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Artifact preservation and post-depositional site-formation processes in an urban setting: a geoarchaeological study of a 19th century neighborhood in Detroit, Michigan, USA

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ABSTRACT

A geoarchaeological study was carried out to assess levels of artifact deterioration occurring in a historic-period urban soil during the 20th century. The study site is a former house-lot in a park created in 1919 by demolition of a residential community in Detroit, Michigan, USA. The results show that despite nearly a century of burial in an urban soil impacted heavily by pollution and other anthropogenic activity, many 19th century artifacts are remarkably well preserved. The observed weathering stability sequence of glass > bone > mortar > plaster > paint is consistent with decreasing solubility product values of the corresponding principal mineral constituent (glass < apatite < portlandite < gypsum < cerrusite). Even severely weathered 19th century nails and mortar can often be distinguished using optical petrographic and SEM-EDAX methods. The excellent state of artifact preservation is attributed to a calcareous soil microenvironment, and artificial compaction which limited the weathering effects of water and oxygen. Artifact preservation was further enhanced by burial beneath a thick biomantle created by the casting activity of an invasive species of earthworm. However, *Lumbricus terrestris* may now pose the greatest threat to artifact preservation because casting and burrowing activities are decreasing bulk density, and promoting the diffusion of air and water into the soil. Early excavation is recommended to recover artifacts in soils impacted by the combined effects of urban pollution and earthworm burrowing. Anthropogenic microparticles smaller than those normally classified as microartifacts were found to be useful indicators of human occupation.

1. Introduction

Previous geoarchaeological studies suggest that environmental changes resulting from anthropogenic activities are having a significant impact on the preservation of archaeological remains buried in soil, particularly in urban settings. Accelerated deterioration rates of buried artifacts, especially metal and other inorganic objects, have been attributed to acid rain, the use of deicing salts on highways, water table lowering, fertilizer applications, and airborne deposition of acid-forming particulates (Kars, 1998; Wilson and Pollard, 2002; Nord et al., 2005; Crow, 2008). A better understanding of artifact weathering mechanisms and site formation processes in urban soils is needed to: 1) ensure the preservation of buried artifacts; 2) improve prospecting techniques for locating sites needing rescue or early excavation, 3) develop better methods for post-excavation preservation, and 4) aid in the identification of highly corroded or weathered objects. Many previous studies of prehistoric sites have shown that, in addition to obtaining information about chronology, building episodes, and settlement patterns, a clear understanding of the geoarchaeological factors of site formation is critical for an accurate interpretation of stratigraphy and artifact context (Schiffer, 1983, 1996; Amour-Chelu and Andrews, 1994; Canti, 2003; Holliday, 2004). However, there have been relatively few studies focused on soil morphogenesis and site formation at historic-period North American sites, especially in urban settings (Davidson et al., 2006; Milek and Roberts, 2013; Prokof'eva et al., 2001).

The purpose of this study was to assess the levels of artifact deterioration which have occurred at a historic-period site since the beginning of the 20th century. We investigated the effects of anthropogenic activities on archaeological site formation and artifact preservation at a former house-lot in Detroit, Michigan, USA.

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The study site has been parkland since it was created ~1919 A.D. when buildings from a mid to late 19th century residential community were demolished. The park is underlain by artifact-rich anthropogenic deposits and is located in an urban setting adjacent to a train station, heavily trafficked streets, and industrial land. In this study, we documented post-depositional site formation processes in the field and examined the effects of weathering on artifacts using optical and scanning electron microscopy.

2. Materials and methods

2.1. Study site and geologic setting

The site studied is Roosevelt Park in the Corktown neighborhood about 1.5 km west of Detroit City Hall (Fig. 1A). Corktown is a largely residential area of about 20 ha that grew rapidly after the Great Irish Potato Famine of the 1840s when Irish immigrants from County Cork arrived in large numbers (Delicato and Demery, 2007). It is one of the oldest neighborhoods in Detroit, with some surviving buildings (e.g. "Worker's Row House") dating back to the 1850s (Swaminathan, 2011). Roosevelt Park sits in front of the now derelict Michigan Central Station (MCS), an iconic Detroit landmark. The MCS was built by the Michigan Central Railroad in 1912–1913 as part of a large mass transportation project that included a train tunnel beneath the Detroit River (completed in 1910). Roosevelt Park was designed to be a well manicured esplanade that would serve as a grand entry to the city. In June 1913, the future park site was comprised of 79 parcels of land and more than 100 structures, including houses, barns and shops (Fig. 1B). According to newspaper accounts in the Detroit Free Press, the last three standing buildings were demolished in 1918 by a Mark IV, WWI army tank called *Britannia*. Work on the park began in 1919, and landscaping was completed in 1921. The park's garden was irrigated by the first outdoor sprinkler system ever constructed in the United States. Construction of the MCS predated the first automobile boom of the 1920s, hence the building was designed to be serviced by a well-established electric streetcar system. The MCS began a long decline following the end of the electric streetcar era in Detroit ~1938. Stiff competition with automobile travel resulted in its eventual closure in 1988.

The study site (located at N42°20.705′ and W083°02.925) is near the Detroit River, and adjacent to Windsor, Ontario, Canada (Fig. 1A). Detroit lies on a nearly level plain formed by a series of glacial paleolakes during the Port Huron phase of late Wisconsinan time about 12,400 yr BP. Roosevelt Park lies on the bed of paleolake Elkton of Sherzer (1916) at an elevation of 200 m. Detroit is generally underlain by a relatively thin (<6 m thick) glaciolacustrine deposit comprised of weakly stratified clayey diamicton overlain by a discontinuous capping of sand usually < 1 m thick (Howard, 2010). The study area has a humid-temperate (mesic) climate, a mean annual temperature of 9 °C (49 °F), 99 cm yr^{-1} of precipitation, and a frost line at 107 cm depth. The Pewamo Series (Typic Argiudoll), Metamora Series (Udollic Ochraqualf), and Blount Series (Aeric Ochraqualf) are native soils that are widespread on the somewhat poorly drained lakebed plains beneath Detroit (Larson, 1977).

2.2. Archaeological and geological field methods

Sanborn maps show the site studied is located at what was formerly the corner of Dalzelle and 15th Street (Fig. 1C and D). In 1889 the site, referred to as Lot #1, was occupied by a one story house, a two story barn, and another outbuilding possibly used as a privy (Fig. 2A). Sanborn maps show that additions were made to the top and rear of the house by 1897. The privy had been removed and a new, somewhat larger barn had been constructed. The map from 1915 shows a similar configuration of buildings. Sixty-one archaeological test-pits (30 × 30 × 60 cm in size) were excavated in Lot #1 using a staggered rectangular grid with a 4 × 2 m spacing (Fig. 2A). Each pit was screened for artifacts at 25 cm depth intervals, a general soil profile description was logged, and the types, numbers and weights of artifacts collected from each level recorded.

In addition to these archaeological test-pits, two separate pits (SP-1, SP-2) were dug within the archaeological grid, screened for artifacts at 10 cm depth intervals, and detailed soil profile descriptions collected. For comparison, detailed soil profile descriptions were collected from two additional pits (SP-3, SP-4)

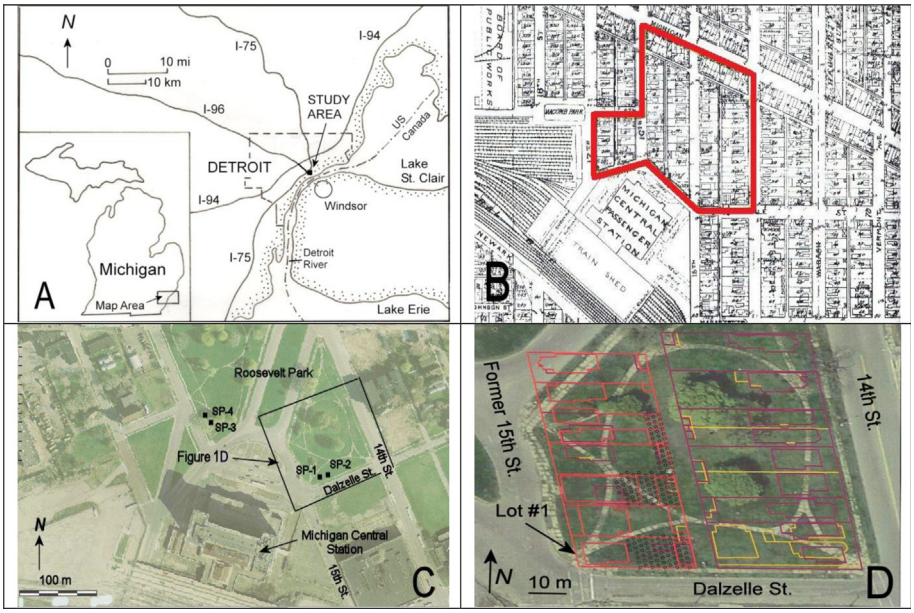

Fig. 1. Maps of the site studied in Detroit, Michigan: A, Location of the study area in southeastern Michigan; B, Housing tracts adjacent to Michigan Central Station ca. 1915 before demolition to create Roosevelt Park; C, Roosevelt Park in 2013 showing site studied; D, Locations of former house lots based on Sanborn maps.