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Immigrants at the Mississippian polity of Cahokia: strontium isotope evidence for population movement

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ABSTRACT

Archaeologists have long debated the role of regional interaction in the 11th to 14th centuries at the Mississippian polity of Cahokia. Architectural styles, exotic materials, and cultural objects provide indirect evidence for cultural interaction and ethnic and social diversity; however, identifying the movement of individuals (rather than materials) is key to our growing understanding of the population history that enabled the formation of this unique polity. This study is the first to use strontium isotope analysis ($^{87}Sr/^{86}Sr$) of human tooth enamel to identify immigrants at Cahokia. Modern and archaeological fauna were used to establish a baseline "local" range of strontium isotope ratios for the American Bottom region surrounding Cahokia. Teeth from individuals interred in diverse mortuary locations, including mounds, within this region were analyzed and compared to the local strontium isotope range to identify individuals of non-local origin. One-third of all individuals analyzed were identified as non-local, and the range and variability of their strontium ratios suggests multiple places of origin. The correlation of isotopic data with available biological and mortuary evidence allows us to examine the role of migration in the history of this Mississippian polity.

1. Introduction

Cahokia, located on the Mississippi River floodplain of the American Bottom near modern-day St. Louis, was the largest pre-Columbian polity in North America, and the epicenter of Mississippian culture from A.D. 1050–1350. At its peak, Greater Cahokia (i.e., inclusive of the Cahokia, East St. Louis, and St. Louis ceremonial precincts) covered 10–15 sq. km. It was comprised of nearly 200 earthen mounds arranged around vast open plazas, with thousands of pole and thatch houses, temples, and public buildings laid out in planned residential, political, and ritual precincts (Pauketat et al., 2013). Archaeological evidence suggests that political and social change at Cahokia happened quickly.

The preceding Terminal Late Woodland societies (A.D. 900–1050) were characterized by low population densities, dispersed communities, and a diverse material culture (Fortier and McElrath, 2002; J. Kelly, 2000). By A.D. 1050, social life, political organization, and religious beliefs were radically transformed. The abrupt emergence of this polity has been referred to as "The Big Bang" (Pauketat, 1994) and was marked by a dramatic population nucleation within the newly formed Greater Cahokia ceremonial and political center and the abandonment of the surrounding countryside. Population estimates for the Cahokia ceremonial precinct at this time are as high as 15,000 + individuals (Milner, 1986; Pauketat and Lopinot, 1997). Cahokia's power and influence flourished through the 12th and 13th centuries. During the 13th century, however, defensive palisades were constructed, suggesting social unrest in the region (Pauketat et al., 2013). The population declined dramatically in the Late Mississippian period, and by the early 14th century Cahokia was virtually abandoned (Emerson, 1997; Emerson and Hargrave, 2000; Emerson and Hedman, 2014; Milner, 1986; Pauketat, 1994, 2004).

Recent modeling of Cahokian origins indicates that the movement of people played a critical role in the formation of this polity and in the spread of Cahokia-influenced ideas and practices throughout the American Trans-Mississippi South and Southeast (Alt, 2006, 2010; Emerson and Hargrave, 2000; Emerson and Lewis, 1991; Pauketat, 2003). Cahokia's archaeologically estimated population numbers cannot be accounted for by birth rates alone (see Emerson and Hedman, 2014; Pauketat, 2003) and necessitate an influx of new people. Some models presume that Cahokia was

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created by drawing in the surrounding Terminal Late Woodland populations; however, the low density of settlements in the American Bottom prior to Cahokia's formation were unlikely to have been sufficient to supply the proposed population influx.

American Bottom Mississippian societies maintained a broad network of interaction and exchange with societies from the Gulf Coast and Southeast, the Caddoan region to the south, the eastern plains, the Upper Mississippi River valley, and the Great Lakes (Emerson and Lewis, 1991; Stoltman, 1991). Evidence for this interaction is reflected in the diversity of mortuary patterns, construction techniques, ceramic styles, exotic raw materials, and shared iconography at Cahokia. In what way(s) these interactions may have impacted Cahokian population growth or social dynamics is not known. While these characteristics are at best proxy evidence, they provide insight into potential population movement and interaction.

Our goal is to provide the first direct evidence of immigrants at Cahokia. To accomplish this includes three analytical steps:

1. Identify and refine the "local" strontium isotopic signature for the American Bottom region;
2. Assess strontium isotopic variation among individuals from diverse burial contexts within the Cahokia site complex;
3. Use strontium isotope analysis to differentiate between individuals who may have moved to Cahokia during or after childhood and individuals who were indigenous to the American Bottom region.

To accomplish these steps, we conducted strontium isotope analysis on dental remains from archaeological fauna and human tooth enamel representing multiple American Bottom burial contexts (Fig. 1 and Table 1). A local strontium isotope signature (i.e., range) for the American Bottom, and Cahokia specifically, was confirmed (Hedman et al., 2009; Price et al., 2007) and refined with archaeological fauna. Having established the local range we compared strontium ratios of teeth from human burials and identified individuals with local and non-local values. This article represents the first use of strontium isotope analysis to document the presence of non-local individuals at Cahokia.

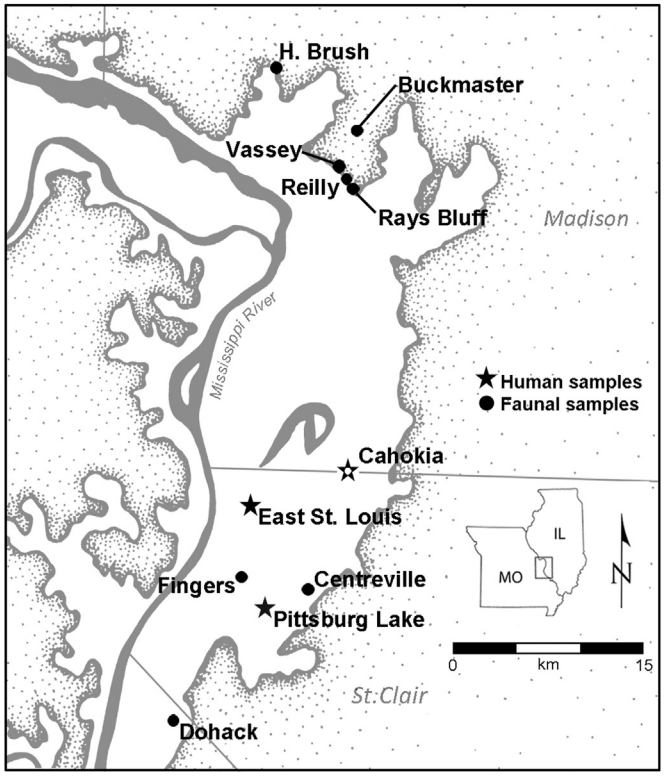

Fig. 1. Locations of all sites in the American Bottom that were sampled in this study. See Table 1 for a list of sites sampled for background fauna.

2. Strontium isotopes and mobility studies

Strontium isotopes of skeletal and dental remains have been used increasingly by archaeologists to identify non-local individuals in prehistoric populations (Andrushko et al., 2009; Bently, 2006; Bently et al., 2004; Eerkens et al., 2014; Ezzo et al., 1997; Ezzo and Price, 2002; Gregoricka, 2013; Hodell et al., 2004; Knudson and Blom, 2009; Knudson and Tung, 2011; Knudson et al., 2004; Price et al., 1994, 2006, 2007; Turner et al., 2009; Wright, 2005; Kendall et al., 2012). While many of the published studies have focused on regions characterized by varied geological zones with very different strontium signatures (e.g., Mesoamerican sites), few studies have applied strontium analysis to populations in the Midwestern US. Price et al. (2007) first used strontium isotope ratios in this region to address the question of migration and the possibility of foreigners at the Mississippian site of Aztalan in southern Wisconsin. Strontium ratios for some non-local individuals identified at Azatalan matched strontium values derived from archaeological and modern fauna at Cahokia suggesting it as a possible place of origin. Hedman et al. (2009) identified small but measureable differences strontium ratios between the American Bottom of Illinois and surrounding regions. They determined that $^{87}Sr/^{86}Sr$ analysis is a viable tool for assessing population movement within this region.

Strontium isotope ratios in rock, soil, groundwater and vegetation vary according to the underlying geology of a region. Strontium becomes bioavailable through weathering of strontium-bearing rocks and minerals into soils. Once weathered, the original terrestrial strontium may be leached into local hydrological systems and enter the biosphere. As an animal eats and drinks, the local strontium isotope composition of the water, plants and animals consumed is recorded in its skeletal tissues when strontium (Sr) substitutes for calcium (Ca) during bone and tooth mineralization (Graustein, 1989; Likins et al., 1960). The isotopic composition ($^{87}Sr/^{86}Sr$) of human bone and tooth enamel reflects that of an individual's diet, which in turn mirrors that of the geology, soils, and water of the region from which the foods were produced. Unlike lighter elements such as carbon, nitrogen and oxygen, the large atomic mass of strontium means that the isotopes pass from bedrock to soils and into plants, bone, tooth enamel, and shell with negligible metabolic fractionation regardless of the animal's diet, body size, or metabolism, which allows their application to provenance studies (Bently, 2006; Bluhm et al., 2000; Price et al., 2002).

Previous analyses of faunal remains have demonstrated that measurable and significant differences in bioavailable strontium isotope ratios are present across the Midwest (Beehr, 2011; Hedman et al., 2009; Price et al., 2007; Widga, 2006). Strontium signatures, however, may not be unique to a specific region. A similar isotope ratio can occur in different geographic regions, and so strontium analysis alone cannot definitively identify where someone is from. It can, however, identify someone who is not from a particular region, which is the primary purpose of this study. To define the local strontium signature for the American Bottom region we used archaeological remains of small non-migratory mammals, such as rabbits and gophers. We chose these types of species because they live and consume food and water within a small area and do not travel long distances, thereby providing us with a good indicator of the local strontium signature.