Journal of Archaeological Research (2020) 28:339–392
https://doi.org/10.1007/s10814-019-09137-6

The Archaeology of the Early Tibetan Plateau: New Research on the Initial Peopling through the Early Bronze Age

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Published online: 9 September 2019

Abstract
Since the last systematic review of Tibetan archaeology in 2004 published in *Journal of World Prehistory* (Aldenderfer and Zhang 2004), a revival of archaeological research on the plateau has begun to reshape our understanding of key issues such as when the plateau was first permanently occupied by humans, and when and how Tibetans first adopted the farming and pastoral systems that characterize the plateau today. Understanding who the first Tibetans were, and how they adapted to this high-altitude environment, both genetically and culturally, have been central themes of recent research on the plateau. We review these developments and place them into a wider regional framework with a focus on the better-known eastern Tibetan Plateau.

Keywords Tibetan Plateau · Archaeology · Domestication · Genetics

Introduction

The archaeology of the Tibetan Plateau may offer important lessons for the nature of human adaptation in extreme environments. As the largest high-altitude landmass on earth and an area that is characterized by a remarkable environmental diversity, the archaeology of the plateau offers lessons about long-term biological and social adaptations to high-altitude environments. As with elsewhere around the world, high-altitude and high-latitude environments respond to shifts in the mean state of climate with higher amplitude than their low-lying counterparts. Understanding how humans

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in these regions have developed long-term strategies of adaptation to these shifts may provide important lessons in our rapidly warming world. High-altitude and mountainous environments have often been viewed through the lens of their marginality, and the Tibetan Plateau is no exception, with many viewing the plateau as an uninhabitable territory for humans until much later periods of time, an assumption we challenge throughout this manuscript. A recent increase in the quantity and quality of archaeological research on the plateau over the past decade has allowed us to begin to examine more deeply basic questions about its habitation and chart the spread of domesticated plants and animals onto the plateau, as well as the chronology of these changes. We are, however, only beginning to chart the variability of these strategies across the wide range of ecotones that characterize the plateau itself.

It is no secret that the Tibetan Plateau is contested territory. The study of the ethnogenesis and origins of the people who have come to occupy the plateau has used genetic, textual, and material cultural data to make statements about the origins of the Tibetan people. Perspectives have ranged from seeing the Tibetan Plateau as an important frontier to an area that was a constant receiver of outside ideas, innovations, but more importantly people. With a few exceptions, approaches to understanding this issue in the Chinese language have largely employed a diffusionist and culture-historical framework that conflates movements of artifacts or similar categories of artifacts with people. Despite the limitations inherent in pursuing such an agenda, both Chinese and, in later periods of time, Western authors have sought to connect archaeological remains with ethnic groups mentioned in early historic texts. As is the case elsewhere in Asia, foragers and pastoralists have often been rendered invisible, particularly following the spread of farming to the region. We seek to highlight emerging evidence that returns agency and visibility to these important agents on the plateau.

While the pace of work across the plateau has increased substantially over the past 10 years, compared to other areas of the world the archaeology of the plateau is still in its infancy. Very few sites have been the object of large-scale and systematic excavations that would allow us to gain a better understanding of the nature of habitation, mobility, and subsistence. With a few exceptions, which are limited to very small areas, no systematic survey data are available to chart changes in mobility and settlement patterns across the plateau. In addition, the excavation of many of these sites has been largely limited to the somewhat more intensively researched eastern parts of the plateau, which we focus on in this article.

We end our discussion of Tibetan archaeology around the second millennium BP with the development of pastoralism and metallurgy-producing groups in the East. We thus do not discuss the emerging evidence from later period sites in Nepal and western Tibet.

The Current Climate of Archaeological Research on the Tibetan Plateau

The pace, location, and type of research carried out on the plateau is closely tied to political developments in the region. The beginnings of the modern era of archaeological research on the plateau can be traced to the establishment of the Tibet

Autonomous Region Cultural Relics Bureau in 1965, which provided the impetus for new archaeological investigation in the region (Jia and Huo 2001). The pace of discoveries picked up during the 1970s with surveys carried out by the Zhongyang Minzu Xueyuan (Ethnic Minority University of China) (Jia and Huo 2001) and the Chinese Academy of Sciences (An 1982). A pivotal moment was the excavation of Karuo in 1978 by Tong Enzheng, Suolang Wangdui (*Bsod-nams dbang-'dus*), one of the few Tibetan archaeologists trained in China, and Leng Jian, who earned a Ph.D. at Washington University in St. Louis (von Falkenhausen 2015). We owe much of what we know about early farming and foraging life on the plateau to these excavations.

Over the past two decades, an interest in renewing scientific archaeology and expanding foreign training opportunities for graduate students in archaeology has led to a reintegration of Chinese archaeology on the international stage. As a consequence, increasing numbers of collaborative fieldwork projects with foreign partners have been undertaken across China, but with the notable exception of the Tibetan Autonomous Region. Currently, only Chinese nationals are permitted to work within the Tibet Autonomous Region, and most Tibetan parts of Qinghai and Sichuan also are closed to foreign collaboration with the exception of the Jiuzhaigou National Park in eastern Tibet, where one of us (d'Alpoim Guedes) carries out an international collaborative project permitted by the *Guojia Wenwuju* (Cultural Relics Bureau). From 1997–2004, Aldenderfer worked with Sichuan University in far western Tibet in Ngari Province on pre-Buddhist and Buddhist-era sites. Tibetan archaeology will thus continue to be dominated by the narrative of the People's Republic of China (PRC).

The bulk of archaeology on the plateau today is conducted within a cultural resource management framework. CRM archaeology in China is both well organized and well funded at the provincial and city level. China's economy and government budgets have grown impressively over the past 10 years at a scale proportional to its urban development. Today, a given provincial institute of archaeology may have over 200 employees and an annual operating budget substantially larger than the entire archaeology budget for United States National Science Foundation (Jiang Zhanghua personal communication to d'Alpoim Guedes 2015). Many of these institutes, including ones that work in Tibet, such as the Chengdu City Institute of Archaeology, have impressive laboratory facilities. To date, the provincial level institutes and smaller city-based offices primarily do "salvage archaeology" in areas that have been historically occupied by Tibetan people. Tibet University in Lhasa is beginning to develop an interest in the Tibetan past as well, primarily by offering courses in the prehistory of the plateau and the spread of Buddhism. Because of the slower pace of urban development, excavations driven by salvage archaeology (which form the bulk of archaeological work in low-lying areas of China) are few and far between on the plateau. A few exceptions include a brief survey that was carried out in the context of the Qinghai Tibet railroad project (Xizang Zizhiqu et al. 2005), although only two ephemeral sites were excavated and to date these remains have not been dated. Two notable exceptions are Karuo and Qugong (Xizang Wenguanhui 1985; Zhongguo Shenhui Kexueyuan 1999), both excavated in the late 1970s and early 1980s following their discovery during factory construction. The more densely populated river valleys of southeastern and northeastern Tibet have been the subject of more systematic salvage excavations, due in part to the construction of dams and roads that threaten their existence. For these reasons we have much poorer understanding of the western reaches of the plateau, although this may change with the planned construction of highways and attendant infrastructure connecting Pakistan, Nepal, and the People's Republic of China as part of the "One Belt, One Road" project.

Much of the archaeology on the higher-altitude plateau is only now developing in the context of nonsalvage-based research projects, to which the Chinese Cultural Relics Bureau has shifted funding. These projects have returned to sites such as Karuo and Xiao'enda to carry out more systematic excavations complete with sampling for plant, animal, and human remains by Sichuan University. They are, however, just beginning and have not been published. A suite of other projects primarily focused on substantially later mortuary remains run primarily by the Chinese Academy of Social Sciences are also ongoing.

An increasing number of projects are taking place outside the PRC in what can be described as ethnographic Tibet (Aldenderfer and Zhang 2004. p. 3) In Nepal, one of us runs an active fieldwork project in Upper Mustang (Aldenderfer and Eng 2016; Eng and Aldenderfer 2017). Several French teams have also begun to carry out Buddhist-era archaeology in Ladakh, along with investigations of rock art (Bruneau and Vernier 2010; Devers et al. 2015; Devers and Vernier 2011). In Himachal Pradesh and Uttarakhand in India, teams have begun to investigate a series of sites that show connections across the Himalayas (Bhatt et al. 2008; Nautiyal et al. 2014). Archaeology in Bhutan is still in its developmental stages, but interest in pursuing research there continues to grow (Penjore 2017). In Kashmir, a recent renewal of archaeobotanical research has also begun (Spate et al. 2017). In northeastern India, archaeological research on areas abutting the Tibetan Plateau has only just begun, primarily via ethnoarchaeology (Hazarika 2017). The comparative paucity of work has meant that basic issues such as chronology have yet to be resolved in many regions of the plateau, and work over the past decade has focused on resolving these issues for a few select regions of the plateau, mostly its better-studied eastern rim.

Tibetologists (scholars who primarily approach the Tibetan past through textual studies of Tibetan Buddhism, the secular history of the plateau, or ethnographic studies of contemporary Tibetans) have turned increasingly to archaeology to gain insight into the preimperial, and imperial periods of Tibet (c. AD 600–800). Bellezza (1997, 2000, 2001, 2008, 2011, 2014) has studied the aspects of ancient Tibet for more than two decades and has documented rock art sites and architectural remains on the Changtang. Combined with extensive textual research, he has helped place the later Tibetan past into a wider regional framework. Hazod (2007) and his colleagues have taken a similar approach directed at the study of the mortuary archaeology of central Tibet's imperial period.

An international conference on the archaeology of the Tibetan Plateau at Sichuan University that was co-sponsored by the Harvard Yenching Institute in 2011 cemented a renewed interest in the plateau (Flad 2016). Other conferences have since been sponsored by Sichuan University and the International Association of Tibetan Studies, the primary venue for Tibetologists. The archaeology of the Tibetan Plateau has been the object of a number of sessions at annual meetings of the Society for American Archaeology and Society for East Asian Archaeology, and journal special issues have been dedicated to Tibetan archaeology (Barton and Flad 2016). Tibetan archaeology no longer takes place in a vacuum, and despite the challenges of politics, scholars working in and outside the PRC have engaged in closer communication, publishing in similar journals, and attracting media attention that spans continents.

Defining the Tibetan Plateau

The Tibetan Plateau extends over 2.5 million km^2 and is the largest high-altitude landmass on the planet. Ecologically, ethnographically, and politically the plateau can mean different things. Ethnographically, the area inhabited by Tibetan and related people is vast, covering Amdo in the northeast, Kham in the southeast, U-Tsang in the center-west, and Ngari in the far west (Kapstein 2006). Ethnic Tibetans also inhabit the many parts of the Himalayas in Nepal, Bhutan, Sikkim, Ladakh, and India. Following its incorporation into the People's Republic China, parts of ethnographic Tibet have been divided into several Chinese provinces. Former Amdo comprises Qinghai and parts of Gansu and Sichuan. Kham encompasses parts of western Sichuan, northern Yunnan, southern Qinghai, and the eastern part of the Tibet Autonomous Region. Former Tsang, U-Tsang, and Ngari covered the central and western portion of Tibet Autonomous Region.

Overall eastern Tibet is lower than western and central Tibet. The average altitude of eastern Tibet is 4000–4500 meters above sea level (masl), but it is punctuated by a number of low-altitude river valleys (< 2500 masl), areas that are crucial for understanding the prehistory and early history of the plateau. These include the Yarlung Tsangpo River as it enters Arunachal Pradesh, the Salween, Mekong, and Jinsha Rivers as they pass through northwestern Yunnan and Sichuan. The Yalong, Dadu, and Min Rivers and their tributaries as they enter the Sichuan Basin are additional rivers that contain land lying below 2500 masl. A few lower-elevation regions dot the northeastern Tibetan Plateau: the large low-lying Qaidam Basin, Xining and the Gonghe Basin, and the Ruo'ergai Plateau in Sichuan range between 3500 and 4000 masl (Fig. 1A).

In central Tibet, altitudes of 4500–5000 masl constitute the majority of the terrain. A few river valleys are lower, including the Yarlung Tsangpo River and its tributaries at altitudes of 3500–4000 masl. To the west, the Changtang tableland is 4500–5000 masl on its southern portion and 5000–5500 masl on its northern portion (Fig. 1A). This interior portion of the high plateau is dotted with small lakes, many of which are brackish and whose size fluctuates with patterns of glacial melt. These lakes increase in size during the summer, making this area difficult to traverse (Madsen 2016).

In western Tibet, the turn of the Sutlej River as it enters Ngari is the only low river basin with altitudes below 4500 masl that penetrates this side of the plateau; it is flanked by a wide-open area that ranges between 4000 and 4500 masl. As the Indus River runs its course through Ladakh and Kashmir, it constitutes another

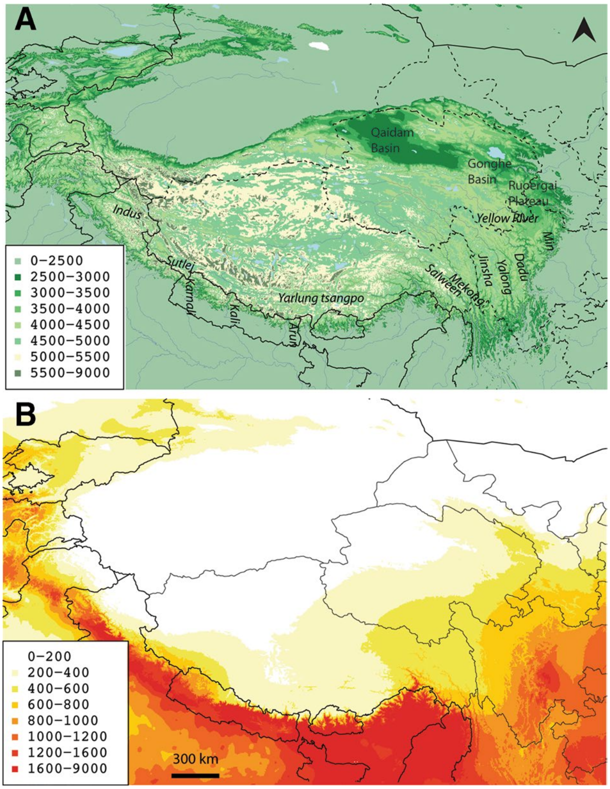

Fig. 1 The Tibetan Plateau. **A**: Digital elevation model of the plateau (masl) (source ETOPO1); **B**: Mean annual rainfall across the plateau (mm) (data source Worldclim.org)

deep ravine that bisects this otherwise high-altitude area with valleys at around 4000 masl (Fig. 1A).

Rainfall and temperature patterns are highly variable across the plateau. Heating of the land in central Asia and over the Indian subcontinent heats the lower atmosphere causing it to rise. This generates a low-pressure cell centered in the midcontinent that draws warm, wet air into the continental interior from the surrounding oceans: this phenomenon is known as the Asian (or Indian Summer) Monsoon. Warm air arriving primarily from the Bay of Bengal first hits the eastern rim of the Himalayas, and it is this region that receives the highest amount of precipitation across the plateau (Fig. 1B). The amount of rainfall progressively decreases to the west, where parts of the Changtang and Taklimakan Desert to the north receive as little as 200 mm per year. Temperatures across the plateau co-vary largely with altitude and latitude. Amdo is situated the farthest north between 34 and 39 degrees of latitude, where mean temperatures range between − 5 and − 0°C, except in the lower altitude area of the Qaidam Basin and around Xining (Fig. 2A). Mean annual temperatures on the large Changtang rangeland range between − 5 and − 10°C. Much of higher-altitude central Tibet ranges between 0 and 5°C. The low-lying valleys of the rivers that cross the plateau, particularly those in eastern Tibet, are substantially warmer (5–10°C) than the higher-altitude plateau and the mountains that surround them. A key exception is the deep Yarlung Tsangpo gorge in Shannan and Nyingchi Prefectures, with a mean annual temperature of 10–15°C.

From Where and When did People Move onto and Permanently Occupy the Plateau

Genetic Data and the Deep Tibetan Past

Because relatively few archaeological sites with secure chronologies have been discovered and reported from the plateau, the genetics of modern Tibetans have been used as a proxy measure to explore the deep Tibetan past. These studies have been employed in three distinct, but sometimes overlapping, ways: estimating the time and the migration routes of the first permanent inhabitants of the plateau; the

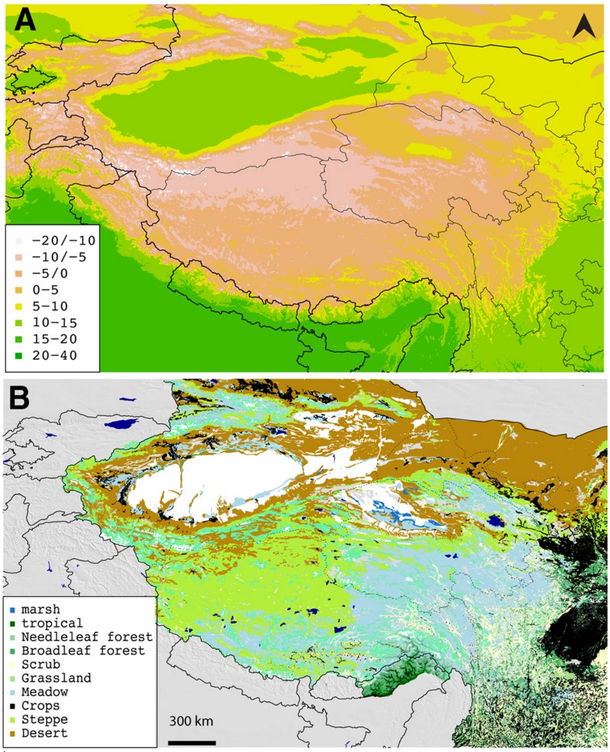

Fig. 2 The Tibetan Plateau. **A**: Mean annual temperature (degrees Celsius) (data source Worldclim.org); **B**: Vegetation classes (data provided by Environmental and Ecological Science Data Center for West China, National Natural Science Foundation of China, http://westdc.westgis.ac.cn)

migrations of people subsequent to the initial peopling; and the ethnogenesis of the people we call today Tibetans. These scenarios are complicated by the distinct possibility that many early or initial occupations of the plateau could have been “permanent” only for short periods of time because of demographic collapse.

Because genetic adaptations to hypoxia are required to sustain long-term population growth in this high-elevation environment, the analysis of human genomes has until recently been the primary source of data about the peopling of the plateau. Genetic analysis has also been used extensively to identify source areas of the populations that moved onto the plateau (Aldenderfer 2012). With one exception (Institute of Archaeology and Culture Peking University 2005), all such studies to date on the plateau proper have been conducted on modern populations of ethnic Tibetans. The analysis of aDNA has been applied in two regions of ethnographic Tibet: Upper Mustang, Nepal (Jeong et al. 2016), and the low-elevation zones of northeastern Qinghai Province (Gao et al. 2007; Zhao et al. 2011). However, studies of aDNA from the plateau are currently underway and will be published in due course.

Unsurprisingly, due to the use of different methods, initial assumptions about the most probable routes of entry, mutation rates of key genes, and groups sampled, these genetic studies have often come to contradictory conclusions. Su et al. (2000) using Y chromosome haplogroups, suggest that the ancestors of modern Tibetans are from the upper and middle reaches of the Yellow River in northern China, who began a widespread migration after 10,000 BP (all dates presented in calibrated years BP unless otherwise noted) that entered not only the plateau but moved to Yunnan, northeastern India, and Bhutan. Zhao et al. (2009) argue instead for an initial peopling of the plateau just before the Last Glacial Maximum (LGM, 22,000–18,000 BP) and conclude that the source area of these migrants was somewhere in Eurasia. Qi et al. (2013) extensively sampled both Y chromosome and mitochondrial haplogroups of modern Tibetans and argue for an initial peopling of the plateau by 30,000 BP. Lu et al. (2016) come to a similar conclusion but push the date of an initial occupation back to at least 40,000 BP. They argue (pp. 590–591) that the source was “…a group of hybrids of ancient Siberians (modern humans), and several archaic populations—including Denisovan-like, Neanderthal-like, and most likely a few unknown nonmodern human groups that currently have not been identified by archaeological or genetic studies.” Wang et al. (2018) examined the Y chromosome phylogeny of modern Tibetans and offer a similar date for the initial peopling of the plateau, but aside from asserting that this initial population is characterized by the Y haplogroup D-M174, they offer no inference as to the likely geographic source of this population. Wang and Li (2013), however, argue that this haplogroup likely originated in South Asia and that it was present on the plateau by 60,000 BP; others argue that this haplogroup originated farther north in Asia. In contrast, Wang et al. (2011), while acknowledging a likely LGM presence of humans on the plateau, suggested a different source population from eastern and southeastern China via the Hengduan mountains that are more closely related to the Tibeto-Burman speaking Yi. The conclusions of each of these studies are plausible, but few of them, with the exception of recent data from the Nywa Devu site on the central plateau (Zhang et al. 2018; see below), conform with what is known of the archaeological record of the plateau. Although it is difficult to reconcile the data from genetics, it is clear that these analyses point to the likely presence of a small but permanent population on the plateau by at least 15,000 BP, and quite possibly much earlier, perhaps at 30,000 BP. There is less consensus, however, about the source areas of these early migrants.

The recent discovery of the Xiahe mandible, described as being of Denisovan origin, contrasts sharply with these scenarios (Chen et al. 2019). The findspot, Baishiya Karst Cave, lies at an elevation of 3280 m and is located at the extreme margin of the northeastern Tibetan Plateau. The mandible is said to have been discovered by a local Tibetan monk in 1980 and was handed over to authorities at Lanzhou University later in the decade. Surface survey in the vicinity of the site, as well as excavations, has been conducted since 2010 (Chen et al. 2019). Although details of the excavation of the site have not been published, "abundant Paleolithic stone artifacts and cut-marked animal bones" are said to be present, and the investigators were able to date an adhering carbonate crust on the mandible using U-Th methods. The results are striking; the carbonate samples range in date from 155,000±15,000 to 164,500±6200, placing the find near the end of the Middle Pleistocene (Chen et al. 2019, p. 409). As the investigators note, this is 120,000 years earlier than any other known site on the Tibetan Plateau, including Nywa Devu (c. 30,000 BP, see below).

The mandible has been assigned a Denisovan phylogenetic status via proteins recovered from one of the intact teeth; some of these proteins are comparable to those found in the Denisovan D3 genome (Chen et al. 2019, p. 409). Unfortunately, no endogenous ancient DNA could be found; thus, it cannot be determined if this specimen has the EPAS1 allele known from the Denisovan genome and which is critical for adaptation to hypoxia. The morphology of the mandible and teeth are said to be comparable to other Middle Pleistocene fossil finds from China.

Although this is an exciting find that has the potential to contribute significantly to improving our understanding of the peopling of the Tibetan Plateau, the authors make a number of unwarranted claims about the significance of the discovery. They state "Our results indicate that archaic hominins occupied the Tibetan Plateau in the Middle Pleistocene epoch and successfully adapted to high-altitude hypoxic environments long before the regional arrival of modern *Homo sapiens*" (Chen et al. 2019, p. 409). The data presented support neither claim. The site is on the extreme margins of the plateau at a slightly higher elevation than the valley floor below. It is more plausible that this site reflects a temporary use of the plateau margins from lower-elevation base camps, a pattern seen much later in time on the northeastern plateau at sites such as Heimahe 1 (3210 masl) and Jiangxigou 1(3330 masl), which date to 15,000–13,000 BP (Madsen et al. 2006). The temporary use of the margins of high-elevation regions does not require genetic adaptations, and the authors offer no evidence of these aside from the assignment of the mandible to the Denisovans. Terms like "occupied" imply permanent residence, and until the type of use of the site is determined by the composition of the archaeological assemblage, the larger significance of the Xiahe mandible in relationship to the peopling of the plateau remains to be seen. These observations do not diminish the importance of the find, but they do place it in a broader context (Aldenderfer 2019).

Although the Xiahe mandible may represent an early migration to the plateau by a Denisovan-related population, later migrations are better understood and are generally framed within the context of "Neolithic expansion" or "wave of advance" models (e.g., Ammerman and Cavalli-Sforza 1973; Bellwood 2005) that postulate the movement onto the plateau of populations from northern China that grew subsequent to their increased reliance on domesticated plants and animals. Some geneticists, however, such as Zheng et al. (2011) who examined mtDNA haplogroups, have argued that this expansion began at 13,000 BP, persisted until 4000 BP, and was a prime mover for domestication. This view is not shared by Zhao et al. (2009) and Wang et al. (2011), who postulate the movement onto the plateau of "Proto-Tibeto-Burmese speakers" at various times between 10,000 and 2000 BP, bringing agriculture with them. Qi et al. (2013) narrow the time frame of population movement onto the plateau to 10,000–7000 BP and explicitly state that the source population was Han Chinese peoples. These authors also invoke archaeological data from Qinghai and use ethnonyms like Di-Qiang taken from considerably later literature (see below) to describe these migrants. Wang et al. (2018) take the argument further and make an explicit connection between the hypotheses proposed by Chen et al. (2015), who assert that permanent habitation on the plateau was impossible without domesticated plants and animals, and a wave of Han migrants. The Chen et al. (2015) model does not presume the presence of earlier peoples on the plateau, who may have interacted with moving farmers, or who may have been themselves responsible for adapting farming and pastoral lifestyles to the plateau.

There is no question that modern Tibetan genomes show signs of mixing with low-elevation populations. Recognizing this, however, does not necessarily imply support for wave of advance models. The Himalayas and other mountainous regions around the southern and eastern margins of the plateau are seen as barriers, yet ethnographic and ethnohistoric data describe multiple population movements at different scales ranging from individuals to families, to whole clans, such as the Sherpa (Aldenderfer 2012, pp. 365–366). The question, then, is to identify the anthropological processes by which these genetic signals became part of who we call Tibetans today.

Genetic data obviously play a significant role in developing an understanding of the ethnogenesis of modern Tibetans. It is important, however, to understand the limits of these data. Using ethnonyms derived from modern ethnography or historical sources to denote genetic relationships (or differences) can be highly misleading. In response to this problem, Jeong et al. (2016) in their analysis of the aDNA of human remains ranging in date from 3000 to 1300 years ago from Upper Mustang, Nepal (a region of ethnographic Tibet today), discovered that the genomes of these peoples fell very tightly within the range of genetic variability of modern Tibetans. However, they avoided the term "Tibetan" to describe these peoples and instead labeled them as "high-elevation East Asians." This might be an excess of caution to some, but it is best to avoid easy (and likely misleading) ethnonyms when genetic data are in play in most archaeological contexts.

Archaeological Data and the Deep Tibetan Past

Although the material cultural record for early habitation on the plateau provides complimentary data to address the early peopling of the plateau, almost all sites we discuss here were found during nonsystematic surveys and sometimes have only benefitted from very small-scale excavation. As a result, it is difficult at moment to determine if these finds reflect true temporal and spatial patterns of distribution or whether these patterns are the artifact of research bias.

Based on archaeological evidence, two key schools of conflicting thought have emerged about the initial peopling of the plateau. The majority of these studies tend not to refer to genetic evidence. One group of researchers emphasizes the marginal nature of the plateau and the challenges humans would have faced moving into the area. They argue that the plateau does not contain sufficient plant or animal resources to support year-round habitation, and it was only very late in time that humans were able to occupy the area on a permanent basis, after the introduction of barley agriculture and pastoralism (Barton 2016; Chen et al. 2015; Rhode 2016a). Brantingham et al. (2013) have argued that by 30,000 years ago areas below 3000 masl were occupied by Levallois-blade-producing foragers who practiced high mobility; they only occasionally started to move into middle-elevation steppe (3000–4000 masl) by 25,000 years ago. The high-elevation steppe (> 4000 masl) was occupied permanently only much later in time, and that occupation "was at best extremely limited prior to the early Holocene approximately 11,000–8200 yr BP" (Brantingham et al. 2013, p. 426). Alternative models, including those developed by one of us (Aldenderfer), have emphasized that foragers penetrated deeply into the high plateau as early as the Late Pleistocene/Early Holocene without the need to descend to lower altitudes (Meyer et al. 2017).

Plateau lithic sites have been generally placed into two main groups. "Paleolithic" assemblages represented by cobble core and flake retouched assemblages that lack microliths (Aldenderfer and Zhang 2004; An 1982; Brantingham and Gao 2006; Chiu 1958; Frenzel et al. 2001; Yuan et al. 2007) and those containing microliths and called "epi-Paleolithic," "Mesolithic," or "Neolithic" (An 1982; Gai and Wang 1983; Li 1992; Rhode 2016a; Rhode et al. 2007b). Microlithic assemblages on the Tibetan Plateau show close similarities to technology that spread throughout northern Asia and China during the Last Glacial Maximum, particularly those from sites such as Shuidonggou (Chen 1984; Yi et al. 2013). Rhode (2016a) argues that humans who produced microblade technologies and once inhabited the high-latitude Eurasian steppe and central China during the LGM would have the greatest range of available strategies for coping with high-altitude environments, such as an ability to track game across snow and to produce clothing to deal with cold temperatures (Yi et al. 2013); this signals that humans likely moved into the Tibetan Plateau from its northeastern margins (Rhode 2016a).

For years, many of these lithic assemblages represented surface-only finds; they were not directly dated, leading to the impression that they were Late Pleistocene finds and that the Tibetan Plateau may have been occupied prior to or even during the LGM (Aldenderfer and Zhang 2004; An 1982; Brantingham et al. 2001; Huang 1994).

Initial dates of 40,000–30,000 years ago from two key sites, Siling Tso and Xiao Qaidam, seemed to confirm this impression (Huang 1994; Yuan et al. 2007) (Fig. 3). However, these dates have been subject to critique as only the sediment surrounding the artifacts was dated, and the association between stone tools and the deposits was unclear as no systematic excavation took place at these sites (Aldenderfer

2011; Brantingham et al. 2013; Madsen, et al. 2014). The recent publication of findings from Nywa Devu has once again lent some credence to a pre-LGM occupation of the plateau (Zhang et al. 2018). The site is located on the central plateau just south of Siling Tso at an elevation of 4600 m. The site is said to be stratified, and optically stimulated luminescence (OSL) dating of the deposit indicates utilization 40,000–30,000 years ago, making it the earliest known site on the central plateau. The site is described as a quarry or workshop for the extraction of fine slate, and the reduction strategy is best characterized as one that produced large prismatic blades. No other artifacts were discovered. This technology is distinct from other early sites (but much later than Nywa Devu) on the plateau, and the authors speculate that the makers of these tools were descendants of Denisovan-related peoples. This scenario, while not confirmed, is not improbable, as a warmer and wetter climate prevailed during the late stages of Marine Isotope Stage (MIS) 3 (c. 57,000–24,000 BP) (Shi 2002; Yang et al. 2004; Zhao et al. 2014), and it conforms roughly to the dates of initial occupation postulated by genetic studies (Lu et al. 2016). Northern China was characterized by conifer forests and forest meadow steppe, and the extent of forest likely also expanded across the lower margins of the Tibetan Plateau during this period (Zhao et al. 2014).

At present, no sites that date to the Last Glacial Maximum (c. 26,000–20,000 BP) have been discovered on the plateau. This is perhaps not surprising. Although

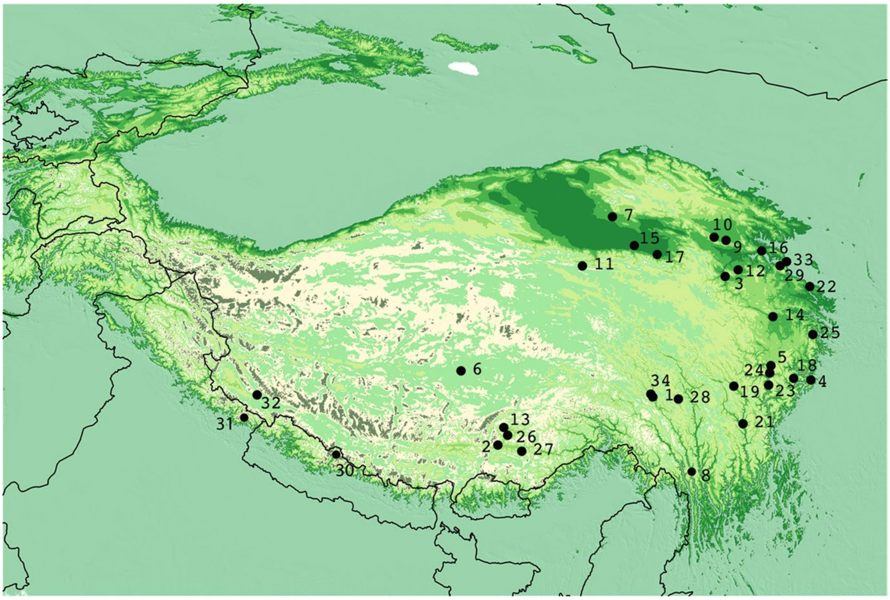

Fig. 3 Map of sites mentioned in the text. 1. Karuo; 2. Changguogou; 3. Zongri; 4. Yingpanshan; 5. Haxiu; 6. Siling Co.; 7. Xiao Qaidam; 8. Zhongdian); 9. Jiangxigou; 10. Heimahe; 11. Xidatan; 12. Layihai; 13. Chusang; 14. Xiemajian; 15. Talitaliha; 16. Shangbanzhuwa; 17. Tawendaliha; 18. Zidazhai; 19. Yan’erlong; 20. Gazalong; 21. Benjiadi; 22. Mogou; 23. Shidaqiu; 24. Mu’erxi; 25. Ashaonao; 26. Qugong; 27. Bangga; 28. Xiangbei; 29. Sulkhasa; 30. Samdzong, 31. Malari; 32. Chuvtag; 33. Lajia; 34. Xiaoenda

proxies differ in their estimates of amplitude according to pollen (Ni et al. 2010; Shi 2002; Sun et al. 2000) and ice core records (Shi 2002), temperatures were likely 6–9°C cooler on the Tibetan Plateau during the LGM relative to today, and the extent of xerophytic shrubland and cold deserts extended across the plateau at that time (Ni et al. 2010; Zhao et al. 2014). Because these earlier periods are known only from nonsystematic surveys, it is difficult to comment on the extent to which these patterns conform to the reality of site distribution. Future, more intensive survey across the plateau will be crucial in helping us understand its earliest habitation. However, if Nywa Devu is an early permanent occupation of the plateau, it is likely that river valleys such as the Yarlung Tsangpo served as refugia during these intensively cold times.

During the transition to the warmer Bølling-Allerød (c. 14,500–12,800 BP), sites again appeared on the northeastern margins of the plateau, this time, ones that are solidly dated. Until recently, the earliest well-dated sites on the plateau were Heimahe 1 (3210 masl), Jiangxigou 1 (3330 masl), and locality 93-13 (3310 masl) near Lake Qinghai (Madsen et al. 2006). These sites date between 15,000 and 13,000 years ago. The excavators argue that they were ephemerally occupied hunting camps that were monitored from lower-elevation base camps. No pieces of evidence for permanent structures were found, and only camp fires and small hearths were present. In addition, very small numbers of bone and tools were uncovered, suggesting that they may have been occupied for as little as one evening (Madsen et al. 2006). Madsen et al. (2006) envision that the foragers using these camps moved seasonally onto this part of the plateau for hunting expeditions, returning to lower altitudes for the rest of the year; similar patterns of mobility characterize the initial stages of occupation and utilization of the high-elevation regions of the Andean altiplano (Aldenderfer 1998; Haas et al. 2017a)

Following the short and cold Younger Dryas (c. 12,800–11,500 BP), there was an increase in the number of sites on the margins of the plateau throughout the Early Holocene (11,500–5000 BP). Finds of willow wood at sites on the northeastern Tibetan Plateau dating to 12,000–10,500 BP suggest that a warmer climate prevailed and that the extent of forest had crept farther north and into higher altitude than it currently is today (Rhode 2016b). A recent redating of contexts associated with microlithic technology has led to reevaluations of the dating of these artifacts. A systematic campaign of radiocarbon, ^{10}Be-^{26}Al cosmogenic surface exposure, and OSL dates at Xidatan 2 showed that, despite similarities in manufacture to LGM and Late Upper Paleolithic assemblages of central China, these assemblages were no earlier than 8200–6300 BP (Brantingham et al. 2013). Jiangxigou 2 has also been radiocarbon dated to 9140 +- 90 and 5580 +- 60 BP (Rhode et al. 2007b). Heimahe 3 (3200 masl) has also been dated to 8400 BP (Rhode et al. 2007b). These authors argue that these sites may reflect an occupation pattern composed of base and field camps. Xidatan 2 and Heimahe 3 contained only expediently prepared hearths that sometimes contained only the processed remains of a single animal, suggesting that they may represent overnight hunting camps. Lower-elevation microlithic sites such as Layihai (2580 masl) (7500–6500 BP) yielded a wider variety of tools and features: cores, flakes, microblades, and microblade cores suggest a longer occupation (Rhode et al. 2007b). Systematic excavation and dating at many more of these sites in other regions of the plateau is necessary to pin down their ultimate chronology and determine how much variability existed in the timing of their occupations. Systematic survey combined with careful dating campaigns will be equally crucial for determining if proposed occupation patterns of base and field camps hold true. It also is necessary to determine if these patterns were present beyond the northeastern plateau and in other regions of Tibet.

Recent work at the Chusang site may overturn models that posit there were only ephemeral or temporary occupations of the plateau during the Younger Dryas and Early Holocene (Meyer et al. 2017). Located at 4270 masl, Chusang contained 19 human hand and footprints that were preserved in travertine. Initial OSL dates indicated that the site was 20,000 years old, making it the earliest known site on the plateau (Zhang and Li 2002). A recent redating campaign at the site suggests two possible ranges for the site, 8500–7400 BP or a maximum age of 12,700 BP (Meyer et al. 2017), although the 20,000 BP date has been rejected as unreliable. Meyer et al. (2017) argue that the foragers who occupied Chusang regularly used surrounding river valleys of 3600 masl during the Early Holocene; they occupied the plateau permanently and were able to find sufficient resources to support themselves. Proponents of the late or agricultural model for permanent occupation of the plateau argue that occupation at this site could only have been seasonal and that food availability prior to farming would have been so limited that it would have been impossible to establish a year-round camp. These arguments, however, require foragers to have had longer residential or logistical radii that are not supported by ethnographic evidence (Haas et al. 2017b)

Resources for Forager Subsistence on the Plateau

Ethnobotanical research on the plateau demonstrates that, despite initial appearances of a lack of resources, the plateau is rich in wild plant food resources that would not have been ignored by foragers and that we argue could have sustained year-round habitation. The present-day inhabitants of Tibetan Plateau employ a wide variety of wild plant foods. Many tubers have historically been exploited on the plateau, including *Potentilla anserina* (Tib: *drolma*), *Arisaema* sp. (*Tib: dawa*), and knotweed (*Polygonum* sp. or *Tib: rambu*). Potentilla tubers have been found in archaeological sites on the plateau, demonstrating the antiquity of its use (Fu 2001), and they have a wide distribution across plateau. In eastern Tibet, a number of edible "nuts" such as pine nuts, acorns, and walnuts are available. A wide variety of wild fruits including rose hips, peaches and plums (*Prunus* sp.), wild apples (*Malus* spp.), crab apples (*Cratageus* spp.), mulberry (*Morus* spp.), and goji berries (*Lycium* spp.) are also distributed across the area (Kang et al. 2016). The fruits of some species are distributed into very high altitude, including schisandra berry (*Schisandra sphenanthera*, up to 5100 masl), gooseberry (*Ribes* spp., up to 4300 masl), wild strawberries (*Fragaria* spp.), Lonicera fruits (*Lonicera* spp.), Himalayan mayapple (*Sinopodophyllum hexandrum*), and seabuckthorn (*Hippophae rhamnoides*), whose tart yellow berry is extremely high in vitamin C. Seabuckthorn is an important market product today (d'Alpoim

Guedes personal observation) and is made into a commercial juice (Battacharya 1991; Boesi 2014; Koelz 1979; Li et al. 2015; Weckerle et al. 2006). It also has been recovered in archaeological sites in eastern Tibet (d'Alpoim Guedes et al. 2015b).

A wide variety of leaves including goosefoot (*Chenopodium* spp.), a number of nettles (*Urtica* spp.), amaranth (*Amaranthus* spp.), garlic greens (*Allium* spp., known in Tibetan as *gokpa*), *Thlaspi arvense*, *Helwingia japonica*, Shepherd's purse (*Capsella bursis pastoris*), mallow (*Malva* spp.), and *Rheum* spp. provide critical resources for humans on the plateau. Ferns and fungi are other important species for consumption and trade, particularly in eastern Tibet (Kang et al. 2016). The warmer temperatures of the climatic optimum would have only increased the range of these species and likely led to many of the resources that are today limited to lower altitudes to establish themselves in higher-altitude river valleys of the plateau.

The Tibetan Plateau is home to a wide variety of animals that may have been exploited by ancient hunters (Schaller 2000). Unlike plants, their distribution is not spatially fixed, and hunters likely tracked onto the seasonal movements of these animals. Over 500 bird species have been recorded in Tibet alone (Vaurie 1972). Despite the contemporary Tibetan taboo for fish consumption, lakes and rivers on the plateau are home to a wide variety of fish, and birds and fish remains have been found in archaeological sites on the plateau (d'Alpoim Guedes et al. 2013; Xizang Wenguanhui 1985). Key ungulates include blue sheep (*Pseudois nayaur*), Tibetan argali (*Ovis ammon hogsoni*), chiru (*Pantholops hodgsoni*), goitered gazelle (*Gazella subgutturosa*), Tibetan gazelle (*Procapra gutturosa*), ibex (*Capra ibex sibirica*), kiang (*Equus kiang*), *and* wild yak (*Bos grunniens*). The modern distribution of these ungulates varies widely across the plateau, although broadly speaking they track onto alpine meadow and steppe ecotones. A number of deer species also occupy forested biomes around the margins of the plateau. Other mammals that are smaller in size and migration radius also occupy the plateau: the Himalayan marmot (*Marmota himalayana*), the Tibetan wooly hare (*Lepus oistolus*), pika (*Ochotona macrotis*), steppe lemming (*Eolagurus przewalskii*), and a variety of hamsters (*Cricetulus* spp.). These species have been found in zooarchaeological assemblages in sites across the plateau (Dong Guanghui, personal communication 2018) and may also have been important food resources.

Ethnographic data on wild plant food use may reflect deep memory and knowledge for how to survive periods of time when food is lean (Morell-Hart 2012). Modern Tibetans have rich traditions of knowledge of how to preserve plants that peak in production in the summer to use during the longer winters. Leafy greens as well as ferns can be dried or lacto-fermented in wooden barrels for later use. Greens, fern fronds, fruits, and tubers also are frozen and later reconstituted with water to be cooked (Kang et al. 2016; d'Alpoim Guedes personal observation). This may have been an important way that foragers (and farmers and pastoralists) survived winters with lower densities of plant resources, allowing them to more permanently occupy the higher reaches of the plateau.

Forager/Farmer Interaction at the Frontier and the Spread of Early Millet Agriculture

The volume of research on when and how farming first spread to the plateau has rapidly increased over the past five years. Precipitated by reanalysis of material at Karuo and sites in western Tibet (d'Alpoim Guedes et al. 2013), this research has deep implications for understanding how foragers who once occupied the plateau (seasonally or permanently) began to engage with plants that were domesticated in lowland China and the people that brought these plants to their margins. With few exceptions, foragers have been largely absent from discussions of agricultural origins in China, and the Tibetan Plateau has been no exception.

Archaeologists and linguists alike have presumed that it was migrating farmers who spoke Proto-Tibeto-Burman who were responsible for both linguistic (Sagart 2008; Van Driem 2005) and genetic (Su et al. 2000) contributions to modern Tibetans. However, work carried out in eastern Tibet and its margins is beginning to challenge the idea that farmers moved onto the plateau as a wave of advance, and we are starting to recognize the likely complex set of interactions between the foragers (discussed above) and farmers on the plateau's margins. Increasing work is demonstrating that when farmers carried their products onto the margins of the plateau, they did not move into a void but rather a land that was full of other people.

Following their domestication sometime during the Early Holocene in either central (Lu et al. 2009), northeastern (Zhao 2005), or northwestern China (Bettinger et al. 2010), broomcorn and foxtail millet (combined with pig husbandry) provided the subsistence basis on which the early Yangshao culture (7000–5000 BP) relied. It is the latest expression of the Yangshao, the Majiayao period, that saw the first wave of millet and pig farming expansion to regions adjacent to the northeastern Tibetan Plateau: upland western Gansu and Qinghai by 5000–4650 BP (Fig. 4).

Recent data from three key sites demonstrate that resident foragers already may have had complex relationships with these farming peoples as they moved into forager territory. While resolving questions of identity in archaeology is notoriously difficult even when we have excellent data from excavations, genetics, and cultural historical assemblages, we argue that emerging data from the margins of the Tibetan Plateau complicate the story of a single wave of advance of farmer populations onto the plateau. At first glance, data from Yingpanshan (5300–4600 BP) (1600 masl) in lower altitude western Sichuan at first seem to confirm the wave of advance model (Chengdu Shi Wenwu Kaogu Yanjiusuo et al. 2002). Wattle and daub houses with burials in their foundations showed strong similarities to those in lower elevations of northwestern China. Painted vessels that were manufactured in northwestern China might have been directly traded into the region (Cui et al. 2011; Hung 2011), although some disagree (Ren et al. 2013). In addition to this high-quality ware that may have served a prestige function, sand-tempered grayware for daily use is almost identical in form to sites in Gansu, such as Linjia in Dongxiang County and Dalijiagang in Wudu County; no

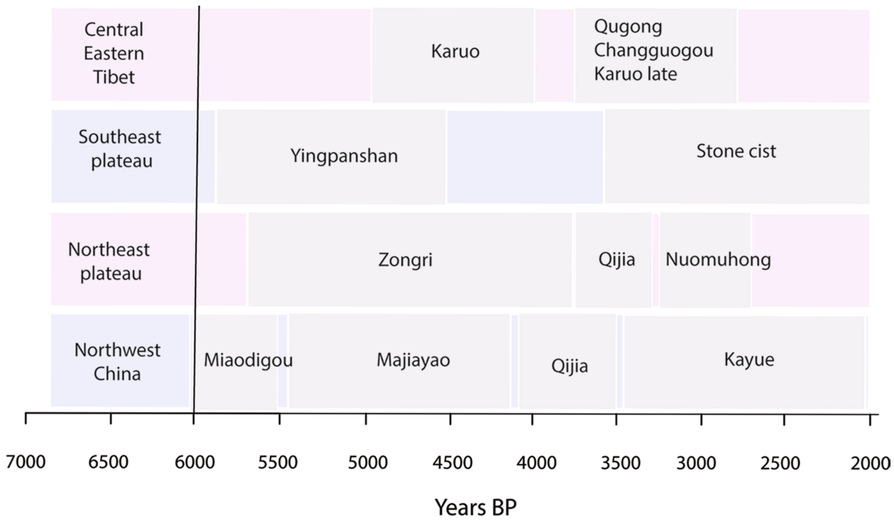

Fig. 4 Key cultural phrases in different regions of the Tibetan Plateau

local tradition of pottery is present (He 2011). High proportions of both foxtail and broomcorn millet were found at the site (Zhao and Chen 2011). Zooarchaeological analysis shows that the inhabitants of the site occasionally hunted large mammals but relied primarily on domesticated pig (He et al. 2009). Using MNI and predicted flesh weight, He et al. (2009) calculate that the contribution of pig to the diet dwarfed that of wild deer and other hunted animals at Yingpanshan, further suggesting that its inhabitants had a sedentary lifestyle that allowed them to fodder pigs.

However, the picture changes in higher elevations, where there were highly complex interactions between foragers and farmers on the northeastern Tibetan Plateau (Hung 2011; Hung et al. 2014). Discovered in 1994, Zongri (2800 masl) (c. 5600–4000 BP) in the Gonghe Basin in Qinghai contains an eclectic assemblage of burials. A small percentage of the burials show close similarities to those known from lower-lying Majiayao sites: people were buried in a primary burial and in an extended supine position (Hung 2011) (Fig. 5). However, the largest percentage (70%) of the burials were found deposited in an extended prone position (Chen et al. 1998). Other key differences exist between the burials at Zongri and those at sites in the central Majiayao area. In the central Majiayao area, burial shafts are traditionally dug into the earth, whereas at Zongri, burials were lined with timber or slate. Chen (2003; Chen et al. 1998) and Hung (2011; Hung et al. 2014) argue that extended supine burials likely belonged to farmer pioneers who began to move into this region and who interacted with local foragers (prone burials) who continued to form the majority of the population throughout the occupational sequence at the site.

Stable isotope analysis carried out by Cui et al. (2006) also demonstrates that individuals buried in the prone position had lower contributions of millet to their diet and a higher proportion of meat during the initial period of colonization. Individuals in supine burials, however, had a high contribution of C_4 plant consumption

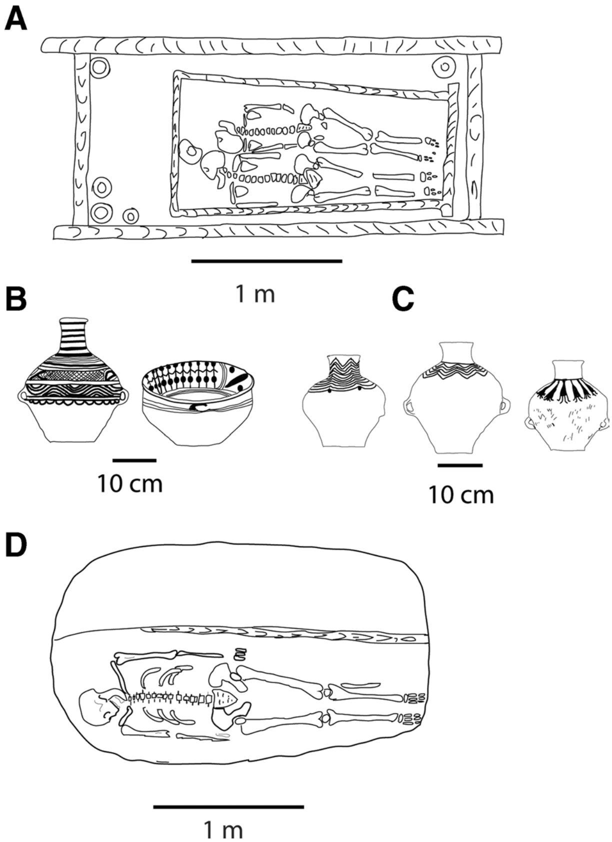

Fig. 5 Burials and pottery at Zongri. **A**: Extended prone double burial (M215) (after Qinghai Sheng 1998: fig. 23); **B**: Majiayao-phase pottery from Zongri argued to be from low-elevation northwestern China (after Qinghai Sheng 1998, fig. 15); **C**: Pottery from Zongri (after Qinghai Sheng 1998, fig. 15); **D**: Extended supine single burial (M179) (after Qinghai Sheng 1998, fig. 11)

and appeared to consume less meat. The proportion of C_4 plants, presumably millets, in the diet of individuals buried in a prone position increased over time. A recent analysis of archaeobotanical material at the site shows that few weed seeds were present alongside the millets, which suggests that individuals at Zongri may have traded clean grain with areas in lower altitude (Dong Guanghui, personal communication 2018). Unlike at Yingpanshan, the inhabitants at Zongri do not appear to have taken up animal husbandry; they only hunted animals such as wild boar, gazelle, *bharal*, deer, and marmot (An and Chen 2010).

The pottery unearthed at Zongri also tells an interesting story about interaction. The two main categories of vessels at Zongri are a small number high-quality burnished and high-fired Majiayao-type painted vessels and a larger number of vessels of a distinctive regional tradition of painted pottery made out of coarse clays and of coarser manufacture (Figs. 5B and 5C). While Majiayao pots are decorated with swirling and circular designs, those of Zongri are painted in zig zags. Pottery belonging to the first group also do not contain the full range of Majiayao-type pottery; large vessels appear to have been deliberately excluded from the assemblage, and only vessels smaller than 40 cm were present. Hung (2011) argues that these vessels were likely selected because they could be easily transported. In addition, other parts of the typical Majiayao assemblage are missing from the repertoire at Zongri; unpainted vessels characteristic of northwestern China that were found at Yingpanshan were entirely missing from the Gonghe Basin. Archaeometric analysis of vessel tempers carried out by Hung (2011) shows a clear difference in chemical composition between the painted pottery and the coarser locally produced vessels, suggesting that the former was manufactured in the Majiayao heartland in northwestern China and then carried to the Gonghe Basin by migrating farmers (Hung 2011; Hung et al. 2014). Farmers do not appear to have been the only individuals on the move during this period, as foragers also appear to have moved into agricultural heartlands. During the Machang phase (4300–4000 BP), burials in extended prone position began to appear at sites like Minhe Yangshan in the lower Huangshui River valley (Hung et al. 2014).

Karuo (3200 masl) (c. 5000–2900 BP) is not only one of the most well-known sites on the plateau, but it also is one that has been the most carefully documented and excavated (Xizang Wenguanhui 1985). Despite the prevalence of models for farmer expansion, the researchers argued that they were dealing with the remains of a group that was indigenous to the plateau and not a mere diffusion of farmers from the central Yellow River valley (Xizang Wenguanhui 1985).

Three clear phases of occupation were present at Karuo. Eight houses from the earliest phase of occupation at the site were unearthed. F26 is a typical Phase 1 dwelling, described by the excavators as a small circular "tent-like" structure, 3.5 m in diameter (an interior area of 9.6 m^2), that was dug approximately 35 cm into the earth and housed a central hearth. Braided plant material was wrapped around a wooden frame and covered with a thin layer of mud (Fig. 6A) (Xizang Wenguanhui 1985). While these structures do represent an investment in building, they likely did not last for multiple years of use, which suggests the inhabitants of the buildings relocated to different points around the landscape over the course of the year. Depending on the measures of residential density one uses, these structures likely housed no more than a small nuclear family.

Phase 2 at the site saw changes in both investment in building construction and an increase in the total number of houses at the site to 16. Houses from this phase were square in shape with stone-lined foundations. A series of 24 postholes were irregularly distributed outside the structure, while more regularly distributed postholes were inside the structure. The excavators argue that this structure supported a covered balcony around the house that allowed the inhabitants to carry out activities either in the shade or protected from rain. During the excavations, the preserved walls of this structure consisted of large wooden planks that were sealed using a layer of clay. This building is hypothesized to have had a flat roof, much like many Tibetan buildings today (Fig. 6B).

Only three houses from Phase 3 were unearthed in the original excavations at the site (Fig. 6C). Like houses from the middle phase of occupation, these houses

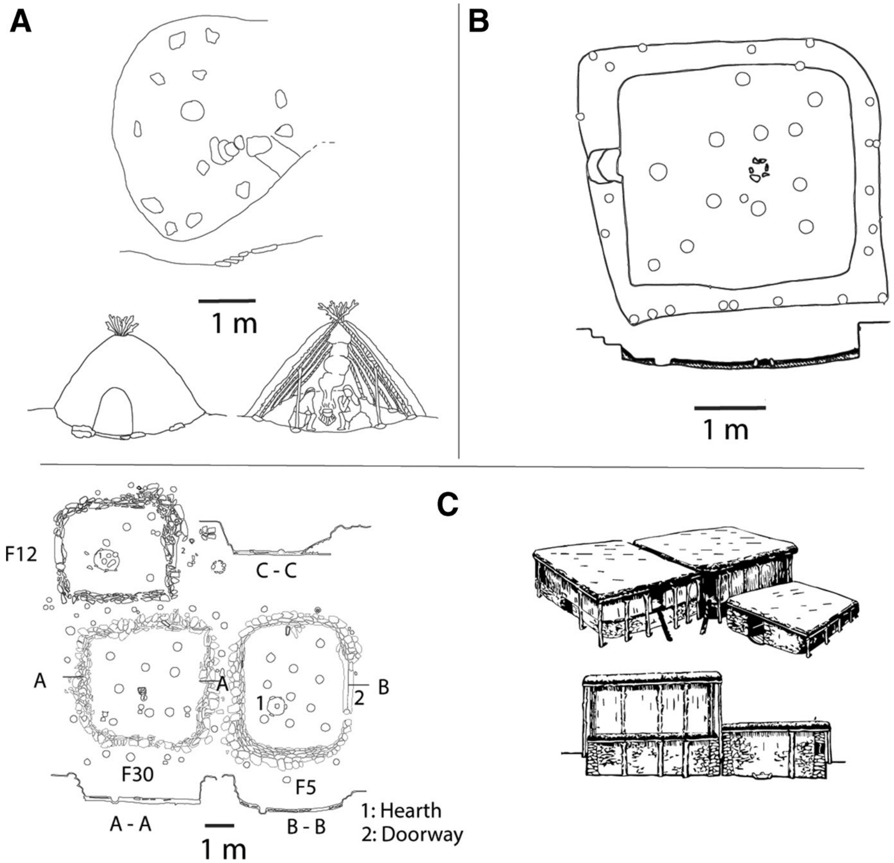

Fig. 6 Houses at Karuo. **A**: Phase I typical house (F26) (redrawn from Xizang Wenguanhui 1985, figs. 7 and 8); **B**: Phase 2 typical house (F8) (redrawn from Xizang Wenguanhui 1985, fig. 18); **C**: Phase 3 typical house (F5, F12, F30) (redrawn from Xizang Wenguanhui 1985, figs. 25 and 27)

also are square; however, they are lined with deeper stone foundations, implying that they may have accommodated a second story. These houses share a number of similarities with houses unearthed in recent excavations at the later Bronze Age site of Bangga, meaning that this phase may be later than radiocarbon dates based primarily on charcoal suggest; recent dates on wheat and barley from these layers all postdate 4000 BP (Lu 2016b). In sum, a transition appears to have taken place from more ephemeral dwellings designed to last a season or a few years to a more permanent investment in house structure. A lack of ashpits (where trash was burned) that are commonly found in excavations in other parts of western China suggests that fundamentally different ways of inhabiting this settlement characterized Karuo during its early phases of occupation.

Like Zongri, the remains from Karuo paint a complicated picture of forager/farmer interaction (d'Alpoim Guedes 2017). In terms of diet, the assemblage at the site is similar to that of Zongri. Only wild animals and fish were present in the assemblage, yet both broomcorn and foxtail millet have been unearthed at the site (d'Alpoim Guedes 2013, 2017). The assemblage at Karuo, however, is distinct from Zongri in one key regard: no Majiayao-style painted pottery vessels or even Majiayao-tradition plain ware vessels were present at Karuo. Rather, a distinctive tradition of local, incision-decorated pottery that includes bowls and single and double-bellied *guan* exists at the site. Vessels also are decorated with a variety of zig-zag and triangular designs; this is another point of departure from Majiayao-phase vessels in northwestern China that display swirling and round designs (Fig. 6). This design principle is shared with Zongri, except that the execution is different: designs at Zongri are painted, whereas those at Karuo are incised.

A very high proportion of microliths and larger stone tools like scrapers represent continuity with earlier traditions of lithic technology discussed above. Large numbers of worked bone also are present at Karuo, including needles, awls, and implements that may have been used to prepare hide, as well as items of personal ornamentation such as necklaces and bracelets. Items that might indicate exchange include stone knives that may be sickles and adzes. Both are small and portable objects that could have arrived at the site via down the line exchanges or from migrating farmers (Fig. 7). Chemical composition analysis, however, is necessary to test these claims. To date, at Karuo, there is no conclusive evidence that millet farmers ever moved into the area, that domesticated animals were ever moved to the site, or that farmer's traditions of pottery were present.

In other parts of the eastern plateau, there are sites occupied by individuals who continued a mobile lifestyle. Although no report is published yet, excavations at Xiemajian and Qurujian (3600 masl) in the high-altitude Ruo'ergai Plains of eastern Tibet have produced important information on foragers who lived contemporaneously with farmers who spread into the area. This research by Sichuan University revealed no evidence of permanent or even ephemeral housing; however, large quantities of microblades and microcores indicate that individuals likely used these areas to fix composite tools and process carcasses and hide (although use-wear analysis is necessary to test this hypothesis). At Xiemajian, both microliths and painted Majiayao-style pottery were present, indicating that whoever the individuals who occupied these sites were, they were in contact (either through down-the-line exchange or directly) with individuals who manufactured these vessels (d'Alpoim Guedes 2017; Gugong Bowuguan et al. 2014).

A variety of different types of exchange may have taken place between foragers and farmers on the plateau. While farmers appeared to have physically arrived at Zongri, bringing parts of their material culture with them (Hung et al. 2014), at Karuo farming products appear to have arrived at the site via down-the-line exchanges between foragers and farmers in lower altitudes, as there is little evidence that farmers directly brought their own cultural material to the site (d'Alpoim Guedes 2017). Foragers at both sites may have exchanged goods like salt, fur, and hide for farmer's grain. Alexander (1977) uses ethnographic examples from the American frontier and Australia to argue that members of farming societies who specialize in hunting and bush foods were likely to be responsible for early penetrations of the forager frontier. As these individuals often adopted both the lifestyle, and sometimes the material culture of foragers, revealing their

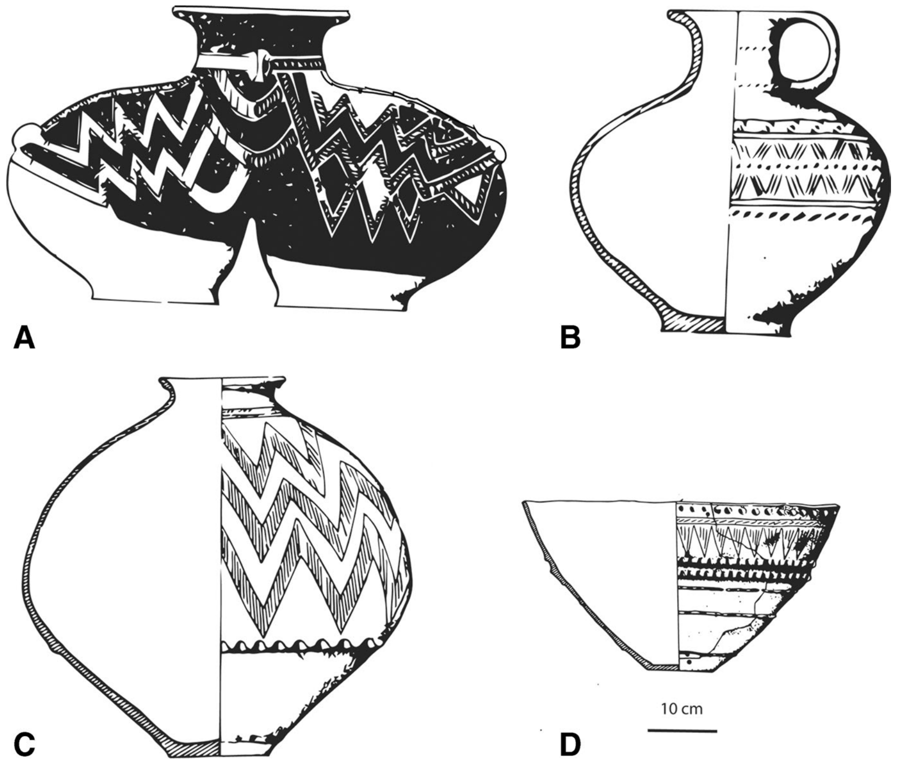

Fig. 7 Pottery and material culture from Karuo. **A**: Double-bellied *guan* vessel (redrawn from Xizang Wenguanhui 1985, fig. 66.6); **B**: *Guan* vessel (redrawn from Xizang Wenguanhui 1985, fig. 66.6); **C**: *Guan* vessel (redrawn from Xizang Wenguanhui 1985, fig. 65.7) D: *Pen* or bowl (redrawn from Xizang Wenguanhui 1985, fig. 67.16)

presence in the archaeological record remains a difficult task. More systematic applications of both strontium isotopic analysis and genetic work on samples from the plateau may help reveal the complexity of these interactions.

Regardless of how millet first spread onto the Tibetan Plateau, its cultivation seems to have come to an abrupt end on the margins of the southeastern Tibetan Plateau after 3750 BP. One of us (d'Alpoim Guedes 2015a, b) has argued that cooling temperatures at the end of the climatic optimum (after 3750 BP) made cultivating these crops a highly risky endeavor as the probability of their successful cultivation on the margins fell below 60%. Some of the farmers that occupied sites like Yingpanshan and Haxiu may have migrated into warmer lower-lying areas such as the Chengdu Plain by 4800–4600 BP (d'Alpoim Guedes 2013; d'Alpoim Guedes and Wan 2016). Did they simply pack up and follow others into warmer areas, or did the behavioral flexibility exhibited by foragers at places like Karuo allow them to simply transition back to higher reliance on game and foraged foods? Further research, systematic excavations, and careful radiocarbon dating at more sites on the Tibetan Plateau are necessary to understand how people who farmed, opportunistically cultivated, or exchanged millet coped with this dramatic decline in temperatures.

Changes in Material Culture, Burial Practice, and Settlement Layout during the Early Bronze Age

After the fourth millennium BP, the Tibetan Plateau became imbricated in deeper networks of exchange with populations across Eurasia. A new economic model also developed that gradually transitioned to the Tibetan economy we know today: one based on barley farming and pastoralism. These transformations in subsistence are mirrored by substantial changes in both the layout and the distribution of settlements and material culture. We focus on three primary regions: the northeastern, southeastern, and central Tibetan Plateau.

Northeastern Tibetan Plateau

On the margins of the northeastern plateau, Majiayao painted pottery was replaced during the Qijia period (4250–3450 BP) by a new sequence of highly burnished, unpolished pottery often composed of double-handled vessels (Fig. 4). Qijia period sites have a wide distribution ranging from the western part of Qinghai Lake up to Tianshui in Gansu (Chen 2013). Like Majiayao period farmers, Qijia farmers still practiced millet agriculture and pig husbandry; however, small amounts of wheat and barley as well as pastoral animals have been found at Qijia sites (Chen 2013). In addition, both late Majiayao and Qijia sites contain some of the earliest known examples of metallurgy in East Asia. Metal work production is an important part of the archaeological record on the Tibetan Plateau in the subsequent period, which is sometimes referred to as the “Bronze Age.”

At around 3450 BP, a regional fragmentation and a diversification of material culture and lifestyles occurred across northwestern China and parts of the plateau. On the northeastern Tibetan Plateau, two roughly contemporaneous but distinct groups emerged: Kayue (3550–2750 BP) and Nuomohong (3300–2700 BP). Two contemporaneous groups—Siwa and Xindian—occupied lower-lying regions to the east (Chen 2013).

Kayue sites are distributed over a wide area in northeastern Tibet and have a mean elevation of 2791 masl (Dong et al. 2013) (Figs. 3 and 4). Many sites also are situated far away from river valleys, which suggests that the inhabitants of these sites were likely involved in some aspect of pastoralism (Dong et al. 2013). Kayue period pottery mimics that of the earlier Qijia period. They are characterized by double-handed jars that are sometimes decorated with a design interpreted as either yak horns or a ram’s head, signaling the potential importance of these animals in the Kayue economy. Bronzes that show clear connections with the steppe form a key component of Kayue assemblages, including small bronze knifes, *ge* daggers, small bells, buttons that could be attached to clothing, and beads (Fig. 8). Kayue burials contain small numbers of grave goods, such as painted double-handled *guan* jars with ram's head decoration, an occasional bronze knife or bell, or a spindle whorl and an occasional offering of an (often partial) animal (Fig. 8) (Qinghai Sheng Wenwu Kaogu Dui and Hainan Zangzu Zishizhouqun Yishuguan 1987; Qinghai Sheng Wenwu Kaogu Yanjiusuo 1998). There are very few known Kayue period settlements, and most Kayue materials have derived from graves.

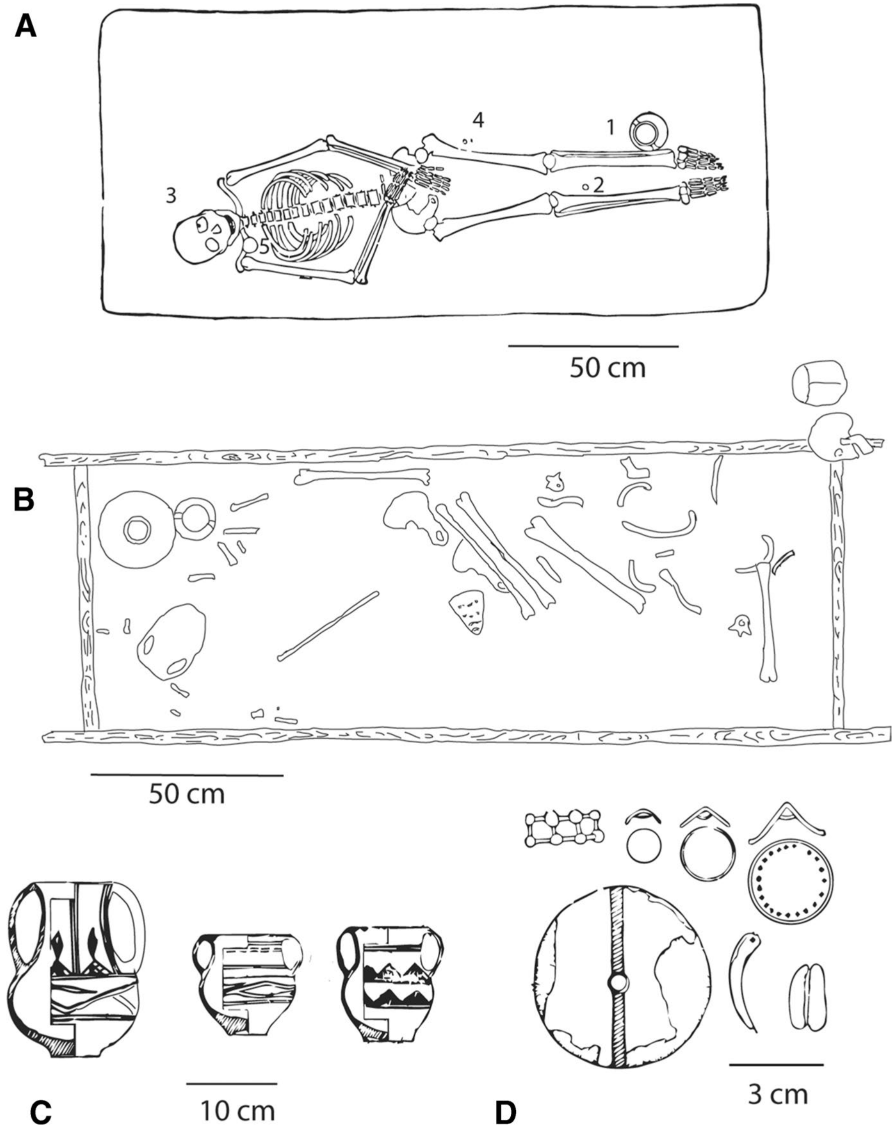

Fig. 8 Two typical Kayue burials and associated material culture. **A**: Qinghai Sulkhasa Tomb M74; **B**: Qinghai Sulkhasa Tomb M63; **C**: Kayue pottery from Sulkhasa; **D**: Metal and bone objects from Sulkhasa (after Qinghai Sheng Kaogu Yanjiusuo 1994, figs. 24, 25, 27, and 30)

Burial ritual has been used to make statements about ethnic identity and to connect archaeological remains with either Tibetans or other historically reported ethnic minorities. Unlike Majiayao-phase burials that are normally primary burials, a large portion of Kayue burials have been described as "secondary burials" by local archaeologists (Qinghai Sheng Wenwu Kaogu Dui and Hainan Zangzu Zishizhouqun Yishuguan 1987; Qinghai Sheng Wenwu Kaogu Yanjiusuo 1998). At Shangbanzhuwa, a wide range of different burials also were present, including single primary burials and secondary burials (Qinghai Sheng Wenwu Kaogu Yanjiusuo 1998) (Fig. 8). Finally, a number of burials that did not contain any human remains—cenotaphs—also were unearthed at the site (Qinghai Sheng Wenwu Kaogu Yanjiusuo 1998). Li (1999) has argued that these secondary burials held ritual meaning similar to that of Tibetan sky burials today and that these changes in burial ritual are associated with the development of a nomadic lifestyle. In contrast, Stoddard (2009) argues that sky burials only reached the plateau with the second diffusion of Buddhism c. AD 1000. As we argue below, far more osteological research is necessary before this type of connection might be made.

Osteological research has focused heavily on craniometry to determine the ethnic identity of the individuals buried the cemeteries. For Kayue graves, researchers in China have argued that connections exist between the individuals buried in these and modern eastern Tibetan populations (Han 2000; Zhang 1993, 2002). The analysis of aDNA is sorely needed to understand how people across the eastern plateau were related to each other, and more careful work on recording also is necessary to document what might be subtle differences in burial practices in very broadly defined units, such as at Kayue.

Discovered during survey in the late 1950s (Qinghai Wenwu Guanli Huiyuanhui 1960), Nuomuhong sites (c. 3300–2700 BP) share close connections to the Kayue but are located in higher-altitude areas of Qinghai (2700–4600 masl) (Dong et al. 2016). Talitaliha (2730 masl) (3000–2700 BP) (Qinghai Sheng Wenwu Guanli Huiyuanhui et al. 1963) in Dulan County Qinghai is one of the few Nuomuhong sites that has been properly published; the excavators argue that it represents the remains of early agropastoralists on the margins of the Tibetan Plateau. Talitaliha contains a number of unique architectural features, including nine small elliptical enclosures formed by rammed earth walls, some of which were still standing at over 2.5 m at the time of investigation (Dong et al. 2016; Qinghai Sheng Wenwu Guanli Huiyuanhui et al. 1963). These enclosed pits are 0.8–1.3 m in diameter and 60–80 cm deep. The excavators interpret these as food storage pits; however, a large quantity of manure from sheep, horse, cattle, and donkey was found in the interior of one structure that they believe served as an animal pen (Qinghai Sheng Wenwu Guanli Huiyuanhui et al. 1963). It also is possible that people stored dung as a fuel in this pit, much like Tibetans do today.

Houses at Talitaliha were square, with a surface area of 16 m^2 that likely housed a small nuclear family. In some houses, uncharred wooden beams were preserved, as was even a window, an obvious central hearth, and impressions of where pots were stored on the floor. A raised structure that contained multiple different holes is similar to traditional roasting stove tops used on the Tibetan Plateau today (Fig. 9) (Qinghai Sheng Wenwu Guanli Huiyuanhui et al. 1963). All the houses at the site were made out of mudbrick, a construction technique that is more reminiscent of Central Asia than of the wattle and daub technique used at Qijia and Majiayao.

Artifacts that show increasing relationships of exchange with the higher latitude Central Asian steppe were found at Talitaliha. For instance, three bronze knifes are identical to those at Tianshanbeilu in Xinjiang, which share similarities to knives of the Seima-Turbino complex in southern Siberia (Li 2011). Adzes and arrowheads dominate the lithic assemblage. Bone implements at the site, including awls, knives, and two spades made from cattle scapulae, indicate that the inhabitants of the site plowed fields. Because of excellent preservation at the site, a pair of shoes, argued by the excavators to be made out cow leather, also was recovered (Fig. 9). Unlike the Kayue sites, few to no burials have been recovered from Nuomohong sites, making it difficult to know how burial ritual might have been similar to or different from those at lower-elevation Kayue sites.

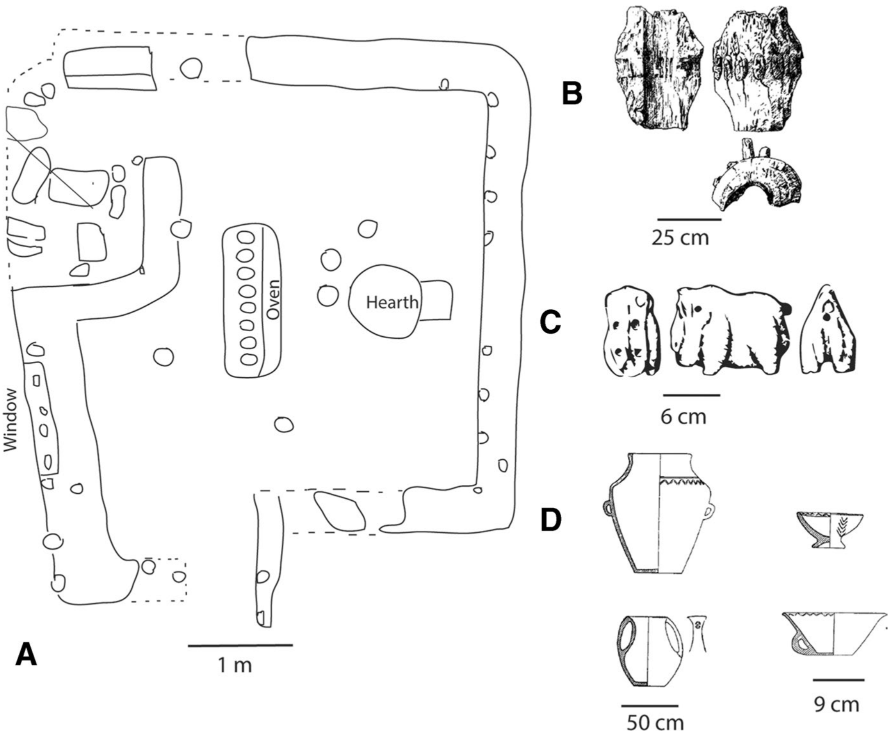

Fig. 9 Material culture from the Talitaliha site **A**: Nuomuhong house (F9) from Talitaliha (redrawn from Qinghai Sheng 1963, fig. 4); **B**: Wheel spoke (redrawn from Qinghai Sheng 1963, fig. 18); **C**: Yak figurine (redrawn from Qinghai Sheng 1963, fig. 20); **D**: Nuomuhong pottery (redrawn from Qinghai Sheng 1963, fig. 15)

Southeastern Tibetan Plateau

Following a visible hiatus in radiocarbon dates on the southeastern Tibetan Plateau after 4000 BP, there was renewed occupation in the region c. 3500 BP (d'Alpoim Guedes 2015; d'Alpoim Guedes et al. 2016). The next visible phenomena to appear in southeastern Tibet are various types of graves called "stone cist tombs," or *shiguanzang* in Chinese. The objects in these graves share close similarities to material from Kayue sites, leading some to suggest that new populations migrated into the southeastern plateau from the northeastern plateau during this period (Li 2011).

Although there is a huge amount of variability among tombs that use a stone cist, most contain double-handled jars that are similar to those known from Kayue sites; however, these are black and highly burnished as opposed to being painted (Fig. 10). Like Kayue burials, these graves contain steppe-style weapons and personal ornaments (e.g., ring-pommel knives, arch-backed knives, double-circle headed daggers, and ornaments depicting horses), suggesting that the inhabitants of the eastern plateau were part of long-distance networks of exchange that connected them to mobile pastoralists on the Central Asian steppe (Li 2011; Miyamoto 2015; Miyamoto and Gao 2013). A number of personal decorative items also characterize assemblages in

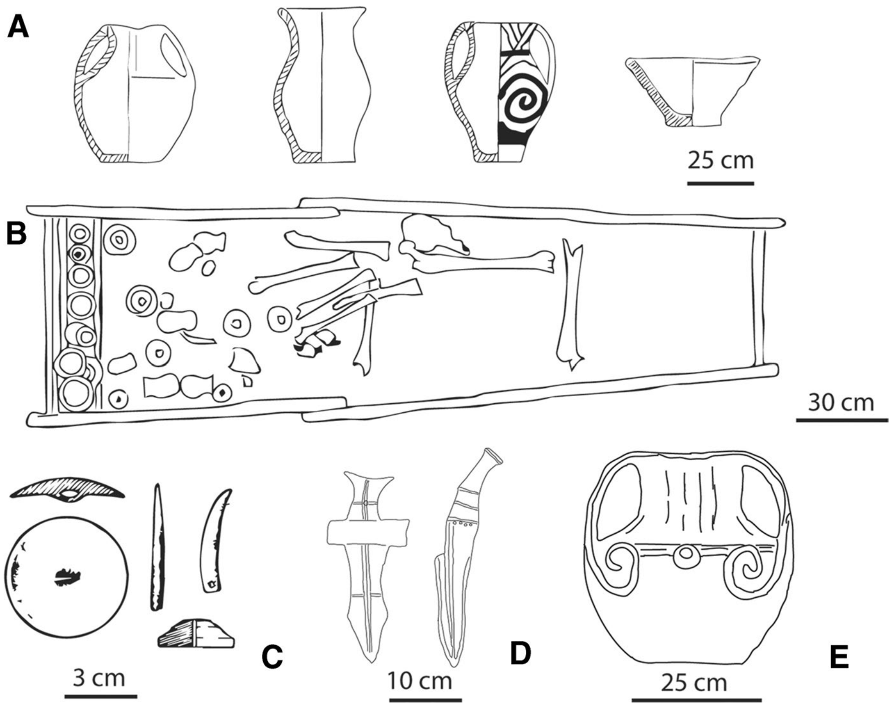

Fig. 10 Typical stone cist tomb and associated material culture. **A**: Pottery from Shiguanzang (after Xie and Jiang 2002, figs. 3 and 5); **B**: Yingpanshan M45 (after Chengdu et al. 2013, fig. 14); **C**: Bronze buttons (after Maowen 1981, fig. 16); **D**: Bronze daggers (after Miyamoto 2015, fig. 5); **E**: Shuanger'*guan* (after Miyamoto 2015, fig. 4)

these tombs, including turquoise beads and small round copper "bubble-like" buttons that were likely sewn onto clothing; the latter have been found in sites across the Central Asian steppe. For this reason, Li (2011) posits that stone cist burials spread to southeastern Tibet from the northeastern plateau.

Although occasionally a burial of an adult together with an infant has been found, cist tombs on the southeastern plateau are generally large enough to contain only a single burial. Yet cremations, secondary burials, and cenotaphs also are common. Li (2011) argues that the latter practices were used only when individuals died in places too far away to have their body buried at home.

At some sites, such as Yan'erlong, Gazalong, and Benjiadi, male skeletons are accompanied by halberds, stone adzes, and bone gimlets, whereas female skeletons are associated with ornaments and tools for working fabric such as bone needles (Miyamoto 2015; Sichuan Sheng Wenwu Kaogu Yanjiusuo et al. 2012). These patterns indicate that divisions of labor were present in this society. Material in elite burials seems to emphasize prowess in battles, raids, or military exploits. The occupant of a tomb at Zidazhai (SLM1) on the southeastern plateau was flanked by a wooden shield that was covered in bronze bosses. This individual wore a defensive bronze wrist band and was interred with a large number of daggers, and its head was covered with round bronze plaques that reinforced a textile or leather helmet. A belt hook in the burial indicates that traditions of wearing pants had already arrived in the region. One cenotaph in Mutuo in Maoxian County contained over 250 artifacts that had originated both from steppe and lowland China: bronze bells, rich personal ornaments, and 46 bronze weapons (Maoxian Qiangzu Bowuguan et al. 2012; von Falkenhausen 1996).

Until very recently, no habitation sites of this time period were known from the southeastern Tibetan Plateau, suggesting that human settlement patterns focused on mobile strategies at least in parts of the area (d'Alpoim Guedes and Hein 2018). However, in the last five years, four sites have been discovered: Shidaqiu (Chen Jian, personal communication 2013), Mu'erxi (Aba et al. 2007), Ashaonao (d'Alpoim Guedes et al. 2015b; Lu et al. 2010,), and Yan'erlong (Sichuan Sheng Wenwu Kaogu Yanjiusuo et al. 2012).

Small-scale excavations at Ashaonao (2768 masl) (2750–1951 BP) in the Jiuzhaigou National Park uncovered a multiroom house that was constructed with a combination of mudbrick, stone, and wood. The interior part of the house appears to have been finished with a mud floor that was constructed using a roughly 3-cm thick layer of white to gray mud, the surface of which was compacted after years of use (Lu et al. 2010; Sichuan Daxue Kaoguxi et al. 2018). A storage pit that had been carefully lined with mud was found in one edge of one room. This pit contained debris from the destruction of the building but also the remains of pottery and an iron sickle (d'Alpoim Guedes et al. 2015b).

Central Tibetan Plateau

It is unclear how these emerging traditions of material culture on the eastern Tibetan Plateau relate to emerging traditions in central Tibet. Two settlements, Changguogou (3570 masl) and Qugong (3700 masl), contain important evidence for life on the central Tibetan Plateau after the fourth millennium BP (Li and Zhao 1999; Zhang and Dui 1985; Zhongguo Shehui Kexueyuan Kaogu Yanjiusuo 1999). An additional key settlement, Bangga, is currently being excavated by Sichuan University (Lu 2016b).

Small-scale excavations and surveys have been carried out at Changuogou (3450–2650 BP), but proper maps of these excavations have never been published (Li and Zhao 1999). More extensive excavations at Qugong revealed two key periods of occupation: an ephemeral "domestic" habitation (3700–3000 BP) and a second period characterized by intrusive graves (2807–2350 BP). No house features were visible in excavation units, leaving us little information on settlement layout; however, a number of ash pits were unearthed that contained remains of lithics, pottery, bone instruments, and other tools. These trash pits were relatively large, suggesting that whoever created them might have spent a substantial amount of time at the site, which hints at a relatively sedentary lifestyle (Xizang Wenguanhui Wenwu Puchadui 1985; Zhongguo Shehui Kexue Yuan Kaogu Yanjiusuo and Guanliju 1999). However, the lack of domestic architecture at the site makes it possible that the inhabitants occupied the site on a more ephemeral basis. It is also possible that buildings were located in another unexcavated portion of the site.

The pottery assemblage at Qugong does not share clear parallels with materials on the eastern Tibetan Plateau, suggesting that the occupants of this site had a different origin, or that this tradition of pottery developed independently on the plateau (Fig. 11). Stone and bone tools from the site seem consistent with an assemblage focused on hunting and potentially hide production; these include ground stone tools with a comb-like appearance that might have been used to degrease hide alongside bone awls, needles, and arrowheads.

The burial evidence from Tsang and U-Tsang is patchy and not has been as systematically documented or excavated as burials in eastern Tibet. In addition, very few of these tombs have been directly dated, making it difficult to place them in a solid chronological framework. While the majority of these burials are subterranean and placed inside a stone chamber, the chambers differ from those in eastern Tibet in that they are not made with vertically placed slabs to construct a coffin but rather horizontally piled stones to build walls that enclose a small square space (Fig. 11). While supine or secondary burials are the norm in tombs in eastern Tibet, in the central plateau individuals appear to have been buried in a fetal or flexed position.

The tradition of burials in a square stone cist with individuals placed in a flexed position seems to be distributed along the Jinsha, the Maqu, and Lancang Rivers ranging from Chamdo in the north all the way south to Deqin in northwestern Yunnan Province. Very little material has been found in these tombs aside from the occasional piece of pottery, bronze knife, cowrie shell, or turquoise bead. It is clear that the individuals in these tombs exchanged (or imitated) pottery with individuals buried in primary supine burials in stone cists. This is not surprising as there is somewhat of an overlap in their distribution. There is unfortunately very little radiocarbon dating on this type of burial, with a few exceptions. Dates on two tombs at Qugong range between 3450 and 2350 BP (Zhongguo Shehui Kexue Yuan Kaogu

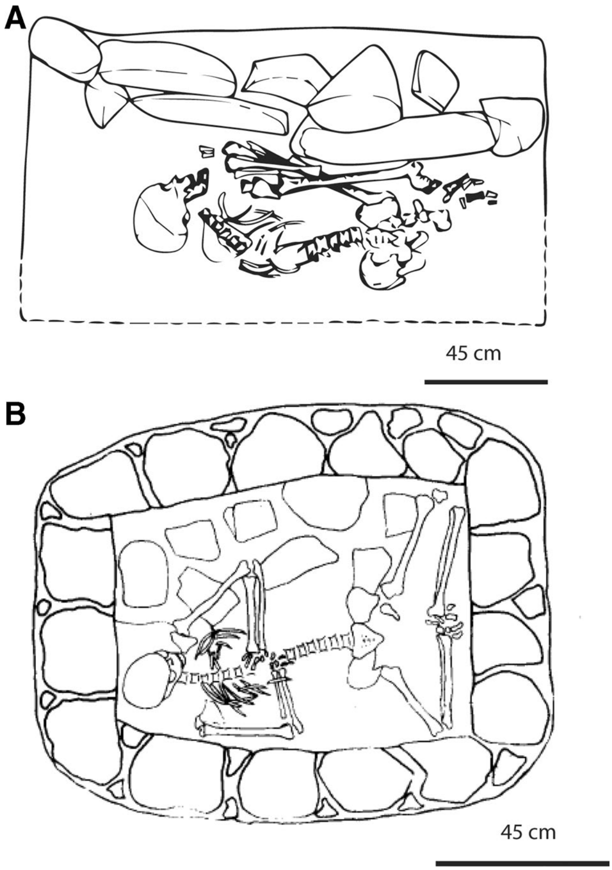

Fig. 11 Square stone cist burials. **A**: M207 from Qugong (redrawn from Zhongguo Shehui Kexueyuan 1999, fig. 130); **B**: M2 from the Xiangbei (redrawn from Xizang Wenguanhui 1989, fig. 2)

Yanjiusuo et al. 1999), and another at Zhongdian ranged between 2950 and 2750 BP (Yunnan Sheng Wenwu Kaogu Yanjiusuo 2005).

Identity and Burial Ritual on the Tibetan Plateau

Better osteological research and documentation of the graves is necessary to determine the exact type of mortuary practice that led to the appearance of a secondary burial in both Kayue, Nuomuhung, as well as the various types of stone cist burials across the central and eastern plateau. Were these reductions or true secondary burials? In a reduction, the grave is reopened, and the bones are rearranged after decomposition; however, true secondary burial implies that the body decomposed or was otherwise defleshed in another location, after which the bones were brought to the tomb. Carrying out a systematic inventory of the bones can help distinguish between these two different types of burial ritual. For instance, if bones such as phalanges, whose labile connections are the first to give way during decomposition, are present, one is likely looking at a reduction. The absence of these bones may imply that the body decomposed elsewhere and is a true secondary burial. Postmortem processing such as active removal of flesh may also account for some "secondary burials," as recent evidence from later sites in Upper Mustang in Nepal is beginning to show (Aldenderfer and Eng 2016). The presence of true secondary burials and cenotaphs may point to increasing mobility during at this time, which possibly made it difficult to transport the bodies of individuals back to a more appropriate burial locus. However, much more systematic work on these burials and systematic survey aimed at understanding settlement patterns in the region need to be carried out before such a connection can be made. The dearth of systematic osteological analysis in China, in general, means that we still have a very long way to go before we can understand how burial ritual changed on the margins of the eastern Tibetan Plateau.

Attempting to create historiographic links between archaeological remains and peoples mentioned in early texts has been prevalent throughout Chinese archaeology as a means of contributing to the understanding of the origins of the Chinese nation state and the writing of national history (Hein 2016, von Falkenhausen 1993). Research on the Tibetan Plateau has often been marked by this type of political flavor, where it plays a key political role in tracking the origins of the multiple ethnic groups that occupy the People's Republic of China into a coherent and stable political unit (Hein 2016). On both the northeastern and southeastern plateau, a range of scholars, both Chinese and Western, have attempted to link cultural remains from the eastern Tibetan Plateau to peoples mentioned in early Chinese historic texts, such as the Qiang (Hummel 2000). Chen (2013) links the discovery of cremated burials in the Qijia site of Mogou to a historic passage in the *Lushi Chunqiu* that describes the Qiang as practicing cremation as a form of burial ritual. He also links discoveries of white stones in Qijia burials to ethnographic Qiang practices of piling white stones. Li (2011) argues that this same practice was shared by the creators of the stone cist tombs in western Sichuan. Tong (1978) combined data from his excavations with historical texts and ethnographic literature to try to establish the ethnic identity of the stone cist tomb builders, which he concluded were the *Ge* or *Di* people mentioned in the *Shiji* (completed around 94 BC), the *Hua Yang Guozhi* of the fourth century AD, and the *Hou Han Shu* of the fifth century AD. He does so on the basis of a contemporary Qiang oral tradition that states before they arrived in this region, their predecessors, the *Ge*, were buried in slate cist graves. Trying to establish the ethnic identity of the individuals buried in these tombs is a tradition continued by later archaeologists working in the region (Cang 1984; Chen 1981; Li and Li 1986; Li 1985; Shen and Li 1979), who variously connect the builders of the stone cist tombs to *Qiang*, *Ge*, or *Di*.

Ye (2016) argues that the Qiang originated from the Yangshao, Majiayao, then Qijia cultures in low-lying northwestern China. Thus, the Qiang ethnic group represents an offshoot from a culture that originally arose in Central China, situating the origins of Tibetan groups firmly in the Central Chinese heartland.

Our aim is not to expound on how obviously problematic these connections are given the wide range of literature on the problems associated with attempting to make linkages between material culture and groups of people. Current approaches to identity in Tibetan archaeology have tended to essentialize conglomerations of material culture, not taking into account that identity is highly situational and fluid rather than bounded. The material culture itself is, moreover, clearly being interpreted within the necessities of the political context of the present. Far more detailed work is necessary to move this discourse from one of essentialism to one that examines the communities of practice.

Later Developments on the Western Plateau and the High Himalayan Valleys

Relatively little systematic archaeological research has been conducted on the western plateau, the surrounding high Himalayan valleys of northern Nepal, and northwestern India in Ladakh and Spiti, limiting opportunities for fruitful comparisons with cultural developments to the east. Textual sources from the tenth century AD and later describe a polity named Zhangzhung (or Shangshung) and place its capital at *Khyung-lung dngul-mkhar* in what is now Ngari Prefecture. The polity, which is identified as a great rival to the emerging Tibetan empire, was conquered by the first Tibetan emperor, Songsten Gampo, in the mid-sixth century AD. The origins of Zhangzhung are much debated; some ecclesiastical studies written by Bon religion adherents place it far back in time, more than 60,000 years ago. What little archaeological evidence we have, however, identifies a minimal date for Zhangzhung at c. 2350 BP and, perhaps, somewhat earlier (Aldenderfer 2006, 2018). The site, on top a high mesa, has a wall around its perimeter, a warren of residential structures alongside corrals and animal pens, and what appears to be public or ritual architecture. There are other large residential complexes on the valley floor. Although little is known in detail about Zhangzhung as a polity, it does offer a model of what the archaeologically unknown preimperial polities of central Tibet may have looked like.

Although settlement data are lacking, a number of projects have examined in some detail mortuary traditions contemporary with Zhangzhung that may well be local expressions of its hegemony across the region. These traditions cover an area that ranges from Upper Mustang in Nepal, Ngari in Tibet, Himachal, and Uttar Pradesh. Current archaeological works on burials in western Tibet at Chuvtag and Gurugyam (Zhongguo Shehui Kexue Yuan Kaogu Yanjiusuo et al. 2015), in Ladakh at Malari and Leh (Bhatt et al. 2008), and in Upper Mustang at Mebrak (Alt et al. 2003) and Samdzong (Aldenderfer 2013; Aldenderfer and Eng 2016) have revealed a wide and diverse range of burials that span roughly 2400–1200 BP (or 400 BC to the fifth–sixth century AD). Although burial posture and the construction of funerary chambers varied widely across the region, a tradition of placing gold masks in burials appears to have been widespread (Aldenderfer 2013, 2016; Bellezza 2008; Huo 2016; Tao and Li 2016).

A New Economic Model

Wheat, barley, and many of the pastoral animals important to the Tibetan economy today were first domesticated in the Near East and then spread to the Tibetan plateau through a long process of diffusion. Barley is most commonly associated with the Tibetan Plateau and today accounts for 65% of total food production in the Tibet Autonomous Region (Laurent 2015; Li 2010).

A number of different morphological traits indicate that humans may have begun to interfere with the lifecycle of a plant. One of these traits is the development of a nonshattering rachis, a mutation that was selected for as humans had a higher probability of harvesting seeds that remained attached to the plant. This indicates that humans had begun to harvest and replant seeds. The majority of crops have evidence of only a single genetic mutation for such traits, indicating that domestication took place once (Allaby 2015); however, genetic studies on barley indicate that this mutation took place at least twice and that barley can be divided into two key populations, one eastern and one western (Morrell and Clegg 2007). The exact location of the eastern center of domestication, however, has been the subject of some debate. Early work on Tibetan wild barley suggested that Tibet may have been an independent center of barley domestication (Ma 1987; Xu 1982). Based on a genome-wide study, Dai et al. (2012) argue that Chinese naked and six-row barleys are more closely related to Tibetan wild barley than to Near Eastern wild barley, leading them to suggest a separate center of domestication in Tibet. However, recent genetic analysis suggests that the picture might be more complicated than one of simple "centers" of domestication.

Botanists have long known that wild populations of barley have very wide distributions across the Old World (Zohary 1969). Poets et al. (2015) used single nucleotide polymorphisms (SNPs) to examine individual variations within the barley genome and found that wild barley populations could be divided into a number of different regional groups: central Europe, eastern Africa, coastal Mediterranean, and Asia. Wild barley in the region made a contribution to the domesticated barley genome, with wild Asian groups showing a closer relationship to domesticated barleys in the region (Poets et al. 2015). Rather than being a separate center of domestication, it is possible that each of these populations contributed traits that enhanced the adaptiveness of domesticated barleys introduced to the region. In Tibet, it is possible that adaptions that enabled barley to cope with high altitude, such as increased frost resistance, may have assisted the selection of strains that had hybridized with local wild barleys (Zeng et al. 2015).

Where and when wheat and barley first spread to East Asia has been a topic of interest in the archaeobotanical community, and the plateau plays an important role in this research (Barton and An 2014; Boivin et al. 2012; Dodson et al. 2013; Jones et al. 2016). The Tibetan Plateau is situated between East Asia and the Harappan cultural sphere, where both crops were present as early as 9000 BP (Constantini 1984). Wheat and barley appeared in several key locations around the borders of the Tibetan Plateau during the Early Holocene (d'Alpoim Guedes et al. 2013). Introduction of wheat and barley from the northeastern Tibetan

Plateau (Chen et al. 2015) has been the favored model, as it conforms with explanations related to the spread of goods during the fourth millennium BP via the “Inner Asian mountain corridor” that skirts the Taklamakan Desert to the south and Inner Asian mountains to the north (Frachetti et al. 2010). Indeed, the earliest evidence of these crops on the Tibetan Plateau comes from its northeastern margins, where grains have been unearthed from Qijia and later Kayue sites identified during surveys where they began to replace millets after 3700 BP (Chen et al. 2015). Jones et al. (2016) argue that haplotypes of the photoperiod Ppd-H1 gene support this Inner Asian mountain corridor model for the spread of these crops (and a second coastal route) (Jones et al. 2016).

However, recent finds from the southeastern, southern, and western Himalayas complicate this picture of a single direction of introduction (d’Alpoim Guedes et al. 2015b; Spate et al. 2017). When wheat and barley appeared in northwestern China and East Asia, they were not accompanied by the suite of Near Eastern crops that were grown in the Indus or in southwestern Asia—lentil, pea, flax, and oat. On the southeastern Tibetan Plateau at Ashaonao (3350 BP), wheat and barley appeared together with flax, a crop that was cultivated throughout southern and southwestern Asia but is not known from any other assemblage in East Asia (d’Alpoim Guedes et al. 2015b). Likewise, on the central Tibetan Plateau wheat and barley were present at Changuogou (3450–2650 BP) along with a suite of other Near Eastern domesticates like pea and oats (Fu 2001, 2008; Fu et al. 2000). Although there are very few settlement data, by the Chokhopani phase (2950–2400 BP) in Nepal, we know that individuals buried at Mebrak and Phudzeling in the Kali Gandaki River valley were exchanging barley, rice, buckwheat, and flax with individuals in lower elevations (Knörzer 2000). At Qasim Bagh in Kashmir, wheat and barley are found with Chinese broomcorn millet but also lentil, pea, and oat (Spate et al. 2017). These data suggest that the southern Himalayas and the Tibetan Plateau played an important role in crop transmission across Asia (see also Stevens et al. 2016) (Fig. 11). One possible alternate route to the Inner Asian mountain corridor via which the transmission of both crops and animals may have taken place is through Assam, Sikkim, Arunachal Pradesh, Nepal, and Bhutan, all areas that contain conduit valleys to the Tibetan Plateau. These areas remain important, but to date unexplored, conduits over which a great deal of exchange may have taken place.

Buckwheat was likely a native Himalayan domesticate. The wild progenitor *Fagopyrum esculentum* ssp. *ancestralis* is distributed primarily in the southwestern Hengduan mountain chain, and *F. tataricum* ssp. *potanini* has a larger range of distribution that encompasses large parts of the southern Himalayan arc, southwestern China, and the Hengduan mountains (Hunt et al. 2018; Ohnishi 1998). The earliest known finds of buckwheat around the margins of the plateau come from Haimenkou in Yunnan, 2720–2170 BP (Xue 2010). *F. esculentum* and *F. tataricum* appeared at Mebrak and Phudezling in 2950 BP (Knörzer 2000) and at Kohla in Nepal (Asouti and Fuller 2009) and Kyung-lung Mesa (d’Alpoim Guedes et al. 2013; Song et al. 2017) during the first millennium AD, where remains are argued to be either wild or *F. tataricum* (Fig. 12).

To what extent early Tibetans relied on barley farming and the extent to which it enabled a permanent habitation of the plateau has been the subject of debate

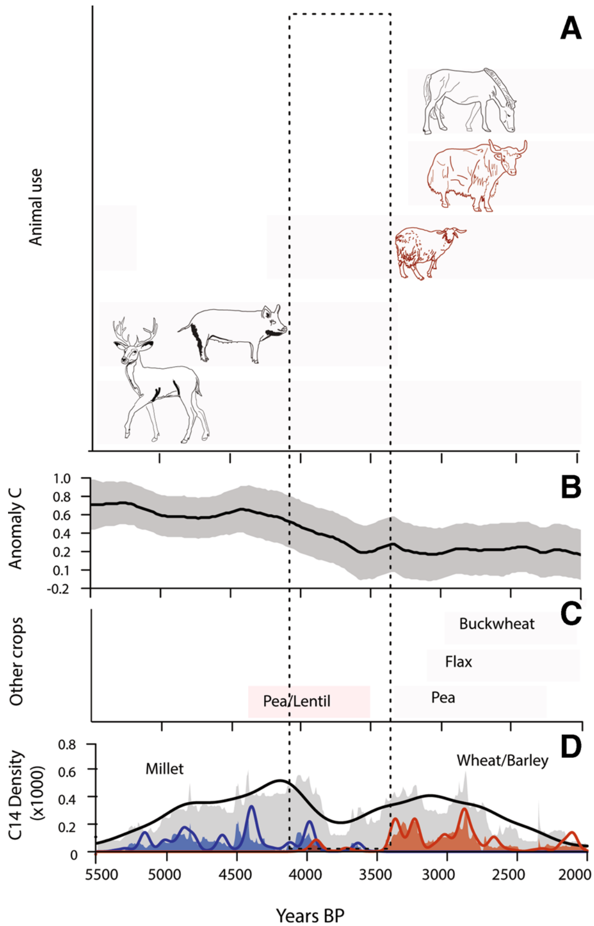

Fig. 12 General patterns in the spread of key domesticates across the plateau. **A**: Dated evidence for animal use across the plateau. Deer represents wild animal usage. Animals in red represent animals for which evidence of domestication is poorly documented; **B**: Holocene temperature anomalies Northern Hemisphere data (Marcott et al. 2013); **C**: Appearance and use of key crops. Pink represents Qasim Bagh on the borders of the western plateau; **D**: Radiocarbon dates on crops on the eastern Tibetan Plateau. Blue represents millets, red represents wheat and barley (Color figure online)

(Bellezza 2017; Chen et al. 2015; d'Alpoim Guedes 2015, 2016; Flad 2016; Lu 2016a). Unlike earlier millets, wheat and barley are frost tolerant, which allowed humans to continue growing these crops under the cooler temperatures that characterized the postclimatic optimum plateau (d'Alpoim Guedes et al. 2016). Following d'Alpoim Guedes' (2013) work explaining why millets fell out of the diet and were replaced by wheat and barley, Chen et al. (2015) employed this framework to assert that on the northeastern plateau these two crops enabled Tibetans to permanently install settlements at altitudes up to 4000 masl. We have argued, however, that the mere presence of grains at high-elevation sites does not constitute evidence for in situ farming. Viewing the spread of farming products to the plateau as a wave of advance overlooks how humans adapted to the wide range of ecological niches that constitute the plateau and developed economic strategies that allowed them to specialize within these niches and travel between them (d'Alpoim Guedes et al. 2015a, 2016). Further, the Chen et al. (2015) model ignores the very large body of genetic and archaeological data that make it clear there was a permanent population resident on the plateau well before 3600 BP (Meyer et al. 2017). Models that focus only on the use and importance of farming grain also ignore the contributions made by Tibetans who practiced pastoralism. Pastoralists played an important role in allowing humans to exploit the different niches of this high-altitude environment. Pastoralists often carry grain with them when driving animals to higher-elevation lands that contain rich pasture (e.g., Browman 1974; d'Alpoim Guedes 2015; d'Alpoim Guedes et al. 2015a).

While it is possible that sheep may have been independently domesticated on the Tibetan Plateau (Bo 1986), potentially from *Ovis orientalis* (Chen et al. 2006), there is no conclusive evidence to support this claim. The earliest directly dated and genetically identified remains of domesticated sheep (*Ovis* sp.) that were foddered with millets are from Inner Mongolia; Ningxia and Shaanxi have been dated to 6650–5950 BP (Dodson et al. 2014) (Fig. 12). Generally, sheep/goat remains increase in proportion in archaeological sites in East Asia after 4000 BP (Cai et al. 2007). For a comprehensive treatment of this issue, see Flad et al. (2007), who summarize the evidence for sheep, goat, and cattle in East Asia. Although systematic zooarchaeology has yet to be carried out in Bronze Age sites on the southeastern Tibetan Plateau, preliminary zooarchaeological evidence from Ashaonao shows that large quantities of sheep and goat were consumed along with pheasant (*Phasianus* sp.), muntjac (*Muntiacus* sp), bamboo rat (*Rhizomys* sp.), and cattle (Sichuan Daxue Kaoguxi et al. 2018).

Cattle domestication is thought to have taken place twice, one in the Near East with taurine (humpless) cattle (*Bos taurus*) and once in South Asia with Zebu (*Bos indicus*) (Meadow 1993). Although recent work indicates that independent attempts to manage wild *Bos* sp. may have taken place in the Early Holocene in China (Zhang et al. 2013), recent genetic analysis of cattle at sites that date from 5000 BP suggests that taurine cattle were introduced to China, possibly from the Near East. It appears that zebu cattle did not arrive in China until c. 3500 BP (Cai et al. 2014). It is unclear what if any contribution these made to cattle that moved onto the plateau; however, recent genetic studies suggest that taurine cattle made a substantial contribution to the genetic makeup of modern yaks (Qi et al. 2010). Yaks are frequently crossbred with domestic cattle. This hybrid is known as *dzo*. *Dzo* are valued for their increased milk production and ability to adapt to the lower altitudinal range for yaks (between 2500 and 3500 masl) (Rhode et al. 2007a).

The yak (*Bos grunniens*) is the domestic animal most commonly associated with Tibet. Yaks have a set of traits that have allowed them to adapt to the high-altitude environment of the plateau: a thick coat that keeps them warm in freezing winters, increased heart and lung size, and increased foraging ability through an adapted tongue that allows them to easily eat the low-lying forage grasses that characterize areas of the plateau (Shao 2010). They likely diverged from wild cattle 4.9 million years ago and adapted to the plateau over the course of its uplift (Qiu et al. 2012). Recent genetic comparisons of the yak to cattle have found that yaks possess unique adaptations to the low oxygen conditions of the plateau; they identified an expansion of protein domains associated with hypoxic stress and nutrition metabolism, both traits that were likely important over the course of its evolution on the plateau (Qiu et al. 2012).

Yaks provide important resources for millions of Tibetans, not just as meat but also as secondary products such as milk, hide, and fur that can be spun into black tents that retain moisture when it rains and prevent the tent from leaking. Yak dung provides not only a vital fuel source (Rhode et al. 2007a) but also serves as construction material in walls, enclosures, storage houses for frozen meat, dog houses, tethers to which dogs and yaks can be attached, and even for manufacturing toys (Lan 2010). Rhode et al. (2007a) have argued that meeting fuel needs may have led to the integration of the yak into early foragers' survival mechanisms on the plateau and eventually its domestication.

Unfortunately, there is currently very little concrete evidence for yak domestication in the archaeological record (Fig. 12). Physical evidence of yak skeletal remains is scattered at Nuomohong sites on the northeastern portion of the plateau, including Xiariyamakebu and Tawendaliha (3300–2700 BP); however, only their presence is noted, and it is not clear if they show signs of domestication (or what these signs of domestication might look like in yaks). At Talitaliha (3000–2700 BP), a clay sculpture of a yak demonstrates the importance this animal may have held for the site's inhabitants (Qinghai Sheng Wenwu Guanli Huiyuanhui et al. 1963). At Qugong, a yak skull was unearthed in an ashpit that dates to roughly 3650 BP (Zhongguo Shehui Kexue Yuan Kaogu Yanjiusuo et al. 1999). The authors argued that because of the relatively small size of the horns of the animal, it was likely domesticated (or hybridized with cattle). Yak skulls also were present in Samdzong 5 at AD 450 (Aldenderfer and Eng 2016). Historic documents dating to roughly 2450 BP suggest that hybridization with cattle had already begun to take place on the margins of the plateau (Rhode et al. 2007a).

Some have argued that there is evidence for an environmental signature for the creation of grazing lands associated with yak pastoralism in pollen records early as 8000 BP (Miehe et al. 2009, 2014). These suggestions are at odds with recent studies on wood charcoal from the northeastern plateau, which show that spruce woodland expanded over the course of the Holocene until about 4000 BP, when modification of the landscape due to pastoralism had not yet taken place (Rhode 2016b). They also predate the know arrival of other pastoral animals to the plateau.

Others argue that the actions of yak pastoralists resulted in an anthropogenically modified environment only later (c. 5900 BP), a date that still predates any physical evidence for yak exploitation (Meyer et al. 2009; Schlütz and Lehmkuhl 2009). Genetic data have not been helpful in resolving this debate; some genetic papers predict a very early domestication (c. 10,000 BP) (Guo et al. 2006), while other MtDNA data suggest it took place twice roughly 5000 years ago (Bailey et al. 2002; Rhode et al. 2007a). However, more recent assessments suggest that the divergence of mtDNA in yaks took place prior to its domestication (roughly 100,000 years ago)

(Li et al. 2014). Future genetic analysis on archaeological specimens may help us resolve the timing of yak domestication.

Finally, another key animal to the Tibetan economy is the horse. Recent work in Mongolia dates the beginning of domestic horse burials to roughly 3250 BP (Taylor 2017; Taylor et al. 2017). Many of these horses had deformations along their nasal bones and premaxillae that are consistent with wearing bridles, indicating these horses were already mounted (Taylor et al. 2015). Shortly after, horse and chariot sacrifices appear in central China at sites like Yinxu c. 3200 BP (Anthony and Vinogradov 1995; Barbieri-Low 2000; Shaughnessy 1988). On the Tibetan Plateau, entire horse skeletons were placed in "sacrificial features" at Qugong, but these have not been directly dated (Zhongguo Shehui Kexue Yuan Kaogu Yanjiusuo and Guanliju 1999). Similar horse sacrificial burials are known from across the central Asian steppe (e.g., Allard and Erdenebaatar 2005; Fitzhugh 2009), suggesting that Tibetans engaged in traditions of ritual practice that were beginning to form across the steppe. In the eastern plateau, at Jililong in Ganzi, a horse head and leg were accompanied by the skeleton of two dogs placed on top of the sealed burial of a 35–40-year-old man in a cist tomb (Sichuan Sheng Wenwu Guanli Weiyuanhui 1986). Unfortunately, there are no direct radiocarbon dates associated with the latter two features. Although currently not published, horses have also been unearthed at the Butaxiongqu cist tomb that has been directly dated to between 2710 and 2360 BP (Lu et al. 2016). Horse teeth also were unearthed in a similar cist tomb at Xiangbei in Gongjiao County (Xizang Wenguanhui Wenwu Puchadui 1989) and a single burial from Xiao'enda (Xizang Wenguanhui Wenwu Puchadui 1990). On the southwestern borders of the Tibetan Plateau in the Yanyuan Basin (2000–2500 masl), horse skulls have also been interred with burials associated with warriors (Hein 2014)

At Nuomuhong sites, horse bones as well as wooden wheel boxing and spokes suggest that horse-harnessing technology was present on the northeastern plateau by 3300–2700 BP (Dong et al. 2016; Qinghai Sheng Wenwu Guanli Huiyuanhui et al. 1963). At Chuvtag (2350–2050 BP) (Chinese Academy of Social Sciences: Institute of Archaeology and Cultural Relics Conservation Institute of Tibet Autonomous Region 2016) horse heads were placed with bits in their mouths as offerings in the tombs, confirming that they were mounted and domesticated animals. A complete horse skeleton dated to 2450–1850 BP was recovered from the Gelingtang mortuary complex in far western Tibet (Aldenderfer 2013; Jiaoyubu 2008). In later sites such as Mebrak in Mustang, Nepal, horse remains have been unearthed from deposits dating to roughly 2300–2000 BP (Alta et al. 2003; Simons et al. 1998).

The introduction of the horse likely changed the way humans occupied the Tibetan Plateau in several ways. Transport on horseback made it easier for humans to cross larger distances in shorter amounts of time, which increased Tibetan's ability to engage in longer-distance patterns of trade and exchange that characterize subsistence on the Tibetan Plateau. If ethnographic and historic examples of the introduction of the horse to the Americas are any guide, then it is possible that the introduction of the horse also changed the way that humans on the plateau hunted and herded wild and domestic animals (Hamailanen 2003; Osborn 1983; Wissler 1914).

We still have much work to do to understand how pastoral economies first emerged on the Tibetan Plateau. Future archaeological research on the plateau should be careful to not conceive of pastoralism as one monolithic practice but should strive to reveal the wide range of different strategies humans on the plateau have ethnographically employed with pastoral animals. These range from nomadic pastoralism (Goldstein and Beall 2002), seasonal transhumance (Tan 2013), and simple foddering of pastoral animals by otherwise sedentary farmers. Each of these has fundamental implications for human mobility and settlement on the plateau. Additional research to detect these different patterns of mobility is sorely needed so that Tibetan archaeology can work toward understanding these pastoral economies in all their complexity. Thankfully, we can draw inspiration from similar detailed studies carried out in other areas of the steppe (Honeychurch and Makarewicz 2016; Kirsanow et al. 2008; Makarewicz and Tuross 2006, 2012).

Moving Archaeology Forward on the Tibetan Plateau

Over the next decades, essential and basic-level documentation and excavation of a wider number of sites on the plateau is crucial to understanding spatial and temporal variability, especially in the wide swathes of the plateau where little to no research has been carried out. Likewise, systematic surveys aimed at documenting regional patterns of settlement across the landscape are sorely needed to replace the haphazard work or very small-scale work that has characterized the area to date. This will be essential for moving beyond blanket statements of, for example, "subsistence patterns on the plateau" to arguments that account for the likely wide variability that existed in this region's highly diverse ecological niches.

Many sites we discussed were excavated prior to the systematic application of AMS radiocarbon dating. Systematic application of radiocarbon dating will be essential to resolving basic questions of chronology, particularly in the central and western plateau.

Compared to other areas of the world, archaeology on the Tibetan Plateau is still in its infancy, yet the increasing application of archaeobotanical, zooarchaeological, and genetic research to both old and newly excavated material from the plateau has allowed us to begin to answer basic questions about the plateau's habitation and the introduction of agricultural and pastoral products. To date, this research has focused primarily on identifying key animal and plant species and dating the timing of their arrival.

To date, archaeobotanical research has been more systematically applied than zooarchaeology. Sampling is a particularly big issue in zooarchaeological assemblages on the plateau, and animal bones have not been derived through systematic sieving. This has likely biased zooarchaeological assemblages toward larger ungulates, potentially ignoring the wide range of fish and birds that may have been consumed by the inhabitants of the plateau. Future zooarchaeological research on the plateau should aim to move beyond simply documenting the presence of different species to examining age-at-death (mortality) and sex of prey. This would help us differentiate between hunting and pastoral lifestyles, help delineate the harvesting strategies employed by the region's first herders, and establish if milk, meat, tender meat, and/or wool were production goals (Helmer and Vigne 2007; Payne 1973). Notwithstanding increased systematic archaeobotanical research, large swathes of the plateau have not been targeted, and higher spatial resolution of the distribution of these remains is necessary. The application of strontium stable isotopes could also help us resolve if such products were traded over long distances as they have been in the ethnographic record (d'Alpoim Guedes et al. 2016).

With some exceptions (Eng and Aldenderfer 2017), research on human osteology has lagged far beyond the other archaeological sciences. In a region where historically complex patterns of burial ritual and treatment of the body have been at play, systematic study of cut and wear patterns on human bones as well as detailed studies of their positioning could help us resolve questions about the evolution of identity and burial ritual on the plateau. More detailed studies on paleopathology and demography could also resolve basic questions about life expectancy and disease load in high altitude. This would allow us to begin to resolve questions about the formation of ethnic identity that go beyond the current diffusionistic paradigms that have characterized research in this region.

The preimperial period on the plateau continues to be poorly understood and researched. It is well known from secular and ecclesiastical documents that the nascent Tibetan empire was formed by Songsten Gampo in the mid-seventh century AD. There is little archaeological evidence, however, that frames the social and political contexts of the polities that existed on the plateau from roughly 500 BC to AD 650. Textual sources identify clan names, their likely locations, and aspects of their interrelationships, but there are no settlement pattern studies or excavations that can be used to support the statements made in these texts. We do not know if these were chiefdoms, petty states, or more irregular political formations. This is perhaps the next great frontier for archaeology on the plateau—a systematic effort to define on the ground the extent and organization of these early polities. These most basic issues of documentation are necessary before we can truly move the archaeology of the plateau onto more interesting theoretical ground.

Future research on the plateau should attempt to more actively engage active debates about the slippery nature of identity that have been the mainstay of archaeology over the past 30 years. Such approaches should more critically examine the use of historic texts and modern narratives of nation building as well as attempt to carry out a more detailed analysis of communities of practice at both the site and regional level.

Acknowledgments Jade d'Alpoim Guedes is grateful to the funding provided by the Chiang Jing Kuo Foundation, which supported her during the time this article was written.

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