Journal of Archaeological Science: Reports 2 (2015) 94–105

Contents lists available at ScienceDirect

Journal of Archaeological Science: Reports

journal homepage: http://ees.elsevier.com/jasrep

Geochemical and geophysical prospecting at three multicomponent sites in the Southwestern Lake Erie Basin: A pilot study

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ARTICLE INFO

Article history:
Received 25 July 2014
Received in revised form 19 November 2014
Accepted 3 January 2015
Available online 22 January 2015

Keywords:
Soil phosphate
Magnetic susceptibility
Lake Erie Basin
Community structure

ABSTRACT

We explore the application of an inexpensive and less-invasive method of discovering community patterning at a series of complex sites in the glacio-lacustrine region of northern Ohio. In this pilot study we employ systematic soil phosphate (SP) and soil magnetic susceptibility (MS) analyses on these three northeast Ohio archaeological sites. This is the first such effort in the Lake Erie Basin to combine SP and MS surveys to understand site activity structure. We investigate activity patterning at three northern Ohio habitation sites: White Fort (33Ln2), a multi-component, Late Prehistoric (Sandusky Tradition) site in Lorain County; Burrell Orchard (33Ln15), a multi-component site with a substantial Late Archaic component in Lorain County; and Heckelman (33Er14), a multi-component Woodland Period enclosure and habitation in Erie County. The analysis of SP was complicated by extremely high values, in one case reaching an apparent saturation point, and complex occupation histories. The combination of both MS and P makes for a robust survey strategy to identify details of activity structure even at places with complex and overlapping use histories. We demonstrate the promise and problems of this analytical technique and shed light on the applicability of this method of prospection to the glacio-lacustrine region of Ohio. Especially when used in a multi-pronged research design, soil analysis is a powerful supplement to traditional techniques that enables whole-site analysis without full excavation.

1. Introduction

Geochemical and geophysical surveys offer great potential to supplement traditional archaeological data-generation techniques for detecting site-wide activity patterning. These two suites of geoscience techniques offer the ability to measure things beyond what can be measured via palpable, tactile recovery of traditional archaeology. Geochemistry and geophysical investigations are shedding new light on both large and small scale patterning in the archaeological record beyond the stories that can be told from artifacts and visible features alone. In many cases, these techniques offer more cost-effective solutions that are more efficient in terms of the consumption of financial and archaeological resources. The recent surge in application of geoscience techniques has largely skipped Ohio (for exceptions see Cook and Burks, 2011; Nolan, 2010; Roos and Nolan, 2012).

Soil phosphate (SP) saw early application in Ohio (Solecki, 1951); however, it has seen limited use as the applications of geochemistry in archaeology have grown in number and sophistication over the last half century (e.g., Costa et al., 2013; Crowther, 1997, 2002; Dietz, 1957; Eidt, 1973, 1977; Entwistle and Abrahams, 1997, 2000; Holliday and Gartner, 2007; Linderholm, 2007; Marwick, 2005; Middleton, 2004; Nolan, 2010, 2014; Roos and Nolan, 2012; Salisbury, 2012a, 2012b; Sandor et al., 1990; Terry et al., 2000; Wells et al., 2000; Wilson et al., 2008; Woods, 1977). This lack of geochemistry and particularly SP application in Ohio archaeology is likely due to Skinner's (1982, 1986) equivocal results. The reasons for Skinner's results have been discussed by Nolan (2010: 63–67) elsewhere. A major issue is that Skinner was using "total" P which gives a geogenic signal which often swamps the smaller anthropogenic signal. This situation can be remedied by focusing on the fine fraction and using a weak acid extraction (see Terry et al., 2000; Roos and Nolan, 2012; Swihart and Nolan, 2013, 2014; Wells et al., 2000). Further, Skinner expected her P results to be completely redundant with the tactile artifact distributions. This should not necessarily be the case. Soil P and artifact deposits are generated by different processes. Artifacts can also be moved by original inhabitants and modern agricultural processes (Beck, 2007; Odell and Cowan, 1987; Dunnell and Simek, 1995; Lewarch and O'Brien, 1981; Navazo and Díez, 2008; see discussion in Roos and Nolan, 2012: 23–24). Expecting distributions of SP and artifacts to be redundant misses the advantages of using multiple methods. If geochemistry can only reinforce or duplicate traditional tactile methods, then it is not useful.

The application of these geoscience techniques is extremely useful in cases where artifacts are not present or not expected. For example, in places where intensive collector activity has deflated or skewed the distribution of surface and shallow artifact distributions, geoscience

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http://dx.doi.org/10.1016/j.jasrep.2015.01.002
2352-409X/

applications can provide an unbiased view of the distribution of prehistoric activity (e.g., Nolan et al., 2014; Roos and Nolan, 2012; Swihart and Nolan, 2014). Soil chemistry analysis can be a meaningful supplement to typical compliance-style reconnaissance surveys, providing crucial context for the interpretation of regional patterns and assessments of the importance of certain local sites. Geoscience applications can also be used to detect activities that are all but invisible to traditional, artifact-based data generation strategies (e.g., Costa et al., 2013; Entwistle and Abrahams, 1997; Middleton et al., 2010; Nolan, 2014; Oonk et al., 2009; Purtill, 2013; Salisbury, 2012a, 2012b, 2013; Sandor et al., 1990; Schuldenrein, 1995; Schuldenrein and Purtill, 2008; Verrill and Tipping, 2010; Wells, 2004). While geoscience applications are increasing in frequency and sophistication globally, the glacio-lacustrine region of Ohio has been largely excluded from these trends. Different parent material and different soil forming factors may complicate the application of certain analytical procedures. Soil MS has been applied successfully in the Lake Erie Basin (see Redmond and Scanlan, 2009), but SP has not.

We conduct an archaeological study of prehistoric activity patterning using soil chemistry and magnetism at three sites in northern Ohio: the Heckelman site (33Er14), the White Fort site (33Ln2), and the Burrell Orchard site (33Ln15). We test the ability of combined MS and SP to reveal patterns of activity at three distinct settings with complex, but distinct occupation histories and variable soil-forming factors. The availability of excavation data for all three of these sites offers a unique opportunity to directly evaluate the results of MS and SP within known archaeological contexts. The use of both datasets to map activity patterning is uncommon, especially in the Midwestern United States (see Nolan, 2010; Swihart and Nolan, 2014 and Roos and Nolan, 2012 for exceptions). Demonstration of the effectiveness of these soil analysis techniques will make for a less expensive and less invasive way to locate activity areas on the landscape and to analyze activities across whole site settings in future investigations.

All three sites are located in north-central Ohio (Fig. 1), and lie on elevated remnants of glacial lake plain and beach ridge sediments with steep escarpments bordering their respective river valleys. The study sites fall within the Interior Plains major division of the Huron–Erie Lake Plains section of the Central Lowlands province. Within this section the sites are within the Erie Lake Plain and the Berea Headlands of the Erie Lake Plain. This region is made up of the sandy beach ridges and dunes that have formed near the shores of Lake Erie (Brockman, 1998).

All three locations are found in the Conotton–Conneaut–Allis soil region. These soils are made up of a combination of glacial lacustrine and beach deposits. The combination of coarser grains with some clay-sized particles means that the soils retain a good amount of moisture making them good for growing crops (Ohio DNR n.d.). There are a total of six soil phases within the areas surveyed for this project (Figs. 2A, 3A, 4A; see Nolan et al., 2014: Fig. 2). The 33Ln2 and 33Ln15 survey areas are composed entirely of soils from a single phase, Oshtemo sandy loam (OtA) and Haskins loam (HsB), respectively. Oshtemo soils are very deep, coarse, loamy mesic Hapludalfs (Soil Survey Staff 2013) and constitute the coarsest sediments encountered during the project. Haskin series soils are very deep, fine loamy, mesic Aeric Epiaqualfs.

1.1. Previous investigations and land use histories

Each of the three archaeological sites examined in this study has been the focus of test excavations by the Cleveland Museum of Natural History (CMNH). All three sites have also been subjected to agricultural land use since initial settlement of the area by Euro-Americans. White

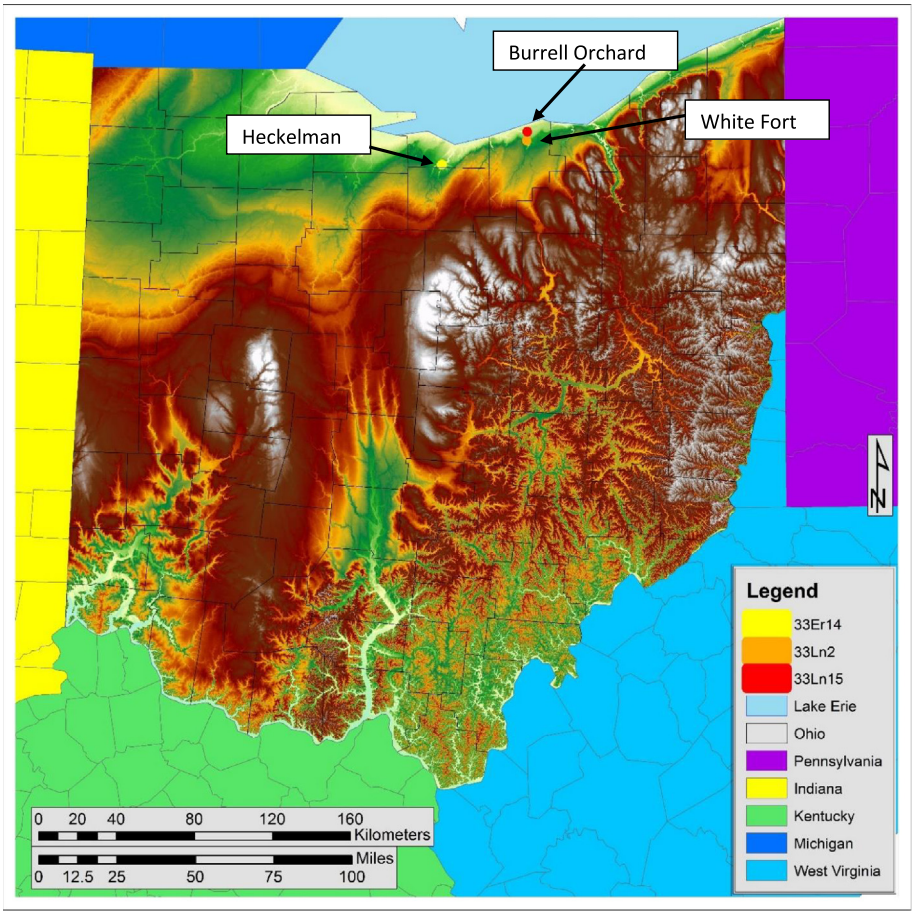

Fig. 1. Location of targeted sites over elevation model of the State of Ohio.