The archaeology of archaic and early modern humans in northwest China

a report on the 2007 Paleolithic Survey Project in eastern Longxi Basin, Gansu

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1.0 Introduction

The details of late Pleistocene human evolution in northeast Asia are the subject of considerable debate. We know little about the earliest appearance of anatomically modern humans and next to nothing about their pre-modern, “archaic” *H. sapiens* predecessors. The research reported here speaks to this problem by establishing an archaeological record of hunter-gatherer land-use in China’s Western Loess Plateau from the last interglacial (MIS5) to the Last Glacial Maximum (MIS2), roughly 90 – 25 kya. Not only does this work bridge the well-known gap in the archaeological and fossil records of northeast Asia between 100 and 40 kya, it adds considerable dimension to the archaeological record of a region where the scope of Paleolithic research has been isolated and unsystematic. Here we report the results of fieldwork conducted in the summer of 2007, including locations, stratigraphic relationships, and assemblage composition for 48 archaeological sites, 36 in secure Pleistocene stratigraphic context and another 12 from uncertain contexts but with typologically Paleolithic artifacts. The spatial distribution of these archaeological sites suggests a late Pleistocene hunter-gatherer settlement subsistence strategy focused on three distinct geographic provinces: low-elevation river margins, mid-elevation basins, and saddles along ridge-lines leading up to the Liu Pan Mountains. While the rivers and ridges were probably used throughout the late Pleistocene, the mid-elevation basins were most heavily used during the humid MIS3 when they were regular and predictable sources of water, vegetation, and game. In the absence of biological proxies of population history, land use patterns provide a baseline for detecting and evaluating late Pleistocene hominid interactions in northeast Asia.

2.0 Project Goals

Excavations in 2006 at the Dadiwan site on the south side of the Qing Shui River produced a stratigraphic record of human occupation from ca. 62.0 – 5.8 kya. Field visits to the ZJC01 site (formerly called SD001) on the ridge dividing the Qing Shui and Niu Tou River drainages, 25km southeast of Dadiwan, identified a stratified assemblage of crude quartz artifacts in sediments overlying the S1 soil. Together these sites showed that the western Loess Plateau was not abandoned between 100 and 40 kya, this allowing for possible co-existence, competition, and admixture between archaic humans already living in the area and migrating groups of anatomically modern *Homo sapiens*. Our research was designed to establish chronological anchors for these sequences, locate additional sites, characterize lithic technologies, and establish a pattern of site distribution to track the nature of these interactions.

The research was conducted in the eastern Longxi Basin of the Chinese Loess Plateau, west of the Liu Pan Mountains in Gansu Province. Our survey area was focused on the valleys and ranges between the Shui Luo and Qing Shui Rivers, with occasional forays into adjacent areas (Figure 1). Our survey was designed to expand the Paleolithic record established by others (Xie 1991; Xie 1996; Xie and Chen 2004; Xie, et al. 1987; Xie, et al. 2004), and by ourselves in in

2002, 2004, 2005, and 2006 (Barton 2007; Barton, et al. 2007; Bettinger, et al. 2005a; Bettinger, et al. 2005b; Bettinger, et al. 2007; Ji, et al. 2005) (see Figure 2).

Initially, our goal was to collect a sample large enough to characterize the stone tool assemblage of the region. We limited our excavations, however, to a single site (ZJC02), this confined to a single column of profile-cleaning that removed 0.25 x 0.15 x 1.00 m blocks for water screening prior to collection of environmental proxies. All other collection was limited to mapping and collecting artifacts and faunal remains from section walls. Excavation at ZJC02 produced 205 pieces of chipped stone, 169 from excavation and 36 from section sampling. Together with the samples excavated from Dadiwan, this will enable a fine-grained analysis of stone-tool production and use. While the results of these analyses are forthcoming, they are preliminary – larger samples generated by future stratigraphic excavations are planned.

Excavation at many of these sites is difficult, dangerous, and time-consuming. Paleolithic assemblages are typically buried under 5 to 10 meters of sediment, making vertical excavation problematic. Horizontal excavation is complicated because of overhangs and their potential for collapse. Soils are compacted, and those with high clay or carbonate content are difficult to screen even when water is used to break up the matrix. Furthermore, water is typically difficult to acquire, as many of these sites are remote. Future excavation will require extensive planning, large labor crews, thoughtful safety precautions, and time.

Systematic survey in the Loess Plateau is difficult. The area is large and topographic relief is substantial. Furthermore, the landscape is heavily altered by agricultural terracing, making transect-sampling difficult (and dangerous). Surface finds come either from soils altered by terrace-building or by amendments brought from elsewhere. However, in-situ deposits are visible in terrace cuts and in gullies exposing late Pleistocene stratigraphic sections. Because of these problems, exploratory survey can appear somewhat haphazard, drawing on expectations of hunter-gatherer land-use based on topography rather than a systematic sampling strategy. Our 2007 survey focused on the ridges connecting the Liu Pan Mountains to the river valleys in the Hulu River watershed, and on the middle-elevation basins below these ridges. While river valleys and floodplains were certainly part of the Paleolithic foraging round, most previous research was focused on these areas, and we chose to expand to other geographic provinces rather than reproduce our understanding of these lower-elevation settings.

3.0 Survey Areas

The 2007 survey of the eastern Longxi Basin was divided into several regional projects. While each survey targeted a specific landform (e.g., ridge or canyon), some aspects of specific surveys included forays into adjoining areas. Therefore, a survey of Suancigou (a canyon) might also include the ridge surrounding it. Each of these areas along with their most important archaeological sites is described below (Figures 1 & 3).

3.1 Suancigou

Suancigou is a deeply incised tributary drainage of the Hulu River basin, southeast of Jing Ning city. Our investigation of this steep-sided canyon was encouraged by reports (Feng, et al. 2007; Li, et al. 2006) of numerous well-preserved tree trunks in gleyed, lacustrine deposits at the base of the canyon. Dating to ca. 44,000 rcybp, the preserved wood anchors the bottom of a 30,000-year lithostratigraphic sequence dominated by wetland soils interspersed with loess deposits. We chose to survey the region both for its potential as a mid-elevation water source during MIS3 and because of the exceptional organic preservation documented here.

Our survey began south of Suanciwan Village, on the ridge dividing Suancigou (to the north) from Shanmagou (to the south). This location appeared ideal for ridge-line survey because of its proximity to several small drainage basins and because it provides a direct ridge-line path east to the Liu Pan Mountains. Though we did attempt to survey the ridge south, west, and east of Suancigou, as well as the uplands of the Shanmagou drainage, most of our efforts were concentrated on the cultivated slopes and fallow gullies of the southern end of Suancigou itself.

Here we recorded two small, buried sites of uncertain age (Figure 4). The first (SCG01) is an isolated piece of quartz shatter exposed in an agricultural terrace only meters from the road that crosses the saddle. The second (SCG02), consists of a single quartz core in loess soils at the mouth of a small tributary gully to the main Suancigou drainage. Though the age of both of these finds is unclear, the morphology of the tools, their locations, and their depositional settings are consistent with other late Paleolithic locations elsewhere in the eastern Longxi Basin.

Future surveys of the eastern Longxi Basin should focus on topographic and depositional settings similar to those at Suancigou, namely Dingxi Shiquan and Jingnin, both of which possess wood preserved in deeply buried gleyed sediments dating to MIS3 and 4 (Feng, et al. 2007; Feng, et al. 1998; Li, et al. 1988).

3.2 Changweigou

Changweigou ("Long Tail Canyon") drains a large area of the uplands north of the Shui Luo River (Figure 5). Initial explorations at the base of the canyon, near a large brick mine, produced quartz tools, a partial human cranium, and an uncalibrated age of 27,100 +\-600 rcybp based on a half-life of 5730 years (Xie 1991; Xie 1996). The quartz tools were recovered from a thick gravel layer overlying red Tertiary-age clay beds, and the radiocarbon age (LZU-881098) was taken from carbonates from the same stratum, suggesting the actual date of deposition may be much older. The partial human cranium is most of the os frontal of a juvenile. While it was found in the gully below the artifact-bearing layer, it is undamaged, suggesting it may have come from the strata near the artifacts. Though a complete morphometric analysis could not be conducted, subtle post-orbital constriction in this specimen alludes suggests primitive attributes. Though the specimen appears partially fossilized, it should be dated directly by AMS and a complete morphometric analysis be made.

Since these initial investigations, the site has been visited several times by our team over the past few years, both with the original investigators (Xie and Ding), and without. Collections and notes from 2002 reference "Changweigou" as well as QN02 (Bettinger, et al. 2005b). In 2004, a major survey of the site produced in-situ finds at ZS04 and ZS15 (including "WPT-45"), as well as a sizeable surface collection from the fields below the brick mine and the eroded Pleistocene river terrace. Surface finds included cores, flakes, shatter, and retouched tools made from vein quartz, a few pieces made from a sedimentary, carbonate-rich dolomite, and a single meta-sedimentary flake with possible evidence of Levallois-style preparation.

3.2.1 CWG01

Because of the potential for recovering human fossils, and because the dating of the in-situ remains at Changweigou were problematic, we chose to revisit the site with Xie Junyi in 2007. Our goal was to re-record and re-date the originally reported section. Here we found several small quartz artifacts in fluvially reworked loess, immediately atop a 2.5m thick layer of alluvial gravels (Figure 11). Adjacent to the artifacts, 10cm above the gravels, we took an OSL sample. Roughly 10m to the west of the OSL sample, and 30cm into the gravels was a large, quartzite cobble tool, superficially resembling an incomplete Acheulean handax. Though found within the alluvial gravels, the artifact is undamaged, suggesting it was dropped on the surface of the gravels relatively near where it was originally discarded. The OSL sample should date the few artifacts on the surface of the gravels in loess, but will post-date (perhaps substantially) the deposition of those in the gravels.

The proximity of the brick mine suggests the presence of an S1 soil, but so far we have not located artifacts in this stratum. Deposition of the alluvial gravels is likely much older than the radiocarbon date given for the carbonates within it – a tentative date consistent with others associated with S1 soils in the region is suggested (MIS5/4 transition, ~90-60kya). The OSL date should help to resolve this, though if the loess above the gravels is alluvial redeposition, the method may not work. Regardless, the site was likely important to hominid foragers throughout the Pleistocene, as this is one of the few areas where a long, steep drainage converges on the floodplain of the Shui Luo River Valley. Here, water was likely abundant and accessible, even if the floodplain was dominated by marsh during interstadial phases. However, a small ostrich shell (perhaps the first evidence for *Struthio* sp. in the Western Loess Plateau), found on the surface immediately across the gully from the CWG01 section suggests the area was arid in the past.

The layout, stratigraphy, and contents of the site indicate it is a prime candidate for future excavations. The artifacts are buried, and the area could be cleared of overburden prior to excavation. The stream-course below could provide water sufficient for water screening, and the site is easily accessible. The potential for stratified remains including chipped stone artifacts, fauna, and human fossils, exceeds that of other sites, and may represent the single most promising example of a riparian occupation in the area.

3.3 Heilaogua Ridge

The survey of Heilaogua Liang ("Black Crow Ridge") was designed to access a portion of a ridge road closer to the Liu Pan Mountains than those surveyed in 2007. This ridge can be accessed from the Qing Shui River valley in the south (near Long Cheng), and followed to the upper reaches of the Nan Shui Luo River which drains out from a pass across the Liu Pan Mountains. A single day of survey from the ridge road produced 10 buried and 4 surface collections, the most significant of which are HLG01 and HLG04 (Figure 6).

3.3.1 HLG01

This site consists of quartz and quartzite artifacts in an intact stratigraphic section. It bridges a saddle between two canyons, with deposits found on both sides of the road. With the exception of two quartzite pieces found out of context, all artifacts here are fashioned from massive quartz using bi-polar and direct percussion. Both the north and south segments of the site are exposed in an eroded terrace revealing roughly equivalent, perhaps contemporaneous patterns on either side. Artifacts on the north portion of the site were found in the upper limits of a yellow A-A/B-horizon soil, just below the A-horizon boundary (Figure 12). The yellow A-A/B-horizon sits atop a bed of large carbonate nodules forming atop a reddish clay substrate. Artifacts on the south section came from both an overlying, weakly-developed loess soil and an underlying, well-developed, clayey loess soil. Two radiocarbon dates on the same piece of charcoal collected from the lower limits of the A-A/B-horizon loess soil in the north section puts the human occupation of the site and the age of the dark, A-horizon soil at 27.9-26.8 kcalBP (22,739 +/-230 rcybp, CAMS 134380; 22,590 +/-70, CAMS 135381). However, another radiocarbon date on charcoal from the lower "weak loess soil" (stratum B) in the south section came to 49.5 kcalBP (46,240 +/- 1090 rcybp, CAMS 135382). Though the spread between these dates calls the depositional context into question, the earlier set of dates sits almost immediately atop one of the quartz artifacts. The site deserves further attention, but for the moment the 30 kya date for the human occupation of it should be considered tentative.

3.3.2 HLG04

Though no convincing in-situ archaeological deposits were recorded here, this site contains one of the most extensive samples of Paleolithic tool technology in the region, with 108 artifacts collected from the margins of a clay mine and brick factory on the saddle of a long ridge. Most of the artifacts, which include cores, flakes, shatter, formal tools, un-worked cobbles, and fossilized fauna, were collected from a large pile of rubble, including abundant carbonate nodules sorted and pulled from the bulldozed clay deposits before they were shaped and baked into bricks. Additional artifacts were found on the surface of the mine and on surrounding terraces over a roughly 1000 m^2 area.

Most of the chipped-stone artifacts are massive quartz, though a few are quartzite. In comparison to other assemblages from the region, these artifacts are quite large, owing perhaps in part to the proximity of deep, poorly sorted, Tertiary gravel beds less than 200m away. As with other nearby assemblages, lithic reduction and tool manufacture appears a combination of bipolar and hard-hammer direct percussion, and the frequency of formed and edge-modified tools is low. Because site soils were not screened, smaller artifacts may be underrepresented. Nevertheless, this site hints at the scale of recovery possible when large amounts of matrix are removed from saddle-ridge sites.

As with many of the brick mines in the region, this one is designed to exploit the clay-rich loess of the Pleistocene S1 soil (ca. 125-75 kya). Though none of the artifacts were found in-situ, it seems likely that the artifacts came from a fairly circumscribed area, probably within the deeply-buried S1 stratum, from 3.6 to 5.3 m below surface (Figure 13). If the soil is indeed S1, it is surely beyond the range of radiocarbon dating. Nonetheless, we collected five charcoal samples from this soil. Of the artifacts collected from the floor of the mine immediately below the S1 section, several were found embedded in their original soil matrix. Morphologically, the matrix resembles the S1 stratum in the profile: if the matrix of these specimens is intact, they may provide enough unaltered quartz grains to produce an OSL date for the site. However, truly reliabl dating will only happen with the discovery of *in situ* artifacts.

The presence of large unmodified cobbles, large tools, and large reduction debris suggest the nearby Tertiary beds may have been quarried for raw materials. The position of this site on the saddle of a ridge connecting the low elevation river floodplains with the upland slopes and valleys of the Liu Pan Mountains, further suggests this quarry site may have been embedded within a mobile, seasonal hunting round focused on *Bos* sp., *Bison* sp., and *Equus* sp., the remains of which were found - out of context - with the lithics, and identified by Xie Junyi. Ultimately, the spatial distribution of archaeological sites should reflect the seasonal and inter-annual abundance of these and other taxa. Temporal changes in the spatial distribution of archaeological sites (including saddle-ridge sites such as these) may reflect either changes in the relative abundance of prey or changes in patterns of hominid resource acquisition. Rapid, wholesale changes in the latter may suggest incursions by non-local immigrant human populations.

Exposed in a cutbank only meters downslope from the brick mine, we recovered a partially fossilized, broken, and potentially worked antler in loess soil (HLG12). Together with a single piece of quartz shatter, roughly 185 m northeast (HLG11), and a single in-situ quartz flake some 375 m (HLG03) to the northeast, these finds suggest that more intensive exploration of the area might produce intact archaeological deposits capable of providing chronological anchors and environmental proxies for the large stone tool assemblage found at HLG04.

3.4 Doujiagou

Doujiagou canyon is east of the ridge dividing the Shui Luo and Qing Shui River drainages. The Doujiagou drainage connects with Hua Gou and then flows south to join the Qing Shui. Sites found east of the ridge line (DJG01, DJG02, DJG03) were named after Doujiagou while sites to the northwest were called SLR01 and SLR02, indicating their provenance on the ridge above the Shui Luo River valley (Figure 7). Sites connected to the Doujiagou drainage were found on saddles along the ridge line. The deeply buried, Pleistocene DJG01 is described below. Though DJG03 is more than 200 m northeast of DJG01, it probably represents a similar occupation of the same space on the ridge. Located nearly 1 km to the northeast in a saddle below a historic fortress, DJG02 is spatially distinct, and its age is problematic. Here buried deposits on either side of the road contain abundant chipped quartz and pottery. The pottery is reminiscent of the Qijia/Changshan horizon, but the stratigraphic association between the lithics and ceramics has not been established. While DJG02 may well be an in-situ Paleolithic deposit capped by Neolithic occupation, it may also be a Neolithic hunting camp marked by crude or expedient lithic technology. DJG02 should be studied in-depth, but is excluded from the present study due to its questionable temporal context.

3.4.1 DJG01

This is another saddle-ridge site, discovered only a few meters down the east slope of the ridge road, toward the village of Gao Miao. The site consists of three clusters of artifacts (LMK212, 213, 214) found in-situ, in walls cut first by fluvial erosion and then by either road construction or terrace building. Together these clusters comprise a single site, representing roughly contemporaneous occupation of the same space. LMK213 is the furthest down slope and the most deeply buried, though much of the 12 m of section at this locality may actually be the slope of a hill and thus not represent continuous deposition. LMK212 and LMK214 are closer in space and appear stratigraphically equivalent. The artifacts from each of the three localities occur in a dark loess soil overlying a banded, red and gray clay marl (Figure 14). The lower levels of this soil complex contain scattered 3-4 cm diameter carbonate nodules increasing in density toward the contact with the clay. Overlying the soils at LMK213 is a thick band of yellowish loess. If this is Malan Loess, then the soils containing the artifacts of chipped quartz probably date to the middle of MIS3. The LMK214 location is the furthest upslope, with artifacts distributed along an 8 m soil section, roughly 1.5 m thick. An OSL sample from this soil (330 cm below the top of the section, and 106 cm from the bottom) should provide an age for at least one occupation at the site.

The site contains small clusters of artifacts spread out over more than 1000 m^2, making large-scale recovery difficult. Because the LMK214 deposit is relatively shallow and easily accessible by car, however, this portion of site is an excellent candidate for future excavation.

3.5 Shui Luo Ridge

Survey points taken along the ridge dividing the Shui Luo and Qing Shui River drainages between the Yuweigou and Doujiagou surveys were assigned to the Shui Luo Ridge survey area (Figure 7). For the most part, these are survey points on the north and west side of the divide, facing the Shui Luo River valley. Only two buried archaeological isolates were recorded during this survey, both of which are downslope and northwest of DJG01. The first, SLR01, was found at the base of a small canyon adjacent a historic, rammed-earth fortress. While a single large quartz flake was found out of context in the wall of the fortress (which is made of bricks cut from the clay-rich Pleistocene soil on which it is built), only animal bone and charcoal were found in-situ in a buried Pleistocene paleosol. Likewise, SLR02 is an isolated piece of quartz shatter in a similarly undated, but presumably secure Pleistocene context.

3.6 Huagou

Huagou is a long, steep canyon draining most of the south east portion of the divide between the Shui Luo and Qing Shui River drainages. We initiated survey of the middle reaches of this valley in search of sediments and cultural deposits similar to the mid-elevation wetland deposits at YWG01. Our survey began in the small village of Xi Tai, north of Shi Ban Chuan – a somewhat larger town which can be accessed by road from Long Shan on the Qing Shui River. Due to rain the road through Hua Gou north of Xi Tai became impassible, so our survey from here was limited to a few hours walk from the village.

The environmental and depositional history of Hua Gou is complex, and should be the subject of more detailed research. Xi Tai village sits at the confluence of two drainage systems: a short, steep canyon to the northwest emanating from the ridge-top covered by the Doujiagou survey, the other longer and more gradual on the northeast. The village of Hua Gou is located in the steeper, northwest canyon. The two merge in a basin that may have been closed during the Pleistocene, this accounting for the deep lacustrine or marsh sediments (~ 6 m deep) upon which the village sits today. Survey of the basin suggests that this depositional environment extends at least 760 m to the northeast and 570 m to the northwest. Further up the northwest drainage towards Doujiagou is another topographic basin with its own record of lacustrine deposition. These mid-elevation lacustrine-wetland settings may have originated by a combination of high aerial loess deposition during MIS4 and subsequent landslides generated by heavy rain-fall during early MIS3. The resulting basins were fed by a combination of high precipitation and perched-groundwater seepage throughout the humid MIS3 interstadial (Feng, et al. 2007: 282-283). Whether the two depositional settings in Hua Gou are coeval or represent a shifting history of geomorphic and hydrological change is unclear. A working, preliminary hypothesis suggests that this and other narrow drainage systems in the eastern Longxi Basin experience a down-slope migration of small, seasonally inundated basins contingent on erosion, precipitation, and subsequent migration of the water table throughout the late Pleistocene.

The lower elevation basin is rich in archaeological remains. Though our survey area extends almost 2 km from Xi Tai, most of the archaeological finds cluster around the village in an area just under three hectares. One buried site containing two quartz flakes in lacustrine sediments

(HG04) was found 700 m northwest of the main site cluster. The highest density of artifacts is found in and around the HG05 site, covering approximately 1500 m^2 underneath the village, exposed in steep cut banks on the west side of the flood plain (Figures 7, 16).

3.6.1 HG01

Here we collected six in-situ quartz artifacts in an 8.5 m section east of the road northwest of Xi Tai village (Figure 15). The artifact-bearing deposit resembles the waterlogged wetland/lacustrine sediments at YWG01, and is likely the same deposit encountered at HG05, roughly 280 m to the southeast. Though we did not locate any datable carbon associated with the artifacts, there are ample carbonized organic remains in the lower, darker, and more heavily oxidized wetland sediment. The assemblage consists of a single core, flakes, shatter, and a bifacial, radially retouched tool, all of which are made from either bi-polar or hard-hammer edge percussion. As with other archaeological exposures in this part of Huagou, HG01 represents short-term use of a marshy wetland setting. Whether or not the reworked, altered soils that contain the artifacts are the product of seasonal standing water, floodplain meadows, or some combination of the two. The exact nature of hominid use of these settings and the resolution of paleoenvironmental reconstruction here is preliminary and should be the subject of future research.

3.6.2 HG05

Originally located by D.J. Zhang, this site sits below the southeastern edge of Xi Tai village. Though HG05 is a specific locality consisting of abundant chipped stone in wetland sediments distributed over 40 horizontal meters, the site is actually much larger, incorporating isolated finds at HG02, HG07, and HG09. Localities HG01 and HG06 might also be included in the larger HG05 site cluster but are excluded here simply because they are further than 150 m from HG05 proper (Figure 16).

All in-situ artifacts in this area are found in a deeply buried (~ 6m), stratified wetland/lacustrine sediment (Figure 16). The stratum is a reworked, yellowish gray loess soil containing oxidized veins and carbonate root casts. While at HG01 this stratum overlies a high energy fluvial sequence, the same is not visible here. Though time constraints precluded collecting samples for dating or environmental reconstruction, this section should be sampled thoroughly to establish the timing and environmental context of human occupation of the valley. A preliminary assessment suggests contemporaneity with wetland/lacustrine soils at YWG01 where human occupation during MIS3 dates to 30.8 kcalBP (26,020 +/- 720 rcybp).

With the exception of HG05, other sites in the vicinity are either surface finds or buried isolates. Noteworthy artifacts other than those at HG05 include a single in-situ core at HG09 resembling the bi-polar flat-faced core technology seen at Shuidonggou. The HG05 locality itself contains 23 in-situ artifacts and 12 finds from uncertain contexts. The in-situ assemblage is primarily massive quartz, but quartzite and meta-sedimentary materials are also present. No formal tools were recovered, but several of the pieces may have been intentionally retouched, and a few appear to have been used. Where discernable, the method of preparation was bi-polar.

In addition to the excellent buried assemblage, the un-provenienced artifacts from HG05 are remarkable: two pieces of chalcedony, one of which is small prismatic blade from a prepared core, and a possible microblade core fashioned from quartz, allude to an occupation of this valley coeval with the Dadiwan microlithic (Bettinger, et al. 2007). Though we were unable to find any of these pieces in-situ, their source is clearly in the upper half of the HG05 section as two of the pieces were found in cracks and slumps near the main distribution of artifacts. Unlike the local quartz and quartzite readily available in stream beds and gravel deposits, the chalcedony, which is visually identical to the light colored fine-grained cryptocrytalline excavated at Dadiwan in 2006, is not, indicating it would have to imported from elsewhere. This site offers the first realistic opportunity to study the forager to farmer transition northwest China outside of Dadiwan. Stratigraphic excavation of the entire sequence of deposition at HG05, from within Xi Tai village, may well locate a pre-ceramic hunter-gatherer component contemporary with the earliest agriculturalists at Dadiwan.

3.7 Yuweigou

Yuweigou ("Fish Tail Canyon") is a relatively short, steep canyon draining the southeast side of the range and dividing the Shui Luo and Qing Shui River drainages. The canyon drops approximately 410 m from the top of the ridge to the Qing Shui floodplain in less than 10 km. The lower reaches of the canyon are steep-sided, broad, and contain agricultural plots. The upper reaches are basin-like and are characterized by gently-sloping, arable, terraced slopes giving way to steep walled narrow gullies near the apex of the ridge.

During the second phase of excavation at Dadiwan in the mid 1990s, Xie Junyi organized a preliminary archaeological survey of the northern slope of the Qing Shui River valley between Shao Dian and Long Shan. The purpose of this exploration was to find routes connecting the cultural remains of the Qing Shui valley (e.g., Dadiwan) to those of the Shui Luo valley (namely Changweigou). Yuweigou provides the most direct route over the ridge from Dadiwan (in Shao Dian village) to Changweigou on the north side of the Shui Luo River. In the canyons along the north slope of the Qing Shui, Xie's brief survey recorded a series of likely Paleolithic-age sites, of which YWG01 was the most substantial. Despite numerous Neolithic and early Historic remains recorded prior to this survey, including the Wang Jia Yin Wa Banpo cemetery in Yuweigou itself, the Paleolithic was unknown to the Qing Shui drainage.

Two sites, YWG01 and YWG02, are the largest and most significant finds indicating human occupation of a mid-elevation basin and a ridge-top saddle, respectively. A single buried isolate (YWG03) suggests that human hunters traversed the slopes between the two areas, and numerous surface finds recommend additional survey and testing of the numerous side gullies in the area (Figure 8).

3.7.1 YWG01

This site sits consists of deeply buried chipped-stone flakes and tools and possible hearth features in an eroded buttress at the confluence of two intermittent stream channels (Figure 17a). Artifacts are exposed on either side of the buttress, eroding out of a loess paleosol series that provides a local record of environmental change. Preliminary assessments based on an April 2, 2007 visit suggested the site was occupied during a humid phase of MIS3. All artifacts occur in a grayish wetland soil overlying a stratum containing carbonate nodules. These nodules form at the boundary between the upper soil and the lower fluvial system, the latter characterized by interbedded gravels, oxidized bands, and carbonates of various ages. This fluvial system rests on older Tertiary clay and marl beds. Overlying the gray wetland soils are darker, richer soils, perhaps the S0 complex indicative of a geomorphologically stable, vegetated riparian margin developing after downstream erosion drained the preceding wetlands. Though thorough stratigraphic and paleoenvironmental analysis has yet to be done here, massive Malan Loess tops this humid soil complex, this marking the end of MIS3 and the onset of the Last Glacial Maximum (MIS2).

OSL samples from the Northeast Wall should provide dates bracketing human occupation of the site, the formation of the associated wetland soils, the transition between the two soil complexes, and the age of the dark rich soil itself. Radiocarbon samples collected (in July of 2007) from what appears to be a swept hearth (oxidized minerals, charcoal, and quartz artifacts) within the wetland soil complex on the Southwest Wall date between 31.5 and 28.1 kcalBP (26,020 +/- 720 rcybp, CAMS 134377; 23,700 +/-110 rcybp, CAMS 135380), providing support for the preliminary chronostratigraphic sequence presented here.

Artifacts at YWG01 include 22 in-situ pieces of chipped quartz, 1 in-situ battered granitic cobble, and 14 surface finds (all but one of which are quartz). As with other, contemporaneous sites in the eastern Longxi Basin (TX08, TX03, ZS08, Changweigou and Shuangbuzi - (Barton, et al. 2007), the artifacts here are flakes, angular shatter, and core fragments produced by bipolar and hard-hammer percussion. Here a few pieces exhibit possible use-wear while one is an edge-retouched quartz flake tool.

The low density of artifacts in wetland soils suggests occasional hunter-gather occupation of an upland basin where either water-tables were high enough or outflow was sufficiently contained to entail standing water, relatively heavy vegetation, and soil development. The importance of such concentrated resource patches to migratory game and therefore human hunters is significant given that regional biomass was probably low, despite the overall humidity of MIS3 (cf. Feng, et al. 2007; cf. Li, et al. 2006). Thus far, faunal recovery at the site is minimal, but a single fossilized molar of either *Bos* sp or *Bison* sp. indicates large ungulates were available here (and perhaps targeted by humans) during the Paleolithic. Discovery of YWG01 adds another dimension to the known distribution of Paleolithic sites in the region, suggesting that MIS3 hunter-gatherers occupied these mid-elevation upland catchments as well as the lower elevation river margins and valley floodplains (e.g. ZS08, Dadiwan, and Changweigou).

3.7.2 YWG02

Located in a saddle on the ridge dividing Yuweigou (to the west) from an un-named canyon to the east, near the village of Tang Liu, YWG02 was found in a narrow, eroded gully cut by channeled run-off from the ridge road above. Numerous in-situ artifacts (n=31), including bone, chipped stone and charcoal were found within 2 meters of the bottom of the gully and 14 meters from the top of the adjacent knoll (Figure 18). Two radiocarbon estimates on a single charcoal sample, paired with an as-yet unanalyzed OSL date, returned dates beyond the limits of the radiocarbon time scale (>53,000 rcybp, CAMS 135379; >45,700 rcybp, CAMS 134378). Because the background laboratory sample associated with the latter (younger) of these two estimates also returned a date that was too young, the older one should be considered more reliable: with confidence we can say the site was occupied prior to 53,000 radiocarbon years before present. The two OSL samples from the site should bracket the artifact-bearing stratum, this consisting of a massive, moderately compact and indurated loess A/B horizon soil. Stratigraphically and morphologically, the soil sequence here resembles those at ZJC01, ZJC02, and perhaps HLG04, all of which likely belong to the later half of the S1 soil complex dating between 90 and 65 kya.

All but one of the 17 pieces of chipped stone found in-situ at YWG02 are made of massive quartz, and all are fashioned from bipolar and/or hard-hammer percussion. Formal tools are absent, with only four flakes exhibiting edge retouch and seven exhibiting use wear along one or more margins. A single, radially reduced quartz core suggests rudimentary core preparation. Numerous but currently unidentified medium-to large sized mammalian faunal bone fragments were also recovered. The site was not excavated, instead artifacts were plotted and removed from section (Figure 18). As with other sites in the region, the depth of the cultural deposit makes vertical excavation here dangerous and costly, though a stepped, horizontal excavation might be both possible and productive.

Environmentally, the site clearly warrants further study, with dating the various strata contained in the soil sequence key to this task. Collection of paleoenvironmental proxies (e.g., pollen, magnetic susceptibility, and the like) enabling comparison between this and other ridge-top saddle sites would illuminate patterns of land-use through time and across space, and provide baseline data as to whether land use patterns remained static or changed during the period spanning the archaic-modern human interface. A comparison of saddle-ridge sites, and those in both the middle-elevation basins (e.g. YWG02 and HG05), and on the river margins (e.g. Dadiwan and Changweigou) should provide a more complete picture of the landscapes and resources exploited by different Paleolithic hunter-gatherers and the behaviors associated with doing so.

3.8 Zhangjiachuan Ridge

Our survey of the ridge dividing the Qing Shui and Niu Tou River drainages began with the discovery of ZJC01 and ZJC02, both of which were named for the city in the valley bottom southeast of the pass (Zhangjiachuan). Later we expanded our survey along the ridge to the south and west to provide coverage for the southern boundary of the Qing Shui River drainage. While the small valleys draining north from this ridge surely deserve further investigation (see Gedachuan Canyon Survey), our survey of the ridge was disappointing compared to others (e.g. Heilaogua) where Pleistocene strata and Paleolithic artifacts were abundant. The reason for this is unclear, but may reflect an unstable depositional regime that either eroded or failed to deposit loess and allow the development of the Pleistocene loess-paleosol sequence found further north. Here Holocene soils overly Tertiary beds, this indicating a substantial unconformity during the Pleistocene. Aside from ZJC01 and ZJC02, only one of our ridge-line surveys produced in-situ Paleolithic remains (see Figure 9). Here (ZJC03) we found 3 quartz flakes in a deep soil section immediately above the Teritiary beds, on the northwest side of the ridge road. Also at ZJC03 was a fossil *Cervus* tooth in old pond sediments above the Tertiary clays, though this may be much older than the chipped stone. In addition to the Paleolithic sites reported here, we also recorded a series of late Neolithic sites (LMK001, LMK004) that may warrant additional work guided by a different research agenda.

3.8.1 ZJC01

A 2005 survey of the Qing Shui drainage recorded a large quartz cobble buried 4.5 m below the top of the terrace in a road-side cut-bank (Barton 2007). Originally called "SD001" the site was renamed during a visit on April 1, 2007, during which time the stratigraphy was resolved and OSL samples were collected. Though absolute dating has not been completed, the loess-paleosol sequence at the site appears to span MIS5 (S1), MIS4 (L1L2) and MIS3 (L1S1), all of which rest on a bedded Tertiary red-clay (Figure 19).

Three quartz artifacts including 1 piece of shatter, one large core, and one bipolar split pebble were recovered from the main exposure, on the boundary of the S1 and L1L2 strata, and well into the latter. Within 100 m we recorded 3 isolated pieces of quartz in sediments resembling the L1L2 and L1S1 strata visible in the main exposure. If the stratigraphic assessment is correct, these artifacts attest to a hominid presence in the western Loess Plateau during the MIS4 stadial (75-57 kya) a cool moist interval marked by the expansion of coniferous forests (Feng, et al. 1998).

The appeal of this location to Pleistocene hunter-gatherers is quite clear. The modern road cuts through a natural pass over a ridge leading directly to the Liu Pan Mountains. From this ridge-top saddle one has a clear view of the valleys on either side of the ridge, making it a good place to monitor and intercept game moving from the river bottoms to higher elevation pasture. The presence of several small Neolithic Yangshao and Changshan sites near the pass likely attests to the persistent value of this location to hunters well into the Holocene.

3.8.2 ZJC02

Roughly 230 m south of ZJC01, on the same ridge is another saddle. From here one can see ZJC01, the valleys below, and the road to the pass. The main exposure of this site is in a deep gully cut on the east side of the saddle, right off the small dirt road that descends into Yangshang village. Artifacts (including Paleolithic chipped stone, Neolithic ceramics, and bone of uncertain age) are found on the surface and in terrace cuts around this site, but the largest density of artifacts occurs in a single exposure roughly 7 m long (Figure 20).

Stratigraphically, the exposure resembles that at ZJC01, save that there are more easily-identified strata. Based on the Pleistocene soils typology developed for the western Loess Plateau (Chen, et al. 1999; Chen, et al. 1997) the section appears to contain a sequence spanning S1 to L1L1. It thus provides a record of deposition from the end of MIS5 to MIS2 (Last Glacial Maximum), roughly 90-25 kya. Though intriguing, this evaluation is preliminary and requires more in-depth chrono-stratigraphic study based mostly on the results of forthcoming OSL analyses.

Artifacts (chipped stone and bone) appear in section throughout a 3m thick by x 7m long block of soil containing several district strata. To establish a crude picture of artifact change through time and collect a sample size large enough to characterize, we initiated a small excavation in 0.25 x 0.15 x 1.00 m blocks over 2.50 vertical meters (Table 1, Figure 20). Each excavation unit was measured relative to a horizontal datum, but the nature of the deposit made exact volumetric sampling difficult – the artifact frequencies can only be considered very rough approximations of change through time. Nevertheless, the main density of artifacts occurs in a 2 m thick band including strata B-E (Figure 20). Because the stratigraphic sequence is uncertain, we collected three OSL samples, two of which should define the period of occupation, the other an age for the sterile soil at the bottom of the excavation unit that likely corresponds to the S1. If the bottom two strata (F & G) are in fact the upper strata of the S1, then the site saw most intensive occupation during MIS4. However, it may have been occupied sporadically from anywhere between MIS5 and MIS3. The uppermost loess deposit resembles the L1L1 Malan Loess of the LGM, but it was too high in the section for us to evaluate, and it does not appear to contain artifacts.

The ZJC02 assemblage is currently the largest collection of pre-LGM chipped stone in the western Loess Plateau (n=205, 168 from excavation). Additionally, some 228, mostly fragmentary, pieces of bone were recovered from in-situ contexts. Several teeth and longbones attest to the presence of large ungulates, including *Bos* sp. The chipped stone assemblage is composed primarily of quartz (~90%), with a few pieces of quartzite and other metasedimentary materials. As with other regional assemblages, this one was made by a combination of bipolar and hard hammer percussion leaving mostly un-modified flakes and shatter. Roughly nine percent of the assemblage exhibits evidence of retouch, of which two artifacts appear to be formal tools. At least one flake and one core suggest a prepared core technology – both come from the same stratum, equivalent to ZJC02.106 – a correlation suggesting further investigation. The assemblage produced roughly 10 pieces of linear flakes and shatter resembling bipolar bladeforms. The sample is small, but may suggest an intended product of bipolar reduction. Lastly, four small scalar flakes indicate controlled retouch, possibly bifacial or unifacial thinning. Thorough quantitative analysis is in process.

strat	**lvl**	**N**	**length**		**width**		**thickness**		**Raw Material**			**qtzite**
		in screen	*avg*	*sd*	*avg*	*sd*	*avg*	*sd*	*qtz*	*qtzite*	*other*	*%*
B	109	18	6.5	7.4	5.4	5.8	2.7	3.8	15	3		20.0
B	108	25	5.9	6.2	4.0	4.1	2.2	1.7	24	1		4.2
C	107	39	5.0	10.1	4.0	8.1	2.7	4.7	36	3		8.3
C	106	25	4.5	6.7	4.0	6.0	2.3	3.3	23		2	0.0
D	100	9	1.0	0.0	1.0	0.0	1.0	0.0	9			0.0
D	101	19	7.4	8.6	6.5	7.5	2.6	2.6	16	3		18.8
E	102	19	9.3	13.3	8.1	11.7	3.6	3.8	15	4		26.7
E	103	10	7.7	14.2	6.2	11.6	4.5	7.9	10			0.0
F	104	2	17.0	22.6	15.5	20.5	12.5	16.3	2			0.0
F	105	3	5.3	7.5	3.7	4.6	2.7	2.9	3			0.0
	totals	***169***	***6.1***	***9.3***	***5.0***	***7.8***	***2.8***	***4.2***	***153***	***14***	***2***	***0.10***

Table 1. Artifact data from the ZJC02 excavation column. Artifacts pulled from strata outside excavation column (those numbered in Figure 20) are not included.

Occupation of this ridge-top saddle appears roughly contemporaneous with that at ZJC01, and possibly YWG02 and HLG04, all of which also contain ungulate remains, likely *Bos* sp. Though these animals may have been taken in lower elevation settings and transported to the ridge for later consumption, this scenario seems unlikely. Rather, their presence at these sites suggests they were being taken on, or on their ascent to the ridge, which itself is a natural game corridor between the broad, lower-elevation floodplains and the higher pastures of the Liu Pan Mountains. The local environmental setting of these ridges is currently unknown, but a complete palynological column sample taken in 5 cm levels from the 3.15 m excavation unit should provide a local vegetation history. While we did attempt a reconstruction of soil development and therefore humidity with the Bartington magnetic susceptibility probe, the results seem problematic. The site was revisited in the fall of 2007, and additional stratigraphic analyses are underway.

3.9 Gedachuan Canyon

Gedachaun is an unexcavated Banpo site (6.1-6.0 kcalBP) on a low terrace at the confluence of two streams that join and flow north into the Qing Shui River. We investigated this site as a possible location for finding microlithic components related to those found at the Dadiwan site and HG05. Beyond this, we moved further south up the main arm of the drainage stopping to conduct a limited survey along the ridge-road north of the Zhangjiachuan Ridge survey route (see LMK243 on Figure 9). Below this, in the upper reaches of the main drainage we surveyed the area around Songshu village, looking for MIS3 lacustrine-wetland sediments and associated Paleolithic remains similar to those found at HG05 and YWG01. Aside from a few scattered surface isolates, we did not find anything, though the lacustrine-wetland sediments are present in several exposures near the village.

North of Songshu is an active brick mine on a promontory separating the confluence of two streams. A 2005 survey of this promontory recorded nothing, but this year we found three pieces of chipped quartz in a dark loess A-horizon soil overlying a yellowish B-horizon, both atop a clay-rich soil with large carbonate nodules. We did not collect datable samples from this site (GDC02), but it bears rough similarity to the sequence found at HLG01. The fact that this is a brick mine suggests the basal, clay-rich deposit may be S1.

3.10 Qin'an Road

On our final day of field work we decided to extend the Zhangjiachuan Ridge survey further west, in search of evidence for human occupation of the southwestern stretch of the Qing Shui River drainage. Our survey was limited to small forays off the ridge road connecting Lian Hua to Qin'an – a route that must have connected the Qing Shui and Hulu River regions in the past as it does today. Two sites (QAR01 and QAR02) in deep dark soil sections attest to human use of this ridge (Figure 10). Though the soils here resemble the MIS3 soils seen on the ridges north of the Qing Shui River, their age cannot be determined with certainty. As with other artifacts common to the region, the ones found here are simple quartz flakes and shatter made from bipolar reduction. As quartz cobbles do not appear in eolian loess, these must have been come from gully bottoms or Tertiary gravel beds, and brought to the ridge as tools for hunting, skinning or butchering. This area may have been a prominent pass linking human and animal access to the Qing Shui and Hulu Rivers, and may have been part of a mobile annual round including the floodplains of the Wei River much further south.

4.0 Summary & Discussion

The earliest anatomically modern humans in East Asia come from Laibin and Liujiang in southern China; Huanglong, Tianyuan (Zhoukoudian), Shandingdong (Zhoukoudian), and Salawusu in northern China; and Minatogawa in Japan (Table 2). Additional candidate fossils are described in Wu & Poirier (1995). Because the range of possible dates for many of these fossils is so great, and because the association between fossil and provenience is often questionable (specifically at Liujiang, for example), many of these ages should be viewed with caution. However the Tianyuan *H. sapiens* from Zhoukoudian was dated directly and provides a solid minimum date for the appearance of anatomically modern humans in northeast Asia by 40 kya (Shang, et al. 2007).

Middle Pleistocene hominids from East Asia are typically parsed into distinct *blauplan* groups – *Homo erectus*, and archaic or "early" *Homo sapiens* – with a variety of unique shared, derived features between them (Wu 2004; Wu and Poirier 1995). Despite the considerable time lapse between the fossil evidence for these two groups (Etler 2004), the shared features are considered evidence of evolutionary continuity between them. Likewise, features shared across both the archaic and modern human *blauplan* are thought to support continuous local evolution of *Homo sapiens* in East Asia, despite the lack of archaic fossils after 100 kya. It should be noted that this continuous local evolution does not imply independent evolution, rather roughly contemporaneous appearance of each of these groups across Eurasia implies regional variation with considerable admixture between locally distinct populations (Wolpoff, et al. 2000; Wu 2004).

For many (e.g. Brown 2001), the total lack of hominin fossils with reliable dates between 100 and 40 kya suggests the disappearance of pre-modern humans in East Asia and implies that anatomically modern humans walked into this vast and diverse landscape uncontested. Though this "gap" can been attributed to the limits of the dating methods (Shen 2004), it is often marshaled as the most compelling archaeological evidence against continuous evolution of the genus *Homo* in northeast Asia (Brown 1992; Brown 2001).

In recent years, a few sites have been dated both to the same age as Tianyuan (that is, the earliest appearance of anatomically modern humans), and to the interval before it (Table 3). None of these contains human fossils nor can they be attributed to specific biological populations with any confidence, but they do demand that we consider either an earlier date for the appearance of anatomically modern humans, or the persistence of archaic populations well beyond their supposed disappearance.

site	**age**	**method**	**subject**	**material**	**ref**
Laibin	44-38 kya	U-Series	Human fossil	calcite	(Shen, et al. 2007)
Liujiang	>139-68 kya	U-series	AMH fossils	calcite	(Shen, et al. 2002)
Huanglong	103 OR 44 kya	ESR, U-Series	Fossil human teeth, stone tools	Animal teeth; stalagmite	(Wu, et al. 2006)
Salawusu	125-35 kya	TL, Thorium, IRSL, 14C	AMH scapula	various	(Shang, et al. 2006)
Tianyuan	42-39	AMS	AMH fossils	Human femur	(Shang, et al. 2007)
Shandingdong	29-24 kya	AMS	AMH fossils		(Chen, et al. 1992)
Minatogawa 1	23-19 kya	AMS	AMH fossils		(Brown 1999)

Table 2. A list of the earliest anatomically modern human fossils in northeast Asia. Ages are approximate, calendar years. The most reliable ages and associations are the last three.

site	age	method	subject	material	ref
Jingshuiwan	81-74 kya	OSL	MP tools	Sandy deposit	(Pei, et al. 2003; Pei, et al. 2006)
Dadiwan	61 kya	OSL	Quartz artifacts	Loess	unreported
Dadiwan	39 kya	AMS	Quartz artifacts	Loess	(Bettinger, et al. 2007)

Table 3. Archaeological sites from north China with reliable ages contemporary with or immediately prior to the earliest modern human fossils. Ages are approximate, calendar years.

Currently we know very little about the biological identity of the tool-makers living in the western Loess Plateau during the Late Pleistocene. Previous studies put anatomically modern humans along the upper Wei River at Gutougou by 38 kya (Wu and Poirier 1995; Xie, et al. 1987), but the partially fossilized cranium of this “Wushan Man” was not recorded *in situ*, has not been dated directly, and most likely belongs with the abundant Changshan Neolithic settlements and cemeteries found at the same location (Chen, Xie, Barton, Zhang – field notes April, 2007). The partially fossilized skull fragments from Changweigou (see above) may be the only late Pleistocene human remains known from the western Loess Plateau, but require direct dating and morphometric evaluation. Beyond this, the nearest examples of early anatomically modern humans come from Shuidonggou (Wu, et al. 2004), Salawusu (Shang, et al. 2006), Jingchuan (Liu, et al. 1984), and Changwu (Wu and Poirier 1995) – all north and east of the Liu Pan mountains, and all with questionable ages and associations.

Though fossil evidence from Xujiayao in Shanxi attests to the persistence of archaic *H. sapiens* until 139 kya or even 104 kya, the fossil nearest to the western Loess Plateau is more than 300 km to the east at Dali, and dates between 230 and 180 kya (Chen and Zhang 1991).

Preliminary data from this study points to two distinct occupations of the western Loess Plateau prior to the LGM: one affiliated with warmer intervals of the MIS3 interstadial, the other affiliated with the terminal sequence of the S1 soil on the MIS5/4 transition (Tables 4 and 5). Currently, the dating is too coarse to determine if the sequence is continuous or not. Resolution will come from more precise, absolute dates for the cultural remains found in green/gray lacustrine sediments here and elsewhere in the Loess Plateau (at Liujiacha for example). These green/gray deposits with chipped-stone assemblages and Salawusu fauna, are typically assigned to the warmer interstadial as a whole, but may date to any of the warmer inter-stades in northeast Asia that parallel the hemispheric Dansgaard/Oeschger events visible in Greenland ice (Dansgaard 1997; Wunnemann, et al. 2007). If modern humans arrived during Stage 3, as they did in other parts of the world (e.g. van Andel 2002), the dramatic climatic fluctuations of this period likely played a role in the biogeography of these distinct hominid populations.

		Site Type			
		river	**basin**	**ridge**	*total*
Context	**buried**	1	16	21	*38*
	surface	0	5	8	*13*
	total	*1*	*21*	*29*	**51**

Table 4. Distribution of archaeological sites recorded during the 2007 survey.

The appearance of dense cultural deposits in sediments resembling the S1 soils confirms the presence of hominin tool makers in the western Loess Plateau 20-40 thousand years earlier than the earliest known modern human fossils, but perhaps 10-30 thousand years later than the youngest known archaic human. Who were these people? Were they relict populations of *Homo erectus*, persistent archaics like the *H. heidelbergensis* from Dali, a mixture of archaic and modern forms similar to those found on the island of Flores, or something else entirely? There are at least two, unstudied and undated fossils from locations on both ends of the western Loess Plateau that may help to resolve this: the child at Changweigou, and another from the mountains to the west of Linxia. These specimens may yet expand the known range of Eurasian archaics with biological affinity to the European Neanderthals as recorded from Tesik Tash in Uzbekistan and now Okladnikov Cave in the Siberian Altai (Krause, et al. 2007). East Asia may have been a stage for successive pulses of hominid migration, interaction, and perhaps interbreeding, prior to the eventual crest of the modern human wave.

Currently we cannot determine if the archaic and modern human populations occupied the western Loess Plateau at the same time. If they did, it's possible they could have interbred, and a few studies point to archaic features in modern human fossils found nearby (e.g. Wu, et al. 2004). But whether or not the two populations interbred, one persisted and the other did not, perhaps implying competitive exclusion. Assuming they did co-exist, we should look for archaeological patterns that suggest distinct adaptive strategies and ask how one might be better suited to the variable environment of MIS3. Differences in behaviors like mobility, group formation, resource focus, social networking, and communication have been cited time and again as the reasons for the persistence of modern humans over archaic humans in a changing environment (e.g. Finlayson and Carrion 2007; Gamble, et al. 2004) .

When two distinct adaptive strategies are juxtaposed, theory suggests one will endure when environmental change, population pressure, *or anything else*, puts a strain on resource acquisition (Bettinger 1999; Bettinger and Baumhoff 1982). When resource "stresses" vary in time, space, and content, rather than degree, the strategy with the greatest flexibility should prevail. When all else is equal, the strategy with the greatest diversity of dietary sources will provide the most consistent nutritional support, will promote infant survivorship, and will ultimately put more people in competition over limited resources (Hockett and Haws 2003; Hockett and Haws 2005; Stiner, et al. 2000).

To generate workable hypotheses, here we assume that all late Pleistocene archaeological evidence prior to 50 kya belongs to archaic *H. sapiens* and all evidence after 50 kya belongs to moderns. For the moment, this will suffice because nothing here dates to 50 kya, and we can evaluate the patterns we see on either side of this divide. The small "gap" here is probably artificial – both the continuous record at Dadiwan (Bettinger, et al. 2007) and the contemporaneous occurrence of archaics (i.e. Neanderthals) and modern humans across northern Eurasia (Krause, et al. 2007; Mellars 1999; Shang, et al. 2007) allow for the possibility of their co-existence at some time in the western Loess Plateau. By looking at temporal extremes we can evaluate archaeological patterns specific to hypothetical hominid groups. The rough chronology established during this survey fits this dichotomy, and for the purposes of this analysis, we assume the following (drawn from Table 5):

Archaics = MIS5/4 = narrow spectrum, ridge-line hunters
Moderns = MIS3 = broad spectrum ("extensive"), ridge-basin-riverine strategy

If there were archaic humans living in the area when modern humans arrived, the moderns may have gained a foothold because the archaics were focused on a narrow range of resources in a limited number of ecological settings. That all of the archaeological sites prior to 50 kya recorded on this survey come from ridge tops suggests the archaic populations were disproportionately oriented towards acquisition of large game in predicable places (Table 5). When modern humans moved in, they took advantage not only of a broader range of resources, but a broader range of areas as well (Table 5). In this way, face-to-face competition over mutually critical resources was not an issue. Moderns could still access large game, but could cope with lower abundance (fewer encounters) in less-desirable locations because they could fill their dietary budget with other, more abundant resources available elsewhere. Archaics on the other hand, remained focused on a narrow range of resources and the areas where encounters were greatest: the funnel-like trackways of ridge-line migration routes. Along these routes, movement is less costly, and encounter rates are high. This does not imply that archaics were less mobile, merely that their mobility was confined to the most productive (or cost effective) niches given a diet focused on a narrow range of high-return resources. Ultimately, declines in the efficiency of the archaic foraging strategy, perhaps affiliated with environmental change or the added hunting pressure of regional population growth, might force archaic populations to expand their resource base or move into novel settings. However, if these novel settings (the rivers, the uplands, the marshes, and the plains) were already occupied and exploited by modern humans, the archaics would be forced into decline.

		Site Type			
		river	**basin**	**ridge**	*total*
Age	**MIS3**	1	11	5	*17*
	MIS5/4	0	0	8	*8*
	unknown	0	10	16	26
	total	1	11	13	**51**

Table 5. Distribution of site-types by age. Ages based on a combination of absolute and stratigraphic dating methods.

The fact that all hunters appear to use the ridges does not compromise this story. Anatomically modern humans surely used the ridges for hunting as well – all hunters did. However the earliest modern arrivals could schedule their use of these ridges to avoid territorial conflict with resident archaic hunters. When resource stress forced archaic groups to cover greater distances or expand their resource base, they were excluded from doing so by the growing presence of modern humans. As the ranks of the modern human population increased, the archaics dwindled and ultimately disappeared leaving the prime hunting ridges uncontested.

Though the two part division presented here is currently speculative, it provides a good foundation for tracking changes in the distribution and evolution of human populations in the western Loess Plateau during the late Pleistocene. Associating stone-tool industries and foraging strategies with specific biological populations may be problematic (Adler, et al. 2006; Brantingham, et al. 2004; Lieberman and Bar-Yosef 2005), but in the absence of fossils, this may be the only way to evaluate human evolution in northeast Asia. The first step is to explore and describe the archaeological record of the late Pleistocene. Excepting the limited incursion of the early Upper Paleolithic in arid northern China ca. 35-29 kya (Brantingham, et al. 2001), and the widespread appearance of formal microblade technology after the Last Glacial Maximum (Barton, et al. 2007), the stone-tool industries of northern China seem largely unchanged throughout the late Pleistocene. This study corroborates this and points to other avenues for tracking population change during this time. The numerous undated archaeological deposits recorded on this survey (Table 5) could disrupt the pattern we report here. Future efforts should focus on additional survey, absolute dating, metric evaluation of chipped stone artifacts, environmental reconstruction, and faunal collection and analysis. More data will close the already narrow gap around 50 kya and establish a changing history of land use which can be evaluated in light of regional environmental change and continental trends in human migration, cultural evolution, and biological composition.

5.0 Conclusion

Though we began with the desire to establish a chronological sequence from which to build a regional understanding of hominid dispersal, we ended up with much more: a distribution of occupation areas that illustrate patterns of hominid land use during the Pleistocene. Changes in resource abundance and acquisition are reflected in the distribution of archaeological sites across a changing landscape. Ultimately, understanding how these changes evolve in tandem will allow us to generate and test hypotheses about the persistence of archaic humans, the subsequent arrival of anatomically modern humans, and the degree to which these two populations interacted or competed.

Laboratory Number	Sample Name	Field ID	$\delta^{13}C$	fraction Modern	±	$D^{14}C$	±	rcybp	±	CalPal mid	CalPal 1s +	CalPal 1s -
CAMS 134377	YWG01 CAMS 001	YWG01.104-3	-25	0.0392	0.0035	-960.8	3.5	26020	720	30837	31502	30172
CAMS 135380	YWG01 CAMS 002	YWG01.104-3	-25	0.0523	0.0007	-947.7	0.7	23700	110	28390	28670	28110
CAMS 134380	HLG01 CAMS 002	HLG01.001-3	-25	0.0590	0.0016	-941.0	1.6	22730	230	27399	27832	26966
CAMS 135381	HLG01 CAMS 101	HLG01.001-3	-25	0.0600	0.0005	-940.0	0.5	22590	70	27340	27900	26780
CAMS 135382	HLG01 CAMS 003	HLG01.003	-25	0.0032	0.0004	-996.8	0.4	46240	1090	49490	52770	46210
CAMS 134378	YWG02 CAMS 001	YWG02.021	-25	0.0009	0.0017	-1000.9	1.7	>45700	-	-	-	-
CAMS 135379	YWG02 CAMS 101	YWG02.021	-25	0.0005	0.0004	-999.5	0.4	>53000	-	-	-	-

Table 6. All radiocarbon dates from the 2007 Paleolithic survey.
Calibrated using the 2007 Hulu Comparison curve with the CalPal software package.
http://www.calpal.de

site			lithics		fauna		total	dating		location	occupation
name	*lon*	*lat*	*insitu*	*surface*	*insitu*	*surface*	*all artifacts*	*OSL*	*14C*	*type*	*estimated*
CTM 7-19-2	106.03594	34.93293		1			1			basin	?
CWG01	105.93895	35.12526	4	1	2	1	8	1		river	MIS3
DJG01	106.01439	35.10117	15				15	1		ridge	MIS3
DJG02	106.02207	35.10892		1			1			ridge	?
DJG03	106.01611	35.10247	1				1			ridge	MIS3
GDC02	106.07464	34.97718	3				3			basin	MIS3
GPS545	106.14651	35.13268	1				1			ridge	?
GPS555	106.03638	35.08425	1				1			basin	?
GPS565	106.01147	34.93388		2			2			basin	neolithic
GPS566	106.04487	34.92904	1				1			basin	?
HG01	106.03316	35.08568	6				6			basin	MIS3
HG02	106.03468	35.08486	1				1			basin	MIS3
HG03	106.03435	35.08775	1				1			basin	MIS3
HG04	106.04172	35.09193	2				2			basin	MIS3
HG05	106.03565	35.08518	23	12			35		1	basin	MIS3
HG06	106.03210	35.08667	1				1			basin	MIS3
HG07	106.03543	35.08440	1				1			basin	MIS3
HG08	106.03550	35.08933	1		1		2			basin	MIS3
HG09	106.03552	35.08422	1	2			3			basin	MIS3
HLG01	106.15381	35.13127	5	9			14		6	ridge	MIS3
HLG03	106.19888	35.17799	1				1			ridge	MIS5/4
HLG04	106.19560	35.17477		108		3	111	1	5	ridge	MIS5/4
HLG05	106.14862	35.13163	1				1			ridge	?
HLG06	106.14735	35.13220	1				1			ridge	?
HLG07	106.15943	35.13450	1				1			ridge	?
HLG08	106.14814	35.13183	2				2			ridge	?
HLG09	106.14708	35.13206	1				1			ridge	?
HLG10	106.19873	35.19328	2				2			ridge	?
HLG11	106.19692	35.17553	1				1			ridge	MIS5/4
HLG12	106.19525	35.17389			1		1			ridge	MIS5/4
LMK210	105.94665	35.05633		1			1			basin	?
LMK218	106.14575	35.13303		1			1			ridge	?
LMK223	106.19835	35.17927		1						ridge	?

site			lithics		fauna		total	dating		location	occupation
name	*lon*	*lat*	*insitu*	*surface*	*insitu*	*surface*	*all artifacts*	*OSL*	*14C*	*type*	*estimated*
LMK241	106.10787	34.94737		1			1			ridge	?
LMK243	106.01168	34.93115		1			1			ridge	?
LMK245	106.04085	34.93648		1			1			ridge	?
QAR01	105.77312	34.98671	1				1			ridge	MIS3
QAR02	105.77809	34.98401	1				1			ridge	MIS3
SCG01	105.82874	35.49548	1		0		1			ridge	?
SCG02	105.82553	35.50313	1		0		1			basin	?
SLR01	106.00375	35.10260		1			1			ridge	?
SLR02	106.00584	35.11313	1				1			ridge	?
WPT059	105.94319	35.05461		2			2			basin	?
WPT070	105.94860	35.06055		1			1			basin	?
YWG01	105.94392	35.05466	23	14	2		39	4	4	basin	MIS3
YWG02	105.96824	35.05848	19	2	12	3	36	2	7	ridge	MIS5/4
YWG03	105.95913	35.06373	1		0		1			basin	?
YWG04	105.94185	35.05765	1		0		1			basin	?
ZJC01	106.17230	35.00155	6	4			10	3		ridge	MIS5/4
ZJC02	106.17061	34.99728	205		228		433	3		ridge	MIS5/4
ZJC03	106.09886	34.92929	3		1		4			ridge	MIS5/4
TOTALS			**338**	**165**	**247**	**7**	**757**	**15**	**23**	**51**	

Table 7. Summary of all sites located during the 2007 field survey, including locations, artifacts, and assumed ages.

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The archaeology of archaic and early modern humans in northwest China

a report on the 2007 Paleolithic Survey Project in eastern Longxi Basin, Gansu

L. Barton, C. T. Morgan, R. L. Bettinger, D. J. Zhang

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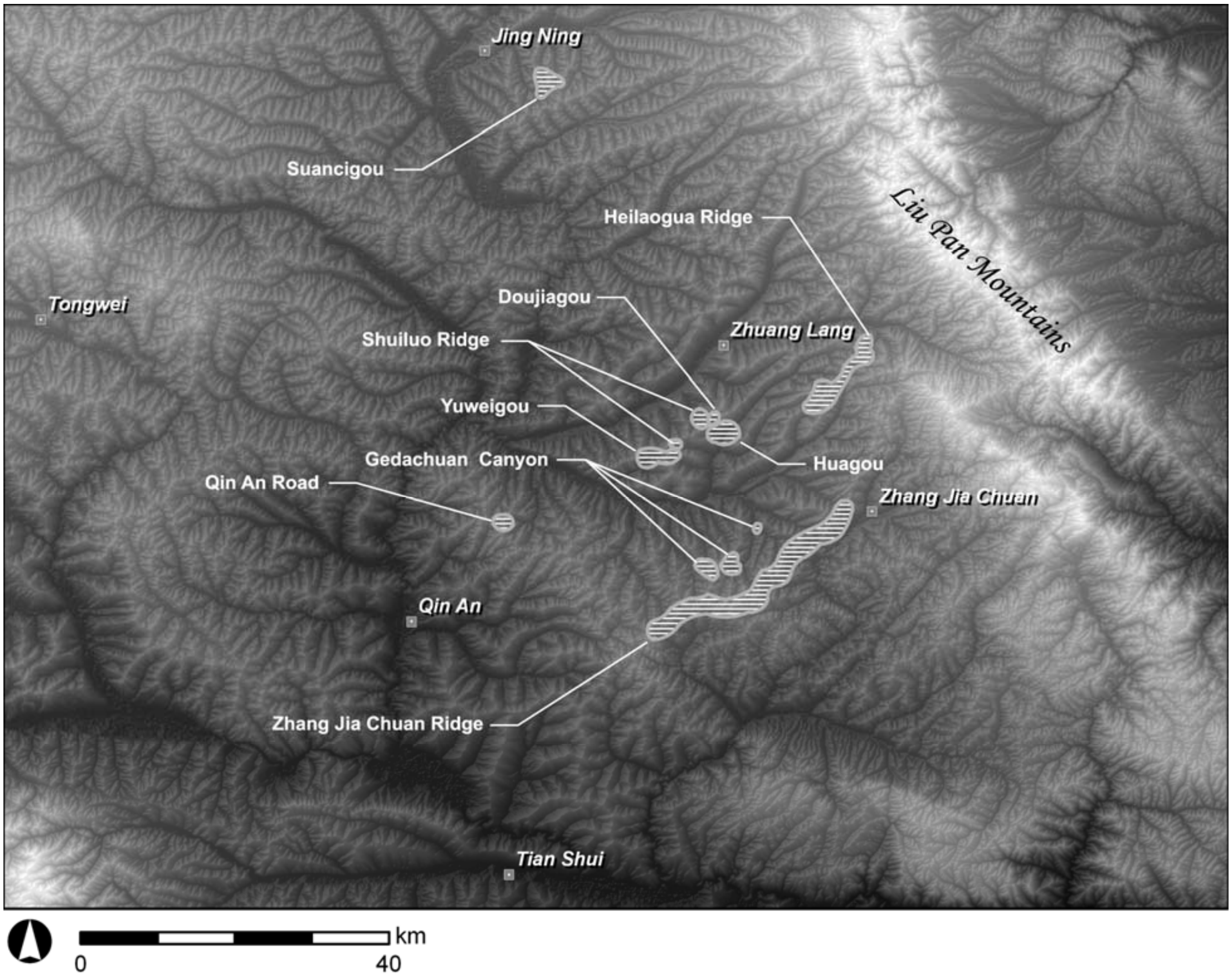


Figure 1. Areas visited during the 2007 Paleolithic Survey of the Eastern Longxi Basin

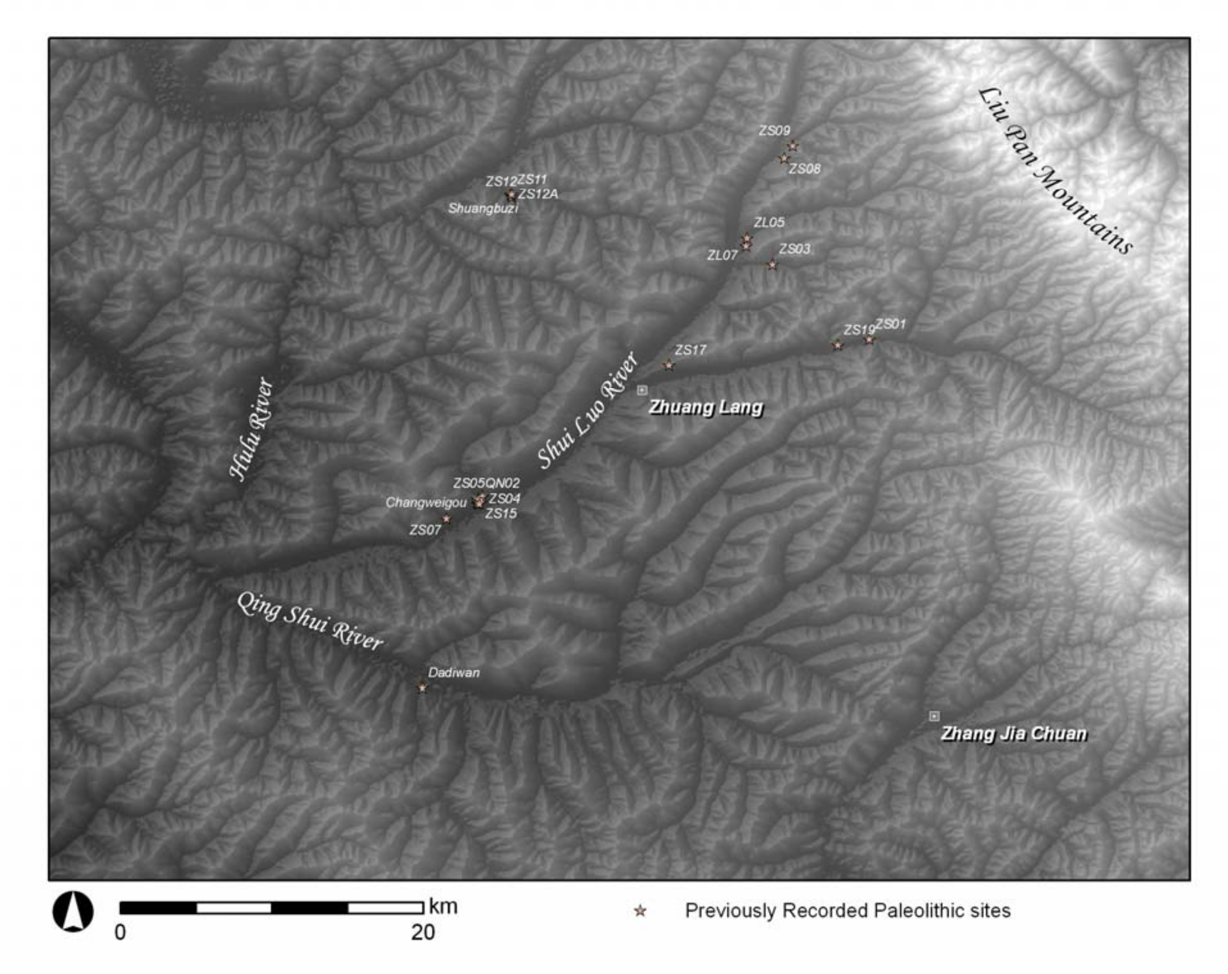


Figure 2. Paleolithic sites previously recorded in the eastern Longxi Basin

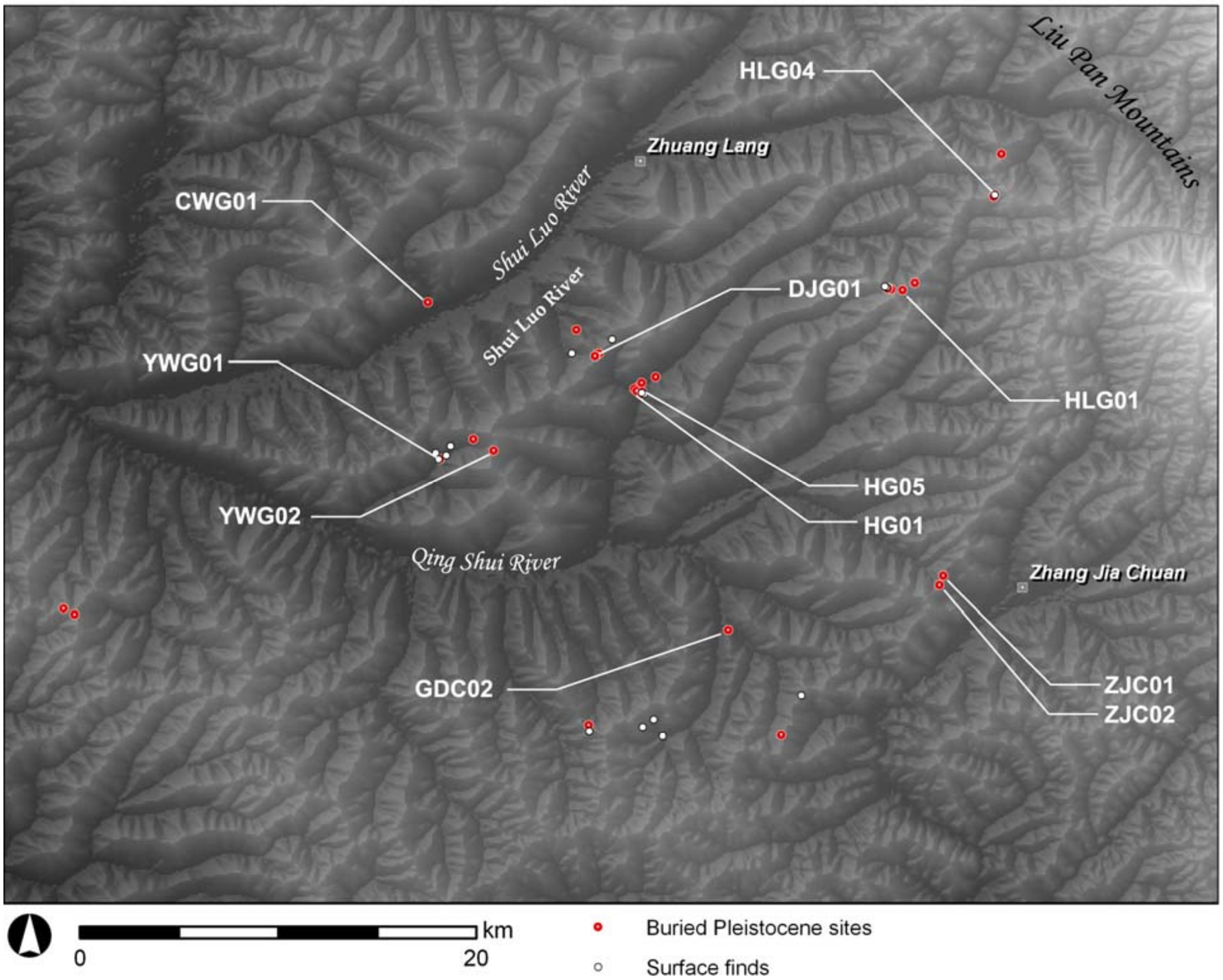


Figure 3. Major sites recorded during the 2007 Paleolithic Survey of the Eastern Longxi Basin

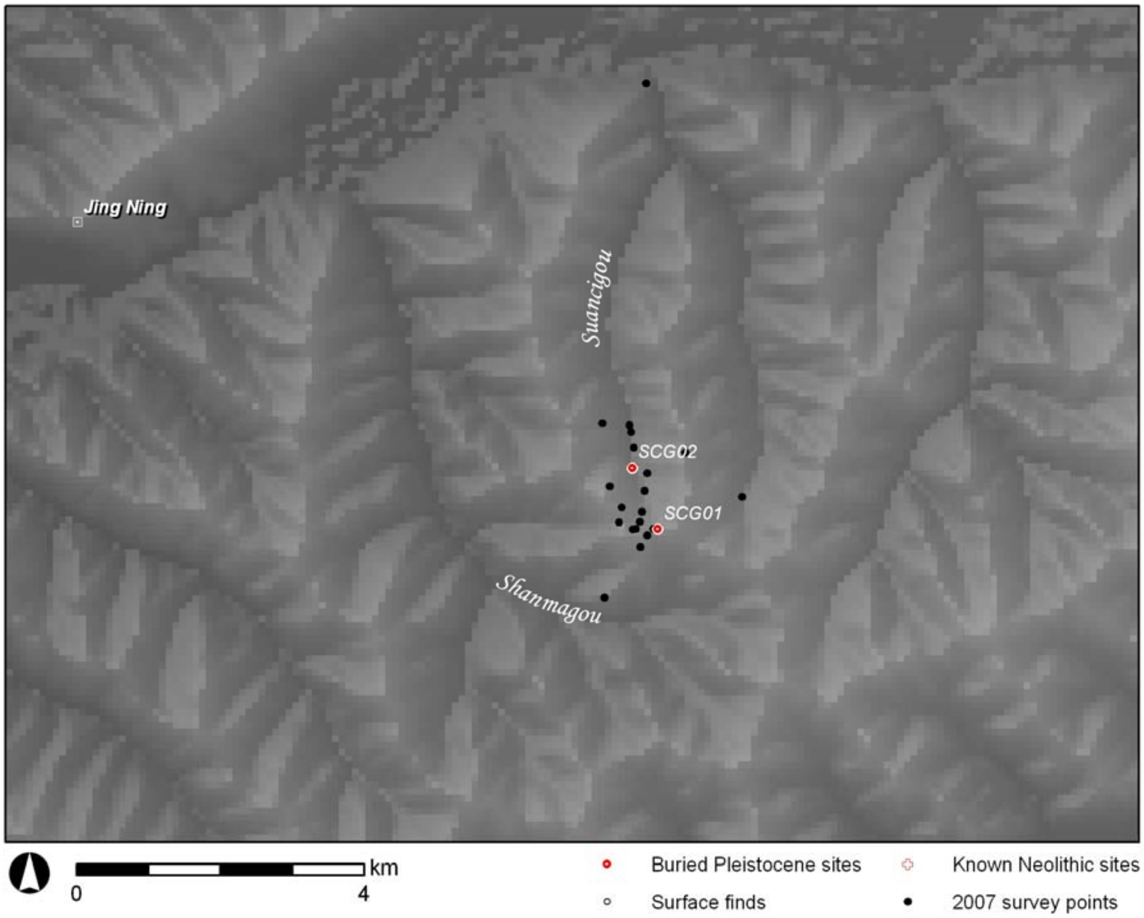


Figure 4. Site distribution at Suancigou

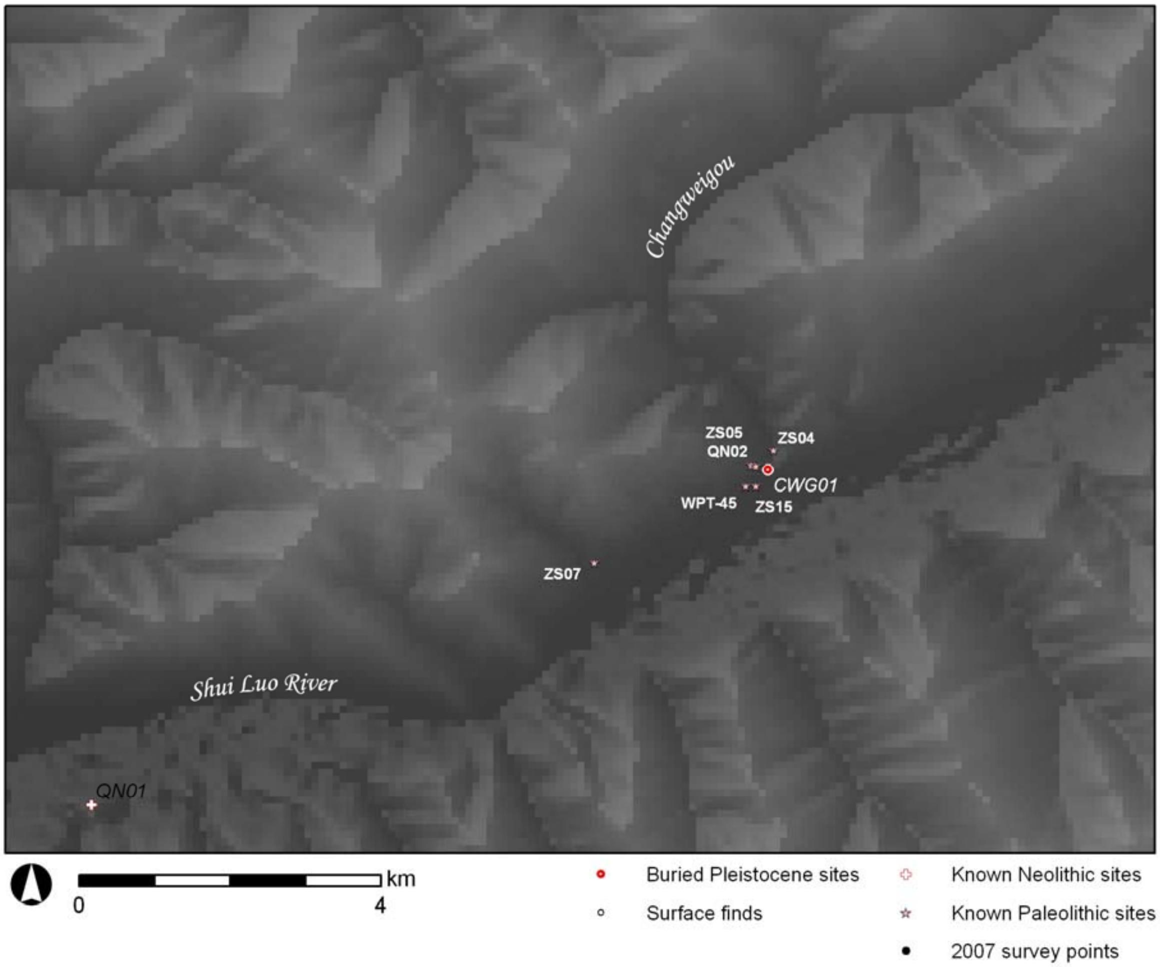


Figure 5. Site distribution at Changweigou

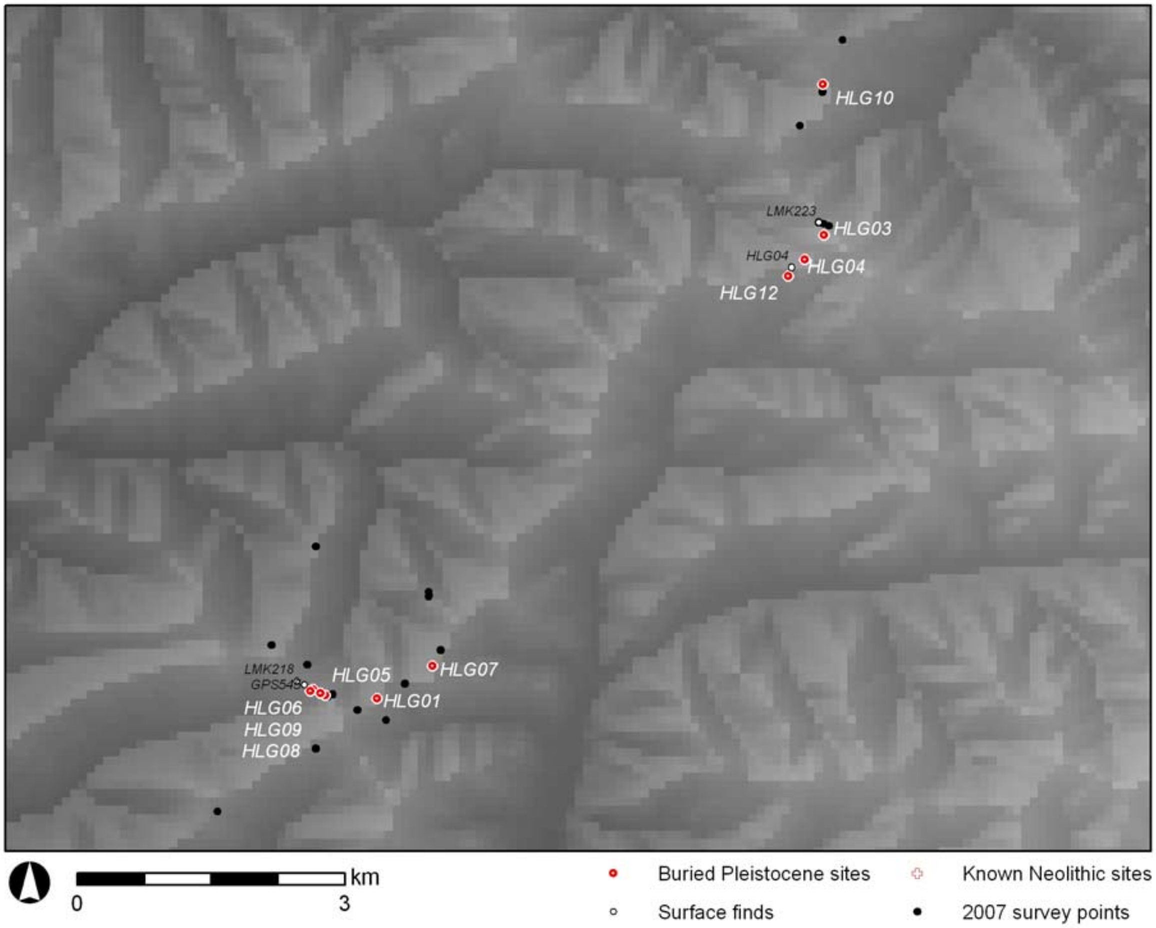


Figure 6. Site distribution along Heilaogua Ridge

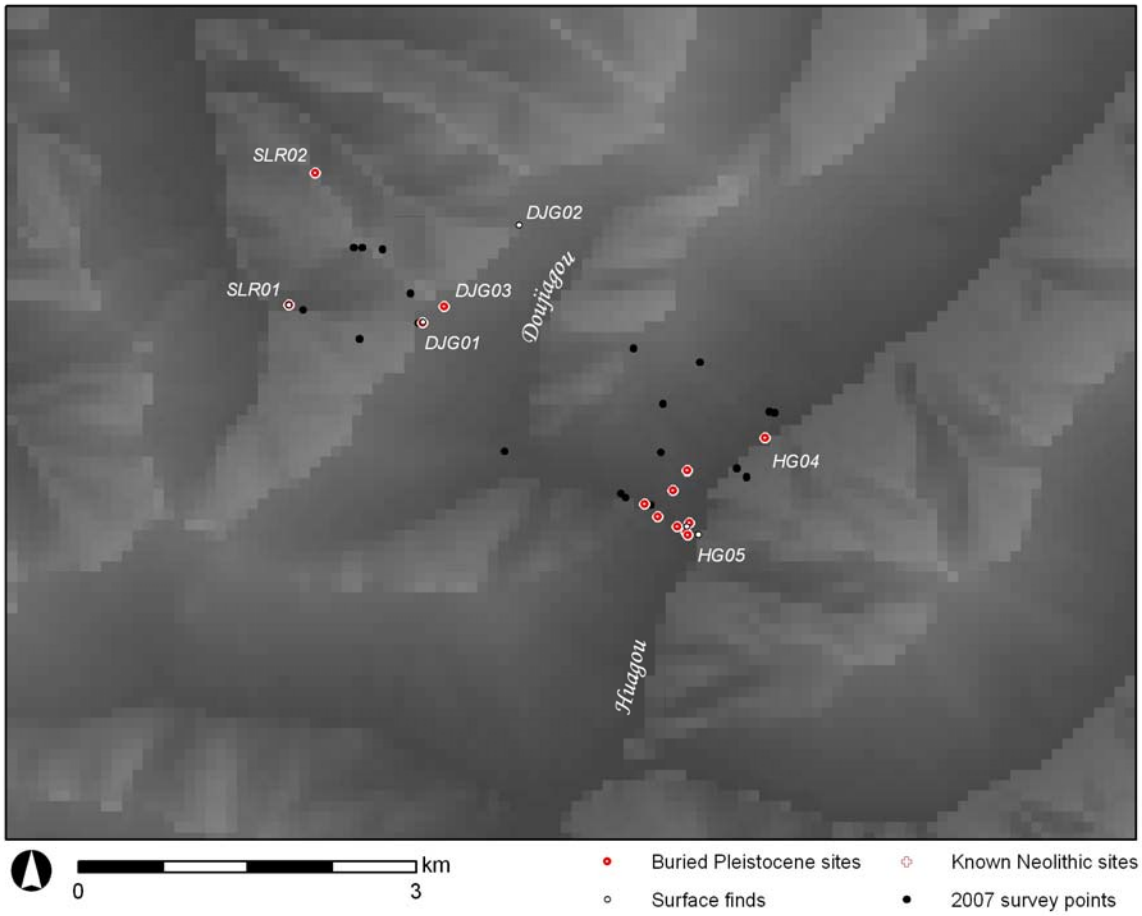


Figure 7. Site distribution at Doujiagou, Shuiluo Ridge, and Huagou.

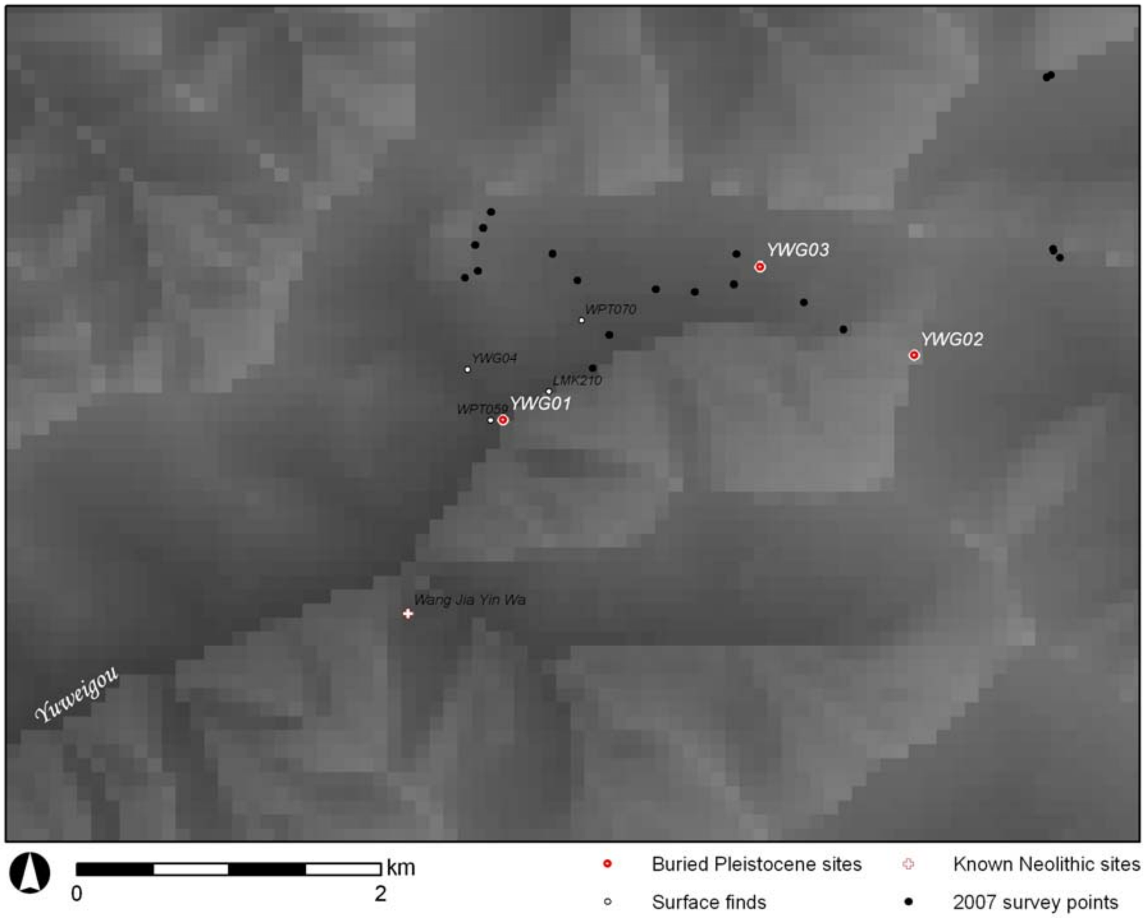


Figure 8. Site distribution at Yuweigou

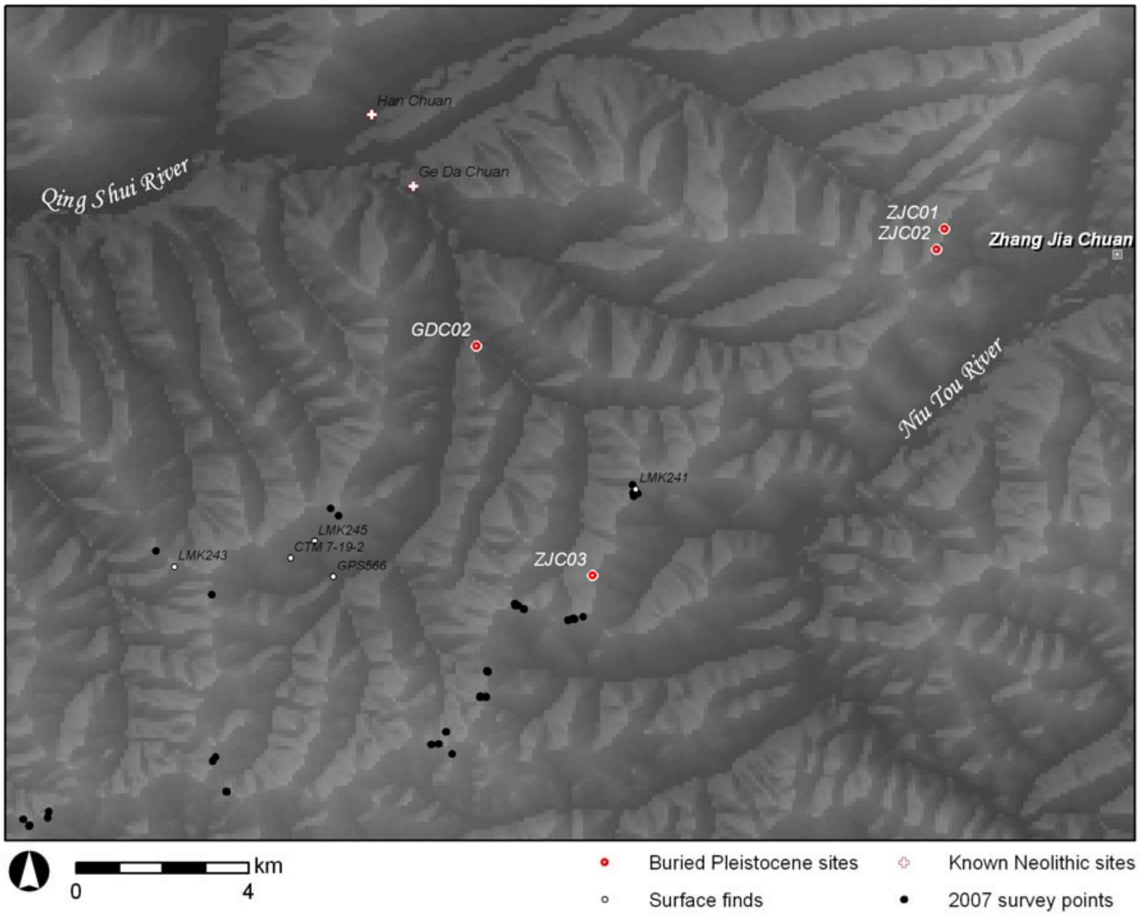
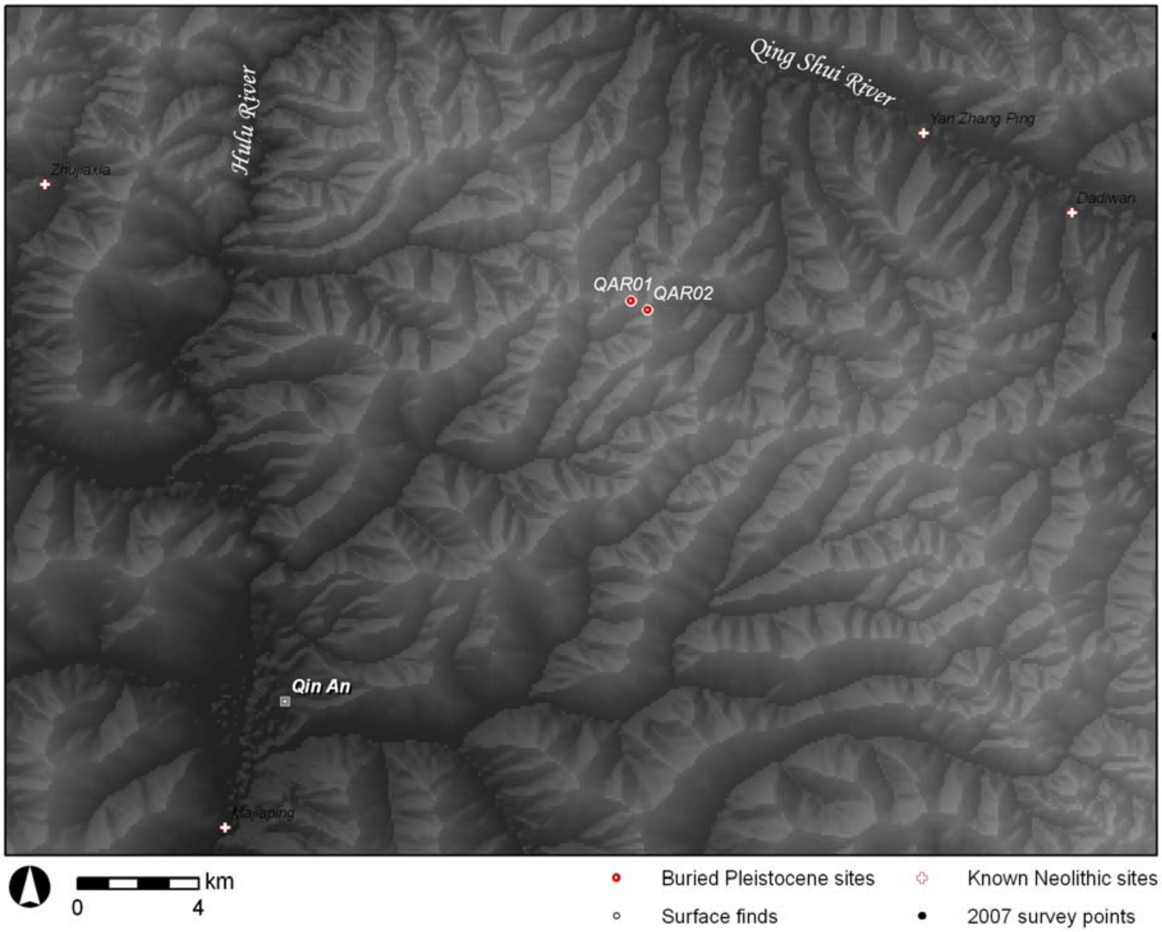


Figure 9. Site distribution along Zhangjiachuan Ridge and at Gedachuan Canyon



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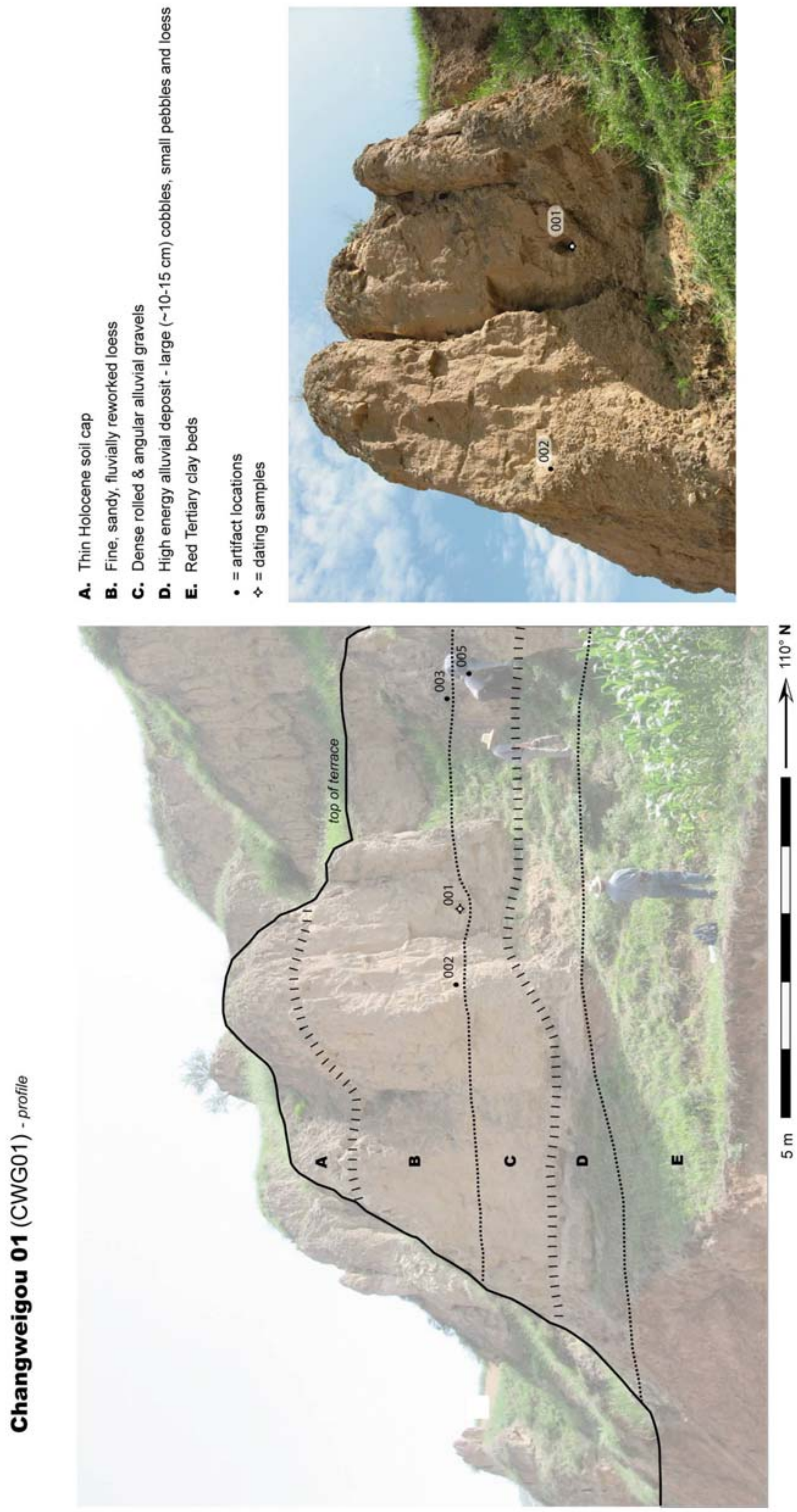


Figure 11. CWG01 profile

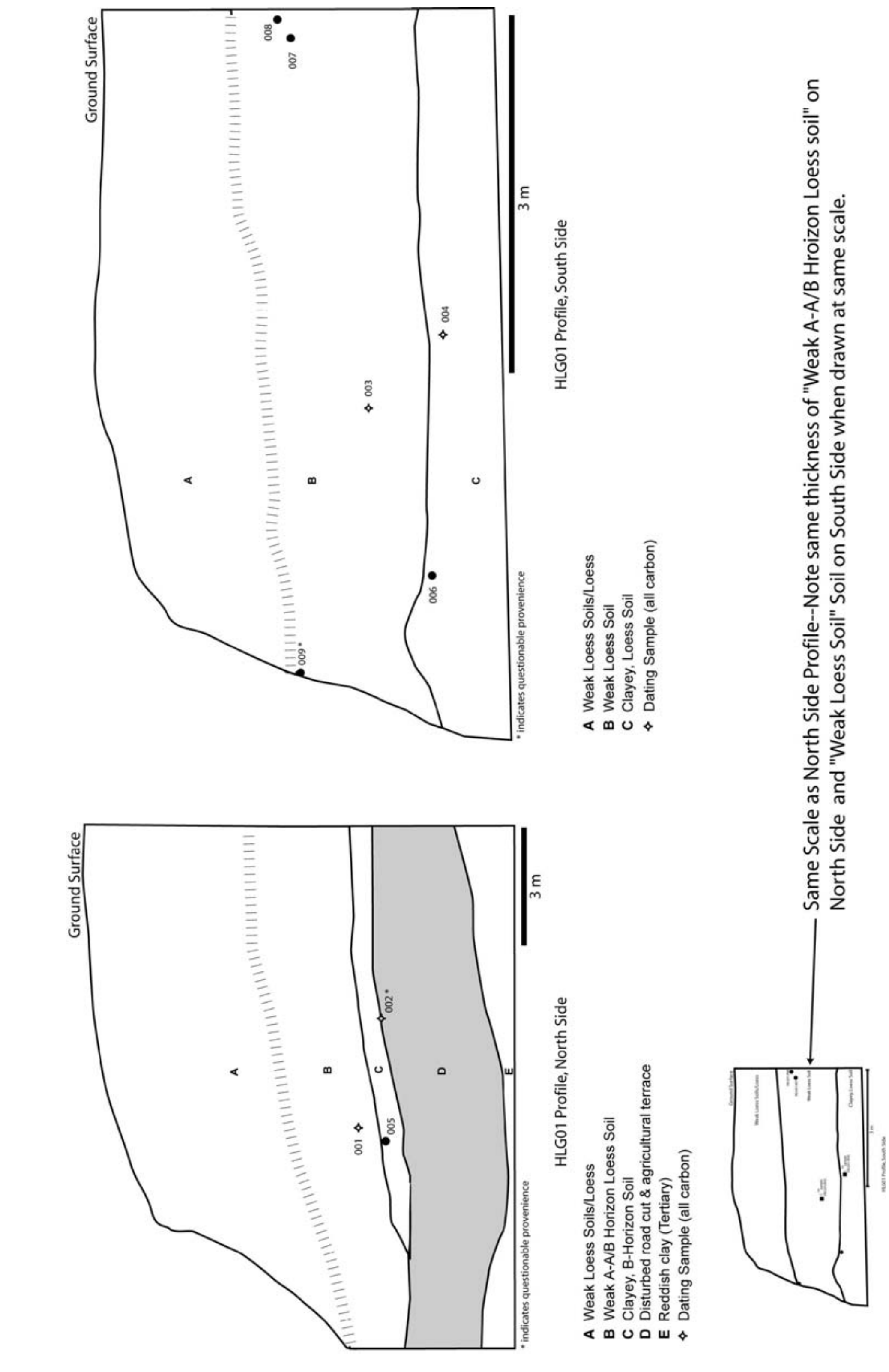


Figure 12. HLG01 profile.

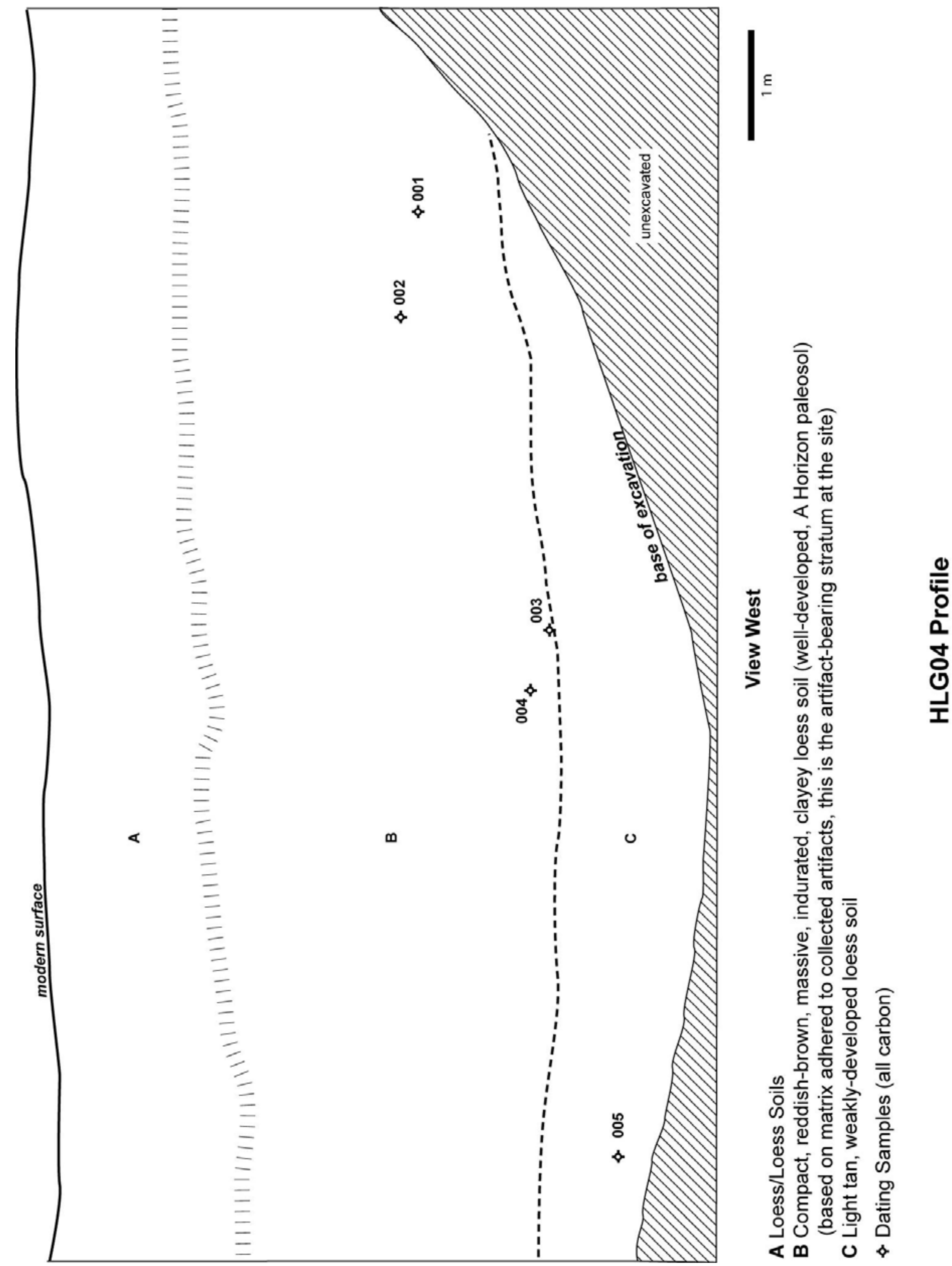


Figure 13. HLG04 profile.

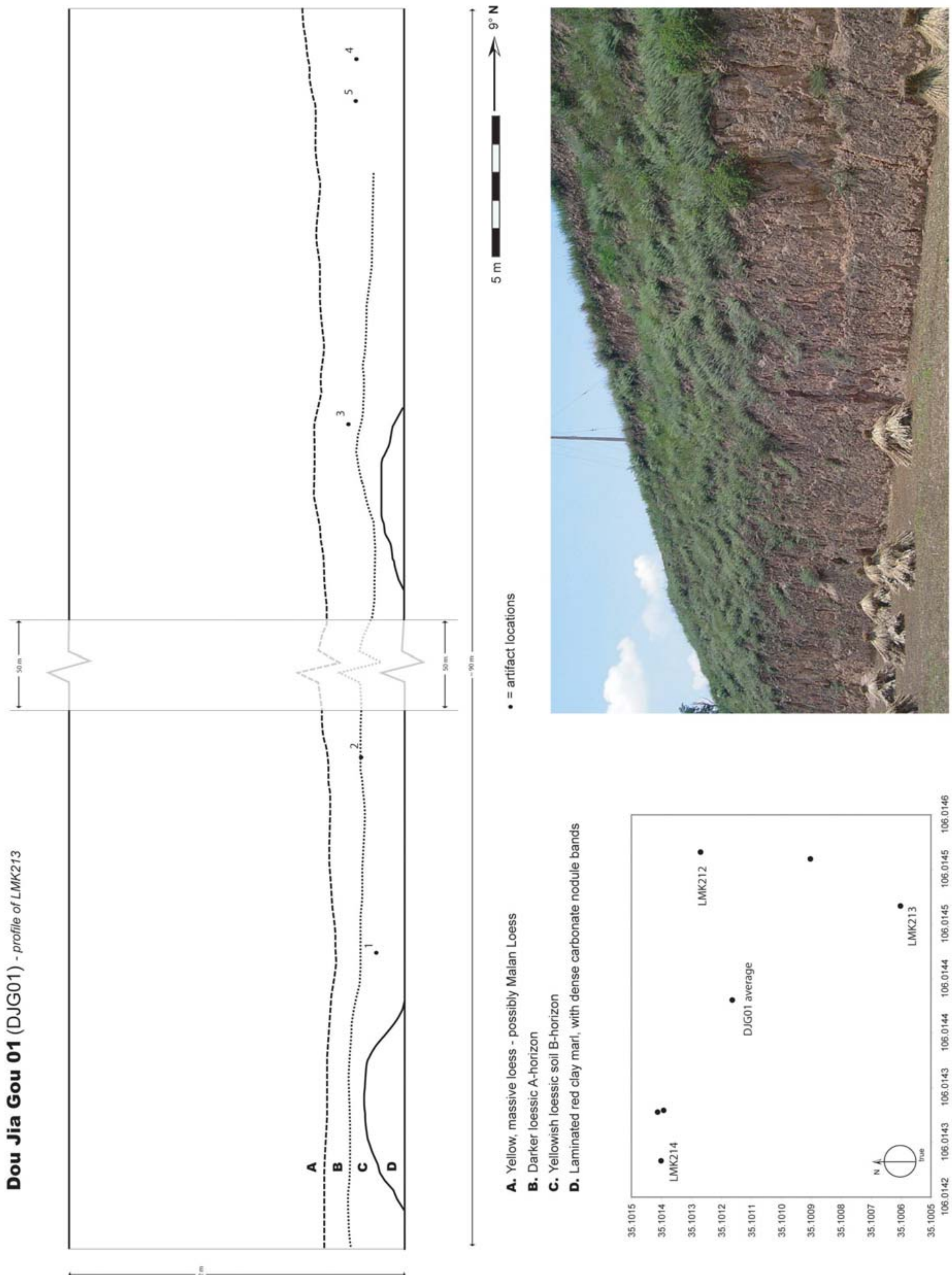


Figure 14. DJG01 profile

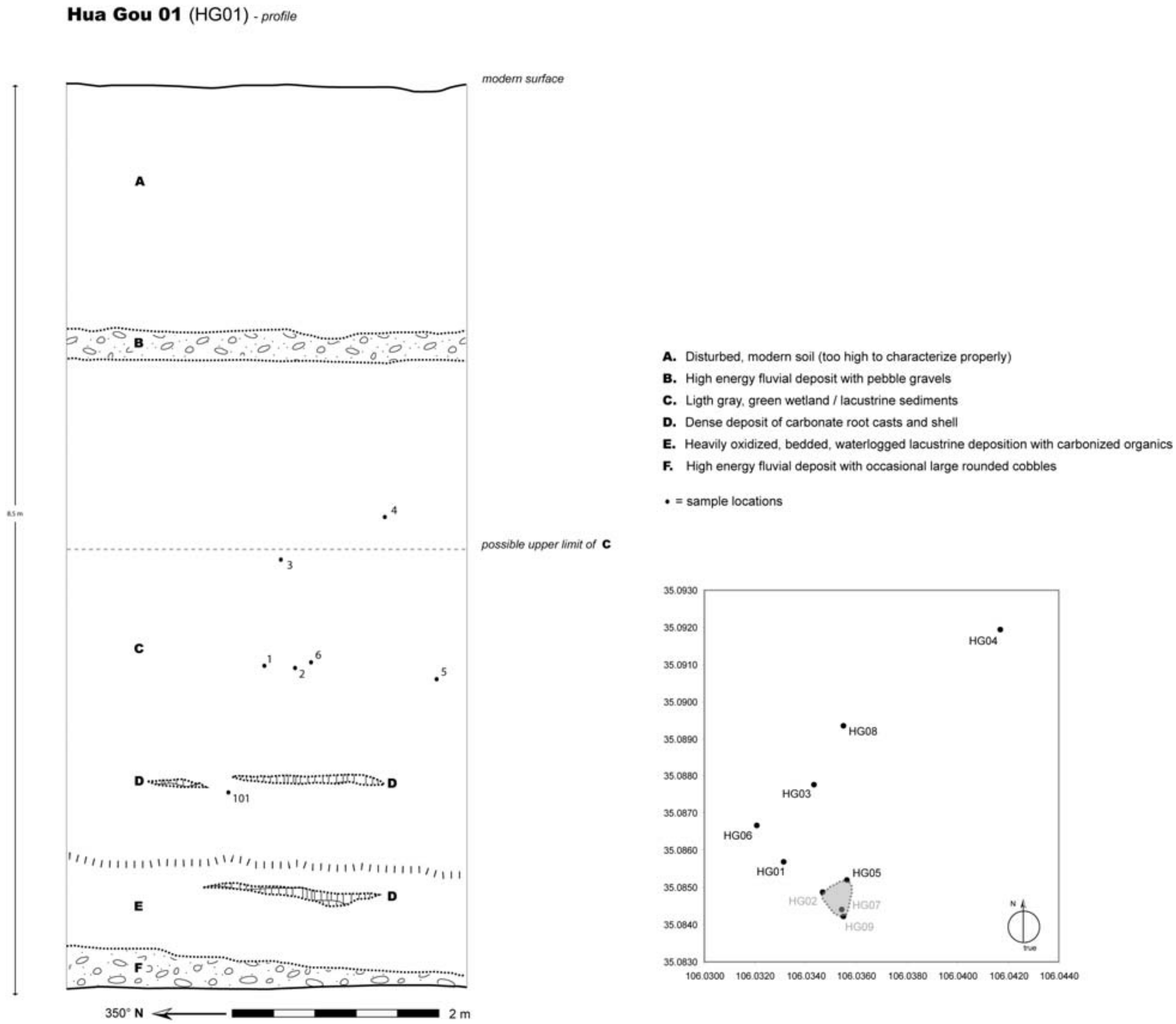


Figure 15. HG01 profile

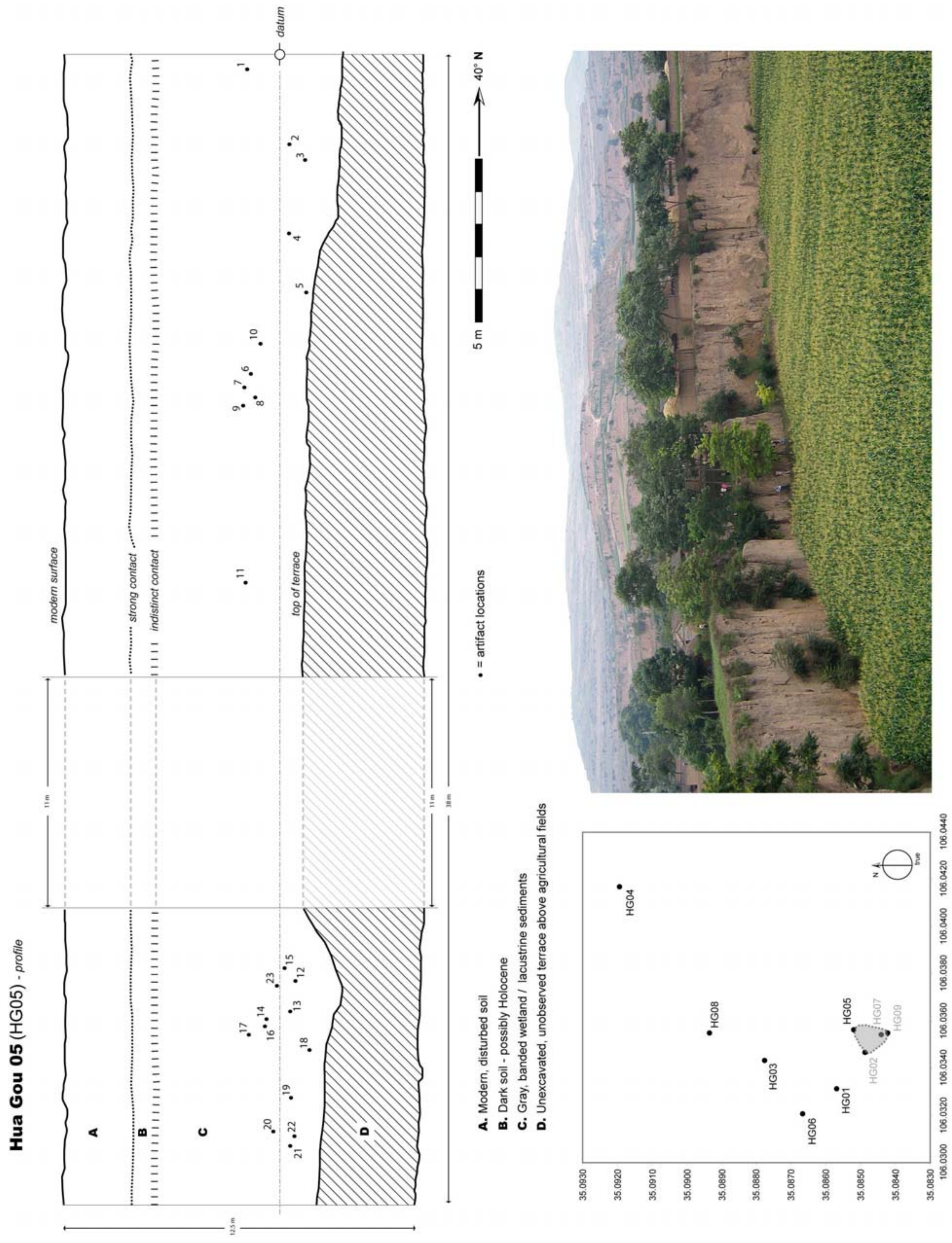


Figure 16. HG05 profile.

Figure 17a. YWG01 sections

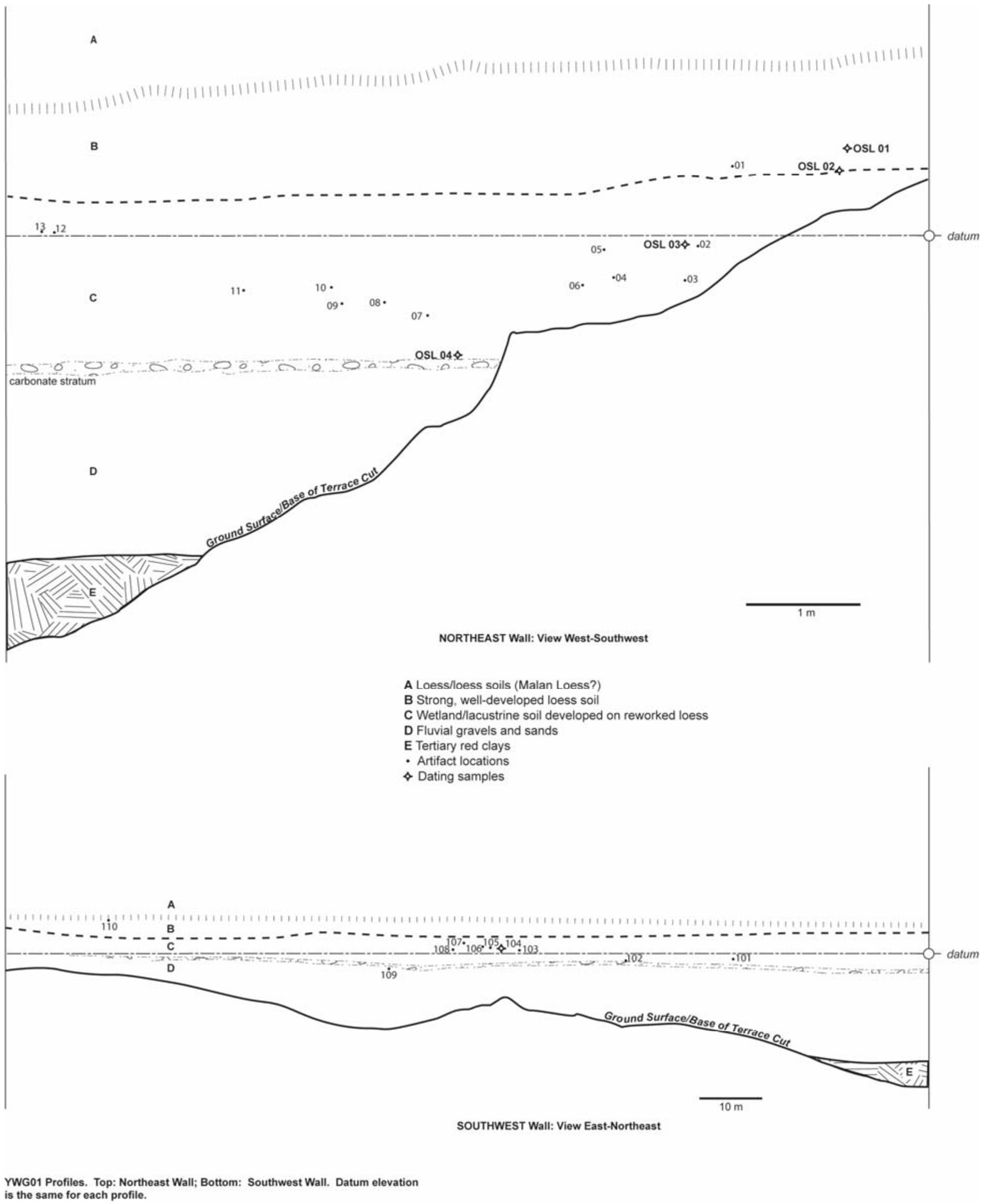


Figure 18b. YWG01 profile drawings

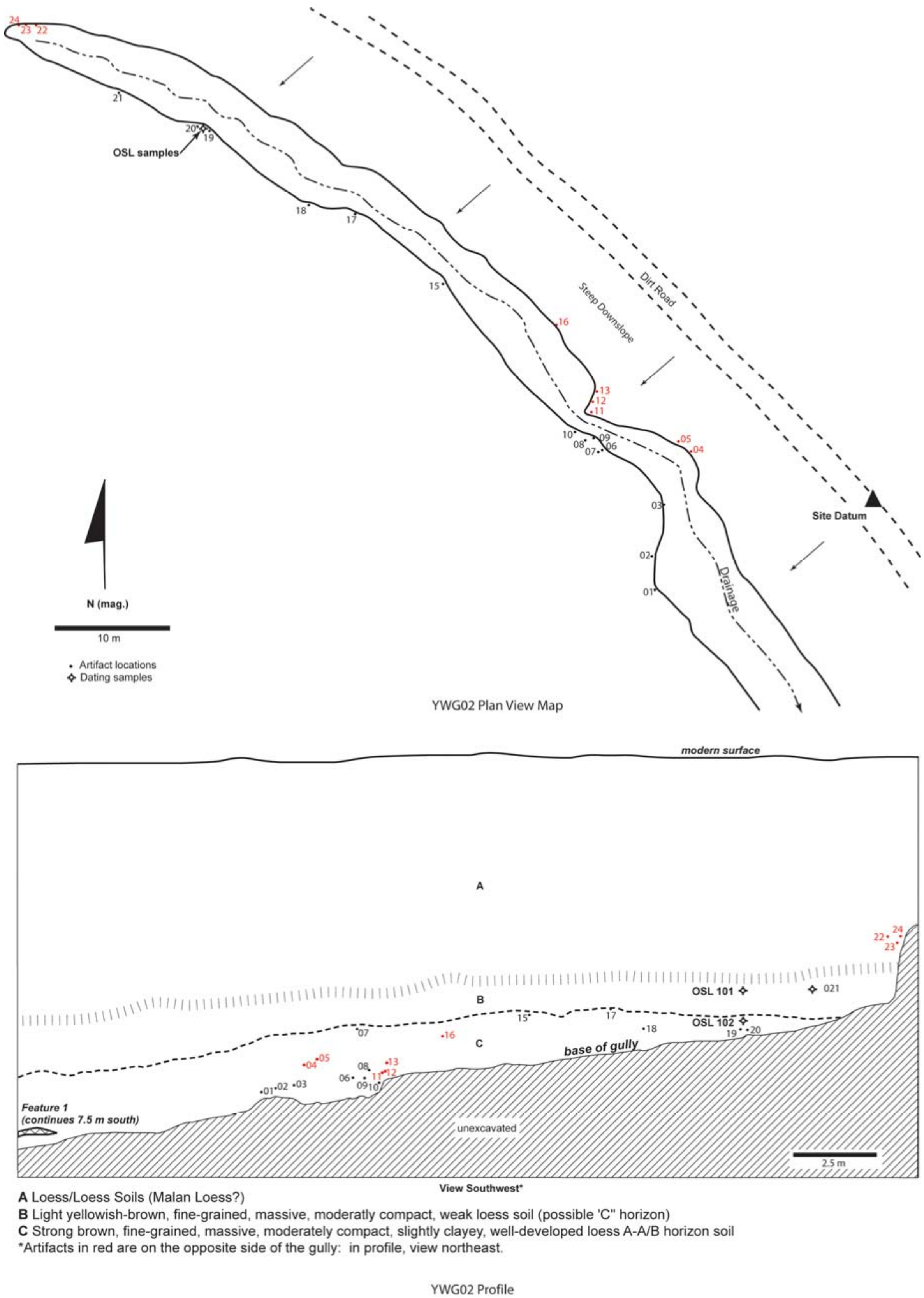


Figure 19. YWG02 profile and plan views.

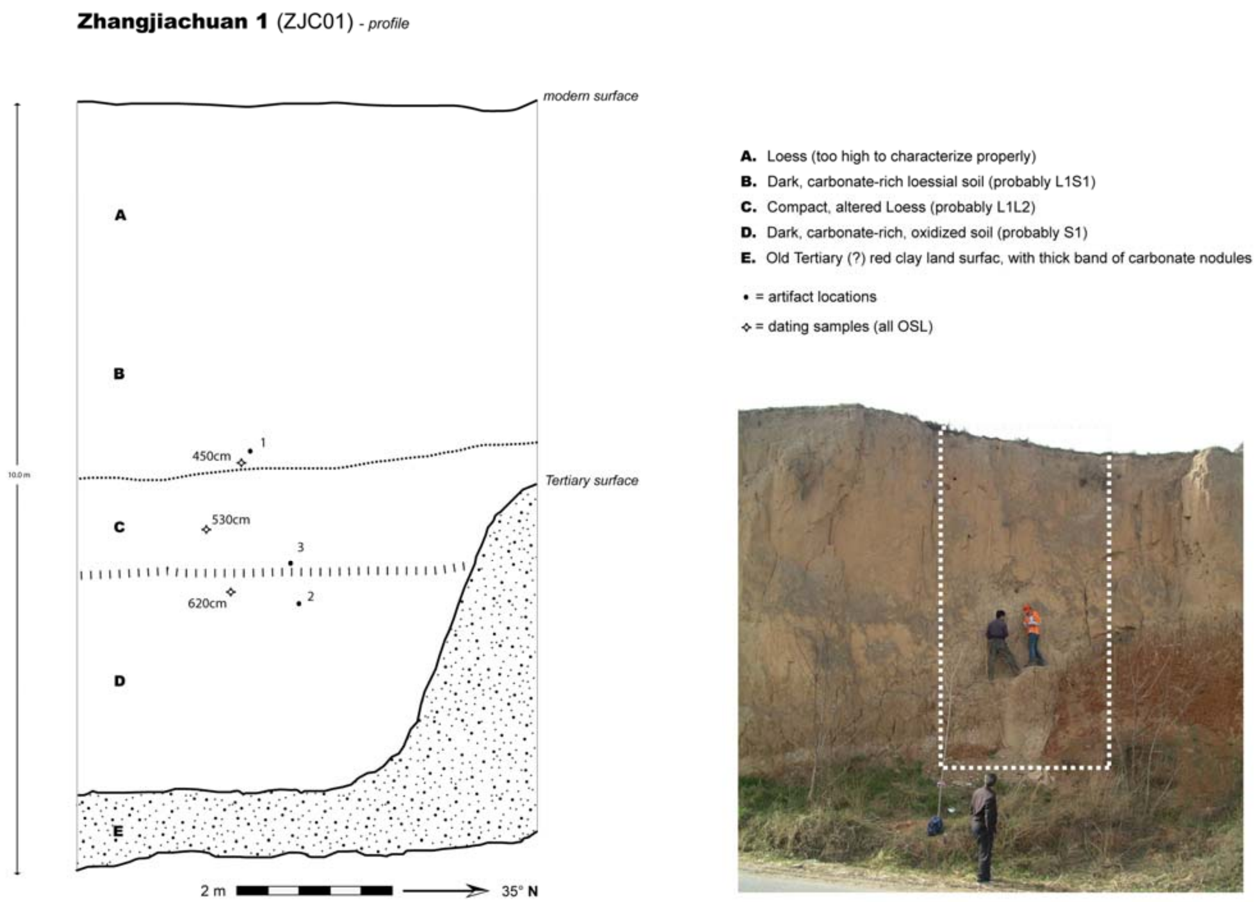
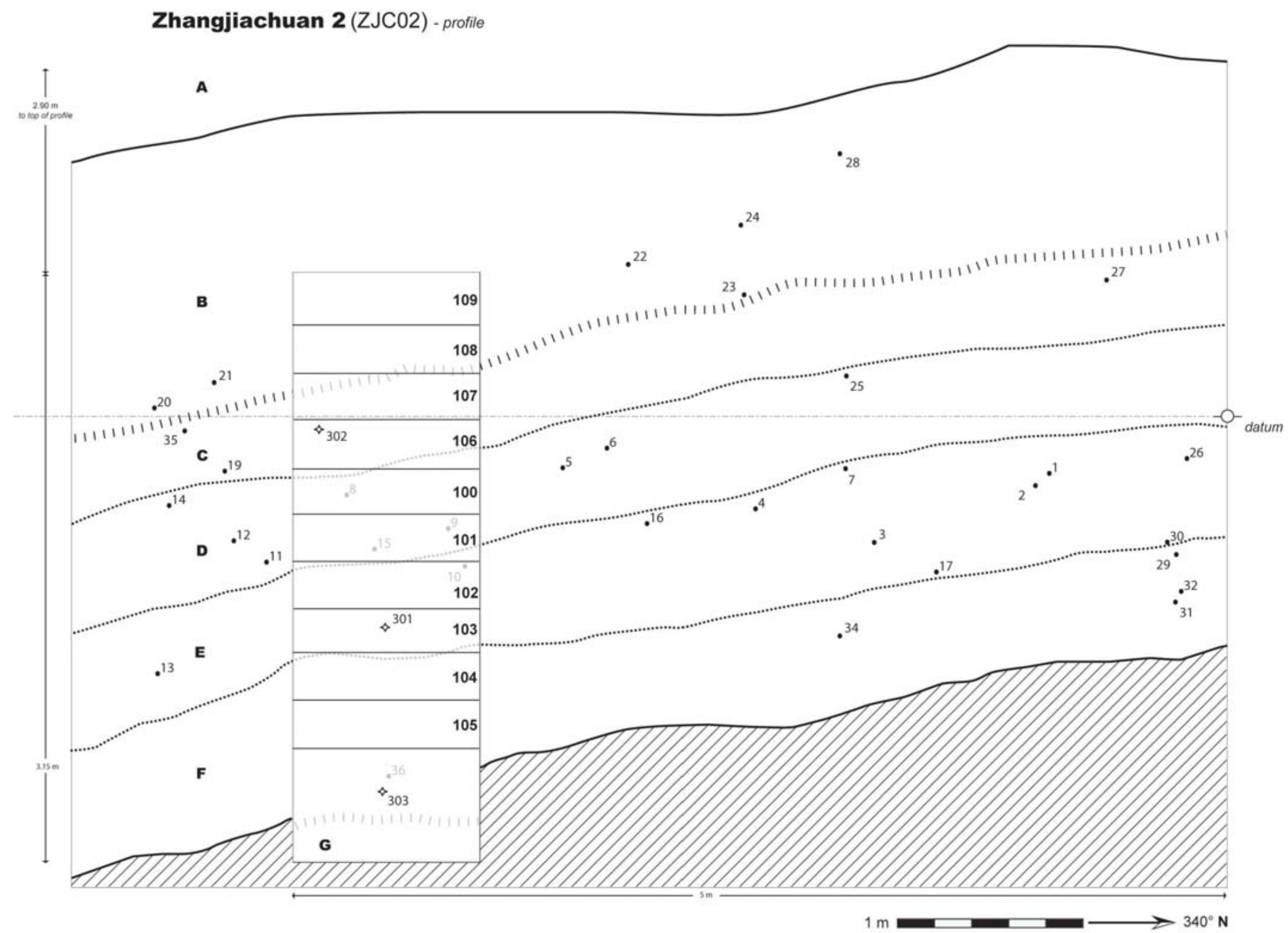


Figure 20. ZJC01 profile



A. Malan Loess (?)

B. Dark, blocky moderately compact, fine clayey loess, indurated with carbonate; Moderately developed "AB/B" horizon

C. Massive, well sorted, very compact, fine clayey loess soil, somewhat indurated with carbonate. Weakly developed "C" horizon on loess

D. Massive, well sorted, moderately compact fine loess soil. Well developed "A" horizon loess soil

E. Moderately blocky, moderately compact, fine clayey loess soil with moderate clay and carbonate content. Well developed "B" horizon on loess

F. Massive, moderately compact fine clayey loess soil with carbonate inclusions. Well developed, high clay "A" horizon on loess

G. Fine, massive, moderately compact clayey subsoil, with a littel sand and alot of clay. A "B" horizon associated with overlying Stratum F.

• = artifact locations
✧ = dating samples

Figure 21. ZJC02 profile and horizontal excavation unit

(note: strata divisions outside of excavation column are approximate)