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Human settlements and plant utilization since the late prehistoric period in the Nujiang River valley, Southeast Tibetan Plateau

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ABSTRACT

The combined application of archeological excavation, radiocarbon dating, and macrofossil analysis in recent years has produced valuable datasets for understanding when and how humans settled on the Tibetan Plateau during late prehistoric times. Dozens of suggested prehistoric sites were found in the Nujiang River valley, Yunnan Province, Southwest China, located on the southeast edge of the Tibetan Plateau. Previously, however, the ages and plant use associated with most of these sites has remained unclear. To address this lacuna, we investigated archeological sites in the area, taking samples from seven sites for radiocarbon dating and macrofossil and microfossil analysis. Our results indicate the ages of these sites range between 2250 and 1250 cal BP, considerably younger than previous estimations determined by the characteristics of artifacts, and the identified crop microfossils from these sites are mainly remains of rice. To study the history of human settlement and their subsistence strategy in the Nujiang River valley, we further review the published results of radiocarbon dating and archaeobotanic studies. Humans had intensively settled in the Nujiang River since the late Neolithic period, and utilized a variety of crops including rice, millet, wheat and barley in the Bronze Age. Our work suggests that since the availability of archeological investigation and macrofossil analysis is limited in the Nujiang River valley, more systematic archaeobotanic study and radiocarbon dating from excavated sites are needed for the studying of past human activities in the area.

1. Introduction

The history of human habitation on the Tibetan Plateau and the factors influencing it have been issues of increasing concern in recent years (e.g., Brantingham and Gao, 2006; Madsen et al., 2006; Aldenderfer, 2011; Brantingham et al., 2013; Dong et al., 2013; Rhode et al., 2007; Guedes and Butler, 2014; Guedes et al., 2014, 2015; Chen et al., 2015). Multidisciplinary study, especially involving collaboration between geographers and archeologists, has contributed to the rapid advance of this research field. For example, the combined application of archeological excavation and survey, archaeobotanical and zooarchaeological analysis, radiocarbon dating, geographic information system (GIS) technology, and palaeoclimatic studies has promoted our understanding of the history of agricultural development in the Tibetan Plateau and its surrounding areas (An et al., 2010; Jia et al., 2013; Guedes and Butler, 2014; Guedes et al., 2013a, 2013b, 2014; 2015; Chen et al., 2015), and suggests agricultural innovation might have facilitated human settlement on the high areas of the Tibetan Plateau (e.g., Chen et al., 2015; Guedes et al., 2015). While most of these researches were performed in the northeast Tibetan Plateau and Chengdu Plain, when and how ancient human settlement developed in Yunnan Province on the southeast margin of the Tibetan Plateau, an important land passageway connecting southwest China and many countries of Southeast Asia, has not been thoroughly understood.

Hundreds of prehistoric sites have been found in Yunnan Province (BNCR, 2001), about a quarter of which are distributed along the Nujiang River valley, indicating it was one of the most important areas for human settlement in Yunnan Province during the prehistoric period. While a few sites including Haimenkou, Baiyangcun, and Yushuiping have been excavated, the ages of most sites in this area are determined by characteristics of artifacts (stone tools, pottery sherds, etc.) collected in archeological survey, which may be unreliable according to recent geoarchaeolgical studies in the north and central Tibetan Plateau (Sun et al., 2010; Hudson et al., 2014). The subsistence strategies of ancient

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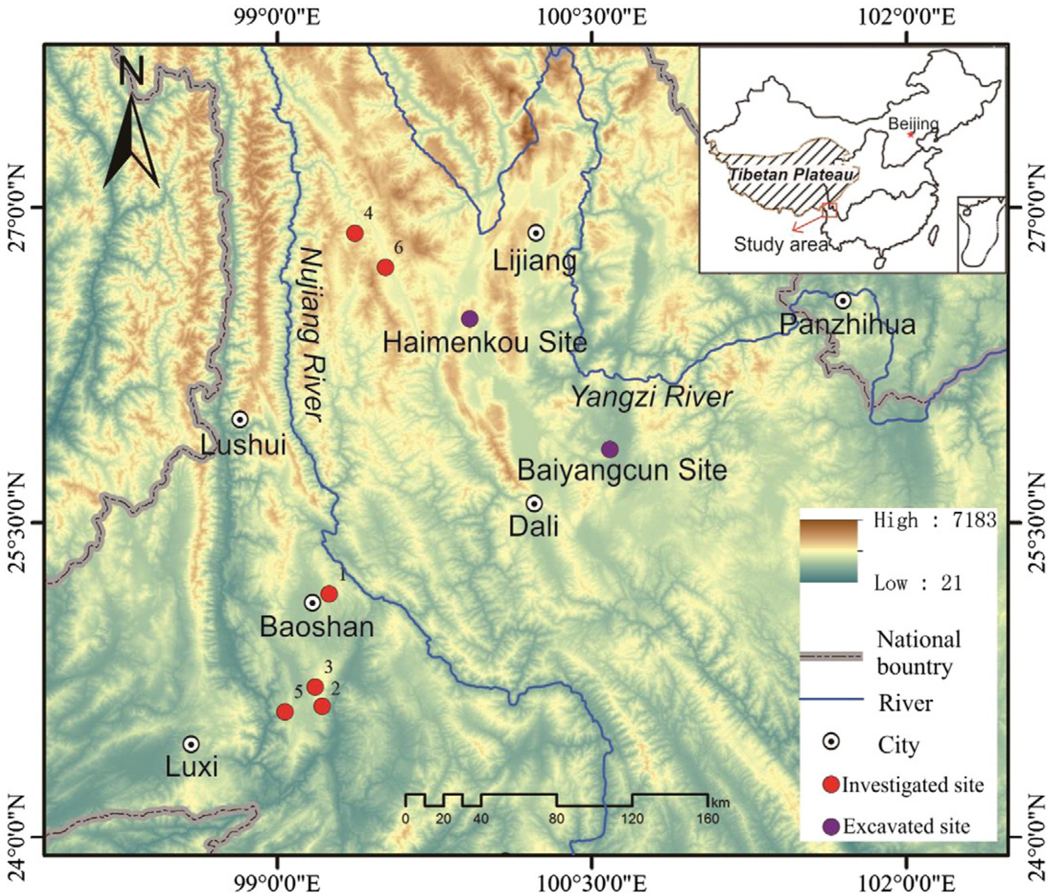

Fig. 1. Location of the study area and the sites investigated. 1 Jiangtaisi; 2 Wanrengang; 3 Shigushan; 4 Wulipai; 5 Guojiadibaobao; 6 Tatashan

humans in the Nujiang River valley also remain unclear, limited by the deficiency of archaeobotanical and zooarchaeological analysis from archeological sites in the area. In this study, we investigate sites in the Nujiang River valley suggested to be prehistoric through the application of plant macrofossil and phytolith analysis, radiocarbon dating, and a review of previous archeological research. We study the history of human settlement and associated plant-based subsistence in the Nujiang River valley, and discuss the advantage and disadvantage of different archaeobotanical approaches applied in geoarchaeological studies in northwest Yunnan Province.

2. Study area

The study area (24°–27.5°N, 98°–102°E) is located on the southeastern margin of the Tibetan Plateau in southwest China (Fig. 1). It extends 300 km from Lisu Autonomous Prefecture in the west to Dali Bai Autonomous Prefecture in the east, and 400 km from Lijiang in the north and to Baoshan in the south. The annual temperature ranges from 6.1–23.2 °C and mean annual precipitation is 1115 mm. Altitude gradually declines from north to south. The Nujiang River, Lancan River, Dulong River and their tributaries flow through the study area.

3. Materials and methods

Seven prehistoric sites (Fig. 1) have been investigated where exposed pits or cultural layers were found based on consultation with local archeologists who participated in the recent archeological survey of the Nujiang region in 2014. Fifteen samples were collected from exposed pits and cultural layers of six sites (Fig. 2). Using sediment flotation, seven charcoal accelerator mass spectrometry (AMS) ^{14}C samples were collected and prepared with the standard pre-treatment (acid–alkali–acid) at the MOE Key Laboratory in Lanzhou University and then measured at Peking University. The IntCal09 curve (Reimer et al., 2009) and the Libby half-life of 5568 years were used in the calculation of all dates. Due to the poor preservation of charcoal from these sites, only five of these seven samples were successfully dated. Archeological remains (Fig. 3) such as stone artifacts, pottery sherds and bones were gathered by flotation from collected samples as well.

A slightly modified wet ashing method was used for extraction of phytoliths from all 15 samples (Piperno, 1988; Runge, 1999; Zhang et al., 2010). The general steps are described as following: First, ~2 g of dry sample was deflocculated with 5% sodium polyphosphates ($Na_4P_2O_7$) and the supernatant was washed with distilled water three times; second, the sample was oxidized by H_2O_2 (30%); third, carbonates were excluded by HCl (10%); fourth, phytoliths were extracted by heavy liquid ($ZnBr_2$) with a specific density of 2.35, then the extracted phytoliths were mounted on a slide using Canada Balsam; and fifth, phytoliths were observed and counted with a Leica DM750 microscope at 400× magnification. More than 500 phytoliths were counted in each slide and the morphotypes and classification were described according to (Lu, 1998; Lu and Liu, 2003a, 2003b) and the International Code for Phytolith Nomenclature (Madella et al., 2005). All phytolith extractions and identifications were performed in the Phytolith Lab of the Institute of Geology and Geophysics, Chinese Academy of Sciences.