Journal of Archaeological Science 50 (2014) 414–419

Contents lists available at ScienceDirect

Journal of Archaeological Science

journal homepage: http://www.elsevier.com/locate/jas

# Isotope studies of human remains from Mayutian, Yunnan Province, China

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ARTICLE INFO

*Article history:*
Received 26 April 2014
Received in revised form
31 July 2014
Accepted 1 August 2014
Available online 11 August 2014

*Keywords:*
Strontium
Carbon and oxygen isotopes
Human remains
Red River
Bronze Age Yunnan

ABSTRACT

In order to examine human mobility during the first millennium BC in the Red River region of Southeast Asia, we examine strontium and stable isotopes in human dental enamel from the Mayutian site. We here report the initial results from this area. Local individuals have $^{87}Sr/^{86}Sr$ values of 0.7096 ± 0.0003. The highest status individual of Mayutian is distinctly different (0.7066) suggesting a geographic origin further northwest, possibly near Dali. Stable isotopes reveal a mixture of C3 and C4 resources in the diet and indicate that they did not have an agricultural strategy that was dominated by either millet or rice.


## 1. Introduction

Mayutian is located in southern Yunnan on the north bank of the Yuanjiang section of the Red River (Fig. 1). Discovered in 2006 and excavated by the Yunnan Provincial Institute of Culture Relics and Archaeology et al. (2013), Mayutian is the first Bronze Age site to be recognized in this region of Yunnan (Yunnan Provincial Institute of Culture Relics and Archaeology et al., 2013).

The site is unusual in that there are well-preserved human remains, which have been dated through $^{14}C$ analyses of collagen to the fifth through fourth centuries BC. Because of acidic soils in the Yuanjiang River region, human remains are rare at archaeological sites, but at Mayutian, apparently due to the dryness of the soils, burials of 16 Bronze Age individuals (#M6–#M21) were found.

The Bronze Age burials (Fig. 2), located together 65 m from the main residential area, are in rectangular vertical shaft pit tombs with predominantly northwest/southeast orientations. Burials are in extended supine positions and without burial furniture. Tomb offerings include a bronze *yue*, bronze spear points, a bronze hoe, and ceramic vessels and fragments of stone implements similar to those in the residential area (Table 1).

Artifact assemblages resemble those from contemporary sites in highland Yunnan, and suggest interaction not only with neighboring Dong-Son and nascent Dian cultures but also possibly with the Early Warring States of central China (Yunnan Provincial Institute of Culture Relics and Archaeology et al., 2013).

Because of the possibility of significant cultural interactions beyond the Yuanjiang region, we undertook isotopic analyses of teeth from these burials in an initial attempt to assess mobility among the individuals as well as to begin to develop an isotope database for the region.

We also have a particular interest in comparing the isotope patterns in this region with gender and status. Except for some Mayutian burials that are questionably male, identification by sex was not adequate for such a study, but burial goods (Table 1) indicate one relatively high status individual, GMM12 (Fig. 3).

## 2. Method

To assess mobility at Mayutian, we analyzed isotopes of strontium, oxygen and carbon of tooth enamel and strontium in bone.

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http://dx.doi.org/10.1016/j.jas.2014.08.001
0305-4403/

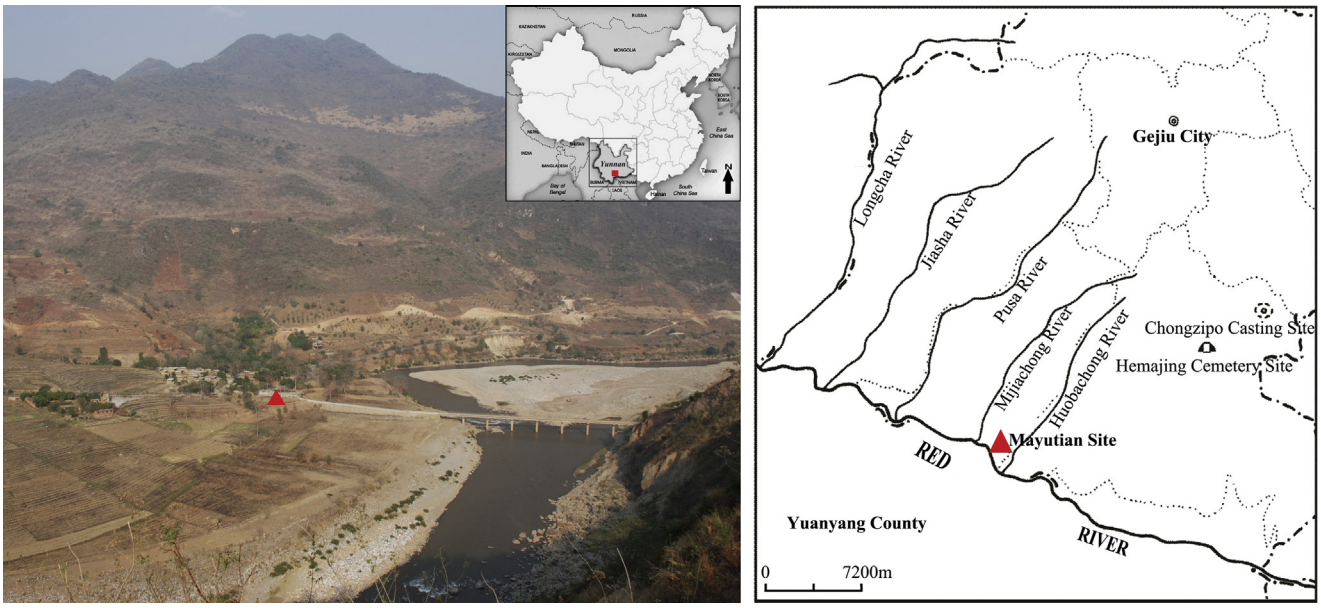


**Fig. 1.** The location of Mayutian (Red triangle) and adjacent rivers (modified from Yunnan Provincial Institute of Culture Relics and Archaeology et al. (2013)). (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

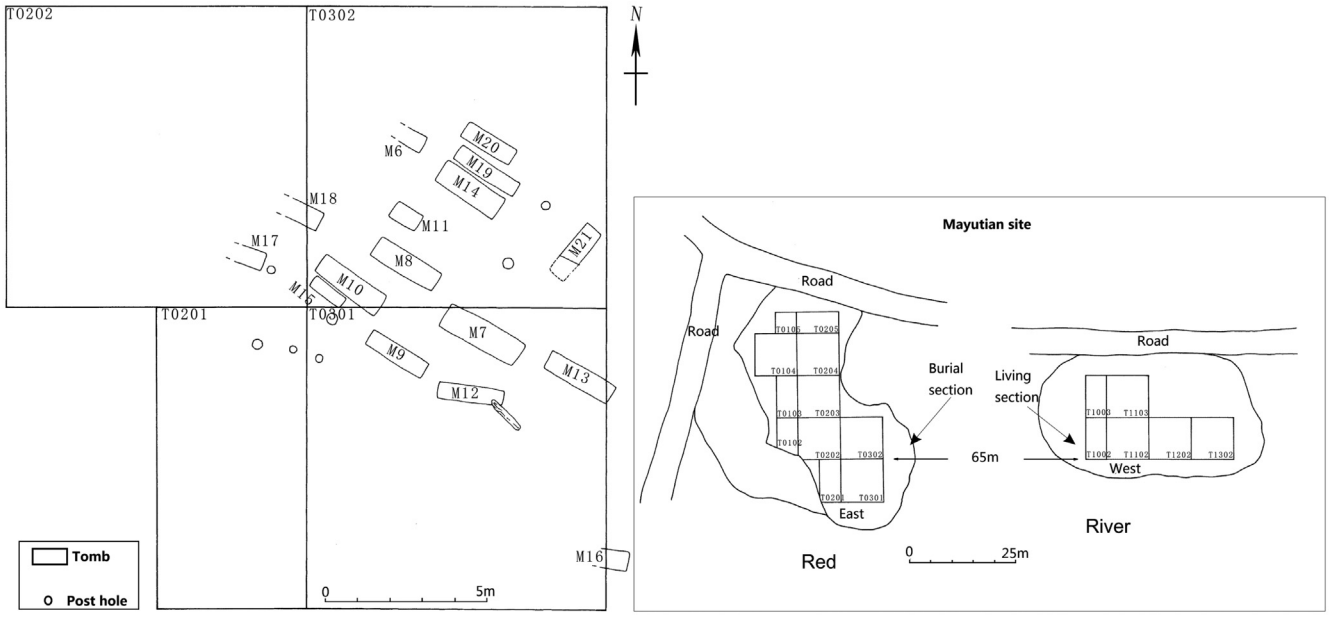


**Fig. 2.** The distribution of the tombs (modified from Yunnan Provincial Institute of Culture Relics and Archaeology et al. (2013)).

Dental enamel mineralizes as hydroxyapatite, $Ca_{10}(PO_4)_6(OH)_2$ during the first years of life and retains its chemical and isotopic composition throughout the life of the individual. The isotopes of strontium, carbon and oxygen in the enamel thus reflect the isotopes in the diet during childhood.

Depending on preservation and availability, all selected teeth were molars but no identification of specific molars (M1, M2 or M3) was attempted. First and second molars (M1 and M2) mineralize during early childhood; the third molar (M3) mineralizes about the age of 12 years (ElNesr and Avery, 1994; Hillson, 2005). Thus there is some uncertainty in the data of the timing of mineralization. A total of 14 tooth samples, each from a separate individual, listed in Table 2, were selected for analysis.

In contrast to enamel, bones continually remodel during life so that, for an individual who moves from one place to a new location with a different isotope pattern, the bones shift isotopically toward that of the new place of residence. Ericson (1985), in the seminal strontium isotope paper, suggested that one could compare tooth isotopes to bone isotopes to see if someone was an immigrant. While a match might be equivocal, a big difference between tooth and bone ratios would imply recent relocation. We now know that bones are easily contaminated in the post mortem-environment, so they tend to be similar to that of the burial location regardless of if or when an individual might have relocated. Nonetheless, a match between bone and tooth data can help to reinforce an assessment of what might be the local isotope