on the upper and lower surfaces. A still remaining carbonaceous inclusion on the top of this core may evidence that it was found in the layers *in situ*. Fig. 10,2 shows a ridge blade made of black lydite from Banggor and Fig. 10,3 represents a core tablet made of black lydite. It was found in the Banggor site, too.

Tools are in general blanks, retouched by flakes. The average sizes of the 25 tools are: length 51.80 mm, width 35.58 mm, and thickness 13.5 mm. This indicates that we are dealing here with light-duty tools. The tool category consists of side scrapers, notched, denticulate tools, end scrapers and „pointed" end scrapers. Side scrapers definitely prevail in the tool-kit. They can be subdivided into one sided scrapers (straight, convex, and concave), double side scrapers, convergent scrapers, transverse side scrapers, and alternate retouched side scrapers. Notches and denticulations are common. Fig. 10,4 shows one denticulated specimen, which was found in the Banggor site. It is made of a black lydite flake. The retouches are found on the dorsal surface. On the other hand, end scrapers, „pointed" scrapers and burins are rare or totally absent. Fig. 10,5 shows an asymmetrical end-scraper made of a black lydite blade from the Banggor site. Here the retouch is on the dorsal surface of the distal end. In general, the retouches on the dorsal surface are a typical character of the industry. Only some pieces have an inverse retouch. The angle formed by the two surfaces on both sides of the edge is usually not too abrupt. Both scalar and stepped retouches are quite common retouch morphologies. One point shown in Fig. 11, was found in the Siling Co site. It is made of a thick black lydite flake and exhibits the typical stepped retouch on the ventral surface of the two lateral edges. Its proximal end is thinning from the ventral and the dorsal surfaces for hafting. No parallel or subparallel retouch can be recognized in the assemblage.

Microliths form another important component of the assemblage. They consist of wedge-shaped cores, ridge blades, micro-blades and „pieces prepared for flaking". Among them, the wedge-shaped cores made of black lydite, both from the Banggor and Siling Co sites, shown in Figs. 12,1.2 and 4 are very interesting, because usually the micro-blade scars on the working surface are reverse. The „piece prepared for flaking" is a bifacial flaking piece, a core for producing micro-blades. They are common in sites in China, where there were found microliths associated with other micro artefacts such as cores, blades, ridge blades and tools. Fig. 12,5 shows one of them of the Siling Co site. It is made of a greyish black lydite. Ridge blades are common, too, in the two sites. Fig. 12,3 shows one of them from the Banggor site, which is made of black lydite.

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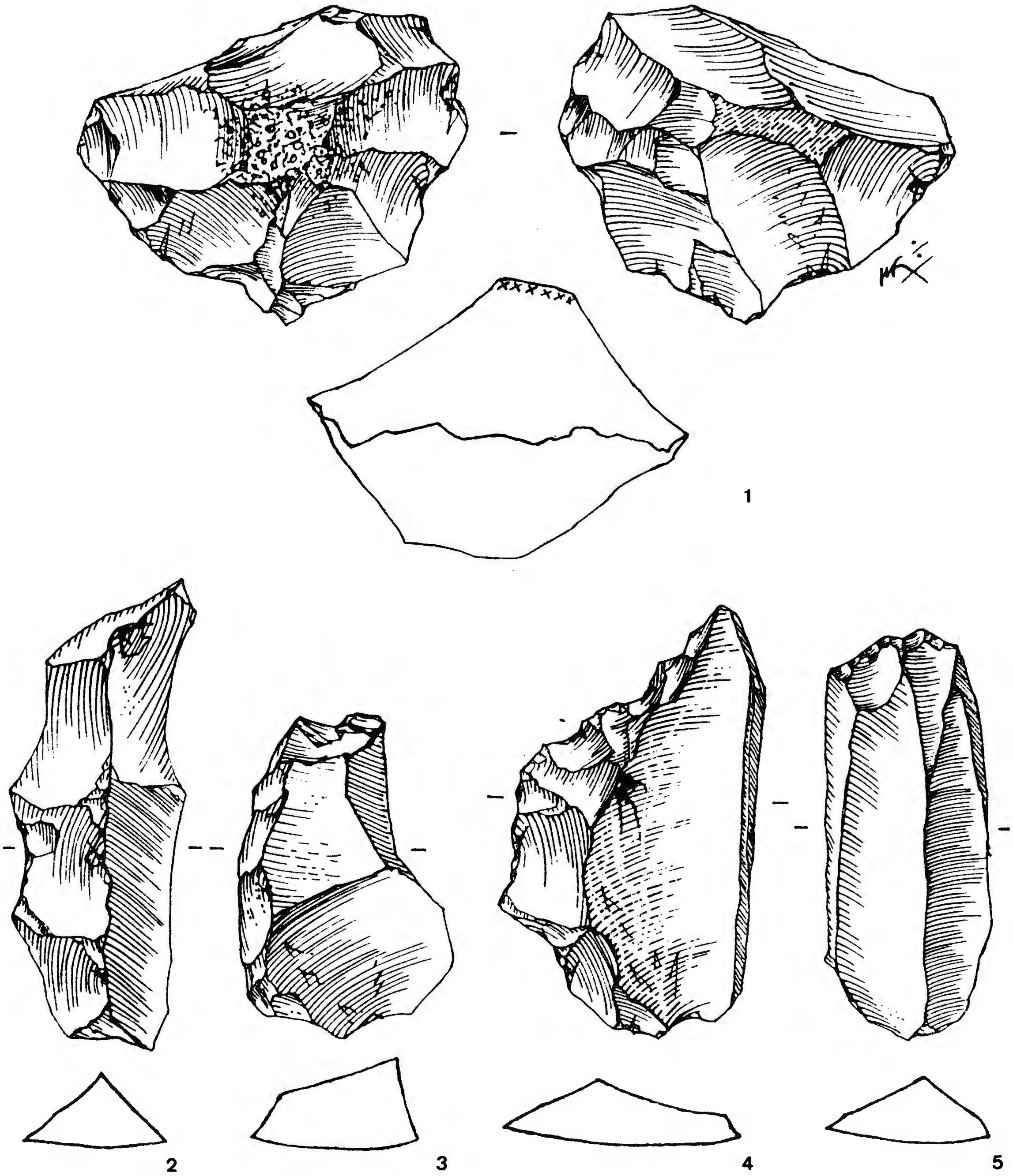

Fig. 10. Some examples of prehistoric stone-artefacts found during the 1996 expedition. 1 discoid core, Banggor site, lydite; 2 ridge blade, Banggor site, lydite; 3 core tablet, Banggor site, lydite; 4 denticulated side scraper, Banggor site, lydite; 5 asymmetrical end-scraper, Banggor site, lydite.

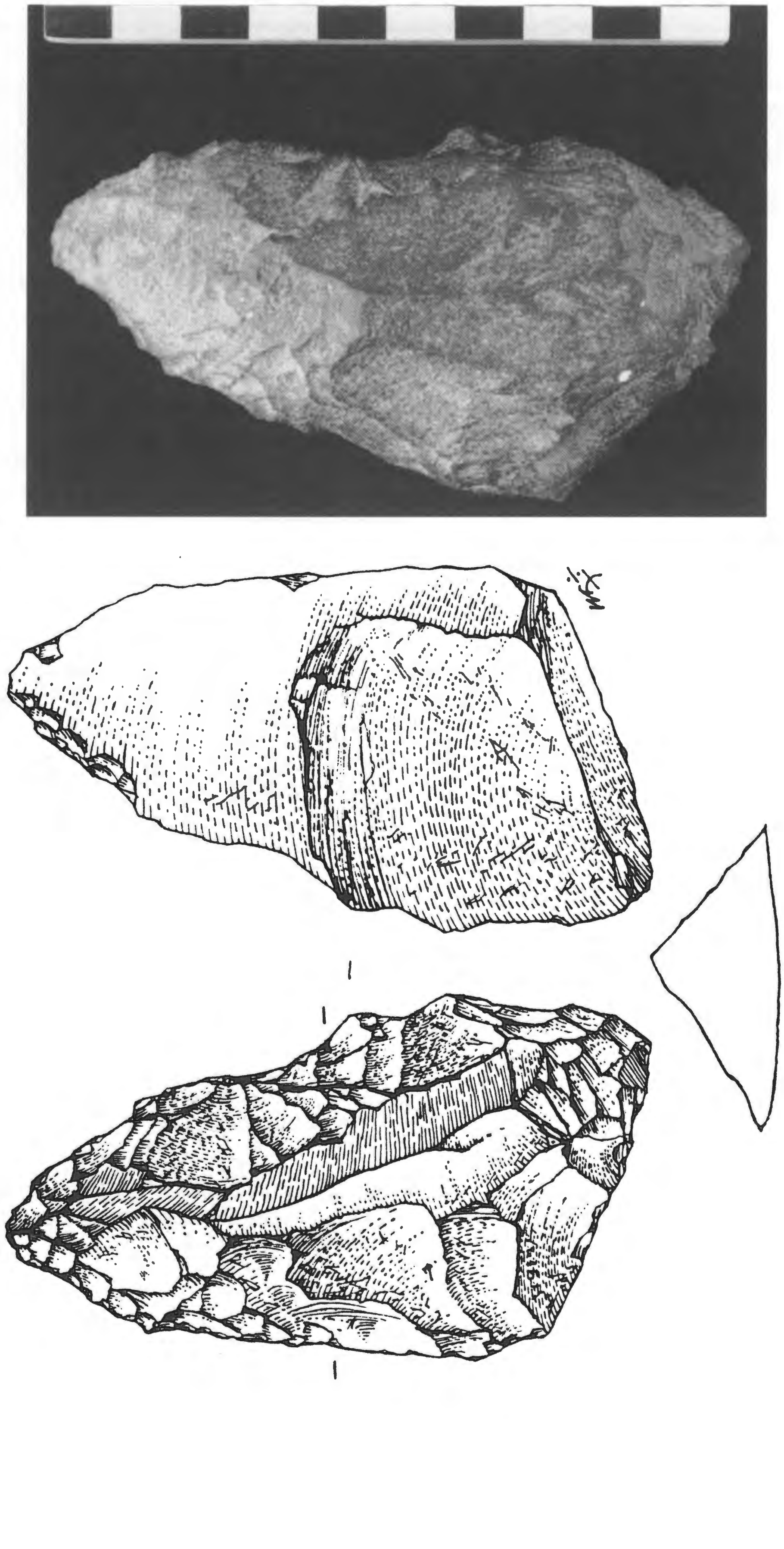

Fig. 11. Point, Siling Co site, lydite.

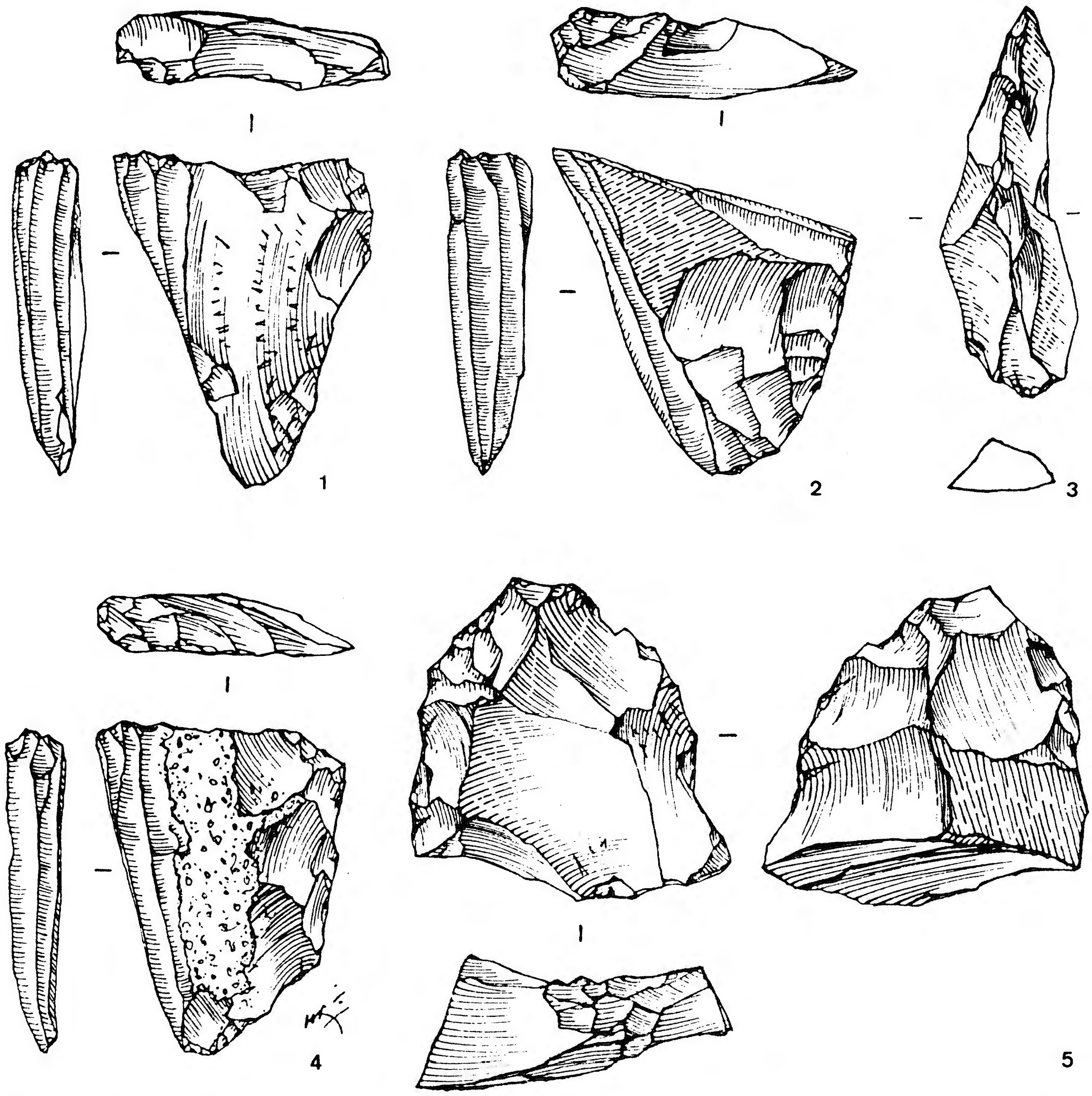

Fig. 12. Some examples of prehistoric stone artefacts found during the 1996 expedition. 1 wedge-shaped core, Banggor site, lydite; 2 and 4 wedge-shaped cores, Siling Co site, lydite; 3 ridge blade, Banggor site, lydite; 5 microlithic tool, Siling Co site, lydite.

Discussion and Conclusions

The present paper is not the first one to report on stone artefacts found in Tibet. The expeditions organized by the Chinese Academy of Sciences and the Chinese Academy of Geological Sciences during the 1970s and 1980s had brought back stone artefacts found in an area of central North Tibet, from 87° to 88° E, and 30° to 34° N (An et al., 1979; Qian et al., 1988; Huang, 1994). However, their stratigraphical context was uncertain, because they were picked up from the soil surface only. Thus it should be greatly appreciated that the German-Chinese expedition of the year 1996, which was led by Burkhard Frenzel and Liu Shijian could shed some new light on this problem. Their field-work suggests that at least at the Siling Co site the stone artefacts originated in slope sediments, which stratigraphically correspond to the lake-sediments of the highest fossil beach (4.610 m a.s.l.) of former Siling Co, the modern level of which is situated at about 4.539 m. The corresponding sediments of the high lake level are overlain at the site studied by late-glacial to holocene sediments.

Recent investigations suggest that the high levels of this and of several other Tibetan lakes (Liu et al., 1999; Frenzel, 1993; Frenzel and Gliemeroth, 1998; Frenzel et al., 1995; Fang, 1991; Hövermann and Süßenberger, 1986; Huang, 1994; Kong et al., 1993; Zhang, 1993) date from an interstadial of the Last Glaciation together with lower levels, which were formed during the Late Glacial, Early and Middle Holocene. Thus, the fossil beach yielding the above mentioned stone assemblage was deposited during the Last Glaciation. Considering the suitable ecological conditions for early man, which must have prevailed at that time, we suggest that the relatively suitable conditions for early man to live there should have dated from the interstadial just before the LGM (the Last Glacial Maximum, ca. 23.000 BP). This is supported by results of the 1988 China-Japan Expedition into the same area. During this expedition, Prof. Yuan Boyin (Institute of Geology, Chinese Academy of Sciences) and his colleagues collected a lot of stone artefacts from the ca. 4.600 m a.s.l. fossil beach at the southeastern side of Siling Co. Some stone artefacts were dug out from the greyish brown fine sand and silty fine sand *in situ,* though most of the artefacts were found on the surface. The ^{14}C age of the carbonic material from the fossil beach at the site studied is 23.480 + 380/-370 BP (personal communication of Prof. Yuan).

In comparison with the till now known material and its interpretation, the new finds add several significant details, which enable a better understanding of the essential features of the stone assemblages from Central Tibet to be done. Yet the problem is, whether all these artefacts found during the 1996 expedition date from one relatively short span of time only or whether the sites have been used repeatedly. In this respect two facts should be mentioned:

1) The 1996 expedition had chosen the same sites for camping on the Banggor and Siling Co sites as were used by prehistoric man and if one should have looked for an appropriate site for camping in the Gyaring Co-Shenza area one would have taken the site where we found the artefacts mentioned. This means that the number of appropriate places for living in the areas studied is restricted. Thus it is possible that these sites were chosen repeatedly.

2) In the Banggor site besides the stone artefacts described a very primitive, badly tempered piece of pottery was found, too (far away from the sites on the lake-shore, where most of the artefacts came from). This, too, points to the possibility of a repeatedly done use of the sites by early man.

Yet as mentioned above, the stone-artefacts discussed here, consist of two major groups, i.e. the normal chipping artefacts and microliths. In contrast to the till now known material typical for relatively simple chipping techniques of stone artefacts, the new collection has a much complexer appearance concerning both technology and typology, as for instance prepared cores, discoid cores, core tablets, ridge blades, scalar retouch, stepped retouch, etc. They are types of flaking and retouching, which are typical for Middle and Upper Paleolithic assemblages of those regions, which surround Tibet, like Shuidonggou (formerly Choeitong-keou, ca. 34.000 and 38.000 BP based on Uranium series dating: Breuil, 1928; Jia and Huang, 1985; Huang, 2000), Xiao Qaidam (ca. 30.000 BP, based on ^{14}C dating: Huang, 1994), and Xiachuan (ca. 16.000~23.000 and 36.000 BP, based on ^{14}C dating: Huang and Hou, 1998; Huang, 2000) or even some earlier industries such as Panxian Dadong (130 to 260 ka BP) of the Yunnan-Guizhou Plateau of Southwestern China (Huang et al., 1997). On the other hand, some techniques and types of tools, as e. g. blade technique, pressure technique, end scrapers, burins, etc., which are typical for European Upper Paleolithic assemblages and some Upper Paleolithic industries of North China, such as Shuidonggou and Xiachuan, are rare or are less developed in Central Tibet. Thus, it seems that the stone assemblages of Central Tibet discussed here, show more similar features with Middle Paleolithic, than with Upper Paleolithic techniques. This means that they don't date from too long a span of time.

For long, the microliths found in the Qinghai-Tibetan Plateau were held without any exception to date from the Neolithic. However, it seems now that this view cannot be held any longer. The Central Tibetan material discussed by us here suggests that microliths associated with the normal chipping technique of stone artefacts belong to the Paleolithic period. In fact, comparable assemblages occurred in the adjacent Xiao Qaidam region according to recent discoveries. The same holds for some Paleolithic sites of North China, for example, Xiachun and Chaishi (ca. 26.400 BP, based on Uranium series dating, or > 40.000 BP by ^{14}C, Huang, 2000). Moreover, some typological differences can be seen in the microliths of Central Tibet and those of typical Neolithic assemblages from Tibet such as at the Karou site (ca. 4.955 BP based on ^{14}C, Huang, 1994) of Eastern Tibet. This holds for both, their technology and their typology, as well. At any rate it becomes evident that our prehistoric knowledge of the Tibetan Plateau is at its beginning only. Much has to be done, still; yet, as could be shown, there do exist promising sites in an appreciably great number on the Plateau, which should be investigated intensively.

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Acknowledgments

We are grateful for the financial support of this investigation given Burkhard Frenzel by the Deutsche Forschungsgemeinschaft and the Max-Planck-Gesellschaft zur Förderung der Wissenschaften, and by the Chinese Academy of Sciences, given to Liu Shijian. We also thank Drs Eric Boeda (Dept. of Ethnology, Comparative Sociology, Prehistory and Ethnomuseology of the University Paris X), Dr. Hubert Forestier (Institut de recherche pour le développement, IRD, Orléans, France), and Masatoshi Sagawa (Faculty of Letters, Tohoku Gakuin University, Japan) for their helpful discussions with Huang Weiwen during their stay in Beijing, and especially for the sincere helps by Hubert Forestier and Masatoshi Sagawa in drawing and photographing the stone artefacts, respectively.

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