Lithic assemblages from the Chang Tang Region, Northern Tibet

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Archaeological evidence from the Chang Tang Reserve suggests that humans may have first colonized the Tibetan Plateau during the late Pleistocene. Blade, bladelet and microblade technologies are found as surface assemblages in a variety of contexts above 4500 m elevation. The lack of modern analogues for foraging populations in high-elevation environments brings about a reconsideration of the diversity and organization of Pleistocene hunter–gatherer adaptations.

Key-words: Tibetan Plateau, late Pleistocene, foraging adaptations, blade technology, microblade technology

Introduction

This paper presents new evidence from surface stone tool assemblages collected by George Schaller in the Chang Tang Reserve, northern Tibet, at elevations above 4500 m asl. Eighteen separate localities have yielded lithic assemblages ranging in size from a single artefact to as many as 158 specimens. A number of the assemblages contain unique Upper Palaeolithic blade and bladelet technologies. This is perhaps surprising given that true blade technologies are rare in Chinese contexts (Brantingham 1999; Gao 1999; Lin 1996; Zhang 1999). Microblade cores, blanks and tools are also found at several of the Chang Tang localities. Microblade technology is common at Chinese archaeological sites dating to the terminal Pleistocene and early Holocene (Elston *et al.* 1997; Lie 1998; Madsen *et al.* 1998). A wide range of stone raw materials was used in manufacturing these technologies. Core reduction was intensive and many of the collected artefacts show patterns of intensive retouch and recycling. The collection methods employed limit the statistical value of these assemblages. Nevertheless, the range of lithic technologies represented and the specific characteristics of raw material utilization are significant for addressing questions of the nature of foraging adaptations in this hostile environment. Indeed, these surfaces assemblages from the Chang Tang are significant for understanding not only specific aspects of East Asian prehistory, but also for broader issues concerning the range and complexity of Pleistocene forager adaptations.

The Chang Tang Reserve

Located in the northwestern part of the Tibetan Plateau, the Chang Tang Reserve encompasses approximately 334,000 sq. km and exceeds 4500 m asl in average elevation (FIGURE 1) (Schaller 1998). The Chang Tang is bounded to the north by the Kunlun Mountains and the Xinjiang Uygur Autonomous Region, to the east by Qinghai province, and to the south and west by the 'northern highway', which traverses Tibet at roughly 32°N. The area is characterized by large internal-drainage basins, saline and brackish lakes, and broad, rolling steppes broken by hills and snow-capped mountains. The Chang Tang is presently too cold and arid to support forests, but rather is dominated by cold desert grasslands, sedges, forbs and low shrubs. Schaller & Liu (1996) divide the Chang Tang into three vegetation zones: alpine steppe, desert steppe and alpine meadows. Alpine steppe is dominant in the southeastern half of the reserve. The alpine steppe occupies elevations between 4300 and 5100 m asl and is characterized by cold, windy conditions, poor soils and 100–350 mm precipitation annually. Plant cover is sparse in the alpine steppe zone (<30%). Species of *Stipa* are the dominant plants followed

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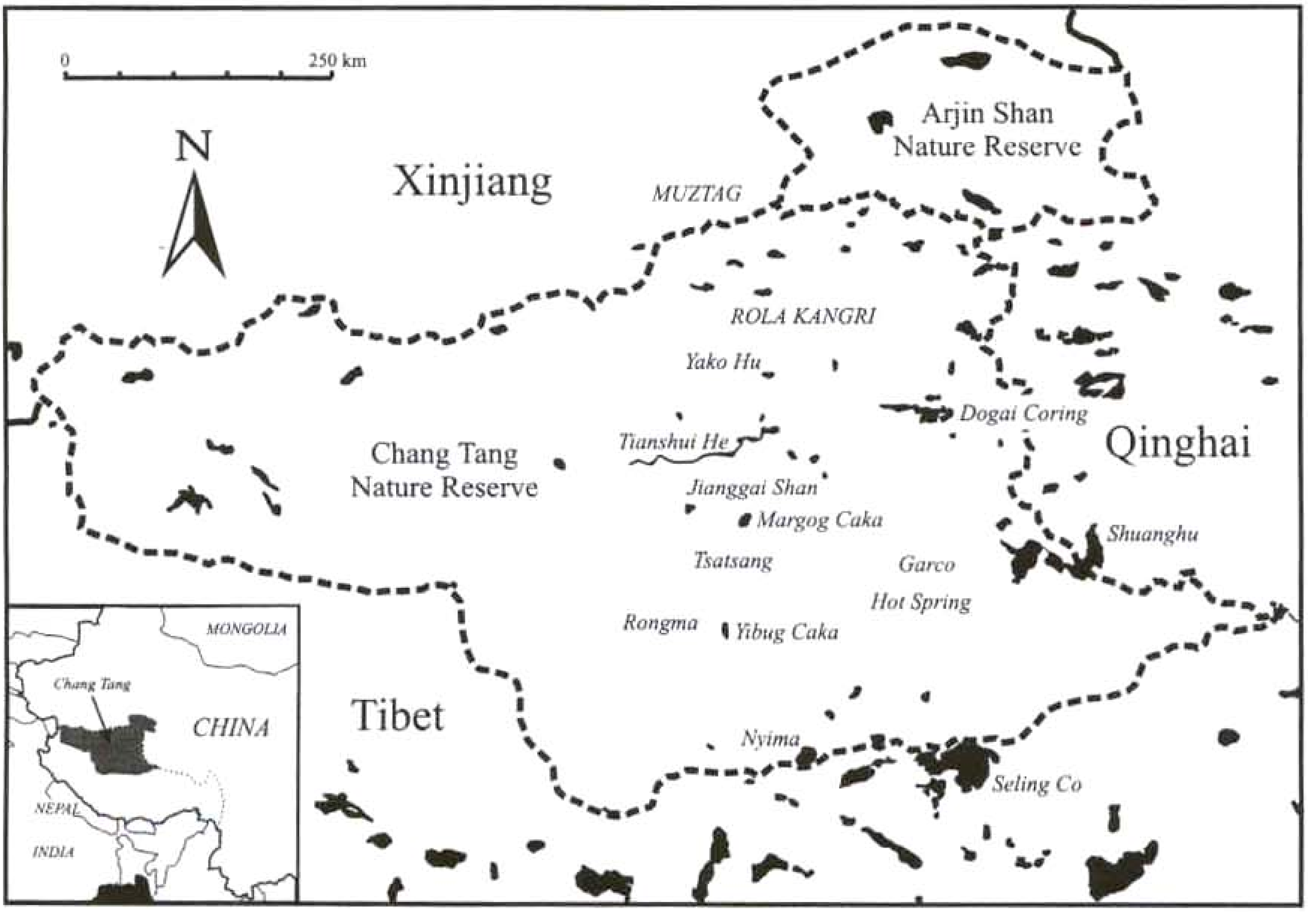

FIGURE 1. *Map showing the location of the Chang Tang Reserve and the locations of sites discussed in the text.*

by other graminoids, dwarf shrubs, herbaceous plants and a few legumes such as *Astragalus*. Desert steppe is dominant in the uninhabited northern areas and replaces alpine steppe between 34°30'N and 35°N, where a mere 50–100 mm of precipitation falls annually. The diversity of plant species in the desert steppe zone is similar to the alpine steppe, though plant cover is significantly more sparse. Alpine meadows dominate the landscape where annual precipitation exceeds 350–400 mm. Alpine meadows are found in areas of east Qinghai, and in Tibet along the Lhasa-Golmud highway and as far west as Seling Co (Co = 'lake'). Within the Chang Tang, alpine meadows are limited to riparian contexts along streams, seepages and swamps. Short sedges (*Kobresia* spp.) and forbs are the dominant vegetation types in the apline meadow zone.

These three vegetation zones provide an array of seasonally available plants that support six wild and four domestic ungulate species. The wild ungulates include the Tibetan antelope (*chiru*), Tibetan gazelle, Tibetan argali, blue sheep, Tibetan wild ass (*kiang*) and the wild yak (Schaller 1998). All but the blue sheep occur today only on the Tibetan Plateau, and several of these species are endangered as a result of heavy poaching. As recently as the 1890s, there were large gregarious wild ungulate herds on the Plateau with the total animals numbering perhaps in the millions (Schaller 1998).

Pastoralists currently occupy only the southern margins of the Chang Tang. Areas farther to the north present extremely harsh conditions for human occupation, and provide too little forage and too few sources of fresh water for large domestic herds. While there are presently no permanent human occupations north of Gar Co (34°N), archaeological evidence presented here points to the presence of foraging populations in these areas perhaps into the late Pleistocene.

History of archaeological research on the Tibetan Plateau

Prehistoric archaeological sites have been recognized on the Tibetan Plateau since the mid

1950s when the Chinese Academy of Sciences first sent multidisciplinary research teams to investigate the geology and palaeoenvironment of the area (An 1982; Huang 1994). Until recently, archaeological research on the Plateau has been ancillary to geological, lacustrine, glacial and palaeontological studies. Extensive excavations at the late Neolithic site of Karou (4000–5000 BP) are an exception (CPAM 1985). In the 1980s, Chinese and international projects began to include archaeologists among the researchers investigating the Quaternary of the Tibetan Plateau (An 1982; Huang 1994; Huang *et al.* 1987). These projects have brought to light the diversity of archaeological sites on the Plateau and have provided tentative dates of first occupation.

Simple core and flake tools made on quartzite, quartz and siliceous stones have been recorded from at least 10 localities (Huang 1994: table 1). At the site of Xiao Qaidam (3100 m asl) in the central Qaidam Depression of China's Qinghai province, simple cores and retouched flakes were recovered from a mixed gravel-sand terrace 8–13 m above the modern salt lake. Radiocarbon dates of 33,000±3300 and 35,200±1700 BP on ostracods and lake marls were obtained from deposits that correlate geologically with the terrace (Huang 1994: 204). While radiocarbon dates on molluscs are often too old (Goodfriend & Stipp 1983), these dates may still indicate human presence on the Tibetan Plateau sometime prior to the last glacial maximum (LGM) approximately 22–18,000 years ago. Light-duty tools and microliths also have been recovered from a number of localities in Qinghai and Tibet including: Sure (4500 m asl), Huo-er (4630 m asl), Zhongba (4600 m asl), Saga (4500–4900 m asl) and Ngam-ren (4300–5000 m asl) in southern Tibet; and Mani (4920 m asl), Amugang (5200 m asl), Zuluole (4800 m asl), Xulong (4770 m asl), Duogezhai (4830 m asl) and Ge'ting (4663 m asl) in northern Tibet (Huang 1994: table 1). These sites are thought to represent the terminal Palaeolithic or early Neolithic, dating to sometime after glacial termination (see Elston *et al.* 1997; Lie 1998; Madsen *et al.* 1998). Developed Neolithic economies are present in low-elevation areas of the Plateau by approximately 5000 years ago. These cultures are identified by the presence of microliths, ground stone artefacts, ceramics, and semi-permanent dwellings. The site of Karou (3100 m asl) is the best known of these Neolithic settlements (An 1982; CPAM 1985). Finally, the timing of the appearance of nomadic pastoralism on the Tibetan Plateau is difficult to constrain. However, evidence from Gansu Province and Mongolia suggests that pastoralism was an outgrowth of developed Neolithic economies sometime after 5000 years ago (Chang 1986).

Lithic assemblages from the Chang Tang Reserve

Stone tool samples from 18 archaeological localities are described and analysed in the following sections (TABLE 1). The sites were discovered by George Schaller and colleagues in the course of systematic ecological field surveys in the Chang Tang (Schaller 1998). The majority of these sites were found in the eastern part of the Reserve, from the southern border north to the base of the Rola Kangri massif at 35°15'N. The sites consist of moderate- and low-density surface lithic scatters and are associated with a range of topographic features including freshwater stream channels, ancient lake beachlines, dry lake basins, and one mountain pass.

All artefacts were surface finds, and no excavations were attempted to establish if stratified deposits existed. Collection procedures were not rigorously controlled and a sample of the collected artefacts remains in Tibet. As a result, there appears to be a size bias in the artefacts represented; most of the artefacts exceed 3 cm in size. There is no clear bias with respect to technology, however, because Schaller and colleagues did not employ a lithic typological scheme during collection or splitting of the sample. This allows us to be more confident in discussing the range of flaked stone technologies represented in high-elevation contexts on the Plateau.

The assemblages recovered from the Chang Tang are technologically diverse. However, three broad technological groups are readily separated from one another:

1 generalized core technology;
2 large blade and bladelet technology; and
3 microlithic technology, including microblade cores and their products.

The retouched tool types present reflect these basic blank forms (i.e. general flakes, blades, bladelets and microblades). A wide variety of raw materials are represented including chert, chalcedony, obsidian, argillite and a limited amount of quartzite (TABLE 1). At present, the sources for these raw materials are unknown. However, both extrusive igneous and meta-sedimentary rocks are found in abundance on the Tibetan Plateau and provide potential raw material source areas. Argillite, cherts of various colours and obsidian were used in manufacturing unstandardized cores and flakes, as well as blades, bladelets and a range of retouched tools. Only small packages of fine-grained cherts and chalcedonies were used for microblade technology.

Chang Tang blade technologies

One of the most interesting aspects of the materials recovered from the Chang Tang Reserve is the abundance of large blades, bladelets and associated core trimming elements (TABLES 2 & 3). These products were recovered from Yako Hu, Lava Camp, Zhangshui He, Nyima, Tianshui He, Yibug Caka and Margog Caka. The presence of large blades in these assemblages is surprising given that such technologies are very rare in Chinese archaeological contexts. At present, only the site of Shuidonggou, Ningxia Hui Autonomous Region, contains clear evidence for the manufacture of large stone blades (Brantingham 1999; Zhang 1999). However, there are some striking differences between the blade technology represented at Shuidonggou and that seen in the Chang Tang assemblages. At Shuidonggou, blade production is focused on Levallois-like, flat-faced cores and hard hammer percussion (Brantingham 1999). The resulting blades are very flat with large bulbs of percussion, facetted striking platforms, irregular margins and length–width ratios not exceeding 4:1. In the Chang Tang, large blades are trapezoidal or strongly convex, have flat bulbs of percussion, small lenticular or punctiform striking platforms with limited facetting, very regular lateral margins and tend to be very elongate (FIGURE 2). These features are suggestive of a true prismatic blade technology utilizing either soft hammer, or indirect percussion. Core trimming elements such as crested blades are present both at Shuidonggou and the Chang Tang localities. And both contain numerous flake blades — specimens that meet the metric definition of blades, but are not standardized end products (TABLE 2). Many of the recovered Chang Tang blades are proximal or medial fragments, displaying clear traces of intentional segmentation. This patterning suggests that blade and bladelet elements were sometimes hafted as complex composite tools (see Bar-Yosef & Kuhn 1999).

Bladelets also comprise a large part of the Chang Tang collections. It is not clear whether blades and bladelets form two distinctive tech-

site	raw material					
	chert	chalcedony	argillite	quartzite	obsidian	*total*
Yako Hu	11	42	104	1	1	*159*
Lava Camp		6	13		11	*30*
Shuang Hu	12	3	9			*24*
Zhanglong He	1	3	2			*6*
Zhangshui He	5	8	1			*14*
Hot Spring	7		60			*67*
Nyima	3		18			*21*
Tianshi He	2	16	4			*22*
Yibug Caka	2		15			*17*
Jianggai Shan	2					*2*
Dogai Coring	3	1				*4*
Gar Co			2			*2*
Yibug Caka			1			*1*
Tsatsang			5			*5*
Tsatsang	1	1	1			*3*
Margog Caka	2	2	2			*6*
Beilai Co			2			*2*
Zhuoni Co		1	5			*6*
Rongma	1					*1*
Seling Co			1			*1*
total	*52*	*83*	*245*	*1*	*12*	*393*

TABLE 1. *Stone raw material types represented at each of the Chang Tang localities.*

nological modes, or are part of a single reduction continuum. Acknowledging the statistical limitations of the collections, it is interesting to note that the distribution of blade and bladelet widths is unimodal (median 15 mm) and only slightly skewed. This may suggest that blades and bladelets are part of a technological continuum. The recovery of a single bladelet core from Yako Hu may suggest, however, that a distinctive bladelet production strategy was used in some situations (FIGURE 2a). This core is clearly different from the blade technologies characterizing the initial Upper Palaeolithic as well as later microblade technologies in Northeast Asia (Brantingham 1999; Chen & Wang 1989). The core is sub-prismatic, displaying bladelet removals from approximately 200° of the core's perimeter, and the striking platform is acute and unfacetted. In contrast, initial Upper Palaeolithic blade cores are flat, restricting re-

	core type									
site	**discoid**	**levallois flake core**	**sub-prismatic bladelet core**	**pebble micro-blade core**	**flake micro-blade core**	**indeter-minate micro-blade core**	**un-finished preform**	**narrow-faced core**	**broad-faced core**	***total***
Yako Hu			1	5	3	11	1			*21*
Shuang Hu				3	1	1				*5*
Hot Spring							2			*2*
Nyima								1		*1*
Tianshi He						2			1	*3*
Jianggai Shan		1		1						*2*
Tsatsang	1									*1*
Zhoni Co				1						*1*
total	*1*	*1*	*1*	*10*	*4*	*14*	*3*	*1*	*1*	*36*

TABLE 2. *Core types recovered from the Chang Tang localities.*

	flake type										
site	**flake**	**levallois product**	**blade**	**blade-let**	**micro-blade**	**core tablet**	**core trim-ming element**	**kombewa**	**crested blade**	**flake-blade**	***total***
Yako Hu	66	2	14	33	2	1	12		1	12	*143*
Lava Camp	19	1	1	2			1			6	*30*
Shuang Hu	14						2	1		1	*18*
Zhanglong He	6										*6*
Zhangshui He	8			1			1		1	3	*14*
Hot Spring	52	2				1	4		1	7	*67*
Nyima	15		1	1			1			2	*20*
Tianshi He	5		6	3		1	1			5	*21*
Yibug Caka	14		1						1	2	*18*
Dogai Coring	4										*4*
Gar Co	2										*2*
Tsatsang	5									2	*7*
Margog Caka	3		2							1	*6*
Beilai Co	2										*2*
Zhuoni Co	3			1						1	*5*
Rongma							1				*1*
Seling Co	1										*1*
total	*219*	*5*	*25*	*41*	*2*	*3*	*23*	*1*	*4*	*42*	*365*

TABLE 3. *Flake types from the Chang Tang localities.*

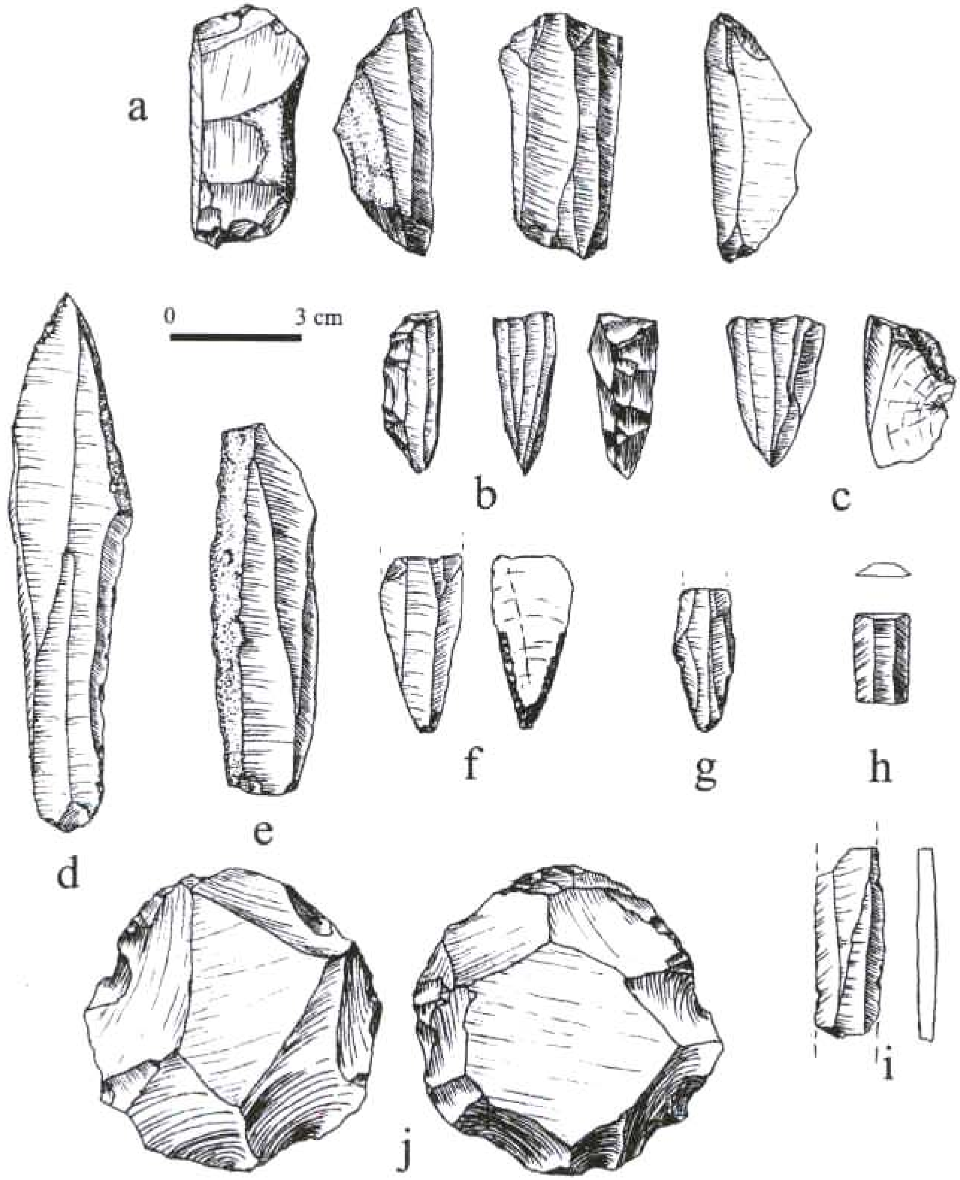

FIGURE 2. *Stone tools from the Chang Tang Reserve in Northern Tibet.*
a *bladelet core*
b, c *microblade cores*
d, e *large prismatic blades*
f, g *proximal blades with hafting accommodations*
h, i *prismatic bladelets*
j *Levallois-like flake core.*

duction to a single plane of removal, and tend to display steep, facetted striking platforms. Microblade cores based on pebbles and flakes tend to have centripetally worked striking platforms angled at roughly 90° to the percussion axis.

Microblade technology comprises another important feature of the materials recovered from the Chang Tang Reserve. Most of the examples consist of microblade cores in various stages of reduction (FIGURE 2). Only two microblades were recovered, both from Yako Hu. Numerous microblade core preparation and rejuvenation flakes, including several small platform tablets, were also recovered. While it is difficult to determine the original form of the raw material blanks from spent microblade cores, those discarded at an early reduction stage appear to be based on small pebbles of chert or chalcedony (see also An 1982; Elston *et al.* 1997). Microblade cores based on biface blanks (Chen & Wang 1989) are not represented among the cores or core preparation debitage, nor are there true bifaces in the collections.

Utilization intensity

The Chang Tang assemblages as a whole show interesting patterns of retouch modification. While the exceptionally high frequencies of retouch tools must be treated with caution as a result of potential collection biases, the ways in which tools were modified is independently very revealing of intensive utilization histories.

Contrary to expectations, many of the retouched tools found at these localities are *not* based on standardized blanks such as blades and bladelets. Rather, chunks, flake shatter, discarded cores, rejuvenation flakes, cortical flakes and other generalized pieces show secondary retouch at nearly equal frequencies compared with blades and bladelets. Many retouched tools display more than one segment of discrete retouch. Indeed, combination tools with mixtures of retouch elements such as side scrapers, burins and retouched notches are the single most common tool type at most of the localities. The only uniquely specialized tool type appears to be blades modified at the proximal end for hafting (FIGURE 2). Although the two specimens of this type from Margog Caka and Tianshui He are broken, it is clear that they were end-hafted blades used possibly as projectiles. Overall, retouched tools in the Chang Tang are indicative of intensive utilization of virtually everything bearing a sharp edge and high rates of recycling of artefacts through different tasks and activities.

Discussion

The rigours of living at high altitudes are well known from a range of anthropological and other studies (see Frisancho 1993). The Tibetan Plateau, with average elevations above 4500 m, would have presented significant adaptive challenges to foraging populations colonizing the region. The present climate above 5000 m is characterized by mean annual air temperatures below freezing and temperatures above 0°C only during June–September (Schaller 1998). Between 4000–5000 m, temperatures are higher during the summer months (6·6–15·5°C). Areas around Lhasa may have 50–180 days annually where temperatures exceed 10°C, while areas of northern Tibet have fewer than 50 such days (Lin & Wu 1981). Annual precipitation is primarily under the control of the Asian monsoon and falls between June and September. However, much of this precipitation does not reach the northern portions of the Plateau around the Chang Tang, which is generally arid to semi-arid (Lin & Wu 1981).

Foraging populations in the Chang Tang would have had to contend with chronic and acute cold exposure and persistent low water availability. Other challenges may have included high levels of solar radiation and high winds. Importantly, because of low overall primary productivity, food resources on the Plateau are concentrated in ungulate biomass. Few of the extant plant species are appropriate for human foragers. This leads to the expectation that subsistence strategies on the Tibetan Plateau would have focused primarily on large game hunting.

The characteristics of the Chang Tang lithic assemblages may reflect the importance of such environmental and subsistence stresses. Settlement and mobility patterns are difficult to tease out of the available evidence. Many of the known sites are associated with palaeohydrological features such as river channels and relict lake beaches. This patterning may be significant with respect to subsistence organization and tethering to available water sources. We might also expect to see high mobility as one of the keys to successful colonization of hostile Plateau environments. The great diversity of stone raw materials found at the Chang Tang sites may be evidence of this. However, the sources of these raw materials are not yet known, thus it is difficult to place boundaries on raw material transport distances.

Specific technological attributes of the Chang Tang assemblages may also provide clues about mobility and levels of subsistence stress. One of the most striking features of the assemblages is the degree of specialization represented by blade, bladelet and microblade technologies. These technologies tend to be both very efficient at generating usable cutting edges and predictable in terms of critical performance characteristics. As such, they may reflect risk reduction strategies and, more generally, the importance of 'over-designed', well-planned lithic technologies in stressful environments (see Bousman 1993; Winterhalder *et al.* 1999). Blades and bladelets from the Chang Tang constitute a separate core reduction strategy from microblades. Both blades and bladelets were likely used as elements in composite tools. Two blades retain traces of modification for use as end-hafted tools, possibly projectiles. The common occurrence of segmented blades and bladelets may also suggest side hafting into complex armatures. Such technologies are well suited to specialized hunting adaptations in that they are both strong and lethal (Ellis 1997; Elston & Brantingham in press).

The importance of time-stressed activities, or alternatively raw material stress, may also be indicated by the extensive modification and utilization of cores, blanks and tools. The majority of nuclei, whether simple flake, bladelet or microblade cores, were utilized until size constraints, or irreparable errors prevented further effective working. Yet these nuclei were not always discarded. Rather, many spent cores, as well as general flakes and irregular chunks, were subsequently retouched into hand-held tools. This is indicative of strategies aimed at squeezing maximum utility out of available stone raw materials. The behavioural implication is that there were high costs associated with casual or wasteful raw material use. Similarly, the majority of the tools show complex combinations of retouched elements, suggesting multiple use episodes or multi-functionality. Virtually all flaked stone materials were utilized in one form or another. There are very few specimens in the Chang Tang collections that can be strictly classified as waste by-products of core and tool production.

Another critical question surrounds the absolute age of the Chang Tang assemblages. On the basis of stone tool typology and a limited number of radiocarbon dates on lake features associated with surface archaeological sites, Huang (1994) believes that the earliest period of occupation of the Tibet Plateau dates to between 30–40,000 years ago. Contrary to some reports (e.g. Kuhle 1985), there is no evidence that a continental-sized ice sheet capped the Tibetan Plateau during the late Pleistocene (Derbyshire 1991; Lehmkuhl *et al.* 1998). Thus, there was no necessary physical barrier to human colonization at this time. Heavily ablated general flake technology from the Chang Tang could be of this age. However, there is as yet no independent confirmation of this hypothesis.

Blade technology in North China, though rare, is found at sites such as Shuidonggou dating to between 25–30,000 years ago (Brantingham 1999). As mentioned above, however, the blades and bladelets from the Chang Tang are technologically quite different from those seen at Shuidonggou. The chronological significance of these technological differences is unclear. Conservatively, the Chang Tang materials are probably no older than 25,000 years. It is also possible that the Chang Tang blades and bladelets were used alongside microblade technologies by the same foraging groups. This would imply that the Chang Tang materials date, at most, to 15–13,000 years ago (see Elston *et al.* 1997; Gai 1985; Madsen 1998; but also Lie 1998). To the best of our knowledge, however, microlithic technologies in China were not used in conjunction with blade and bladelet technologies (see Lie 1998; Lin 1996; Zhang 1999). At the Tibetan Neolithic site of Karou (4000–5000 years ago) microblades and simple flake tools were found in abundance, but large blade and bladelet technologies were not identified. This may indicate that the blade and microblade technologies recovered from the Chang Tang date to different occupation periods.

Conclusion

Archaeological evidence from high-elevation (>4500 m asl) environments of the Tibetan Plateau suggest that foraging groups occupied the region during the latter portions of the late Pleistocene or early Holocene. Large blade and bladelet technologies reminiscent of classic Upper Palaeolithic adaptations elsewhere in Eurasia may be diagnostic of a late Pleistocene colonization event. The Chang Tang microblade technologies, on the other hand, are likely younger than 15,000 years, and may date as late as 4000–5000 years ago. Regardless of the absolute ages of these assemblages, they point to the presence of foraging groups occupying some of the most hostile environments on the face of the planet. The limited evidence available from the Chang Tang indicates that these environmental extremes were met with flexible and successful behavioural strategies involving high levels of mobility and reliance on specialized stone tool technologies.

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