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# Hydrogeomorphic settings of late Paleolithic and early-mid Neolithic sites in relation to subsistence variation in Gansu and Qinghai Provinces, northwest China

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## ABSTRACT

Gansu and Qinghai provinces of northwest China form an important region for the domestication and early utilization of millet crops. Studies on the subsistence strategy variation and environmental background of prehistoric cultural transition in this area have made substantial progress, but the geomorphic environment and hydrologic conditions of the different culture stages remains poorly known. Based on high resolution DEM and GPS coordination of typical sites, a GIS aided hydrogeomorphic analysis was conducted to indicate the abundance of cultivable flat lands and proximity to local surface runoff within walking access of nine typical sites. The results were compared with the records of plant-animal remains and tool assemblages from published literature. There is a good correlation between sites' hydrogeomorphic settings and the subsistence strategy adopted. Our case study provides valuable information for understanding how humans selected their habitat locations in corresponding to subsistence strategy shift during the transitional period between late Paleolithic and Neolithic periods.

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## 1. Introduction

The late Paleolithic and early-mid Neolithic were one of the most important periods for studying the evolution of human societies and the subsistence strategy transition from hunting and gathering to the raising of domestic plants and animals (Yan, 2000; Lee et al., 2007; Liu et al., 2013). The variety of human subsistence strategies (especially the origin of agriculture) and its relation to cultural expansion and climate change during that period has been intensively discussed (Weiss, H. and Bradley, R.S., 2001; Bellwood, P., 2005; Larson et al., 2007; Crawford, G., 2009; Chen et al., 2015; d'Alpoim Guedes et al., 2015). However, the changing hydrogeomorphic settings of human settlements during different phases has not been well understood, due to the absence of transitional sites between late Paleolithic and early Neolithic in most parts of the world and the scarcity of quantitative analysis of hydrogeomorphic features of prehistoric sites.

Gansu and Qinghai provinces in northwest China are one of the key regions for the spread of millet cultivation (Zhang et al., 2010; Liu et al., 2012, 2014), where thousands of late Paleolithic and Neolithic sites are known (BNCR, 1996, 2011). The diversity of landforms in the region provides suitable space for different economies such as farming and herding, both in ancient times and nowadays. Subsistence strategy variation during prehistoric times in Gansu and Qinghai Provinces became increasingly clear from archaeobotanic and zooarchaeological studies and isotopic analysis of human and animal bones from prehistoric sites in this area (eg. Li et al., 2007; Dodson et al., 2013; Jia et al., 2013; Ma et al., 2013, 2014; Liu et al., 2014; Chen et al., 2015). The environmental background of prehistoric cultural transition has also been intensively studied (eg. An et al., 2004, 2006; Dong et al., 2012, 2013a,b; Hou et al., 2015). Nevertheless, most these works focus on human-land evolution during mid-late Neolithic and Bronze periods, the relationship between subsistence strategy and geomorphic settings of human settlements during late Paleolithic and early-mid Neolithic periods remains enigmatic.

Subsistence strategy during late Paleolithic and early-mid Neolithic periods in Gansu and Qinghai can be roughly divided to

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three phases, hunting and gathering during late Paleolithic period, primary hunting and gathering and auxiliary farming during Dadiwan I period (7800–7200 BP), and primary intensive farming since 5900 BP (Barton et al., 2009). In this paper, we select nine well-dated typical sites of these three phases, conducting quantitative analysis of their hydrogeomorphic settings and examining the changing patterns in local scales, to aid understanding how ancient people engaged in habitat selection in relation to subsistence variation.

## 2. Study area

### 2.1. Geographic background

The study area is located in the western part of the Loess Plateau and the northeastern margin of the Tibet Plateau, covering an area from A'nimaqing Mountains and Qinghai Lake in the west to the

Liupan Mountains in the east (Fig. 1a). The mean annual temperature ranges from  $-0.3$ – $14.8$  °C and the mean annual precipitation from 50 to 860 mm. Altitude declines gradually from 6295 m a.s.l at Animaqing Mountain in the west to 490 m a.s.l at Qingyang County in the east.

### 2.2. Materials and database

We selected three late Paleolithic sites (151, Jiangxigou I and Yantaidong), three pre-Yangshao and early-mid Yangshao sites (Dadiwan, Xishanping and Gaositou sites), and three Majiayao sites (Shuza, Hulijia and Linjia) (Fig. 1) to study the variety of human habitat selection during the transitional period from hunting-gathering to millet cultivation. Among the nine sites, seven were excavated systematically with  $^{14}\text{C}$  dating and tools assemblage statistics (The excavation report of Yantaidong site is unpublished yet). Detailed results of radiocarbon dating, statistics of artifacts

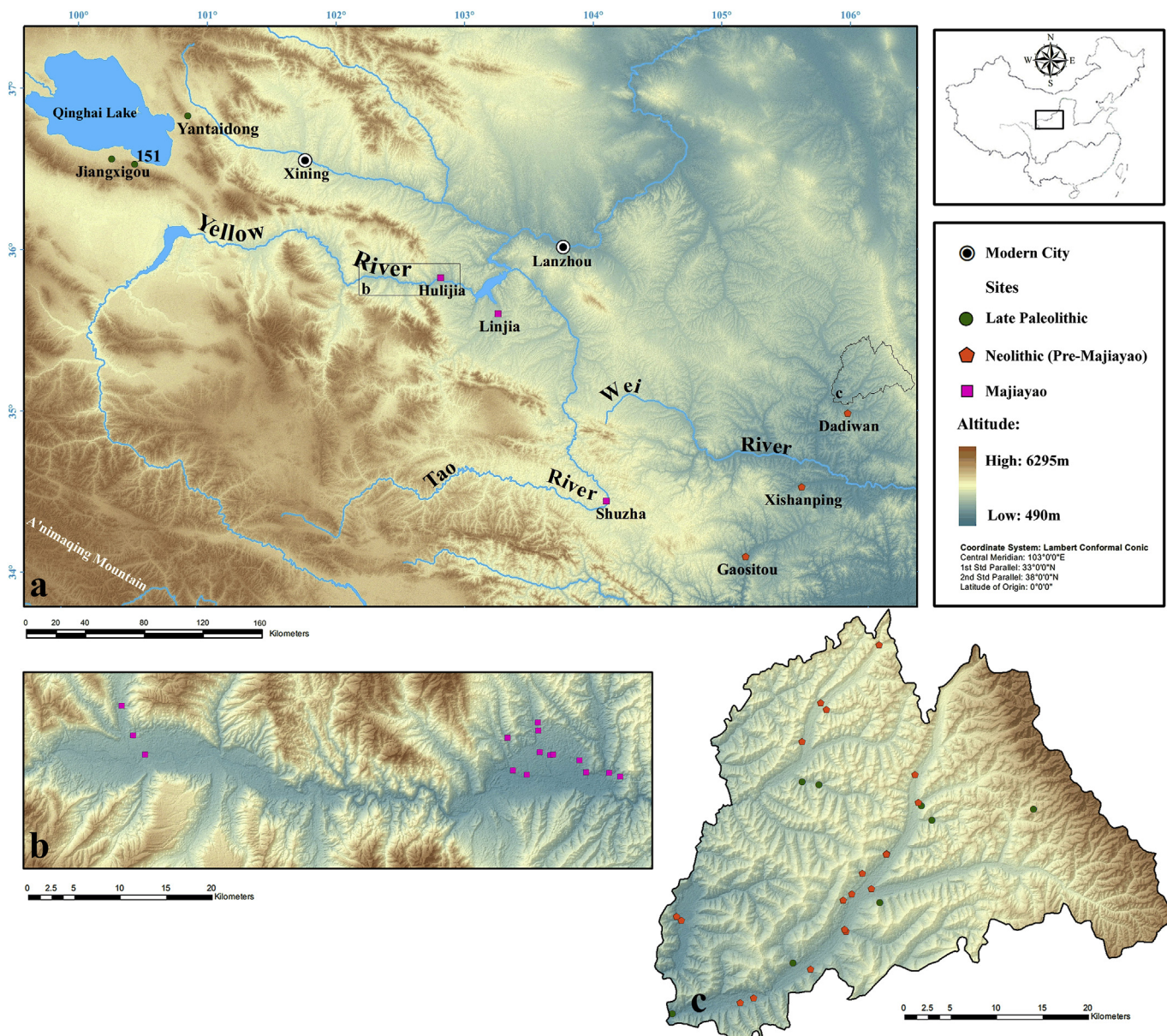


Fig. 1. a. Nine typical sites in our study area. b. Distribution of Majiayao sites in Guanting and Hualong basin (Jia, 2012). c. Distribution of late Paleolithic sites and early Yangshao sites in Zhuanglang County, Gansu (Zhang, 2010a).

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