Introduction

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This special issue of *Geoarchaeology* is the second part of a pair of issues devoted to advances in geoarchaeological approaches to anthrosol chemistry. The first issue (Volume 22, Number 3) focuses on applications to detecting and studying aspects of ancient agriculture. The current issue turns to another area of geoarchaeology where recent advancements in soil chemistry have significantly improved our ability to detect and study activity areas in the archaeological record where little or no material evidence has survived.

Early applications of soil chemistry to site prospection and ancient agriculture (reviewed in the previous special issue) have opened up a new avenue of archaeological research: the investigation of activity loci in prehistoric households and other spaces (e.g., Barba and Manzanilla, 1992; Entwistle, Abrahams, and Dodgshon, 1998, 2000; Hutson and Terry, 2006; James, 1999; Wells et al., 2000; Parnell, Terry, and Nelson, 2002; Parnell, Terry, and Sheets, 2002; Sampietro and Vattuone, 2005; Terry et al., 2004; Wells, 2004; Wells et al., 2007). Holliday (2004: 290–337) provides an instructive overview of the methods and theories behind activity area studies in archaeological soil chemistry. The basic premise is that certain chemical compounds are deposited in soils as a result of particular human activities. For example, phosphate deposition can be associated with the preparation and consumption of foods and beverages, sodium and potassium compounds are generated by the production of wood ash in hearths and kilns, and iron oxide and mercuric sulfide are accumulated in soils through the use of certain pigments (i.e., hematite and cinnabar) in ceremonial settings, such as burials and caches. Since these compounds are rapidly fixed to the mineral surfaces of sediments, they tend to remain stable and immobile (resistant to horizontal and vertical migration) for very long periods. Wells (2006: 126) refers to this process—"how soils encode the physical, biological, and chemical effects of different human activities"—as "soil memory."

In the mid-1960s, Cook and Heizer (1965) noted a number of chemical properties of anthropogenic soils from archaeological sites, including high concentrations of phosphorus, calcium, and organic matter. Soon thereafter in the early 1970s, Heidenreich and Konrad (1973) published their work on Iroquoian long houses at the site of Robitaille in southern Ontario, Canada, which examined the distribution of phosphorus, calcium, magnesium, and organic carbon. By mapping the distribution

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of these elements across the archaeological site, they were able to determine the precise locations of long houses.

Two contributions to this issue build on the above-mentioned work. First, Jane A. Entwistle and colleagues take a "landscape approach" to investigating land-use history in the Hebrides, Scotland, through soil chemistry. The authors employ variograms and kriging—a geostatistical approach for predictive modeling through interpolation—to describe and study spatial patterns among different chemical elements from soils and loch sediments associated with ancient habitation sites. Second, Johan Linderholm provides a summary of the various ways in which soil chemistry has been used to detect and analyze human activities from the Bronze Age to the Late Iron Age (3500–1000 B.P.) in Sweden since Arrhenius's (1929, 1931) first efforts. Focusing on phosphorus and iron cycling systems in soils, Linderholm shows how postdepositional environments greatly affect soil chemistry and our ability to study it. These two contributions join a growing list of other papers recently published on chemical analyses of soils and sediments applied to a wide range of archaeological contexts throughout Europe (Entwistle and Abrahams, 1997; Sánchez Vizcaíno and Cañabate, 1999; Entwistle, Dodgshon, and Abrahams, 2000; Marshall, 2001; Adderley et al., 2004; Macphail et al., 2004; Sarris et al., 2004; Gerlach et al., 2006).

Many of the studies carried out today to analyze activity areas make use of ethnographic observations of human behavior, specifically, the ways in which human activities impact soil chemistry in nonindustrial, "traditional" societies (e.g., Middleton and Price, 1996; Fernández et al., 2002; Wells and Urban, 2002; Terry et al., 2004). Luis Barba and his colleagues (Barba and Bello, 1978; Barba and Denise, 1984; Barba, 1986, 1990; Barba and Ortiz Butrón, 1992; Barba et al., 1995) at the Laboratory of Archaeological Prospection, part of the Mexican National Autonomous University's Institute for Anthropological Studies, have been at the forefront of this research. Working in the households of indigenous groups in small, rural villages in various parts of Mexico, they have demonstrated that variation in certain chemical elements, compounds, and soil properties can be used to detect and study domestic activities, such as cooking, storage, and craft manufacture. Barba's contribution to this issue in the pages that follow extends the analytical methods of these previous studies on house floor sediments to show how human activities also impact plaster floors at two prehispanic central Mexican urban centers, Teotihuacan and Tenochtitlán.

Also taking an ethno-archaeological approach, Margaret E. Beck offers tantalizing clues to the physical and chemical behavior of soils in the formation of middens—an important context for artifact recovery in many archaeological sites that can provide data on chronology, site size, occupancy and abandonment, economic specialization within and between communities, and attitudes about sanitation and the use of community space. In her contribution to this issue, Beck combines observations on midden formation processes in Dalupa, a modern Kalinga village in the Philippines, with soil chemical data to infer the manner by which different physical processes impact midden chemistry.

Although soil chemistry is only now becoming a standard instrument in archaeologists' toolkits, it is nonetheless of critical importance in many areas of investigation.

Chemical analyses of anthrosols that combine both organic and inorganic material residues provide a powerful means to reconstruct past human behavior in a range of contexts. Future advancements in the method and theory of archaeological soil chemistry inevitably will rely on ethno-archaeological research aimed at linking soil chemical signatures of modern human activities with those of prehistoric peoples in archaeological sites.

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