EARLY HUMAN ADAPTATION TO THE TIBETAN PLATEAU

David Madsen,[1] Ma Haizhou,[2] Jeffrey Brantingham,[3] David Rhode,[1] Gao Xing,[4] John Olsen,[5] and Zhang Haiying[6]

(1) Division of Earth and Ecosystem Sciences, Desert Research Institute; (2) Qinghai Salt Lakes Institute, Chinese Academy of Science; (3) Department of Anthropology, University of California Los Angeles; (4) Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Science; (5) Department of Anthropology, University of Arizona; (6) Department of Anthropology, University of Washington.

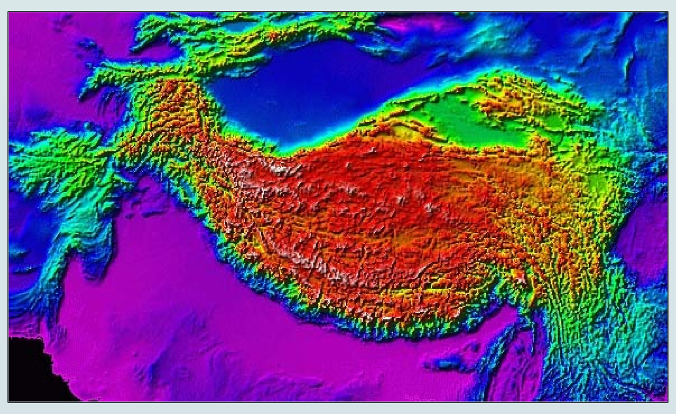

Figure 1 - False-color, shaded-relief image of the Qinghai-Tibetan Plateau showing the three major elevational steps of the Tibetan highlands: Blue= low elevation deserts 2000-3000m a.s.l., Green= intermediate lake basins on the northern and eastern plateau margin 3000-4000m, Red=high plateau and mountains above 4000m.

A Model for the Occupation of the Qinghai-Tibetan Plateau

We hypothesize colonization of the northern Qinghai-Tibetan Plateau (Fig. 1) occurred in discrete stages coinciding with major fluctuations in regional paleoclimate over the past 50 ka, with each stage involving different forms of hunter-gatherer foraging organization:[1]

(1) A 50-25 ^{14}C ka initial stage occupation of elevations below 3000m by highly mobile foragers following a "random walk" mobility pattern and focused on the collection of high ranked resources.

(2) A 25-10 ^{14}C ka second stage immediately before and after the LGM during which broad-spectrum foragers operating from more permanent home bases along the lower 3000-4000m elevation margins of the plateau occupied temporary, short-term, special purpose foraging sites on the middle and upper steps of the Plateau (that is, there was no "colonization" of the plateau during this period).

(3) Full-scale, year-round occupation of the upper >4000m regions of the plateau after ~10 ^{14}C ka by early Neolithic pastoralists dependent on domestic herd animals for fuel.

(1) Early Low Elevation Sites

Until recently, elaborated large core-and-blade technologies characteristic of the general Eurasian Initial Upper Paleolithic (IUP) were thought to be limited in north China. Shuidonggou, in the Ordos Desert, is the most well-studied of only a handful of previously known sites characteristic of this industry. Our dating of Shuidonggou to 29-24 ^{14}C ka[2] led us to speculate that it was part of a north-to-south spread of this technology.[3] However, our recent work (See poster by Barton et al.) suggests this industry is much more widespread in China and may also date much earlier. We obtained a date of ~41 ^{14}C ka on a Shuidonggou-like blade (Fig. 2) from a site on the western flank of the Helan Mountains in western Inner Mongolia and now think this technology may be part of a generalized spread of modern humans throughout northern Asia during early MIS 3.[4]

Sites associated with this IUP technology are restricted to elevations below 3000m and appear to be associated with grassland environments that were well-developed during MIS 3 across what is now arid northwestern China.[5] Limited subsistence data suggest these early human foragers were focused on medium-to-large herd animals, such as wooly rhinoceros and horse (Fig. 3), and engaged in a high mobility foraging strategy. Simulation models of these foraging strategies suggest that landscape colonization may have proceeded much like a "random walk" within non-patchy environments.[1]

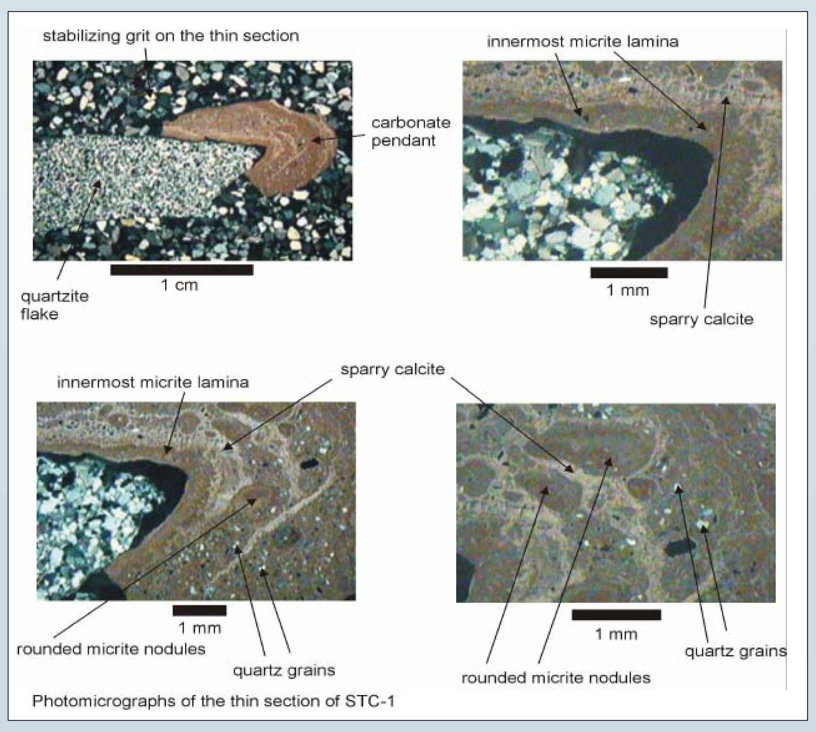

Figure 2 - Cross-section micrographs of the carbonate pendant on a SDG quartzite flake from South Temple Canyon. Carbon from the innermost micrite lamina dates to 41,070±890 ^{14}C yr BP.

Figure 3 - Bifacially flaked and use-wear polished bone tool from Shuidonggou dating to ~25.7 ^{14}C ka. The tool is constructed on a shattered long bone fragment from a horse-sized or larger mammal.

Figure 4 - View looking across a MIS 3 shoreline feature on the western margin of the Da Qaidam basin. Archaeological materials deposited on the beach appear to represent a palimpsest of Late Upper Paleolithic to Neolithic occupations associated with both a recessional lake stage pre-dating the LGM and a post-glacial lake rebound.

(3) Upper Elevation Sites

We have identified sites above 4000m a.s.l. on the Tibetan Plateau, south of the Kunlun Mountain Chain in the Kekexili and Chang Tang Nature Reserves, containing large blade, bladelet and microblade technologies consistent with a terminal Pleistocene and/or early Holocene occupation of the high Plateau.[14] Three sites have yielded obsidian artifacts from two chemically distinct sources and provide evidence of transport of tool stone over distances as great as 440km (Fig. 11). Test excavations at Xidatan #2 below Kunlun Pass at 4100m a.s.l. identified a microblade complex with ^{14}C and TL dates suggesting an age of 8.2-6.3 cal ka (Fig. 12) (See poster by Brantingham et al.). At Jiangxigou #2, on the southern shores of Qinghai Lake, ceramics and domesticated animals are tentatively associated with a radiocarbon age estimate of 8.2 ^{14}C ka. All of these sites are consistent with the ages of previously known Neolithic sites on the Tibetan Plateau.[15]

Figure 11- Obsidian microblade core from Erdaogou on the central Tibetan Plateau. Obsidian artifacts on the Plateau were transported up to 440km from two chemically distinct sources whose locations have yet to be identified.

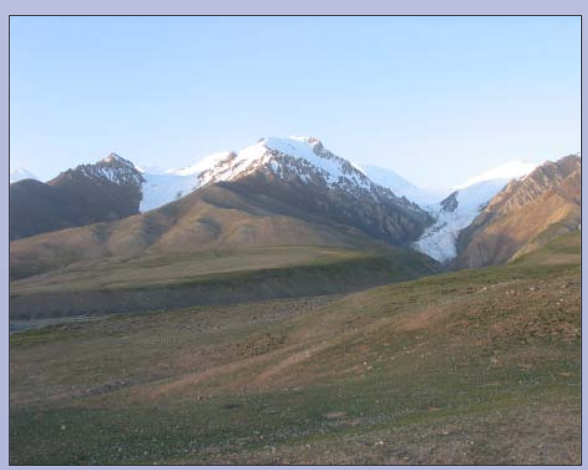

Figure 12- View of terraces along a glacially fed stream near the Kunlun Pass area, northern Tibetan Plateau. Microlithic debris occurs on the lower T4 terrace at the right, dated to a Be-Al mean age of ~8126 cal yr BP.[21] Charcoal from a hearth not directly associated with the microlithic debris dates to ~6450 cal yr BP.

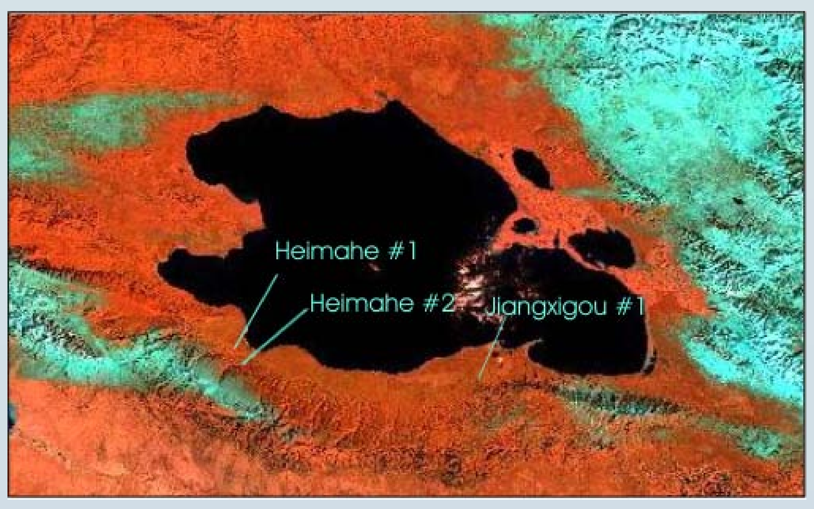

Figure 5 - Satellite image of the Qinghai Lake basin showing the location of the late Upper Paleolithic sites along the southern lake margin.

Figure 6 - Loess capped dune at Jiangxigou #1 containing a small isolated hearth (near notebook).

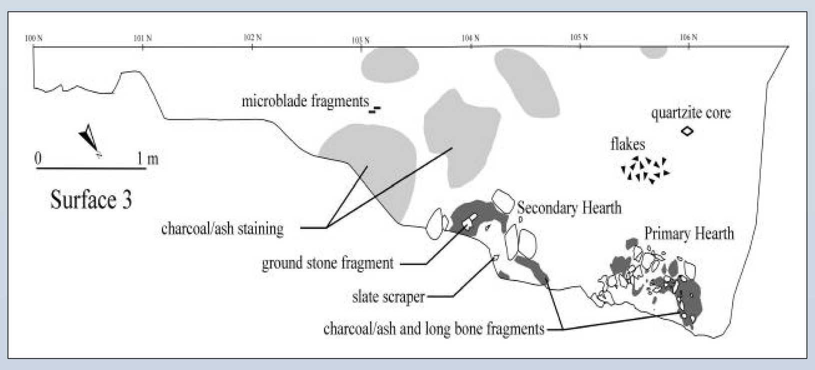

Figure 7- Plan view schematic of the occupational surface at Heimahe #1 dating to ~11.1 ^{14}C ka.

Figure 8 - View of the partially exposed primary hearth at Heimahe #1, Qinghai Lake. Fire-cracked stream cobbles in the hearth were probably used as boiling stones.

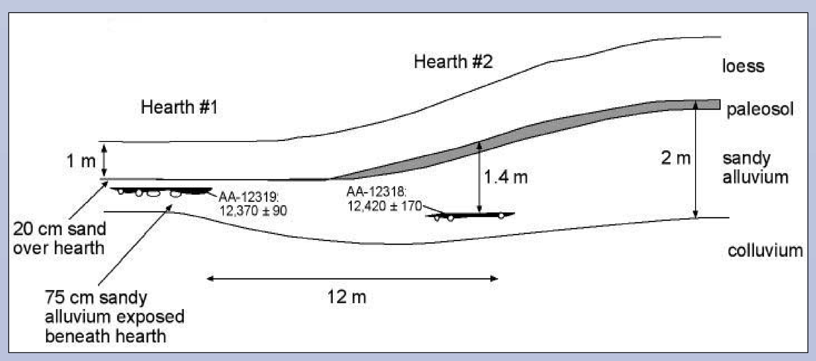

Figure 9 - Heimahe #2 cross-section showing the stratigraphic relationship of isolated hearths in sequential cultural occupations (image courtesy Stephen Porter).

Figure 10 - Fire-cracked stream cobbles, charcoal, and ash in the upper hearth at Heimahe #2 prior to excavation (image courtesy Stephen Porter).

(2) Middle Elevation Sites

We have identified sites at intermediate elevations of 3000-4000m along the northwestern margin of the Qinghai-Tibetan Plateau dating to immediately before and after the LGM. We recovered Shuidonggou-like materials dating to between ~30-15 cal ka,[6] including a large blade and generalized Levallois-like core, above a MIS 3 2800m shoreline in the Leng Hu basin. Similar materials were recovered from shorelines in the Xiao Qaidam and Da Qaidam basins.[7] The latter site overlooks a recessional shoreline dating to before 19 ^{14}C ka and apparently dates to ~25-20 ^{14}C ka (Fig. 4).[8-10] Three late Upper Paleolithic sites along the southern shore of Qinghai Lake (Fig. 5) date to between 12.5-11 ^{14}C ka (Table 1). Jiangxigou #1 is a simple isolated hearth eroding from cross-bedded aeolian sand on a wave-cut platform associated with the highest paleoshoreline of Qinghai Lake, ~3330m a.s.l. (Fig. 6). What is left of the ~12.4 ^{14}C ka hearth is a short, 50cm-long, 2cm-thick lens of charcoal-stained sand associated with two fire-cracked stream cobbles, 3 fragments of split gazelle-sized long bone fragments, 2 pieces of microdebitage and a single microblade.

Heimahe #1, exposed and excavated in 2004, consists of an isolated hearth and associated use surface in loess (See poster by Rhode et al.) at ~3210m a.s.l. on the southwestern Qinghai Lake margin (Fig. 5). Temporarily stabilized surfaces are present in the 3.5m-thick aeolian sequence isolated by a meander of the Black Horse River. One, dating to ~11.1 ^{14}C ka, contained recognizable cultural materials. These consist of a primary hearth composed of charcoal, ash, and fire-cracked stream cobbles overlying an oxidized surface, a secondary concentration of fire-cracked cobbles and charcoal apparently raked from the main hearth, and a surrounding small, but diverse, array of artifacts including groundstone, a slate scaper, microblades and microdebitage, and a core and flake concentration resulting from a tool manufacturing episode (Figs. 7-8). Numerous split long-bone fragments from a gazelle-sized mammal were recovered from in and around the hearth. Egg shell fragments and two small mammal scapular fragments were also recovered.

Heimahe #2, initially identified and dated as part of a geomorphological investigation,[11] consists of two stratigraphically separate isolated hearths at ~3230m a.s.l. in sandy alluvium cut by a small tributary of Qinghai Lake (Figs. 5, 9). The lower hearth is a ~1.7m-long lens of charcoal and fire-cracked stream cobbles dating to ~12.42 ^{14}C ka. The upper hearth is a ~2.1m-long exposure of intermittent charcoal concentrations and heat fractured granite stream cobbles (Fig. 10) dating to ~12.37 ^{14}C ka. The hearth surfaces were exposed and excavated in July 2005 so the nature of associated cultural materials remained unknown at the time this poster was prepared.

The limited cultural features and small number and diversity of artifacts suggest the sites represent short-term, single visit foraging camps occupied by small groups for very short, perhaps only overnight, stays. The splintered long bone at the sites, together with the evidence of rock heating, suggests a primary activity was grease and marrow extraction.[12-13] This, in turn, suggests Late Upper Paleolithic foragers along the southern margin of Qinghai Lake were operating from residential bases located elsewhere. The limited subsistence data, together with the apparent bone boiling, suggests these small groups were broad-spectrum foragers.

Table 1
Radiocarbon Age Estimates from the Upper Paleolithic of Qinghai Lake

Site	Material	Age Estimate	Approximate Cal. Yr. Age Range	Laboratory #
Jiangxigou #1	Charcoal	12,420±50	14,830-14,158	Beta 149997
Heimahe #2[11]				
Lower Hearth	Charcoal	12,420±170	15,058-13,975	AA 12319
Upper Hearth	Charcoal	12,370±90	14,854-14,047	AA 12318
Heimahe #1				
Cultural Surface	Charcoal	11,160±50	13,174-12,943	Beta 169901
Hearth	Charcoal	11,140±50	13,150-12,929	Beta 169902
Cultural Surface	Charcoal	11,040±70	13,093-12,868	Beta 149998

Discussion

We hypothesize that the desert margins of the Qinghai-Tibetan Plateau were first colonized by early Upper Paleolithic hunter-gatherer groups who first ventured into the desert regions surrounding the Qinghai-Tibetan Plateau during MIS 3[1] when lakes were at their highest stands of the late Pleistocene, and steppe environments supported large wild ungulate populations.[14] These groups arrived perhaps as early as 40 ^{14}C ka[16] and certainly by 29-25 ^{14}C ka,[2] and were engaged in a high mobility foraging strategy that specialized on medium- and large-sized game and employed a unique type of stone technology based on large stone blades. As a result of the relatively uniform abundance of resources on these steppe landscapes, early Upper Paleolithic hunter-gatherers were able to move frequently from one lake basin to another as high-ranked resources became locally depressed. Populations following such a logistical or "random walk" foraging strategy may thus have first reached the middle elevation step (3000- 4000m a.s.l.) incidentally around 25 ^{14}C ka.

We further hypothesize that the second stage in the occupation of the Plateau occurred during the transition from MIS 3 to the LGM (MIS 2), when changes in the fundamental character of resource distributions likely had a dramatic impact on the organization of hunter-gatherer adaptations. Around 24-23 ^{14}C ka, MIS 3 lakes started to retreat and desert environments began to replace steppe environments on the Qinghai-Tibetan Plateau and surrounding areas. Both vegetation and game likely concentrated around the receding lakes in each basin, producing a patchy distribution of resources. Simulation models indicate that a high-mobility foraging strategy becomes increasingly untenable as the patchiness of resource distributions increases and correlations in the quality of adjacent resource patches decrease. Theory suggests that small hunter-gatherer groups operating under increasingly patchy landscape conditions on the middle elevation step of the plateau would have to (1) increase their diet breadth to incorporate lower ranked resources concentrated around the receding lakes, such as small, fast game or plant resources with higher processing costs,[17-19] and/or (2) engage in more systematic seasonal strategies of landscape use (i.e., non-random walk).

As yet there is limited evidence of Upper Paleolithic occupation of the higher elevation Tibetan Plateau,[7, 14, 15, 20] and it appears full-scale year-round occupation did not occur until after ~10 ^{14}C ka. We hypothesize this may be related to yak-based nomadic pastoralism using dung for fuel.

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