RADIOCARBON DATING OF ANCIENT CANOES FROM GUANGXI, CHINA

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ABSTRACT. Several canoes were excavated from coastal rivers in the Guangxi Zhuang Autonomous Region, southwest China. In order to confirm the age of the canoes, 6 samples were selected for radiocarbon dating from 3 canoes. The mean value of canoe NLJ was 365 ± 35 BP, and 2 samples from canoes MLJ and DFJ were 520 ± 21 and 499 ± 33 BP, respectively. The calendar ages cover a period from AD 1328 to 1641 at the 95% confidence level. These results disagree with previous studies that suggested canoes were only used over 1000 yr ago in China. We discuss the possible reasons for the results being younger than expected.

INTRODUCTION

The Guangxi Zhuang Autonomous Region is located in southwest China. The total land area of Guangxi is 236,700 km^2, accounting for just 2.5% of the national total but is one of the most abundant water regions in China. The total number of rivers with a catchment area larger than 50 km^2 in Guangxi is more than 1000. The rivers belong to different basins, including the Pearl River basin, the Yangtze River basin, the coastal rivers of south Guangxi and Red River basin, according to their source region and geographical position. The coastal rivers of south Guangxi comprise a total catchment area of 24,386 km^2, i.e. 10.3% of total area of Guangxi Province, and include the main coastal rivers of Nanliu, Dafeng, Qiangjiang, Fangcheng, Maolian, and Beilun.

In regions like Guangxi where the topography is mountainous and water transportation is feasible, boats are the most efficient means of moving goods and people. Thus, canoes play an important role in the history of this region. Based on the appearance of different styles, canoe types can be divided into 3 periods: germination period; development and prosperity period; and the decline and fall period. It is thought that the canoe appeared in China in the Neolithic, approximately 8000 yr ago, and slowly disappeared from the Han Dynasty (206 BC–AD 220) to Song Dynasty (AD 960–1279) due to the advance of shipbuilding technology and requirement for increasing load capacity.

In 2001, the earliest known canoe from China was excavated in Xiaoshan City, Zhejiang Province, which was dated between 6991 and 7070 BP (Jiang and Liu 2005). About 40 ancient canoes have been uncovered in different sites over the past 50 yr in China, and most of these canoes dated to between 5000 and 1000 yr old. For example, in 1960, 4 canoes belonging to the same period with an age of 1215 ± 70 BP were found at the Xishan site, Wenzhou City, Zhejiang Provience (Jin 1990), and in 1965 a canoe dated to 2900 ± 75 BP was found at the Yancheng site, Jiangsu Province (Zhou et al. 1999). In 2004, 2 canoes were found to be 1200–1300 yr old based on the association with datable artifacts from Shandong Province (Cui 2004), and in 2009, a canoe with an age 3185 ± 40 BP was excavated in Xinyang, Henan Provience (Hu 2010). Further details on other excavations of canoes can be found in Wu (2008) and Yuan (1994). The existence and use of canoes was obviously influenced by the emerging shipbuilding technology, which is evident in the age distribution of the excavated canoes. The development of ships and shipbuilding technology in ancient China is described by Qu and Chen (2008).

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In this study, we collected 6 wood samples from 3 canoes for radiocarbon dating, from Nanliu River, Maolin River, and Dafeng River, respectively. Since all 3 canoes were discovered during dredging projects, no associative artifacts such as coins or pottery can be used to correlate their age.

SAMPLING SITES AND METHODS

The arrows shown in Figure 1 indicate the specific position from which the canoes were excavated from the 3 different rivers. The Nanliu River site is located in the lower reaches of Nanliu River in Beihai, Guangxi Province. Canoe NLJ was removed from an underwater sand bed over 10 m deep during sand mining in the summer of 2002; the canoe was broken into 2 parts. About two thirds of the canoe, 6.2 m in length and 1.05 m in width, was removed, and the other part remained in the sand bed.

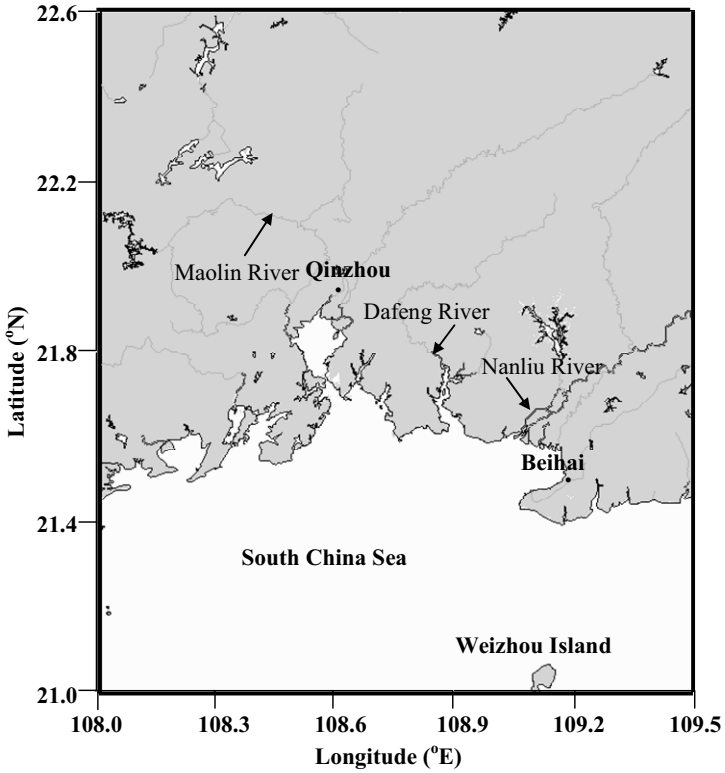

Figure 1 Location of sampling sites in the coastal region of south Guangxi. Arrows indicate the excavation sites of the canoes.

The other 2 well-preserved canoes MLJ and DFJ were discovered in the Maolin River and Dafeng River, respectively, during waterway regulation works for the city of Qinzhou (Figure 1). In fact, there have been 8 canoes discovered in the region of Qinzhou in the past 30 yr, but only 6 canoes were kept (Wu 2008). The shape, manufacturing technology, and wood species for all 6 canoes are similar. Thus, 2 of these, MLJ and DFJ, were selected for dating. According to the identification of wood species, the canoes were all made of camphor wood (*Cinnamomum* sp.). The Maolin River site is located in the northwest of Qinzhou, ~30 km away from the river mouth (Figure 1). Canoe MLJ is 9.2 m in length and has a maximum width of 0.95 m. The Dafeng River site is located in the

southeast of Qinzhou, ~20 km away from the river mouth (Figure 1). Canoe DFJ is 7.8 m in length, and is slightly narrower than canoe MLJ. The interior and exterior surfaces of all the canoes are smooth and flat. Their manufacturing technology was better than other early excavated canoes from nearby sites. Some regular chisel spots, not burnt spots, are visible on the interior surface, indicating that the ages of the canoes are not very old.

Four wood samples from different parts of canoe NLJ (namely, the prow, stern, larboard, and starboard) were processed with acid-alkali-acid (AAA) treatments and combusted to CO_2. The purified CO_2 was reduced to graphite with H_2 over Fe. These 4 samples were prepared and measured in the School of Archaeology and Museology of Peking University using the compact AMS system at the Peking University (PKU-AMS; Liu et al. 2007). Another 2 individual wood samples that were drilled from the prow of canoes MLJ and DFJ were also pretreated by the AAA method. The wood sample material was converted into a graphite target using the modified zinc reduction method (Marzaioli et al. 2008) at the CIRCE laboratory, Naples Second University, and measured with the CIRCE 3MV AMS system (Terrasi et al. 2008). Sample details and measurement results are given in Table 1.

Table 1 Results of ^{14}C and calibrated ages of canoes from Guangxi, China.

Sample	Sample description	Lab code	^{14}C age BP	Calendar age	
				1σ (68.2%)	2σ (95.4%)
NLJ	Wood, starboard	BA051039	360 ± 35	AD 1466 (0.54) 1522 AD 1574 (0.46) 1627	AD 1450 (0.49) 1530 AD 1538 (0.51) 1635
	Wood, larboard	BA051040	390 ± 35	AD 1446 (0.82) 1514 AD 1601 (0.18) 1617	AD 1440 (0.68) 1525 AD 1557 (0.32) 1632
	Wood, stern	BA051041	370 ± 35	AD 1453 (0.71) 1521 AD 1591 (0.29) 1620	AD 1446 (0.55) 1530 AD 1540 (0.45) 1635
	Wood, prow	BA051042	340 ± 35	AD 1488 (0.34) 1527 AD 1555 (0.66) 1632	AD 1467 (1) 1641
DFJ	Wood, prow	DSH1342	499 ± 33	AD 1412 (1) 1440	AD 1328 (0.03) 1341 AD 1395 (0.97) 1450
MLJ	Wood, prow	DSH1433	520 ± 21	AD 1409 (1) 1429	AD 1330 (0.02) 1339 AD 1397 (0.98) 1440

Calibration

The ^{14}C ages of the canoes are given in Table 1 together with their calibrated calendar age ranges. The mean value of canoe NLJ from Nanliu River site was 365 ± 35 BP, and the 2 samples from canoes MLJ and DFJ were 520 ± 21 and 499 ± 33 BP, respectively. For each sample, the calibrated age is considered at the 68.2% and 95.4% confidence intervals using the OxCal online software v 4.1 (Bronk Ramsey 2009) and the IntCal09 calibration curve (Reimer et al. 2009). The results indicate that 3 canoes were all built in the Ming Dynasty (AD 1368–1644). Figure 2 summarizes the ^{14}C ages and calibrated ages of the 3 canoes from the different coastal rivers of south Guangxi.

CONCLUSIONS AND DISCUSSIONS

Our study of 3 different canoes using 6 different samples shows that the calendar ages of all the samples cover a period from AD 1328 to 1641 at the 95% confidence level. The results obtained give ages of cal AD 1440–1641 for canoe NLJ, cal AD 1328–1450 for canoe DFJ, and cal AD 1330–1440 for canoe MLJ. Thus, it is clear that the use of canoes lasted much longer than previously

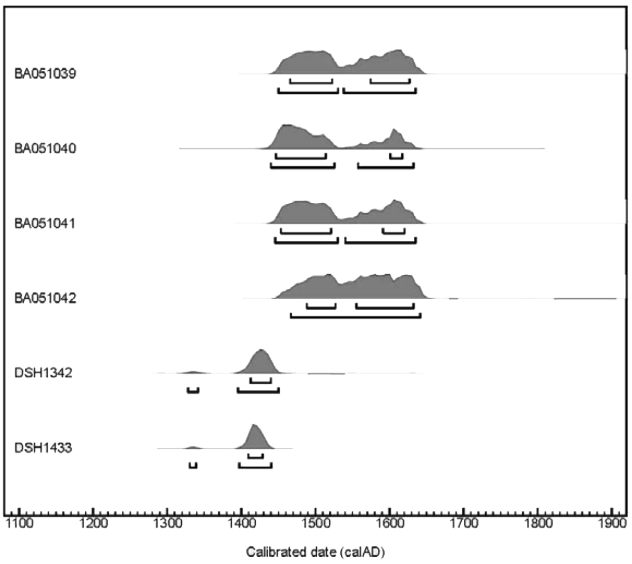

Figure 2 Combined probability distribution of wood ages from all 6 samples. The software used is OxCal online software v 4.1.

believed. Canoes played an important role in ancient China during a long period, but slowly disappeared in most areas in the Han and the Tang dynasties (206 BC–AD 220 and AD 618–907) due to the advance of shipbuilding technology. All of the canoes excavated from other sites present in the literature with are older than 1200 yr (Wu 2008; Qu et al. 2008). However, all 3 canoes excavated from Guangxi were built in the last 500–700 yr, and the ages are at least 500 yr younger. We conclude that canoes continued to be used until more recently in the coastal region of south Guangxi than in other regions. These more recent results can be explained by the 1) abundant water resources in the region and 2) the relatively low cost of a canoe. As previously discussed, Guangxi contains several rivers and some mountains that are difficult to traverse. Thus, in this region, a boat is the most efficient means of moving goods and people. Up to now, according to the literature (Qu et al. 2008) and our results, relatively young canoes from all the excavated and dated canoes are mainly distributed in the coastal rivers of Guangdong, Guangxi, and Fujian provinces. There are suitable trees growing in the region for preparing the canoe. Although shipbuilding technology sufficiently advanced to build larger wooden boats, it was relatively easy and cheap to fabricate a simple canoe. A simple canoe was enough for the regular daily use in the past centuries.

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