into more recent times than in other regions in Eurasia. For example, in the Near East, the Middle-Upper Paleolithic transition occurred as early as 47,000 BP, and in most of Europe between 45,000 and 38,000 BP (Bar-Yosef 1999). The earliest Upper Paleolithic assemblages in Siberia have associated radiocarbon ages ranging from at least 43,200 BP to around 25,000 BP. These data allow us to infer that the chronological "boundary" between the latest Mousterian and earliest Upper Paleolithic cultural complexes is quite wide. It may be placed broadly within the time interval 43,000–27,000 BP, primarily in the Altai and Sayan Mountain regions. It is also clear that we have definite evidence for the temporal coexistence of Mousterian and early Upper Paleolithic sites within this broad time interval (figure 13.3). This is a very distinctive feature of the Siberian Paleolithic sequence and consequently, more research is needed to understand the temporal-spatial peculiarities of the Middle-Upper Paleolithic transition process. The most promising areas to address these questions include the Altai and Sayan Mountains and the Transbaikal.

ACKNOWLEDGMENTS

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14

Initial Upper Paleolithic Blade Industries from the North-Central Gobi Desert, Mongolia

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There is ample evidence to suggest that distinctive initial Upper Paleolithic assemblages are found in southern Siberia and portions of northwest China (Derevianko et al. 1998f; Brantingham et al. 2001, chapter 15, this volume; Goebel, this volume; Kuzmin, this volume). Two recently excavated cave sites in the Mongolian Gobi, Tsagaan Agui (White Cave) and Chikhen Agui (Ear Cave), extend the known geographical range of the initial Upper Paleolithic into the cold desert regions of northeast Asia. Late Middle Paleolithic assemblages from Tsagaan Agui, which may date to the early (Zyrian) glacial, contain Levallois-like core technologies specialized for dealing with poor quality stone raw material (Brantingham et al. 2000). Initial Upper Paleolithic assemblages from both Tsagaan Agui and Chikhen Agui are focused on blade production from flat-faced, Levallois-like cores. Radiometric age determinations from both cave sites indicate that initial Upper Paleolithic blade technologies first appeared in the Gobi between 27 and 33 ka, during the last half of the Kargan interstadial (Brantingham et al. 2001; Derevianko et al. 2001, 2000b). Despite continuity in the general character of core technologies across the Mongolian Middle-Upper Paleolithic boundary, it is difficult to support a model of continuous occupation of the Gobi and in situ evolution of the Upper Paleolithic.

TSAGAAN AGUI

Tsagaan Agui (White Cave) is located at approximately 44°42′43.3″ N, 101°10′13.4″ E, in Bayan Hongor aimag (province), Mongolia (figure 14.1). The cave is situated in a limestone outlier, Tsagaan Tsakhir, on the southern piedmont of the Gobi Altai massif, southwest of the Zuun Bogd Uul range. Initial, small-scale excavations at Tsagaan Agui were conducted

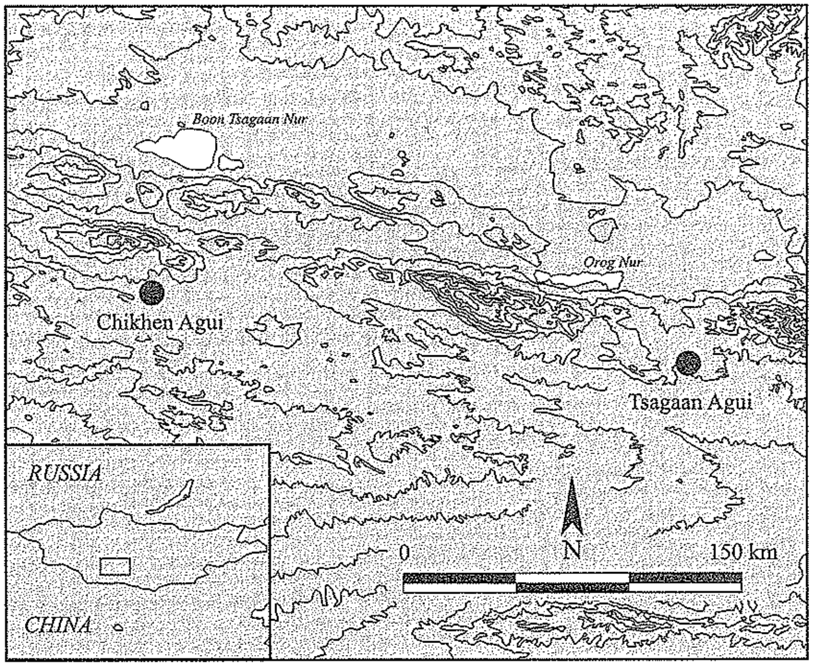

Figure 14.1. Map of the north-central Gobi Desert showing the locations of Tsagaan Agui and Chikhen Agui. Boon Tsagaan Nur (lake) is at about 1300 m elevation. The contour interval is 300 m. The inset shows the location of the detail.

by the Soviet-Mongol Archaeological Expedition between 1987 and 1989 (Derevianko and Petrin 1995b). Excavations resumed in 1995 under the direction of the Joint Mongolian-Russian-American Archaeological Expedition (Derevianko et al. 1996, 1998c, 2000b; Brantingham 1999).

Four main depositional basins have been identified in the cave system, the largest of which (the main chamber) preserves a total of fourteen distinct strata divided into two major depositional regimes (figure 14.2). Strata 6–13 in the main chamber are predominantly fluvial in origin, whereas strata 2a and 2b are primarily aeolian. Strata 4 and 5 appear to be transitional between the two regimes. Stratum 6 is a matrix-supported limestone *éboulis* possibly indicating cold, humid environmental conditions (see Brantingham et al. 2000). Stratum 3 is a thin (2–4 cm) anthropogenic ("occupational") horizon formed on stratum 4. It is dark in color, and greasy and rich in organic material. Strata 0 and 1 are recent historical deposits formed by a variety of anthropogenic and aeolian processes (see Derevianko et al. 2000b).

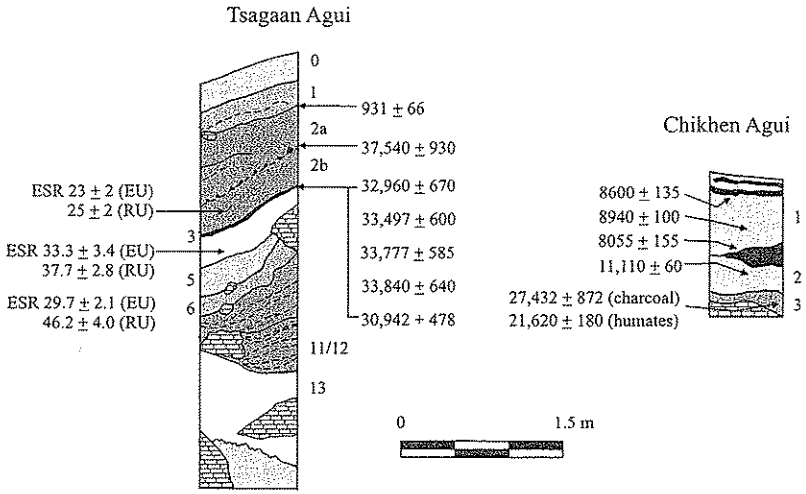

Figure 14.2. Stratigraphic sections and radiometric dates from Tsagaan Agui and Chikhen Agui. Electron spin resonance (ESR) dates are given as thousands of years before present (ka calendric). All remaining dates are radiocarbon years before present (BP). Hearth and hearth-like features in the Chikhen Agui sequence are indicated in black. *Abbreviations:* EU, early uranium uptake model; RU, recent uranium uptake model.

Ages of the main chamber deposits are constrained by seven AMS radiocarbon dates and three ESR determinations (table 14.1). Four of the five AMS radiocarbon dates from stratum 3 average to 33,541 ± 311 BP and provide a chronological benchmark for the sequence. The one statistically aberrant date of 30,942 ± 478 (AA-26589) may indicate that stratum 3 formed over the course of several thousand years, but may also be the result of bioturbation. The single bone collagen date from a gravel deflational horizon separating strata 2a and 2b produced an inversion. Given the consistency of the dates from stratum 3, it may be that this bone had been redeposited from older units farther back in the cave system. It is also possible that the date inversion is related to extreme irregularities in atmosphereric radiocarbon production during the late Pleistocene (Beck et al. 2001; Kitagawa and van der Plicht 1998a). Nonetheless, three ESR dates, all on equid teeth (Bonnie Blackwell, pers. comm.), are consistent with the available dates from stratum 3. The age of the base of stratum 4 is constrained by two separate dates. Specimen QT40 (one subsample) yielded an Early Uptake (EU)

TABLE 14.1 Radiometric Dates from Tsagaan Agui and Chikhen Agui

Site	*Stratum*	*Method*	*Age (BP)*[1]	*Standard Deviation*	*Material*	*Lab Number*
Tsagaan Agui	1	AMS radiocarbon	931	66	Charcoal	AA-26586
	2a	AMS radiocarbon	37,540	930	Bone collagen	AA-31869
	2b	ESR (Early Uptake)	23,000	2000	Equid tooth	
	2b	ESR (Recent Uptake)	25,000	2000	Equid tooth	
	3	AMS radiocarbon	32,960	670	Charcoal	AA-23159
	3	AMS radiocarbon	33,497	600	Charcoal	AA-26588
	3	AMS radiocarbon	33,777	585	Charcoal	AA-26587
	3	AMS radiocarbon	33,840	640	Charcoal	AA-23158
	3	AMS radiocarbon	30,942	478	Charcoal	AA-26589
	4	ESR (Early Uptake)	29,700	2100	Equid tooth	QT40
	4	ESR (Recent Uptake)	46,200	4000	Equid tooth	QT40
	4	ESR (Early Uptake)	33,300	3400	Equid tooth	QT41
	4	ESR (Recent Uptake)	37,700	2800	Equid tooth	QT41
	5	RTL	227,000	57,000	Sediment	RTL-804
	6	RTL	450,000	123,000	Sediment	RTL-803
	12	RTL	520,000	130,000	Sediment	RTL-805
Chikhen Agui	3	AMS radiocarbon	27,432	872	Charcoal	AA-26580
	3	AMS radiocarbon	21,620	180	Humates	AA-32207
Chikhen Agui, locality 2	3	AMS radiocarbon	30,550	410	Bone collagen	AA-31870

[1]ESR and RTL (radiothermoluminescence) dates are reported in calendar years. Two ESR dates, using different uranium uptake models, are reported for each sample. The different uptake models represent minimum (Early Uptake) and maximum (Recent Uptake) estimated ages.

age of 29.7 ± 2.1 ka and Recent Uptake (RU) age of 46.2 ± 4.0 ka (calendric). Specimen QT41 (six subsamples) yielded ages of 33.3 ± 3.4 (EU) and 37.7 ± 0.8 ka (RU) (calendric). Stratum 2b is dated between 23 ± 2 (EU) and 25 ± 2 ka (RU) (calendric) by ESR. Radiothermoluminescence dates on sediments from stratum 5 (227 ± 57 ka), stratum 6 (450 ± 123 ka), and stratum 12 (520 ± 130 ka) (Derevianko et al. 2000b) are much too old as a result of long transport times of sediments through the cave system.

Pollen assemblages recovered from strata 6–13 are generally indicative of cool, humid climatic conditions (Derevianko et al. 1998c). Arboreal taxa dominate and include fir *(Abies)*, pine *(Pinus)*, birch *(Betula)*, alder *(Alnus)*, hornbeam *(Carpinus)*, and lime *(Tilia)*. Nonarboreal grass and shrub species dominate the pollen assemblages from strata 2–5, indicating much drier climatic conditions and widespread steppe environments. Common taxa in strata 2–5 include grasses (Poaceae [Graminae]), asters (Compositae), and goosefoots (Chenopodiaceae) and ephedra (*Ephedra* sp.). Given the available radiocarbon and ESR dates, stratum 2a appears to correspond to the last (Sartan) glaciation (Oxygen Isotope Stage 2), whereas strata 2b–5 correspond to the Kargan interstadial (Oxygen Isotope Stage 3). Strata 6–13 may correspond to the early (Zyrian) glacial (Oxygen Isotope Stage 4) and perhaps the last part of the last (Kazanstev) interglacial (Oxygen Isotope Stage 5). The lack of reliable radiometric age determinations from the lower stratigraphic units remains a concern in assigning these ages. Faunal remains were not recovered from the lower stratigraphic units (stratum 6 and below). The large mammal species recovered from strata 2–5, including two extinct Pleistocene forms *(Crocuta spelaea* and *Coelodonta antiquitatis)* and several ungulates *(Equus hemionus, E. przewalskii, Procapra gutturosa, Pantholops hodgsoni, Capra sibirca,* and *Ovis ammon)*, are consistent with the radiometric age determinations.

An excavated sample of 549 lithic specimens was analyzed from the main chamber at Tsagaan Agui as part of a larger study of the early Upper Paleolithic in northeast Asia (Brantingham 1999; Brantingham et al. 2001). Of this sample, nearly 33% (*n* = 181) consists of undiagnostic flake and core shatter. The diagnostic specimens (*n* = 368) are unevenly distributed between the lower fluvial (strata 6–13; *n* = 152), transitional (strata 4–5; *n* = 83), and upper aeolian (strata 2–3; *n* = 88) units. Only those specimens from stratum 3 (*n* = 24) clearly derive from an occupational horizon dated to approximately 33 ka. The remainder (*n* = 299; 81%) is from dispersed contexts within the vertical sediment column and cannot be related to any discrete occupational events. Rather, these specimens are time-averaged samples from occupations spanning the bulk of the late Pleistocene, which may have been both highly intermittent and ephemeral.

These caveats aside, the Tsagaan Agui sequence can be divided into three primary phases on the basis of recovered diagnostics. The earliest phase, represented by strata 5–13, may be classified as late Middle Paleolithic and is characterized by broad-faced prepared cores, a unique Levallois-like core technology based on large flake blanks (Brantingham et al. 2000). The ESR dates from the base of stratum 4 (33–46 ka, calendric) provide a tentative minimum age for this phase. Stratum 3 marks the appearance of initial Upper Paleolithic technologies, characterized by the production of both parallel and pointed blades from Levallois-like flat-faced cores. The radiocarbon evidence places this event at approximately 33 ka. Finally, the initiation of a third phase may be indicated by the recovery of two microblade segments and a single biface thinning flake from stratum 2a, overlying the gravel deflational horizon that may correspond to the Last Glacial Maximum. Although stratum 2a is currently undated, it is clearly younger than 23–25 ka (calendric) (ESR stratum 2b) and possibly younger than 18 ka. Our analyses are concerned with characteristics of the initial Upper Paleolithic blade technology appearing in stratum 3 and its relationship to the broad-faced Levallois-like core technologies from the underlying stratigraphic units.

The stone raw material environment at Tsagaan Agui is centered on an outcrop of heavily weathered chert located above the cave. This material is of relatively poor quality, containing numerous voids and inclusions (Brantingham et al. 2000). It is the dominant raw material used in core reduction and tool manufacturing throughout the sequence. More than 92% of all artifacts in strata 4–13 is made on this local raw material. The remainder is made on two types of agate (distinguished on the basis of color) that occur as very small, irregular nodules and derive from isolated outcrops on the limestone ridge opposite the cave. A dramatic change in raw material procurement patterns occurs in stratum 3 and accelerates through stratum 2. A few artifacts of high quality cryptocrystalline raw materials were recovered in stratum 3; in stratum 2, such materials make up nearly 20% of the entire assemblage. The sources of these raw materials are unknown. However, all of the "exotic" raw materials are represented by blanks and retouched tools only, suggesting that the sources are some distance from the site.

Core technology throughout the sequence at Tsagaan Agui is dominated by generalized core forms, including polyhedrons (globular cores), choppers, discoids, and tested pebbles (table 14.2). This predominance is explained in part by the poor quality of the raw material and resulting difficulty in executing formal designs. However, a unique prepared core technology for flake and point production is represented in certain frequencies in the lower strata, despite the evident raw material constraints (Brantingham et al. 2000). In many respects, these broad-faced prepared cores are reminiscent of Levallois technology. Such cores generally limit reduction to a single face of the raw material blank, are predominantly unidirectional, and commonly exhibit platform faceting. They are unique in being based frequently on large flake blanks, the ventral surfaces of which provide a ready-made Levallois-like core geometry that does not require much additional preparatory shaping. This specialized core design, which reduces the probability of generating serious reduction errors by minimizing the amount of preparation, appears to have been developed in response to the poor quality of stone raw material available at the site (Brantingham et al. 2000).

TABLE 14.2 Counts of Core Types from Tsagaan Agui and Chikhen Agui

	Tsagaan Agui Stratigraphic Unit						*Chikhen Agui Stratigraphic Unit*
Core Type	1	2	3	4–5	6–8	9–13	3
Tested pebble	3	2		4	5	1	1
Chopper						2	
Polyhedron	6	4		5	3	3	
Discoid		1		2	1		
Levallois-like flake core			1		1	1	1
Levallois-like point core							1
Levallois-like blade core			1				7
Pyramidal blade core							1
Change-of-orientation				1		1	3
Pebble microblade core[1]							1
Narrow-faced core					2	1	2
Broad-faced core						5	2
Other					2		2
Total	9	7	2	12	14	14	21

[1] Intrusive from overlying stratigraphic units.

Formal, Levallois-like blade technologies appear in stratum 3, represented by a single core, debitage, and blade-based tools. The core has a moderate distal convexity with some distal trimming (figure 14.3: 1). The core platform displays some minor faceting, forming an acute angle of approximately 45° with the primary reduction face. One edge is prepared with a lateral crest, which appears to be a generalized design feature for transferring reduction from the primary face to the narrow face during later stages of core utilization. Cores with lateral crests and associated debitage (i.e., *lames à crêtes, lames débordants*) are common at surface localities in the Arts Bogd range in Mongolia and at Shuidonggou in northwest China (Krivoshapkin 1998; Brantingham et al., chapter 15, this volume), and resemble core technologies seen in certain Bohunician sites (Svoboda and Svoboda 1985: 511; Svoboda, this volume).

A small collection of blanks ($n = 5$) in strata 3 and 2 at Tsagaan Agui clearly derive from prepared blade cores (table 14.3). Prismatic or sub-

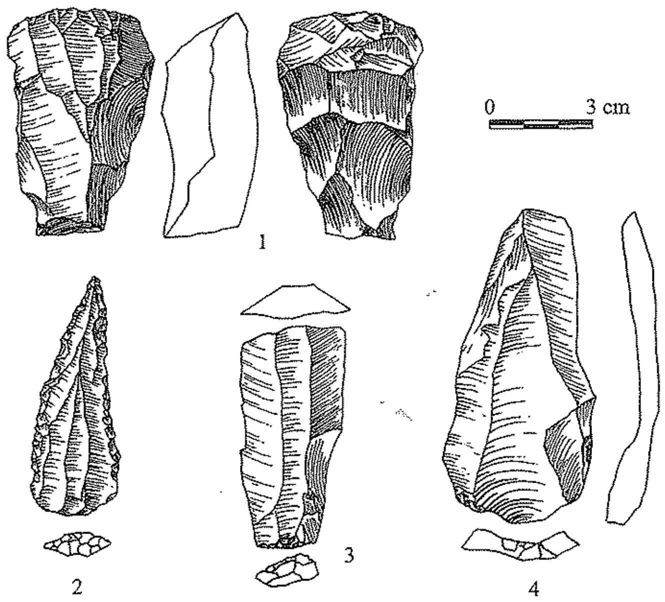

Figure 14.3. Tsagaan Agui stratum 3 lithics: flat-faced blade core (1); elongate Levallois points (2, 4); subprismatic blade (3).

prismatic blades display parallel edges, parallel to subparallel dorsal scars, and strongly triangular or trapezoidal cross sections (figure 14.3: 3). In contrast, Levallois blades display subparallel to irregular edges, subparallel to convergent dorsal scars, and generally flat cross sections. Note that that these criteria are insufficient to completely distinguish between true prismatic blade technologies, where blades are removed in continuous series from all or part of the core's perimeter (Boëda 1995a; Bar-Yosef and Kuhn 1999: 323), and Levallois blade production strategies, which limit reduction to a single plane of removal. This distinction can be made unequivocally only on the basis of the recovered cores. The only blade core recovered from the main chamber falls well within the Levallois definition. Both the Levallois and subprismatic blades recognized at Tsagaan Agui most likely derive from similar Levallois-like flat-faced blade cores. The same conclusion reasonably applies to large Levallois-like points recovered from stratum 2 (figure 14.3: 2, 4).

Significantly, all of the technical elements recovered from both the lower and upper strata at Tsagaan Agui are strongly suggestive of a Levallois-like prepared core technology. The consistent occurrence of edge elements is particularly important. Edge elements are rejuvenation spalls that remove part or all of the edge of a core and serve to control the lateral convexity of the primary core surface. The technical elements designated as core tablets are irregular, or partial tablets. Although commonly associated with prismatic blade and bladelet technologies, here they are consistent with the removal of platforms from Levallois-like cores. In one case, the tablet was apparently aimed at removing a large raw material impurity that could potentially interfere with primary reduction. In the other case, it is uncertain whether tab removal was intentional or accidental. The remaining artifacts designated as "other technical elements" in table 14.3 are primarily *outrepassé* flakes removing the distal ends of prepared cores. Although these are also consistent with a Levallois-like core technology, it is unclear whether they are intentional technical elements (for core rejuvenation) or reduction errors.

TABLE 14.3 Counts of Flake Types from Tsagaan Agui and Chikhen Agui

	Tsagaan Agui Stratigraphic Unit						*Chikhen Agui Stratigraphic Unit*
Flake Type	1	2	3	4–5	6–8	9–13	3
Generalized flake	21	33	9	47	24	44	40
Levallois flake	1	1				2	
Levallois point		1					4
Levallois blade			2				28
Pointed blade							3
Bladelet							9
Pointed bladelet							1
Subprismatic blade			1	1			
Microblade		2					
Biface thinning flake	1						
Core tablet	1		1		1		1
Edge element	2	1		2	1	1	
Crested blade							5
Other technical element		3	2			7	
Bipolar flake				1	1		
Kombewa flake	2			3			
Total	27	39	16	56	27	47	98

The retouched tool inventory from the main chamber at Tsagaan Agui contains a number of diagnostic tool forms, although the most common types—combination tools possessing more than one functional edge, generalized retouched flakes, denticulates, and side scrapers—are arguably less diagnostic (table 14.4). The retouched elongate Levallois point recovered

TABLE 14.4 Counts of Retouched Tool Types from Tsagaan Agui and Chikhen Agui

	Tsagaan Agui Stratigraphic Unit						*Chikhen Agui Stratigraphic Unit*
Tool Type	1	2	3	4–5	6–8	9–13	3
Single side scraper		2		2	1	4	
Double side scraper		1					2
Convergent scraper	1						
Transverse scraper		1					
Single end scraper		2		1	2	3	1
End scraper on retouched blade		1					1
Thumbnail end scraper	1	1		1			1
Carinated end scraper			1		1	1	
Nosed end scraper	1						
Core scraper (rabot)					1		
Simple burin	1	1	1	1	2		2
Dihedral burin	1			2	2	2	
Burin on truncation					1		
Irregularly backed knife						1	
Backed fragment					1		
Clactonian notch		1			1		
Single retouched notch				2		1	1
Multiple notches					1		
Denticulate		1		1	4	3	
Combination tool	1	3		5	5	6	1
Retouched flake		4	2		2	3	1
Flake retouched into point					1		
Blade one edge retouched							5
Blade two edges retouched							3
Blade retouched into point	2		1				
Bladelet with abrupt retouch							1
Other	1				1		1
Total	9	18	5	15	26	24	20

from stratum 3 is typologically distinctive of initial Upper Paleolithic industries (figure 14.3: 1, 2) (Kuhn et al. 1999). There are a number of specialized end scraper types in the upper strata. However, the sample sizes are too small to provide any definitive typological classification of the assemblage as a whole.

CHIKHEN AGUI

Excavated concurrently with Tsagaan Agui, Chikhen Agui is a small rock shelter located in an isolated limestone outcrop 200 km to the west (44°46′22.3″ N, 99°04′08.7″ E; see figure 14.1) (Derevianko et al. 2001). Deposits at Chikhen Agui reach a maximum thickness of about 75 cm, and the site lacks the earlier archaeological sequence present in strata 5–13 at Tsagaan Agui. The sequence is divided into three archaeological zones on the basis of stratigraphy, recovered artifacts, and available radiocarbon dates (see figure 14.2). The upper two archaeological zones are microlithic and have fifteen associated radiocarbon dates ranging between about 11,200 and 5600 BP. These archaeological horizons are not discussed here (see Derevianko et al. 1998c, 2000a). The lower archaeological zone (stratum 3) contained several hearth or hearth-like features and a large blade industry resembling that recovered from stratum 3 at Tsagaan Agui. Unlike Tsagaan Agui, these features may mark a relatively intensive occupational episode at the rock shelter. The stratum 3 deposits at Chikhen Agui are maximally 30 cm thick and lie along the contact with limestone bedrock outside the drip line of the rock shelter. A single AMS radiocarbon date on hearth charcoal places this stratigraphic unit at 27,432 ± 872 BP (AA-26580), with the humate fraction dating to 21,620 ± 180 BP (AA-32207) (see table 14.1). A bone collagen date from an associated open-air component (locus 2) yielded an age of 30,550 ± 410 (AA-31870), providing broad confirmation for the age of this industry (Brantingham et al. 2001). Faunal remains are fragmentary and mostly confined to the terminal Pleistocene and Holocene strata (Derevianko et al. 2001). Pollen from stratum 3 is dominated by grass and shrub taxa, including goosefoots (Chenopodiaceae), asters (Asteraceae), and carrots (Apiaceae), as well as sage *(Artemesia)* and ephedra. This evidence is consistent with steppe, or desert-steppe environments in the vicinity of the site.

We examined all of the 169 artifacts from the 1996–97 excavations of stratum 3. The raw material environment at Chikhen Agui differs dramatically from that at Tsagaan Agui. There are no immediate sources of fine-grained lithic raw material surrounding Chikhen Agui, save for rare pebbles (<5 cm) of jasper-like and chert materials that occur on nearby *gobi* pavements and in local washes. The abundance of workable stone materials occurring in the immediate vicinity at Tsagaan Agui is not matched. Not surprisingly, therefore, the majority of stone raw materials are imported from nonlocal sources that have yet to be identified. There are three broad types of stone represented. Approximately 94% of the entire assemblage consists of high quality, opaque cherts. Quartzites, one potential local material, make up only 3.6% of the assemblage. Translucent chalcedonies occur in even lower frequencies, comprising only 2.4% of the assemblage. There are four raw materials groups within the opaque cherts, distinguished on the basis of color. In order of decreasing frequency, these groups are dark gray, olive gray, grayish brown, and dark reddish gray varieties. Whether these color varieties represent discrete sources remains to be established, as does the reason for their differing frequencies in the assemblage.

Cores represent nearly 12% ($n = 20$) of the total lithic assemblage (see table 14.2). Of these, fourteen are prepared cores dedicated to the production of elongate blanks. The remainder consists of a single tested pebble, one formal and one casual microblade core (both likely introduced from the overlying deposits through bioturbation), a flake preform for a broad-faced flake core, and two opportunistic narrow-faced cores. The prepared cores are flat-faced, restricting reduction to a single plane, and exhibit complex patterns of platform preparation and faceting. The majority of the prepared cores are Levallois-like bidirectional blade cores with opposed striking platforms situated at the ends of slightly elongate cobble blanks (figure 14.4: 1, 2). Only two specimens are classified as Levallois flake and point cores, based on the character of the final removal before core discard. Two cores are classified as simple broad-faced blade cores. Both are bidirectional, and one shows an attempt to develop a lateral crest along one side. Broad-faced cores are not intensively reduced and are likely part of a reduction continuum that includes bidirectional flat-faced blade cores.

Generalized flakes ($n = 41$) form the single largest category of debitage at Chikhen Agui (see table 14.3). All of the blade and bladelet products combined ($n = 42$), however, match the frequency of generalized flakes in the assemblage. Levallois-like, flat-faced specimens make up the majority of the blade products followed by bladelets, pointed blades, and pointed bladelets (figure 14.4: 3, 6). There is no evidence at present to suggest that the blade and bladelet blanks from Chikhen Agui were produced by different reduction strategies. They are morphologically similar in all respects, save for metric dimensions, and the core population is metrically consistent with the production of both blades and bladelets. A similar conclusion may also apply to the series of elements resembling Levantine Levallois points (figure 14.4: 7–9). Flat-faced blade cores at Chikhen Agui display a tendency to evolve gradually toward convergent reduction. Over its entire use life, a flat-faced core may thus generate products that are parallel, subparallel, and convergent in plan form, as well as metric blades and bladelets.

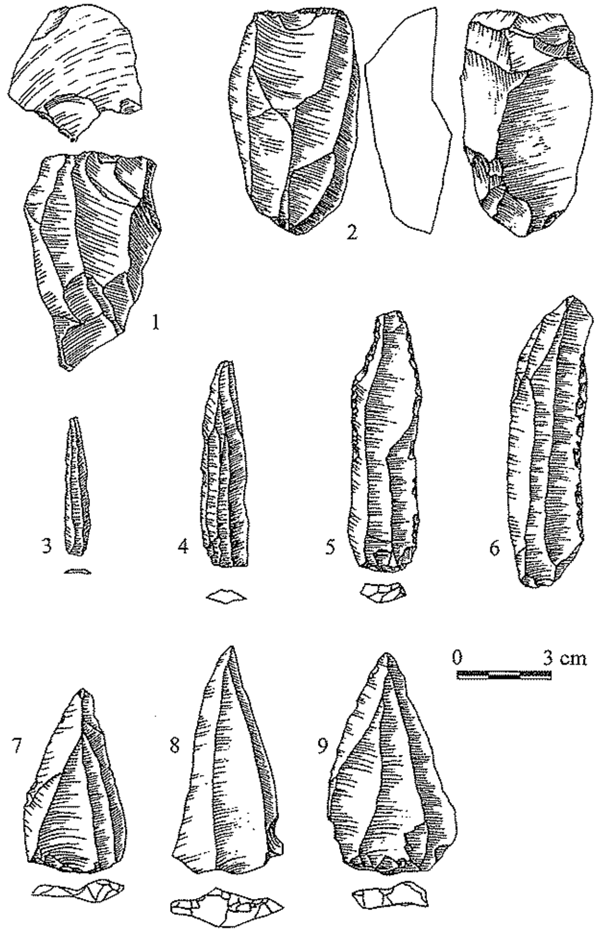

Figure 14.4. Chikhen Agui stratum 3 lithics: flat-faced blade cores (1, 2); blades and bladelets (3–6); classic Levallois points (7–9).

The technical elements from Chikhen Agui reinforce this impression. The relatively high frequencies of crested and overpassed blades (the latter classified under "other technical elements" in table 14.3) are consistent with a blade-focused assemblage. Another series of technical elements are morphologically indistinguishable from classic Upper Paleolithic crested blades *(lames à crêtes)* (Inizan et al. 1992). As at Tsagaan Agui and other sites in the region, these elements were employed in shifting reduction from the primary face to the edge of the core. It is not certain whether the single core tablet is actually a platform rejuvenation spall or a reduction error. The tablet is within the size range of a large microblade, or bladelet core.

The tool assemblage from Chikhen Agui comprises nearly 12% ($n = 20$) of the total recovered artifacts (table 14.4). Although a wide array of tool types is represented, including a number of burin and end scrapers types, no single tool form occurs in excessive frequencies. Tools classified as blades with one or two edges retouched are the only exception. However, the elevated frequency of this tool type likely reflects the predominance of blade blanks in the assemblage.

DISCUSSION

It is clear that Tsagaan Agui and Chikhen Agui give evidence of some of the technological trends accepted for the initial Upper Paleolithic in western Eurasia (Bar-Yosef and Kuhn 1999; Kuhn et al. 1999; Bar-Yosef 2000). Core technologies at these sites are specialized for blade production. Core morphologies generally fall within the Levallois definition, and blade blanks tend to display faceted platforms (see Brantingham et al. 2001). Platform tablets are uncommon, further emphasizing the importance of platform faceting in core preparation and maintenance. Crested blades are common, but were used within the Levallois method as lateral rather than initial preparations. Levallois-like points, pointed blades, and retouched blade tools are also represented in the collections. The remainder of the retouched tool inventory is rather generic in character.

Perhaps unique is the marked diversification of stone raw material exploitation patterns at the beginning of the Upper Paleolithic in Mongolia (see also Postnov et al. 2000). The transport and specialized use of high quality cryptocrystalline stone raw materials is conspicuous following the appearance of initial Upper Paleolithic technologies at roughly 27–33 ka. At Tsagaan Agui, this pattern is particularly striking, given the complete absence of any nonlocal stone raw materials through the entire Middle Paleolithic sequence. Such evidence would seem to imply dramatic changes in land use patterns, conceivably involving increased mobility and/or more structured seasonal foraging rounds. We can speculate that land use changes of this nature may have allowed initial Upper Paleolithic foraging groups to colonize extreme environments that were previously uninhabitable because of a lack of toolstone in close proximity to food and water resources. This appears to describe the situation at Chikhen Agui, where there is as yet no evidence for Middle Paleolithic occupation prior to the appearance of the initial Upper Paleolithic at around 30 ka. At Tsagaan Agui, the first occupations may reach back as far as 70–90 ka, during the early (Zyrian) glacial. The abundance of raw material at the site, despite its poor quality, appears to have been main attractor for these early occupations.

The Levallois-like blade cores from both Tsagaan Agui and Chikhen Agui are strikingly similar to the "flat cores" and "cores with lateral crests" identified by Svoboda and Svoboda (1985: 511) as characteristic of the Bohunican in central Europe. Such core technologies are often described as transitional, in that they show a mixture of Middle and Upper Paleolithic characteristics. We conclude that the initial Upper Paleolithic blade technologies in Mongolia are similarly transitional in character. Indeed, it is easy to see the strong degree of technological continuity with Middle Paleolithic Levallois core technologies at Tsagaan Agui, Chikhen Agui, and other locations in the Gobi (e.g., Okladnikov 1965, 1978, 1981; Kozłowski 1971; Derevianko et al. 1990a; Derevianko and Petrin 1995a; Jaubert et al. 1997; Krivoshapkin 1998). What is problematic is the interpretation of "transitional" technologies, or technological "continuity" in terms of population histories and human behavioral evolution. The greatest interpretive hazards are in assuming that the identified trends in lithic technologies are directly related to hominin cladistics.

It is clear to us that the development of Levallois-like blade technologies has more to do with foraging strategies in local ecological contexts than with any form of modern behavioral revolution or biological shift in cognitive capacities (Brantingham and Kuhn 2001). There is abundant evidence that blade technologies emerged repeatedly during both the late middle and late Pleistocene (Révillion and Tuffreau 1994; Révillion 1995; Bar-Yosef and Kuhn 1999), indicating that the ecological conditions driving the emergence of these technological behaviors were localized and cyclical in nature. A similar pattern of repeated, independent origins may apply to other archaeological traits, such as ornamental objects, frequently assumed to signal the emergence of modern human behavior (McBrearty and Brooks 2000; Kuhn et al. 2001). Rather than assuming that each of these events represents cladogenesis of anatomically modern humans, we must conclude that hominin populations, widely distributed during the late middle and late Pleistocene, slipped in and out of "behavioral modernity" with great ease. We do not deny that there is a relationship between the appearance of novel technologies and human population dynamics, but we insist that the relationship is complex and not yet well understood. We see no possibility simply equating the on-again–off-again character of various technologies with the origin of one hominin group or the demise of another.

How then do we characterize the apparent technological continuity between the Mongolian Middle and Upper Paleolithic? Is this simply another localized transition involving an archaic Middle Paleolithic population slipping over the precipice into behavioral modernity (d'Errico et al. 1998)? Unfortunately, it is difficult to prove direct continuity across the

Middle-Upper Paleolithic boundary. Regarding strict technological continuity, we argue that Levallois core designs are not sufficiently derived in character to demonstrate a direct "phylogenetic" relationship, even where they occur in stratigraphic order at a single site, as at Tsagaan Agui. There is always a possibility of convergence on similar generic technological designs, and in the case of Levallois core technologies, this possibility is particularly strong (Brantingham and Kuhn 2001).

It is even more difficult to establish occupational or population continuity, even at a regional level. In Mongolia, it is clear that Middle Paleolithic populations using various forms of Levallois-like core technologies were present as early as 70–90 ka (Okladnikov 1965, 1978, 1981; Derevianko et al. 1992b, 1998f, 2000b; Jaubert et al. 1997; Brantingham et al. 2000). However, many of these sites are poorly dated and are placed in sequence only within very broad chronological boundaries. Even at sites such as Tsagaan Agui, where initial Upper Paleolithic materials occur stratigraphically above Middle Paleolithic assemblages, it is difficult (if not impossible) to demonstrate occupational continuity. Indeed, it is abundantly clear that occupations throughout the Tsagaan Agui sequence were often ephemeral and always intermittent, with unspecified blocks of time seeing no human occupation whatsoever. It may be impossible to know whether this sequence represents a single population lineage (with a derived technological adaptation) or multiple unrelated lineages (with similar generic adaptations) repeatedly occupying the cave as their populations expanded and contracted under changing ecological conditions. It is misleading to think of the Tsagaan Agui sequence—or any sequence of individual sites—as reflecting direct population continuity.

CONCLUSIONS

We include the assemblages from Tsagaan Agui stratum 3 and Chikhen Agui stratum 3 within the initial Upper Paleolithic, emphasizing the coherence between these assemblages and technological parallels with accepted initial Upper Paleolithic assemblages from western Eurasia. The primary technological features of the Mongolian initial Upper Paleolithic include (1) expanded patterns of raw material exploitation and transport; (2) emphasis on blade production from Levallois-like prepared cores; (3) high frequencies of retouched blades; (4) occasional classic and elongate Levallois points; and (5) a persistence of Middle Paleolithic retouched tool types, especially side scrapers, notches, and denticulates. Note that the assemblages discussed here also fit the general chronological profile for the origin and elaboration of the initial Upper Paleolithic, all appearing after 45 ka. However, the ages for the initial Upper Paleolithic in Mongolia (27–33 ka) are younger than most documented assemblages in western Eurasia.

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The Initial Upper Paleolithic at Shuidonggou, Northwestern China

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Shuidonggou has long been recognized as unique within the north Chinese Paleolithic sequence (Licent and Teilhard de Chardin 1925; Boule et al. 1928; Jia et al. 1964; Bordes 1968; Kozłowski 1971; Li 1993; Yamanaka 1995; Lin 1996). It is one of only a few archaeological sites in northern China known to contain a formal blade technology. The initial excavators, Licent and Teilhard de Chardin (1925: 210), classified the lithic industry from Shuidonggou as evolved Mousterian, or emergent Aurignacian (see also Boule et al. 1928: 120–21). They observed that core forms from Shuidonggou closely resembled those found at western Mousterian sites and retouched tools were reminiscent of western Upper Paleolithic types. Bordes (1968: 130) reaffirmed this seemingly paradoxical classification some years later, adding: "The impression given [by the Shuidonggou industry] is in fact that of a very evolved Mousterian in the process of transition to an Upper Paleolithic stage, but of a type which, taken all round, has not much connection with western forms." Chinese researchers, beginning with Pei (1937: 226), have noted typological connections between Shuidonggou and western Middle Paleolithic industries. However, later studies have favored an Upper Paleolithic designation, based on the substantial differences seen between Shuidonggou and the Chinese Middle Paleolithic type site of Dingcun (Jia et al. 1964: 80). More recently, Shuidonggou has been placed squarely within the Upper Paleolithic solely on technological grounds (Li 1993; Lin 1996). These researchers emphasize the abundance of blades and retouched blade tools in the assemblage. Lin (1996: 12) considers Shuidonggou to be the only known site in China possessing a Mode IV Upper Paleolithic blade technology, adding that Mode III Middle Paleolithic prepared core technologies are entirely absent. Although these researchers have consistently described a suite of traits present at Shuidong-