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Conceptualizing the Tibetan Plateau: Environmental constraints on the peopling of the "Third Pole"

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ABSTRACT

Understanding the geomorphological and environmental constraints on the human use of the Tibetan Plateau (TP) is critical in reconciling genetic and archeological interpretations of the initial occupation of the world's "Third Pole." The TP has essentially two major components: a high, relatively flat region above ~4000 m that constitutes the plateau proper and a mountainous region between ~1500–4000 m on the TP margins that is heavily dissected by the drainage systems of major Southeast Asian rivers. A biotic gradation ranging from subtropical environments to alpine steppe deserts is superimposed upon this geomorphology by the South and East Asian monsoons that lose strength as they move to the north and northwest. The distribution of the current Tibetan population mirrors these differences in environmental productivity, with the large majority restricted to river valleys in the TP margins below ~4000 m. The distribution of the initial TP occupants was likely similar, as was that of the earliest pastoralists, and any occupations dating to immediately before and after the Last Glacial Maximum are likely to be found in these TP marginal zones. Current archeological data suggests that the initial use of zones much above ~2500 m, even in these marginal areas, was by small hunting parties who occupied short-term camps before returning to lower elevation residential areas. Low incidences of cerebral edema and other similar short-term high altitude health issues during these trips would lead to genetic adaptations to high altitudes in their home population, even if that population occupied elevations well below 2500 m. When family groups of pastoralists began to seasonally occupy the higher elevations of the TP between ~8–5 ka, genetic adaptations to longer-term health issues, such as low birth weights, would occur at a faster rate, even if these family groups and the farming populations they interacted with occupied lower elevations for all or most of the year.

1. Introduction

The questions of when the first anatomically modern human populations arrived at the Tibetan Plateau (TP), how and when they gradually conquered and occupied its higher elevations, and when and where genetic adaptations to high altitude stress took place remain mostly topics of speculation. Interpretive scenarios vary widely as a result, yet despite their many differences these speculations share a common thread: they all refer to the Tibetan Plateau as if the plateau was a singular geomorphic, hydrological, and environmental phenomenon. It is not. Rather, elevational, ecological, climatological, and geomorphological conditions vary significantly across the TP, in both east–west and north–south directions, and these significant differences have a dramatic impact on the distribution and adaptive responses of modern Tibetans. These modern constraints on where people live, how they make their living, and how they interact with one another likely have deep roots in the past, and shed light on the archeological and biological questions posed above. Here, I briefly review some of these environmental constraints and discuss how these variables affect our interpretations of when, where, and how humans populated the TP.

2. Tibetan Plateau geomorphology

Geomorphically, there are really two TPs: the high, relatively flat, plateau above ~4000 m and the plateau margins between ~1500–4000 m (Fig. 1):

The high plateau — The Tibetan Plateau proper consists of an elevated platform, >30% of the contiguous U.S. and ~25% of the entire European continent in area, that is sharply bounded on all sides by extensively faulted, rugged, heavily dissected mountainous escarpments. Interior mountains occur, particularly the Tanggula Mountains that run east–west across the center of this platform separating the more desolate and sparsely populated Chang Tang region of the northern TP from more environmentally friendly regions to the south. However, these mountains are relatively low in relation to the elevation of the plateau itself, rising less than 1000 m above the plateau floor in most cases, limited in distribution, and readily scaled or circumvented. Even Tanggula Pass, through which the main highway and railroad route across Tibet have been constructed, reaches only 5231 m. One can

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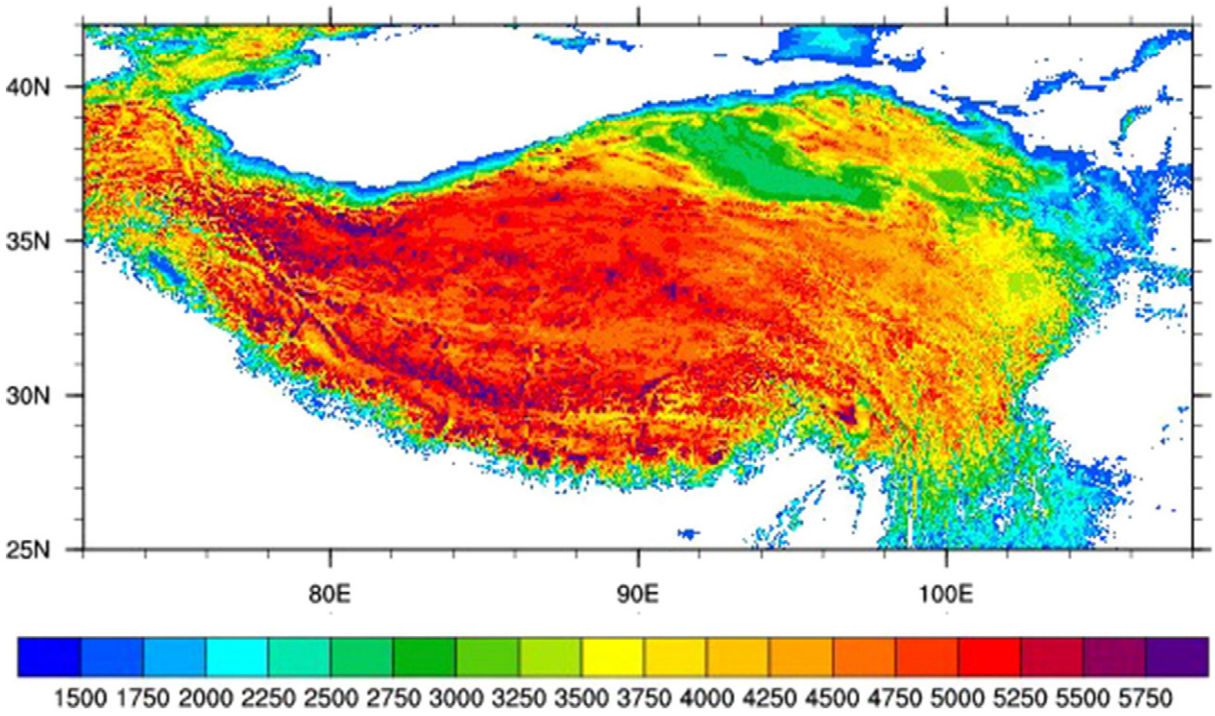

Fig. 1. Color-coded elevation map of the Tibetan Plateau. Elevations are in meters above sea level. Modified from NCAR Command Language (http://dx.doi.org/10.5065/D6WD3XH5).

walk more than 2000 km east–west and nearly 1000 km north–south across the high plateau through terrain that does not vary much between 4000 and 5000 m. To the east, south and west, this vast plain is drained by small rivers that eventually merge to form many of the major rivers of Southeast Asia, but the interior of the high plateau consists of a series of interior basins in which innumerable shallow lakes have formed (Fig. 2). Most of these lakes have brackish to saline waters as a result of their internal drainage patterns, but are fed by small streams of fresh water. In summer, the great difficulty in traversing the high plateau is related to the crossing of these lakes and associated wetlands that are made into vast bogs by melting permafrost. Many areas are only accessible during the winter months.

The plateau margins — The TP is a product of plate tectonics, and is the result of what is now the Indian subcontinent colliding with Asia beginning about 50 ma, accelerating 13–8 ma, and continuing until at least the mid-Pleistocene (Molnar et al., 1993; An et al., 2001; Royden et al.,

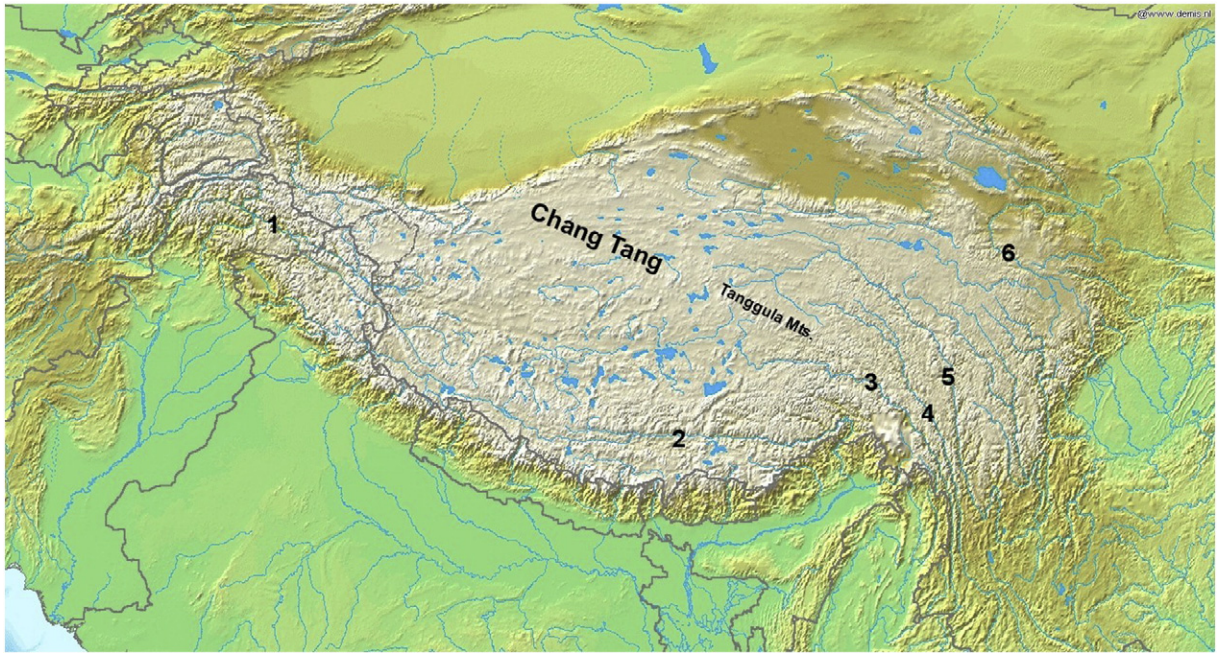

Fig. 2. Topographic map of the Tibetan Plateau showing the locations of major river systems on the northeastern, southeastern and northwestern margins of the plateau and many of the large Tibetan lakes on the high plateau (http://www.demis.nl/home/pages/Gallery/examples.htm). Numbered rivers are as follows: 1) Indus; 2) Brahmaputra (Yarlung Tsangpo); 3) Salaween; 4) Mekong; 5) Yangtze; and 6) Yellow.